

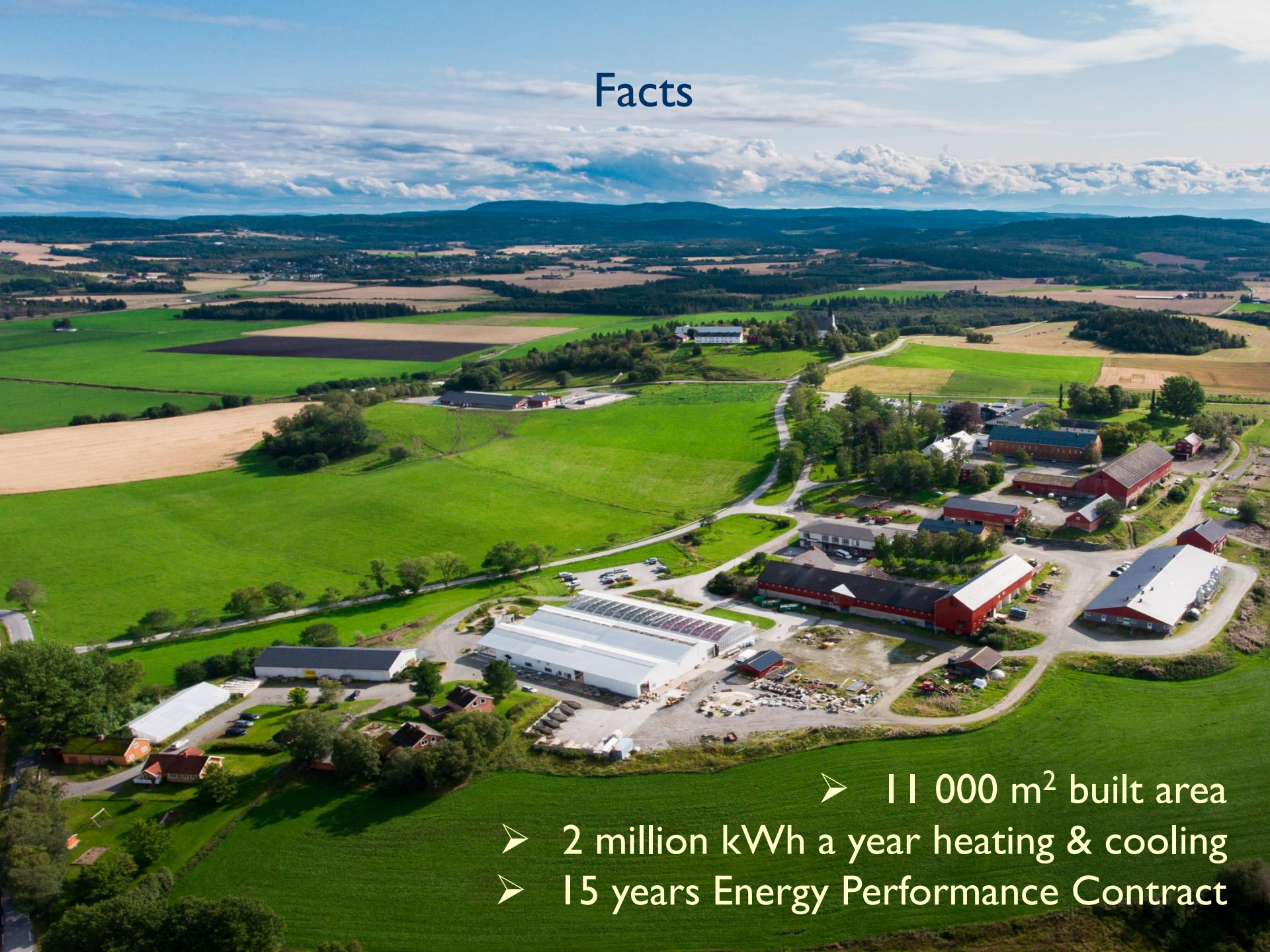
Practical Experience with Energy- and Climate Performance Contracts Towards Future Energy Efficiency Gains and Sustainability



