

Integration of energy storage devices in an industrial process plant

HighEFF Annual Consortium Meeting 2019

Arne Fredrik Lånke

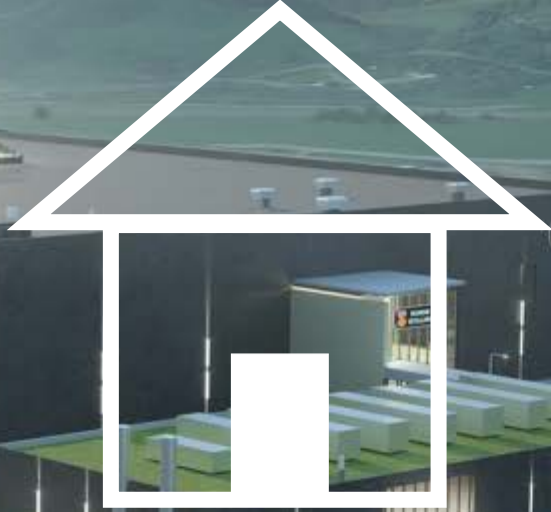


Energy concept



Energy concept

= 3000 x



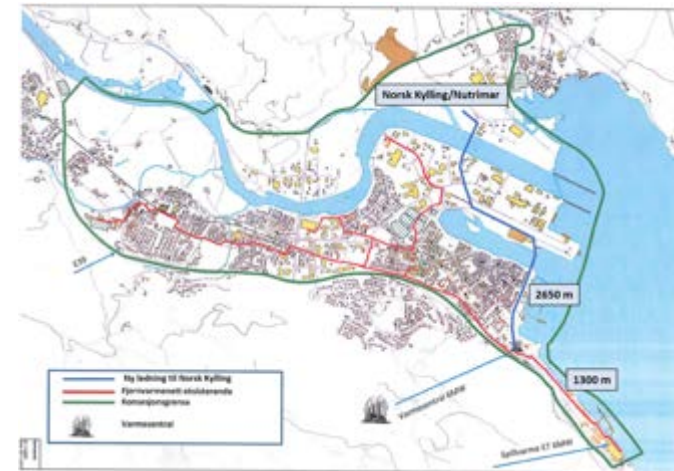
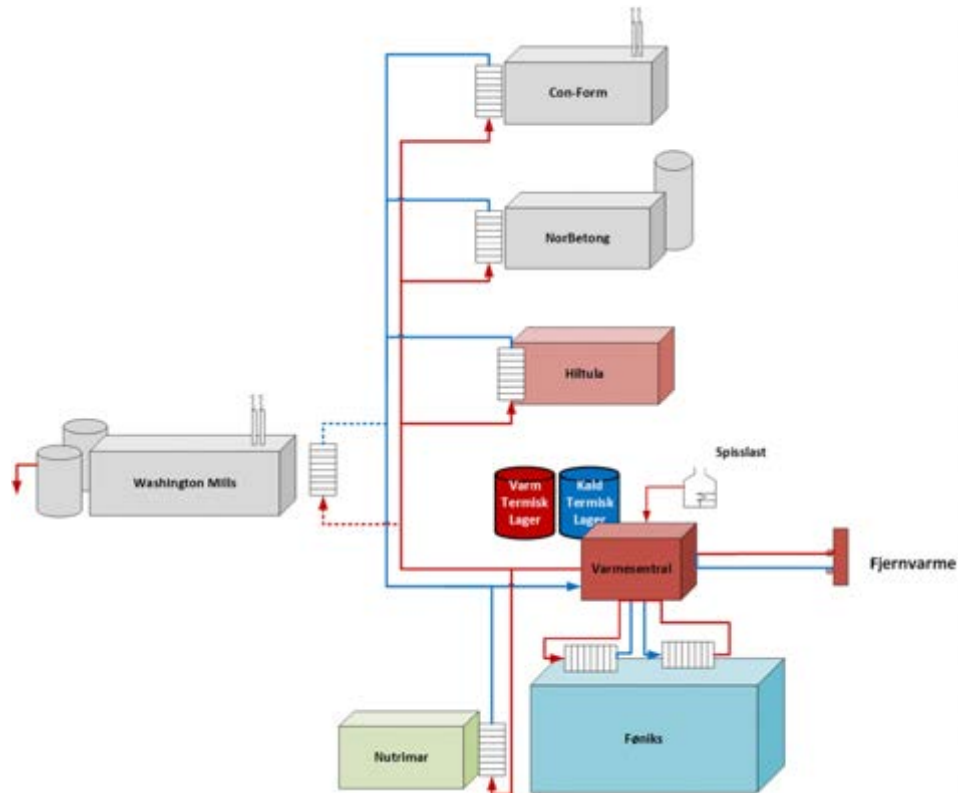
Energy concept

