RWE Power's Coal Innovation Centre at Niederaussem, Germany

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The energy to lead

Coal Innovation Center Niederaussem

WTA®-Drier since late 2008
→ Efficiency enhancement

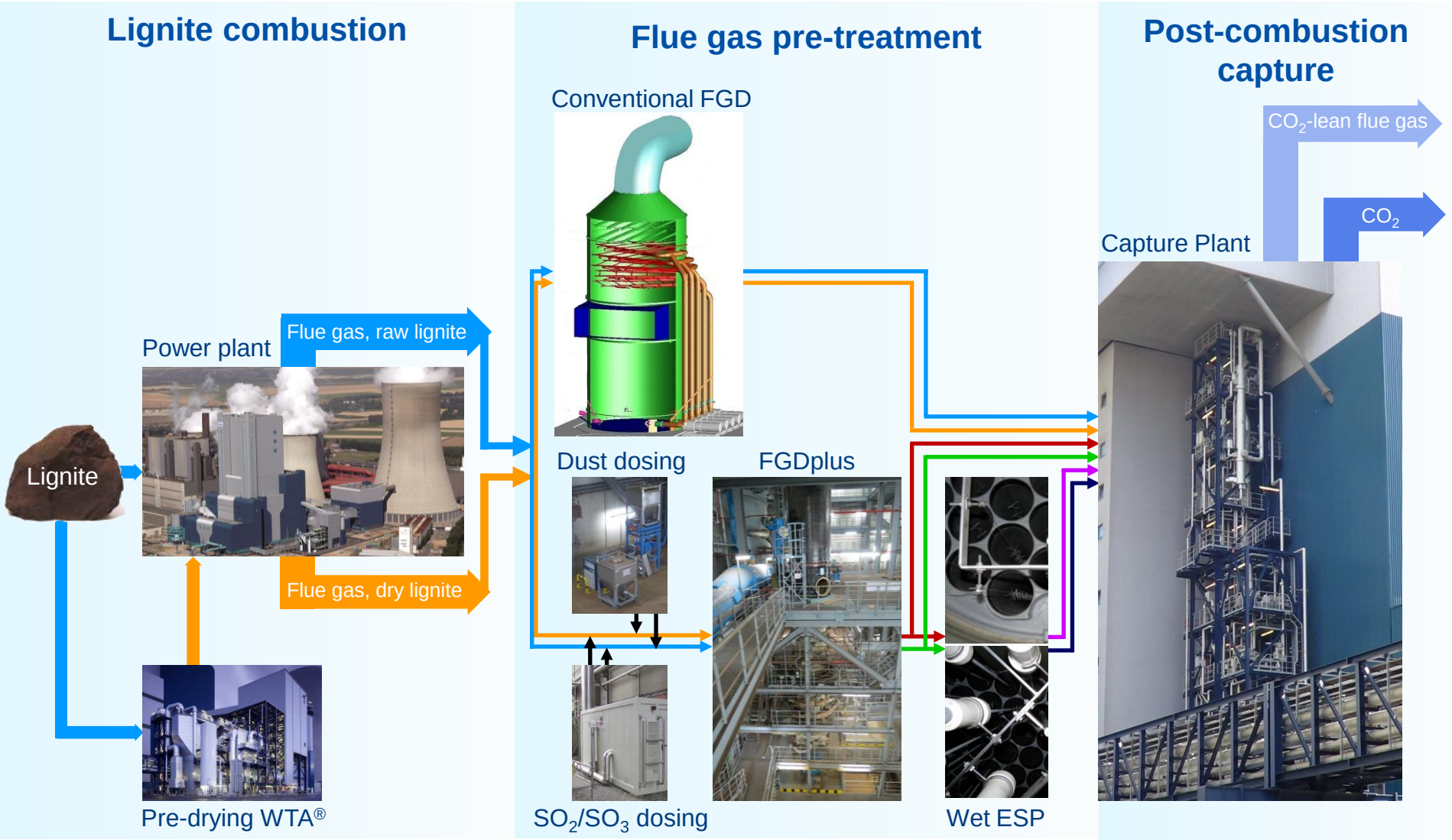
FGDplus
Since 2009
→ SO_2/Dust-Mitigation

CO_2-Scrubber since 2009
→ CO_2-Capture
CO_2-Filling station since 2011
→ CO_2-Utilisation

