Scottish & Southern Electricity Networks

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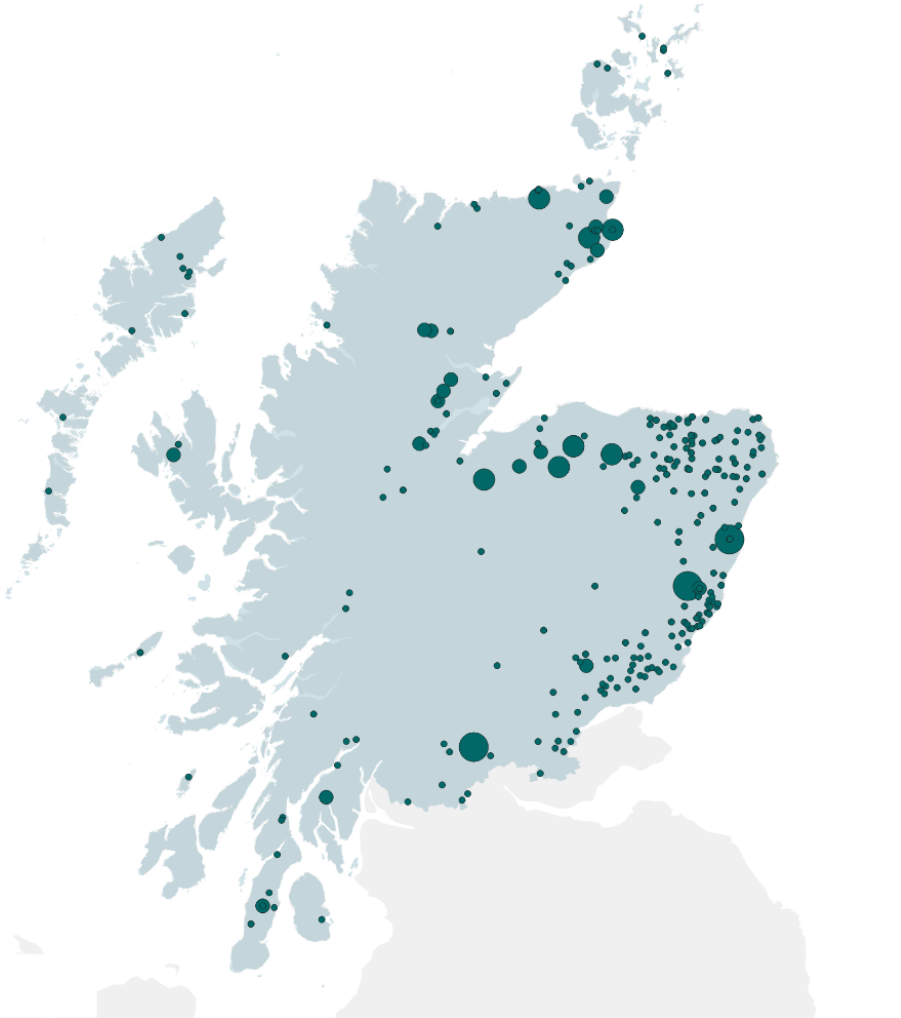
Scottish and Southern Electricity Networks

2022 Near Term Growth Review

North of Scotland licence area

Summary report September 2022



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Contents

1. Introduction and background

The distribution network in the North of Scotland licence area contains some of the most unique regions in the UK. This includes the Scottish Islands, the Highlands and urban population centres such as such as Aberdeen and Dundee.

In 2021 Regen carried out a full **Distribution Future Energy Scenarios** (DFES) analysis of the North of Scotland 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 re-emergence of a more proactive industrial strategy.

In the Scottish context the energy sector is seeing the ongoing impacts of COP 26 and the heightening of Scotland's decarbonisation and growth ambitions, the oil and gas sector transition and the increased

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 the North of Scotland in the RIIO-ED2 period: onshore wind, solar PV, battery storage, heat pumps, hydrogen electrolysis, electric vehicles and EV chargers.

Summary of findings

The significant economic, political, market and policy changes over the past year have had a very 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, a combination of the UK and Scottish 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 generation, energy storage and hydrogen electrolysis.

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 3.7 GW to 5.9 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 the North of Scotland grew from 4,300 to 7,800 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 Scottish Government as well as 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.

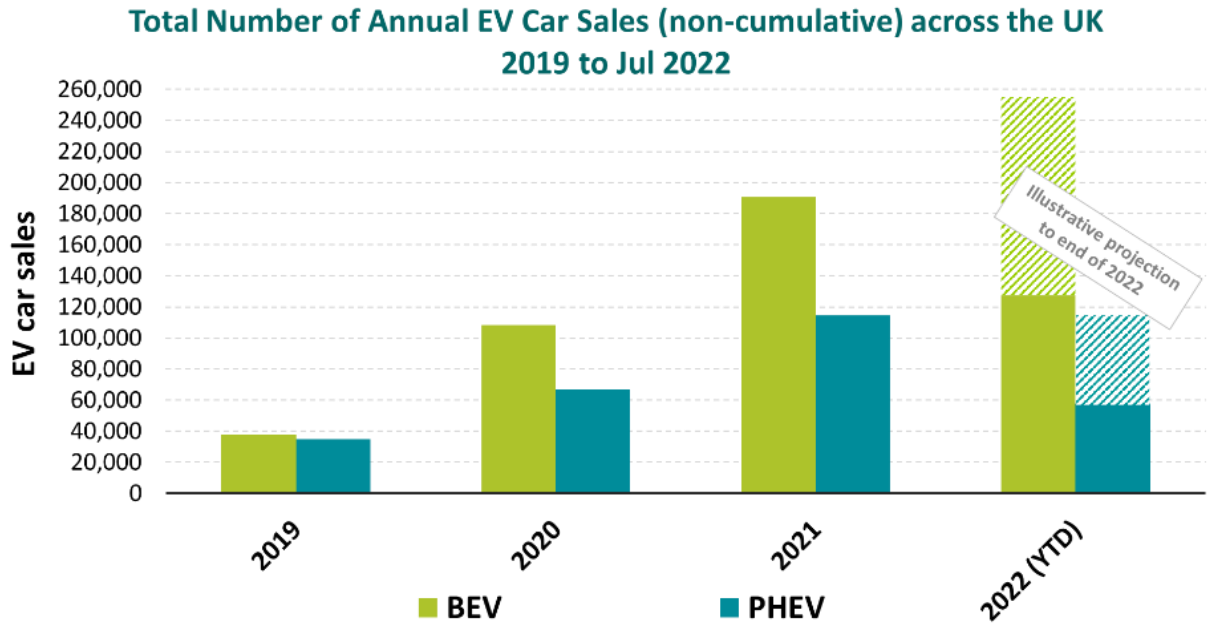


Figure 1 Annual UK Battery (BEV) and Plug-in hybrid (PHEV) car sales, 2019 to Jul 2022
Source: SMMT vehicle sales data

The very large pipelines of solar, wind and battery storage projects identified in the analysis is a positive sign of investor interest, but it 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 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.

[1] LCCC Market Reference Price Variable Generation

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

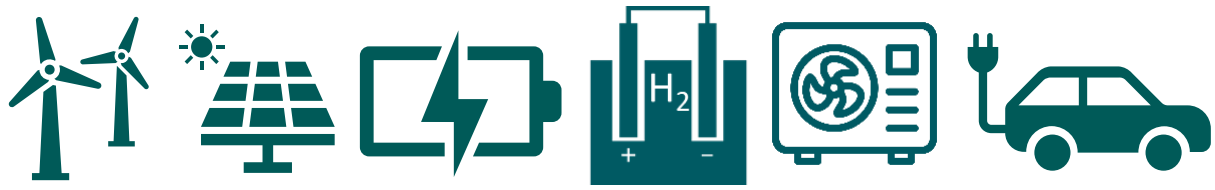
[3] Cornwall Insight https://www.cornwall-insight.com/press/energy-prices-to-remain-significantly-above-average-up-to-2030-and-beyond/

[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 the North of Scotland in 2022

Headline results

This load growth report highlights recent developments in deployment and connection offer activity and a near-term outlook to 2030, for the following key generation, storage and demand technologies in the North of Scotland licence area:



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

For each technology Regen has 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

The distributed generation mix has remained largely the same over the past three years, dominated by onshore wind and hydropower. In 2022 the overall installed capacity of distributed generation reached 3.5 GW, a 180 MW (over 5%) increase of newly commissioned generation capacity connecting over the past 8-10 months:

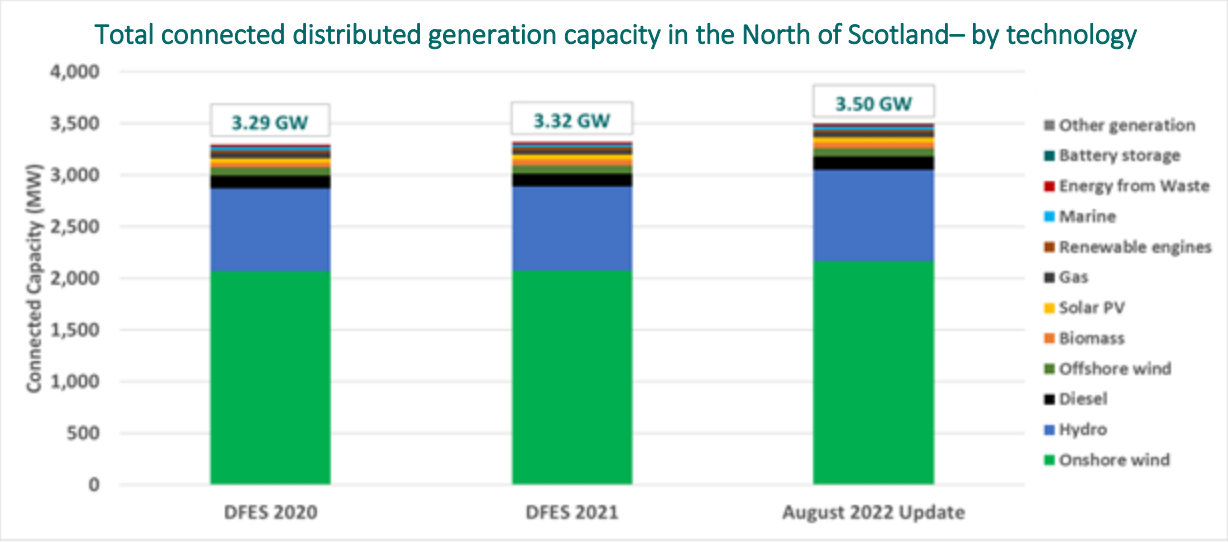


Figure 2: Connected distributed generation capacity in the North of Scotland 2020 to August 2022

Source: SSEN connection data (August 2022)

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 onshore wind, solar PV, battery storage and other generation projects accepting connection offers in the licence area increased from 2.9 GW in 2020, to 3.7 GW in 2021, and over the past 8-10 months the volume of accepted connection offers has jumped again to just below 6 GW. This surge in pipeline growth is dominated by multiple large-scale standalone battery storage projects across the region, a flurry of new solar farms seeking to connect and a handful of new onshore wind sites.

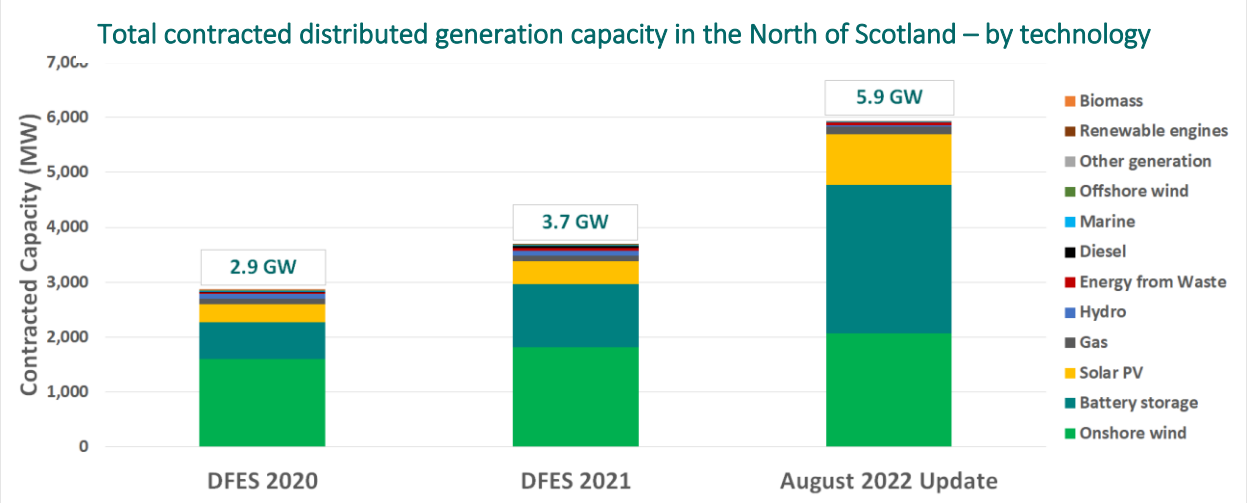


Figure **3**: Contracted distributed generation capacity in the North of Scotland 2020 to Aug 2022

Source: SSEN connection data

A number of these prospective projects have also entered the planning system, with c.300 MW of battery storage, just under 50 MW of solar and c.40 MW of onshore wind submitting or being granted planning permission within 2022.

