



 SINTEF

SINTEF

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Content



- About SINTEF
- Centres for Environment-friendly Energy Research (FME)
- FME Zero emission buildings
- FME Zero Emission Neighbourhoods in Smart Cities
- Klima 2050 - Risk reduction through climate adaptation of buildings and infrastructure
- Laboratories

AN INDEPENDENT, NOT-
FOR-PROFIT RESEARCH
INSTITUTE

SINTEF is one of the largest independent research institutes in Europe



3.3 billion NOK
Turnover

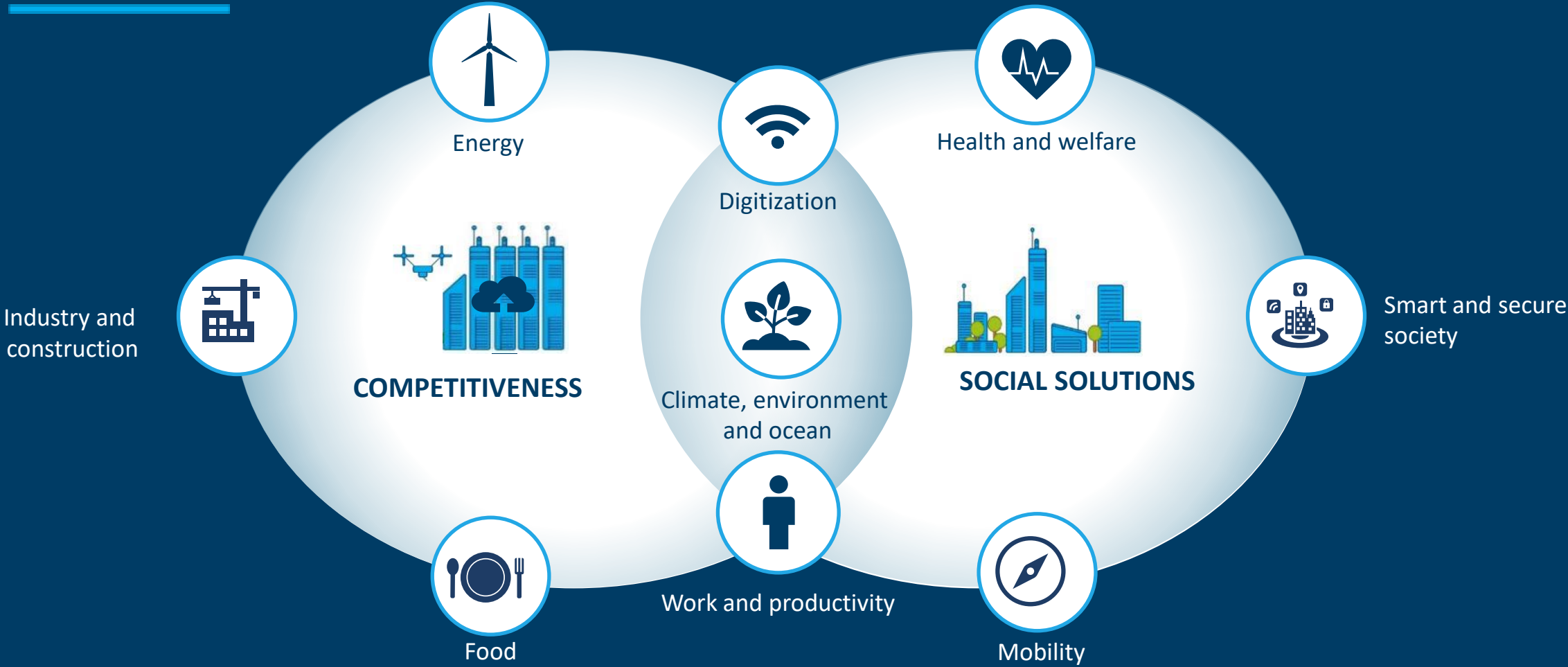
410 million NOK
International sales

A rapidly changing world

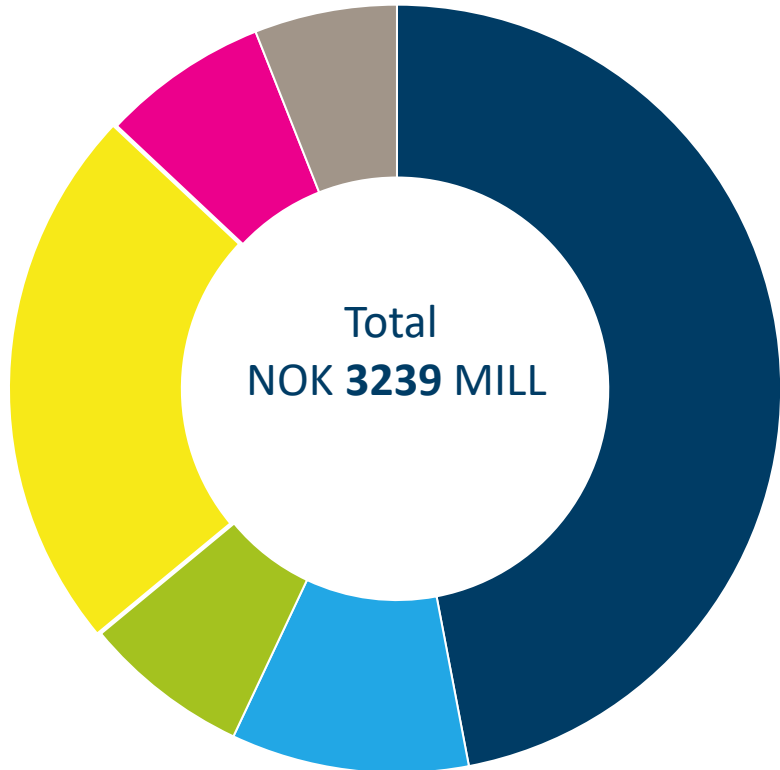


SINTEF's vision: Technology for a better society

Research from ocean to space



More than 90 percent of our **income** comes from contracts won in open competition



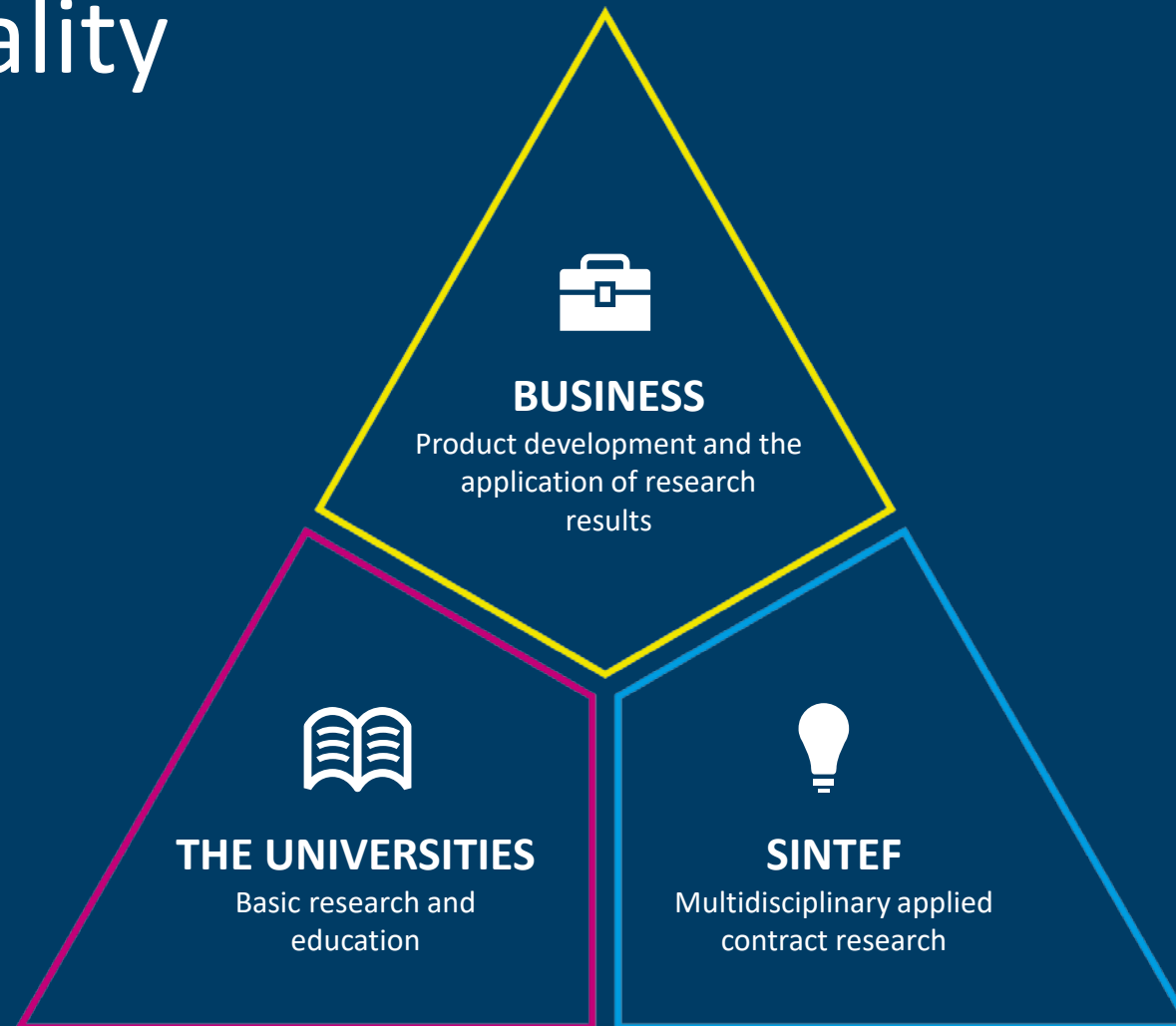
- Business and industry (Norway & international): 47%
- Public sector: 10%
- EU: 7%
- Project grants from The Research Council of Norway: 23%
- Basic grants from The Research Council of Norway: 7%
- Other sources: 6%



