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# Why Britain needs Smart Grids



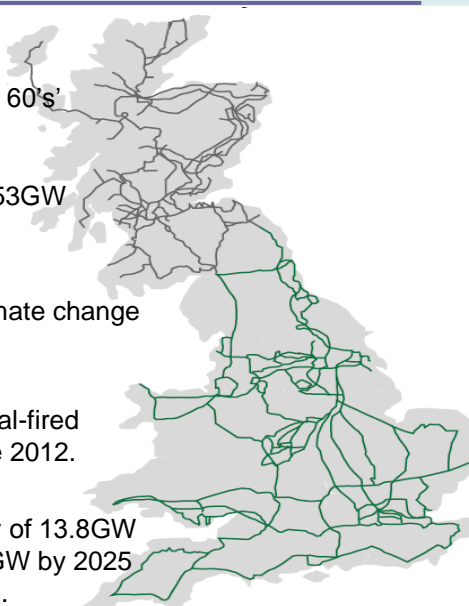
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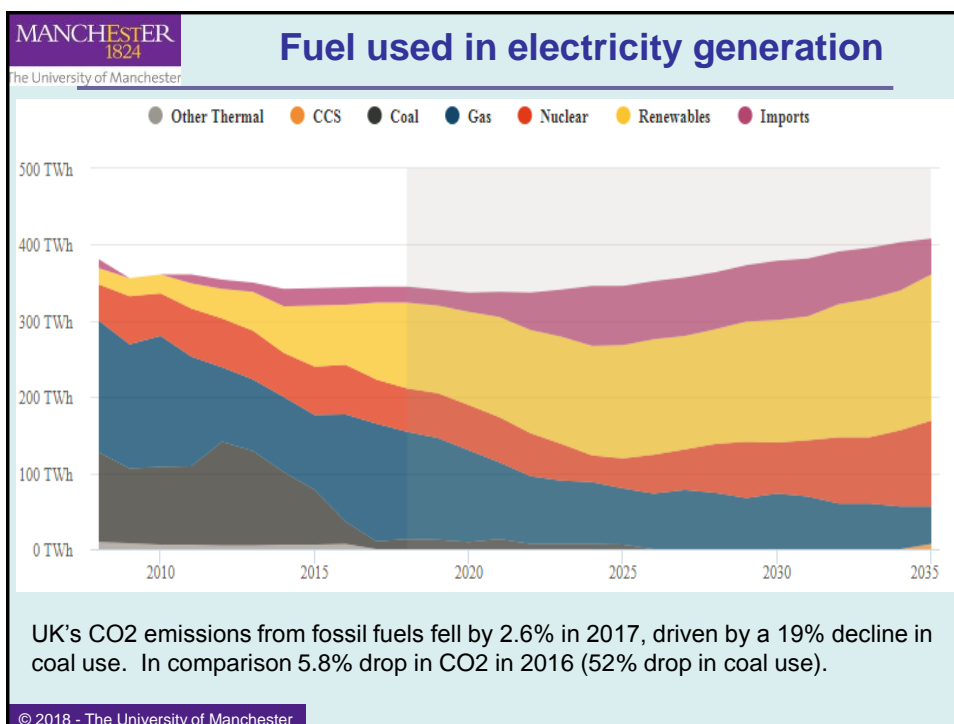
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## GB electricity transmission

- Legacy Transmission Network built around centralised coal stations in "Midlands of England" in 1950's and 60's
- Incremental growth since 1970
- Peak demand stable since 1970  $\cong$  53GW
- Generation available  $\cong$  80GW
- Generation closures due to age, climate change and renewables legislation
- March 2016: more than 16GW of coal-fired capacity will have been closed since 2012.
- Government predicts coal's capacity of 13.8GW in 2017 will have plummeted to 1.5GW by 2025 because of unfavourable economics.



