

ZEB Laboratories at NTNU

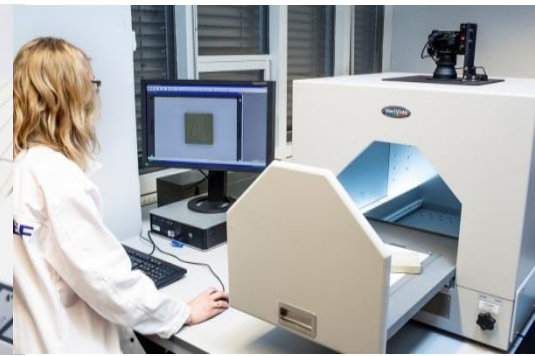
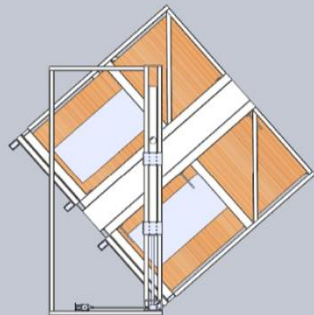
Arild Gustavsen
Professor, NTNU



The Research Centre on
Zero Emission Buildings



Laboratories for characterization and research on building materials and components



Establishment of Research Buildings at NTNU – ZEB Living Lab and ZEB Test Cell Lab

Architect: Luca Finocchiaro, NTNU.

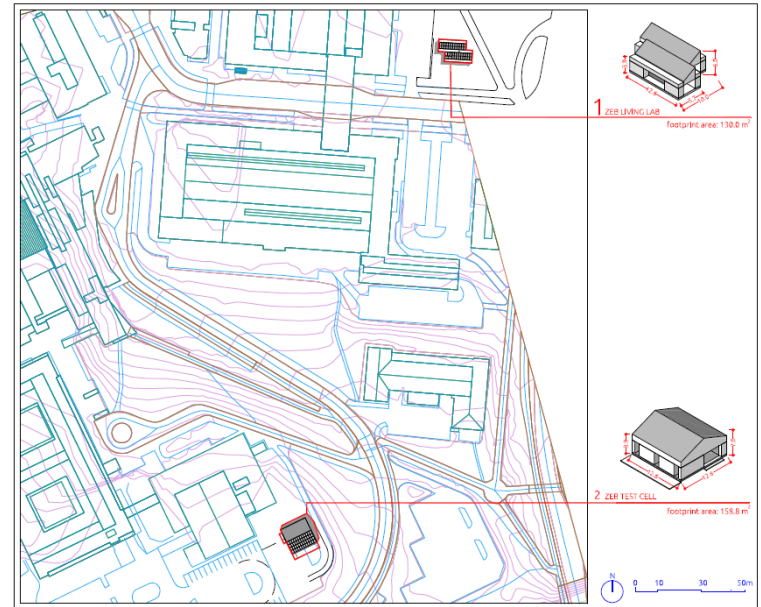


ZEB Living Lab – A dwelling for user-
Technology interaction studies



Architect: Luca Finocchiaro, NTNU.

