WESTERN POWER DISTRIBUTION

INNOVATION

NEXT GENERATION NETWORKS

Enabling Future Smart Grid Capability

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Transport Museum London

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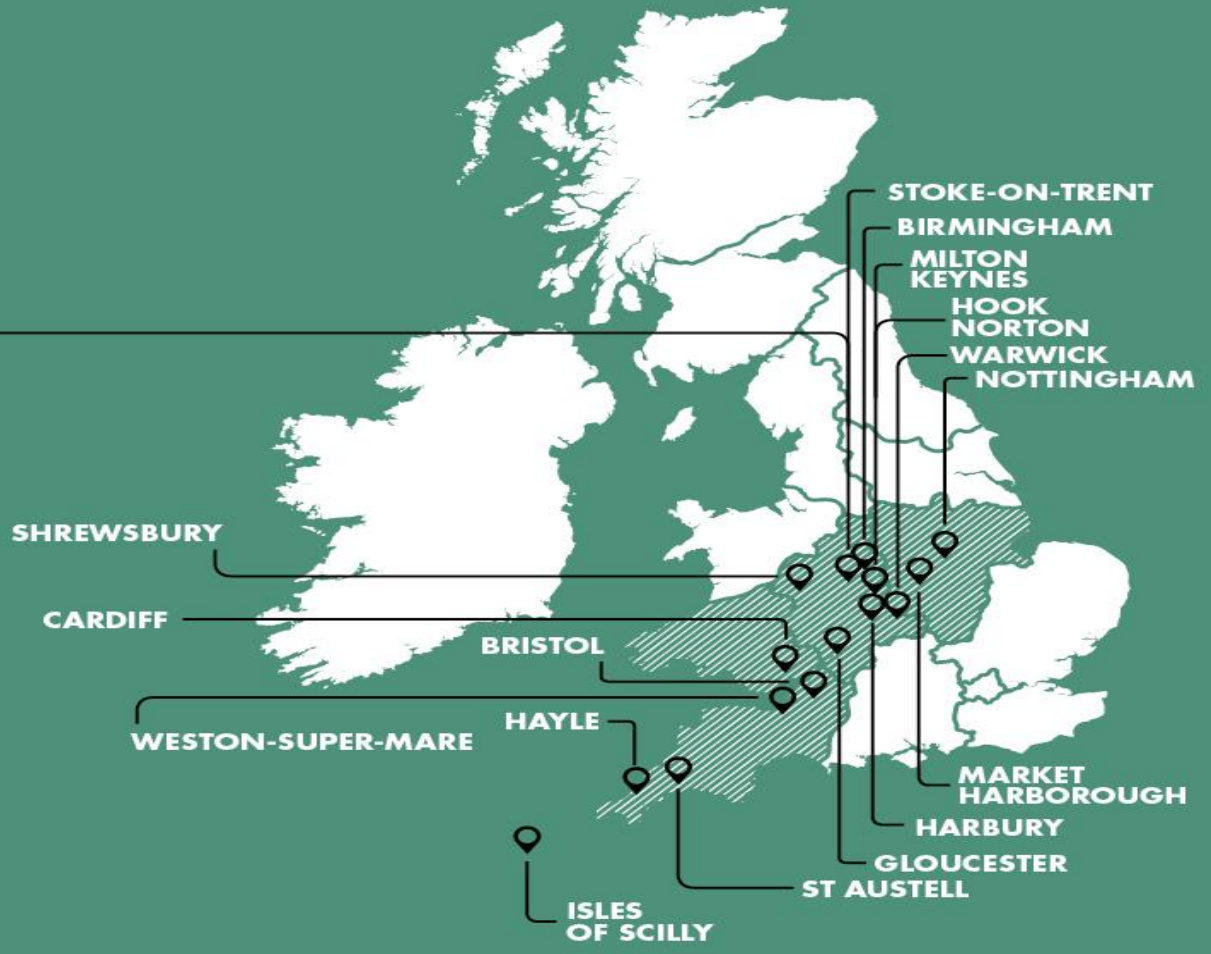
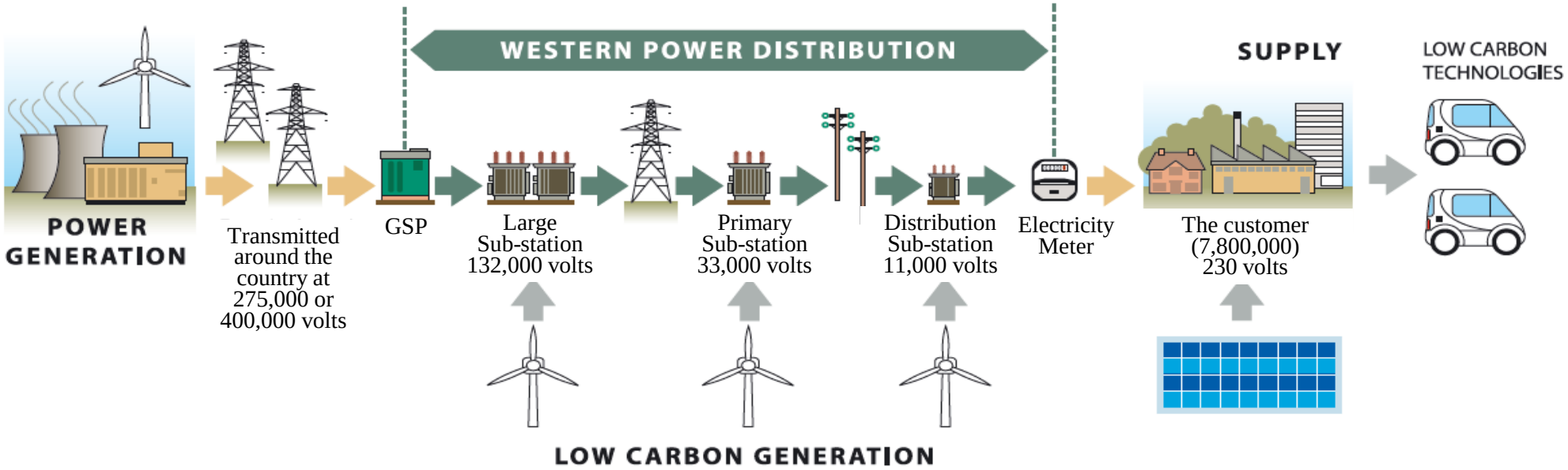


