

# **Operating the Transmission System: Future Requirements and Future Services**

Graham Stein – National Grid

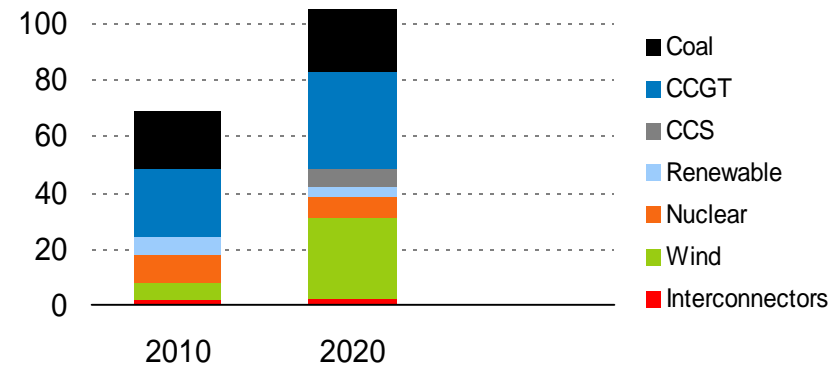
# National Grid's thinking: 'gone green' 2020

Generation gap caused by closures is filled with wind, augmented by gas & clean coal

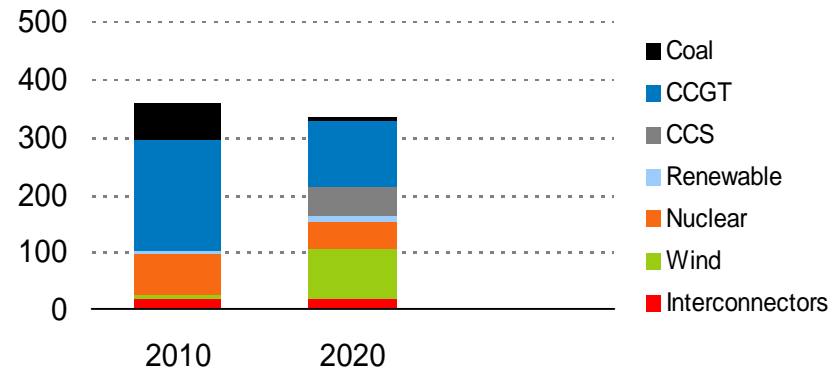
- ◆ 29GW of wind
- ◆ Small amounts of other renewable (hydro, tidal, biomass)
- ◆ 7GW nuclear available post 7GW of closures and 3GW new build
- ◆ CCS coal supplying 3GW
- ◆ Unabated coal still available (run for low wind, high demand conditions)
- ◆ Demand decreases through energy efficiency and smart meters

Target met: 15% of all energy to come from renewable sources by 2020

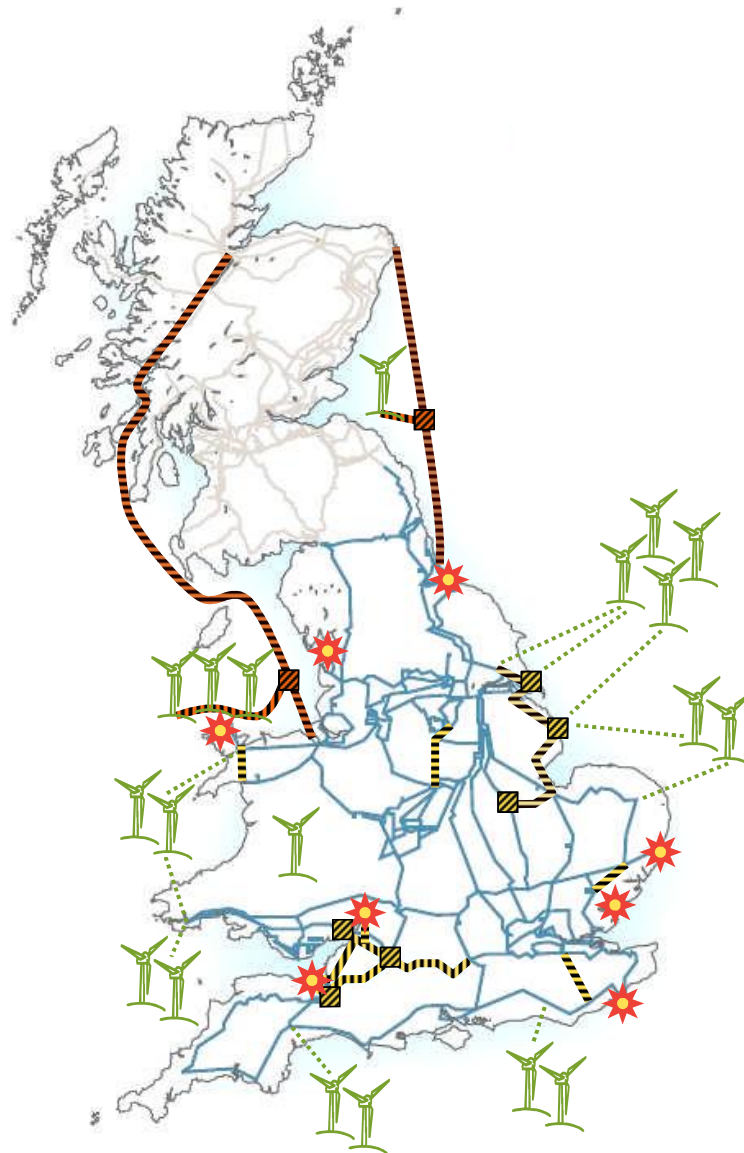
Generation capacity (GW)