ZEB Test Cell Lab for research and development of ZEB technologies

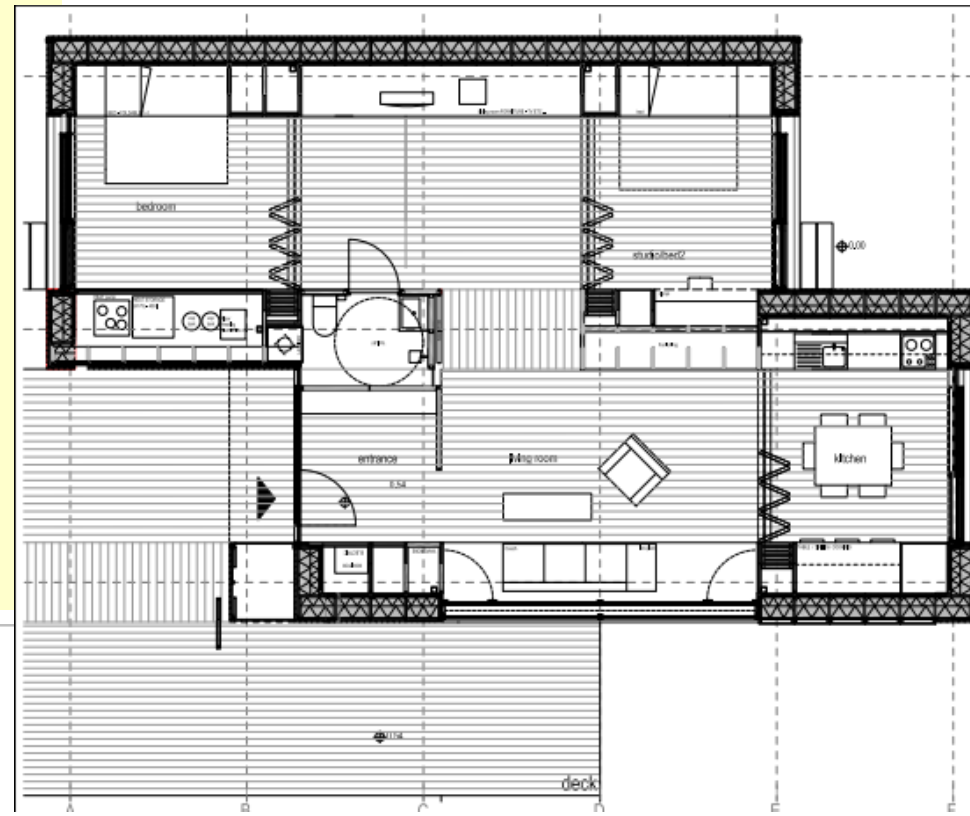


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ZEB Living Lab

- 100 m² living area
- ZEB-OM (Operation and Materials)
- Building Integrated Photovoltaics: 80 m²
- Solar panel in the facade
- Ground to water heat pump
- Heat recovery system (Flexit)
- PCM in the roof (DuPont)
- VIP in sliding doors (NorDan)
- Reflective vapor barrier (Isola)
- Mixed mode ventilation (Sapa, VELUX, and Caverion)
- LED Lights (NorDesign)



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The Living Lab – building envelope features

U-value wall	0.11	W/m ² K
U-value floor	0.10	W/m ² K
U-value roof	0.10	W/m ² K
U-value windows (south façade)	0.65 (not ventilated)	W/m ² K
U-value windows (north façade)	0.97	W/m ² K
U-value windows (east-west façade)	0.66	W/m ² K
U-value skylight	1.0	W/m ² K
g-value	0.5	-
Air tightness	0.7	ach
Thermal bridges (normalized)	0.03	W/m ² K

