WESTERN POWER DISTRIBUTION

Serving the Midlands, South West and Wales

Strategic Investment Options for Growth in the West Midlands Demand

23rd May 2017

Agenda – Session 1

10.00 **Arrival and registration**

10.30 **Welcome and demand investment strategy overview**

Ben Godfrey, Network Strategy Team Manager, WPD

11.30 **Demand scenarios development process**

Joel Venn, Senior Analyst, Regen

11.50 **Growth in residential and commercial/ industrial developments**

Amy Brimmicombe, Analyst, Regen

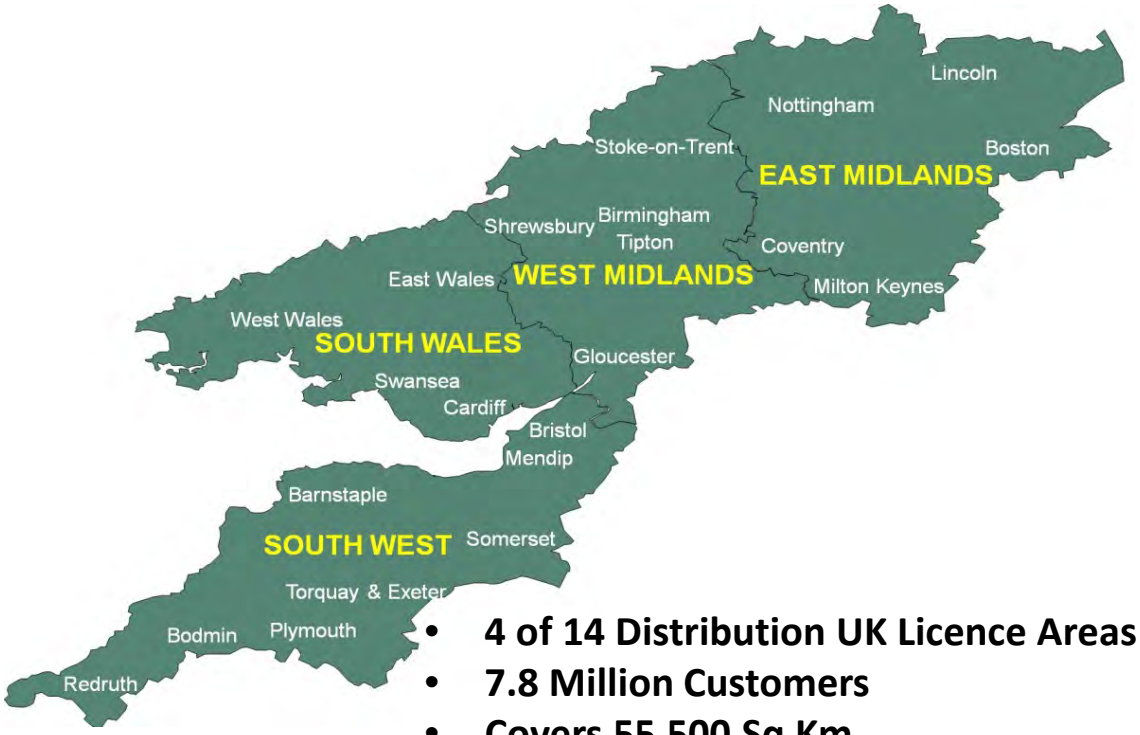
12.10 **Q&A with WPD and Regen presenters**

12.45 **Lunch and networking**

Demand investment strategy overview

- Western Power Distribution – Who are we?
- Drivers for the project
- Aim and approach of the study
- Timetable
- What else are we doing to help demand customers?

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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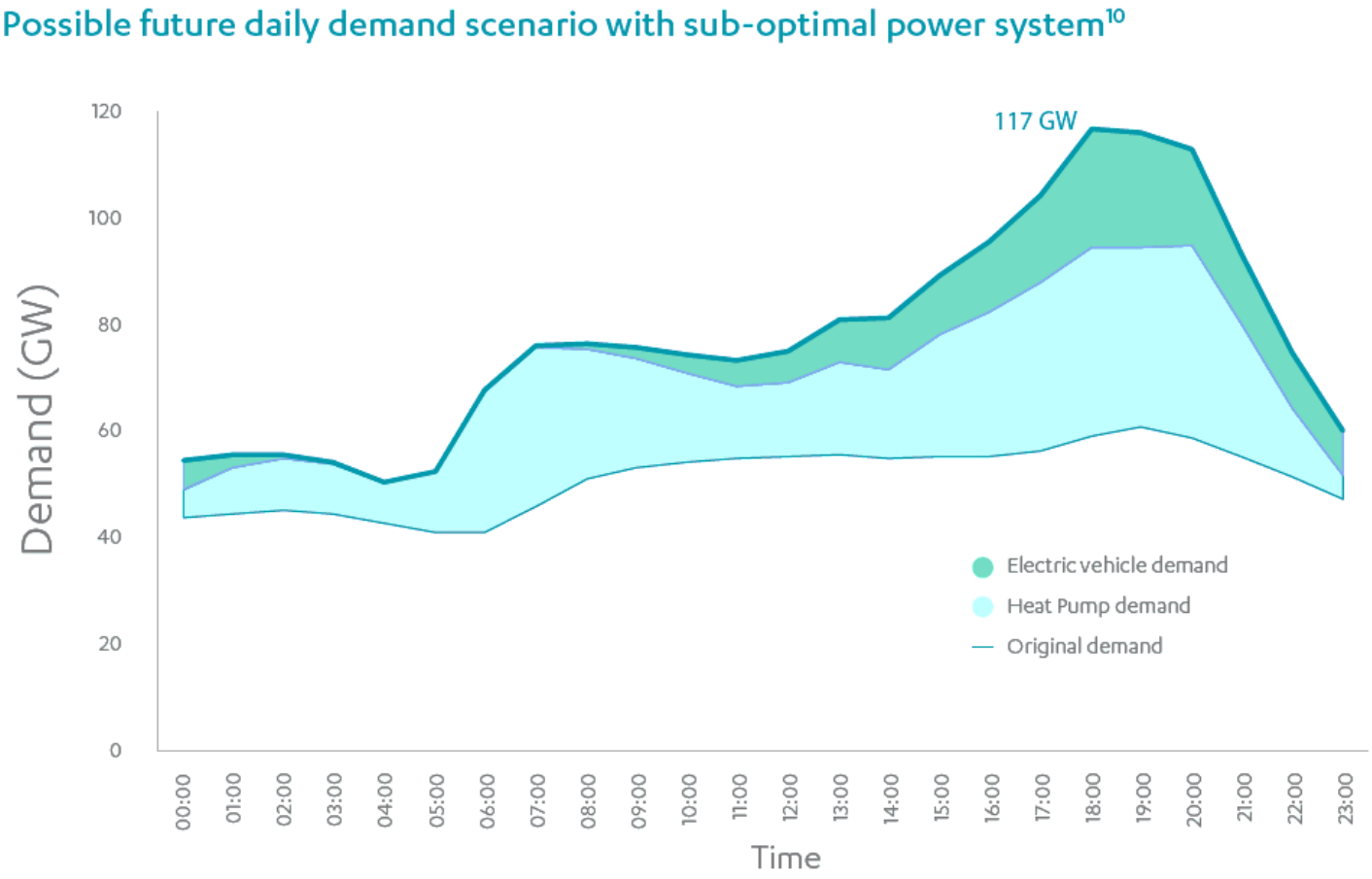
Drivers of the need for this project

- Uncertainty in the future path of demand growth
- Variability and volatility in network flows increasing; usage patterns changing
- Potential growth of new domestic, industrial and commercial demand in West Midlands
  - HS2
  - Midlands Engine

Drivers of the need for this project

- Ofgem wanting to understand the value to the wider customer base if they were to fund strategic reinforcement
- Need to understand whether there are ‘no/low regret’ investment options
- The move to electro-heat and e-mobility will happen, but when?
- Is this an incremental build or larger steps?

Significant uncertainty of future growth in electricity demand



Infrastructure Commission Smart Power Report March 2016

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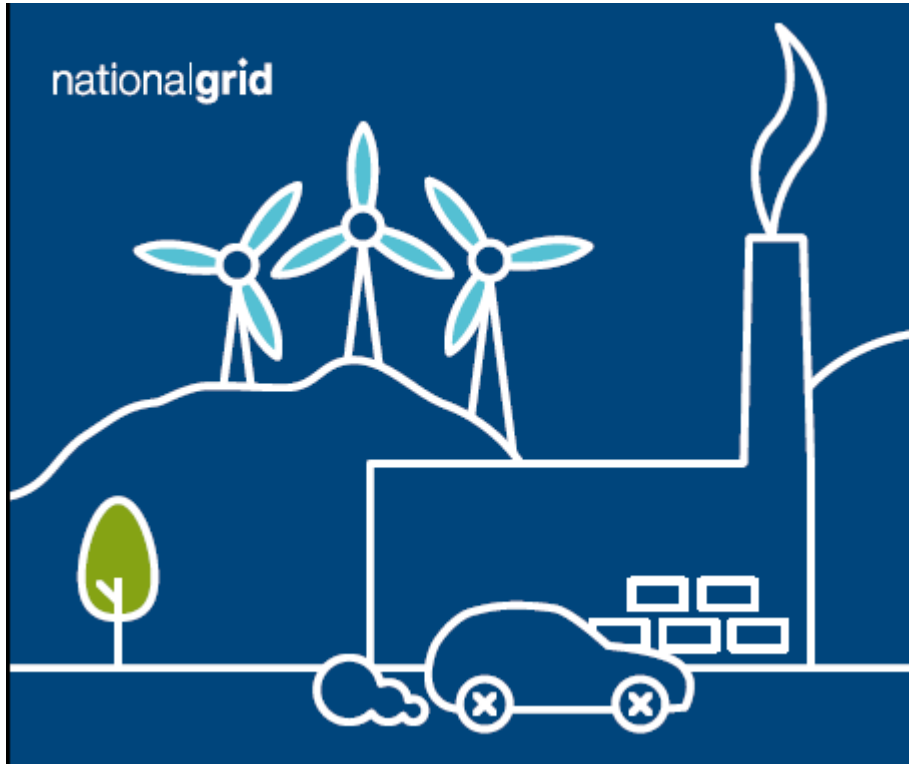
Aim of Study

- Assessing the potential growth of customer demand and LCT uptake by type, general location and year
- Identifying thermal, voltage and fault level constraints that result
- Assessing options for conventional 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

Approach

- Background Energy Scenarios (decision to use the 4 developed by National Grid to assess GB)
- Resulting Generation and Demand Scenarios for West 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 – May 2017
- Undertake network studies and identify solutions with costs - 2017 Q3
- Sensitivity work – i.e. how much ‘headroom’ do the potential solutions give – 2017 Q4
- Assess potential for demand response/generation constraint – 2017 Q4
- Complete report – December 2017
- Dissemination event or webinar – January 2018

WPD Online Capacity Tool

- > Distribution Generation owner/operator forum
- > Generation Infrastructure Schemes
- > Community Energy Schemes
- > Facilitating sharing of information for potential generation connections consortiums
- > Trial
- > Export Capacity Recovery

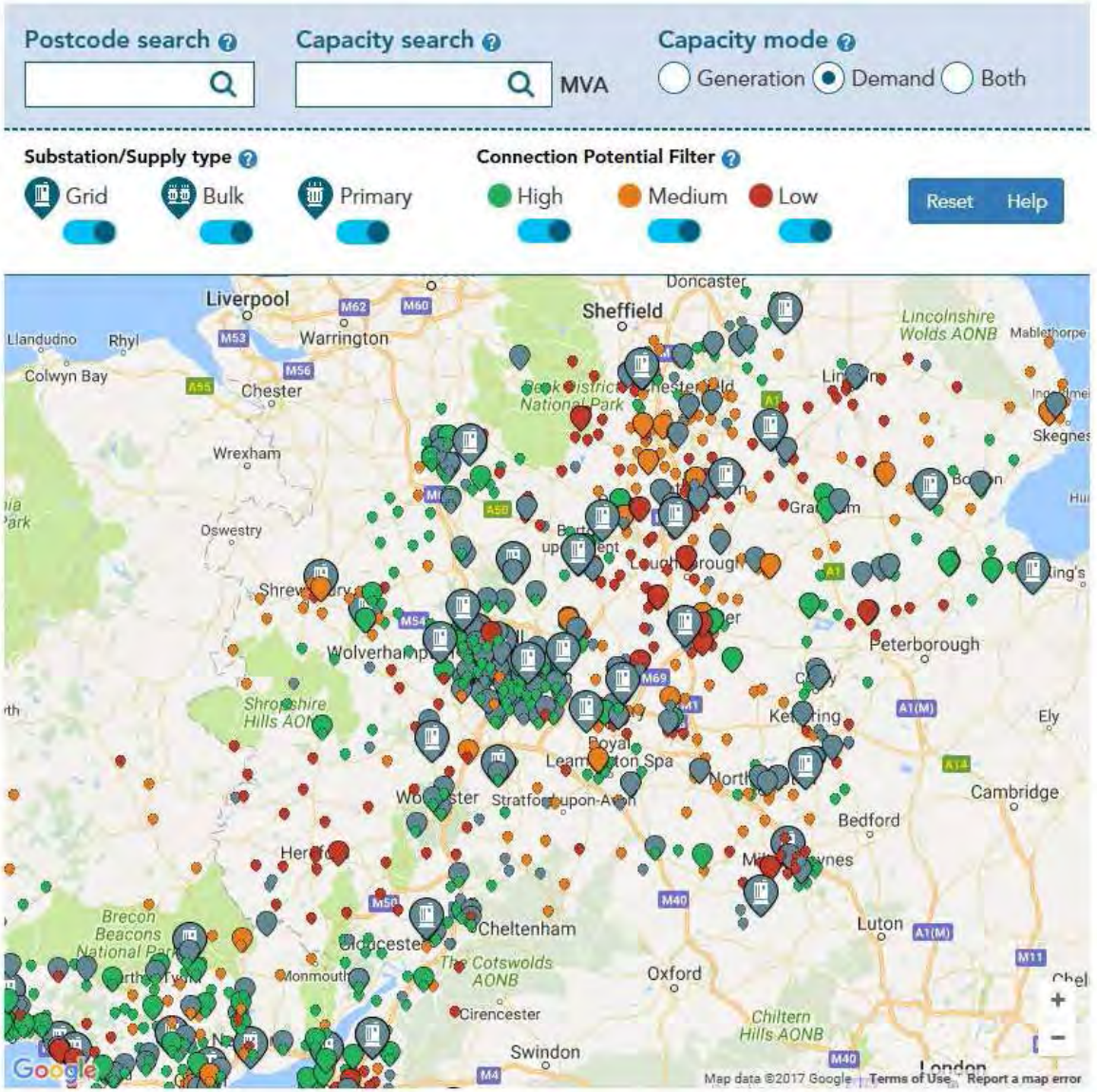
Service alterations

Information for electrical installers

Useful information

Incentive for Connections Engagement

Contact us



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WPD Online Capacity Tool

Fault Levels

	Make	Break
Upstream Equipment Ratings 3Ph:		
Upstream Short Circuit Currents 3Ph:		
Upstream Equipment Ratings 1Ph:		
Upstream Short Circuit Currents 1Ph:		
Downstream Equipment Ratings 3Ph:	32.75 kA	13.10 kA
Downstream Short Circuit Currents 3Ph:	21.92 kA	7.99 kA
Downstream Equipment Ratings 1Ph:		
Downstream Short Circuit Currents 1Ph:	2.88 kA	1.95 kA

Generator Information

Generator Types:	Photovoltaic
Connected Generation:	6.47 MVA
Offers sent but not yet accepted:	
Offers accepted but not yet connected:	

Statement of Works

Start date:	Thursday, December 15th 2016, 12:00 AM
Comments:	National Grid Electricity Transmission (NGET) has instructed that WPD shall maintain a facility such that under emergency conditions on the National Electricity Transmission System (NETS), WPD shall have the ability to de-energise embedded generation (>=1MW) upon instruction from NGET.

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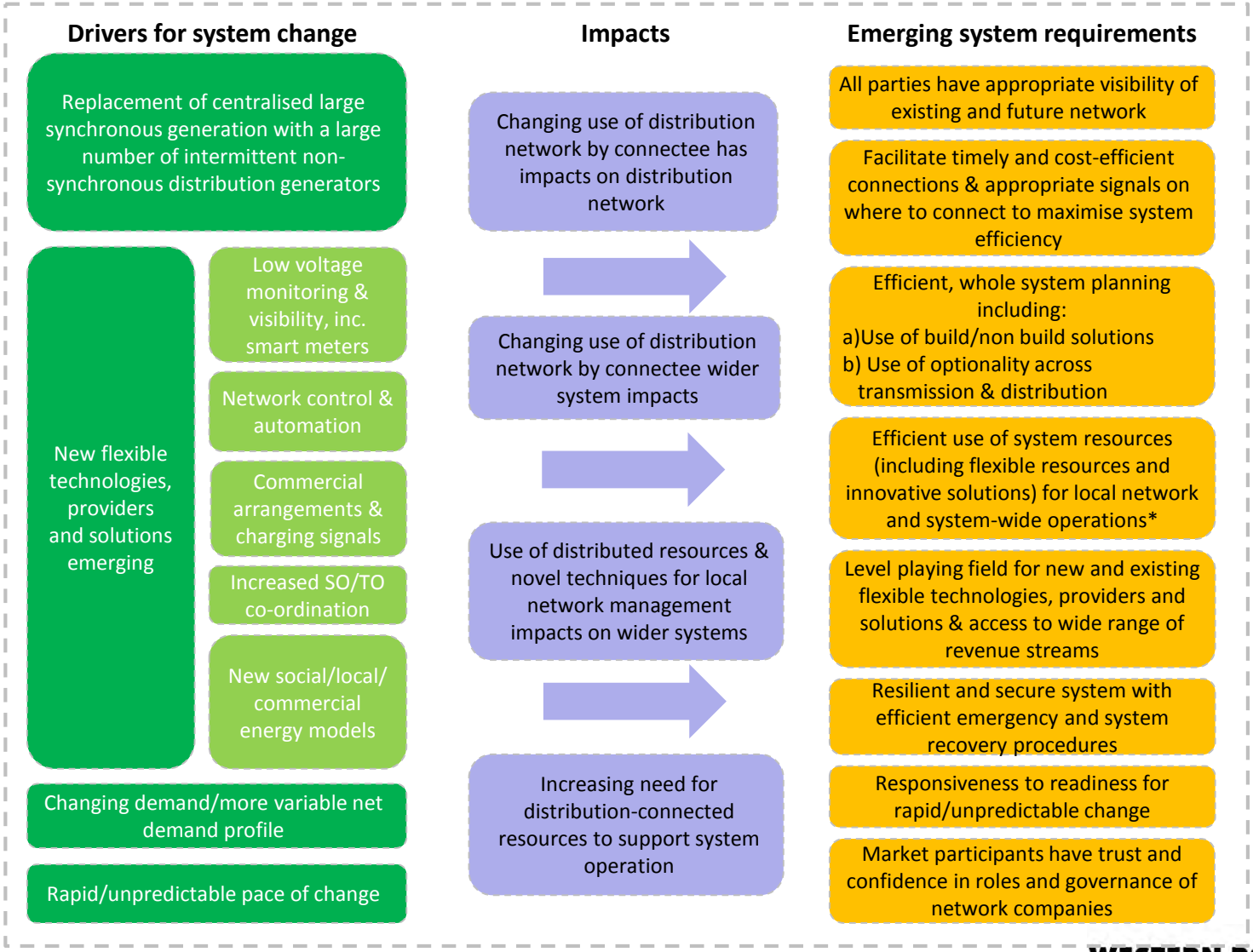
The need for change in how networks operate



BEIS
A smart, flexible energy system 2016

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The Transition from Distribution Network Operator to Distribution System Operator

Distribution Network Operator

Distribution System Operator

Passive networks managing maximum power flows

Active networks managing real-time energy flows

DSO Four point plan

Expand the existing roll out and application of smart network solutions to the higher voltage networks, prioritising areas which are the most likely to benefit. From this we will optimise investment decisions, deliver greater network flexibility and maximise customer connection choice (flexible connections for demand, generation and storage).

Contract with customers and aggregators for non network solutions. Co-ordinate with other parts of the industry by helping to establish visibility platforms for suppliers, aggregators and customers. This will include the requirement to raise the awareness of DSR and to help customers to value stack where appropriate.

Co-ordinate with SO at the T/D interface. Share data and forecasts in multiple time horizons. Maintain overall system security. Consider whole system issues and propose solutions. Secure additional flexibility through prosumer awareness – actively support Power Responsive. No exclusivity in DSO flexibility contracts.

Protect the integrity and safety of lower voltage networks. We will maximise the use of smart meter data, apply additional network sensing where relevant and implement simple control schemes. We aim to develop wider flexibility for the use of import/export capping as an alternative to conventional solutions only reinforcing the networks when these solutions cannot deliver what is required.

What might this mean for demand customers?

- Active Network Management for demand customers
- Revenue streams for DSR services – DSO requirements will be forecast in advance and predictable
- Demand control for some LCTs in certain areas: managed electric vehicle charging can avoid/defer reinforcement
- Revenue from demand ‘turn up’ services
- Investing in grid-parity PV systems
- Investment in domestic energy storage system
- Cross-vector heating systems (hybrid heat-pumps)

www.westernpowerinnovation.co.uk

Questions?

Future Electricity Demand Growth in the West Midlands licence area

Stakeholder workshop – 23 May 2017

West Midlands licence area

regen
transforming energy

This morning

- Scope

- Demand technology growth scenarios to 2030
  - Methodology
  - Building the scenarios
  - Results – EVs and Heat pumps

- Identifying new residential and non-residential developments:
  - Methodology
  - Results

Scope

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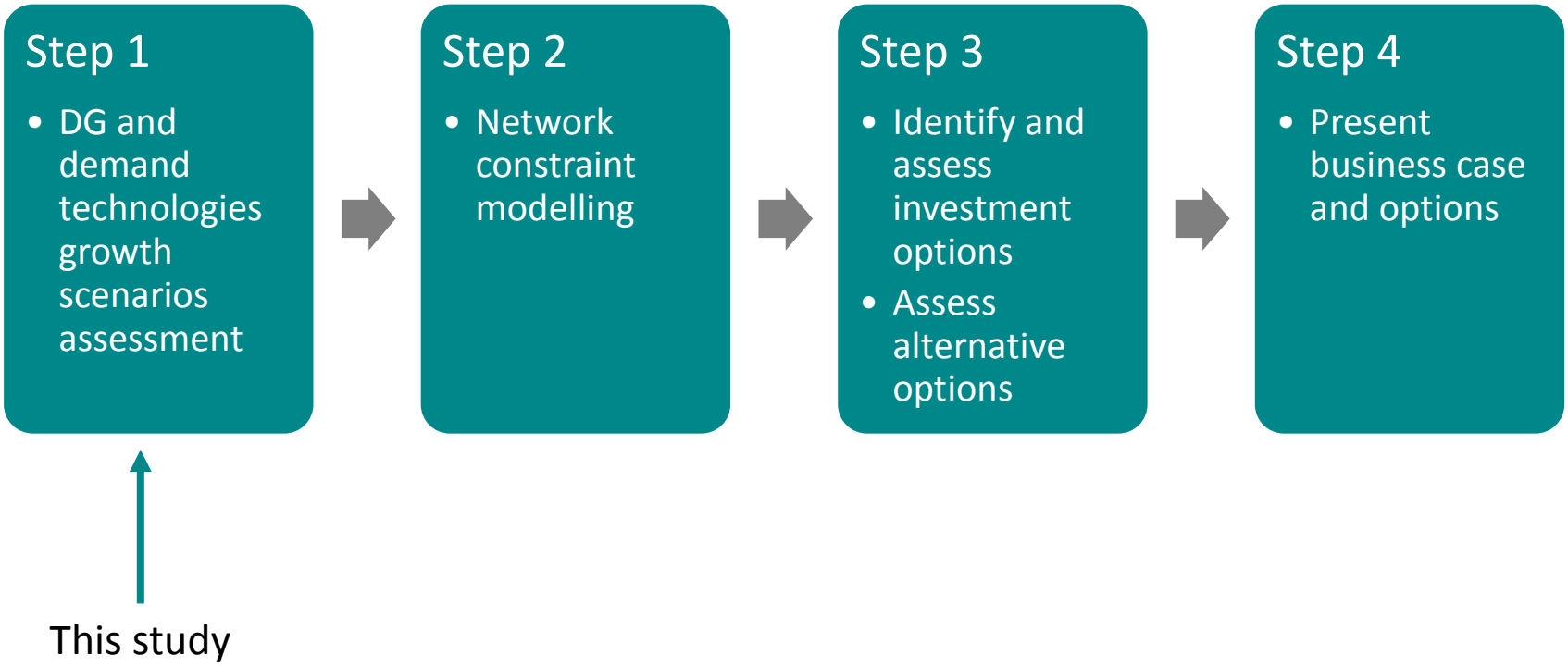
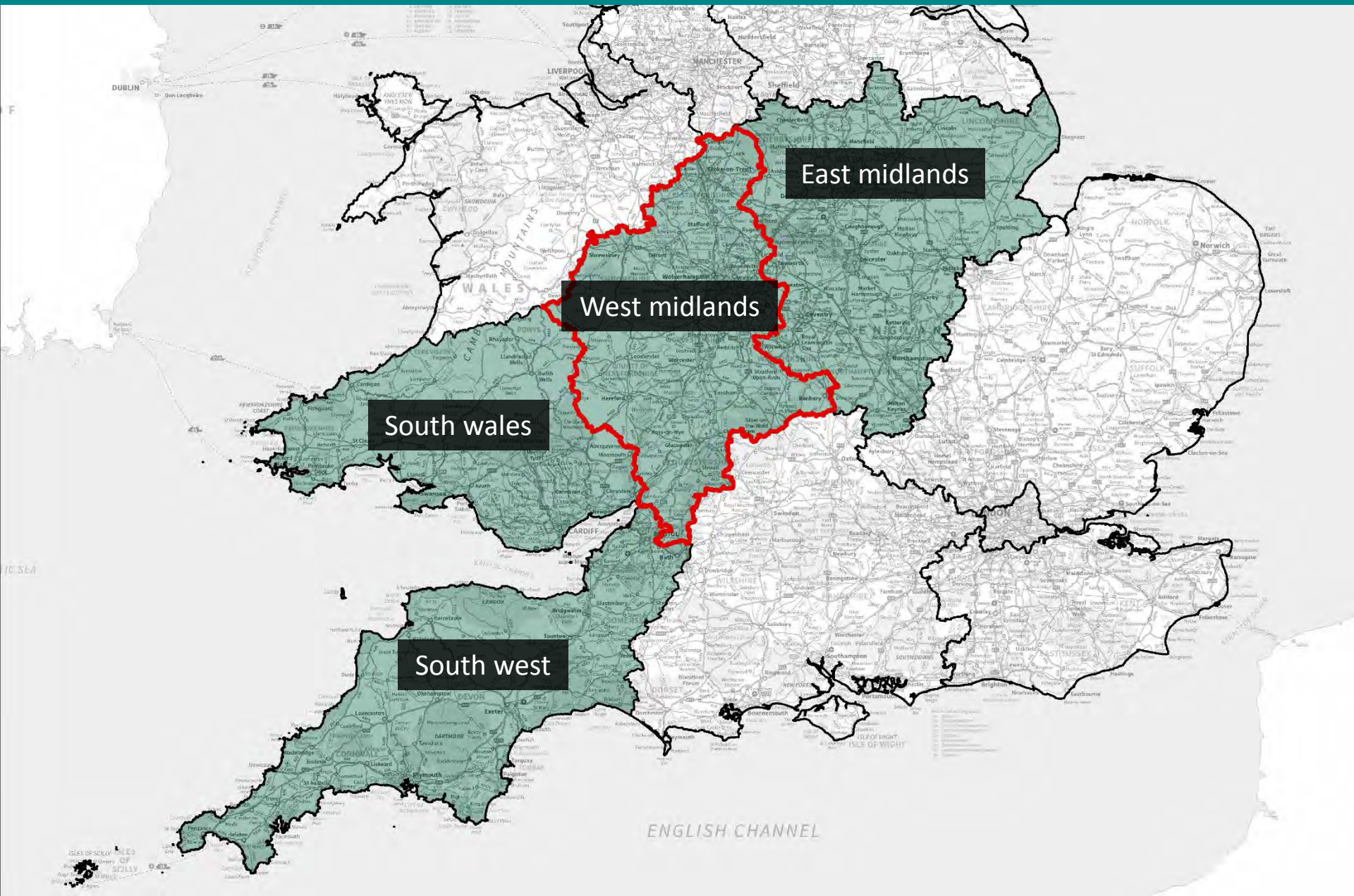
First step in process

