Distribution Future Energy Scenarios 2020

South West licence area

Results and assumptions report

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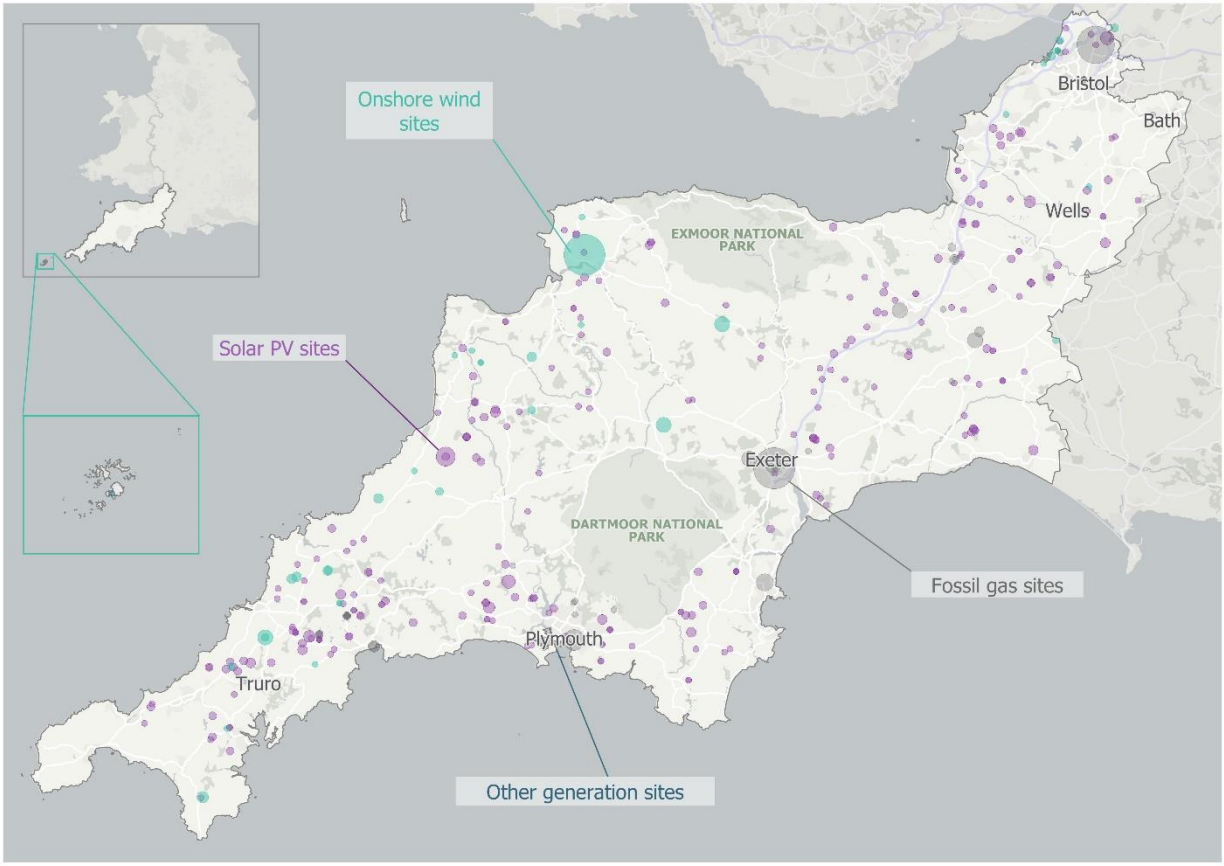
The South West licence area

The South West licence area contains the densely populated areas of Bristol, Exeter and Plymouth, as well as sparsely populated rural areas, two national parks and hundreds of miles of coastline.

Distributed electricity generation in the area has increased significantly in recent years, with over 50% of capacity having only connected since 2014. However, others such as hydropower sites on Dartmoor have been connected for over 100 years. The South West licence area has some of the best solar irradiance in the UK and saw very high deployment of solar PV from 2012. Just under half of all distribution connected generation in the South West licence area is solar PV. The solar capacity is made up from a large number of smaller sites, as is visible across the licence area in Figure 1.

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 1% of South West homes currently have a heat pump and 0.6% of cars are electric, widespread change is expected, with the potential to radically change the current shape of demand.

Figure 1 – The South West 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:

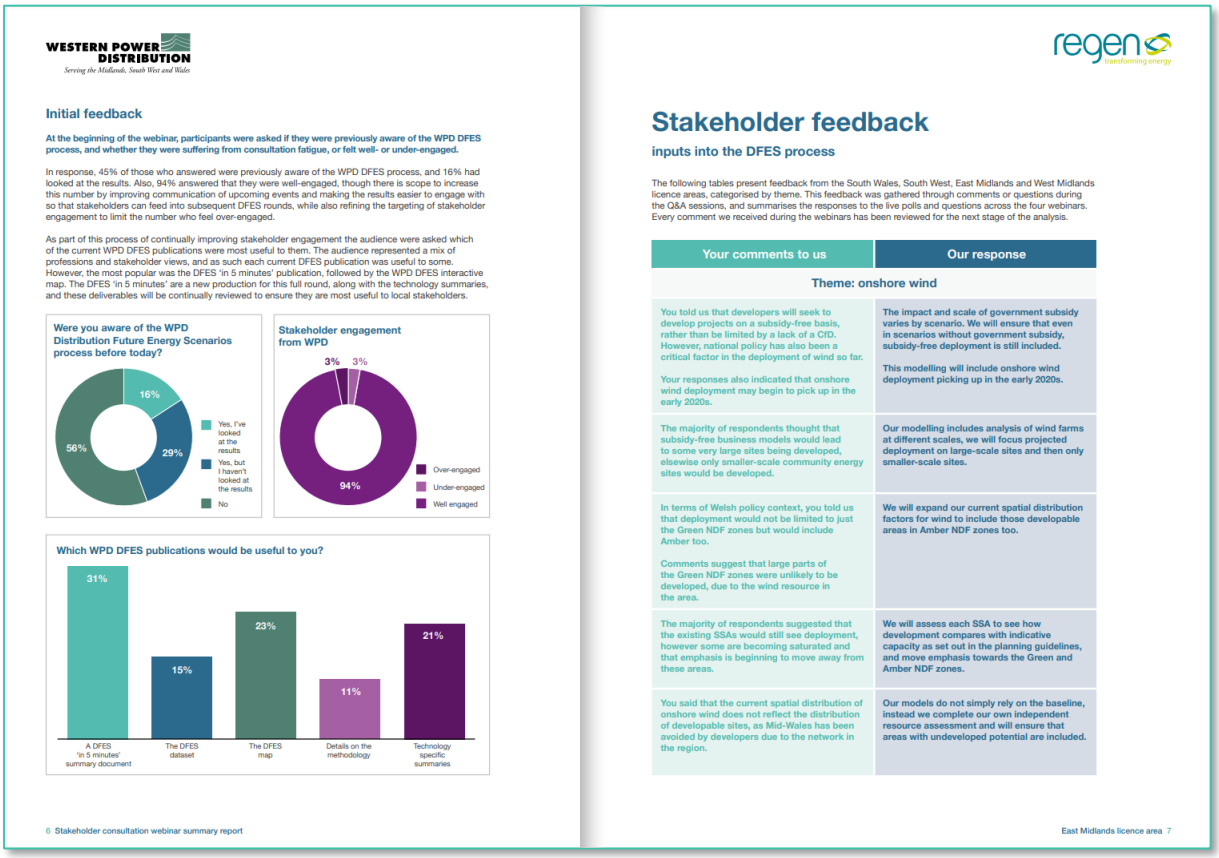
The WPD DFES 2020 is reported to areas known as Electricity Supply Areas (ESAs), which are defined as '*the geographical area supplied by a Primary Substation (which contains WPD-owned distribution substations) providing supplies at a voltage below 33 kV, or a customer directly supplied at 132, 66 or 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.

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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.

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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.

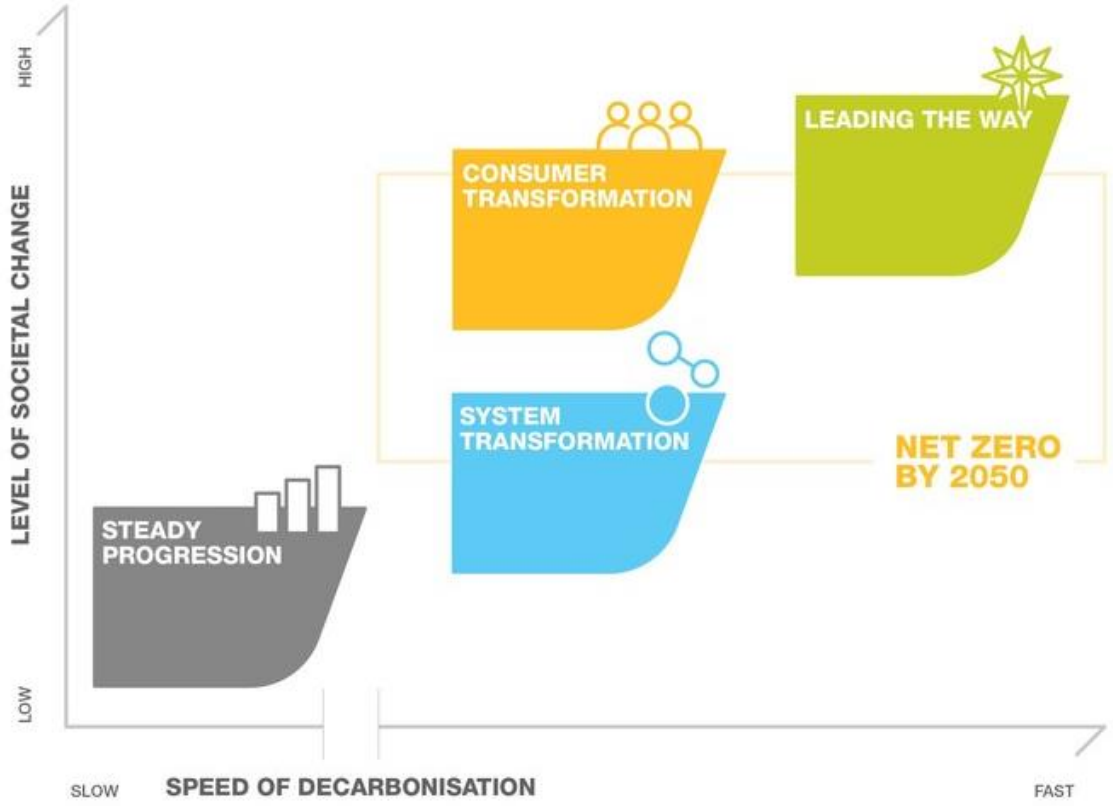
Scenario projections:

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 South West licence area

Summary of modelling assumptions and results.

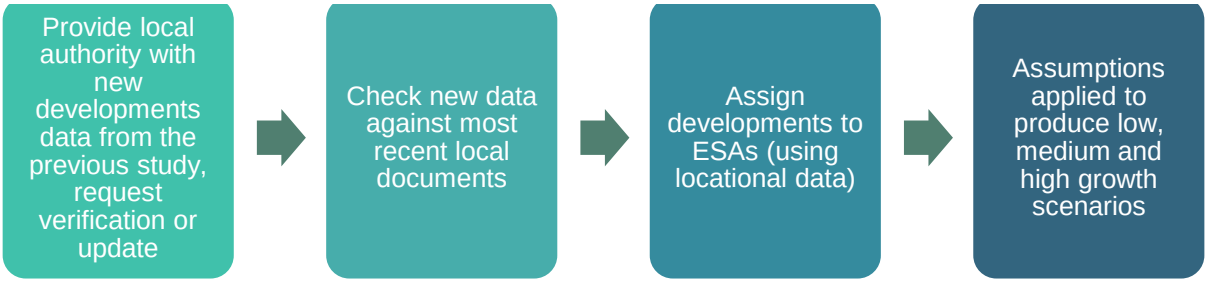
Specification:

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 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

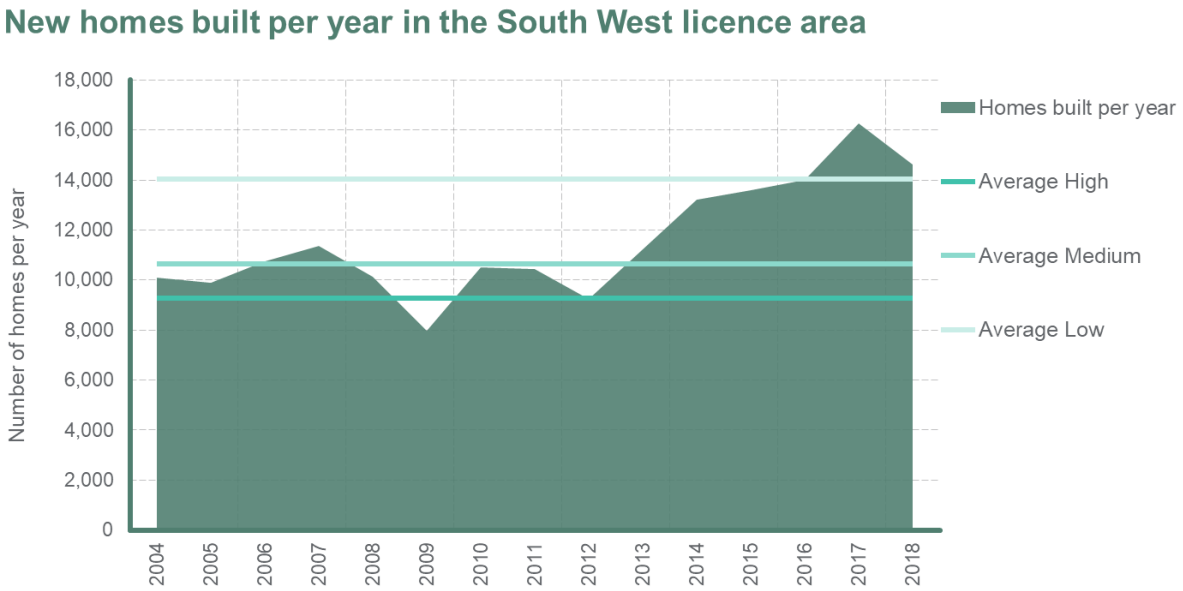


- The data from local authorities is used to create low, medium, and high growth scenarios for domestic and non-domestic developments, reported at ESA level.
- Every local authority within the licence area was contacted, with the existing DFES data presented for verification or modification. The local 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 South West licence area, the high trajectory assumes c.14,000 new homes per year, and the low assumes c.9,000 new homes per year. These 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

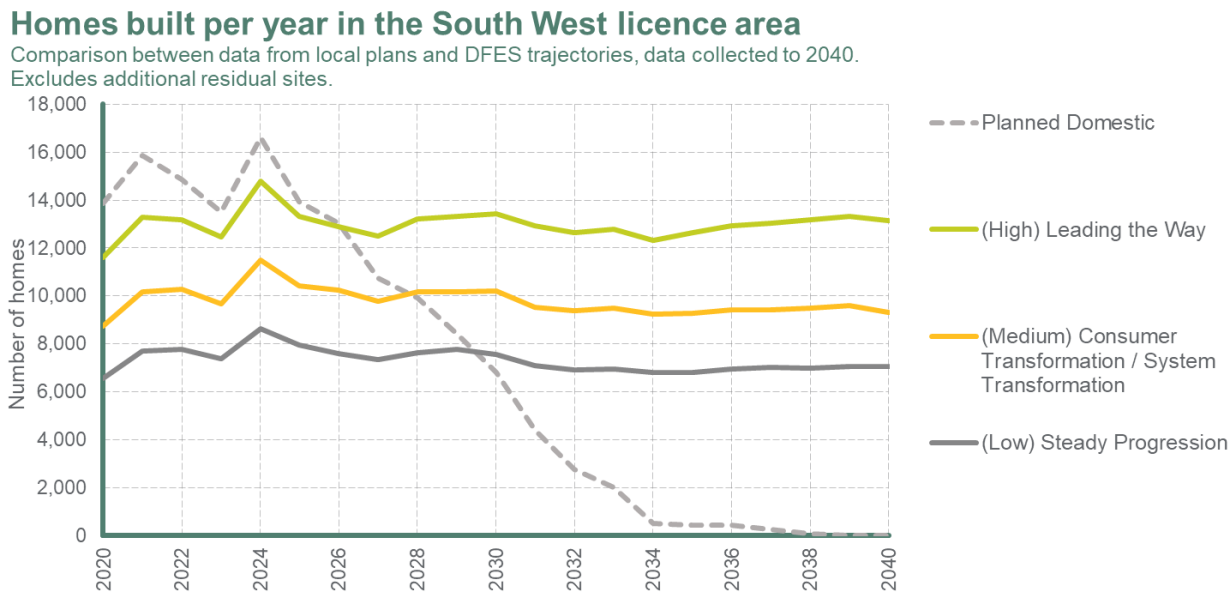
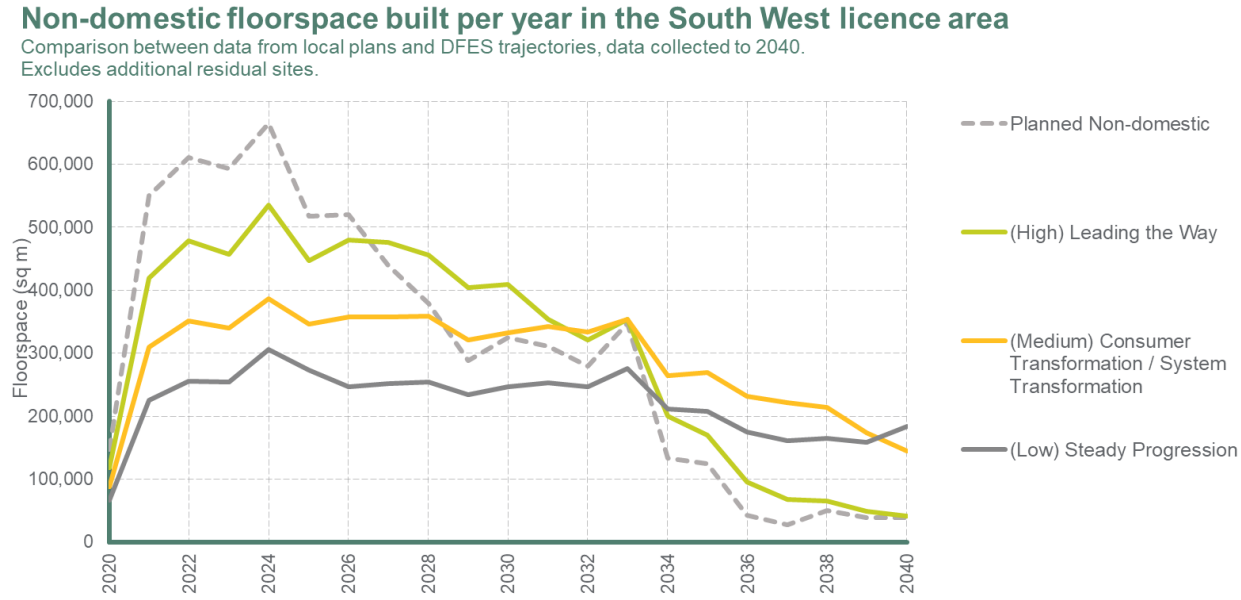


Figure 6



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 South West 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 South West licence area:

Thousands of heat pumps		Baseline	2025	2030	2035	2040	2045	2050
Non-hybrid	Steady Progression	15	20	24	52	94	182	257
	System Transformation	15	40	89	154	218	317	397
	Consumer Transformation	15	142	347	576	775	958	1,143
	Leading the Way	15	142	348	510	682	872	905
Hybrid	Steady Progression	0	1	10	23	29	45	73
	System Transformation	0	14	32	69	88	131	173
	Consumer Transformation	0	7	24	54	84	106	133
	Leading the Way	0	26	85	155	243	341	340

Summary:

- In line with changes nationwide, there is a dramatic shift to low carbon heating in the South West licence area, in all three of the net zero compliant scenarios. In the more electrified Consumer Transformation and Leading the Way scenarios, c.73% of homes are primarily heated by a heat pump by 2050.
- The housing stock in this licence area has some differences when compared to national average, with a low level of social housing and smaller numbers of detached homes, along with a high number of hard-to-insulate houses.
- The potential uptake of hybrid systems is lower than the UK average in this licence area because of the high proportion of off-gas homes. In this licence area, 33% of homes are not connected to the gas network, compared to 15% for GB as a whole.

