

From zero emission buildings to zero emission neighbourhoods

Arild Gustavsen, Professor, Centre Director
NTNU Faculty of Architecture and Design
Research Centre on Zero Emission Neighbourhoods in Smart Cities

Accelerating the Clean Energy Transition
European Parliament
2018-06-27



Contents

- Background
- The concept of zero emission buildings (ZEB), with examples
- Zero emission neighbourhoods (ZEN)
 - From definition to real projects



Background

- Better construction and use of buildings in the EU would influence about **40% of our final energy consumption**, about **35% of our greenhouse gas emissions** and more than **50% of all extracted materials**.
- Policies for promoting a low and zero-emission building stock in EU has to be put forward.
- The new policies should promote energy efficiency and zero emission building concepts that look at **a wider range of environmental impacts across the life-cycle of buildings and infrastructure**.

Research Centre on Zero Emission Buildings

- **Duration:** 2009 – 2017
- **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**

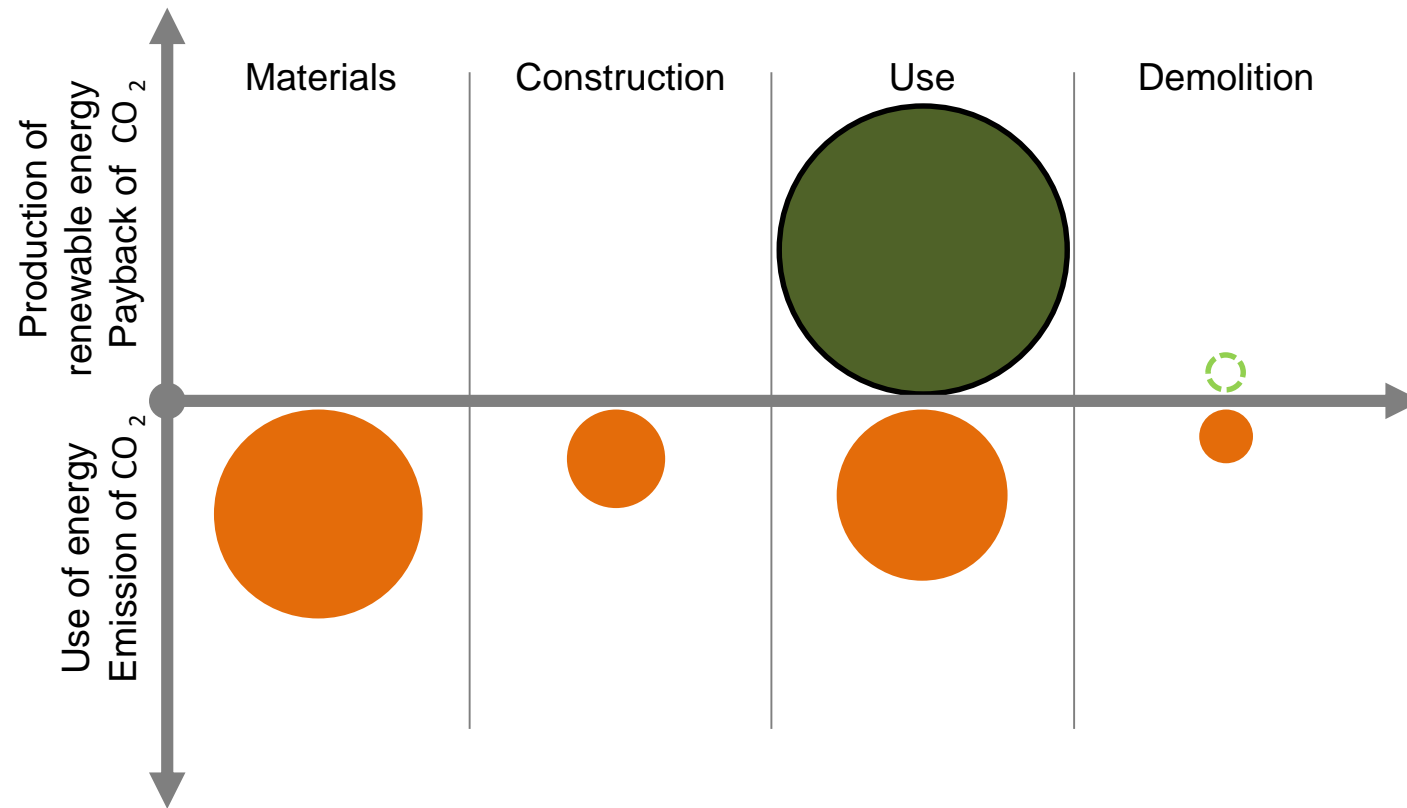


Research Centre on Zero Emission Neighbourhoods in Smart Cities

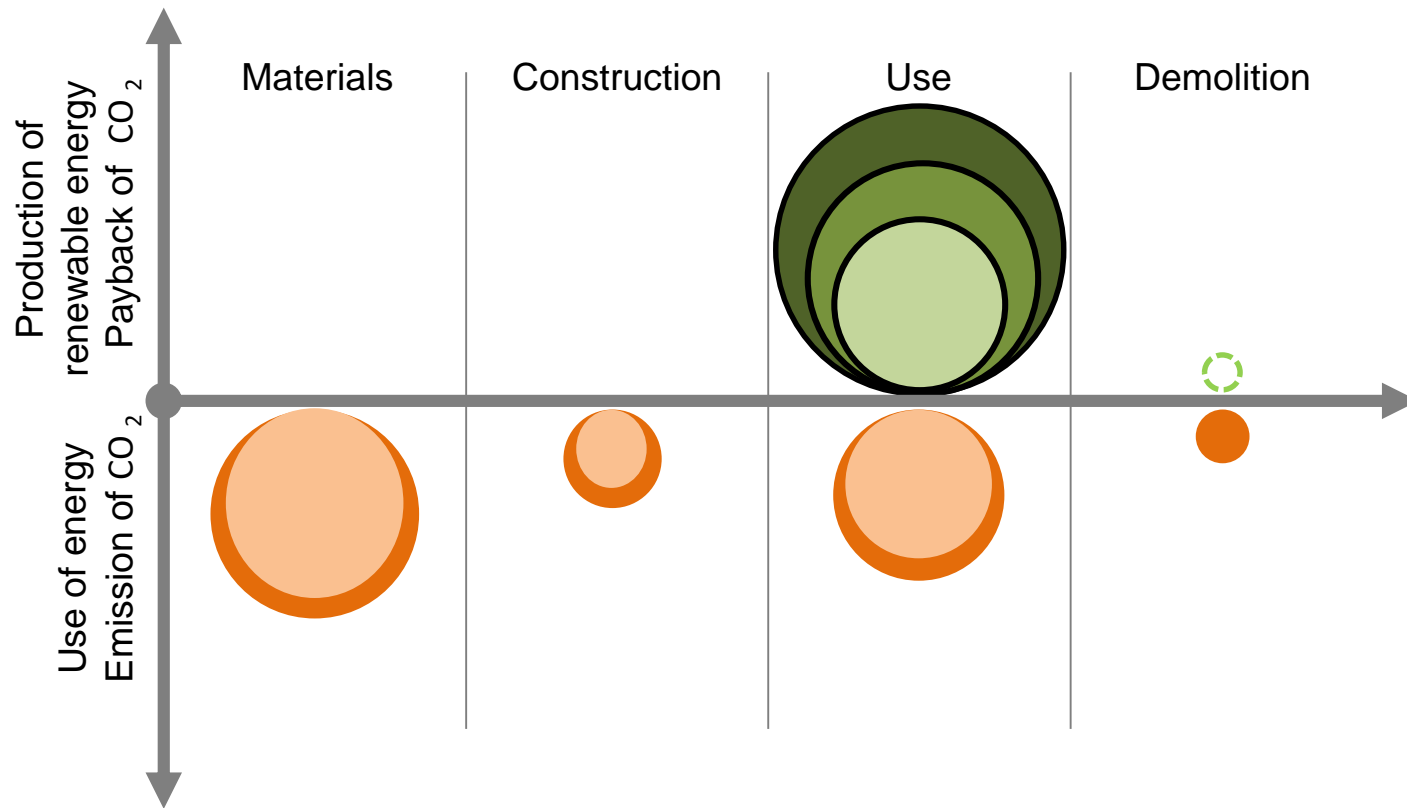
- **Duration:** 2017-2024
- **Objective:** Speed up **decarbonisation of the building stock** (existing and new), use more renewable energy sources and **create positive synergies among the building stock, energy, ICT and mobility systems, and citizens.**
- **www.zenresearchcentre.com**



