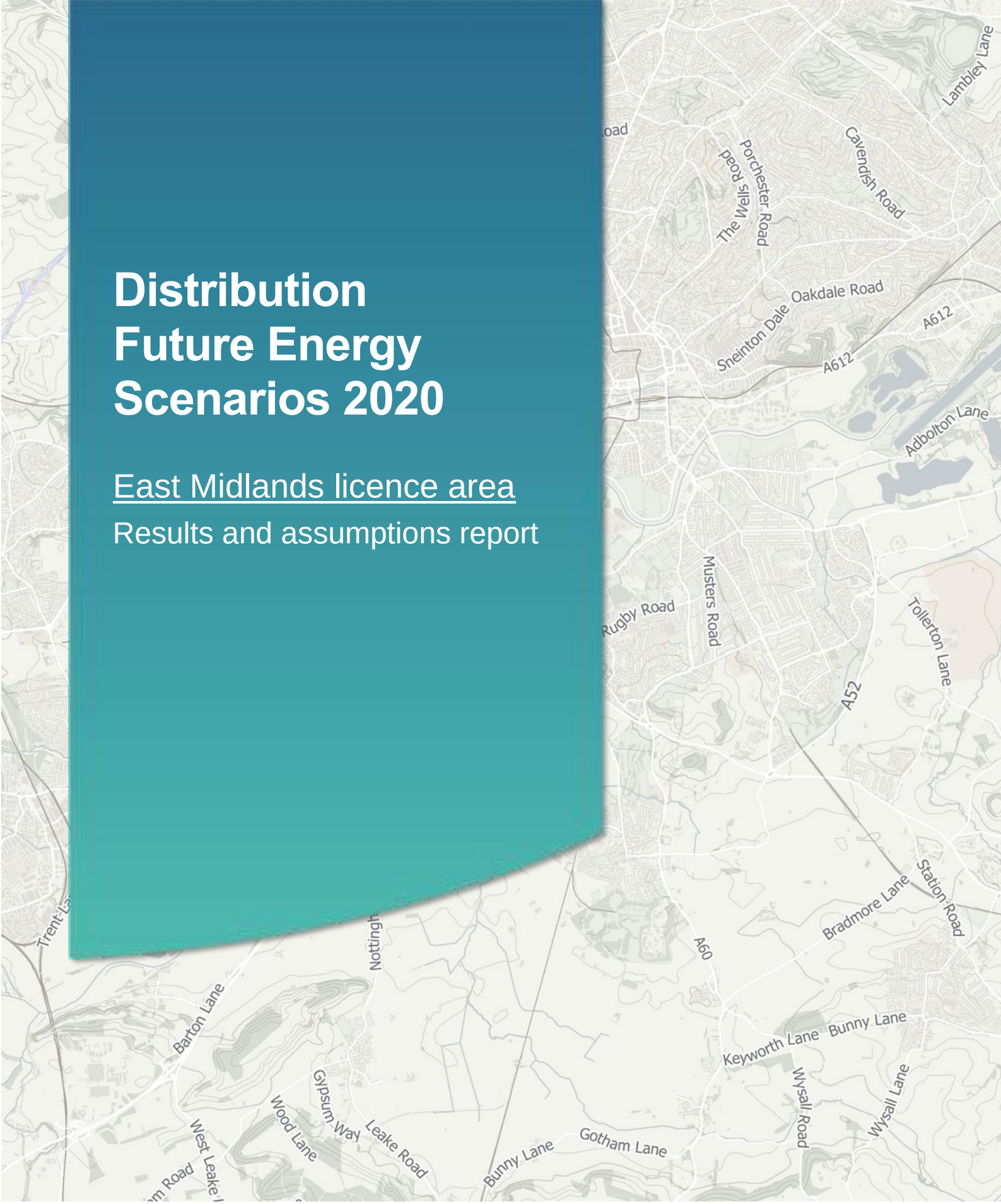
Distribution Future Energy Scenarios 2020

East Midlands licence area

Results and assumptions report



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WESTERN POWER DISTRIBUTION
Serving the Midlands, South West and Wales

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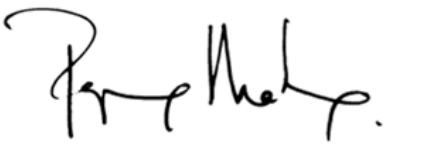
Approved by:	
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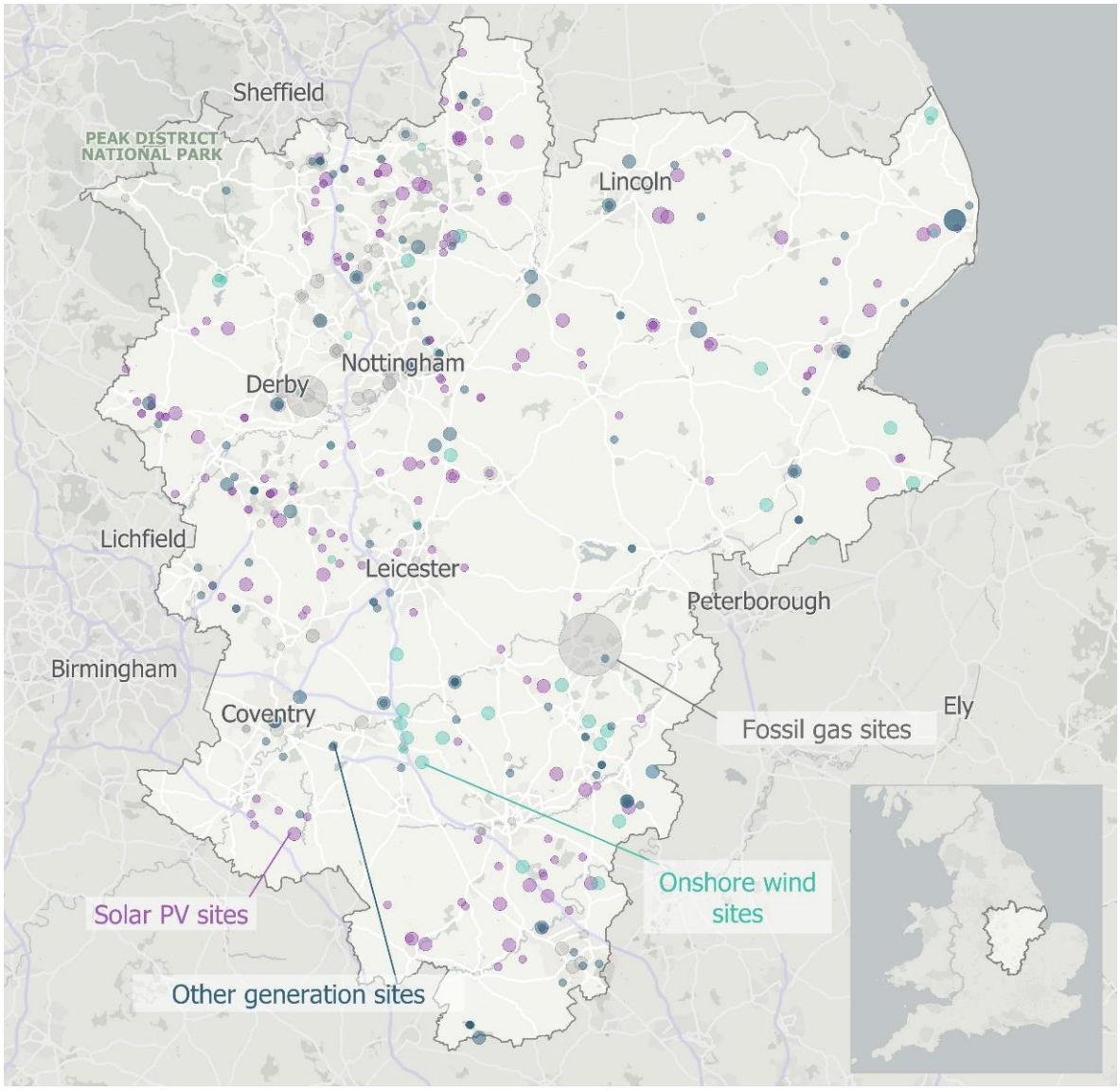
The East Midlands licence area

The East Midlands licence area is characterised by two halves. On the western half is a high population corridor along the M1 through Leicester, Milton Keynes, and Nottingham. The eastern half in comparison is more sparsely populated with high-grade agricultural land.

Distributed electricity generation in the area has increased significantly over the last five years, with over 50% of capacity connected since 2015. Fossil-gas and solar PV make up over two-thirds of the total distributed power generation capacity. Just two sites make up over 50% of fossil-gas capacity, in comparison, the largest 40 solar sites make up 50% of solar capacity. The largest fossil-gas site, Corby Power Station, is visible near the centre of the licence area in Figure 1.

Distributed electricity demand is also changing. Average annual domestic energy demand has fallen over the last 10 years, however new low carbon technologies are expected to change consumption patterns of both homes and businesses. Though only 0.3% of homes currently have a heat pump and 0.8% of cars are electric, widespread change is expected with the potential to radically change the current shape of demand.

Figure 1 – The East Midlands licence area with key generation sites



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Introduction to the WPD DFES 2020

Background:

Distribution Future Energy Scenarios (DFES) provide granular scenario projections for the growth (or reduction) of generation, demand and storage technologies which are expected to connect to the GB electricity distribution networks. The WPD DFES 2020 also includes projections for new housing growth and increase in commercial and industrial developments. The projections are also informed by stakeholder engagement to understand the needs and plans of local authorities and other stakeholders.

For the DNOs, DFES allows network planners to model and analyse different future load scenarios for their network. This data then informs integrated network planning and investment appraisal processes.

The DFES also provide a key data resource and evidence base to enable WPD to appraise different investment options and develop the business case necessary to support future investment, including regulated business plans.

The scope:

The WPD DFES 2020 analyses the baseline of existing connections and pipeline of future projects expected to connect to the distribution network in the four WPD licence areas, South Wales, South West, East Midlands, and West Midlands. The results exclude any asset connected at transmission level.

The DFES analyses technology types which are of a similar scope to the National Grid FES 2020, and these are standardised against the “building blocks” as reported in the FES 2020, developed by the ENA Open Networks project. The full list of technology types in the analysis is shown in Table 1.

The scenarios used for projection purposes extend from 2019 to 2050 and are aligned to the four FES 2020 scenarios: Steady Progression, Consumer Transformation, System Transformation, and Leading the Way. These scenarios are described in more detail in this document. The technology types and assumptions are under constant review and may change with future FES and DFES rounds in line with stakeholder feedback.

The results and assumptions:

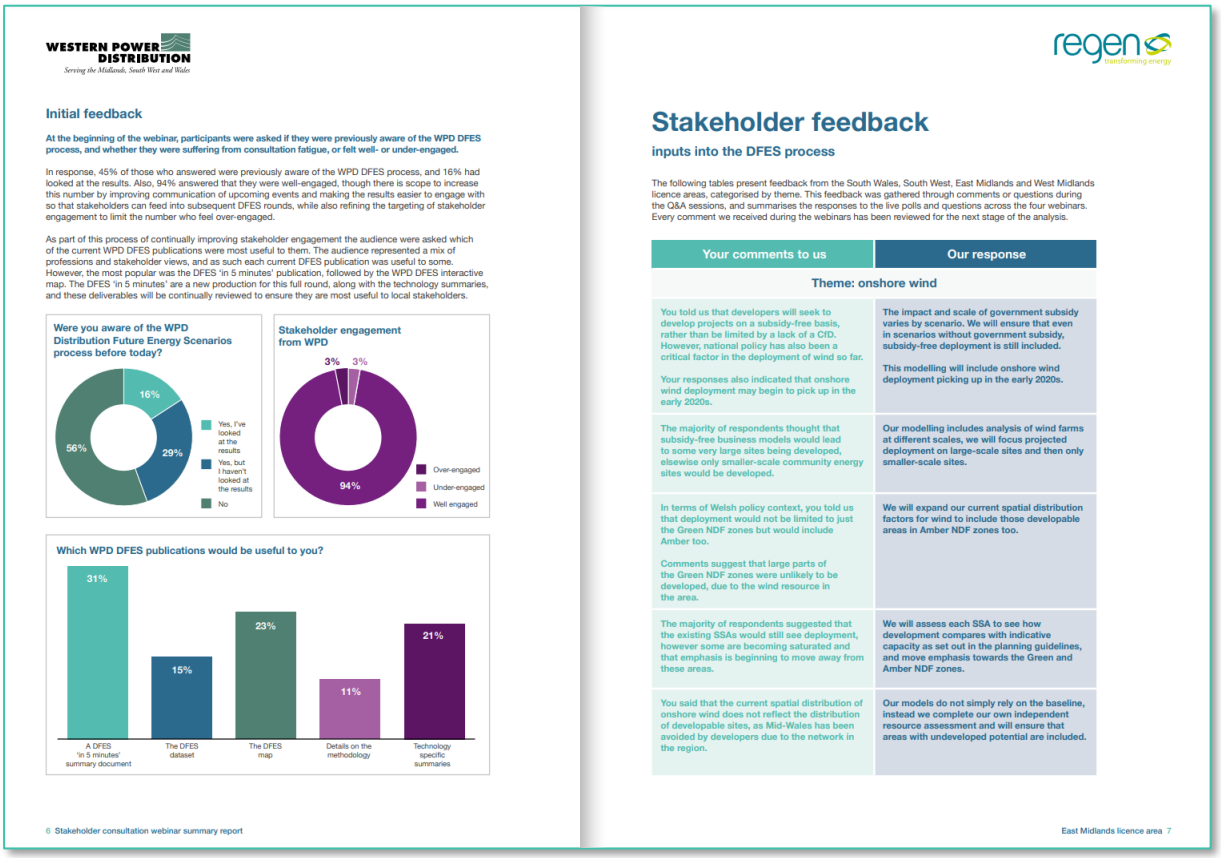
The WPD DFES 2020 is reported to areas known as Electricity Supply Areas (ESAs), which are defined as ‘*the geographical area supplied by a Primary Substation (which contains WPD-owned distribution substations) providing supplies at a voltage below 33 kV, or a customer directly supplied at 132, 66 or 33 kV or by a dedicated Primary Substation’.* These ESAs are also split by local authority boundaries meaning that the data can be viewed as local authority totals, or by primary substation totals. There are over 3,000 unique ESAs across the four WPD licence areas. The ESAs can be collated up to the level at which National Grid present regional FES data. The DFES is, therefore, reconciled to the FES 2020 results as far as possible.

The DFES does not include analysis of network loads, load profiles or peak demand etc. This network load analysis is run by WPD network strategy and planning teams. WPD has published the results of this process on their website.

Local stakeholder influences

The development of DFES has enabled WPD to take a more proactive approach to network planning. Stakeholders were consulted via a series of consultation events, as well as direct engagement with local authority planners and climate emergency officers. For technology projections detailed discussions were held with project developers.

This year the events were held online due to restrictions on large gatherings, and there were more attendees than ever before. To watch a recording of the stakeholder engagement events, or to read the reports summarising how the feedback has been incorporated into the DFES, visit the WPD DFES website.



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Initial feedback

At the beginning of the webinar, participants were asked if they were previously aware of the WPD DFES process, and whether they were suffering from consultation fatigue, or felt well- or under-engaged.

In response, 45% of those who answered were previously aware of the WPD DFES process, and 16% had looked at the results. Also, 94% answered that they were well-engaged, though there is scope to increase this number by improving communication of upcoming events and making the results easier to engage with so that stakeholders can feed into subsequent DFES rounds, while also refining the targeting of stakeholder engagement to limit the number who feel over-engaged.

As part of this process of continually improving stakeholder engagement the audience were asked which of the current WPD DFES publications were most useful to them. The audience represented a mix of professions and stakeholder views, and as such each current DFES publication was useful to some. However, the most popular was the DFES 'in 5 minutes' publication, followed by the WPD DFES interactive map. The DFES 'in 5 minutes' are a new production for this full round, along with the technology summaries, and these deliverables will be continually reviewed to ensure they are most useful to local stakeholders.

Were you aware of the WPD Distribution Future Energy Scenarios process before today?

Stakeholder engagement from WPD

Which WPD DFES publications would be useful to you?

6 Stakeholder consultation webinar summary report

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Stakeholder feedback

inputs into the DFES process

The following tables present feedback from the South Wales, South West, East Midlands and West Midlands licence areas, categorised by theme. This feedback was gathered through comments or questions during the Q&A sessions, and summarises the responses to the live polls and questions across the four webinars. Every comment we received during the webinars has been reviewed for the next stage of the analysis.

Your comments to us	Our response
Theme: onshore wind	
You told us that developers will seek to develop projects on a subsidy-free basis, rather than be limited by a lack of a CfD. However, national policy has also been a critical factor in the deployment of wind so far. Your responses also indicated that onshore wind deployment may begin to pick up in the early 2020s.	The impact and scale of government subsidy varies by scenario. We will ensure that even in scenarios without government subsidy, subsidy-free deployment is still included. This modelling will include onshore wind deployment picking up in the early 2020s.
The majority of respondents thought that subsidy-free business models would lead to some very large sites being developed, elsewise only smaller-scale community energy sites would be developed.	Our modelling includes analysis of wind farms at different scales, we will focus projected deployment on large-scale sites and then only smaller-scale sites.
In terms of Welsh policy context, you told us that deployment would not be limited to just the Green NDF zones but would include Amber too. Comments suggest that large parts of the Green NDF zones were unlikely to be developed, due to the wind resource in the area.	We will expand our current spatial distribution factors for wind to include those developable areas in Amber NDF zones too.
The majority of respondents suggested that the existing SSAs would still see deployment, however some are becoming saturated and that emphasis is beginning to move away from these areas.	We will assess each SSA to see how development compares with indicative capacity as set out in the planning guidelines, and move emphasis towards the Green and Amber NDF zones.
You said that the current spatial distribution of onshore wind does not reflect the distribution of developable sites, as Mid-Wales has been avoided by developers due to the network in the region.	Our models do not simply rely on the baseline, instead we complete our own independent resource assessment and will ensure that areas with undeveloped potential are included.

East Midlands licence area 7

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Methodology summary

A detailed methodology report is available on the WPD DFES website, and is summarised in brief in this report.

Baseline analysis

A database of current distribution network connected assets is created based primarily on WPD connection data, and supplemented with subsidy registers, Department for Transport data, and other national datasets. This data is used to analyse the spatial trends within a licence area, and how those trends have changed up to the present day.

Pipeline analysis:

Once a baseline is established, an analysis of sites that may connect in the next five-to-ten years is completed. This includes sites that have accepted a connection offer from the DNO but that have not yet connected, or sites that are active, for example having no connection offer but have applied for planning permission. Where possible, a discussion is held with a developer or interested group directly to inform the connection dates in the scenario projections.

Demand from new domestic and non-domestic property developments is also included in the analysis. The local plans from each local authority that intersect the licence areas are analysed. The local authority planners are contacted to verify the information and to provide insight into the rate of development within their planning period (in most cases the next 10-15 years). This consultation with local authorities also identifies where there are plans or strategies for supporting energy efficiency measures, renewable energy deployment, or decarbonising heat and transport. These are then reflected in the analysis and spatial distribution.

Annual cycle:

WPD DFES is now scheduled to be published on an annual basis, having previously been carried out on a two-yearly cycle. The National Grid ESO FES is developed through the spring and launched in the summer while the WPD DFES will use the latest FES to build the analysis, which is produced over the summer and published in the autumn.

Data will be collected and refreshed in this yearly cycle, and the scope and scenarios may differ year to year depending on changes to the FES. Stakeholder feedback will be gathered throughout the year and may continue after the main DFES process, to be incorporated in the following year.

The WPD DFES uses the FES as a framework, however itis a bottom-up analysis of a changing energy system at a regional and sub-regional level that reflects regional and local factors. It is, therefore, likely that there will be some variance between the WPD DFES view and the FES view. The regular annual cycle allows for data sharing between the WPD DFES and the National Grid ESO FES teams, facilitating continuous improvement of the data quality and processes.

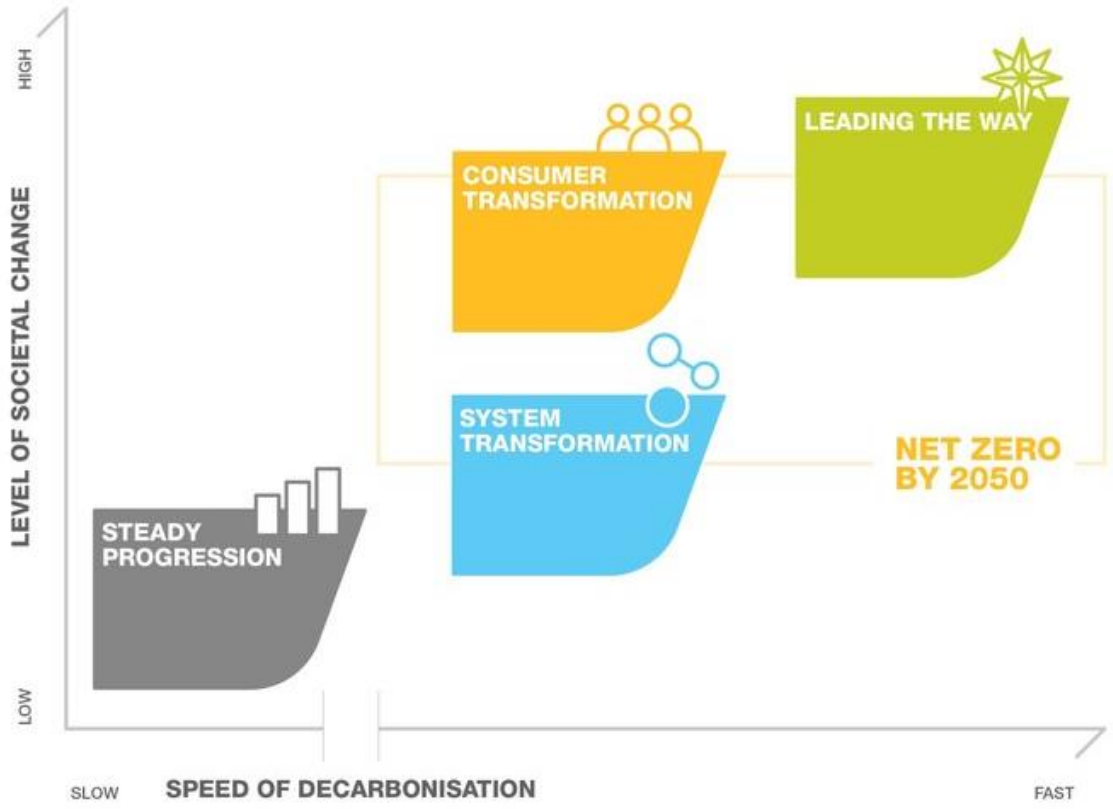
Scenario projections:

The WPD DFES 2020 uses the same four future scenarios as the National Grid ESO FES 2020. These scenarios are significantly different from those used in previous studies, reflecting changing legislation and incorporating new technology types in the analysis. The scenarios each have a different speed of decarbonisation and assume various levels of societal change. The location of these scenarios on those axes are shown in Figure 2.

Three of the four scenarios assessed in the WPD DFES 2020 meet the government target of net zero emissions by 2050, however they achieve these emissions reductions in different ways and at different rates. The net zero compliant scenarios are Leading the Way, Consumer Transformation, and System Transformation. The Steady Progression scenario is not compliant with the 2050 net zero target and has lower levels of societal change.

There are published assumptions made by in the FES 2020 which have been included in the DFES analysis and shown throughout this report. Further DFES assumptions including technology costs, spatial distribution, the development of sites in the pipeline are detailed in the technology specific sections of this report.

