Net-Zero Future 2024

Universidad Politécnica de Cartagena

Østfold University College

Economic and carbon footprint assessment for energy upgrading of buildings. Scenarios for a combined warehouse and office building in Norway

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Background

- New Energy Performance in Building Directive (EPBD) approved 2024
- Aims for triggering a renovation wave
- For non-residential buildings, it requires renovating the 16% worst-performing buildings by 2030
- Green finance and support is growing

Problem statement

What is the most beneficial I terms of carbon footprint and costs, to either renovate, build new or leave as is?

Can green finance and support change the benefit of each scenario?

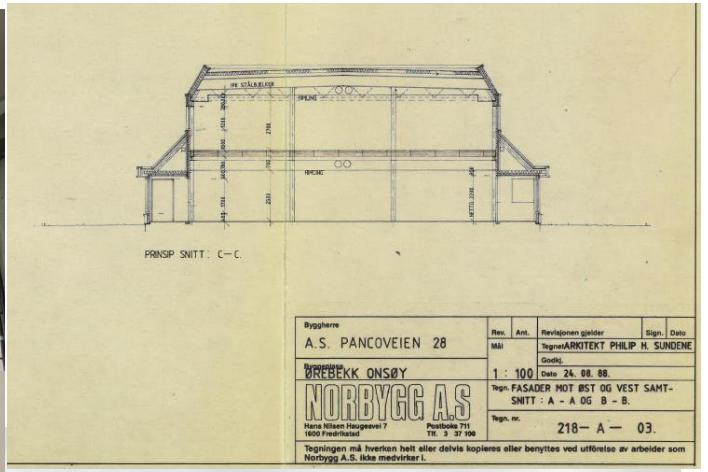
Case building:

Floor area (office + warehouse):
1653 m^2

Heated floor area (office):
735 m^2

Location: Fredrikstad, Norway

Built: 1989



Two methods applied – goals and software

Cost assessment

Goal to have a cost estimate according to common practice

Cost estimated by case study entrepreneur. LCC tool from Difi.

Carbon footprint

Goal to follow new building code requirements

Material amounts based on cost analysis. Material footprint from Reduzer software

Scope cost assessment and carbon footprint

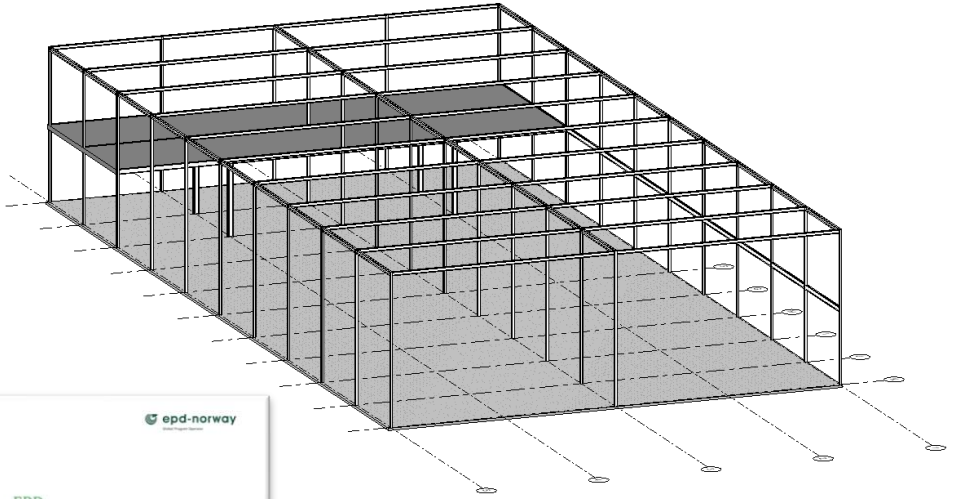
- The cost included all cost to erect the buildings
- The carbon footprint follows requirements from new building code and scope of activities are less than the cost scope
- Based on Level(s) GWP method
  - Simplification 1 – energy focus

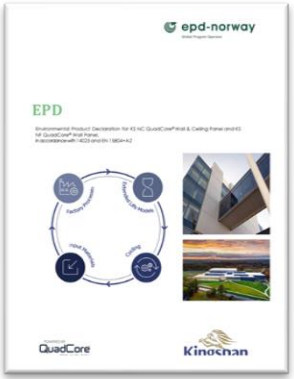
Table 3. Scope of materials and modules in carbon footprint assessment

