Reporting on dissemination activities carried out within the frame of the Desire project

conferences, seminars and meetings

Østergaard, Poul Alberg

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2007

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Work Package 8 final report

Reporting on dissemination activities carried out within the frame of the DESIRE project

- Conferences, seminars and meetings -

This report document the dissemination activities carried out within the framework of the DESIRE project. Being a dissemination project, the project has naturally had a very large focus on disseminating the knowledge of how renewable energy may me integrated into the energy systems by various means. The timing of the project has been very good in as much as fluctuating renewable energy resources are getting increased attention – politically as well as in terms of actual physical expansion, for which reason there is an increasing focus on how to integrate substantial amounts of fluctuating renewable energy.

The message has therefore also generally been received well, and the partners of the project have been very active in disseminating the knowledge in articles as well as meetings, seminars and conferences.

The contributions of the individual partners are ordered according to the following list of partners. Each contribution is documented in a dissemination report followed by the actual contribution where possible

1 Aalborg University, Sustainable Energy Planning Group
2 EMD International A/S
3 PlanEnergi
4 University of Birmingham
5 Institut für Solare Energieversorgungstechnik Verein an der Universität Kassel e.V. (ISET)
6 Universität Kassel
7 EMD Deutschland
8 Fundación Labein
9 Warzaw University of Technology
10 Tallin University of Technology

Poul Alberg Østergaard
Editor and Work Package Leader, WP8

Dissemination strategy on Electricity balancing

DESIRE

large Scale Integration of Renewable Energy

Reporting on dissemination activities carried out within the frame of the DESIRE project (WP8)

Name, Affiliation	Henrik Lund, Aalborg University
E-mail	lund@plan.aau.dk
Title of dissemination	The Desire project
Type of activity	Presentation at conference
Title of forum	CHP units in the context of power markets
Language	English
Date of dissemination	May 10 2007
Place of dissemination	ISET, Kassel, Germany
Brief abstract / description of dissemination activity	Today big power plants are used to balance most aspects of electricity supply and demand. The DESIRE project will disseminate cutting edge software tools and systems that will enable small and medium sized CHP-plants to combine or 'co-produce' their electricity allowing them to partly balance the fluctuating output of wind turbines thus ensuring that most wind power can be used locally, thereby relieving the pressure on system operators to offload surplus wind. In turn this will relieve pressure on international inter-connectors and allow international trade in electricity to be come more competitive. This will allow consumer electricity prices to be lower and the quality of electricity supplied to become higher. CHP can work with wind power to produce a balanced, more predictable, supply of electricity because of techniques disseminated in this project. CHP plant need accumulators (heat storage) to act in this way. When there is excessive wind power production, the CHP unit decreases production and relies on its heat store in the accumulator to satisfy its heat demand. When wind production is low, the CHP plant operates in order to build up heat stores and make up for a lack of wind power electricity production. This is the theory of the co-production system being demonstrated in this project. The techniques of coordinating CHP and wind power plant mean that these plants can help maintain reliability for electricity supplies rather than make a problem for the electricity system that can jeopardise international trade in electricity.
Audience impact assessment	Information was given to highly relevant persons within German CHP operation.
Dissemination	Included after this form

DESIRE

Dissemination strategy on Electricity balancing for large Scale Integration of Renewable Energy

A project funded by
the Sixth Framework Programme
of the European Commission

Project partners

Aalborg University, Denmark
EMD International A/S, Denmark
PlanEnergi S/I, Denmark
University of Birmingham, United Kingdom
Institut für Solare Energieversorgungstechnik e.V, Germany
Universität Kassel, Germany
EMD Deutschland, Chun und andere GBR, Germany
Fundación Labein, Spain
Warzaw University of Technology, Poland
Talinn University of Technology, Estonia

Program

- Background (EU policies)
- The problem (based on the Danish case)
- DESIRE: Main objectives and activities
- Expected results

Dissemination Strategy on Electricity Balancing
for Large Scale Integration of Renewable Energy

Background

Promoting electricity produced on Renewable Energy Sources within the internal electricity market

DIRECTIVE 2001/77/EC:

By 2010, 22,1% of the total electricity consumption in the EU shall be supplied by Renewable Energy Sources.

Dissemination Strategy on Electricity Balancing for Large Scale Integration of Renewable Energy

Background

Developing competitive electricity markets, specifically in the field of decentralised energy supplies

COMMON POSITION (EC) No 52/2003

On the promotion of co-generation based on a useful heat demand in the internal energy market and amending Directive 92/42/EEC

Dissemination Strategy on Electricity Balancing for Large Scale Integration of Renewable Energy

Background

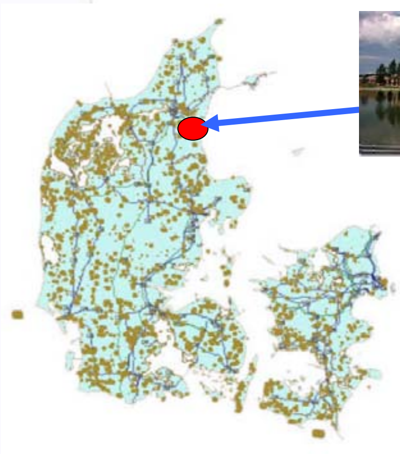
Developing Pan-European Electricity Markets

DIRECTIVE 2003/54/EC:

In order to ensure effective market access for all market players, including new entrants, non discriminatory and cost-reflective balancing mechanisms are necessary.

As soon as the electricity market is sufficiently liquid, this should be achieved through the setting up of transparent market-based mechanisms for the supply and purchase of electricity needed in the framework of balancing requirements.

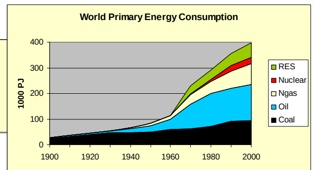
Aalborg University, Denmark

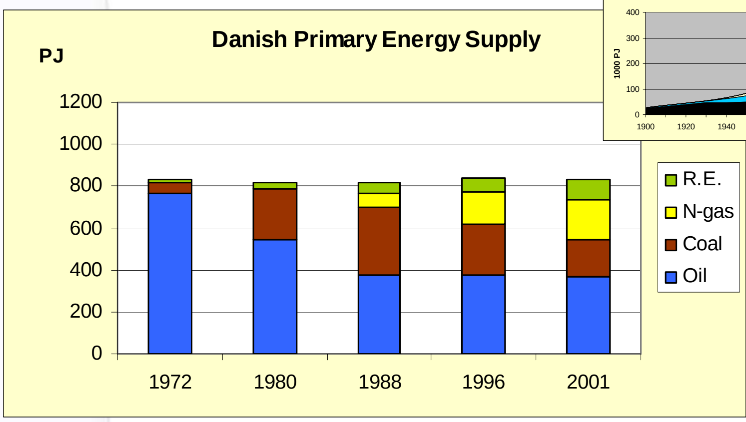


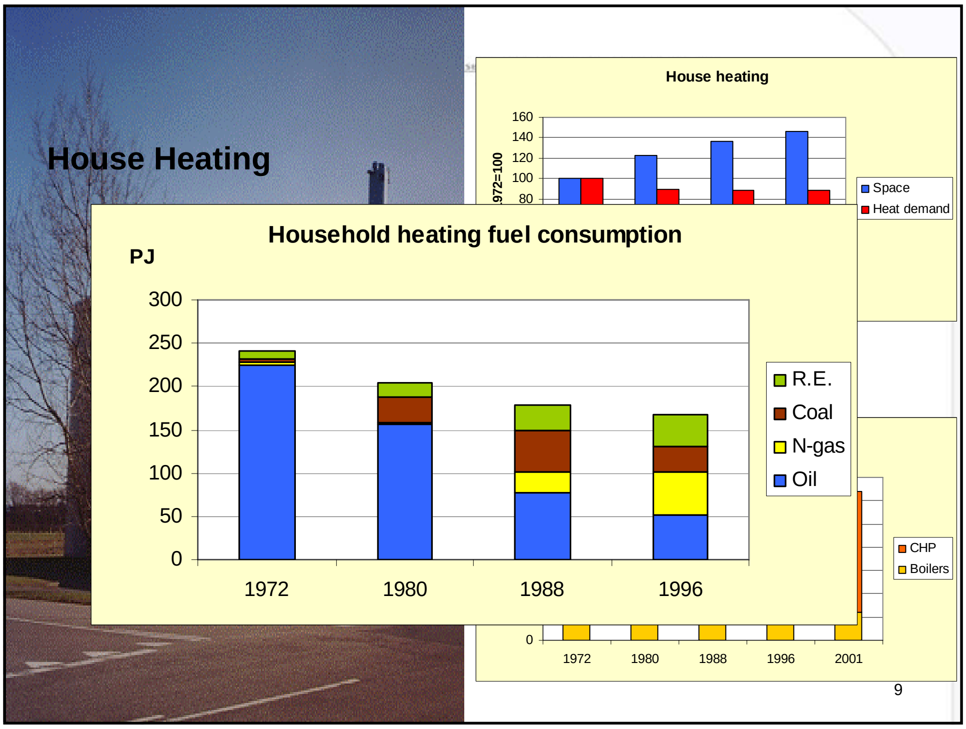
Jutland/Denmark:

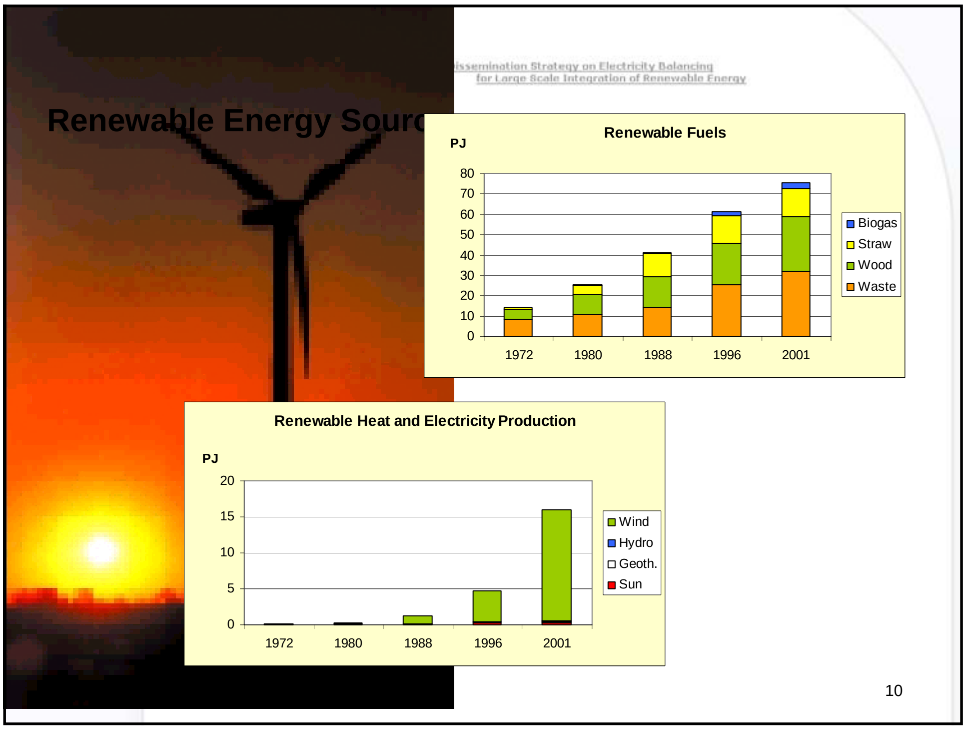
- 20% wind power (120,000 owners)
- 85% of worlds offshore (2003)
- 30% Distributed Generation
- 50% of electricity from CHP

30 years of Danish Primary Energy Supply

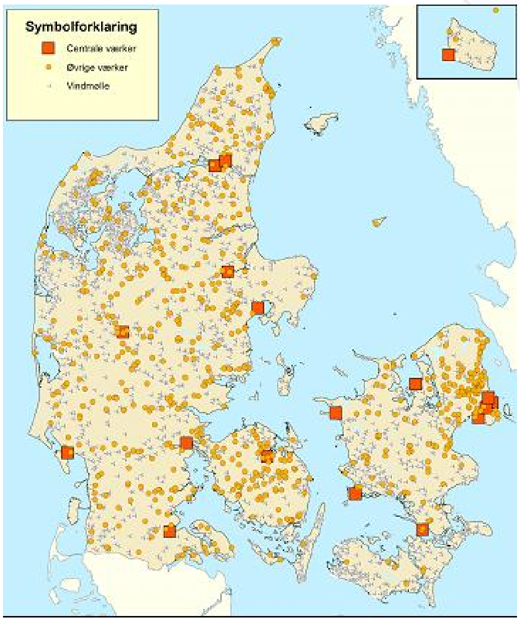





House Heating
House heating
160
140
120
100
80
Space
Heat demand
Household heating fuel consumption
PJ
300
250
200
150
100
50
0
1972
1980
1988
1996
R.E.
Coal
N-gas
Oil
CHP
Boilers
0
1972
1980
1988
1996
2001
9


for Large Scale Integration of Renewable Energy
Renewable Energy Sourc
Renewable Fuels
PJ
80
70
60
50
40
30
20
10
0
1972
1980
1988
1996
2001
Biogas
Straw
Wood
Waste
Renewable Heat and Electricity Production
PJ
20
15
10
5
0
1972
1980
1988
1996
2001
Wind
Hydro
Geoth.
Sun
10

Danish electricity production



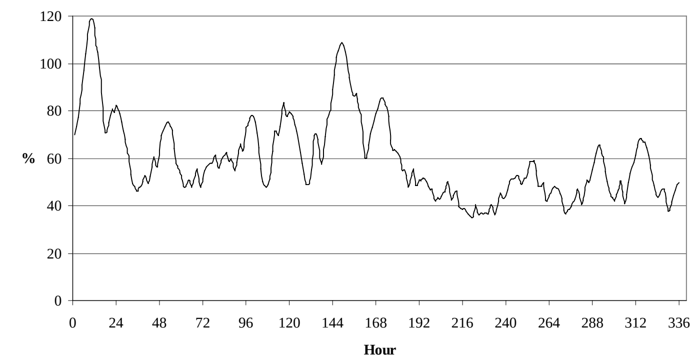
Big power stations

Small CHP plants

Wind turbines

ENERGISTYRELSEN

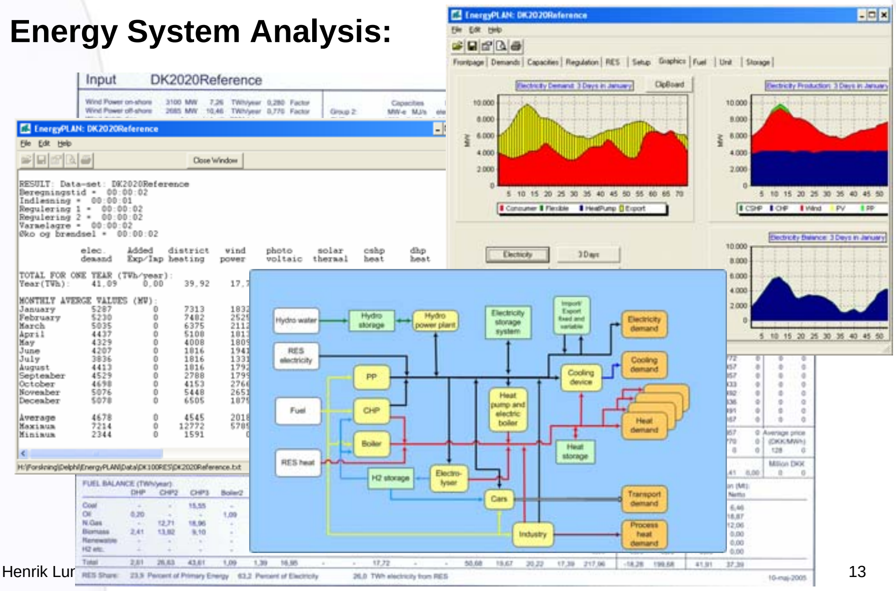
Wind and CHP share of electricity demand in Eltra 2001 (jan-mar)



From Poul Østergaard based on data from eltra

Dissemination Strategy on Electricity Balancing for Large Scale Integration of Renewable Energy

Energy System Analysis:



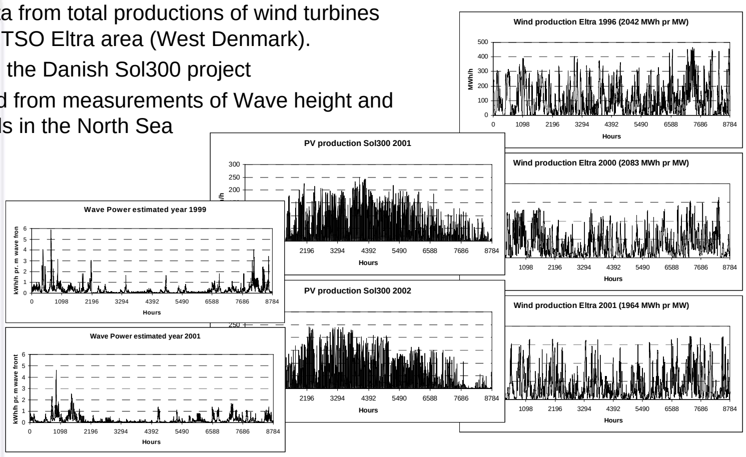
Dissemination Strategy on Electricity Balancing for Large Scale Integration of Renewable Energy

Data: Wind, PV and Wave Power

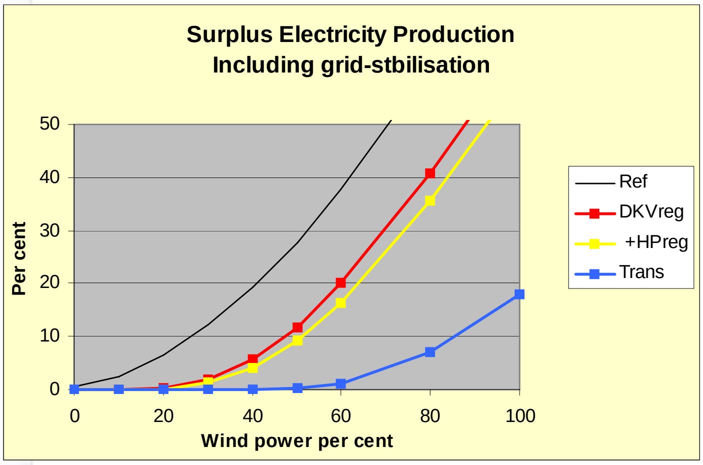
Wind: Data from total productions of wind turbines in the TSO Eltra area (West Denmark).

Data from the Danish Sol300 project

Calculated from measurements of Wave height and periods in the North Sea



Principle results of technical analyses



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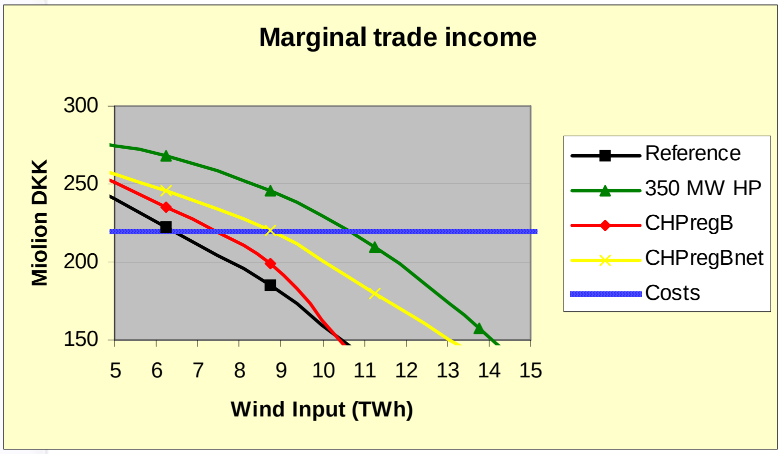
Dissemination Strategy on Electricity Balancing for Large Scale Integration of Renewable Energy

Modelling of NordPool

- Standard system price hour by hour distribution (based on recent years)
- Construction of “Wet” “Dry” and “Normal” years (Hydro in Norway)
- Modelling of influence for DK trade and splitting in price areas due to bottle-neck in transmission
- Modelling of influence from Trade on the German Boarder.

Dissemination Strategy on Electricity Balancing for Large Scale Integration of Renewable Energy

Feasibility of Alternative Regulation Systems



Henrik Lund, Aalborg University, Denmark 17

Dissemination Strategy on Electricity Balancing for Large Scale Integration of Renewable Energy

Main objectives:

To promote the integration of fluctuating renewable energy supplies, primarily wind power, into local and regional electricity systems.

To disseminate ways in which CHP plants can help to achieve a balance between supply and demand in an electricity system with fluctuating power.

Henrik Lund, Aalborg University, Denmark 18

In short:

The DESIRE project wants
to show how
small CHP plants can be part of the
solution instead of being part of
the problem

DESIRE
Dissemination Strategy on Electricity Balancing
for Large Scale Integration of Renewable Energy

Means – in the short term

Co-production of CHP and wind power

Small and medium-sized CHP plants can co-produce electricity to balance the fluctuating output of wind power plants

At excessive wind power production, the CHP unit decreases its production and relies on its heat store to satisfy the heat demand

At low wind power production, the CHP unit builds up the heat store and counterbalances the low electricity production of the wind power plants

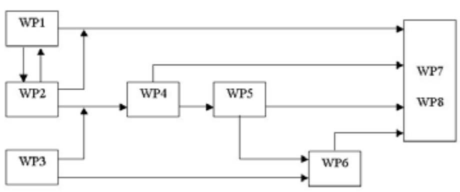
Means – in the long term

The use of heat pumps for balancing electricity supply and demand

At excessive wind power production, electricity is converted by the heat pump to supply local heat demand or to recharge the accumulator heat store to meet the future heat demand.

Content: Work Packages

WP1: The balancing problem
WP2: Short-term solutions and long-term perspectives
WP3: Barriers and opportunities for demonstrating projects in participant countries
WP4: Developing organisational set-ups, optimising tools and IT for demonstration projects
WP5: Demonstration projects
WP6: Evaluation and recommendations
WP7: Project home page
WP8: Participation at meetings and conferences



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Dissemination Strategy on Electricity Balancing for Large Scale Integration of Renewable Energy

Expected results

- Provide guidelines for the future development of CHP plants
- Present schemes which ensure the promotion of the balancing techniques
- Demonstrate the financial and organisational techniques as well as the software needed to implement the balancing techniques.
- Create a broad knowledge among CHP and wind turbine operators and market operators of the use of CHP for the integration of more renewable electricity production.
- Secure a rapid and effective proliferation of the knowledge created.

Henrik Lund, Aalborg University, Denmark 23

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Dissemination Strategy on Electricity Balancing for Large Scale Integration of Renewable Energy

WP 1: The balancing problem

WP Leader: Ebbe Münster, PlanEnergi A/S

Objectives:

To identify key operation tasks for medium and small-sized CHP plants if they are to participate in balancing the electricity production and consumption.

To quantify the problems which rising proportions of electricity generation from renewable sources will cause in Europe.

To identify the least cost solutions in the regions involved.

Henrik Lund, Aalborg University, Denmark 24

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Dissemination Strategy on Electricity Balancing
for Large Scale Integration of Renewable Energy

WP 2: Short-term solutions and long-term perspectives

WP Leader: John Sievers, Universität Kassel

Objectives:

To disseminate knowledge about appropriate technical solutions to overcome the problems caused by large-scale integration of renewable energy and CHP.

To identify the differences between CHP designs in the countries involved.

To find out how future CHP plants must be designed in order to contribute to the balancing of the electricity production and consumption.

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Dissemination Strategy on Electricity Balancing
for Large Scale Integration of Renewable Energy

WP 3: Barriers and opportunities for demonstrating projects

WP Leader: Carlos Madina, Fundación Labein

Objectives:

To identify the regulatory and trading conditions that will affect the implementation of the project in the countries involved.

Suggest ways of disseminating knowledge according to these conditions.

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Dissemination Strategy on Electricity Balancing for Large Scale Integration of Renewable Energy

WP 4: Developing organisational set-ups, optimising tools and IT

WP Leader: Anders N. Andersen, EMD International A/S

Objectives:

To design and develop particular organisational set-ups, optimising tools and information technology for the demonstration of the balancing system.

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Dissemination Strategy on Electricity Balancing for Large Scale Integration of Renewable Energy

WP 5: Demonstration projects

WP Leader: Peter Ritter, EMD Deutschland

Objectives:

To operate and demonstrate the organisational set-ups, the optimising tools and the information technology developed in WP 4.

WP 6: Evaluation and recommendations

WP Leader: David Toke, University of Birmingham

Objectives:

To review the operation of the demonstration part in WP 5.

To make recommendations concerning the best way of promoting the balancing techniques.

WP 7: Project home page

WP Leader: Florian Schlögl,
Institut für Solare Energieversorgungstechnik

Objectives:

To set up the project home page which provides information, disseminates results and serves as a communication tool – between the project partners, between the EC and the project partners, and between the project and the public.

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Dissemination Strategy on Electricity Balancing for Large Scale Integration of Renewable Energy

WP 8: Participation at meetings and conferences

WP Leader: Poul Alberg Østergaard, Aalborg University

Objective:

To disseminate the knowledge created, including the operating and organisational experiences to a broad number of operators and authorities.

Henrik Lund, Aalborg University, Denmark 31

Reporting on dissemination activities carried out within the frame of the DESIRE project (WP8)

Name, Affiliation	Henrik Lund, Aalborg University, Denmark
E-mail	lund@plan.aau.dk
Title of dissemination	30 års aktiv energipolitik og hvad så nu? (In English: 30 years' of active energy policy and what now?)
Type of activity	Presentation at conference Media coverage in trade magazine
Title of forum	Conference, Danish District Heating Association
Language	Danish
Date of dissemination	October 2006
Place of dissemination	Århus, Denmark
Brief abstract / description of dissemination activity	The presentation focussed on Danish energy policies during the past 30 years and the possibility of integrating new technologies in the future energy system. The technologies developed with DESIRE play an important part in this energy system.
Audience impact assessment	The presentation was directed at 1,500 participants who represent the Danish district heating industry and thus one of the important target groups of DESIRE. The presentation is expected to influence the formulation of future Danish energy policies.
Dissemination	Included after this form (Presentation + Media coverage)

Dansk Fjernvarmes landsmøde i Århus
Torsdag den 26. og fredag den 27. oktober 2006

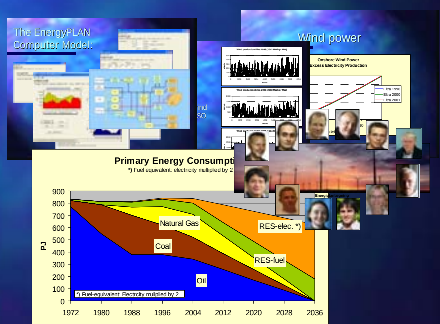
30 års aktiv energipolitik og hvad så nu?

Henrik Lund
Professor i Energiplanlægning
Aalborg Universitet

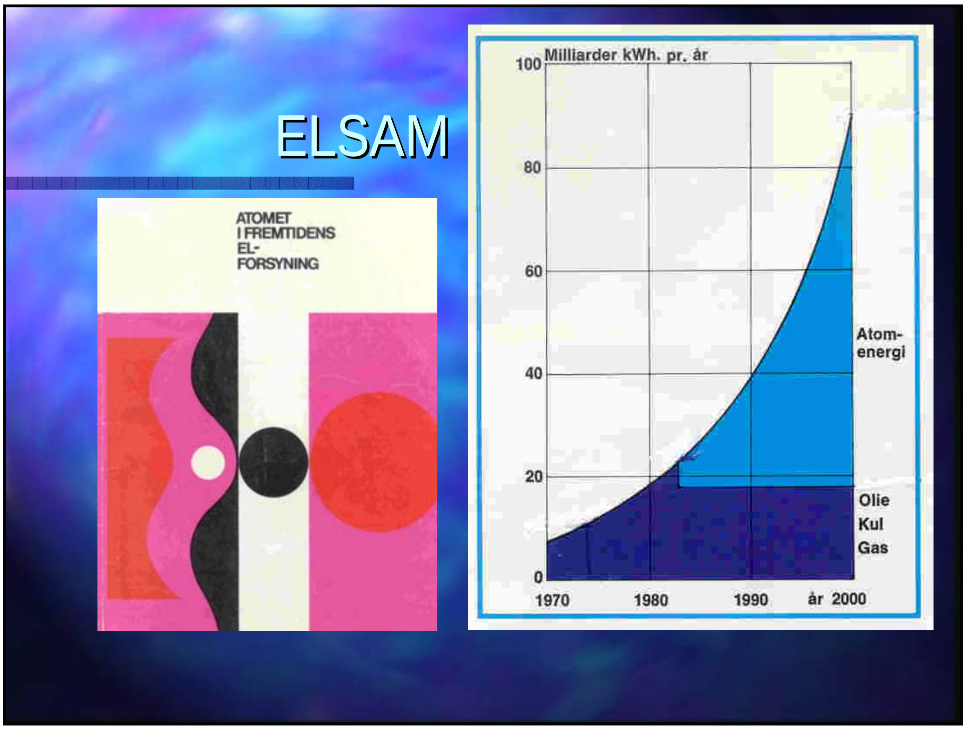
Indhold

- 30 års aktiv dansk energipolitik...... og hvad så nu..?

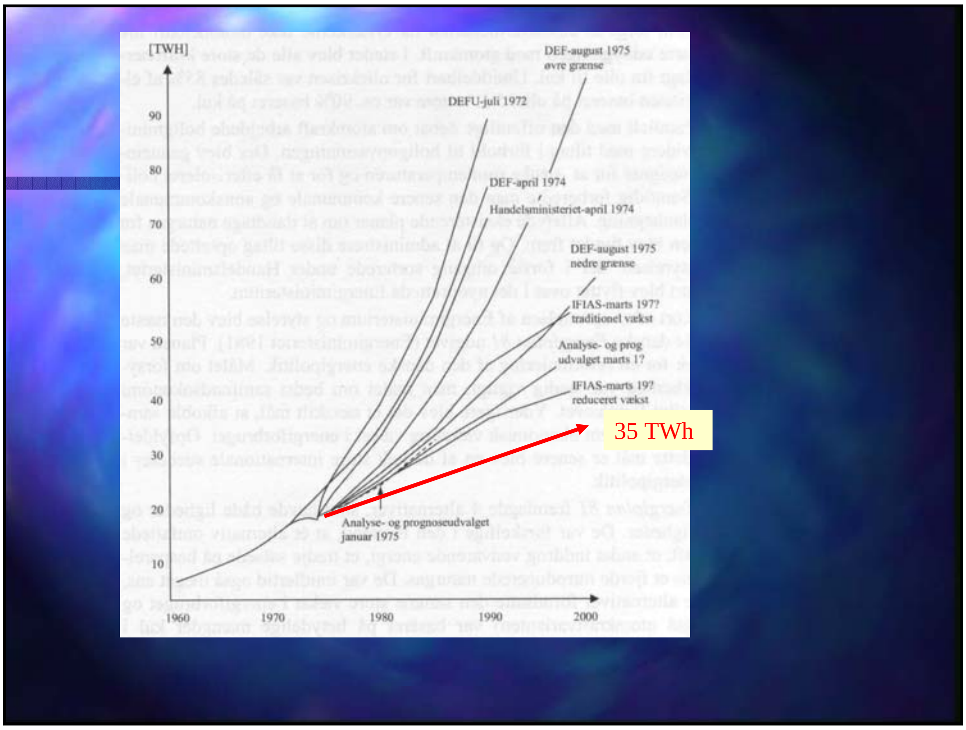
- Et bud på fremtidens energiforsyning.......... 100% vedvarende energi.




Første oliekrise 1973
DK Energiforbrug 1972
Olie
Kul
Ngas
V.E.


ELSAM
ATOMET
I FREMTIDENS
EL-
FORSYNING
Milliarder kWh. pr. år
100
80
60
40
20
0
1970
1980
1990
år 2000
Atom-
energi
Olie
Kul
Gas

70erne: Oliekrise og Atomkraft
Formål i fokus:
Olie afhængighed
Primære midler:
Kul og Atomkraft
Alternativ energiplan:
Besparelser
Kraft/varme
Vedvarende energi
Dansk energipolitik 1976
Skitse til alternativ energiplan for Danmark



[TWH]
DEF-august 1975 øvre grænse
DEFU-juli 1972
DEF-april 1974
Handelsministeriet-april 1974
DEF-august 1975 nedre grænse
IFIAS-marts 197? traditionel vækst
Analyse- og prog udvalget marts 1?
IFIAS-marts 19? reduceret vækst
35 TWh
Analyse- og prognoseudvalget januar 1975
10
20
30
40
50
60
70
80
90
1960
1970
1980
1990
2000

80erne: Samfundsøkonomi

Formål i fokus:

Samfundsøkonomi
(Beskæftigelse
og betalingsbalance)

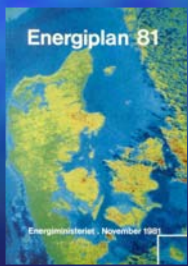
Alternativ Energiplan:

- Energibesparelser
- Kraftvarme
- Vedvarende energi

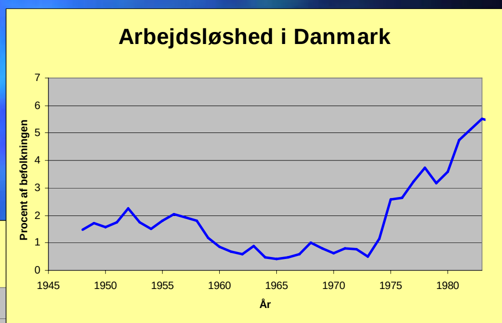
Forslag:

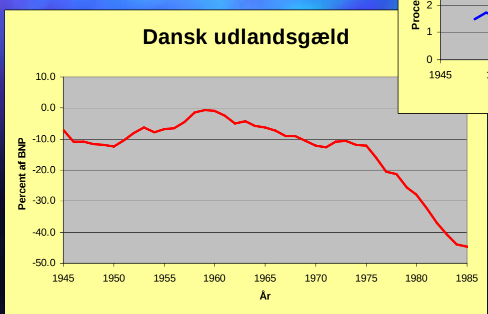
3 Alternativer:

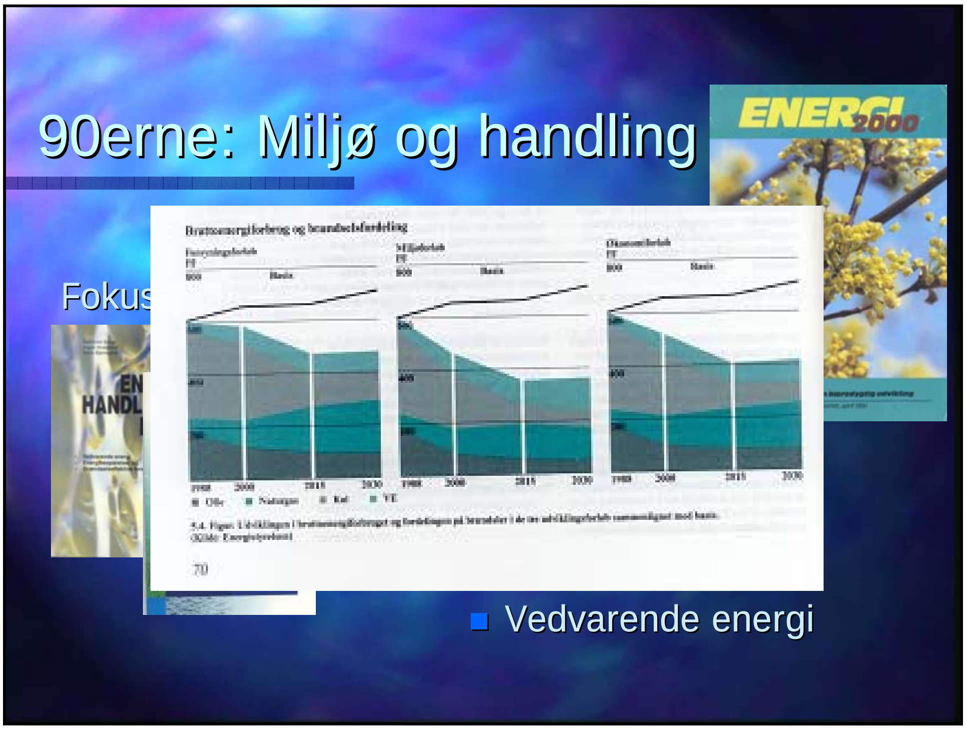
Kul + besparelser
Kul + Atomkraft
Kul + Naturgas

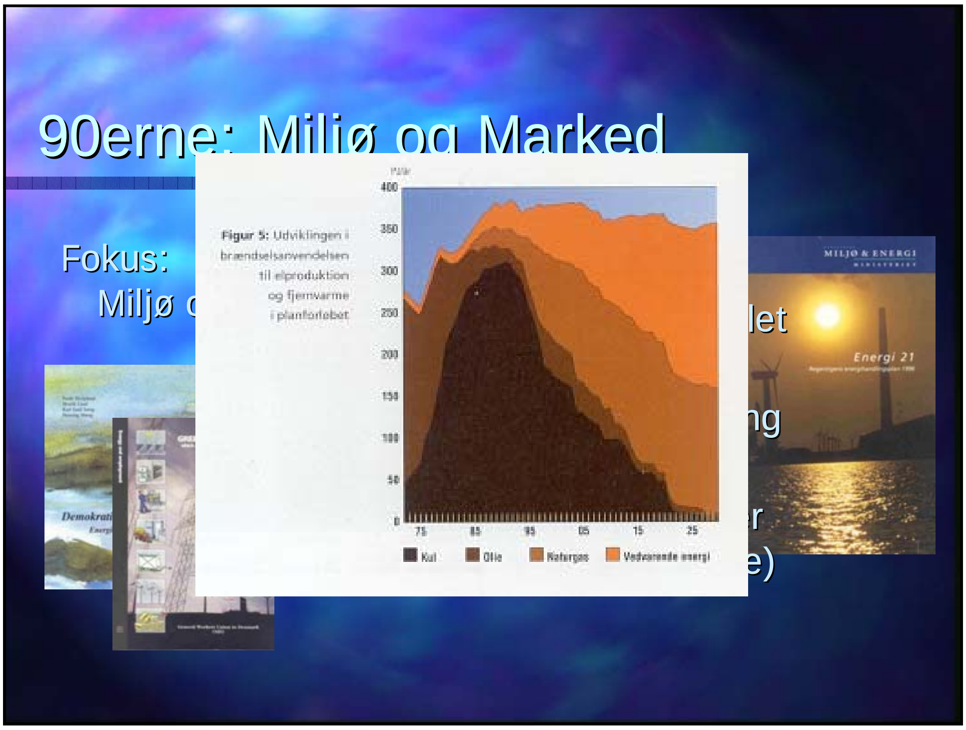


Udlandsgæld og høj arbejdsløshed i firserne

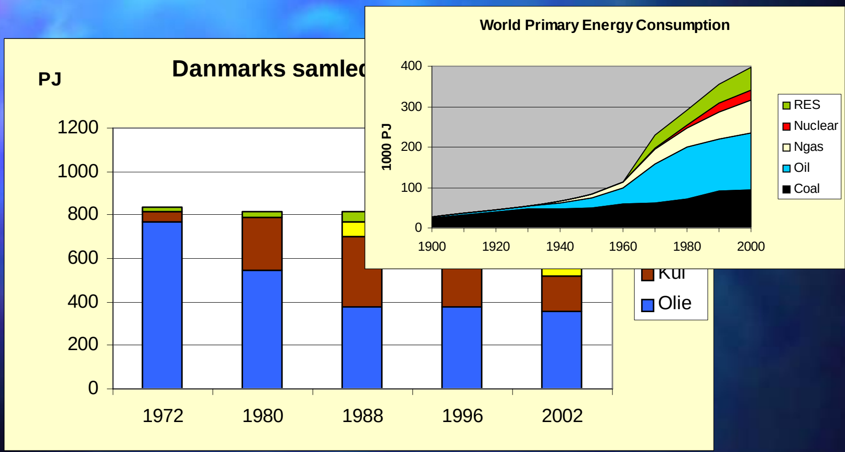




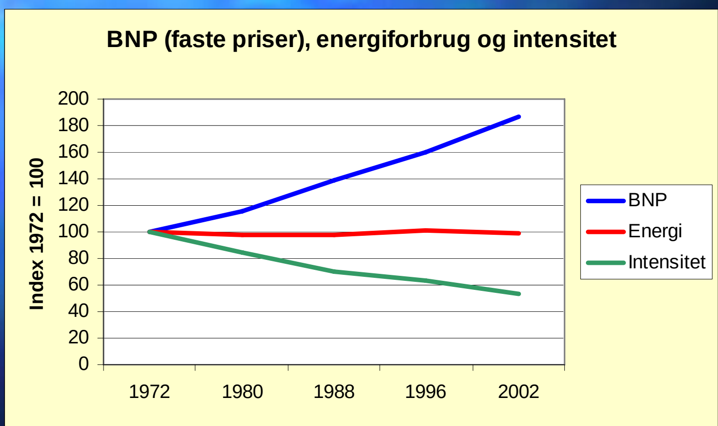

90erne: Miljø og handling
ENERGI 2000
Fokus
Vedvarende energi

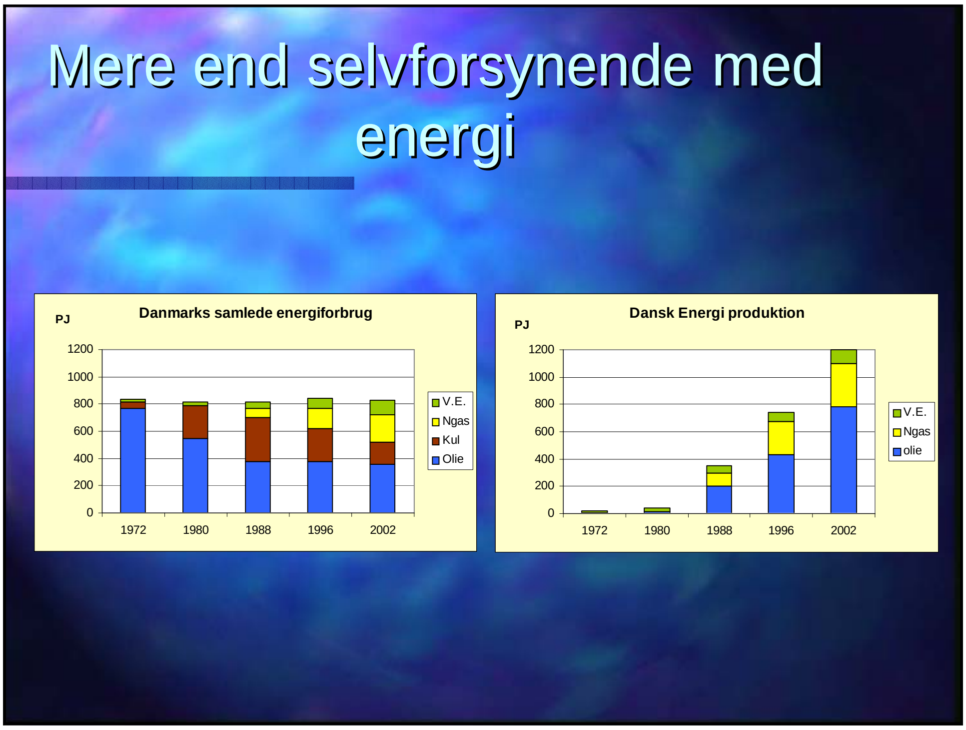

90erne: Miljø og Marked
Fokus:
Miljø o
Figur 5: Udviklingen i brændselsanvendelsen til elproduktion og fjernvarme i planforløbet
400
350
300
250
200
150
100
50
0
75
85
95
05
15
25
Kul
Olie
Naturgas
Vedvarende energi
MILJØ & ENERGI
Energi 21

30 år uden stigninger i det samlede energiforbrug

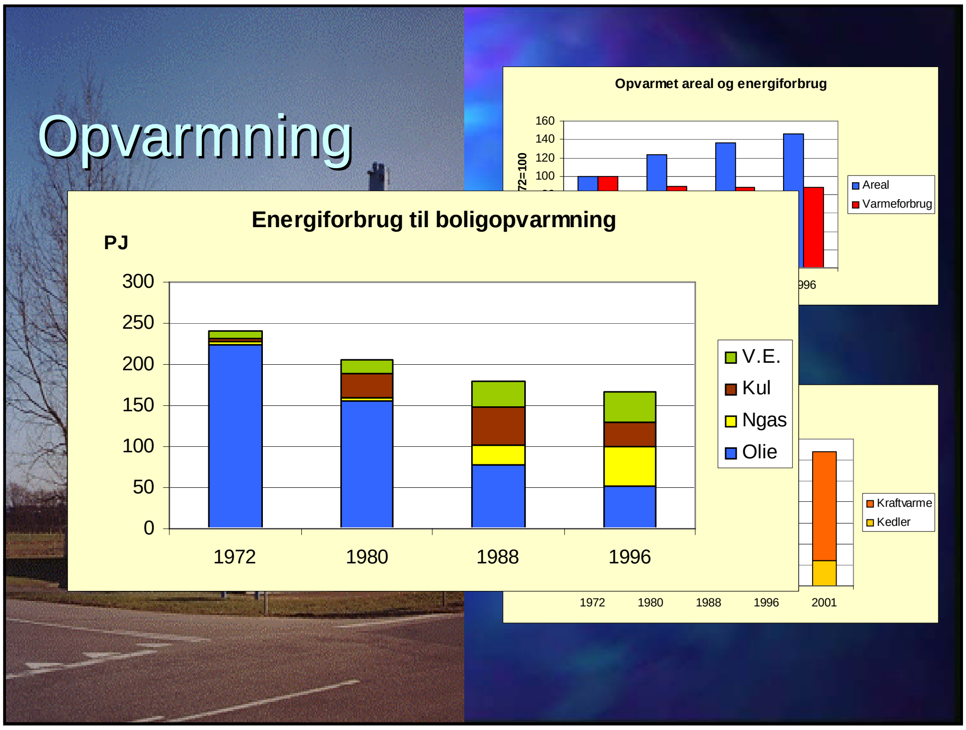


Energi effektivitet fordoblet



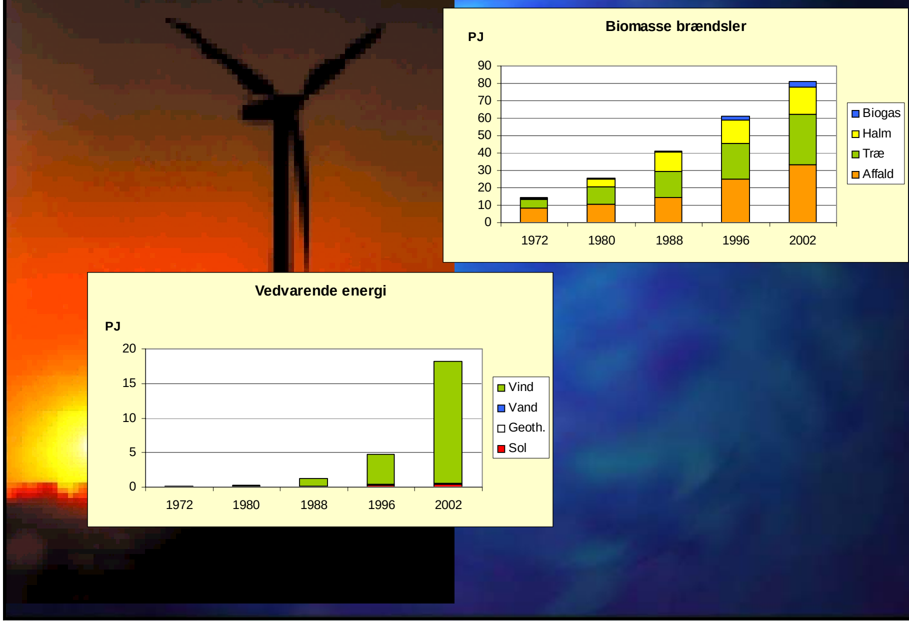


Mere end selvforsynende med energi
Danmarks samlede energiforbrug
PJ
1200
1000
800
600
400
200
0
1972
1980
1988
1996
2002
V.E.
Ngas
Kul
Olie
Dansk Energi produktion
PJ
1200
1000
800
600
400
200
0
1972
1980
1988
1996
2002
V.E.
Ngas
olie



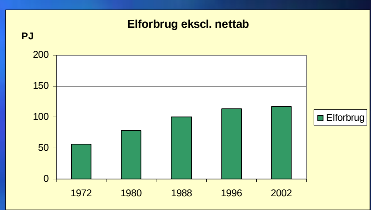
Opvarmning
Opvarmet areal og energiforbrug
160
140
120
100
Areal
Varmeforbrug
Energiforbrug til boligopvarmning
PJ
300
250
200
150
100
50
0
1972
1980
1988
1996
V.E.
Kul
Ngas
Olie
Kraftvarme
Kedler
1972
1980
1988
1996
2001

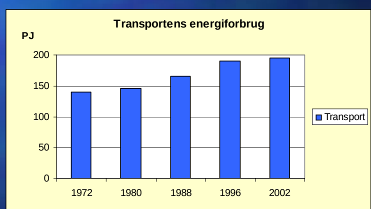
Vedvarende energi



Stigende energiforbrug

- Mens varmeforbruget er faldet er elforbruget steget
- Transportens energiforbrug er steget og steget

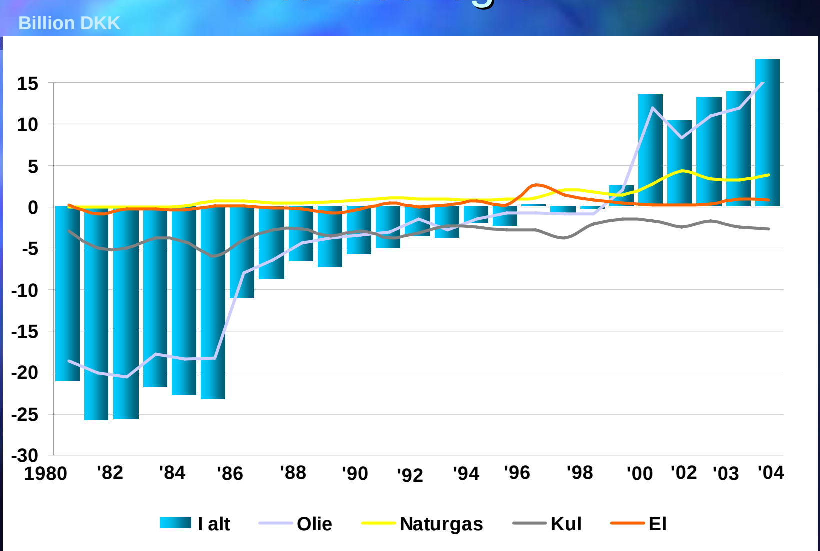




Energipolitik giver resultat

- Den aktive politik på varmebesparelser, kraftvarme mv. og senere el-besparelser har nedbragt energiforbruget væsentligt.
- Ingen aktiv politik på transportområdet, el-besparelser (i de første årtier) har derimod ført til stigende brændselsforbrug.

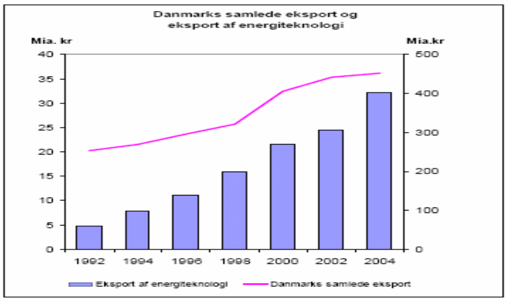
Nettoindtægt fra handel med brændsel og el



Eksport af Energiteknologi

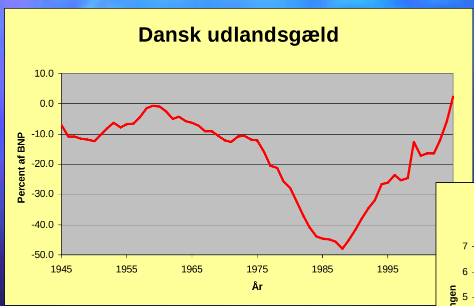
2. Eksport af energiteknologi

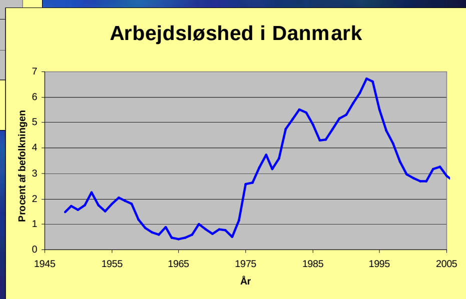
Værdien af eksporten af energiteknologi mv. er i år 2004 opgjort til 32,1 mia. kr. Det svarer til 7,1 % af Danmarks samlede eksport i år 2004. Eksporten er gennem de seneste år vokset mere end værdien af Danmarks samlede eksport. For 6 år siden udgjorde den således ca. 5 % af Danmarks samlede eksport.



Figur 2.1

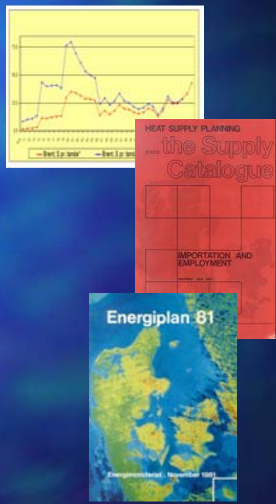
Udlandsgæld og Arbejdsløshed





Tre vigtige beslutninger

- Olieafgifterne i 1985/86
- Samfundsøkonomi = job&Valuta i 1981/82
- Formulering af målet om 10% vindkraft i år 2000 (i Energiplan 1981)



Klimastrategi 2003

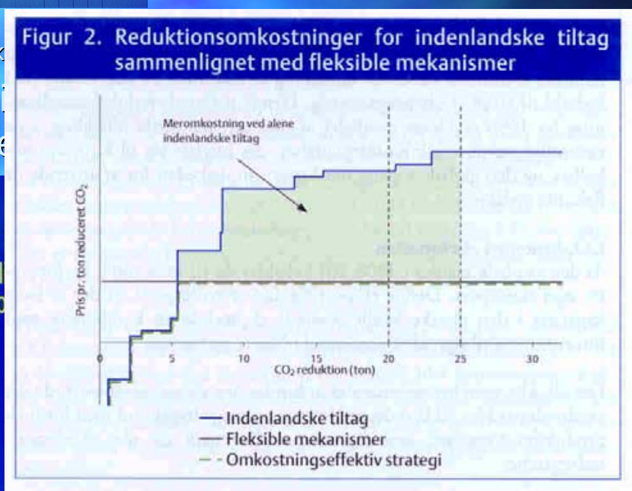
Formål i fok

Mest mi

penge

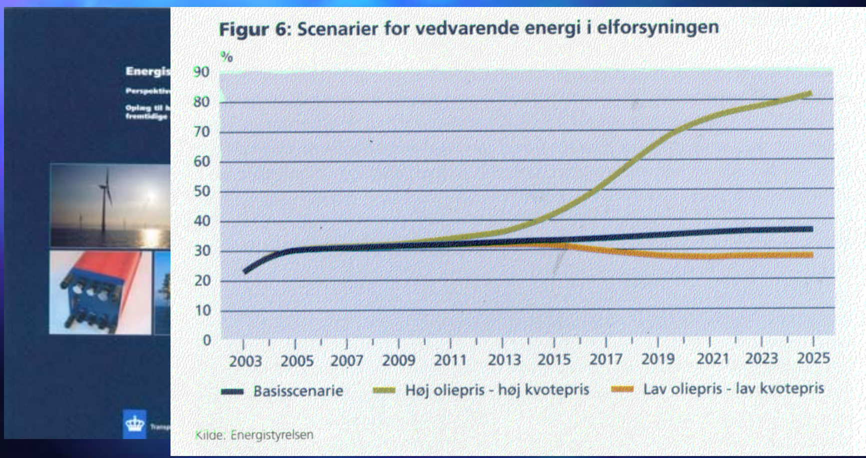
i

er:



Figur 2. Reduktionsomkostninger for indenlandske tiltag sammenlignet med fleksible mekanismer

Energistrategi 2025



Nuværende energipolitik (2001-2006)

- Ingen konkrete politiske mål (markedet bestemmer)
- Ingen prioritet til ”danske løsninger”
- Usikker situation for den industri der skal udvikle og sælge de nye teknologier

Kommende Energipolitik

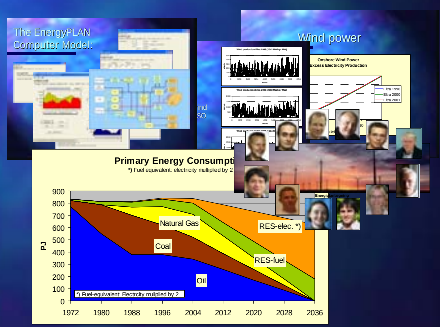
- Mål om 100% selvforsynet Danmark (Også efter Nordsø-olien slipper op)
- Ingen Atomkraft
- Sikkerhedspolitik er vigtigt hensyn

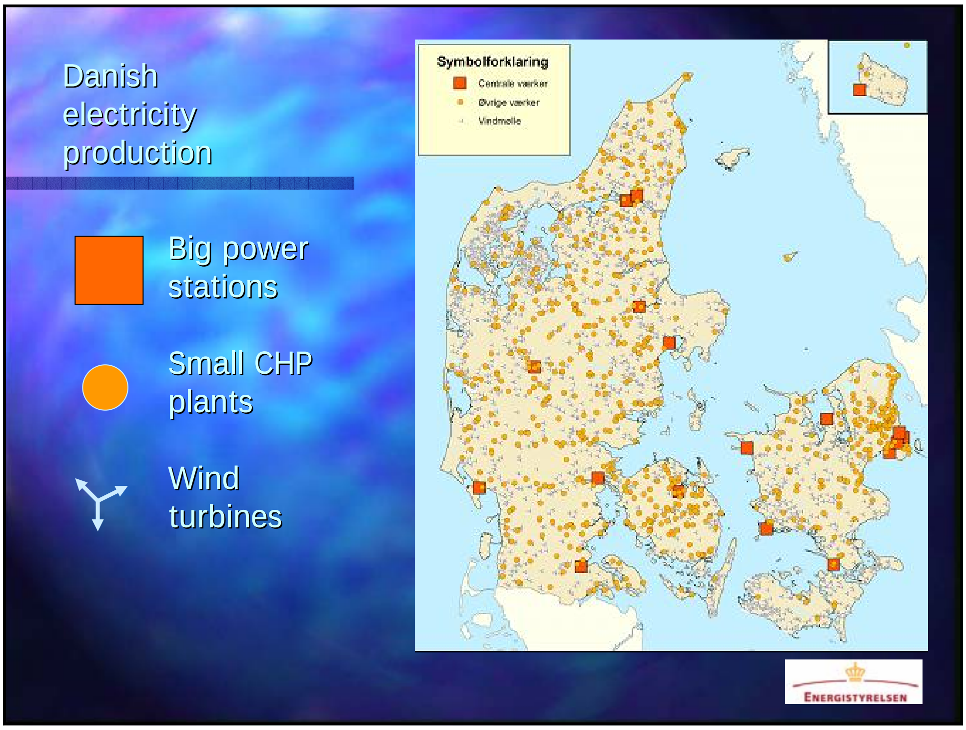
- Aktiv indspil ift. EU (allerede besluttet)

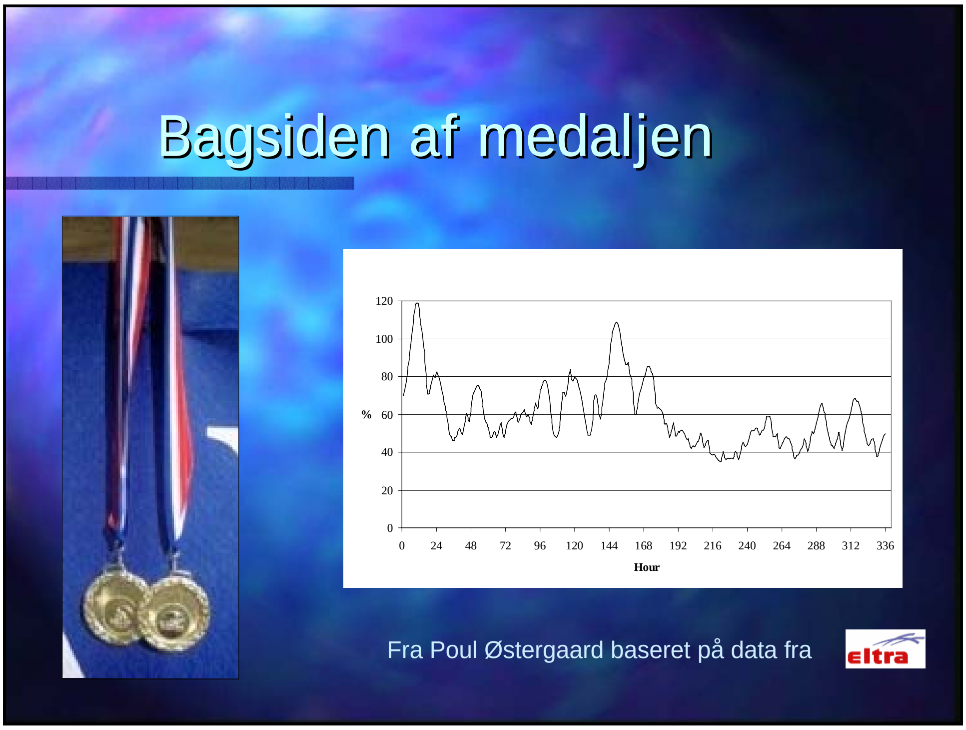
Indhold

- 30 års aktiv dansk energipolitik...... og hvad så nu..?

- Et bud på fremtidens energiforsyning.......... 100% vedvarende energi.

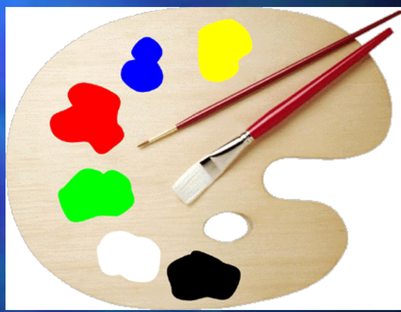



Danish electricity production
Big power stations
Small CHP plants
Wind turbines
Symbolforklaring
Centrale værker
Øvrige værker
Vindmølle
ENERGISTYRELSEN

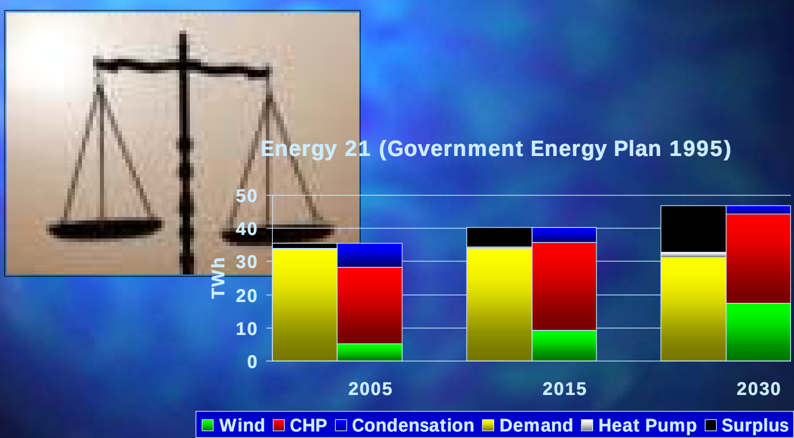

Bagsiden af medaljen
120
100
80
% 60
40
20
0
0 24 48 72 96 120 144 168 192 216 240 264 288 312 336
Hour
Fra Poul Østergaard baseret på data fra
eltra

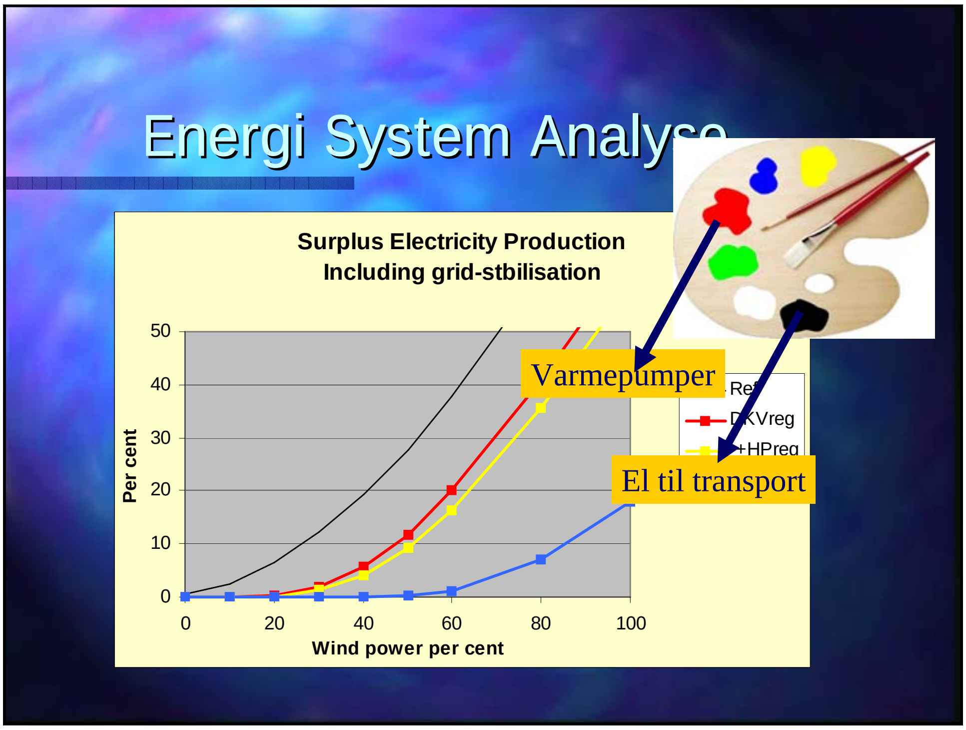
Mange forskellige løsningsforslag på paletten

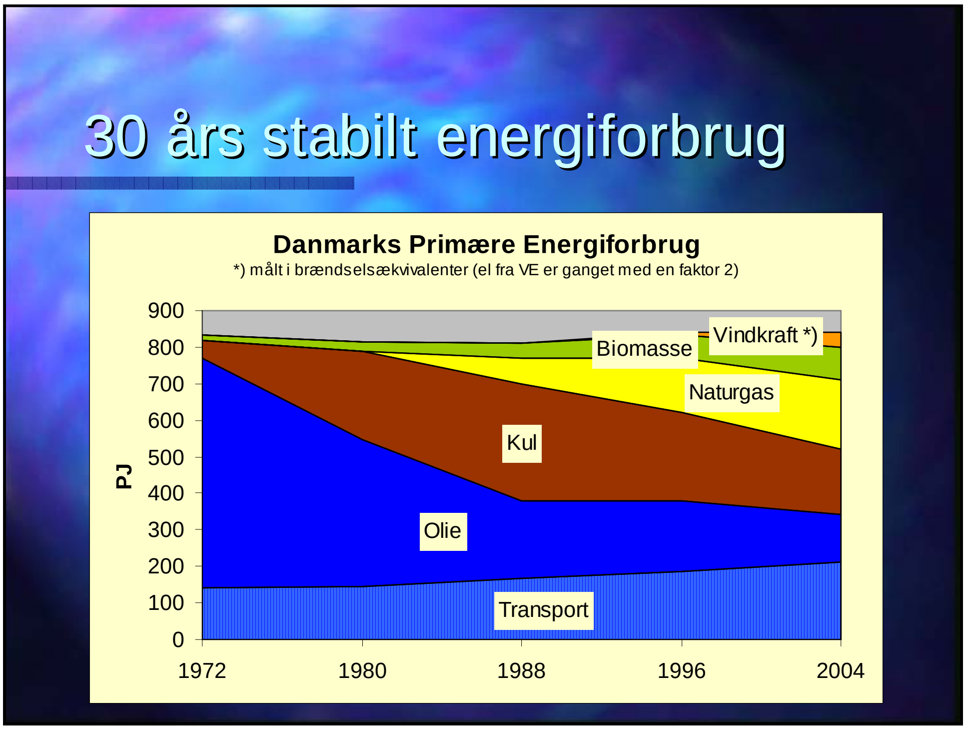
- Fleksibelt forbrug
- El-lagre
- CAES-systemer
- Regulering af kraft/varme-anlæg
- El-varme
- Varmepumper
- El-biler
- Stoppe vindmøllerne
- Lave brint
- Transmission til udlandet
- V2G



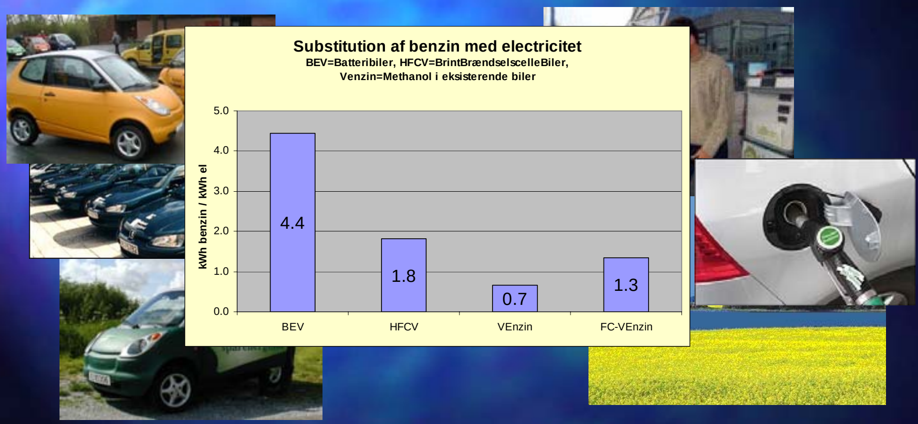
El / varme balancen




Energi System Analyse
Surplus Electricity Production
Including grid-stbilisation
Per cent
50
40
30
20
10
0
0
20
40
60
80
100
Wind power per cent
Varmepumper
El til transport
DKVreg
+HPreg

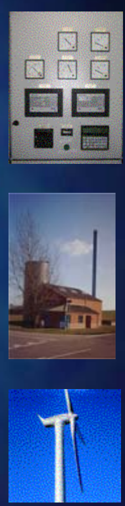

30 års stabilt energiforbrug
Danmarks Primære Energiforbrug
*) målt i brændselsækvivalenter (el fra VE er ganget med en faktor 2)
PJ
900
800
700
600
500
400
300
200
100
0
1972
1980
1988
1996
2004
Biomasse
Vindkraft *)
Naturgas
Kul
Olie
Transport

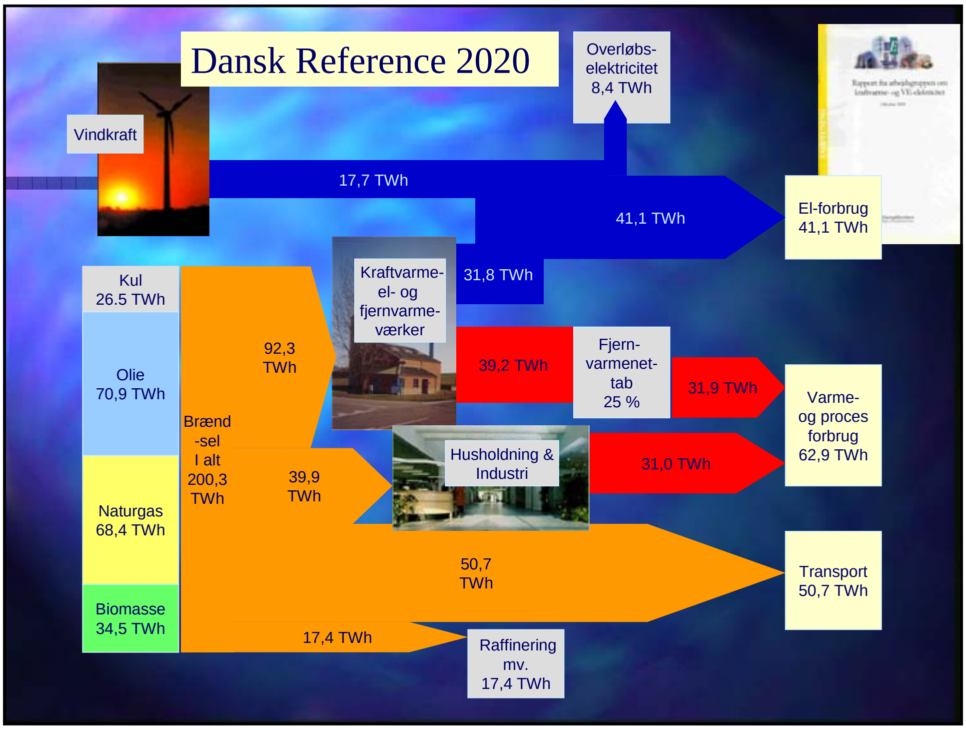
Biler på vedvarende energi



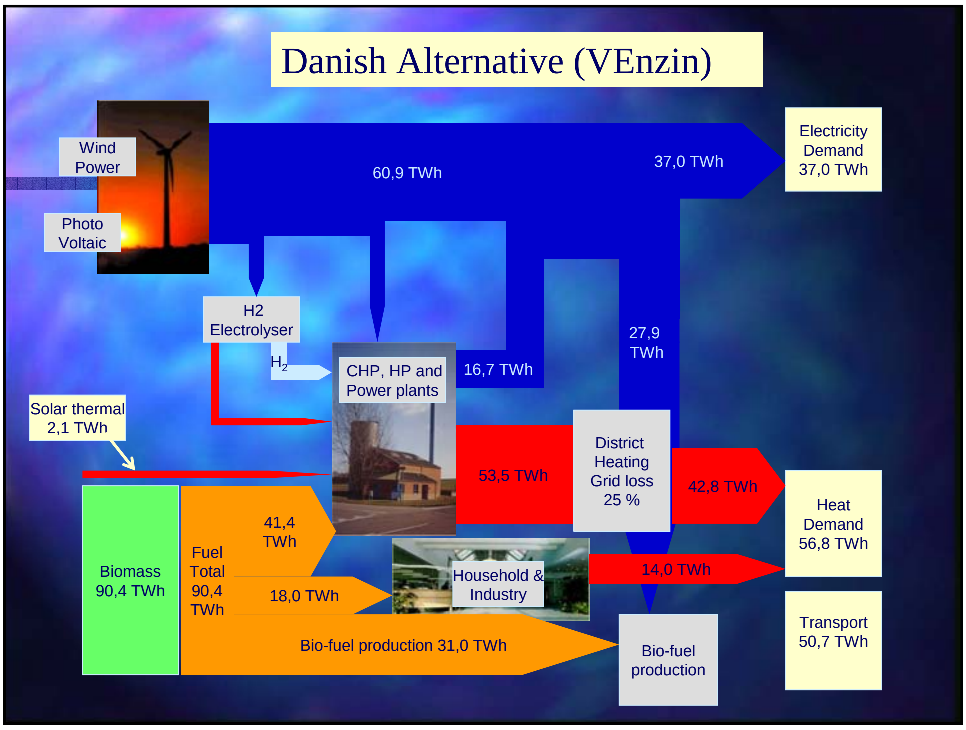
Hovedpunkter

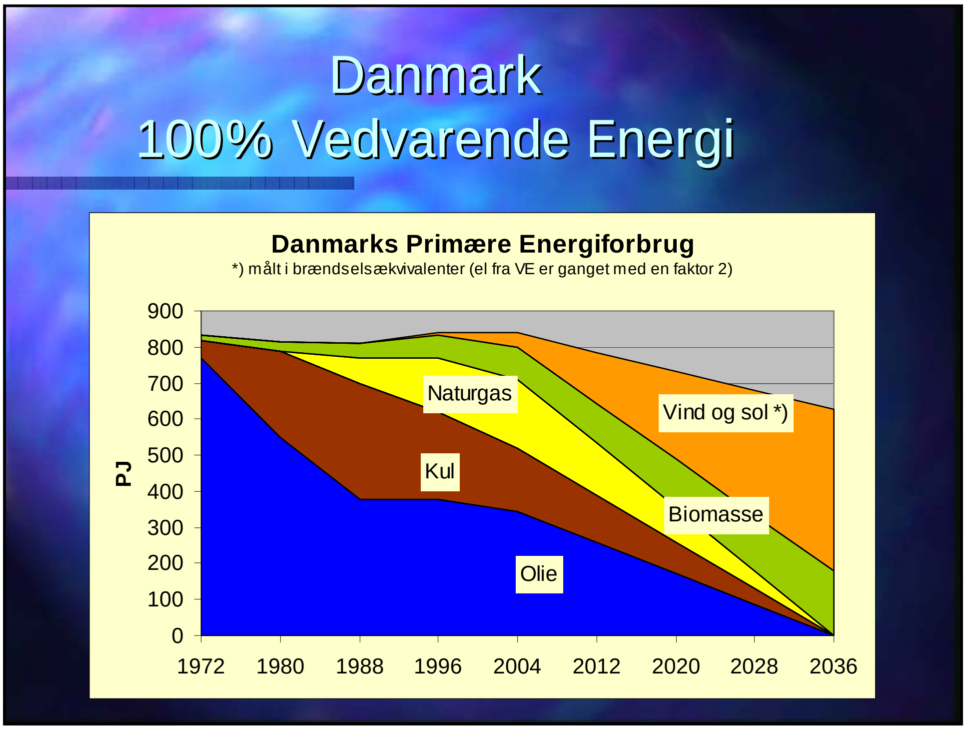
- **Besparelser:** 10% besparelser på el- og varme-forbruget
- **Effektiviseringer:** 50% mere kraft/varme og bedre kraftværker evt. Brændselsceller (Eff. = 50%)
- **Vedvarende energi:** 180 PJ/år biomasse plus solvarme (2 TWh) og solceller (5 TWh) plus off-shore vindkraft.