Results and assumptions:

Baseline

- The South West licence area has c.14,500 heat pumps, all of which are non-hybrid. This represents 1.0% of homes, a higher baseline than in other WPD licence areas, and higher than the GB baseline 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). 15% of heat pumps accredited by the RHI have been in the South West licence area.

Near term (2020 – 2025)

- Heat pump uptake increases under the net zero compliant scenarios in the near term, supported by the continued Domestic RHI and the Green Homes Grant, which is available from September 2020 and supports the installation of domestic energy efficiency measures and heat pumps.
- From 2022, there is a step change in installation rates under 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 target off-gas homes over the next decade (indicated in the Clean Growth Strategy 2017), the high proportion of off-gas homes in the South West 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 implemented, resulting in an increase of non-hybrid deployments in new builds from 2025 onwards.

Medium term (2025 – 2035)

- Installations of heat pumps in the late 2020s and 2030s are driven largely by national heat strategy and policy rather than consumer choice.
- The lower proportion of detached or semi-detached homes (55% in the South West, compared to 61% nationally) and social housing (13% compared to 18%) results in dampened uptake in the medium term. Larger homes have higher uptake of heat pumps currently and this is assumed to continue into the near and medium term.
- 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.
- Heat pumps represent around half of domestic heating system replacements in off-gas homes under Leading the Way and Consumer Transformation in the 2030s.

Long term (2035 – 2050)

- 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. 73% of homes in the licence area are served by a non-hybrid or hybrid heat pump by 2050 under these scenarios.
- Heat pump uptake under System Transformation and Steady Progression remains low, as heating fuelled by hydrogen and fossil gas boilers respectively, is preferred.

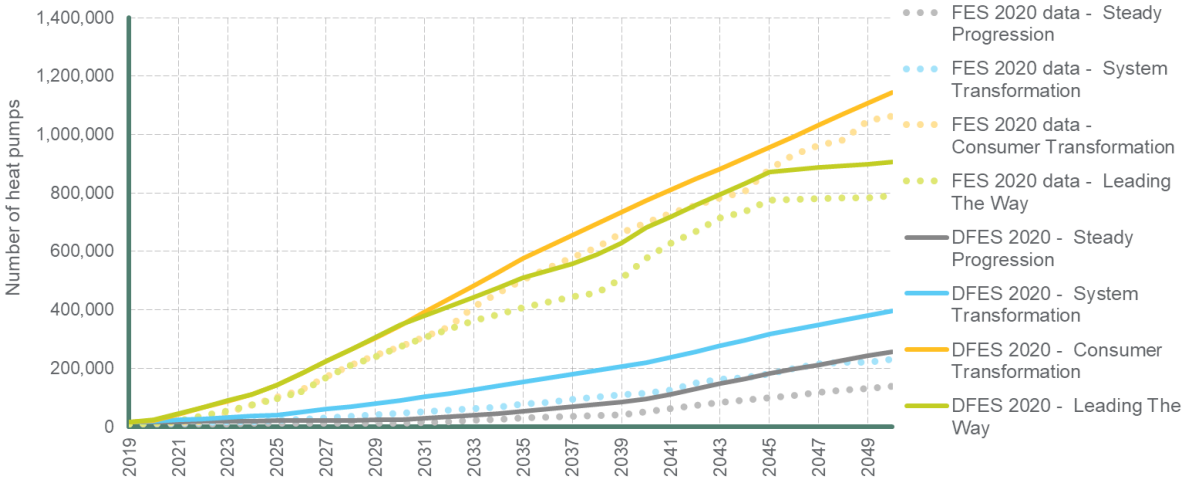
Reconciliation with National Grid FES 2020:

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 for non-hybrid heat pumps are higher than FES 2020, as there are more homes not connected to the gas network than national average, providing a greater potential customer base for non-hybrid heat pumps.
- The WPD DFES 2020 projections for hybrid heat pumps are lower than FES 2020, reflecting the lower availability of gas connections in the licence area. Currently, 67% of homes are connected to the gas network, compared to 85% nationally.

Figure 7

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



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

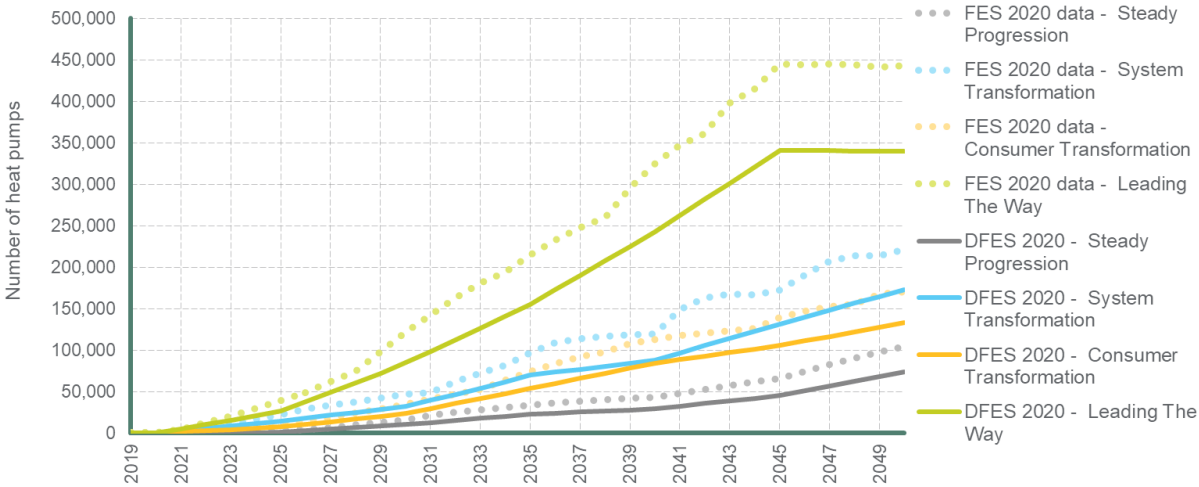


Figure 8

Factors that will affect deployment at a local level:

- 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.
- Uptake in off-gas, and on-gas homes is modelled separately. Within these two separate areas, weighting factors such as whether homes are detached or terraced, levels of affluence, and floorspace are used to assess deployment at a local level.
- 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 less floorspace are assumed to have slightly higher preference for direct electric heating in the near and medium term.
- 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 towards zero as heat pumps become the heating solution of choice under some scenarios. Subsequently, homes that are currently less likely to adopt heat pumps, such as rental properties and poorly insulated buildings, drive the distribution of heat pump uptake in the long term.
- Hybrid heating distribution is driven by the above factors, with an additional weighting towards homes with high floor space (i.e. with the requisite 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 South West were asked 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 South West 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 South West licence area:

Number of households (1,000s)	Baseline	2025	2030	2035	2040	2045	2050
Steady Progression	101	106	110	114	119	124	130
System Transformation	101	107	110	112	113	113	112
Consumer Transformation	101	107	109	110	110	108	107
Leading the Way	101	108	112	115	116	116	116

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)

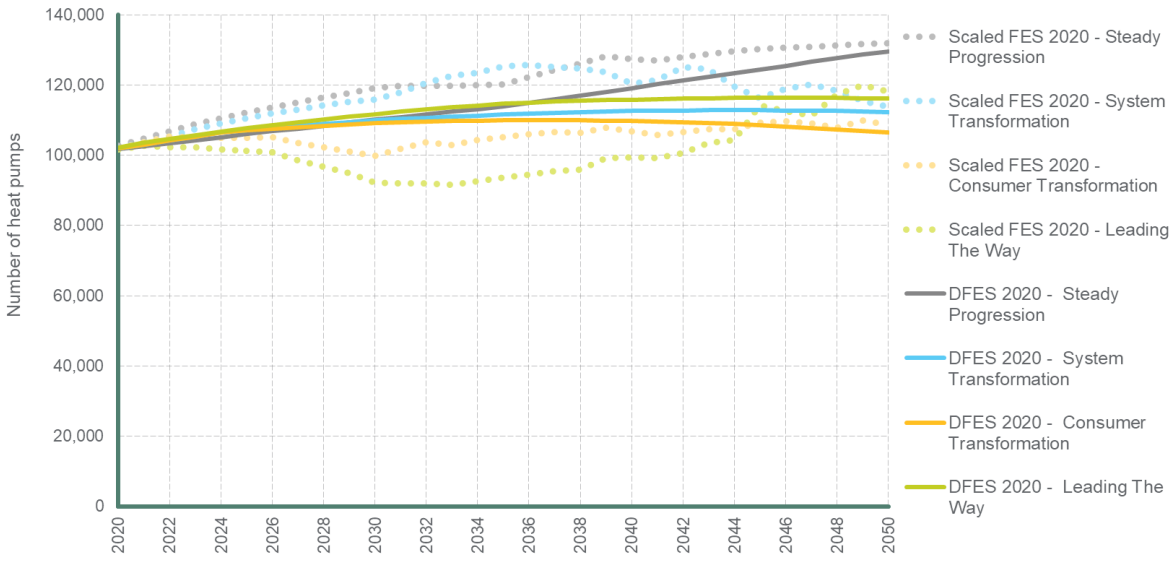
- In the medium term, there is a steady decline in the numbers of domestic direct electric heating units in existing homes. It is assumed to be a steady annual reduction in the absence of clear policy drivers within the medium term. In Steady Progression, the baseline installations are not projected 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 130,000, compared to a 106,000 in Consumer Transformation.

Figure 9

Domestic direct electric heating by scenario
Comparison to scaled FES 2020 data for the South West 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 South West 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 South West licence area:

Number of EVs (total, 1000s)		Baseline	2025	2030	2035	2040	2045	2050
Battery EVs	Steady Progression	7	50	197	579	1,259	1,946	2,172
	System Transformation	7	66	294	948	1,826	2,150	2,062
	Consumer Transformation	7	141	599	1,457	2,008	2,061	1,894
	Leading the Way	7	148	690	1,650	2,035	1,915	1,524
Hybrid EVs	Steady Progression	11	40	98	191	261	164	26
	System Transformation	11	38	89	140	99	30	-
	Consumer Transformation	11	26	50	64	39	6	-
	Leading the Way	11	36	67	51	21	-	-

Summary:

- At present, EVs represent approximately 0.6% of all vehicles in South West licence area, which is below the national average uptake of EVs in GB, which is 0.8%. The area is projected to align with the GB average as EVs become ubiquitous by the late 2020s.
- Local initiatives to lower air quality or expand access to charging are expected to increase local uptake. ‘Clean Air Zones’ have been proposed in both Bath and Bristol and are assumed to go ahead in all net zero compliant scenarios from 2021 at the earliest.
- While the number of plug-in hybrid EVs is currently higher than battery EVs, across all scenarios battery EVs become the dominant technology in the near term and quickly eclipse plug-in hybrids because of their higher efficiencies and lower carbon emissions. All net zero compliant scenarios have zero plug-in hybrids by the 2040s, and so this assumptions report focusses on trends for battery EVs.

- Analysis of Autonomous Vehicles (AVs) was introduced in FES 2020, which projects these vehicles to 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 6,697 battery EV cars in the South West licence area.
- There are a total of 10,930 plug-in hybrid EV cars in the South West licence area.

Near term (2020 – 2025)

- Across all scenarios the uptake of EVs is expected to increase dramatically by 2025, driven particularly by second car owners in the near term.
- It is projected that by 2025, there could be between 50,000 battery EVs in Steady Progression and 148,000 in Consumer Transformation. Autonomous vehicle uptake starts at the earliest in 2023 under all scenarios, however, uptake is very slow in the near term.

Medium term (2025 – 2035)

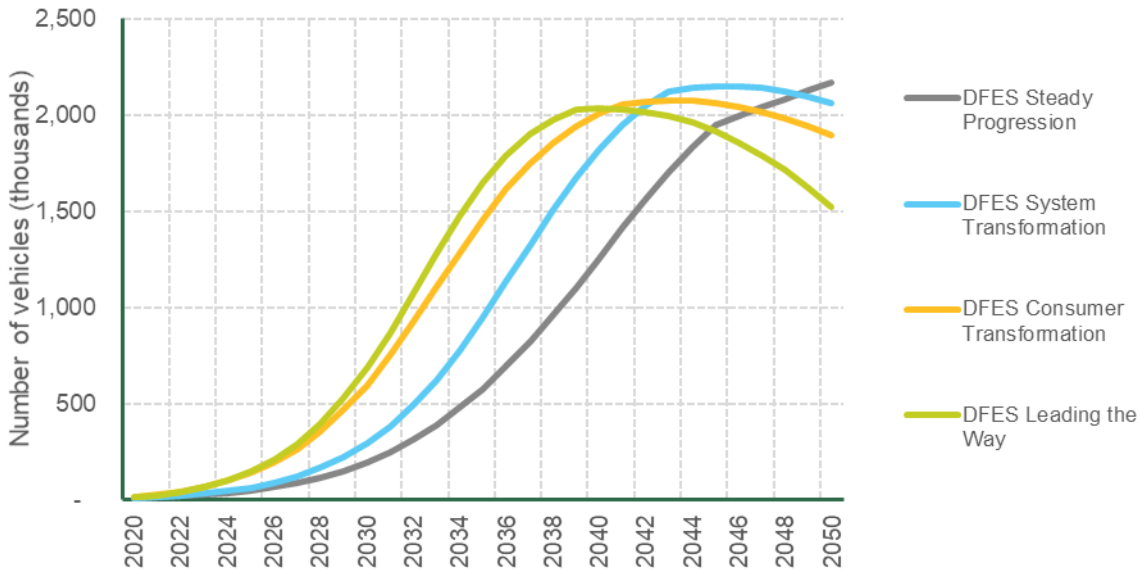
- Uptake of EVs is expected to increase between 2025 and 2035 across all scenarios.
- Steady Progression has the fewest estimated battery EVs in 2035, with nearly 0.6 million. Leading the Way has the most, with nearly 1.7 million battery EVs by 2035.
- EV uptake begins to slow in the mid-2030s as EV adoption approaches saturation and only the hardest-to-electrify vehicles, such as HGVs, remain as fuelled by petrol or diesel.
- Other factors are assumed to 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 2.1 million.
- In Leading the Way and Consumer Transformation, the number of EVs reduces from the late 2030s and mid 2040s respectively. This results from high levels of societal change resulting in high use of AVs, public and active travel, which results in many homes opting to have fewer cars, or no car at all.
- In Leading the Way, the number of battery EVs and total vehicles reduces substantially, peaking at c.2 million before reducing to 1.5 million in 2050.

Figure 10

Battery electric vehicles by scenario



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'.

- Interim assumptions have been made as to the uptake of 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:

- 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 under all net zero compliant scenarios uptake is assumed to be ubiquitous. This means that almost all consumers are assumed to have the same likelihood of adopting an electric vehicle.
- The overall level of households with two or more cars is higher in the South West licence area than the average in England, 41% compared to 35%. These households are assumed to be more likely to adopt an electric vehicle in the near term.

Relevant assumptions from National Grid FES 2020:

Assumption number	4.1.3
Steady Progression	Steady Progression assumes autonomous vehicles will be privately owned. In this scenario, this increases average miles travelled, as they can make longer commutes less effort or run errands during the working day.
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.

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.

Stakeholder feedback from the consultation events

References:

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

Electric vehicle chargers in the South West 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 South West licence area:

Number of EV chargers (thousands)		Baseline	2025	2030	2035	2040	2045	2050
Domestic off-street EV chargers	Steady Progression	5	29	101	281	569	805	816
	System Transformation	5	36	142	426	762	851	851
	Consumer Transformation	5	90	335	726	869	869	869
	Leading the Way	5	91	369	791	891	891	891
Non-domestic EV chargers	Steady Progression	2	3	8	22	46	70	77
	System Transformation	2	4	12	38	72	86	90
	Consumer Transformation	2	7	21	48	70	77	80
	Leading the Way	2	8	25	60	75	78	80

Summary:

- At present, the installation of public EV chargers in the South West licence area is below the GB average for the number of EVs in the licence area, though 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 and reconciled to the FES 2020 where possible.

Results and assumptions:

Baseline

- There are a total of 705 public EV chargers in the South West licence area
- It is estimated that there are around 5,000 domestic EV chargers in the South West licence area.

Near term (2020 – 2025)

- Across all scenarios the uptake of EV chargers is expected to increase dramatically in the near term.
- It is projected that by 2025, there could be between 29,000 domestic off street chargers in Steady Progression and 91,000 in Leading the Way.
- In addition, it is projected that by 2025, there could be between 48 MW of non-domestic off street chargers in Steady Progression and 118 MW in Leading the Way.

