

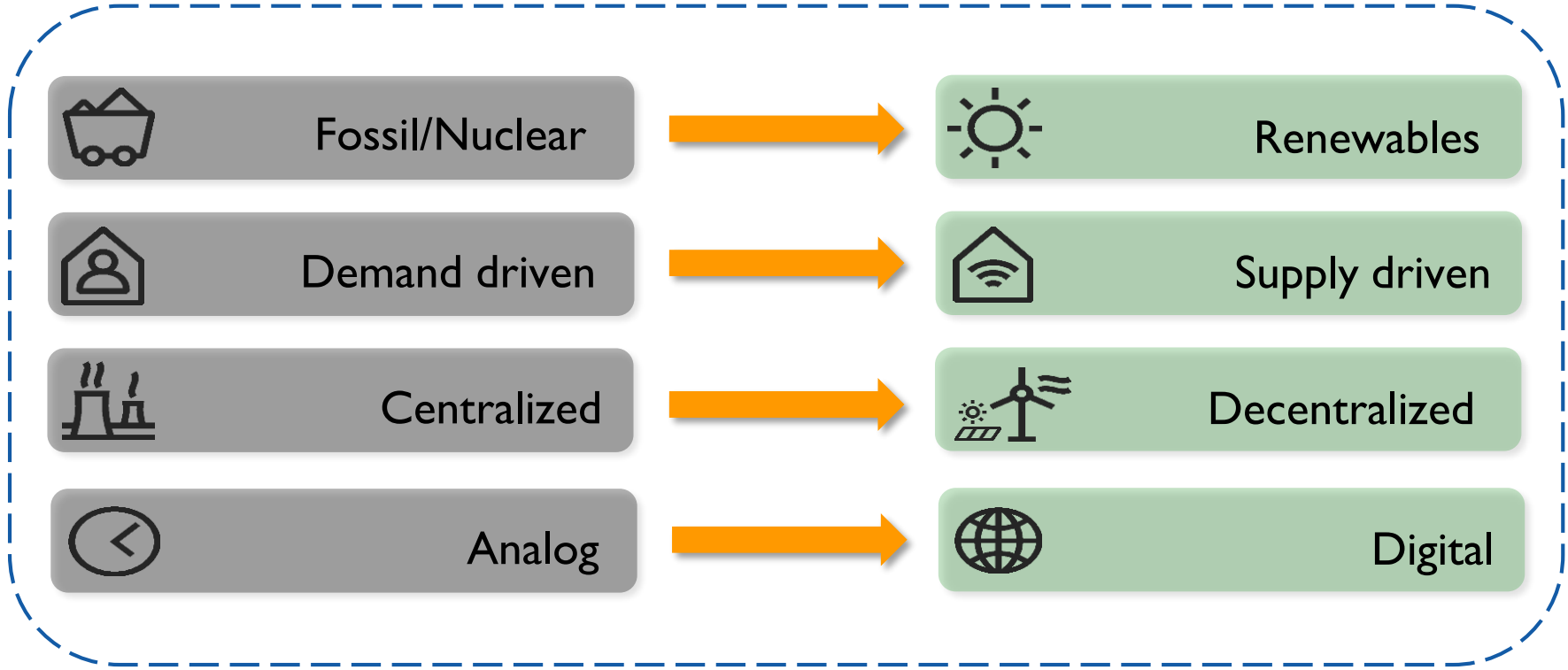
# Energy Transition and the role of hydrogen

