

# ZEB Pilot buildings - overview

Klimax Breakfast Meeting  
October 12, DIGS Trondheim

Inger Andresen, Professor NTNU



The Research Centre on  
Zero Emission Buildings





 ABOUT ZEB

ZEB report nr. 24 - Life Cycle GHG Emissions of Material Use in the Living Laboratory

 PARTNERS

This report documents the design and construction of the ZEB Living Laboratory in Trondheim; with a view to better understand the implication of design...

 NEWS AND EVENTS

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 PUBLICATIONS

Videreutdanningskurs i prosjektering av nullutslippsbygg og plusshus

Foto: Chris Aadland Ønsker du faglig påfyll og formell kompetanse i prosjektering av fremtidens bygninger? Da kan du melde deg på eksamensrettet videreutdanningskurs ved...

 PILOT PROJECTS

 LABORATORIES

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 CONTACT



## ZEB PARTNERS



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# ZEB Research Activities

**WP1** Advanced materials technologies

**WP2** Climate-adapted low-energy envelope technologies

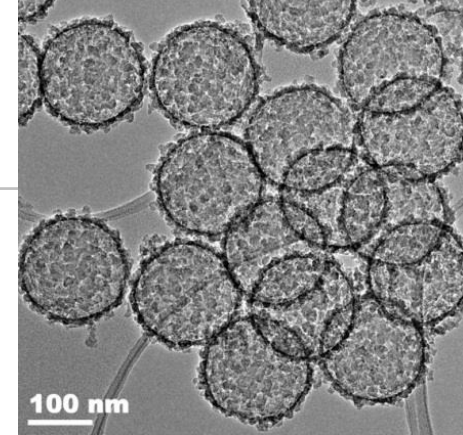
**WP3** Energy supply systems and services

**WP4** Use, operation, and implementation

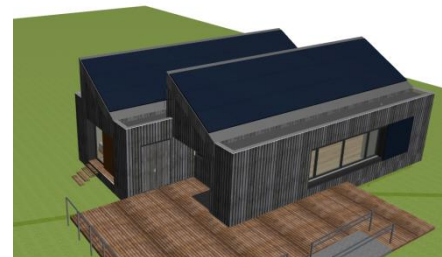
**WP5** Concepts and strategies and Pilot buildings



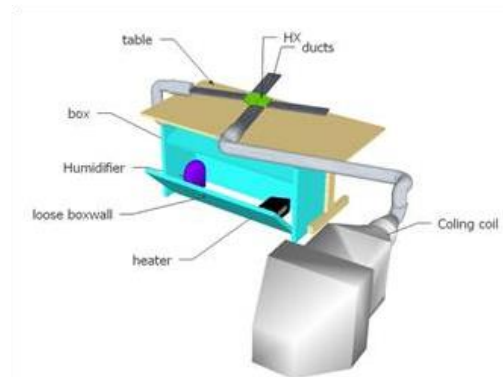
VIP Leca Isoblokk



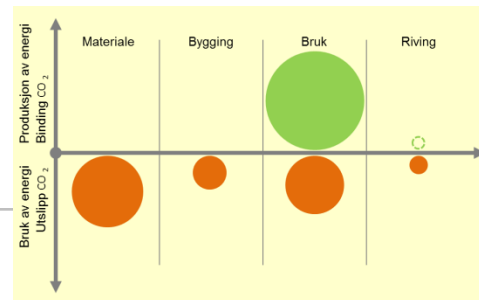
Nano insulation material



ZEB Living Lab



Membrane heat exchanger



ZEB Definition

ZEB Pilot buildings



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# How to make a Zero Emission Building?

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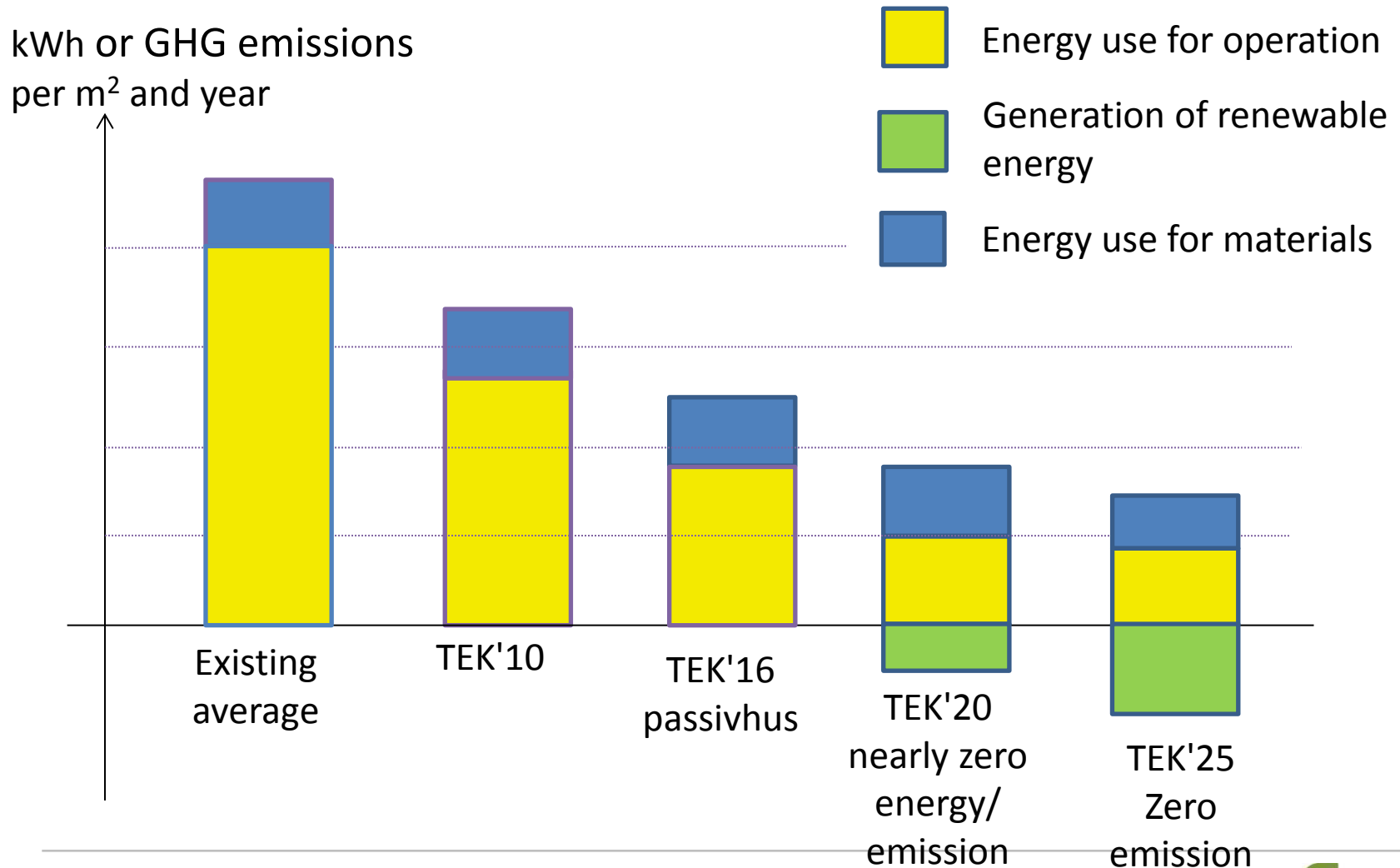
- What kind of cake
- Recipe
- Cooks
- Ingredients

