



Mit **neuer** Energie



German Government's Scenario to Supply 80% of Power Consumption by Renewable Energy in 2050

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Fraunhofer IWES: Institute Profile



Wind energy

Research spectrum:

Wind energy from material development to grid optimization

Energy system technology for all renewables

Foundation: 2009

Personal: approx. 500



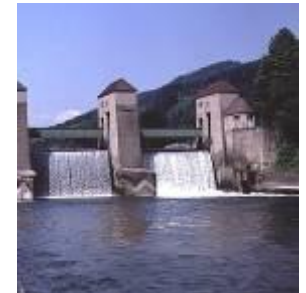
Photovoltaics



Bio energy



Electricity grids



Hydro power



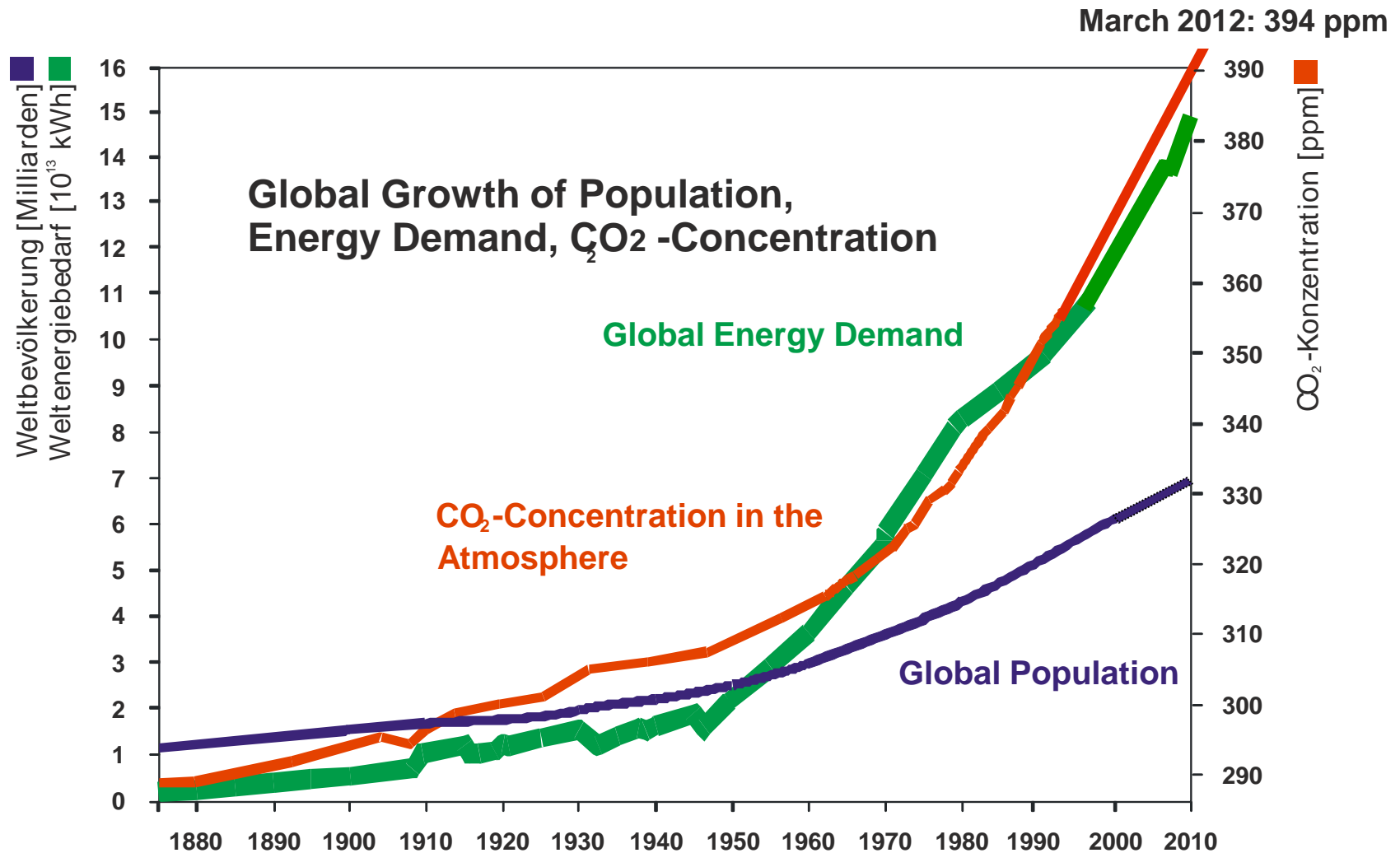
Marine energies

advancing wind energy and energy system technology



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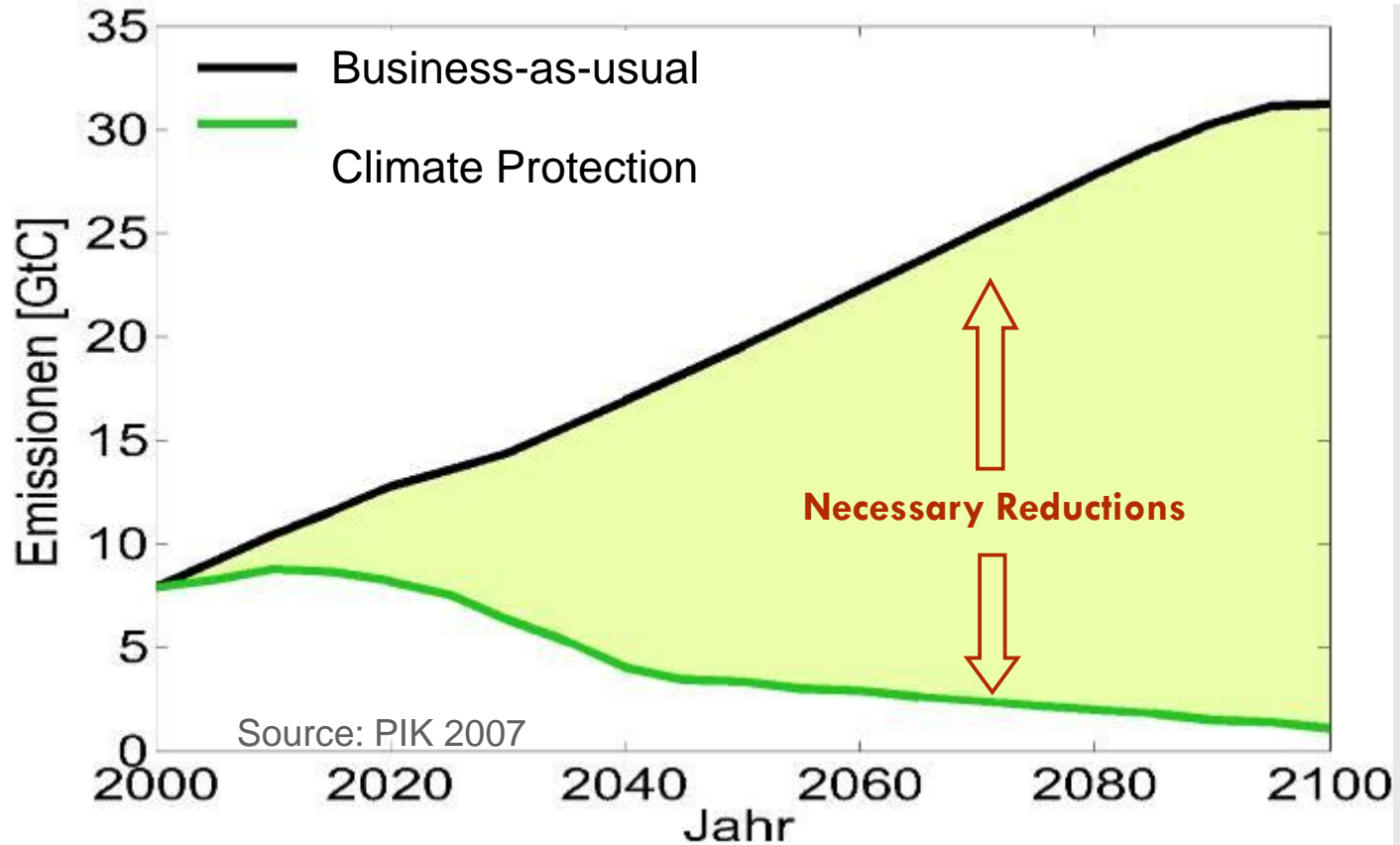
Global Situation and Future Trends