Generation delivery (TWh)



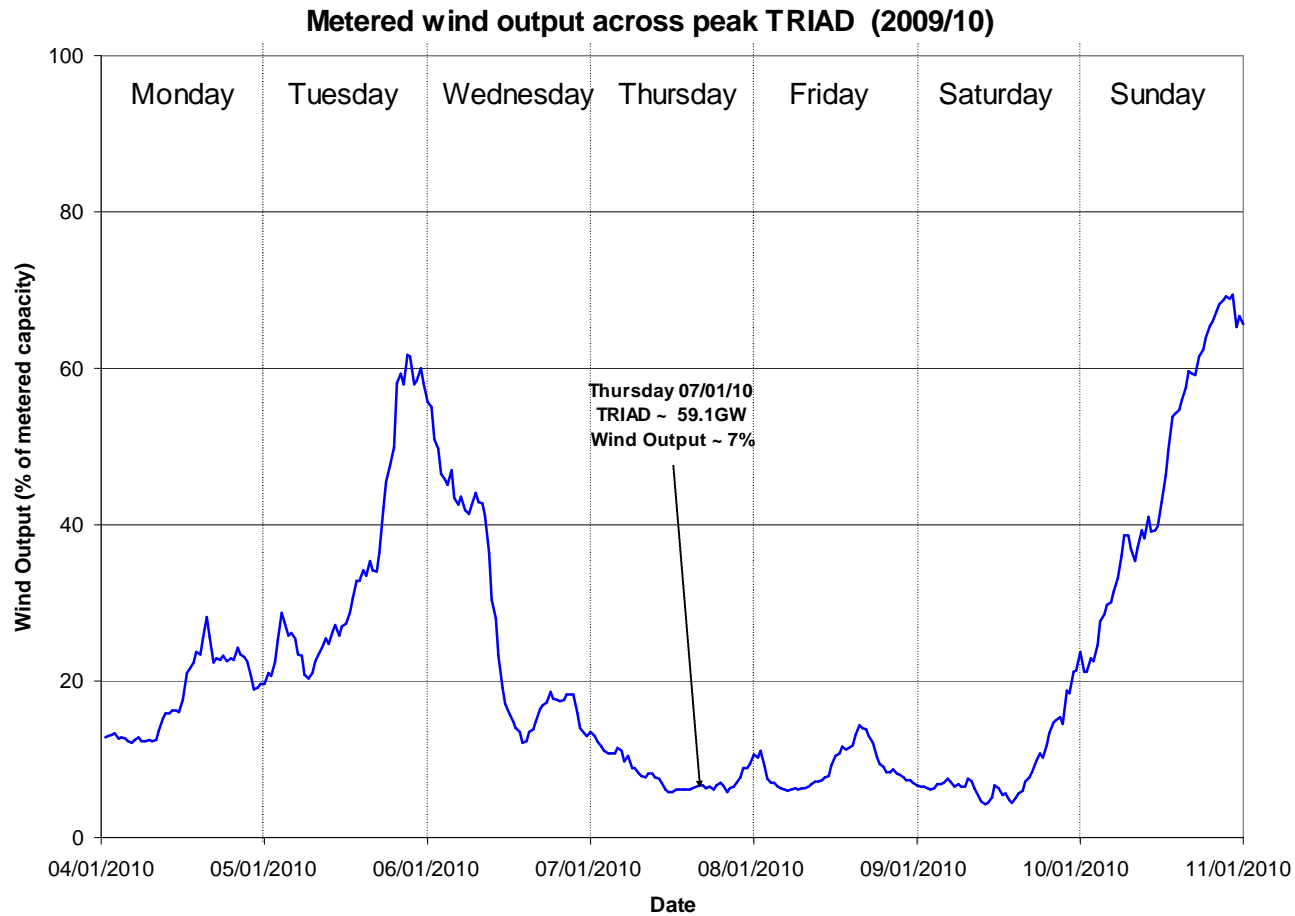
# UK electricity transmission load related investment