- Low carbon footprint
- Contribute to the neighbourhood
- Adapt to the energy system of the future
- Innovation and learning
- Efficient energy use
- Local energy sources
- Renewable energy



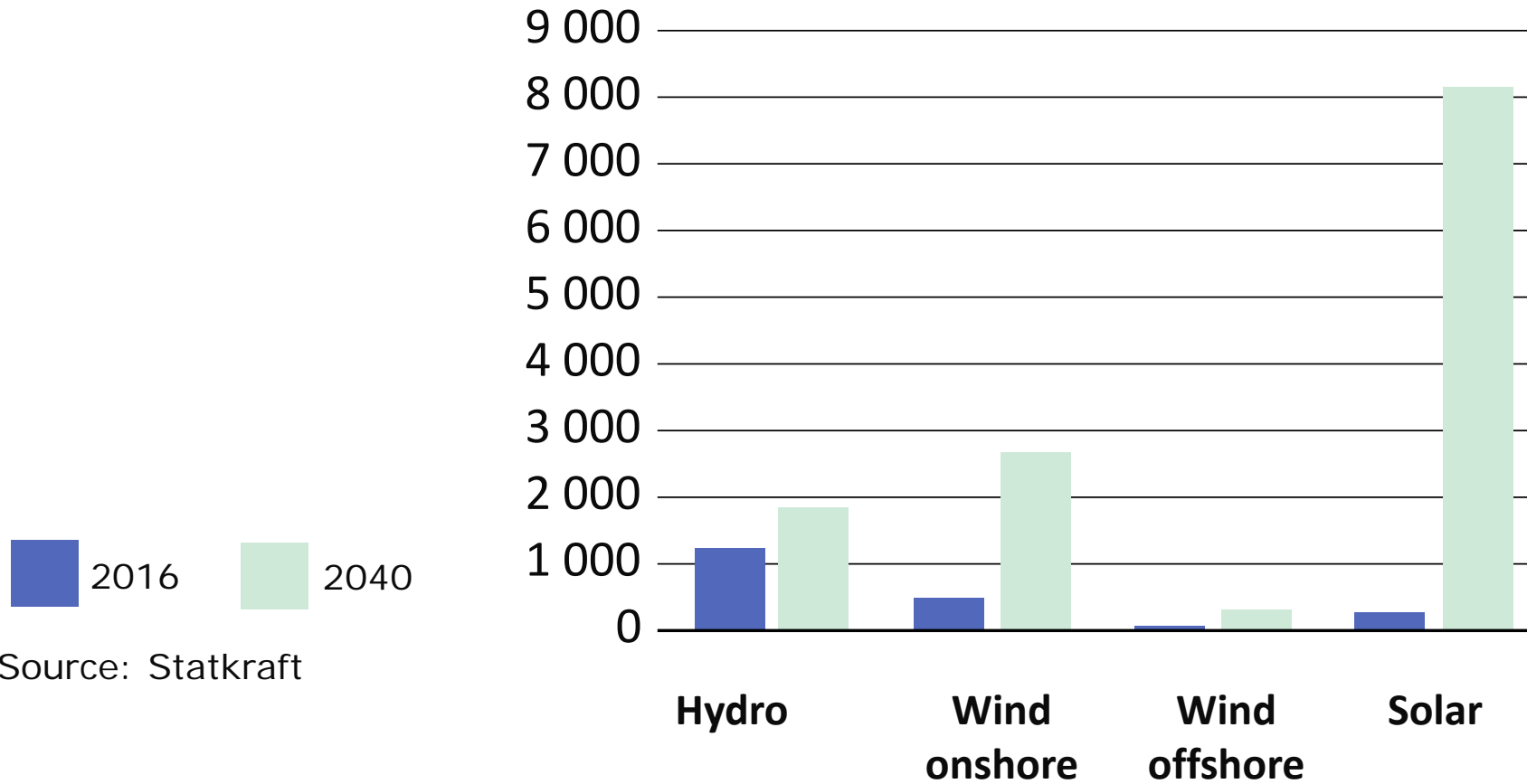
Energy efficiency and local energy sources

