Scottish & Southern Electricity Networks

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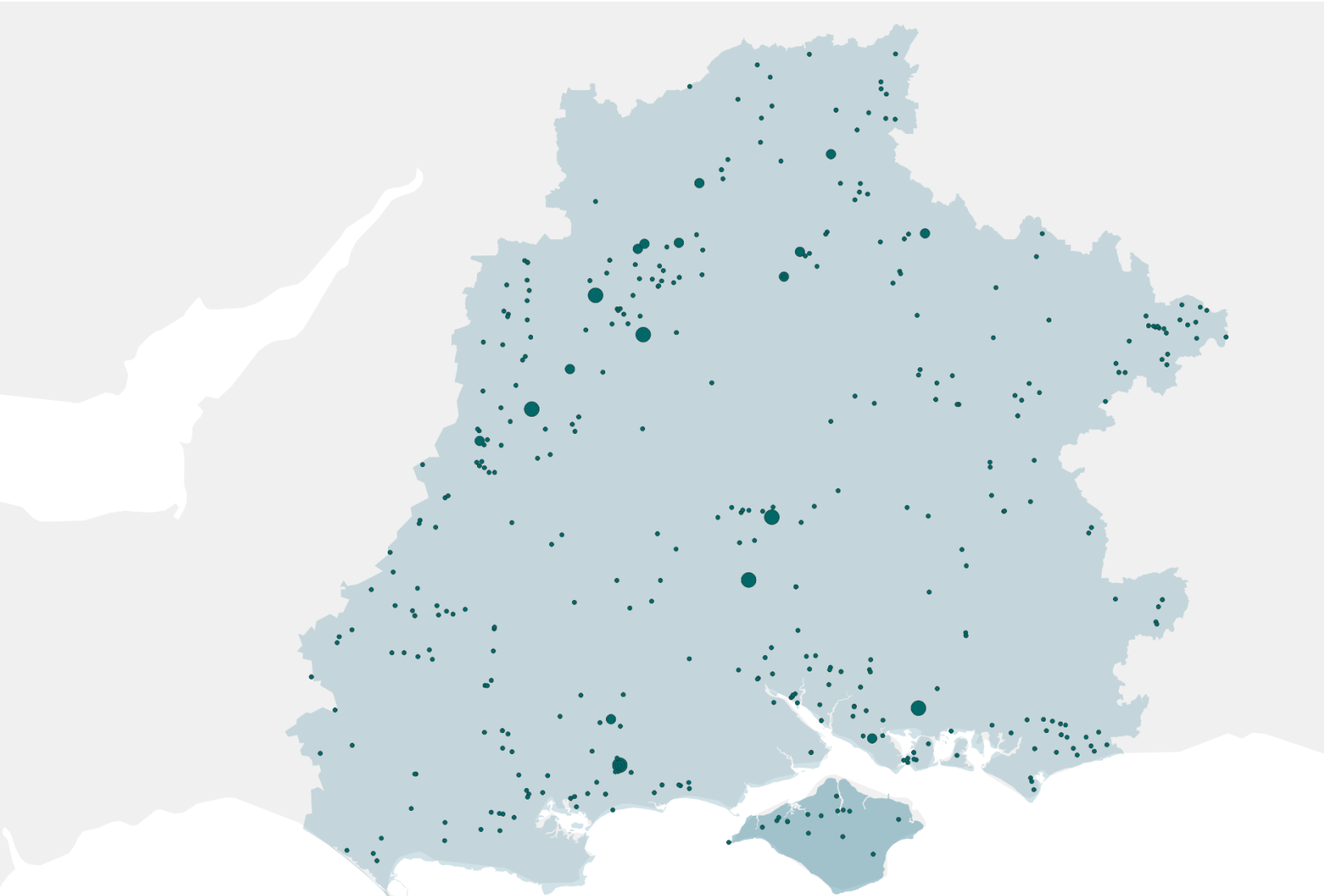
2022 Near Term Growth Review

Southern England licence area

Summary report September 2022



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1. Introduction and background

The distribution network in the Southern England licence area includes very densely populated areas such as parts of West London, Oxford, Swindon, Southampton, Portsmouth and Bournemouth, as well as more unique areas such as the Isle of Wight and the New Forest. The licence area also includes some of the highest solar irradiance levels in the UK.

In 2021 Regen carried out a full **Distribution Future Energy Scenarios** (DFES) analysis of the Southern England licence area using baseline data from September 2021. The 2021 DFES report and dataset were published in March 2022, and can be found of SSEN's website here.

Since the data was compiled for the 2021 DFES, the energy system and wider economy has undergone a tremendous amount of change and upheaval, including:

- Post-Covid 19 recovery
- War in Ukraine and energy crisis
- Phenomenal rise in gas and electricity prices
- Cost of living crisis, inflation and likely recession
- Ongoing impacts of Brexit
- Changes in government

There have also been a number of important energy policy developments, including the setting of new targets for offshore wind and hydrogen, and the publication of the Government's Net Zero Energy Strategy: Build Back Greener and British Energy Security Strategy. Other important industry developments have included new support packages for hydrogen production, Allocation Round 4 of the Contract for Difference scheme, long duration energy storage competition grant funding and continued growth in the uptake of electric vehicles. In addition to this, there have been important policy developments in the wider economy focused on green growth, levelling up and a reemergence of a more proactive industrial strategy.

This period of change has coincided with the final development and review stages of the distribution networks' business plans for the next price control period from 2023 to 2028 (RIIO-ED2), including SSEN's RIIO-ED2 business plan.

Given the level of change that has affected the energy sector, and as part of its ED2 due-diligence process, SSEN has commissioned Regen to complete a short update review on the factors that may impact on network load growth, including recent market developments, in the short term and out to 2030. This load growth review has focused on seven key technologies that have the biggest load growth potential on the distribution network in Southern England in the RIIO-ED2 period: solar PV, battery storage, hydrogen electrolysis, data centers, electric vehicles, EV chargers and heat pumps.

Summary of findings

The significant economic, political, market and policy changes over the past year have had a mixed and variable impact on the prospects for network load growth.

Downward factors, such as the risk of recession, commodity price rises and the cost-of-living crisis, would normally be expected to reduce investment across the economy and impact areas such as housing, commercial energy demand and potentially even domestic demand.

However, the nature of this particular energy crisis, which has been the result of a steep rise in fossil fuel prices, appears to be accelerating the uptake of low carbon technologies and especially electric vehicles. Heat pump growth continues at a slower pace, however even here there is the potential for an accelerated uptake as domestic and non-domestic consumers are encouraged to make the switch from very expensive fossil fuels as heat pumps become more affordable.

Meanwhile, the UK government's commitment to net zero and the imperative to tackle climate change, combined with a forward projection of very high electricity wholesale prices, is encouraging investors and project developers to continue to focus on low carbon energy technologies.

HIGH GAS AND ELECTRICITY PRICES SET TO CONTINUE

Short-term wholesale prices and even medium-term (seasonal to three years) contracts for electricity are extremely high and volatile. So far in 2022, day-ahead wholesale prices for variable generation have been running at an average of over £180 per MWh, with peaks of £260 per MWh[1].

Electricity contracts for forward delivery for winter 2022 and spring 2023 are around £200 per MWh[2]. There is no sign of an early return to pre-crisis levels. In fact, energy analysts Cornwall Insight are projecting wholesale prices to remain at or above £130-150 per MWh through to 2030, well above the historic average of around £50-60 per MWh[3].

The predicted long duration of high electricity prices, driven by the price of gas, has important implications for investment in renewable technologies, energy efficiency and energy storage.

There is a higher degree of uncertainty on investment compared to a year ago. The expected recession could be deeper and longer than anticipated, and it is possible that a new UK government could row back on its net zero targets and even begin to undo some of the policy commitments and investments. These factors could dampen near-term growth across the seven technologies studied and risk the UK falling behind in progress towards carbon reduction commitments.

However, there is no evidence in Regen's load growth analysis that the pipeline of new projects coming forward for development, and therefore seeking grid capacity, is slowing down. In fact, it has increased significantly over the last 12 months, with the active generation and storage connection pipeline growing from 4.8 GW to 6.8 GW. This positive indicator of investor appetite suggests that the potential for

investment in the green economy, energy transition and a "build back better" post-covid recovery is still strong. The clean energy sector could be amongst the critical high-growth areas where investment continues to flow.

The fundamental investment outlook for the net zero transition remains positive, due to the imperative to decarbonise, the need to shift from expensive imported fossil fuels, the (comparative) falling cost of low carbon technologies and the pace of clean tech innovation. For example, the number of battery electric vehicles in Southern England more than doubled, from 50,000 to over 100,000, in a little over six months to end Q1 2022; even a backward step by government is unlikely to slow down this consumer-led uptake over the medium term[4]. This resilience is especially true if economic growth, and the net zero transition, continues to be supported and led by individual cities and regions.

The bigger concern for the uptake of low carbon technologies, and the wider economy, is that supply chain and infrastructure constraints hinder growth. This includes the capacity of the networks at both the distribution and transmission voltage levels.

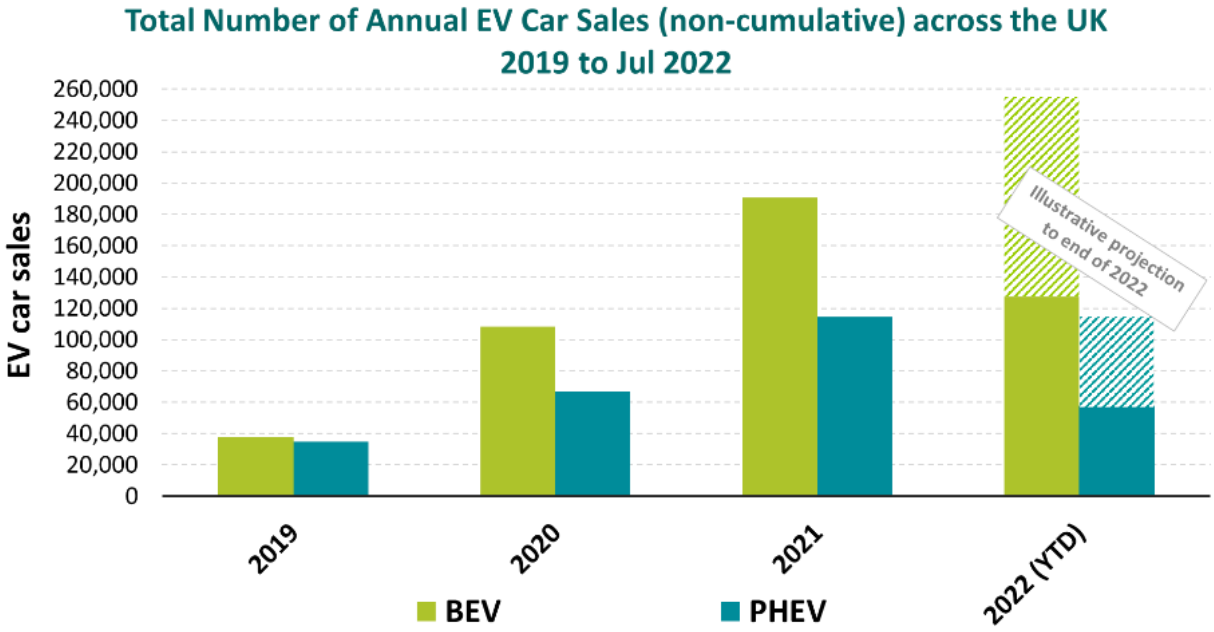

Figure 1 Annual UK Battery (BEV) and Plug-in hybrid (PHEV) car sales, 2019 to Jul 2022
Source: SMMT vehicle sales data

The very large pipelines of solar and battery storage projects identified in the analysis is a positive sign of investor interest and a reflection of the strong solar resource in the licence area. But this is also the result of a queue of projects that are now waiting for a network connection and potentially for network upgrades to be completed. The outlook for new developments is especially complicated if distribution network constraints are compounded by connection delays at the transmission level. The Southern England licence area has a number of GSPs that are subject to Statement of Works and long-term upgrades to the transmission network. This has become critical in West London, where network

constraints, in part caused by the surge in demand for new data centres around Slough, has led to connection delays for new housing developments.

The low voltage network is especially vulnerable, comprising hundreds of thousands of individual assets which may, over time, need to be upgraded and replaced. Avoiding 'blackspots' by making sure that networks are able to support the electrification of transport and heat, as well as new housing and economic growth, will be critical, not just for the economy and levelling up agenda, but also for the fairness and equity of the energy transition.

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[1] LCCC Market Reference Price Variable Generation

[2] Ofgem Wholesale price analysis weekly average 16 Aug https://www.ofgem.gov.uk/wholesale-market-indicators

[3] Cornwall Insight https://www.cornwall-insight.com/press/energy-prices-to-remain-significantly-above-average-up-to-2030-and-beyond/

[4] 54% of drivers want to switch to an EV over next 5 years - https://www.current-news.co.uk/news/54-of-drivers-want-to-switch-to-electric-cars-within-the-next-5-years-says-hive

2. Load growth in Southern England in 2022

Headline results

This load growth report will look to highlight some of the more detailed recent developments in deployment and connection offer activity, as well as a near-term outlook to 2030, for the following key distributed generation, storage and demand technologies:

Large-scale solar PV | Commercial battery storage | Hydrogen electrolysis | Commercial data centres | Heat pumps | EVs and EV chargers

For each technology we have reviewed:

- The position and projection from DFES 2021
- An update to the capacity that has connected or contracted to the distribution network
- Mapped connected and contracted projects to identify development hubs/clusters
- Reviewed planning activity (where applicable)
- A comparison to the July 2022 published National Grid FES 2022
- Significant policy and/or market developments over the past 6-12 months

In 2022 the overall installed capacity of distributed generation reached 3 GW, a 129 MW increase of newly commissioned generation capacity connecting over the past 8-10 months:

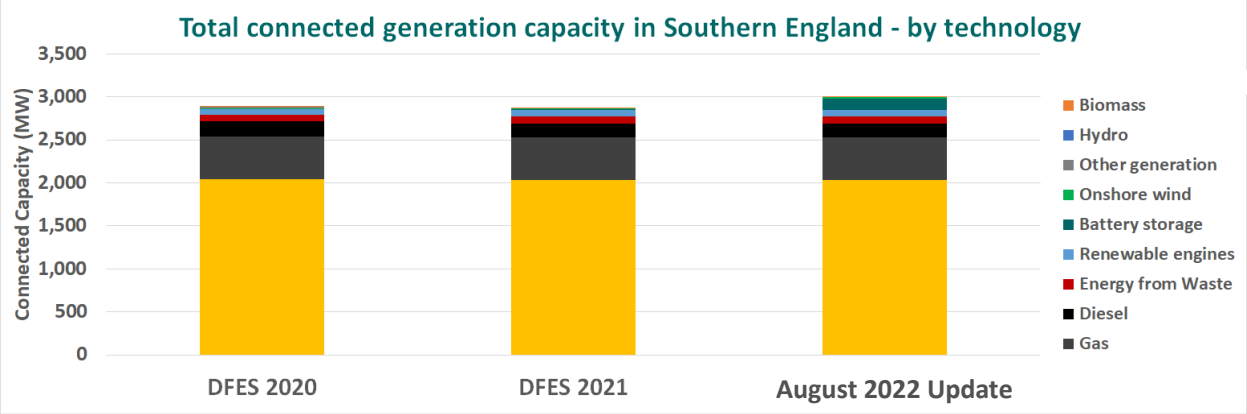

Figure 2: Connected distributed generation capacity in Southern England 2020 to Aug 2022

Source: SSEN connection data (DFES 2021 and Aug 2022 updated connection sites)

In addition to this increase in connected sites and capacity, the pipeline of prospective new projects has significantly increased year on year. The capacity of projects accepting connection offers in the licence area has increased from 2.1 GW in 2020, to 4.8 GW in 2021, and over the past 8-10 months the volume of accepted connection offers has jumped again to 6.8 GW. This is dominated by large-scale standalone battery storage and solar projects across the region.