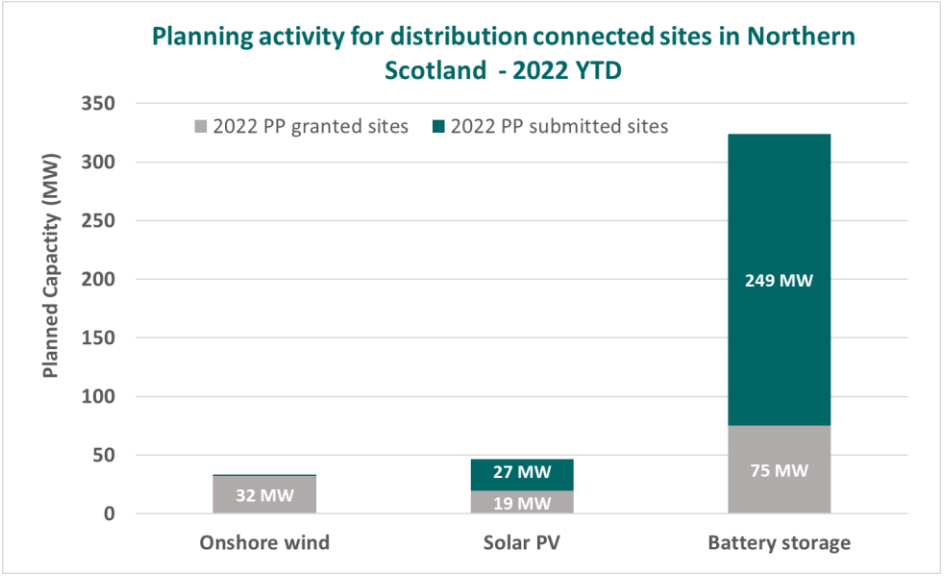


Figure **4**: Overview of planning activity in 2022 for key technologies in the North of Scotland licence area

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	
Onshore Wind	2,121	2,165	1,822	2, 066 ↑ + 13%	Wholesale & PPA price rise CfD AR4 capacity and price Network constraints TNuOS uncertaintity Commodity price rise
Solar PV	47	50	417	914 ↑ + 119%	Wholesale & PPA price rise CfD AR4 capacity and price Scottish STA ambition Network constraints Commodity price rise TNuOS uncertaintity
Commercial Battery Storage	0	8	1,138	2709 ↑ + 138%	New frequency balancing and reserve services NOA pathfinders DNO procured flexibility services Network constraints
Hydrogen Electrolysis	1.4	1.4	0	0	UK Hydrogen strategy progress update Hydrogen Sector Development Action Plan National 1 GW by 2025 ambition First electrolytic application round
Heat Pumps (number)	2,000	4,500 ↑ + 125%	N/A	N/A	Boiler Upgrade Scheme Heat Pump Investment Accelerator competition Scottish Gov Heat in Buildings strategy
Electric Vehicles (number)	4,263	7781 ↑ + 82%	N/A	N/A	Rapid growth in EV sales
Public EV Charger Capacity	7.5	7.8	N/A	N/A	N/A

3. Technology outlook – onshore wind

DFES 2021 overview

Building on strong wind resources and a legacy of significant onshore wind capacity deployment in the region, the DFES 2021 analysis outlined the potential for notable additional project onshore wind development under most scenarios. A summary of the DFES 2021 is below:

- As of the end of 2020, 163 large-scale onshore wind farms, totalling just under 2 GW and 319 smaller-scale wind turbines, totalling 137 MW, were connected to the distribution network in the North of Scotland.
- A very large pipeline of potential new onshore wind projects were also active in the licence area:
    - 83 sites, totalling 1.8 GW, with accepted connection offers
    - 11 sites, totalling a further 164 MW, with connection quotes issued
    - 4 sites, totalling an additional 118 MW, that are active in planning but had not yet secured a connection agreement with SSEN.
- Of this development pipeline our analysis showed that:
    - Up to 281 MW was due to come online in 2022-2023, due to being already under construction or construction beginning imminently
- This evidence, alongside the assumptions behind each of the four scenarios used in the 2021 DFES, resulted in a range of near-to-medium term onshore wind capacity projections across the four DFES scenarios.
- By 2030 capacity was modelled highest under Consumer Transformation, at 4.6 GW.
- The DFES 2021 results for battery storage capacity is summarised below:

Table 2: DFES 2021 projections for distribution-connected onshore wind in the North of Scotland licence area

Scenario	Installed Power Capacity (MW)		
	Baseline (2020)	Projection by 2025	Projection by 2030
Steady Progression	2,121	2,377	2,848
System Transformation		2,621	3,473
Consumer Transformation		3,199	4,578
Leading the Way		3,255	3,900

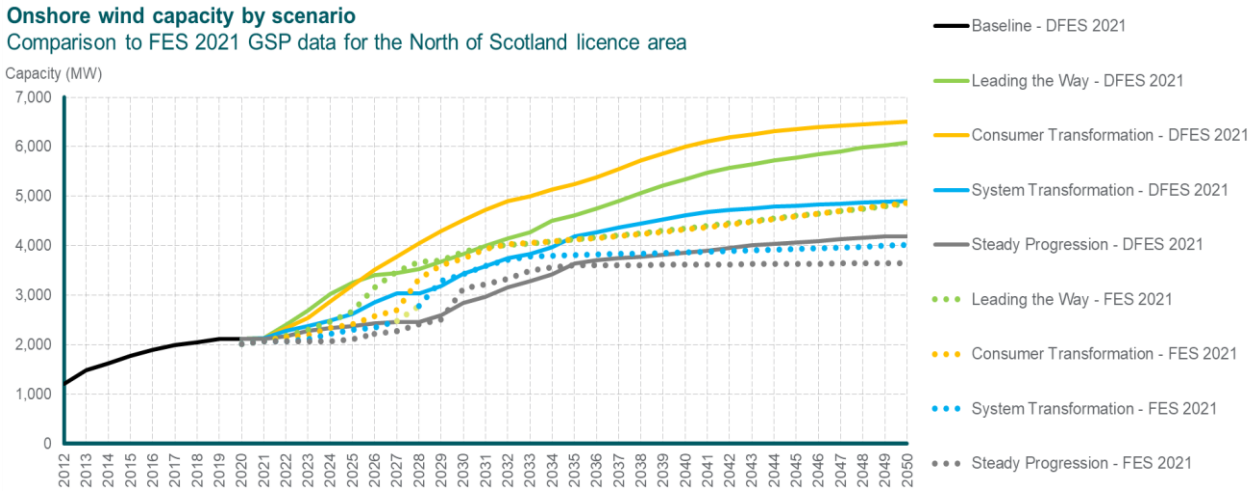


Figure 5: SSEN DFES 2021 projections for onshore wind in North of Scotland
(reconciled to FES 2021 GSP data)

Update to connection activity (as of August 2022)

A moderate but steady increase in connected onshore wind capacity has been seen over the past few years, with 52 MW connecting between 2020 and 2021, and a further 44 MW connecting over the past 8 months.

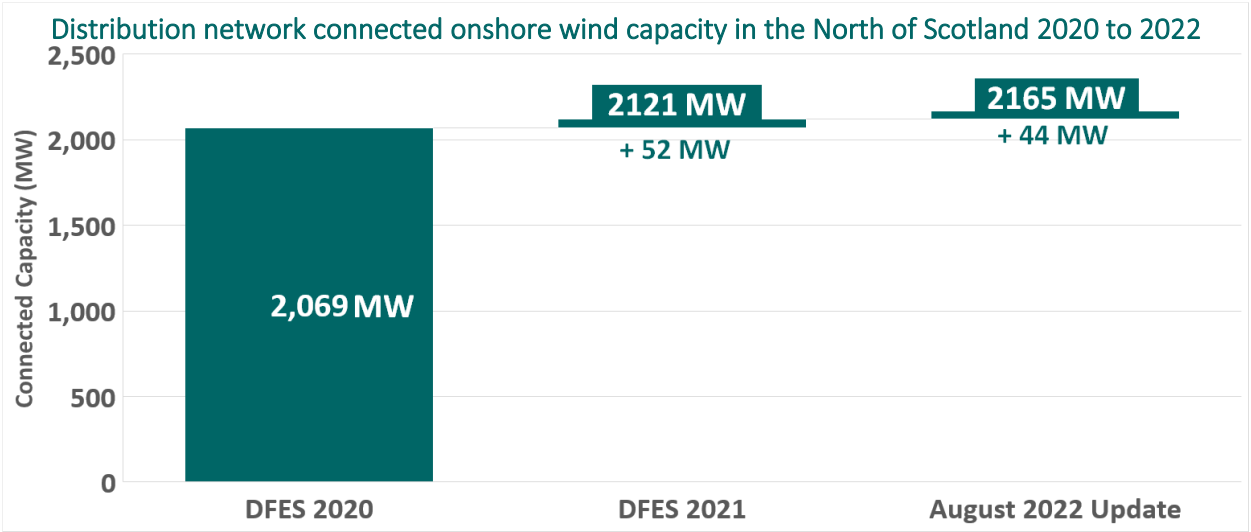


Figure **6**: Onshore wind capacity connected to the distribution network in the North of Scotland (2020 to Aug 2022)
Source: SSEN DFES 2020 and 2021 datasets and SSEN connection data from August 2022

Latest development pipeline year to date

The pipeline of prospective new onshore wind projects has continued to grow in Scotland. In the North of Scotland, there are a significant number of wind projects securing connections:

- In 2020, there was 1.6 GW of contracted onshore wind projects
- In 2021, this grew to 83 projects totalling c.1.8 GW
- As of August 2022, this has seen a further increase to 92 projects totalling c.2.1 GW.

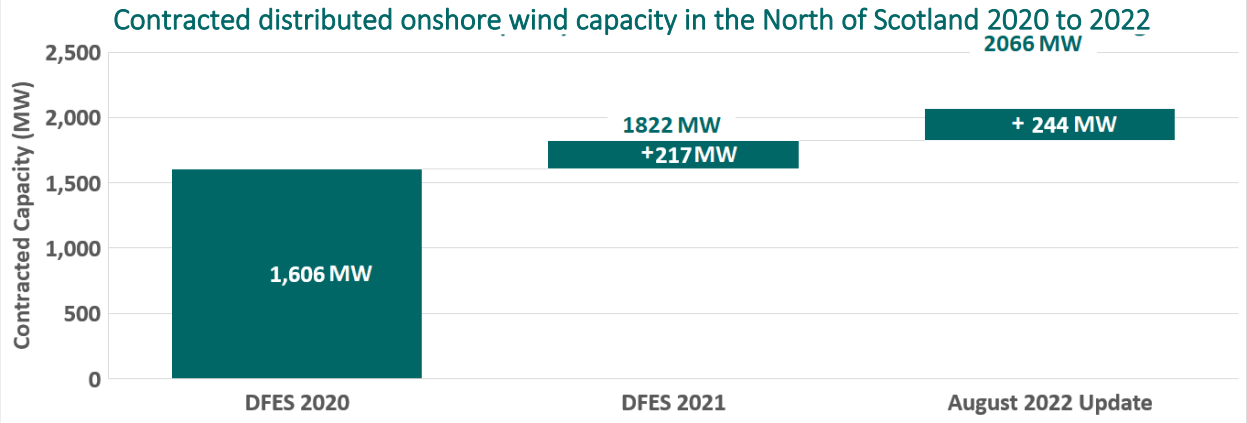


Figure **7**: Contracted onshore wind capacity in the North of Scotland licence area (2020 to Aug 2022)
Source: SSEN DFES 2020 and 2021 datasets and SSEN connection data from August 2022

Planning activity in 2022

Two distribution network-connected onshore wind sites (32 MW) have been granted planning permission so far in 2022. An additional 1 MW single turbine site has come forward with an application.

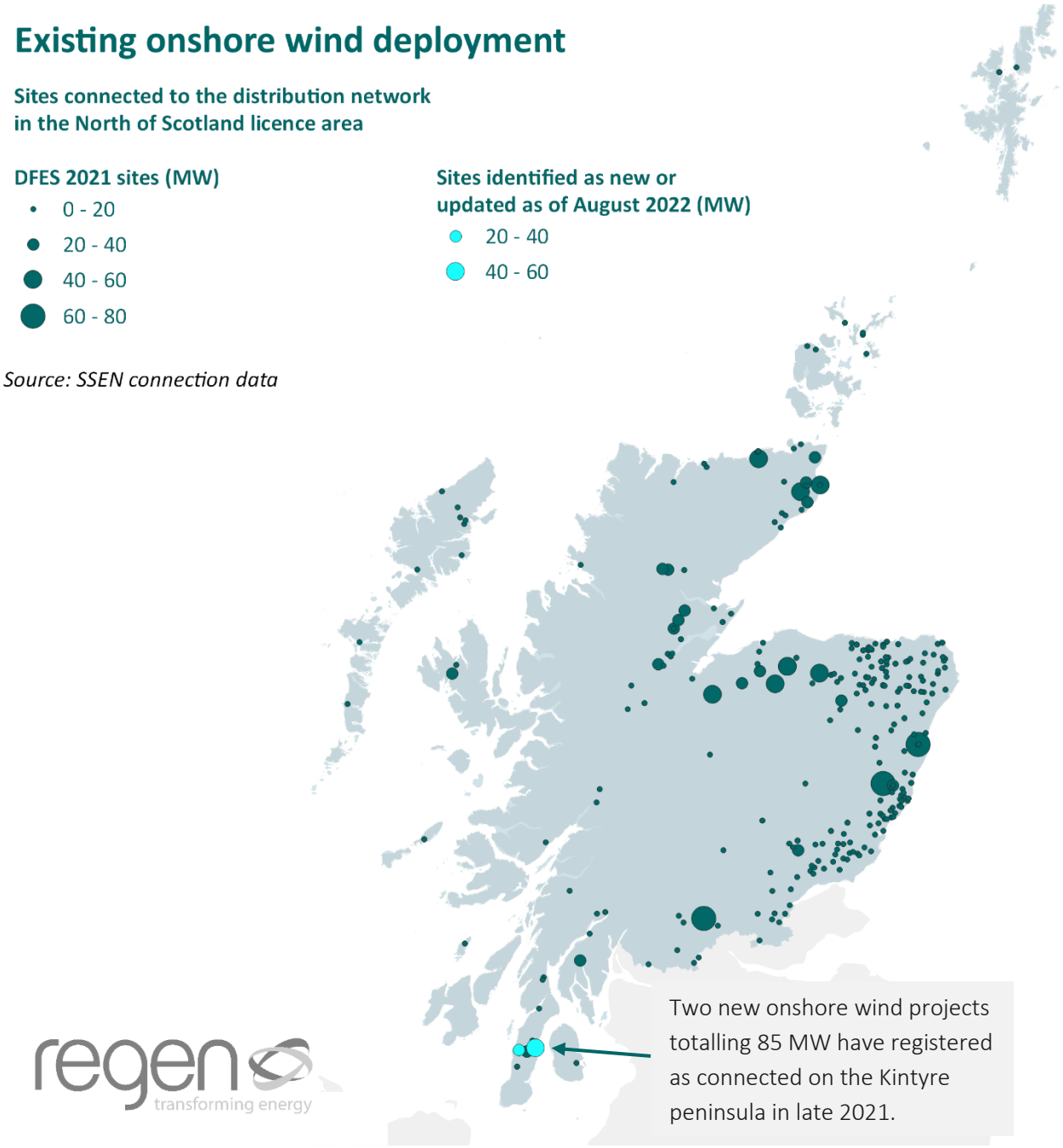


Figure **8**: Map of onshore wind sites connected to the distribution network in the North of Scotland (Aug 2022)
Source: SSEN connection data (August 2022)