Dansk Reference 2020
Overløbs-elektricitet 8,4 TWh
Vindkraft
17,7 TWh
41,1 TWh
El-forbrug 41,1 TWh
Kul 26.5 TWh
Olie 70,9 TWh
Naturgas 68,4 TWh
Biomasse 34,5 TWh
Brænd-sel I alt 200,3 TWh
92,3 TWh
Kraftvarme-el- og fjernvarme-værker
31,8 TWh
39,2 TWh
Fjern-varmenet-tab 25 %
31,9 TWh
Varme- og proces forbrug 62,9 TWh
39,9 TWh
Husholdning & Industri
31,0 TWh
50,7 TWh
Transport 50,7 TWh
17,4 TWh
Raffinering mv. 17,4 TWh


Dansk Alternativ 20??
Transport (50,7 TWh) equvalent
Vindkraft
Sol-celler
62,3 TWh
17,8 TWh
37,0 TWh
El-forbrug 37,0 TWh
Brint electrolyse
H2
Kraft/varme-Varmepumper El og fjv.-værker
14,7 TWh
Solarvarme 2,1 TWh
53,5 TWh
Fjernvarme-nettab 25 %
42,8 TWh
Proces- og Varme-behov 56,8 TWh
Biomasse 49,4 TWh
Brænd-sel I alt 49,4 TWh
31,4 TWh
18,0 TWh
husholdninger & Industri
14,0 TWh


Danish Alternative (VEnzin)
Wind Power
Photo Voltaic
60,9 TWh
37,0 TWh
Electricity Demand 37,0 TWh
H2 Electrolyser
CHP, HP and Power plants
16,7 TWh
27,9 TWh
Solar thermal 2,1 TWh
53,5 TWh
District Heating Grid loss 25 %
42,8 TWh
Heat Demand 56,8 TWh
Biomass 90,4 TWh
Fuel Total 90,4 TWh
41,4 TWh
18,0 TWh
Household & Industry
14,0 TWh
Transport 50,7 TWh
Bio-fuel production 31,0 TWh
Bio-fuel production


Danmark
100% Vedvarende Energi
Danmarks Primære Energiforbrug
*) målt i brændselsækvivalenter (el fra VE er ganget med en faktor 2)
PJ
900
800
700
600
500
400
300
200
100
0
1972
1980
1988
1996
2004
2012
2020
2028
2036
Naturgas
Kul
Olie
Vind og sol *)
Biomasse

Resultat

- Der behøves mellem 15.000 and 27.000 MW vindkraft for at kunne omstille Danmark til 100 % vedvarende energi (Nu har vi ca. 3.000 MW).
- 15.000 MW kan nås med 500 MW/år
- Danske vindmølle-fabrikker producerer ca. 3000 MW/år.

Dansk Fjernvarmes landsmøde i Århus
Torsdag den 26. og fredag den 27. oktober 2006

Tak!

Henrik Lund
Professor i Energiplanlægning
Aalborg Universitet

Landsmøde med fokus på fremtiden

Dansk Fjernvarmes formand, Uffe Bro, talte om energibesparelser, og Energistyrelsens direktør, Ib Larsen, gav både ris og ros til fjernvarmebranchen ved årets landsmøde i Århus.

LANDSMØDE

Af journalist Flemming Rasmussen og journalist Lone Völcker, Dansk Fjernvarme

- Det, at vi endnu engang kan sætte rekord med antallet af træfpunkter viser, at fjernvarmebranchen lever og har det rigtig godt, fastslog FIF Marketings formand, Lars Chr. Lilleholt, da han åbnede træfpunkterne ved dette års landsmøde. Foto: Michael Bo Rasmussen/Baghuset.

Selvom det kan komme til at lyde som en genudsendelse af tidligere års omtaler af landsmøder, så var årets landsmøde større end de foregående. Med over 1.500 deltagere tangerede den 48. udgave af Dansk Fjernvarmes landsmøde den tidligere deltagerrekord, og de mange deltagere fik et arrangement med et varieret fagligt program samt aktiv erfaringsudveksling og social hygge med kolleger fra hele landet.

Det faglige program udgør dog langt fra et landsmøde på egen hånd, også de mange træfpunkter og stande er med til at skabe et godt arrangement. På denne front blev der sat ny rekord ved årets landsmøde. 73 træfpunkter og tre stande fyldte foyeren i Århus Musikhus, der sammen med nabobygningen Scandinavian Center lagde lokaler til landsmødet.

Det var derfor også en meget tilfreds formand for FIF Marketing, Lars Chr. Lilleholt, der kunne åbne årets træfpunktarrangement fra en balkon i Musikhusets foyer.

- Det, at vi endnu engang kan sætte rekord, viser, at fjernvarmebranchen lever og har det rigtig godt. Danmark er et foregangsland på fjernvarmeområdet, både når det gælder produktion og udvikling, sagde han.

Lars Chr. Lilleholt understregede også, at han forventede, at fjernvarme vil komme til at spille en rolle i mange andre lande fremover. Her gælder det for den danske fjernvarmesektor naturligvis om at udnytte sine kompetencer bedst muligt.

Fjernvarme er ikke et brændsel

I Musikhusets store sal var det Århus' borgmester, Nicolai Wammen (S), der bød landsmødedeltagerne velkommen til byen, og dermed kunne han for første gang stå for den officielle åbning af et landsmøde.

Dansk Fjernvarmes formand, Uffe Bro, var traditionen tro den næste på talerstolen. Og han lagde ikke fingrene imellem, da han lagde ud med at tale om et af de emner, der utvivlsomt har optaget fjernvarmebranchen siden sidste landsmøde: Energibesparelser.

- Jeg ved godt, at "energifar" - altså ministeren - er skuffet over os, men jeg kan forsikre om, at vi er endnu mere skuffede over, at man fra det energipolitiske flertals side har valgt ganske at se bort fra de besparelsesmuligheder, der ligger på fjernvarmeområdet. Det har man, fordi man helt har været fokuseret på slutbrugerne. Jeg vil bestemt ikke afvise, at det ville være rigtigt at fokusere på slutbrugeren, hvis fjernvarme ellers havde været et brændsel på samme måde som naturgas, olie og til dels el. Men det er fjernvarme jo som bekendt ikke, konstaterede Uffe Bro og fortsatte:

- Lad mig slå fast med syvtommersøm: Fjernvarme er ikke et brændsel, men et system. Energibesparelser i et system opnås ikke ved slutbrugerne, men ved at optimere systemet. Det er så simpelt, at det nærmest gør ondt at sige det.

Uffe Bro følte sig sikker på, at han talte på hele fjernvarmesektorens vegne, da han erklærede sig utrolig ked af, at "man ønsker at indføre et system, der medfører, at fjernvarmen ikke kan bidrage til yderligere formindskelse af forbruget af fossile brændsler", som han formulerede det.

Dansk Fjernvarmes formand konstaterede, at bekendtgørelsen om energibesparelser først og fremmest vil føre til højere fjernvarmepriser, og at den derfor mest af alt minder om en skjult skat på fjernvarme.

Uffe Bro anså hele sagen for at være et skoleeksempel på, hvor galt det kan gå, når der går politik i en sag, og han opfordrede ministeren til at lave en ny energispareaftale med Dansk Fjernvarme, der tager udgangspunkt i de særlige præmisser, der gør sig gældende på fjernvarmeområdet.

- Så behøver ministeren ikke at være skuffet, men til gengæld glad og stolt over at være minister for det bedste energisparesystem i verden, nemlig det danske fjernvarmesystem, mente Uffe Bro.

Glædeligt energipolitisk skifte

I forlængelse af sin kritik af den meget omtalte energispareaftale fortsatte Uffe Bro sit indlæg ved at dvæle lidt mere ved den aktuelle danske energipolitik. Her var der til gengæld ros at hente for de seneste meldinger på den energipolitiske front.

- Når vi taler om dansk energipolitik, vil jeg også fremhæve, at vi på det seneste har været vidne til en tilsyneladende fuldstændig ændring af den officielle danske energipolitik. Jeg glæder mig over, at vi i Danmark tilsyneladende er på vej tilbage til en mere aktiv energipolitik, og at der er et bredt politisk flertal bag, sagde Uffe Bro.

Uffe Bro undrede sig dog over, hvor lidt fjernvarmen fylder, når de danske energipolitikere drøfter deres felt. Han glædede sig derfor over, at Poul Erik Morthorst, forskningsspecialist på Risø, ved landsmødet skulle holde et indlæg, der netop handler om fjernvarmens placering i fremtidens energisystemer.

Dansk Fjernvarmes formand, Uffe Bro, kritiserede energispareaftalen for at være en sag, der "gik politik i". Til gengæld mente han, at nye meldinger fra regeringen tyder på en mere aktiv energipolitik fremover, hvilket bør blive til gavn for fjernvarmen. Foto: Michael Bo Rasmussen/Baghuset.

Trods den lidt beskedne fokus på fjernvarmen vurderede Uffe Bro dog, at konsensuspolitik på energiområdet er til fordel for den mest udbredte danske opvarmningsform, fjernvarmen. Og med de aktuelle meldinger om en øget satsning på vedvarende energi så han en positiv fremtid for fjernvarmen.

- De mange kilder til fjernvarmeegnet varmt vand eller ditto brændsler ser ikke ud til at udtømmes foreløbig. Tværtimod vil øget anvendelse af vedvarende energi, biomasse, brint som energibærer og meget af det øvrige, man kan forestille sig om fremtidens energiforsyning, øge mængden af overskudsvarme, og så vil fjernvarmens centralisering af varmebehovet være afgørende for effektiviteten, mente Dansk Fjernvarmes formand.

Uffe Bro understregede i sin tale, at fjernvarmens store potentiale på EU-niveau netop er dokumenteret i projektet ECOHEATCOOL. Projektet viser, at fjernvarme kan udnytte energi så effektivt, at EU ved at fordoble anvendelsen kan spare, hvad der svarer til forbruget af energi i Sverige. Samtidig betyder det, at CO_2-udslippet vil blive reduceret med 400 millioner tons om året – det svarer til det nuværende CO_2-udslip fra brændselsforbruget i Frankrig.

(Fortsættes næste side)

(fortsat fra forrige side)

Fik fjernvarmen kolde fødder?

Efter Uffe Bros tale var det planen at byde velkommen til transport- og energiminister Flemming Hansen(K). Han havde dog, endnu en gang, meldt afbud men til gengæld var Energistyrelsens direktør, Ib Larsen, i topform, da han overtog talerstolen.

Som kommentar til, at Uffe Bro havde overskredet tidsplanen en smule, sagde Ib Larsen:

- Det er et godt gammelt politikertrick at bruge al tiden, men den går ikke Uffe. Jeg kommer til at tale i det meste af din pause.

Dermed var linien lagt, og Energistyrelsens direktør havde både ros og ris med til Dansk Fjernvarme.

- Økonomien er vokset med 50 procent, uden at energiforbruget er øget. Det kunne vi ikke have gjort uden fjernvarme, og det skyldes ikke mindst, at vi har en meget høj andel af kraftvarme her i landet, sagde Ib Larsen, som ikke overraskende havde energispareaftalen på minussiden.

- Dansk Fjernvarme var de eneste, der sagde nej til en frivillig aftale om energibesparelser. Det er vanskeligt at forstå, men måske var det temperaturen i det gamle Fjernvarmens Hus, der var skyld i, at I fik kolde fødder?

- Det er helt utilbørligt, at en embedsmand kommenterer på formandens tale, men det vil jeg alligevel gøre. Jeg forstår ikke, hvorfor du er så mavesur over det her, Uffe. Det går jo godt, så se på de positive ting. Det vil være en god ide for os alle at kigge fremad og få realiseret besparelserne frem for at se bagud.

- Fjernvarme er rentabelt, miljøvenligt og tilmed billigt, og alle fremskrivninger viser, at fjernvarme også vil være den mest udbredte opvarmningsform i 2025, sagde Ib Larsen.

Han tilføjede, at der, så vidt han er orienteret, ikke er nogen planer om at liberalisere fjernvarmesektoren.

- Men det betyder ikke, at branchen går fri af krav om effektivisering.

Ib Larsen kunne bekræfte, at regeringen i de kommende måneder vil fremlægge et energipolitisk udspil, men kunne ikke sige, hvad det kommer til at indeholde.

Uffe Bro takkede for indlægget med en bemærkning til Energistyrelsens direktør:

- Det er ikke passende for en politiker at gå i diskussion med en embedsmand, så det lader jeg være med.

Et meget højt deltagerantal og et stort engagement i debatten fra de fremmødtes side var også i år kendetegnende for Dansk Fjernvarmes landsmøde. Foto: Michael Bo Rasmussen/ Baghuset.

Professor-ros til Foghs nye kurs

Således fik Uffe Bro og Ib Larsen, trods det, at de begge med et glimt i øjet kaldte det for upassende, alligevel krydset klinger fra talerstolen. Og dermed var landsmødet skudt godt i gang.

Senere fulgte det omtalte indlæg fra Poul Erik Morthorst og en bramfri energipolitisk debat mellem Socialdemokraternes Kim Mortensen, Venstres Lars Chr. Lilleholt og Dansk Fjernvarmes Uffe Bro (mere om begge dele på de følgende sider, red.). Om aftenen trak den traditionelle festmiddag cirka 850 deltagere, der blev underholdt af en veloplagt Pernille Schrøder og hendes trio.

På landsmødets anden dag samlede professor ved Aalborg Universitet, Henrik Lund, fint tråden op fra Uffe Bros tale, da han i et indlæg så nærmere på de sidste 30 års danske energipolitik. Ganske som Uffe Bro var professoren nemlig glad for den nuværende regerings kursskifte tilbage mod en mere aktiv energipolitik, som han i sit indlæg redegjorde for, havde været kendetegnende for de sidste 30 år.

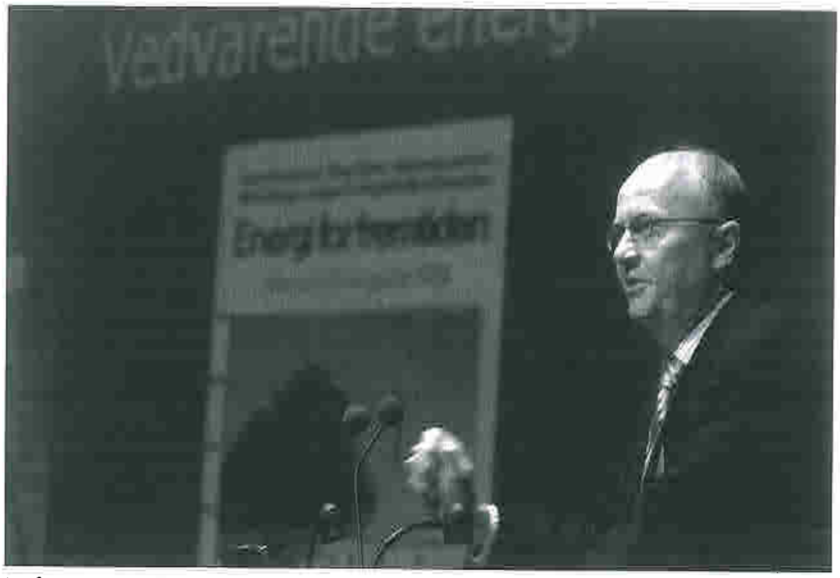
- I 2001 stoppede al aktiv energipolitik i Danmark, og regeringen valgte i stedet at lade markedet være styrende. CO_2-kvotesystemet er et eksempel. Her bliver der sparet på CO_2 hvor markedet siger, det er billigst at gøre det. Det er virkelig et brud med mange års strategi og et nyt signal til industrien om, at vi ikke skal have nye anlæg i Danmark, hvis det koster lidt. Derfor er jeg er utrolig lykkelig over Anders Fogh Rasmussens nye udmeldinger, for jeg forstår ham således, at vi vil have 100 procent vedvarende energi i Danmark, sagde Henrik Lund.

Aktiv energipolitik betaler sig

Inden professoren i sit indlæg var nået frem til den konklusion, gav han et godt overblik over den energipolitik, der er blevet ført siden den første oliekrise.

I 70'erne var afhængigheden af olie naturligt nok i fokus, og kulfyring var det foretrukne løsningsforslag. Der var dog også forslag om atomkraft, mens en alternativ energiplan allerede dengang fokuserede på de nøglebegreber, der er i fokus i dag: Energibesparelser, kraftvarme og vedvarende energi.

I 80'erne havde dansk energipolitik fokus på samfundsøkonomi og mulighederne for at skabe beskæftigelse og en positiv betalingsbalance. I 90'erne skete der som bekendt et skift, hvor fokus blev rettet mod miljøet. Den energiplan, der hidtil havde været den alternative, blev nu den officielle med fokus på især vedvarende energi.



Kraftvarmens succes med at holde det danske energiforbrug i ro, trods stor økonomisk vækst, anså professor Henrik Lund fra Aalborg Universitet som et klart eksempel på, at en aktiv energipolitik betaler sig i form af helt konkrete resultater. Foto: Michael Bo Rasmussen/Baghuset.

Og hvad har vi så opnået med alt det?, spurgte Henrik Lund forsamlingen og svarede selv på spørgsmålet:

- Det samlede energiforbrug har været konstant over de sidste 30 år, og det er sket samtidig med en økonomisk vækst. Det er der ikke andre lande i verden, der kan fremvise. Vi kan bestemt være stolte, mente Henrik Lund, der fremhævede opvarmning som en af de helt store succeshistorier i dansk energipolitik.

- Vi opvarmer halvanden gang så meget bolig med samme energi. Kraftvarmen er en virkelig stor succes. Nettobrændstofforbruget er væsentligt mindre end i 1972. Samtidig er elforbruget steget, og transportsektorens energiforbrug er steget endnu mere, konstaterede professoren, der ikke var i tvivl om, hvad man kan lære af det.

- En aktiv energipolitik betaler sig virkelig. Det fører rent faktisk til resultater.

På den måde fik professor Henrik Lund også fremhævet fjernvarmens væsentlige bidrag til den opnåede succes for dansk energipolitik. Så landsmødedeltagerne kunne med godt humør sætte sig til rette til landsmødets sidste indlæg med en af den danske medieverdens skrappe damer, Trine Gregorius.

Hun afsluttede landsmødet med et underholdende indlæg om betydningen af at kommunikere tydeligt. Og en ting, der i hvert fald kan kommunikeres klart er, at landsmødet næste år bliver nummer 49 i rækken, og at det finder sted i Aalborg.

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Reporting on dissemination activities carried out within the frame of the DESIRE project (WP8)

Name, Affiliation	Niels I. Meyer, Aalborg University
E-mail	nim@byg.dtu.dk
Title of dissemination	Learnings from Wind Energy Policy in EU, With Focus on Denmark, Sweden and Spain.
Type of activity	Presentation at conference Article in peer-reviewed journal (submitted)
Title of forum	GIN Wind Stream Conference, Cardiff, July 2006 The article is submitted for publication in the journal *European Environment.*
Language	English
Date of dissemination	03-07-2007
Place of dissemination	Cardiff, UK
Brief abstract / description of dissemination activity	The paper describes the learnings from different wind energy policies in EU and compares the Danish development to that in Sweden and Spain. It is concluded that liberalisation of the electricity market in EU has created a number of problems for the promotion of wind power and for the establishment of a sustainable energy development in general.
Audience impact assessment	The message of the paper was well received and gave rise to a broad discussion at the session.
Dissemination	Included after this form

WIND POLICIES IN DENMARK, SWEDEN AND SPAIN

- Energy is on the agenda of most countries in the world.
- Main problems: long-range supply security, ”oil peak”, global warming.
- These problems were not in focus when liberalising the EU electricity market in 1996: only low consumer prices.
- 10 years of experience has exposed a number of problems in addition to the above mentioned: e.g. lower utility priority to maintenance and technical innovation.
- Long range planning is needed, but the market has a short time horizon. This is not consistent.

NUCLEAR POWER

- The EU Commission is reconsidering nuclear power.
- But: Unsolved security problems, no safe deposit of high level waste, limited uranium resources, potential for nuclear weapons - and manipulated cost claims.
- Far from full insurance cost, underestimated cost for removing of old plants, hidden state subsidies through cheap investment loans and export credits.
- EU has subsidised nuclear power by more than 60 billion euros over the years.

HISTORICAL DANISH WIND ENERGY POLICY

- Long historical development: Poul la Cour in the 1890s.
- Rotor diameter of 22 m with mechanical speed control.
- Testing of rotor profiles in wind tunnel.
- Producing hydrogen by electrolysis of water (for illumination).
- In 1918, 120 rural wind power stations in Denmark with a total capacity of 3 MW, covering 3% of Danish demand.
- 200 kW Gedser mill in operation 1959 to 1967: three blades on a horizontal axis in upwind position.

MODERN PHASE OF DANISH WIND POWER

- Startíng in the mid seventies with the Gedser Mill as the ”mother concept” promoted by small private entrepreneurs. Turbine capacities beginning at 22 kW.
- Support from the Danish Academy of Technical Sciences and Danish NGO’s.
- Ridiculed by utilities and supporters of nuclear power.
- Heated debate on nuclear power from 1974 to 1985.
- Official plans (1976,1981), alternative plans (1976, 1983)
- Supporters of RES and opponents of nuclear power were accused of trying to overthrow Danish democracy.

MAIN FEATURES OF DANISH WIND ENERGY POLICY

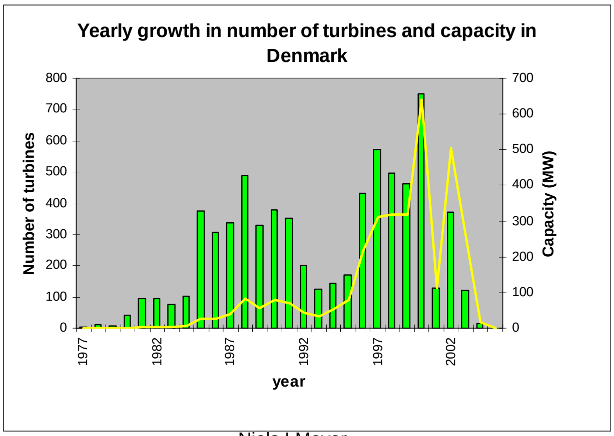
- 1976 to 1990: modest room for wind in official plans, voluntary agreements between utilities and wind energy producers, some state support for research/development
- 1990: New energy plan with main goal: sustainable energy development. Follow-up in 1996.
- 1992: State rules for wind tariffs and grid access.
- 1994 to 2002: Rapid growth in installed wind capacity.
- 2003-2006: Stagnation in new wind capacity after change of Danish government i 2001.

STRATEGIC ELEMENTS OF DANISH WIND POLICY

- Long-term government support for R&D.
- Early national tests and certification of wind turbines.
- Safe technological development from small to large size.
- Siting rules caring for the environment and dwellings.
- Local ownership of wind turbines, mainly co-operatives – 150,000 households involved in 2002.
- Favourable feed-in tariffs from 1992 to 2002: 8 euc/kWh.
- Specified and ambitious targets for RES-E in official energy plans from 1990 and 1996: 1,500 MW wind in 2005 and 5,500 MW in 2030 (4,000 MW offshore).

YEARLY GROWTH OF WIND CAPACITY IN DENMARK

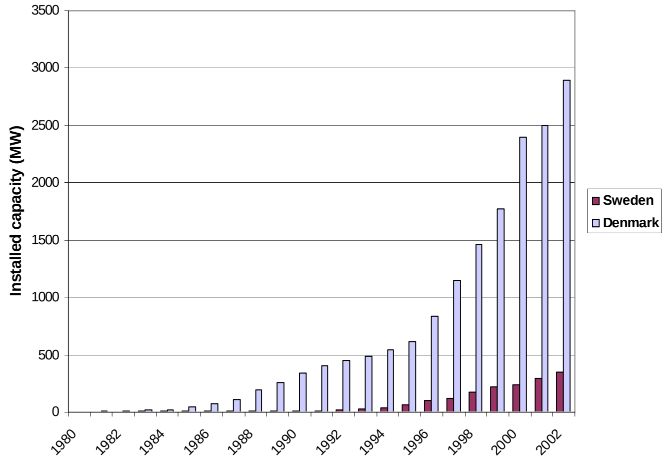
- Green columns indicate number of turbines, while yellow curve indicates yearly installed capacity (MW). Net increase in capacity close to zero from 2004 to mid 2006.



MAIN FEATURES OF SWEDISH WIND DEVELOPMENT

- Late and limited interest from Swedish government and utilities for wind power.
- Early technological state support for MW turbines only.
- Slow and bureaucratic permission procedures.
- Focus in RES-policy on biomass rather than on wind.
- Unsuccessful introduction of scheme with trading of green certificates.
- Recent streamlining of green certificates scheme and increasing interest in wind power from utilities.

COMPARISON BETWEEN SWEDEN AND DENMARK



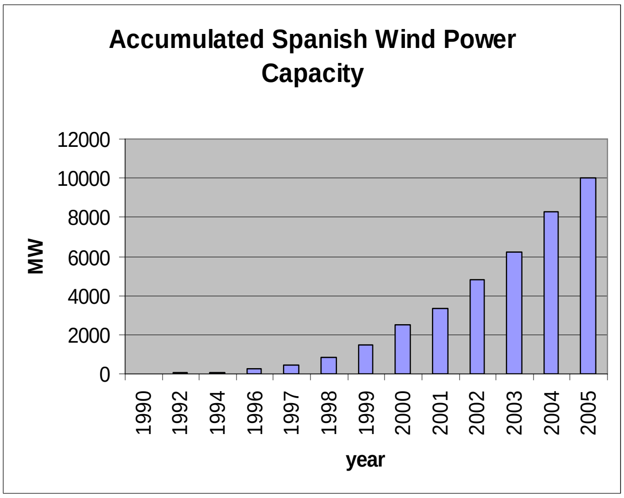
SWEDISH SUPPORT SCHEMES FOR WIND POWER

- Investment subsidies from 1991 to 2002 ranging from 35% to 15% - resulting in 290 MW installed in 2002 .
- New scheme: Trading of green certificates introduced in 2003.
- No success due to lack of stable and long-range framework conditions.
- Adjusted scheme from 2006 running to 2030 with 15 years contracts for certificates.
- Negotiations for a common certificates market with Norway has been closed in early 2006.

MAIN FEATURES OF SPANISH WIND DEVELOPMENT

- First Spanish state support for wind related to law about energy conservation (1980).
- First Spanish grid connected wind farm (600 kW) in 1984
- Late start on real Spanish wind development (only 100 MW in 1995) mainly due to varying support schemes.
- After 1995, the Spanish growth rate for wind power has been among the highest in the world resulting in more than 10,000 MW installed capacity at the end of 2005.

ACCUMULATED SPANISH WIND CAPACITY



KEY ACTORS IN SPANISH WIND POWER

- Governmental actors: *Institute for Energy Diversification and Saving* (1984) and *National Energy Regulatory Authority* (1998).
- Developers Associations: *Association of Renewable Energy Producers* (1987) with about 300 members.
- Regional governments in Autonomous Communities.
- Second largest power utility, Gamesa Eólica owns 3,000 MW wind plus 15 production sites (number two in world).
- *Wind Energy Enterprise Association* (2002), large corp.

PLANNING OF WIND POWER IN SPAIN

- First comprehensive energy plan (1991) with a target of 175 MW wind capacity in year 2000. The realised capacity was 2,500 MW!
- Subsequent plans in 1999 (9 GW by 2010), 2002 (13 GW by 2011) and 2005 (20 GW by 2010).
- Spanish wind industry wants to increase this target further, but this will demand strong technical requirements for turbines (e.g. overcoming voltage dips on the grid and entering delegated dispatch centers).

ECONOMIC SUPPORT SCHEMES IN SPAIN

- From 1980 to 1994 varying and uncertain economic schemes.
- New electricity law in 1994 introducing five year contracts and tariffs set by governmental Royal Decree.
- Tariffs from 1995-1998: 6.5 to 6.9 eurocents/kWh.
- After liberalised market in 1996 RES producers may choose between different alternatives: Pool system, bilateral contracts and ”special regime” (with a specified tariff).
- Since 2004 market oriented energy policy but with favourable tariffs. Tender system for offshore farms.

COMPARISON: DENMARK, SWEDEN AND SPAIN

- Denmark pioneered modern phase of wind power and has still the worlds highest coverage by wind (19%).
- The Swedish government and Swedish utilities have shown only modest interest in wind until recent years.
- Spain has experienced a slow growth in wind power capacity until the mid 1990s where an extraordinary high growth rate took off.
- In 2006, wind power is stagnating in Denmark, blooming in Spain and wakening up in Sweden.

EXPLAINING FACTORS FOR DENMARK

- Historical tradition and step by step increase in capacity.
- Alliances between NGOs and academic institutions.
- Early test and certification institution at Risø and early state support for R&D including offshore farms.
- Local ownership of turbines (150,000 households).
- Private industrial entrepreneurs leading to large production plants in the 1990s.
- Far-sighted government plans from 1990 and 1996 including ambitious capacity targets.
- Stagnation from 2003 due to conservative-liberalistic government with fundamentalistic market policy.

EXPLAINING FACTORS FOR SWEDEN

- Questionable choice of turbine technology (MW range) from the outset.
- No strong driving forces for wind power.
- No successful national production of wind turbines.
- Bureaucratic procedures for plant permissions.
- More focus on biomass than on wind.
- Recent streamlining of scheme for trading of green certificates may create hígher growth rates.

EXPLAINING FACTORS FOR SPAIN

- Uncertain and short range support schemes for the period up to mid nineties.
- No significant turbine production until late nineties.
- Strong incentives from feed-in scheme after mid nineties.
- Support from Autonomous Communities and some utilities like Iberdrola.
- Increasing electricity demand: extra room for wind.
- Dependence on imported fossil fuel and Kyoto commitment support shift to wind power.

CONCLUSIONS

- Governmental energy policy is a decisive factor for penetration of wind power.
- Favourable feed-in schemes have so far proved to promote wind power most efficiently.
- A sustainable energy development requires fluctuating RES as a significant element in the supply system, e.g. 50% before 2030.
- High fractions of fluctuating RES-E require these plants to actively support the overall system balance.
- Development of such systems should have high priority.

Dissemination strategy on Electricity balancing

DESIRE

large Scale Integration of Renewable Energy

Reporting on dissemination activities carried out within the frame of the DESIRE project (WP8)

Name, Affiliation	Poul Alberg Østergaard, Aalborg University, Denmark
E-mail	poul@plan.aau.dk
Title of dissemination	Cogeneration of power & heat and cogeneration of power and desalinated water; modelling for optimal system performance
Type of activity	Presentation at conference Article in conference proceedings
Title of forum	PowerGEN Middle East 2007
Language	English
Date of dissemination	22 January 2007
Place of dissemination	Manama, Bahrain
Brief abstract / description of dissemination activity	Cogeneration of heat & power and cogeneration of desalinated water and power have similarities from an energy systems perspective. Both introduce limitations in the freedom of action but also introduce possibilities for integrating fluctuating renewable energy sources. Through energy systems analyses, it was demonstrated how storage tanks desalinated water could introduce a buffer corresponding to heat storages for optimising performance of energy systems with respect to integrating fluctuating energy sources.
Audience impact assessment	POWERGEN Middle East is the largest series of power conferences and trade shows in the Middle East with a high attendance. The idea that CPH plants can be used to integrate fluctuating power sources is a novel idea in the Middle East and did generated some interest in the audience causing feed back after the conference session
Dissemination	Included after this form

Sustainable Energy Planning

PowerGEN Middle East
Manama, Bahrain
January 22nd 2007

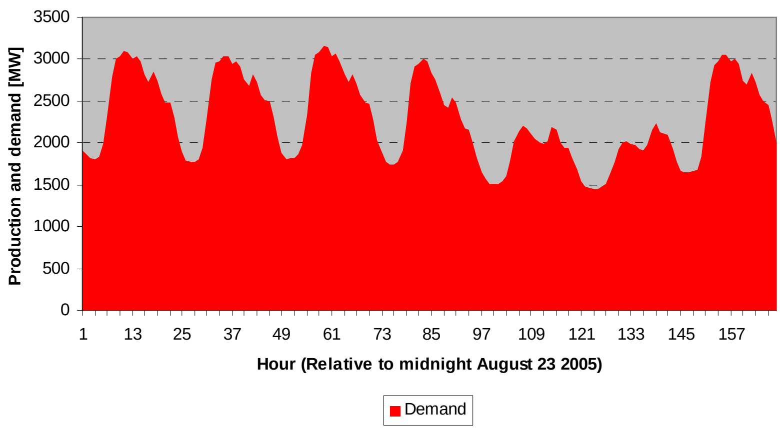
Cogeneration of power & heat and Cogeneration of power and desalinated water; *modelling for optimal system performance*

Poul Alberg Østergaard
Aalborg University
Denmark

1

Sustainable Energy Planning

Load curve building in complex energy systems



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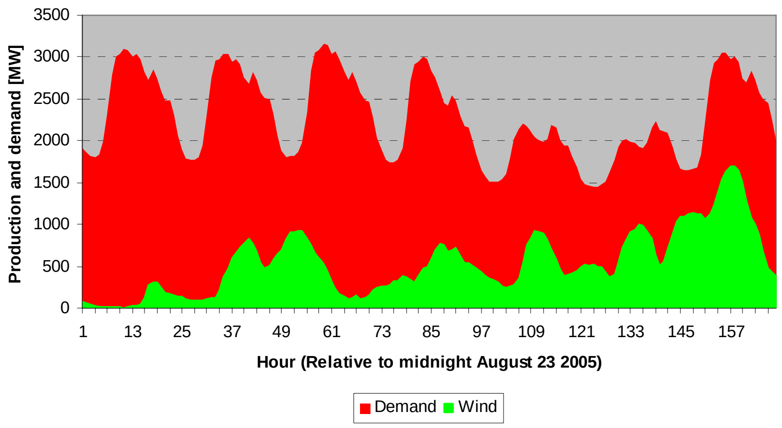
Sustainable Energy Planning

Aalborg University

Load curve building in complex energy systems



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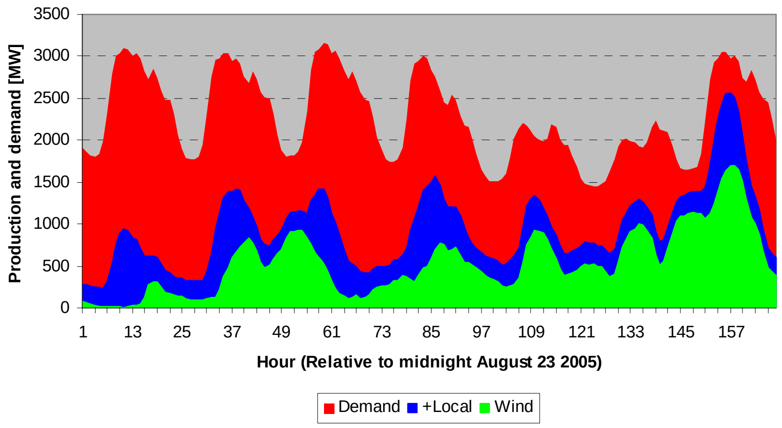
Sustainable Energy Planning

Aalborg University

Load curve building in complex energy systems



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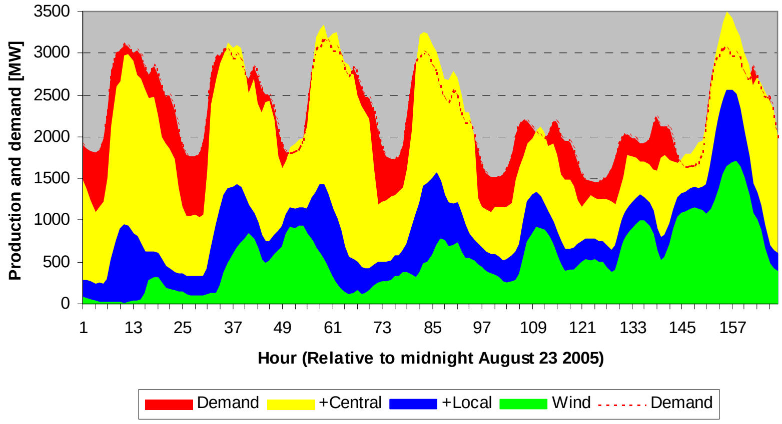
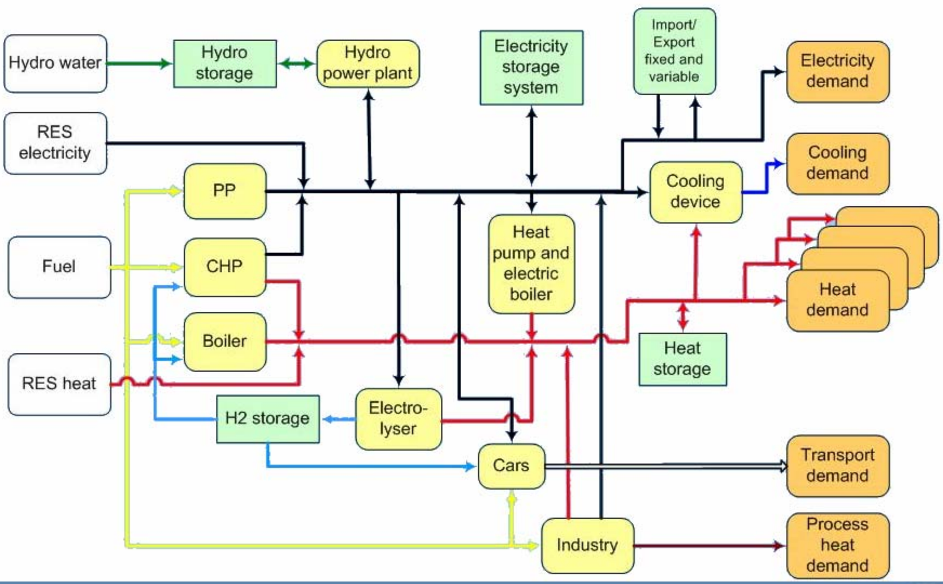
Load curve building in complex energy systems





Energy units and TSO control

Units typically outside the control of the TSO	Units typically under the control of the TSO
Photo-voltaic cells Wind power Solar collectors Run-of-river hydroelectricity Wave power Geothermal Nuclear CHP Boilers Heat pumps Heat storages	CHP Condensing mode power plants Hydro electricity with reservoir (including pumped storage and control of reservoir contents & precipitation) Boilers at centrally dispatchable power plants Heat pumps Compressed air storages Reversible fuel-cell storages Heat storages

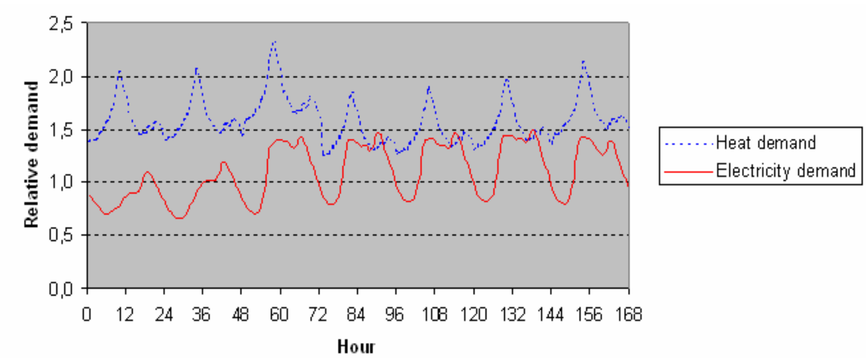
Demands

Electricity demand
Flexible electricity demand
Electricity demand for transportation
Heat demand – areas with dispatchable CHP plants
Heat demand – areas with non-dispatchable CHP plants

Energy system scenario

Consumption [TWh]	Generating capacity [MW]	
24.87 Electricity	2750	Cogeneration of heat and power (CHP)
20.00 District heat	5000	Central stations – Condensing operation
	2400	Wind (inland and off-shore)

Electricity and heat demand variation over a week



Conclusions

- energy models aimed at analysing energy systems with heat demands and complex interdependencies may be applied to analyse energy systems with desalination plants
- a high degree of wind power has been modelled in order to give an uncontrollable element of production. The analyses demonstrate how the integration of this is improved with storage capacity for desalinated water which enables a time-shift between electricity and water generation and the actual demand of water

Reporting on dissemination activities carried out within the frame of the DESIRE project (WP8)

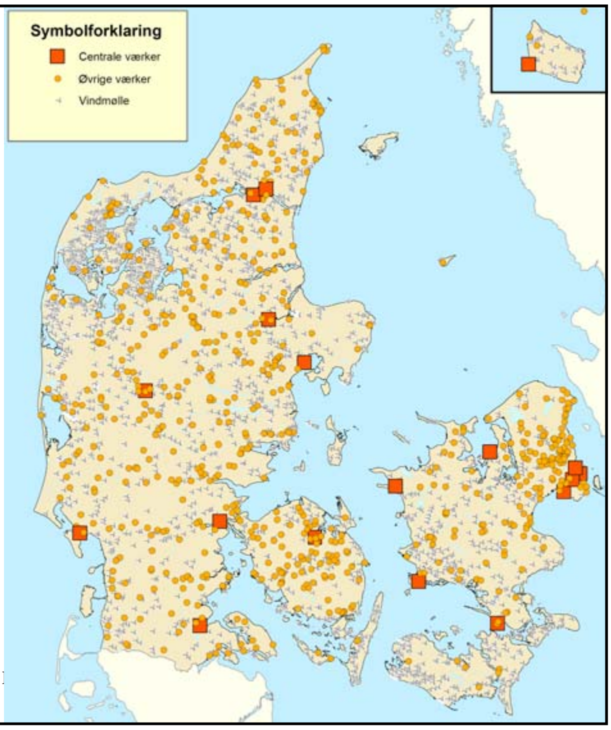
Name, Affiliation	Anders N. Andersen, EMD International A/S
E-mail	ana@emd.dk
Title of dissemination	How can CHP plants help balancing the system
Type of activity	Presentation made at seminar.
Title of forum	Integration of fluctuating renewables into the grid using CHP
Language	English
Date of dissemination	9 November 2005
Place of dissemination	University of Birmingham, UK
Brief abstract / description of dissemination activity	In the presentation was shown the necessity for CHP plants offering balancing of fluctuating Renewable Electricity Productions, and the necessity for larger amounts of Regulating Power when balancing fluctuating Renewable Electricity Productions. In the presentation was shown how CHP plants offers regulating power.
Audience impact assessment	Approximately 40 persons participated. More of these showed afterwards interest in the presentation. Especially interesting was the contact to Dr Alastair Martin, Managing Director www.flexitricity.com
Dissemination	Included after this form.

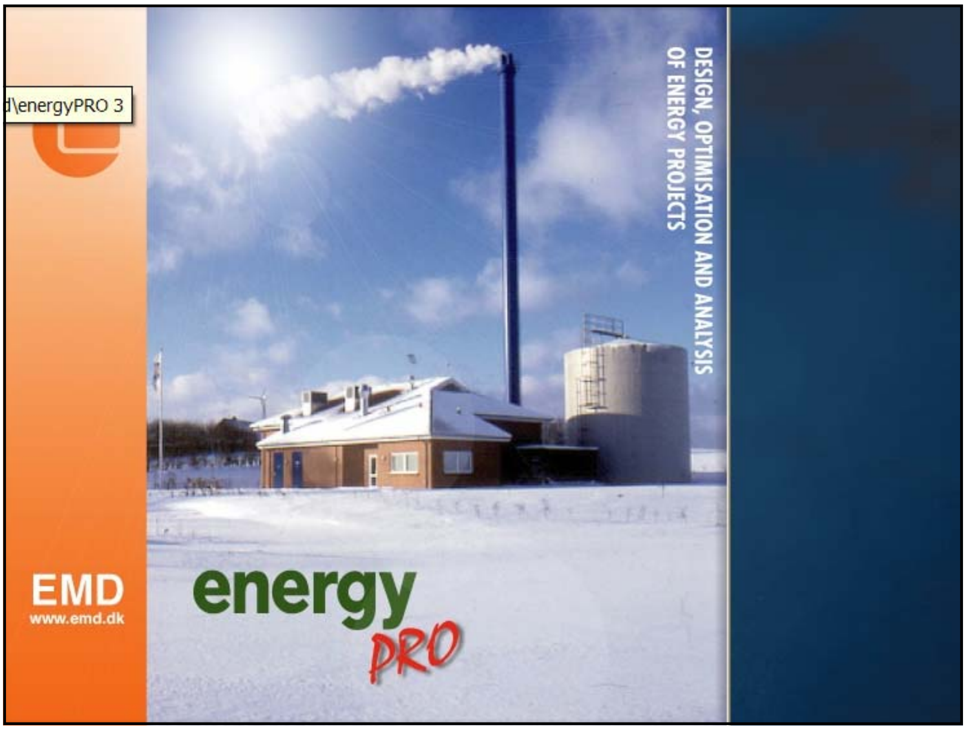
How can CHP plants help balancing the system ?

Presentation made at the DESIRE seminar in Birmingham, Nov. 9th, 2005
- Integration of fluctuating renewables into the grid using CHP -
Speaker Anders N. Andersen
EMD International A/S, www.emd.dk

DESIRE seminar in Birmingham,
November 9th 2005

The necessity for CHP plants offering balancing of fluctuating Renewable Electricity Productions





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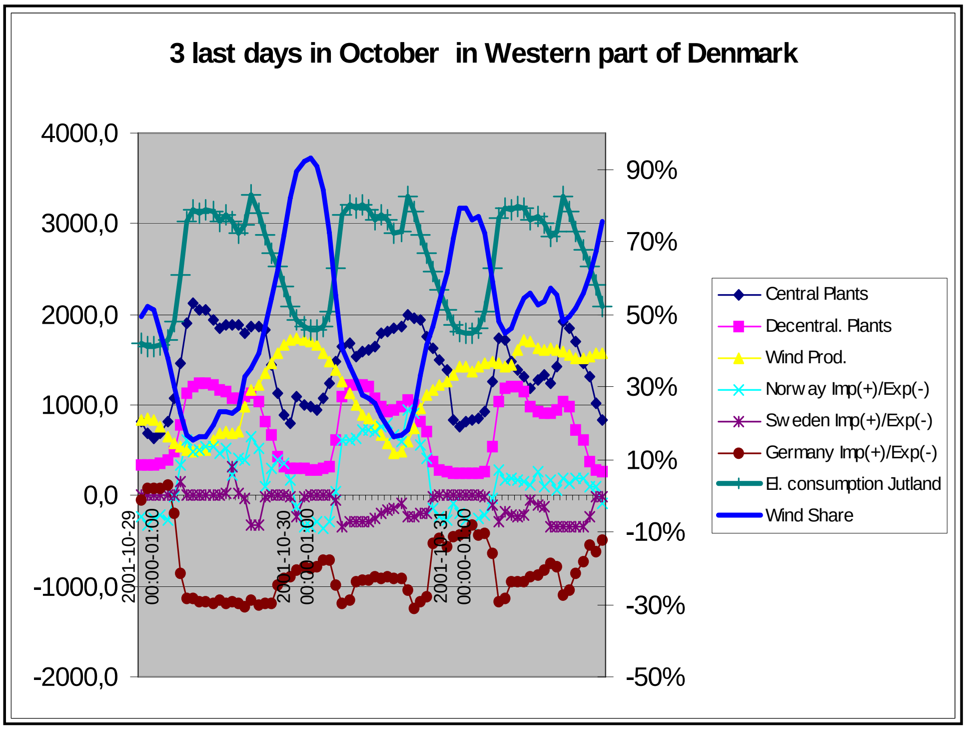
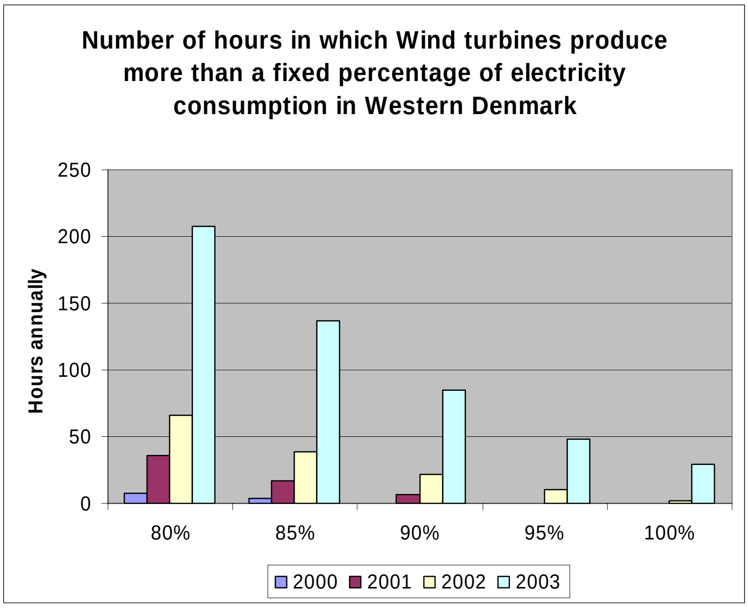


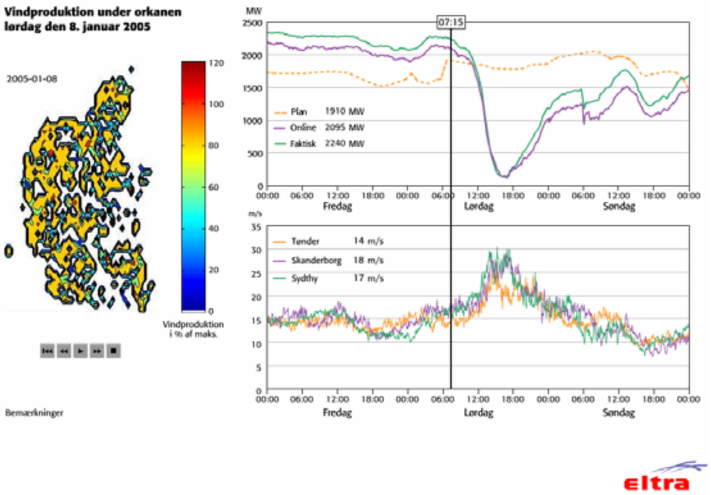
3 last days in October in Western part of Denmark
4000,0
3000,0
2000,0
1000,0
0,0
-1000,0
-2000,0
90%
70%
50%
30%
10%
-10%
-30%
-50%
2001-10-29 00:00-01:00
2001-10-30 00:00-01:00
2001-10-31 00:00-01:00
Central Plants
Decentral. Plants
Wind Prod.
Norway Imp(+)/Exp(-)
Sweden Imp(+)/Exp(-)
Germany Imp(+)/Exp(-)
El. consumption Jutland
Wind Share



The necessity for larger amounts of Regulating Power when balancing fluctuating Renewable Electricity Productions

Hurricane approaching West Denmark

The 8. of January 2005



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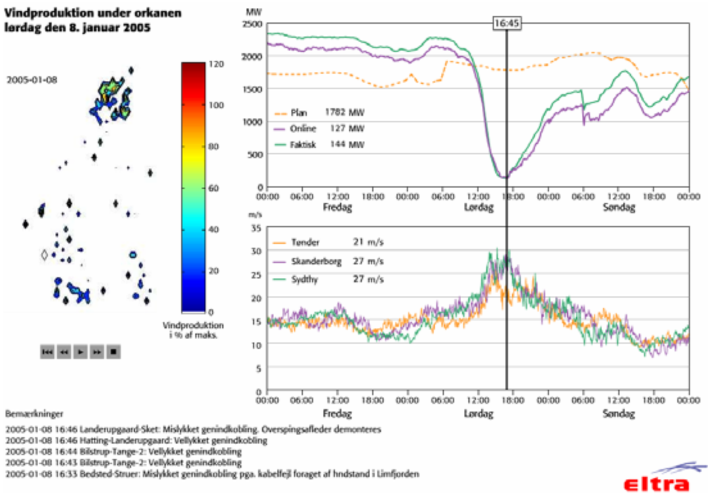
November 9th 2005

Source:WWW.ELTRA.DK

Hurricane peaks at 16.45

the 8. of January 2005



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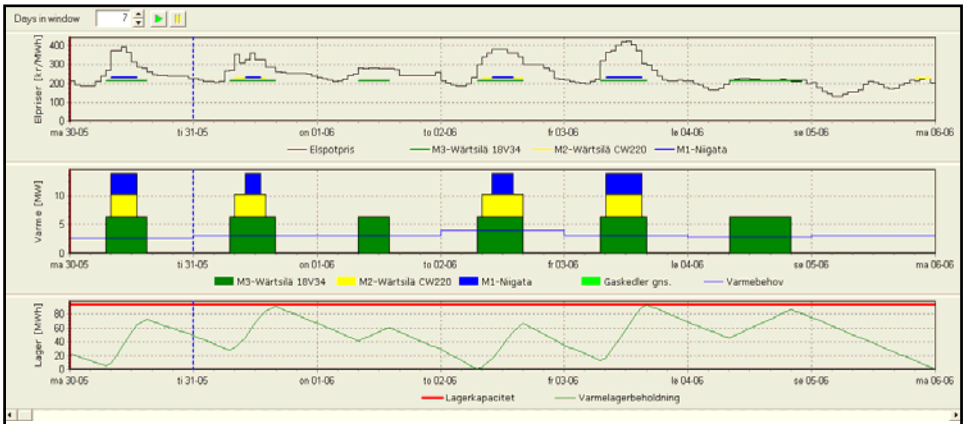
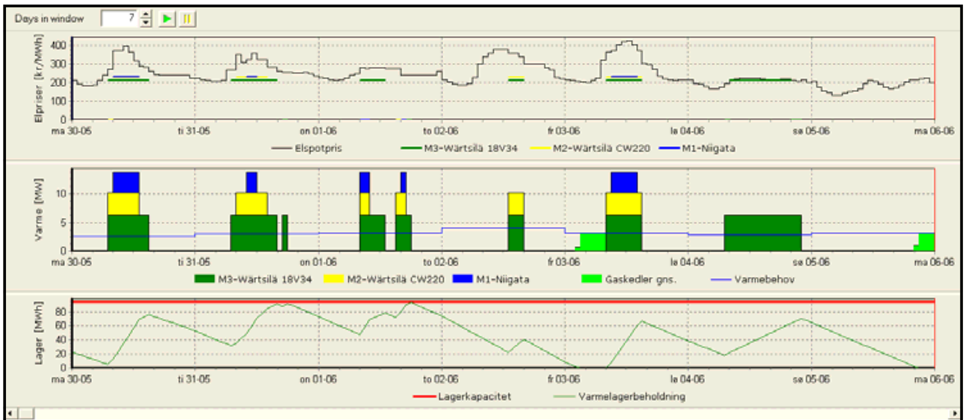
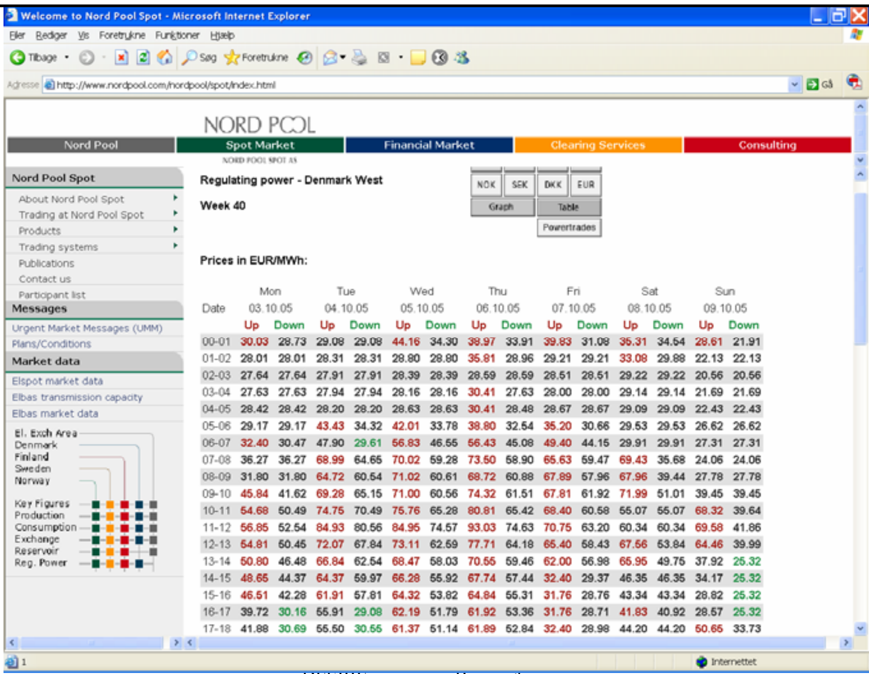


The CHP plant only selling at the spotmarket



The CHP plant selling at both the spotmarket and the regulating power market



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	Up	Down	Up	Down	Up	Down	Up	Down	Up	Down	Up	Down	Up	Down
00-01	30.03	28.73	29.08	29.08	44.16	34.30	38.97	33.91	39.83	31.08	35.31	34.54	28.61	21.91
01-02	28.01	28.01	28.31	28.31	28.80	28.80	35.81	28.96	29.21	29.21	33.08	29.88	22.13	22.13
02-03	27.64	27.64	27.91	27.91	28.39	28.39	28.59	28.59	28.51	28.51	29.22	29.22	20.56	20.56
03-04	27.63	27.63	27.94	27.94	28.16	28.16	30.41	27.63	28.00	28.00	29.14	29.14	21.69	21.69
04-05	28.42	28.42	28.20	28.20	28.63	28.63	30.41	28.48	28.67	28.67	29.09	29.09	22.43	22.43
05-06	29.17	29.17	43.43	34.32	42.01	33.78	38.80	32.54	35.20	30.66	29.53	29.53	26.62	26.62
06-07	32.40	30.47	47.90	29.61	56.83	46.55	56.43	45.08	49.40	44.15	29.91	29.91	27.31	27.31
07-08	36.27	36.27	68.99	64.65	70.02	59.28	73.50	58.90	65.63	59.47	69.43	35.68	24.06	24.06
08-09	31.80	31.80	64.72	60.54	71.02	60.61	68.72	60.88	67.89	57.96	67.96	39.44	27.78	27.78
09-10	45.84	41.62	69.28	65.15	71.00	60.56	74.32	61.51	67.81	61.92	71.99	51.01	39.45	39.45
10-11	54.68	50.49	74.75	70.49	75.76	65.28	80.81	65.42	68.40	60.58	55.07	55.07	68.32	39.64
11-12	56.85	52.54	84.93	80.56	84.95	74.57	93.03	74.63	70.75	63.20	60.34	60.34	69.58	41.86
12-13	54.81	50.45	72.07	67.84	73.11	62.59	77.71	64.18	65.40	58.43	67.56	53.84	64.46	39.99
13-14	50.80	46.48	66.84	62.54	68.47	58.03	70.55	59.46	62.00	56.98	65.95	49.75	37.92	25.32
14-15	48.65	44.37	64.37	59.97	66.28	55.92	67.74	57.44	32.40	29.37	46.35	46.35	34.17	25.32
15-16	46.51	42.28	61.91	57.81	64.32	53.82	64.84	55.31	31.76	28.76	43.34	43.34	28.82	25.32
16-17	39.72	30.16	55.91	29.08	62.19	51.79	61.92	53.36	31.76	28.71	41.83	40.92	28.57	25.32
17-18	41.88	30.69	55.50	30.55	61.37	51.14	61.89	52.84	32.40	28.98	44.20	44.20	50.65	33.73

DESIRE seminar in Birmingham,
November 9th 2005

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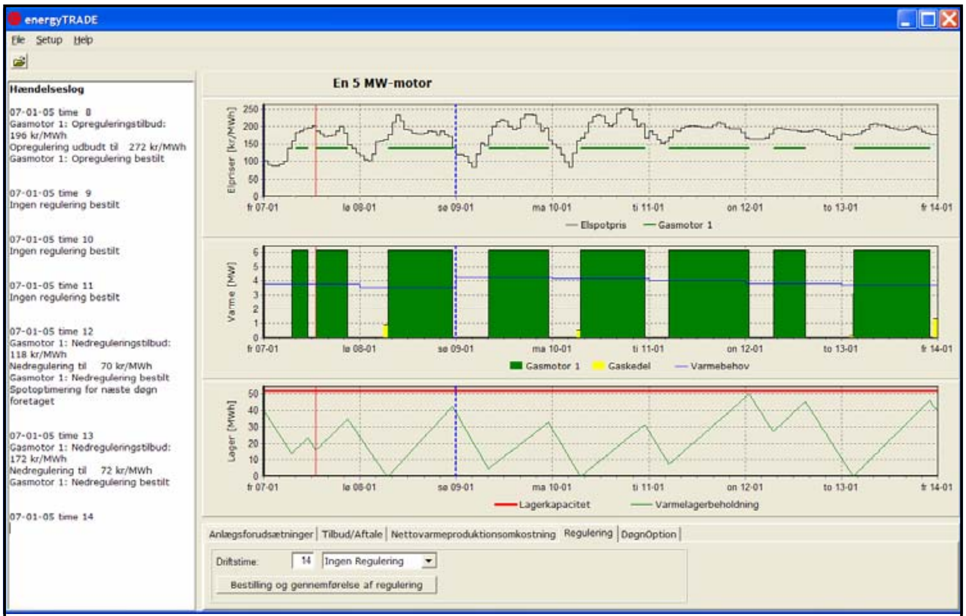

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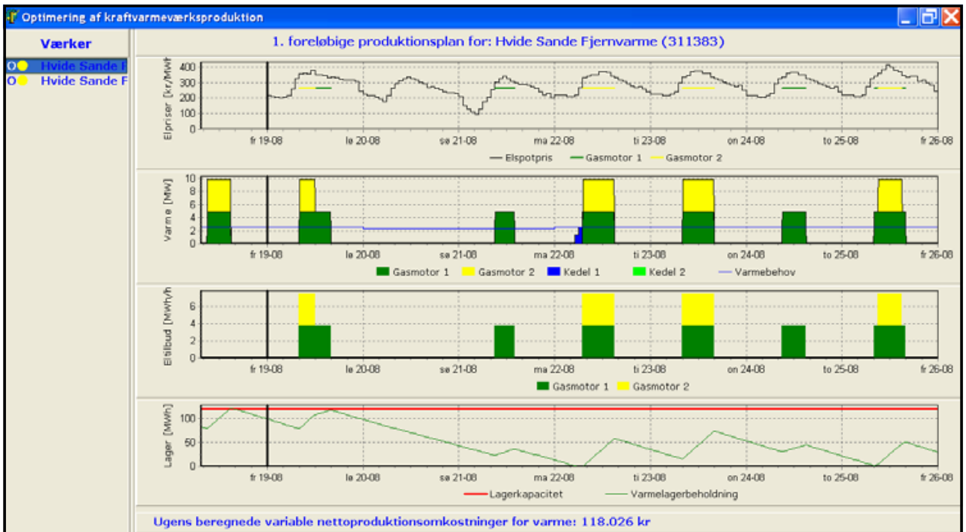
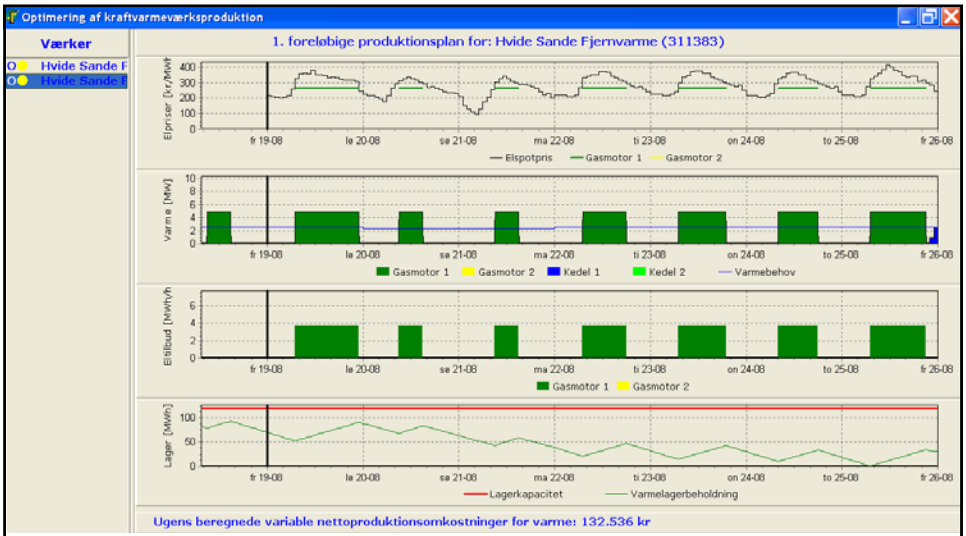
Offering monthly regulating reserves for august 2005





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Manual regulating reserve

-	Upward regulation		Downward regulation	
-	Price (DKK/MW/ month	Amount	Price (DKK/MW/ month	Amount
January February March -*)	DKK 45,700	345 MW	DKK 11,000	300 MW
April - *)	DKK 35,300	232.5 MW	DKK 12,000	200 MW
May - *)	DKK 42,500	100 MW	DKK 11,100	200 MW
June - *)	DKK 49,600	100-232.5 MW	DKK 10,900	200 MW
July	DKK 38,000	482.5 MW	DKK 11,700	200 MW
August	DKK 20,900	482.5 MW	DKK 12,000	200 MW
September	DKK 21,900	482.5 MW	DKK 11,800	200 MW
October	DKK 29,300	482.5 MW	DKK 14,200	200 MW
November	DKK 27,500	482.5 MW	DKK 14,100	200 MW
December	DKK 21,800	482.5 MW	DKK 14,600	200 MW

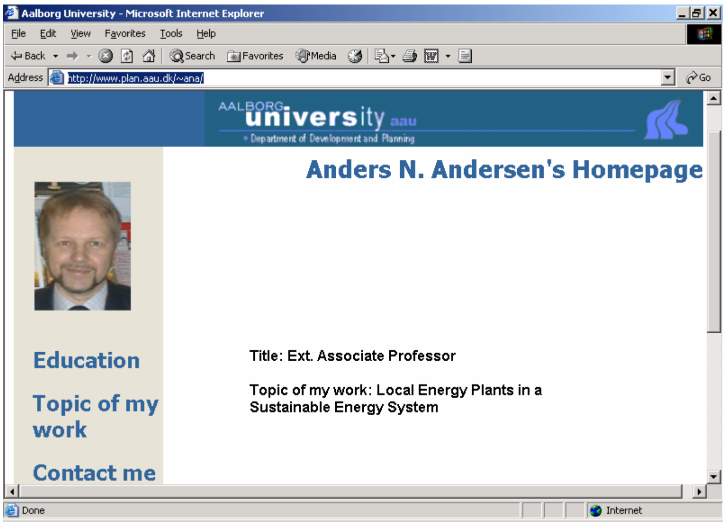
DESIRE seminar in Birmingham,
November 9th 2005

DESIRE seminar in Birmingham,
November 9th 2005

DESIRE seminar in Birmingham,
November 9th 2005

DESIRE seminar in Birmingham,
November 9th 2005

http://www.plan.aau.dk/~ana/



November 9th 2005

End.

DESIRE seminar in Birmingham,
November 9th 2005

Reporting on dissemination activities carried out within the frame of the DESIRE project (WP8)

Name, Affiliation	Anders N. Andersen, EMD International A/S
E-mail	ana@emd.dk
Title of dissemination	How CHP plants with big thermal stores can help balancing the system
Type of activity	Presentation made at seminar.
Title of forum	CHP units in the context of power markets
Language	English
Date of dissemination	May 9th, 2006
Place of dissemination	Kassel, Germany
Brief abstract / description of dissemination activity	In the presentation was shown the necessity for CHP plants offering balancing of fluctuating Renewable Electricity Productions, and the necessity for larger amounts of Regulating Power when balancing fluctuating Renewable Electricity Productions. In the presentation was shown how CHP plants offers regulating power.
Audience impact assessment	Approximately 20 persons participated. Especially interesting and relevant was the contact made to STEAG Saar Energie AG
Dissemination	Included after this form.

How CHP plants with big thermal stores can help balancing the system ?

