

A large, leafy tree stands in a field of tall grass under a bright blue sky with scattered white clouds. The tree's leaves are slightly blurred, suggesting a breeze. The overall scene is peaceful and natural.

Low-energy buildings in Norway

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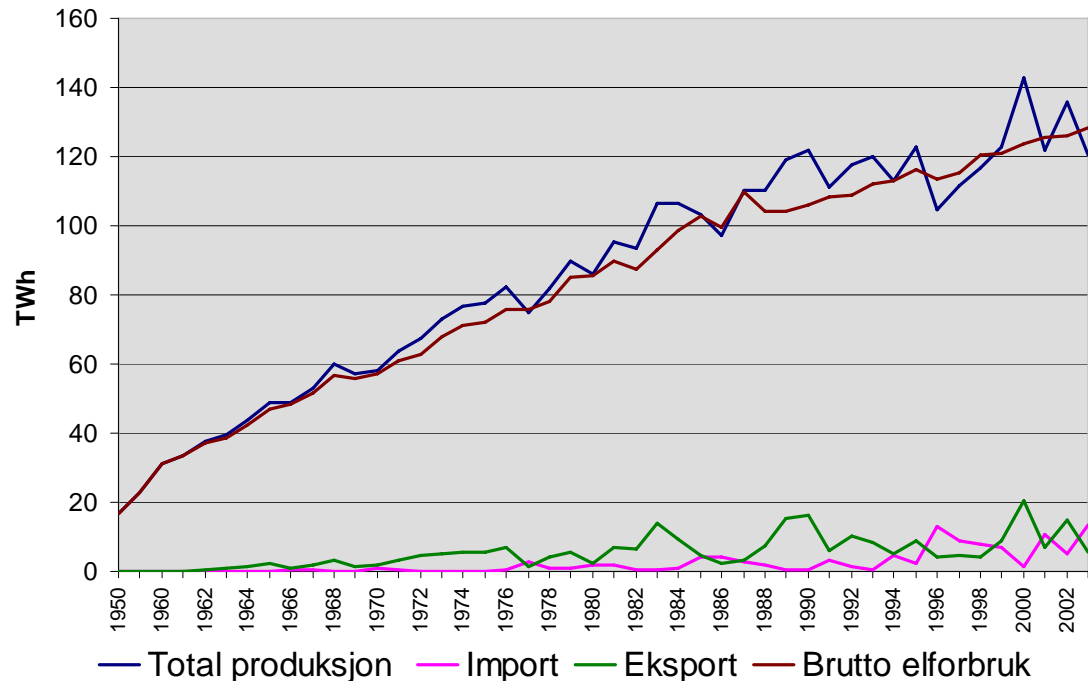
Structure

- The Norwegian challenge with regard to energy use
- Why low energy buildings are becoming popular
- Strategy for designing low-energy and passive houses
- Low-energy houses and energy supply
- Project examples
- Summary

The Norwegian energy challenge

- Shortage of self-produced electricity
- Risk of power crisis
- Climate obligations (Kyoto)
- The building sector use nearly 50% of the energy in Norway (40% of the el.), and is the fastest growing sector.
- Energy frames (2006)

Produksjon, import, eksport og bruttoforbruk av elektrisk kraft (TWh). 1950 - 2003.

