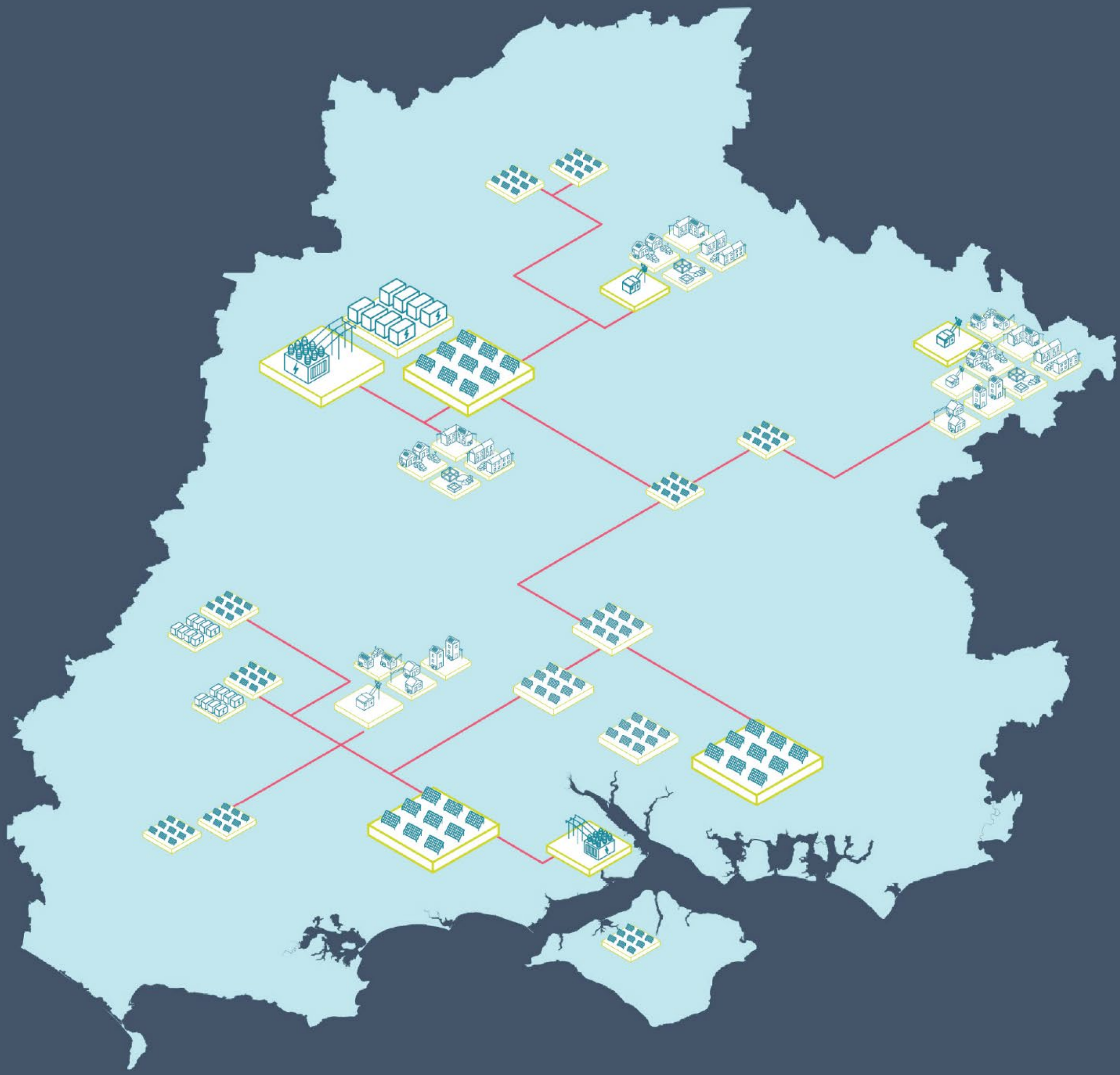
Distribution Future Energy Scenarios 2024

Southern England licence area



About Scottish and Southern Electricity Networks (SSEN)

SSEN Distribution is the electricity Distribution Network Operator (DNO) responsible for delivering power to 3.9 million homes and businesses across the north of Scotland and central southern England. With over 5,000 employees across the country, we manage and maintain over 128,000 km of overhead lines and underground cables, alongside 460 km of subsea cables which power our island communities.

We're working to get more people and projects connected to a growing electricity system. We're accelerating our Distribution System Operator (DSO) capabilities, enabling the delivery of local smart grids and flexibility services across our licence areas, while facilitating the uptake of low carbon technologies such as EV charging and domestic heat pumps. Our approach is tailored to local needs, to drive a just and fair transition, advising and guiding our customers and stakeholders in coordination with local communities.

About Regen

Regen is an independent centre of energy expertise with a mission to accelerate the transition to a zero-carbon energy system. We have nearly 20 years' experience in transforming the energy system for net zero and delivering expert advice and market insight on the systemic challenges of decarbonising power, heat, and transport.

Regen is also a membership organisation, managing the Regen members network and the Electricity Storage Network (ESN) – the voice of the UK storage industry. We have over 150 members who share our mission, including clean energy developers, businesses, local authorities, community energy groups, academic institutions, and research organisations across the energy sector.

Acknowledgements

We would like to express our sincere appreciation to all those who contributed to the successful completion of this report.

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Prepared by	Regen
Approved by	Ray Arrell, Associate Director
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Contents

Section 1: Introduction

This report provides the technical overview and analytical results of the 2024 iteration of the Distribution Future Energy Scenarios (DFES) analysis for Scottish and Southern Electricity Networks (SSEN)' Southern England licence area. In addition to this document, there is a separate technical report for the North of Scotland licence area and an introductory report which outlines the background, framework and context for the DFES analysis as well as an explanation of each of the DFES scenarios. These can be found online:

- Forecasting Future Needs of the Network - SSEN

The DFES analysis produces high granularity forecasts for the growth and/or reduction of electricity generation, demand and storage technologies connecting to SSEN's electricity distribution network. Underpinning the DFES analysis is the National Energy System Operator's (NESO) Future Energy Scenarios (FES) framework.[1] Published annually, the FES outlines different scenarios for the future of the whole energy system and the overarching assumptions that define these scenarios are integral to the DFES analysis. DFES builds on the FES scenarios by engaging a diverse and expert range of stakeholders, undertaking detailed investigations into the pipeline of projects seeking to connect, as well as extensive industry and local area insight to forecast future load on SSEN's network.

SSEN use the DFES analysis as part of an integrated network planning, optioneering and investment appraisal process. The DFES projections enable SSEN to model changes to future electricity demand across the network and subsequently assess where network improvements are needed, to ensure the capacity is available to meet future demand and deliver UK Government ambitions for both clean power 2030 and net zero 2050.

This technical report is divided into two sections. The first section provides some of the highlights for the current electricity load in the Southern England licence area and how this is projected to change in 2030 and 2050 under the Holistic Transition scenario (page 2 to 8). The second part of the report provides the details for each individual technology included within the DFES 2024 analysis and describes the detailed assumptions, methodology and results (page 9 onwards).

Section 2: SSEN's Southern England Licence Area

The Southern England electricity distribution licence area refers to the area served by the low voltage (LV), 11 kV, 33 kV and 132 kV network that is managed by SSEN in the southern central geographical area of England.

This area spans the borders of south Somerset and west Dorset to the west, Five Oaks, Ealing and Chiswick to the east, Chipping Norton and areas of the Cotswolds in the north and the coastal towns of Weymouth, Bournemouth, Southampton and Portsmouth to the south. The Isle of Wight also falls within the licence area, fed by three subsea cables managed by SSEN. Within the licence area are the urban centres of Oxford, Swindon, Reading, Southampton and West London, as well as the national parks and rural countryside of the South Downs, New Forest and the Chiltern Hills.

The licence area comprises 53 local authority areas, either wholly or partially, including city regions (such as Oxford) and large district and borough councils (such as Wiltshire).

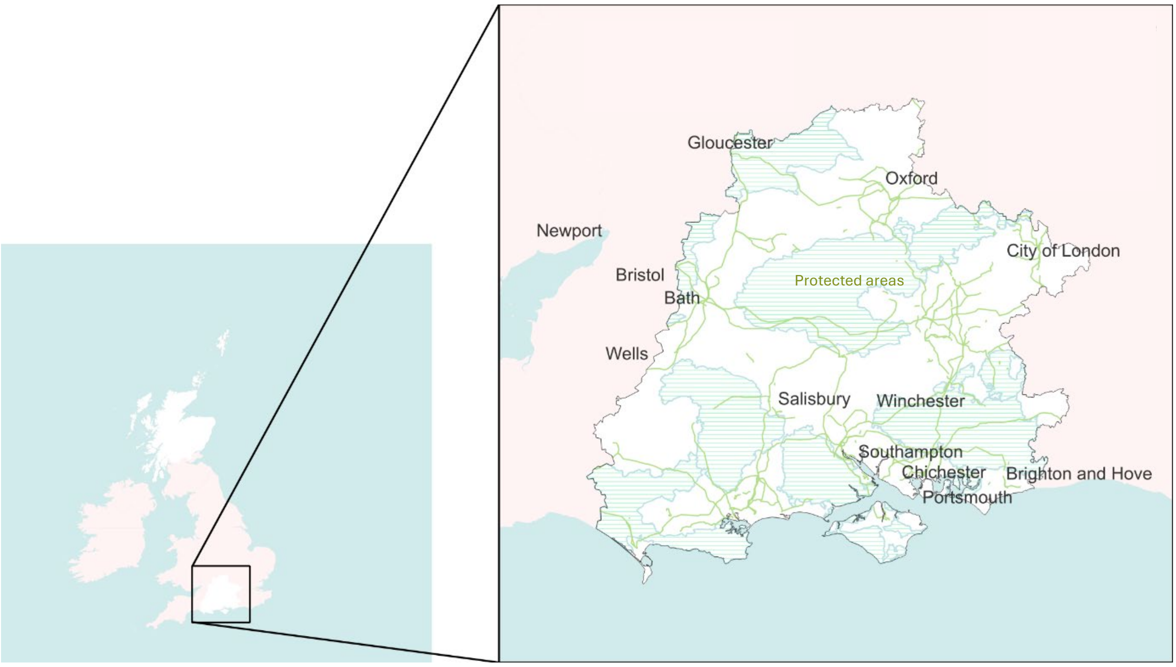


Figure 1 The Southern England licence area with cities, protected areas and grid network infrastructure highlighted (source: Regen)

2.1. Southern England licence area baseline

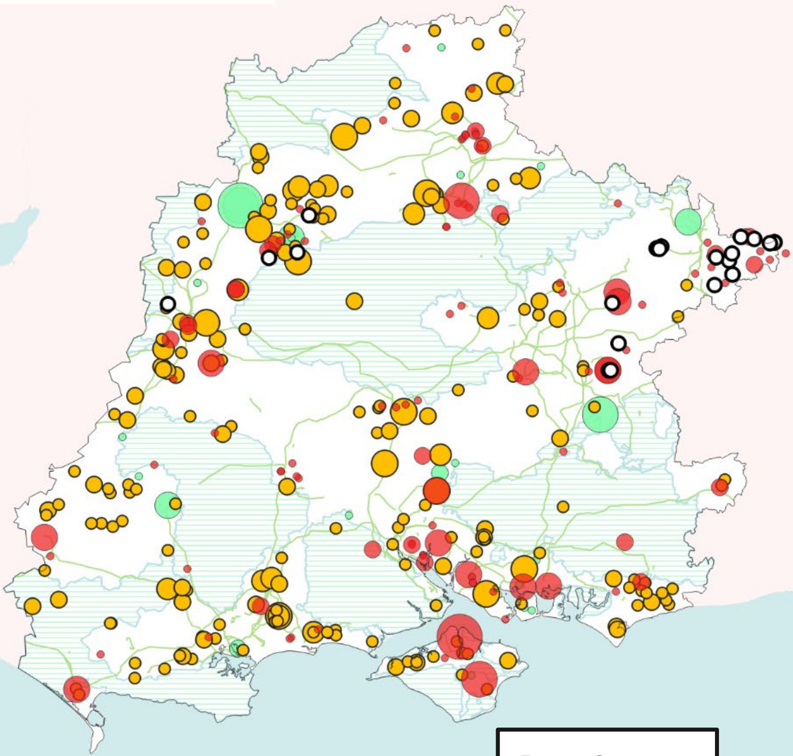
There is currently 3.5 GW of generation and storage capacity connected to SSEN's distribution network in the Southern England licence area and Figure 2 illustrates the spatial distribution of key baseline technologies.

Solar PV

Just over 2 GW of large-scale solar generation is deployed across over 200 sites and nearly 600 MW of small-scale solar is connected to the network.

Battery Storage

There are currently 16 operational large-scale battery storage sites, totalling 281 MW of capacity.



Fossil Fuel

There is 730 MW of fossil fuel generation capacity operating across the licence area. The largest site is the marine diesel power station at Cowes on the Isle of Wight which provides both peak generation and frequency response services.

Data Centres

There are currently 24 data centres totalling 805 MW of demand capacity in operation. These sites are concentrated to the west of London (primarily Slough) and Swindon.

Figure 2 A map of the Southern England licence area and location of key baseline technologies (source: Regen)

2.2. Southern England licence area pipeline

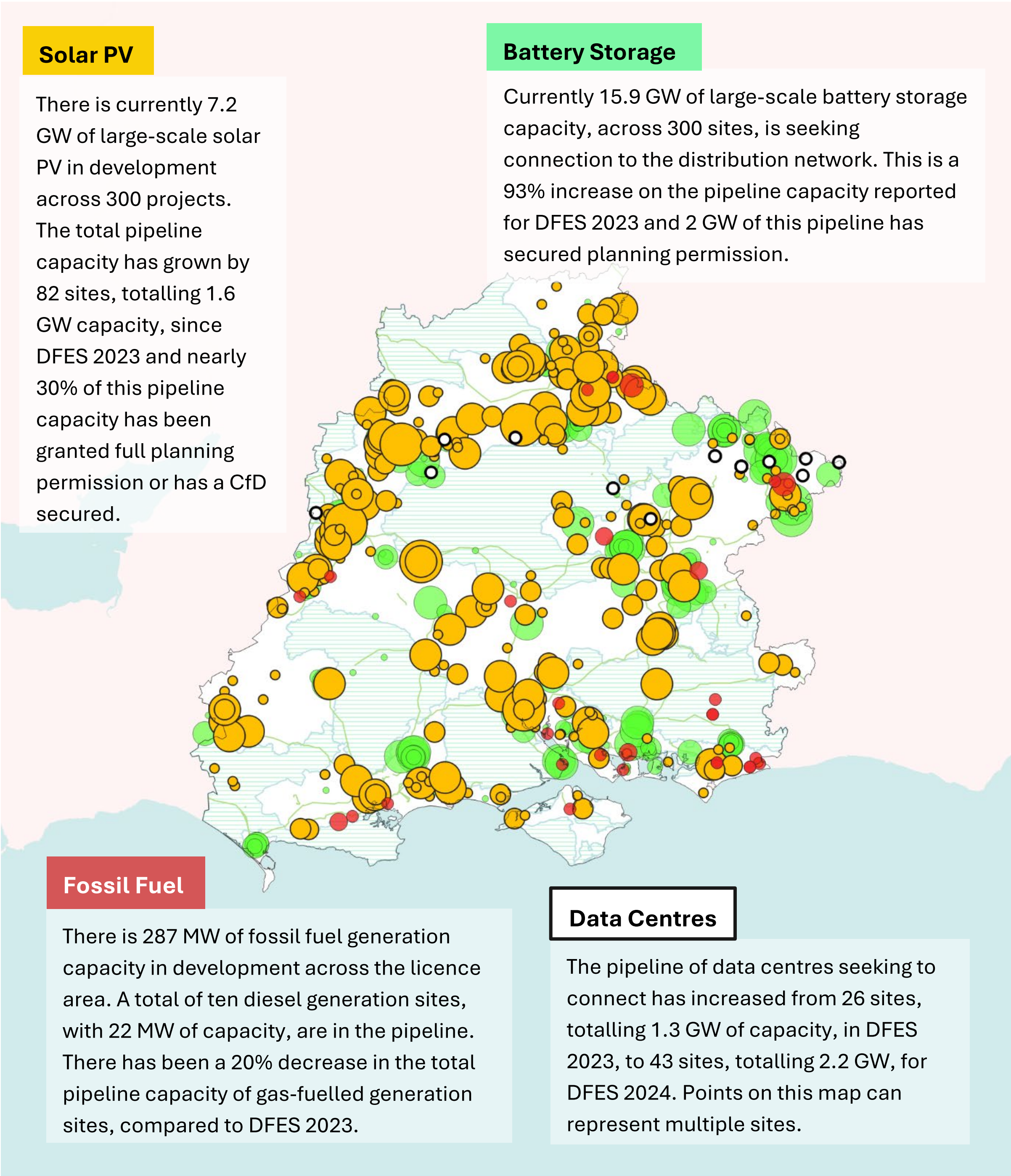
There is 23.6 GW of generation and storage capacity that have connection offers to connect to SSEN's distribution network and Figure 3 illustrates the spatial distribution of key pipeline technologies.

Solar PV

There is currently 7.2 GW of large-scale solar PV in development across 300 projects. The total pipeline capacity has grown by 82 sites, totalling 1.6 GW capacity, since DFES 2023 and nearly 30% of this pipeline capacity has been granted full planning permission or has a CfD secured.

Battery Storage

Currently 15.9 GW of large-scale battery storage capacity, across 300 sites, is seeking connection to the distribution network. This is a 93% increase on the pipeline capacity reported for DFES 2023 and 2 GW of this pipeline has secured planning permission.



Fossil Fuel

There is 287 MW of fossil fuel generation capacity in development across the licence area. A total of ten diesel generation sites, with 22 MW of capacity, are in the pipeline. There has been a 20% decrease in the total pipeline capacity of gas-fuelled generation sites, compared to DFES 2023.

Data Centres

The pipeline of data centres seeking to connect has increased from 26 sites, totalling 1.3 GW of capacity, in DFES 2023, to 43 sites, totalling 2.2 GW, for DFES 2024. Points on this map can represent multiple sites.

Figure 3 A map of the Southern England licence area and location of key pipeline technologies (source: Regen)

2.3. Southern England baseline summary

Renewable generation			
Solar 2.7 GW	**Onshore wind** 11.8 MW	**Marine** 0 MW	**Hydropower** 2.4 MW

There is currently a total of 2.7 GW of operational renewable generation in the licence area, over 99% of this capacity is solar PV. Small-scale solar PV has seen the highest growth over the past year.

Waste and bioenergy generation		
Biomass 1 MW	**Waste** 188 MW	**Renewable engines** 74 MW

There is currently a total of 263 MW of operational waste and bioenergy generation. These technologies have not grown significantly in the past year. The technology with the highest deployed capacity is waste-fuelled generation with 188 MW.

Fossil and gas generation		
Diesel 336 MW	**Gas** 394 MW	**Hydrogen generation** 0 MW

There is currently 730 MW of operational diesel and fossil gas generation. Cowes Power Station, on the Isle of Wight, remains the largest generation site with a capacity of 140 MW whilst the 100 MW Didcot gas power station is also significant generation source in Southern England.

Sources of demand				Energy storage
EVs 365,000	**Domestic heat pumps** 36,000	**Electrolysis** 0 MW	**Data centres** 805 MW	**Large-scale batteries** 281 MW

EV ownership has accelerated rapidly and the number of domestic heat pumps has also increased substantially since DFES 2023. Whilst most homes in Southern England are heated by gas boilers, approximately 1% of homes have a heat pump installed, which is slightly ahead of the national average. 72 MW of large-scale batteries have connected to the network in the past year.

2.4. 2030 highlights under Holistic Transition

Renewable generation			
Solar 7.8 GW	**Onshore wind** 29 MW	**Marine** 20 MW	**Hydropower** 2.5 MW

Nearly 8 GW of renewable generation is projected to deploy by 2030, over double the current deployment. This is mostly due to the significant large-scale solar PV pipeline commissioning and continued high rates of small-scale solar PV uptake.

Waste and bioenergy generation		
Biomass 2 MW	**Waste** 239 MW	**Renewable engines** 84 MW

The current pipeline of energy from waste and renewable engine sites builds out by 2030, while some older sites decommission in the same timeframe.

Fossil and gas generation		
Diesel 0 MW	**Gas** 417 MW	**Hydrogen generation** 0 MW

By 2030 all diesel standalone plants have been decommissioned. Some new gas generation sites are commissioned but decommissioning of older gas sites continues.

Sources of demand			
EVs 1.2m	**Domestic heat pumps** 305,000	**Electrolysis** 44 MW	**Data centres** 2.4 GW

High EV uptake is projected and the initial uptake of heat pumps in the 2020s is modelled to occur more commonly in off-gas houses and new-build homes. Data centre demand has grown over 200% to 2.4 GW.

Energy Storage	New developments	
Large-scale and small-scale batteries 3.9 GW	**Domestic** 193 k	**Non-domestic** 4.7 m sqm

Battery storage capacity is projected to increase significantly by 2030, primarily due to the connection of sites with planning permission. Up to 193,000 new homes and 4.7m sqm of non-domestic floorspace are also projected to be built in this timeframe.

2.5. 2050 highlights under Holistic Transition

Renewable generation			
Solar 13.3 GW	**Onshore wind** 152 MW	**Marine** 85 MW	**Hydropower** 3 MW

Post-2030 growth in solar PV, from domestic and commercial scale units alongside large-scale sites, drives total renewable generation capacity to nearly 13.5 GW by 2050.

Waste and bioenergy generation		
Biomass 3 MW	**Waste** 86 MW	**Renewable engines** 80 MW

Conventional waste incineration is modelled to decommission, reflecting a reduced volume of waste in this scenario and the drive to reduce carbon emissions. Sewage gas remains operational.

Fossil and gas generation		
Diesel 0 MW	**Gas** 0 MW	**Hydrogen generation** 326 MW

By 2050 the 140 MW Cowes Power station is projected to decommission, and no diesel or fossil gas capacity remains. Some fossil generation sites convert to low carbon hydrogen once it is available.

Sources of demand			
EVs 5m	**Domestic heat pumps** 2.6m	**Electrolysis** 497 MW	**Data centres** 6.7 GW

Heat pump rollout is modelled for most housing stock by 2050. A core hydrogen transmission network enables commercial-scale hydrogen electrolysis. Data centres represent a significant demand source.

Energy Storage	New developments	
Large-scale and small-scale batteries 5.7 GW	**Domestic** 544 k	**Non-domestic** 10.5 m sqm

Battery storage continues to deploy, though the large-scale market has saturated and small-scale energy storage is the main source of growth. Growth in new domestic and non-development has slowed by 2050.

2.6. 2050 spatial deployment of low-carbon technologies under Holistic Transition

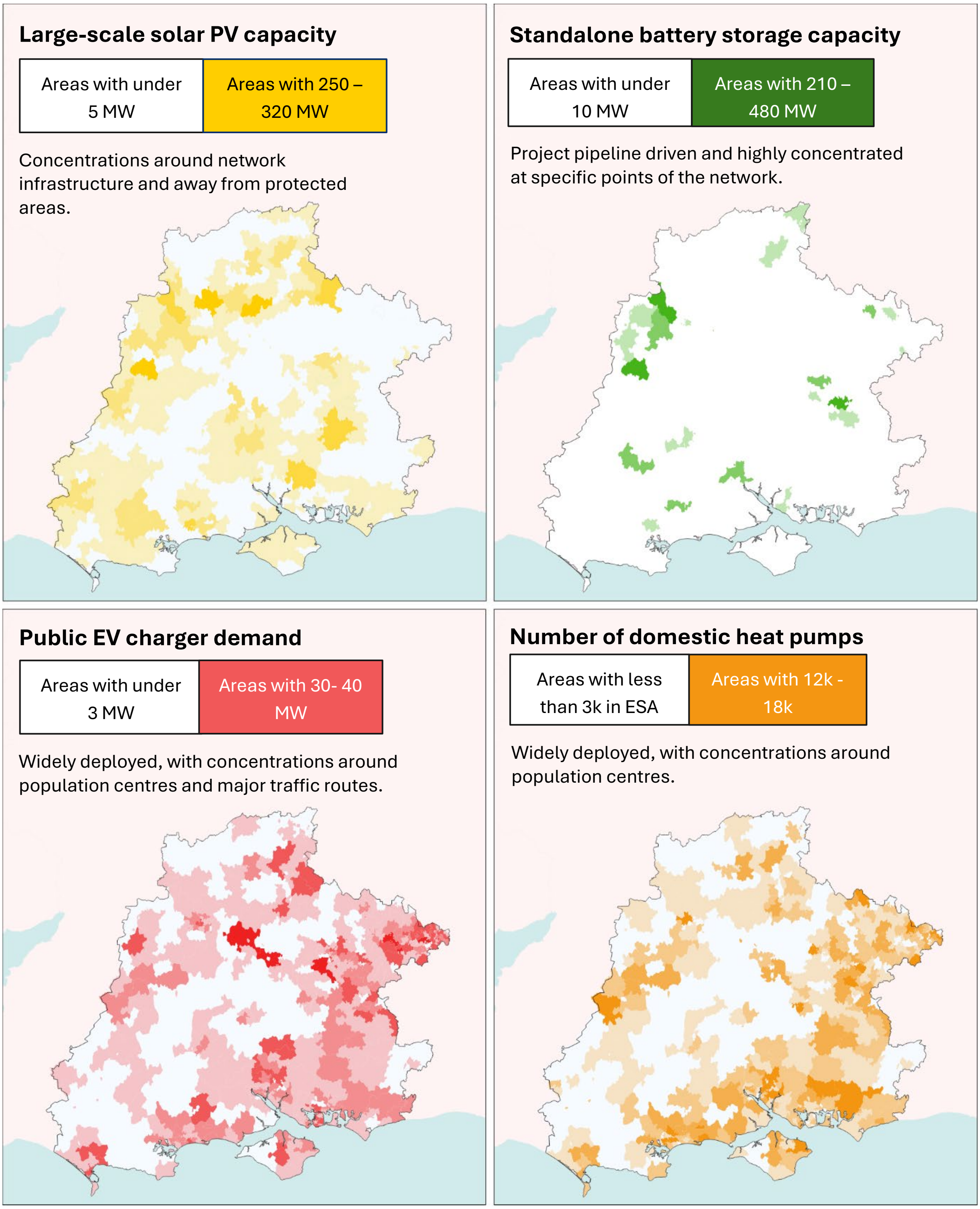


Figure 4: 2050 deployment of key technologies in the licence area under the Holistic Transition scenario (source: Regen)

Section 3: Distributed electricity generation technologies

Results and assumptions

This section includes the results and assumptions for the following technologies:

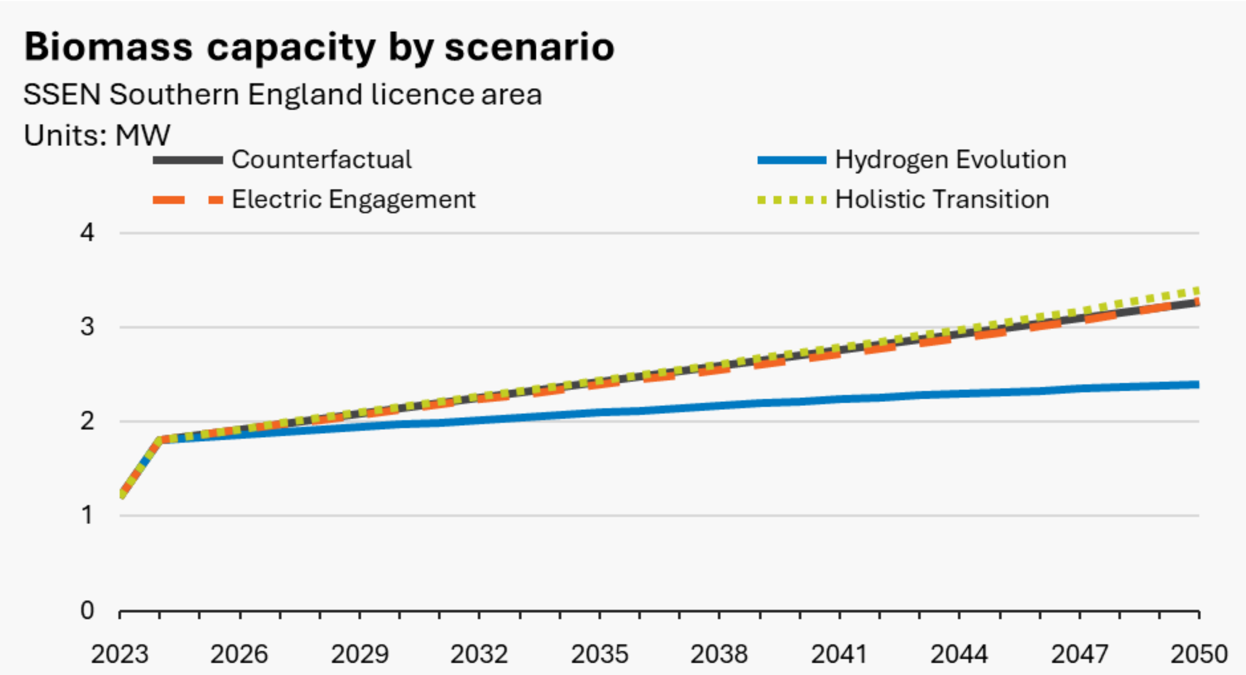
- Biomass generation
- Diesel generation
- Fossil gas-fired generation
- Hydropower
- Hydrogen-fuelled electricity generation
- Marine generation
- Onshore wind generation
- Other generation
- Renewable engines
- Solar PV (large-scale)
- Solar PV (small-scale)
- Waste-fuelled generation

3.1. Biomass generation

Technical specification	Building blocks
Biomass-fuelled electricity generation connecting to the distribution network, including biomass for standalone power generation and biomass combined heat and power (CHP).	Gen_BB010

3.1.1. Summary

- The Southern England licence area currently hosts just over 1 MW of biomass electricity generation capacity across three baseline sites.
- Small-scale biomass CHP sees limited growth in all four scenarios as a means of decarbonising local heat and industrial energy. **Hydrogen Evolution** sees lower uptake compared to the other three scenarios due to the greater availability of hydrogen for CHP in this scenario.



3.1.2. Modelling and outcomes

Baseline

Source: SSEN connections data

Scale	Capacity (MW)	Sites	Description
Above 1 MW	0	0	The Southern England baseline consists entirely of three small-scale projects. Two of these projects are located on farms, while the third is an industrial site.
Below 1 MW	1	3	

Pipeline

Source: SSEN connections data

Status	Capacity (MW)	Description
Already operational	0.6	There is just one site in the SSEN connections pipeline in the Southern England licence area. Desktop research suggests this site is already operational, and as such has been modelled to connect in 2024 under every scenario.

Scenario projections

Scenario	Capacity (MW)		Description
	2030	2050	
Holistic Transition	2	3	None of the four scenarios see a major role for distribution connected biomass in heat decarbonisation. As shown by the lack of pipeline and minimal biomass generation deployment in the Southern England licence area to date, there is limited potential for growth in biomass generation capacity. However, there is still some deployment, particularly for heating at business parks and industrial sites. **Hydrogen Evolution** sees slightly lower uptake compared to the other three scenarios due to the preference for hydrogen (rather than biomass) for CHP in this scenario.
Electric Engagement	2	3	
Hydrogen Evolution	2	2	
Counter-factual	2	3	

Spatial factors

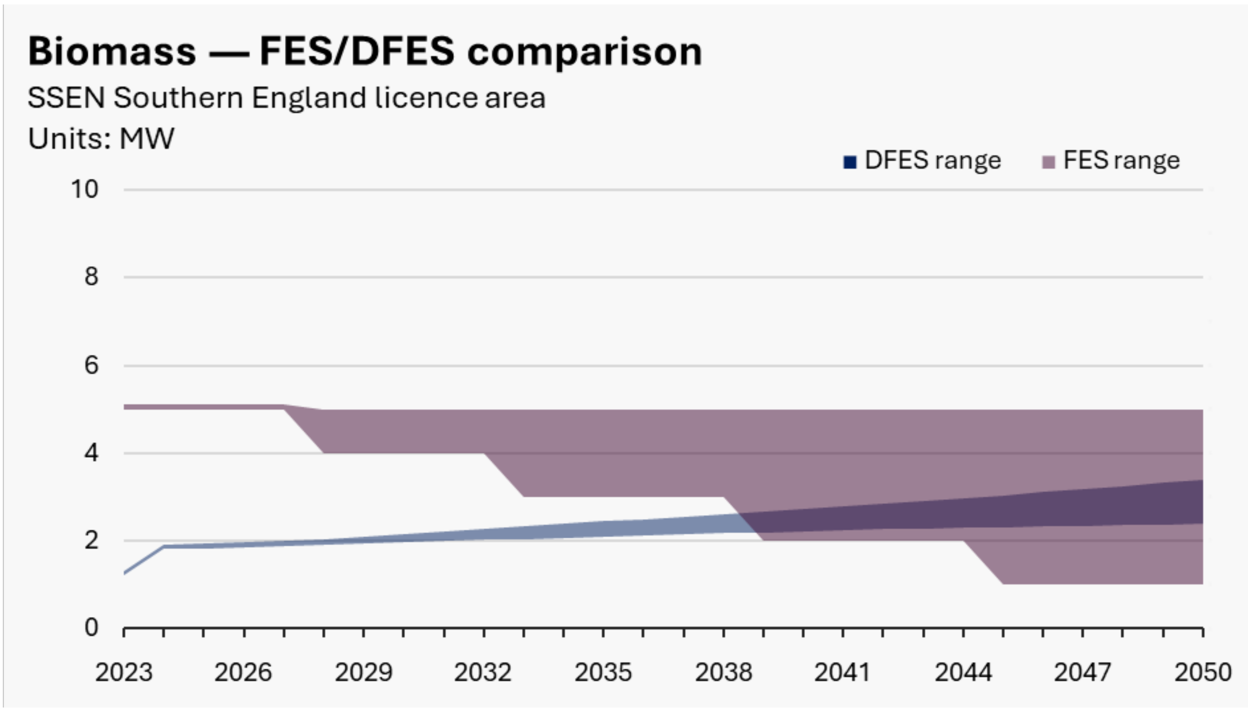
Factor	Description
Existing baseline and pipeline sites	Alongside the existing baseline and pipeline, growth in small-scale biomass CHP capacity is distributed to existing small-scale biomass connections.

3.1.3. Comparisons

Reconciliation to FES 2024

The outcomes of the DFES modelling have been compared against the FES 2024 outcomes for the same licence area.

- The DFES and FES baselines both show a very small capacity of biomass in the licence area. The 4 MW difference between the DFES and FES baseline is likely due to differences in how the baseline data has been categorised by technology.
- While the projections broadly overlap, the FES outcomes trend downwards whereas the DFES models a small amount of growth in all scenarios. The DFES outcomes are based on the assumption that the decommissioning of biomass electricity generation is likely to impact large-scale biomass power generation sites rather than small-scale biomass CHP, whereas the FES outcomes reflect the overall national trend for biomass power generation in the FES 2024 scenarios.