- Heat sharing - Concept study with neighbours, Enova and Sintef
- Surplus heat from existing industry at Elkem
- Enables new district heating to neighbours and surrounding areas
- Sea water cooling



Future of energy supply

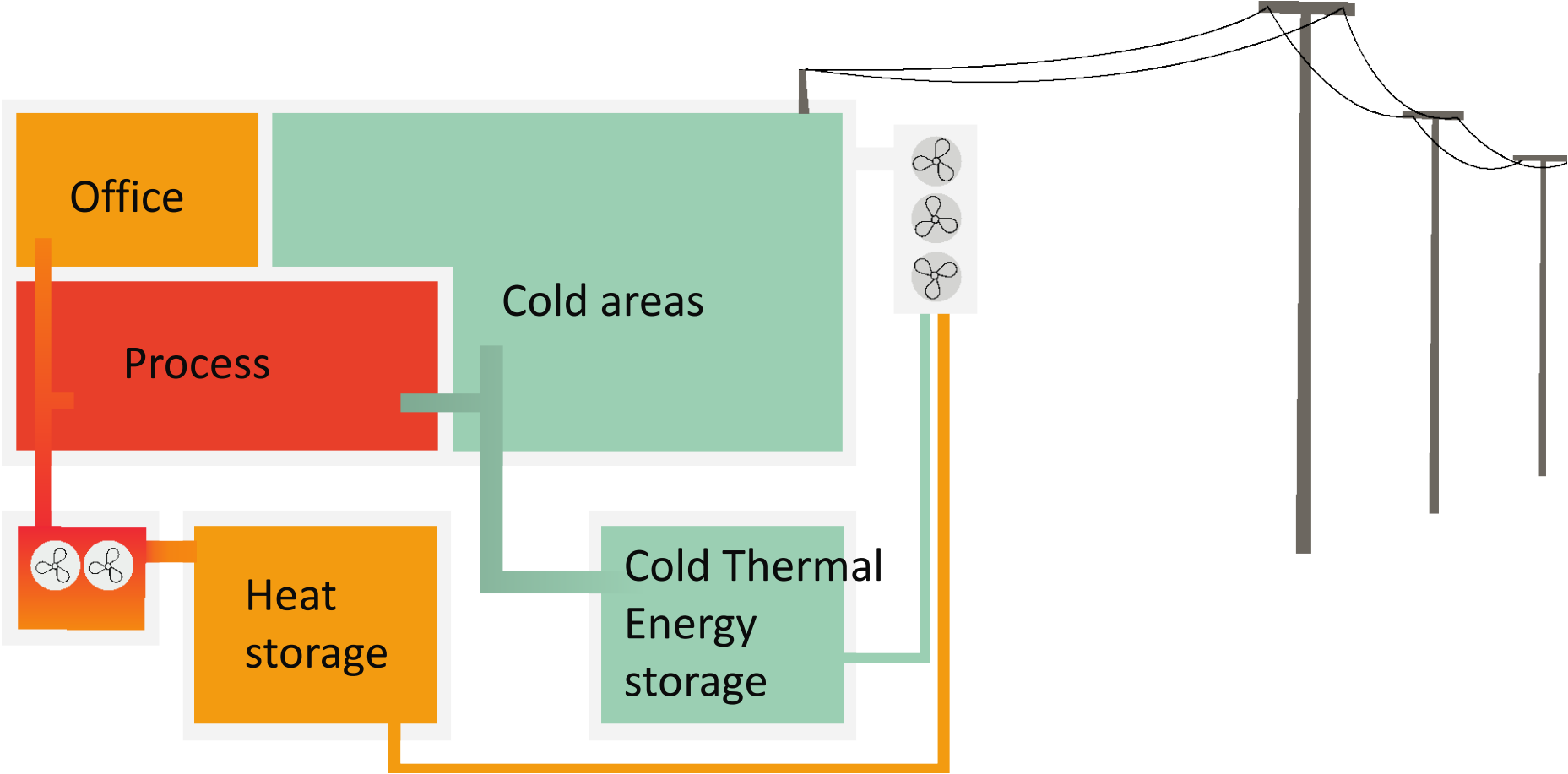
Renewables globally
GW



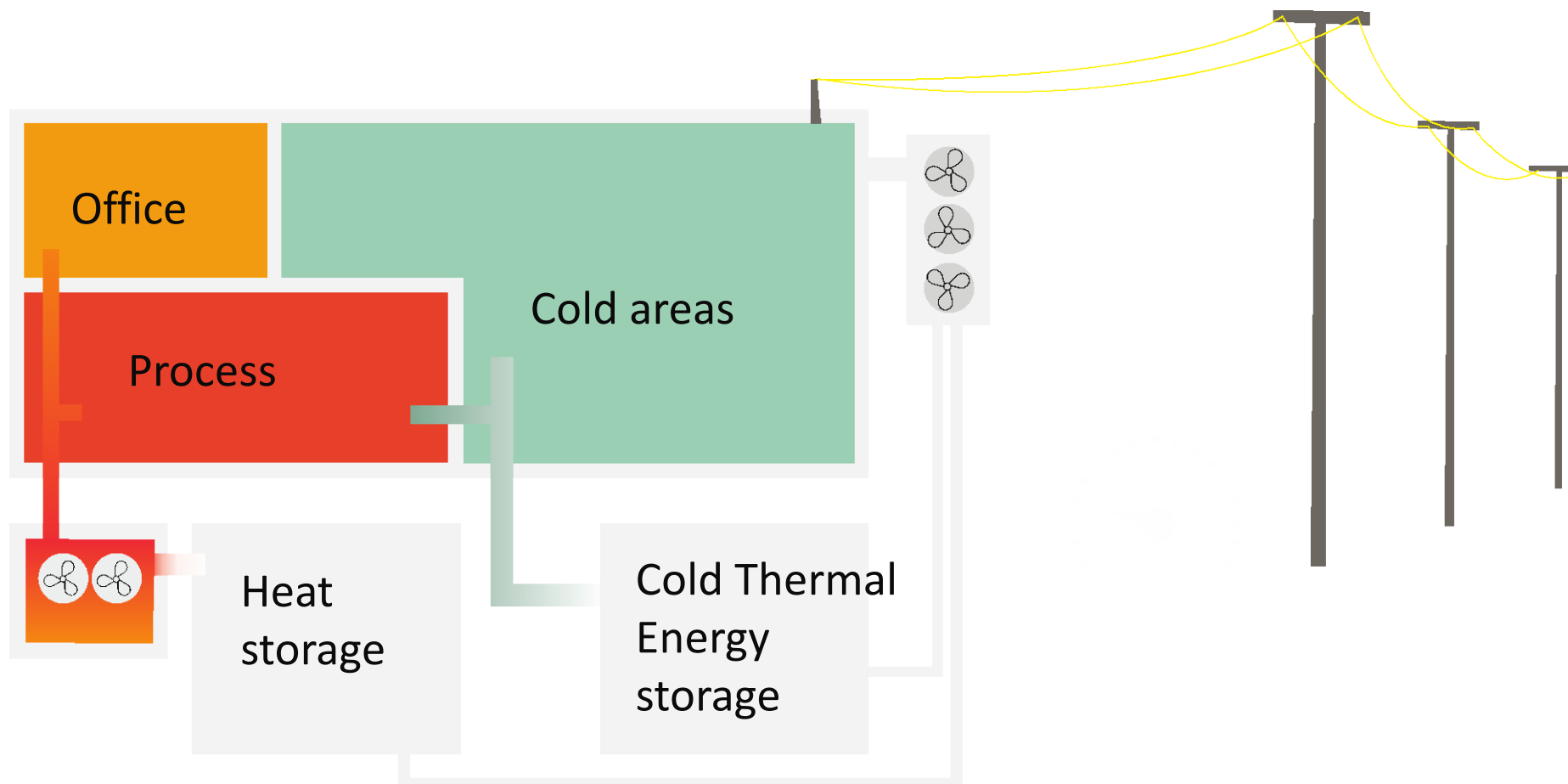
Source: Statkraft



Energy storage