Power-to-Gas
2013
→ Energy Storage

Catalyst testing
since 2013
→ CO_2 usage

Coal Innovation Center Niederaussem



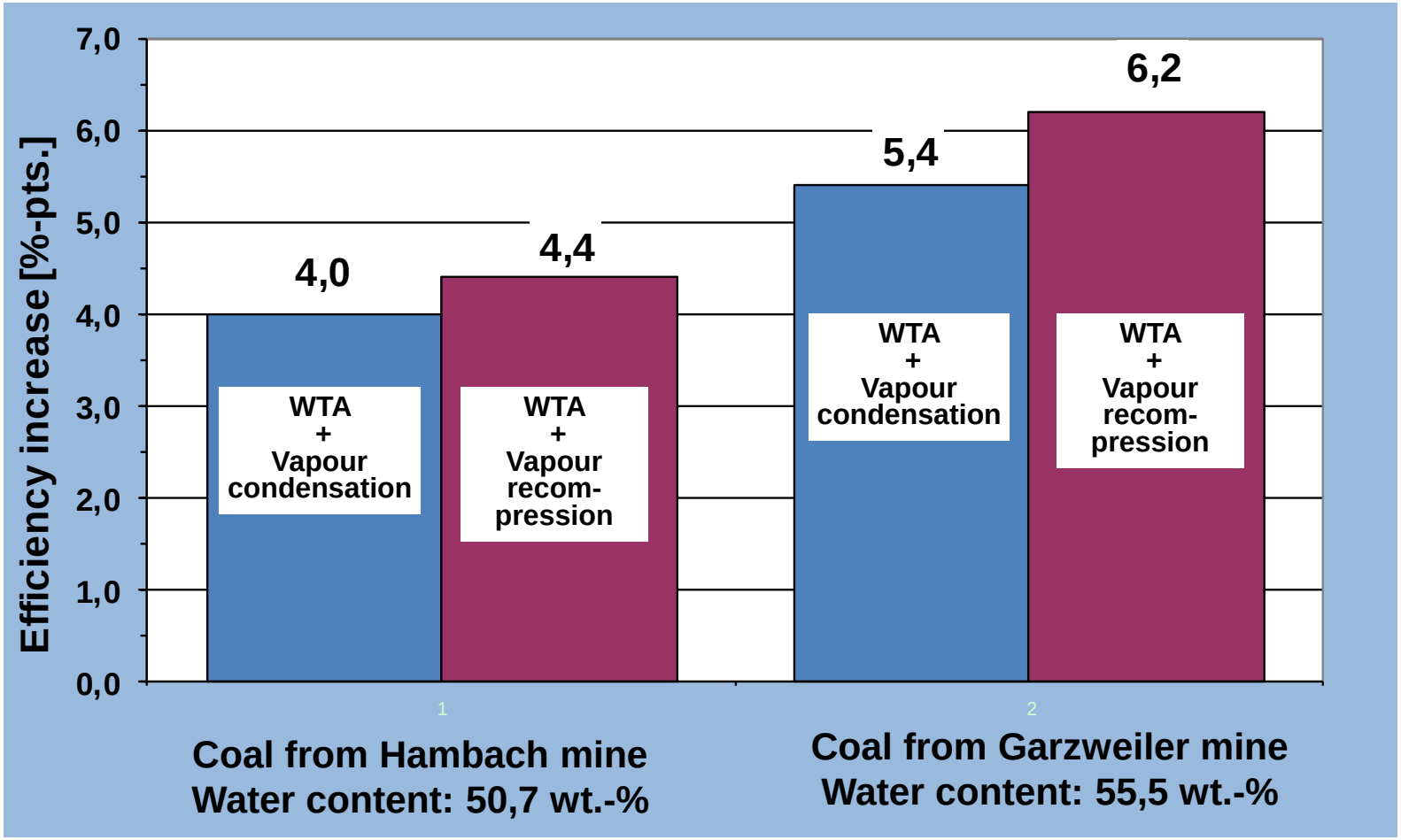
Selected R&D projects

1 **WTA**

2 FGDplus

3 CO_2 Capture and Utilisation

Power Plant Efficiency Increase due to WTA®



WTA® -Prototype - Revolving Chute Distributer

Selected R&D projects

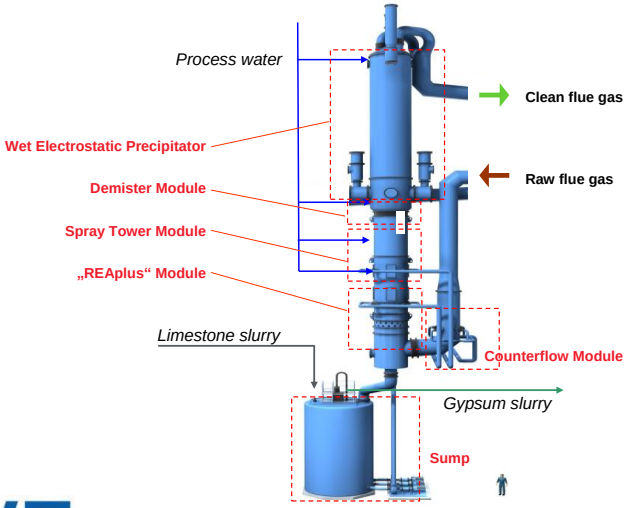
1 WTA

2 FGDplus

3 CO_2 Capture and Utilisation

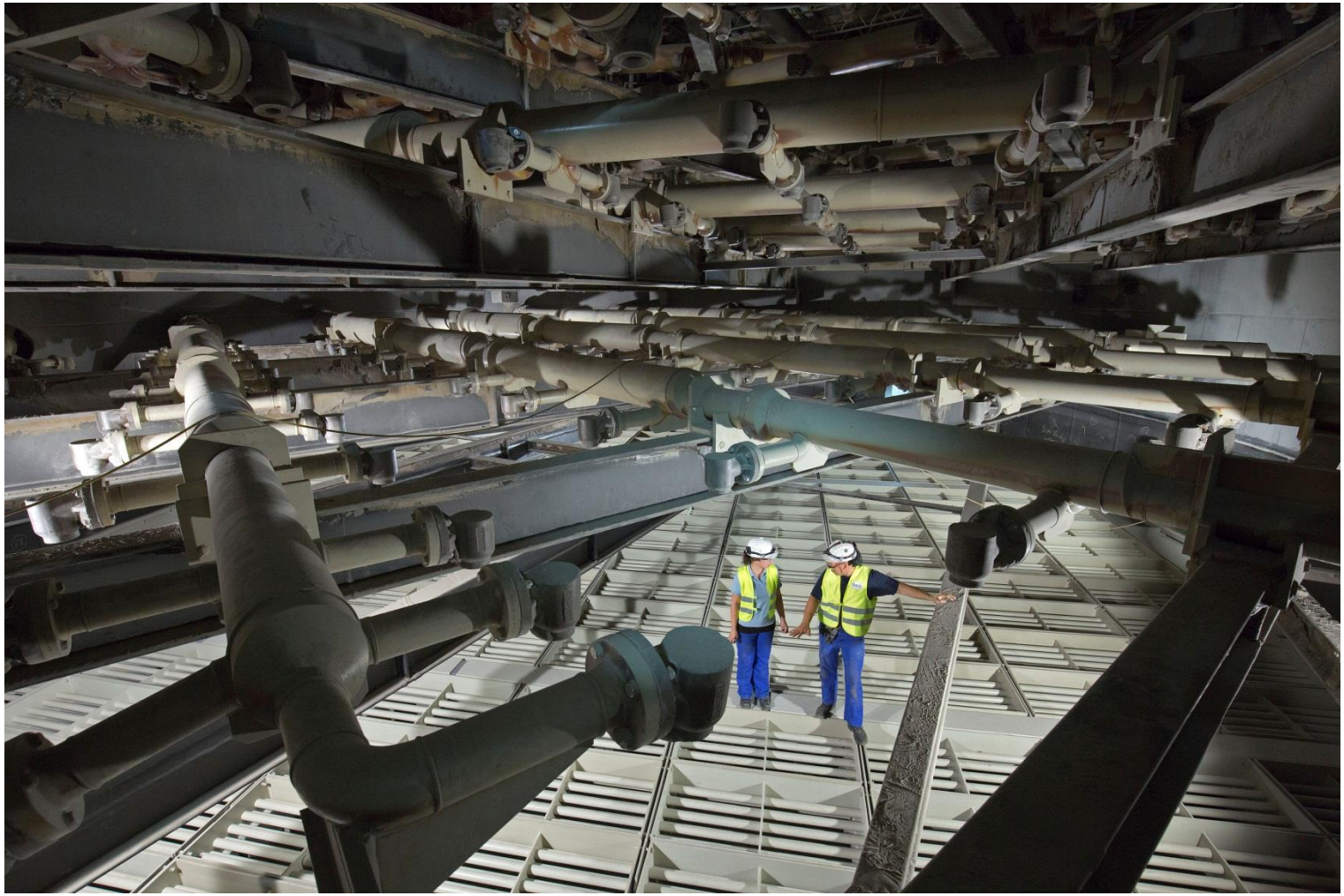
FGDplus Pilot Plant

- Joint project of RWE Power and Andritz
- Duration 2009 – 2014
- Highest removal rates for SO_2 (Target: >99,5%)
- Reduction of SO_3, Aerosols and Dust, with and without Wet Electrostatic Precipitator
- Flue gas treatment according to the requirements of PCC systems



FGDplus Pilot Plant
at the Coal Innovation Center Niederaussem

FGDplus - Full-scale Validation



Absorber G1, 600 MW unit G, power plant Niederaussem

Selected R&D projects

1 WTA

2 FGDplus

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PCC optimisation: Holistic approach and interdisciplinary cooperation

Cooperation
BASF - Linde - RWE Power

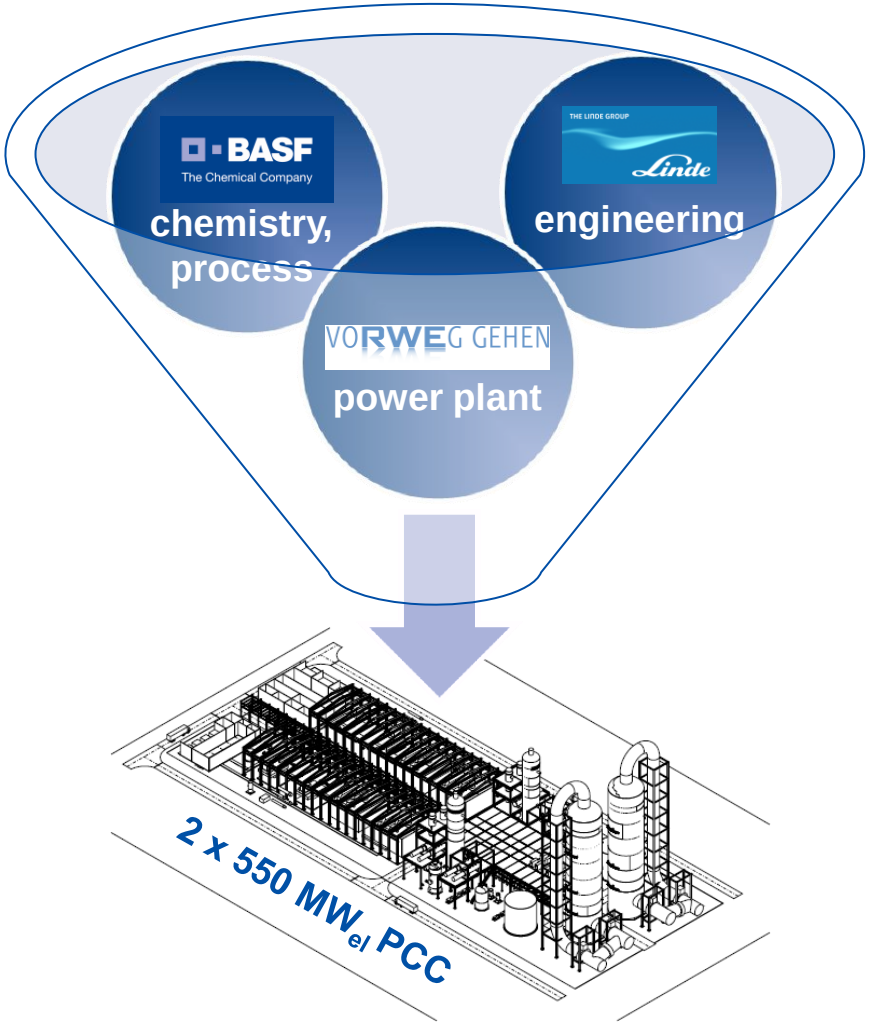
Tasks for optimisation:

> **BASF**
Capture process, solvent performance (efficiency, solvent stability, economics)