(CHP plants in Denmark and the advantages of big heat stores for participation at power markets)

Presentation made at the DESIRE seminar in Kassel, May 9th, 2006
Speaker Anders N. Andersen
EMD International A/S, www.emd.dk

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The necessity for larger amounts of Regulating Power when balancing fluctuating Renewable Electricity Productions

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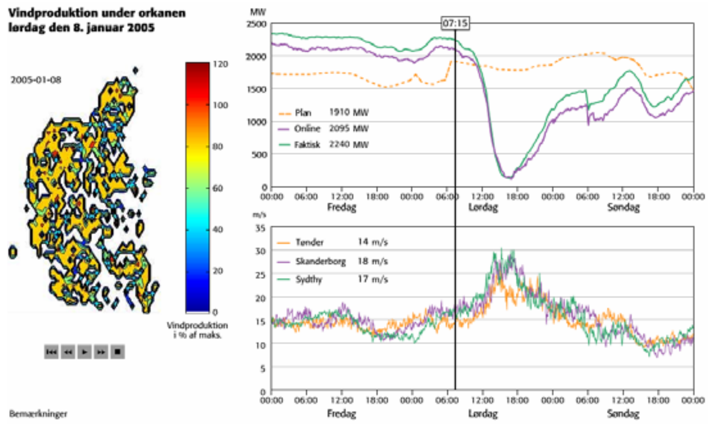
Hurricane approaching West Denmark

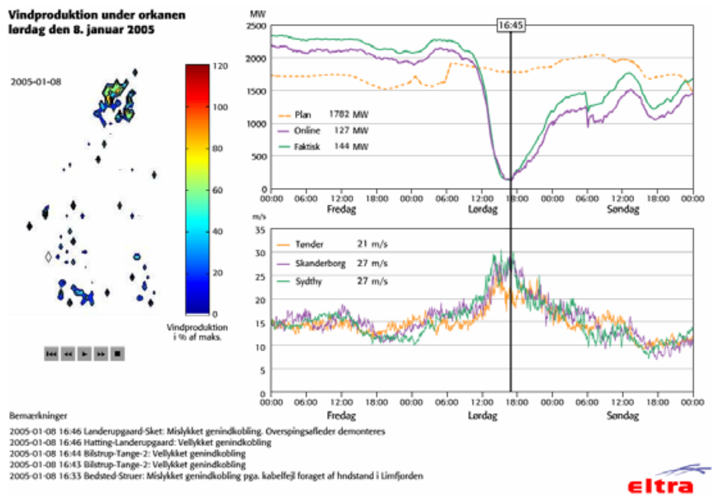
The 8. of January 2005



Source:WWW.ELTRA.DK

Hurricane peaks at 16.45

the 8. of January 2005



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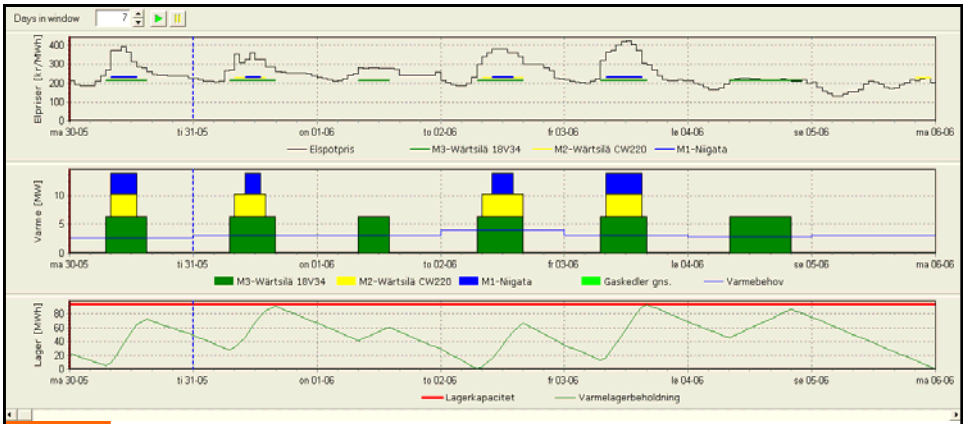

A CHP plant only selling at the spotmarket

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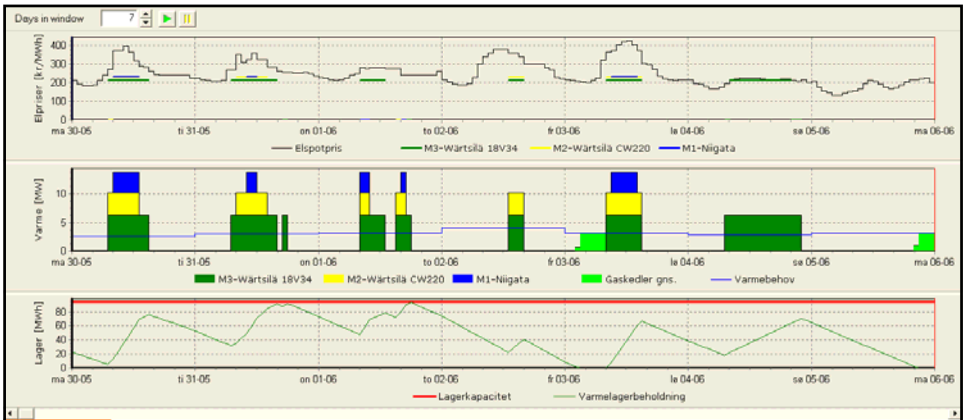


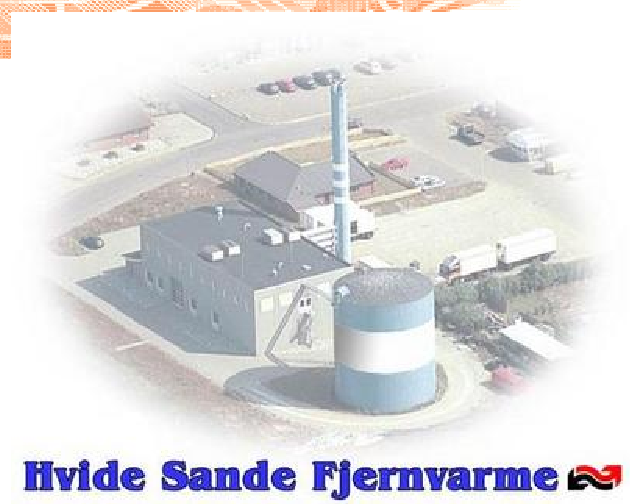
The CHP plant selling at both the spotmarket and the regulating power market

EMD
www.emd.dk

Hvide Sande Combined Heat and Power plant is participaing in the DESIRE project

as one of the Danish testplants

EMD
www.emd.dk



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Heat capacity in thermal store	90	MWh
Two gasengines, each of them with the following data		
Natural gas input	9440	kW-fuel
Heat output	4900	kW-heat
Electricity output	3770	kW-el.
Operation and maintenance costs	37	Dkr/MWh-el.
Starting cost	240	Dkr/start
Time for synchronisation	8	minutes
Time from synchronisation to full load	9	minutes
Closing down	11	minutes
Peak load boilers		
Natural gas input	10000	kW-fuel
Heat output	9800	kW-heat

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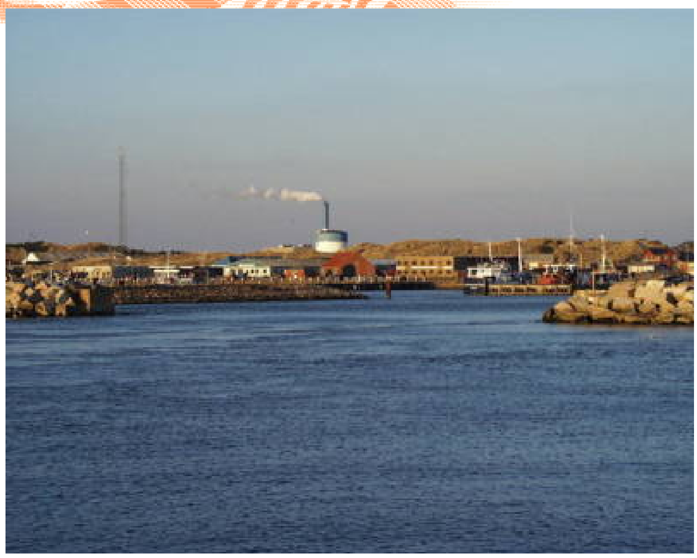

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www.emd.dk

The homepage of Hvide Sande Combined Heat and Power Plant is http://www.hvidesandefjernvarme.dk/

The homepage of Hvide Sande is http://www.hvidesande.dk/uk/

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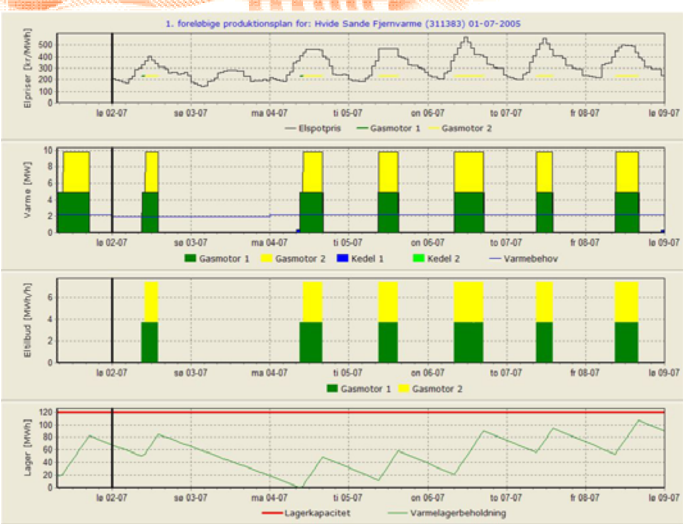
www.emd.dk

The operation at spotmarket of this plant being illustrated through DONG´s tool for optimimal bidding at spot market



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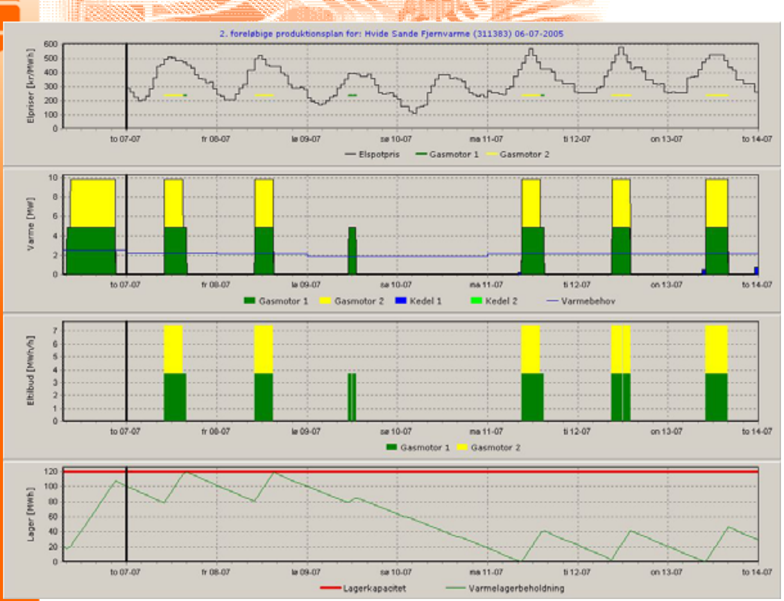
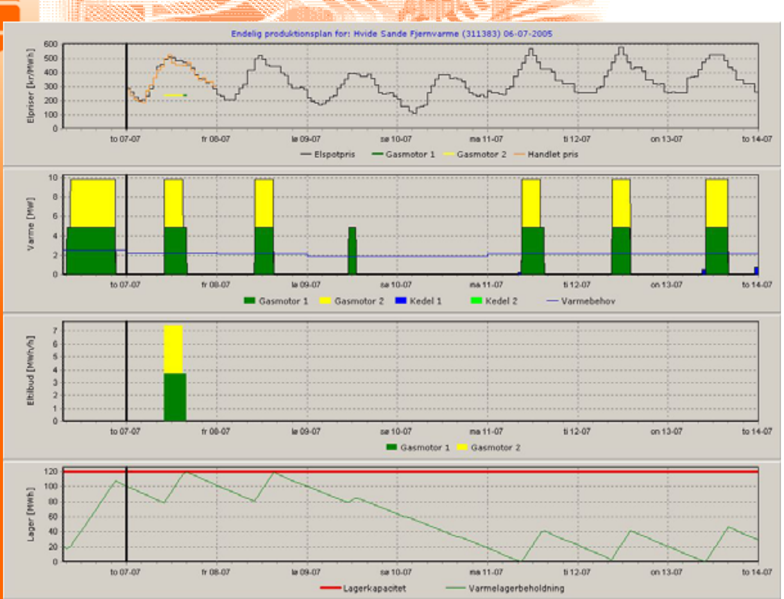
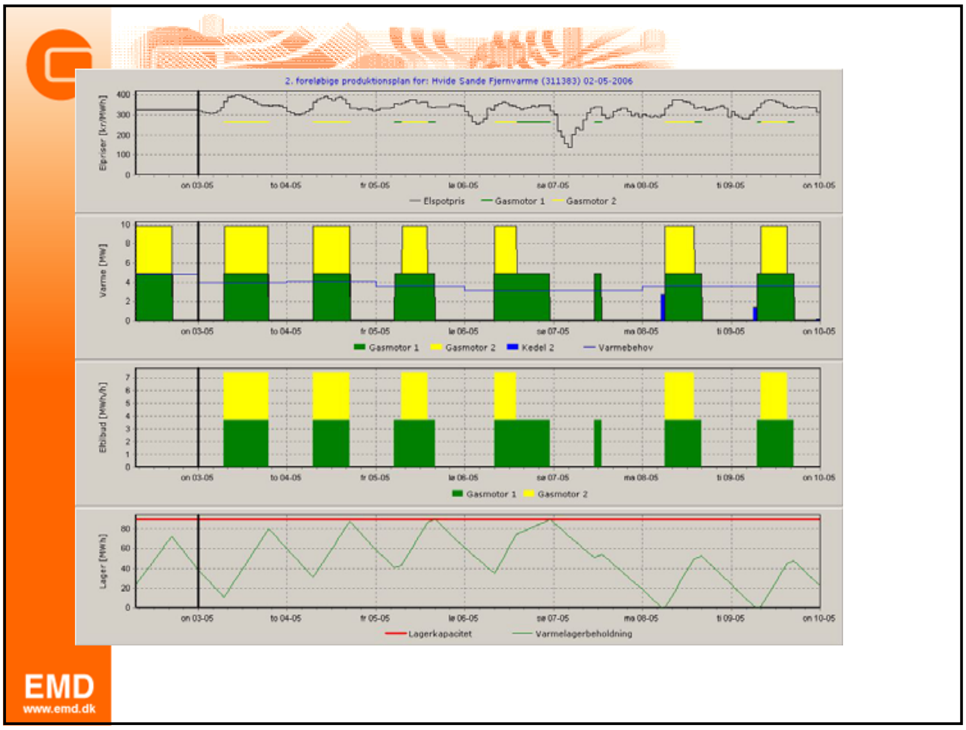

2. foreløbige produktionsplan for: Hvide Sande Fjernvarme (311383) 06-07-2005
Elpriser [kr/MWh]
to 07-07
fr 08-07
lø 09-07
sø 10-07
ma 11-07
ti 12-07
on 13-07
to 14-07
Elspotpris
Gasmotor 1
Gasmotor 2
Varme [MW]
Kedel 1
Kedel 2
Varmebehov
Eltilbud [MWh/h]
Lager [MWh]
Lagerkapacitet
Varmelagerbeholdning


Endelig produktionsplan for: Hvide Sande Fjernvarme (311383) 06-07-2005
Elpriser [kr/MWh]
to 07-07
fr 08-07
lø 09-07
sø 10-07
ma 11-07
ti 12-07
on 13-07
to 14-07
Elspotpris
Gasmotor 1
Gasmotor 2
Handlet pris
Varme [MW]
Kedel 1
Kedel 2
Varmebehov
Eltilbud [MWh/h]
Lager [MWh]
Lagerkapacitet
Varmelagerbeholdning


2. foreløbige produktionsplan for: Hvide Sande Fjernvarme (311383) 02-05-2006
Elpriser [kr/MWh]
Elspotpris
Gasmotor 1
Gasmotor 2
Varme [MW]
Gasmotor 1
Gasmotor 2
Kedel 2
Varmebehov
Elbud [MWh/h]
Gasmotor 1
Gasmotor 2
Lager [MWh]
Lagerkapacitet
Varmelagerbeholdning
on 03-05
to 04-05
fr 05-05
lø 06-05
sø 07-05
ma 08-05
ti 09-05
on 10-05
EMD
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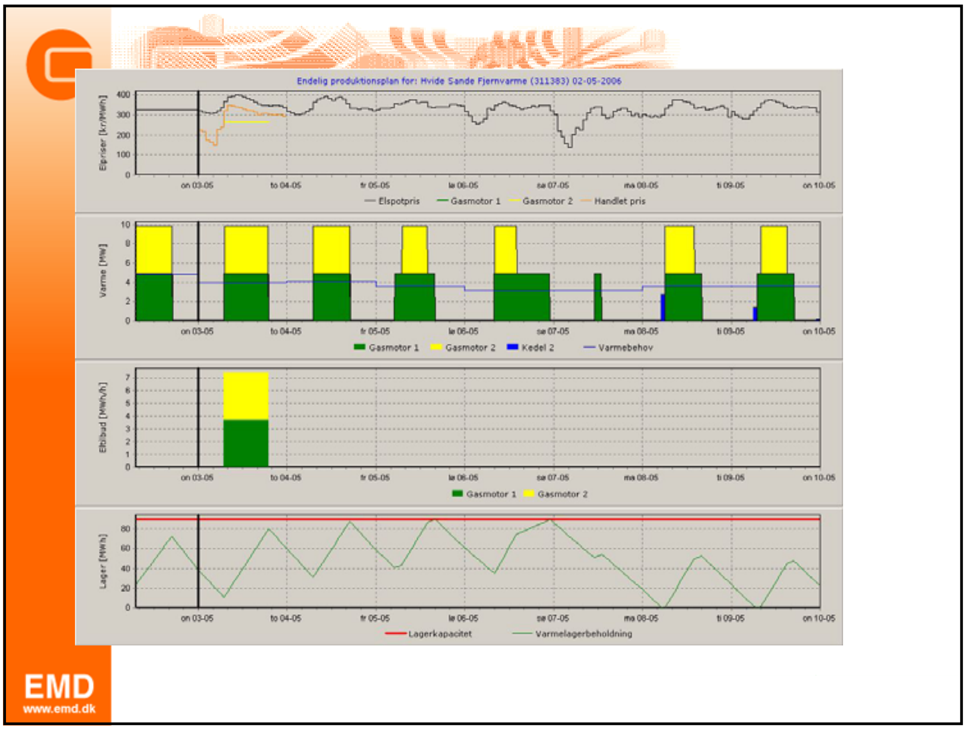
Endelig produktionsplan for: Hvide Sande Fjernvarme (311383) 02-05-2006
Elpriser [kr/MWh]
Elspotpris
Gasmotor 1
Gasmotor 2
Handlet pris
Varme [MW]
Gasmotor 1
Gasmotor 2
Kedel 2
Varmebehov
Elbud [MWh/h]
Gasmotor 1
Gasmotor 2
Lager [MWh]
Lagerkapacitet
Varmelagerbeholdning
on 03-05
to 04-05
fr 05-05
lø 06-05
sø 07-05
ma 08-05
ti 09-05
on 10-05
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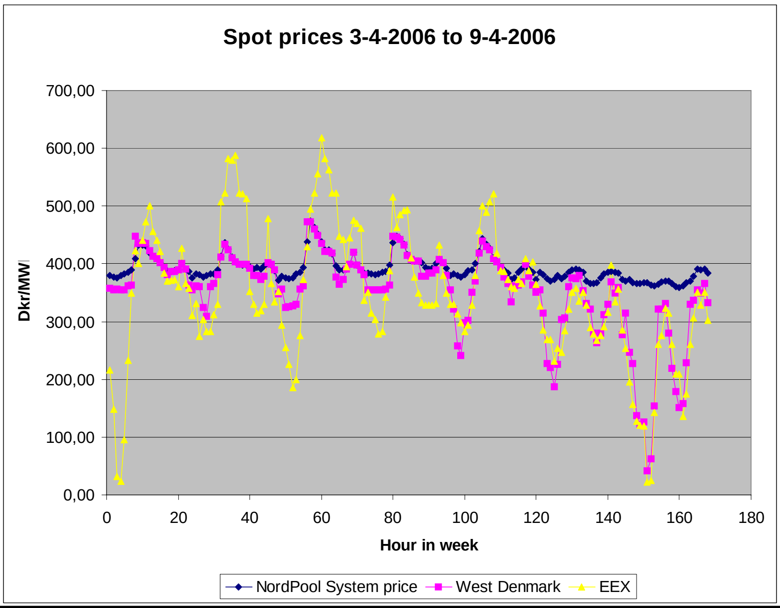
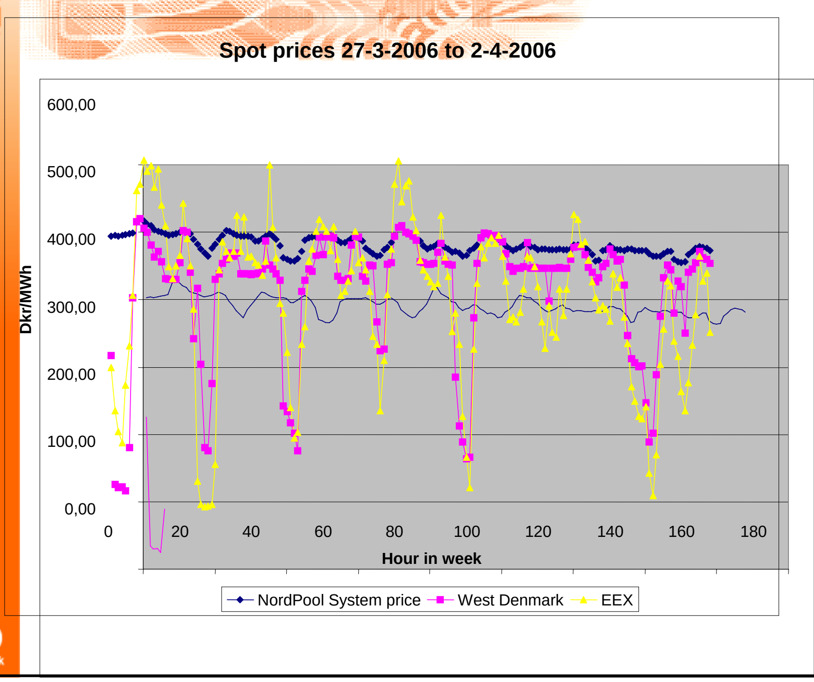
Optimization at spotmarket being even more challenging in Germany than in Denmark





Finally in Stadtwerke Schwäbisch Hall the challenge of optimization could also be about peakshaving, when using the regional grid,
paying 35.000 €/MW for the yearly peak

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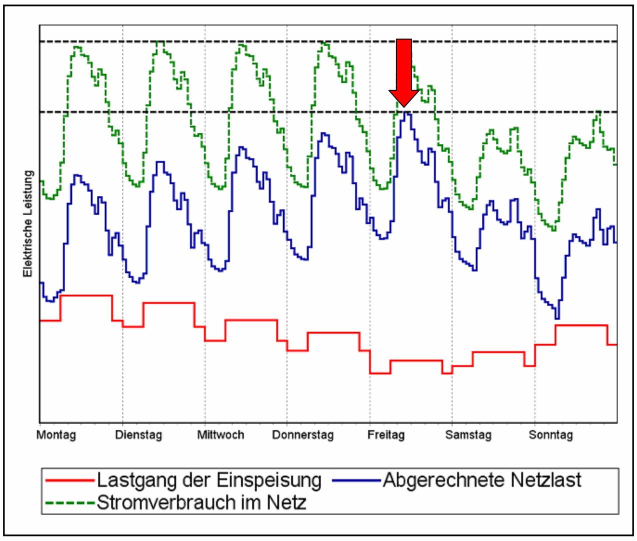
Netzlast-optimierung



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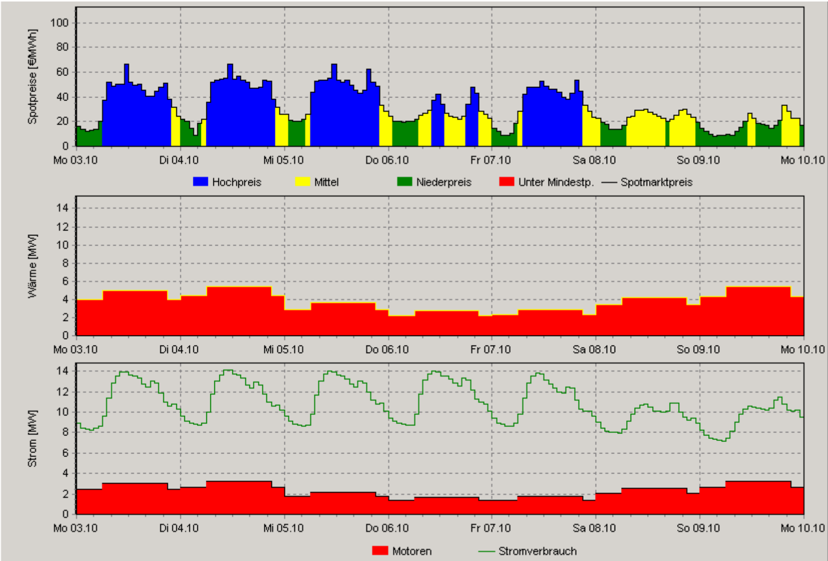
Existing operation without thermal store



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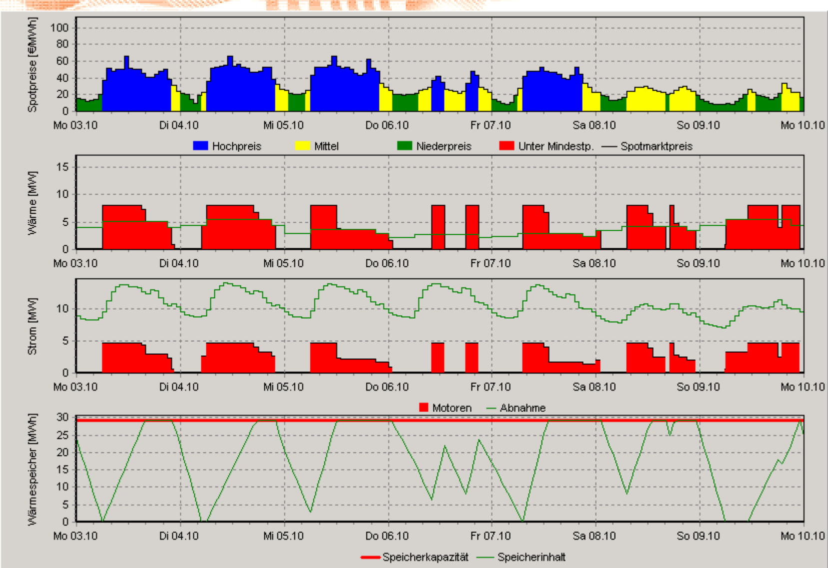
Optimized operation against spot prices



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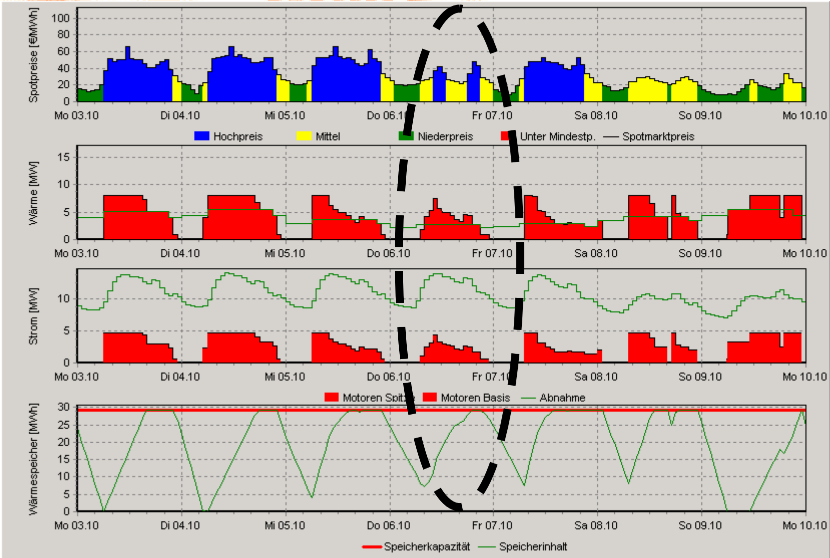
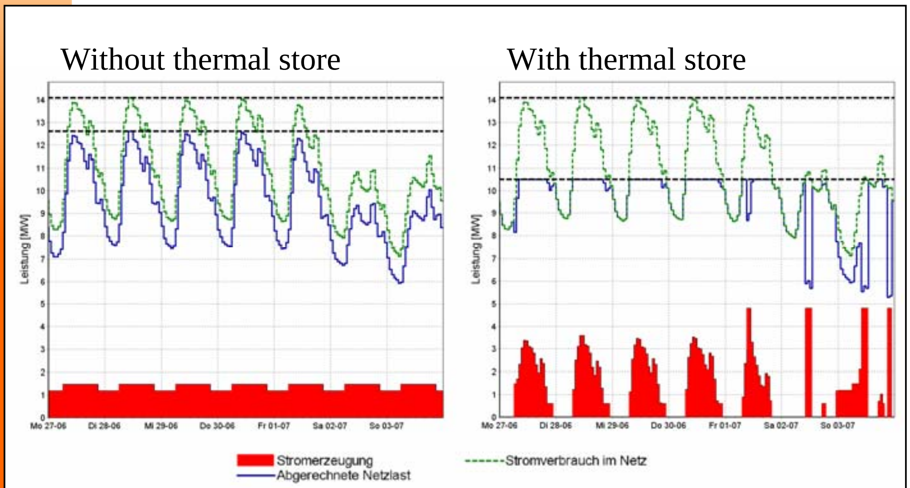
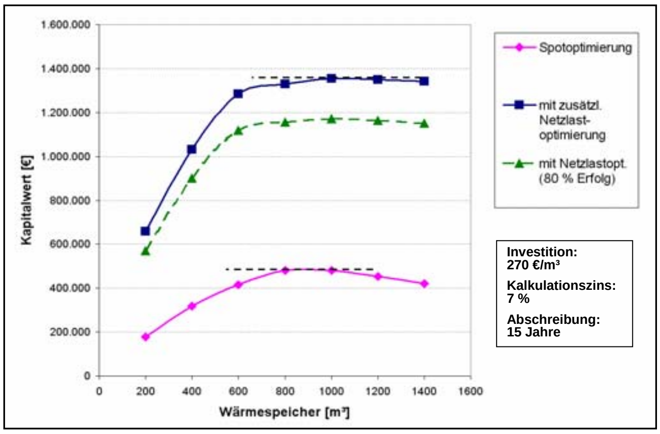
Optimized operation against spot prices and peakshaving



Peakshaving



Investmentanalysis



Ergebnisse für einen Wärmespeicher mit 800 m³	Investitions-summe [€]	Durchschnittl. Mehreinnahmen [€/a]	Kapitalwert (7%; 15 Jahre) [€]	Amortisations-zeit [a]
Reine Spotoptimierung	216.000	75.703	480.260	2,85
Mit zusätzl. Netzlastoptimierung	216.000	168.682	1.329.620	1,28
Mit Netzlastopt. (80% erfolgreich)	216.000	149.690	1.156.643	1,44

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Reporting on dissemination activities carried out within the frame of the DESIRE project (WP8)

Name, Affiliation	Anders N. Andersen, EMD International A/S
E-mail	ana@emd.dk
Title of dissemination	Into depth with the electricity market (In Danish: Gå i dybden med elmarkedet)
Type of activity	Course held for managers of CHP-plants
Title of forum	Danish District Heating Association (www.danskfjernvarme.dk)
Language	Danish
Date of dissemination	February 5th 2007
Place of dissemination	Kolding, Denmark
Brief abstract / description of dissemination activity	At the course EMD was invited to tell at this course about the bidding methods at spot market and regulating power market, being disseminated in the DESIRE-project.
Audience impact assessment	22 persons participated.
Dissemination	Included after this form.

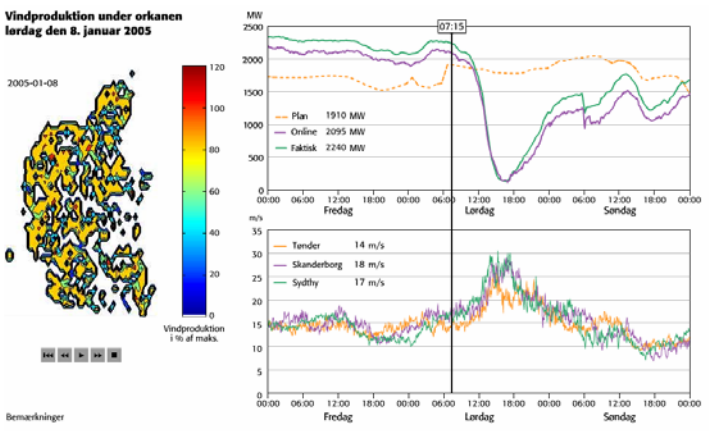
Gå i dybden med elmarkedet

Planlægning af decentrale kraftvarmeværkers bud på spot- og regulerkraftmarkederne

v. Anders N. Andersen, www.emd.dk

Dansk Fjernvarmes kursus i
elmarkedet den 5. maj 2007

Orkanen den 8. januar 2005



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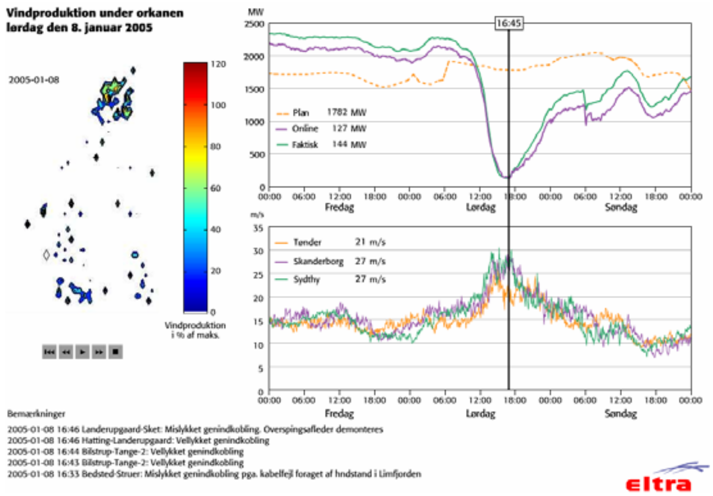
Dansk Fjernvarmes kursus i
elmarkedet den 5. maj 2007

Source:WWW.ELTRA.DK



Dansk Fjernvarmes kursus i elmarkedet den 5. maj 2007

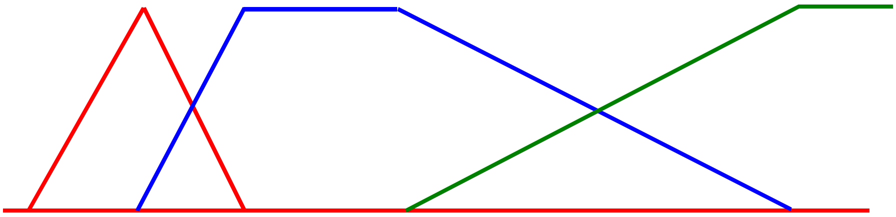
Source:WWW.ELTRA.DK

Elreguleringsydelser til at fjerne en ubalance

Primærreserve

Automatiske reserver

Manuel regulerkraftreserve



Type	Mængde	Udbuds Periode	Prissætning
Primærreserve	+ 25 MW - 25 MW	Februar måned 2007.	Fast kapacitetsbetaling
Automatiske reserver	+ 140 MW - 140 MW	Februar måned 2007.	Fast kapacitets- og energibetaling
Manuel reguleringsreserve	+ 520 MW - 160 MW	Februar måned 2007.	Fast kapacitetsbetaling. Energibetaling via regulerkraftmarkedet.

Budgivning på spotmarkedet

Beregning af <u>balance elpris</u> mellem kraftvarmeenheden og den kedel, som vil blive fortrængt af kraftvarmeenhedens varmeproduktion.

Analyse af budpriser - Hvide Sande kraftvarmeværk

Analysens forudsætninger

(oplysningerne i de gule felter er inddata, resten er beregnet)

Værksoplysninger		
CO2-kvotepris	50	kr/ton
Indfødningstarif	0,40	øre/kWh
Handelsomkostning	0,40	øre/kWh
Kraftvarmeenhed		
Navn på KV-enhed	Gasmotor 1	
Brændselsnavn	naturgas	
Energienhed for naturgas	m³	
Energiindhold i naturgas	11	kWh/m³
Marginal pris på naturgas	2	kr/m³
Energiafgifter på andel til varme af naturgas	2,24	kr/m³
Indfyret effekt	9440	kW-gas
Varmeeffekt	4900	kW-varme
Eleffekt	3770	kW-el
Elvirkningsgrad	39,9%	
Varmevirkningsgrad	51,9%	
Andel af brændsel med afgifter	38,6%	E-formlen
D&V	37	kr/MWh-el
D&V	0	kr/MWh-varme
Del af eltilskud indregnet i budpris	0	kr/MWh-el
CO2-udledning	56,9	kg/GJ

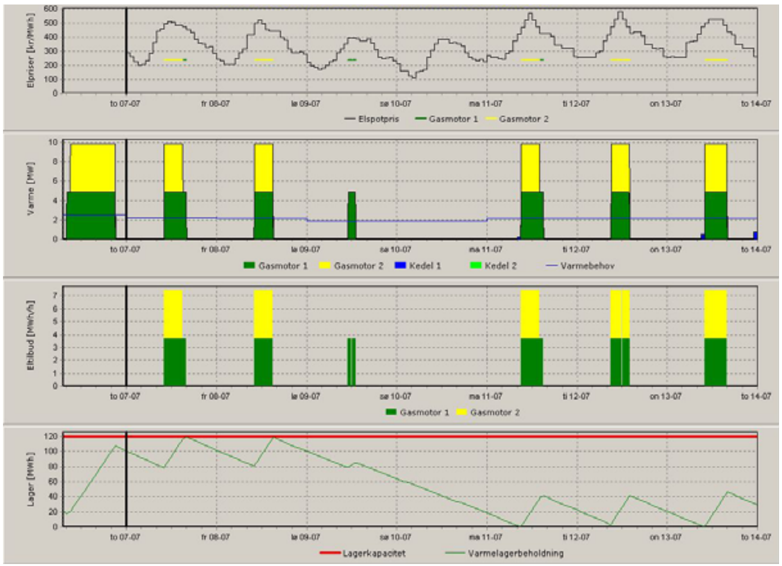
Kedel som fortrænges af Gasmotor 1		
Navn på kedel	Kedel 2	
Brændselsnavn	Naturgas	
Energienhed for Naturgas	m³	
Energiindhold i Naturgas	11	kWh/m³
Marginal pris på Naturgas	2,0000	kr/m³
Eksisterende energiafgifter på Naturgas	2,24	kr/m³
Nye energiafgifter på Naturgas	50	kr/GJ-fjernvarme
Indfyret effekt	10000	
Varmeeffekt	10500	
Varmevirkningsgrad	105,0%	
D&V	5	kr/MWh-varme
CO2-udledning	56,9	kg/GJ

Pris for produktion af 1 MWh-varme på Kedel 2, med eksisterende afgifter			
(alle beløb i kr/MWh-varme)			
Brændselsforbrug	86,580	m³	173,16
Energiafgifter på Naturgas			193,94
D&V			5,00
Forbrug af CO2-kvoter	0,195	ton	9,75
Ialt			**381,85**

Dansk Fjernvarmes kursus i elmarkedet den 5. maj 2007

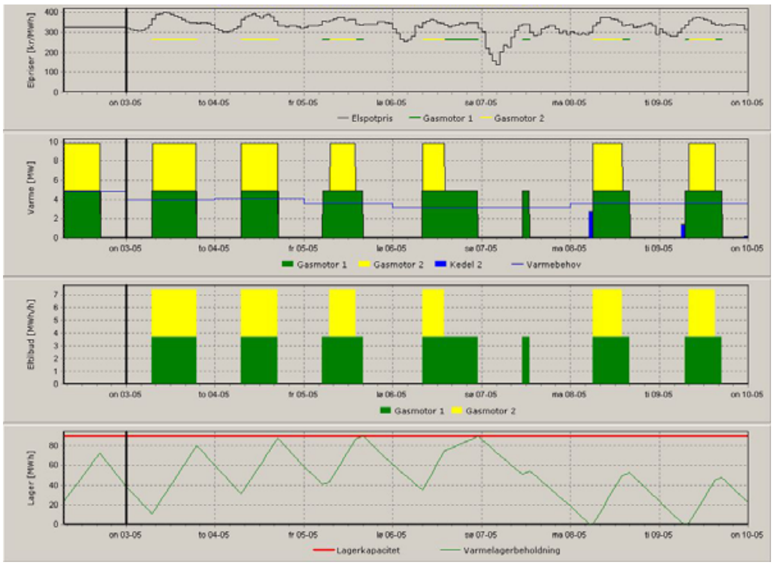
Eksisterende budpris på spotmarkedet, hvor Gasmotor 1 fortrænger Kedel 2			
(alle beløb i kr/MWh-el)			
Brændselsforbrug	227,63	m³	455,27
Energiafgifter på naturgas	87,77	m³	196,61
D&V			37,00
Indfødningstarif			4,00
Handelsomkostning			4,00
Forbrug af CO2-kvoter	0,513	ton	25,65
Værdi af varme (kedelsubstitution)	1,30	MWh-varme	-496,31
Del af eltilskud modregnet i budpris			0,00
Eksisterende budpris på spotmarkedet			**226**

Dansk Fjernvarmes kursus i elmarkedet den 5. maj 2007



Dansk Fjernvarmes kursus i
elmarkedet den 5. maj 2007

Dansk Fjernvarmes kursus i
elmarkedet den 5. maj 2007



Dansk Fjernvarmes kursus i
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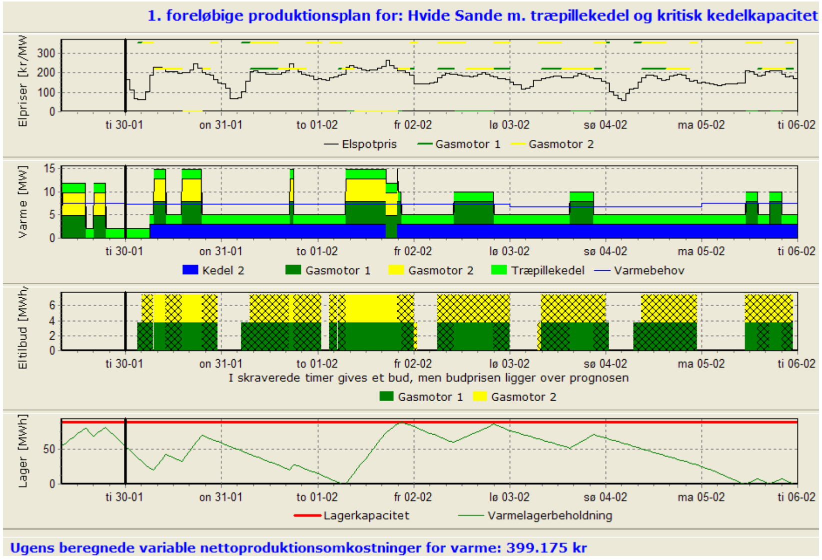
Dansk Fjernvarmes kursus i
elmarkedet den 5. maj 2007

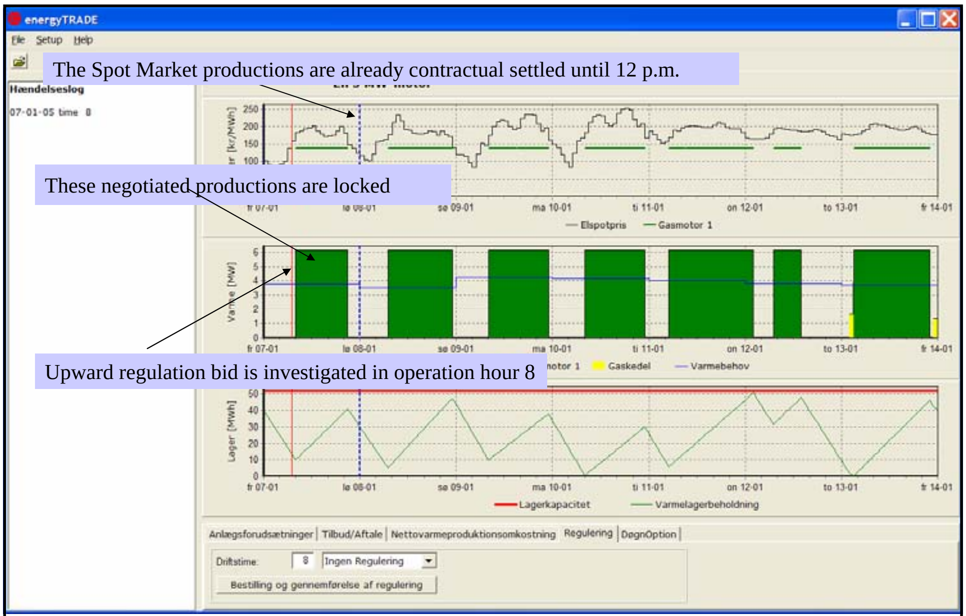
Kedelfortrængningsmetoden

- Trin 0: I dette trin undersøges om kedlerne overhovedet kan dække varmebehovet i de kommende døgn. I modsat fald tilbydes tilstrækkelig elproduktion til 0 kr.
- Trin 1: Den ”dyrest producerende kedel” fjernes. Der indplaceres optimal kraftvarmeproduktion, som producerer varmen denne kedel ellers skal producere.
- Trin 2: Derefter fjernes den ”anden dyrest producerende kedel”. Der indplaceres kraftvarmeproduktion, som producerer varmen denne kedel ellers skal producere.
- O.s.v.

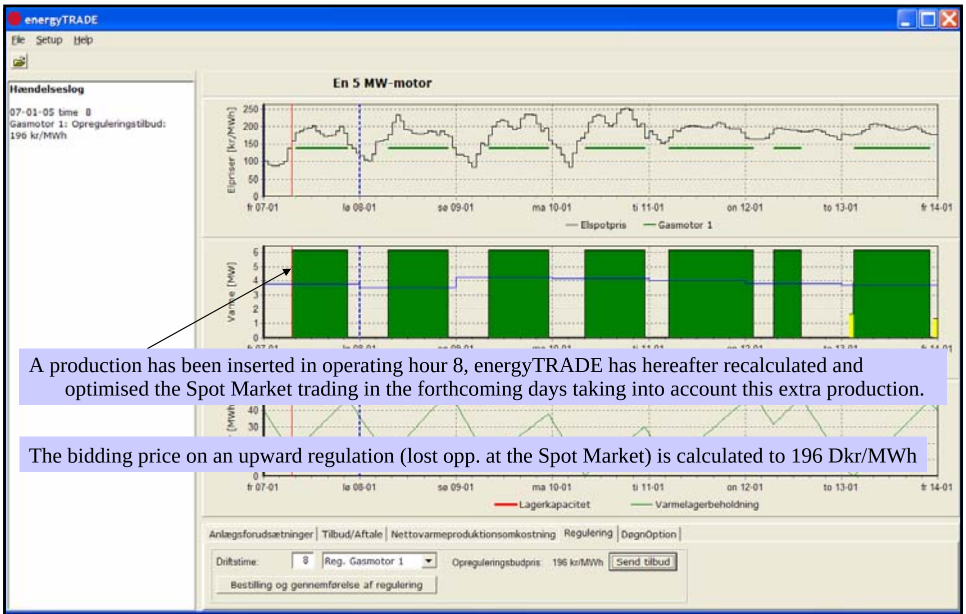
Budprisberegning ved kedelfortrængningsmetoden illustreres med et tænk eksempel, hvor Hvide Sande har en træpillekedel og ikke tilstrækkelig kedelkapacitet.



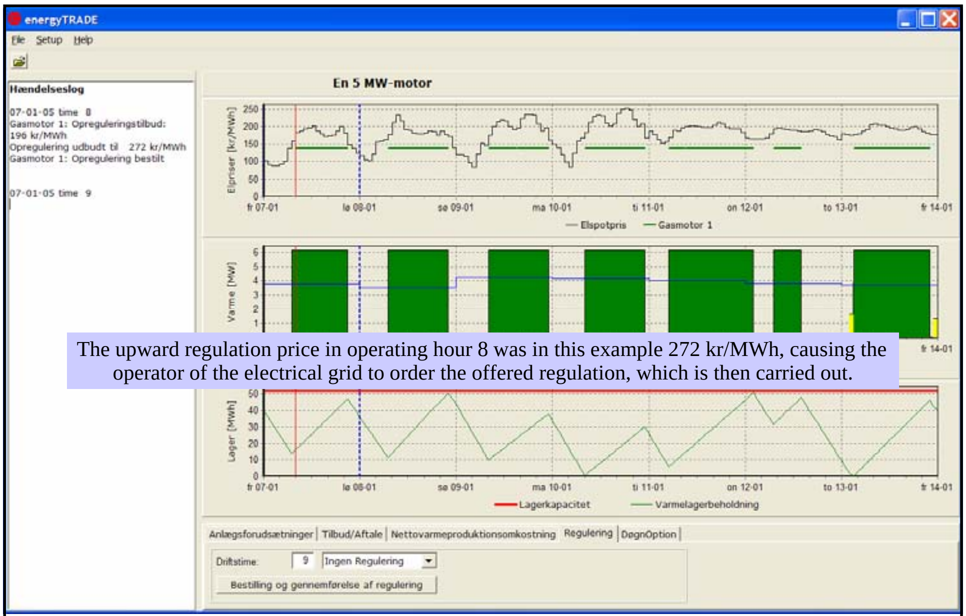
Budgivning på regulerkraftmarkedet, simpelt eksempel, hvor der kun er en motor på kraftvarmeværket



Dansk Fjernvarmes kursus i
elmarkedet den 5. maj 2007

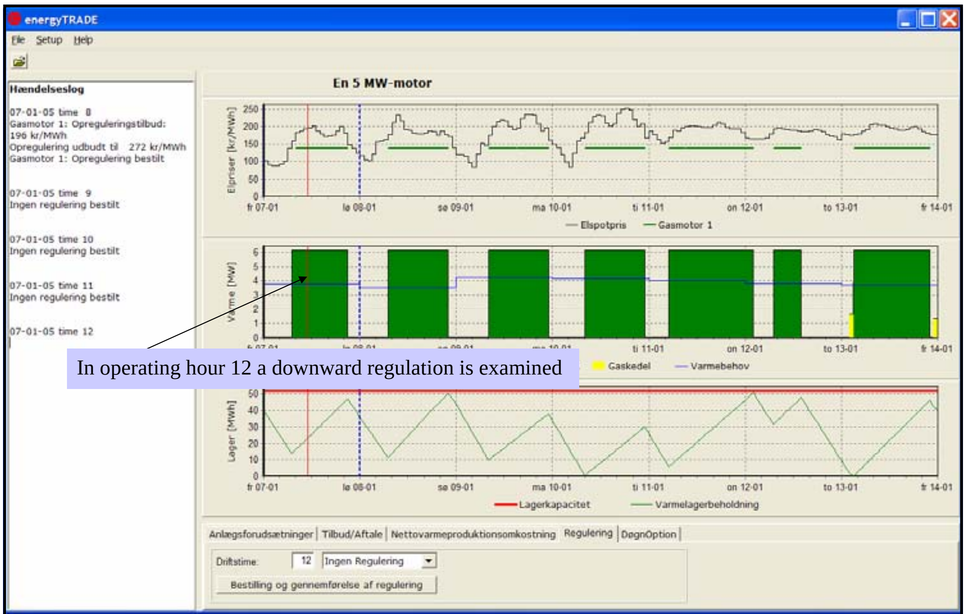


Dansk Fjernvarmes kursus i
elmarkedet den 5. maj 2007



The upward regulation price in operating hour 8 was in this example 272 kr/MWh, causing the operator of the electrical grid to order the offered regulation, which is then carried out.

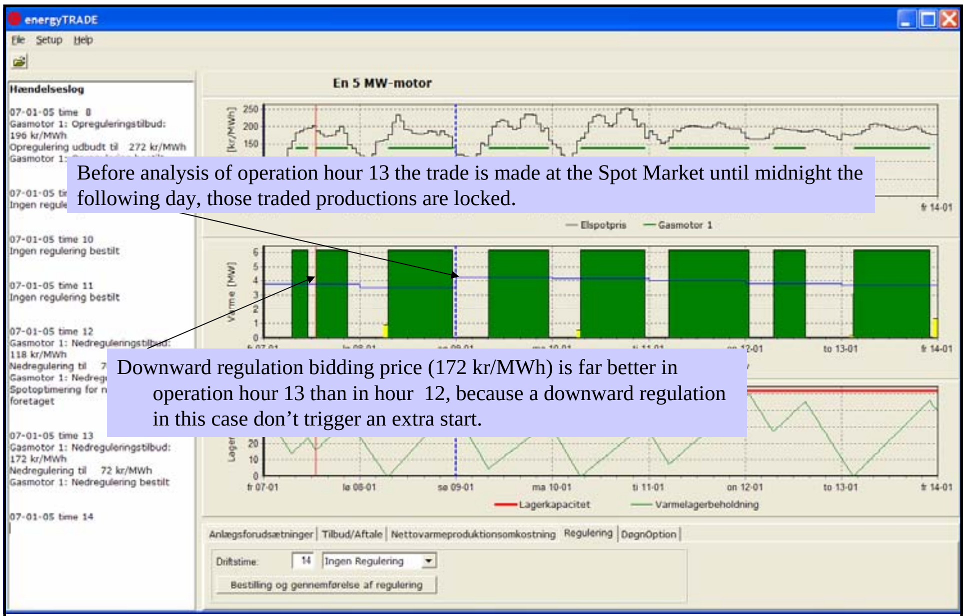
Dansk Fjernvarmes kursus i
elmarkedet den 5. maj 2007



In operating hour 12 a downward regulation is examined

Dansk Fjernvarmes kursus i
elmarkedet den 5. maj 2007

- The system operator of the electrical grid orders the offered regulation in operating hour 12.
- The CHP-plant carries out the regulation.
- The CHP-plant then trade at the Spot Market for the next day.
- The CHP-plant also wins a downward regulation in operation hour 13.



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elmarkedet den 5. maj 2007

- The CHP-plant also win a downward regulation in operating hour 14.

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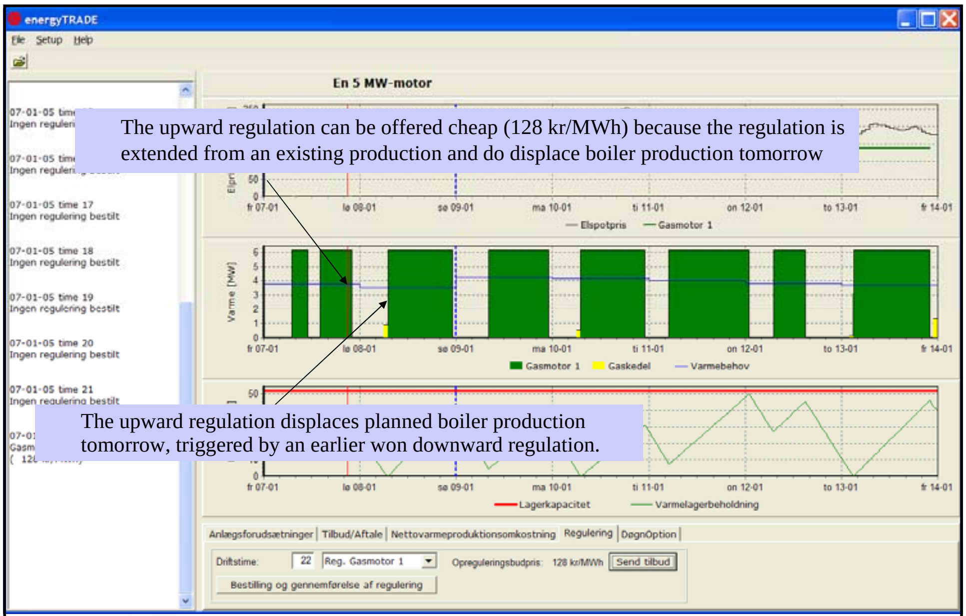
elmarkedet den 5. maj 2007

Hereafter an upward regulation is offered in operating hour 22 extending an already planned production.



Dansk Fjernvarmes kursus i
elmarkedet den 5. maj 2007

Dansk Fjernvarmes kursus i
elmarkedet den 5. maj 2007

Dansk Fjernvarmes kursus i
elmarkedet den 5. maj 2007

Dansk Fjernvarmes kursus i
elmarkedet den 5. maj 2007

Dansk Fjernvarmes kursus i
elmarkedet den 5. maj 2007

The table below show that the Regulating Power bidding prices in the example might vary considerably during a day , depending on already won productions at the Spot Market and already won productions at the Regulating Power Market.

Operating hour	Bid on Reg. Pow. Mar.	Bid. price [kr/MWh]
8	Upward reg.	196
..		
..		
12	Downward reg.	118
13	Downward reg.	172
14	Downward reg.	131
..		
..		
22	Upward reg.	128
23	Upward reg.	172
24	*Upward reg. not poss.*	!!!!

Dansk Fjernvarmes kursus i
elmarkedet den 5. maj 2007

Deltagelse i regulerkraftmarkedet vil alt andet lige give flere starter

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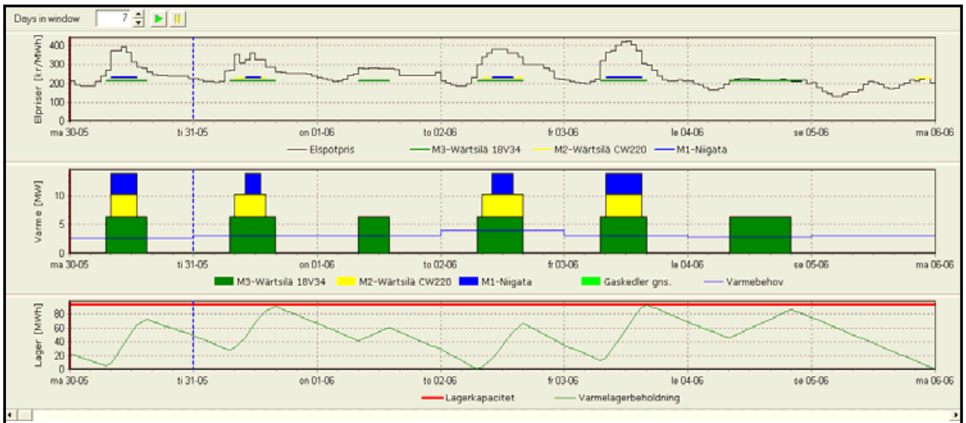
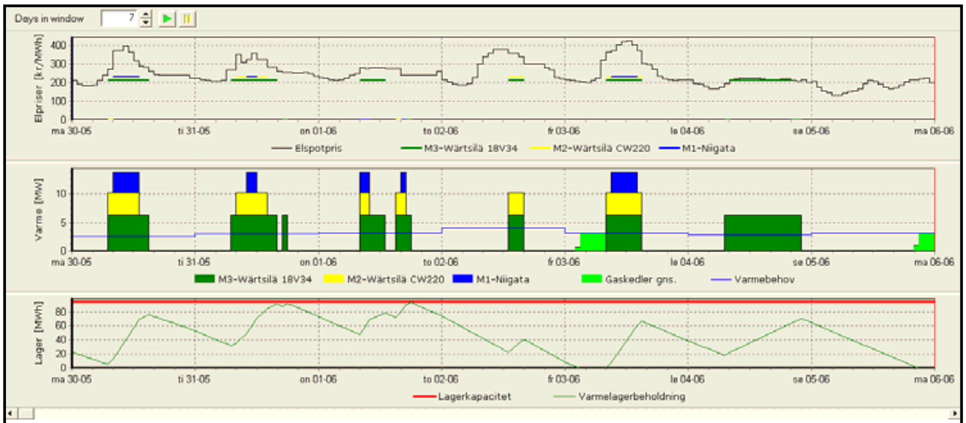
elmarkedet den 5. maj 2007



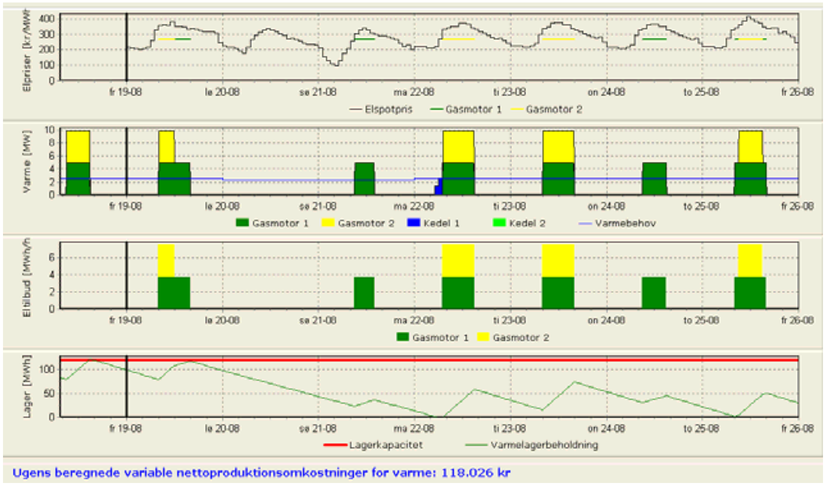
Smørum kraftvarmeværk alene handlet ind i spotmarkedet

Dansk Fjernvarmes kursus i
elmarkedet den 5. maj 2007

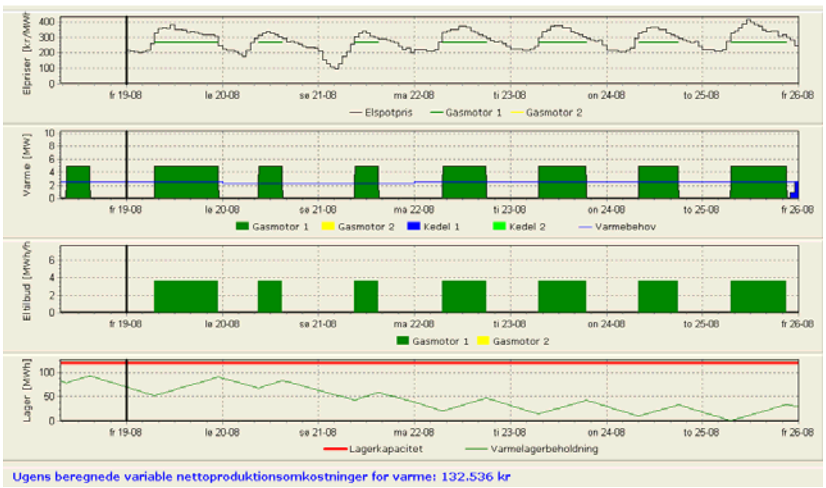


Smørum kraftvarmeværk handlet ind i både spot- og regulerkraftmarkedet

Beregning af budpris på månedsreserve



Først gennemregnes den kommende måned med alle motorer handlet ind i spotmarkedet.

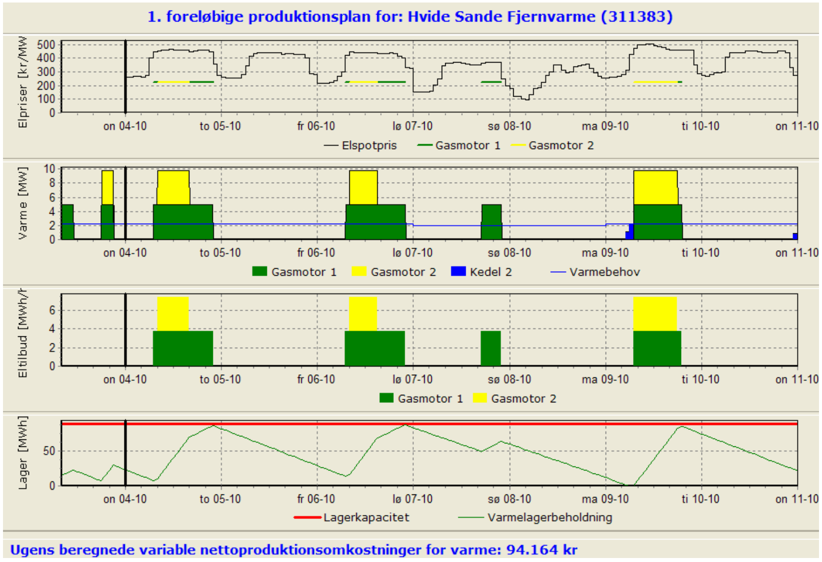


Herefter gennemregnes den kommende måned med reservemotoren holdt ude af spotmarkedet.

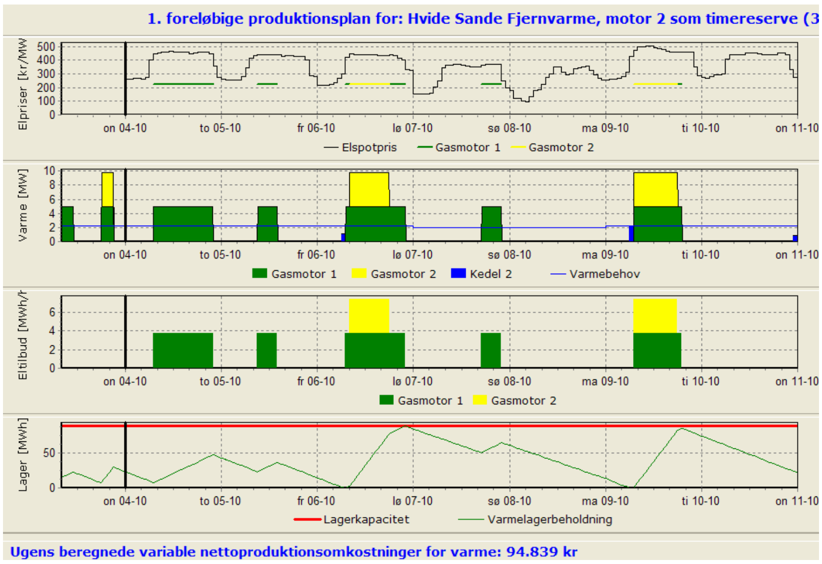
Budpris på en gasmotor som månedsreserve er lig offeromkostningen ved at holde den ude af spotmarkedet i denne måned.

Timereservetilbud

En gasmotor kan tilbydes som timereserve i morgen til offeromkostningen ved at holde den ude af spotmarkedet i morgen.



Dansk Fjernvarmes kursus i
elmarkedet den 5. maj 2007



Dansk Fjernvarmes kursus i
elmarkedet den 5. maj 2007

Hvide Sande kunne således tilbyde Gasmotor 2 på 3,7 MW gratis som timereserve i alle timer, pånær de otte timer fra time 9 til time 16.

I disse otte timer var offeromkostningen ved at holde den ude af spotmarkedet 675 kr, svarende til

23 kr/MW/time.

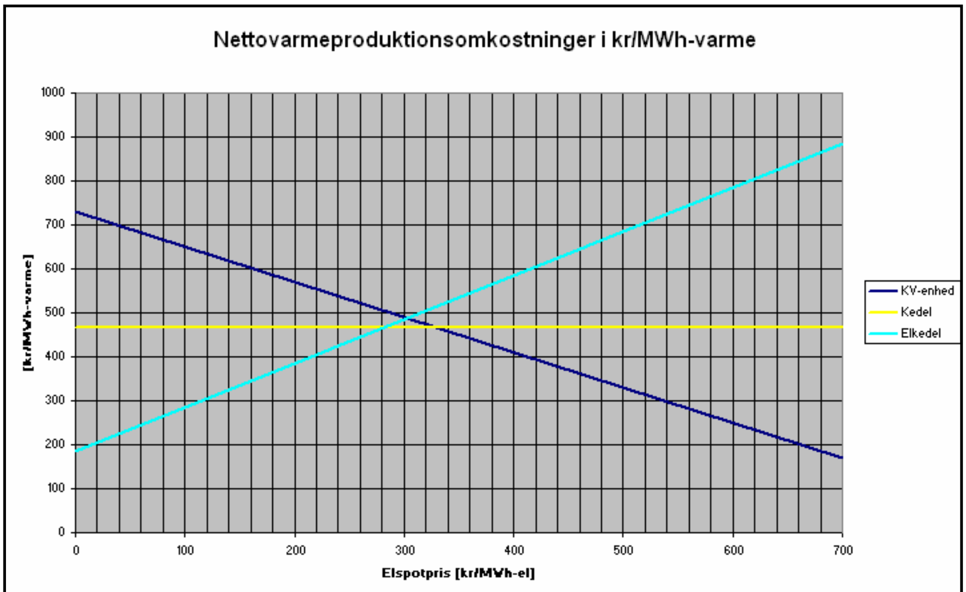
Konsekvenser af elpatron- og gaskedelafgiftslettelsesloven.

Konsekvenser for budprisen

Eksisterende budpris på spotmarkedet, hvor Gasmotor 1 fortrænger Kedel 2			
(alle beløb i kr/MWh-el)			
Brændselsforbrug	227,63	m³	455,27
Energiafgifter på naturgas	87,77	m³	196,61
D&V			37,00
Indfødningstarif			4,00
Handelsomkostning			4,00
Forbrug af CO2-kvoter	0,513	ton	25,65
Værdi af varme (kedelsubstitution)	1,30	MWh-varme	-496,31
Del af eltilskud modregnet i budpris			0,00
Eksisterende budpris på spotmarkedet			**226**
Ny budpris, begrundet i afgiftsændringerne			
Eksisterende budpris på spotmarkedet			226,22
Tillagt eksisterende værdi af varme			496,31
Fratrukket værdi af varme ved nye energiafgifter	1,30	MWh-varme	-478,19
Ny budpris, begrundet i afgiftsændringerne			**244**

energyPRO analyse af økonomien i en elkedel

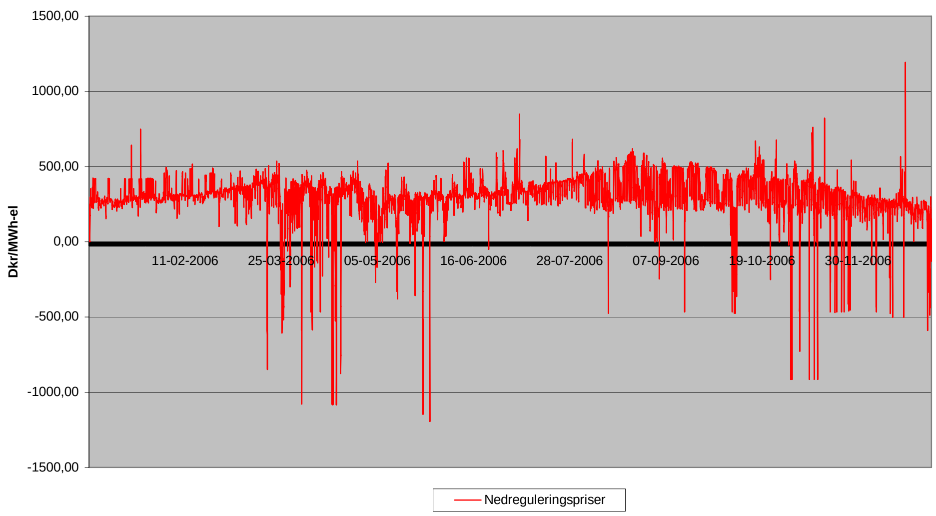
I forhold til referencen udviser den på kurset gennemgåede el-kedel beregning en en simpel tilbagebetalingstid på 3,6 år, alene ved handel på spotmarkedet.



Dansk Fjernvarmes kursus i
elmarkedet den 5. maj 2007

Dansk Fjernvarmes kursus i
elmarkedet den 5. maj 2007

Regulerkraft-nedreguleringspriser i 2006



Dansk Fjernvarmes kursus i
elmarkedet den 5. maj 2007

Markedskobling til den tyske elbørs EEX

Hvide Sande kraftvarmeværk ville i 2006 have tjent 3,5 mill. kr. på en god markedskobling.

Dansk Fjernvarmes kursus i
elmarkedet den 5. maj 2007

energyPRO 3.2.0.27 Nov 2006

Hvide Sande, Eksisterende situation i 2006

Der er kun medtaget de betalinger, som ændrer sig, når de danske spotpriser ændres.

04-02-2007 10:25:55 / 1

EMD International A/S
Niels Jernesvej 10
9200 Aalborg
+45 9635 4444

Resultat af ordinær drift fra 01-01-2006 00:00 til 31-12-2006 23:59

(Alle beløb i kr)

Driftsindtægter								
Spotafregning	:				=	10.776.192		
Produktionsuafhængigttilskud	:				=	1.809.275		
Ialt Driftsindtægter								**12.585.467**
Driftsudgifter								
Gaskøb	:	6.542.239,2 Nm3	á	2,0	=	13.084.478		
Naturgas og CO2-afgift								
Motorer	:	2.510.874,3 Nm3	á	2,24	=	5.624.359		
Kedler	:	30.520,8 Nm3	á	2,24	=	68.367		
Naturgas og CO2-afgift Ialt							**5.692.725**	
Drift- og vedligehold								
Motorer	:	28.606,0 MWh	á	37,0	=	1.058.423		
Kedler	:	319,7 MWh	á	5,0	=	1.599		
Drift- og vedligehold Ialt							**1.060.022**	
Forbrug af CO2-kvoter	:	15.440,7 kvoter	á	50,0	=	772.037		
Elhandelsomkostninger	:	28.606,0 MWh	á	8,0	=	228.848		
Ialt Driftsudgifter								**20.838.110**
Resultat af ordinær drift								**-8.252.643**

energyPRO 3.2.0.27 Nov 2006

Hvide Sande, Afregnet med tyske spotpriser i 2006

Der er kun medtaget de betalinger, som ændrer sig, når de danske spotpriser ændres.

04-02-2007 10:39:16 / 1

EMD International A/S
Niels Jernesvej 10
9200 Aalborg
+45 9635 4444

Resultat af ordinær drift fra 01-01-2006 00:00 til 31-12-2006 23:59

(Alle beløb i kr)

Driftsindtægter								
Spotafregning	:				=	14.603.541		
Produktionsuafhængigttilskud	:				=	1.485.619		
Ialt Driftsindtægter								**16.089.160**
Driftsudgifter								
Gaskøb	:	6.513.240,1 Nm3	á	2,0	=	13.026.480		
Naturgas og CO2-afgift								
Motorer	:	2.486.297,8 Nm3	á	2,24	=	5.569.307		
Kedler	:	65.259,0 Nm3	á	2,24	=	146.180		
Naturgas og CO2-afgift Ialt							**5.715.487**	
Drift- og vedligehold								
Motorer	:	28.326,0 MWh	á	37,0	=	1.048.063		
Kedler	:	683,7 MWh	á	5,0	=	3.418		
Drift- og vedligehold Ialt							**1.051.482**	
Forbrug af CO2-kvoter	:	15.372,3 kvoter	á	50,0	=	768.614		
Elhandelsomkostninger	:	28.326,0 MWh	á	8,0	=	226.608		
Ialt Driftsudgifter								**20.788.672**
Resultat af ordinær drift								**-4.699.512**

Decentrale værker børe etablere køletårne for at være fuldgod reserve

Dansk Fjernvarmes kursus i elmarkedet den 5. maj 2007

Reporting on dissemination activities carried out within the frame of the DESIRE project (WP8)

Name, Affiliation	Anders N. Andersen, EMD International A/S
E-mail	ana@emd.dk
Title of dissemination	The electricity market
Type of activity	Course held by The Danish Society of Engineers for their members
Title of forum	The Danish Society of Engineers (www.ida.dk)
Language	Danish
Date of dissemination	12. March 2007
Place of dissemination	Aalborg, Denmark
Brief abstract / description of dissemination activity	EMD was invited to tell at this course about the results and methods in the DESIRE-project.
Audience impact assessment	11 persons participated.
Dissemination	Not available in printed form

Reporting on dissemination activities carried out within the frame of the DESIRE project (WP8)

Name, Affiliation	Ebbe Münster, PlanEnergi, Denmark
E-mail	em@planenergi.dk
Title of dissemination	The Benefit of integrated Energy and Transportation CO_2 Emission Control Strategies.
Type of activity	Oral presentation.
Title of forum	Risø Energy Conference 2005.
Language	English
Date of dissemination	May 23-24th, 2005
Place of dissemination	Risø, Roskilde, Denmark.
Brief abstract / description of dissemination activity	This paper analyses mutual benefits of integrating future energy and transport CO2 emissions control strategies. The paper illustrates and quantifies for the case of Denmark the mutual benefit of integrating the transport and the energy sector. In short, the energy sector can help the transport sector in replacing oil by renewable energy and CHP. While the transport sector can help the energy system in integrating a higher degree of intermittent energy and CHP. Two scenarios for partial conversion of the transport fleet have been considered. One is battery cars combined with hydrogen fuel cell cars and the other is the use of biofuel (ethanol) and synthetic fuel (methanol) for internal combustion cars. Both scenarios have a substantial effect on decreasing the excess electricity production caused by an eventual increase in the fraction of electricity delivered by fluctuating sources like wind turbines. Henrik Lund was co-author for this paper. It was later published in 'Transport Policy' with Henrik Lund as corresponding author. (reported for WP8 by Henrik Lund)
Audience impact assessment	The participants of the session were interested and the presentation was concluded by a good discussion
Dissemination	Included after this form

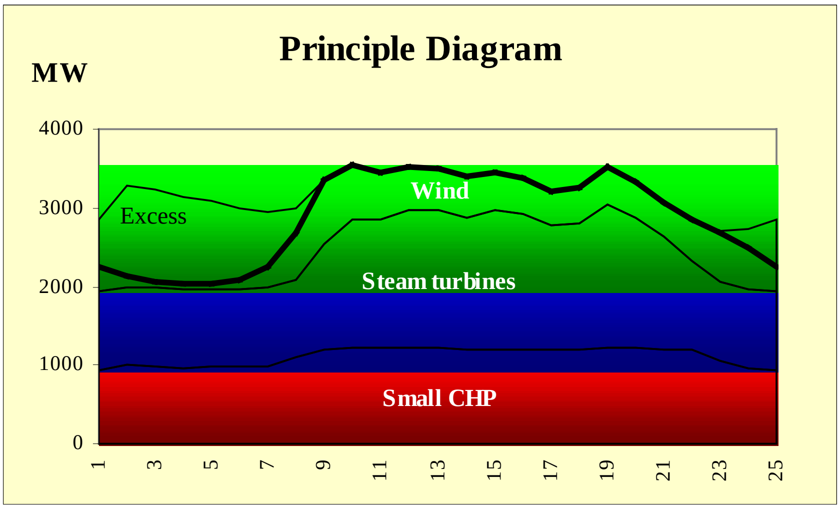
The Benefit of integrated Energy and Transportation CO_2 Emission Control Strategies

Risø, Maj 2005.

Ebbe Münster
PlanEnergi S/I
Henrik Lund
Department of Development and Planning, Aalborg University

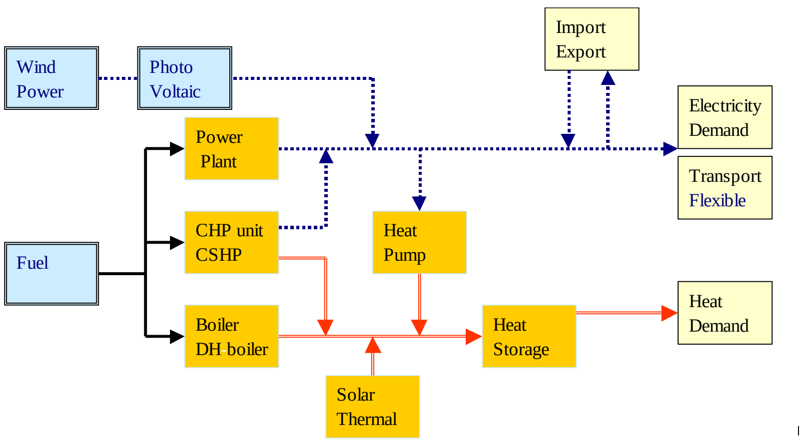
Danish Energy System:
The problem of excess electricity.

Partial electrification of the transport system:
Part of the solution ?



Energy and Environment

EnergyPLAN model



Energy and Environment

Technical analysis.

INPUTS:
- Electricity and heat demands
- Wind and PV productions
- Solar thermal and industrial CHP heat productions
- Capacities and efficiencies of PP, CHP, Boiler and HP
- Limitations (stability)

OUTPUTS:
- Electricity and heat productions
- Import/export of electricity
- Fuel consumptions
- CO2 emissions

PlanEnergi Energy and Environment

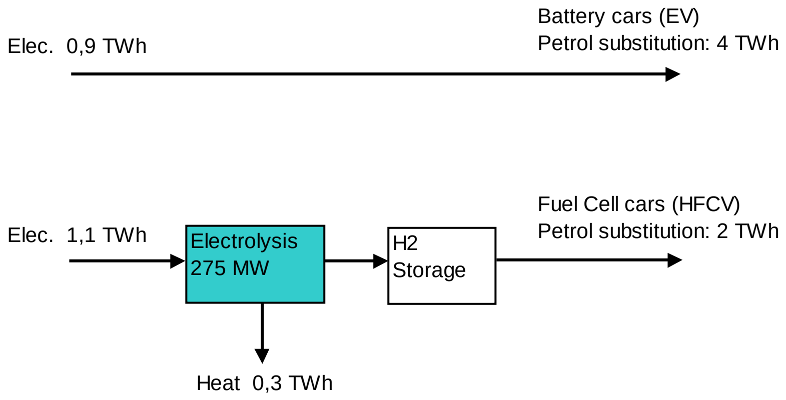
Economical analysis.

IMPUTS:
- Standard Nordpool Spot prices
- Correction factors (dry, wet, normal years)
- Price elasticity
- Limitations (transmission)
- Fuel prices
- Investment and operational costs of PP, CHP and HP

OUTPUTS:
- Net production costs for electricity and heat

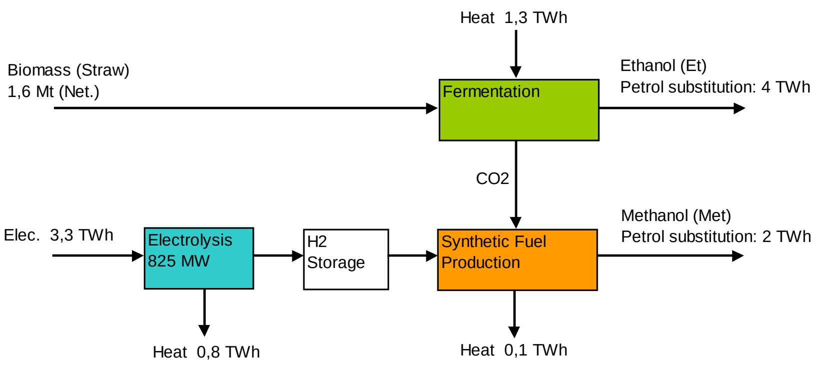
PlanEnergi Energy and Environment

Scenario 1: Battery cars and H2 Fuel Cell cars



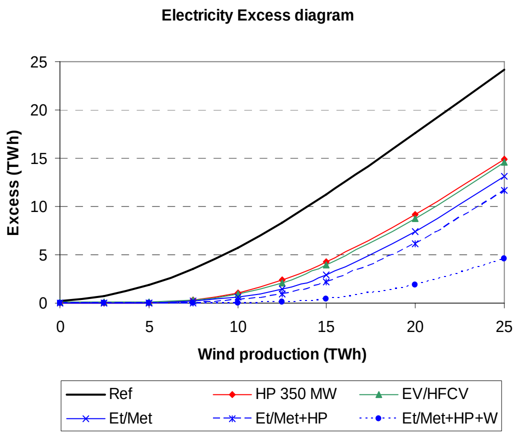
PlanEnergi — Energy and Environment

Scenario 2: Biofuel (Ethanol) and synthetic fuel (Methanol) production.



