

The Norwegian ZEB definition and lessons learnt from nine pilot zero emission building projects



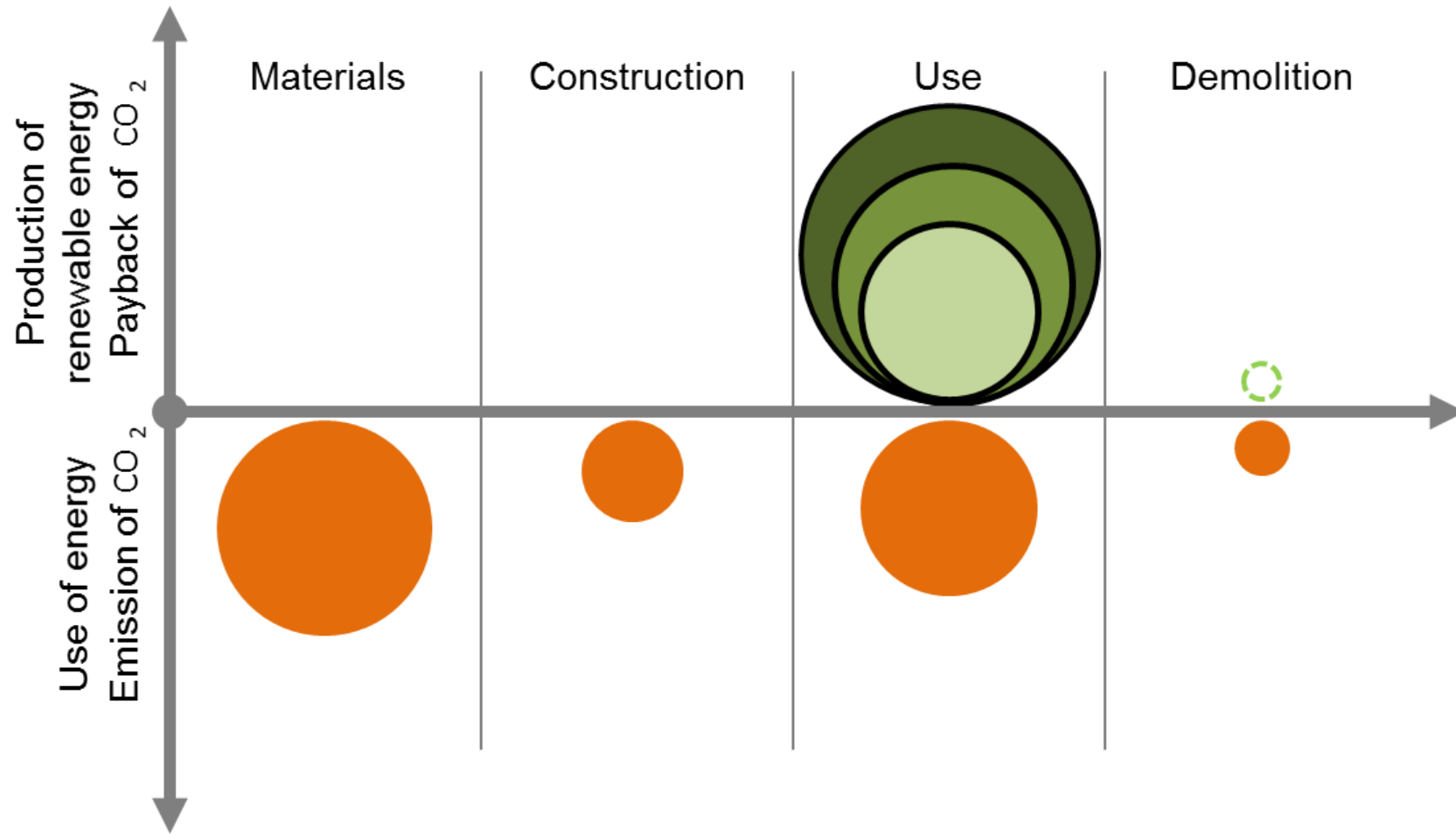
www.fmezen.no
www.zeb.no

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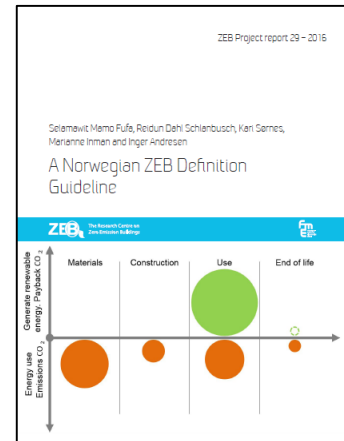
The ZEB Definition

A Zero Emission Building is a building that over its life time compensates for all greenhouse gas emissions related to production, construction and operation of the building