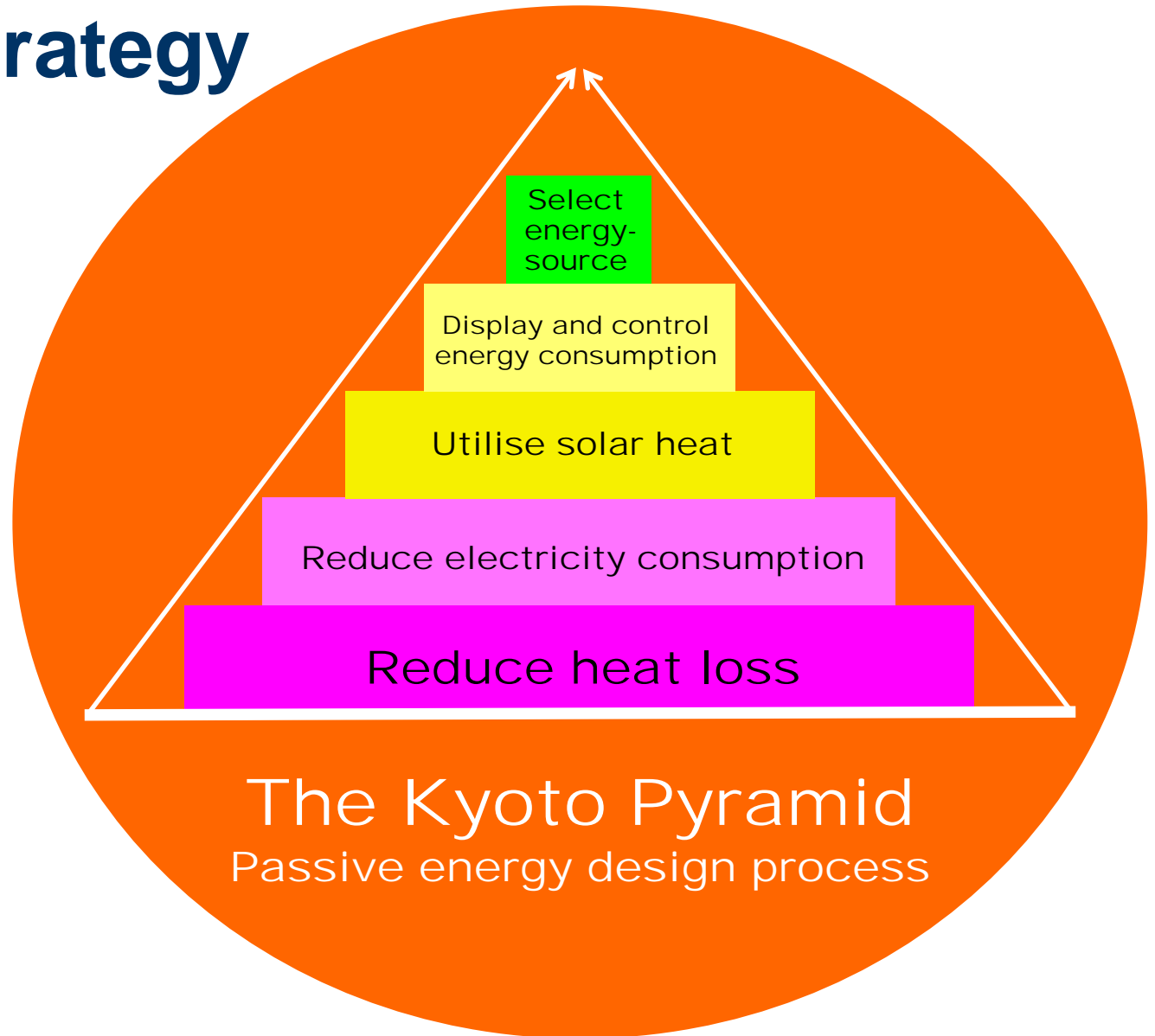


Low-energy buildings – popularity

- High comfort
- No architectural compromises (good building examples)
- Low energy bills (kWh/m²)
- Environmentally focused occupants (buyers/builders)



Design strategy



Design strategy

1. Reduce heat losses (*super insulated and tight building envelopes. Efficient heat recovery of ventilation air*).
2. Reduce the use of electricity (*energy efficient lighting and equipment. Low pressure drops in the ventilation system*).
3. Utilisation of solar energy (*optimum window orientation and size, atrium/sun spaces, thermal mass, solar collectors, photovoltaics*)
4. Display and control the energy use (*demand controlled lighting, cooling and ventilation. User feedback on energy use*)
5. Choice of energy system and energy carrier (*solar collector, heat pump, district heating, firewood, gas, electricity*)

Low-energy houses – energy supply

- The Norwegian Parliament has initiated national goals of increasing the annual use of hydronic heating systems based on renewable energy sources.
- Mandatory installation of hydronic heating systems in new buildings in areas where district heating is developed or potentially could be developed is initiated.
- Recent low-energy projects in Norway has a heating demand as low as 1500 to 2000 kWh/year/dwelling.
- This rises some questions about the interaction between the supply side and the demand side of the energy system, and the choice of optimum energy solutions for future low-energy and “passive” buildings