Total potential investment  
~£5bn to ~£9bn

- existing network
- future potential investment to connect Scottish renewables
- future potential onshore load related investment
- potential wind farm sites
- potential nuclear sites

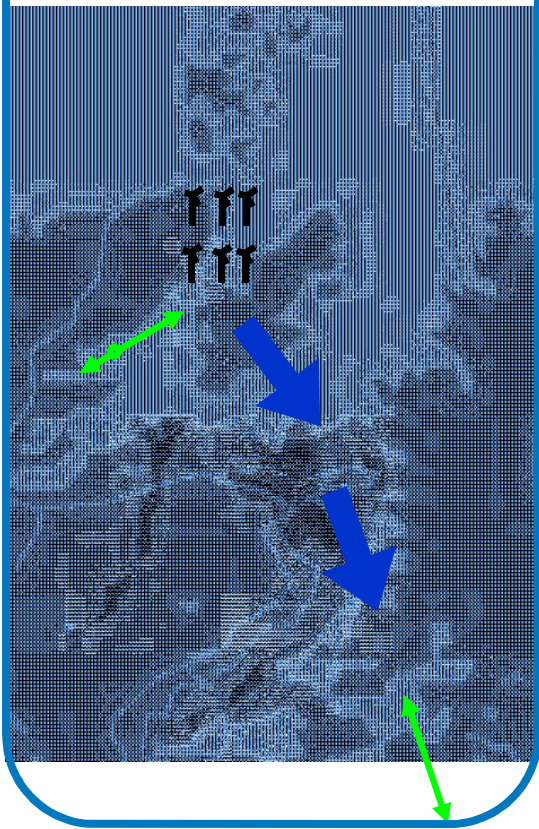
# Operational Challenge



# Operational Challenge

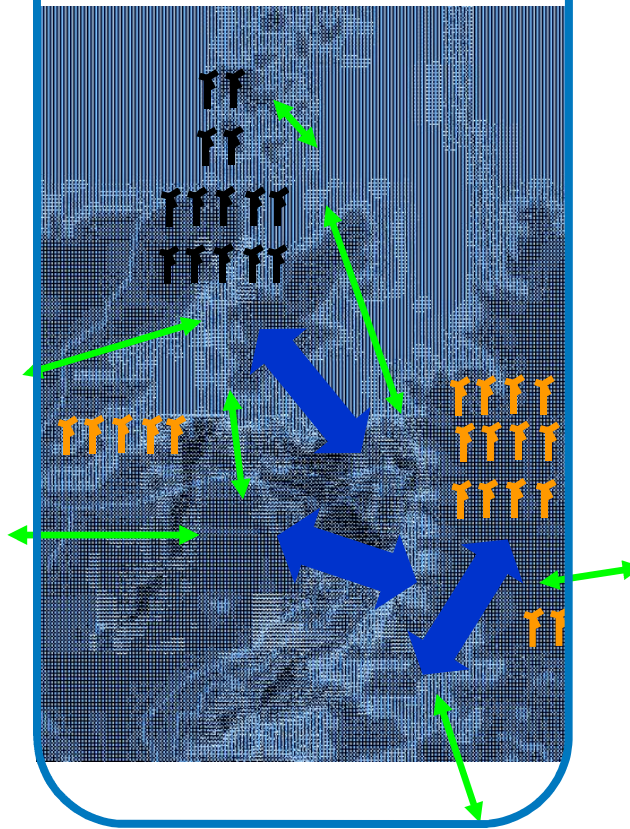
2010

Generally unidirectional  
Reasonably predictable

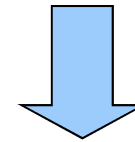


2020

Variable in direction  
Time varying  
Difficult to predict



Transmission  
Flows



from predictable  