Definition of Zero Emission Buildings



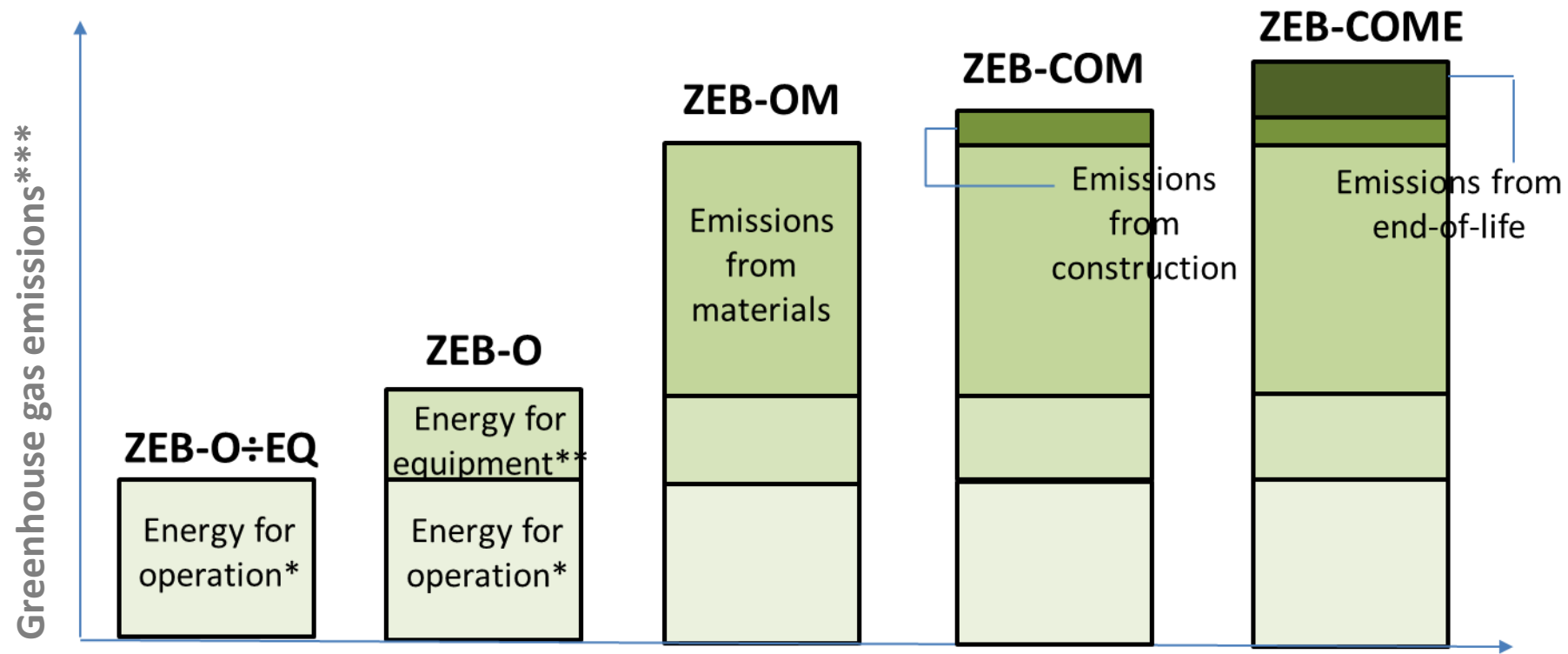
Definition of Zero Emission Buildings



The zero emission building concept will result in

- Reduction of GHG emission
- Energy efficient buildings
- New local renewable energy production
- Reduction of material use
- Reuse of materials
- Use of environmental-friendly materials
- Optimization of energy use/flow

ZEB – Ambition levels



* Energy use for heating, cooling, ventilation, hot water and lighting

** Energy use for equipment/plug loads

*** Greenhouse gas emissions are calculated as kg CO₂-equivalents per m² heated floor area per year (distributed over a 60 years life time)

Working closely with public and private partners to realize real demonstration projects:

- 6 projects are completed
- 2 project are under construction
- 1 project is under evaluation by the municipality

ZEB Pilot Projects



Living Lab. Photo: Geir Mogen.



