

Supermarkets as heat pumps with heat recovery units

Online, 6. July 2020

euramm^on

refrigerants delivered by mother nature

Supermarkets as Heat Pumps

Motivation

District heating systems in Denmark supply approx. 36 TWh heat per year.

In 2017 approx. 2.9% of the total supply came from surplus heat.

Among the largest suppliers of surplus heat are :

Long-term potential for large data centers, etc. will reach as much as 3.47 TWh equivalent to the heating demand for a city the size of Aarhus.

Virksomhed	GWh varmelevering
Aalborg Portland i Aalborg	371
Shell Raffinaderiet i Fredericia	332
Haldor Topsøe i Frederikssund	43
Skjern Papirfabrik i Skjern	32
Nordalim i Aarhus	31
Koppers Denmark i Nyborg	25
Fiskernes Fiskeindustri i Skagen	17
Dupont Nutrition Bioscience i Brabrand	14
Nordic Suggar i Nykøbing F	13
Ardagh Glass Holmegaard i Holmegaard	13
Pandalus Fiskeriindustri i Hanstholm	11

TABEL 2 – LISTE OVER EKSEMPLER PÅ OVERSKUDSVARMELEVERANDØRER, OVER 10 GWH OG MED DATA FRA 2017

Source : CLEAN Supermarkets Kogebog for genbrug af varme fra kølediske

1,000 supermarkets will be able to contribute 230 GWh.
+ reduce demand for their own store heating.

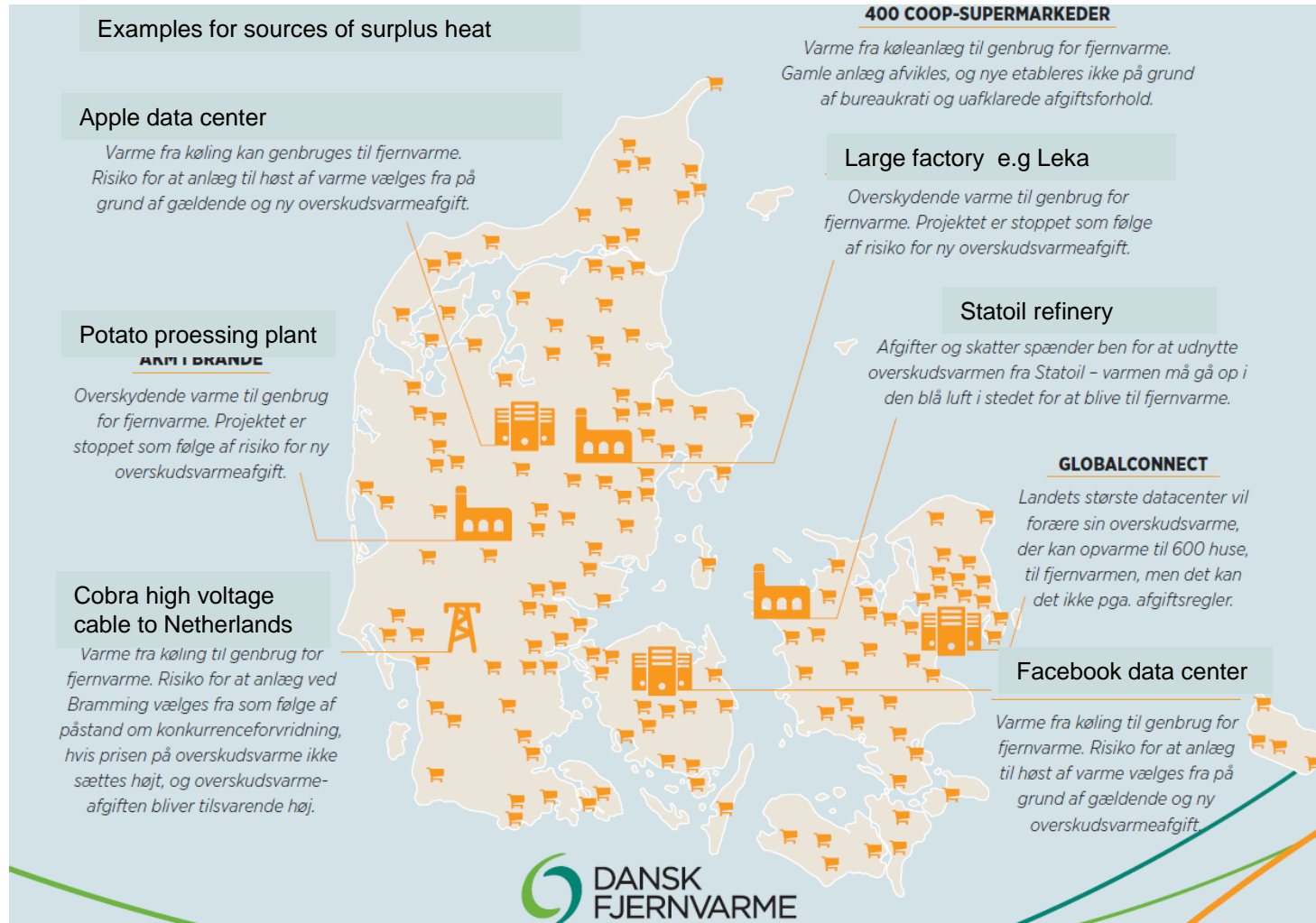
Denmark has approx 2700 supermarkets.

Supermarkets as Heat Pumps

Motivation

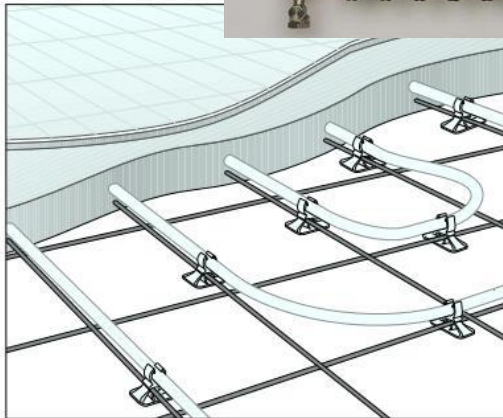
Single locations for large heat suppliers

Supermarkets are spread all over the country.