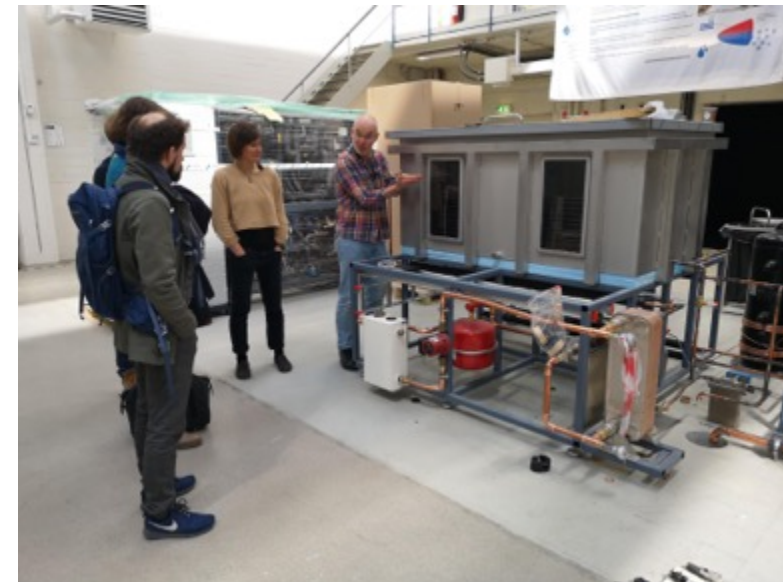


Energy storage



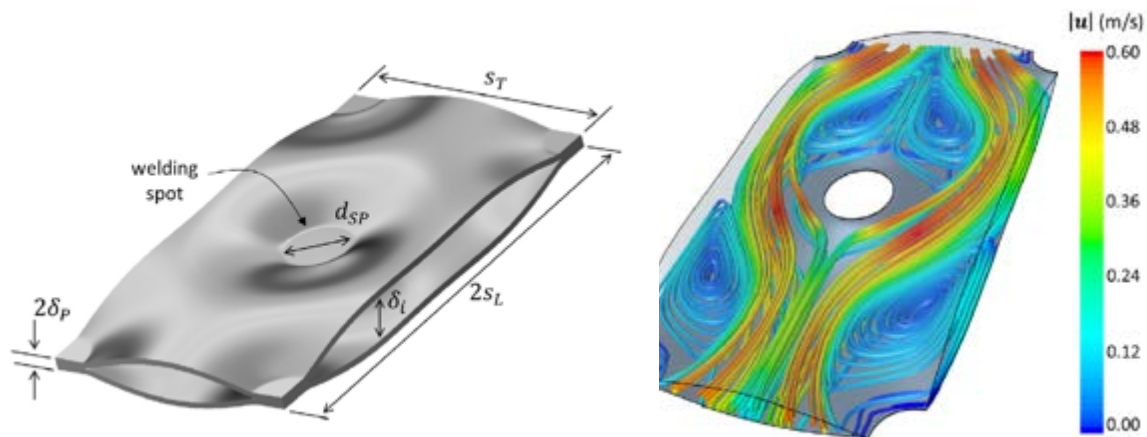
Energy storage

- Steam accumulators and hot water tanks
- Cold thermal energy storage (CTES) based on phase change materials