Figure 2 – The National Grid ESO FES 2020 scenario framework



List of technology types analysed as part of the WPD DFES 2020:

Table 1

DFES technology	DFES sub-technology	Equivalent Building block ID number
Air conditioning	-	-
Battery storage	Domestic batteries (G98)	Srg_BB002
Battery storage	Grid services	Srg_BB001
Battery storage	Co-location	Srg_BB001
Battery storage	High energy user	Srg_BB001
Biomass & Energy Crops (including CHP)	-	Gen_BB010
CCGTS (non CHP)	-	Gen_BB009
Electric vehicles	Pure electric motorcycle	Lct_BB001
Electric vehicles	Pure electric car (non autonomous)	Lct_BB001
Electric vehicles	Hybrid car (non autonomous)	Lct_BB002
Electric vehicles	Hybrid motorcycle	Lct_BB002
Electric vehicles	Pure electric bus and coach	Lct_BB003
Electric vehicles	Pure electric LGV	Lct_BB003
Electric vehicles	Pure electric HGV	Lct_BB003
Electric vehicles	Hybrid LGV	Lct_BB004
Electric vehicles	Hybrid bus and coach	Lct_BB004
Electric vehicles	Hybrid HGV	Lct_BB004
Electric vehicles	Pure electric car (autonomous)	-
Electric vehicles	Hybrid car (autonomous)	-
EV charge point	Domestic	-
EV charge point	Workplace	-

EV charge point	En route	-
EV charge point	Destination	-
Floating wind	-	Gen_BB014
Geothermal	-	Gen_BB019
Heat pumps	Electric back-up	Lct_BB005
Heat pumps	Gas back-up	Lct_BB006
Hydropower	-	Gen_BB018
Marine	Tidal stream	Gen_BB017
Marine	Wave energy	Gen_BB017
Non renewable engines (CHP)	> 1 MW	Gen_BB001
Non renewable engines (CHP)	< 1 MW	Gen_BB002
Non renewable engines (CHP)	(G98/G83)	Gen_BB003
Non-renewable Engines (non CHP)	Diesel	Gen_BB005
Non-renewable Engines (non CHP)	Gas	Gen_BB006
OCGTS (non CHP)	-	Gen_BB008
Offshore wind	-	Gen_BB014
Onshore wind	Large scale (>1MW)	Gen_BB015
Onshore wind	Small scale (<1MW)	Gen_BB016
Other generation	-	-
Renewable engines (landfill gas, Sewage Gas, Biogas)	-	Gen_BB004
Solar PV	Ground mounted (>1MW)	Gen_BB012
Solar PV	Commercial rooftop (10kw - 1MW)	Gen_BB013
Solar PV	Domestic rooftop (<10kw)	Gen_BB013
Waste Incineration (including CHP)	-	Gen_BB011

Results and assumptions

Demand technologies

New demand in the East Midlands licence area

Summary of modelling assumptions and results.

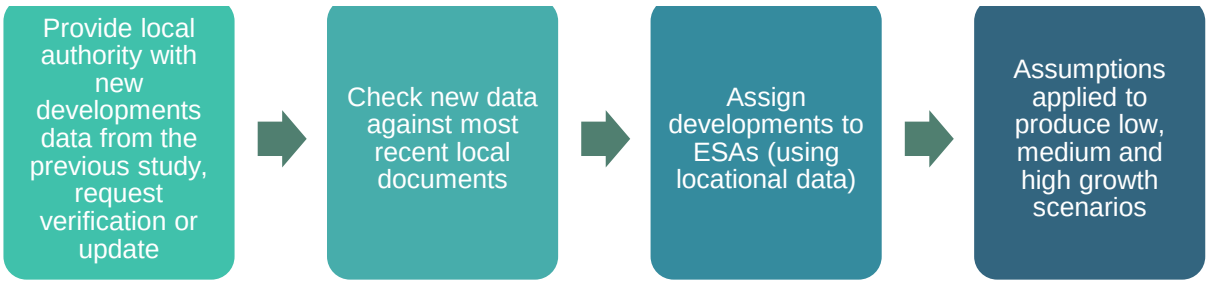
Specification:

New domestic and non-domestic development data is projected using the four FES 2020 scenarios based on an assessment of local authority plans.

Summary:

- New domestic and non-domestic buildings can have a significant impact on local electricity demand. The development local plans of each local authority are analysed to create a record of the planned developments, their location, likely use, and the years over which they are expected to be built. The methodology is summarised in Figure 3.

Figure 3 – Summary of methodology for the assessment of new developments

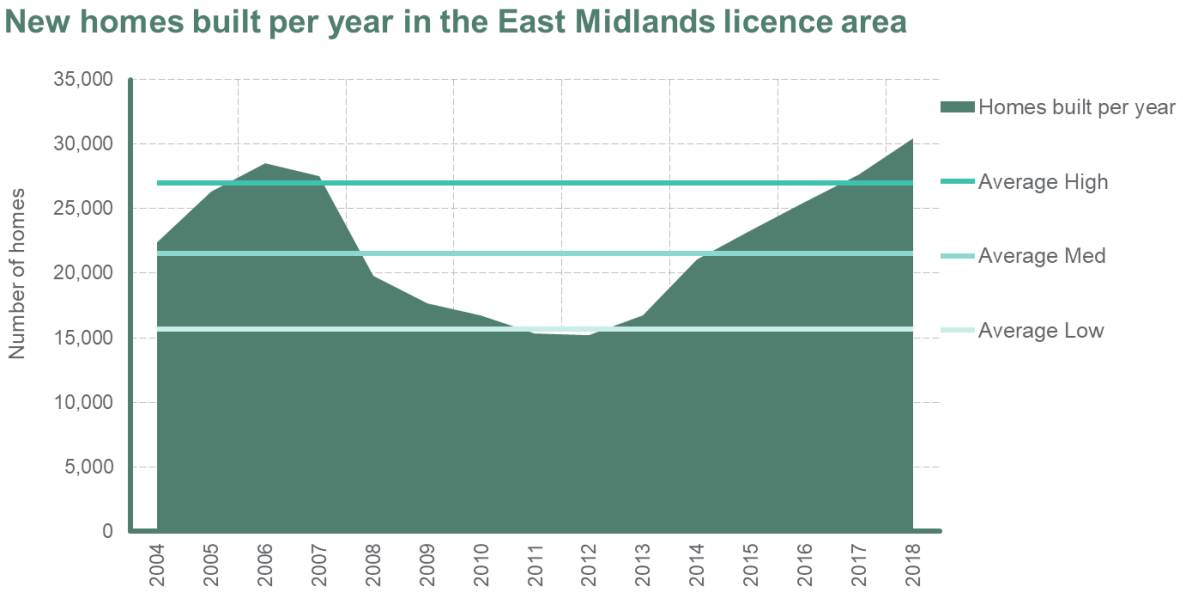


- The data from local authorities is used to create low, medium, and high growth scenarios for domestic and non-domestic developments, reported at ESA level.
- Every local authority within the licence area was contacted, with the existing DFES data presented for verification or modification. The local authorities were also asked about existing or draft decarbonisation strategies for energy, transport, waste, and heating in their local area. This data was used throughout the WPD DFES 2020.
- The minimum size of development captured through the direct analysis of local authority plans was 20 homes, with additional sites allocated based on historic development rates.

Results and assumptions:

- Historic trends in new developments are used to provide upper and lower estimates for a low, medium, and high level of deployment. These are then assigned to the FES 2020 scenarios for the near and medium term as detailed below. All scenarios trend towards the average medium trajectory in the long term.
    - Steady Progression – Low
    - Consumer Transformation – Medium
    - System Transformation – Medium
    - Leading the Way – High

Figure 4 – Example of how the levels of deployment are determined



- The numbers of homes or amount of commercial floorspace, the location, and the building type are taken from the local authority plans, or from a survey filled out by local authority planners.
- Each individual site is assigned to an ESA within the WPD network area and the rate at which new buildings will be completed is noted according to the plan. To create trajectories that fit the historic low, medium, or high rates, the scenarios apply different levels of assumed delay to building completion. In this way, the precise spatial data and scale of development is maintained, but the period over which the sites are built is varied.
- Not all plans extend out to 2030 or later, and therefore there is a natural reduction in the data for planned developments. To compensate for this reduction, additional dwellings and commercial floorspace is modelled, with location weighted towards areas of similar housing density to those of recent deployment.
- For the East Midlands licence area, the high trajectory assumes around 30,000 new homes per year, and the low around 20,000 new homes per year. The building rates interact with the new demand and generation scenarios for domestic technologies such as electric vehicles, heat pumps and rooftop solar PV, and the spatial data from the local plans define where on the WPD network these technologies in new builds are connected.
- A more detailed methodology is presented in the full WPD DFES 2020 methodology report, published alongside this results summary document.

Figure 5

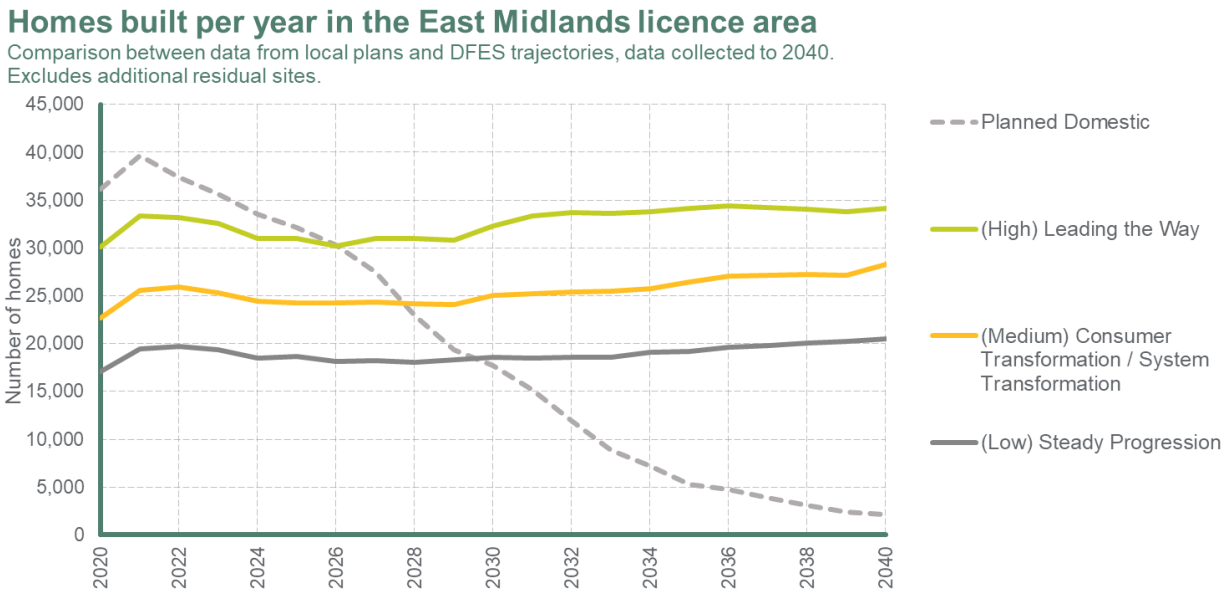
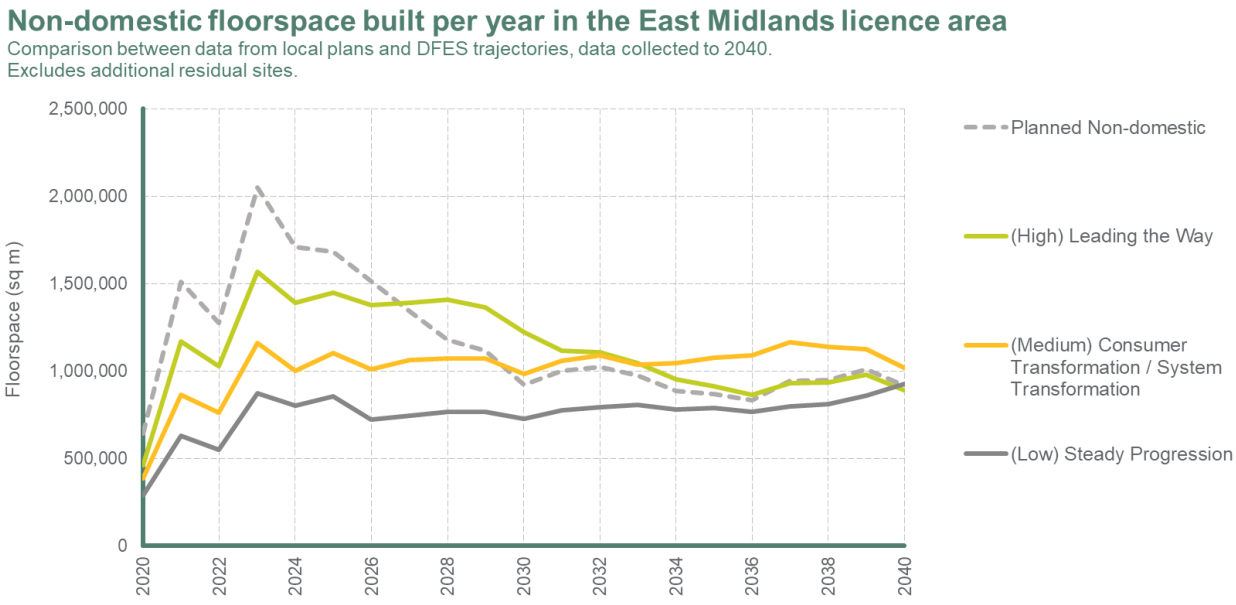


Figure 6



Stakeholder feedback from the consultation events:

Your comments to us	Our response
Theme: new developments	
You asked how the DFES can effectively feed into Local Plan Infrastructure Delivery Plans.	The DFES is designed to account for the most up to date Local Plan information available, and these projections are used in network analysis to determine potential reinforcements required. Our DFES projections are also disseminated to Local Authorities to review our assumptions and understand how WPD can feed into future Infrastructure Delivery Plans.
You asked at what point in the Local Plan process do WPD want to know about development sites – when the plan has been adopted or when it is in draft.	Draft local plans offer an updated position over previously adopted local plans. Plans in the draft stage are therefore preferred.
You asked if half-hourly metered data is used or peak figures with a diversity factor applied, and whether WPD has their own benchmarks to forecast demand based on floor area.	WPD use a combination of half hourly metered customer data and profiles derived from innovation projects applied to the DFES projections for electrical analysis. More information on the electrical profiles used can be found in our Shaping Subtransmission reports: www.westernpower.co.uk/smarter-networks/network-strategy/strategic-investment-options-shaping-subtransmission

References:

Local plan data as verified with all local authorities which intersect the WPD region.

Heat pumps in the East Midlands licence area

Summary of modelling assumptions and results.

Technology specification:

Domestic heat pumps – electric heat pump systems providing space heating and hot water to domestic buildings. This technology is divided into two sub-categories:

- Non-hybrid heat pumps - powered purely by electricity
- Hybrid heat pumps - a combination of a gas boiler and electric heat pump.

Data summary for heat pumps in the East Midlands licence area:

Thousands of heat pumps		Baseline	2025	2030	2035	2040	2045	2050
Non-hybrid	Steady Progression	7	16	22	56	107	205	291
	System Transformation	7	37	88	155	233	367	478
	Consumer Transformation	7	187	545	985	1,369	1,729	2,090
	Leading the Way	7	183	537	814	1,137	1,506	1,571
Hybrid	Steady Progression	0	3	24	52	67	103	166
	System Transformation	0	34	73	154	192	279	359
	Consumer Transformation	0	17	54	118	181	224	277
	Leading the Way	0	61	193	344	525	722	719

Summary:

- In line with changes nationwide, there is a dramatic shift in the East Midlands to low carbon heating in all three of the net zero compliant scenarios. In the more electrified Consumer Transformation and Leading the Way scenarios, c.85% of homes are primarily heated by a heat pump by 2050.
- Due to the East Midland's larger-than-average houses and greater proportion of detached and semi-detached homes, heat pump uptake is projected to exceed the national average over the scenario time frame.
- Due to the slightly lower than average proportion of homes connected to the gas grid in this area – 18% of homes are off-gas, compared to 15% nationally – non-hybrid heat pumps are more prevalent in this region than the projected national average.

Results and assumptions:

Baseline

- The East Midlands licence area has c.7,500 domestic heat pumps, all of which are non-hybrid. This represents 0.3% of homes, a lower baseline than the national average of 0.6%.
- The primary deployment driver for domestic heat pumps in existing homes in GB in recent years has been the domestic Renewable Heat Incentive (RHI). 11% of heat pumps accredited by the RHI have been in the East Midlands licence area.

Near term

- Heat pump uptake slowly increases in the net zero compliant scenarios in the near term, as a result of a continued Domestic RHI and the Green Homes Grant, which is available from September 2020 and supports the installation of domestic energy efficiency measures and low carbon heating.
- From 2022, there is a step change in installation rates in the Consumer Transformation and Leading the Way scenarios where more heat is electrified. In these scenarios it is assumed a national heat strategy prioritises electrification and drives significant change in the heating industry. Installation rates of heat pumps also increase notably in System Transformation, despite a stronger focus on gas network solutions.
- With national policy expected to be targeted in off-gas homes over the next decade (as indicated in the Clean Growth Strategy 2017), the high proportion of off-gas homes in the East Midlands licence area leads to higher near-term deployment of heat pumps.
- Under all net zero compliant scenarios the proposed ban on gas connections in new build housing is assumed to implemented, resulting in an uptick of non-hybrid deployments from 2025 onwards as no hybrid heat pumps are built in new builds from 2025 at the latest.

Medium term

- Installations of heat pumps in the late 2020s and 2030s are driven largely by national heat strategy and policy rather than consumer choice.
- Under System Transformation, hydrogen boilers served by a repurposed gas network are pursued as the dominant low carbon heating technology and heat pump uptake is largely limited to off-gas housing.
- Under Leading the Way and Consumer Transformation heat pumps replace high carbon heating technologies in both on- and off-gas housing, heat pumps representing up to 35% and 56% of heating system replacements in on- and off-gas homes respectively in the 2030s.

Long term

- In the Consumer Transformation and Leading the Way scenarios, continually improving domestic energy efficiency results in almost all homes becoming suitable for a heat pump by 2050.
- Under these scenarios, market conditions mean that electrified heat is the optimal heating solution for the vast majority of homes, with c.85% of the licence area's homes served by a non-hybrid or hybrid heat pump by 2050. A slightly lower uptake of heat pumps in a Leading the Way scenario reflects the uptake of hydrogen heating, which is more absent in Consumer Transformation.
- Heat pump uptake in System Transformation and Steady Progression remains relatively low, as heating fuelled by hydrogen and fossil gas boilers respectively, is preferred.

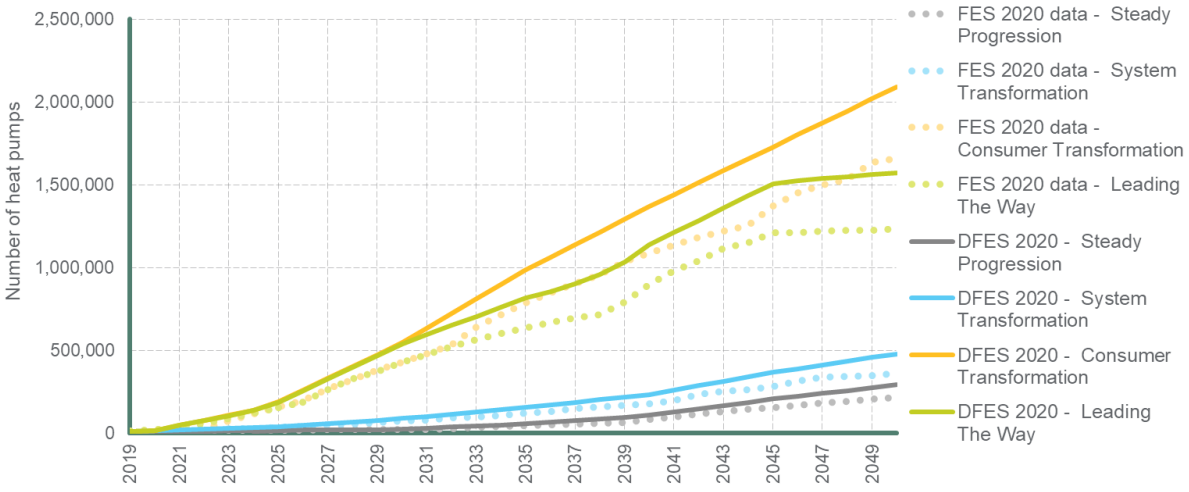
Reconciliation with National Grid FES 2020:

Results in this section relate to the FES 2020 data as reported for the Building Block ID numbers Lct_BB005 and Lct_BB006.

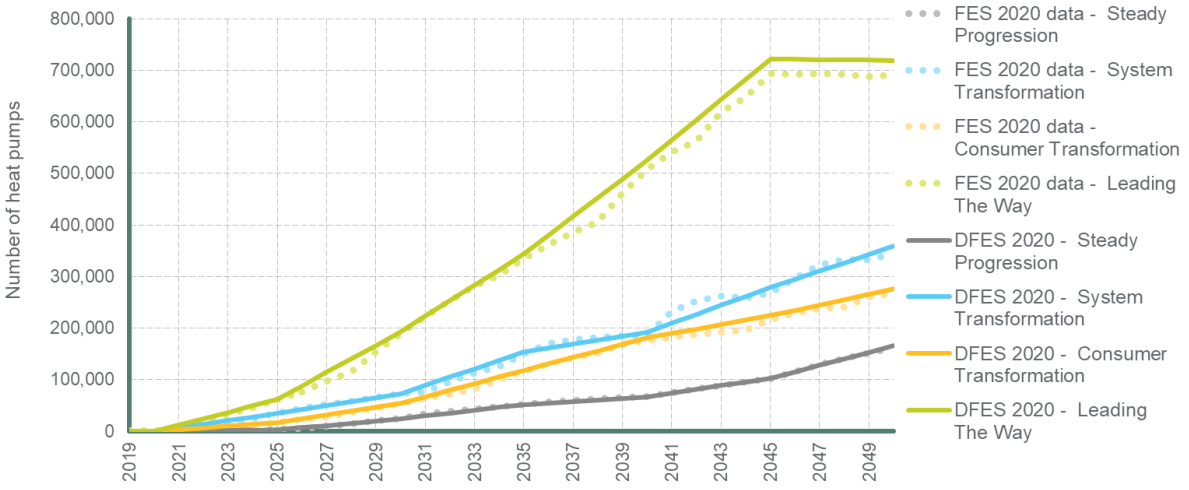
- The WPD DFES 2020 projections are above FES 2020 GSP-level projections for non-hybrid heat pumps for the East Midlands licence area. This reflects the greater number of off-gas homes in the licence area (18%) compared to the national average (15%).
- As heat pump deployment is assumed to be targeted in off-gas homes over the next decade, it is expected that the East Midlands will progress ahead of the national trajectory.
- In the long-term, there is a greater uptake of domestic heat pumps than the national average, reflecting the high proportion of detached and semi-detached housing and higher than average floor space. Homes with higher than average floorspace are more likely to have the space to house the unit, and the higher heat demand increases the payback from installing an efficient heat pump. Homes with smaller floorspace, particularly flats, smaller terraced properties, and bungalows, may be more likely to install direct electric heating due to space constraints and smaller heating demand.

