HEATSTORE WEBINAR SERIES

HOW TO DEVELOP UNDERGROUND THERMAL ENERGY STORAGE (UTES) PROJECTS?

Learnings from the European HEATSTORE project

Host: TNO, The Netherlands

7, 14, 21, 28 Sept. and 5, 12 Oct. 2021 | all 15-16 h (CEST)

Register on www.heatstore.eu

HEATSTORE WEBINAR SERIES 2021

All webinars are at 15 – 16 h CEST

Tuesday 7 Sept. (Holger Cremer, TNO): Challenges in Underground Thermal Energy Storage (UTES)

Tuesday 14 Sept. (Thomas Driesner, ETH Zurich): Advances in subsurface characterization and simulation

Tuesday 21 Sept. (Koen Allaerts, VITO): Integrating UTES and DSM in geothermal district heating networks

Tuesday 28 Sept. (Florian Hahn, Fraunhofer IEG): Abandoned coal mines – promising sites to store heat in the underground

Tuesday 5 Oct. (Bas Godschalk, IF Technology): The ECW Energy HT-ATES project in the Netherlands

Tuesday 12 Oct. (Joris Koornneef, TNO): The role of UTES in the future EU energy system – a moderated table discussion.

heatstore High Temperature Underground Thermal Energy Storage

GEOTHERMICA

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HEATSTORE

- HEATSTORE = GEOTHERMICA ERA-NET co-fund project
- 16.3 M€ | 23 partners in 9 EU countries
- 6 demonstration sites, 8 case studies.
- Coordination: TNO Netherlands Organization for Applied Scientific Research)

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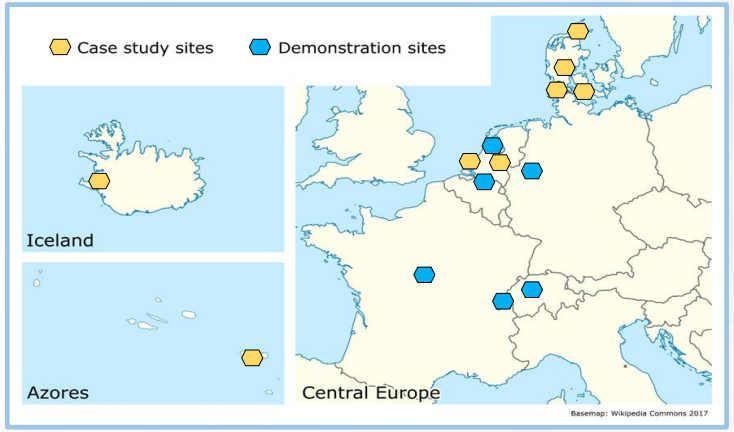


- **Best practice guidelines:** Design & System integration | Business models | Regulatory framework | Stakeholder perception & engagement | Monitoring technical, economic and environmental performance

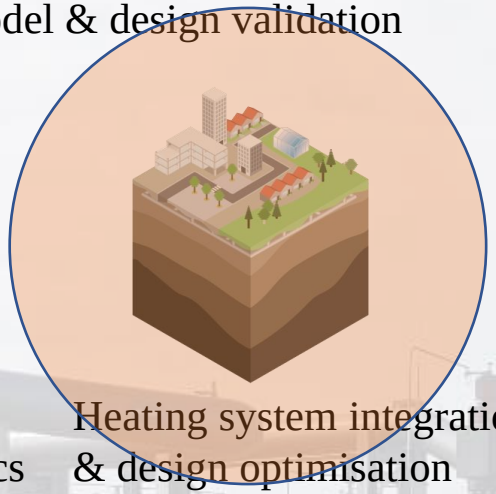
- Proof and operation of UTES and DSM technologies

Fast track market uptake

Model & design validation

Characterization of UTES

Modelling sub-surface dynamics



Heating system integration & design optimisation

Demonstration

System performance monitoring

- **Roadmap Europe**: Technical future potential UTES and DSM in Europe | New business models | Stakeholder engagement | Roadmap for fast track uptake

Design → **Demonstration** → **Replication and scale-up**

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HEATSTORE – 21 Sept. 2021
Integrating UTES and DSM in Geothermal district heating networks