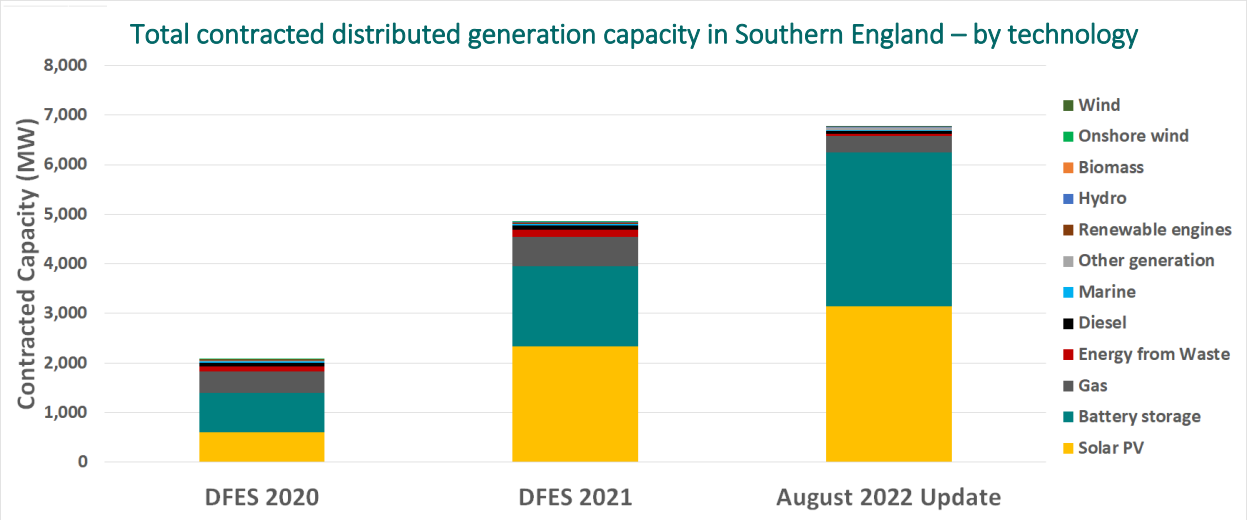

Figure 3: Contracted distributed generation capacity in Southern England 2020 to Aug 2022

Source: SSEN connection data

A number of these pipeline sites are also active in the planning system, with a little under 500 MW of large-scale solar farms and c.220 MW of large-scale battery storage projects either submitting planning applications or receiving approval across 2022.

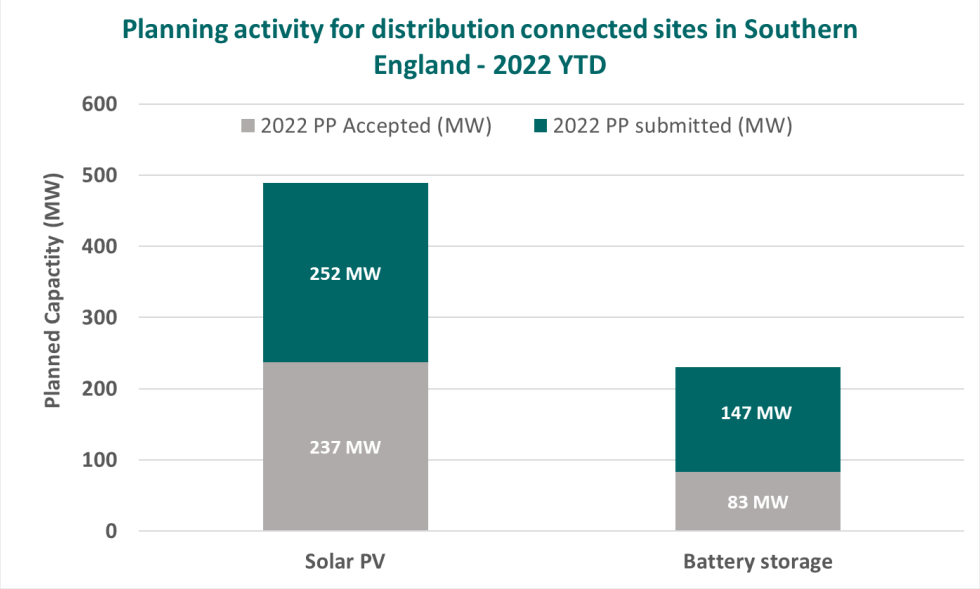

Figure 4: Overview of planning activity in 2022 for key technologies in the Southern England Licence area

Source: Renewable Energy planning Database, July 2022

Table 1: Technology growth summary

Technology	Baseline connected (MW)		Pipeline contracted (MW)		Significant recent market developments
	DFES Sept 2021	Update Aug 2022	DFES Sept 2021	Update Aug 2022	
Solar PV	2,034	2,035	2,342	3,145 ↑ + 34%	Wholesale & PPA price rise CfD AR4 capacity and price UK Energy Security Strategy Network constraints Commodity price rise TNUoS uncertainty
Commercial Battery Storage	113	180 ↑ + 59%	1,603	3,104 ↑ + 93%	New frequency balancing and reserve services NOA pathfinders DNO procured flexibility services Network constraints
Hydrogen Electrolysis	1.2	1.2	N/A	3	UK Hydrogen strategy progress update Hydrogen Sector Development Action Plan National hydrogen production target of 1 GW by 2025 ambition First electrolytic application round Lack of clear long-term direction for green hydrogen use cases
Data Centres	--	--	1,315	1,332	Increasing use of streaming services West London network constraints
Heat Pumps (number)	1,800	4,600 ↑ + 155%	N/A	N/A	Boiler Upgrade Scheme

					Heat Pump Investment Accelerator Competition
Electric Vehicles (number)	51,752	107,296 ↑ + 109%	N/A	N/A	Rapid growth in EV sales
Public EV Charger Capacity	34	38	N/A	N/A	

3. Technology outlook – solar PV

DFES 2021 overview

Due to having some of the highest solar irradiance levels in the UK, the Southern England licence area has a significant amount of operational large-scale solar capacity. At over 2 GW, this accounts for around a quarter of all UK distribution network-connected solar. There is a very large pipeline of new solar projects with accepted connection offers in the licence area. In addition to the strong solar resource, the continued growth of prospective new projects stems from reduced capital costs, improved panel efficiencies and Government ambition.

A summary of the projections for solar from the DFES 2021 is shown below:

- As of the end of 2020, 210 large-scale solar PV arrays, totalling c.2 GW, were connected to the distribution network in Southern England.
- A large pipeline of potential new solar projects were also active in the licence area:
    - 119 sites, totalling over 2.3 GW, with accepted connection offers
    - 40 sites, totalling a further 440 MW, with connection quotes issued.
    - Of this pipeline 44 sites, totalling 1.1 GW were under construction and/or had received planning approval and were awaiting construction.
- This evidence, alongside direct consultation with individual solar project developers and the assumptions behind each of the four scenarios used in the 2021 DFES, resulted in a range of near-to-medium term capacity projections for large-scale solar PV.
- By 2030, capacity was modelled to be highest under Leading the Way, at 4.1 GW.
- The DFES 2021 results for solar PV are summarised below:

Table 2: DFES 2021 projections for distribution-connected large-scale solar PV in the Southern England licence area

Scenario	Installed power capacity (MW)		
	Baseline (2020)	Projection by 2025	Projection by 2030
Steady Progression	1,991	2,464	2,831
System Transformation		3,074	3,453
Consumer Transformation		3,074	3,458
Leading the Way		3,195	4,125

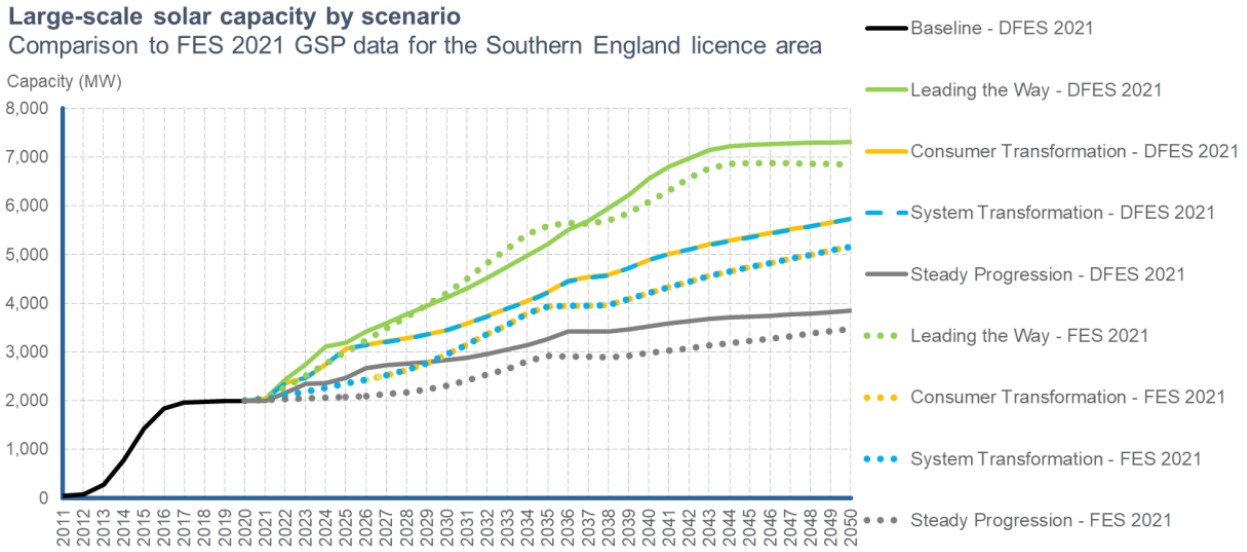

Figure 5: SSEN DFES 2021 projections for large-scale solar PV in Southern England
(reconciled to FES 2021 GSP data)

Update to connection activity (as of August 2022)

SSEN's connection data for solar PV at all scales shows there have been c.1 MW of new solar capacity over the past eight months. The capacity figures below are a summary of the solar sites in SSEN's connection database, but do not include all solar sites in the region, such as some domestic scale solar. However, this provides an indication of some of the activity of solar PV installations in the licence area over the past two years

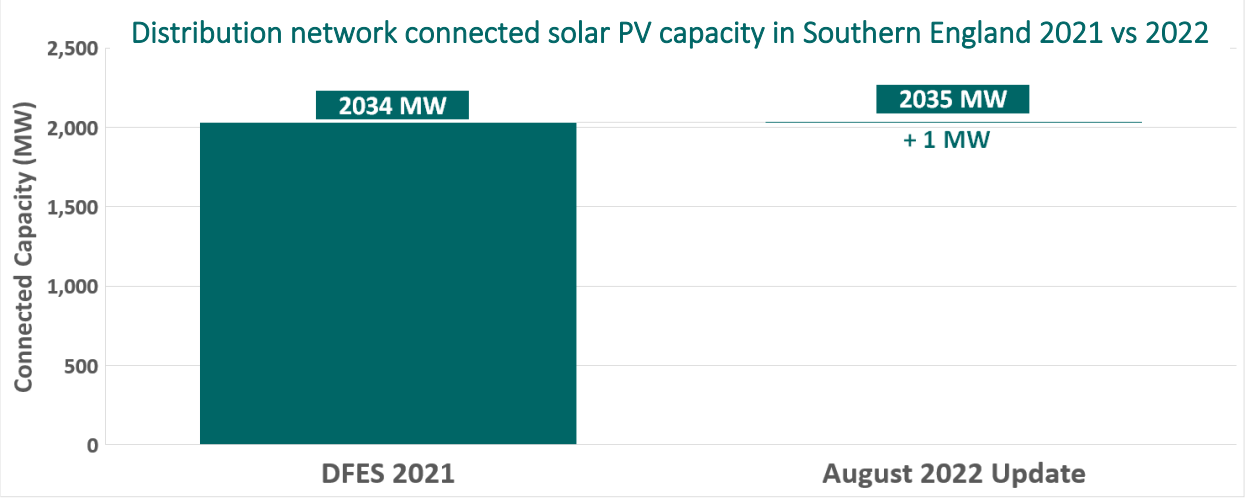

Figure 6: Large-scale solar PV capacity connected to the distribution network in Southern England, 2021 to Aug 2022

Source: SSEN DFES 2020 and 2021 datasets and SSEN connection data from August 2022

Latest development pipeline year to date

The pipeline of prospective new solar projects has significantly grown over the past three years:

- In 2020, there was 601 MW of contracted large-scale solar PV projects
- In 2021, this grew to over 1.7 GW
- As of August 2022, this has seen a significant further increase to over 3 GW.

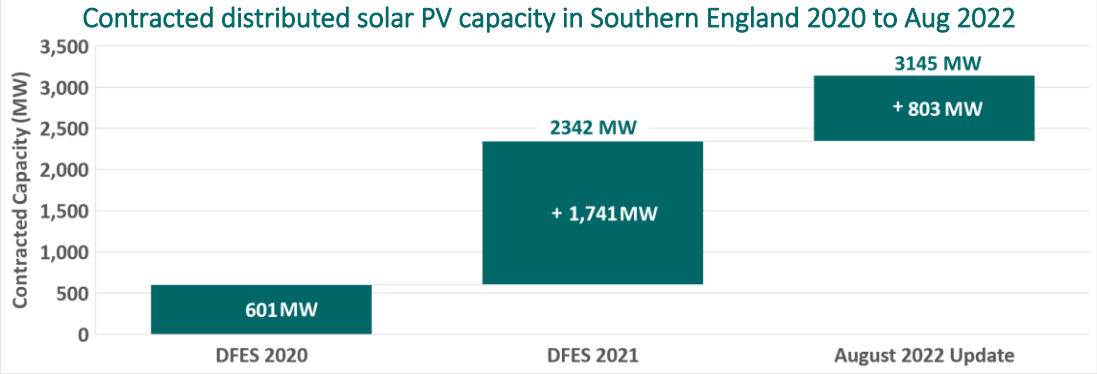

Figure 7: Contracted large-scale solar PV capacity in Southern England licence area, 2020 to Aug 2022

Source: SSEN DFES 2020 and 2021 datasets and SSEN connection data from August 2022

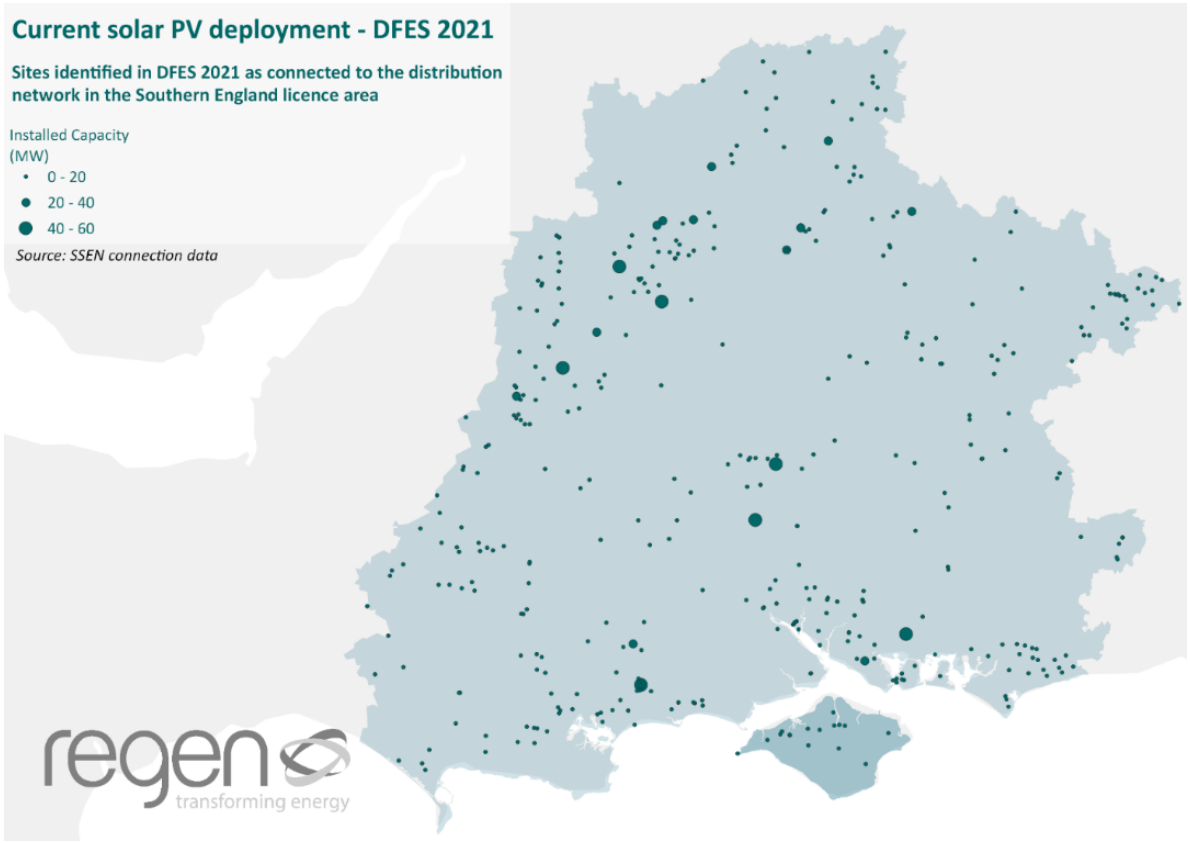

Figure 8: Large-scale solar PV projects connected to the distribution network in Southern England

Source: SSEN connection data from DFES 2021, Regen analysis

There is significant solar developer activity across the licence area, due to the favourable solar irradiance levels in the region. However, a notable cluster of several hundred MW of prospective new large-scale solar farms is appearing on developable land in the north of the licence area, around Chippenham, Swindon, Cirencester and across to Oxford and Bicester.