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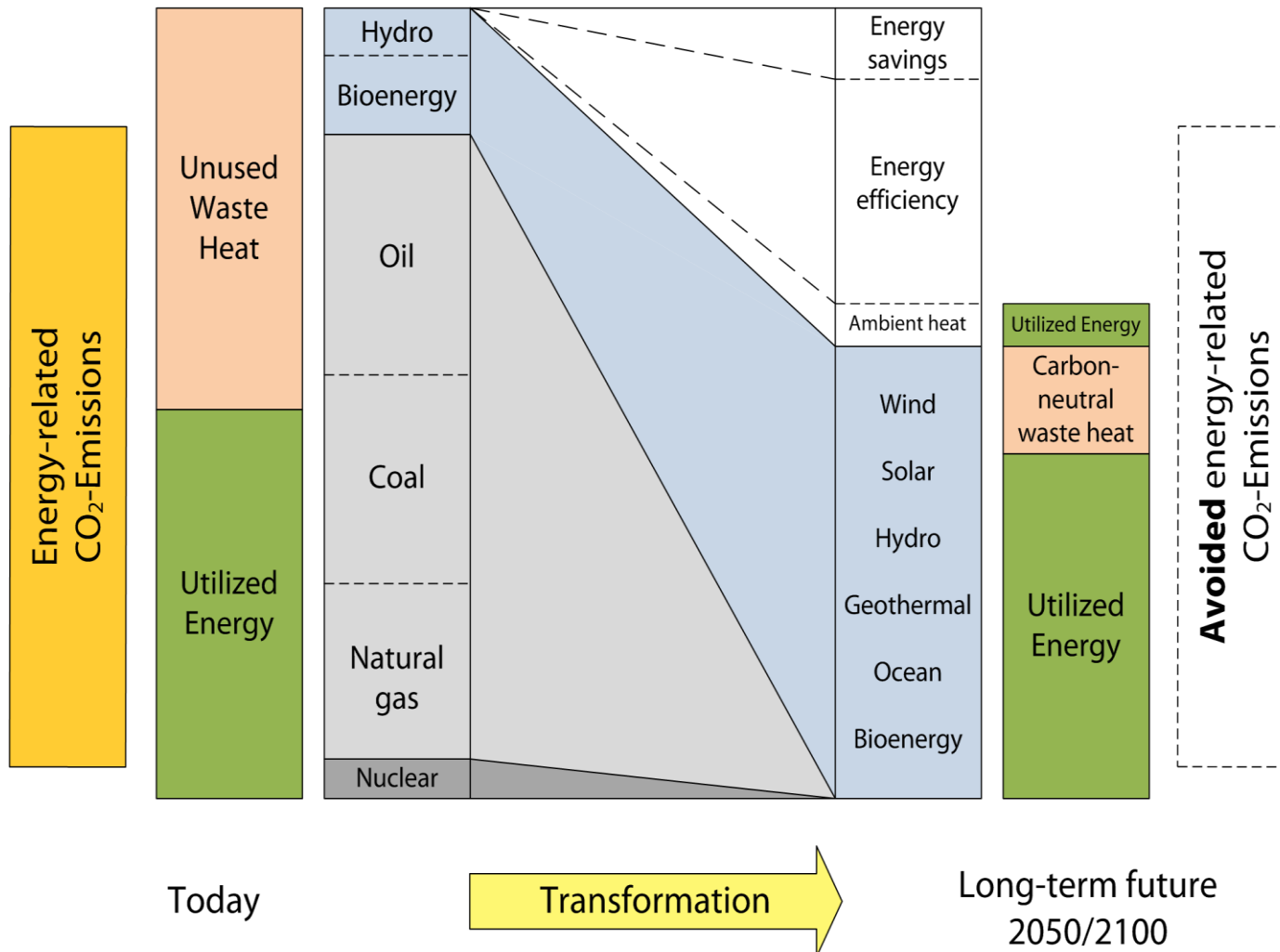
Challenge of Climate Protection





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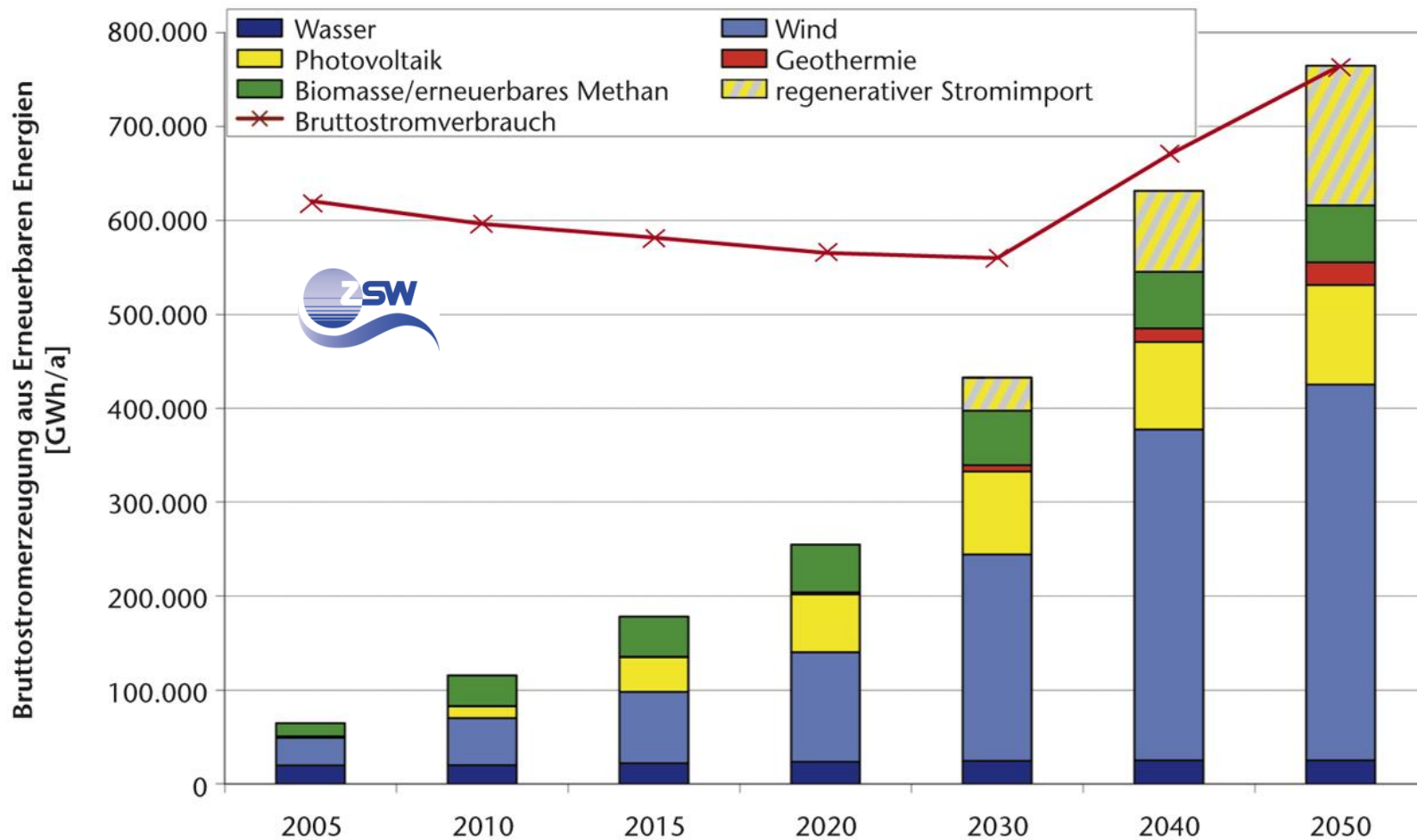
Transformation of Electricity Sector





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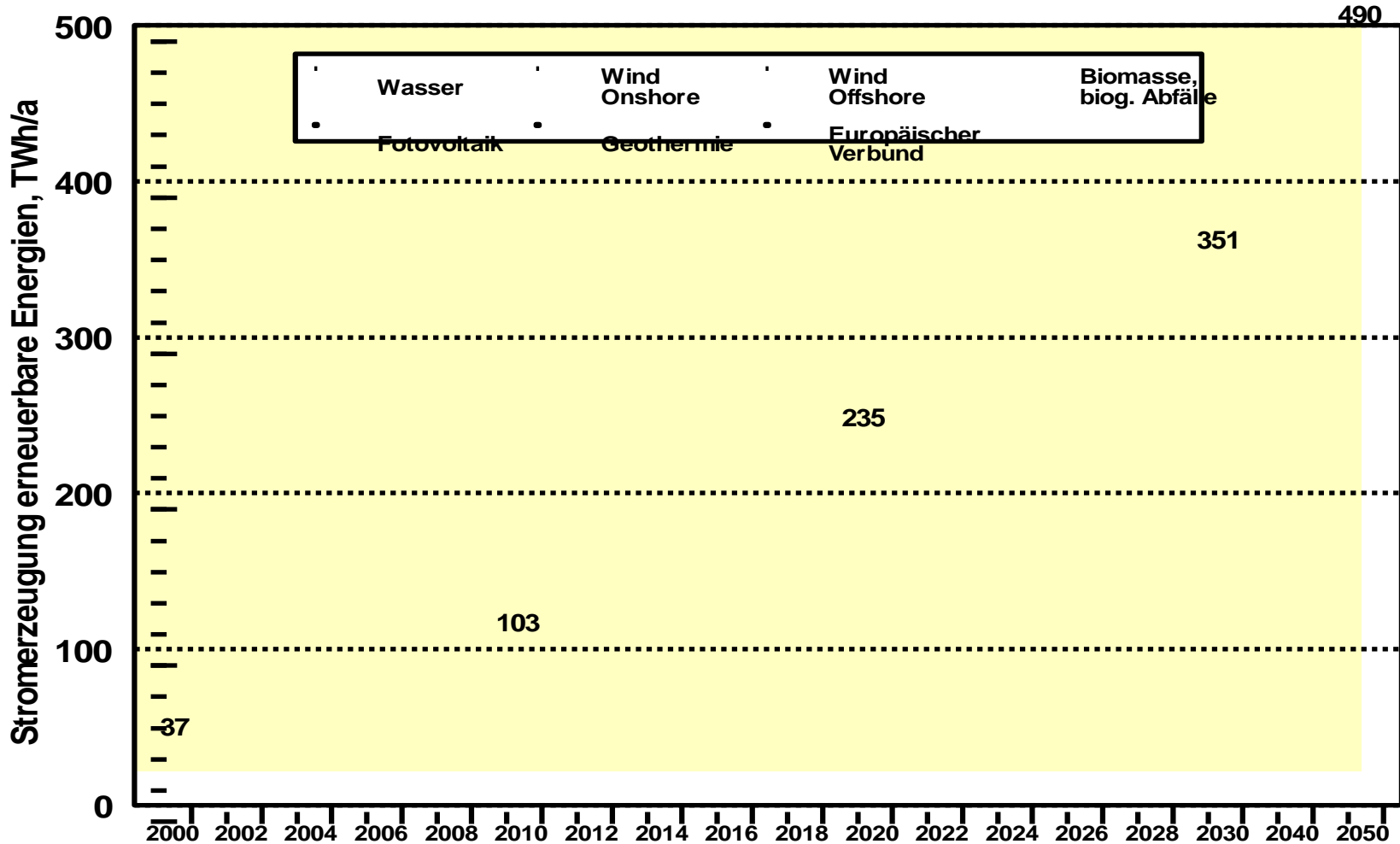
Gross Electricity Generation from RES and Consumption in Germany up to 2050





Electricity generation by technology in Scenario 2011 A

- Szenario 2011 A -





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Definition of Scenarios 2011 / Scenario analyses

Scenario 2011 A: meeting all objectives of the energy concept of the federal government, including 25% reduction of energy consumption (based on end-use energy, 2008) ; CO₂ reduction by 2050: 80%; share of E-mobility to car traffic by 2050: 50%; breakthrough of hydrogen vehicles and related infrastructure development.

