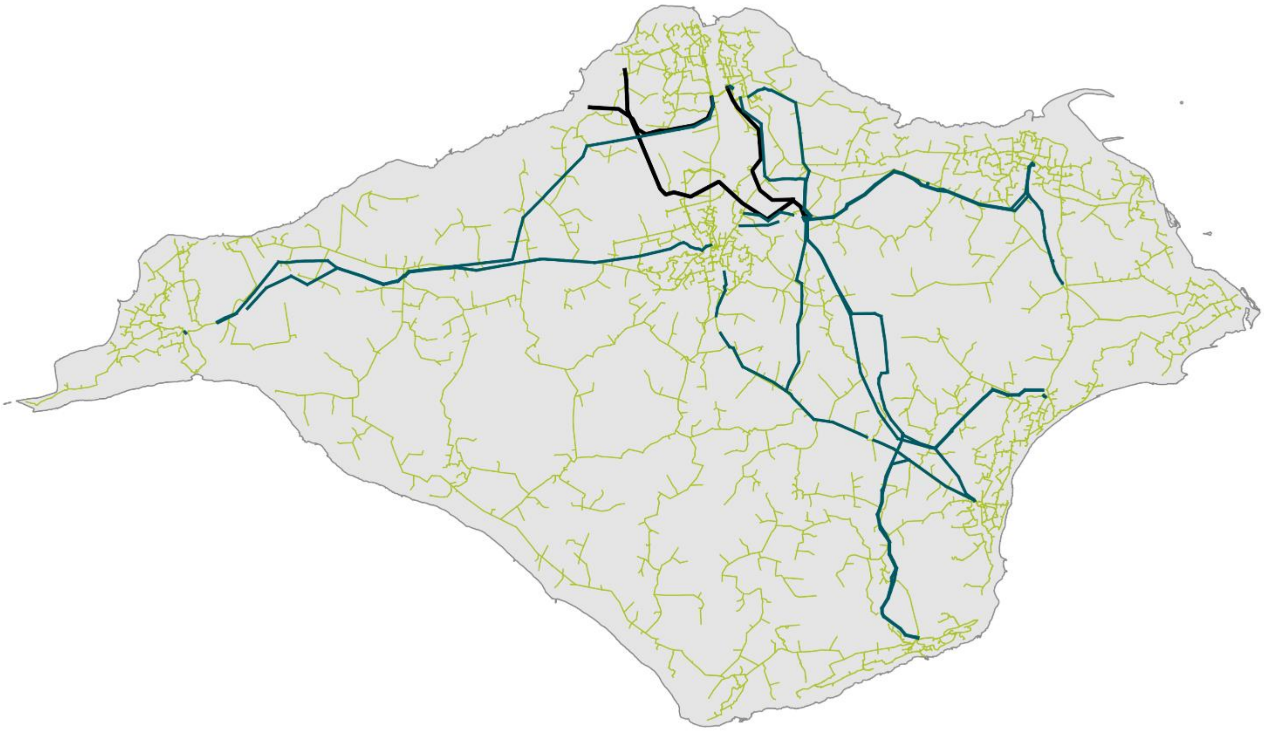
Isle of Wight Net Zero Network Investment Study

An evidence case report for future electricity generation and demand load growth on the Isle of Wight



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Executive summary

Background

Following their climate emergency declaration in July 2019, the Isle of Wight Council in September 2021 published *Mission Zero*[1], a climate and environment strategy for the Island, for the period of 2021 to 2040. This strategy set out the Council's aspirations and targets to achieve net zero carbon for its own operations by 2030 and across the wider Island by 2040.

The strategy focused on significant action across space heating, commercial and industrial users, road transport, marine transport, agriculture and electricity generation. These pathways were based on carbon reduction analysis that Regen completed in 2020. Whilst these figures provide one potential view of sectoral net zero pathways, a number of factors have changed since the analysis and the evidence presented in this study builds on this work.

Table 1: Isle of Wight sector pathways to achieve net zero by 2040, from Regen's 2020 analysis

Sector	Pathway/uptake rate to achieve net zero by 2040
Electricity generation	140 MW fossil fuel power station at Cowes to be decommissioned by 2030. An additional 278 MW of solar PV and 24 MW of onshore wind or other renewables operational by 2040, enabling 70% of electricity demand to be met by on-Island renewables.
Road transport	An average of 83 electric vehicles registered per week from April 2020 to December 2030.
Marine transport	Consideration for full electrification or green hydrogen conversion options for the ferry fleet by 2040.
Domestic heating	An average of 50 heat pumps would need to be installed per week from April 2020 to December 2040. An average of 40 EPC D-G homes would also need to be retrofitted to EPC A-C per week from April 2020 to December 2030, alongside additional improvements to existing EPC A to C homes. This would result in a c.22% decrease in domestic electricity demand for domestic space and water heating by 2040.
Commercial and industrial	Overall energy demand for commercial and industrial buildings falls by 31% by 2030, including a 16% improvement in efficiency, coupled with c.60% of fossil gas-fired processes switching to an efficient heat pump.

