

# RAMBØLL DIGITAL SUSTAINABILITY TOOLS

## DIGITALISERING OG SIRKULÆR ØKONOMI

NTVA - TEKNOLOGIFORUM: DIGITAL BÆREKRAFT I BYGG OG ANLEGG

# KORT OM MEG

## Lucas van Laack

- Senior Energi- og Miljørådgiver
- MRIF godkjent rådgiver Bygningsfysikk
- MSc Environmental Design and Engineering, UCL London
- BA Arkitektur, Hanze University Nederland



BREEAM® NOR



LIVING  
BUILDING  
CHALLENGE™

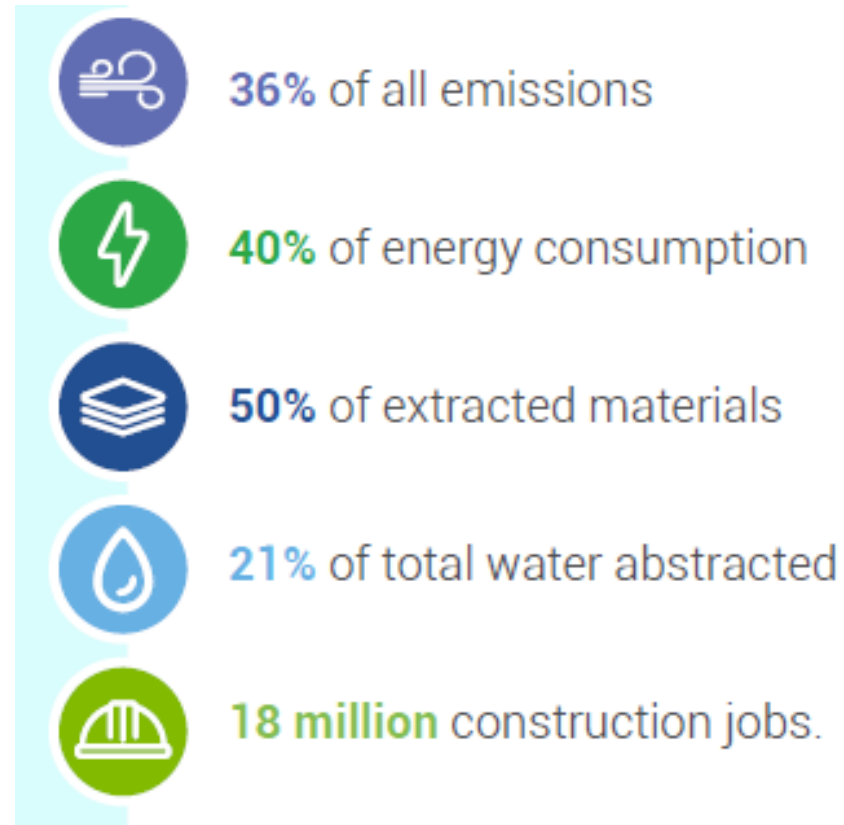


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# SUSTAINABILITY IN BUILDINGS – A GLOBAL FRAMEWORK

FRAMEWORK "WORLD GREEN BUILDING COUNCIL MANIFESTO 2019"

- The goals in the Paris Agreement
- UN Sustainable Development Goals
- The vision for a climate neutral Europe in 2050



# THE SUSTAINABILITY LINE OF SIGHT

## WGBC Manifesto - Priority areas

-  1. CO<sub>2</sub> emissions
-  2. Circular economy
-  3. Health and wellbeing
-  4. Water use
-  5. Value and cost
-  6. Resilience
-  7. Biodiversity
-  8. Just transition

RAMBOLL



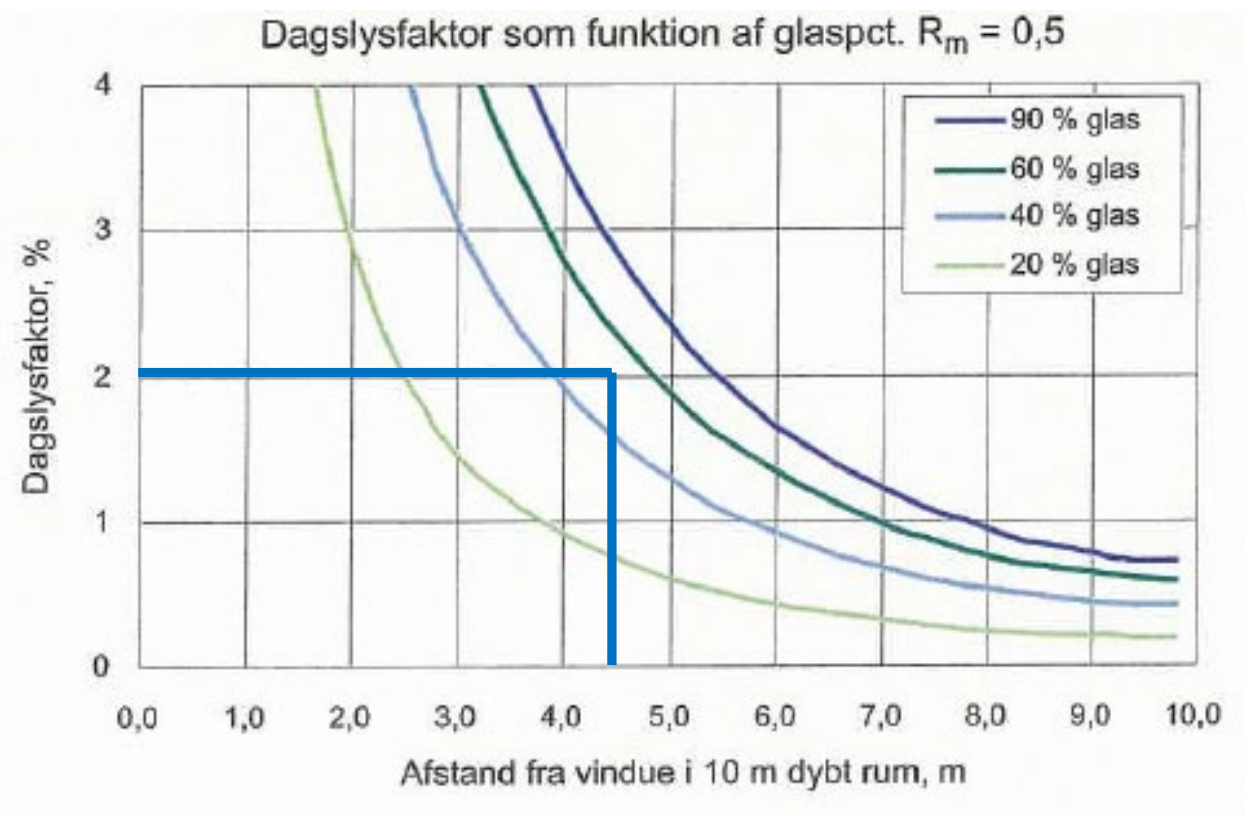
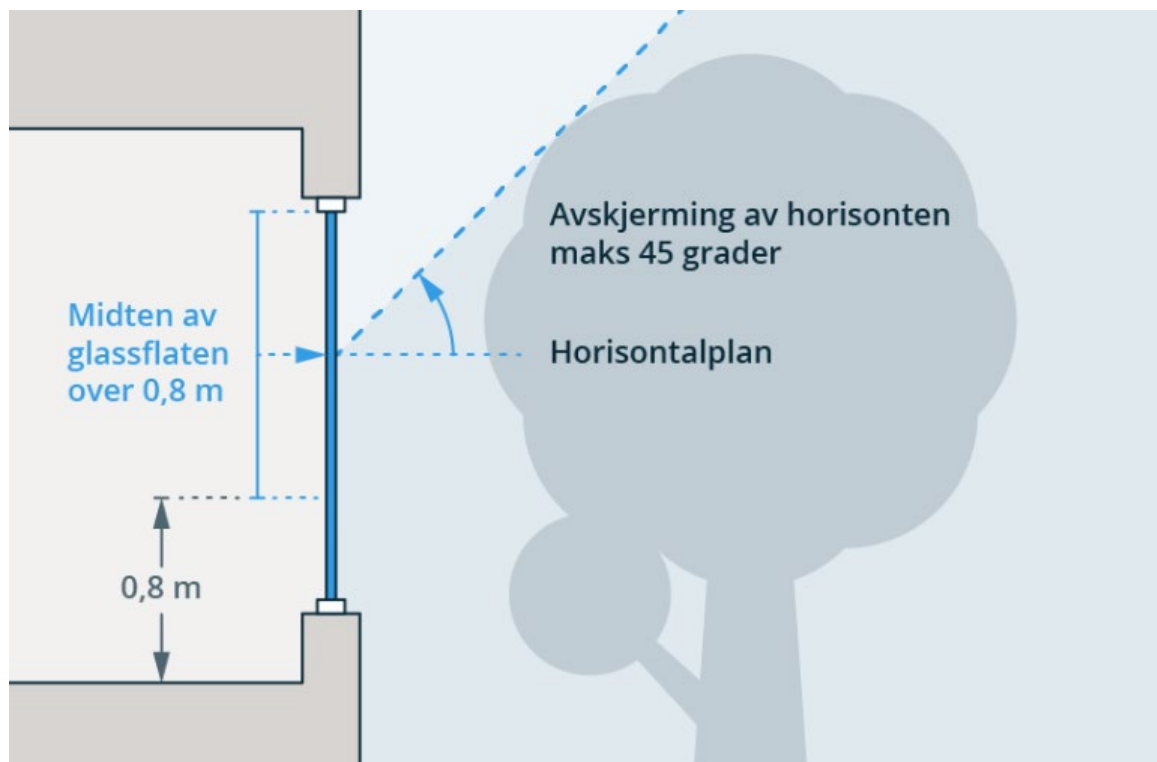
## Ramboll Buildings Sustainability Service areas

- 1. Strategic sustainability services
- 2. Certification services
- 3. Energy efficiency services
- 4. Water & Ecosystem services
- 5. Life Cycle engineering
- 6. Sustainable architecture
- 7. Structural design and materials
- 8. Liveability Services
- 9. Buildings Physics

