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How Renewables and Distributed Resources Have Impacted Transmission in Germany

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Smart. Focused. Done Right.

Fact-Finding Mission to Germany

- SEPA and ScottMadden sponsored the fact-finding mission
- Thirty U.S. executives attended, representing IOUs, public power, vertically integrated, PSC, solar industry, EEI, and EPRI
- Three days were spent in Dusseldorf meeting with German energy participants, such as policy makers, utilities, and others
- Share with you today
 - Overall Context
 - Issues and Impacts
 - Summary Observations



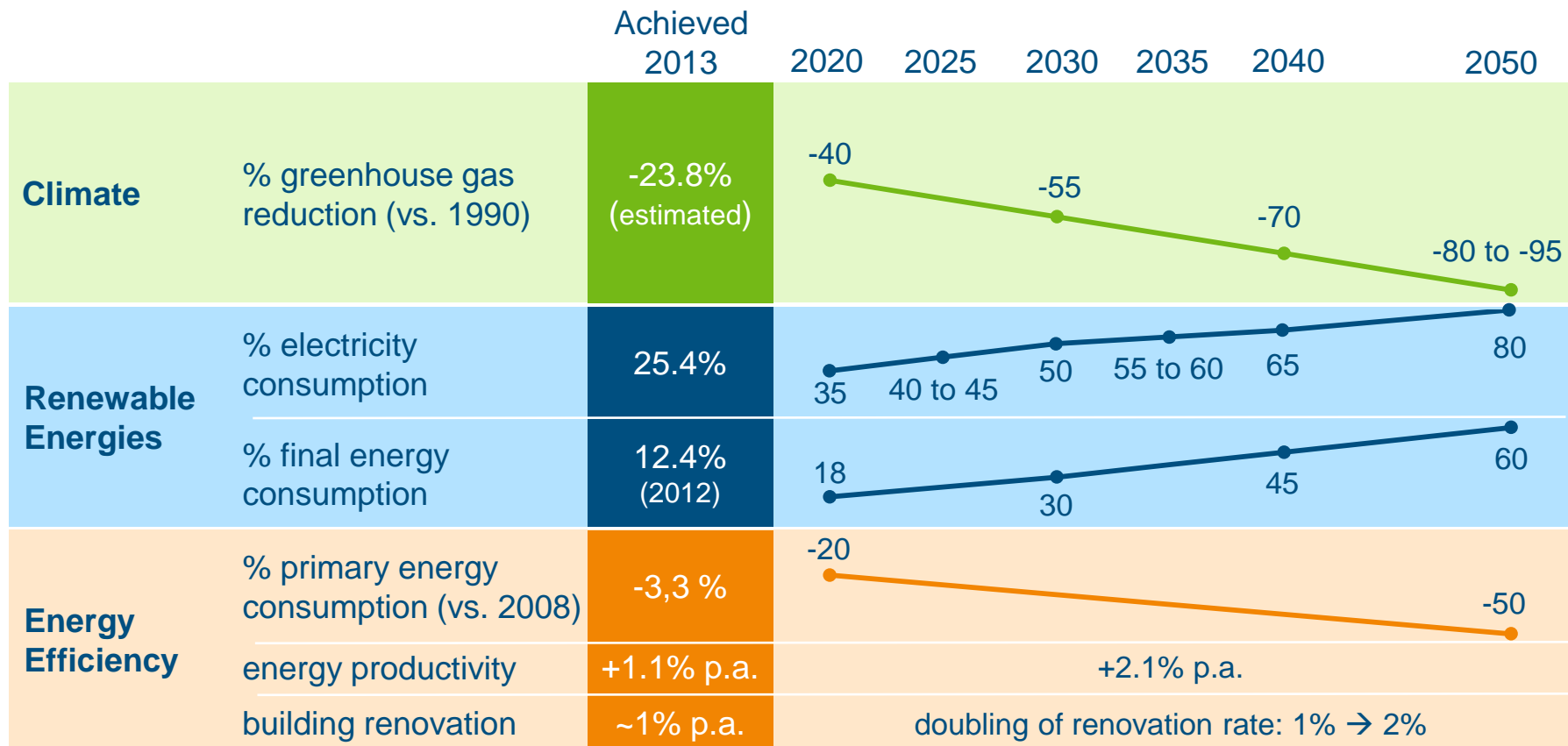
Germany – What You Need to Know

- Liberalization
- Shutdown of nuclear
- High gas prices
- Increase in renewables
- Not an island
 - EU policies
 - Connections with neighboring countries
 - Carbon trading