Figure 7

Domestic - Non-hybrid heat pumps by scenario
Comparison to FES 2020 GSP data for the East Midlands licence area



Domestic - Hybrid heat pumps by scenario
Comparison to FES 2020 GSP data for the East Midlands licence area



Factors that will affect deployment at a local level:

- Uptake in off-gas, and on-gas homes is modelled separately. Within these two separate areas, homes with a larger than average floorspace are assumed to have a slightly higher uptake of heat pumps, with more space to fit hybrid units and typically higher heat demand giving an incentive to install an efficient heating system. Those with smaller floorspace are assumed to have slightly higher preference for direct electric heating in the near and medium term.
- Under Consumer Transformation and Leading the Way where heat pumps become the dominant heating technology, the spatial weightings focus on those areas which are 'first movers' in the near term, and identifies which areas play catch up later on.
- In the near term detached, semi-detached, and owner-occupied properties see higher uptake reflecting analysis of existing RHI supported heat pump installations. Detached and semi-detached properties make up 81% of current installations, despite representing 27% of the housing stock.
- Additionally, as heat pumps perform best in a well-insulated building, properties with an EPC band of a C or higher see higher projected uptake in the near term.
- Distribution weightings used in the near term such as affluence, tenure and building type reduce as a factor in the medium term as heat pumps become the heating solution of choice in Consumer Transformation and Leading the Way. Homes that are currently less likely to adopt heat pumps, such as rental properties and poorly insulated buildings, therefore drive the distribution of heat pump uptake in these scenarios in the longer term.
- Hybrid heating distribution is driven by the above factors and limited to those with access to the gas network, with an additional weighting towards homes with high floor space (i.e. that have space to house the dual heating appliances and likely higher peak heat demand) and with maximum potential EPC ratings of a D or below. These lower efficiency dwellings are unlikely to be suitable for a non-hybrid heat pump without deep retrofit.
- All local authorities in the East Midlands licence area were surveyed regarding whether they had specific plans or strategies for low carbon heat. Those with a positive heat pump strategy were given a small positive weighting, deployment was also weighted away from areas with a district heat network strategy in the near term.

Relevant assumptions from National Grid FES 2020:

Assumption number	3.1.3
Steady Progression	Consumers continue to buy similar appliances to today
System Transformation	Low willingness to change lifestyle results in hydrogen being the preferred low carbon heating technology for consumers
Consumer Transformation	High energy prices and consumer willingness to adapt results in high levels of heat pump uptake
Leading the Way	High income, energy prices and consumer green ambition results in high levels of non-hybrid and hybrid uptake

Stakeholder feedback from the consultation events:

Your comments to us	Our response
Theme: domestic heat	
You asked what analysis of the potential uses of hydrogen do we include in our modelling?	The uptake of domestic hydrogen heating or electric heat pumps differs across the net zero scenarios, and the analysis includes both. However, we focus on electric heat pumps as we are reporting connections to the WPD network.
You told us that hydrogen produced in industrial clusters could be used to generate electricity.	We will review this for the next round of DFES and incorporate stakeholder feedback for including hydrogen peaking plants as an emerging technology by 2050.
The majority of the respondents suggested that gas boilers would continue to be installed in new homes up until 2025, however a significant minority thought that the rate would fall towards 2025.	We will incorporate these into the assumptions which feed our heat modelling work, keeping gas boiler deployment high in new builds out to 2025.
The majority of respondents suggested that though new homes and off-gas areas would receive higher heat pump installation rates, on-gas areas would also see uptake.	We will incorporate this into our spatial modelling, focussing most deployment in the early years in off-gas areas, but widening it out into other areas too.

References:

Energy Performance Certificates, Census 2011, Renewable Heat Incentive data, Climate Emergency declaration data, Regen consultation with local stakeholders and local authorities.

Direct electric heating in the East Midlands licence area

Summary of modelling assumptions and results.

Technology specification:

A system using electricity to provide primary space heat and hot water to domestic buildings that is not driven by a heat pump. Typically, this is night storage heating or direct electric heating. This does not include heat networks.

Data summary for direct electric heating in the East Midlands licence area:

Number of households (1,000s)	Baseline	2025	2030	2035	2040	2045	2050
Steady Progression	156	168	178	188	201	213	225
System Transformation	156	171	179	186	190	192	192
Consumer Transformation	156	171	178	182	184	183	180
Leading the Way	156	173	184	192	196	198	199

Summary:

- The number of electric heating units declines in existing homes as it is gradually replaced by low-carbon heating, the majority of which are non-hybrid heat pumps. There are some installations in homes with homes with smaller floorspace, though there is an overall net reduction in existing homes. Overall, numbers increase as electric heating is projected to be installed in some new build homes. The result is a small increase in overall numbers in the near and medium term.
- In the long term, the uptake rate flattens in Leading the Way, and begins to fall in the long term in Consumer Transformation and System Transformation due to the prevalence of electric heat pumps and hydrogen heating alternatives.

Results:

Baseline

- The baseline number of direct electric heating units is based on analysis of domestic heating technology types from Energy Performance Certificate (EPC) data.
- The installation rate of direct electric heating in new builds is also based on local EPC data. The most recent national data shows that c.11% of new builds are heated by direct electric heating, a proportion which has been relatively stable over recent years.

Near term (2020 – 2025)

- In the net zero compliant scenarios, electric heating units are projected to be replaced by other or more efficient low carbon heating solutions, projected to be mainly non-hybrid heat pump systems.
- Though electric heating has a higher running cost than a heat pump, they are assumed to not be the target of national policy to decarbonise domestic heating, based on the relative emissions of other domestic heating solutions such as oil and LPG. Therefore, in the near term there is projected to be a limited decrease in electric heating in existing homes.
- The WPD DFES 2020 analysis of new build domestic properties is used to project increases in the number of direct electric heating installations, starting at the current average of c.11% of new homes with direct electric heating, falling to c.10% in the net zero compliant scenarios by 2025.

Medium term (2025 – 2035)

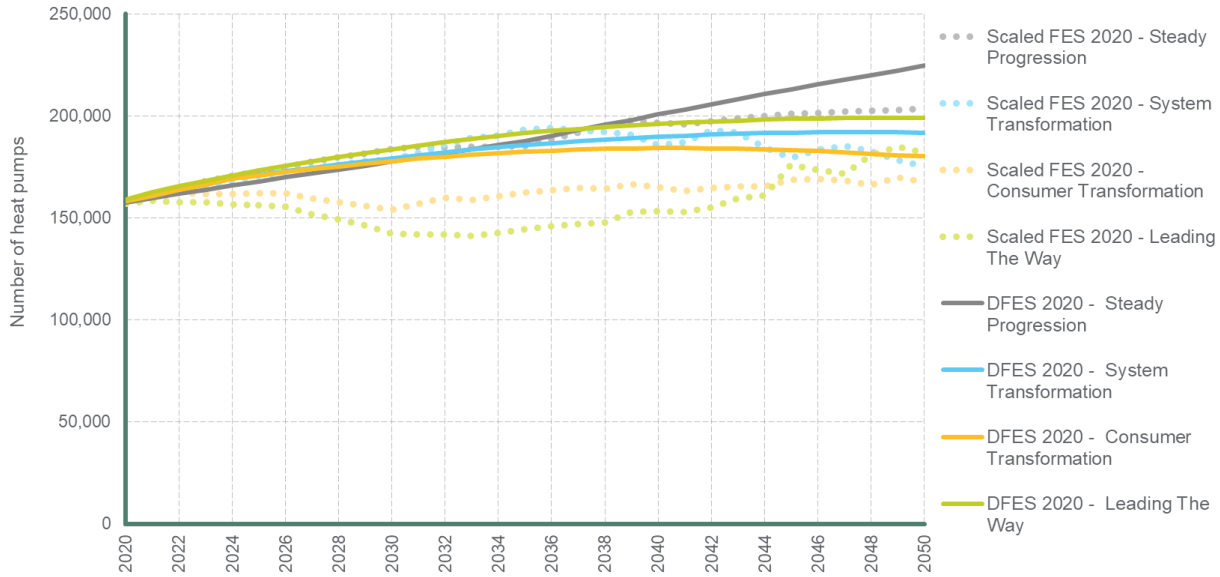
- In the medium term, there is a steady decline in the numbers of domestic direct electric heating units in existing homes. It is assumed to be a steady annual reduction in the absence of clear policy drivers within the medium term. In Steady Progression, the baseline installations are not projected to decrease across the projection period.
- The percentage of direct heating units in new builds is assumed to decrease in the medium term from c.11% to c.3-5% in the net zero compliant scenarios. No change in installation rate is assumed in the Steady Progression scenario in the medium term.

Long term (2035 – 2050)

- The installation rate of direct electric heating in new build domestic properties reduces to zero in Consumer Transformation, and to c.2% in Leading the Way and System Transformation. This reduction in new installations and the continued replacement of the baseline installations leads to a falling total in Consumer Transformation, and a flattening projection in Leading the Way and System Transformation.
- In Steady Progression, the total number of installations rises to 225,000, compared to 180,000 in Consumer Transformation.

Figure 8

Domestic direct electric heating by scenario
Comparison to scaled FES 2020 data for the East Midlands licence area



Reconciliation with National Grid FES 2020:

- There are no direct electric heating numbers presented at GSP level in the FES 2020, therefore the comparison is presented to FES 2020 totals scaled to the baseline level of domestic direct electric heating installations in the licence area.
- The WPD DFES 2020 is broadly in line with FES 2020, although the WPD DFES 2020 trajectory shows less variation within the projection period. At a more granular level the trajectories are less smooth due to the discrete location of planned new domestic developments in the licence area and the clustering of current direct electric heating installations in off-gas areas.

Factors that will affect deployment at a local level:

- The spatial distribution of the baseline installations, and therefore the reduction in total numbers of direct electric heating units, is based on EPC data and are typically located in off-gas properties and homes with smaller floorspace.
- The spatial distribution of new builds is based on data collected from the plans of local authorities.

References:

Energy Performance Certificate data, BEIS local off gas properties data, Regen consultation with local stakeholders and analysis of local authority local plans.

Electric vehicles in the East Midlands licence area

Summary of modelling assumptions and results.

Technology specification:

Electric Vehicles (EVs) – including non-autonomous cars, autonomous cars, buses and coaches, HGVs, LGVs and Motorcycles, including battery EVs and plug-in hybrid EVs.

Data summary for EVs in the East Midlands licence area:

Number of EVs (total, 1000s)		Baseline	2025	2030	2035	2040	2045	2050
Battery EVs	Steady Progression	16	116	403	1,092	2,316	3,543	3,931
	System Transformation	16	139	562	1,730	3,286	3,859	3,700
	Consumer Transformation	16	328	1,224	2,764	3,721	3,796	3,492
	Leading the Way	16	313	1,326	3,041	3,705	3,467	2,748
Hybrid EVs	Steady Progression	25	92	207	378	508	330	76
	System Transformation	25	83	181	274	199	73	11
	Consumer Transformation	25	62	109	136	89	27	5
	Leading the Way	25	79	138	109	54	11	11

Summary:

- At present, EVs represent approximately 0.8% of all vehicles in the East Midlands licence area, which is approximately the average uptake of EVs in GB. The area is projected to continue to align with the GB average as EVs become ubiquitous by the late 2020s.
- While the number of plug-in hybrid EVs is currently higher than battery EVs, across all scenarios battery EVs become the dominant vehicle in the near term and quickly eclipse plug-in hybrids. All net zero compliant scenarios have zero plug-in hybrids by the 2040s, and so this assumptions report focusses on battery EVs.
- Analysis of Autonomous Vehicles (AVs) was introduced in FES 2020. FES projects these vehicles represent between 9% and 23% of all cars by 2050. This is, therefore, the first WPD DFES to include a preliminary analysis of AVs.

Results and assumptions:

Baseline

- There are a total of 15,806 battery EV cars in the East Midlands licence area.
- There are a total of 25,562 plug-in hybrid EV cars in the East Midlands licence area.

Near term (2020 – 2025)

- Across all scenarios the uptake of EVs is expected to increase dramatically by 2025.
- It is projected that by 2025, there could be between 116,000 battery EVs in Steady Progression and 313,000 in Leading the Way.
- Autonomous vehicle uptake starts at the earliest in 2023 in all scenarios, however, uptake is assumed to be very slow in the near term.

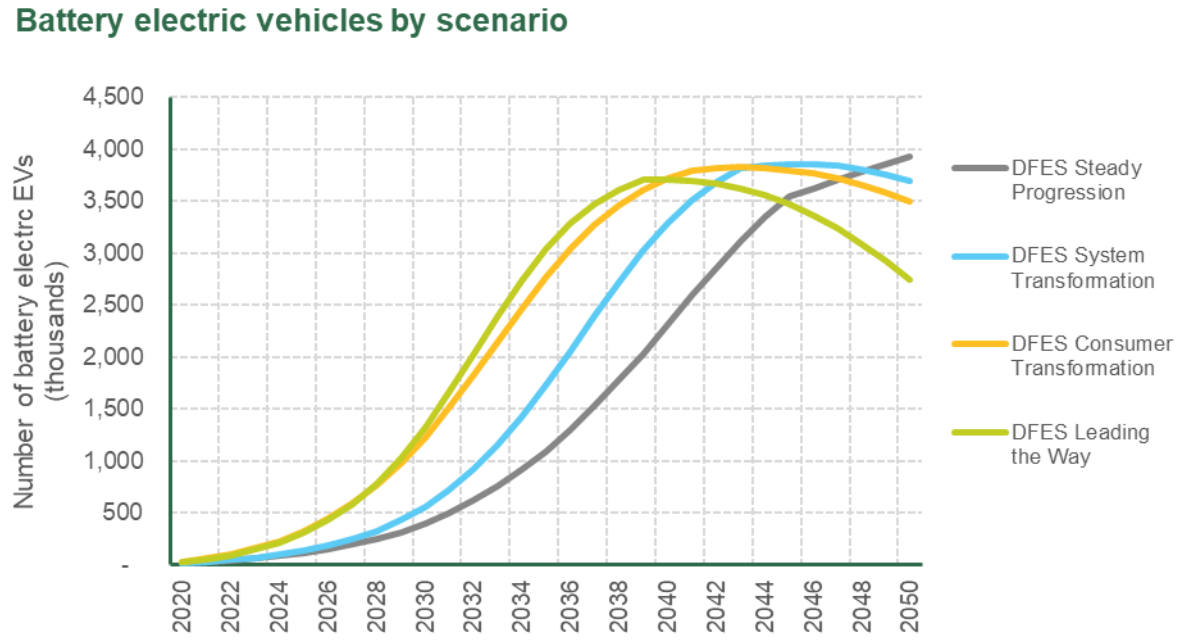
Medium term (2025 – 2035)

- Uptake of EVs is expected to increase between 2025 and 2035 across all scenarios.
- Steady Progression has the fewest estimated battery EVs in 2035, with around 1.1 million. Leading the Way has the most, with over 3 million battery EVs by 2035.
- EV uptake begins to slow in the mid-2030s as EV adoption approaches saturation and only the hardest-to-electrify vehicle such as HGVs, remain as fuelled by petrol or diesel. Other factors also contribute to uptake slowing, including the total number of vehicles reducing, increased use of AVs, and increased use of public transport and active travel.

Long term (2035 – 2050)

- The uptake of EVs continues to increase in Steady Progression, right up until 2050 when battery EVs total nearly 2.2 million. In System Transformation, the uptake of battery EVs approximately flattens from the early 2040s at around 3.9 million.
- In Leading the Way and Consumer Transformation, the numbers of EVs reduces from the late 2030s and mid 2040s, respectively. This results from societal change resulting in high use of AVs, public and active travel results in many homes opting to have one or no car at all.
- In Leading the Way, the number of battery EVs and total vehicles reduces substantially, peaking at c.3.7 million before reducing to c.2.7 million in 2050.

Figure 9



Reconciliation with National Grid FES 2020:

The WPD DFES 2020 projections are in line with the FES 2020 projections in this licence area, as reported for the Building Block ID numbers Lct_BB001, Lct_BB002, Lct_BB003, Lct_BB004'.

- The WPD DFES 2020 results are in line with the FES 2020 projections in the East Midlands. The licence area has approximately average uptake of EVs in the baseline, and this is assumed to continue in the projection period.
- Interim assumptions have been made as to the uptake and distribution of AVs in the absence of other information including:
    - Their spatial distribution is treated the same as non-autonomous EVs due to a lack of information about their future uptake.
    - It is assumed that the uptake of EVs in on and off street settings is the same as for non-autonomous EVs
- The uptake and distribution of AVs is an area that needs to be considered for future analysis when more evidence is available.

Factors that will affect deployment at a local level:

- In the WPD DFES 2020 consultation events, stakeholders raised local plans and policies which could increase uptake and are included as positive weightings in the near and medium term, such as Plug-in Coventry and the Nottingham ULEV experience.
- The spatial distribution of EVs in the near term is based on affluence, rurality, existing vehicle baselines and the distribution of on and off street parking. However, in the late 2020s in all net zero compliant scenarios, uptake is assumed to be ubiquitous. This means almost all consumers are assumed to have the same likelihood of adopting an electric vehicle.

Relevant assumptions from National Grid FES 2020:

Assumptions	
Steady Progression	Steady Progression assumes autonomous vehicles will be privately owned. In this scenario, this increases average miles travelled.
System Transformation	System Transformation assumes that in some cases a two-car household becomes a one car household, where shared autonomous vehicles meet some transport needs. However, most households still have two vehicles, which leads to a modest decrease of only 8% in the number of vehicles compared to Steady Progression.
Consumer Transformation	In Consumer Transformation autonomous vehicles, acting as a taxi service, often replace the need for a second car. They are used by consumers to commute to work or for leisure trips. Combined with greater use of public transport, this results in a 15% decrease in vehicles in this scenario, compared to Steady Progression.
Leading the Way	In Leading the Way, the high levels of societal change have led us to assume that use of autonomous vehicles and public transport reduces the overall number of cars as many homes opt to have no car at all, relying instead on shared mobility solutions, using AVs, which can accommodate four people. Total number of cars is one third less in 2050 than in Steady Progression.

Stakeholder feedback from the consultation events

Your comments to us	Our response
Theme: electric vehicles (EVs)	
You told us that in the long term under a net zero scenario, that both the number of vehicles, and the miles those vehicles drive, would be reduced.	Only 9% of respondents thought there would be no change, a clear message, though vehicle number reduction is not an assumption that is currently included in the FES. We will seek to include it in this round of the DFES under the most ambitious net zero scenario.
You asked what assumptions our model makes about the planned phase-out of petrol and diesel vehicles.	The previous FES incorporated the 2040 target, which has now been brought forward. Our modelling incorporates the new 2035 target, however there are other barriers and drivers which will strongly impact near-term uptake too.
You asked if the projections take into account the new houses and commercial buildings planned in the area, and how does we model deployment in existing homes?	Home-based electric vehicles such as electric cars, motorcycles, and some LGVs are modelled used demographic data such as off-road parking and vehicle ownership. Projected new builds are used to inform the spatial distribution of domestic electric vehicle chargers.

References:

Department for Transport data, Climate Emergency declaration data, Regen consultation with local stakeholders, Census 2011 data.

Electric vehicle chargers in the East Midlands licence area

Summary of modelling assumptions and results.

Technology specification:

Electric Vehicle (EV) Chargers – including eight charger archetypes:

- Off street domestic – homes with somewhere to park a private vehicle off street
- On street residential – charging at roadside car parking spaces
- Car parks – charging at areas solely provided for parking only, thus excludes supermarkets
- Destination – supermarkets, hotels for instance where parking is provided
- Workplace – daytime parking for commuters, at places of work
- Fleet/depot – charging for vehicles which return to a depot to park
- En-route local – charging service stations excluding motorway or A-road services
- En-route national – motorway or A-road charging stations

Data summary for EV chargers in the East Midlands licence area:

Number of EV chargers (thousands)		Baseline	2025	2030	2035	2040	2045	2050
Domestic off-street EV chargers	Steady Progression	12	69	220	578	1,169	1,682	1,747
	System Transformation	12	80	293	859	1,552	1,754	1,754
	Consumer Transformation	12	217	730	1,511	1,825	1,828	1,828
	Leading the Way	12	199	760	1,605	1,828	1,828	1,828
Non-domestic EV chargers	Steady Progression	5	8	18	43	86	125	136
	System Transformation	5	9	25	71	133	159	165
	Consumer Transformation	5	19	46	94	130	144	152
	Leading the Way	5	17	50	109	134	140	144

Summary:

- At present, the installation of public EV chargers is below the GB average for the number of EVs in the licence area. However, it is expected the licence area will align with the GB average quickly in the 2020s as demand for charging increases.
- These projections aim to represent the envelope of the possible spread and rate of deployment of EV chargers. In many modelling areas there is a lack of behavioural evidence and so interim assumptions have been made.

Results and assumptions:

Baseline

- There are a total of 1,226 public EV chargers in the East Midlands licence area
- It is estimated that there are nearly 12,000 domestic EV chargers in the East Midlands licence area.

Near term (2020 – 2025)

- Across all scenarios the uptake of EV changers is expected to increase dramatically in the near term.
- It is projected that by 2025, there could be between 69,000 domestic off street chargers in Steady Progression and 217,000 in Consumer Transformation.
- In addition, it is projected that by 2025, there could be between 126 MW of non-domestic off street chargers in Steady Progression and 287 MW in Consumer Transformation.

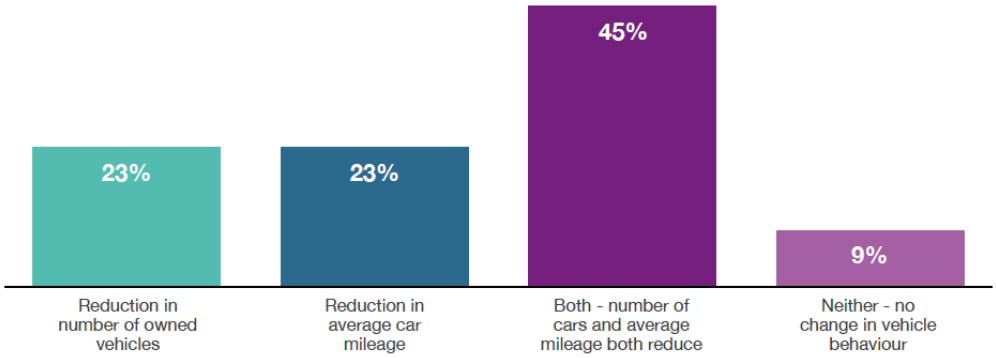
Medium term (2025 – 2035)

- Charger installations are expected to accelerate between 2025 and 2035 across all scenarios.
- Steady Progression has the lowest estimated EV charger capacity in 2035, with around 578,000 domestic EV chargers and 1.4 GW of non-domestic capacity. Leading the Way has the highest capacity, with around 1,605 domestic EV chargers and 1.8 GW of non-domestic capacity.
- EV uptake begins to slow in the mid-2030s as EV adoption approaches saturation. Therefore, the installation rate of EV chargers also slows.

Long term (2035 – 2050)

- While the uptake of EVs slows and total vehicle numbers reduce in some scenarios in the long term, it is assumed that charger capacity will not reduce in line with EVs. EV charger capacity therefore remains at the peak achieved in the years 2040-2050, although utilisation may decrease.
- A reduction in car mileage and numbers of vehicles was supported by stakeholders during the engagement events, as shown in Figure 10.
- The uptake of EVs and EV chargers continues to increase in Steady Progression, right up until 2050 when there are over 1.7 million domestic EV chargers.
- In Leading the Way and Consumer Transformation, the total capacity of EV chargers is static from the late 2030s and mid 2040s, respectively.