# BUILDINGS SUSTAINABILITY

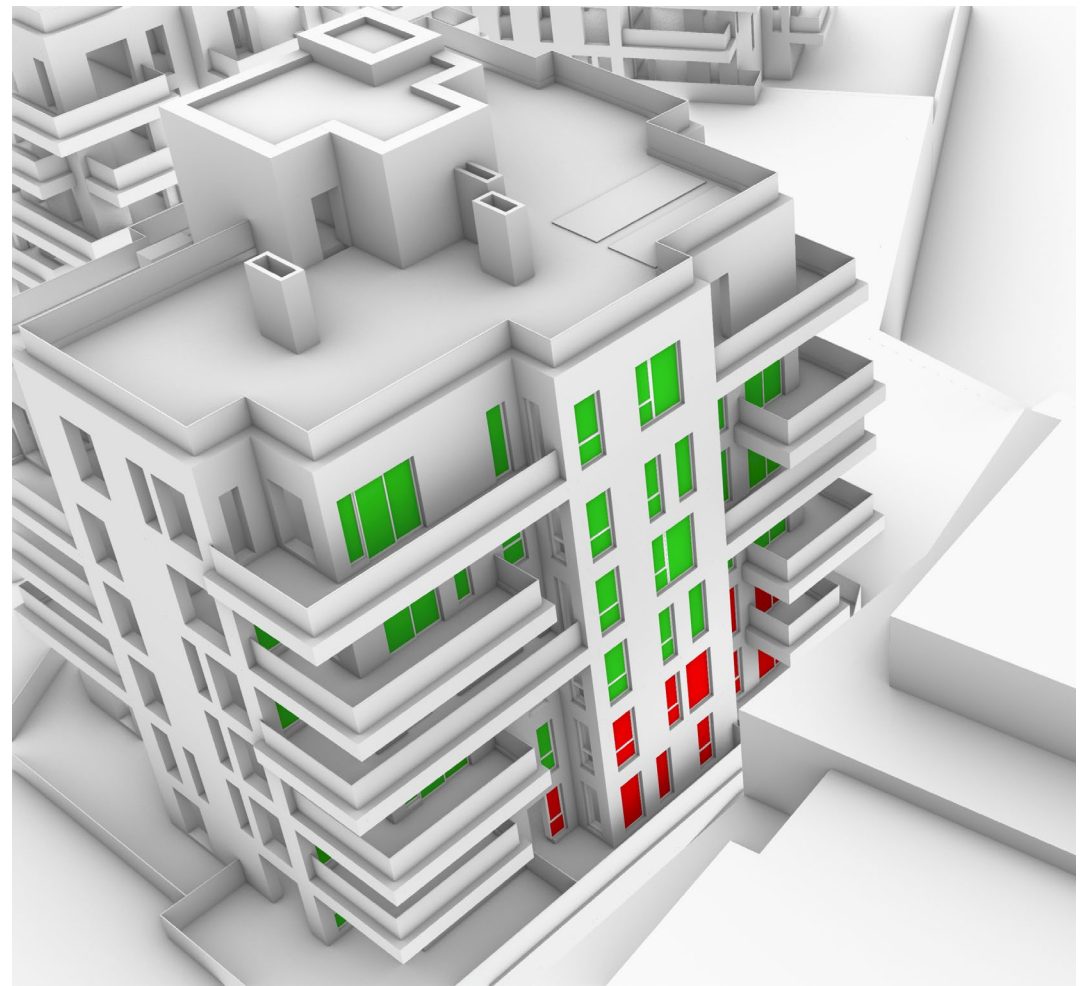
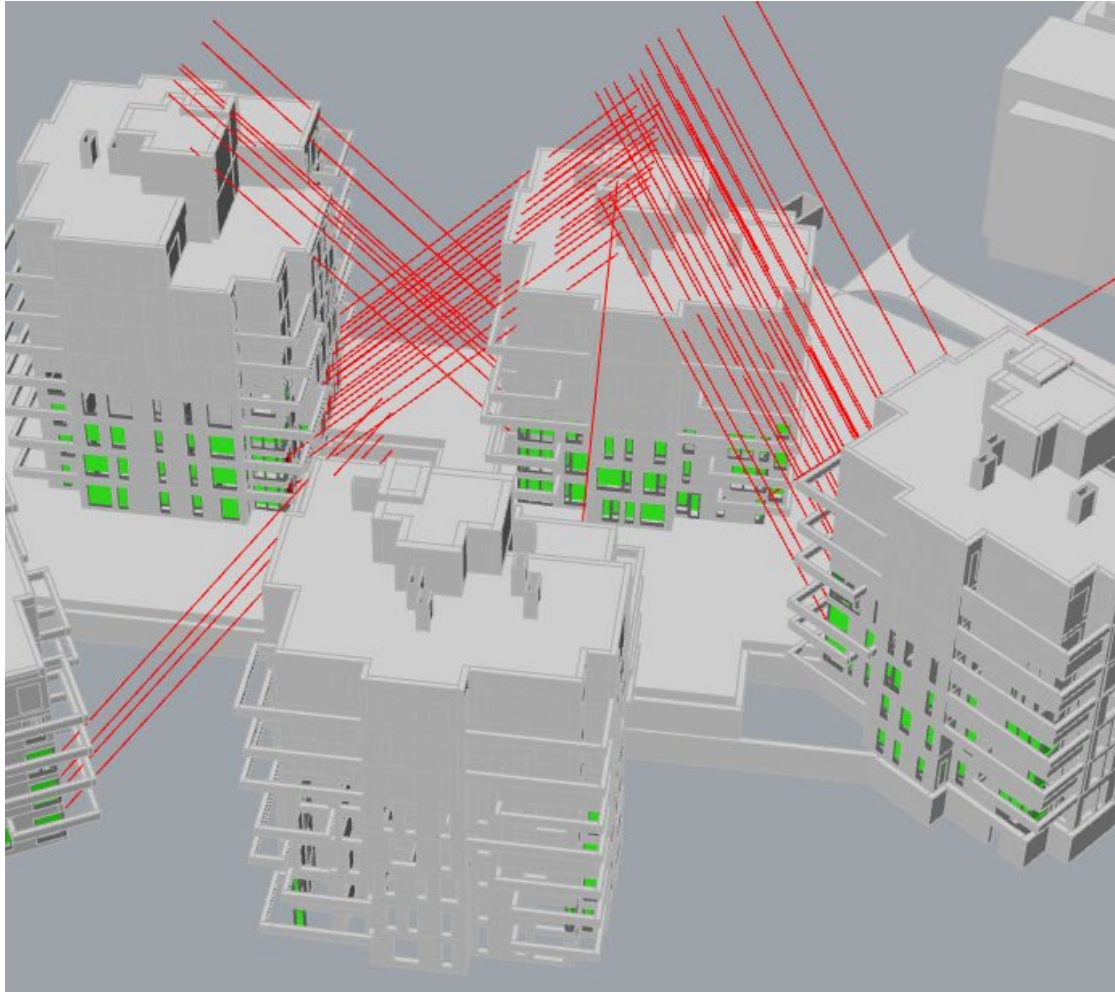
Strategic Sustainability Services	Sustainability Strategies	Feasibility Studies	Life Cycle Cost Calculations	Sustainability Audits & Reporting	Sustainability Training		
Certification Services	LEED	BREEAM	Miljöbyggnad	DGNB	Other systems		
Energy Efficiency Services	Energy analysis & strategy	Renewable Energy Services	SMART building services	Commissioning	Energy declarations	Building Performance Evaluation	Sustainable Facility Management
Water & Ecosystem Services	Water efficiency	Rainwater management	Public Health engineering	Blue & green infrastructure	Biodiversity analysis	Ecosystem services	
Life Cycle Engineering	Life Cycle Analysis of materials	Environmental Product Declarations	Manufacturing Consultancy	Waste Services	Building Material Reuse		
Sustainable Architecture	Site Analysis & Masterplanning	Sustainable Landscape design	Sustainable Architectural Design	Cultural Heritage Services			
Structural design and materials	Embodied Carbon Reduction	Material choice & sourcing	Façade Engineering	Timber structures	Concrete structures	Steel structures	
Liveability Services	Indoor Climate Services	Outdoor Climate Services	Acoustic services	Lighting Design	User Involvement	Post Occupancy Evaluations	Social Impact Assessment
Buildings Physics	Daylight optimization	Moisture Protection	Radon protection services	Hazardous Chemicals			

