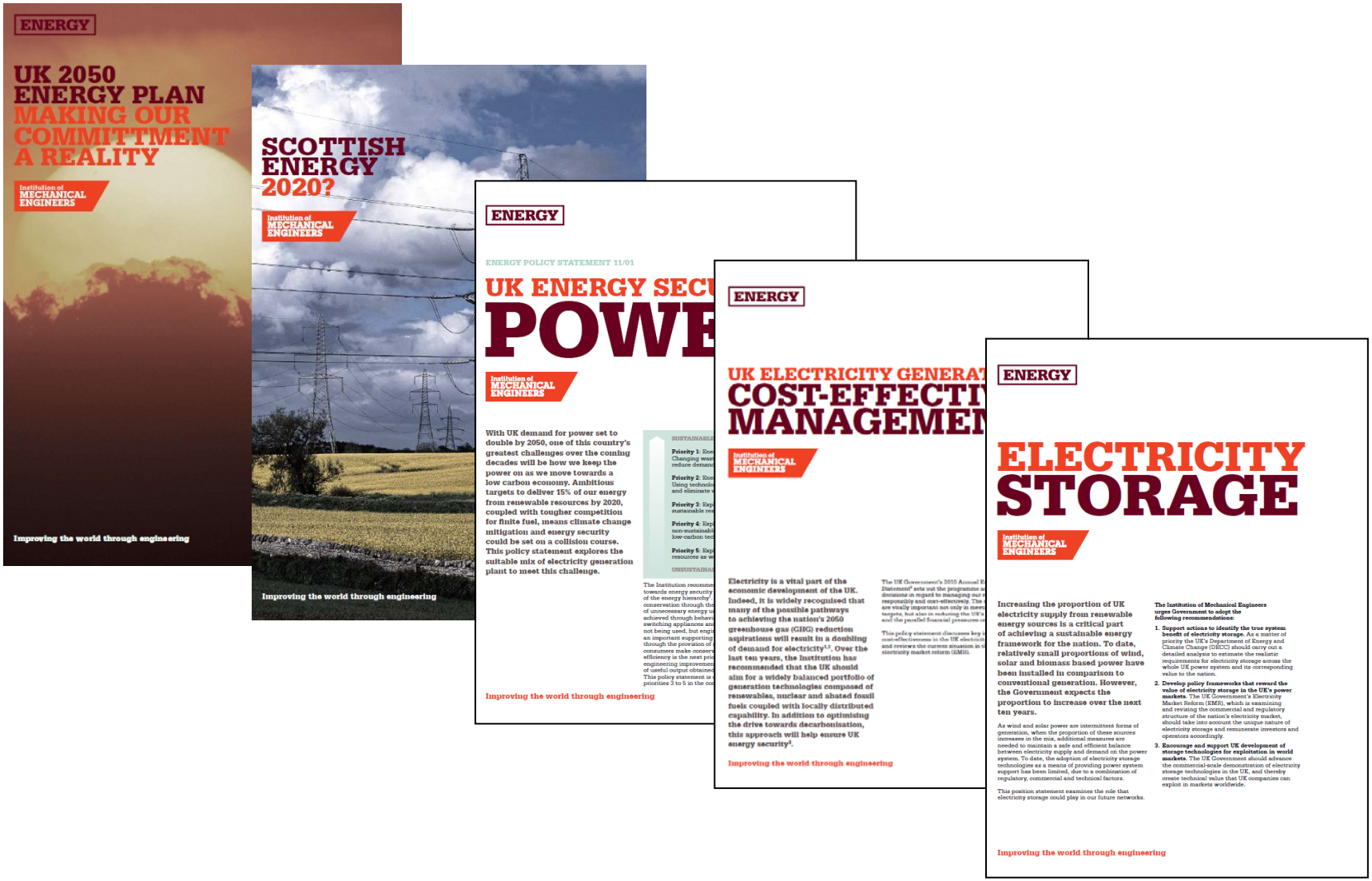
Storing Electricity

Technology in a UK/EU Context

Dr Tim Fox CEng CEnv FIMechE FRSA

Head of Energy and Environment
Institution of Mechanical Engineers
@TimFox_IMechE