Western Power Distribution

- Network - East Midlands, West Midlands, South Wales, and South West
- 7.8 Million customers over a 55,500 sq kms service area
- LV to 132kV Network ownership
- WPD network consists of 216,000 kms of overhead lines and underground cables, and 184,000 substations

What is a DNO?

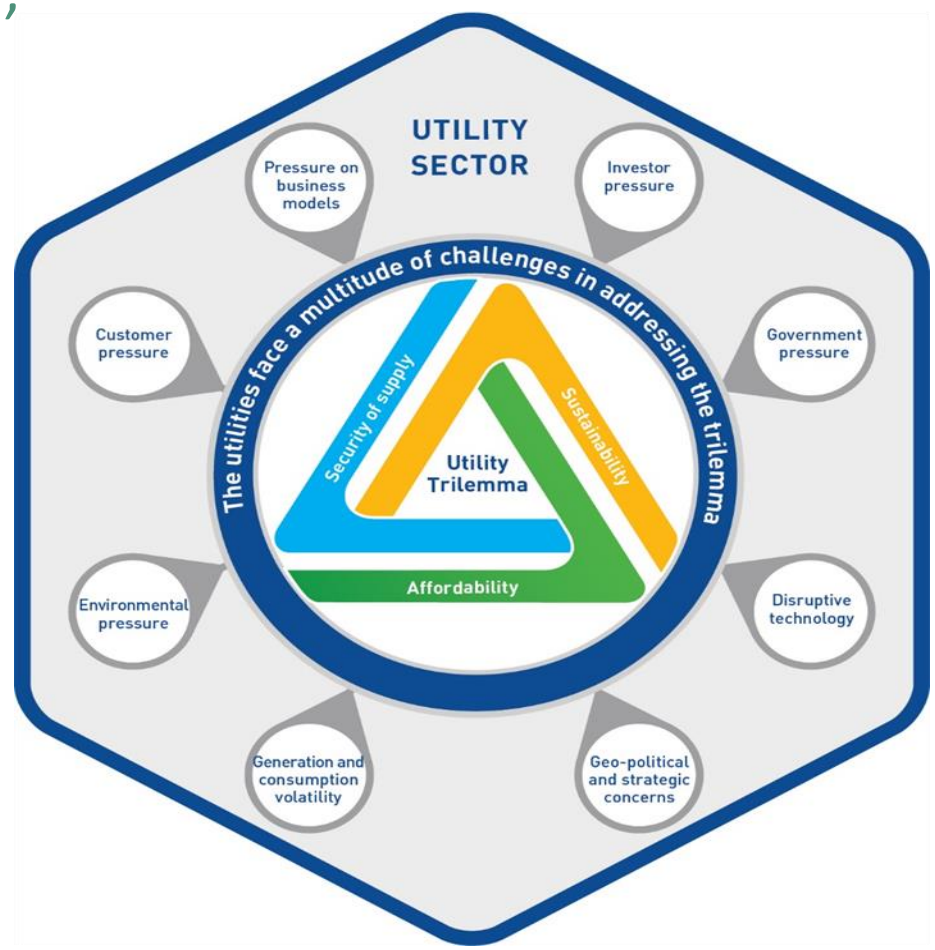


A DNO:

- Keeps the lights on
- Maintains/repairs equipment
- Upgrades the network, and
- Connects customers

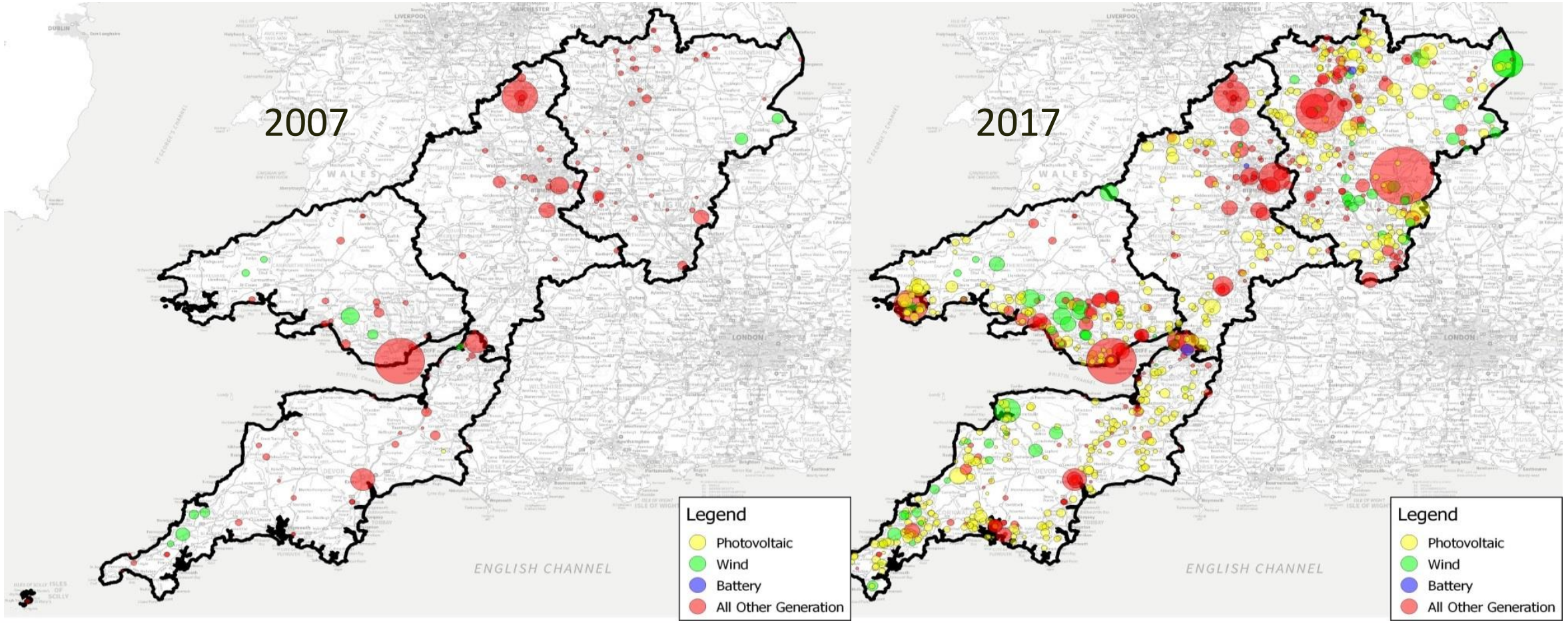
The energy landscape is changing

- Understood in terms of the so-called energy ‘trilemma’
- The main factor driving change is the need to decarbonise the energy system
- Given rise to a growing number of new and highly disruptive technologies within the energy sector
- For WPD and other DNOs, the most significant effect has been:
  - The growth of distributed and renewable energy generation
  - Changes in consumers’ engagement with energy in terms of technologies
  - Consumer behaviours beyond the meter.