# ZEB ambition levels (what kind of cake)

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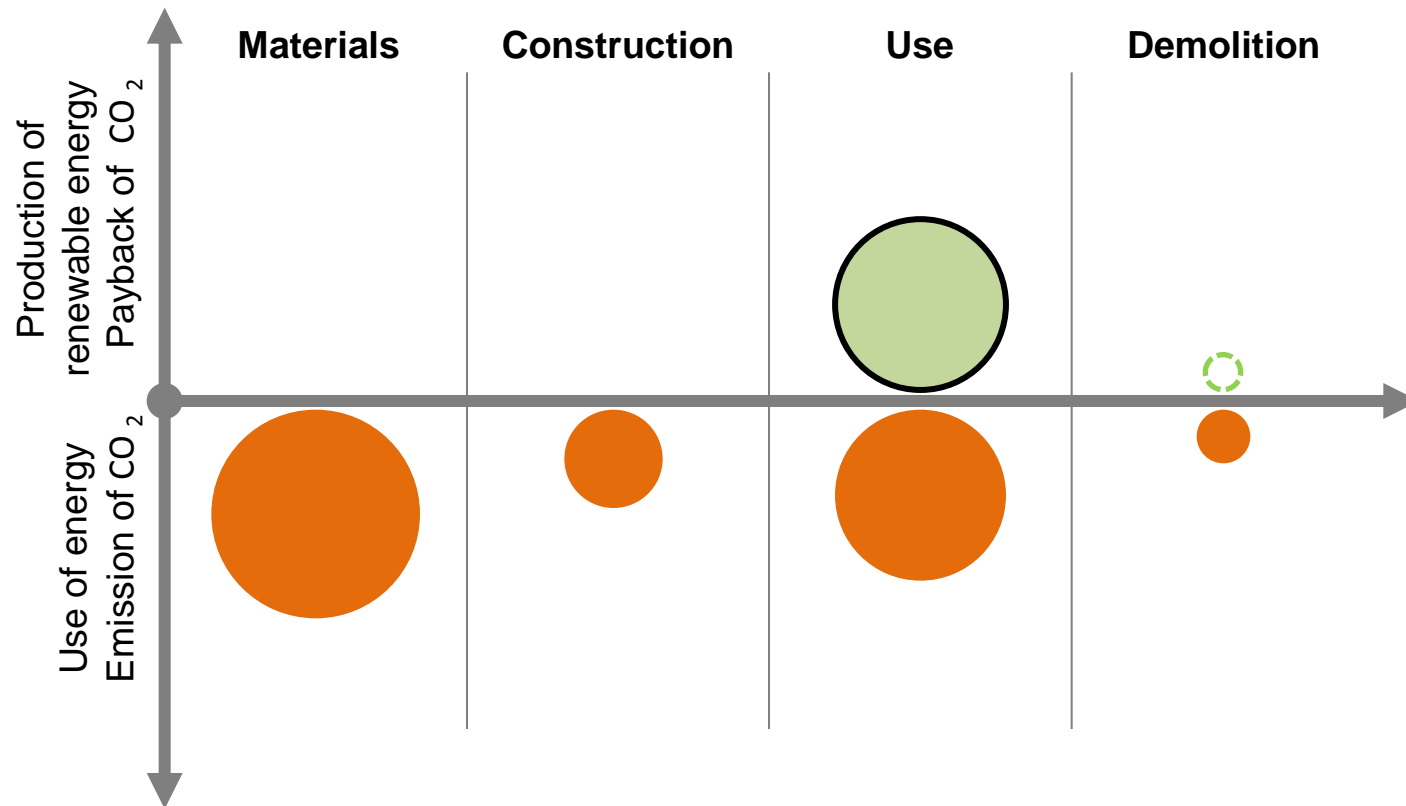