Source : CLEAN Supermarkets Kogebog for genbrug af varme fra kølediske

Supermarkets as Heat Pumps

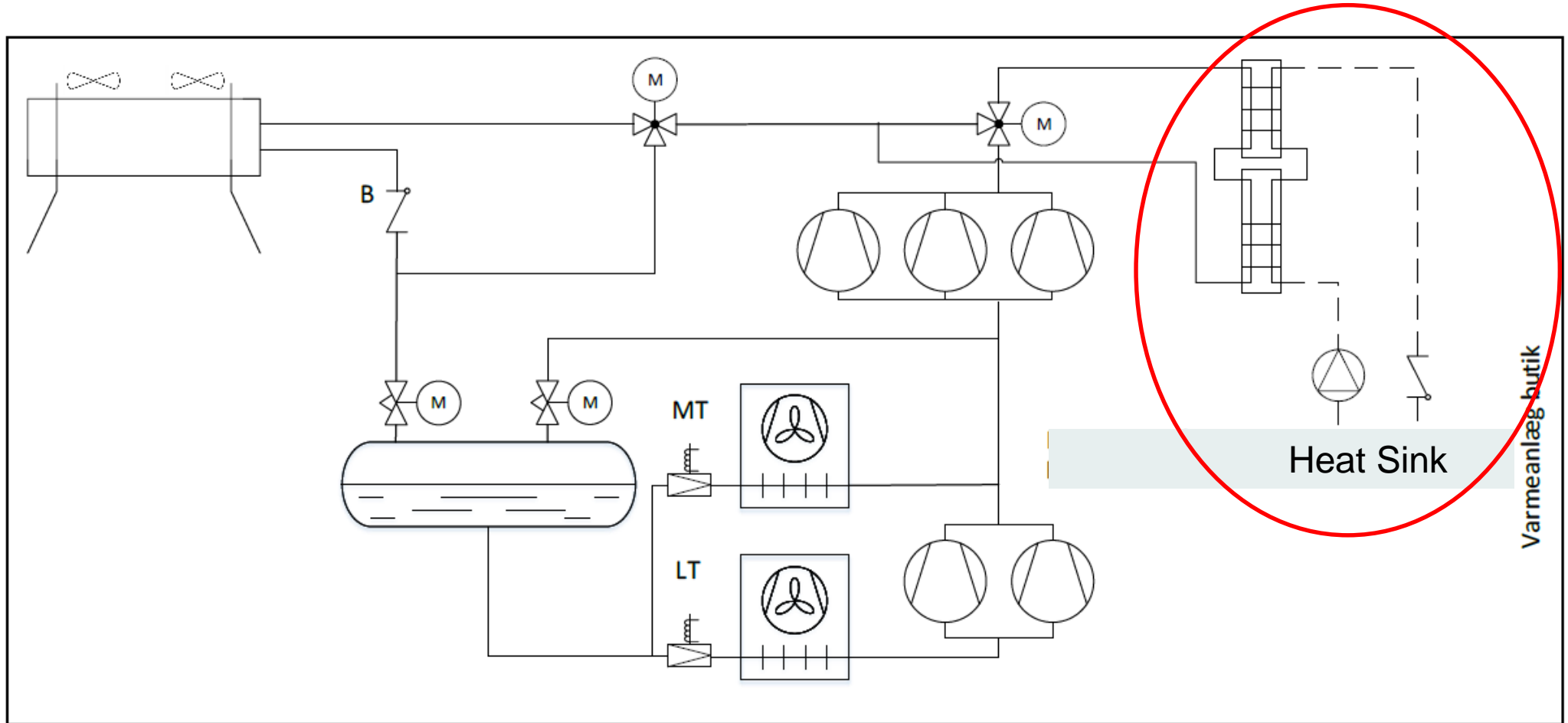


Re-use the heat from the refrigeration system in the store



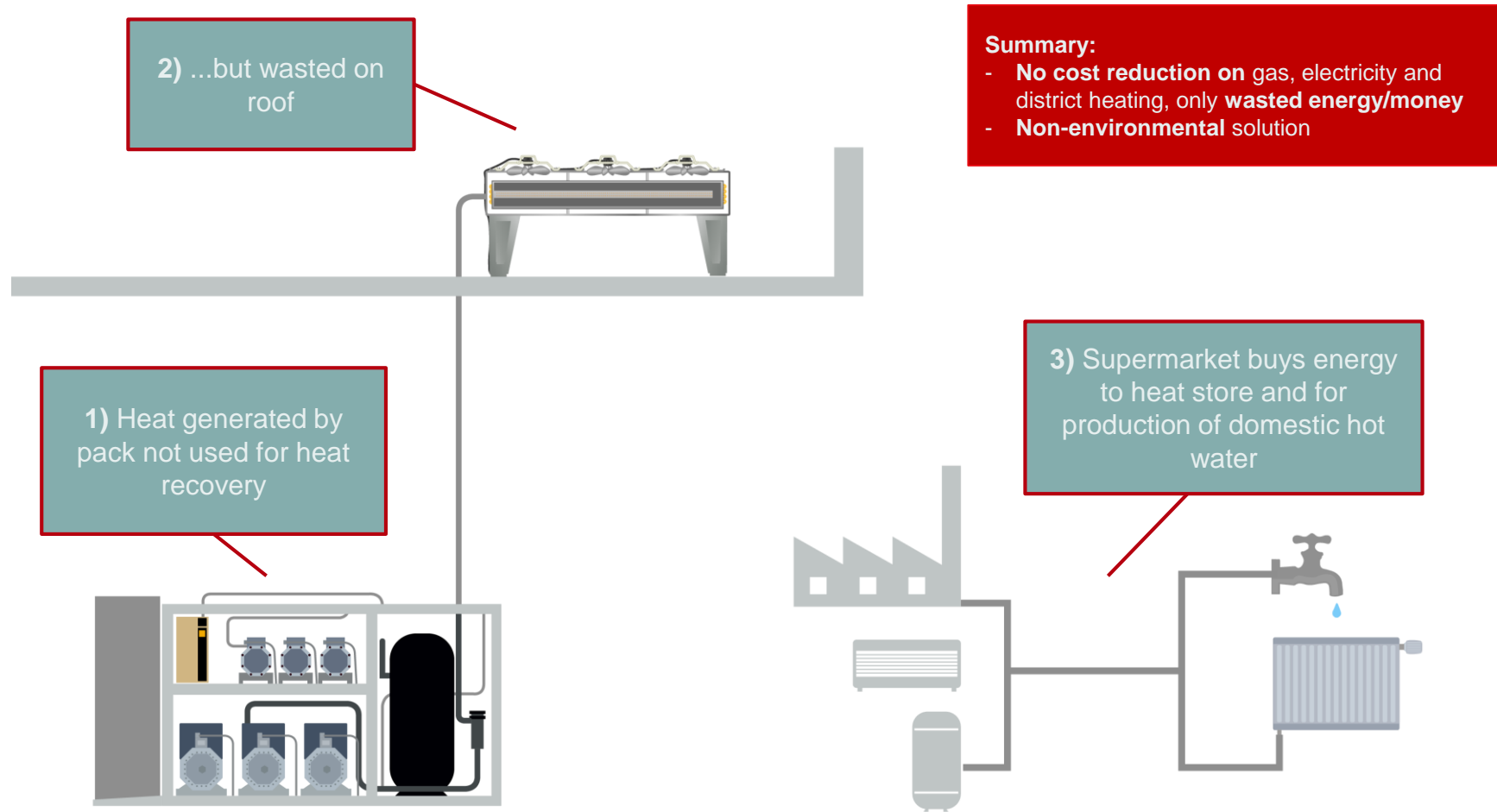
Source : CLEAN Supermarkets Kogebog for genbrug af varme fra kølediske