Isle of Wight electricity network constraints

Mission Zero set out commitments to work with SSEN, as the Island's distribution network operator, to ensure the electricity network does not act as a barrier to the Isle of Wight's decarbonisation aims.

[1] See Isle of Wight website & strategy: https://togetherformissionzero.co.uk/mission-zero/

The Island's electricity system itself is comprised of a meshed 132 kV network, fed by three 132 kV subsea cables from the Fawley Grid Supply Point in Southampton on the mainland. The on-Island 33 kV and 11 kV electricity networks then distribute power across the Island to the towns and population centres through various 33 kV and 11 kV substations. The distribution network on the Island is currently heavily constrained on generation, preventing the connection of new distributed generation sites without triggering high-cost network reinforcement at multiple voltage tiers. The cost to reinforce the network on the Island has been estimated by SSEN to be c.£55m to release 150 MVA of export headroom. This capacity would enable near term development, but may not enable the Isle of Wight to fully meet its renewable energy targets under their net zero strategy.

Table 2: Phased network reinforcement to unlock generation headroom on the Isle of Wight

Phasing	Description of reinforcement activity	Cost	Cumulative export capacity headroom
Phase one	Upgrade onshore sections of Fawley-to-Cowes 132 kV circuit Construction of one new Fawley-to-Cowes 132kV circuit, following the existing route, which includes an additional, 4th, submarine cable	£42m	+100 MVA
Phase two	Upgrade onshore Fawley-to-Wootton Common 132 kV sections	£13m	+50 MVA
Total reinforcement		**£55m**	**150 MVA**

Aims of this study

Strategic network reinforcement for the Isle of Wight was not included in SSEN's final RIIO-ED2 business plan, based on the best evidence available at the time. However, as part of the ED2 planning process, SSEN committed to a specific study to gain a more granular understanding of potential future load growth on the Island[2].

The aim of this study was to assess whether the relatively small pipeline of contracted projects seen in SSEN's DFES 2020 analysis was representative of the true level of demand and project activity that could be seen in the near term, if network headroom was created.

A Working Group was established in early 2022 to deliver this study, with representatives from SSEN, Regen, the Isle of Wight Council and Wight Community Energy. The core aims of the study were agreed to be threefold:

- **To undertake an accurate review of planned and aspirational growth of future electricity demand, electricity generation and storage across the Isle of Wight.**
- **To establish a Working Group of key representatives to provide strategic direction to the study, discuss key issues and explore outcomes of the review.**
- **To translate the outcomes of the review into a written body of evidence to support a follow-on application process for investment and dialogue with Ofgem, under the RIIO-ED2 business planning and operating period.**

[2] See SSEN ED2 final business plan, "1.2.1 Co-creating our DFES", p.96: https://ssenfuture.co.uk/wp-content/uploads/2021/12/24645-SSEN-ED2-Final-Business-Plan-Website.pdf

The ultimate outcome of this study was to act as supporting evidence for what activities and network investment should be considered to be funded through the ED2's Uncertainty Mechanism, as well as considerations for further work to explore other solutions to unlock capacity on the Island. The approach to the study is set out in Figure 1.

