WESTERN POWER DISTRIBUTION

Serving the Midlands, South West and Wales

Distribution Networks:

Moving from passive to active operation

Wednesday 17th January 2018

Welcome

Today's material:

- Overview of planning for passive networks
  - *Traditional methods employed to understand future network growth*
  - *Triggers for future network requirements*
  - *Current considerations for security of supply*

- Effects of non-traditional actors on the distribution system
  - *Potential actors and their expected behaviour*
  - *Increasing volatility and variability*
  - *Clustering, market behaviour, local effects*

- Moving to planning for active networks
  - *Scenario planning using existing data and future predictions*
  - *Potential methodologies for reinforcement triggers*
  - *Considerations for securing networks using third party flexibility*

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Western Power Distribution

Keep the lights on	Maintain equipment	Fix the network	Connect customers
by operating our network assets effectively	so that the network is in a condition to remain reliable	if equipment gets damaged or is faulty	by upgrading existing networks or building new ones

7.8 million CUSTOMERS

6,500 STAFF

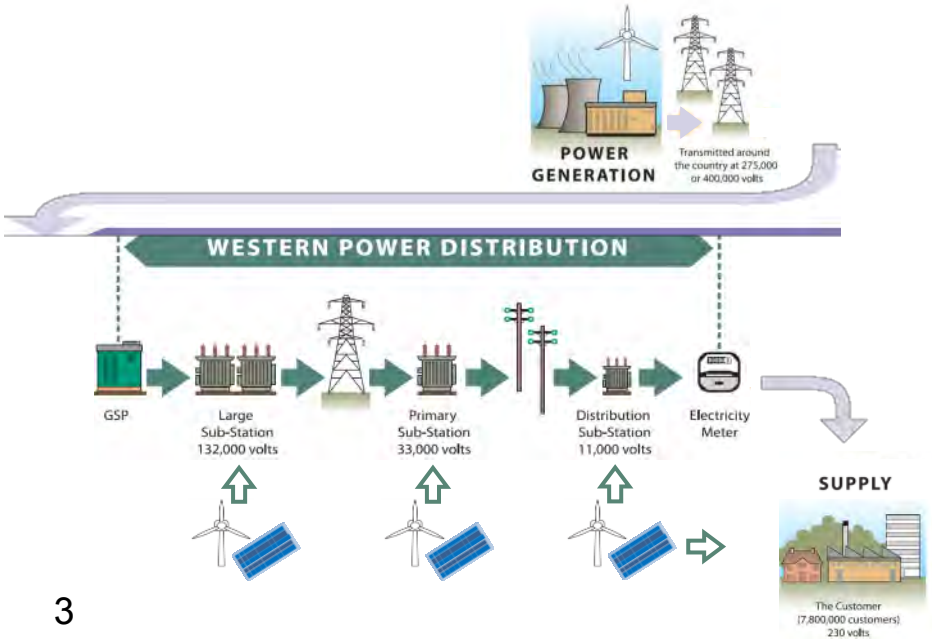
55,000² KILOMETRES COVERED

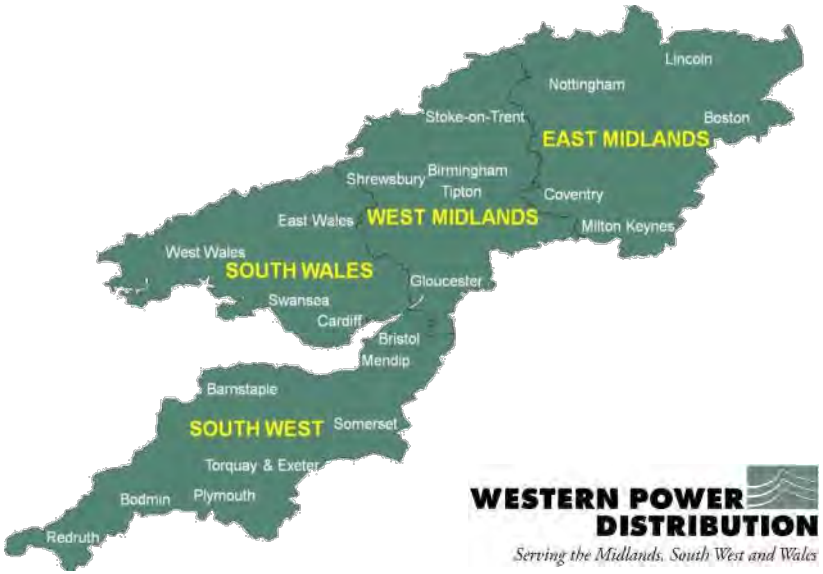
185,000 SUBSTATIONS

220,000 km OVERHEAD LINES & UNDERGROUND CABLES

16% (c.£100) OF AN AVERAGE DOMESTIC ELECTRICITY BILL

REGULATED BY **OFGEM**





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Planning for Passive Networks