Scenario 2011 B: as Scenario A, but no breakthrough of hydrogen in transport, but production and use of synthetic methane in the transport sector and accordingly construction of new capacity to produce the required additional renewable electricity.

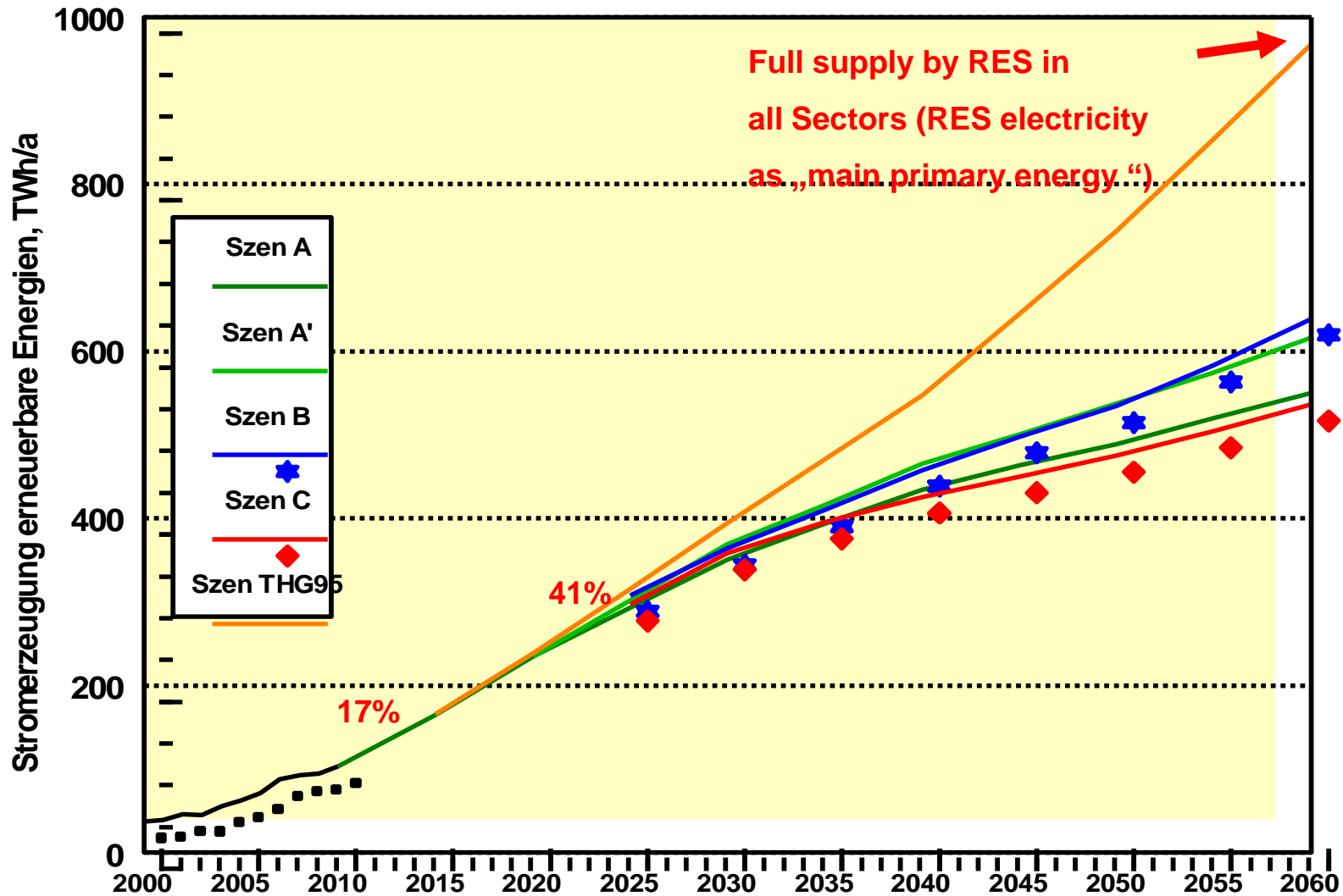
Scenario 2011 C: as Scenario A, but no breakthrough of hydrogen in transport, but full coverage of the car transport services by electric drives (full electric vehicles and serial hybrids).

Outlook: Scenario 2011 THG95: reaching the upper limit of the target range for the reduction of greenhouse gases in the energy concept (95%) by 2060. ? Additional use of electricity and hydrogen as chemical energy storage devices for reconversion and required for full supply of renewable heat and transport sectors.

2011 Scenario A ': as Scenario A, only a lower power consumption reduction of around 15% by 2050 (final energy consumption, based on 2008)



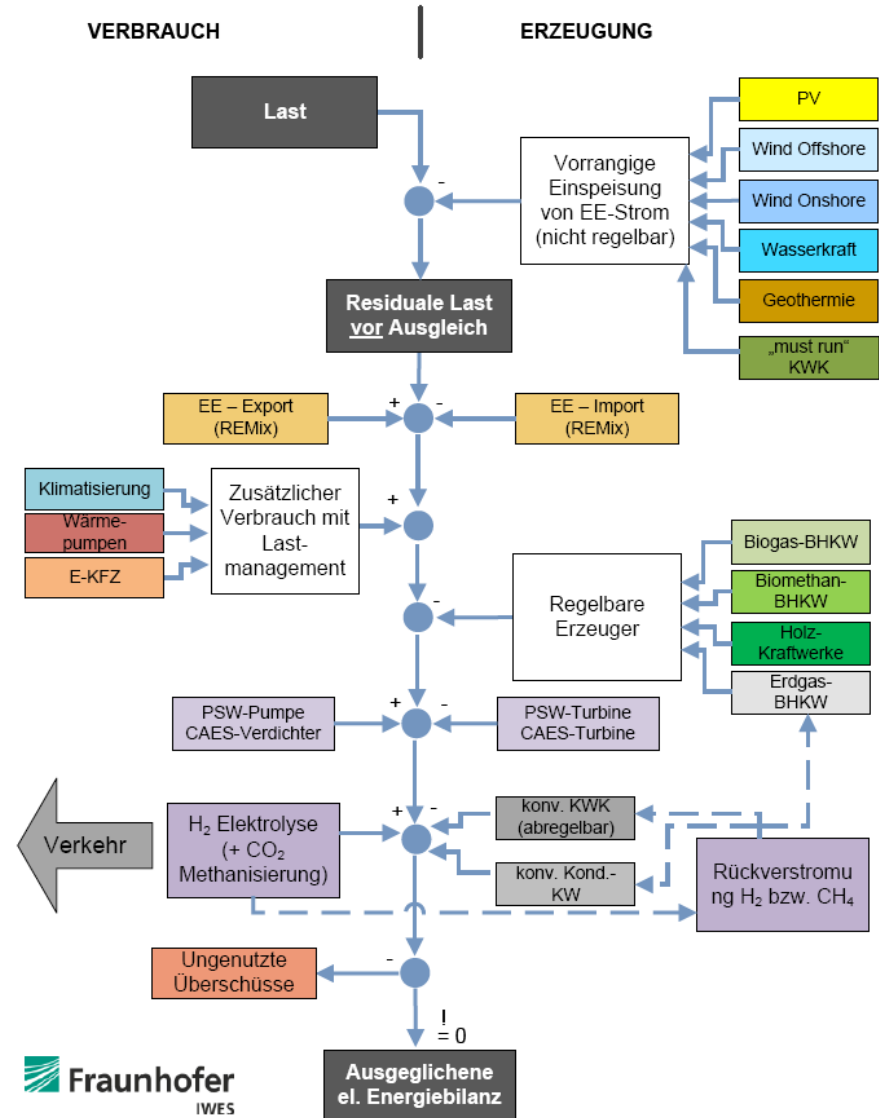
Bandwidth of growth of RES electricity production in Scenarios 2011





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IWES-Simulation Tool SimEE





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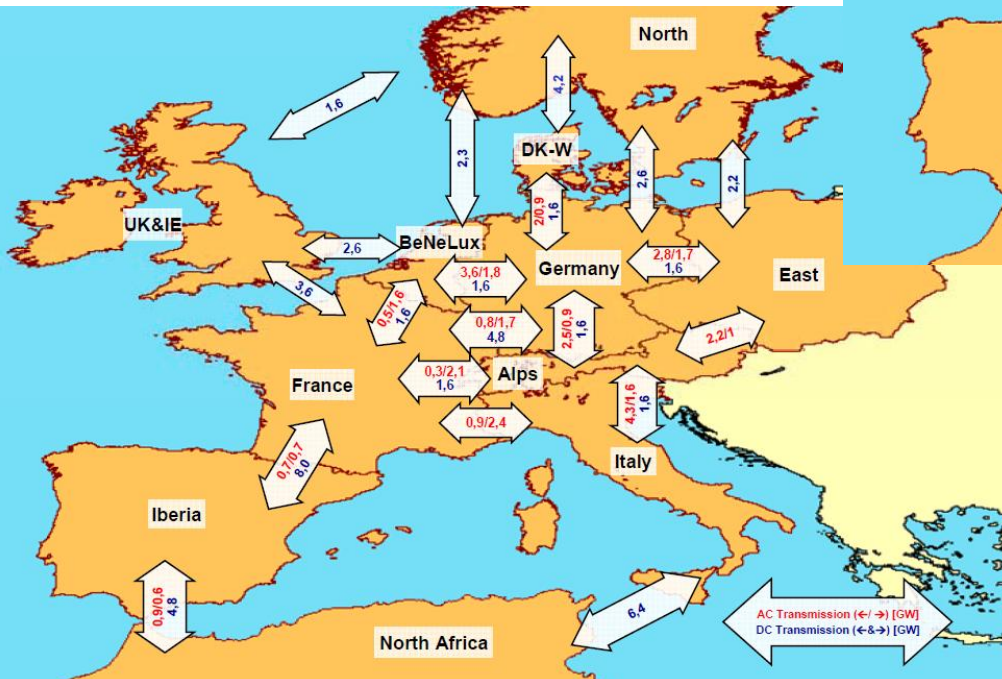
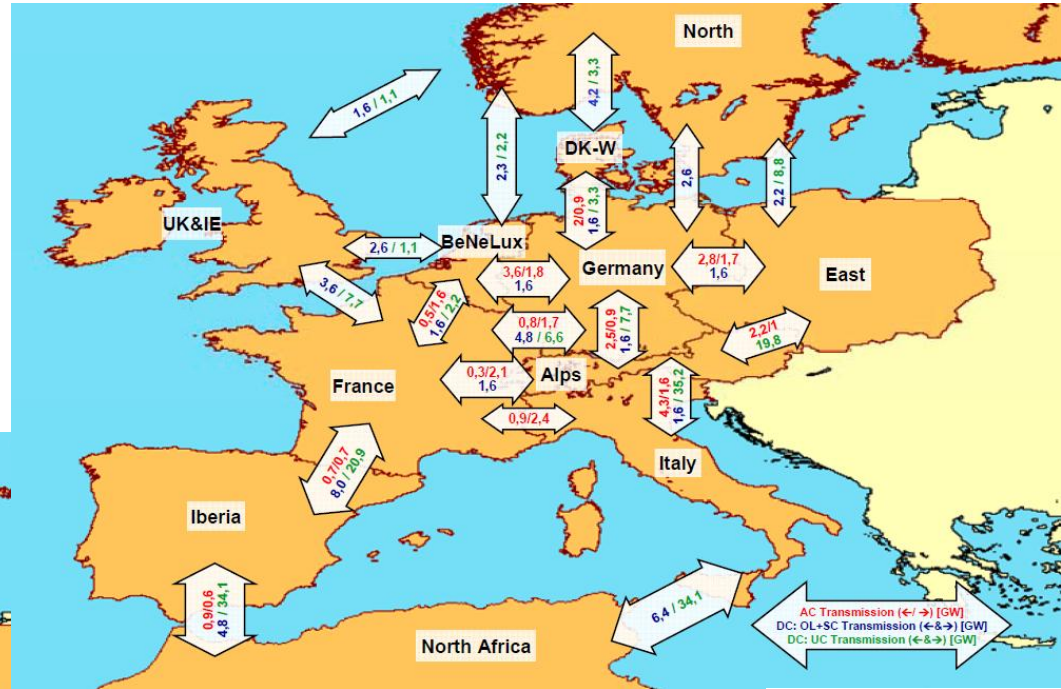
Results: Grid development scenario 2011 A