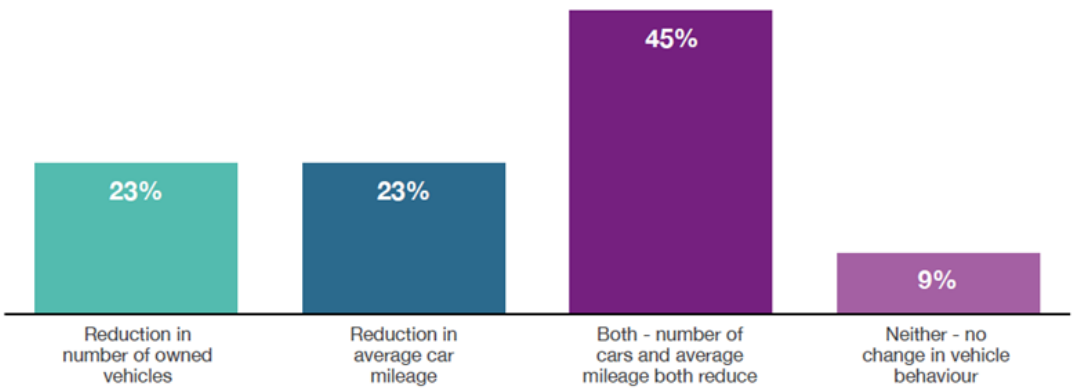
Medium term (2025 – 2035)

- 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 0.3 million domestic EV chargers and approaching 0.4 GW of non-domestic capacity. Leading the Way has the highest capacity, with nearly 0.8 million domestic EV chargers and 1 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 then reduces 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 between 2040 and 2050.
- A reduction in car mileage and numbers of vehicles was supported by stakeholders during the engagement events, as shown in Figure 11.
- The uptake of EVs and EV chargers continues to increase in Steady Progression, right up until 2050 when there are over 0.8 million domestic EV chargers.
- In Leading the Way and Consumer Transformation, the number of domestic EV chargers is static from the late 2030s and mid 2040s respectively.

Figure 11 – Stakeholder responses regarding future changes in vehicle owner behaviour

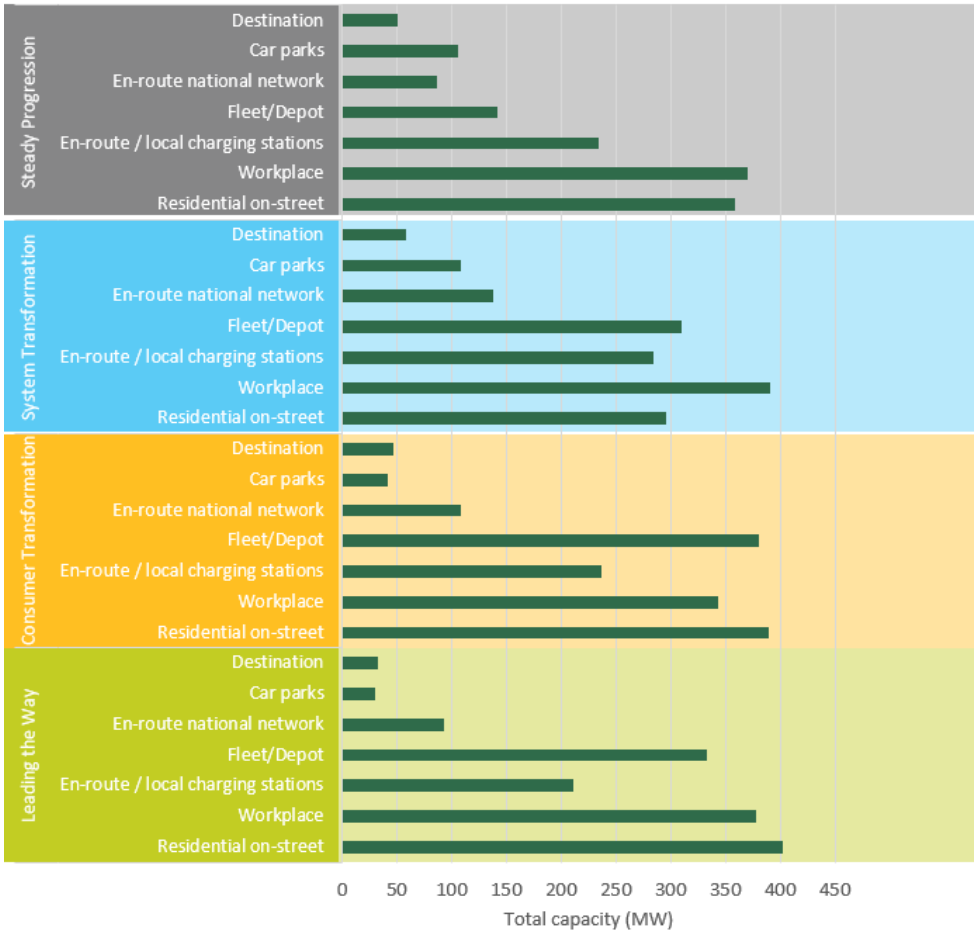


Reconciliation with National Grid FES 2020:

- The FES 2020 results do not provide sufficient breakdown of information to reconcile the EV charger information within the DFES with national projections.
- In order 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 12

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 and second car ownership as 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.

Air conditioning in the South West licence area

Summary of modelling assumptions and results.

Technology specification:

Number of domestic air conditioning units.

Data summary for air conditioning uptake in the South West licence area:

Per cent of homes (%)	Baseline	2025	2030	2035	2040	2045	2050
Steady Progression	1.1	2.2	4.4	8.7	17.2	34.1	67.3
System Transformation	1.1	2.0	3.6	6.4	11.6	20.7	37.0
Consumer Transformation	1.1	2.0	3.6	6.4	11.6	20.7	37.0
Leading the Way	1.1	1.1	1.1	1.1	1.2	1.2	1.2

Summary:

- Air conditioning has limited uptake in GB 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 c.1,500,000 homes in the South West licence area which is projected to increase to c.1,800,000 by 2050.
- Uptake of air conditioning is likely to be focused in urban areas, such as Bristol, with warmer 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.[1]
- Due to the lack of data on current installation rates of air conditioning, national data from FES 2020 has been used as a benchmark. In FES 2020, 1.1% of homes in GB have air conditioning installed in 2019, applied uniformly to this licence area, there are 16,000 homes with air conditioning in the South West. To create the baseline, FES 2020 data has been distributed pro rata to the licence area based on the number of homes.
- The analysis for this section is limited to domestic air conditioning.

[1] https://www.jraia.or.jp/english/World_AC_Demand.pdf

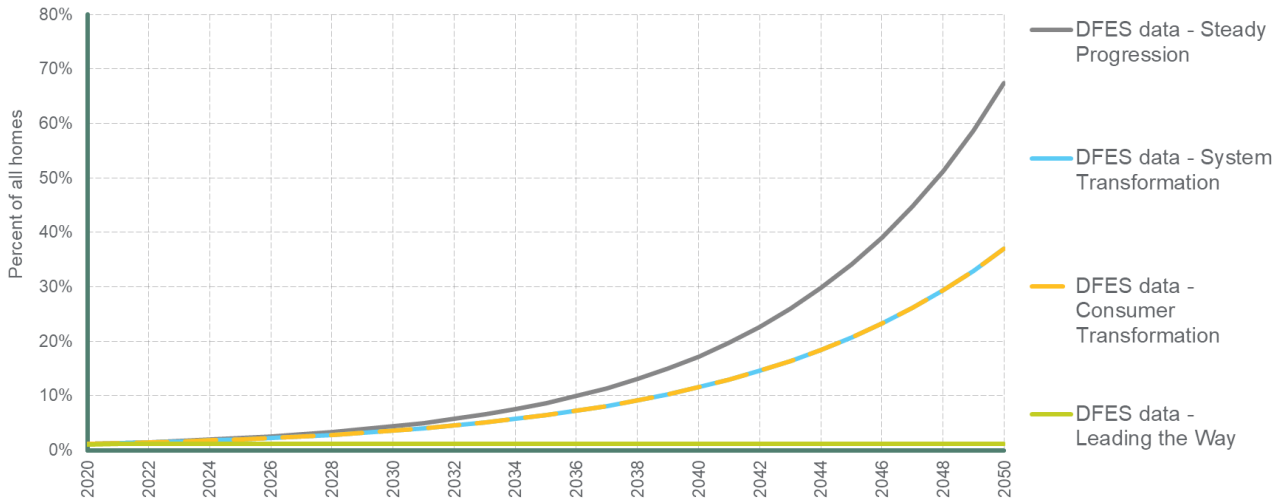
Projections (2020 – 2050)

- 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 because 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 GB homes, due to higher increasing temperatures and limited regulation to avoid active cooling measures in this scenario.
- From a baseline of 16,000 homes (1.1%) in 2019, 70,000 homes in Steady Progression have air conditioning by 2030, and 1,200,000 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 uptake as society is assumed to adopt a mix of different actions to maintain comfort levels. In these scenarios 60,000 homes have air conditioning by 2030, and 660,000 by 2050.

Figure 13

Percent of homes with air conditioning by scenario

DFES projections for the South West 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 South West licence area has above average levels of affluence (22.6% in social grade A or B compared to 20.3% in GB) and home ownership (66.0% compared to 64.3% in GB) as well as being warmer on average. This results in a higher DFES projection of 67.3% of homes with air conditioning installed by 2050.

Factors that will affect deployment at a local level:

- The spatial distribution of air conditioning units in the South West 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 South West 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 South West licence area:

Installed capacity (MW)	Baseline	2025	2030	2035	2040	2045	2050
Steady Progression	337	339	361	371	398	467	488
System Transformation	337	344	394	433	536	612	638
Consumer Transformation	337	407	523	809	1,126	1,419	1,719
Leading the Way	337	387	448	653	863	1,031	1,226

Summary:

- Relatively high wind speeds in the South West licence area contributed to earlier deployment than other WPD areas, though the average wind farm capacity is lower. Improvements in the technology since the early deployments in this licence area have increased the size and efficiency of new turbines.
- A limited pipeline of new sites contributes to relatively low deployment in the near term; however, resource availability and the scenario-specific assumption of a positive planning environment contribute to strong capacity growth in the medium and long term under Consumer Transformation and Leading the Way.

Results and assumptions:

Baseline

- There is a total of 337 MW of onshore wind connected in the South West licence area.
- There were high levels of deployment from 2012 to 2016 following the availability of government subsidies.
- Since 2016, deployment has stalled, due to restrictive national government planning policy and subsidy cuts, with only 5 MW connecting since 2018.

Near term (2020 – 2025)

- There are four pipeline sites with an accepted network connection offer which may connect in the near term in the South West licence area under a high deployment scenario.
- One of the pipeline sites is a community energy development in Bristol, plans for which were approved by councillors in July 2020, at a capacity of 4.2 MW.
- There are two 20 MW pipeline sites in Cornwall, an area which has seen significant deployment to date, one of which has been awarded planning permission. These sites are projected to connect between 2025 and 2031 in Consumer Transformation and Leading the Way.
- 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)

- System Transformation and Steady Progression continue to see very low deployment in the medium term.
- According to stakeholder feedback, a more supportive planning environment for onshore wind would unlock areas with high windspeeds for development in England. This is shown in the high deployment scenarios.
- Following an extended period of low capacity growth there is a high level of deployment in the best wind resource areas in both Leading the Way and Consumer Transformation, in the medium term.
- Feedback from consultation events suggests that although renewed subsidy support through the Contract for Difference scheme would be welcome, obtaining financial support is likely to be extremely competitive. As a result, developers are primarily seeking to develop larger sites in high windspeed areas that can operate profitably without subsidies.

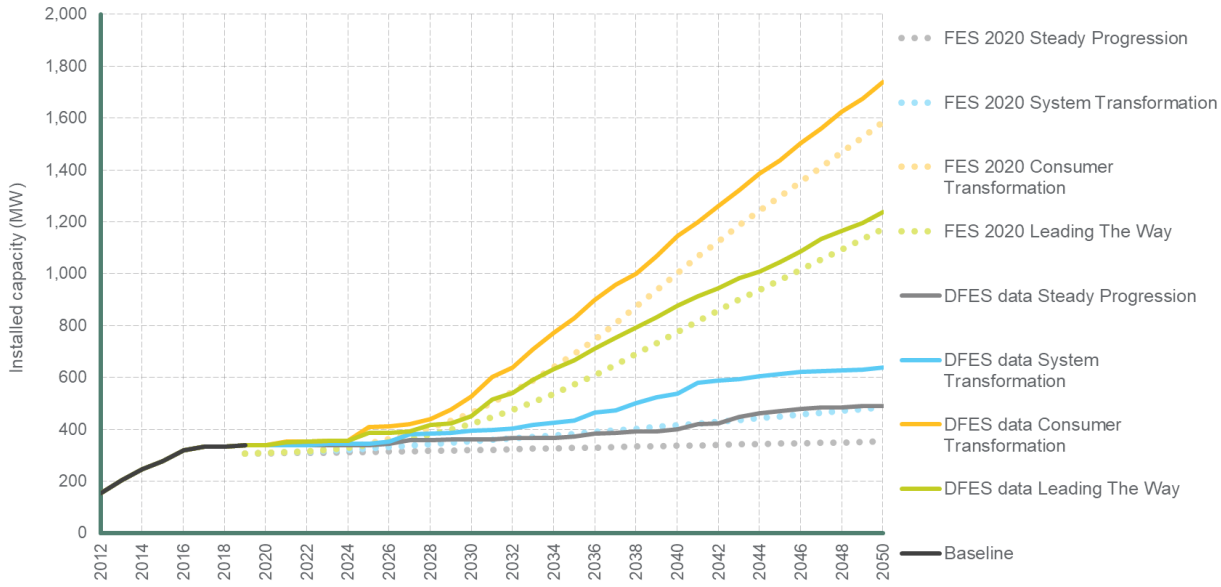
Long term (2035 – 2050)

- Due to technological improvements since the early deployment of onshore wind in the South West licence area, there are many sites which may seek to repower at the end of their operational life and at the same time have the opportunity to significantly increase capacity.
- There are 38 large scale sites currently in the baseline which will come to the end of their operational life before 2050. An assumption has been made that in the net zero compliant scenarios, these wind sites repower earlier with greater increases in capacity. The project life 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 14

Onshore wind capacity by scenario

Comparison to FES 2020 GSP data for the South West licence area



Reconciliation with National Grid FES 2020:

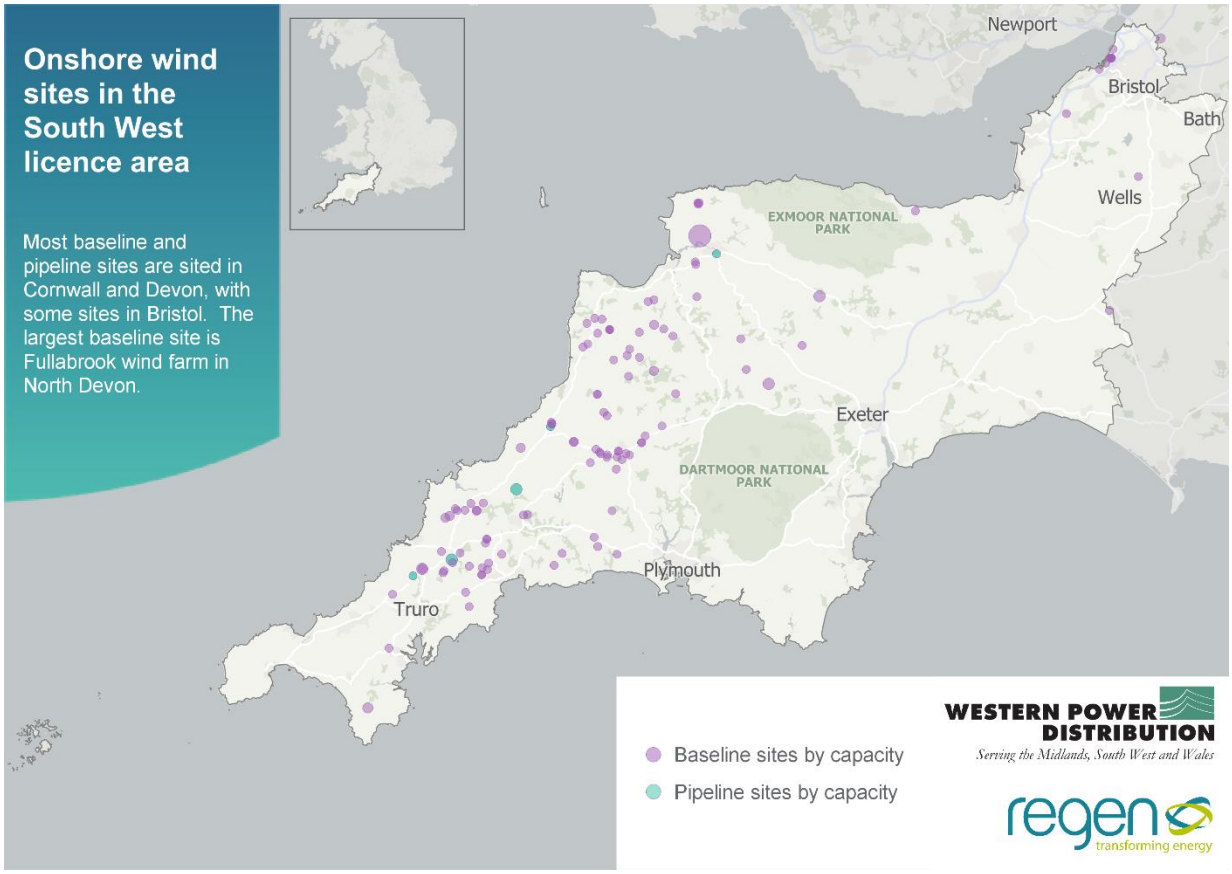
Results in this section relate to the FES 2020 data as reported for Building Block ID numbers Gen_BB015 and Gen_BB016.

- The WPD DFES projections are above those in FES 2020 under Consumer Transformation, reflecting the potential for community-led schemes and the high available wind resource.
- WPD DFES assumptions about the large potential for additional capacity from repowering in this licence area means that all DFES projections are above 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 pipeline sites, which show a similar distribution to the current baseline sites along the northern parts of Cornwall and Devon, and around Avonmouth.
- The other local factors used are:
    - 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 Cornwall Renewable Planning Guidance policies, or policy D3 and D4 in the Sedgemoor District local plan.

Figure 15



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 South West licence area

Summary of modelling assumptions and results.

Technology specification:

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

Data summary for ground mounted solar PV in the South West licence area:

Installed capacity (MW)	Baseline	2025	2030	2035	2040	2045	2050
Steady Progression	1,025	1,075	1,155	1,422	1,560	1,710	1,874
System Transformation	1,025	1,190	1,490	2,109	2,434	2,889	3,345
Consumer Transformation	1,025	1,190	1,490	2,109	2,434	2,889	3,345
Leading the Way	1,025	1,422	1,922	2,974	3,477	4,077	4,651

Summary:

- Developers of ground mounted solar identified the South West licence area as an attractive area for development due to the high irradiance levels. Such high numbers of projects connected to the distribution network that new projects faced new network constraints.
- The pipeline of new projects under development is now significant, although it is the smallest of the four WPD licence areas. Deployment could increase from a baseline of 1 GW up to 4.6 GW by 2050 in a Leading the Way scenario.

Results and assumptions:

Baseline

- The South West licence area was at the forefront of the boom in ground mounted solar PV between 2012 and 2015 and has over 1 GW of projects installed. Developers were attracted by higher than average irradiance and availability of suitable land close to the electricity network and outside of environmental designations and high agricultural land areas.
- With the ending of public subsidies deployment slowed dramatically, just one site has been energised since January 2019, an 8.8 MW project in Dorset.