Future onshore wind deployment

Sites contracted to connect to the distribution network in the North of Scotland licence area

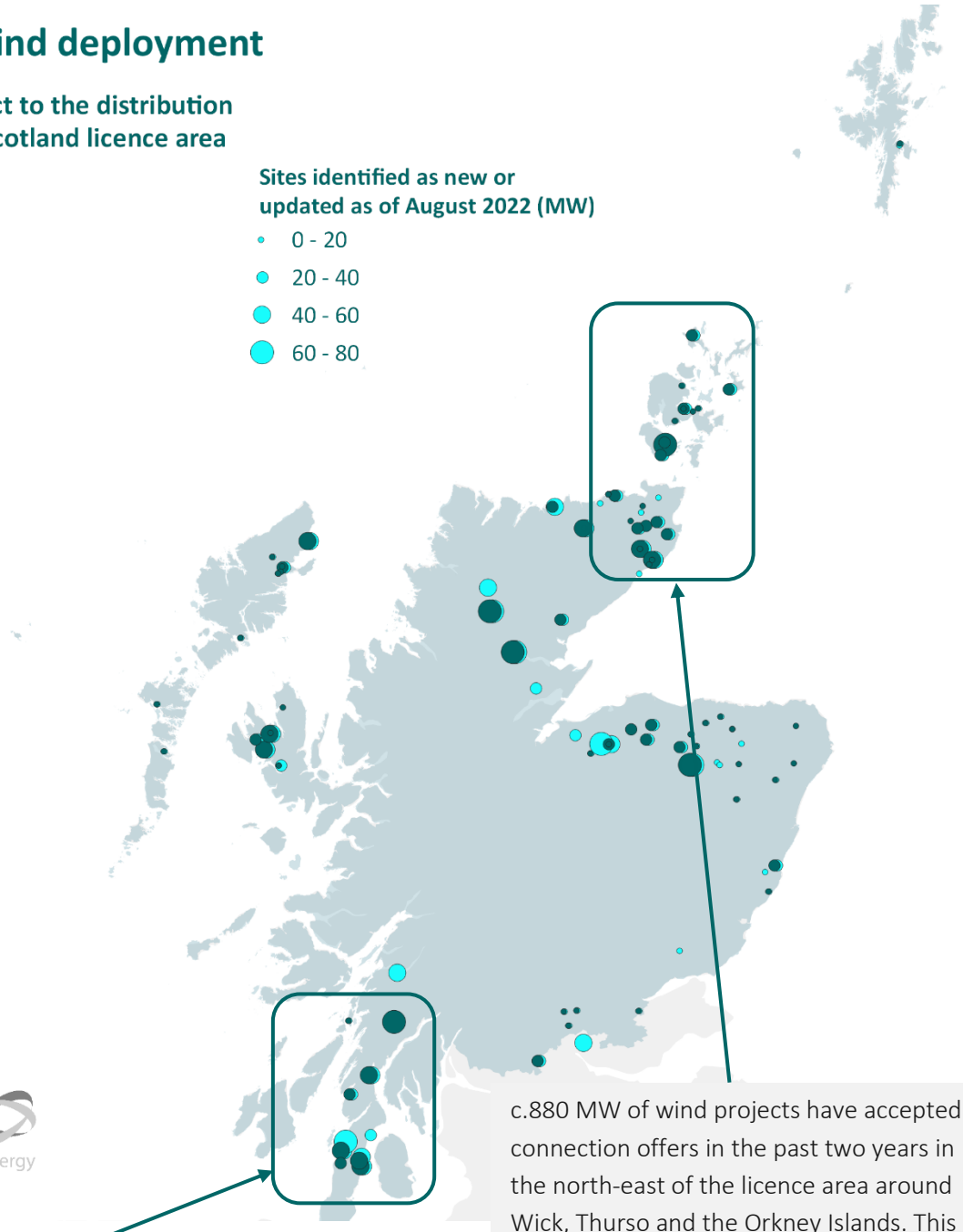
DFES 2021 sites (MW)

- 0 - 20
- 20 - 40
- 40 - 60
- 60 - 80

Sites identified as new or updated as of August 2022 (MW)

- 0 - 20
- 20 - 40
- 40 - 60
- 60 - 80

Source: SSEN connection data



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There is a pipeline of c.530 MW of wind projects seeking to connect across the Kintyre peninsula. Three sites, totalling c.175 MW of capacity, accepted connection offers in 2022.

c.880 MW of wind projects have accepted connection offers in the past two years in the north-east of the licence area around Wick, Thurso and the Orkney Islands. This includes c.100 MW of new sites in 2022. This is partially related to the Ofgem Needs Case for the connection of a new Orkney transmission network link.

Figure 9: Map of contracted onshore wind sites in the North of Scotland 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 reviewing planning evidence for the of c.1.7 GW pipeline and making contact with individual project developers, the DFES 2021 onshore wind capacity projections were based on:

- An analysis of the significant developable wind resource in the North of Scotland
- The connection timeline of the proposed subsea transmission cable to Orkney[5], resulting in some distribution network connected wind capacity in the medium term
- Scottish Government Onshore Wind Policy Statement[6], targeting 8-12 GW of onshore wind by 2030. 2 GW of which was modelled to connect by 2030
- Individual Scottish local authority climate emergency declarations and renewable energy deployment targets
- The repowering of older wind farms developed in the early 2000s with potentially more efficient and higher capacity turbines.

As a result of these factors, a significant amount of onshore wind capacity is modelled to connect to the distribution network across the ED2 period. By 2030, total installed capacity ranges from 2.8 GW under Steady Progression, to 4.6 GW under Consumer Transformation.

Projections from FES 2022[7]

For the North of Scotland licence area, the National Grid ESO FES 2022 has projected a similar deployment of onshore wind in the longer term, but includes a moderately higher connected capacity across the 2020s under Leading the Way and Consumer Transformation. This could be related to Scottish Government's 2030 deployment targets and the pipeline of active projects.

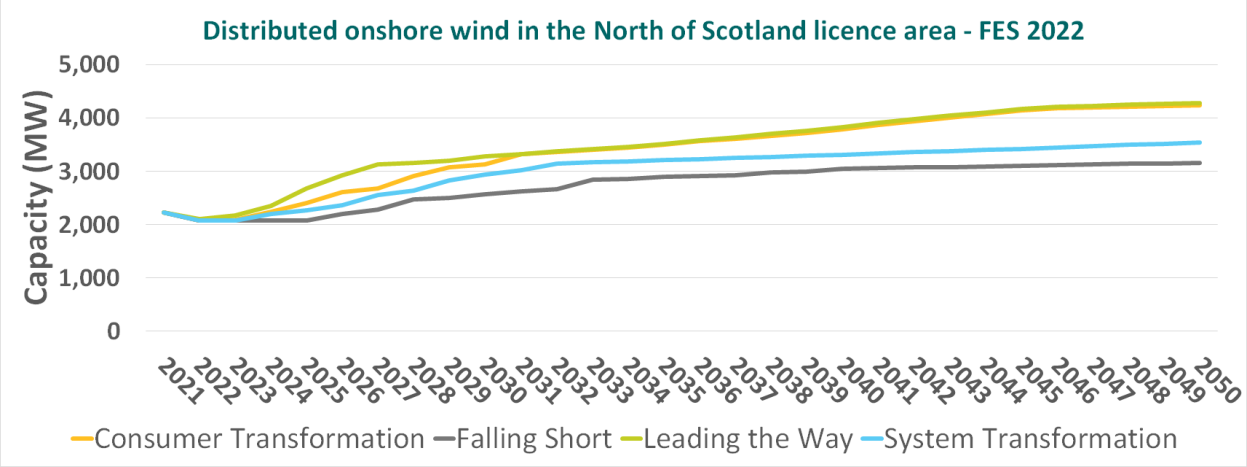

Figure **10**: FES 2022 projections for distributed onshore wind capacity in the North of Scotland

Market outlook commentary

Whilst onshore wind in the England remains stalled by planning policy, the pipeline of new wind projects remains strong in Scotland, with the North of Scotland licence area specifically hosting c.22% of GB onshore wind resource. Some larger wind sites were also successfully awarded a Contract for Difference in the fourth allocation round in July 2022[8], though these will almost entirely be connecting to the transmission network in Scotland. There were two wind projects on Orkney, Hoy (29 MW) and Quarterness (29 MW), that secured a pot 2 CfD, which is positive evidence for the Ofgem Needs Case for the 220 MW Orkney subsea transmission cable, which was extended to December 2022[9]. The fulfilment of the Orkney subsea cable is very likely to increase the connection of generation projects to SSEN's distribution network infrastructure on the island.

Ongoing network charging reforms will still have an impact on the deployment of distributed generation in general and in Scotland specifically. The final decision from Ofgem on the Access Significant Code Review (SCR) was issued in May[10], confirming that Ofgem would "*Reduce the contribution to reinforcement for generation connections by introducing a 'shallow-ish' connection charging boundary. This will involve connecting customer paying for extension assets and a contribution towards reinforcement at the voltage level at point of connection*."

In addition to this, however, the proposed reforms to TNUoS charging, and specifically the nature and use of locational price signals, are still being explored. Across the first half of 2022, Ofgem and National Grid ESO have established a specific TNUOS Taskforce, exploring the TNUOS charging methodology, locational TNUOS price signalling and specific considerations how the appropriate treatment of island connections and offshore generation developments.

The DFES provides a broad envelope of potential outcomes for connected onshore wind capacity in the licence area into the future. This range is echoed in the FES 2022 and reflects the ongoing uncertainties around network charging and network constraints. However, under all scenarios the connected capacity of onshore wind increases notably by 2030 from 0.7GW to over 2 GW, which reflects the strong wind resource, an active project pipeline, recent policy support and positive market developments.

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[5] Ofgem: Orkney Transmission link approval (Sept 2019) – https://www.ofgem.gov.uk/publications/ofgem-gives-go-ahead-orkney-transmission-link-subject-conditions

[6] Scottish Government Onshore Wind Policy Statement (Oct 2021) – https://www.gov.scot/publications/onshore-wind-policy-statement-refresh-2021-consultative-draft/

[7] FES 2022 data workbook - https://www.nationalgrideso.com/future-energy/future-energy-scenarios#fullsuite

[8] 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

[9] Ofgem letter to Orkney developers (May 2021) - https://www.ofgem.gov.uk/sites/default/files/docs/2021/05/ofgem_response_to_orkney_deadline_extension_request.pdf

[10] 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 – solar PV

DFES 2021 overview

Compared to hydro and wind power, solar PV has seen a comparatively small deployment to date. This is largely due to lower levels of solar irradiance affecting the business case of solar projects in the licence area. A notable number of solar connection offer quotes (674 MW) have historically not been accepted and expired. However, with a significant pipeline of accepted connection offers, reduced capital costs, improved panel efficiencies and increased levels of ambition from bodies such as the Scottish Solar Trade Association, a notable uptick in solar PV deployment in the North of Scotland was modelled in the DFES scenarios. The 2021 analysis highlighted:

- As of the end of 2020, six large-scale solar PV arrays, totalling just under 36 MW, were connected to the distribution network in the North of Scotland.
- A pipeline of potential new large-scale solar projects were also active in the licence area:
    - 20 sites, totalling 414 MW, with accepted connection offers
    - 10 sites, totalling a further 262 MW, with connection quotes issued.
    - Of this pipeline, eight sites totalling 187 MW were under construction and/or had received planning approval.
- This evidence, alongside direct consultation with the Scottish STA, 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 715 MW

The DFES 2021 results for solar PV are summarised below:

Table 3: DFES 2021 projections for distribution network connected large-scale solar PV in the North of Scotland licence area

Scenario	Installed power capacity (MW)		
	Baseline (2020)	Projection by 2025	Projection by 2030
Steady Progression	36	193	323
System Transformation		248	431
Consumer Transformation		248	433
Leading the Way		286	715

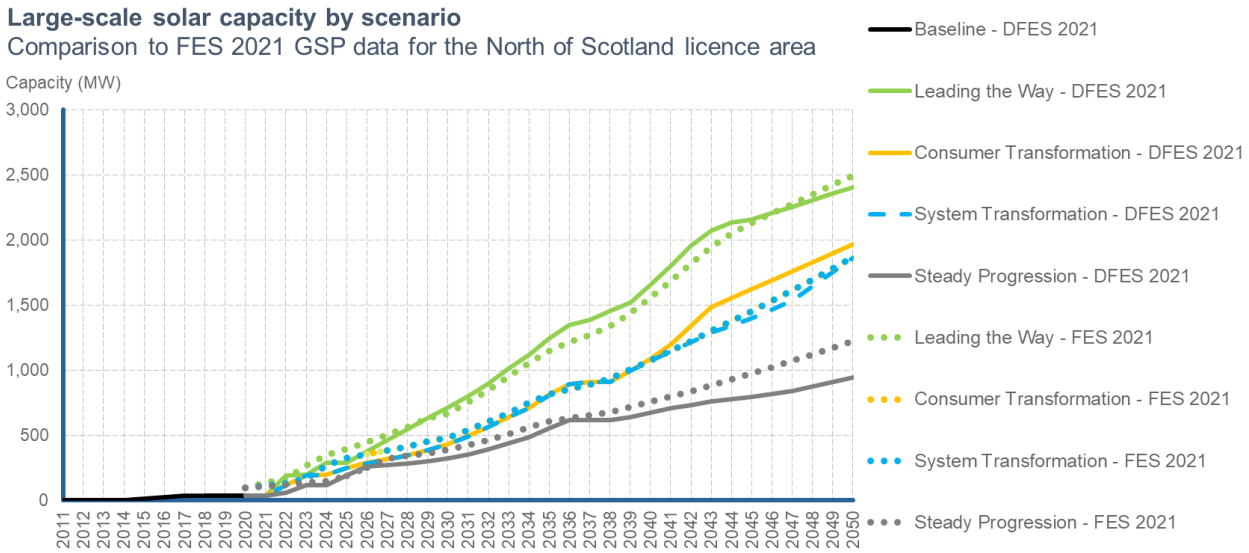

Figure **11**: SSEN DFES 2021 projections for large-scale solar in the North of Scotland (reconciled to FES 2021 GSP data)

Update to connection activity (as of August 2022)

SSEN's connection data for solar PV (at all scales) shows there has been c.3 MW of new solar capacity (all <1MW) coming online as of mid-2021 and a further 3 MW connecting over the past 8 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 the increased activity of solar PV installations in the licence area over the past 2-3 years.