to dynamic

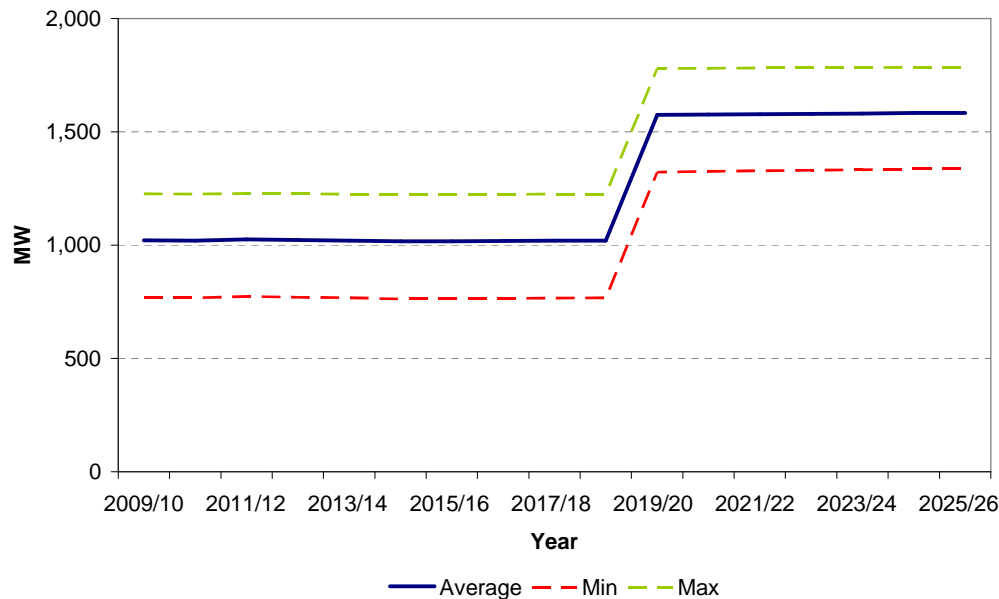
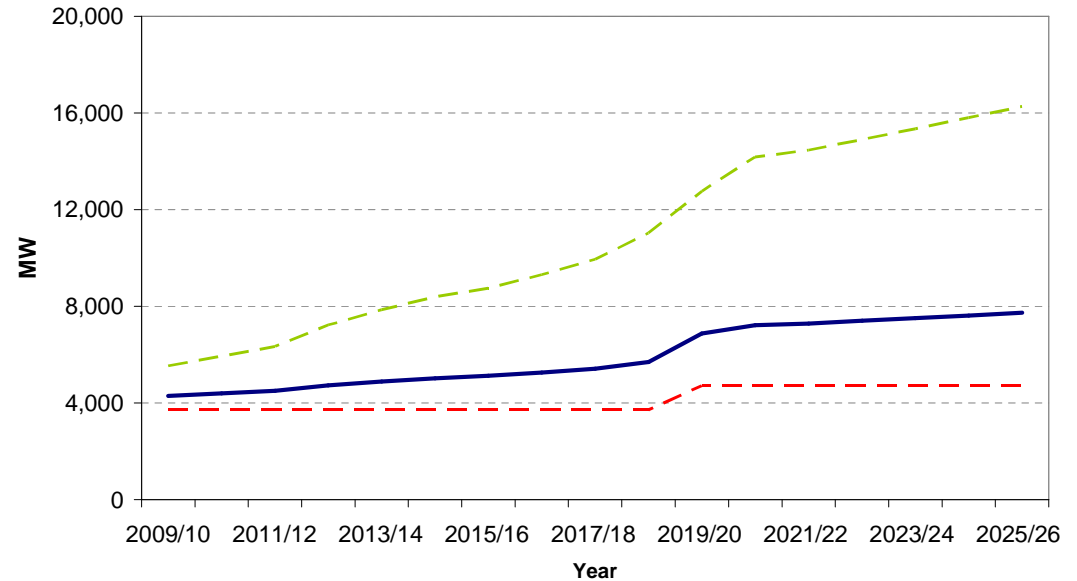
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# Requirement for Services – Reserve and Response

## ◆ Reserve

- ◆ Requirements expected to increase in proportion to Wind Capacity
- ◆ Relationship dictated by Wind Output Forecasting performance



## ◆ Frequency Response

- ◆ Impact of larger secured loss
- ◆ Reserve capacity required to make frequency response available on generation

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# Where do the solutions lie?

