WESTERN POWER DISTRIBUTION

Serving the Midlands, South West and Wales

Strategic Investment Options for Growth of Demand and Distributed Generation in the East Midlands

7th December 2016

Agenda

12.30 **Arrival, registration and buffet lunch**

13.30 **Welcome and introductions**

Nigel Turvey, Network Strategy & Innovation Manager, Western Power Distribution

14.00 **Scenarios for the growth of distributed generation**

Hazel Williams, Head Analyst, Regen

Joel Venn, Senior Analyst, Regen

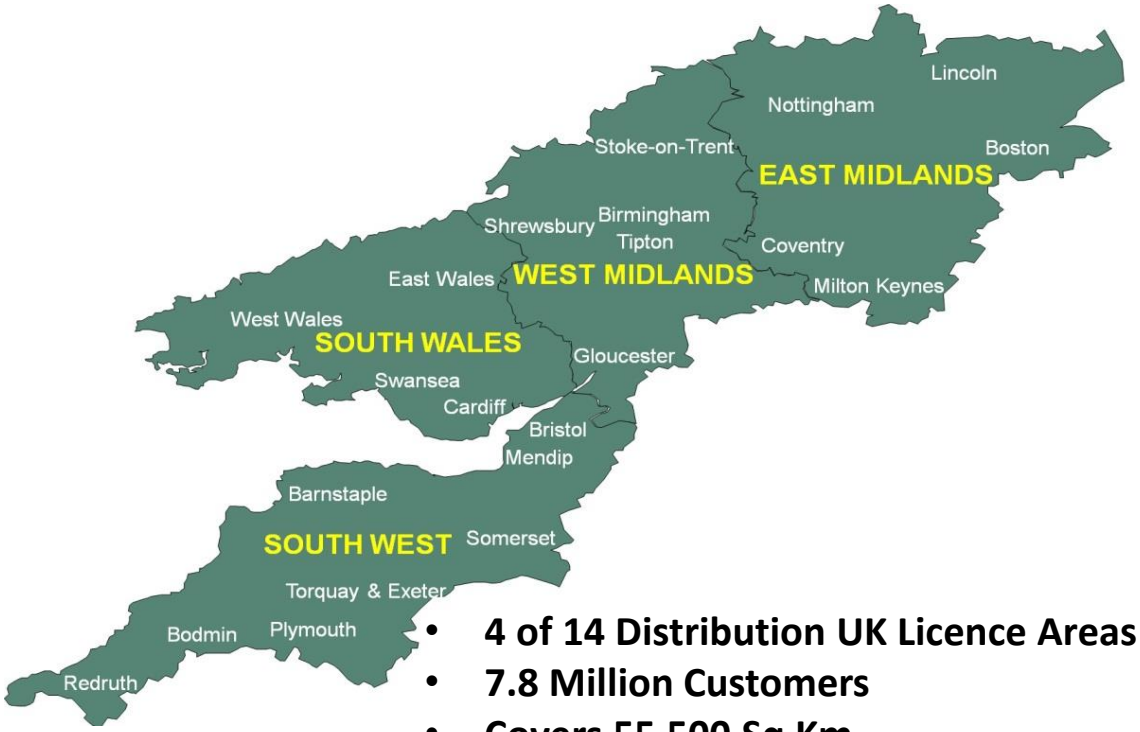
14.45 Project panel Q&A

15.15 **Refreshment break**

15.30 Roundtable discussion and feedback

16.30 **Next steps, chairs remarks and close**

WPD – Our Area



- 4 of 14 Distribution UK Licence Areas
- 7.8 Million Customers
- Covers 55,500 Sq Km
- 220,000km of Network
- 185,000 Substations

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Drivers of the need for this project

- Significant and rapid growth in distributed generation leading to long delays and high costs for further connections
- Uncertainty in future path of both the growth in DG and demand usage
- Potential growth of new domestic, industrial and commercial demand in East Midlands
- Ofgem consultation on ‘quicker and more efficient connections’ raises questions on the role of strategic reinforcement funded by the wider customer base
- Need to understand whether there are ‘no/low regret’ investment options
- Given the last IPCC report and the Paris Agreement on Climate change it’s partly a question of when rather than if there will be further growth in renewable DG and changes in customers usage of electricity