# UTVIKLING INNOM DAGSLYS

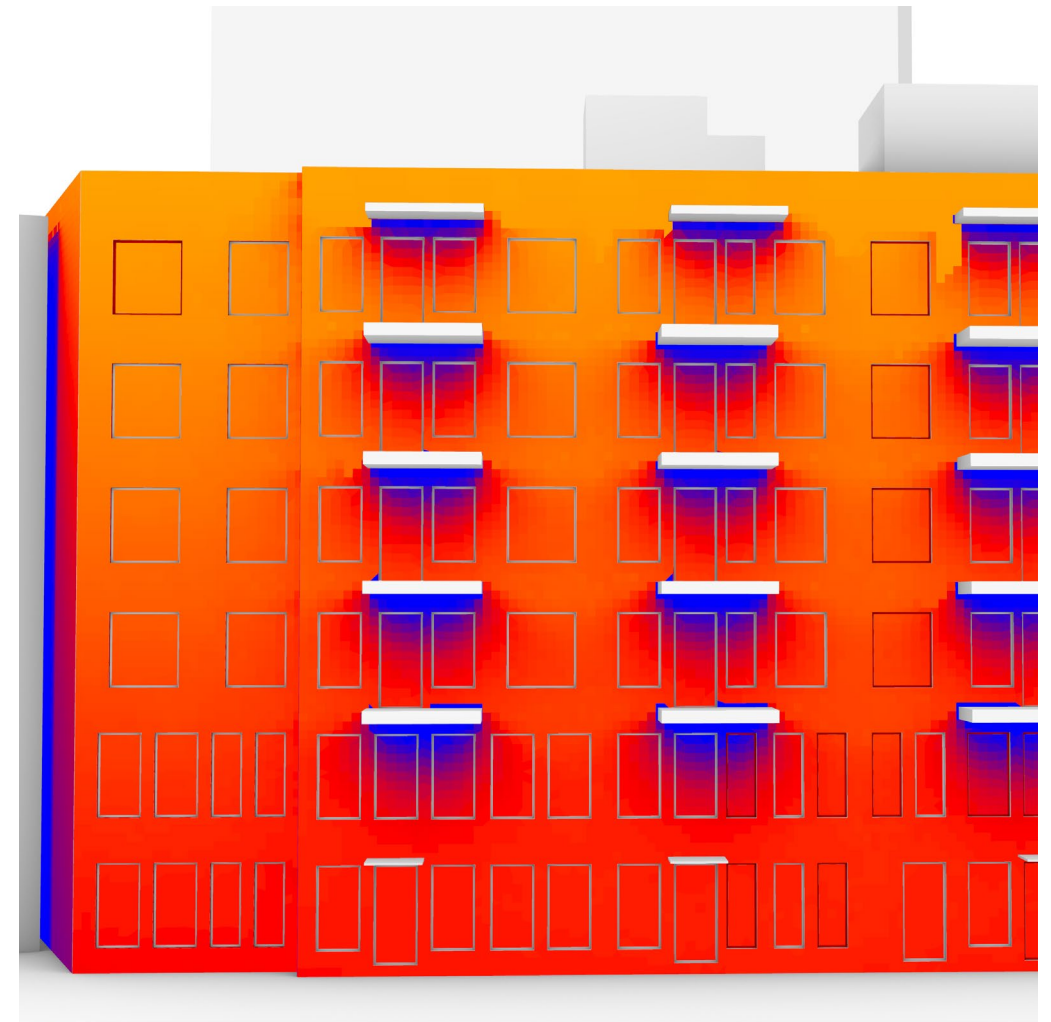
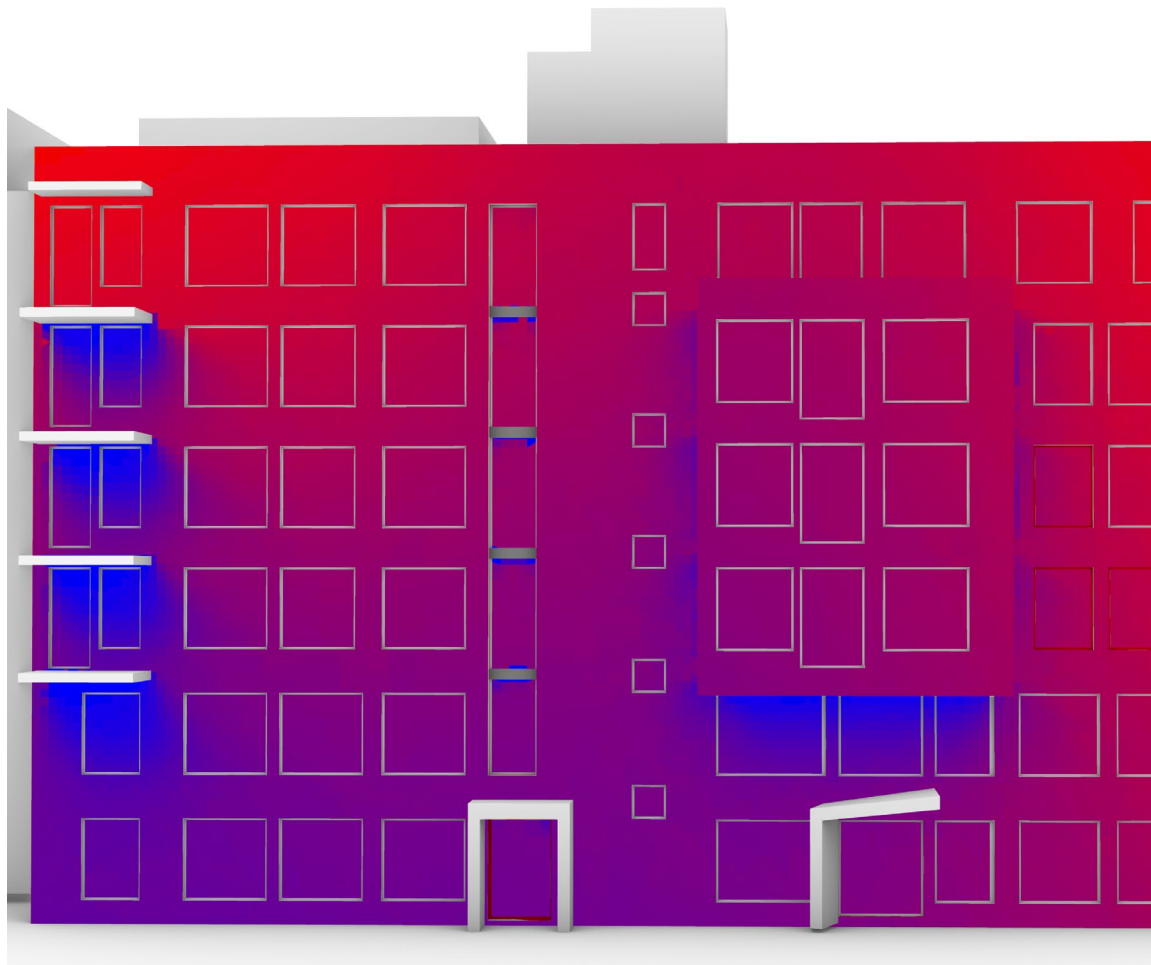




# UTVIKLING INNOM DAGSLYS



# UTVIKLING INNOM DAGSLYS

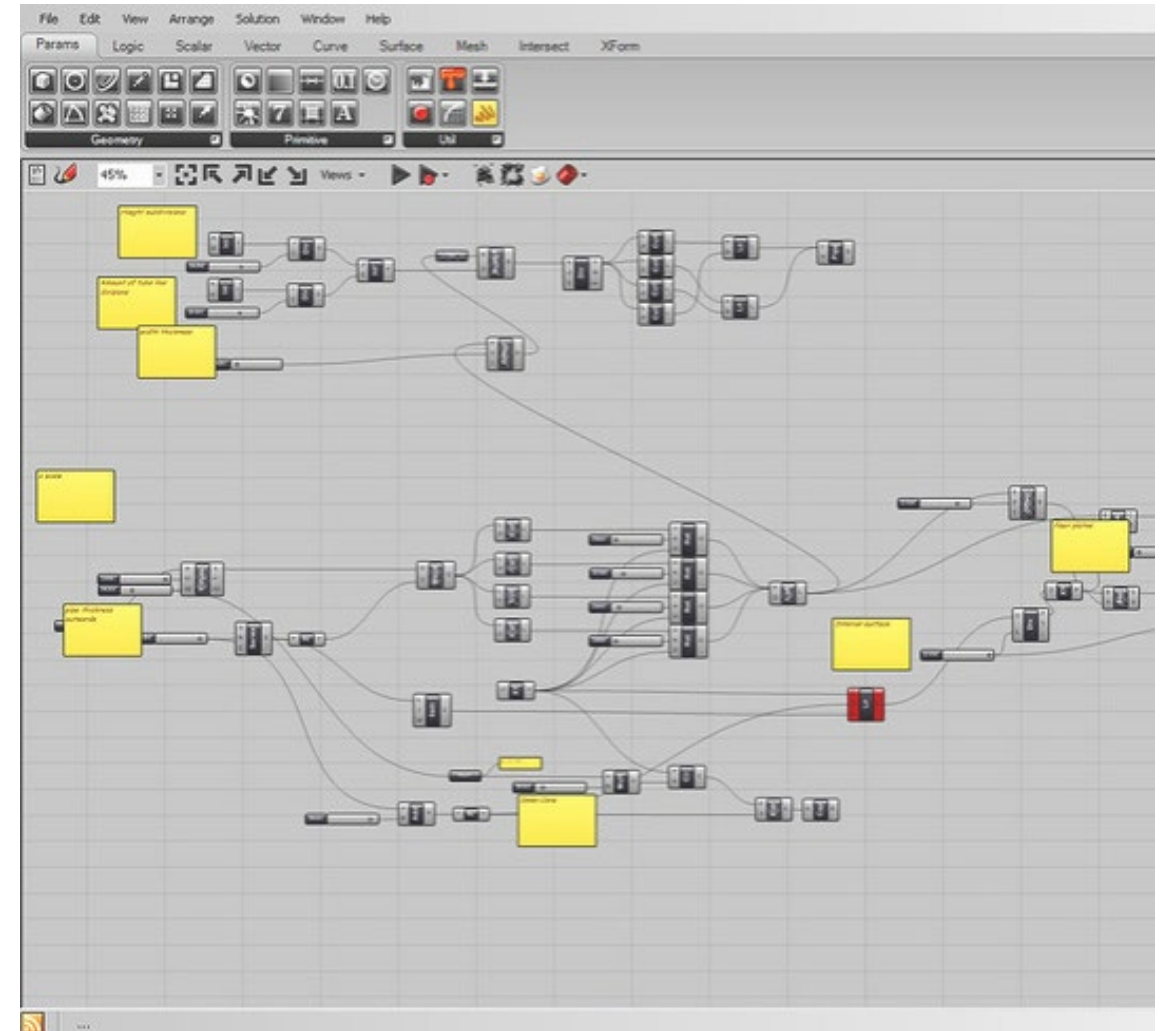
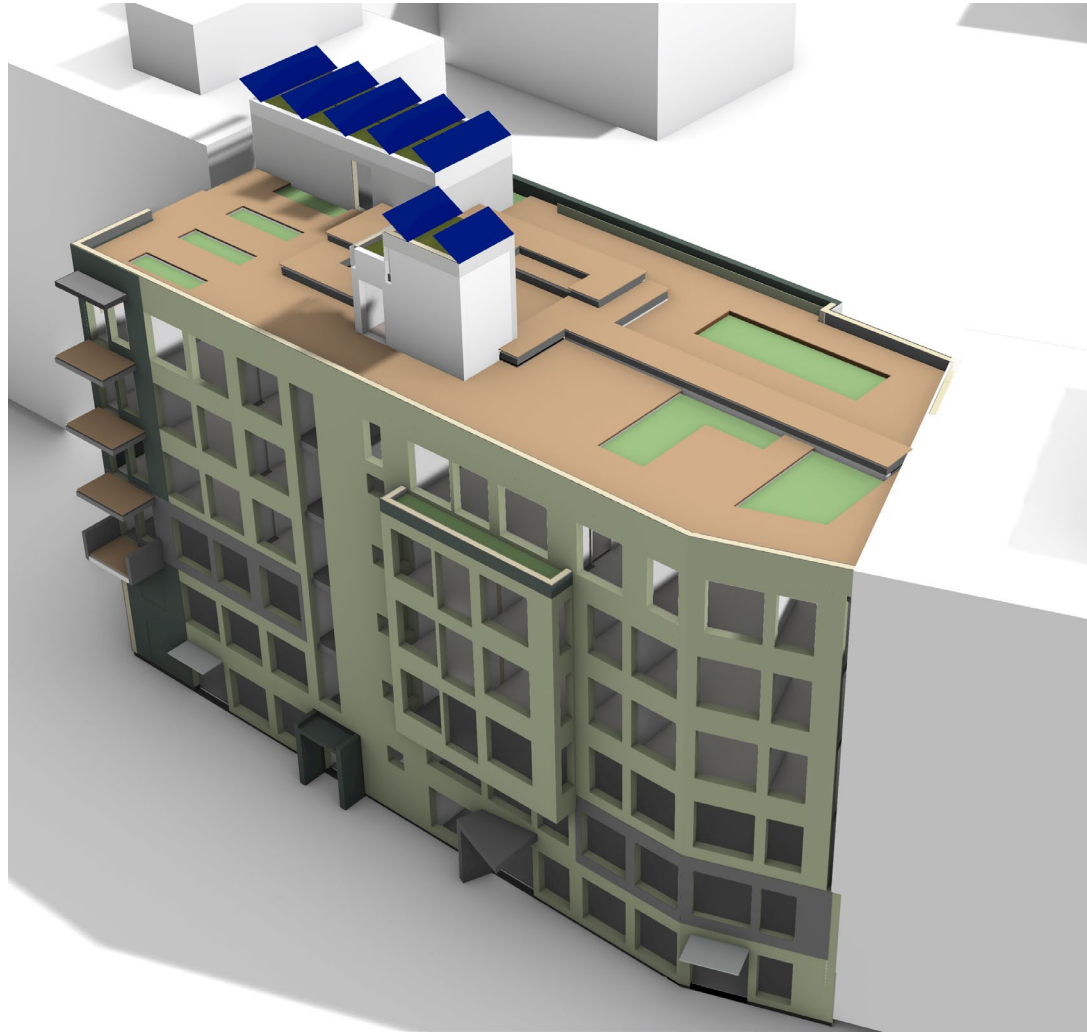