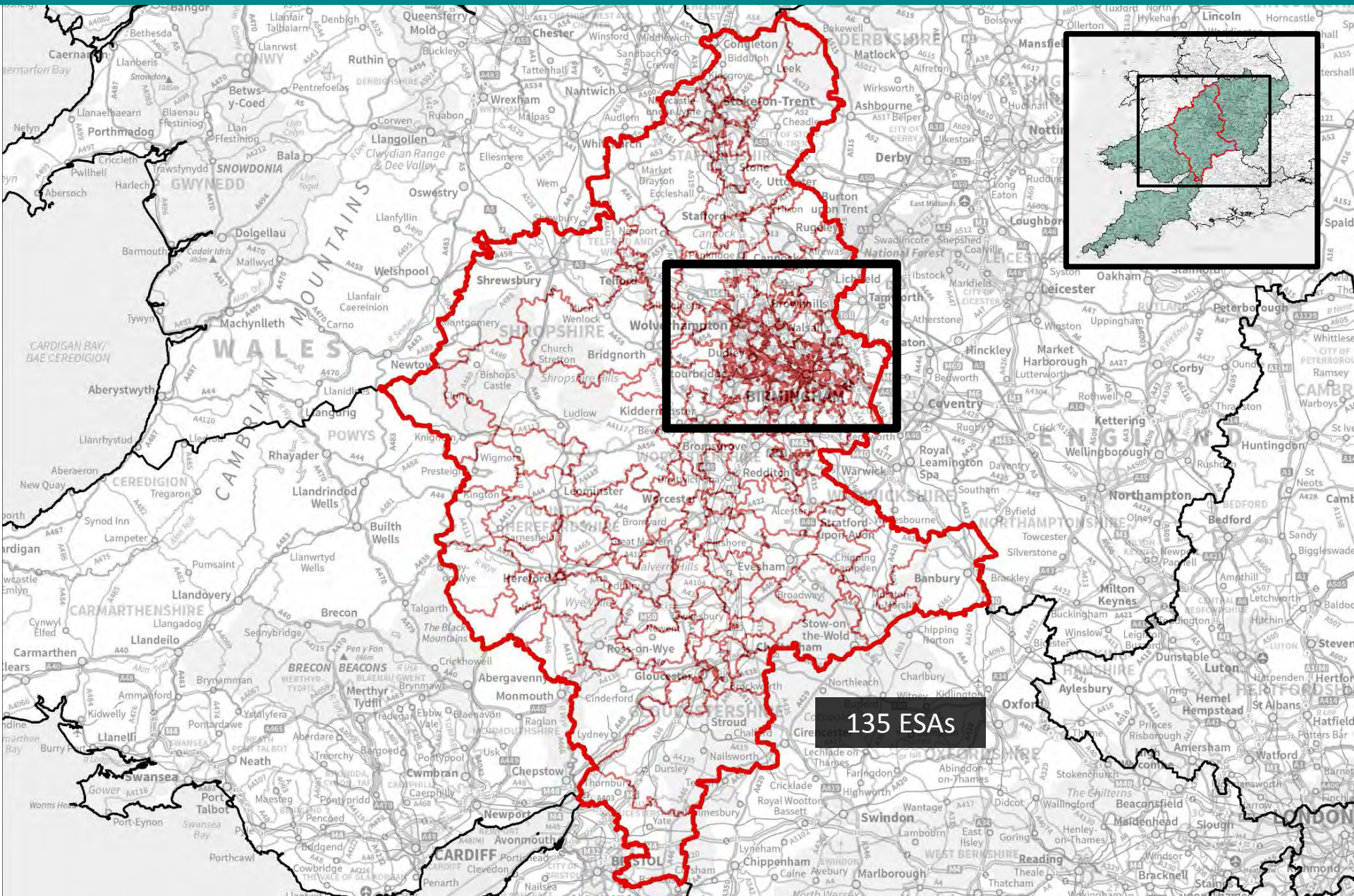
Strategic network investment options study



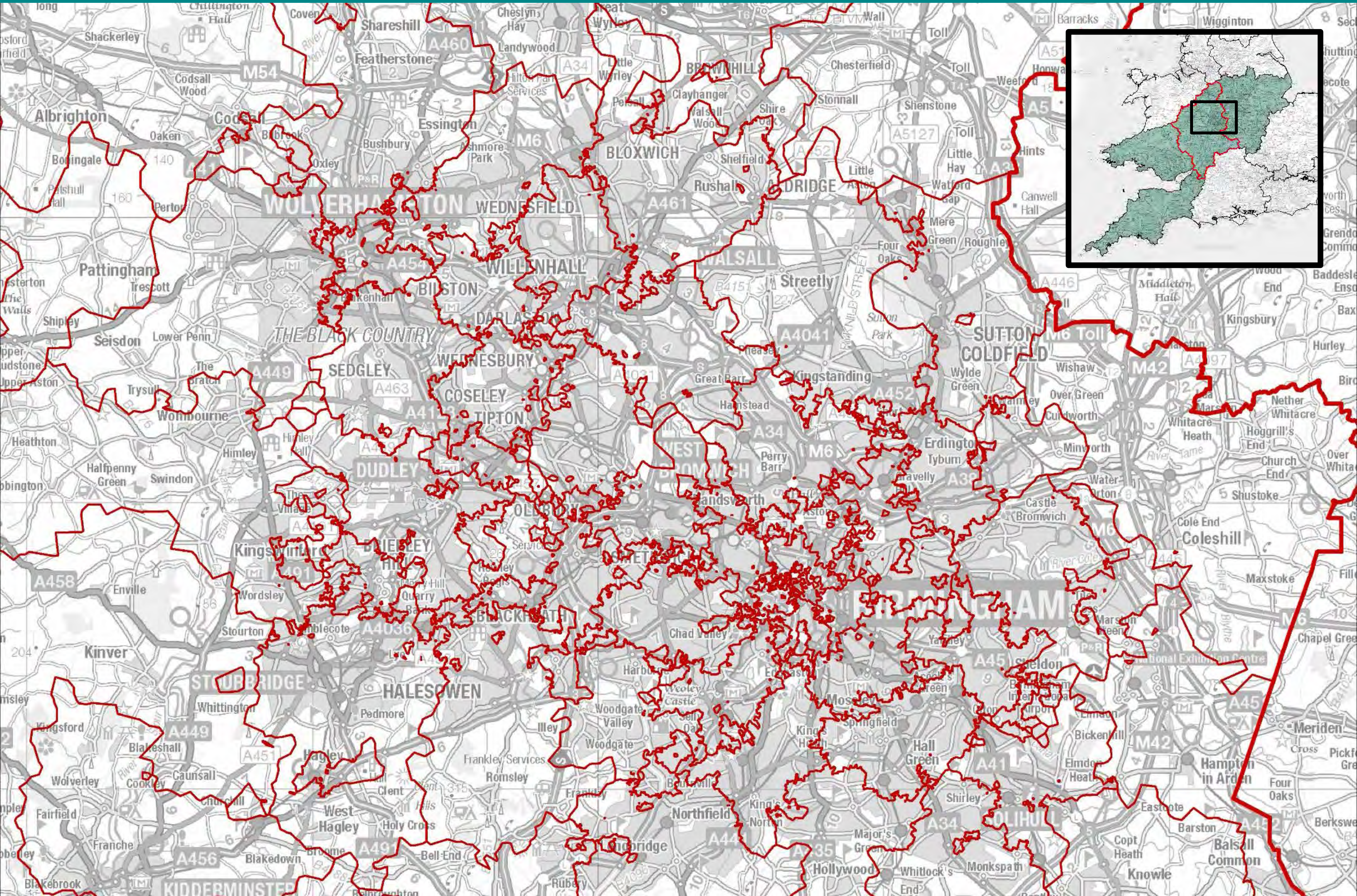
West midlands licence area



Electricity supply areas (ESAs)



Birmingham (ESAs)



Technologies assessed

Generation technologies
Solar PV
Onshore wind
Hydropower
Energy from waste
Anaerobic digestion

New demand
Electric vehicles
Heat pumps
New build developments (residential)
New build developments (non-residential)

Energy storage
Response services
Reserve services
High energy user behind meter
Own use and community
Co-location

Scenario projections

Scope summary

i. West Midlands licence area
ii. 135 ESAs
iii. Generation, storage and demand technologies
iv. Annually from 2017 to 2030
v. Four scenarios defined by differing economic and levels of green ambition

DG and demand technologies growth scenarios:

Methodology

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Methodology stages

Stage 1

Baseline

- Number, capacity and nature of projects currently connected

Stage 2

Pipeline

- Pipeline projection of projects to 2020 where possible

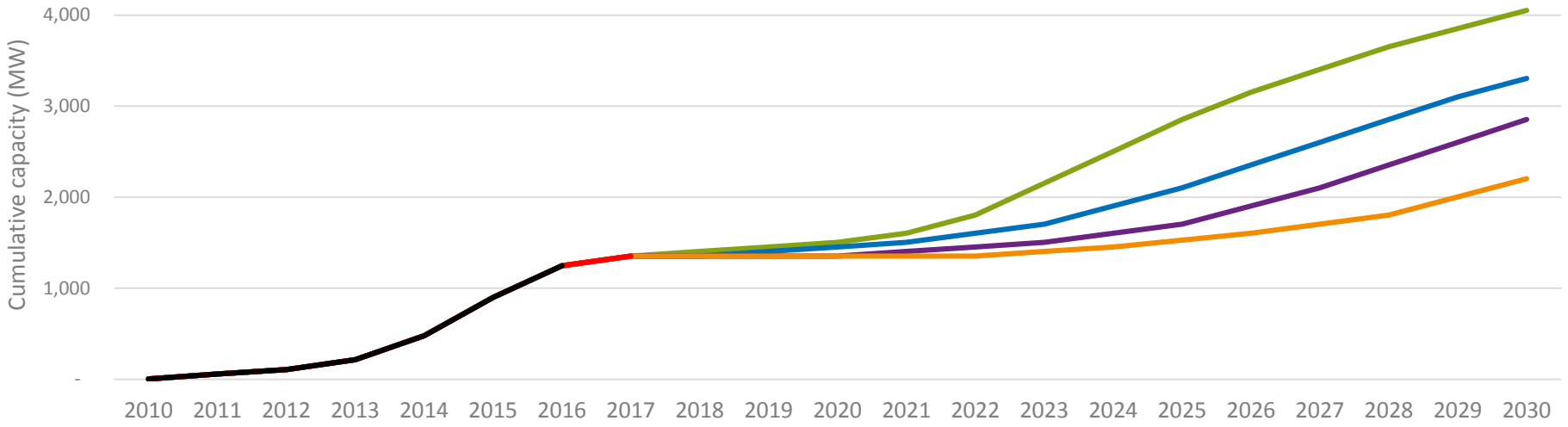
Stage 3

Scenarios

- Scenario projections out to 2030

Illustrative graphical representation of method

Baseline → **Pipeline** → **Scenarios**



Current baseline

WPD connection data, Regen national renewables project database, FiT data, ROC data, plus other publicly available data

Pipeline projection

Analysis of current projects in the planning system and with grid connection agreements for large scale technologies. Dependent on technology when projection goes out to.

Growth scenarios (to 2030)

Growth scenarios based on National Grid's FES- applied at a local level

- Gone Green
- Consumer Power
- Slow Progression
- No Progression

Stage 1 - Baseline (2017)

Key sources of data

- Regen progress report for renewable energy
- Plug-in electric vehicle grants
- Anonymised DVLA EV registered keeper data
- AddressBase (Ordnance Survey) data

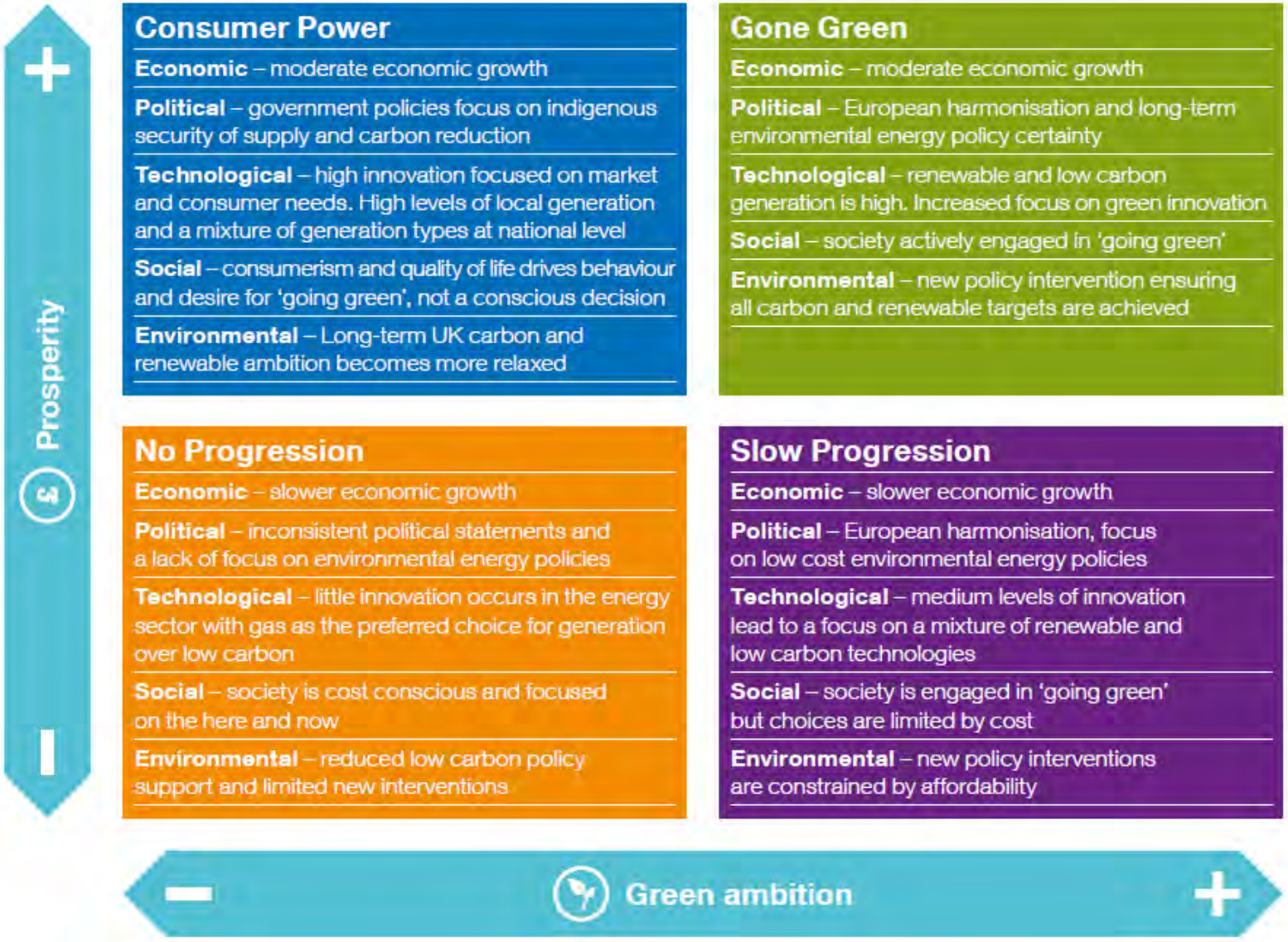
Stage 2 - Pipeline (2017-2020)

Key sources of data

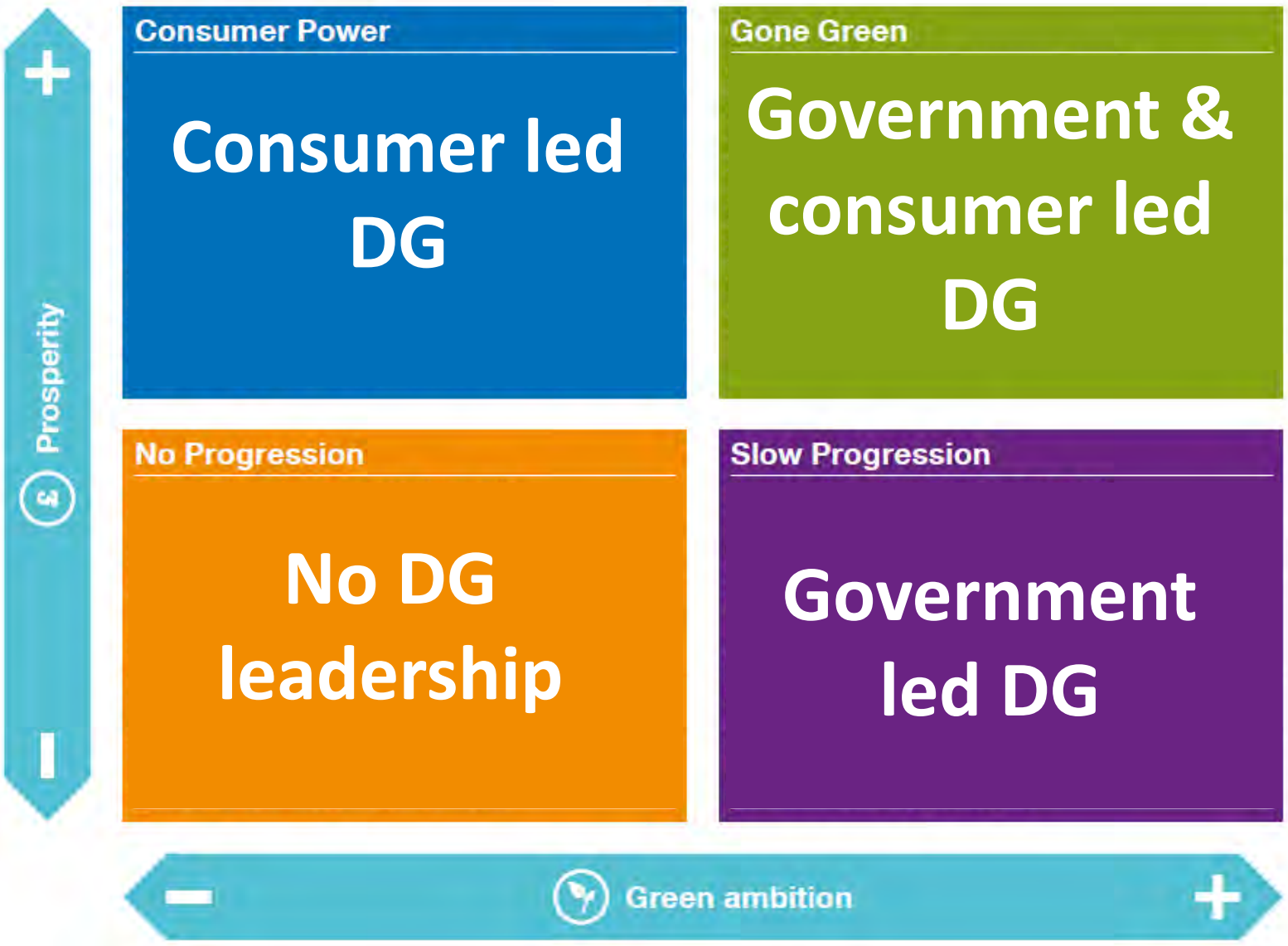
- Less applicable to demand technologies
- Local plans for residential and non-residential projections
- Data validation with local authorities

Stage 3 - Future Energy Scenarios (FES)

Stage 3 - Future Energy Scenarios (FES)



Stage 3 - Future Energy Scenarios (FES)



DG and demand technologies growth scenarios:

Building the scenario projections

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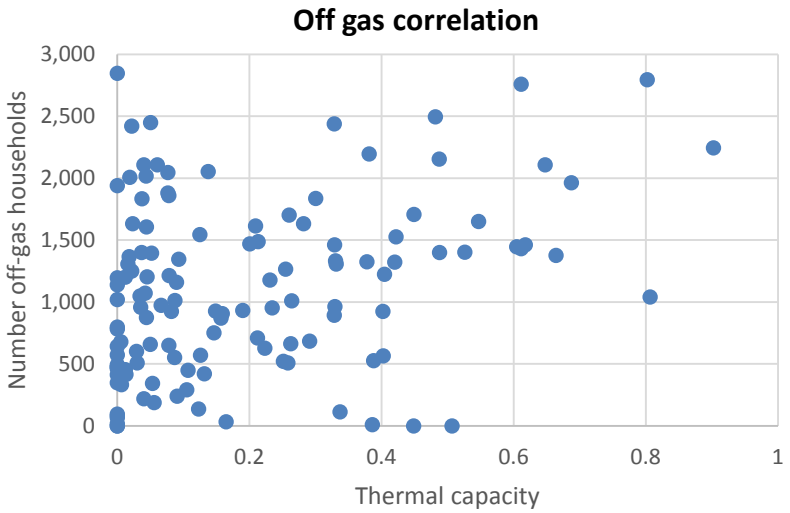
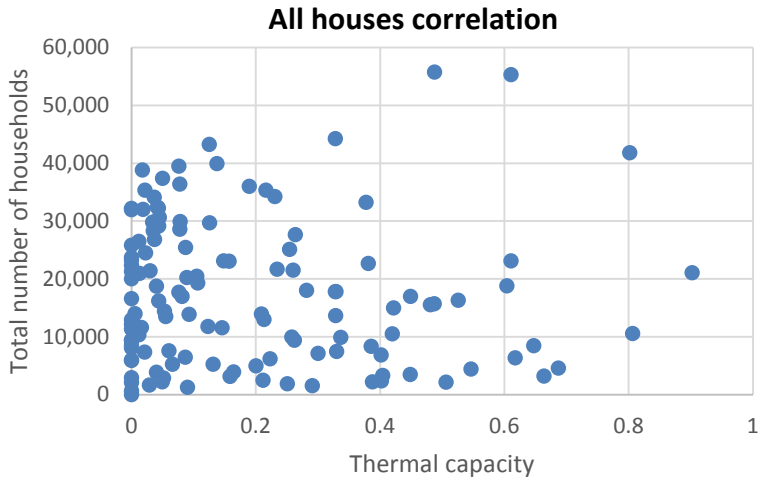
Scenarios: past trends

- Analyse existing trends
- Human and environmental factors
- Baseline and Pipeline
- Current geographical distribution

Correlation between the number of off gas houses and the thermal capacity of heat pumps in each of the West Midlands licence area's ESAs

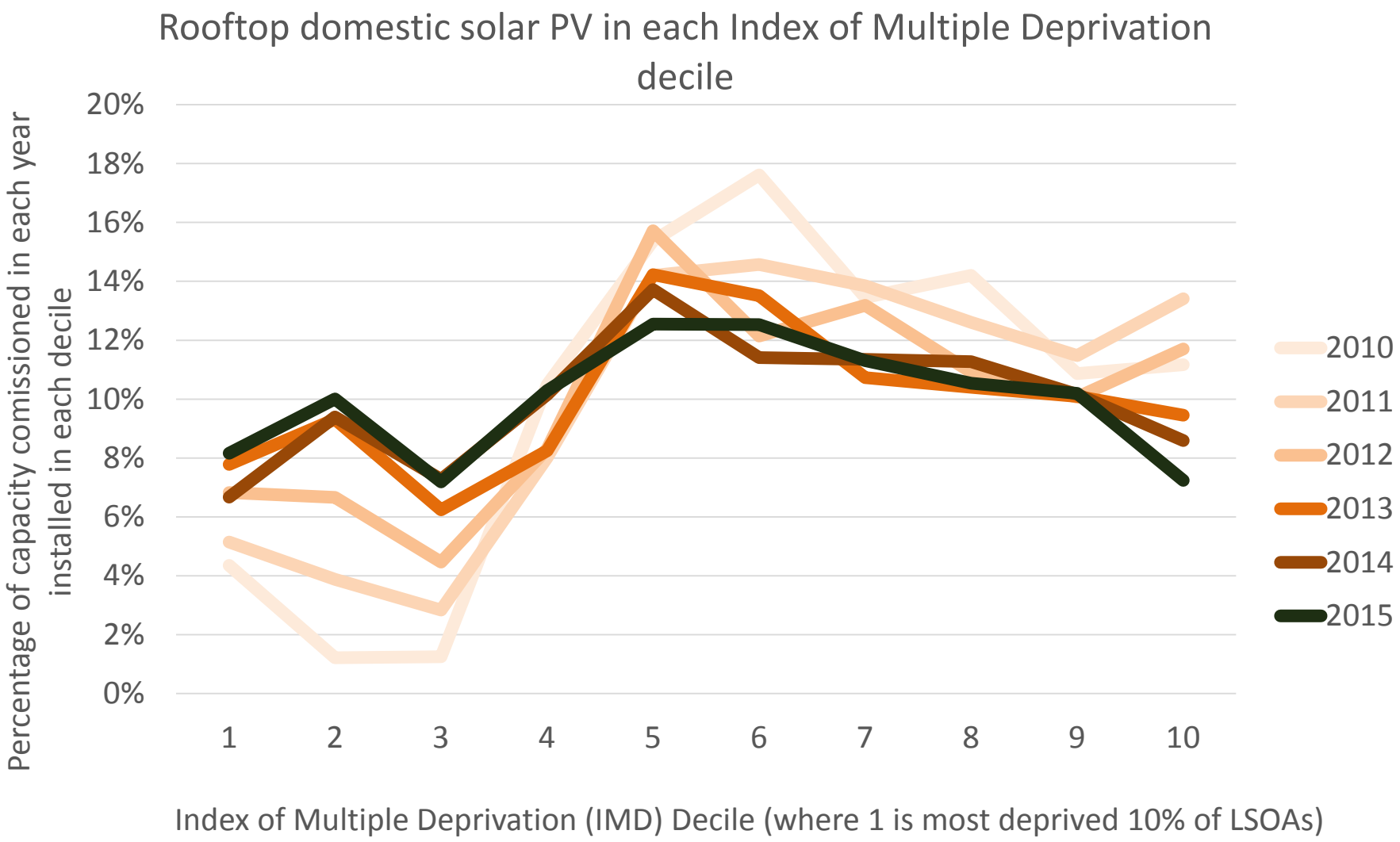




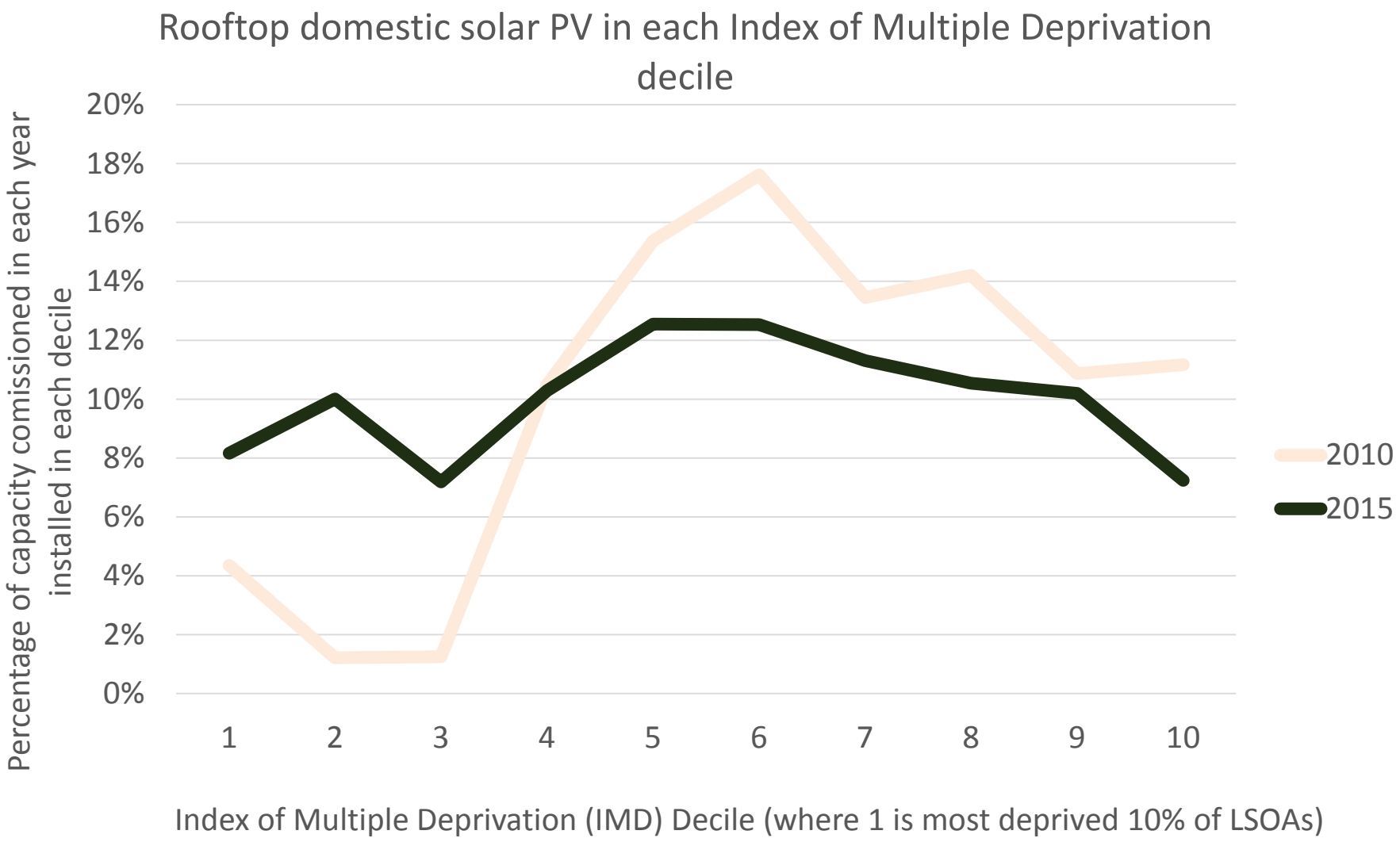
Scenarios: emerging trends

- Greater distribution of domestic technologies
- Emerging new business models
- Electric vehicles purchasing
- Co-location of renewables