Significant uncertainty of future growth in renewable DG and electricity demand

- Significant uncertainty in the UK growth of renewable generation
- Extracts from Amber Rudd's speech on a new direction for UK energy policy:

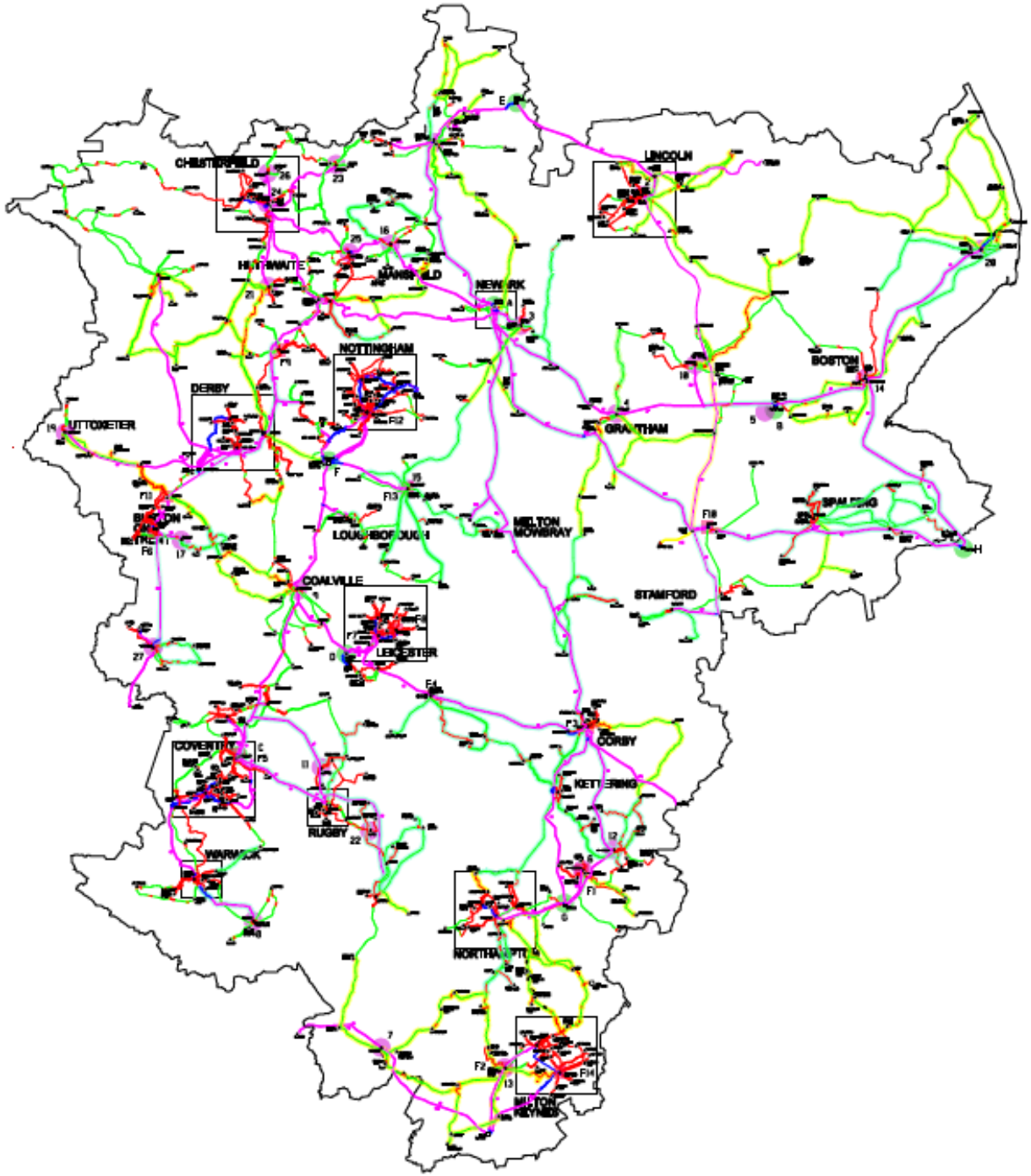
- *…..'Our most important task is providing a compelling example to the rest of the world of how to cut carbon while controlling costs.'…...*
- *….. 'We need to get the right balance between supporting new technologies and being tough on subsidies to keep bills as low as possible.'…....*
- *…..'We need to work towards a market where success is driven by your ability to compete in a market. Not by your ability to lobby Government.'……..*
- *……'Only when different technologies face their full costs can we achieve a more competitive market.'……*

