The Nature of a Flexible Network: Scenarios for Future Power Networks

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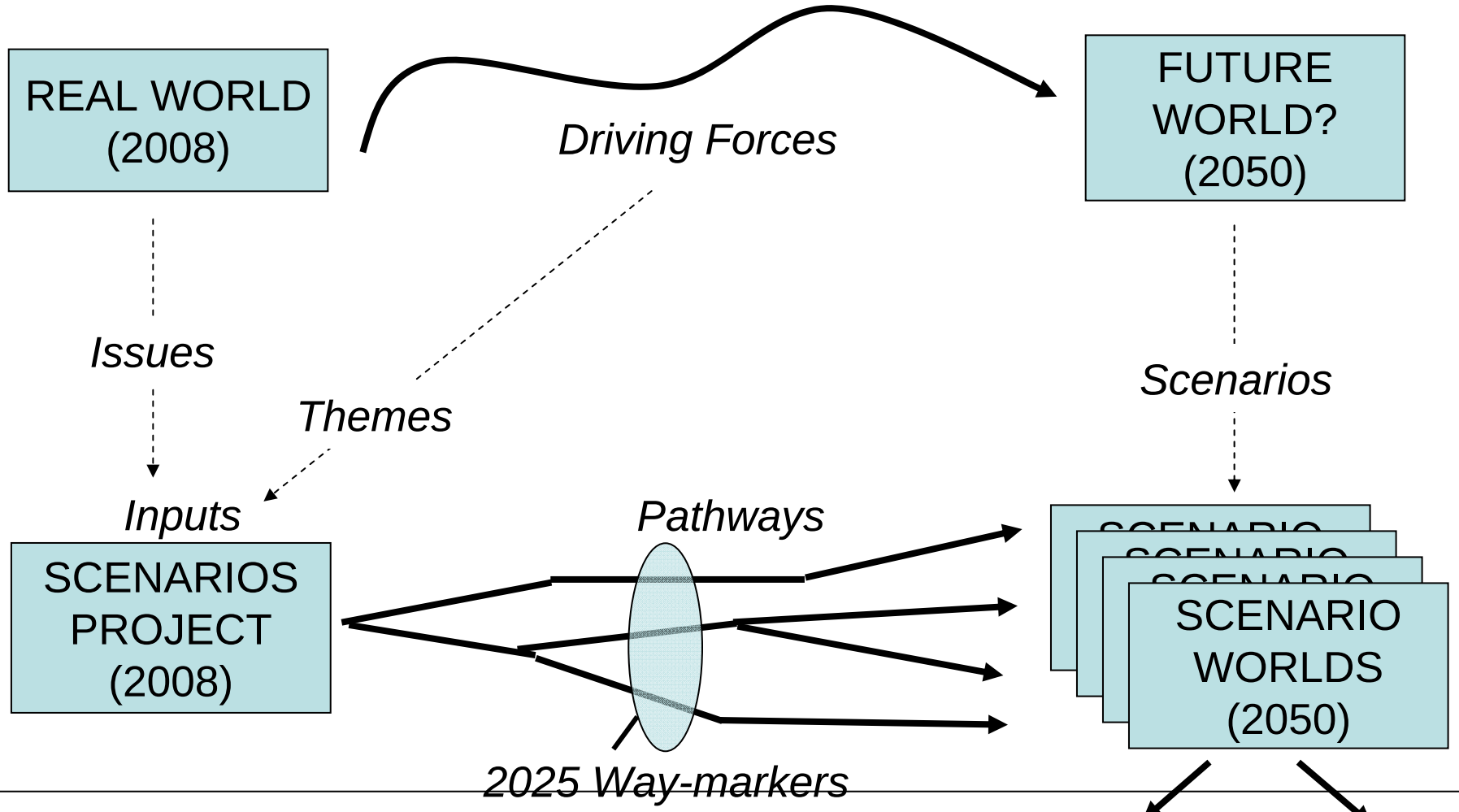
Scenarios concepts and terminology



LENS Project Methodology

- Project in final stages following a structured scenario development methodology:

1. Define the recipient
2. Frame the focal question
3. Information gathering
4. Identify themes
5. Sketch possible pathways
6. Write scenario storylines
7. Model scenarios
8. Identify potential implications of scenarios on the focal question

http://www.ofgem.gov.uk/networks/trans/electranspolicy/lens/Pages/lens.aspx

LENS Themes

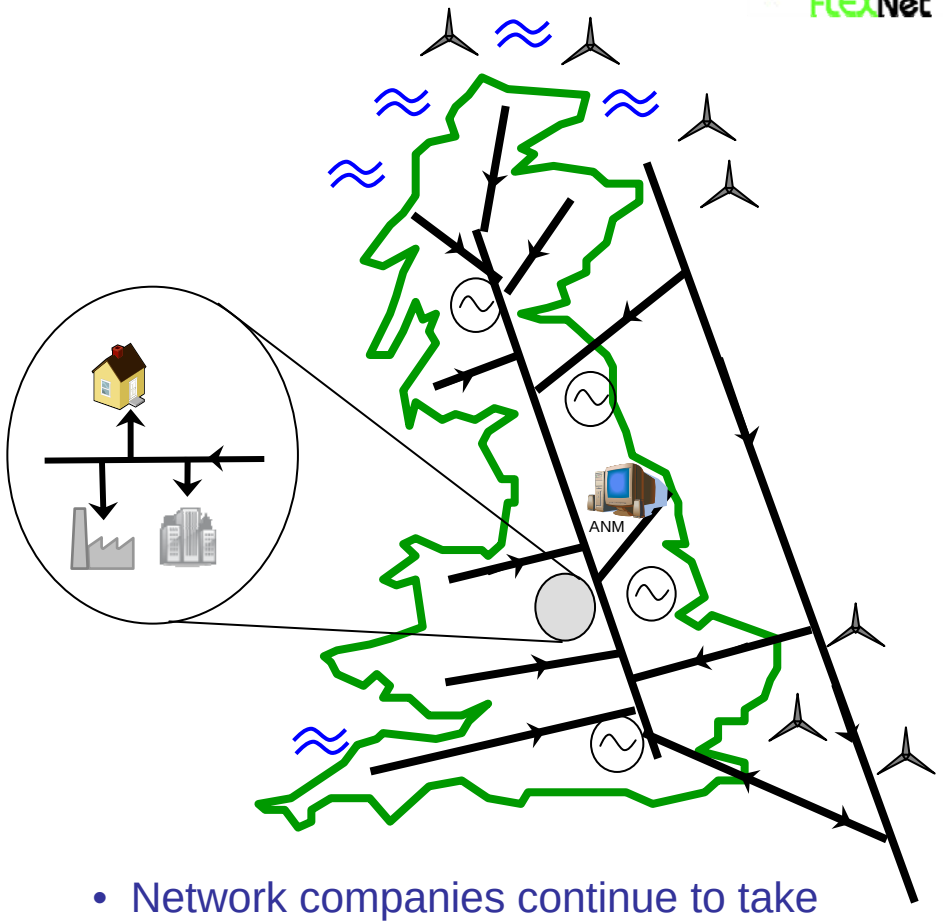
- **Environmental Concern** (Moderate or Acute) is the level to which the environmental situation affects the decision making of individuals, communities, private companies, public institutions and the Government (on a UK and global basis)
- **Consumer Participation** (Passive or Active) is the level to which all types of consumers (commercial, industrial, domestic and public) are willing to participate in the energy market as a whole and specifically the electricity market and electricity networks
- **Institutional Governance** (Market Led or Government Led) is the extent to which institutions will intervene through a variety of mechanisms in order to address specific societal concerns or further overarching policy goals relating to energy use and the environmental and economic implications

LENS Scenarios

- Big Transmission and Distribution ('Big T&D')
- Energy Service Companies ('ESCOs')
- Distribution System Operators ('DSOs')
- Microgrids
- Multi Purpose Networks

Big Transmission and Distribution

- ***Demand growth unhindered*** and ***relatively unmanaged*** in an operational sense.
- Geographical ***reach of transmission network is expanded*** to connect offshore and rural on-shore renewables sites and provide greater ***interconnection with European mainland power systems***.
- T&D infrastructure development and management expands to meet requirements of growing energy demand and renewables development
- ***Network capability enhancing technologies deployed*** to meet growing demands for network services arising from demand growth.