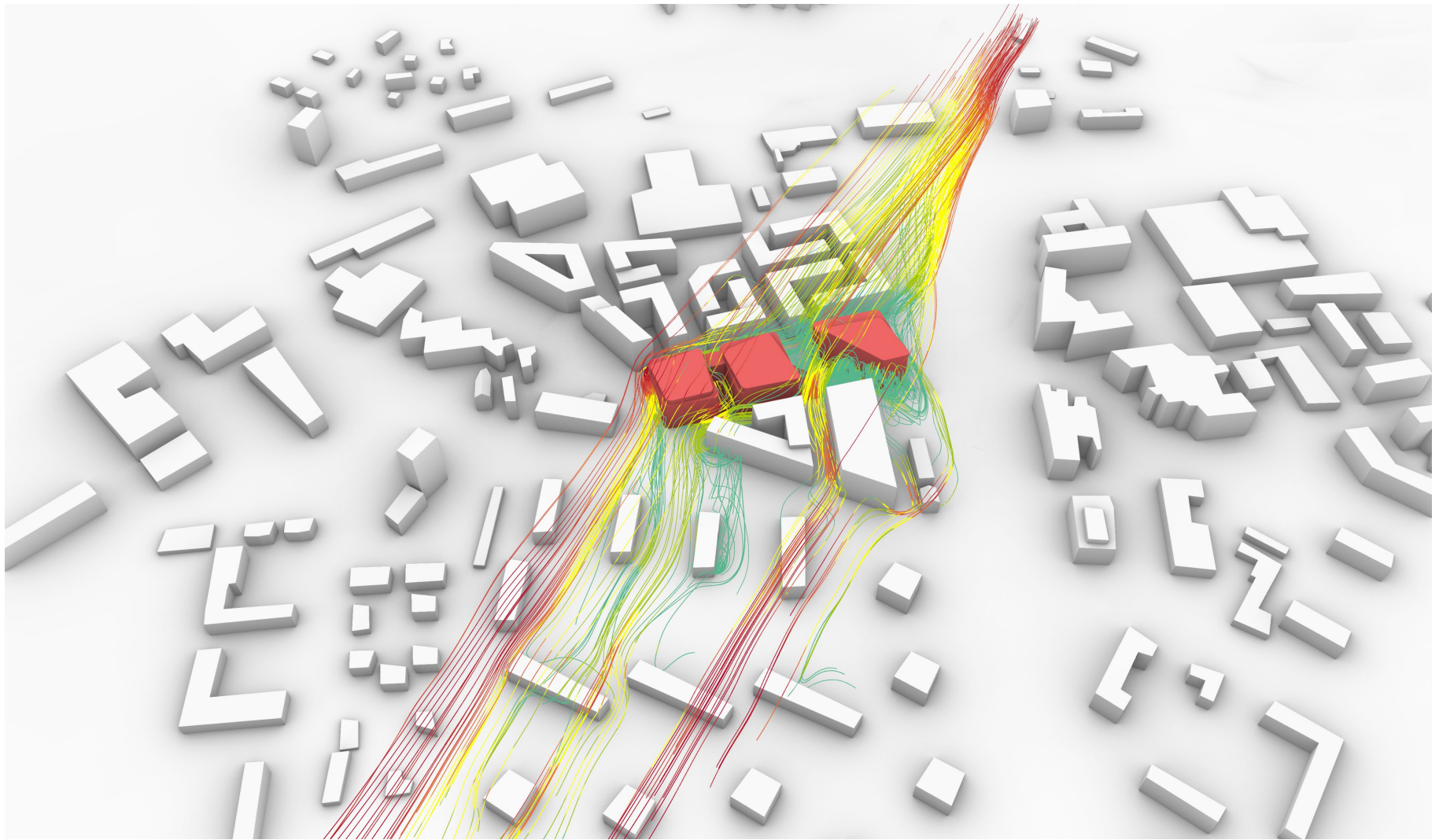
# UTVIKLING INNOM DAGSLYS



# UTVIKLING INNOM ENERGI

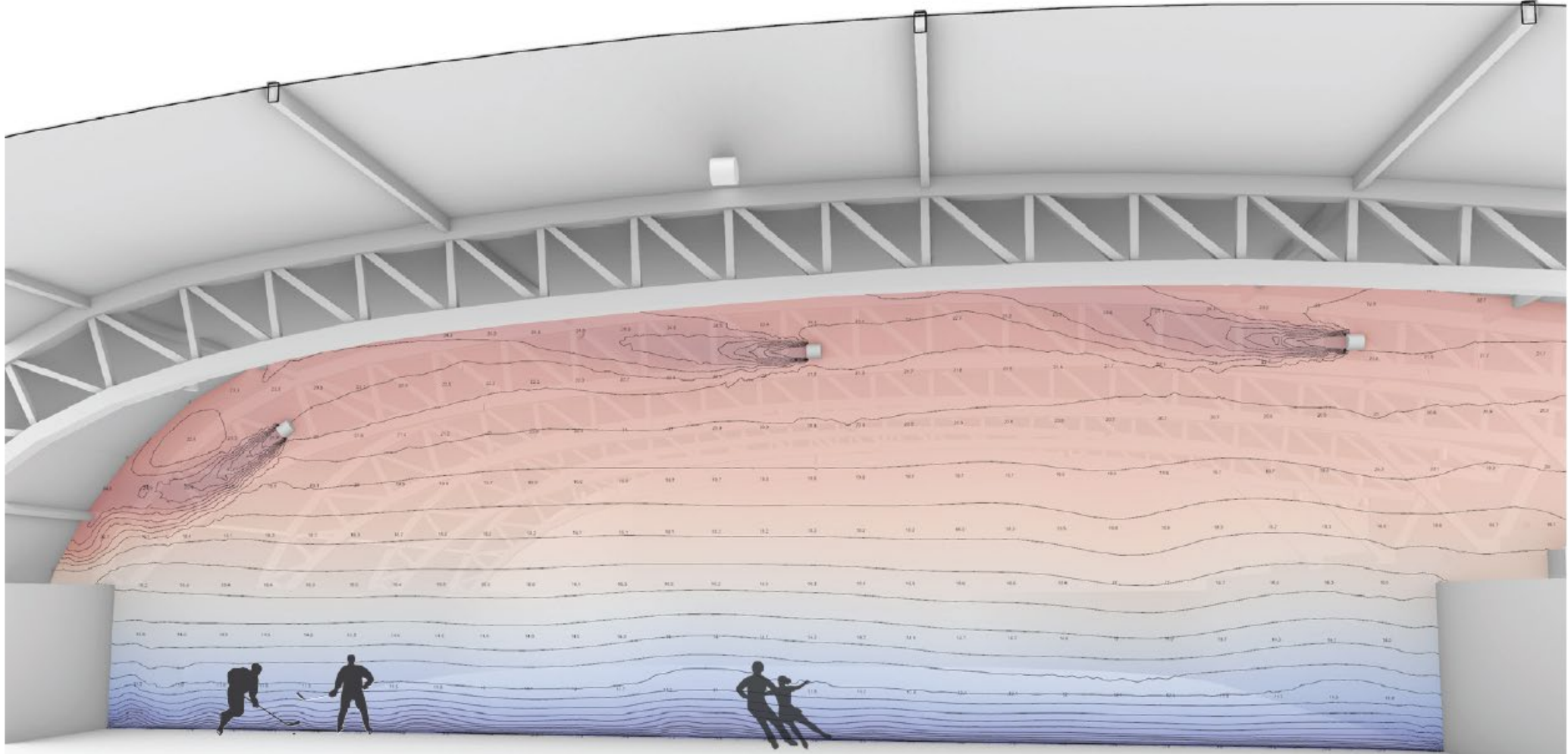


# UTVIKLING INNOM CFD





# UTVIKLING INNOM CFD



# AUTOMATISERT GENERASJON AV BYGNINGER

SiteSolve

File Edit Display View

Undo/Redo Boundary Massing

Site

Latitude: 50.00°  
Longitude: 0.00°

Target Areas

Residential: 100,000.00 m²  
Retail: 0.00 m²

Planning Limits

Maximum Height: 40.00 m  
Maximum Footprint: 60.00 %

Generation

Storey Height: 3.00 m  
First Storey Height: 4.50 m  
Block Depth: 16.00 m  
Road Width: 16.00 m  
Maximum Plot Count: 20.00  
Maximum Block Count: 100.00

Generate x10 x100

Top West South

Options

Sort By: Site Area

Option1 Option2 Option3 Option4 Option5 Option6 Option7 Option8  
Option9 Option10 Option11 Option12 Option13 Option14 Option15 Option16

SiteSolve.