Danish Partnership for Hydrogen and Fuel Cells 2017 - Annual Conference

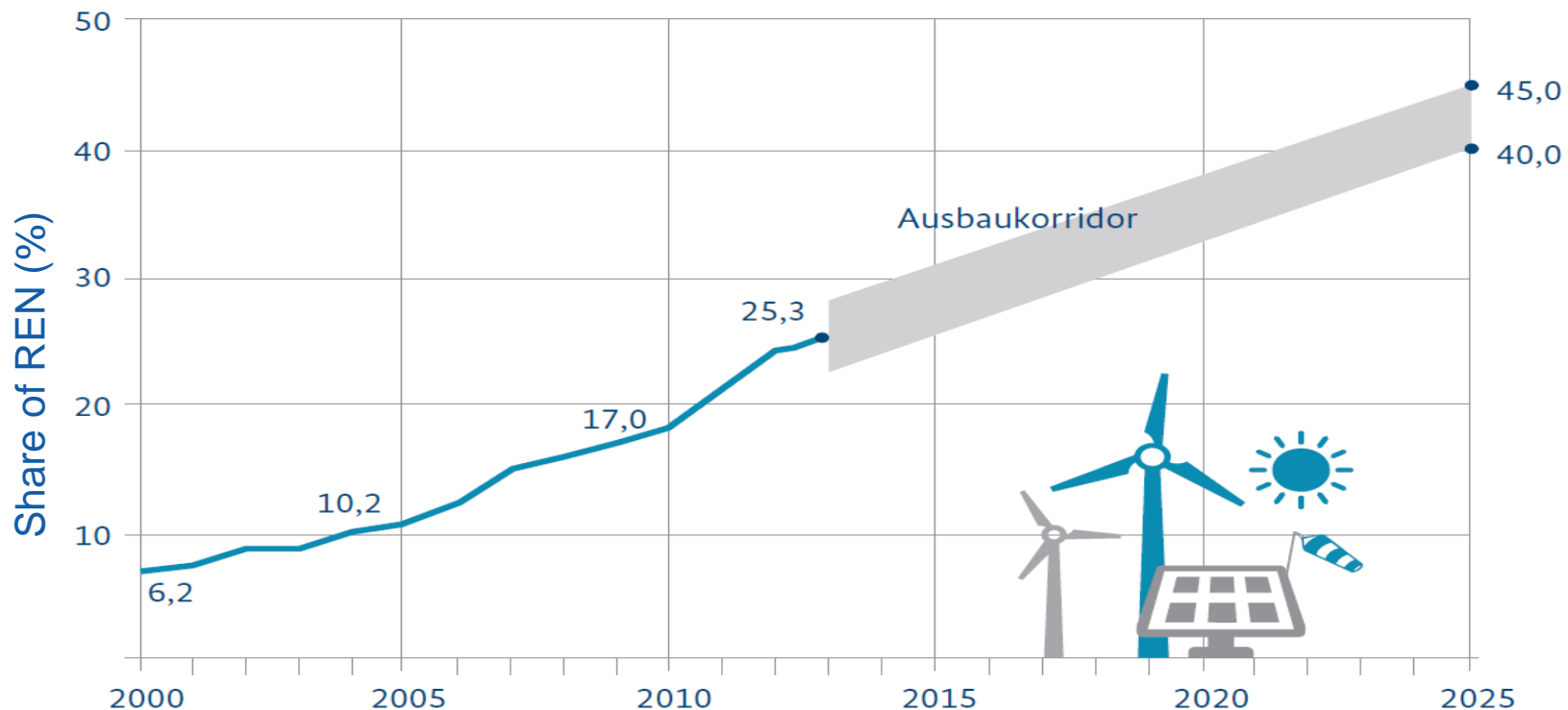
April 25, 2017

Oliver Weinmann

# The Challenges of the Energy Transition



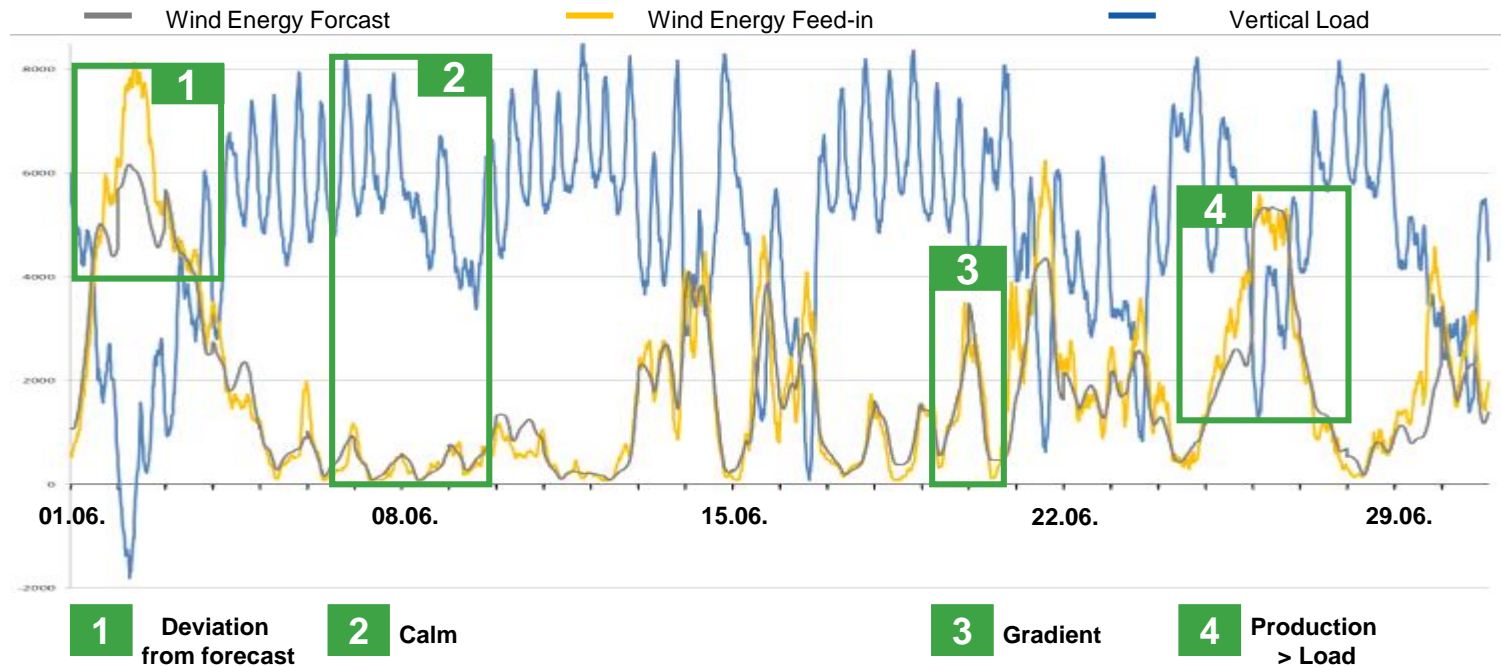
# Share of renewable Energy Feed-in in the German System



