



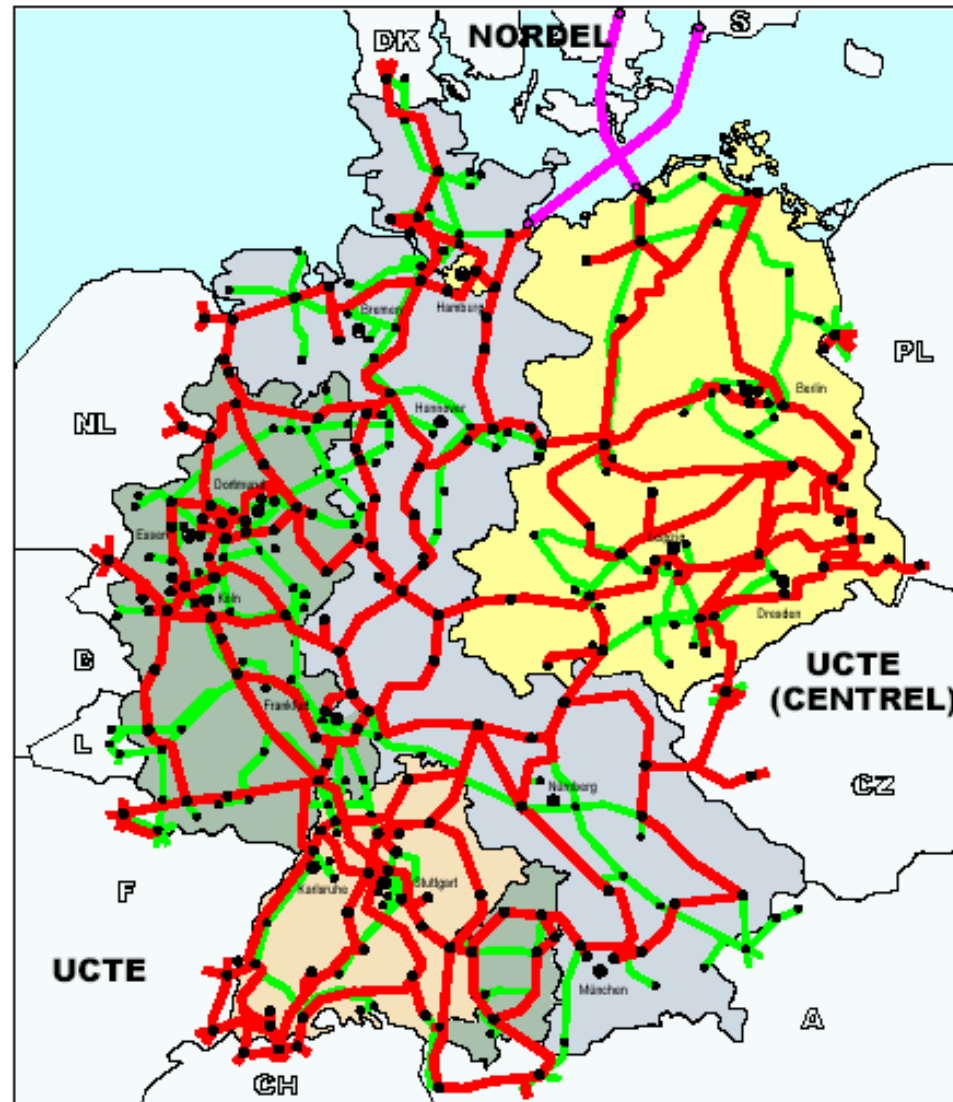
“DENA-Grid-Study”

Integration of Onshore and Offshore Wind Energy into the German Power System – Planning Study 2003 - 2020

Markus Pöller



German Power Transmission System





Actors

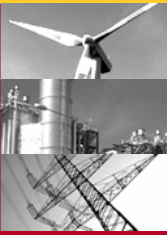


- *EWI-Consortium*
 - *DEWI: Part 1/Scenarios*
 - *E.ON/RWE/Vattenfall: Part 2/Grid*
 - *EWI: Part 3/Power Plant Development*
- ISET and DIGSILENT: Independent assessors
- Project control: Around 50 delegates from different organisations who financed the study.