Site Area: 100,000.00 m²  
Building Footprint: 13,574.52 m²  
Footprint:Site Ratio: 13.72 %  
Gross External Area: 100,826.50 m²  
Facade Area: 53,459.16 m²

Spider





# BUILDINGS SUSTAINABILITY

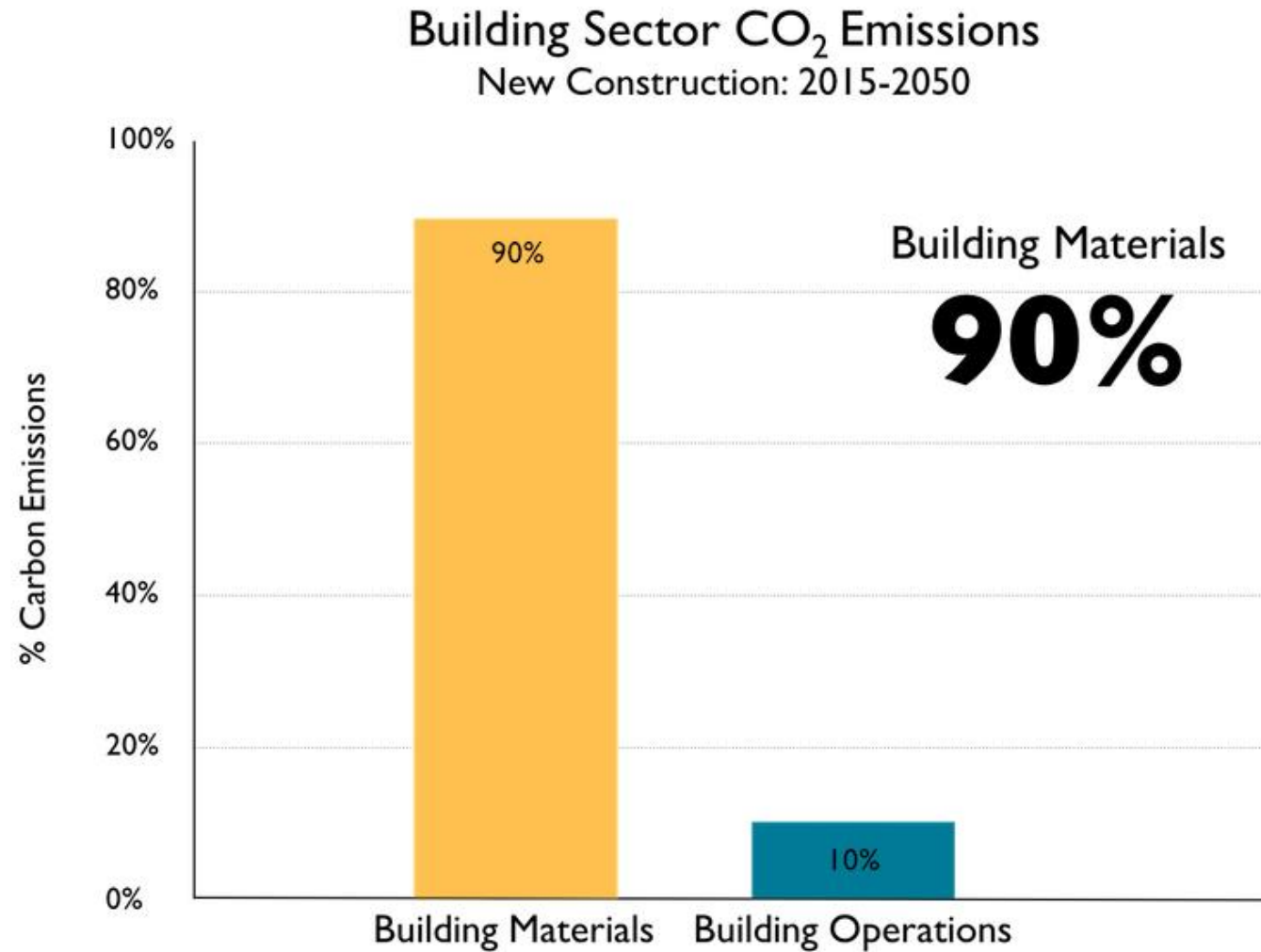
Strategic Sustainability Services	Sustainability Strategies	Feasibility Studies	Life Cycle Cost Calculations	Sustainability Audits & Reporting	Sustainability Training		
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Water & Ecosystem Services	Water strategy	Rainwater management	Public health engineering	Blue & green infrastructure	Biodiversity	Ecosystem services	
Life Cycle Engineering	Life Cycle Analysis of Buildings	Environmental Product Declarations	Manufacturing Carbon Footprint	Waste Services	Building Material Passports		
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# INTRODUCING GREENBIM

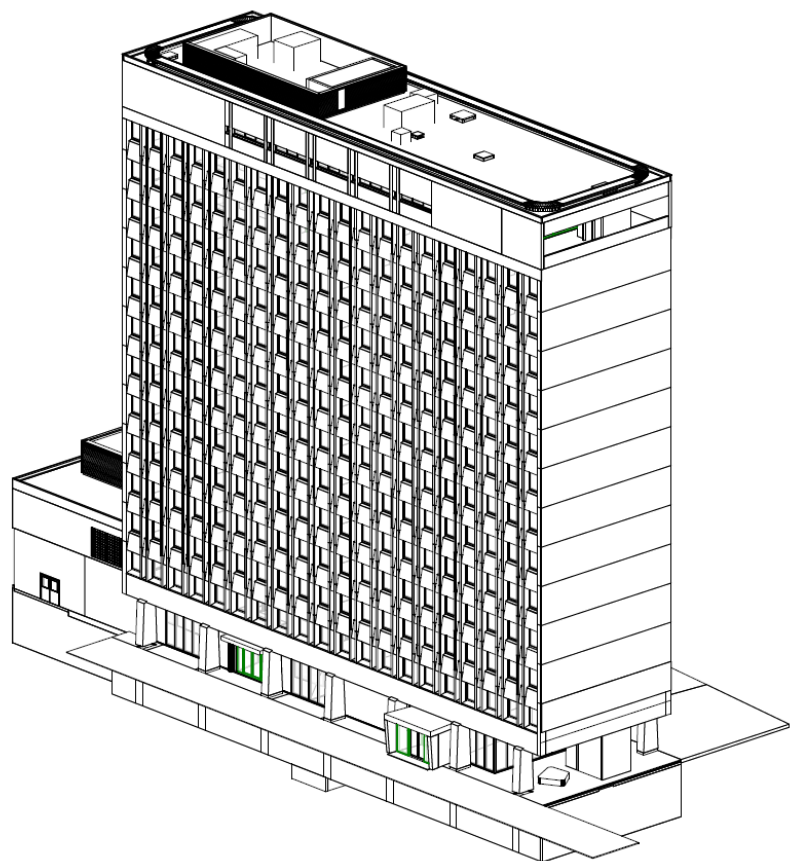
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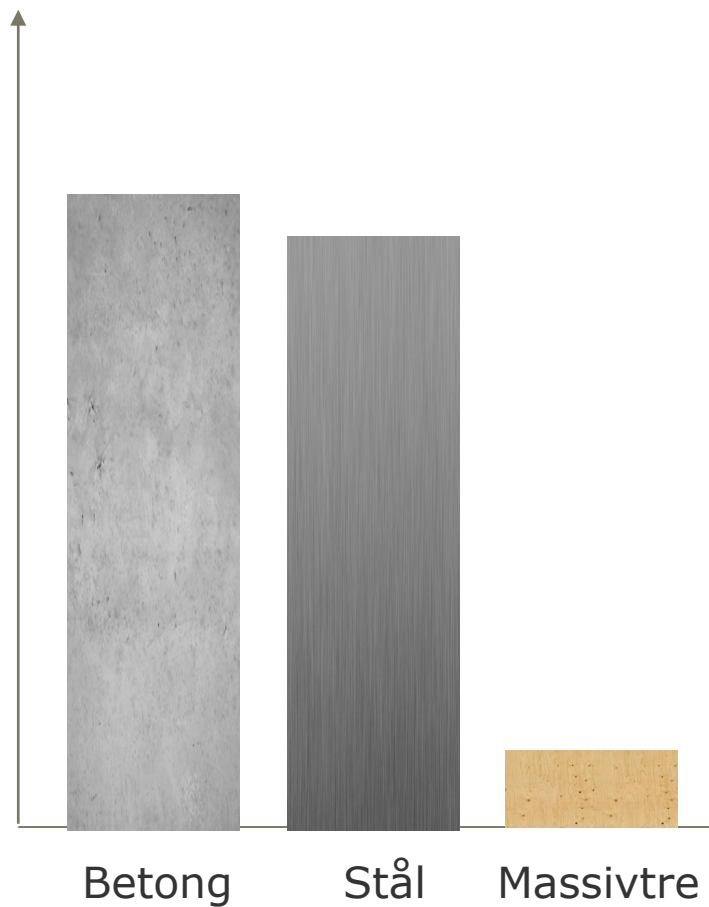


