Future Power Plant Requirements

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Dipl.-Ing. (FH) Christian Schuhbauer, M.Sc.

Structure

1. Current situation and future development
2. Future power plant requirements
3. Role of the electricity market
4. Flexibility of power plants
5. Challenges in energy supply
6. Conclusion

1. Current situation and future development

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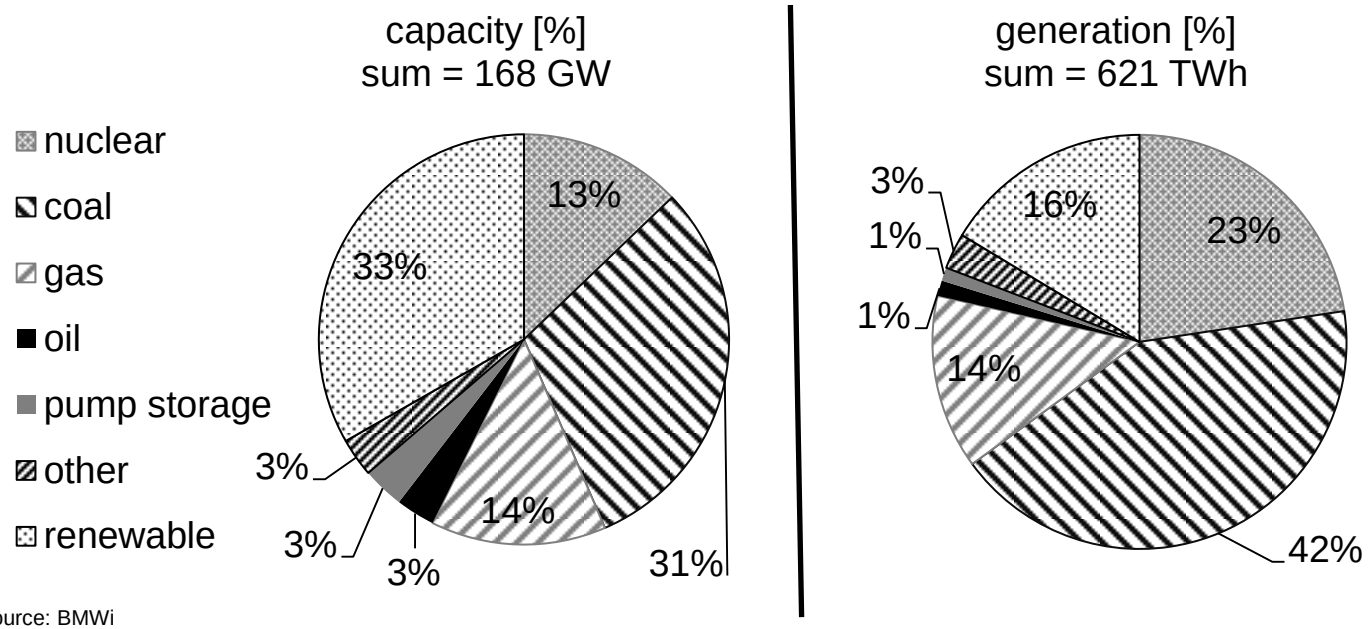
Capacity and power generation in Germany 2010



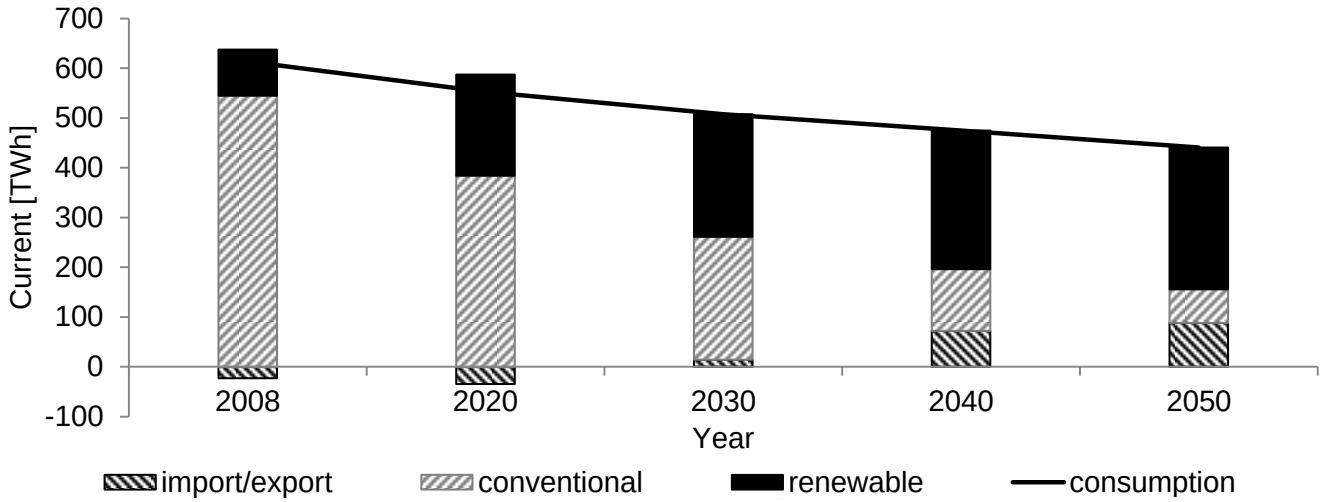
Source: BMWi

Power plant characteristics:

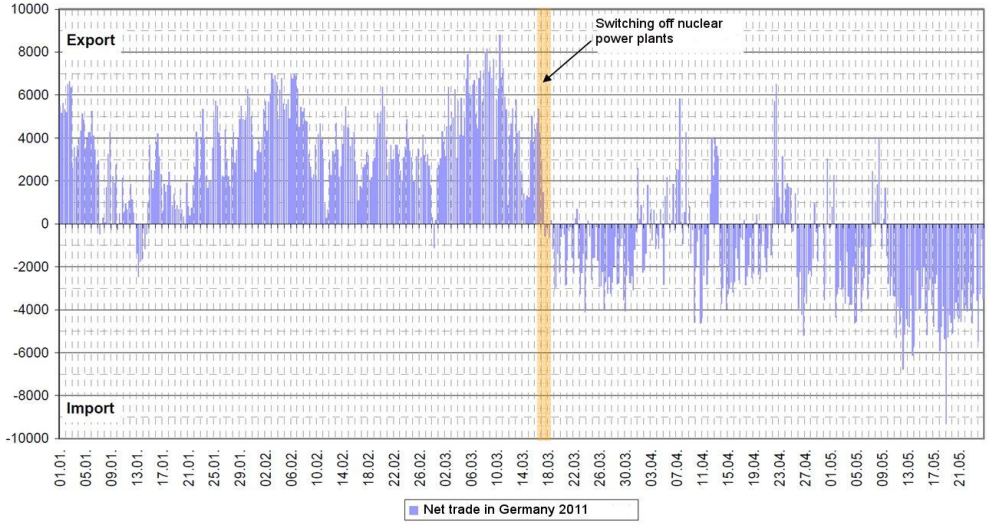
Full load hours (calculated) 3705 h/a

Utilisation: 42 %/a

1. Current situation and future development



Source: BMWi, Bundesnetzagentur



2. Future power plant requirements

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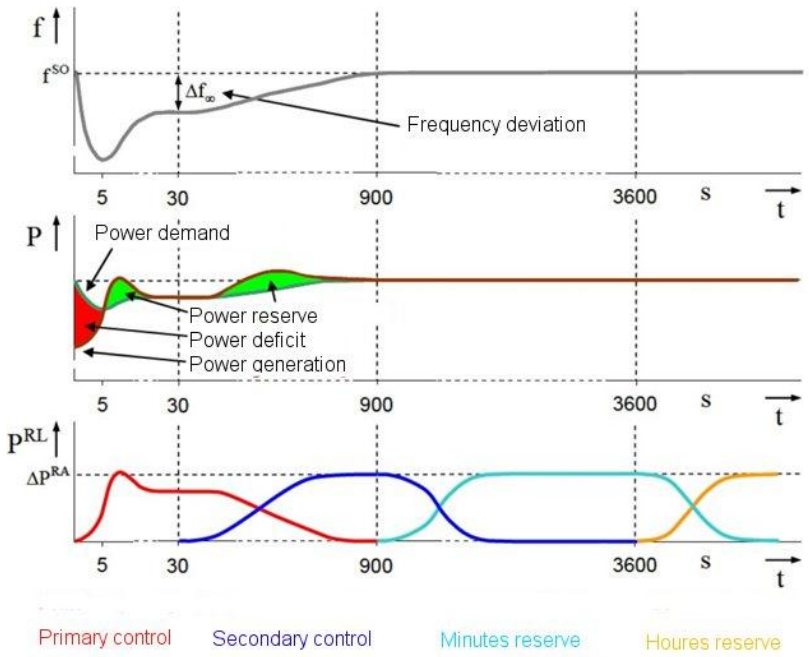
Frequency stability



