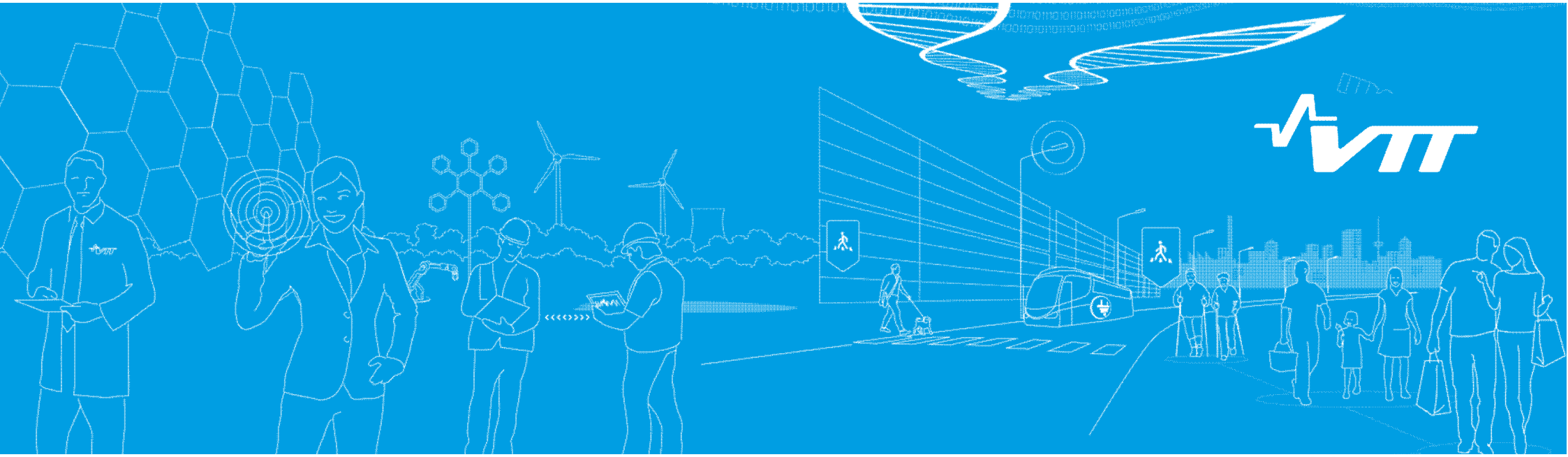

The cryogenic storage project

Neocarbon work meeting 16.12.2014

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Long term electricity storage

- Storage of 460 MW for half a year
  - 1.8 TWh
- The process
  - P2G: Electrylysis + Methanation
  - G2P: Gas combi
  - Standalone plant, no heat integration with the surroundings
- Overall efficiency ~25%

Where are the losses?

- P2G, main losses
  - Input 1590 MW el.
  - Electrolysis efficiency 70% → Cooling duty 460 MW @ 80 °C
  - Methanation reaction, heat of reaction 134 MW @ 250 °C
  - Cooling of Methane 113 MW, 250 °C → 15 °C
  - Total 707 MW
- Energy content of methane ~880 MW
- Power plant efficiency ~50% → El production 440 MW

What are the alternatives

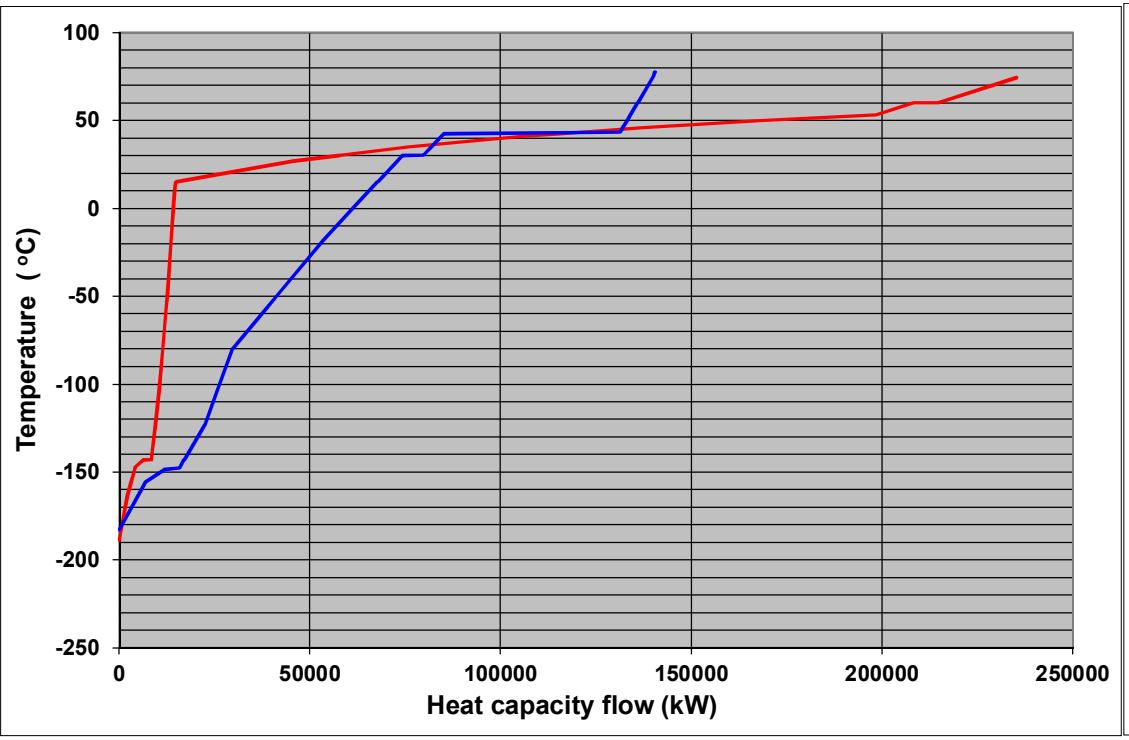
- Car batteries
  - Storage capacity 0.7 kWh
  - 1.8 TWh / 0.7 kWh → 2600 M batteries
  - 10 kg Lb / battery → 26 10^6 ton
  - World annual production of Lb is ~10 10^6 ton
- Water reservoir
  - Would require 10 m wall around Lake Päijänne