- Conventional electrical networks are designed to accommodate all predicted consumption 24/7, 365 days a year

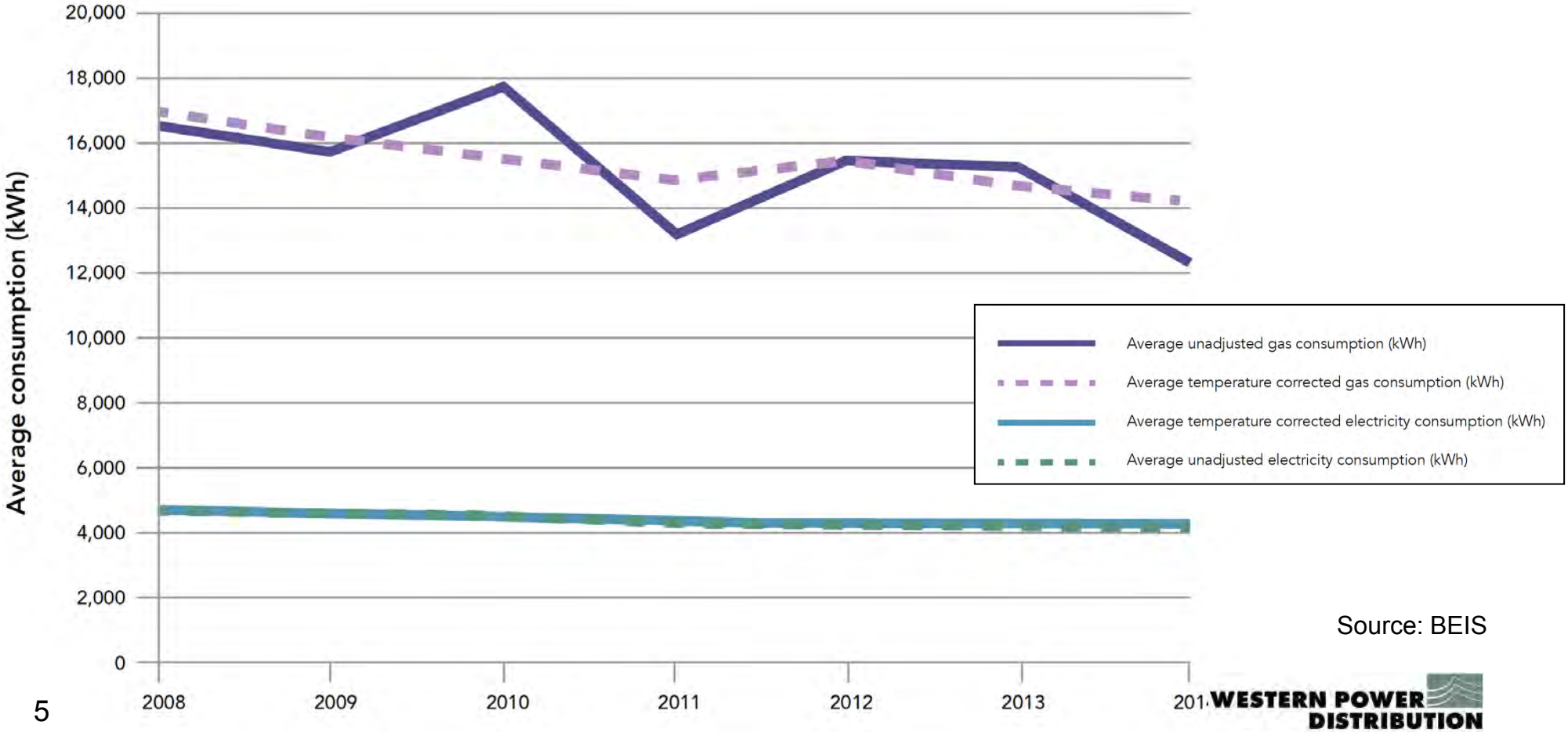
- Diversity for demand is used extensively for existing connected consumers, and assumes peak consumption between adjacent consumers is not concurrent. The diversity factors used are based on historical analysis and have stood the test of time