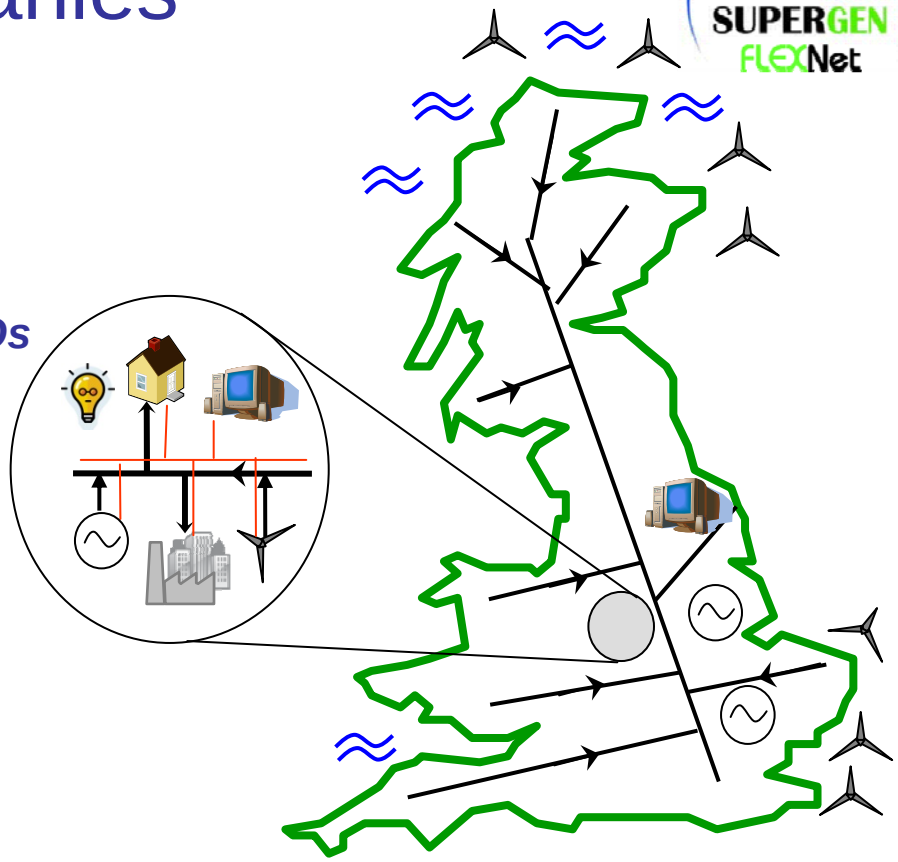


- Network companies continue to take responsibility for providing security and quality of supply.

Making networks fit for renewables …

Energy Service Companies

- ***T&D infrastructure*** required to ***support*** super-supplier or ***ESCO centred world***.
- ESCOs do all the work at the customer side and the ***T&D network operators and ESCOs contract*** with each other for the supply of ***network services***.
- Wide ranging developments and ***vibrant markets*** in energy services, micro-generation, on-site heat and power, demand side management, telecommunications and electric vehicles.
- Services supplied by the networks include transmission system connection to strategic, large scale renewables and access to municipal scale CHP and renewables tailored to local demands.



- ***System management*** is aided by the degrees of flexibility provided by '***empowered' customers with high capability ICT***.

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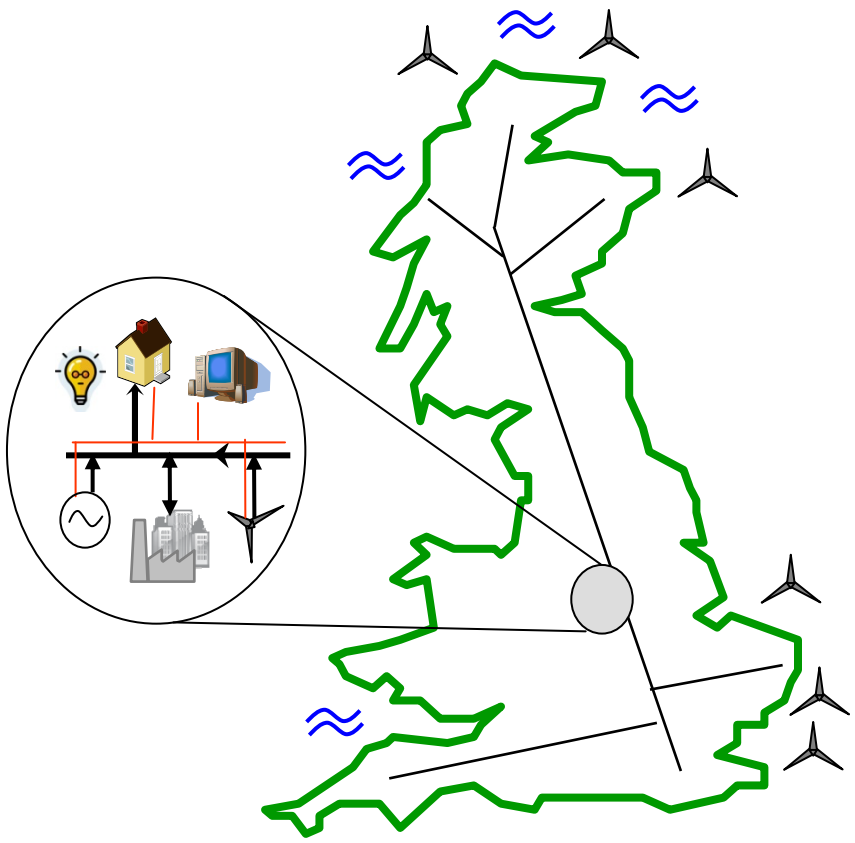
Distribution System Operators