Partnership with NTNU

- Strategic and operational cooperation since 1950
- Joint use of laboratories and equipment
- Cooperation covers research projects, research centers and teaching

Close working relationships generate innovation and high quality



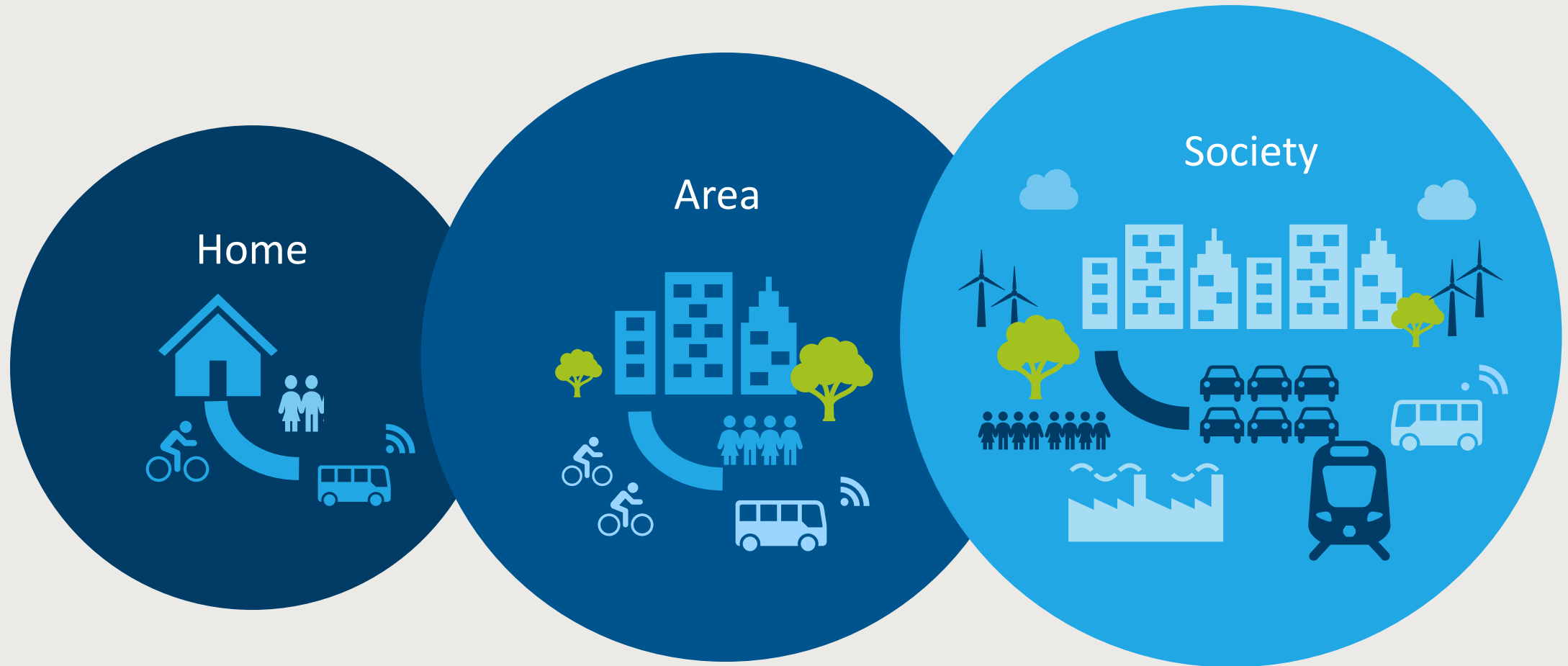


SINTEF

This is
SINTEF COMMUNITY

SINTEF Community

We develop future solutions
for the built society



SINTEF Community offers services in four business areas



Research and development



Research-based consultancy

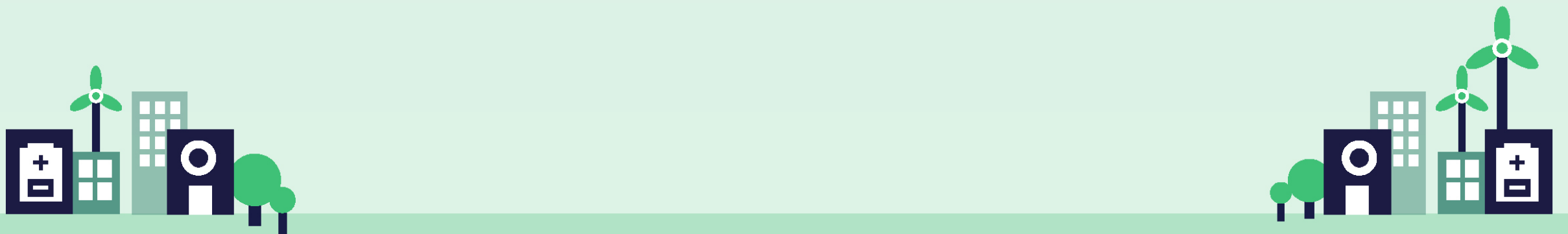


Knowledge dissemination



Product documentation and certification

About Centres for Environment-friendly Energy Research (FME)

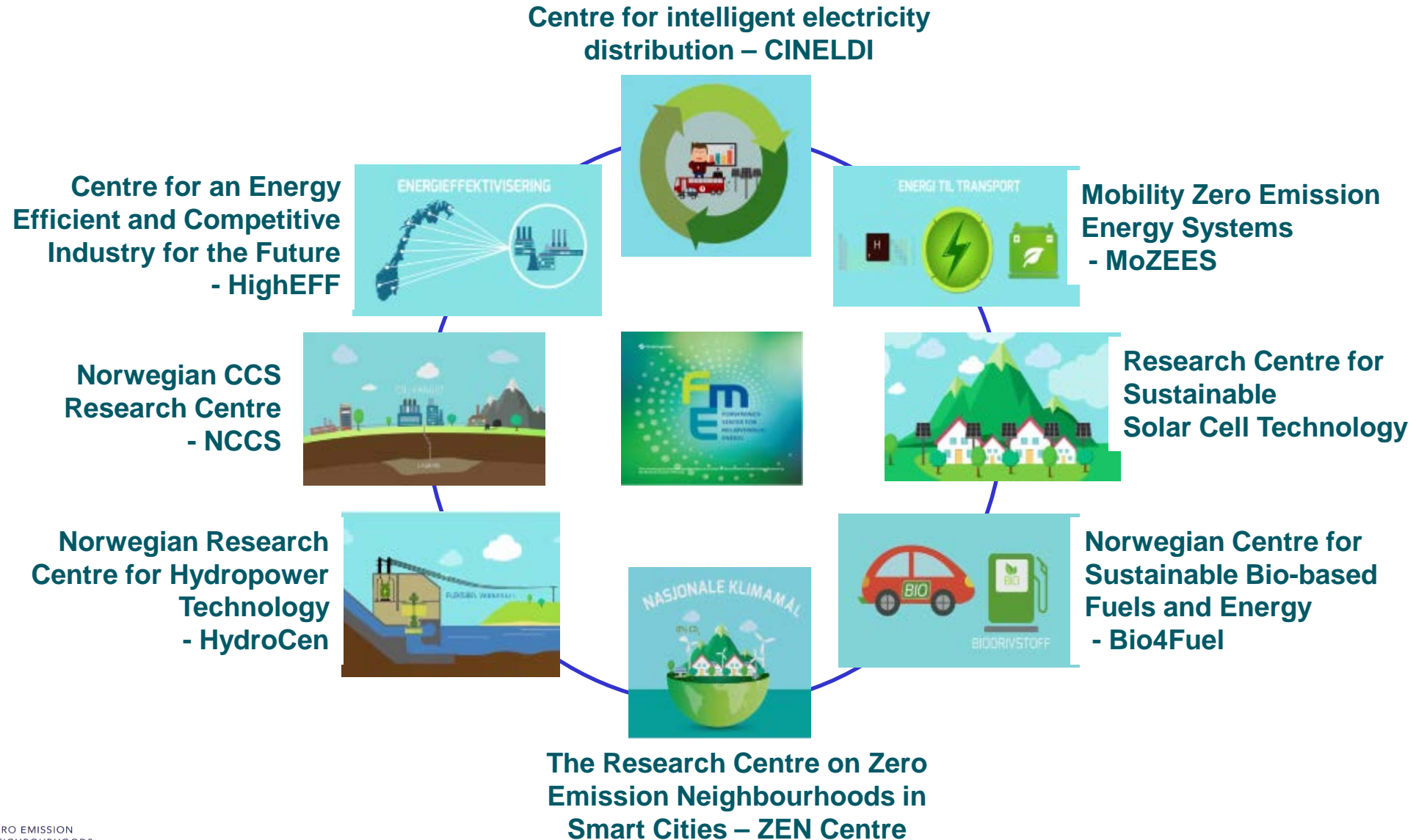


The overall objective of the FME scheme

The overall objective of the FME scheme is to help to solve key challenges in the energy sector, generate solutions for the low-emission society and enhance the innovation capacity of the business sector. The FME scheme is designed to:

- Boost innovation and value creation both for companies and public institutions participating in the centre's activities and for Norwegian society at large;
- Help to reduce national and international greenhouse gas emissions, promote more efficient use of energy and increase production of renewable energy;
- Cultivate research groups that are in the forefront of the international research community and that are an integral part of dynamic national and international networks;
- Increase the visibility of research results and promote a knowledge-based debate on environment-friendly energy.