Fully engaged in public debate



Talk overview

- Energy landscape and policy context
- Overview for storage
- Policy needs
- Energiewende
- Conclusions

UK energy landscape

- Stable demand profile for past three decades
- Need to replace ageing plant and infrastructure
- North Sea gas depleting (by 2020, 80% of gas demand will need to be met through imports)
- Increasing global competition for limited primary energy resources, particularly oil and gas
- Decarbonisation aspirations and obligations (targets)

Supply and demand

- UK primary energy sources
  - Oil: 45%
  - Gas: 32%
  - Electricity (nuclear, wind, hydro): 19%
  - Coal: 1.5%
  - Other renewables: 2.5%
- UK energy consumption
  - Transport: 39%
  - Domestic: 30%
  - Industry: 18.5%
  - Services: 12.5%
  - Heat 49%, Electricity 20%, Transport 31%

UK Energy policy

Sustainability

- EU 20 / 20 /20 targets
- Climate Change Act 2008
- Increased renewables
- Decarbonisation of electricity
- Decarbonisation of other sectors
- Increased use of electricity as a clean energy vector
- Energy conservation
- Energy efficiency
- Distributed generation

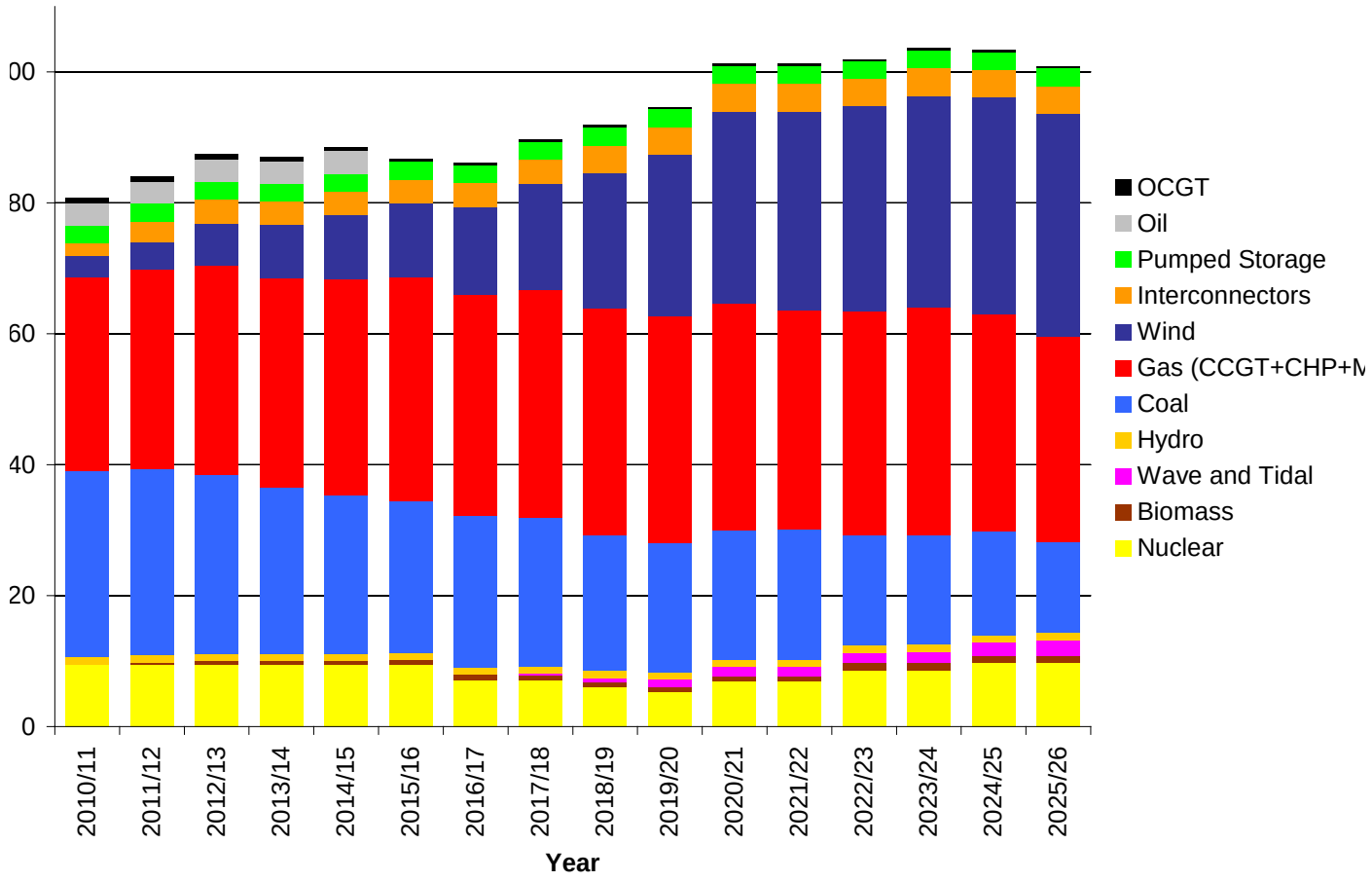
Economy

- Open markets deliver competitive prices
- Interconnections link markets
- Avoid price uncertainty for consumers
- Political intervention and regulation to protect consumers
- Community and domestic stakeholder participation in ownership, production and trading
- Asset optimisation

Security of supply

- Licence conditions provide requirements for supply
- Invest in storage
- Ensure sufficient peak capacity (Winter)
- Maintain margin with adequate reserves
- Increase renewables and nuclear to reduce reliance on imported gas and other fuels
- Develop system flexibility and community level resilience
- Adopt smart grids

Future generation mix

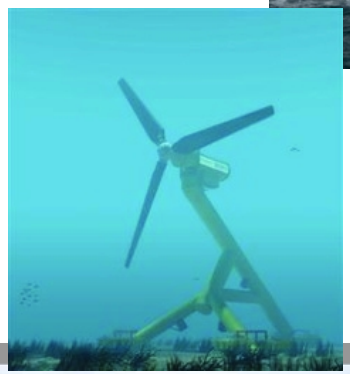


Generation under ‘Gone Green’ scenario

Source: National Grid

Renewables and power system

- Large scale and small scale
- Variability and location
- Surplus and shortfall
- Short and long term reserves
- Markets/subsidies