Comparison to DFES 2023

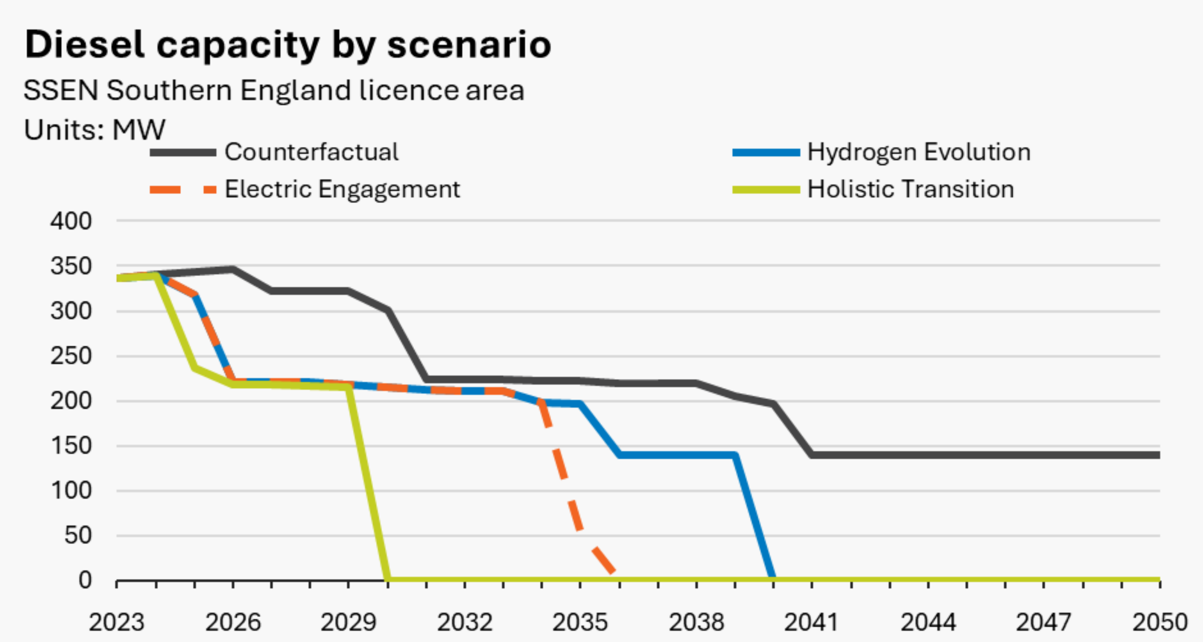
- In line with FES 2024 assumptions, the DFES 2024 results now model a small amount of growth in capacity under all four scenarios as small-scale biomass CHP sees uptake for commercial and industrial heat and power as well as district heating. This is a change from the DFES 2023 modelling, which modelled biomass to reduce under the three net zero scenarios. This change is based on the assumption that the decommissioning of biomass electricity generation is likely to impact large-scale biomass power generation sites rather than small-scale biomass CHP.

3.2. Diesel generation

Technical specification	Building blocks
Diesel generation	Gen_BB015 Gen_BB016

3.2.1. Summary

- The baseline of operational diesel generation capacity in the Southern England licence area currently totals 336 MW. This includes 17 new diesel sites, totalling 36 MW, that have been commissioned within the past year. Of these 17 new sites, 15 sites (totalling 35.4 MW) were in the DFES 2023 contracted pipeline and have now been commissioned. The remaining two, totalling 0.6 MW, recently accepted connection offers with SSEN and were connected in 2024.
- The largest operational site in the licence area is the 140 MW marine diesel power station located at Cowes on the Isle of Wight, which was commissioned in 1990, and provides a range of frequency response, system balancing and restoration services.
- There are ten pipeline sites totalling 21.9 MW of capacity in the licence area. Of these, eight have a connection offer (9.4 MW), while the other two have live connection offers quoted, awaiting acceptance.
- Analysis of sites that have decommissioned in the last few years reveals an operational lifetime of around 12 years. This assumption is reflected in the **Electric Engagement** and **Hydrogen Evolution** scenario. Sites are assumed to decommission more quickly under **Holistic Transition**, where standalone diesel plants are assumed to decommission after 9 years of operational lifetime.
- The use of unabated diesel generators conflicts with net zero emissions targets and is limited by the UK's adoption of the EU Medium Combustion Plant Directive (MCPD), which imposes strict air quality standards. From January 2025, existing standalone diesel plants of above 5 MWth (approximately 2 MWe) must comply with the MCPD. The same applies for plants of 1-5 MWth by January 2030.[2]
- In all three net zero scenarios, standalone generators affected by the MCPD are projected to be decommissioned after 2025.
- Backup generators are modelled to decommission later in the scenario timeframe, as they are unlikely to meet the MCPD threshold of 500 hours of operation. Backup generators are largely decommissioned by 2031 under **Holistic Transition** and 2036 under **Electric Engagement** and **Hydrogen Evolution**.
- Cowes Power Station is considered more specifically due to the site being a strategic asset with a range of contracts with NESO. This site is modelled to remain online until 2040 in **Hydrogen Evolution**, providing ongoing grid balancing purposes. The site is modelled to continue operating under the **Counterfactual** scenario.



3.2.2. Modelling and outcomes

Baseline

Source: SSEN connections data

Scale	Capacity (MW)	Sites	Description
Above 1 MW	334	34	Ten diesel sites greater than 1 MW have commissioned since DFES 2023, meaning that the total baseline capacity of >1 MW sites now totals 334.1 MW. This near-term increase in sites shows a continued appetite for small-scale diesel sites as both standalone and backup generators. The largest site to commission within the past year was the 20 MW 'PeakGen PW Itchen' site which is a backup generator for Portsmouth Water. The large 140 MW marine diesel power station at Cowes on the Isle of Wight remains, by far, the largest diesel generation site in the licence area, holding a number of strategic contracts with NESO.
Below 1 MW	2	10	Ten diesel sites in the licence area have less than 1 MW of capacity each and together total 1.9 MW. Seven

		of these sites (totalling 1.4 MW) came online over the past year.

Pipeline

Source: SSEN connections data

Status	Capacity (MW)	Description
Total	22	Number of sites: 10 The pipeline of prospective new diesel engines in the licence area is c. 12 MW less than the pipeline seen in DFES 2023. This is primarily due some sites progressing to build and coming online over the past year, rather than sites dropping out of the connection queue.
Under construction	4	Two additional sites totalling 4 MW were found to be under construction or near completion and have been modelled to connect in 2025 in all scenarios. No Capacity Market activity was attributed to these sites.
Planning permission granted	2	Two additional sites totalling 2 MW have been granted planning permission. No Capacity Market activity was attributed to these sites.
No information	16	No information could be found for the remaining six sites, totalling 16 MW, in SSEN's connections database. Two of these sites have been issued with connection quotes, four have accepted connection offers.

Scenario projections

Scenario	Capacity (MW)		Description
	2030	2050	
Holistic Transition	0	0	Diesel backup plants are assumed to have a lifetime of 20 years, whereas standalone diesel generation plants are modelled to come offline after nine years. By 2026 all diesel standalone plants have been decommissioned, and by 2031 all backup plants have been decommissioned to be replaced by cleaner alternative technologies, such as long duration

			storage, battery storage or bioenergy, in line with MCPD emissions compliance. The 140 MW Cowes Power Station site is fully decommissioned in 2030 under this scenario.
Electric Engagement	216	0	Diesel backup plants are assumed to have a lifetime of 20 years, whereas standalone diesel generation plants are modelled to come offline after 12 years. By 2026 all diesel standalone plants have been decommissioned, and by 2036 all backup plants have been decommissioned to be replaced by a cleaner alternative, such as long duration storage, in line with MCPD emissions compliance. The 140 MW Cowes Power Station site is fully decommissioned by 2036 in this scenario.
Hydrogen Evolution	216	0	
Counter-factual	322	140	MCPD rules do not come into full force as swiftly as under the net zero scenarios, and diesel generators remain online until 2041 for backup generators, and 2031 for standalone sites. The 140 MW Cowes Power Station site remains connected to the network beyond 2050.

Spatial factors

Factor	Description
Baseline and pipeline locations	The DFES analysis for diesel generation focuses entirely on the decommissioning of existing baseline and pipeline sites. Therefore, no spatial distribution of future capacity and the known locations of these sites are directly reflected in the modelling.

Stakeholder input

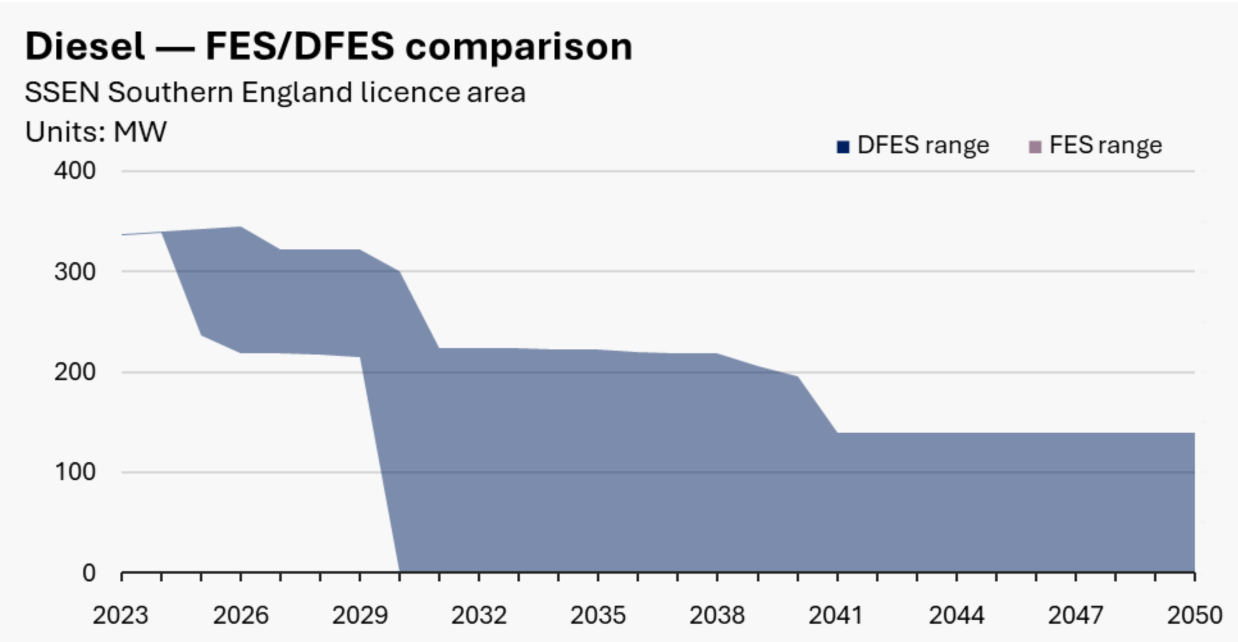
Stakeholder feedback	Impact on DFES analysis
Regional engagement webinar. Stakeholders were asked about the future of fossil fuel generation in the region, with respondents highlighting that the majority of capacity will decommission in the medium term on similar timelines.	This has endorsed the approach we have taken to decommissioning unabated diesel (and fossil gas) generation projects under the net zero scenarios.

3.2.3. Comparisons

Reconciliation to FES 2024

The outcomes of the DFES modelling have been compared against the FES 2024 outcomes for the same licence area.

- There are no FES projections for distribution-connected diesel generation in FES 2024. This is a significant deviation from last year's FES, which showed 100 MW of diesel generation in the FES baseline. The reason for the change in FES data is unclear.



Comparison to DFES 2023

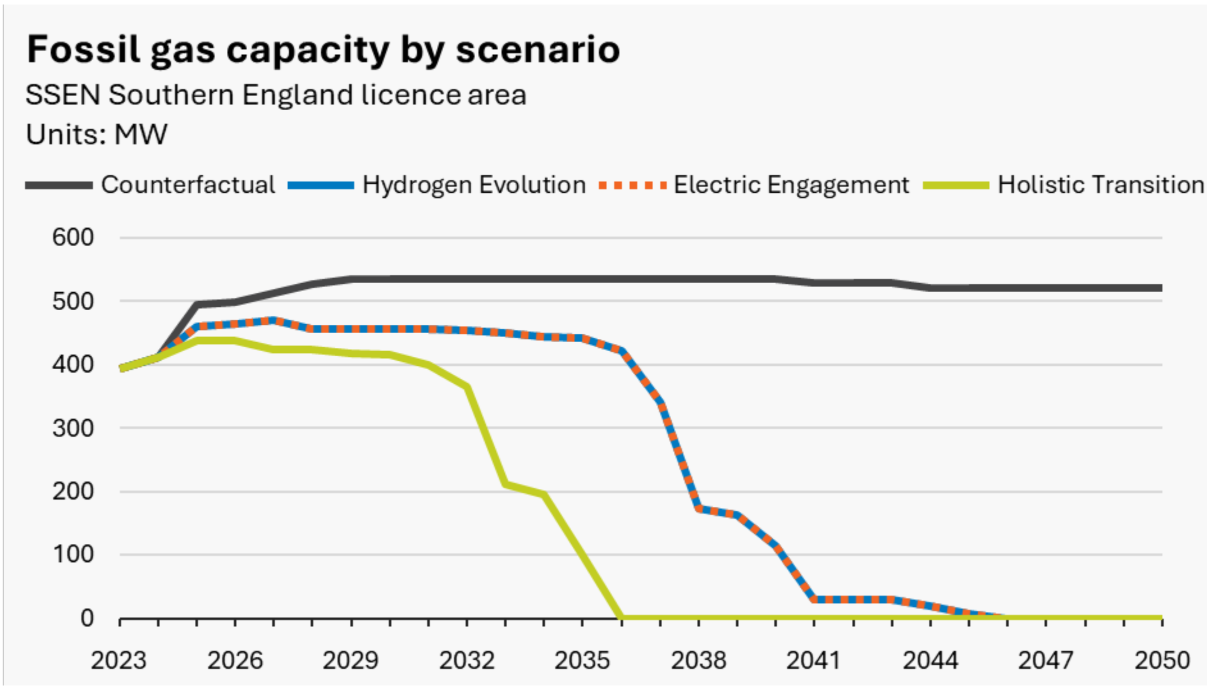
- As in DFES 2023, in DFES 2024 diesel generation decommissions swiftly in all net zero scenarios, with only Cowes Power Station being modelled to remain past 2050 under the **Counterfactual** scenario.
- In DFES 2023, sites were modelled to decommission together by 2030. In DFES 2024, the **Electric Engagement** scenario reflects a more gradual/phased decommissioning in line with the behaviour of owner/operators in response to the MCPD, with standalone sites decommissioning more swiftly than sites serving as backup generation.
- Both DFES 2023 System Transformation scenario and DFES 2024 **Hydrogen Evolution** scenario see a full decommissioning of all plants, including Cowes, by 2040.

3.3. Fossil gas-fired generation

Technical specification	Building blocks
Fossil gas-fired power generation connected to the distribution network, covering four fossil gas generation technology types: • Gas combined heat and power (CHP) • Gas reciprocating engines • Open cycle gas turbines (OCGT) • Closed cycle gas turbines (CCGT)	Gen_BB001 Gen_BB006 Gen_BB008 Gen_BB009

3.3.1. Summary

- There is just under 400 MW of fossil gas-fired electricity generation capacity currently operating in the licence area, split across OCGTs, reciprocating engines and gas CHP.
- Deployment of gas-fired generation is slowing overall as the UK looks to decarbonise its electricity system. There are only 46 (mainly small-scale) projects, totalling 265 MW of capacity, with an accepted connection offer with SSEN and only a minority of these projects have evidence of planning or Capacity Market activity.
- In the net zero scenarios, fossil gas generation capacity is modelled to decrease across the late 2020s and 2030s, as the UK moves to lower carbon forms of dispatchable generation such as batteries, hydrogen-fuelled generation and bioenergy, alongside demand-side flexibility. This aligns with the FES 2024 scenario framework, under which the three net zero scenarios achieve net zero power by 2035 at the latest (though some gas-fired power remains connected for backup purposes).
- All three net zero scenarios model some fossil gas generation sites to repower as hydrogen-fuelled generation plants, particularly under the **Hydrogen Evolution** scenario, where hydrogen is most readily available across the UK.
- Under the **Holistic Transition** scenario all fossil-gas generation is decommissioned by the end of 2035, and by the end of 2040 under **Electric Engagement** and **Hydrogen Evolution**, as the UK moves to net zero power.
- Slower progress towards decarbonisation results in most gas-fired electricity generation capacity remaining online beyond 2050 under the **Counterfactual** scenario, totalling over 500 MW in the licence area.



3.3.2. Modelling and outcomes

Baseline

Source: SSEN connections data

Scale	Capacity (MW)	Sites	Description
Above 1 MW	388	33	A 100 MW OCGT plant at Didcot Power Station is the only operational OCGT in the licence area, providing system balancing and flexibility services. There are 19 gas reciprocating engine sites, totalling just over 200 MW of capacity currently in operation. 14 of these were commissioned between 2016 and 2020 and are mostly located near to urban areas. There are also 13 operational gas CHPs, totalling over 80 MW of capacity. This includes a 36 MW site on the Isle of Wight to provide heat and power to a horticultural site.
Below 1 MW	6	44	The small-scale gas baseline is almost entirely comprised of small gas CHPs, providing heat and

power to buildings such as leisure centres, student accommodation and hotels.

Pipeline

Source: SSEN connections data

Status	Capacity (MW)	Description
Total	265	Number of sites: 46 This represents a 20% decrease in total pipeline capacity compared to DFES 2023.
Already operational	4.2	Three small-scale sites were found to already be operational based on desktop research. These sites have been modelled to connect in 2024 under all scenarios.
Under construction	7.1	One medium-scale site has been under construction since 2023. This site has been modelled to connect in 2024 under all four scenarios.
Planning permission granted	68	There are 16 sites in the pipeline with planning permission granted. Seven of these sites, totalling 28 MW, either have evidence of activity in recent Capacity Market auctions or are less than 1 MW in size, resulting in them being modelled to connect under all four scenarios between 2024 and 2027. The nine remaining sites have less evidence of development beyond their planning permission. These sites are modelled to connect under all scenarios except **Holistic Transition**, which features the least increase in connected fossil gas capacity in the near term.
No information	126	There are 23 sites in the pipeline where no information on planning status could be identified. 12 sites of less than 1 MW each, totalling 3.5 MW, are modelled to connect in 2024 under all four scenarios due to their small-scale. One site, a gas reciprocating engine project with a capacity of 20 MW, has no planning or Capacity Market information and as such is only modelled to connect under the **Counterfactual** scenario.

		Five larger-scale sites totalling 56 MW, ranging from 3 to 35 MW, have no development information but have an accepted connection offer with SSEN. These sites are also modelled to progress only under the **Counterfactual** scenario. Five further sites have no development information and have not yet accepted a connection offer with SSEN. These sites are not modelled to connect under any scenario.
Refused planning, withdrawn or abandoned	59	Four sites in the pipeline, totalling 59 MW, have withdrawn their planning applications or had their applications refused and are not modelled to connect under any scenario.

Scenario projections

Scenario	Capacity (MW)		Description
	2030	2050	
Holistic Transition	417	0	Fossil gas generation capacity decommissions quickly in the late 2020s and early 2030s as the UK looks to achieve a rapidly decarbonised electricity system. Sites are modelled to decommission at the end of their operational life, ranging from 15 years for reciprocating engines to 20 years for OCGTs, or by a backstop date of 2035. No capacity remains online by 2050 under this scenario.
Electric Engagement	456	0	Fossil gas generation capacity decommissions in the late 2020s and throughout the 2030s under these scenarios, as the UK looks to achieve a rapidly decarbonised electricity system. Sites are modelled to decommission at the end of their operational life, ranging from 20 years for reciprocating engines and CHPs to 25 years for OCGTs. Backstop dates for decommissioning have also been considered for CHPs, where 2040 is the latest year for electricity-only generation and 2045 for gas CHPs. No capacity remains online by 2050 under these scenarios.
Hydrogen Evolution	456	0	
Counter-factual	535	522	Fossil gas generation remains online as progress towards net zero is slow and low-carbon alternatives to fossil gas generation see low uptake. Only older projects reaching the end of an extended operational life are modelled to

			decommission, resulting in a limited reduction in fossil gas capacity in the 2040s.

Spatial factors

Factor	Description
Existing baseline and pipeline sites	The DFES projections are modelled directly on a site-by-site basis.

Stakeholder input

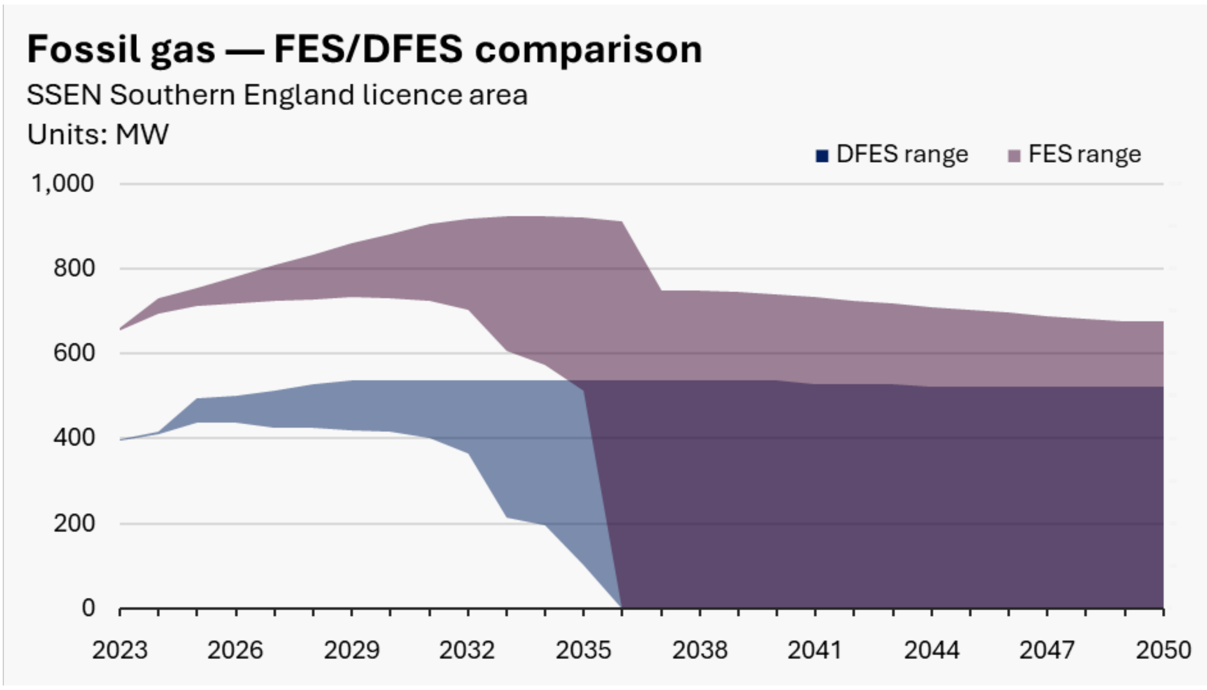
Stakeholder feedback	Impact on DFES analysis
A range of stakeholders were polled on the future of fossil gas-fuelled generation in light of upcoming clean power targets, as part of the Southern England regional DFES engagement webinar.	Stakeholders felt that there would be much less development of new fossil gas generation sites and gas plants would start to decommission in the near and medium term, most likely via a phased approach. This has been reflected in the pipeline analysis, with only sites with contracted Capacity Market contracts or very small sites progressing under the **Holistic Transition** scenario. Phased decommissioning then occurs mostly over the 2030s based on the type and age of individual baseline and pipeline sites.

3.3.3. Comparisons

Reconciliation to FES 2024

The outcomes of the DFES modelling have been compared against the FES 2024 outcomes for the same licence area.

- The baseline for fossil gas generation is substantially different between the FES and DFES, by around 250 MW. This is a similar difference to that seen in the diesel baseline comparison, suggesting this may be due to differences in classification of fossil fuel technologies. This is likely to be predominantly due to the classification of Cowes Power Station on the Isle of Wight as diesel/oil-fuelled in the DFES rather than as a gas-fired OCGT.
- Beyond the baseline variance, the DFES and FES trends are well aligned.



Comparison to DFES 2023

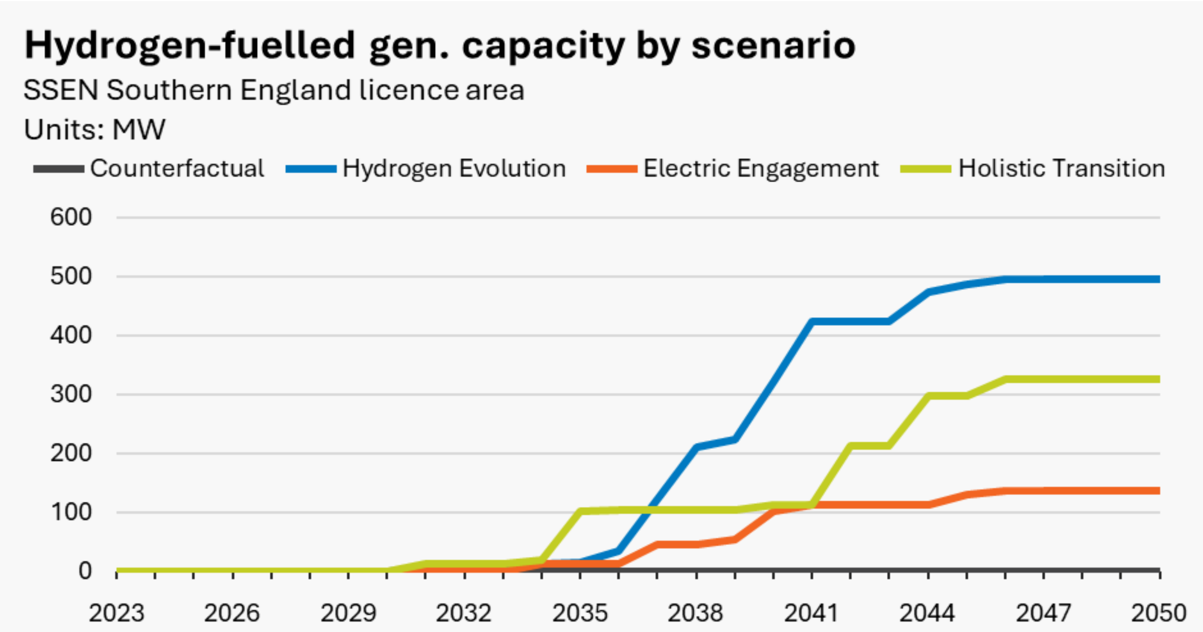
- The overall trend and modelling methods are similar between DFES 2023 and DFES 2024.
- The pipeline has evolved since the DFES 2023 analysis, with several sites dropping out of the connections pipeline and several sites progressing further in planning or in Capacity Market auctions. This has resulted in a narrower range of scenario projections in the near term, as the pipeline narrows from a wider range of less developed projects to a narrower range of more advanced projects.

3.4. Hydrogen-fuelled electricity generation

Technical specification	Building blocks
Hydrogen-fuelled electricity generation, which has been modelled to connect to the distribution network in areas where there is the potential for hydrogen gas supply. This links to the analysis undertaken for fossil gas capacity.	Gen_BB023

3.4.1. Summary

- Hydrogen-fuelled electricity generation is modelled based on the conversion of existing operational and in-development fossil gas generation sites to hydrogen-fuelled generation in the future. This is based on an analysis of ‘if and when’ low-carbon hydrogen becomes regionally and locally available under each of the four scenarios.
- Dispatchable low-carbon electricity supply such as hydrogen-fuelled generation is seen as a key component of a net zero power system based predominantly on variable renewable generation like solar PV and wind power, which occurs under all three net zero scenarios.
- Low carbon hydrogen becomes widely available in the 2030s and 2040s across the UK under the **Hydrogen Evolution** scenario, resulting in a high proportion of existing and pipeline fossil gas generation sites converting to hydrogen-fuelled generation in the longer term. By 2050, over 500 MW of hydrogen-fuelled generation capacity is projected in the licence area under this scenario.
- Under the **Holistic Transition** and **Electric Engagement** scenarios low carbon hydrogen only becomes widely available in and around industrial clusters rather than across most of the UK. This results in less hydrogen-fuelled generation both nationally and in the licence area under these scenarios, reaching approx. 130 MW under **Electric Engagement** and 320 MW under **Holistic Transition**.
- Southern England hosts a significant length of the gas National Transmission System running down to Southampton, which, under National Gas’ Project Union plan, would be converted to transport hydrogen.[3] This results in an extensive supply of low carbon hydrogen for power generation under the **Hydrogen Evolution** scenario.
- There is no distribution-scale hydrogen-fuelled electricity generation anywhere in the UK under the **Counterfactual** scenario, in line with this scenario’s slow progress towards decarbonisation.



3.4.2. Modelling and outcomes

Baseline and pipeline

Source: SSEN connections data

There are currently no connected hydrogen-fuelled generation projects or sites with accepted connection offers in the licence area. The existing baseline and pipeline of fossil gas-fired generation projects are used as a pipeline of prospective locations for future distributed hydrogen-fuelled power generation in the licence area in the medium and longer term.

Scenario projections

Scenario	Capacity (MW)		Description
	2030	2050	
Holistic Transition	0	326	Existing connected and pipeline fossil gas-fired generation sites are modelled to convert to hydrogen once low-carbon hydrogen is locally available and the gas-fired plant has been decommissioned.

Electric Engagement	0	137	Hydrogen availability is modelled based on distance to an anticipated hydrogen or industrial cluster, such as the HyNet or East Coast Hydrogen projects.[4,5] The FES framework assumes that hydrogen transmission infrastructure is limited under these scenarios. Under **Holistic Transition**, fossil gas sites within 20 km of a cluster are modelled to convert to hydrogen from the early 2030s, expanding to over 150 km by the late 2040s. Under **Electric Engagement**, the development of hydrogen-fuelled generation is more limited, starting in the mid-2030s and only occurring at sites within 50 km of an anticipated hydrogen cluster. By 2050, overall capacity reaches approx. 0.1 GW under **Electric Engagement** and 0.3 GW under **Holistic Transition**.
Hydrogen Evolution	0	495	Existing connected and pipeline fossil gas-fired generation sites are modelled to convert to hydrogen once low-carbon hydrogen is locally available and the gas-fired plant has been decommissioned. Hydrogen availability is modelled based on the distance to a planned transmission hydrogen network, namely Project Union, or an anticipated hydrogen or industrial cluster, such as the HyNet or East Coast Hydrogen projects. Fossil gas generation sites within 20 km of a cluster are modelled to convert to hydrogen from the early 2030s, expanding to over 150 km by the late 2040s. In addition, due to the wider availability of hydrogen under this scenario and the benefits of hydrogen as a high-capacity, low-utilisation 'peaking' technology, current gas reciprocating engines are modelled to replant with an additional 50% capacity. Overall capacity reaches approx. 0.5 GW by 2050 under this scenario.
Counter-factual	0	0	In alignment with the FES 2024 framework, there is no development of hydrogen-fuelled generation at any point under this scenario.

Spatial factors

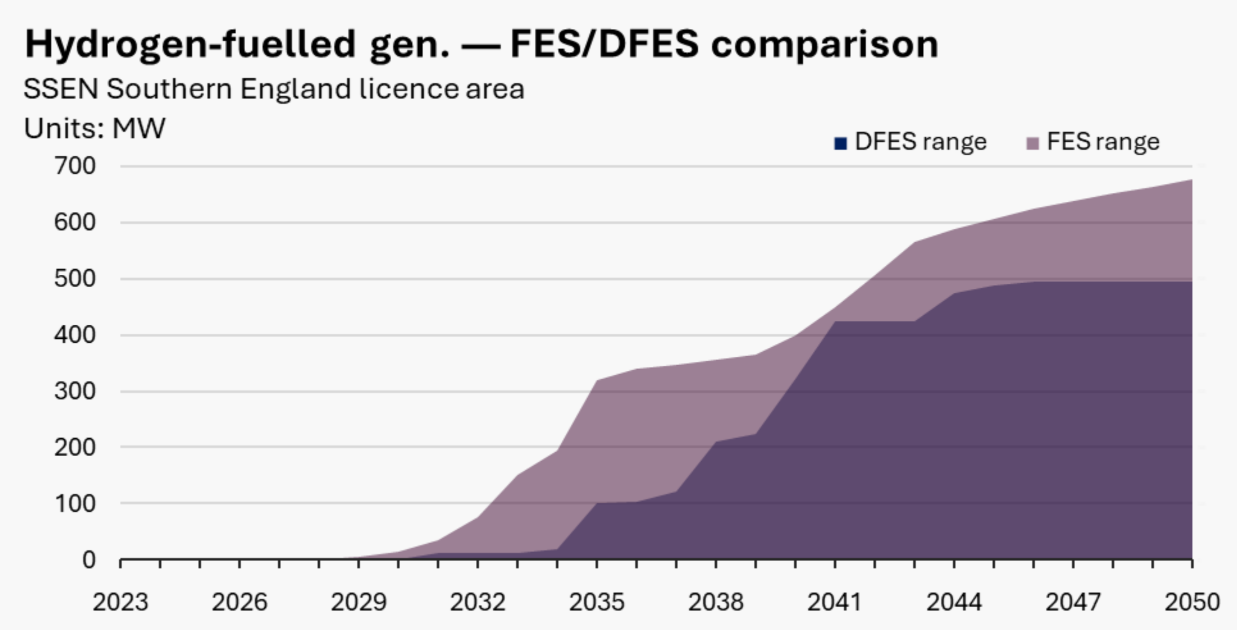
Factor	Description
Existing baseline and pipeline of gas-fired generation.	The location of future hydrogen-fuelled generation sites is based solely on the location of baseline and pipeline gas-fired generation sites in the licence area.
Location of industrial clusters and planned hydrogen clusters.	Timing of the modelled conversion of gas-fired generation sites is based on the distance from industrial clusters and planned hydrogen clusters in all three net zero scenarios.
Location of planned hydrogen networks.	Timing of the modelled conversion of gas-fired generation sites is based on the distance from planned hydrogen networks under the **Hydrogen Evolution** scenario.

3.4.3. Comparisons

Reconciliation to FES 2024

The outcomes of the DFES modelling have been compared against the FES 2024 outcomes for the same licence area.

- The total projected capacities and overall trend of hydrogen-fuelled generation is broadly aligned between the DFES and FES 2024. The DFES uptake is based on the conversion of fossil gas-fired sites at the point they are modelled to decommission. This may explain a slower uptake seen in the DFES when compared to the FES in the near and medium term.
- The DFES and FES align in the **Counterfactual** scenario where no hydrogen-fuelled generation capacity is modelled to connect at all out to 2050.



Comparison to DFES 2023

- The outcomes for **Hydrogen Evolution** and **Holistic Transition** have been inverted compared to DFES 2023, mirroring the same change in the FES 2024 framework. Other than this, the overall trajectory and magnitude of uptake is similar to DFES 2023.
- Sites are no longer limited by a maximum 'mothballing period' of ten years between gas-fired plant decommissioning and hydrogen-fuelled generation commissioning. This aims to represent existing sites as prospective site locations for thermal generation (including hydrogen-fuelled generation), regardless of whether the site is a conversion of an existing plant or a new build project. This has not resulted in a substantial change to the magnitude of projections in the licence area.