2050

HVDC-transport capacity
in Germany: 29 GW

2030

HVDC-transport capacity
in Germany: 9 GW



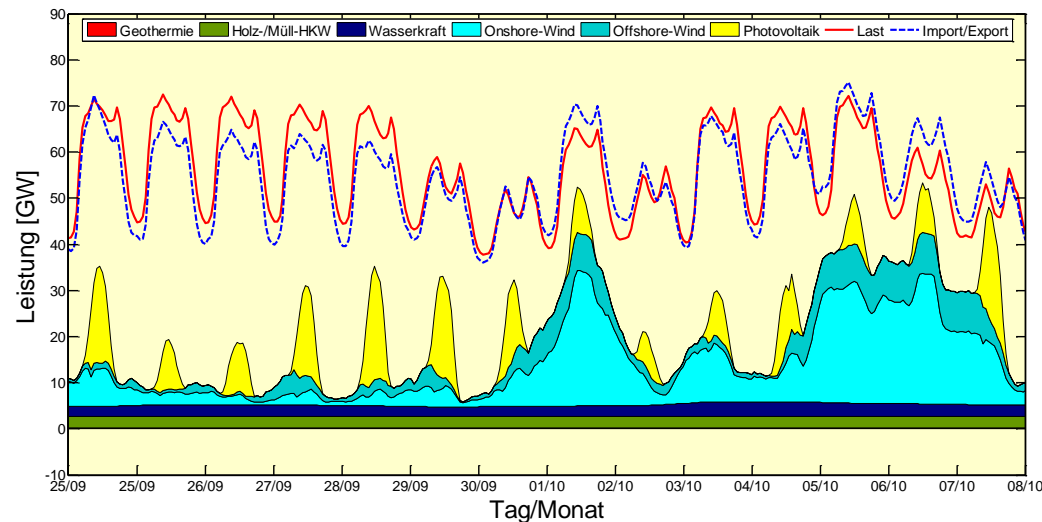
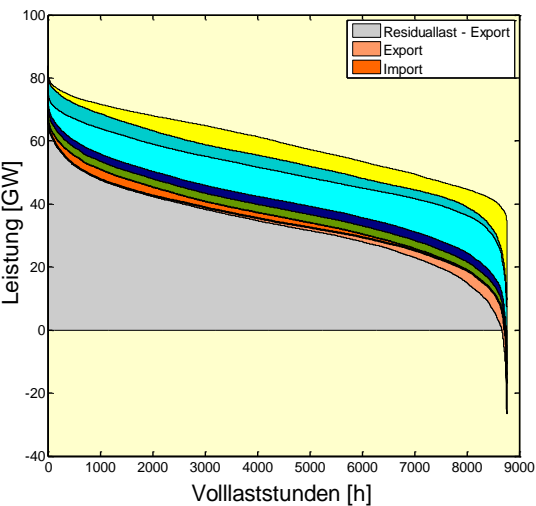
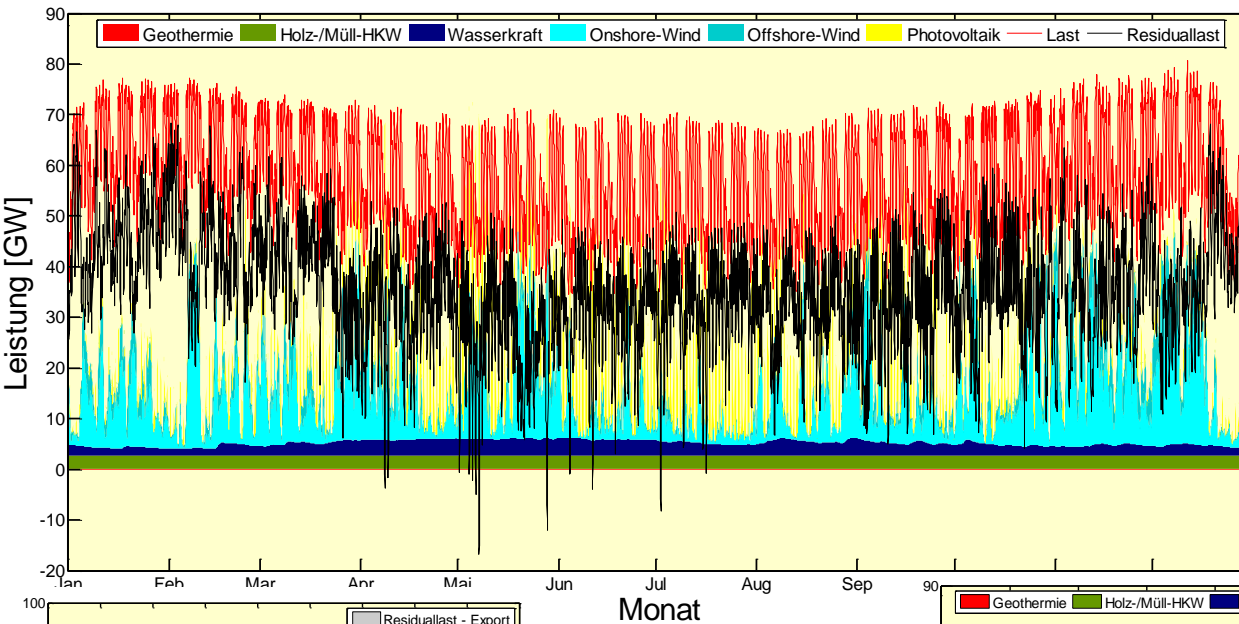
AC Transmission (←→) [GW]
DC: OL+SC Transmission (←&→) [GW]
DC: UC Transmission (←&→) [GW]

Germany	Deutschland
North	Dänemark Nord, Finnland, Norwegen, Schweden
Dk-W	Dänemark West
BeNeLux	Belgien, Luxemburg, Niederlande
Iberia	Portugal, Spanien
Alps	Schweiz, Österreich, Liechtenstein
France	Frankreich
Italy	Italien
East	Polen, Tschechische Republik, Slowakei
UK&IE	Großbritannien, Irland
North Africa	Algerien, Marokko, Tunesien