Figure 10 - Results of stakeholder feedback regarding how vehicle use may change in the long term

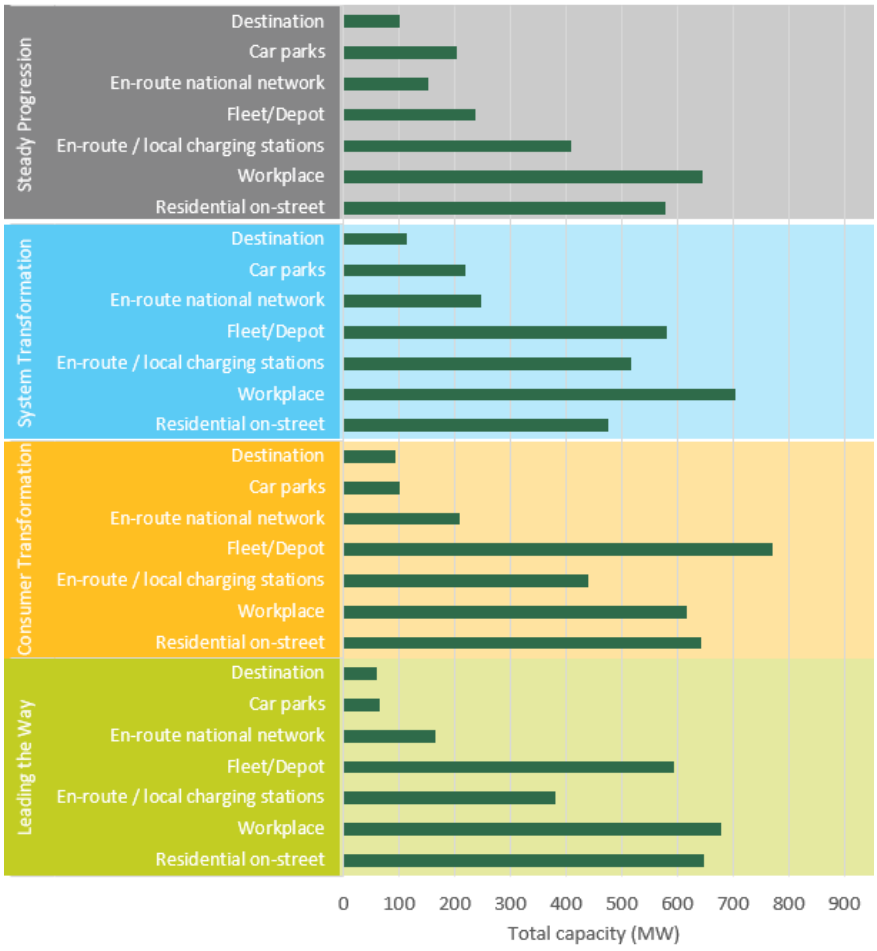


Reconciliation with National Grid FES 2020:

- The FES 2020 results do not provide sufficient breakdown of information to reconcile the EV charger information within the DFES with national projections
- To project EV charger capacities without a FES 2020 framework, assumptions have been made as to the behaviour of EVs and subsequent use of EV chargers, including:
    - Where each EV category will charge (and at which type of EV charger e.g. at home, on street, at work etc.).
    - The EV charger utilisation at each type of charger.
    - These assumptions have been made using industry input and Regen analysis. As more behavioural data and other evidence becomes available, these assumptions will be further refined in the future.
- Interim assumptions have been made as to the behaviour of AV cars in the absence of other information, including:
    - The proportion of AVs that are private or shared in the absence of further information.
    - AV charging behaviour is similar to EVs, the key difference being an increase in fleet/depot charging.
    - AVs are associated with on and off street households and charging at the same rate as EVs.
- The uptake and distribution of chargers associated with AVs is an area that needs to be considered for future analysis.

Figure 11

Non-domestic EV charger capacity results arranged by scenario (2050)



Factors that will affect deployment at a local level:

- The take up of home EV chargers is distributed in the near term towards more rural and affluent areas and those where there are high levels of off street parking.
- The spatial distribution of non-domestic chargers was produced differently for each archetype.
    - En-route local and national charging locations were distributed based on the density of local housing, the volume of local traffic, the distribution of existing petrol stations and the road classification on where the site is located.
    - Car parks, workplace and fleet depot locations were identified from Ordnance Survey data.
    - The on street residential analysis was undertaken in parallel with the off street parking analysis to identify vehicles associated with on street parking.
- The distribution analysis uses affluence as one of the key factors driving the uptake of EV chargers in the near term. For the more ambitious scenarios, from mid to late 2020s, the underlying assumption is that EVs will become ubiquitous. Therefore, the growth in demand for EVs in both on street and off street areas, lower and higher affluence areas begins to increase at equivalent rates.

Relevant assumptions from National Grid FES 2020:

Assumptions	
Steady Progression	Charging at home is limited by a lack of viable solution for those without off street parking.
System Transformation	Emphasis on public rollout of fast chargers to allow rapid charging. More rapid and fast public charging is demanded from consumers.
Consumer Transformation	Charging predominately happens at home. Emphasis on home chargers, taking advantage of consumer engagement levels in flexibility. Leads to some disruption (e.g. reinforcing local networks)
Leading the Way	Charging happens similarly to how it happens today, with various types receiving investment to support an accelerated uptake of electric vehicles. Accelerated rollout of charging infrastructure at home and in public places.

References:

Department for Transport data, Climate Emergency declaration data, Regen consultation with local stakeholders, Census 2011 data.

Air conditioning in the East Midlands licence area

Summary of modelling assumptions and results.

Technology specification:

Number of domestic air conditioning units.

Data summary for air conditioning uptake in the East Midlands licence area:

Percent of homes (%)	Baseline	2025	2030	2035	2040	2045	2050
Steady Progression	1.1	2.1	4.2	8.4	16.6	32.9	65.0
System Transformation	1.1	1.9	3.5	6.2	11.2	20.0	35.8
Consumer Transformation	1.1	1.9	3.5	6.2	11.2	20.0	35.8
Leading the Way	1.1	1.1	1.1	1.1	1.1	1.1	1.1

Summary:

- Air conditioning has limited uptake in the UK at present. However, higher extremes of temperatures from heatwaves and warmer summers due to climate change could increase demand for air conditioning towards the end of the scenario period.
- There are approximately 2,500,000 homes in the East Midlands licence area which is projected to increase to 3,250,000 by 2050.
- Uptake of air conditioning is likely to be focused in urban areas, such as Coventry, not only due to the number of homes but also the higher temperatures from heat island effects.

Results and Assumptions:

Baseline

- There is a lack of reliable baseline data for air conditioning installations, although one study estimates that 203,000 air conditioning units were sold in the UK in 2018, up from 153,000 in 2013.
- Due to the lack of data on current installation rates of air conditioning, national data from FES 2020 has been used as a benchmark. To create the baseline, FES 2020 data has been distributed pro rata to the licence area based on the number of homes. In FES 2020 1.1% of homes in GB have air conditioning installed in 2019, applied uniformly to this licence area there are c.16,000 homes with air conditioning.
- The analysis for this section is limited to domestic air conditioning.

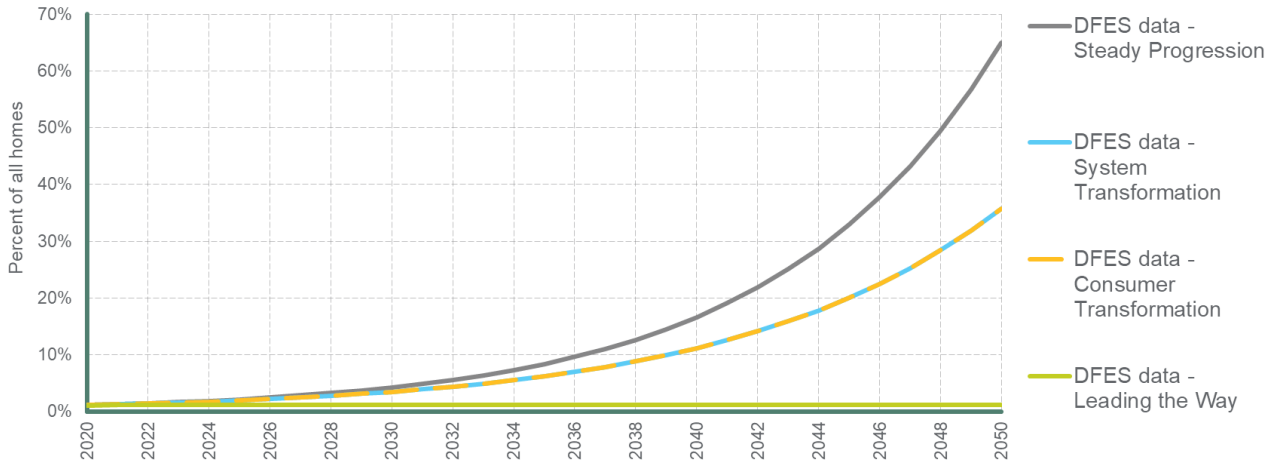
Projections (2020 – 2050)

- Near and medium term deployment of air conditioning is limited, with under 10 % of homes installing air conditioning in all scenarios. This reflects the high upfront cost and the relative lack of demand in the current climate.
- Deployment accelerates after 2035, due to assumed higher extremes of temperatures, as a result of climate change, and some economies of scale, however air conditioning is a mature technology with relatively small cost reductions expected.
- In Steady Progression there are much higher levels of uptake for air conditioning in UK homes, due to increasing temperatures and limited regulation to avoid active cooling measures.
- From a baseline of 27,000 homes (1.1%) in 2019, 115,000 homes in Steady Progression have air conditioning by 2030, and 2,000,000 by 2050.
- Leading the Way has very little increase in the number of air conditioning units installed as more sustainable means of cooling and improved building design are preferred.
- Consumer Transformation and System Transformation both have medium levels of air conditioning uptake as society adopts a mix of different actions to maintain comfort levels. In these scenarios 96,000 homes have air conditioning by 2030, and 1,100,000 by 2050.

Figure 12

Percent of homes with air conditioning by scenario

DFES projections for the East Midlands licence area



Reconciliation with National Grid FES 2020:

- The DFES projection results broadly align with the FES 2020 projections at national level. There are no licence area level projections to compare directly against in FES 2020.
- The FES 2020 percent of homes projection was used as a starting point before applying local factors relative to GB, such as:
    - Cooling degree days (number of days that average temperature is above 15.5°C)
    - Population density
    - Affluence
    - Home ownership
- The FES 2020 projects that 63.7% of homes in GB will have air conditioning installed by 2050 in Steady Progression. The East Midlands has above average levels of affluence (22.8% in social grade A or B compared to 20.3% in GB) and home ownership (66.9% compared to 64.3% in GB) which results in a slightly higher DFES projection (65.0% of homes by 2050).

Factors that will affect deployment at a local level:

- The spatial distribution of air conditioning units in the East Midlands licence area is influenced by factors such as:
    - New developments – new-build regulations aim to improve passive cooling measures e.g. the Future Homes Standard.
    - Affluence – early uptake is heavily influenced by upfront and running cost therefore affluence is a key factor. As deployment becomes more widespread in the long term, affluence becomes less of a factor and uptake is weighted more towards urban areas.
    - Home ownership – homeowners are assumed to be more likely to invest in home improvements.
    - Population density – reflects the impact of heat islands in high density urban areas in the licence area.

Relevant assumptions from National Grid FES 2020:

Assumption number	3.1.2 'Uptake of Residential Air Conditioning'
Steady Progression	Low willingness to change means society takes the easiest route to maintain comfort levels, therefore increased levels of air conditioning.
System Transformation	Medium uptake as society takes a mix of actions to maintain comfort levels (mix of air conditioning, tolerance of higher temperatures, changes to building design)
Consumer Transformation	Medium uptake as society takes a mix of actions to maintain comfort levels (mix of air conditioning, tolerance of higher temperatures, changes to building design)
Leading the Way	Low uptake as society changes to minimise uptake (e.g. personal tolerance of higher temperatures, changes to building design)

References:

National Grid's FES 2020 data, UK Heat Degree Days data.

Results and assumptions

Generation technologies

Onshore wind in the East Midlands licence area

Summary of modelling assumptions and results.

Technology specification:

Onshore wind - including comparison to FES 2020 small scale (< 1 MW) and large scale (≥ 1 MW) data.

Data summary for onshore wind in the East Midlands licence area:

Installed capacity (MW)	Baseline	2025	2030	2035	2040	2045	2050
Steady Progression	409	409	409	410	453	525	544
System Transformation	409	409	477	539	656	713	765
Consumer Transformation	409	474	621	1,004	1,380	1,770	2,142
Leading the Way	409	474	553	795	1,074	1,334	1,621

Summary:

- The East Midlands licence area has seen high deployment of onshore wind capacity, but currently has only a single site in the pipeline. This site has planning permission and accepted a 54 MW network connection offer in 2015.
- The limited pipeline contributes to relatively low capacity increase in the near term; however good resource availability and the assumption of a positive planning environment in Consumer Transformation contribute to an increase in capacity in the medium and long term.

Results and assumptions:

Baseline

- There is a total of 409 MW of onshore wind connected in the East Midlands licence area.
- There was steady capacity growth from 2012 to 2016 following the introduction of government subsidies
- Since 2016, deployment has stalled due to restrictive national government planning policy and subsidy cuts. The most recent large scale connection was in March 2017 at 8.3 MW.

Near term (2020 – 2025)

- The recent period of low capacity growth continues in the near term with the single 54 MW pipeline project connecting under Consumer Transformation or Leading the Way between 2024 and 2025. No other large scale capacity is connected before 2025.
- The pipeline site is delayed under System Transformation, meaning that it only connects in 2027. In Steady Progression, the site does not go ahead, as the challenging conditions for onshore wind in England continue into the 2030s.
- Developers have suggested that the COVID-19 pandemic will have a limited impact on development of new sites, as these are already lengthy processes taking up to 5 years. However, some sites awaiting immediate construction may face some delays.

Medium term (2025 – 2035)

- Following a period of low capacity growth there are rapid levels of deployment in Leading the Way and Consumer Transformation. However, System Transformation and Steady Progression see very low deployment up to 2035.
- According to stakeholder feedback, a more supportive planning environment for onshore wind would unlock areas in England with good wind resource for development. This scenario is shown in the high growth scenarios.
- Consultation with stakeholders suggests that future onshore wind projects are expected to be larger than historic averages, and that though financial support such as a CfD would be welcome, developers are primarily seeking to develop larger, high capacity factor sites with economies of scale that means they can operate profitably without subsidies.

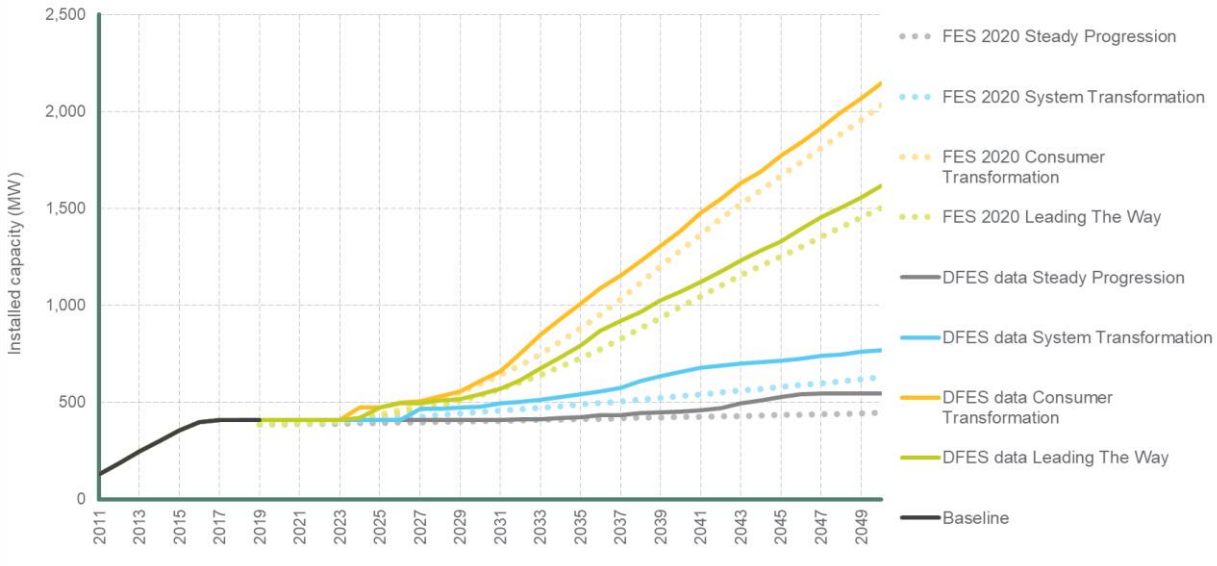
Long term (2035 – 2050)

- The East Midlands licence area has significant areas of high windspeed in the central and western areas. These areas see high capacity growth in the long term in Consumer Transformation and Leading the Way.
- There are 40 large scale sites currently in the baseline which will come to the end of their operational life before 2050.
- Though every site may not increase their capacity through repowering, an assumption has been made that the scenarios with greater green ambition result in sites repowering earlier and have greater increases in capacity. This ranges from 20 to 30 years across the scenarios, with an overall average repowered capacity of 125% of initial capacity in Steady Progression, increasing up to 150% in Consumer Transformation.

Figure 13

Onshore wind capacity by scenario

Comparison to FES 2020 GSP data for the East Midlands licence area



Reconciliation with National Grid FES 2020:

Results in this section relate to the FES 2020 data as reported for Building Block ID numbers Gen_BB015 and Gen_BB016.

- Challenging conditions for onshore wind deployment mean that the pipeline project is assumed to only go ahead in the net zero compliant scenarios. However, the scale of the pipeline site connecting in the near term puts the WPD DFES 2020 above the FES 2020 projections. Additional deployment in the medium to long term reflecting the good resource availability and the repowering assumptions place the WPD DFES 2020 projections slightly above the FES 2020 data for all scenarios.
- Late deployment of the pipeline site and the potential for additional repowered capacity brings Systems Transformation above the FES 2020 in the long term.

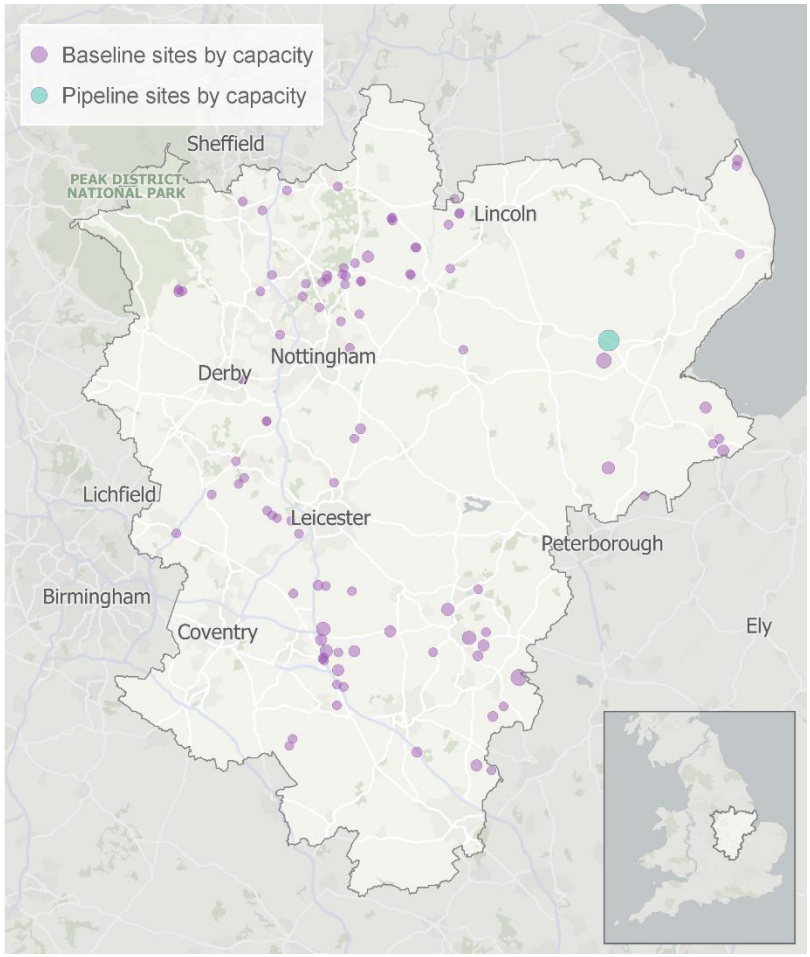
Factors that will affect deployment at a local level:

- The spatial distribution of new onshore wind sites in the near term is based on the location of the single pipeline site. In the medium and long term, new sites are distributed according to local factors including:
    - Areas close to the existing electricity network outside of environmental designations such as AONBs or National Parks and excluding areas of housing.
    - Areas with significant wind speed
    - Planning permission records for the local authority
- Local policies identified by stakeholders are included as positive weightings within the spatial distribution, for example, the East Northamptonshire District 'Wind and Solar Energy Supplementary Planning Document'. Several local authorities who have declared a climate emergency are developing climate energy plans.

Figure 14

Onshore wind sites in the East Midlands licence area

Showing baseline sites and the single pipeline site. Most wind farms in the baseline are located in the western side of the licence area.



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Relevant assumptions from National Grid FES 2020:

Assumption number	4.1.3
Steady Progression	Slower pace of decarbonisation.
System Transformation	Focus on renewables but limited by societal preference for offshore turbines (less impact on land use and visibility)
Consumer Transformation	Strong support for onshore wind across all networks. Some of these projects may be in community ownership.
Leading the Way	High growth driven by the decarbonisation agenda and high demands from hydrogen production from electrolysis.

Stakeholder feedback from the consultation events:

Your comments to us	Our response
Theme: onshore wind	
You told us that developers will seek to develop projects on a subsidy-free basis, rather than be limited by a lack of a CfD. However, national policy has also been a critical factor in the deployment of wind so far. Your responses also indicated that onshore wind deployment may begin to pick up in the early 2020s.	The impact and scale of government subsidy varies by scenario. We will ensure that even in scenarios without government subsidy, subsidy-free deployment is still included. This modelling will include onshore wind deployment picking up in the early 2020s.
The majority of respondents thought that subsidy-free business models would lead to some very large sites being developed, elsewise only smaller-scale community energy sites would be developed.	Our modelling includes analysis of wind farms at different scales, we will focus projected deployment on large-scale sites and then only smaller-scale sites.

References:

WPD connection offer data, System Wide Resource Registers (GB), the TEC register, the Renewable Energy Planning Database, Climate Emergency declaration data, Regen consultation with local stakeholders and discussion with developers.

Solar generation in the East Midlands licence area

Summary of modelling assumptions and results.

Technology specification:

Ground mounted solar - solar generation sites of installed capacity of 1 MW and above.

Data summary for ground mounted solar PV in the East Midlands licence area:

Installed capacity (MW)	Baseline	2025	2030	2035	2040	2045	2050
Steady Progression	1,081	1,236	1,492	1,744	1,951	2,076	2,160
System Transformation	1,081	1,421	1,972	2,704	2,938	3,484	4,025
Consumer Transformation	1,081	1,421	1,972	2,704	2,938	3,484	4,025
Leading the Way	1,081	1,859	2,592	3,501	4,208	5,013	5,642

Summary:

- The East Midlands licence area has become a key area for the development of ground mounted solar PV. The area has the largest installed capacity of the WPD licence areas, and a very large pipeline of projects that have accepted network connection offers.
- The licence area has extensive development of ground-mounted solar PV in all the net zero compliant scenarios.

Results and assumptions:

Baseline

- The East Midlands licence area has 1,081 MW currently installed, the largest installed capacity of ground mounted solar PV of the four WPD licence areas. After the initial focus on the south of England, developers were attracted by the grid availability, land space and acceptable irradiation levels. Around 0.5 GW connected in 2015 alone.
- Deployment of ground mounted solar has slowed in recent years, just two projects have connected since 1st January 2019, adding a total of 5.7 MW.