3.5. Hydropower

Technical specification	Building blocks
Hydropower generation connecting to the distribution network. This does not include pumped hydroelectric storage.	Gen_BB018

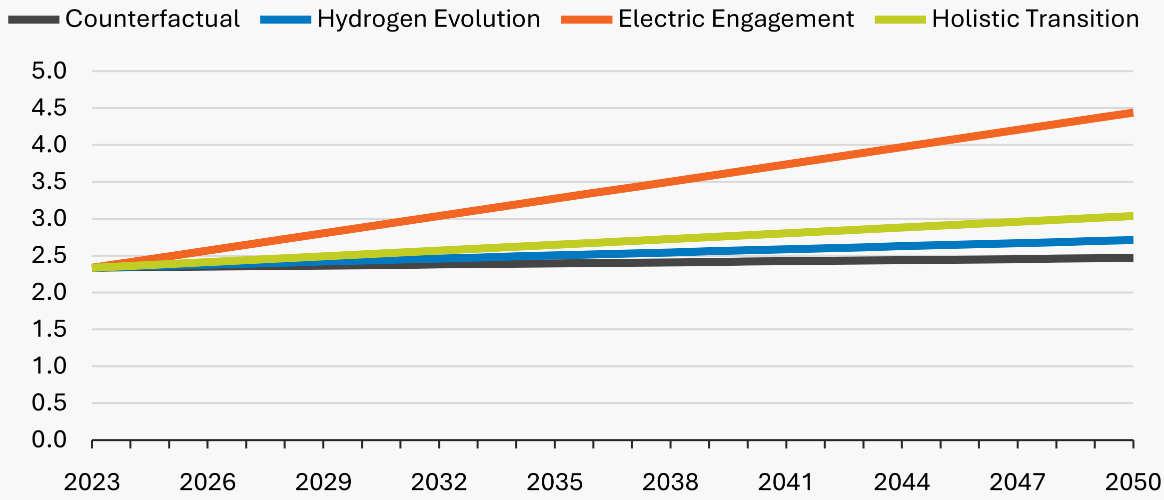
3.5.1. Summary

- There is currently 2.4 MW of installed hydropower capacity across 54 sites in the Southern England licence area.
- No additional sites have connected since the previous DFES study in 2023. However, the connected baseline has increased by 0.8 MW due to a recategorisation of some projects that were previously in the development pipeline that have since been found to be operational.
- Development of further hydropower in the licence area is very limited. Additional capacity is proportionate to NESO’s FES 2024, driven primarily by the repowering of existing sites with higher generation capacities.
- Hydropower capacity in the licence area in 2050 resultantly ranges from 2.6 MW under the **Counterfactual** scenario to 3.2 MW under the **Electric Engagement** scenario.

Hydropower capacity by scenario

SSEN Southern England licence area

Units: MW



3.5.2. Modelling and outcomes

Baseline

Source: SSEN connections data

Scale	Capacity (MW)	Sites	Description
Above 1 MW	0	0	There are no hydropower sites over 1MW capacity in the licence area.
Below 1 MW	2.4	54	Most existing projects were installed between 2010 and 2016, when the Feed-in Tariff scheme was operational. The two largest sites are both in South Oxfordshire; one site has a capacity of 567 kW and another, Culham Hydro, has a capacity of 427 kW. Nearly 50 of these small-scale operational sites have capacities less than 100kW.

Pipeline

There are no hydropower sites in the pipeline in the Southern England licence area.

Scenario projections

Scenario	Capacity (MW)		Description
	2030	2050	
Holistic Transition	2.5	3.0	This scenario supports large-scale renewable energy projects, so small renewable projects, such as micro hydropower, receive less support. Therefore, low growth is modelled out to 2050. Without small-scale hydropower subsidy support, projects are supported by the Smart Export Guarantee only.
Electric Engagement	2.9	4.4	This scenario features favourable UK Government policies and support for small-scale renewable energy projects. Therefore, this scenario projects the highest development of additional hydropower. A moderate but sustained growth in hydropower capacity is projected out to 2050 and is driven by repowering.

Hydrogen Evolution	2.4	2.7	This scenario supports large-scale renewable energy projects, so small renewable projects, such as micro hydropower, receive less support. Therefore, low growth is modelled out to 2050. Without small-scale hydropower subsidy support, projects are supported by the Smart Export Guarantee only.
Counter-factual	2.4	2.5	Under this scenario, no additional capacity growth has been modelled out to 2050, reflecting the limited support for small-scale renewables.

Spatial factors

Factor	Description
Site location	The distribution of hydropower capacity is entirely based on the location of known projects and resource availability. Additional small-scale, medium and long-term projections are distributed spatially based on areas of theoretical hydropower potential and repowering.

Stakeholder input

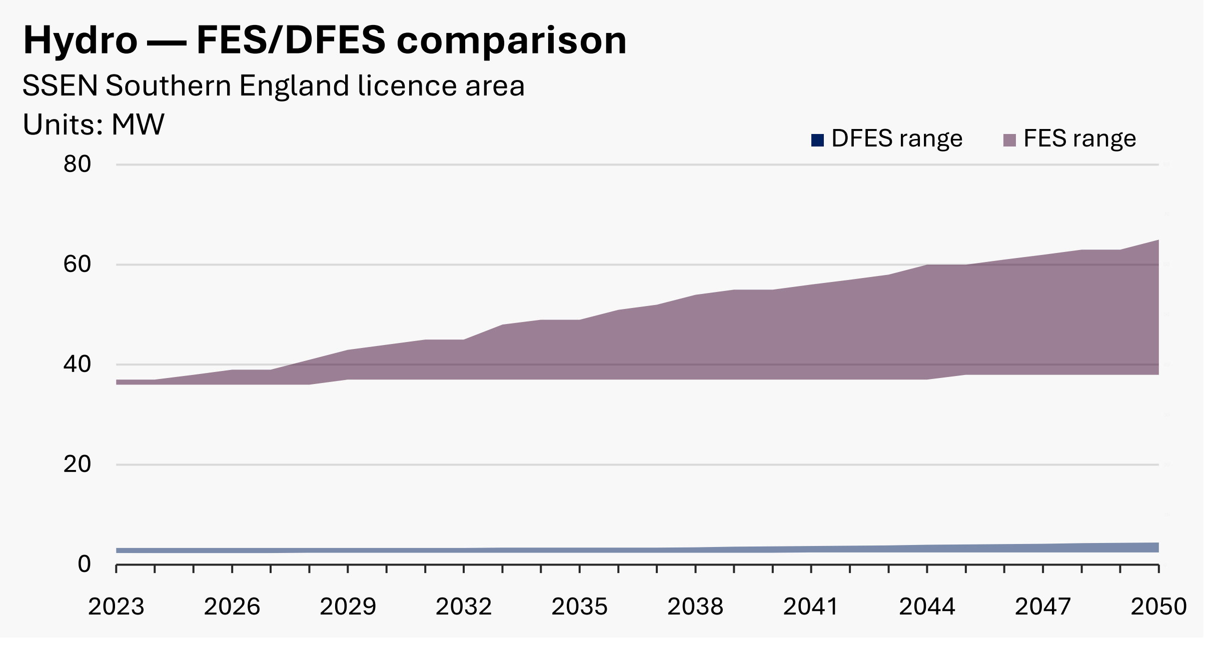
Stakeholder feedback	Impact on DFES analysis
Engagement with the British Hydropower Association	During the development of last year's DFES study (2023), the British Hydropower Association were engaged to consider the resource assessment and projection numbers from the FES analysis. They confirmed that hydropower is highly dependent on funding mechanisms and developments in micro-scale schemes. This feedback influenced the assumption of growth for micro and pico-scale projects under the Consumer Transformation scenario in DFES 2023 which has been brought forward to DFES 2024 in the **Electric Engagement** scenario. The British Hydropower Association also confirmed the constraints on resources in the licence area, and as a result, supported a theoretical absolute ceiling capacity of 10 MW for projects in the southern England region.

3.5.3. Comparisons

Reconciliation to FES 2024

The outcomes of the DFES modelling have been compared against the FES 2024 outcomes for the same licence area.

- FES projections for hydropower are significantly higher than DFES 2024.
- The higher FES projections are due to a much higher baseline of installed hydropower capacity, totalling 36 MW. The DFES is a bottom-up analysis and this site-by-site approach has only discovered 2.4 MW of existing hydropower capacity. The reason for this significant variance is unclear.
- However, the DFES does reflect the proportional growth of the FES across the scenarios, albeit from a significantly lower baseline capacity.



Comparison to DFES 2023

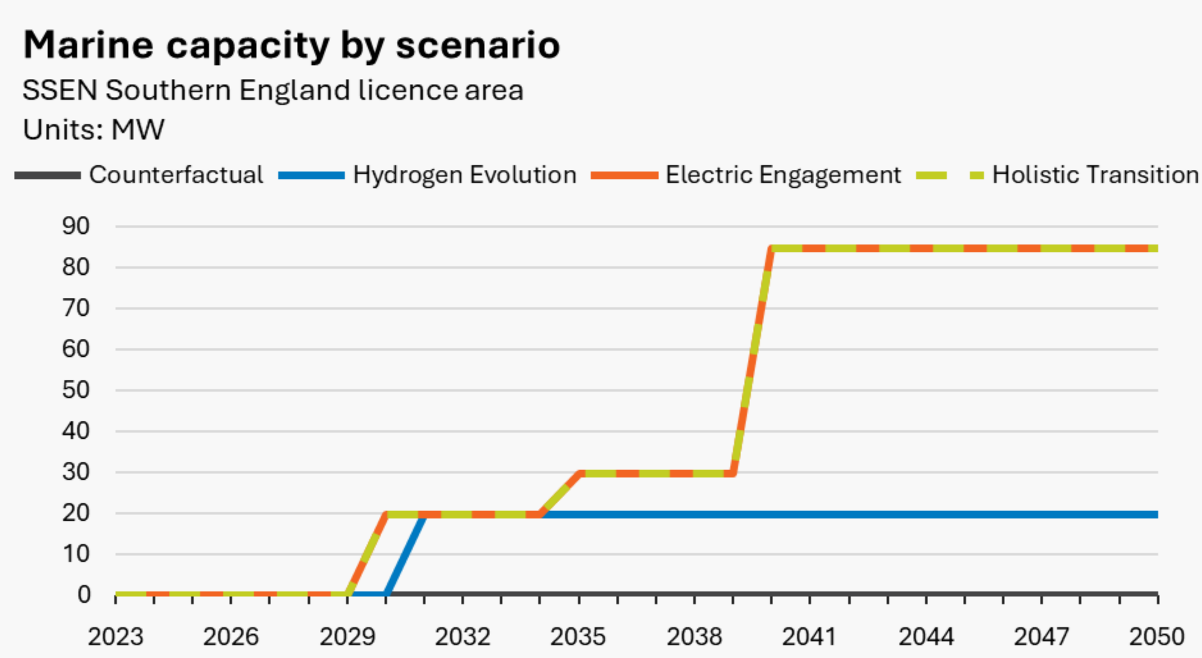
- DFES 2024 has a narrower range of outcomes than DFES 2023.
- There is 2.4 MW of installed hydropower capacity across 54 sites in DFES 2024.
- No additional sites have connected since the previous DFES study in 2023. However, the connected baseline has increased by 0.8 MW due to a recategorisation of some projects that were previously in the development pipeline and have since been found to be operational.

3.6. Marine generation

Technical specification	Building blocks
Marine (tidal stream, wave power, tidal lagoon)	Gen_BB017

3.6.1. Summary

- There are no operational grid-connected marine energy generation projects in the Southern England licence area.
- 28 MW of tidal stream capacity secured Contracts for Difference (CfD) across Great Britain in Allocation Round 6 (AR6) in 2024. However, no projects in England won contracts.
- There is one project that holds an accepted connection offer with SSEN, the Perpetuus Tidal Energy Centre (PTEC) site on the Isle of Wight. This project has a connection offer for 20 MW with possible additional phases leading to capacity increases in the future (with a potential 85 MW maximum capacity). However, not securing CfD support to date and a recent announcement of the lapsing of this site's planning permission, means that it is only modelled to connect under the net zero scenarios.
- Projections assume no further growth in generation capacity beyond the pipeline site.



3.6.2. Modelling and outcomes

Baseline

Source: SSEN connections data

Scale	Capacity (MW)	Sites	Description
N/A	0	0	There are no existing marine generation sites in the Southern England licence area.

Pipeline

Source: SSEN connections data

Status	Capacity (MW)	Description
Total	85	Number of sites: 1
Planning permission granted	20 – 85 MW	Perpetuus Tidal Energy Centre (PTEC) has an accepted connection offer for 20 MW and had previously obtained planning consent for a 30 MW development. Further development and network connection is dependent upon securing a CfD. The project did not win a CfD in AR6 and in December 2024 its existing planning permission was announced to have lapsed.[6] The future of this site is, therefore. uncertain but remains one of the only live development areas for marine generation in the licence area. Therefore, phased capacity has been modelled under the net zero scenarios only: • Phase 1 (20 MW) is modelled to connect in 2030 in **Holistic Transition** and **Electric Engagement** and 2031 in **Hydrogen Evolution**. • Phase 2 (10 MW additional capacity) connects in 2035 in **Holistic Transition** and **Electric Engagement** scenarios only. • Phase 3 (55 MW additional capacity) connects in 2040 in **Holistic Transition** and **Electric Engagement** scenarios only.

Scenario projections

Scenario	Capacity (MW)		Description
	2030	2050	
Holistic Transition	20	85	Marine technologies receive good support across all scales, and there is consistent industry development out to 2050. Therefore, despite recent setbacks, the PTEC site has been modelled to be revisited and expand its site capacity further to approximately 85 MW in the longer term.
Electric Engagement	20	85	
Hydrogen Evolution	0	20	Support for marine generation technologies is lower than in the other net zero scenarios and so the PTEC site is modelled to connect later (2031) and does not expand capacity beyond the initial 20 MW.
Counter-factual	0	0	There is low support for tidal stream overall and no further ring-fenced budgets for tidal stream are considered to be included in future CfD Allocation Rounds. As a result, projects in Southern England do not receive UK Government support and no development occurs, including a full the PTEC project not going ahead.

Spatial factors

Factor	Description
Site locations	Location of known pipeline projects.

Stakeholder input

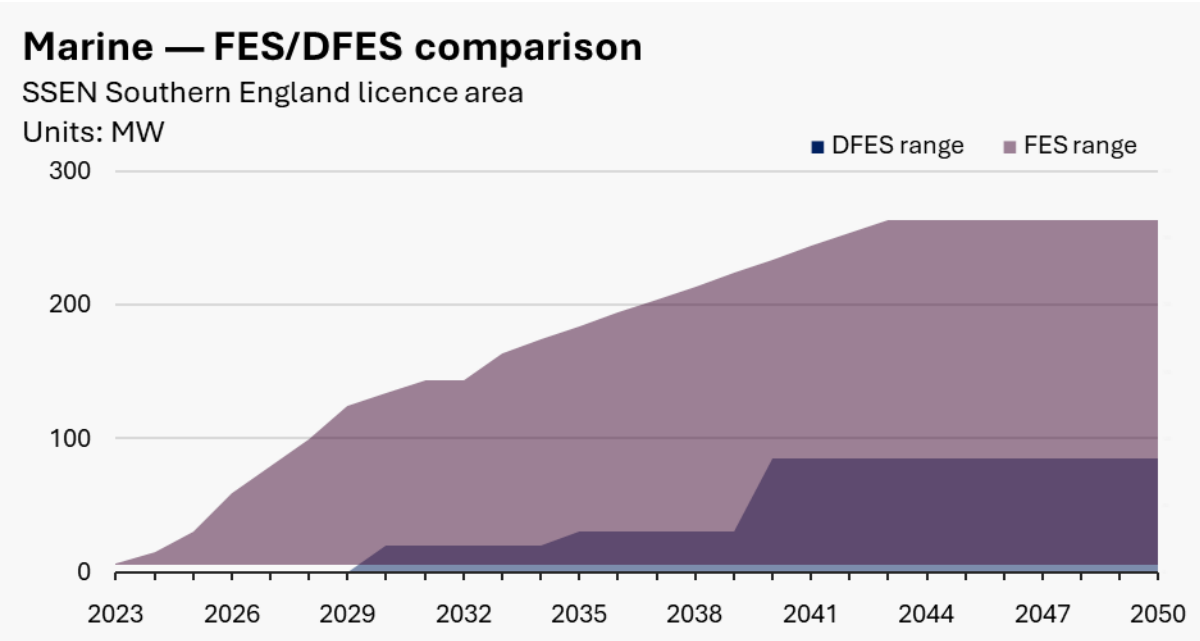
Stakeholder feedback	Impact on DFES analysis
Representatives from the Isle of Wight, EMEC, MEC and the marine energy development sector have previously been engaged	Information related to sites without a connection offer was provided and included in the projections.

3.6.3. Comparisons

Reconciliation to FES 2024

The outcomes of the DFES modelling have been compared against the FES 2024 outcomes for the same licence area.

- The FES 2024 baseline is 5.4 MW. However, the DFES analysis has confirmed that there are no operational marine projects in the Southern England licence area.
- FES projections are much higher than DFES in the **Holistic Transition** and **Electric Engagement** scenarios (reaching 264 MW by 2050). FES and DFES are aligned in the **Counterfactual**, with no capacity projected.
- In FES 2024, all marine capacity is connected to the Melksham GSP. However, this GSP does not have any coastline and so it is unlikely that marine generation would connect here. As such, this is likely to be a data oddity coming from the FES GSP allocation modelling.



Comparison to DFES 2023

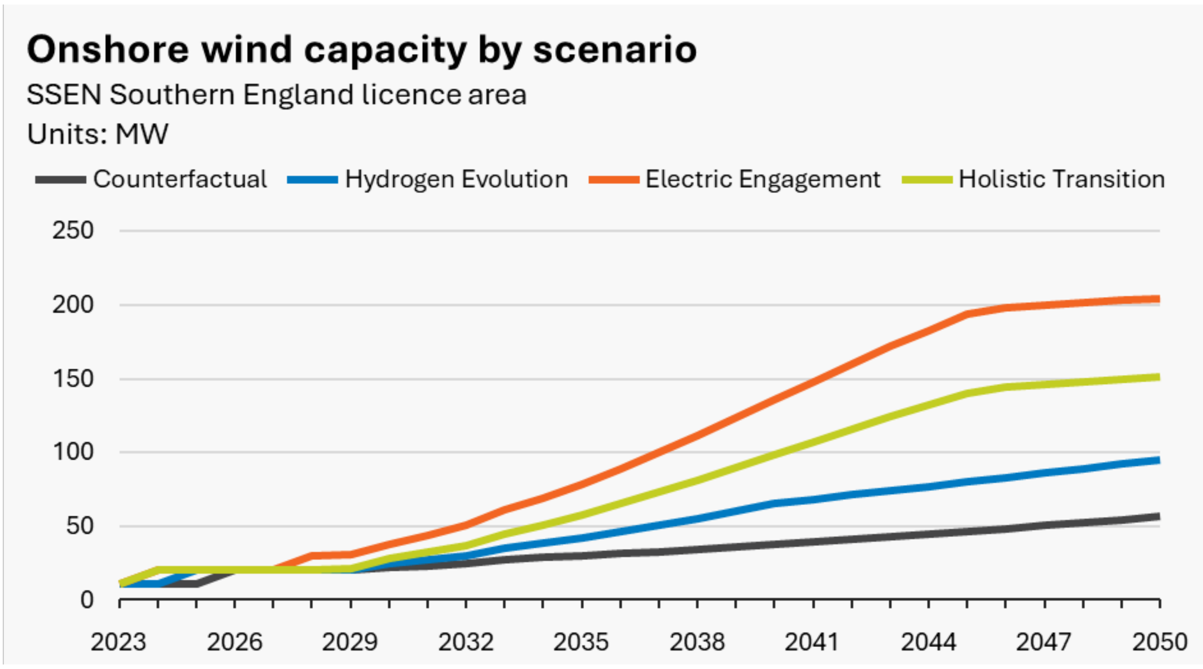
- The DFES 2024 projections have seen only minimal change compared to DFES 2023.
- The only change is that the single pipeline site is now modelled to connect in 2030 in the **Holistic Transition** and **Electric Engagement** scenarios, one year later than in DFES 2023. This is due to the project not being awarded a CfD in the 2024 AR6 auction and its planning approval has since lapsed.

3.7. Onshore wind generation

Technical specification	Building blocks
Large-scale onshore wind generation (>= 1MW)	Gen_BB015
Small-scale onshore wind generation (<1 MW)	Gen_BB016

3.7.1. Summary

- The Southern England licence area has seen minimal deployment of onshore wind to date, including a very small increase in capacity since 2012, resulting in an 11 MW baseline.
- The 8.2 MW Alaska Wind Farm in Dorset, currently under construction, is the only project expected to deploy in the near-term in the licence area.
- Deployment has been heavily restricted for many years, in part due to an unsupportive planning policy regime for onshore wind projects in England, which was in force between 2015 and 2024.
- In July 2024, the incoming UK Labour Government revised onshore wind planning policy, as set out in the 'Policy statement on onshore wind', removing this barrier to deployment in the National Planning Policy Framework (NPPF).[7] While the full effect of this reform is yet to be seen in the pipeline of in-development onshore wind projects in England, the impact of this policy change has been reflected in an increase to the lower bounds of the DFES projections for onshore wind in English licence areas, relative to previous years' analysis. There is already an assumption inherent in the more ambitious scenarios for onshore wind (**Electric Engagement** and **Holistic Transition**) that planning reform would take place and, therefore, these scenarios already reflect this policy change.
- Engagement with representatives from the onshore wind sector confirmed that the development of new onshore wind capacity is expected to be limited before 2029. Long connection queues (even after connection reforms are applied) and uncertainty around the impact of the aforementioned planning reforms were cited as the main barriers to near-term deployment.
- A renewed deployment of new onshore wind sites is projected in all scenarios post 2029. This results in 200 MW deployed across the licence area by 2050 under the most ambitious scenario.



3.7.2. Modelling and outcomes

Baseline

Source: SSEN connections data

Scale	Capacity (MW)	Sites	Description
Above 1 MW	8.5	2	The 6.2 MW Westmill Windfarm, near Swindon, remains the largest onshore wind site in the licence area, connecting in 2008.
Below 1 MW	3.3	6	Some small-scale onshore wind sites connected between 2011 and 2014, taking advantage of the higher early rates of the Feed-in-Tariff incentive programme.

Pipeline

Source: SSEN connections data

Status	Capacity (MW)	Description
Total	18.2	Number of sites: 5
Under construction	9.2	The 9.2 MW Alaska wind farm project in Dorset is currently under construction and is modelled to commission between 2024 and 2026 under all scenarios. [8]
No information or n/a	9	Four sites that are each between 2-3 MW in capacity have accepted connection offers with SSEN within the past year. However, as there is no evidence that these sites have entered the planning system, they are modelled to build out only under **Electric Engagement**, as the scenario that is most supportive of decentralised onshore wind. These sites are modelled to connect in 2028 under this scenario.

Scenario projections

Scenario	Capacity (MW)		Description
	2030	2050	
Holistic Transition	29	152	The modelling under these ambitious scenarios assumes a renewed deployment of onshore wind in the licence area through the 2030's and 2040's. However, due to the very small baseline in the licence area, the re-powering of older sites to higher capacities has only a negligible impact on overall deployed capacity by 2050.
Electric Engagement	39	205	By 2050, 152 MW of onshore wind is deployed under **Holistic Transition** and 205 MW under **Electric Engagement**. While this represents a large growth in connected capacity relative to the current baseline on onshore wind, it remains a small overall total capacity, relative to equivalent large-scale solar or grid-scale battery storage projections in the licence area.
Hydrogen Evolution	25	96	This scenario sees a greater focus on transmission network-connected electricity generation to achieve net zero targets, resulting in limited onshore wind deployment on the distribution network. Despite this, a moderate renewed

			deployment of new onshore wind sites is projected post-2029 due to a more supportive planning environment in England. By 2050, nearly 100 MW of onshore wind capacity is deployed in the licence area under this scenario.
Counter-factual	23	57	The least ambitious scenario, the **Counterfactual**, has the least amount of growth in onshore wind capacity. However, due to the improved planning environment, a renewed deployment of onshore wind is still considered in the licence area, resulting in 57 MW deployed by 2050.

Spatial factors

Factor	Description
Onshore wind resource assessment	Regen's in-house resource assessment, taking into consideration wind resource, land availability and planning constraints in the licence area, is used to inform the spatial distribution of post-pipeline onshore wind capacity.
Local ambition	Local ambition is also reflected in the distribution of post-pipeline capacity. This includes local authority policy landscape, localised commitments to renewable energy development and wider net zero goals/targets.

Stakeholder input

Stakeholder feedback	Impact on DFES analysis
Local Area Energy Plans	Explicitly stated local targets for wind power through available LAEPs inform the distribution of post-pipeline capacity. DFES projections are also checked against these targets to ensure they are captured within the envelope of scenarios, where applicable and viable.
Developer engagement	Engagement with onshore wind developers in attendance at a Regen in-person event re-affirmed the view that reforms to English planning law would not result in immediate near-term growth in deployment. As a result, growth is only projected post-2029.
Location of onshore wind development from the Southern Central England regional webinar	Attendees at the Southern England regional webinar in October 2024 were asked about the likely location of any future onshore wind sites. The responses received re-affirmed that the locations for future onshore wind

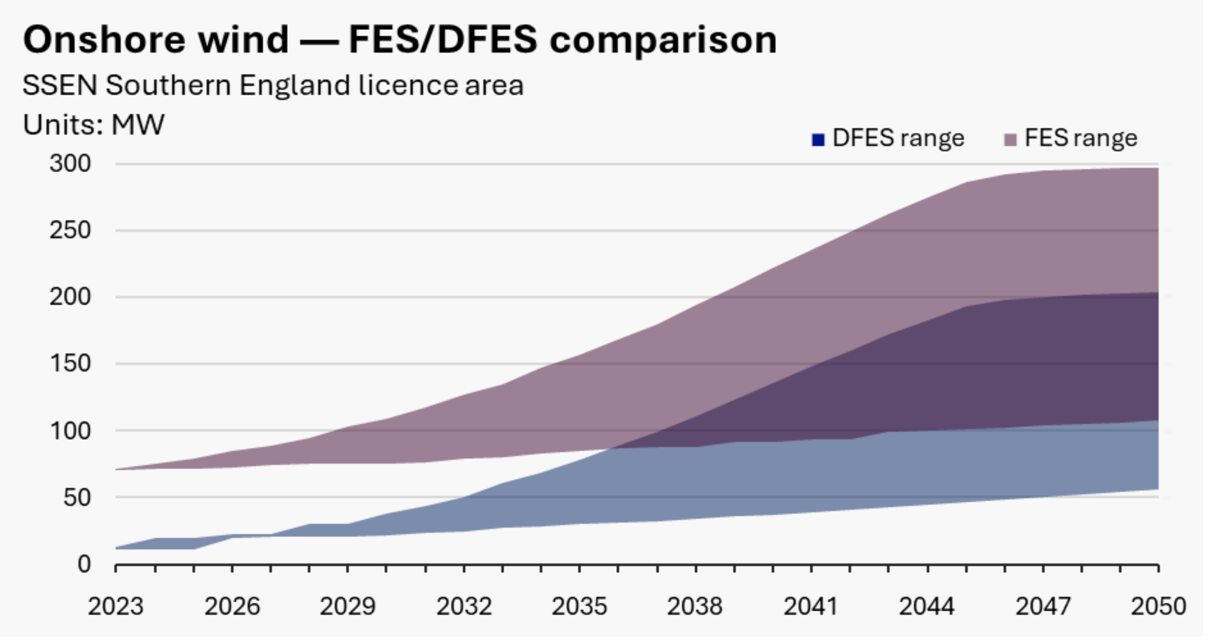
development are likely to be near existing grid infrastructure, and protected areas (such as AONBs) are unlikely to be candidates for future development. This is reflected in the distribution of post-pipeline capacity.

3.7.3. Comparisons

Reconciliation to FES 2024

The outcomes of the DFES modelling have been compared against the FES 2024 outcomes for the same licence area.

- As was the case with FES 2023, FES 2024 reports a baseline of 70 MW in the licence area. This is not evidenced in the SSEN connections data and, consequently, the DFES baseline is notably lower than the FES.
- FES 2024 projects some near term growth under more ambitious scenarios. The DFES has not found evidence of a development pipeline of new onshore wind projects ready to deploy in the licence area, so does not reflect any significant growth until post-2029.
- FES 2024 and DFES 2024 have similar long term growth projections under the **Electric Engagement** and **Holistic Transition** scenarios (when accounting for variance seen in the baseline capacity).
- The DFES scenarios that are less supportive for distributed onshore wind, **Hydrogen Evolution** and the **Counterfactual**, both project higher long-term growth in onshore wind capacity than the FES 2024 equivalent scenarios. This is primarily due to the reflection of recent onshore wind planning reforms in England in the DFES 2024 modelling. The FES 2024 was published prior to the announcement of this reform.



Comparison to DFES 2023

- DFES 2024 near term projections closely aligned with the equivalent projections within DFES 2023. This is due to the continued absence of a pipeline of sites in development.
- DFES 2024 long-term projections are closely aligned with DFES 2023 projections under the more ambitious scenarios **Electric Engagement** and **Holistic Transition**.
- The less ambitious DFES 2024 scenarios, **Hydrogen Evolution** and the **Counterfactual,** have higher long-term growth than the equivalent, less ambitious DFES 2023 scenarios. This is due to recent onshore wind planning reform being reflected in the DFES 2024 modelling.

3.8. Other generation

Technical specification	Building blocks
Connected or contracted generation sites that could not be positively identified as a specific technology type.	n/a

3.8.1. Summary

- Other generation sites are typically small-scale fossil-fuel generation sites, but they could not be specifically identified as such in the SSEN connections data.

3.8.2. Modelling and outcomes

Baseline

Source: SSEN connections data

Scale	Capacity (MW)	Sites	Description
Above 1 MW	0	0	12 small-scale baseline sites could not be identified as a specific form of generation.
Below 1 MW	0.7	12	

Pipeline

Source: SSEN connections data

Status	Capacity (MW)	Description
Contracted	24	Nine sites, including a 20 MW hybrid site near Southampton, have been modelled to connect in 2024 under all scenarios.
Quote issued	28	27 sites have only been issued a quote and are not modelled to connect under any scenario.

Scenario projections

There are no scenario projections for other generation.

Spatial factors

Factor	Description
Location of connected and in-development sites	The DFES projections are wholly based on operational and in-development sites, as identified through SSEN's connection data.

3.8.3. Comparisons

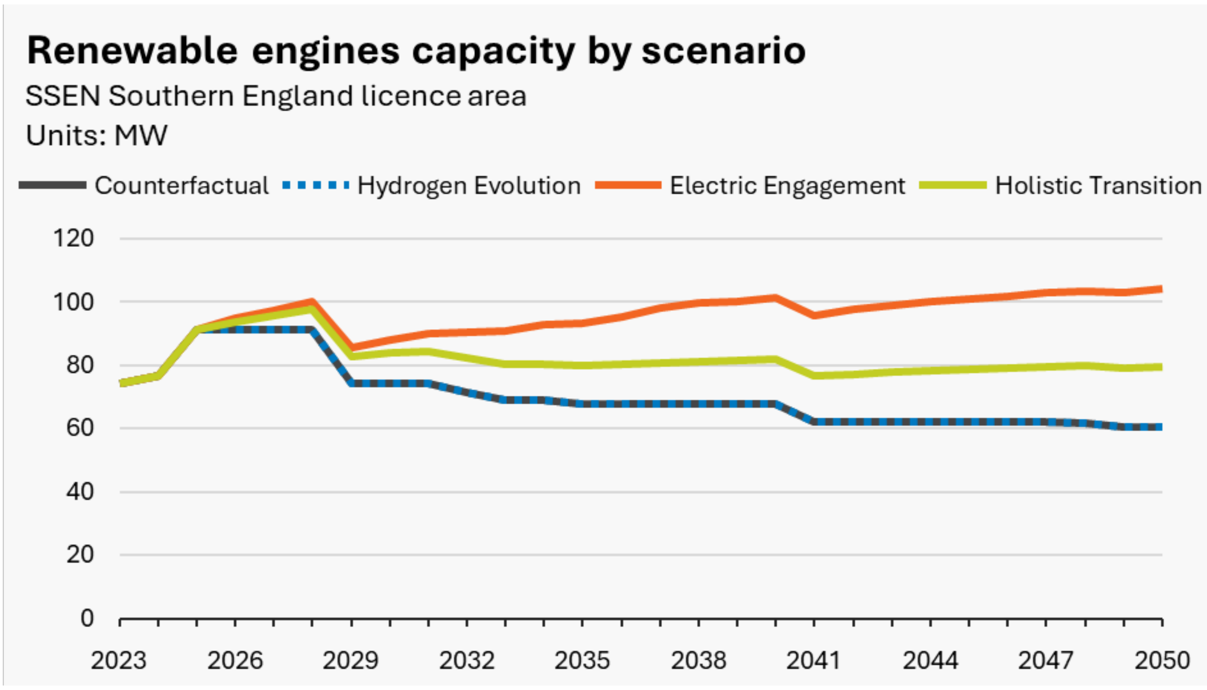
Due to the nature of other generation sites, a comparison between FES 2024 or DFES 2023 data is not possible.

3.9. Renewable engines

Technical specification	Building Blocks
Electrical capacity of gas engines and combined heat and power (CHP) fuelled by renewable and low-carbon gas, including sewage gas, landfill gas and biogas from anaerobic digestion of biogenic feedstocks such as crop waste and animal slurry.	Gen_BB004

3.9.1. Summary

- Renewable engines comprise three types of site: landfill gas, the anaerobic digestion of farm and food waste, and sewage gas at sewage treatment plants.
- Landfill gas, which makes up two-fifths of the baseline capacity in Southern England, is modelled to decommission over time in every scenario as the UK moves towards more sustainable waste treatment and an overall reduction in waste.
- Anaerobic digestion, accounting for around two-fifths of the renewable engines baseline capacity, is projected to increase under the **Electric Engagement** and **Holistic Transition** scenarios. However, bioenergy resource is prioritised, where possible, in all scenarios for harder-to-decarbonise sectors such as industry, aviation and shipping, thereby limiting its role in electricity generation.
- Sewage gas, which makes up the remainder of the baseline capacity, is assumed to remain relatively stable in all scenarios, with much of the sewage gas resource already being captured and used for electricity and CHP generation at sewage treatment works.
- Combining these trends results in an overall reduction in renewable engines capacity in the licence area, from 74 MW currently operational to between 104 MW in **Electric Engagement** and 61 MW in the **Hydrogen Evolution** and **Counterfactual** scenarios.



3.9.2. Modelling and outcomes

Baseline

Source: SSEN connections data

Scale	Capacity (MW)	Sites	Description
Above 1 MW	68	27	Just under half of baseline capacity is at sites above 1 MW and is located at landfill gas sites near to population centres. Most of the remaining baseline comprises anaerobic digestion sites between 1 and 5 MW in size, located at farms across the licence area. Sewage gas, totalling 12 MW across six sites, is located at sewage treatment works near population centres such as Oxford, Christchurch and Southampton.
Below 1 MW	6	16	The majority of the baseline sites below 1 MW are anaerobic digestors located on farms. Over half of these sites are based in Wiltshire or Oxfordshire.