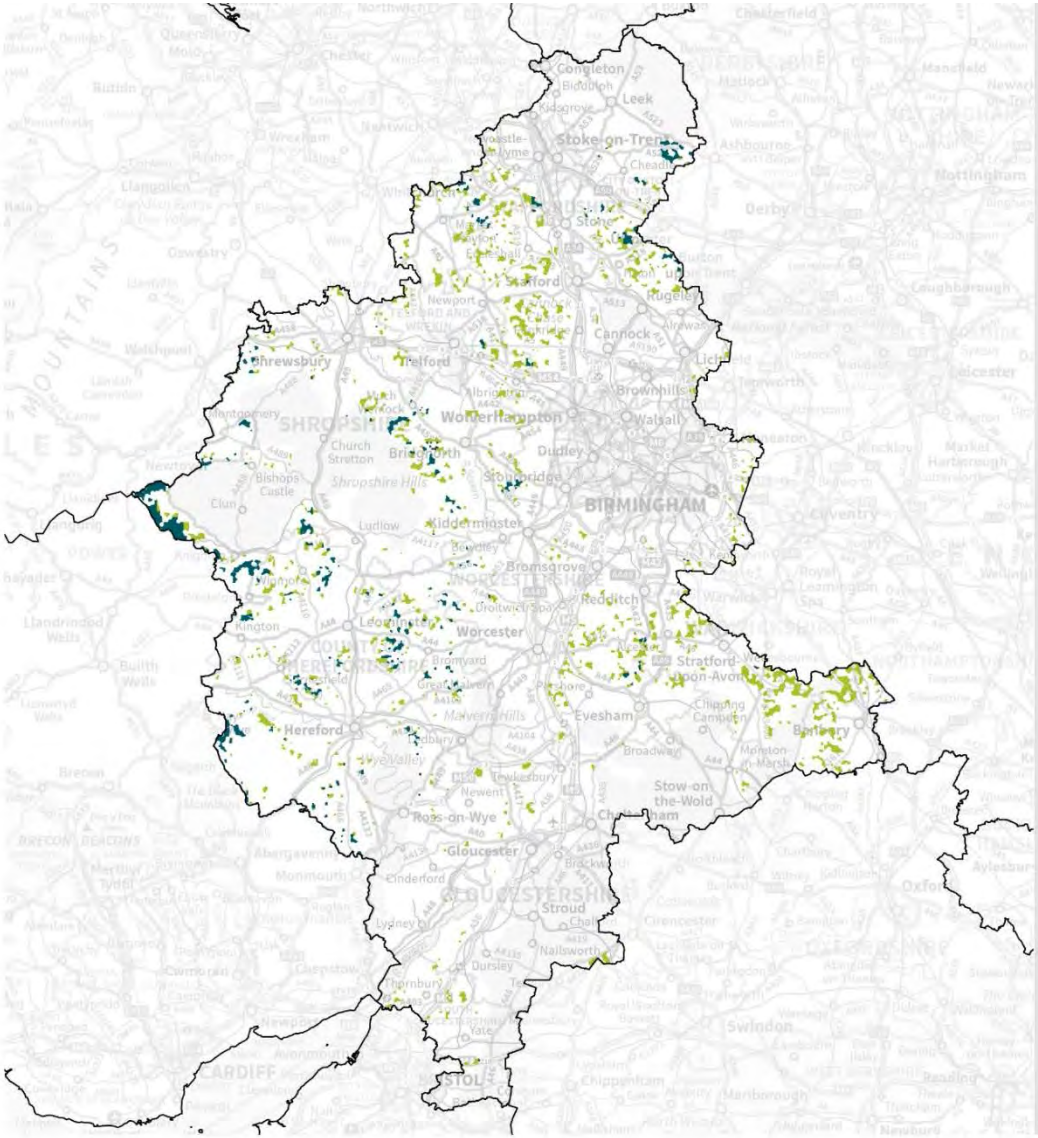
Scenarios: emerging trends



Scenarios: emerging trends



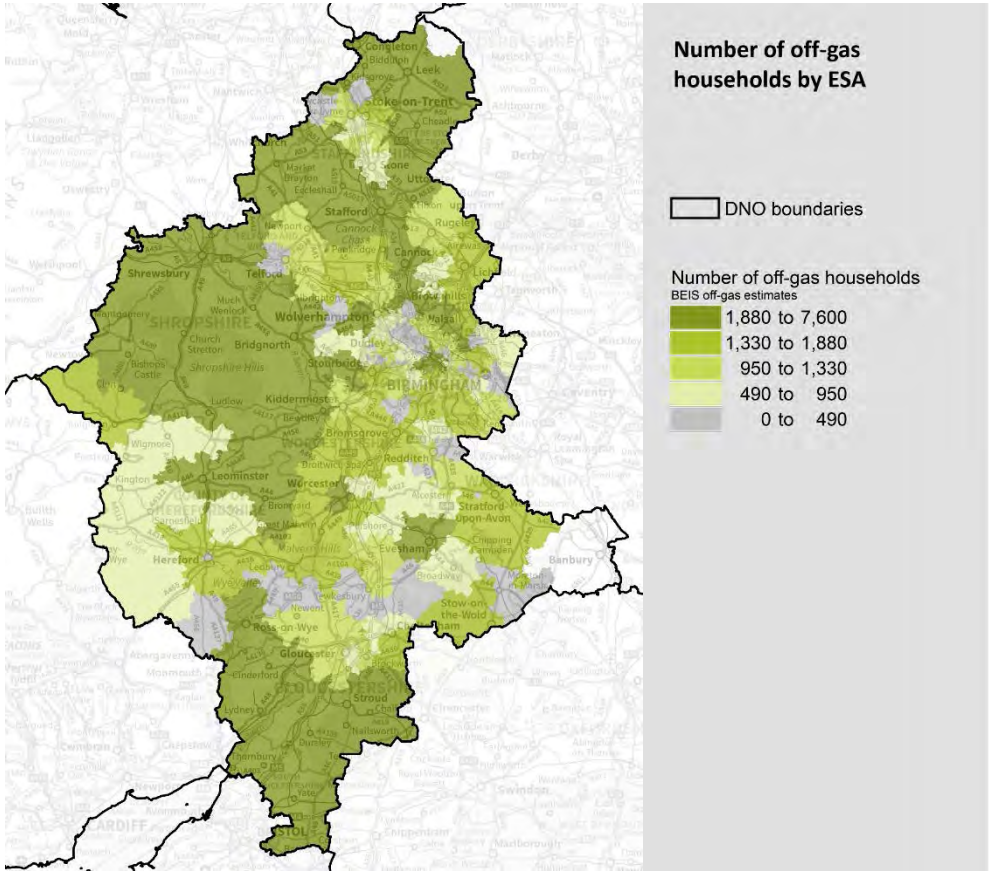
Scenarios: resource assessments



Building the scenarios: spatial data

Spatial data

- Deprivation index
- Off-gas areas
- Planning environment
- Housing density
- Community groups



DG and demand technologies growth scenarios:

Initial results – electric vehicles

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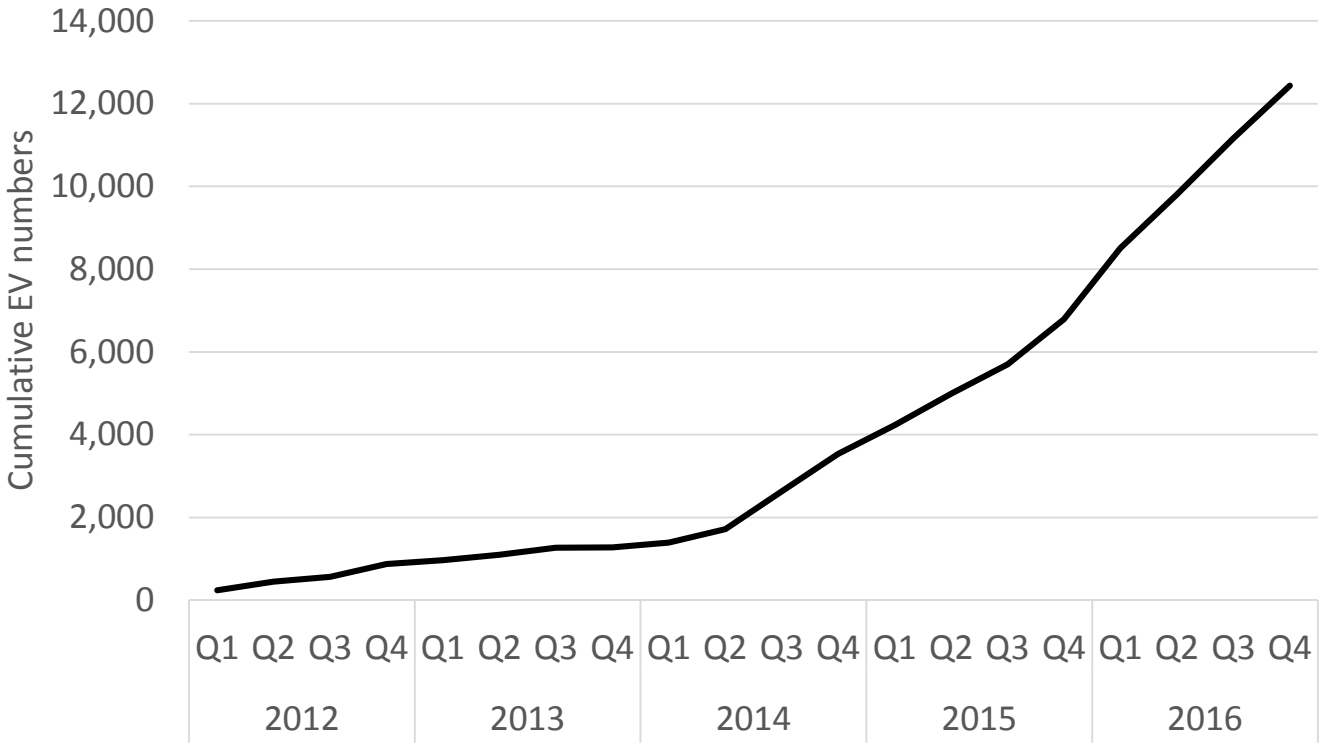
Electric vehicles - baseline

Cumulative growth of pure and plug-in hybrid electric vehicles in the West Midlands licence area



	Number of EVs purchased in year
2012	633
2013	313
2014	2,138
2015	2,563
2016	3,932

Scenario growth factors – electric vehicles

Potential factors enabling electric vehicle uptake	GG	CP	SP	NP
Government influenced factors				
Continued programme of grants for electric vehicle purchases post-2018	●			
Public sector led programme of investment in electric vehicle infrastructure	●		●	
Strengthened legislation restricting the use of diesel vehicles	●		●	
Electric vehicles continue to be exempt from road tax	●	●	●	
Technology costs and development				
Costs continue to fall rapidly due to investment in the UK market	●	●		
Performance of electric vehicles improves rapidly due to R&D investment	●	●		
Availability of finance				
Strong economy means individuals, communities and small businesses have capital available to buy new cars	●	●		
Other factors				
Consumer appetite for electric cars increases, with high profile endorsements	●	●	●	

Electric vehicles – growth scenarios

Estimates for EV penetration by 2020 vary by 11x, depending on the source

Consider the range of EV adoption from these trusted sources:

- 1% - US EIA
- 3% - Deloitte
- 5% - Boston Consulting Group
- 7% - CIMB
- 7% - Roland Berger
- 10% - PwC
- 11% - Deutsche Bank

Source - A Confusing Debate: Electric Vehicle Growth Projections - Christopher Wedding, PhD

Electric vehicles – growth scenarios

And how about projections for EVs as a percentage of all new car sales?

- 15-30% of global vehicle sales, by 2030 - Source: Total
- 35% of global vehicle sales, by 2040 - Source: Bloomberg
- 12-85% of U.S. vehicle sales, by 2030 - Source: Wood Mackenzie
- 65-90% of global vehicle sales, by 2040 - Source: On Climate Change Policy

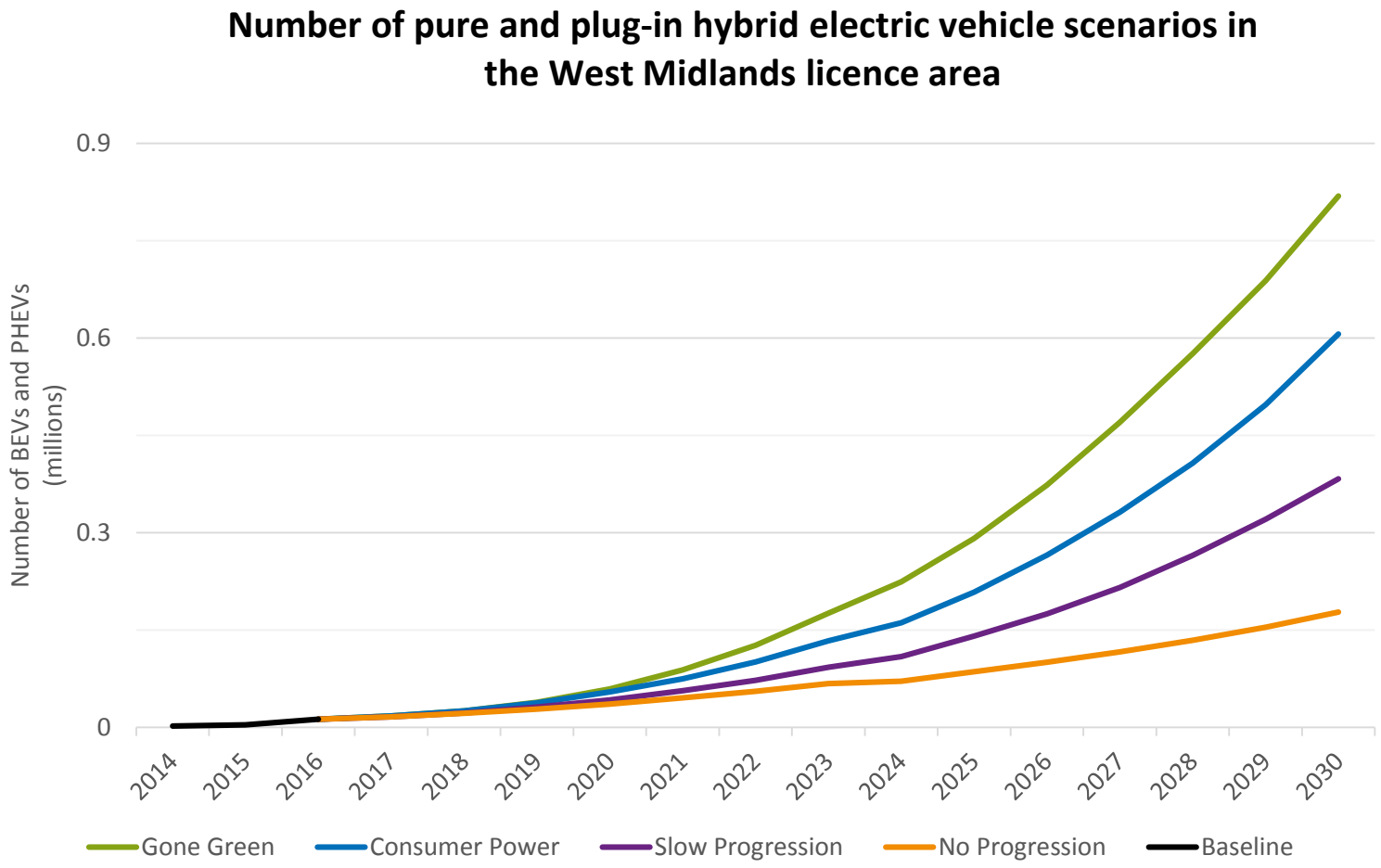
Source - A Confusing Debate: Electric Vehicle Growth Projections - Christopher Wedding, PhD

Electric vehicles – growth scenarios

Percentage of new vehicles being plug in hybrid and pure electric vehicles

	2017	2020	2025	2030
Gone Green	2.0%	8.1%	28.8%	67.5%
Consumer Power	2.0%	6.8%	20.7%	54.0%
Slow Progression	1.8%	5.7%	14.0%	31.5%
No Progression	1.8%	4.0%	7.2%	13.5%

Electric vehicles – growth scenarios



DG and demand technologies growth scenarios:

Initial results – heat pumps

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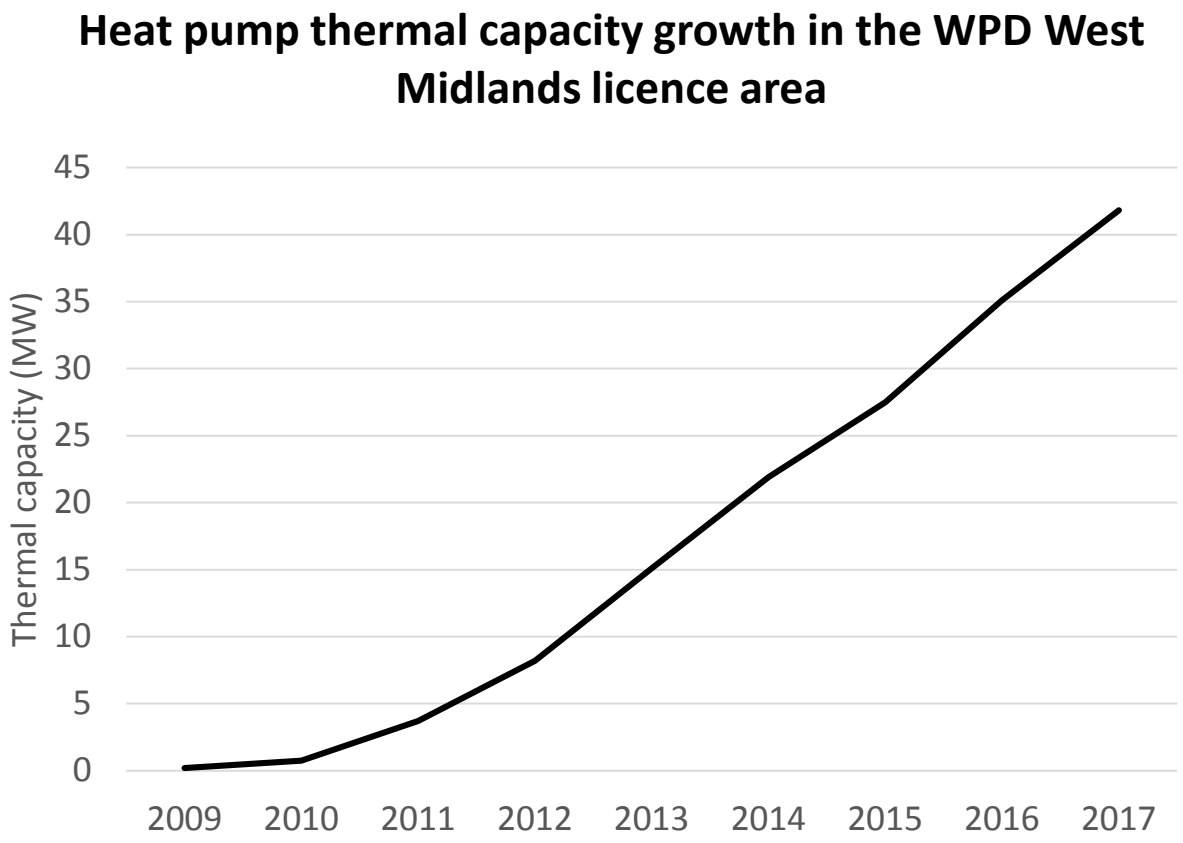
Heat pumps baseline

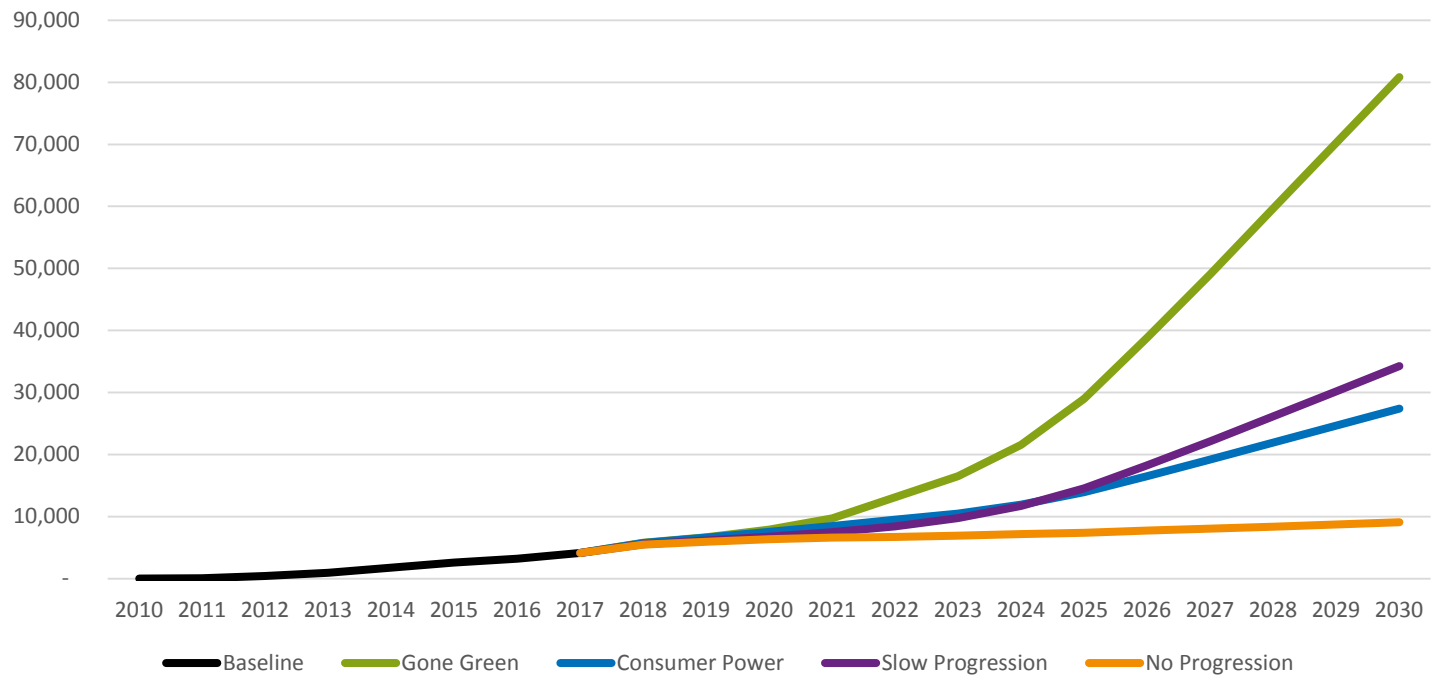


Scenario growth factors – heat pumps

Potential factors enabling heat pump deployment	GG	CP	SP	NP
Government influenced factors				
Government heat policy includes drivers for heat pumps, including continued/ expanded RHI	●		●	
Energy efficiency standards for new properties are tightened, either through national building regulations or widespread local planning policies	●		●	
Technology costs				
Upfront costs of conventional heat pumps falls due to strong markets and R&D	●	●		
Technological innovation – emerging technologies become more established enabling new applications and cost reductions	●	●		
Wholesale price of power and gas				
Rising electricity and gas wholesale price – potentially driven by economic growth	●	●		
Availability of finance				
Strong economy means individuals, communities and small businesses have capital available to invest	●	●		
Other factors				
Consumer appetite for heat pump technology increases	●			
Public sector investment programmes drive installations in local areas	●		●	

Heat pumps

Scenarios for the number of heat pumps in the West Midlands licence area



Identifying new residential and non-residential developments:
Methodology

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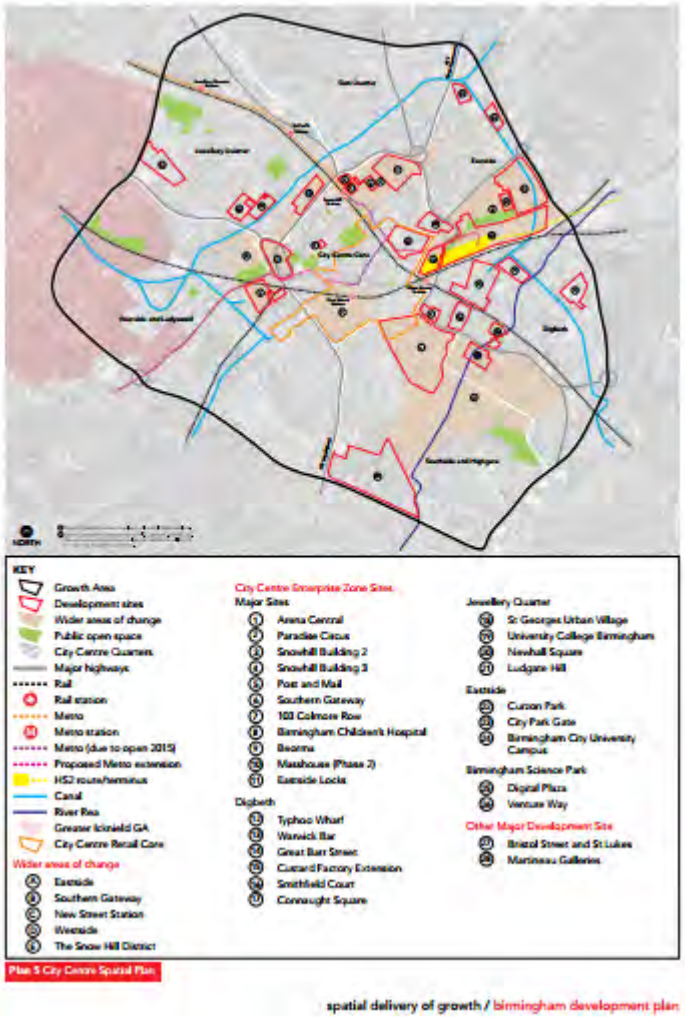
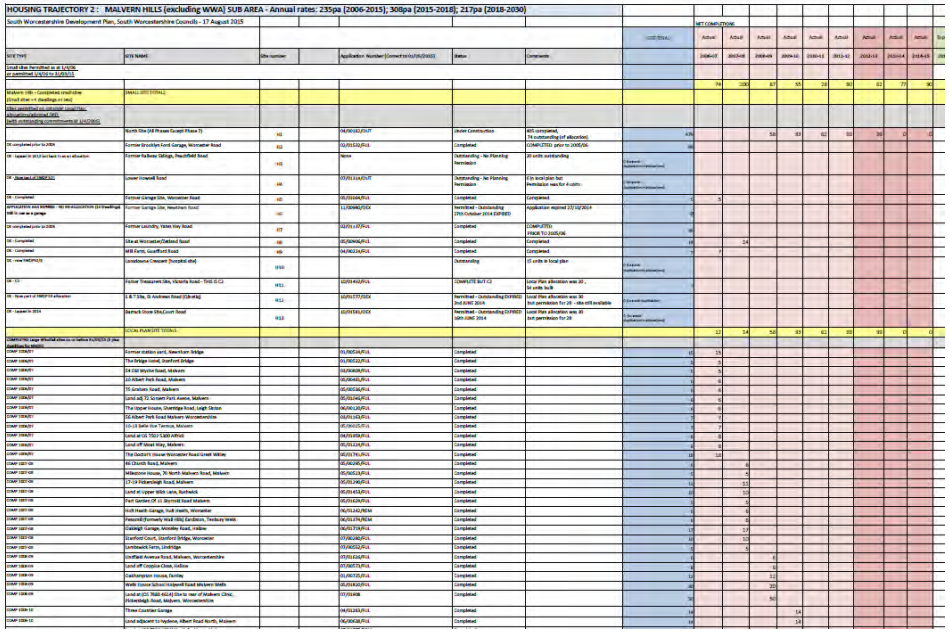
Data sources



