



SUPER Supermarkets

The hidden refrigeration capacity in Supermarkets

HUSUM – Innovative energy projects

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The project Super Supermarkets - Agenda:

1. Why a project like SUPER Supermarkets
2. Background
3. Main focus & main activities
4. Recycling heat, heat recovery & demand side flexibility
5. Project structure
6. Knowledge sharing in the project
7. Cookbook / script for projects
8. Time schedule & funding
9. Partners
10. Market potentials



Super Supermarkets – WHY?

Supermarkets are using only 30% of their installed capacity!!!

Supermarkets use up to 2% of total electricity

Danish Parliament must align the legislation:

- Surplus heat tax must be abolished



In other words – great potentials!

The district heating sector will harvest recycling heat

Recycled heating can be harvested directly from the industries; ex.

- From processes in the industry
- Refineries
- High temperatures and large quantities

Recycled heating from point sources

- Data centers, dairies, sewage plants, etc.
- Low temperature and low energy density
- Requires heat pumps
- Recycled heating from supermarkets
 - Very high potential - many shops
 - Provides great temperature - suitable for district heating
 - Local heat for local use - less transmission losses

BACKGROUND

- The background is the successful implementation of recycling heat recovery for app. 10 Danish supermarkets
- Feasibility studies undertaken in the mid 1990's on solar heating for district heating companies and for larger buildings
- Recycling of heat from cooling systems is not new, but needs to be optimized and standardized to be implemented in supermarkets

Butik	Produktion (MWh)	Eget forbrug (MWh)	Salg (MWh)	Huse (18 MWh)	
Super Brugsen Skjern	94	46	48	(5,2)	2,7
Kvickly Ebeltoft	217	121	96	(12,1)	5,3
Kvickly Odder	257	144	113	(14,3)	6,3
Super Brugsen Hedensted	194	135	59	(10,8)	3,3
Super Brugsen Løkken	128	87	41	(7,1)	2,3
Super Brugsen Ryomgård	90	47	43	(5,0)	2,4
Super Brugsen Terndrup	99	44	55	(5,5)	3,1
Super Brugsen Ølgod	182	117	65	(10,1)	3,6
Super Brugsen Give - NYT	360	240	120	(20,0)	6,7