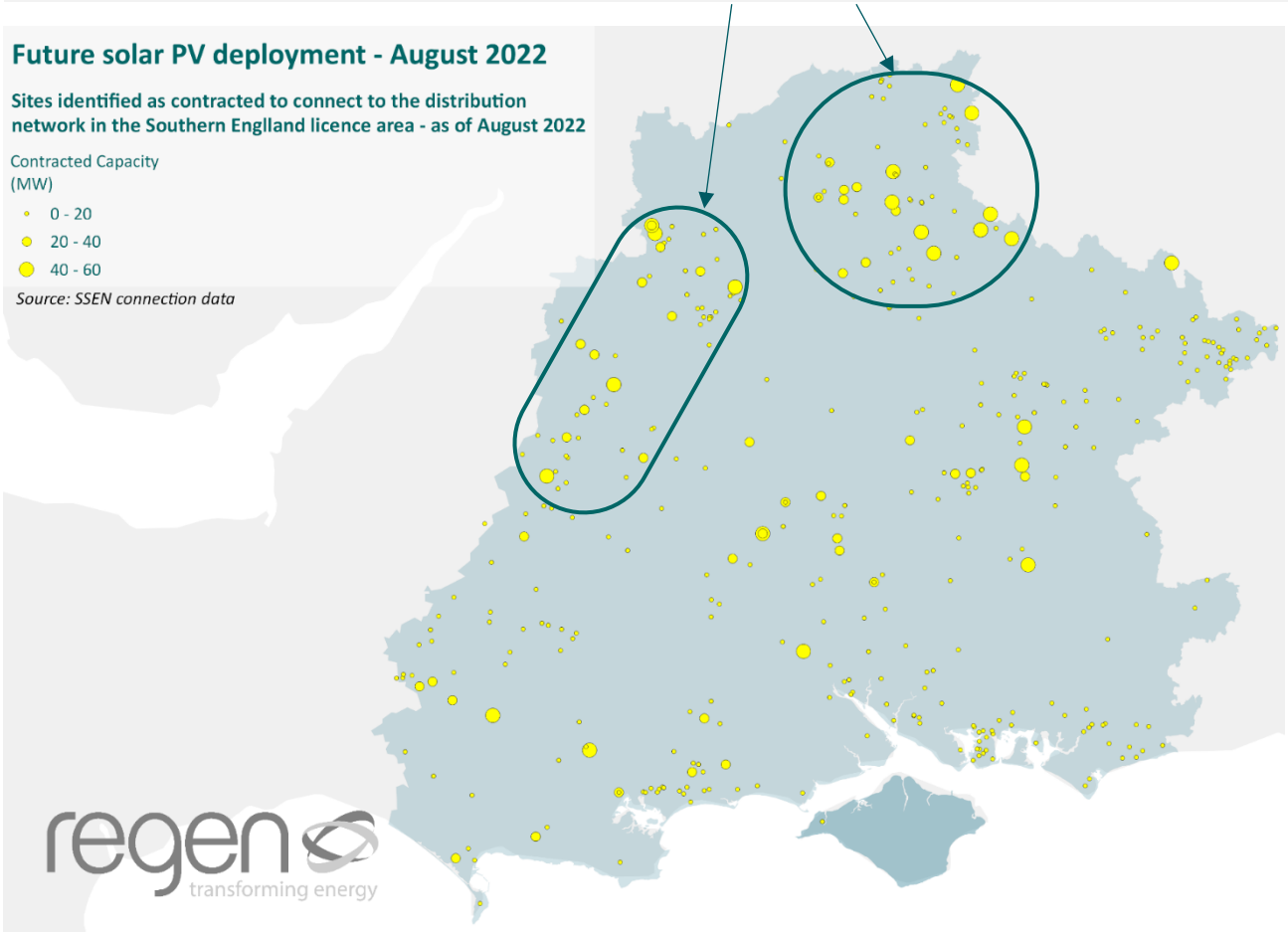

Figure 9: Map of contracted solar PV sites in Southern England licence area (Aug 2022)

Source: Latest SSEN connection data registers (Aug 2022)

Planning activity in 2022

2022 has seen 24 sites (240 MW) approved, and a further 14 sites (250 MW) applying for planning permission. These are distributed around the licence area, and the larger sites are seeking to co-locate with battery storage.

Outlook to 2030

Assumptions from DFES 2021

The resources, pipeline and positive developer engagement drove an increase in solar capacity to 2030 under all scenarios. The range of capacity increases across the scenarios acknowledged the uncertainties around network charging and near-term constraints in particular parts of the network. As a result, connected capacity ranges from 2.8 GW under Steady Progression to 4.1 GW under Leading the Way.

Projections from FES 2022[5]

For the Southern England licence area, the National Grid ESO FES 2022 has projected a very similar uptake of large-scale solar PV capacity out to 2050. The most ambitious scenario (Leading the Way) has c.4 GW online by 2030 and c.7 GW by 2050.

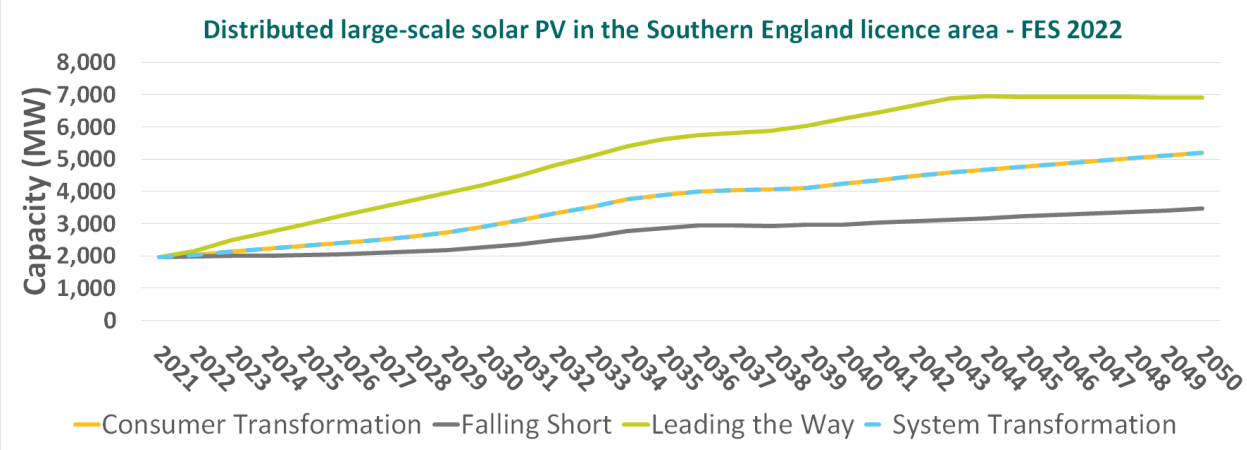

Figure 10: FES 2022 projections for distributed large-scale solar PV capacity in Southern England

Market outlook commentary

Based on recent market analysis, solar PV (and other renewable power generation) costs have continued to fall to the end of 2021[6]. In addition to this, 68 solar PV sites across England, totalling c.6 GW, successfully secured Contracts for Difference under the fourth allocation round of the programme, published in July 2022[7].

Ongoing network charging reforms could impact the deployment of solar PV. The Access SCR decision, issued in May[8], may provide some benefits to reduced connection costs. Ongoing reforms to TNUoS charging, (including locational TNUOS price signalling) are still being explored by the recently appointed TNUoS Taskforce. The outcome and final decision around the reforms to TNUoS charging are uncertain, but could result in a potentially detrimental additional cost to distributed generation developers in generation-dominated regions.

These uncertainties around network charging reforms should be considered alongside positive development factors such as very high solar irradiance levels and one of the largest pipelines of accepted

connections for new large-scale solar in any licence area. The uncertainty is echoed in future projected capacity under the FES 2022 and the DFES 2021. However, under all scenarios the connected capacity of large-scale solar in the licence area significantly increases by 2030, to c. 3-4 GW. With the pipeline now standing at over 3 GW alone, the near-term deployment to 2030 could be modelled higher this year than in DFES 2021.

In a broader view, the publication of the UK Energy Security Strategy in 2022 highlighted the potential for a five-factor growth in installed solar capacity by 2035. Southern England is a key solar resource region for developers to target deployment, reflected by the very large pipeline. This UK-wide ambition could reinforce the potential for accelerated near-term deployment of solar capacity in the licence area.

[5] FES 2022 Data Workbook - https://www.nationalgrideso.com/future-energy/future-energy-scenarios#fullsuite

[6] IRENA Renewable Power Generation Costs 2021 - https://www.irena.org/publications/2022/Jul/Renewable-Power-Generation-Costs-in-2021

[7] BEIS CfD AR4 results - https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1088875/contracts-for-difference-allocation-round-4-results.pdf

[8] Ofgem Access SCR final decision (May 2022) - https://www.ofgem.gov.uk/publications/access-and-forward-looking-charges-significant-code-review-decision-and-direction

4. Technology outlook – battery storage

DFES 2021 overview

The 2021 DFES analysis showed that the Southern England licence area had very strong potential for both near-term development and long-term growth in battery storage capacity connecting to the distribution network. The 2021 analysis highlighted:

- Eight battery storage projects, totalling 113 MW, were operational in the licence area
- A very large pipeline of potential new battery projects:
    - 79 sites, totalling 1.6 GW, with accepted connection offers
    - 20 sites, totalling a further 740 MW, with connection quotes issued
- Of this development pipeline our analysis showed that:
    - 3 sites, totalling 298 MW, were already under construction, potentially due to be commissioned in 2022
    - 8 sites, totalling 591 MW, were to be taken forward to construction in 2023 or 2024 after direct consultation with individual project developers
    - 25 sites, totalling 632 MW, had recently secured planning approval
    - 16 sites, totalling 404 MW, had either pre-qualified or secured Capacity Agreements in recent Capacity Market T-4 or T-1 auctions
- This evidence, alongside the assumptions behind each of the four scenarios used in the 2021 DFES, resulted in a significant near-to-medium term increase in battery storage capacity in the licence area, peaking at c.1.6 GW by 2030 under Leading the Way.

The DFES 2021 results for battery storage capacity are summarised below:

Table 3: DFES 2021 projections for distribution network connected battery storage in the Southern England licence area

Scenario	Installed power capacity (MW)		
	Baseline (2020)	Projection by 2025	Projection by 2030
Steady Progression	113	431	941
System Transformation		721	924
Consumer Transformation		1,078	1,241
Leading the Way		1,342	1,572

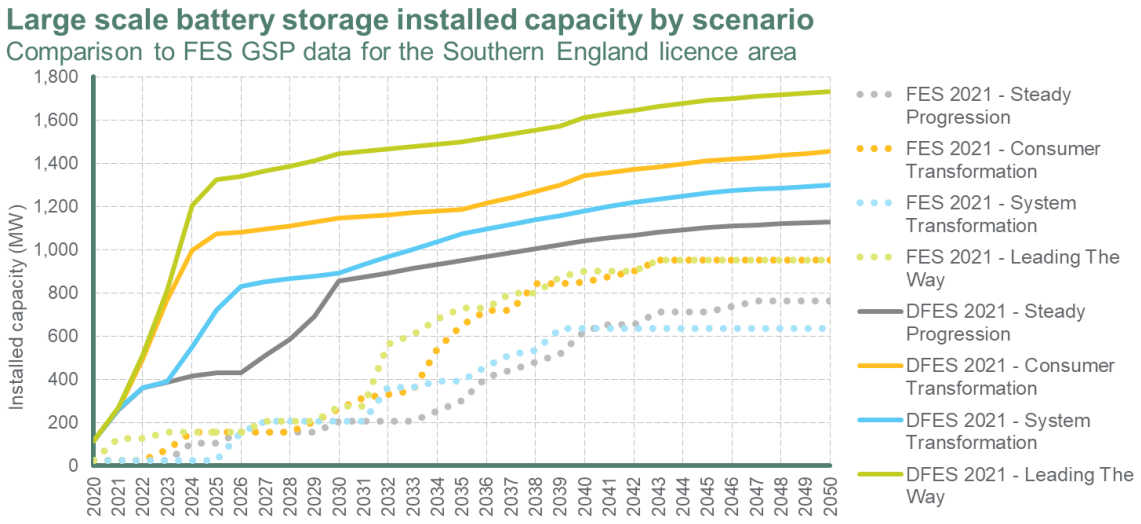

Figure 11: SSEN DFES 2021 projections for battery storage capacity in Southern England (reconciled to FES 2021 GSP data)

Update to connection activity (as of August 2022)

Connected battery storage capacity has notably increased since 2020. This is predominantly due to a large-scale 150 MW standalone battery project located at Minety in Wiltshire, which saw the first 100 MW phase constructed and commissioned within 2021. The remaining 50 MW is due to be commissioned soon – potentially in 2022 or 2023. This will solidify this project as one of the largest operational batteries in the UK and Europe. Alongside this site, a number of smaller battery sites have also progressed through to construction, bringing the total number of operational batteries in the licence area to 16 and the total installed capacity to 180 MW.