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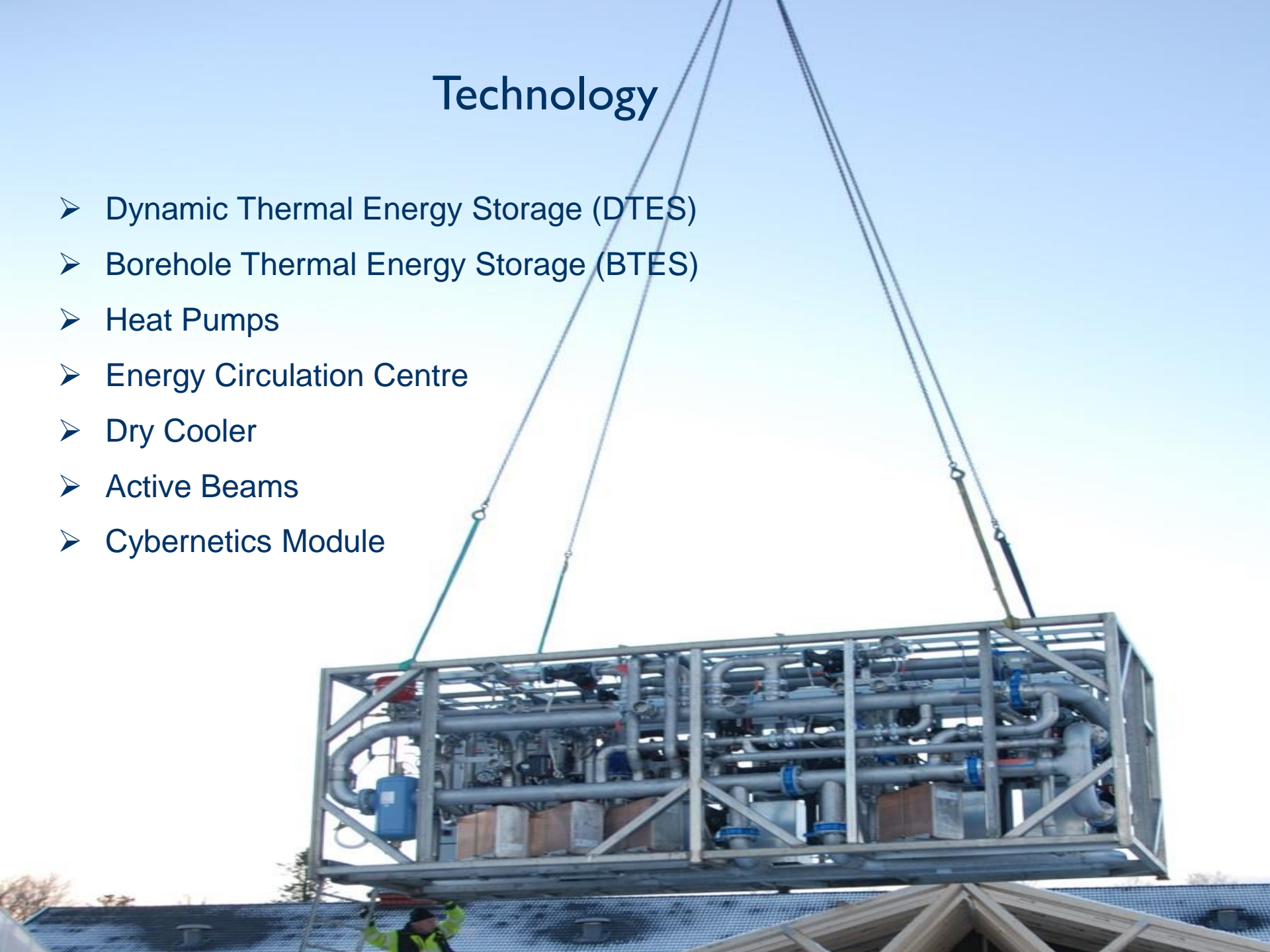
Facts



