

How to use cooling to avoid peak-load

Tommie Månsson, PhD Candidate from Chalmers University of Technology

Utilizing the refrigeration system in supermarkets for demand side management

Tommie Månsson, PhD Candidate from Chalmers University of Technology

Energy generation



Supermarket



Technology



Concluding remarks



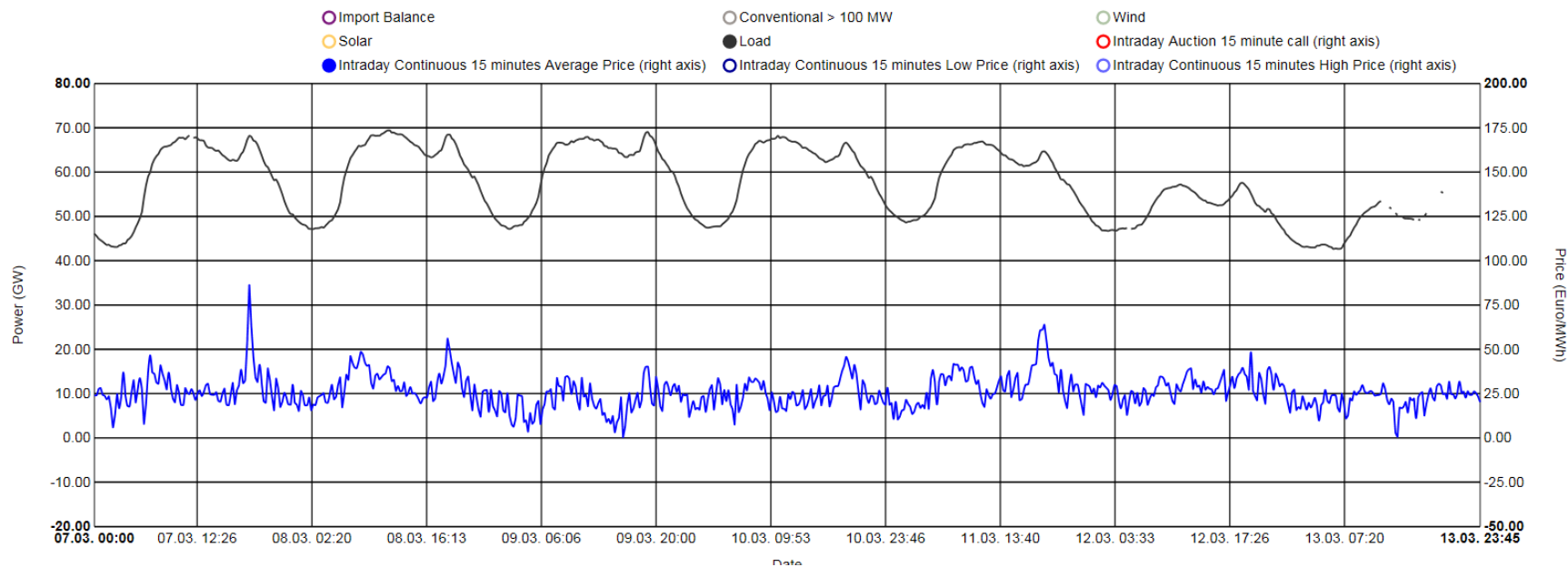
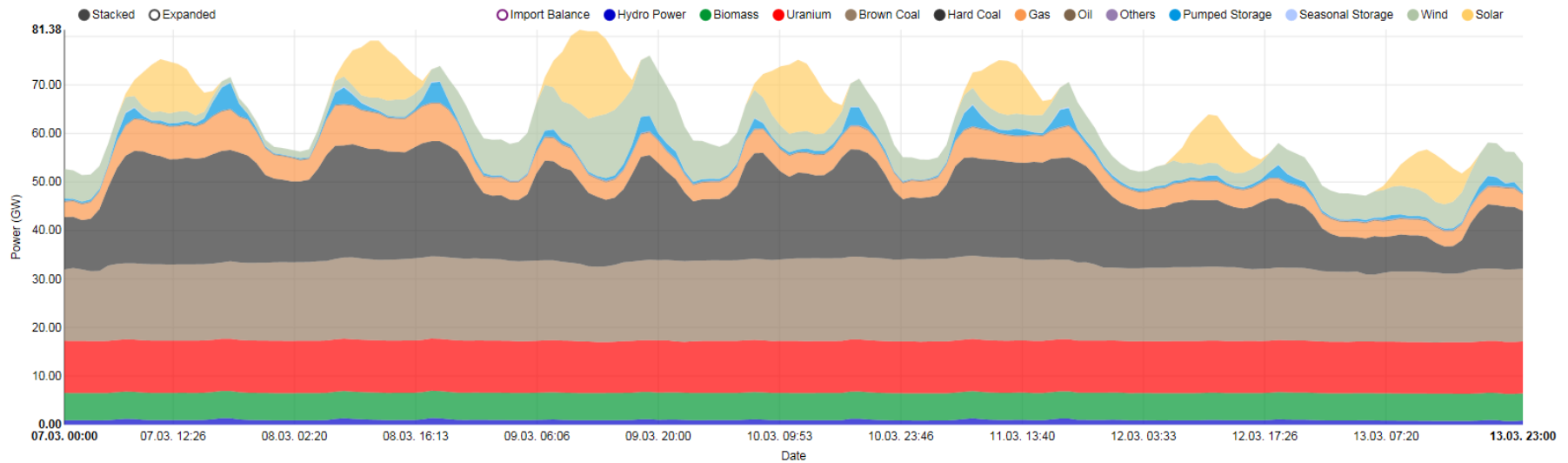
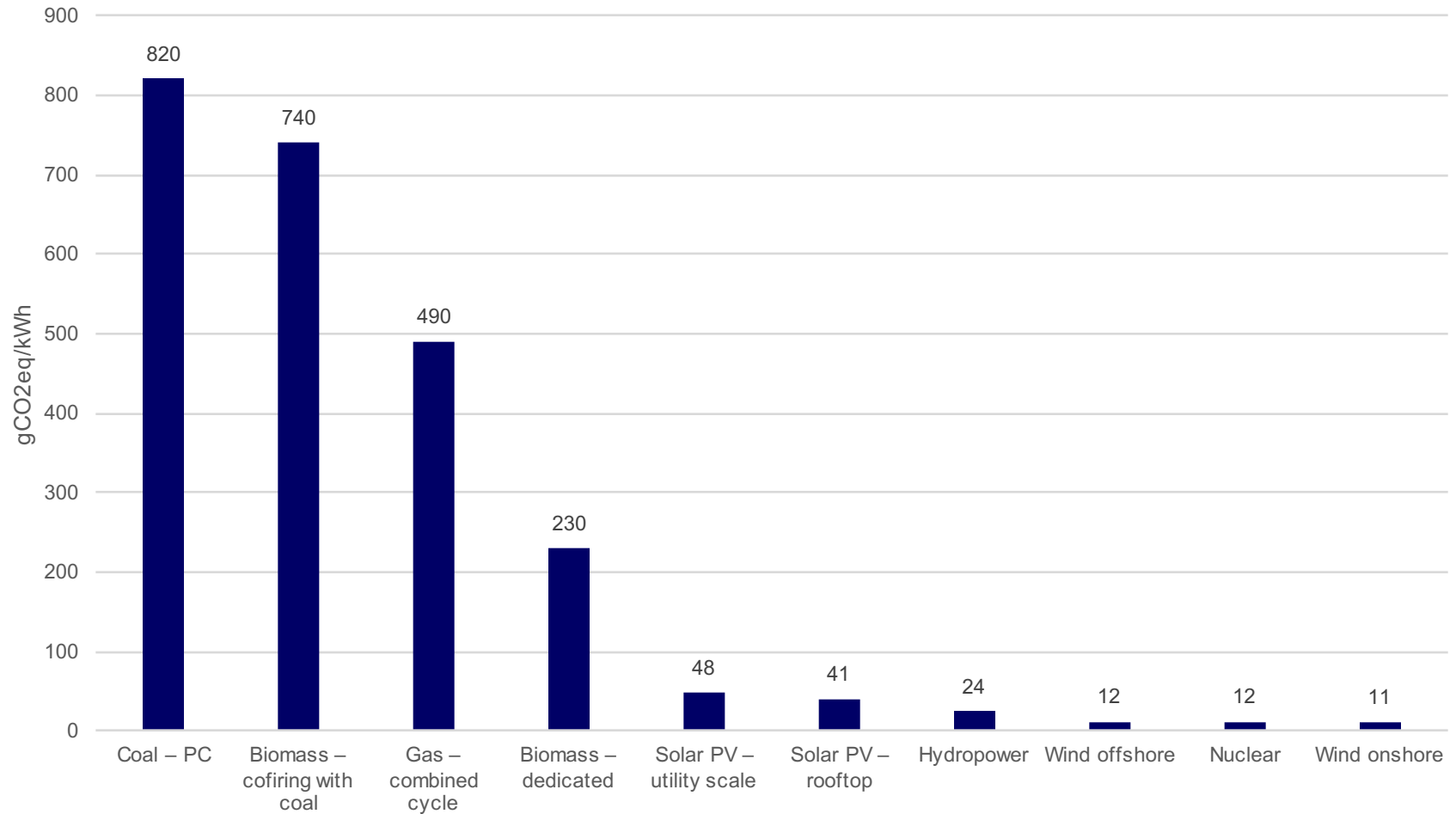