UK power network

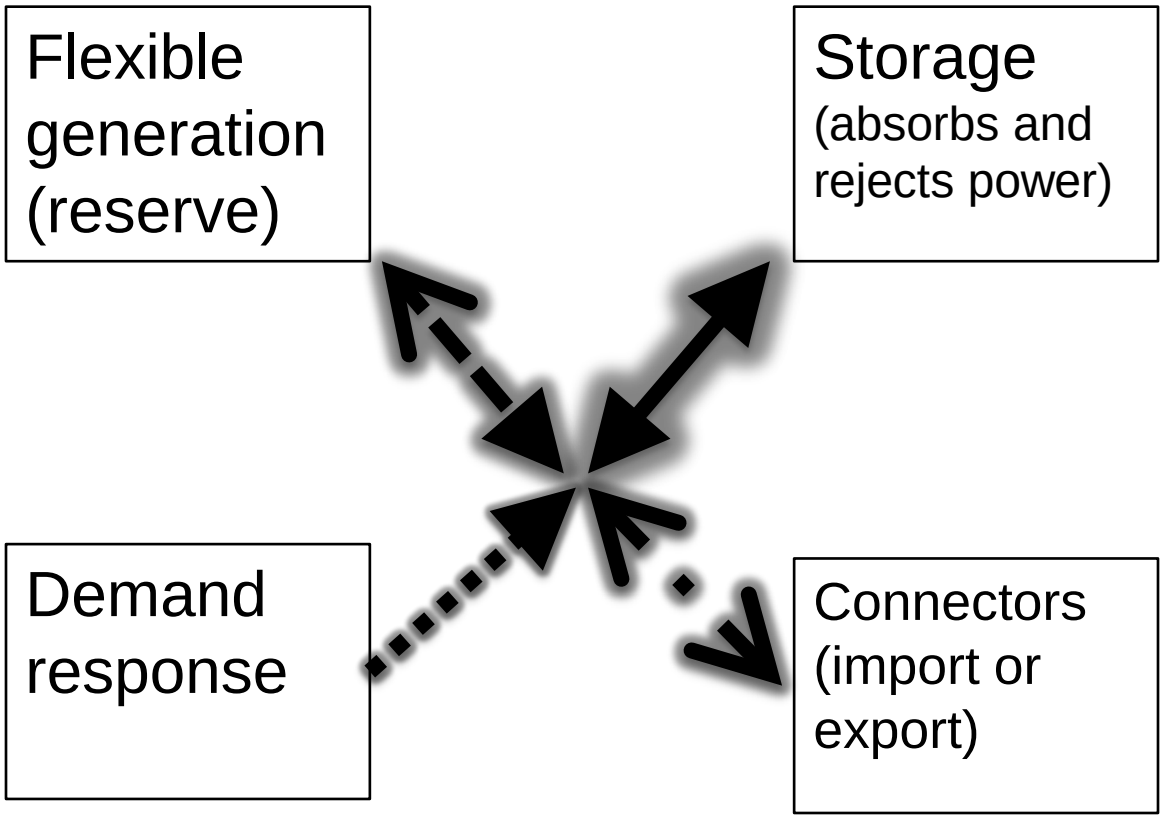
Today's network

- Large scale competitive generation, regulated transmission and distribution
- Limited embedded generation (at distribution level)
- Wholesale market supplies retail customers
- Limited number of self suppliers
- System planned to meet peak demand plus reserves – spare (or under utilised assets)
- Low level of interconnections to other networks
- Regulated wires businesses
- Facing substantial change

The future

- Significant shift from dispatchable generation to time variable generation
- Peaky demands from digital society, switch to heat pumps, uncertain effect of electric vehicles
- Distributed community and domestic level generation and trading
- Average and peak domestic demand likely to increase
- Balancing the system requires more flexibility
- Higher level on continental interconnection

Tools for system balancing



Storage – enabling technology

- Intermittent renewable energy sources
  - ‘Wrong time’ electricity generation – too much or too little
  - Optimises return on investment (ROI) in renewables plant
  - Reduces need for idle spare capacity (reduces investment costs in asset base) and avoids (volatile) fuel costs
- Large base-load electricity generation
  - Sweats assets for improved ROI – e.g nuclear and biomass
- Flexibility of scale and location
  - Mix of storage technologies analogous to generation mix
  - Defers network investments and lowers system costs