- Whilst Government has been reorganised since this speech, the UK has signed up to the Paris Agreement on climate change

Current WPD East Midlands DG Data

Generator type	**Connected [MVA]**	**Accepted [MVA]**	**Offered [MVA]**	**Total [MVA]**
Photovoltaic	1,147.0	1,099.4	33.5	2,279.9
Wind	562.3	234.0	2.2	798.6
Landfill Gas, Sewage Gas, Biogas and Waste Incineration	211.8	85.2	61.9	358.9
CHP	129.2	33.5	18.1	180.7
Biomass and Energy Crops	66.2	146.5	0.0	212.7
Hydro, Tidal and Wave Power	1.4	0.3	0.0	1.7
Storage	0.0	292.8	311.2	604.0
All Other Generation	946.4	972.2	1,017.1	2,935.7
Total	**3,064.4**	**2,863.8**	**1,444.1**	**7,372.3**

Current WPD Network Constraints in East Midlands



POTENTIAL GRID CONSTRAINTS
A : STAYTHORPE
B : BICKER FEN
C : COVENTRY
D : ENDERBY
E : WEST BURTON
F : RATCLIFFE
G : GRENDON
H : WALPOLE

REVERSE POWER FLOW
1 : CHECKERHOUSE
2 : LINCOLN
3 : HAWTON
4 : GRANTHAM
5 : BICKER FEN
6 : WELLINGBOROUGH
7 : BRACKLEY
8 : HARBURY
9 : COALVILLE
10 : SLEAFORD
11 : PAILTON
12 : IRTHLINGBOROUGH
13 : STONY STRATFORD
14 : BOSTON
15 : WILLOUGHBY
16 : CLIPSTONE
17 : GRESLEY
19 : UTTOXETER
20 : SKEGNESS
21 : ALFRETON
22 : CRICK
23 : WHITWELL
24 : CHESTERFIELD
25 : MANSFIELD
26: STAVELEY
27 : TAMWORTH BSP

CIRCUITS WITH IDENTIFIED CONSTRAINTS:-
VOLTAGE CONSTRAINT
THERMAL OVERLOAD

FAULT LEVEL LIMITATION
F1 : WELLINGBOROUGH
F2 : STONY STRATFORD
F3 : CORBY
F4 : KIBWORTH
F5 : COVENTRY
F6 : BURTON SOUTH
F7 : LEICESTER 132kV
F8 : LEICESTER EAST 33kV
F9 : HEANOR
F10 : BOURNE BSP
F11 : BURTON BSP
F12 : NOTTINGHAM 33kV
F13 : WILLOUGHBY 33kV
F14 : BLETCHLEY BSP

KEY
POWER STATION
N.G.C. GRID SUPPLY POINT
132kV/66kV OR 33kV SUBSTATION
132kV/11kV OR 25kV SUBSTATION
66kV SUBSTATION
33kV SUBSTATION
33kV SWITCHING STATION
66kV SWITCHING SUBSTATION
132kV SWITCHING STATION
25kV TRACKSIDE SUBSTATION (BR)
132kV OVERHEAD LINE
132kV UNDERGROUND CABLE
66kV OVERHEAD LINE
66kV UNDERGROUND CABLE
33kV OVERHEAD LINE
33kV UNDERGROUND CABLE
OTHER NETWORK OPERATORS' CIRCUITS
25kV CIRCUITS

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Current National Grid constraints affecting the East Midlands

The latest National Grid responses to Statement of Works request include the following:

- Generators need to have reactive capability between 0.95 leading power factor and 0.95 lagging power factor at Rated MW Output to maintain voltage control on the National Grid
- Requirement for emergency disconnection arrangements
- Reverse power flow constraints at Bicker Fen and Staythorpe GSPs (may be able to manage through ANM scheme)
- Fault level constraints on switchgear at Grendon GSP

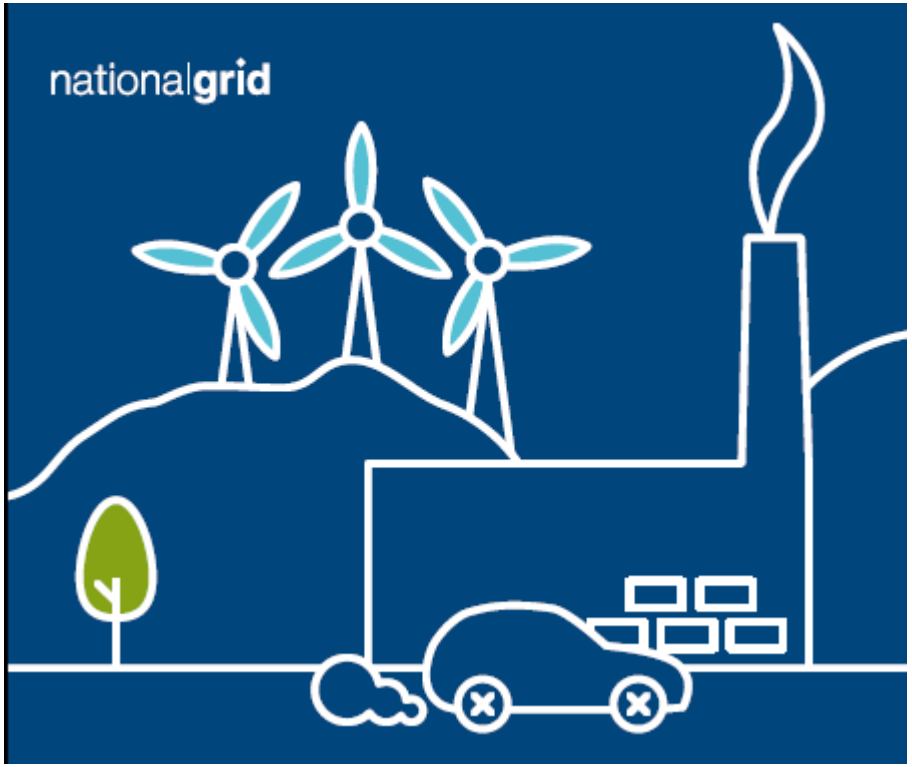
Aim of Study

- Assessing the potential growth in DG by type, general location and year against potential demand changes
- Identifying thermal, voltage and fault level constraints that result
- Assessing options for reinforcement
- Providing recommendations for ‘low regret’ investment and identifying the cost and timescale of these
- Use this to understand the economic potential for demand side response and/or generation constraint to avoid reinforcement
- Whilst not part of this project the scenarios will also be used to develop a Distribution Operability Framework to help identify issues in addition to capacity that will need to be addressed e.g. harmonics, system protection performance etc.

Approach

- Background Energy Scenarios (decision to use the 4 developed by National Grid to assess GB)
- Resulting Generation and Demand Scenarios for East Midlands
- Identification of potential solutions (including those on National Grid)
- Estimation of capacity provided by those solutions
- Cost/timescales of those solutions
- Potential for demand or generation response given the cost of network solutions