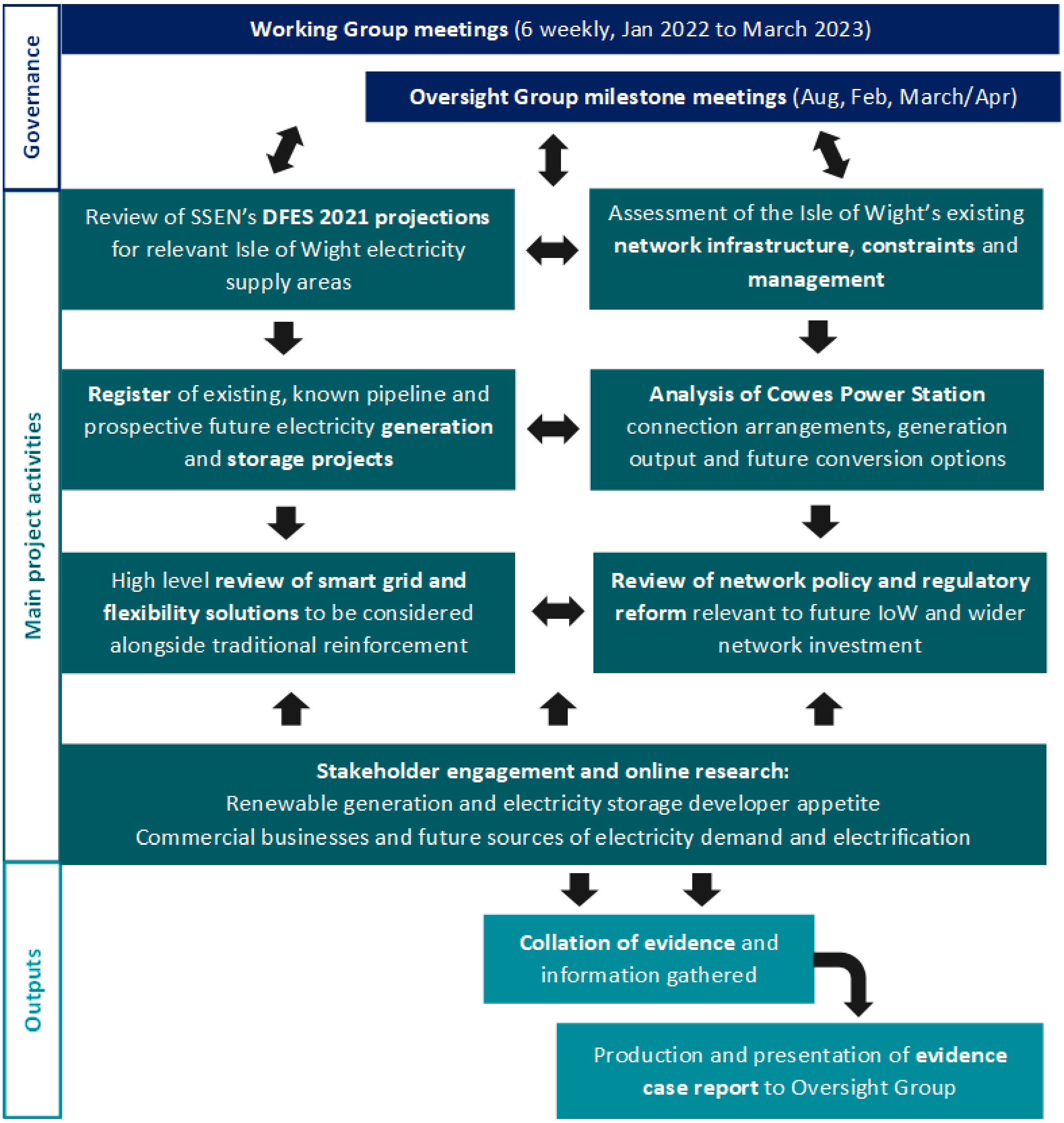

Figure 1: Isle of Wight Net Zero Network Investment Study high-level process diagram

This report comprises the results of that study, summarising the evidence gathered around potential future load growth on the Island and setting out a set of conclusions and recommendations for next steps and further work.

Future generation load growth

The analysis of potential future generation load growth on the Island concluded that:

- There is an existing baseline of 252 MW of distributed generation operating on the Island, which is dominated by the 140 MW fossil-fuel OCGT site at Cowes.
- There is a pipeline of 178 MW of potential new/prospective large-scale generation sites seeking to connect, many of which are under the existing ANM scheme.
- There is a 146 MW pipeline of previously abandoned projects that could be revisited, should network capacity be unlocked.
- An additional 21 MW of sites previously had planning applications that have either expired or been refused, the former of which could be related to connection costs.

The project team engaged representatives from a number of UK renewable energy project developers and asset operators, some of which are active on the Isle of Wight. These included: Vogt Solar, Wight Community Energy, Low Carbon, Lightsource BP, RES, Ridge Clean Energy, Perpetuus Tidal Energy Centre and RWE.

The key outcomes and views fed back from these organisations were:

i) The existing network constraints are acting as a barrier to the operation of existing renewable sites and the development of new sites.

ii) The Isle of Wight could be a positive location for new rooftop and ground mount solar PV development, should constraints be alleviated and headroom created. Several developers suggested that they would prioritise and fast-track new grid applications on the Island, totalling around 80-100 MW, if network headroom was created.

iii) There are opportunities to build other technologies like battery storage & hydrogen.

iv) There are wider economic benefits to reviving renewable development on the Island.

v) The future of Cowes Power Station is unclear, but it will almost certainly be different to today's unabated fossil fuel operation, including potentially low carbon hydrogen.

The evidence gathered indicates that generation and storage capacity on the Island could exceed the medium-term projections from SSEN's DFES 2020 and 2021 analysis, if network was unlocked. The future of Cowes Power Station, operated by RWE is also key. See Figure 2.