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- ◆ Generation
  - ◆ Services from large conventional generators
  - ◆ Flexibility from unexpected sources – Nuclear, Supercritical Coal
  - ◆ Wind – highly controllable in the right conditions
  - ◆ Distributed Generation
- ◆ Storage
- ◆ Interconnectors
- ◆ Demand
- ◆ More effective networks

# Technology has a key role...

**The Smart Grid Can Deliver**

**BENEFITS**

- Enhanced energy security
- Reduced greenhouse gases
- Improved urban air quality
- Increased grid asset utilization

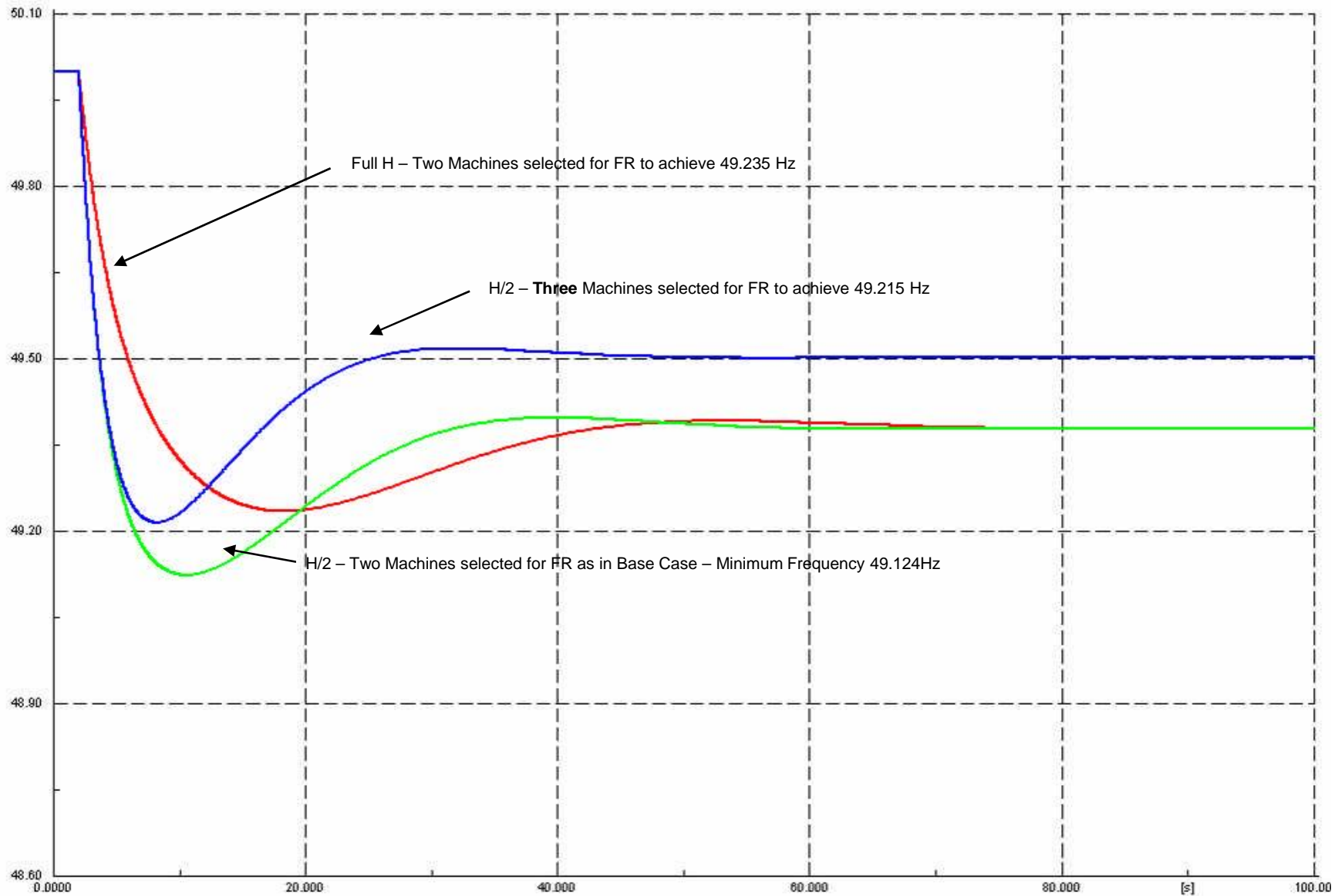
**"Valley Filing" (Energy for PHEVs)**

Hours of day

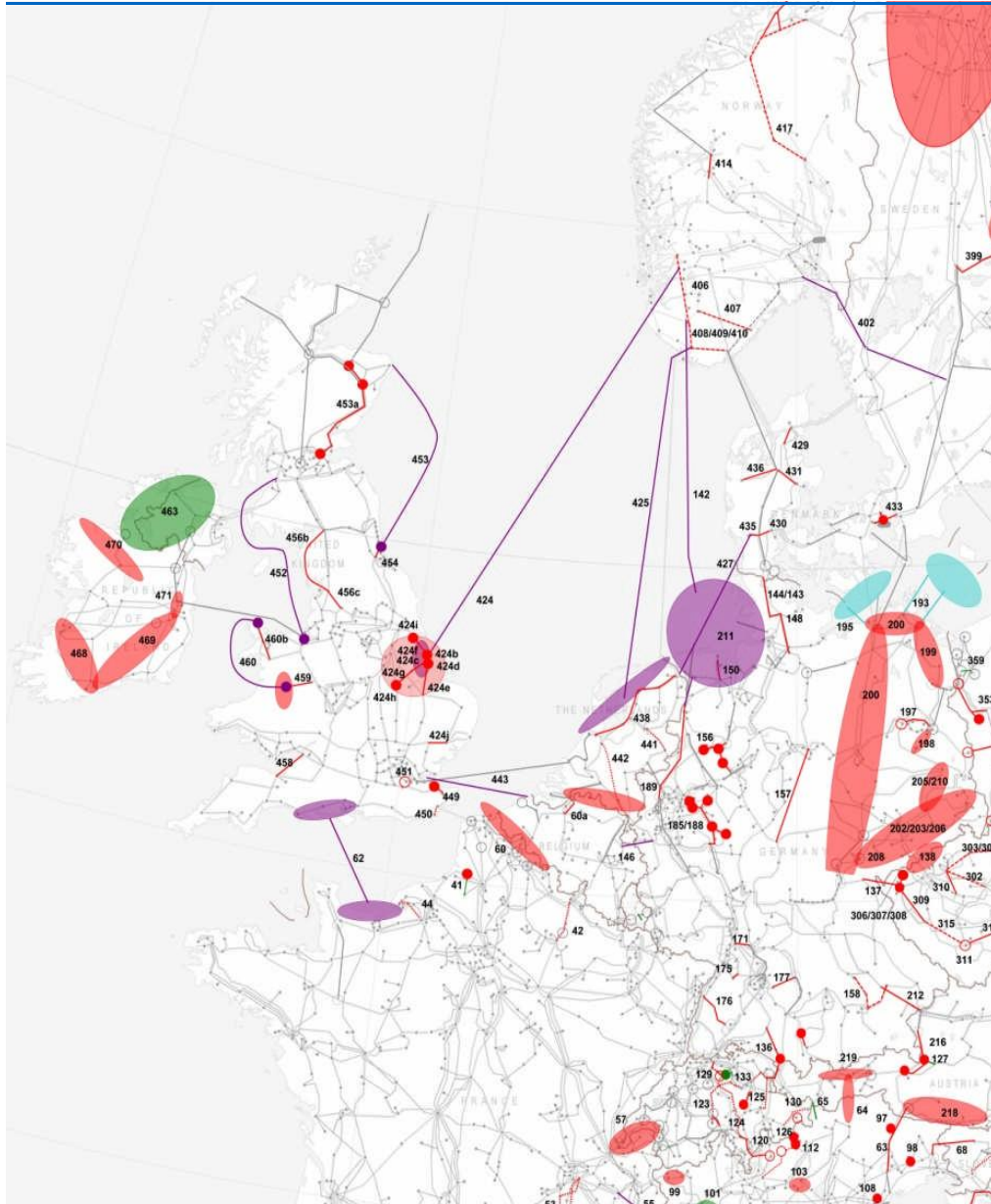
Category	Before 2010	After 2010
CO <sub>2</sub> Emissions	High	Low
Urban Emissions	High	Low
Electricity Sales	Low	High
Infrastructure Requirements	High	Low
Utility Rates	High	Low