Several Changes at Once

The German Energy Transition

Energiewende Targets until 2050



Source: "Costs and Benefits of the Energy Transition"
 Dr. Martin Schöpe, Federal Ministry for Economic Affairs and Energy

Context

German Electric Market Structure “Liberalization”

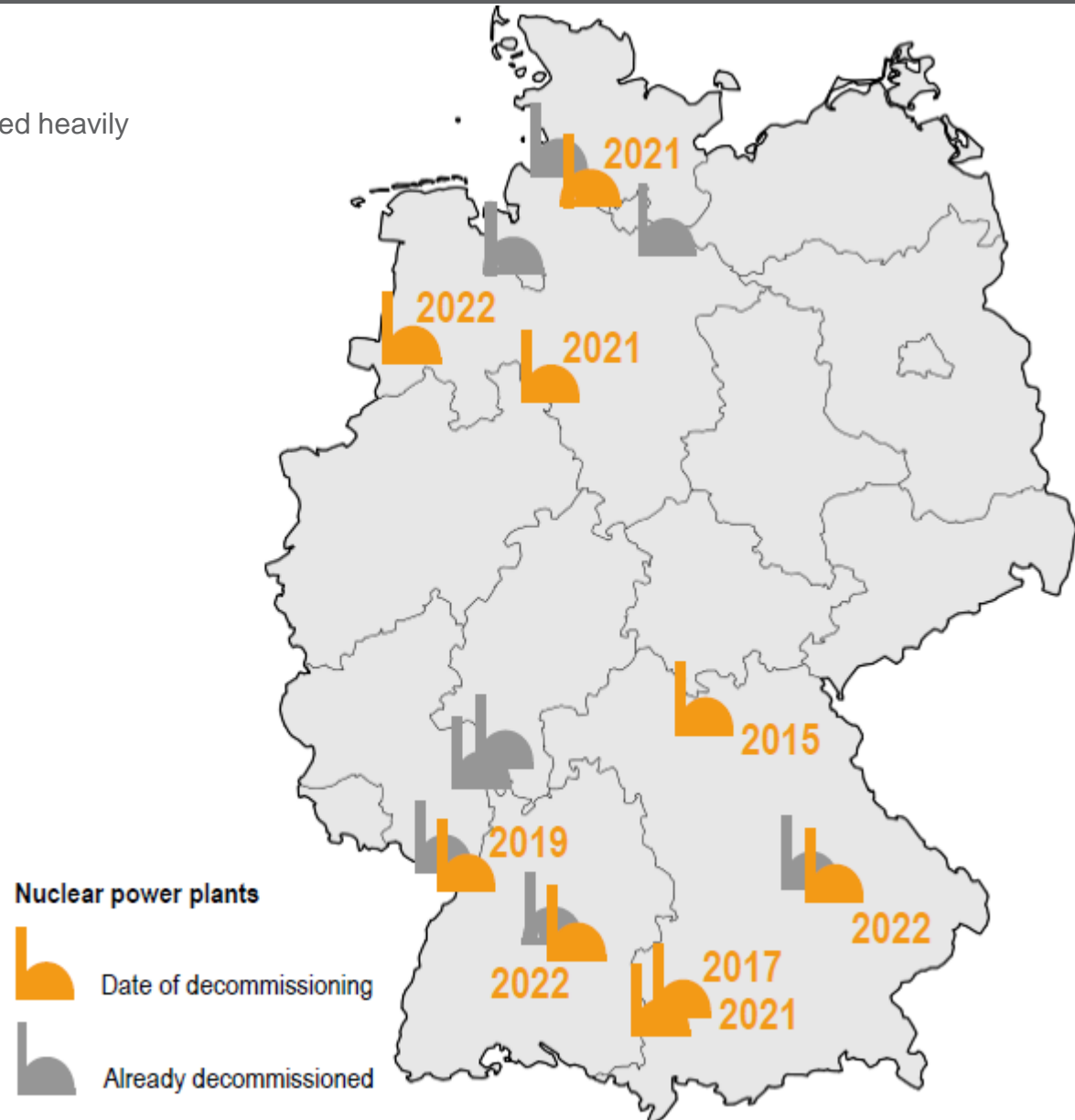
- Generators
 - Utility scale
 - Individuals
- Retailers
- More than 800 Distribution System Operators
 - IOUs and municipals
 - 20-year franchise
- Four Transmission System Operators (TSOs)
 - Plan the transmission system
 - Manage the supply market
 - Energy-only market



