“Heat Pump City of the Year Award 2019”

The Decarbindustry category

The Winner 2019: TINE Bergen.

“TINE's ambition is to be the best in sustainability within the Norwegian food industry. The combination of heating and cooling is a good starting point for finding good and energy-efficient solutions.”
TINE SA - In Brief

- Cooperative owned by Norwegian milk producers
- 31 dairies in Norway and 7 subsidiaries in six foreign countries.
- Main products: milk, cheese and other dairy products
- Annual turnover in 2018: NOK 23,5 Billion.
- Employees: 5355.
TINE Bergen: «The greenest dairy in Europe»

- “Modernizing the dairy industry”
- Worked to find the most modern solutions for energy use and the environment.
- All heat and cooling supplied by cooling machines and heat pumps in interaction.
- First dairy complete without fossil or direct electric heating.
- Consumption can be reduced by almost 5 GWh.
- 40% reduction in energy consumption or 59,605 kg CO₂.
- NOK 16.4 million in support from Enova.
- TINE is the winner of the Norwegian Heat Pump Award 2019.
Traditional Dairy – Separated Cooling/Heating

-1.5/+4°C

Chillers

- Compressors
- Rinse Milk Cooler
- Pasteurs

Snow Melting
- Dry Cooler
- Pre-Heating Water

Fossil Fueled Boiler/Steam 100/120°C

- Building Heat
- Hot Water

CIP, Pasteur and other high temp. needs

Space/product cooling and other needs

HybridEnergy
TINE Bergen – Integrated Energy Recovery Using Heat Pumps

-1.5/+4°C

Chillers
- 20/40°C tank
- Snow Melting
- Dry Cooler
- Pre-Heating Water

NH₃ Heat Pumps
- 60/67°C tank
- Building Heat
- Hot Water

Hybrid Heat Pump (GreenPAC)
- 73/95°C tank
- El. boiler

Compressors
- Rinse Milk Cooler
- Pasteurs

Space/product cooling and other needs

CIP, Pasteur and other high temp. needs

District Heating

TINE Bergen – Integrated Energy Recovery Using Heat Pumps

Using Heat Pumps

Space/product cooling and other needs
TINE Bergen – Technical Details

System:
• Max. capacity of Hybrid Heat Pump: 940 kW, COP 5,4.
• Max. capacity of NH₃ Heat Pumps 1 & 2: 1577 kW
• Max. capacity of Chiller plant (3 Chillers): 2400 kW

Thermal Storage:
• 95°C: 130 m³
• 67°C: 130 m³
• 40°C: 130 m³
• 20°C: 130 m³
• 1.5°C: 60 m³
• 0.5°C: 60 m³
TINE Bergen – Key Success Factors

- Research projects like HighEff/HeatUp
- State Aid by ENOVA
- Research partners like SINTEF
- Suppliers and cooperative partners like:
  - Sweco and AF Group consultants and building contractors
  - Hybrid Energy AS. Delivery of Hybrid Heat pump, Heat pumps and Refrigerant plant including control systems.
  - Johnson Controls AS and Sabroe. Manufacturing of Components for Energy Central.

The solutions are based on conventional knowledge, but the overall composition ensures that the project goes beyond the best available technology.
TINE Bergen – Photos

The Hybrid Heat Pump Skid
TINE Bergen – Photos

The Hybrid Heat Pump HMI
Hybrid Energy AS

• Emerged from Institute for Energy Technology (IFE) in Norway
• Founded in 2004
• Commissioned plants in dairies, abattoirs, fish feed producers, biogas production plants, district heating, process industries

• 17 High Temperature Heat Pump systems commissioned.
• Proven technology with over 500,000 operational hours
What is a Hybrid Heat Pump?

• Natural working medium (50/50 water and ammonia)
• Can deliver 120 °C at low pressure
• Yields exceptional COP’s, especially with large glides (Δt’s) on hot and cold side
• Uses Standard refrigeration equipment
• Offers unique flexibility after commissioning
A hybrid heat pump has the same five components as a regular ammonia heat pump:
- condenser
- receiver
- expansion valve
- evaporator
- compressor

However, as the working medium in a hybrid heat pump is ammonia AND water (50/50% mass basis), so the water will not evaporate in the evaporator/desorber.

The level in the HP tank influences the practical mixture ratio in the process. This enables you to adjust temperature levels on hot and cold side during operation.

Heat is released through condensation AND absorption (Hence the name «Hybrid»)

A solution pump is added to pressurize and pump the solution to the mixing point in the absorber/condenser.

The mass flow ratio between the solution pump and the compressor is defined as the «circulation number». It defines the glide (Δt) in the absorber and desorber.

During operation, the circulation number is continually adjusted automatically, optimizing COP.

A separation tank is added to separate gas (about 98% ammonia) and solution (about 35% ammonia).
The Hybrid Heat Pump Family

1. The GreenPAC
2. The HyPAC-R
3. The HyPAC-S

Designed for dairy purposes
The GreenPAC

**Typical applications:**
- Washing
- Pasteurization
- CIP
- Process heat
- General heating

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<td>Output Temperature:</td>
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<td>Output Effect Range:</td>
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<tr>
<td>COP:</td>
<td>5-8</td>
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The HyPAC-R

Typical applications:
• Pressurized water circuits
• Boiler replacement
• Pasteurization
• CIP
• Process heat
• General heating

<table>
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<tr>
<th>Source Temperature:</th>
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<tr>
<td>Output Temperature:</td>
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<td>Output Effect Range:</td>
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<td>COP:</td>
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Speaker Mr. Richard Horntvedt, Hybrid Energy AS.

Questions will be addressed after the four presentations.

Thank You!