Data sources

SHLAA 2016

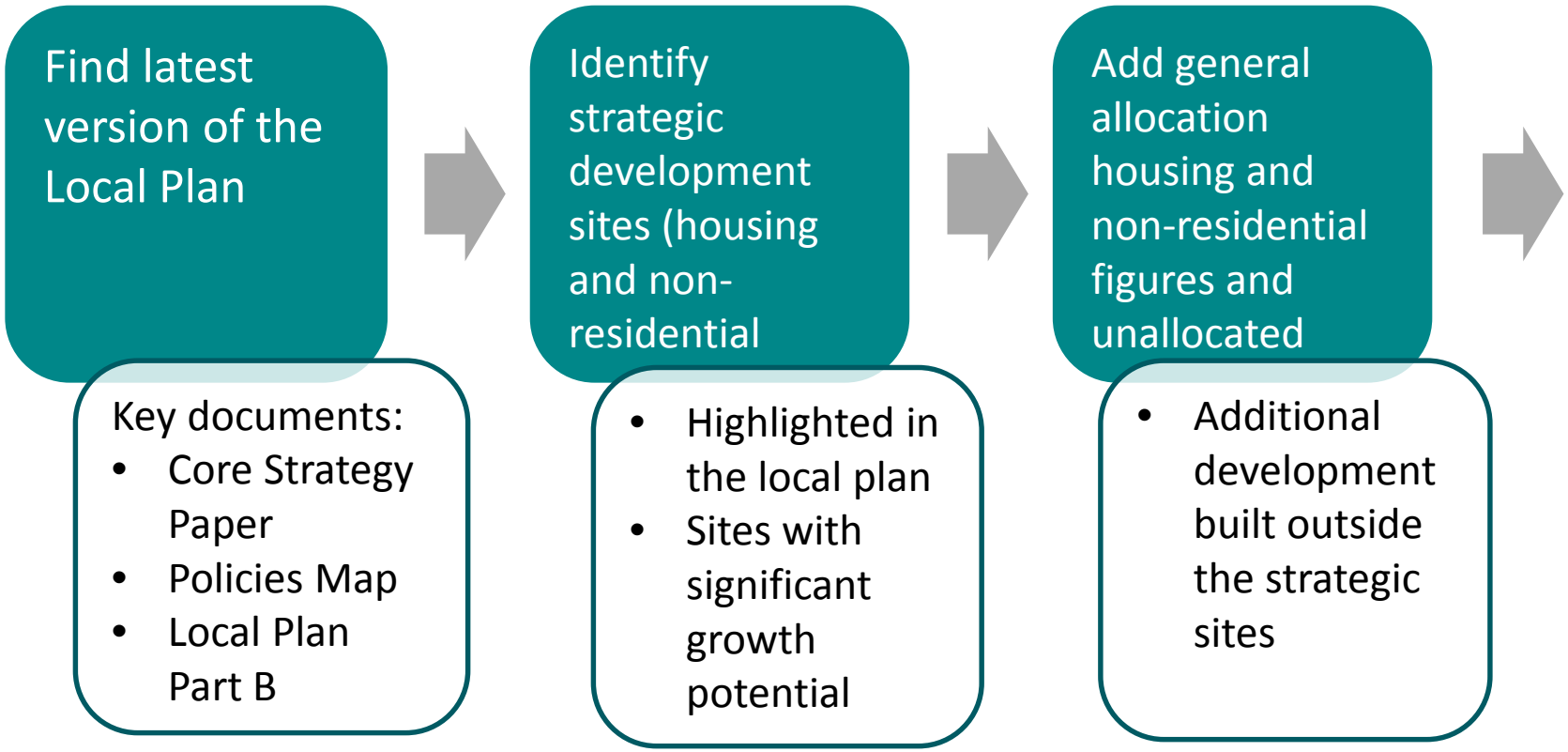
Ref:	Address:	Details	Size (Ha):	within 5 Years	6-10 years	beyond 10 years
CC1	Ledsam Street	Allocated in Adopted Plan	3.38	0	0	152
		Birmingham Development Plan. Greater Icknield Masterplan				
CC2	83 to 97 Camden Street	Other Opportunity in BDP Growth Area	0.39	0	0	20
		Identified by City Council. Expired Planning Permission				
CC10	Barr Street 154-156	Other Opportunity in BDP Growth Area	0.12	0	8	0
		Previously allocated in plan				
CC13	41 Cuild Close	Other Opportunity in BDP Growth Area	0.14	0	0	5
		Identified by City Council Officers				
CC26	Land bounded by Hospital St / Summer La / Henrietta St / Hampton St	Other Opportunity in BDP Growth Area	0.5	0	0	50
		Identified by Consultants				
CC28	27-51 Constitution Hill	Other Opportunity in BDP Growth Area	0.11	0	0	8
		Identified by Consultants				
CC29	Land bounded by Henrietta St / Buckingham Road / Hampton St / Hospital St	Other Opportunity in BDP Growth Area	1.28	0	0	90
		Identified by Consultants				
CC30	Land bounded by Hampton St / Motts St / Buckingham St	Other Opportunity in BDP Growth Area	0.42	0	0	29
		Identified by Consultants				
CC31	Land bounded by Motts St / Howard St / Hampton St / Constitution Hill	Other Opportunity in BDP Growth Area	1.24	0	0	87
		Identified by Consultants				
CC33	Rear of 70 -80 Unett St	Other Opportunity in BDP Growth Area	0.09	0	0	6
		Previously Allocated in Plan				
CC34	Lower Loveday St / Hanley St / Princip St / New Town Row	Other Opportunity in BDP Growth Area	2.84	0	0	191
		Identified by Consultants				
CC35	Junction of Band St & Constitution Hill	Other Opportunity in BDP Growth Area	0.12	0	0	8
		Identified by Consultants				
CC42	Adj 240 Holiday St	Other Opportunity in BDP Growth Area	0.19	0	0	13
		Identified by Consultants				
CC43	82 Granville St	Other Opportunity in BDP Growth Area	0.16	0	0	11
		Identified by Consultants				
CC45	White Swan Public House Grosvernor St West	Under Construction	0.15	3	0	0
		2013/03227/PA				



HOUSING TRAJECTORY 2 : MALVERN HILLS (excluding WWA) SUB AREA - Annual rates: 235pa (2006-2015); 308pa (2015-2018); 217pa (2018-2030)

South Worcestershire Development Plan, South Worcestershire Councils - 17 August 2015

Method to identify new developments



Method to identify new developments

Use housing trajectory to outline dwelling build out rates

- Annual build out rates
- Or total figures spread equally across the plan period

Non-residential sites phasing and usage type

- Building use proposed
- Developments over 50,000m² split across plan period

Assign to ESA

- Using policies map/specific inset maps
- Or using site name to identify location

Method to identify new developments

If up to date version of local plan unavailable alternative data sources used

- Strategic Housing Land Availability Assessment (SHLAA)
- Employment Land Review

SHLAA identifies available sites within a local authority

- Updated regularly for each planning authority
- Covers next 5 years of housing development

Employment land review assesses future supply

- Focus on 'B class' employment uses
- Some analysis of retail, healthcare, education uses

Method to identify new developments

QA stage:
contact all local authorities in licence area to check figures

Predominantly highlighted use of

- Monitoring reports
- SHLAA
- Employment land reviews
- Site Allocations Document

Scenarios for new demand

Apply scenario growth factors to data

Scenario 1 High economic growth: Consumer Power & Gone Green

High growth rates with build out rate matches targets given in local plan

Scenario 2 Low economic growth: Slow Progression & No Progression

Strategic sites: likely to go ahead but with delays

- Based on the development stage of local plan

General allocation and unallocated: total number of dwellings reduced

- Based on previous trends - total annual completed build figures in the UK

Final database

	Development name	Development name version	Local authority	ESA	Allocation type	Number of homes	Development plan stage	Local Plan to SHLAA	SHLAA stage / planning	Link to information	End of plan period	Notes	submitted or adopted date	Scenario 1 - Higher economic scenario - Gone Green and Const
3	Greenhill lane, Leabrooks		1 Amber Va	ALFRETON 33kV S STN	General allocation	29	Adopted	SHLAA	Planning pe	http://info.ambervalley.gov.uk/do	2020		01/04/2016	
4	Hands Road, Heanor		1 Amber Va	HEANOR 33kV S STN	General allocation	99	Adopted	SHLAA	Planning pe	http://info.ambervalley.gov.uk/do	2019		01/04/2016	
5	Cromford Road, Langley Mill		1 Amber Va	HEANOR 33kV S STN	General allocation	71	Adopted	SHLAA	Planning pe	http://info.ambervalley.gov.uk/do	2020		01/04/2016	
6	Church street, Heanor		1 Amber Va	HEANOR 33kV S STN	General allocation	12	Adopted	SHLAA	Planning pe	http://info.ambervalley.gov.uk/do	2018		01/04/2016	
7	Delves Court, Heanor		1 Amber Va	HEANOR 33kV S STN	General allocation	32	Adopted	SHLAA	Planning pe	http://info.ambervalley.gov.uk/do	2017		01/04/2016	
8	Salcombe Road, Alfreton		1 Amber Va	ALFRETON 33kV S STN	General allocation	21	Adopted	SHLAA	Planning pe	http://info.ambervalley.gov.uk/do	2020		01/04/2016	
9	King Street, Alfreton		1 Amber Va	ALFRETON 33kV S STN	General allocation	11	Adopted	SHLAA	Planning pe	http://info.ambervalley.gov.uk/do	2017		01/04/2016	
10	Mansfield Road, Alfreton		1 Amber Va	ALFRETON 33kV S STN	General allocation	10	Adopted	SHLAA	Planning pe	http://info.ambervalley.gov.uk/do	2025		01/04/2016	
11	Lea Road, Lea Bridge		1 Amber Va	WINSTER 33kV S STN	General allocation	26	Adopted	SHLAA	Planning pe	http://info.ambervalley.gov.uk/do	2018		01/04/2016	
12	Bradshaw avenue, Riddings		1 Amber Va	HEANOR 33kV S STN	General allocation	93	Adopted	SHLAA	Planning pe	http://info.ambervalley.gov.uk/do	2018		01/04/2016	
13	Cemetary Road, Ripley		1 Amber Va	HEANOR 33kV S STN	General allocation	20	Adopted	SHLAA	Planning pe	http://info.ambervalley.gov.uk/do	2025		01/04/2016	
14	Wyatts Way, Ripley		1 Amber Va	HEANOR 33kV S STN	General allocation	185	Adopted	SHLAA	Planning pe	http://info.ambervalley.gov.uk/do	2025		01/04/2016	
15	Station Road, Langley Mill		1 Amber Va	HEANOR 33kV S STN	General allocation	99	Adopted	SHLAA	Planning pe	http://info.ambervalley.gov.uk/do	2025		01/04/2016	
16	Parkside close, Ironville		1 Amber Va	HEANOR 33kV S STN	General allocation	60	Adopted	SHLAA	Planning pe	http://info.ambervalley.gov.uk/do	2025		01/04/2016	
17	Bulbridge Hill, Ambergate		1 Amber Va	HEANOR 33kV S STN	General allocation	85	Adopted	SHLAA	Planning pe	http://info.ambervalley.gov.uk/do	2025		01/04/2016	
18	Bulbridge Hill, Ambergate		2 Amber Va	ALFRETON 33kV S STN	General allocation	85	Adopted	SHLAA	Planning pe	http://info.ambervalley.gov.uk/do	2025		01/04/2016	
19	Eastview Terrace, Langley Mill		1 Amber Va	HEANOR 33kV S STN	General allocation	40	Adopted	SHLAA	Planning pe	http://info.ambervalley.gov.uk/do	2020		01/04/2016	
20	Black horse inn, Somercotes		1 Amber Va	ALFRETON 33kV S STN	General allocation	18	Adopted	SHLAA	Planning pe	http://info.ambervalley.gov.uk/do	2025		01/04/2016	
21	Former Thorntons factory, Belper		1 Amber Va	ALFRETON 33kV S STN	General allocation	50	Adopted	SHLAA	Planning pe	http://info.ambervalley.gov.uk/do	2019		01/04/2016	
22	Derwent Street, Belper		1 Amber Va	SPONDON 33kV S STN	General allocation	107	Adopted	SHLAA	Planning pe	http://info.ambervalley.gov.uk/do	2020		01/04/2016	
23	Pit lane, Shipley		1 Amber Va	STANTON 33kV S STN	General allocation	308	Adopted	SHLAA	Planning pe	http://info.ambervalley.gov.uk/do	2025		01/04/2016	
24	Holborn View, Condor		1 Amber Va	HEANOR 33kV S STN	General allocation	79	Adopted	SHLAA	Planning pe	http://info.ambervalley.gov.uk/do	2021		01/04/2016	
25	Roes lane, Crich		1 Amber Va	ALFRETON 33kV S STN	General allocation	108	Adopted	SHLAA	Planning pe	http://info.ambervalley.gov.uk/do	2019		01/04/2016	
26	Crich Road, Fritchley		1 Amber Va	HEANOR 33kV S STN	General allocation	16	Adopted	SHLAA	Planning pe	http://info.ambervalley.gov.uk/do	2017		01/04/2016	
27	Kilbourne Road, Belper		1 Amber Va	SPONDON 33kV S STN	General allocation	14	Adopted	SHLAA	Planning pe	http://info.ambervalley.gov.uk/do	2017		01/04/2016	
28	Home farm, coach road, Ripley		1 Amber Va	HEANOR 33kV S STN	General allocation	31	Draft	SHLAA	In planning	http://info.ambervalley.gov.uk/do	2019		01/04/2016	
29	Loves Hill, Ripley		1 Amber Va	HEANOR 33kV S STN	General allocation	86	Draft	SHLAA	In planning	http://info.ambervalley.gov.uk/do	2025		01/04/2016	
30	Greenhillocks, Ripley		1 Amber Va	HEANOR 33kV S STN	General allocation	154	Draft	SHLAA	In planning	http://info.ambervalley.gov.uk/do	2025		01/04/2016	
31	Adale Road, Smalley		1 Amber Va	HEANOR 33kV S STN	General allocation	22	Draft	SHLAA	In planning	http://info.ambervalley.gov.uk/do	2017		01/04/2016	
32	Millford Mills, Millford		1 Amber Va	SPONDON 33kV S STN	General allocation	69	Draft	SHLAA	In planning	http://info.ambervalley.gov.uk/do	2018		01/04/2016	
33	Meadow Lane, Alfredo		1 Amber Va	ALFRETON 33kV S STN	General allocation	50	Draft	SHLAA	In planning	http://info.ambervalley.gov.uk/do	2018		01/04/2016	
34	Main Road, Pye bridge		1 Amber Va	HEANOR 33kV S STN	General allocation	17	Draft	SHLAA	In planning	http://info.ambervalley.gov.uk/do	2025		01/04/2016	
35	Evans Concrete, Peasehill road, Ripley		1 Amber Va	HEANOR 33kV S STN	General allocation	27	Draft	SHLAA	In planning	http://info.ambervalley.gov.uk/do	2017		01/04/2016	
36	Newlands drive, Riddings		1 Amber Va	HEANOR 33kV S STN	General allocation	18	Draft	SHLAA	In planning	http://info.ambervalley.gov.uk/do	2017		01/04/2016	
37	Maple avenue, Ripley		1 Amber Va	HEANOR 33kV S STN	General allocation	21	Draft	SHLAA	In planning	http://info.ambervalley.gov.uk/do	2025		01/04/2016	
38	Waingroves Road, Ripley		1 Amber Va	HEANOR 33kV S STN	General allocation	84	Draft	SHLAA	In planning	http://info.ambervalley.gov.uk/do	2019		01/04/2016	
39	Heanor Road, Smalley		1 Amber Va	HEANOR 33kV S STN	General allocation	120	Draft	SHLAA	In planning	http://info.ambervalley.gov.uk/do	2020		01/04/2016	
40	Eachwell Lane, Alfreton		1 Amber Va	ALFRETON 33kV S STN	General allocation	140	Draft	SHLAA	In planning	http://info.ambervalley.gov.uk/do	2019		01/04/2016	
41	Nottingham Road, Ripley		1 Amber Va	HEANOR 33kV S STN	General allocation	126	Draft	SHLAA	In planning	http://info.ambervalley.gov.uk/do	2018		01/04/2016	
42	Fall Road, Heanor		1 Amber Va	HEANOR 33kV S STN	General allocation	176	Draft	SHLAA	In planning	http://info.ambervalley.gov.uk/do	2021		01/04/2016	
43	Loscoe Miners Welfare		1 Amber Va	HEANOR 33kV S STN	General allocation	68	Draft	SHLAA	In planning	http://info.ambervalley.gov.uk/do	2025		01/04/2016	
44	Coast hill, Crich		1 Amber Va	ALFRETON 33kV S STN	General allocation	18	Draft	SHLAA	In planning	http://info.ambervalley.gov.uk/do	2019		01/04/2016	
45	Danseby Rise, Danseby		1 Amber Va	HEANOR 33kV S STN	General allocation	85	Draft	SHLAA	In planning	http://info.ambervalley.gov.uk/do	2021		01/04/2016	
46	Land at Radbourne lane		1 Amber Va	Derby 132/33	Strategic site	390	Adopted	SHLAA	Planning pe	http://info.ambervalley.gov.uk/do	2020		01/04/2016	
47	Outseats Farm, Alfreton		1 Amber Va	ALFRETON 33kV S STN	Strategic site	317	Draft	SHLAA	In planning	http://info.ambervalley.gov.uk/do	2028		01/04/2016	
48	Coppice farm, Peasehill Road, Ripley		1 Amber Va	HEANOR 33kV S STN	Strategic site	360	Draft	SHLAA	In planning	http://info.ambervalley.gov.uk/do	2025		01/04/2016	
49	Derby Road, Swanwick		1 Amber Va	HEANOR 33kV S STN	Strategic site	600	Draft	SHLAA	In planning	http://info.ambervalley.gov.uk/do	2032		01/04/2016	
50	Skegby Lane		1 Ashfield	MANSFIELD 33kV S ST	General allocation	250	Adopted	Local Plan		http://www.ashfield-dc.gov.uk/res	2032	No annua	06/10/2016	
51	Main st, Huthwaite		1 Ashfield	ANNESLEY 33kV S STN	General allocation	85	Adopted	Local Plan		http://www.ashfield-dc.gov.uk/res	2032	No annua	06/10/2016	
52	Ashland road west, Sutton		1 Ashfield	ANNESLEY 33kV S STN	General allocation	235	Adopted	Local Plan		http://www.ashfield-dc.gov.uk/res	2032	No annua	06/10/2016	
53	Coxmoor Road, Sutton		1 Ashfield	ANNESLEY 33kV S STN	General allocation	266	Adopted	Local Plan		http://www.ashfield-dc.gov.uk/res	2032	No annua	06/10/2016	
54	Chesterfield Road, Huthwaite		1 Ashfield	ANNESLEY 33kV S STN	General allocation	100	Adopted	Local Plan		http://www.ashfield-dc.gov.uk/res	2032	No annua	06/10/2016	
55	Priestsic Road, Ashfield		1 Ashfield	ANNESLEY 33kV S STN	General allocation	24	Adopted	Local Plan		http://www.ashfield-dc.gov.uk/res	2032	No annua	06/10/2016	
56	Beck Lane, Sutton		1 Ashfield	MANSFIELD 33kV S ST	General allocation	400	Adopted	Local Plan		http://www.ashfield-dc.gov.uk/res	2032	No annua	06/10/2016	

Growth in residential and non-residential developments:

Initial results

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regen
transforming energy

Initial results: housing developments

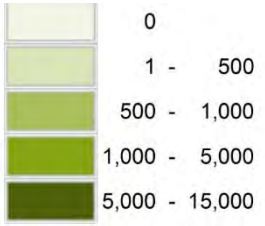
	Local authority	Total number of homes (up to 2030)	
		Higher economic scenario	Lower economic scenario
1	Birmingham	36895	21986
2	Worcester	24074	14392
3	Herefordshire	11242	7798
4	Stroud	11239	7022
5	Tewkesbury	10582	2988
6	Sandwell	10057	8818
7	Stafford	7990	4879
8	Malvern Hills	6783	4461
9	Cheltenham	6782	2345
10	Lichfield	6511	4732

Growth in new housing developments by ESA

Scenario 1:
Gone Green and Consumer Power

Scenario 2:
Slow Progression and No Progression

Number of homes by scenario and supply area
WPD West Midlands licence area



Initial results: non-residential developments

	Local Authority	Total non-residential (hectares) (up to 2030)	
		Higher economic scenario	Lower economic scenario
1	South Staffordshire	356	254
2	Birmingham	175	111
3	Shropshire	115	97
4	Worcester	97	60
5	Telford and Wrekin	94	37
6	Tewkesbury	87	5
7	Forest of Dean	67	67
8	Solihull	64	43
9	Wychavon	60	39
10	Stafford	57	28

Growth in non-residential developments: largest sites

Next steps

- Are the results what you would expect?
- Any information to add?
- Any questions/comments on the approach and outcomes

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Strategic Investment Options for Growth in the West Midlands Generation

23rd May 2017

Agenda – Session 2

12.45 **Lunch and arrival/registration**

13.30 **Welcome and generation investment strategy overview**

Ben Godfrey, Network Strategy Team Manager, WPD

14.10 **Generation scenarios development process**

Joel Venn, Senior Analyst, Regen

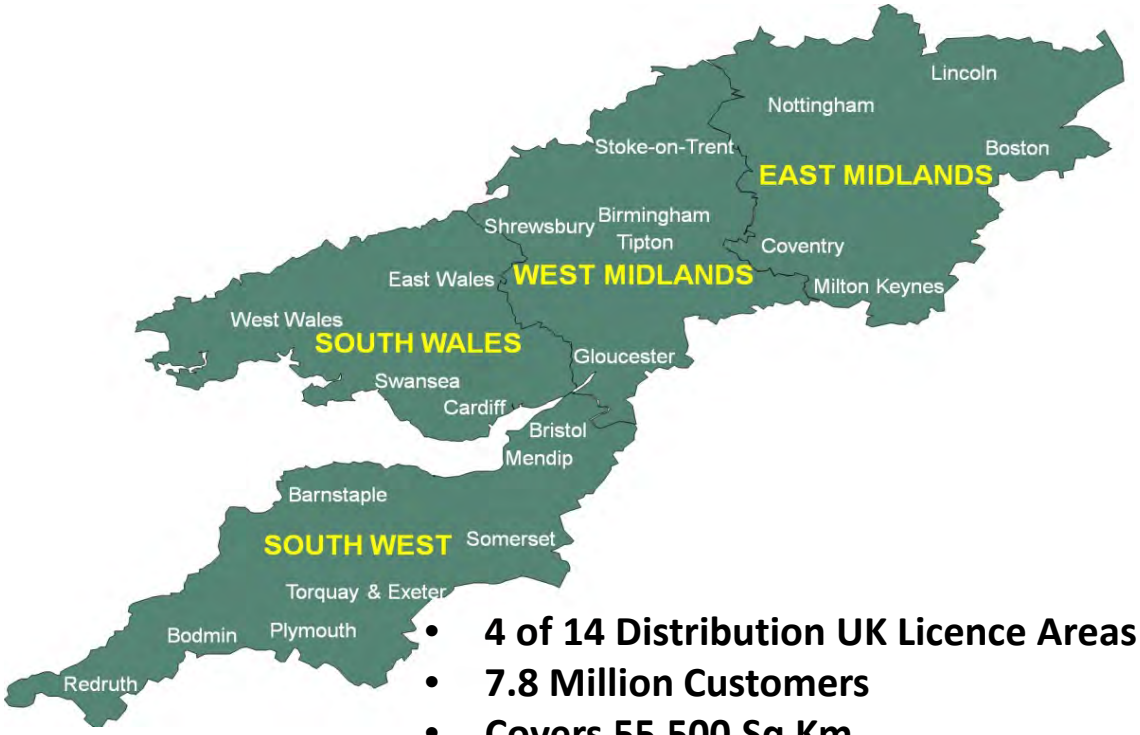
14.50 **Electricity storage scenarios development process**

Joel Venn, Senior Analyst, Regen

15.10 **Q&A with WPD and Regen presenters**

15.30 **Next steps and closing remarks**

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

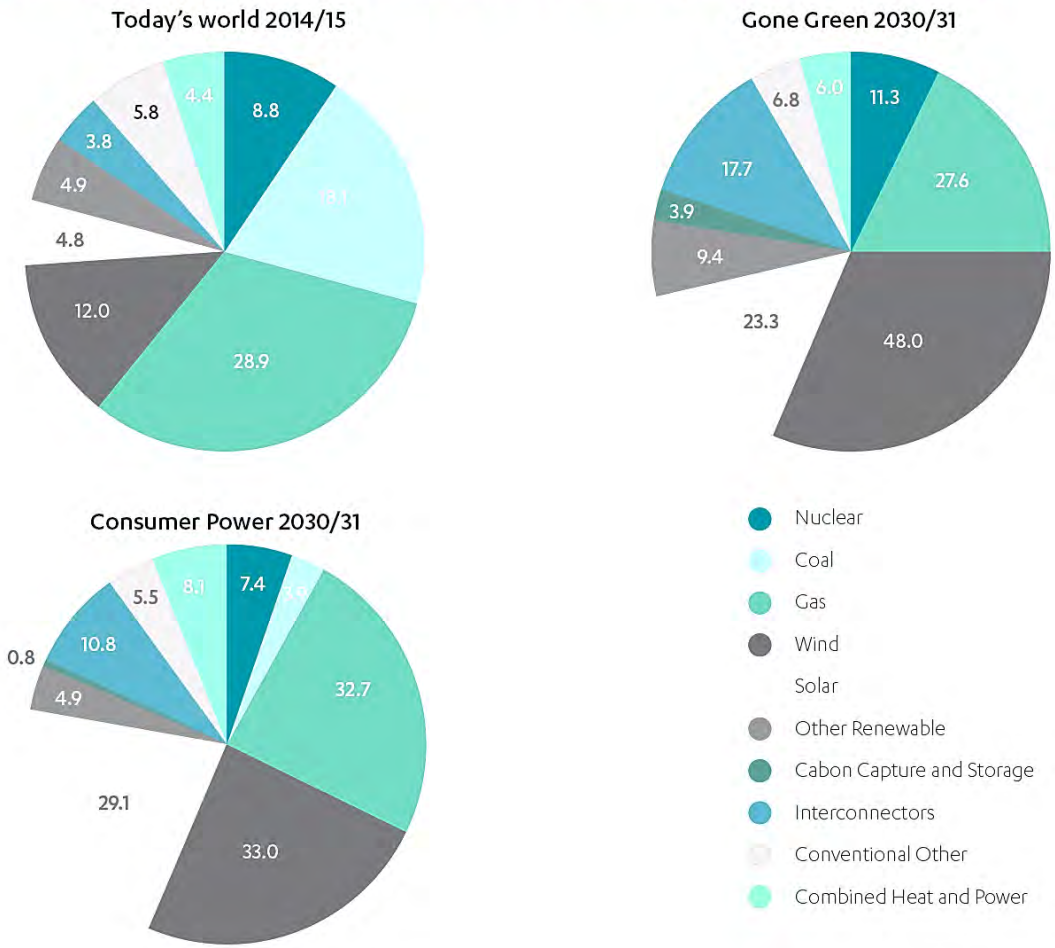
- Uncertainty in the future path of DG and DER growth
- Variability and volatility in network flows increasing; directionality of flow now critical
- 14GW Winter Peak; 20GW DG, 12% of Energy
- Significant and rapid growth in distributed generation leading to long delays and high costs for further connections
- Ofgem wanting to understand the value to the wider customer base if they were to fund strategic reinforcement
- Need to understand whether there are ‘no/low regret’ investment options
- What does Brexit mean for renewables, LCTs and electrical self sufficiency?

Demand investment strategy overview

- Western Power Distribution – Who are we?
- Drivers for the project
- Aim and approach of the study
- Timetable
- What else are we doing to help generation customers?

