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

<table>
<thead>
<tr>
<th>Year</th>
<th>Hydro</th>
<th>Wind onshore</th>
<th>Wind offshore</th>
<th>Solar</th>
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<tbody>
<tr>
<td>2016</td>
<td>1,000</td>
<td>2,000</td>
<td>500</td>
<td>500</td>
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<tr>
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<td>2,000</td>
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Source: Statkraft
Energy storage

Office

Process

Cold areas

Heat storage

Cold Thermal Energy storage
Energy storage

Office
Process
Heat storage
Cold areas
Cold Thermal 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 CO$_2$ 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