Project examples

- Husby Amfi, in Sør-Trøndelag (51 low-energy dwellings)
- Grong in Nord-Trøndelag (10 low-energy row-houses)
- Rosenborg park in Trondheim (over 400 low-energy apartments)

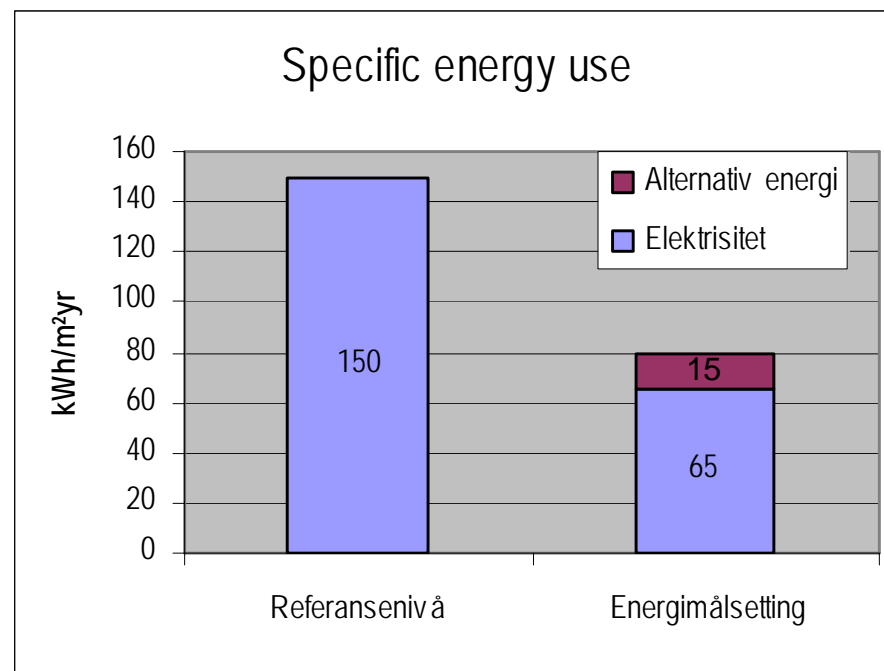


Husby Amfi: 51 low-energy dwellings



Husby Amfi – Energy Objectives

- Total energy use should be below 80 kWh/m² per year.
- Space heating load including ventilation air heating should be below 25 kWh/m² per year
- Electric energy use should be below 65 kWh/m² per year, which is about 45% of a standard apartment