- Domestic diversity is significant nationally – consider a 3200kWh annual bill with a standard domestic service being capable of delivering that every week

- Traditional demand forecasting relied on growth being incremental, consistent and small – typically 1 or 2% per year

Planning for Passive Networks

- Energy efficiency trends increased the level of diversity



Source: BEIS

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Planning for Passive Networks

- Energy efficiency, recession and early distributed generation in the first few years of the 21st century contributed to demand shrinking by 1 or 2% per year

- When deciding whether a network can accommodate an increase in demand, the DNO would consider the diversified annual peak demand requirements of the new connection and ensure the network could deliver that on top of its existing annual peak demand

- Traditionally, peak annual demands are considered to be concurrent due to the dominance of heating and lighting demands. Only a single study is required to determine peak power requirements

- If the new connection's peak cannot be accommodated on the existing peak, new passive network will be required

Planning for Passive Networks

Class of supply	Range of Group Demand	Minimum demand to be met after: First Circuit Outage	Minimum demand to be met after: Second Circuit Outage
A	Up to 1MW	In repair time: Group Demand	Nil
B	Over 1MW and up to 12MW	(a) Within 3 hours: Group Demand minus 1MW (b) In repair time: Group Demand	Nil
C	Over 12MW and up to 60MW	(a) Within 15 minutes: Smaller of (Group Demand minus 12MW); and 2/3 of Group Demand (b) Within 3 hours: Group Demand	Nil
D	Over 60MW and up to 300MW	(a) Immediately: Group Demand minus up to 20MW (automatically disconnected) (b) Within 3 hours: Group Demand	(c) Within 3 hours; For Group Demands greater than 100MW: Smaller of (Group Demand minus 100MW); and 1/3 Group Demand (d) Within time to restore arranged outage: Group Demand
E	Over 300MW and up to 1500MW	(a) Immediately: Group Demand	(b) Immediately: All consumers at 2/3 Group Demand (c) Within time to restore arranged outage: Group Demand
F	Over 1500 MW	In accordance with the relevant transmission company licence security standard	

- ENA ER P2/6 recommends security of supply requirements for demand
- Greater demand groups require more resilient network design
- Assets in parallel reduce consequence of exceedance
- Transfer capacity reduces likelihood of exceedance

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Planning for Passive Networks