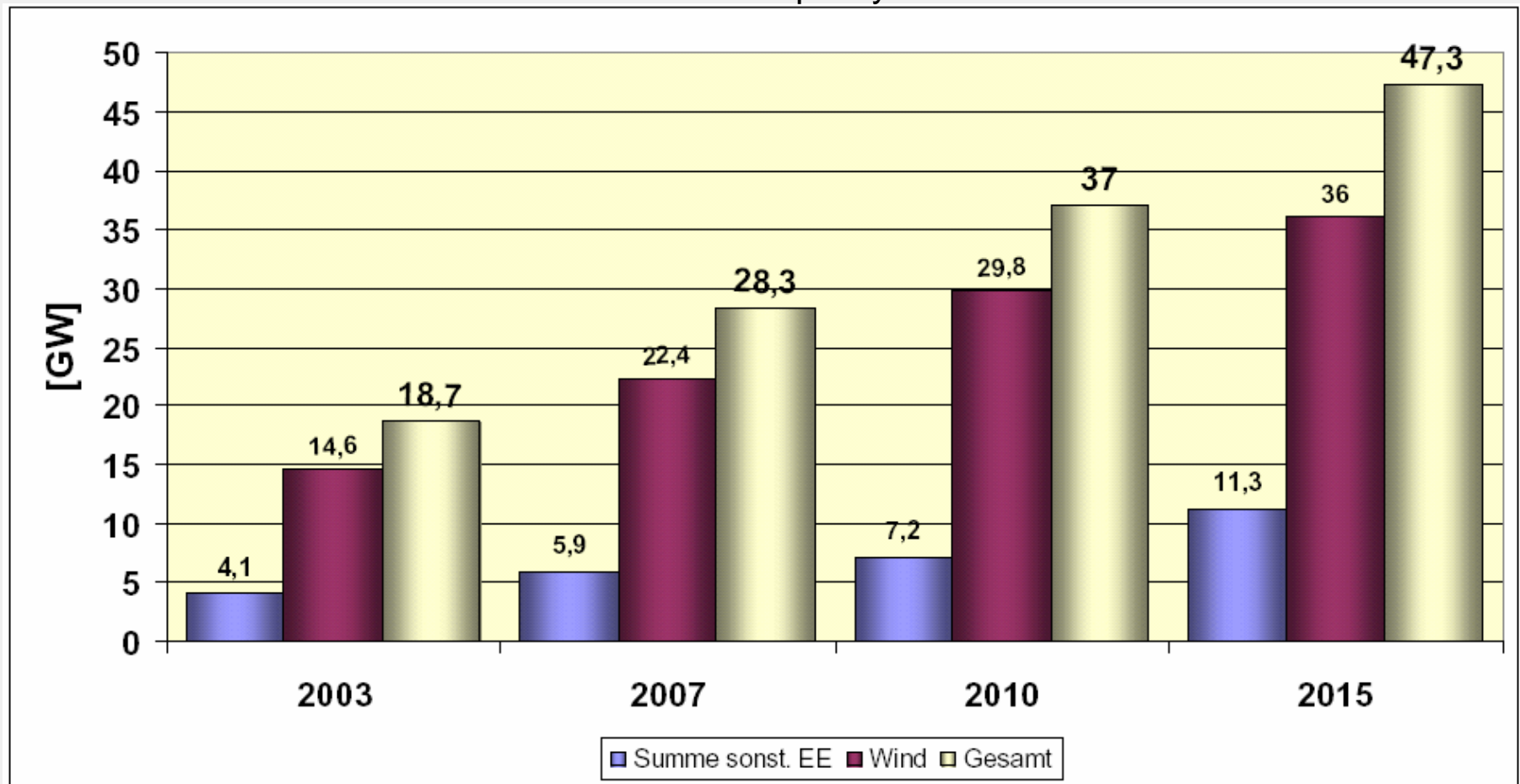
Organisation

1. Scenarios for future development of wind power and other renewable energies (solar, biomass, hydro, geo-thermal)
2. Power system impact/required network reinforcements
3. Influence on conventional power plant park, reserve requirements, costs and CO2 emission.