A number of supermarkets supplies heat to the grid and for own consumption

THE MAIN FOCUS & MAIN ACTIVITIES

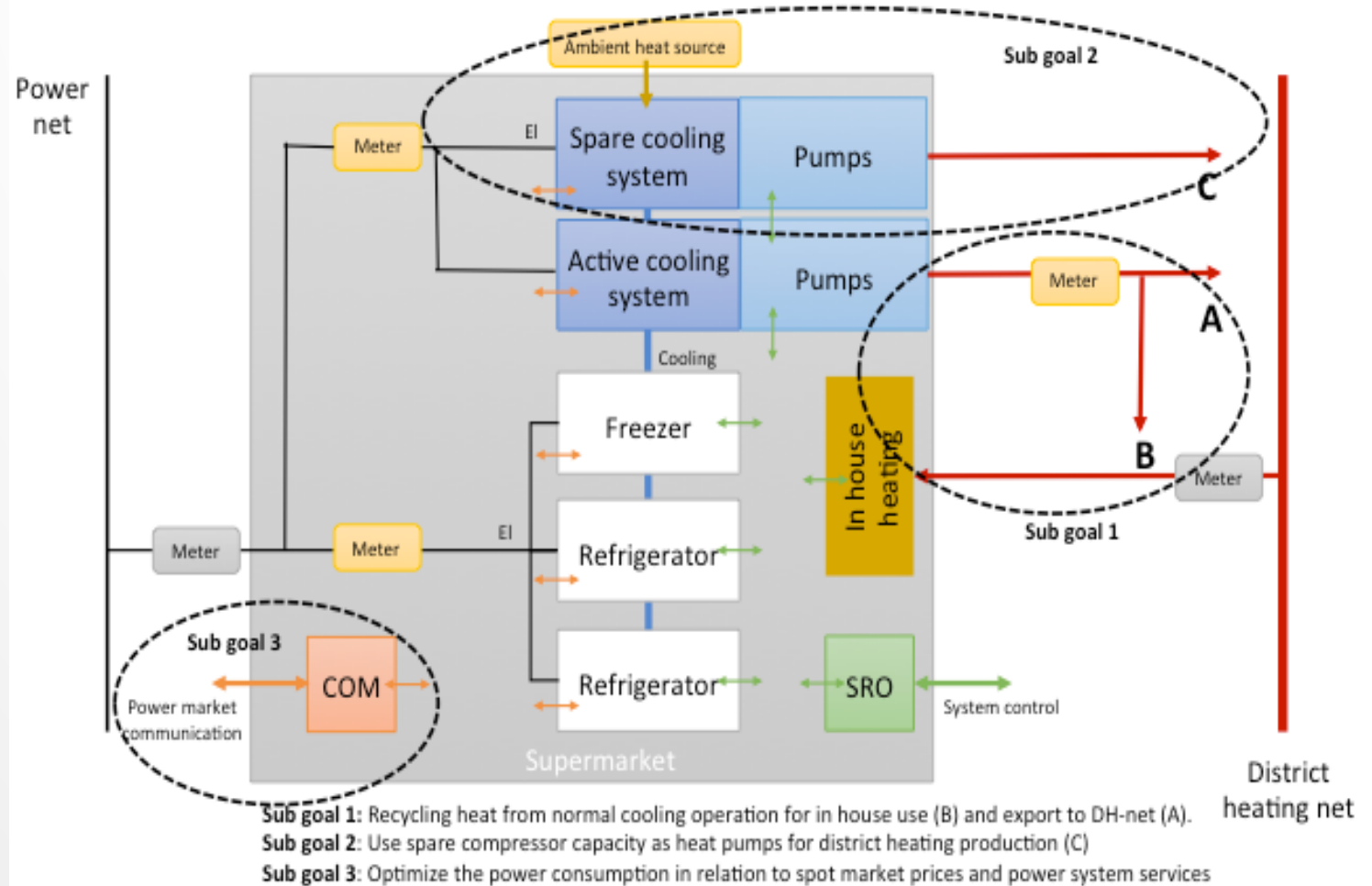
The main focus of the Super Supermarkets project is to evaluate, demonstrate and implement the full potential of district heating production and electricity grid system services already available, but unexploited in Supermarkets.

The Super Supermarkets project will optimize and standardize the technology:

Sub-goal 1: recycle heat from normal cooling operation for in house use (B) and export to DH-net (A)

Sub-goal 2: Use spare compressor capacity as heat pumps for district heating production (C)

Sub-goal 3: Optimise the power consumption in relation to Spot market prices and power system services. This is the smart grid part of the project. Has already been investigated on related systems, but not demonstrated as a commercial concept in supermarkets



BEST PRACTICE & POTENTIALS

Best practice:

- Based on experience of the already installed systems combined with the extensive knowledge from the project partners, Best Practice for recycling heat, will be developed and demonstrated
- App. 15 feasibility studies will be carried out to serve as an accelerator together with the retrofitting of three COOP Supermarkets.

Utilize extra heat pump capacity in supermarkets for district heating production:

- The 2.684 supermarkets in Denmark have an installed capacity of heat pumps/cooling system of app. 400 MW
- In average yearly operation only 30% of the capacity is used
- It is estimated that the cooling capacity can deliver 390 MW of district heating

DEMAND RESPONSE - DEMAND SIDE FLEXIBILITY

Smart grid – demand side flexibility:

- Supermarket cooling systems are characterized by high power consumption and quite long response time
- Further a high extra standby capacity
- Therefore well suited for demand side flexible purposes
- The project will investigate and, if feasible, demonstrate cooling systems designed for selling power system services
- OK A.M.B.A. - as a leading power trader - will investigate the technical and economical possibilities of aggregating such small suppliers of power system services in a feasible model for the power market
- The task will draw on former project findings on demand side flexibility operations based on Nordpool Spot market prices and how to aggregate a large number of small entities as one market player on regulating services.

Project Structure (1)

WP 1: Pre-studies for all three solutions (technical, economical, legislation)

Danfoss, TI, KTH, AK-C, ...