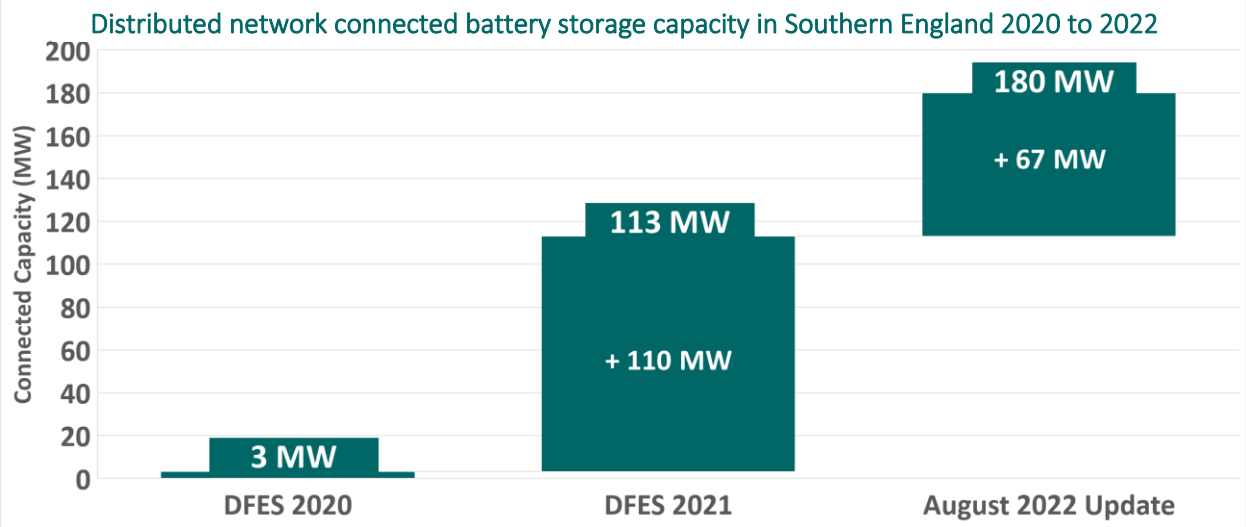

Figure 12: Battery storage capacity connected to the distribution network in Southern England (2020 to Aug 2022)

Source: SSEN DFES 2020 and 2021 datasets and SSEN connection data from August 2022

Latest development pipeline year to date

The pipeline of prospective new battery storage projects seeking to connect to the distribution network across the UK has seen a significant increase year-on-year since 2020. This has been particularly pertinent in SSEN's licence areas, with the Southern England licence area seeing both one of the largest overall pipelines and some of the largest individual prospective battery projects in the UK. An overview of battery storage projects with accepted connection offers over the past three years can be summarised as follows:

- In 2020 there were 34 contracted battery projects, totalling 804 MW
- In 2021 this grew significantly to 79 contracted projects, totalling c.1.6 GW
- As of August 2022, whilst the number of projects holding accepted connection offers has dropped to 52 projects, the total capacity of these projects has significantly increased to c.3.1 GW
- The average individual project size has significantly increased from c.24 MW in 2020/21 to over 50 MW in 2022. The latest view of sites with accepted connection offers includes 10 sites that are individually 100 MW or larger.

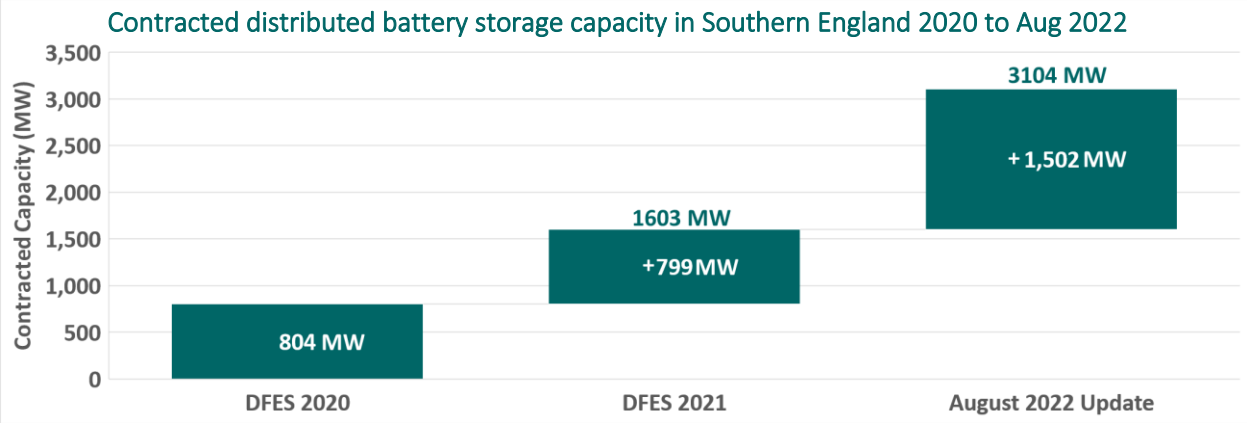

Figure 13: Contracted battery storage capacity in Southern England licence area (2020 to Aug 2022)

Source: SSEN DFES 2020 and 2021 datasets and SSEN connection data from August 2022

Planning activity in 2022

So far in 2022, 83 MW of new storage capacity has been granted planning permission. This is primarily from a 50 MW standalone site, and two sites colocated with solar PV and/or EV charging.

Three standalone battery sites, totalling 147 MW, have applied for planning permission in the licence area within 2022. In addition to this, a further eight sights have applied for planning permission without a proposed capacity, so this value may well increase as the applications are progressed and consulted upon.

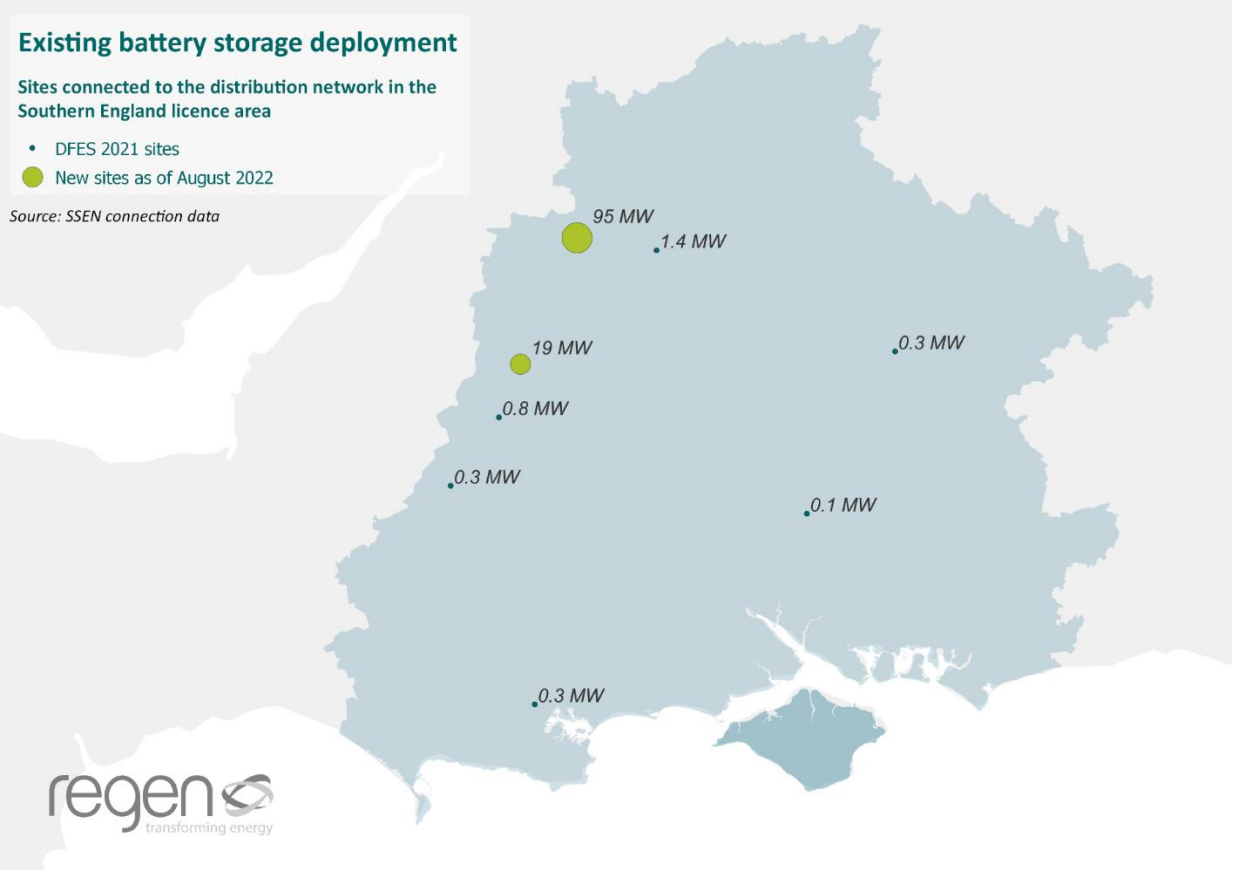

Figure 14: Map of distribution-connected battery storage in the Southern England licence area (Aug 2022)

Source: SSEN DFES 2021 datasets and SSEN connection data (Aug 2022)

A significant number of large-scale (50-150 MW) battery projects are seeking to connect to the network in and around the north-west of the licence area on developable land around Cirencester, Minety and Malmesbury. This could be related to proximity to National Grid 400 kV transmission network substations.

A number of large batteries are also targeting land areas around Reading and towards West London.

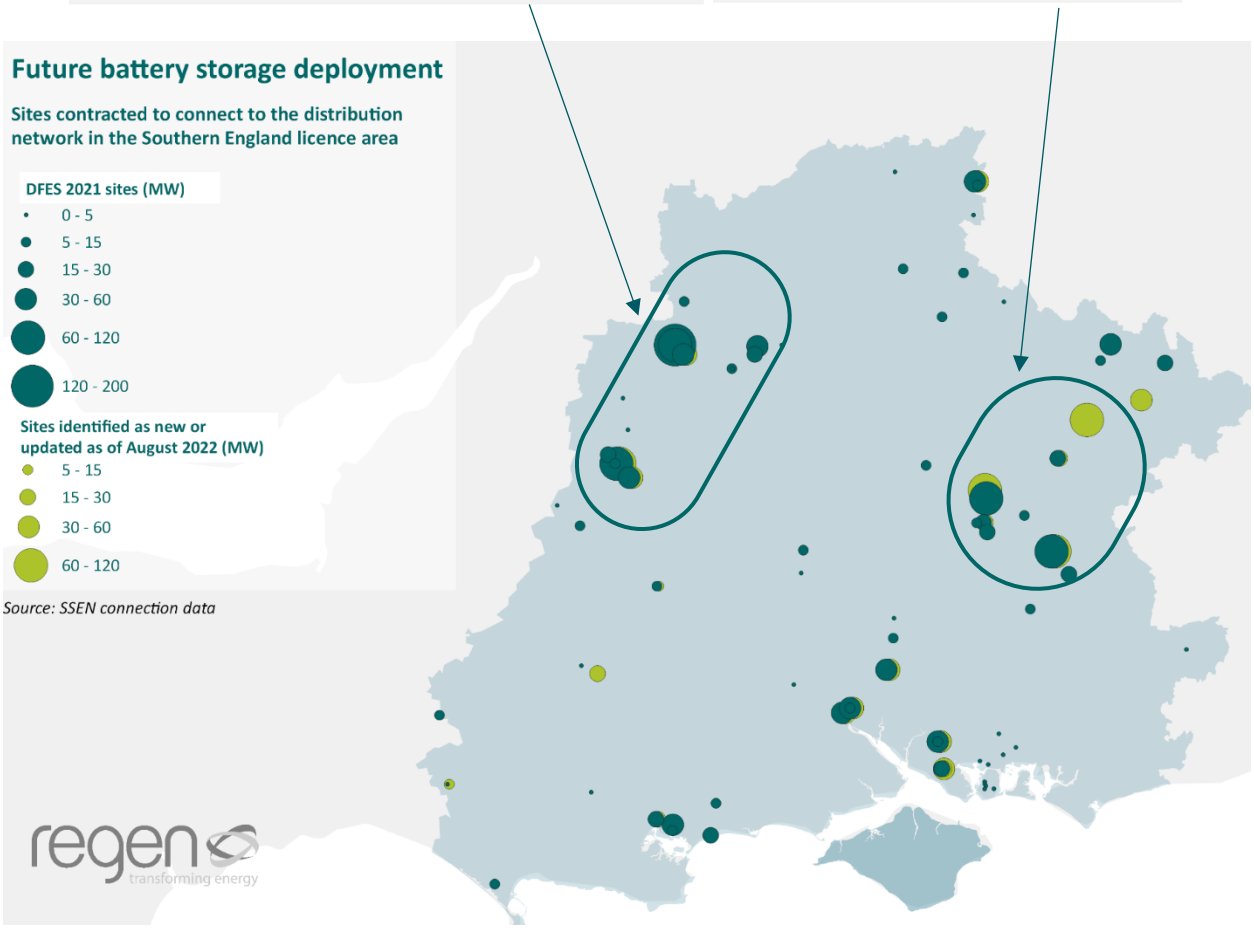

Figure 15: Map of contracted distribution-connected battery storage in the Southern England licence area (Aug 2022)

Source: SSEN DFES 2021 datasets and SSEN connection data (Aug 2022)

Outlook to 2030

Assumptions from DFES 2021

In addition to direct engagement with individual project developers and an analysis of planning and Capacity Market activity, projections for operational battery storage capacity in the licence area to 2030 was based on the following additional factors:

- A proportion of the near-term increase in large-scale ground mount solar PV capacity (2.8 – 4.1 GW MW by 2030), for potential colocation with battery storage
- A proportion of existing commercial and industrial high energy consumer businesses (up to 500 commercial and industrial premises by 2030) seeking to installed smaller-scale behind-the-meter battery storage
- A proportion of the near-term increase in domestic and commercial scale rooftop solar PV (540-822 MW by 2030), for behind-the-meter colocation with small-scale battery storage

As a result of these factors, the near-term outlook for battery storage in the licence area saw a deployment of multiple projects of various scales, over the next five-to-eight years. By 2030, capacity in the licence area ranged from 0.9 GW under Steady Progression to 1.6 GW under Leading the Way.

Projections from FES 2022[9]

For the Southern England licence area, the National Grid ESO FES 2022 has projected a much more ambitious and accelerated deployment of battery storage compared to FES 2021, with installed capacity in the licence area growing to over 700 MW by 2024, c.1.3 GW by 2035 and c.2.2 GW by 2050 under the most ambitious scenarios. This significant increase in capacity is echoed across the wider FES 2022 GB projections and in-part recognises the very large pipeline of battery sites currently seen across GB and in the licence area specifically.

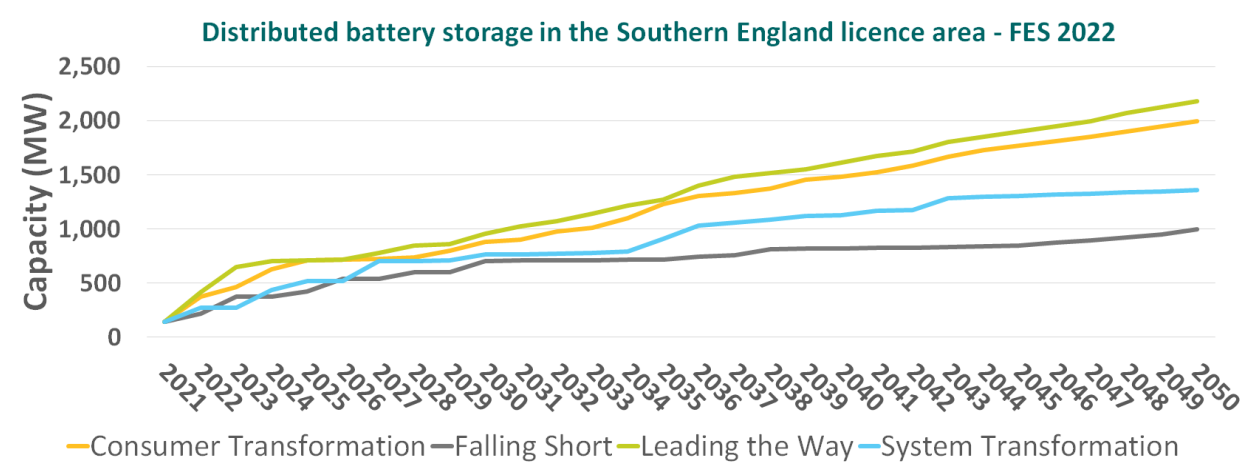

Figure 16: FES 2022 projections for distributed battery storage capacity in Southern England

Market outlook commentary

As a development sector, battery storage is growing significantly year on year. The number of projects, total capacity, individual project sizes (in terms of both power and storage capacity) and the number of companies that are active in battery storage project development have all collectively and consistently increased.

