Solar systems and district heating

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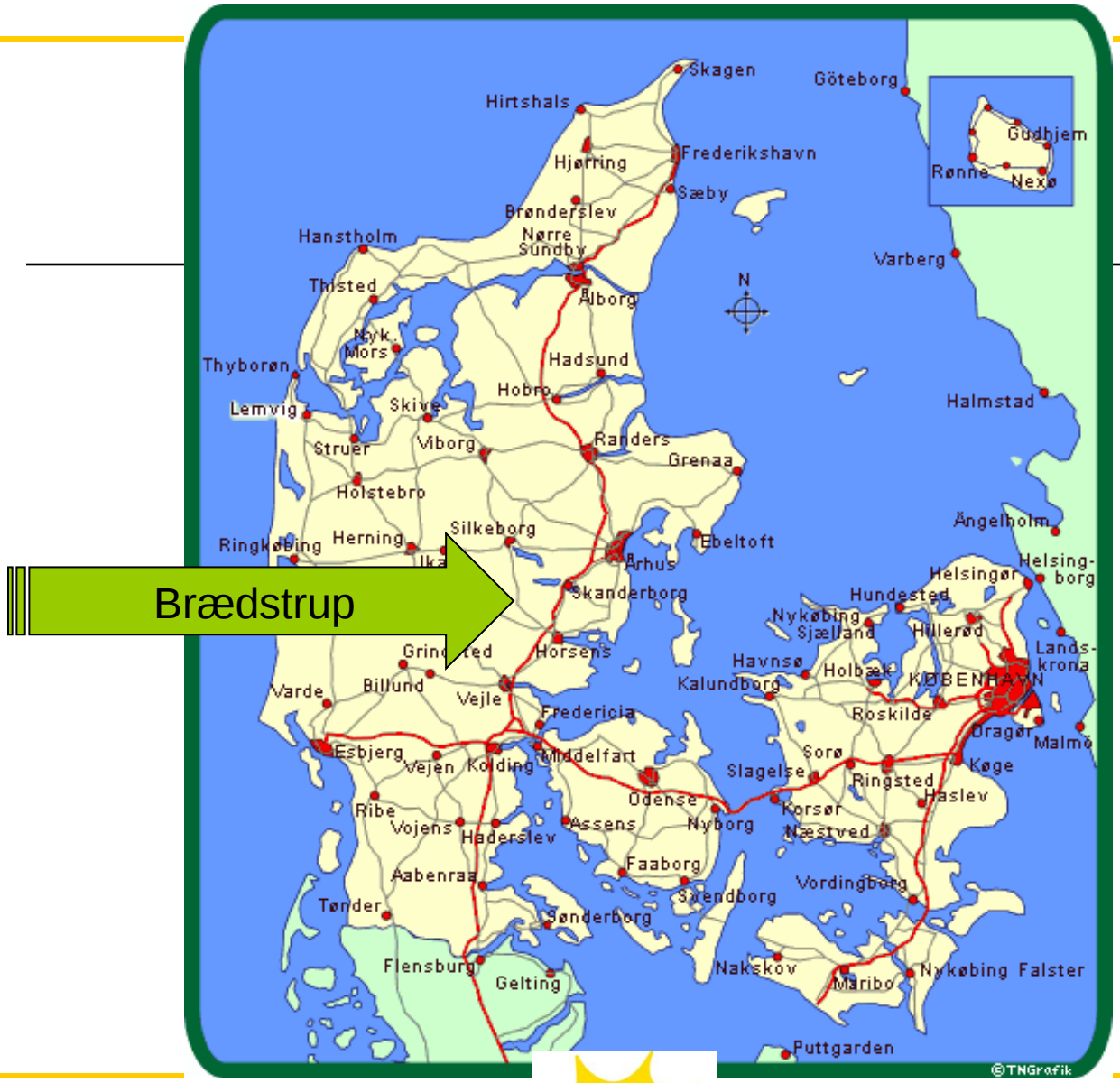
Braedstrup District Heating Company,
Denmark

Braedstrup District Heating



Braedstrup District Heating

Consumer owned district heating company

Brædstrup District Heating is a consumer owned district heating company with almost 1,500 consumers.

All large decisions are taken by the annual general assembly, where all consumers are invited and have a vote.

Consumers // total annual heat sales 2016 numbers:
296.378 m2 connected floor area
39.633 MWh heat produced
31.100 MWh heat sold

DH network
27.9 km distribution and 21.1 km service pipes. Network age of 17 years.

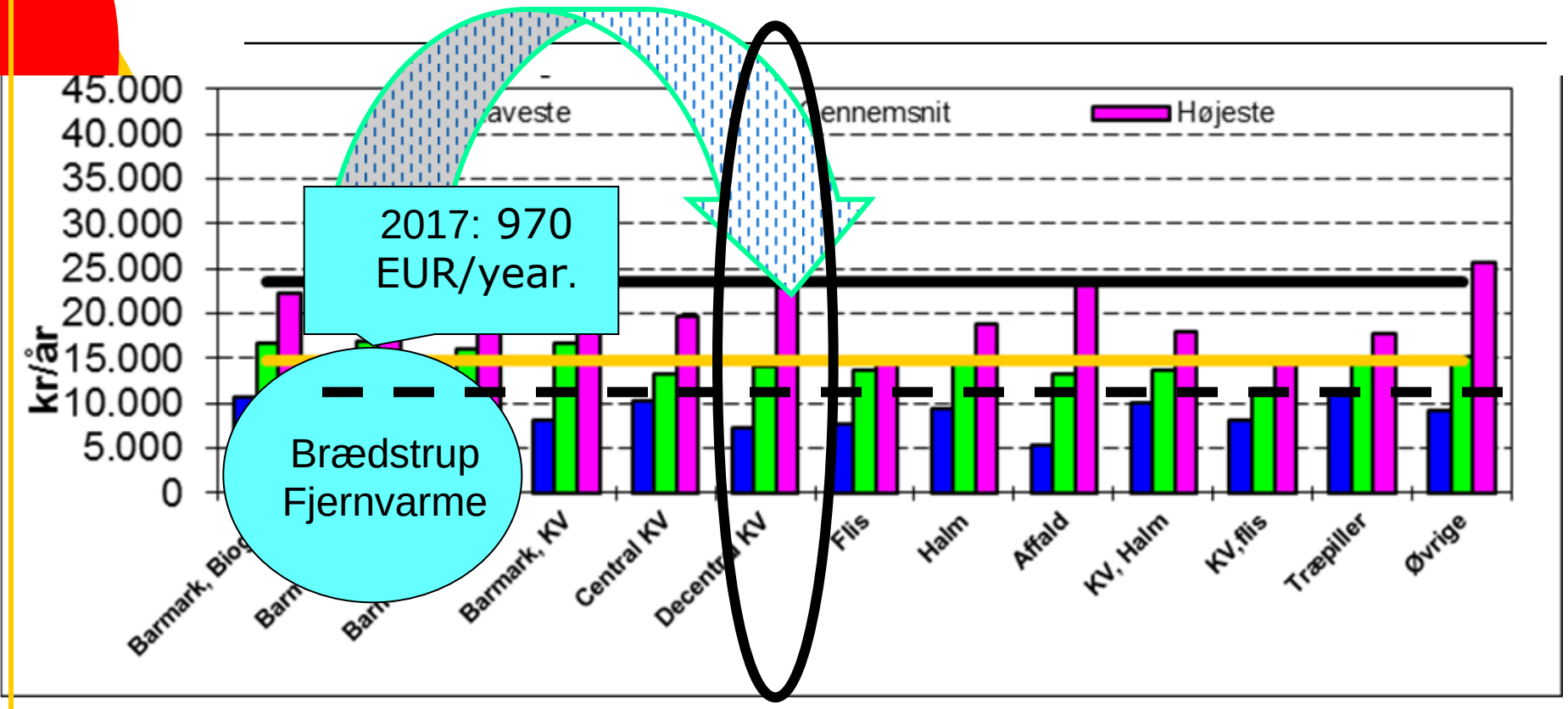
How to make district heating efficient

Brædstrup DH has over the last 10 years been a frontrunner in Denmark in how to make district heating efficient, cheap for the consumers and environmentally friendly at the same time.

This is done through activities in the electricity market, smart metering and introduction of service visits and support to improvement of house installations.

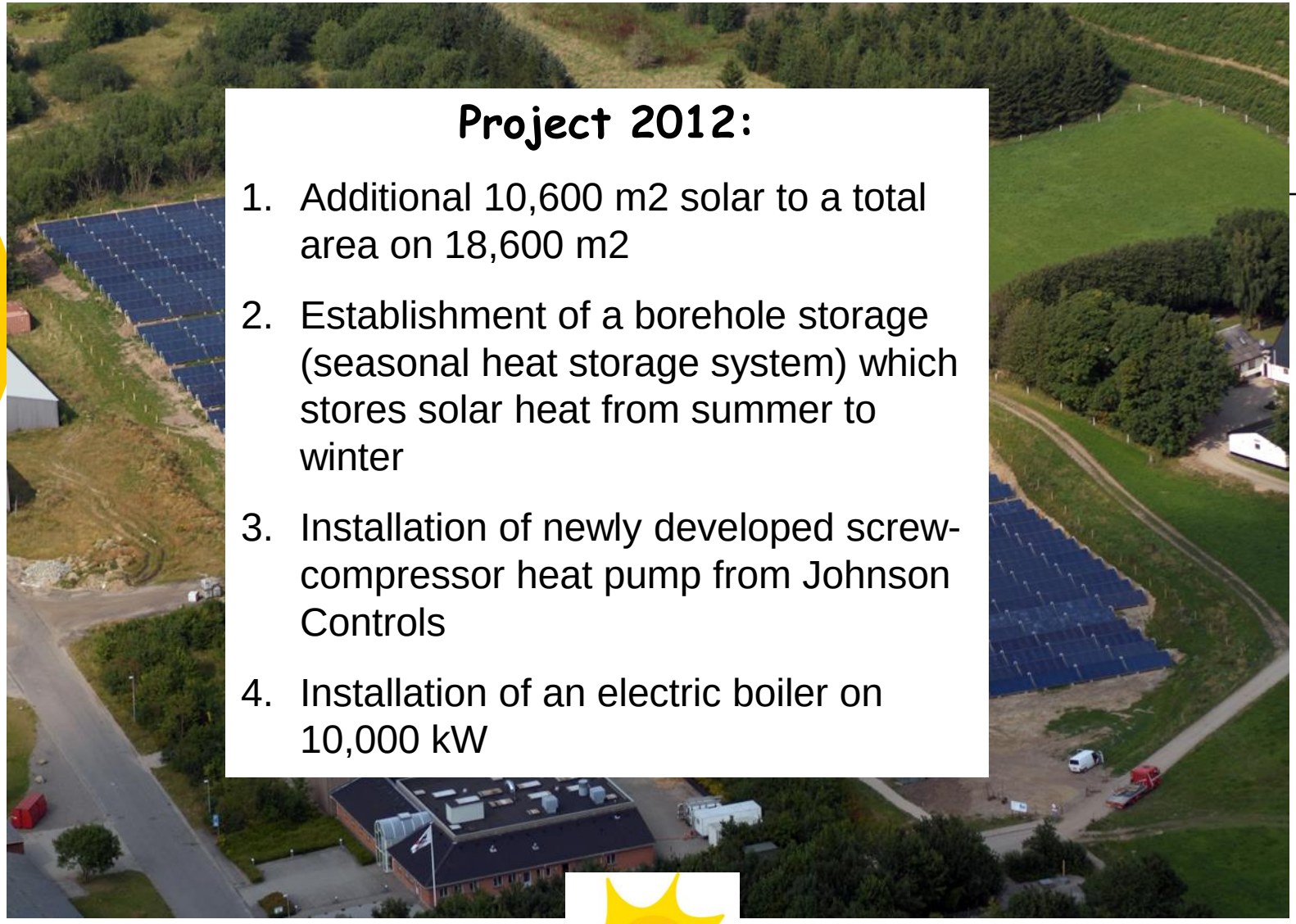
Increasing the efficiency and optimizing the production and distribution facilities in terms of technical economical and environmental aspects are central parts of the district heating company´s future policy.