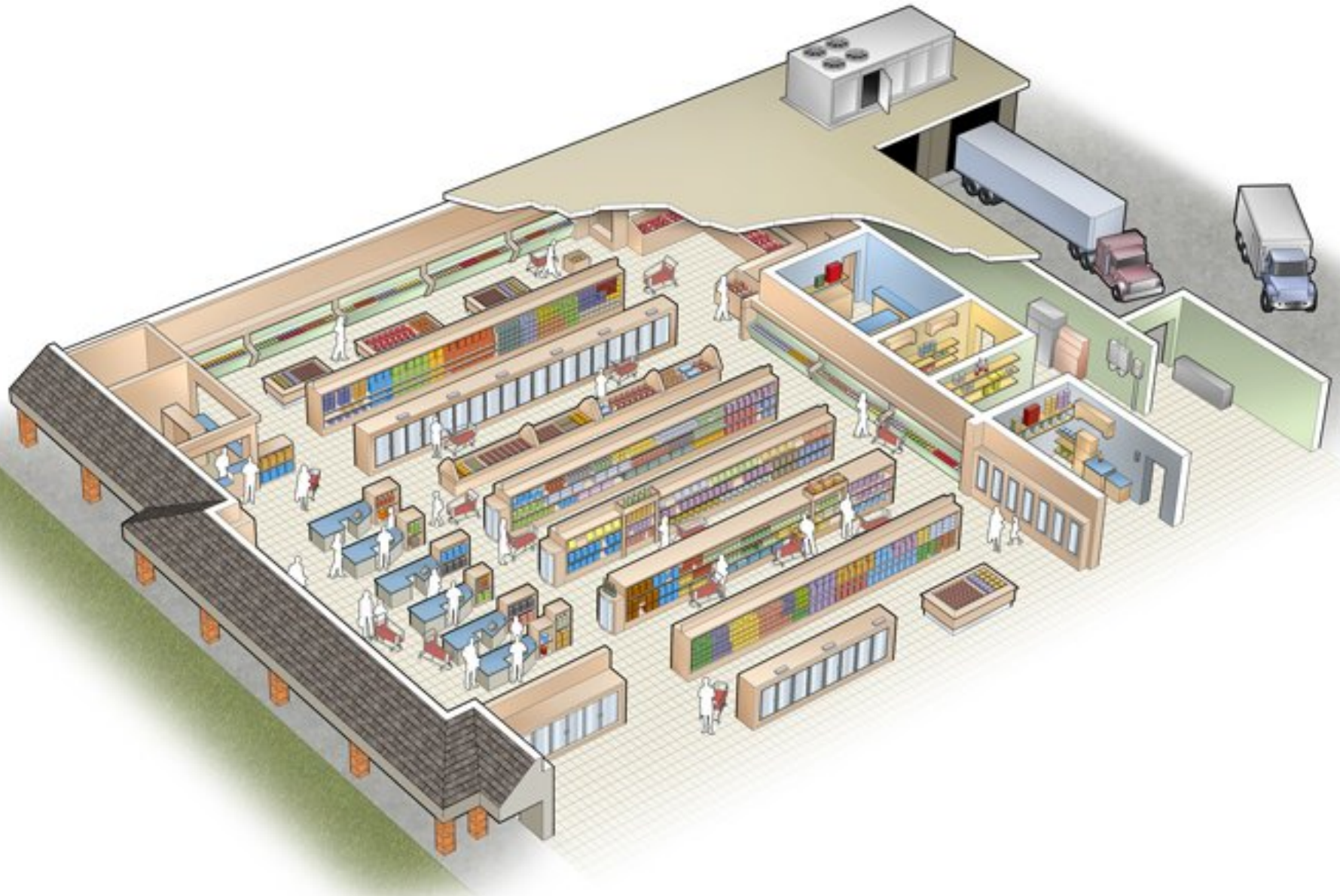
Image Source: <https://www.energy-charts.de/>