Centres for Environment- friendly Energy Research (FME) (2017-2024)



Centres for Environment- friendly Energy Research (FME) (2019-2027)

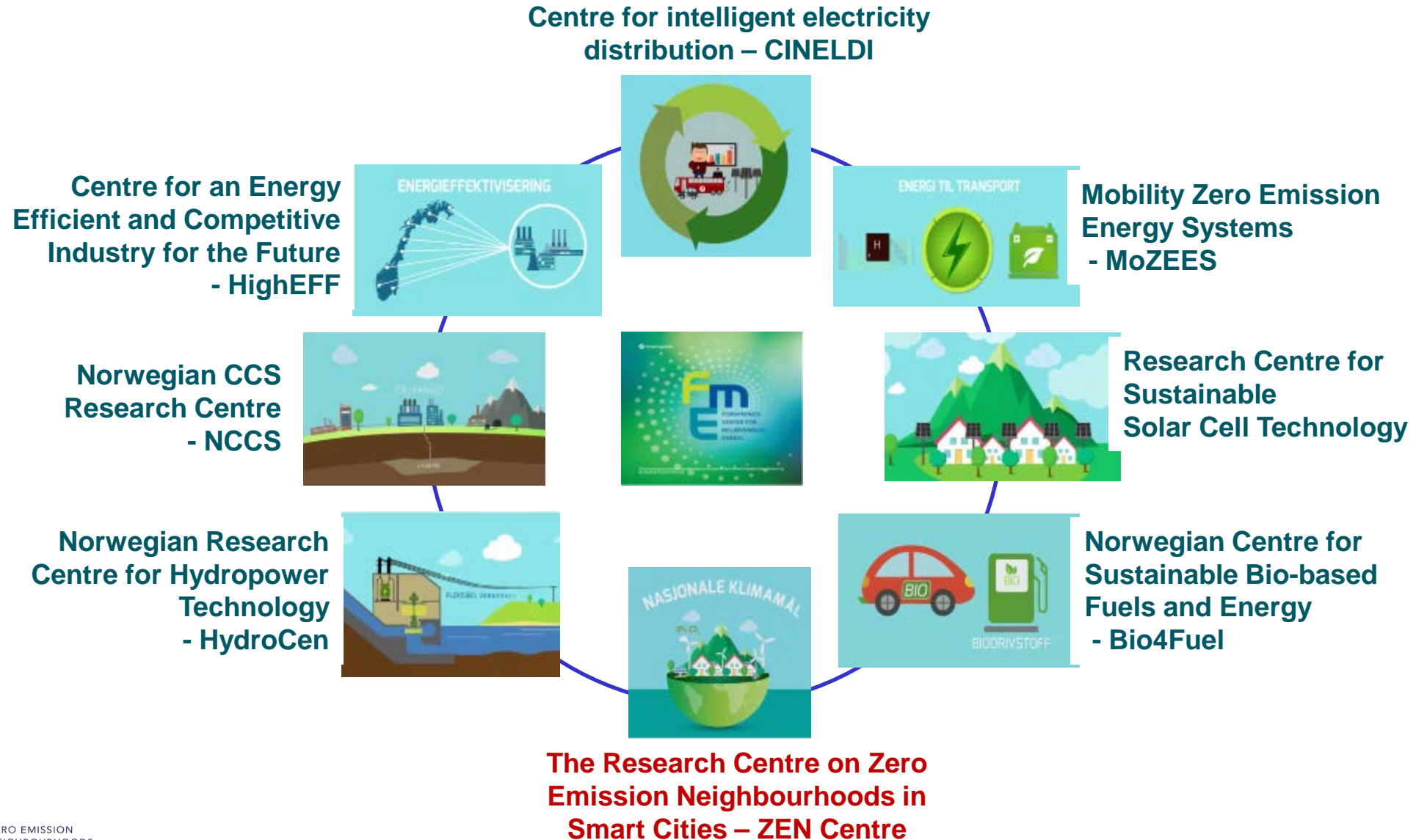


Two centres on social science:

INCLUusive: Decarbonisation and Energy transition - a centre for socially inclusive solutions through co-creation with stakeholders

NTRANS: Norwegian Centre for Energy Transition Strategies

Centres for Environment- friendly Energy Research (FME) (2017-2024)





THE RESEARCH CENTRES ON Zero Emission Buildings and Zero Emission Neighbourhoods in Smart Cities

Arild Gustavsen, professor NTNU, director FME ZEB and ZEN
Terje Jacobsen, Vice President, Research, SINTEF Community

Background – Why Zero Emission Buildings and Neighbourhoods?

- The buildings and buildings construction sectors combined are responsible for 36% of global final energy consumption and nearly 40% of total direct and indirect CO₂ emissions⁽¹⁾
- The energy use and related emissions may double or potentially even triple⁽²⁾ by mid-century due to
 - Increased access to adequate housing and related facilities for people in developing countries
 - Population growth, migration to cities, household size changes, and increasing levels of wealth and lifestyle
- Improving the energy performance of the building stock and developing zero emission building and neighbourhood concepts are crucial to avoid an increase in energy use and GHG emissions.

UN's Sustainability Development Goals



(1) <https://www.iea.org/topics/energyefficiency/buildings/>

(2) IPCC (2014). Climate Change: Mitigation of Climate Change. Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change.

Research Centre on Zero Emission Buildings

- **Duration:** 2009 – 2017
- **Budget:** 280 MNOK
- **Objective:** Develop competitive products and solutions for existing and new **buildings** that will lead to market penetration of buildings with **zero greenhouse gas emissions related to their production, operation, and demolition.**
- www.zeb.no



Research Centre on Zero Emission Neighbourhoods in Smart Cities

- **Duration:** 2017-2024
- **Budget:** 380 MNOK
- **Objective:** Speed up **decarbonisation of the building stock** (existing and new), **use more renewable energy sources** and **create positive synergies among the building stock, energy, ICT and mobility systems, and citizens.**
- www.zenresearchcentre.com



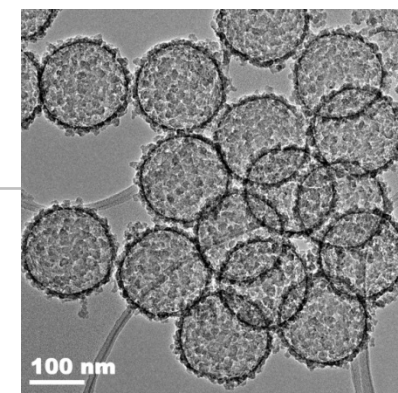
ZEB research activities

ZEB focuses its work in areas that interact and influence each other:

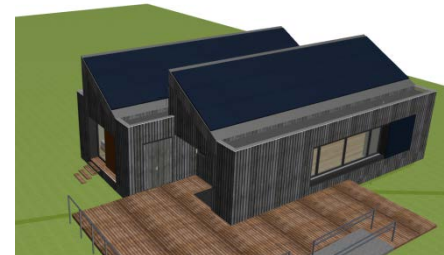
- Advanced materials technologies
- Climate-adapted low-energy envelope technologies
- Energy supply systems and services
- Use, operation, and implementation
- Concepts, strategies and demonstration buildings
- **Laboratories**