Heat rate



standard house 18.1 MWh; 130 m2 incl. VAT

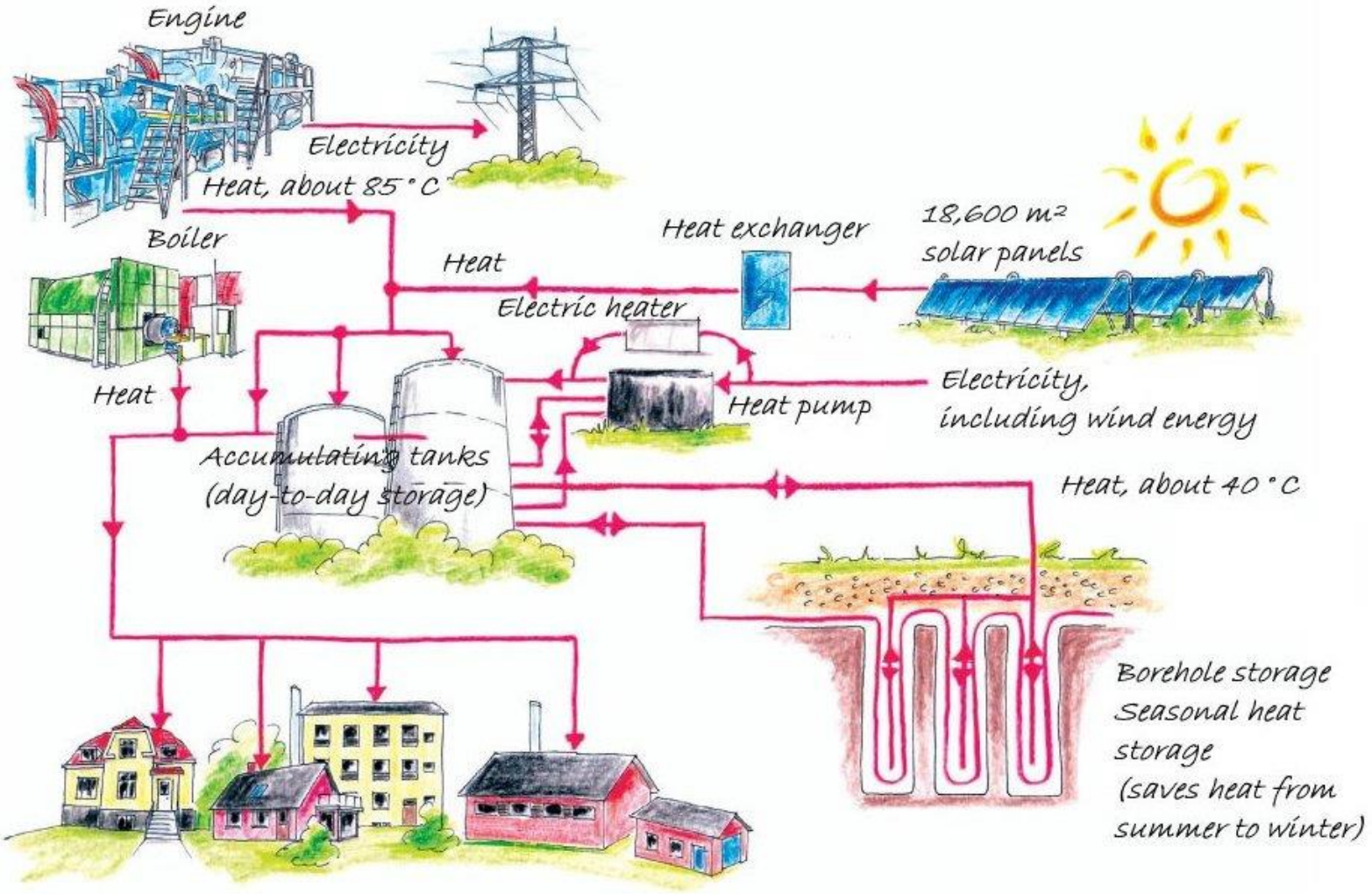
Kilde: Dansk Fjernvarme 2016

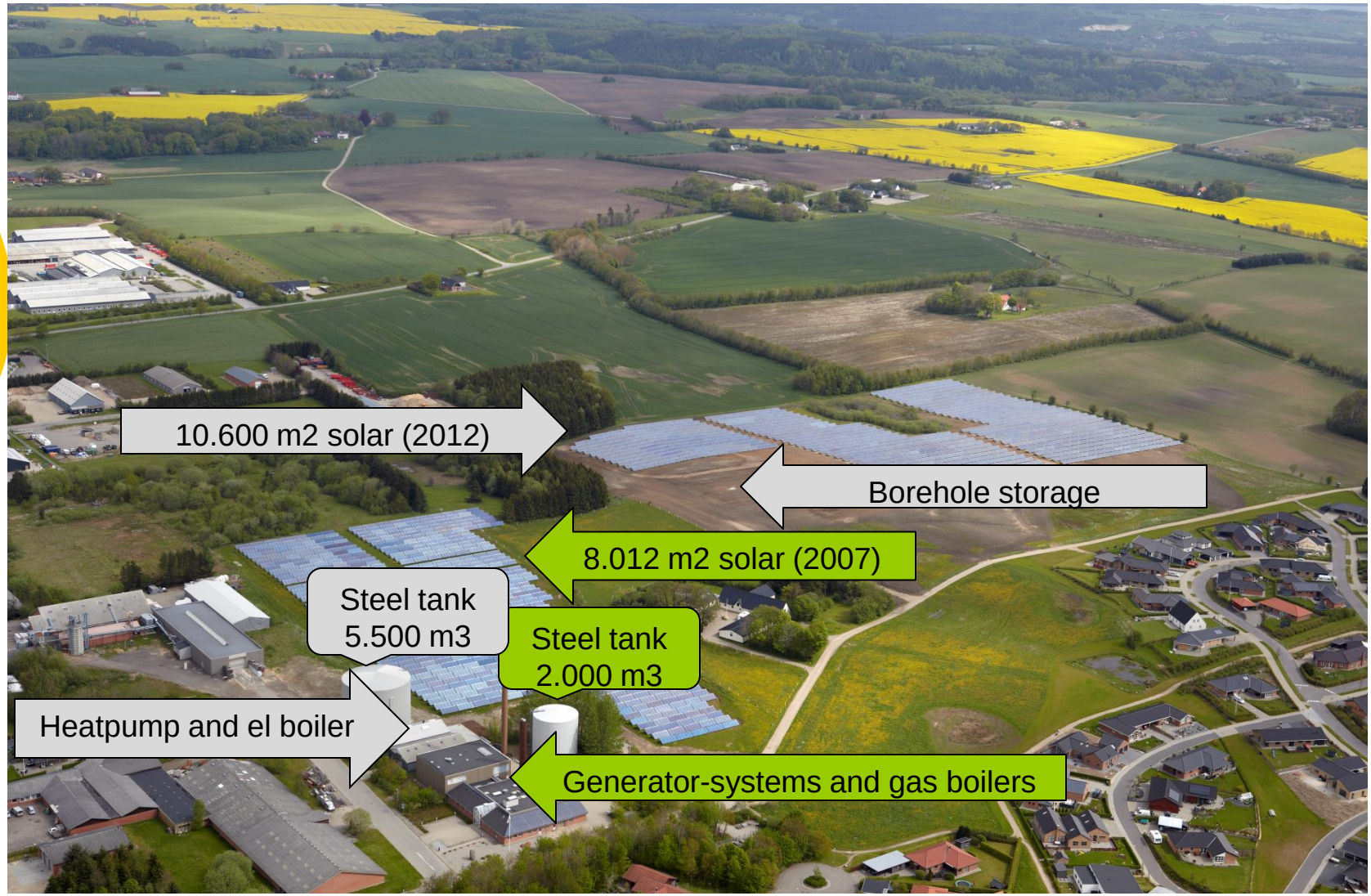


Project 2012:

1. Additional 10,600 m2 solar to a total area on 18,600 m2
2. Establishment of a borehole storage (seasonal heat storage system) which stores solar heat from summer to winter
3. Installation of newly developed screw-compressor heat pump from Johnson Controls
4. Installation of an electric boiler on 10,000 kW

Production plant




10.600 m2 solar (2012)
Borehole storage
8.012 m2 solar (2007)
Steel tank
5.500 m3
Steel tank
2.000 m3
Heatpump and el boiler
Generator-systems and gas boilers