  - Reduces SMART grid and interconnection risks

Enablers - storage

- Pumped hydro
- Compressed-air
- Power to gas
- Flywheels
- Thermo processes
- Batteries
- Stockpiling

Storage application matrix

Application scales and potential users

	Small Under 1 MW	Medium 1–10 MW	Large 10 MW–100 MW	Very large 100 MW +
Power producers	Standalone systems for self-generation and renewables		Energy trading Supply of ancillary services	
Network operators	Deferral of network reinforcement	Local network management Deferral of network reinforcement	Deferral of system reinforcement Peak shaving	Network constraint management
Consumers of power	Small commercial, domestic users for local load management and tariff reduction	Local load management, smart grid support and external ancillary services	Peak shaving for energy cost reduction and ancillary services	Peak shaving for energy cost reduction

Barriers and challenges

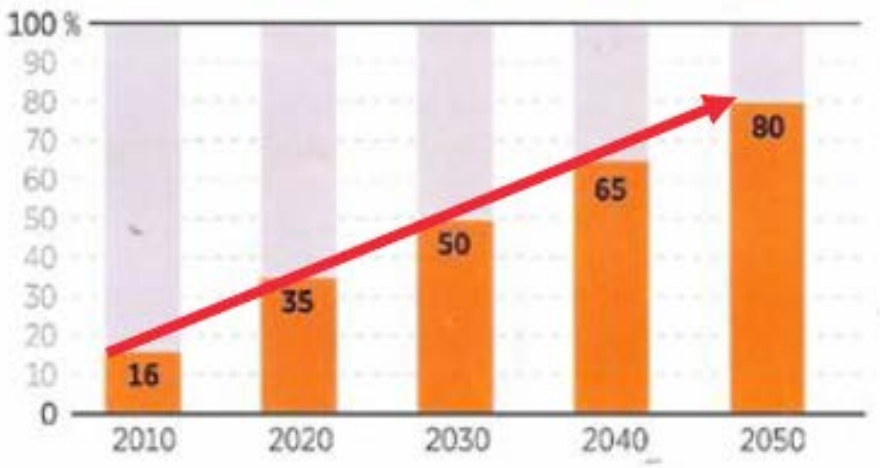
- Classification of storage solutions
  - Electricity “consumer” and electricity “generator”
- Electricity market structure
  - Competitive generation and highly regulated transmission and distribution – disincentive for investment
  - Lack of income certainty increases financial risk - need to be allowed to access multiple income streams
  - No clear business model
- Government policy
  - No current UK Government policy for widespread deployment/adoption of storage capability