Significant uncertainty of future growth in electricity generation

Generation mix today and possible future scenarios (installed capacity (GW))[1]



Infrastructure Commission Smart Power Report March 2016

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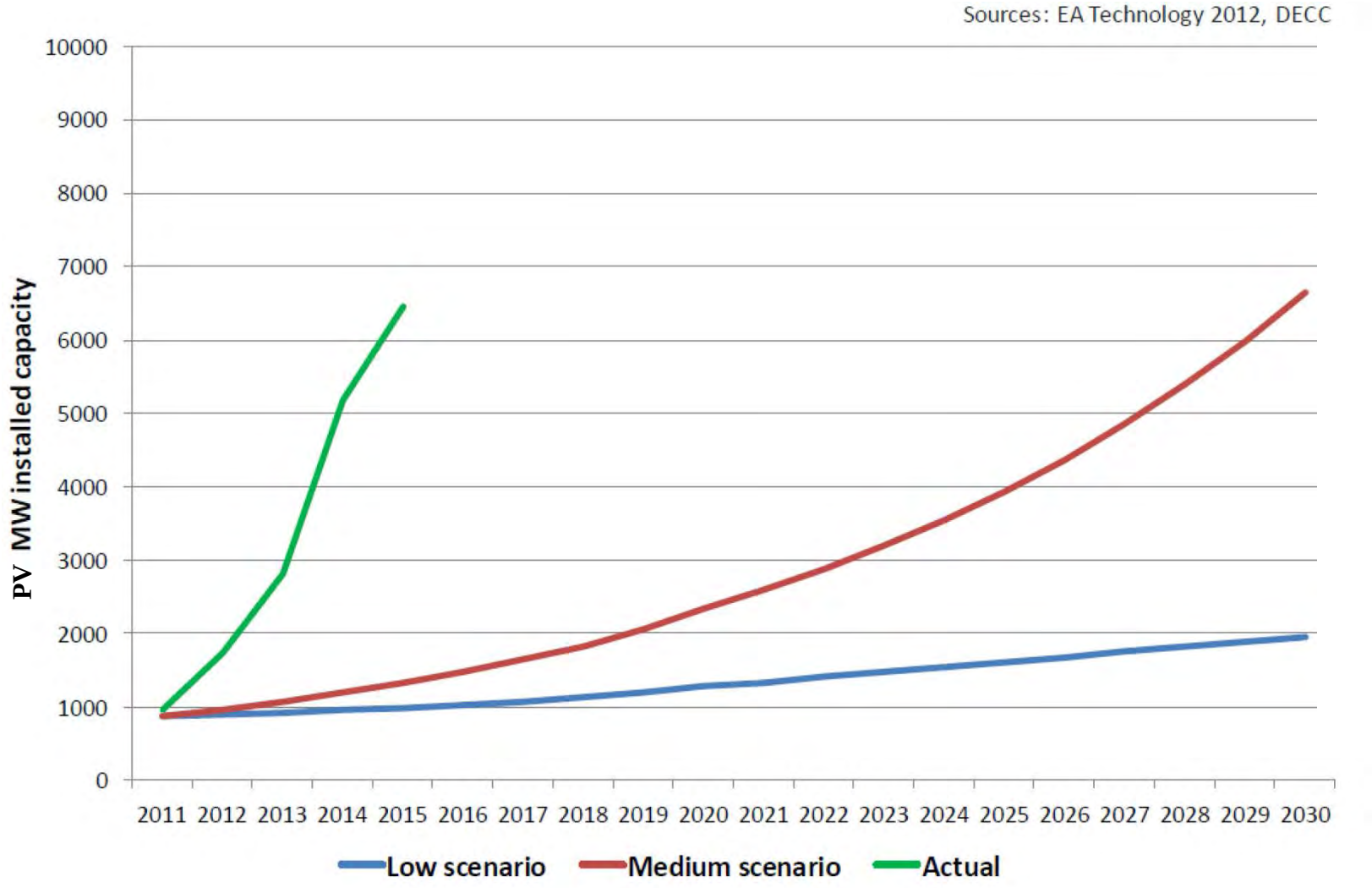
Significant uncertainty in DG growth



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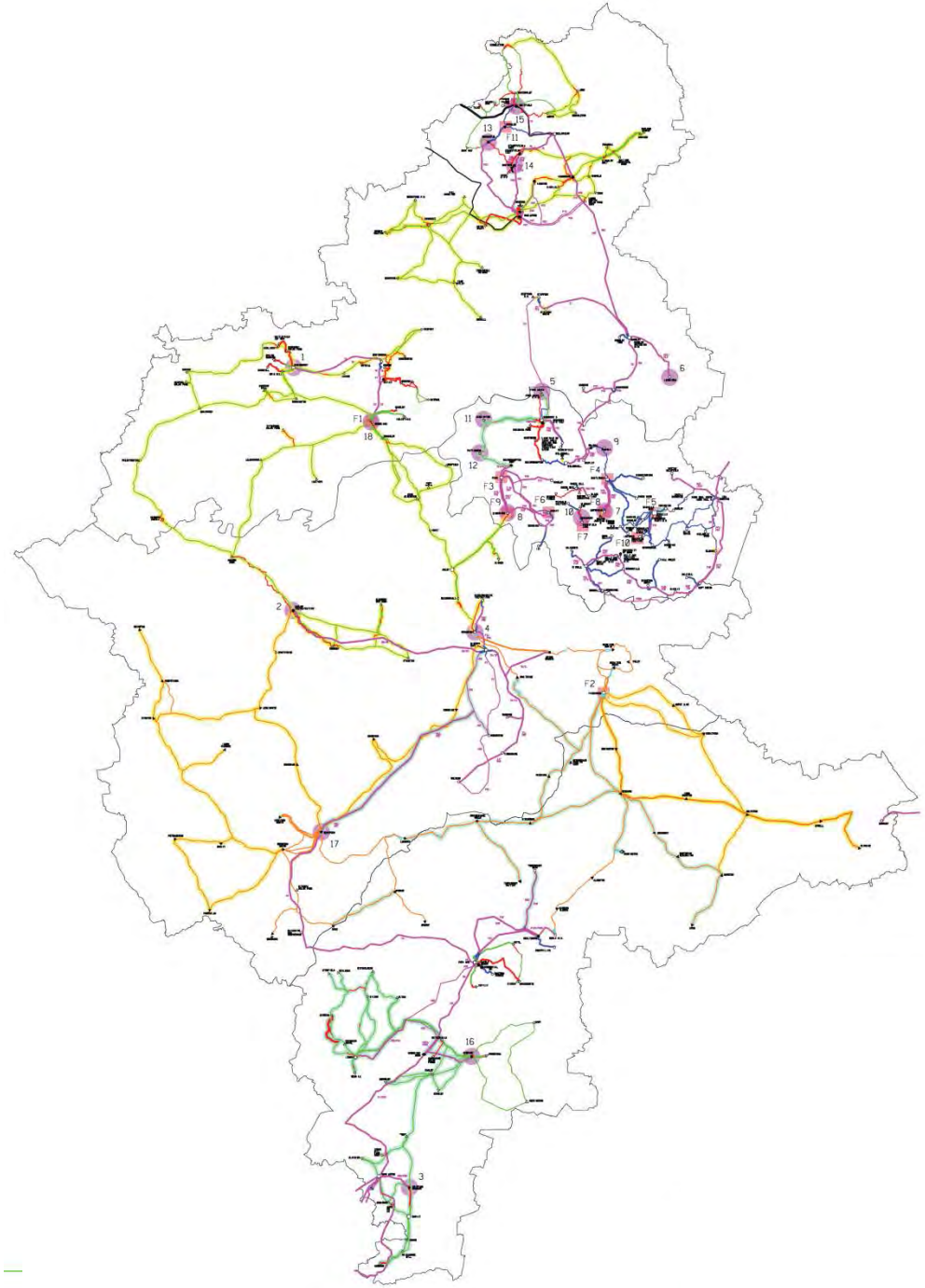
Current WPD West Midlands DG Data

Generator type	Connected [MVA]	Accepted [MVA]	Offered [MVA]	Total [MVA]
Photovoltaic	591.37	282.43	22.07	895.86
Wind	48.08	4.00	4.00	56.08
Landfill Gas, Sewage Gas, Biogas and Waste Incineration	201.95	64.00	5.55	271.50
CHP	13.79	32.80	302.92	349.51
Biomass and Energy Crops	32.81	16.50	-	49.31
Hydro, Tidal and Wave Power	0.59	0.50	-	1.09
Storage	2.90	703.90	298.58	1,005.38
All Other Generation (inc Mixed)	745.40	934.60	553.16	2,233.16
Total	**1,637**	**2,039**	**1,186**	**4,862**

Current WPD Network DG Constraints in West Midlands



CIRCUITS WITH IDENTIFIED CONSTRAINTS:-

VOLTAGE CONSTRAINT

THERMAL OVERLOAD

REVERSE POWER FLOW

1 : SHREWSBURY
2 : LUDLOW
3 : CHIPPING SODBURY
4 : STOURPORT
5 : FOUR ASHES
6 : LICHFIELD
7 : SMETHWICK
8 : HINKSFORD
9 : RUSHALL
10 : OLDBURY 33kV
11 : ALBRIGHTON
12 : PATTINGHAM
13 : NEWCASTLE
14 : BOOTHEN
15 : WHITFIELD
16 : RYEFORD
17 : HEREFORD
18 : IRONBRIDGE

FAULT LEVEL LIMITATION

F1 : IRONBRIDGE
F2 : FECKENHAM
F3 : PENN
F4 : BUSTLEHOLM
F5 : NECHELLS
F6 : OLDBURY
F7 : BIRCHFIELD LANE
F8 : SMETHWICK
F9 : HINKSFORD
F10 : CHEAPSIDE
F11 : BURSLEM

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 WPD Networks

Many of 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 GSPs (may be able to manage through ANM scheme)
- Fault level constraints on GSP switchgear

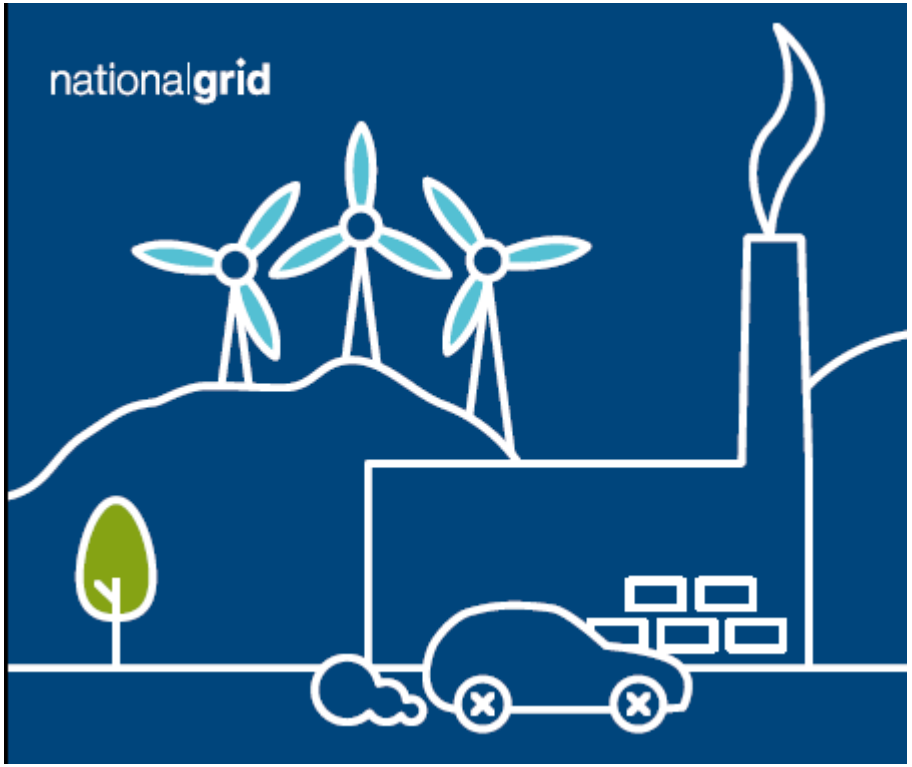
Aim of Study

- Assessing the potential growth in DG and DER installations by type, general location and year against other 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

Approach

- Background Energy Scenarios (decision to use the 4 developed by National Grid to assess GB)
- Resulting Generation and Demand Scenarios for West 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 – May 2017
- Undertake network studies and identify solutions with costs - 2017 Q3
- Sensitivity work – i.e. how much ‘headroom’ do the potential solutions give – 2017 Q4
- Assess potential for demand response/generation constraint – 2017 Q4
- Complete report – December 2017
- Dissemination event or webinar – January 2018

WPD Online Capacity Tool

- > Distribution Generation owner/operator forum
- > Generation Infrastructure Schemes
- > Community Energy Schemes
- > Facilitating sharing of information for potential generation connections consortiums
- > Trial
- > Export Capacity Recovery

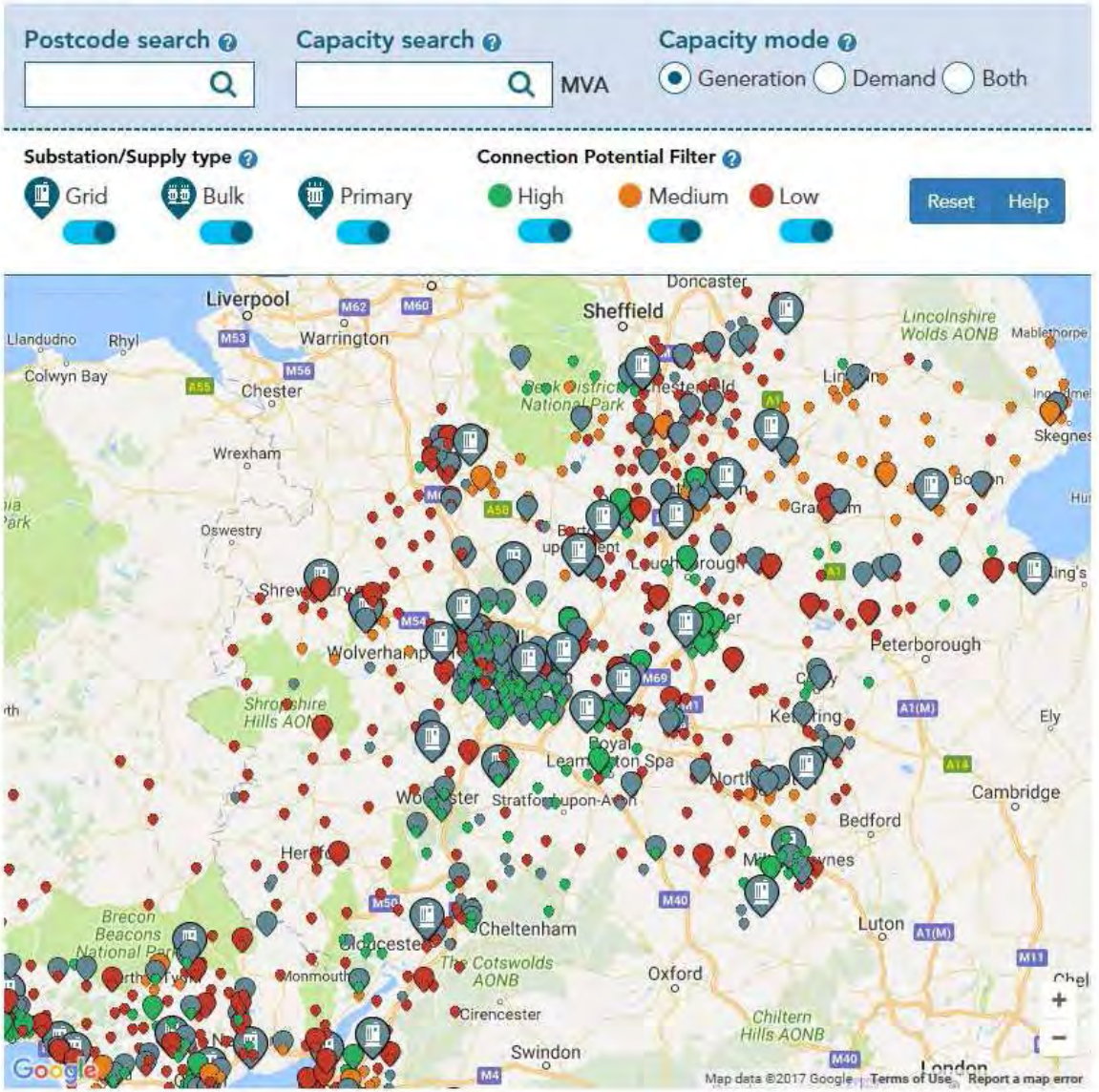
Service alterations

Information for electrical installers

Useful information

Incentive for Connections Engagement

Contact us



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WPD Online Capacity Tool

Fault Levels

	Make	Break
Upstream Equipment Ratings 3Ph:		
Upstream Short Circuit Currents 3Ph:		
Upstream Equipment Ratings 1Ph:		
Upstream Short Circuit Currents 1Ph:		
Downstream Equipment Ratings 3Ph:	32.75 kA	13.10 kA
Downstream Short Circuit Currents 3Ph:	21.92 kA	7.99 kA
Downstream Equipment Ratings 1Ph:		
Downstream Short Circuit Currents 1Ph:	2.88 kA	1.95 kA

Generator Information

Generator Types:	Photovoltaic
Connected Generation:	6.47 MVA
Offers sent but not yet accepted:	
Offers accepted but not yet connected:	

Statement of Works

Start date:	Thursday, December 15th 2016, 12:00 AM
Comments:	National Grid Electricity Transmission (NGET) has instructed that WPD shall maintain a facility such that under emergency conditions on the National Electricity Transmission System (NETS), WPD shall have the ability to de-energise embedded generation (>=1MW) upon instruction from NGET.

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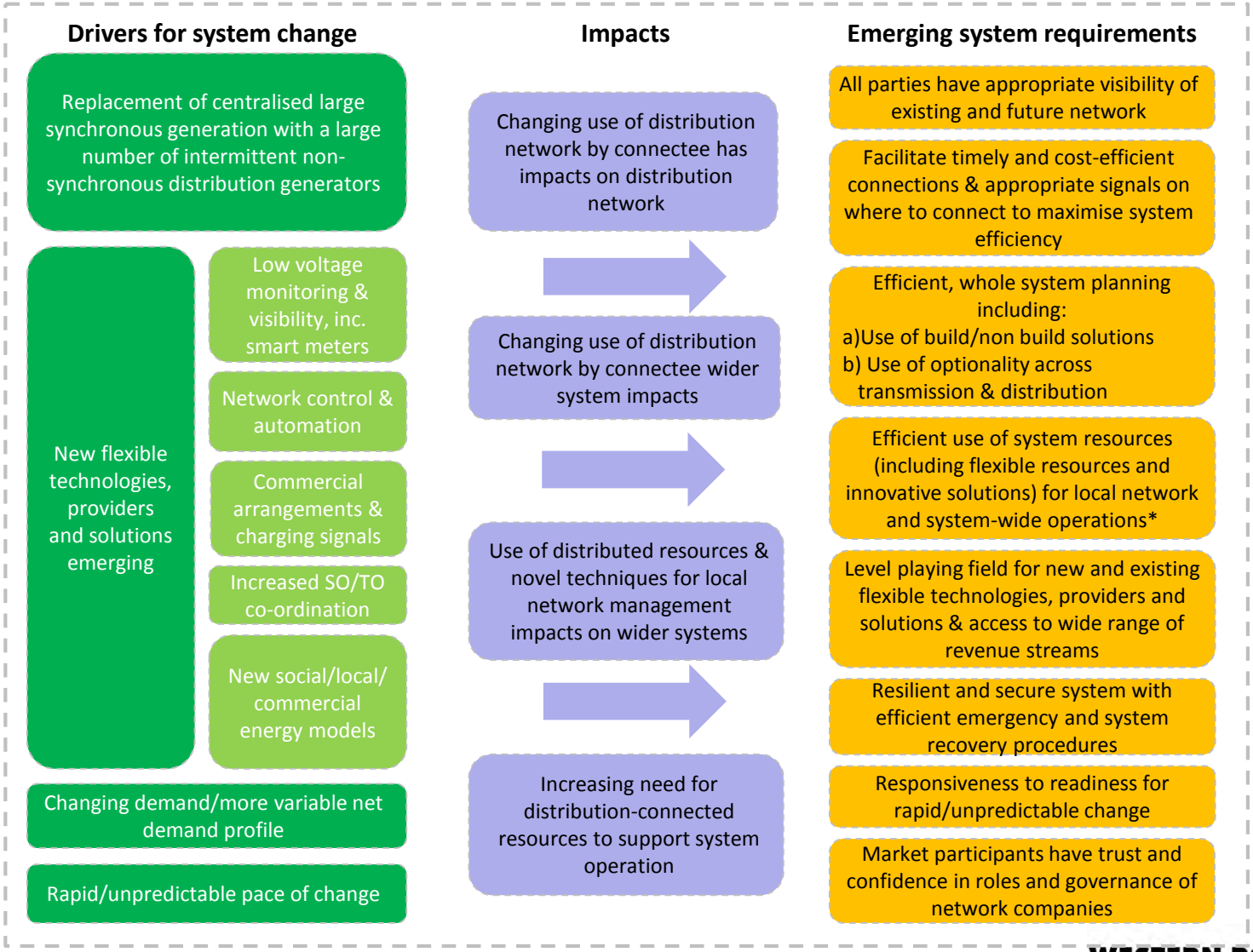
The need for change in how networks operate



BEIS
A smart, flexible energy system 2016

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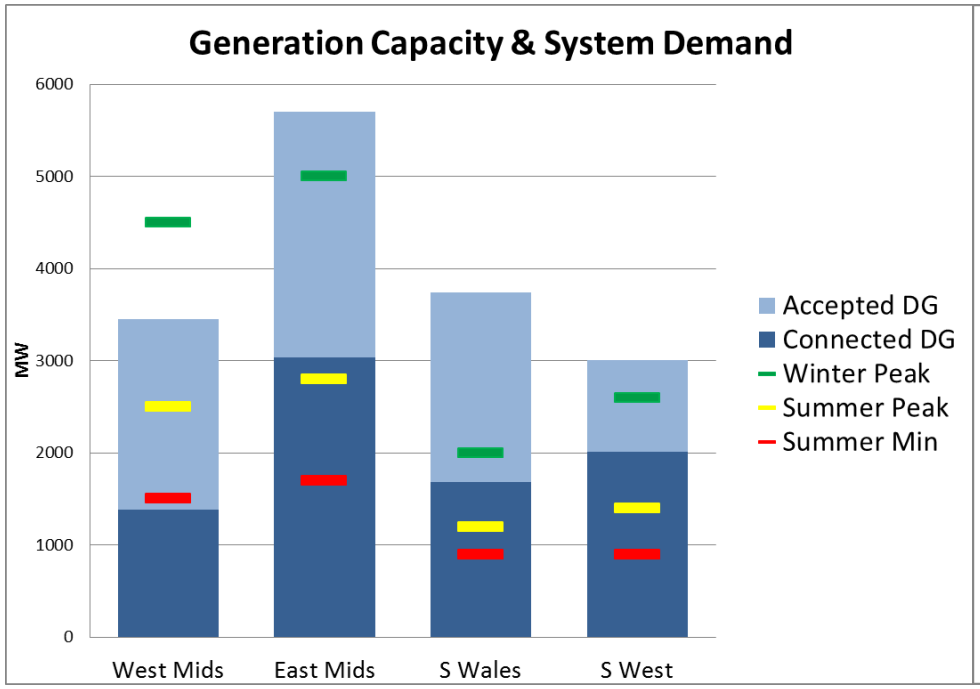
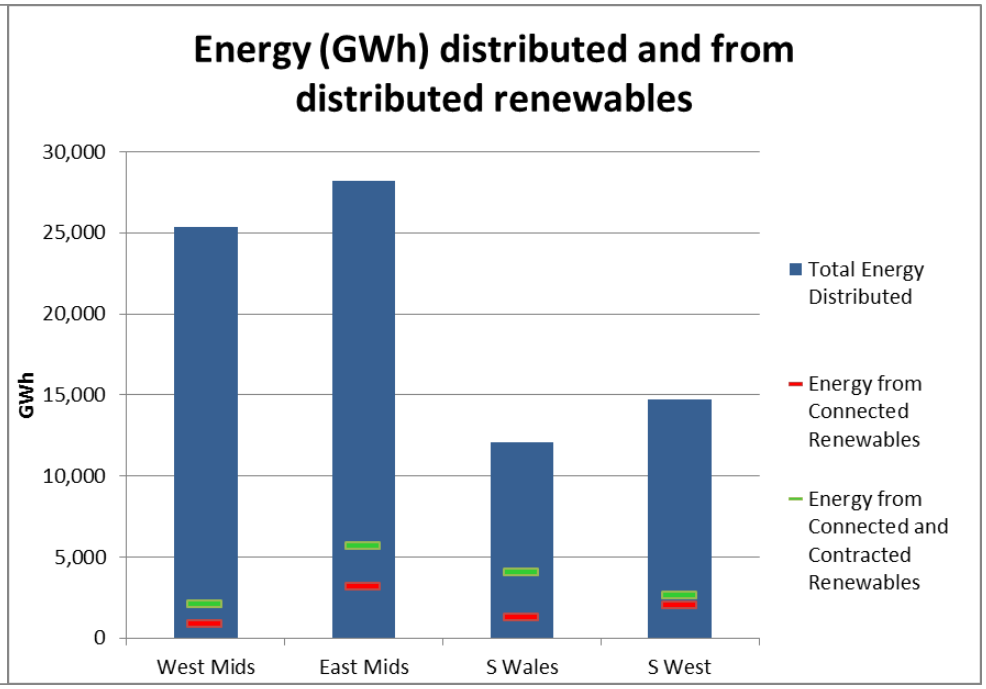
Growth in and Current DG and Demand data





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The Transition from Distribution Network Operator to Distribution System Operator

Distribution Network Operator

Distribution System Operator

Passive networks managing maximum power flows

Active networks managing real-time energy flows

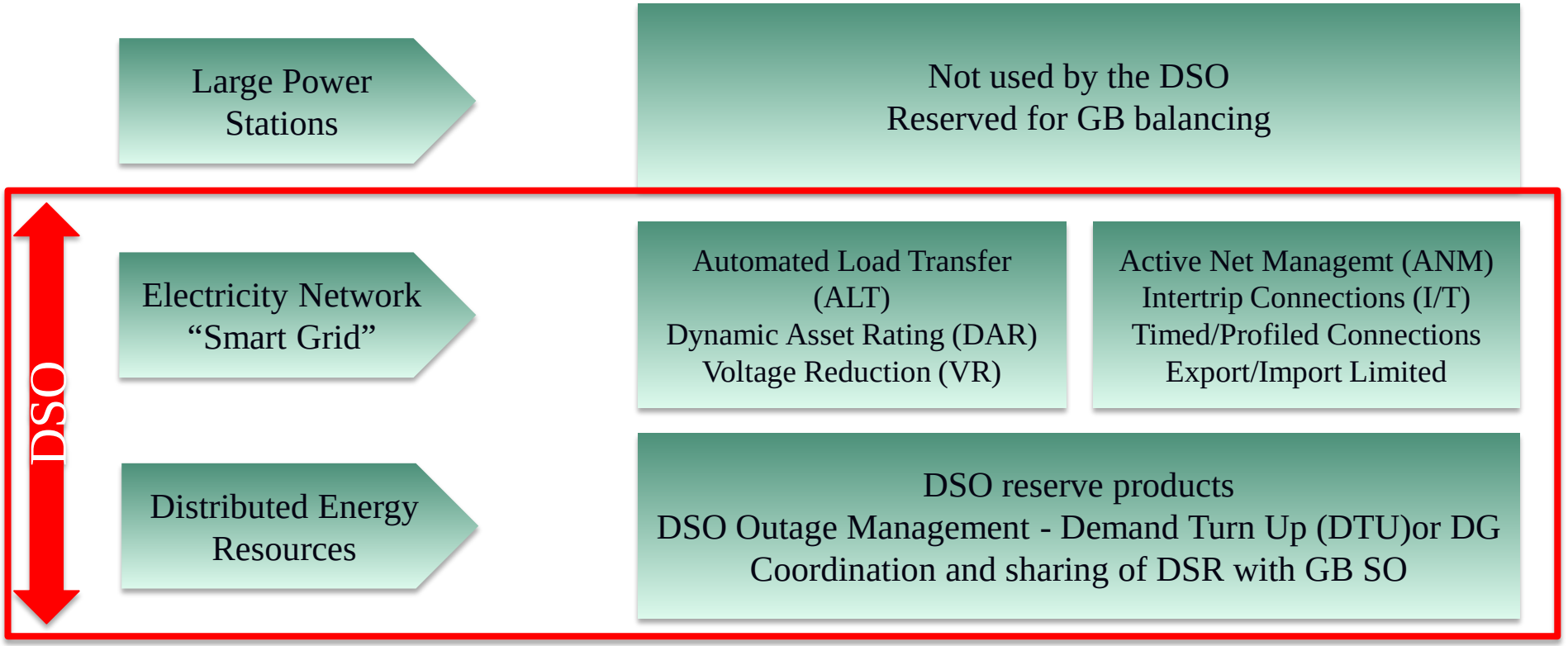
Distribution System Operator

- Generation is becoming more distributed, load flows are becoming more 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)

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

DSO Sources of flexibility



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DSO Four point plan

Expand the existing roll out and application of smart network solutions to the higher voltage networks, prioritising areas which are the most likely to benefit. From this we will optimise investment decisions, deliver greater network flexibility and maximise customer connection choice (flexible connections for demand, generation and storage).

Contract with customers and aggregators for non network solutions. Co-ordinate with other parts of the industry by helping to establish visibility platforms for suppliers, aggregators and customers. This will include the requirement to raise the awareness of DSR and to help customers to value stack where appropriate.

Co-ordinate with SO at the T/D interface. Share data and forecasts in multiple time horizons. Maintain overall system security. Consider whole system issues and propose solutions. Secure additional flexibility through prosumer awareness – actively support Power Responsive. No exclusivity in DSO flexibility contracts.