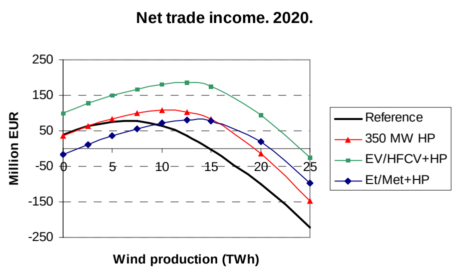
PlanEnergi — Energy and Environment

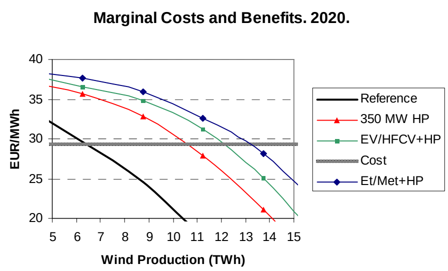
Electricity Excess



PlanEnergi
Energy and Environment

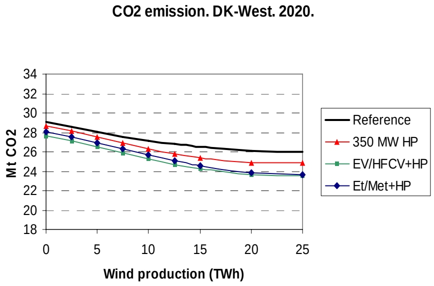
Socio Economics

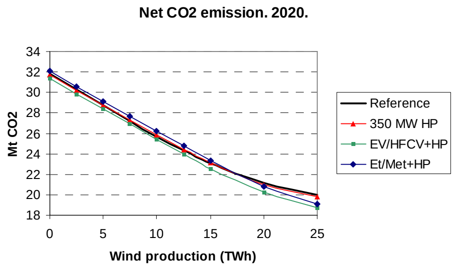




PlanEnergi
Energy and Environment

CO2 emissions





PlanEnergi Energy and Environment

Conclusions:

For both transport scenarios:

•Reducing excess electricity (at 50 % wind power: 70 %)

•Increasing economical optimum for wind power (from 40 % to 50 %)

•Reducing CO2 emission (1 to 2 Mt/year for West Denmark)

PlanEnergi Energy and Environment

Dissemination strategy on Electricity balancing

DESIRE

large Scale Integration of Renewable Energy

Reporting on dissemination activities carried out within the frame of the DESIRE project (WP8)

Name, Affiliation	Ebbe Münster, PlanEnergi, Denmark
E-mail	em@planenergi.dk
Title of dissemination	Explanation of the low potential for the balancing of fluctuating electricity production, which is typical for nuclear power
Type of activity	Ex-auditorio contribution to discussion.
Title of forum	Intelligent Energy for Europe.
Language	English
Date of dissemination	September 23rd 2005
Place of dissemination	Landstingssalen, Christiansborg, Copenhagen.
Brief abstract / description of dissemination activity	The use of nuclear power in general and the Euratom Treaty in particular were in focus at this conference organised by Friends of the Earth, Organisationen for Vedvarende Energi, NOAH, IDA a.o. With reference to the Desire project I contributed to the discussion in relation to the low potential for the balancing of fluctuating electricity production, which is typical for nuclear power.
Audience impact assessment	The participants of the conference, which encompassed members of the Danish and the EU parliament along with high ranking officials from the energy- and environment administrations from a number of EU countries, seemingly understood the importance of assessing not just yearly amounts of electricity but also flexibility of production.
Dissemination	Not available in printed form

Reporting on dissemination activities carried out within the frame of the DESIRE project (WP8)

Name, Affiliation	Ebbe Münster, PlanEnergi, Denmark
E-mail	em@planenergi.dk
Title of dissemination	Explanation of the possibility for increasing the share of wind power for electricity production in Denmark by the use of heat pumps at the decentralised CHP plants.
Type of activity	Ex-auditorio contribution to discussion.
Title of forum	Renewable Energy for Power and Transport.
Language	Danish
Date of dissemination	November 20th 2006
Place of dissemination	Foreign Ministry, Copenhagen.
Brief abstract / description of dissemination activity	The conference was organised by the Danish Energy Association , Risø Research Center a.o. Referring to the Desire project I stressed the possibility for increasing the share of wind power for electricity production in Denmark by the use of heat pumps at the decentralised CHP plants.
Audience impact assessment	Some of the invited MP's in the panel seemingly understood the above point of view.
Dissemination	Not available in printed form

Reporting on dissemination activities carried out within the frame of the DESIRE project (WP8)

Name, Affiliation	Ebbe Münster, PlanEnergi, Denmark
E-mail	em@planenergi.dk
Title of dissemination	Explanation of the importance of performing dynamic scenario analysis of the electrical distribution system.
Type of activity	Ex-auditorio contribution to discussion.
Title of forum	Opening conference for the 'Energy Year' of the Danish Society of Engineers, IDA,
Language	Danish
Date of dissemination	January 23rd , 2006
Place of dissemination	IDA, Copenhagen.
Brief abstract / description of dissemination activity	The point of view of the importance of the dynamic behaviour of the energy system and the need to perform dynamic scenario analysis of the electrical distribution system in particular was raised.
Audience impact assessment	Not evaluated
Dissemination	Not available in printed form

Dissemination strategy on Electricity balancing

DESIRE

large Scale Integration of Renewable Energy

Reporting on dissemination activities carried out within the frame of the DESIRE project (WP8)

Name, Affiliation	Ebbe Münster, PlanEnergi, Denmark
E-mail	em@planenergi.dk
Title of dissemination	Explanation of core idea of the Desire project.
Type of activity	Ex-auditorio contribution to discussion.
Title of forum	Meetings in the Danish Association of Wind Power..
Language	Danish
Date of dissemination	November 4th 2006 and February 5th ,2007
Place of dissemination	Risø, Roskilde and Nordkraft, Aalborg, Denmark.
Brief abstract / description of dissemination activity	The meetings were each attended by app. 200 members of the Association (mainly wind turbine owners) along with invited guests. The first meeting included a speech by the minister of environment, the second by a member of parliament. At such meetings the questions of the value of wind power electricity and the problem of the excess electricity is always in focus. At both meetings I explained the core idea of the Desire project: To make use of the heat accumulators and eventual heat pumps at the CHP plants to improve the capacity of the electricity system to balance fluctuating electricity production sources like wind power.
Audience impact assessment	According to personal requests after the meetings several members found the above point of view relevant and important.
Dissemination	Not available in printed form

Reporting on dissemination activities carried out within the frame of the DESIRE project (WP8)

Name, Affiliation	Ebbe Münster, PlanEnergi, Denmark
E-mail	em@planenergi.dk
Title of dissemination	Explanation of core ideas behind the DESIRE project.
Type of activity	Direct contact to other seminar attendants.
Title of forum	Price flexible electricity consumption (Seminar arranged by the Danish TSO, Energinet.dk, and Dansk Industri. (in Danish))
Language	Danish
Date of dissemination	May, 16th , 2007
Place of dissemination	Dansk Industri, Copenhagen.
Brief abstract / description of dissemination activity	The importance of coordinating the establishment of new communication networks including all decentralised electricity producers and major consumers between the two purposes: A. securing stability and balance in smaller regions of the transmission grid (cells). B. Enabling fast and effective online markets for the balancing of fluctuating electricity producers, was discussed with representative of the TSO. Relevant links and documents were exchanged.
Audience impact assessment	Not evaluated
Dissemination	Not available in printed form

Dissemination strategy on Electricity balancing

DESIRE

large Scale Integration of Renewable Energy

Reporting on dissemination activities carried out within the frame of the DESIRE project (WP8)

Name, Affiliation	David Toke, Katerina Fragaki, University of Birmingham
E-mail	d.toke@bham.ac.uk
Title of dissemination	DESIRE UK – Dissemination Conference held at the University of Birmingham May 18th
Type of activity	Conference
Title of forum	DESIRE dissemination Conference May 18th 2007
Language	English
Date of dissemination	May 18th 2007
Place of dissemination	United Kingdom
Brief abstract / description of dissemination activity	Over 60 people attended this conference representing a range of companies concerned with CHP, local authority officers, potential developers, Councillors, consultants and academics. The Conference was addressed by D. Toke, K. Fragaki and a range of expert speakers discussing practical implementation of strategies involving CHP and thermal stores.
Audience impact assessment	The Conference has had widespread impact in putting forward a coherent strategy in the UK heading towards 'aggregating' community CHP with thermal stores to dramatically improve the economics of community CHP. A range of actors (mentioned above) have been informed about a number of details regarding this strategy.
Dissemination	Not available in printed form

Reporting on dissemination activities carried out within the frame of the DESIRE project (WP8)

Name, Affiliation	David Toke, University of Birmingham
E-mail	d.toke@bham.ac.uk
Title of dissemination	Interactive Load Management
Type of activity	Presentation at Conference
Title of forum	Conference 'Coping with Variability: Integrating Renewables into the Electricity System'
Language	English
Date of dissemination	January 24th 2006
Place of dissemination	Held at the Open University, Milton Keyne
Brief abstract / description of dissemination activity	This described the Danish system of using CHP with thermal stores to integrate fluctuating renewable energy supplies into the grid and also discussed how this could be transferred into the UK
Audience impact assessment	This spread knowledge among around 50 academics, industrial engineers and consultants attending the conference
Dissemination	Available via http://stadium.open.ac.uk/stadia/preview.php?s=1&whichevent=720

Reporting on dissemination activities carried out within the frame of the DESIRE project (WP8)

Name, Affiliation	David Toke, University of Birmingham
E-mail	d.toke@bham.ac.uk
Title of dissemination	Wind Power Planning And Finance In The United Kingdom – Future Prospects
Type of activity	Presentation at conference
Title of forum	ENERGEX 2006 Conference
Language	English
Date of dissemination	12-15th June 2006
Place of dissemination	Stavanger, Norway,
Brief abstract / description of dissemination activity	The prospects of wind power were discussed for the UK taking into account the issues surrounding the Renewable Obligation and also the balancing issue
Audience impact assessment	A number of academics from a range of EU countries learned about the issues
Dissemination	Not available in printed form

Dissemination strategy on Electricity balancing

DESIRE

large Scale Integration of Renewable Energy

Reporting on dissemination activities carried out within the frame of the DESIRE project (WP8)

Name, Affiliation	David Toke, University of Birmingham
E-mail	d.toke@bham.ac.uk
Title of dissemination	Energy Efficiency in the UK
Type of activity	Presentation at conference
Title of forum	ENERGEX 2006 Conference
Language	English
Date of dissemination	12-15th June 2006
Place of dissemination	Stavanger, Norway,
Brief abstract / description of dissemination activity	The make-up and costs of different demand reduction strategies including the impact of CHP were analysed.
Audience impact assessment	A number of academics from a range of EU countries learned about the issues
Dissemination	Not available in printed form

Dissemination strategy on Electricity balancing

DESIRE

large Scale Integration of Renewable Energy

Reporting on dissemination activities carried out within the frame of the DESIRE project (WP8)

Name, Affiliation	David Toke, The University of Birmingham
E-mail	d.toke@bham.ac.uk
Title of dissemination	DESIRE Public Seminar
Type of activity	Organization of a one day free public seminar
Title of forum	DESIRE Seminar
Language	English
Date of dissemination	November 9th 2005
Place of dissemination	Austin Court, Birmingham, UK
Brief abstract / description of dissemination activity	The seminar explained the DESIRE project and the types of integration techniques (centring on CHP-wind co-production demonstrations). The aim of this meeting was to solidify co-operation for the initiative among key players as a preparation for the demonstrations of the co-production, after which there will be wider dissemination including a rather larger event.
Audience impact assessment	People with interests and involvement in related sectors with CHP and renewable energy both from the University as well as from private sector participated and showed interest in the DESIRE project objectives.
Dissemination	Available via http://www.ierp.bham.ac.uk/events.htm

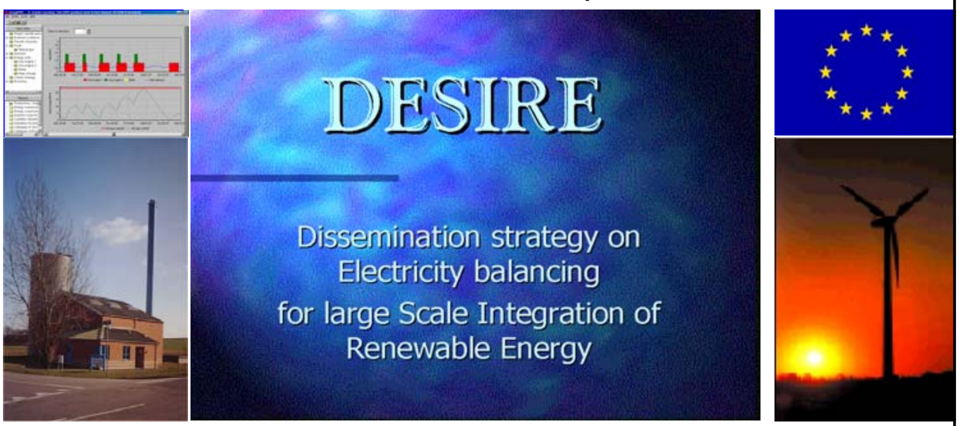
Reporting on dissemination activities carried out within the frame of the DESIRE project (WP8)

Name, Affiliation	David Toke, Senior Lecturer, University of Birmingham
E-mail	d.toke@bham.ac.uk
Title of dissemination	Where Will Desire get us
Type of activity	PowerPoint Presentation
Title of forum	DESIRE dissemination conference
Language	English
Date of dissemination	9th Nov 2005
Place of dissemination	Birmingham, England
Brief abstract / description of dissemination activity	This event spread information about the aims of the DESIRE project and use of thermal stores in integrating renewables into the grid and also improving CHP economics
Audience impact assessment	Many CHP opinion leaders attended this even and knowledge of thermal stores has been spread widely
Dissemination	Included after this form

Where will DESIRE get us?

Dr David Toke, Senior Lecturer,
University of Birmingham

Aalborg University   PlanEnergi   Universität Kassel   Birmingham University
Tallinn Technical University



Energi- og Miljødata   Institut für Solare Energieversorgungstechnik   EMD Deutschland
LABEiN Technological Centre in Bilbao   Warzaw Technical University

Having no wind is not a great problem

What can we do when there's too much wind?

Options for balancing

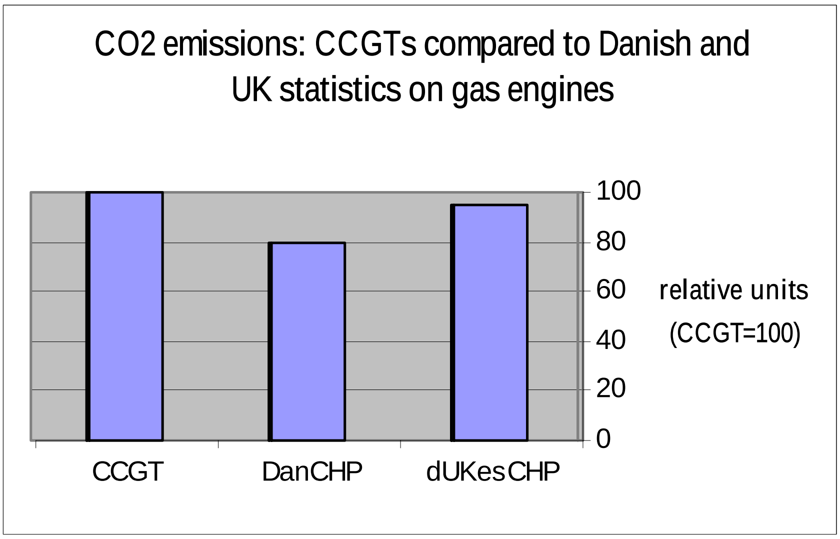
- Turn off some windmills
- Turn off a lot of conventional power stations
- Build bigger electricity inter-connectors
- Use CHP to balance wind power

How balancing works

- When there’s too much wind……store heat in accumulators
- When there’s not enough wind……pump heat into accumulators

Picture of CHP unit with two heat accumulators (thermal stores) on left

Danish Gas CHP reduces CO2 emissions a lot better than CCGTs



How to get a lot more good CHP

- Feed-in tariff for good quality CHP
- Set up good quality CHP obligation
- Make good quality CHP mandatory for next 5 or ten years
- Make good quality CHP mandatory for all new buildings (where gas is available)

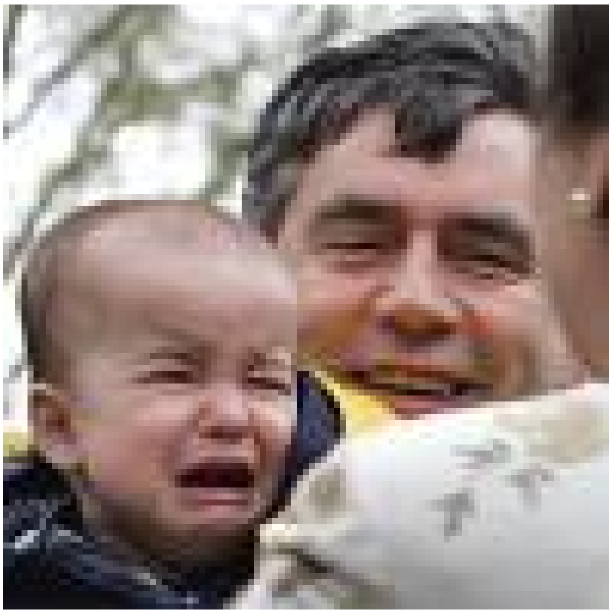
How does balancing help in the short term?

(1) CHP plant can co-operate to bid for the short term operating reserves market, utilising thermal stores

How can balancing help in the short term?

(2) It can reduce BETTA penalties if CHP and windfarms co-produce

Country	Tariff in p/KWh	Average capacity factor (%)	Annual Return per installed MW (£)
Germany	5.5(declining)	18	87,000
United Kingdom	5.0 (15 yr contract) 6.0 (10 yr contract) 8.0(annual contract)	28	123,000 147,000 172,000
Spain	4.5	28	110,000



In 2011 the Conservatives might be in office, and they may reduce prices for onshore wind……..

Country	Tariff in p/KWh	Average capacity factor (%)	Annual Return per installed MW (£)
United Kingdom 2005	5.0 (15 yr contract) 6.0 (10 yr contract) 8.0(annual contract)	28	123,000 147,000 172,000
United Kingdom 2011	4.0 (15 yr contract) 4.5 (10 yr contract) 5.3(annual contract)	28	98,000 110,000 130,000

In 2011 an extra £3-4/MWh might come in quite handy for wind power developers (through reducing BETTA penalties on intermittency)

Dissemination strategy on Electricity balancing
DESIRE
large Scale Integration of Renewable Energy

Reporting on dissemination activities carried out within the frame of the DESIRE project (WP8)

Name, Affiliation	Bernhard Lange, ISET
E-mail	blange@iset.uni-kassel.de
Title of dissemination	Integration of Wind Power into the Electrical Energy Supply System in Germany – The ISET Wind Power Management System
Type of activity	Presentation at seminar
Title of forum	DESIRE Seminar
Language	English
Date of dissemination	November 9th 2005
Place of dissemination	Birmingham, UK
Brief abstract / description of dissemination activity	The talk gives an overview about the wind power management system and especially the forecasting system developed by ISET and also used in the DESIRE project.
Audience impact assessment	The talk at the seminar was well received. Some questions were posed and private discussions in the break followed.
Dissemination	Included after this form

Integration of Wind Power into the Electrical Energy Supply System in Germany –

The ISET Wind Power Management System

B. Lange, K. Rohrig, F. Schlögl

Institut für Solare Energieversorgungstechnik e. V.

Kassel, Germany

DESIRE Seminar 9.11.2005 Birmingham

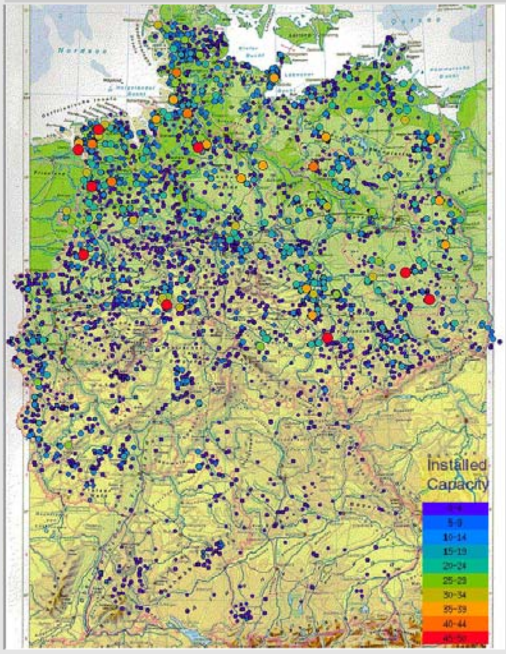
Overview

- Introduction
- Wind Power Management System
  - Online-monitoring
  - Day ahead forecast
  - Short-term forecast (2-8 hours)
- Application

DESIRE Seminar 9.11.2005 Birmingham

Introduction

I/Ro 06-2003



Wind Power in Germany

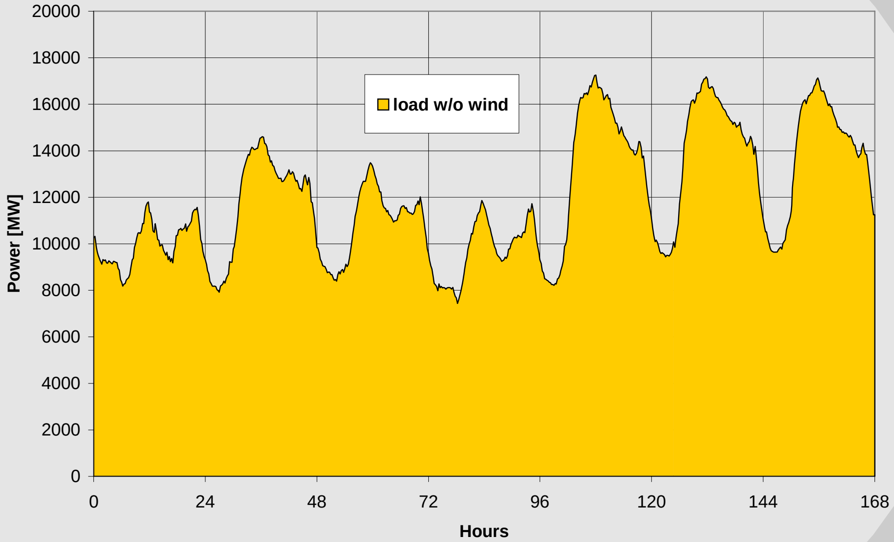
as of 12/2004:

16,000 Wind turbines
16 GW installed capacity

50 % of installed capacity in Europe
30 % world wide

DESIRE Seminar 9.11.2005 Birmingham

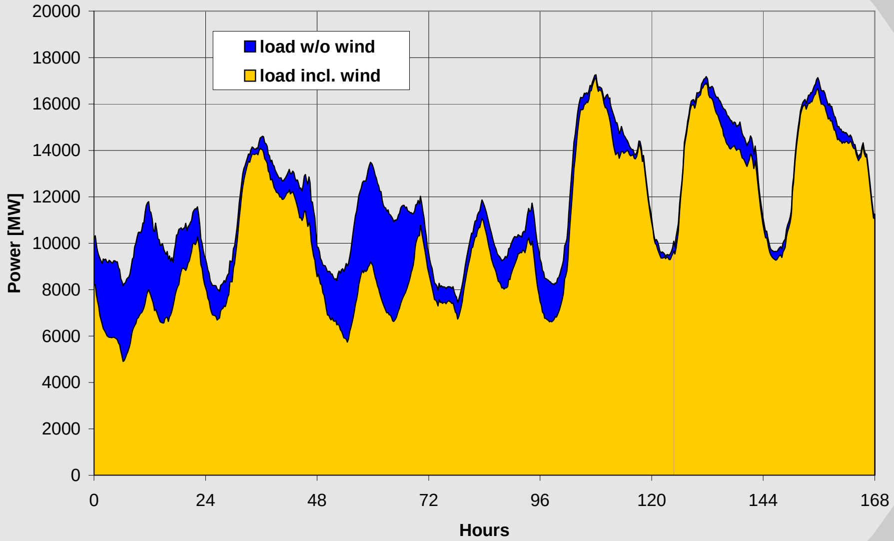
Introduction



Electricity demand profile of E.ON Netz – 1.5. – 7.5.2003

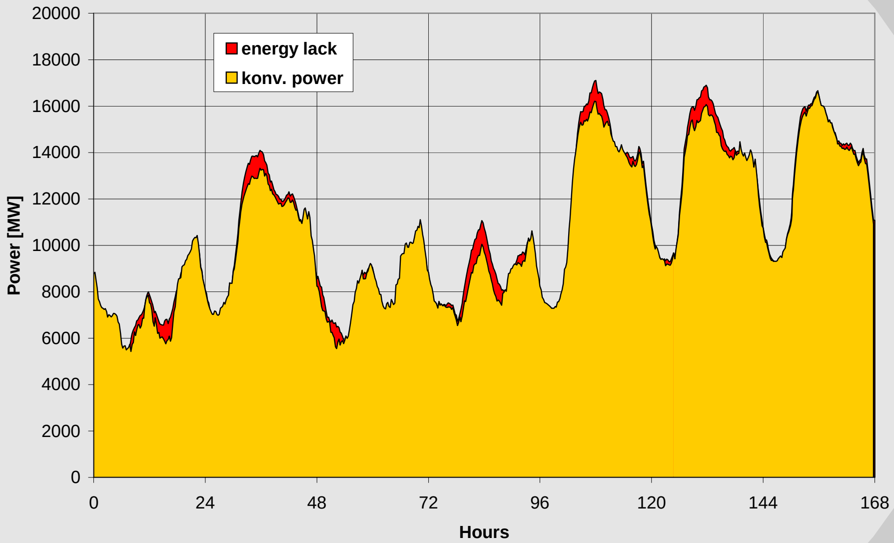
DESIRE Seminar 9.11.2005 Birmingham

Introduction



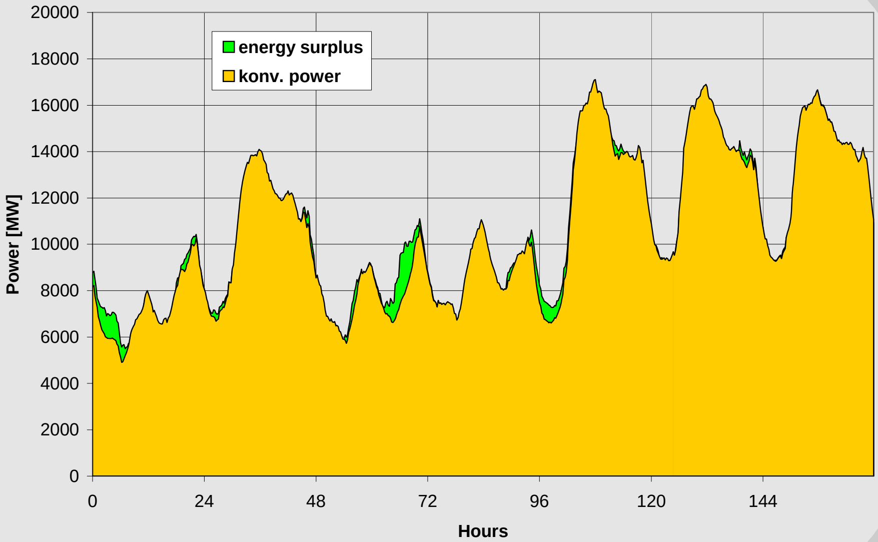
Electricity demand profile of E.ON Netz – 1.5. – 7.5.2003

Introduction



Electricity demand profile of E.ON Netz – 1.5. – 7.5.2003

Introduction



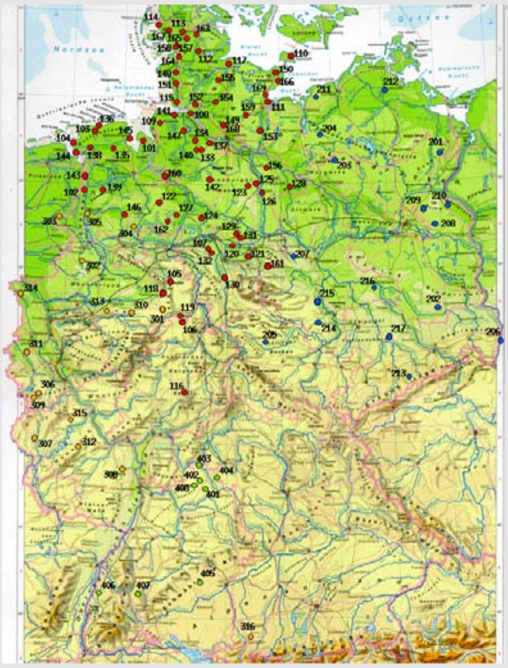
Electricity demand profile of E.ON Netz – 1.5. – 7.5.2003

Wind Power Management System WPMS

Consists of three parts:

- Online-monitoring
- Day ahead forecast
- Short-term forecast (2-8 hours)

WPMS Online-monitoring

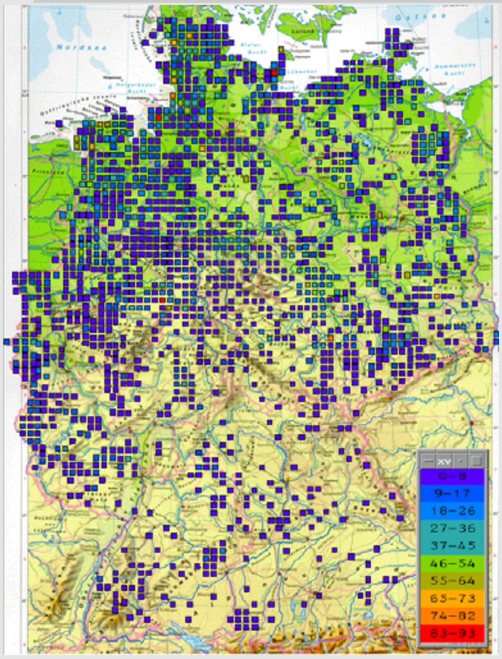


Online Measurements

Online acquisition
of power output of
representative wind farms
at transformer stations

E.ON: 69 sites 2356 MW (33,2 %)
VE-T: 17 sites 725 MW (11,4 %)
RWE: 16 sites 461 MW (15,2 %)
EnBW: 7 sites 108 MW (41,3 %)

WPMS Online-monitoring



Calculation algorithm

subdivision of the
concerning utility
supply area
into grid squares

WPMS Online-monitoring

Transformation algorithm

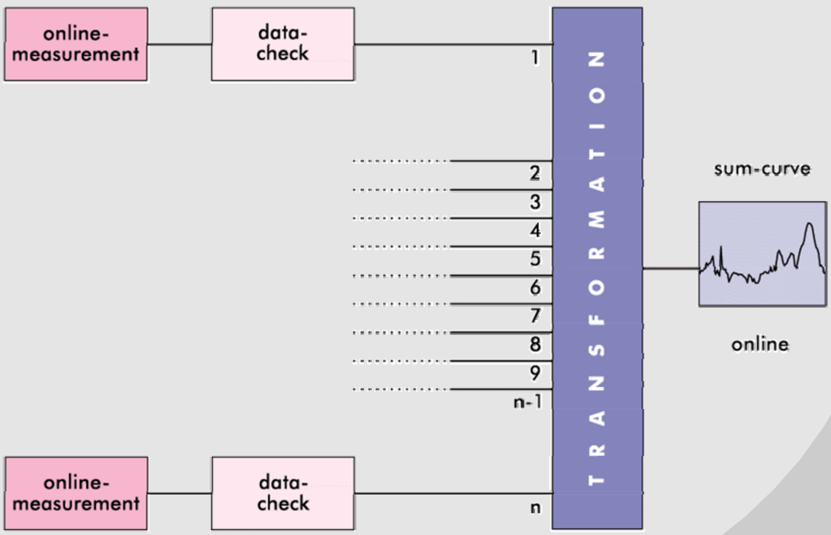
Calculation of **current power output** of each grid square by evaluation of all representative power signals

considered parameters:

- distance
- roughness
- control systems

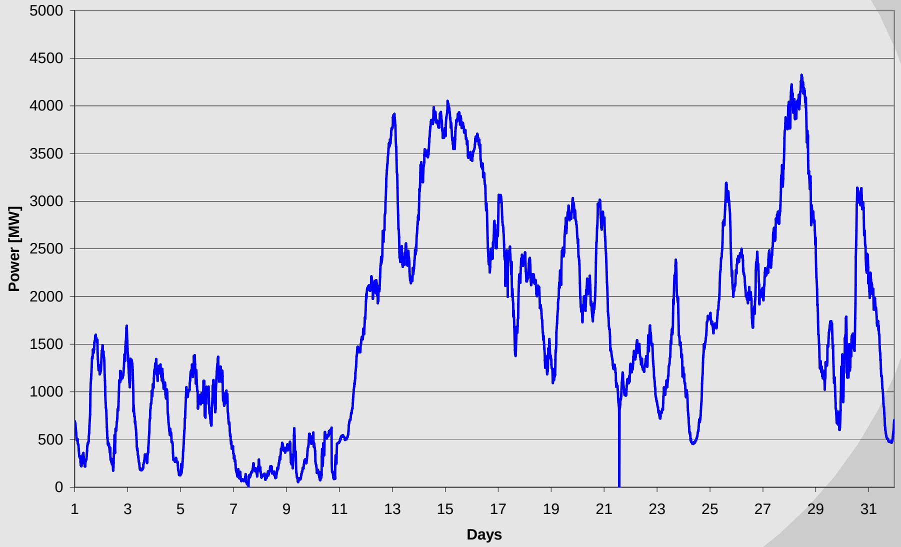
WPMS Online-monitoring

Schematic run of WPMS Online-monitoring



WPMS Online-monitoring

Wind power production in January 2003



WPMS Day-ahead prediction

Day-ahead prediction

- Input:
  - Numerical Weather Prediction (NWP) models
- Prediction method:
  - Artificial Neural Networks
  - Trained with measured wind farm power production
- Output:
  - Time resolution 15 minutes
  - Forecast horizon 48 hours
  - Updated twice per day

WPMS Day-ahead prediction

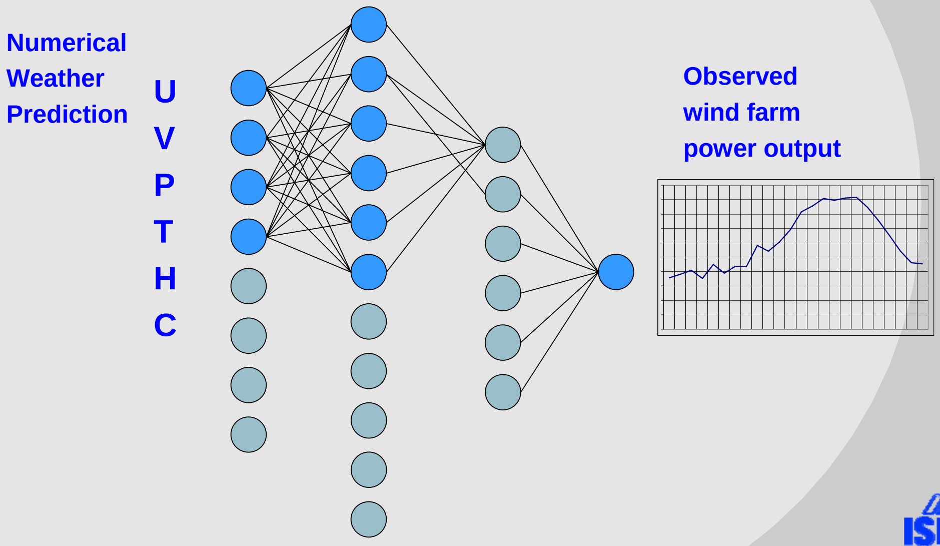
Standard Numerical Weather Prediction model

Local Model LM from the German Weather Service (DWD)

Size	325 x 325 grid points
Grid size (horizontal)	0,0625° (7 km)
Forecast schedule	48 hours
Model runs	00 UTC, 12 UTC

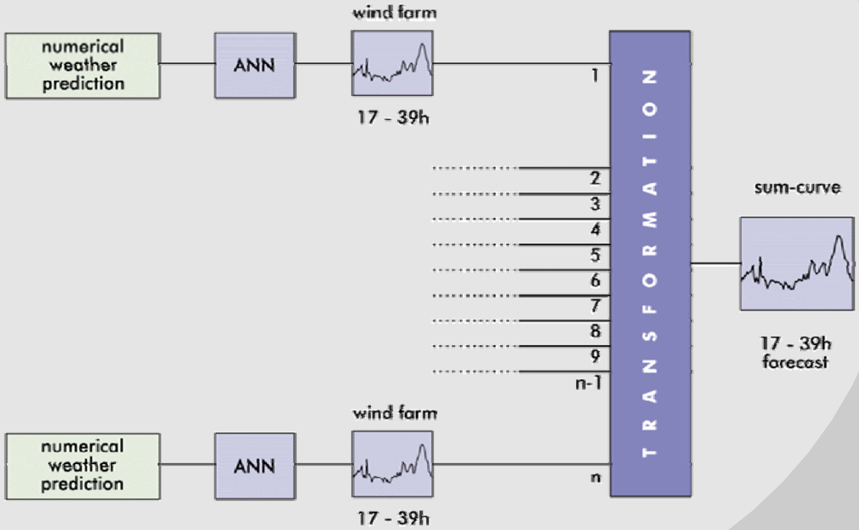
WPMS Day-ahead prediction

Artificial Neural Networks

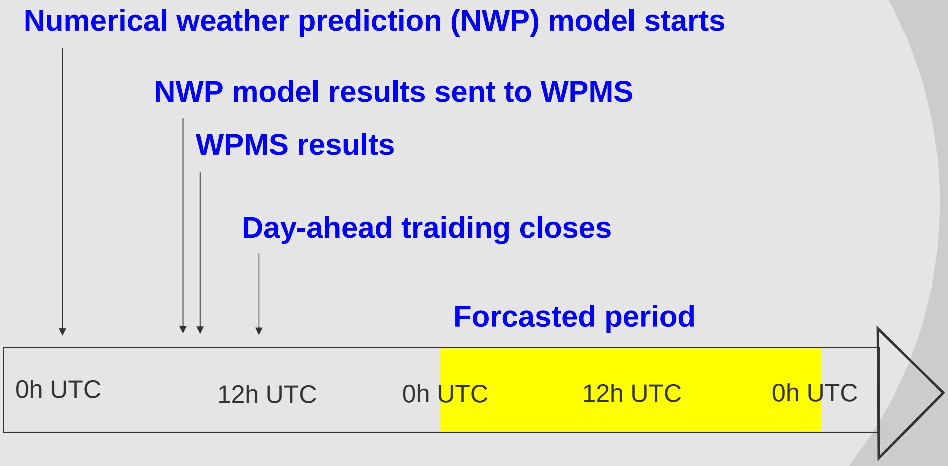


WPMS Day-ahead prediction

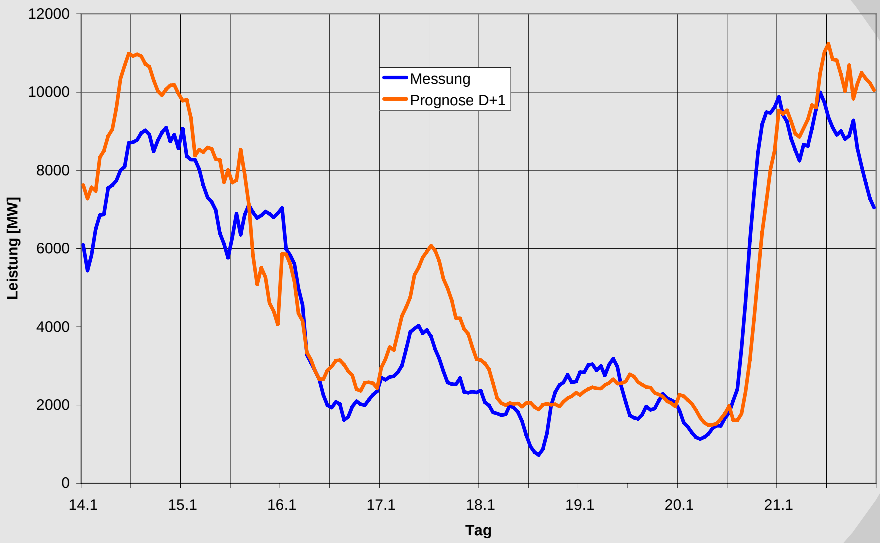
Schematic run of WPMS Short term prediction



WPMS Day-ahead prediction



WPMS Day-ahead prediction



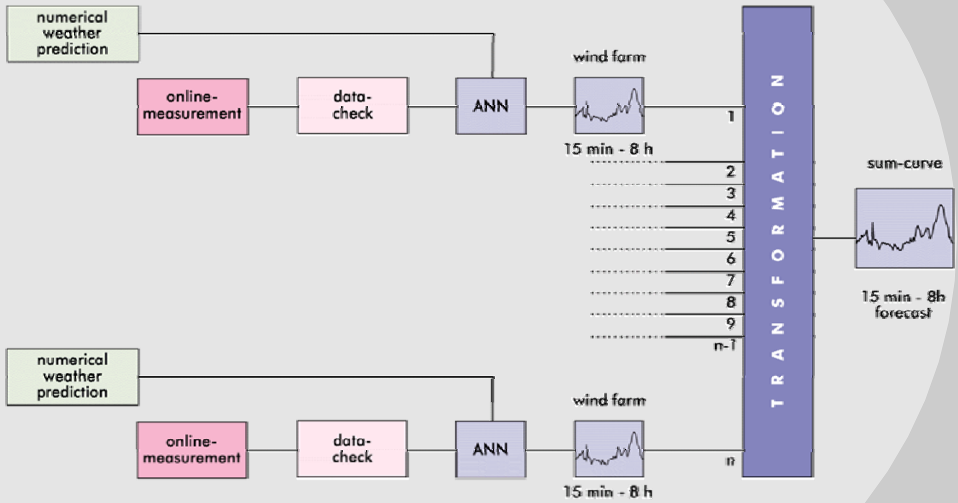
Wind power production in Germany – online and day-ahead prediction

WPMS Short term prediction

Short term prediction

- Input:
  - Online measurements of wind farm power production
  - Numerical Weather Prediction (NWP) models
- Prediction method:
  - Artificial Neural Networks
  - Trained with measured wind farm power production
- Output:
  - Time resolution 15 minutes
  - Forecast horizon up to 8 hours
  - Updated every hour

WPMS Short term prediction



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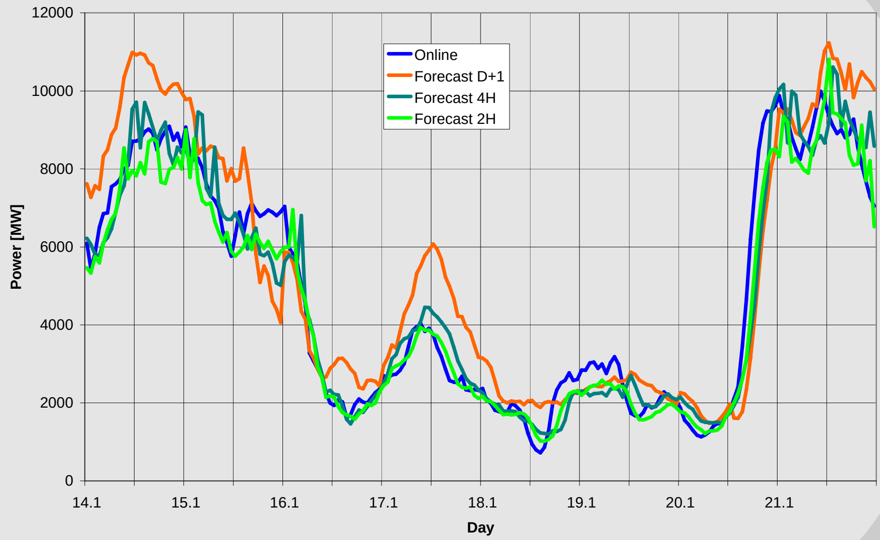
WPMS Short term prediction



Wind power production in Germany – online, day-ahead, 4hr, 2hr predictions

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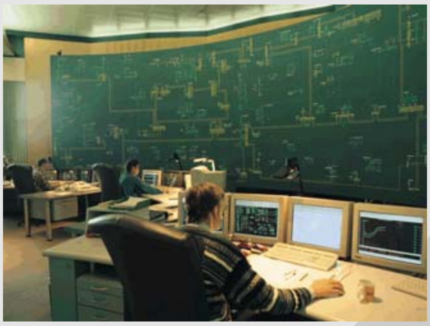
WPMS Application

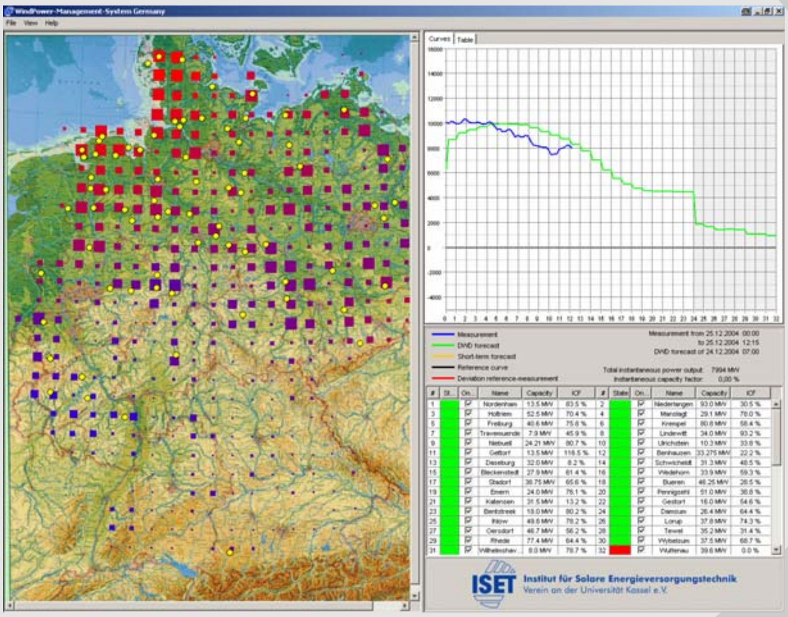
Application

In operation at
- E.ON Netz,
- RWE Netz
- Vattenfall Europe Transmission GmbH

Currently implemented at
- EnBW



WPMS Application



Thank you for listening!

www.iset.uni-kassel.de

Reporting on dissemination activities carried out within the frame of the DESIRE project (WP8)

Name, Affiliation	Sievers, John University of Kassel (UniK)
E-mail	sievers@re.e-technik.uni-kassel.de
Title of dissemination	Speicherung von thermischer Energie zum Ausgleich der Stromerzeugung aus Windenergie
Type of activity	Presentation
Title of forum	2. Internationale Konferenz "Energieautonomie durch Speicherung Erneuerbarer Energien", 19.-21.11.2007
Language	German
Date of dissemination	20th November 2007
Place of dissemination	Bonn, Germany
Brief abstract / description of dissemination activity	The intention of this presentation is to inform about the technical results of the Desire project. Heat stores are a necessary module for balancing wind power fluctuations by the instruments Demand Side Management and Cogeneration. The results were obtained by calculations, which have quantified how far this is possible. Like legislation for instance in Denmark and Germany has shown it is possible to set the right boundary conditions and to then obtain the DESIRED results; in this case a high share of wind power and cogeneration.
Audience impact assessment	Not available yet
Dissemination	The results are taken from Deliverables 2.3 and 2.4. Available via http://www.project-desire.org/ Not available in printed form

Dissemination strategy on Electricity balancing

DESIRE

large Scale Integration of Renewable Energy

Reporting on dissemination activities carried out within the frame of the DESIRE project (WP8)

Name, Affiliation	Sievers, John University of Kassel (UniK)
E-mail	sievers@re.e-technik.uni-kassel.de
Title of dissemination	The economics of heat storage in CHP plants and integration techniques such as use of buildings as 'batteries' and heat pumps
Type of activity	Presentation at seminar
Title of forum	DESIRE seminar – integration of fluctuating renewables into the grid using combined heat and power –
Date of dissemination	9th November 2005
Place of dissemination	Birmingham, UK (internet)
Brief abstract / description of dissemination activity	The presentation should inform experts about the activities of UniK in the field of integrating renewable energies and the research within the Desire project. To give an overview about how much the contribution of renewable energies will grow and how cogeneration can assist in securing power supply; the important role and economy of thermal stores in that respect. In addition to electricity supply the electricity demand side can be influenced in order to balance renewables. A higher integration of renewables is possible with cogeneration and demand side management like they are proposed and investigated in the Desire project.
Audience impact assessment	The investigated solution which leads to a high cogeneration flexibility (power) and efficiency by use of thermal stores and the possibilities of demand side management has been brought into discussion.

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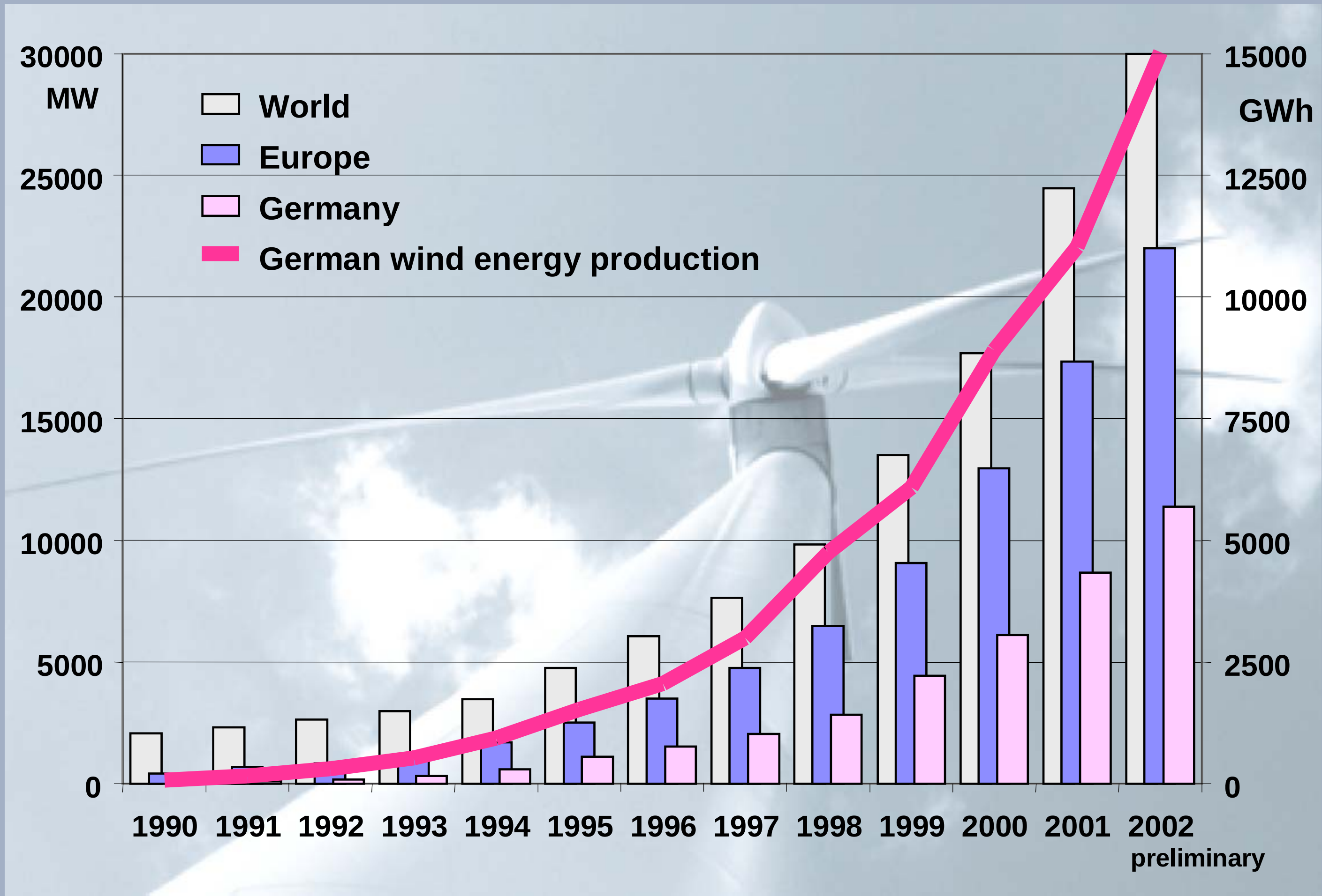
The economics of heat storage in CHP plants and integration techniques such as use of buildings as ‘batteries’ and heat pumps.

John Sievers

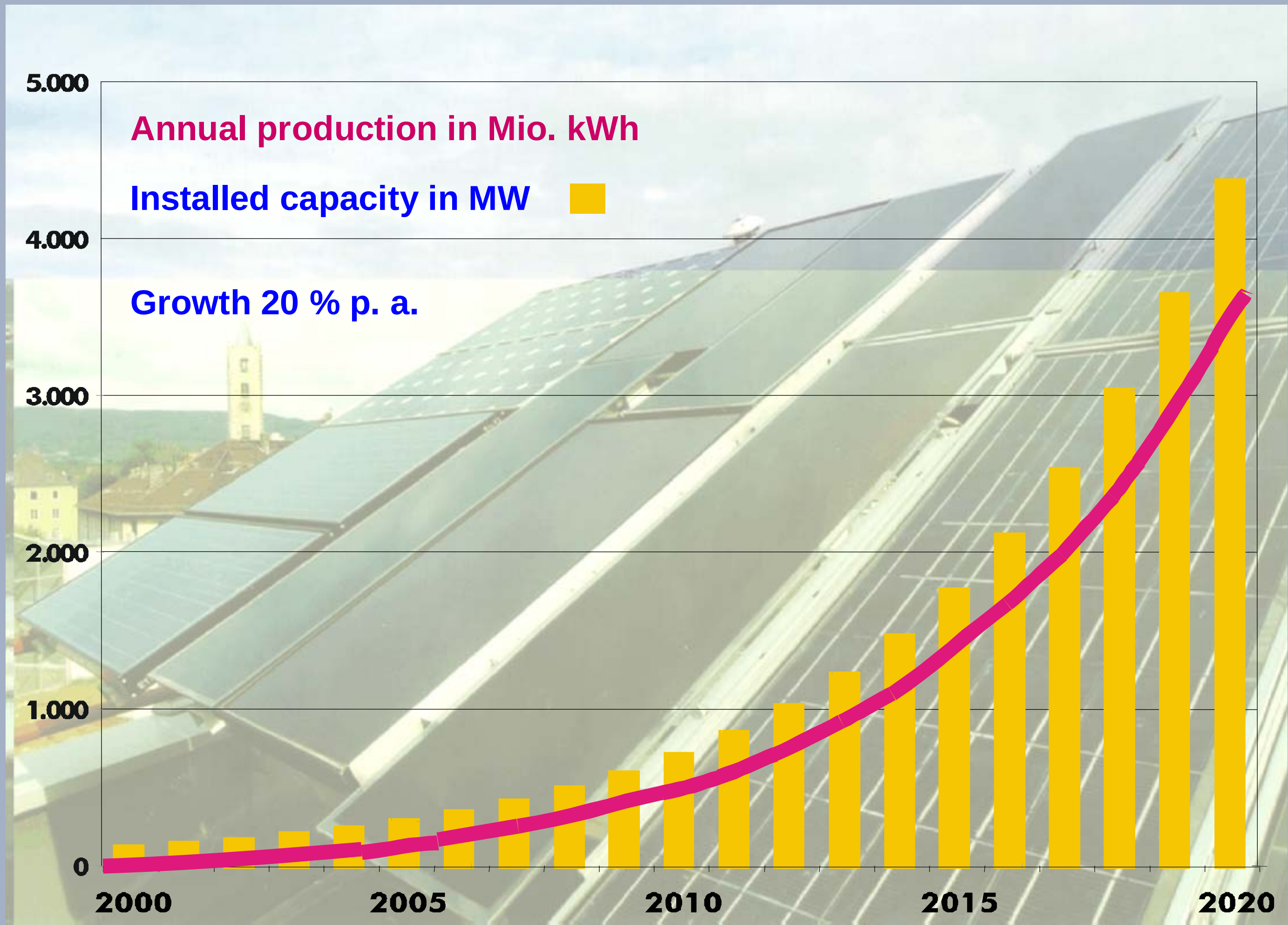
of the University of Kassel

Wind Energy



Source: ISET

Photovoltaic Scenario for Germany



Source: ISET

Marine Current Turbines Ltd

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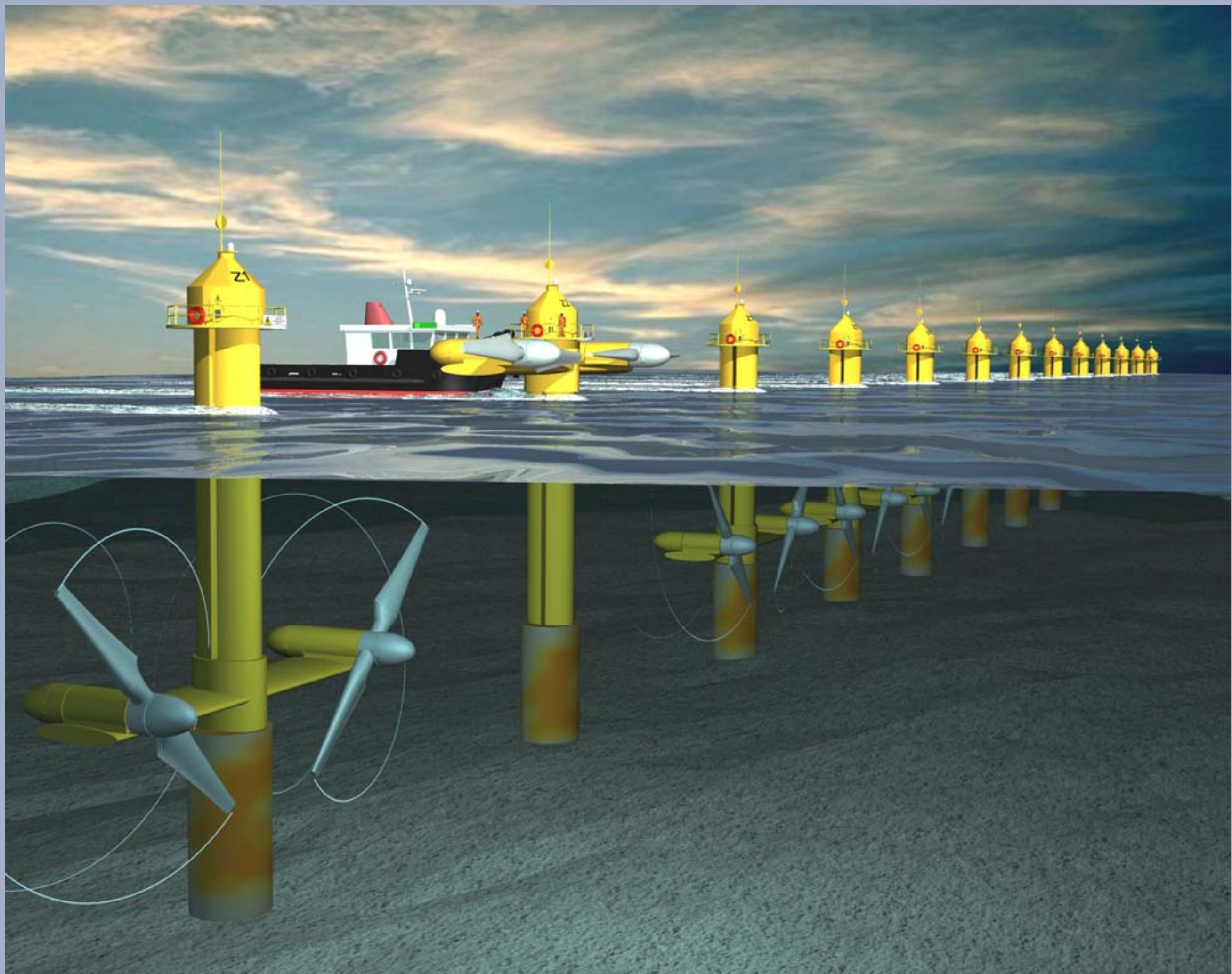

Source: MCT, ISET

Seaflow installed

rotor dia. 11m, rated power 300kW, pile dia. 2.1m

operational


raised for access

First run (unloaded)
30 May 2003

Source: MCT, ISET

How to manage a rising contribution of fluctuating electricity generation by RES

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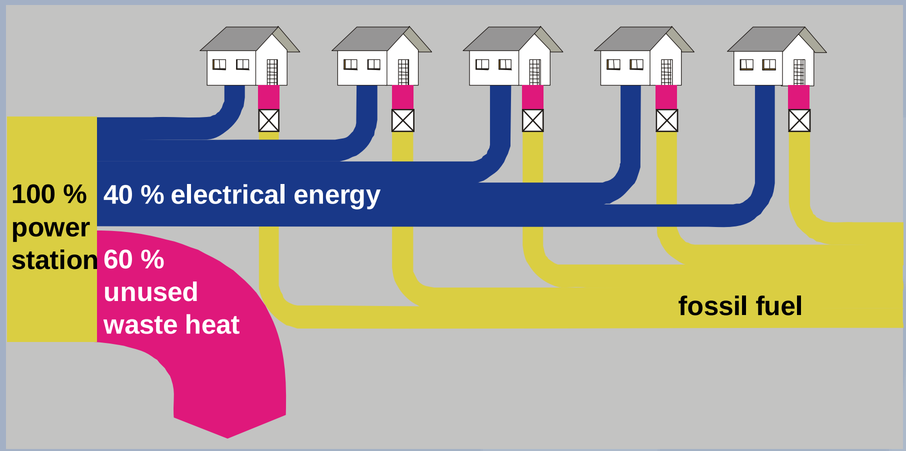
- Wind turbines: skills of pitch regulation

- Larger grid capacities balancing by connecting (within) EU states and neighbours

- Supply side:
- Hydro power from reservoirs
- CHP plants

- Demand side
- Hydro power with reservoirs (pumping storage)
- Heat pumps (compressors)
- Consumer shifting

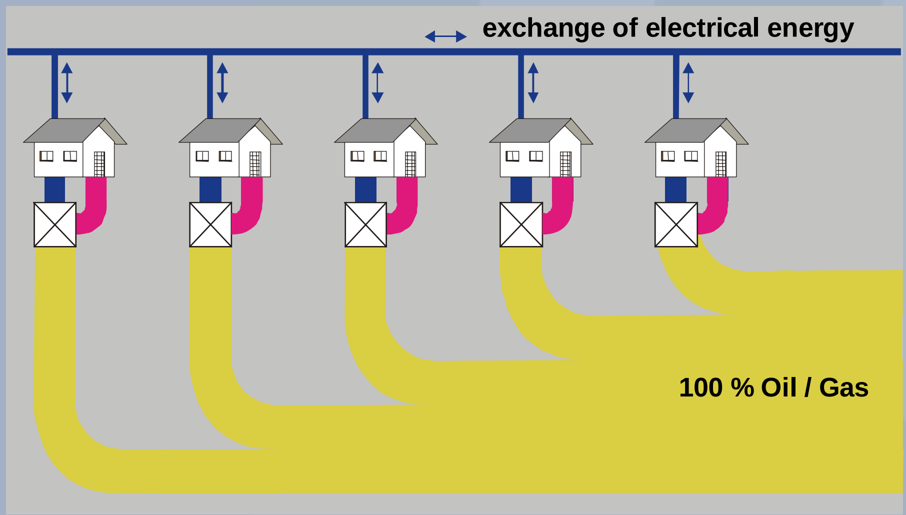
- **Objective: concepts for CHP and heat storages to equalize fluctuating renewable energies**



Up to now:

Centralized power stations

Decentralized heat production



In Future:

Decentralized combined heat and power

⇒ 1/3 less consumption of fossil Energy sources

Source: ISET

Present CHP plant design "German philosophy"

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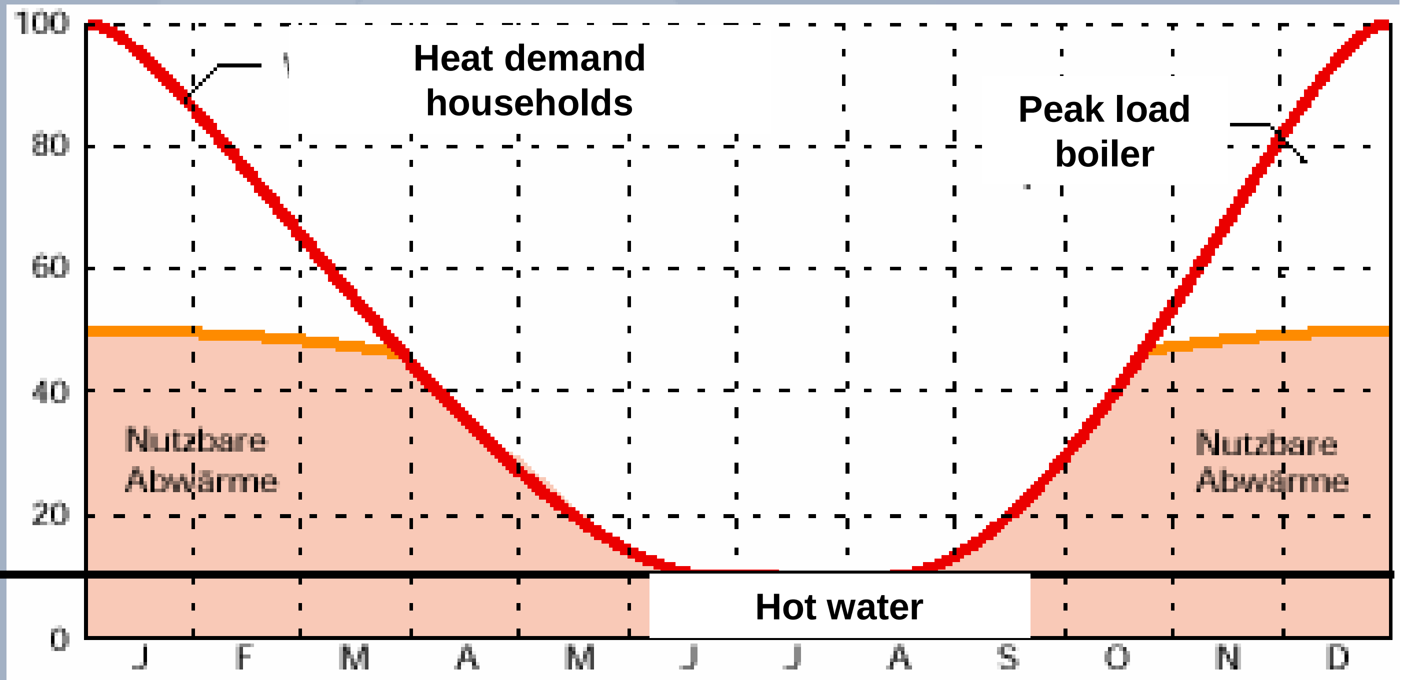
Past Missing incentive to shift generation
2 tariffs => cover own demand or feed-in

„Ideal" German CHP Plant design



Small CHP plant and peak load boiler (reserve boiler)

Present CHP plant design Type 1

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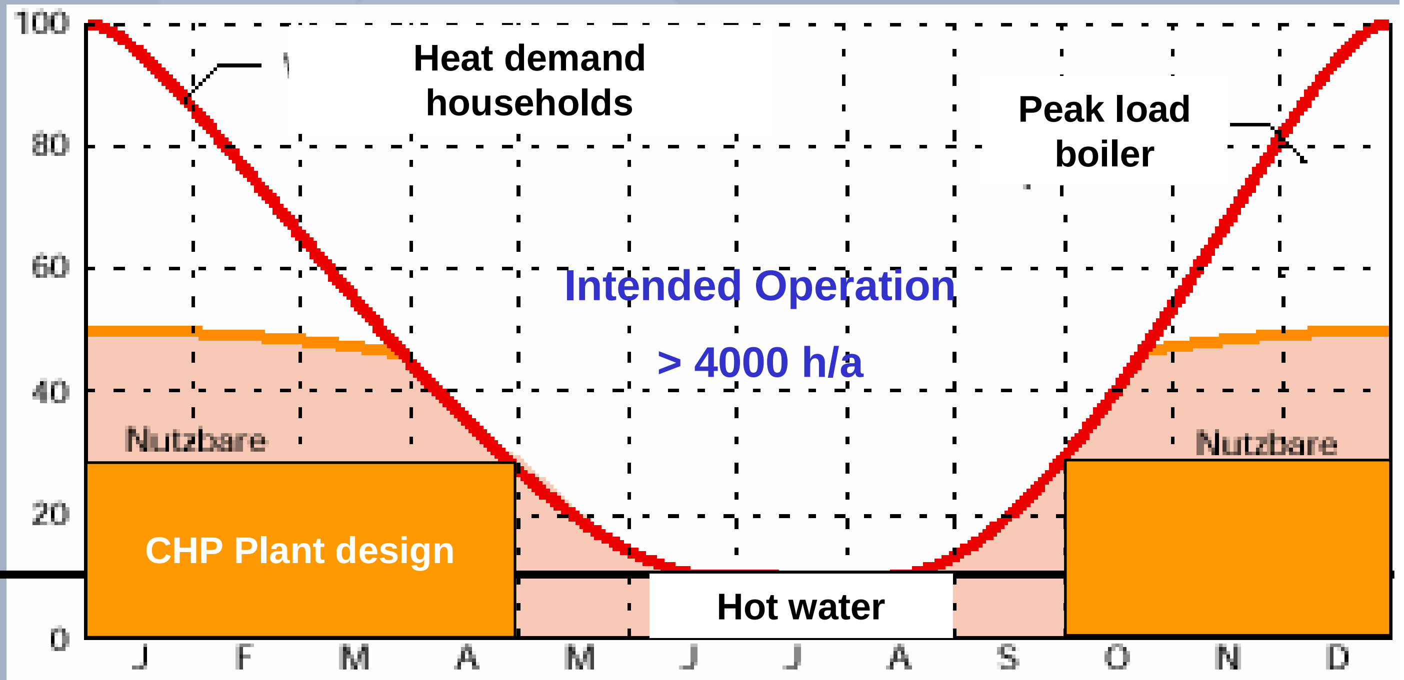
One module:

„Ideal“ German CHP Plant design



Low investment, long operation and a fast pay back

Present CHP plant designs Type 2

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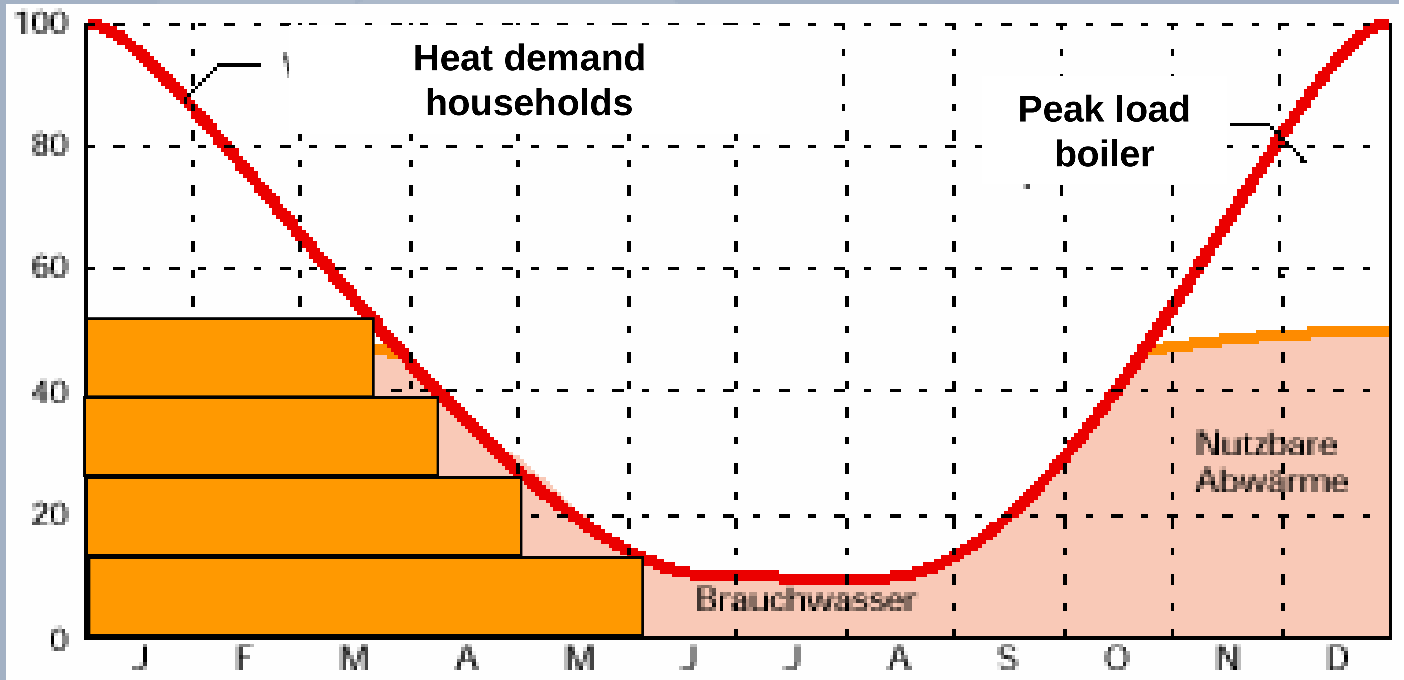
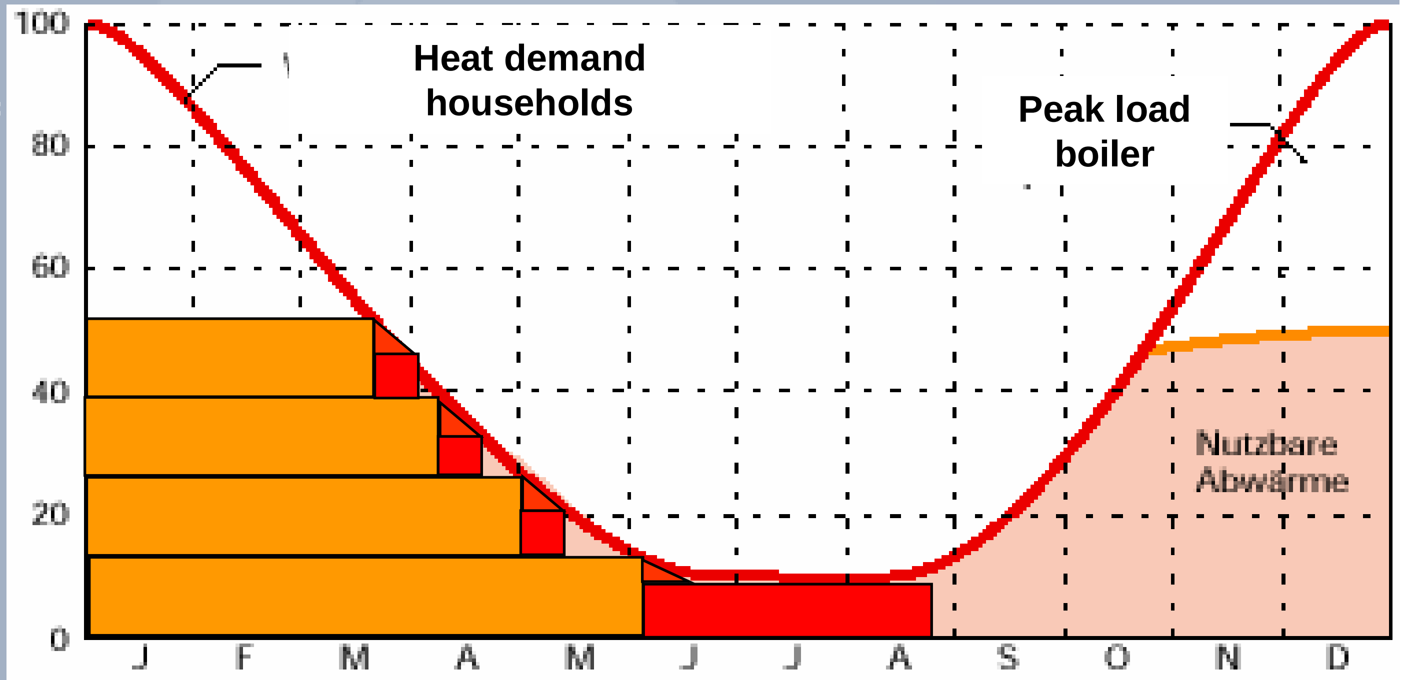
- Several modules:
- Higher coverage of heat demand
- With long enough hours of operation