Near term (2020 – 2025)

- Since 2018 a large pipeline of ground mounted solar PV projects has secured network connections across the UK, as technology costs have fallen and interest from investors in 'subsidy-free' business models has grown.
- The pipeline projects are typically very large 50 MW projects due to the economies of scale required to successfully deploy subsidy-free wind. Though the focus of developers has moved to the Midlands where there is greater availability of grid capacity and land suitable for the larger projects, there are over 500 MW of projects with an accepted network connection in the South West licence area.

- Engagement with stakeholders indicates that the COVID-19 pandemic has put back the date at which pipeline projects could be built. Developers and investors currently expect projects to begin to be built in 2022. The speed at which the pipeline is built is the key assumption in the scenarios.

Medium term (2025 – 2035)

- The South West licence area is assumed to remain attractive to ground mounted solar developers due to the relatively high irradiance, provided network constraints are addressed.
- The availability of land for the larger projects favoured by developers will be a constraint, however less than 1% of technically developable land for ground mounted solar PV in the licence area has so far been developed.
- All the net zero compliant scenarios see continued deployment, although at a slower rate than in the peak years of 2012-2015. In a Steady Progression scenario, it could take until 2035 for the current pipeline to be built out as the investment case would remain challenging.

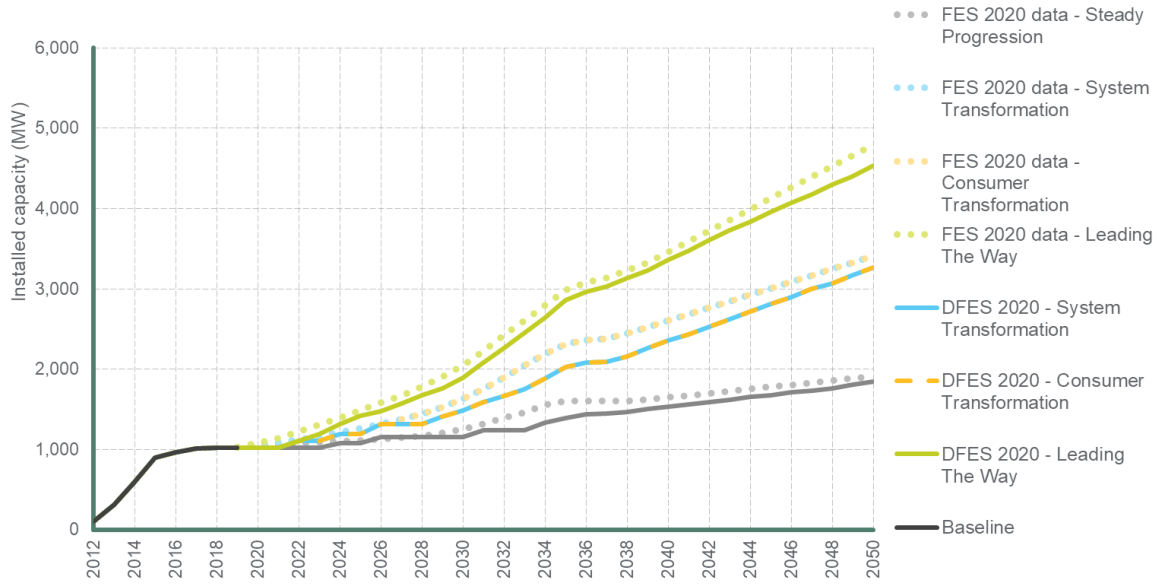
Long term (2035 – 2050)

- The development of ground mounted solar PV could be limited by the relatively low demand for power during summer daytime.
- As the amount of solar installed increases, price cannibalisation (low electricity prices) during peak solar periods is a key concern for investors in the long term. Without a guaranteed price for the power generated, sites may invest in co-location with storage or using surplus power to produce hydrogen to maximise value.
- In Leading the Way there is 4.5 GW of ground mounted solar PV installed in the South West licence area by 2050, as this technology becomes a key part of the GB energy mix.

Figure 16

Ground mounted solar capacity by scenario

Comparison to FES 2020 GSP data summated for the South West licence area



Reconciliation with National Grid FES 2020:

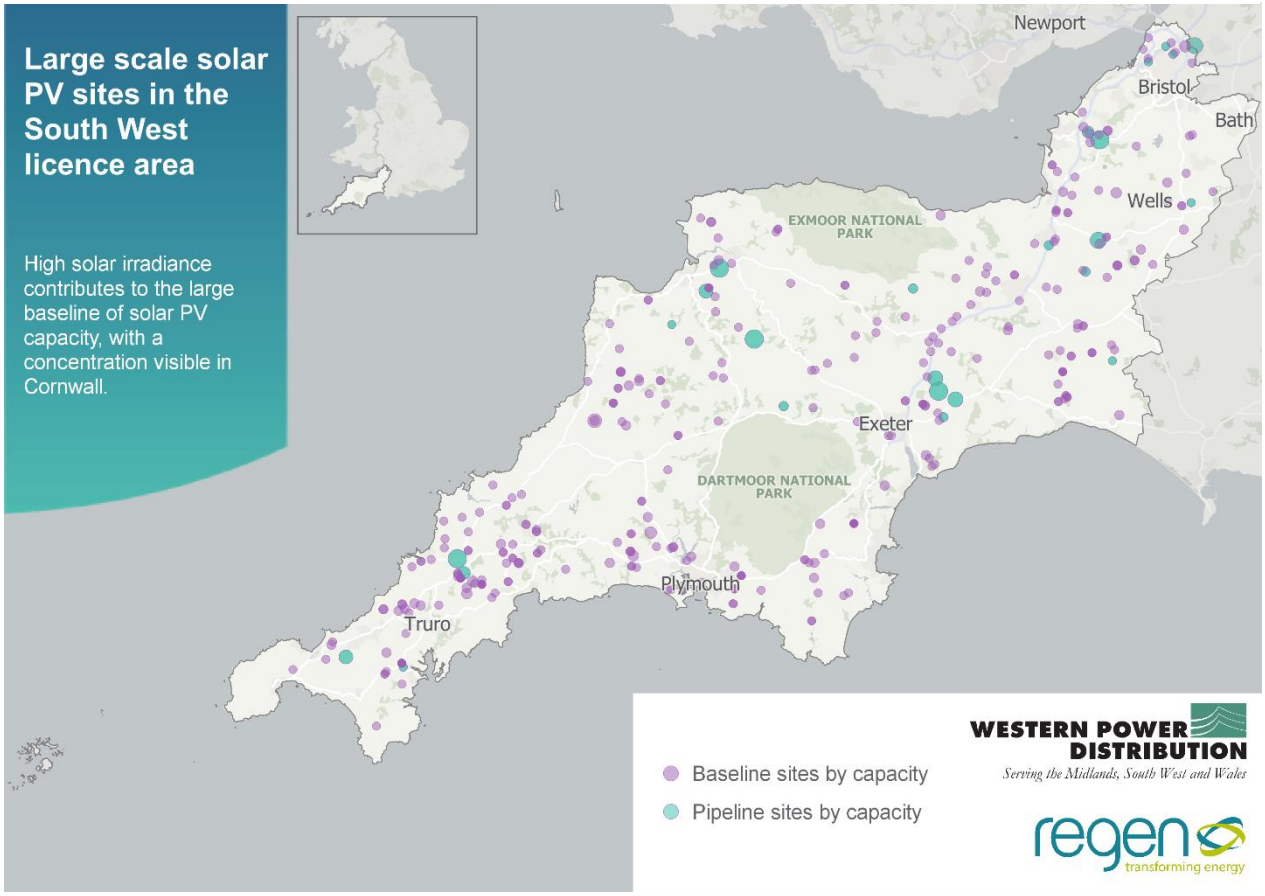
Results in this section relate to the FES 2020 data as reported for Building Block ID number Gen_BB012, Solar Generation - Large (G99).

- 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 in the South West licence area. WPD DFES 2020, therefore, shows the first new projects being energised later than FES 2020 GSP data.
- There is less ground mounted solar PV capacity in WPD DFES 2020 in this licence area than FES 2020 due to the relatively small pipeline of projects that have obtained network connections.

Factors that will affect deployment at a local level:

- The spatial distribution of new ground mounted solar PV in the South West 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 used 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
- Consultation with stakeholders showed that all of the local authorities in the South West licence area have declared a climate emergency and that this leading to positive policies in local planning policies, for example the Cornwall Renewable Planning guidance, which will be replaced by a Climate Change Development Plan Document. Local policies identified by stakeholders are included as weightings within the spatial distribution.

Figure 17



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 high deployment of large solar.
Consumer Transformation	Transition to net zero results in high 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 South West 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 (<1 MW) in the South West licence area:

Installed capacity (MW)	Baseline	2025	2030	2035	2040	2045	2050
Steady Progression	476	518	593	692	796	894	988
System Transformation	476	583	857	1,151	1,422	1,651	1,826
Consumer Transformation	476	722	1,299	1,964	2,638	3,284	3,849
Leading the Way	476	590	878	1,201	1,492	1,741	1,933

Summary:

- There is currently 476 MW of small scale solar PV in the South West, 64% of installations are at the domestic scale, with an average capacity of 3.3 kW.
- 43% homes in the South West host rooftop solar PV by 2050 in Consumer Transformation, the highest capacity growth scenario. This is alongside widespread adoption of electric cars and electric domestic heating provided by heat pumps.

Results and assumptions:

Baseline

- The South West licence area currently has 77,000 domestic solar PV installations, representing 5.2% of homes, the highest in WPD's four network areas.
- 5,000 commercial properties currently have a solar PV array, with an average capacity of 45 kW.
- The vast majority of existing capacity has been commissioned since 2011 in line with government support via the feed-in-tariff, with deployment slowing significantly since 2015 following a reduction in the subsidy rate.

Near term (2020 – 2025)

- There is very low deployment in the early 2020s due to the challenging business case for smaller scale solar, as well as construction delays due to COVID-19. This was reflected in stakeholder feedback.
- There is a pipeline of 38 commercial solar sites totalling 3 MW that have accepted a grid connection offer, which are projected to connect between 2021 and 2023.
- New build homes are modelled separately. Stakeholder feedback from the consultation events suggested that the current rate of rooftop solar PV deployment on new domestic development is between 5% - 10%. This provides the baseline in the modelling.

Medium term (2025 – 2035)

- Deployment is projected to accelerate from 2025 onwards in the net zero compliant scenarios as the cost of solar panels continue to decrease. This is combined with increasing financial viability due a combination of the Smart Export Guarantee, high uptake of electric vehicles and in combination with domestic batteries and heat pumps.
- Social housing is assumed to have higher rates of solar PV installation as Housing Associations invest for the benefit of their tenants. This assumption is based on analysis of the baseline uptake by housing type.
- The medium term capacity increase follows the same trajectory as FES 2020 for the South West licence area and capacity increases to just under 2 GW by 2035 in Consumer Transformation, and just under 700 MW in Steady Progression.

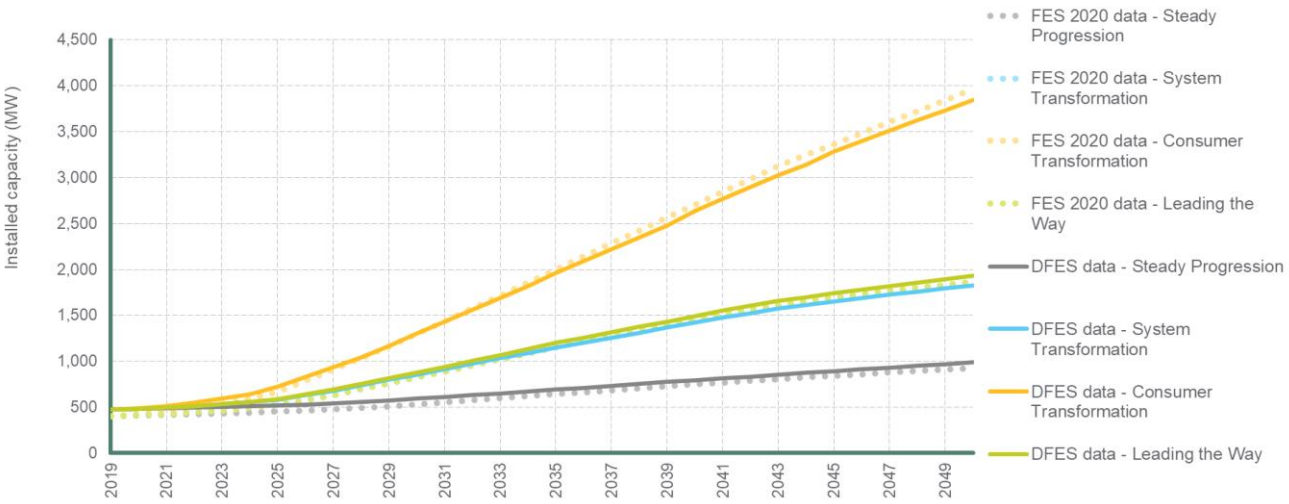
Long term (2035 – 2050)

- The installation rate of small scale solar PV is projected to begin to slow in the long term as the most suitable homes and commercial properties are already fitted with solar PV.
- Over 40% of homes have with rooftop PV by 2050 in Consumer Transformation, and around 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 and new developments in the South West licence area.
- The number of commercial properties with PV installed goes up from 5,000 in 2020 to 31,000 in Consumer Transformation, 15,000 in Leading the Way and System Transformation, and 9,000 in Steady Progression by 2050.

Figure 18

Solar (sub 1 MW) capacity by scenario

Comparison to FES 2020 GSP data for the South West 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.

- Deployment of small scale solar PV in the WPD DFES 2020 is broadly in line with the FES 2020 projections.
- The South West licence area has above average levels of affluence (22.6% in social grade A and B compared to 20.3% in GB) and home ownership (66.1% compared to 64.3% in GB) which drive uptake, but below average levels of social housing which is also a key factor (11.7% compared to 15.7% in GB). This results in a capacity projection that broadly matches FES 2020, with a total of 3.8 GW in 2050 in the Consumer Transformation scenario, or 770,000 domestic PV arrays and 30,000 commercial units.

Factors that will affect deployment at a local level:

- The spatial distribution of new small scale solar PV in the South West 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, uptake is weighted towards affluent areas and social housing where solar is installed by housing associations and becomes more spread across all affluence levels towards 2050, especially in Leading the Way and Consumer Transformation.
- Approximately 300,000 new homes are projected to be built in the South West between now and 2050. In Consumer Transformation (the highest deployment scenario), 45% of the new build homes have a total of 500 MW of rooftop solar capacity installed by 2050, a fifth of the total domestic projection. Cornwall, the largest local authority district in the South West licence area, has the highest number of installations in new builds (21,000).

Relevant assumptions from National Grid FES 2020:

Assumption number	4.1.5 'Solar generation (plant smaller than 1 MW)'
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 South West 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. Excludes pumped hydro storage.

Data summary for hydropower in the South West licence area:

Installed capacity (MW)	Baseline	2025	2030	2035	2040	2045	2050
Steady Progression	12.6	12.6	12.7	12.7	12.7	12.7	12.7
System Transformation	12.6	12.6	12.7	12.7	13.3	13.3	13.3
Consumer Transformation	12.6	12.6	13.6	15.0	16.9	18.0	18.1
Leading the Way	12.6	12.6	13.1	14.5	14.9	15.0	15.1

Summary:

- The South West licence area saw early deployment of hydropower sites, with sites being installed since the 1930s at reservoirs on Dartmoor. There was a rise in capacity again in the 2010s with the introduction of government support.
- Consultation with stakeholders suggests low deployment in the near term under all scenarios. Under a Consumer Transformation scenario, an additional 6 MW are installed by 2050, a 50% increase on current installed capacity.

Results and assumptions:

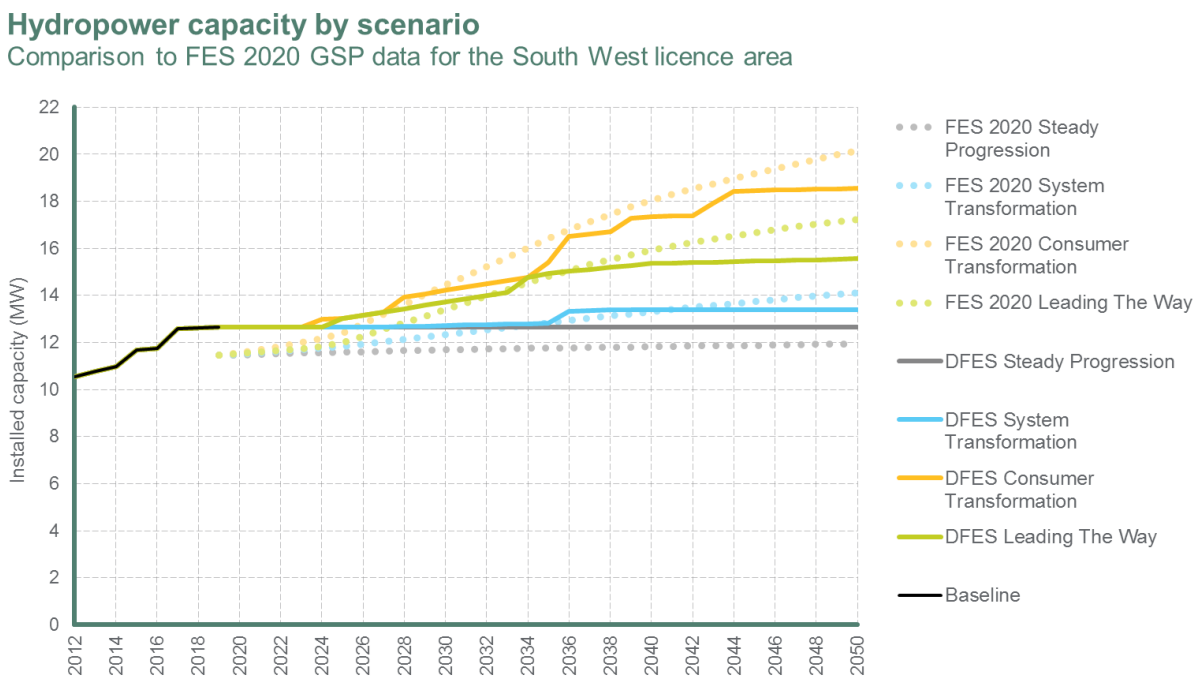
Baseline

- There is 12.6 MW of installed hydropower schemes operational in the South West licence area. The largest is the site at Mary Tavy at a capacity of 2.6 MW.
- Many reservoirs, particularly on Dartmoor, have hydropower installed and at a larger capacity than typical run-of-the-river hydropower schemes.