BIPV

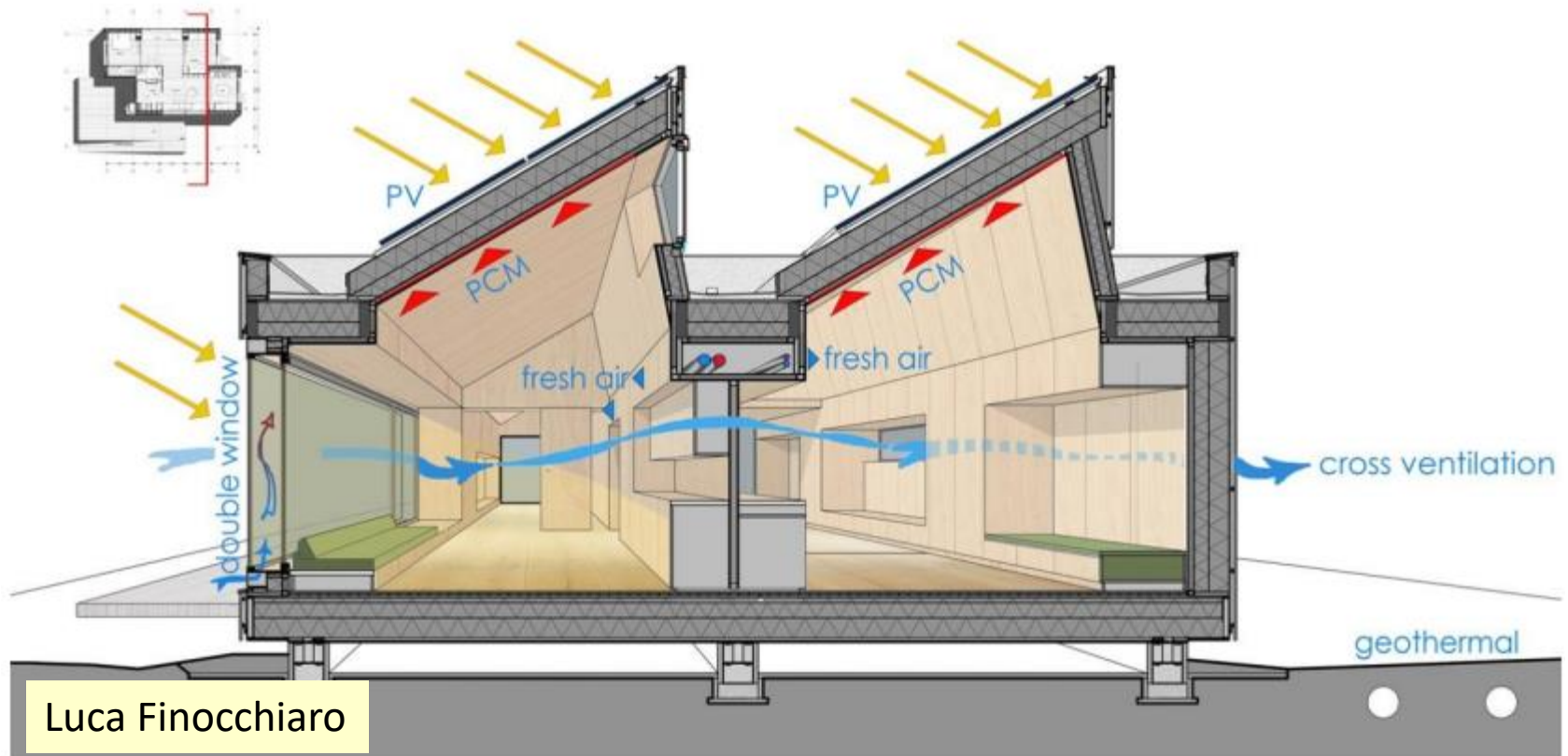


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ZEB Living Lab – Interior View

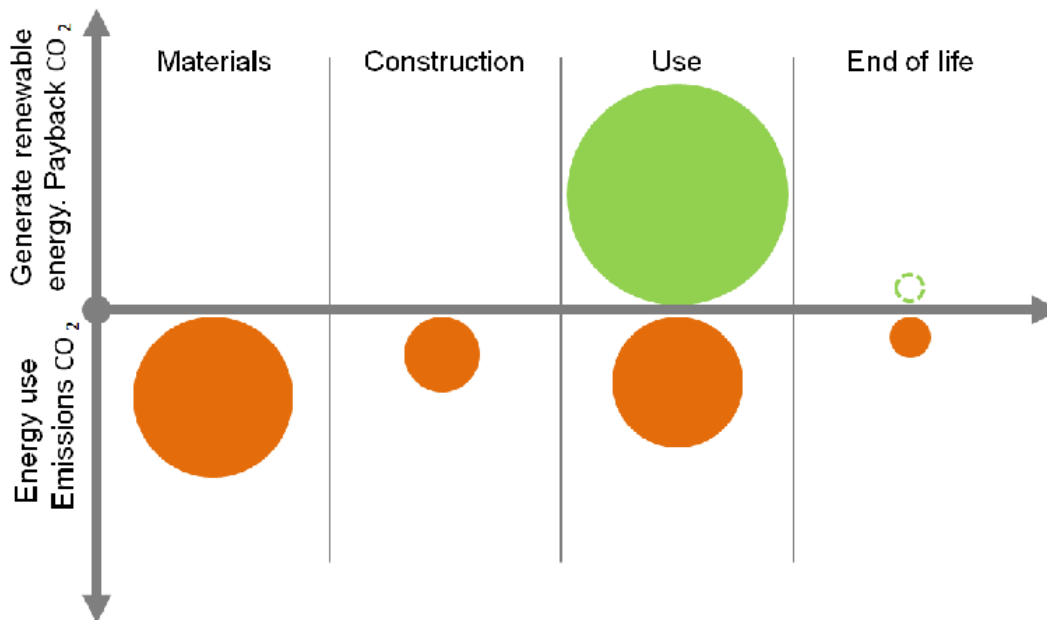


ZEB Living Lab



The Living Lab as Zero Emission Building

The building's renewable energy harvesting (PV, 12.5 kWp, polycrystalline silicone cells) compensates for greenhouse gas emissions from operation and production of its building materials (level ZEB – OM)