- Koen Allaerts (VITO): Convenor & Opening
- Per Alex Sørensen (PlanEnergi): Modelling and managing district heating systems in Denmark
- Koen Allaerts (VITO): Smart control of a district heating network in Belgium
- Martijn Clarijs, Ryvo Octaviano (TNO): System integration and optimization of underground storage systems in the Netherlands

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HEATSTORE WEBINAR

INTEGRATING UTES AND DSM IN GEOTHERMAL DISTRICT HEATING NETWORKS
MODELLING AND MANAGING DISTRICT HEATING SYSTEMS IN DENMARK

PER ALEX SØRENSEN, PLANENERGI

GEOTHERMICA

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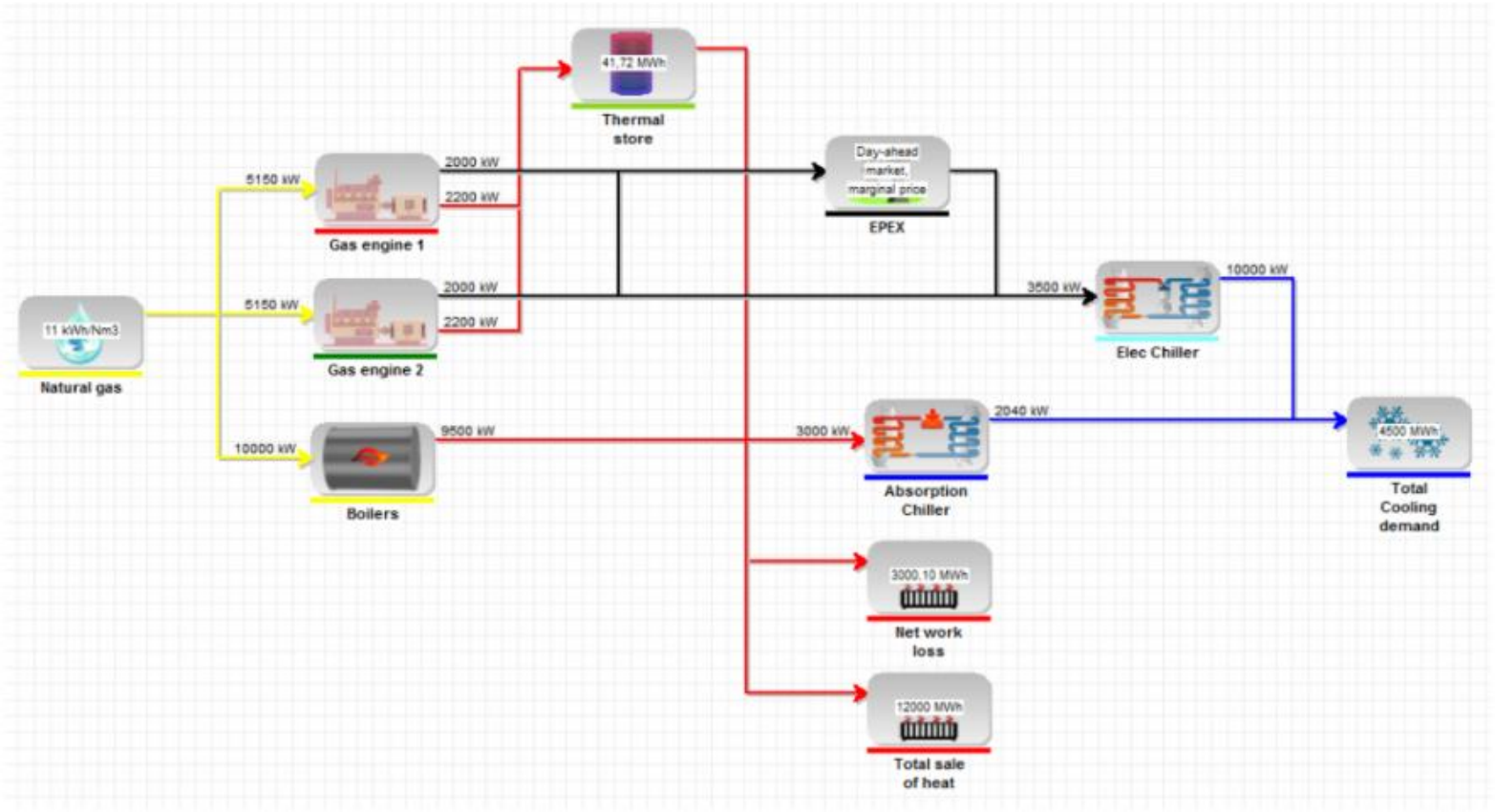
High Temperature Underground Thermal Energy Storage