Despite this ever-growing pipeline of prospective projects, the proportion of sites that will progress to commissioning in the next 5-10 years is unclear. There are a number of national commercial markets and revenue opportunities that battery storage projects are targeting, such as the relatively recently reformed trio of commercial frequency balancing services[10], reformed 'Quick' and 'Slow' reserve services[11] and the network option assessment pathfinders[12]. In addition to these markets, SSEN and other DNOs have also been ramping up activity to procure flexibility services in discrete constraint management zones in 2022[13].

There are, however, a number of significant constraints in a several areas of SSEN's network, potentially delaying the deployment of projects seeking to move forward to construction. This includes a number of Statement of Works highlighting upstream transmission network reinforcement works required. This strategic network issue could delay the connection of many battery projects.

[9] FES 2022 Data Workbook - https://www.nationalgrideso.com/future-energy/future-energy-scenarios#fullsuite

[10] National Grid ESO frequency services: Dynamic Containment, Dynamic Moderation and Dynamic Regulation - https://www.nationalgrideso.com/industry-information/balancing-services/frequency-response-services

[11] National Grid ESO reserve services: Quick Reserve, Slow Reserve, Fast Reserve - https://www.nationalgrideso.com/industry-information/balancing-services/reserve-services

[12] National Grid ESO NOA pathfinders - https://www.nationalgrideso.com/future-energy/projects/pathfinders

[13] SSEN local flexibility market launch webinar (Aug 2022) - https://www.ssen.co.uk/news-views/2022/ssen-goes-to-market-for-flexibility-capacity-worth-6.7m/

5. Technology outlook – hydrogen electrolysis

DFES 2021 overview

The connection of hydrogen electrolysis plants to the distribution network as a source of future demand is potentially one of the more disruptive and uncertain loads within the scope of the DFES analysis. This is a reflection of the significant amount of uncertainty around the development of electrolysis.

The Southern England licence area is a transport hub, comprising road and rail networks, Heathrow Airport, and multiple ports along the southern coast. Combined with large industrial clusters, including Southampton, oil refineries currently producing hydrogen and potential hydrogen storage facilities in Portland, the Southern England licence area has the potential to host a number of hydrogen hubs.

In the DFES 2021, a range of capacity deployment was modelled across the four scenarios to 2030. This included:

- Canford Renewable Energy aiming to expand its operations at a former landfill site at Canford Resource Park to include a solar park and a hydrogen fuel processing plant
- Hydrogen refuelling stations in both Perivale, Ealing and Fawley, Southampton received planning permission in 2020.
- Swindon and Oxford have been identified as future hydrogen hubs, particularly for hydrogen-powered transport. Swindon already has two hydrogen refuelling stations, while Oxford hopes to use hydrogen and fuel cell technologies to achieve net zero.

This evidence, alongside the broad range of assumptions and outcomes for hydrogen within each of the four scenarios used in the 2021 DFES, resulted in an equivalent range of capacity projections, being highest at 253 MW by 2030 under Leading the Way.

The DFES 2021 results for hydrogen electrolysis capacity is summarised below:

Table 4: DFES 2021 projections for distribution-connected hydrogen electrolysis capacity

Scenario	Installed power capacity (MW)		
	Baseline (2020)	Projection by 2025	Projection by 2030
Steady Progression	1.2	1.3	15
System Transformation		5	30
Consumer Transformation		5	61
Leading the Way		19	253

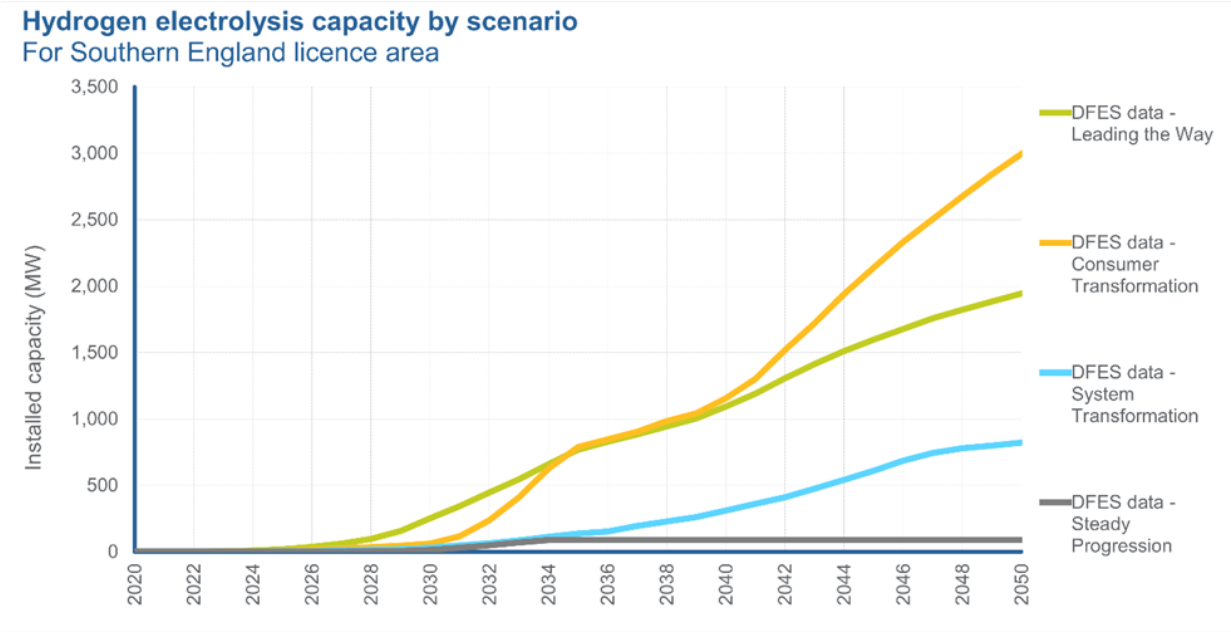

Figure 17: SSEN DFES 2021 projections for hydrogen electrolysis capacity in the Southern England licence area

Latest connection activity year to date

There are a number of hydrogen electrolyser sites in development in 2022 across the UK. In the Southern England licence area the following activity has been identified:

- Shell's existing Hydrogen Refueling Site at Beaconsfield is undergoing an upgrade which will increase its capacity to 0.3 MW and enable it to serve 250 kg per day for cars and LGVs. This is expected to finish in summer 2022.
- A Logan Energy & Green Hydrogen Systems site in Dorset is under construction. Expected to be operational in Q4 2022, it will have a capacity of 0.9 MW and provide 389 kg of hydrogen per day.
- The Canford Renewable Energy site has received a £1.5m grant to build a hydrogen fuel processor.

Outlook to 2030

Projections from FES 2022[14]

The National Grid ESO FES 2022 is the first to include distribution network licence area projections for hydrogen electrolysis, having previously only provided GB national projections. Whilst the FES 2022 has projected significantly less total installed capacity on the distribution network by 2050 than was seen in the SSEN DFES 2021, the FES 2022 has projected a more accelerated deployment of electrolysers in the licence area in the late 2030s and 2040s, under Consumer Transformation.

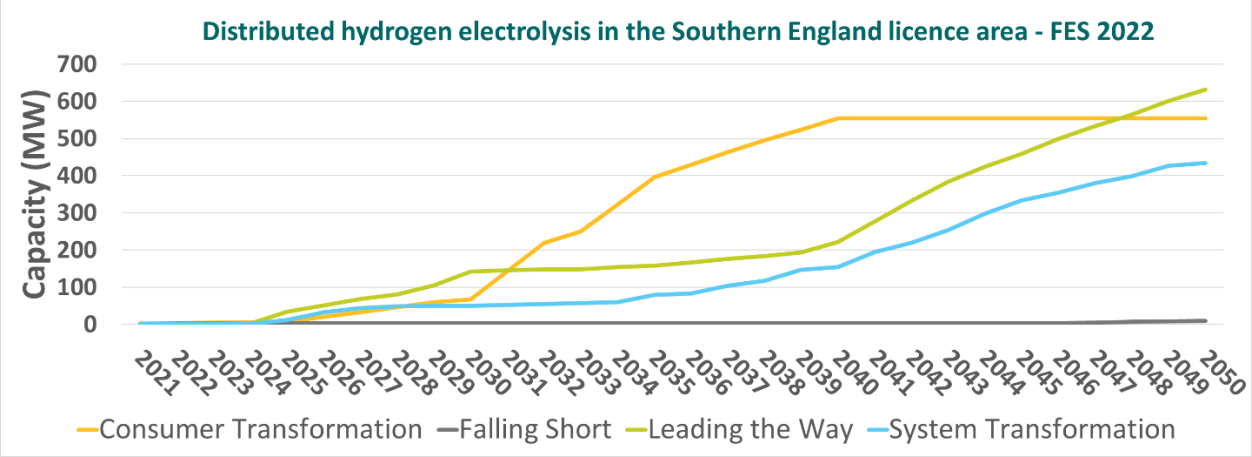

Figure 18: FES 2022 projections for distribution network connected hydrogen electrolysis in Southern England
Source: FES 2022 data workbook

Market outlook commentary

There have been a number of hydrogen policy developments that could potentially drive investment and increase the development of hydrogen production facilities across the UK. These were launched as a suite of policy documents in July 2022:

- A progress update[15] on the UK Hydrogen Strategy published in August 2021
- A Government response[16] to the consultation: *Hydrogen Business Model and Net Zero Hydrogen Fund: Market Engagement on Electrolytic Allocation* (which closed May 2022)
- A Hydrogen Sector Development Action Plan[13] and Map of Example UK Hydrogen Projects[17]

These policy documents included a number of tangible measures to increase the deployment of hydrogen in the UK, such as:

- An increased focus on support and incentives to reach 1 GW of operational or in-construction electrolytic hydrogen production capacity by 2025, specifically with the launch of the first electrolytic application round[18]. A scheme that is designed to provide financial support to both up-front capital costs and ongoing revenue.

- Planned development of a Hydrogen Certification Scheme by 2025 to enable standardisation and quality assurance for future hydrogen production projects participating in markets.
- Reforms to the design of the UK Capacity Market to support investment in low carbon technologies such as low carbon hydrogen fired generation.
- A consultation on domestic boiler and heating system standards, as part of further exploration of supplying hydrogen for domestic heating.
- Amendments to the Renewable Transport Fuel Obligation[19] (RTFO) scheme enabling hydrogen electrolysers to put in place power purchase agreements for electricity and thus removing the mandatory requirement to be collocated with renewable generation to receive RTFO subsidy payments.
- A commitment to issue a policy decision in 2023 around allowing up to 20% of hydrogen blended into the existing natural gas grid.

The joining together of the Net Zero Hydrogen Fund (NHZF) and Hydrogen Business Model (HBM) schemes is a strong policy signal for potential hydrogen electrolysis developers. The NHZF provides £240m in grant funding to support upfront capital costs and the HBM provides revenue support through a contractual business model for hydrogen producers, to incentivise the production and use of low carbon hydrogen. To be able to apply for these combined support funds, projects are required to

- Be operational no later than the end of 2025,
- Have a minimum capacity of 5 MW
- Have at least one qualifying offtaker (i.e. blending is not eligible).

The design of this scheme and the urgency of the target could see up to 250 MW of electrolysis capacity supported in 2023, up to a further 750 MW in 2024 and a price-competitive allocation of additional capacity in 2025. With Southern England having a number of potential hydrogen development hubs and major transport infrastructure, a proportion of this incentivised capacity could be developed and connect directly to the distribution network in the licence area under some scenarios.

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[14] FES 2022 Data Workbook - https://www.nationalgrideso.com/future-energy/future-energy-scenarios#fullsuite

[15] Progress update on the UK Hydrogen strategy - https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1011283/UK-Hydrogen-Strategy_web.pdf

[16] Government Response to Hydrogen Business Model consultation - https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1092176/hbm-nzhf-market-engagement-electrolytic-allocation-govt-response.pdf

[17] Map of Example UK Hydrogen Projects https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1092353/hydrogen-sector-development-action-plan.pdf

[18] First Electrolytic Allocation round - https://www.gov.uk/government/publications/hydrogen-business-model-and-net-zero-hydrogen-fund-electrolytic-allocation-round-2022

[19] Renewable Transport Fuel Obligation - https://www.gov.uk/guidance/renewable-transport-fuels-obligation

6. Technology outlook – Data centres

DFES 2021 overview

Large-scale commercial data centres have only recently featured as specific sources of disruptive demand in the DFES analysis. The first analysis for data centres was conducted in the DFES 2020, due to a significant pipeline of new commercial data centre sites applying for large import connections in the Southern England licence area. The DFES 2021 built on this analysis, with more sites seeking connection agreements. The analysis highlighted that:

- 27 data centre sites, totalling c.1.3 GW, had secured connection agreements with SSEN
- Six of these sites were individually seeking import capacities of 100 MW or higher (the largest being 160 MW)
- Many of these larger sites were aiming to undertake a staged build out of servers and associated equipment on site (such as cooling plant), meaning that some of the pipeline sites could build out and increase their operational demand capacity over 3-5 years
- Five of the sites had secured planning approval
- This portfolio of new data centre sites represented a significant amount of new electricity demand on a small number of 33 kV and 132 kV substations in the Southern England licence area, heavily focused in/around Slough and West London
- Due to a lack of specific projections in the FES 2021, the DFES analysis focused on a single projection of a staged development timeline for the 27 known data centre sites, reaching 1.3 GW of new connected demand in the early 2030s.

Table 5: DFES 2021 projections for data centre capacity in the Southern England licence area

Scenario	Installed Demand Capacity (MW)			
	Baseline (2020)	Projection by 2025	Projection by 2030	Projection by 2035
Single projection	--	693	1,180	1,315

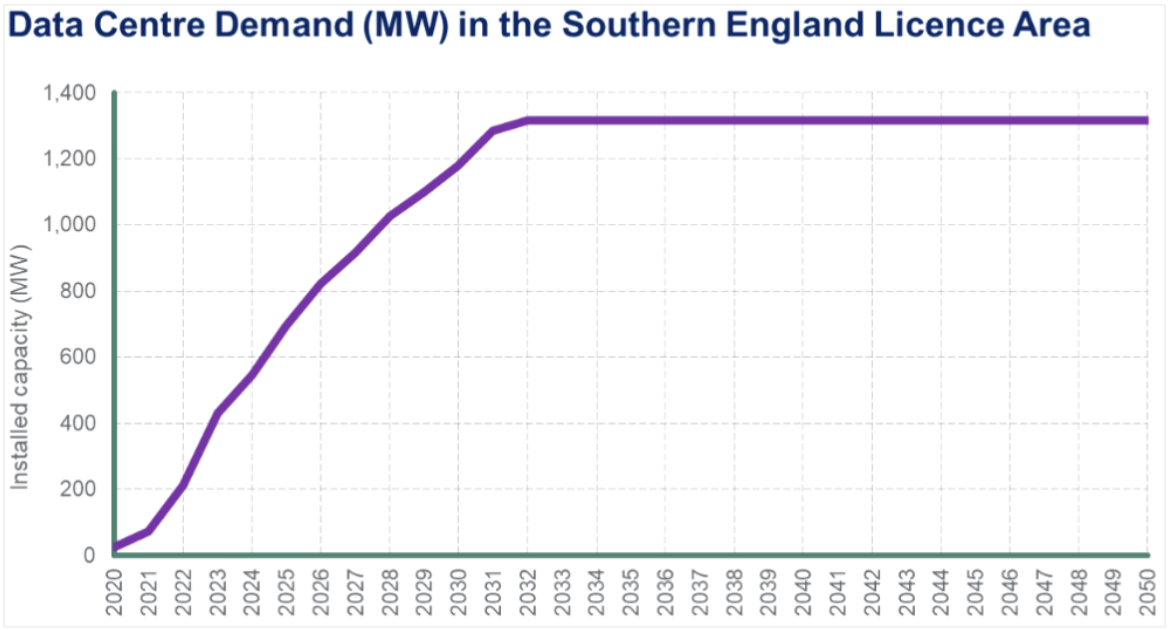


Figure 19: SSEN DFES 2021 projections for new data centre capacity in the Southern England licence area

Latest connection activity year to date

As of September 2021, the UK housed 452 data centres in total, 70 of which are based in and around London. The topic of data centre demand has featured in the media across 2022[20], highlighting the scale of demand and impact that sites around Slough and West London could have on local network demand headroom, specifically for new housing.