Pipeline

Source: SSEN connections data

Status	Capacity (MW)	Description
Total	22	Number of sites: 11
Already operational	1	One site, a small 0.6 MW anaerobic digestor at a farm in Wiltshire, is believed to be already operational and, therefore, modelled to connect in 2024 under all scenarios.
Planning permission granted	16	Five sites, including a sewage gas site of 7.1 MW in Reading and a landfill gas site of 7.6 MW near Didcot, have been granted planning permission and are modelled to connect in all scenarios. There are three sites under 1 MW and these are modelled to connect in 2024, while the remaining two larger sites are modelled to connect in 2025.
No information	5	Five sites, including a 4 MW landfill gas site in Wiltshire, were not found in planning or other desktop research. The 4 MW site has not accepted its connection offer quote and a recent planning application for a standby generator did not mention a potential landfill gas generator. As such, this site is not modelled to progress under any scenario. The four remaining sites are very small-scale and, as such, are modelled to connect in 2024 under every scenario.

Scenario projections

Scenario	Capacity (MW)		Description
	2030	2050	
Holistic Transition	84	80	Landfill gas sites that are operational or in development are modelled to have an operational lifespan of 30 years under every scenario, after which point the connection is decommissioned. This reflects desktop research on landfill gas output over the lifetime of the project. Sewage gas sites that are operational or in development are modelled to remain connected at a consistent capacity out to 2050 under every scenario. The lack of projects being
Electric Engagement	88	104	

Hydrogen Evolution	74	61	developed indicates there is low potential for growth in sewage gas capacity, but that existing sites have long operational lifespans. Previous engagement with water companies suggests that further development of sewage gas resources would be focused on on-site heat and power generation, rather than exporting to the grid.
Counter-factual	74	61	There is potential for anaerobic digestion deployment in the licence area where agricultural land is present. Under **Electric Engagement** and **Holistic Transition**, anaerobic digestion sees a small amount of deployment throughout the scenario timeframe, whereas under **Hydrogen Evolution** and **Counterfactual** there is no further deployment beyond the pipeline.

Spatial factors

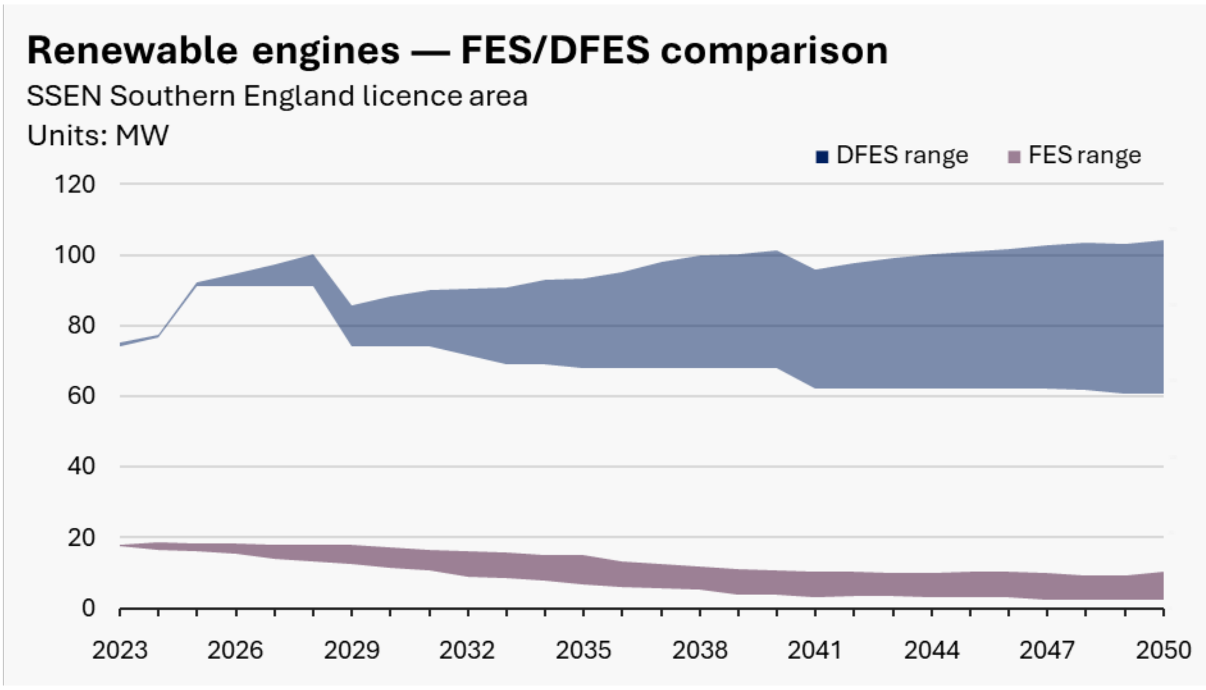
Factor	Description
Existing baseline and pipeline sites	The baseline, pipeline and decommissioning are modelled directly on a site-by-site basis. Growth in anaerobic digestion capacity is distributed to existing anaerobic digestion sites.

3.9.3. Comparisons

Reconciliation to FES 2024

The outcomes of the DFES modelling have been compared against the FES 2024 outcomes for the same licence area.

- The FES and DFES baselines in the licence area are not well aligned, with the FES baseline being much lower than the DFES. The reason for this is unclear, but it could be related to differences in technology classifications.
- Beyond the pipeline sites connecting in the early 2020s, the FES and DFES projections follow a similar downward trend. The difference in the scale of the baseline is mirrored in the wider range of scenario outcomes seen in the DFES modelling.



Comparison to DFES 2023

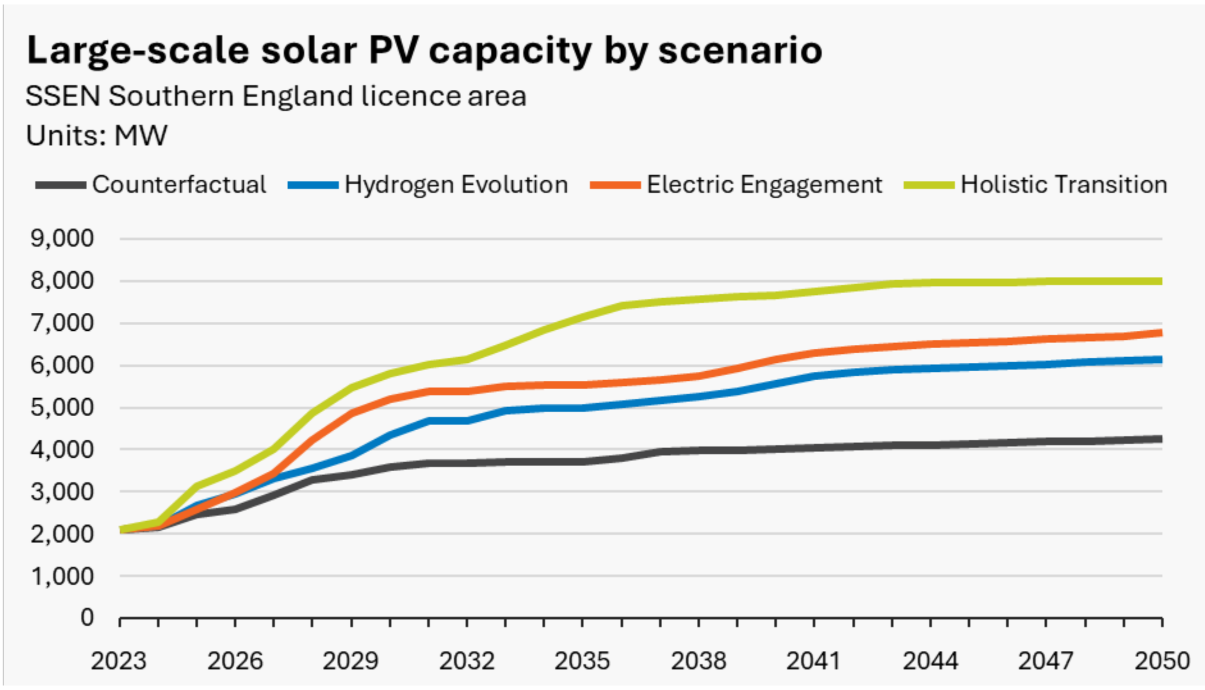
- The outcomes and modelling methods for renewable engines are similar between DFES 2023 and DFES 2024.

3.10. Solar PV (large-scale)

Technical specification	Building blocks
Large solar generation (G99)	Gen_BB012

3.10.1. Summary

- Solar power is one of the critical enablers for a net zero electricity system, with the UK Government aiming to treble solar generation as part of its plan to achieve a Clean Power system by 2030. Under this plan, the distribution networks will play a key role in the deployment of new solar projects, with solar projects that are yet to be built expected to account for 90% of solar capacity by 2030.[9]
- There are currently 300 large-scale solar PV projects, totalling 7.2 GW, with an accepted connection offer with SSEN in the Southern England licence area. This is an increase of over 1.6 GW over the last 12 months. Just over half (53%) of these sites have entered the planning system and 30% have been granted full planning permission.
- The CfD Allocation Round 6 was favourable for large-scale solar in the Southern England licence area, with eleven sites, totalling 289 MW, being awarded contracts.
- By 2050, the capacity of large-scale solar PV in the licence area ranges from 4.2 GW under the **Counterfactual** scenario, twice the current baseline, to 8 GW under **Holistic Transition**, nearly four times the current baseline.



3.10.2. Modelling and outcomes

Baseline

Source: SSEN connections data

Scale	Capacity (MW)	Sites	Description
Above 1 MW	2,098	218	Since the DFES 2023 analysis was completed, the connected baseline of large-scale solar PV sites in the Southern England licence area has increased by 48 MW. This is entirely due to a reassignment of technology in SSEN connections data, as no new large-scale solar sites came online in 2024.

Pipeline

Source: SSEN connections data

A range of outcomes for this significant pipeline have been modelled under the scenarios. With significant ongoing reforms to manage the very large queue of projects seeking to connect to the network and wider regional 'technology caps' under the UK Government's Clean Power 2030 plan, the proportion of the pipeline of large-scale solar that will move through to connection, and by when, is still unclear. The evidence collected for these sites has been considered at the time of the analysis and it is recognised that some projects may drop out of the connection queue in SSEN's licence areas into 2025 as these policies are enacted.

Status	Capacity (MW)	Description
Total	7,234	Number of sites: 300 The large-scale solar pipeline for DFES 2024 of accepted connection offers or quote issued sites has grown by 82 sites (totalling 1.6 GW additional capacity) since DFES 2023. However, no development information could be found for 1.2 GW of this new pipeline capacity.
Contract for Difference Allocation Round 6	289	Eleven sites, totalling 289 MW, were identified as having been awarded a CfD in Allocation Round 6. All of these sites have been modelled to connect by their relevant delivery years (2026/28), except for sites in areas of grid constraint. These sites were modelled to connect by their delivery year under all three net zero scenarios and were

		modelled to connect by the year that statement of works upstream network reinforcement is set to complete under **Counterfactual**.
Operational	37	Seven sites, totalling 37 MW, were found to be operational by Q3 2024. This was based on evidence from the Renewable Energy Planning Database and supported by recent satellite imagery and engagement with developers.
Under construction	207	Nine new large-scale solar projects, totalling 207 MW, were found to currently be under construction in the Southern England licence area. These sites are modelled to connect in 2025 under all scenarios.
Planning permission granted	1,438	In addition to sites currently under construction and with CfDs, there are 73 sites in the Southern England licence area with granted planning permission, totalling over 1.4 GW. This includes 28 sites, each with capacities greater than 20 MW. The two largest sites with planning permissions are the Lee Lane BESS co-located site in Nursling (99 MW) and Haseley Solar Farm in Oxford (50 MW).
Planning application submitted	573	There are also 29 sites in the Southern England licence area, totalling 573 MW, that have submitted planning applications and are awaiting a decision. This includes a 40 MW site in Test Valley that has been awarded a CfD in Allocation Round 6. Seven sites, all larger than 20 MW, are modelled to connect in the mid- to late 2020s under **Holistic Transition**. This is in line with FES assumptions of larger and co-located sites connecting under this scenario. Under **Electric Engagement**, 25 sites with a capacity of less than 20 MW were modelled to connect in the late 2020s. Based on an analysis of planning status, 23 sites were modelled to connect in the late 2020s and early 2030s under **Hydrogen Evolution**. Under the **Counterfactual** scenario, three sites in areas with high levels of historic planning success for large-scale solar PV or that secured a CfD, were modelled to connect.
Pre-planning	975	Pre-planning includes sites with evidence of pre-development beyond an accepted connection offer, such as a screening

		opinion for the need for an environmental impact assessment (EIA) or early-stage community engagement. Sites in the pre-planning stages are only modelled to connect under the three net zero scenarios. Under **Electric Engagement** and **Hydrogen Evolution**, 25% of the pre-planning capacity is modelled to connect, based on local ambition and historic planning permission success rates. Under **Holistic Transition**, this is increased to 50%.
No information	3,861	Due to the size of the large-scale PV pipeline, several sites have no evidence of development. Whilst this could indicate that the site is unlikely to connect, many of these sites have only recently accepted a connection offer with SSEN. Therefore, 30% of these sites are modelled to connect under **Holistic Transition** and **Electric Engagement**.
Refused planning, withdrawn or abandoned	114	There are 114 MW of large-scale solar sites that have been rejected in planning, withdrawn their planning applications or abandoned development. These sites are not modelled to connect under any scenario.

Scenario projections

Scenario	Capacity (MW)		Description
	2030	2050	
Holistic Transition	5,827	8,027	This scenario sees the largest growth in large-scale solar PV, driven by a high proportion of the known pipeline being modelled to connect. Baseline sites are modelled to repower with an additional 50% capacity at the end of a 20-year operational life. Solar capacity resultantly reaches 8 GW by 2050 in the licence area under this scenario.
Electric Engagement	5,185	6,761	Solar PV deployment increases substantially under this scenario, reaching 6.8 GW by 2050. Repowering of baseline sites at the end of a 25-year operational life is modelled to increase capacity by 25%.
Hydrogen Evolution	4,370	6,180	Solar PV deployment increases steadily under this scenario, driven by high levels of local ambition, reaching over 6.1 GW by 2050. Repowering of baseline sites at the

			end of a 25-year operational life is also modelled to increase capacity by 25%.
Counter-factual	3,585	4,271	While the least ambitious of the four scenarios for renewable energy development, a significant capacity increase of nearly three and a half times the baseline by 2050 is modelled under this scenario, reaching 4.2 GW by 2050. This is driven by the high proportion of pipeline sites with granted planning permission connecting with longer development timelines, pushing development up to the late 2030s, where growth in new connected solar capacity levels off. Repowering is assumed to have a minimal impact under this scenario, with most site owners choosing to extend the life of their existing panels, rather than increasing capacity.

Spatial factors

Factor	Description
Solar resource assessment (Solar irradiance data, Natural England, OS Addressbase)	Regen's in-house resource assessment, taking into consideration solar resource, land availability and planning constraints in the licence area, is used to identify potential future areas for large-scale solar development.
Local ambition (Climate Score Cards, DFES local authority energy strategy survey, Local Area Energy Plans)	Local ambition, including the local authority policy landscape and commitment to renewable energy and net zero goals, is reflected in the large-scale solar projections at a local authority level.

Stakeholder input

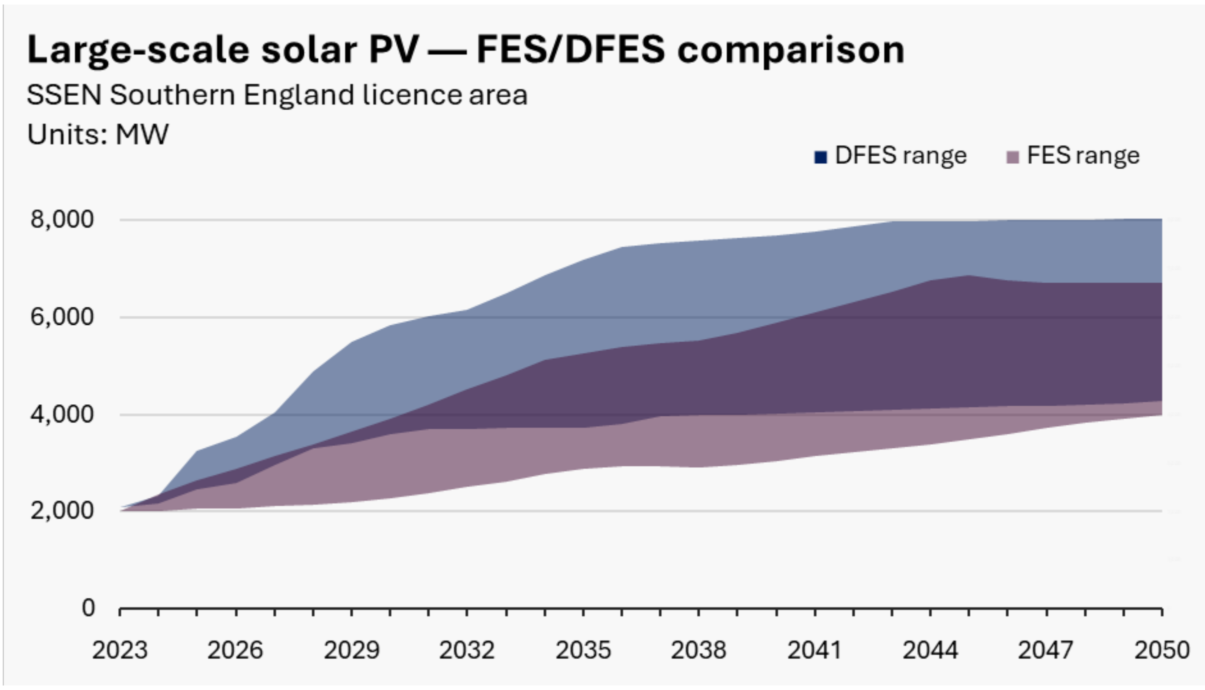
Stakeholder feedback	Impact on DFES analysis
During the webinar for Southern England licence area, stakeholders were asked if previous support from local authorities was a good indicator for future support of large-scale solar projects.	The response from stakeholders was that they did not think previous support from local authorities was a good indicator of future support for large-scale solar projects. Previous DFES modelling used historic planning status as an indicator for future connections for all scenarios. However, for DFES 2024, this factor was removed for all the net zero scenarios to align with the stakeholder feedback received, except under the **Hydrogen Evolution** and **Counterfactual** scenario.
Solar developers were contacted by email and phone to supplement desktop-based research on progress with planning applications and the expected commissioning years of individual projects in SSEN's connection pipeline.	Feedback from developers was incorporated into the pipeline analysis. Direct feedback was prioritised over information published online when assigning pipeline commissioning years in each scenario and the commercial confidentiality of projects was preserved in the DFES analysis.

3.10.3. Comparisons

Reconciliation to FES 2024

The outcomes of the DFES modelling have been compared against the FES 2024 outcomes for the same licence area.

- The FES 2024 baseline is 97 MW lower than the DFES baseline for the Southern England licence area, which is 2.1 GW. This could be due to the method that the FES uses to assign solar farms to GSPs on the edge of the licence area.
- The DFES 2024 near-term uptake reflects the very large pipeline of projects at various stages of development, augmented by direct engagement with developers on target connection years. This results in the medium-term DFES projections for the Southern England licence area being significantly higher than the FES in every scenario and is due to a significant proportion of the large pipeline capacity having strong evidence for near-term deployment (such as full planning permission and/or being awarded CfD).



Comparison to DFES 2023

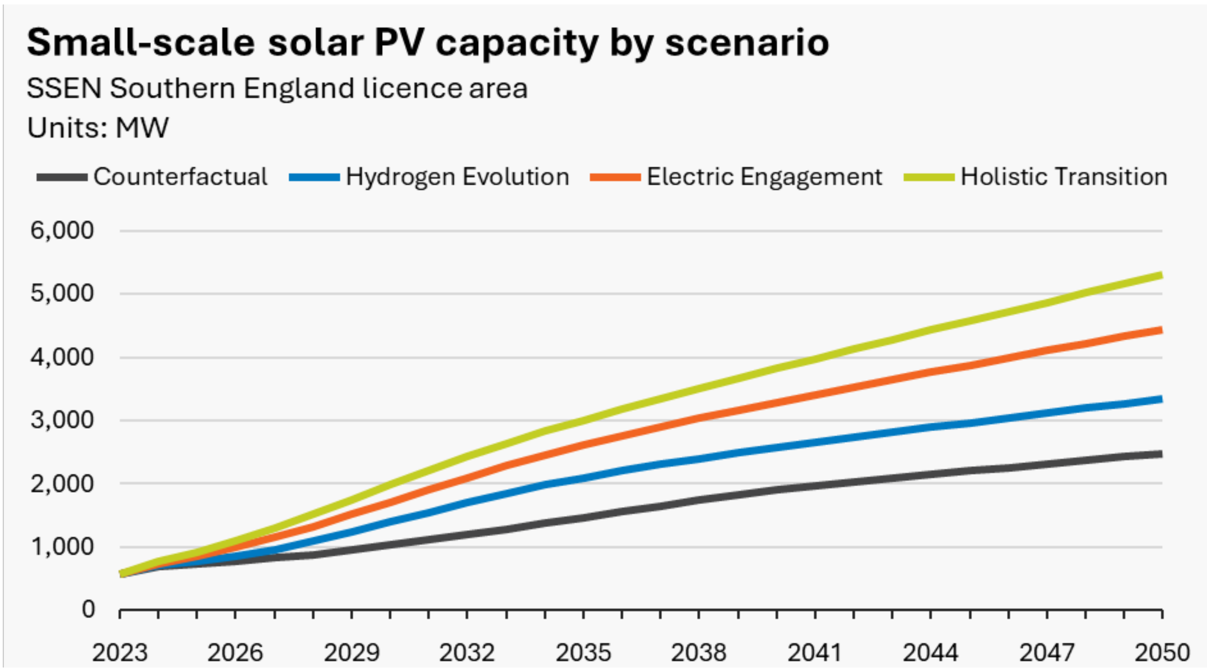
- There are no major differences between DFES 2023 and DFES 2024 outcomes.

3.11. Solar PV (small-scale)

Technical specification	Building Blocks
Solar generation sites with <1 MW of installed capacity, including domestic rooftop PV (<10 kW) and commercial rooftop PV (10 kW – 1 MW)	Gen_BB012 Gen_BB013

3.11.1. Summary

- High energy prices over the past few years have resulted in an increase in small-scale solar PV deployment across the UK, reaching its highest level of annual deployment in over a decade. In the Southern England licence area, installed small-scale solar capacity currently totals c. 570 MW, with over 430 MW of this installed on domestic rooftops.
- This trend is projected to continue as solar panel and installation costs continue to fall and domestic solar generation remains attractive for households and businesses, especially when paired with a domestic battery or EV.
- High levels of electrification of transportation and heating drive the uptake of small-scale solar in homes and businesses under the net zero scenarios.
- By 2050, c. 5.3 GW of small-scale solar PV capacity is connected to the distribution network in Southern England under **Holistic Transition**, 4.4 GW under **Electric Engagement** and 3.3 GW under **Hydrogen Evolution**.
- The **Counterfactual** reflects lower levels of electrification, but still shows significant growth in small-scale solar PV, with 2.5 GW of capacity deployed by 2050 under this scenario.



3.11.2. Modelling and outcomes

Baseline

Source: SSEN connections data

Scale	Capacity (MW)	Sites	Description
Domestic (<10 kW)	436	128,129	The majority of small-scale solar was deployed in the FiT era in the 2010s, with the annual installation rate for rooftop solar in the licence area peaking at 80 MW installed in 2012.
Commercial (10 kW – 1 MW)	137	4,764	Southern England is currently seeing high levels of ongoing deployment of small-scale solar, with 123 MW of new capacity connecting in the last year alone. This growth is driven by several factors, including continued high electricity and gas prices and a recent decrease in solar installation costs.

Pipeline

Source: SSEN connections data

Status	Capacity (MW)	Description
All	72	Number of sites: 999 Due to rooftop solar PV being small-scale and quick to install in most cases, all pipeline sites have been modelled to connect in 2024 in all scenarios. Almost all pipeline capacity comprises commercial-scale rooftop solar PV.

Scenario projections

Scenario	Capacity (MW)		Description
	2030	2050	
Holistic Transition	1,982	5,301	Very high levels of consumer engagement with smart electricity usage, dynamic electricity tariffs and high levels of green ambition in homes and businesses, helps to boost small-scale solar deployment under the **Holistic Transition** and **Electric Engagement** scenarios. This is augmented by solar deployment on new-build homes, which is modelled to occur on 80% of new homes and a high proportion of new non-domestic buildings. This is in line with the Future Homes Standard, once it is fully implemented. Small-scale solar PV capacity reaches 5.3 GW in the licence area by 2050 under the **Holistic Transition** scenario.
Electric Engagement	1,714	4,441	
Hydrogen Evolution	1,395	3,341	With the need to decarbonise electricity demand quickly to meet carbon reduction targets, solar PV deployment is also high under the **Hydrogen Evolution** scenario. However, due to customers being less engaged with smart energy and dynamic tariffs, and an overall lower level of electrification of heat and transport, the uptake of rooftop PV is not as high as in the other net zero scenarios. This is, however, augmented by solar deployment on new-build homes, which is modelled to occur on 80% of new homes and a high proportion of new non-domestic buildings, in line with the Future Homes Standard, once fully implemented. Small-scale solar PV capacity reaches 3.3 GW in the licence area by 2050 under the **Hydrogen Evolution** scenario.
Counter-factual	1,028	2,478	Reflecting an overall lower uptake of low-carbon technologies, smart tariffs and lesser engaged consumers, the **Counterfactual** scenario results in lower uptake of small-scale solar. This is augmented by solar deployment on new-build homes, which is modelled to occur on around 50% of homes and a moderate proportion of new non-domestic buildings by the 2030s.

Small-scale solar PV capacity reaches 2.5 GW in the licence area by 2050 under the **Counterfactual**.

Spatial factors

Factor	Description
Building type	The building type of domestic homes, such as detached, terraced and flats, is the primary distribution factor for domestic rooftop solar PV, used as a proxy for available roof space.
Tenure	The tenure of domestic homes, such as owner-occupied, social-rented or private-rented, is a secondary distribution factor for domestic rooftop solar PV, with more uptake on owner-occupied and social-rented homes.
Affluence	Affluence plays a minor role in the distribution of domestic solar PV in the near term, as stakeholder feedback and analysis of baseline trends show that the cost of solar PV is still a major contributing factor to uptake. Affluence is modelled using the ONS census Socio-economic Classification (NS-SEC) variable.
Non-domestic buildings with potential for rooftop solar PV	Based on engagement with stakeholders, we have identified existing non-domestic buildings with potential for rooftop solar to be included in the modelling. This includes schools, universities, warehouses, hospitals, shopping centres and offices.

Stakeholder input

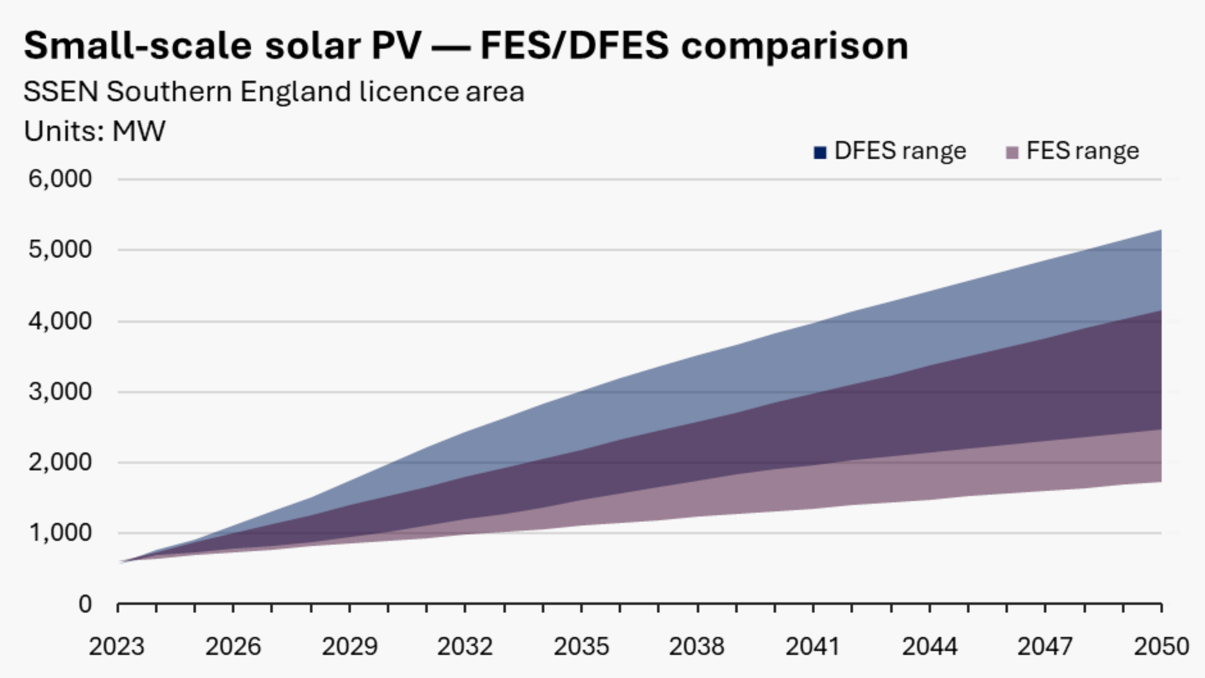
Stakeholder feedback	Impact on DFES analysis
LAEP targets	Where local authorities have targets for small-scale solar PV or overall capacity solar PV, these have been reflected in the modelling, where possible.

3.11.3. Comparisons

Reconciliation to FES 2024

The outcomes of the DFES modelling have been compared against the FES 2024 outcomes for the same licence area.

- The DFES 2024 outcomes have a comparable trend to FES 2024. However, the longer-term projections in the DFES 2024 analysis are higher than the FES 2024 projections. This is likely due to the DFES analysis including a high proportion of new-build homes with rooftop solar PV, in line with anticipated updates to building standards that may require, or strongly encourage, solar PV on new-build homes and non-domestic buildings.[10] It is not clear if the FES accounts for new builds in this way.



Comparison to DFES 2023

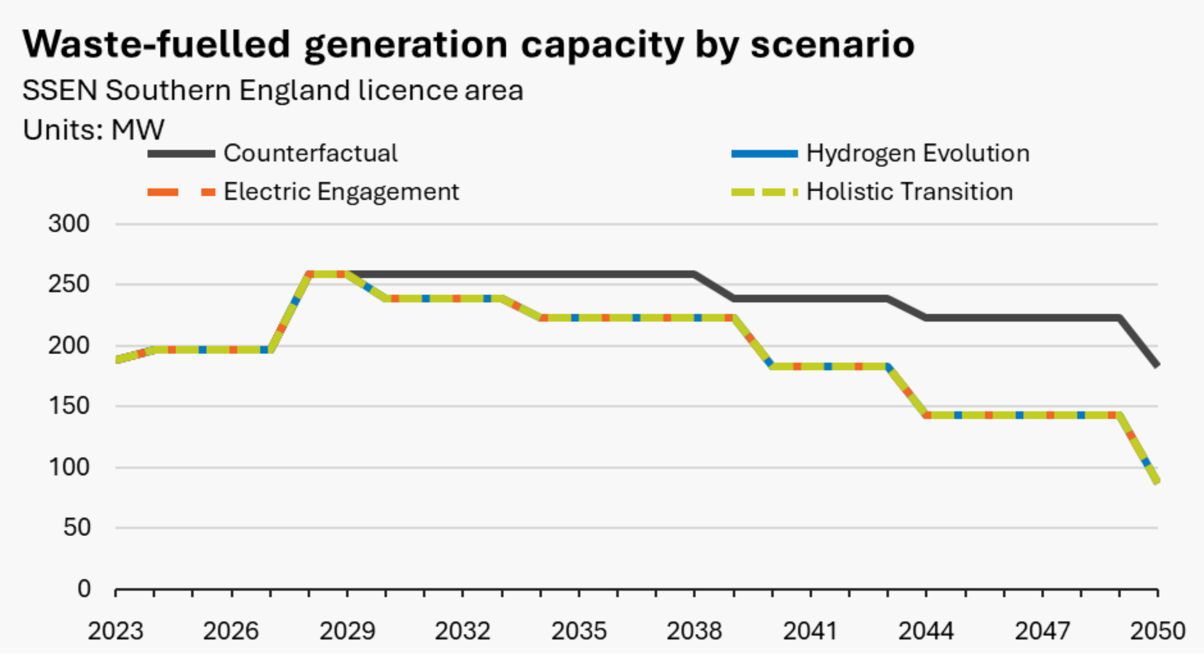
- Similar to the FES comparison, the DFES 2024 outcomes have a comparable trend to the DFES 2023 outcomes. However, the DFES 2024 projected capacities are higher than the DFES 2023 projections. This is due to the DFES 2024 analysis including a higher proportion of new build homes being built with rooftop solar PV, in line with anticipated updates to building standards

3.12. Waste-fuelled generation

Technical specification	Building Blocks
Capacity of distribution connected Energy from Waste (EfW) sites, including incineration and Advanced Conversion Technologies (ACT).	Gen_BB011

3.12.1. Summary

- Energy from waste, conventionally in the form of waste incineration, has historically been used alongside the landfill of waste that cannot been reused or recycled. There is a 188 MW baseline of energy from waste projects operating in the licence area.
- In the near term, energy from waste capacity increases in all scenarios as several projects with existing planning permission are commissioned.
- Waste incineration is highly carbon intensive and, therefore, sites are modelled to decommission under the three net zero scenarios out to 2050 as cleaner approaches to waste management become commonplace. More efficient energy from waste plants, such as advanced conversion technology (ACT) gasification plants, operate beyond 2050 under all four scenarios. However, the majority of the Southern England capacity is either recently commissioned or sites in the pipeline that are modelled to connect in the near term. As a result, a higher proportion of energy from waste capacity remains online in 2050 under all four scenarios compared to the rest of the UK.
- In contrast, only a handful of older waste incineration plants are modelled to decommission under the **Counterfactual**, with nearly 200 MW of energy from waste capacity still operating in 2050.



3.12.2. Modelling and outcomes

Baseline

Source: SSEN connections data

Scale	Capacity (MW)	Sites	Description
Above 1 MW	188	8	The waste-fuelled generation baseline consists of eight sites ranging from 2 to 56 MW, all located near to population centres such as Portsmouth, Slough and Bicester. While two sites were deployed prior to 2005, the majority of the baseline was connected to the distribution network between 2010 and 2020, with no further sites connecting since then.
Below 1 MW	0	0	Three sites, connected in the late 2010s and totalling 16 MW, are advanced waste recovery or ACT sites. This type of waste-fuelled generation is intended to be cleaner than waste incineration.

Pipeline

Source: SSEN connections data

Status	Capacity (MW)	Description
Total	127	Number of sites: 8
Under construction	8	A single site is listed in the Renewable Energy Planning Database as under construction and, as such, is modelled to connect in 2024 under all four scenarios.
Planning permission granted	63	Two large-scale sites, located near Westbury and Bournemouth, were granted planning permission in 2023. Based on an analysis of the typical time between attaining planning permission and commissioning for this type and scale of site, these sites are modelled to connect in 2028 under all scenarios.
No information	11	A single 11 MW site has a connection quote but further development information and could not be found in planning. This site is not modelled to progress under any scenario.