Context

Nuclear Shutdowns

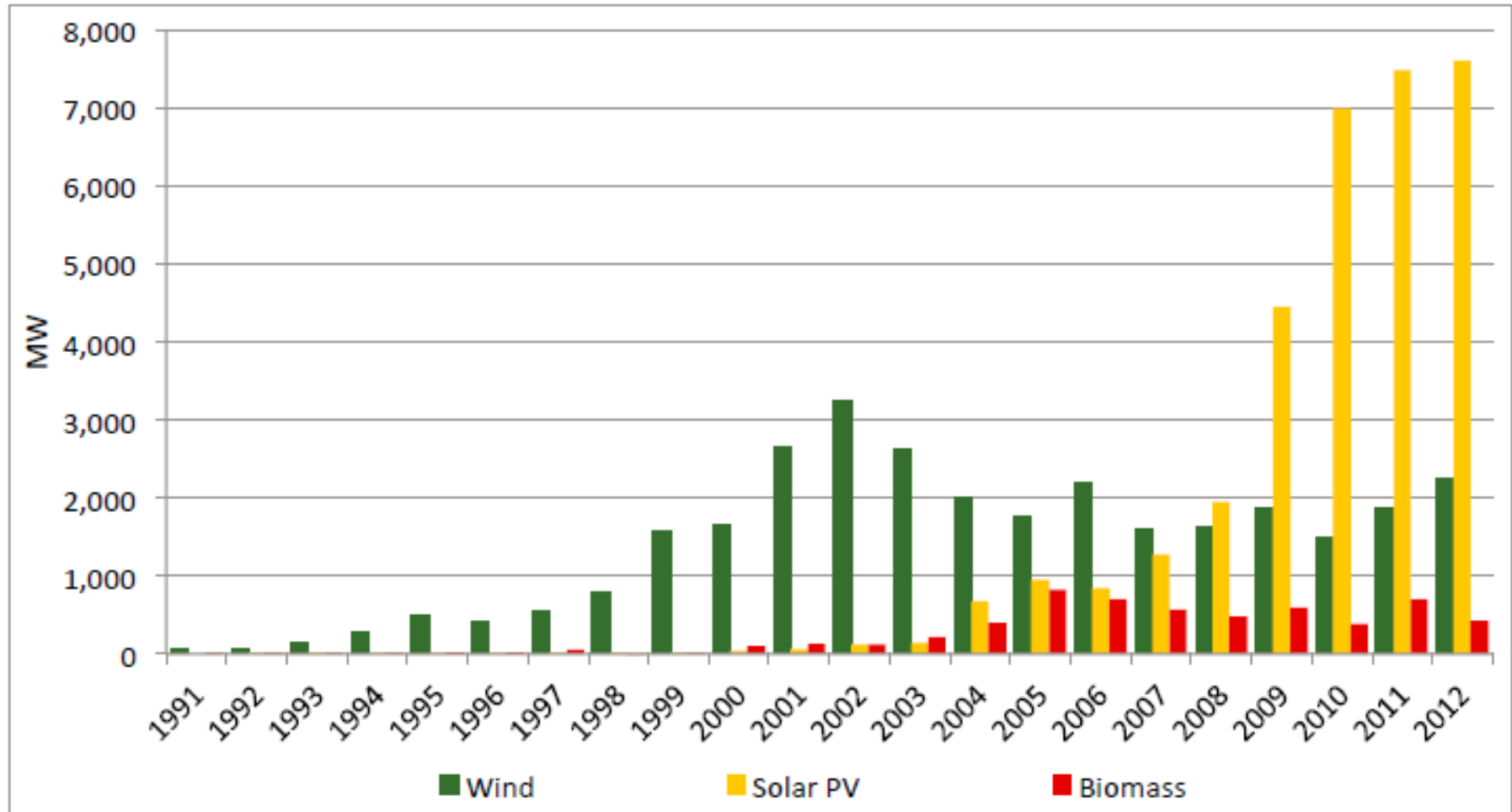
- All nuclear to be shut down by 2022
- Incumbents made the bet on gas—invested heavily



Source: "Energiewende and Grid Development in Germany"
Ulrike Hansen, International Affairs Energy, BNetzA