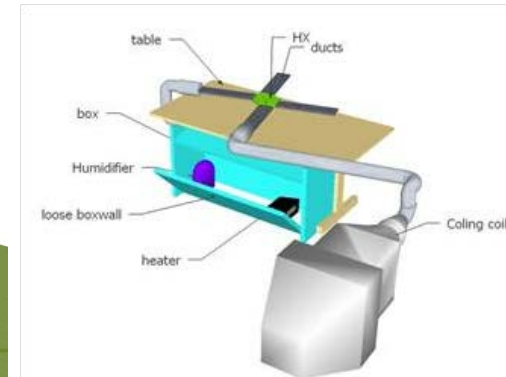
VIP Leca Isoblokk



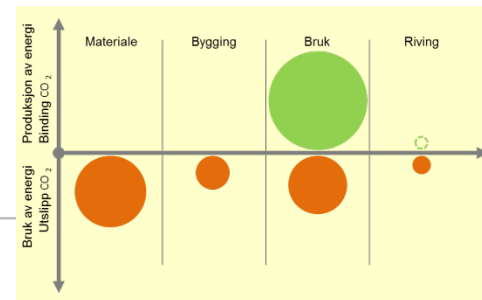
Nano insulation material



ZEB Living Lab



Membrane heat exchanger

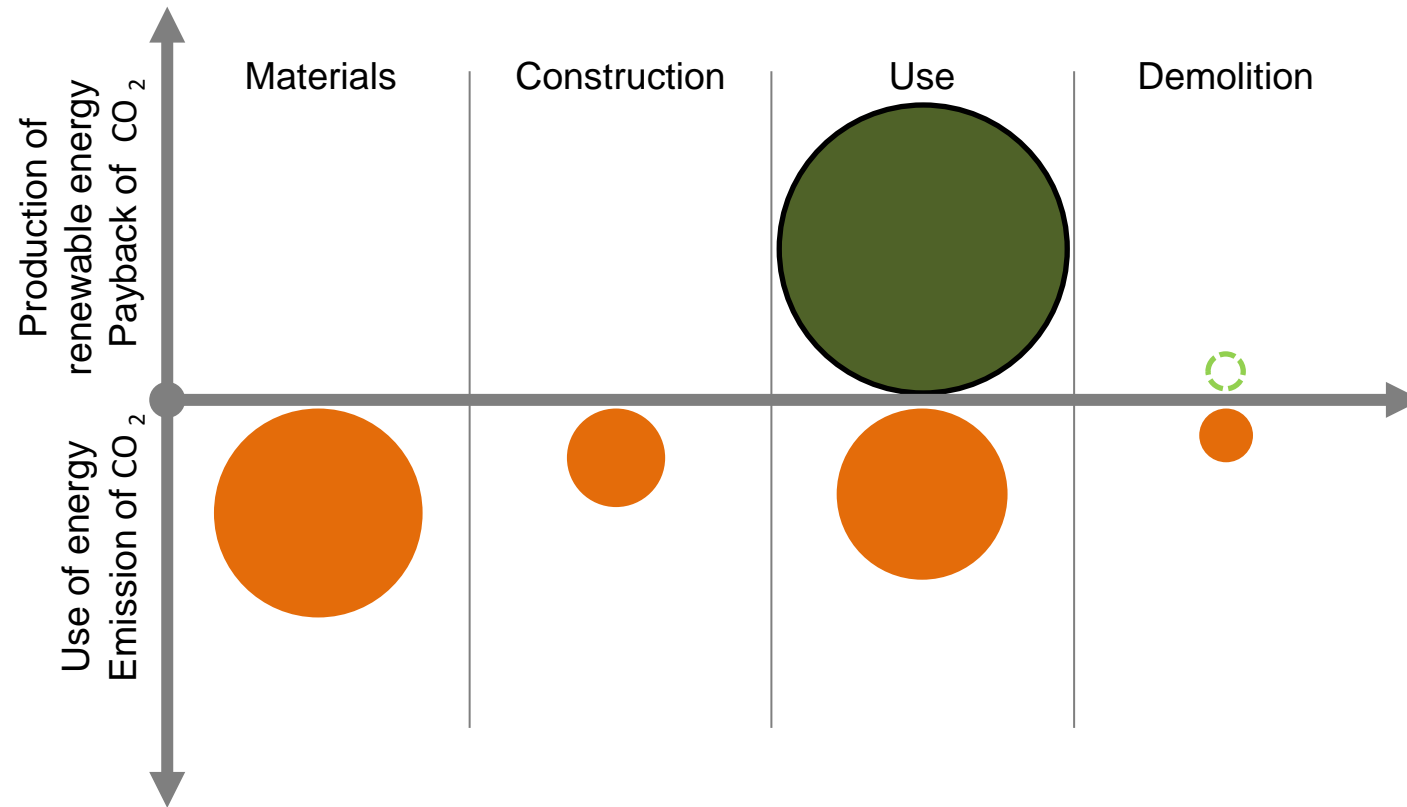


ZEB Definition

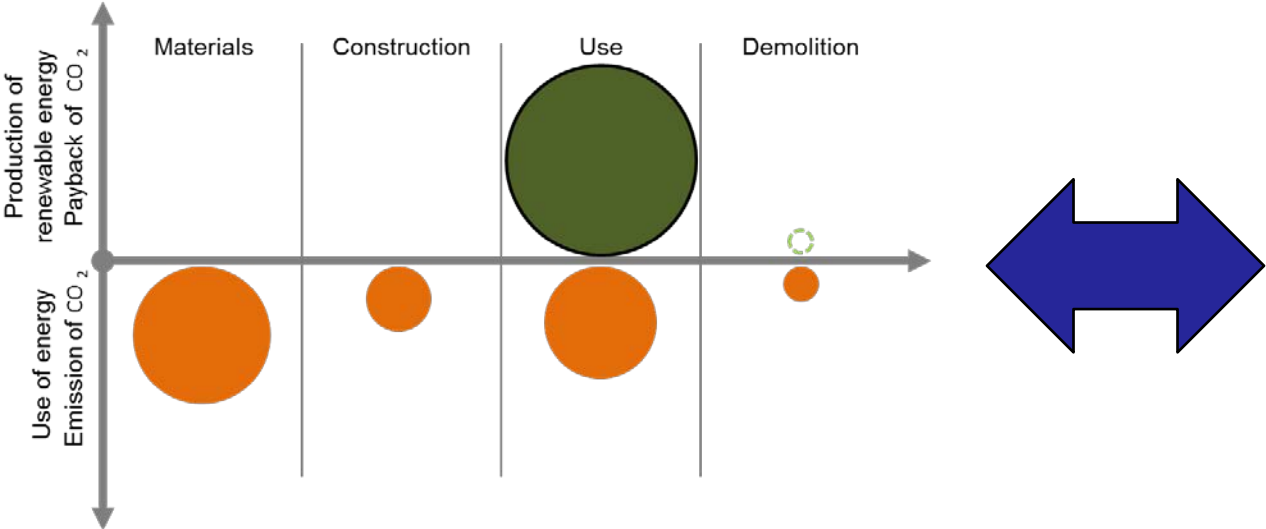
ZEB demonstration buildings



Definition of Zero Emission Buildings



ZEB Centre – From vision to real buildings in 8 years



Over all milestones from ZEB

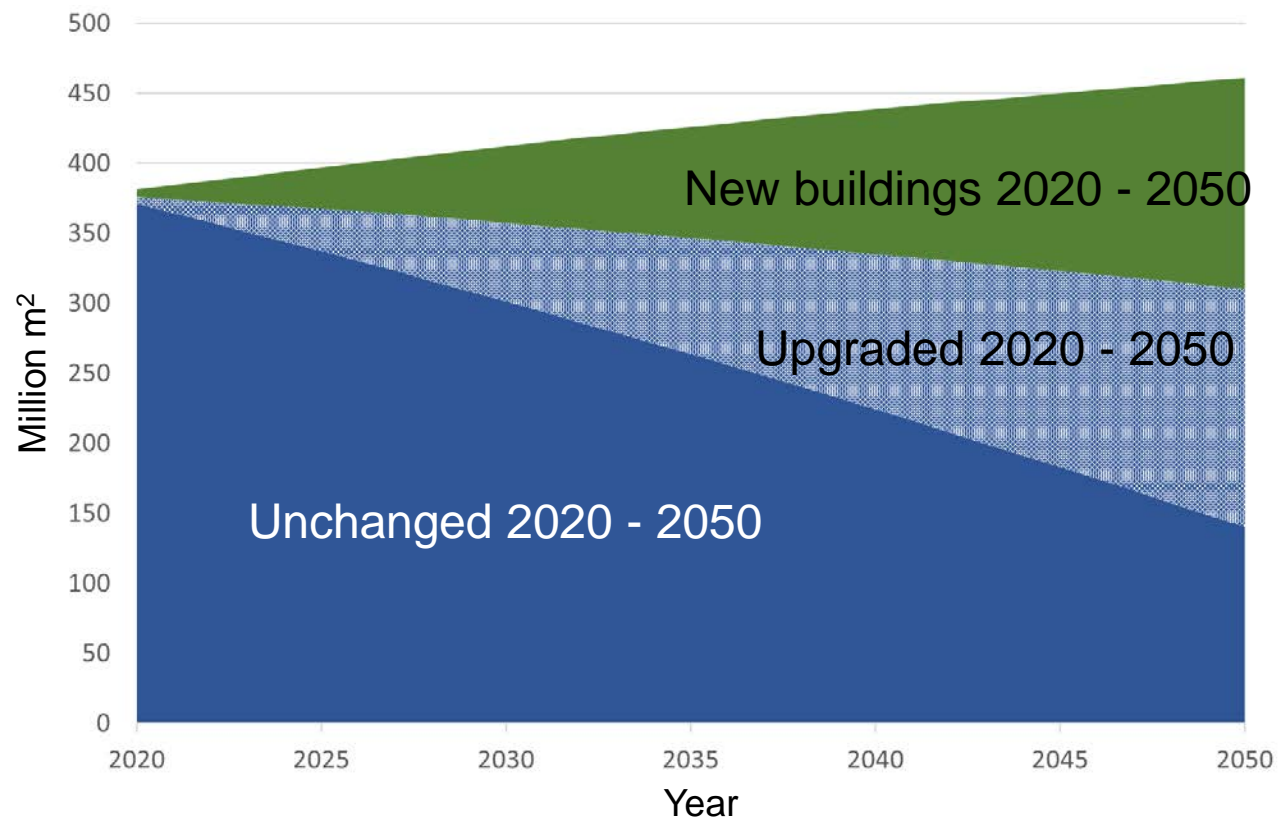
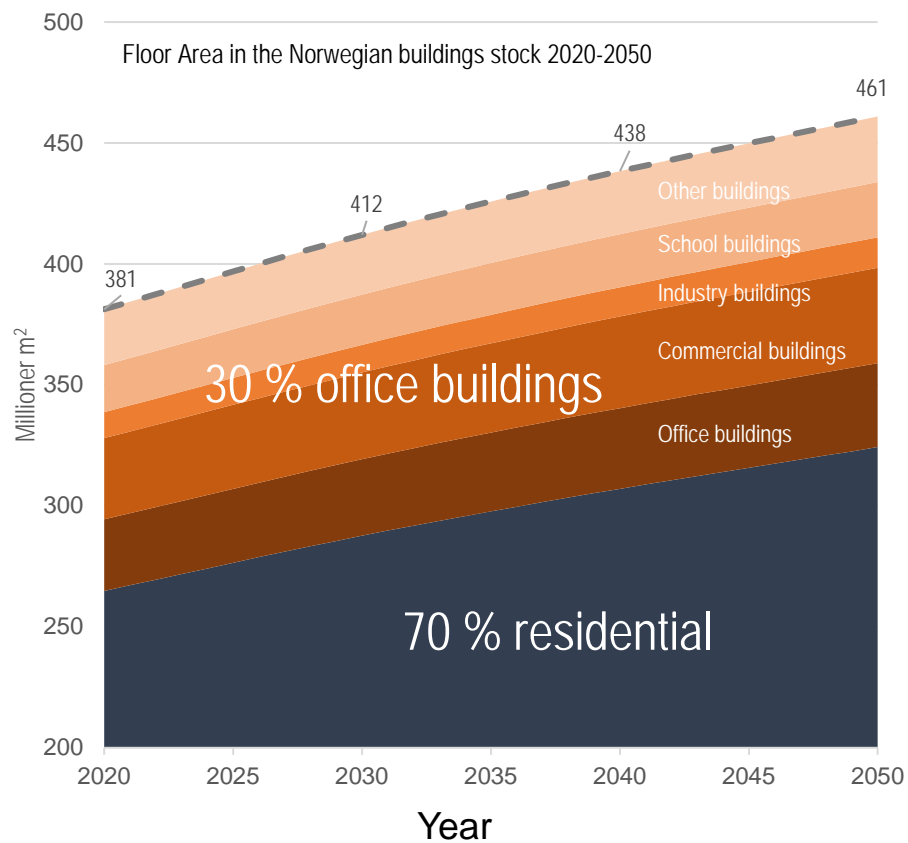
- Shown how to construct zero emission buildings
- Started the development of new technologies for future zero emission buildings
- Implemented research tools for this development, i.e. laboratories, definitions, pilot buildings
- Educated MSc- and Ph.D.-candidates for the building industry and the research community
- The partners in the ZEB Centre are implementing (the art of) zero emission buildings in their business strategies
- Results from the ZEB Centre are included in a national standard on calculation of GHG emissions in buildings.
- Some of the larger cities in Norway have started to implement solutions for the low carbon society in their master plans on environment by looking at the possibilities demonstrated by the ZEB Centre. Further developments are expected, due to activities in pilot areas in the new ZEN Centre.
- Shown the way towards the development of the zero emission society (i.e. The Research Centre on Zero Emission Neighbourhoods in Smart Cities – ZEN Centre).