Selected Groups

- 155 groups applied to live in the Living Lab
- 6 groups were selected



Group #	1	2	3	4	5	6
Category	Student	Student	Family with children	Elderly	Family with children	Elderly
Details	Male and female couple, 22 years old. Live in a 52 m2 student apartment.	Two female friends, 20 and 21 years old. Live in a shared apartment together with three other girls, built 1905.	Mother 31 years old and father 36. Son 6 years old and daughter 2. Live in an attached house of 185m2, built 2007	Husband 81 and wife 68. Live in a detached house of 170 m2.	Mother 31 years old and father 37. Two daughters of 3 and 2 years old. Live in a detached house of 135 m2.	Husband 61 and wife 56. Live in a detached house of about 120 m2.

Fig. 1. Støylen Korsnes, M. 2016

A home



Selected week

Group 1
2nd week



Group 2
3-4th week (mix)



Group 3
3rd week



Group 4
2nd week



Group 5
2-3rd week (mix)



Group 6
3rd week

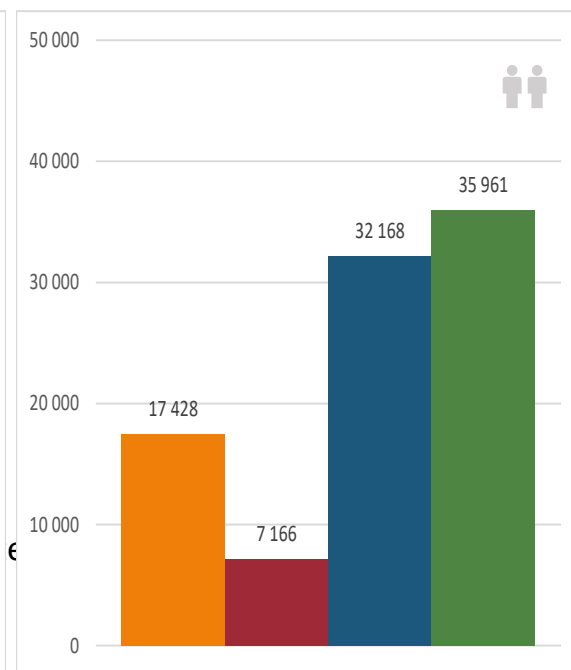
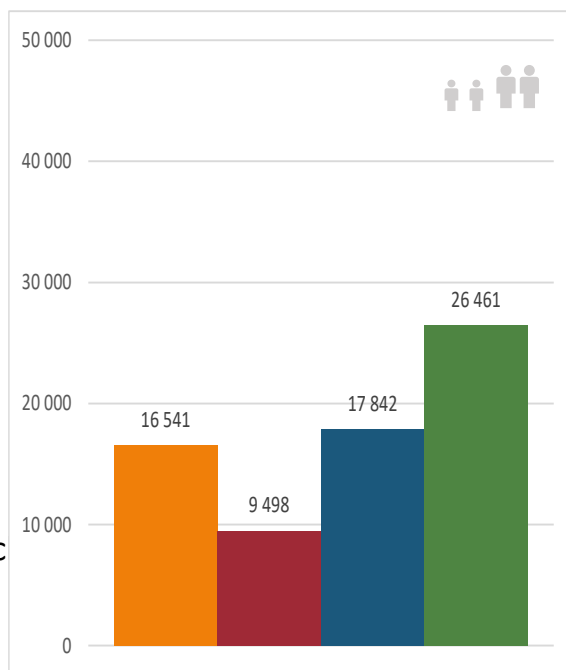
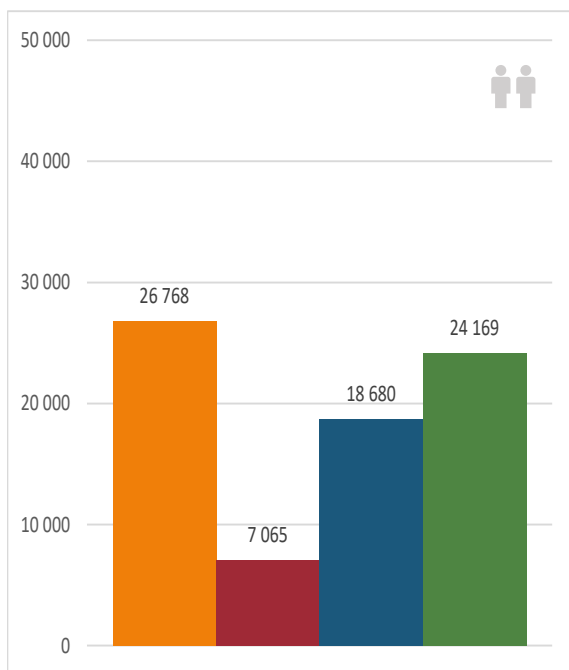
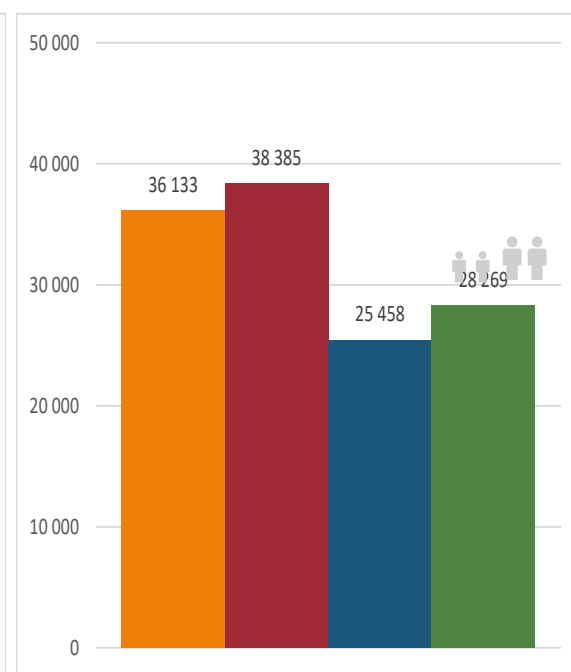
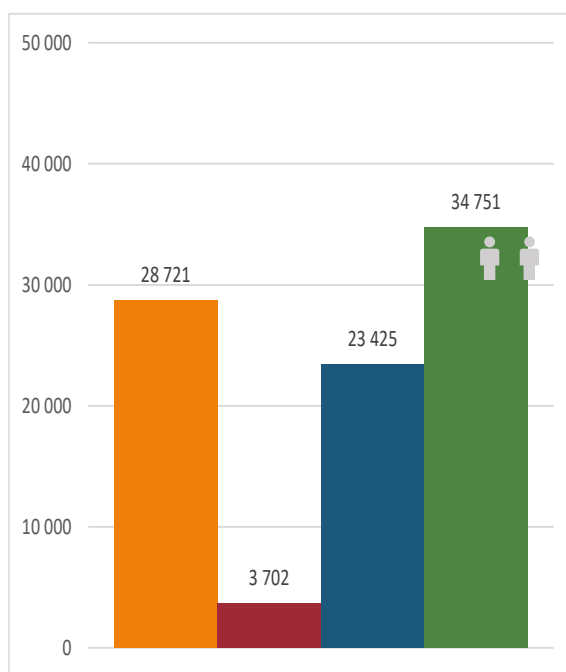
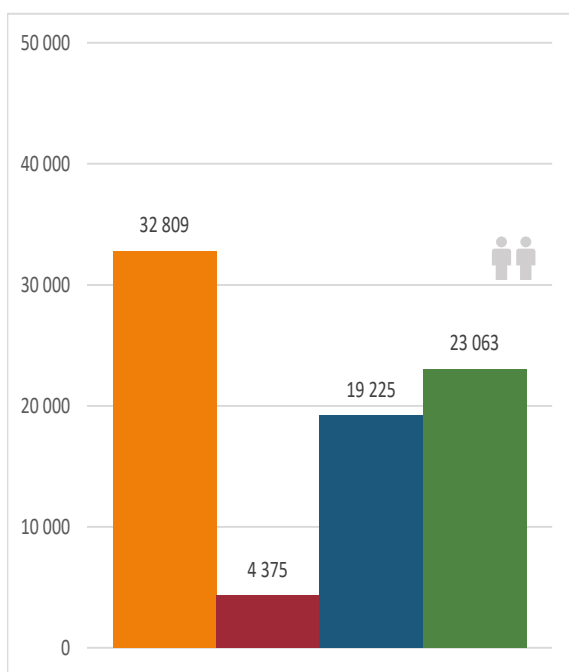