# From standard building to ZEB



# ZEB Ambition levels (what kind of cake)

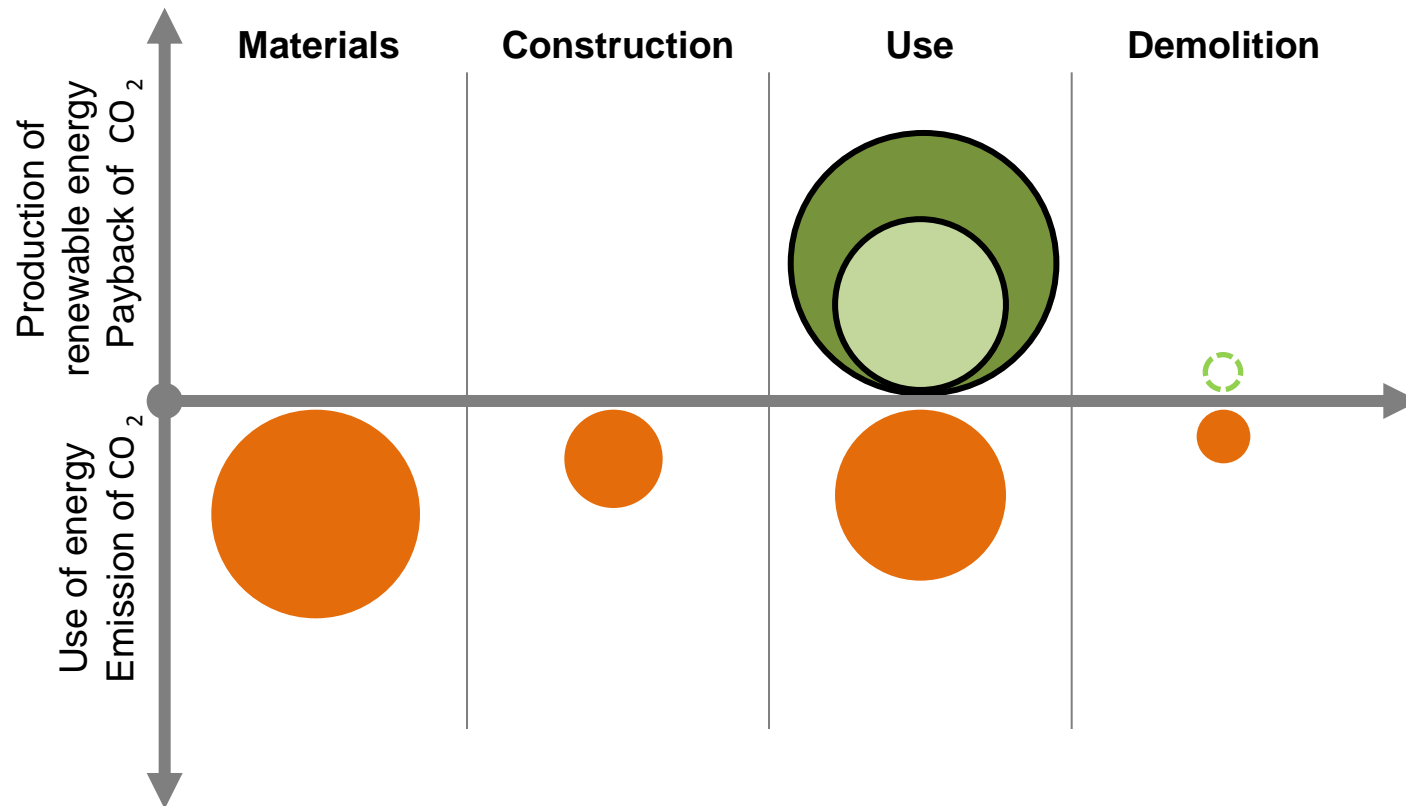
## ZEB-O





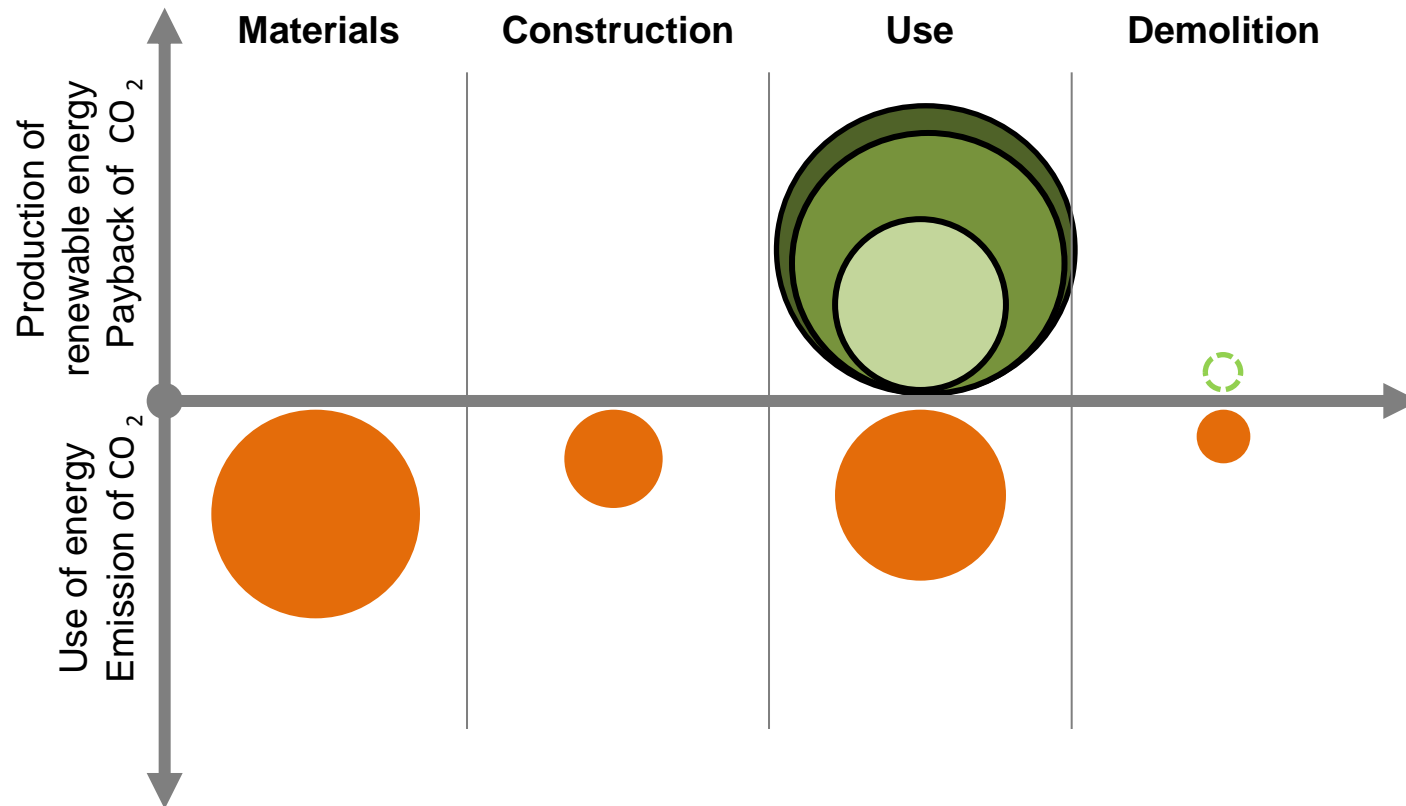
# ZEB Ambition levels (what kind of cake)

## ZEB-OM



# ZEB Ambition levels (what kind of cake)

## ZEB-COM



# ZEB definition (recipe)

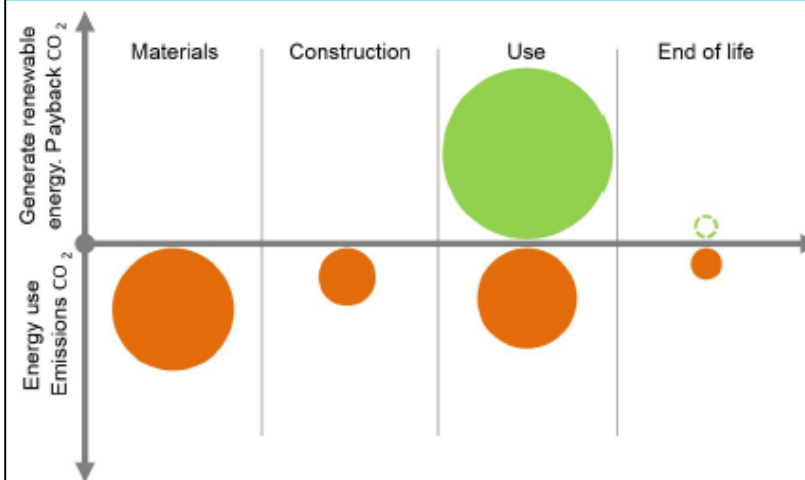
<b>2. THE ZEB BALANCE .....</b>	<b>7</b>
2.1 NET ZERO ENERGY BUILDINGS (NET ZEB) .....	7
2.2 ZERO EMISSION BUILDING (ZEB) .....	8
2.2.1 ZEB Ambition Level Definitions and System Boundaries .....	8
2.2.2 Components and materials included in the "M" .....	10
2.2.3 Addressing Embodied Emissions at all Ambition Levels .....	13
<b>3. OPERATIONAL ENERGY CALCULATION PROCEDURES .....</b>	<b>14</b>
3.1 OPERATIONAL ENERGY AND EMISSION CALCULATION PROCEDURE .....	14
3.2 CO <sub>2</sub> CONVERSION FACTORS .....	15
3.2.1 CO <sub>2</sub> Factor for Grid Electricity .....	15
3.2.2 CO <sub>2</sub> Factors for Bioenergy and Waste Incineration .....	17
3.2.3 Summary of CO <sub>2</sub> Factors .....	18
3.3 SYSTEM BOUNDARY FOR OPERATIONAL ENERGY .....	19
3.4 MISMATCH OF GENERATION AND DEMAND .....	20
3.5 ENERGY EFFICIENCY REQUIREMENTS .....	20
3.6 INDOOR CLIMATE REQUIREMENTS .....	20
<b>4. LIFE CYCLE EMISSION CALCULATION PROCEDURES FOR MATERIALS .....</b>	<b>21</b>
4.1 GOAL AND SCOPE DEFINITION .....	21
4.1.1 Functional Unit .....	21
4.1.2 System Boundary .....	22

