Energy-efficient HVAC solution-sets for apartment buildings in a Nordic climate

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Research questions

- **What are the common HVAC solutions?**

- **How does each system element affect energy efficiency?**
  - **What are the additional challenges/costs?**

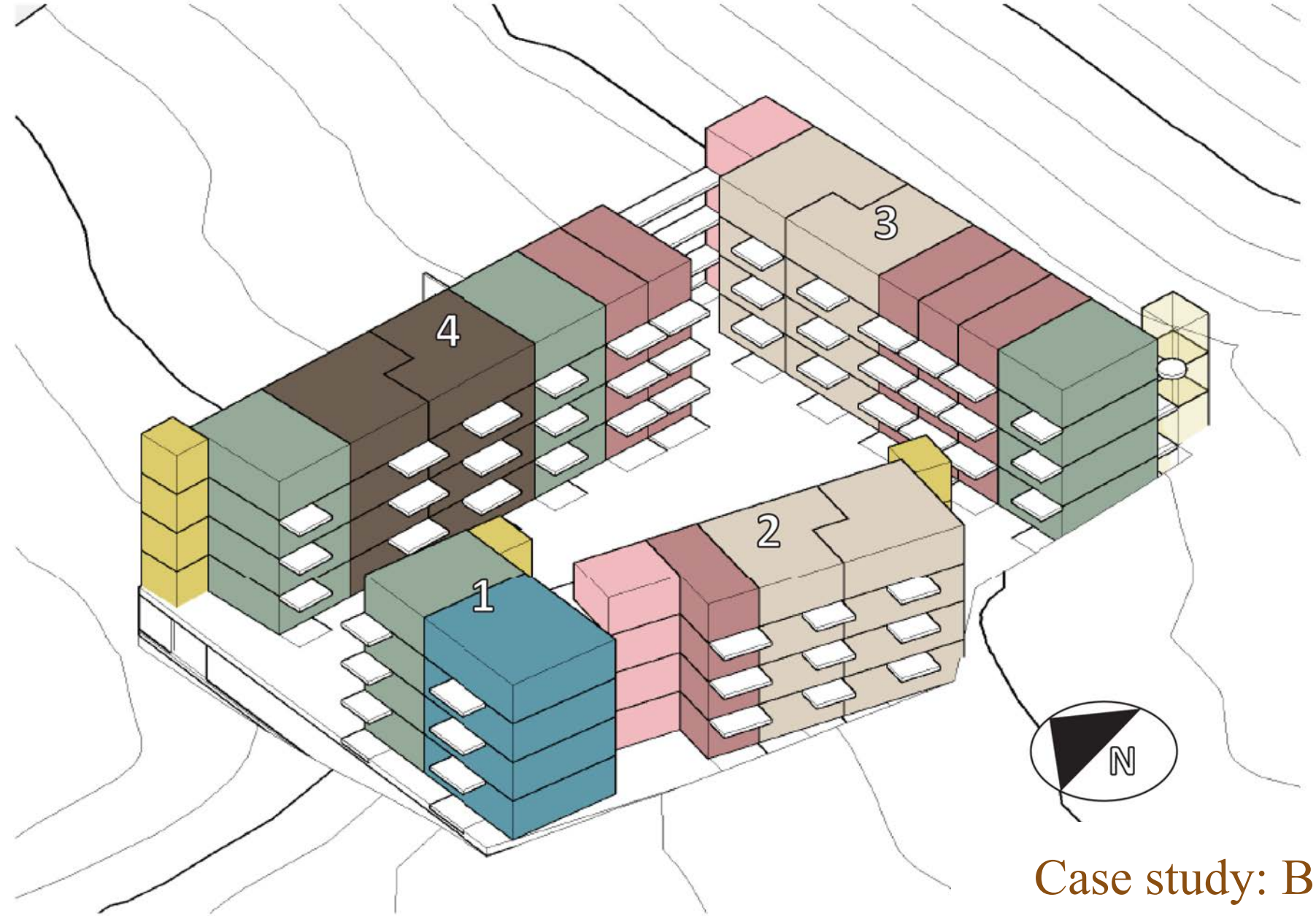
- **Is there a possibility for energy flexibility?**

Common HVAC solutions

- **Statistical review of EPC databases in Norway, Sweden and Finland**

- **District heating or Ground source heat pumps**
- **Secondary heating with electric**
- **Balanced ventilation with heat recovery**
- **Increasing share of energy demand for domestic hot water**
- **Increasing use of solar thermal collectors and photovoltaics**