- CTES Pilot module in the lab at NTNU



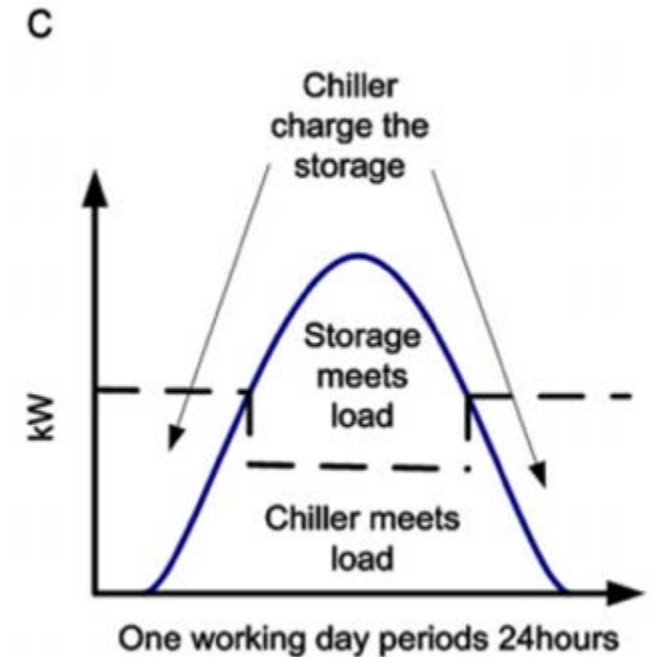
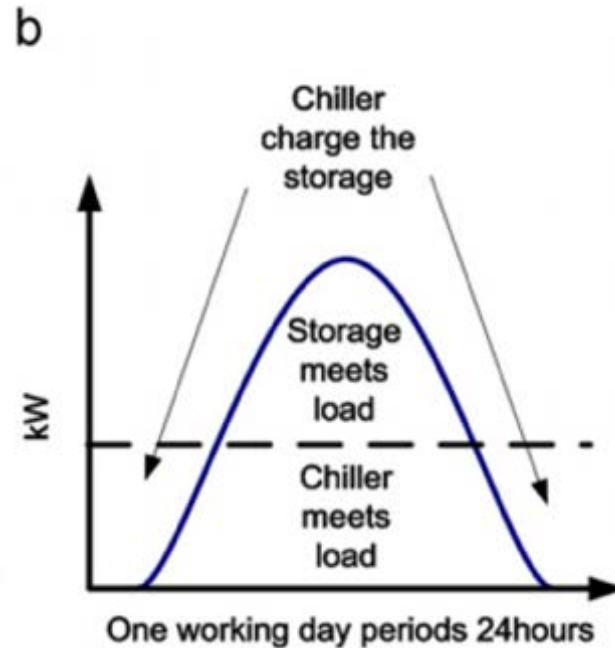
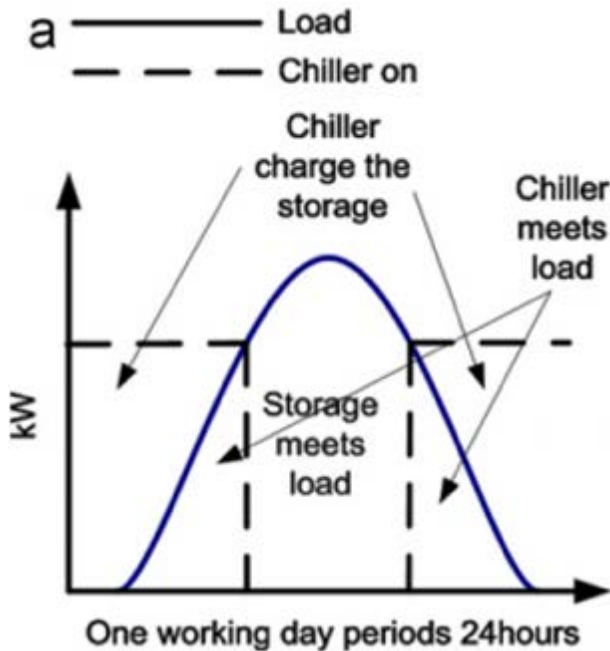
CTES Technology