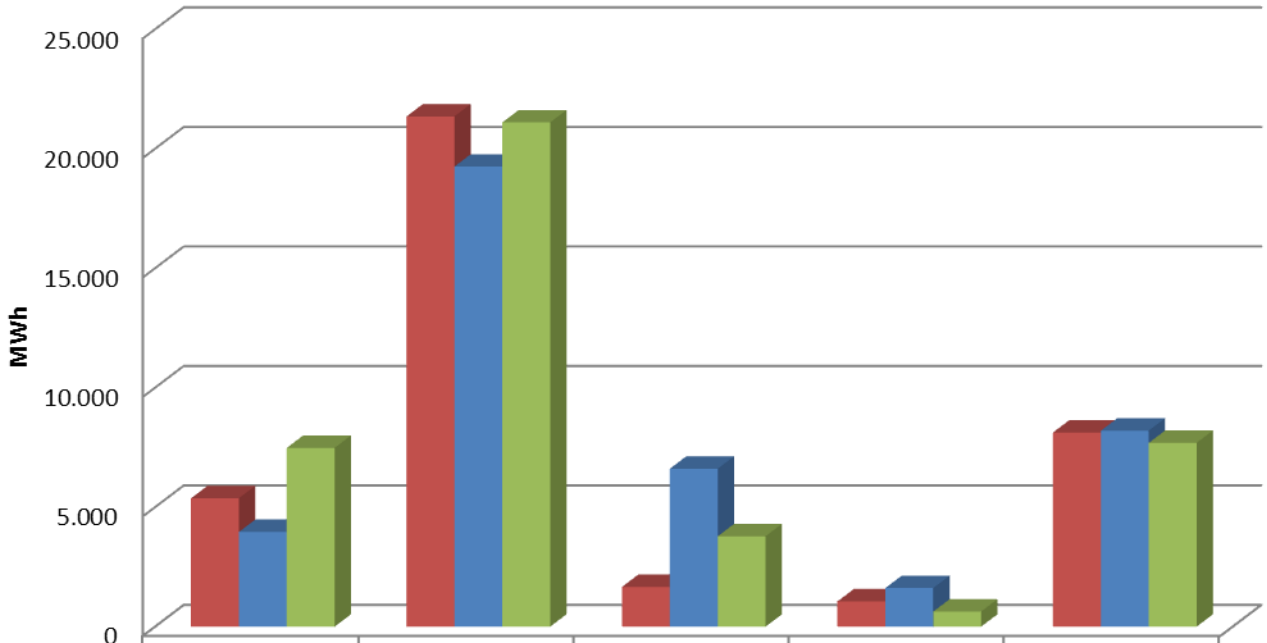
Technical data

18,600 m2 solar collectors
Electric boiler, 10 MW
Heat pump (high pressure screw compressor), 1.2 MW
Boiler 1, natural gas, 13.5 MW, 2006
Boiler 2, natural gas, 10 MW
Engine 1, natural gas, 4.1 MW (8.7 MW fuel)
Engine 2, natural gas, 4.1 MW (8.7 MW fuel)

Efficiency of plants

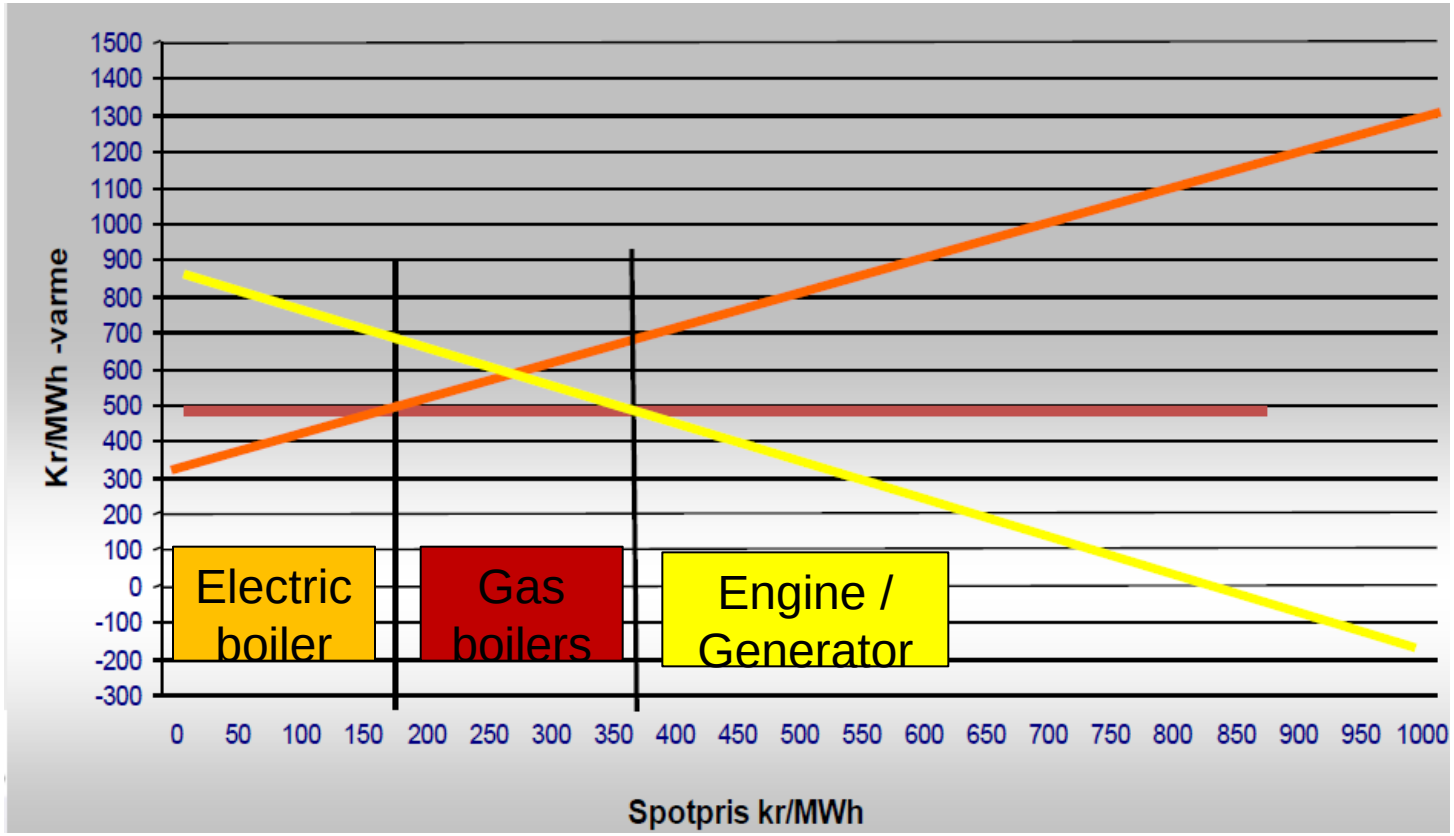
Boiler 1: 104%
Boiler 2: 100 %
Engine 1: η(heat) 47%, η(el) 42%
Engine 2: η(heat) 47%, η(el) 42%

Production of heat (MWh)

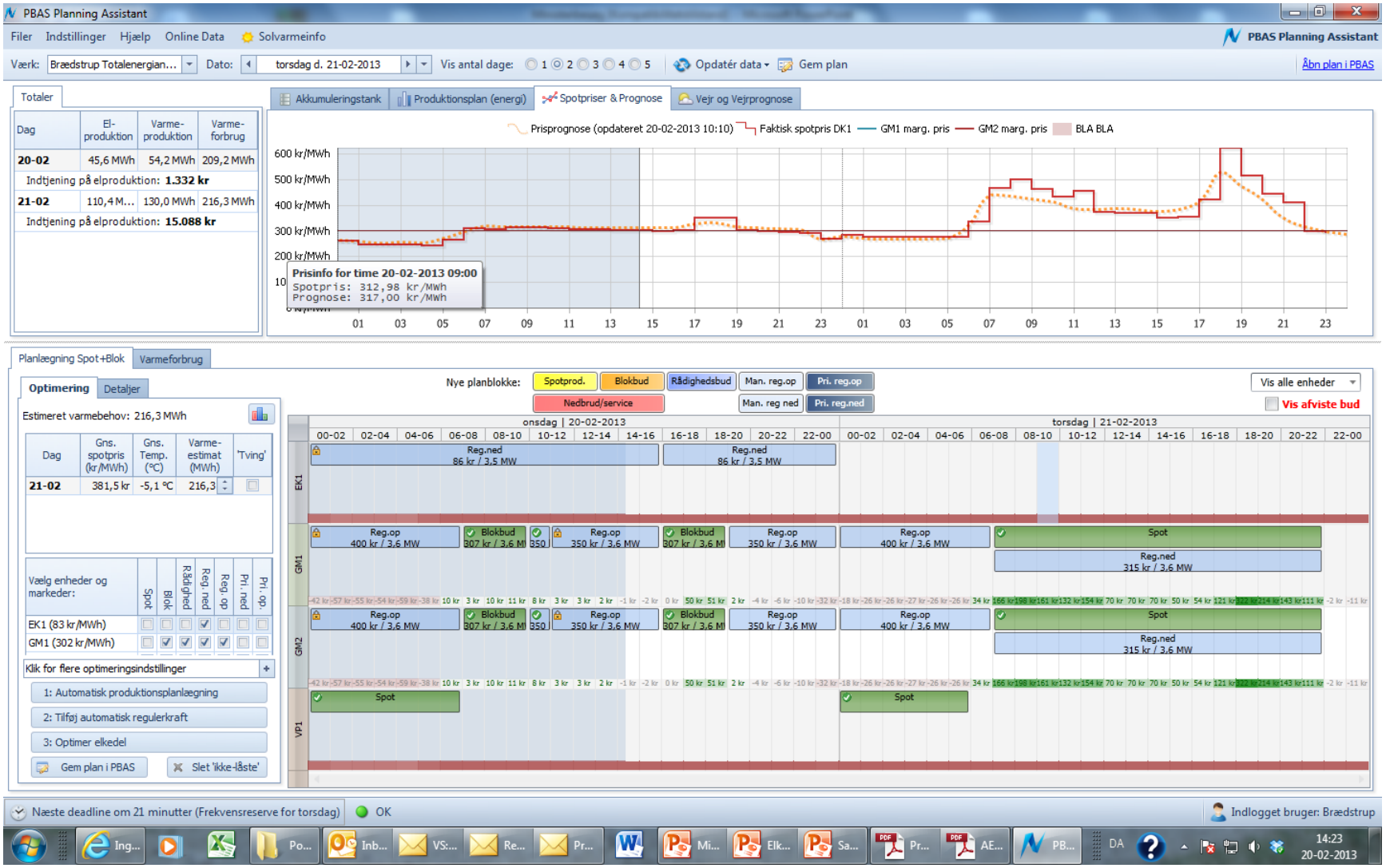


	Engine	Gas boilers	Electric boiler	Heat pump	Solar
2014	5.369	21.348	1.663	1.054	8.123
2015	3.961	19.250	6.607	1.614	8.201
2016	7.481	21.099	3.781	628	7.687