Present CHP plant designs Type 2

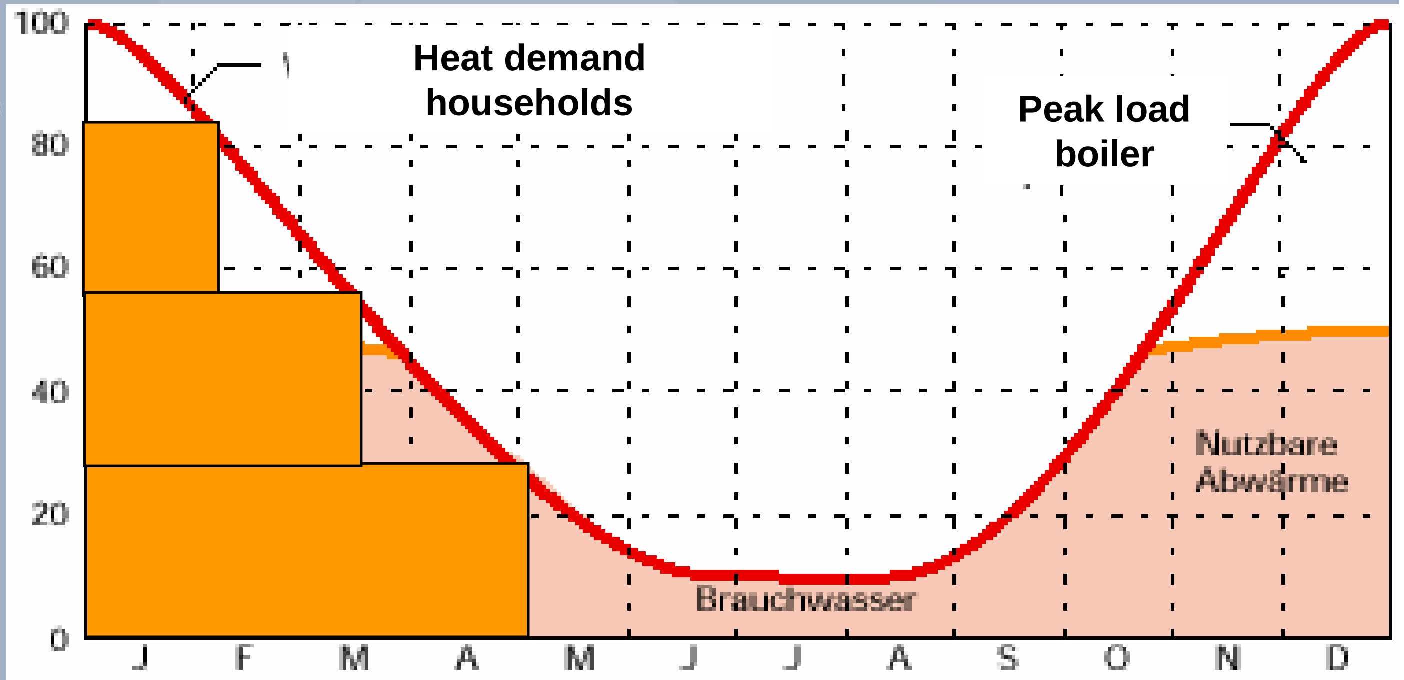
- Partial load:
- Higher coverage of heat demand
- Lower electric efficiency



Present CHP plant design Danish Type

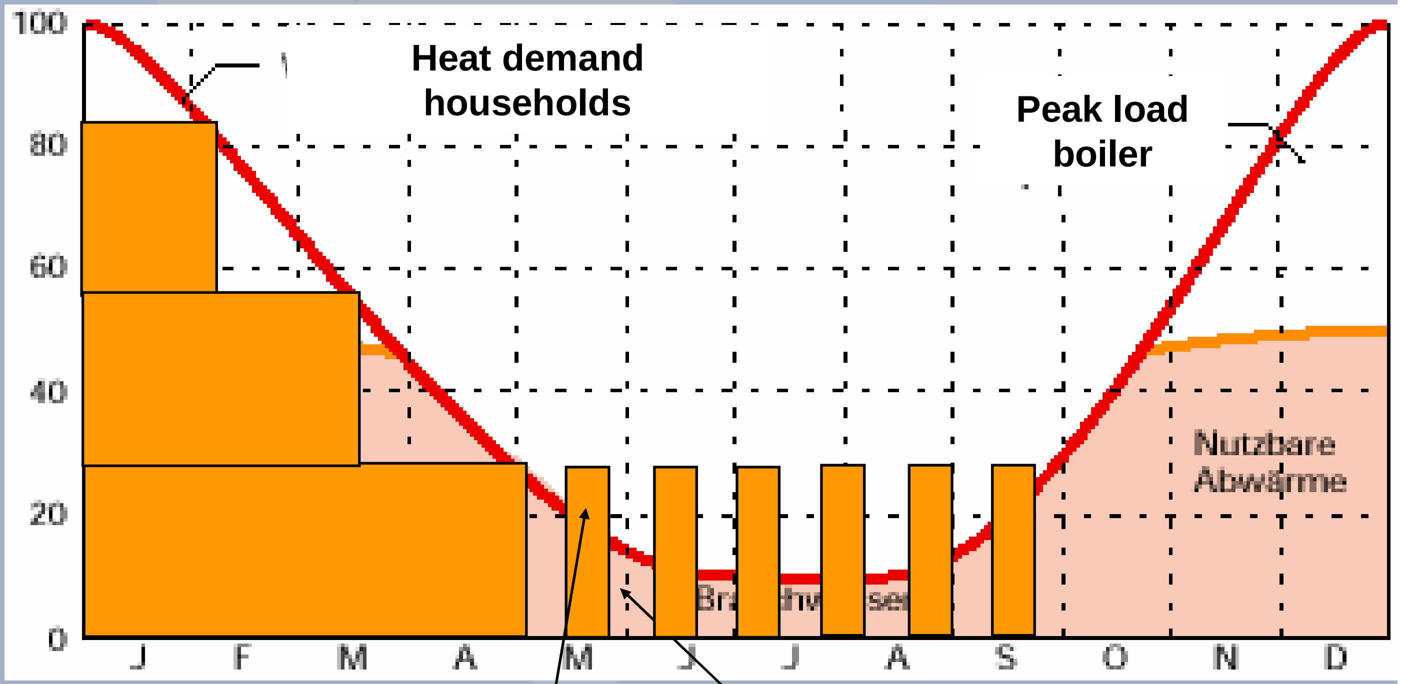
- Several modules:

- Higher coverage of heat demand
- Big heat storage



Present CHP plant design Danish Type

- Heat storage in summer:
- Electricity generation in the best paid hours
- Heat supply by heat accumulator

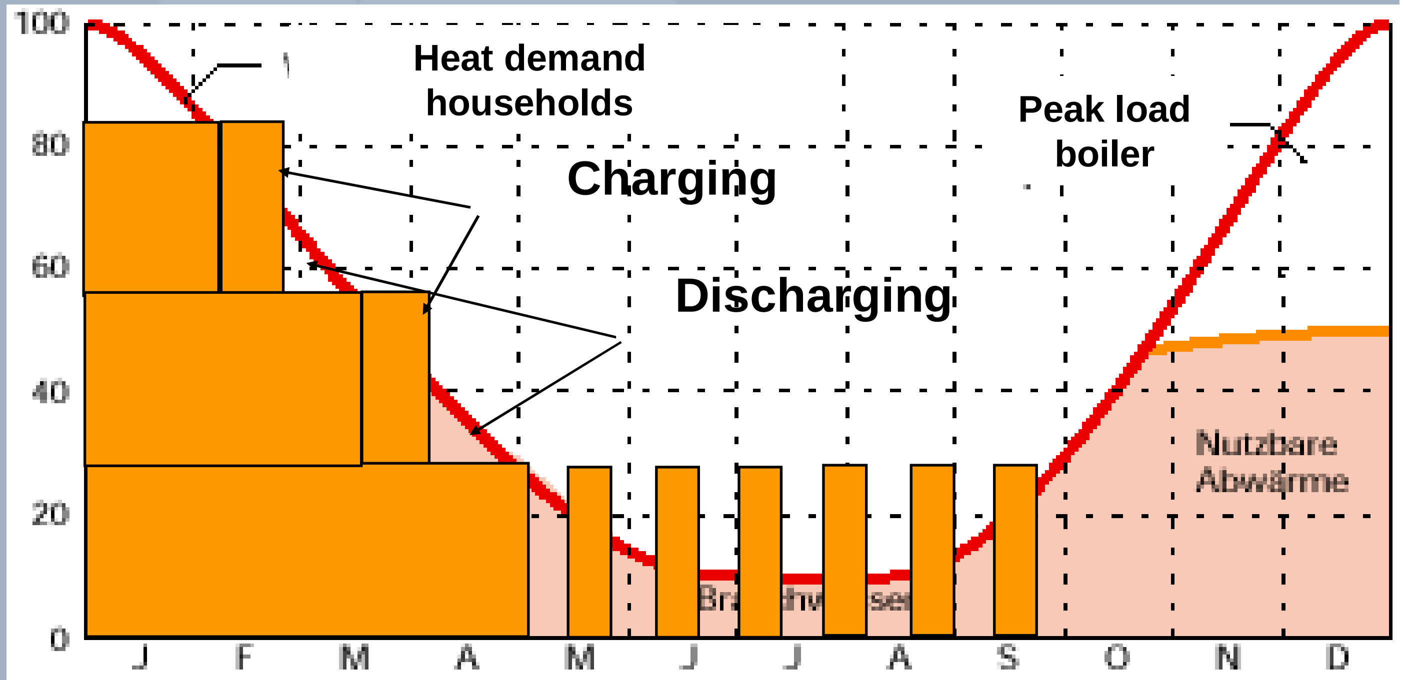


Charging the thermal battery

Discharging the thermal battery

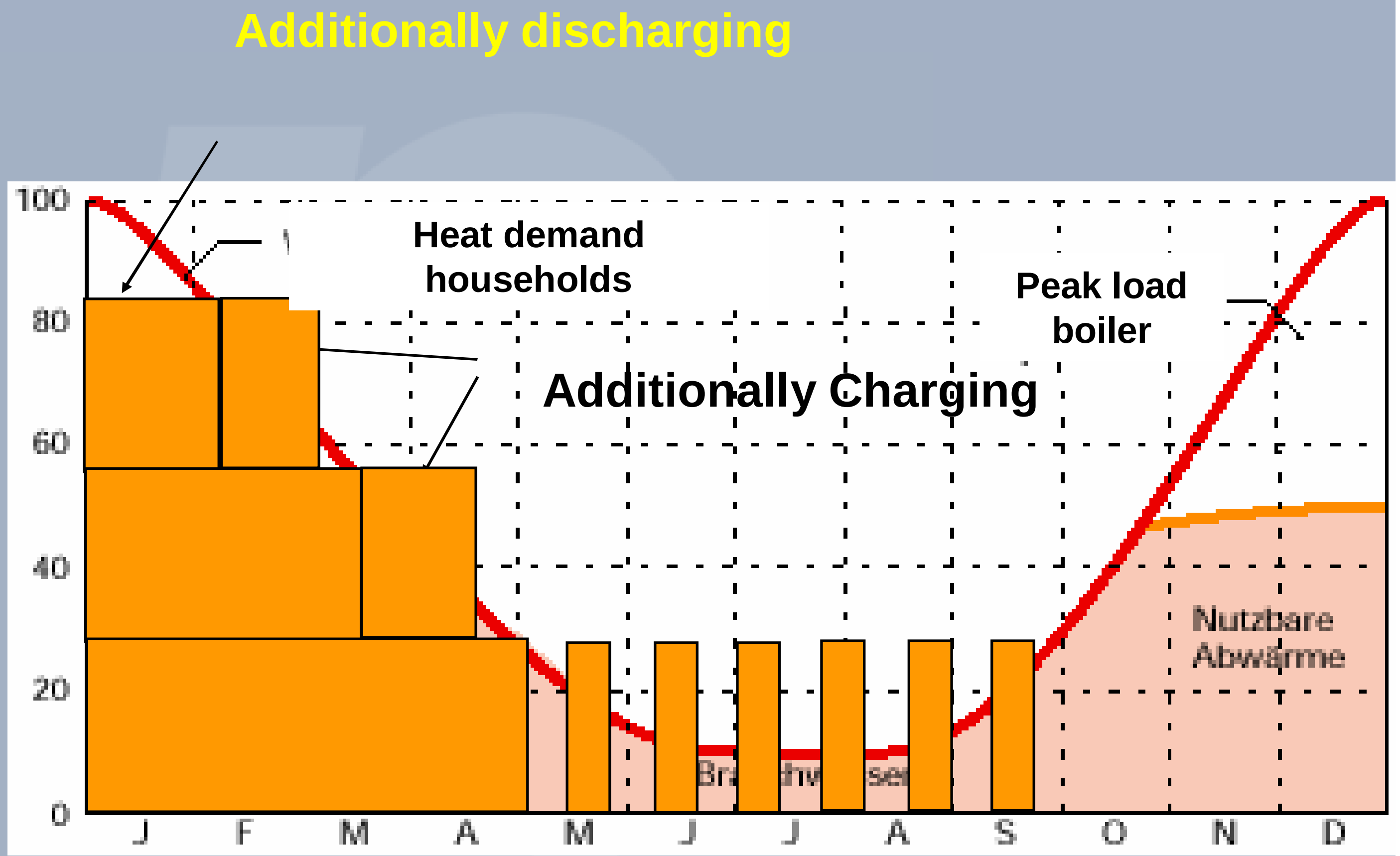
Present CHP plant design Danish Type

- Heat storage at **medium load**:
- Electricity generation in the best paid hours
- Heat supply by heat accumulator



Present CHP plant design Danish Type

- Loading for the
- cold times



- Electricity generation in the best paid hours
- Heat supply by heat accumulator

- Supply by heat accumulator instead of boiler
- More co generated heat

Present CHP plant designs District Heating, small consumers

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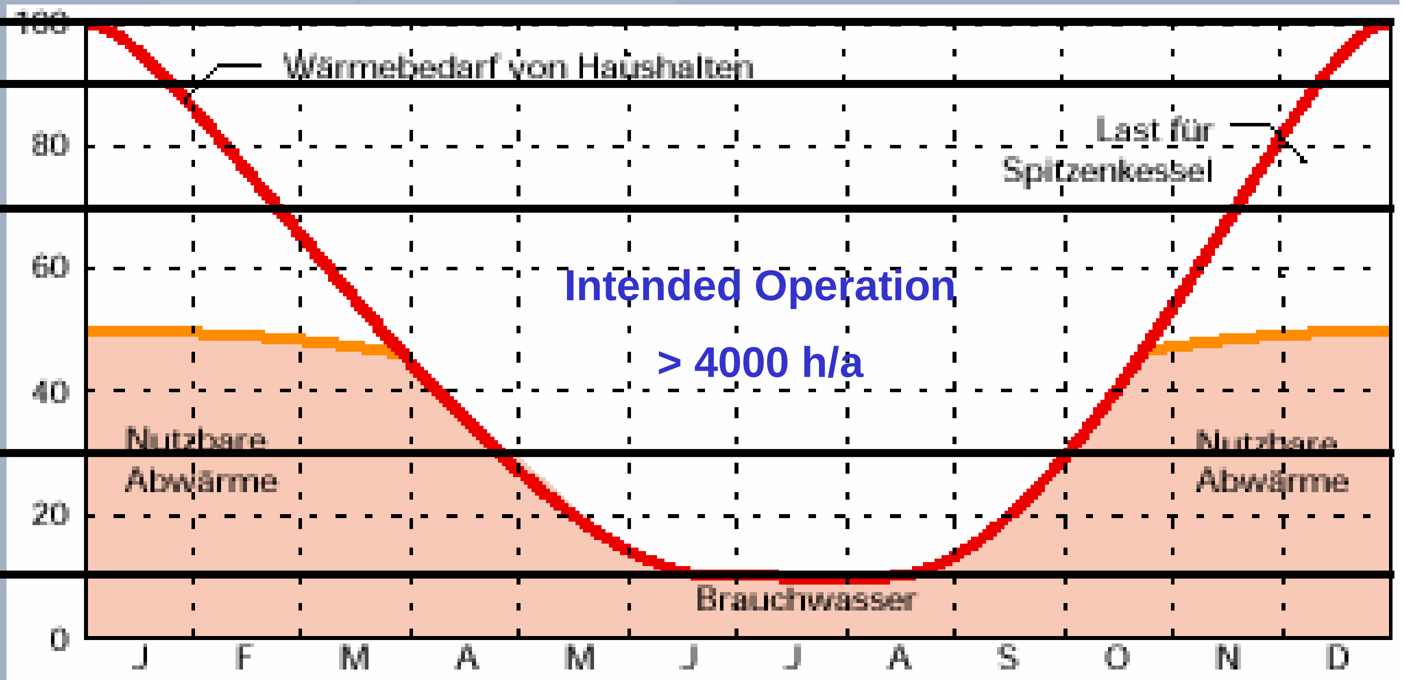
Common Present State in Denmark

Monovalent Design

Common Present State in Germany

„Ideal“ German CHP Plant design



Investitionskosten Gas-BHKW
Investment costs Gas motor CHP

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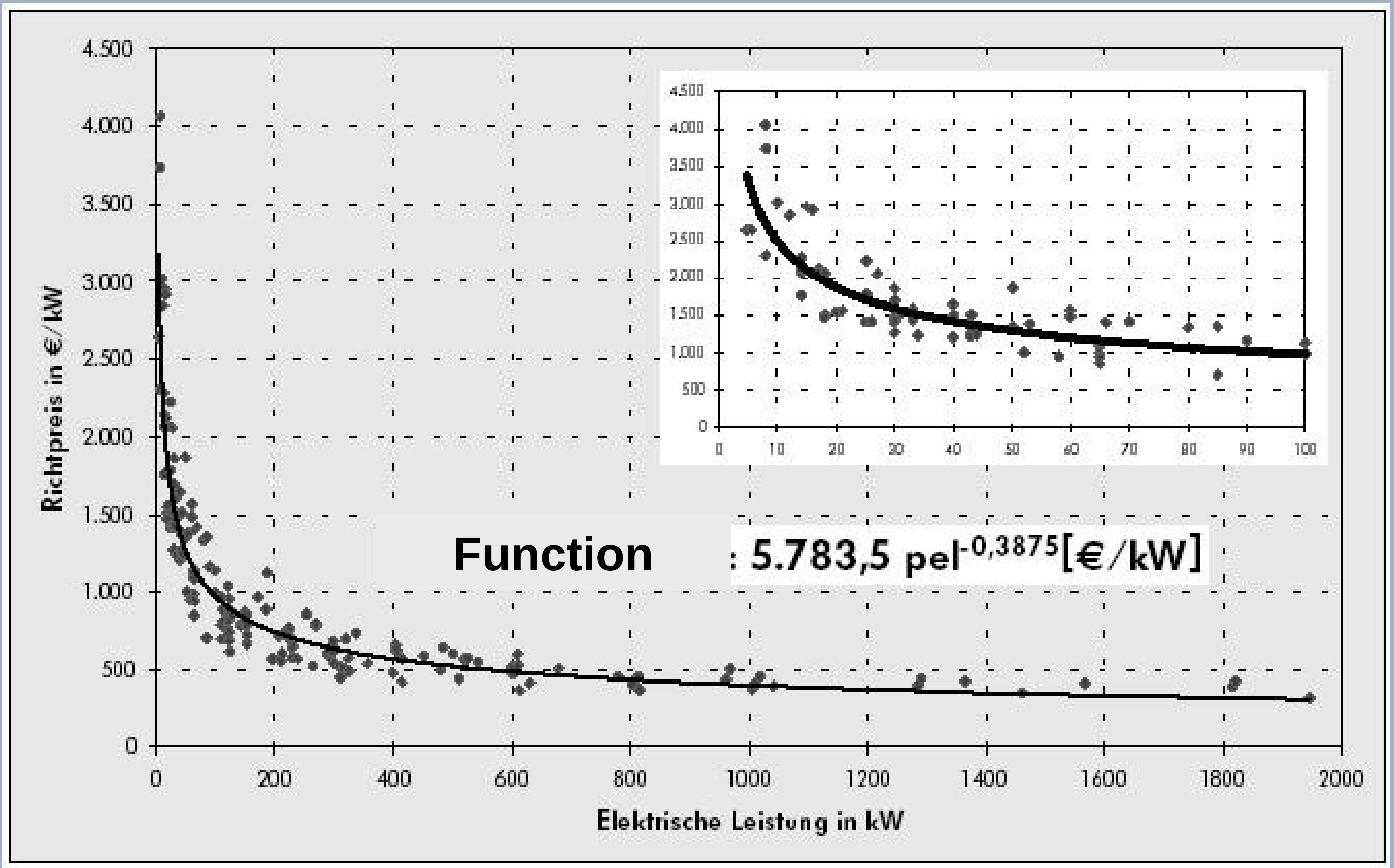
Price in €/kW



Capacity in kW

Source: ASUE-BHKW-Kenndaten

Wartungskosten Gas-BHKW
Maintenance costs for gas-motor CHP plants

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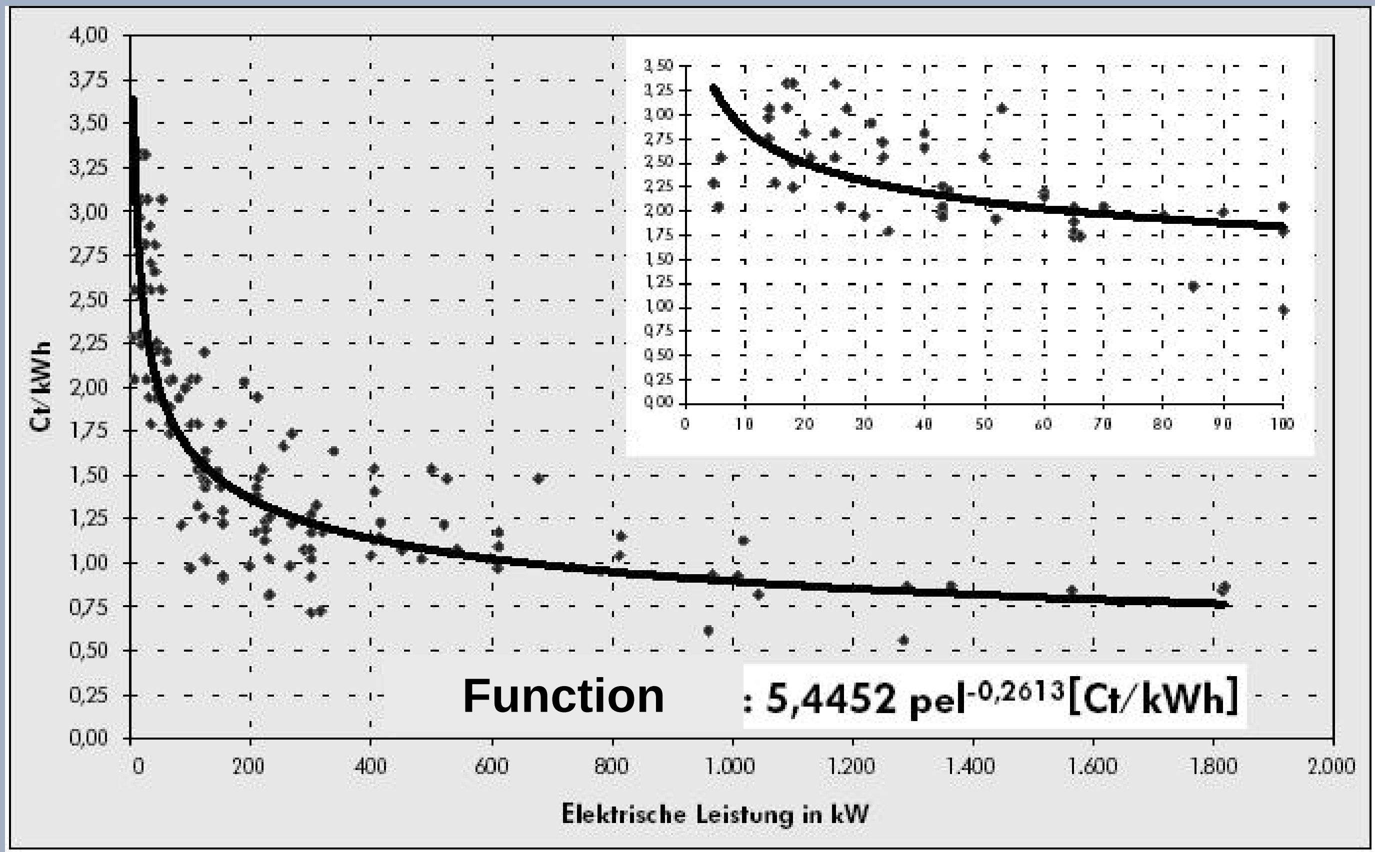
Price in €/kW



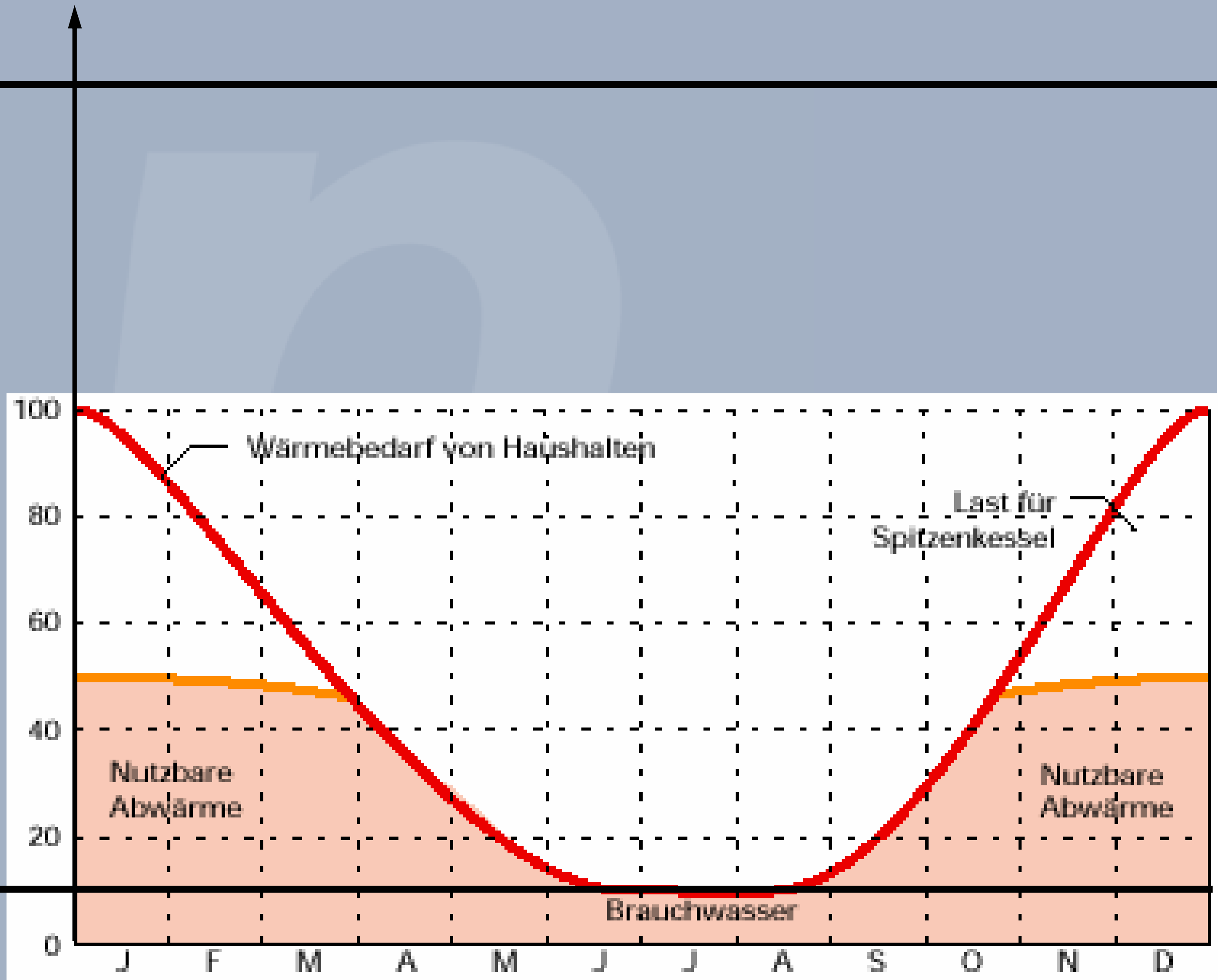
Capacity in kW

Source: ASUE-BHKW-Kenndaten

for CHP units and heat storages being able to equalize fluctuating renewable energies

Ideal CHP Plant for Balancing Purposes

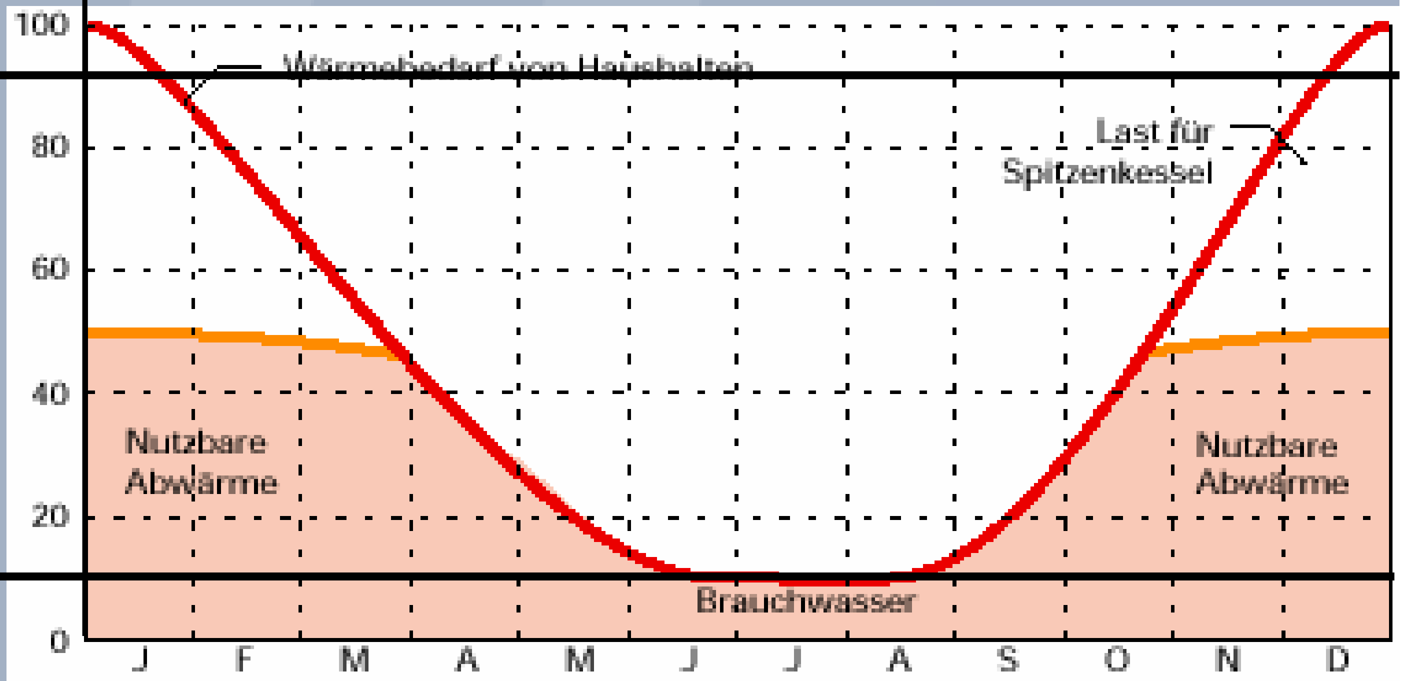
German CHP Plant



Ideal CHP Plant for Balancing Purposes

Best CHP Plant under Market Conditions?

Ideal German Size
One tariff
Scarce economy



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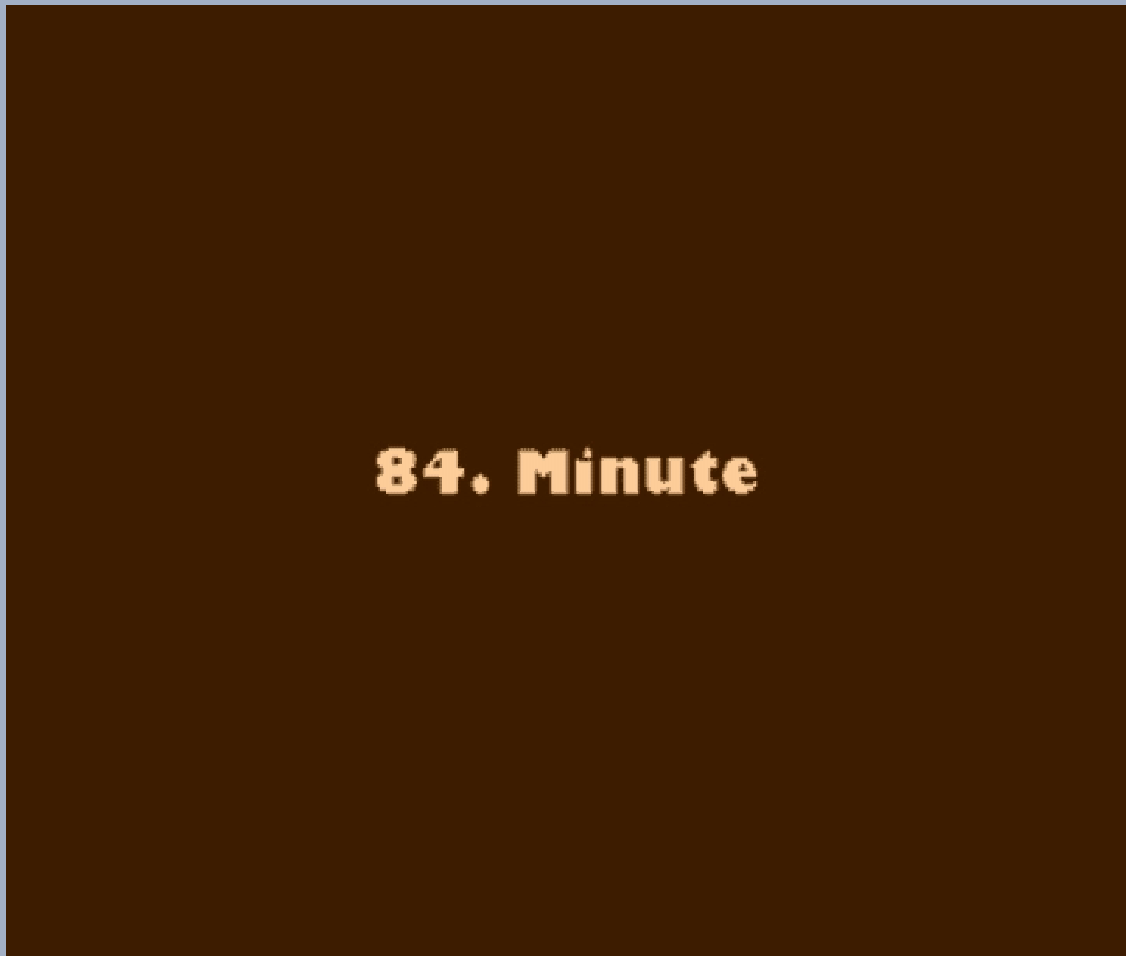
Demand Side Management as a solution for the energy balancing problem

Requirement for Electricity Storage



Sorry, but this is

Demand Side Management

Built Environment as Electricity Storage

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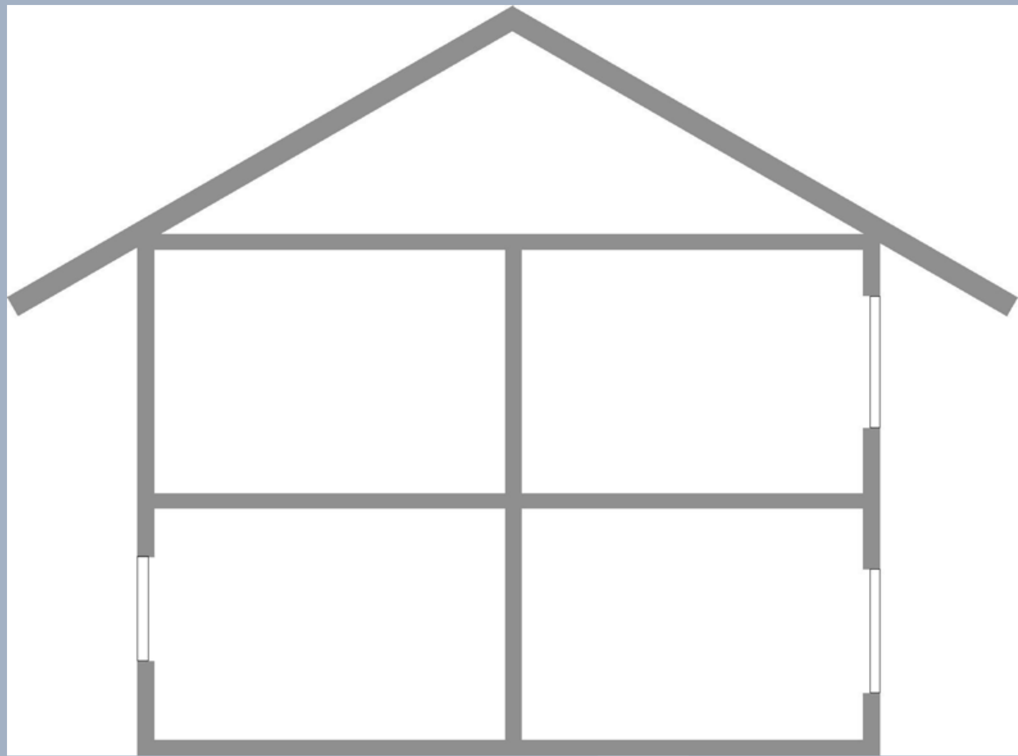
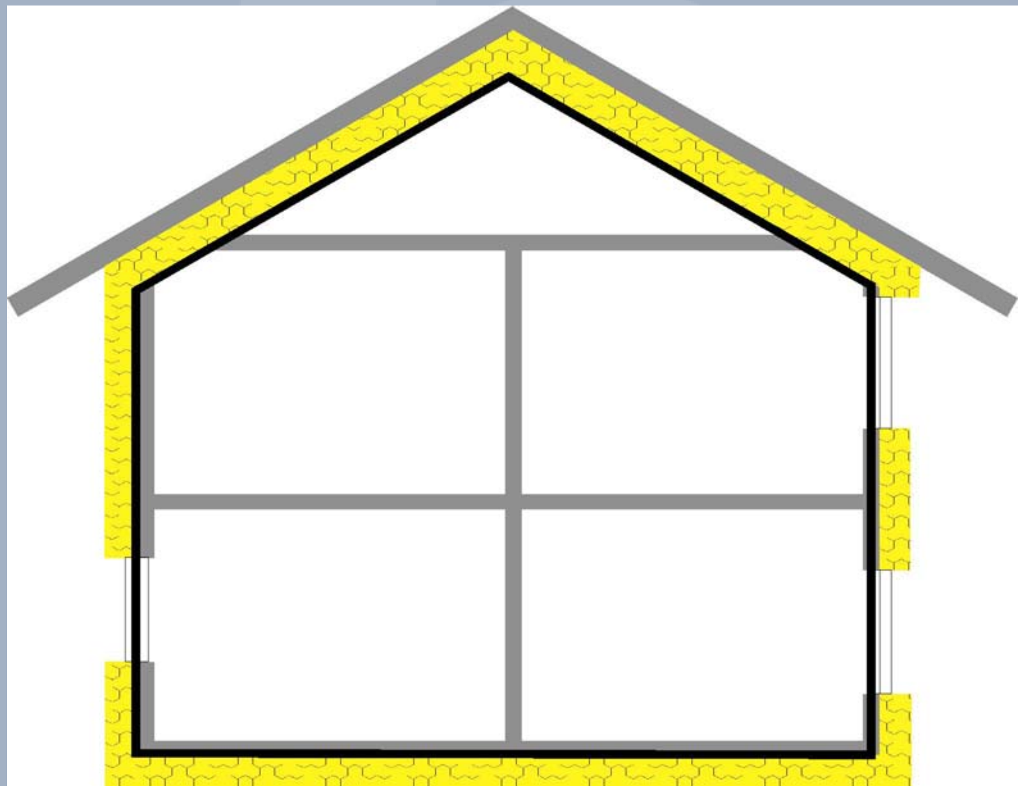
Built Environment as Electricity Storage

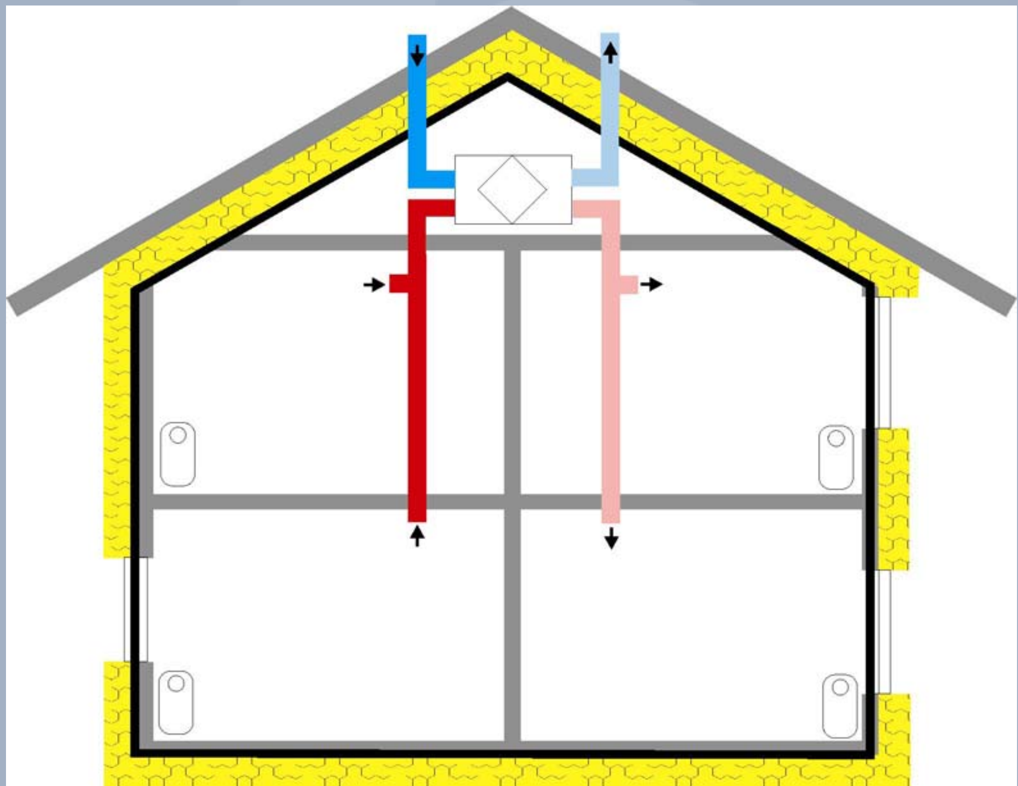
IEE-RE | UNIKASSEL VERSITÄT





Heat insulation
Air Tightness

IEE-RE UNIKASSEL VERSITÄT



… but electrical driven building facilities

For heating systems

(centralised in building with hot water generated by oil, gas, etc.)

circulation pump

transports heat

electric consumer

influence on distribution

by switching pumps off the "battery" is discharged

Built Environment as Electricity Storage, Heating

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… in larger buildings not negligible at all.

… this man is carrying a battery!

Circulation pumps in households

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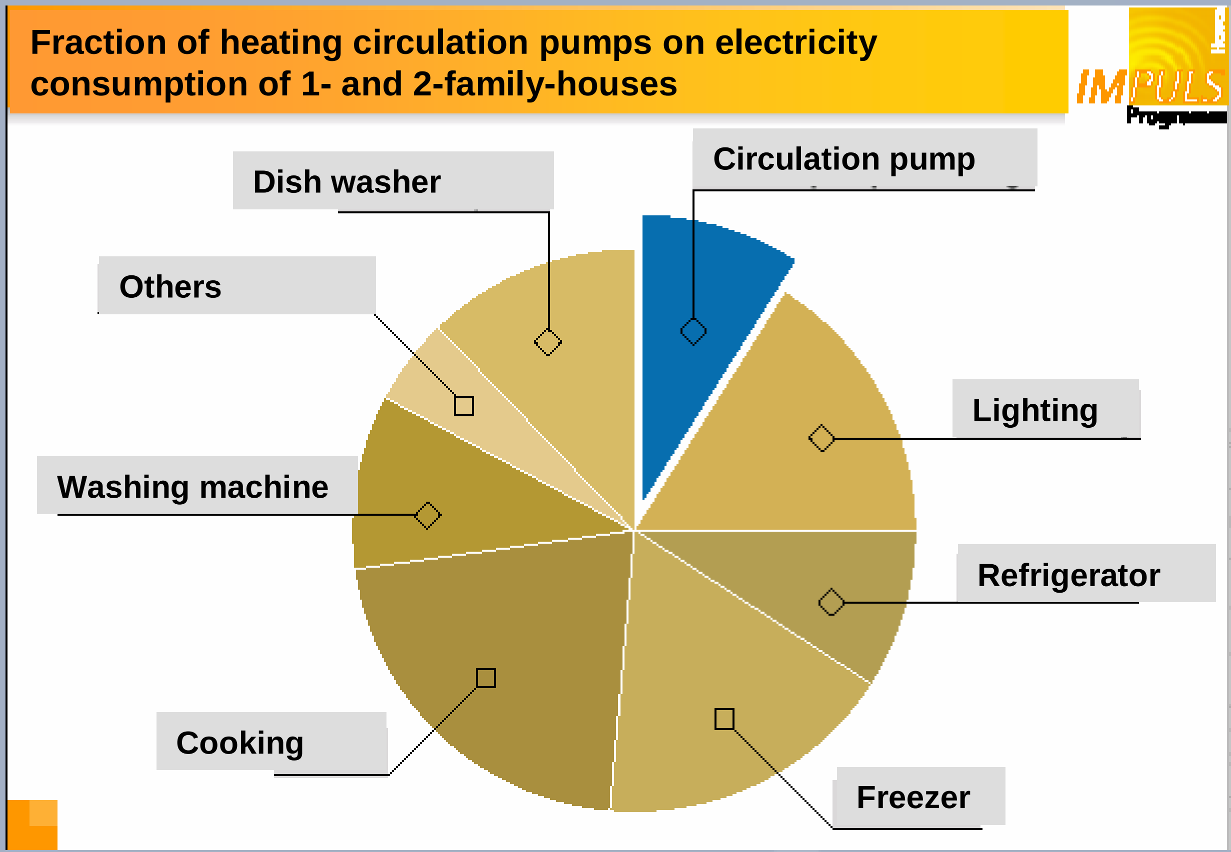
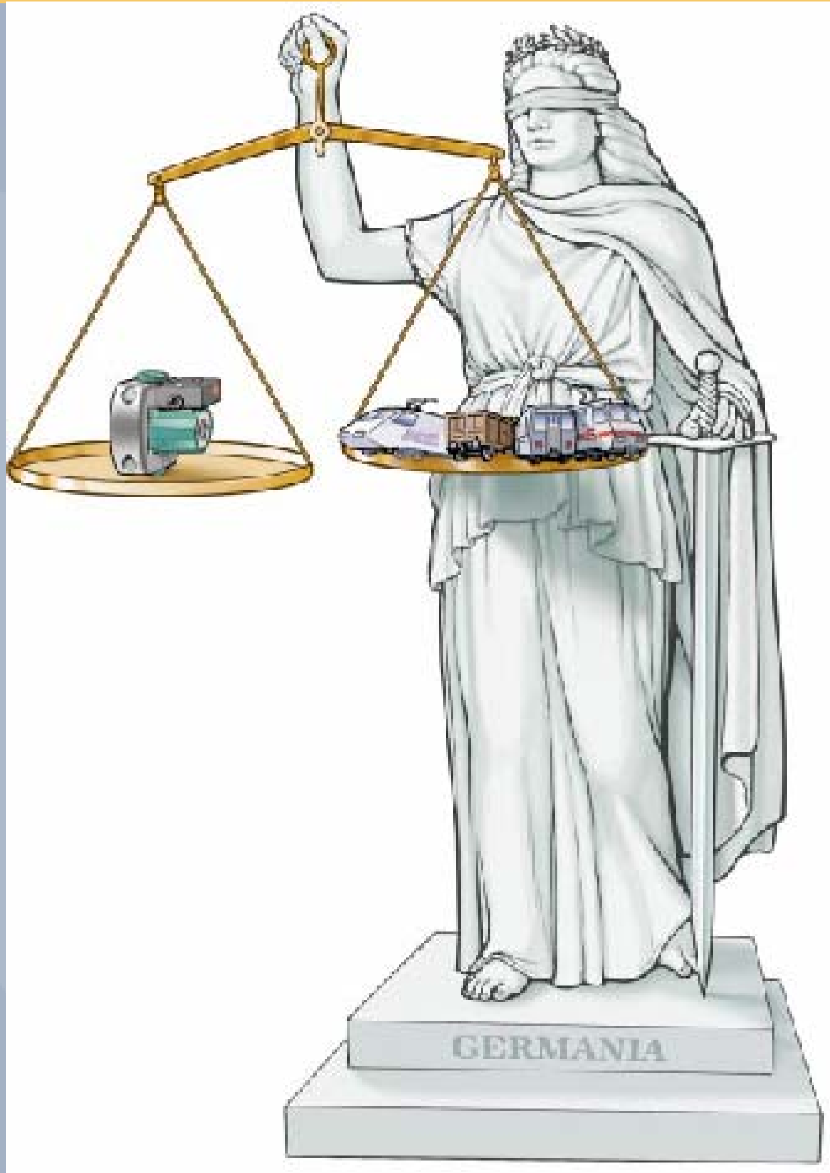


German Circulation pump demand:

3,5 % of electricity consumption

energy consumption: 15 billion kWh

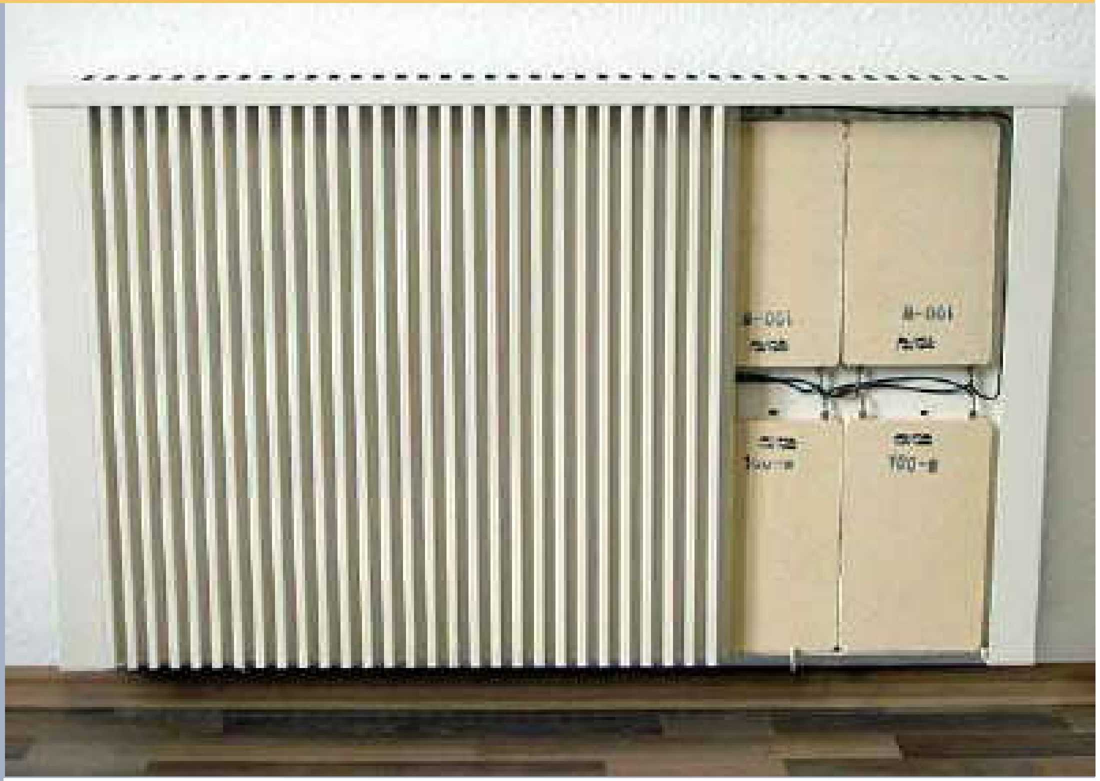
Corresponds to the amount of electricity for railway and tramway systems

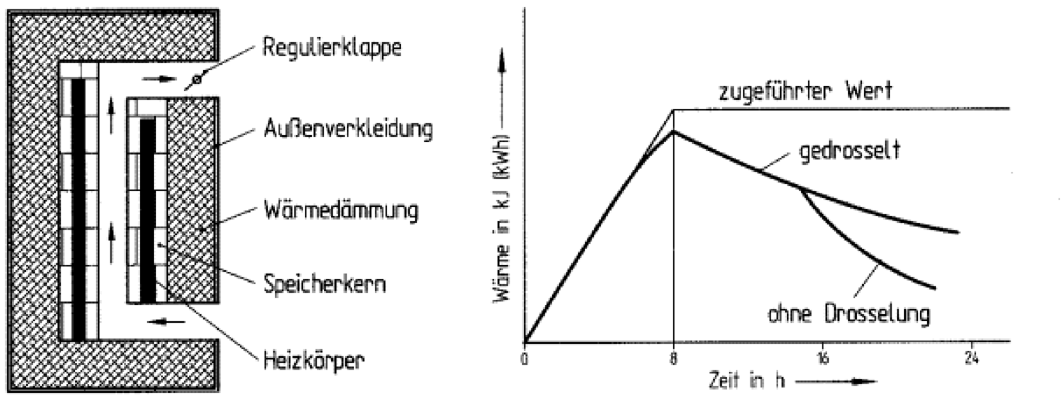


Source: Impuls Programm

Less common but much higher storage potential:

- direct use of electricity for heating
- night storage heating with fireclay bricks





Source: I. Stadler

Built Environment as Electricity Storage, Heating

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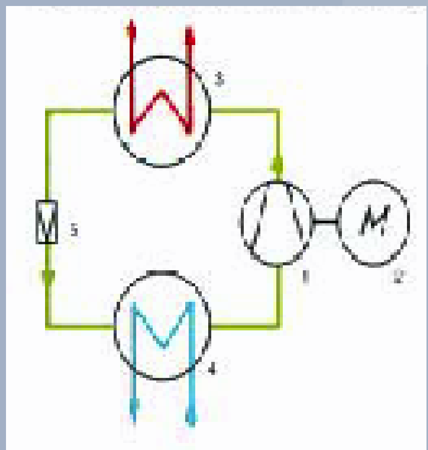
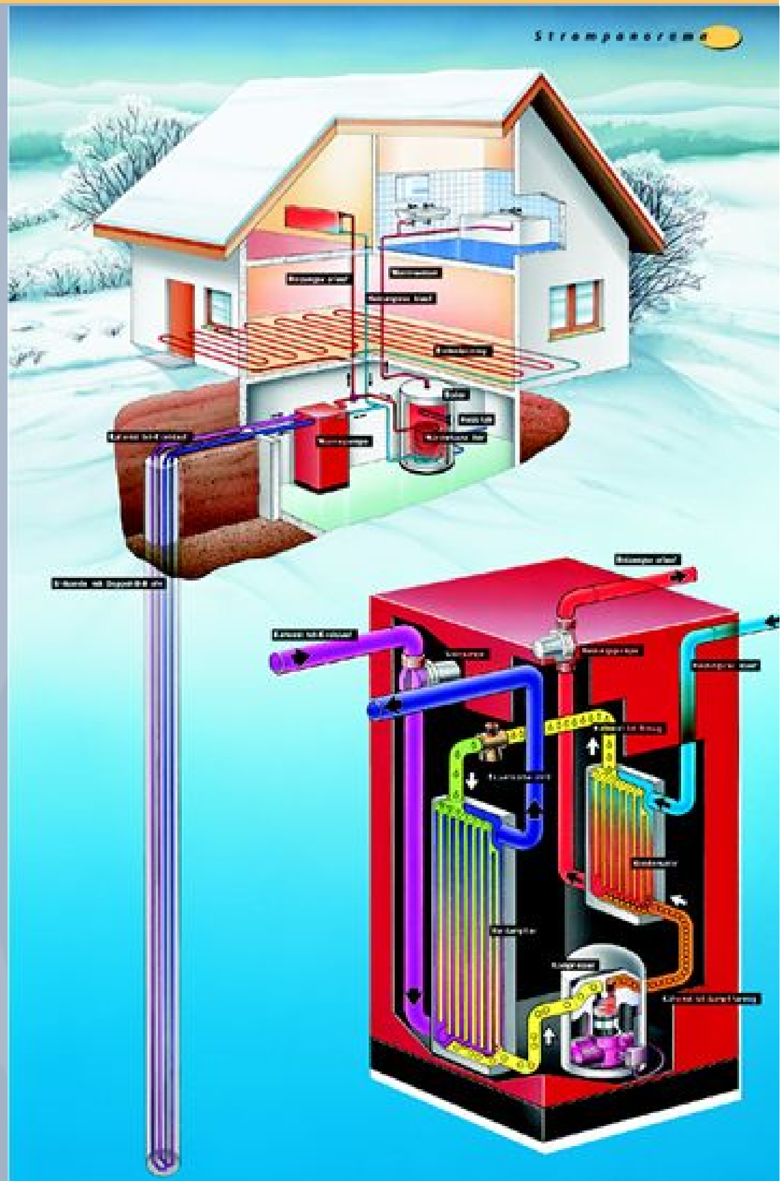
Less common but much higher storage potential:

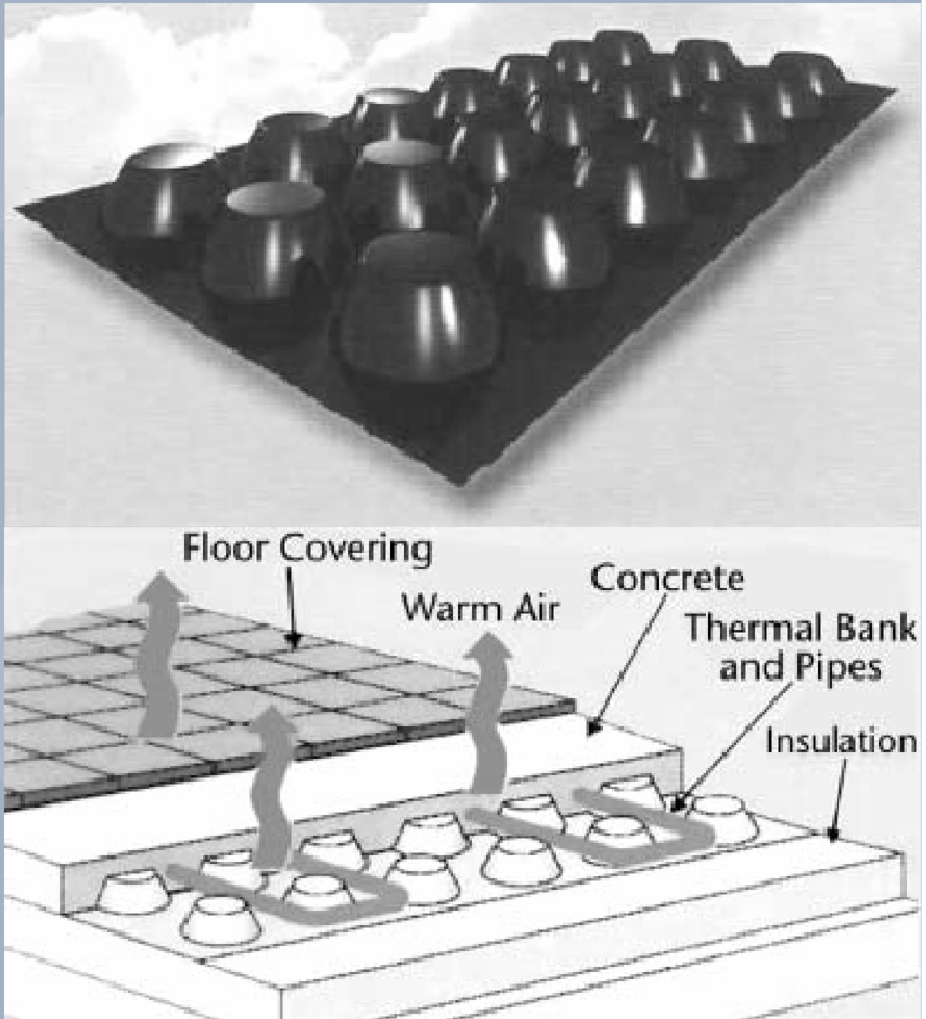
- direct electricity use for heating
- heat pumps use environmental heat and electricity for room heating
- ~ 1/3 of heat energy is electricity





Thermal Storage for Space Heating

- New heat insulation materials
- Phase Change Material (PCM)
- Melting temperatures: 20 - 30 °C
- Heat protection in summer
- Can also be used for space heating.
- E.g. floor heating 100m², 10cm width: ~560 kWh
- Shifting demand



Source: TEAP Energy

Built Environment as Electricity Storage, Cooling

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•electricity for cooling

• present in every household (>99 %)

• "Electricity" stored in

Refrigerators

Freezers

Electricity consumption in DE is approximately 28 Billion kWh

• switching off means "battery" discharge

Source: I. Stadler

Built Environment as Electricity Storage, Cold

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- Use of cold in supermarkets
  - cooling shelves
  - chest freezers

- Electricity consumption Germany: approximately 13 billion kWh

Source: Remis

- Ice storage
- Advantage:
- Large storage capacity at low temperature difference
- Energy storage capacity:
  phase change 334 kJ/kg + heat up 41 kJ/kg (10°-0°)

Source: BUCO

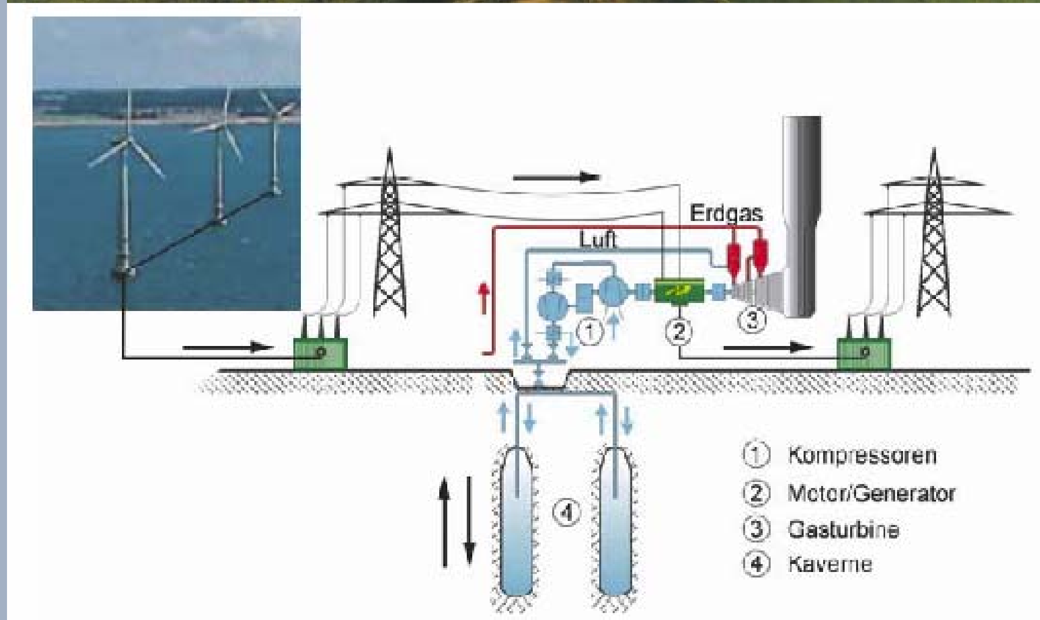
Built Environment as Electricity Storage, hot water

- hot water storage
- electrical demand side management

- electricity for heating:
- heat pumps
- “night” storage heating
- direct electric heating

- over dimensioning here becomes an advantage

- Compressed Air Energy Storage (CAES) power stations
- Alternative to Pumped Storage Power Stations
- Not a new topic, Huntorf late 70s 290 MW, 2 h
- Unnecessary conversion losses: electricity – mechanical energy – compressed air – mechanical energy - electricity



Source: I. Stadler

Compressed Air Storage in Industry

- More efficient:
- store energy as compressed air in industry
- Add air storage
- Compress during renewable peaks
  Discharge storage or direct use

- Electricity consumption in Germany: approximately 21 billion kWh

Source: I. Stadler

- Thank you
- for your attention

Dissemination strategy on Electricity balancing
DESIRE
large Scale Integration of Renewable Energy

Reporting on dissemination activities carried out within the frame of the DESIRE project (WP8)

Name, Affiliation	Heiki Tammoja, Olaf Terno, Tallinn University of Technology John Sievers, Kassel University
E-mail	heiki.tammoja@ttu.ee, olaf.terno@ttu.ee; sievers@re.e-technik.uni-kassel-de
Title of dissemination	"EU-Project DESIRE – The assisting role of co-generation for a power supply with renewable energies#", a presentation given by John Sievers from Kassel University
Type of activity	Presentation at seminar
Title of forum	Seminar on the DESIRE-project related problems of wind turbines, CHP plants and energy stores, organised by the Department of Electrical Power Engineering, Tallinn University of Technology for department staff, with participation of experts from Estonian Power System, Ministry of Economic Affairs and Communication, and Energy Market Inspectorate.
Language	English
Date of dissemination	18. September 2006
Place of dissemination	Department of Electrical Power Engineering, Tallinn, University of Technology, Tallinn, Estonia
Brief abstract / description of dissemination activity	To avoid excess wind power and balance wind power fluctuations using cogeneration plants with thermal storages was the main aim of the presentation. Different energy storing means and demand side management were considered, replacement of centralised and de-centralised only heat boilers in industry and district heating plants with CHP also.
Audience impact assessment	Officials of the Energy Department of the Ministry of Economic Affairs and Communication were interested in the economic efficiency of balancing wind turbines with CHP plants. There could be seen some interest in this topic by other participants as well
Dissemination	Included after this form

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EU-Project DESIRE
The assisting role of cogeneration for a power supply with renewable energies

John Sievers
University of Kassel

SIXTH FRAMEWORK PROGRAMME
PRIORITY 6.1.3.1.1.2

Large-scale integration of renewable energy sources into electricity supplies

- Project acronym: DESIRE
- Project full title: **Dissemination strategy on Electricity balancing for large Scale Integration of Renewable Energy**

Partners

IEE-RE | UNIKASSEL VERSITÄT

(1) Aalborg University (AAU) = *Co-ordinator*
(2) Energi- og Miljødata (EMD)
(3) PlanEnergi S/I (PE)
(4) University of Birmingham (UoB)
(5) Institut fuer Solare Energieversorgungstechnik (ISET)
(6) Universitaet Kassel (UniK)
(7) EMD Deutschland, Chun und a. GBR (EMD-DE)
(8) LABEiN Technological Centre in Bilbao (LABEiN)
(9) Warzaw University of Technology (WUT)
(10) Tallinn University of Technology (TUT)

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Work

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- Combination of wind power and combined heat and power generation
- Increase wind power contribution (2010: 22% renewable, Directive 2001/77/EC)
- Avoid excess wind power
- Balance wind power fluctuations
- Cogeneration using heat stores
- Software development, demonstration projects and knowledge transfer

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Wind Energy

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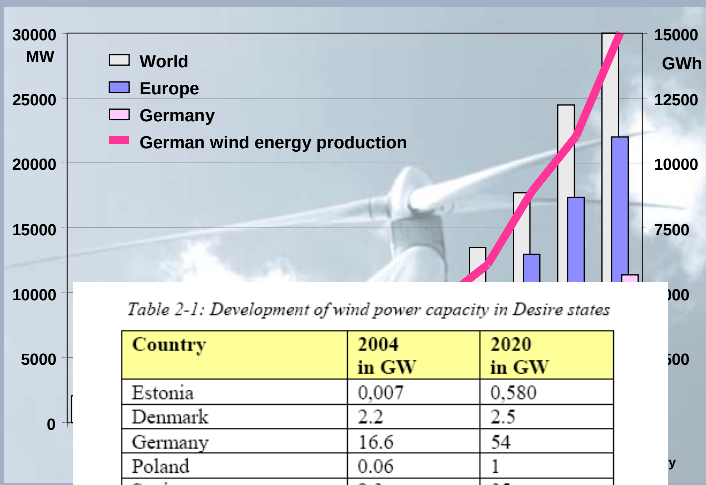

Table 2-1: Development of wind power capacity in Desire states

Country	2004 in GW	2020 in GW
Estonia	0,007	0,580
Denmark	2.2	2.5
Germany	16.6	54
Poland	0.06	1
Spain	8.3	35
UK (Scotland)	0.2	3

Data Source: Desire

Photovoltaic Scenario for Germany

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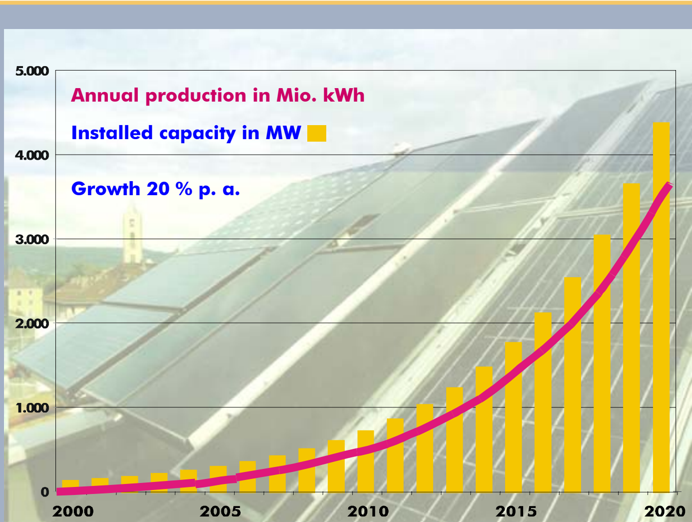

Character of fluctuating renewable energies

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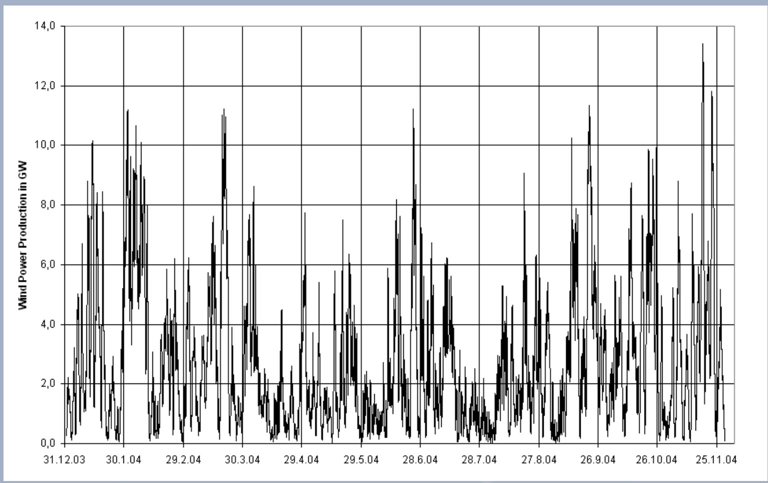

Data Source: ISET

Character of fluctuating renewable energies

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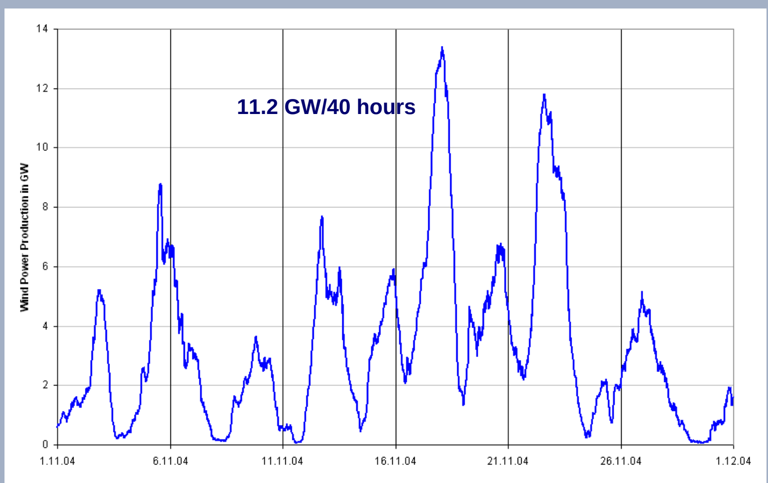

Data Source: ISET

Electricity Consumption (Denmark)

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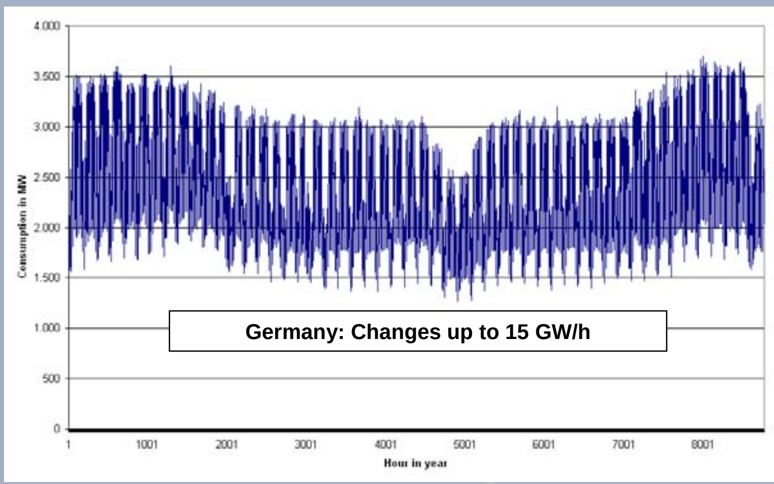

Data Source: ELTRA

Daily Electricity Demand of Households

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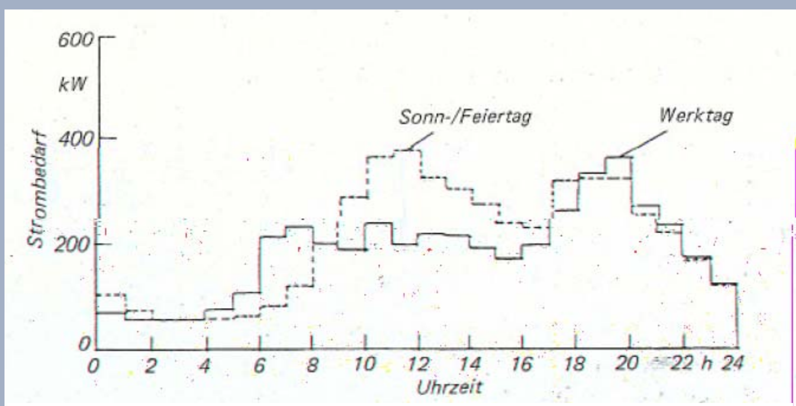

Demand curves for different days in winter for a block of flats

Data Source: VDI 3985

Consumption and wind (Germany)

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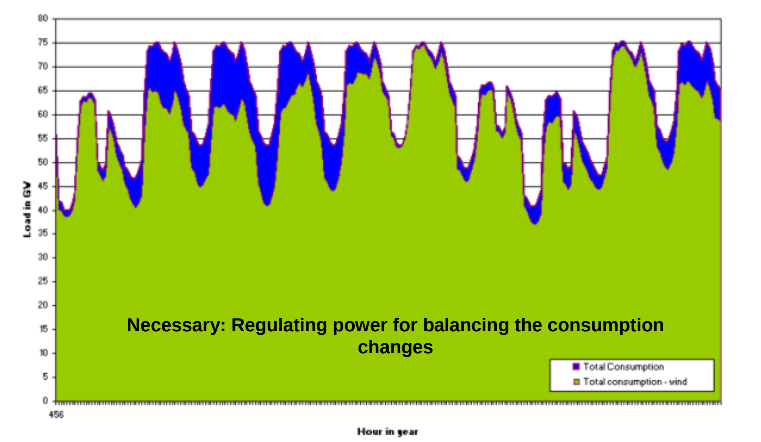

Figure 2-7: Electricity consumption versus consumption subtracted by wind power production (Germany)

Data Source: ISET

At which level shall wind energy be balanced?

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- Consumption
- Wind energy
- Consumption - Wind energy

How is balancing done?

Electricity Balancing

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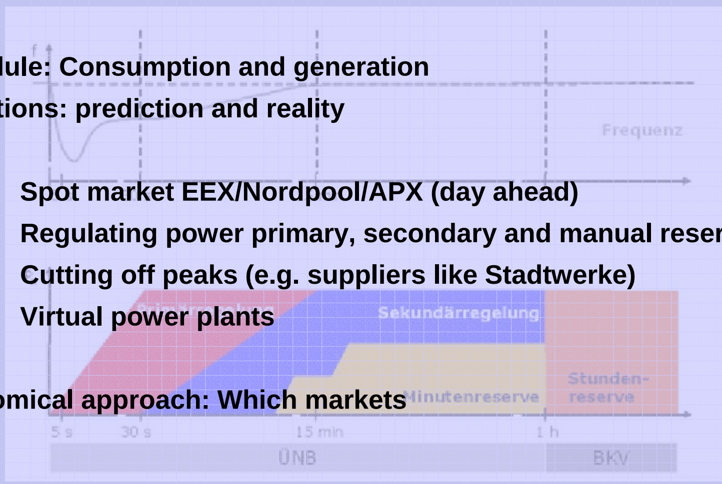
Power regulation: power always in balance



Schedule: Consumption and generation
Deviations: prediction and reality

- Spot market EEX/Nordpool/APX (day ahead)
- Regulating power primary, secondary and manual reserve
- Cutting off peaks (e.g. suppliers like Stadtwerke)
- Virtual power plants

Economical approach: Which markets

Data Source: Bund der Energieverbraucher

At which level shall wind energy be balanced?