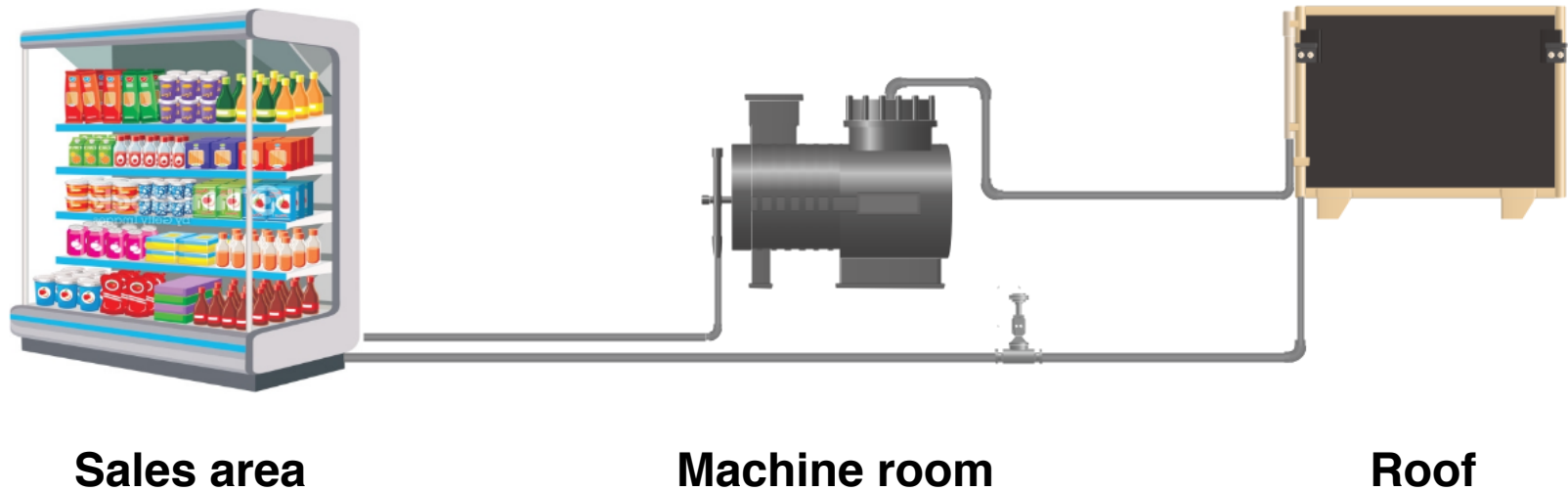


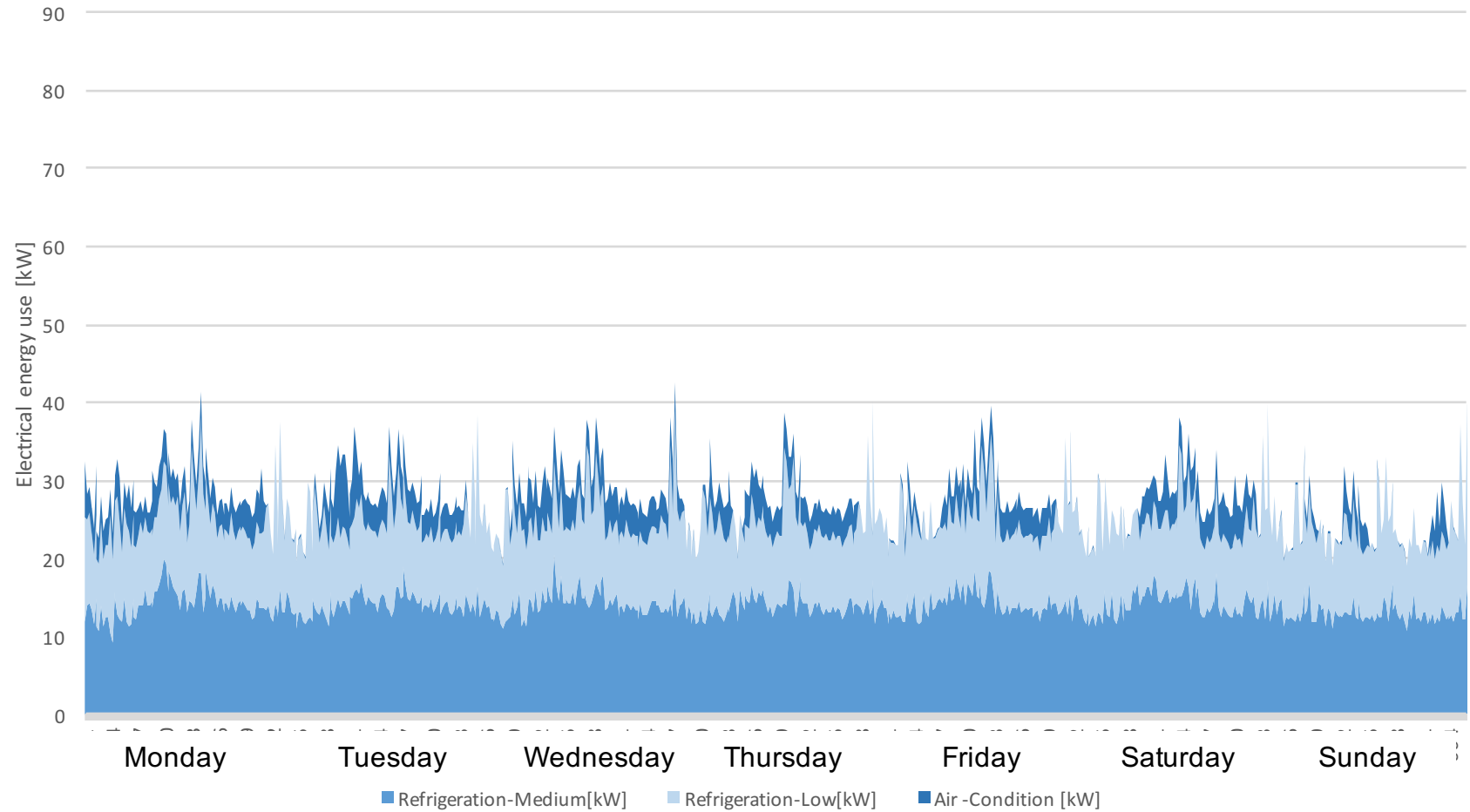
Datasource: 50 Hertz, Amprion, Tennet, TransnetBW, EEX
Last update: 19 Mar 2016 23:14