The pipeline of new data centre connections accepting connection offers has increased year on year since 2020. Many of these sites are individually over 100 MW and feedback from engagement with the developers suggests that many will stage their deployment over several years, increasing infrastructure and associated import demand incrementally up to their contracted capacity.

There are a number of existing data centres of various sizes operating in the licence area, but data on this is not complete, therefore the analysis has focused solely on prospective new large-scale commercial data centres that have accepted connection offers.

- In 2020 there were 13 proposed data centre developments, totalling 665 MW
- In 2021 this grew significantly to 27 sites, totalling 1,315 MW
- As of August 2022, two new data centre sites located near Park Royal and Hayes in West London have accepted connection offers, further increasing the pipeline to 29 sites totalling 1,343 MW.

This scale of capacity is equivalent to the diversified demand of c.600,000 domestic homes without electric heating or c.38,000 domestic homes with three-phase electric heating.

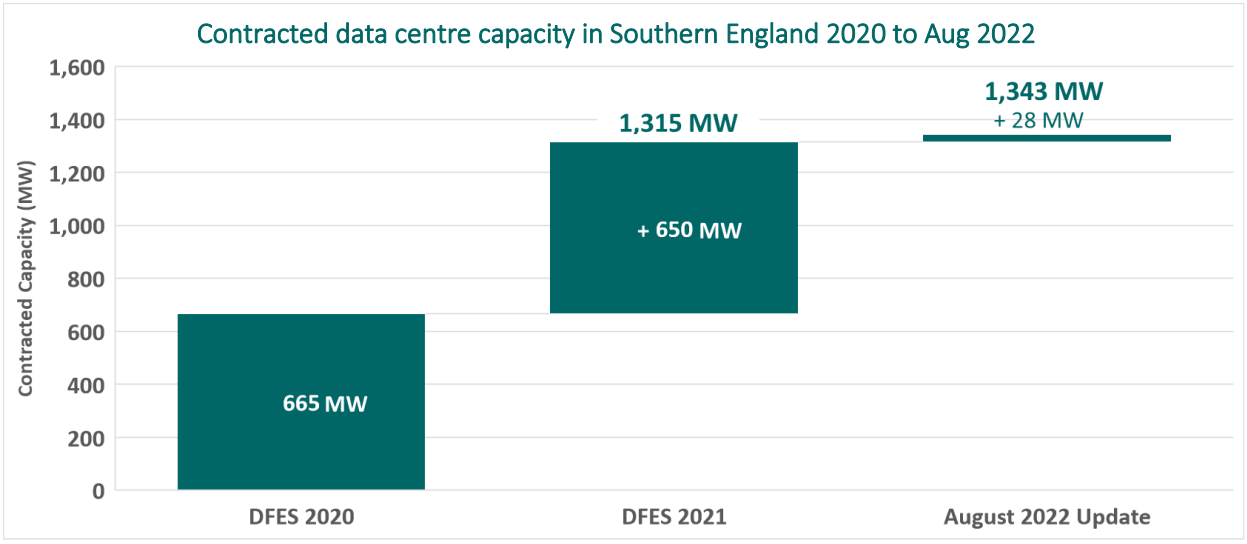


Figure 20: Contracted data centre capacity in Southern England licence area (2020 to Aug 2022)
Source: SSEN connection data (DFES 2020, 2021 and August 2022 update)

Planning activity

In 2021 five data centre sites, totalling 207 MW, had successfully secured planning approval. A sixth site has since been found to have secured planning approval, bringing this total to 212 MW.

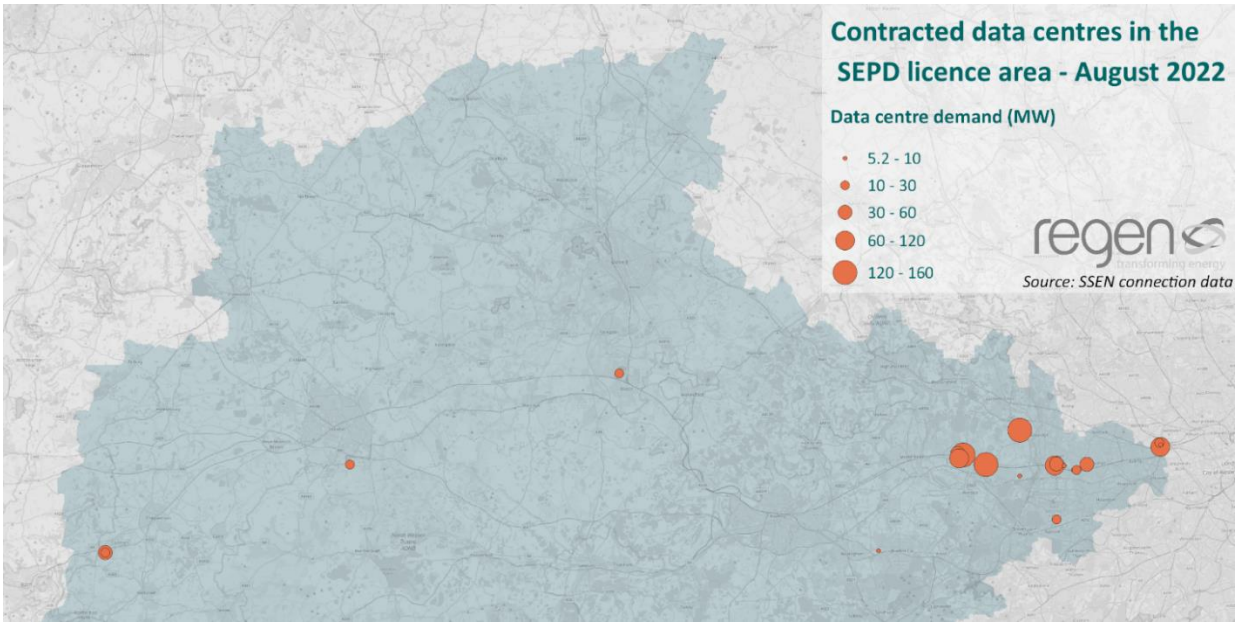
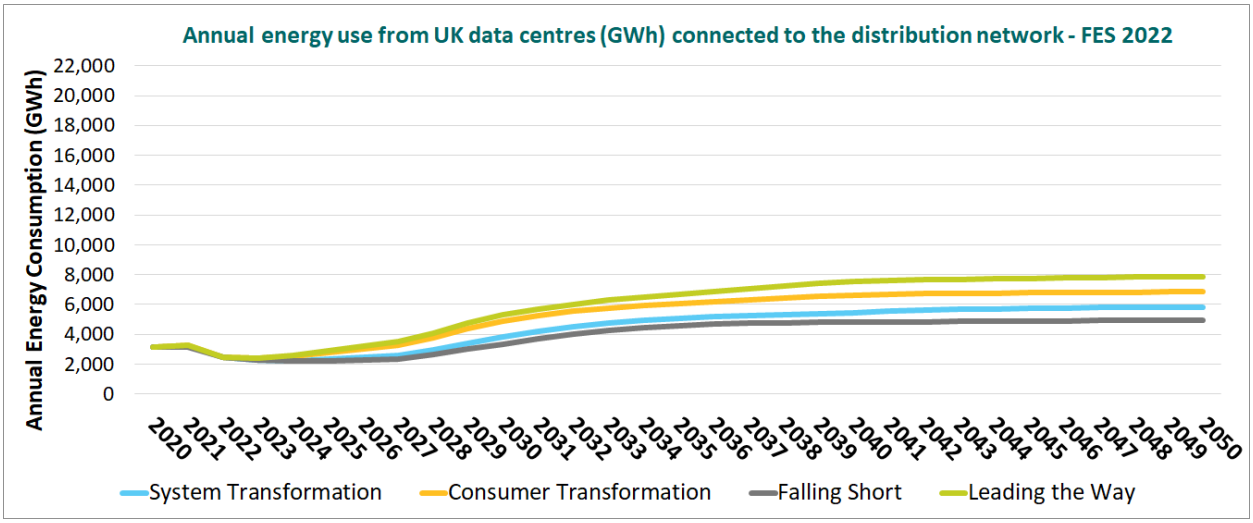


Figure 21: Data centres contracted to connect to the SPED distribution network as of August 2022, all sites are in the north of the licence area, with a large concentration in West London.
Source: SSEN Connection Data

Outlook to 2030

Projections from FES 2022[21]

The FES 2022 has referenced the growth of data centre energy consumption specifically in their publication and scenario projections out to 2050. This shows that whilst overall there is significant future growth, a notable majority of future data centres could be directly connected to the transmission network under all scenarios.



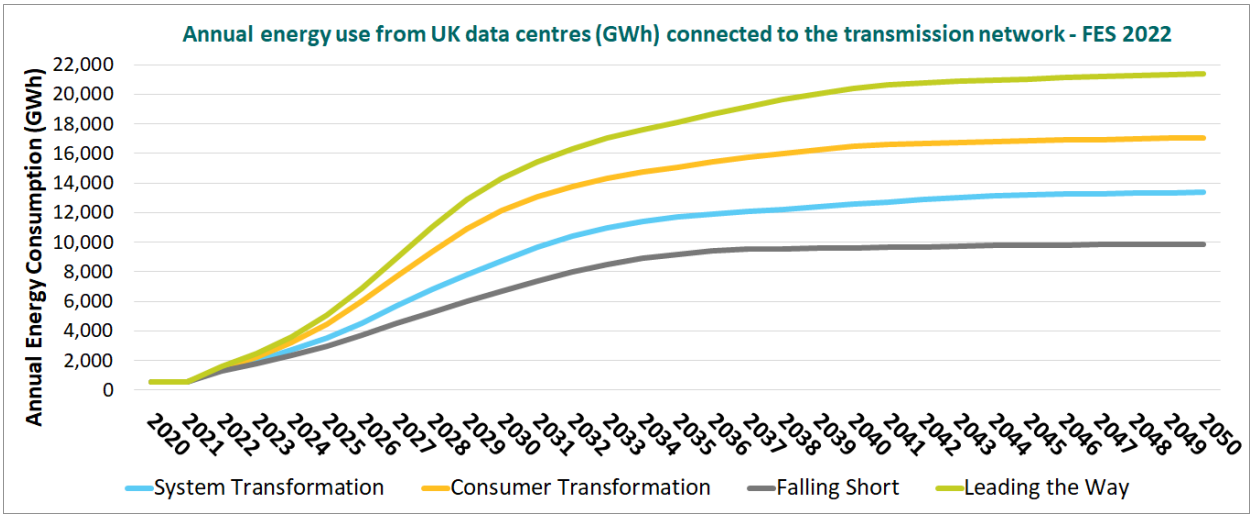


Figure 22: FES 2022 projections for UK net annual data centre electricity consumption out to 2050
Source: FES 2022 data workbook

Market outlook commentary

The FES 2022 has classified a number of different types of data centre asset classes:

- Enterprise data centres – where organisations use the IT infrastructure onsite.
- Co-location data centres – where a host organisation rents out areas of a commercial data centre building, providing building and support infrastructure like cooling, external internet connection and site security etc. and the renting organisation provides the IT infrastructure themselves.
- Cloud data centres – where host organisations provide and rent out all onsite infrastructure and the renting organisation simply pays for usage.
- Hyperscale data centres – very large-scale sites in terms of both physical footprint and data centre capacity, usually owned by a data-driven commercial organisation. These are used for big data storage and large-scale, high-speed, cloud-based services.

The pipeline sites present in the SSEN licence area are likely to be a mixture of these data centre types, but some of the larger capacity connections suggest hyperscale data centres.

The FES 2022 analysis suggests that the number of co-location and hyperscale data centres could see significant growth over the next ten years and beyond, potentially resulting in data centres accounting for around 6% of the UK's total electricity consumption by 2030.

Due to the proximity to London (the UK's data centre and internet connectivity hub), the Southern England licence area is amongst the most active for new hyperscale data centres, as seen in the recent surge of new connection applications. How many more sites may seek to connect to the distribution network is unclear, and competition for developable land and site locations to access high-speed internet connectivity could limit the deployment of new sites on the distribution network.

In terms of a general market for data centres, a number of societal drivers are causing individual and collective data consumption to increase significantly:

- An increasingly IT-literate population.
- The increase in quality and volume of entertainment streaming services.
- The pandemic creating a seismic shift to remote working and video calling.

With physical limitations in efficiencies and data storage density, an increase in data centre IT infrastructure and associated cooling load, collectively increasing power demand is possible.

[20] See Financial Times, "*West London faces new homes ban as electricity grid hits capacity*", July 2022: https://www.ft.com/content/519f701f-6a05-4cf4-bc46-22cf10c7c2c0

[21] FES 2022 pre-paper on Data Centres (March 2022) and FES 2022 main data workbook: https://www.nationalgrideso.com/document/246446/download https://www.nationalgrideso.com/future-energy/future-energy-scenarios#fullsuite

7. Technology outlook – EVs and EV chargers

DFES 2021 overview

The DFES 2021 analysis for EVs and EV chargers in Southern England highlighted that:

- A total of 51,752 battery EVs and 42,590 plug-in hybrid EVs were registered in the licence area
- Around 32,000 domestic EV chargers and 3,134 public chargers, totalling c. 95 MW, were online
- The uptake of EVs was modelled to increase and accelerate in all scenarios to 2030
- Whilst some variation was seen across the scenarios, the deployment of both domestic and non-domestic EV charger archetypes was modelled to increase rapidly in all scenarios out to 2030.

Table 6: DFES 2021 projections for EVs in the Southern England licence area

Scenario	Number of battery EVs (thousands)		
	Baseline (2020)	Projection by 2025	Projection by 2030
Steady Progression	52	254	752
System Transformation		255	927
Consumer Transformation		248	1793
Leading the Way		531	1969
Scenario	Number of plug-in hybrid EVs (thousands)		
	Baseline (2020)	Projection by 2025	Projection by 2030
Steady Progression	43	114	213
System Transformation		93	172
Consumer Transformation		82	125
Leading the Way		105	169

Table 7: DFES 2021 EV charger capacity projections in the Southern England licence area

Scenario	Domestic off-street chargers (thousands)		
	Baseline (2020)	Projection by 2025	Projection by 2030
Steady Progression	32	168	428
System Transformation		269	579
Consumer Transformation		401	1069
Leading the Way		405	1226
Scenario	Non-domestic EV chargers (thousands)		
	Baseline (2020)	Projection by 2025	Projection by 2030
Steady Progression	95	279	550
System Transformation		310	721
Consumer Transformation		483	1097
Leading the Way		527	1360

Update to vehicle registrations (as of August 2022)

Latest data for battery EVs and plug-in hybrids in the licence area shows a notable increase in registered vehicles n Southern England. Battery EV numbers have increased 107% between DFES 2021 and Q1 2022. Plug in hybrid numbers have increased 53% between DFES 2021 and Q1 2022.