Results – Development of Renewables until 2015

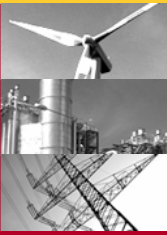
Installed Capacity



Other renewables

Wind

Total

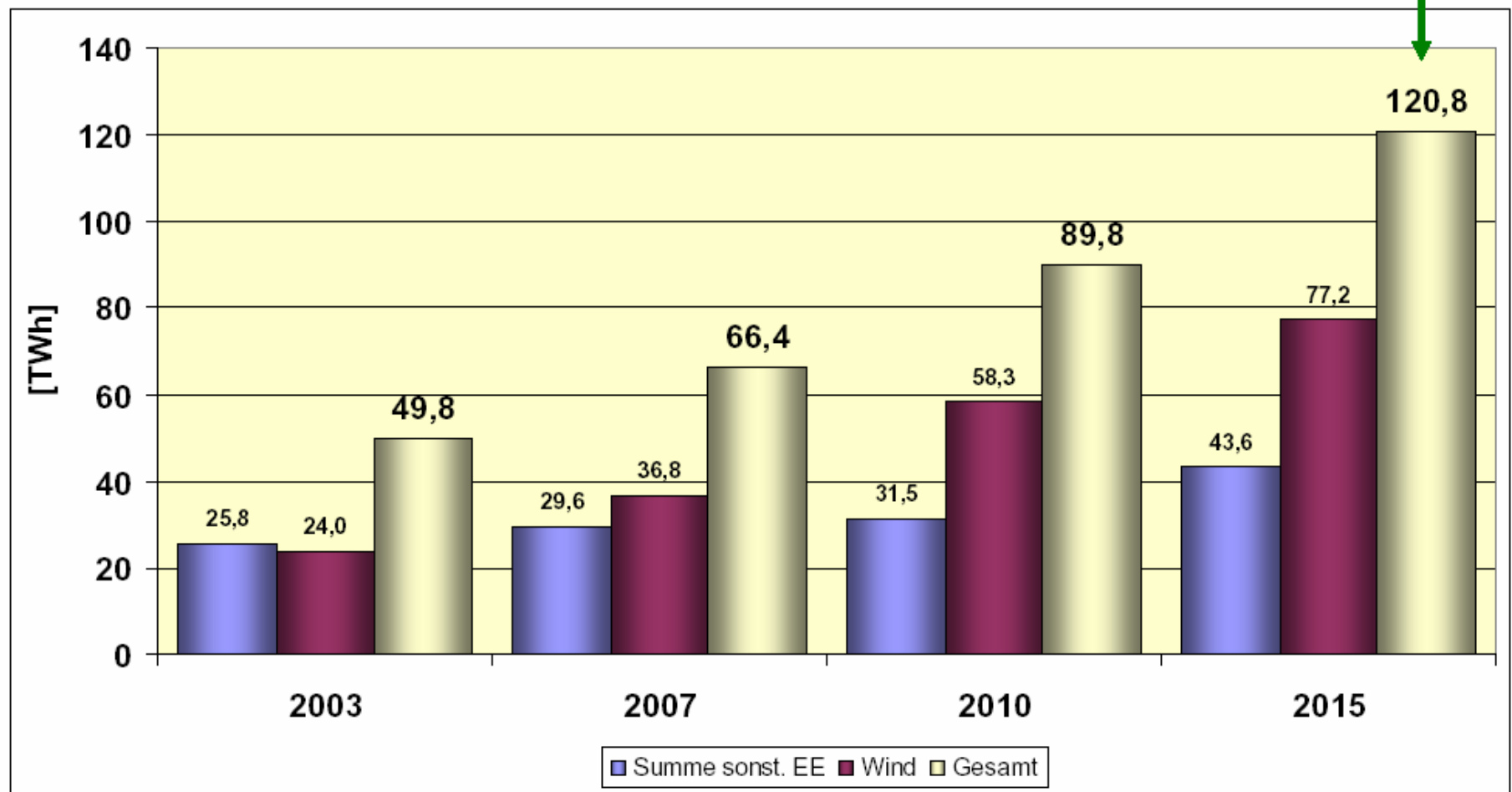


Results – Development of Renewables until 2015



Energy Production

20% of total demand



Other renewables

Wind

Total

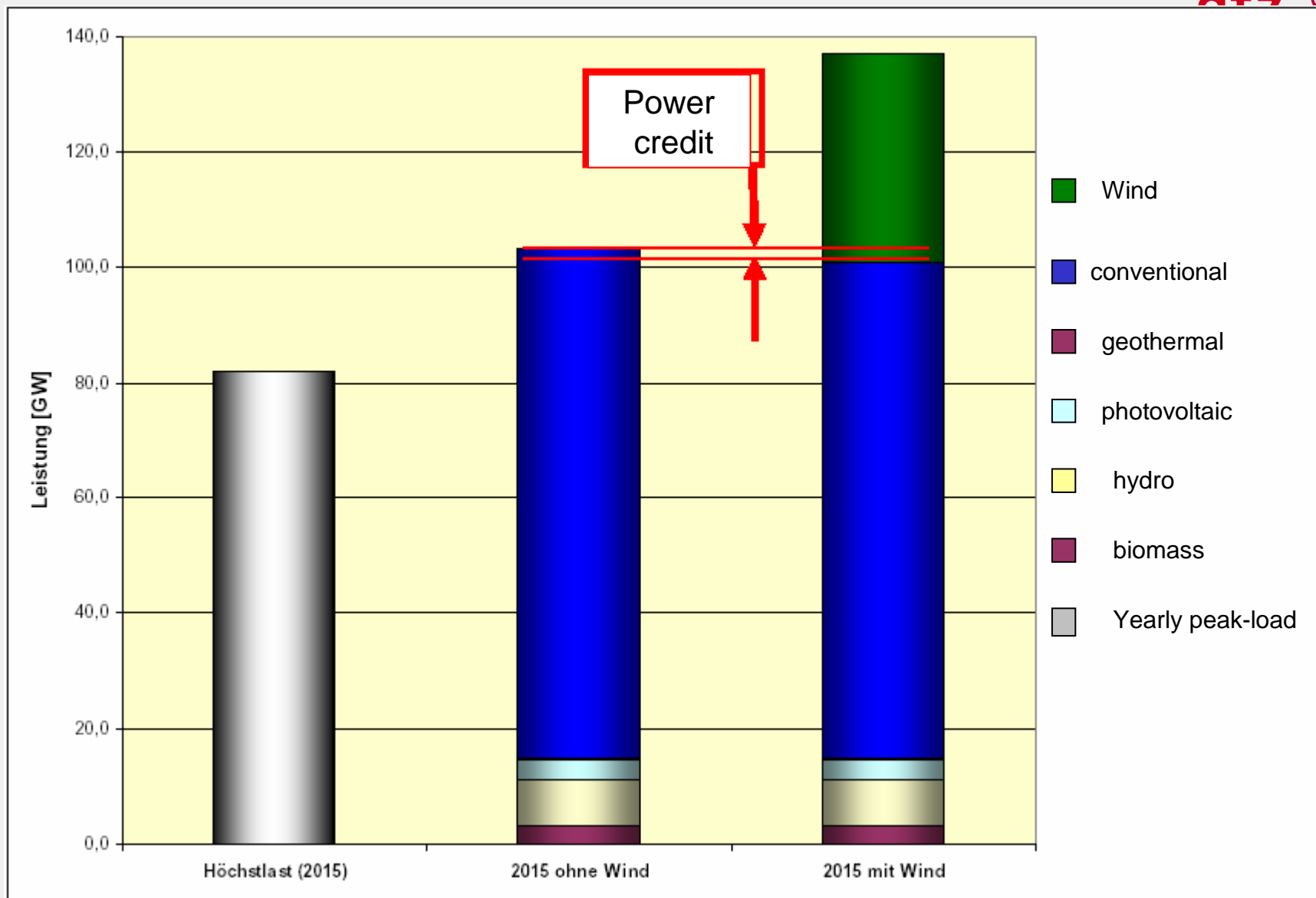


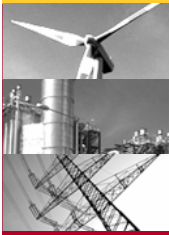
Results – Network Reinforcements



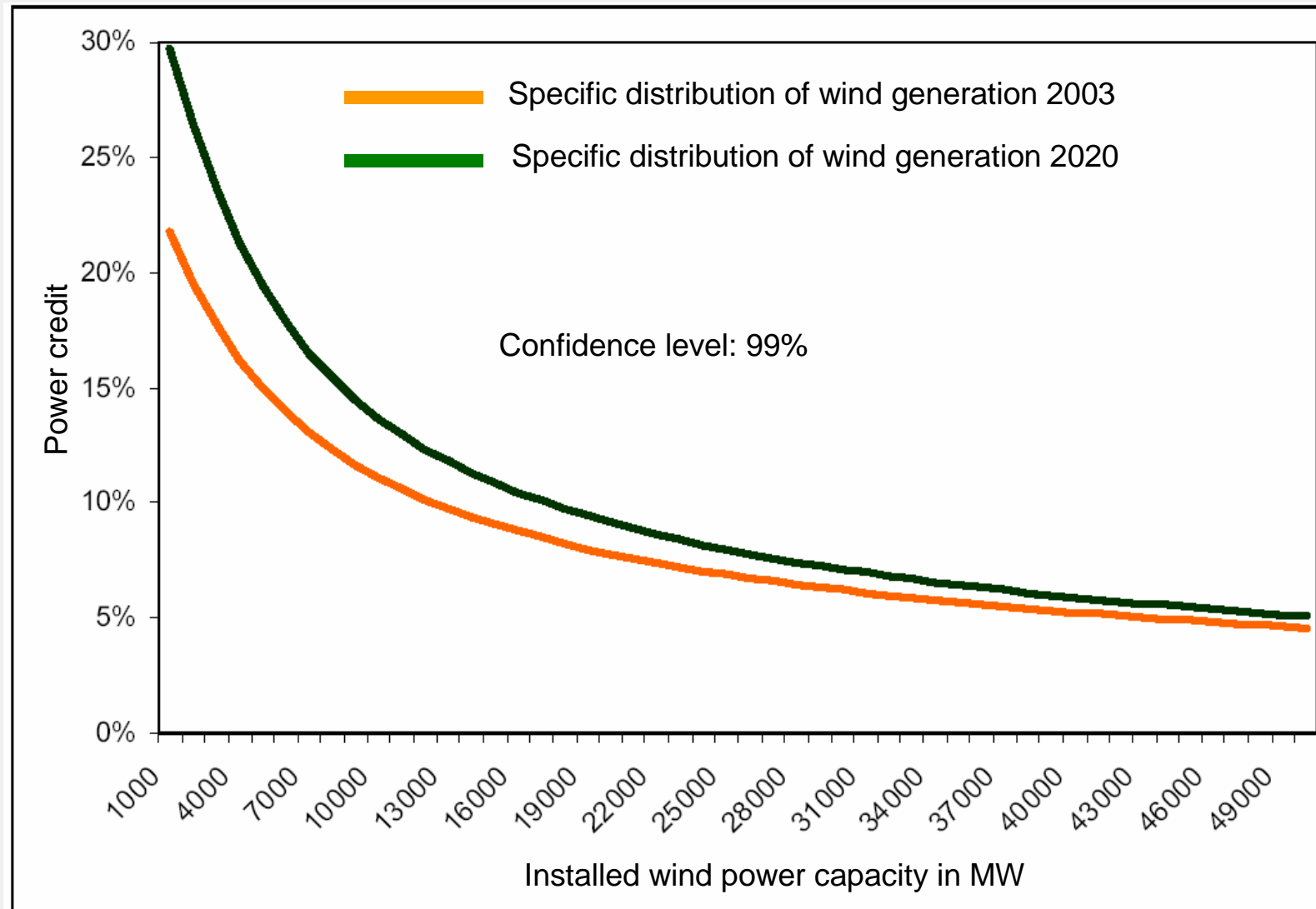
- Reinforcement of 392km of existing overhead lines
- 850km of new transmission lines (until 2015)
- Additional reactive power sources (Capacitors, SVCs)
- Costs: ca 100 Million/year -> tarif increases by 0,025 cent/kWh

Results – Power Credit





Results – Power Credit



Challenges – Power Plants

- Replacement of 40000MW thermal power plants until 2020 (facing out nuclear power, age)
- Integration of wind energy and other renewables
- CO2 trading, development of fuel costs



Scenarios

- Scenario 1:
 - Constant fuel costs (gas, oil, coal)
 - No costs of CO2 emission certificates
- Scenario 2:
 - Constant fuel costs (gas, oil, coal)
 - Auction for distributing CO2-certificates -> Equivalent increase in fuel costs -> more gas/oil
- Scenario 3:
 - Moderate increase of oil and gas price, coal price constant.
 - Auction for distributing CO2-certificates -> Compensation of CO2-costs on coal by increasing oil and gas prices