Near term (2020 – 2025)

- Since 2018 a pipeline of ground mounted solar PV projects has secured network connections across the UK as costs have fallen and interest from investors in 'subsidy-free' business models has grown. These projects are typically 50 MW scale.
- The East Midlands is an attractive area to solar developers, and as a result has a pipeline of 58 projects totalling 1.7GW capacity, 11 of which have been identified as having planning permission.

- Engagement with stakeholders indicates the COVID-19 pandemic has delayed deployment of pipeline sites under construction. Developers and investors currently expect the projects in the pipeline to begin to be built in 2022. The speed at which the pipeline is built out is the key assumption in the scenarios.

Medium term (2025 – 2035)

- Regen's resource assessment shows the East Midlands to be the WPD licence area with the largest technically developable resource area for ground mounted solar PV.
- In all the net zero compliant scenarios the pipeline of projects is projected to be built out by 2035 leading to more than doubling of the installed capacity over the next 15 years.
- In Steady Progression most of the current pipeline of projects will not have been built by 2035 as the investment case for ground mounted solar PV remains challenging.

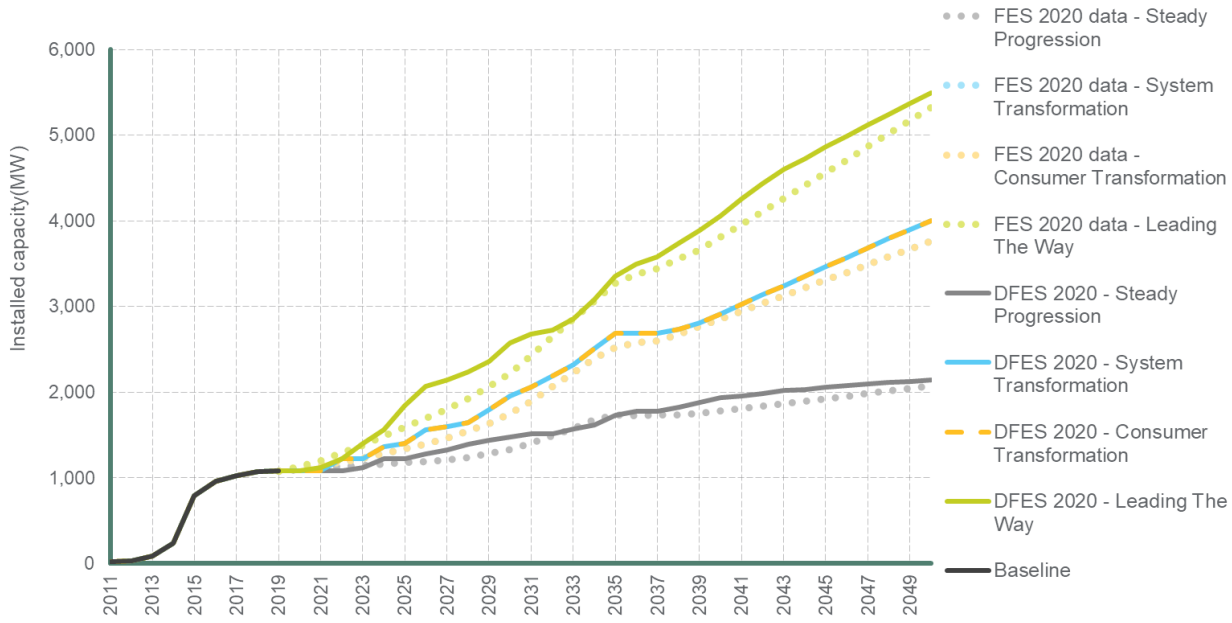
Long term (2035 – 2050)

- The continued development of ground mounted solar PV could be limited by the relatively low demand for power during summer daytime.
- Price cannibalisation as the amount of solar installed increases is a key concern for investors looking at subsidy-free merchant projects with no guaranteed price for the power generated. Co-location with storage or using surplus power to produce hydrogen may be required to overcome this.
- Leading the Way shows over 5 GW of ground mounted solar PV installed in the East Midlands licence area by 2050 as solar PV becomes a key part of the UK's energy mix.

Figure 15

Ground mounted solar PV capacity by scenario

Comparison to FES 2020 GSP data for the East Midlands licence area



Reconciliation with National Grid FES 2020:

Results in this section relate to the FES 2020 data as reported for Building Block ID number Gen_BB012, Solar Generation - Large (G99).

- Due to the relatively large pipeline of projects where developers have already obtained connections to the network, there is more ground mounted solar PV in East Midlands in WPD DFES 2020 than projected in FES 2020.
- Stakeholder feedback indicates the COVID-19 pandemic will delay the point at which investors are comfortable to make final investment decisions to build ground mounted solar PV projects. WPD DFES 2020, therefore, also shows the first new projects being energised later than FES 2020 GSP data.

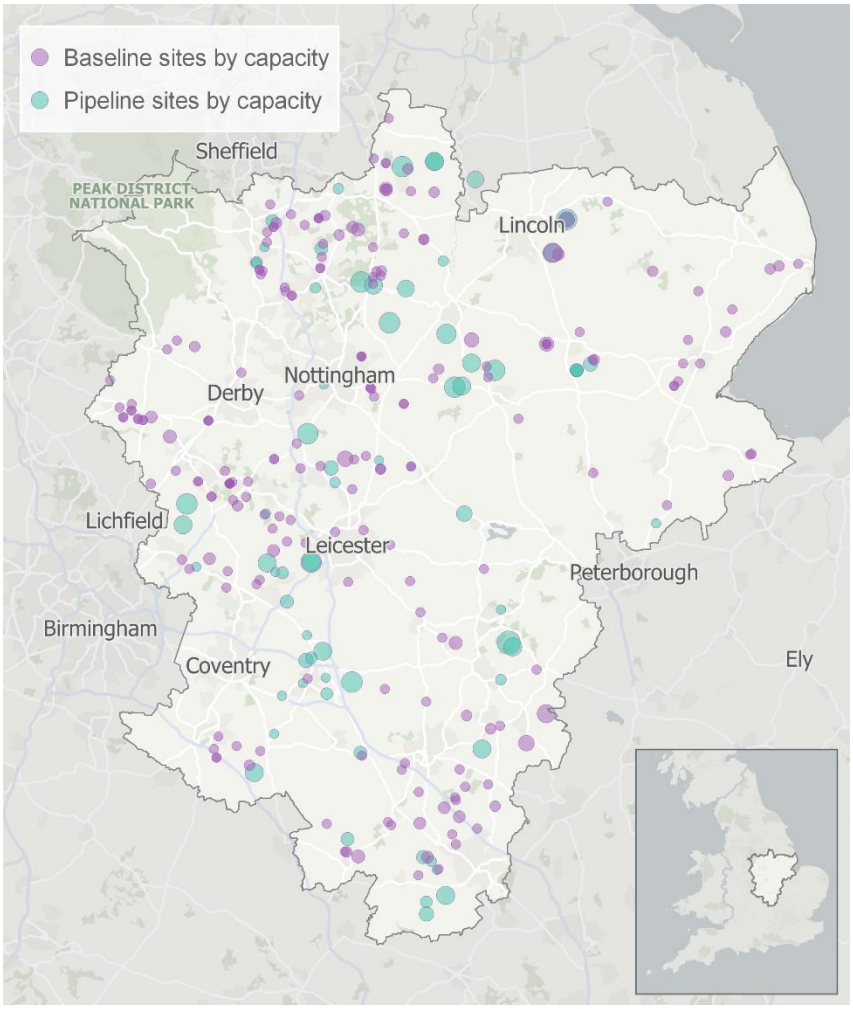
Factors that will affect deployment at a local level:

- The spatial distribution of new ground mounted solar PV in the East Midlands licence area out to 2030 is based on the location of projects in the pipeline with an accepted network connection offer. This shows a similar distribution to the current baseline sites which are located close to the high voltage electricity network.
- The other local factors that are used to develop these scenarios are:
    - Areas close to the existing electricity network outside of environmental designations such as AONBs or National Parks
    - Solar irradiance
    - Planning permission records for the local authority
- All the local authorities in the East Midlands licence area have declared a climate emergency. Local policies raised during the stakeholder consultation are included as weightings within the spatial distribution, including the West Midlands Regional Energy Strategy (areas like Coventry are in the West Midlands Combined Authority area but in the East Midlands licence area) and North East Derbyshire District's emerging local plan.

Figure 16

Large scale solar PV sites in the East Midlands licence area

The East Midlands licence area has the largest pipeline of solar PV capacity of any of the WPD licence areas.



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Relevant assumptions from National Grid FES 2020:

Assumption number	4.2.15
Steady Progression	Slower pace of decarbonisation.
System Transformation	Transition to net zero results in strong deployment of large solar.
Consumer Transformation	Transition to net zero results in strong deployment of large solar.
Leading the Way	Very high ambition to decarbonise drives a focus on technologies that are low carbon. Supports production of hydrogen by electrolysis.

Stakeholder feedback from the consultation events:

Your comments to us	Our response
Theme: solar PV	
You suggested that solar farm deployment would begin to increase again in the early 2020s, from 2022 onwards.	We will incorporate this trajectory into our models. There are many projects with accepted connection offers which could potentially be sites of development in the early 2020s.
You said that there is high potential for solar farm deployment, which could deploy at a high rate in the medium to long term.	

References:

WPD connection offer data, System Wide Resource Registers (GB), the TEC register, the Renewable Energy Planning Database, Climate Emergency declaration data, Regen consultation with local stakeholders and discussion with solar developers.

Solar generation in the East Midlands licence area

Summary of modelling assumptions and results.

Technology specification:

Small scale solar generation - commercial rooftop installations up to 1 MW, and domestic solar PV installations below 1 MW.

Data summary for small scale solar generation in the East Midlands licence area:

Installed capacity of sites less than 1 MW (MW)	Baseline	2025	2030	2035	2040	2045	2050
Steady Progression	540	595	693	826	972	1,122	1,294
System Transformation	540	676	1,028	1,412	1,784	2,083	2,335
Consumer Transformation	540	847	1,572	2,406	3,265	4,056	4,775
Leading the Way	540	691	1,075	1,513	1,910	2,284	2,629

Summary:

- There is currently 540 MW of small scale solar PV in the East Midlands, 64% of installations are at the domestic scale with an average capacity of 3.3 kW.
- Nearly one-in-three homes in East Midlands host rooftop solar PV by 2050 in Consumer Transformation, the highest capacity growth scenario. This is alongside widespread adoption of other new domestic technologies such as electric cars and electric domestic heating provided by heat pumps.

Results and assumptions:

Baseline

- The East Midlands licence area currently has 96,600 domestic solar PV installations, representing 3.8% of homes.
- 5,000 commercial properties currently have a solar PV array, with an average capacity of 50 kW.
- Most of the existing capacity has been commissioned since 2011 in line with government support via the feed-in-tariff, with growth slowing significantly since 2015 following a reduction in the subsidy rate.

Near term (2020 – 2025)

- There is very low deployment projected in the early-2020s due to the challenging business case for smaller scale solar, as well as construction delays due to COVID-19. This reflects stakeholder feedback.
- There is a pipeline of 27 small scale solar sites totalling 4.5 MW that have accepted a network connection offer. These form most of the new capacity growth out to 2025.

Medium term (2025 – 2035)

- Capacity growth is projected to accelerate from 2025 onwards as the cost of solar panels continue to decrease. This is combined with increasing financial viability due a combination of the Smart Export Guarantee, uptake of electric vehicles, domestic batteries, and heat pumps. The highest level of deployment is in Consumer Transformation, with high consumer engagement leading to significant uptake of electric vehicles and heat pumps.
- The medium term capacity increase follows the same trajectory as FES 2020 for the East Midlands licence area, and capacity increases to over 3 GW by 2040 in Consumer Transformation.

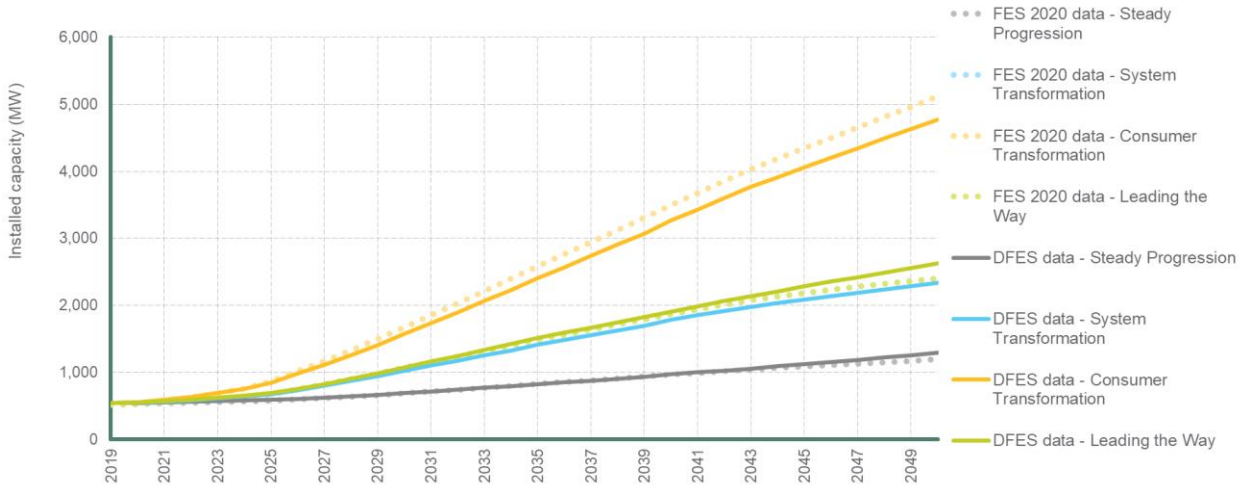
Long term (2035 – 2050)

- The continued increase of small scale solar PV begins to slow in the long term as the most suitable homes and commercial properties are fitted in the baseline, near, and medium term.
- Almost a third of homes have rooftop PV by 2050 in Consumer Transformation, and almost a fifth in Leading the Way.
- Three quarters of new-build homes have rooftop PV by 2050 in Consumer Transformation and Leading the Way, and around half in System Transformation and Steady Progression. The spatial distribution of new homes with solar PV is based on data from the local plans of local authorities in the East Midlands licence area.
- The number of commercial properties with PV installed goes up from 5,000 in 2020 to 37,000 in Consumer Transformation, 18,000 in Leading the Way and System Transformation, and 10,000 in Steady Progression by 2050.

Figure 17

Solar (sub 1 MW) capacity by scenario

Comparison to FES 2020 GSP data for the East Midlands licence area



Reconciliation with National Grid FES 2020:

Results in this section relate to the FES 2020 data as reported for the Building Block ID number Gen_BB013.

- The WPD DFES 2020 results broadly align with FES 2020 data for small scale rooftop PV. Regen has used the FES 2020 GSP data as well as Feed-In-Tariff data, WPD's connections data, and stakeholder feedback to establish a baseline, and to model the uptake of solar PV in new-builds.
- The East Midlands has the most homes (2.8m) in WPD's four network areas which results in the area having the highest capacity projection with a total of 4.8 GW in 2050 in the Consumer Transformation scenario.
- The WPD DFES 2020 scenarios are slightly lower than the FES 2020 projections for Consumer Transformation in the long term, reflecting the slightly below average level of social housing (13.9%) compared to a GB average of 15.7%. Social housing in some areas have historically had very high uptake levels of rooftop solar PV, and it has been assumed that this trend continues in a Consumer Transformation scenario. Uptake in social housing is assumed to be lower in the other net zero compliant scenarios, and as such this difference is less pronounced.

Factors that will affect deployment at a local level:

- The spatial distribution of new small scale solar PV in the East Midlands licence area has been divided into domestic scale solar PV (<10 kW) and commercial scale (10 kW – 1 MW).
- Domestic uptake is mainly influenced by factors such as affluence, home ownership, and social housing. In the early years, growth is weighted towards affluent areas and becomes more spread across all affluence levels towards 2050, especially in Leading the Way and Consumer Transformation.
- The East Midlands licence area has average levels of affluence (22.8% in social grade A or B compared to 20.3% in GB) and home ownership (66.9% compared to 64.3% in GB).
- Approximately 800,000 new domestic homes are projected to be built in the East Midlands between now and 2050. In Consumer Transformation (the highest growth scenario), 40% of the new builds are assumed to have solar PV installed, making up 1 GW, a third of the total domestic projection. Areas such as Leicester, Coventry and Milton Keynes have particularly high numbers of new developments with rooftop PV installed.

Relevant assumptions from National Grid FES 2020:

Assumption number	4.1.15
Steady Progression	Slower pace of decarbonisation.
System Transformation	Transition to net zero results in strong growth in small solar. Supports production of hydrogen by electrolysis.
Consumer Transformation	Very high growth in small solar as it supports the transition to net zero and is highly aligned to the high societal change.
Leading the Way	Transition to net zero results in strong growth in small solar. Supports production of hydrogen by electrolysis. Growth limited by overall lower annual demands than Consumer Transformation.

References:

WPD connection offer data, Feed-In-Tariff data, Climate Emergency declaration data, Regen consultation with local stakeholders and discussion with local authorities and businesses.

Hydropower in the East Midlands licence area

Summary of modelling assumptions and results.

Technology specification:

Hydropower - including comparison to FES 2020 small scale (< 1 MW) and large scale (≥ 1 MW) data.

Data summary for hydropower in the East Midlands licence area:

Installed capacity (MW)	Baseline	2025	2030	2035	2040	2045	2050
Steady Progression	5.4	5.4	5.4	5.4	5.4	5.4	5.4
System Transformation	5.4	5.4	5.4	5.4	5.4	5.9	5.9
Consumer Transformation	5.4	5.4	5.4	6.0	7.1	7.6	9.1
Leading the Way	5.4	5.4	5.5	5.5	5.6	6.1	6.1

Summary:

- The East Midlands licence area has relatively low deployment of hydropower, with only a single site over 1 MW in scale. There are no significant pipeline sites; there are only two new microgeneration sites with an accepted connection offer.
- Consultation with stakeholders suggests low deployment in the near term in all scenarios.
- Significant hydropower deployment only takes place in Consumer Transformation, and only after 2035.

Results and assumptions:

Baseline

- There are 5.4 MW of installed hydropower capacity in the East Midlands licence area. The largest is a site at Chatsworth House. This site was first installed in the late 19th century and was replaced in 2017 with a new turbine.

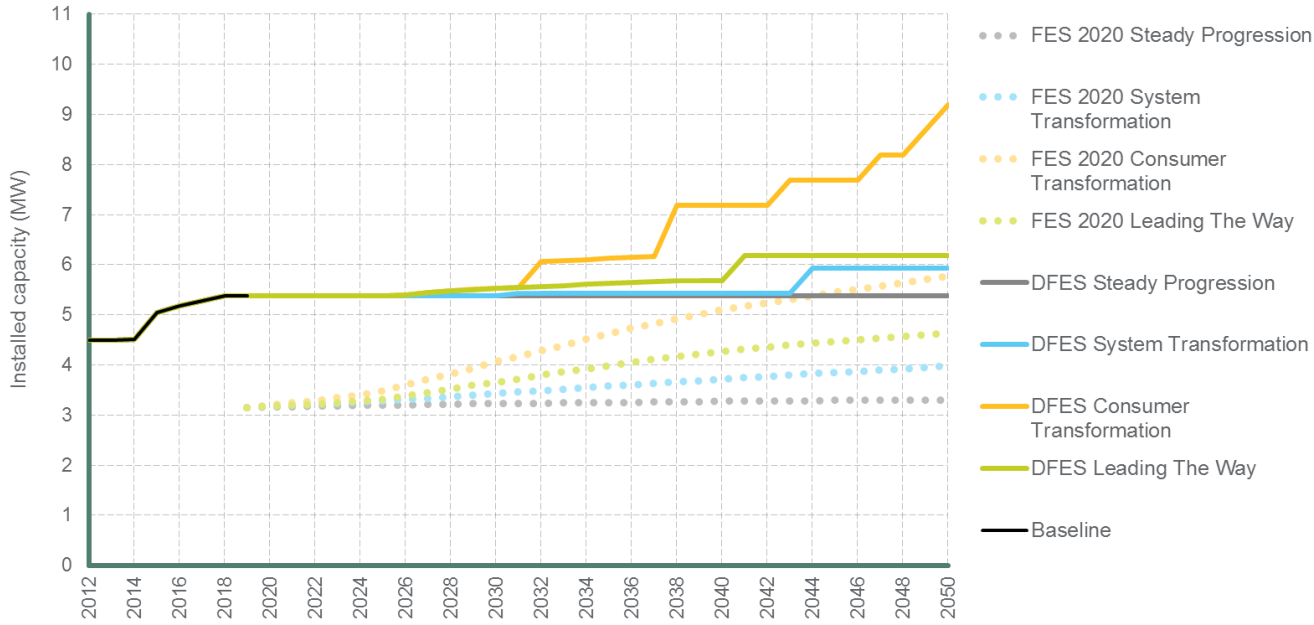
Projections

- There is no new hydropower connected in the near term in all scenarios.
- New deployment is delayed until the medium and long term. A number of sites connect in Consumer Transformation in the late 2030s, and to a lesser extent in Leading the Way in the 2040s.
- Sites are likely to be limited to private wire connections or through developments where wider objectives override the need for return on investment, for example sites with a link to tourism, heritage, or corporate sustainability objectives.
- The civil infrastructure installed for existing sites tends to be long-lasting, meaning that sites can be expected to repower when the machinery reaches the end of its useable life. Where sites need to re-power, it has been assumed that they repower at the same capacity: as a mature technology, hydropower has limited cost reduction potential.

Figure 18

Hydropower capacity by scenario

Comparison to FES 2020 GSP data for the East Midlands licence area



Reconciliation with National Grid FES 2020:

Results in this section relate to the FES 2020 data as reported for Building Block ID number Gen_BB018.

- The current installed capacity of hydropower in the East Midlands licence area is much higher in the WPD DFES data than in the FES 2020 publications.
- Relative to their respective baselines, the WPD DFES projections in the near term are significantly below those in FES 2020 in all scenarios, reflecting feedback from industry consultation.
- However, due to the higher registered baseline capacity as identified in the WPD DFES 2020 analysis, total capacity is higher than in FES 2020 in all scenarios.
- While modelling credible pathways to net zero, the DFES must also capture the near term worst case conditions that the distribution network could see, which is important for strategic investment modelling. While National Grid ESO may discount generators without a supply contract, WPD DFES includes all generators with valid connection agreements regardless of absent supply contracts, this may lead to some discrepancies in the baseline totals.

Factors that will affect deployment at a local level:

- The distribution of new hydropower sites is based on the location of water features and barriers which could potentially host a hydropower site, as well as the microgeneration sites in the pipeline.

Relevant assumptions from National Grid FES 2020:

Assumption number	4.1.1
Steady Progression	High costs associated with large scale projects. Little ambition or support
System Transformation	High costs associated with large scale projects. Some support is forthcoming for large scale projects, limited societal change from large scale remote generation
Consumer Transformation	Potential for a lot of small scale projects that will have larger societal impact
Leading the Way	Potential for rapid deployment of large and small scale projects; society is more in favour of disruptive projects. Limited by the reduction in energy demand

References:

WPD connection offer data, System Wide Resource Registers (GB), the Renewable Energy Planning Database, the Environment Agency, Regen consultation with local stakeholders and discussion with developers.

Offshore wind in the East Midlands licence area

Summary of modelling assumptions and results.

Technology specification:

Offshore located wind sites connected to the distribution network.