Pacific Northwest National Laboratory

# Evolving Background: System Inertia and Frequency Response



# Co-ordination across Europe – 10 year plan



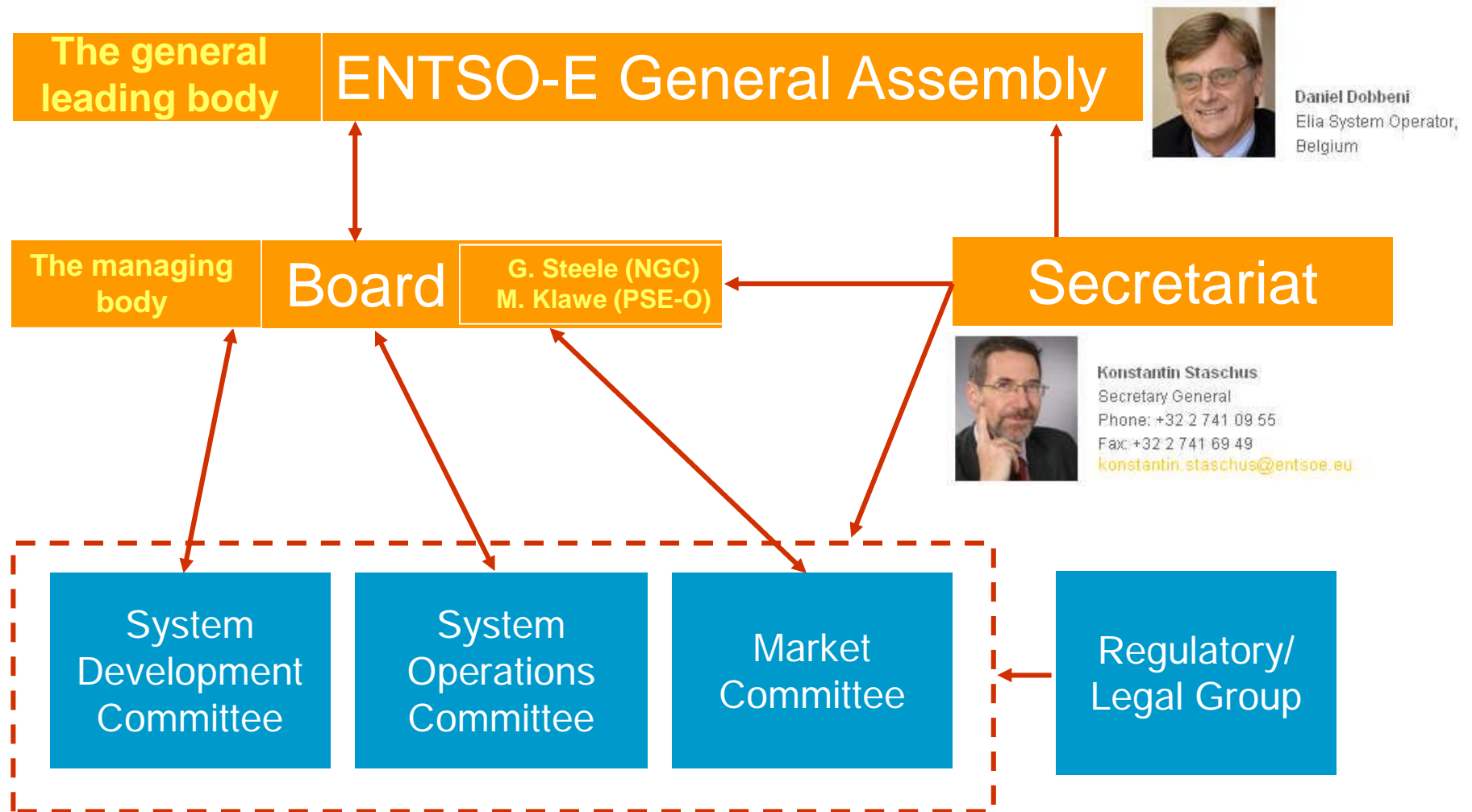
Reliable Sustainable Connected

- ◆ Pilot 10 year network development plan (published 1 March 2010)
- ◆ Looked at projects of pan European significance
- ◆ €23bn – €28bn of investment by 2014
  - ◆ €12bn – €14bn in the North Sea regional group

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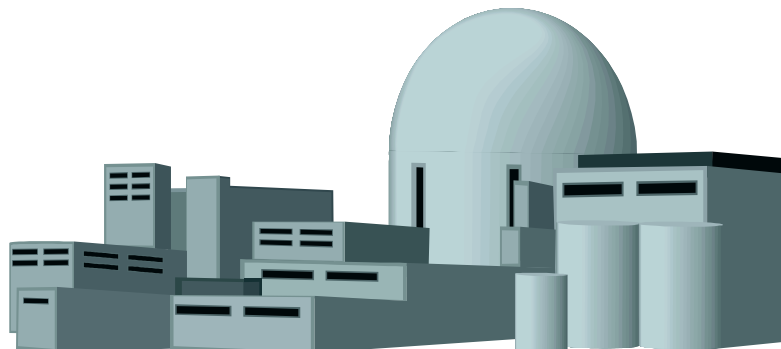
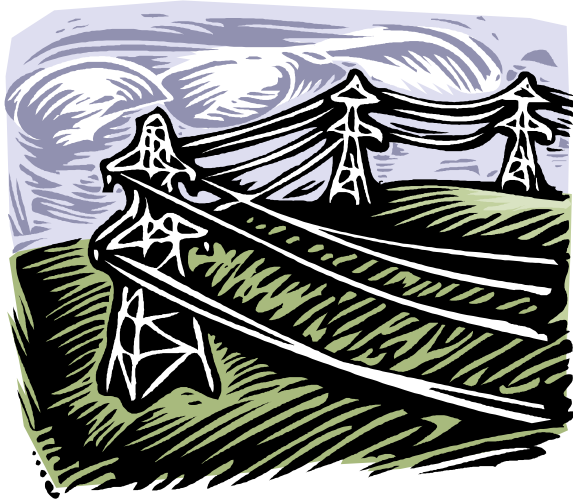
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# ENTSO-E Structure & Management Bodies