- ***Most electricity production*** facilities ***connected to distribution networks*** thus reducing the role for the transmission network.
- ***Distribution System Operators*** (DSOs) take much greater ***responsibility for system management*** including generation and demand management, supply security, supply quality and system reliability.
- ***DSM provides greater options for DSOs*** in system operations but also leads to a generally reduced demand.
- ***DSOs balance generation and demand*** in local areas with the aid of system management technologies such as energy storage and DSM.
- Transmission system acts to provide connections between DSOs and to strategic renewables deployments.



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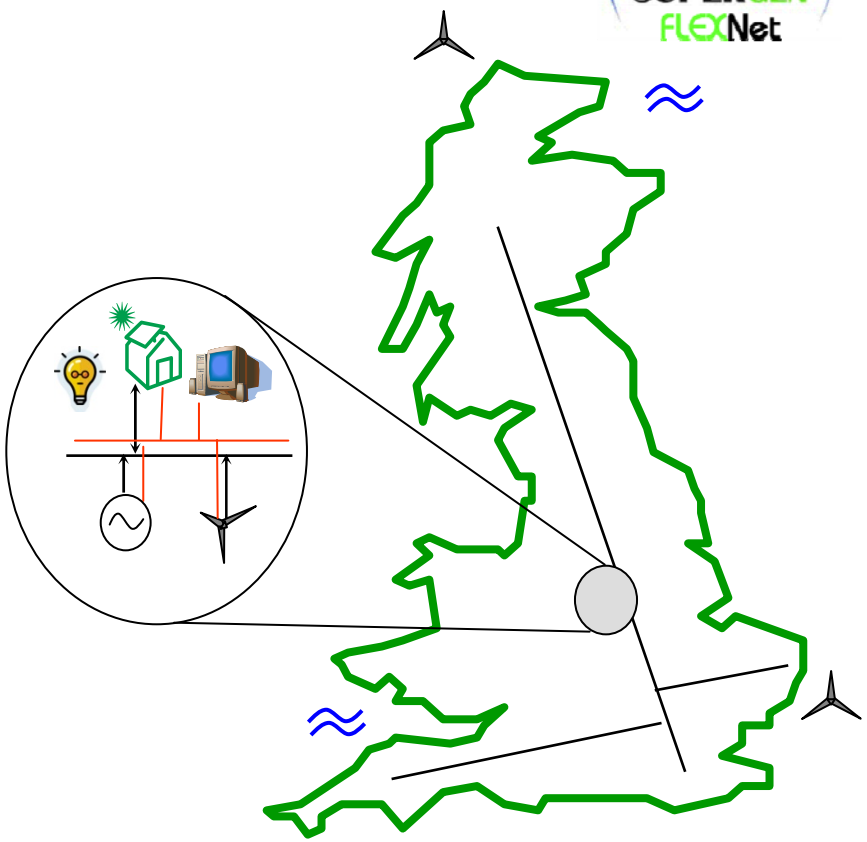
Microgrids

- ***Self-sufficiency concept develops*** very strongly in power and energy supplies - electricity consumers take very much more responsibility for managing their own energy supplies and demands.
- ***Greatly reduced role for bulk power transfer***
- Individually and collectively ***customers actively manage their own energy consumption*** against their own or locally available supplies and ***minimise exports to and imports*** from the local grid.
- ***Microgrid System Operators*** (MSO) emerge to provide the ***system management*** capability to enable customers to achieve this with the aid of ICT and other network technologies such as energy storage.



- Customers take a lead role in their own energy provision and the security, quality and reliability of the supply with the support of the MSO.