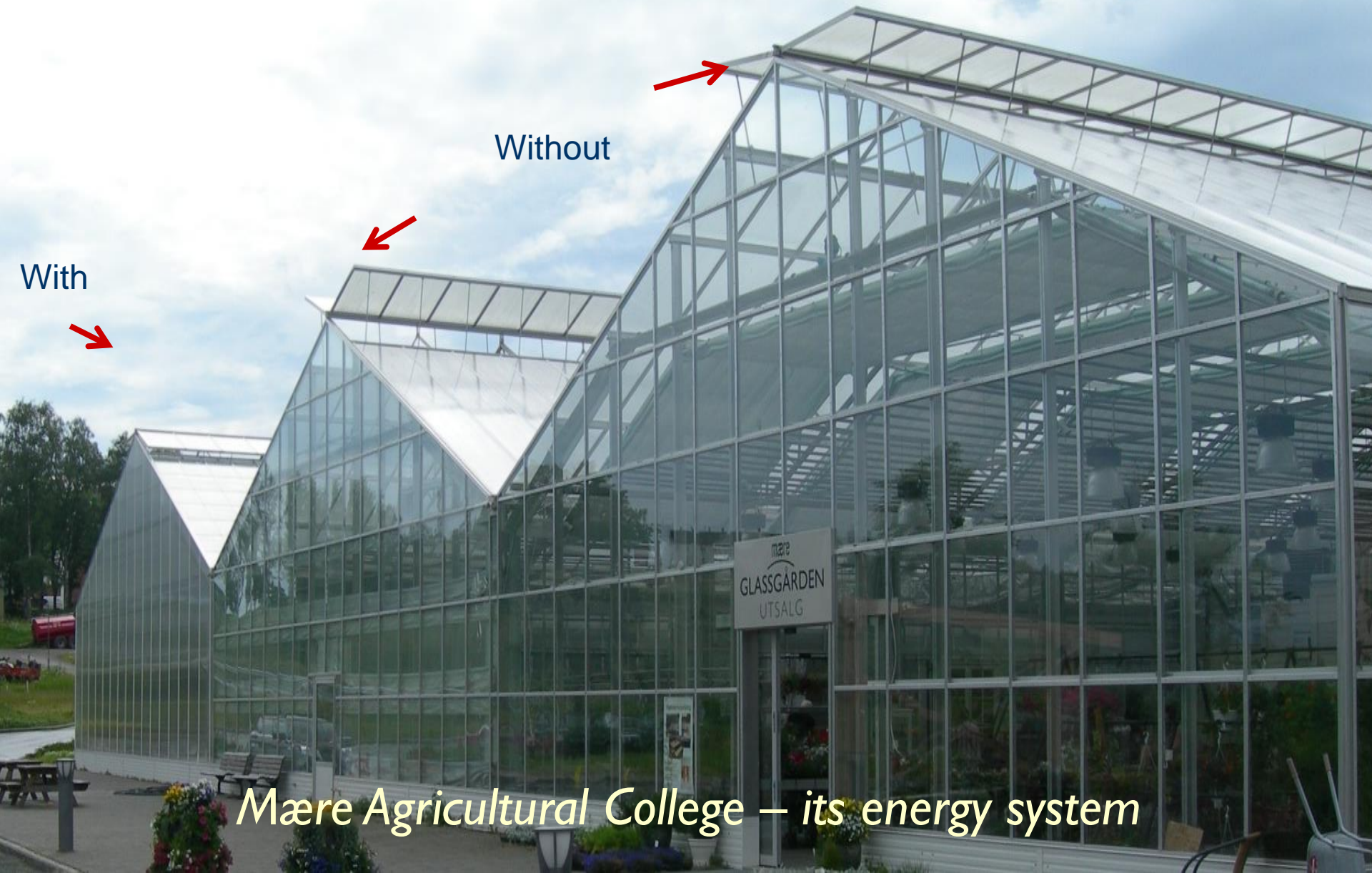
- 11 000 m² built area
- 2 million kWh a year heating & cooling
- 15 years Energy Performance Contract

Technology

- Dynamic Thermal Energy Storage (DTES)
- Borehole Thermal Energy Storage (BTES)
- Heat Pumps
- Energy Circulation Centre
- Dry Cooler
- Active Beams
- Cybernetics Module