29.6m customers

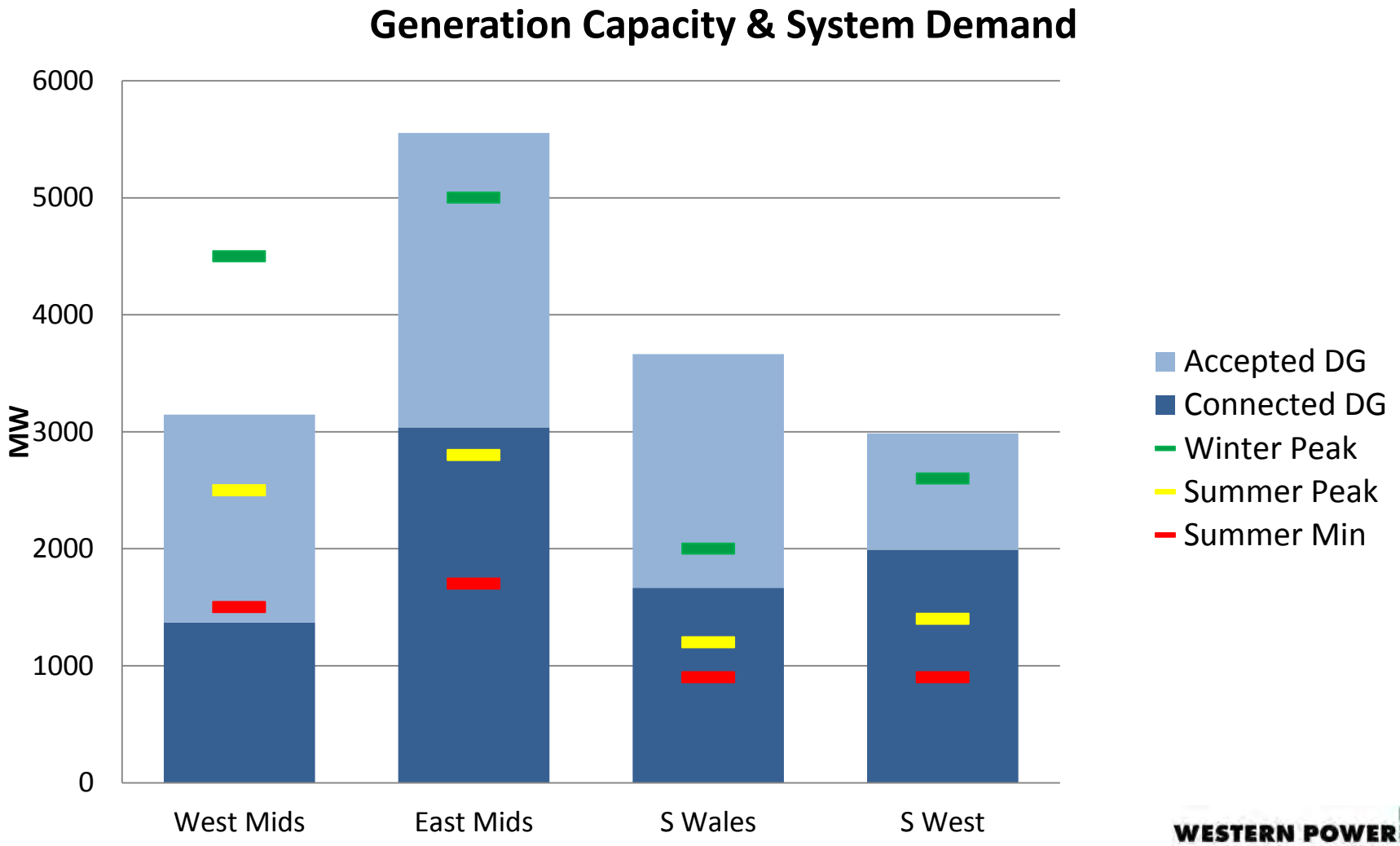
798,817 km of assets

35.7

minutes off-supply per customer per year

>99.99% reliability

Effects of non-traditional actors on the distribution system