Selamawit Mamo Fufa, Reidun Dahl Schlanbusch, Kari Sørnes,  
Marianne Inman and Inger Andresen

## A Norwegian ZEB Definition Guideline

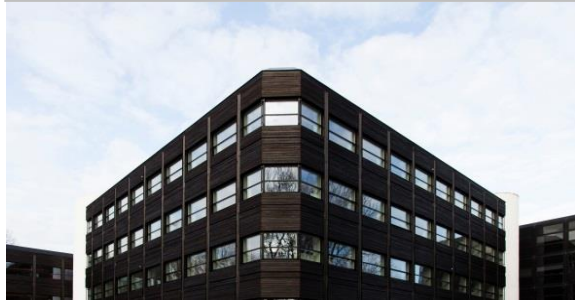
**ZEB** The Research Centre on  
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**FM**  
E





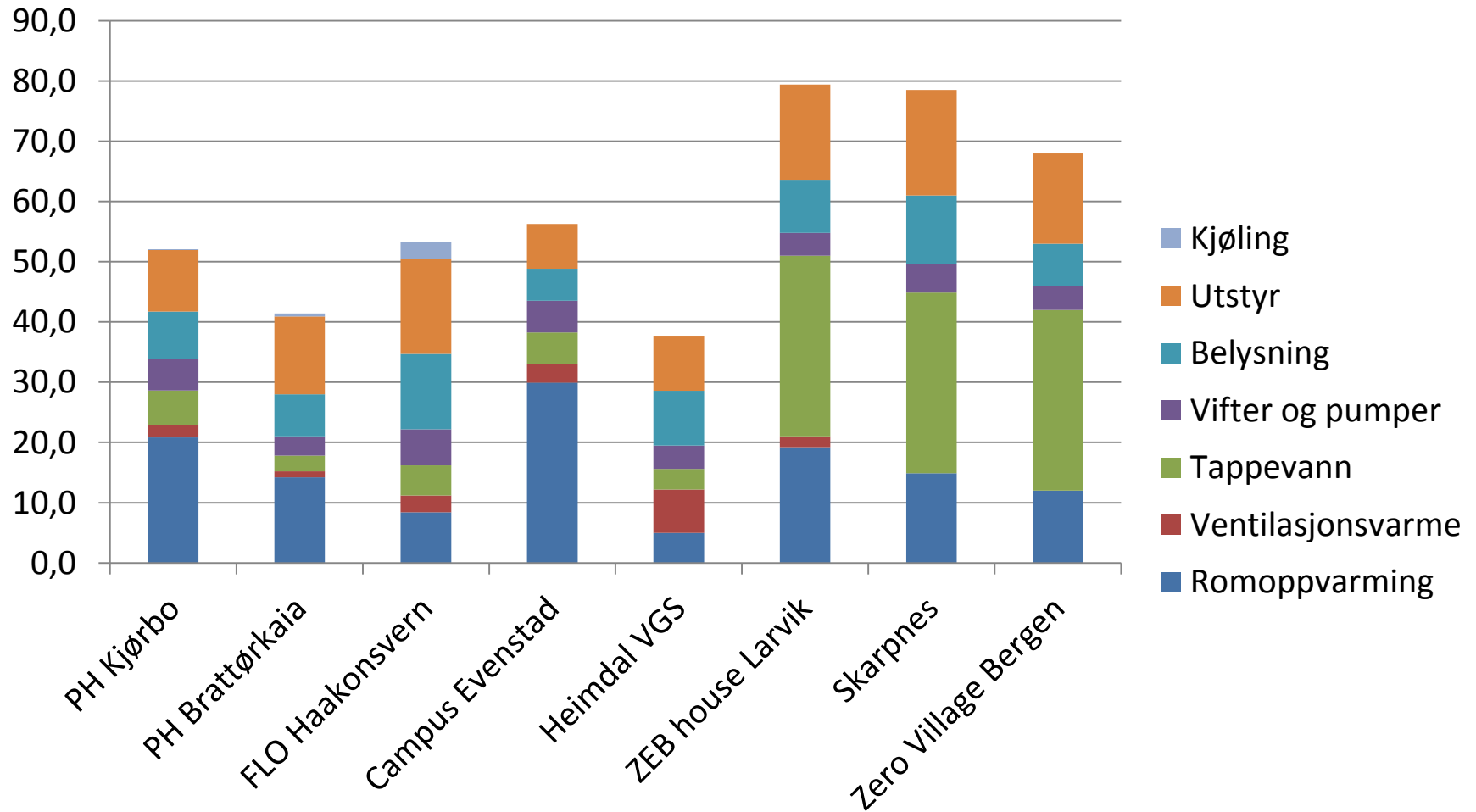
# ZEB Pilot buildings - examples of ingredients



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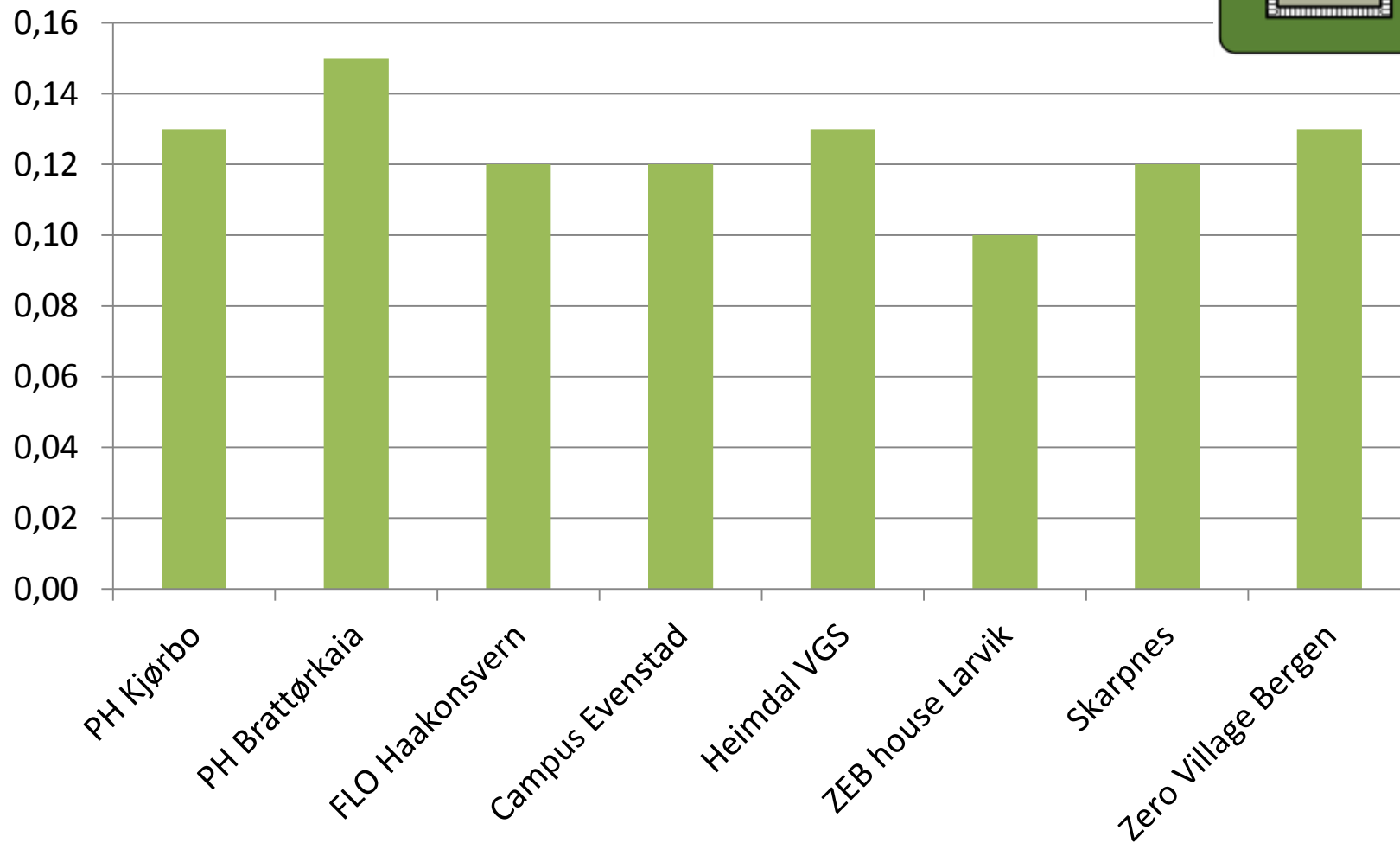
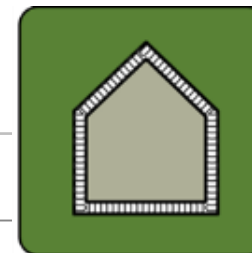