Dynamic Thermal Energy Storage



Mære Agricultural College — its energy system

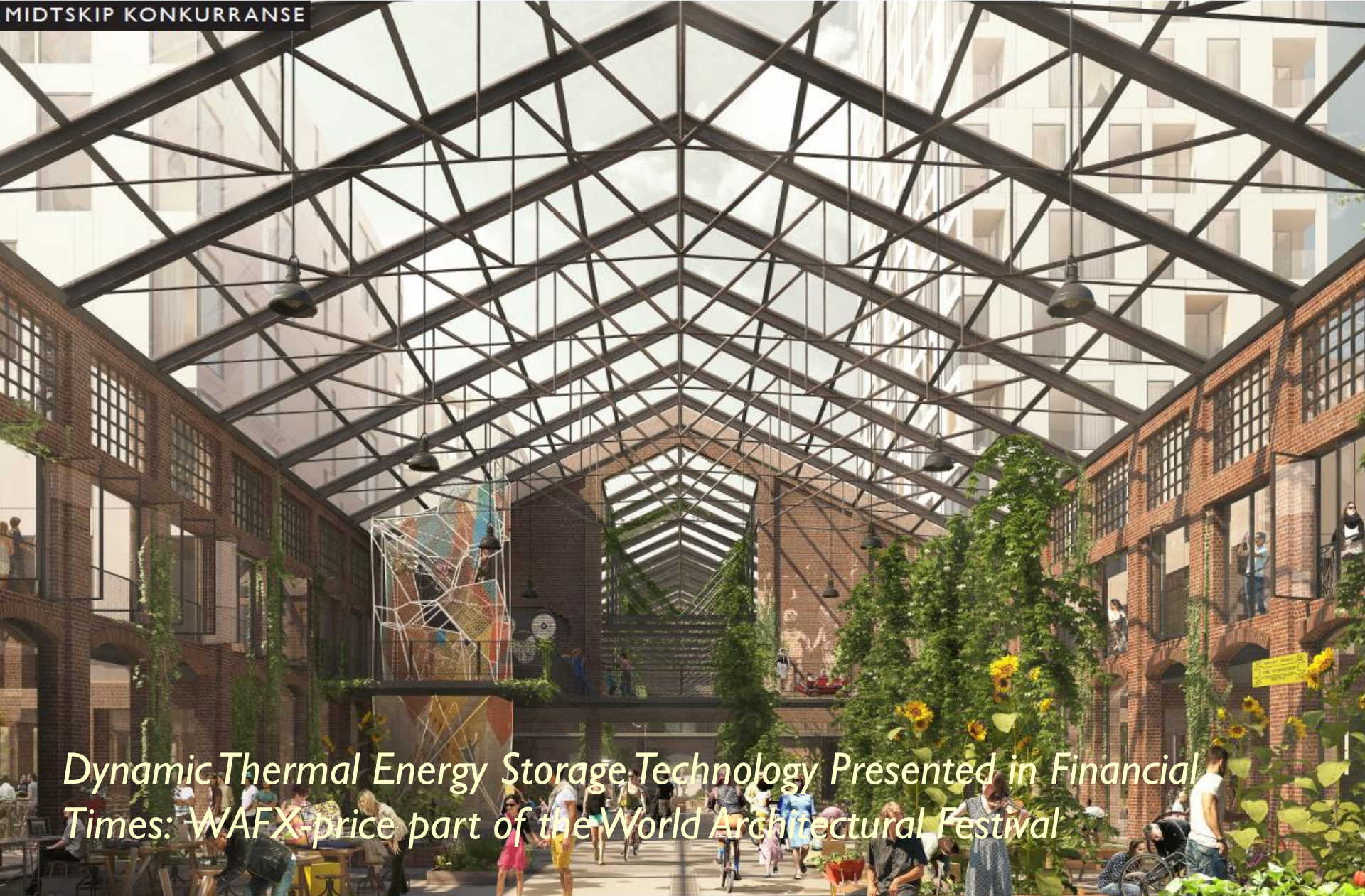
An architectural rendering of a large-scale greenhouse complex. The structure consists of several interconnected domes made of a white, triangular-patterned geodesic framework. The lower portion of the domes is clad in vertical wooden slats. Large, arched glass openings provide views into the interior, which are filled with lush green plants and trees. People are shown walking on a paved path and sitting on benches in the courtyard between the domes. The entire facility is surrounded by green lawns and mature trees.