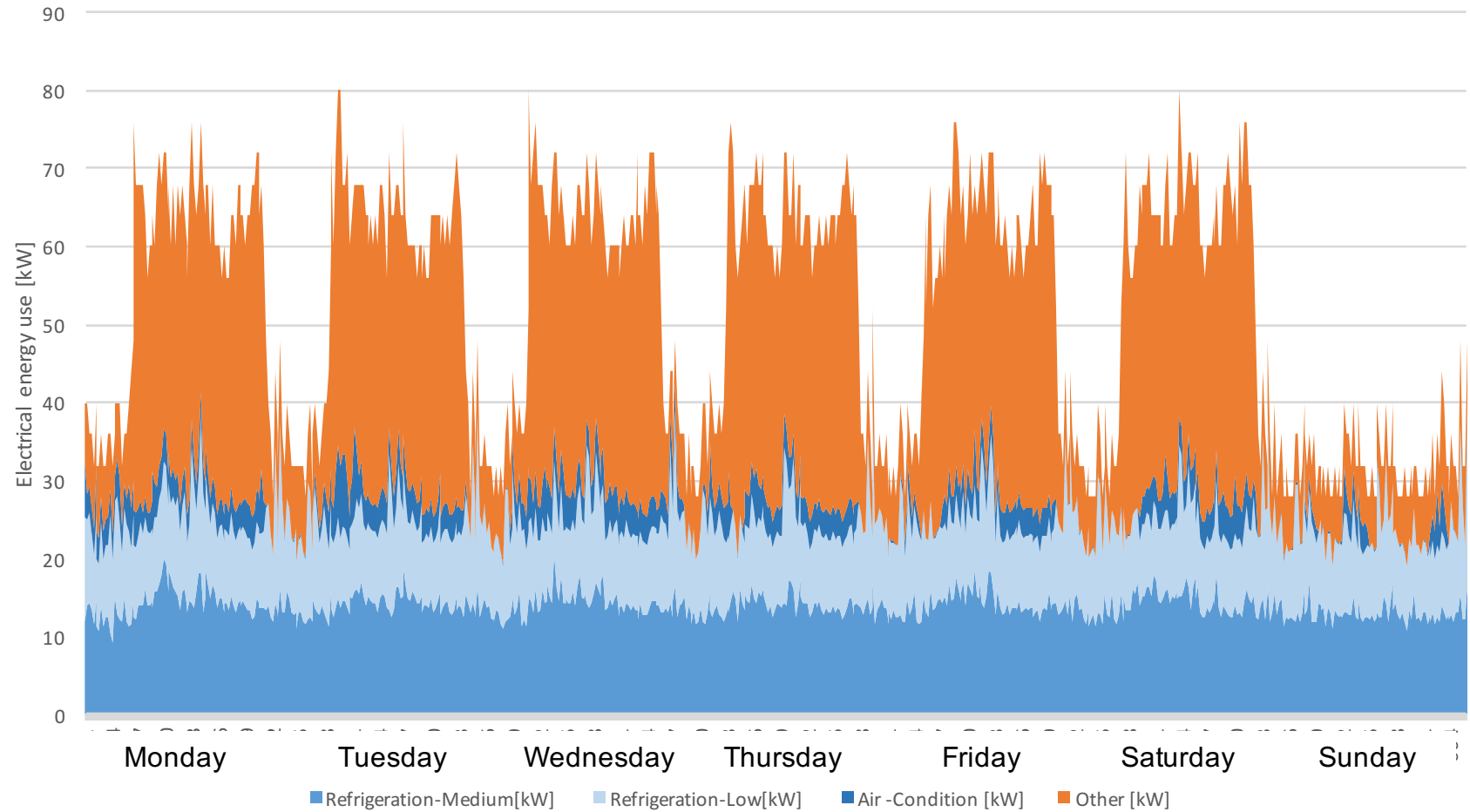
Image Source: <https://www.energy-charts.de/>











Load shedding / reduction

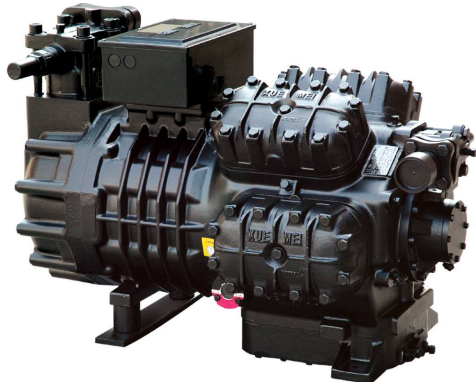


Image source: <http://image.made-in-china.com/2f0j00CvQEmtBRhMpF/>

By use of only controls the supermarket can within seconds respond to a signal from a smart grid. Reducing the compressor electrical load.

Aggregated defrosting strategies for stores.

Thermal inertia



Image source: <http://healthylunchrecipes.org/frozen-food-pros-cons/>

By sub cooling the products, the compressor work can be stored and used at a later stage.

Or by the implementation of a thermal storage tank.