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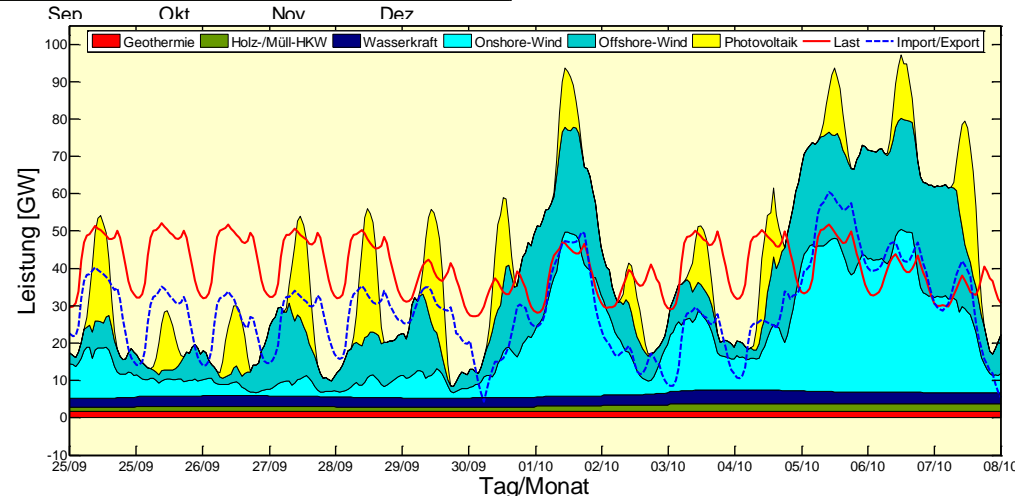
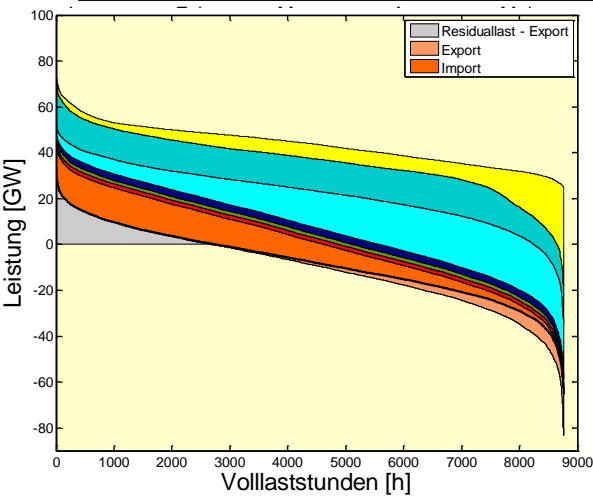
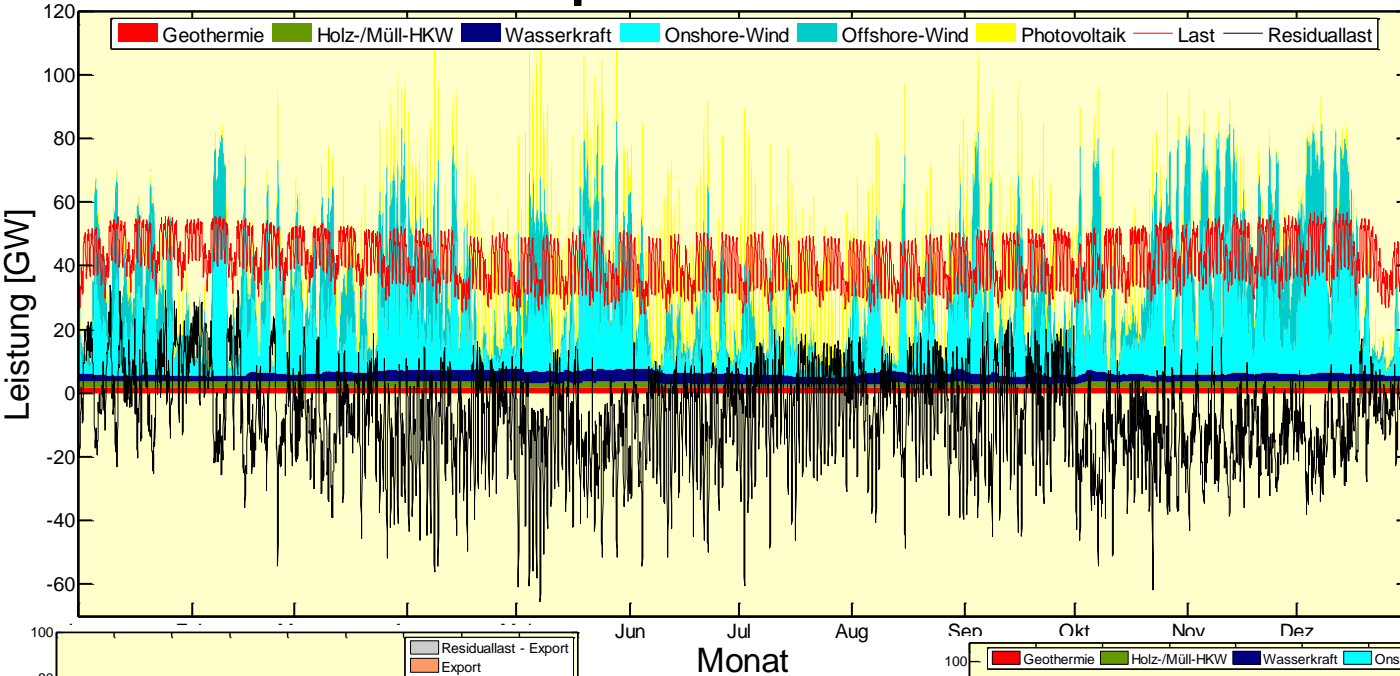
Effects of RES production – Scenario A 2020





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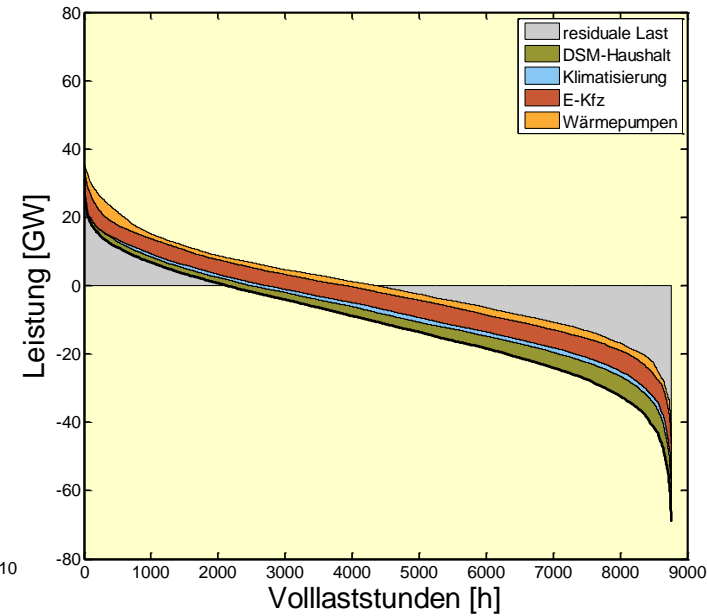
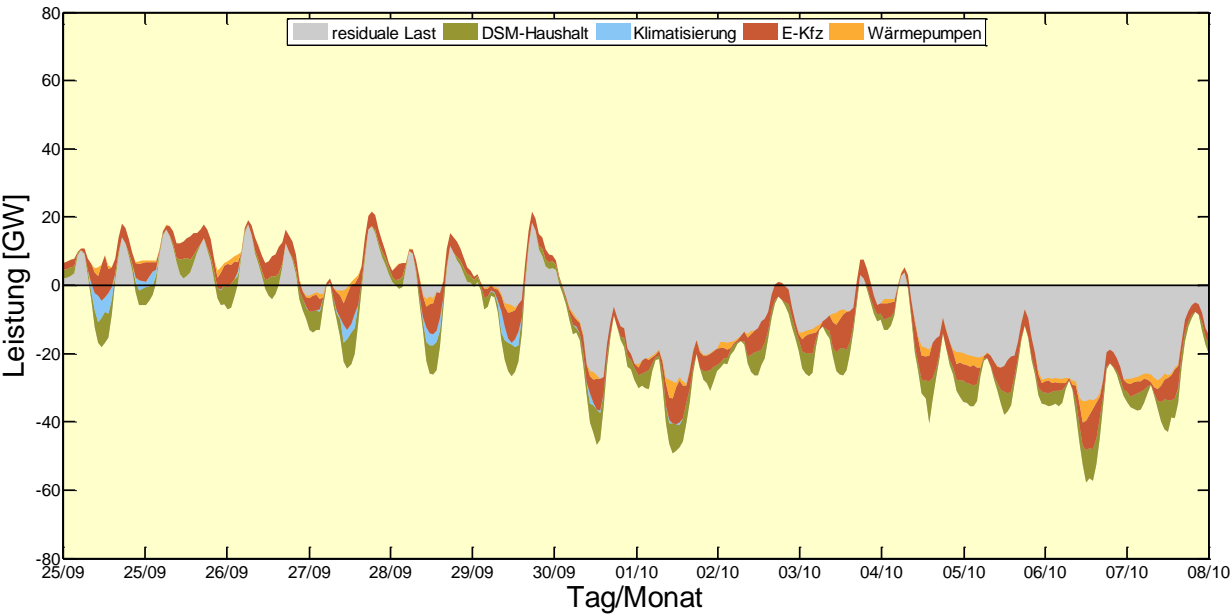
Effects of RES production – Scenario A 2050





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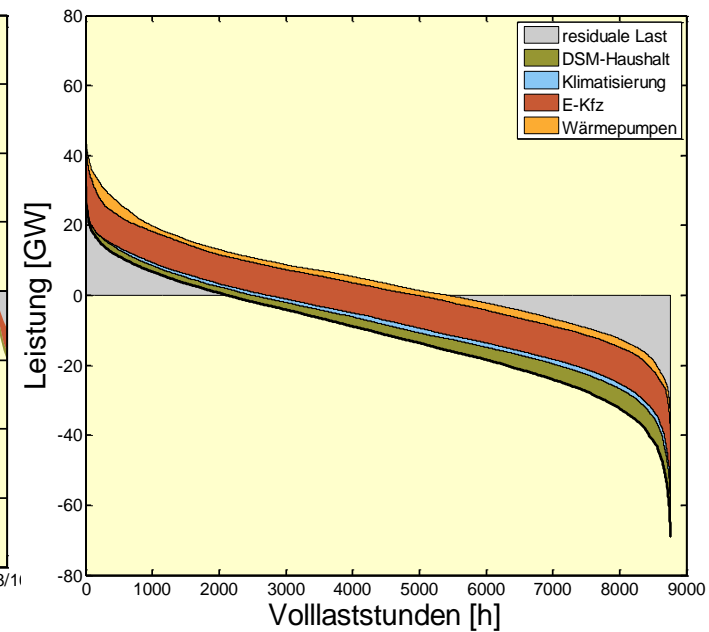
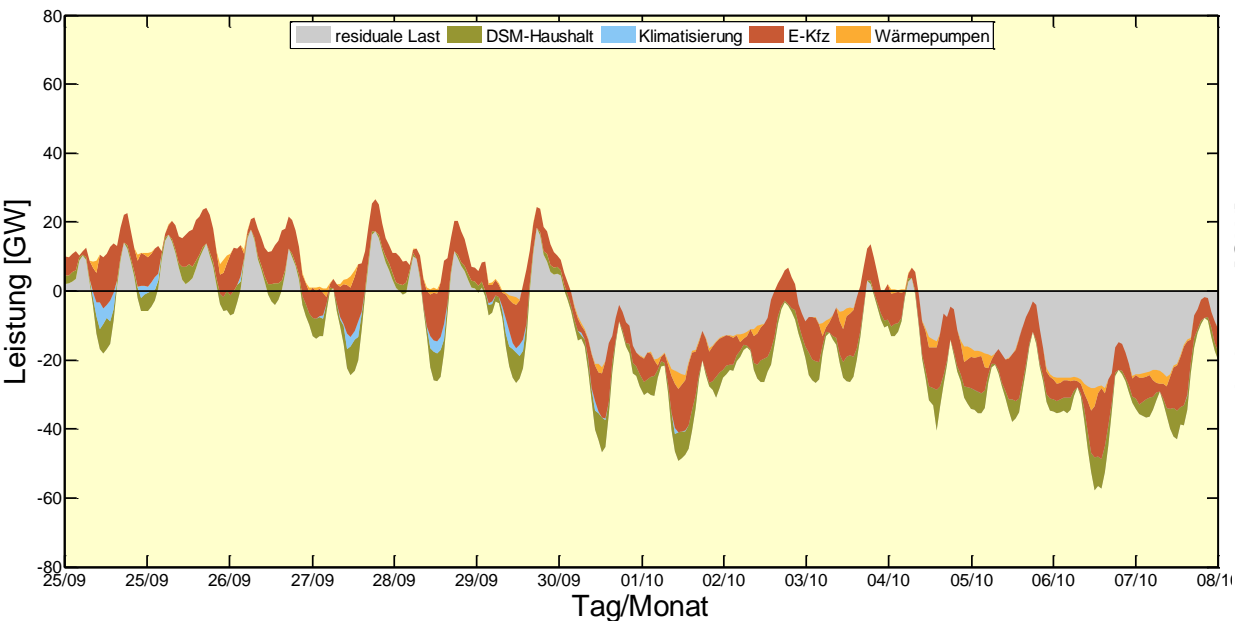
Demand side management – Scenario A 2050