Policy needs

- Recognise the value of storage
  - Strongly dependent on network generating mix and local market rules
- Separate classification for storage
  - Recognise unique roll as both ‘consumer’ and ‘provider’
- Create competitive incentivised environment
  - Needs to ensure inclusion and access to multiple streams
- Support demonstration at commercial scale

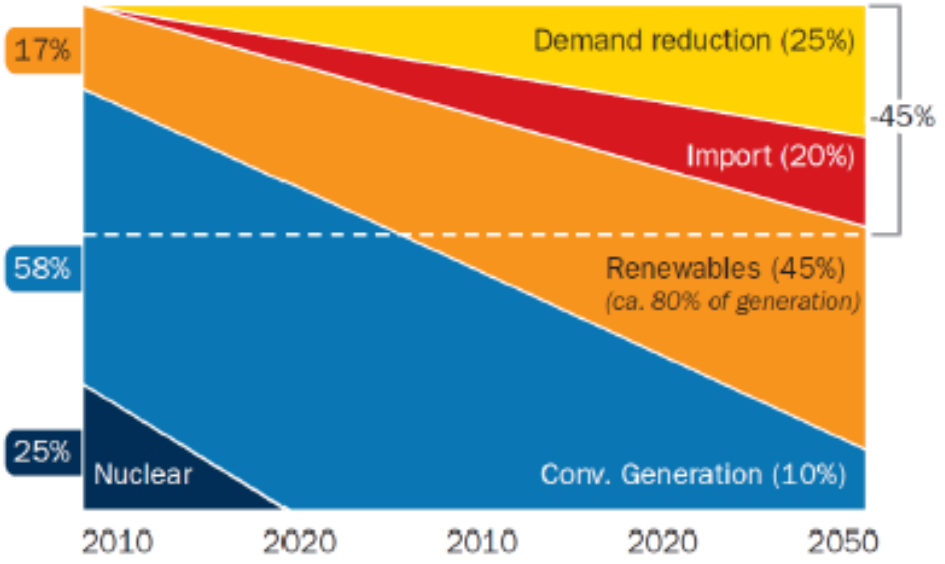
Germany's Energiewende

- **Biggest renewable transition experiment in the world**
  - Legally binding (Renewable Energy Act 2000) with cross-party support and strengthened by recent no nuclear policy
  - Nuclear provided 25% primary power in 2011 when 8 stations were closed with immediate effect, remaining 9 by 2022
  - Total power generation capacity 155GW
  - Aspiration is 35% of electricity generation from renewable sources by 2035, 80% by 2050 (2012 figure was 20%)



Energiewende plan

- Transition
  - 45% to be achieved by demand reduction and increase in imports
  - Plan a 42GW connection with Norway
  - Focus is wind and solar resources



Source: EWI/Prognos/GWS study

- Issues
  - Dumping of power on neighbours (Poland and Czech)
  - 2011 experienced 200,000 blackouts of more than 3 mins

Energy storage focus

- Current
  - Pump storage (30 sites in operation; 7.6GW, 4.9% total power generation) but few available for future

- Future
  - Government spending €200 million in period 2011-2014 on energy storage R&D
  - Focus is on power-to-gas capability (methane, hydrogen)
  - 250 kW pilot plant in Suttgart largest in world; €3.5 million
    - Methane from water and CO_2 (50% efficient)
    - CO_2 from sewage and agricultural sludge
  - Early stage in thinking about energy storage potential