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- Consumption
- Wind energy
- Consumption - Wind energy

Technical approach:

- single wind turbine or farm
- a region
- country ….

Wind power availability changes and balancing level

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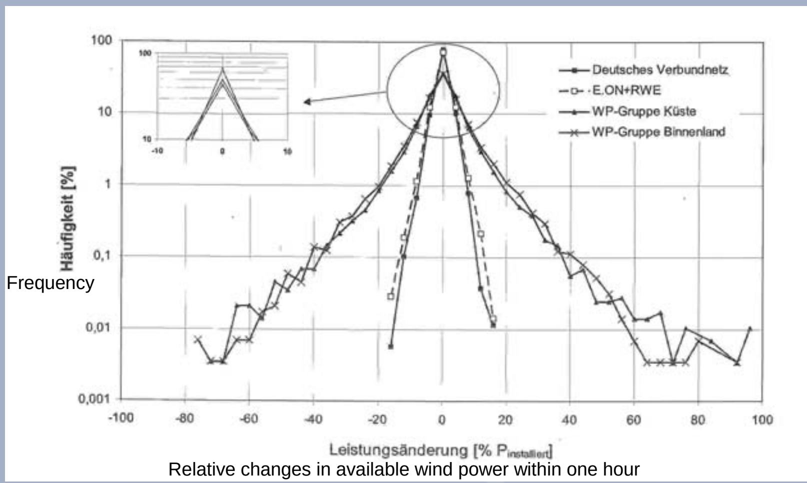

From the technical point of view balancing should comprise a large area:
The best would be balancing at UCTE or larger level

Data Source: ISET

Solutions for balancing fluctuating wind energy:

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- **Larger grid area** including Northern Africa and Eastern Europe **efficient high voltage transmission grid**
  (important losses in the distribution, i.e. regional grids)
  (G. Czisch Dissertation at University of Kassel)
- **Wind prognosis** better integration into schedule for power generation
- (ISET Institute at University of Kassel)
- **Hydro power** with reservoirs and pump storages (fast regulating power)
- **Demand Side Management**: Electric consumers (machines) that work according to the offer of power
- (I. Stadler Habilitation at University of Kassel)
- **CHP plants** generate when demanded

Possibilities in buildings

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Demand Side Management as a solution for the energy balancing problem

Basis and Data Source: Presentation of I. Stadler University of Kassel

Habilitation: Demand Response

Requirement for Electricity Storage

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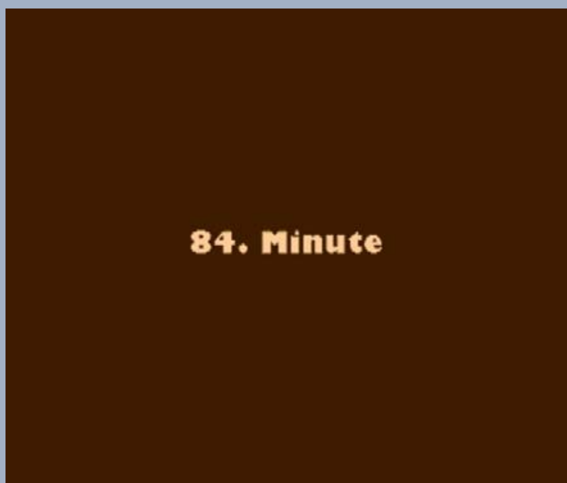


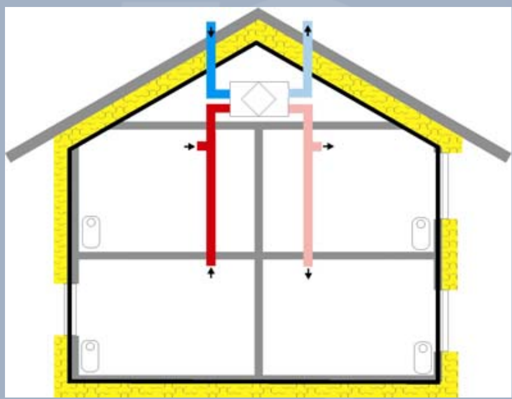
Basis and Data Source: I. Stadler

Sorry, but this is

Demand Side Management

Built Environment as Electricity Storage

Built Environment as Electricity Storage



... but electrical driven building facilities

Basis and Data Source: I. Stadler

Built Environment as Electricity Storage, Heating

Common in Germany:

For heating systems
(hot water generated by oil, gas, etc.)

circulation pump transports heat
electric consumer

switching pumps off
discharges the "battery"

Basis and Data Source: I. Stadler

Built Environment as Electricity Storage, Heating

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... in larger buildings not negligible at all.

Basis and Data Source: I. Stadler

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Built Environment as Electricity Storage, Heating

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... this man is carrying a battery!

Basis and Data Source: I. Stadler

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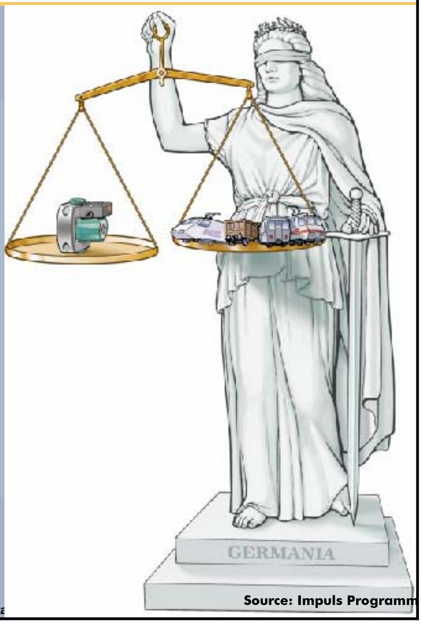
German Circulation pump demand:

3,5 % of electricity consumption

energy consumption: 15 billion kWh

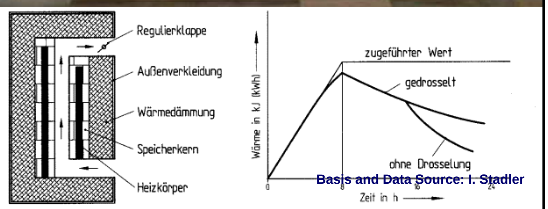
Corresponds to the amount of electricity for railway and tramway systems



Source: Impuls Programm

Less common but much higher storage potential:

- **direct use of electricity for heating**
- **night storage heating with fireclay bricks**



Basis and Data Source: I. Stadler

Built Environment as Electricity Storage, Heating

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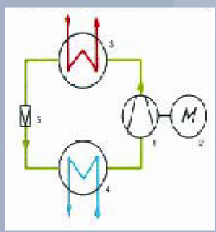
- ~ 1/3 of heat energy is electricity



Basis and Data Source: I. Stadler

Thermal Storage for Space Heating

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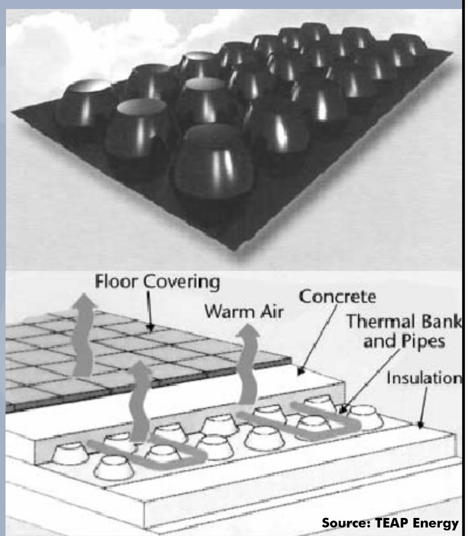
- New heat insulation materials
- Phase Change Material (PCM)
- Melting temperatures: 20 - 30 °C
- Heat protection in summer
- Can also be used for space heating.
- E.g. floor heating 100m², 10cm width: ~560 kWh
- Shifting demand



Basis and Data Source: I. Stadler

Built Environment as Electricity Storage, Cooling

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- electricity for cooling
- present in every household (>99 %)
- "Electricity" stored in
  - Refrigerators
  - Freezers

Electricity consumption in DE is approximately 28 Billion kWh

- switching off means "battery" discharge

Basis and Data Source: I. Stadler

Built Environment as Electricity Storage, Cold

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- Use of cold in supermarkets
- cooling shelves
- chest freezers
- Electricity consumption Germany: approximately 13 billion kWh

Basis and Data Source: I. Stadler

Thermal Storage in Industry, Ice Storage

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- Ice storage
- Advantage:
- Large storage capacity at low temperature difference
- Energy storage capacity:
  phase change 334 kJ/kg + heat up 41 kJ/kg (10°-0°)

Built Environment as Electricity Storage, hot water

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- electrical demand side management

electricity for heating in combination with:

- heat pumps
- "night" storage heating
- direct electric heating

- over dimensioning here becomes an advantage

Compressed Air Storage in Industry

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- store energy as compressed air in industry
- Add air storage
- Compress during renewable peaks
  Discharge storage or direct use

- Electricity consumption in Germany: approximately 21 billion kWh

Basis and Data Source: I. Stadler

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Circulation pumps in households

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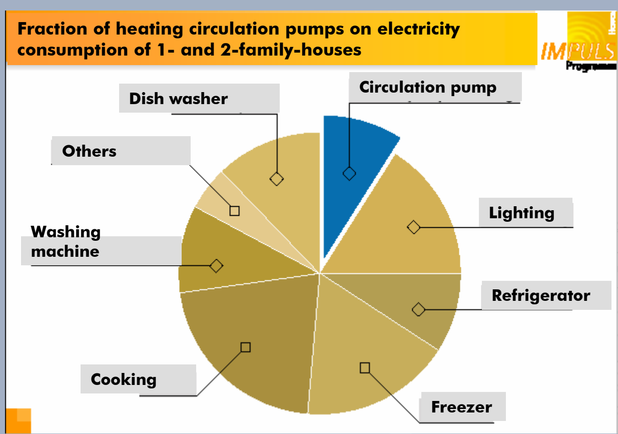

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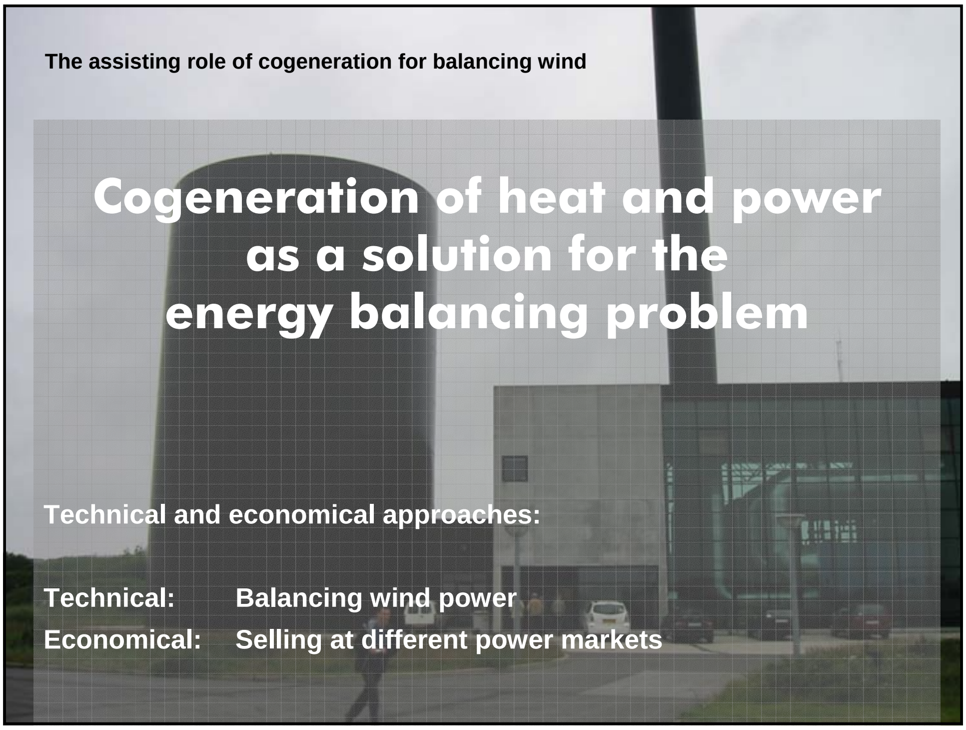
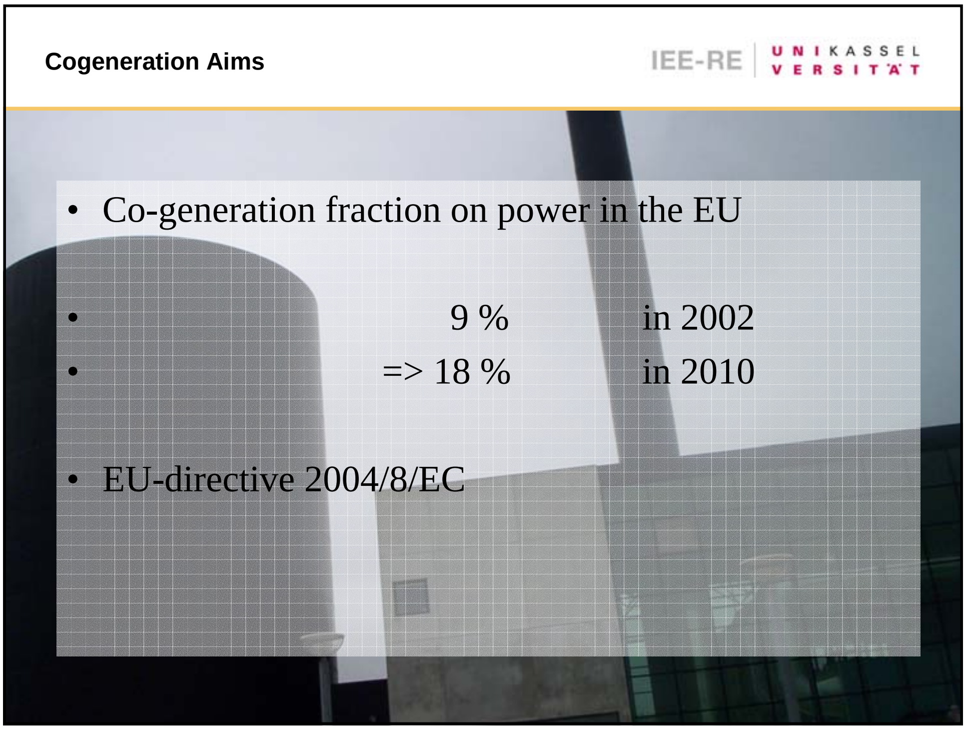
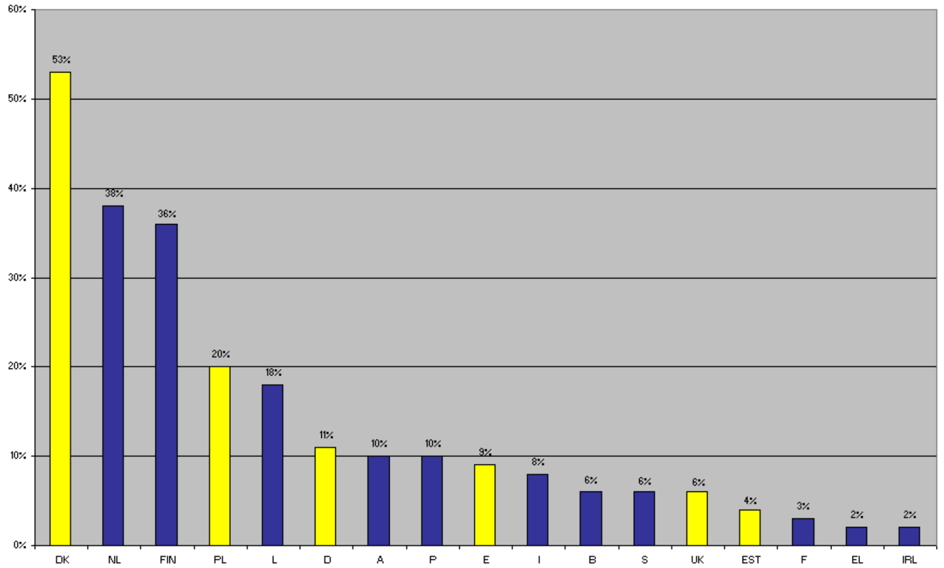

The assisting role of cogeneration for balancing wind
Cogeneration of heat and power as a solution for the energy balancing problem
Technical and economical approaches:
Technical: Balancing wind power
Economical: Selling at different power markets


Cogeneration Aims
IEE-RE
UNIKASSEL VERSITÄT
• Co-generation fraction on power in the EU
• 9 % in 2002
• => 18 % in 2010
• EU-directive 2004/8/EC

Contribution of cogeneration in EU-states



Components of a motor-CHP unit

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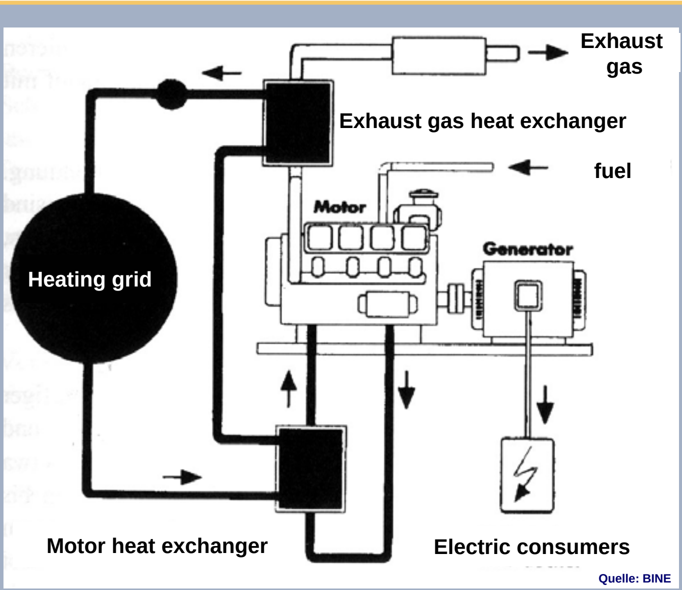

Reasons for cogeneration

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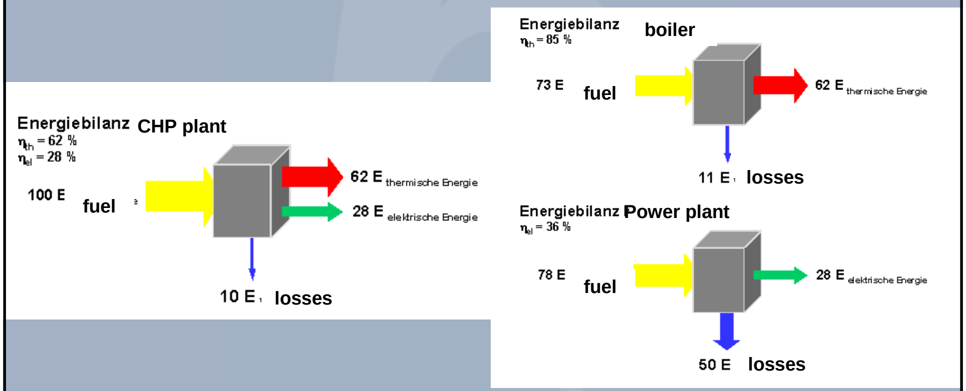

Efficient energy conversion

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- Only heat generation dissipates exergy (work)
- Only electricity generation dissipates anergy (heat)
- Advantages of co-generation in contrast to separated only heat or only electricity generation are
  - Reduced fuel consumption, less primary energy and cumulated energy demand
  - Reduction of emissions in particular CO2 as a main causer for global warming
- Extension of co-generation will lead to replacements of:
  - decentralised and centralised only heat generating boilers in industry, at small consumers and at energy supplier's district heating plants
  - energy suppliers centralised only electricity generating power plants.

Boundary Conditions of CHP

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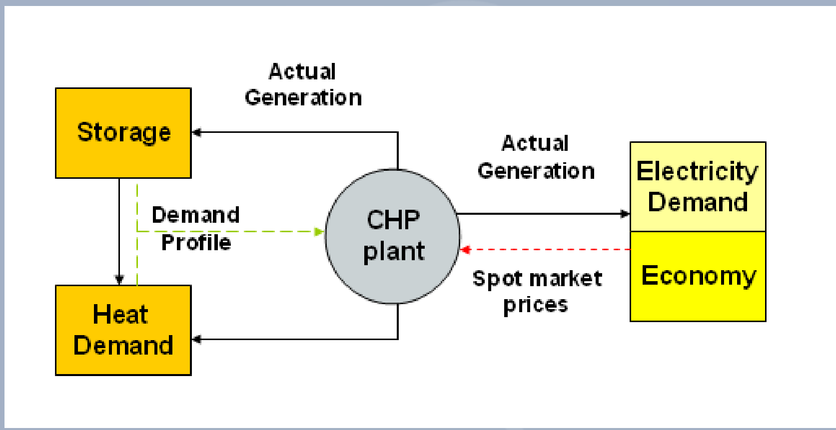

Base load co-production of wind and CHP

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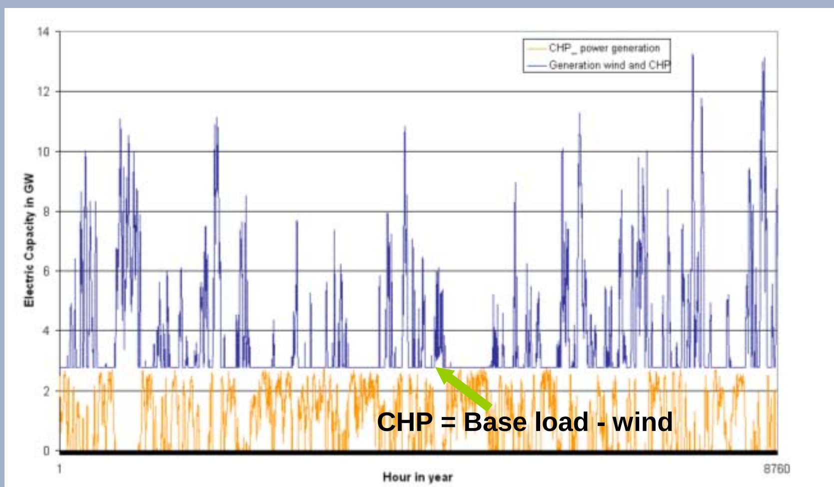

Wind and CHP together achieve a base load (Germany). CHP fill the gaps up to a base load.

Base Load Variation

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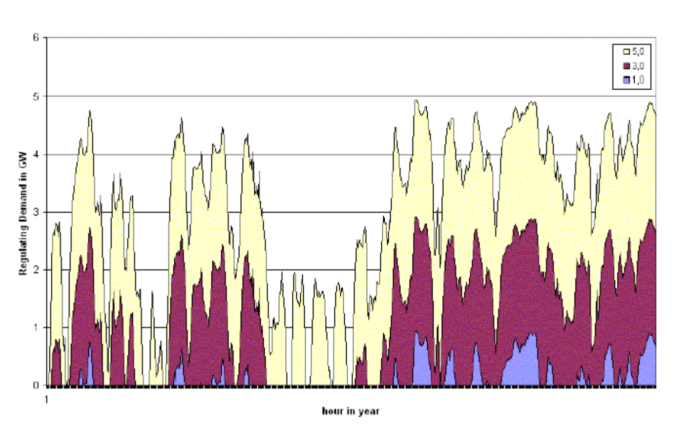

Figure 4-5: Power demand for balancing wind gaps for different defined base load capacities

Example wind, CHP and heat

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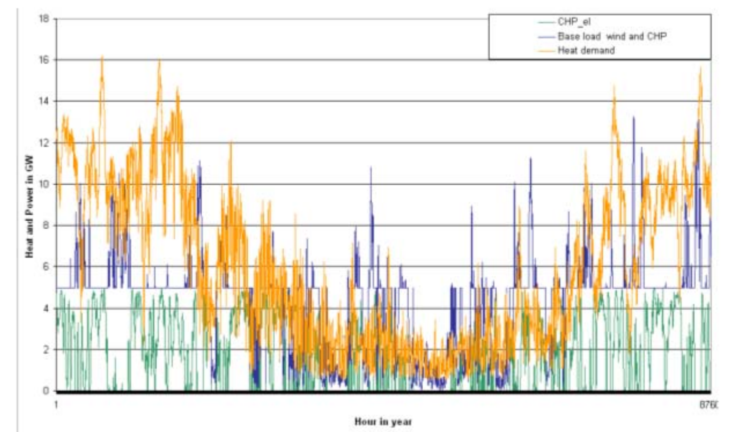

Figure 4-7 Result of a variation with a heat demand factor 1.6 for old 1 family houses

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Small storage

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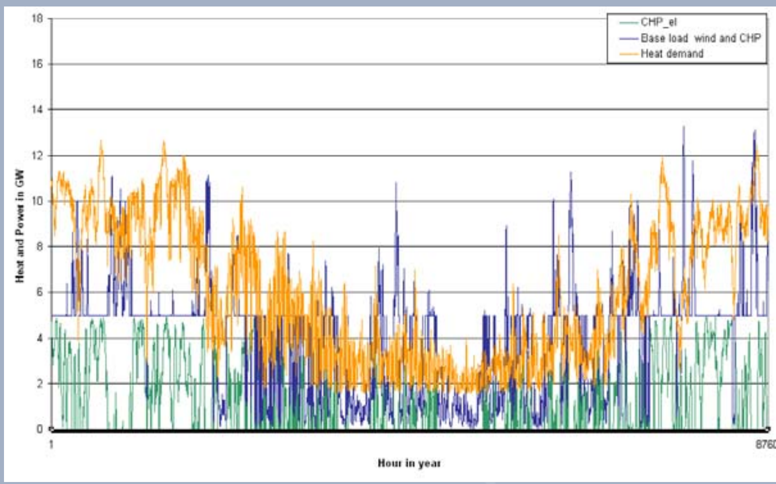

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1 day storage

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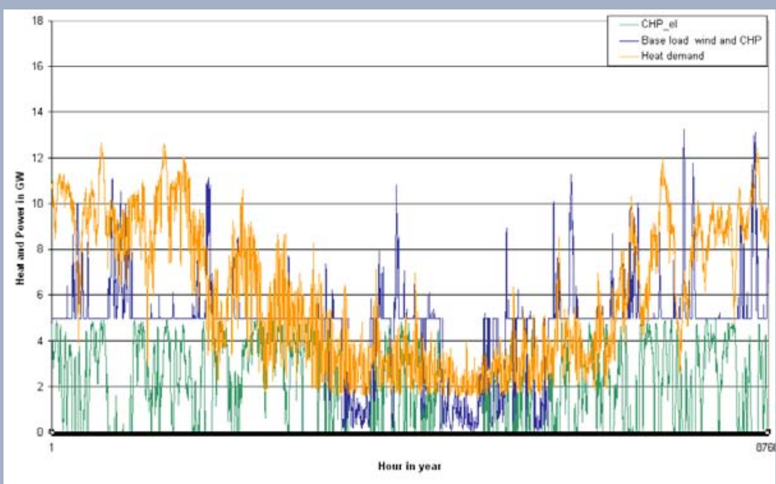

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2 days storage

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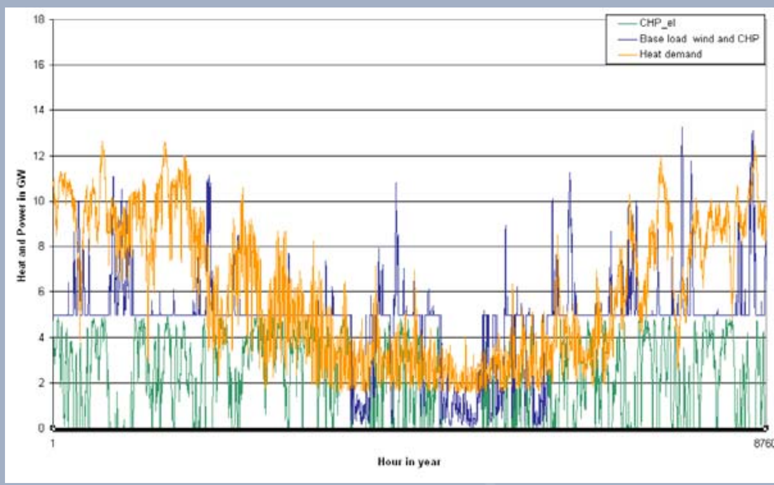

DESIRE – Work Package 2 – Subtask 2.1 – Del. 2.2

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- Actually **heat demands** cause restrictions in summer

If heat shall as much as possible be used (which is the advantage of cogeneration)

=> Extreme heat demand profiles for the investigation:

- Constant, more and less fluctuating (temperature dependant) type

- Industrial (process heat demand)
- Buildings with low
- and with high insulation standard

Present CHP plant design Type 1

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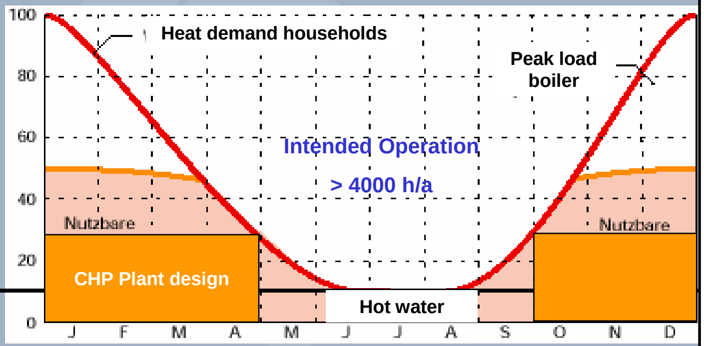
One module:



„Ideal" German CHP Plant design

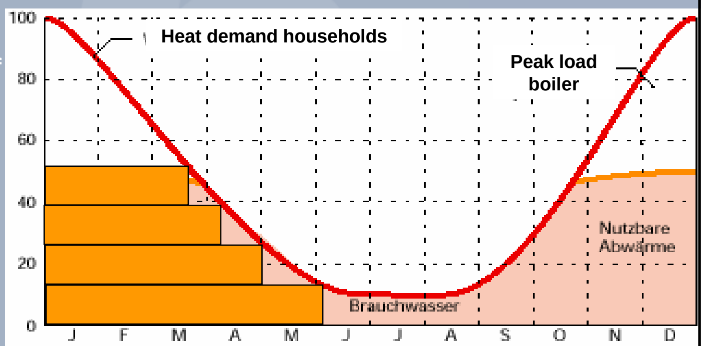
Low investment, long operation and a fast pay back

Present CHP plant designs Type 2

IEE-RE | UNIKASSEL VERSITÄT

- Several modules:

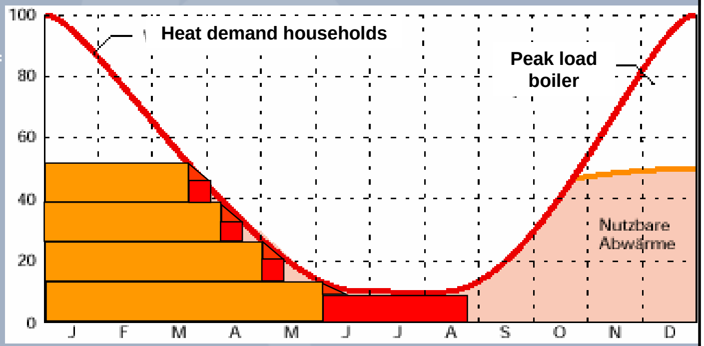
- Higher coverage of heat demand
- With long enough hours of operation



Present CHP plant designs Type 2

IEE-RE UNIKASSEL VERSITÄT

- Partial load:

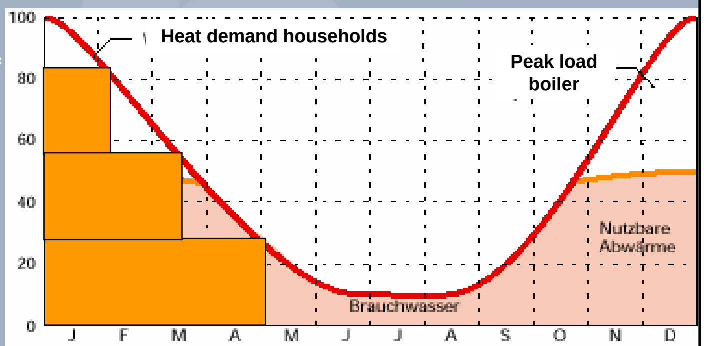


- Higher coverage of heat demand
- Lower electric efficiency

Present CHP plant design Danish Type

IEE-RE UNIKASSEL VERSITÄT

- Several modules:

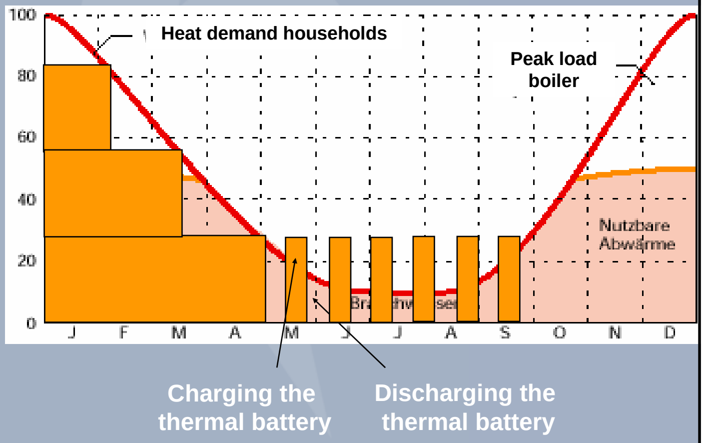


- Higher coverage of heat demand
- Big heat storage

Present CHP plant design Danish Type

IEE-RE | UNIKASSEL VERSITÄT

- Heat storage in **summer**:
- Electricity generation in the best paid hours
- Heat supply by heat accumulator



Present CHP plant design Danish Type

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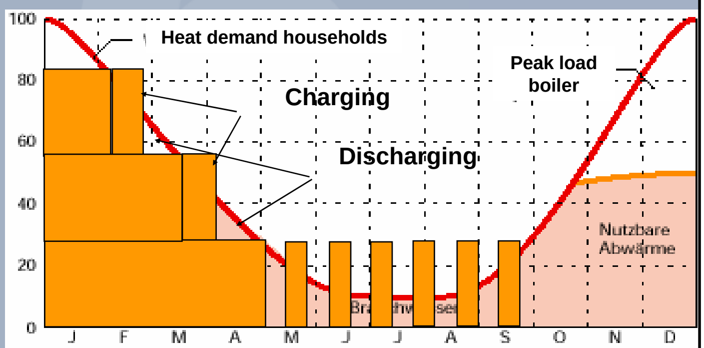
- Heat storage at **medium load** :
- Electricity generation in the best paid hours
- Heat supply by heat accumulator



Present CHP plant design Danish Type

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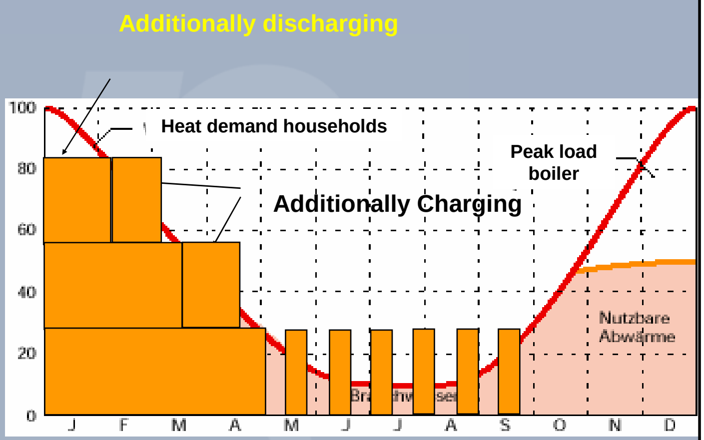
- Loading for the
- cold times

- Electricity generation in the best paid hours
- Heat supply by heat accumulator



- Supply by heat accumulator instead of boiler
- More co generated heat

Heat storage size variation

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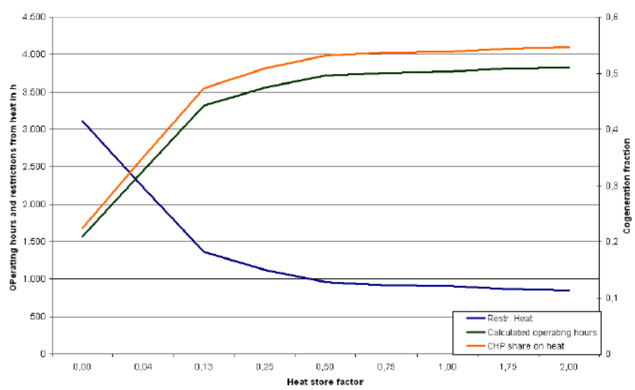
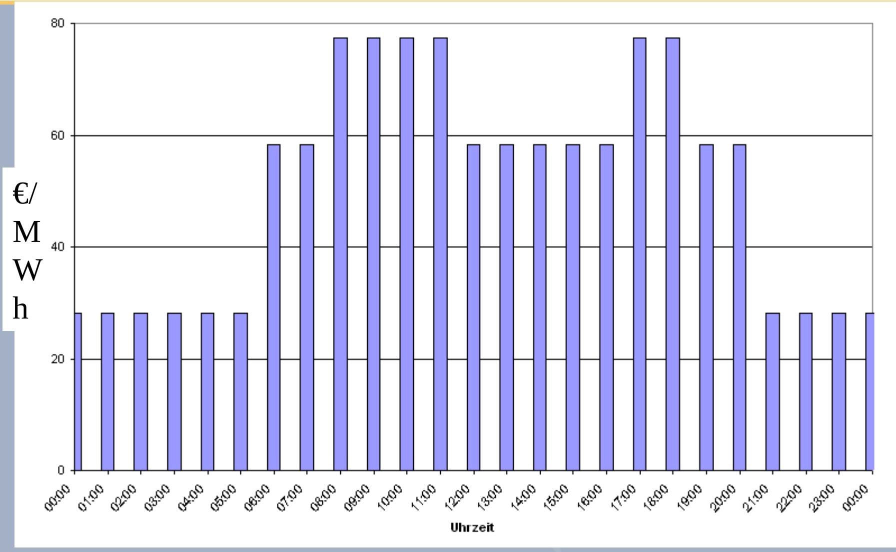
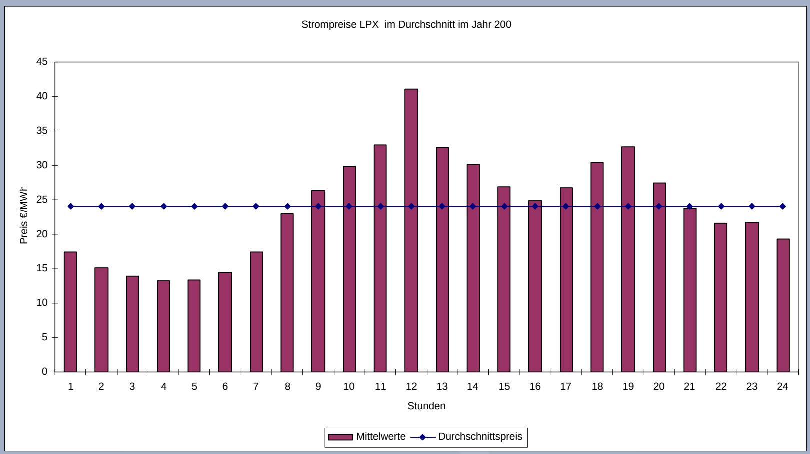


Figure 4-20: Influence of heat stores on restrictions from heat, operating hours and cogeneration fraction

Danish Triple tariff:



Spot market price for power



Source: LPX-Leipziger Strombörse

Summary

IEE-RE | UNIKASSEL VERSITÄT

- Many possibilities to help integrating higher shares of renewable energies
- Demand side management and cogeneration as solutions in DESIRE
- Advantages of Danish CHP design with big heat stores

John Sievers University of Kassel — Desire Project Presentation — Tallin Estonia 18.09.2006

IEE-RE | UNIKASSEL VERSITÄT

- Thank you
- for your attention

Reporting on dissemination activities carried out within the frame of the DESIRE project (WP8)

Name, Affiliation	Peter Ritter, EMD-Deutschland
E-mail	pr@emd.dk
Title of dissemination	Software zum Betrieb von Energieerzeugungsanlagen im liberalisierten Strommarkt (Softwaretool for operation of power generation systems in the liberalised market)
Type of activity	Presentation at workshop
Title of forum	Netzwerk Energie und Kommunikation (NEuK) (Network of Energy and Communication)
Language	German
Date of dissemination	April 11th 2006
Place of dissemination	Dortmund, Germany
Brief abstract / description of dissemination activity	1. This Network of Energy and Communication are interested to know about our activities of DESIRE. 2. We present a Power point presentation with short discussion by 30ty participants. 3. We get useful contacts. Based of them maybe projects will be created for the future.
Audience impact assessment	The integration of big thermal store in CHP plants to be more flexible in power generation is not so much in the mind of people. This kind of presentation helps to start a new thinking. This message was well received at the workshop attended by approximately 30 people, but we have to show at the next step real demonstration projects. So DESIRE meets a small part of the actual demand on this marked.
Dissemination	

Software zum Betrieb von Energieerzeugungsanlagen im liberalisierten Strommarkt

Dipl. Ing. Peter Ritter
ENERGI- OG MILØJDATA (EMD) Deutschland
Kassel

www.emd.dk

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Slide 1

Übersicht:

- Kurzvorstellung EMD
- Kraft-Wärme-Kopplungsanlagen in Deutschland
  - Auslegung
  - Vergütung
  - Unterschiede zu Dänemark
- Herausforderungen an Kraft-Wärme-Kopplungsanlagen im liberalisierten Strommarkt
  - Strombörse
  - Regelenergiemarkt
  - Pooling von Kraftwerken (virtuelle Kraftwerke)
  - Beispiele Südweststrom und STEAG
- EnergyPRO: Software zur Auslegung und Betrieb von Kraft-Wärme-Kopplungsanlagen
- EnergyTrade: Software zum Betrieb von KWK-Anlagen

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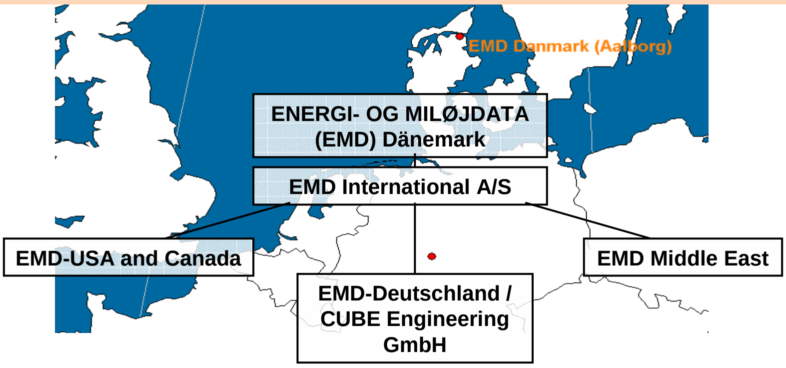
Slide 2

Kurzvorstellung ENERGI- OG MILØJDATA



2006

- EMD-DK 20-jähriges Firmenjubiläum
- EMD-Deutschland 15-jähriges Firmenjubiläum

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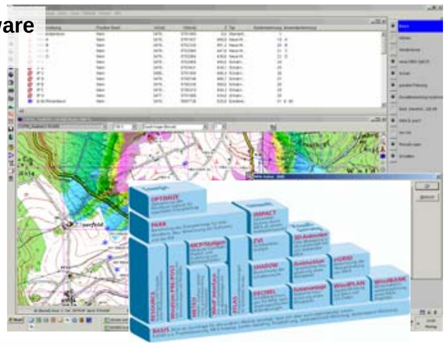
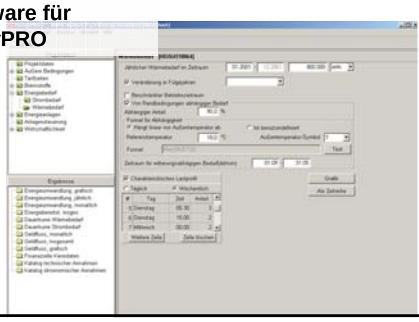
Kurzvorstellung : Produkte von EMD

- **Planungs- und Projektierungssoftware für Windenergieprojekte WindPRO**



- **Projektierungs- und Auslegungssoftware für Energiesysteme (z.B. BHKWs) energyPRO**



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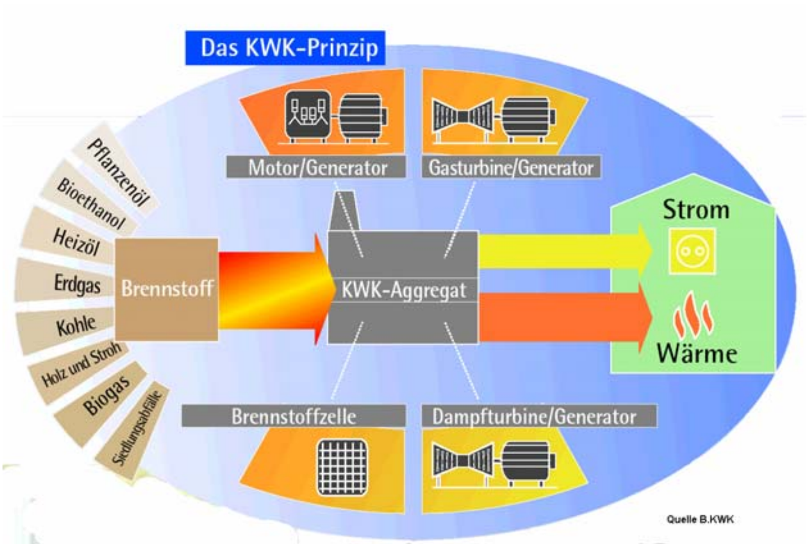
Kraft-Wärme-Kopplung KWK



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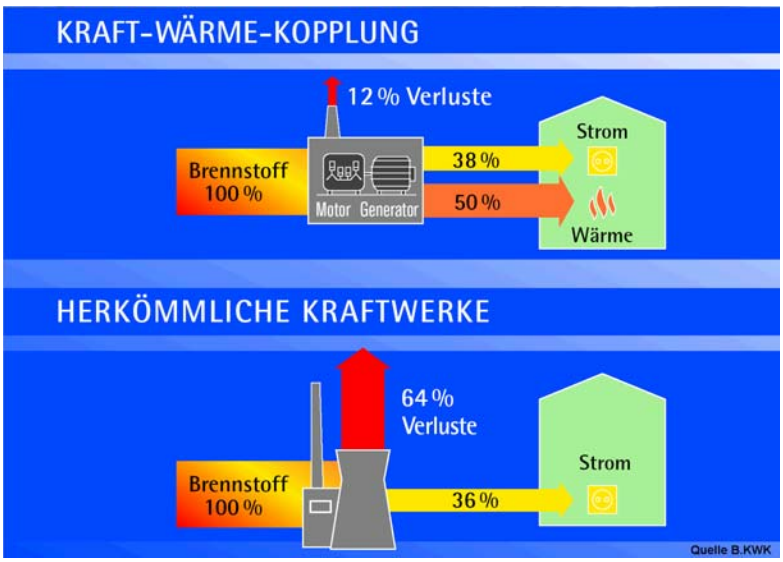
Slide 5

Kraft-Wärme-Kopplung KWK



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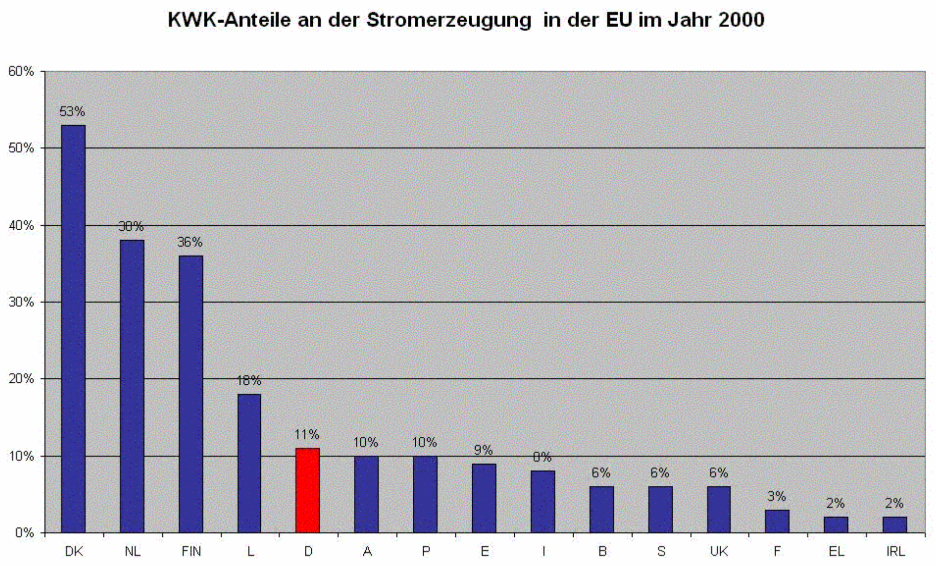
Slide 6

Kraftwärmekopplungsanlagen in Deutschland



Quelle B.KWK

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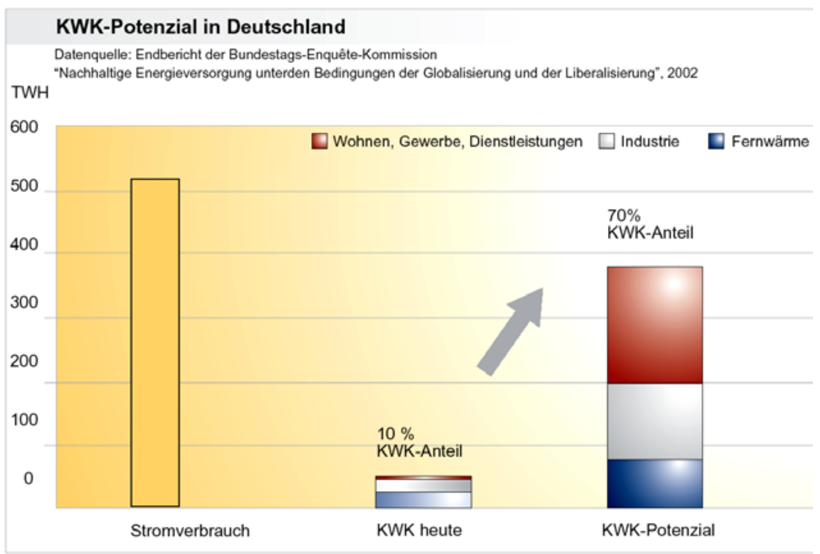
Kraftwärmekopplungsanlagen in Deutschland



Der Ausbau der dezentralen Versorgung mit KWK-Anlagen ist Deutsches und Europäisches Ziel um den CO2-Ausstoß zu reduzieren.

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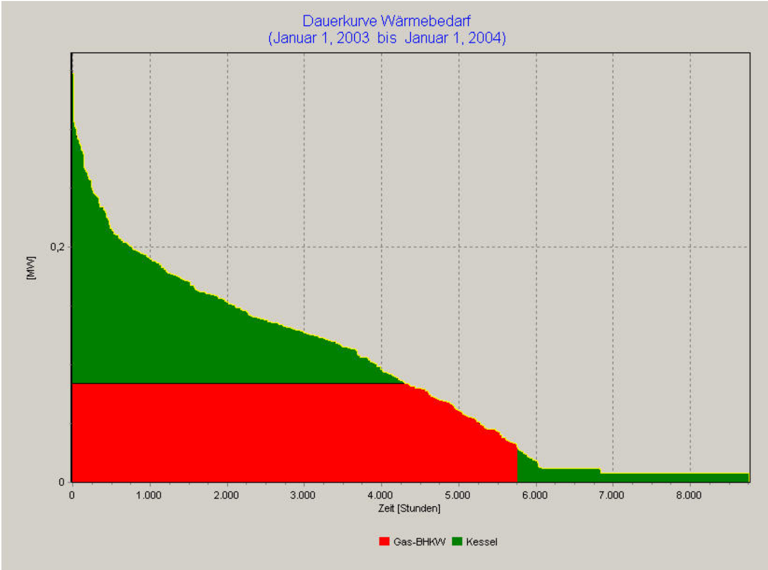
Slide 8

Kraftwärmekopplungsanlagen in Deutschland

Typische Auslegung BHKW nach minimalem Wärmebedarf (Grundlast) um hohe Volllaststunden zu erreichen



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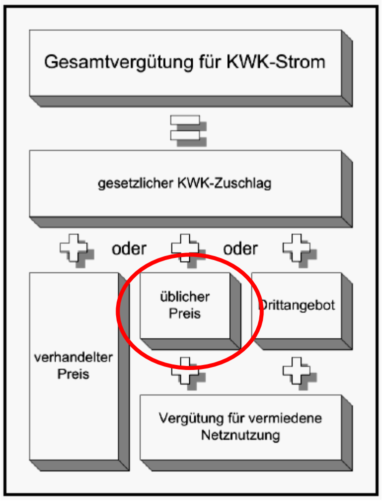
Vergütung KWK-Strom



„Als üblicher Preis gilt der durchschnittliche Preis für Baseload-Strom an der Strombörse EEX im jeweils vorangegangenen Quartal.“

Quartal	Üblicher Preis Base Load EEX
I / 2006	65,1 € / MWh
IV / 2005	59,8 € / MWh
III / 2005	43,9 € / MWh
II / 2005	41,5 € / MWh
I / 2005	38,5 € / MWh

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Kraftwärmekopplungsanlagen in Deutschland

Eigenschaften von KWK-Anlagen

- Die Motoren können im Minutenbereich zu- und abgeschaltet werden
- Die Anlagen werden überwiegend wärmegeführt betrieben und der Strom fällt als „Nebenprodukt“ ab
- Die Leistungsklasse liegen von wenigen kW (Hausversorgung) bis einige MW (Stadtwerke Fernwärmenetz oder Industrie)
- Die Anlagen speisen dezentral ein und reduzieren daher Netzverluste
- Die Vergütung erfolgt entsprechend den gesetzlichen Vorgaben in Verbindung von langfristigen Verträgen
- Der Ausbau ist politisch gewollt und es bestehen große Potentiale, jedoch ist der Zubau derzeit sehr gering

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Kraft-Wärme-Kopplung in Dänemark

Vergütung historisch:

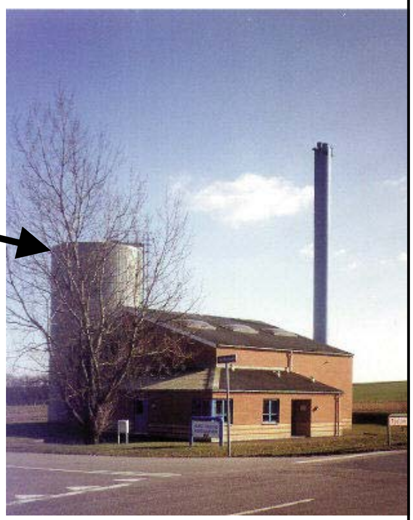
3-Tarifsystem z.B.

Spitzentarif ST:	77,3 €/MWh
Hochtarif HT:	58,3 €/MWh
Niedrigtarif NT:	28,1 €/MWh

Stromerzeugung im Spitzen- und Hochtarif

Großer Wärmespeicher

Wärmebedarf des Nahwärmenetzes wird oft über den Speicher bedient



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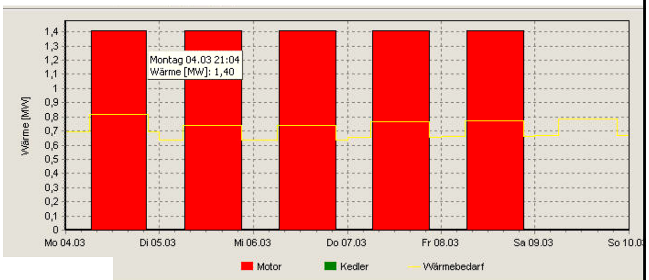
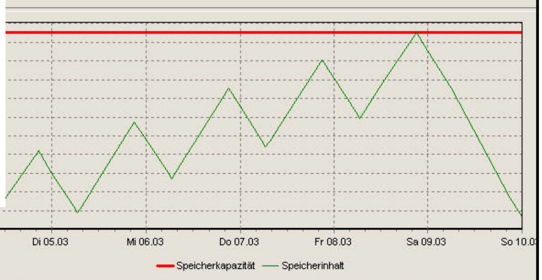
Kraft-Wärme-Kopplung in Dänemark

Zeitverlauf KWK-Anlage mit großem Wärmespeicher
Die optimale Auslegung des Speichers bedarf genauere Simulation z.B. mit EnergyPRO



Fazit:

Die KWK-Anlage kann unabhängiger von dem Wärmebedarf betrieben werden. Durch die Flexibilität kann das Kraftwerk am liberalisierten Strommarkt zusätzlich Geld ein-nehmen.



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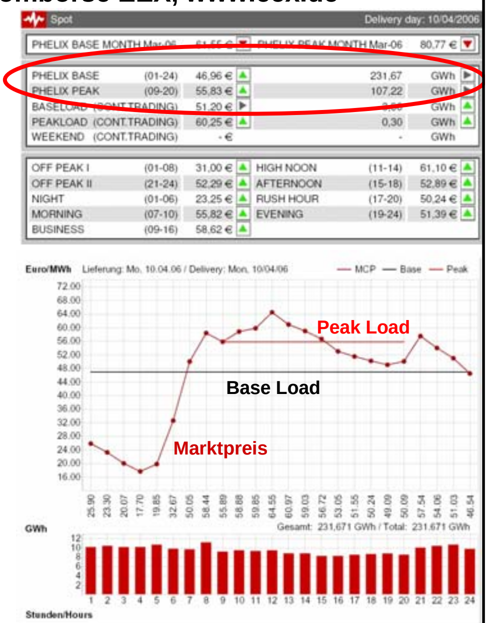
Slide 13

Neue Märkte für KWK-Anlagen

1. Leipziger Strombörse EEX, www.eex.de

Handel jeden Werktag in Blöcken zu einzelnen oder mehreren Stunden

Ein Volumen von ca. 20% wird bereits gehandelt



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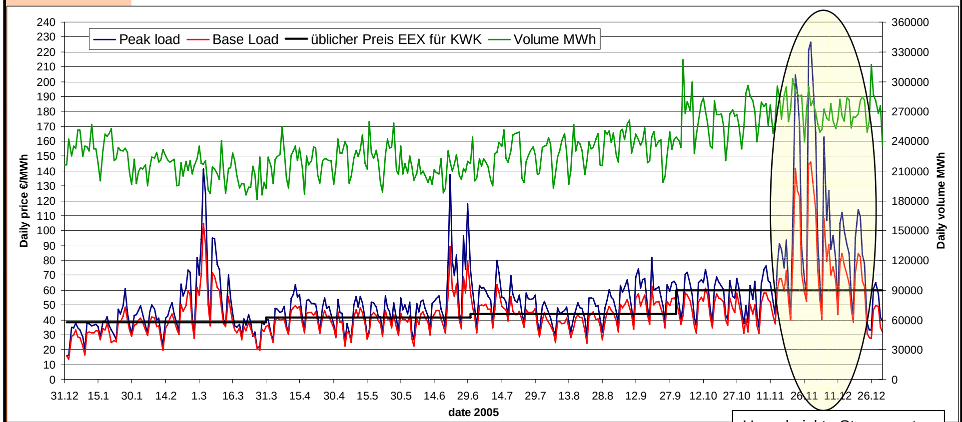
1. Strombörse EEX

Strompreise und Volumen an der Strombörse EEX Leipzig



Umgeknickte Strommasten in Westdeutschland

Der Preis für den Peak-Load liegt weit über dem Base-Load

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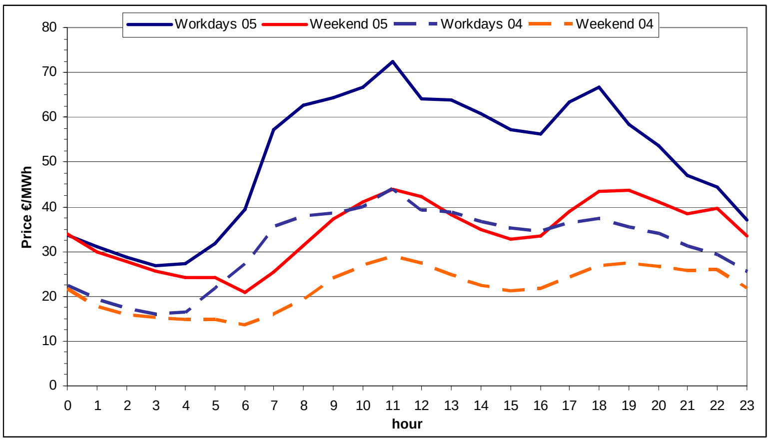
Slide 15

1. Strombörse EEX

Tagesgang Stundenpreise Wochentag/Wochenende



Ziel ist es für einen wirtschaftlicheren Betrieb die KWK-Anlage möglichst nur zu Hochpreiszeiten zu betreiben. Vorausschauende Prognose ist dazu notwendig

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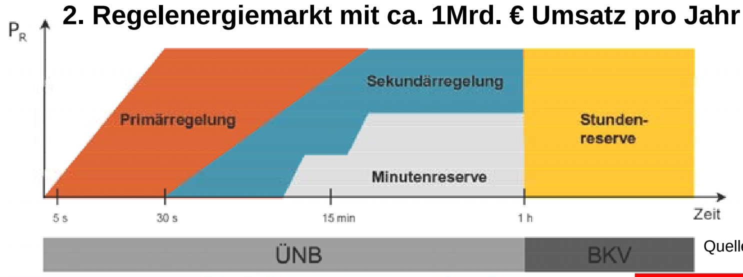
Neue Märkte für KWK-Anlagen

2. Regelenergiemarkt mit ca. 1Mrd. € Umsatz pro Jahr



Quelle STEAG

	Primärregelenergie	Sekundärregelenergie	Minutenreserve
Regelband / Poolgröße	± mind. 2% der Nennleistung der EE, mind. 2 MW	mind. ± 30 MW	mind. ± 30 MW
Leistungsgradient	2% der Nennleistung	2% pro Minute der Nennleistung	30 MW in 15 Min.
Aktivierungsge-schwindigkeit	< 30 sek., muss mind. 15 Min. abgegeben werden	< 5 Min	< 15 Min.
Arbeitsverfügbarkeit	-	100 %	100 %
Zeitverfügbarkeit	100 %	95 %	100 %
Ausschreibungszeitraum	halbjährlich	halbjährlich	täglich
Aufgabe	Wiederherstellen d. Frequenzgleichgewichts	Frequenz- und Leistungsregelung	
Besonderheiten	Frequenz-Leistungszahl muss einstellbar sein	kontinuierliches Regelsignal	Manueller Aufruf

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2. Regelenergiemarkt

Negative Minutenreserve

Erzeuger abschalten/reduzieren

(z.B. Kraftwerke, BHKW-Anlage, etc.)

Verbraucher zuschalten/erhöhen

(z.B. Mühlen, Pumpen, Verdichter, etc.)

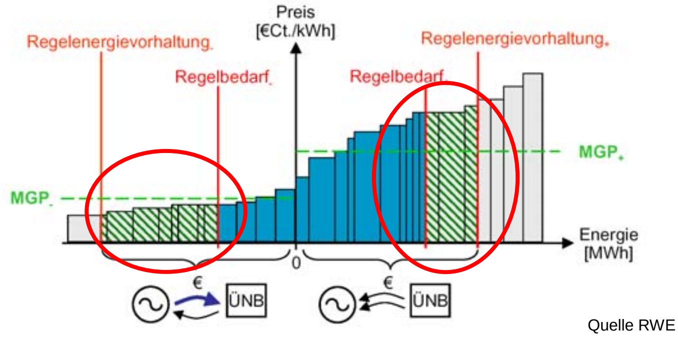
Positive Minutenreserve

Erzeuger zuschalten/erhöhen

(z.B. Kraftwerke, Notstrom-Diesel, etc.)

Verbraucher abschalten/reduzieren

(z.B. Elektrolysen, Schmelzöfen, etc.)



Quelle RWE

Täglich Internetbasierte Ausschreibung zur Minutenreserve

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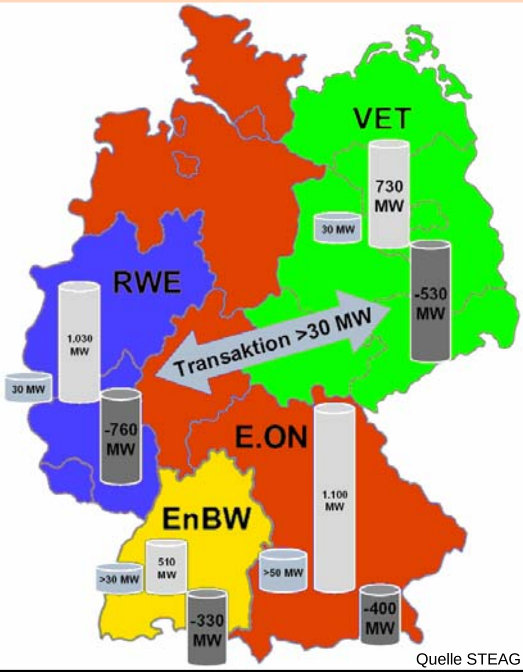
2. Regelenergiemarkt

Marktvolumen Minutenreserve

Positiv: 3.370 MW
Negativ: 2.450 MW



Quelle STEAG

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2. Regelenergiemarkt/Minutenreserve Preise

Leistungspreise Minutenreserve ENBW in €/MW				**Grenzanbieter**			
		Mittlerer Preis MGP		Hochtarif (HT)		Niedertarif (NT)	
		Negative	Positive	Negative	Positive	Negative	Positive
20.03.2006	Montag	50,4	119,5	0,11	120	50,44	12,69
21.03.2006	Dienstag	50,4	161,1	0,11	184	50,44	12,74
22.03.2006	Mittwoch	50,4	265,1	0,11	350	50,44	12,69
23.03.2006	Donnerstag	50,4	301,3	0,11	329	50,5	12,59
24.03.2006	Freitag	50,4	256,9	0,11	269	50,49	12
25.03.2006	Samstag	77,8	29,3			80	31
26.03.2006	Sonntag	158,1	25,7			163,9	27

Ziel ist es für einen wirtschaftlicheren Betrieb auch die KWK-Anlage als Anbieter für Minutenreserve zu integrieren.

Besonders wenn die Minutenreserve nicht abgerufen wird, kann ohne Energielieferung bzw. Reduktion der Erzeugung zusätzlich Einnahmen generiert werden.

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3. Weitere Märkte

Grüner Strom-Mark (Ausgleich zwischen Prognose und Lieferung im Bilanzkreis)

Erzeugungsmanagement (Pooling mit anderen dezentralen Erzeugungsanlagen; z.B. statt Abschaltung von Windenergie können KWK-Anlagen reduziert werden.)

Spitzenlastabdeckung / Bilanzkreismanagement

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Beispiel 1: Südwestdeutsche Stromhandelgesellschaft (Südweststrom) Pooling von mehreren KWK-Anlagen Handel an der Strombörе EEX

Pooling von 43 Stadtwerke
in Baden-Württemberg

Südwestdeutsche
Stromhandelgesellschaft GmbH

Strombeschaffung

Stromhandel

Stromabsatz in 2003

2.500 Mio. kWh
Höchstlast: 390 MW

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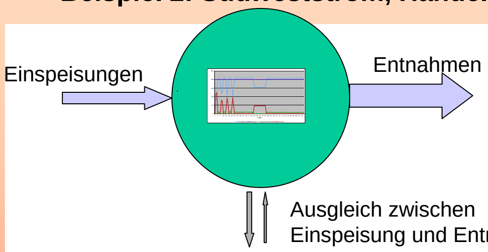
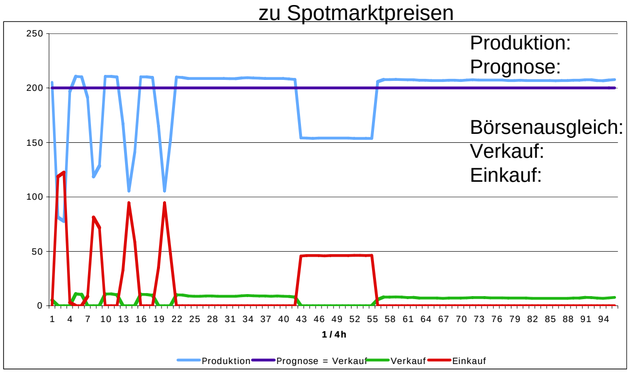
Beispiel 2: Südweststrom, Handel an der Stromböre EEX



Ausgleich zwischen Einspeisung und Entnahme zu Spotmarktpreisen



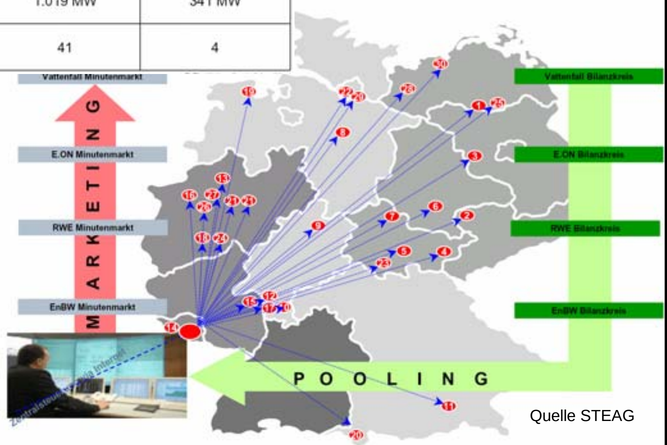
Produktion:	4.600 kWh
Prognose:	4.800 kWh
Börsenausgleich:	
Verkauf:	143 kWh
Einkauf:	343 kWh

Quelle: Stadtwerke Schwäbisch Hall

Produktion und Lieferung an einem Tag

Beispiel: Virtuelles Regelkraftwerk STEAG

	Positiv	negativ
Marktvolumen	3.370 MW	2.450 MW
Marktanteil (%)	10 %	2,5 %
Marktanteil (abs.)	300 – 400 MW	20 – 80 MW
Präqualifizierte Leistung	1.019 MW	341 MW
Bereitsteller	41	4



Quelle STEAG

Anforderungen an KWK-Anlagen für die neuen Strommärkte

Pooling von KWK-Anlagen, damit sie als virtuelle Kraftwerke betrieben werden können und am liberalisierten Stromhandel teilnehmen können

Flexibilität im zeitlichen Betrieb der KWK-Anlagen z.B. durch große Wärmespeicher

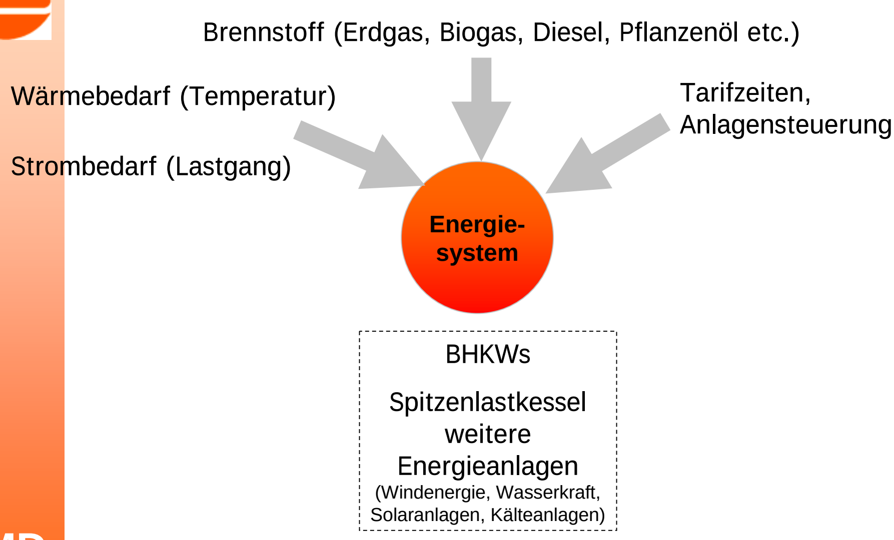
Integration von Soft- und Hardwarelösungen zum teilautomatisierten Betrieb als virtuelle Kraftwerke (Prognose zu Strompreis, Datentransfer, Leitwarte, Kommunikation, usw.)