Powerhouse Brattørkaia. Illustration: Snøhetta/Mir.



Visund, Haakonvern. Photo: Hundven Clements.



Multikomfort. Photo: Bo Mathisen.



Campus Evenstad. Photo: Leikny Havik Skjærseth.



Powerhouse Kjerbo. Photo: Bo Mathisen.



Zero Village Bergen. Illustration: Snøhetta/Mir.



Heimdal High School. Illustration: Snøhetta/Mir.



Skarpnes. Photo: Skanska.

Powerhouse Kjørbo, Sandvika – Refurbished Office Building



Powerhouse Kjørbo

Ambition: ZEB – OM-EQ

Exposed concrete – thermal mass.

Reuse of glass/concrete.

Use of wood in the façade.

Hybrid ventilation.

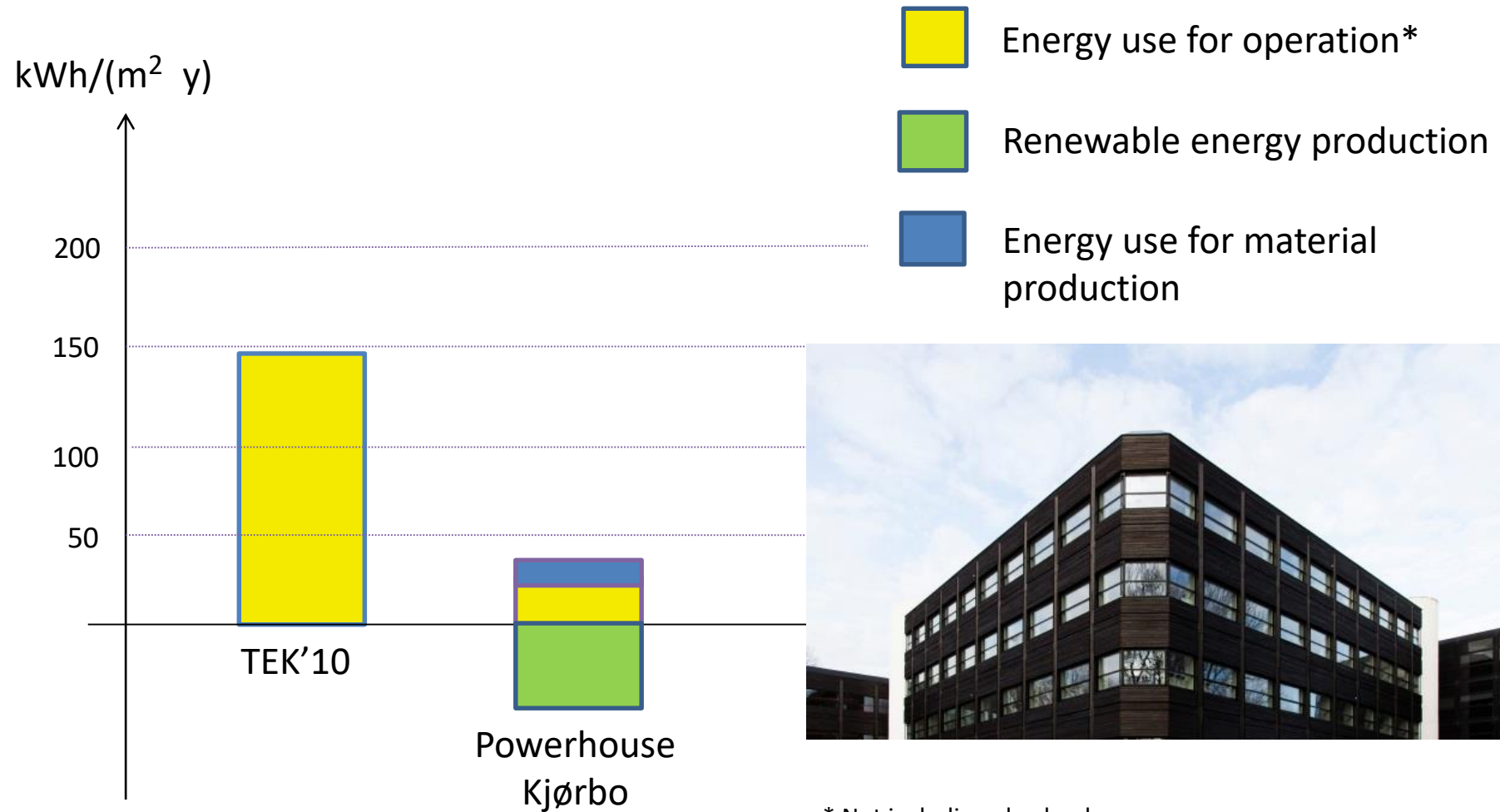
1560 m² PV.