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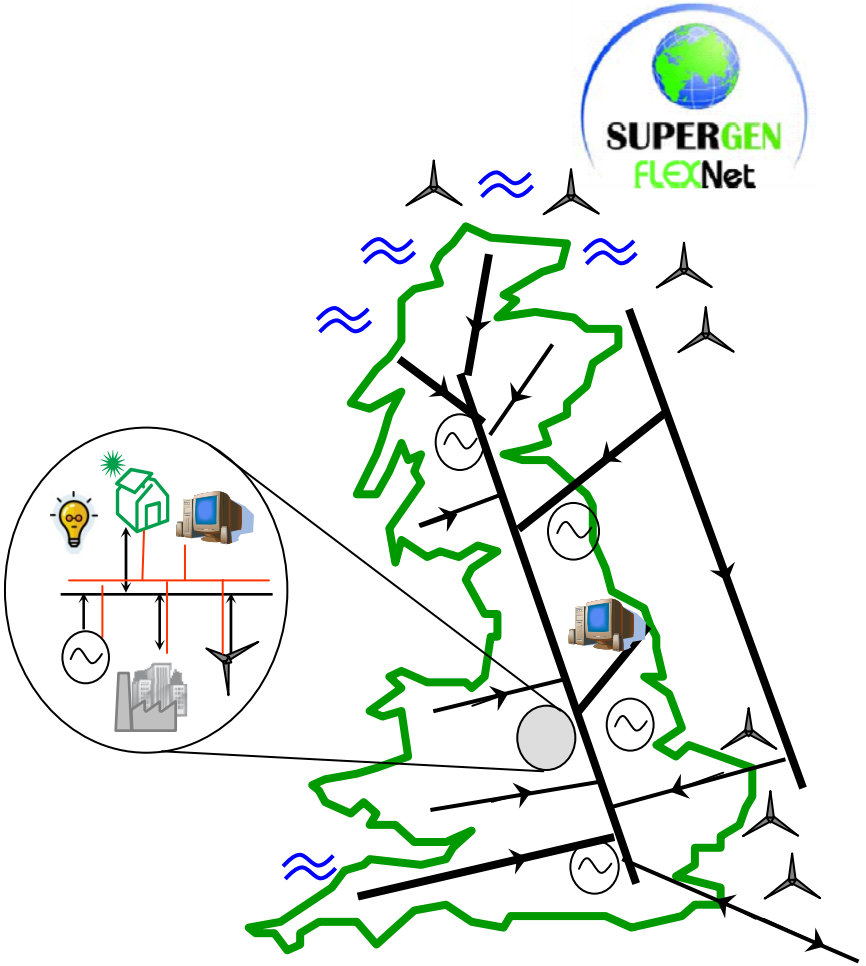
Multi Purpose Networks

- Attempts have been made to exploit many energy technologies over time and there exists a ***large diversity in electricity production and demand side management initiatives*** implemented.
- Network is characterised by ***diversity in development and management approaches*** as a result of changing energy policies and company strategies.
- ***Substantial differences*** exist in ***network capabilities*** between areas.
- ***Electricity networks fulfil different roles*** including bulk transfer, interconnection, backup and security and meeting renewable and demand side objectives.
- Challenges in ***managing diverse system architectures*** are accompanied by opportunities from the ***diversity of generation, network and demand side provision***.



- The ***stranding*** of certain ***power system assets*** becomes more apparent over time due to the lack of consistency in energy policy and the subsequent diverse network infrastructures that emerge

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Implications for Networks

- Development of ***primary power carrying infrastructure*** is different across scenarios but development of ***communications and control infrastructure*** is (relatively) common across the scenarios
- Level and nature of ***consumer participation*** varies across the scenarios from passive to active and from self-motivated or self-initiated to 3rd party provided
- Organisational implications will differ across scenarios with ***new players*** (e.g. ESCOs, microgrid operators) and ***new roles*** (e.g. for DSOs) emerging over time
- This in turn requires clarity of ***responsibilities*** for security, quality and economy of supplies

Implications for Networks

- ***Technical and operational challenges*** in areas such as microgrid-type operation, DSO functions, TSO system balancing could create problems for a ***contracting skills base***
- ***Regulatory arrangements*** to supervise more complex markets, incentivise worthwhile services and reward performance are not trivial (e.g. DSO reward mechanism)
- ***Active management*** of distribution networks (HV, MV and LV) and consumer demand becomes more prevalent in several scenarios

Implications for Networks

- ***Interconnectors*** take on various roles in different scenarios:
  - bulk import
  - two way economic exchanges
  - large-scale and small scale pan-European balancing (due to intermittent renewables and/or micro-generation)
- ***Offshore grids*** develop strongly in several scenarios to exploit indigenous marine and offshore wind resource
- ***Network capacity*** requirements are relatively similar across scenarios but levels of ***network utilisation*** differ widely depending on generation portfolio and customer activity