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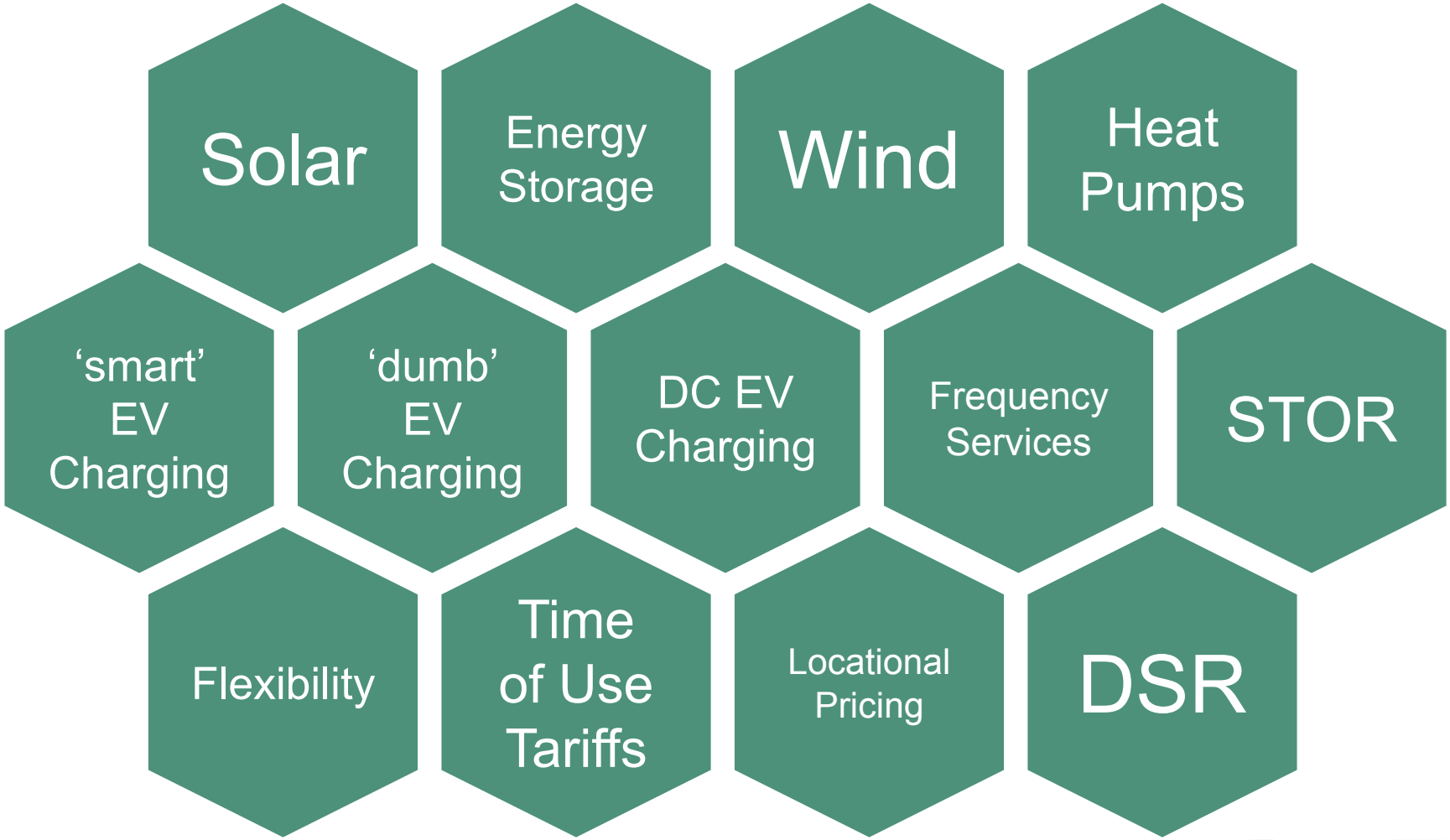
Effects of non-traditional actors on the distribution system