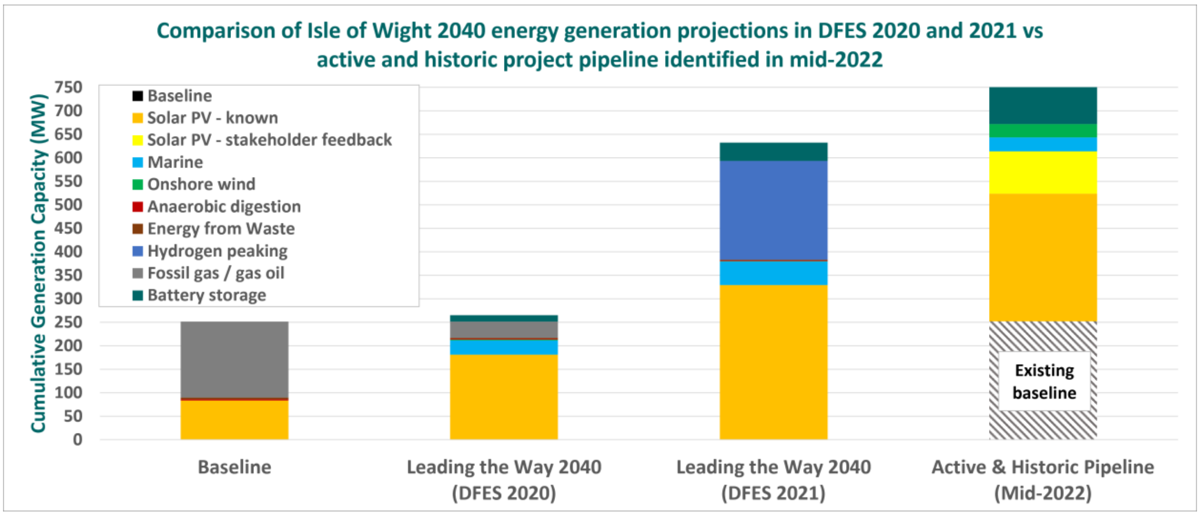

Figure 2: Comparison of Isle of Wight 2040 energy generation and storage projections in DFES 2020 and 2021 vs active and historic pipeline identified in mid-2022

Future demand load growth

Electricity consumption on the Island in 2020 was around 520 GWh. Whilst there is demand headroom across all of the electricity network substations on the Island today, the potential future electrification of transport and heat could create significant new loads.

Based on SSEN's DFES 2021 projections:

- 92,000 EV cars and LGVs could be registered on the Island by the early 2040s.
- This could translate to 400 MW of connected EV charging capacity by 2045.
- Tourist influx could also see pinch points of EV charging in some areas on the Island.

In addition to this analysis, engagement with the Island's bus operator, Southern Vectis, indicated intentions to electrify the Island's 86 buses, which could require c.5 MW of additional EV charging capacity.

Engagement with the Island's ferry operators, Wightlink and Red Funnel, also indicated plans to look into electrification of their ferries. This may require the need for shore power charging infrastructure on the north of the Island in the realm of 20-30 MW. This is in addition to the shore power charging needed for the domestic and private boats that use the island's ports, the potential future capacity to charge these smaller vessels is unknown and would require a more detailed analysis of private vessel ownership and electrification.

Based on the Isle of Wight Council's strategy to prioritise heat pumps for space heating, under a Leading the Way scenario, heat electrification in homes and businesses could see c.35,000 heat pumps (of all variants) by 2030, increasing to over 70,000 by 2050. This equates to a total installed heat pump capacity of 485 MW by 2030, rising to 970 MW by 2050.

Smart grid and flexibility solutions

Outside of traditional network reinforcement options, there are other potential solutions to mitigate the impact of network constraints, as well as enabling smarter uses of energy at a regional and local level.

A number of potential smart grid and flexibility solutions have been highlighted and rated for the **level of impact** the solution would potentially have on the Island's network constraints and the **viability of the implementation** of each solution, in terms of technical potential and a high-level view of cost-benefit.

The solutions highlighted and considered were as follows:

- Alternative connections
- Strategic deployment of flexibility technologies (such as batteries and hydrogen)
- Commercial local flexibility markets
- Smart energy solutions (such as smart EV charging)
- Power purchase agreements and peer-to-peer arrangements
- Strategic energy efficiency deployment

The project team was made aware that the Isle of Wight energy system has been chosen as a demonstrator for the BEIS National Digital Twin Programme 2022-25. This presents an opportunity to explore and assess the viability of some of the smart grid, flexibility and reinforcement options highlighted in this report.

Conclusion

This in depth analysis provides strong evidence that electricity load growth will very likely be significantly higher on the Isle of Wight than indicated in DFES 2020 projections. There is significant potential and market interest in renewable energy development, whilst the electrification of transport, heat and other sources of demand from businesses operating on the Island will drive increased demand.

SSEN will need to develop the most cost-effective solution to unlock new generation capacity on the Isle of Wight in the near term and prepare the Island's electricity network for the level of demand electrification that the net zero transition will bring.

Alongside this conclusion, the study makes recommendations on ten energy system areas:

1. Isle of Wight Net Zero commitments and strategy
2. Isle of Wight electricity system management
3. Evidence of future energy generation load growth
4. Evidence of future electrified transport load growth
5. Evidence of future electrified heat load growth
6. Decarbonisation strategy for Isle of Wight commercial businesses
7. Energy flexibility services on the Isle of Wight
8. Smart tariffs and smart EV charging
9. Energy efficiency deployment
10. Digital Twin – Isle of Wight energy system demonstrator

The recommendations under these areas are summarised in Table 3.

Table 3: Key recommendations for the Isle of Wight net zero network investment study, categorised by energy system area

Area 1: Isle of Wight Net Zero commitments and strategy
Recommendation 1: **SSEN should consider the evidence presented in this report and how it builds on the council's Mission Zero strategy, to ensure that the Isle of Wight's electricity network can meet the demand for new renewable generation, storage and load growth in the near term and enable the connection of up to (or potentially in excess of) c.300 MW of new renewable energy capacity, required to meet the Island's net zero targets in the longer term.**
Area 2: Isle of Wight electricity system management
Recommendation 2: **SSEN should stay closely engaged with the outcomes and recommendations of ENA's Open Networks Workstream 1a Product 5, which is looking at primacy rules and ANM assumptions.** **Modifying the ANM control system to uncap 140 MW, associated to Cowes Power Station operation, for a proportion of the year could enable some new generation projects to be developed and to operate, until wider network capacity headroom is created.**