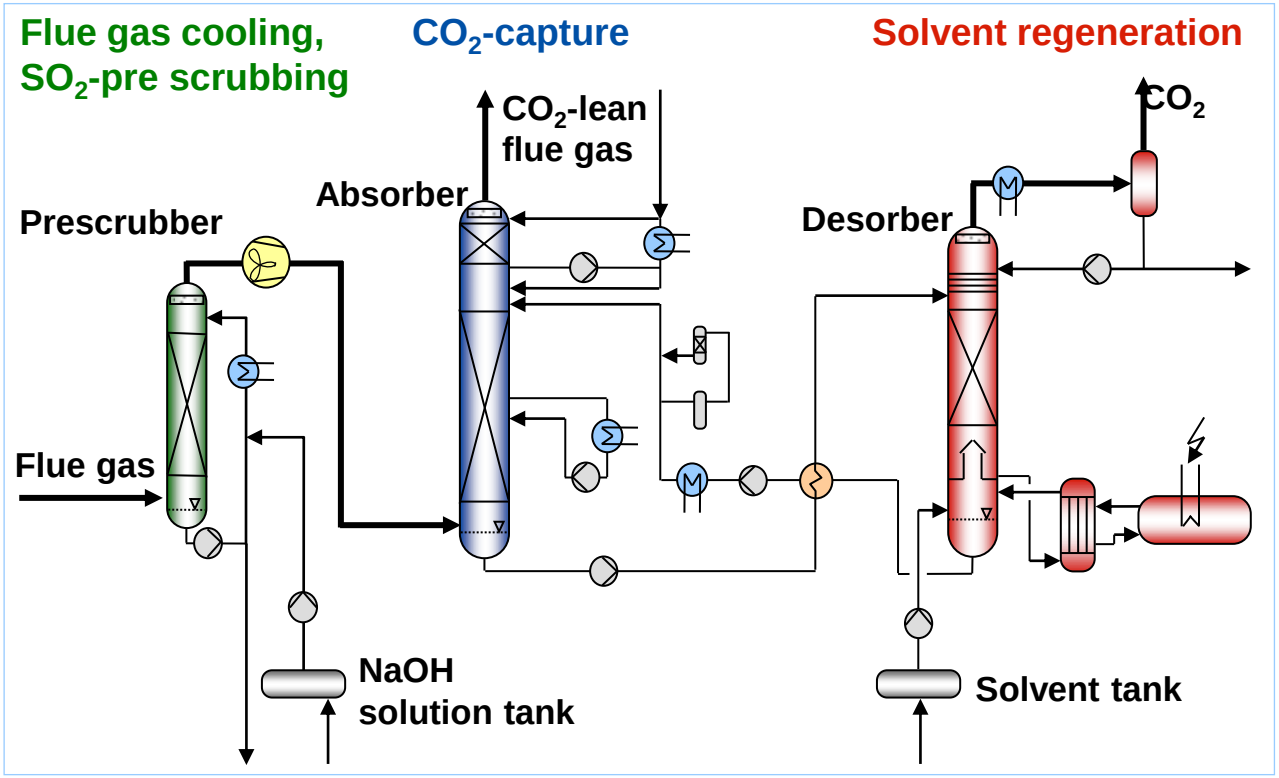
> **Linde**
Engineering capture plant, components (efficiency, scale-up, economics)

> **RWE Power**
Integration of PCC into power plants (efficiency, operation, economics)

Goal: **90% CO_2-capture rate with a high efficient PCC-technology , loss of efficiency <10%-points, PCC-design for a 1,100 MW power plant**

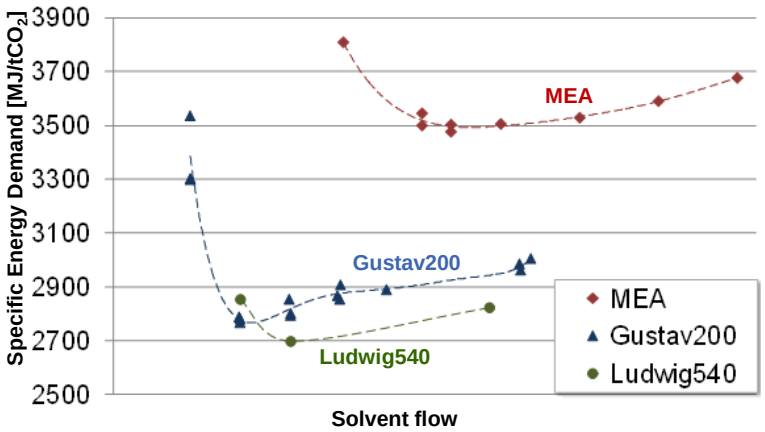


CO_2 Capture Pilot Plant at Niederaussem

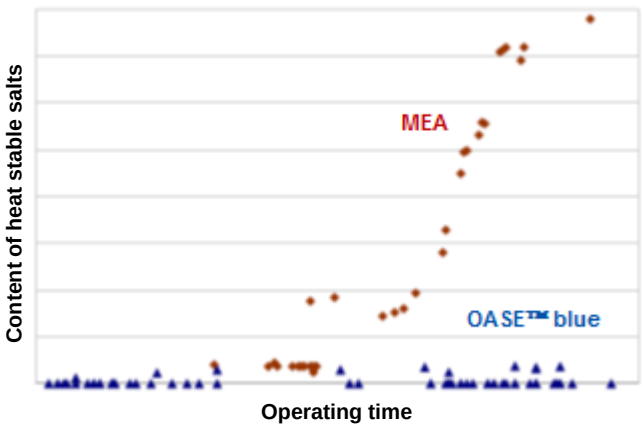


- Flue gas: 1,550 m^3_N/h
- CO_2 product: 7.2 t_{CO2}/day; capture rate 90%
- Absorber height corresponds to full scale
- Instrumentation: 275 measuring points
- Availability: 97%
- Budget of RWE for phases I/II/III: 20 Mio. €
- 40% funding by the Federal Ministry of Economics and Technology

A big step forward for Post-Combustion Capture Technology



®



> Energy demand for solvent regeneration 20% better for new solvents than for an optimised MEA process.

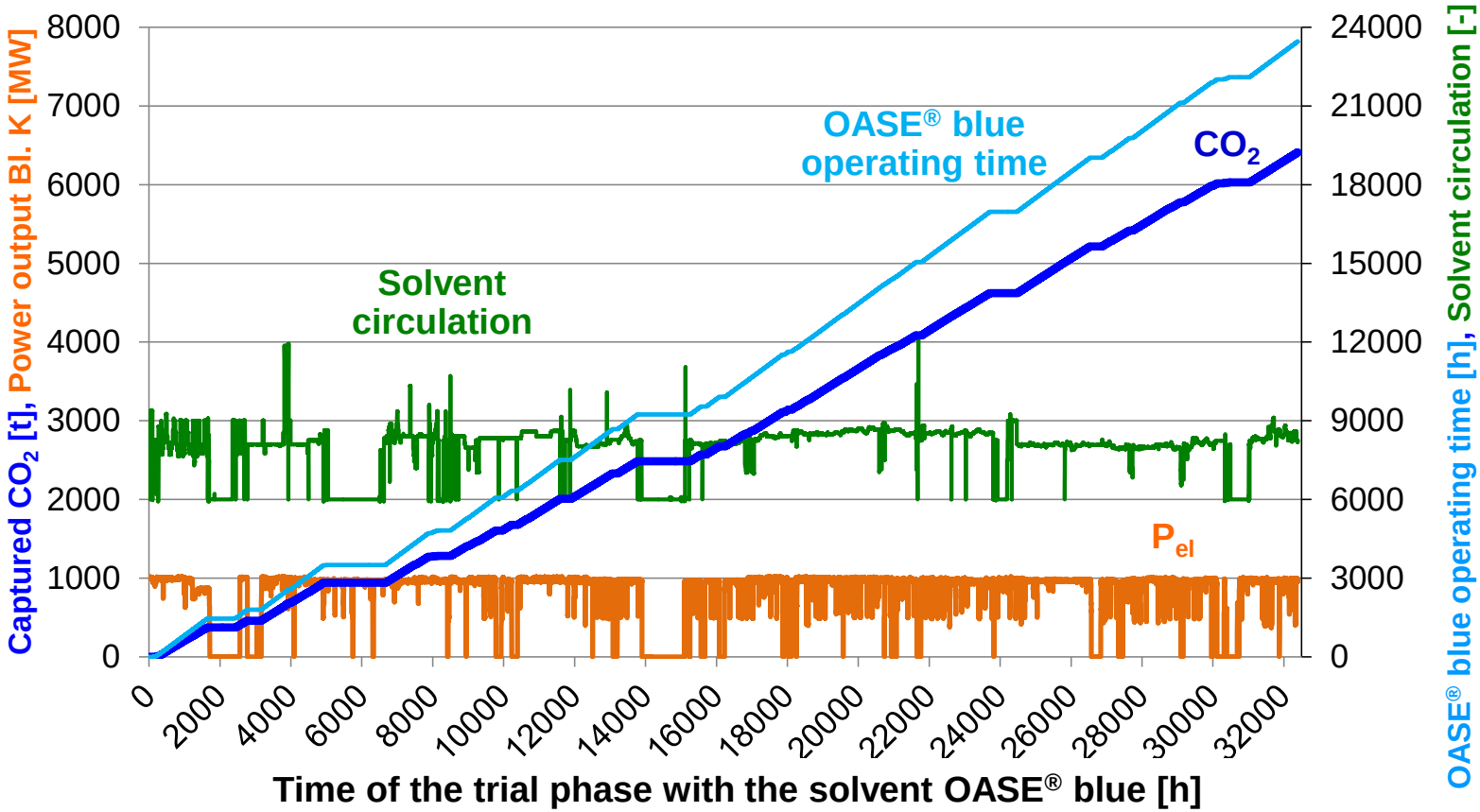
> Solvent flow rate significantly lower than for MEA.

> Low solvent losses for new scrubbing agents compared to MEA.

> OASE™ blue is more stable against oxidation than MEA.