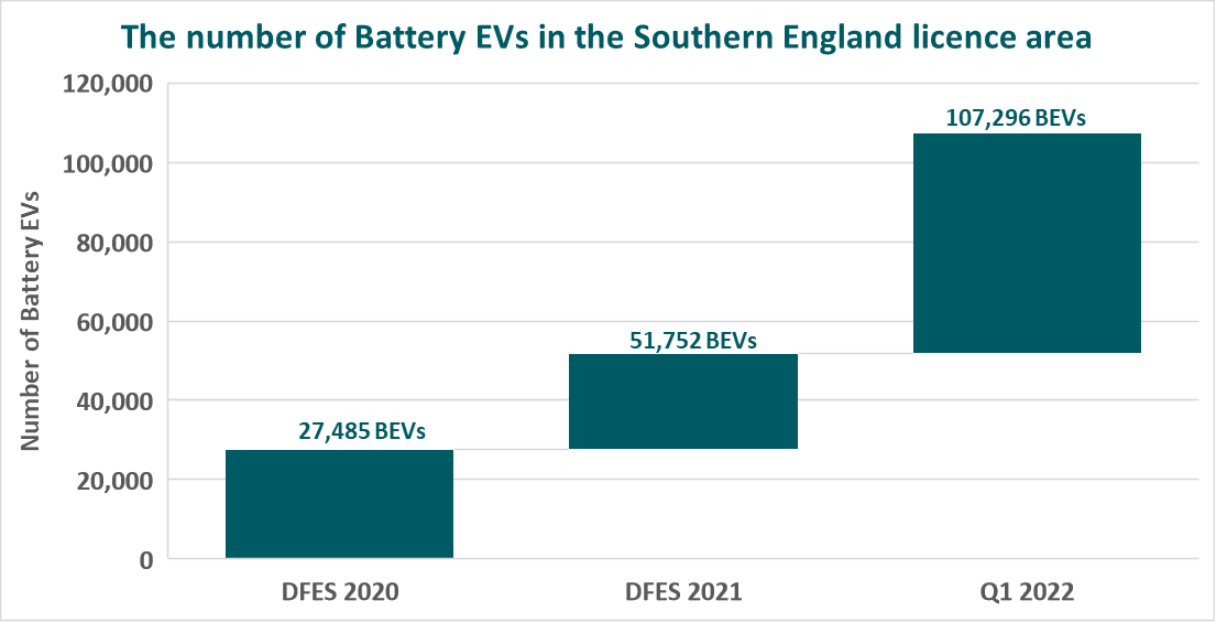


Figure 23: Battery EV registrations in the Southern England licence area 2020 to Q1 2022

Source: Department for Transport data and SSEN notifications data

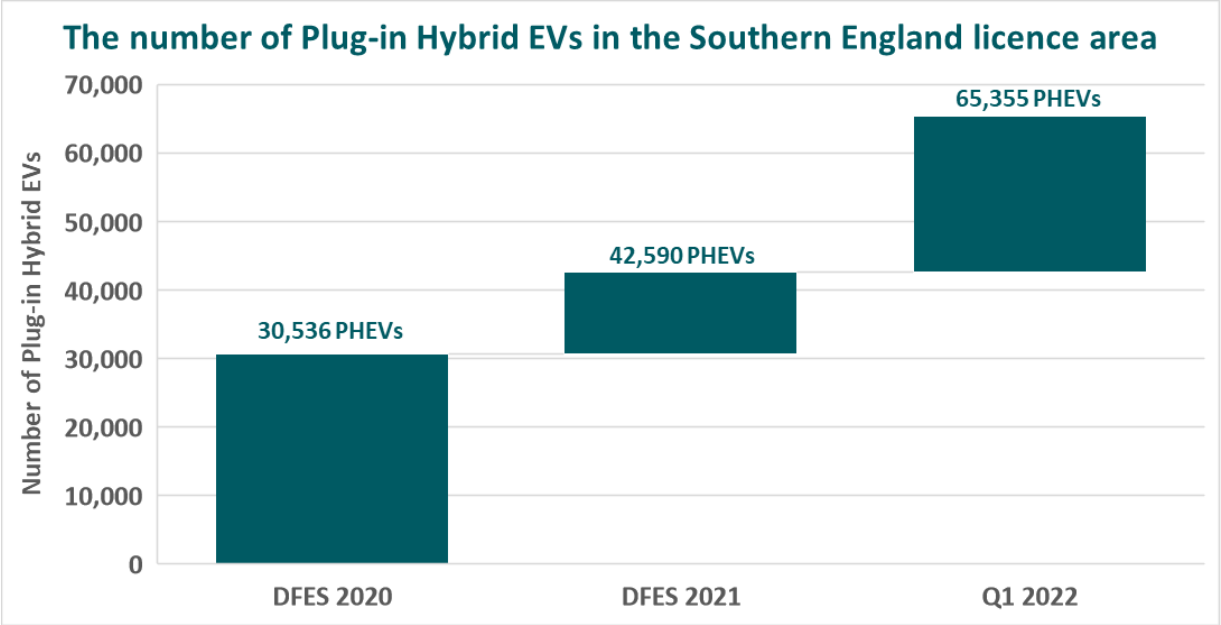


Figure 24: Plug-in hybrid EV registrations in the Southern England licence area 2020 to Q1 2022

Source: Department for Transport data and SSEN notifications data

In addition to this, there has been a steady increase in public EV charger capacity, which has increased by more than 12% in the first half of 2022.

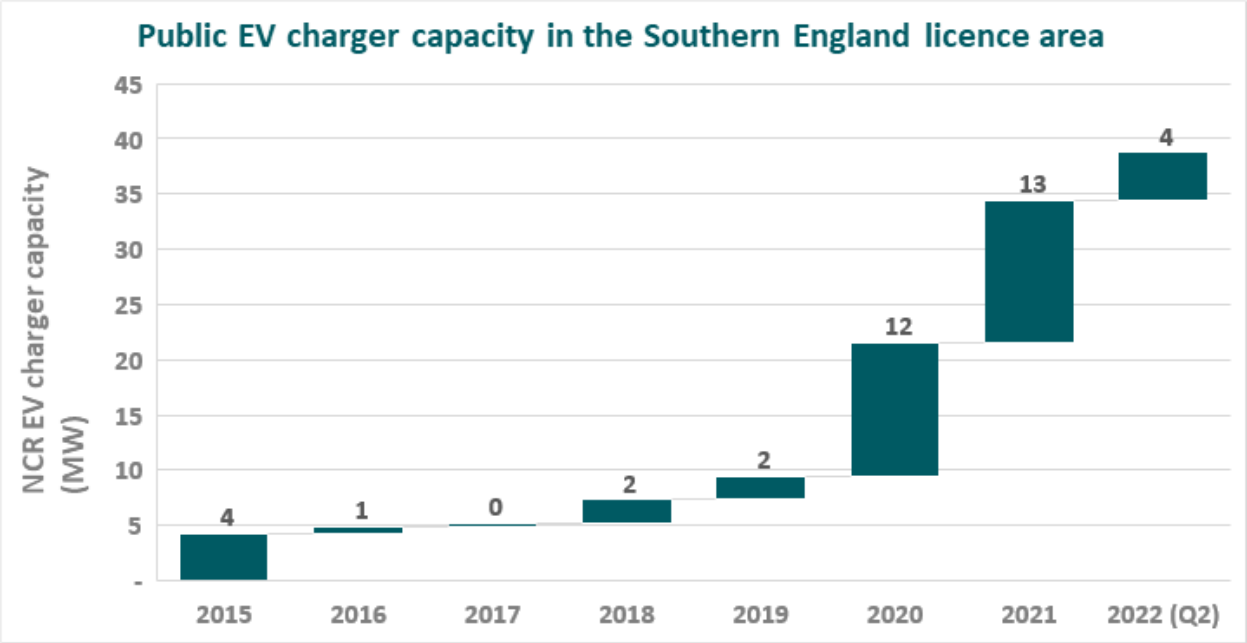


Figure 25: Public EV charger capacity in the Southern England licence area from 2015 to Q2 2022
Source: National Chargepoint Registry

Outlook to 2030

Projections from FES 2022[22]

For the Southern England licence area, the National Grid ESO FES 2022 has projected a very similar EV uptake to FES 2021. This shows an upper (Leading the Way) and lower (Falling Short) uptake of between c.1.5 million and 500,000 battery EVs respectively by 2030.

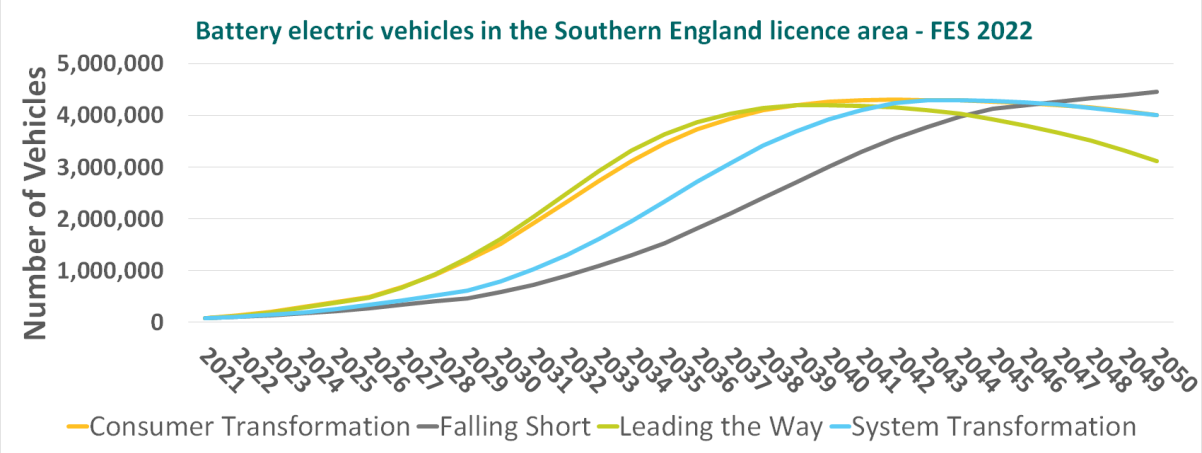


Figure 26: FES 2022 projections for battery electric vehicles in the Southern England licence area

Market outlook commentary[23]

Since 2019, annual sales of EVs have steadily increased, with 2021 seeing c.191,000 EVs sold – the highest annual figure to date. This trend is set to continue, with over 127,000 EVs sold year to date (end of July 2022), already surpassing total annual sales in 2020.

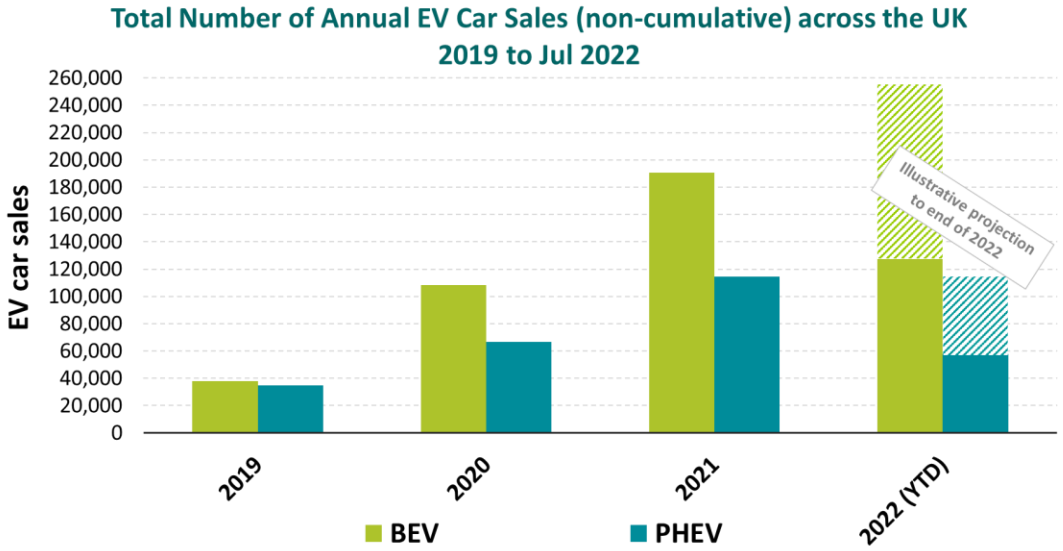


Figure 27: Annual UK EV car sales 2019 to Jul 2022

Source: SMMT vehicle sales data

The overall market share for EV sales is also increasing, with EV and PHEV sales already accounting for 20% of all UK car market sales, as of the end of July 2022.

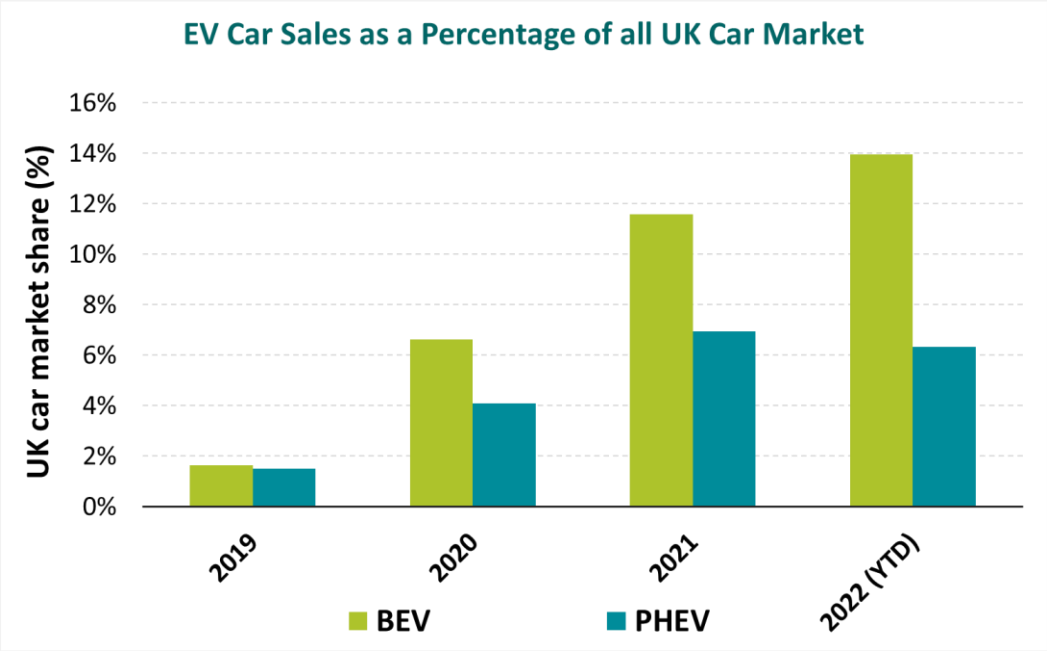


Figure 28: Annual UK EV car sales as a proportion of all car sales 2019 to Jul 2022
Source: SMMT vehicle sales data

The UK's used car market shrank by c.19% during the second quarter of 2022. However, used battery electric vehicle (BEV) sales rose 57.1% to reach 16,782 units, doubling market share to 1.0%.

Aside from this national acceleration towards EVs, there is also significant activity from Local Authorities in developing regional low carbon transport strategies and enabling charging infrastructure. For example:

- Hampshire county Council have an EV charger framework which has so far delivered a number of charge points around Southampton and Portsmouth[24]
- Swindon Borough Council have installed a number of public charge points[25]

As well as this, there are projects such as Oxfordshires' LEO[26], which are developing solutions to achieve regional net zero targets, with zero carbon transport being a key component. These types of projects from regional governments will likely accelerate the transition to electrified transport.