Source: Siemens

1) Power decrease

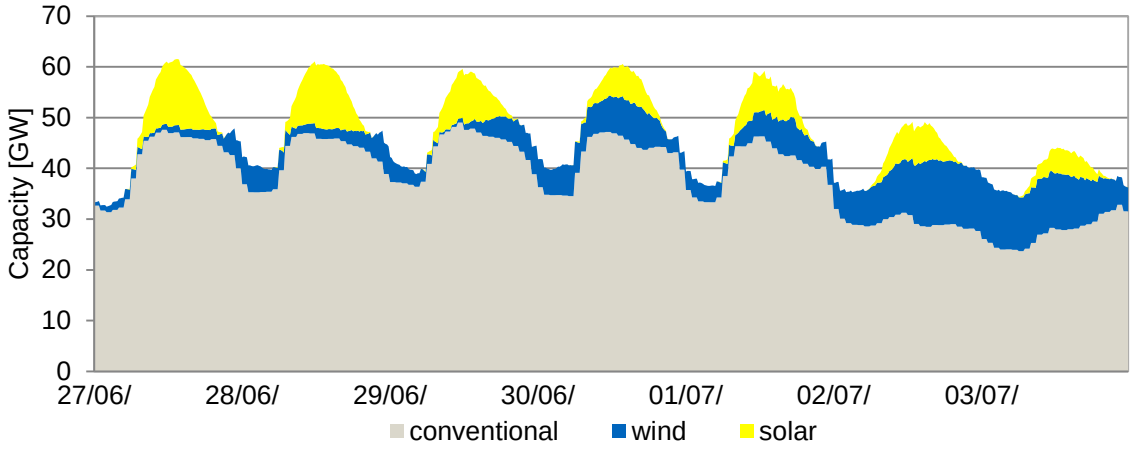
2) Frequency deviation

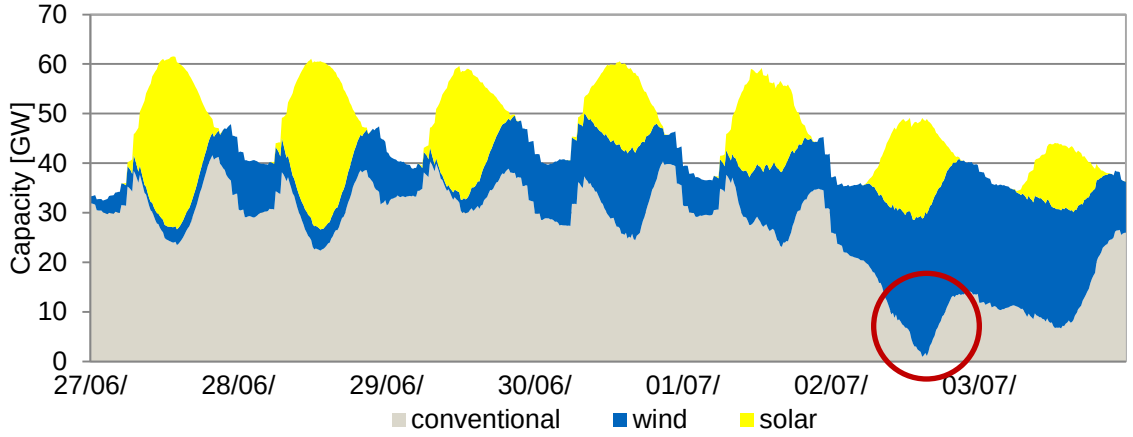
3) Primary controlling power
→ Stabilisation of frequency

4) Secondary controlling power
→ Reset the frequency to 50Hz

2. Future power plant requirements

Development of the residual load until 2020





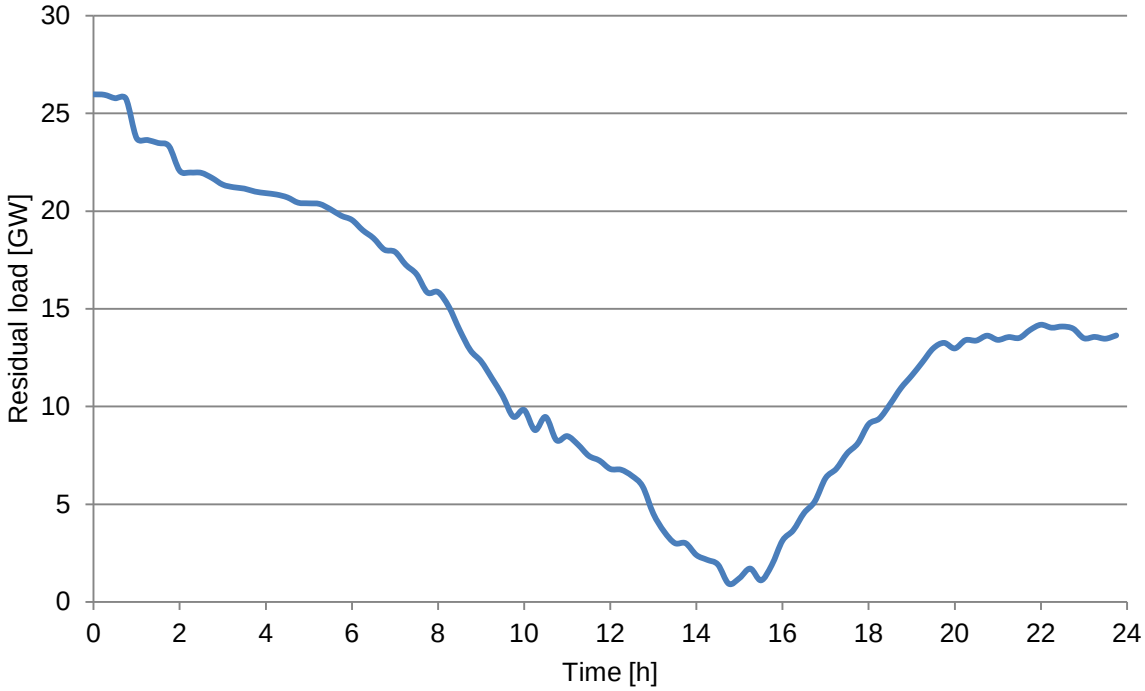
Summer week 2011 (top)