- **Results of measurements and simulations show perfect match**
- **Innovative material concept holds promise**
- **Further potential for optimisation identified ⇒ Modification & long-term trials**

Test run history with OASE™ blue

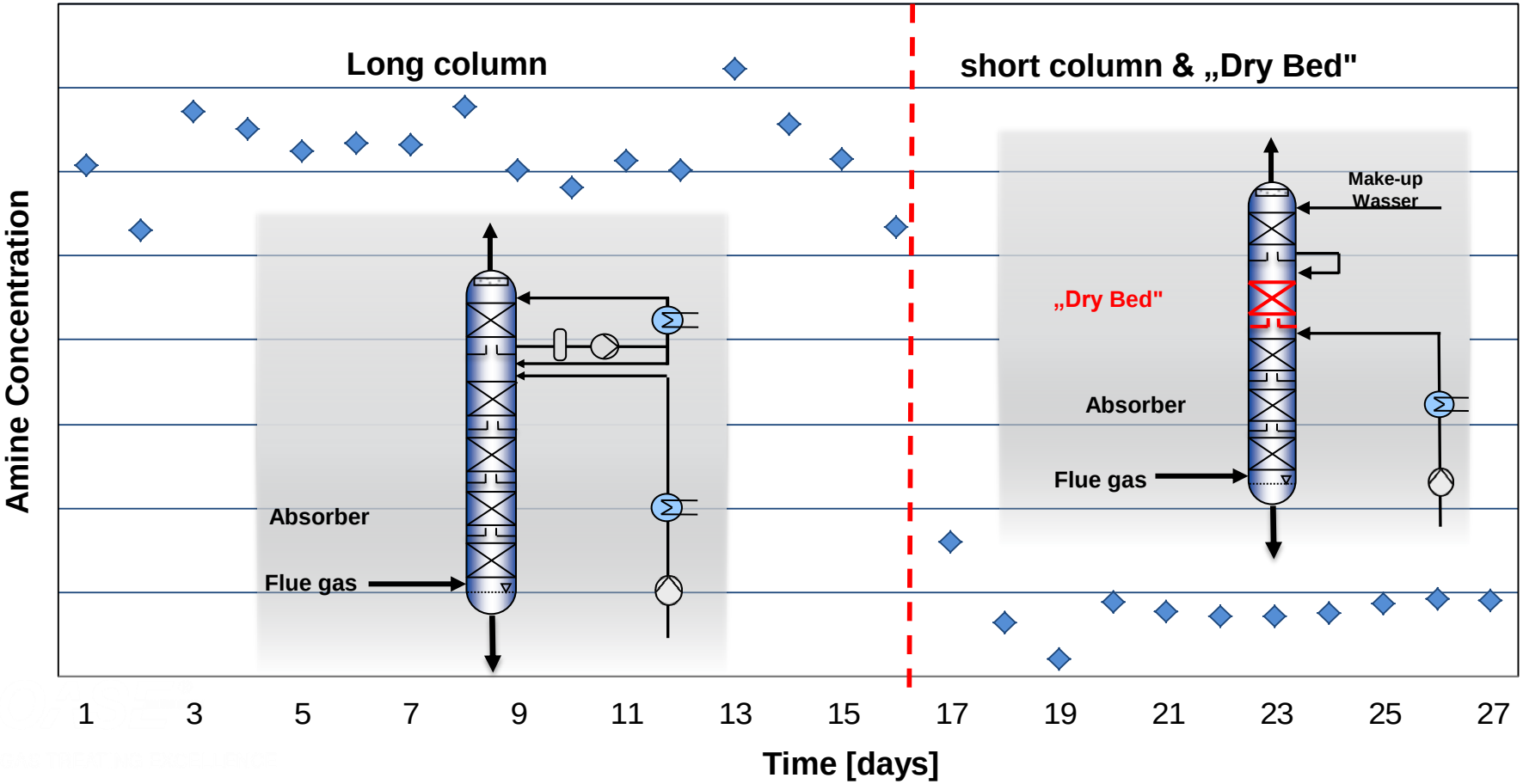


➢ **More than 24,000 h operating time with OASE® blue provide reliable results**

Change of the Packing in the Absorber Column

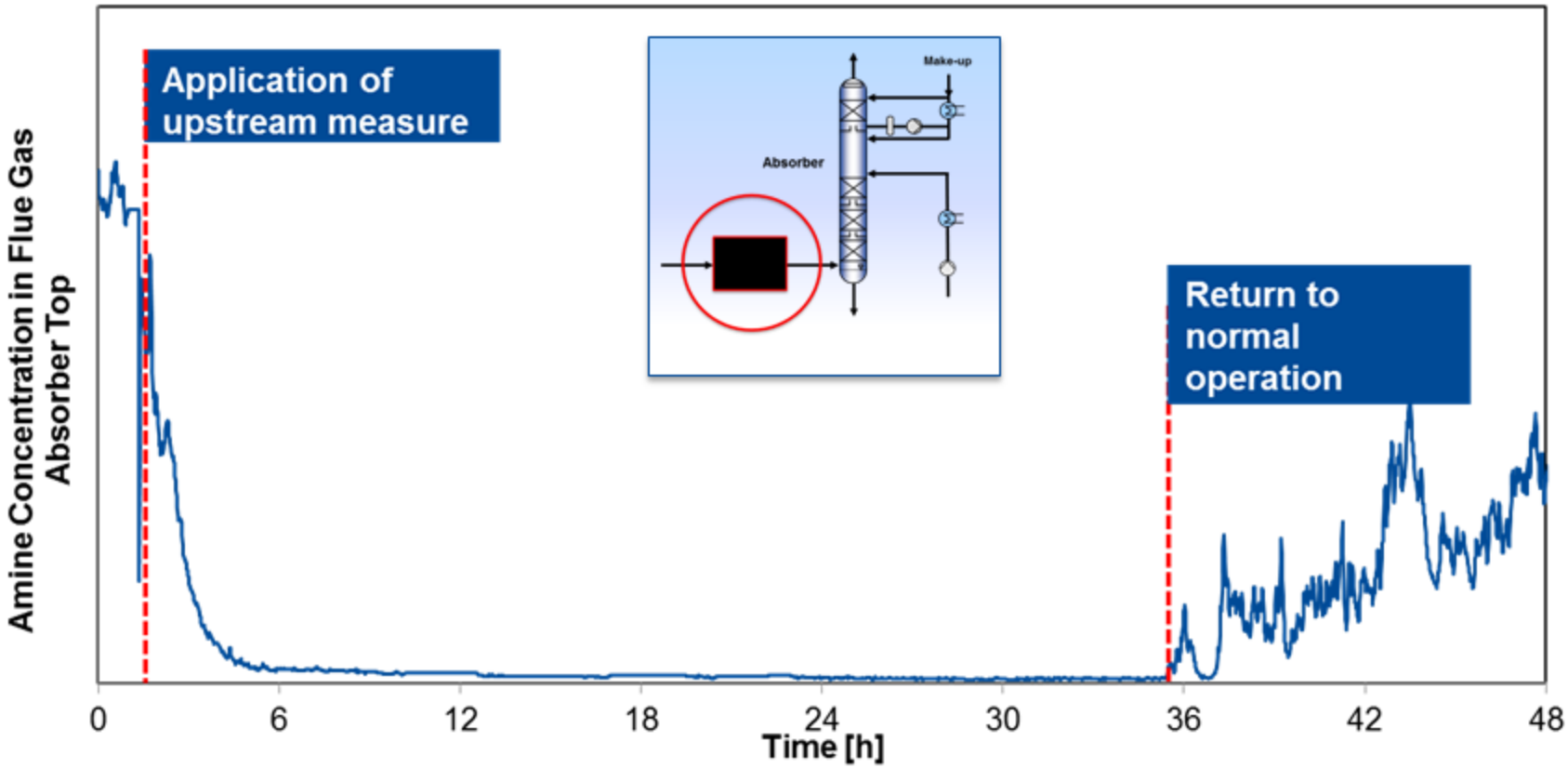
Smaller column design is possible

Emission Mitigation „Dry Bed”



Reduction of amine emissions by an order of magnitude: Process configuration „Dry Bed“