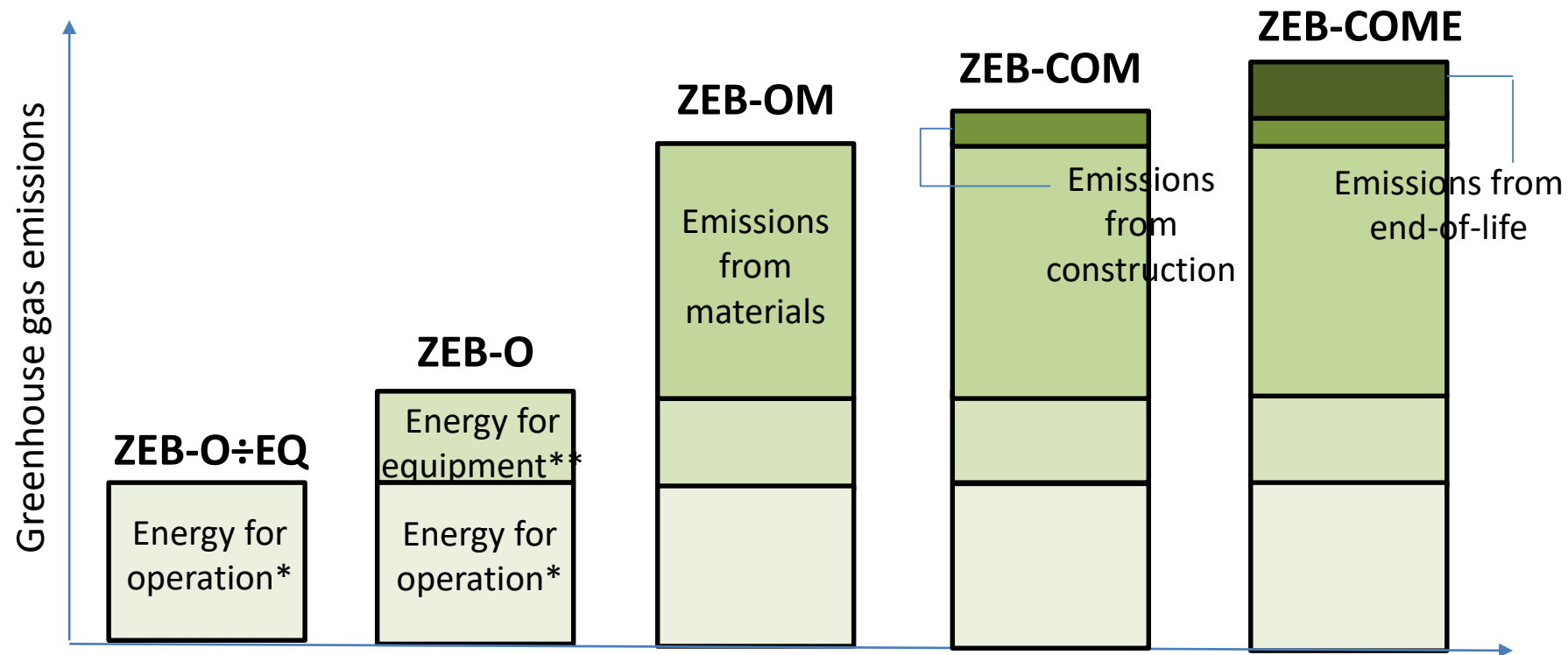




Functional unit: kg CO₂-equivalents per m² heated floor area pr year over a life time of 60 years



ZEB definition – ambition levels



*Energy for heating, cooling, ventilation, DHW, and lighting

** Energy for white goods, IT, etc.

The ZEB Pilot Buildings





ZEB Project report 30 – 2017

Anite Moum, Åshild Leppegard Heuge and Judith Thomsen

Four Norwegian Zero Emission Pilot Buildings – Building Process and User Evaluation

ZEB The Research Centre on Zero Emission Buildings

ZEB Project report 25 – 2015

William Throndsen, Thomas Berker and Espen B. Knoll

Powerhouse Kjørbo.
Evaluation of construction process and early use phase

ZEB The Research Centre on Zero Emission Buildings

ZEB Project report 33 – 2017

Åse Lekang Sørensen, Inger Andresen, Torhildur Kristjensdóttir, Harald Amundsen (BD) and Kristian Edwards (Snehette)