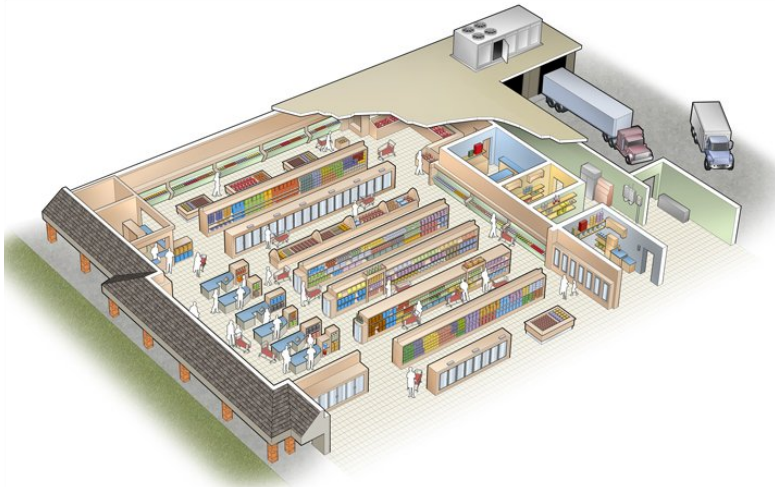
Flexibility of one supermarket

Parameter	Value	Comment
Thermal storage in products	25 kWh	5K change in 20 RDCs with 500kg food.
Compressor power	40 kW	COP vary during the year
Time with 100-60% reduced power	10-25 min	
Time without defrost	90 min	
Defrost power flexibility	13kW	
Total power flexibility	53kW	500 stores => 26,5MW

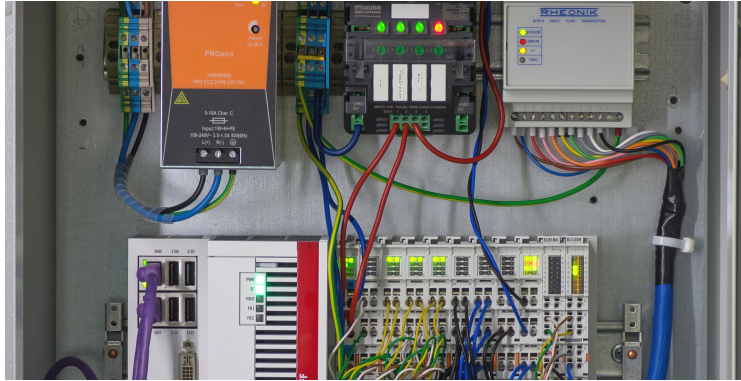
Source: Danfoss presentation at the XVI European Conference about technological innovations in refrigeration and air conditioning

Why supermarkets?

- Low investment
 - High electrical intensity
 - Aggregated impact
 - High refurbishment rate
-
- Possible and beneficial with larger cold thermal storage units to increase the flexibility from minutes to hours.