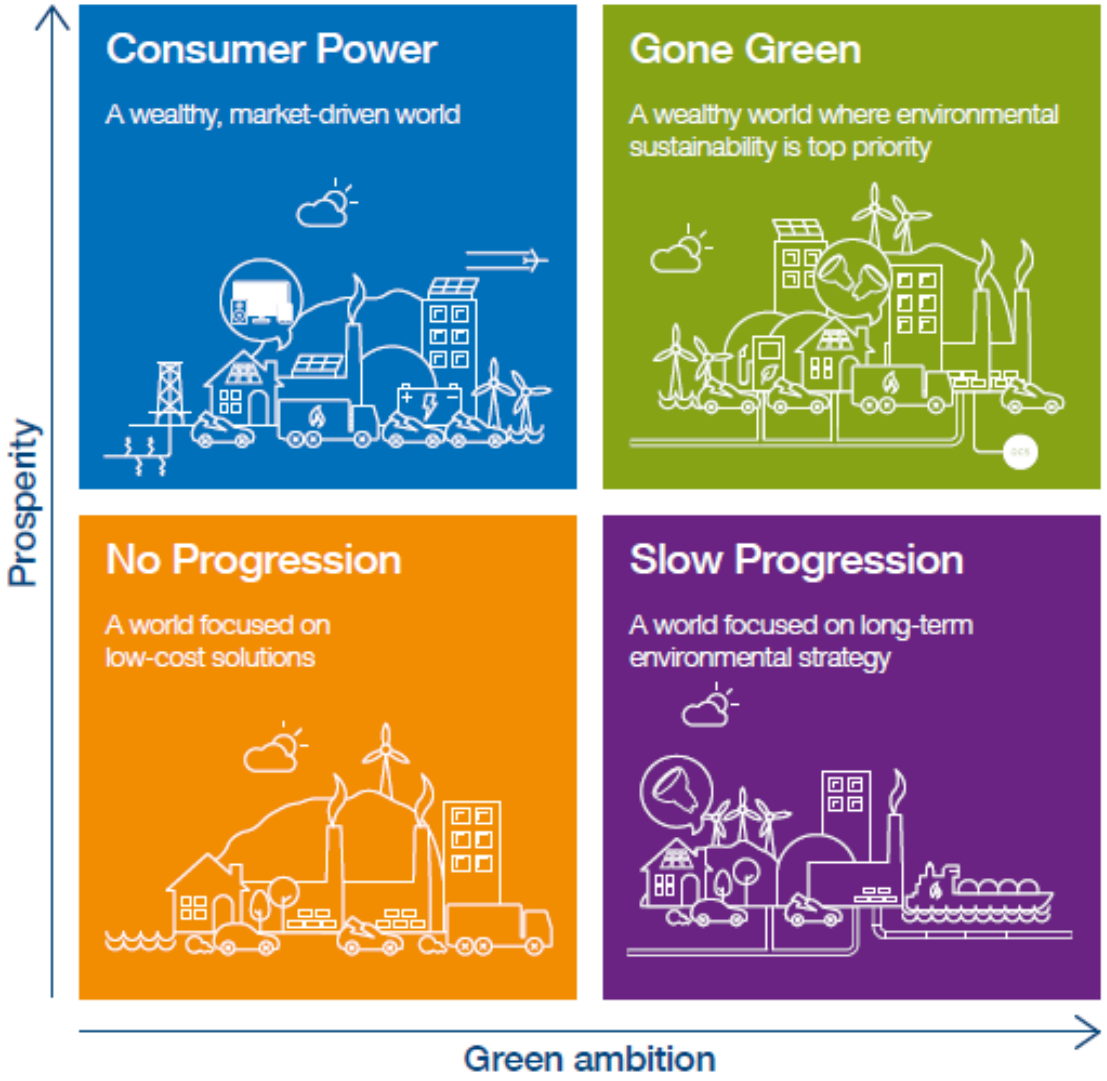
National Grid – Future Energy Scenarios



- Annual Publication

  FES 2016
- Considers GB Wide Future Energy Landscape
- Four future scenarios
- From now to 2040
- Electricity Demand & Generation
- Gas Demand and Supply

National Grid – Future Energy Scenarios



nationalgrid

FES 2016

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Timetable for Strategic Study

- Stakeholder workshop to get stakeholder input to approach and scenarios to be considered – December 2016
- Complete development of detailed demand and generation scenarios – January 2017
- Undertake network studies and identify solutions with costs - Spring 2017
- Sensitivity work – i.e. how much ‘headroom’ do the potential solutions give – Spring 2017
- Assess potential for demand response/generation constraint – Late Spring 2017
- Complete report – Late Spring 2017
- Dissemination event or webinar – July 2017