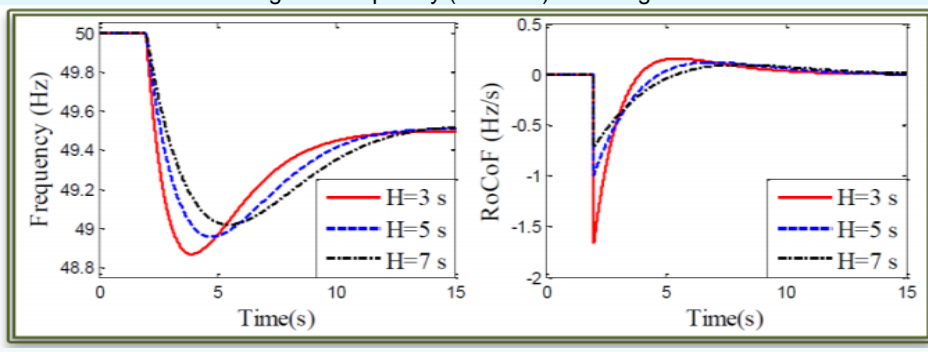


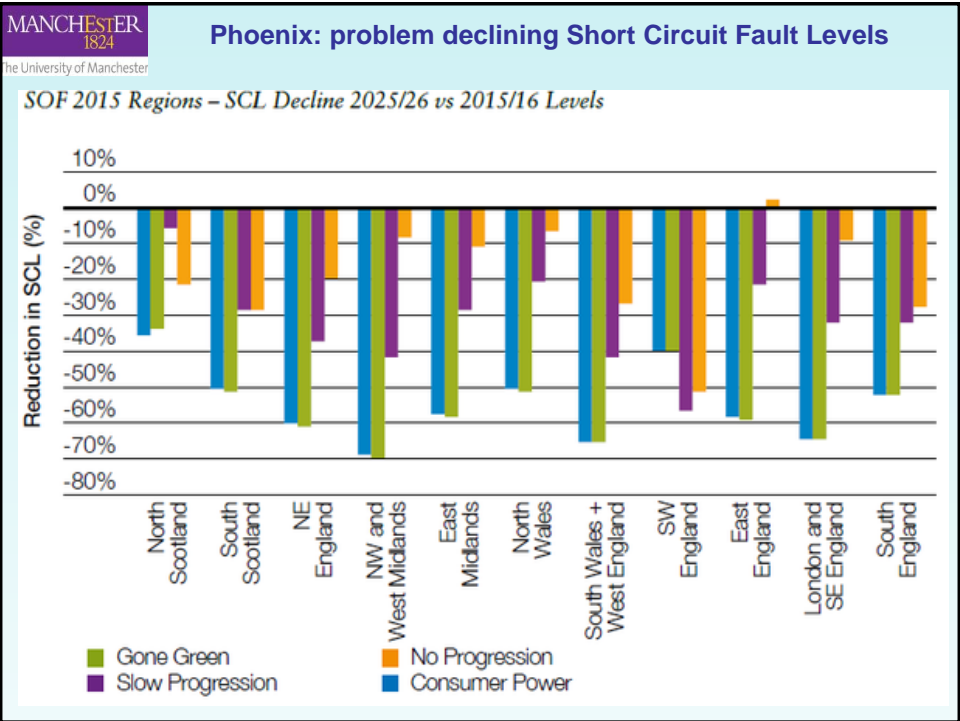
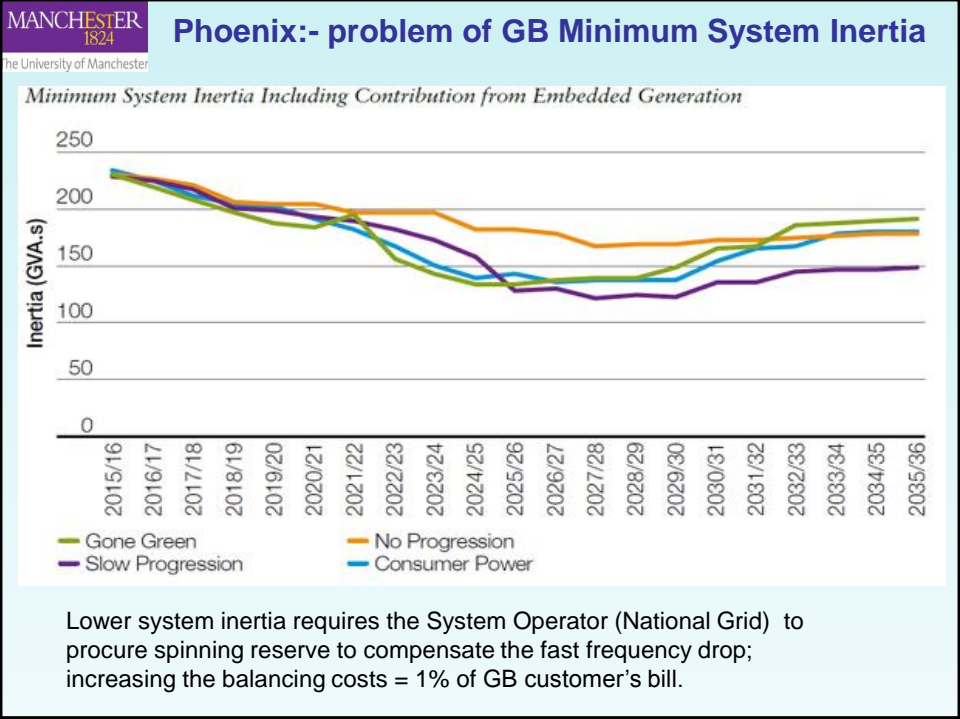
## Nov 2016, Ofgem awards funds for NIC Projects