Renewable Energy Capacity Additions

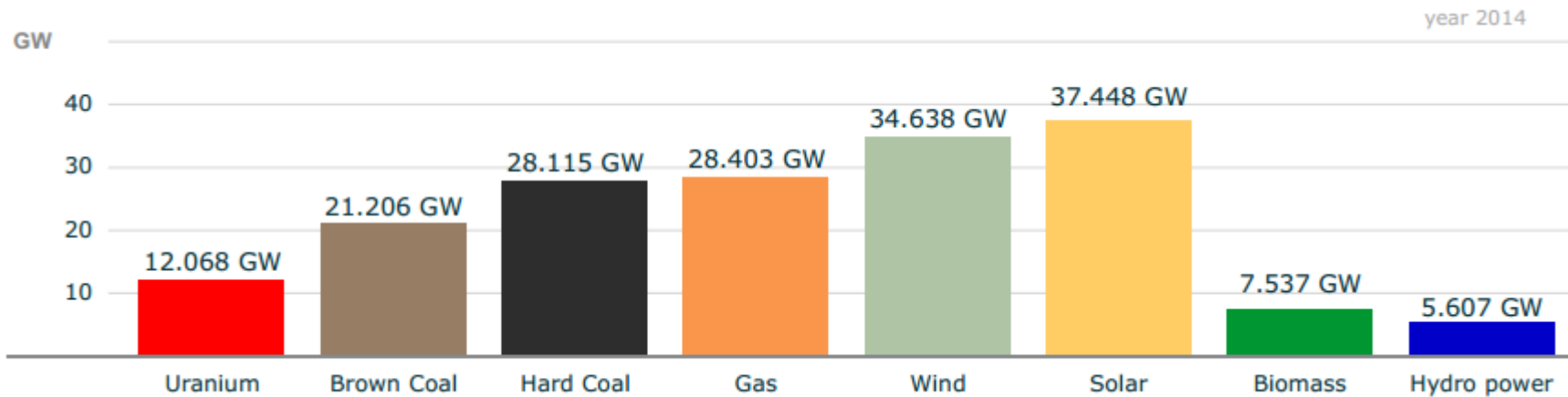
Annual Renewable Energy Capacity Additions in Germany, 1990–2012