Data summary for marine energy in the East Midlands licence area:

Installed power capacity (MW)		Baseline	2025	2030	2035	2040	2045	2050
Offshore Wind	Steady Progression	194	194	194	194	194	194	194
	System Transformation	194	194	194	194	194	194	194
	Consumer Transformation	194	194	194	194	194	194	194
	Leading the Way	194	194	194	194	194	194	194

Summary:

- Two large offshore wind farms are connected to the distribution network in the East Midlands licence area, however due to the increased scale of new offshore wind farms all future development is assumed to connect to the transmission network.
- There is no tidal or marine energy installations currently deployed and no increase in capacity is projected.

Results and assumptions:

Baseline

- The 194 MW baseline comes from a pair of offshore wind sites, 'Lynn' and 'Inner Dowsing' which are located off the coast of Lincolnshire, both sites are 97.2 MW each and connected in 2008.

Projection period (2020 – 2050)

- There are no pipeline sites in this licence area with an accepted network connection offer.
- The scale of the early offshore wind farm development in the baseline contrasts with typically larger offshore wind sites developed more recently. Following industry trends, no new offshore wind is assumed at distribution level in the projection period.

Reconciliation with National Grid FES 2020:

Offshore and Floating Wind

Results for offshore wind relate to the FES 2020 data as reported for Building Block ID number Gen_BB014.

- The WPD DFES 2020 projections for offshore wind in the East Midlands licence area is in line with FES 2020 for two scenarios, FES 2020 also projects an increase in capacity which isn't included in WPD DFES results as now distribution connected increase has been assumed.

Renewable engines (landfill, sewage, biogas) in the East Midlands licence area

Summary of modelling assumptions and results for anaerobic digestion.

Technology specification:

Anaerobic digestion (AD) installed capacity used for electricity generation only. This is the 'biogas' component of the building block technology "Renewable engines (landfill, sewage, biogas)".

Data summary for anaerobic digestion in the East Midlands licence area:

Installed capacity (MW)	Baseline	2025	2030	2035	2040	2045	2050
Steady Progression	58	66	81	105	120	124	127
System Transformation	58	74	101	130	150	156	160
Consumer Transformation	58	76	107	140	163	175	188
Leading the Way	58	77	109	142	168	186	204

Summary:

- The East Midlands licence area has 58 MW of AD capacity, the highest across the four WPD licence areas. It has 8.6 % of the total GB installed capacity.
- Further deployment of AD plants in the East Midlands requires sufficient local feedstock either from agricultural or food waste. Only a quarter of local authorities currently collect food waste, therefore along with above-average agricultural land grades, there is good potential for future growth in capacity. The licence area has one pipeline AD site which is expected to connect between 2021 and 2022 in all but Steady Progression.
- Additional AD capacity may also be expected in the licence area that produces biomethane for use in transport or injection into the gas network in addition to that burnt for electrical generation. This additional capacity is not covered in this analysis.

Results and assumptions:

Baseline

- There are 40 sites in the baseline with an average capacity of 1.5 MW. All electrical AD capacity connected between 2010 and 2015, when projects benefitted from government subsidies. No new sites have connected since 2016, reflecting the difficulty of developing a business case for AD without subsidy.

Near term

- All deployment of sites out to 2023 are based on the existing pipeline sites with an accepted network connection offer.

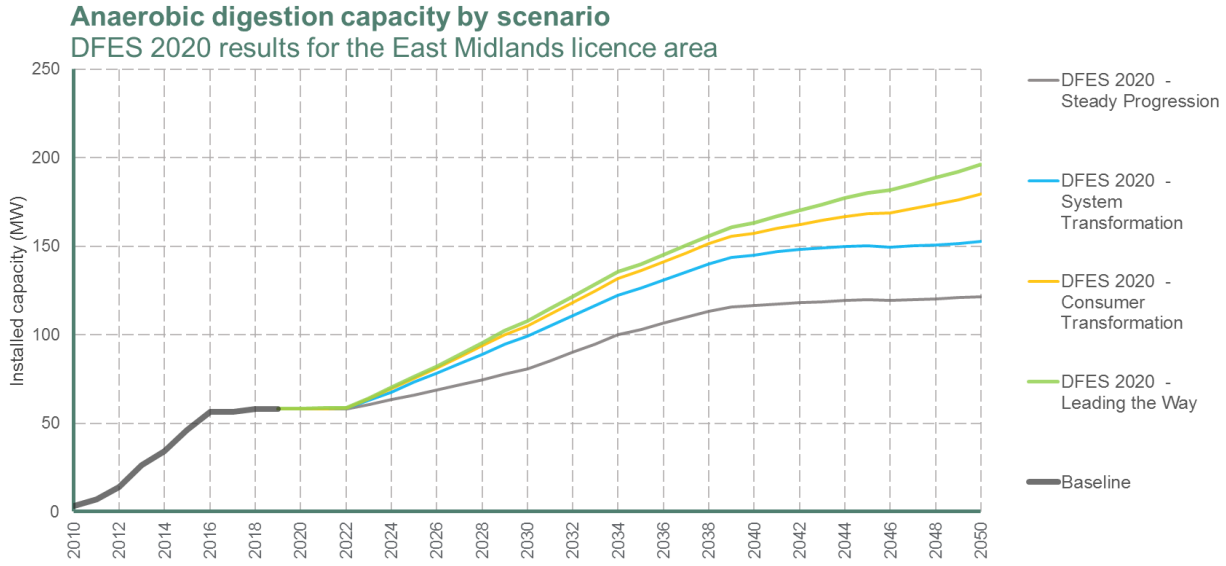
Medium term

- In the medium term, growth in AD capacity is assumed to be driven by English local authorities requiring additional food waste processing facilities in the mid-2020s as indicated in the latest Environment Bill[1].

Long term

- Further capacity growth in AD generation will be driven by cost reductions in the technology, potentially through modularisation, and the high revenues that could be captured from AD plants providing more flexible electricity supply and balancing services to networks, capturing high electricity prices expected in periods of low renewable generation or high demand.
- However, capacity growth is expected to slow in the long term as burning biomethane for electricity generation is likely to be competing with higher demand for biomethane for zero carbon heat or transport. This could lead to a reduction in electrical capacity deployment as the government look to incentivise a switch to 'green gas'.
- In addition, it is assumed that the food waste produced per person will decrease towards 2050 meaning there may be less available for AD processing.

Figure 19



Factors that will affect deployment at a local level:

- All deployment of sites out to 2023 is based on the existing pipeline sites with an accepted network connection offer. Outside of the pipeline projects, local factors have been used to weight deployment from 2023 onwards, such as:
    - Areas with high numbers of cattle (a key feedstock for farm based AD)
    - Agricultural land grades 1 & 2 as a proportion of UK average
    - Local Authority food waste collection potential
    - Renewable energy strategies as raised during the consultation events

Summary of modelling assumptions and results for landfill gas.

Technology specification:

Landfill gas installed capacity used for electricity generation only.

Data summary for landfill gas in the East Midlands licence area:

Installed capacity (MW)	Baseline	2025	2030	2035	2040	2045	2050
Steady Progression	133	133	133	133	133	133	133
System Transformation	133	133	133	133	131	122	64
Consumer Transformation	133	133	133	133	131	122	64
Leading the Way	133	133	133	131	122	64	30

Summary:

- Landfill gas capacity is expected to decline over time in all scenarios as residual waste is either burnt or gasified as opposed to buried.
- Baseline landfill gas sites are decommissioned using scenario specific assumptions made about the site lifetime, though no sites are decommissioned in the Steady Progression scenario.

Results and assumptions:

Baseline

- There are 102 sites connected to the distribution network in East Midlands licence area totalling 133 MW. It has the largest baseline of all WPD licence areas.
- 28 of the 102 sites are above 2 MW in size, with the largest being a 5 MW landfill site at Cotebach, Leicestershire.

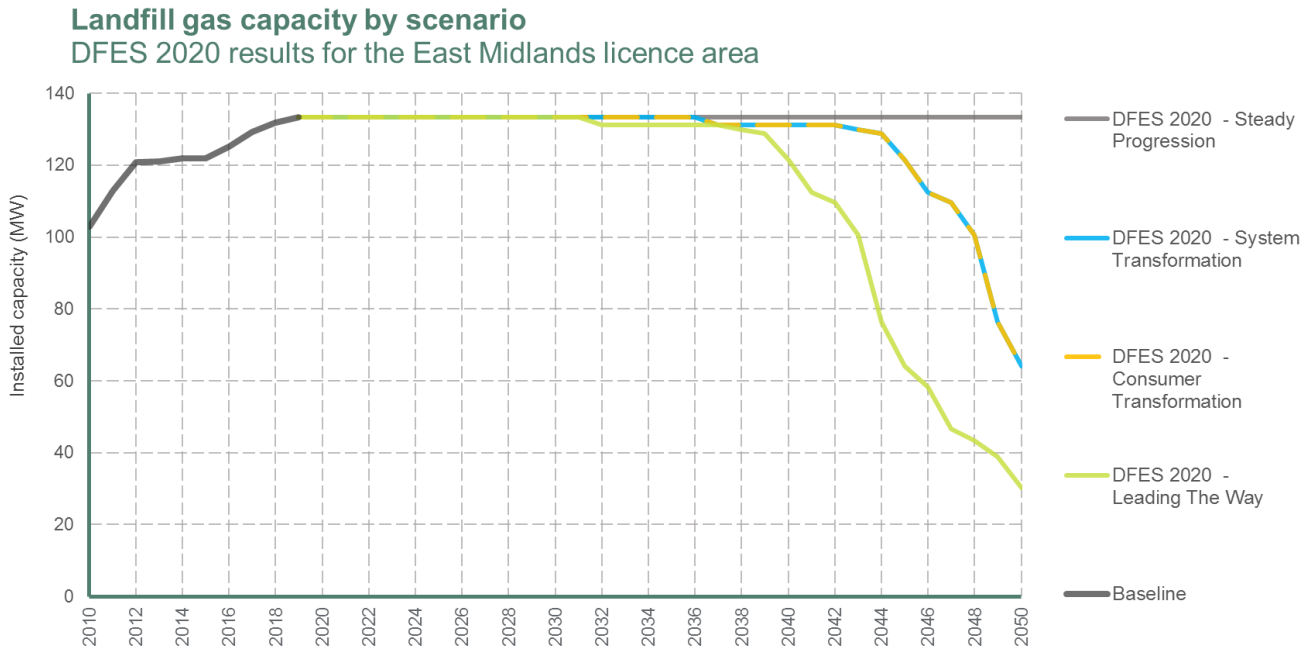
Near term

- There is no change projected in the output capacity or connections before 2030.

Medium and long term

- Older sites are expected to decommission as a result of declining waste availability per person and competition with other waste processing technologies such as EfW and ACT.
- To ensure DFES captures the near term worst case conditions on the distribution network within the scenarios, sites have been modelled as staying online, even if it is projected that under the net zero scenarios they may cease operation or see running hours may significantly reduce.
- After 2030 in Leading the Way there is a reduction in capacity reflecting the declining waste availability per person and competition with other waste processing technologies. Sites going offline in Consumer Transformation and System Transformation are assumed to face at least a 45 year delay on the connection agreement date. To ensure the worst case conditions on the distribution network are modelled, all existing sites with connection agreements stay online in Steady Progression out to 2050.
- Sites may also switch to biomethane as the market for biomethane continues to expand.

Figure 20



Summary of modelling assumptions and results for sewage gas.

Technology specification:

Sewage gas installed capacity used for electricity generation only.

Data summary for sewage gas in the East Midlands licence area:

Installed capacity (MW)	Baseline	2025	2030	2035	2040	2045	2050
Steady Progression	9	9	14	19	19	19	19
System Transformation	9	9	19	19	19	19	19
Consumer Transformation	9	9	19	19	19	19	19
Leading the Way	9	11	19	19	19	19	19

Summary:

- The scenario projection for sewage gas has very little change out to 2050 according to FES 2020.
- At a local level, there are currently no sites in the pipeline in this licence area.
- Some growth is projected by 2050 with an additional 10 MW of capacity.

Results and assumptions:

Baseline

- There are nine sites in the baseline totalling 9 MW.
- This largest baseline site is a 3 MW sewage gas plant in Canwick which connected in 1997.

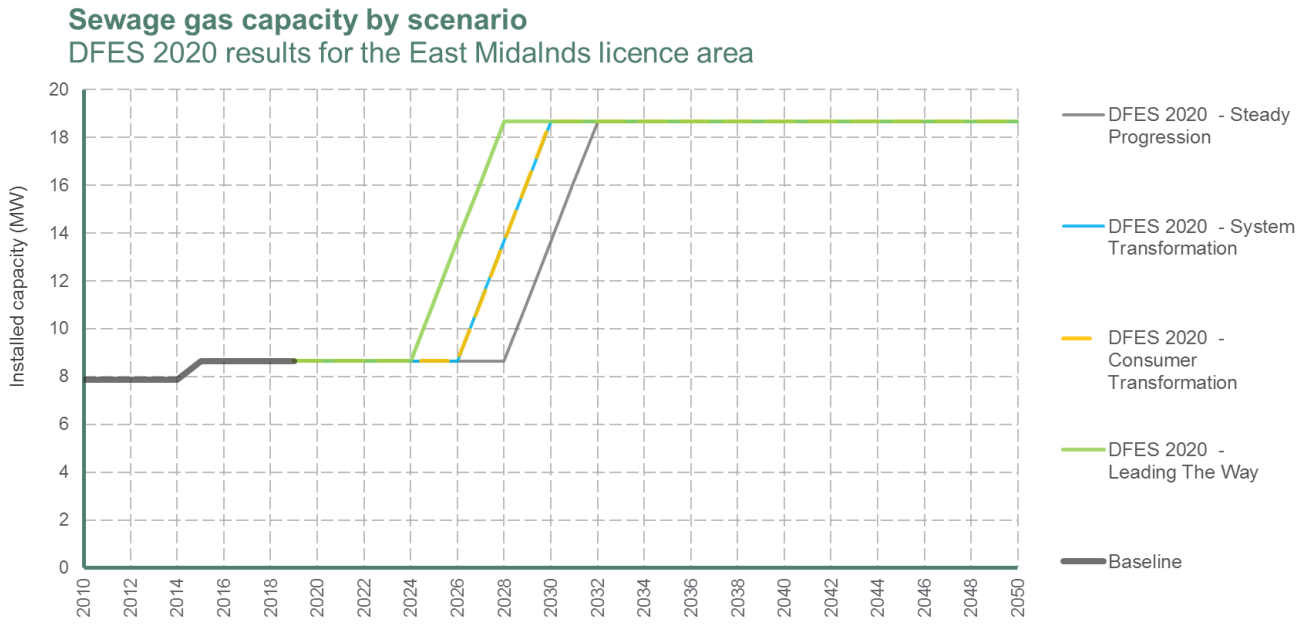
Near term

- There is no change projected in the output capacity or connections before 2030.

Medium to long term

- Population calculations suggest that the maximum potential resource for sewage gas used for electricity generation in the East Midlands is c.30 MW.
- An additional four sites (10 MW in total) of sewage gas has been projected to connect in all scenarios between 2025 and 2032 based on the available resource.
- In the long term, the conversion of sites to biomethane remains an uncertainty factor for the sector. It is assumed for this analysis that sites do not convert to biomethane, in line with FES 2020 assumptions.

Figure 21

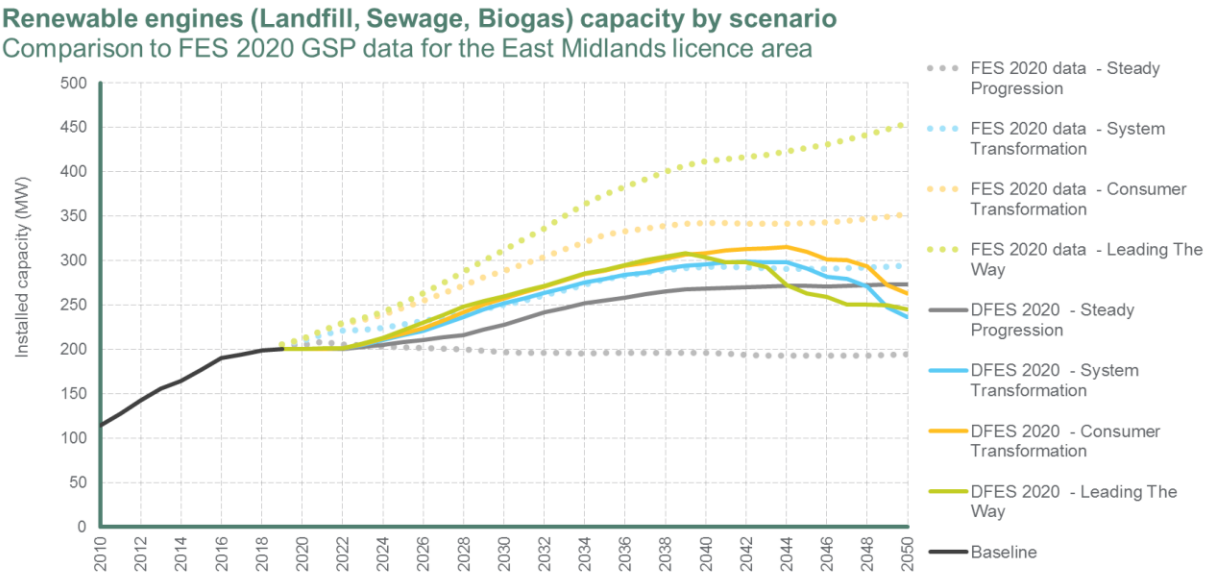


Summary of anaerobic digestion, landfill gas and sewage gas compared to the FES 2020 'Renewable engines (landfill, sewage, biogas)' building block technology ID number Gen_BB004.

Reconciliation with National Grid FES 2020:

- The growth in renewable engine capacity comes primarily from anaerobic digestion as landfill gas capacity decreases over time and sewage gas capacity only increases by 10 MW in all scenarios to 2050.
- The scenarios to 2050 are lower than FES 2020. Calculations of the estimated long term maximum capacity of renewable engines is based on 2050 population and assumptions about declining levels of waste production which impact the feedstocks available.
- Additional growth is expected in sites which focus on biomethane injection rather than electrical capacity. This capacity is not included in this analysis.

Figure 22



Relevant assumptions from National Grid FES 2020:

Assumption number	1.1.5 Support: Incentive regime for biomethane (and other 'green gas') production.
Steady Progression	Support is focused on areas with greater potential volumes (UKCS/shale).
System Transformation	Bigger push for renewable gas as required to meet longer term decarbonisation targets.
Consumer Transformation	Bigger push for renewable gas as required to meet longer term decarbonisation targets.
Leading the Way	All sources of renewable fuels encouraged and biomethane used in niche areas in transport/industry.

References:

WPD connection offer data, Local Authority food waste collection status, UK cattle statistics, Land grade statistics, Climate Emergency declaration data, Regen consultation with local stakeholders and discussion with developers.

Biomass in the East Midlands licence area

Summary of modelling assumptions and results.

Technology specification:

Biomass generation – including biomass for power generation and biomass CHP. Excludes biomass used solely for heat, and bioenergy with carbon capture and storage.

Data summary for biomass power (including CHP) in the East Midlands licence area:

Installed capacity (MW)	Baseline	2025	2030	2035	2040	2045	2050
Steady Progression	107	136	136	136	136	136	136
System Transformation	107	125	132	145	100	100	118
Consumer Transformation	107	113	153	167	122	141	166
Leading the Way	107	122	162	117	117	154	154

Summary:

- New biomass power plants are assumed to connect in this licence area only under a Steady Progression or System Transformation scenario.
- In all scenarios there are significant capacity reductions, as the existing sites come offline and are not replaced.
- In the net zero scenarios, sustainable biomass is assumed to be prioritised for use in sectors that are harder to decarbonise, or for use in power generation with carbon capture and storage.

Assumptions and results:

Baseline:

- The East Midlands has the highest installed capacity of biomass power generation of any of the WPD licence areas, with a total of 107 MW from 16 sites.
- The largest site is the Sleaford biomass power plant, at a capacity of 45 MW.

Near term (2020 – 2025)

- All the biomass power sites with a current accepted connection offer across the WPD areas are in the East Midlands licence area. However, the pipeline capacity is relatively limited compared to historic deployment rates.
- Analysis of the pipeline shows that there are four sites with an accepted connection offer with a potential total capacity of 42 MW, consultation with developers suggests that some of these may be installed at a lower capacity. These sites go ahead under all scenarios but at different capacities to reflect the uncertainty expressed by developers.

Medium term (2025 – 2035)

- The WPD DFES 2020 projections are based on an assessment of the age of biomass power generation sites, reflecting assumptions about the lifespan and competing uses for biomass feedstocks.
- To ensure DFES captures the near term worst case conditions on the distribution network within the scenarios, sites have been modelled as staying online, even if it is projected that under the net zero scenarios they may cease operation or see running hours may significantly reduce.
- While modelling credible pathways to net zero, the DFES must also capture the near term worst case conditions that the distribution network could see, which is important for strategic investment modelling. While National Grid ESO may discount generators without a supply contract, WPD DFES includes all generators with valid connection agreements regardless of absent supply contracts, this may lead to some discrepancies in the baseline totals.

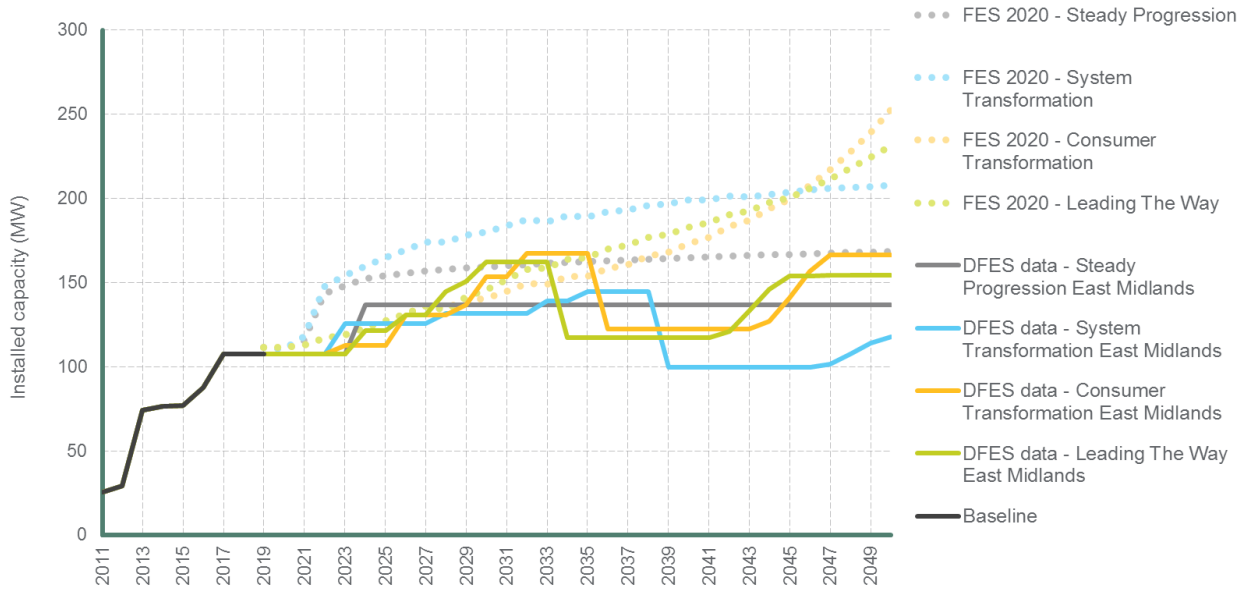
Long term (2035 – 2050)

- It is assumed that there is no biomass with carbon capture and storage used in power generation at the distribution level, instead these sites are installed at much larger capacities at the transmission level from the late 2020s and 2030s onwards.
- The spatial distribution of new and decommissioning sites is based on the location of existing sites either currently connected or identified by developers through planning applications.
- After 2030 in Leading the Way there is a reduction in capacity in the largest sites only. Sites going offline in Consumer Transformation and System Transformation are assumed to stay online for longer. To ensure the worst case conditions on the distribution network are modelled, all existing sites with connection agreements stay online in Steady Progression out to 2050.
- These sites are not repowered under the net zero scenarios where subsidies are restricted and biomass fuel sources are assumed to be prioritised for other uses, such as in increased carbon sinks and for use in construction. This reflects the recommendations from the Committee on Climate Change in their report '[Biomass in a low-carbon economy]'.