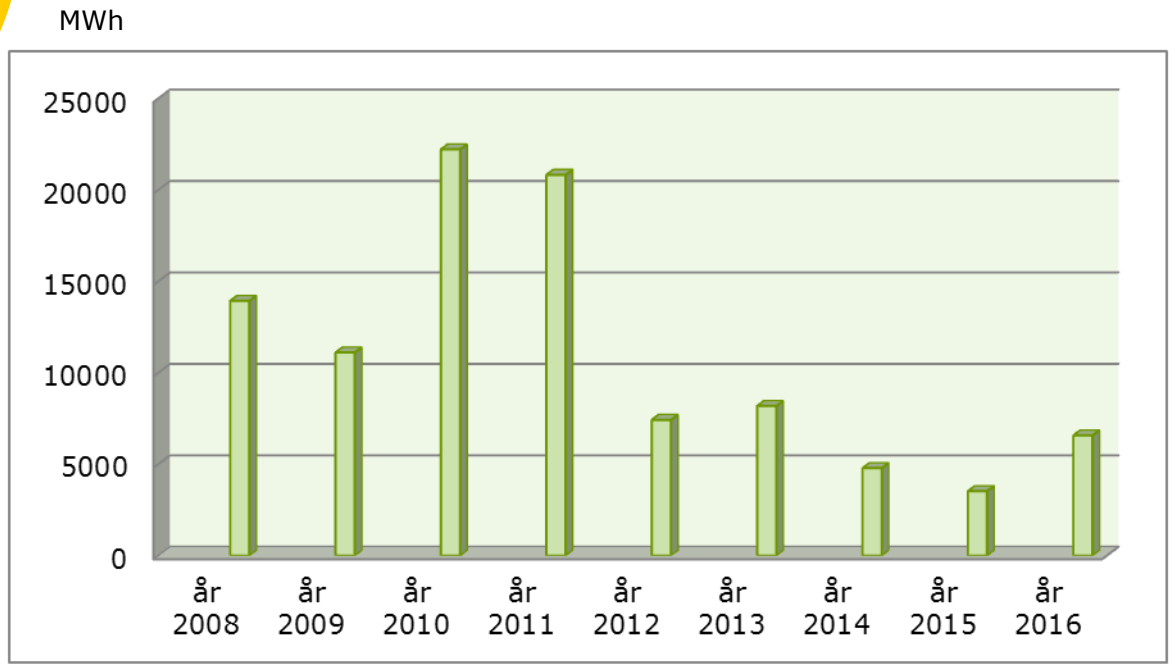
Combined heat and power
“Marginal Price”



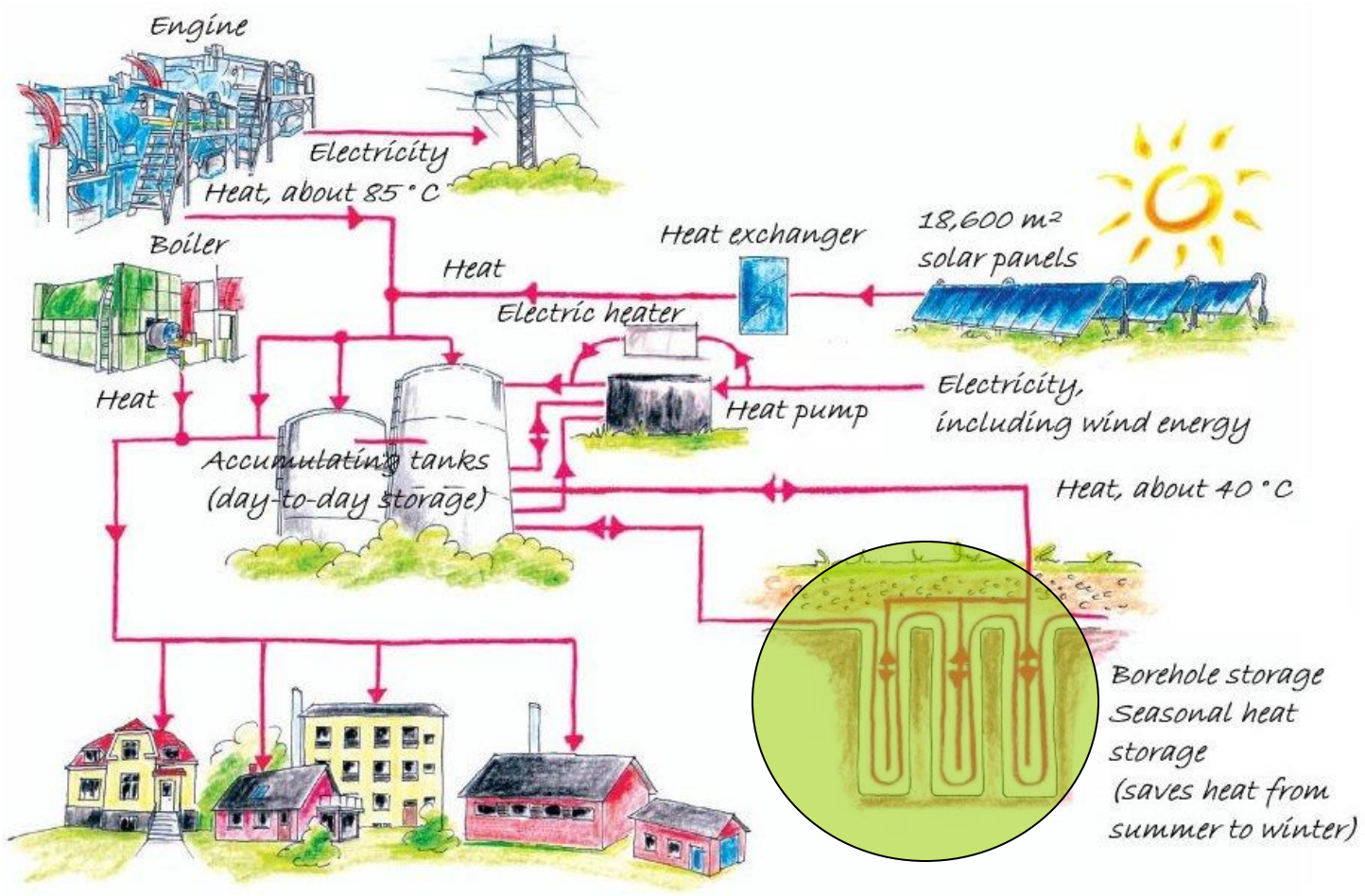
How to operate a combined heat and power plant



Historical electricity sales.

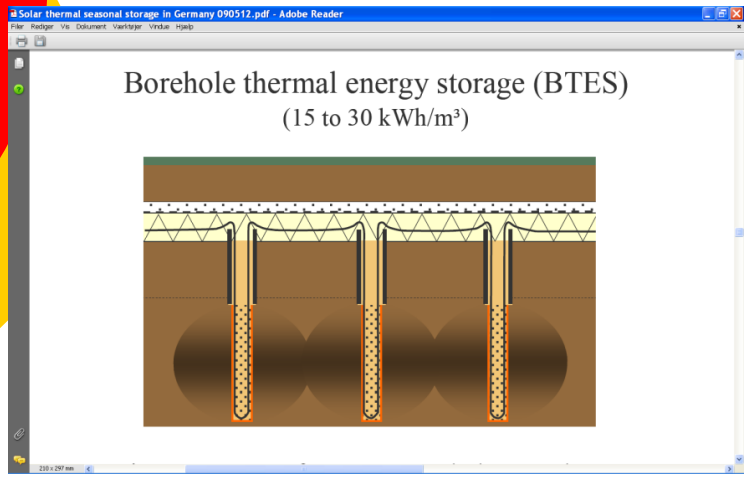


Borehole storage / 450 MWh BTES



Brædstrup 450 MWh BTES

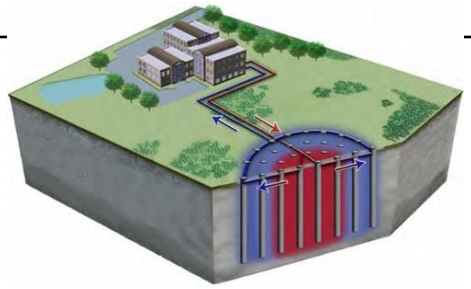
Brædstrup 450 MWh BTES

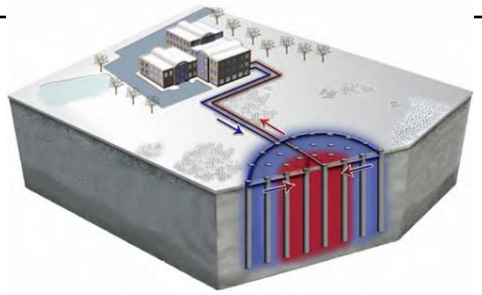


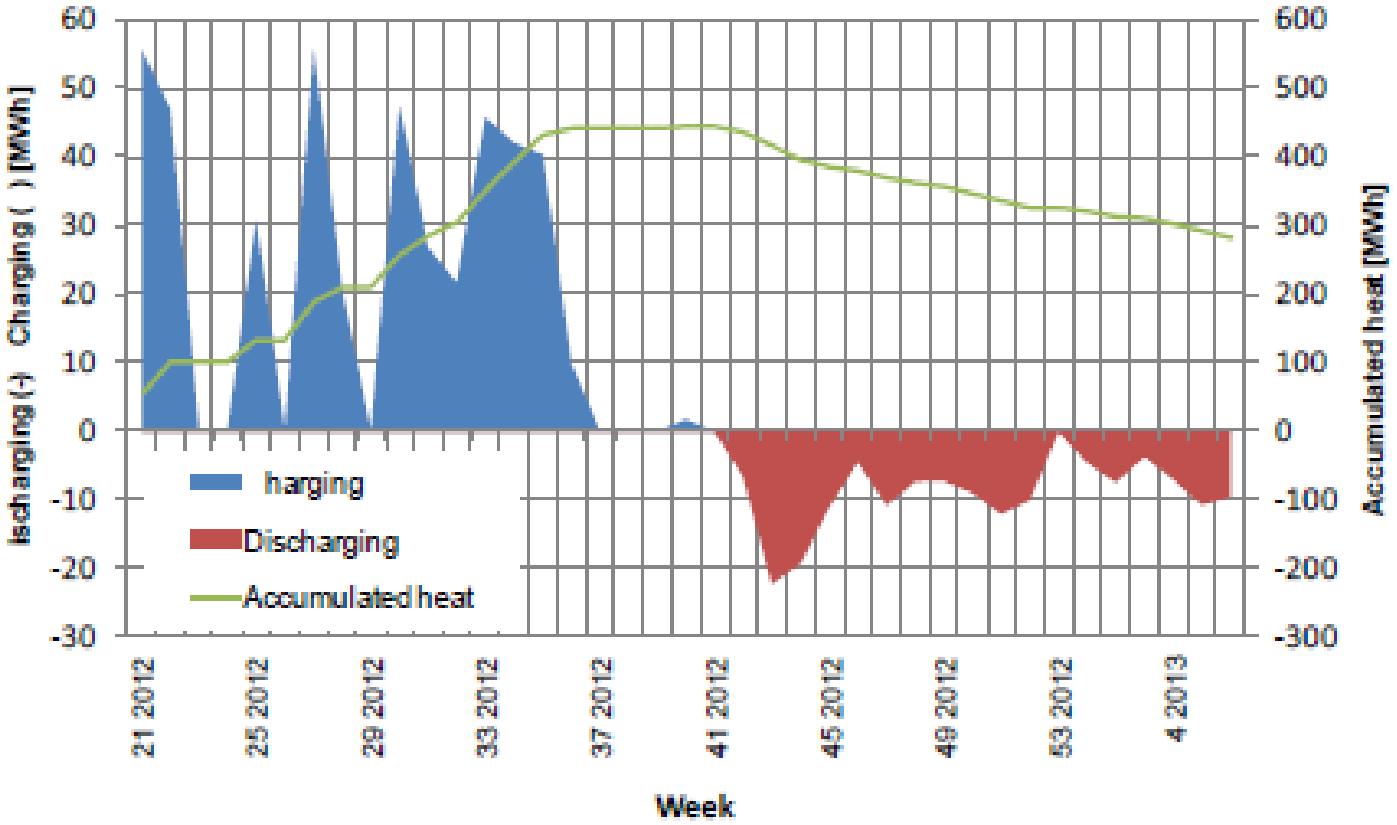
Bore hole – seasonal storage:
48 bore holes
Probes lowered to a depth of 45 meters
5 x 60 meters deep holes for temperature sensors
19,000 m³ soil is heated
4.750 m3 water