PowerHouse Alliance:

Skanska, Entra, Snøhetta, Zero, Asplan Viak, Hydro, SAPA

Illustration SNØHETTA / MIR

Powerhouse Kjørbo



* Not including plug loads

ZEB Pilot House Larvik - demonstration home

Owner: Brødrene Dahl and Optimera, Architects: Snøhetta, Illustration: MIR



ZEB Pilot House Larvik – Demonstration home.

Ambition ZEB – OM.

Reuse of bricks. Use of wood.

Combines different systems:

Heat pump, PV and solar collector.

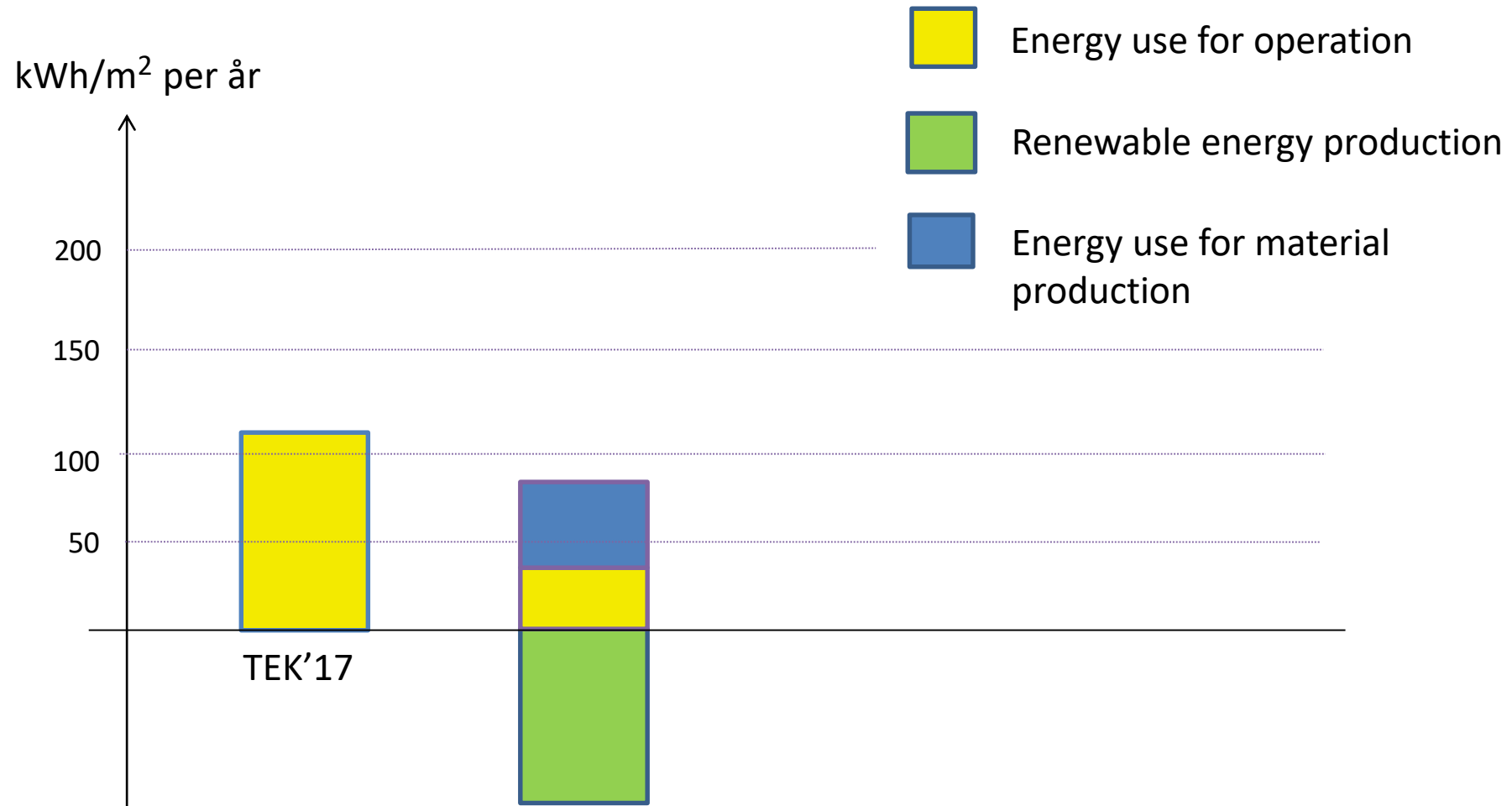
Owner: Brødrene Dahl and Optimera

Architects: Snøhetta

Illustration: MIR



ZEB pilot house Larvik energy use and production





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

BUILDINGS – USERS – ENERGY SYSTEMS – PILOT PROJECTS

WORK PACKAGES

① WP1 Analytical framework for design and planning of ZEN

② WP2 Policy measures, innovation and business models

③
WP3
Responsive and
energy efficient
buildings

④
WP4
Energy flexible
neighbourhoods

⑤
WP5
Local energy system
optimization within
a larger system

⑥ WP 6 Pilot projects and living labs

What is a zero emission neighbourhood (ZEN)?

A neighbourhood is defined as a group of interconnected buildings with associated infrastructure, located within a confined geographical area.

The neighbourhood should focus on the following:



Plan, design and operate buildings and associated infrastructure components **towards zero life cycle greenhouse gas emissions;**



Become **highly energy efficient** and **powered by a high share of new renewable energy** in the neighbourhood energy supply system;