WP 2: Design and implementation of the three demonstration cases

TI, ILK, FJV, DFP, ...

WP 3: Start up and validation; i.e. commissioning, data collection and validation of data model

TI, KTH, AK-C, COOP, ...

WP 4: Preparing for nationwide roll out; develop cookbook for the engineering part, contracts, finance (calculation model)

CLEAN, TI, DFF, Danfoss, ...

WP 5: Use cookbook for the preparation of 15 feasibility studies, including international cases

CLEAN, ILK, Danfoss, COOP, ...

WP 6: Communications (homepage, conferences, PR, etc.)

DFF, CLEAN, DFP, TI, ...

WP 7: Project management

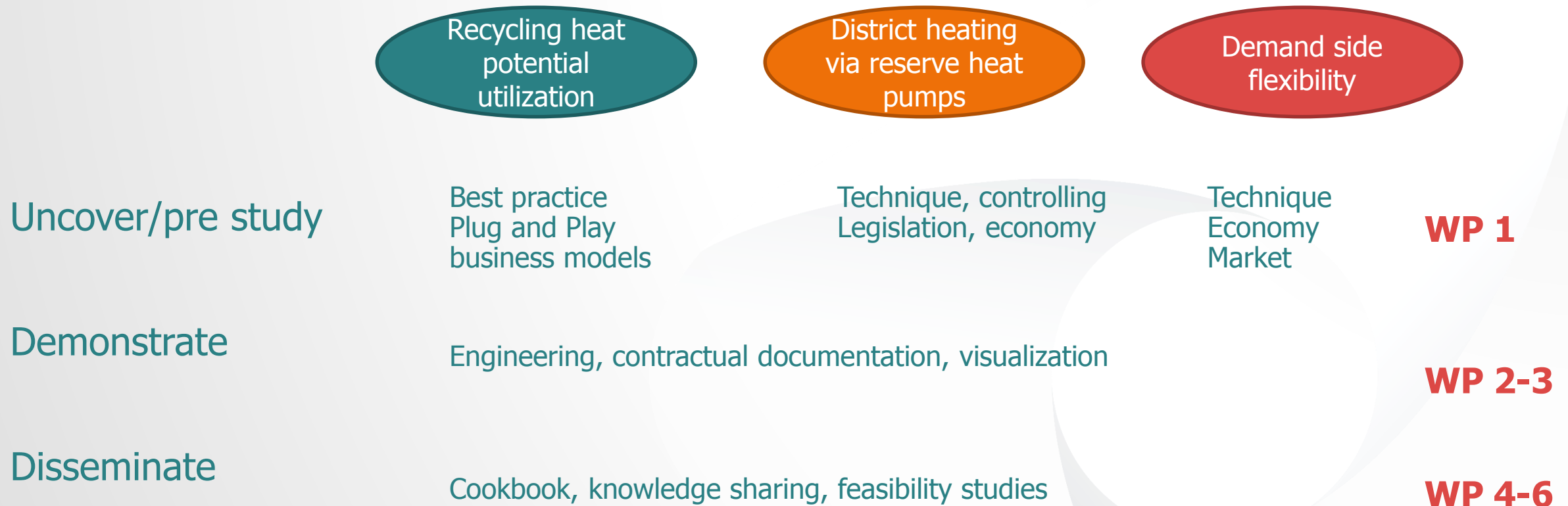
CLEAN

Recycling heat
potential
utilization

District heating
via reserve heat
pumps

Demand side
flexibility

Project Structure (2)

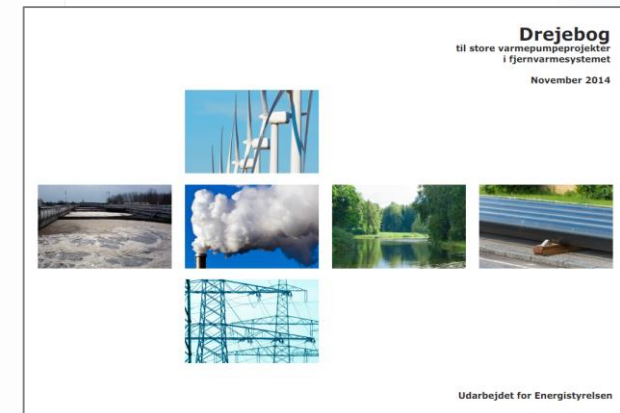


The knowledge sharing in the project

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1. Cookbook with guidelines
 2. Information meetings
 3. Seminars for consultants and district heating companies
 4. Articles in trade journals
 5. Webpage with case studies and project documents
 6. Closing Conference