# Net energy demand (netto energibehov) for operation kWh/(m<sup>2</sup>år)



\*design values

# Insulation of exterior walls, W/(m<sup>2</sup>K)



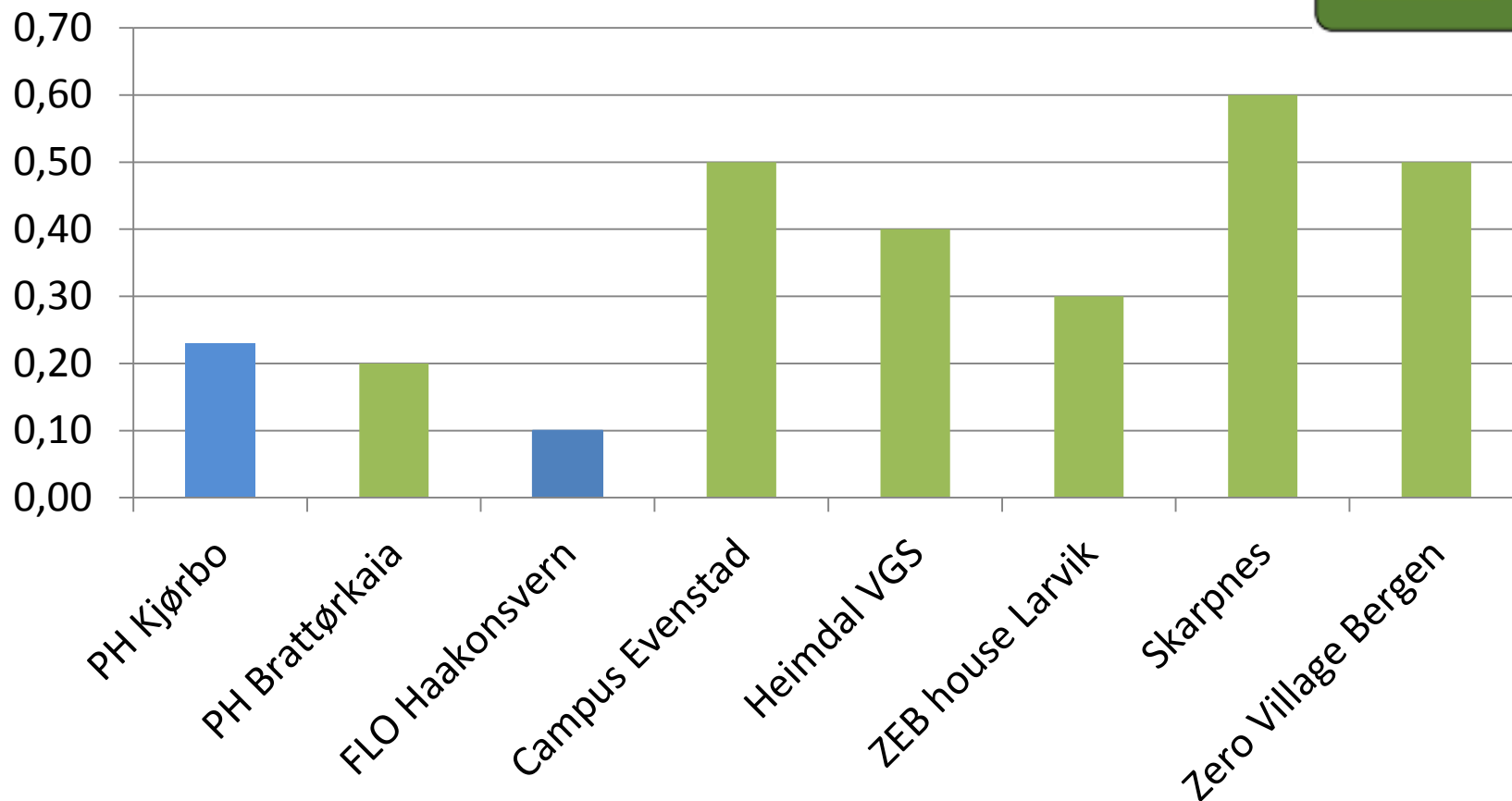
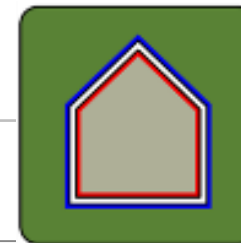
\*design values



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# Air leakage numbers, $n_{50}$