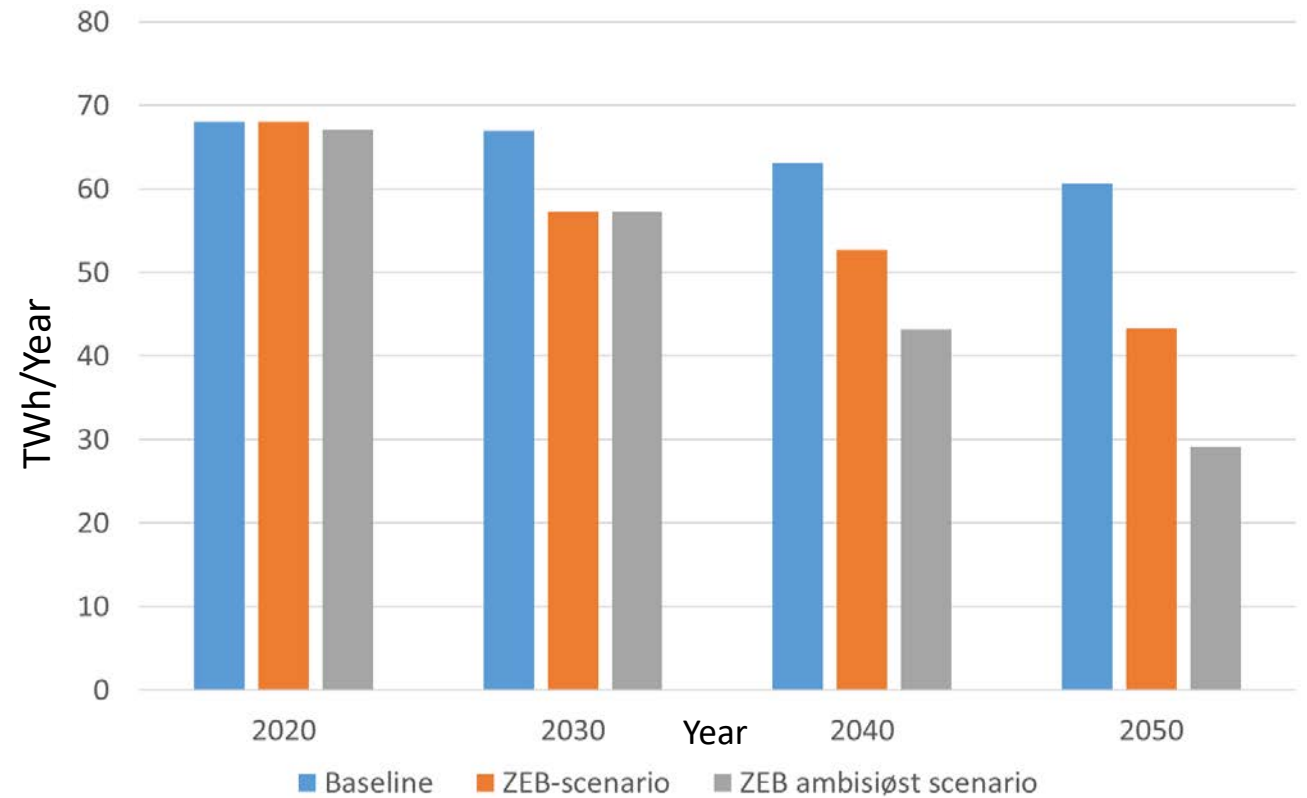
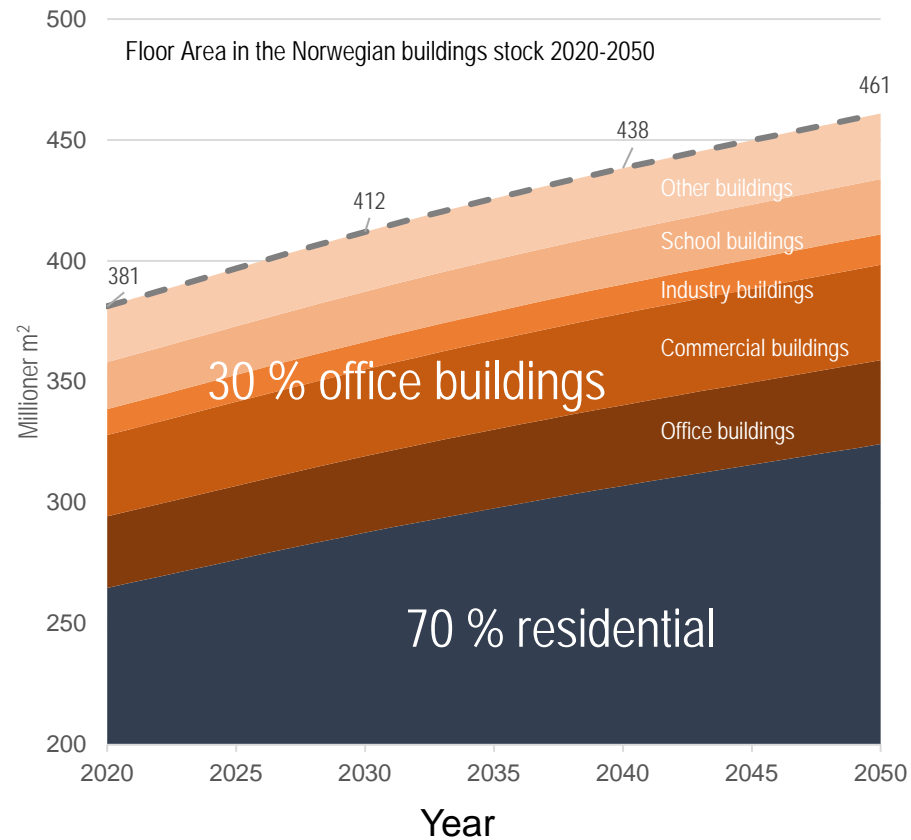
The Research Centre on
Zero Emission Buildings