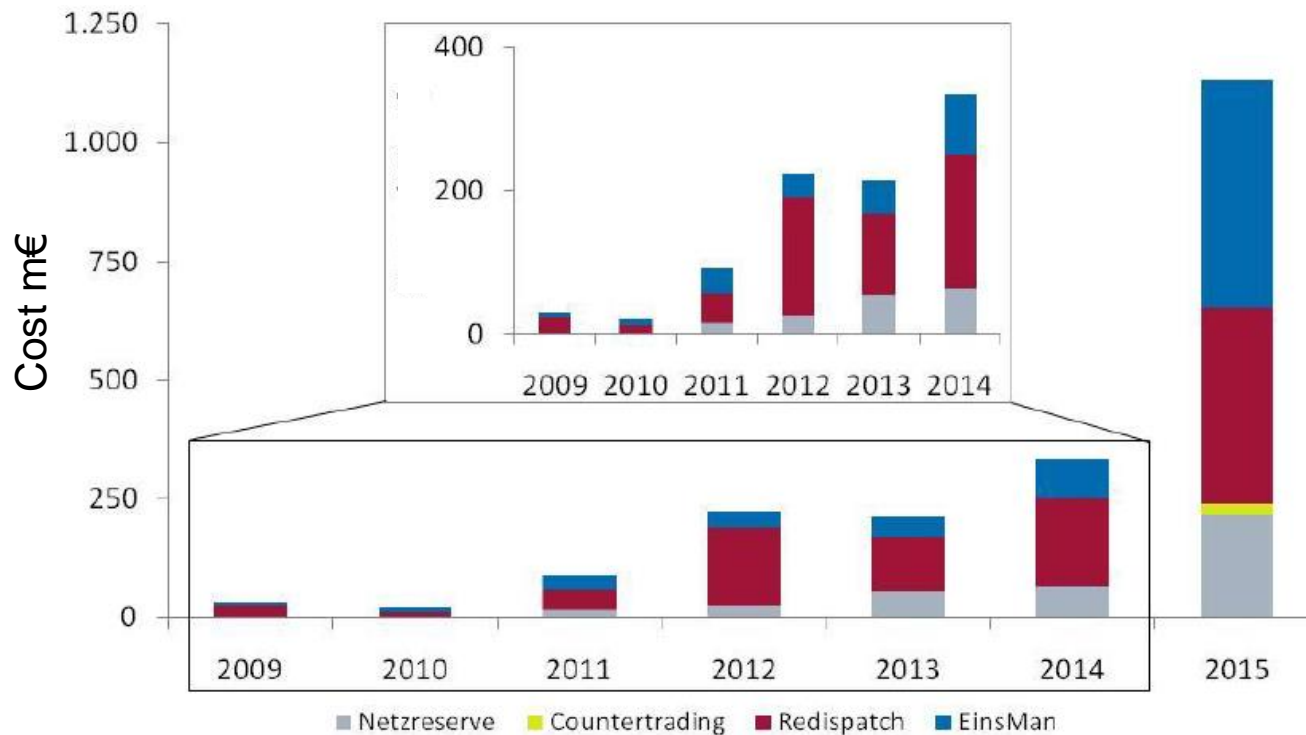
Source: ZSW nach Arbeitsgruppe Erneuerbare Energien-Statistik (AGEE-Stat)