Dynamic Thermal Energy Storage Planned in Large Scale Operation

Statsbygg – Greenhouse to the Botanical Garden at the University of Oslo

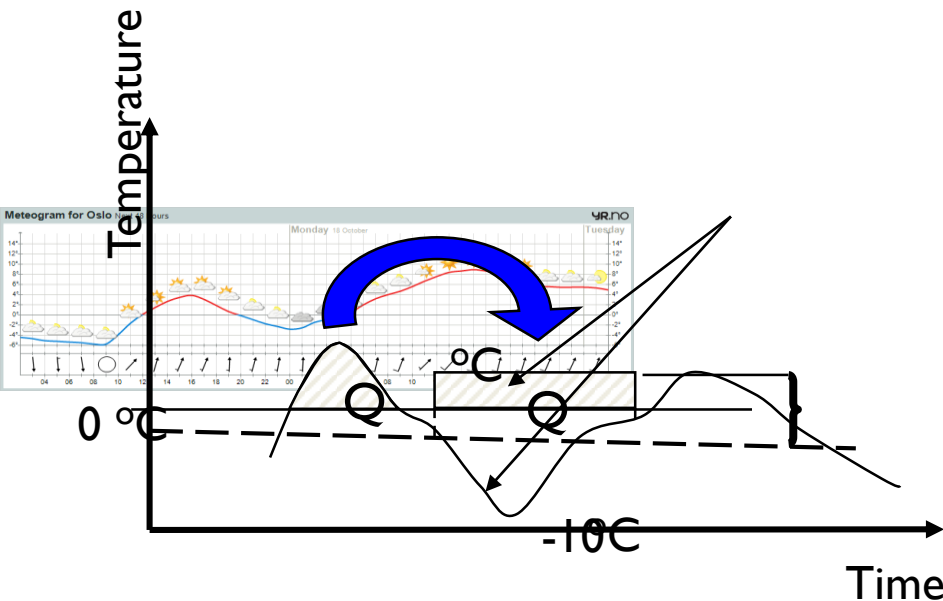
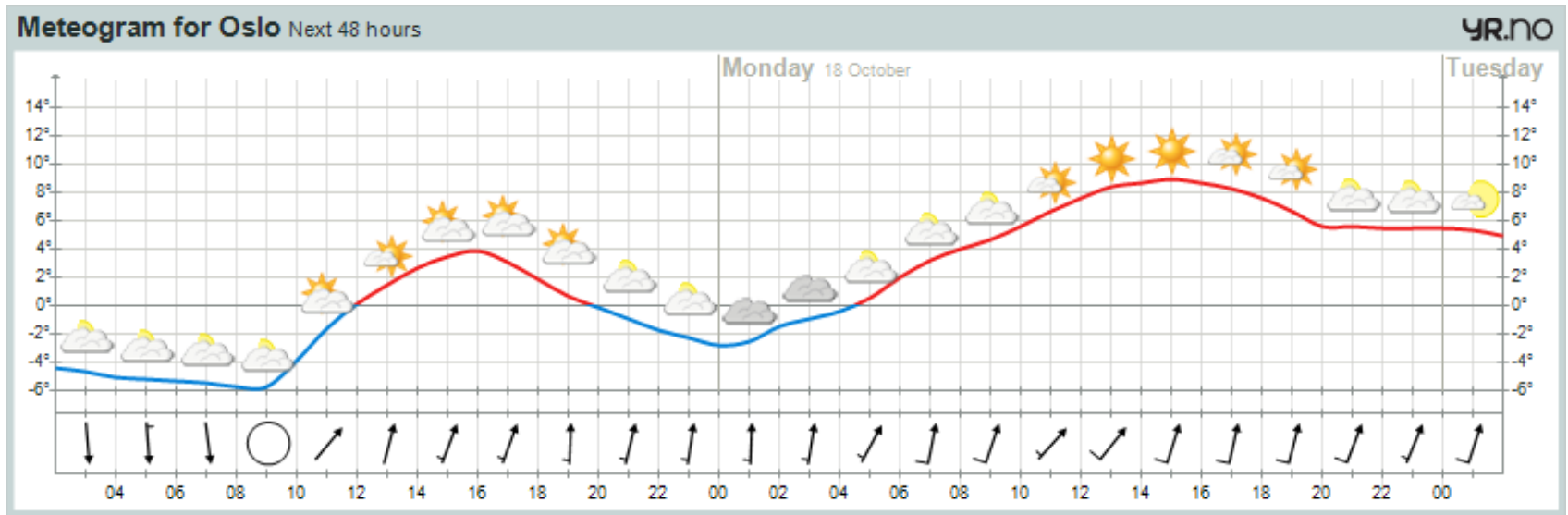
Dynamic Thermal Energy Storage Planned in Buildings

MIDTSKIP KONKURRANSE



Dynamic Thermal Energy Storage Technology Presented in Financial Times: WAFX-price part of the World Architectural Festival

Variation as a Renewable Source of Energy



- Fast response from a well-operating dynamic energy storage facility gives energy savings of some 70 – 85 per cent

Energy & Performance Contract (EPC/ESCO)

- Create a *decentralized*, sustainable production of heating and cooling, contributing to improved energy efficiency as well as improved productivity to the end-user.
- To supply solely sustainable energy. Buildings are lasting constructions. Important to allow harvest of most thermal energy, *not just “the low-hanging fruits”*.
- *Multiple value elements* are included in the agreement. Productivity, here as production of tomatoes, is measured.
- *Gains are shared*, divided in part on capital investments in the energy technology and by improvements attained.
- *Penalties (malus) are deliberately not imposed* in order to encourage further gains without the co-operators making reservations.