Cryogenic storage

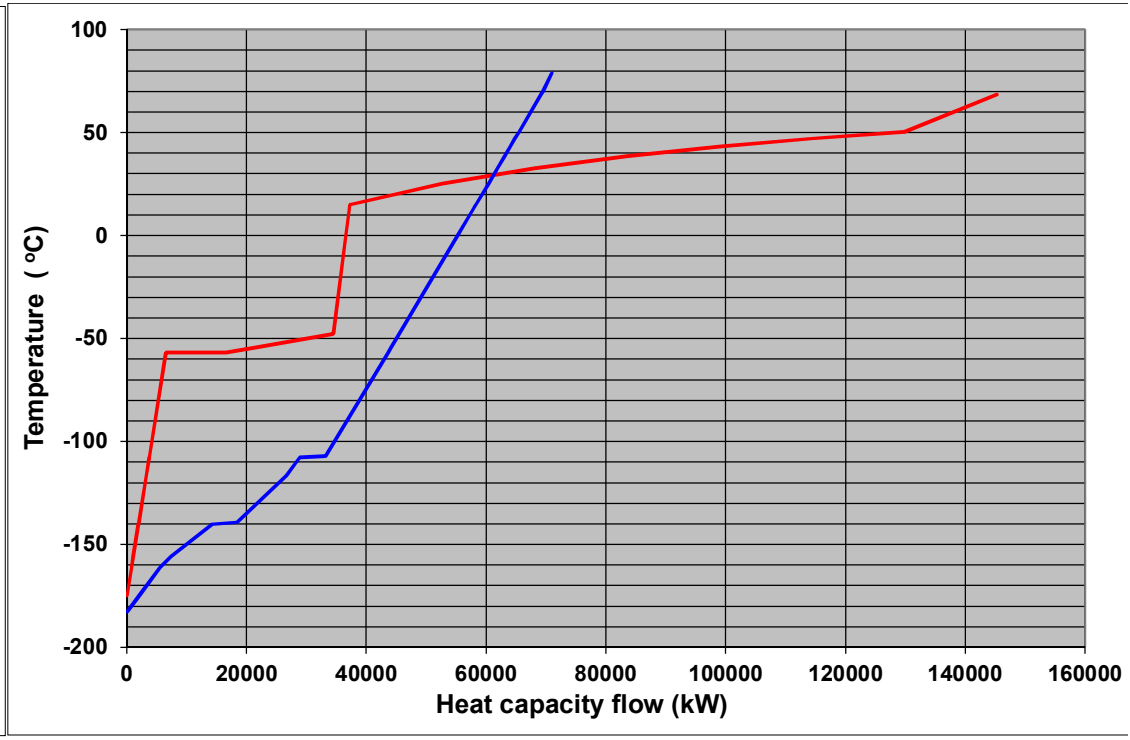
- Two alternatives have been compared
  - Cycle based on CH4
    - CO2 stored in solid form
    - O2 and CH4 in liquid form at ambient pressure
  - Cycle based on NH3
    - O2, N2 and NH3 stored in liquid form at ambient pressure
- Why NH3?
  - Heat of reaction lower than that of methanation