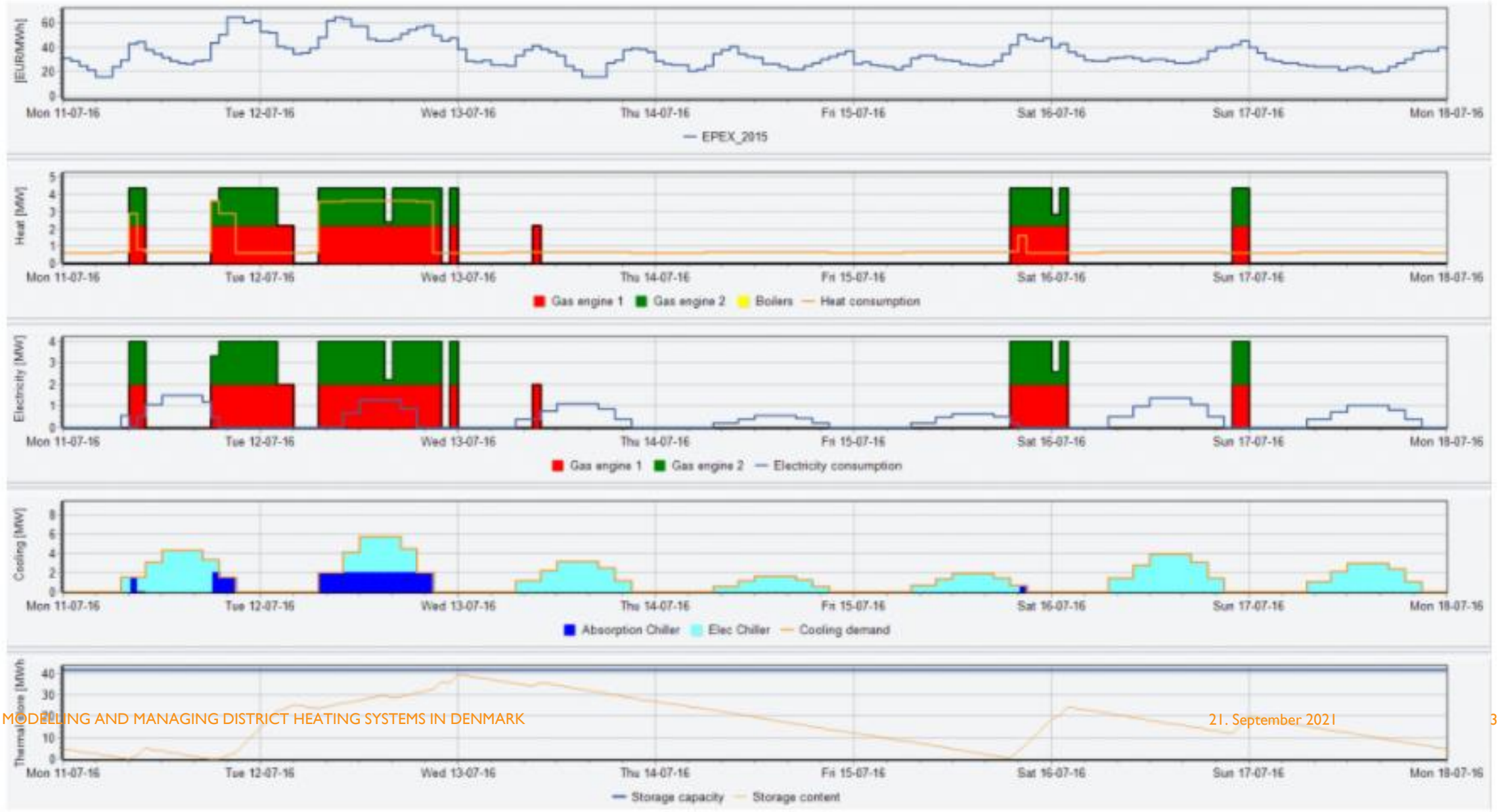
Modelling.