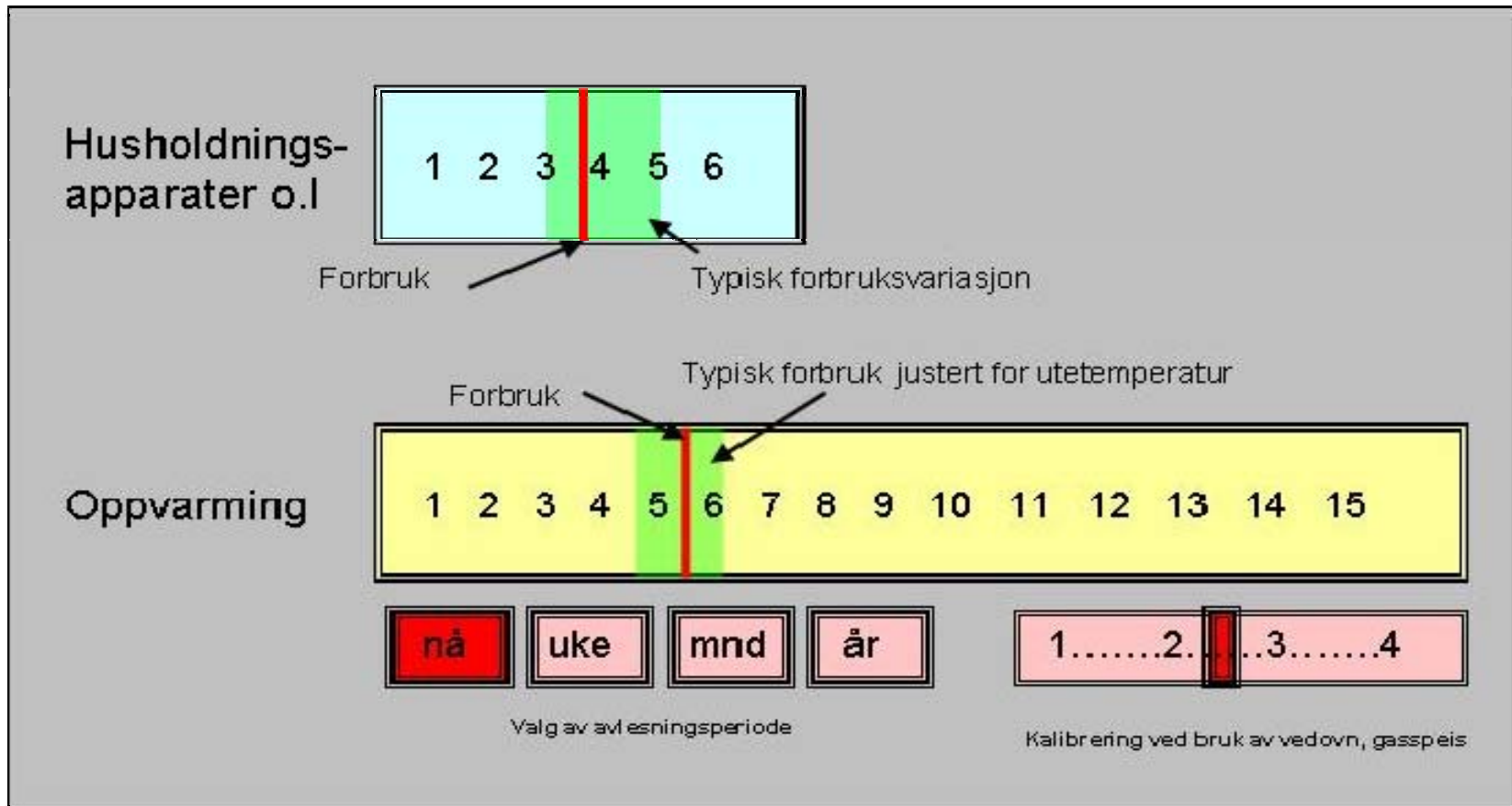
Husby Amfi – Technical solutions

- Extra insulated envelope (250mm in the walls and the roof, 300mm in the floor)
- High performance windows (triple glazing with 2 LE coatings, argon and steel spacer)
- Construction details that minimises thermal bridges and air infiltration
- Energy efficient lights and appliances
- Balanced ventilation with high efficient heat recovery
- South orientation – passive solar
- Exposed thermal mass (concrete slabs/partitions)
- Grey water heat pump
- Feedback on energy use to user

Feedback on energy use

- Central power switch in the entrance that turns the apartment into “rest-mode”, (reduced ventilation, reduced temperature, turns off lights and equipment).
- Web-based energy supervision system, including PC for all apartments. Shows actual energy use versus expected (simulated) energy use.