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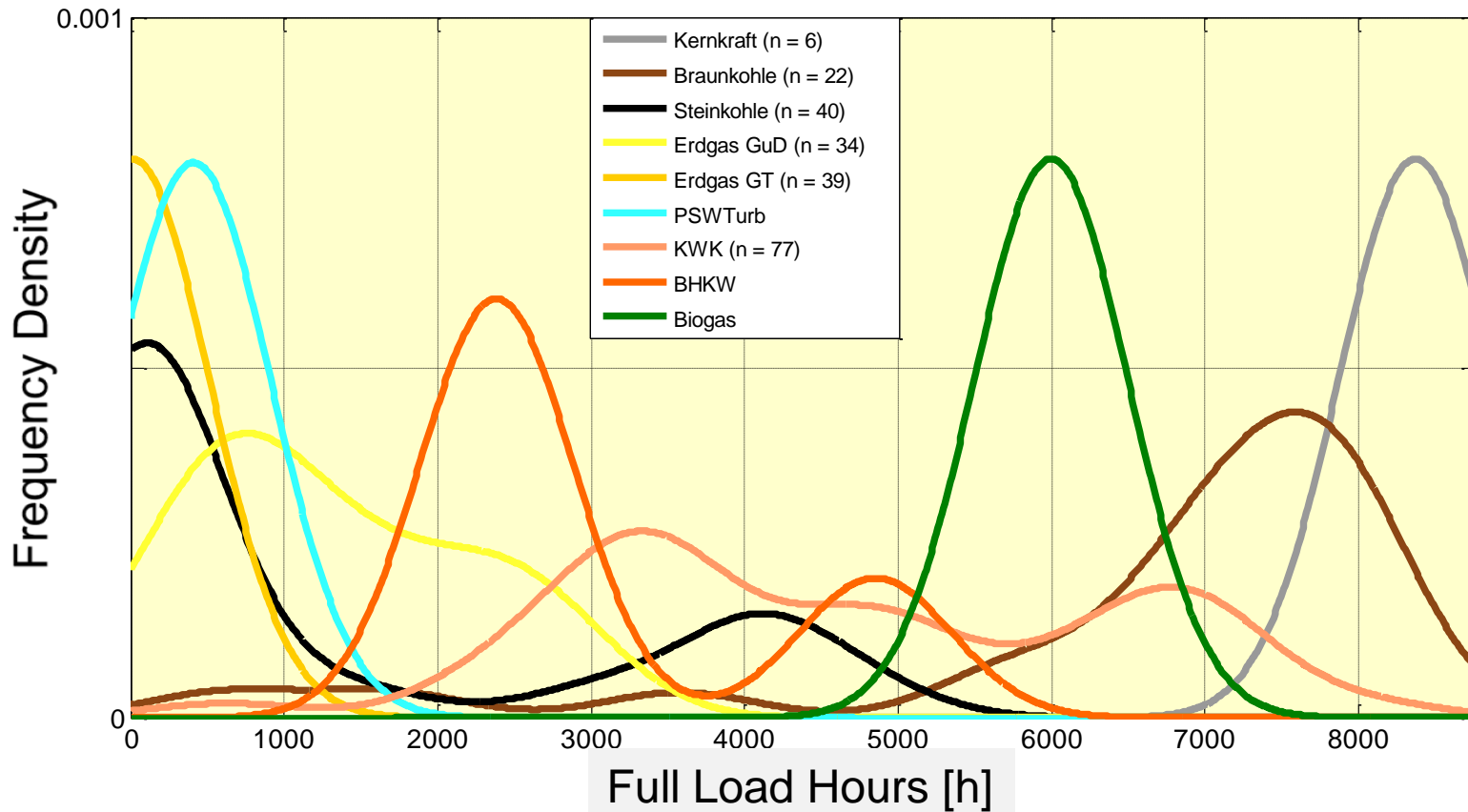
Demand side management – Scenario C 2050





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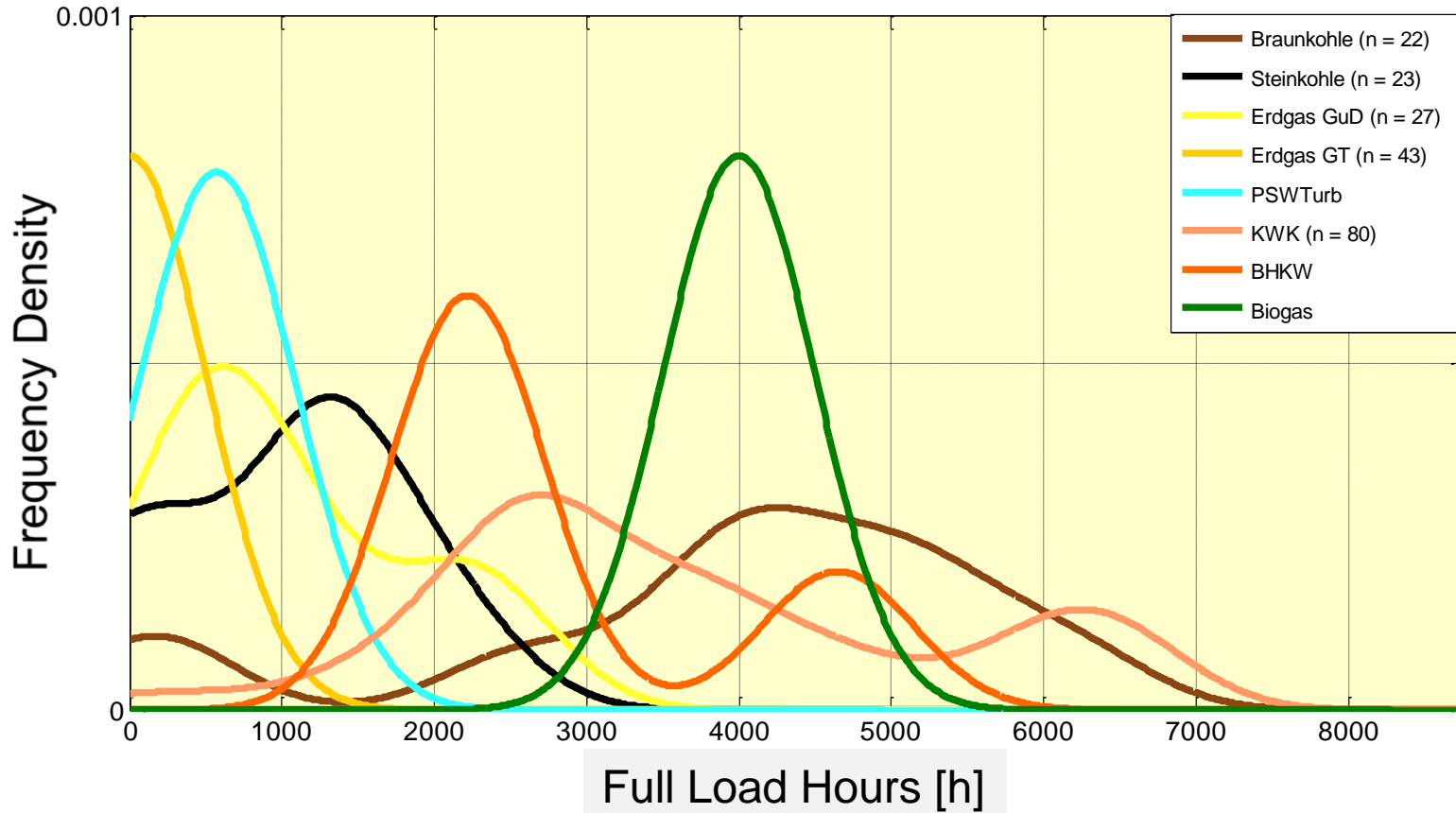
Frequency Distribution of Power Plants 2020