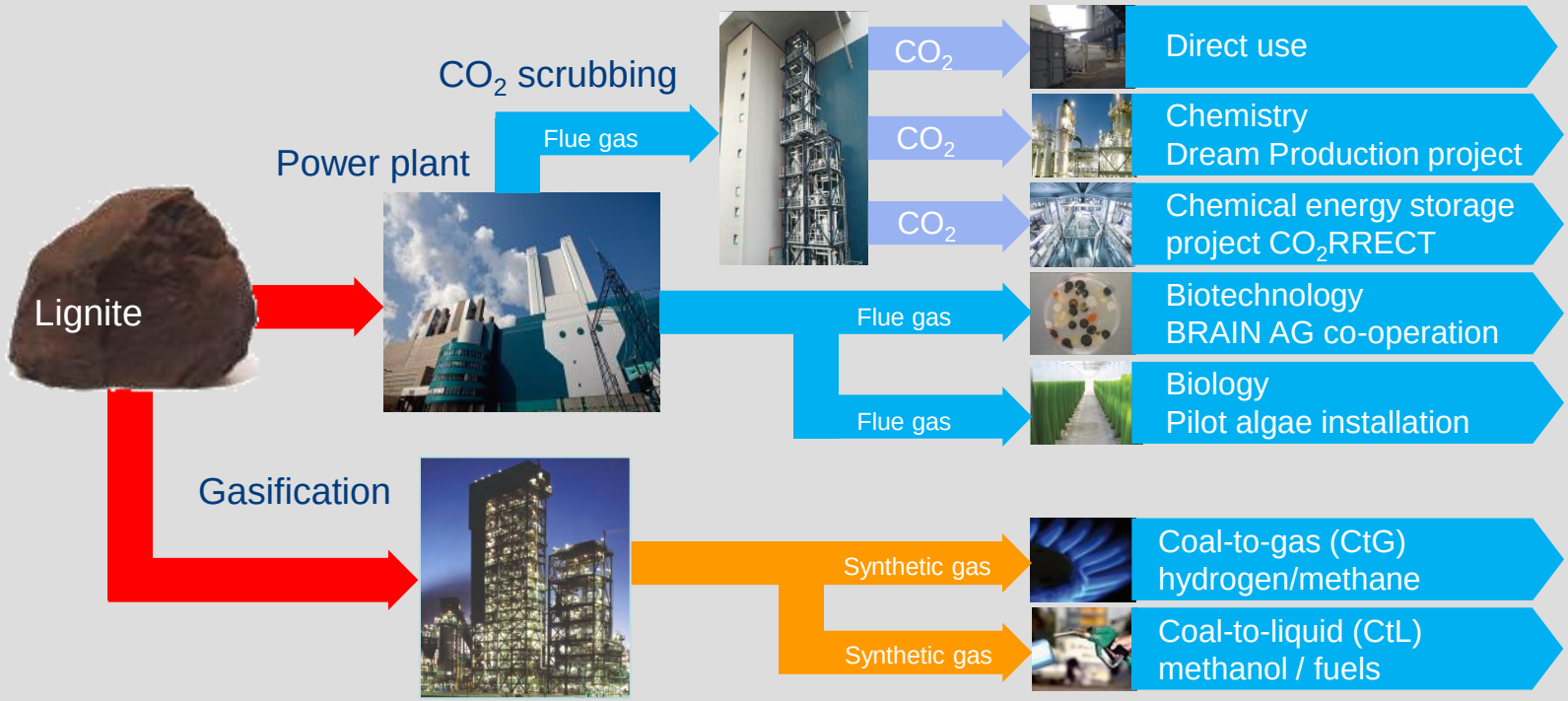
Emission Reduction by Upstream Measure
OASE™ blue run



Reduction of amine emissions by an order of magnitude: Process configuration „Upstream Measure“

Opening up new business areas outside the power and heat market

Lignite and CO_2 as raw materials for chemistry and biotechnology



- **However, the overall potential for CO_2 Utilisation in Germany is < 10 MT/a. Reward for CCU in form of free Allocated EUAs is not given.**

Challenges for Power Generation and CCS at Germany

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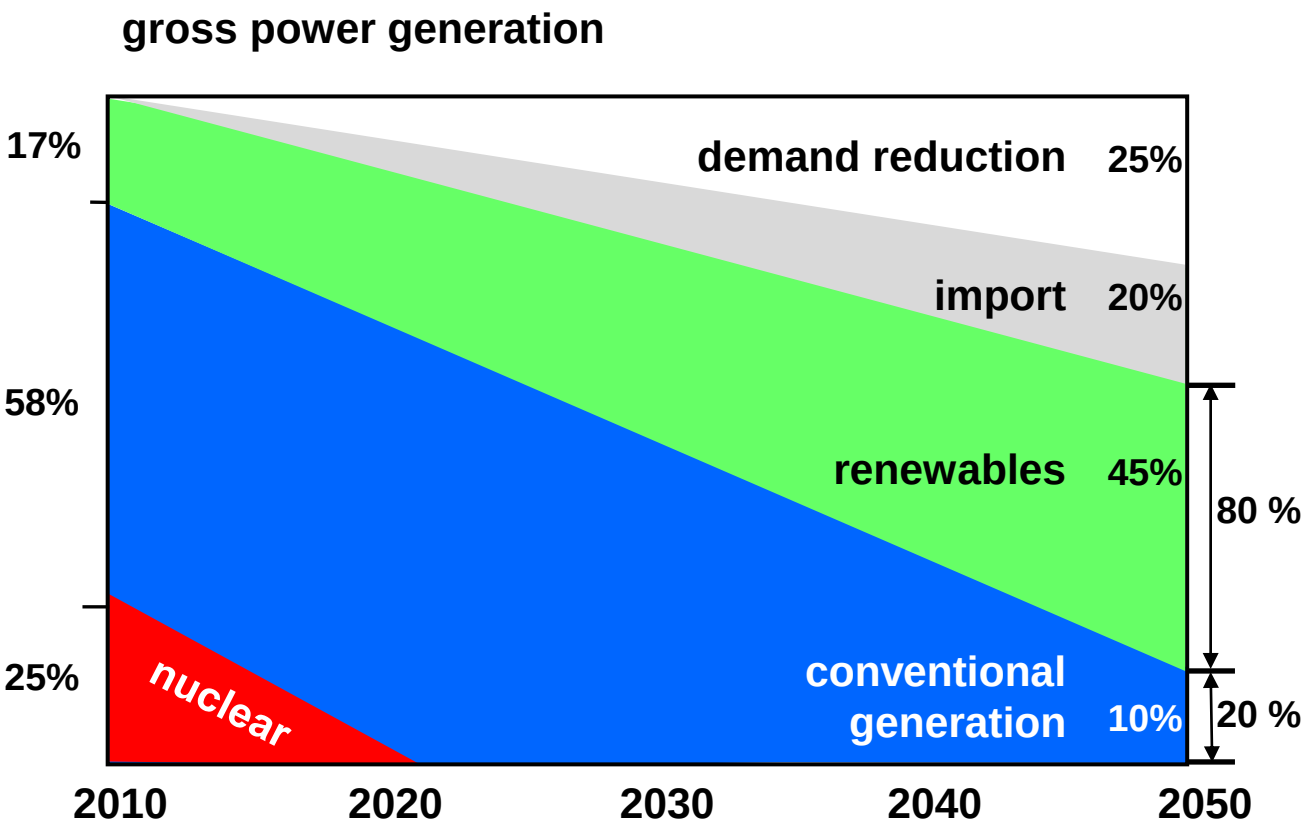
Power Generation Sector to Realize Highest Contribution to match goals of government‘s „Energy Concept“

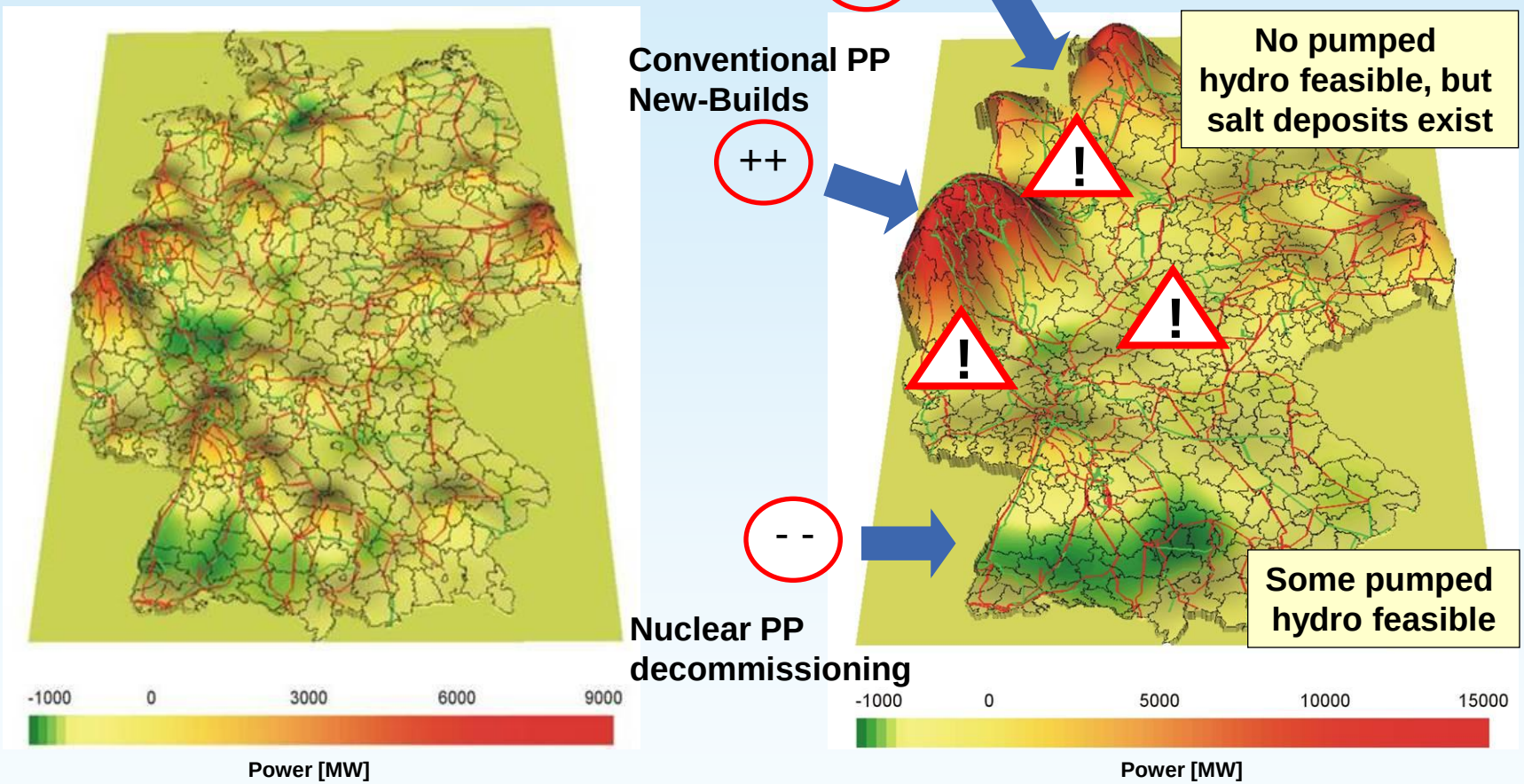


(EWI/Prognos/GWS Studie)