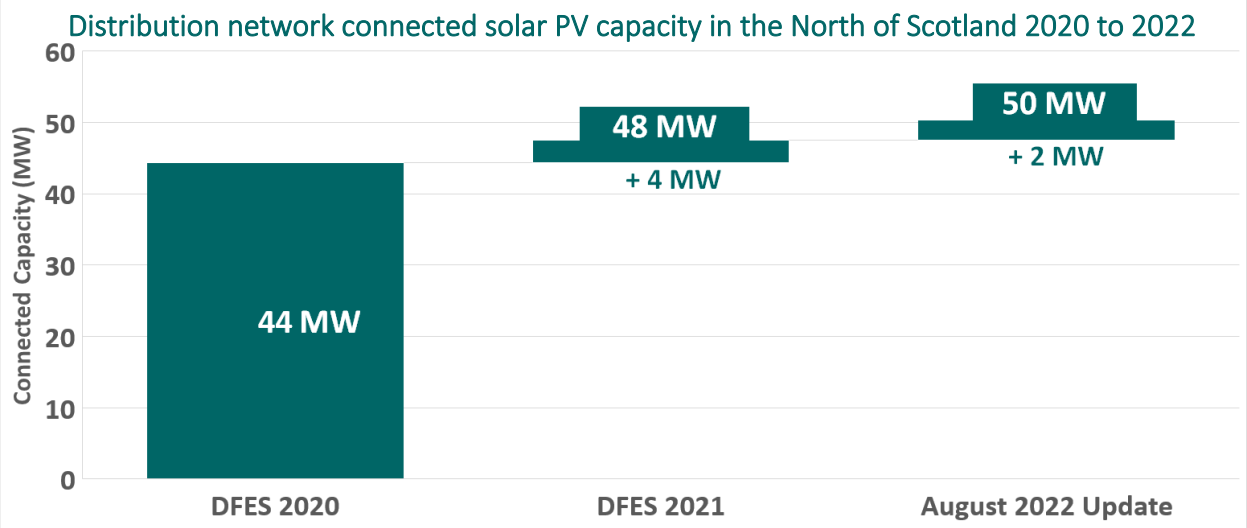

Figure **12**: Solar PV capacity connected to the distribution network in the North of Scotland (2020 to Aug 2022)
Source: SSEN DFES 2020 and 2021 data and connection data from August 2022 – not including MCS solar data

Latest development pipeline year to date

The pipeline of prospective new solar projects has continued to grow significantly in Scotland. In the North of Scotland, there are a significant number of solar projects securing connections:

- In 2020 there was 330 MW of contracted solar PV projects
- In 2021 this grew to 20 projects totalling c.417 MW
- As of August 2022, this has seen a further increase to 78 projects totalling c.914 MW.
- In addition to this, the number of sites with quotes issued currently stands at 25, totalling an additional 161 MW. A significant growth in the past 8-10 months.

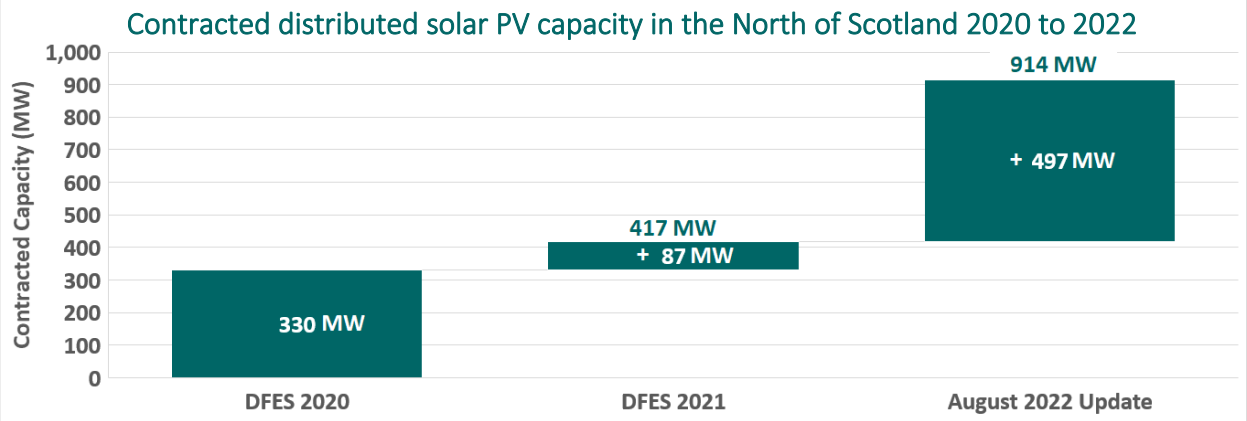

Figure **13**: Contracted large-scale solar PV capacity in the North of Scotland licence area (2020 to Aug 2022)
Source: SSEN DFES 2020 and 2021 datasets and SSEN connection data from August 2022

Planning activity in 2022

2022 has seen eight sites (20 MW) approved, and a further seven (27 MW) applying for planning permission. The majority of these are located in or around Aberdeen or Dundee.

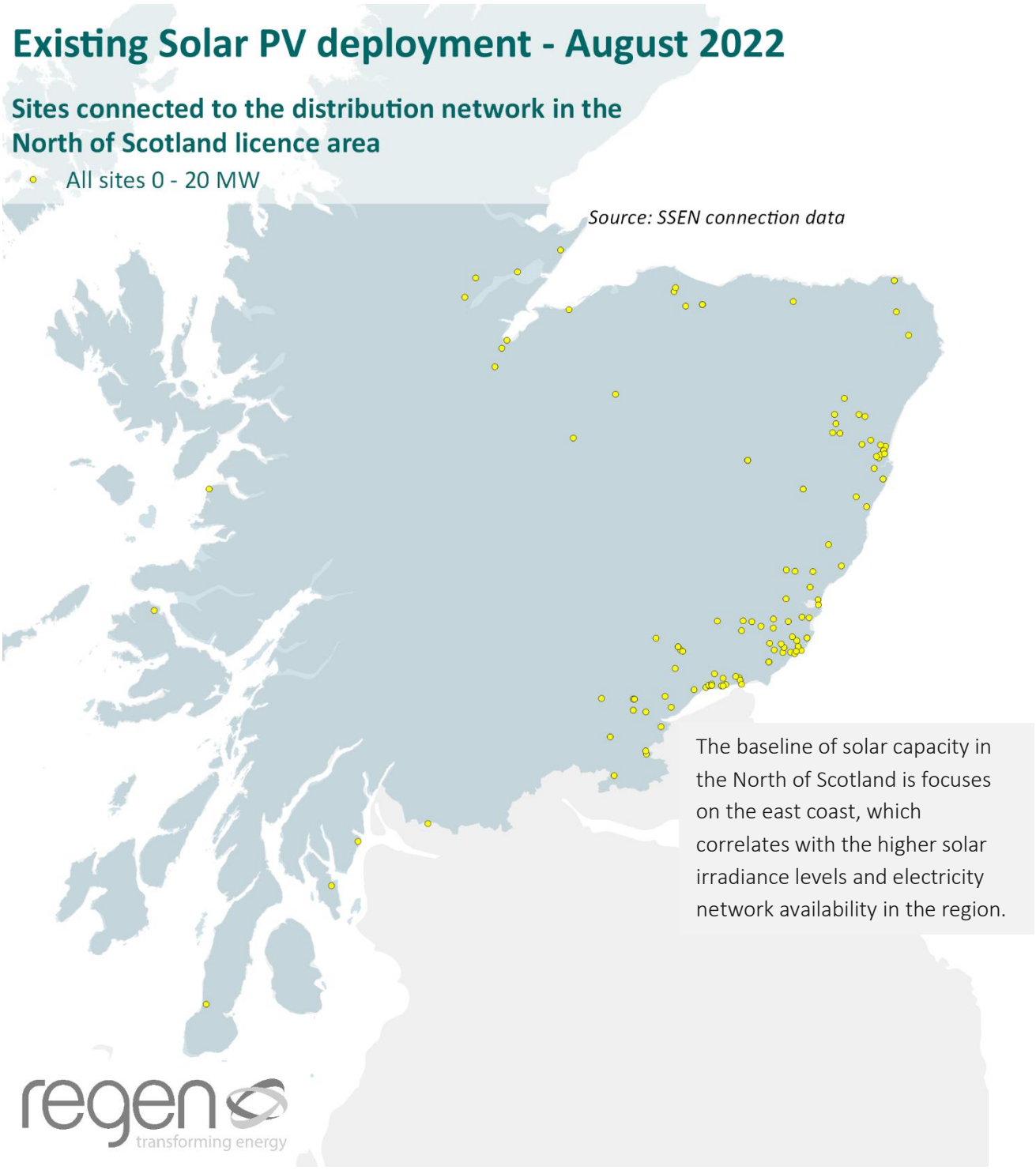

Figure **14**: Map of large-scale solar PV projects connected to the distribution network in the North of Scotland (Aug 2022)

Source: SSEN connection data (Aug 2022)

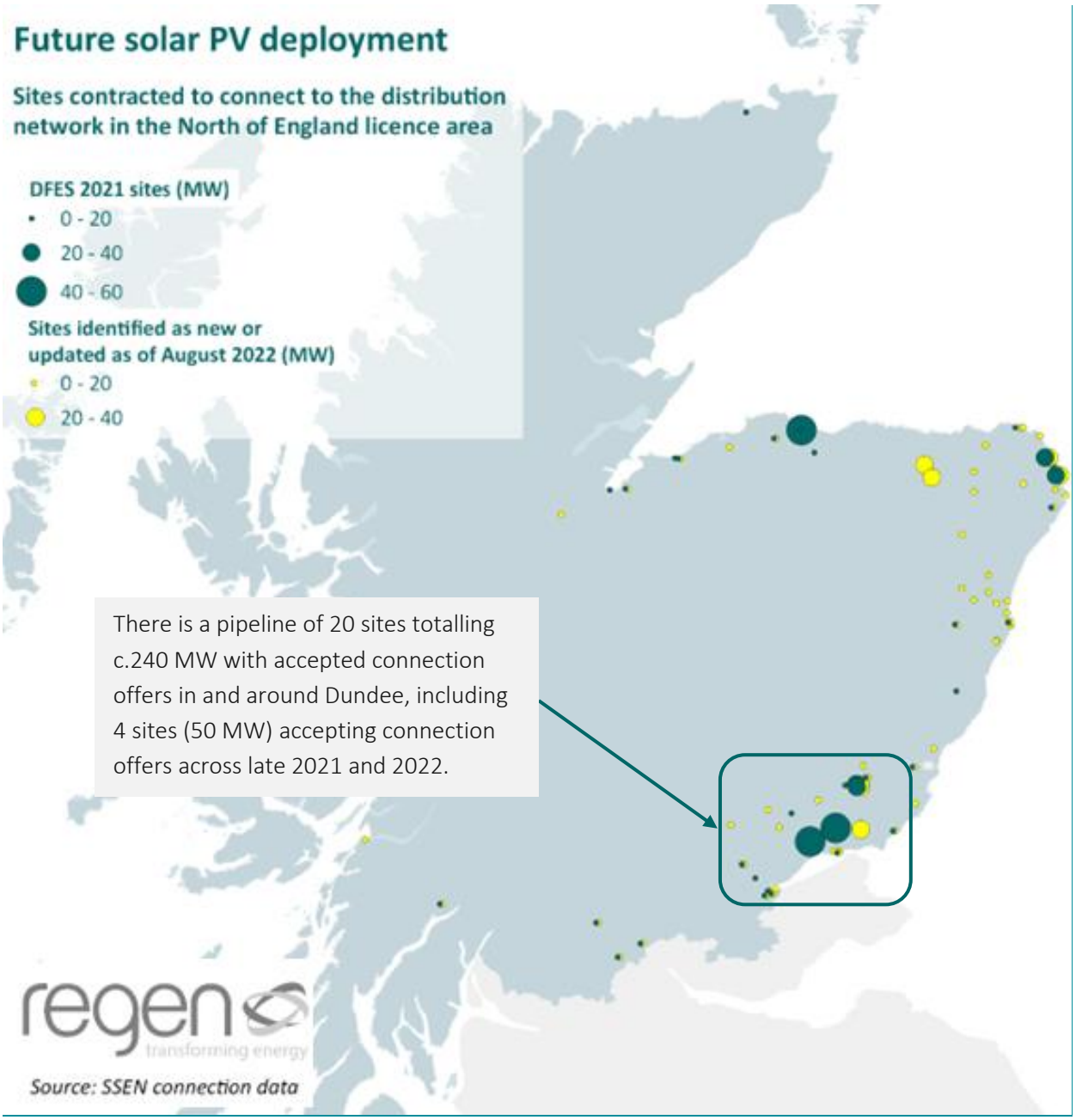

Figure **15**: Map of contracted large-scale solar PV sites in the North of Scotland licence area (Aug 2022)
Source: SSEN DFES 2021 datasets and SSEN connection data (Aug 2022)

Outlook to 2030

Assumptions from DFES 2021

The growing pipeline of prospective projects, positive engagement with solar developers in the region and relevant renewable energy targets from both Scottish Government and the Scottish STA, sees an increase in solar capacity to 2030 modelled under all scenarios. The range of capacity across the scenarios acknowledges known uncertainties around network charging and near-term constraints in particular parts of the network. As a result, connected capacity ranges from 323 MW under Steady Progression to 715 MW under Leading the Way in the DFES 2021.