ZEB pilot house Larvik
As Built Report

ZEB The Research Centre on Zero Emission Buildings

ZEB Project report 40 – 2018

Igor Sartor, Kristian S. Skeie, Ken Sannes and Inger Andresen

Zero Village Bergen
Energy system analysis

ZEB The Research Centre on Zero Emission Buildings

ZEB Project report 24 – 2015

Marienne Rose Inman and Aoife Houlihan Wiberg

Life Cycle GHG Emissions of Material Use in the Living Laboratory

ZEB The Research Centre on Zero Emission Buildings

ZEB Project report 27 – 2016

Jørn Stene and Marie Justo Alonso

Field Measurements – Heat Pump Systems in NZEB

ZEB The Research Centre on Zero Emission Buildings

ZEB Project report 34 – 2017

Reidun Dahl Schanbusch, Selamawit Mamo Fufa, Inger Andresen, Tore Wigestad and Torger Mjenes

ZEB pilot Heimdal high school and sports hall
Design phase report

ZEB The Research Centre on Zero Emission Buildings

ZEB Project report 36 – 2017

Marianne Kjendseth Wik, Åse Lekang Sørensen, Eivind Selvik, Zdena Cervenka, Selamawit Mamo Fufa and Inger Andresen

ZEB Pilot Campus Evenstad, administration and educational building
As-built report

ZEB The Research Centre on Zero Emission Buildings

Design process

Integrated design process

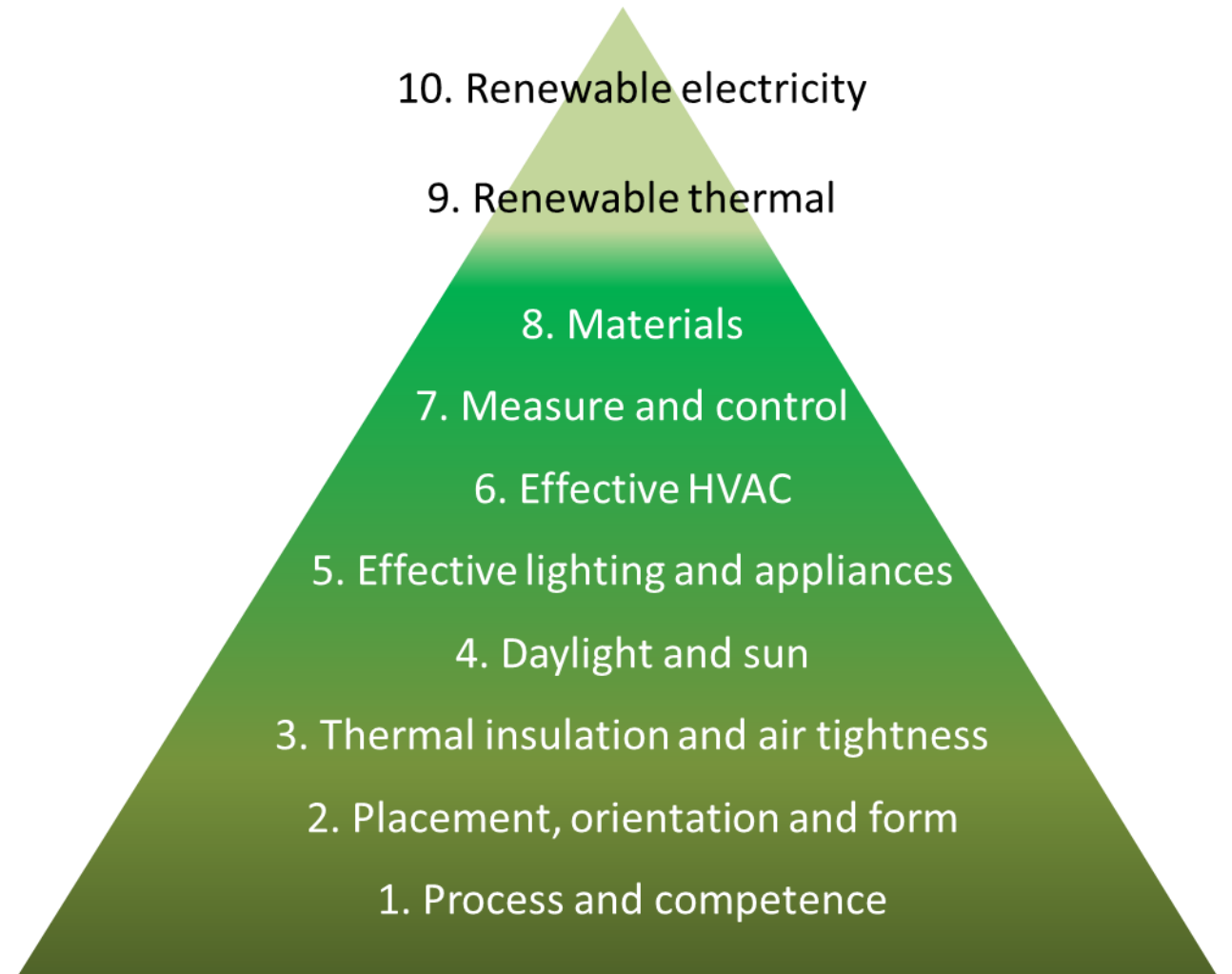
- Energy- and environment skills in from the beginning
- Specific goals and systematic plan for follow- up
- Culture of sharing and trust
- Solutions as part of a whole