Feedback on energy use



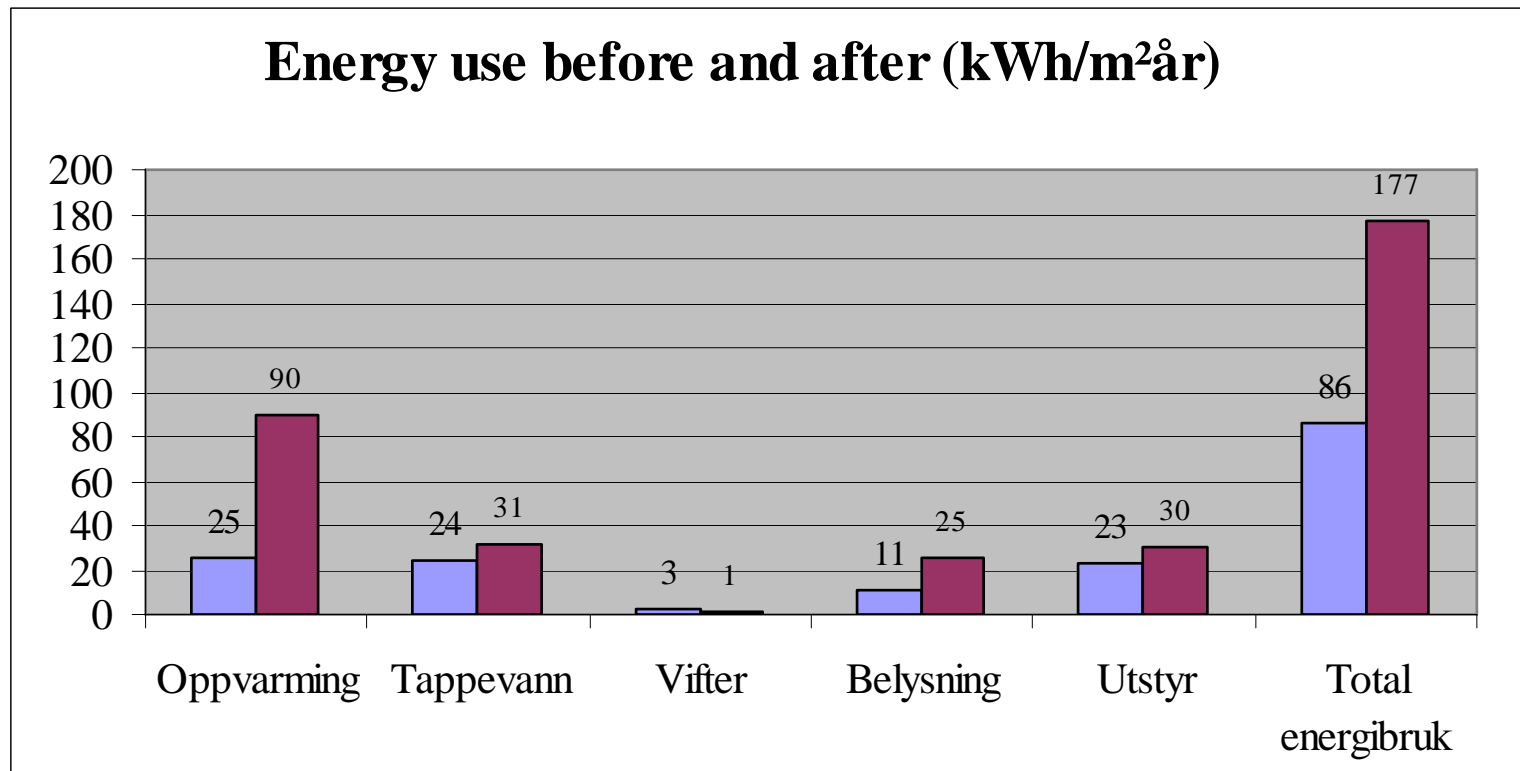
Grong in Nord-Trøndelag: 10 low-energy apartments in row-houses



Grong – Energy Objectives

- 50% reduction in energy use compared to a similar row-house built according to current building code
- Focus on robust solutions, robust with respect to user habits and faults
- The project should be as cost-effective as possible
- The project should be an example for cost-effective buildings in Norway (demonstration project in IEA Task 28).
- Should be common practice for new dwellings in near future

Grong – Energy Objectives



Yearly energy bill: 5.300 NOK (9600 kWh/yr)