Large Energy Efficiency Potential by building Zero Emission Buildings



Large Energy Efficiency Potential by building Zero Emission Buildings



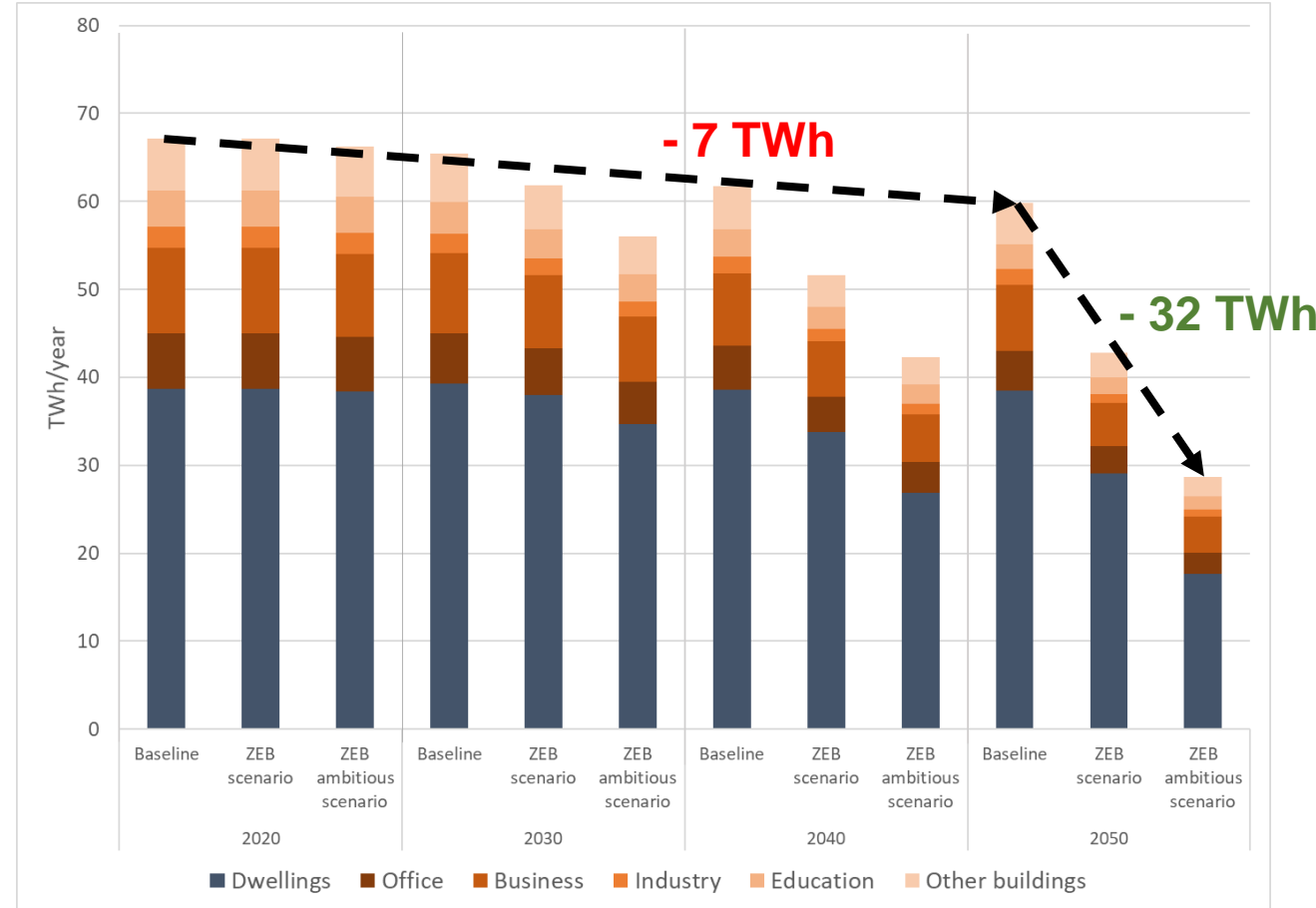
Energy use in the Norwegian buildings stock will be 39 TWh less in 2050 than in 2020, if introducing zero emission buildings in the building code, this will contribute with 31 TWh.



Scenario results: delivered energy

Energy saving potential 2020-2050:

- Baseline: 7 TWh
- ZEB 1: 25 TWh
- ZEB 2: 39 TWh (7+32)





2017 – 2024:
THE RESEARCH CENTRE ON
**Zero Emission
Neighbourhoods
in Smart Cities**

BUILDINGS – USERS – ENERGY SYSTEMS – PILOT PROJECTS

ZEN Research Centre Partners

| | |
|----------------------|---|
| 11 public partners | <p>Oslo, Bergen, Trondheim, Bærum Bodø, Elverum, Steinkjer Trøndelag fylkeskommune Statsbygg NVE – Norges vassdrag og energidirektorat DiBK – Direktoratet for byggkvalitet</p> |
| 21 industry partners | <p>ByBo, Elverum Vekst TOBB Snøhetta, ÅF Engineering, Asplan Viak Multiconsult, SWECO, Civitas FutureBuilt Energi Norge, Norsk Fjernvarme NTE – Nord-Trøndelag Energiverk Statkraft Hunton Moelven Norcem Smart Grid Services Cluster Skanska GK, Caverion</p> |
| 2 research partners | <p>NTNU SINTEF</p> |



The ZEN Centre's vision:

Sustainable
neighbourhoods
with zero
greenhouse gas
emissions



Main Objectives

1. Develop neighbourhood design and planning instruments while integrating science-based knowledge on greenhouse gas emissions;
2. Create new business models, roles, and services that address the lack of flexibility towards markets and catalyze the development of innovations for a broader public use; This includes studies of political instruments and market design;
3. Create cost effective and resource and energy efficient buildings by developing low carbon technologies and construction systems based on lifecycle design strategies;
4. Develop technologies and solutions for the design and operation of energy flexible neighbourhoods;
5. Develop a decision-support tool for optimizing local energy systems and their interaction with the larger system;
6. Create and manage a series of neighbourhood-scale living labs, which will act as innovation hubs and a testing ground for the solutions developed in the ZEN Research Centre.

Research Areas



ZEN pilot projects

Bodø: Airport area

Steinkjer: Agricultural College Campus

Trondheim: Knowledge Axis (NTNU Campus & Sluppen)



Evenstad: Campus

Elverum: Ydalir

Bergen: Zero Village Bergen

Oslo: Furuset

Bærum: Oksenøya and Tårnet, Fornebu

 30 000
 > 1 million



ZEN Pilotprosjekter – resultater (eksempler)



Skole og barnehage tatt i bruk



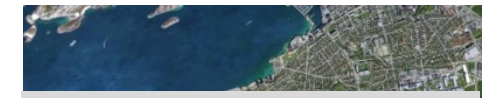
Ydalir, Elverum



Mikroenergisystem under planlegging



Furuset, Oslo



ByLab for brukermedvirkning



NyBy, Bodø



Input reguleringsplan og skisseprosjekt for Nidarvoll skole og helsehus



Sluppen, Trondheim



Premissdokument miljø. Energisystemanalyse



NTNU Campus, Trondheim



Ny ZEN-pilot. Workshop.



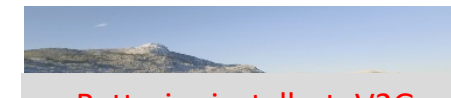
Mære landbruksskole, Steinkjer



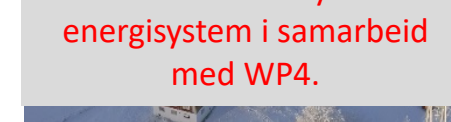
Prosjektet er godkjent!



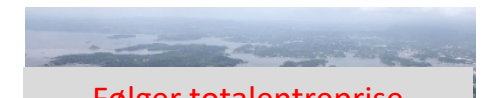
Zero Village Bergen



Batterier installert, V2G underveis. Analyse av energisystem i samarbeid med WP4.



Campus Evenstad



Følger totalentreprise Oksenøya. Input reguleringsplan Flytårnet



Fornebu, Bærum

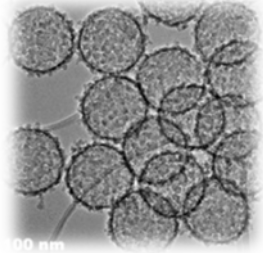
Innovation in ZEN

*ZEN pilot Ydalir
Ill.: Tegn_3 / Ydalir*

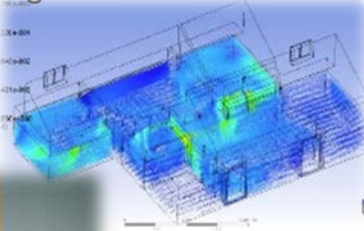


Illustration of Technology Readiness Level

Material development



Material and component testing - modelling - simulations



Real performance test cell – living lab



Material development and characterization

Component and system verification

Market implementation



Internationalisation International Cooperation





The ZEN Centre engages in several International Energy Agency Annexes & Tasks, such as:

- IEA EBC Annex 71 **Building energy performance assessment based on in situ measurements**
- IEA EBC Annex 67 **Energy Flexible Buildings**
- IEA **District Heating and Cooling, TS1 Low Temperature District for Future Energy Systems**
- IEA EBC **Working Group on Cities and Communities (WGCC)**

Participation in IEA

Sustainable plus energy neighbourhoods

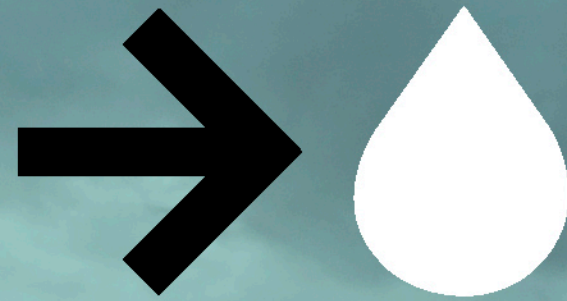
LC-EEB-03-2019: New developments in plus energy houses (IA)

EUR 7.4 million

<http://ec.europa.eu/research/participants/portal/desktop/en/opportunities/h2020/topics/lc-eeb-03-2019.html>