Short time storage:
Steel-tank, in total 7,500 m3
2,500 m3 in connection to CHP
5,500 m3 in connection to solar collectors, electric boiler

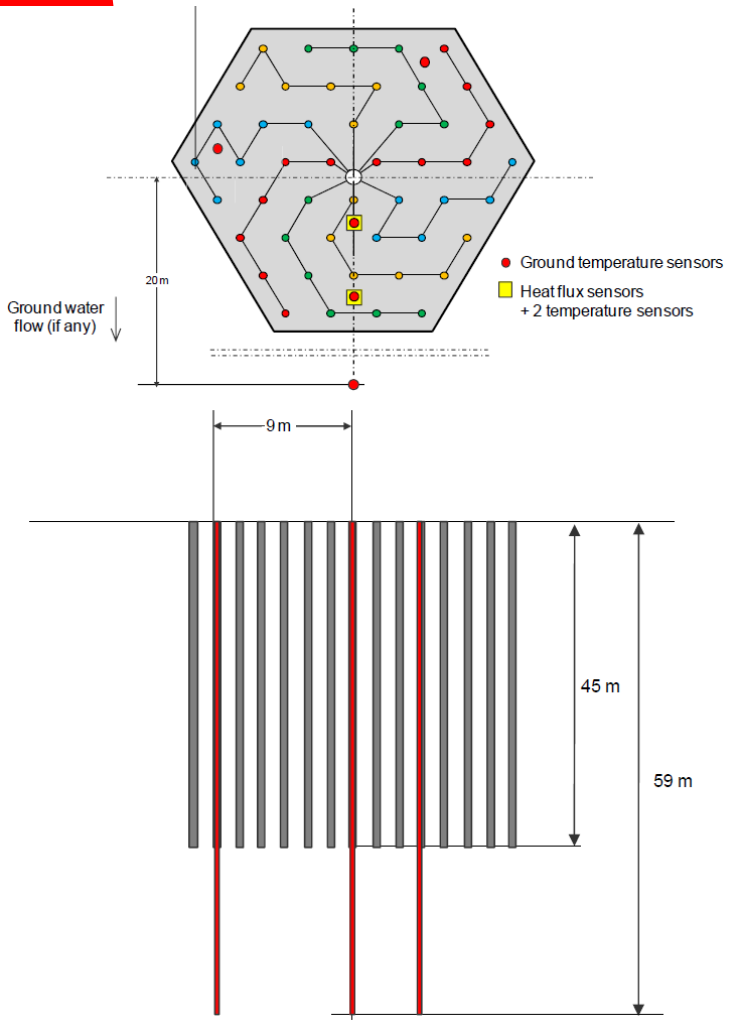
Borehole-storage system



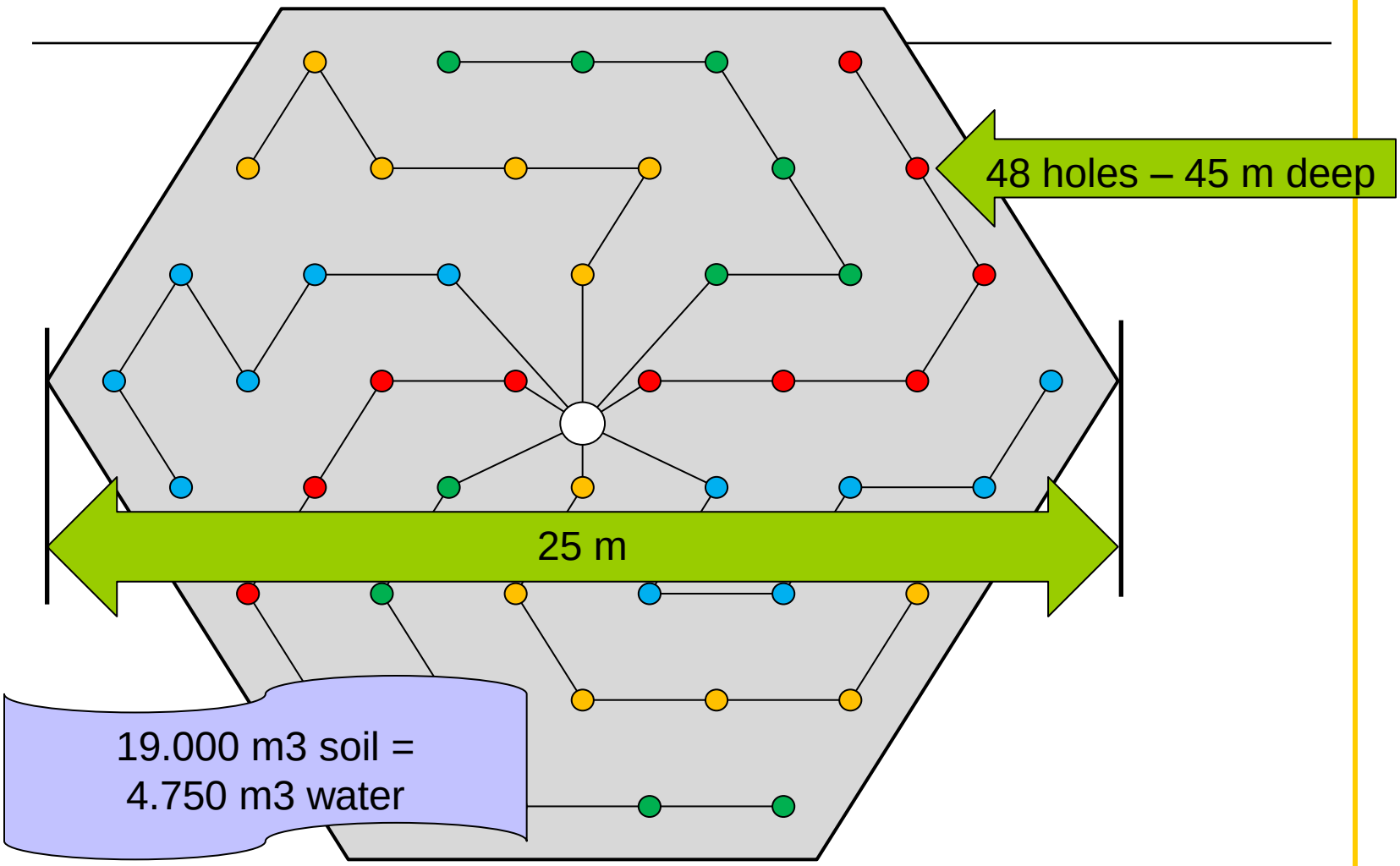




Borehole-storage system

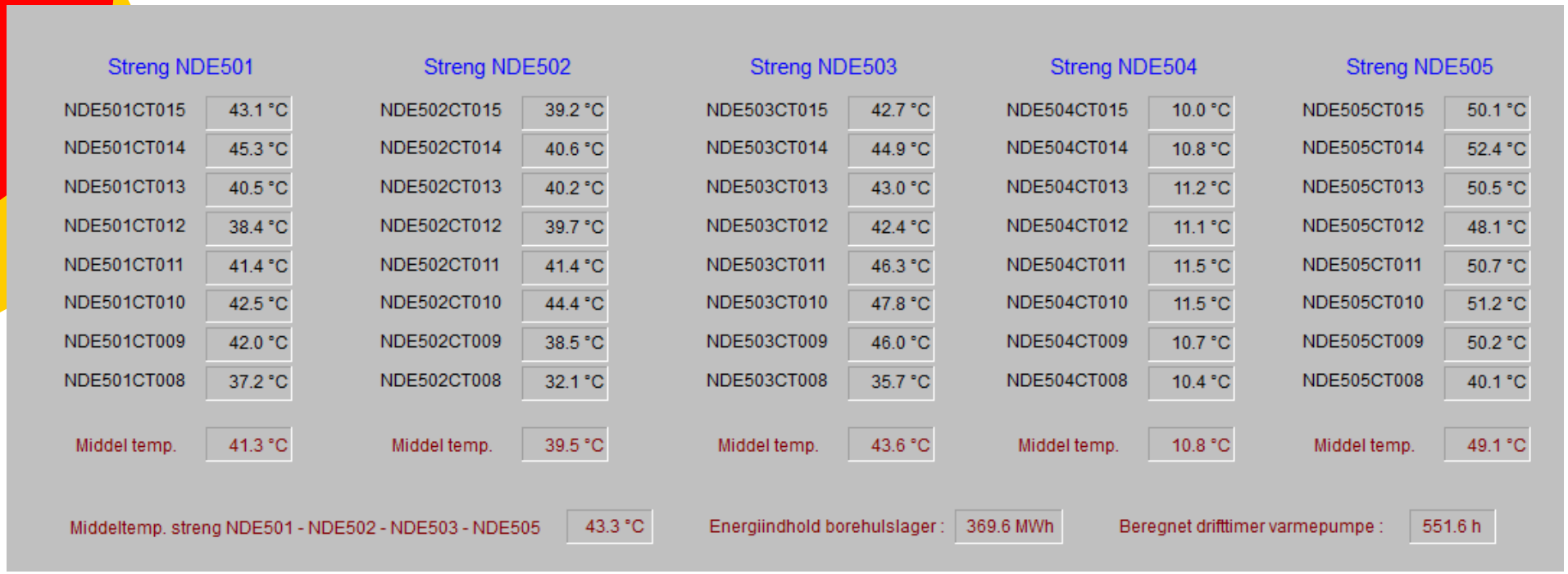


Borehole-storage system



Borehole-storage system

Borehole-storage system
Energy and temperature



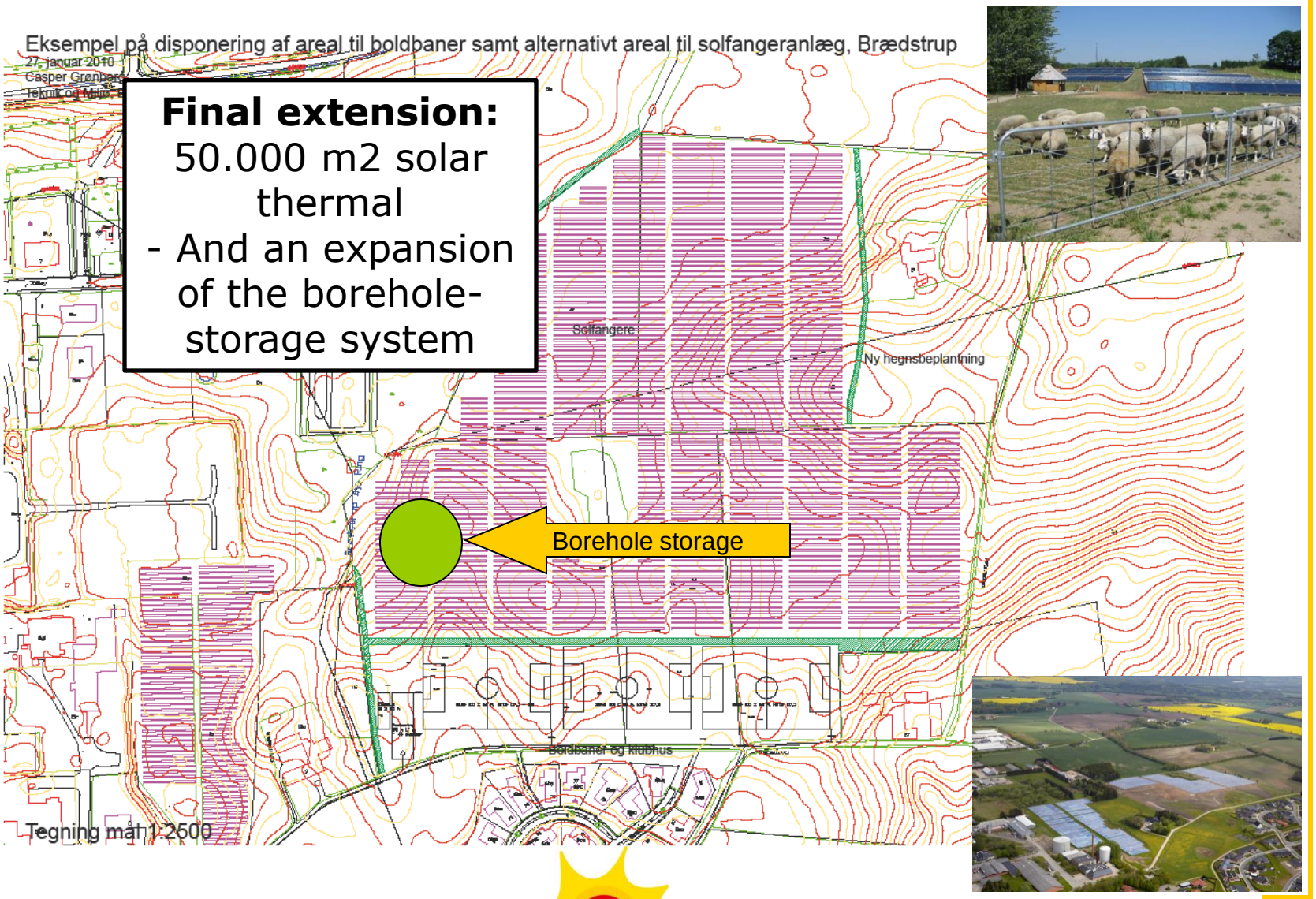
Streng NDE501		Streng NDE502		Streng NDE503		Streng NDE504		Streng NDE505	
NDE501CT015	43.1 °C	NDE502CT015	39.2 °C	NDE503CT015	42.7 °C	NDE504CT015	10.0 °C	NDE505CT015	50.1 °C
NDE501CT014	45.3 °C	NDE502CT014	40.6 °C	NDE503CT014	44.9 °C	NDE504CT014	10.8 °C	NDE505CT014	52.4 °C
NDE501CT013	40.5 °C	NDE502CT013	40.2 °C	NDE503CT013	43.0 °C	NDE504CT013	11.2 °C	NDE505CT013	50.5 °C
NDE501CT012	38.4 °C	NDE502CT012	39.7 °C	NDE503CT012	42.4 °C	NDE504CT012	11.1 °C	NDE505CT012	48.1 °C