[22] FES 2022 Data Workbook - https://www.nationalgrideso.com/future-energy/future-energy-scenarios#fullsuite
[23] SMMT EV sales data - https://www.smmt.co.uk/vehicle-data/evs-and-afvs-registrations/
[24] Hampshire CC EV charger framework - https://www.hants.gov.uk/transport/electric-vehicles/central-southern-regional-framework
[25] Swindon Public chargepoints https://www.swindon.gov.uk/news/article/701/council_helps_residents_to_be_the_change_with_the_installation_of_new_electric_vehicle_charging_points_across_swindon
[26] Oxfordshire LEO - https://project-leo.co.uk/the-energy-challenge/

8. Technology outlook – Heat pumps

DFES 2021 overview

The DFES 2021 analysis for heat pumps in Southern England highlighted that:

- A total of c.19,400 domestic heat pumps and c.2,800 non-domestic heat pumps were installed as of the end of 2020.
- With the System Transformation scenario focusing less on electrification and more on hydrogen fuelled heating systems, a relatively broad envelope of homes and businesses with a type of heat pump was projected across analysis period.
- Overall, the number of heat pumps increases in all scenarios by 2030, but this was highest in Leading the way (c.281,000) and lowest in Steady Progression (c.54,000).

Table 8: DFES 2021 domestic heat pump projections for the Southern England licence area

Scenario	Number of homes with a heat pump (thousands)		
	Baseline (2020)	Projection by 2025	Projection by 2030
Steady Progression	19	54	185
System Transformation		72	174
Consumer Transformation		131	455
Leading the Way		281	840
Scenario	Number of homes with a hybrid heat pump (thousands)		
	Baseline (2020)	Projection by 2025	Projection by 2030
Steady Progression	0	9	19
System Transformation		10	54
Consumer Transformation		13	53
Leading the Way		48	120

Table 9: DFES 2021 non-domestic heat pump projections for the Southern England licence area

Scenario	Number of properties with a heat pump (thousands)		
	Baseline (2020)	Projection by 2025	Projection by 2030
Steady Progression	3	9	15
System Transformation		15	40
Consumer Transformation		23	53
Leading the Way		19	46
Scenario	Number of properties with a hybrid heat pump (thousands)		
	Baseline (2020)	Projection by 2025	Projection by 2030
Steady Progression	0	0	0
System Transformation		1	2
Consumer Transformation		1	2
Leading the Way		1	4

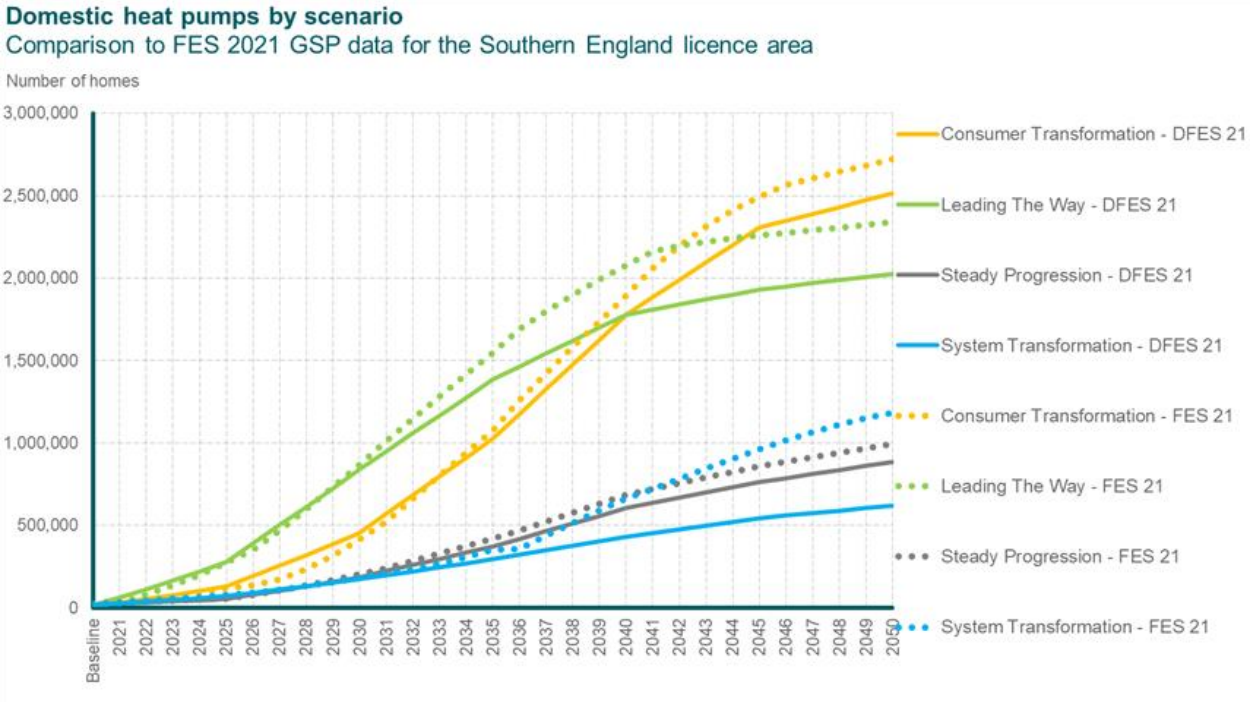


Figure 29: SSEN DFES 2021 projections for domestic heat pumps in Southern England (reconciled to FES 2021 GSP data)

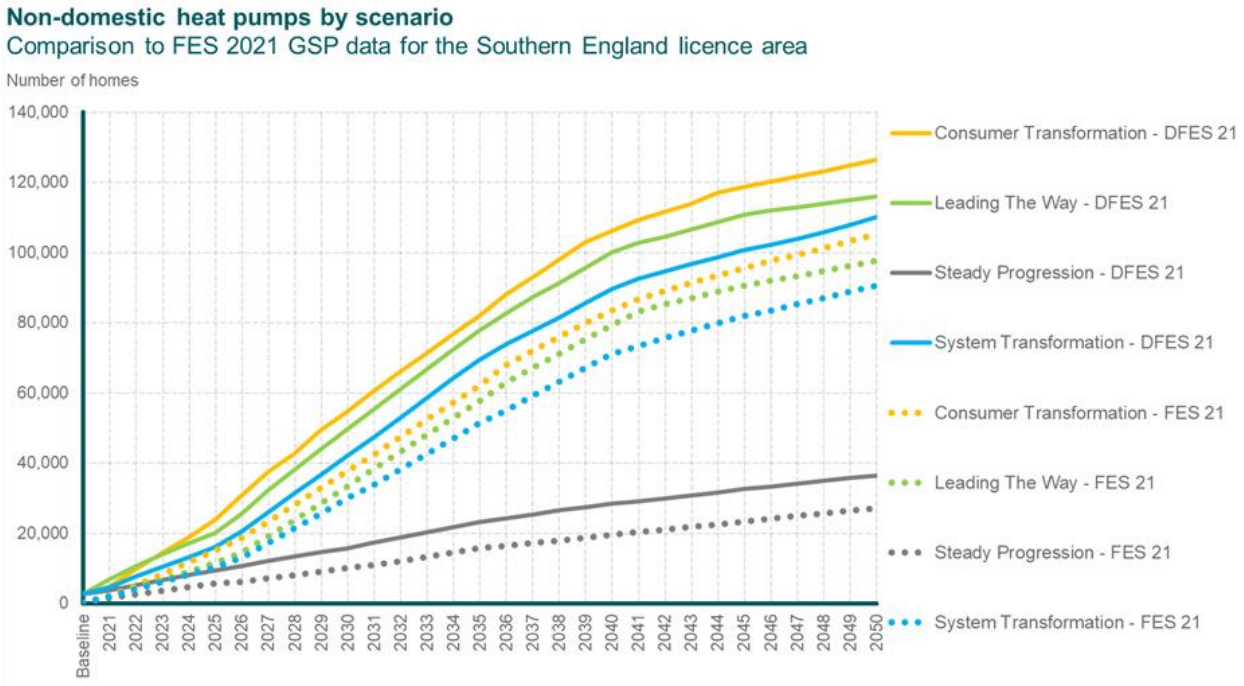


Figure 30: SSEN DFES 2021 projections for non-domestic heat pumps in Southern England (reconciled to FES 2021 GSP data)

Update to connection activity (as of August 2022)[27]

There has been a marked increase in the number of heat pump notifications in the Southern England licence area, with a 156% increase in annual installations from July 2021 to July 2022.

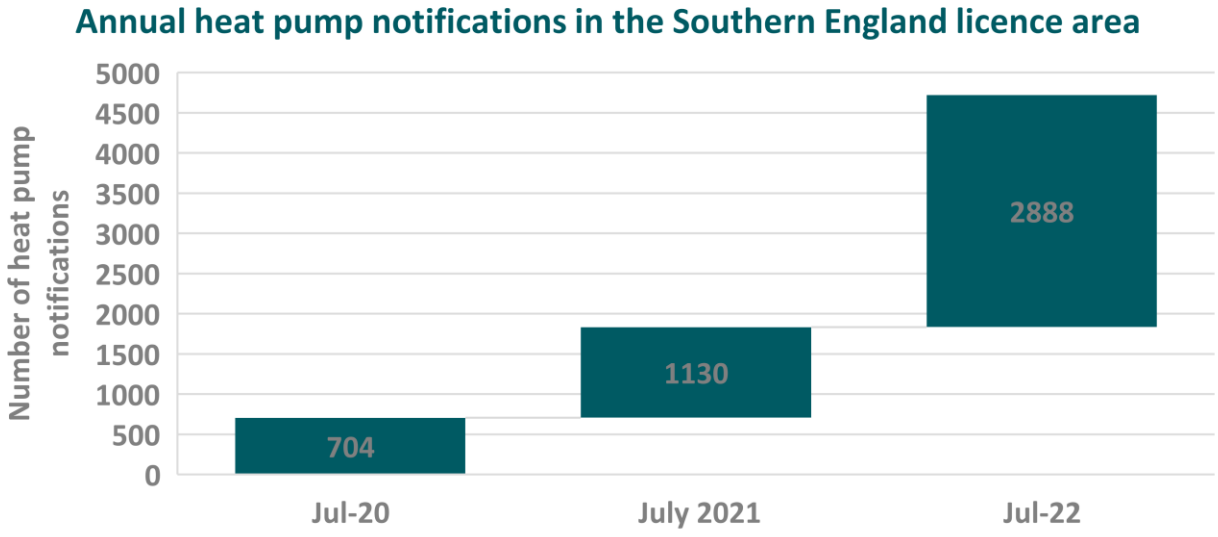
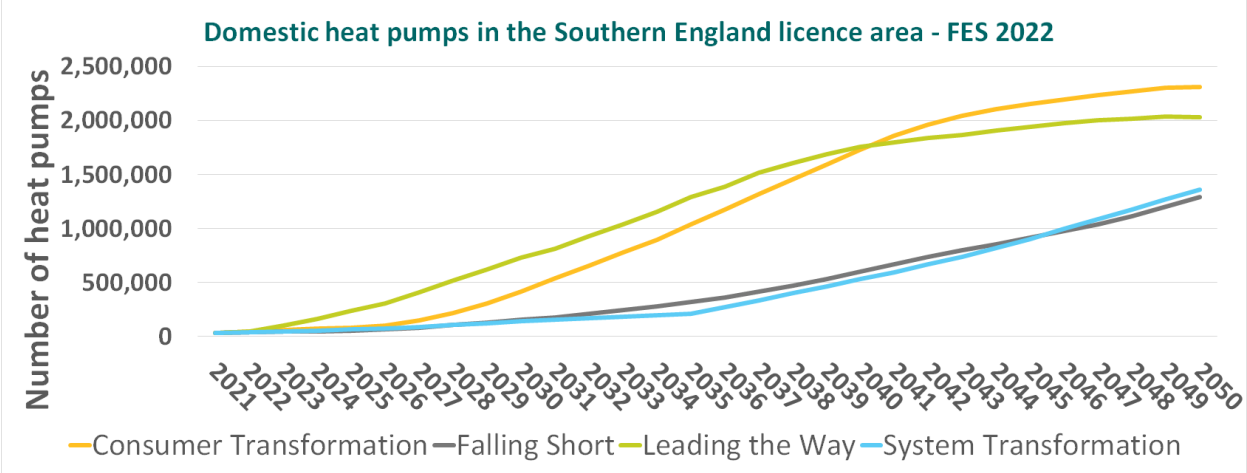


Figure 31: Annual Heat Pump notifications in the Southern England licence area
Source: SSEN data

Outlook to 2030

Projections from FES 2022[28]

For the Southern England licence area, National Grid ESO's 2022 FES projects an uptake of domestic heat pumps reaching c.800,000 by 2030 in the Leading the Way scenario. This is slightly lower than the 2021 DFES projection.



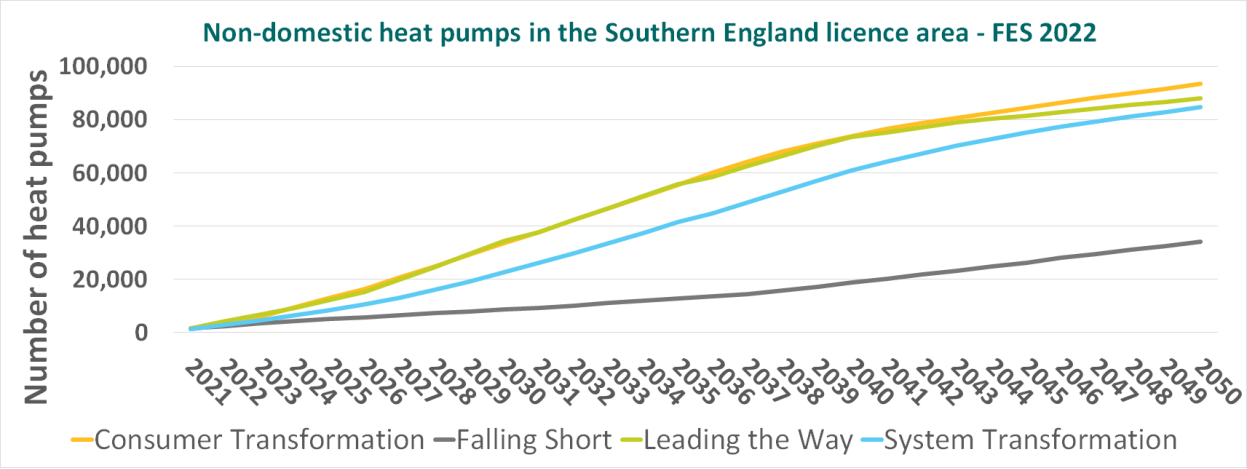


Figure 32: FES 2022 projections for the number of heat pumps in the Southern England licence area

Market outlook commentary

Whilst previous support mechanisms such as the Renewable Heat Incentive have enabled some deployment of heat pumps, in order to incentivise significant uptake in the near-term, BEIS announced additional policy support in 2022 in the form of the Boiler Upgrade Scheme[29]. In addition to this, as part of the publication of the UK Energy Security Strategy, a new scheme to scale up heat pump manufacturing was announced in the form of the £30million Heat Pump Investment Accelerator Competition[30], which will be run in 2022 to increase British manufactured heat pumps and reduce demand for natural gas.

These national schemes will operate alongside regional efforts to accelerate the decarbonisation of heat. A number of Local Authorities in the SEPD licence area have stated within their development plans that planning applications must consider the compatibility of the new development with zero carbon heat sources, such as heat pumps:

- In the case of Portsmouth, new developments must demonstrate an approach to design that prioritises energy efficiency – allowing for the future installation of heat pumps
- Dorset Council have stated that any council-led project will offer the opportunity to create 'zero carbon homes and commercial spaces'.

Whilst Local Authorities are currently pushing for greater local uptake of heat pumps, the UK government's 2025 ban on boilers in new builds, and target of 600,000 annual installations, will result in a significant increase in the rate of heat pump deployment.

[27] SSEN heat pump notifications data - SSEN team
[28] FES 2022 Data Workbook - https://www.nationalgrideso.com/future-energy/future-energy-scenarios#fullsuite
[29] BEIS Boiler Upgrade Scheme - https://www.gov.uk/guidance/check-if-you-may-be-eligible-for-the-boiler-upgrade-scheme-from-april-2022
[30] Heat Pump Investment Accelerator Competition - https://www.gov.uk/government/news/major-acceleration-of-homegrown-power-in-britains-plan-for-greater-energy-independence