		A further site of just 0.2 MW has a connection offer. Due to the very small-scale of this project, it is modelled to connect in 2024 under all four scenarios.
Refused planning, withdrawn or abandoned	45	Two sites have withdrawn their planning application, and a further site was refused planning permission. These sites are not modelled to go ahead under any scenario.

Scenario projections

Scenario	Capacity (MW)		Description
	2030	2050	
Holistic Transition	239	86	Under the net zero scenarios, conventional waste incineration sites are projected to decommission after 30 years of operational life, reflecting a reduced volume of waste in these scenarios and the drive to reduce carbon emissions. More efficient sites, using ACT gasification or sites classified as 'Energy Recovery Facilities' (incineration sites that meet higher energy efficiency criteria), are not projected to come offline under any scenario out to 2050. This assumes that any remaining waste in the 2030s and 2040s is processed at less carbon-intensive, highly efficient ACT sites under these scenarios.
Electric Engagement	239	86	
Hydrogen Evolution	239	86	
Counter-factual	259	183	Lower levels of societal change and limited progress towards carbon emission reduction means that waste incineration sites continue to operate up to 40 years after their commissioning date.

Spatial factors

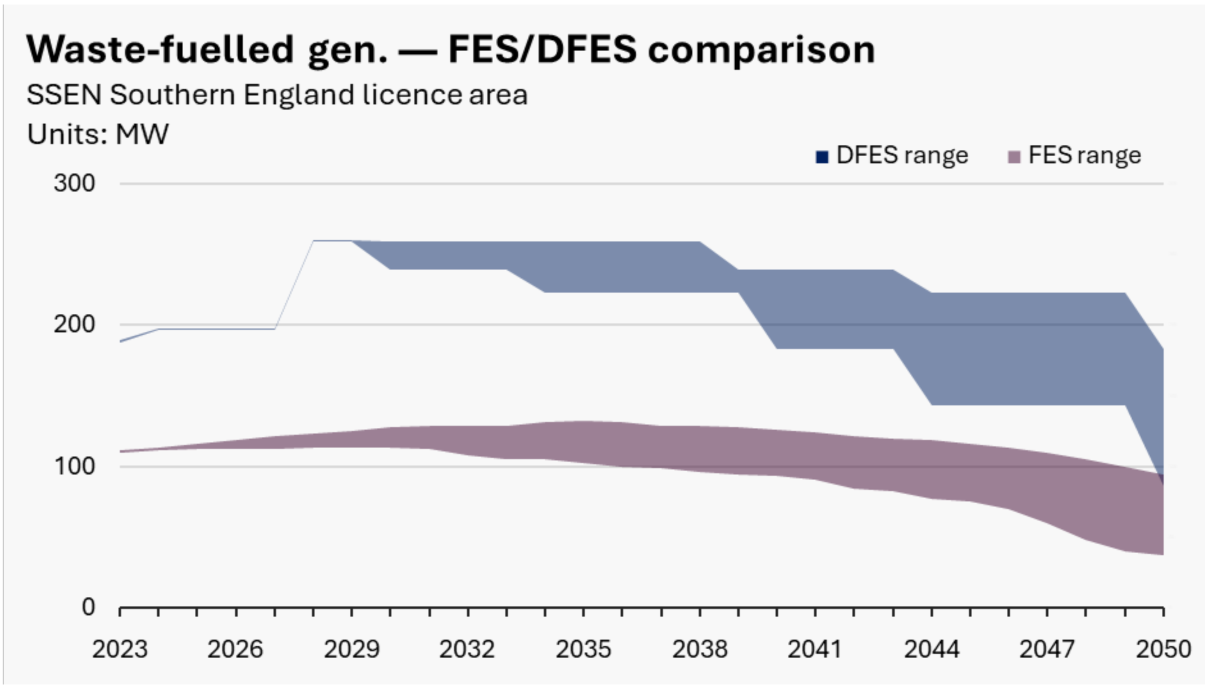
Factor	Description
Location of existing baseline and pipeline sites	All energy from waste spatial modelling is based on existing baseline and pipeline sites.

3.12.3. Comparisons

Reconciliation to FES 2024

The outcomes of the DFES modelling have been compared against the FES 2024 outcomes for the same licence area.

- The FES and DFES baselines in the licence area are not well aligned, with the FES baseline being much lower than the DFES. The reason for this is unclear but could be related to differences in technology classifications.
- The pipeline of prospective sites connecting in the 2020s in the DFES modelling is not reflected in the FES data. These sites have been identified and researched via local authority planning portals in the DFES analysis.
- Beyond the baseline difference and pipeline sites connecting in the early 2020s, the FES and DFES projections follow a similar downward trend and both analyses assume waste-fuelled generation decreases in the long term, especially under the three net zero scenarios.



Comparison to DFES 2023

- The outcomes and modelling methods for waste-fuelled generation are similar between DFES 2023 and DFES 2024. However, several pipeline sites in the DFES 2023 modelling are no longer modelled to connect in DFES 2024, due to either no longer holding a connection offer or withdrawing their planning application. This has the biggest impact in the **Counterfactual** (previously Falling Short) scenario, which results in a capacity of 183 MW in 2050 in DFES 2024 compared to 291 MW in DFES 2023.

Section 4: Electricity storage technologies

Results and assumptions

This section includes the results and assumptions for the following technologies:

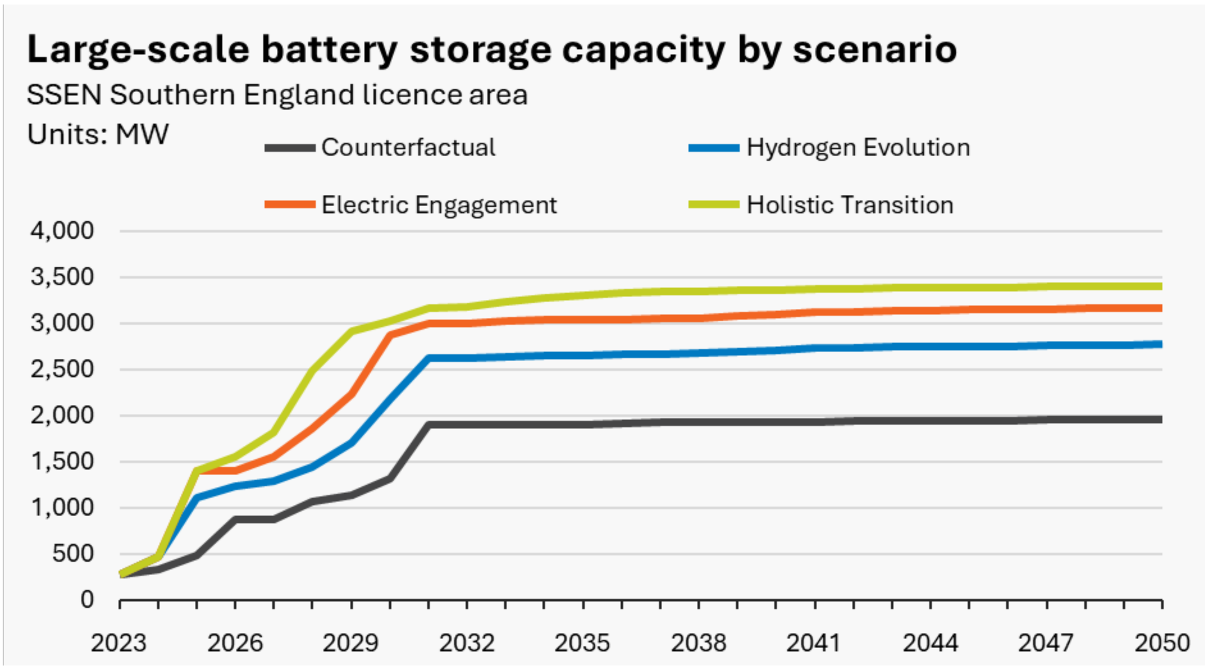
- Battery storage (large-scale)
- Battery storage (small-scale)
- Liquid Air Energy Storage

4.1. Battery storage (large-scale)

Technical specification	Building Blocks
Large-scale battery storage	Srg_BB001

4.1.1. Summary

- Grid-scale battery storage has become one of the most active development sectors in the UK, with numerous developers and four listed capital investment funds seeking to develop battery storage projects at various scales across the country.
- In the context of the wider UK energy system, low-carbon dispatchable power and flexibility are required to manage variable generation, meet peak demand, ensure security of supply, manage network constraints and maximise the economic value of abundant renewable energy when it is available. As the UK looks to achieve Clean Power by 2030 and a net zero power system by 2035, the rapid deployment of new large-scale (almost entirely lithium-ion based) battery storage is projected under every scenario as a key component to achieving these goals.
- The Southern England licence area currently has 16 operational large-scale battery storage sites, totalling 281 MW. Of this, 74 MW capacity was built within the past year.
- The pipeline of sites that have a quote issued or accepted connection offer with SSEN has now grown to 15.9 GW across 300 sites in the licence area. This is a 93% increase on the 8.2 GW pipeline reported for DFES 2023.
- However, with significant reforms to network connection policy and battery storage asset revenues becoming challenging for new entrants, it is likely that only a limited proportion of this pipeline will progress through to development, even in the longer term. This is partially evidenced by only 2 GW (12.5% of the full pipeline capacity)) being found to have obtained planning approval to date.
- As a result, even under more ambitious scenarios, only sites with evidence of full planning submissions or permissions are modelled to build out. **Holistic Transition** is the scenario that supports the highest uptake of decentralised battery storage, reaching 3 GW by 2030, while the **Counterfactual** reaches less than 1.3 GW in the same timeframe.
- Deployment of large-scale battery storage is projected to slow in the 2030s and 2040s as the market becomes saturated and alternative sources of flexibility see increased uptake, for instance small-scale battery storage, thermal storage and V2G.
- The development of a new market mechanism for long-duration electricity storage (LDES) creates the potential for other storage technologies to begin to build out in the longer term, though many of these may end up connecting to the transmission network, due to their scale (e.g. new strategic pumped hydropower sites).



4.1.2. Modelling and outcomes

Baseline

Source: SSEN connections data

Status	Capacity (MW)	Sites	Description
Operational	281	16	Currently 16 large-scale battery storage sites, totalling 281 MW, are in operation across the licence area, the majority of which has been built over the past 8 years. Of this, 72 MW capacity has commissioned in the past year alone. These sites are primarily standalone sites offering grid balancing services. The 150 MW Minety/Stonehill storage project, in Wiltshire, remains the largest battery storage project currently connected to the Southern England distribution network, and among the largest individual sites nationally.

Pipeline

Source: SSEN connections data

A range of outcomes for this significant pipeline have been modelled under the scenarios. With significant ongoing reforms to manage the very large queue of projects seeking to connect to the network and wider regional 'technology caps' under the UK Government's Clean Power 2030 plan, the proportion of the pipeline of battery storage projects that will move through to connection, and by when, is still unclear. The evidence collected for these sites has been considered at the time of the analysis and it is recognised that some projects may drop out of the connection queue in SSEN's licence areas into 2025 as these policies are enacted.

Status	Capacity (MW)	Description
Total	15,928	Number of sites: 300 A 93% increase in capacity on the 8.2 GW reported for DFES 2023.
Under construction	662	10 sites totalling 662 MW are currently under construction or due to commission imminently. This includes three sites with Capacity Market pre-qualifications. These sites are modelled to connect in 2024 and 2025 under all scenarios.
Planning permission granted	1,956	38 sites totalling nearly 2 GW of capacity have secured planning permission. The growing scale of individual battery storage projects is evidenced by the seven sites in this group that are individually between 99 MW and 150 MW. The 150 MW 'Norrington gate farm' battery storage project, that has planning approval, would become the joint largest site in the licence area upon commissioning. This is situated near Melksham, an area seeing high levels of developer interest for both large-scale battery storage and solar PV projects. Four of these sites, totalling 190 MW, have prequalified for, or won, a Capacity Market agreement. These sites are modelled to connect in the relevant contract delivery year under every scenario. Projects not found to be active in Capacity Market auctions, which make up the majority of the sites with planning approval, are projected to connect between five and seven years from the date they obtained planning permission.

		The eleven sites that are subject to a Statement of Works scheme have been considered to connect in the relevant completion years of these works under the **Counterfactual**, the latest being 2037.
Planning application submitted	1,317	25 sites totalling 1.3 GW have submitted applications for full planning permission. This includes another 150 MW project 'Stonehill', near Malmesbury. The total capacity of battery projects with planning applications submitted has doubled in size in the year since DFES 2023. This is an indication that a backlog of planning applications for battery sites is building up. Without additional resources or further reforms, Local Authority planning assessment processes could become a bottleneck in the buildout of new battery storage sites. Due to the significant scale of the battery storage pipeline, and information around NESO's Clean Power 2030 advice to the UK Government, sites with granted planning permission are likely to represent enough capacity to meet 2030 and 2035 targets for large-scale battery storage capacity in SSEN's licence areas. This, alongside proposed reforms to connection processes, may mean that the pipeline of battery projects may evolve significantly in the coming year. As a result, only the three sites with submitted planning applications that have pre-qualified in Capacity Market auctions have been modelled build out in the relevant contract year under **Holistic Transition** and **Electric Engagement**.
Pre-planning	1,405	26 sites totalling 1.4 GW have submitted documents to local authorities ahead of full planning applications. The average scale of a project in this pre-planning category is 55MW, with six sites each over 98 MW. The capacity of projects in pre-planning has grown by approximately 0.5 GW in the past year, which is an indication that even more battery projects are seeking to enter the planning system. Sites with pre-planning applications have not been modelled to progress under any scenario.

No information	9,945	191 sites totalling 9.9 GW could not be found in local authority planning databases. This is over 60% of the total pipeline capacity. The total capacity of battery storage projects with accepted connection offers, but no development evidence has nearly tripled since DFES 2023. This is likely to be due to the fact that a lot of sites only accepted connection offers with SSEN in the past 12 months. These sites have not been modelled to progress under any scenario.
Refused planning, withdrawn or abandoned	643	Seven sites, totalling 643 MW, have had planning applications refused or planning permission expire. This includes two 200 MW projects. These sites do not progress under any scenario.

Scenario projections

Scenario	Capacity (MW)		Description
	2030	2050	
Holistic Transition	3,025	3,402	In the four main DFES scenarios, individual pipeline project evidence drives the vast majority of large-scale battery storage capacity deployment in the licence area. Additional deployment beyond the pipeline, starting in the early 2030s under the three net zero scenarios and the mid-2030s under the **Counterfactual**, is modelled mostly as battery storage co-located with the deployment of large-scale solar PV and onshore wind generation in the licence area across the 2030s and 2040s.
Electric Engagement	2,875	3,174	
Hydrogen Evolution	2,188	2,776	
Counter-factual	1,329	1,964	Overall, post-pipeline development of large-scale battery storage is limited, owing to the high levels of deployment seen in the 2020s and early 2030s, as the UK aims to achieve Clean Power by 2030 and a net zero power system by 2035. However, the deployment of battery storage continues in the licence area, through the uptake of small-scale battery installations in homes and businesses, as detailed in the small-scale battery storage section of this report.

Spatial factors

Factor	Description
Location of existing baseline and pipeline sites	The vast majority of projected large-scale storage capacity is based on existing baseline and pipeline sites within SSEN connections data.
Distribution of large-scale solar PV and onshore wind	Beyond the pipeline, the location of additional battery storage capacity in the late 2030s and 2040s is aligned to the distribution of large-scale solar PV and onshore wind capacity within SSEN DFES 2024.

Stakeholder input

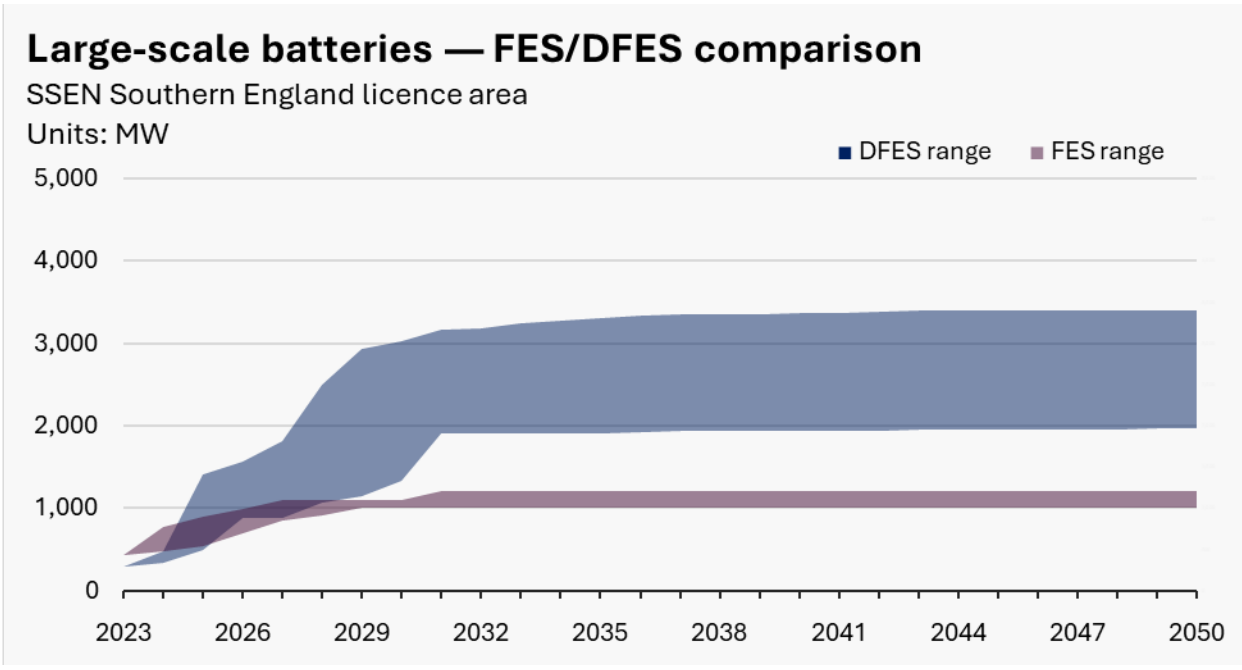
Stakeholder feedback	Impact on DFES analysis
Electricity Storage Network (ESN) engagement	Regen, through its management of the UK Electricity Storage Network (ESN) has an ongoing dialogue with grid-scale storge project developers. The past year has seen a challenging environment for battery storage revenues, with some developers selling off portfolios and diversifying.
Connections reform engagement	Regen is also engaging with Ofgem, DESNZ and NESO on the ongoing connections reform process; this has given insight into the potential treatment of existing pipeline sites. This is reflected in the DFES 2024 with moderated near-term deployment rates, and more conservative assumptions around site buildout, when compared with DFES 2023.
Local stakeholder regional webinar	At the Southern Central England stakeholder webinar, held in October 2024, attendees were asked if the business model to co-locate battery storage with wind and solar projects would become more attractive in future. The majority of respondents believed that it would be. The DFES models most of the post-2030 battery storage capacity deployment coming from co-located sites.

4.1.3. Comparisons

Reconciliation to FES 2024

The outcomes of the DFES modelling have been compared against the FES 2024 outcomes for the same licence area.

- The 281 MW baseline reported for DFES 2024 is lower than the 432 MW baseline reported in FES 2024; this misalignment was also seen in 2023 results. It is possible that one of the sites identified as 'Under construction' in the DFES might be considered as operational in the FES, but the absolute reason for this significant variance is unknown.
- The DFES 2024 projections diverge from FES 2024 projections in all scenarios; more ambitious scenarios diverge earlier and have higher annual growth rates. These growth rates are driven by the increased pipeline of sites with accepted connection offers with SSEN and sites found to have secured planning permission and Capacity Market agreements/pre-qualifications.
- Variance between FES 2024 and DFES 2024 becomes significant in the medium-term in the most ambitions scenarios, reaching a 2 GW difference by the early 2030s.
- Post-2030 deployment across the scenarios is similar in DFES 2024 and FES 2024 and this means differences in overall projected capacity are maintained out to 2050.



Comparison to DFES 2023

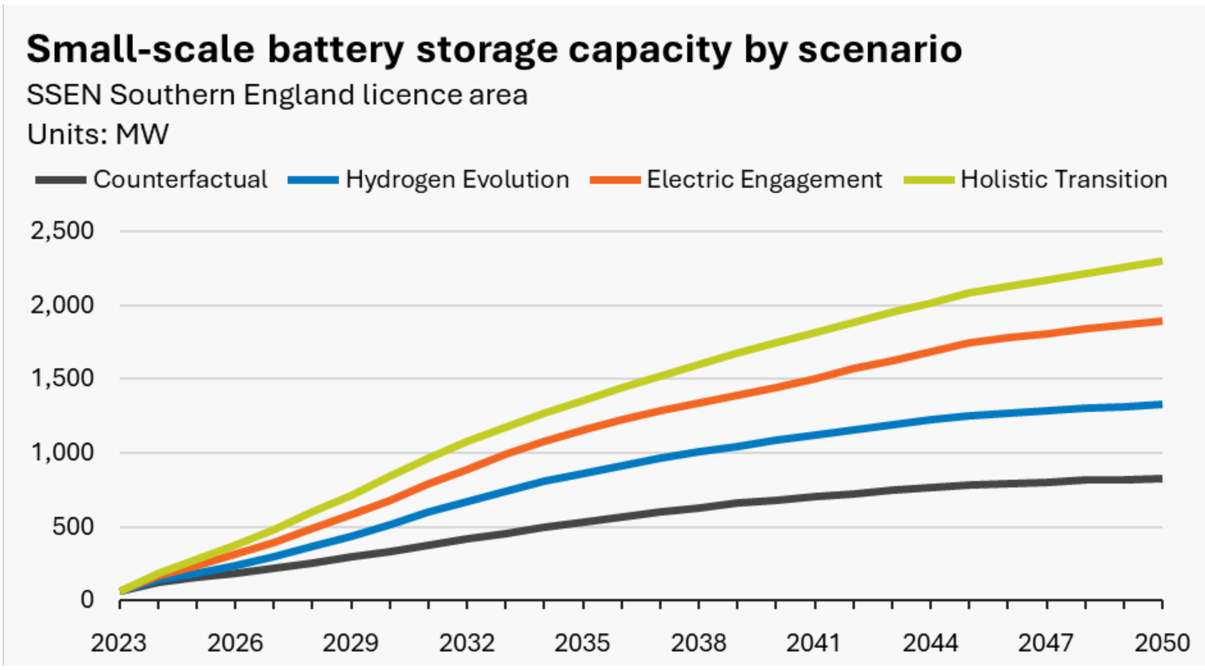
- The assessment and assumptions around the future deployment of the pipeline have been more conservative in DFES 2024, in line with recent stakeholder feedback. This limits the uptake of new battery storage in all four scenarios to only sites with granted planning permission or positive Capacity Market activity.
- As a result, DFES 2024 projections are broadly aligned with DFES 2023 projections, despite the increased scale of the project pipeline.
- Under the more ambitious scenarios, **Holistic Transition** and **Electric Engagement**, DFES 2024 projects less near-term deployment of large-scale battery storage capacity than DFES 2023. This is due to updated pipeline assumptions, reflecting the current barriers to the near-term deployment of such a large number of sites.

4.2. Battery storage (small-scale)

Technical specification	Building Blocks
Small-scale battery storage (<1 MW), comprising Domestic Batteries (G98) and High Energy Users.	Srg_BB001 Srg_BB002

4.2.1. Summary

- Small-scale battery storage, in the form of domestic batteries and batteries installed at commercial and industrial properties with high energy demand, has a relatively small baseline in Southern England but a high potential to grow under every scenario.
- Domestic battery uptake is closely tied to the uptake of domestic rooftop solar PV. In the past two years, over half of domestic PV installations have been installed alongside a domestic battery. This trend is modelled to continue in the near term under all four scenarios. In the longer term, adoption of domestic batteries reduces, as other forms of demand flexibility are favoured.
- Installations of behind-the-meter batteries at 'high energy user' sites, such as factories, hospitals, water company sites and universities, are projected to increase under all four scenarios. This is a reflection of businesses seeking to maximise the consumption of renewable energy generated onsite, as well as using batteries for onsite energy management and participating in commercial balancing services.
- There is some uncertainty around how prevalent domestic and non-domestic batteries will be in the future, compared to alternative sources of flexibility such as smart charging, V2X and thermal storage. As a result, there are a range of outcomes modelled for small-scale battery storage in the licence area, from 0.8 GW under the **Counterfactual** to 2.3 GW under **Holistic Transition**.



4.2.2. Modelling and outcomes

Baseline

Source: SSEN connections data

Scale	Capacity (MW)	Sites	Description
Domestic (<10 kW)	12	2,878	The lack of available data for domestic battery storage installations means that the true baseline capacity in the Southern England licence area is not well understood. This is due to the majority of home batteries being installed alongside solar PV installations and only one of the technology types typically being recorded. There is currently no complete national database for domestic battery installations. Engagement with domestic solar and battery installers suggests that over half of domestic solar PV installed in 2023 and 2024 were installed alongside a home battery. This aligns with a market outlook report by SolarPower Europe, which suggests a UK-wide residential battery storage capacity of approx.1.1 GWh.[11]

			The domestic battery baseline has, therefore, been modelled based on a disaggregation of this market outlook to the licence area, based on known domestic solar uptake.
High energy user (10 kW – 1 MW)	3.28	40	There are 40 'high energy user' battery storage sites in the baseline, these were identified through analysis of battery storage sites in the SSEN connections data that were smaller scale and located at commercial business sites.

Pipeline

Source: SSEN connections data

Status	Capacity (MW)	Description
Total	28	Number of sites: 17 Due to small-scale battery storage being quick to install in most cases, all pipeline sites have been modelled to connect in 2024 in all scenarios. Almost all pipeline capacity comprises commercial-scale High Energy User batteries. This includes capacity at business parks, public buildings and farms, including five sites between 1 and 5 MW in size.

Scenario projections

Scenario	Capacity (MW)		Description
	2030	2050	
Holistic Transition	844	2,293	Under these scenarios, the proportion of domestic solar installations being commissioned with an accompanying domestic battery starts at 55% in the near term, reflecting current market reports, and decreases to 20-25% by 2050.[12] This reflects the uptake of EVs (potentially with V2X capability) and thermal storage reducing the case for standalone domestic storage. Overall uptake still remains high due to the number of highly engaged consumers. Deployment at high energy user sites increases over the scenario timeframe as more businesses seek to manage their onsite energy use and costs through flexibility
Electric Engagement	684	1,892	

			technologies, as well as leveraging the potential to participate in commercial flexibility markets and balancing services. Small-scale battery storage capacity reaches 2.3 GW under **Holistic Transition**.
Hydrogen Evolution	518	1,327	Under this scenario, the proportion of domestic solar installations being commissioned with an accompanying domestic battery starts at 55% in the near term, reflecting current market reports, and decreases to 12% by 2050. This reflects the uptake of EVs (potentially with V2X capability) and thermal storage reducing the case for standalone domestic storage, as well as consumers not being strongly engaged in demand side flexibility. Deployment at high energy user sites increases moderately over the scenario timeframe, as a limited number of businesses seek to manage their onsite energy use and costs through flexibility technologies and participation in commercial flexibility markets is also limited. Small-scale battery storage capacity reaches 1.3 GW under **Hydrogen Evolution**.
Counter-factual	336	828	Under this scenario, the proportion of domestic solar installations being commissioned with an accompanying domestic battery starts at 55% in the near term, reflecting current market reports, and decreases to 10% by 2050. This reflects the uptake of EVs (potentially with V2X capability) and thermal storage reducing the case for standalone domestic storage, as well as very limited engagement in demand side flexibility by consumers. Deployment at high energy user sites increases slowly over the scenario timeframe, as only a small number of businesses seek to manage onsite energy use and costs through flexibility technologies and participation in commercial flexibility markets is low. Small-scale battery storage capacity reaches 0.8 GW under the **Counterfactual**.

Spatial factors

Factor	Description
Domestic rooftop solar PV uptake	The uptake and location of domestic battery storage installations is directly tied to the uptake of domestic solar PV.
Number and location of 'high energy user' commercial and industrial sites	High energy user battery storage uptake and distribution is based on the number and location of existing energy-intensive non-domestic properties, such as industrial estates, hospitals, universities and factories.

Stakeholder input

Stakeholder feedback	Impact on DFES analysis
SolarPower Europe market outlook report	The baseline and near-term uptake of domestic battery storage as a proportion of domestic solar PV installations, has been based predominantly on SolarPower Europe market outlook report data, augmented and verified by engagement with domestic battery installers.
Direct developer engagement	Several domestic battery installers were engaged to confirm that the modelled baseline numbers were in-line with their installation experience over the past two years. In addition, modelling assumptions around the typical size and capacity of domestic battery installations, and the proportion of domestic solar PV installations currently coming with a domestic battery, were checked and updated based on this direct engagement.

4.2.3. Comparisons

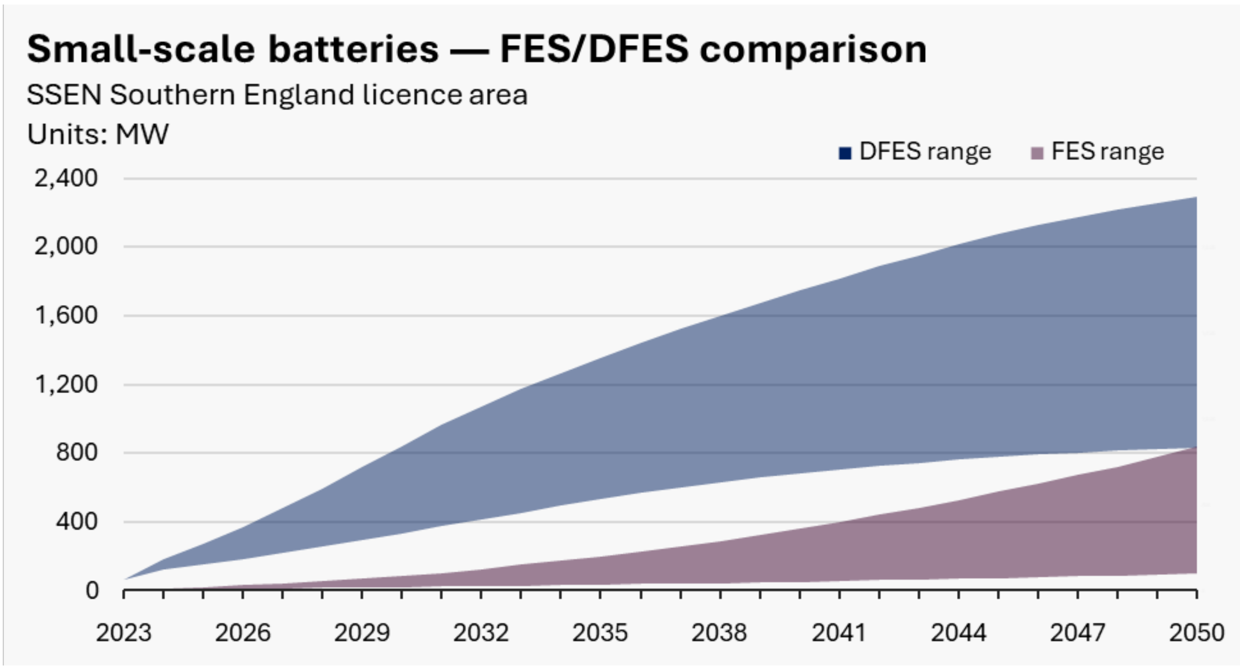
Reconciliation to FES 2024

The outcomes of the DFES modelling have been compared against the FES 2024 outcomes for the same licence area.

- The DFES 2024 baseline and projections out to 2050 are significantly higher than the FES 2024 outcomes. This is likely driven by differences in the modelling approach regarding domestic batteries:
  - The DFES small-scale battery storage baseline is significantly above the FES. This is due to market data and stakeholder engagement with domestic solar and

battery installers indicating that higher levels of domestic battery installations has been seen over the past two years.

- In the near-term, engagement suggests that the uptake of domestic battery storage systems is set to continue, in-line with the uptake seen through joint domestic solar and battery installations seen over the past few years.
- The DFES projections are then modelled to level out in the longer term as other domestic flexibility options, such as smart charging, V2X and thermal storage become more prevalent. This is opposite to the FES trend, where domestic battery uptake continues to accelerate over the scenario timeframe out to 2050.



Comparison to DFES 2023

- The small-scale battery projections have changed significantly compared to DFES 2023 for domestic batteries, in both the baseline and the magnitude of projections over the scenario timeframe. This is based on recent market report data and direct engagement with domestic battery installers, which suggests that the current domestic battery baseline and near-term growth is under recorded and likely to be much higher than only those domestic battery installations registered with (or notified to) the DNOs or the Microgeneration Certification Scheme (MCS).
- Previous DFES small-scale battery projections were closely tied to the FES projections. As such, the changes detailed in the reconciliation to FES above also apply to this comparison, with greater levels of growth in the near-term in line with current uptake trends rather than uptake accelerating in the longer term.
- High energy user batteries at commercial sites have been modelled similarly to DFES 2023 and have similar 2050 outcomes.

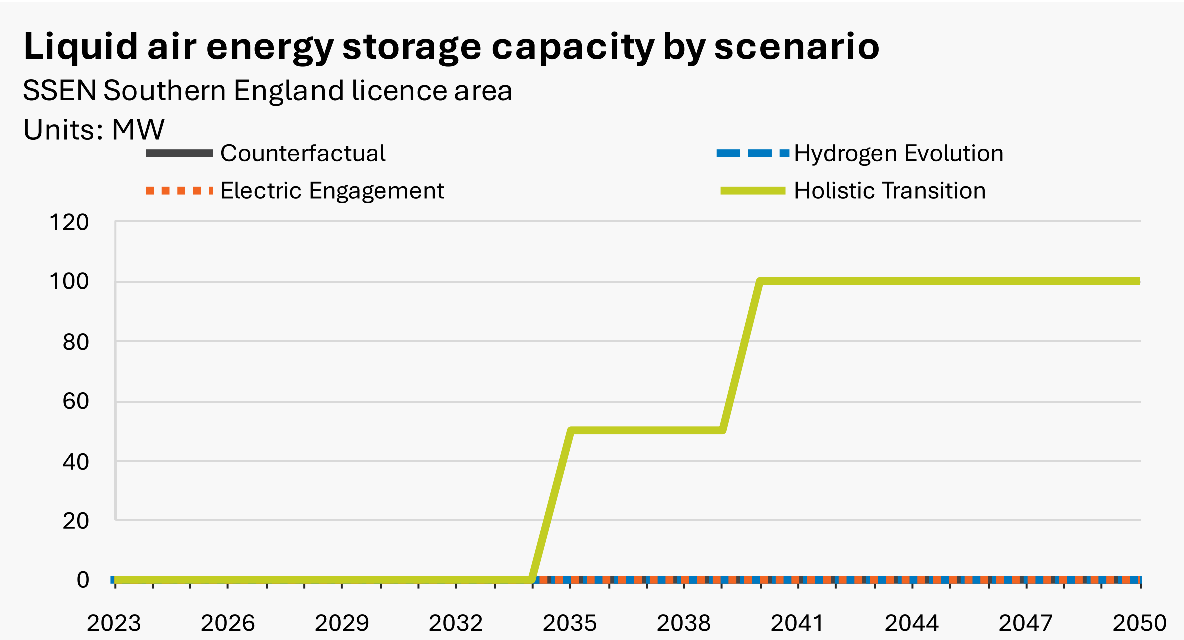
4.3. Liquid Air Energy Storage

Technical specification	Building Blocks
The analysis covers liquid air energy storage (LAES), sometimes referred to as cryogenic electricity storage, connected to the distribution network in the Southern England licence area.	No direct equivalent technology building block currently exists, but the analysis could be reconciled in part to building block: **Srg_BB004** – Other energy storage.