Photo: Snøhetta

ZEB – Design strategy

- 1) Reduce the demand
- 2) Use effective technologies
- 3) Utilize renewables





ZEB – strategies and solutions

Source: 'Zero Emission Buildings', Fagbokforlaget 2018

Construction process

Lessons learnt from the construction process

- Can be challenging to follow-up the material emission budget:
 - Changes, unforeseen challenges, decisions taken on-site, sub-contractors not on board
- Bring sub-contractors on board:
 - Transition from design phase: facilitator
 - Highlight the skills and knowledge development benefits for participants in such projects

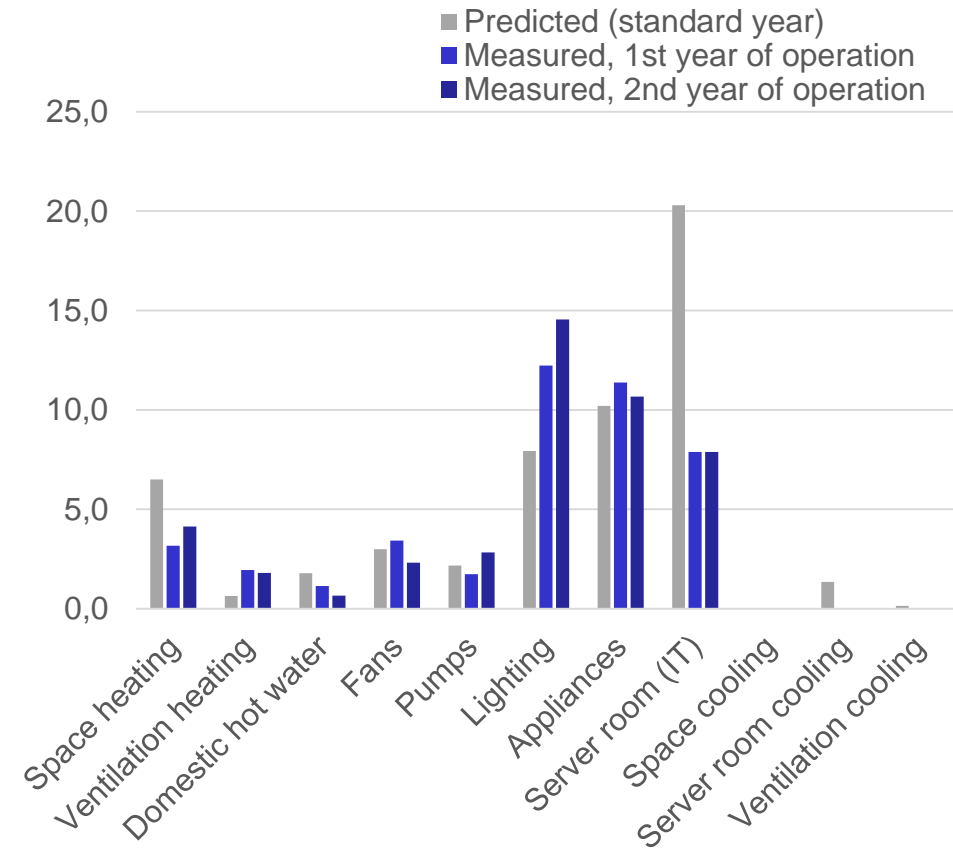


Photo: Skanska

Operation and use

Lessons learnt from the operation and use

- Quite good match between predicted and measured energy performance
- Good indoor environment
- Special care for non-professional users (residential buildings)



Predicted and measured energy performance for Powerhouse Kjørbo (office building, renovated)

Addressing the users

**'We are not idealists,
we sort waste,
but we do not do
difficult things for the
Environment'**

*Resident of
a ZEB house*

**'We just wanted a
kindergarten.
We did not know what
a ZEN was'**

*Kindergarten employee
in prospect ZEN area*

Berker: We need to address:

- 1) The level of end-user control
- 2) The level of complexity of systems
- 3) The need for information about correct use

Sources:

Berker T 2018 From potential to performance – people matter, in *Zero Emission Buildings*, ed AG Hestnes and NL Eik-Nes (Bergen: Fagbokforlaget)
Moum, Hauge and Thomsen (2017). 'Four Norwegian Zero Emission Pilot Buildings – Building Process and User Evaluation.' ZEB project report 30-2017
Woods, Andresen, Skaar og Berker (2019). 'Utvikling av pilotprosjekt i Steinkjer kommune', ZEN project report 16-2019.

Thank you!

ZEB PARTNERS