# Challenges of REN Feed-in into the System

Vertical Load, Wind Energy Forecast and Wind Energy Feed-in in East Germany  
(1.-30.06.2013, MW)

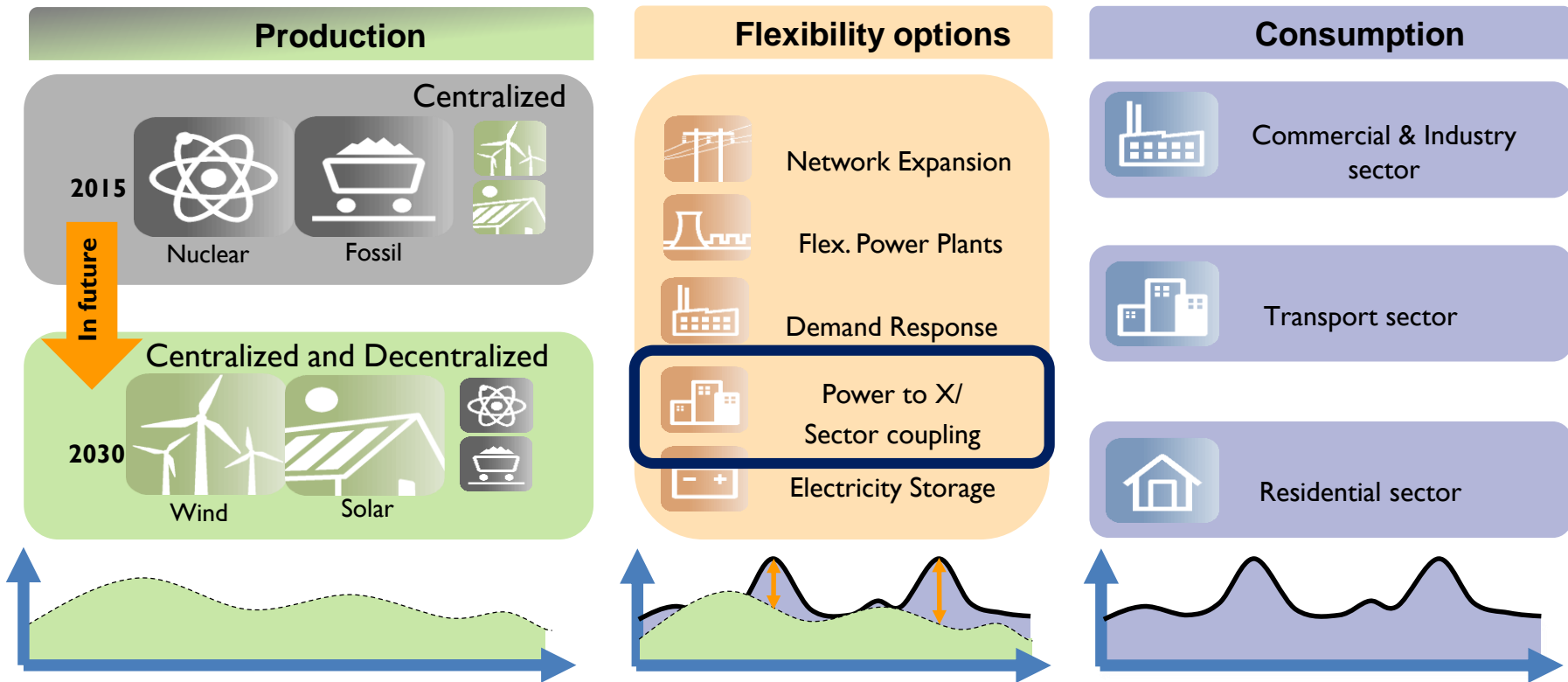


# Cost figures Congestion Management (Germany)



Source: BDEW

# Change from Demand to Supply Driven System



# Sector Coupling

- Goals:
  - Decarbonisation of mobility and heat
  - Implementation of renewable electricity (incl. surplus production) for house heating, industrial heat, and transport.
- technologies:
  - Power to Gas (Hydrogen)
  - Power to Heat
- Main applications:
  - Utilization of renewable electricity for heat and transport
  - Supply of ancillary services

# Hydrogen as transportation fuel

- Hydrogen (power to gas) production with electrolysis can be used to balance volatile production
- Most attractive business case for H2 is transportation fuel
- Vattenfall operates the largest European H2 filling station since 2011 in Hamburg
- H2Mobility builds up refueling infrastructure for H2 vehicles – 400 filling stations until 2023
- Several European cities are interested in H2 busses for public transportation
- Alstom has developed hydrogen fuel cell train
- Vattenfall currently investigates hydrogen production infrastructure solutions to serve emission transport on a commercial basis