\*green are design values, blue are measured values

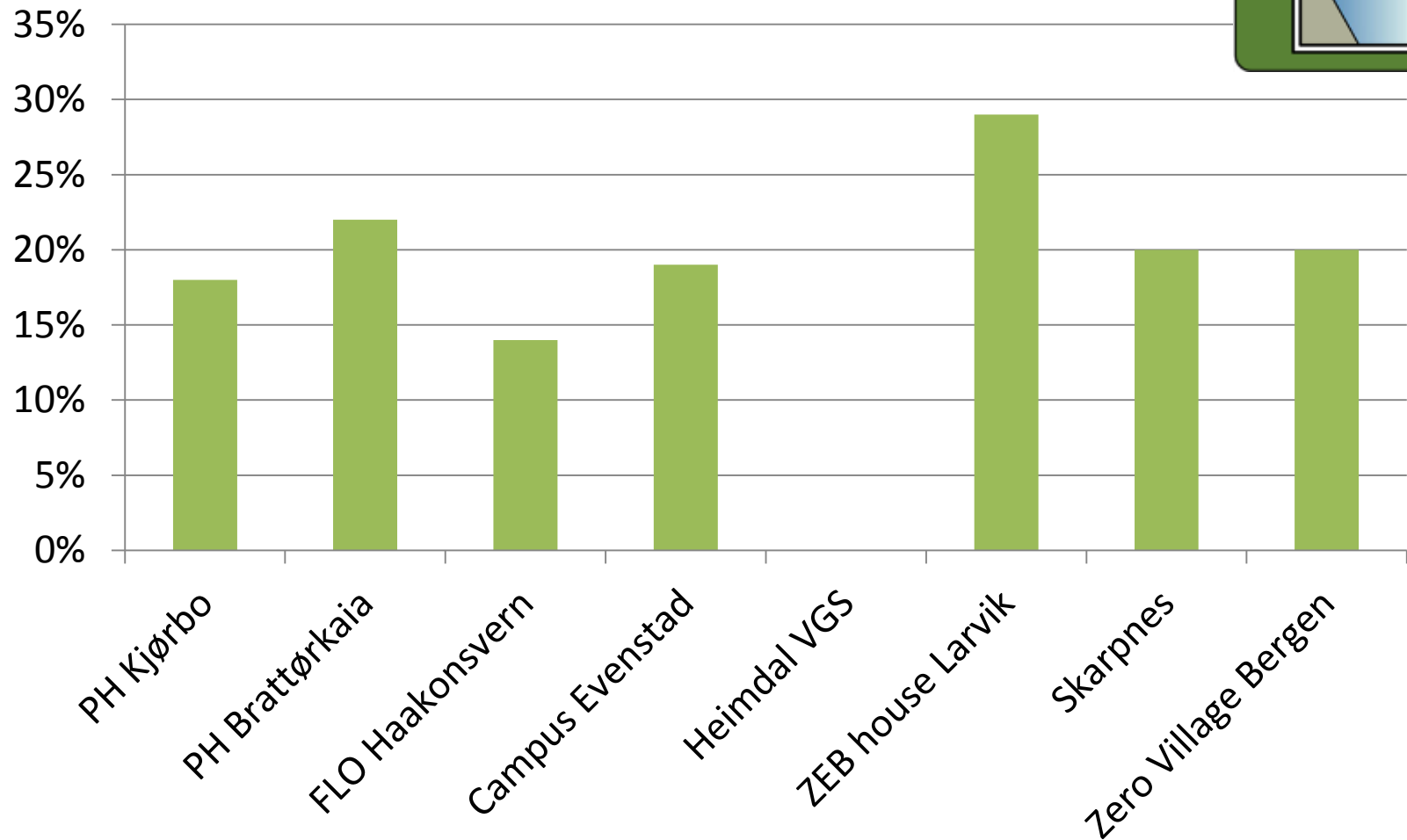
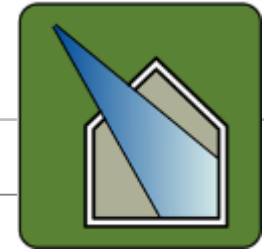


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# Window area (% of heated floor area)

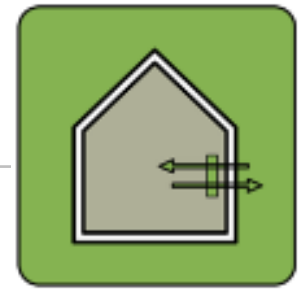


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# HVAC systems

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## Project

Powerhouse Kjørbo

Powerhouse Brattørkaia

FLO Haakonsvern

Campus Evenstad

Heimdal VGS

ZEB House Larvik

Skarpnes

Zero Village Bergen

## System type

Displacement ventilation. Centrally located shafts and radiators. Large thermal mass.

Displacement ventilation. Underfloor air supply. Large thermal mass.

Mixing ventilation with active diffusers. Radiators in offices. Ventilation cooling.

Hybrid ventilation, displacement. No cooling system.

Displacement/mixing. Decentralised ventilation units.

Mixing ventilation. One radiator per floor.

Mixing ventilation. One radiator per floor.

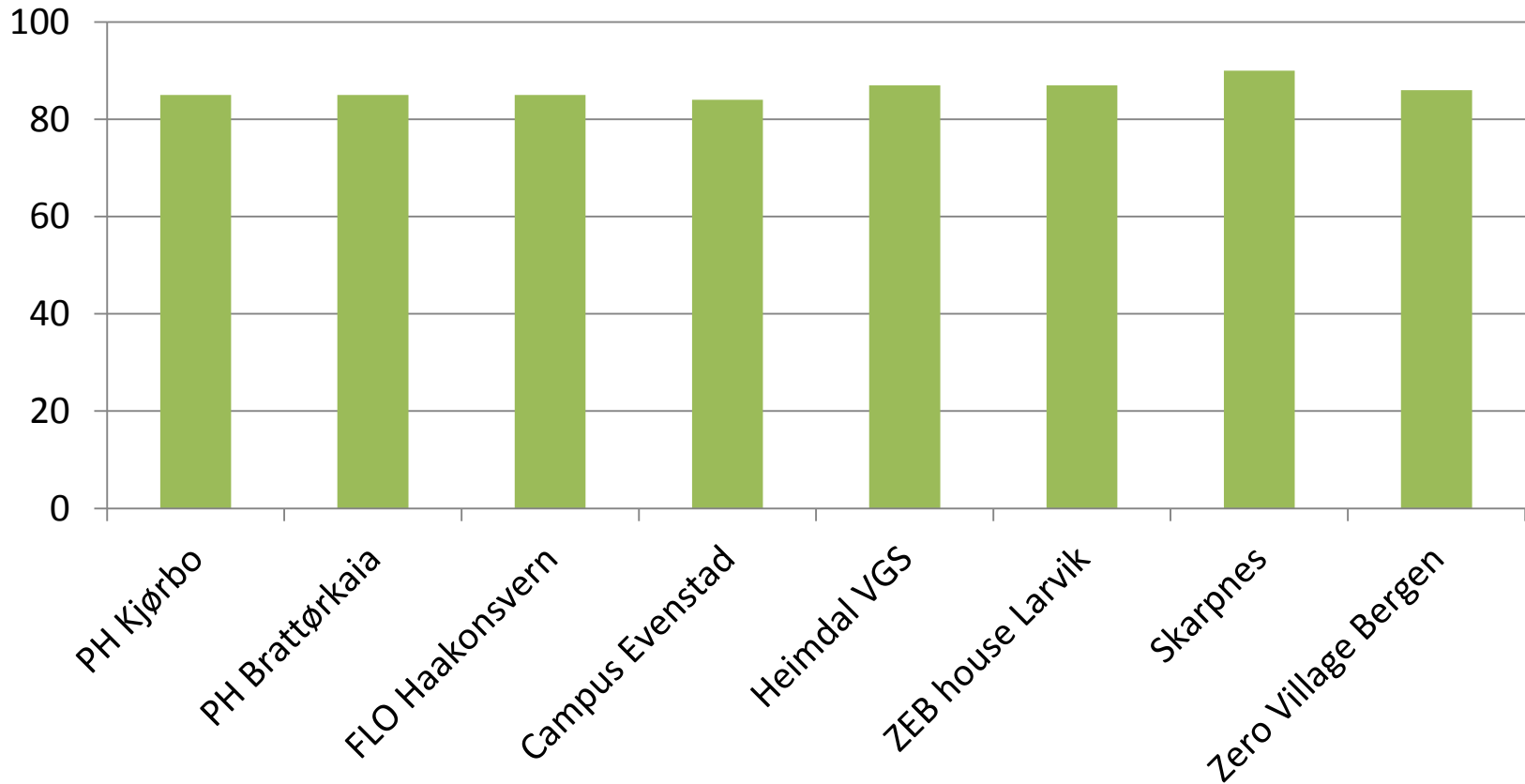
Mixing ventilation.