Supermarkets as Heat Pumps



Supermarket

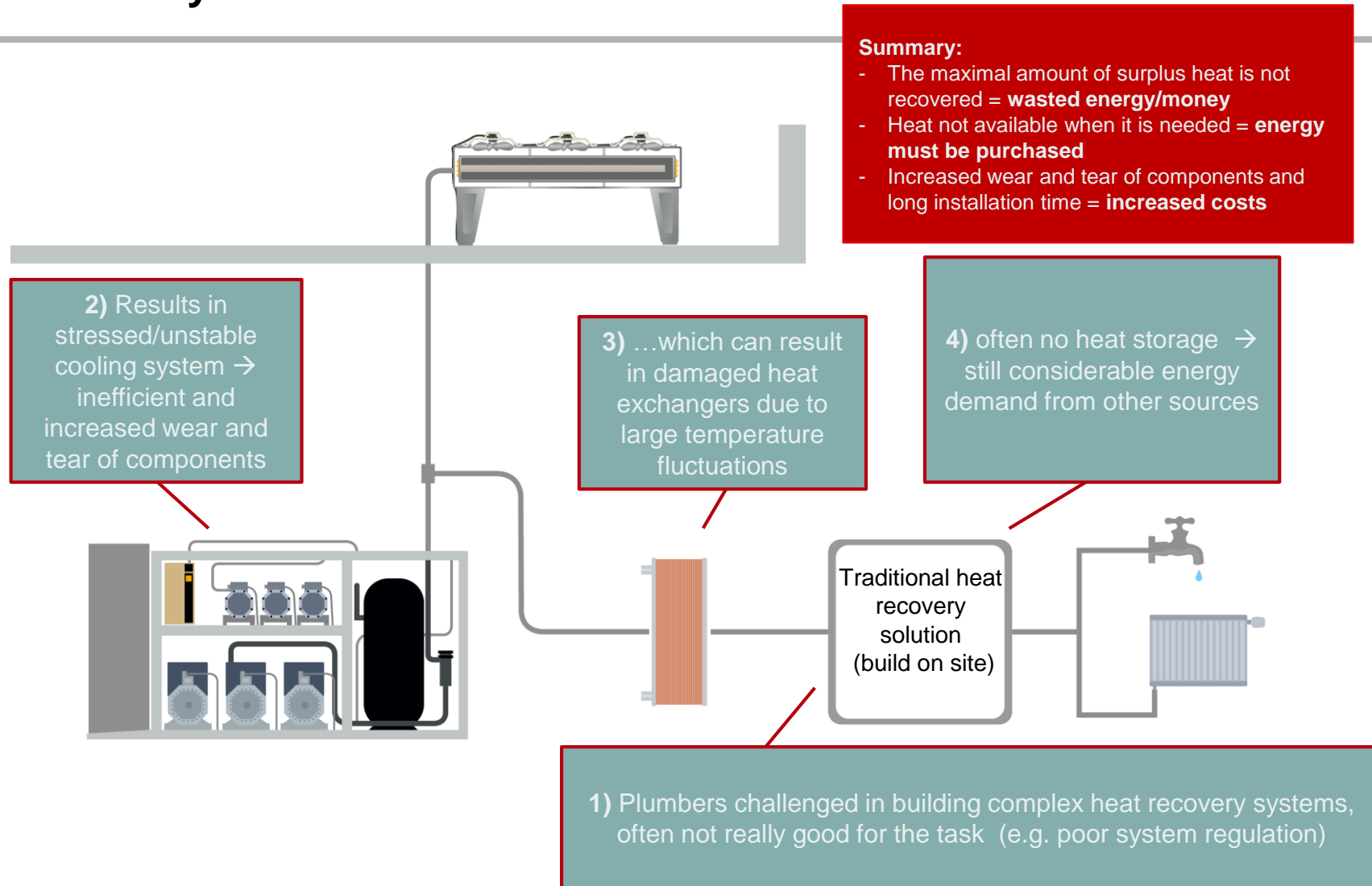
- No heat recovery



Simplified system illustration

Supermarket

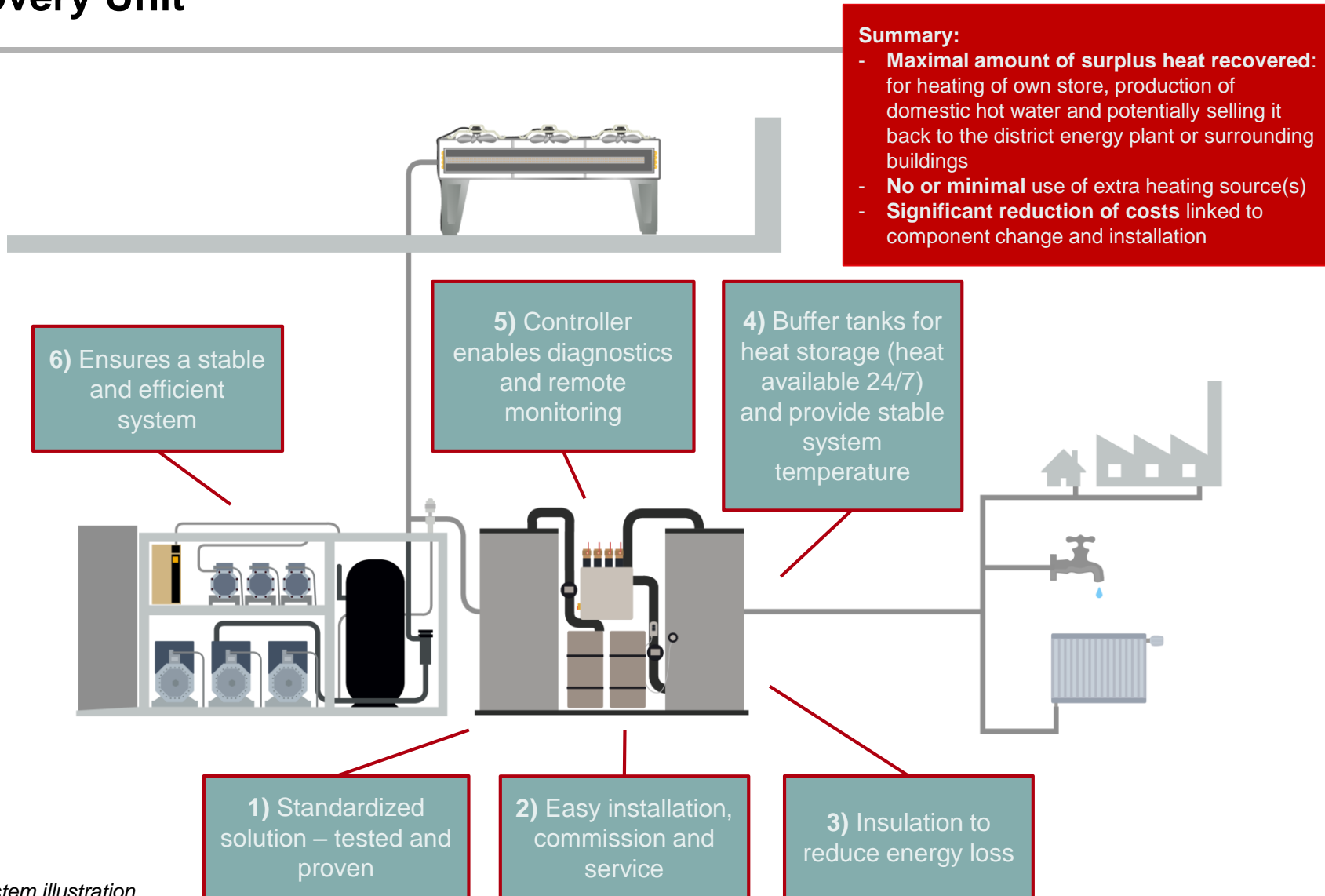
- Traditional heat recovery



Simplified system illustration

Supermarket

- with Heat Recovery Unit



Simplified system illustration

Heat Recovery in supermarket systems



Heat Recovery units with buffer tank option

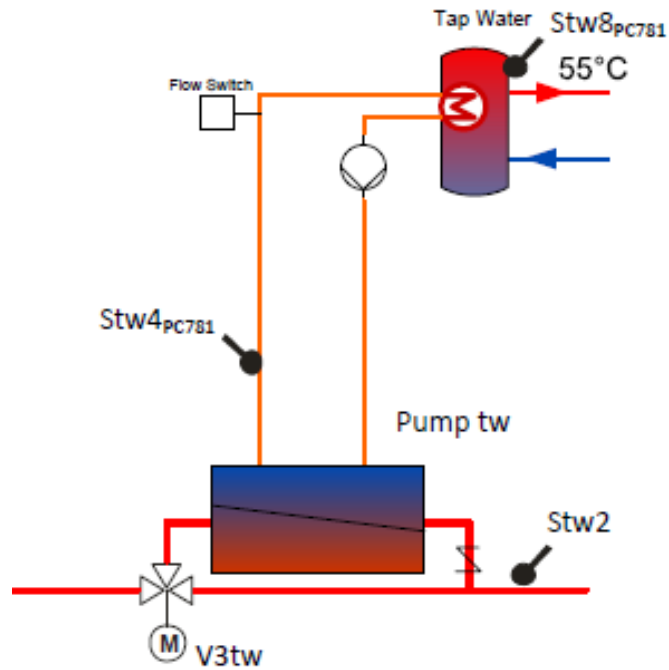


„Self made“ solution

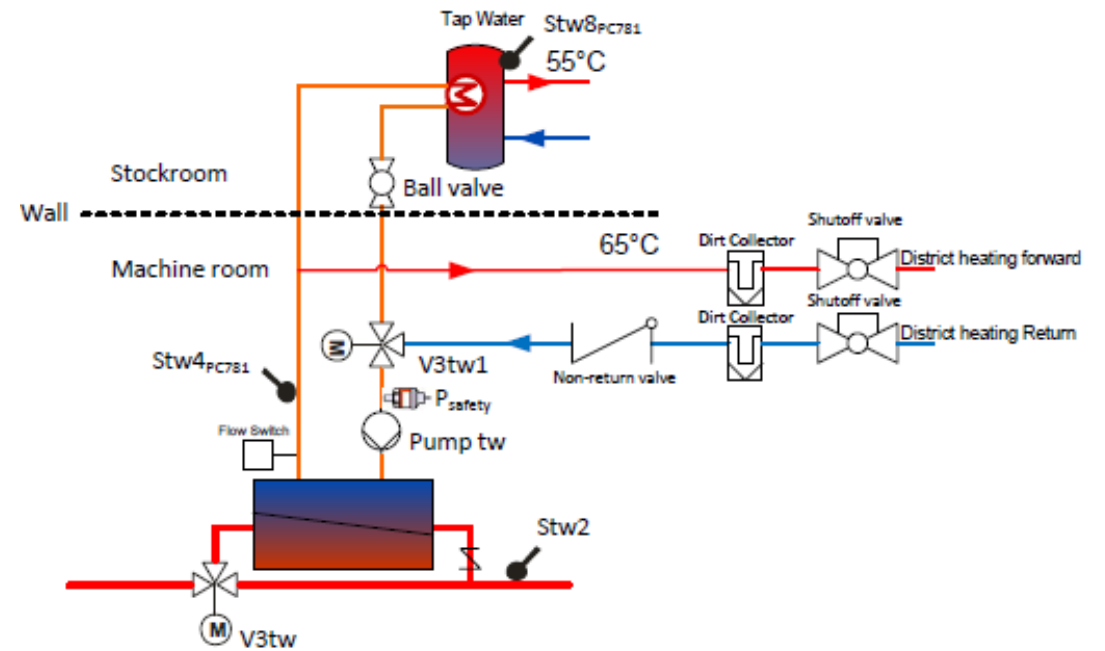
Supermarket

Heat recovery

Without district heating connection



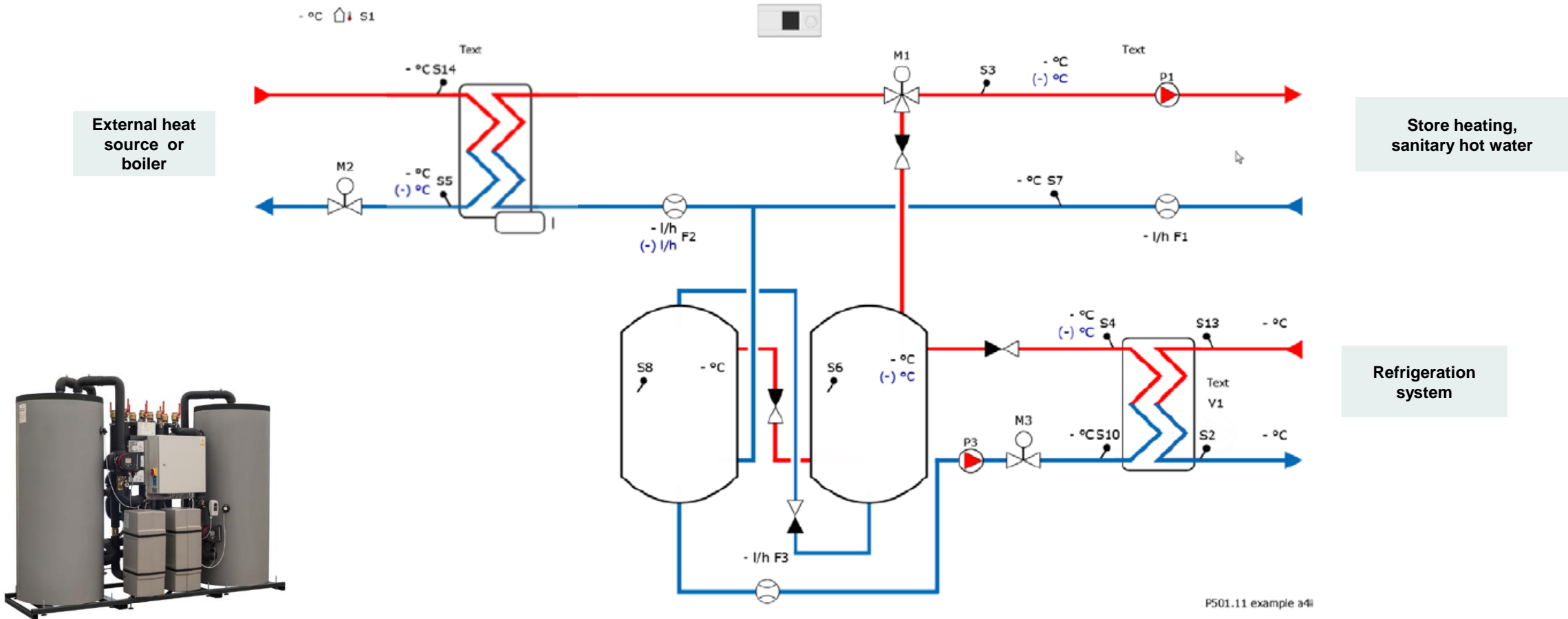
With district heating connection