NDE501CT011	41.4 °C	NDE502CT011	41.4 °C	NDE503CT011	46.3 °C	NDE504CT011	11.5 °C	NDE505CT011	50.7 °C
NDE501CT010	42.5 °C	NDE502CT010	44.4 °C	NDE503CT010	47.8 °C	NDE504CT010	11.5 °C	NDE505CT010	51.2 °C
NDE501CT009	42.0 °C	NDE502CT009	38.5 °C	NDE503CT009	46.0 °C	NDE504CT009	10.7 °C	NDE505CT009	50.2 °C
NDE501CT008	37.2 °C	NDE502CT008	32.1 °C	NDE503CT008	35.7 °C	NDE504CT008	10.4 °C	NDE505CT008	40.1 °C
Middel temp.	41.3 °C	Middel temp.	39.5 °C	Middel temp.	43.6 °C	Middel temp.	10.8 °C	Middel temp.	49.1 °C

Middeltemp. streng NDE501 - NDE502 - NDE503 - NDE505 43.3 °C

Energiindhold borehulslager : 369.6 MWh

Beregnet drifttimer varmepumpe : 551.6 h

Braedstrup District Heating

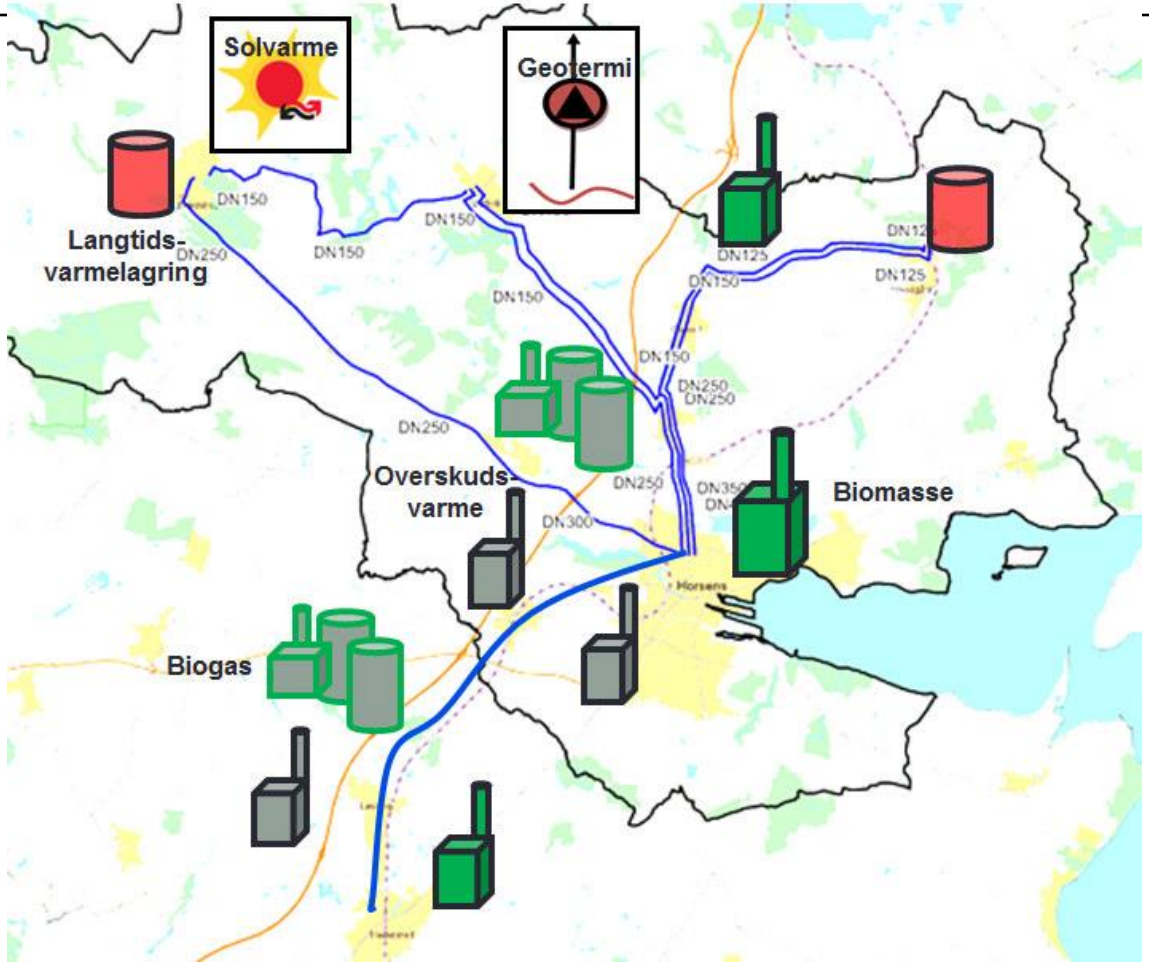


Final extension:
50.000 m2 solar thermal
- And an expansion of the borehole-storage system

Alternative possibilities to maintain the low prices and so high customer satisfaction as possible - and with focus on the environmental conditions