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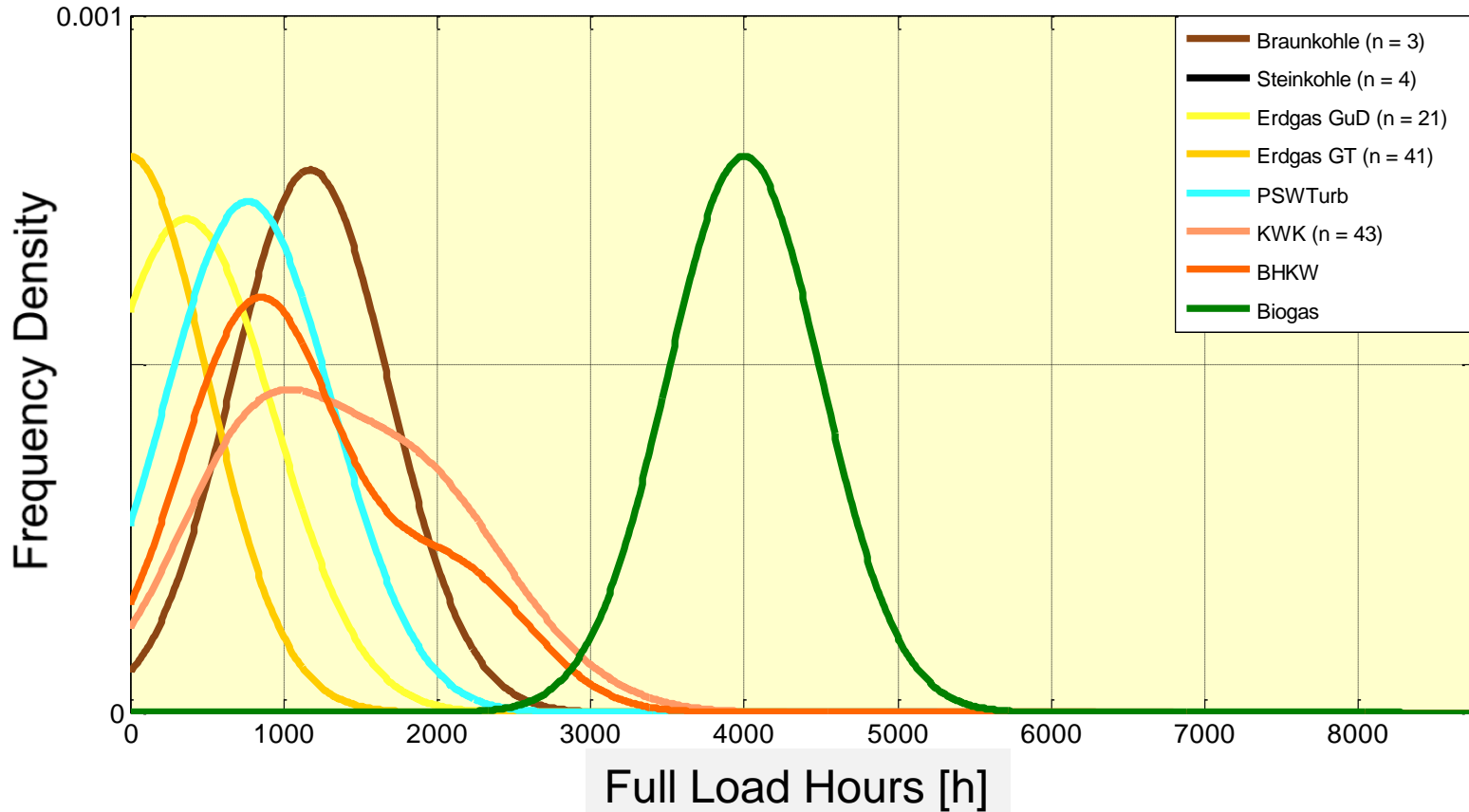
Frequency Distribution of Power Plants 2030





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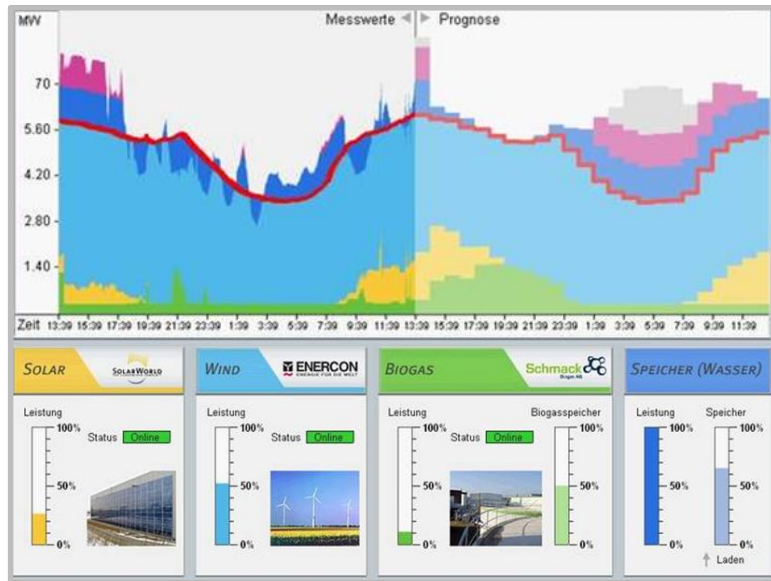
Frequency Distribution of Power Plants 2050





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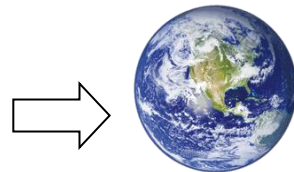
Das Regenerative Kombikraftwerk II



Kombikraftwerk 1

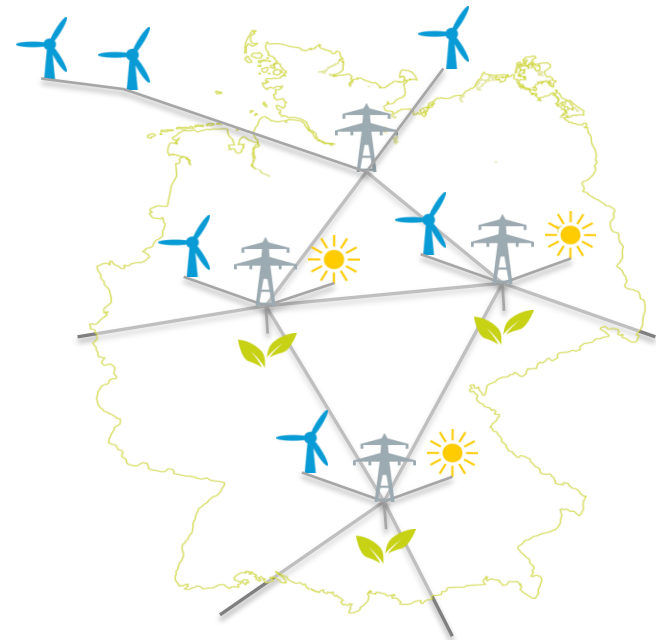
Demonstration of load coverage (1/10000)
Only by RES in combination with storage

Deutsche Umwelthilfe



Deutscher
Klimaschutzpreis

2009



Kombikraftwerk 2

Demonstration of grid stability supported only by RES



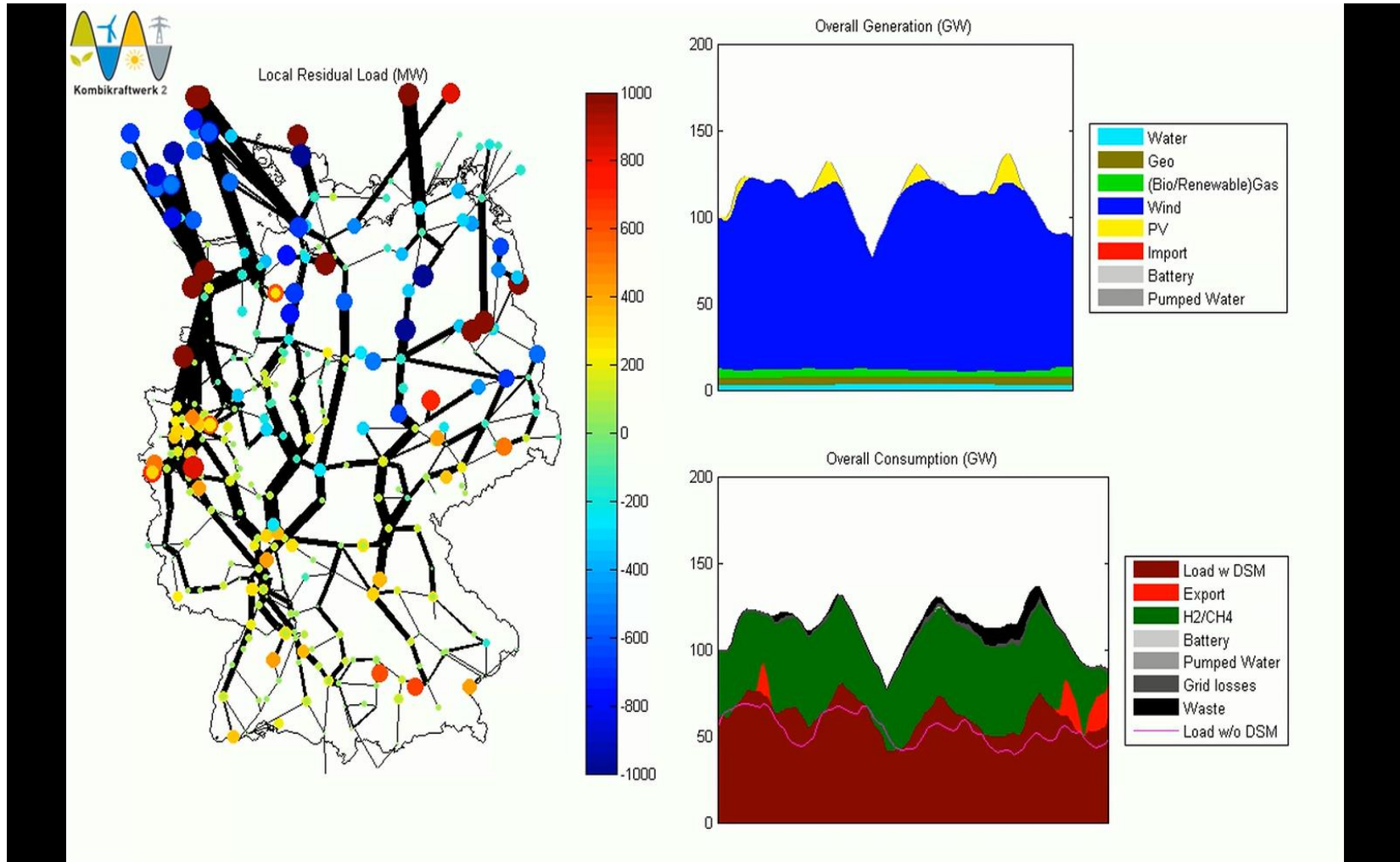
Kombikraftwerk 2

- frequency
- volage
- black start



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Security of supply – frequency and voltage control