To be considered:

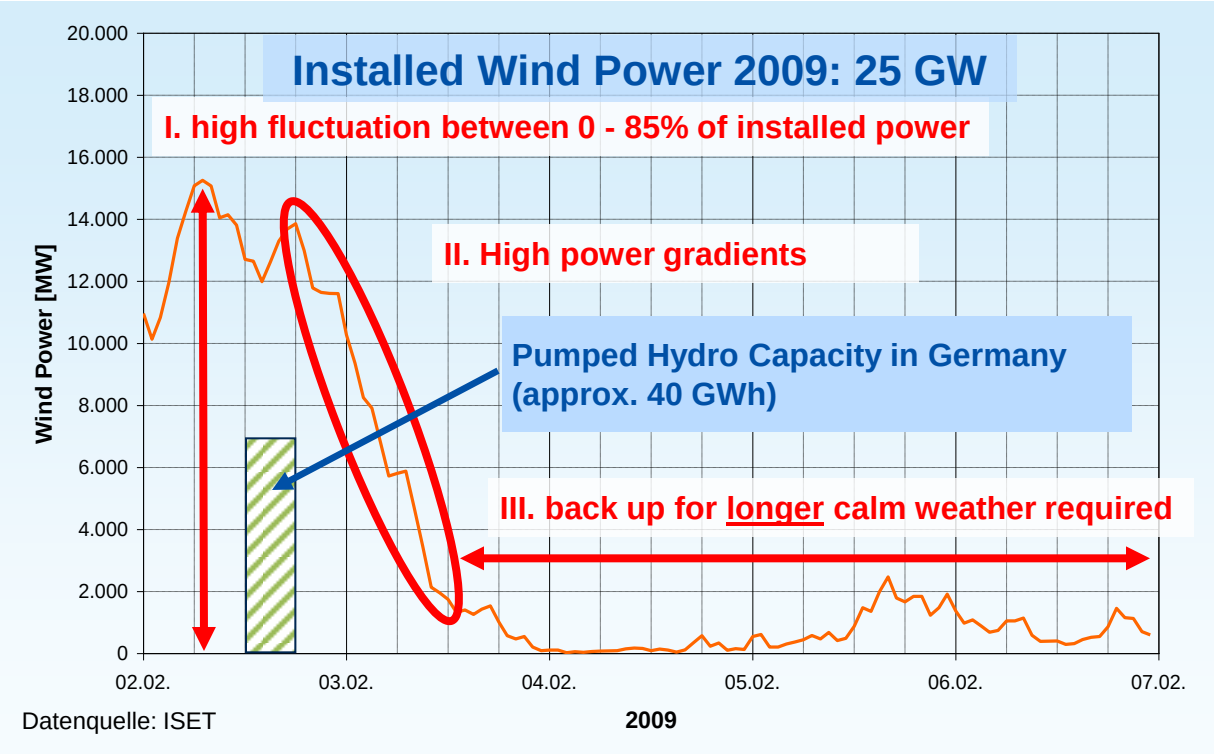
- **Deployment potential of renewables**
- **Security of supply and power quality**
- **Price development**
- **Grid stability and grid extension**

In Germany a dramatically increasing Asymmetry between Demand and Supply is expected



Regional Power Balance 2008 Source: Amprion **Regional Power Balance 2030**

Dramatic Changes of Wind Power Output



Feb 2009

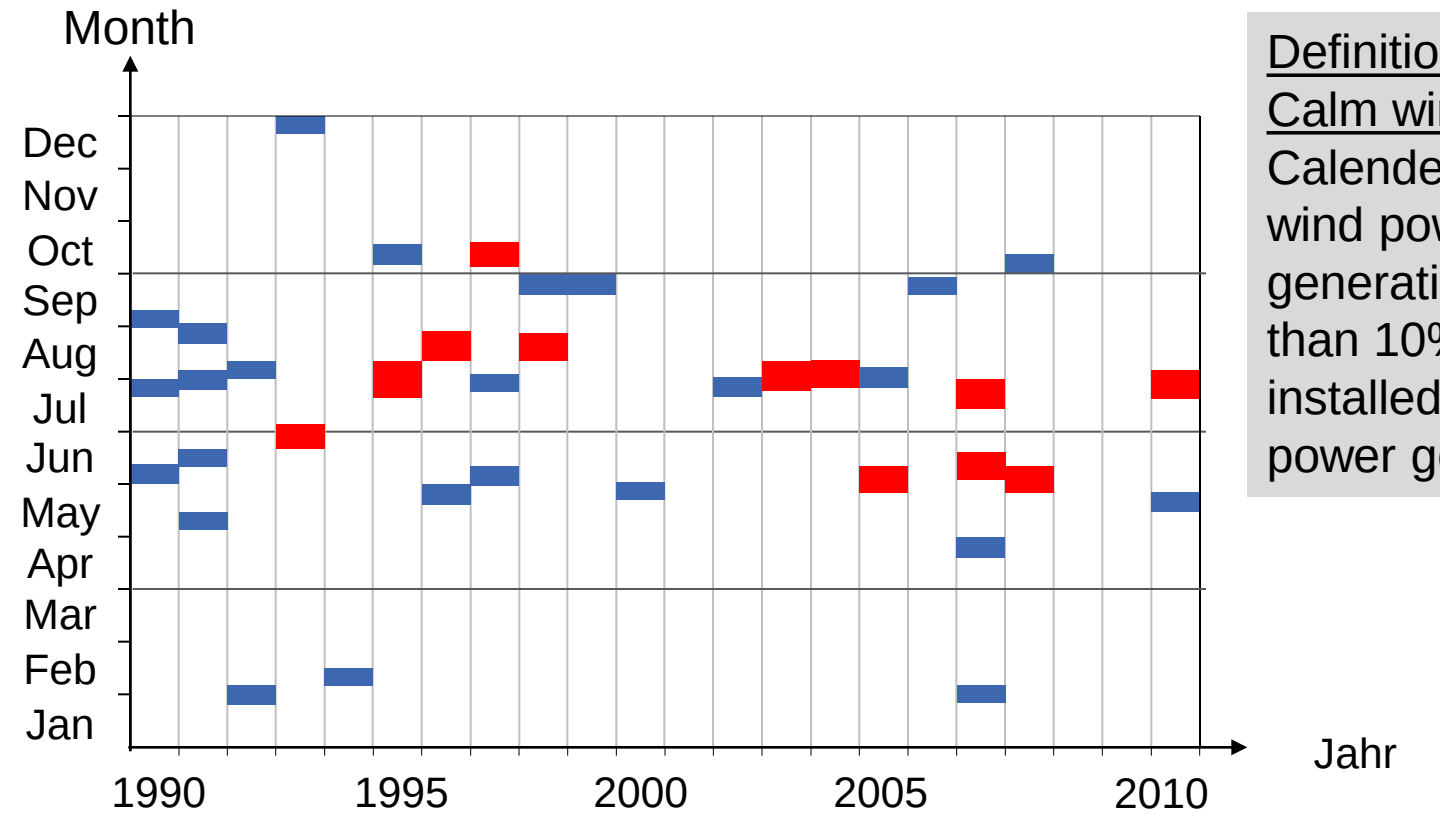
- Initial strong wind phase
- Several days of calm & foggy weather with very low temperatures (inversion weather)
- Peak residential heating demand
- Whole Germany was affected

When doubling installed capacity until 2020 to 50 GW:

- grid enforcement required, but alone not sufficient to solve the problem
- existing storage capacity too low
- at least 90% of demand as back-up required by conv. power plants
- focus on NG (CC & OCGT) appears to be very risky

Periods of Calm Wind happen regularly (P_{el_wind}<10%$P_{inst.}$)

Experience made during more than 20 years (1989 to 2010)