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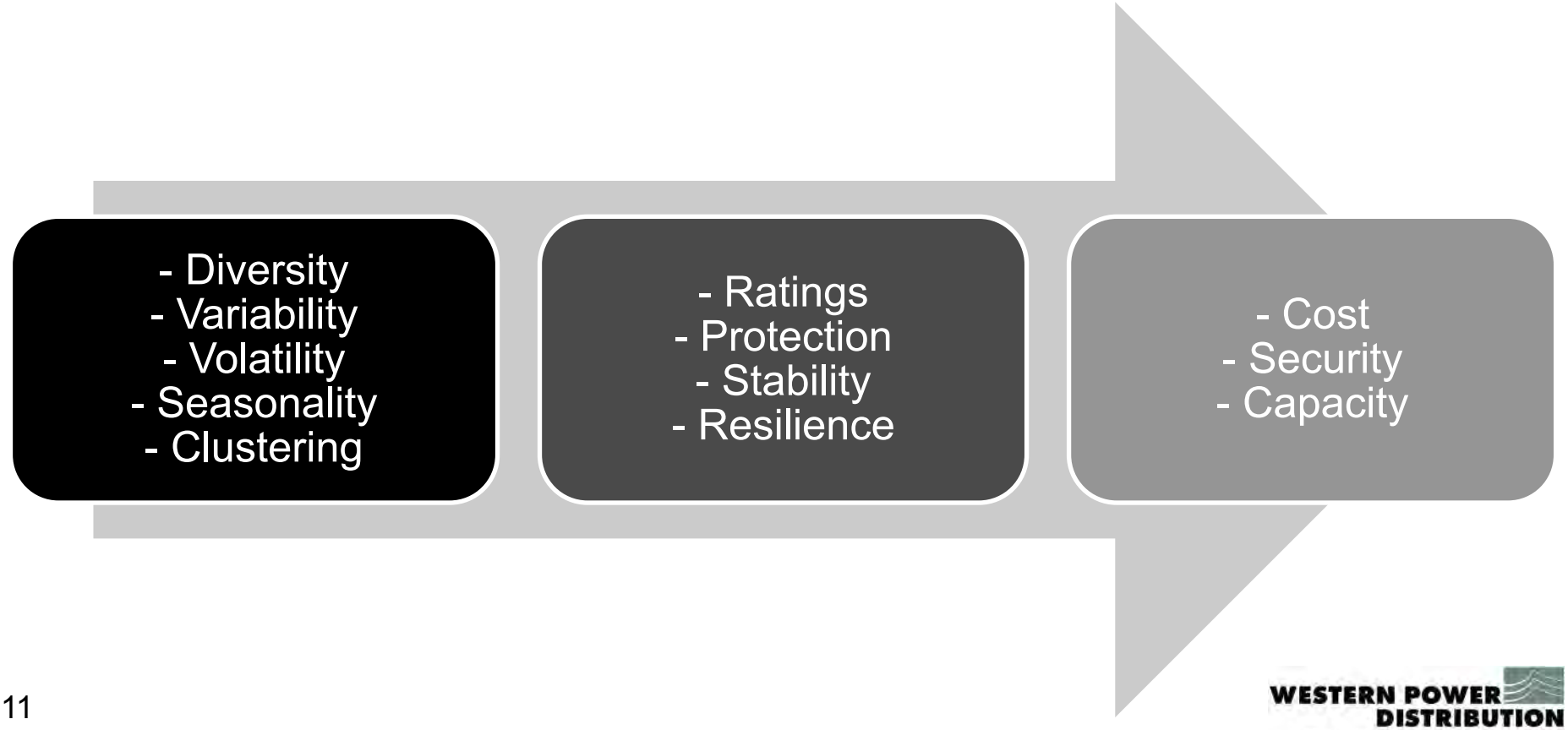
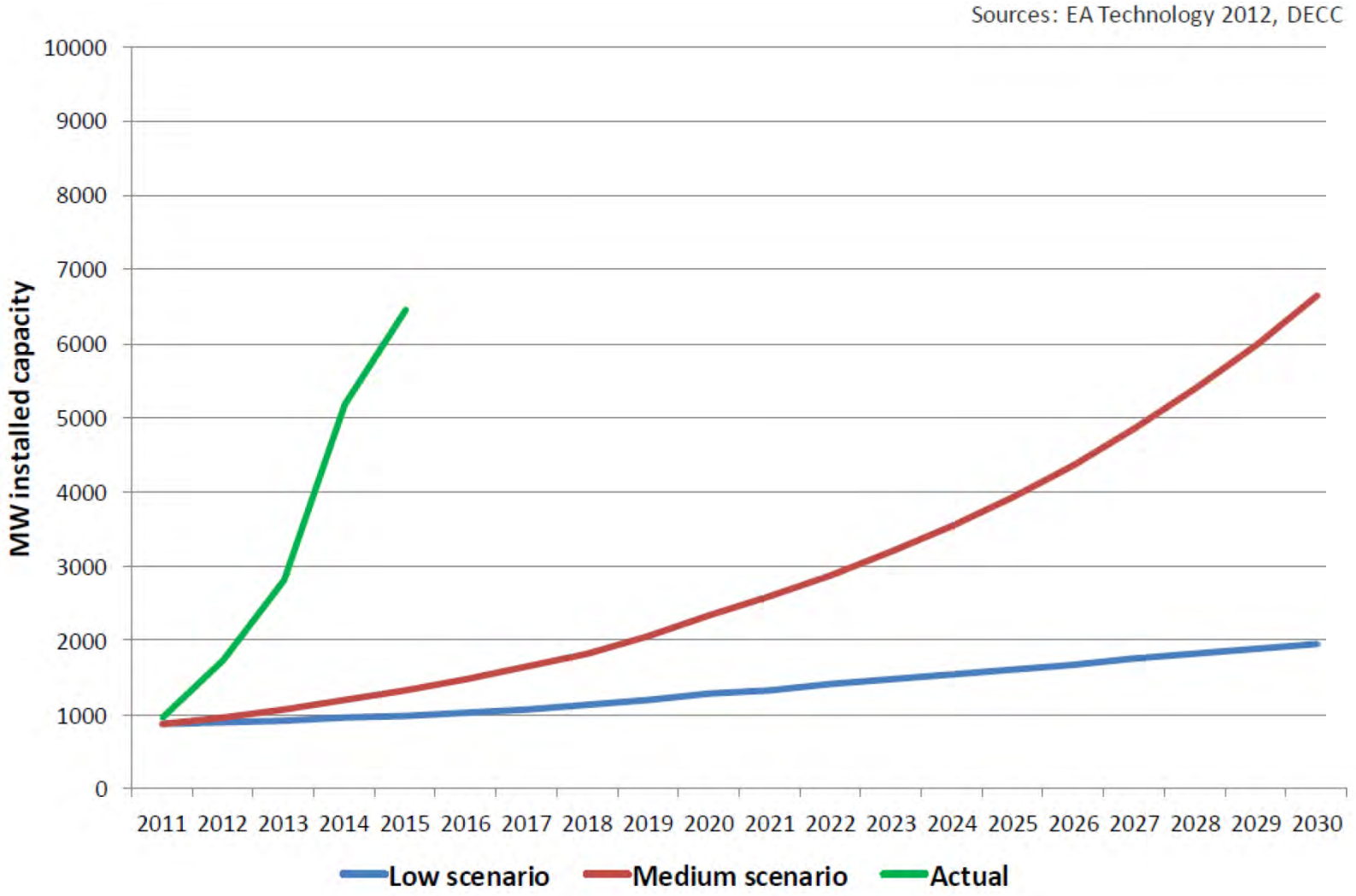
Effects of non-traditional actors on the distribution system