Area 3: Evidence of future energy generation load growth
Recommendation 3a: **SSEN should continue engaging with existing asset operators as the ANM control system is developed, to ensure any change in levels of curtailment or available capacity headroom for new connections is clearly communicated.** **Recommendation 3b:** **SSEN should use the project pipeline and stakeholder feedback in this study as evidence of potential future solar PV, tidal stream and battery storage project development.** **Recommendation 3c:** **Isle of Wight asset operators and developers should engage with RWE and SSEN to explore options for grid connection sharing at Cowes Power Station.**
Area 4: Evidence of future electrified transport load growth
Recommendation 4a: **Through the DFES process and broader ongoing engagement, SSEN should continue to engage Isle of Wight stakeholders to identify the substation areas that may experience the highest near-term levels of EV charger uptake. This could also be linked to exploring an Isle of Wight EV car club or time-of-use tariff tailored to make use of Island solar generation.** **Recommendation 4b:** **SSEN should continue to engage and work with Wightlink and Red Funnel to gain a more detailed understanding of the amount of shore power capacity that will be needed to charge Isle of Wight ferries. This could expand to a broader study of shore power requirements to include domestic and private boats as well; their proposed locations, potential charging profiles and the timescale of their possible implementation.**
Area 5: Evidence of future electrified heat load growth
Recommendation 5a: **SSEN and Regen should make use of Census 2021 data, updated views of the Isle of Wight Council's new housing build-out plans and wider heat decarbonisation policy reforms, to inform SSEN's DFES 2022 heat pump projections for the Isle of Wight electricity supply areas.** **Recommendation 5b:** **SSEN and Isle of Wight Council should continue to engage with SGN to combine the findings of this assessment, SSEN's DFES 2022 analysis and SGN's Isle of Wight whole system study, to determine a shared vision of the Island's future energy system.** **Recommendation 5c:** **Ahead of these additional analyses, the evidence shown in this report should be considered a clear indication that network reinforcement to meet future heat and transport electrification demand capacity, as well as distributed generation capacity, is likely to be required.**
Area 6: Decarbonisation strategy for Isle of Wight commercial businesses
Recommendation 6: **SSEN and the Isle of Wight Council should consider establishing a broader energy working group for the Island, potentially as part of or an extension to the existing Isle of Wight Net Zero Energy Hub or the Working Group that has supported this study. This group could work with SSEN to explore some of the recommendations of this report and may include representatives from some commercial businesses or major energy users across the Island.**

Area 7: Energy flexibility services
Recommendation 7a: **The Isle of Wight Council could work with SSEN to develop of an Isle of Wight Energy Flexibility Strategy, exploring the optimum levels of electricity storage, (at multiple voltage tiers), demand side response and other sources of energy flexibility on the Island to maximise generation use and reduce constraints. This could be a complimentary analysis to the proposed renewable energy generation rollout. Funding for this could be through linkages with existing Local Area Energy Planning delivery funding.** **Recommendation 7b:** **Working with Isle of Wight stakeholders, SSEN could implement trial constraint management zones on the Island via an associated tender process and promotion campaign. This would seek to procure commercial flexibility services specifically designed to tackle generation constraints on the Island, through demand turn-up or generation turn-down services.**
Area 8: Smart tariffs and smart EV charging
Recommendation 8a: **Ahead of the deployment of more solar capacity and the electrification of heat and transport across the Island, Isle of Wight Council should seek industry partners to design, test and implement a set of tailored Isle of Wight time-of-use-tariffs. Working with SSEN, this tariff could be designed to act as a source of evidence to influence the assumptions behind generation constraints currently being applied.** **Recommendation 8b:** **SSEN and the Isle of Wight Council should seek to implement a trial of smart EV charging across the Island to work alongside any dynamic tariffs, potentially looking at the BEIS EV Smart Charger Action Plan funding options.**
Area 9: Energy efficiency deployment
Recommendation 9: **Working with SSEN, Isle of Wight Council could consider a strategic approach to energy efficiency rollout and how it could be a viable option to mitigate future demand peaks across the Island.**
Area 10: Digital Twin – Isle of Wight energy system demonstrator
Recommendation 10: **Isle of Wight Council should consider if the conclusions and recommendations from this study could be trialled, tested or verified through the Isle of Wight Digital Twin demonstrator.**

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Forewords

"The Island has experienced a generation constraint since 2012. Up to that point we were making good progress towards our renewable energy target, but the appetite for new projects, with the extra cost and risk resulting from the constraint, has dwindled.

This is unfortunate because the council has an ambitious target for the Island to be net zero by 2040, well ahead of the national target. We call this "Mission Zero" and it is critical that we decarbonise our energy systems as quickly as possible if we are to achieve our aim.

As well as the crucial environmental benefits of net zero, we also see an opportunity for economic benefits from the construction, operation and maintenance of renewable energy systems. These are the highly skilled, well paid jobs that the Island needs and which will encourage our young people to stay and develop their careers on the Island. For us, it's green growth in practice.