Coordinating new H2020 project





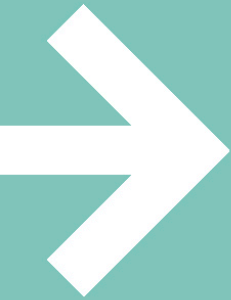
KLIMA 2050

RISK REDUCTION THROUGH CLIMATE ADAPTATION
OF BUILDINGS AND INFRASTRUCTURE



Targeting the building sector
- a large value-chain of actors

- 58 000 companies
- 235 000 employees



KLIMA 2050

CONSORTIUM

Private sector



Public sector



Research & education



ZEB Laboratories



HVAC Lab



ZEB Living Lab



ZEB Test Cell



Building component laboratories

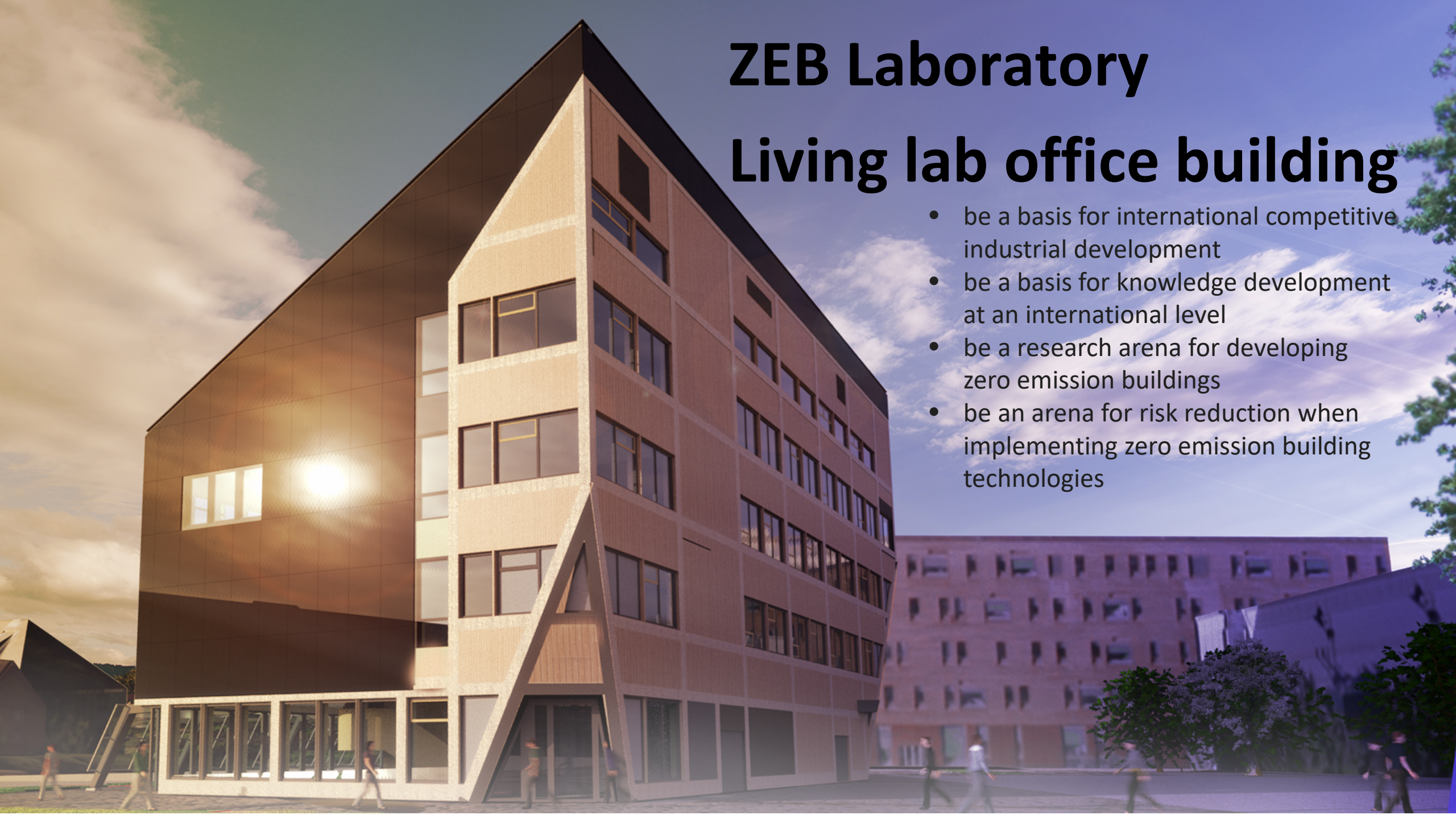
New ZEB Flexible Lab



ZEB Laboratory

Living lab office building

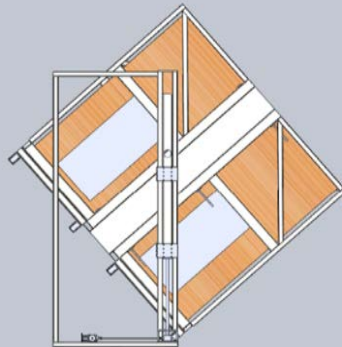
- be a basis for international competitive industrial development
- be a basis for knowledge development at an international level
- be a research arena for developing zero emission buildings
- be an arena for risk reduction when implementing zero emission building technologies







Laboratories for characterization and research on building materials and components

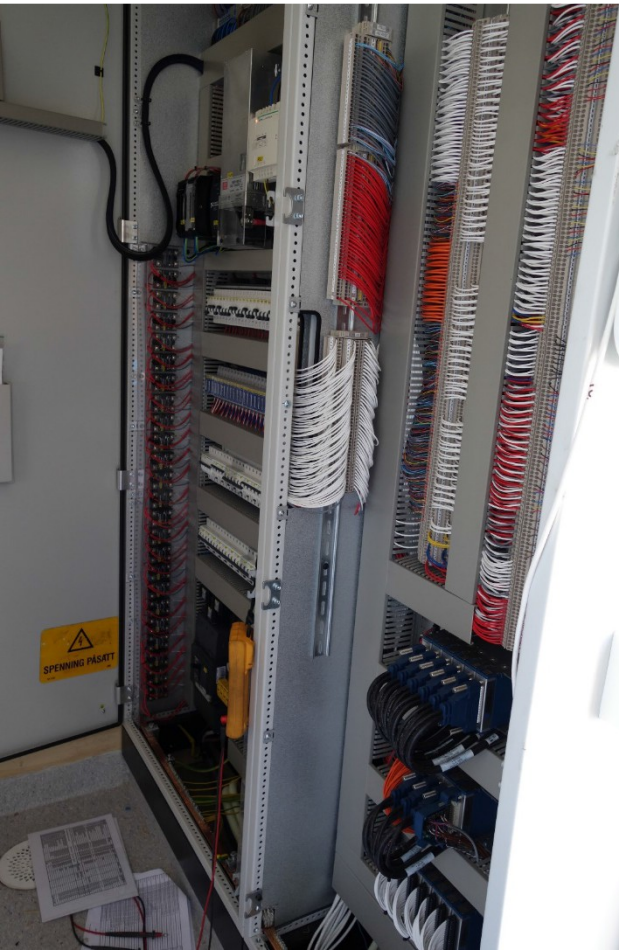


ZEN

ZERO EMISSION
NEIGHBOURHOODS
IN SMART CITIES



**ZEB
LIVING LAB**



ZEB Living Laboratory

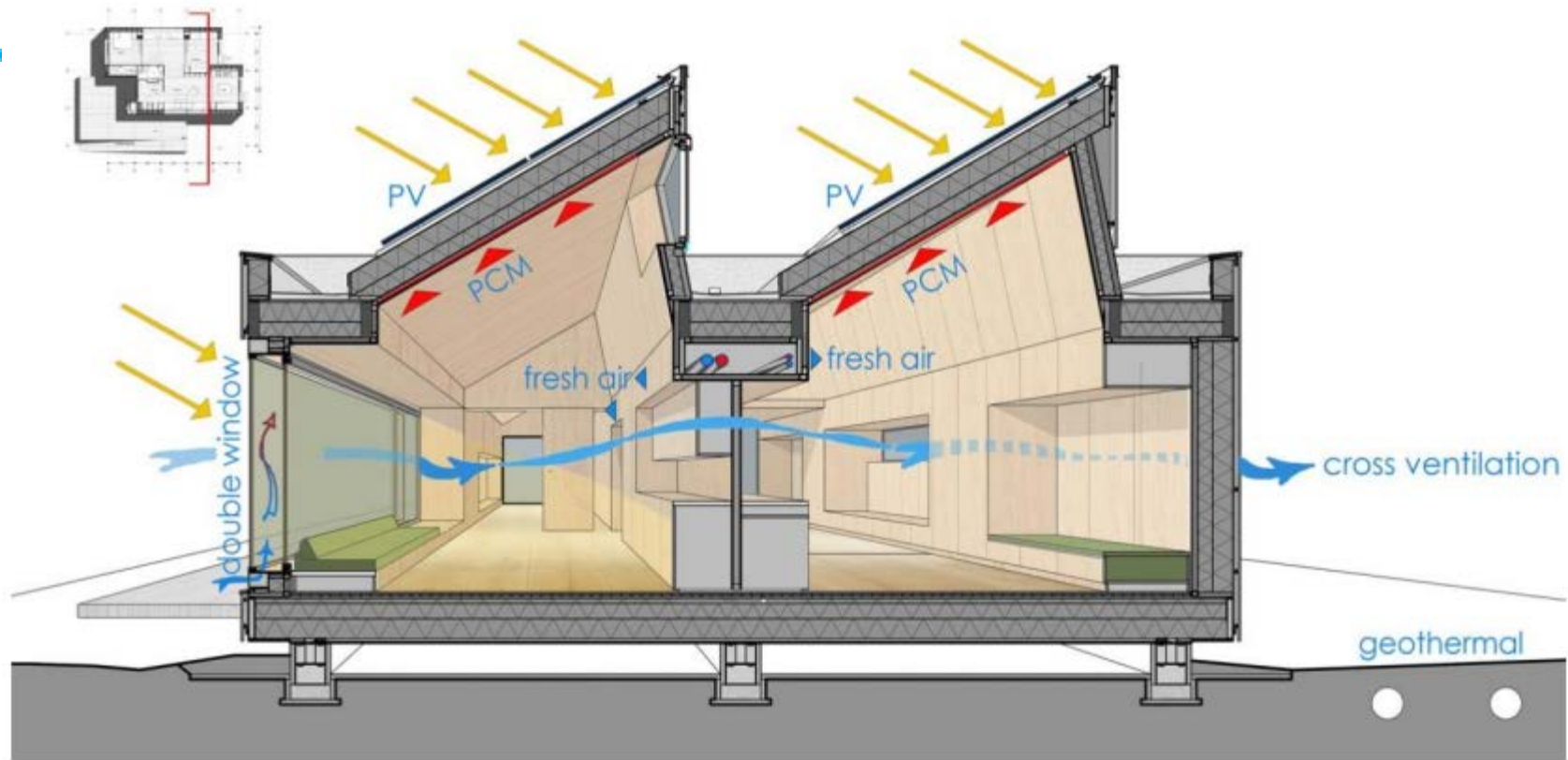
A living-laboratory to carry out research on