- Once connected, new technologies will have a disruptive impact on the way electrical networks have to be designed and operated



Effects of non-traditional actors on the distribution system



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Effects of non-traditional actors on the distribution system

- Whilst there is a clear long term intention from Government on the importance that the electrification of transport and heating will have in a low carbon transition, there is little certainty of the uptake trajectory

- Changes in the level of Government subsidy, the green agenda, technology prices and energy prices, will all affect the uptake curve and the distribution

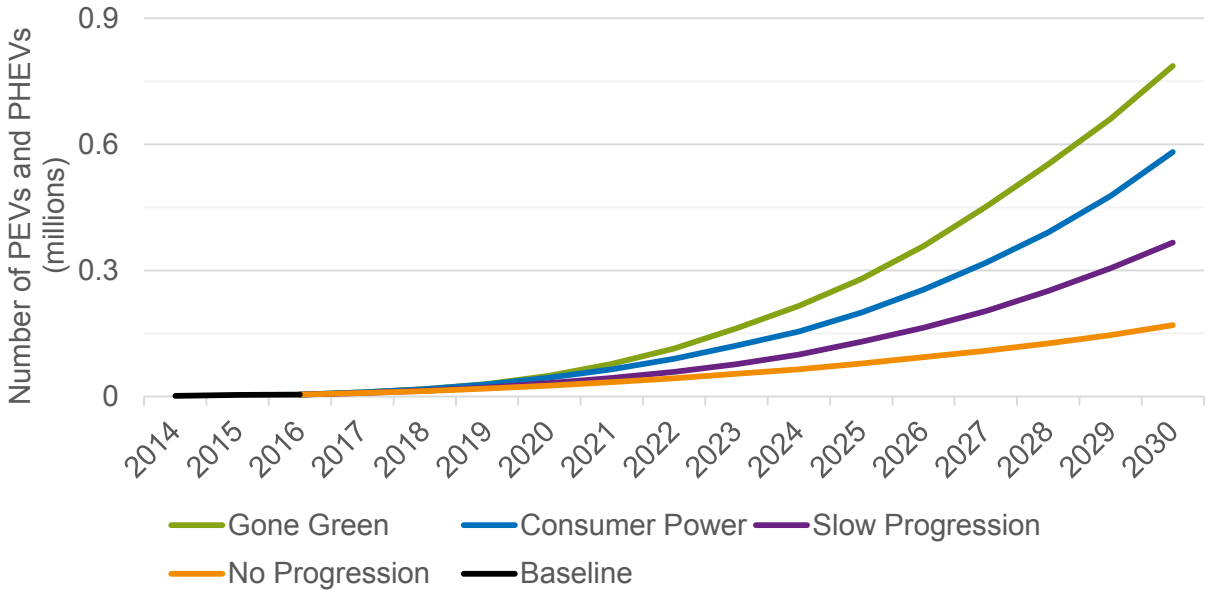
- The acceptability of these technologies to the customer must also not be overlooked

- The modelling of these known and unknown variables will be challenging and accurate predictions will be difficult

