



**22ND GCCA EUROPEAN
COLD CHAIN CONFERENCE**
20-22 MARCH 2019 | BRUSSELS

Energy management in a large scale
warehouse with CO₂

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Presented by



**GLOBAL COLD CHAIN
ALLIANCE®**



PRESENTATION CONTENT

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BUILDING BASE INFORMATION

- **Total area ~62 000m² (+15 000 extension)**
- **Total volume +1 000 000 m³**
- **Temperature controlled area ~29 000m²**
- **Height approx. 22m**
- **MT area ~24 000m²**
- **MT capacity 2400kW**
- **Freezing area ~5000m²**
- **LT capacity 740kW**

OBJECTIVES OF THE PROJECT

The owner's high goals for energy efficiency

The opportunity to explore and evaluate the most energy efficient solutions in design phase

Combining the functions of all building technology equipment together

Utilizing the property's location in system design

Determining, verifying and monitoring energy consumption at the planning stage and in the end-use situation

THINGS TO IMPROVE ENERGY EFFICIENCY

- **1000m³ Sprinkler water tank as a energy buffer for heating at winter time and after cooler at summer time**
- **500kWp electric solar panel field**
- **Demand response based electrical grid attached to whole building**
- **Electric battery (1552kWh) connected to main electrical grid used with demand response option**
- **Active refrigeration heat recovery system**
- **Dimensioning of heating networks designed to work together with properties of CO₂**
- **Two-way heat sales system with district heating company**
- **Weather and property usage prediction to control setpoints of the property. Works as a "peak shaving" system**

REFRIGERANT SELECTION

- 1. The owner was based on natural refrigerants.**
- 2. Owner have got bad experiences about refrigerant legislation changes in past**
- 3. a system with a life span of 20 years must contain a refrigerant that is not subject to restrictions on refrigerant legislation. Only options to compare were ammonia and CO2.**
- 4. Location caused restrictions with the use of ammonia**
 - residential areas very close, causing problems with the residents of the area and inspections by the laws**

REFRIGERANT SELECTION

- 4. Price difference for Ammonia / CO2 cascade freezing units + ammonia chillers and complete CO2 system ~+20% by the requests we did to compare risks and difficulties**
- 5. Payback time with whole energy system is near 5 years with CO2 system**
- 6. In this building and in this location standard CO2 system has better EER below +10 compared to ammonia system. Extra subcooling option and integrated system increased efficiency to be higher over the whole year.**

REFRIGERANT SELECTION

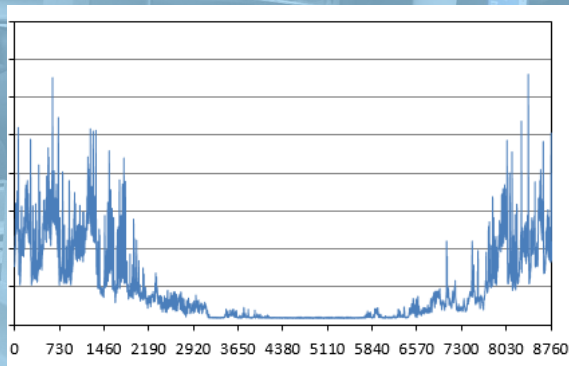
5. Selection was made also by the spare part prices and availability
 - Basically almost all common parts are more or less same as in supermarket racks
7. CO2 as a refrigerant makes 2-way district heating contract to be possible by the high temperature output from heat recovery
8. CO2 made adjustable heat recovery to be possible
9. All features added around system made Bream Excellent certificate to be possible quite easily → Increasing value of a building

CALCULATION OF ENERGY CONSUMPTION

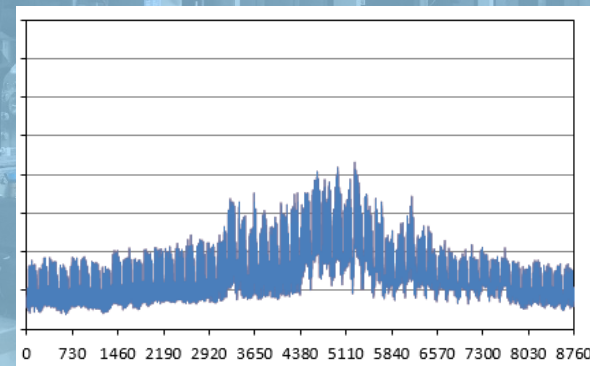
Hourly based calculation for energy consumption with calculated heat recovery yield

All heating and cooling networks have been calculated separately.

The needs for heating and cooling have been assessed and efforts have been made to arrange energy revenues and consumption for the same time.



Heating demand



Cooling demand

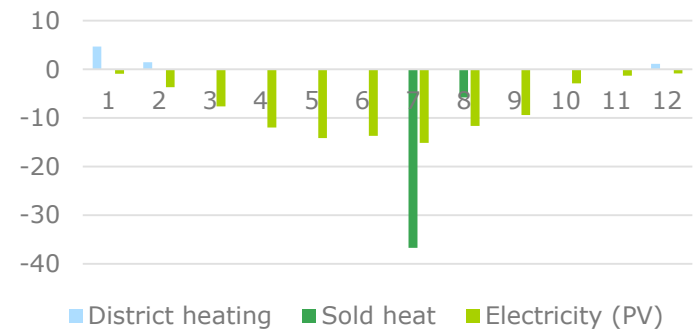
PROJECT SITUATION AND RESULTS

- **Building is on use with 70% of maximum capacity**
- **Some of options have not been started completely**
- **For now without heat pump option, we have been able to operate the system without additional energy to -5°C**
- **System have been stable and have worked without special problems after turn on period**
- **In our opinion, large freezing stores should be implemented more often with pump circulated wet evaporator system**

A SUMMARY OF THE PROPERTY'S EMISSIONS

- Estimation of CO2 emissions by the realistic calculations shows that property is negative CO2 emission producer when all features are on use
- Property reduces emissions of district heating network 30tkg/a
- Property uses emission free electricity by the wind and water
- Cost reducing is +20% compared normal logistic center without energy efficiency extras. With demand response of electricity network calculated total reduce is near 70%.

Montly emissions (CO2 tkg)



"For our energy efficient warehouse in Järvenpää, CO2 system was chosen due to its benefits on overall energy efficiency and its environmental friendly qualities to support our goals"

Kalle Hintikka, Project leader of Logistic center LIDL Järvenpää



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QUESTIONS?



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THANK YOU!



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