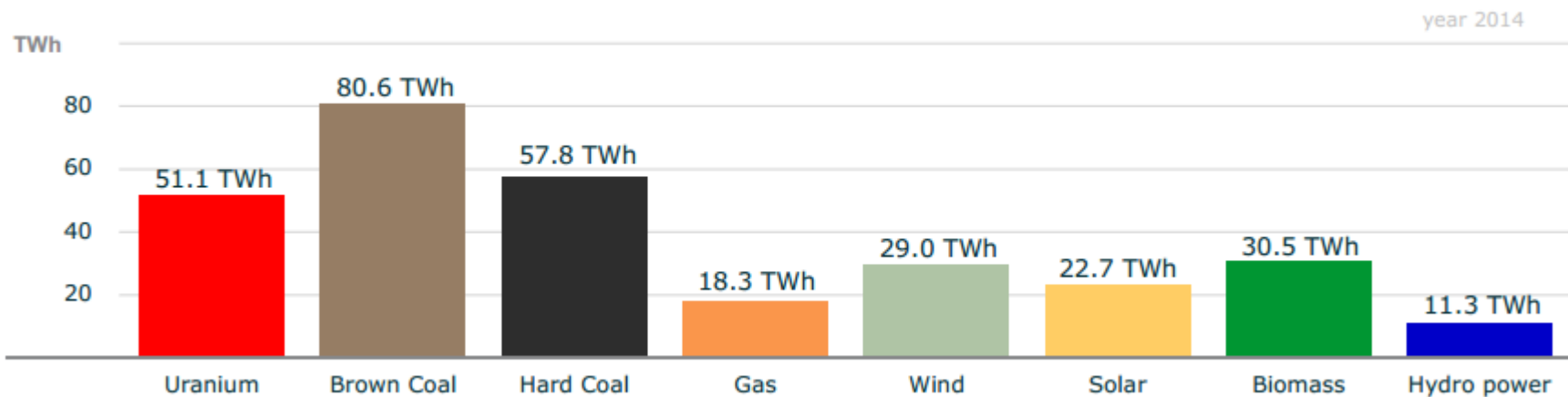
Source: Finadvice

Current Capacity and Generation

Net Installed Capacity Rating as of July 16, 2014

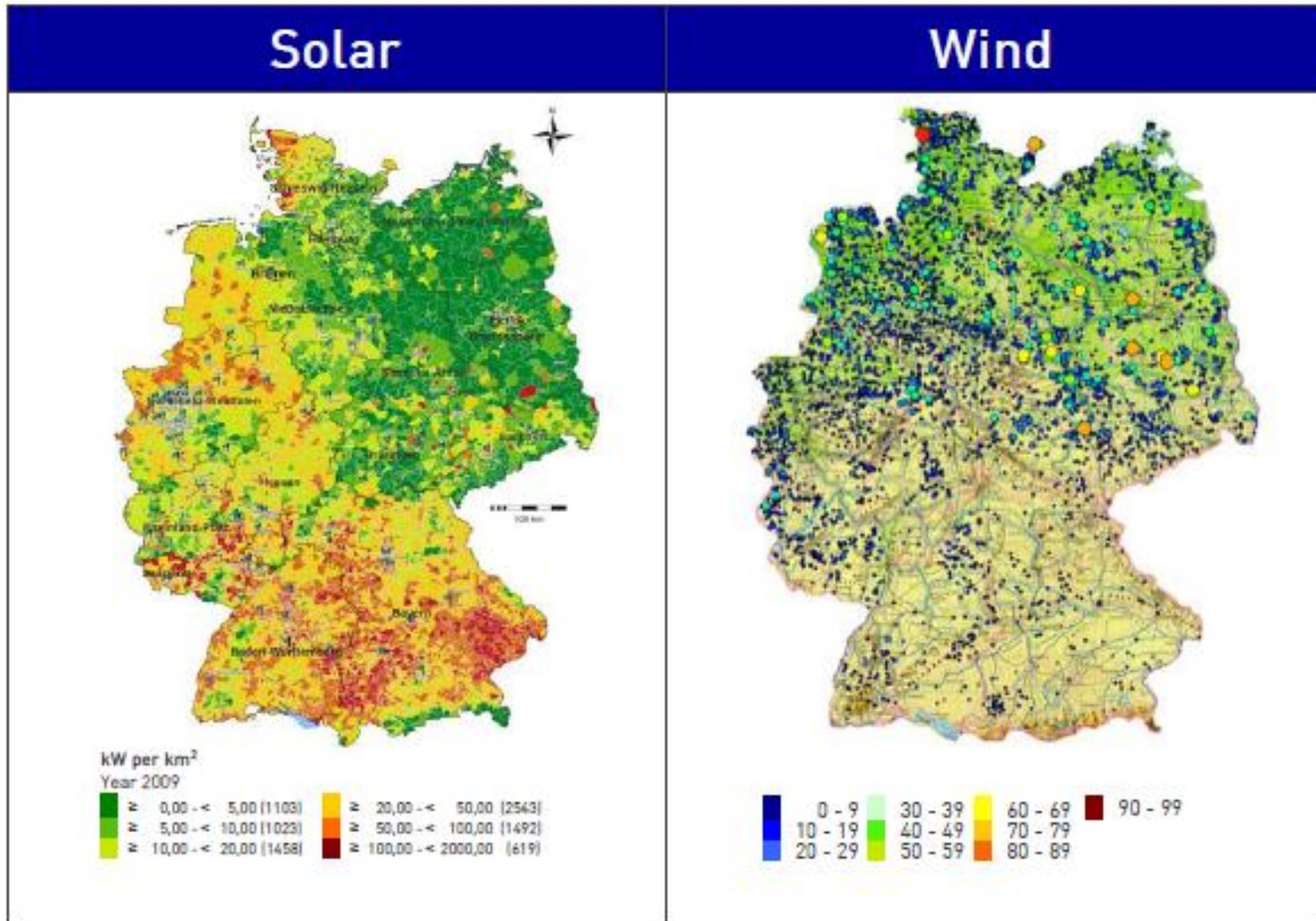


YTD Electricity Production through July 2014



Source: Fraunhofer Institute for Solar Energy Systems

Utility-Scale Wind in the North, Distributed Solar in the South

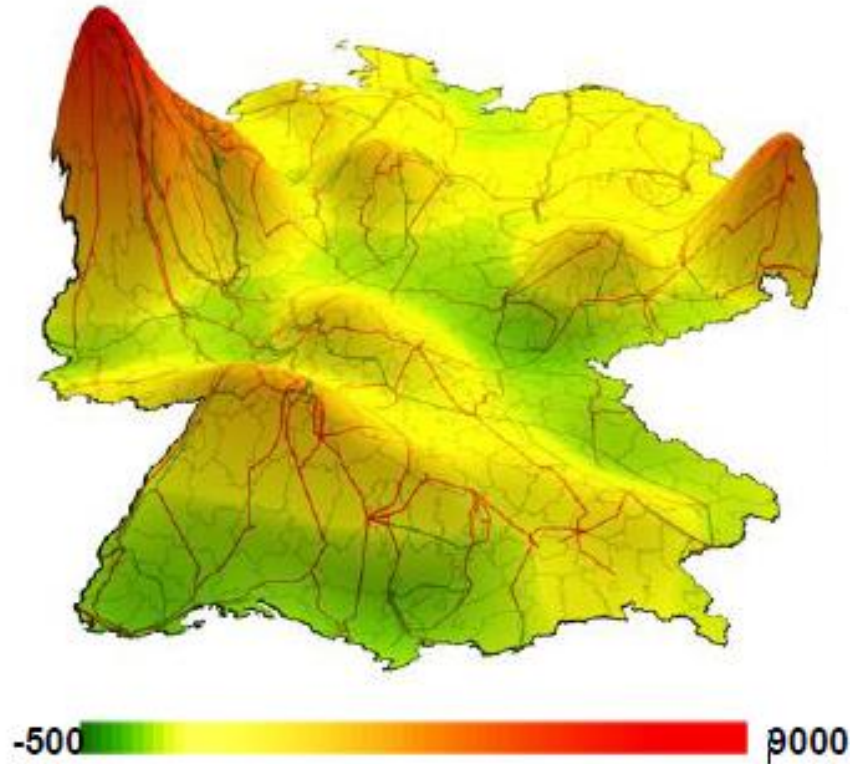


Source: SEPA Executive Fact-Finding Mission – September 17, 2014 – Netze BW GmbH, Gerhard Walker

Significant Variation in Load and Supply

- Industrial south net user
- Utility-scale wind in north with constrained transmission
 - Loop flows through Poland
- Intermittency means significant reliance on neighbors
- Imports of French nuclear and Czech coal
- “Dumping” excess output

Electricity account balance 2013 [MW]



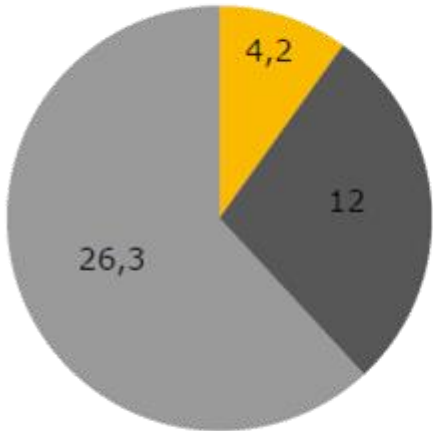
Source: “Energiewende and Grid Development in Germany”
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Significant Capital Investment Needed

- Long-range plans submitted jointly by the four TSOs
- Approval by the federal regulator
- Recovery through kWhr charge
- Investment through 2030