Building part NS 3451	Modules EN 15978
21 Foundation	A1-A3 Product stage
22 Superstructure	A4 Transport to building
23 Outer walls	A5 Installation
24 Inner walls	B2 Maintenance
25 Slabs	B4 Replacement
26 Roofs	B6 Operational energy

Building data and assumptions

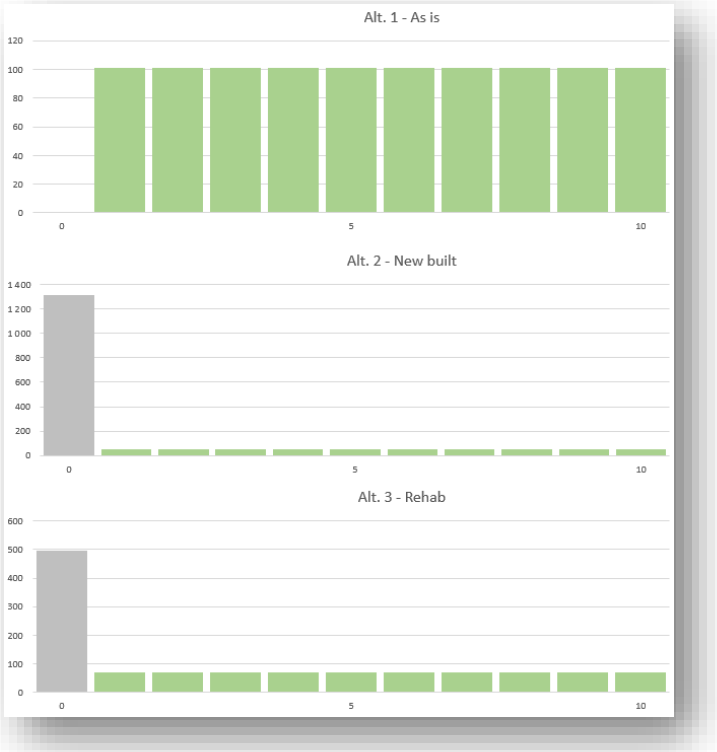
- As is energy from 2023
- New built estimated from previous concept building
- Rehabilitation
  - Keep main structure and rest as new
  - Assumes 30 % reduced operational energy
- Three electricity mixes:
  - Norwegian consumption
  - Future European
  - Residual Norwegian