User dependent energy use for a selected week |

Energy use [Wh/week]

Gruppe nr:

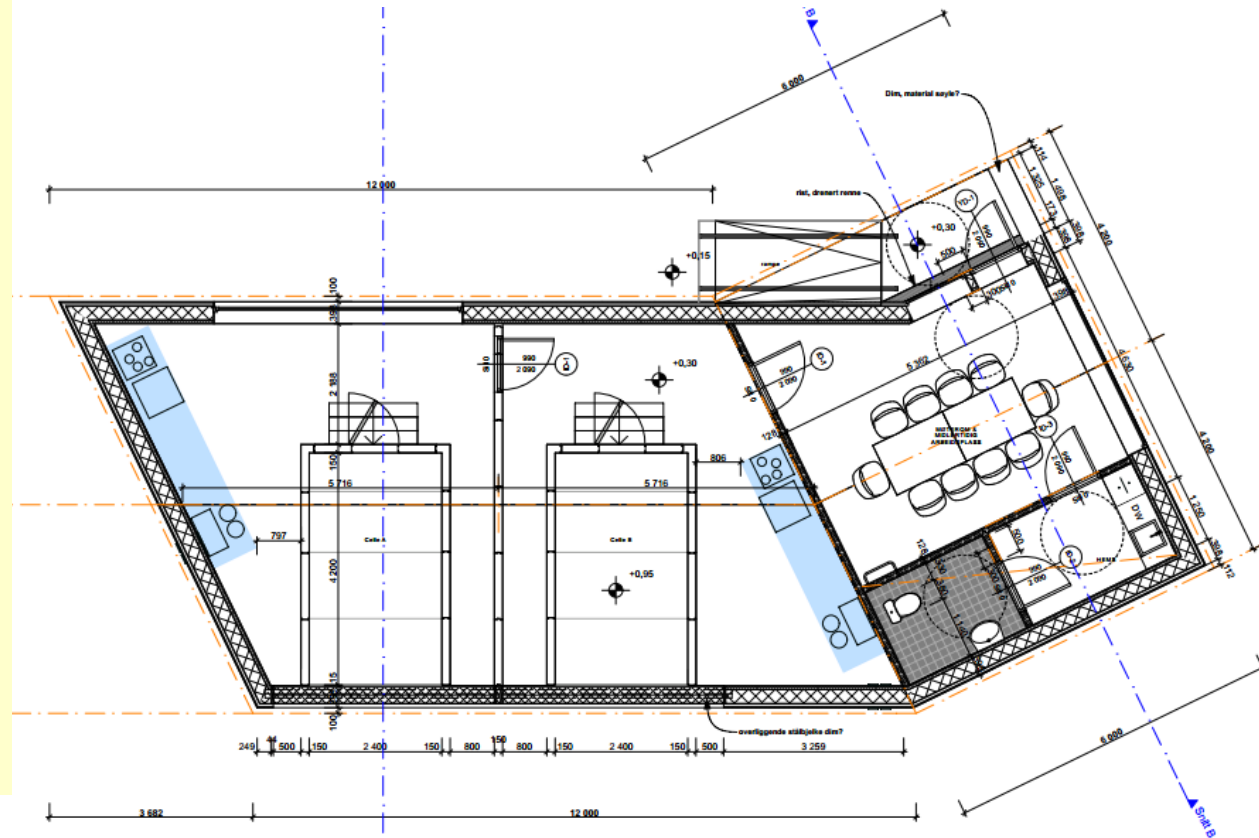
1	2	3
4	5	6



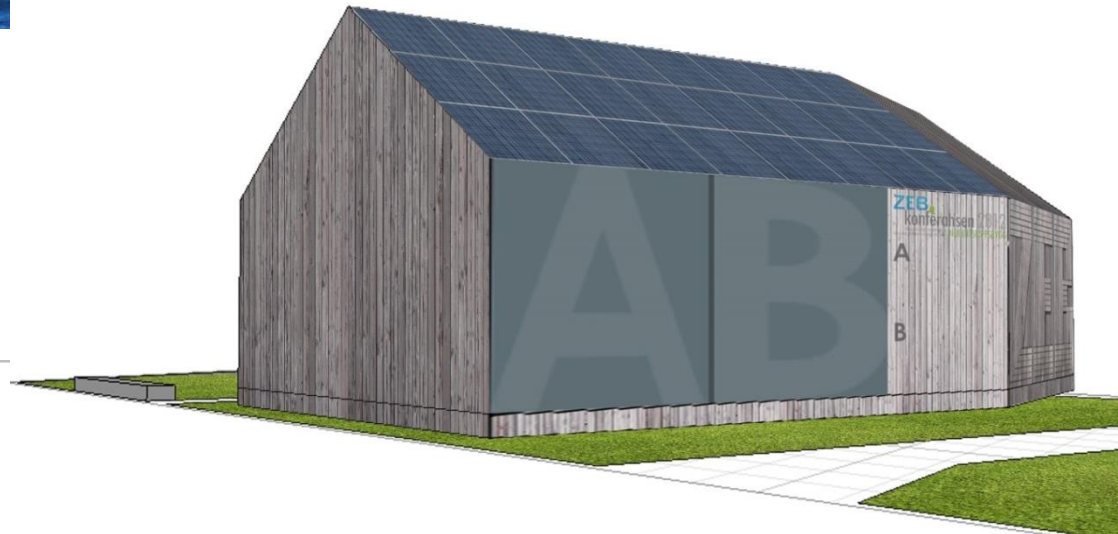
ZEB Test Cells Lab

Laboratory for experiments and research on

- Facades
- Space heating solutions
- Ventilation systems/ strategies
- Daylighting systems
- New materials and products
- Solar collectors and panels
- Building integrated systems
- And more



ZEB Test Cells Lab

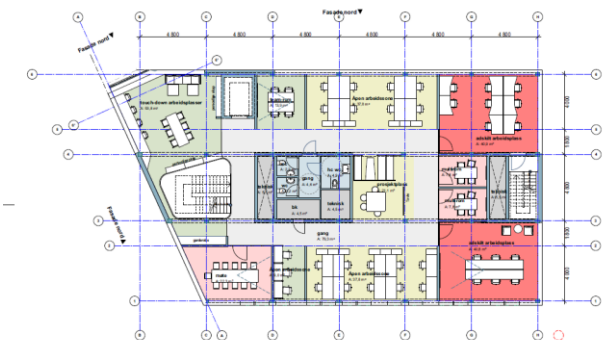
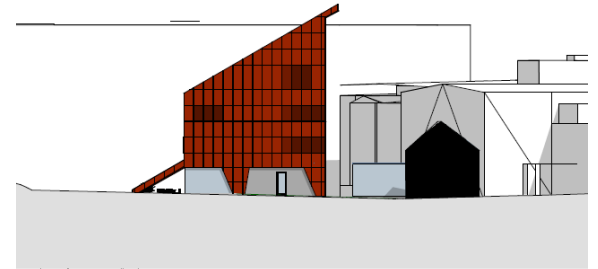


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New ZEB Flexible Lab



- The Norwegian Research Council, NTNU and SINTEF will build a new ZEB Flexible Lab.
- This laboratory will be a central part of the new ZEN Centre, where products for buildings and energy systems will be developed and tested.
- ZEB Flexible Lab is a full scale office building designed to carry out experiments on new technologies for zero emission buildings in interaction with users (incl. effective office and teaching solutions).
- Floor area of 1 800 m², to be completed 2020-01-01



Illustrasjoner: LINK Arkitektur



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Thank you for your attention!

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