Heat recovery system principles

Connection : In-Direct

Selling heat : no



P501.11 example a4i

Heat recovery system principles

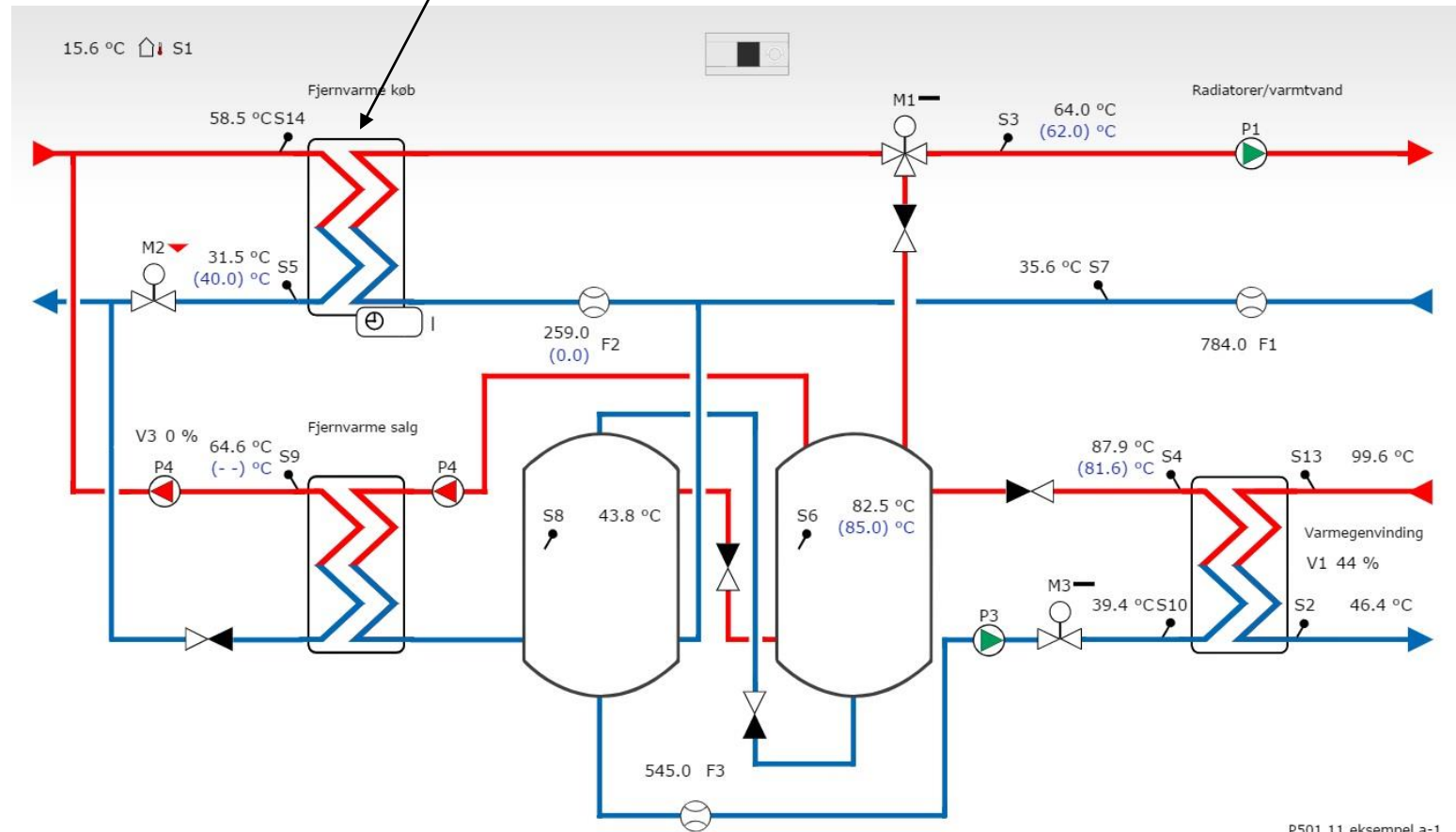
Connection :

In-Direct

For direct remove this HX

Selling heat : yes

External heat source or boiler



Store heating, sanitary hot water

Refrigeration system

Heat Recovery Units

Easy selection

		CO ₂ output [kW] (sales demand)			
		up to 100	up to 150	up to 300	up to 400
Heating demand [kW]	up to 22	146B9108	146B9109		
	up to 54	146B9120	146B9121	146B9122	146B9123
	up to 85	146B9126	146B9127	146B9128	146B9129
	up to 135	146B9132	146B9133	146B9134	146B9135