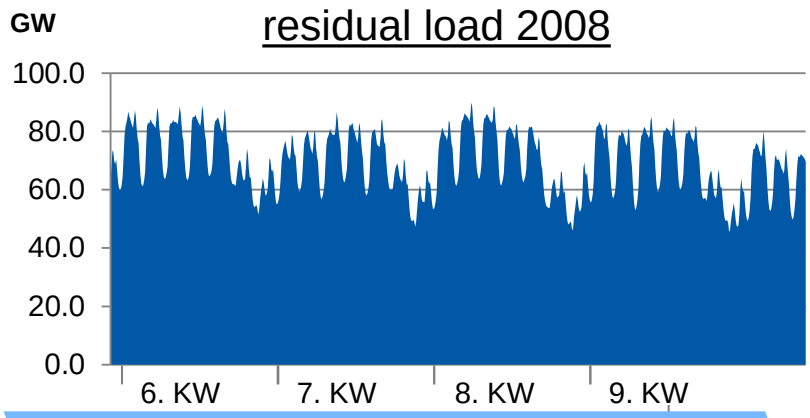


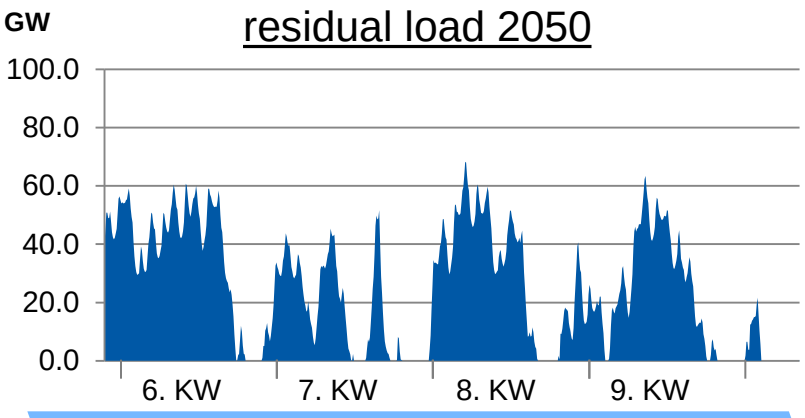
Definition of Calm wind day: Calender day with wind power generation of less than 10% of installed wind power generators

calm wind period 10-12 days

calm wind period > 12 days

Properties of conventional Power Plants will need to change





up to now

large power plant fleet, three different dispatch schemes:

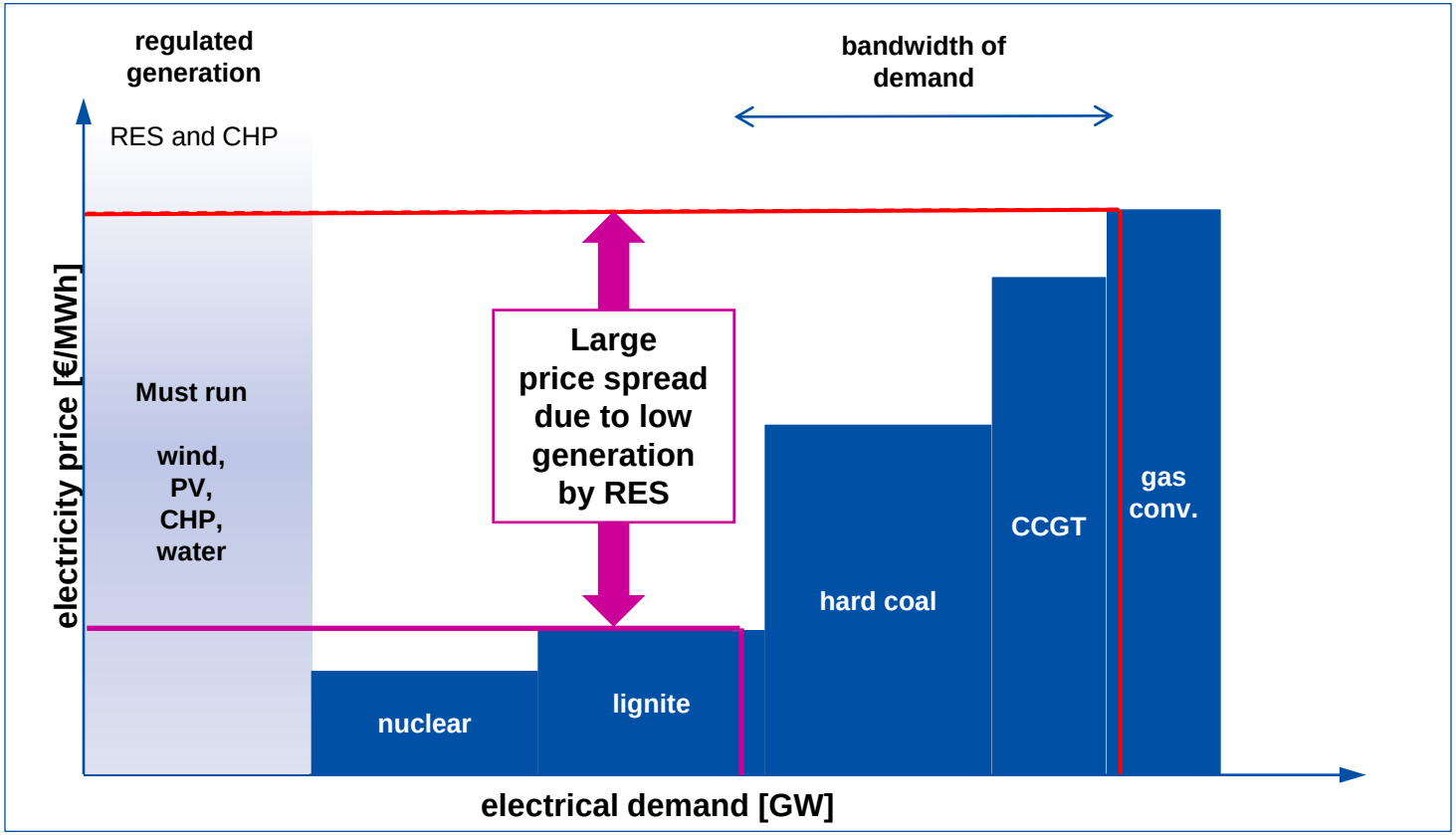
- base load power plant
- mid load power plant
- peak load power plant
- High efficiency at nominal power

future

Still large power plant fleet, three different dispatch schemes:

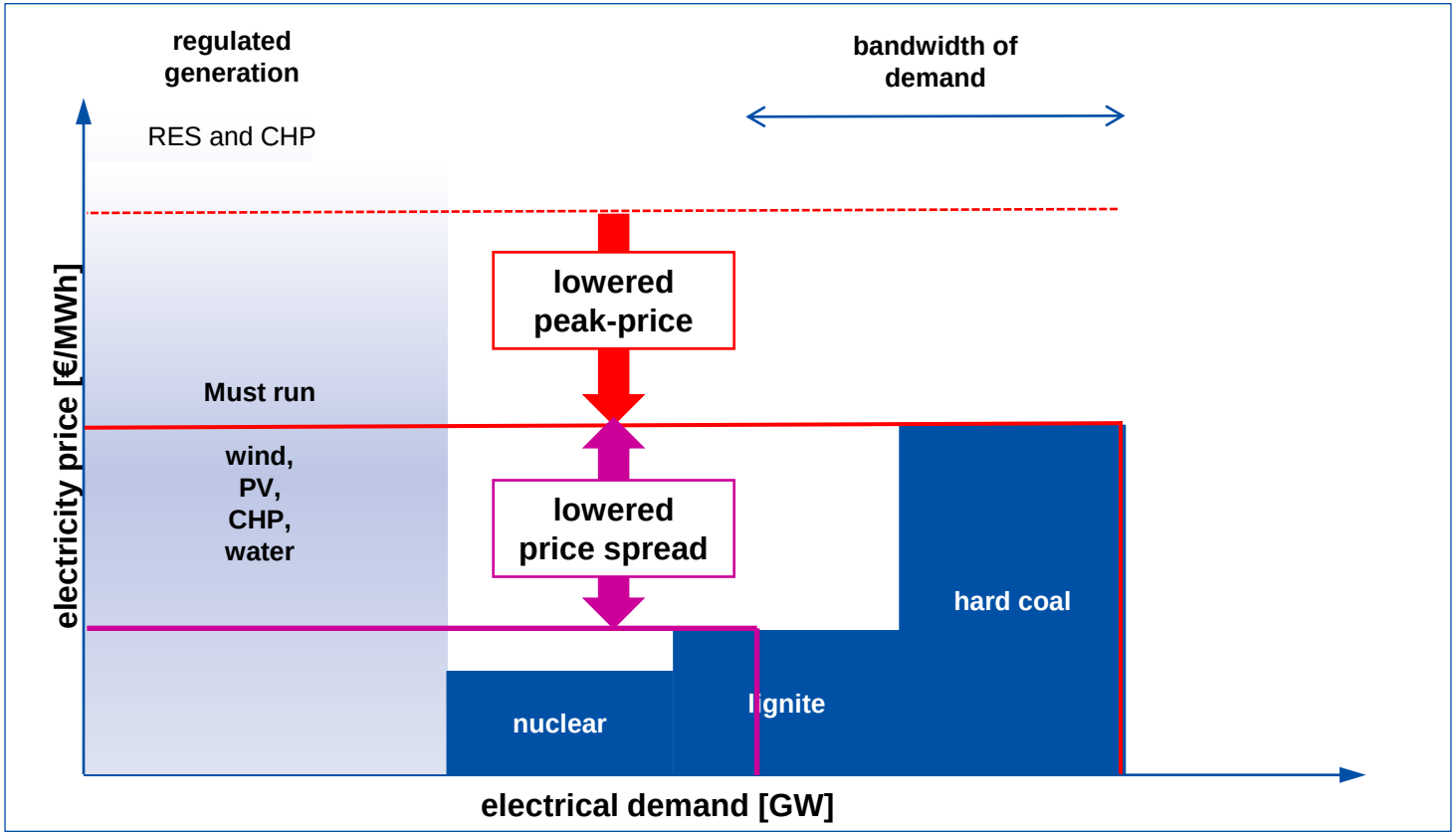
- fast load gradients
- Low min load and many load changes
- Good efficiency over wide load range