4.3.1. Summary

- LAES uses electricity to power compression and refrigeration equipment to cool air until it liquefies. This liquid air is then stored in cryogenic energy storage tanks for the duration required. When electricity is needed, the liquid air is exposed to ambient temperature air (or waste heat from industrial processes) to convert it back to a gaseous state. This resultant expanded gas is used to turn a turbine to generate electricity.
- Battery storage technologies dominate the UK storage pipeline (see the battery storage chapter of this report) but LAES is considered one of the technologies that could provide longer-duration storage services and other support services to the electricity system.
- Highview Power is one of the leading UK developers of this technology, due to deliver the first commercial scale LAES plants with funding through the National Wealth Fund (formally UK Infrastructure Bank) and the private sector. These projects are as follows:
    - The upscaling of an existing pilot site in Carrington, Manchester, to an 800 MWh commercial scale plant, due to commission in 2026.
    - A new 2.5GWh facility in Hunterston, south of Glasgow, has been announced.
    - A new 2.5 GWh site in Aberdeenshire is in development, designed to support the onshoring of North Sea wind power and provide grid stability.[13]
    - An additional 2.5GWh facility in England is indicated as an ambition.
- These 2.5 GWh projects will be connected to the electricity transmission network and make use of a Cap and Floor revenue guarantee mechanism for commercially deployable LDES projects.[14] Ofgem and DESNZ are due to consult on the detailed design of this scheme in 2025 and the first contract allocations are proposed to be awarded in 2026.

- The scale of the Highview projects indicates that the future of the technology lies in direct connection to the transmission network for the provision of grid services. However, previous engagement with Highview had indicated the consideration of co-location with renewables and large-scale data centres. This is reflected in the modelling of two 50 MW sites co-locating with a data centre from the mid-2030s under **Holistic Transition** in the Southern England licence area. This is the same approach that was taken for DFES 2023.
- A wide range of long duration storage technologies is being developed with potential applications on the distribution network.
- In addition to the proposed cap and floor mechanism, there have been two rounds of innovation grant funding to support pre-commercial Longer Duration Energy Storage (LODES) technologies with the majority of the successful projects located in Scotland.[15]
- These successful projects include redox flow batteries, thermal energy storage, gravitational energy storage, as well as power-to-X projects making use of surplus energy. Successful development of these trial projects and continued policy support could see these technologies significantly impacting the distribution network in the future. This may also mean the non-battery storage technology analysis in the DFES may adapt to allow for a more diverse range of technologies in future assessments.



Section 5: Future sources of disruptive electricity demand

Results and methodology

This section includes the results and assumptions for the following technologies:

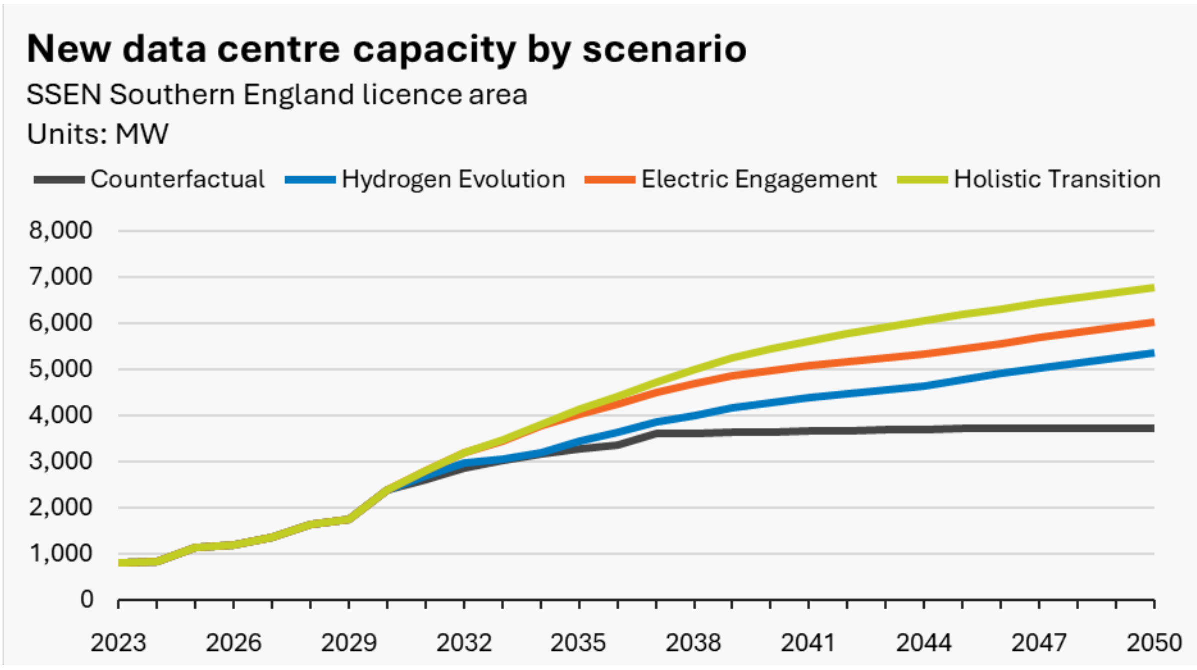
- Data centres
- Domestic air conditioning
- Electric vehicles and EV chargers
- Heat pumps and resistive electric heating
- Hydrogen electrolysis
- New property developments

5.1. Data centres

Technical specification	Building Blocks
Distribution network connected data centres	Uses FES data and assumptions for 'EC.C.07 - net additional annual electricity demand for data centres

5.1.1. Summary

- Large-scale commercial data centres have featured as a specific source of disruptive demand in the SSEN DFES analysis since 2020. This is due to a significant pipeline of new commercial data centre sites applying for large import connections in the Southern England licence area.
- The DFES 2024 analysis focuses on the baseline of existing data centres, additional sites which hold accepted connection offers with SSEN, and a longer-term projection of the future growth of connected data centre capacity out to 2050.
- 24 data centre sites, totalling 804 MW, are already connected and in operation in the licence area, situated around west London (primarily Slough), and Swindon.
- Slough is an attractive location for data centres and is the data centre hub of Europe. It is located along the route of a main fibreoptic cable running from London to Ireland, and on to the US, and it is close to London's financial services industry and technology companies based in London, Oxford and Cambridge.
- In addition to the operational baseline, 30 sites, totalling 1.8 GW of capacity, are in the pipeline to connect to the network, with either accepted connection offers, offers pending acceptance, connection applications submitted or expected. Nearly half of these sites are due to connect at the Iver 132 kV substation, which serves Slough.
- Additional capacity beyond the project pipeline has been projected using FES 2024 projections for national distribution connected data centre electricity consumption. This has resulted in significant growth projected out to 2050, with up to 6.7 GW deployed under **Holistic Transition,** as the most ambitious scenario for data centres.
- This scale of growth is justified when considering the recent pace of progress in hi-tech industries and the potential disruptive impact of 5G and artificial intelligence – all driving data demand centres. This view has been supported by stakeholder engagement conducted by the FES team and was the basis of their increased projections.
- It is unclear how many more sites may seek to connect to the distribution network. Competition for developable land and site locations to access high-speed internet connectivity could limit the future deployment of new sites on the distribution network.
- The reliance on a small geographic area in the south east of England may be opposed on the grounds of resilience and equity, considering data centres are now designated as Critical National Infrastructure and a key economic growth opportunity.[16] If so, the future deployment of data centres may be seen in other UK regions.



5.1.2. Modelling and outcomes

Baseline

Source: SSEN connections data & desktop research

Capacity (MW)	Sites	Description
805	24	The Southern England licence area currently hosts 24 data centres totalling 805 MW of demand capacity. These sites are concentrated in the west of London, primarily Slough, and Swindon. The average site has a capacity of 33 MW, though there are key clusters of sites which significantly contribute to this capacity. These are the Slough Heat and Power cluster (240 MW), Virtus London 4, 5 and 6 (120 MW) site, and the Slough Trading Estate (modelled at 100 MW).

Pipeline

Source: SSEN connections data

Status	Capacity (MW)	Description
Total	2,258	Number of sites: 43 This is an increase on DFES 2023 which reported 1,343 MW from 26 sites.
Accepted connection offers	900	18 sites totalling 900 MW of demand capacity have accepted connection offers. Nearly half of this capacity is due to connect at the Iver 132kV substation, which serves Slough. In all scenarios these sites are modelled to connect on their offered connection date, which are all between 2025 and 2030. The largest sites are modelled to phase their build-out and connected capacity across a number of years.
Offered connection	248	Six sites totalling 248 MW of capacity have been offered a connection agreement that have not yet been accepted. The connection dates offered range from 2024 to 2037, and these sites are modelled to connect accordingly under all scenarios. A 120 MW site with a connection offer has been modelled to connect in two annual phases of 60 MW from 2036.
Application Submitted	634	Five sites totalling 634 MW have submitted applications for a network connection. This includes a 272 MW site at Maidenhead Office Park site, due to connect at the Iver 132kW substation. This is modelled to connect in three 90 MW phases from 2029. All of these sites, with the exception of a 3 MW extension project, are modelled to commission between 2030 and 2032.
Pre-application	6	A single 6 MW extension to an existing site, is due to connect in 2027.
Additional sites	470	Regen have identified an additional 13 sites that may seek a connection offer with SSEN in the future. Insufficient evidence has been found to discount duplication with some existing sites in SSEN's connections database. Therefore, with the exception of four sites specifically identified by the Old Oak and Park Royal development corporation, these sites have not modelled been in the near term pipeline.

Scenario projections

Scenario	Capacity (GW)		Description
	2030	2050	
Holistic Transition	2.4	6.7	The DFES analysis has sought to develop projections for data centre capacity in the licence area beyond the known pipeline of sites. To do so, FES 2024 projections for annual electricity consumption from distribution network connected data centres has been applied as a proxy for future capacity.
Electric Engagement	2.4	6.0	These FES 2024 projections show rapid growth in annual energy usage from distribution network connected data centres. Under the scenario with the highest future uptake, **Holistic Transition**, the current annual consumption of 3.7 TWh nearly triples by 2030 to 9.1 TWh, and continues to increase, reaching 25.8 TWh in 2050.
Hydrogen Evolution	2.4	5.4	The **Electric Engagement** and **Hydrogen Evolution** scenarios project slightly lower growth, reaching up to 19.2 TWh and 22.7 TWh by 2050 respectively.
Counter-factual	2.4	3.7	This growth in annual electricity consumption is used to inform future data centre demand capacity in the Southern England licence area. This approach assumes current usage profiles and load factors are maintained until 2050 and that the Southern England licence area is broadly representative of the national development of new data centres on the distribution network. This results in additional capacity connecting, beyond the current pipeline, out to 2050. By 2050, 6.7 GW of demand capacity is built out under **Holistic Transition**, while 3.7 GW builds out under the **Counterfactual** scenario.

Spatial factors

Data centres spatial distribution
Within SSEN's November 2024 data centre connections dataset, just 3% of pipeline capacity is due to connect at 11kV primary level, with the majority of data centres connecting instead at GSP or BSP level. This trend is assumed to continue in the longer term with the industry moving towards larger 'hyper-scale data centres' which brings economies of scale. The DFES 2024 analysis models

95% of post-pipeline capacity as connecting directly to 132kV substations where known pipeline sites are being developed.

The remaining 5% of the post-pipeline capacity is modelled to connect to 11kV ESAs which already have, or are adjacent to, existing data centre connections. This reflects the likelihood that future data centres will continue to be located close to existing technology companies, industrial estate locations along the M4 corridor, and close to west London.

Stakeholder input

Stakeholder feedback	Impact on DFES analysis
Local Authority Engagement	The local authority new developments data exchange highlighted the development of four data centres either under construction or with planning permission under the remit of Old Oak and Park Royal development corporation. These sites are included within the model.
FES team engagement	As part of DFES 2024, the FES team were engaged to discuss the scale of the increases seen in the FES 2024 projections for national data centre energy consumption (relative to FES 2023 projections). Stakeholder engagement with industry representatives and research into the latest developments in AI and cloud computing was the reason for these increases.

5.1.3. Comparisons

Comparison to FES 2024

Data centre power capacity is not projected in FES 2024. Therefore, a reconciliation could not be undertaken. The annual energy consumption from distribution network connected data centres was used as a growth driver for post-pipeline DFES capacity modelling.

Comparison to DFES 2023

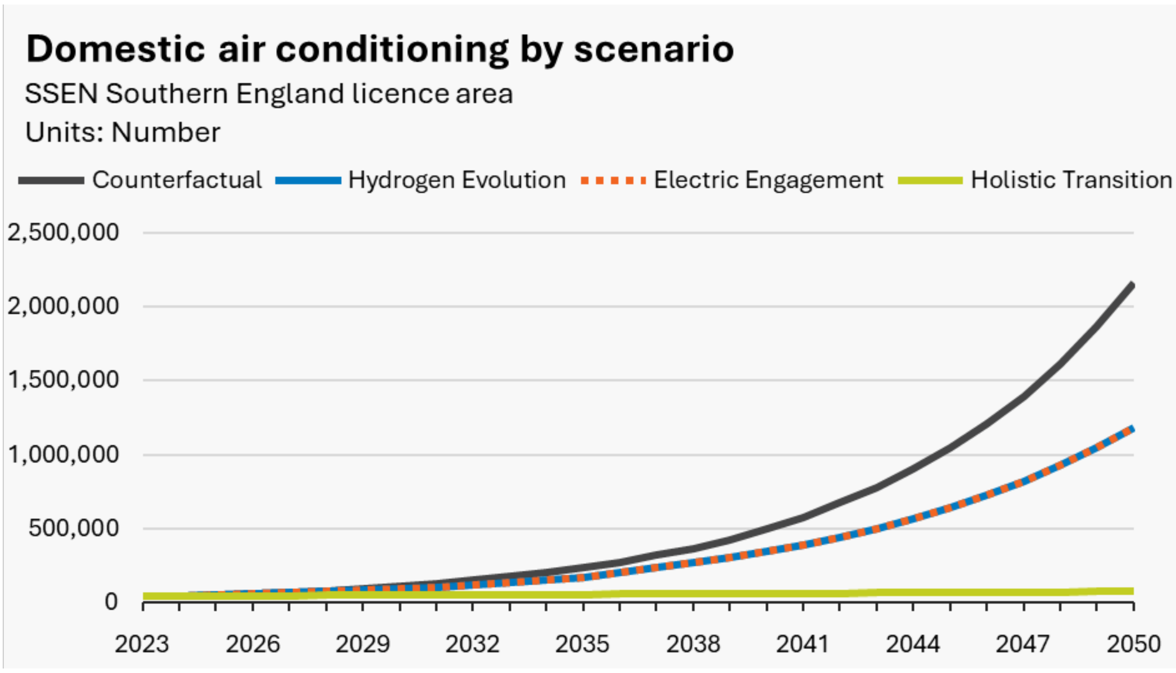
- Connected baseline data for data centres was not available in DFES 2023.
- The near-term pipeline data centre projects and future demand in the Southern England licence area have significantly increased on DFES 2023.
- Under the highest growth scenario, **Holistic Transition**, 2050 capacity has also significantly increased, nearly trebling on the highest growth scenario within DFES 2023.
- This is evidenced by the larger pipeline of sites with accepted connection offers, connection offers issued, or applications submitted, as well as the very large increase in national FES projections for data centre electricity consumption seen since FES 2023.

5.2. Domestic air conditioning

Technical specification	Building Blocks
Number of domestic air conditioning units, based on a typical portable or window-mounted air conditioner. Note that a single home has potential to own multiple units.	Lct_BB014

5.2.1. Summary

- Domestic air conditioning (A/C) is not currently common in the UK - an estimated 1% of UK homes are thought to have an installed domestic A/C unit. As no public or network register of domestic A/C installations has been found, the regional baseline has been modelled as a proportion of the FES 2024 figures for current domestic A/C across GB.
- Increased summer temperatures and extended heat waves are likely to result in an increased uptake of domestic A/C in the future. The UK building stock is not optimised for passive cooling, which could see the uptake of A/C increase more significantly under scenarios with limited retrofit.
- Given the limited visibility of the baseline and high level of uncertainty around how homes in the UK will be cooled in the future, there is a broad range of scenario outcomes. Uptake is modelled to be higher in areas such as west London due to the 'heat island effect' causing denser urban areas to experience higher temperatures.
- By 2050, up to 2.1 million domestic A/C units are installed under the **Counterfactual** scenario. Minimal domestic A/C units are installed under **Holistic Transition** by 2050, which assumes effective passive cooling measures are more prevalent across homes.



5.2.2. Modelling and outcomes

Baseline

Source: FES 2024

Scale	Units (000)	Description
All	42	There is limited baseline data on domestic A/C levels in the UK. The DFES modelling aligns with FES 2024's estimate of 370,000 domestic air conditioners in the UK in 2024.

Scenario projections

Scenario	Total units (000)		Description
	2030	2050	
Holistic Transition	52	77	Uptake is minimal, with households opting for passive cooling methods such as shading, ventilation and insulation. This results in the equivalent of just 3% of homes having A/C in 2050.
Electric Engagement	94	1,187	Uptake accelerates, particularly in urban areas due to heat island effects and the prevalence of smaller dwellings such as flats that may be more susceptible to overheating. However, uptake and awareness of passive cooling methods means that active cooling via A/C remains relatively uncommon. This results in the equivalent of 45% of homes having A/C in 2050 under this scenario.
Hydrogen Evolution	94	1,187	
Counter-factual	111	2,159	Increasing frequency of heat waves and low uptake and awareness of passive cooling methods leads to high uptake of A/C to achieve comfortable internal temperatures in homes. This results in the equivalent of 82% of homes having A/C in 2050 under this scenario.

Spatial factors

Factor	Description
Population density	Urban areas experience a 'heat island effect' as asphalt, pavement, and other built areas replace natural landscapes, causing heat to be absorbed rather than reflected. Although domestic A/C uptake occurs in

all types of households, it is distributed towards denser urban areas in towns and cities to account for this.

5.2.3. Comparisons

Reconciliation to FES 2024

- FES 2024 does not detail A/C projections by region, so no direct comparison could be made.

Comparison to DFES 2023

- There are no major differences between DFES 2023 and DFES 2024 outcomes.

5.3. Electric vehicles and EV chargers

Technical specification	Building blocks
Electric vehicles (EVs) – including cars, buses and coaches, HGVSs, LGVs and motorcycles, covering both battery EVs and plug-in hybrid EVs	Lct_BB001 Lct_BB002 Lct_BB003 Lct_BB004
Electric vehicle chargers (EV chargers)	No FES building blocks are available for EV chargers.

Regen transport model EV charger archetypes		
Domestic EV chargers	Off-street domestic	Homes with somewhere to park a private vehicle off-street
Non-domestic EV chargers	On-street residential	Charging at roadside car parking spaces
	Car parks	Charging at areas provided for parking only, hence excludes supermarkets
	Destination	Supermarkets, hotels and other destinations where parking is provided
	Workplace	Parking for commuters at places of work
	Fleet/depot	Charging for vehicles that 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 outside of urban areas

Note: The projection units for domestic and non-domestic EV chargers in the DFES 2024 analysis are different to previous DFES analysis. To illustrate the scale of EV charger uptake, domestic off-street EV chargers are displayed as numbers of chargers, while non-domestic EV chargers are displayed in total connected capacity (MW). For non-domestic EV chargers, different numbers of chargers could be required to deliver the same amount of EV charging energy, making capacity a better indicator of future uptake and network impact. While this is also true of domestic chargers, since there is assumed to be much less variability in their individual capacity, the number of chargers is considered a more useful indicator of the scale of future uptake, as it enables comparisons of chargers on a per household and per EV basis.

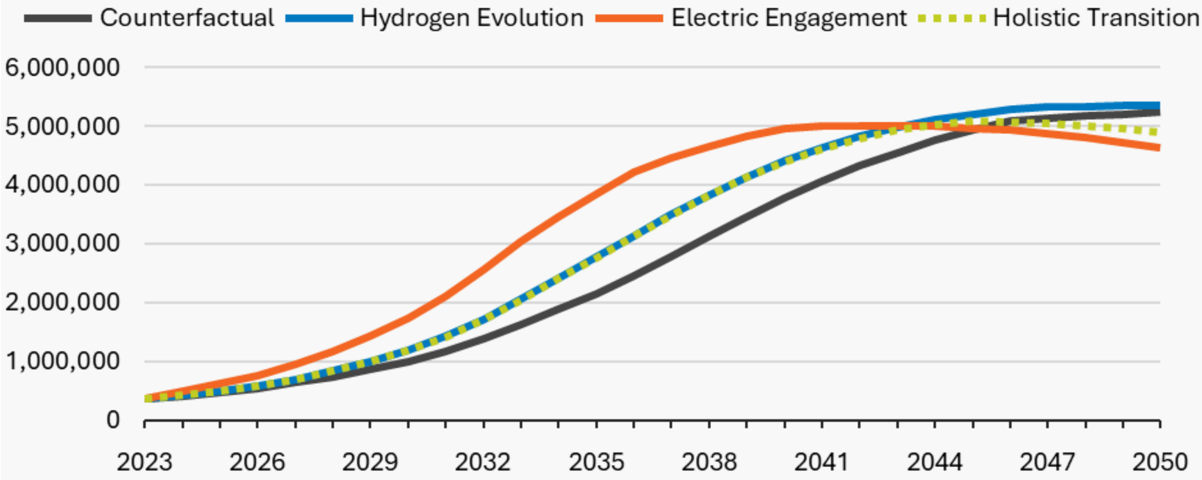
5.3.1. Summary

- Around 6% of vehicles in the Southern England licence area are currently battery electric or plug-in hybrid. This is anticipated to increase substantially under every scenario, as the UK looks to decarbonise the transport sector through electrification.
- In the **Hydrogen Evolution** and **Holistic Transition** scenarios, the electrification of vehicles reflects the current Zero Emission Vehicle (ZEV) mandate of no new petrol or diesel cars to be sold after 2035.[17]
- Under **Electric Engagement**, EV uptake has been modelled to align with an accelerated ZEV mandate, with no new petrol or diesel cars sold after 2030. Although this has been publicly discussed by the UK Government, it has not yet been legislated.[18] Under this scenario, passenger vehicles such as cars and LGVs are rapidly electrified over the 2020s and the early 2030s. Non-passenger vehicles, such as HGVs and buses, follow suit though over a longer timeframe. By 2050, almost all road vehicles are electrified, with the vast majority of EVs being fully battery electric.
- A greater availability of low-carbon hydrogen, including in cities, under the **Hydrogen Evolution** scenario, results in vehicles that are typically harder-to-electrify (such as buses and HGVs) adopting hydrogen-fuelled alternatives which results in a more limited EV uptake.
- The electrification of transport is slowest overall under the **Counterfactual** scenario, however, the vast majority of vehicles are still electrified by 2050.
- **Electric Engagement** and **Holistic Transition** both see a fall in overall vehicle ownership as car sharing, active travel and greater use of public transport reduce the overall need for private vehicles under these scenarios.
- Regen's DFES transport modelling determines the charger capacity that is required for the number of vehicles projected under each of the four DFES scenarios. This future charger requirement is split across a number of different domestic and non-domestic charger types as seen in the table above and includes domestic off-street chargers, rapid en-route chargers and chargers in public car parks etc.
- Domestic off-street chargers are modelled and presented in numbers of chargers. It is assumed that homes with multiple EVs do not purchase a second charger at the same rate as their first, leading to a levelling out of domestic EV charger capacity under all scenarios.
- The **Counterfactual** and **Electric Engagement** scenarios see the greatest variation in the medium term, with between 1.3 GW and 2.5 GW of EV charging capacity connected in the licence area in 2035, respectively. These scenarios converge in the longer term as road transport electrification progresses, resulting in a minimal range of projected outcomes around by 2050.

EV cars, LGVs and motorcycles by scenario

SSEN Southern England licence area

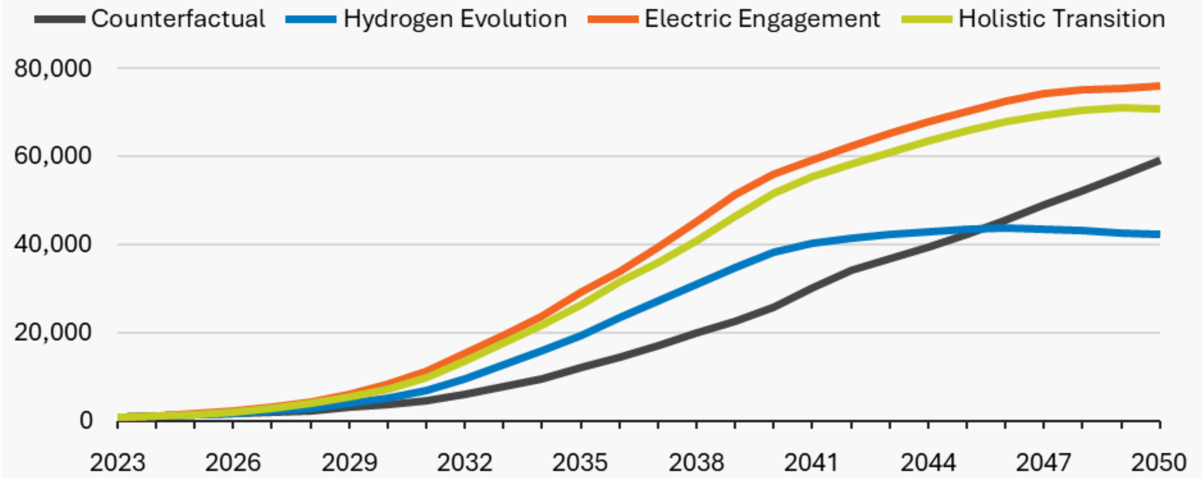
Units: Number



EV buses, coaches and HGVs by scenario

SSEN Southern England licence area

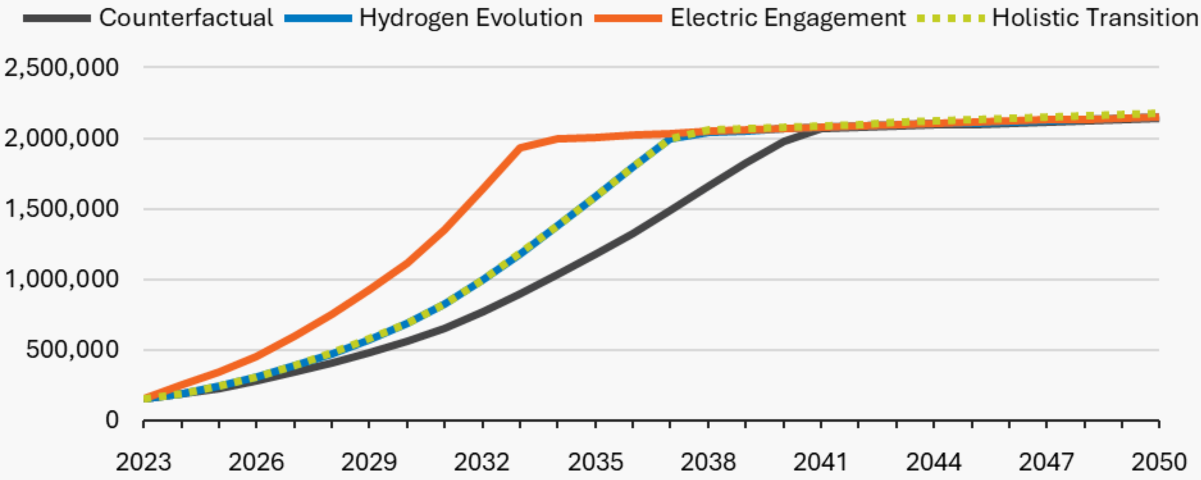
Units: Number



Domestic EV chargers by scenario

SSEN Southern England licence area

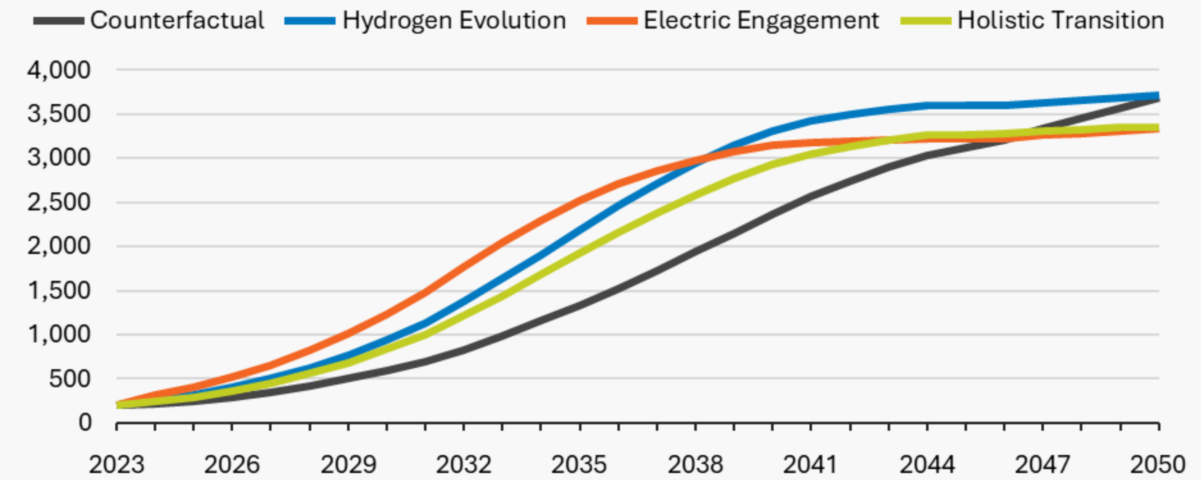
Units: Number



Non-domestic EV charger capacity by scenario

SSEN Southern England licence area

Units: MW



5.3.2. Modelling and outcomes

Baseline

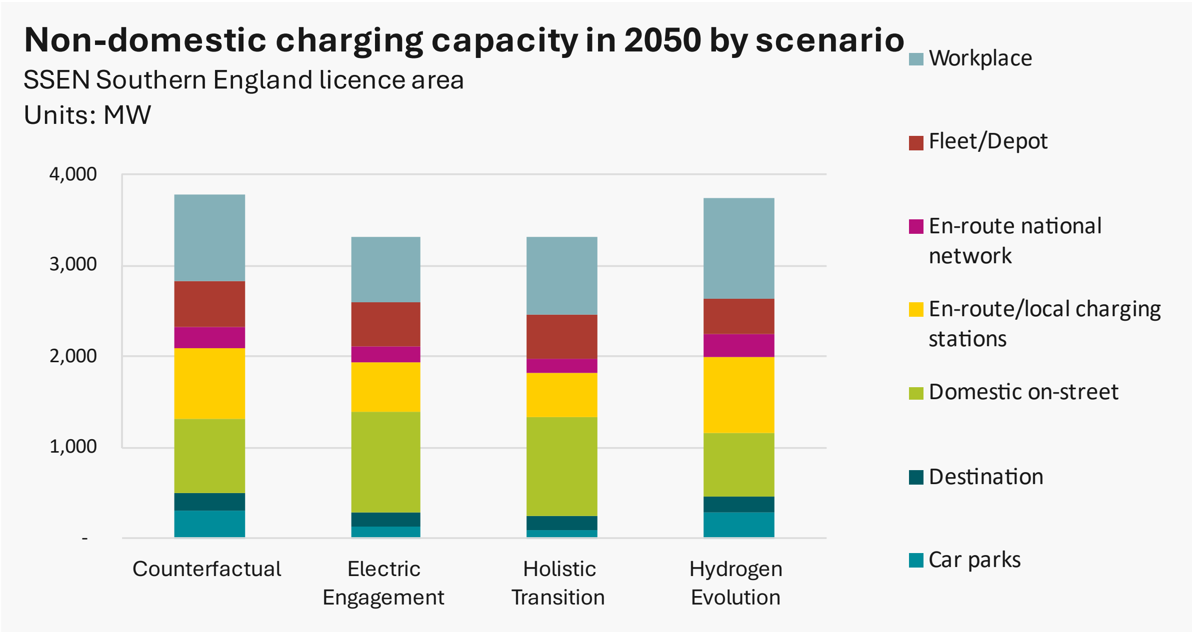
Source: DfT data, OpenChargeMap data, SSEN connections data

Type	Vehicles (000s)/ Capacity (MW)	Description
Electric Vehicles		
Pure electric car	231	EV uptake in the Southern England licence area is currently ahead of the national average, the uptake of battery EVs is increasing rapidly, increasing from approximately 158,000 in DFES 2023 to over 230,000 in DFES 2024. This is due to several factors, including: • Favourable tax benefits for ultra-low emissions vehicles • Increasing consumer confidence and awareness of EVs • Electrification of commercial vehicle fleets • Financial benefits of high mileage EVs, compared to petrol or diesel vehicles.
Plug-in hybrid car	112	
Pure electric LGV	19	
Other EVs	3	While most EV uptake has centred on cars, other electric vehicles such as LGVs and buses are also beginning to see uptake. EV uptake in the licence area is proportionally higher in urban areas such as West London. However, evidence suggests that urban and rural uptake rates are beginning to converge.
EV chargers		
Domestic	1,101	The baseline of EV chargers has increased from around 900 MW in DFES 2023 to 1,300 MW in DFES 2024. Most domestic EV owners in the licence area are assumed to have access to off-street parking and, therefore, are assumed to have a home off-street EV chargers.
Non-domestic	203	

Scenario projections

Scenario	EVs (number) and EV charger capacity (MW)		Description
	2030	2050	
Holistic Transition	1,2 million EVs 5,662 MW charger capacity	5.0 million EVs 18,614 MW charger capacity	A high proportion of new car and LGV sales are EVs in the late 2020s and early 2030s. Harder-to-electrify vehicles, such as buses and HGVs, see some uptake in the medium-term, but hydrogen-fuelled alternatives also begin to be adopted under these scenarios, limiting EV uptake for these heavier vehicles, particularly under **Hydrogen Evolution**. Plug-in hybrid vehicles see moderate uptake under both the **Holistic Transition** and **Hydrogen Evolution** scenarios, with battery electric vehicles being the dominant EV technology across all vehicle classes. While domestic charging is most common, rapid en-route charging also sees significant uptake under these scenarios. Car ownership falls under **Holistic Transition** in the mid-2040s as car sharing via autonomous vehicles, active travel and greater use of public transport reduces the need for private vehicle ownership overall.
Hydrogen Evolution	1.2 million EVs 5,740 MW charger capacity	5,4 million EVs 18,797 MW charger capacity	
Electric Engagement	1.7 million EVs 9,080 MW charger capacity	4.7 million EVs 18,441 MW charger capacity	EVs dominate new car and LGV sales from the late 2020s under the **Electric Engagement** scenario and from 2030 almost all new cars are electric. Harder-to-electrify vehicles, such as buses and HGVs, also see uptake in the medium-term, with the majority of all road vehicles electrified by 2040. With such a rapid shift toward battery electric vehicles, plug-in hybrid vehicles see relatively low uptake and the number of hybrid vehicles declines in the late 2030s. EV uptake is facilitated by a widespread rollout of domestic and non-domestic charging. This includes 350 kW and 1 MW eHGV chargers at major service stations. Overall vehicle ownership falls in the mid-2040s as car sharing via autonomous vehicles, active

			travel and greater use of public transport moderately reduces private vehicle ownership.
Counter-factual	1.0 million EVs 4,510 MW charger capacity	5.3 million EVs 18,652 MW charger capacity	In the **Counterfactual** scenario, a high proportion of new car and LGV sales are EVs by the early 2030s. Harder-to-electrify vehicles, such as buses and HGVs, see limited uptake in the medium-term. Plug-in hybrid vehicles see moderate uptake, yet battery electric vehicles remain the dominant EV technology across all vehicle classes. There is a much lower rate of domestic off-street charging under this scenario, with a higher number of car park, workplace and local charging stations being rolled out in the 2030s. Overall, private vehicle ownership remains higher in the long term under this scenario, reflecting lesser use of both public transport and active travel.