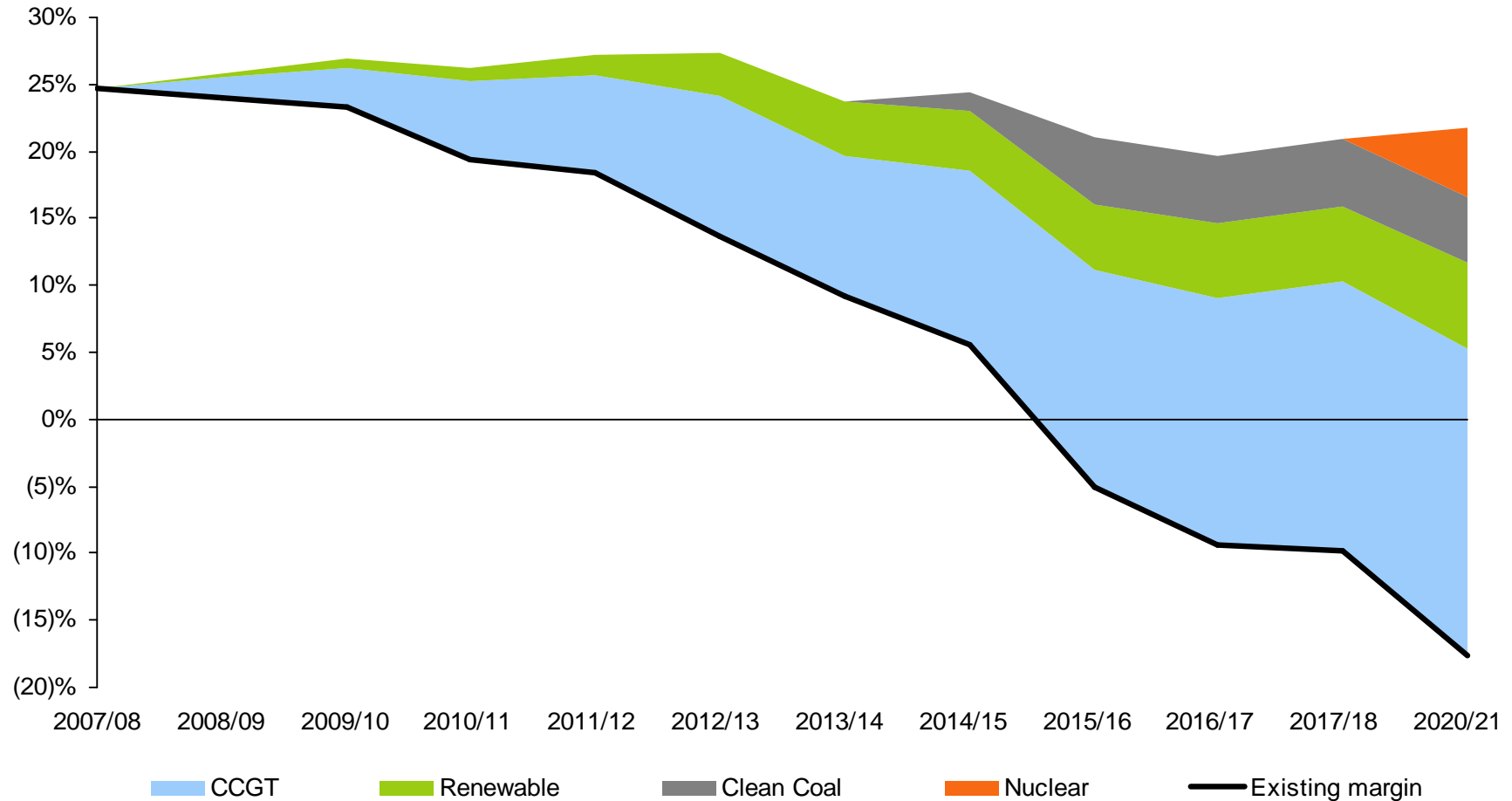


# Infrastructure Required

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# Best view of new UK generation



\* Margin refers to the difference between the total generation capacity and total demand.