Control system

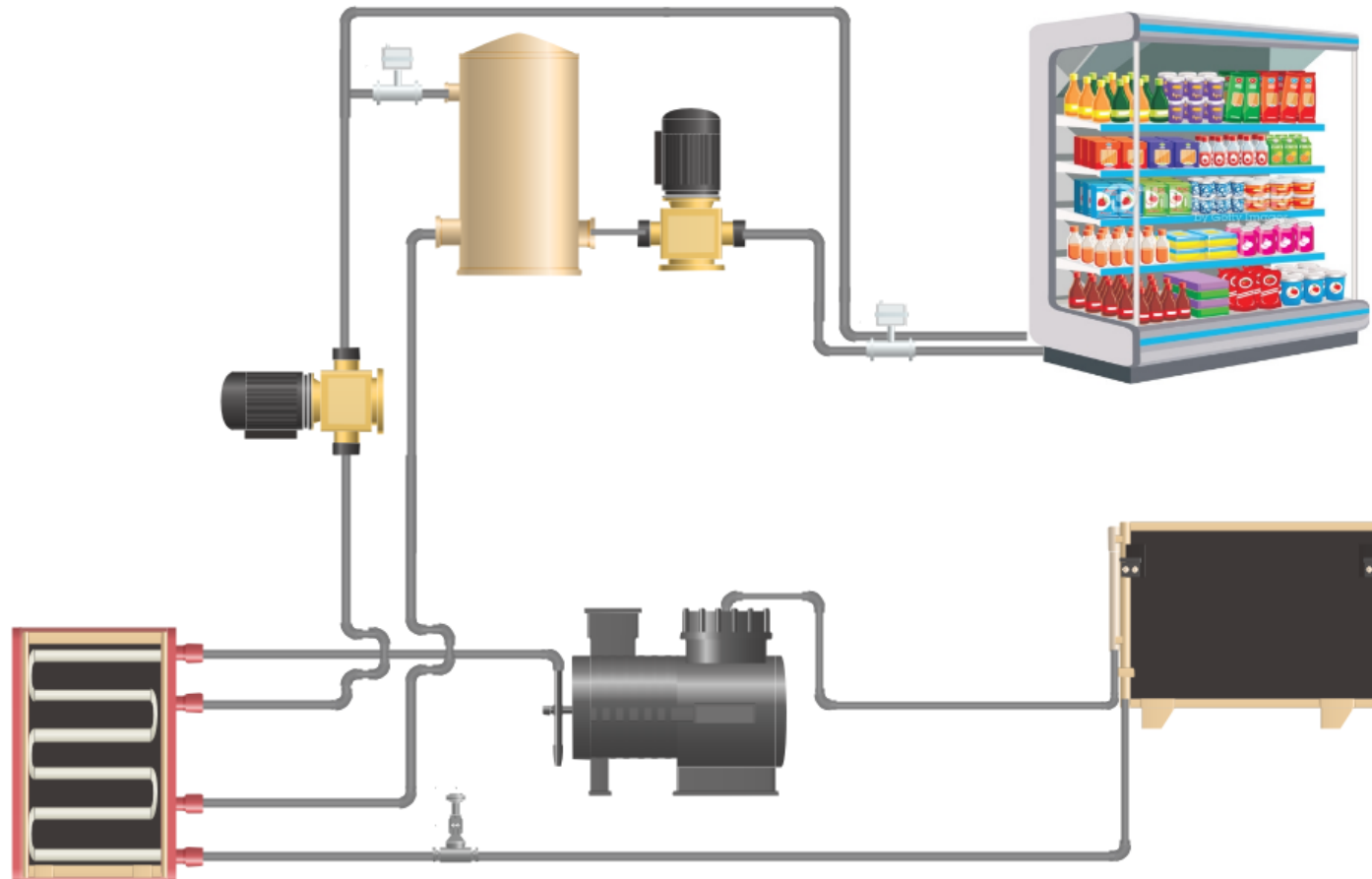


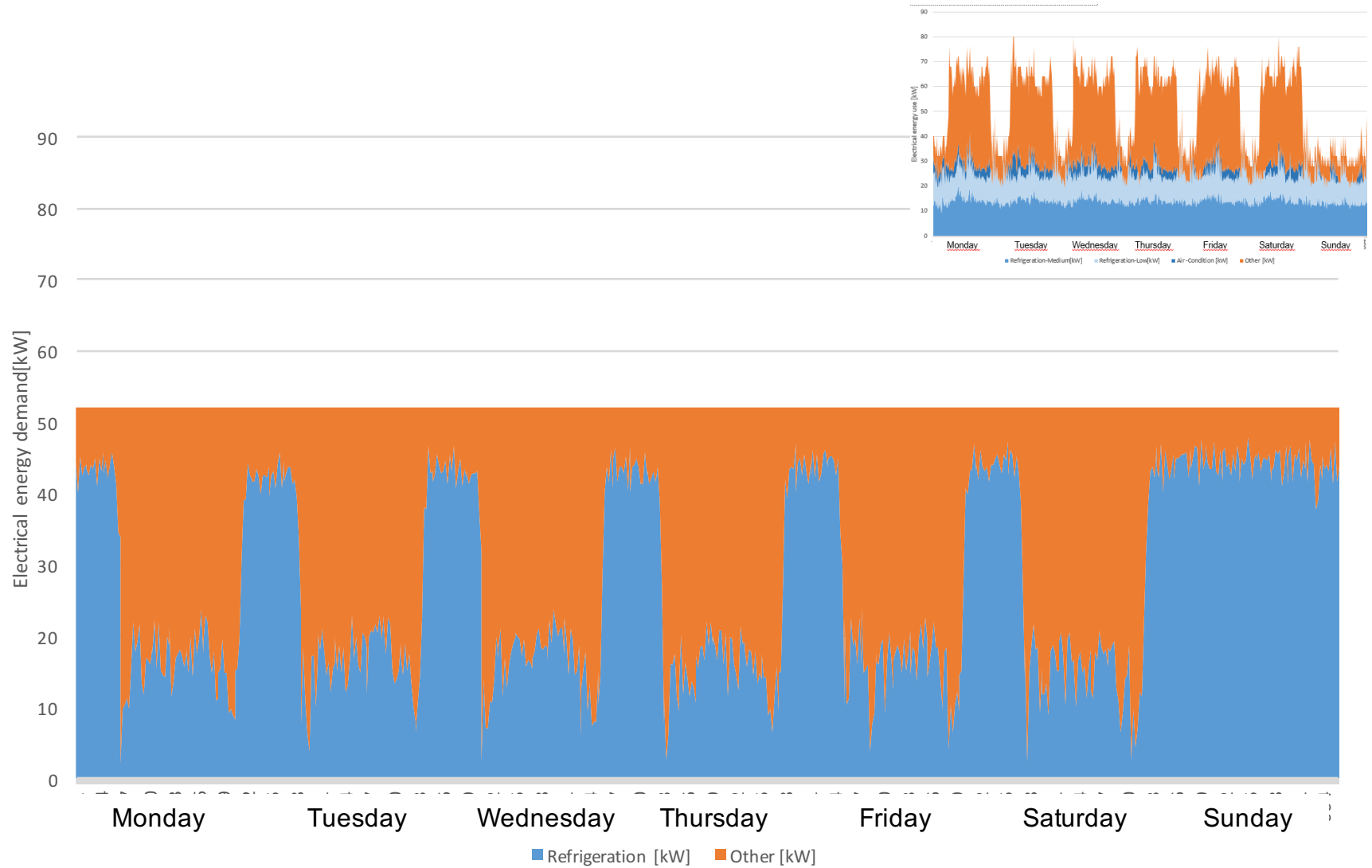
- Product temperature prediction
Food safety first priority
- Economical cooling strategy
- Env. Friendly cooling strategy
- **Forecasting energy demand**