The main part of Danish DH systems are calculated in the EnergyPRO software from www.emd-international.com

Each unit in the production system, demand, prices for fuels, emissions etc. is defined and the calculation result is economical and environmental benefits for scenarios compared to a reference If needed the thermal storage can be calculated in TRNSYS and files used in EnergyPRO

The illustration is an example of a tri-generation system. The next slide illustrates when the units are running.




[EUR/MWh]
Mon 11-07-16
Tue 12-07-16
Wed 13-07-16
Thu 14-07-16
Fri 15-07-16
Sat 16-07-16
Sun 17-07-16
Mon 18-07-16
EPEX_2015
Heat [MW]
Gas engine 1
Gas engine 2
Boilers
Heat consumption
Electricity [MW]
Electricity consumption
Cooling [MW]
Absorption Chiller
Elec Chiller
Cooling demand
Storage capacity
Storage content

Operation

The job is to find the cheapest heat production price. An example:

Støvring Kraftvarmeværk (yearly production app. 80,000 MWh) has 3 gas engines, an air to water heat pump and gas boilers. They get every day a price prognose for electricity.

From this prognose they decide how to operate the different units during the next 24 hours and if they will give bids on up- or downregulation of the electricity production.

centrica

Spotprisprognose Jylland /Fyn (DK1)

Morten Andersen 99 39 57 34
Jakob Munk 99 39 57 32

15. september 2021

	16/09/2021	17/09/2021	18/09/2021	19/09/2021	20/09/2021
Prognose for:	Torsdag	Fredag	Lørdag	Søndag	Mandag
Time	DKK/MWh	DKK/MWh	DKK/MWh	DKK/MWh	DKK/MWh
0-1	967	795	837	818	835
1-2	938	837	831	799	832
2-3	856	837	819	782	833
3-4	827	837	828	766	819
4-5	847	838	818	751	817
5-6	922	817	828	745	795
6-7	1214	885	828	758	958
7-8	1363	1153	828	785	1101
8-9	1405	1205	832	819	1124
9-10	1354	1174	840	780	1124
10-11	1174	1121	848	780	1104
11-12	1115	1084	826	795	1077
12-13	982	976	854	774	1073
13-14	942	976	824	693	1058
14-15	959	892	849	780	1035
15-16	1045	876	821	780	1051
16-17	1165	877	840	804	1104
17-18	1242	873	841	830	1207
18-19	1327	871	842	876	1282
19-20	1428	868	842	940	1307
20-21	1457	868	841	876	1229
21-22	1314	861	839	832	901
22-23	1177	852	835	824	854
23-24	1044	841	830	828	845
Base 1-24	1128	926	834	801	1015
Peak 8-20	1178	983	838	804	1129
Off-Peak	1077	868	830	797	902

Indikative priser kvartaler og år (alle elpriser DKK/MWh, CO2 DKK/Ton) ekskl. handelsomkostninger

(Centricas køb- og salgspriser er angivet. Købspriser er den pris Centrica forventer at kunne købe til og omvendt)

Q4-2021	Køb	Salg	Q1-2022	Køb	Salg	Q2-2022	Køb	Salg	Yr-22	Køb	Salg
Base	917	1013	Base	800	888	Base	571	658	Base	600	687
Peak	-5		Peak	-5		Peak	-5		Peak	-5	