The Transition from Distribution Network Operator to Distribution System Operator

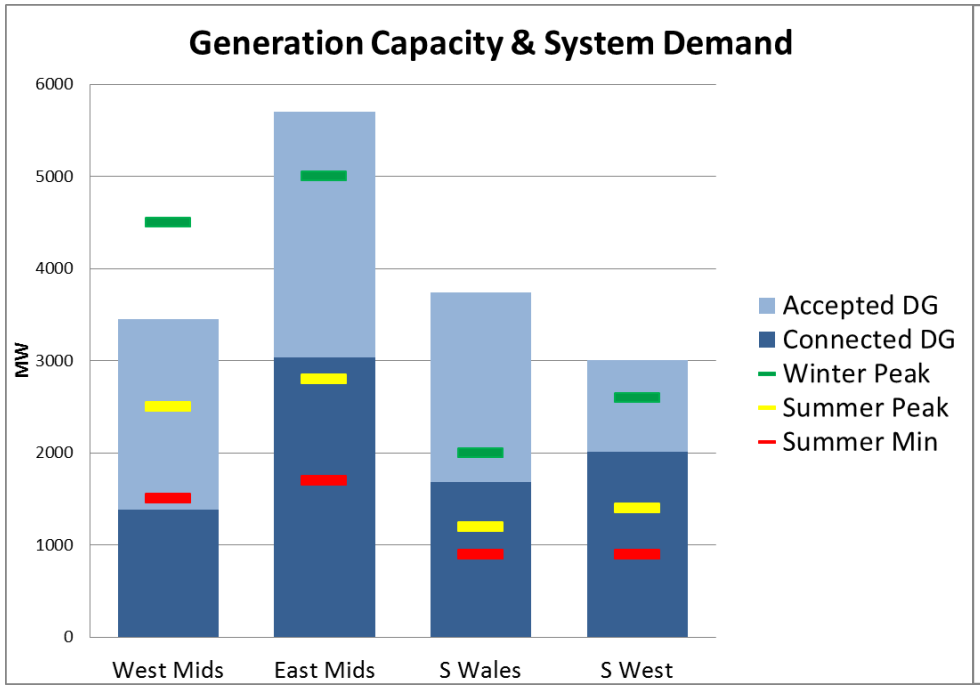
Drivers of need to change how we operate the network

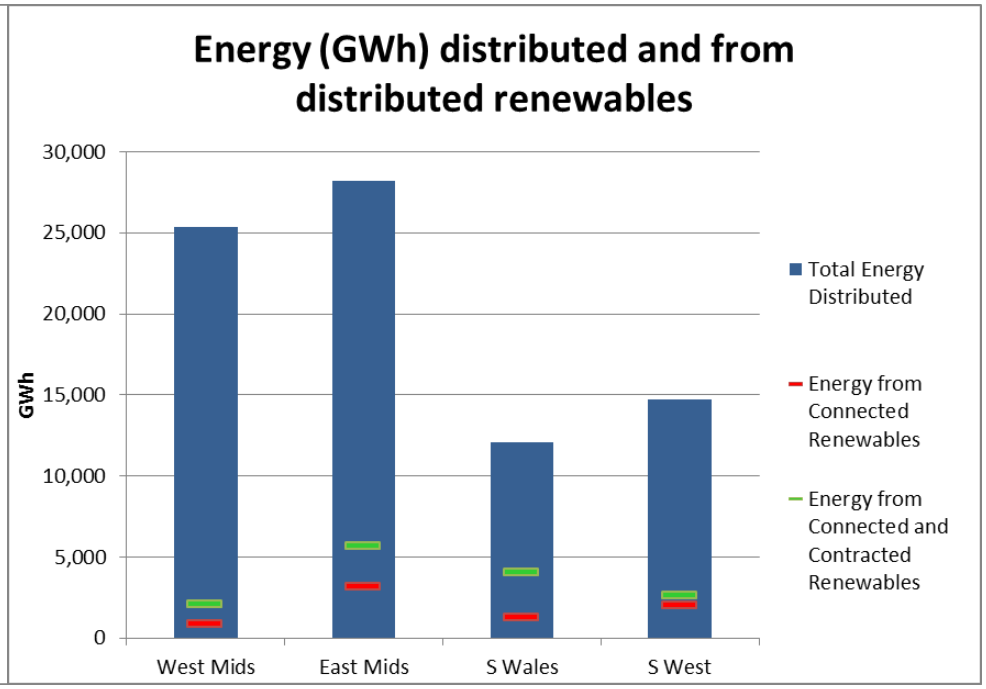
- Support mechanisms for renewables have resulted in a significant growth in distributed generation connections
- Reinforcement in anticipation of need for network capacity strongly discouraged by regulatory mechanism due to risk of stranded assets
- Low load factors for many renewables would result in uneconomic networks for passive operation
- Both D and T networks either have or are reaching thermal and voltage limits in many areas
- Both load shape and demand/generation growth and timing uncertain due to:
  - EVs – speed of adoption?, use of rapid charging? and pattern of charging?
  - Growth in behind the meter generation
  - Storage – currently uneconomic for most applications but price dropping rapidly
  - Renewables – further costs reductions expected making projects viable without subsidy