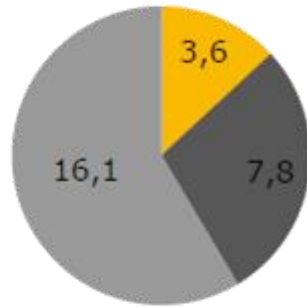
Scenario 1

(increased and faster expansion of renewables): €42.5bn



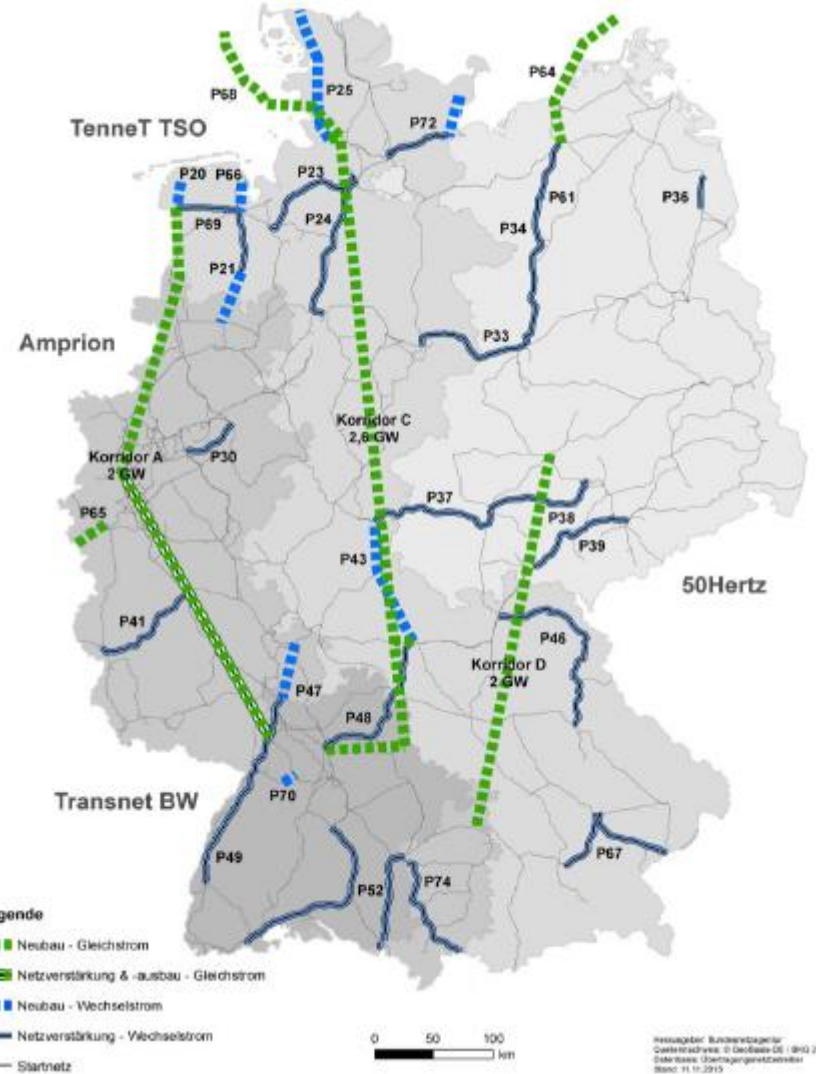
Scenario 2

(conservative estimation):



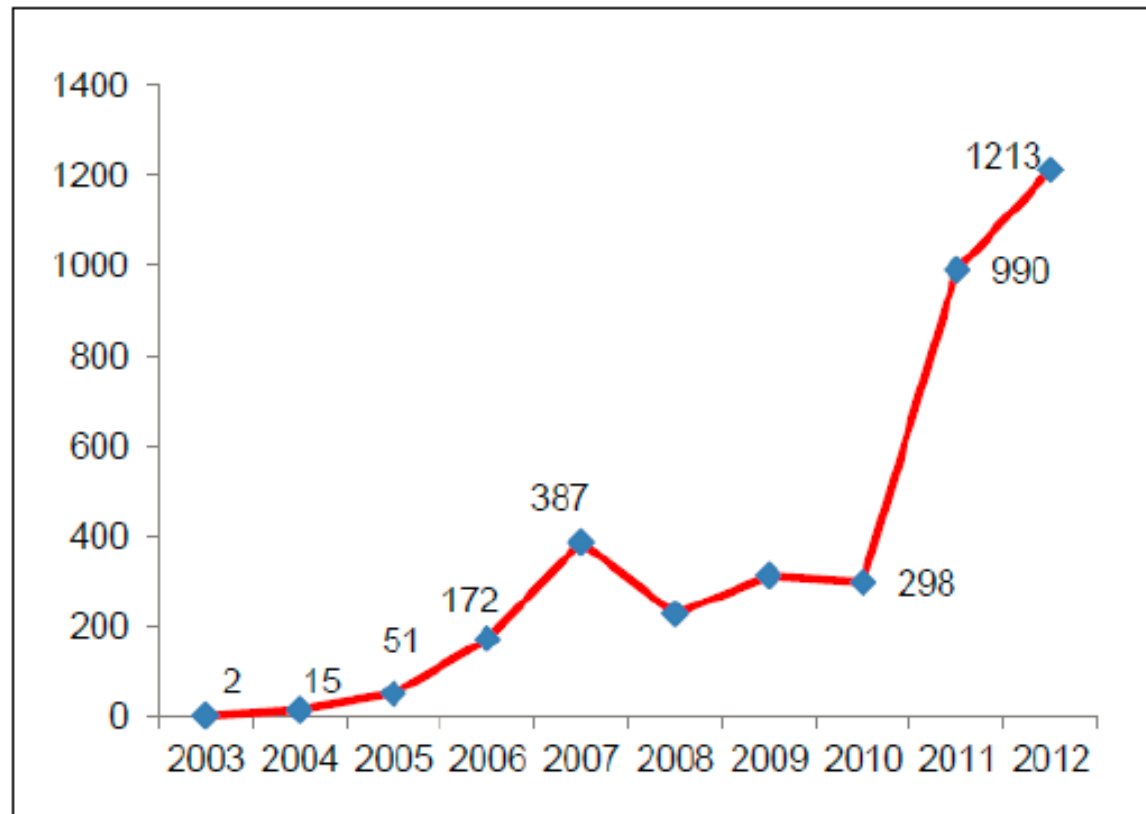
- low-voltage (<400 V)
- medium-voltage (1 - 30 kV)
- high-voltage (60 - 110 kV (150 kV))