Protect the integrity and safety of lower voltage networks. We will maximise the use of smart meter data, apply additional network sensing where relevant and implement simple control schemes. We aim to develop wider flexibility for the use of import/export capping as an alternative to conventional solutions only reinforcing the networks when these solutions cannot deliver what is required.

What might this mean for generation customers?

- Active Network Management - roll out underway across network underway
- Revenue streams for DSR services – DSO requirements will be forecast in advance and predictable
- Revenue from demand ‘turn up’ services
- Storage alongside solar installation
- Investment in industrial & commercial storage co-location
- VAr provision revenue streams

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Questions?

Future Electricity DG Growth in the West Midlands licence area

Stakeholder workshop – 23 May 2017

West Midlands licence area

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This afternoon

- Scope
- Distributed generation technology growth scenarios to 2030
  - Methodology
  - Scenarios
  - Results – EVs and Heat pumps
- Storage scenarios development process

Scope

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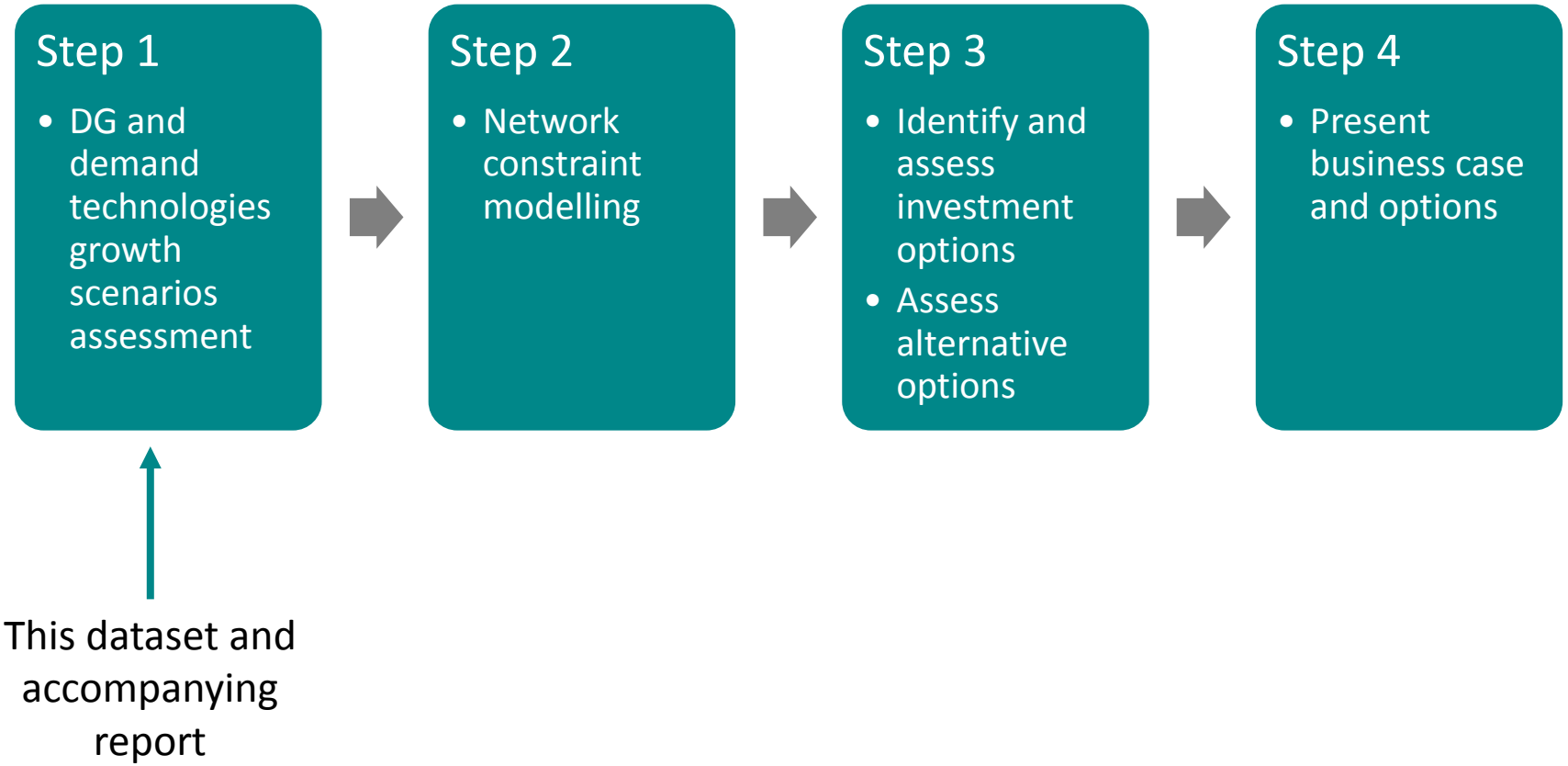
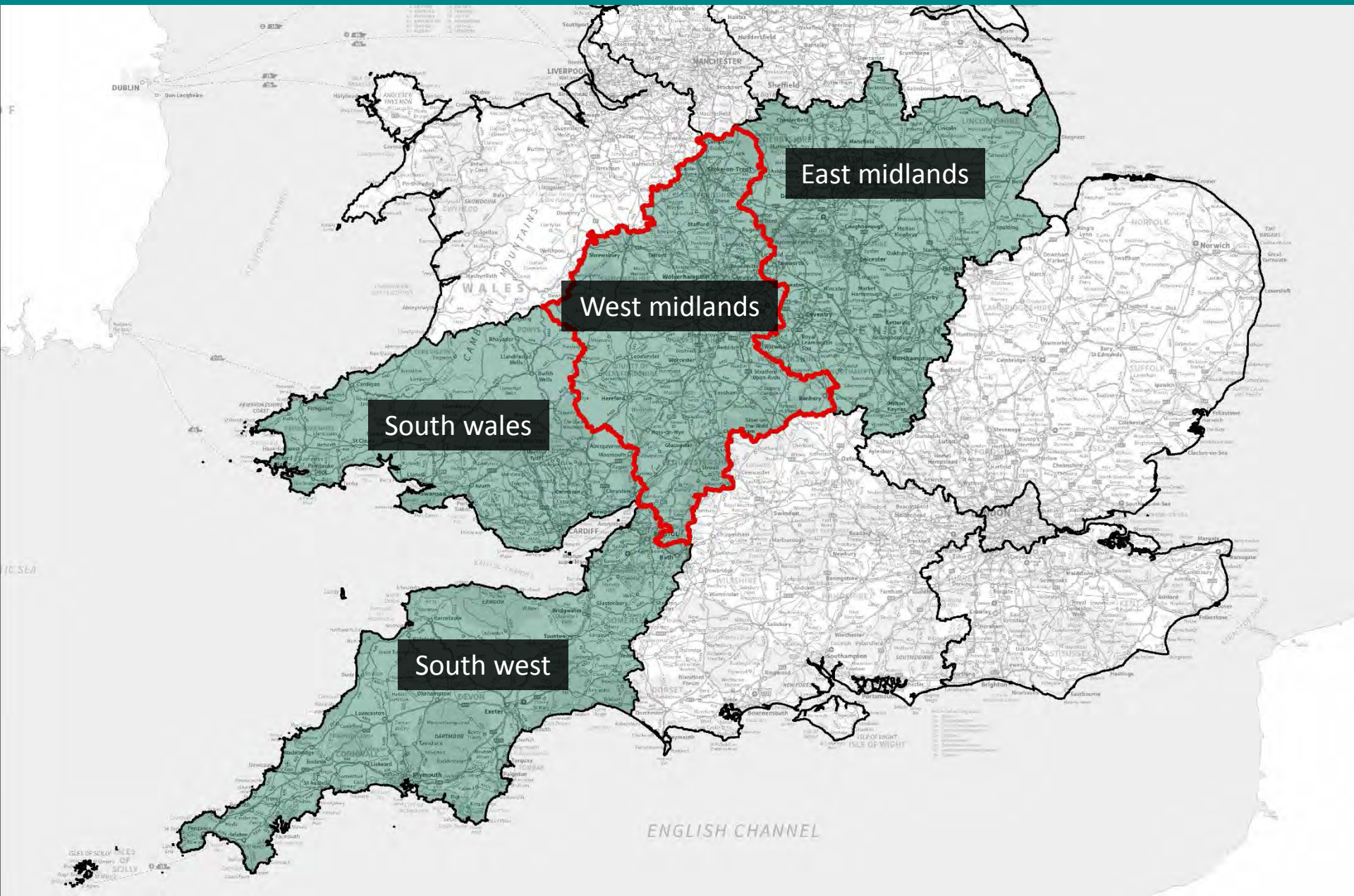
First step in process

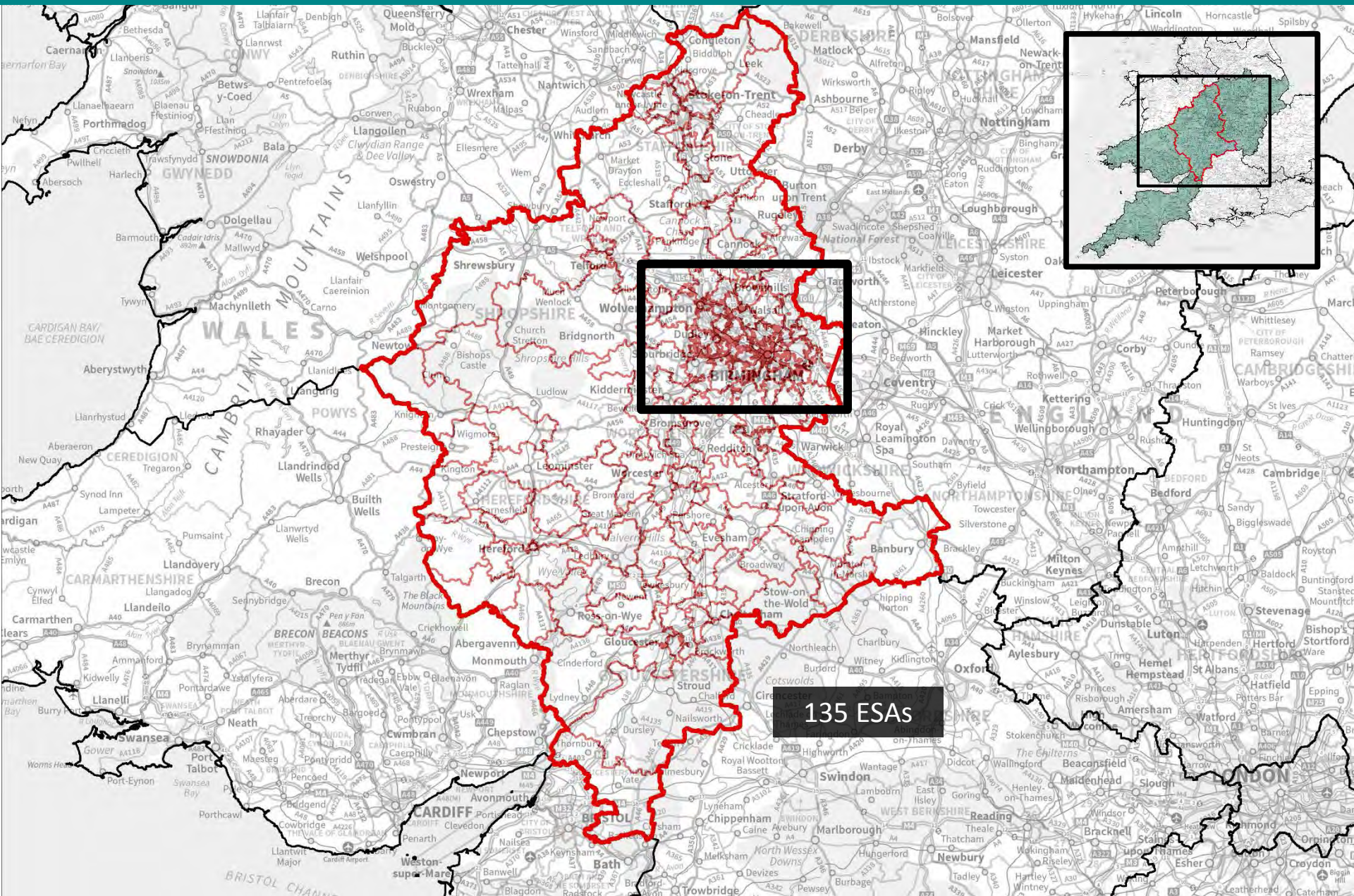
Strategic network investment options study



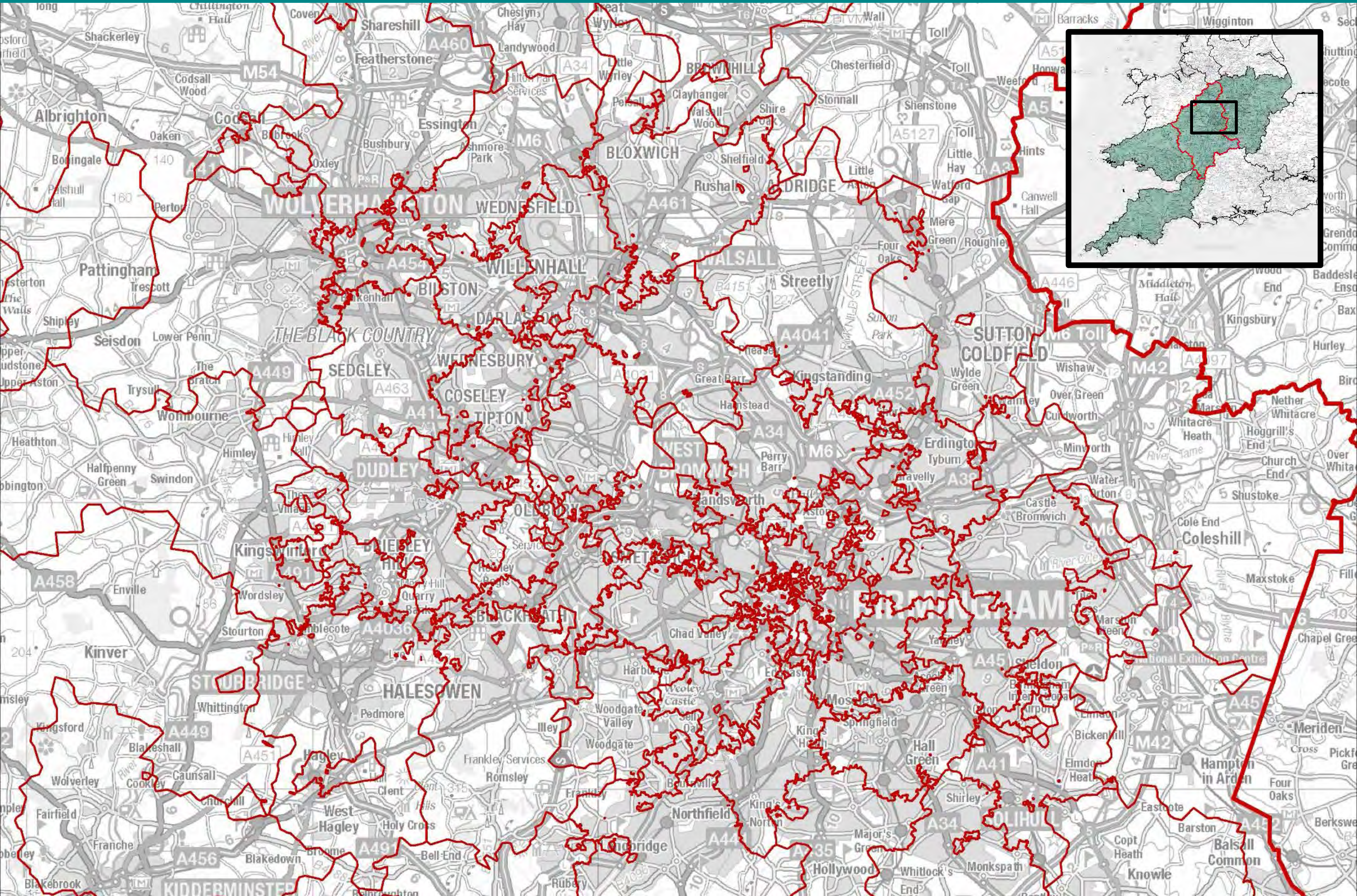
West midlands licence area



Electricity supply areas (ESAs)



Birmingham (ESAs)



Technologies assessed

Generation technologies
Solar PV
Onshore wind
Hydropower
Energy from waste
Anaerobic digestion

New demand
Electric vehicles
Heat pumps
New build developments (residential)
New build developments (non-residential)

Energy storage
Response services
Reserve services
High energy user behind meter
Own use and community
Co-location

Scenario projections

Scope summary

i. West Midlands licence area
ii. 135 ESAs
iii. Generation, storage and demand technologies
iv. Annually from 2017 to 2030
v. Four scenarios defined by differing economic and levels of green ambition

DG and demand technologies growth scenarios:

Methodology

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Methodology stages

Stage 1

Baseline

- Number, capacity and nature of projects currently connected

Stage 2

Pipeline

- Pipeline projection of projects to 2020 where possible

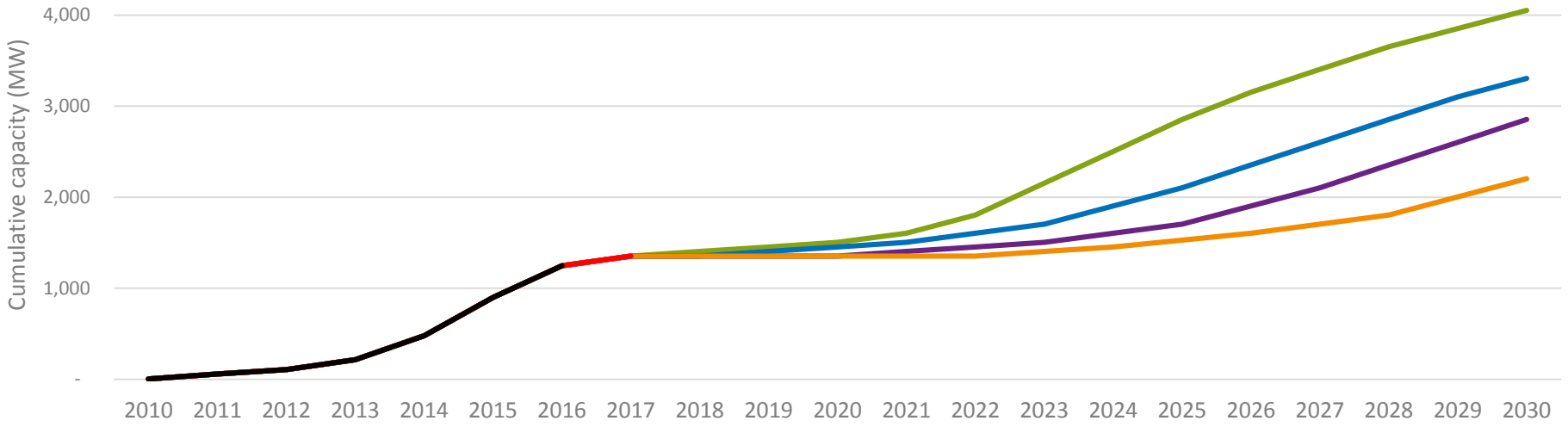
Stage 3

Scenarios

- Scenario projections out to 2030

Illustrative graphical representation of method

Baseline → **Pipeline** → **Scenarios**



Current baseline

WPD connection data, Regen national renewables project database, FiT data, ROC data, plus other publicly available data

Pipeline projection

Analysis of current projects in the planning system and with grid connection agreements for large scale technologies. Dependent on technology when projection goes out to.

Growth scenarios (to 2030)

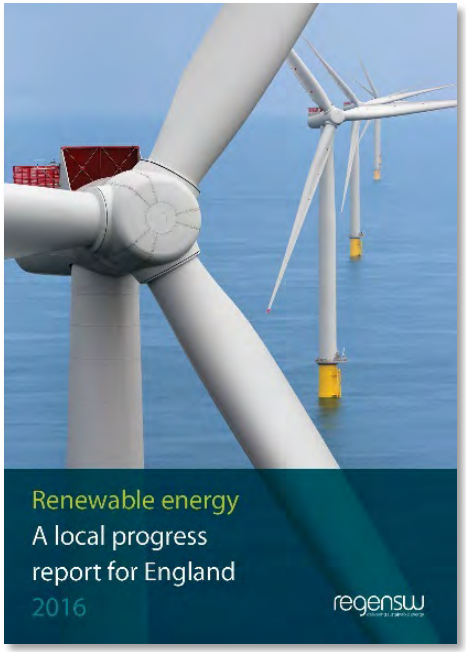
Growth scenarios based on National Grid's FES- applied at a local level

- Gone Green
- Consumer Power
- Slow Progression
- No Progression

Stage 1 - Baseline (2016)

Key sources of data

- WPD connected projects data
- Regen progress report for renewable energy
- Installers and organisations
- Plug-in electric vehicle grants
- FiT installation reports
- Planning data
- ROCs data
- FOI requests
- EFR and Capacity market bids data
- Anonymised DVLA EV registered keeper data



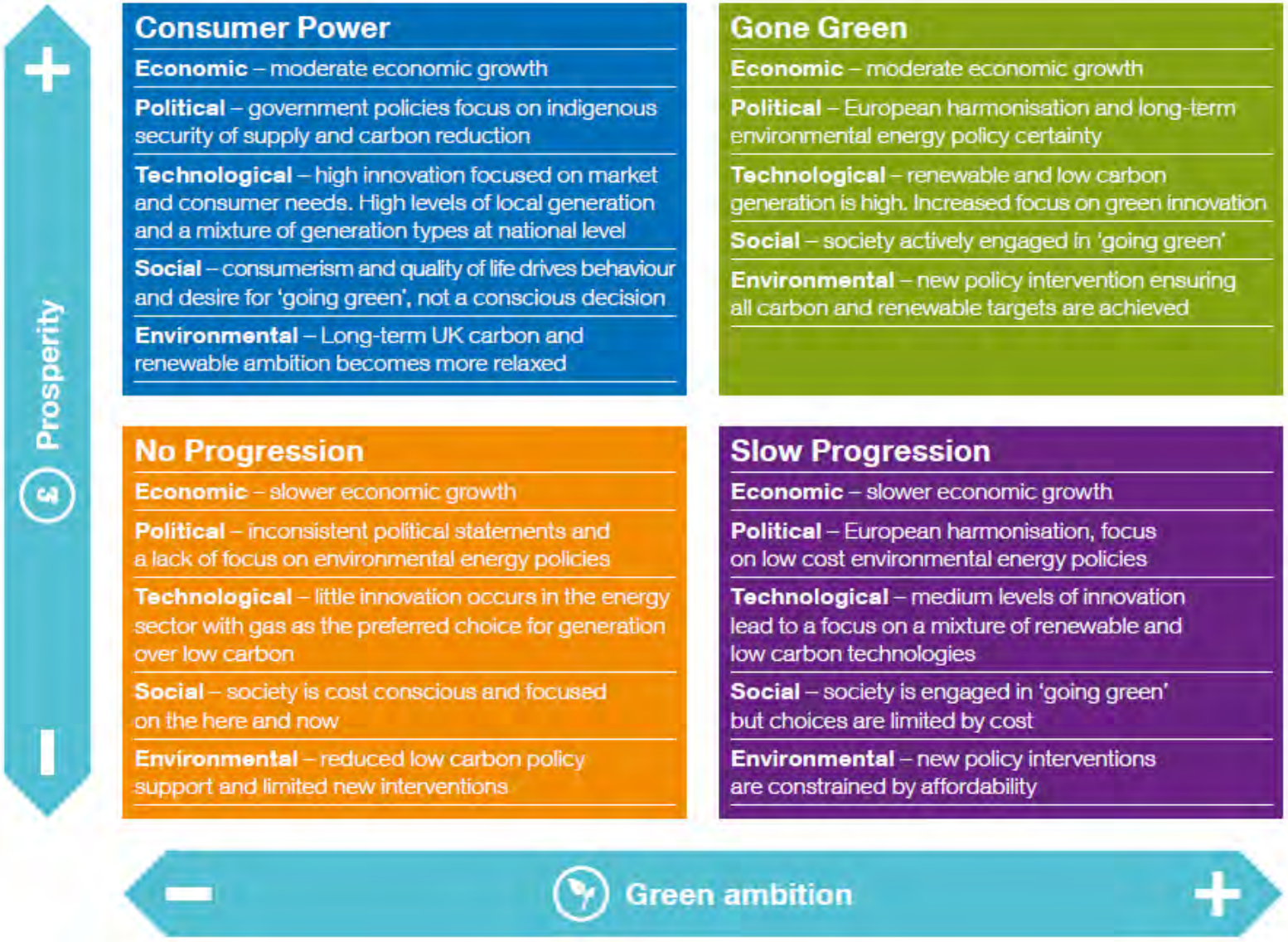
Stage 2 - Pipeline (2016-2020)

Key sources of data

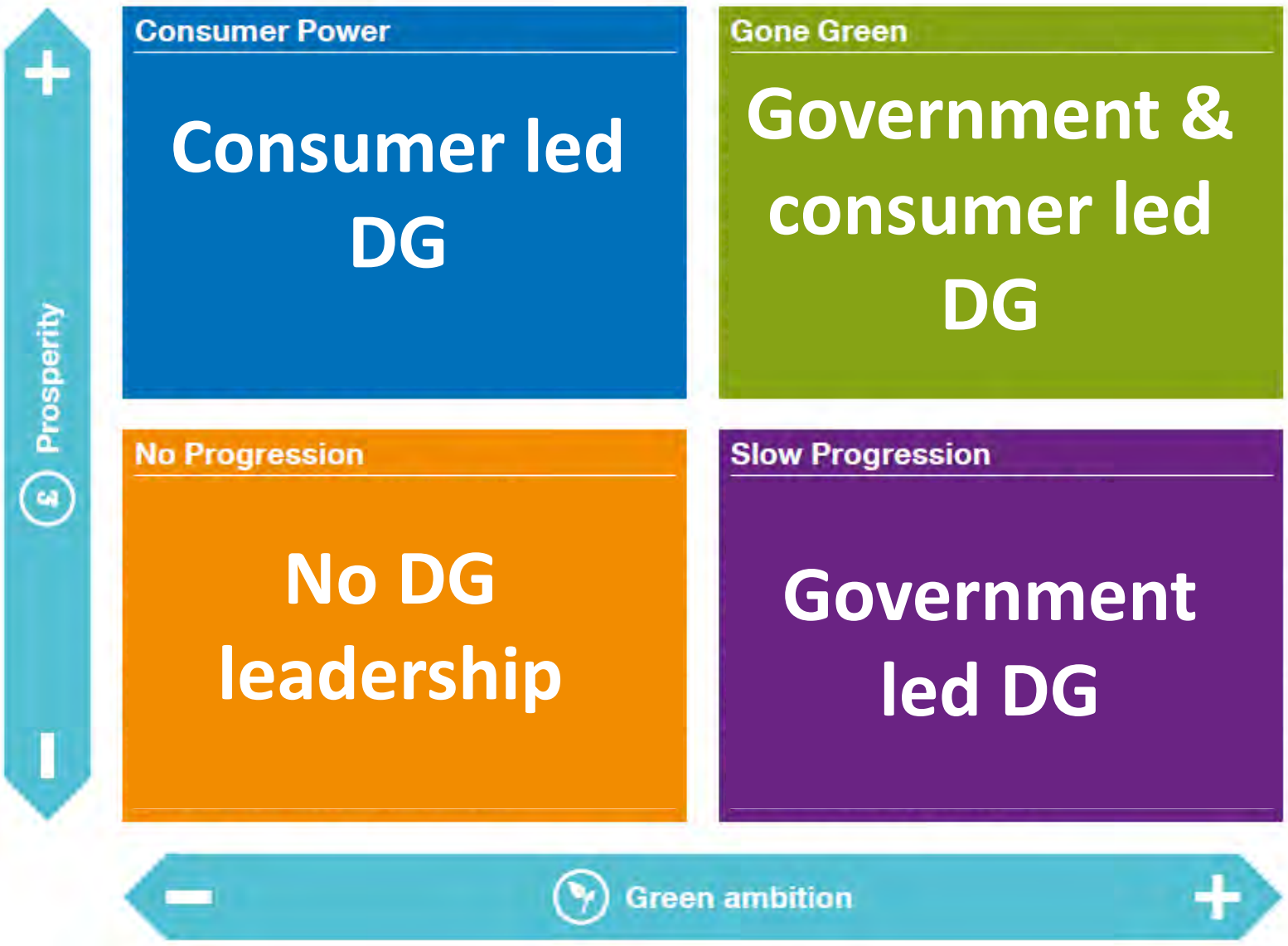
- WPD accepted offers data
- BEIS RE planning database
- Local authority planning data
- Developers and installers
- Stakeholders
- Verification

Stage 3 - Future Energy Scenarios (FES)