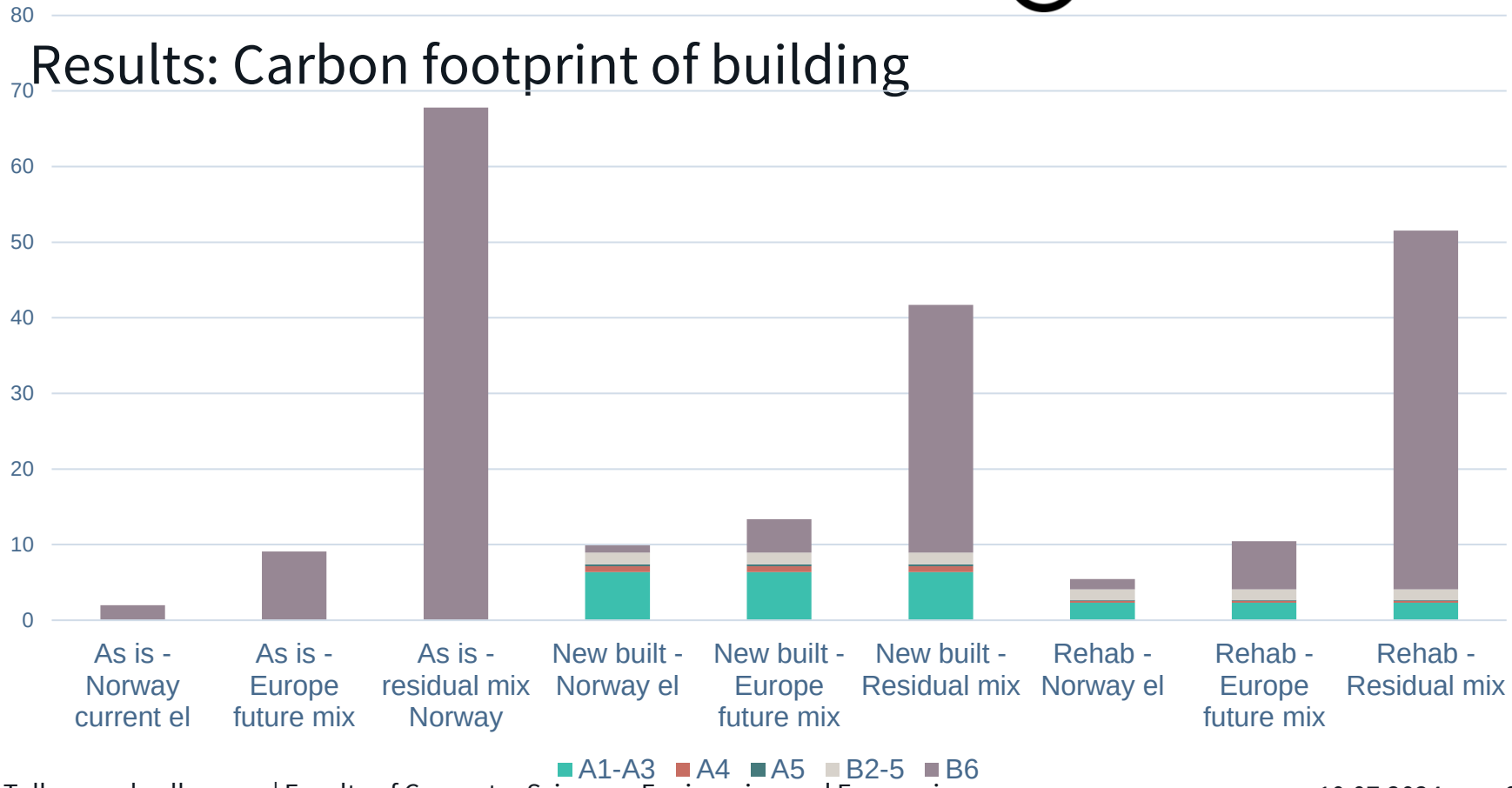


Life cycle costing (LCC) parameters and software

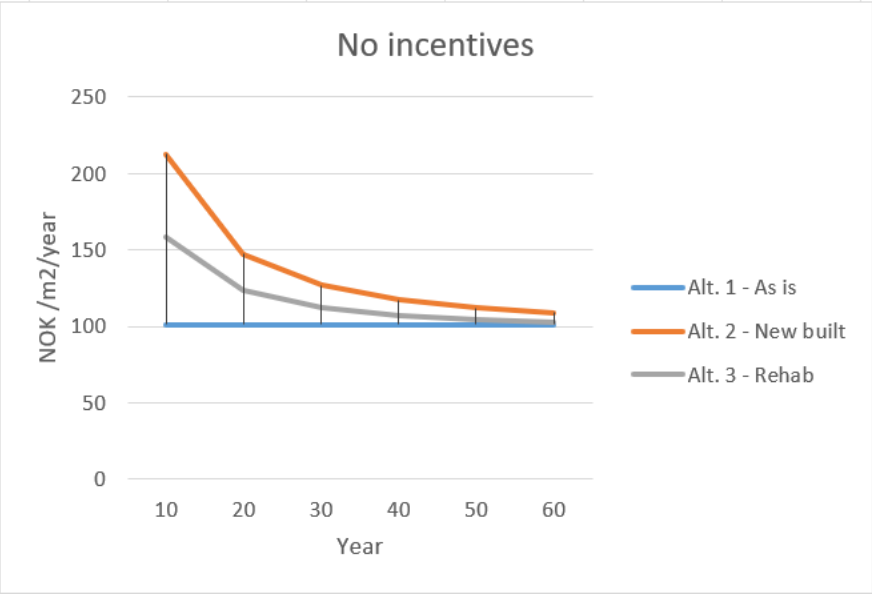
- 4 % discount rate
- 1 NOK per kWh (0.1 EUR)
- 0.5 % green loan discount in new built and rehab
- 30 % of rehab investments supported from Government energy efficiency program (Enova)