### Phoenix:

- Trial a novel combination of compensation equipment.
- Equipment provides ancillary services (frequency regulation and voltage control) to SO, traditionally provided by large thermal generators.
- Project evaluates how these services can be offered commercially, and investigate the associated agreements that need to be put in place for this to become a business as usual option across the GB network.
- **Scottish Power Transmission awarded £15.6M.**

Rate of Change of Frequency (ROCOF) following a disturbance





## Nov 2016, Ofgem awards funds for NIC Projects

### Transmission and Distribution Interface:

- Demonstrates how services offered by transmission-connected generation to the SO can be provided by distribution-connected energy resources.
- Distribution company acts as gatekeeper in providing some services to SO.
- Project also examines how these new services would interact with the existing commercial arrangements.
- Investigates technical feasibility of proposed approach as well as introduce market-based mechanisms for coordinated network management.
- **National Grid Electricity Transmission (NGET) awarded £8.0M**



## Nov 2016, Ofgem awards funds for NIC Projects

### OpenLV:

- Software platform which enables enhanced real time assessment and visibility of low voltage network capacity.
- Improved visibility allows the distribution network companies to more actively manage LV network
- Necessary as more generation and demand is connected locally.
- Ensures available capacity is used more effectively, minimising the costs of reinforcement.
- **Western Power Distribution awarded £4.9m**

### PowerFuL-CB:

- Develop and test two new types of circuit breaker to ease constraints caused by network faults, making more capacity available.
- Aim is to demonstrate the increased capacity can aid the connection of distributed generation and district heating in urban areas.
- **UK Power Networks (UKPN) awarded £4.6m**

## Nov 2017, Ofgem awards funds for NIC Projects

### Active Response:

- Aims to address network constraints that may slow the uptake of low carbon technologies.
- Develop and demonstrate advanced automation and power electronic devices at low and high voltage levels, enabling increased network meshing.
- Includes network technologies “soft open point” and “soft power bridges”.
- If successful will release network capacity quickly at minimum cost and avoid traditional reinforcement.
- **UK Power Networks awarded £13.8M.**

### LV Engine:

- Trials solid state transformers at secondary substations
- Enhance network flexibility and release capacity within existing LV infrastructure.
- Facilitate increasing uptake of Low Carbon Technologies.
- Potential to provide DC connections to network customers.
- **Scottish Power Energy Networks awarded £7.3M**

## Nov 2017, Ofgem awards “conditional” funds for NIC Projects

### Electricity Flexibility and Forecasting System (EFFS):

- Build and test new network software to improve network load forecasting.
- Identify opportunities for the buying and selling of flexibility services (flexibility refers to ability to modify generation and consumption patterns in reaction to an external signal)
- Provide learning regarding the creation of software for forecasting the need for, and sources of, flexibility on distribution networks.
- **Western Power Distribution conditional award of £2.9M.**

### Fusion:

- Trial local flexibility market using an existing structured and competitive market-based framework developed in Europe.
- Universal Smart energy Framework has the potential to support the DNO and all market actors unlock the value of local network flexibility.
- Demonstrate how a network constraint in East Fife can be managed.
- Provide relevant and timely learning regarding application of an existing market framework, mapped to the GB Network.
- **Scottish Power Distribution conditional award of £5.3M**

## Nov 2017, Ofgem awards “conditional” funds for NIC Projects

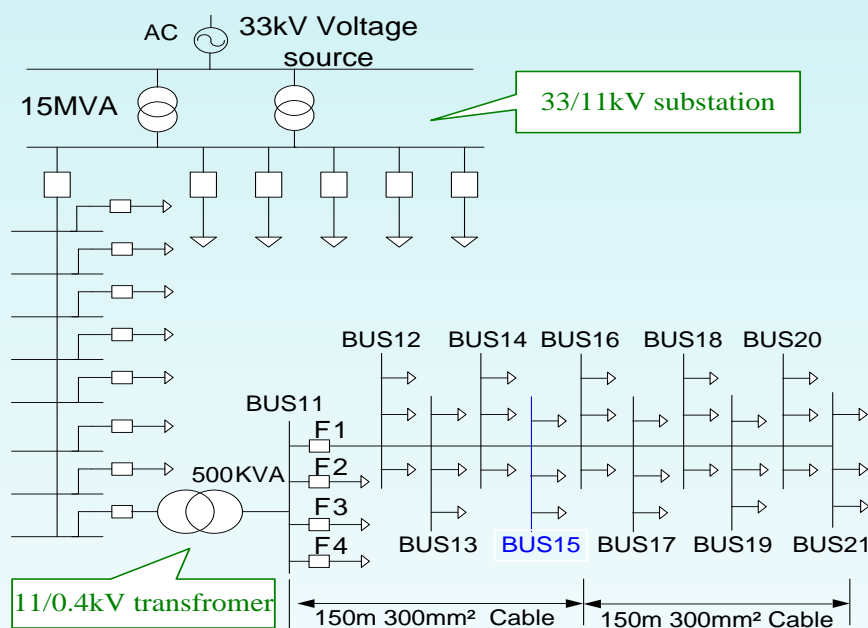
### Transition:

- Design and demonstrate tools needed for accessing flexibility considered by the Open Networks Project.
- **Scottish and Southern Energy Networks conditional awards of £13.1M**

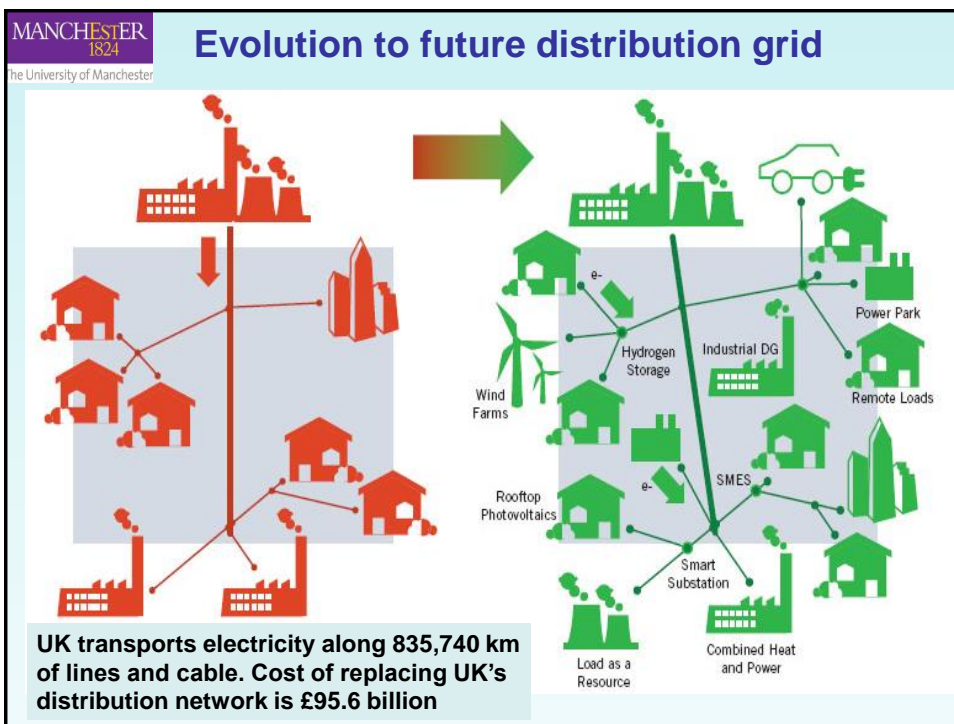
Objectives of the Open Networks Project for the first phase of work in 2017 are to:

- Develop improved transmission and distribution processes around connections, planning, shared TSO/DSO services and operation
- Assess the gaps between the experience customers currently receive and what they would like.
- Develop a more detailed view of the required transition from *DNO* to *DSO* including the impacts on existing organisation capability
- Consider the financial *charging* requirements of future transmission and distribution systems

## Typical UK urban distribution network







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## $E = mc^2$

**Manchester Metropolitan University**

GB Electrical Networks need to change, due to:

- Population growth = increased electricity demand
- Time of day pricing based on demand & availability of low carbon energy
- Electrification of heat, including cooling
- Transition from gasoline to Electric vehicles
- Storage of electrical energy (domestic, local community, town, region)
- Inclusion of low carbon technologies in buildings
- Rollout of ICT, the Ethernet of Things and Smart Phones

**low carbon Energy needs measurements, control & Communications**

The diagram shows a network of energy sources and consumers connected by a central grid. The components include: Wind Turbines, Industrial Plants, Offices, Smart Homes, Fuel Cells, Micro-turbines, Storage, Virtual Power Plant, and Central Power Plant. The network is represented by a blue grid with various nodes and connections, indicating a highly interconnected and flexible system.

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