	up to 216	146B9138	146B9139	146B9140	146B9141
	up to 337	146B9144	146B9145	146B9146	146B9147
up to 540	146B9150	146B9151	146B9152	146B9153	

Fast installation & commissioning
in new and existing supermarkets



Store Management System



Evaporator Control	Pack Control	HVAC	Light, Aux. Control
<p>High-End Basic Controller Tray</p>	<p>Mid-Range HFC High End HFC/CO₂</p>	<p>Basic Control HVAC Control</p>	<p>Programmable Control 3rd Party HVAC, Light, Controllers</p>
<p>Display Cases</p>	<p>Compressor Pack</p>	<p>Heat Recovery</p>	<p>Air Handling Lighting</p>

Examples of realized systems

By	Supermarked	Fjernvarmeselskab	Varme produktion (MWh)	Varme levering (MWh)
Ebeltoft	Kvickly	Ebeltoft Fjernvarme	230	98
Skjern	SuperBrugsen	Skjern Fjernvarme	94	48
Give	SuperBrugsen	Give Fjernvarme	360	125
Odder	Kvickly	Odder Fjernvarme	257	113
Hedensted	SuperBrugsen	Hedensted Fjernvarme	194	59
Løkken	SuperBrugsen	Løkken Varmeværk	128	41
Ryomgård	SuperBrugsen	Ryomgård Fjernvarme	90	43
Terndrup	SuperBrugsen	Terndrup Fjernvarme	99	55
Ølgod	SuperBrugsen	Ølgod Tekniske Værker	182	66
Aalborg	Bilka	Aalborg varme	550	325
Randers	Bilka	Verdo	531	316
Sønderborg	Bilka og Føtex	Sønderborg Fjernvarme	990	580
København	Bilka OneStop	HOFOR	501	295
Vejen	Kvickly	Vejen Varmeværk	263	50
Augustenborg	SuperBrugsen	Sønderborg Fjernvarme	480	272