Moving to planning for active networks

We have developed regional scenarios with reinforcement requirements for all four of our licence areas which establishes the envelope of system operation

Number of pure and plug-in hybrid electric vehicle scenarios in the East Midlands licence area



Cumulative number of pure electric vehicles and plug-in electric vehicles in WPD licence area

	Baseline	2020	2025	2030
Gone Green	5,023	49,663	279,600	786,240
Consumer Power	5,023	45,463	199,800	582,120
Slow Progression	5,023	31,969	130,302	366,660
No Progression	5,023	26,245	79,002	169,722

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Moving to planning for active networks

- By analysing networks for deficiencies under future scenarios, we can lay a roadmap out for future investment required.
- But quantifying the deficiencies accurately is difficult.

GSP	2020				2025			
Bishops Wood			CP	GG	NP	SP	CP	GG
Bushbury							CP	GG
Bustleholm							CP	GG
Cellarhead					NP	SP	CP	GG
Feckenham	NP	SP	CP	GG	NP	SP	CP	GG
Iron Acton								
Ironbridge and Shrewsbury			CP	GG			CP	GG
Kitwell							CP	GG
Lea Marston/Hams Hall			CP	GG	NP	SP	CP	GG
Nechells	NP	SP	CP	GG	NP	SP	CP	GG
Ocker Hill							CP	GG
Oldbury								
Penn						SP	CP	GG
Port Ham/Walham			CP	GG	NP	SP	CP	GG
Rugeley			CP	GG	NP	SP	CP	GG
Willenhall				GG		SP	CP	GG

Moving to planning for active networks

Approach to date – Representative Days:

- **Winter Peak Demand day:** The 24 hour demand data (48 half hourly average readings) was selected from the annual demand data for the day where the peak demand occurred. Only data from the months December, January and February was considered. These months are defined as winter in WPD's overhead line ratings policy, ST:SD8A/2.
- **Summer Peak Demand day:** The 24 hour demand data was selected from the annual demand data for the day where peak demand occurred. Only data from the months May, June, July and August was considered. These months are defined as summer in WPD's overhead line ratings policy, ST:SD8A/2.
- **Summer Peak Generation day:** The 24 hour demand data was selected from the annual demand data for the day where the smallest peak demand occurred. Only data from the months May, June, July and August was considered. These months are defined as summer in WPD's overhead line ratings policy, ST:SD8A/2.
- **Autumn Peak Demand day:** The 24 hour demand data was selected from the annual demand data for the day where peak demand occurred. Only data from the months September, October and November was considered. These months are defined as autumn in WPD's overhead line ratings policy, ST:SD8A/2.

Moving to planning for active networks

Approach to date – Representative Networks:

- **Urban,** representing BSP's supplying areas with high densities of domestic, commercial and light to medium industrial demand.
- **Rural**, representing BSP's supplying areas with low domestic demand, medium industrial demand and agricultural demand.
- **Mixed**, represent a mix of urban and rural demands.
- **Midday**, representing BSP's that have a midday peak as opposed to an early evening peak. These BSP's are in urban areas and have commercial and industrial demand.

Moving to planning for active networks

Approach to date – Multi-edge-case modelling to determine reinforcement triggers:

- 4 growth scenarios
  - 4 representative days
    - 4 seasonal networks
      - 48 half hours
        - real and reactive power
          - voltage, thermal and fault level analysis

Moving to planning for active networks

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Moving to planning for active networks

- As we move to operating networks more actively, it will become more important to plan for delivery of energy rather than power
- We are moving from a single winter peak scenario to determine network capability through to a time-series based approach, understanding the energy requirements during times of network exceedance
- Active Network Management (ANM) and other technologies will ensure we have control of the network and keep the lights on, but they do not look for optimal solutions
- Network and system operators can provide visibility of the system needs and actions, but the market will need to be incentivised to deliver optimum solutions

All our reports, webinars and presentations are published online at:
http://www.westernpower.co.uk/netstrat

If you have any questions in relation to WPD's Network Strategy work, please contact WPD on the details below:

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Q&A

Q&A

- If we are to move to providing increased visibility of system needs, how we describe the requirements across a year, accurately, but without complexity?
- Upper limit and lower limit?
- 8760 half hour time slices?
- Somewhere in between? Are some conditions of network usage more representative/likely that others? How can these be described?