



# LARGE-SCALE HEAT PUMPS – A KEY TECHNOLOGY IN THE INTEGRATED ENERGY SYSTEM

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# LARGE HEAT PUMPS A KEY COMPONENT IN THE INTEGRATED ENERGY SYSTEM – THE VIRTUAL BATTERY

- Economy of scale for heat pumps, DH and DC including large thermal storages
- Modes of operation of the heat pump optimizing with respect to electricity, heat and cold
  - Combined heating and cooling – no curtailed energy
  - Cooling only in summer – heat can be curtailed
  - Heating only in winter – cooling can be curtailed
  - Ground source cooling ATEs store heat and cold
  - Heat and cold storages tanks for optimization
  - Disrupt in case of power shortage or large electricity prices



# CASE: COMBINED DH&C IN TÅRNBY, GREATER COPENHAGEN

- **Heat pump: 4,3 MW cold / 6,3 MW heat**
- 4,3 MW cooling capacity to new DC system
- 9.000 MWh cooling to the DC system
- Interacts with 2.000 m<sup>3</sup> chilled water tank
- Interacts with 2 MW ground source cooling
- Up to 4,3 MW heat from treated waste water
- 45.000 MWh heat to the DH system in optimal load dispatch with other production and storage facilities in Greater Copenhagen:
  - 13.000 MWh heat from the cooling
  - 32.000 MWh from the waste water
- 2 MW power to the heat pump can be interrupted in case of power shortage