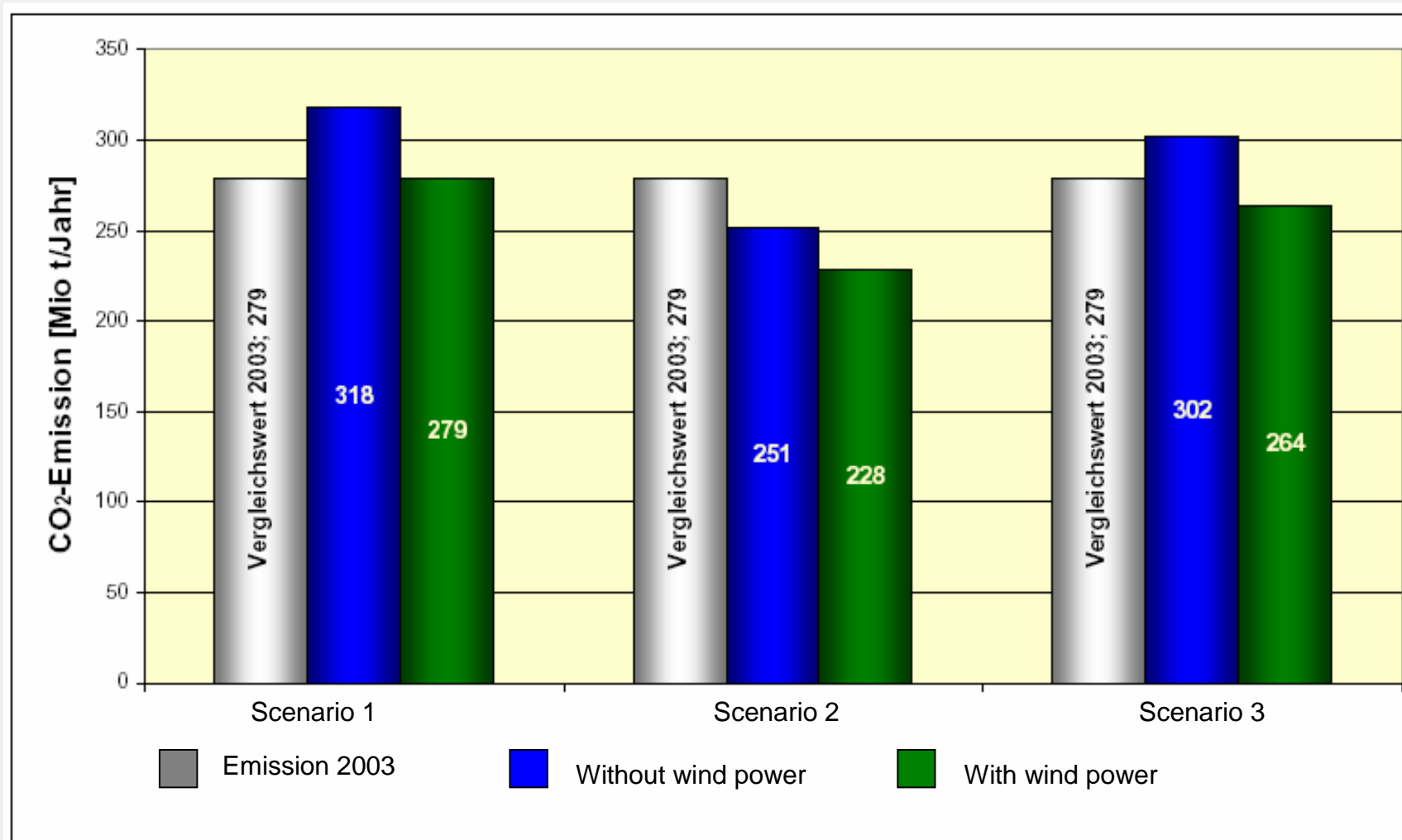
Results – Influence on Regulating and Reserve Power **gtz**

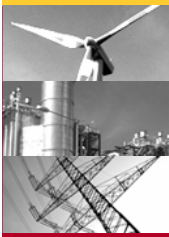


- 2003:
 - Positive: 1200MW average, 2000MW max.
 - Negative: 750MW average, 1900MW max.
- 2015
 - Positive: 3200MW average, 7000MW max.
 - Negative: 2800MW average, 5500MW max



CO2 Emissions





Costs

- Scenario 1: 0,485 Cent/kWh
- Scenario 2: 0,415 Cent/kWh
- Scenario 3: 0,385 Cent/kWh

- Network Reinforcement: 0,025 Cent/kWh



Thank You



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