Manage energy flows (within and between buildings) and exchanges with the surrounding energy system in a smart and flexible way;

What is a zero emission neighbourhood (ZEN)? (Cont.)



Promote **sustainable transport** patterns and **smart mobility systems**;



Plan, design and operate with respect to **economic sustainability**, by minimizing total life cycle costs and life cycle system costs;



Plan and locate amenities in the neighbourhood to provide **good spatial qualities and stimulate sustainable behavior**;



Development of the area is characterized by **innovative processes** based on new forms of cooperation between the involved partners leading to **innovative solutions**.

Further reading: <https://fmezen.no/what-is-a-zen>

ZEN pilot projects

Bodø: Airport area

Steinkjer: Residential area

Trondheim: NTNU Campus & Sluppen



Evenstad: Campus

Elverum: Ydalir

Bergen: Zero Village Bergen

Oslo: Furuset

Bærum: Oksenøya, Fornebu

 30 000
 m^2 > 1 million



Ydalir, Elverum



Furuset, Oslo



NyBy, Bodø



Sluppen, Trondheim



NTNU Campus, Trondheim



NRK tomt, Steinkjer



Zero Village Bergen



Campus Evenstad



Oksenøya, Bærum

Conclusions/summary

Zero emission building and neighbourhood concepts will result in

- Reduction of GHG emission
- Energy efficient buildings/neighbourhoods
- Use of renewable energy and new local renewable energy production
- Reduction of material use
- Reuse of materials and use of environmental-friendly materials
- Smarter buildings for optimization of energy flows
- Connection/interaction to e-vehicles

THANK YOU!

Contact: Arild.Gustavsen@ntnu.no