- Developed by NTNU and Skala Fabrikk AS
- Directly integrated in CO₂ refrigerant circuit
- Pillow plate design
- Two metal sheets welded together and inflated with high pressure
- Creates flow channels
- Good refrigerant distribution and low velocities
- Phase change materials for storage between pillow plates
- >100 bar operating pressure possible



Operational strategies for load shifting with CTES

- a) Full storage
- b) Load-leveling partial storage
- c) Demand-limiting partial storage

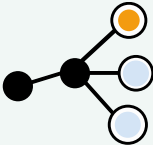
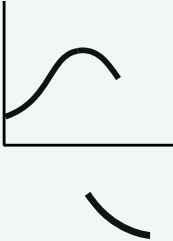


Energy management and AI

Weather
Hot weather coming up. Better prepare!

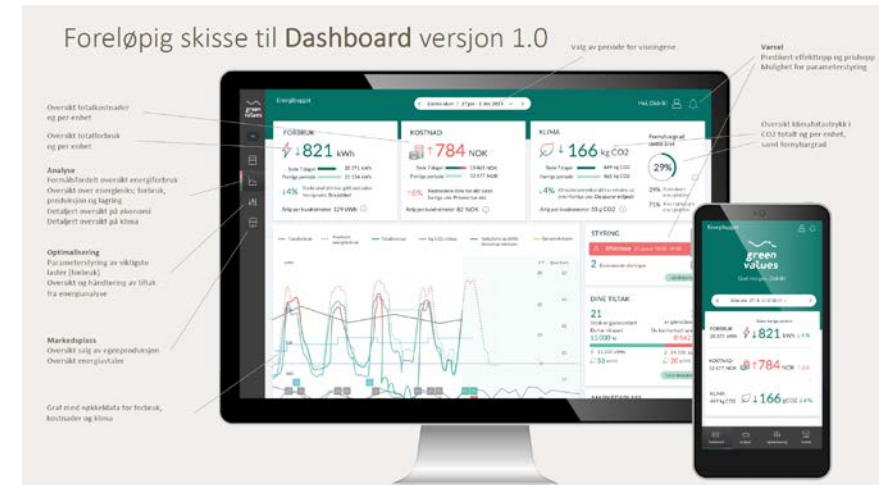
Power Price
Low prices on Sunday. Better store some energy.

Machine learning
What happened last year?



Energy management and AI

- Pilot-e supported project
- Norsk Kylling, TrønderEnergi and Green building Solutions
- Green Values
- First version installed at present factory
- 400 points of energy measurement
- Non Intrusive Appliance Load Monitoring (NIALM) for data collection
- 100 additional sensors from Disruptive Technologies





Factory of the future