# H<sub>2</sub> MOBILITY

FUELLING HYDROGEN

# Power to Gas at Refineries (1)

- Transportation sector has legal obligations to reduce the CO<sub>2</sub> footprint of fuels (eg diesel, gasoline)
- CO<sub>2</sub> reduction today is done by addition of biofuels, however the biofuel supply chain potential is uncertain regarding the increasing CO<sub>2</sub> reduction requirements
- Huge amounts of hydrogen are needed in the refinery process, today produced by steam reforming of natural gas
- Replacing this hydrogen with green hydrogen (power to gas with renewables, P2G) can deliver CO<sub>2</sub> reductions comparable to blending of biofuels



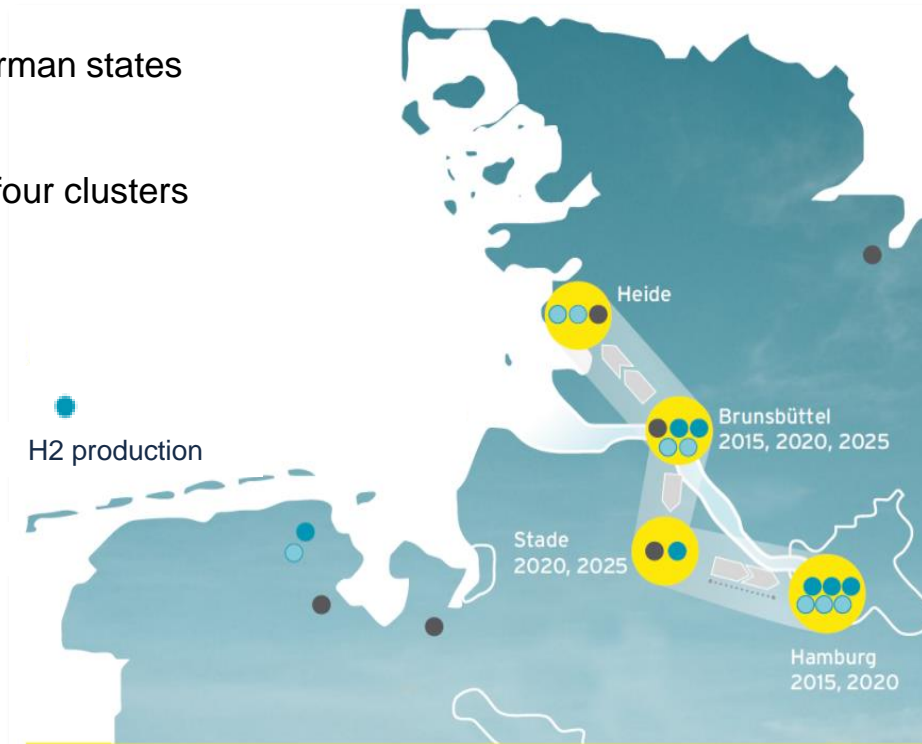
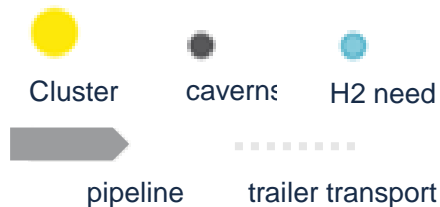
# Power to Gas at Refineries (2)

- Business case is achievable since power to gas competes to (expensive) biofuels, not with cheap hydrogen from steam reforming
- P2G will replace biofuels in the refinery process and achieve the same CO2 reductions
- Potential: Germany some 1GW, EU 10GW
- Major obstacle: permission to get CO2 reductions credited similar to biofuels not yet in place – regulation needs to be adapted (EU and national)



# ChemCoast Initiative Northern Germany

- High wind penetration in the north German states
- Industry requires huge amounts of H2
- Many options have been identified in four clusters
- First project in Hamburg



# Conclusions

- Share of renewables will further increase
- Volatile sources like wind and solar will be the dominating electricity energy source in the future
- Besides electricity the energy sectors heat and transport need to be decarbonized as well to fulfill the goals of the Paris COP agreement
- Main source for decarbonization of heat and transport will be renewable electricity.
- sector coupling will play a more important role in the future
- Today business cases for these systems are only possible in niche applications
- For large scale roll out attractive business are required:
  - The regulatory and legal framework needs to be adapted to develop economical viable business cases.
  - Cost of sector coupling systems need to decrease

# THANK YOU

Dr. Oliver Weinmann, Vattenfall Europe Innovation GmbH

Hydrogen in the future energy system /  
25.04.2017