Pinch curves for G2P -case

NH3

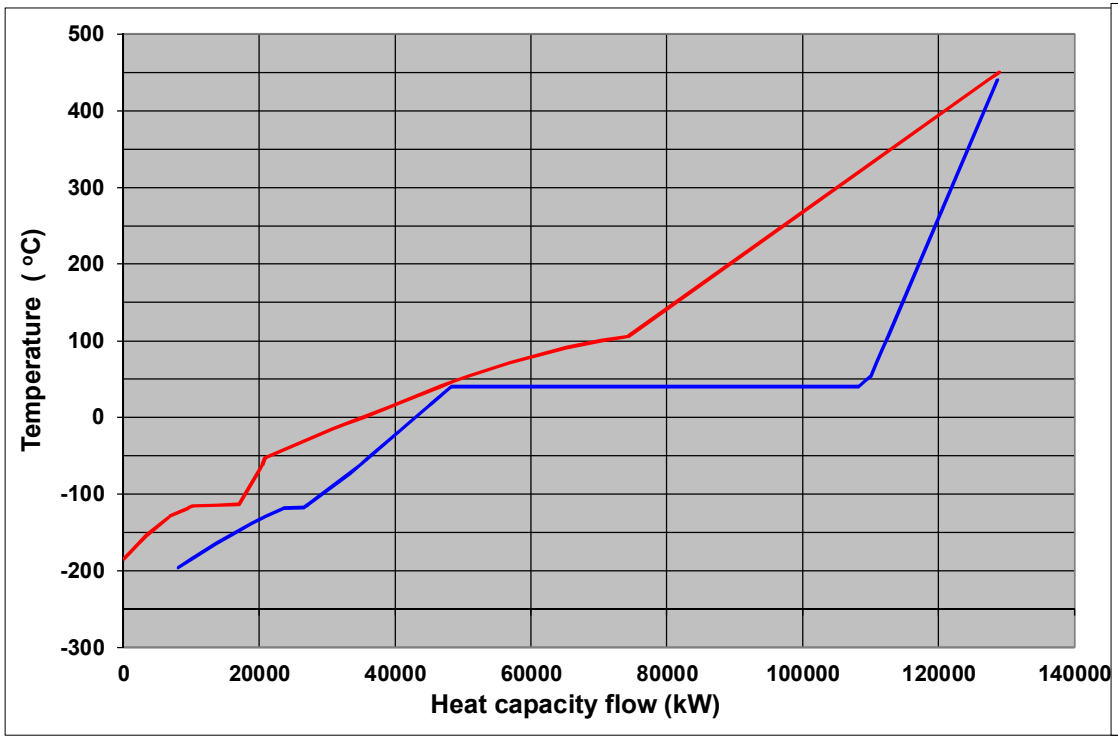


CH4



Pinch curves for P2G case

NH3



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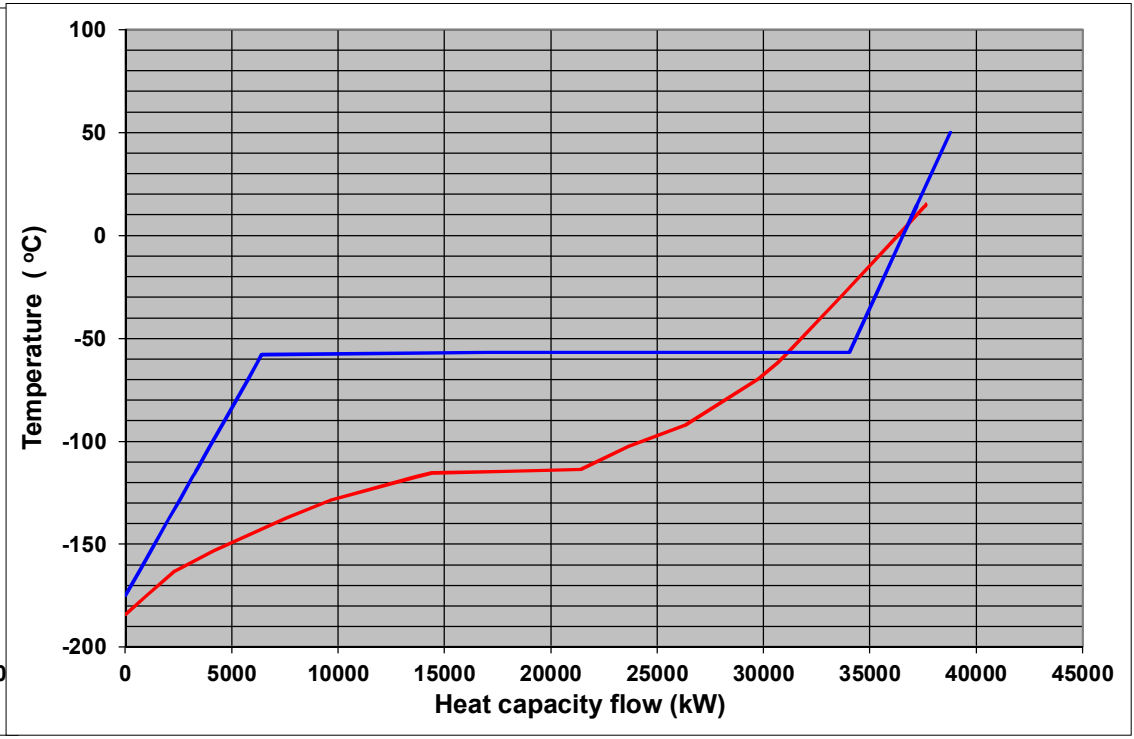