Increased not-demand-driven Generation does not automatically lead to enhanced Economics for Storage



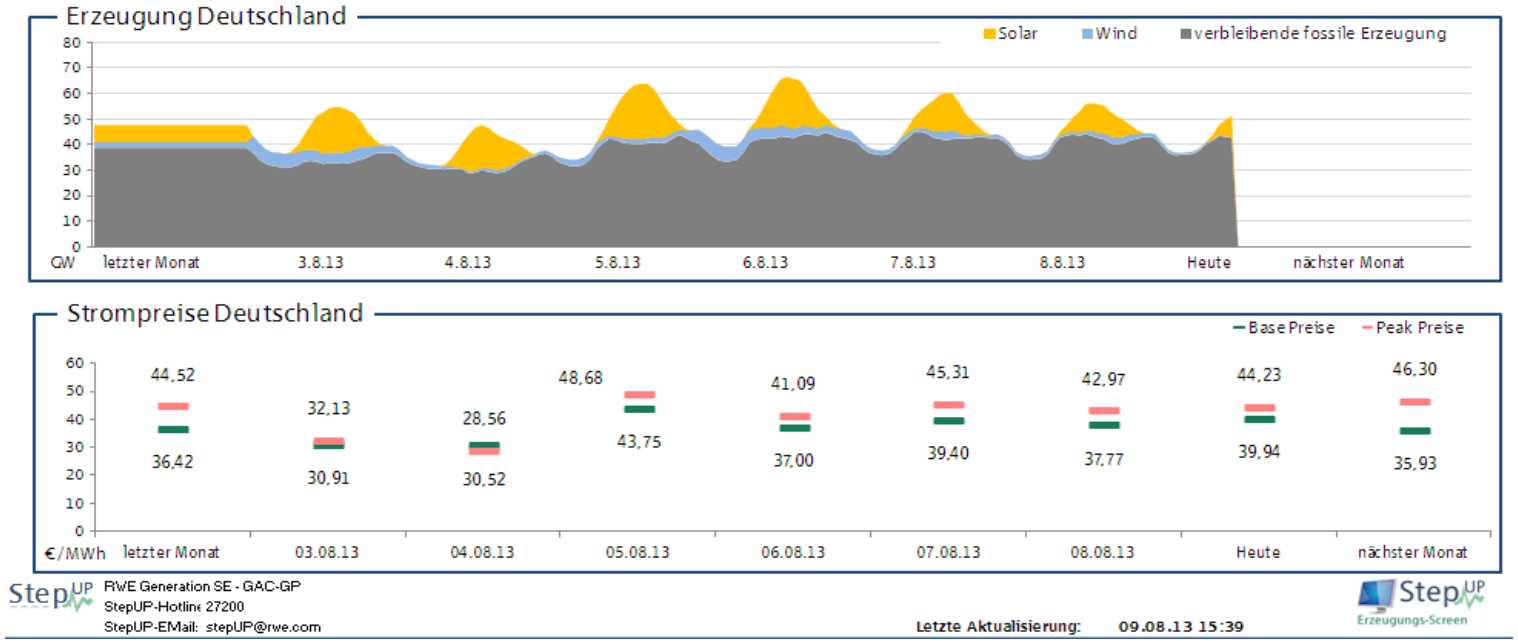
Price mechanisms influenced by regulatory measures, Merit-Order-Market is distorted

Increased not-demand-driven Generation does not automatically lead to enhanced Economics for Storage



Price mechanisms influenced by regulatory measures, Merit-Order-Market is distorted

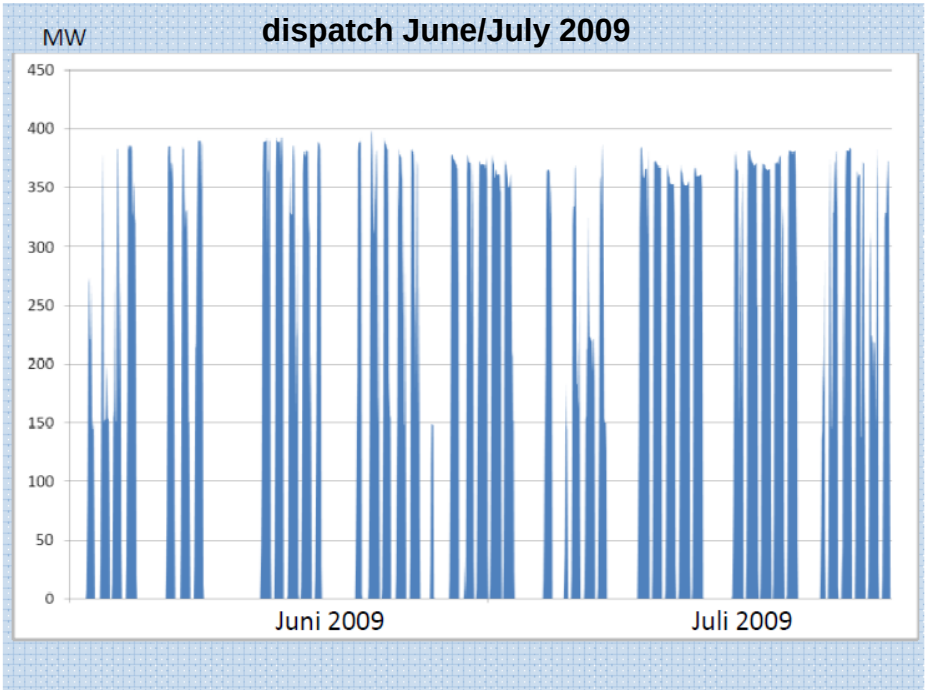
PV cuts at Noon Peak of residual Load and Price

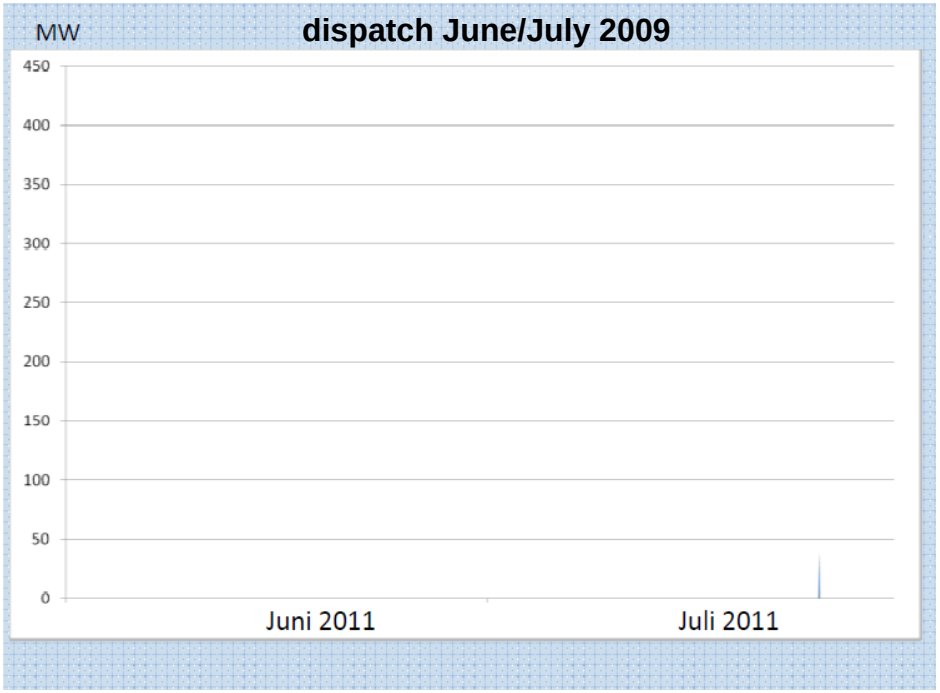


- **In summer time residual load is more even due to PV → price drop, no price spread**

Consequence for Natural gas-fired Power Plants: Dramatically reduced Operation

Comparison of the dispatch of a 400 MW NG-combi-plant (topping GT + gas fired boiler) 2009 vs 2011





- **NG power plants first to be decommissioned; a reasonable CO_2-Price will not change this**
- **Though: Due to lower CO_2 foot print, NG plants planned to be complementary to RES in the government's Energy Concept**

Thank you for your attention!

RWE

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