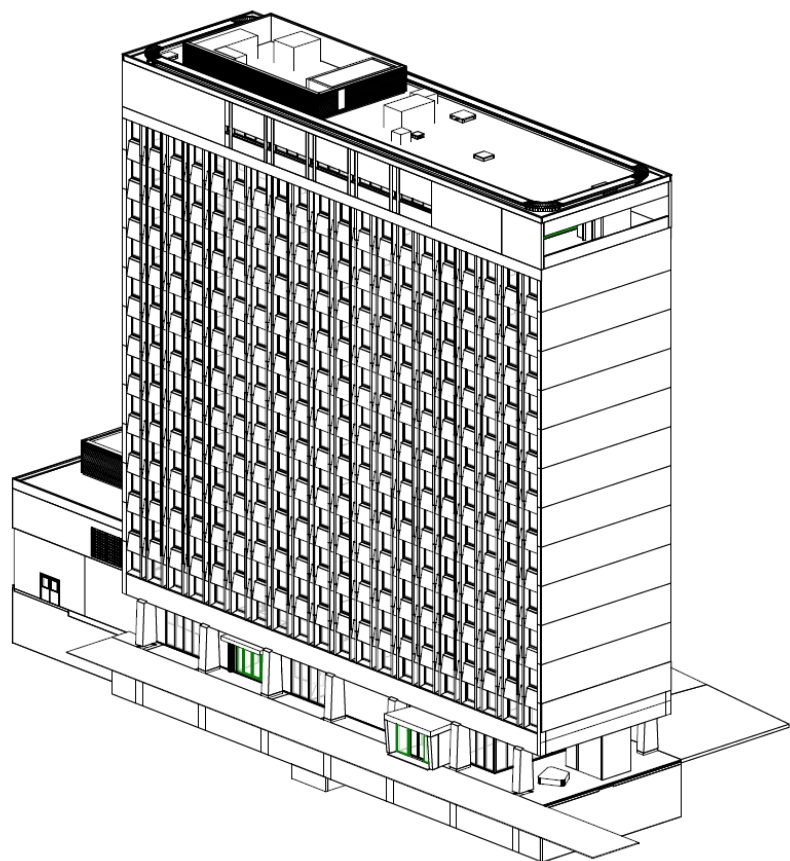


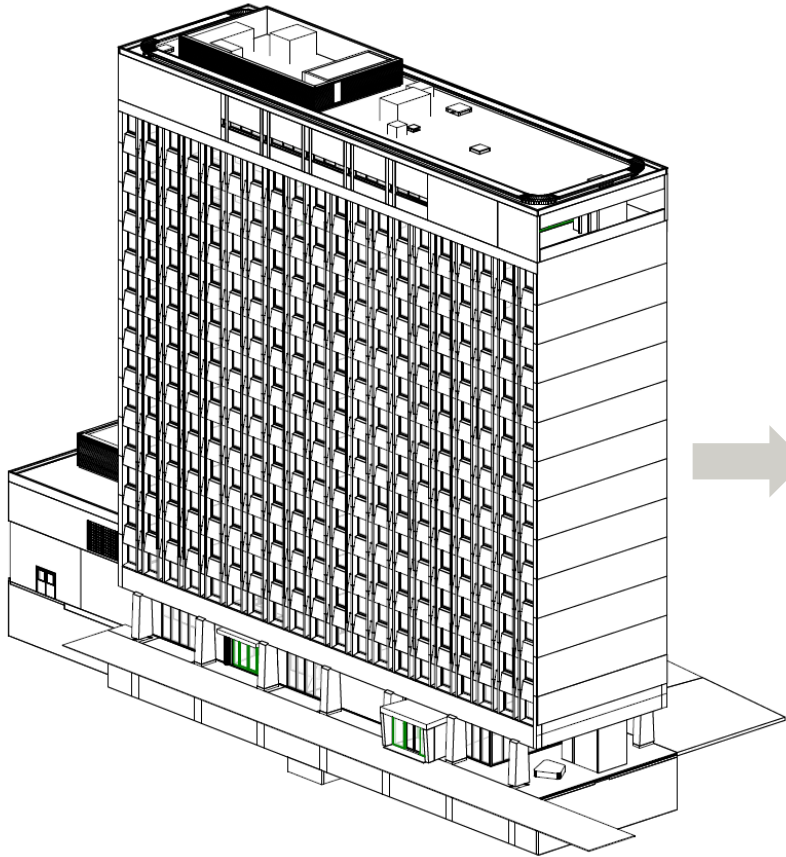




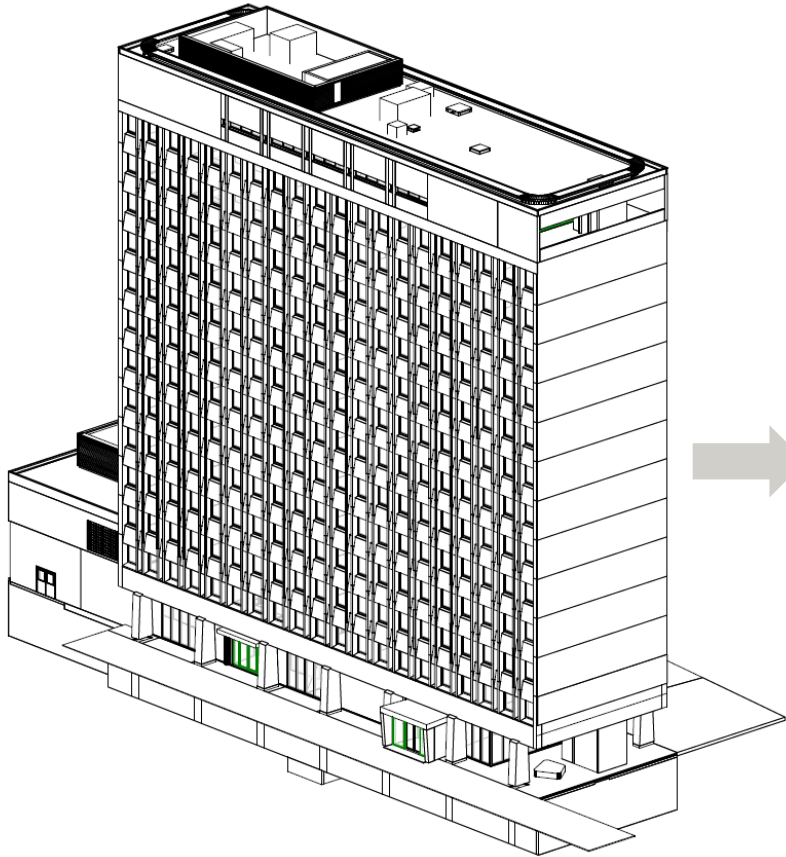
**Tonn CO<sub>2</sub>e/  
Livssyklus**







- Ceiling
  - Door
  - Floor
  - Roof
  - Columns
  - Wall
  - Window
  - Generic
- Project Info
  - Id
  - Materialtag
  - Net Volume
  - Net Area



- Ceiling
  - Door
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  - Net Volume
  - Net Area



Green  
BIM

# Green BIM





Type in Quantities[Project Name: Ny Harbitz Kontor] ✓

1

Create Project

2

Load BIM  
Model/Type in

3

Select Element

4

Run Analysis

⚙

Menu ...

+

Type	Description	Unit for Quantity	Quantity	
Slab		Select	27,270	✖
Slab		Select	8,400	✖
Ground Slab		Select	5,454	✖
Outer Walls		Select	10,736	✖
Internal Walls		Select	10,524	✖
Select		Select	5,800	✖
Windows		Select	7,300	✖

💾

Save

⚠

Proceed to Step 3

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## Elements

Select

Element Name

Element Name



Roofing felt, top layer, slate coated

insulating glass 2-disc 1.2 (m<sup>2</sup>/)

Alum



Ground deck w/ EPS insulation (750 mm)

Multilayered Parquet 0.012 (m<sup>2</sup>/) Con  
EPS rigid foam (Styrofoam ®) for ceilings /

Floor slabs of wood elements w/ mineral wool

Tubular Chipboard 0.007 (m<sup>2</sup>/) SolidHollow core slab w/ suspended ceiling and  
linoleum flooring (250 mm)Concrete of compressive strength class C 25/30 0.003 (m<sup>2</sup>/) Mineral Wool 0.015 (m<sup>2</sup>/) Concrete of compressive strength class C 25/30 0.174 (m<sup>2</sup>/) Steel profile 0.4 (kg/)  
Screed mortar cement screed 1 (kg/) Steel profile 5.3 (kg/)

## Edit Element

X

Type \*

Slab

Element Name \*

Hollow core slab w/ suspended ceiling and li

Country \*

Denmark

Life Span (Years) \*

100

Unit for Quantity

Select

Sound Level

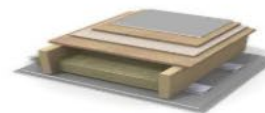
Select

U-Value (W/m<sup>2</sup>K)

Strength Class

G-Value

LT-Value



Material Name

Amount

1	Screed mortar cement screed	1	(kg/)	
2	Concrete of compressive strength class C 25/30	0.003	(m <sup>3</sup> /)	
3	Steel profile	5.3	(kg/)	
4	Concrete of compressive strength class C 25/30	0.174	(m <sup>3</sup> /)	
5	Steel profile	0.4	(kg/)	
6	Mineral Wool	0.015	(m <sup>3</sup> /)	



Edit Element





Select element for building [Project Name: Ny Harbitz Kontor] ✓



Create Project



Load BIM Model/Type in



Select Element



Run Analysis



## Scenarios



### Baseline

Concrete with mineral wool and plaster / Outer wall of concrete with solid mineral wool and plaster, Betondæk, Ground deck w/ EPS...

Last Updated By  
expert.login

Last Updated On  
09/19

### Scenario

#### Brick Facade

Betondæk, Ground deck w/ EPS insulation (750 mm), OuterWall\_Uvalue=0.3\_brick+insulation+brick, Partition with...

Last Updated By  
expert.login

Last Updated On  
09/19

### Scenario

#### Metall Panels Facade

Alufacade, Betondæk, Ground deck w/ EPS insulation (750 mm), Partition with plasterboard and steel skeleton, Roof construction 30 ...

Last Updated By  
expert.login

Last Updated On  
09/19

### Scenario

#### Wood Facade

Betondæk, Ground deck w/ EPS insulation (750 mm), OuterWall\_Uvalue=0.3\_Woodenstructure, Partition with plasterboard and steel...