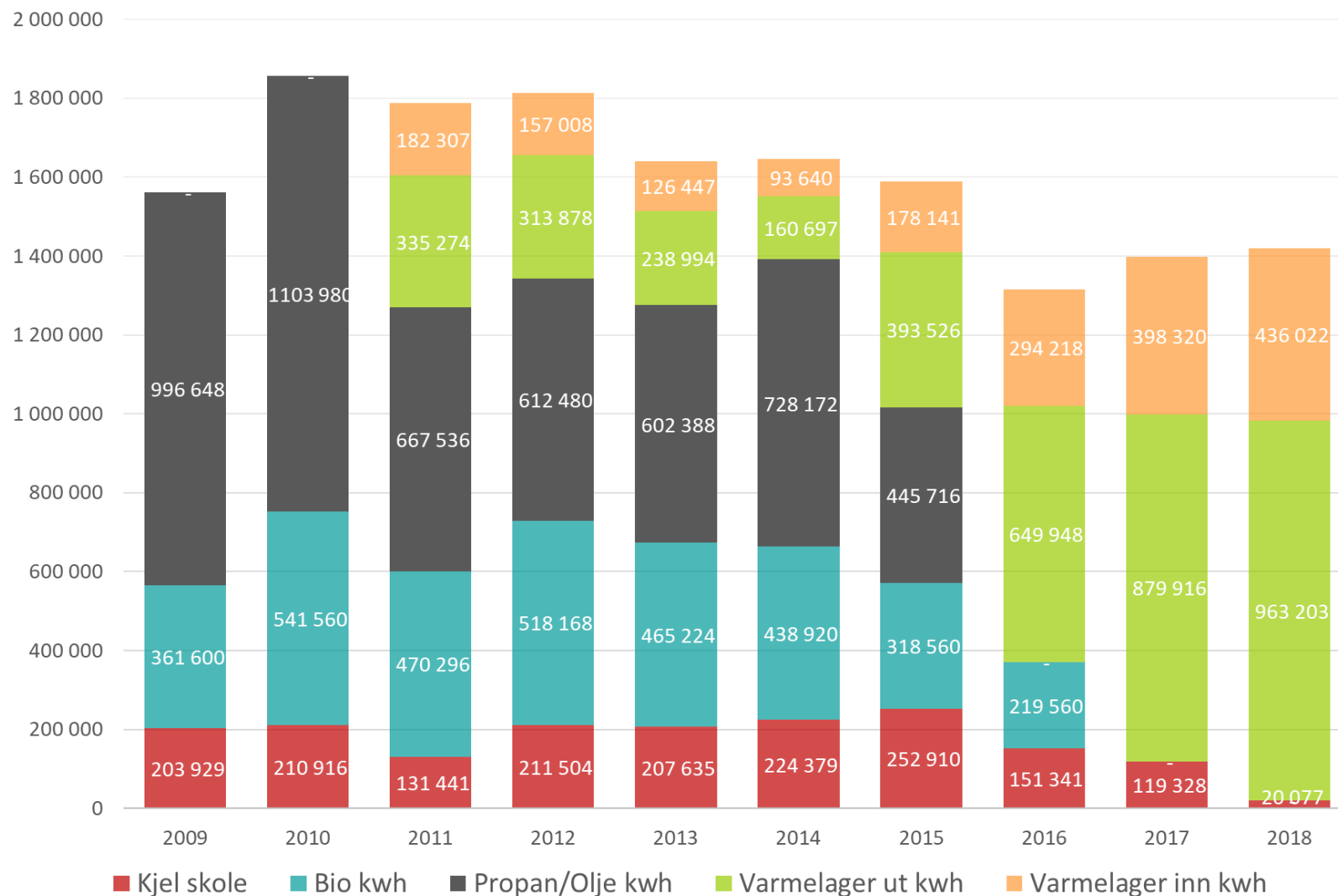
Performance at Mære Agricultural College

- Capital Investments: Interest 7 per cent (County) & 10 per cent (Firm). Amounts above €100 000 are equally shared.
- Production of tomatoes: Under 50 kg/m², all gains go to the Agricultural College. Amounts above 50 kg/m² are equally shared.