Projections

- There is no large scale deployment expected in the near term, although there is potential for a community energy site which is at an early stage of development in Bristol.
- New deployment is delayed until the medium and long term, and only takes place in the Consumer Transformation and Leading the Way scenarios. 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 19



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 WPD DFES baseline capacity is made up from a combination of WPD connection agreement data, feed in tariff, and renewable obligation registration data. The WPD DFES baseline for hydropower is slightly higher than the FES 2020 baseline at licence area level.
- The WPD DFES projections in the near term are significantly below those in FES 2020 under all scenarios, reflecting feedback from industry consultation regarding the challenging business case for new hydropower projects. High upfront development costs mean that hydropower has only been deployed at significant scale in the South West either with the development of new reservoirs or when government subsidy was available.
- Consequently, though deployment increases slightly in the long term, the installed capacity remains below the FES 2020 projections out to 2050.

Factors that will affect deployment at a local level:

- The spread 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 pipeline site in Bristol.

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.

Geothermal power in the South West licence area

Summary of modelling assumptions and results.

Technology specification:

Geothermal power generation sites, which could be used in conjunction with low-carbon heat generation.

Data summary for geothermal power in the South West licence area:

Installed capacity (MW)	Baseline	2025	2030	2035	2040	2045	2050
Steady Progression	0	1	3	3	3	3	3
System Transformation	0	2	5	5	8	8	8
Consumer Transformation	0	11	16	27	27	32	32
Leading the Way	0	6	11	13	16	19	19

Summary:

- The South West has significant geothermal resource which could provide heat and power, however deployment has faced challenges and future capacity growth depends on the success of the pioneering developments at the Eden project and the United Downs geothermal power project, both in Cornwall.

Results and assumptions:

Baseline

- There are no sites in operation; however the United Downs power site is under active construction, with two wells completed in 2019.

Near term (2020 – 2025)

- The United Downs site is scheduled to be commissioned in 2021. The site has reported undertaking final testing over summer 2020 before power plant construction. As the results of this testing is uncertain, it is assumed to connect in 2021 in Consumer Transformation and Leading the Way, and in 2022 in System Transformation and Steady Progression at a lower capacity.
- The Eden Project in Cornwall is aiming to develop a 3-4 MW geothermal electricity power generation site. The purpose of this development is to heat and power the tourist site, and to export power onto the distribution network. Depending on successful results from the initial drilling, this site could connect as early as 2023 in a Consumer Transformation scenario. It connects in all scenarios but is projected to be delayed in System Transformation and Steady Progression, and at a lower capacity.

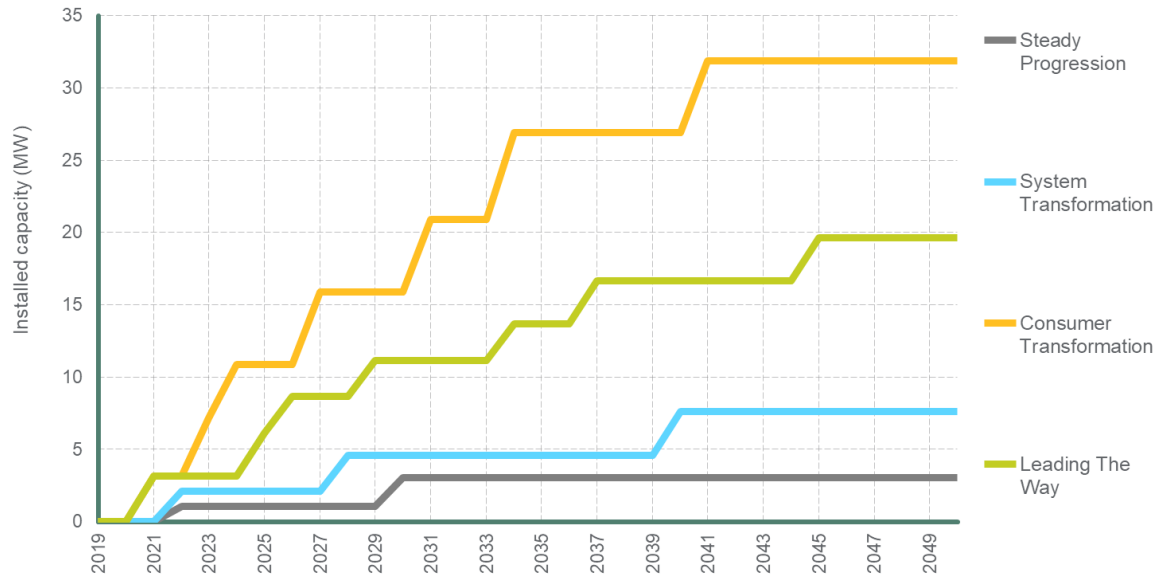
Medium to long term (2025 – 2050)

- The potential success of the pilot sites could lead the way for further developments out to 2050, with four additional sites projected for Consumer Transformation and Leading the Way. A single additional site is assumed to connect in System Transformation, reflecting the difficulties of securing funding in this scenario for less proven distributed technologies.
- If the pilot projects are found to be costly or inefficient, there is likely to be limited further deployment. No new sites other than the sites currently under consideration are projected in a Steady Progression scenario.
- The total generating power can be uncertain before full drilling operations are completed. Based on discussion with industry, it has been assumed that under Consumer Transformation each new site will have 5 MW anticipated capacity at other potential sites in the South West. Under Leading the Way the medium and long term sites are assumed to be developed to a lower generating capacity.

Figure 20

Geothermal capacity by scenario

For the South West licence area



Reconciliation with National Grid FES 2020:

There is no geothermal distributed connected capacity in the FES 2020 data in the WPD licence areas and building block ID number Gen_BB019.

- As there are is no capacity projected in FES 2020 for geothermal power generation in this licence area, no direct comparison is made to FES 2020 results.
- Due to the existing site under construction, discussion with industry about the potential pipeline sites, and the resource in the South West licence areas, a significant potential increase in capacity has been projected under a Consumer Transformation scenario. There is wide divergence between the WPD DFES 2020 scenario projections, reflecting the uncertainty about whether the pilot projects will spark wider deployment in the region.

Factors that will affect deployment at a local level:

- The location of geothermal sites is highly dependent on the geology and is therefore assumed to only be developed in Cornwall, where there is granite bedrock. The location of the United Downs pilot project was chosen for the available heat resource, as well as the proximity to the electricity network and road access.
- Though there is potential heat resource on Dartmoor, this national park has been excluded to reflect the lack of network and road coverage, and potential planning barriers.

References:

WPD connection offer data, the Renewable Energy Planning Database, Regen consultation with local stakeholders and discussion with geothermal developers.

Marine and offshore (floating) wind in the South West England licence area

Summary of modelling assumptions and results.

Technology specification:

Small scale demonstration and early stage marine energy development projects.

- Wave energy – typically small array and demonstration projects
- Tidal stream energy– harnessing kinetic tidal flows around headlands
- Offshore floating wind – Floating demonstration projects ahead of full commercial scale developments.

Data summary for marine energy in the South West licence area:

Installed power capacity (MW)		Baseline	2025	2030	2035	2040	2045	2050
Wave Energy	Steady Progression	0	0	0	0	0	0	0
	System Transformation	0	0	5	10	20	50	50
	Consumer Transformation	0	0	20	50	100	100	100
	Leading the Way	0	0	20	50	100	100	100
Tidal Stream Energy	Steady Progression	0	0	0	0	0	0	0
	System Transformation	0	0	0	5	5	5	5
	Consumer Transformation	0	0	5	10	15	15	15
	Leading the Way	0	0	5	10	15	15	15
Offshore Wind (inc. Floating)	Steady Progression	0	0	0	0	0	0	0
	System Transformation	0	0	20	20	20	20	20
	Consumer Transformation	0	30	30	60	60	60	60
	Leading the Way	0	30	30	60	60	60	60

Summary:

- The sea around the South West of England has been identified by the UK government and by regional bodies as a key strategic area for the development of offshore energy resources including wave energy, tidal stream, tidal range and offshore wind.
- Withdrawal of subsidy support for wave and tidal energy in 2016 has affected industry confidence and has led to the withdrawal and delay of pre-commercial projects. This has particularly affected wave energy demonstration projects that were previously expected to connect to the distribution network at Hayle.
- Recently, developer attention has switched to floating wind where the South West of England is working closely with South Wales to develop potential sites in the Celtic Sea, with further potential in the West of the Isles of Scilly, and South of the Lizard, as shown in Figure 22.
- No new distribution connected marine energy is assumed to be deployed in Steady Progression.

Results and assumptions:

Baseline

- There are no baseline marine energy or offshore wind projects connected to the WPD network in the South West, however, the testing facility at Wave Hub does have a network connection agreement, and infrastructure in place.
- Withdrawal of subsidy support for wave and tidal energy in 2016 has affected pre-commercial projects. The previously identified wave energy projects that planned to connect to the Wave Hub, and the Hayle sub-station, have been withdrawn.
- Previously identified tidal stream projects that would have connected to the WPD network in North Devon have also been withdrawn and the tidal demonstration zone has been removed.

Near term (2020 – 2025)

- There are no pipeline sites in this licence area with an accepted network connection offer.
- In the near term, wave and tidal energy is expected to continue to focus on technology development with non-grid connected prototype deployments.
- Wave Hub is also now focused on the development of floating wind and has received government backing to support floating wind deployments. In Leading the Way and Consumer Transformation, Wave Hub demonstration scale (30 MW) floating wind projects are projected to connect by 2025.
- With the withdrawal of the North Devon Demonstration Zone no tidal stream projects are expected to connect to the distribution network by 2025. However, non-grid connected testing of wave and tidal devices will continue at test sites.

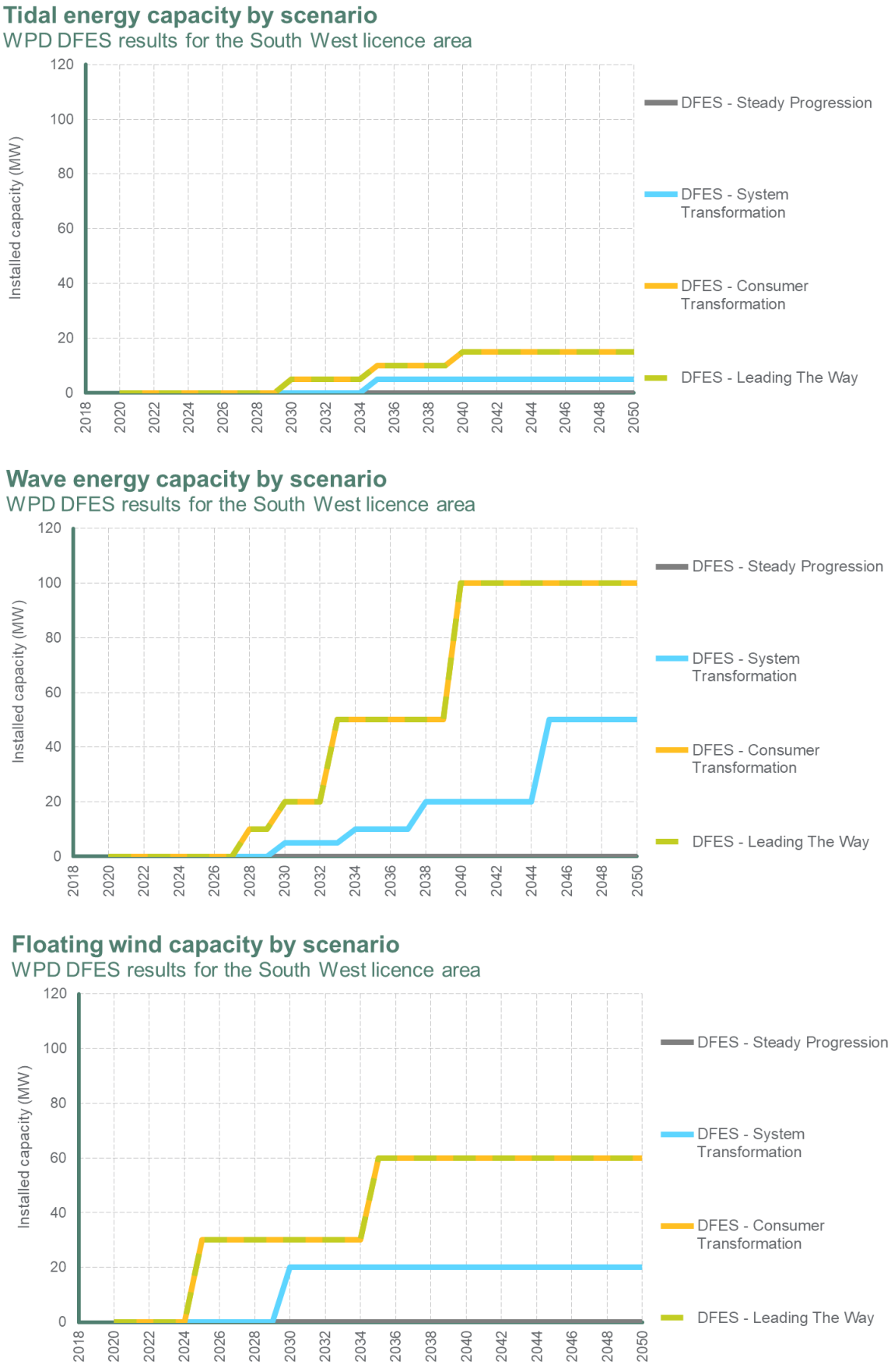
Medium term (2025 – 2035)

- UK government is currently consulting on how the Contract for Difference mechanism could be tailored to support marine energy and the potential for further support through capital grants and the use of innovative PPAs.
- In Leading the Way and Consumer Transformation, with higher levels of UK government and regional support, pre-commercial scale wave energy sites connect in the South West licence area.
- In addition to the Wave Hub site, further small scale floating wind projects of circa 10-30 MW may are also projected to connect in the areas around West Cornwall, Isles of Scilly and possibly south of Plymouth in the net zero compliant scenarios.
- Major floating wind projects could be developed in the medium term under favourable conditions but have been assumed to connect to the transmission network.

Long term (2035 – 2050)

- Although the commercial viability of marine energy technology remains unproven, in Leading the Way and Consumer Transformation, wave and tidal energy projects are assumed to prove successful in testing and are deployed in the Celtic Sea and in the Bristol Channel.
- The potential for tidal stream energy will be limited by resource and suitable locations, and will likely consist of smaller projects connected to the distribution network.
- If wave energy technology develops beyond c.30 MW pre-commercial scale sites, it is assumed that these would connect to the transmission network.
- Some wave and tidal projects have also been assumed in a System Transformation scenario but none in Steady Progression.
- Large scale offshore wind projects, including floating wind, are likely to be transmission connected.

Figure 21


Tidal energy capacity by scenario
WPD DFES results for the South West licence area
Installed capacity (MW)
0
20
40
60
80
100
120
2018
2020
2022
2024
2026
2028
2030
2032
2034
2036
2038
2040
2042
2044
2046
2048
2050
DFES - Steady Progression
DFES - System Transformation
DFES - Consumer Transformation
DFES - Leading The Way
Wave energy capacity by scenario
WPD DFES results for the South West licence area
Installed capacity (MW)
DFES - Steady Progression
DFES - System Transformation
DFES - Consumer Transformation
DFES - Leading The Way
Floating wind capacity by scenario
WPD DFES results for the South West licence area
Installed capacity (MW)
DFES - Steady Progression
DFES - System Transformation
DFES - Consumer Transformation
DFES - Leading The Way

Reconciliation with National Grid FES 2020:

Wave and Tidal Energy

Results for wave and tidal energy relate to the FES 2020 data as reported for Building Block ID number Gen_BB017 (tidal stream, wave power and tidal lagoons).

- The WPD DFES 2020 are higher than FES 2020 projections; there is no wave and tidal energy in FES 2020 for the South West licence area.
- The only capacity in the south of England projected in FES 2020 is 126 MW, connected to the Oldbury GSP in South Gloucestershire by 2030 in the West Midlands licence area. It is not clear what marine technology this capacity represents. It is possible that this capacity represents the projected level of deployment across the entire South West and South Wales. This should be investigated with the ESO FES team.
- The WPD DFES 2020 includes a limited amount of distributed connected wave and tidal energy in a Leading the Way scenario to reflect the continued development and support for the industry in the South West.

Offshore and Floating Wind

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

- The WPD DFES 2020 projections for offshore and floating wind in the South West licence area is above FES 2020, which assumes no connections for this technology at distribution level.
- The WPD DFES results include a potential floating wind demonstration project at a repurposed Wave Hub, reflecting the current change in the Wave Hub strategy and potential sale to a wind farm developer

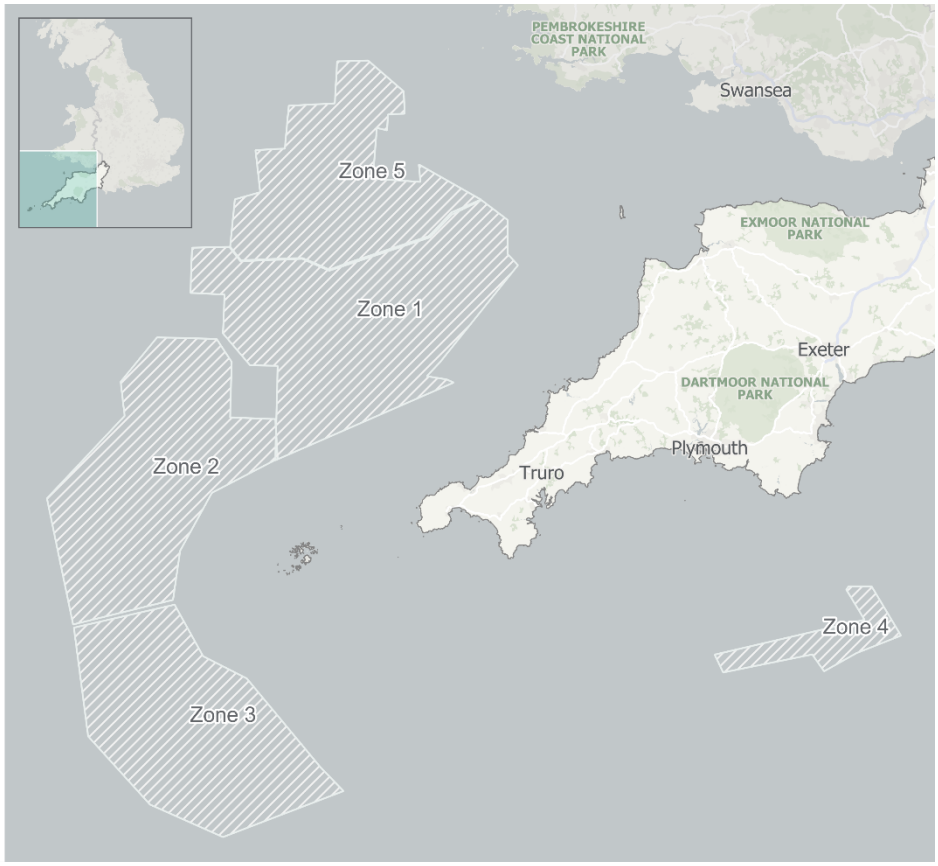
Factors that will affect deployment at a local level:

- The future of wave and tidal energy is uncertain, and it should be recognised that the industry is still in a period of technology development.
- The key assumption affecting the growth prospects of wave and tidal energy is the availability of UK government support both for technology development and for the first commercial projects. This is currently the subject of a consultation.
- Wave, tidal and floating wind projects will be highly dependent on the available energy resource, seabed depths and conditions, marine designations and impacts on other marine users, port availability and access to the distribution network or national grid.
- Previous studies have identified areas for development in the South West:
    - Wave energy off North Cornwall, Lizard and Isles of Scilly
    - Tidal energy off headlands of North Devon (near Lynmouth) and Bristol Channel
    - Floating offshore wind at locations in the Celtic Sea and to the West of Lundy, also potentially western approaches and south of Plymouth See Figure 22
- Port facilities exist at Falmouth, Plymouth, Bristol and North Devon, and likely onshore grid connections include the WPD sub-station at Hayle and Grid supply point at Alverdiscott. However, connection could be impacted by the potential development of interconnectors to Ireland and to France (via south west England).