Last Updated By  
expert.login

Last Updated On  
09/19

## Brick Facade

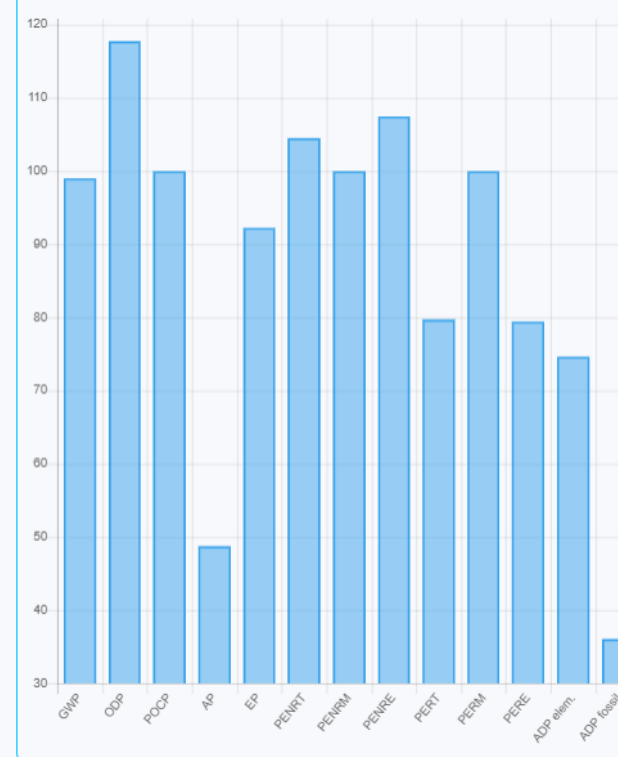
Component Id	Type	Description	Element(Element Id)	Unit for Quantity	Quantity
Ground Slab			Ground deck w/ EPS insulation		5
Concrete of compressive strength class C 25/30 : 0.1 (m³/m²), EPS rigid foam (Styrofoam ®) for ceilings / floors and as perimeter insulation B / P-035 : 0.35 (m³/m²), Multilayered Parquet : 0.012 (m³/m²), Rebar : 4 (kg/m²), Split 2/15 : 0.3 (m³/m²)					
Slab			Betondæk(B016)		27
Bitumen G 200 S4 (en) : 5 (kg/m²), Concrete of compressive strength class C 45/55 : 0.174 (m³/m²), Screed mortar cement screed : 1 (kg/m²)					
Slab			Betondæk(B016)		8
Bitumen G 200 S4 (en) : 5 (kg/m²), Concrete of compressive strength class C 45/55 : 0.174 (m³/m²), Screed mortar cement screed : 1 (kg/m²)					
Outer Walls			OuterWall_Uvalue=0.3_brick+in		10
Brick : 0.186 (m³/m²), Mineral Wool : 0.1 (m³/m²), Mortar : 66 (kg/m²)					
Internal Walls			Partition with plasterboard and		10
Facade paint emulsion paint : 0.38 (kg/m²), Mineral Wool : 0.075 (m³/m²), Plasterboard (Perforated Panel) : 0.026 (m³/m²), Steel profile : 1.96 (kg/m²)					
			Roof construction 30 or Lattice		5

Save Scenario

Proceed to Step 4

Bitumen G 200 S4 (en) : 5 (kg/m²), Bituminous Sheetting PYE-PV 200 S4 ns (delivered) : 6.2 (kg/m²), Concrete of compressive strength class C 45/55 : 0.174 (m³/m²), Mineral Wool (Flat Roof Insulation) : 0.015 (m³/m²), Rebar : 4 (kg/m²), Steel profile (s) : 0.44 (kg/m²)

## Selected vs Baseline(%)



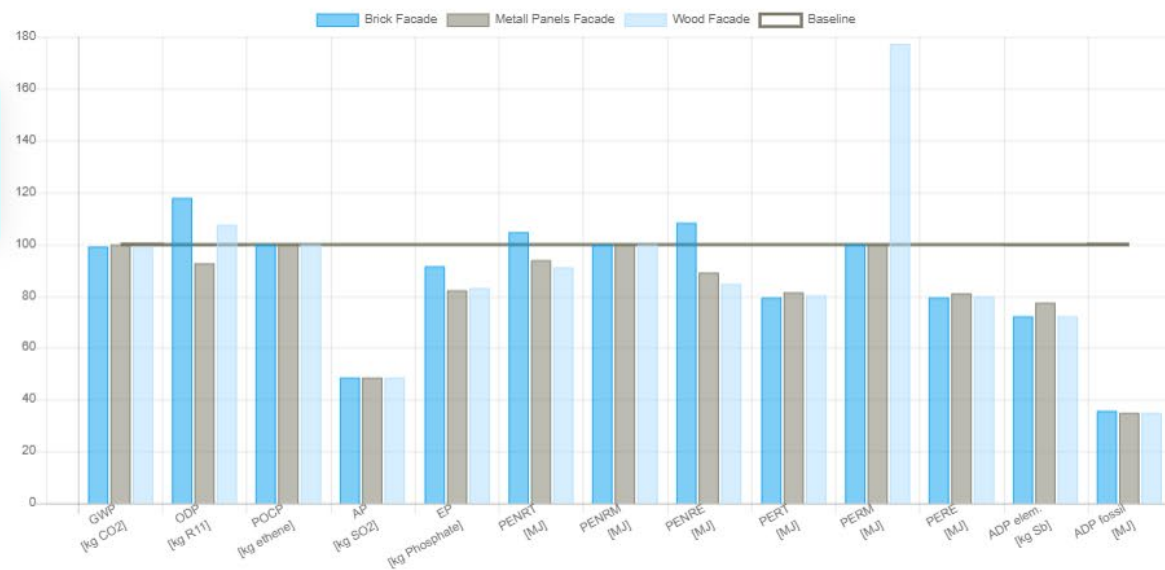
https://greenbimdevphase1.azurewebsites.net/home/index



<b>Elements</b>	Ground deck w/ EPS insulation (750 mm) Betondæk Betondæk <a href="#">OuterWall_Uvalue=0.3_brick+insulation+brick</a> Partition with plasterboard and steel skeleton Roof construction 30 gr. Lattice truss with mineral wool and brick-Flat Roofing felt, top layer, slate coated	Ground deck w/ EPS insulation (750 mm) Betondæk Betondæk <a href="#">Alufacade</a> Partition with plasterboard and steel skeleton Roof construction 30 gr. Lattice truss with mineral wool and brick-Flat Roofing felt, top layer, slate coated	Ground deck w/ EPS insulation (750 mm) Betondæk Betondæk Concrete with mineral wool and plaster / Outer wall of concrete with solid mineral wool and plaster Partition with plasterboard and steel skeleton Roof construction 30 gr. Lattice truss with mineral wool and brick-Flat Roofing felt, top layer, slate coated	Ground deck w/ EPS insulation (750 mm) Betondæk Betondæk <a href="#">OuterWall_U-value=0.3_Woodenstructure</a> Partition with plasterboard and steel skeleton Roof construction 30 gr. Lattice truss with mineral wool Roofing felt, top layer, slate coated
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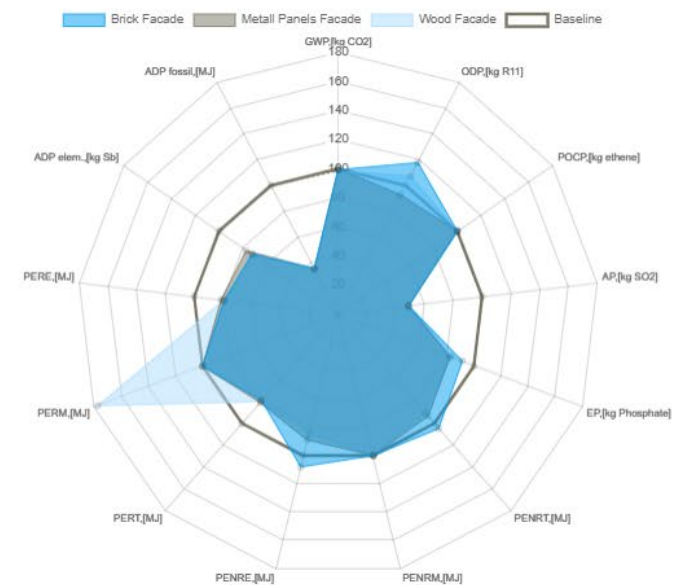
Help guide