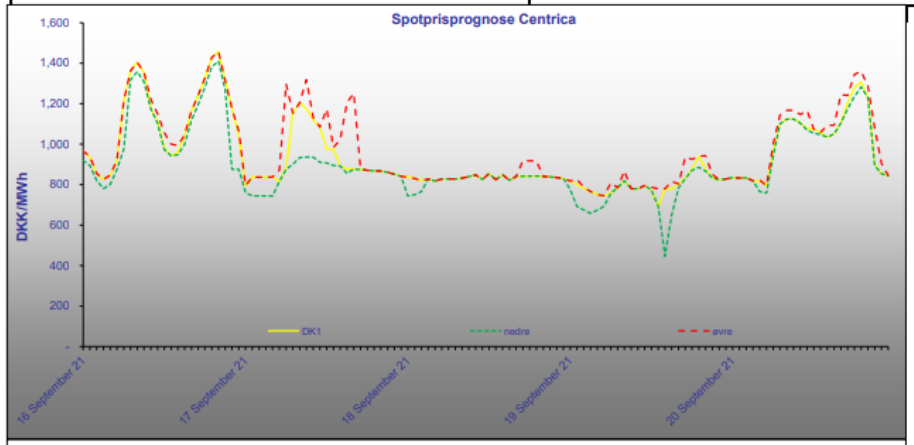
Indikative priser måneder

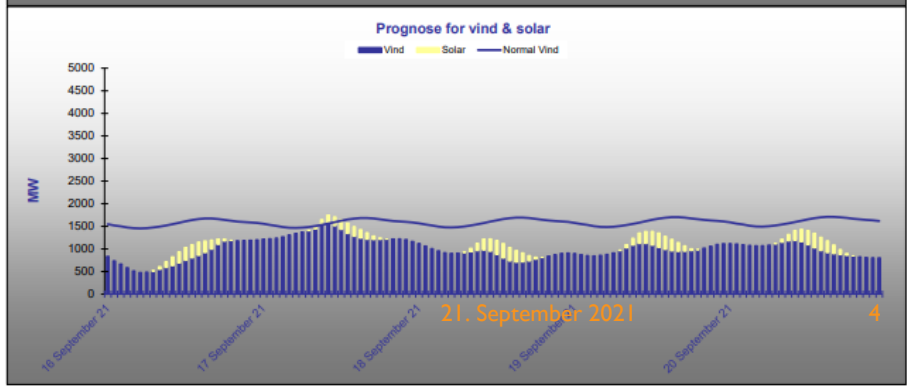
	Køb	Salg		Køb	Salg
Okt Base	984	1080	Nov Base	906	1002
Okt Peak	-5		Nov Peak	-5	