Local renewable energy generation also provides resilience. We are well placed, with our abundant natural resources, to generate much of the energy we need and, with the further development of storage and flexibility, to use this locally. Over time we hope this will reduce energy costs for local business, public sector services and households.

Strengthening the electricity network is critical to all of this and we very much welcome the opportunity to work with SSEN to design a solution which meets our net zero and resilience goals."

Lora Peacey-Wilcox,
Leader of the Isle of Wight Council

ISLE of WIGHT COUNCIL

"As the Distribution Network Operator for the region, we are focused on making the local electricity network an enabler for net zero, and wider prosperity and well-being on the Isle of Wight. We want to avoid network constraints slowing development and we are therefore delighted to lead this important and collaborative piece of work to unlock the island's net zero potential.

There is already a strong commitment to the net zero transition on the Isle of Wight, including the Council's aspirations and targets to achieve net zero carbon for its own operations by 2030 and across the wider Island by 2040, providing direction and ambition. This important report builds on that solid base and looks further, assessing future growth areas such as onshore renewables, electric vehicles, electric heat, energy services and the green marine sector on a long-term basis. This level of granularity will help SSEN plan for network investment to meet the anticipated increase in electricity demand these technologies will bring.

Our role has never been more important. The communities we serve depend on us to deliver a safe, reliable supply of electricity so they can thrive today while also working to deliver the infrastructure to create a prosperous and sustainable net zero tomorrow. That means addressing existing constraints and readying our network for the uptake in low carbon technologies such as electric vehicles, heat pumps and local renewables, which will need smart connections to be able to interact with the grid.

SSEN already works with Regen to anticipate the location and timing of new demand across our licence areas, their Distribution Future Energy Scenarios inform our network development plans, but this hyper-detailed study is vital in supporting informed decision-making which enables timely and cost-effective network management. Crucially, it gives us the robust evidence required to seek investment funding from regulatory structures available to us to enable strategic investment.

This report will form a key input to our submission to Ofgem under the uncertainty mechanism in the coming months. I'd like to thank Regen, the Isle of Wight Council and the wider community for their work on this essential and timely report and we look forward to working with them to deliver a net zero future for the Isle."

Patrick Erwin,
Director of Regulation

Scottish & Southern Electricity Networks

Introduction and background

Purpose of this report

This report sets out the findings of a study, undertaken across 2022, looking at the Isle of Wight electricity network infrastructure and the potential investment that will very likely be required to prepare the network to meet future net zero ambitions and technology adoption.

The Island's network has been heavily constrained since 2012, preventing the connection of additional distributed generation without costly network reinforcement at multiple voltage tiers. This has potentially limited developers from progressing renewable energy and battery projects on the Island. No strategic network reinforcement has been included for the Isle of Wight in SSEN's near-term investment planning (see SSEN's RIIO-ED2 business plan[3]). However, through ongoing direct engagement with Isle of Wight stakeholders, SSEN committed to undertaking an evidence case study around potential future electricity load growth on the Island and the solutions that could be implemented to meet that growth.

The aims of this study were threefold:

- **To undertake an accurate review of planned and aspirational growth of future electricity demand, electricity generation and electricity storage across the Island.**
- **To establish a Working Group of key representatives to provide strategic direction to the study, discuss key issues and explore outcomes of the review.**
- **To translate the outcomes of the review into a written body of evidence to support a follow-on application process for investment and dialogue with Ofgem, under the RIIO-ED2 business planning and operating period.**

This report is the culmination of this study and represents an overview of the evidence that has been collated across 2022 through engagement with the members of the Working Group and Oversight Group from SSEN, Isle of Wight Council and Wight Community Energy.

This report, issued to SSEN, is intended to enable the following outcomes:

- To instigate a dialogue between SSEN and Ofgem around investment options to create network headroom on the Island for new generation and demand capacity to connect between now, 2030 and beyond.
- To act as a body of evidence and reference material, justifying that, should network capacity headroom be unlocked (via traditional network reinforcement, smart grid and flexibility solutions, or a mixture), the network headroom released will be utilised.
- To provide recommendations for further work to explore some individual solutions or more detailed systemic analysis for a net zero Isle of Wight energy system.
- To be a reference and evidence base for the Working Group and Oversight Group to use to highlight the importance of the electricity network in the Isle of Wight's wider transition to net zero.

The study has also sought to identify and, where viable, coordinate with other assessments and initiatives that have been undertaken, or are currently in progress, that are also looking at the Isle of Wight energy system or transition to net zero energy.

[3] See SSEN *Powering Communities to Net Zero* business plan, 2022: https://ssenfuture.co.uk/

Overview of the process undertaken

The study was initiated in January 2022, after discussions held between SSEN, Isle of Wight Council and Regen, reviewing the outputs from SSEN's 2021 Distribution Future Energy Scenarios (DFES) analysis, completed by Regen.

The key elements of the study, encapsulated in the mutually agreed Terms of Reference, can be summarised in Figure 3 and as follows:

- Oversight and governance of the study via a Working Group and Oversight Group
- Analysis and research around the Island's network, active and historic connection data held by SSEN, information about projects in development, future scenario projections, high-level smart/flexible solutions and relevant policy reform.
- Stakeholder engagement and direct interviews with key sector representatives.
- Evidence case collation and summarising written report reviewed by Working Group.