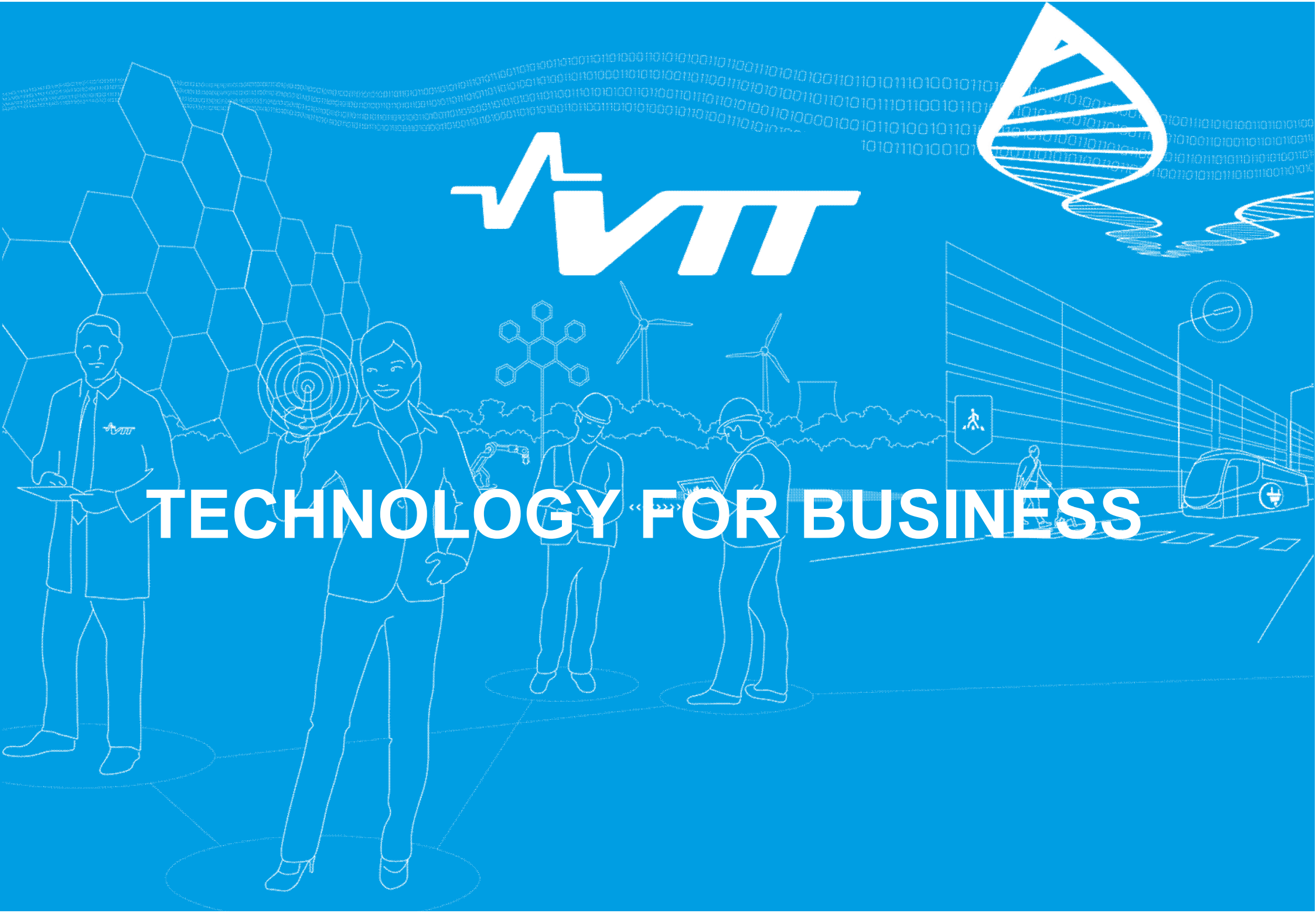
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