Cookbook / Script for projects

- *The main deliverable of the project.*
- *For Supermarkets and district heating companies and their advisers.*
- *Results from the three COOP demonstration projects and 15 feasibility studies.*
- *Manuals, drawings, contracts, etc.*
- *Inspiration from "Script for large heat pumps in the district heating system".*



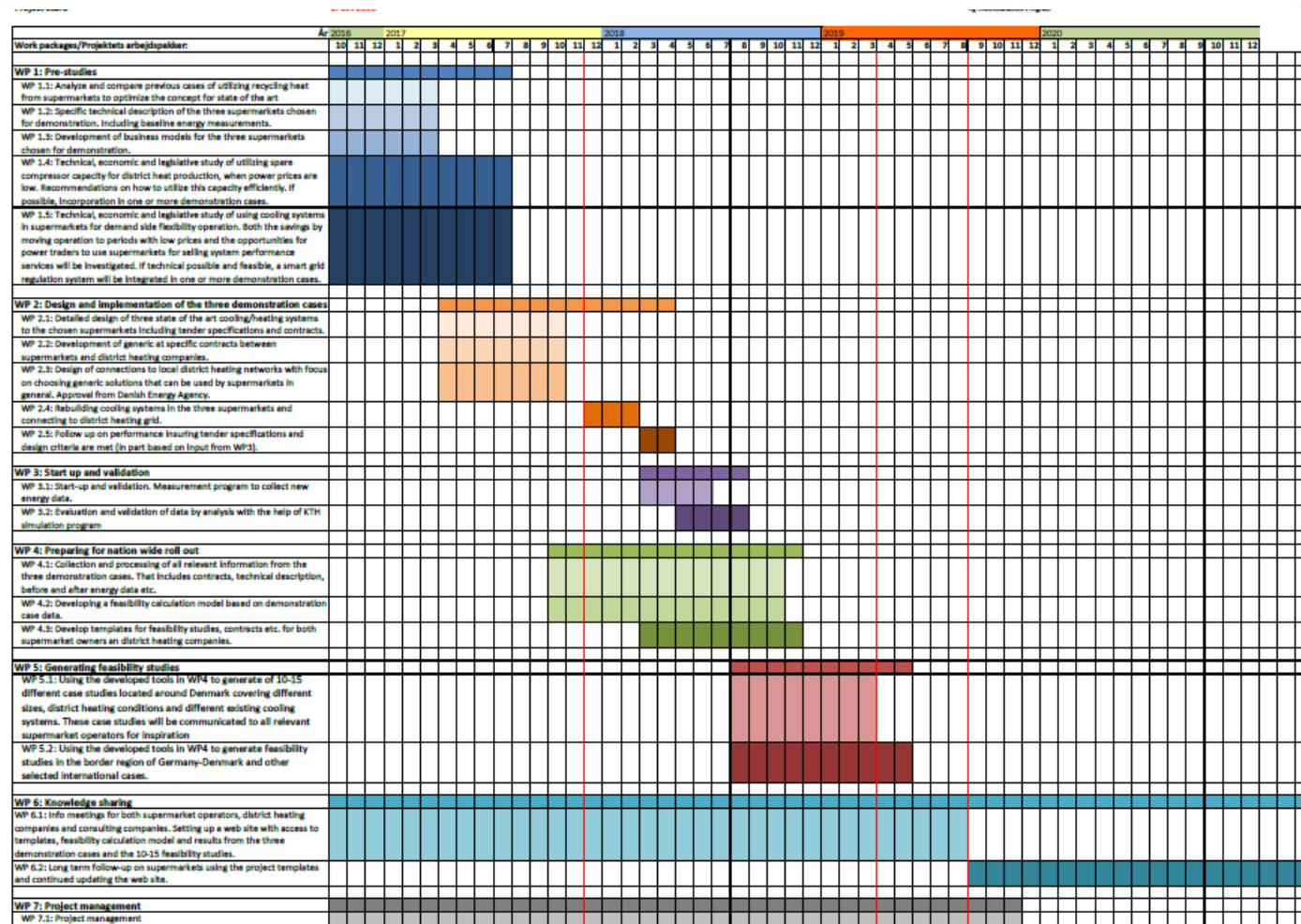
Time schedule and funding

Energy Technology Development and Demonstration Program - EUDP - supports the project

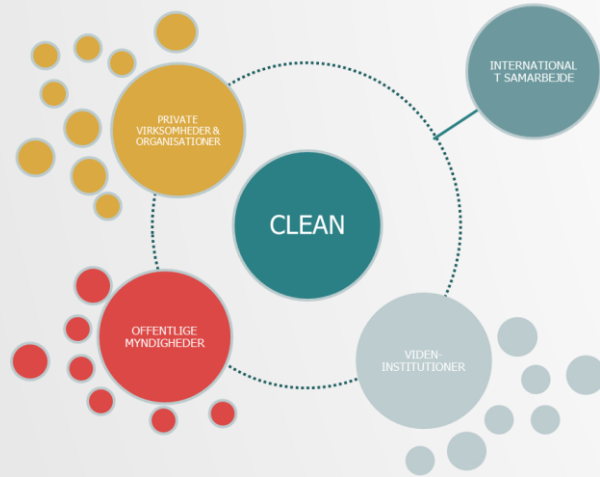


- Research salaries, total: 2.407.570 dkr.
- Equivalent to 5.355 hours
- Total other expenses: 652.538 dkr.
- Overhead: 1.847.967
- Total expenses: 4.908.075
- EUDP grant: 2.881.072 dkr.