Penetration of Embedded Generation

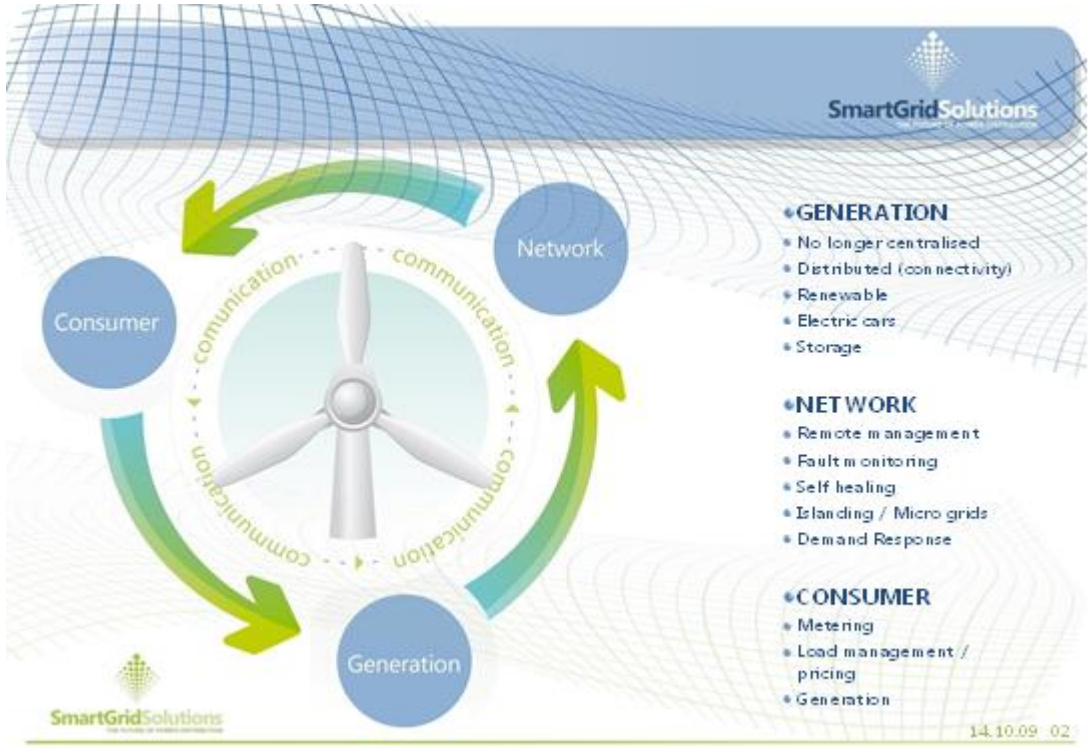
Distributed generation on WPD's network: 2007 & 2017, Source: WPD DSOF 2017



The Smart Grid Cycle

Generation

- The original public electricity supply systems were based upon a very simple model
  - Large-scale power generating stations
  - Until power reached the consumer
- These systems had little or no remote monitoring or management
- Any loss of supply was usually first identified by customer complaints
- Transformation must be made across all three main areas (generation, network and consumer)



The Smart Grid Cycle

Network

- The most fundamental change within our Smart Grid ecosystem will undoubtedly be within the distribution networks
- Nothing from a technical, operational or economic standpoint will be as it was before
- Distributed generation, EVs, etc., require DNOs to implement levels of power distribution monitoring and control
- Smart Grids will need to deploy and maintain complex telecoms and information systems
- The two very different domains of power and telecoms will therefore become completely integrated
- With every substation, every power line and every consumer point being monitored and potentially controlled remotely, and many in real time.