Figure 22

Potential development zones for offshore floating wind

Courtesy of the Offshore Renewable Energy Catapult 2030 study.



Stakeholder input:

Marine energy and floating wind has been identified as a key energy and economic opportunity for the south west of England and Cornwall in particular. It features strongly in the Cornwall and Isles of Scilly LEP industrial strategy and net zero carbon planning. There is also strong interest from both Plymouth and Bristol city regions.

The Regen DFES team has undertaken direct discussion with floating wind and marine energy developers, the Wave Hub management team and has been part of the South West floating offshore wind and marine networks. Regen has also separately held discussion with the Crown Estate

Evidence to support the DFES has however been collated from a number of recent publications including

- Recent publicity regarding the award of funding for Wave Hub and proposals to repurpose the site for floating wind
- Celtic Sea resource assessment and constraint mapping.
- Cornwall and Isles of Scilly LEP draft Industrial Strategy
- Cornwall and Isles of Scilly Climate Change Action Plan

A direct discussion was held with the developers of the Erebus Floating Wind project.

References:

MEW, Erebus Floating Wind project, UK government Consultation on support for wave and tidal energy using Contracts for Difference (2020), Wave Hub, Cornwall and Isles of Scilly Draft Industrial Strategy, Cornwall and Isles of Scilly Climate Change Action Plan.

Renewable engines (landfill, sewage, biogas) in the South West 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 South West licence area:

Installed capacity (MW)	Baseline	2025	2030	2035	2040	2045	2050
Steady Progression	25	29	34	44	51	55	59
System Transformation	25	32	46	64	74	79	84
Consumer Transformation	25	34	57	84	99	105	111
Leading the Way	25	36	59	87	108	118	128

Summary:

- The South West licence area has 25 MW of AD capacity. It has 3.6% of the GB installed capacity in 2019, according to FES 2020.
- Further deployment of AD plants in the South West requires sufficient local feedstock either from agricultural or food waste. The licence area has a pipeline of two AD sites with a total of 3.8 MW, projected to connect between 2021 and 2023.
- To note that additional AD capacity would also be expected in the licence area that produce biomethane for use in transport or injection into the gas network rather than burnt for electrical capacity. This additional capacity is not covered in this analysis.

Results and assumptions:

Baseline

- There are 28 sites in the baseline with an average capacity of 0.9 MW. Most of the currently installed electrical AD capacity connected between 2012 and 2015, when projects benefitted from government subsidies.
- Only 3 MW of capacity has connected in the last five years reflecting the difficulty of developing a business case for AD without subsidy.

Near term

- The two pipeline sites in this licence area accepted their network connection offers in 2018 and 2019, both are projected to connect in all scenarios between 2021 and 2023.

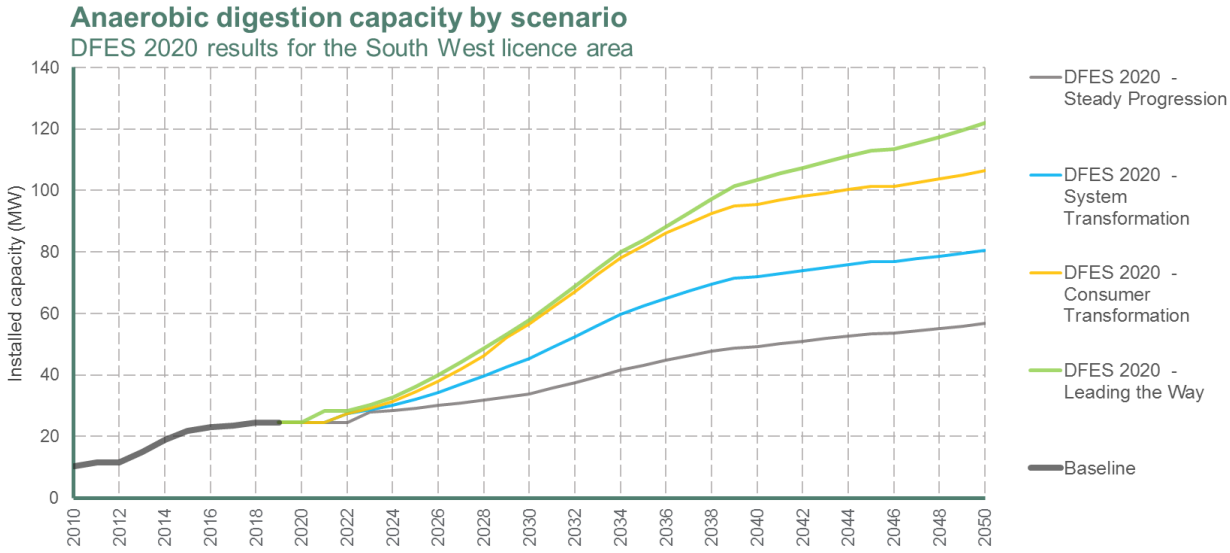
Medium term

- There is limited scope for continual increase in the availability of household food waste as a feedstock, as it is already collected in 64% of local authorities in this licence area.
- Increases in AD capacity are assumed to be driven by farm-based AD, particularly from the significant number of dairy farms in the South West.

Long term

- Further increases in AD capacity will be driven by cost reductions in the technology, potentially through modularisation, and high revenues that could be captured from AD plants providing flexible electricity supply and balancing services to networks. It is assumed that this would include capturing high electricity prices expected in periods of low renewable generation or high demand.
- However, deployment is expected to be lower 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 looks 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 23



Factors that will affect deployment at a local level:

- The location of all new capacity out to 2023 is based on the existing pipeline sites with an accepted grid connection offer. Outside of the pipeline period, 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 GB average
    - Local Authority food waste collection potential

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 South West licence area:

Installed capacity (MW)	Baseline	2025	2030	2035	2040	2045	2050
Steady Progression	41	45	45	45	45	45	45
System Transformation	41	42	42	36	36	27	16
Consumer Transformation	41	38	38	33	33	27	16
Leading the Way	41	42	33	33	27	16	8

Summary:

- Landfill gas capacity is expected to decline over time in all net zero compliant scenarios, as residual waste is either burnt or gasified, as opposed to buried.
- This is brought about by the decommissioning of baseline and pipeline sites with scenario specific assumptions made about the site lifetime.

Results and assumptions:

Baseline

- There are 21 sites connected to the distribution network in South West totalling 41 MW, with an average site size of 2 MW.

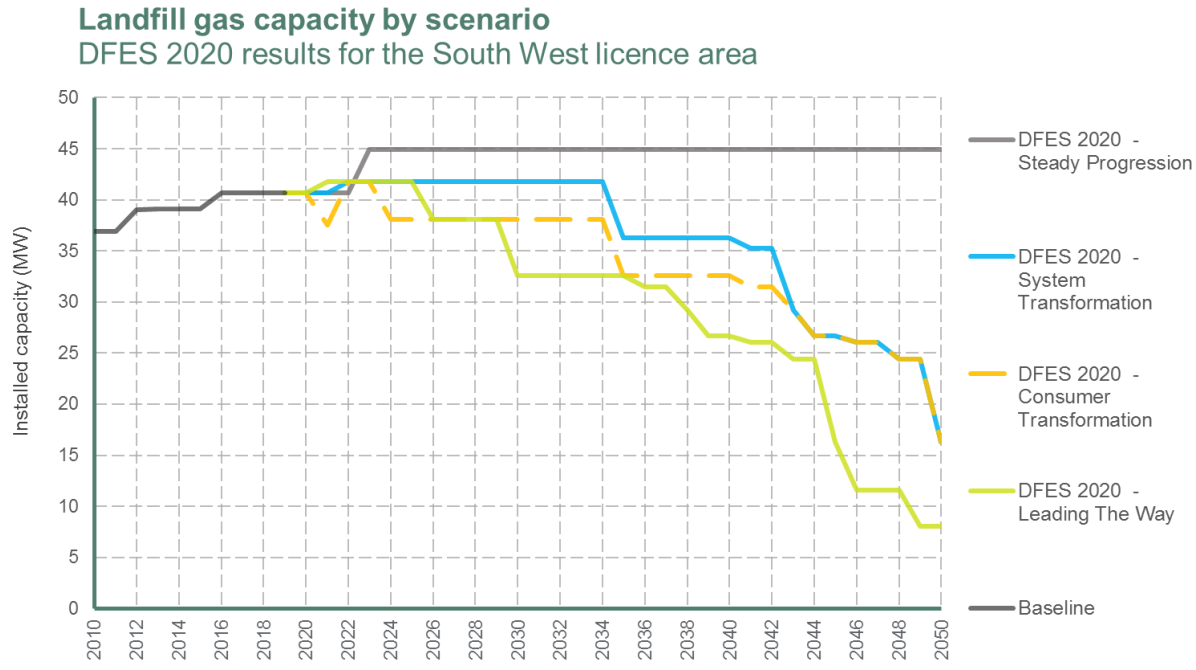
Near term

- There are three pipeline landfill gas sites in the South West totalling 6 MW. Only one of these sites (4 MW in Langage, near Plymouth) has a recent connection offer and therefore goes ahead in all scenarios by 2023.

Medium and long term

- Older sites begin to decommission in the medium term as sites have no additional waste due to high landfill taxation. There is also declining waste availability per person and competition with other technologies such as 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 injection into the gas network or exported for transport as the market for biomethane continues to expand.
- Sites that have connected more recently (in the last decade) have decommissioning rates matched to the declining export capacity assumed in FES 2020.

Figure 24



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 South West licence area:

Installed capacity (MW)	Baseline	2025	2030	2035	2040	2045	2050
Steady Progression	27	32	32	32	32	32	32
System Transformation	27	32	32	32	32	32	32
Consumer Transformation	27	32	32	32	32	32	32
Leading the Way	27	32	32	32	32	32	32

Summary:

- The scenario projection for sewage gas has very little change out to 2050 outside of the identified pipeline sites.
- At a local level, there is one pipeline site in the South West with a recent connection offer and this is projected to connect in all scenarios by 2023.

Results and assumptions:

Baseline

- There are 27 sites in the baseline totalling 27 MW.
- The 8 MW sewage gas plant in Avonmouth, Bristol connected in 1999 is by far the largest connected site in all four of the WPD licence areas.

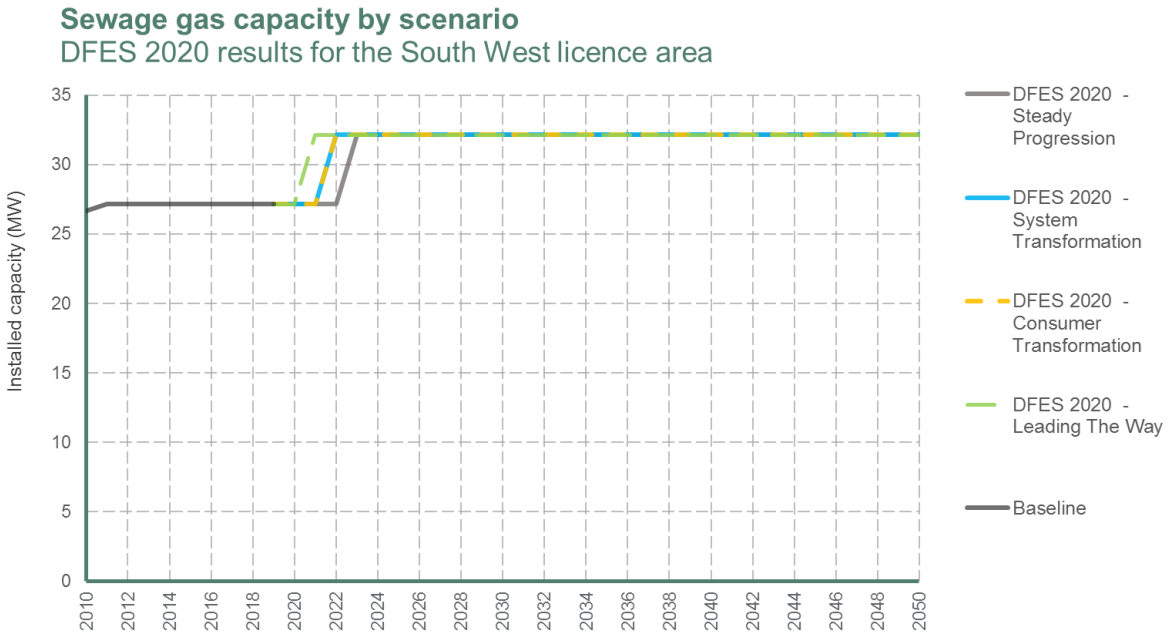
Near term

- There is one 5 MW sewage gas pipeline site, located in Plymouth. It has a recently agreed network connection offer and connects by 2023 in all scenarios. This is the only sewage gas pipeline site across the four WPD licence areas.

Medium and long term

- Population projections suggest that the maximum potential resource for sewage gas in the South West is 25 to 35 MW. Therefore, there is no projected increase in capacity beyond the pipeline.
- There is the uncertainty that sites may convert to biomethane at this point as the market continues to grow, but FES 2020 has not included this assumption.
- In the long term, the conversion of sites to biomethane remains an uncertainty factor.

Figure 25



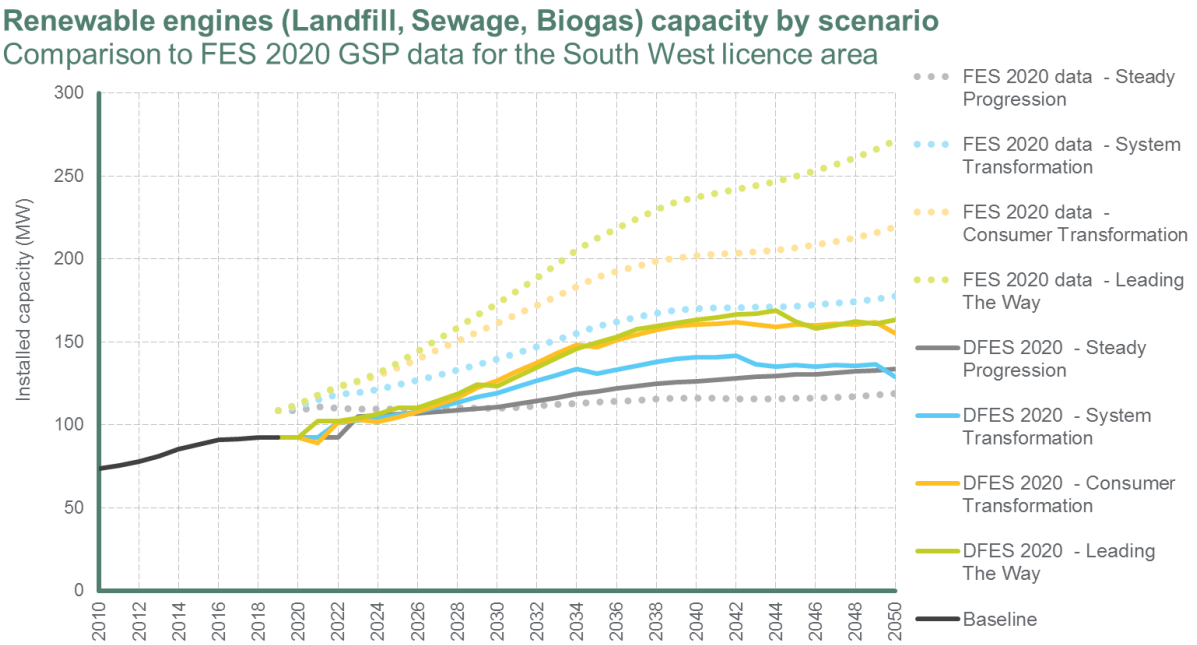
Summary of anaerobic digestion, landfill gas and sewage gas compared to the FES 2020 ‘Renewable engines (landfill, sewage, biogas)’ building block technology

Reconciliation with National Grid FES 2020:

Results in this section relate to the FES 2020 data as reported for Building Block ID number Gen_BB004.

- The increase in renewable engines generating capacity comes primarily from anaerobic digestion as landfill gas capacity decreases over time and sewage gas capacity only increases by 5 MW in all scenarios to 2050.
- There is a 20 MW baseline discrepancy between the WPD DFES 2020 and FES 2020.
- The WPD DFES scenarios to 2050 are below FES 2020. It has been assumed in the WPD DFES 2020 that the landfill gas sites are decommissioned after an operational life of 30 – 40 years, due to a reduction in available waste resource.
- The long term maximum capacity of renewable engines is based on assumed declining levels of waste production. Additional deployment is expected in sites which focus on biomethane injection rather than electrical capacity, this additional capacity is assumed to be reflected in FES 2020 projections. However, the capacity is not included in this analysis.
- 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.

Figure 26



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 power generation in the South West licence area

Summary of modelling assumptions and results.

Technology specification:

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

Data summary for biomass power (including CHP) in the South West licence area:

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

Assumptions and results summary:

- There are currently no biomass power sites in the South West licence area baseline; there are also no sites with an accepted connection offer in the South West licence area.
- There has been developer interest in the past. There were 12 unsuccessful planning applications in this licence area for biomass power plants, two of which were 100 MW or over. Three of these were refused in planning. Nine other sites either withdrew or abandoned their planning applications. The last site to be refused planning was in Bristol in 2016.
- No increase in biomass power capacity is assumed under all scenarios in the South West licence area.
- In the net zero scenarios sustainable biomass is assumed to be prioritised for use in sectors that are harder to decarbonise such as in construction, in increased carbon sink capacity, or for use in power generation with carbon capture and storage. This reflects the recommendations from the Committee on Climate Change in their report 'Biomass in a low-carbon economy'[2],
- Bioenergy with carbon capture and storage for use in power generation is deployed only at transmission level in the FES 2020, reflecting the higher cost barrier due to carbon capture which may make smaller sites unviable.

[2] https://www.theccc.org.uk/publication/biomass-in-a-low-carbon-economy/
Accessed 07 Sep 2020

Reconciliation with National Grid FES 2020:

- As analysis shows that there are no projects in the pipeline or indication of interest from developers there is no local evidence on which to base where any new projects that do arise could be located. WPD DFES 2020 does not, therefore, project any biomass power generation on the distribution network in the South West licence area.
- The baseline data for WPD DFES 2020 is lower than FES 2020 by just under 20 MW.
- These points will be reviewed with the FES team for the next round of WPD DFES scenarios.