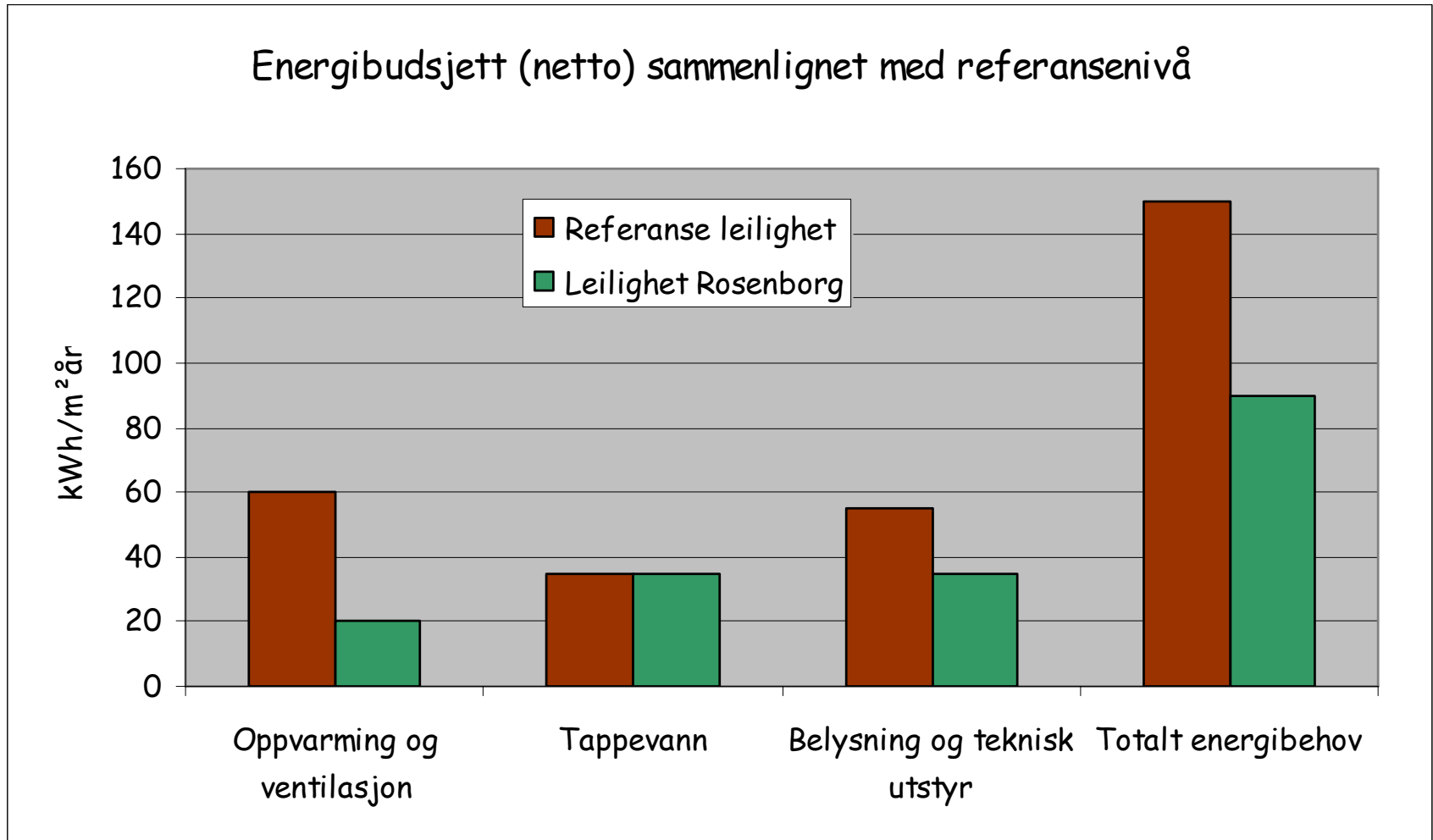
Grong – Technical Solutions

- High performance windows, U-value 1.0 W/m²K
- Doors with U-value: 0.85 W/m²K
- External walls with 250 mm insulation, U = 0.16 W/m²K
- Roof construction with 400 mm insulation, U = 0.10 W/m²K
- Floor with 250 mm polystyrene, U = 0.11 W/m²K
- Measures to reduce air leakage down to 1.0 ach at 50 Pa
- Balanced ventilation with 85 % heat recovery
- Low energy lighting
- Low energy appliances (EU-labelled)
- Water saving armatures

Rosenborg Park: 400-500 Low-energy apartments



Rosenborg Park – Energy objectives



Rosenborg Park – Technical solutions

- Extra insulated envelope, super insulated windows, building details that minimise risk of cold bridges and air leakages.
- Low energy lighting and appliances, balanced mechanical ventilation with efficient heat recovery.
- Feedback on energy use and control possibilities.
- Sunspaces towards south and west.
- Water saving armatures. Hot tap water with energy from district heating.
- Hydronic heating system (floors) in bathrooms from district heating.
- Remaining heating needs (very little) covered by electrical panel ovens with thermostat.



Low-energy buildings...

- Provide high comfort and good IAQ
 - Are energy-economic profitable
 - Reduce the environmental load
- } Environmentally- and economically best for the society, the builder, and the occupants/users
- Simple and good passive concepts and solutions gives buildings with a long lifetime and little maintenance
 - Relatively simple for the builders to realise

We have the knowledge; *-it's just to get on with it!*

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Thank you for your attention!