Indikative priser

	DKK/T		EUR/T
EUA spot	444.68	EUA spot	59.80

USD/tønde
Brent Crude 73.60



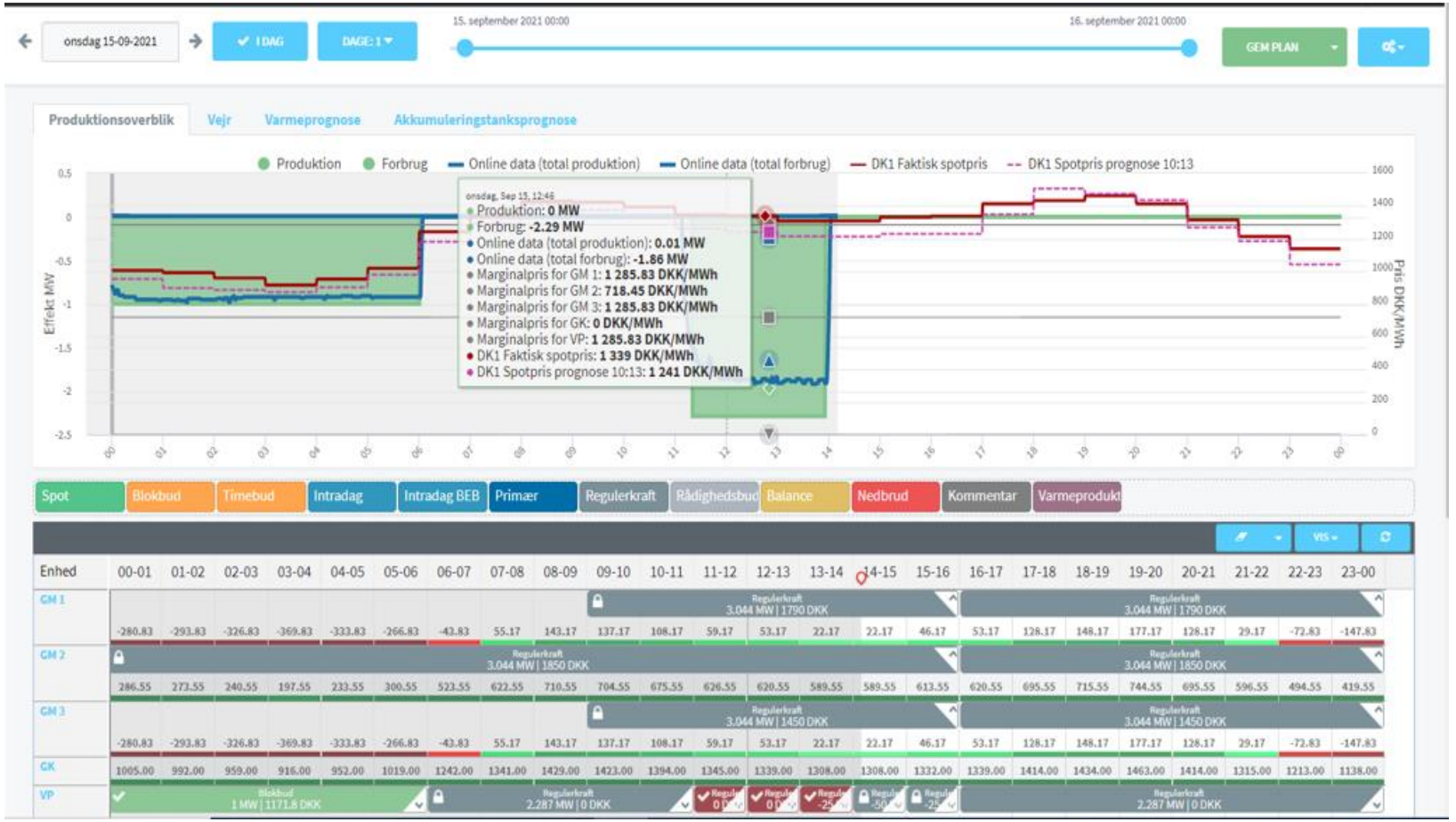


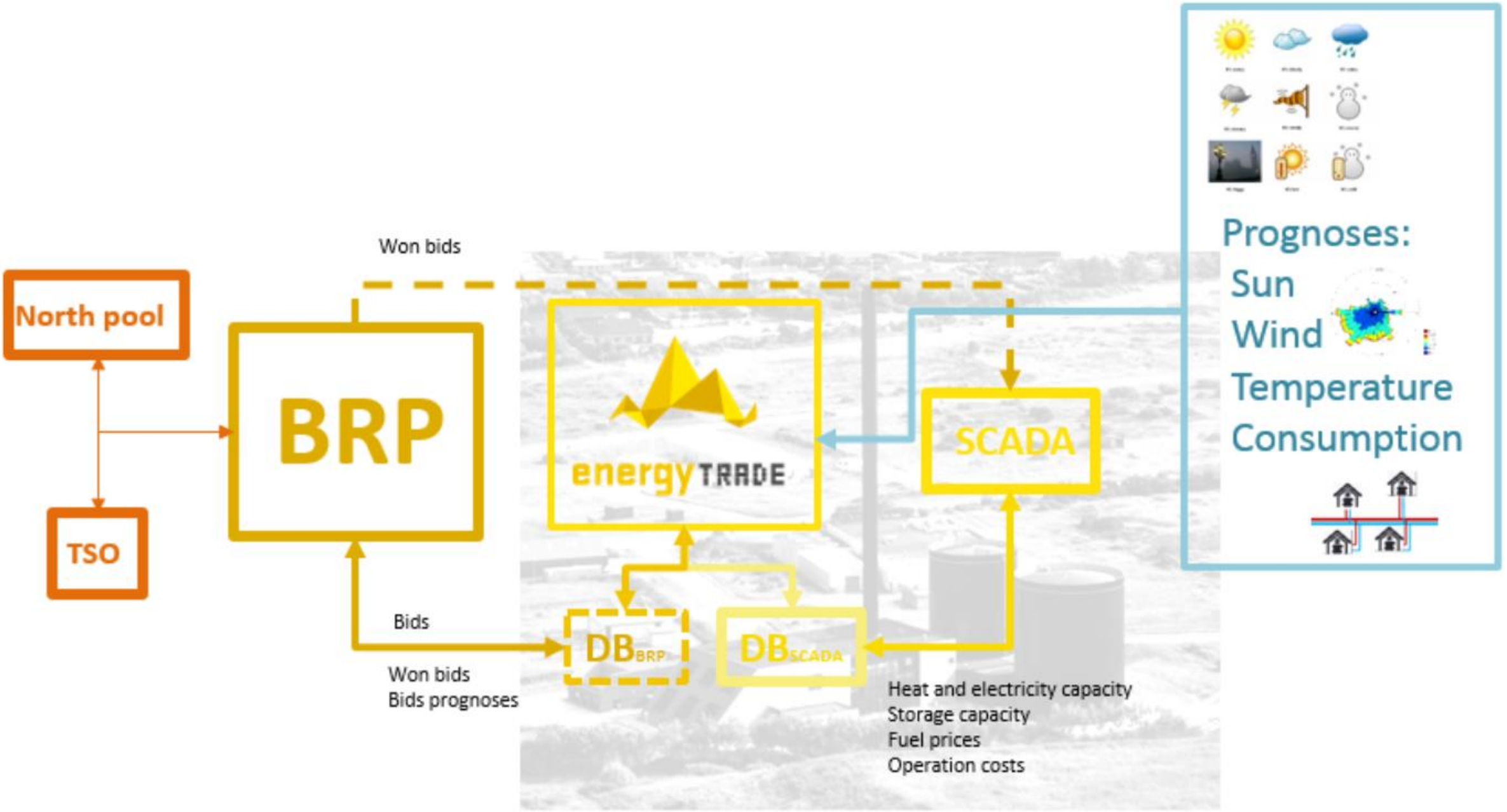
Operation

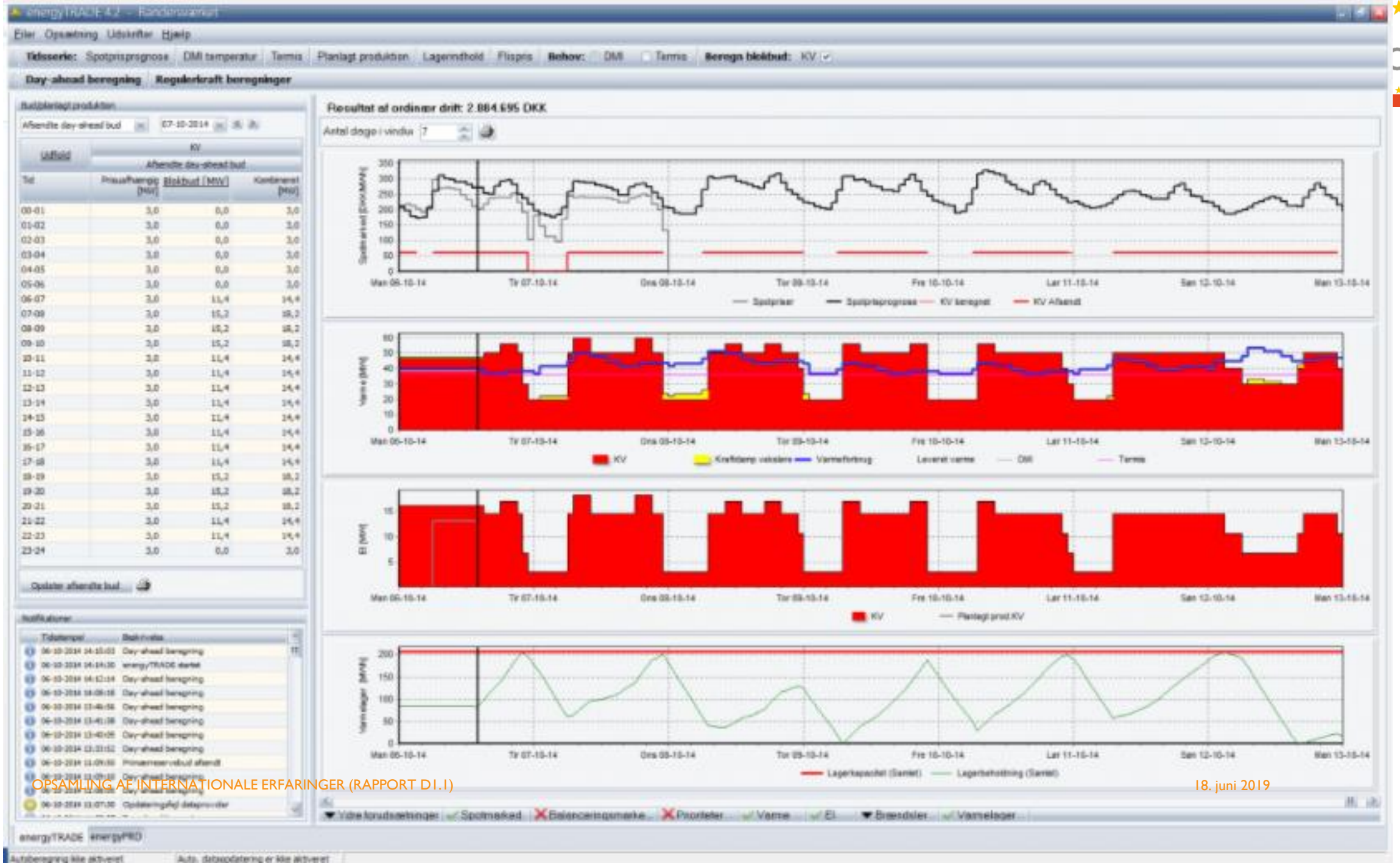
Wednesday last week the marginal electricity price for starting the engines were 1,285 DKK/MWh and if the electricity price is lower it is more feasible to run the heat pump.

During the day the heatpump (last line) was running on a fixed electricity price the first 6 hours. After that the heat pump was offered as down regulation.

The actual electricity price at the middle of the day was 1,339 DKK/MWh so the heat pump skould not run, but down regulation was accepted for an electricity price less than 0 DKK for 3 hours




Won bids
North pool
BRP
TSO
energy TRADE
SCADA