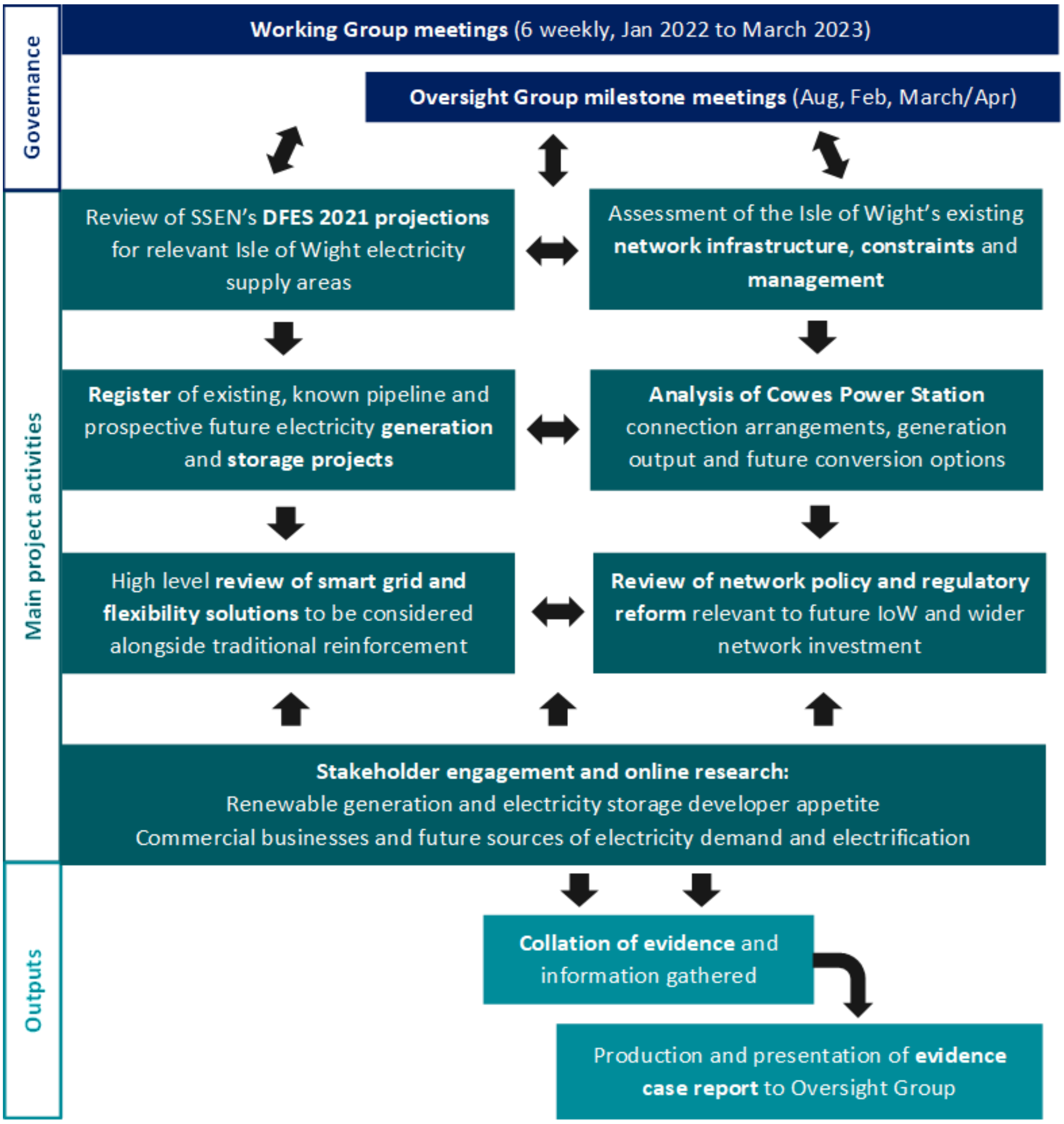


Figure 3: Isle of Wight Net Zero Network Investment Study high-level process diagram

Governance of the study

The governance of the study comprised of both:

- A **Working Group** that met every six weeks across 2022 to discuss progress, key issues and the analysis undertaken, to inform the evidence case.
- An **Oversight Group** that met at key milestones in the project to provide direction and to review the key concluding outcomes and recommendations from the study.

The Working Group included members of the network planning team at SSEN, key representatives from the Isle of Wight and the Regen project delivery team, see Table 4.

Table 4: Isle of Wight Net Zero Network Investment Working Group

Name	Job title	Organisation	Role in study
Ray Arrell	Head of Future Energy Systems	Regen	Project manager Working Group chair
Robbie Evans	Energy Analyst	Regen	Project analyst
Jim Fawcett	Principal Officer, Low Carbon Projects	Isle of Wight Council	Lead Isle of Wight representative
Holly Jones	Climate Change Project Officer	Isle of Wight Council	Isle of Wight representative
Rob Sauven	Mission Zero Adviser	Isle of Wight Council	Isle of Wight representative
Colin Palmer	Director	Wight Community Energy	Isle of Wight representative
Steve Atkins	DSO Transition Manager	SSEN	Lead SSEN representative
Richard Hartshorn	EV Readiness Manager	SSEN	SSEN EV lead
Yuan Gao	Lead Systems Planning Engineer	SSEN	SSEN network planning lead

In addition to this, an Oversight Group was also established with senior representatives from the SSEN, Regen and the Isle of Wight Council, see Table 5. The Working Group met with members of the Oversight Group and a number of wider representatives from the Isle of Wight Council in Newport in August 2022. The findings from the report were also presented to a wider group of representatives in a further meeting in Newport in February 2023.