## Results-comparison based on Baseline and Brick Facade,Metall Panels Facade,Wood Facade”(%)



Select / Unselect

☐ GWP ☐ ODP ☐ POCP ☐ AP ☐ EP ☐ PENRT ☐ PENRM ☐ PENRE ☐ PERT ☐ PERM ☐ PERE ☐ ADP elem. ☐ ADP fossil

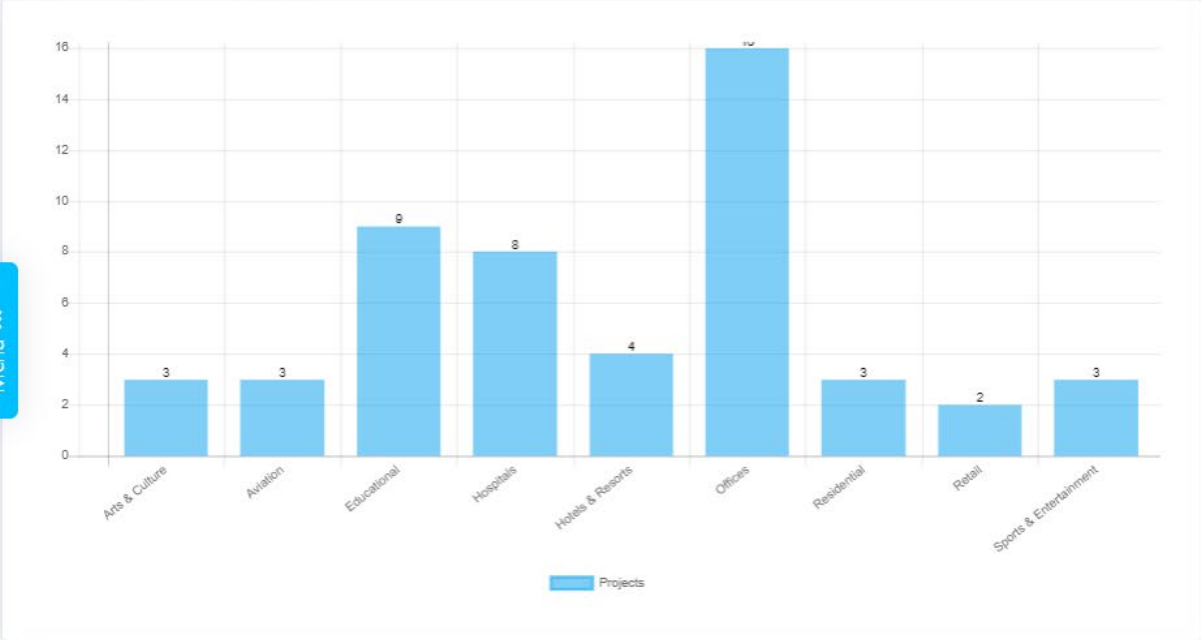


## Component-wise contribution

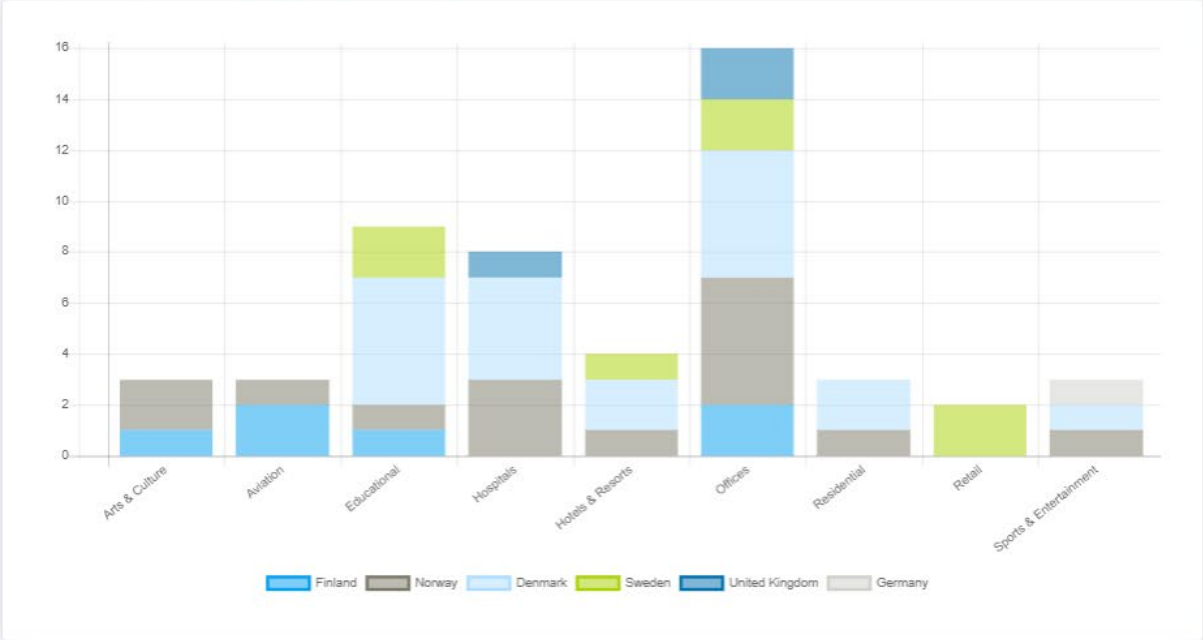
Select

Dashboard

Projects By Building Type



Projects By Building Type (Country)



Certification Goal Overall



Certification Goal Detail By Country

Denmark ▼





# SPØRSMÅL



- Hvilke materialer har de høyeste emisjoner?
- Kan vi stole på verdier av databaser/beregningsverktøy?
- Må materialer være nytt?

# INTRODUCING REHUB

# Samfunnsproblemet: Enorme ressurser i byggeindustrien behandles som avfall



Bruk av ressurser til  
bygningmaterialer kommer  
til å øke 85% innen 2060



CO<sub>2</sub>-økningen vil følge  
med

Rehub



Powered by

RAMBOLL



# Er det tungvint nok, kommer de gode ideene...

- Erfaringer fra prosjektet Gol sambruksstasjon som utløste initiativet Rehub
- Ambisjoner om gjenbruk var mer krevende enn antatt
- Tydelig behov for effektivisering
- Søkte om å delta i Byggflokken





# Barrierer



Finne materialer +  
dokumentasjon



Finne rett  
kompetanse



Logistikk



Finne informasjon

# Rehub

-Lukker sirkelen i byggeprosjekter



Rehub

# Funksjonaliteter



Informasjon



Søk i  
materialer



Logistikk



Teknisk  
testing



Risiko



Kompetanse

CO<sub>2</sub>

CO<sub>2</sub>-  
regnskap



011101011

Digital tvilling



# «Urban mining»









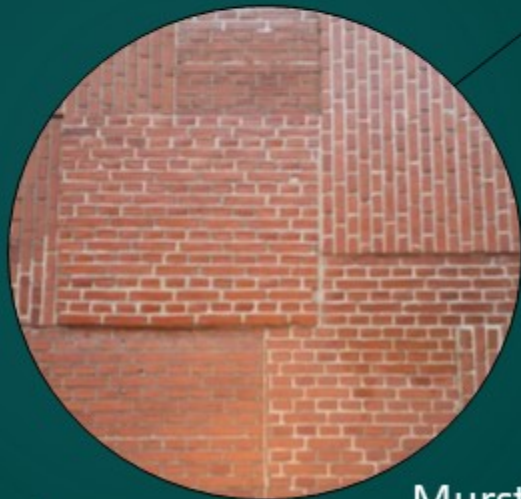
Med en digital tvilling kan man designe med materialene i et bygg før en leietaker flytter ut og lenge før bygget skal rives.



Vindu



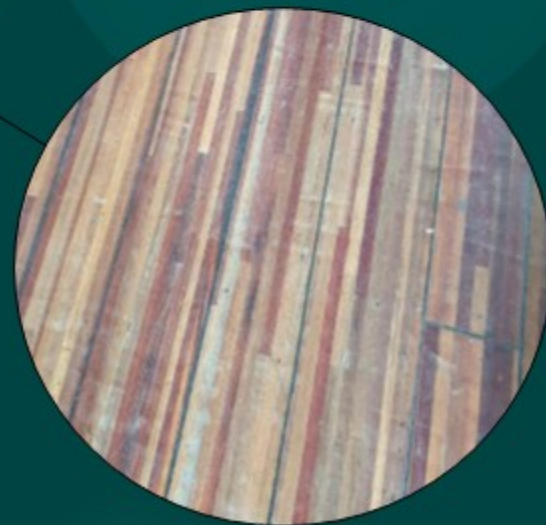
Takstein



Murstein

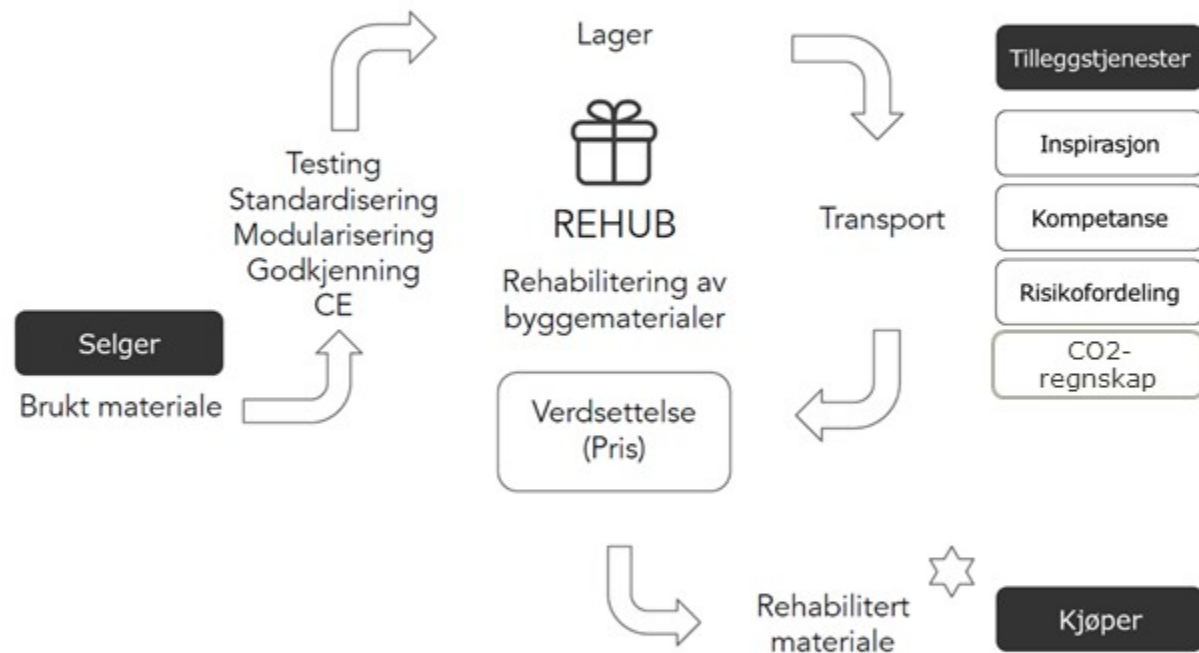


Betongelementer



Gulv

# Materiallets reise gjennom Rehub



## Brukte bygningsmaterialer «Rehubbes»

- Barrierer løftet fra bransjen, ble utgangspunktet for videreutviklingen av Rehub.
- Ideen er at brukte bygningsmaterialer skal rehabiliteres for videre salg
- Rehabiliteringen innebærer en løsning på de barrierene som løftes som de største



# La bygget fortelle en historie!

Credit: BlueCity Rotterdam (NL)

Rehub



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RAMBOLL



# Rehubs kjerneteam



Synniva Baarnes  
CEO



Johanne Thurmann-Moe  
CPO



Stine Haugen  
CMO



Lucas van Laack  
CTO



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