contra

Summer week 2020 (bottom)

onshore wind: 27,2 GW → 33,3 GW
offshore wind: 0 GW → 7,6 GW
photovoltaic: 17,3 GW → 33,3 GW

2. Future power plant requirements



- Residual load decrease to 1 GW
- Increase of 3,5 GW/h
- Power plants at 30% load

→ Reserves reached after 40 minutes

More capacities are needed after 40 min without accurate prediction!!

3. Role of the electricity market

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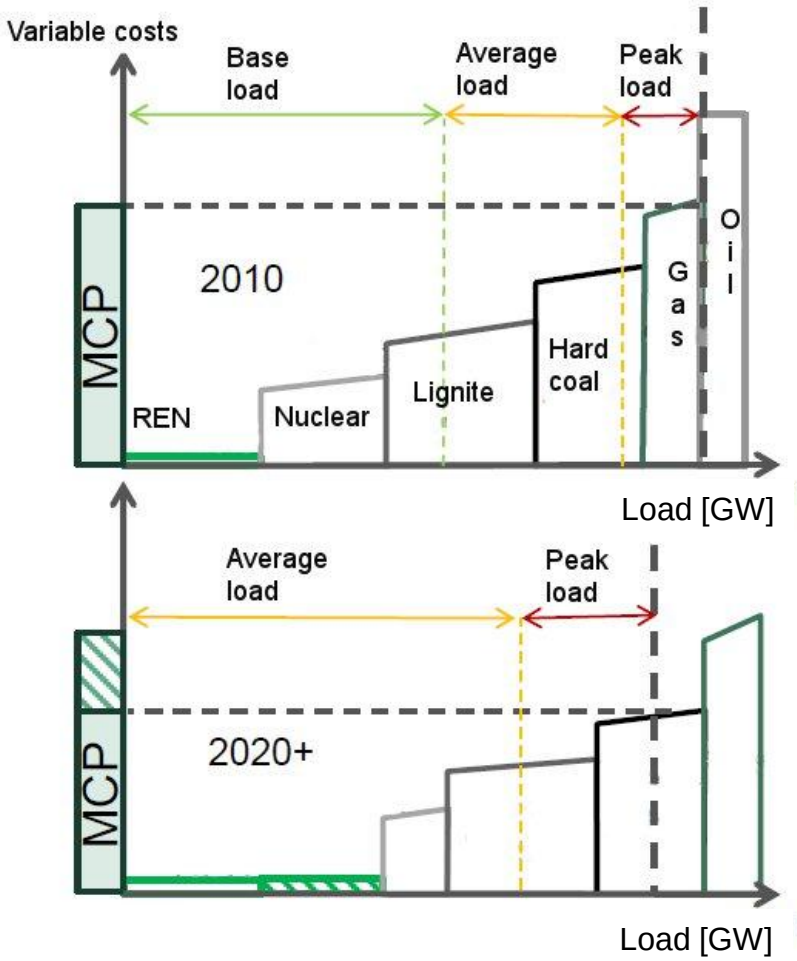

Merit-Order-Effect:

1) Increase of renewables leads to lower market clearing price (MCP)

2) Load volume for conventional power is decreased
   → No more classic base load
   → Full load hours decrease