TABEL 3 – EKSEMPLER PÅ EKSISTERENDE ANLÆG HOS SUPERMARKEDER FOR VARMELEVERING – OKTOBER 2019

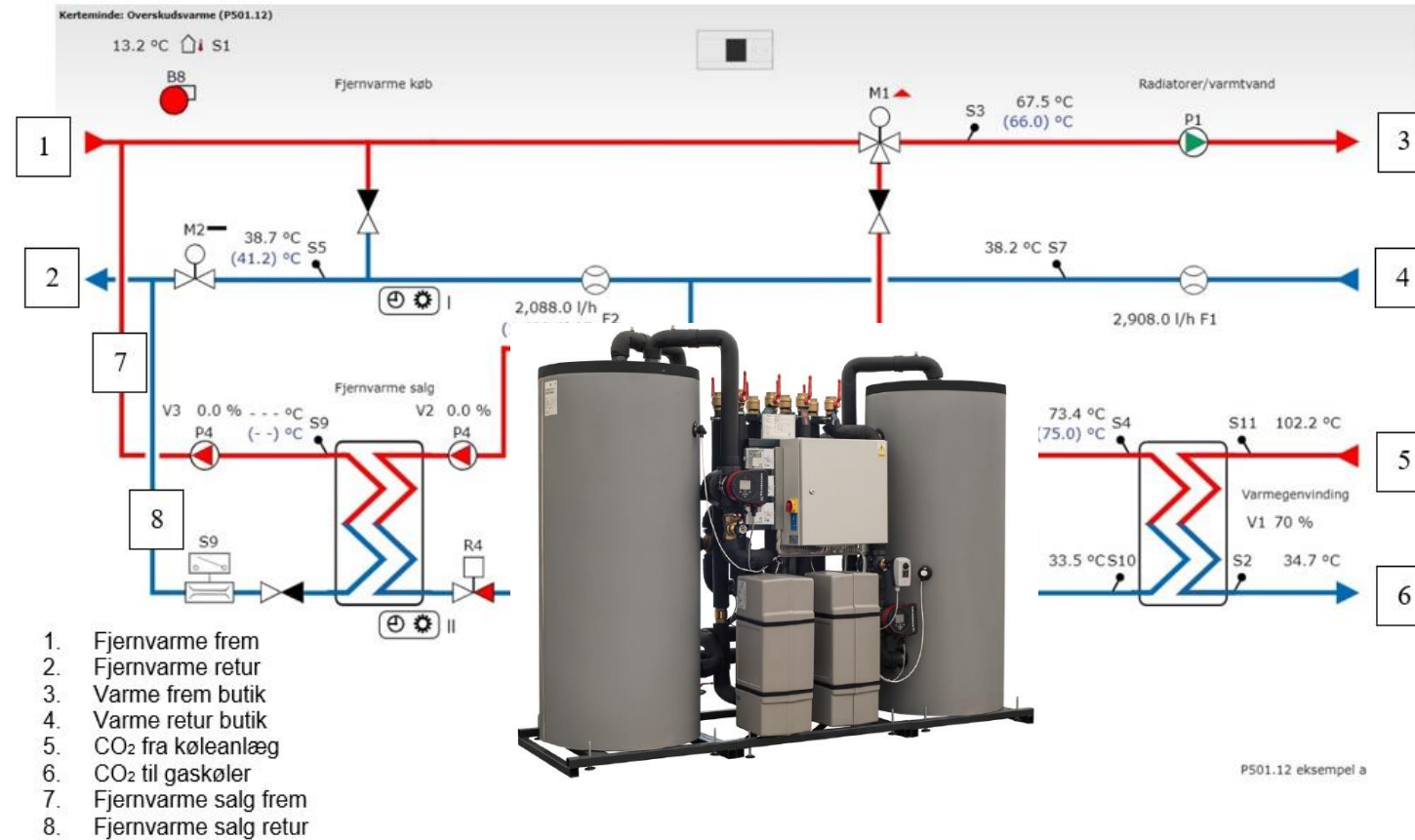
Source : CLEAN Supermarkets Kogebog for genbrug af varme fra kølediske

Examples of realized systems

COOP Superbrugsen, Kerteminde, Denmark

Retail area : 3.500 m²

Installed solution :
Using existing direct connection to a district heating network.
Possibility to sell heat



Examples of realized systems

COOP Superbrugsen, Kerteminde, Denmark

Retail area : 3.500 m²

Test period : Jan – Oct 2018

Expected energy demand store before modification : 290 MWh

Measured energy demand after modification : approx. 125 MWh.