Renewable Model Region Harz

Übersicht

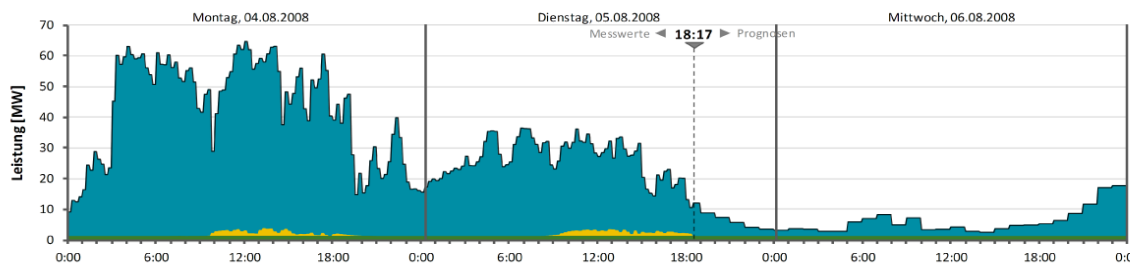
Vermarktung

Topologie

Meldungen

Energie

Historie und Prognose des Strommix



Momentane Leistungsbilanz

- 8 MW Nennleistung 86 MW
Momentanleistung 12 MW (14%)

Momentaner Speicherstand

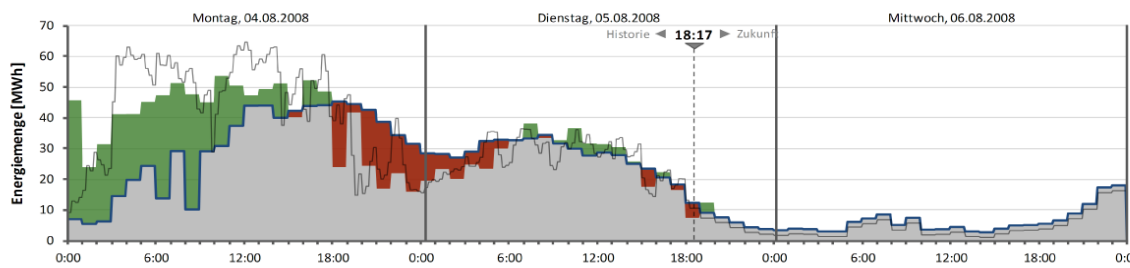
Speicher: 126 MWh
Speicherstand 102 MWh (81%)

Momentaner Stromerzeugungsmix



Vermarktung

Verlauf der Vermarktung



19:00 - 20:00 Menge / Umsatz

Menge	Umsatz
- 2,9	13,3
- 213,05	683,12
10,4 MWh	470,07 €

Sa, 01.01.2011 Menge / Umsatz

Menge	Umsatz
- 7,3	108,8
- 434,52	4.779,74
22,2	1.086,31
123,7 MWh	5.431,53 €

Menge und Umsatz gesamt

Menge	Umsatz
21.371,9 MWh	1.168.401,77 €

Benutzerkennung: max.mustermann / Angemeldet seit: 29.11.2010 09:00

Generation

Loads

Storage



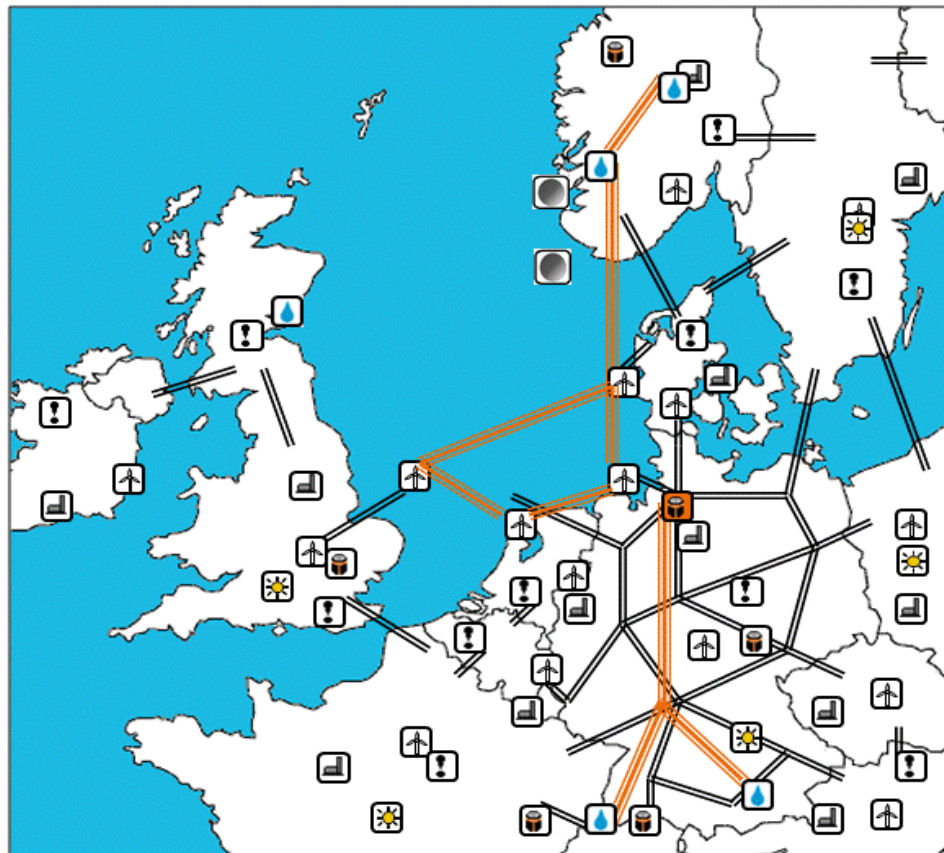
Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit













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North Sea Offshore Grid and Storage Alliance



North-Sea Offshore Grid and Storage Alliance

-  Wind farms
-  PV-plants
-  Power plants
-  Storage plants
-  Demand
-  Transmission grid
-  Deep sea storage
-  Hydro pump storage

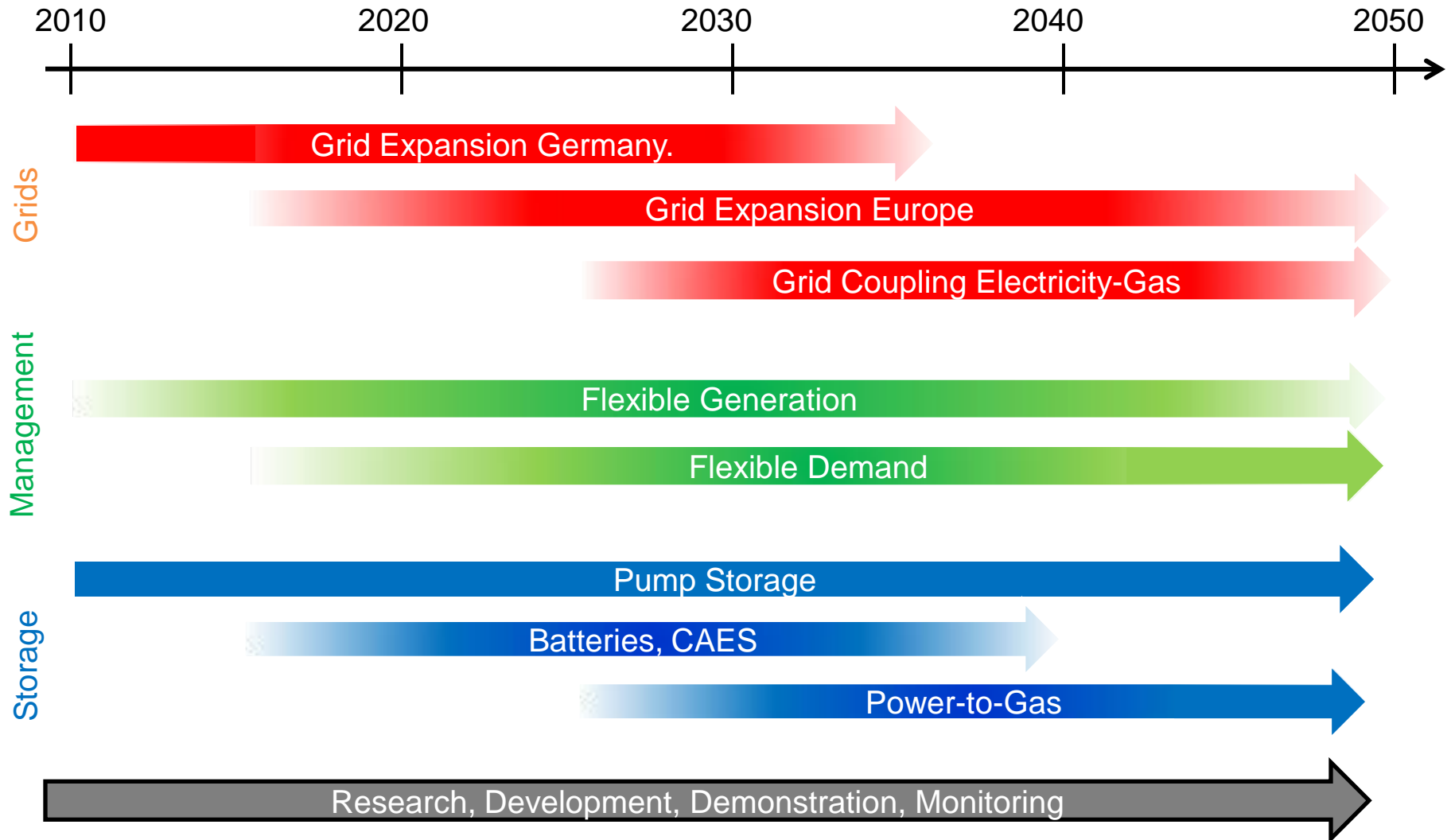
Integration action

-  Additional storage
-  Grid expansion



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Roadmap Energiewende System Transformation Power Sector





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Thank You for Your Attention !

**Fraunhofer-Institut für Windenergie und Energiesystemtechnik
Bremerhaven und Kassel**

advancing wind energy and energy system technology

Research Spectrum:

- Wind Energy from Materials to Grid Operation
 - Energy Systems Technology for RES

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