Prognoses:
Sun
Wind
Temperature
Consumption
Bids
Won bids
Bids prognoses
DB BRP
DB SCADA
Heat and electricity capacity
Storage capacity
Fuel prices
Operation costs


Day-ahead beregning
Regulerkraft beregninger
Resultat af ordinær drift: 2.884.695 DKK
Antal dage i vindue
Spotpriser
Spotprisprognose
KV beregnet
KV Afsendt
KV
Kraftvarme
Varmeforbrug
Leveret varme
Dif
Termis
El [MW]
Plantegl prod.KV
Lagerkapacitet (Samlet)
Lagerbeholdning (Samlet)
Videre forudsætninger
Spotmarked
Balancemarkede
Priorteter
Varme
El
Brændsler
Varmelager
energyTRADE
energyPRO

THANK YOU

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HEATSTORE (170153-4401) is one of nine projects under the GEOTHERMICA – ERA NET Cofund aimed at accelerating the uptake of geothermal energy by 1) advancing and integrating different types of underground thermal energy storage (UTES) in the energy system, 2) providing a means to maximise geothermal heat production and optimise the business case of geothermal heat production doublets, 3) addressing technical, economic, environmental, regulatory and policy aspects that are necessary to support efficient and cost-effective deployment of UTES technologies in Europe. The three-year project will stimulate a fast-track market uptake in Europe, promoting development from demonstration phase to commercial deployment within two to five years, and provide an outlook for utilisation potential towards 2030 and 2050.

The GEOTHERMICA project is supported by the European Union's HORIZON 2020 programme for research, technological development and demonstration under grant agreement No 731117.