- **Published in: A review of HVAC solution-sets and energy performance of nearly zero-energy multi-story apartment buildings in Nordic climates by statistical analysis of environmental performance certificates and literature review**



Case study: BoKlok at Sørumsand

Project and apartment images provided by Boklok

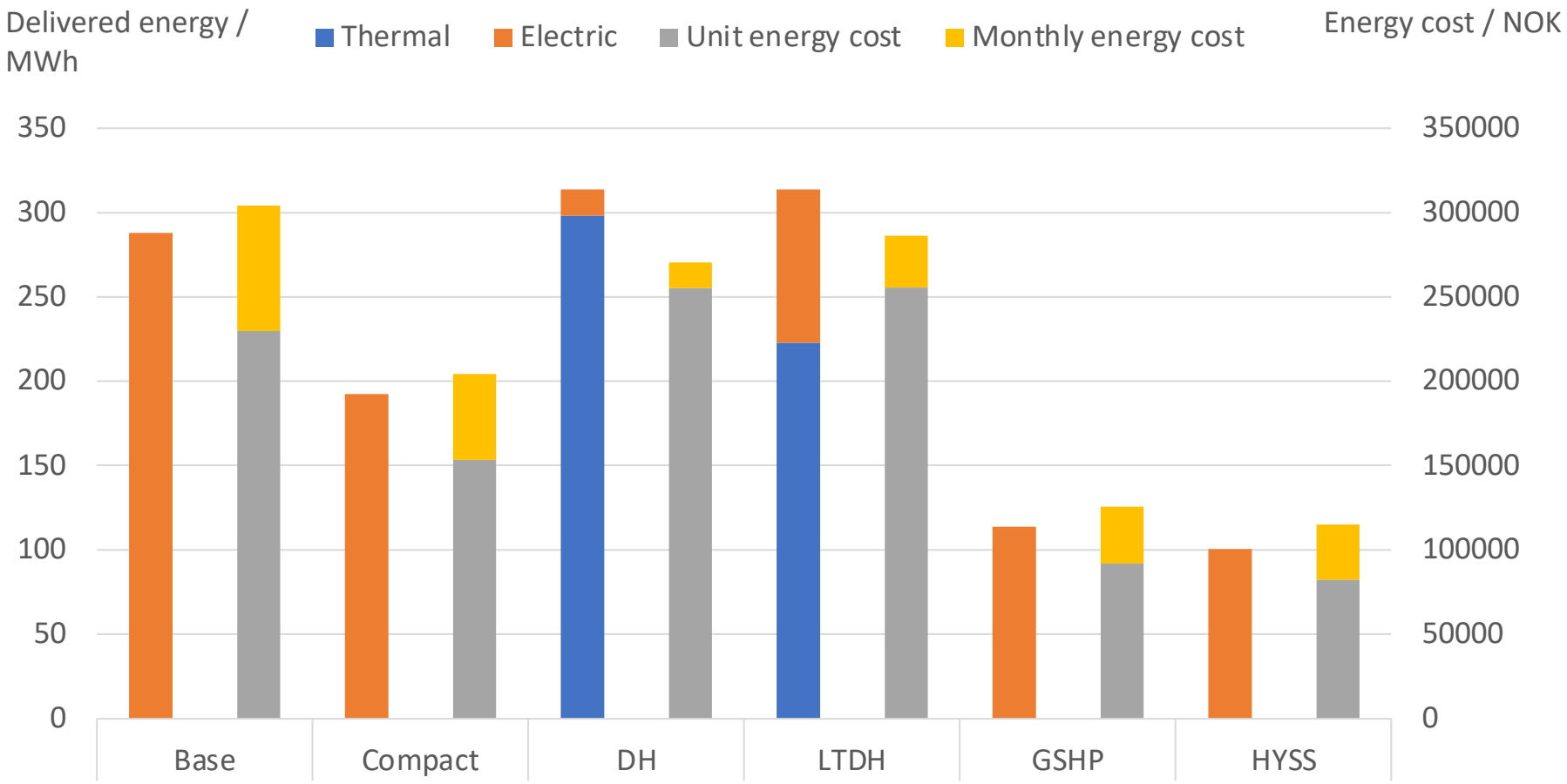
Map adapted from: Ssolbergj *(2008)* SVG map of Europe. Borders of nation states. *Url:* https://commons.wikimedia.org/wiki/File:Location_European_nation_states.svg *(20.05.21)*

Delivery systems

- Heat emitter
  - Small difference in energy use.
  - Supply temperature is more important.
  - Fan convectors and underfloor heating also allows for cooling.