4. Flexibility of conventional power plants

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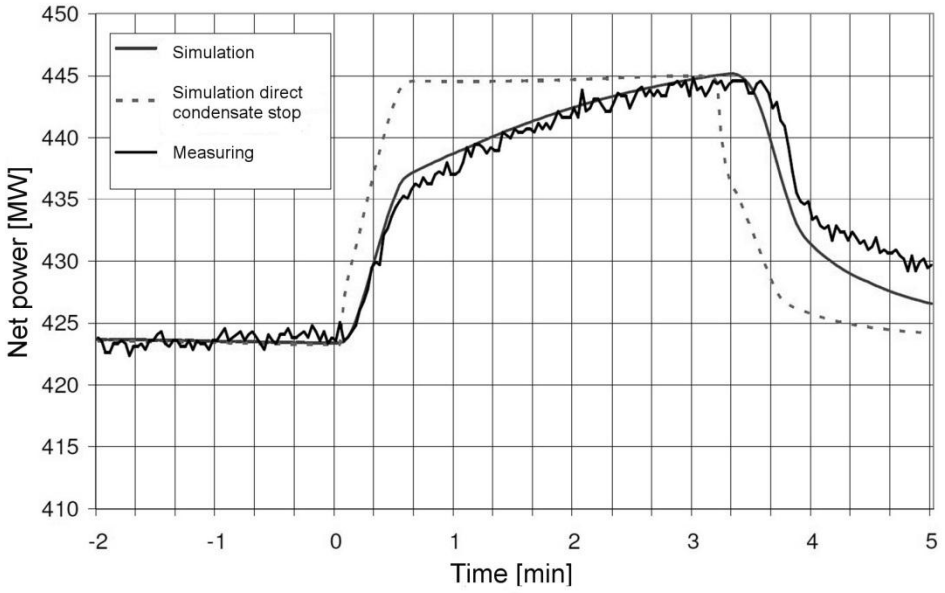
	Nuclear	Coal	Gas-CCP	Gasturbine
Load change	4 – 5 %/min	2 – 6 %/min	4 – 9 %/min	15 %/min
During load	50 – 100 %	40 – 100 %	40 – 100 %	50 – 100 %
Primary control	60 %/min	>60 %/min	180 %/min	180 %/min
Minimum load	20 – 35 %	20 – 40 %	15 – 50 %	50 %
Minimum operating duration	24 h	3 – 5 h	1 h	15 min
Minimum down time	24 h	3 – 8 h	1 h	15 min
Hot start-up	60 – 120 min	80 – 150 min	30 – 60 min	A few min
Warm start-up	2 – 3 h	3 – 5 h	1 – 1,5 h	A few min
Cold start-up	15 – 20 h	5 – 10 h	2 – 3 h	Ca. 15 min

Source: Balling 2011 (Siemens); Steck und Mauch 2008

4. Flexibility of conventional power plants



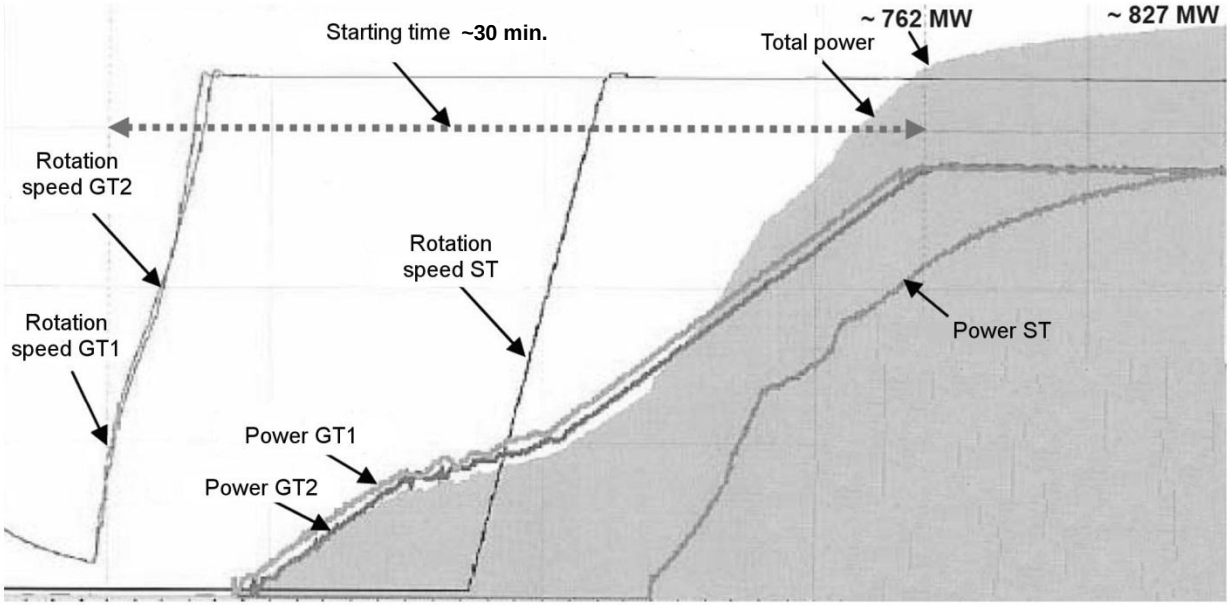
Source: Zehtner 2009

Condensate stop for primary control

Indirect method:
- Choking condensate pump and / or condensate valves
- slower but no additional costs

Direct method:
- Additonally closing the bleeder valves
- Very quick but additional costs

4. Flexibility of conventional power plants



Source: Siemens (Irsching)

Advantages:

- Short start-up time
- Higher load change gradients

→ BENSON Once-through operation leads to higher flexibility

5. Challenges in energy supply

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KW 21 – BY5DE: Dynamic of the 700°C hard coal-fired power plant

- Higher electrical efficiency: Increase from 46 % to 50 %
- Higher pressures and temperatures: live steam parameters 365 bar / 705 °C
- New materials: Ni-base alloys instead of ferritic steels

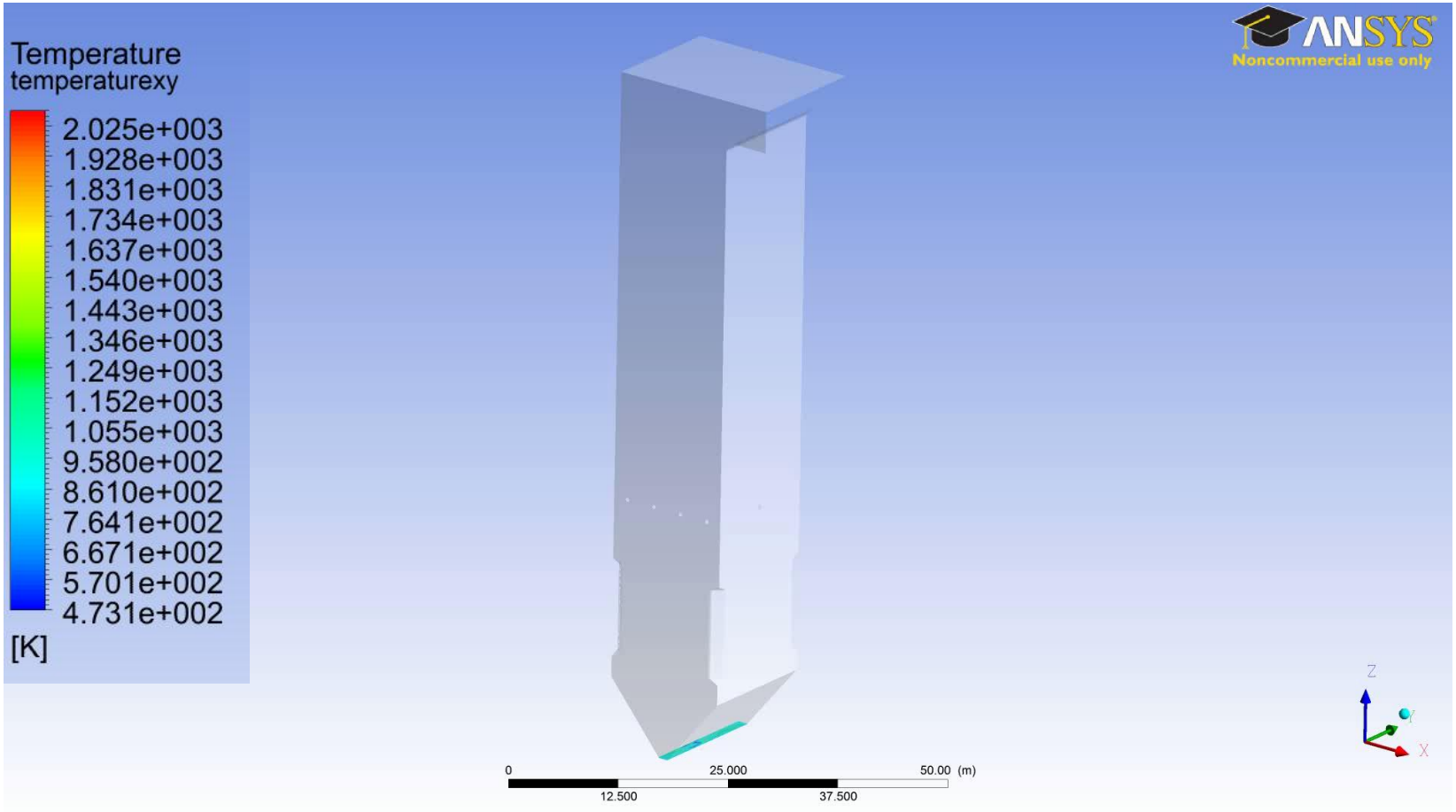
Focus on:

- Influence of flue gas imbalances and fouling
- Transient behaviour during load changes and start-ups
- Durability decrease of thick-walled components caused of start-ups

Project partners:

- E.ON Energy AG
- Alstom Power Systems
- Bayerisches Staatsministerium für Wissenschaft, Forschung und Kunst

5. Challenges in energy supply – Video: Temperatur as f(boiler height)



6. Conclusion

Conventional power generation still needed for frequency stabilisation!