DSO Transition – WPD's Objectives

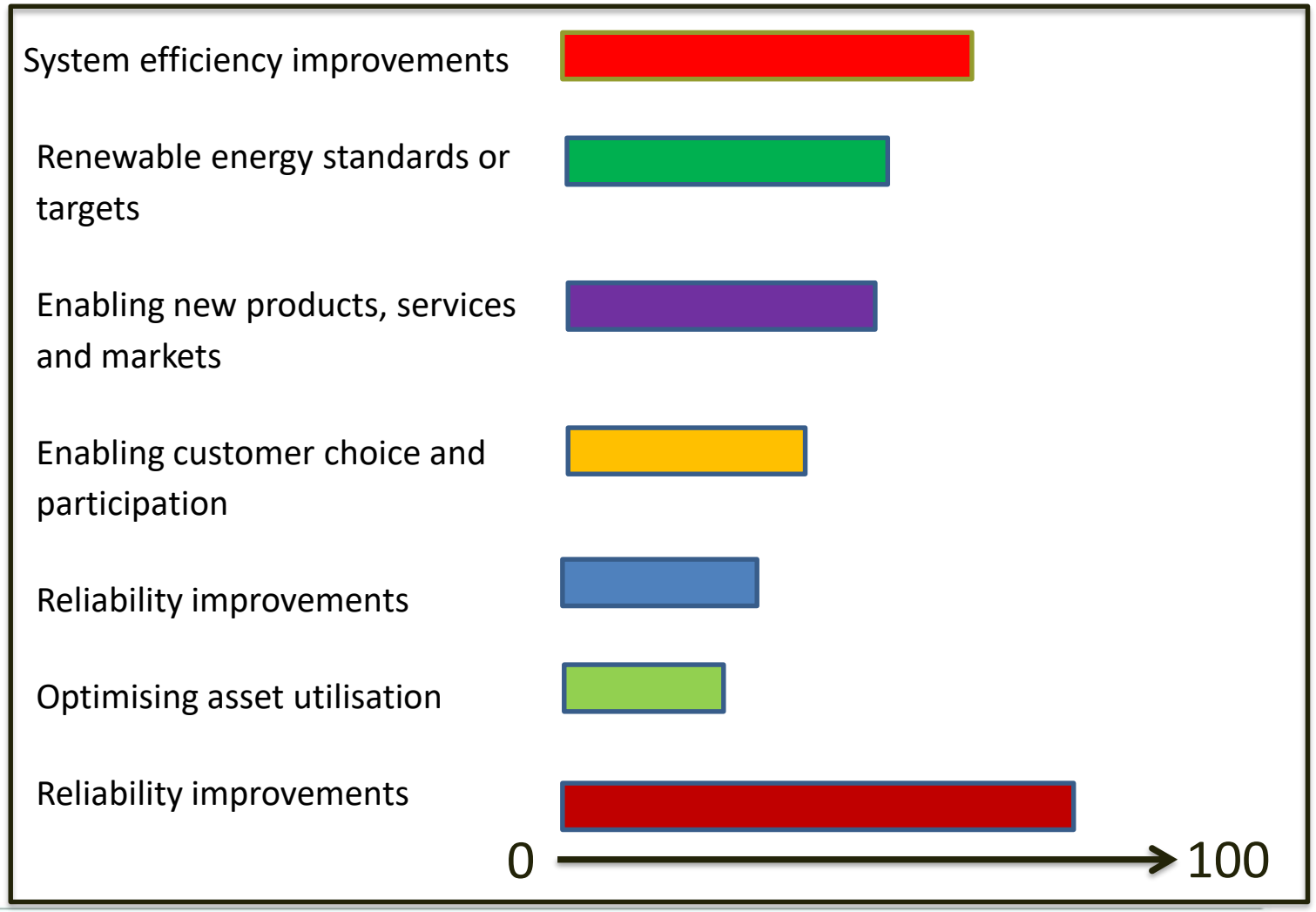
As WPD moves from being a Distribution Network Operator to a Distribution System Operator, it will carry out its existing functions and take on some new ones so as to:

- Develop and maintain an efficient, co-ordinated and economical system of electricity distribution
- To facilitate competition in electricity supply, electricity generation and flexibility services - flexibility from demand and generation to manage network flows
- Improve the resilience and security of the electricity system at a local level
- Facilitate neutral markets for more efficient whole system outcomes
- Drive competition and efficiency across all aspects of the system; and
- Promote innovation, flexibility and non-network solutions.