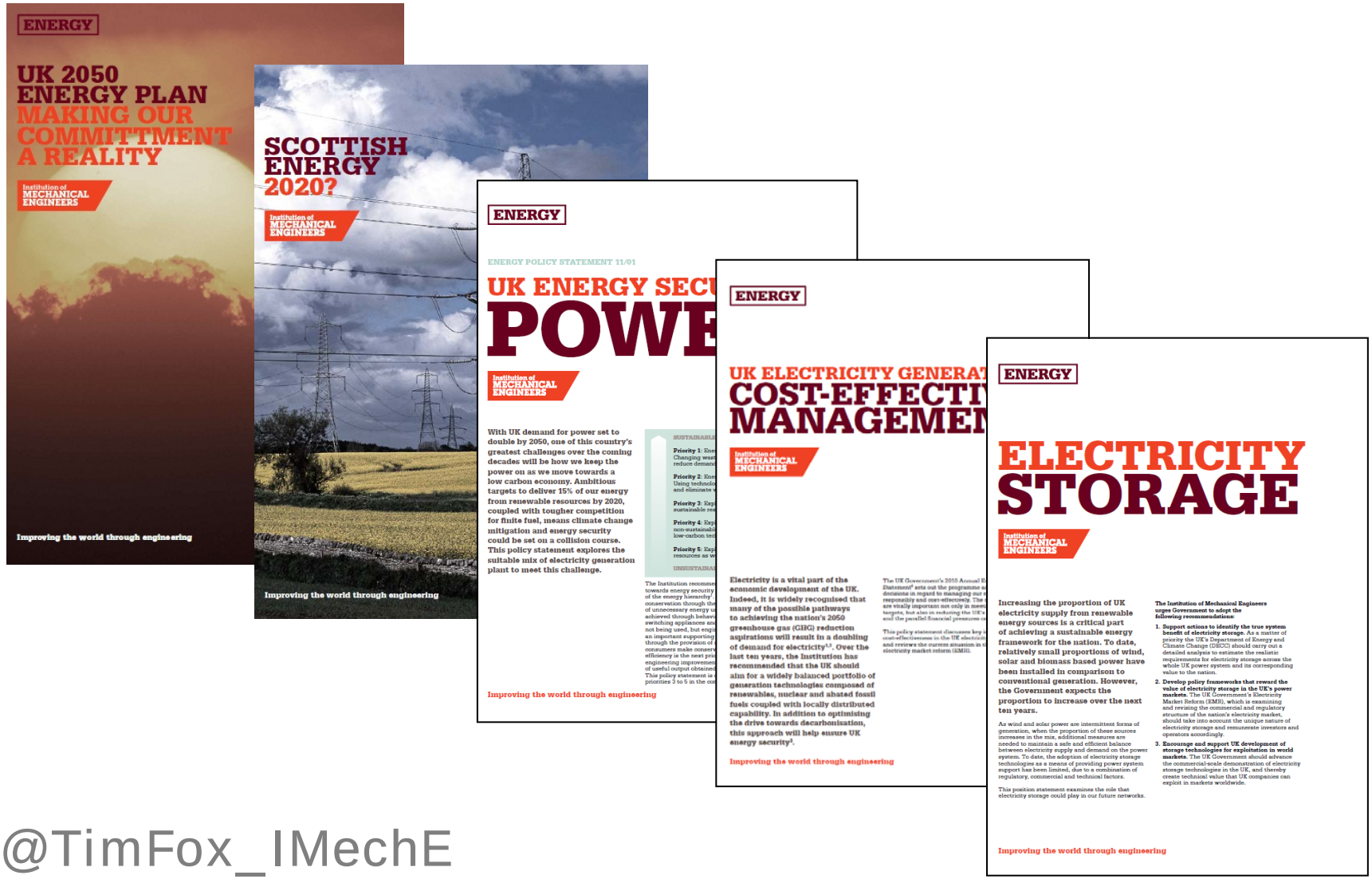
UK conclusions

- Support action to identify true system benefit of electricity storage

- Develop policy frameworks that reward value of electricity storage in UK power markets

- Encourage/support UK companies and research organisations that are developing storage technologies

Thank you



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