Organisatorische Anbindung an die Strombörse und/oder an die Minutenreserve-Ausschreibung

Präqualifikation zur Teilnahme

EMD

Simulation und Auslegung von Energiesystemen mit energyPRO



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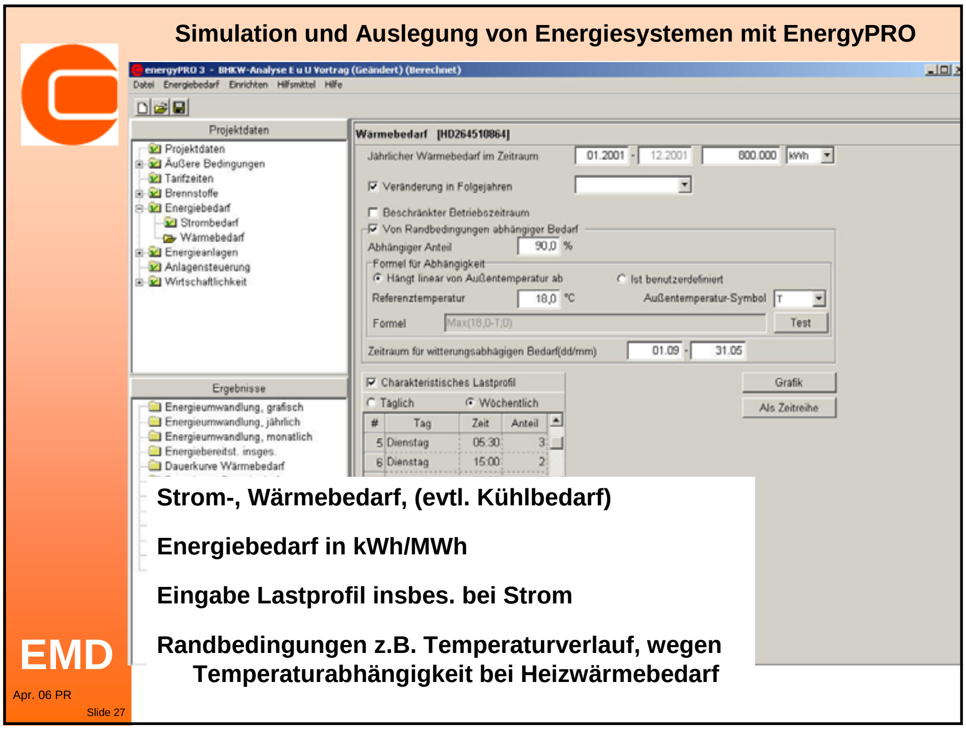
Simulation und Auslegung von Energiesystemen mit EnergyPRO
Strom-, Wärmebedarf, (evtl. Kühlbedarf)
Energiebedarf in kWh/MWh
Eingabe Lastprofil insbes. bei Strom
Randbedingungen z.B. Temperaturverlauf, wegen Temperaturabhängigkeit bei Heizwärmebedarf
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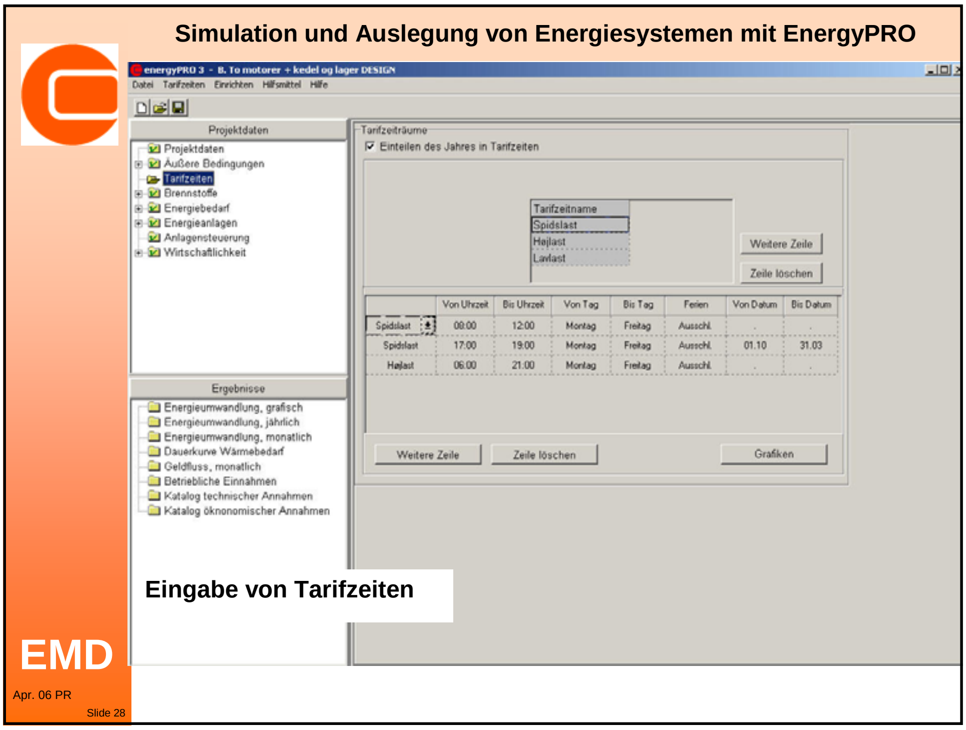
Simulation und Auslegung von Energiesystemen mit EnergyPRO
Eingabe von Tarifzeiten
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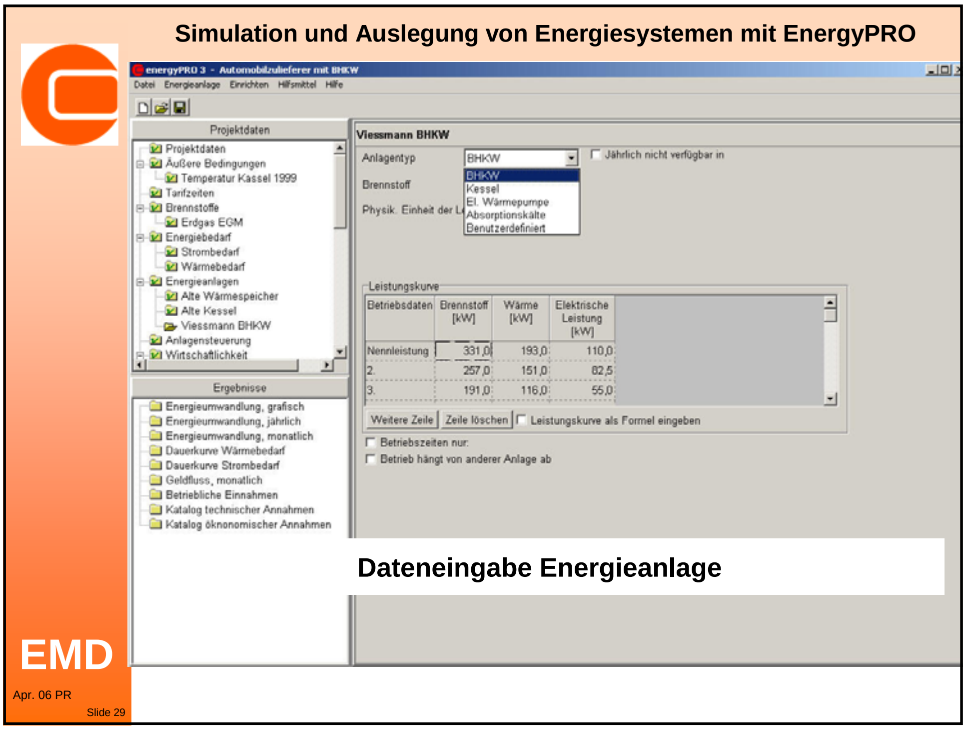
Simulation und Auslegung von Energiesystemen mit EnergyPRO
energyPRO 3 - Automobilzulieferer mit BHKW
Datei Energieanlage Einrichten Hilfsmittel Hilfe
Projektdaten
Projektdaten
Äußere Bedingungen
Temperatur Kassel 1999
Tarifzeiten
Brennstoffe
Erdgas EGM
Energiebedarf
Strombedarf
Wärmebedarf
Energieanlagen
Alte Wärmespeicher
Alte Kessel
Viessmann BHKW
Anlagensteuerung
Wirtschaftlichkeit
Ergebnisse
Energieumwandlung, grafisch
Energieumwandlung, jährlich
Energieumwandlung, monatlich
Dauerkurve Wärmebedarf
Dauerkurve Strombedarf
Geldfluss, monatlich
Betriebliche Einnahmen
Katalog technischer Annahmen
Katalog ökonomischer Annahmen
Viessmann BHKW
Anlagentyp
BHKW
Kessel
El. Wärmepumpe
Absorptionskälte
Benutzerdefiniert
Jährlich nicht verfügbar in
Brennstoff
Leistungskurve
Betriebsdaten
Brennstoff [kW]
Wärme [kW]
Elektrische Leistung [kW]
Nennleistung 331,0 193,0 110,0
2. 257,0 151,0 82,5
3. 191,0 116,0 55,0
Weitere Zeile
Zeile löschen
Leistungskurve als Formel eingeben
Betriebszeiten nur
Betrieb hängt von anderer Anlage ab
Dateneingabe Energieanlage
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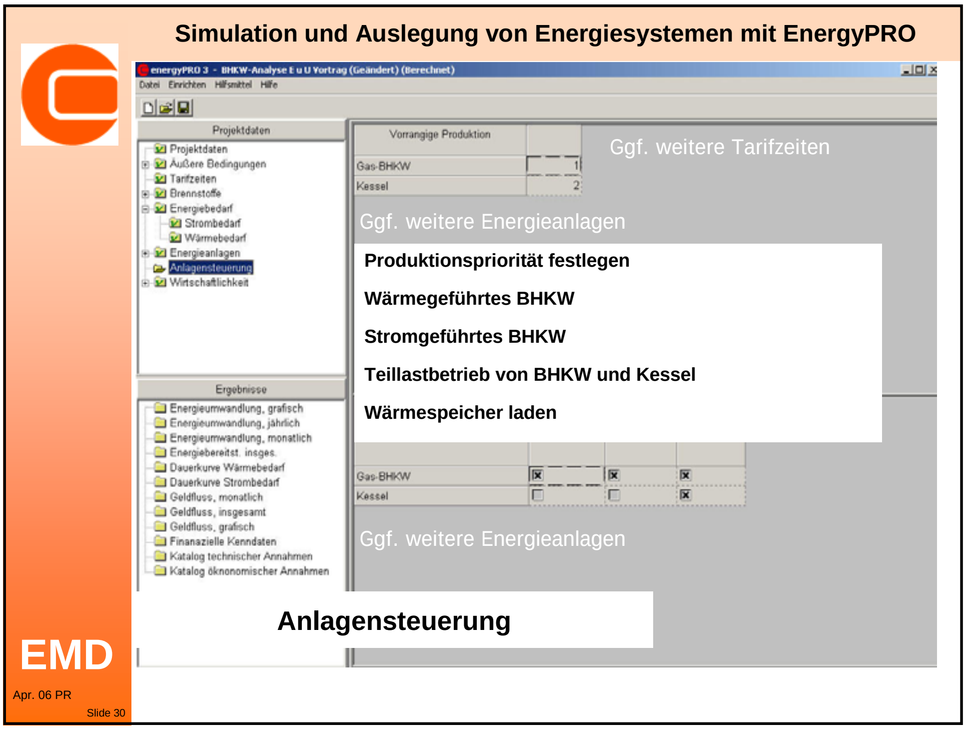
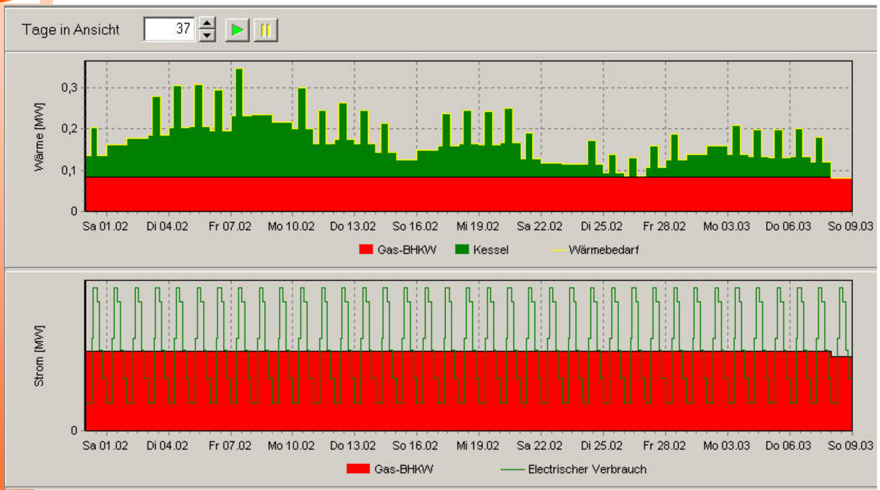

Simulation und Auslegung von Energiesystemen mit EnergyPRO
energyPRO 3 - BHKW-Analyse E u U Vortrag (Geändert) (Berechnet)
Datei Einrichten Hilfsmittel Hilfe
Projektdaten
Projektdaten
Äußere Bedingungen
Tarifzeiten
Brennstoffe
Energiebedarf
Strombedarf
Wärmebedarf
Energieanlagen
Anlagensteuerung
Wirtschaftlichkeit
Ergebnisse
Energieumwandlung, grafisch
Energieumwandlung, jährlich
Energieumwandlung, monatlich
Energiebereitst. insges.
Dauerkurve Wärmebedarf
Dauerkurve Strombedarf
Geldfluss, monatlich
Geldfluss, insgesamt
Geldfluss, grafisch
Finanzielle Kenndaten
Katalog technischer Annahmen
Katalog ökonomischer Annahmen
Vorrangige Produktion
Gas-BHKW 1
Kessel 2
Ggf. weitere Tarifzeiten
Ggf. weitere Energieanlagen
Produktionspriorität festlegen
Wärmegeführtes BHKW
Stromgeführtes BHKW
Teillastbetrieb von BHKW und Kessel
Wärmespeicher laden
Gas-BHKW
Kessel
Ggf. weitere Energieanlagen
Anlagensteuerung
EMD
Apr. 06 PR
Slide 30

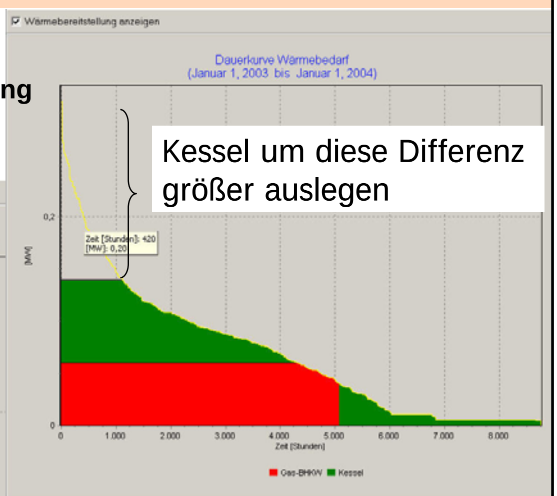
Ergebnisse Zeitreihen (deutsches Beispiel ohne Wärmespeicher)

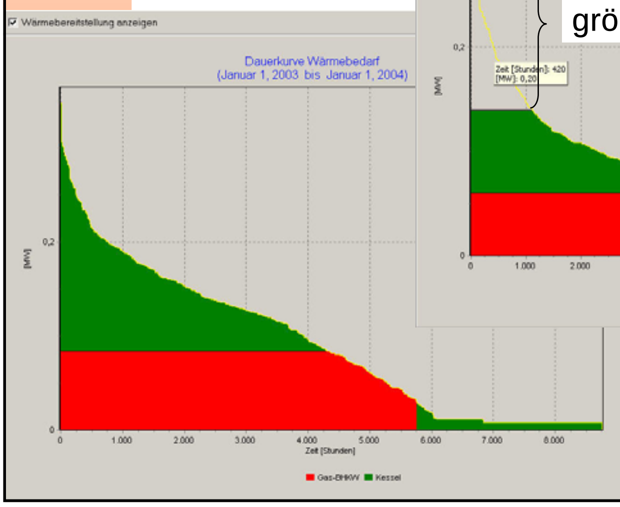


Wärmegeführtes BHKW grafischen Darstellung der Zeitreihen

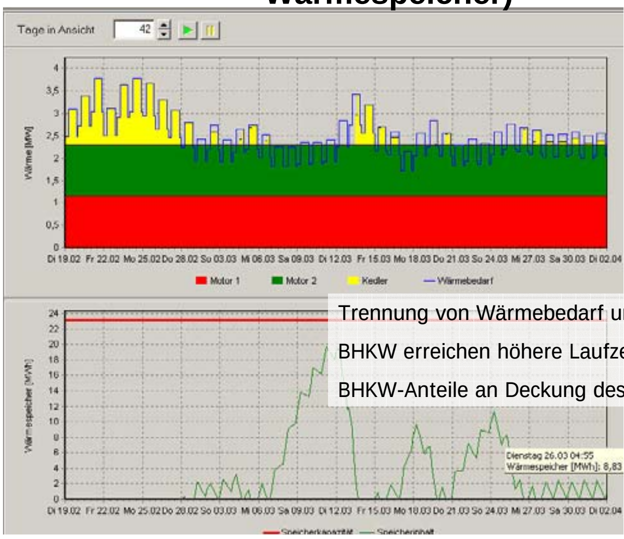
Simulation und Auslegung von Energiesystemen mit EnergyPRO

Jahresdauerlinien
Prüfung der Abdeckung





Ergebnisse Zeitreihen (dänisches Beispiel mit Wärmespeicher)



Trennung von Wärmebedarf und -erzeugung
BHKW erreichen höhere Laufzeiten und
BHKW-Anteile an Deckung des Wärmebedarfs

Auslegung überprüfen, z.B. BHKW-Laufzeiten und Speicherdimensionierung analysieren, Teillast erlauben evtl.

EMD

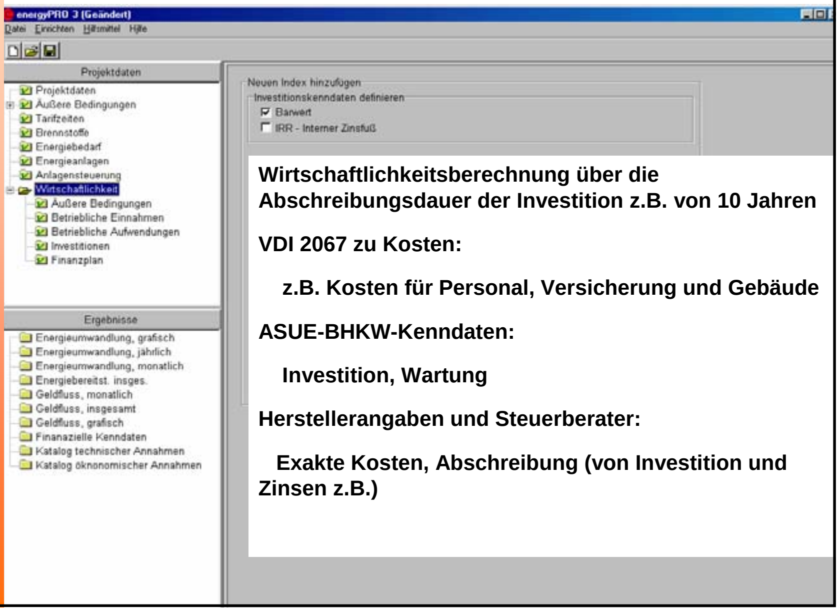
1. Jahresdauerlinie **und Zeitreihen der** Energieumwandlung **verhindern eine Unterdimensionierung von Anlagen**

2. Wirtschaftlichkeitsberechnung, verhindert Überdimensionierung

EMD

Simulation und Auslegung von Energiesystemen mit EnergyPRO

Wirtschaftlichkeitsberechnung in energyPRO



Wirtschaftlichkeitsberechnung über die Abschreibungsdauer der Investition z.B. von 10 Jahren

VDI 2067 zu Kosten:

z.B. Kosten für Personal, Versicherung und Gebäude

ASUE-BHKW-Kenndaten:

Investition, Wartung

Herstellerangaben und Steuerberater:

Exakte Kosten, Abschreibung (von Investition und Zinsen z.B.)

EMD

Aktuelle Situation in West-Dänemark

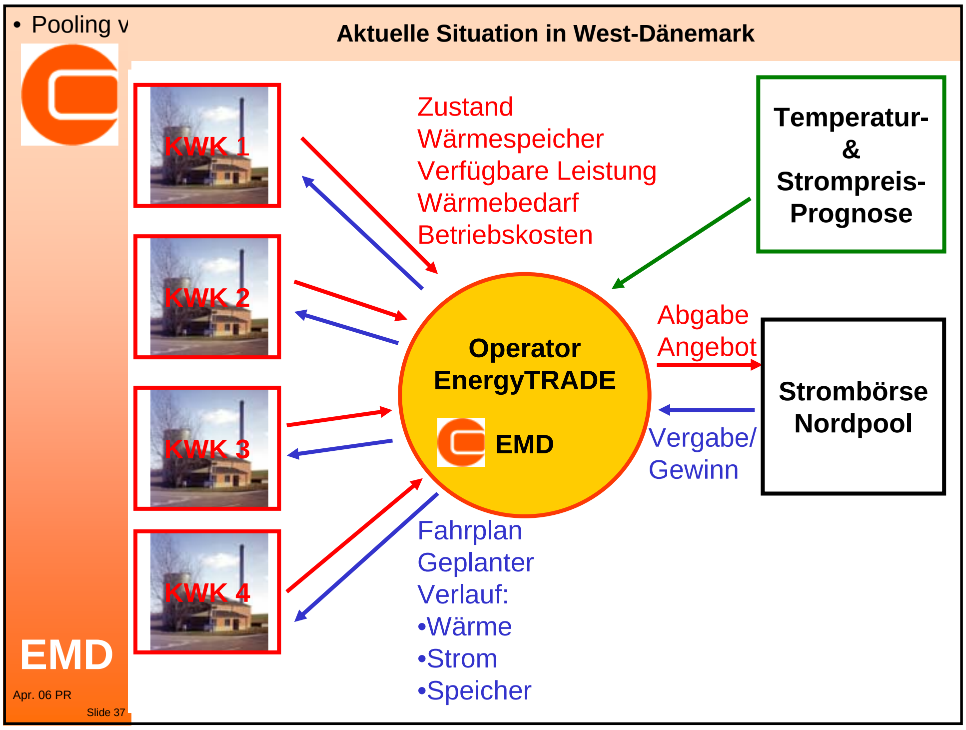
- In Starkwind- und Schwachlastzeiten wird der Strombedarf bis zu 100% von Windenergie abgedeckt
- KWK-Anlagen erhalten daher keine Vergütung nach dem 3-Tarifsystem mehr und müssen den Strom an der Strombörse (Nordpool) verkaufen
- KWK-Betreiber schließen sich zusammen um die neuen Märkte gemeinsam zu erschließen
- Übertragungsnetzbetreiber, große und kleine Energieversorger arbeiten eng zusammen

Im Rahmen des EU Projekts DESIRE (www.project-desire.org) werden neue Softwaretools entwickelt zum optimalen Betrieb der KWK-Anlagen im liberalisierten Strommarkt

EMD

Apr. 06 PR

Slide 36


• Pooling v
Aktuelle Situation in West-Dänemark
KWK 1
KWK 2
KWK 3
KWK 4
Zustand
Wärmespeicher
Verfügbare Leistung
Wärmebedarf
Betriebskosten
Temperatur-
&
Strompreis-
Prognose
Operator
EnergyTRADE
EMD
Abgabe
Angebot
Strombörse
Nordpool
Vergabe/
Gewinn
Fahrplan
Geplanter
Verlauf:
•Wärme
•Strom
•Speicher
EMD
Apr. 06 PR
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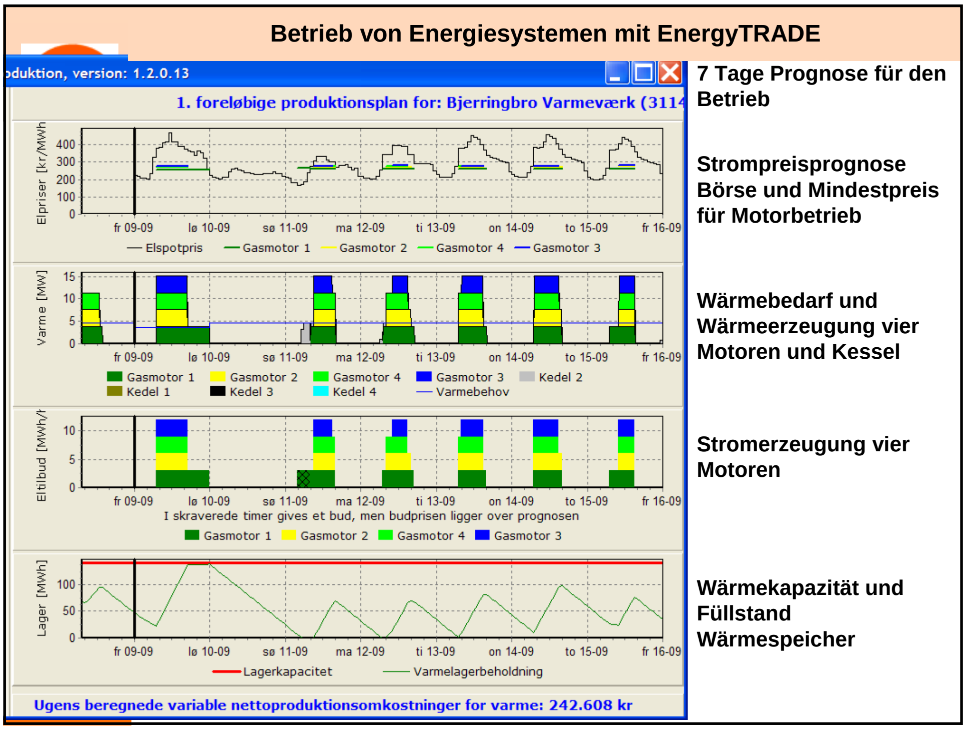
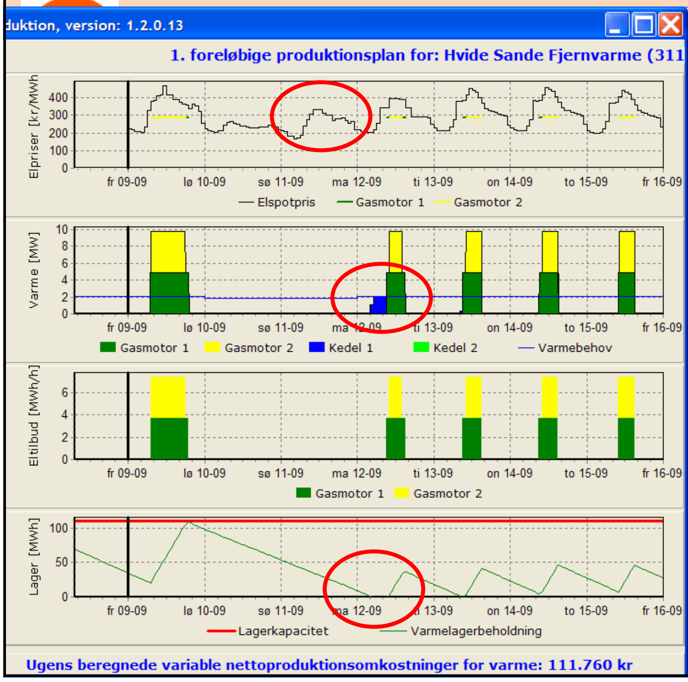

Betrieb von Energiesystemen mit EnergyTRADE
oduktion, version: 1.2.0.13
1. foreløbige produktionsplan for: Bjerringbro Varmeværk (3114
Elpriser [kr/MWh]
fr 09-09
lø 10-09
sø 11-09
ma 12-09
ti 13-09
on 14-09
to 15-09
fr 16-09
Elspotpris
Gasmotor 1
Gasmotor 2
Gasmotor 4
Gasmotor 3
Varme [MW]
Gasmotor 1
Gasmotor 2
Gasmotor 4
Gasmotor 3
Kedel 2
Kedel 1
Kedel 3
Kedel 4
Varmebehov
Eltilbud [MWh/t
I skraverede timer gives et bud, men budprisen ligger over prognosen
Lager [MWh]
Lagerkapacitet
Varmelagerbeholdning
Ugens beregnede variable nettoproduktionsomkostninger for varme: 242.608 kr
7 Tage Prognose für den Betrieb
Strompreisprognose Börse und Mindestpreis für Motorbetrieb
Wärmebedarf und Wärmeerzeugung vier Motoren und Kessel
Stromerzeugung vier Motoren
Wärmekapazität und Füllstand Wärmespeicher

Betrieb von Energiesystemen mit EnergyTRADE



7 Tage Prognose für den Betrieb

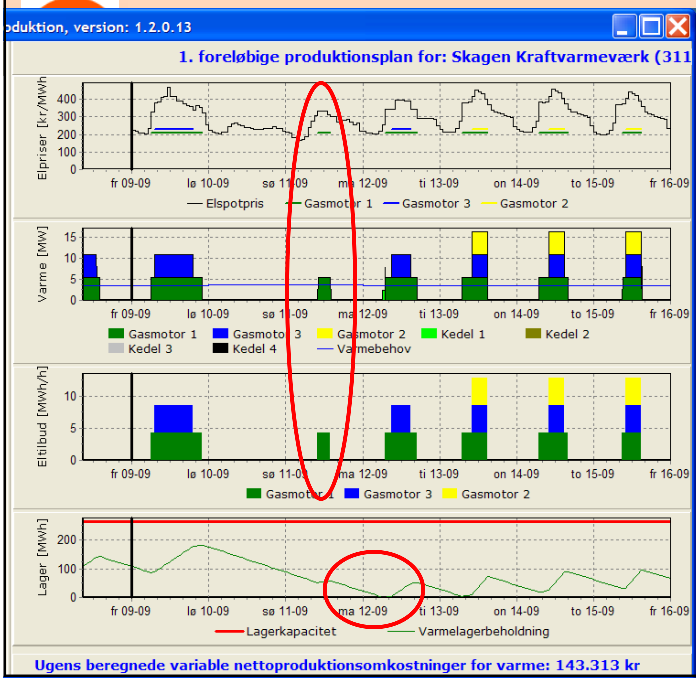
Strompreisprognose Börse und Mindestpreis für Motorbetrieb

Wärmebedarf und Wärmeerzeugung zwei Motoren und Kessel

Stromerzeugung zwei Motoren

Wärmekapazität und Füllstand Wärmespeicher

Betrieb von Energiesystemen mit EnergyTRADE



Zusammenfassung

- KWK hat ein großes Potential zur CO_2 Reduktion
- Dänische KWK-Anlagen sind durch große Wärmespeicher flexibel und können als Art Stromenergiespeicher verwendet werden
- Strombörse und Minutenreserve sind interessante neue Märkte für große KWK-Anlagen
- Für die neuen Märkte müssen KWK-Anlagen als virtuelle Kraftwerke betrieben werden und sich präqualifizieren
- Für den Betrieb als virtuelle Kraftwerke sind neue Software- und Hardwarelösungen notwendig

Danke für Ihre Aufmerksamkeit
FRAGEN?

EMD

Apr. 06 PR

Slide 41

Reporting on dissemination activities carried out within the frame of the DESIRE project (WP8)

Name, Affiliation	Peter Ritter, EMD-Deutschland
E-mail	pr@emd.dk
Title of dissemination	Optimisation of CHP plants for the growth of renewable energies. (Optimierung von KWK-Anlagen für den Ausbau der Erneuerbaren Energien)
Type of activity	Poster presentation, ~ 35 people
Title of forum	Conference for municipal utility "Stadtwerke" (Stadtwerke-konferenz 2007) organized by BHKW-Consult. Topic: Basic legal and economic conditions for the municipal utility
Language	German
Date of dissemination	13.-14. Feb. 2007
Place of dissemination	Berlin, Germany
Brief abstract / description of dissemination activity	1. Forum for municipal utility for the development of CHP in Germany to promote DESIRE 2. Detail description of the demand of flexible power generation and the benefits of thermal stores for CHP 3. We get useful contacts. Maybe further projects with thermal stores could realised in the future. 4. Feedback of the participants, why the development of CHP in Germany is low in opposite of the strived for goal of the government.
Audience impact assessment	The integration of big thermal store in CHP plants to be more flexible in power generation is not so much in the mind of people. This kind of presentation helps to start a new thinking and show the economic benefit of operation with thermal stores. Also a presentation of BET (Büro für Energiewirtschaft, Aachen) at this conference supported the idea of DESIRE.
Dissemination	Included after this form

Optimierung von KWK-Anlagen für den Ausbau der Erneuerbaren Energien

DESIRE – Dissemination strategy on Electricity balancing – large Scale Integration of Renewable Energy

EU Sixth Framework Programme, www.projekt-desire.org

Überblick

Durch den geplanten weiteren Ausbau der Energieversorgung mit Erneuerbaren Energien (besonders Windenergie) und der damit verbundenen schwankenden Einspeisung, ist eine Flexibilisierung der Energieversorgung in Europa notwendig. Im Rahmen des Europäischen Demonstrationsprojekts DESIRE (Dissemination strategy on Electricity balancing for large-Scale Integration of Renewable Energy www.projekt-desire.org) wird aufgezeigt, dass es andere Möglichkeiten und Technologien für den Ausgleich von Erzeugung und Verbrauch gibt, die gleichzeitig die Energieeffizienz erhöhen und den CO_2–Ausstoß reduzieren. Einen besonderen Stellenwert erhalten dabei die Kraftwärmekopplungs-Anlagen (KWK) mit kurzen Anfahrzeiten und geringen Startkosten wie z.B. BHKW in Verbindung mit großen Wärmespeichern.

Gleichzeitig zur Flexibilisierung zeigt sich, dass die Wirtschaftlichkeit von KWK-Anlagen durch den Einsatz von Wärmespeichern im Liberalisierten Strommarkts mit Strombörsen und Regelenergiemärkten auch in Deutschland erheblich gesteigert werden kann.

In DESIRE werden an konkreten KWK-Beispielen der flexible und wirtschaftliche Betrieb aufgezeigt und durch EMD International A/S ein Softwaretool (EnergyTRADE) für den optimalen Betrieb von KWK-Anlagen mit 7 Tage Vorausprognose im liberalisierten Strommarkt entwickelt (siehe Abb. 6). An zwei dänischen Anlagen wird EnergyTRADE bereits erfolgreich eingesetzt. Der Betrieb kann online im Internet verfolgt werden (Siehe Abb. 7).

In einem weiteren Schritt des Projekts wird analysiert, inwiefern durch die Teilnahme der KWK-Anlagen an weiteren Strommärkten, wie dem Regelenergiemarkt (z. B. Minutenreserve) und dem Intraday-Markt eine zusätzliche Gewinnsteigerung möglich ist.

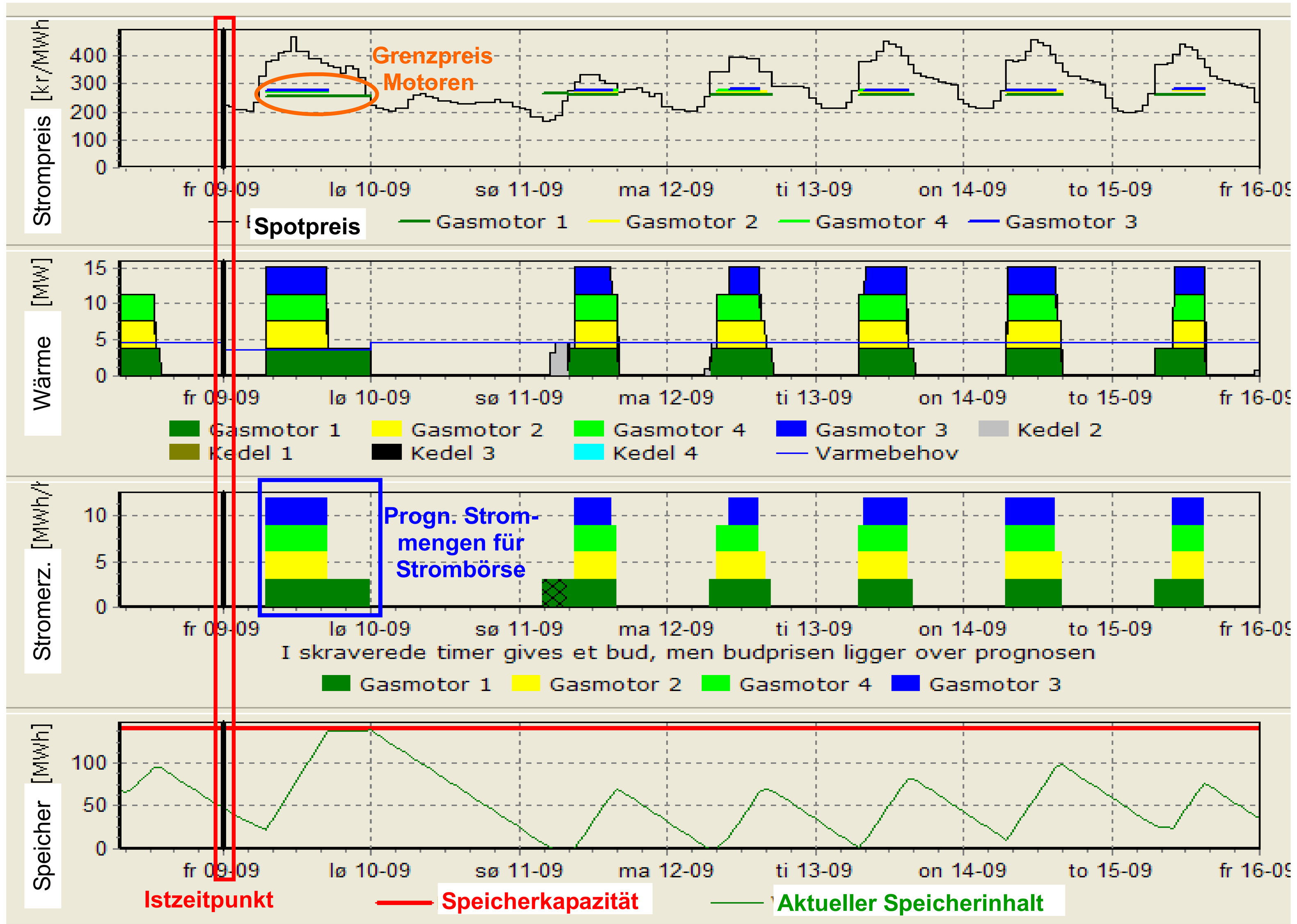


Abb. 6: Betriebsprognose für KWK-Anlage 4x4 MW 7 Tage im Voraus mit EnergyTRADE von EMD

Ausgleich von Stromangebot und –nachfrage bei Einspeisung großer Anteile von Erneuerbaren Energien

Derzeit spielt die Windenergie aufgrund ihrer Wirtschaftlichkeit die größte Rolle unter den erneuerbaren Energien und soll daher weiterhin umfangreich ausgebaut werden. Die Schwankungen der Windenergie haben jedoch den großen Nachteil, dass sie sich nicht mit dem Bedarf der Stromerbraucher deckt. Das Lastprofil der typischen Verbraucher können unter Berücksichtigung der üblichen Temperaturschwankungen über das Jahr, den Feiertagen und Wochenabläufen recht gut prognostiziert werden. Die Stromerzeugung aus Wind ist jedoch nur ab ca. 48 Stunden im Vorfeld recht gut prognostizierbar. Dies hat zur Folge, dass bei Windstille Kraftwerke zur Verfügung stehen müssen, die diesen Verbrauch abdecken, die aber bei windstarken Zeiten nicht benötigt werden. Derzeit sind die Schwankungen in Deutschland noch gering und zusätzliche Regelreserven wurden nicht benötigt, da die Schwankungen der Verbraucher über den Wochenablauf überwiegen (siehe Abb. 1). Jedoch der weiteren Ausbau, ähnlich wie in Dänemark, mit einer Abdeckung des Stromverbrauchs durch die Windenergie von zeitweise über 120% und mit über 50% Strom aus KWK (siehe Abb. 2), stellt neue Anforderungen an das Versorgungssystem. Entgegen der verbreiteten Auffassung, dass diese Probleme nur mit neuen Reservekraftwerken und Speicherkraftwerken gelöst werden können, wurde die Energieversorgung in Dänemark mit Hilfe der Marktinstrumente Strombörse und Regelenergiemarkt flexibilisiert.

Strombörse und Regelenergiemarkt als Indikator für Strommangebot und -nachfrage

Die Flexibilisierung der Energieversorgung wurde in Dänemark dadurch erreicht, dass die Wind- und KWK-Anlagenbetreiber ihren Strom an der Strombörse verkaufen. Windenergieanlagen bieten einen Tag im voraus mit prognostizierten Energiemengen ihren Strom für 0 €/MWh an der Strombörse an und erhalten den an der Strombörse ermittelten Preis. Dadurch beeinflussen die Windenergieanlagen in DK im Gegensatz zu Deutschland den Preis an der Strombörse erheblich. Dies kann dazu führen, dass der Preis sogar auf 0 € fällt (siehe Abb. 3).

Im Vergleich besteht in Deutschland derzeit nur ein geringer Zusammenhang zwischen der Energieeinspeisung aus Erneuerbaren Energien und dem mittleren Tagesstrompreis (Baseload) an der Strombörse, da die Übertragungsnetzbetreiber die Energie aus erneuerbaren Energien, die nach dem Erneuerbaren Energien Gesetz (EEG) vergütet werden, zu einem Tagesband (fester Wert für 24h) veredeln. Der zu erwartende Anteil der Windenergie wird dabei mit Hilfe des Prognosemodells vom Institut für Solare Energieversorgungstechnik e.V. (ISET) zu festen Uhrzeiten bis zu 48 Stunden im voraus von den vier Übertragungsnetzbetreibern (ÜNB: E.ON, RWE, EnBW, VET) berechnet. Die Beschaffung der zusätzlichen Strommengen zur Veredlung der Energie aus den EEG-Anlagen ist derzeit nicht transparent, wir aber überwiegend über feste Lieferverträge abgedeckt. Daher sind in Deutschland die Strompreise an der Börse im Tagesverlauf nicht von der Einspeisung durch Erneuerbaren Energien abhängig, sondern sie sind im Wesentlichen von der Nachfrage geprägt.

Jedoch für eine Flexibilisierung der Energieversorgung und des Stromverbrauchs zu Gunsten der Einspeisung großer Anteile aus Erneuerbaren Energien mit höherer Energieeffizienz und weniger Kraftwerksreserven zum Ausgleich des schwankenden Stromangebots ist der Indikator Strompreis für die Einspeisung aus Erneuerbaren Energien notwendig. Eine weitere wichtige Maßnahme zur Flexibilisierung ist der seit September 2006 eingeführte Intraday-Stromhandel in dem Energiemengen derzeit 75 Minuten und später 45 Minuten vor der Lieferung noch gehandelt werden können. Durch den Intraday-Markt kann der Bedarf an Regelenergie für die Windenergieeinspeisung reduziert werden, da der Prognosefehler der Windenergieprognose bei kürzerer Vorhersagedauer wesentlich abnimmt und dann Abweichungen der Energiemengen zwischen Vortagsprognose und kurzzeitprognose auf dem Intraday-Markt beschafft werden können.

Neue wirtschaftliche Potentiale für KWK-Anlage*n*

Viele KWK-Anlagen werden in Deutschland neben den je nach Alter, Typ und Größe festgelegten Zuschlägen mit dem an der Strombörse quartalsweise ermittelten „üblichen" Preis vergütet. Wird der übliche Preis mit den Preisen an der Strombörse verglichen (siehe Abb. 4) zeigt sich für KWK-Anlagen, die nicht permanent betrieben werden, welcher zusätzliche Gewinn erwirtschaftet werden kann, wenn sie nur zu Zeiten mit hohen Strompreisen an der Strombörse ins Stromnetz einspeisen. So wäre zum Beispiel im 1. Quartal 2005 eine Ertragssteigerung von 12% für eine KWK-Anlage mit 80% Auslastungsdauer möglich gewesen. Das Potential steigert sich weiterhin mit abnehmender Auslastung der KWK-Anlage z.B. bei Überkapazitäten. So liegt im gleichen Quartal die Gewinnsteigerung bei 20% wenn die KWK-Anlage nur zu 65% ausgelastet ist.

Bei dem Verkauf des KWK-Stroms an der Strombörse gibt es natürlich auch Zeiträume, in denen der Betrieb inkl. Brennstoffeinkauf (Grenzkosten) teurer ist als der Erlös aus Strom- und Wärmeverkauf. Dann ist es günstiger die notwendige Wärme entsprechend dem Bedarf mit Kesseln zu erzeugen. Im Rahmen des Projekts DESIRE wird für diese Fälle bei niedrigen Strompreisen weiterführend untersucht, inwiefern dann Stromverbrauchende Wärmepumpen die Wärmeerzeugung übernehmen können.

Um den Strom entkoppelt von dem Wärmebedarf nur zu Zeiten mit hohen Strompreisen in das Netz einspeisen zu können, müssen die KWK-Anlagen mit großen Wärmespeichern ausgerüstet werden. Die wirtschaftlichste Größe des Wärmespeichers ist individuell z.B. mit der Software EnergyPRO von EMD International A/S zu ermitteln, liegt aber üblicherweise in der Größenordnung von 1-2 Tagen Wärmespeicherung des normalen Wärmebedarfs. Die Software ermittelt auf Basis von Zeitreihen unter Berücksichtigung des Wärmebedarfs, der Speicherkapazität des Wärmespeichers und verschiedenen Anlagensteuerungsparametern den wirtschaftlichsten Betrieb der KWK-Anlage. Für den Betrieb ist dann zusätzlich eine Betriebssoftware wie EnergyTRADE notwendig, die unter Berücksichtigung der aktuellen Betriebszustände wie Verfügbarkeit der Anlage, Wärmeinhalt des Speichers, zu erwartendem Wärmebedarf und prognostiziertem Strompreis und Wärmebedarf die optimalen Betriebszeiten über mehrere Tage im voraus berechnet. Daraus können für den Folgetag die Zeiten und Strommenge für die Angebotsabgabe an der Strombörse ermittelt werden (siehe Abb.6). Um den organisatorischen Aufwand und die Bedingungen für den Handel an der Strombörse zu bewältigen, müssen mehrere KWK-Anlagen gebündelt werden, da sie meist zu klein sind. Erst durch das Bündeln (Pooling) von mehreren Kraftwerken zu „virtuellen" Kraftwerken, können die Voraussetzungen für diese neue Betriebsstrategie für KWK-Anlagen erfüllt werden (siehe Abb.5).

In den dänischen Beispielen von DESIRE wird das Pooling und der Handel mit Hilfe von EnergyTRADE bereits durchgeführt und zeigt sehr gute Erfolge, deren Betrieb Online (www.emd.dk/desire/skagen) im Internet verfolgt werden kann (siehe Abb.7). Um die Wirtschaftlichkeit der KWK-Anlagen noch zusätzlich zu steigern, werden die Anlagen künftig auch im Intraday-Handel Regelenergie anbieten. Je nachdem ob die Anlage an der Strombörse verloren oder gewonnen hat, kann sie noch negative Regelenergie (Einschalten) oder positive Regelenergie (Abschalten) angeboten werden kann.

Kontakt: EMD Deutschland, www.emd.dk
Peter Ritter, pr@emd.dk, Ludwig-Erhard-Str. 4,
34131 Kassel, 0561-3105960

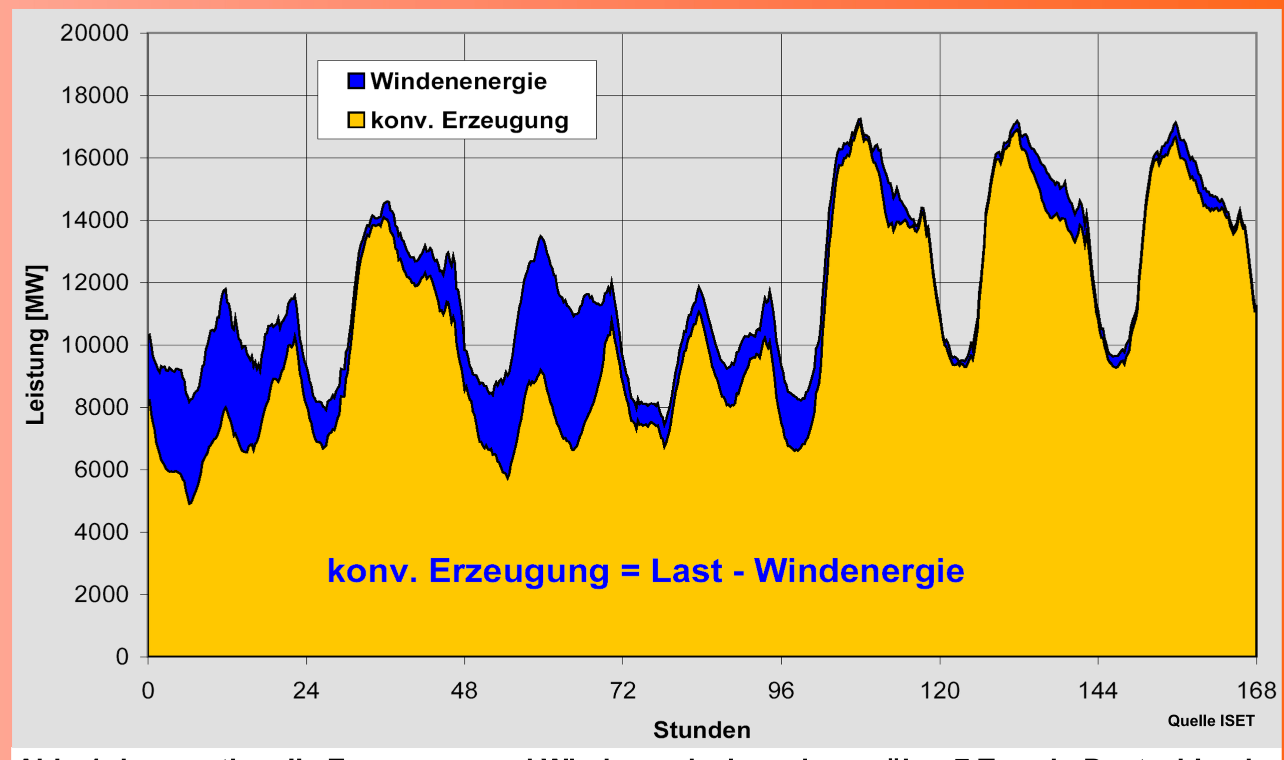


Abb. 1: konventionelle Erzeugung und Windenergieeinspeisung über 7 Tage in Deutschland

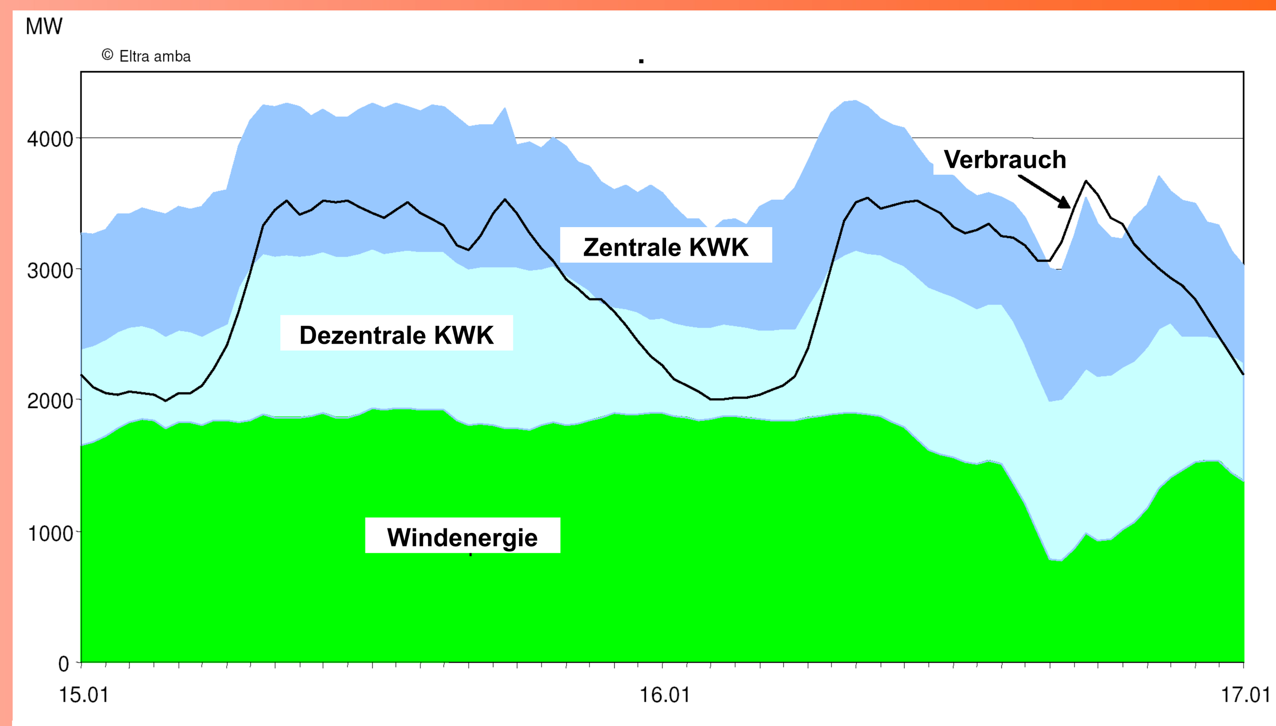


Abb. 2: Stromverbrauch, Erzeugung und Windenergieeinsp. über 2 Tage in Dänemark 2003

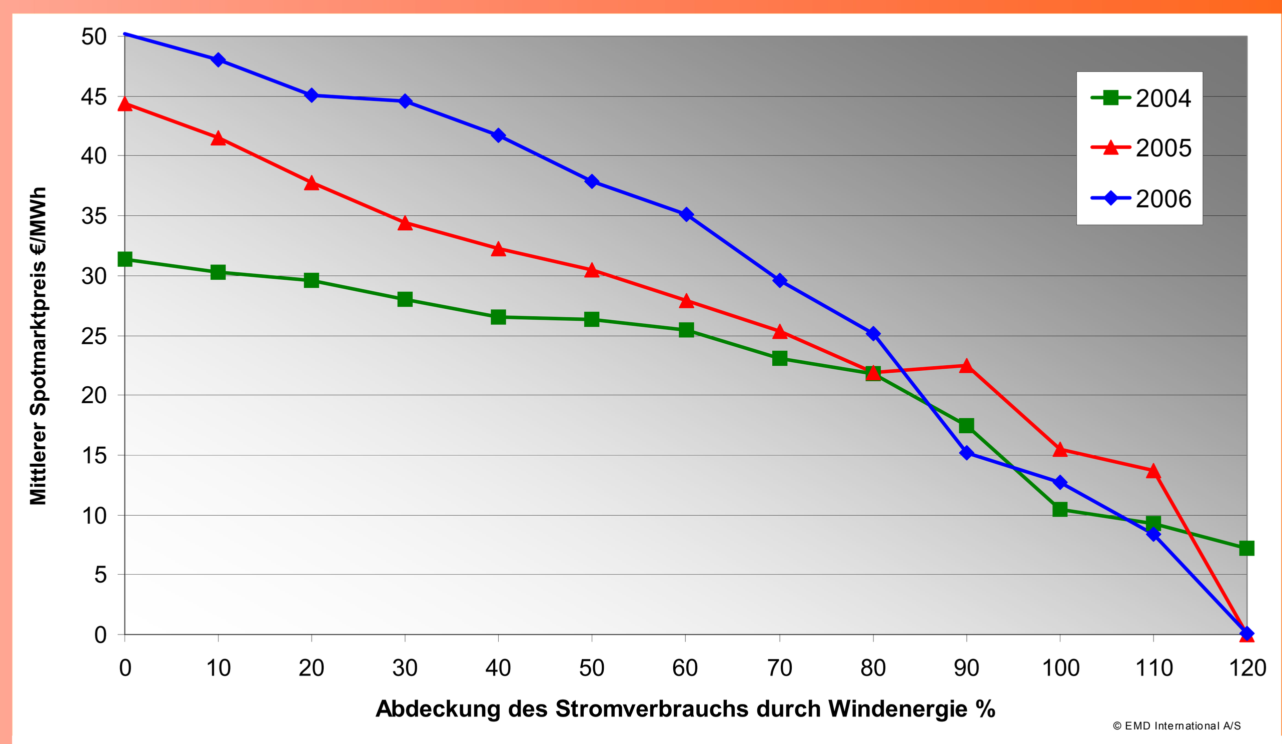


Abb. 3: Börsenpreis bei verschiedenen Anteilen der Windenergieeinspeisung in West DK

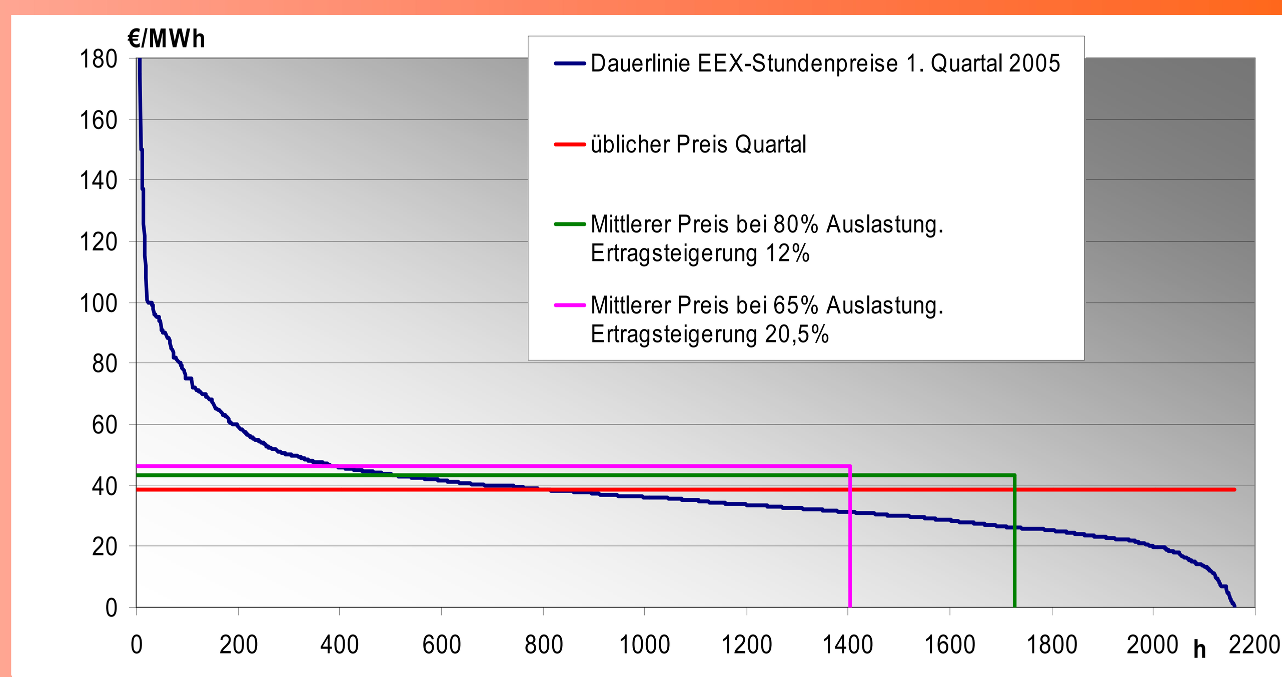


Abb. 4: Vergleich der Vergütung aus üblichem Preis und Spotpreis

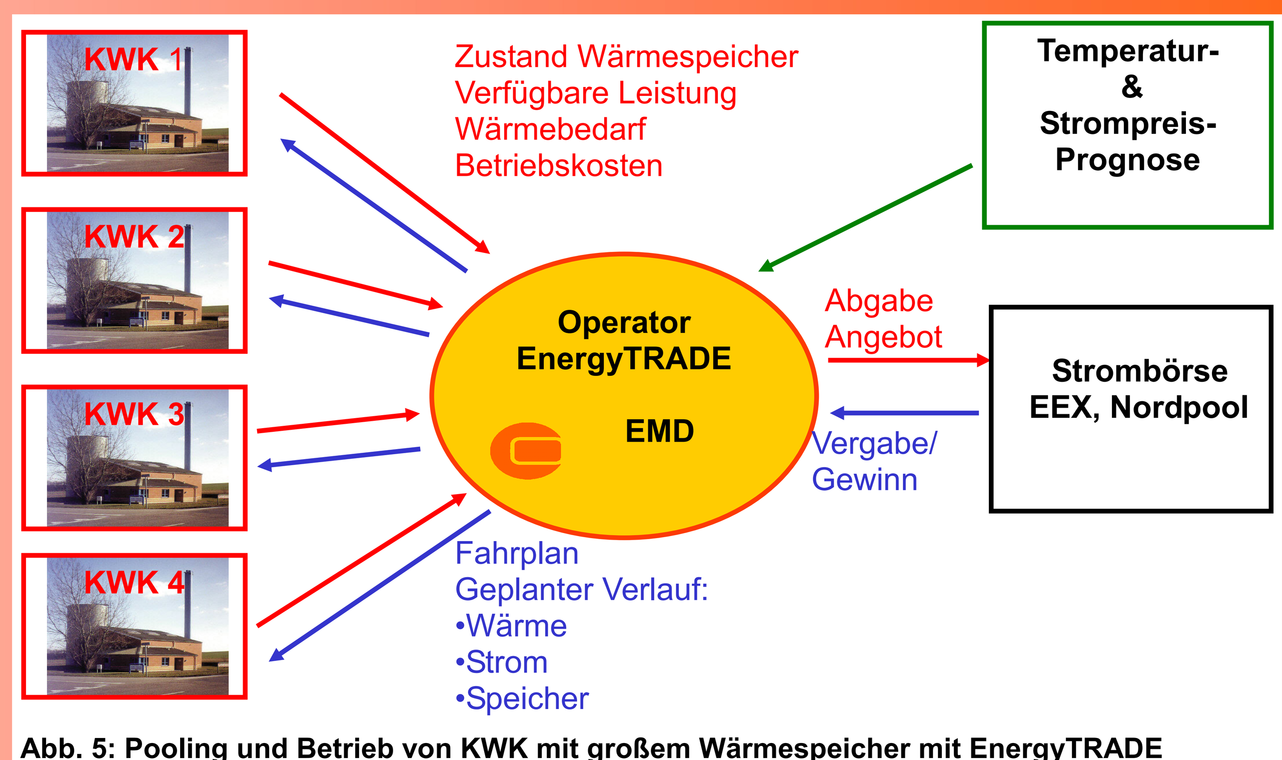


Abb. 5: Pooling und Betrieb von KWK mit großem Wärmespeicher mit EnergyTRADE

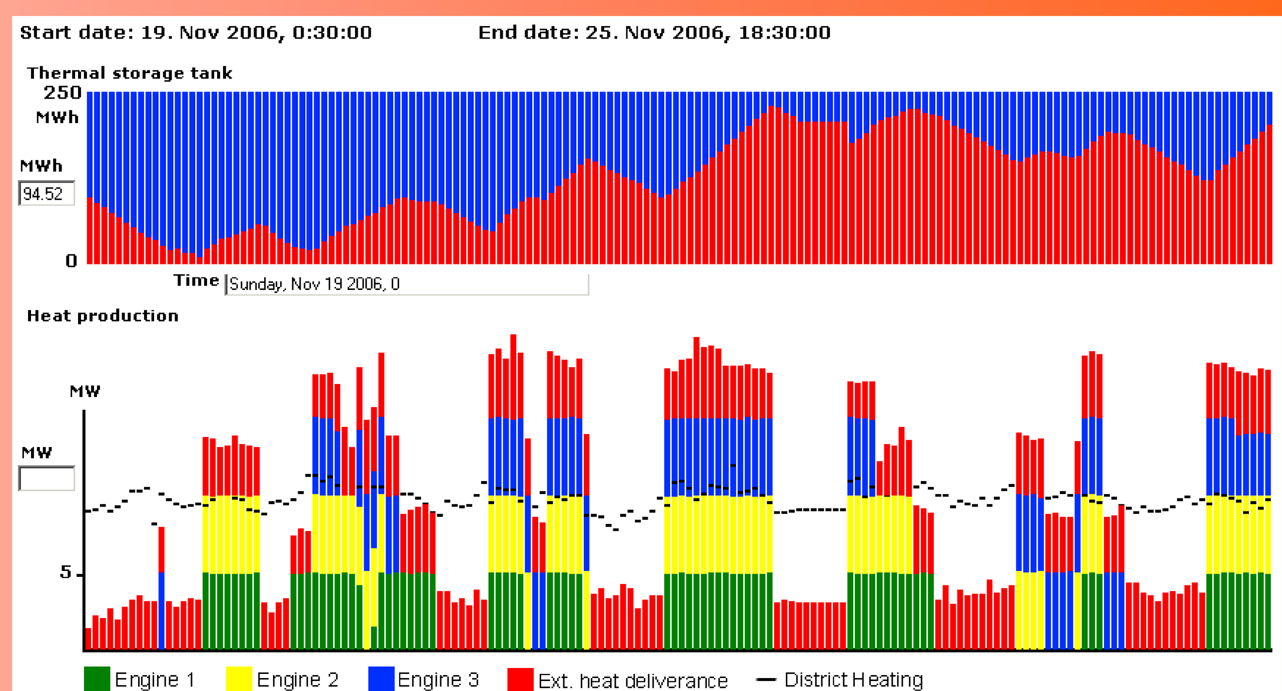


Abb. 7: Betrieb KWK-Anlage Skagen, mit Wärmespeicher, www.emd.dk/desire/skagen *History*

Reporting on dissemination activities carried out within the frame of the DESIRE project (WP8)

Name, Affiliation	Peter Ritter, EMD-Deutschland
E-mail	pr@emd.dk
Title of dissemination	Higher economic benefits for CHP plants with thermal stores. (Erhöhte Wirtschaftlichkeit von KWK-Anlagen durch große Wärmespeicher)
Type of activity	Poster presentation, ~ 50 people
Title of forum	Yearly conference 2006 for operators and planners of CHP plants including municipal utility “Stadtwerke” (Stadtwerke-konferenz 2007) organized by B.KWK (Bundesverband Kraft Wärme Kopplung). Several presentations and a forum discussion with politician of several parties
Language	German
Date of dissemination	November 29-30 2006
Place of dissemination	Berlin, Germany
Brief abstract / description of dissemination activity	1. Forum for CHP operators and planner in Germany to promote DESIRE 2. Detail description of the demand of flexible power generation and the benefits of thermal stores for CHP 3. We get useful contacts. 4. Feedback of the participants, why the development of CHP in Germany is low in opposite of the strived for goal of the government.
Audience impact assessment	The integration of big thermal store in CHP plants to be more flexible in power generation is not so much in the mind of people. This kind of presentation helps to start a new thinking and show the economic benefit of operation with thermal stores. Also a presentation of ISE (Frauenhofer Institut für Solare Energiesysteme, Freiburg) at this conference supported the benefits of thermal stores.
Dissemination	Included after this form

Erhöhte Wirtschaftlichkeit von KWK-Anlagen durch große Wärmespeicher

Dissemination strategy on Electricity balancing
DESIRE
large Scale Integration of Renewable Energy

EU Sixth Framework Programme, www.projekt-desire.org

Überblick

Durch den geplanten weiteren Ausbau der Energieversorgung mit Erneuerbaren Energien (besonders Windenergie) besteht Bedarf an einer Flexibilisierung der Energieversorgung in Europa. Bisher besteht überwiegend die Auffassung, dass dies nur durch den Ausbau der Regelenergiereserven mit modernen großen Kraftwerken (z.B. Gasturbinen) und durch neue Speicherkraftwerke (z.B. Druckluftspeicher) realisiert werden könne. Im Rahmen des Europäischen Demonstrationsprojekts DESIRE (Dissemination strategy on Electricity balancing for large-Scale Integration of Renewable Energy www.projekt-desire.org) mit Projektpartner aus Dänemark, Deutschland, Großbritannien, Spanien, Polen und Estland wird aufgezeigt, dass es andere Möglichkeiten für Technologien für den Ausgleich von Erzeugung und Verbrauch gibt, die gleichzeitig die Energieeffizienz erhöhen und den CO_2 –Ausstoß reduzieren. Einen besonderen Stellenwert erhalten dabei die Kraftwärmekopplungs-Anlagen (KWK) mit kurzen Anfahrzeiten und geringen Startkosten wie z.B. BHKW) in Verbindung mit großen Wärmespeichern.

Gleichzeitig zeigt sich, dass innerhalb der bestehenden Strukturen des Liberalisierten Strommarkts mit Strombörsen und Regelenergiemärkten die Wirtschaftlichkeit von KWK-Anlagen durch den Einsatz von den Wärmespeichern auch in Deutschland erheblich gesteigert werden kann.

Im Rahmen von DESIRE werden an konkreten KWK-Beispielen in Dänemark, Deutschland und Großbritannien die Möglichkeiten für einen wirtschaftlicheren Betrieb aufgezeigt und durch EMD International A/Sein Softwaretool (EnergyTRADE) für den optimalen Betrieb von KWK-Anlagen im liberalisierten Strommarkt entwickelt. An zwei der dänischen Anlagen wird EnergyTRADE bereits erfolgreich eingesetzt. Der Betrieb kann online im Internet verfolgt werden (Siehe Abb. 7).

In einem weiteren Schritt des Projekts wird analysiert, inwiefern durch die Teilnahme der KWK-Anlagen an weiteren Strommärkten, wie dem Regelenergiemarkt (z. B. Minutenreserve) und dem Intraday-Markt eine zusätzliche Gewinnsteigerung möglich ist.

Ausgleich von Schwankungen bei Einspeisung großer Anteile von Erneuerbaren Energien

Derzeit spiel die Windenergie aufgrund seiner Wirtschaftlichkeit die größte Rolle unter den erneuerbaren Energien und soll daher weiterhin umfangreich ausgebaut werden. Die Schwankungen der Windenergie haben jedoch den großen Nachteil, dass sich deren Schwankungen nicht mit den Schwankungen der Stromerbraucher deckt. Die Schwankungen der typischen Verbraucher können unter Berücksichtigung der üblichen Temperaturschwankungen über das Jahr, den Feiertagen und Wochenabläufen recht gut prognostiziert werden. Die Stromerzeugung aus Wind ist jedoch nur ab ca. 48 Stunden im Vorfeld recht gut prognostizierbar. Dies hat zur Folge, dass bei Windstille Kraftwerke zur Verfügung stehen müssen die den Verbrauch abzudecken, sollen die aber bei windstarken Zeiten nicht benötigt werden. Derzeit sind die Schwankungen in Deutschland noch gering und zusätzliche Regelreserven wurden nicht benötigt, da die Schwankungen der Verbraucher über den Wochenablauf überwiegen (siehe Abb. 1). Jedoch der weiteren Ausbau, ähnlich wie in Dänemark, mit einer Abdeckung des Stromverbrauchs durch die Windenergie von zeitweise über 120% und mit über 50% Strom aus KWK (siehe Abb. 2), stellt neue Anforderungen an das Versorgungssystem. Entgegen der verbreiteten Auffassung, dass diese Probleme nur mit neuen Reservekraftwerken und Speicherkraftwerken gelöst werden können, wurden die Energieversorgung in Dänemark mit Hilfe der Marktinstrumente Strombörse und Regelenergiemarkt flexibilisiert.

Strombörse und Regelenergiemarkt als Indikator für Strommangebot und Stromnachfrage

Die Flexibilisierung der Energieversorgung wurde in Dänemark dadurch erreicht, dass die Wind- und KWK-Anlagenbetreiber ihren Strom an der Strombörse verkaufen. Windenergieanlagen bieten einen Tag im voraus mit prognostizierten Energiemengen ihren Strom für 0 €/MWh an der Strombörse an und erhalten den an der Strombörse ermittelten Preis. Dadurch beeinflussen die Windenergieanlagen in DK im Gegensatz zu Deutschland den Preis an der Strombörse erheblich. Dies kann dazu führen, dass der Preis sogar auf 0 € fällt (siehe Abb. 3).

Im Vergleich besteht in Deutschland derzeit kein nennenswerter Zusammenhang zwischen der Energieeinspeisung aus Erneuerbaren Energien und dem Strompreis an der Strombörse, da die Übertragungsnetzbetreiber die Energie aus erneuerbaren Energien, die nach dem Erneuerbaren Energien Gesetz (EEG) vergütet werden, zu einem Tagesband (fester Wert für 24h) veredeln. Der zu erwartende Anteil der Windenergie wird dabei mit Hilfe des Prognosemodells vom Institut für Solare Energieversorgungstechnik e.V. (ISET) zu festen Uhrzeiten bis zu 48 Stunden im voraus von den vier Übertragungsnetzbetreibern (ÜNB: E.ON, RWE, EnBW, VET) berechnet. Die Beschaffung der zusätzlichen Strommengen zur Veredlung der Energie aus den EEG-Anlagen ist derzeit sehr undurchsichtig. Da die Kosten für den Strom aus Erneuerbaren Energien inklusive der zusätzlichen Energiemengen den Verbrauchern zu 100% in Rechnung gestellt werden, haben die Übertragungsnetzbetreiber kein Interesse daran, die benötigten Strommengen zur Veredelung besonders preisgünstig zu beschaffen. Aufgrund dieser Tatsachen sind in Deutschland die Strompreise an der Börse nicht von der Einspeisung durch Erneuerbaren Energien abhängig, sondern sie sind im Wesentlichen, bis auf Zeiträume mit Ausfall von Kraftwerken oder Stromleitungen, von der Nachfrage geprägt.

Jedoch für eine Flexibilisierung der Energieversorgung zu Gunsten der Einspeisung großer Anteile aus Erneuerbaren Energien mit höherer Energieeffizienz und weniger Kraftwerksreserven zum Ausgleich des schwankenden Stromangebots ist der Indikator Strompreis für die Einspeisung aus Erneuerbaren Energien notwendig. Eine weitere wichtige Maßnahme zur Flexibilisierung ist der seit September 2006 eingeführte Intraday-Stromhandel in dem Energiemengen derzeit 75 Minuten und später 45 Minuten vor der Lieferung noch gehandelt werden können. Durch den Intraday-Markt kann der Bedarf an Regelenergie für die Windenergieeinspeisung reduziert werden, da der Prognosefehler der Windenergieprognose bei kürzerer Vorhersagedauer wesentlich abnimmt und dann die Energiemengen auf dem Intraday-Markt beschafft werden können.

Neue wirtschaftliche Potentiale für KWK-Anlagen

Viele KWK-Anlagen werden in Deutschland neben den je nach Alter, Typ und Größe festgelegten Zuschlägen mit dem an der Strombörse quartalsweise ermittelten „üblichen" Preis vergütet. Wird der übliche Preis mit den Preisen an der Strombörse verglichen (siehe Abb. 4) zeigt sich für KWK-Anlagen, die nicht permanent betrieben werden, welcher zusätzliche Gewinn erwirtschaftet werden kann, wenn sie nur zu Zeiten mit hohen Strompreisen an der Strombörse ins Stromnetz einspeisen. So wäre zum Beispiel im 1. Quartal 2005 eine Ertragssteigerung von 12% für eine KWK-Anlage mit 80% Auslastungsdauer möglich gewesen. Das Potential steigert sich weiterhin mit abnehmender Auslastung der KWK-Anlage z.B. bei Überkapazitäten. So liegt im gleichen Quartal die Gewinnsteigerung bei 20% wenn die KWK-Anlage nur zu 65% ausgelastet ist.

Bei dem Verkauf des KWK-Stroms an der Strombörse gibt es dann natürlich auch Zeiträume, in denen der Betrieb inkl. Brennstoffeinkauf teurer ist als der Erlös aus Strom- und Wärmeverkauf. Dann ist es günstiger die notwendige Wärme entsprechend dem Bedarf mit Kesseln zu erzeugen. Im Rahmen des Projekts DESIRE wird für diese Fälle bei niedrigen Strompreisen weiterführend untersucht, inwiefern dann Wärmepumpen als Ergänzung zu den KWK-Anlagen die Wärmeerzeugung übernehmen können.

Um den Strom flexibel nur zu Zeiten mit hohen Strompreisen in das Netz einspeisen zu können, müssen die KWK-Anlagen mit großen Wärmespeichern ausgerüstet werden. Die wirtschaftlichste Größe des Wärmespeichers ist individuell z.B. mit der Software EnergyPRO von EMD International A/S zu ermitteln, liegt aber üblicherweise in der Größenordnung von 1-2 Tagen Wärmespeicherung des normalen Wärmebedarfs. Die Software ermittelt auf Basis von Zeitreihen unter Berücksichtigung des Wärmebedarfs, der Speicherkapazität des Wärmespeichers und verschiedenen Anlagensteuerungsparametern den wirtschaftlichsten Betrieb der KWK-Anlage. Für den Betrieb ist zusätzlich eine Betriebssoftware wie EnergyTRADE notwendig, die unter Berücksichtigung der aktuellen Betriebszustände der Anlage, Wärmeinhalt des Speichers, zu erwartendem Wärmebedarf und prognostiziertem Strompreis vorausschauend für eine Woche die Zeiten und Strommenge für die Angebotsabgabe an der Strombörse ermittelt (siehe Abb.6). Darüber hinaus müssen mehrere KWK-Anlagen gebündelt werden, da sie meist zu klein sind, um den organisatorischen Aufwand und die Bedingungen für den Handel an der Strombörse zu erfüllen. Erst durch das Bündeln (Pooling) von mehreren Kraftwerken zu „virtuellen" Kraftwerken, wie z.B. bei der Südwestdeutsche Stromhandelsgesellschaft, können die Voraussetzungen für diese neue Betriebsstrategie für KWK-Anlagen erfüllt werden (siehe Abb.5).

In Dänemark wird im Rahmen von DESIRE das Pooling und der Handel mit Hilfe von EnergyTRADE bereits durchgeführt und zeigt sehr gute Erfolge, deren Betrieb Online im Internet (www.emd.dk/desire/skagen) verfolgt werden können (siehe Abb.7). Um die Wirtschaftlichkeit der KWK-Anlagen noch weiterhin zu steigern, werden die Anlagen zusätzlich künftig noch Regelenergie anbieten. Zeitlich liegt die Angebotsrückmeldung von der Strombörse soweit im voraus, dass danach noch Regelenergie angeboten werden kann. Nach der Rückmeldung ob der Betreiber an der Strombörse gewonnen hat oder nicht, kann er dann entsprechend negative Regelenergie (Einschalten der Anlage) oder positive Regelenergie (Abschalten der Anlage) anbieten.

Erste Untersuchungen am deutschen Beispiel der Stadtwerke Schwäbisch Hall zeigen exemplarisch auch für deutsche Stadtwerke die großen Potentiale für eine höhere Wirtschaftlichkeit mit von Amortisationszeiten des Wärmespeicher von 2-3 Jahren.