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# Ventilation heat recovery, %



\*design values, average during operation

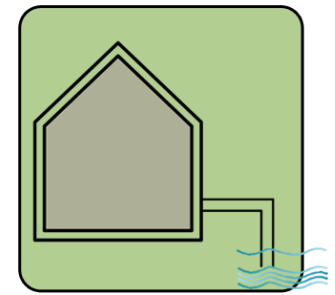


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# Renewable thermal supply

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## Project

Powerhouse Kjørbo

Powerhouse Brattørkaia

FLO Haakonsvern

Campus Evenstad

Heimdal VGS

ZEB House Larvik

Skarpnes

Zero Village Bergen

## Systems

Ground source **heat pump** + heat from servers

Sea water **heat pump** + district heat

Sea water **heat pump** (from local central)

CHP system based on gasification of wood chips

CHP system with biogas, ground source **heat pump**

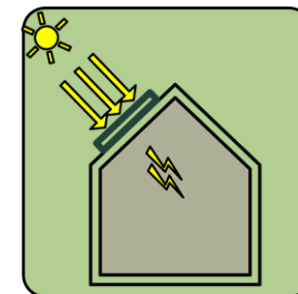
Ground source **heat pump**, greywater heat recovery, solar collectors, exhaust air heat pump

Ground source **heat pump**

? Ground source **heat pump** or CHP

# Renewable electrical supply

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## Project

## Systems

Powerhouse Kjørbo

Photovoltaics

Powerhouse Brattørkaia

Photovoltaics

FLO Haakonsvern

Photovoltaics

Campus Evenstad

CHP system based on gasification of wood chips

Heimdal VGS

Photovoltaics + CHP

ZEB House Larvik

Photovoltaics

Skarpnes

Photovoltaics

Zero Village Bergen

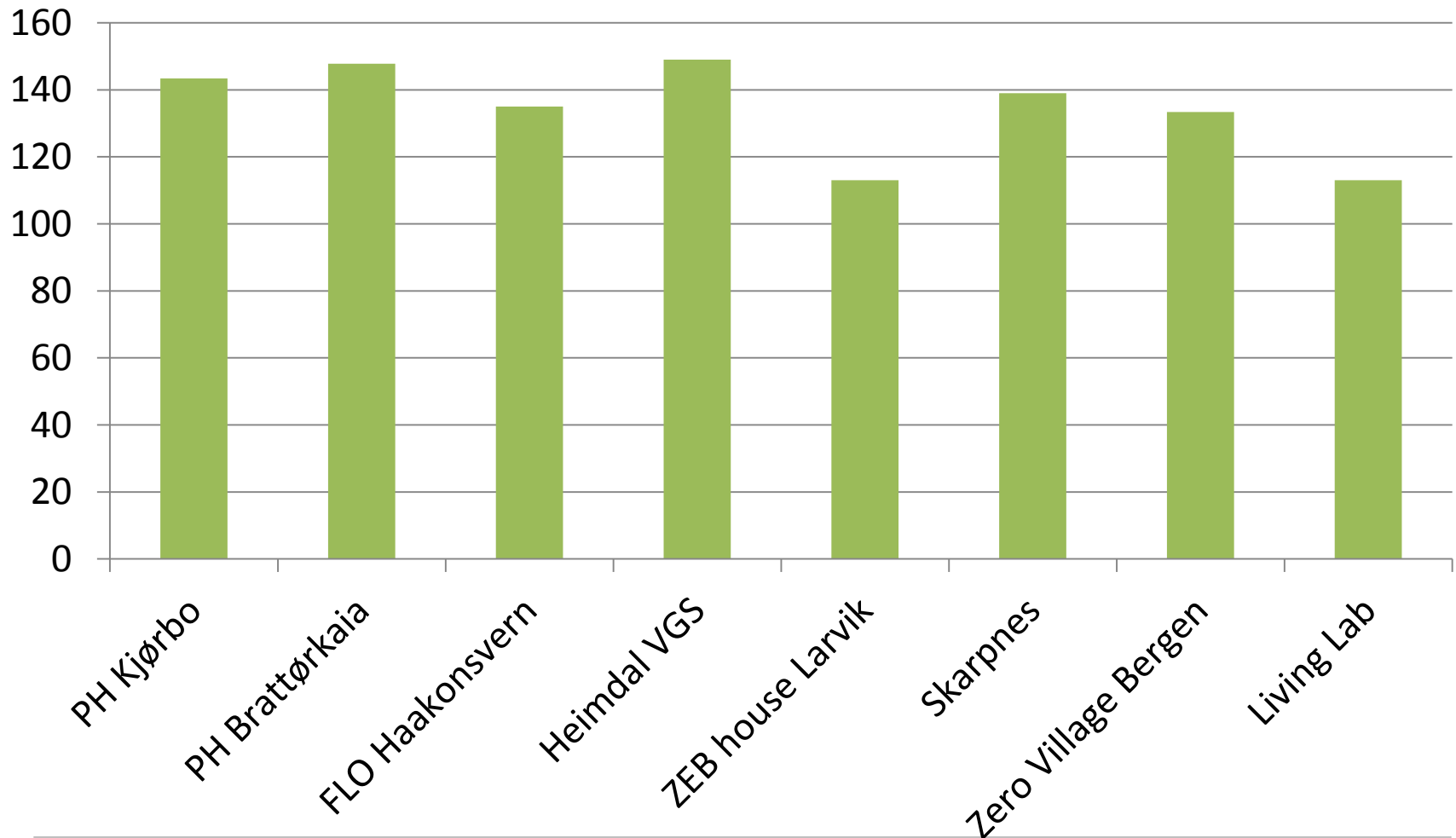
Photovoltaics (+CHP?)