- how users interact with **state-of-the-art technologies** and **low-energy buildings**
- advanced building components and systems to achieve **energy flexible buildings**

More than **200 signals** are continuously acquired to **monitor energy and environmental performance**

Ca. 100 m² heated floor surface area

ZEB Living Lab



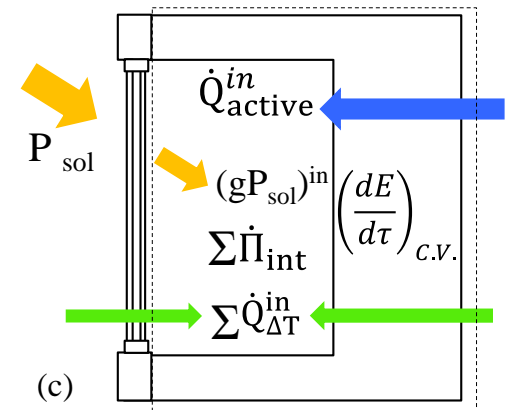
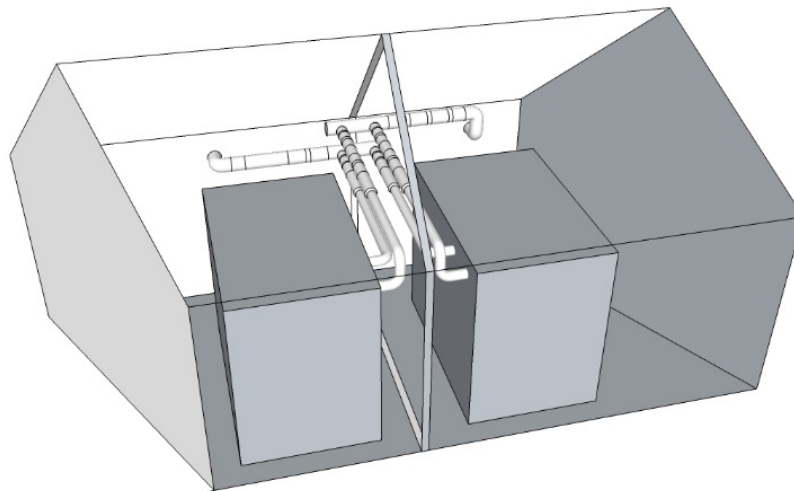
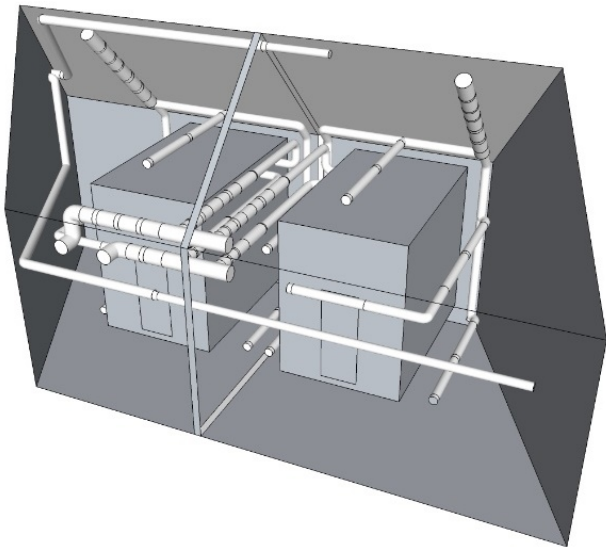
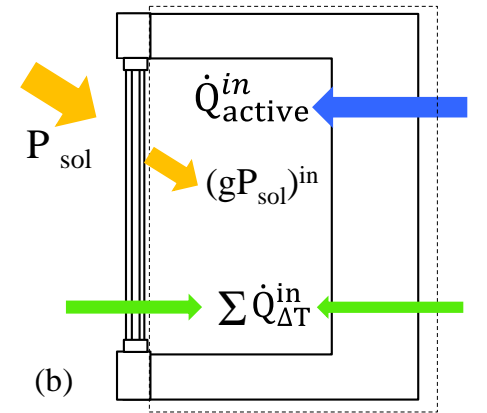
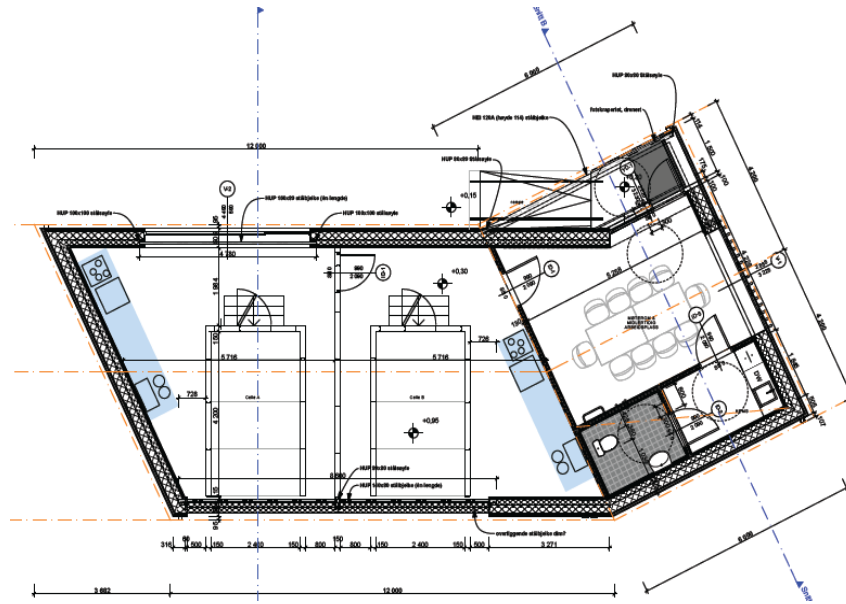
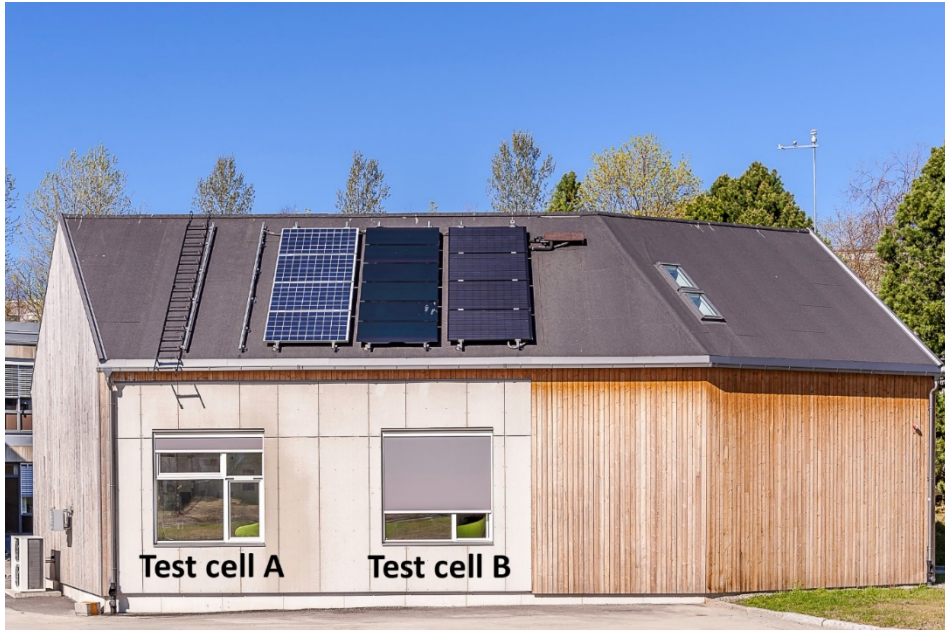
ZEB Test Cell



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

Test buildings: ZEB Test Cells



Some relevant web-pages

- www.zeb.no
- www.fmezen.no
- www.zeblab.no
- <https://www.sintef.no/en/>



Technology for a better society