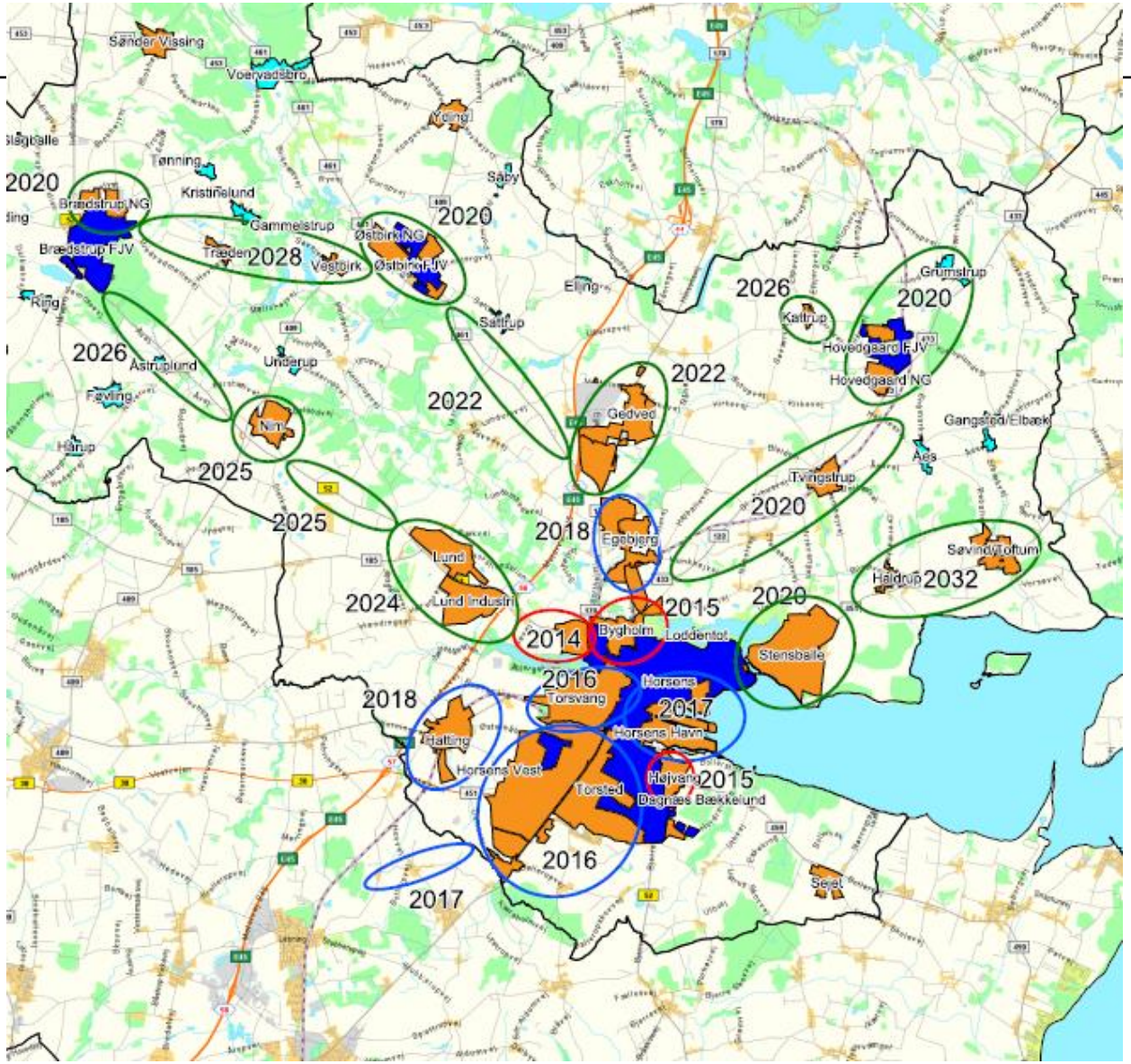
The next step towards 100 % RE solutions is prepared in cooperation with six other district heating utilities in the municipalities Horsens and Hedensted. Brædstrup DH took initiative to this cooperation in 2011. Until now the cooperation has resulted in a common design study called FlexCities analysing how to convert to 100 % RE solutions using combinations of excess heat from industries, large solar thermal plants connected to the transmission pipes, large scale heat storages, large scale heat pumps, biogas CHP and conversion of individually heated houses to district heating.

Projekt ”Flex Cities”

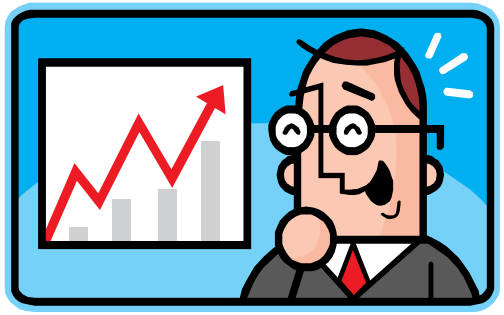


Transmission pipes

” Strategic energy plan”



How to motivate citizens to start and join a district heating project



Positive interest among housholds and business

City council can make a ” Strategic energy plan”

The opportunities for economically feasible, to start CO2-neutral heat carefully analyzed and generated a price per. MW incl. operation and maintenance.

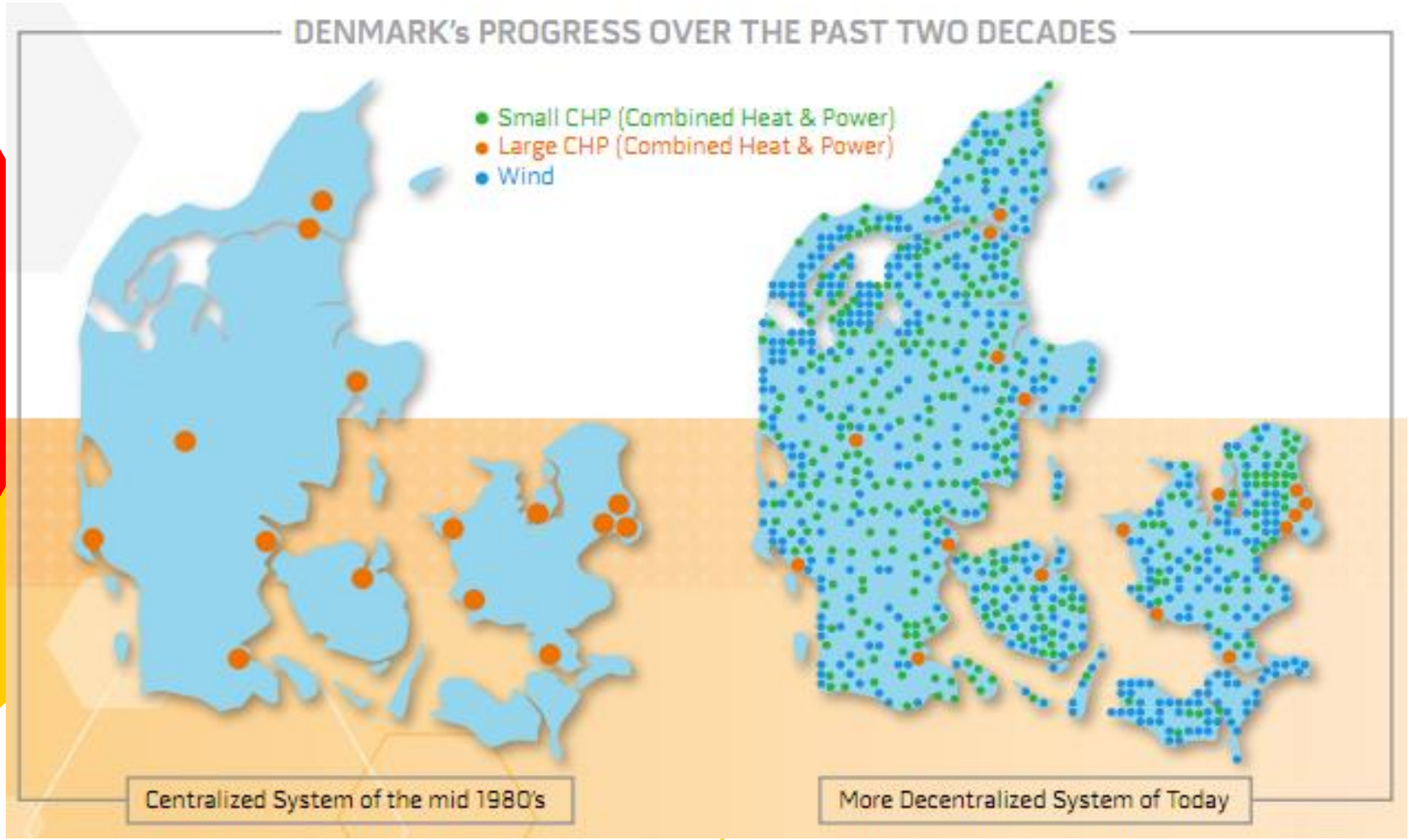
Activities in the electricity market and consider a lot on flexibility

Smart metering and introduction of service visits and support to improvement of house installations.

Consider new business opportunities

” Strategic focus ”

In order to ensure a stable energy supply at a reasonable price you have to think very long and not be afraid to think innovatively. Consider a lot on flexibility