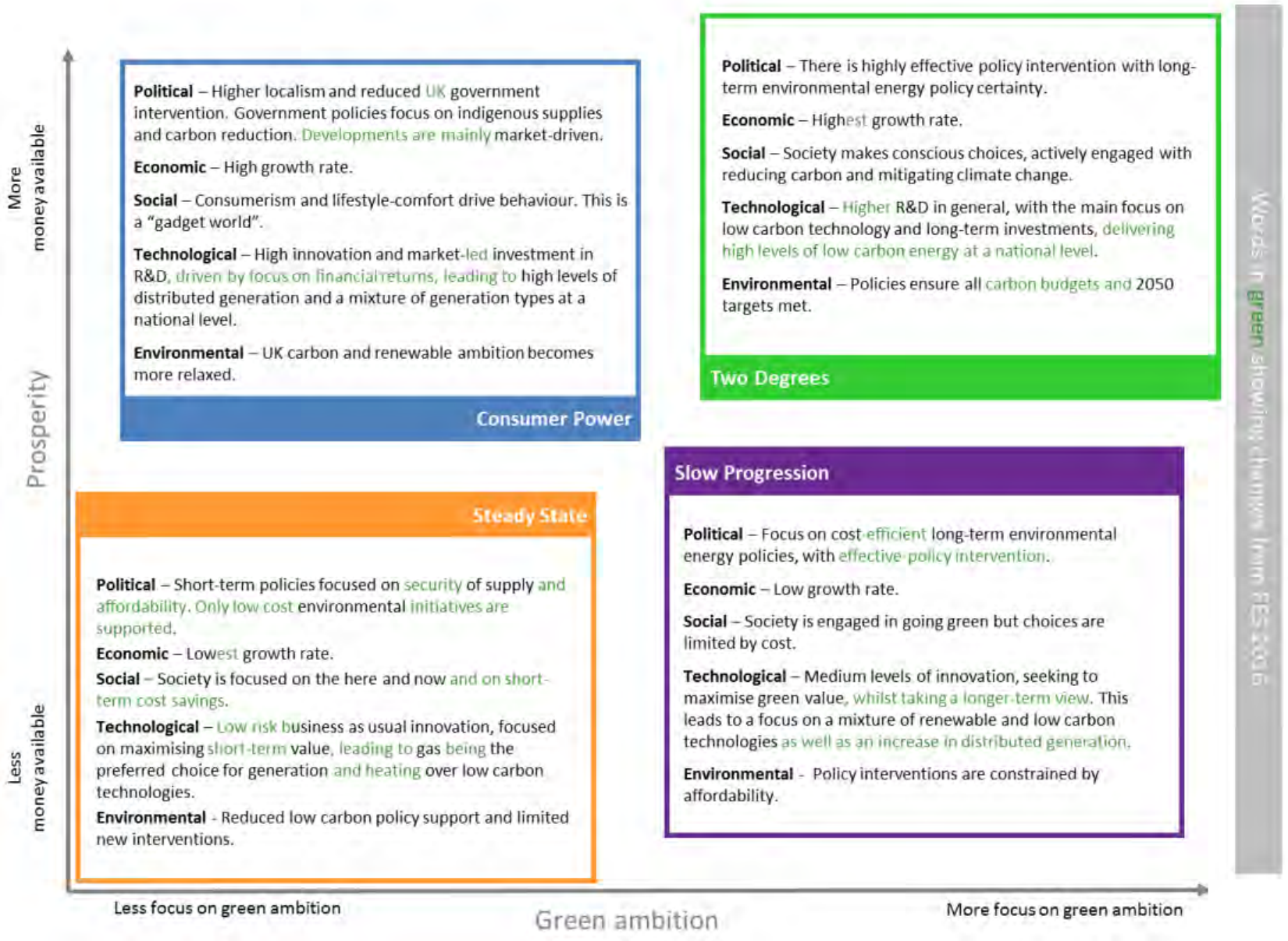
Stage 3 - Future Energy Scenarios (FES)



Stage 3 - Future Energy Scenarios (FES)



Stage 3 - Future Energy Scenarios (FES)



DG and demand technologies growth scenarios:

Building the scenario projections

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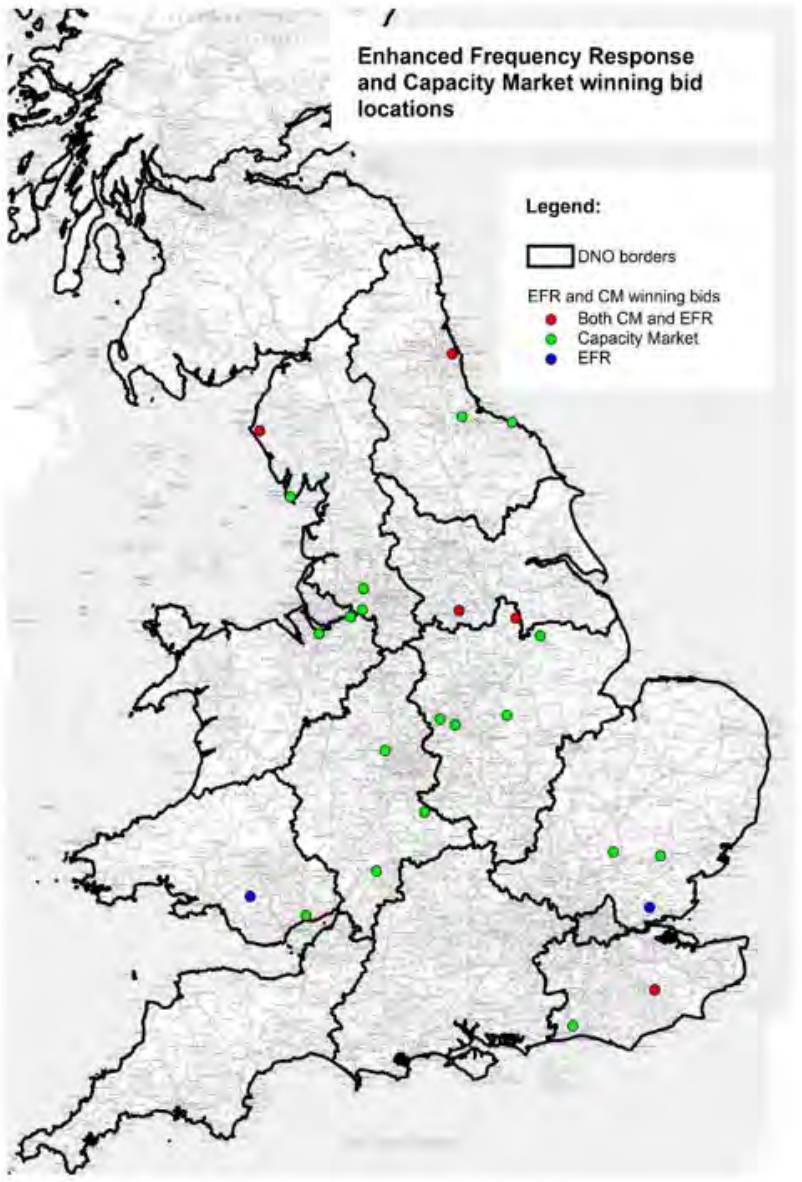
Scenarios: past trends

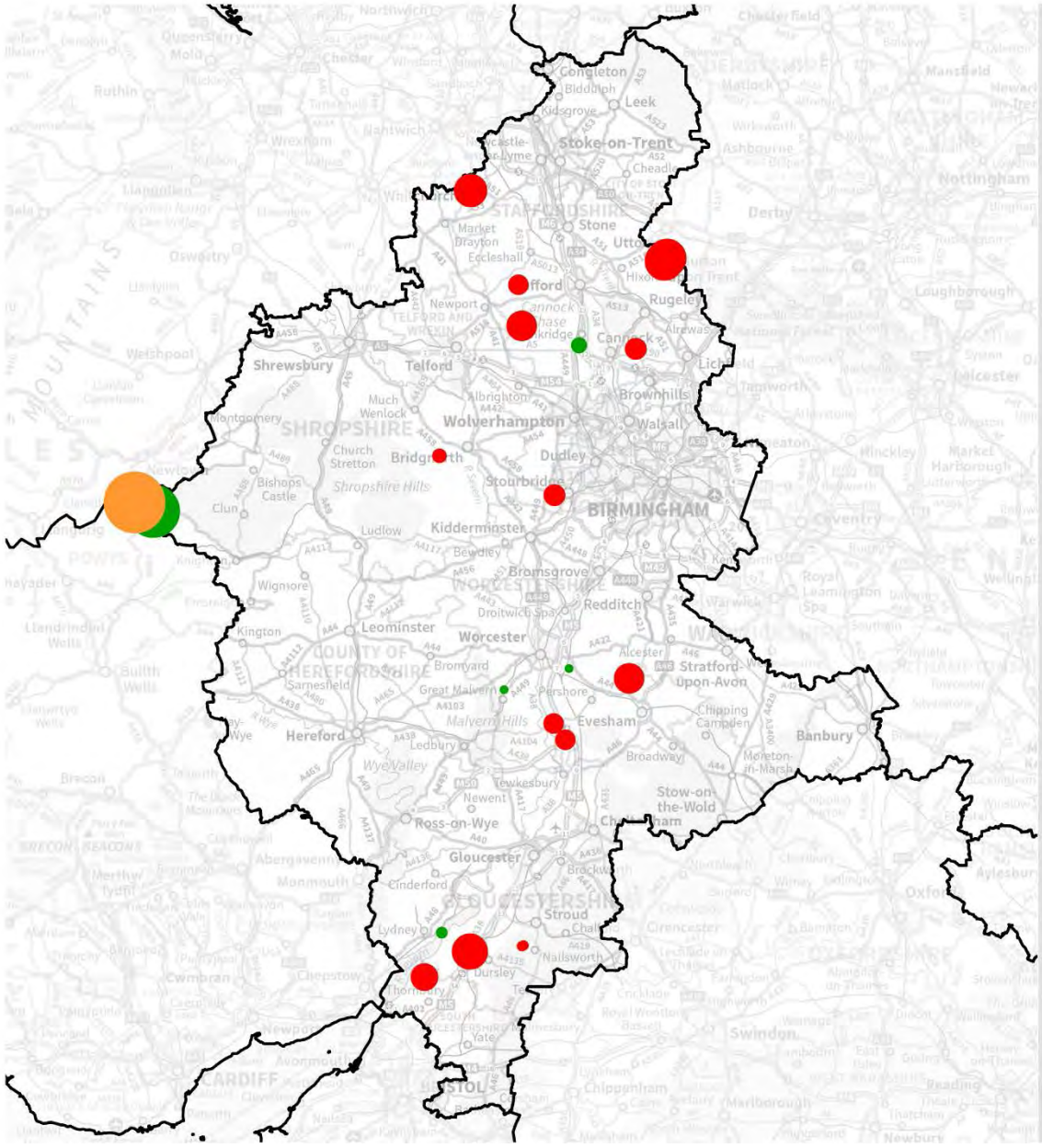
- Analyse existing trends
- Human and environmental factors
- Baseline and Pipeline
- Current geographical distribution
- Planning trends

Scenarios: emerging trends

- Greater distribution of domestic technologies
- Emerging new business models
- Electric vehicles purchasing
- Co-location of renewables



Building the scenarios: planning trends



Planning history of wind projects in the West Midlands licence area

Projects successful at planning

- 30 MW
- 3 MW

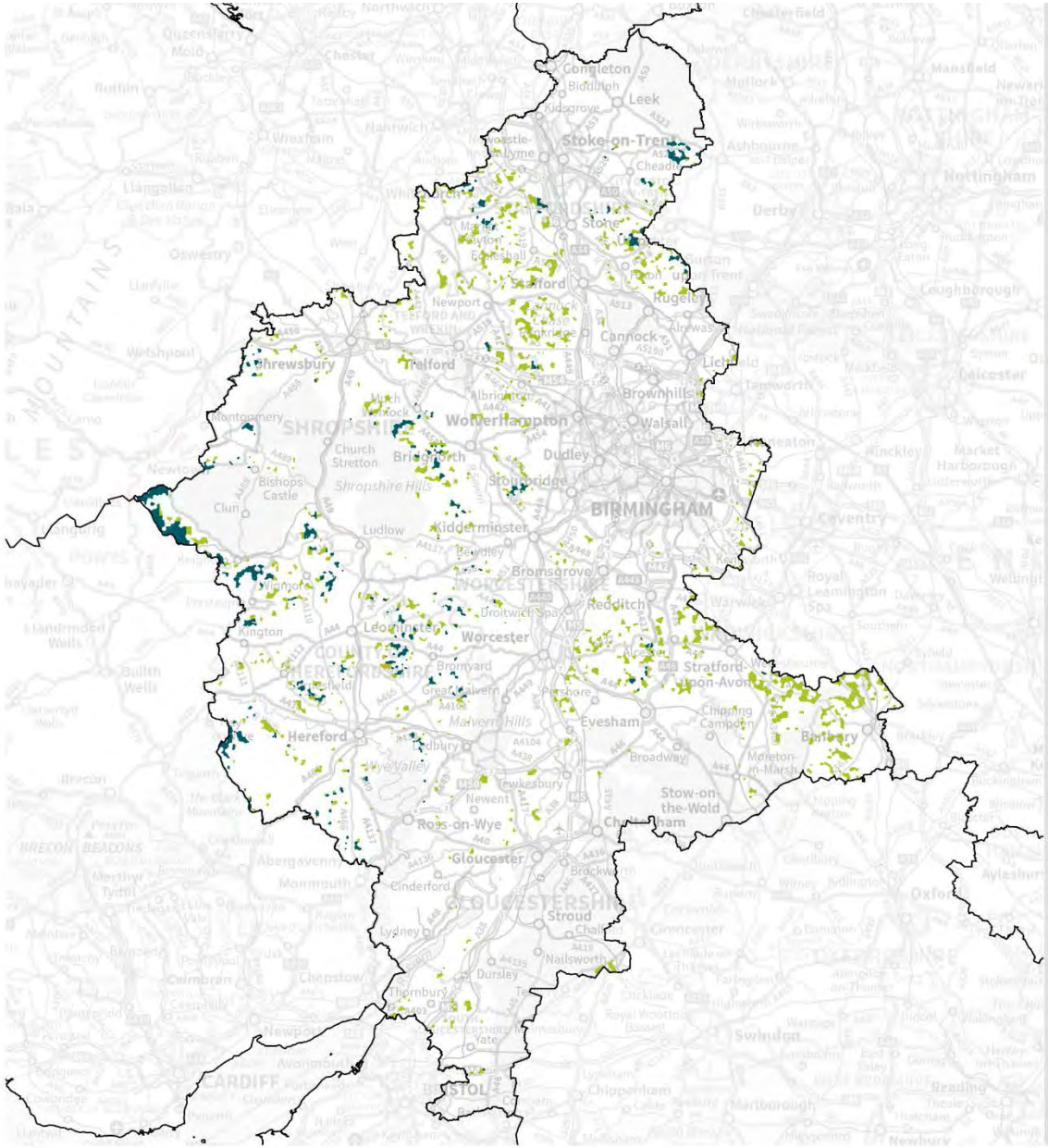
Bryngydfa Wind Farm in planning

Projects refused or withdrawn at planning and appeal

- 30 MW
- 3 MW

DNO licence areas

Scenarios: resource assessments (onshore wind)



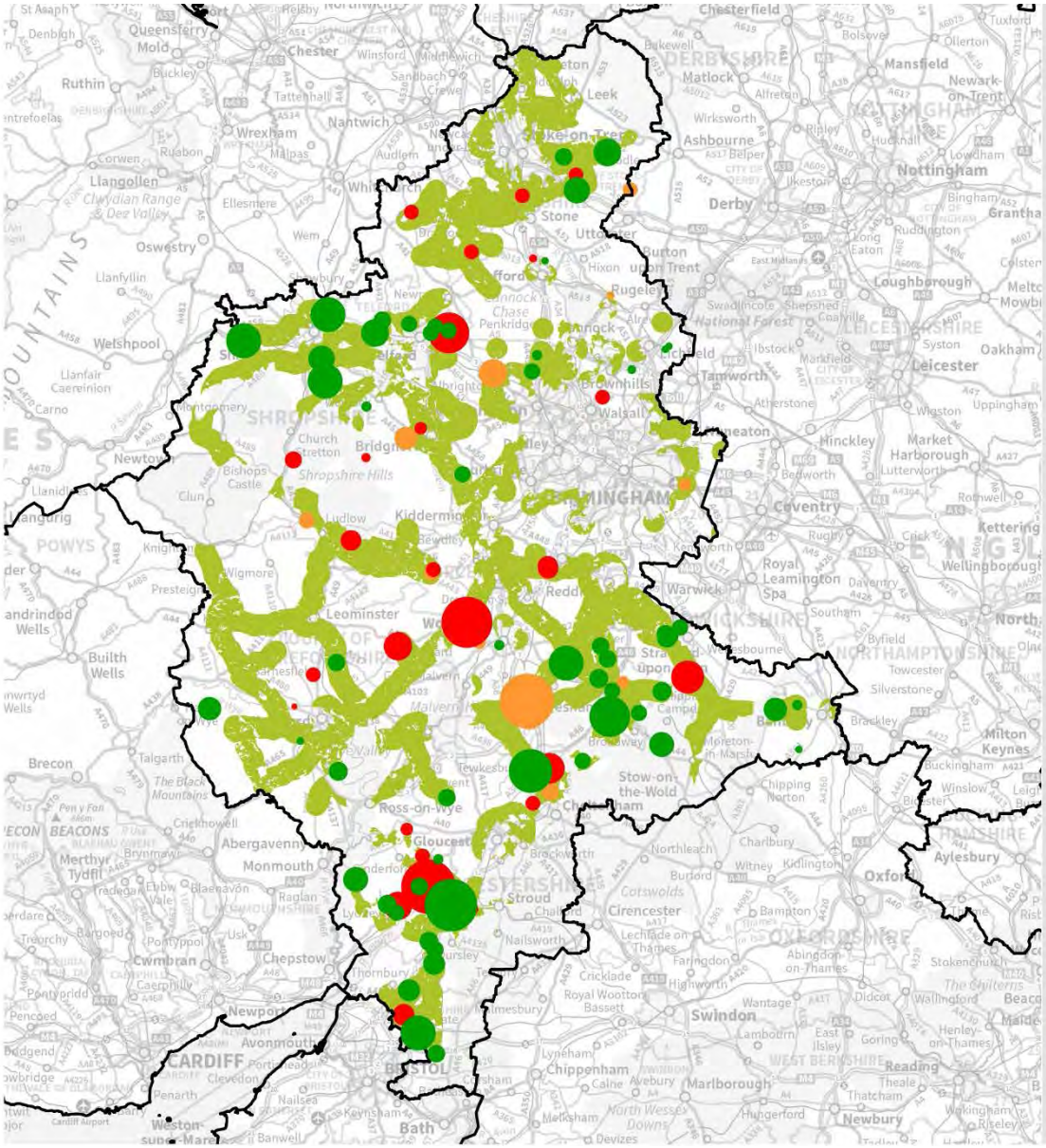
Unconstrained wind resource areas in the West Midlands licence area

Wind resource areas

Wind resource areas with highest wind speeds

DNO licence areas

Scenarios: resource assessments (solar PV)



Comissioned, in progress and refused solar projects (>1 MW) in the West Midlands

Comissioned >1 MW solar projects

- 30 MW
- 15 MW
- 3 MW

In planning and approved but not constructed solar projects

- 30 MW
- 15 MW
- 3 MW

Refused at appeal and committee, withdrawn and at appeal solar projects

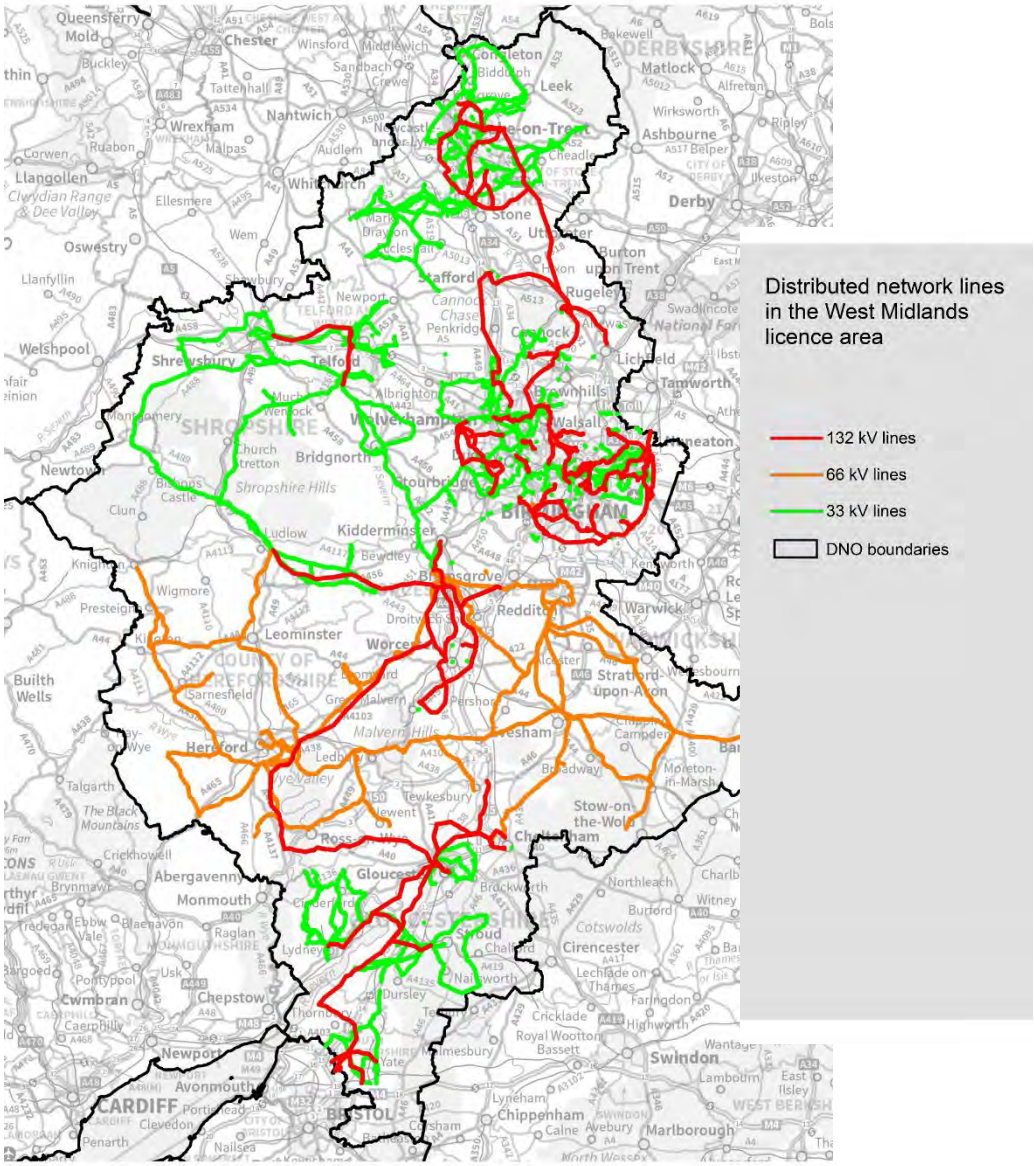
- 30 MW
- 15 MW
- 3 MW

Unconstrained solar resource areas

Building the scenarios: spatial data

Spatial data

- Deprivation index
- Off-gas areas
- Planning environment
- Housing density
- Community groups



Distributed generation growth scenarios:

Initial results – ground-mounted PV

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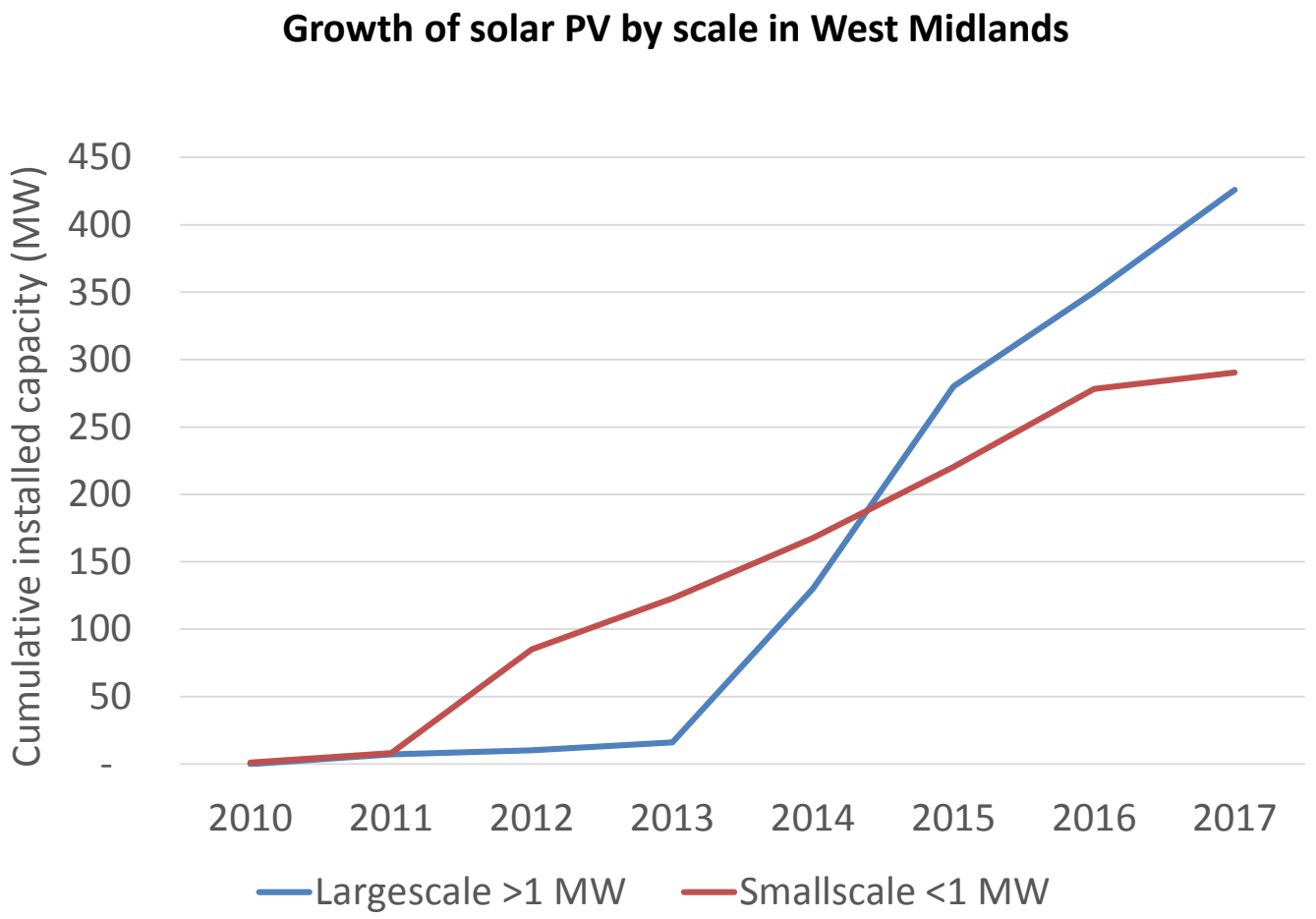
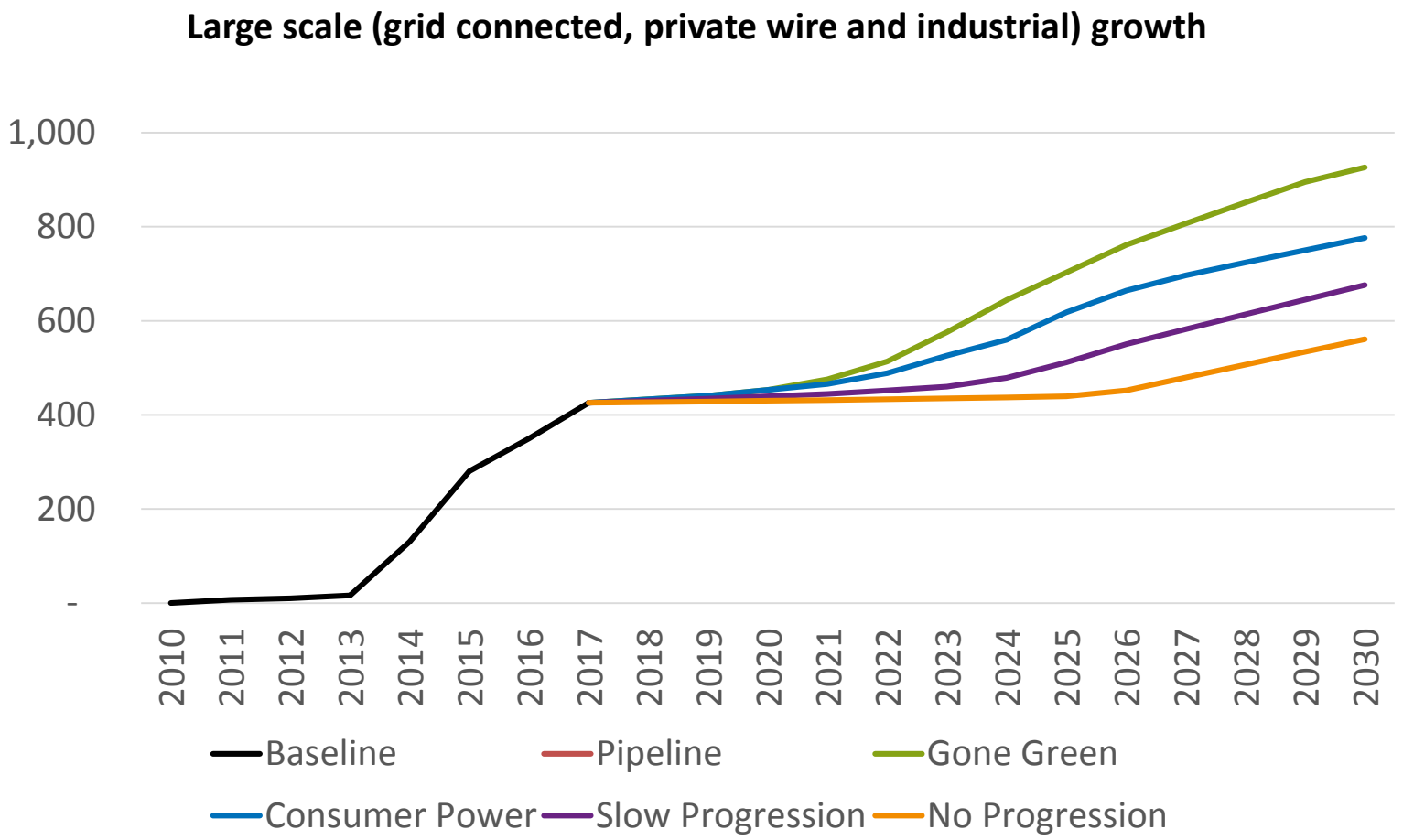
Solar PV baseline