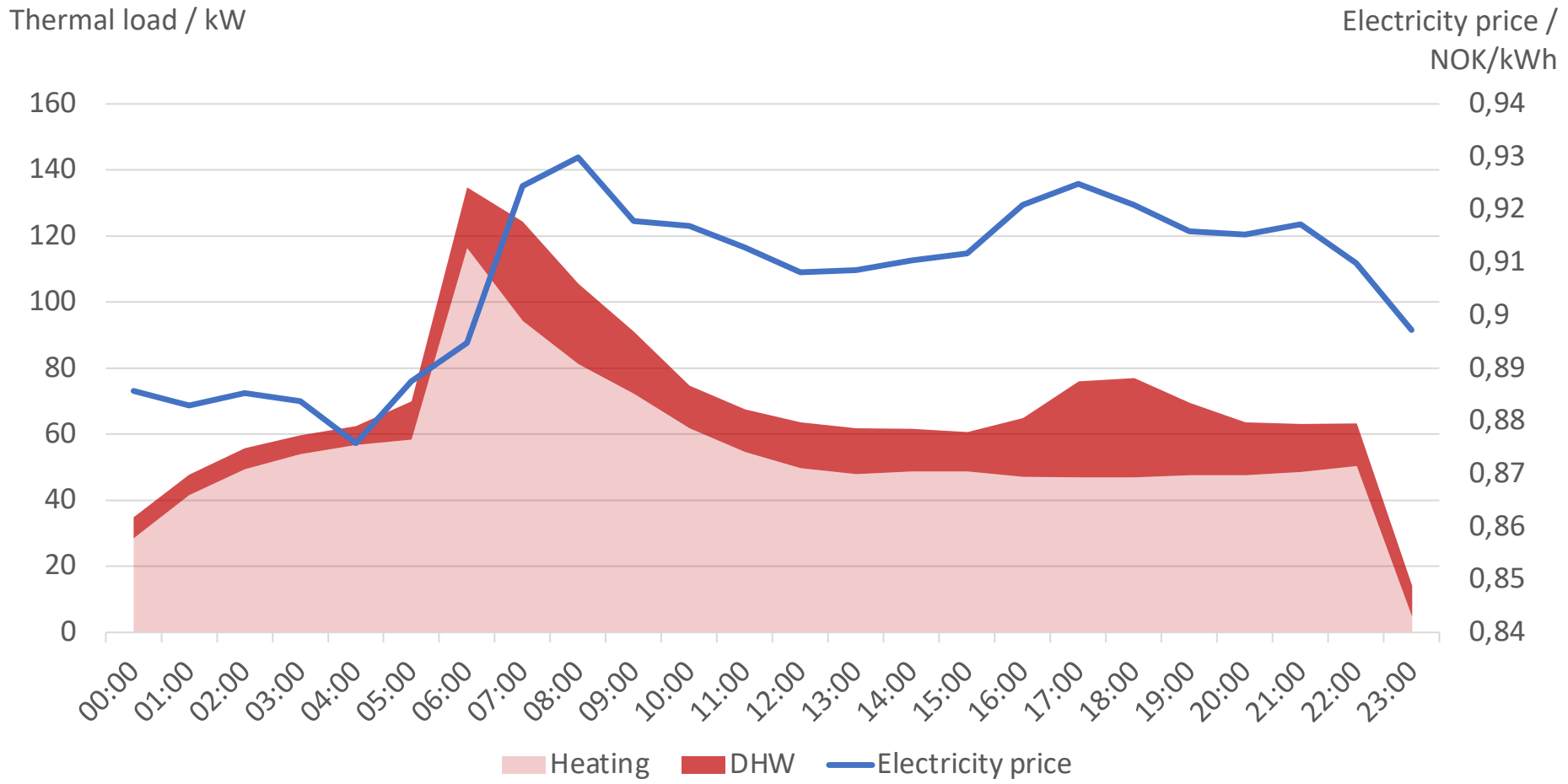
- Balanced ventilation better than exhaust
  - Similar energy need after heat pump
  - Extra cost of exhaust air heat pump and larger equipment.
  - Balanced with electrical heating element allows part year operation of heating system.

Energy supply systems



Annual delivered energy and energy cost for each energy supply system, using a fan coil and a variable schedule. Balanced ventilation system with heat recovery.

Energy flexibility



Variable setpoint demand profile over the peak load day (13.01) against electricity price.

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