Enabling Future Smart Grid Capability

Drivers

- System efficiency improvements
- Enabling new products, services and opportunities
- Reliability improvements
- Optimising asset utilisation
- Economic advantages
- Renewable energy penetration
- Enabling customer choice and participation
- Generation adequacy



Evolution of a DNO comms network

- How can DNOs deploy and optimise available communications solutions
- Maintain an effective, efficient and sustainable power distribution system.
- Must be achieved against the backdrop of significant regulatory and operational change
- The electricity distribution systems are required to support increasing levels of network intelligence
- Advances in telecoms software and hardware have made the possibility of a fully intelligent power/energy delivery value chain realisable both operationally and economically
- Merging of a power delivery system and a ubiquitous telecoms network.

NEXUS Project

- Desk research on most relevant sources and authorities to determine smart grid categorisation
- Based on publications by various authorities seek to extract existing categories and structures
- Review and consider the positives and negatives of each of these categorisations
- Alignment and Interoperability with International DNO and DSO standards:
  - Learning from activities and alignment coming from DSOs and related organisations
- Relevance and Applicability to WPD:
  - Short term alignment with organisation – Communications Template
  - Longer term strategic view

Considering a telecoms network

Immediate strategic decision is between :

- Build or buy
  - Build
    - In a low volume, non-critical scenario, buying in capacity may be more economical
  - Buy
    - Traffic is highly critical to network services
      - Network Protection
      - Network Security
      - Network reliability
    - In order to guarantee core service responsibilities

Development of a smart grid

- Evolutionary process
  - Will happen over time
  - Not in a single step
- There is clearly no single communications technology which can economically provide the full range of network services necessary to support the diverse range of solutions and applications that make up the complex ecosystem of a smart grid.
  - Wired technologies (Fibre-optic communications, Power line communications, DSL over Copper lines ,etc.
  - Wireless technologies (Microwave communications, Mobile technologies (2G, 3G, 4G, and even 5G, etc.)

New project

Next Generation Wireless Telecoms Analysis:

- NIA funded project
- £260,000
- Project between WPD and JRC
- Managed by Future Networks team and Surf Telecoms

Our own role in new wireless technologies - Surf

- Installed, managed and maintained all of WPD's telecoms infrastructure and assets
- Experience in UHF communications and is integrally responsible for the design, development and operation of its infrastructure.
- Developmental progression has led to the trial of eLTe technology as a potential pathway for future communications for the smarter grid.
- Specified the brief and specifications for the current eLTE trial in Portishead, as well as the design and selection of the candidate trial location.
- Directly involved in the installation, commissioning, configuration and testing and have built on the knowledge and understanding of radio communications to incorporate this newer technology.
- Manage the increasingly diverse and dynamic WPD electricity network

Project Aims & Objectives

Building on the current WPD eLTE trial in Portishead:

- Identify the amount and characteristics of radio spectrum needed
- Define the scale of equipment and infrastructure deployment necessary
- Determine the performance characteristics
- Characterise the functionality available to enable ‘Smart Grid’ operations
- Inform the investment requirements for future communications capability
- Facilitate awareness raising with Government & Ofcom
- Inform the business case for system roll-out that will be a key enabler of the DNO to DSO transition:
  - Re-enforcement of the networks has traditionally been the response but at significant cost and disruption

What this project will do

- The project will build on an existing WPD telecommunications trial by expanding from a single site trial (Portishead) into a full network design
- It will provide a practical insight into the radio spectrum needs of UK Energy Utilities to support the digitalisation of their core energy networks
- Estimating the key parameters and the resolution of their values to calculate the data volume from each point to be monitored
- These data flows will be turned into a geographic data traffic profile in order to establish radio network capacity
- Establish Power Density at substations and distribution poles for data communications and taking into account electrical systems operational requirements.

Expected outcomes

Development of a detailed, robust and resilient radio network

- Enable greater visibility and control of network assets in a more granular, rich data and real-time context
- Facilitate more control at the edge of the energy network to support greater flexibility:
  - Real and reactive power flows at strategic locations in the network;
  - The direction of power flows for both real and reactive power;
  - Voltage magnitude and phase angle;
  - Protection operations;
  - Asset condition monitoring
- Make the networks more intelligent and responsive
- Replacement of legacy systems in the process

WESTERN POWER DISTRIBUTION

Serving the Midlands, South West and Wales

THANKS FOR LISTENING

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