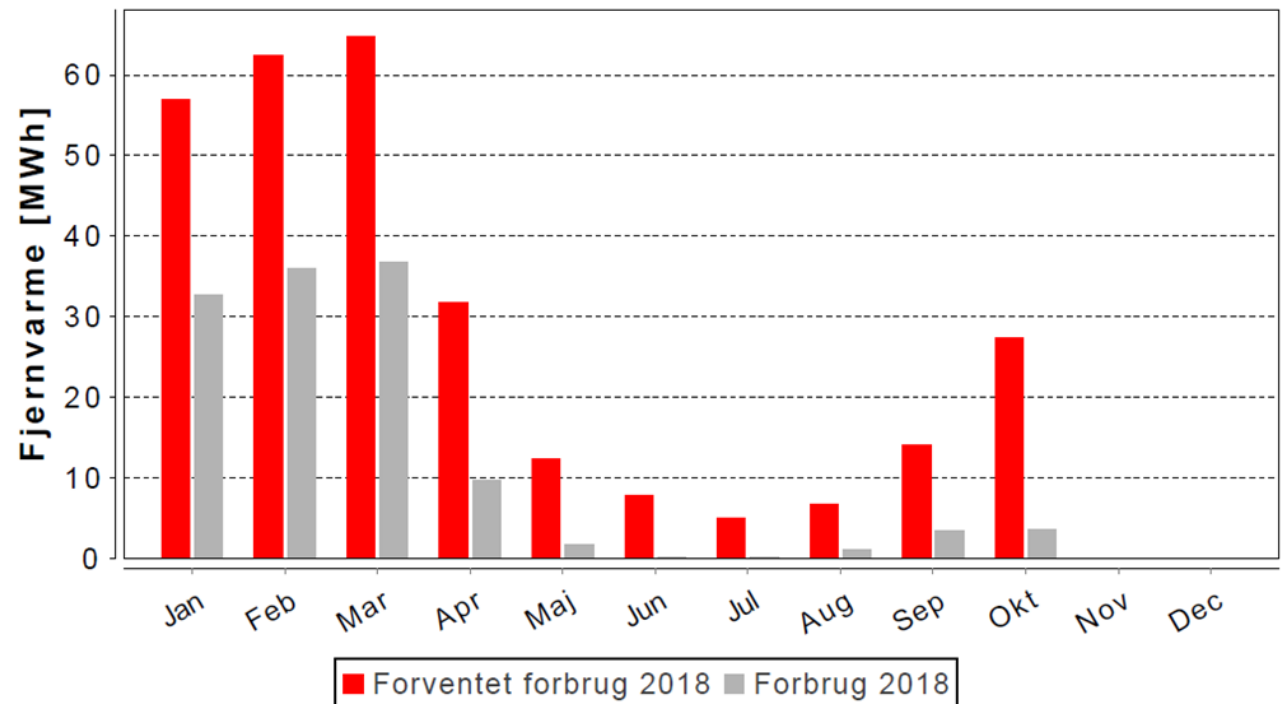
Savings : 165 MWh

Costs : Total investment of DKK 180,000 (23.400 €) plus internal hours for negotiation with the district heating company.

During winter, heat production does not cover the entire store's heat consumption.

Danish tax rules for heat recovery make it a bad business to regulate the cooling system in a way that extra heat can be produced in these periods.

Payback time of approx. 2 years.



Source : CLEAN Supermarkets Kogebog for genbrug af varme fra kølediske

Examples of realized systems

COOP Superbrugsen, Kjellerup, Denmark

Retail area : 2.000 m²

The project was completed in 2017.

The supermarket was already among the 5 most energy efficient in the group.

With the new solution it was possible to reach an additional 20% reduction of the energy bill.

There is no heat supply for the district heating system but for neighboring shops.



SSUPERBRUGSEN I KJELLERUP, PETER POULSEN MED VARMESYSTEMET

Source : CLEAN Supermarkets Kogebog for genbrug af varme fra kølediske

Examples of realized systems

COOP Superbrugsen, Skjern, Denmark

Retail area : 3.400 m²

The system was designed for selling surplus heat to a district heating network.

Earnings for heat sales to district heating were only approx 33.000 DKK (4.300 €) per year. Due to 33% tax and costs for yearly audits, it was decided to stop selling heat.

Now the heat from refrigeration system is used for the supermarket only (heating & hot water).

The system still runs fine due to the buffer and controls functions of the heat recovery unit.



SUPERBRUGSEN IN SKJERN, JØRGEN ANDERSEN with Danfoss Heat Recovery Unit

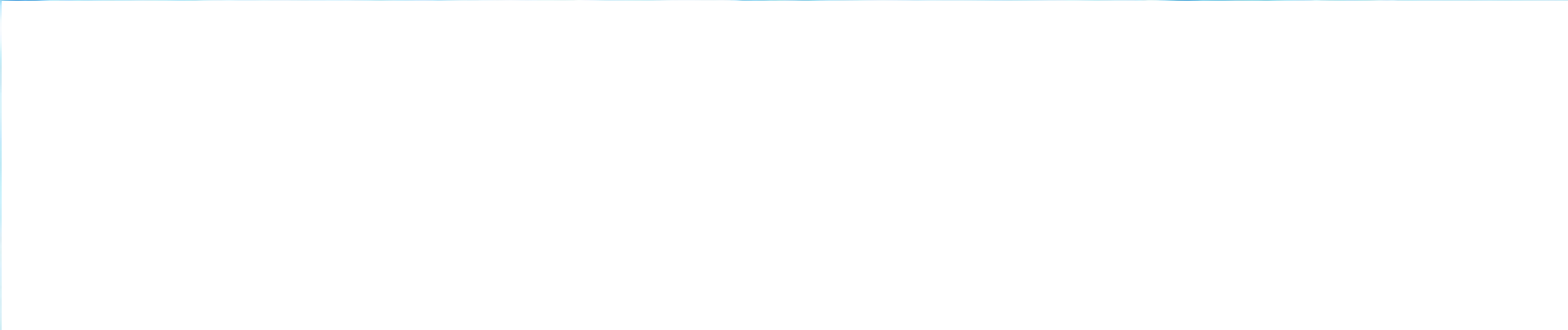
Source : CLEAN Supermarkets Kogebog for genbrug af varme fra kølediske

Summary

Heat Recovery Units

- Provide a stable operation of the refrigeration system which secures optimal heat recovery
- Easy selection, installation & commissioning
- Increased reliability of the complete system
- Help your supermarket turning waste heat into heat for store purposes = turning a supermarket into a heat pump
- Selling heat as additional income option





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refrigerants delivered by mother nature