Spatial factors

Factor	Description
Access to off-street and on-street parking, affluence and rurality (source: ONS Census data)	These factors influence the near-term location of EVs and the associated off-street and on-street domestic EV chargers.
Location of petrol/diesel fuelling stations (source: OS Addressbase)	The location of petrol and diesel fuelling stations are used to indicate the location for projected en-route EV chargers.
Location of car parks, workplaces and fleets/depots (source: OS Addressbase)	The location of car parks, workplaces and depots are used to indicate the projected location of car park, workplace and fleet/depot chargers.
Ambition of local authority (source: Regen DFES local authority survey, LAEP publications)	Local authorities who confirmed they had a low-carbon transport plan in place (as part of the DFES 2024 local authority engagement workstream) are assumed to have a slightly accelerated uptake of electric buses and coaches, as well as en-route/local charging stations. Specific LAEP targets for the rollout of EV charger capacity have also been reviewed and incorporated where available and where possible.
SSEN low carbon technology data	The location of EV chargers currently connected to SSEN's network is used to inform the baseline of existing chargers.

Stakeholder input

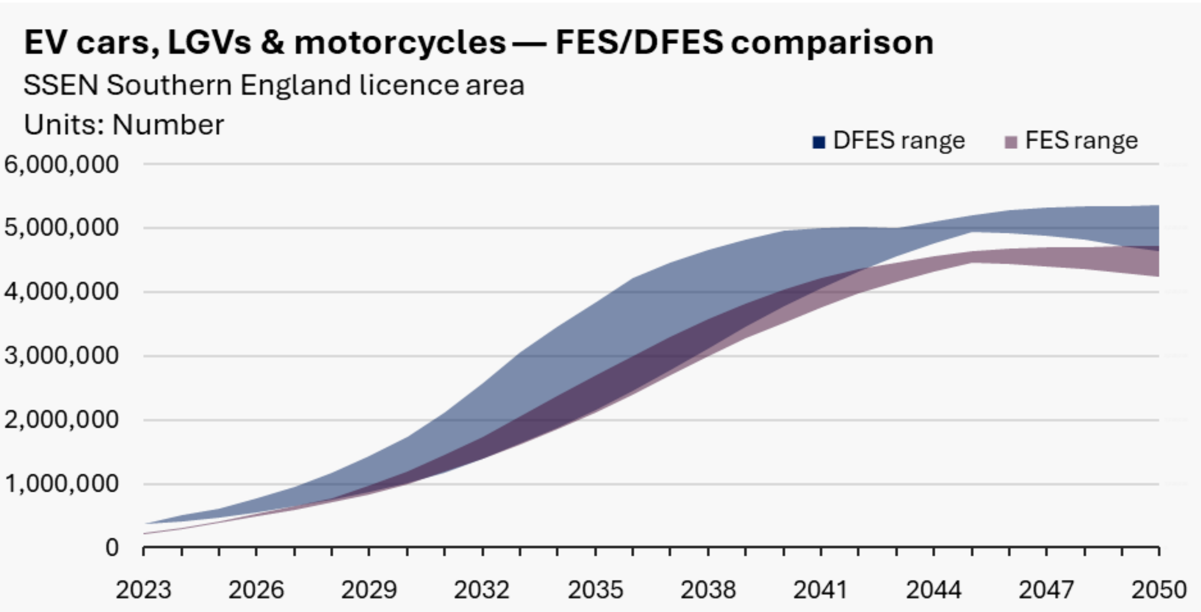
Stakeholder feedback	Impact on DFES analysis
Local Area Energy Plans	Published LAEPs were reviewed, but unfortunately no applicable EV/EV charger related targets were able to be used and reconciled to DFES projections for the Southern England licence area.
The stakeholders in the Southern England regional DFES webinar noted over 20 different factors as barriers to the widespread uptake of EVs in the licence area.	This validated existing DFES modelling assumptions that already reflects a range of factors that limits EV uptake under some scenarios.

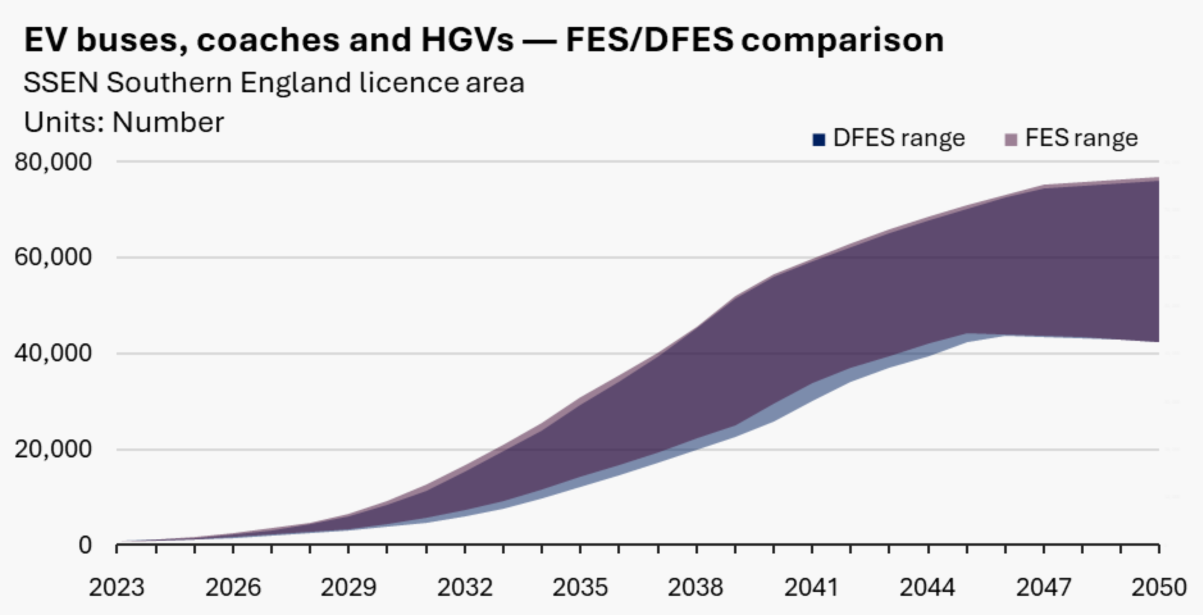
5.3.3. Comparisons

Reconciliation to FES 2024

The outcomes of the DFES modelling have been compared against the FES 2024 outcomes for the same licence area.

- As the uptake of EVs and provision of EV charging infrastructure is heavily driven by national trends and factors, the DFES projections for EVs and EV chargers in the licence area strongly mirror the national FES 2024 outcomes. The exception to this is **Electric Engagement**, which has an accelerated uptake for cars and vans tailored to reflect recent policy uncertainty around the ZEV mandate being applied in 2030 or 2035. This creates a larger envelope of scenario outcomes in the DFES, compared to the FES.
- Overall, vehicle uptake for electric cars, LGVs and motorcycles is marginally lower in the FES compared to the DFES. The reason for this variance is unclear but is likely due to differences in the modelling of the existing vehicle stock. The DFES modelling uses DfT vehicle licencing data to inform the overall number of different vehicle types in the licence area, which subsequently guides the future uptake of EVs.
- Vehicle uptake for electric buses, coaches and HGVs are very closely aligned between the FES and the DFES.
- The different EV charger technologies are not broken down in the FES 2024 data at a GSP, licence area or national level. As such, reconciliation of EV charger capacity in the licence area is not possible. However, FES assumptions on vehicle efficiencies, mileage and vehicle numbers are used to inform the DFES analysis where possible.





Comparison to DFES 2023

- The envelope of values remains broadly similar to DFES 2023, with the overall methodology remaining unchanged. A key difference this year is the divergence of **Electric Engagement** from FES 2024, in order to reflect a proposed (but not yet legislated) change to the ZEV mandate.
- Any other changes reflect the updated projections from FES 2024, which includes a more ambitious uptake of EVs in the **Counterfactual** and greater alignment between **Hydrogen Evolution** and **Holistic Transition**.

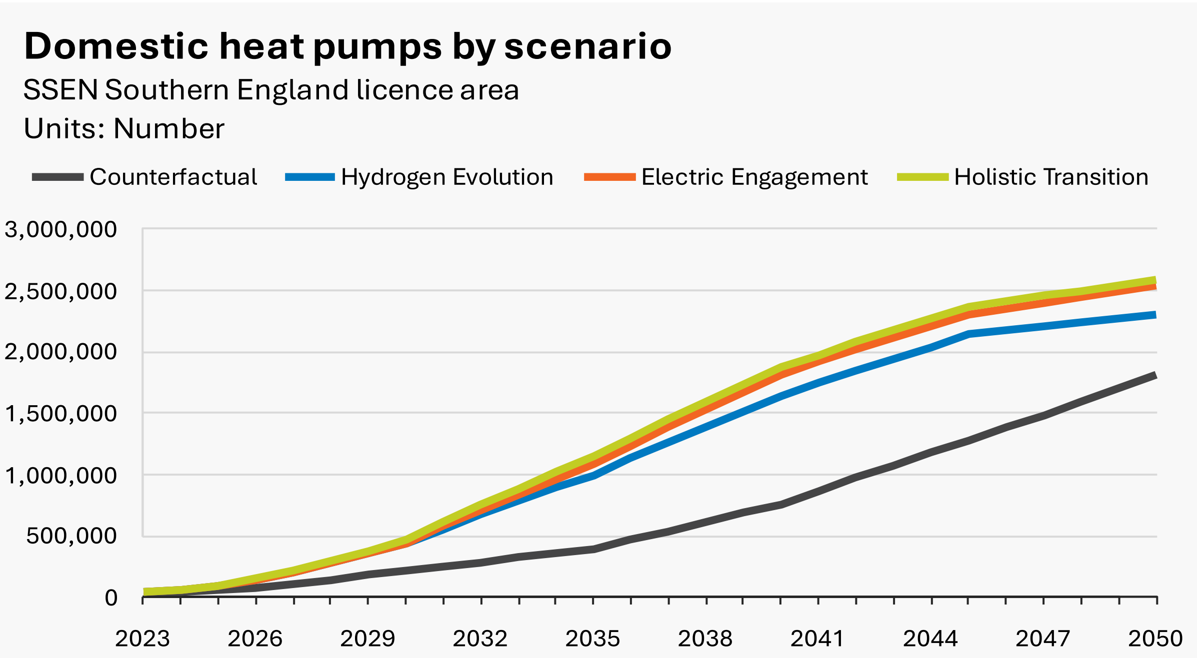
5.4. Heat pumps and resistive electric heating

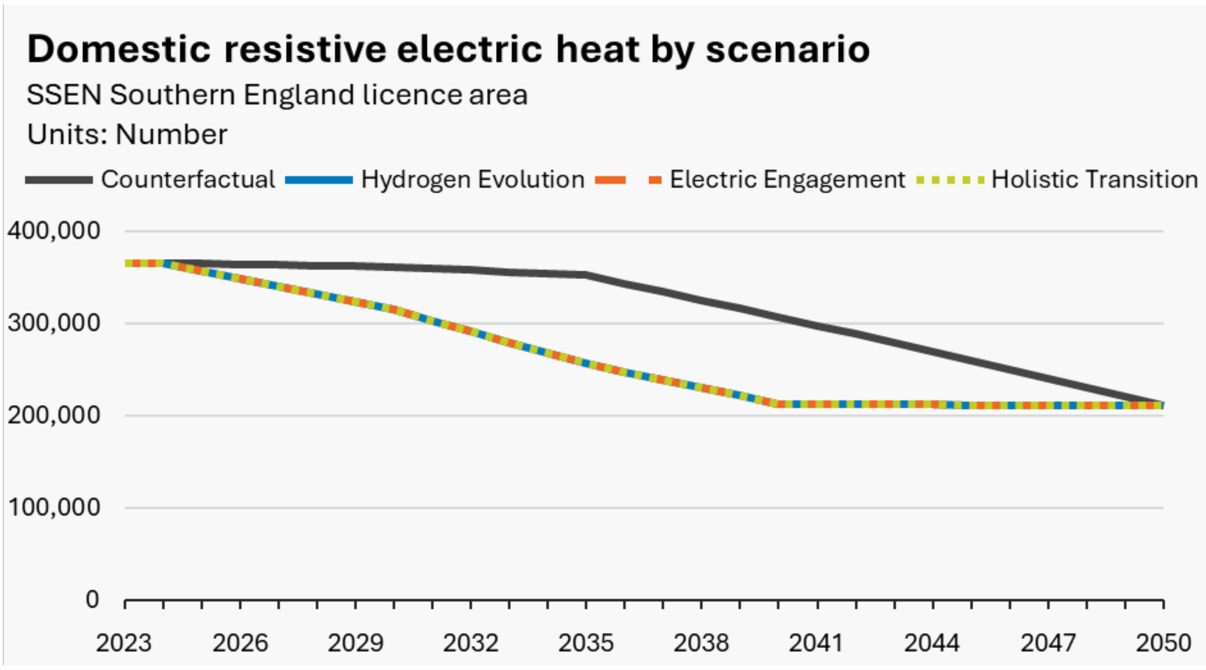
Technical specification	Building Blocks
Domestic and non-domestic non-hybrid heat pumps Domestic and non-domestic hybrid heat pumps Domestic and non-domestic resistive electric heating	Lct_BB005 Lct_BB006 Lct_BB007 Lct_BB008

5.4.1. Summary

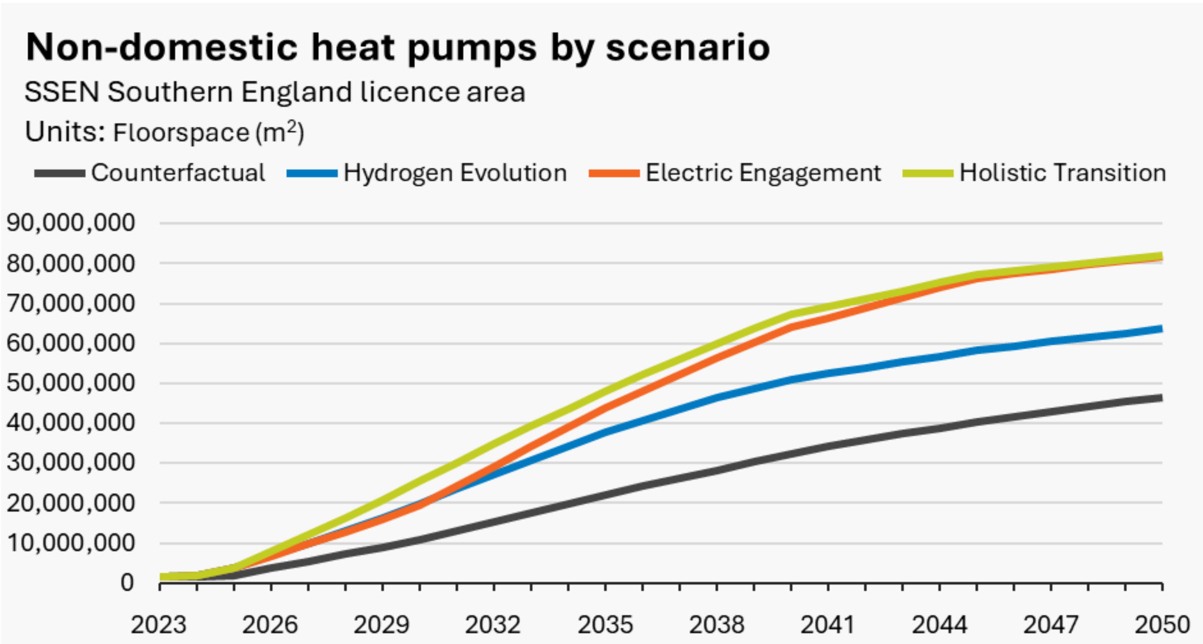
- The Southern England licence area has a broad range of housing. Built-up urban areas, such as Reading, Portsmouth and Southampton, tend to have dense areas of on-gas houses and flats, while more rural areas, such as the New Forest, tend to be off-gas. Overall, the building stock in the licence area is representative of the UK average in terms of current heating technology use, housing types and tenure.
- Under the **Holistic Transition** and **Electric Engagement** scenarios, domestic heating is mostly decarbonised through heat pumps in Southern England, in line with national trends. Initial uptake in the 2020s is modelled to occur more frequently in off-gas houses and new-build homes. This is a reflection of anticipated energy performance and new build housing regulations, which will be required to meet UK Government's target of 600,000 heat pump installations per year by 2028.
- In the medium and long term, a wider-scale rollout is modelled, with the majority of housing stock having heat pumps by 2050. This results in between 2.4 million and 2.5 million homes using a form of heat pump by 2050 under the **Holistic Transition** and **Electric Engagement** scenarios.
- Under the **Hydrogen Evolution** scenario, domestic heating is mostly decarbonised through a combination of non-hybrid heat pumps and low-carbon hydrogen, in the form of standalone hydrogen boilers or hybrid heat pumps. Hybrid and non-hybrid heat pumps total 2.2 million by 2050 in the licence area in this scenario.
- Under the **Counterfactual** scenario, progress towards heat decarbonisation is slow despite some uptake of heat pumps in the late 2030s and 2040s. This results in approx. 1.7 million homes using a form of heat pump by 2050 under this scenario.
- The number of households on resistive electric heating decreases in all scenarios, being replaced by more efficient heat pumps and district heating schemes. Direct electric heating, as the most expensive form of resistive electric heating, sees the greatest reduction in the near term. There is a shift from direct electric heating to storage heating in homes where a boiler or heat pump is less suitable.
- Heating in non-domestic buildings is currently dominated by gas-fired central heating, resistive electric heating and air conditioning for cooling/temperature control.
- Evidence from DESNZ on low-carbon heating and cooling in non-domestic buildings found that non-domestic building decarbonisation scenarios are strongly influenced by the existing heating system and heating, ventilation and air conditioning (HVAC) environment.[19]

- In all four scenarios, the near-term uptake of heat pumps in non-domestic buildings is focused on buildings heated with off-gas and direct electric heating systems due to the higher operational costs of these technologies.
- In the medium to long term, buildings currently heated by gas, oil or Liquid Petroleum Gas (LPG) heating systems are modelled to move either to an air-source or ground-source heat pump, or connect to a district heat network. Most buildings with resistive electric heating are modelled to move to more efficient air-to-air heat pumps, operating similarly to air conditioners.
- Non-domestic buildings are primarily decarbonised with heat pumps in the three net zero scenarios, resulting in heat pumps heating approx. 62-80 million sqm of non-domestic floorspace by 2050.
- In all scenarios, resistive heating declines substantially from 2025 through to 2050 in non-domestic buildings, due to the uptake of more efficient heat pumps and district heating. Direct electric heating, as the most expensive heating method, sees a greater reduction in the near term. Under the **Electric Engagement** scenario, a higher proportion of non-domestic buildings remain on resistive electric heating in the long term due to the particularly strong focus on electrification of heat and limited low-carbon alternatives under this scenario.

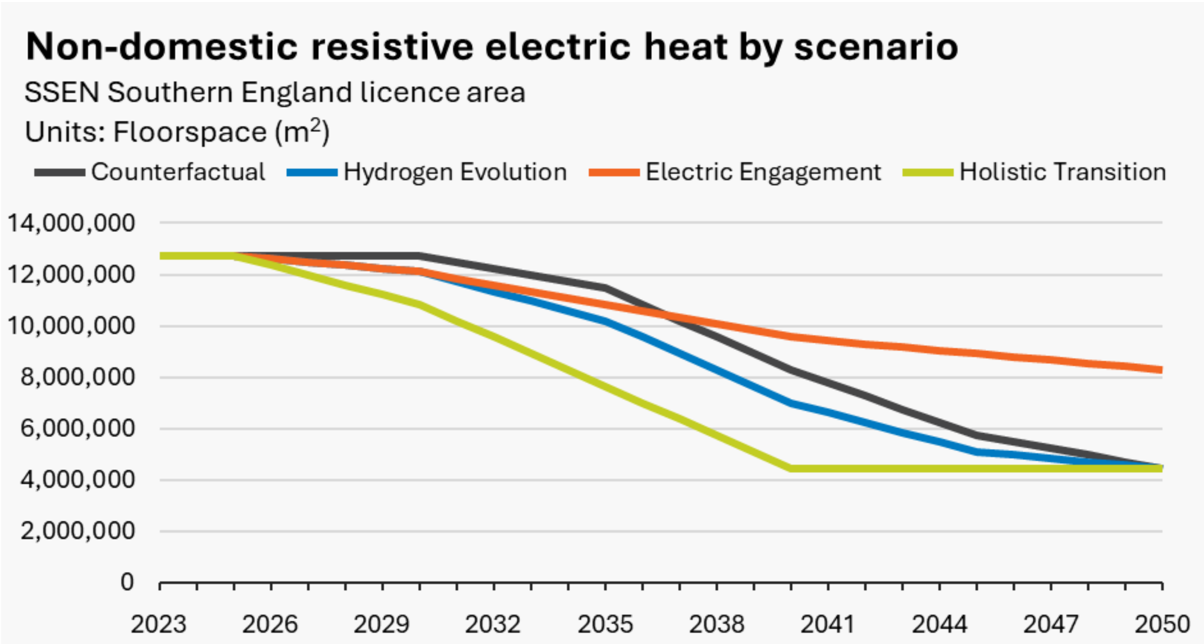




Domestic resistive electric heat by scenario
SSEN Southern England licence area
Units: Number
Counterfactual
Hydrogen Evolution
Electric Engagement
Holistic Transition
400,000
300,000
200,000
100,000
0
2023
2026
2029
2032
2035
2038
2041
2044
2047
2050



Non-domestic heat pumps by scenario
SSEN Southern England licence area
Units: Floorspace (m2)
Counterfactual
Hydrogen Evolution
Electric Engagement
Holistic Transition
90,000,000
80,000,000
70,000,000
60,000,000
50,000,000
40,000,000
30,000,000
20,000,000
10,000,000
0
2023
2026
2029
2032
2035
2038
2041
2044
2047
2050



5.4.2. Modelling and outcomes

Baseline

Source: SSEN connections data, EPCs, Census 2021, MCS, DECs

Domestic heating technology	Number (000s)	Description
Non-hybrid heat pumps	36	Most heat pumps in existing homes in the Southern England licence area were supported by the Renewable Heat Incentive scheme, which ran from 2014 to 2022. This has since been succeeded by the Boiler Upgrade Scheme, which moves support to an upfront grant payment to reduce the capital costs of installing a heat pump.[20]
Hybrid heat pumps	<1	Approximately 1% of homes in the licence area have a heat pump, very slightly ahead of the national average. This reflects the breakdown of current heating systems of homes in Southern England, which is similar to the UK as a whole, with the majority of homes heated by gas boilers.
Resistive electric heating	366	Resistive electric heating is marginally more common in Southern England compared to the national

		average, heating around 12.5% of homes, compared to 10% nationally.

Non-domestic heating technology	Floorspace (000 sqm)	Description
Non-hybrid heat pumps	1,658	EPC and DEC data does not record whether a non-domestic building is heated by a heat pump. As a result, the heat pump baseline is informed by MCS installation data.
Hybrid heat pumps	0	
Resistive electric heating	12,744	Analysis of EPC and DEC data suggests that approx. 13 million square meters of non-domestic floorspace is currently heated by resistive electric heating. This does not include buildings with air conditioning that are recorded as predominantly providing cooling.

Pipeline

There is no pipeline in the SSEN connections data for domestic or non-domestic heat pumps or resistive electric heating.

Domestic scenario projections

<table>
<tr><th rowspan="2">Scenario</th><th colspan="2">Heat pumps (000s)</th><th rowspan="2">Description</th></tr>
<tr><th>2030</th><th>2050</th></tr>
<tr><td>Holistic Transition</td><td>305</td><td>2,586</td><td rowspan="2">Homes are mostly decarbonised with heat pumps in the Holistic Transition scenario. Initial uptake in the 2020s is modelled to occur more commonly in off-gas houses and new-build homes, due to anticipated energy performance and new-build housing regulations, before a wider-scale rollout is modelled on the majority of housing stock by 2050.

District heating plays a role in domestic heat decarbonisation in urban areas across Southern England, especially after 2030. Where a district heat network area has been identified, the majority of flats and terraces, and a substantial proportion of semi-detached and detached homes, in the area are modelled to connect. New-build homes in district heat network areas are also projected to connect to the network in most cases.

Between 2.5 and 2.6 million domestic heat pumps are modelled to be in operation by 2050 under these scenarios.

The number of households on resistive electric heating decreases in all scenarios, replaced by more efficient heat pumps and district heating. Direct electric heating, as the most expensive form of resistive electric heating, sees the greatest reduction in the near term. There is a shift from direct electric heating to storage heating in homes where a boiler or heat pump is less suitable. However, around 60% of the baseline remains on resistive heating in 2050, particularly in smaller flats where a heat pump may not be suitable or economical.</td></tr>
<tr><td>Electric Engagement</td><td>283</td><td>2,532</td></tr>
<tr><td>Hydrogen Evolution</td><td>280</td><td>2,304</td><td>Homes are decarbonised in the Hydrogen Evolution scenario via a combination of non-hybrid heat pumps and low-carbon hydrogen options, through the use of standalone hydrogen boilers or hybrid heat pumps. In the Southern England licence area, where there is a high proportion of on-gas homes, this results in the vast majority of homes being heated by hydrogen hybrid heat pumps or standalone heat pumps. A minority of homes decarbonise their heating through hydrogen boilers.</td></tr>
</table>

			District heating plays a role in domestic heat decarbonisation in urban areas across Southern England under this scenario, especially after 2030. Where a district heat network area has been identified, the majority of flats and terraces, and a substantial proportion of semi-detached and detached homes, in the area are modelled to connect. New-build homes in district heat network areas are also projected to connect to the network in most cases. Around 2.3 million domestic heat pumps are modelled to be in operation by 2050 under this scenario. Resistive heating declines throughout the scenario timeframe due to the uptake of heat pumps and district heating. Direct electric heating, as the most expensive heating method, sees a greater reduction in the near term. There is a shift from direct electric heating to next-generation storage heating in homes where a boiler or heat pump is less suitable. However, around 60% of the baseline remains on resistive heating in 2050, particularly in smaller flats where a heat pump may not be suitable or economical.
Counter-factual	121	1,807	Under the **Counterfactual** scenario, progress towards heat decarbonisation is slow, despite some uptake of heat pumps in the late 2030s and 2040s. In this scenario, many homes remain heated by fossil gas boilers in 2050, and the UK fails to meet its carbon emissions reduction targets. District heat networks also see lower uptake under this scenario, as progress towards net zero is slower. Around 1.8 million domestic heat pumps are modelled to be in operation by 2050 under this scenario. Resistive heating declines after 2035 due to the uptake of heat pumps and district heating. Direct electric heating, as the most expensive heating method, sees a greater reduction in the near term. There is a shift from direct electric heating to next-generation storage heating in homes where a boiler or heat pump is less suitable. However, around 60% of the baseline remains on resistive heating in 2050, particularly in smaller flats where a heat pump may not be suitable or economical.

Non-domestic scenario projections

Note that non-domestic heating outcomes are projected in square meters of heated floorspace. This is due to the wide range of non-domestic building sizes, making floorspace a more useful unit than number of units for non-domestic heating.

<table>
<tr><th rowspan="2">Scenario</th><th colspan="2">Heat pumps (000 sqm)</th><th rowspan="2">Description</th></tr>
<tr><th>2030</th><th>2050</th></tr>
<tr><td>Holistic Transition</td><td>25,611</td><td>80,203</td><td rowspan="2">Non-domestic buildings are primarily decarbonised with heat pumps in the Holistic Transition scenario. Similar to heating in domestic buildings, near-term decarbonisation of heat in non-domestic buildings is focused on buildings heated with off-gas and direct electric heating systems due to the higher operational costs of these technologies.

Resistive heating declines sharply throughout the scenario timeframe from 2025 to 2040, due to the uptake of heat pumps and district heating. Around 35% of the baseline remains on resistive heating in 2050.</td></tr>
<tr><td>Electric Engagement</td><td>19.317</td><td>80,357</td></tr>
<tr><td>Hydrogen Evolution</td><td>19,847</td><td>62,259</td><td>Non-domestic buildings are primarily decarbonised with heat pumps in the Hydrogen Evolution scenario. Similar to heating in domestic buildings, near-term decarbonisation of heat in non-domestic buildings is focused on buildings heated with off-gas and direct electric heating systems.

Resistive heating declines throughout the scenario timeframe from 2025 to 2050, due to the uptake of heat pumps and district heating. Around 35% of the baseline remains on resistive heating in 2050.</td></tr>
<tr><td>Counter-factual</td><td>10,933</td><td>46,758</td><td>Although to a lesser extent, non-domestic buildings are still primarily decarbonised with heat pumps in the Counterfactual scenario. Similar to heating in domestic buildings, near-term decarbonisation of heat in non-domestic buildings is focused on buildings heated with off-gas and direct electric heating systems. This results in the lowest level of heat pump uptake in non-domestic buildings of the four scenarios, with a number of properties likely still remaining on fossil fuel heating systems by 2050.

Resistive heating declines throughout the scenario timeframe from 2025 to 2050, due to the uptake of heat pumps and district heating. Around 35% of the baseline remains on resistive heating in 2050.</td></tr>
</table>

Spatial factors

Factor	Description
Current heating technology	Current heating technology, categorised into on-gas, resistive electric heating and off-gas, affects when the uptake of decarbonised heating technology is projected to occur and what type of heating technology is likely to be installed.
Building type	Building type, categorised into semi-detached, detached, terraced and flats, affects when the uptake of decarbonised heating technology is projected to occur and what type of heating technology is likely to be installed.
Tenure	Tenure, categorised into owner-occupied, privately rented and socially rented, affects when uptake of decarbonised heating technology is projected to occur.
Construction age band	Construction age band, categorised into pre-1930 and post-1930 construction, affects when the uptake of decarbonised heating technology is projected to occur and what type of heating technology is likely to be installed.
Areas with potential for district heat networks, or an existing heat network pipeline project	Areas with potential for district heat networks or an existing heat network pipeline project affects the likelihood of properties connecting to a district heat network as opposed to decarbonising with other heat technologies.
Hydrogen supply for domestic heating	In FES 2024, the **Holistic Transition** scenario features a small proportion of homes heated by hydrogen boilers or hydrogen hybrid heat pumps. The location of these homes is likely to be primarily on the east coast of the UK, in line with the East Coast Hydrogen project from Humber to Teesside, and the north west, in line with the HyNet North West project.[21,22] Therefore, in this scenario, it is assumed that hydrogen supply for domestic heating does not extend to the Southern England licence area. Under **Hydrogen Evolution**, it is assumed that hydrogen supply follows the existing gas distribution network.
Local Area Energy Plans	Data from Local Area Energy Plans has been obtained where available and reconciled against the DFES outcomes.

Stakeholder input

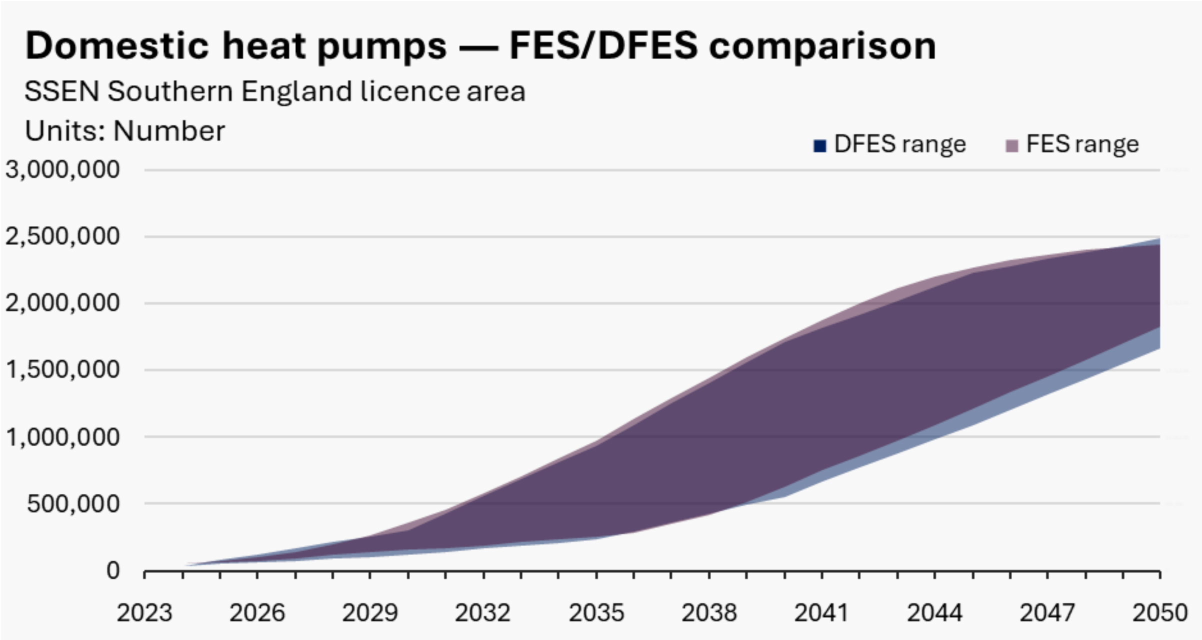
Stakeholder feedback	Impact on DFES analysis
Local Area Energy Plans	Data and technology specific targets from Local Area Energy Plans have been obtained where available and reconciled against the DFES outcomes. This includes targets for annual heat pumps installations in west London from the OPDC.
Engagement with district heat developers	A leading district heat network developer was engaged to confirm modelling assumptions around the uptake of district heat.
Engagement with DESNZ heat network team	The DESNZ heat network team was engaged to confirm modelling assumptions around the location of district heat and wider assumptions around heat decarbonisation across GB.

5.4.3. Comparisons

Reconciliation to FES 2024

The outcomes of the DFES modelling have been compared against the FES 2024 outcomes for the same licence area.