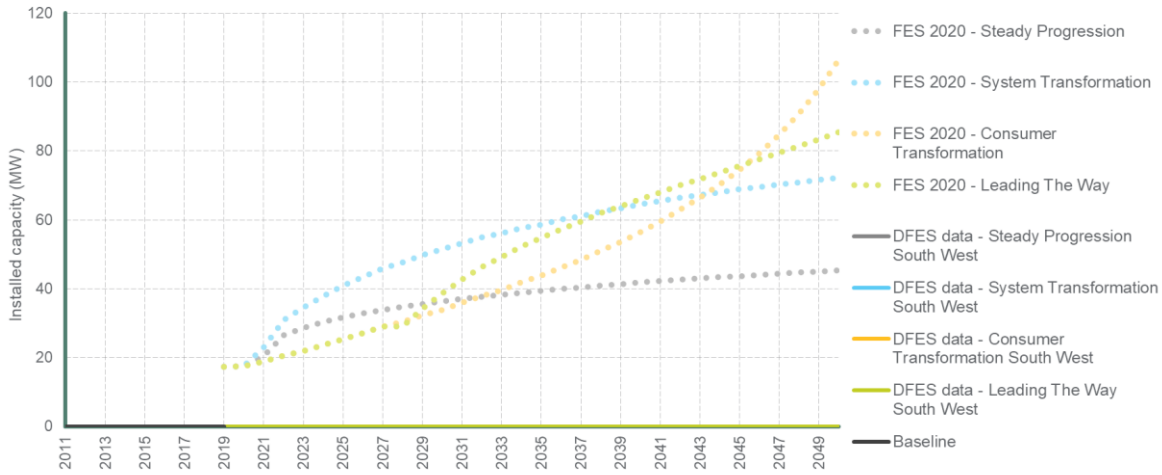
Relevant assumptions from National Grid FES 2020:

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.

Installed biomass power capacity by scenario
Comparison to FES GSP data for the South West licence area



Waste (incineration) in the South West 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 (incineration) in the South West licence area:

Installed capacity (MW)	Baseline	2025	2030	2035	2040	2045	2050
Steady Progression	226	226	226	226	226	226	226
System Transformation	226	226	218	167	135	64	64
Consumer Transformation	226	226	226	226	177	177	169
Leading the Way	226	226	218	167	135	64	64

Summary:

- The carbon emissions from unabated EfW incineration plants are not consistent with a net zero goal. As a result, it is assumed that in the net zero compliant scenarios EfW capacity reduces after 2028 in the South West licence area as sites reach the end of their lifetime and existing capacity is not replaced.
- ACT gasification plants are expected to have lower associated carbon emissions and therefore are assumed to continue at current operational capacity out to 2050.

Results and assumptions:

Baseline

- There are 10 EfW sites in the baseline totalling 211 MW.
- There are three sites between 40 - 50 MW capacity. Two are in Bristol (Severnside Energy Recovery Centre and Severn Road, Chittening) and one in Plymouth.
- There is one ACT site in the baseline (16 MW, Avonmouth) which gasifies waste wood and does not decommission before 2050 in any scenario.
- The 50 MW incinerator plant in Severnside does not decommission as it is assumed that it will convert to ACT at the end of its EfW operating life and remain connected.

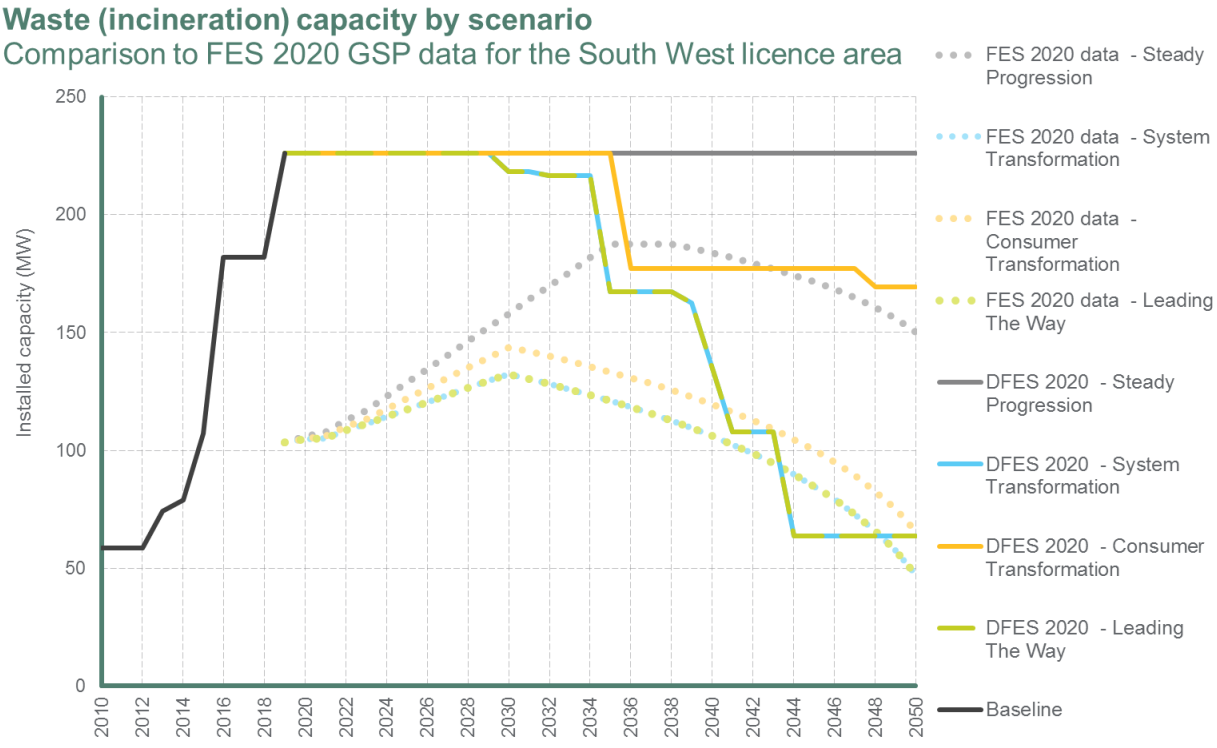
Near term

- There are two pipeline sites which have accepted a connection offer, totalling 21 MW. However, neither are projected to connect in any scenarios due to a lack of planning consent.

Medium term and long term

- No additional sites have been projected beyond the pipeline due to limitations in new waste resource streams.
- The medium and long term projection is projected to be determined by the decommissioning of 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, no sites are projected to come offline in Steady Progression, and a delayed decommissioning rate is applied after 2030.

Figure 27



Reconciliation with National Grid FES 2020:

Results in this section relate to the FES 2020 data as reported for Building Block ID number Gen_BB011.

- The assumptions underpinning this work are broadly in line with FES 2020, although the specific assumptions about the operational lifespan of projects by scenario means that there is a greater reduction in the medium term in the WPD DFES 2020.
- WPD connections data suggest a baseline capacity which is over 100 MW higher than the FES 2020 baseline for the South West licence area.
- There is no near term increase in capacity due to the lack of planning evidence of the pipeline sites.

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.

Fossil gas power generation in the South West licence area

Summary of modelling assumptions and results.

Technology specification:

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

Data summary for fossil gas power in the South West licence area:

Installed capacity (MW)		Baseline	2025	2030	2035	2040	2045	2050
OCGT (non-CHP)	Steady Progression	123	123	149	161	161	161	161
	System Transformation	123	123	123	123	123	0	0
	Consumer Transformation	123	123	123	123	123	0	0
	Leading the Way	123	123	123	0	0	0	0
Reciprocating engines (non-CHP)	Steady Progression	144	353	518	597	625	659	673
	System Transformation	144	200	200	200	200	165	162
	Consumer Transformation	144	200	200	200	200	165	162
	Leading the Way	144	200	200	164	118	56	56
Gas CHP	Steady Progression	110	118	118	118	118	118	118
	System Transformation	110	110	110	110	99	80	68
	Consumer Transformation	110	110	110	110	99	80	68
	Leading the Way	110	110	110	90	49	0	0

Summary:

- Fossil gas-fired power generation decreases in all net zero compliant scenarios, whereas for some generator types, capacity increases significantly under a Steady Progression scenario.
- In all scenarios, the primary role of fossil gas is to provide flexibility and back up services. Therefore, though 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 this flexibility is provided by higher levels of energy storage and residential thermal stores.

Results and assumptions:

Baseline

- There is a total of 377 MW of fossil gas generation connected in the South West licence area. This is made up mostly from gas reciprocating engines and large OCGT sites. There are two large OCGT sites, based in Exeter and Bristol, with a total of 123 MW total capacity. There are no CCGT sites identified with a network connection agreement for the WPD South West licence area.
- Consultation with stakeholders suggested that local climate emergency declarations may impact planning applications for fossil fuel sites. In 2019 a proposal for a gas-fired power plant was rejected in planning on the grounds that it failed to minimise fossil fuel use and reduce carbon emissions, however it has since been appealed.

Near term (2020 – 2025)

- There are 26 pipeline sites which have accepted a network connection offer in this licence area, most of which are gas CHP and gas reciprocating engines.
- Evidence of these sites having planning applications, planning approval and activity in Capacity Market auctions are key factors in whether the sites connect and their year of connection depending on the scenario.
- Four of the pipeline sites have had planning permission granted, and two sites have been rejected.
- Three pipeline sites have planning permission and have secured a Capacity Market agreement for delivery in the years spanning 2020 – 2022. Five more of the pipeline sites applied but only progressed as far as pre-qualifying for a Capacity Market auction.
- The Industrial Emissions Directive, in place since 2016, places emissions requirements on large power plants, with limitations on the annual operating hours. This affects some large plants in the area, with operational hours assumed to reduce across the projection period even if installed capacity stays level.

Medium term (2025 – 2035)

- Relative to the other WPD licence areas, fossil gas generators in this licence area connected earlier, with most of the capacity connecting before 2001. As a result, a larger proportion of baseline sites reach the end of the operational life in the near and medium term in comparison to the other licence areas. 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.

Long term (2035 – 2050)

- In the long term under all net zero compliant scenarios, the annual running hours of all unabated fossil gas plant are projected to fall to almost zero, 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 are projected to come offline 45 years after the connection date to capture reasonable worst case conditions, even if they are projected to come offline under the scenario framework.

Figure 29

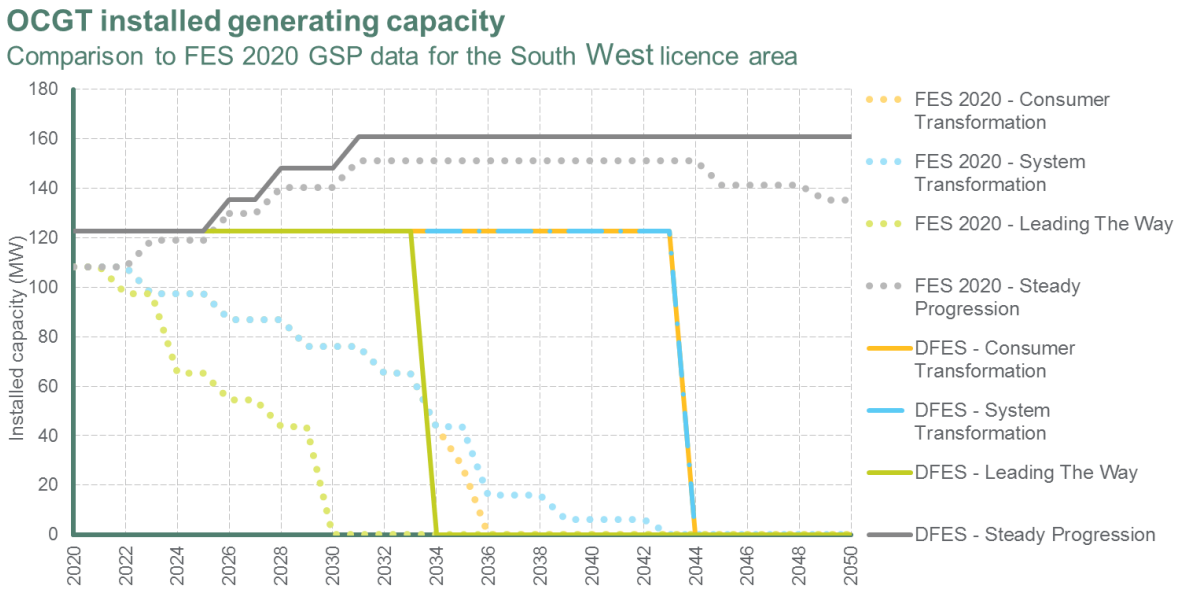


Figure 28

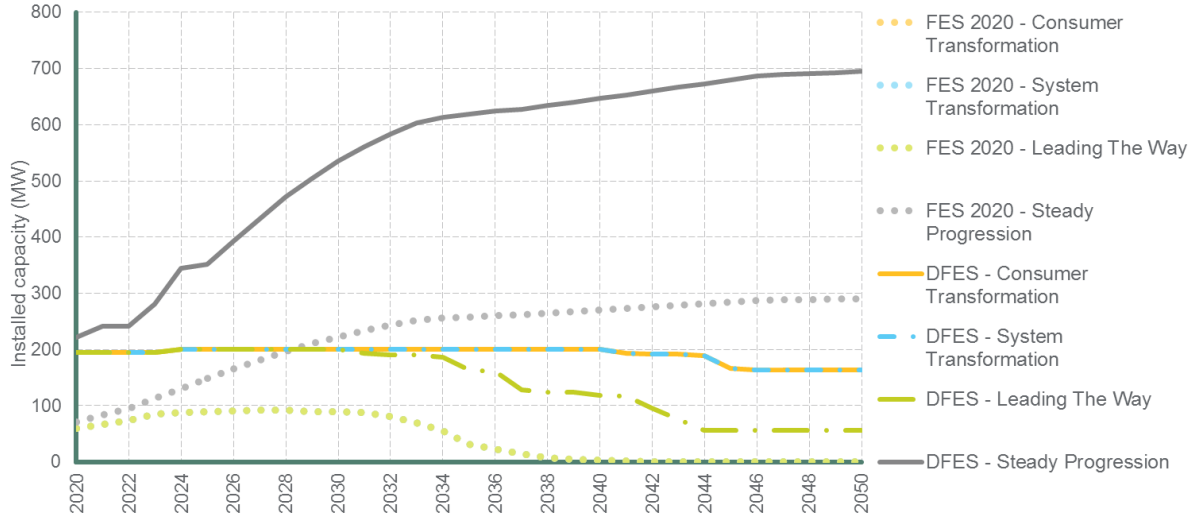
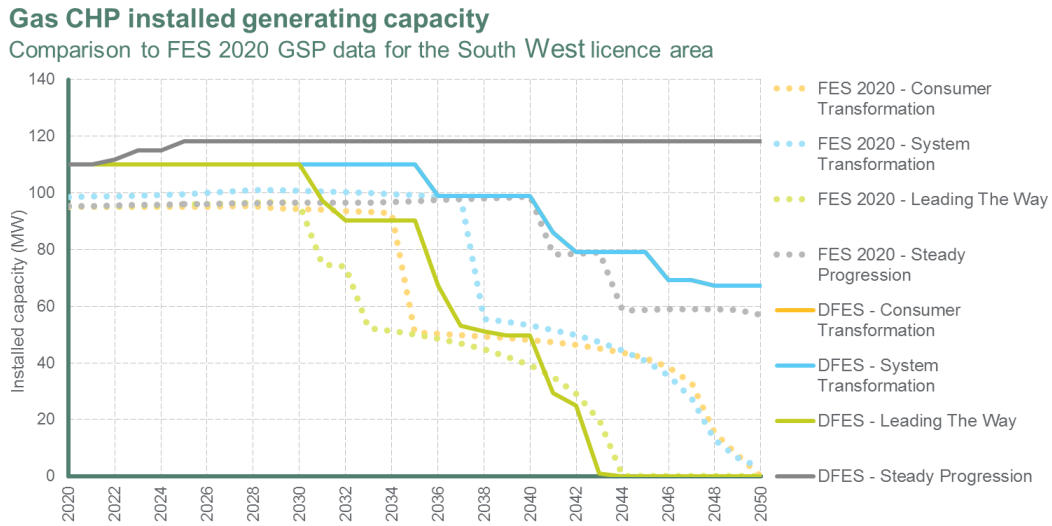


Figure 30



Reconciliation with National Grid FES 2020:

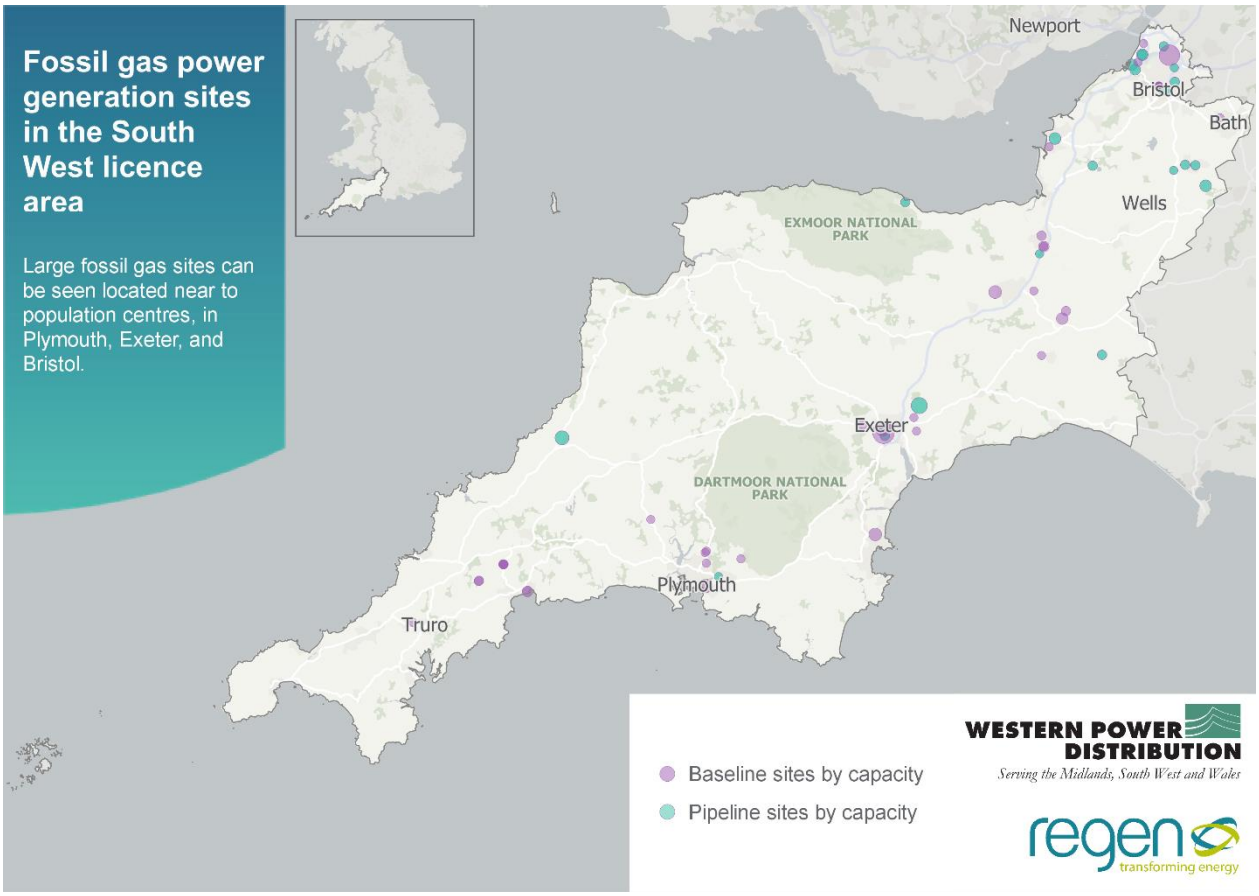
Results in this section relate to the FES 2020 data as reported for Building Block ID numbers Gen_BB001, Gen_BB002, Gen_BB006, Gen_BB008, Gen_BB009.