- Storage technologies are going forward → takes time
- Electricity network expansion too slow

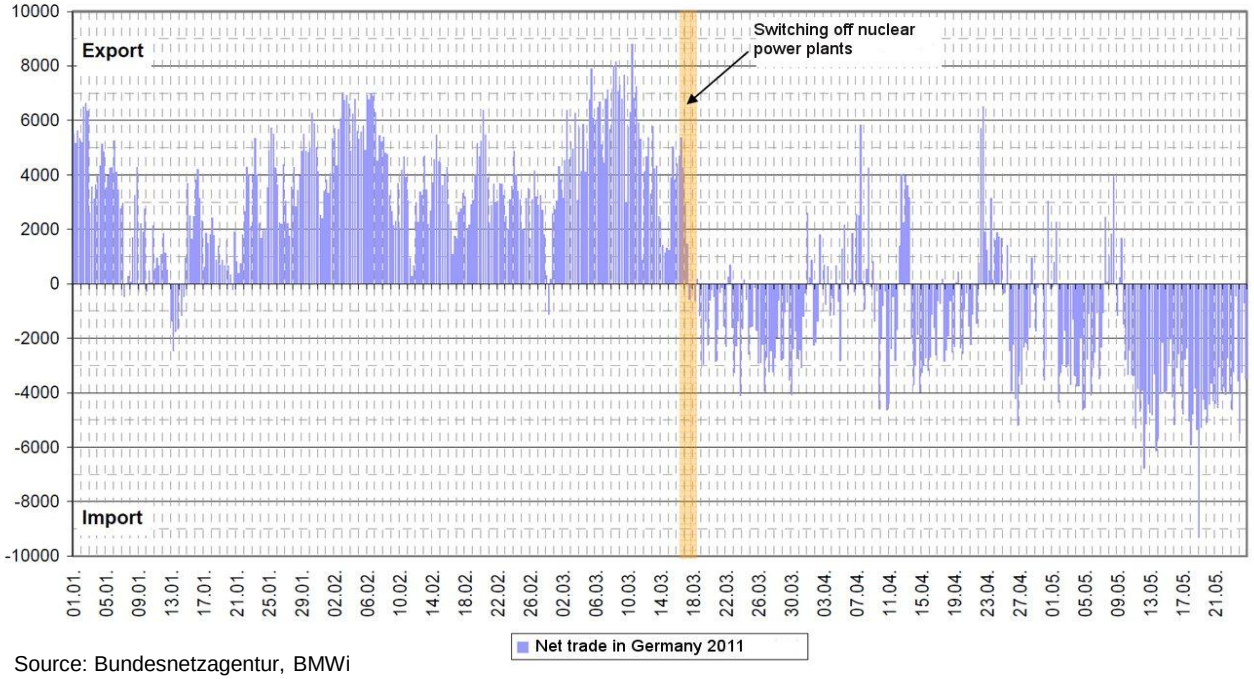
Electricity market problematic for the future:

- Capacity market would be one possibility
- CCPs only economical if the provided capacity is paid

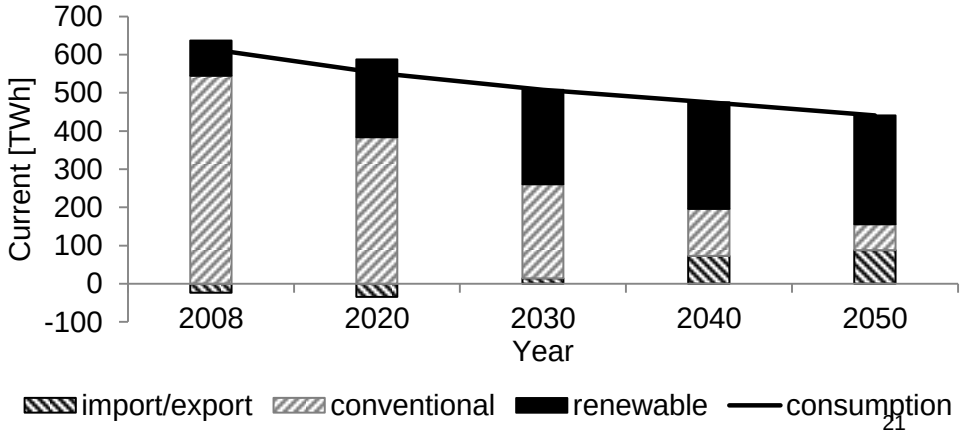
Dynamic and flexibility of conventional power plants has to be further improved to meet the necessary requirements for the future!