- The DFES 2024 domestic projections is well aligned to the FES 2024 projections.
- The DFES projects non-domestic heat in terms of heated floorspace rather than number of units. As a result, a direct comparison with the FES outcomes is not possible.



Comparison to DFES 2023

- The DFES 2024 domestic heat outcomes are in line with the DFES 2023 projections.
- The DFES 2024 scenario projections for **Hydrogen Evolution** differ the most when compared to System Transformation, as the most similar scenario in DFES 2023. This is due to an updated FES 2024 framework, which has increased the number of heat pumps and reduced the amount of hydrogen for domestic heating under this scenario.
- The **Holistic Transition** and **Electric Engagement** scenario projections for heat pumps are lower than the equivalent projections from DFES 2023 until the mid 2040s. This is due to an updated FES 2024 framework which has reduced the uptake of heat pumps in the near term, reflecting current national uptake trends.
- The **Counterfactual** scenario is broadly aligned with the DFES 2023 projections under the equivalent Falling Short scenario, although slightly higher in the long term. This is due to the more ambitious uptake of heat at a national level modelled in FES 2024, which has been reflected in the DFES 2024 modelling.
- The DFES 2024 projects non-domestic heat in terms of heated floorspace whereas projections in DFES 2023 were number of units. This is due to the wide range of non-domestic building sizes, making floorspace a more useful unit than number of units for non-domestic heating. As a result, a comparison with DFES 2023 outcomes is not possible for non-domestic heat.

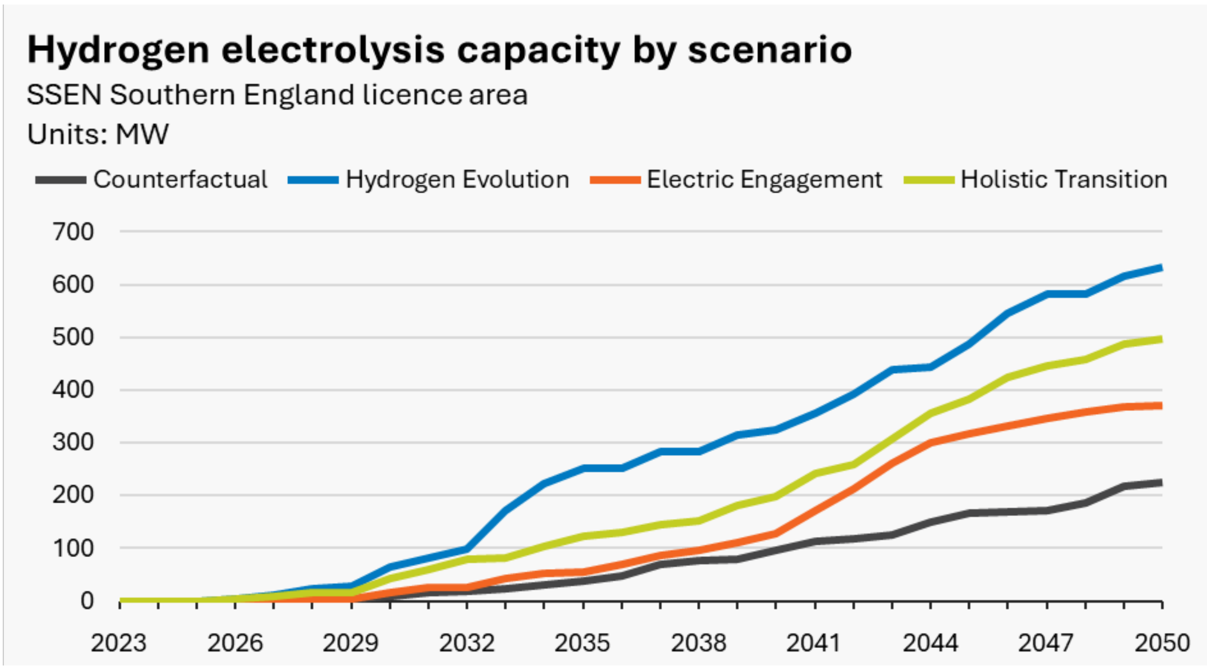
5.5. Hydrogen electrolysis

Technical specification	Building Blocks
Distribution connected hydrogen electrolysis	Dem_BB009

5.5.1. Summary

- The production of low carbon hydrogen through commercial scale hydrogen electrolysis is still an emerging sector, with uncertainty around the scale of its future role in the energy system. The extent to which hydrogen electrolysis will scale-up and seek to connect to the transmission network is one such uncertainty. This results in a wide range of projections in the Southern England licence area.
- The 2022 British Energy Security Strategy outlined a target of 10 GW of low-carbon hydrogen production by 2030, of which 5 GW is to be from electrolysis (also known as 'green hydrogen'). In addition, the UK Government has set an interim aim for 1 GW of electrolytic production capacity to be in construction or operation by 2025.
- Funding has been committed in support of this target:
    - 11 electrolysis projects are receiving funding through the first Hydrogen Allocation Round (HAR 1), totalling 125 MW of green hydrogen production capacity
    - 875 MW of additional hydrogen production capacity will be supported through the second allocation round (HAR 2), with winning projects set to be announced in the first half of 2025
    - An additional 1.5 GW of hydrogen production capacity will be funded across both HAR 3 and HAR 4, launched in 2025 and 2026, respectively
    - Subsequent allocation rounds will be held annually between 2025 and 2030.
- Engagement with electrolyser developers and hydrogen industry groups has highlighted the importance of these allocation rounds in enabling the near-term deployment of commercial-scale projects. The development of commercial electrolysis projects outside of this support mechanism is not considered feasible in the near term. The results of HAR 2, and subsequent allocation rounds, will give greater certainty to the near term development of electrolysis capacity in the licence area and across GB.
- There are no projects in the Southern England licence area with HAR funding to date; the only site modelled to connect in the near term is a prospective project currently under development by the South West Energy Hub, for a 5 MW electrolyser at Wroughton Airport. This site has been modelled to commission between 2026 and 2028 in the net zero compliant scenarios, and does not build out under the **Counterfactual**.
- Beyond the known pipeline, the potential for additional new capacity out to 2050 is based on FES 2024 projections for national networked electrolysis, paired with a regional analysis of potential supply and demand drivers for hydrogen.

- Compared to other licence areas throughout the UK, the Southern England licence area has relatively high levels of industrial demand and gas network coverage; blending into the gas network is a driver in the near term under some scenarios. Significantly, the licence area is set to host a section of National Gas' proposed future hydrogen backbone transmission network, through Project Union. It's route through the centre of the licence area, running approximately from Oxford to Southampton, is a key locational factor driving medium- and long-term deployment.[23] Demand from aviation is also a long term factor in the modelling, with a number of airports in the licence area.
- By 2050, under **Hydrogen Evolution**, as the scenario that is most supportive of green hydrogen development, 632 MW of hydrogen electrolysis is modelled to be deployed in the licence area.
- Under the least ambitious scenario, the **Counterfactual**, only 236 MW is deployed.



5.5.2. Modelling and outcomes

Baseline

Source: Desktop research

Description
The Southern England licence area has previously hosted hydrogen refuelling stations with small-scale electrolysis on site. As of the end of 2022, there were three known sites connected to the grid totalling 2.4 MW. These stations have closed in the past two years. Therefore, the current baseline capacity is considered to be 0 MW.

Pipeline

Source: Desktop research

Description
Engagement with the sector has highlighted the importance of UK Government support, specifically through the HAR scheme, to the viability of near-term commercial business models for electrolyser projects. The pipeline assessment has therefore focused on projects with UK Government support. However, many of these sites fall out-of-scope of the analysis due to deriving hydrogen from on-site generation and/or not seeking a distribution network connection. For example, a project at RWE's Didcot power station has received funding though the UK Net Zero Hydrogen fund, for a Front-End Engineering Design (FEED) study into green hydrogen production onsite. It is currently assumed that this would make use of existing transmission network infrastructure. The only project modelled to connect in the near term is a prospective site currently under development by the South West Energy Hub, for a 5 MW electrolyser at Wroughton Airport.[24] This is commissioned between 2026 and 2028 in the net zero compliant scenarios, and does not build out under the **Counterfactual**.

Scenario projections

Scenario	Capacity (MW)		Description
	2030	2050	
Hydrogen Evolution	64	632	Under this scenario, the main driver for the growth of hydrogen electrolysis capacity in the medium term is the high levels of hydrogen blending into the gas network. This means the coverage of the existing gas network infrastructure is an important regional supply consideration. Demand from industrial decarbonisation in the licence area is also a key medium-term driver. In the long term, a core hydrogen transmission network is built out and links with regional distribution networks, such as those proposed by HyNet and Hyline Cymru.[25,26] This reduces the need for demand and production to be so locally tethered and allows hydrogen production sites to be developed in areas that are most suitable. This results in a balance between the proximity to any future hydrogen gas

			network, renewable energy projects (including for co-location) and sources of low-carbon hydrogen demand. Hydrogen electrolysis capacity reaches over 0.6 GW by 2050 under this scenario.
Holistic Transition	44	497	Under this scenario, high levels of hydrogen blending means that the coverage of the existing gas network infrastructure is an important regional consideration for the development of hydrogen electrolysis projects. Demand from industrial decarbonisation is also a key medium-term driver. A core hydrogen transmission network is developed, but to a lesser extent than seen under **Hydrogen Evolution**, and without regional distribution networks. This makes the route of the core transmission network an important locational factor for electrolysis, alongside existing gas fired electricity generation and industrial activity. Hydrogen electrolysis capacity reaches just under 0.5 by GW 2050 under this scenario.
Electric Engagement	15	371	With less hydrogen blending, the demand from industrial decarbonisation, heavy transport and existing gas-powered electricity generation are the main medium-term drivers for electrolysis development under this scenario. A core hydrogen transmission network is developed, but to a similarly lesser extent as seen in **Holistic Transition**, including no regional distribution networks. This makes the route of the core transmission network an important locational factor, alongside existing gas fired electricity generation and industrial activity. Hydrogen electrolysis capacity reaches over 0.4 GW 2050 under this scenario.
Counter-factual	9	226	Hydrogen production and demand are more directly matched at a regional level, as hydrogen networks are not developed. Electrolyser projects are therefore limited and only developed close to hydrogen demand. In the medium and long term, this demand is primarily driven by the industrial sector, heavy road transport and power generation. Hydrogen electrolysis capacity is limited to just over 0.2 GW 2050 under this scenario.

Uptake modelling factors

The below factors are used to inform the overall uptake of hydrogen electrolysis in the Southern England licence area.

Factor	Description
Proportion of hydrogen electrolysis projects that connect to the distribution network	A number of anomalies within the FES 2024 GSP level projections for hydrogen electrolysis have led to them being removed as an input to the DFES model. As a result, post-pipeline projections for distribution network connected electrolysis are based upon the FES 2024 GB total networked electrolysis projections, with an assumed ratio of deployment on the distribution network. This ratio is 20% under **Hydrogen Evolution**, **Holistic Transition**, and **Electric Engagement** and 60% under the **Counterfactual**, where the industry does not scale-up and deploy transmission network scale connections.
Hydrogen distribution factors	An assessment of the presence of hydrogen supply and demand factors across all GB licence areas was completed. These factors were used to inform the level of electrolytic hydrogen requirements and thus the projected capacity of hydrogen electrolysis in the licence area, by scenario. These factors include the presence of: o Industrial energy demand o Heavy transport demand o Planned hydrogen network coverage o Gas distribution network coverage o Gas fired electricity generation o Hydrogen innovation projects o Aviation activity o Existing grey hydrogen production o Renewable energy generation

Spatial factors

Factor	Description
Baseline and pipeline sites	The location of known baseline and pipeline sites is used to inform the existing and very near term projected capacity. Post-pipeline capacity is also assigned to areas which host existing hydrogen electrolysis projects, or will do so in the future. This is regardless of a project's use of the distribution network.
Route of the proposed hydrogen transmission network	Areas along the route of the proposed Project Union hydrogen transmission network are also identified and considered for the spatial analysis of future hydrogen electrolysis capacity.
Industrial sites	Areas surrounding industrial energy users are identified as hub areas driving the need for localised low carbon hydrogen.
Local authority ambition	Local authorities that have hydrogen strategies or targets in place is also a consideration for the spatial distribution of future hydrogen electrolysis capacity. This information is obtained through the DFES Local Authority Energy Strategies survey.

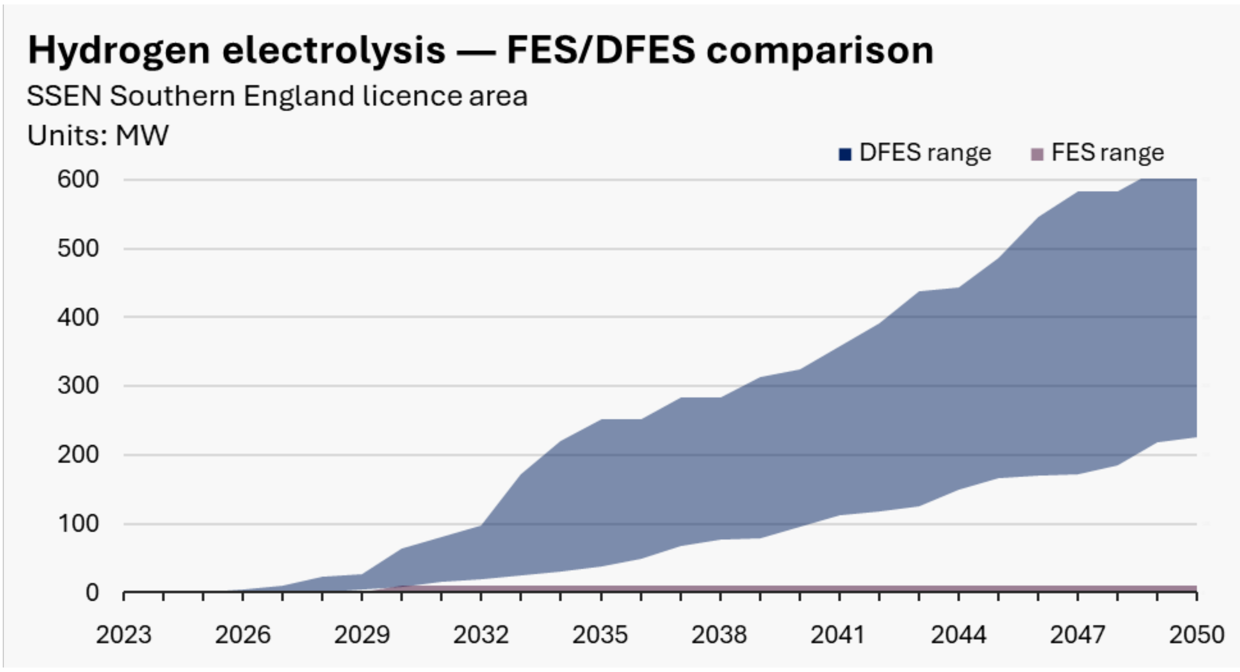
Stakeholder input

Stakeholder feedback	Impact on DFES analysis
Engagement with the wider hydrogen sector has highlighted the importance of HAR funding to the viability of near-term commercial scale electrolysis projects. It also re-affirmed that the use of onsite generation would be key in determining impact on the distribution network.	The pipeline assessment was focused on these factors.
Engagement with the Scottish Futures Trust re-affirmed a number of modelling assumptions which impacted the modelling. These included: • Small-scale development and securing of supply chains will precede any large-scale development. • A hydrogen network infrastructure is critical to enabling hydrogen electrolysis at scale.	These factors are all considered within the modelling of the technology.

5.5.3. Comparisons

Reconciliation to FES 2024

The outcomes of the DFES modelling have been compared against the FES 2024 outcomes for the same licence area.



- FES 2024 projects zero hydrogen electrolysis in the Southern England licence area under the **Counterfactual** and **Holistic Transition** scenarios. Under **Hydrogen Evolution** and **Electric Engagement**, 10 MW and 6 MW connects in the early 2030s and this capacity remains unchanged out to 2050. The basis of these very low and flatlined projections have been queried with the FES team.
- DFES 2024 projects significantly higher capacities, up to a maximum of 632 MW by 2050 under **Hydrogen Evolution**.
- However, DFES 2024 does reflect the overall increase in national electrolysis projections seen across GB in the FES 2024, as well wider updates to how distributed electrolysis is considered under the four scenarios. Resultantly, **Hydrogen Evolution** is now the most ambitions scenario for grid-connected hydrogen electrolysis in the DFES 2024, followed by **Holistic Transition**, **Electric Engagement** and finally the **Counterfactual**, which sees limited development.

Comparison to DFES 2023

- The most ambitious scenario under DFES 2024 projects significantly lower electrolysis capacity before 2030, compared to the most ambitious scenario under DFES 2023. This is a reflection of the current lack of evidence for both a pipeline of commercial scale electrolyser projects that have UK Government support, and that some developments will connect to the distribution network as their primary source of electricity supply.

- Relative to DFES 2023, DFES 2024 projects greater more capacity beyond 2030 under each scenario, resulting in moderately higher connected electrolysis capacity in the licence area by 2050. This reflects updated FES 2024 projections for national networked electrolysis, alongside regionally specific supply and demand drivers.
- The DFES 2024 projections also reflect changes to how electrolysis is supported in the FES 2024 scenario framework. **Hydrogen Evolution** is now the most ambitions scenario for grid-connected hydrogen electrolysis, followed by **Holistic Transition**, **Electric Engagement** and finally the **Counterfactual**, which sees limited development.

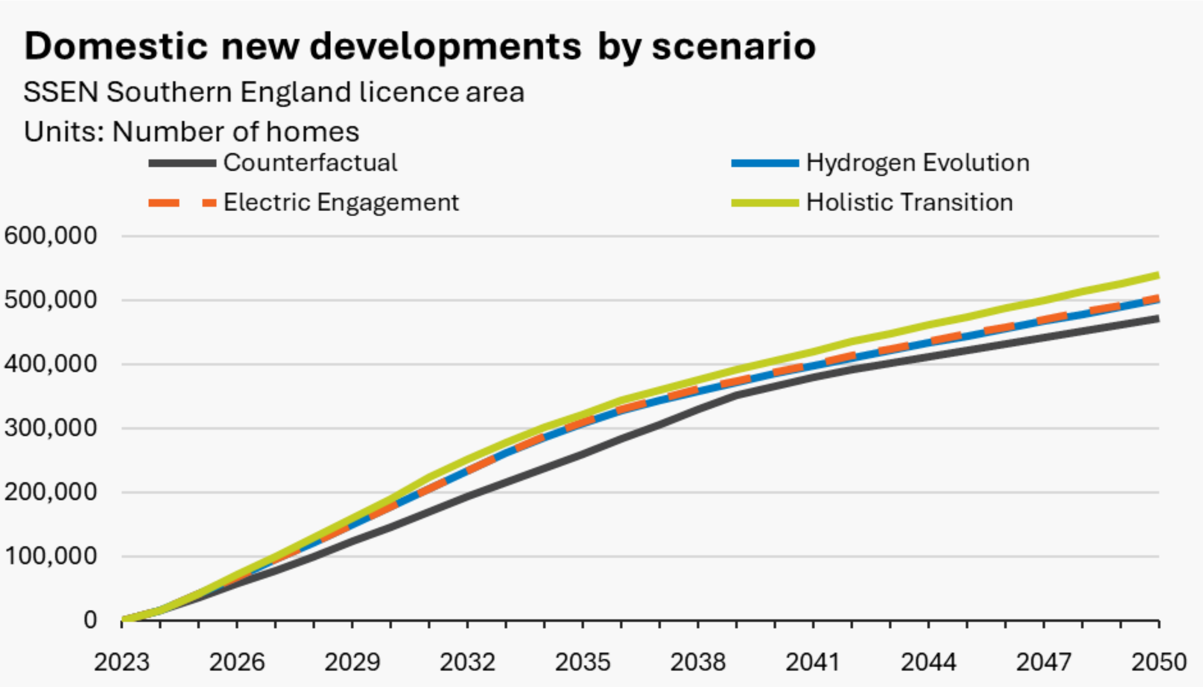
5.6. New property developments

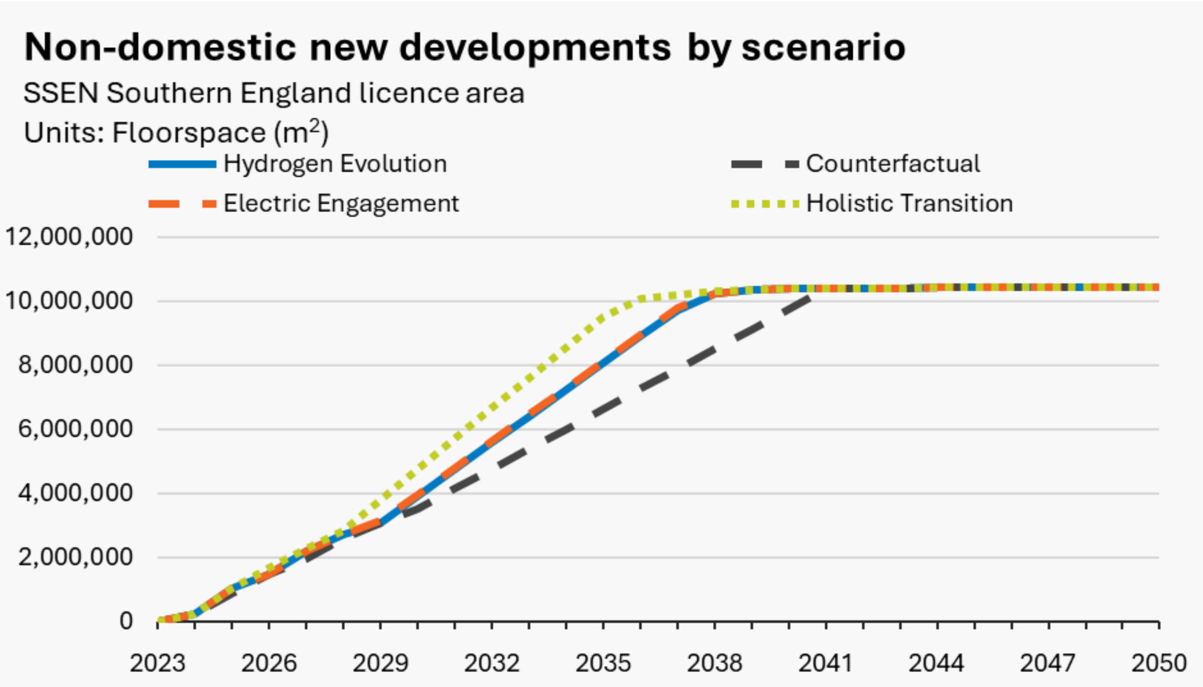
Technical specification	Building Blocks
Number of domestic customers	Gen_BB001a
Meters squared of I&C (industrial and commercial) customers	Gen_BB002b

5.6.1. Summary

- The new developments modelling within the DFES is based on direct engagement with local authority planning departments and an analysis of local planning documents submitted to Regen.
- Of the 44 local authorities in the Southern England licence area, thirty-six shared updates for their domestic new development plans and thirty-one shared updates for their non-domestic new development plans.
- By 2050, the domestic modelling results in between 477,000 and 544,000 new homes in the Southern England licence area across the scenarios.
- By 2050, an **additional** 10.4 million square meters of non-domestic floorspace is also modelled in the licence area under each DFES scenario.
- UK Government is currently consulting on a new methodology to establish localised housing targets. While the impact that this may have on future new developments is recognised, this has not been directly reflected in the analysis, as it is still in the consultation phase. The DFES modelling does, instead, use the most recently compiled ONS housing projections and historical buildout rates for each scenario.
- In the Southern England licence area, the local authorities of Wiltshire (39,719), Ealing (37,370) and Dorset (29,053) have the highest number of new homes projected by 2050.
- Notable non-domestic sites include the former Honda manufacturing site in Swindon.[27] Demolition on this site began in early 2024 with plans to construct 11 buildings for manufacturing or warehouses.

Note: all new development projection graphs are displayed on a cumulative basis (whereas for DFES 2023 the same projections were displayed as non-cumulative). This is to ensure consistency across the DFES 2024 projections by aligning the format of the projection graphs for each technology so that they are all displayed with cumulative totals.





5.6.2. Modelling and outcomes

Baseline

Scale	Capacity (MW)	Sites	Description
The analysis of new developments in the DFES focuses on additional future domestic and non-domestic buildings. Therefore, no baseline is defined for this technology.			

Pipeline

Source: Local authority engagement and local planning portals

Status	Number of domestic sites (homes)	Number of non-domestic sites (sqm)	Description
Total	1,246 (347,944)	950 (10,451,516)	These sites were provided through direct engagement with local authority planning departments and analysis of local planning documents submitted to Regen via a SharePoint data exchange. DFES 2024 received updates for 82% of local authorities' domestic data and 70% of local authorities' non-domestic data.
Buildout provided	1,182 (330,604)	331 (3,668,236)	These sites are modelled according to proposed buildout rates provided by the local authority.
Sites with no buildout information provided by local authorities			
Under construction	13 (1,769)	133 (839,498)	Sites that have been identified as under construction are modelled to build out in 2025 under all scenarios.
Planning permission granted	9 (3,462)	71 (575,546)	Approved planning permission is strong evidence that a development site is progressing towards construction. All new development sites which have been granted planning permission are

			modelled to connect to the distribution network between 2026 and 2028.
Planning application submitted	0	4 (15,010)	A submitted planning application demonstrates a development site has been identified and progressed but is waiting for approval from the local authority. These sites are modelled to connect between 2029 and 2032.
Outline or Reserved Matter	2 (266)	16 (259,022)	Outline planning applications are less detailed than a full planning application and are only applicable to some new buildings (or extensions to existing buildings). While outline planning may be approved, developers still need to obtain full approval on specific details, which are referred to as ‘reserved matters’. Once all reserved matters are approved the site is considered to have full planning approval. These sites are modelled to connect between 2028 and 2030.
Allocated/ pre-planning	37 (10,054)	60 (938,172)	Allocated and pre-planning sites are those typically identified by local authorities as areas for specific development. As allocated sites are often not yet at the full planning stage, they are the latest sites modelled to connect, doing so between 2030 and 2033.
No Information	3 (1,789)	335 (3,904,257)	Residual sites with no development stage information provided by the local authority are modelled to connect between 2030 and 2032.

Scenario projections

Post-pipeline projections are only modelled for domestic new developments due to there being no reliable data sources for non-domestic building targets. The ONS household projections provide a baseline to model future domestic housing numbers for specific localities.

Scenario	2030	2050	Description
Holistic Transition	Domestic (homes)		Under this scenario, sites are modelled to connect at the earliest possible date based on their development stage. In addition to the planned development sites, ONS household projections from 2018 are used to uplift long-term projections out to 2050. A 16% increase over the yearly ONS projections is added to this scenario, based on analysis of building rates over the last 10 years. This reflects the increase in low carbon technologies (including EV chargers, rooftop solar PV and electrified heating technologies) that is expected to occur at new developments under this scenario.
	193,491	544,104	
	Non-domestic (sqm)		
	4,747,149	10,451,516	
Electric Engagement	Domestic (homes)		This scenario is modelled to reflect a moderate range of new builds for both domestic and non-domestic developments. The **Electric Engagement** scenario uses the fastest build-out rate, the same as **Holistic Transition**. In addition to the planned development sites, ONS household projections from 2018 are used to uplift the long-term projections. This scenario is also modelled to reflect less ambitious yearly buildouts, aligned to below the average of historic yearly builds. This reflects the increase in low carbon technologies (including EV chargers, rooftop solar and heating technologies) that are expected to occur at new developments under the **Electric Engagement** scenario.
	181,244	507,8373	
	Non-domestic (sqm)		
	3,972,749	10,451,516	
Hydrogen Evolution	Domestic (homes)		This scenario also models a moderate range of new builds for both domestic and non-domestic

	181,105	505,934	developments. Using the same ONS 2018 long-term uplift and alignment to average historic yearly build as **Electric Engagement**. **Hydrogen Evolution** uses a slower build-out rate, i.e. fewer homes connected per year.
	Non-domestic (sqm)		
	3,927,682	10,451,516	
Counter-factual	Domestic (homes)		This scenario models sites to connect at the slowest buildout rate and in the last year of the connection range in each case. In addition to the planned development sites, ONS household projections from 2018 are used to uplift the long-term projections. A 22% decrease over the yearly ONS projections is applied to this scenario, based on analysis of building rates over the last 10 years. This scenario is the only one that does not connect every home provided by local authorities, with some allocation sites not assumed to be completed by 2050.
	151,281	477,640	
	Non-domestic (sqm)		
	3,517,226	10,451,516	

Spatial factors

Factor	Description
Planned sites (Local authority SharePoint)	Planned sites are located based on their address or the description of their location.
Housing density (Census 2021)	Modelled sites (domestic properties only) are distributed across all areas, weighted to areas with moderate housing density such as town and city suburbs, as analysis of historic housing development shows these areas see higher levels of housebuilding than denser city centres or highly rural areas.

Stakeholder input

Stakeholder feedback	Impact on DFES analysis
Local authority data exchange	A central part of the new developments analysis relies on ongoing engagement with local authorities in the licence area. Thirty-six local authorities in the Southern England licence area provided a domestic new development update and thirty-one provided a non-domestic new development update either via the data exchange portal or directly to the DFES project team. For the remaining local authorities, Regen's existing project database was used.

5.6.3. Comparisons

Reconciliation to FES 2024

The outcomes of the DFES modelling have been compared against the FES 2024 outcomes for the same licence area.

- The FES scenarios do not include specific data on new property developments that can be directly reconciled against the DFES. The FES building block DEM_BB001a for new domestic customers shows a similar proportional growth of new housing compared to the DFES analysis of domestic developments.
- In the DFES, a range of scenario outcomes have been modelled for 2024 to aid distribution network planning, as new domestic customers can represent key bulk loads of conventional demand on the network.
- Non-domestic floorspace is not detailed in the FES data and cannot be directly compared.
- As a result of these factors, the new developments outputs cannot be fully reconciled against the FES 2024 data.

Comparison to DFES 2023

- DFES 2024 has changed the method of assigning scenarios to local authority provided data. DFES 2023 did not use a range of connection years, based on site development status, but instead developments were assigned to scenarios based on historical build-out rates to benchmark future development. For sites where no buildout data was provided, the DFES 2024 analysis has used development status to assign the year buildout would commence. This change brings new development modelling in line with other technologies by using planning developments stages to assign connection years.
- There is no significant change in the domestic projections between DFES 2023 and DFES 2024.

- The DFES 2024 non-domestic projections have increased by 3.5 million sqm compared to DFES 2023. The main driver behind this increase is the improved engagement and response from local authorities this year with 31 local authorities providing an updated non-domestic dataset. The increase of 3.5 million sqm is provided through direct local authority engagement and has been reflected in the DFES 2024 non-domestic modelling.

Endnotes and references

[1] https://www.neso.energy/publications/future-energy-scenarios-fes

[2] https://www.gov.uk/guidance/medium-combustion-plant-when-you-need-a-permit

[3] https://www.nationalgas.com/future-energy/hydrogen/project-union

[4] https://www.eastcoasthydrogen.co.uk/

[5] https://hynet.co.uk/

[6] https://www.bbc.co.uk/news/articles/c80vp28vdx5o

[7] https://www.gov.uk/government/publications/policy-statement-on-onshore-wind/policy-statement-on-onshore-wind

[8] https://www.swanage.news/twenty-year-battle-to-build-purbeck-wind-farm-is-finally-over/

[9] https://www.neso.energy/document/346651/download

[10] https://www.gov.uk/government/consultations/the-future-homes-and-buildings-standards-2023-consultation/the-future-homes-and-buildings-standards-2023-consultation

[11] https://api.solarpowereurope.org/uploads/1424_SPE_BESS_report_12_mr_84bdb6c5ae.pdf

[12] https://api.solarpowereurope.org/uploads/1424_SPE_BESS_report_12_mr_84bdb6c5ae.pdf

[13] https://highviewpower.com/news_announcement/highview-launches-second-phase-of-its-long-duration-energy-storage-ldes-programme-with-2-5gwh-power-plant-at-hunterston-ayrshire/

[14] https://highviewpower.com/projects/

[15] https://www.gov.uk/government/publications/longer-duration-energy-storage-demonstration-programme-successful-projects

[16] https://www.gov.uk/government/news/data-centres-to-be-given-massive-boost-and-protections-from-cyber-criminals-and-it-blackouts#:~:text=Data%20centres%20powering%20the%20economy,minimising%20impacts%20on%20the%20economy.

[17] https://www.gov.uk/government/news/pathway-for-zero-emission-vehicle-transition-by-2035-becomes-law

[18] https://labour.org.uk/change/kickstart-economic-growth/#transport

[19] https://www.gov.uk/government/publications/evidence-update-of-low-carbon-heating-and-cooling-in-non-domestic-buildings

[20] https://www.gov.uk/apply-boiler-upgrade-scheme

[21] https://www.eastcoasthydrogen.co.uk/

[22] https://hynet.co.uk/

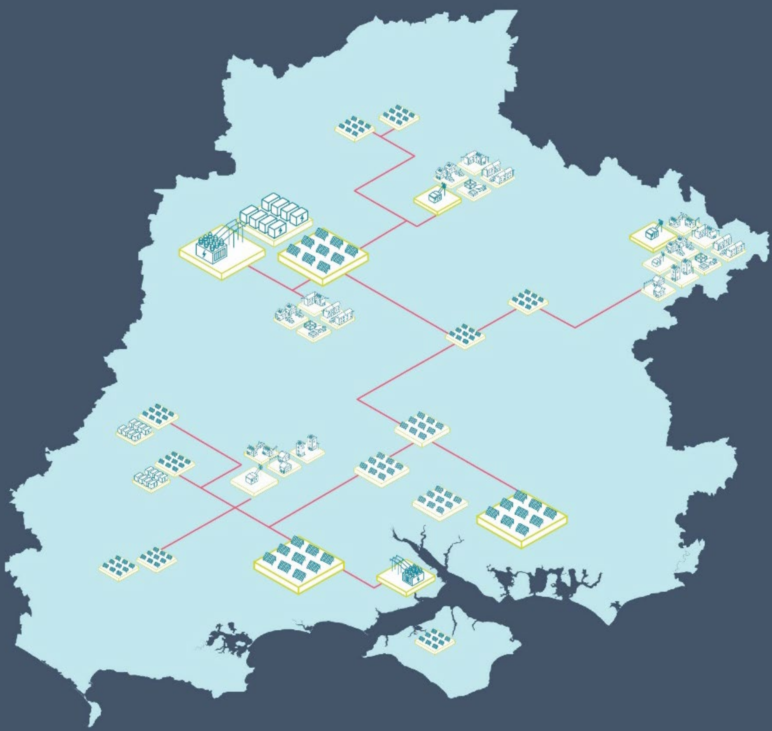
[23] https://www.nationalgas.com/future-energy/hydrogen/project-union

[24] https://www.swnetzerohub.org.uk/about-us/case-studies/case-study-green-hydrogen-production-in-wiltshire/

[25] https://hynet.co.uk/

[26] https://www.wwutilities.co.uk/media/5323/wwu-hyline-public-report.pdf

[27] https://www.bbc.co.uk/news/uk-england-wiltshire-67911549



Regen

Bradninch Court,

Castle St,

Exeter

EX4 3PL

01392 494 399

www.regen.co.uk

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