- The WPD DFES projections are above those in FES 2020 in the near term due to analysis of pipeline sites, including those with a Capacity Market contract awarded. However, in the medium and long term the capacity changes are in line with the FES 2020 projections.
- There is a baseline capacity discrepancy for all sub-technologies, with the largest difference in reciprocating engines where capacity is 150 MW higher in DFES than FES. Though the trajectories are the same, 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.
- 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 spatial distribution of new fossil gas sites is based on proximity to the electricity network and reflects activity in the pipeline and Capacity Markets.

Figure 31



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 South West licence area

Summary of modelling assumptions and results.

Technology specification:

Distributed diesel generation.

Data summary for diesel generation in the South West licence area:

Installed capacity (MW)	Baseline	2025	2030	2035	2040	2045	2050
Steady Progression	127	127	127	127	124	119	113
System Transformation	127	127	127	1	1	0	0
Consumer Transformation	127	127	127	1	1	0	0
Leading the Way	127	127	127	1	1	0	0

Summary:

- Increasingly stringent air quality limits mean there is no increase in diesel generation capacity in the net zero compliant scenarios for the South West. The adoption of the EU Medium Combustion Plant Directive (MCPD) into UK law enforces air quality levels by 2025 which impacts the viability of diesel generators, 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 in enforcement and capacity reduces to zero by 2032.

Results and assumptions:

Baseline

- There are 29 sites in the baseline totalling 127 MW. Two of these are back up generators.
- There are four diesel plants above 10 MW in the South West licence area. The largest is a 20 MW facility in Exeter that connected in 2016.

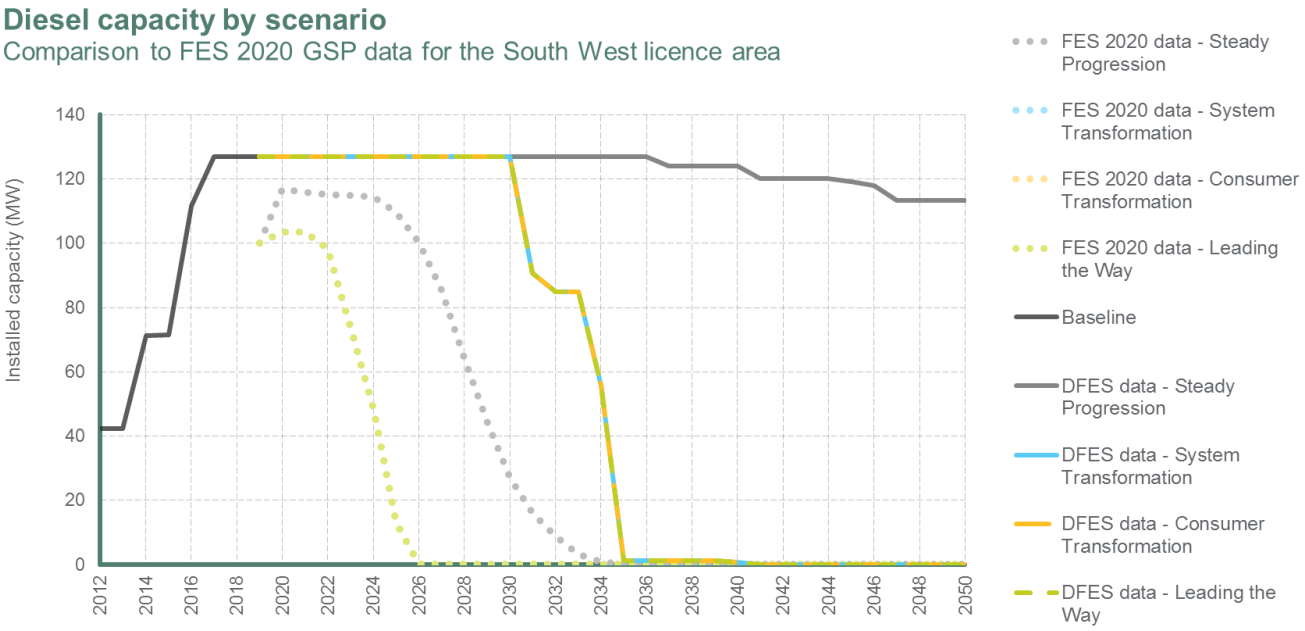
Near term (2020 – 2025)

- With stringent air quality standards under the MCPD, diesel plants will no longer be able to operate from 2025 without abatement technologies. These abatement technologies 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 27 standalone diesel sites in the baseline 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 no pipeline of diesel sites with an accepted network connection offer in the South West licence area.

Medium to long term (2025 – 2050)

- No further deployment of distributed diesel has been modelled beyond 2025.
- 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 32



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 small discrepancy in the total capacity currently installed. WPD connections data suggest a baseline capacity which is higher than the FES 2020 baseline for the South West licence area.
- In the three net zero compliant scenarios, diesel sites decommission at the same rate by 2025, and by 2032 in Steady Progression, which is in line with NG FES 2020.
- 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 'Unabated small scale thermal generation'
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 South West 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 South West licence area:

Installed capacity (MW)	Baseline	2025	2030	2035	2040	2045	2050
Steady Progression	41	52	52	52	52	52	52
System Transformation	41	52	52	52	52	52	52
Consumer Transformation	41	52	52	52	52	52	52
Leading the Way	41	52	52	52	52	52	52

Summary:

- There is 41 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 are under 5 MW.
- There is 11 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 South West licence area

Summary of modelling assumptions and results.

Technology specification:

Battery storage, comprising four business models:

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

Data summary for battery storage in the South West licence area:

Installed power capacity (MW)		Baseline	2025	2030	2035	2040	2045	2050
Standalone network services	Steady Progression	43	112	113	130	156	188	207
	System Transformation	43	112	113	127	150	157	165
	Consumer Transformation	43	128	132	146	182	191	200
	Leading the Way	43	119	123	148	193	202	212
Generation co-location	Steady Progression	1	16	27	30	35	44	52
	System Transformation	1	12	17	22	28	44	50
	Consumer Transformation	1	22	41	56	83	99	113
	Leading the Way	1	18	52	92	115	122	139
Behind-the-meter high energy user	Steady Progression	4	5	30	32	37	71	91
	System Transformation	4	6	11	11	21	32	52
	Consumer Transformation	4	16	63	67	76	102	122
	Leading the Way	4	31	96	101	156	169	169
Domestic batteries	Steady Progression	0	1	8	9	21	51	117
	System Transformation	0	0	1	2	3	9	10
	Consumer Transformation	0	2	42	75	154	270	576
	Leading the Way	0	11	86	249	534	654	750

Summary:

- Though there is relatively low deployment of onshore wind and solar PV in the near term, the baseline sites and long term potential for renewable energy means that there is high deployment of co-located battery storage sites in the South West licence area.
- High deployment levels of domestic batteries in the South West licence area in Consumer Transformation and Leading the Way reflects the higher than average proportion of homes that have rooftop solar PV.
- Overall battery storage capacity in 2050 ranges from 0.3 GW in System Transformation to c.1.5 GW in Leading the Way.

Results and assumptions:

Baseline

- There are 11 battery storage projects totalling 48 MW currently connected in the South West licence area, all of which have connected since 2016.
- Most of the current baseline capacity comes from standalone battery projects. The average installed capacity is 4.5 MW.

Near term (2020 – 2025)

- There are 14 projects with an accepted network connection offer in this licence area, totalling 121 MW.
- The pipeline is relatively low compared to the other WPD licence areas; however the pipeline does show an increase in average capacity, c.9 MW average in the pipeline compared to 4.5 MW in the baseline.
- Most of the pipeline capacity comes from standalone sites. The largest is a 33 MW site near Bristol.
- Of these projects, 100 MW (7 sites) have planning approval and 37 MW (2 sites) have contracted or pre-qualified for a number of Capacity Market T-4 and T-1 auctions.
- It is assumed that sites with positive capacity market activity or planning permission are more likely to be commissioned in the near term.
- By 2025, connected battery storage capacity in the South West licence area is highest (236 MW) in the Consumer Transformation scenario and lowest (135 MW) in the System Transformation scenario.

Medium term (2025 – 2035)

- The four business models for battery storage are modelled separately and are driven by different factors.
- Standalone storage accounts for most of the existing storage market activity and there is significant growth in capacity for this business model across all scenarios by 2035.
- Generation co-location is driven by a strong ground mounted solar PV deployment and a moderate onshore wind deployment in the South West licence area in the medium term.
- Engagement with stakeholders suggested that storage assets co-located with high energy users could be the business model that sees the highest deployment, and high uptake of behind-the-meter storage projects has been projected in the licence area.
- With a higher-than-average uptake of rooftop PV in the South West licence area, an above-average deployment of domestic batteries has been modelled in the medium and long term. The scenarios with lower societal change (System Transformation and Steady Progression) see significantly lower uptake of domestic batteries than Consumer Transformation and Leading the Way.

Long term (2035 – 2050)

- In the long term, the biggest increase in projected battery storage capacity is projected to occur in a Leading the Way scenario with deployment of domestic batteries by 2050 reflecting high levels of rooftop PV uptake.
- The System Transformation scenario has the lowest overall storage deployment, reflecting a general lesser need for this form of flexibility.
- Overall, installed battery storage capacity in the South West licence area is highest (c.1.3 GW) in Leading the Way and lowest (c.0.3 GW) in System Transformation by 2050.

Figure 33

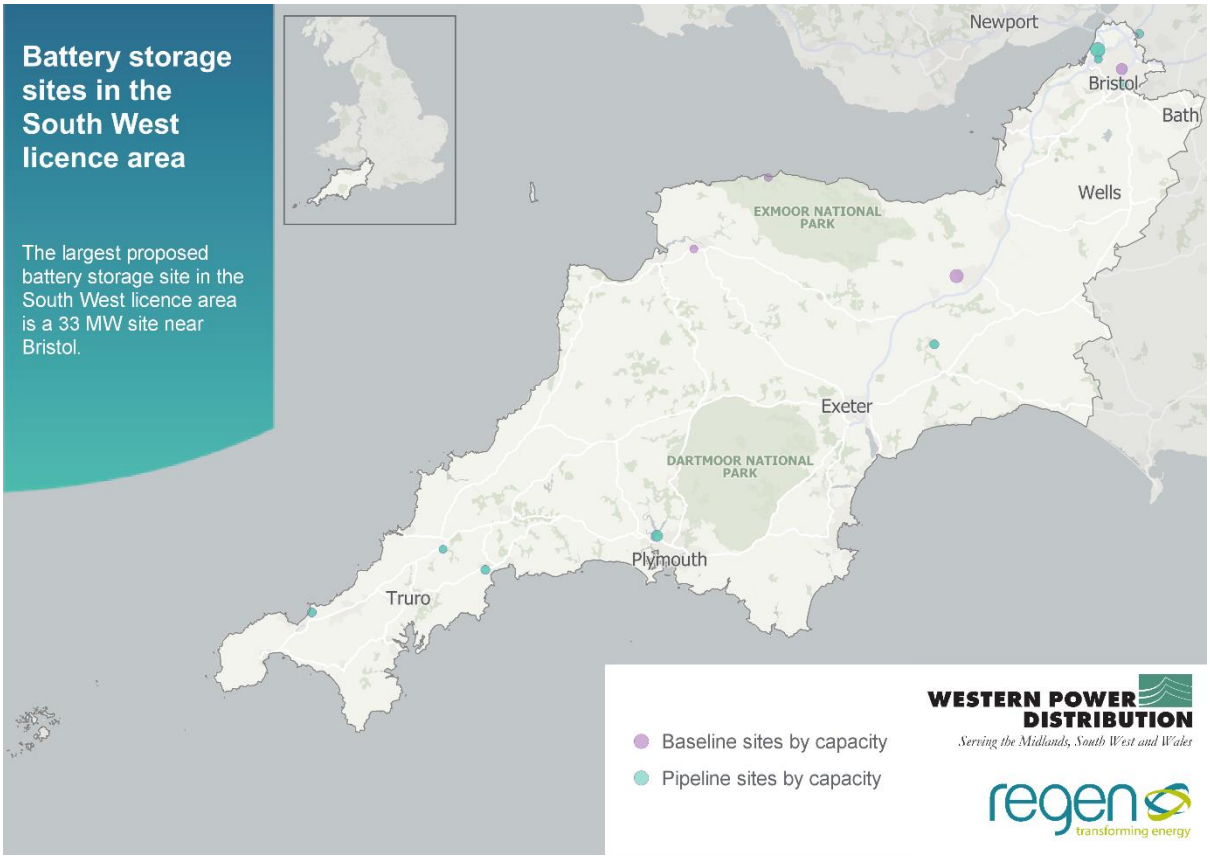
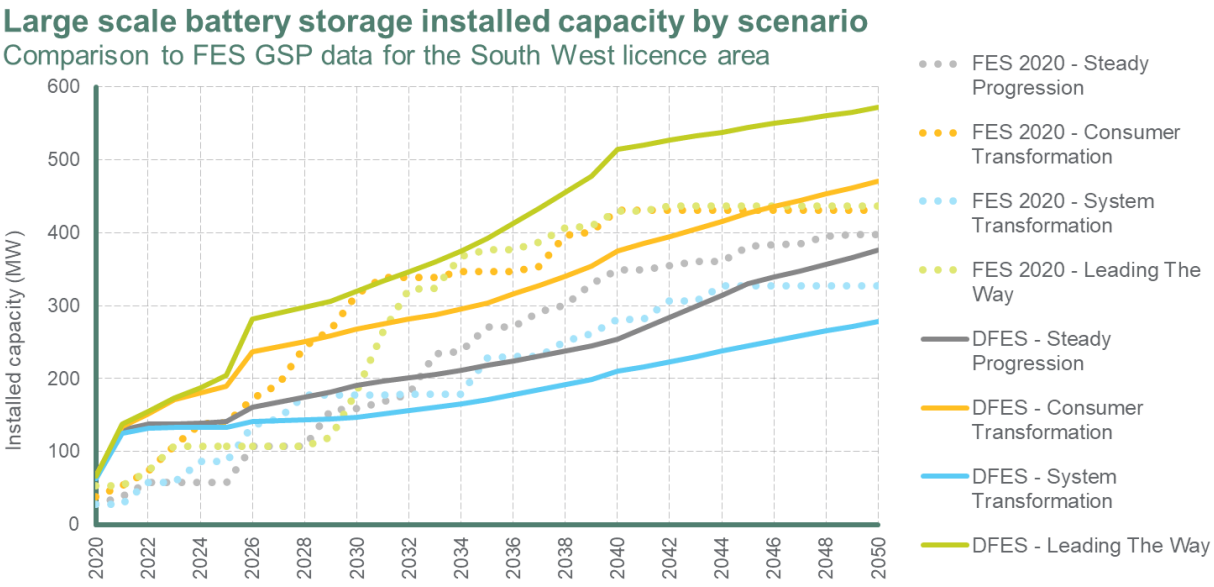


Figure 34



Reconciliation with National Grid FES 2020:

Results in this section relate to the FES 2020 data as reported for Building Block ID number Srg_BB001 and Srg_BB002.

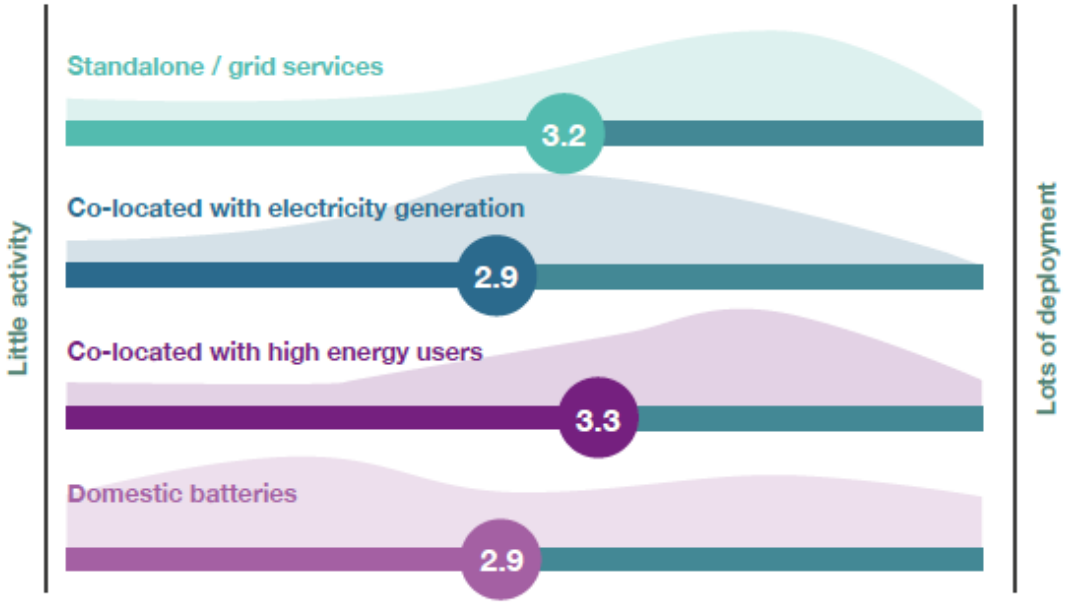
- The WPD DFES 2020 projections in the near term are moderately higher than the FES 2020 projections, reflecting the positive Capacity Market and planning activity of the identified pipeline sites.
- The WPD DFES 2020 projections for small scale domestic batteries are lower than in the FES 2020, reflecting stakeholder feedback that they are the business model least likely to see significant deployment.
- The WPD DFES 2020 projections for large scale battery storage capacity are higher than FES 2020, reflecting stakeholder feedback about the individual business models, as well as the high level of ground mounted solar capacity projected in the South West licence area by 2050.

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:** Proximity to 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.

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 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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