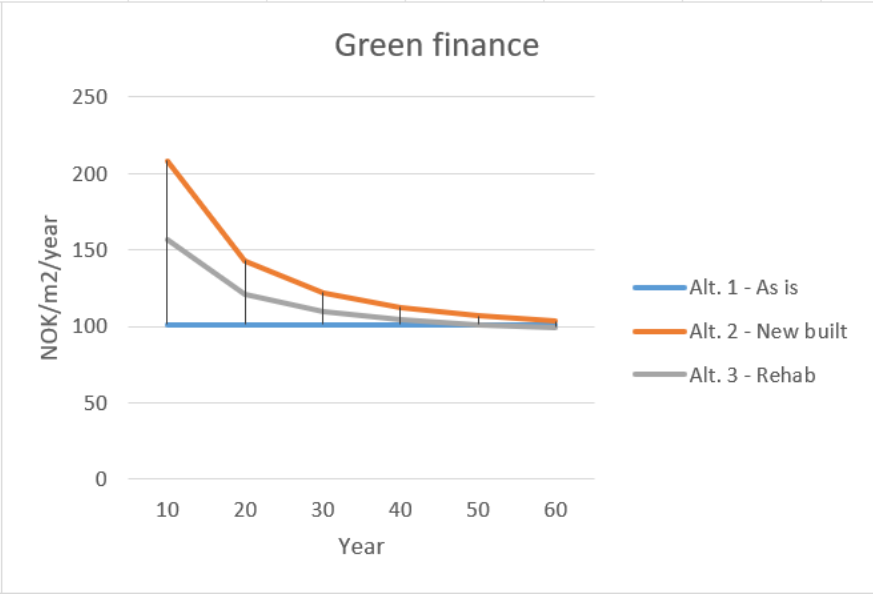


Results: Carbon footprint of building

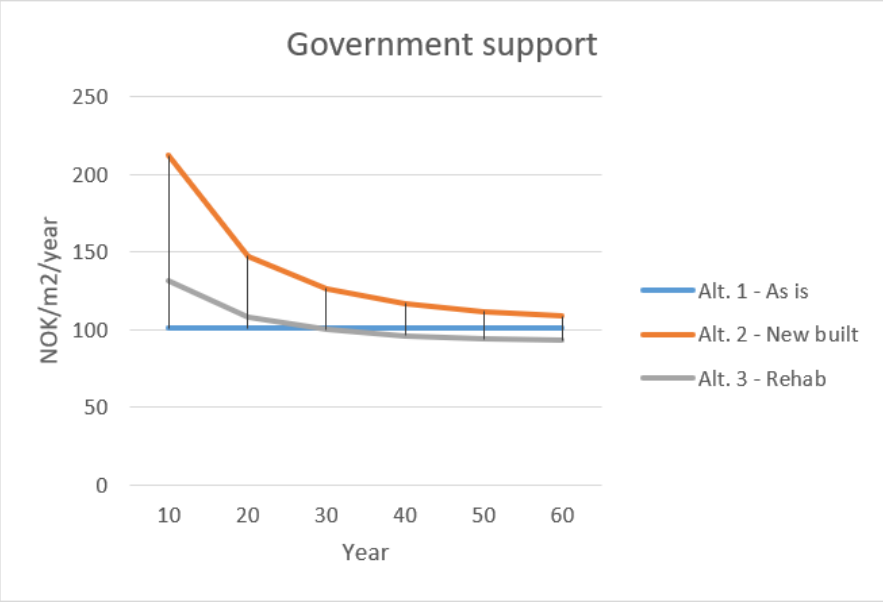


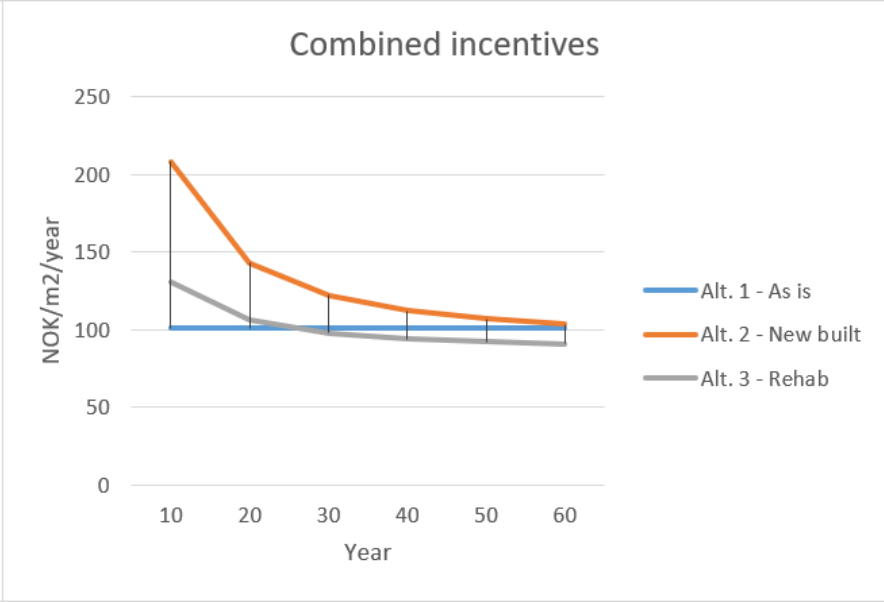
Results: Cost assessment



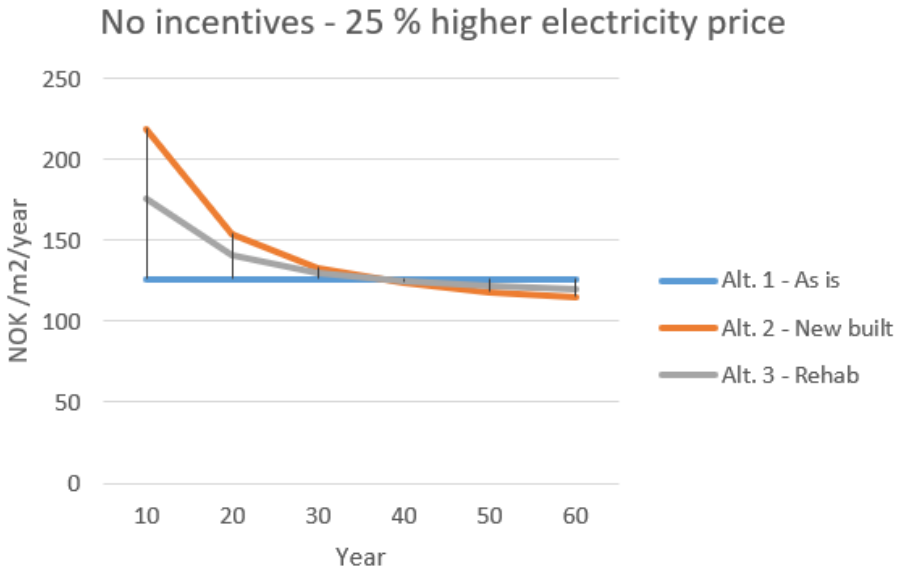


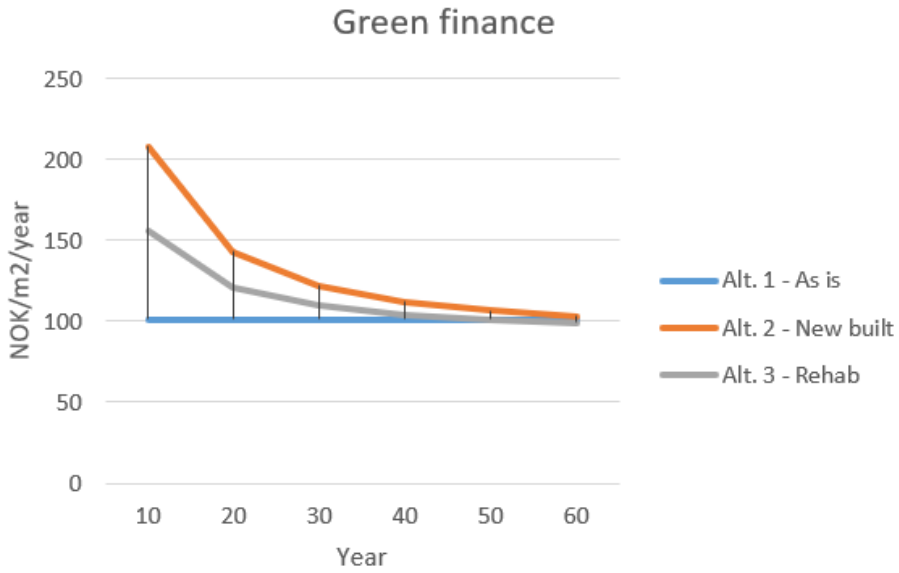
Results: Influence of government support





Results: Higher electricity prices





Conclusions

- Carbon and costs estimates at conceptual level for commercial building
- Carbon footprint depends much on future electricity impacts assumed.
- Government support and electricity prices important to make reduction cost efficient, green finance less important
- More detailed analysis should focus on:
  - Detailed rehab scenario
  - Sensitivity of prices and interest rates. Also annual to hour rates.

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Thank you!

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VIKEN FYLKESKOMMUNE

References

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Reduzer. Carbon footprint tool. https://reduzer.com/

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