Figure 23

Installed biomass power capacity in WPD DFES 2020

Comparison to FES GSP data for the East Midlands licence area



Reconciliation with National Grid FES 2020:

- In the near term the pipeline of potential projects is assumed to be built successfully under System Transformation and Steady Progression. In the near term the WPD DFES projections for these scenarios are in line with the FES 2020 projections.
- In the medium and long term however, the WPD DFES 2020 projections are below the FES 2020 projections at distribution level, reflecting the assumption that, as plants reach the end of their operational life, they are not replaced by unabated biomass for power generation due to competing priorities for sustainable biomass.
- The limited number of sites in the baseline mean that there are larger 'step' changes in the WPD DFES projections as single sites connect or reach the end of their operational life, than compared to the FES 2020 projection.

Relevant assumptions from National Grid FES 2020:

Assumption number	4.1.13
Steady Progression	Limited support for biomass due to less of a drive to decarbonise and lack of CCUS. Some growth in decentralised biomass without CCUS.
System Transformation	Uptake in biomass generation linked to CCUS driven by the decarbonisation agenda.
Consumer Transformation	Uptake in biomass generation linked to CCUS driven by the decarbonisation agenda.
Leading the Way	High growth driven by the decarbonisation agenda. Linked to CCUS as this results in negative emissions.

References:

WPD connection offer data, Committee on Climate Change, the Renewable Energy Planning Database, Regen consultation with local stakeholders and discussion with developers.

Waste (incineration) in the East Midlands licence area

Summary of modelling assumptions and results.

Technology specification:

Energy from Waste (EfW) technologies including incineration and Advanced Conversion Technologies (ACT).

Data summary for waste (incinceration) in the East Midlands licence area:

Installed capacity (MW)	Baseline	2025	2030	2035	2040	2045	2050
Steady Progression	137	244	244	244	244	244	244
System Transformation	137	224	216	155	154	114	114
Consumer Transformation	137	224	224	224	176	168	155
Leading the Way	137	224	216	155	154	114	114

Summary:

- The carbon emissions from unabated EfW incineration plants are not consistent with a net zero goal. As a result, it is assumed in the scenarios that EfW capacity reduces after 2030 as older EfW facilities reach the end of their lifetime and the capacity is not replaced.
- ACT gasification plants are expected to have lower associated carbon emissions and are part of a net zero 2050 scenario assuming that residual emissions are abated. All ACT sites on WPD's network connected in the last decade, and do not disconnect before 2050.

Results and assumptions:

Baseline

- There are 12 EfW sites in the baseline totalling 137 MW.

Near term

- There are six pipeline sites in WPD's connection database totalling 117 MW.
- Four pipeline sites connect by 2023 in all scenarios and a further ACT site connects by 2025 in Steady Progression.

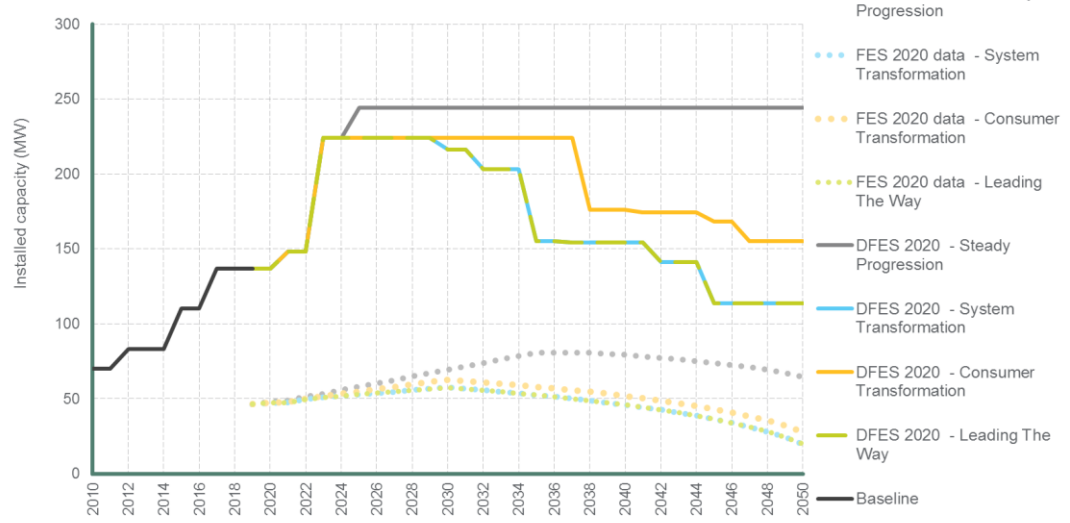
Medium and long term

- No additional sites have been projected beyond the pipeline which is in accordance with NG FES 2020.
- The medium and long term projection is determined by the decommissioning of existing baseline and pipeline sites based on an assumed lifetime of the EfW facility. The assumed lifetime is 25 years in Leading the Way and System Transformation, 30 years in Consumer Transformation, and 35 years in Steady Progression. However, for the purposes of capturing the worst case distribution network conditions, all sites stay online until 2030 and see delayed capacity reduction after that. No sites are projected to come offline in Steady Progression.

Figure 24

Waste (incineration) capacity by scenario

Comparison to FES 2020 GSP data for the East Midlands licence area



Reconciliation with National Grid FES 2020:

- The assumptions underpinning this work are in line with the FES 2020 results, however the results differ due to local spatial distribution.
- WPD connections data suggests a baseline capacity which is significantly higher than the FES 2020 baseline for the East Midlands licence area. While modelling credible pathways to net zero, the DFES must also capture the near term worst case conditions that the distribution network could see, which is important for strategic investment modelling. While National Grid ESO may discount generators without a supply contract, WPD DFES includes all generators with valid connection agreements regardless of absent supply contracts, this may lead to some discrepancies in the baseline totals.
- Near term growth is significant due to the four pipeline sites which are expected to connect by 2023 in all scenarios as they all have both a connection offer, and positive planning results with either a planning application submitted, or granted.
- The decommissioning of sites in the medium and long term means that the decline in EfW capacity is staggered.

Relevant assumptions from National Grid FES 2020:

Assumption number	4.1.11 'Waste generation'
Steady Progression	No great change in waste management from society; leaving waste available as a fuel source.
System Transformation	Less waste to burn in general due to a highly conscious society adapting to low waste living.
Consumer Transformation	Limited societal change in waste management; less waste than current produced, limiting waste to burn generation.
Leading the Way	Less waste to burn in general due to a highly conscious society adapting to low waste living.

References:

WPD connection offer data, Renewable Energy Planning Database, Climate Emergency declaration data, Regen consultation with local stakeholders and discussion with developers.

Fossil gas power in the East Midlands licence area

Summary of modelling assumptions and results.

Technology specification:

Fossil gas power generation covering four technology types – OCGT, CCGT, reciprocating engines and CHP sites.

Data summary for fossil gas power in the East Midlands licence area:

Installed capacity (MW)		Baseline	2025	2030	2035	2040	2045	2050
CCGT (non-CHP)	Steady Progression	407	407	407	407	407	407	407
	System Transformation	407	407	407	407	407	407	407
	Consumer Transformation	407	407	407	407	407	407	407
	Leading the Way	407	407	407	407	407	0	0
Reciprocating engines (non-CHP)	Steady Progression	413	668	1,103	1,293	1,369	1,460	1,486
	System Transformation	413	454	454	454	454	341	335
	Consumer Transformation	413	454	454	454	454	341	335
	Leading the Way	413	454	447	314	313	41	41
Gas CHP	Steady Progression	403	451	451	451	451	451	451
	System Transformation	403	409	409	408	408	405	364
	Consumer Transformation	403	409	409	408	408	405	364
	Leading the Way	403	409	407	398	323	7	7

While modelling credible pathways to net zero, the DFES must also capture the near term worst case conditions that the distribution network could see, which is important for strategic investment modelling. While National Grid ESO may discount generators without a supply contract, WPD DFES includes all generators with valid connection agreements regardless of absent supply contracts, this may lead to some discrepancies in the baseline totals.

Summary:

- Fossil gas-fired power generation decreases in all net zero compliant scenarios, whereas for some generator types capacity increases significantly in a Steady Progression scenario.
- In all scenarios, the primary role of fossil-gas is to provide flexibility and back-up services. Therefore, although the installed capacity may remain stable over some years, the annual running time, and energy output, decreases.
- At a national level, after 2030 hydrogen generation becomes a more economical source of supply-side flexibility in System Transformation, whereas Leading the Way and Consumer Transformation have higher levels of energy storage and residential thermal flexibility.

Results and assumptions:

Baseline

- The East Midlands licence area has the highest installed capacity of fossil gas generation of all the WPD licence areas, with a total of 1,244 MW connected. This capacity is made up in roughly equal thirds from three technology types, CCGT, reciprocating engines, and gas CHP.
- The largest site currently connected is Corby Power Station, which operated first in 1992 and has a total thermal capacity of 407 MW, and a typical net export of 350 MW.

Near term (2020 – 2025)

- The Industrial Emissions Directive, in place since 2016, places emissions requirements on power plants operating between 2016 and 2020. Corby power plant has opted out of this directive, opting instead for Limited Lifetime Derogation which limits total running hours and ensures closure before 2024 in all scenarios. However as WPD would currently have no mechanism to reclaim the capacity held in existing connection agreements, there is no modelled capacity reduction from existing sites before 2030 to capture reasonable worst case conditions on the distribution network.
- There are 39 pipeline sites which have accepted a network connection offer in the licence area, the majority of which are gas CHP and gas reciprocating engines.
- The pipeline sites show a wide variation in capacity, ranging from 60 MW to under 1 MW, the average capacity is around 8 MW. Six of these pipeline sites have had planning permission approval identified.
- 16 pipeline sites have either pre-qualified or secured a Capacity Market agreement in auctions since 2017, and four more sites were either rejected or did not pre-qualify.
- Evidence of planning applications, planning approval and activity in Capacity Market auctions are key factors for the year of connection in the near term by scenario.

Medium term (2025 – 2035)

- Most of the fossil-gas generation capacity in this licence area connected from 2016 onwards. There is no reduction in capacity before 2030 and limited reduction in fossil capacity in the medium term in the net zero compliant scenarios. However, operational hours may well reduce as outlined above.

Long term (2035 – 2050)

- In all net zero compliant scenarios, the annual running hours of all unabated fossil-gas plant are expected to fall to almost zero in the long term, as other providers of flexibility are more economical, and baseload demand is met by other sources. This leads to a reduction of total installed capacity down to near zero by 2050 in Leading the Way. As WPD would have no mechanism to reclaim the capacity held in existing connection agreements, under Consumer Transformation and System Transformation sites come offline 45 years after the connection date to capture reasonable worst case conditions.

Figure 25

CCGT installed generating capacity

Comparison to FES 2020 GSP data for the East Midlands licence area

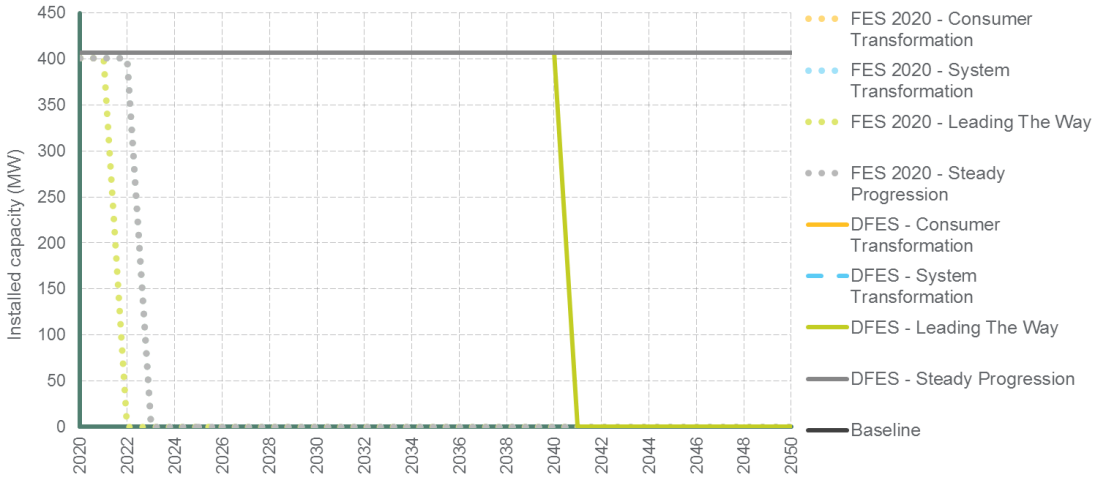


Figure 27

Reciprocating engines installed generating capacity

Comparison to FES 2020 GSP data for the East Midlands licence area

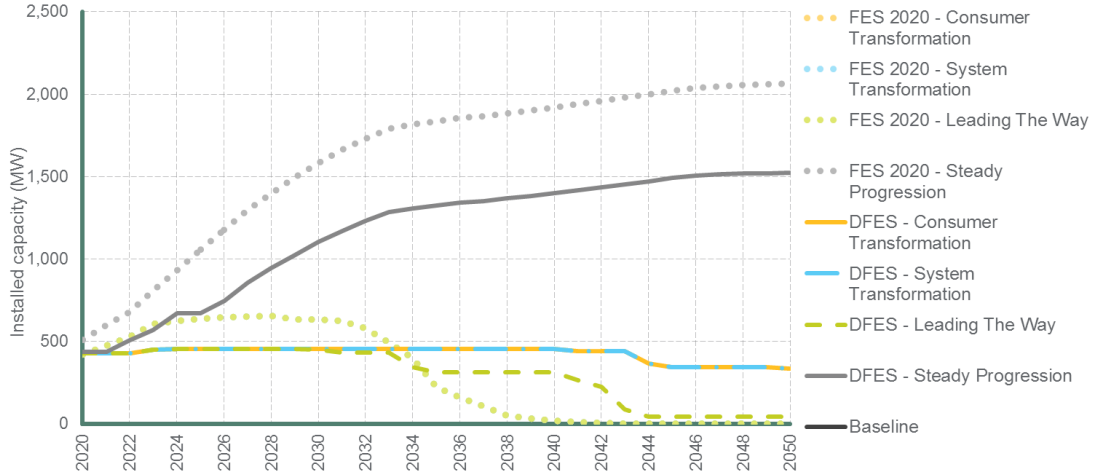
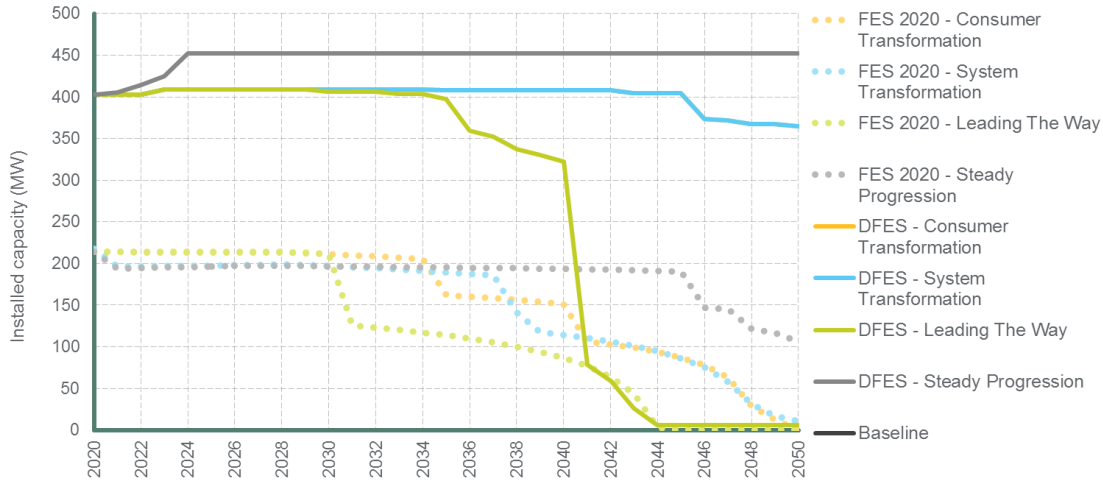


Figure 26

Gas CHP installed generating capacity

Comparison to FES 2020 GSP data for the East Midlands licence area



Reconciliation with National Grid FES 2020:

Results in this section relate to the FES 2020 data as reported for Building Block ID numbers Gen_BB001, Gen_BB002, Gen_BB006, Gen_BB008, Gen_BB009.

- The WPD DFES projections are below those in FES 2020 for reciprocating engines due to a slightly lower baseline and due to the treatment of the sites in the pipeline. In the medium and long term, deployment is in line with the FES, but remains lower due to the lower near term deployment of pipeline sites
- There is a baseline capacity discrepancy for all sub-technologies, though most pronounced for CHP sites, with an over 150 MW capacity difference. The baseline difference for OCGT and reciprocating engines is 6 MW and 13 MW, respectively. The assumptions have been applied uniformly although compared to the FES 2020 data, the WPD DFES projections show large 'step' changes as specific large sites come offline, reflecting the limited number of sites for some technology types.

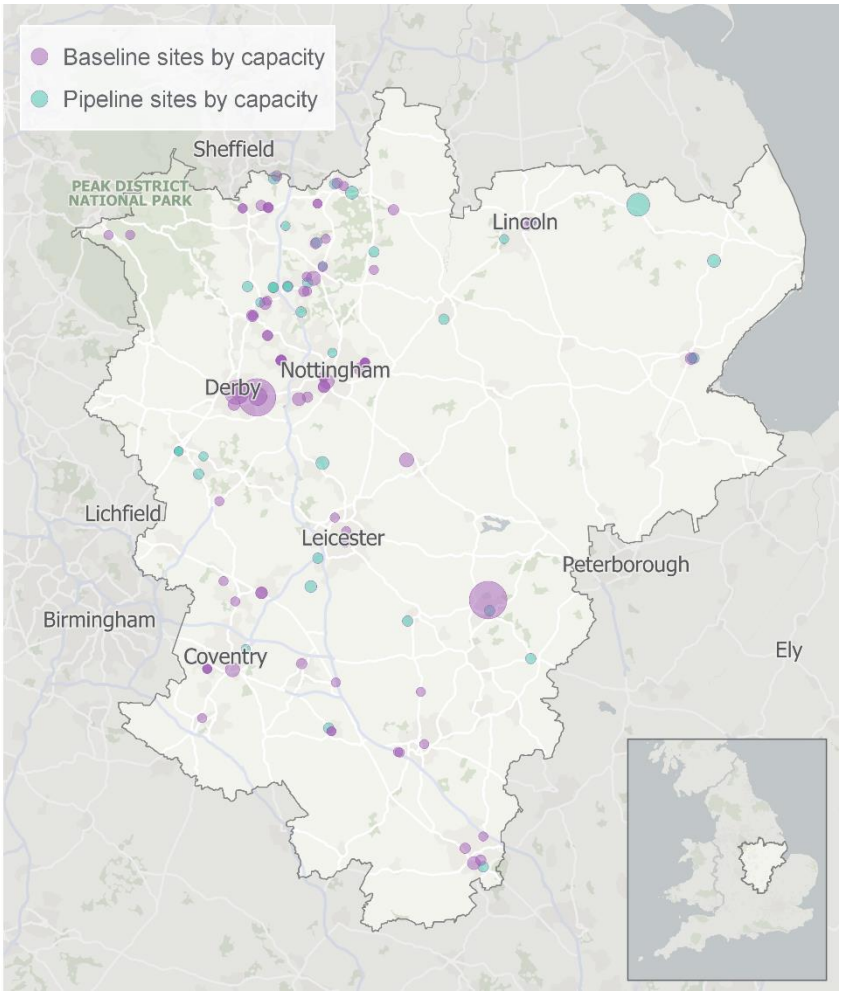
Factors that will affect deployment at a local level:

- The spatial distribution of new gas sites is based on proximity to the electricity network and reflects activity in the pipeline and Capacity Markets.

Figure 28

Fossil gas sites in the East Midlands licence area

The largest fossil gas site currently connected is Corby Power Station, which has a connected capacity of 407 MW.



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Relevant assumptions from National Grid FES 2020:

Assumption	Assumption number
Unabated large scale gas generation	**4.1.6**
Steady Progression	Low gas price and lower focus on decarbonisation promotes gas as the source of flexible generation.
System Transformation	High levels of decarbonisation, plus other sources of flexibility reduce the need for unabated gas.
Consumer Transformation	High levels of decarbonisation, plus other sources of flexibility reduce the need for unabated gas.
Leading the Way	Highest level of decarbonisation significantly reduces the amount of unabated gas.
CHP gas generation	**4.1.14**
Steady Progression	Low gas price supports growth however there is less emphasis on small scale generation that could be considered societal disruptive.
System Transformation	Renewable technologies are preferred due to the ambition to decarbonise.
Consumer Transformation	Renewable technologies are preferred due to the ambition to decarbonise.
Leading the Way	Gas generation not favoured in an accelerated net zero world; renewable technologies are favoured earlier.

References:

WPD connection offer data, Capacity Market auction results and data, System Wide Resource Registers (GB), the TEC register, the Renewable Energy Planning Database, Climate Emergency declaration data, Regen consultation with local stakeholders and the results from the WPD DFES consultation events.

Diesel generation in the East Midlands licence area

Summary of modelling assumptions and results.

Technology specification:

Distributed diesel generation.

Data summary for diesel generation in the East Midlands licence area:

Installed capacity (MW)	Baseline	2025	2030	2035	2040	2045	2050
Steady Progression	77	87	87	87	77	77	77
System Transformation	77	77	75	2	0	0	0
Consumer Transformation	77	77	75	2	0	0	0
Leading the Way	77	77	75	2	0	0	0

Summary:

- Increasingly stringent air quality limits mean there is no increase in diesel generation capacity in the net zero compliant scenarios for East Midlands. The EU's Medium Combustion Plant Directive (MCPD) adoption into UK law enforces air quality limits in 2025 that impact the viability of diesel generators in WPD's licence areas (except those used solely for back-up).
- All existing plants not used solely for back-up are therefore decommissioned by 2025 in the net zero compliant scenarios. In Steady Progression it is assumed that there is a delay and capacity reduces to zero by 2036.

Results and assumptions:

Baseline

- There are 18 sites in the baseline totalling 76.5 MW. Five of these are back-up generators.
- Three of the baseline sites over 10 MW capacity, which all connected in 2013.

Near term (2020 – 2025)

- With stringent air quality standards under the MCPD, diesel plants will no longer be able to operate from 2025 without abatement technologies which are unlikely to be financially viable in the near term. However, as WPD currently would have no mechanism to reclaim the capacity held in existing connection agreements, there is no modelled capacity reduction from existing sites before 2030, to capture reasonable worst case conditions on the distribution network.
- The 13 standalone diesel sites have been modelled to reduce operational hours to zero 10 years after their connection year, or by 2025, whichever comes first, but stay online until at least 2030 to capture reasonable worst case conditions on the distribution network.
- Back-up generators are assumed to have a lifetime of 15 years and are unaffected by the MCPD.
- There is one pipeline site in the East Midlands with a Capacity Market agreement and planning permission. It connects only in Steady Progression and has a 10 year lifetime.