Projections from FES 2022[11]

For the North of Scotland licence area, the National Grid ESO FES 2022 has projected a very similar deployment of large-scale solar PV in the near-term and longer term, compared to 2021.

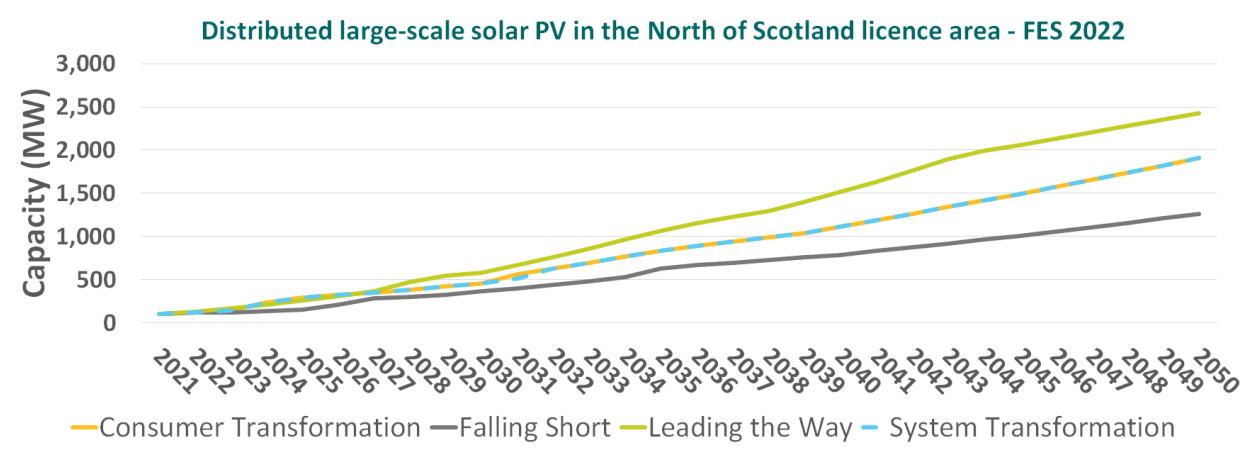

Figure **16**: FES 2022 projections for distributed large-scale solar PV capacity in the North of Scotland

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[12]. In addition to this, three solar PV sites located in the licence area (totalling c.79 MW) successfully secured Contracts for Difference under the fourth allocation round of the programme published in July[13].

As discussed in the onshore wind section, ongoing network charging reforms could impact the deployment of solar PV in Scotland. The Access SCR decision issued in May[14], may provide some benefits to reduced connection costs, but 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 the North of Scotland, being a generation-dominated region.

Challenging factors such as lower solar irradiance levels in Scotland and the uncertainty of network charging reforms have been considered alongside other positive factors such as a stronger-than-ever pipeline of accepted connections for new large-scale solar and high levels of ambition from the Scottish STA. This range of uncertainty is echoed in the FES 2022 and the DFES 2021. However, under all scenarios, the connected capacity of large-scale solar in the licence area increases by 2030, to between 320 MW and 700 MW. With the connection pipeline now standing at c.1 GW, the near-term deployment to 2030 could be 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. Whilst the North of Scotland isn't the best solar resource region to target deployment, this UK-wide ambition could reinforce the likelihood of a near-term increase in solar capacity in the licence area.

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

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

[13] 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

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

5. Technology outlook – battery storage

DFES 2021 overview

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

- Whilst there were a handful of small-scale batteries connected off-grid on some smaller Scottish islands and alongside an offshore wind farm, there were no operational battery projects connected to the distribution network in the licence area in 2021.
- There was, however, a large pipeline of potential new battery projects:
    - 34 sites, totalling 1.1 GW, with accepted connection offers
    - 13 sites, totalling a further 590 MW, with connection quotes issued
- Of this development pipeline our analysis showed that:
    - A 49.9 MW standalone battery was due to come online in Dundee in mid-2021
    - Three sites, totalling 139 MW, were to be taken forward to construction in 2022, 2023 or 2024 after direct consultation with individual project developers
    - 15 sites, totalling 434 MW, had either recently secured planning approval or were imminently going to receive a planning decision
    - Four sites, totalling 69 MW, pre-qualified in recent Capacity Market auctions.
- This evidence, alongside the assumptions behind each of the four scenarios used in the 2021 DFES, resulted in a notable near-to-medium term increase in battery storage capacity in the licence area, being highest at 792 MW by 2030 under Leading the Way.

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

Table 4: DFES 2021 projections for distribution-connected battery storage in the North of Scotland licence area

Scenario	Installed power capacity (MW)		
	Baseline (2020)	Projection by 2025	Projection by 2030
Steady Progression	0	64	322
System Transformation		217	426
Consumer Transformation		445	630
Leading the Way		596	792

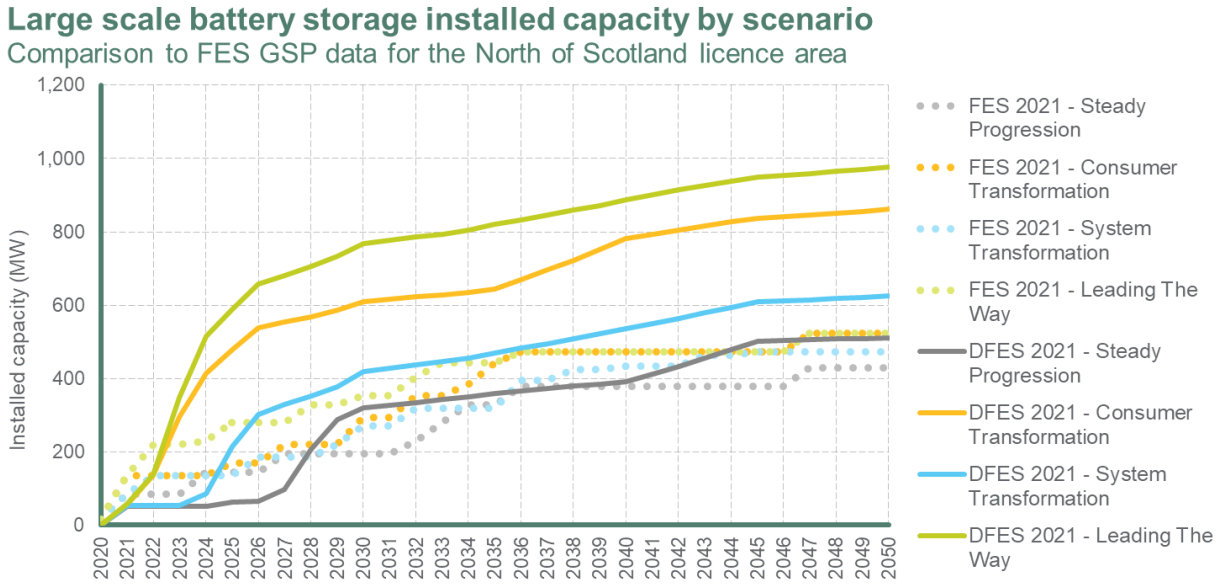

Figure 17: SSEN DFES 2021 projections for battery storage capacity in the North of Scotland (reconciled to FES 2021 GSP data)

Update to connection activity (as of August 2022)

2022 saw the first battery storage project connecting to the distribution network in the North of Scotland licence area, an 8 MW battery located at Lerwick Power Station on Orkney.

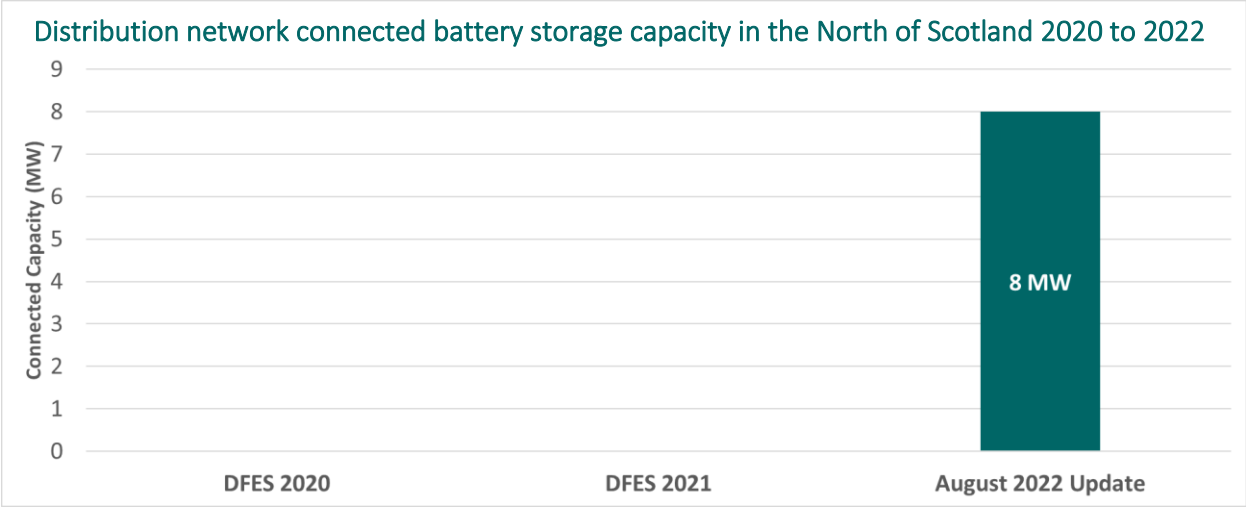

Figure **18**: Battery storage capacity connected to the distribution network in the North of Scotland (2020 to Aug 2022)

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. Despite a lack of actual deployment to date, the North of Scotland licence area has a significant pipeline of projects with accepted connection offers. An overview of prospective battery storage projects over the past 3 years can be summarised as follows:

- In 2020 there were 22 contracted battery projects, totalling 668 MW
- In 2021 this grew significantly to 34 contracted projects, totalling c.1.1 GW
- As of August 2022, this has seen a further increase to 45 contracted battery projects, totalling c.2 GW.
- A 49.9 MW battery at Dundee Technology Park is set to commission at the end of August 2022, which was originally due to commission in 2021.
- The average individual project size has significantly increased from 30 MW in 2020 to 44 MW in 2022. The latest view of sites with accepted connection offers includes 5 sites that are individually larger than 50 MW.

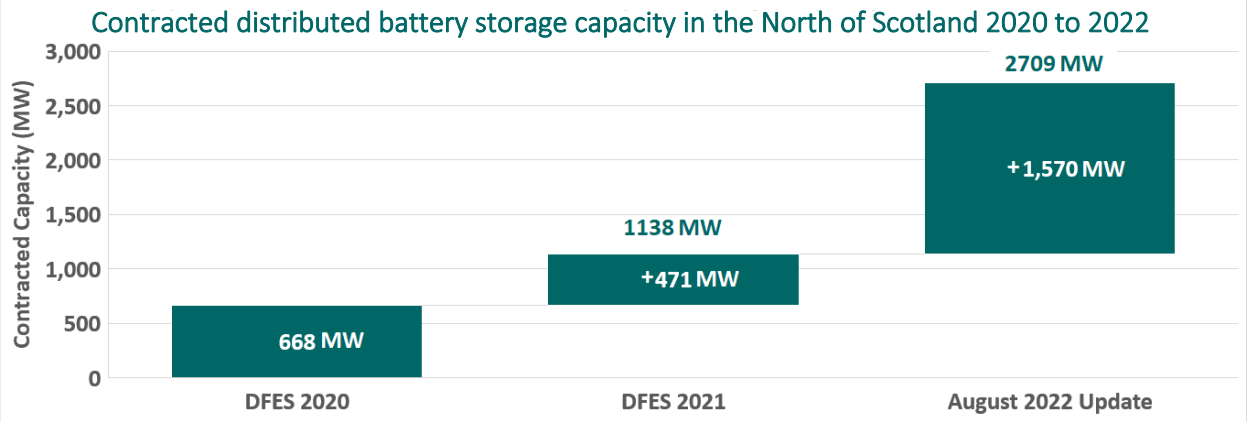

Figure **19**: Contracted battery storage capacity in the North of Scotland licence area (2020 to Aug 2022)
Source: SSEN DFES 2020 and 2021 datasets and SSEN connection data from August 2022

Planning activity in 2022

2022 has so far seen four battery storage sites (75 MW) receiving planning permission – all located on the east coast. An additional seven sites, totalling c.250 MW, have applied for planning permission.