Scenario growth factors – ground-mounted solar PV

Potential factors enabling further ground-mounted solar PV growth	GG	CP	SP	NP
Government influenced factors				
Introduction of a price guarantee mechanism, such as a CfD or government backed PPA	●			
Planning environment is straight-forward, reducing planning risk	●		●	
Technology costs				
Falling UK solar PV panel and inverter costs – potentially due to reduction in import duties, exchange rate stabilisation and also manufacturing innovation and economies of scale	●	●	●	●
Technological innovation – especially for rooftop and building fabric technologies	●	●		
Innovative integrated systems – PV linked to electric vehicle charging for example	●	●		
Negative medium and long term impact of Brexit on import costs				●
Impact of storage				
New business models – 'own use' enabled by energy storage	●	●	●	
New business models – 'capacity utilisation' enabled by energy storage	●	●	●	
New business models – 'energy market' enabled by energy storage	●	●		
Network costs				
Lower network reinforcement costs – enabled by strategic investment	●		●	
Lower network reinforcement costs – enabled by 'smart' solutions, active network management and demand response solutions etc.	●	●		
Wholesale price of power				
Rising electricity wholesale price – potentially driven by economic growth, increased demand and/or falling supply	●	●		
Other factors				
Strong economy or government backing means investment capital is available	●	●	●	
High levels of intervention and central green ambition drives commercial investment decisions	●		●	
Local and individual green ambition drives investment decisions	●	●		

Large scale solar PV growth scenarios



Distributed generation growth scenarios:

Initial results – onshore wind

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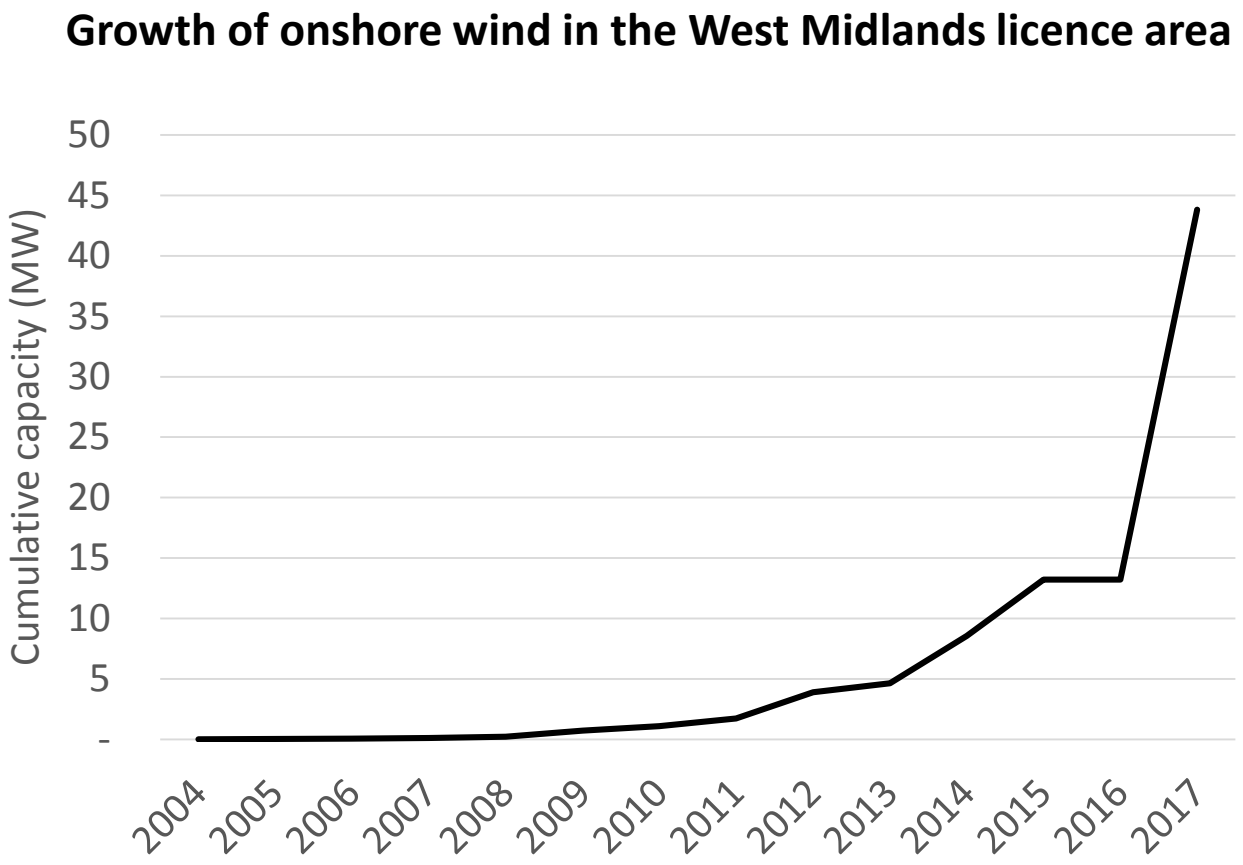
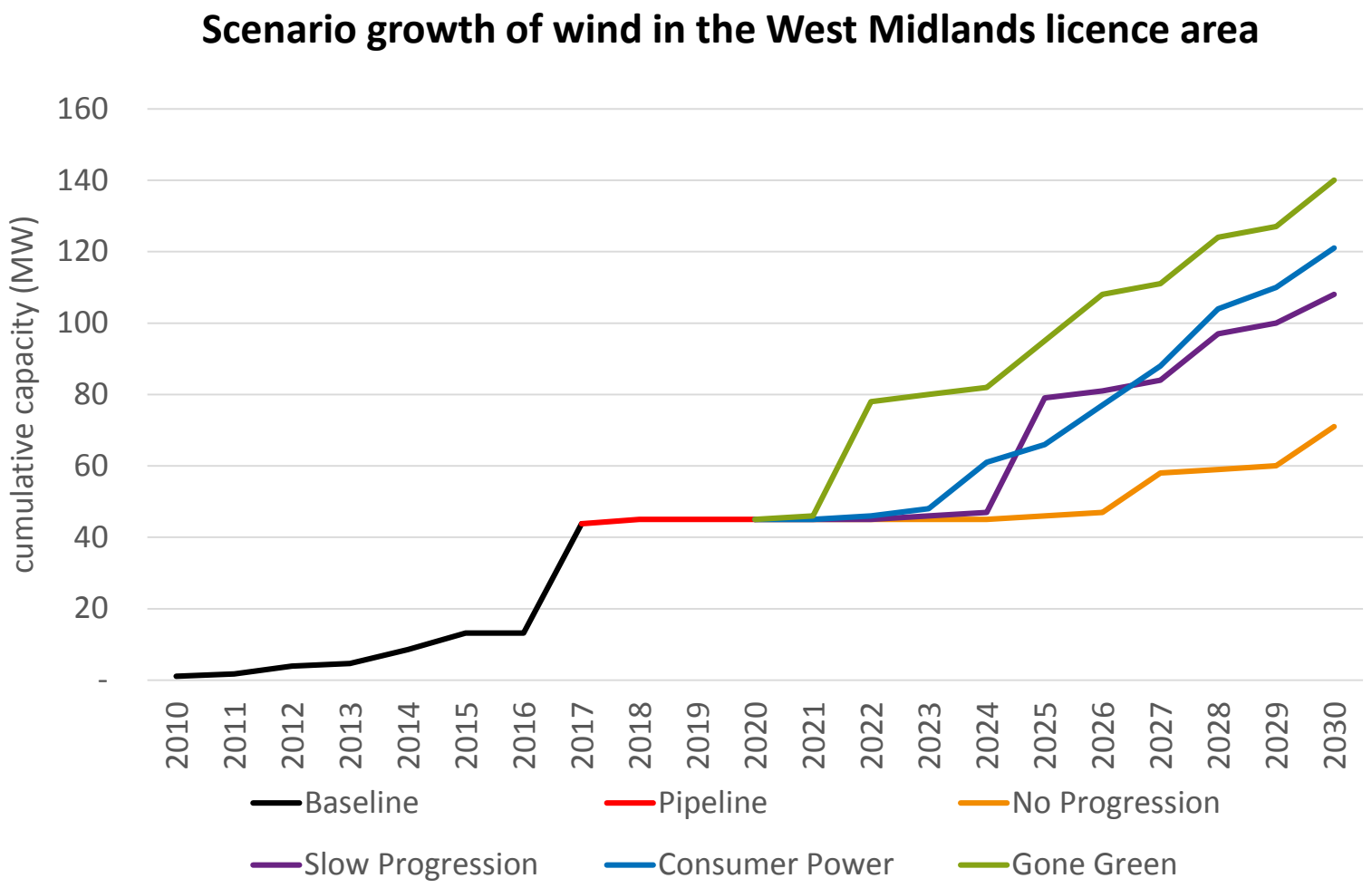
Onshore wind - baseline



Scenario growth factors – onshore wind

Potential factors enabling further onshore wind growth	GG	CP	SP	NP
Government influenced factors				
Price guarantee mechanism introduced for large scale wind e.g. CfD or government backed PPA	●			
Government re-introduces limited revenue support for small and medium scale turbines		●		
Planning environment changes to enable commercial wind development, with a strategic approach favouring large scale projects over small scale	●		●	
Planning environment changes to enable community scale wind development	●	●		
Technology costs				
Global prices continue to fall rapidly	●	●		
Technological innovation – turbine efficiencies improve rapidly	●	●		
Negative medium and long term impact of Brexit on import costs				●
Network costs				
Lower network reinforcement costs – enabled by strategic investment	●		●	
Lower network reinforcement costs – enabled by 'smart' solutions, active network management and demand response solutions etc.	●	●		
Wholesale price of power				
Rising electricity wholesale price – potentially driven by economic growth, increased demand and/or falling supply	●	●		
Availability of finance				
Strong economy or government backing means investment capital is available	●	●	●	
Other factors				
High levels of intervention and central green ambition drives commercial investment decisions	●		●	
Local and individual green ambition drives investment decisions	●	●		
Agricultural land values fall, decreasing rents paid to landowners			●	●

Onshore wind growth scenarios



DG and demand technologies growth scenarios:

Results – storage

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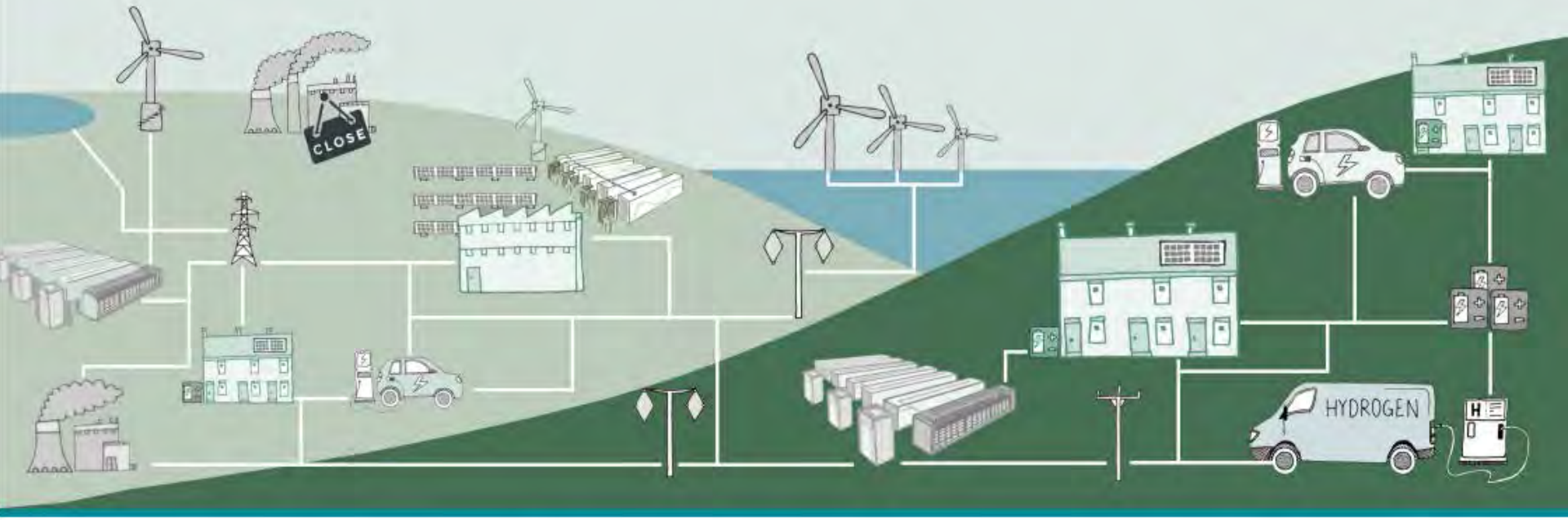
Pathways to Parity - Market insight series

Energy Storage - Towards a commercial model - 2nd Edition



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Business models / project classes

1. Response service	*Providing higher value ancillary services to transmission and distribution network operators, including frequency response and voltage support for network balancing (i.e. FFR, EFR, ERPS)*
2. Reserve service	*Specifically aiming to provide short/medium term reserve capacity for network balancing, such as the Capacity Market, Short Term Operating Reserve (STOR) and Fast Reserve*
3. C&I high energy 'prosumers'	*Located with a higher energy user (with or without on-site generation) to avoid peak energy costs, and peak transmission and distribution charges while providing energy continuity*
4. Domestic and community 'own-use'	*Domestic, community or small commercial scale storage designed to maximise own use of generated electricity and avoid peak electricity costs – i.e. with rooftop PV*
5. Generation co-location	*Storage co-located with variable energy generation in order to a) price/time shift or b) peak shave to avoid grid curtailment or reinforcement costs*
6. Energy trader	*The business model that references the potential for energy supply companies, local supply markets and/or generators using storage as a means of arbitrage between low and high price periods - likely aggregated - and peak shaving.*

Potential scale of the storage market

Business model	GB market growth scenarios by 2030*		
	High Growth Scenario	Slower and no growth Scenario	Possible upside very high growth scenario
Response service	2 GW	0.5 - 1 GW	2 - 3 GW
	2 GWh	0.5 - 1 GWh	4 - 5 GWh
Reserve Services*	3-4 GW	2-3 GW	4 GW
C&I high energy user & behind the meter	2.5 - 4 GW	0.6 - 1.2 GW	5 GW
	10 - 16 GWh	2.5 - 5 GWh	20 GWh
Domestic and community own use with PV***	1.5 - 2 GW	0.37 - 0.75 GW	3 GW
	6 - 8 GWh	1.2 - 3 GWh	12 GWh
Generation co-location	2 GW	0.5 - 1GW	4 GW
	6 - 8 GWh	2-4 GWh	16 GWh
Total GB market	10 - 12 GW	4 - 5 GW	15 GW**
	24 - 44 GWh	6 - 13 GWh	50 GWh

* Includes existing 2.7 GW of storage – mainly pumped hydro reserve services

** A very high growth scenario for all business models would probably imply some degree of revenue cannibalisation between business models and is therefore less likely by 2030.

*** Would include EV vehicle-to-house storage discharge although this has not been modelled separately

Storage growth factors

Wave 1 - led by response services

- Storage dominates the EFR, FFR, DSR and new voltage support services
- Higher value services drive market growth with focus on MW and response time
- First applications for high energy industrial and commercial users behind the meter models
- Domestic and community scale early adopters
- Development of a DSO distribution network model creates new market opportunities
- Government creates framework for a flexible and smart energy system

Wave 2 - co-location business models become viable

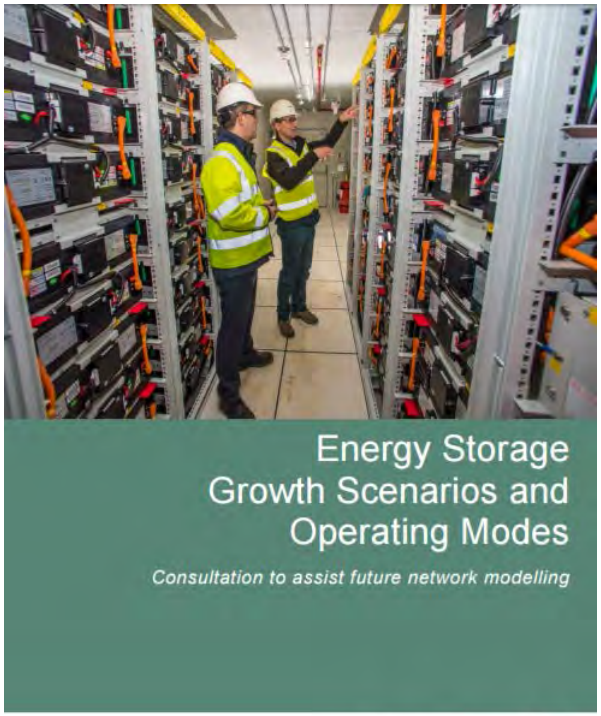
- Market for C&I high energy user/generators grows rapidly
- Emission controls and an attractive business case mean that storage effectively replaces diesel generators for most C&I application
- First co-location projects with solar PV lead to a rapid expansion and new ground mounted solar PV farms are developed
- Domestic and community scale storage market expands rapidly driven by falling costs

Wave 3 - expansion and new market models

- Aggregation and new trading platforms develop
- Local supply markets, private wire and virtual markets rely heavily on electricity storage
- Domestic electricity storage becomes common as costs fall and electric vehicle purchases increase, alongside growth in the electrification of heat
- Most new solar and wind farms now include electricity storage to harness low marginal cost energy and price arbitrage
- Towards the end of the decade, heat storage and electricity storage are increasingly integrated

Consultation paper

Ray Arrell
Senior project manager
rarrel@regensw.co.uk



In undertaking this consultation, WPD is seeking to understand:

- The potential scale of growth of energy storage within its distribution networks
- The type of energy storage assets/projects that are likely to be deployed and their business models
- The typical operating behaviour of storage assets, how they are likely to be used and their typical daily mode(s) of operation

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Joel Venn - jvenn@regensw.co.uk

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

23rd May 2017

WPD Online Capacity Tool

File Edit View Favorites Tools Help

Distribution Generation owner/operator forum

Generation Infrastructure Schemes

Community Energy Schemes

Facilitating sharing of information for potential generation connections consortiums

Trial

Service alterations

Information for electrical installers

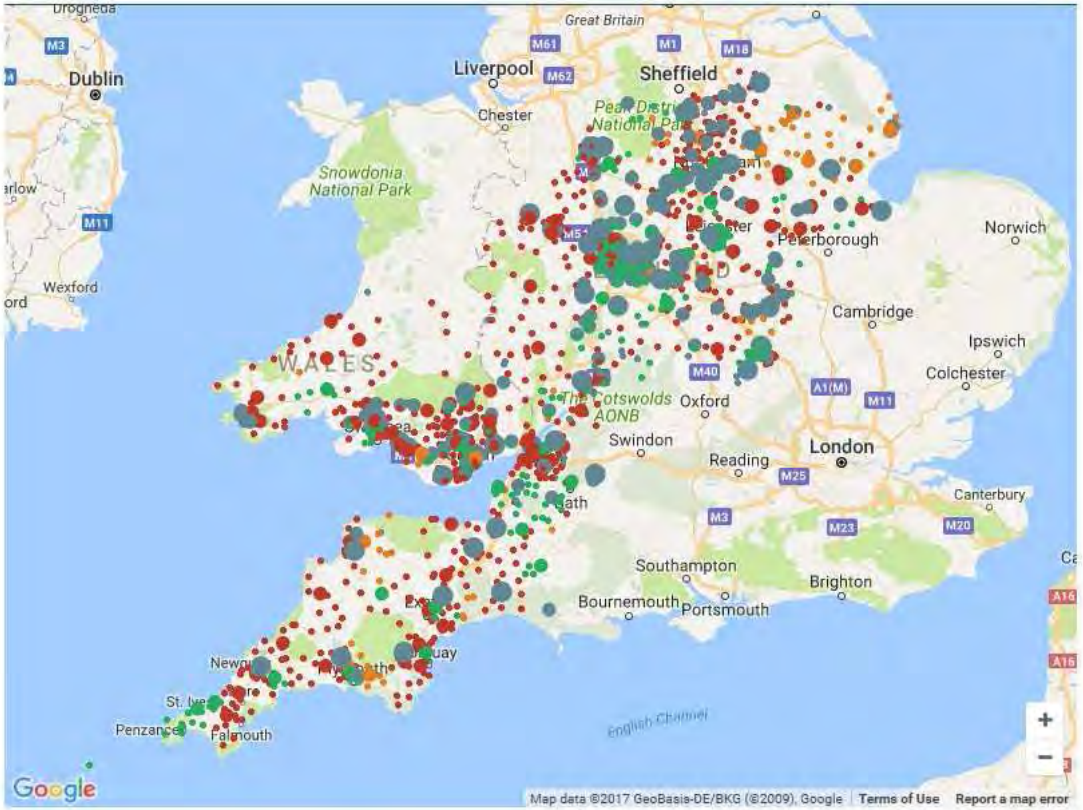
Useful information

Contact us

We are aware that not all data is currently displayed on the map and we are working to resolve the issue.

Postcode search **Capacity search** MVA **Capacity mode** Generation Demand Both

Substation/Supply type Grid Bulk Primary **Connection Potential Filter** High Medium Low Reset Help



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Timetable for Strategic Study

- Stakeholder workshop to get stakeholder input to approach and scenarios to be considered – May 2017
- Undertake network studies and identify solutions with costs - 2017 Q3
- Sensitivity work – i.e. how much ‘headroom’ do the potential solutions give – 2017 Q4
- Assess potential for demand response/generation constraint – 2017 Q4
- Complete report – December 2017
- Dissemination event or webinar – January 2018

Strategic Study Timelines

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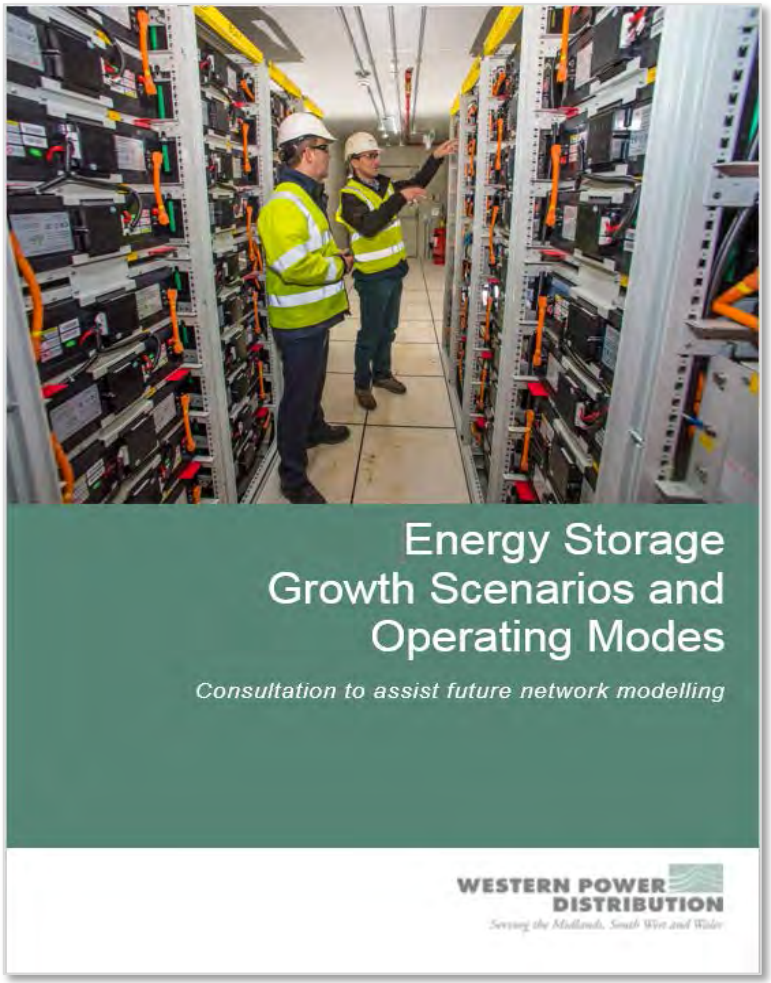
Consultation on storage



WPD is seeking to understand:

- *The potential scale of growth of energy storage within its distribution network*
- *The type of energy storage assets/projects that are likely to be deployed within its network and their business models*
- *The typical operating behaviour of storage assets, how they are likely to be used and their typical modes of operation*

Working with regen transforming energy

Consultation on storage

Question 2 - *What energy storage technologies do you think will be deployed?*

Timescale	Storage Technology: Batteries - Solid State *(i.e. Lithium Ion)*	Batteries - Flow State *(i.e. Vanadium Redox)*	Compressed Air Energy Storage (CAES)	Fly-wheels	Hydrogen	Pumped Hydro	Super-capacitors
Within 18 months	☐	☐	☐	☐	☐	☐	☐
2-5 years	☐	☐	☐	☐	☐	☐	☐
Beyond 5 years	☐	☐	☐	☐	☐	☐	☐

Other technologies not listed, please specify:

Power and Energy Ratios

The ratio of **storage power output (MW) to storage capacity (MWh)** is a key characteristic of a storage system and can vary depending on the business model that is driving the specification of the storage asset.

If storage is co-located with generation, we have also made some assumptions around the ratio of **storage power (MW) to generation power (MW)**, by technology. These ratios are only applicable to some of the business models

If storage is installed alongside demand, we have made some assumptions around the ratio of **storage power (MW) to peak demand (MW)**, at both domestic and C&I scale. Again, these ratios only apply to some business models.

The below tables outline the assumptions we have made around these ratios, showing storage power as the **reference value** and the ratio to storage energy (now and at 2030), generation power capacity and power demand, against the 5 business models:

Business model	Storage Power [MW]	Storage Energy [MWh]		Generation Capacity [MW]	Peak Power Demand [MW]
		Now-2020	By 2030		
1. Response service	1	*1*	*1*	--	--
2. Reserve service	1	*3*	*4*	--	--
3. Commercial & Industrial	1	*3*	*4*	--	*1*
4. Domestic & Community	1	*2*	*3*	*1*	*0.25*
5a Generation Co-Location Solar	1	*3*	*4*	*1*	--
5b Generation Co-Location Wind	1	*6*	*8*	*2*	--

Figure 6 – Table of assumed Power and Energy Ratios

Consultation paper is available at:
www.westernpower.co.uk/netstrat

Responses can be sent to:
Email - *wpdnetworkstrategy@westernpower.co.uk*
By post - *Network Strategy Team*
Western Power Distribution
Feeder Road
Bristol
BS2 0TB

*All responses will be shared with **Regen***
The closing date for this consultation is
21st June 2017
WPD will publish an anonymised, aggregated summary of the responses shortly after this closing date.

We welcome further collaboration:

wpdnetworkstrategy@westernpower.co.uk