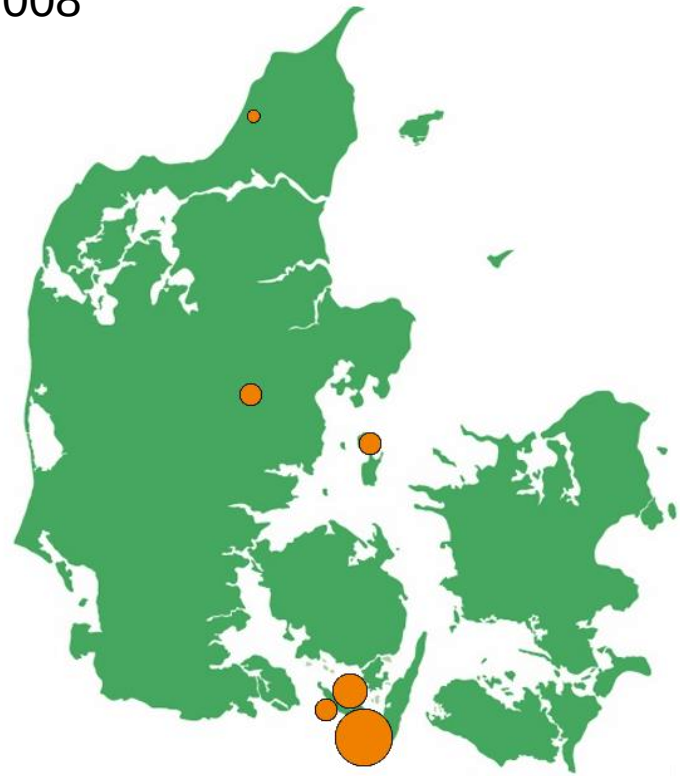


Braedstrup District Heating

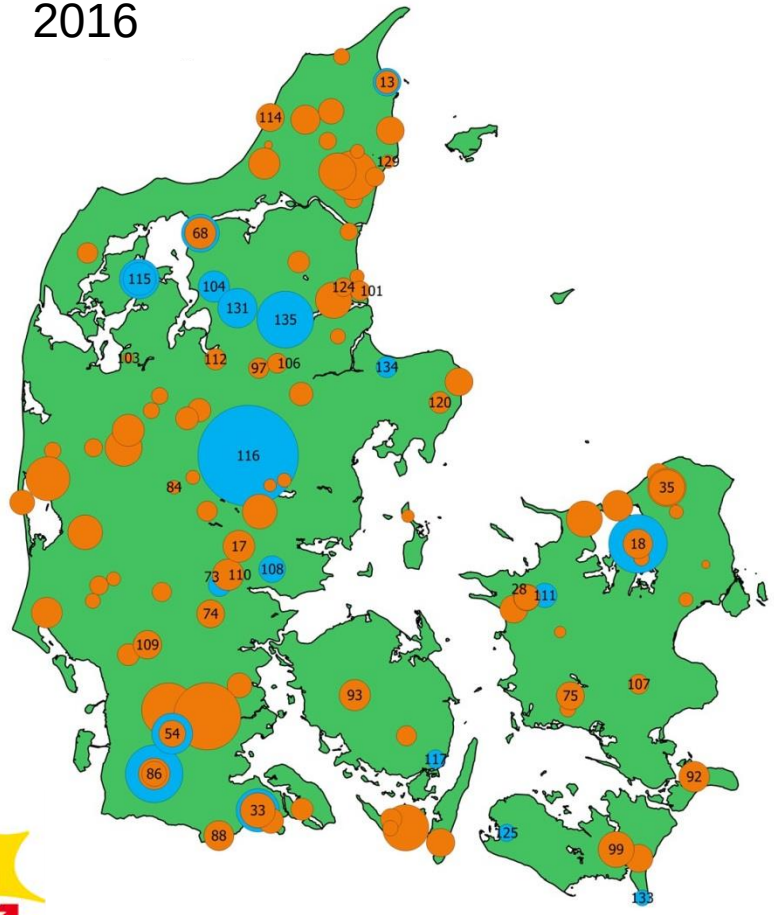
what are the first steps?

Existing
Planned
Unit: m^2

2008



2016



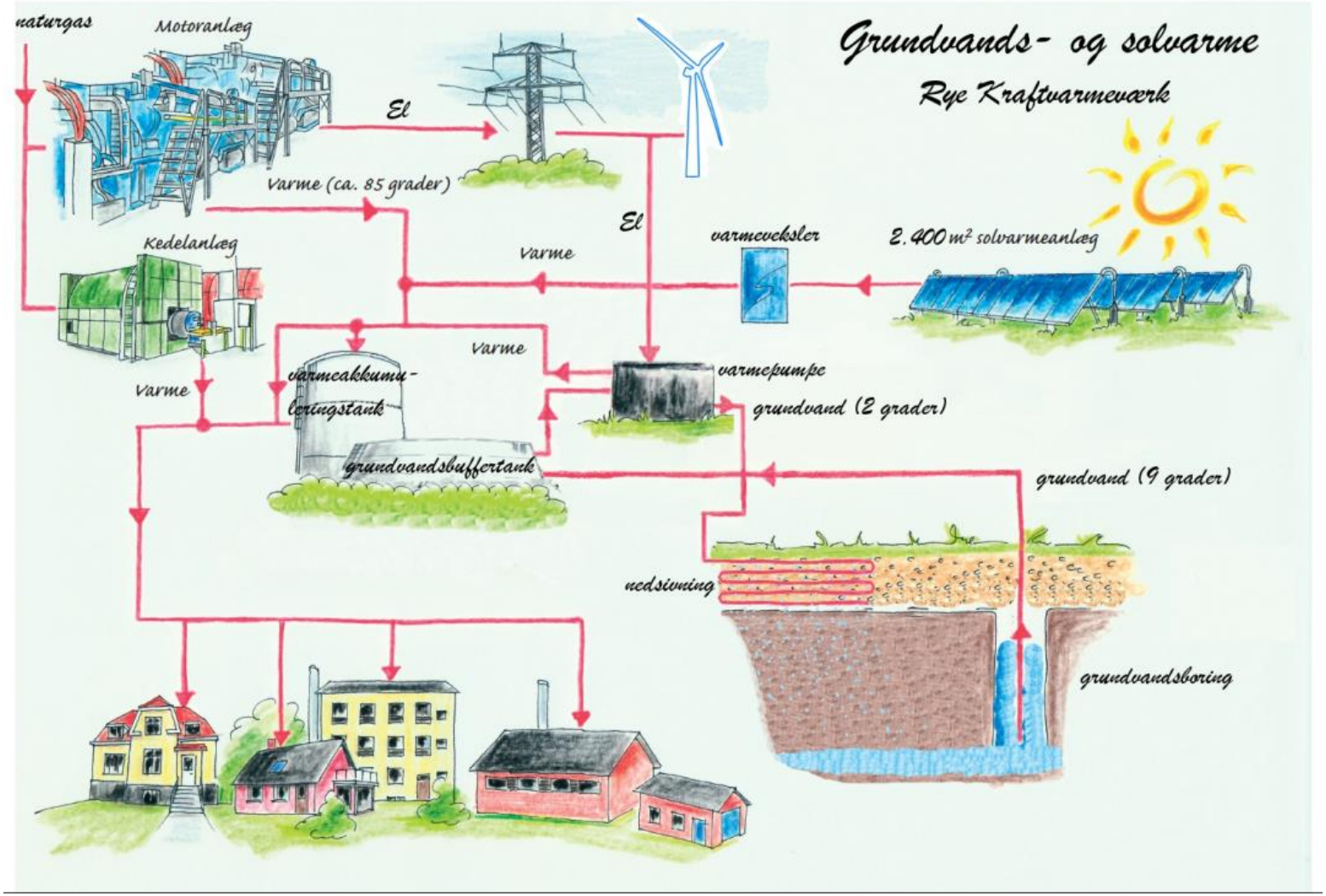
what are the first steps?

Braedstrup District Heating

The world's largest solar heating plant is in DK
The total installation consists of a 156.694 m2 solar heating plant and number of solar collectors is 12.436

Operations and administration of Rye Kraftvarmeværk

Operations and administration of Rye Kraftvarmeværk



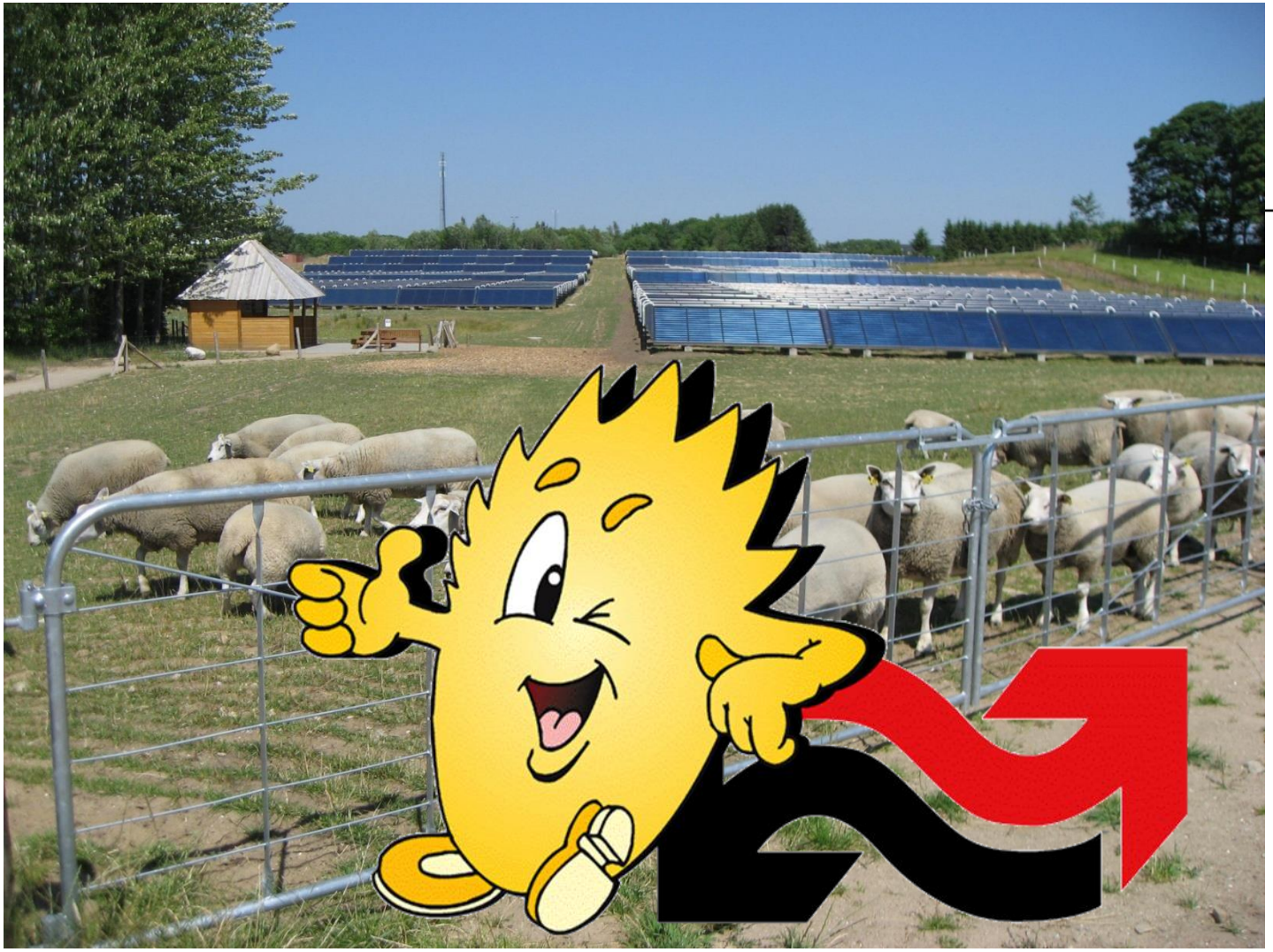
Operations and administration of Rye Kraftvarmeværk

Data samlet for hele anlægget

Køleeffekt:	1.584 kW
Varmeeffekt:	2.048 kW
Optagen el-effekt:	515 kW
Kold side:	194,6 m³/h vand kølet fra +9°C til +2°C
Varm side:	44 m³/h vand opvarmes fra +35°C til +75°C

Samlede COPvarme bliver ved ovenstående driftskonditioner: 2.048 kW/515 kW = 3,98

Financiel management and administration of 11 water utilities companies



Thank you for your attention