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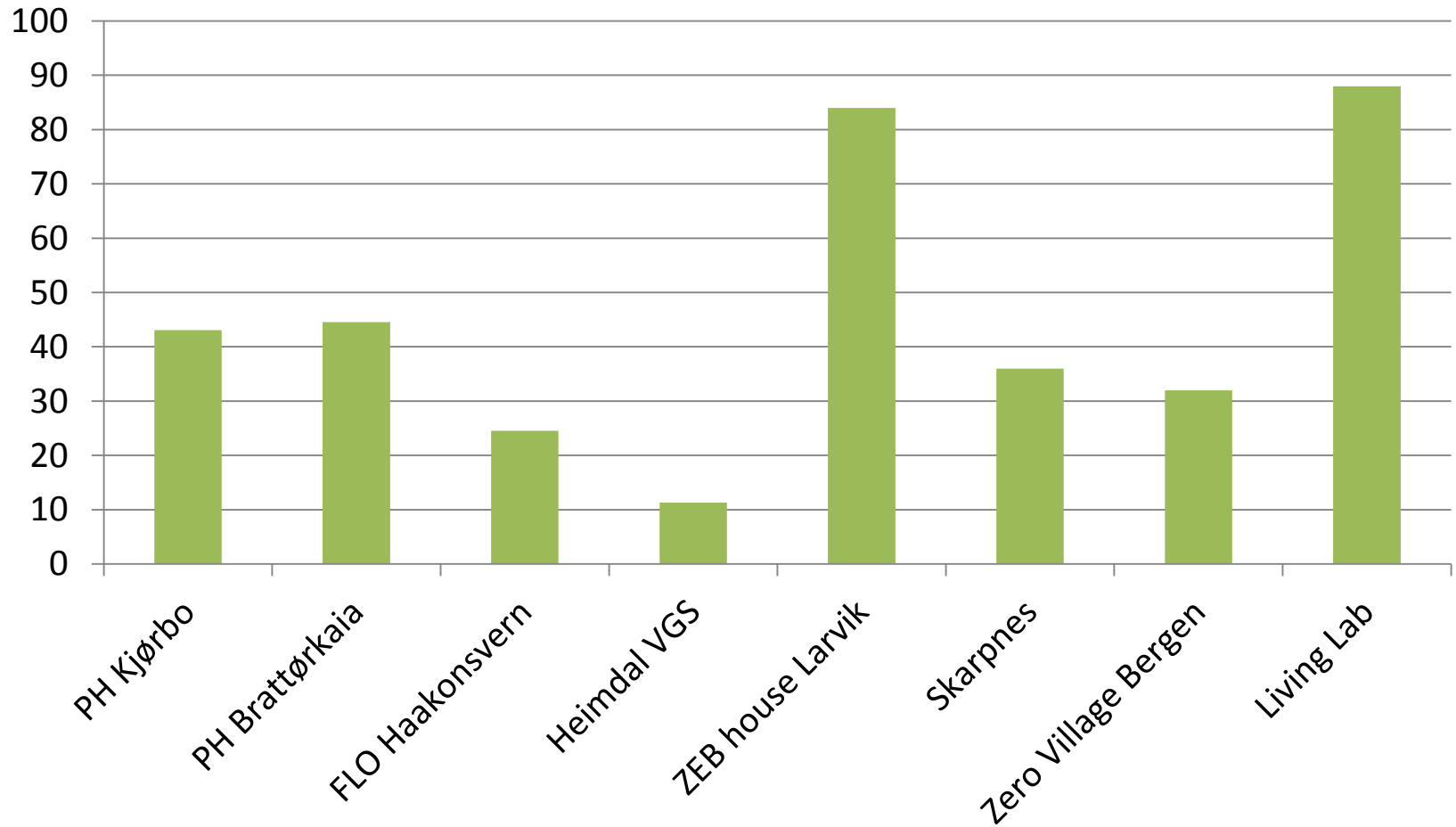
# Yearly output per m<sup>2</sup> PV area, kWh/m<sup>2</sup>



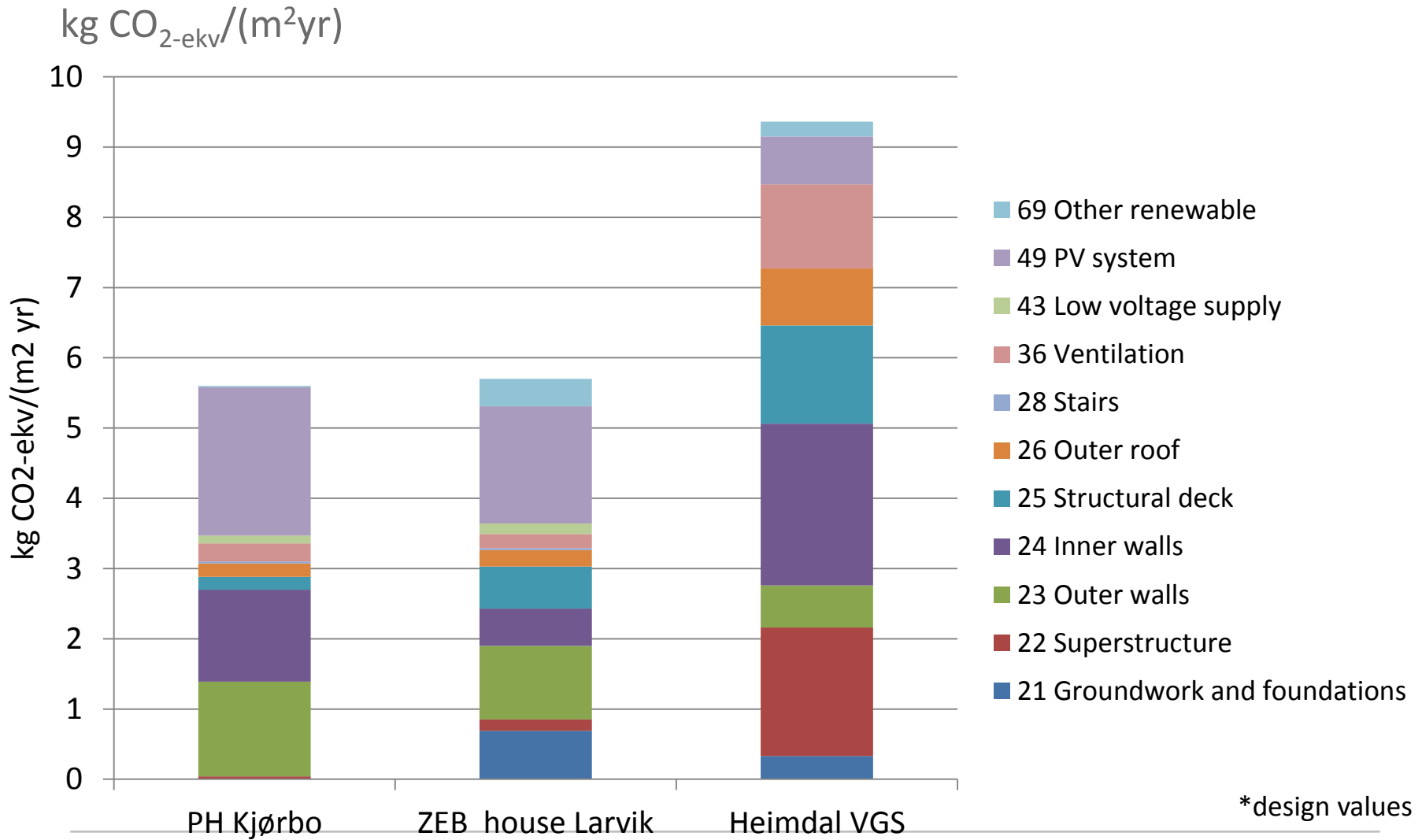
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# Yearly output per m<sup>2</sup> floor area, kWh/m<sup>2</sup>



# Embodied emissions in materials







Open for registration now:

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# ZEB konferansen 2017

TORS DAG 19. JANUAR 2017  
SCANDIC NIDELVEN TRONDHEIM

Nullutslippsbygg – Vi får det til!



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