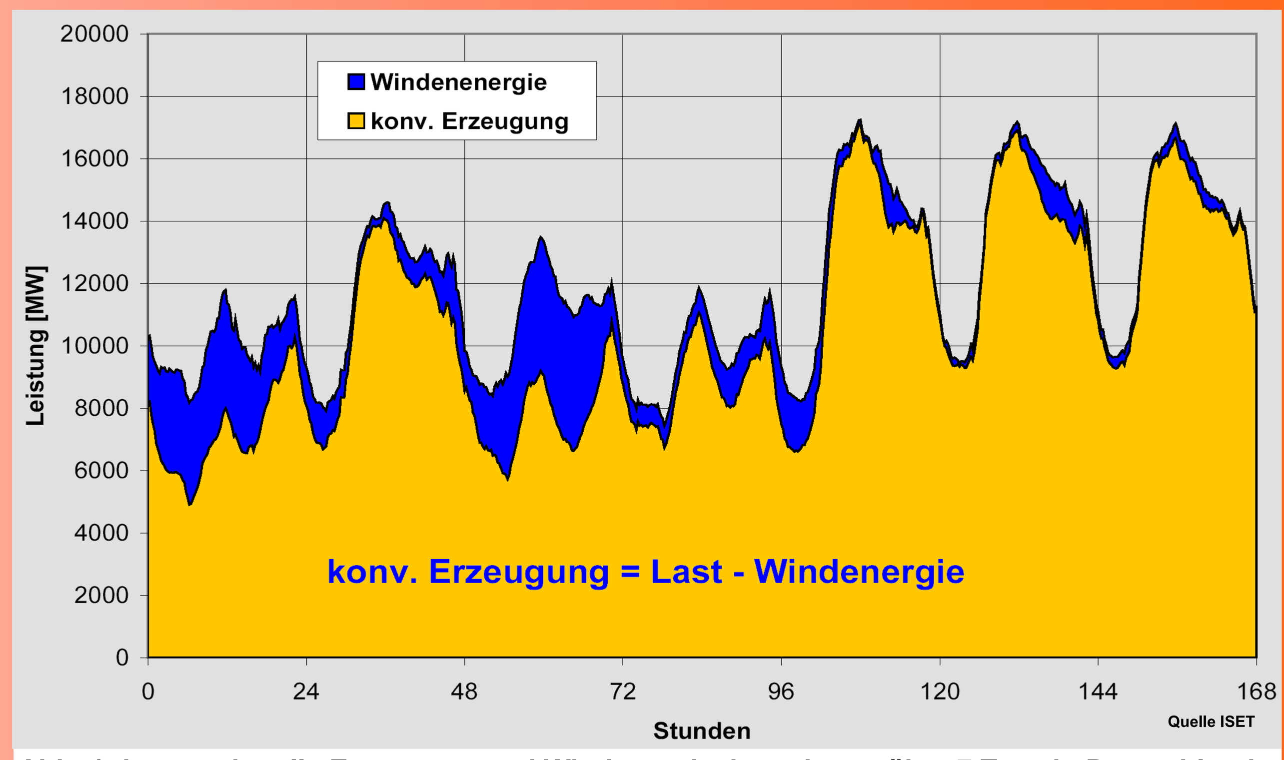


Abb. 1: konventionelle Erzeugung und Windenergieeinspeisung über 7 Tage in Deutschland

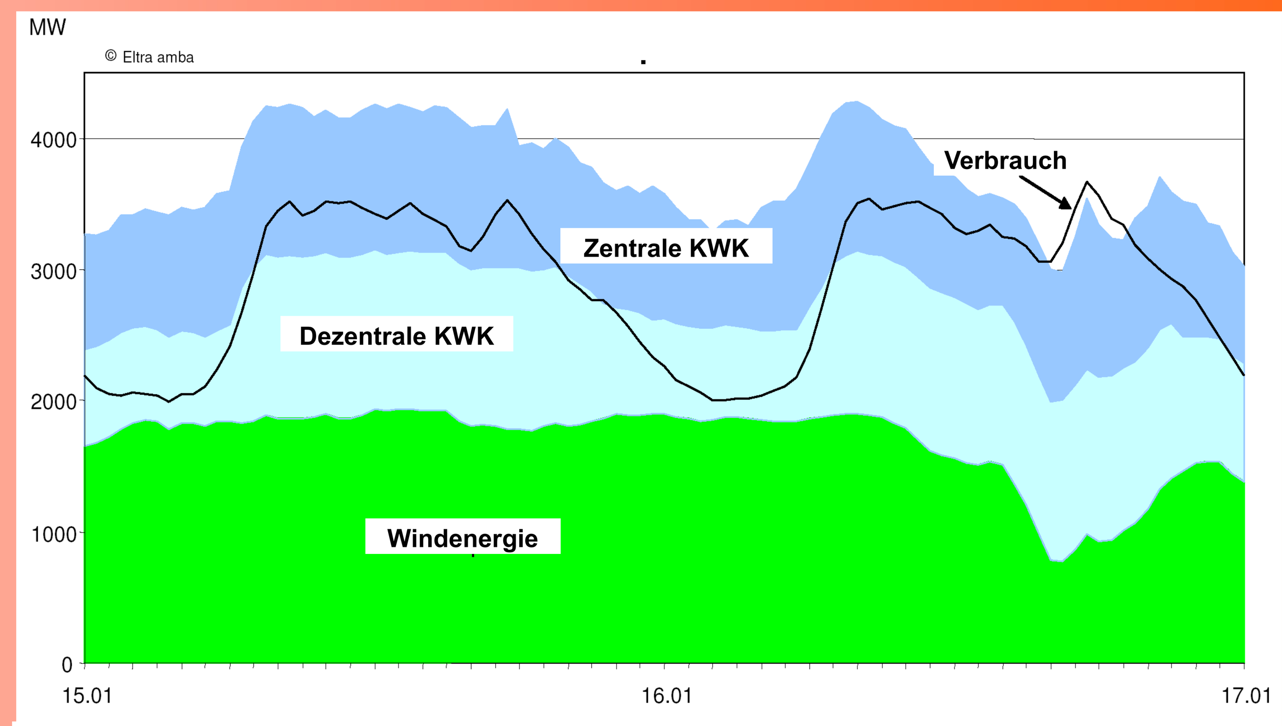


Abb. 2: Stromverbrauch, Erzeugung und Windenergieeinsp. über 2 Tage in Dänemark 2003

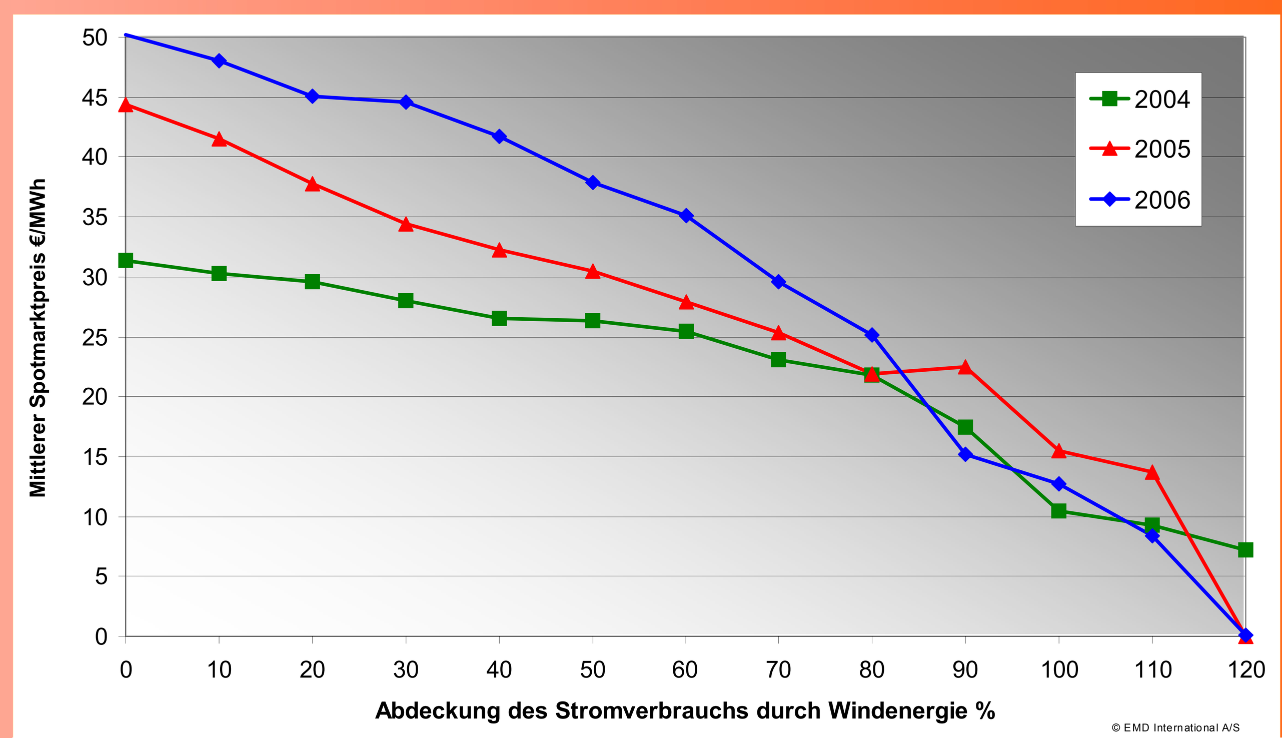


Abb. 3: Börsenpreis bei verschiedenen Anteilen der Windenergieeinspeisung in West DK

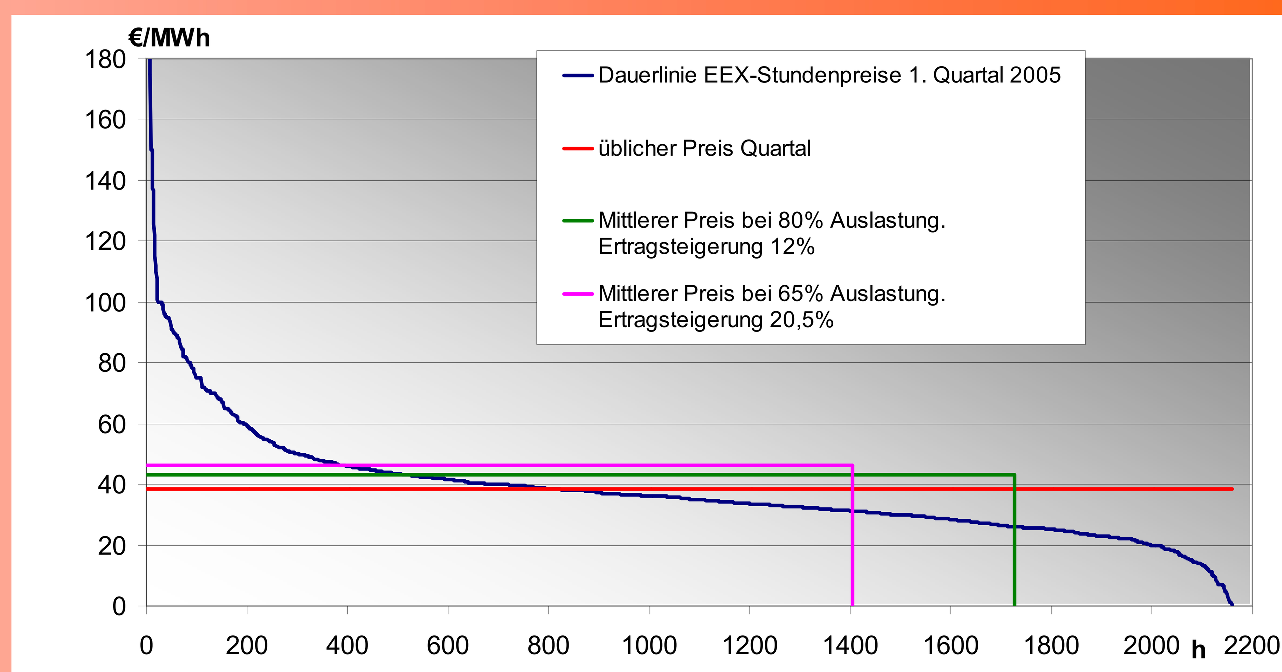


Abb. 4: Vergleich der Vergütung aus üblichem Preis und Spotpreis

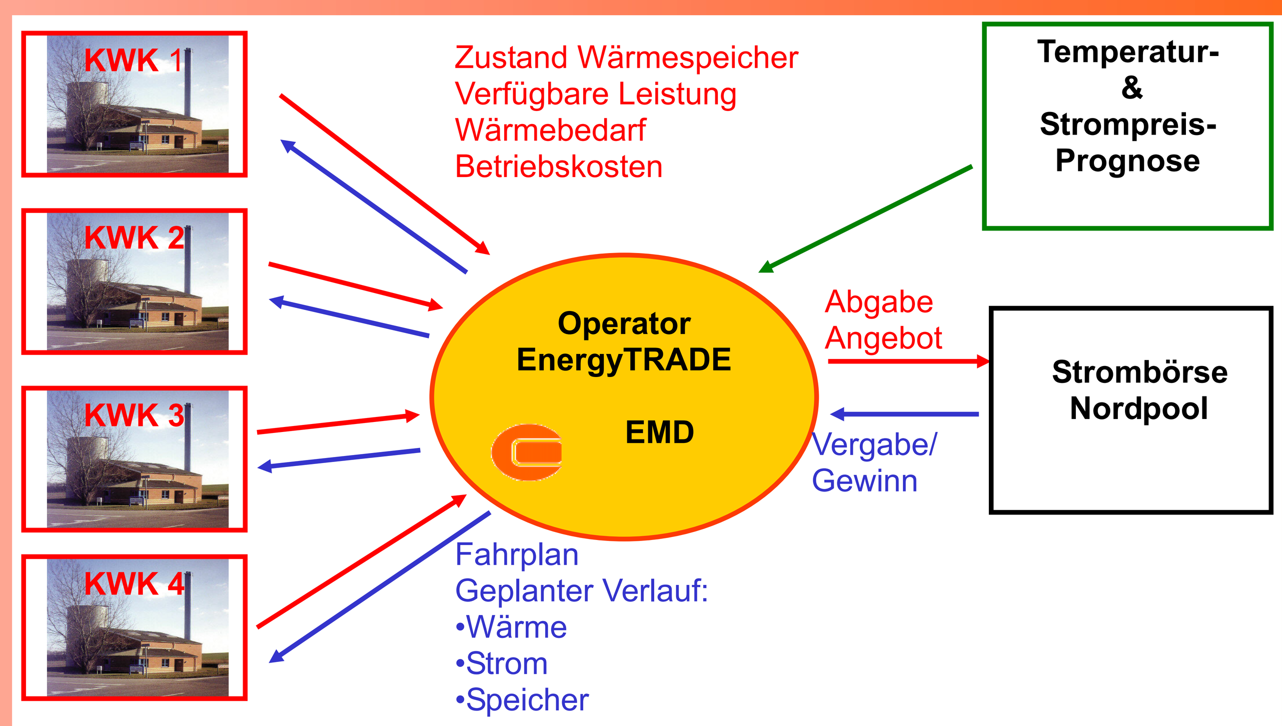


Abb. 5: Pooling und Betrieb von KWK mit großem Wärmespeicher mit EnergyTRADE

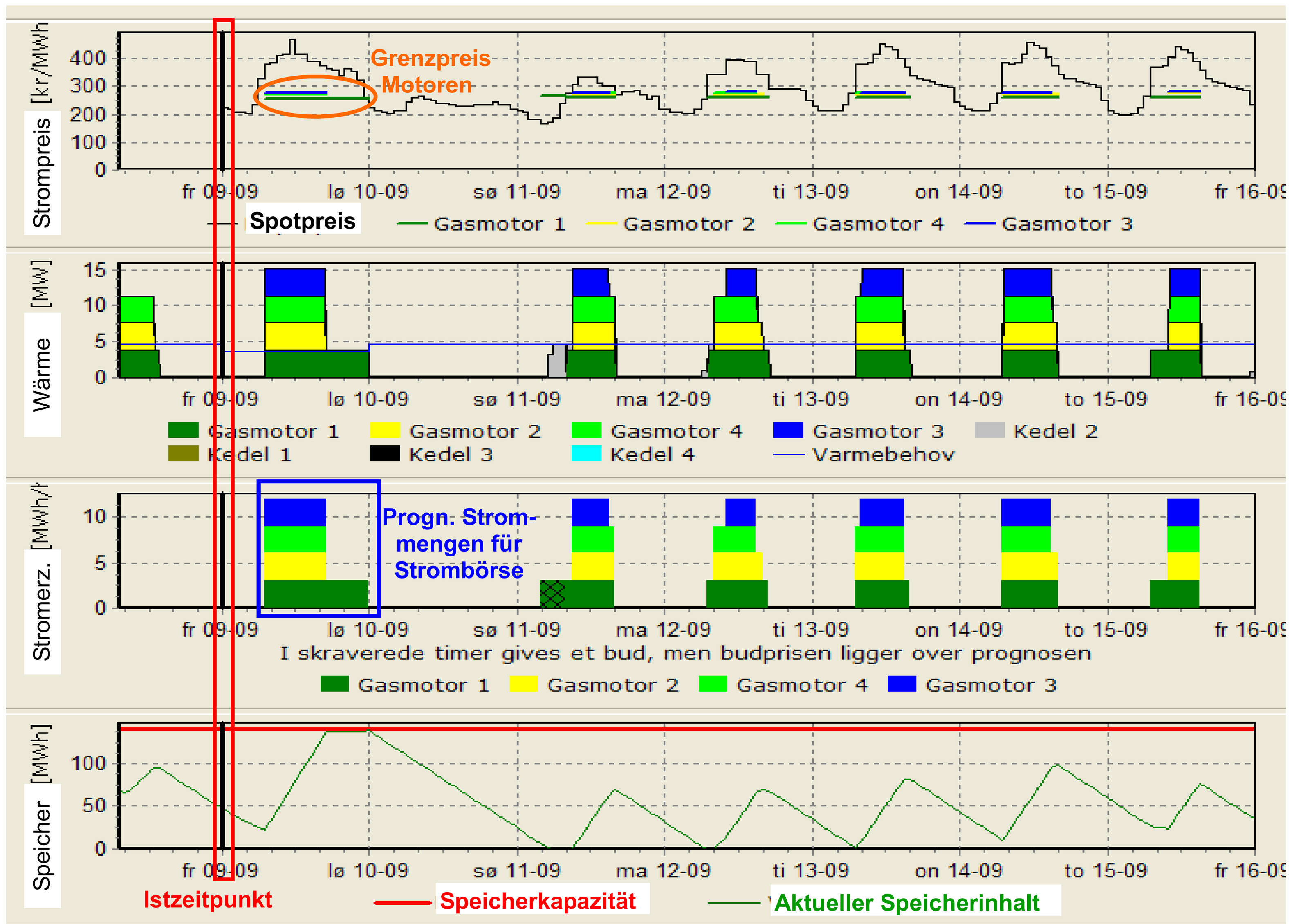


Abb. 6: Betriebsprognose für KWK-Anlage 4x4 MW 7 Tage im Voraus mit EnergyTRADE von EMD

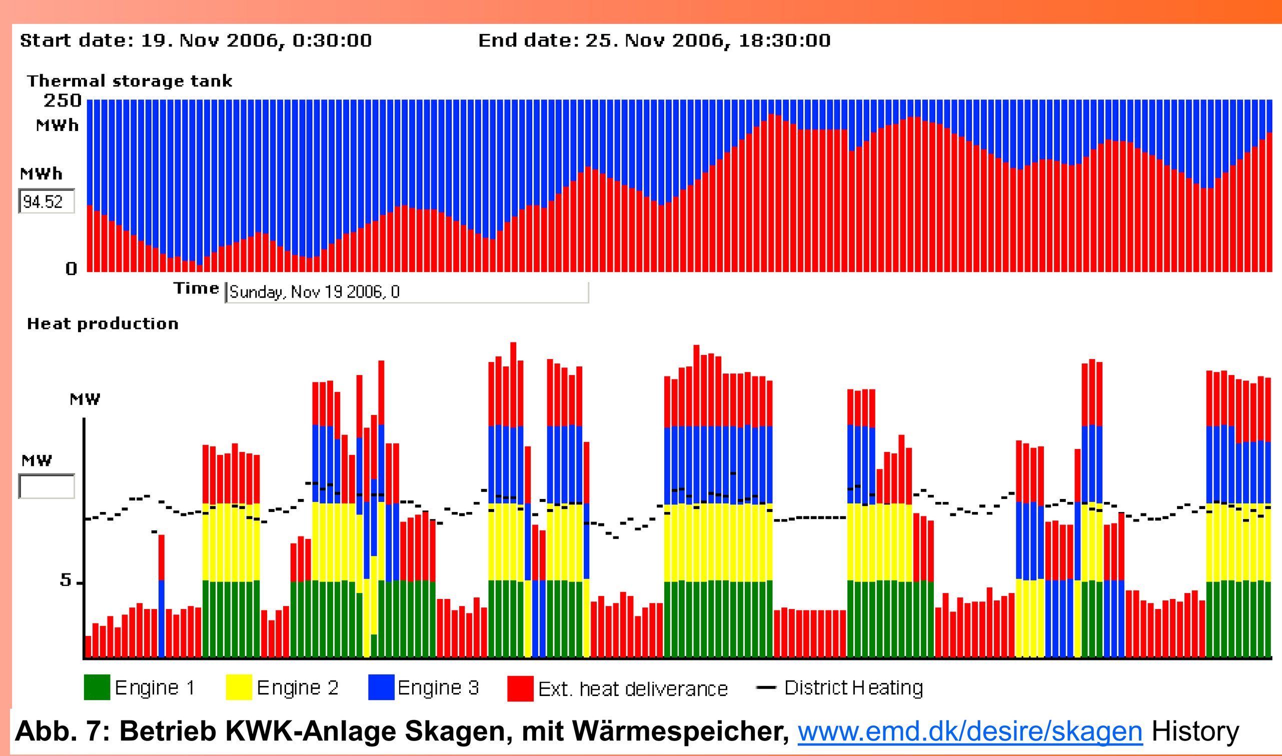


Abb. 7: Betrieb KWK-Anlage Skagen, mit Wärmespeicher, www.emd.dk/desire/skagen History

Kontakt:
EMD Deutschland, www.emd.dk
Peter Ritter, pr@emd.dk,
Ludwig-Erhard-Str. 4, 34131 Kassel,
0561-3105960

Dissemination strategy on Electricity balancing

DESIRE

large Scale Integration of Renewable Energy

Reporting on dissemination activities carried out within the frame of the DESIRE project (WP8)

Name, Affiliation	Carlos Madina, Labein
E-mail	cmadina@labein.es
Title of dissemination	Wind-CHP "Virtual Power Plants" in different European countries
Type of activity	Presentation at conference
Title of forum	Distribution Europe 2006
Language	English
Date of dissemination	17-may-2006
Place of dissemination	Barcelona (Spain)
Brief abstract / description of dissemination activity	The presentation compared the possibilities that regulatory frameworks in the countries participating in DESIRE offer for the balancing techniques proposed in the project. Europe is facing/will face important energy challenges, so wind power and CHP can be good solutions, but they both have problems, so the combined use of them can reduce each technology's problems, but, before implementing the combined use, the regulatory conditions must be determined and, therefore, a summary of WP3 was made. As a result of the analysis, it could be seen that conditions are good in Denmark; they can quite easily be good also in Germany if market integration of RES is promoted; Spain required the promotion of flexible CHP; the UK needs the promotion of flexible CHP and a better promotion of wind power; Poland has a good potential, but requires that the regulation takes the right direction to promote wind power and flexible CHP, and to effectively open the electricity market; and Estonia needs to open its electricity market, before thinking of using these techniques.
Audience impact assessment	The presentation was quite short, but reference to the homepage was made, so that interested parties could search for more information. Individual questions were also received during coffee breaks, from people from Germany, Denmark, Spain and the UK. The Danish TSO appeared to be interested in the project and asked for the contact person in Denmark.
Dissemination	Included after this form

Wind-CHP "Virtual Power Plants" in Different European Countries

Distribution Europe 2006
Barcelona, 17 May 2006

Carlos Madina, Labein-Tecnalia

CONTENTS

- European energy situation overview
- Proposed solution
- Comparison of regulatory frameworks in different countries

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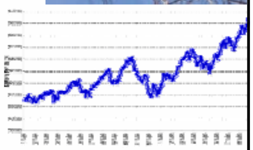
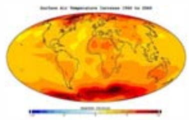
EUROPEAN ENERGY SITUATION OVERVIEW
(Green Paper "Energy")

- € 1 billion investments to meet Europe's demand and replace ageing infrastructure
- Rising dependency on imports:
  - Reserves concentrated in a few countries
  - Oil and gas have doubled in 2 years in EU



- Global warming: Kyoto Protocol

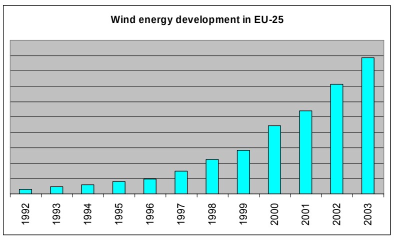


- Policy output (EU-Directives):
  - Directive 2001/77/EC: Promotion of RES electricity → National support schemes
  - Directive 2002/91/EC: Energy in buildings
  - Directive 2003/30/EC: Promotion of biofuels
  - Directive 2003/54/EC: Electricity market
  - Directive 2003/55/EC: Gas market
  - Directive 2003/87/EC: GHG emissions
  - Directive 2004/8/EC: Promotion of CHP
  - Directive 2006/32/EC: Efficient use of energy

4

EUROPEAN ENERGY SITUATION OVERVIEW
(Opportunities and Barriers for Wind Power)

- Opportunities:
  - Technology close to maturity
  - Almost competitive with traditional electricity generation
  - Fast growth, in Europe in particular



- Barriers:
  - Difficult forecasting → imbalances → more reserves needed in the market for Ancillary Services
  - Under-usage of electric infrastructures
  - Difficult management of promoters by System Operators

5

PROPOSED SOLUTION
(Description)

- Balancing of wind power, by using flexible CHP (thermal storage)
- Flexible CHP can modify its power output to balance wind power
- Advantages:
  - Forecasting error reduction
  - Better usage of transmission infrastructure
  - Better coordination with TSO when dispatching DG units
  - Improvement of both CHP and wind power economics
  - Increase of competition in electricity markets

6

PROPOSED SOLUTION
(DESIRE project)

Dissemination Strategy on Electricity Balancing

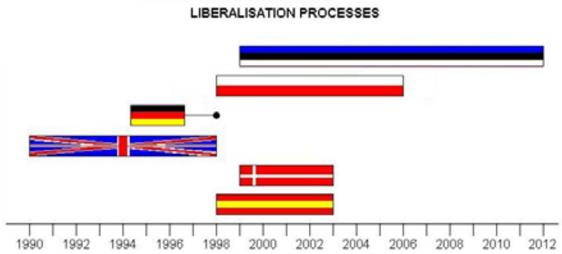
DESIRE

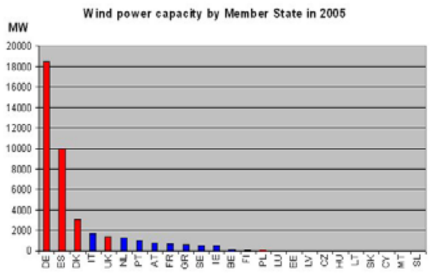
for Large Scale Integration of Renewable Energy

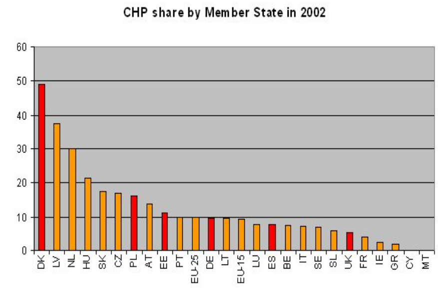
Dissemination Strategy on Electricity Balancing for Large Scale Integration of Renewable Energy

http://www.project-desire.org

REGULATORY FRAMEWORKS – GENERAL CONDITIONS







8

REGULATORY FRAMEWORKS
(Actors 1)

- Regulator:
  - Guarantees the good functioning of the market
  - Settles disputes between market actors
  - Approves tariffs proposed by system operators
  - Grants or revokes licenses (new power plants, suppliers, DSOs,…)
  - Acts an advisory body for the government: new laws, state energy policy,…
  - German regulator started its operation in 2006
- Market Operator:
  - Manages wholesale electricity market (except GB)
  - Performs clearing services
  - It is independent from energy interests
  - Its relationships with market participant are governed by public laws

9

REGULATORY FRAMEWORKS
(Actors 2)

- System Operator – Transmission System Operator:
  - Guarantees continuity and security of supply
  - Operates and maintains transmission grid
  - Regulated prices for network access
  - Independence from energy interests in ES, DK and E&W
  - Germany has 4 SOs → 4 balancing areas
- Distribution System Operators:
  - Operate, maintain and develop distribution grid
  - Suppliers of last resort in Spain, Poland and Estonia
  - Must connect small RES and CHP plants
  - Must buy electricity to small RES/CHP producers at a fixed price (except Great Britain and Poland).
  - In Poland they must supply a certain percentage from RES/CHP

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REGULATORY FRAMEWORKS
(Actors 3)

- Wind or CHP producers:
  - Wind producers receive a guarantee of origin (except Spain)
  - CHP producers must fulfil some efficiency criteria to receive a special treatment
  - CHP producers receive a guarantee of origin only in Great Britain, where they receive CCL exemption
  - Small producers receive a regulated price (higher), except in Great Britain, where RES receive a ROC (suppliers must sell a percentage of electricity)
  - Big producers have different options:
    - Regulated price
    - Market price plus a bonus
    - Negotiated price
    - Only market price

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REGULATORY FRAMEWORKS (Market)

- Centralised (Spain, Denmark, Germany, Poland):
  - Pool-based marginal price
  - Sessions (Market Operator):
    - Daily market
    - Intradaily market (only in Spain and Poland)
    - Futures market (except in Spain)
    - Bilateral contracts
  - Ancillary Services (System Operator):
    - Upward/downward reserves
    - Payment for capacity and for actual increase/decrease in electricity generation/consumption
    - Divided into areas: DSO (Spain) or TSO (Denmark, Germany)
- Decentralised (UK):
  - OTC or Power Exchanges
  - Standard terms and conditions
  - Futures and forward markets
  - Balancing Mechanism:
    - SO is the sole counterparty
    - Payment: Paid as bid
- No competition (Estonia):
  - The TSO is the only counterparty for generators and consumers
  - The TSO establishes prices
  - The regulator monitors these contracts

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ADVANTAGES/DISADVANTAGES OF EACH REGULATORY REGIME

- Spain:
  - ▲ Effective promotion of wind → Enough capacity
  - ▲ Promotion of market integration → Need to balance output
  - ▼ No specific promotion of flexible CHP
- Denmark:
  - ▲ Effective promotion of wind → Enough capacity
  - ▲ Promotion of market integration → Need to balance output
  - ▲ Promotion of flexible CHP (through DH)
- Great Britain:
  - ▲ Promotion of market integration → Need to balance output
  - ▼ No effective promotion of wind power
  - ▼ No specific promotion of flexible CHP
- Germany:
  - ▲ Effective promotion of wind → Enough capacity
  - ▲ Promotion of market integration → Need to balance output
  - ▲ Promotion of flexible CHP (through DH)
- Poland:
  - ▼ No effective promotion of wind power
  - ▼ No effective promotion of market integration (long-term contracts)
  - ▼ No specific promotion of flexible CHP
- Estonia:
  - ▼ No real competitive market → Market monitoring

THANK YOU FOR YOUR ATTENTION

http://www.labein.es

http://www.project-desire.org

Dissemination strategy on Electricity balancing

DESIRE

large Scale Integration of Renewable Energy

Reporting on dissemination activities carried out within the frame of the DESIRE project (WP8)

Name, Affiliation	Carlos Madina, Labein
E-mail	cmadina@labein.es
Title of dissemination	Methods used by Spanish utilities to integrate the rapidly increasing capacity of wind power in Spain into the electricity grid
Type of activity	Presentation at seminar
Title of forum	DESIRE seminar - Integration of fluctuating renewables into the grid using combined heat and power
Language	English
Date of dissemination	9-November-2005
Place of dissemination	Birmingham
Brief abstract / description of dissemination activity	The presentation described the problems that the integration of wind power into electricity grids creates on network operators. It started with an overview to the situation and the development of wind power in Spain, which problems it has created and how the system operators solve them. Conclusions are that, although wind power creates some problems to Spanish system operators, they are able to solve them at the moment, or the needed regulatory chages are under preparation, to help them in solving those problems.
Audience impact assessment	The audience seemed to be interested in the contents of the presentation, although nothing was put in motion after it.
Dissemination	Included after this form

DESIRE Presentation Seminar
Birmingham
9 November 2005

labein tecnalia

labein tecnalia

AGENDA

- Spanish energy situation overview
- Energy priorities
- Historical development of regulation affecting wind power
- Historical development of wind power
- Present regulation on wind power
- Problems faced by wind power promoters
- Problems created by wind power
- Solutions
- Future perspectives
- Comments and Questions

ENERGY SITUATION OVERVIEW

- Primary energy dependency on imports: 80%
- Electricity demand increases: 4.8% per year on average since 1994
- GHG emissions 40% over 1990 level (15% allowed)
- Renewable energy sources for electricity in 2004:
  - 14% Hydro
  - 6% Wind
  - 1% Biomass

ENERGY PRIORITIES

- Reduction of electricity demand increase to GDP increase level
- Increase of bio-fuels' share up to 5.75%
- Increase electricity production from RES up to 29.4%:
  - Wind: 13.0%
  - Hydro: 11.0%
  - Biomass: 4.4%
  - Solar thermal: 0.4%
  - MSW: 0.4%
  - PV: 0.2%

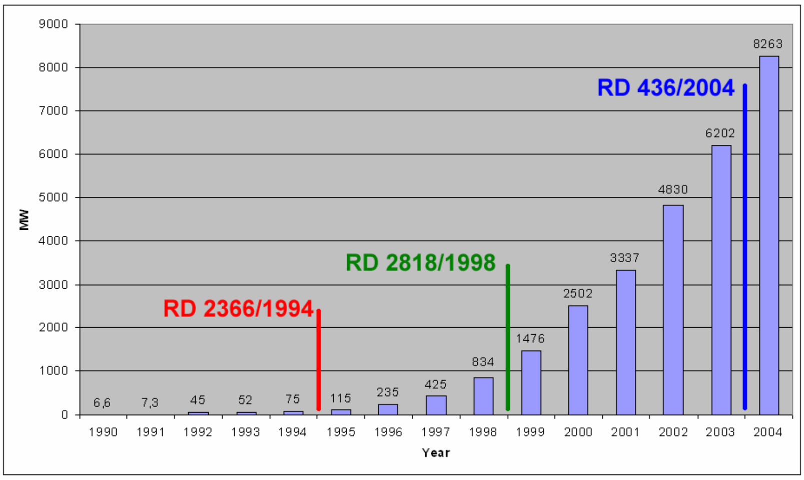
HISTORICAL DEVELOPMENT OF REGULATION (I)

- Law 82/1980: Connection of generation units in parallel to the grid
- September 1985: Connection of DG to the grid. Still in force
- RD 2366/1994: Establishment of "Special Regime":
  - Renewable energy sources or CHP
  - Up to 100 MVA
  - Producers receive a payment for electricity and a bonus for the low environmental impact

HISTORICAL DEVELOPMENT OF REGULATION (II)

- RD 2818/1998: New "Special Regime" definition:
  - Up to 50 MW
  - Producers have three options to sell their electricity output:
    - Sell to the DNO at a fixed price
    - Sell to the DNO and receive the average market price plus a bonus
    - Sell to the market and receive the market price plus a bonus
- Plan to foster renewables (1999): 8 974 MW wind in 2010
- RD 841/2002: "Special Regime" producers receive an incentive to enter the market
- Infrastructure planning document (2002): 13 GW wind in 2011
- RD 436/2004: Present regulation

HISTORICAL DEVELOPMENT WIND POWER



9 November 2005 DESIRE Presentation Seminar

PRESENT REGULATION FOR WIND POWER

- Up to 50 MW
- DNOs must integrate wind power generation into their grids
- Payments are related to the Reference Electric Tariff: RET_{2005}= 73.304 Euro/MWh
- They are not forced to enter the market, but they are encouraged to do so
- Producers have two options to sell their electricity output:
  - Sell to the DNO at a fixed price: 90% RET
  - Sell to the market and receive the market price plus a bonus and an incentive: MP + 40% RET + 10% RET
- In any option: Complement for reactive power (between -4% and 8% RET)

9 November 2005 DESIRE Presentation Seminar

PROBLEMS FOR WIND POWER PROMOTERS

- Local environmental associations (NIMBY)
- Difficult forecasting: imbalances
- Payment for feeders from wind farm to grid connection point:
  - Deep costs
  - New connections must pay for their part

PROBLEMS CREATED BY WIND POWER

1. Imbalances → More reserves in the market of AS
   - Forecasting tools / Aggregation
2. Disconnection when a voltage drop occurs
   - Payment for ride-through drops: 5% RET, 4 years
3. Anticipated clearing: 10% market price
   - Increase the cost for anticipated clearing (30% MP)
4. DNO option: No payment for imbalances
   - If capacity > 10 MW: 10% RET 01/01/2006 (± 20% imbalance cost free)
5. Difficult communication for system operators
   - Delegated dispatch centres
6. Reactive power problems
   - Complement for reactive power

SOLUTIONS

6. Many requests
   – Specific studies. Delay for promoters
7. No room for other Special Regime sources
   – Improvement of the grid. Slow process
8. Excessive concentration in some transmission grid nodes
   – Offering of other connection points
9. New protection requirements
   – Upgrading of equipment
10. New lines only for wind power
   – Application of deep costs

FUTURE PERSPECTIVES

- Obligation for wind farms to ride-through voltage drops
- Creation of delegated dispatch centres for system operators to control wind power capacity
- Improvement of forecasting ability
- Wind power forecasts for 2010:
  - Capacity: 20 155 MW
  - Production: 45 511 GWh
  - First off-shore wind farms
- Stricter requirements in DNO option

QUESTIONS

http://www.labein.es

Reporting on dissemination activities carried out within the frame of the DESIRE project (WP8)

Name, Affiliation	Carlos Madina, Miguel Ángel Sanz – Labein, Spain
E-mail	cmadina@labein.es
Title of dissemination	Presentation of DESIRE project.
Type of activity	Meeting with stakeholder.
Title of forum	
Language	Spanish
Date of dissemination	June 22nd 2005 November 7th 2005 November 15th 2005 April 18th 2006 February 20th 2007
Place of dissemination	Iberdrola, Madrid.
Brief abstract / description of dissemination activity	Presentation of project objectives to staff from different activities (generation, distribution, supply), as well as receiving information for D3.3. In further interviews intermediate results and final results were also presented.
Audience impact assessment	They appeared to be receptive to project's proposals and wanted to learn more once the project further developed. They want to wait until the new Royal Decree for CHP is published to analyse how results can be implemented.
Dissemination	Not available in printed form

Dissemination strategy on Electricity balancing

DESIRE

large Scale Integration of Renewable Energy

Reporting on dissemination activities carried out within the frame of the DESIRE project (WP8)

Name, Affiliation	Carlos Madina, Iñaki Laresgoiti, Miguel Ángel Sanz, Ángel Díaz – Labein, Spain
E-mail	cmadina@labein.es
Title of dissemination	Presentation of DESIRE project.
Type of activity	Meeting with stakeholder.
Title of forum	
Language	Spanish
Date of dissemination	September 27th 2005 May 16th 2006 March 13th 2007
Place of dissemination	Red Eléctrica de España, Madrid.
Brief abstract / description of dissemination activity	Presentation of project objectives to the transmission system operator, as well as receiving information for D3.3. In further interviews intermediate results and final results were also presented.
Audience impact assessment	They appeared to be receptive to project's proposals and wanted to learn more once the project further developed. They find interesting the idea of the project, as it will help them in managing the system, although there is no flexible CHP in Spain at the moment.
Dissemination	Not available in printed form

Reporting on dissemination activities carried out within the frame of the DESIRE project (WP8)

Name, Affiliation	Miguel Ángel Sanz – Labein, Spain
E-mail	masanz@labein.es
Title of dissemination	Presentation of DESIRE project.
Type of activity	Meeting with stakeholder.
Title of forum	
Language	Spanish
Date of dissemination	September 15th 2005 October 3rd 2005
Place of dissemination	Gamesa, Madrid.
Brief abstract / description of dissemination activity	Presentation of project objectives to staff from different activities (wind farm operation and electricity marketing), as well as receiving information for D3.3.
Audience impact assessment	They appeared to be receptive to project's proposals and wanted to learn more once the project further developed. A change in regulation did not allow them to aggregate wind farms and CHP, unless they owned CHP plants, and they were not interested in building such plants at that moment.
Dissemination	Not available in printed form

Reporting on dissemination activities carried out within the frame of the DESIRE project (WP8)

Name, Affiliation	Carlos Madina – Labein, Spain
E-mail	cmadina@labein.es
Title of dissemination	Presentation of DESIRE project.
Type of activity	Meeting with stakeholder.
Title of forum	Meeting of the Spanish Wind Power Technological Platform, REOLTEC
Language	Spanish
Date of dissemination	November 30th 2005 February 14th 2006
Place of dissemination	Asociación Empresarial Eólica, Madrid.
Brief abstract / description of dissemination activity	Presentation of project objectives and first results to some participants in the technological platform: Spanish association of wind power producers (Asociación Empresarial Eólica) and a wind farm owner (Desarrollos Eólicos)
Audience impact assessment	They do not show great interest in the project. They argued that they can balance their output with their whole generation portfolio, and that CHP is not flexible in Spain at the moment. They seemed to be only interested in the present, and not care about the future.
Dissemination	Not available in printed form

Reporting on dissemination activities carried out within the frame of the DESIRE project (WP8)

Name, Affiliation	Iñaki Laresgoiti – Labein, Spain
E-mail	lares@labein.es
Title of dissemination	Presentation of DESIRE project.
Type of activity	Meeting with stakeholder.
Title of forum	
Language	English
Date of dissemination	August 30th 2006
Place of dissemination	Gaz de France, Paris.
Brief abstract / description of dissemination activity	Presentation of project objectives and first results to staff from research activity.
Audience impact assessment	They appeared to be receptive to project's proposals although they did not see how the project could be applied in France.
Dissemination	Not available in printed form

Reporting on dissemination activities carried out within the frame of the DESIRE project (WP8)

Name, Affiliation	Miguel Ángel Sanz, Ángel Díaz – Labein, Spain
E-mail	masanz@labein.es
Title of dissemination	Presentation of DESIRE project.
Type of activity	Meeting with stakeholder.
Title of forum	
Language	Spanish
Date of dissemination	September 30th 2006 February 13th 2007
Place of dissemination	Endesa, Madrid.
Brief abstract / description of dissemination activity	Presentation of project objectives and results to staff from new business activity.
Audience impact assessment	They appeared to be receptive to project’s proposals and results, but when trying to collaborate for further research, they argued that wanted to wait until the new CHP Royal Decree is published.
Dissemination	Not available in printed form

Dissemination strategy on Electricity balancing

DESIRE

large Scale Integration of Renewable Energy

Reporting on dissemination activities carried out within the frame of the DESIRE project (WP8)

Name, Affiliation	Miguel Ángel Sanz – Labein, Spain
E-mail	masanz@labein.es
Title of dissemination	Presentation of DESIRE project.
Type of activity	Meeting with stakeholder.
Title of forum	
Language	Spanish
Date of dissemination	November 16th 2006
Place of dissemination	Gas Natural, Barcelona.
Brief abstract / description of dissemination activity	Presentation of project objectives and first results to staff from innovative businesses.
Audience impact assessment	They are interested in CHP, so they liked the project, and wanted to get the final results.
Dissemination	Not available in printed form

Reporting on dissemination activities carried out within the frame of the DESIRE project (WP8)

Name, Affiliation	Carlos Madina, Miguel Ángel Sanz – Labein, Spain
E-mail	cmadina@labein.es
Title of dissemination	Presentation of DESIRE project.
Type of activity	Meeting with stakeholder.
Title of forum	
Language	Spanish
Date of dissemination	February 6th 2007 April 12th 2007
Place of dissemination	Acciona, Madrid.
Brief abstract / description of dissemination activity	Presentation of project objectives and results to staff from energy division.
Audience impact assessment	They appeared to be receptive to project's proposals, but wanted to wait until the new CHP Royal Decree is published.
Dissemination	Not available in printed form

Reporting on dissemination activities carried out within the frame of the DESIRE project (WP8)

Name, Affiliation	Krzysztof Wojdyga, Marcin Lec, Rafal Laskowski Warsaw University of technology
E-mail	krzysztof.wojdyga@is.pw.edu.pl
Title of dissemination	Renewable Energy Production – the Comparison for Countries Members of DESIRE Project.
Type of activity	Presentation at conference Article in conference proceedings
Title of forum	I International Conference on Solar Energy and Ecobuildings. RENEWABLE ENERGY - Innovative ideas and technologies for buildings.
Language	Polish
Date of dissemination	May 17 – 20 , 2006
Place of dissemination	Solina Poland
Brief abstract / description of dissemination activity	The situations of energy market in the countries participate in DESIRE project are different. In this paper the situation sources of energy, especially renewable sources of energy are presented. Energy assumptions these countries till 2025 with special including renewable sources of energy are shown.
Audience impact assessment	The presentation at the conference was received with great interest. Discussion was connected to differences in production sources of electricity production in DESIRE – countries and directions of development renewable energy in Poland. The article has been published in conference proceedings prepared by Resovia University of Technology “Folia Scientiarum Universitatis Resoviensis”. Conference materials consist of 79 articles connected to renewable energy sources.
Dissemination	Included after this form

I Międzynarodowa Konferencja Energii Słonecznej i Budownictwa Ekologicznego

Energia Odnawialna
Innowacyjne Idee i Technologie w Budownictwie

Solina 17-20 maj 2006

1

Produkcja energii odnawialnej - analiza porównawcza dla 6 krajów europejskich - desire

Dissemination strategy on Electricity balancing large Scale Integration of Renewable Energy

Krzysztof WOJDYGA, dr inż.
Rafał LASKOWSKI, mgr inż.
Marcin LEC, mgr inż.

Politechnika Warszawska
Wydział Inżynierii Środowiska
Wydział Mechaniczny, Energetyki i Lotnictwa

2

Wprowadzenie

W 6. PROGRAMIE RAMOWYM BADAŃ I ROZWOJU TECHNICZNEGO UE organizowany jest projekt „Dissemination Strategy on Electricity Balancing for Large Scale Integration of Renewable Energy”
-rozpowszechnienie na dużą skalę strategii bilansowania energii elektrycznej produkowanej w odnawialnych źródłach energii - DESIRE, który ma za zadanie określenie możliwości współpracy odnawialnych źródeł energii elektrycznej, jakimi są elektrownie wiatrowe ze źródłami skojarzonej produkcji energii elektrycznej i ciepła (CHP) w systemie elektroenergetycznym.

3

Wprowadzenie

W celu zapewnienia ciągłości dostaw energii elektrycznej i ciepła większość krajów tworzy narodowe programy rozwoju rynku energii. W programach tych opisuje się sytuację energetyczną krajów, prognozuje się zapotrzebowanie i kierunki rozwoju źródeł wytwarzających energię elektryczną i ciepło. Porównano scenariusze dotyczące produkcji ciepła i energii elektrycznej do roku 2020 w krajach biorących udział w projekcie DESIRE:
Polska, Hiszpania, Niemcy, Dania, Wielka Brytania (Szkocja) i Estonia.

4

Produkcja energii elektrycznej w krajach uczestnikach projektu DESIRE

	energia elektryczna		udział w produkcji energii %				
Państwo	**moc GW**	**produkcja TWh/a**	**nuklearna**	**węgiel**	**olej opałowy**	**gaz ziemny**	**odnawialne**
Niemcy	116	580	28	49	2	10	9
Dania	13	44	0	55	21	5	19
Hiszpania	72	265	24	29	5	21	21
Estonia	2,5	9,2	0	0	98	2	0
Polska	35	150	0	95	0	2	3
Wielka Brytania	77	400	19	33	1	41	4

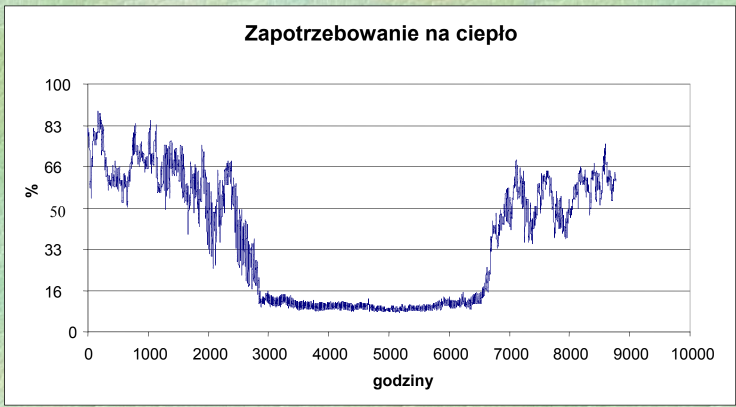
5

Produkcja ciepła w krajach uczestnikach projektu DESIRE

	ciepło TWh/a		udział w produkcji ciepła %				
Państwo	**ogrzewanie**	**w skojarzeniu**	**energia elektryczna**	**węgiel**	**olej opałowy**	**gaz ziemny**	**odnawialne**
Niemcy	**870**	**105**	**6**	**11**	**32**	**51**	**0**
Dania	**197**	**106**	**4**	**13**	**18**	**35**	**29**
Hiszpania	**b.d**	**b.d**	**38**	**4**	**14**	**41**	**3**
Estonia	**44**	**b.d**	**0**	**1**	**20**	**52**	**23**
Polska	**300**	**92**	**0**	**87**	**3,5**	**7**	**0**
Wielka Brytania	**556**	**62**	**5**	**2**	**7**	**85**	**0**

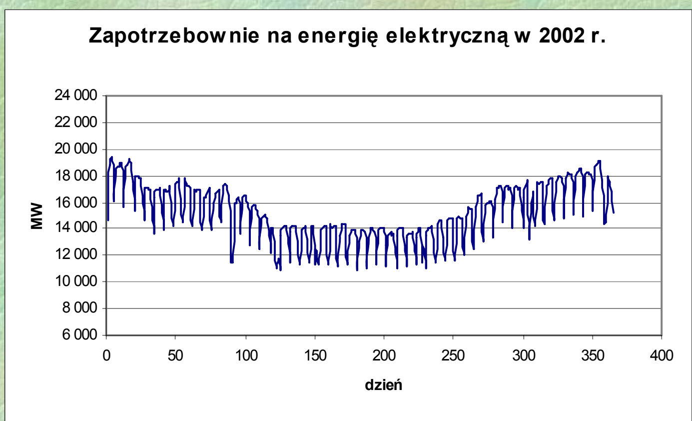
6

Zapotrzebowanie na ciepło dla typowego systemu ciepłowniczego



7

Zapotrzebowanie na energię elektryczną w Polsce w 2002 r. (źródło PSE)



8

Można stwierdzić, że występuje pewna analogia między zapotrzebowaniem na ciepło i energię elektryczną. W miesiącach zimowych zapotrzebowanie na energię elektryczną wzrasta a w miesiącach letnich zmniejsza się, podobnie jak dla zapotrzebowania na ciepło.

Najbardziej racjonalnym wytwarzaniem energii elektrycznej i ciepła są nowoczesne układy skojarzonego wytwarzania obu rodzajów energii (układy kogeneracyjne), w których uzyskuję się ponad 30 % ograniczenie zużycia paliw pierwotnych, w stosunku do produkcji rozdzielonej.

Oprócz istniejących źródeł powstawać będą nowe inwestycje zgodne z Dyrektywą 2004/8/WE w sprawie promowania kogeneracji w oparciu o zapotrzebowanie na ciepło użytkowe na wewnętrznym rynku energii

9

Odnawialne źródła energii

Dania

	2004	**2020**
Lądowe elektrownie wiatrowe	2 185 MW / 5,44 TWh	2 500 MW / 6,05 TWh
Elektrownie wiatrowe na morzu	160 MW / 0,71 TWh	1 445 MW / 6,11 TWh
Energia słoneczna	0,6 MW / 0,6 GWh	0,6 MW / 0,6 GWh

Hiszpania

	2004	**2020**
Lądowe elektrownie wiatrowe	8 351 MW / 15,6 TWh	35 000 MW / 70 TWh
Elektrownie wiatrowe na morzu	0 MW / 0,0 TWh	5 000 MW / 15 TWh
Energia słoneczna	16 MW/ 0,017 TWh	2 400 MW / 4,8 TWh

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Odnawialne źródła energii

Niemcy

	2004	2020
Lądowe elektrownie wiatrowe	16 629 MW / 25 TWh	28 000 MW / 76 TWh
Elektrownie wiatrowe na morzu	0 MW / 0 TWh	20 000 MW / 54,9 TWh
Energia słoneczna	705 MW / 0,5 TWh	5 400 MW / 5,2 TWh

Szkocja

	2004	2020
Elektrownie wiatrowe	172,1 MW / 0,469 TWh	3 000 MW / 8,031 TWh
Energia słoneczna	611,0 kW / 298,0 MWh	30,5 MW / 15,0 GWh

11

Odnawialne źródła energii

Polska

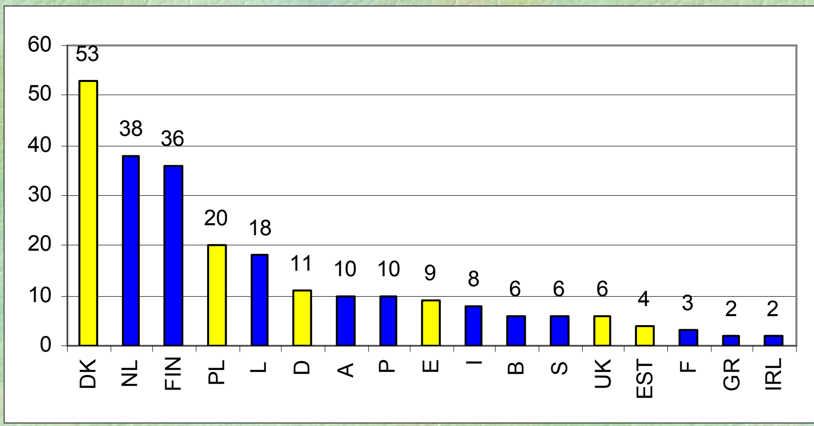
	2003			2020	
	Ilość jednostek	Moc MW	Produkcja elektryczna GWh	Moc MW	Produkcja elektryczna GWh
Małe elektrownie	516	59	181	300	800
Biogaz	49	20	56	100	300
Wiatrowe elektrownie	31	60	124	1000	2000

Estonia

	2004	2020
Lądowe elektrownie wiatrowe	6,7 MW / 7,6 GWh	580 MW / 700 GWh
Elektrownie wiatrowe na morzu	0 MW / 0 GWh	0 MW / 0 GWh
Energia słoneczna	0 MW / 0 GWh	0,5 MW/0,5 GWh

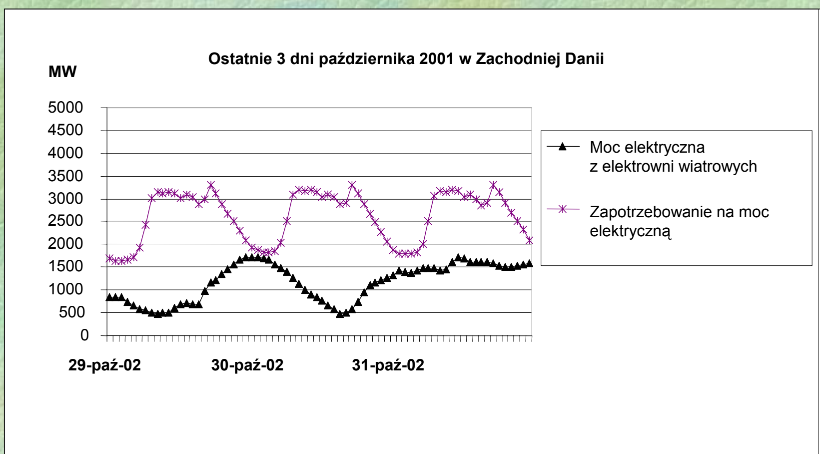
12

Udział energii elektrycznej wyprodukowanej w skojarzeniu do całkowitej produkcji w krajach UE



13

Moc i zapotrzebowanie na energię elektryczną w Zachodniej Danii



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Podsumowanie

Część zamierzeń wydaje się dość trudna do zrealizowania, przede wszystkim, jeśli chodzi o energetykę odnawialną.

Sytuacje na rynkach energii w poszczególnych krajach biorących udział w projekcie DESIRE znacznie się różnią.

Różnice te wynikają w głównej mierze z zasobów surowcowych poszczególnych krajów, tradycji wytwarzania energii elektrycznej jak również w przypadku energetyki odnawialnej położenie geograficzne krajów, które ma wpływ na potencjał energetyki słonecznej wiatrowej i wodnej.

W Polsce produkcja energii elektrycznej i ciepła opiera się na węglu kamiennym i brunatnym.

Bilansowanie energii elektrycznej wytwarzanej z elektrowni wiatrowych będzie przede wszystkim odbywało się przy pomocy elektrowni szczytowo-pompowych.

15

Reporting on dissemination activities carried out within the frame of the DESIRE project (WP8)

Name, Affiliation	Krzysztof Wojdyga, Marcin Lec, Rafal Laskowski Warszaw University of Technology
E-mail	krzysztof.wojdyga@is.pw.edu.pl
Title of dissemination	Dissemination strategy on electricity balancing for large scale integration of renewable energy - DESIRE Project.
Type of activity	Presentation at conference Article in conference proceedings
Title of forum	I International Conference on Solar Energy and Ecobuildings. RENEWABLE ENERGY - Innovative ideas and technologies for buildings.
Language	Polish
Date of dissemination	May 17 – 20 , 2006
Place of dissemination	Solina Poland
Brief abstract / description of dissemination activity	DESIRE will disseminate practices which will integrate fluctuating renewable electricity supplies such as wind power into electricity systems using combined heat and power. This integration will make possible an increase in pan-European trade in electricity, it will improve the economic competitiveness of both CHP and wind power and it will increase the ability of electricity system operators to handle increasing quantities of electricity generated by decentralized sources.
Audience impact assessment	Article presentation on the conference was received with great interest. Discussion was connected to problems of developing national renewable resources in connection with combine heat and electricity production. Article has been published in conference proceedings prepared by Resovia University of Technology “Folia Scientiarum Universitatis Resoviensis”. Conference materials consist of 79 articles connected to renewable energy sources.
Dissemination	Included after this form

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Solina 17-20 maj 2006

1

Rozpowszechnienie na dużą skalę strategii bilansowania energii elektrycznej produkowanej w odnawialnych źródłach energii – desire

Dissemination strategy on Electricity balancing large Scale Integration of Renewable Energy

Krzysztof WOJDYGA, dr inż.
Rafał LASKOWSKI, mgr inż.
Marcin LEC, mgr inż.

Politechnika Warszawska
Wydział Inżynierii Środowiska
Wydział Mechaniczny, Energetyki i Lotnictwa

2

Cel powstania projektu DESIRE

- ***Duża liczba elektrowni wiatrowych działających pojedynczo, może tworzyć duże problemy niekiedy wręcz zagrożenie dla stabilnej pracy lokalnego systemu elektroenergetycznego, które może być przeniesione na system ponad regionalny. Produkcja energii podlega silnym wahaniom, jeśli chodzi o czas i moc generowanej energii elektrycznej .***
- ***DESIRE ma za zadanie określenie możliwości współpracy odnawialnych źródeł energii elektrycznej, jakimi są elektrownie wiatrowe ze źródłami skojarzonej produkcji energii elektrycznej i ciepła (CHP) w systemie elektroenergetycznym.***

3

Zalety takiego rozwiązania

- ***powiększenie europejskiego rynku energii elektrycznej,***
- ***poprawienie konkurencyjności ekonomicznej zarówno elektrociepłowni jak i elektrowni wiatrowych,***
- ***określenie proporcji energii elektrycznej generowanej w źródłach odnawialnych, jaka może zostać zaabsorbowana przez europejski system elektroenergetyczny.***

4

Projekt DESIRE jest zgodny z polityką energetyczną Unii Europejskiej i jest związany z wdrażaniem dyrektyw europejskich:

- ***Dyrektywa 2003/54/EC z 26 czerwca 2003 roku dotyczącej stworzenie bardziej konkurencyjnego europejskiego rynku energii elektrycznej,***
- ***Dyrektywa 2004/8/EC w sprawie promowania kogeneracji w oparciu o zapotrzebowanie na ciepło użytkowe na wewnętrznym rynku energii. Dyrektywa ta przewiduje mechanizmy wspierania energetyki skojarzonej,***

5

- ***Projekt związany jest również z wdrożeniem dyrektywy 2001/77/EC dotyczącej „promowania energii elektrycznej wyprodukowanej z odnawialnych źródeł energii na wewnętrznym rynku energii elektrycznej", której głównym zadaniem jest osiągnięcie 22 % zużycia energii elektrycznej pochodzącej z odnawialnych źródeł energii w krajach Unii do roku 2010.***

6

Opis projektu DESIRE

Projekt DESIRE jest podzielony na 8 zadań tematycznych - pakietów:

1. *PROBLEMY BILANSOWANIA ENERGII ELEKTRYCZNEJ (problemy związane z bilansowaniem produkcji energii elektrycznej z konwencjonalnych i odnawialnych źródeł energii)*
2. *ROZWIĄZANIA TECHNOLOGICZNE NA „DZISIAJ I JUTRO" (rozwiązania techniczne, które pozwolą na rozwiązanie problemów bilansowania)*
3. *ANALIZA WARUNKÓW PRAWNYCH I EKONOMICZNYCH, MOŻLIWOŚCI I BARIERY WDROŻENIA WYNIKÓW PROJEKTU (uwarunkowania prawne dotyczące zagadnień produkcji energii elektrycznej ze źródeł odnawialnych i skojarzonych)*
4. *PRZYGOTOWANIE MODELU KOMPUTEROWEGO „WIRTUALNEJ ELEKTROWNI", PROCEDUR OPTYMALIZACYJNYCH ORAZ INNYCH NARZĘDZI INFORMATYCZNYCH (zbudowany zostanie model „wirtualnej elektrowni" składającej się różnych urządzeń wytwórczych współpracujących ze sobą)*

Opis projektu DESIRE

5. *BADANIA SYMULACYJNE I TESTOWANIE PROGRAMÓW (testowane programów komputerowych „wirtualnej elektrowni" dla wybranych układów kombinowanych elektrociepłowni i farm wiatrowych w Danii, Niemczech i Wielkiej Brytanii)*
6. *PODSUMOWANIE I WNIOSKI (Określenie możliwości współpracy układów kogeneracyjnych z układami turbin wiatrowych)*
7. *STRONA INTERNETOWA PROJEKTU (dostęp do wszystkich dokumentów projektu dla jego uczestników a dla osób zainteresowanych wynikami projektu dostęp w stopniu ograniczonym)*
8. *PREZENTACJA WYNIKÓW (seminaria tematyczne w krajach uczestników projektów oraz publikacja artykułów w prasie fachowej)*

8

Uczestnicy projektu DESIRE

W projekcie udział biorą wyższe uczelnie techniczne, instytuty naukowe i firmy konsultingowe z branży energetycznej z 6 krajów europejskich (Dania, Wielka Brytania, Niemcy, Hiszpania, Polska i Estonia).

Koordynatorem projektu jest profesor Henric Lund z Uniwersytetu Aalborg w Danii. W poniższej tabeli przedstawiono wszystkich uczestników projektu. Stronę polską reprezentuje Uczelniane Centrum Badawcze Energetyki i Ochrony Środowiska Politechniki Warszawskiej.

9

	Nazwa	Kraj
1	Aalborg University, Sustainable Energy Planning Research Group	Dania
2	EMD International A/S	Dania
3	PlanEnergi	Dania
4	University of Birmingham	Wielka Brytania
5	Institut für Solare Energieversorgungstechnik Verein an der Universität Kassel e.V.	Niemcy
6	Universität Kassel	Niemcy
7	EMD Deutschland, Chun und andere GBR	Niemcy
8	Fundación Labein	Hiszpania
9	**Politechnika Warszawska**	**Polska**
10	Tallin University of Technology	Estonia

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Podsumowanie

W ramach projektu realizowanego w 8 pakietach zostaną wykonane :

1. ***Analizy stanu obecnego rynku energii w krajach biorących udział w DESIRE***
2. ***Symulacje komputerowe dla wybranych rynków energii, które pozwolą na wybór optymalnych rozwiązań zarówno technicznych, prawnych i ekonomicznych umożliwiających skuteczne bilansowanie wahań przy produkcji energii elektrycznej z odnawialnych źródeł energii***
3. ***Wyniki projektu mogą pomóc w kształtowaniu dyrektyw Unii Europejskiej.***
4. ***Wyniki tego projektu mogą być przydatne dla rozwiązań technicznych promujących produkcję energii elektrycznej ze źródeł odnawialnych.***

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Reporting on dissemination activities carried out within the frame of the DESIRE project (WP8)

Name, Affiliation	Krzysztof Wojdyga, Warsaw University of Technology
E-mail	krzysztof.wojdyga@is.pw.edu.pl
Title of dissemination	CHP and Renewable Energy Sources in Strategy for Developing District Heating Systems in Poland
Type of activity	Presentation at thematic seminar
Title of forum	Polish – Norwegian Thematic Seminar "Energy supply and Mitigation of Environmental Impacts"
Language	English
Date of dissemination	October 17 – 19 , 2006
Place of dissemination	Trondheim Norway
Brief abstract / description of dissemination activity	The Production of electricity and heat for local heat markets are important role for energy sector. Centralised heating systems cover at the average 72% of heat demand in cities and testify for it. In the power sector decentralisation strategy are recommended: development of small capacity dispersed sources, producing electricity and heat in cogeneration; acceleration of local energy resources, mainly renewable and waste; development of local energy markets. A short presentation about the DESIRE – project and results was given.
Audience impact assessment	Same of presentation was sacrificed of developing renewable sources of energy. Discussing trends in electricity & heat production was very interesting and conclusion were similar to conclusions from the DESIRE – project. The presentation has been published on the webside www.ntnu.no/polen2006/eng The total number of Polish and Norwegian presentation was 38
Dissemination	Included after this form

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Warsaw University of Technology

Polish -Norwegian Seminar:

"Energy Supply and Mitigation of Environmental Impacts"

Trondheim 2006.10.18

„CHP and Renewable Energy Sources in Strategy for Developing District Heating Systems in Poland"

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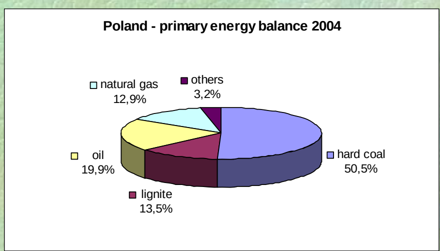

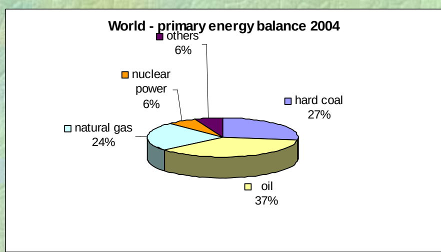

- **Poland is one of the most coal dependent countries in the world.**
- **Poland has significant coal resources.**
- **Total recoverable reserves of hard coal are estimated at over 32 billion tons.**
- **Recoverable reserves of lignite and sub-bituminous coal are estimated at 14 billion tons.**

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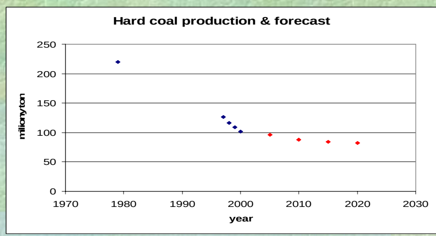

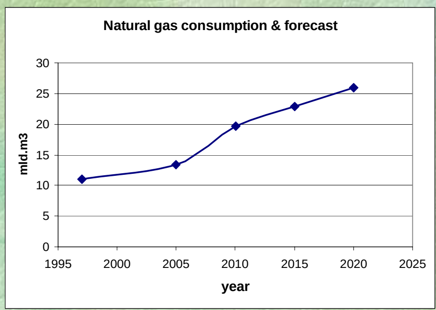

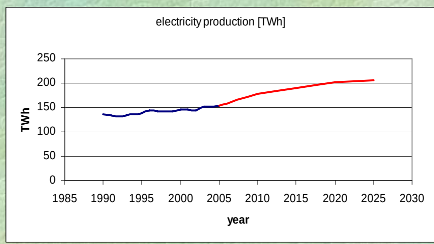

3970 kWh/prs *year

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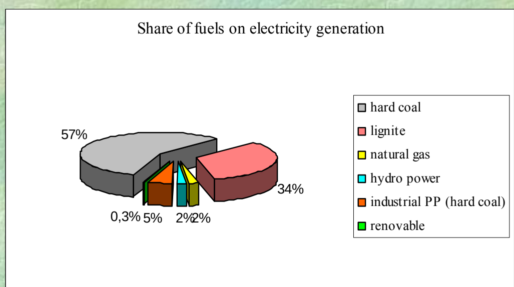
Power sector (2003)

Electrical output capacity – 35 419 MW
including :
Commercial Power Plants – 32 667 MW
Industrial Power Plants - 2 613 MW

Electricity production – 151 TWh
Electricity consumption – 141 TWh



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District heating sector -2003

8197 **DH Companies**
including 7080 companies - heat for own use
Registered companies 2002 - 887 (>1 MW),
2005 – 665 (>5 MW).

Installed heat power 2005 65 189 MW
Total route length of pipeline system 18 577 km

Heat production 168,3 TWh (599 PJ) (heating purposes and industrial needs),
Heat delivered to the network 105 TWh (375PJ).

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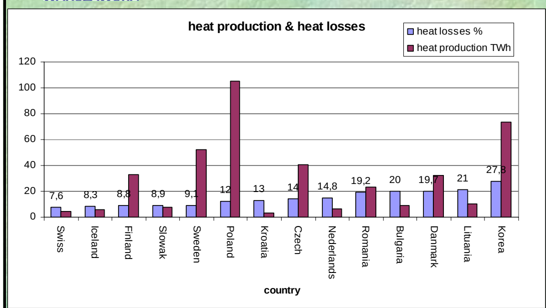
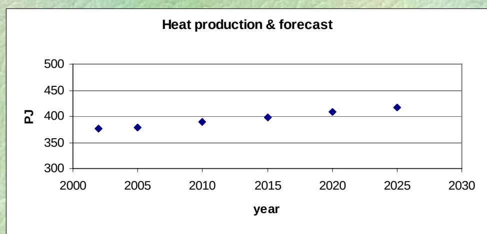


Last decade heat demand decreased by 25 -30 %.
Forecast from 375 to 420 PJ (optimistic)



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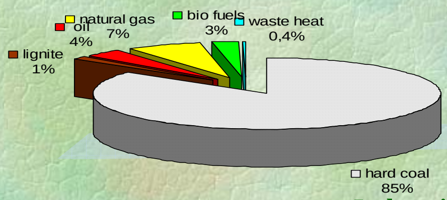
Fuels consumption for heating (2003)



25,8 mln. tons of hard coal

Industrial CHP wood chips – 5,3 PJ
Boilers > 500 kW wood chips - 6,7 PJ
Boilers > 500 kW straw - 0,9 PJ
Geothermal - 0,54 PJ
Heat from biogas - 0,5 PJ
Total heat from renewable - 13,9 PJ (3 %)

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Total heat production in Poland (2003) -- 220 TWh (780 PJ):
including DHC and heat from small boilers & furnaces

Heat from renewable 28 TWh (102 PJ);
including 3,9 TWh (13,9 PJ) for DH
and 25 TWh (91 PJ) for small boilers <500kW - wood

Share of renewable 13 %
it is more than target in 2010 – 7,5 %.

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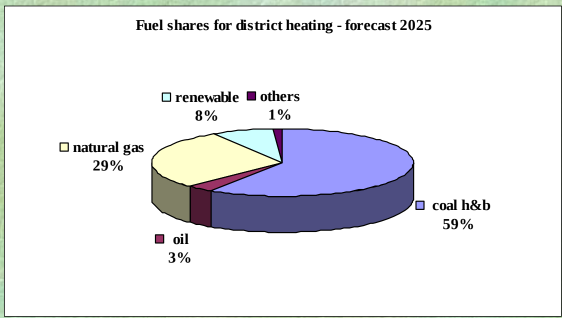

Increase renewable 2003 - 3 %
2025 - 8 %.

Increase NG 2003 - 7 %
2025 - 29 %.

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CHP – 50 TWh of heat in co-generation:
including commercial CHP - 45 TWh
– 97 % of all heat from CHP
industrial CHP - 5 TWh
Share for heat in co-generation
27 %

CHP –21,2 TWh of electricity in co-generation:
including commercial CHP - 16,8 TWh,
industrial CHP - 4,4 TWh.

According to official statistic share for electricity in co-generation

14 %

but real share is estimated for **20 %.**

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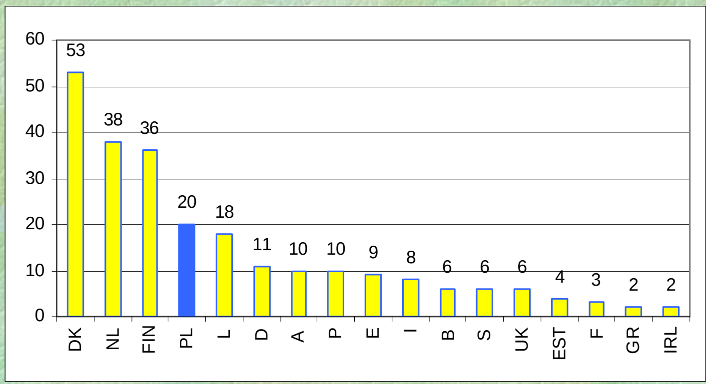

Share of electricity production with co-generation with heat.

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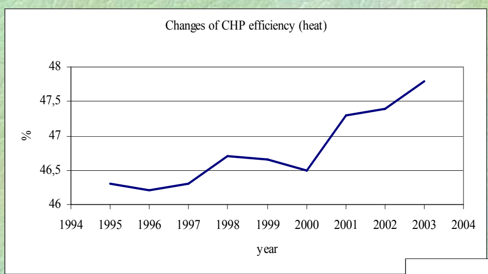
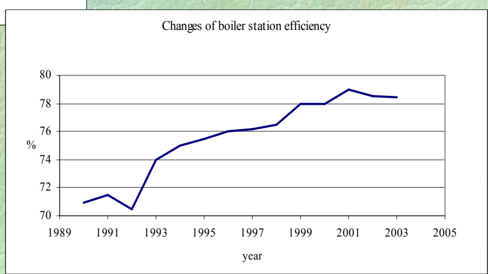


Increase of 1,5 %



Increase of 8 %

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Increasing heat production in co-generation is possible.

But only in small and medium size DHS.

In DHS (15 GW) supply from boiler station

heat demand for hot tape water are 3 GW.

It is potential for co-generation

During next 20 years is possible build installations

with heat demand about 1,5 -3 GW.

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According to the EU Accession Treaty Poland signed obligation of use RES to electricity production - share in 2010 - 7,5 %.

In 2005 Ministry of Economy prepared instruction with new targets:
2005 – 3,1 %
2006 – 3,7 %
2007 – 4,5 %
2008 – 5,5 %
2009 – 7,0 %
2010 – 2014 - 9 %

In year's 2001- 2004 these obligations haven't fulfilled (2003 2,56 % - 2,65 %). According URE 1,27 %

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Heat production using renewable energy resources (RES) must increase to the level 7,5 % in 2010.

It is target signed in "Strategy for RES development" but this target isn't obligatory and government instructions are refer only to electricity.

Achieving targets from "Strategy for RES development" will be impossible without good economical conditions for RES new investment

Our government must prepare principles and action for RES development

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Important role for increasing renewable can play directives connected to environment protection.

Directive 2001/80/EC of 23.10.2001, on emission limitation of air pollution from large combustion plants (Directive LCP),

Directive 2003/87/EC of 31.10.2003 r., establishing a scheme for greenhouse gas emission allowances trading within the Community

Directive 96/61/EC of 24.09.1996 r., *on integrated pollution prevention and control* (Directive IPPC),

Directive 2001/81/EC of 23.10. 2001 r., *on national emission ceilings for certain atmospheric pollutants* (Directive NEC).

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DESIRE PROJECT

In case countries with high share of electricity production from renewable especially from wind farms there is big problem with balancing electricity production.

As proportions of renewable electricity rise, so does the threat to pan-European trading in electricity.

Trans-boundary electricity inter-connectors will become blocked with international transfer of excess wind power supplies.

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DESIRE PROJECT

DESIRE will disseminate practices which will integrate fluctuating renewable electricity supplies such as wind power into electricity systems using combined heat and power.

In the project take part 6 EU countries as Denmark, Germany, UK, Spain, Estonia and Poland.

In the short term we can use wind power and CHP plant to co-produce a balanced, non-fluctuating, electricity output.

This project will promote the integration of fluctuating renewable electricity supplies into local and regional electricity systems.

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Conclusions I

- State energy policy in connection with renewable is unsatisfactory.
- Statistic data of renewable and heat & electricity must be more accurately
- Heat production for DHS during next years will be on the same level
- Consumption of natural gas, wood and straw in DHS will be increase

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Conclusions II

- Heat sources will be modernized: efficiency increase, decrease emission and air pollution, decreasing production costs
- In small DHS will be new investment as CHP with gas engines and heat accumulators
- In small DHS wood & straw will be burning as main fuels basing on local resources
- New boilers will burn only biomass but in old boilers biomass will be co firing with coal
- Burning of wood & straw in big power plants must be forbidden.

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Dissemination strategy on Electricity balancing

DESIRE

large Scale Integration of Renewable Energy

Reporting on dissemination activities carried out within the frame of the DESIRE project (WP8)

Name, Affiliation	Heiki Tammoja, The Tallinn University of Technology
E-mail	Heiki.Tammoja@ttu.ee
Title of dissemination	DESIRE Public Seminar
Type of activity	Organisation of a public seminar
Title of forum	DESIRE seminar
Language	English
Date of dissemination	September 19th, 2006
Place of dissemination	Tallinn University of Technology, Tallinn, Estonia
Brief abstract / description of dissemination activity	The seminar explained the main principles of the DESIRE project and focused on the use of time-dependent feed-in tariffs and the application of the energy stores at the CHP plants. Special attention was paid to the regulating up and regulating down capacities of CHP plants with energy stores and to the market of those capacities
Audience impact assessment	Experts from the Energy Department of the Ministry of Economic Affairs and Communication, Estonian Power Company Eesti Energia, university and private sector showed interst in the DESIRE project objectives, however, noticed the absence of legal incentives for the development of these ideas in Estonia today
Dissemination	Available in the form of John Sievers' presentation.