Distribution System Operator

- Generation is becoming more distributed and variable, and new ways for consumers to monitor and manage energy are being introduced
- To make the most of the opportunities offered by these changes, and to deliver against our carbon commitments, while providing reliable and secure supply at minimum cost, we need to encourage customers to consume and produce electricity more flexibly
- Flexibility can offer alternative solutions which avoid or defer the need for reinforcement and support cheaper and timelier connections
- DNOs engaging with consumers to procure flexibility and having a greater involvement in local balancing will become Distribution System Operators (DSO)

Growth in and Current DG and Demand data





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Some longer term issues

- Outstanding question of whether our role as a Distribution System Operator (DSO) is management of system constraints (including where economic transmission constraints) or whether there is a longer term role of energy balancing

- Currently the System Operator (NGET) contracts with distribution connected demand and generation for services without notification to distributor – is this sustainable within an ANM zone or under a DSO model?

- Peer-to-peer trading – currently often results in development of private networks. Process and commercial arrangements need to be developed to enable this across distribution networks

Other issues to address

- In addition to the thermal and voltage issues on the distribution network there are also issues at the transmission level from:
  - changes in reactive power absorption
  - reverse power capability at interface substations between T and D
  - T system boundary limit being reached and
  - concern that voltage stability limit is being reached in the S West
- Increased whole system issues emerging including voltage control, frequency containment, reverse power management, changes in fault levels
- We are working with the System Operator (NGET) on the options for planning and operation of the combined T and D networks in the S West using long term scenarios
- Methodology needed to determine when constraint is the right overall economic solution or where reinforcement of the network is justified

What could a DSO do?

- Whatever form it takes, it will require more data, increased network visibility, greater control functionality and the ability to better forecast energy volumes
- New role is likely to include:
  - managing, contracting and dispatching power and energy flows
  - brokering ancillary services
  - Network balancing (local power and demand balancing)
- Relationship with the System Operator:
  - coordinate operations
  - provide services
- A platform will be needed for energy suppliers, communities and other market participants to have visibility of network congestion in order to facilitate optimal DG and DSR solutions
- Active involvement in reconfiguration of the system will also be needed

Some of our projects developing flexibility

- Active Network Management - roll out underway across network underway
- Entire – DSR services
- Car connect (marketed as Electric Nation) – includes whether demand control services can avoid/defer reinforcement
- SYNC – includes demand ‘turn up’ services
- Solar Storage – storage alongside solar installation
- Sunshine Tariff – offset generation with local demand
- FREEDOM – Electric/Gas hybrid heating systems (with WWU)
- Industrial & Commercial Storage – understanding benefits of storage in and around I & C premises
- LV connect and manage – ANM at LV to facilitate rapid connection of Low Carbon Technologies
- Network Equilibrium – voltage and power flow management

Questions?