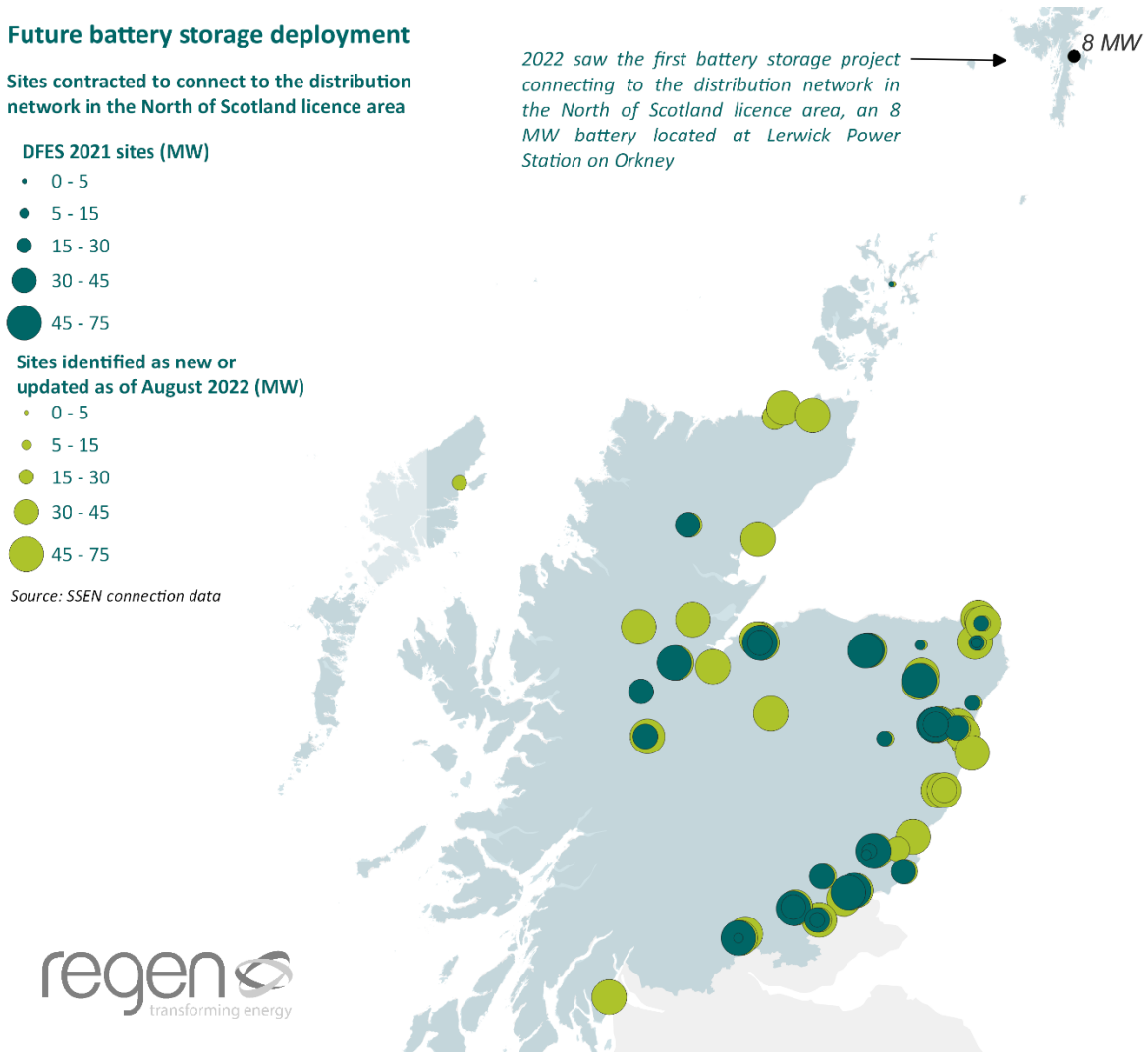

Figure **20**: Map of distribution network battery storage (connected and contracted) in the North of Scotland (August 2022)

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 installed onshore wind capacity (2.7-3.7 GW by 2030) and large-scale ground mount solar PV capacity (320-715 MW by 2030), for potential colocation with battery storage
- A proportion of existing commercial and industrial high energy consumer businesses (90-270 C&I 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 (100-245 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 322 MW under Steady Progress, to 792 MW under Leading the Way.

Projections from FES 2022

For the North of Scotland 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 growing to 600 MW by 2024, c.800 MW by 2035 and over 1.2GW by 2050.

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.

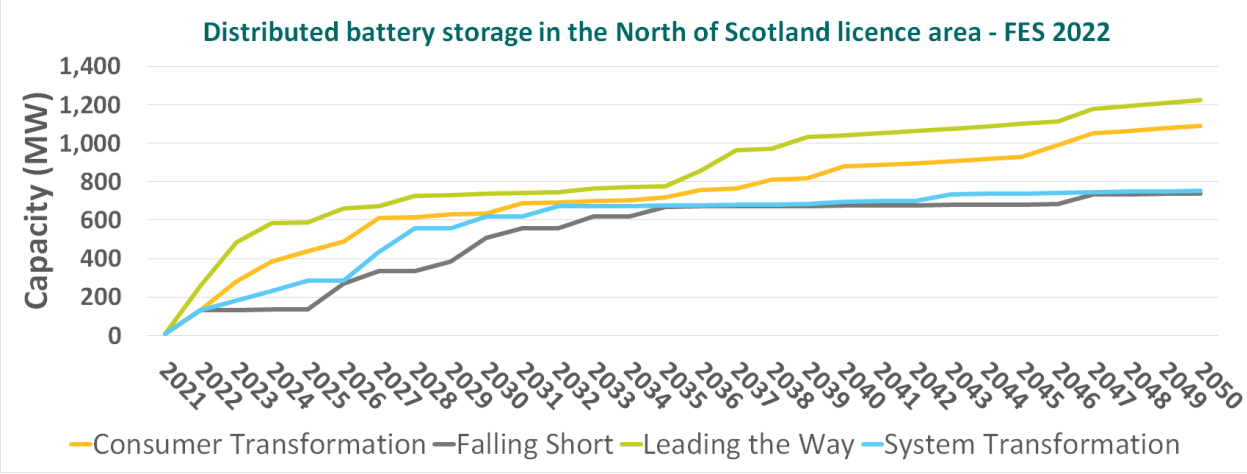

Figure **21**: FES 2022 projections for distributed battery storage capacity in the North of Scotland

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 site 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[15], reformed 'Quick' and 'Slow' reserve services[16] and the network option assessment pathfinders[17]. 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[18].

There are however a number of significant constraints in 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.

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

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

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

[18] 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/

6. Technology outlook – hydrogen electrolysis

DFES 2021 overview

Under some scenarios, the North of Scotland was identified as a potentially significant development hub for electrolytic hydrogen. 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 and of hydrogen generally in Scotland and across the rest of the UK.

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

- Operational electrolysers at hydrogen refuelling stations in Aberdeen and Kittybrewster
- Two pipeline projects, namely the North of Scotland Hydrogen Programme Distillers Project, aiming to connect 35 MW of electrolysers by 2024, and the ITEG innovation project looking at integrating tidal energy and hydrogen production on the Orkney Islands
- A wide range of hydrogen innovation, research and trial projects across Scotland, identifying potential electrolysis deployments in Aberdeen, Dundee, Sullom Voe Oil Terminal on Shetland, Rothesay Dock in Clydebank and Flotta on Orkney
- Specific hydrogen production policy aims from Scottish Government's Hydrogen Action Plan and Hydrogen Policy Statement

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 203 MW by 2030 under Leading the Way.

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

Table 5: DFES 2021 projections for distribution-connected hydrogen electrolysis in the North of Scotland licence area

Scenario	Installed Power Capacity (MW)		
	Baseline (2020)	Projection by 2025	Projection by 2030
Steady Progression	1.4	11	31
System Transformation		20	72
Consumer Transformation		27	68
Leading the Way		46	203

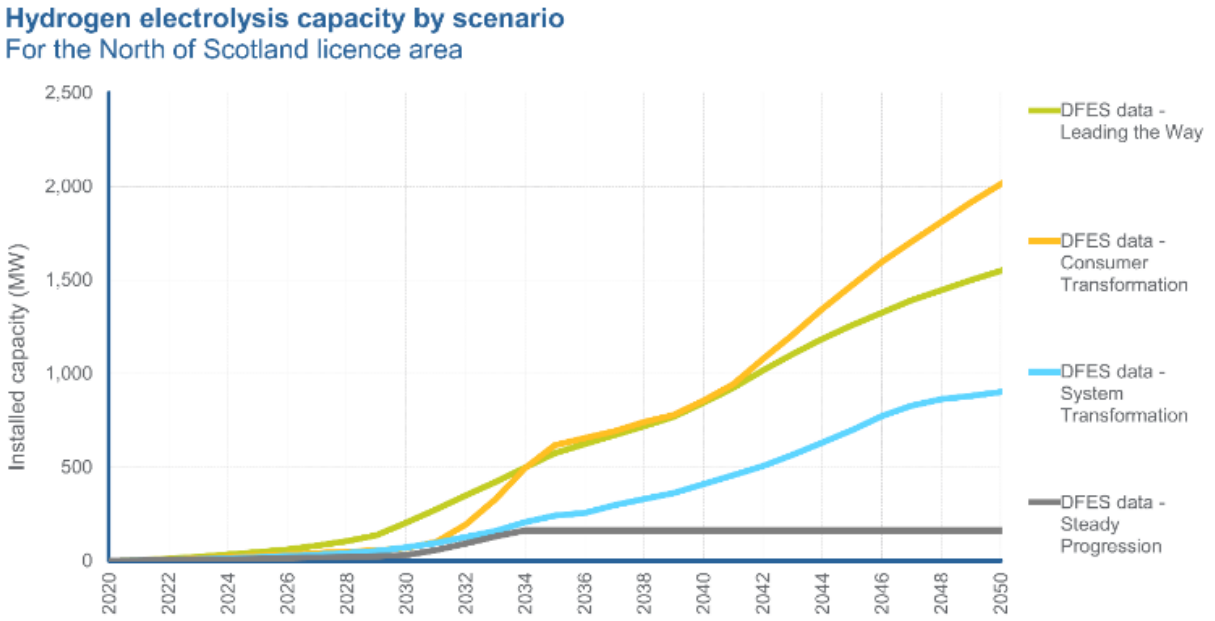

Figure 22: SSEN DFES 2021 projections for hydrogen electrolysis capacity in the North of Scotland licence area

Latest connection activity year to date

In addition to the handful of operational trial projects identified in DFES 2021, no additional electrolysis projects have connected in the North of Scotland across 2022 so far.

There are, however, a number of innovation projects involving electrolyser installations that we are aware of within 2022, including:

- The Dundee Hydrogen Bus Accelerator, which is aiming to support 12 hydrogen fuel cell electric buses on two routes in Dundee's new low emissions zone. This will include hydrogen electrolysis installations.
- The Aberdeen Hydrogen Hub, which is aiming to develop Scotland's first commercially scalable, investable hydrogen production and distribution facility. The production of hydrogen in this model will be based on electrolysers coupled with renewables.
- H_2 Green Inverness, working with SGN, which is looking to develop a green hydrogen production, storage and distribution facility in Inverness on the former gas holder site in Harbour Road. This hub is aiming to service up to 800 hydrogen HGVs a day.

Outlook to 2030

Projections from FES 2022[19]

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 less total installed capacity by 2050 (and a variance by scenario) that 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 2020s and 2030s. Electrolysis capacity passes 200 MW by 2026 and increases to c.400 MW by 2028 under System Transformation. By 2030, capacity in the licence area increases to just over 530 MW under Leading the Way.

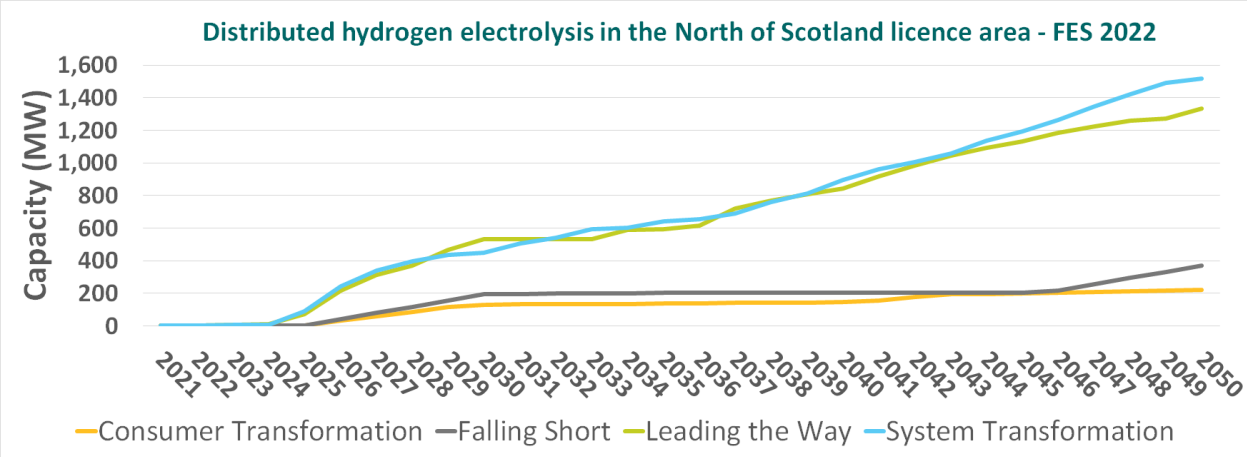

Figure 23: FES 2022 projections for distribution-connected hydrogen electrolysis in the North of Scotland

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[20] on the UK Hydrogen Strategy published in August 2021
- A Government response[21] 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[22]

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[23]. 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[24] (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 the North of Scotland having a number of potential hydrogen development hubs, especially around Aberdeen and the east coast, a proportion of this incentivised capacity could be developed and connect directly to the distribution network in the licence area.

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

[20] 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

[21] 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

[22]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

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

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

7. Technology outlook – EVs and EV chargers

DFES 2021 overview

The DFES 2021 analysis for EVs and EV chargers in the North of Scotland highlighted that:

- A total of 4,263 battery EVs and 2,689 plug-in hybrid EVs were registered in the licence area
- Around 3,000 domestic off-street EV chargers and 1,016 public EV chargers, equating to c.35 MW and c.13 MW of other non-domestic EV charger capacity, were online
- The proportion of public EV chargers per EV is significantly above the UK average, due to Chargeplace Scotland's role in EV charger deployment and Scottish Government policy
- The uptake of EVs was modelled to increase and accelerate in all scenarios to 2030
- Similarly, whilst some variation in projections across the scenarios, the deployment of both domestic and non-domestic EV charger archetypes was modelled to continue in all scenarios out to 2030.

Table 6: DFES 2021 projections for electric vehicles in the North of Scotland licence area

Scenario	Number of battery EVs (thousands)		
	Baseline (2020)	Projection by 2025	Projection by 2030
Steady Progression	4	25	106
System Transformation		34	159
Consumer Transformation		73	244
Leading the Way		62	329
Scenario	Number of plug-in hybrid EVs (thousands)		
	Baseline (2020)	Projection by 2025	Projection by 2030
Steady Progression	3	10	26
System Transformation		10	25
Consumer Transformation		7	15
Leading the Way		10	22

Table 7: DFES 2021 projections for electric vehicle charger capacity in the North of Scotland licence area

Scenario	Domestic off-street chargers (thousands)		
	Baseline (2020)	Projection by 2025	Projection by 2030
Steady Progression	3	15	58
System Transformation		21	69
Consumer Transformation		54	149
Leading the Way		43	187
Scenario	Non Domestic EV chargers (thousands)		
	Baseline (2020)	Projection by 2025	Projection by 2030
Steady Progression	48	70	119
System Transformation		75	144
Consumer Transformation		135	326
Leading the Way		121	318

Update to vehicle registrations (as of August 2022)

Latest data for battery EVs and plug-in hybrids in the licence area shows an 84% increase in the number of registered EVs across the North of Scotland between DFES 2021 and Q1 2022. Similarly, over the past year there has been a 72% increase in the number of Plug-in Hybrids across the North of Scotland.