The project runs from
01.11.2016 – 31.08.2019



NEW solutions in triple helix partnerships

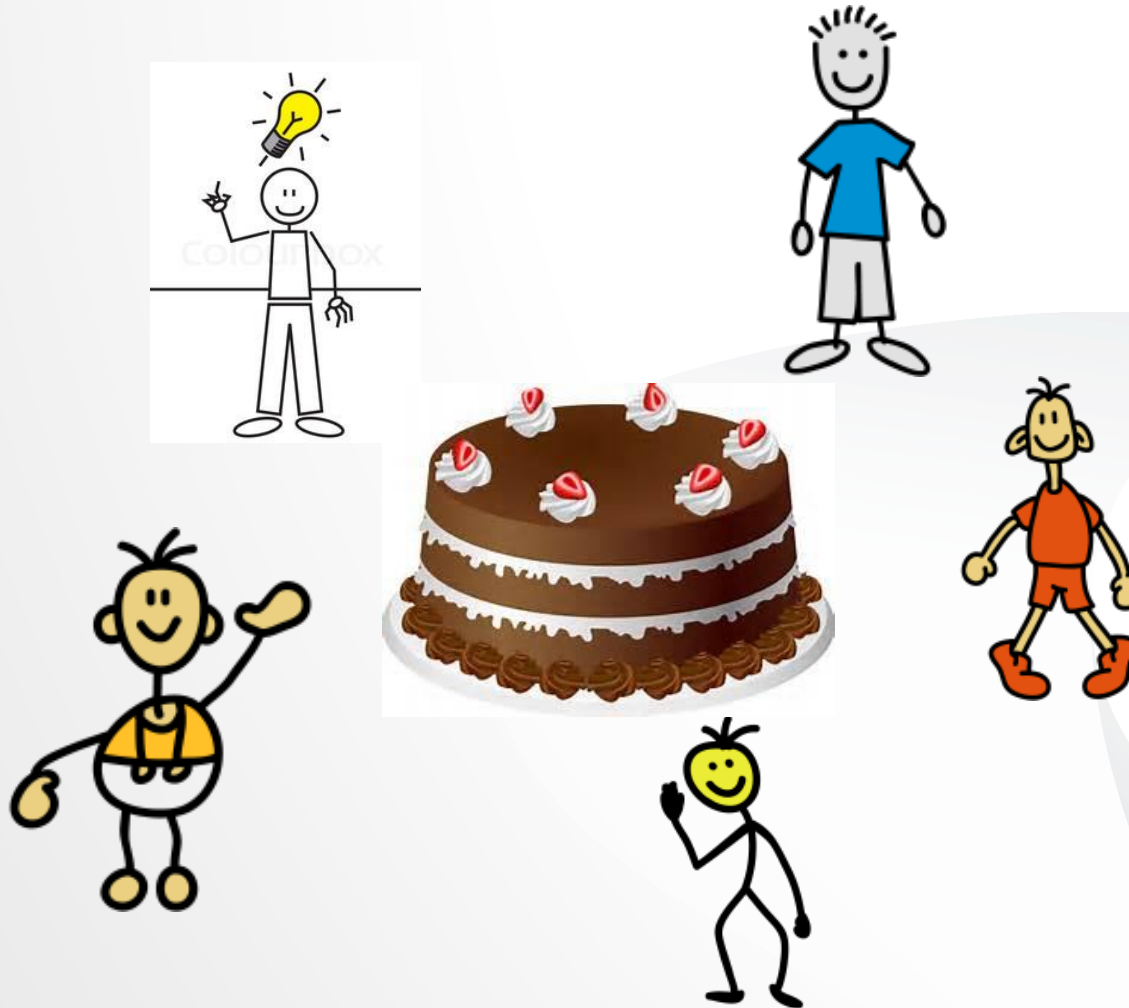


- To reach the ambitious goal, the Super Supermarket project has gathered a very strong project group.
- The project group has good knowledge of cooling and district heating systems, and the main business actors on supermarkets, cooling system equipment and district heating companies are represented in the project group.

PROJECT PARTNERS

- Danfoss A/S
- COOP A.M.B.A.
- Dansk Fjernvarme (DFF)
- OK A.M.B.A.
- Teknologisk Institut (TI)
- Ivar Lykke Kristensen (ILK)
- Dansk Fjernvarmes Projektselskab (DFP)
- AK-Centralen (AK-C)
- KTH Royal Institute of Technology Stockholm (KTH)
- Bramming Fjernvarme
- Mølholm Varmeværk
- Bjerringbro Varmeværk
- CLEAN

Challenge.... Many different partners



The risk... could be



The solution...



Solution in the long run...



Market potentials

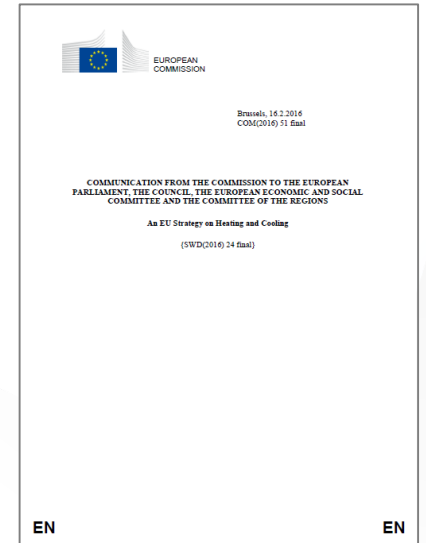
- The market for integrated system solutions is estimated to grow considerably during the coming years
- The global energy agenda and especially the EU agenda exemplified by the Heating and Cooling Strategy is directly targeting the area of heating and cooling efficiency, and even explicitly mentioning supermarkets and district heating

The target group for SUPER Supermarkets are composed by four main stakeholders:

- Supermarket owners
- District Heating suppliers
- Electricity providers
- Further engineering consultants

The number of addressable stores in DK is approximately 2,700:

- Out of these stores, only a certain fraction can be estimated to implement the full solution
- All stores are assumed to be implementing internal heat recovery
- The stores connected to the DH grid (50%) is assumed to sell the extra capacity from basic production to the DH grid, while 25% can also sell additional spare capacity
- 75% of the supermarkets are expected to be able to participate in a demand response program.





Thank you for your attention!

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