Backup

1. Current situation and future development

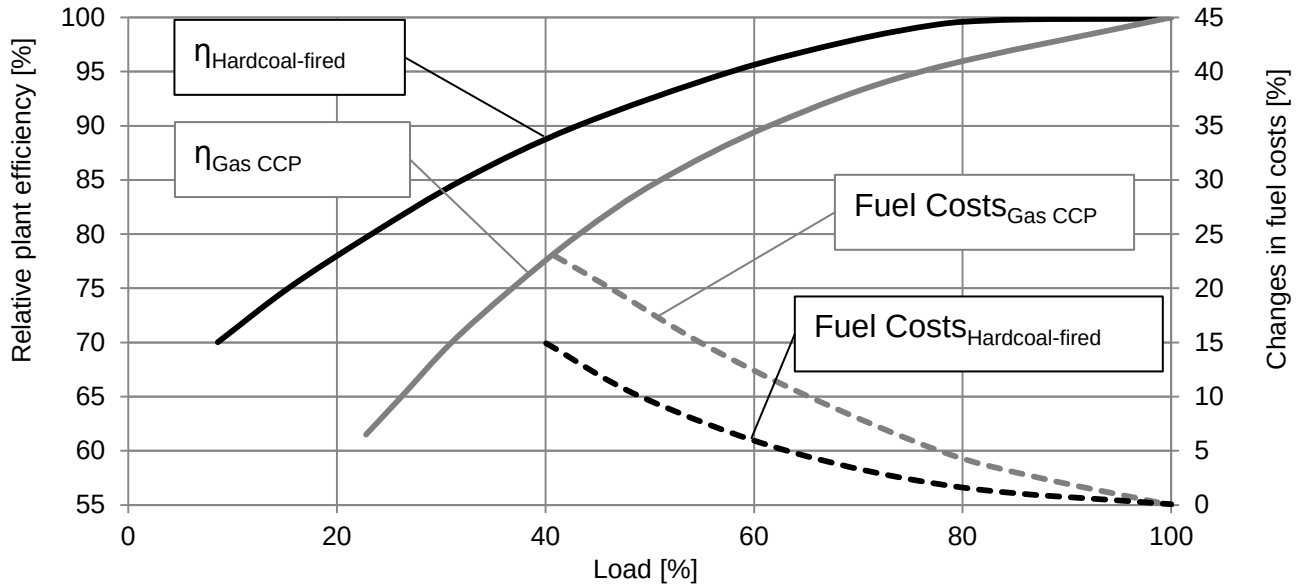


Source: Bundesnetzagentur, BMWi



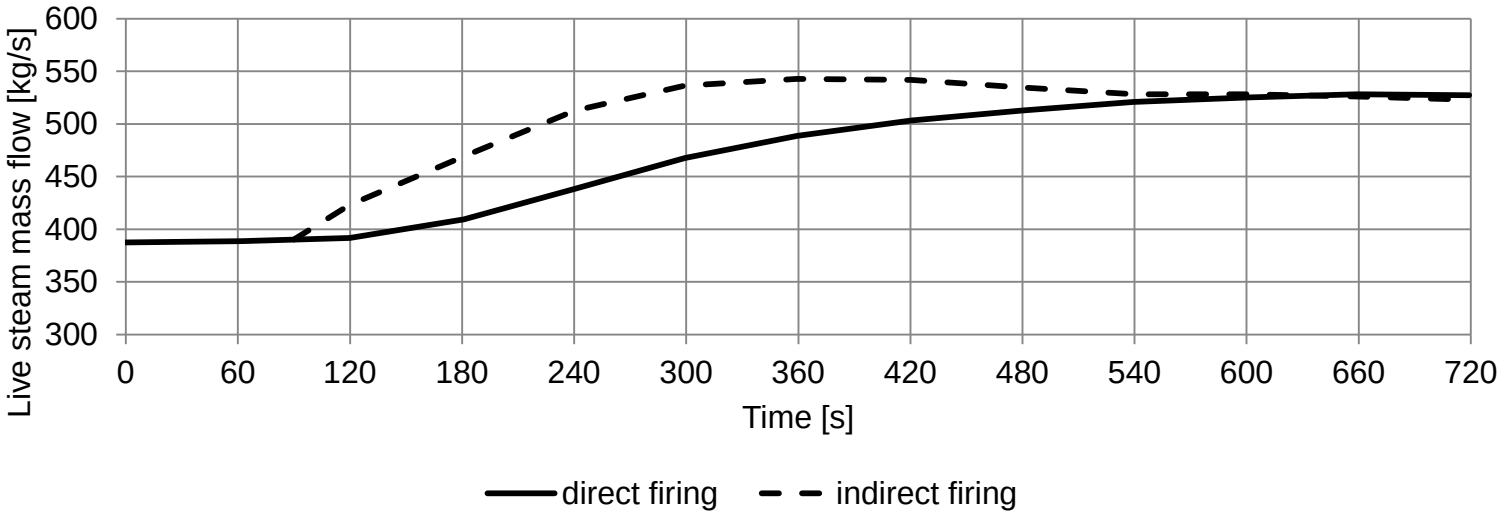
3. Role of the electricity market

Comparing the flexibility and costs of hardcoal-fired and combined cycle plants



Source: Jeschke 2011 (Hitachi Power)

4. Flexibility of conventional power plants



Source: Alstom Power

More flexibility through indirect firing
Feeding out of coal silos→ mills inertia is omitted