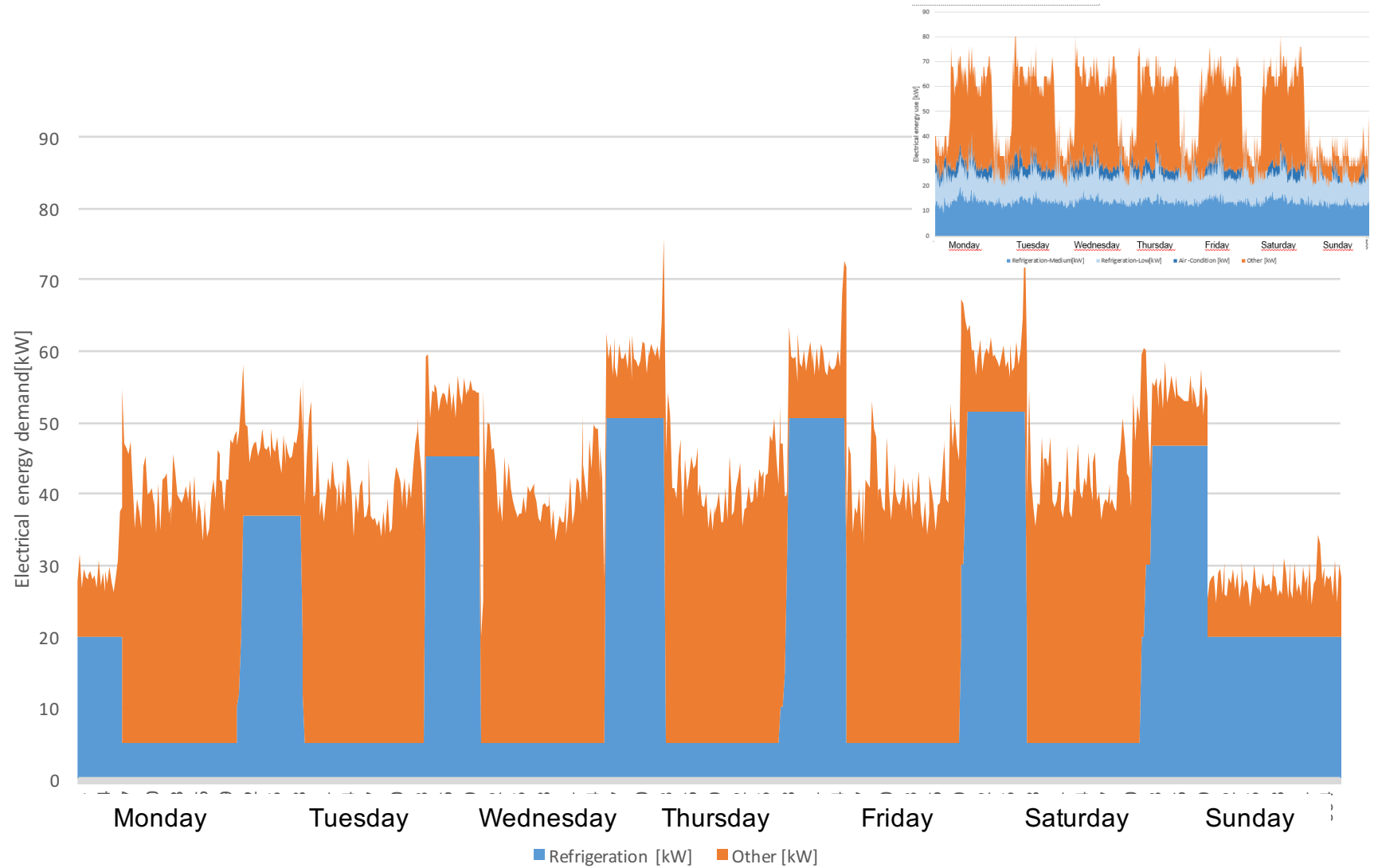
Thermal storage



- Products
- Refrigerant / Brine
- **Thermal storage unit**







Multiple scale problem

Important to keep the energy generation in mind when designing on a component/material scale. A local decrease in efficiency could be beneficial in the larger scale!

Financial incentive for TES in supermarkets

Adapting the demand to the spot price would lower the cost of energy, increasing the profit margin. Potential tax-reductions for reduced greenhouse gas emissions.

Rescillience

A TES would be able to serve the refrigerated display cabinets for a longer period in case of compressor failure, electrical outage etc. Increasing the food safety of the supermarket.



Thank you for listening