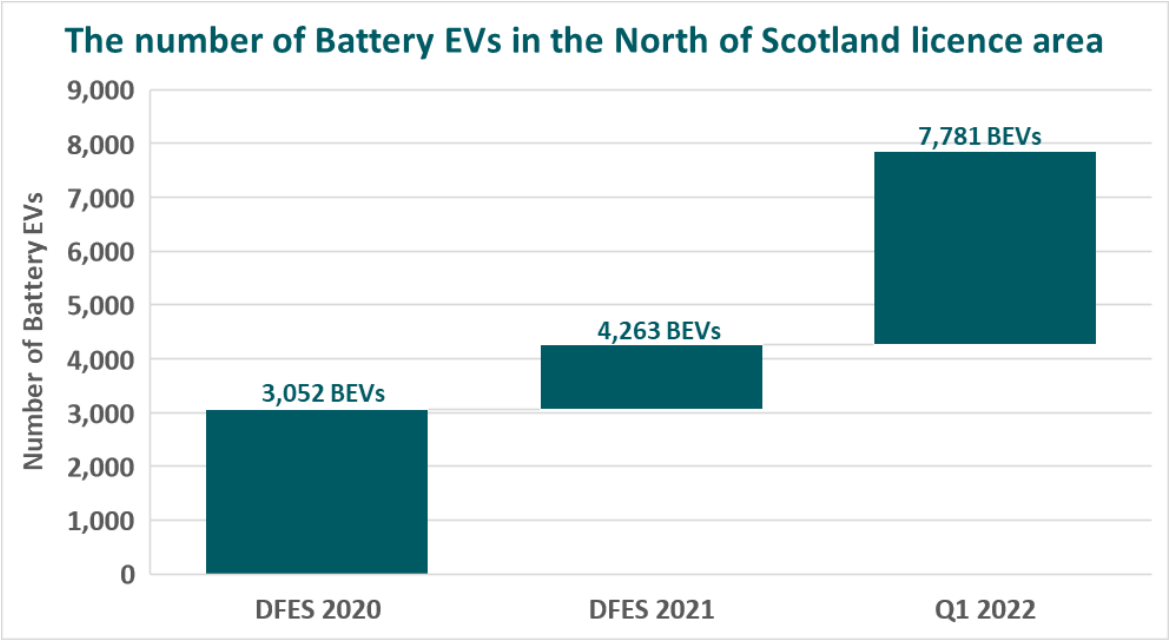


Figure **24**: Battery EV registrations in the North of Scotland licence area 2020 to Q1 2022
Source: Department for Transport data and SSEN notifications data

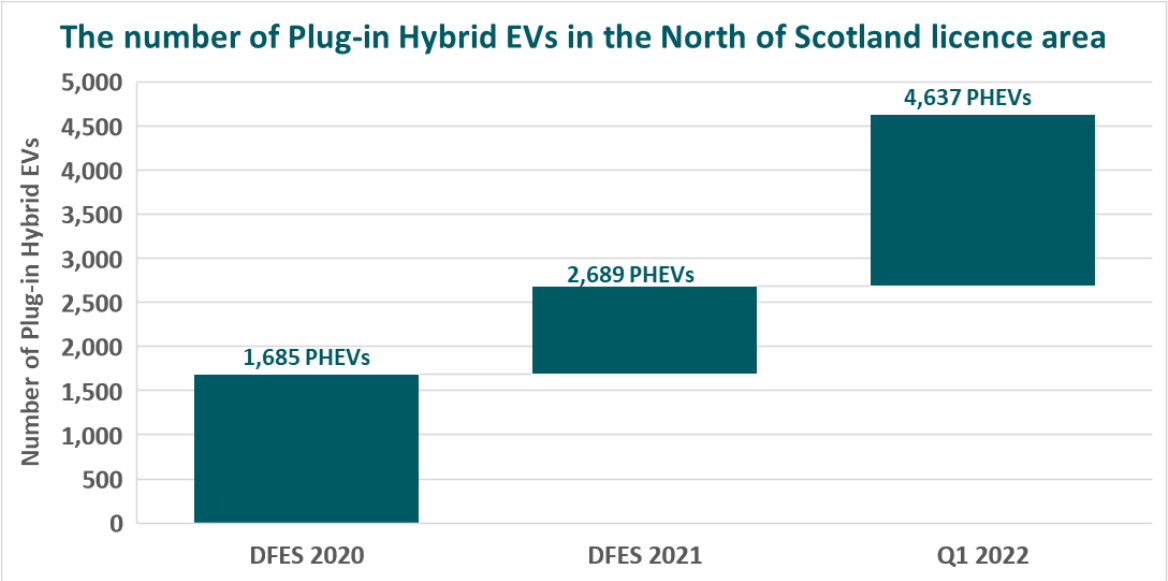


Figure **25**: Plug-in hybrid EV registrations in the North of Scotland licence area 2020 to Q1 2022
Source: Department for Transport data and SSEN notifications data

In addition to this, there has been a steady increase in public EV charger capacity in the licence area since 2016 onwards, with c.300kW additional capacity brought online in the first half of 2022. With the uptake of EV cars shown in the previous section, it is likely that domestic off-street EV chargers have also increased in a similar trend to EV uptake.

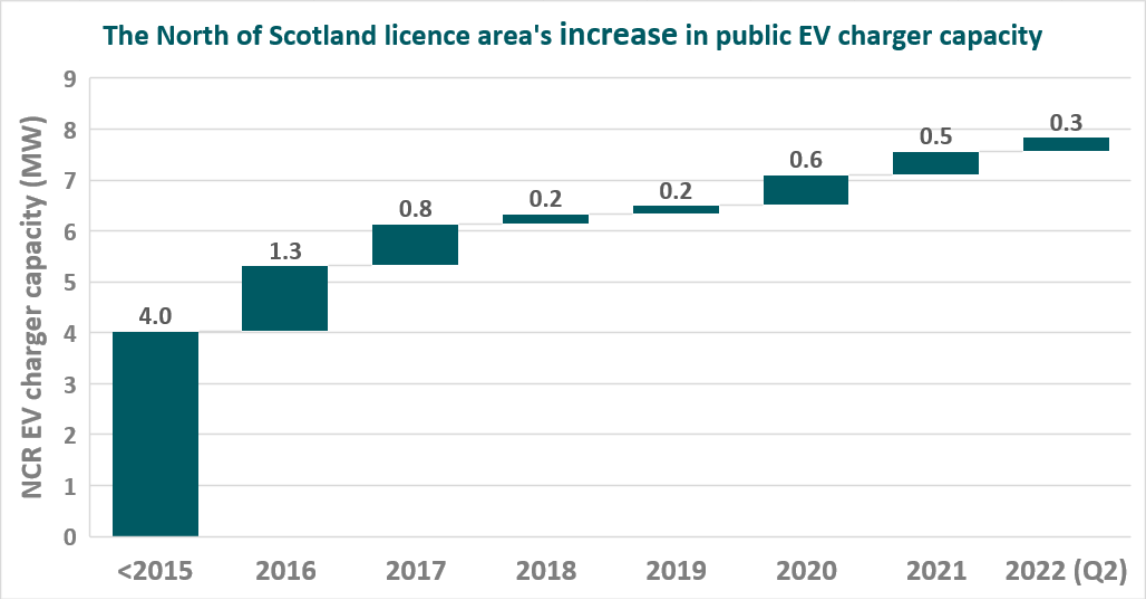


Figure **26**: Public EV charger capacity from 2015 to Q2 2022

Source: National Chargepoint Registry

Outlook to 2030

Projections from FES 2022[25]

For the North of Scotland 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.134,000 and 370,000 battery EVs respectively by 2030.

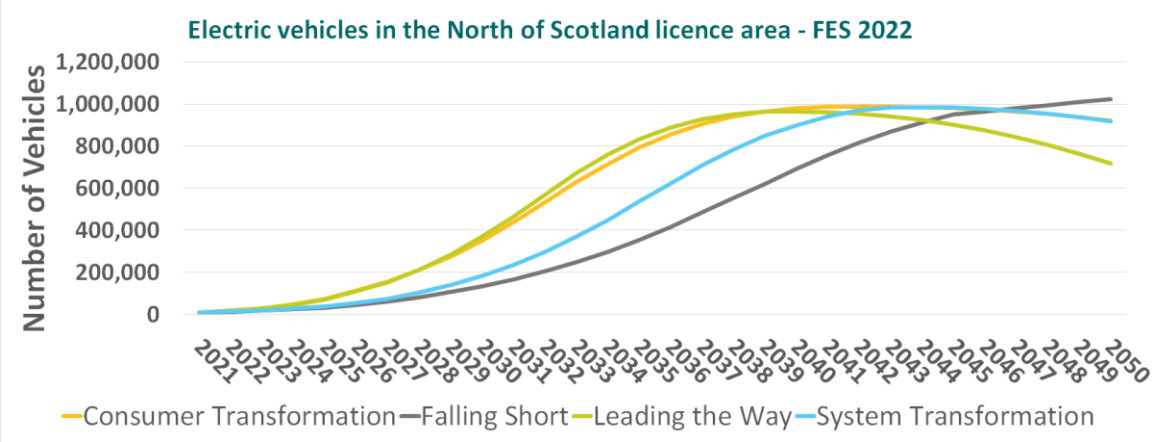


Figure **27**: FES 2022 projections for the number of battery electric vehicles in the North of Scotland licence area

Market outlook commentary[26]

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.

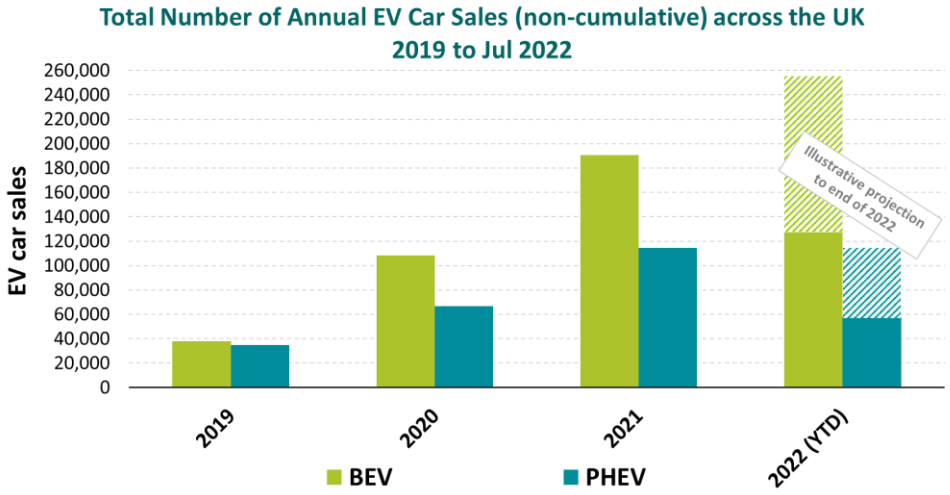


Figure **28**: Annual UK EV car sales 2019 to Jul 2022
Source: SMMT vehicle sales data

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.

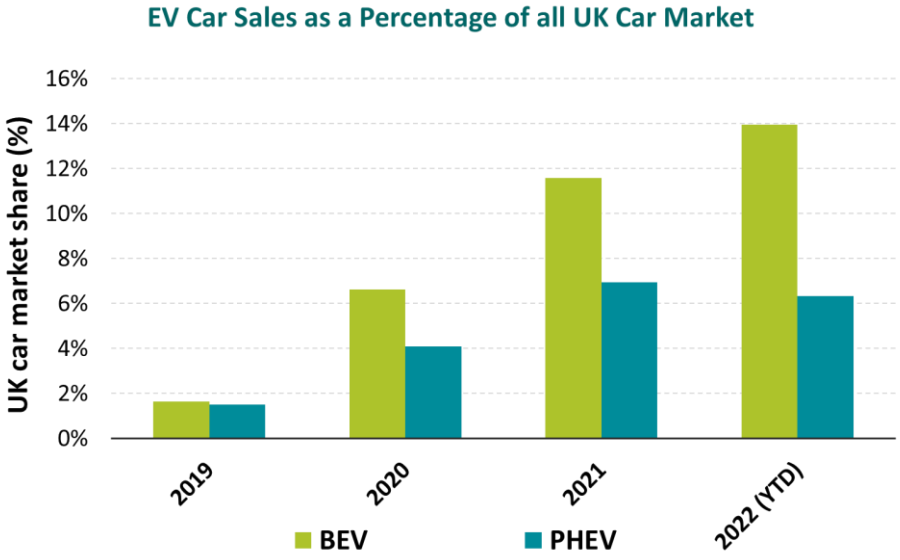


Figure 29: Annual UK EV car sales as a proportion of all car sales 2019 to Jul 2022
Source: SMMT vehicle sales data

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%.

[25] FES 2022 Data Workbook - https://www.nationalgrideso.com/future-energy/future-energy-scenarios#fullsuite
[26] SMMT EV sales data - https://www.smmt.co.uk/vehicle-data/evs-and-afvs-registrations/

8. Technology outlook – Heat pumps

DFES 2021 overview

The DFES 2021 analysis for heat pumps in the North of Scotland highlighted that:

- A total of c.22,000 domestic heat pumps and c.3,000 non-domestic heat pumps were installed as of the end of 2020.
- The Consumer Transformation and Leading the Way scenarios were aligned with the Scottish Government Heat in Buildings Strategy[xxvii], specifically the target of 1 million homes converted to zero emissions heating systems by 2030.
- With the System Transformation scenario focusing less on electrification and more on hydrogen fuelled heating systems, as well as the policies outlined in Scottish Government's Hydrogen Policy Statement[xxviii], the scenarios featured a relatively broad envelope of heat pump uptake.
- Overall the number of heat pumps increases in all scenarios by 2030, but this was highest in Leading the Way (c.315,000) and lowest in System Transformation (c.77,000).