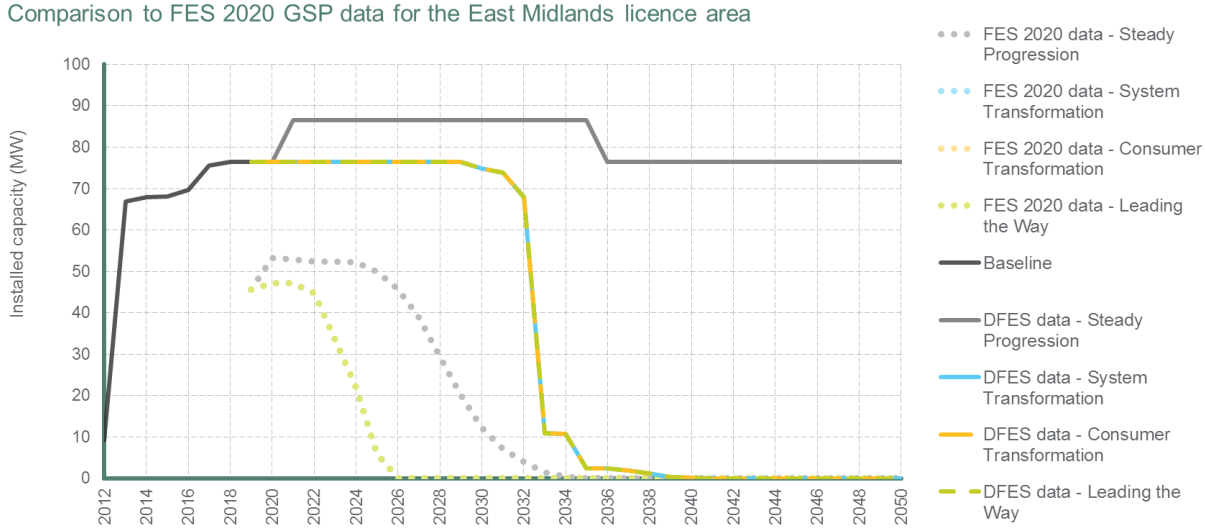
Medium to long term (2025 – 2050)

- No further deployment of distributed diesel has been modelled beyond 2025.
- It should be noted that non-synchronous diesel generation (e.g. only operating as back-up when mains failure occurs) is not subject to the MCPD and therefore remain connected until the end of their lifetime when they are assumed to be replaced with a different technology.

Figure 29

Diesel capacity by scenario

Comparison to FES 2020 GSP data for the East Midlands licence area



Reconciliation with National Grid FES 2020:

Results in this section relate to the FES 2020 data as reported for the Building Block ID number Gen_BB005.

- The assumptions underpinning this work are in line with the FES 2020 results, however there is a discrepancy in the total capacity currently installed.
- WPD connections data suggest a baseline capacity which is significantly higher than the FES 2020 baseline for the East Midlands licence area.
- One pipeline site connects in Steady Progression which is in line with the FES 2020 assumption that there is a small amount of capacity added before sites decommission in this scenario.
- In the three net zero compliant scenarios, diesel sites decommission at the same rate by 2025 which is in line with FES 2020 assumptions.
- While modelling credible pathways to net zero, the DFES must also capture the near term worst case conditions that the distribution network could see, which is important for strategic investment modelling. While National Grid ESO may discount generators without a supply contract, WPD DFES includes all generators with valid connection agreements regardless of absent supply contracts, this may lead to some discrepancies in the baseline totals.

Relevant assumptions from National Grid FES 2020:

Assumption number	4.1.31
Steady Progression	Less focus on decarbonisation compared to other scenarios. Diesel plant retired later than other scenarios.
System Transformation	Initial growth in gas peaking plant as renewables grow (instead of high growth in storage technologies), later switching to Hydrogen.
Consumer Transformation	Initial growth in gas peaking plant as renewables grow (instead of high growth in storage technologies), later switching to alternate sources of flexibility such as storage and V2G.
Leading the Way	Low use as scenario sees greater use of other technologies (e.g. storage). Earliest closure of diesel reciprocating engines.

References:

WPD connection offer data, Regen consultation with local stakeholders.

Other generation in the East Midlands licence area

Summary of modelling assumptions and results.

Technology specification:

All generation connection agreements and accepted offers that are either unidentified as one of the basic technology types.

Data summary for other generation in the East Midlands licence area:

Installed capacity (MW)	Baseline	2025	2030	2035	2040	2045	2050
Steady Progression	33	50	50	50	50	50	50
System Transformation	33	50	50	50	50	50	50
Consumer Transformation	33	50	50	50	50	50	50
Leading the Way	33	50	50	50	50	50	50

Summary:

- There is 33 MW of connected 'other generation' sites that have no identified technology type. In some cases this is because of a lack of available data means that connected site cannot be found, in other cases it is because the fuel source of likely backup generators cannot be confidently identified. All baseline 'other generation' sites other than two are under 3 MW. Most sites seem likely to be either thermal fossil fuel plants or waste processing facilities.
- There are 17 MW of sites that have accepted a network connection offer in the South West licence area, for which the technology type could not be confidently identified. The year of connection projected for these sites is the same across all scenarios and they are projected to connect 3 years after accepting a connection offer.
- All pipeline sites are projected to connect before 2023.

Reconciliation with National Grid FES 2020:

There is no equivalent technology type in National Grid FES 2020 to compare to.

References:

WPD connection agreement and offer data.

Results and assumptions

Energy storage technologies

Battery storage in the East Midlands licence area

Summary of modelling assumptions and results.

Technology specification:

Battery storage, comprising four business models:

- **Standalone network services** – typically multiple megawatt scale projects that provide balancing, flexibility, and support services to the electricity network.
- **Generation co-location** – typically multiple megawatt scale projects, sited alongside renewable energy (or occasionally fossil fuel) generation projects.
- **Behind-the-meter high energy user** – single megawatt or smaller scale projects, sited at large energy-user operational sites to support on-site energy management or to avoid high electricity cost periods.
- **Domestic batteries** – typically 10-20 kW scale batteries that households buy to operate alongside rooftop PV or to provide backup services to the home.

Data summary for battery storage in the East Midlands licence area:

Installed power capacity (MW)		Baseline	2025	2030	2035	2040	2045	2050
Standalone network services	Steady Progression	45	158	162	210	273	354	372
	System Transformation	45	158	159	190	228	251	263
	Consumer Transformation	45	328	346	429	601	661	695
	Leading the Way	45	198	208	302	482	602	722
Generation co-location	Steady Progression	1	53	61	62	80	108	110
	System Transformation	1	51	57	58	71	75	79
	Consumer Transformation	1	58	69	79	134	207	247
	Leading the Way	1	53	96	226	307	364	408
Behind-the-meter high energy user	Steady Progression	4	31	44	63	98	105	113
	System Transformation	4	30	43	61	67	72	76
	Consumer Transformation	4	33	47	80	109	140	152
	Leading the Way	4	41	105	110	170	185	199
Domestic batteries	Steady Progression	0	1	11	12	27	68	168
	System Transformation	0	0	3	4	6	27	76
	Consumer Transformation	0	0	51	93	193	467	874
	Leading the Way	0	14	113	328	467	605	743

Summary:

- The licence area has the highest potential for long term growth in connected storage capacity of the four WPD licence areas. This reflects co-location potential alongside high levels renewable energy deployment and a significant number of non-domestic properties with the potential for behind-the-meter batteries.
- There are 14 battery storage sites currently operational in the East Midlands licence area, and the largest pipeline of battery storage projects of the four WPD licence areas.
- Overall battery storage capacity in 2050 in the East Midlands licence area ranges from c.0.5 GW in System Transformation to 2.3 GW in Leading the Way.

Results and assumptions:

Baseline

- There are 14 battery storage projects totalling 49 MW currently connected in the East Midlands licence area, all of which have come online since 2016.
- Currently operational sites are a mixture of standalone battery projects and behind-the-meter high energy user batteries. Across the baseline, the average installed capacity is 3.5 MW.

Near term (2020 – 2025)

- The East Midlands licence area has a large pipeline of potential battery storage connections, with 28 projects totalling 486 MW. These are an even mix of standalone, generation co-location and behind-the-meter high-energy-user batteries.
- The average capacity of sites in the pipeline is 17 MW and includes a number of 20-50 MW projects.
- Of these projects, 281 MW (11 sites) have planning approval and 99 MW (4 sites) have contracted or pre-qualified for a number of Capacity Market T-4 and T-1 auctions. The planning history and Capacity Market activity of the pipeline sites is a key factor in when these sites connect in the four scenarios.
- By 2025, connected battery storage capacity in the East Midlands licence area is highest (432 MW) in the Consumer Transformation scenario and lowest (246 MW) in the System Transformation scenario.

Medium term (2025 – 2035)

- The four business models for battery storage are modelled separately, and local deployment in each is driven by different factors.
- Standalone storage accounts for a significant proportion of the existing or known near-term storage capacity and this business model sees a very high capacity increase across all scenarios by 2035.
- Generation co-location capacity sees a similarly high uptake in the East Midlands licence area, due to having the highest combined ground mounted solar PV and onshore wind development by 2035 across WPD's network.
- The East Midlands licence area has the second highest number of non-domestic properties with the potential for a battery, thus the uptake of behind-the-meter storage is also relatively high across all scenarios by 2035. This reflects feedback from stakeholders that batteries co-located with high energy users could be the business model with the highest potential for deployment in the near-term.
- The licence area has significant potential for domestic battery deployment in the medium term, with the highest number of homes across WPD's four licence areas as well as the highest capacity of <10 kW rooftop PV deployment. Reflecting stakeholder feedback, in most scenarios, uptake of domestic scale storage is delayed until the medium term.

Long term (2035 – 2050)

- In the long term, the biggest increase in projected battery storage capacity occurs in a Leading the Way scenario, supported by significant potential for co-location with high deployment of solar PV and onshore wind, high levels of consumer engagement leading to uptake of behind-the-meter batteries, and significant deployment of standalone projects.
- The System Transformation scenario sees the lowest overall storage deployment in the East Midlands licence area, reflecting a lesser need for electricity system flexibility. This has been reflected in the longer term out to 2050, across all storage business models.
- Overall, installed battery storage capacity in the East Midlands licence area is highest (c.2.3 GW) in Leading the Way and lowest (c.0.5 GW) in System Transformation by 2050.

Figure 30

Battery storage sites in the East Midlands licence area

The East Midlands licence area has the largest pipeline of storage sites of any of the WPD licence areas.

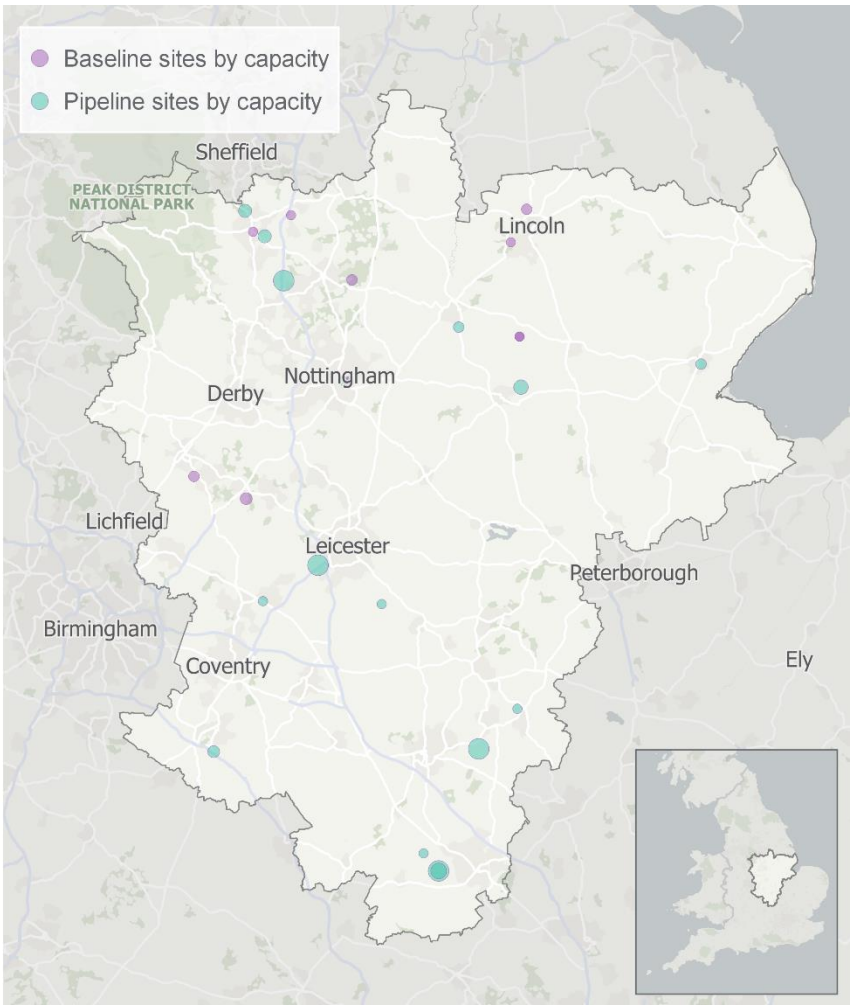


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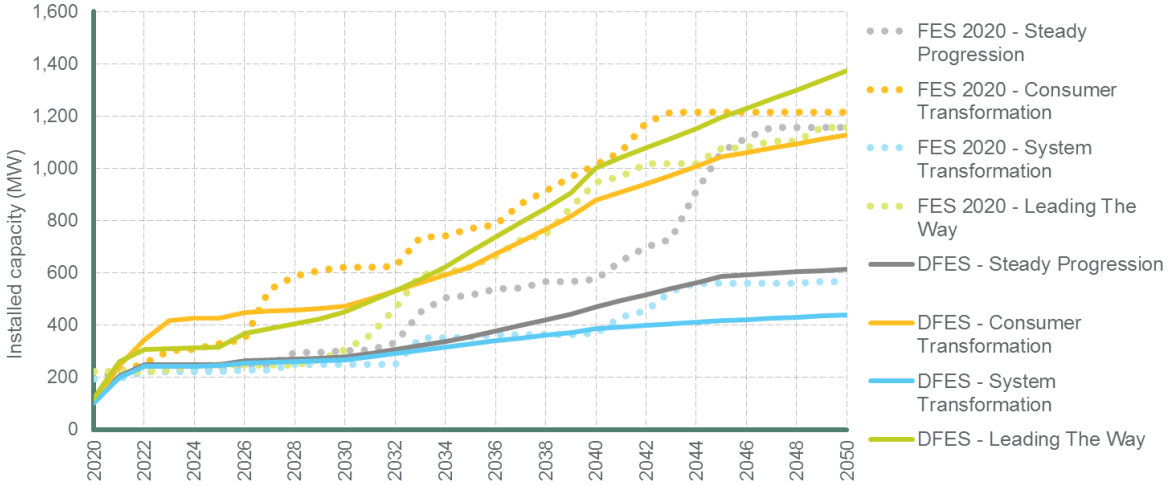
Figure 31

Large scale battery storage installed capacity by scenario

Comparison to FES GSP data for the East Midlands licence area



Reconciliation with National Grid FES 2020:

Results in this section relate to the FES 2020 data as reported for Building Block ID numbers Srg_BB001 and Srg_BB002, Batteries and Domestic Batteries (G98).

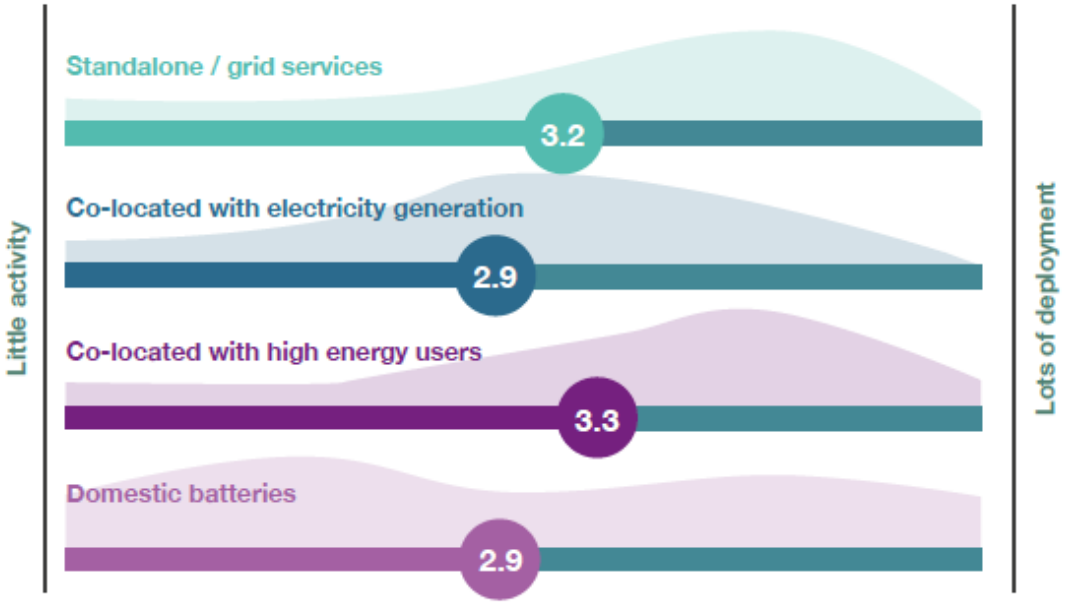
- Reflecting the large near-term pipeline, the WPD DFES 2020 projections across the 2020s are higher than the FES 2020 projections across the early/mid-2020s.
- The WPD DFES 2020 has a higher installation of domestic batteries in System Transformation, reflecting the potential uptake in line with EV and rooftop solar PV deployment in the medium and long term.
- In Leading the Way, a higher number of domestic batteries were modelled to come online by 2050. The WPD DFES 2020 projections have larger scale battery storage projects and fewer domestic batteries, reflecting the WPD DFES renewable energy generation projections in the licence area by 2050 as well as feedback from stakeholders.
- In Steady Progression the FES 2020 projections show a significant increase in connected battery storage capacity in 2044. The WPD DFES 2020 modelling assumptions do not account for this divergent increase in capacity in 2044 and therefore has modelled a smoother projection across the 2040s and an overall lower 2050 projection in this scenario.

Factors that will affect deployment at a local level:

- The spatial distribution of new battery storage projects in the near term is based on the location of the pipeline sites.
- In the longer term, spatial distribution varies according to the four battery storage business models used in the modelling.
- These local factors are:
  - **Standalone:** Developable areas in proximity to the 33kV and 132kV electricity network.
  - **Generation co-location:** Proximity to ground mounted solar PV and onshore wind projects within the licence area.
  - **Behind-the-meter high energy user:** Proximity to industrial estates and commercial buildings.
  - **Domestic batteries:** Domestic dwellings with rooftop PV as projected in the WPD DFES 2020.

Stakeholder feedback from the consultation events:

Your comments to us	Our response
Theme: energy storage	
There was support from stakeholders for all energy storage business models presented. However, domestic batteries were rated the least likely to have high deployment in the near term.	We will continue to analyse energy storage deployment through the four business models, and we will update our projections for domestic batteries to reflect this feedback.
You told us that co-located energy storage facilities would be likely be at least 50% of the power capacity of the solar farm, with around a quarter of respondents suggesting the storage sites would be 100% of the renewable energy asset capacity or larger.	This is higher than the current national baseline average, according to data from the Department for Business, Energy, and Industrial Strategy. We will increase our projected proportional power size for co-located energy storage sites.
You told us that energy storage technologies other than lithium-ion and solid state batteries could be deployed in the future. This included liquid or compressed air storage, power-to-gas sites, and small-scale pumped hydro.	We will review this for the next round of DFES and incorporate stakeholder feedback for which technologies we could include.

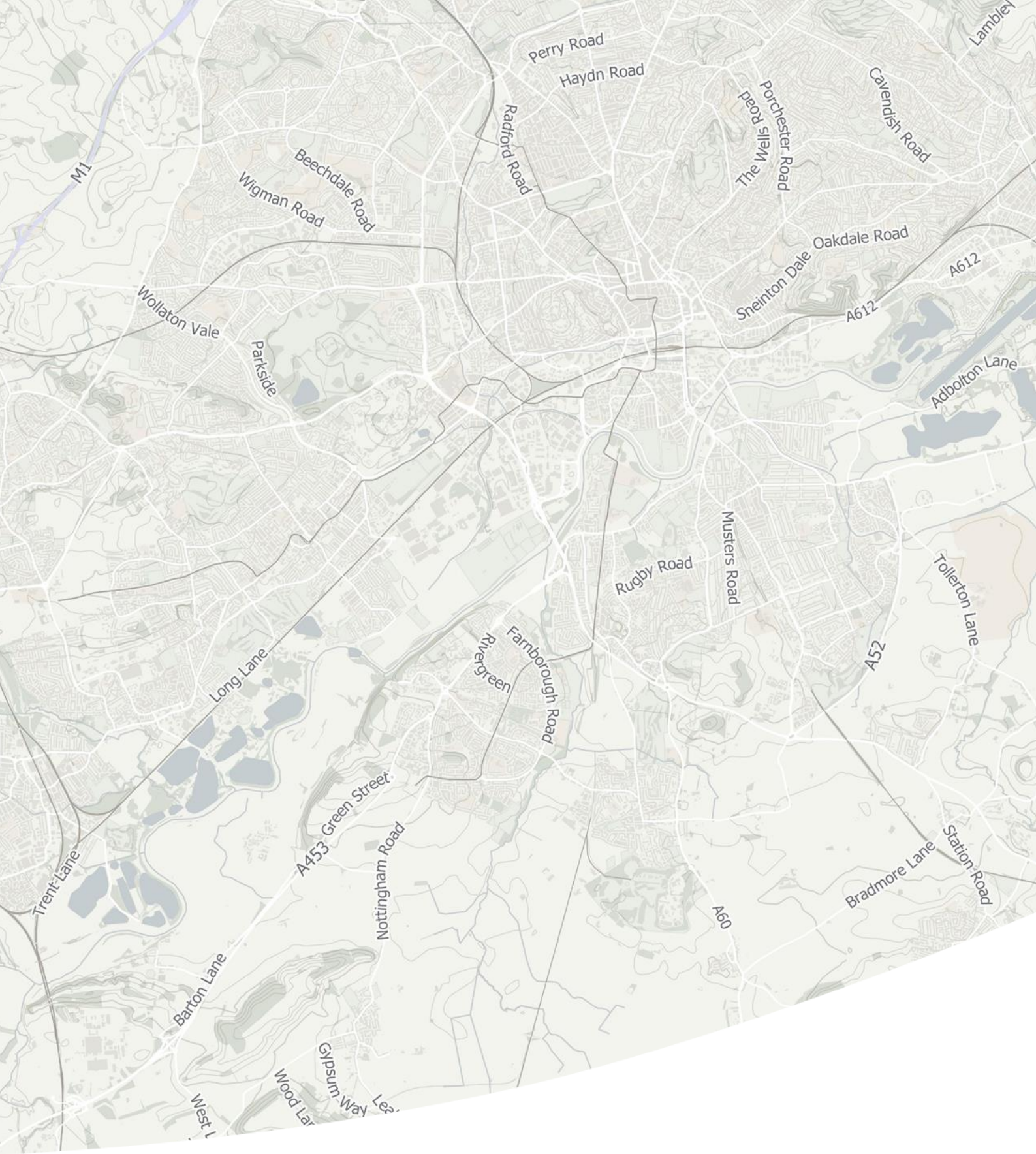


References:

WPD connection offer data, the Renewable Energy Planning Database, various local authority online planning portals, EMR Delivery Body Capacity Market registers, Regen consultation with local stakeholders and discussion with solar developers.

Distribution Future Energy Scenarios 2020

Results and assumptions reports have been published for all four WPD licence areas and are available at the WPD DFES website, along with interactive maps and data download options.



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