Source: German Energy Agency (Dena), 2012: Distribution Grid Study



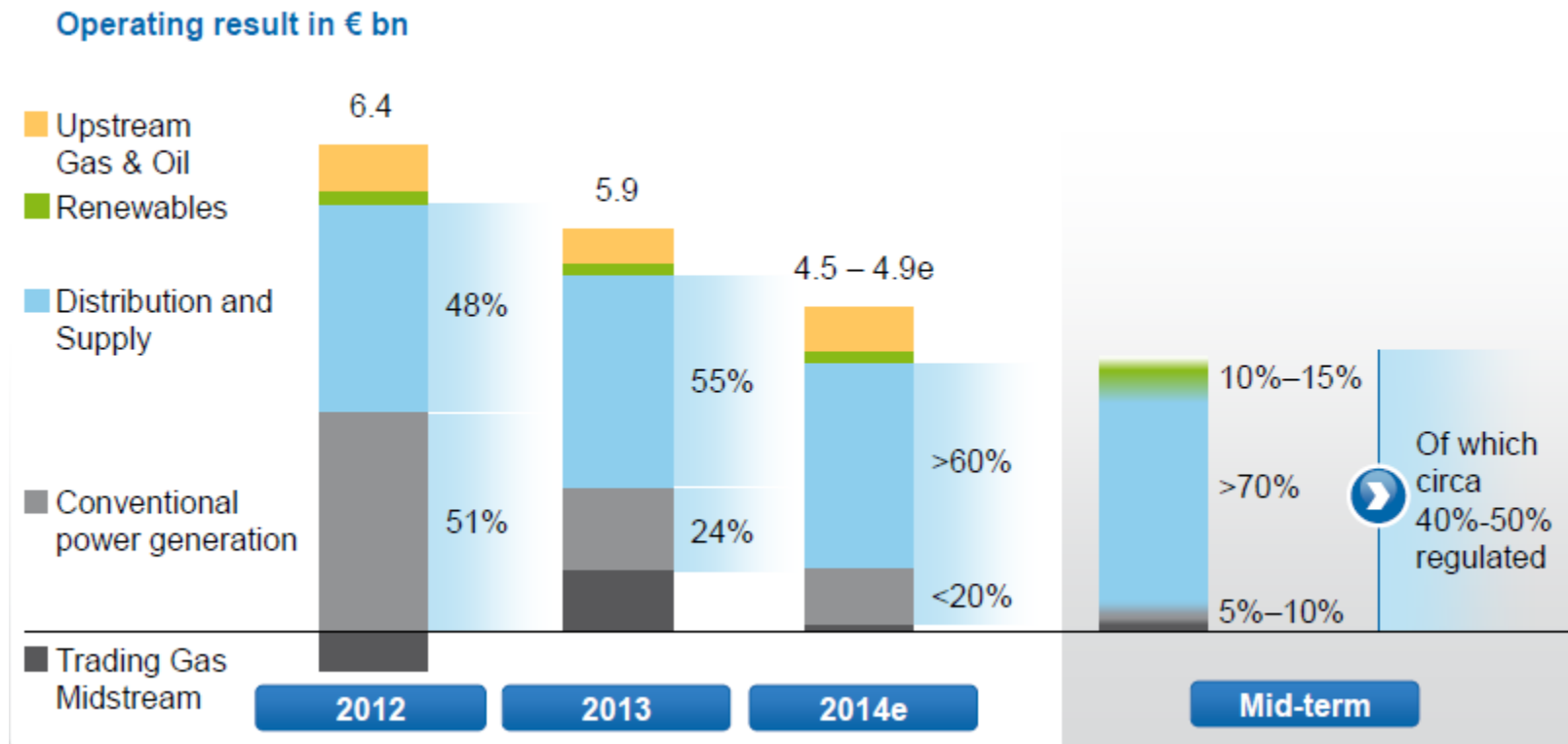
It's Working with More Active Management of the Grid

Grid Interventions to Stabilize the Grid
by Grid Operator TennetT 2003–2012



Significant Destruction of Value for Incumbents

RWE earnings down significantly



Source: RWE

Summary

- To understand Germany, must understand more than renewables
- Have moved to a model much like ERCOT but with TSO ownership of assets
- Reliability has been maintained without significant investment but with active management and reliance on neighboring systems
- But, significant investments are on the horizon at both distribution and transmission levels
- Short-term results are questionable (increased CO2 and higher rates), but focus is on long game