Table 8: DFES 2021 projections for domestic heat pumps in the North of Scotland licence area

Scenario	Number of homes with a heat pump (thousands)		
	Baseline (2020)	Projection by 2025	Projection by 2030
Steady Progression	22	33	78
System Transformation		37	62
Consumer Transformation		46	248
Leading the Way		84	287
Scenario	**Number of homes with a hybrid heat pump (thousands)**		
	Baseline (2020)	**Projection by 2025**	**Projection by 2030**
Steady Progression	0	0	3
System Transformation		1	2
Consumer Transformation		1	4
Leading the Way		1	11

Table 9: DFES 2021 projections for non-domestic heat pumps in the North of Scotland licence area

Scenario	Number of properties with a heat pump (thousands)		
	Baseline (2020)	Projection by 2025	Projection by 2030
Steady Progression	3	4	7
System Transformation		6	12
Consumer Transformation		7	21
Leading the Way		6	16
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		0	1
Consumer Transformation		0	0
Leading the Way		0	1

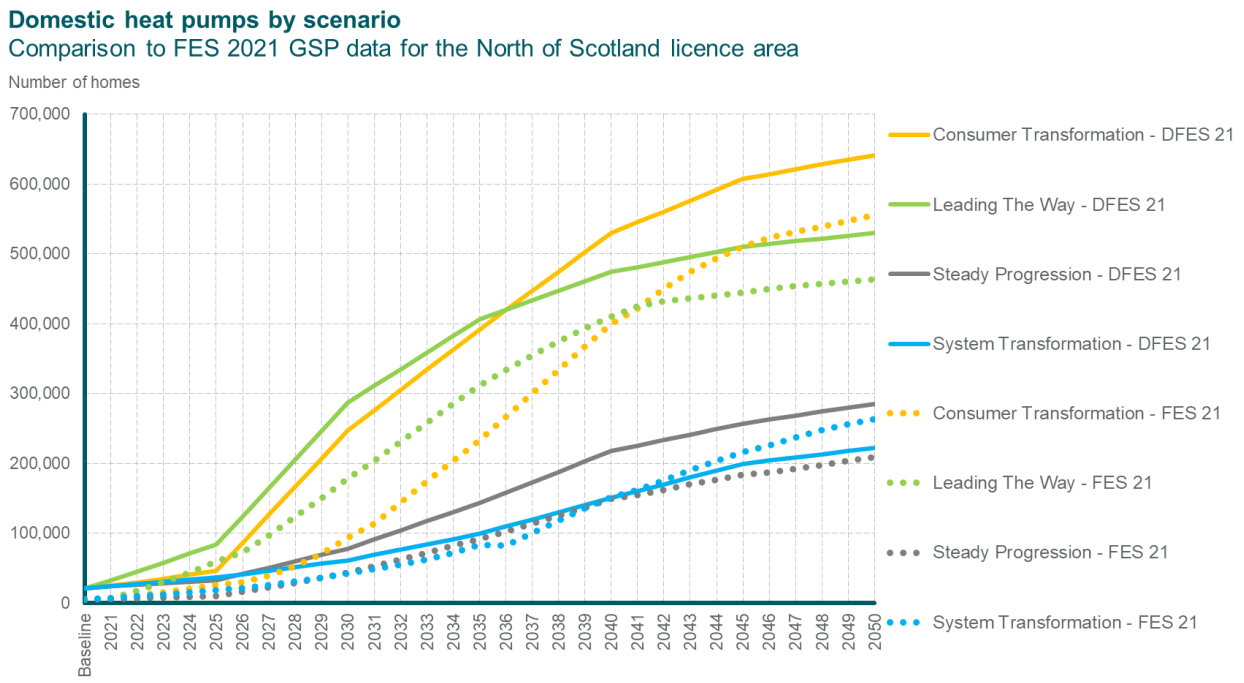


Figure 30: SSEN DFES 2021 projections for domestic heat pumps in North of Scotland (reconciled to FES 2021 GSP data)

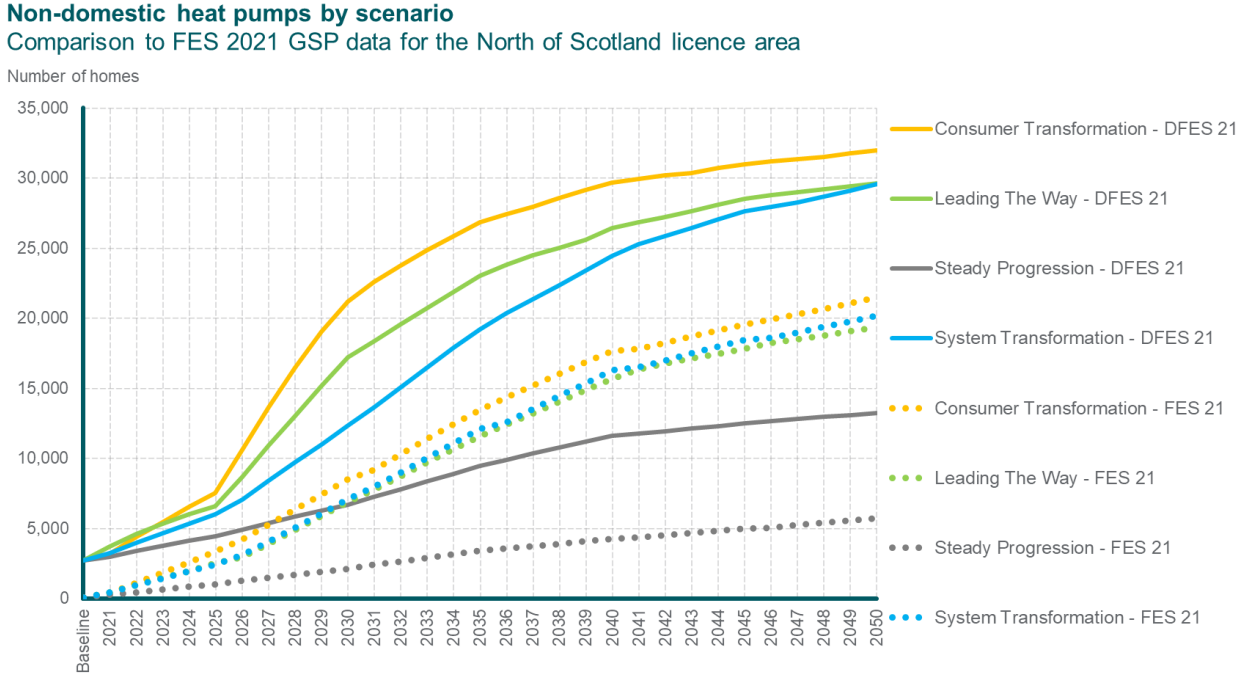


Figure 31: SSEN DFES 2021 projections for non-domestic heat pumps in North of Scotland (reconciled to FES 2021 GSP data)

Update to connection activity (as of August 2022

There has been a marked increase in the number of heat pump notifications in the North of Scotland licence area, with a 107% increase in annual installations from July 2021 to July 2022.

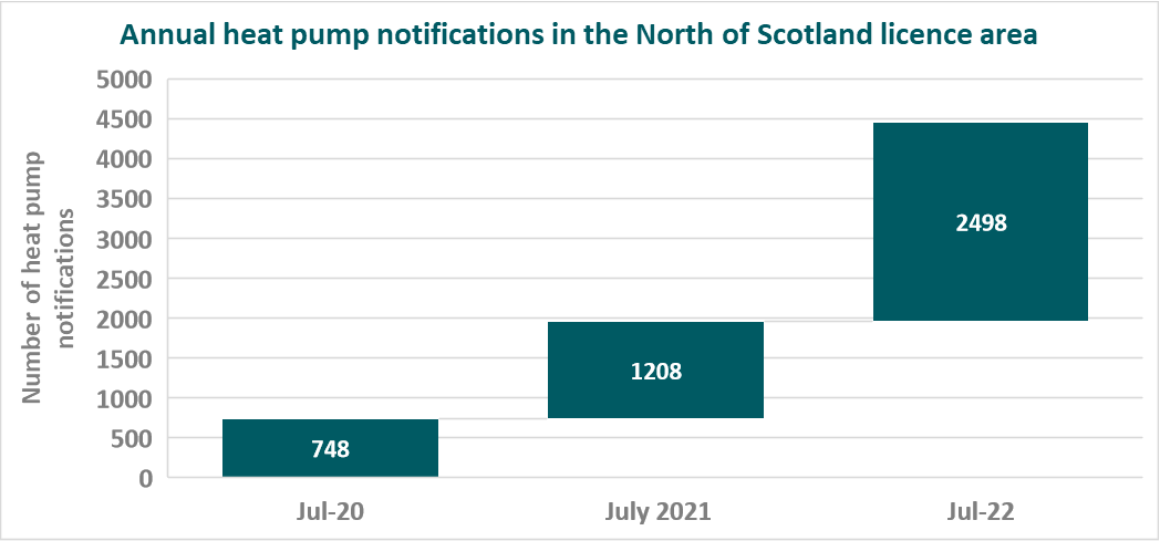


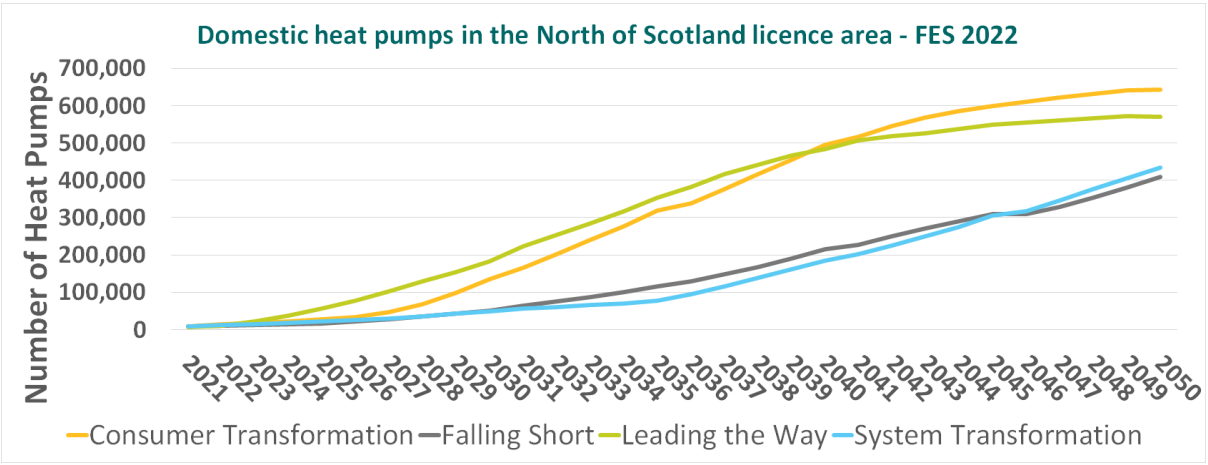
Figure **32**: Annual Heat Pump notifications in the North of Scotland licence area

Source: SSEN connection notifications data

Outlook to 2030

Projections from FES 2022[xxix]

For the North of Scotland licence area, the National Grid ESO FES 2022 has projected a similar uptake of heat pumps in the near-term reaching c.100,000 domestic heat pumps by 2027 under Leading the Way. Projections for heat pumps in the licence area in the 2030s and out to 2050 have increased in FES 2022 compared to FES 2021, with c.100,000 more domestic properties being modelled to have a heat pump by 2050 under Consumer Transformation in FES 2022.



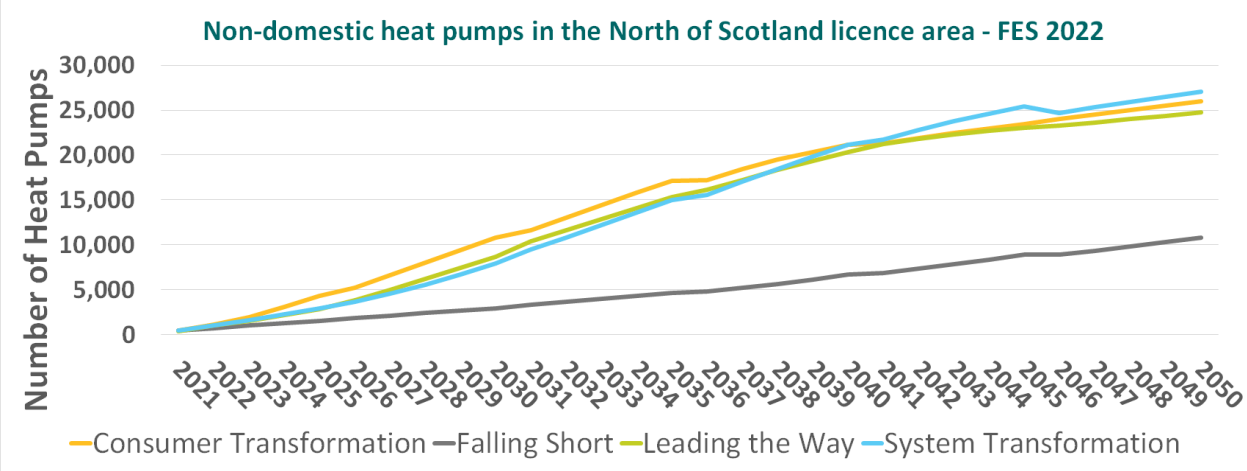


Figure **33**: FES 2022 projections for the number of heat pumps in the North of Scotland licence area

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[xxx]. 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[xxxi], which will be run in 2022 to increase British manufactured heat pumps and reduce demand for natural gas.

[xxvii] Scottish Government Heat in Buildings Strategy (Oct 2021) - https://www.gov.scot/publications/heat-buildings-strategy-achieving-net-zero-emissions-scotlands-buildings/

[xxviii] Scottish Government Hydrogen Policy Statement (Dec 2020) - https://www.gov.scot/publications/scottish-government-hydrogen-policy-statement/

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

[xxx] BEIS Boiler Upgrade Scheme - https://www.gov.uk/guidance/check-if-you-may-be-eligible-for-the-boiler-upgrade-scheme-from-april-2022

[xxxi] Heat Pump Investment Accelerator Competition - https://www.gov.uk/government/news/major-acceleration-of-homegrown-power-in-britains-plan-for-greater-energy-independence