Not yet implemented:

- Temperature and CO₂ concentration limits (e.g. 20 – 26C & below 550 ppm), *gains to the firm if in accordance to the limits. Aim to reduce absenteeism related to indoor climate quality.*

Development in Heating at Mære



**Electrical
heater**

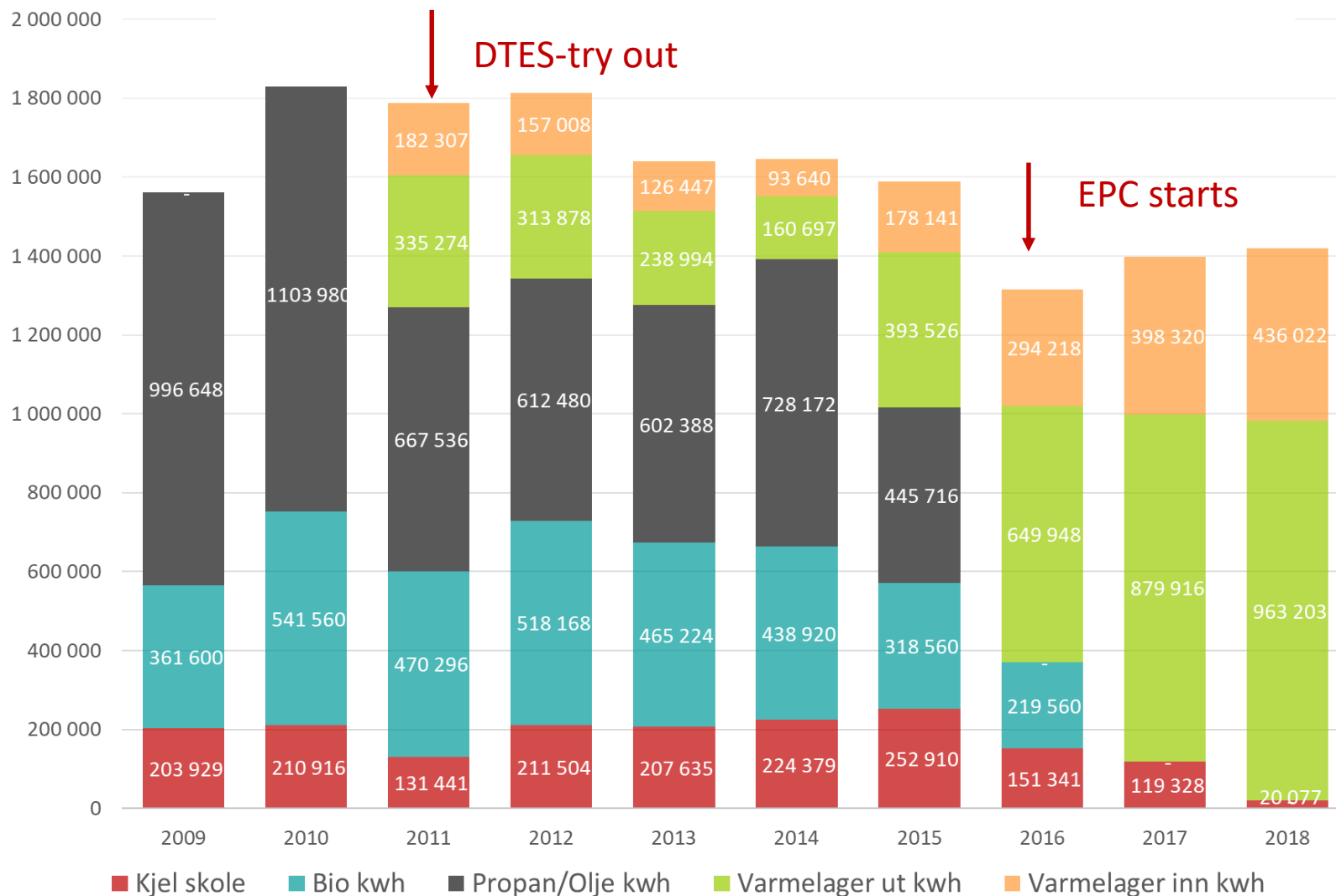
Bio energy

Propane/Oil

**DTES/BTES/
Heat pumps**

**Electricity to
heat pumps**

Development and Experiences at Mære



**Electrical
heater**

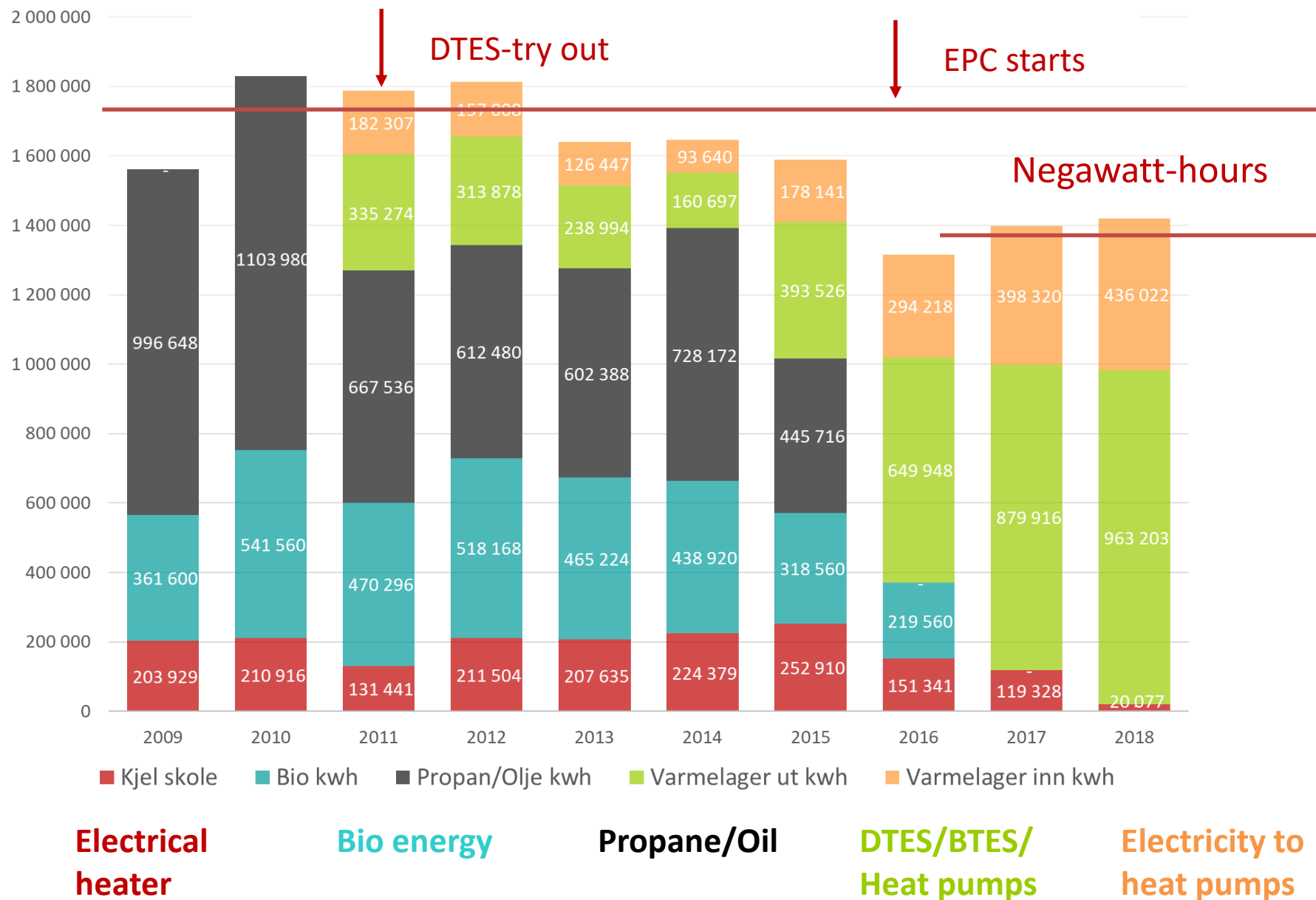
Bio energy

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Development of Negawatt-hours at Mære



Negawatts & Climate Performance

Not yet implemented:

- Negawatts – due to more precise control systems etc. reduced waste of heat occurs. These energy savings tend to be difficult to measure. To compensate reduced energy production we at present look into possibilities of introducing shared gains as energy savings occur from a prefixed level of consumption.
- Productivity gains could be related to climate benefits – such as shared gains if reduced emissions (e.g. fixed benefit €50 per ton CO2 reduction).

Energy efficiency first, but what next?

Conclusions:

- Long lasting contracts of cooperation provides gains that is difficult to estimate before cooperation starts. Energy – climate performance contracts (ECPC) opens for more gains in the long run.
- Negawatts arise from more precise control systems, but even more so as both parties over time gain by cooperation.
- Contracts without punishment and where both parties gains, fosters bravery.

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