Table 5: Isle of Wight Net Zero Network Investment Study Oversight Group

Name	Job title	Organisation
Lora Peacey-Willcox	Leader of the Isle of Wight Council	Isle of Wight Council
Patrick Erwin	Director of Regulation	SSEN
Merlin Hyman	Chief Executive Officer	Regen

Energy on the Isle of Wight

Overview of the Isle of Wight

Isle of Wight population and businesses

The Isle of Wight is a 380 km^2 Island community with a population of c.141,000 people. A significant proportion of the Island is rural, with just over 50% of the Island (mostly on the west side) falling within the designated Isle of Wight Area of Outstanding Natural Beauty. The Island has nine main population areas (see Table 6), most of which are on the east side.

Table 6: Main population centres on the Isle of Wight

Town	Population	Location
Newport	c.25,000	Centre
Ryde	c.30,000	North East
Cowes	c.14,000	North
East Cowes	c.7,000	North
Sandown	c.12,000	South East
Shanklin	c.9,000	South East
Ventnor	c.6,000	South
Freshwater	c.5,000	West
Bembridge	c.4,000	East

There are around 68,000 residential properties across the Isle of Wight, many of which are concentrated in the towns of Newport, Cowes, Ryde and Shanklin, see Figure 4. According to ONS data for the end of 2022[4], c.40% of Isle of Wight dwellings hold EPC ratings of C or above (34% of existing and 97% of new dwellings), which is slightly below the average for housing stock in the South Eastern region (45%).

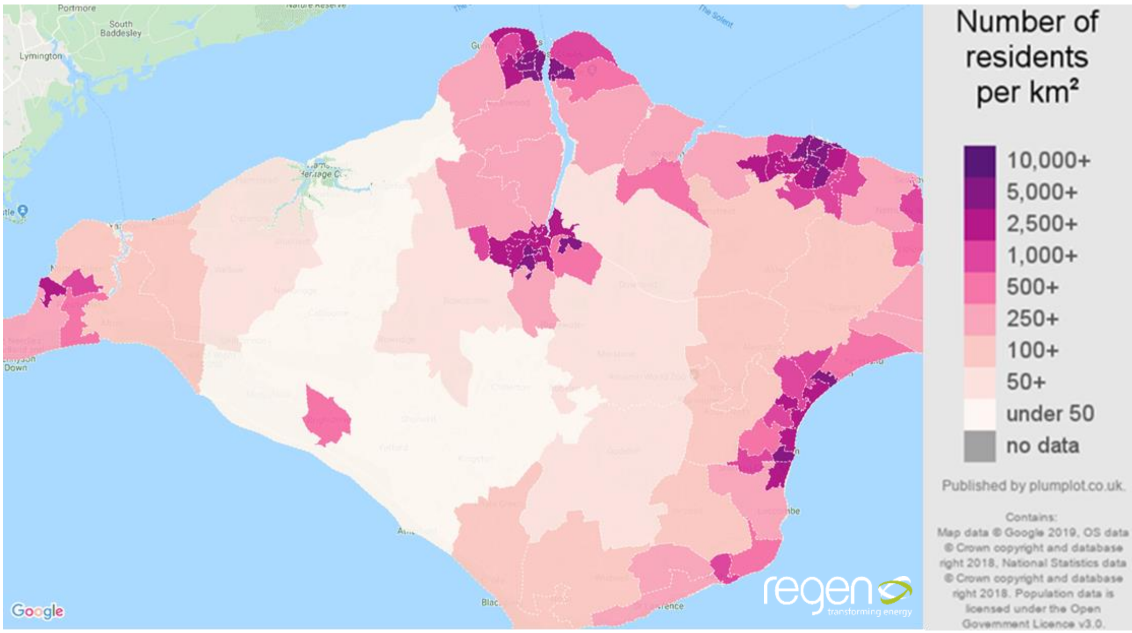


Figure 4: Map of population density on the Isle of Wight, by Lower Super Output Area (LSOA)

[4] See *Energy efficiency of housing in England and Wales*, ONS, October 2022: https://www.ons.gov.uk/peoplepopulationandcommunity/housing/articles/energyefficiencyofhousinginenglandandwales/2020-09-23

The majority of the commercial and industrial premises on the Island are in the larger towns of Newport, Ryde and Cowes. There are no major industrial companies on the Island that consume significant volumes of electricity, though a number of commercial businesses operate across the Island. As of 2019[5], there are 5,660 businesses registered on the Isle of Wight, with SMEs (1-250 employees) accounting for almost all of them (c.99%).

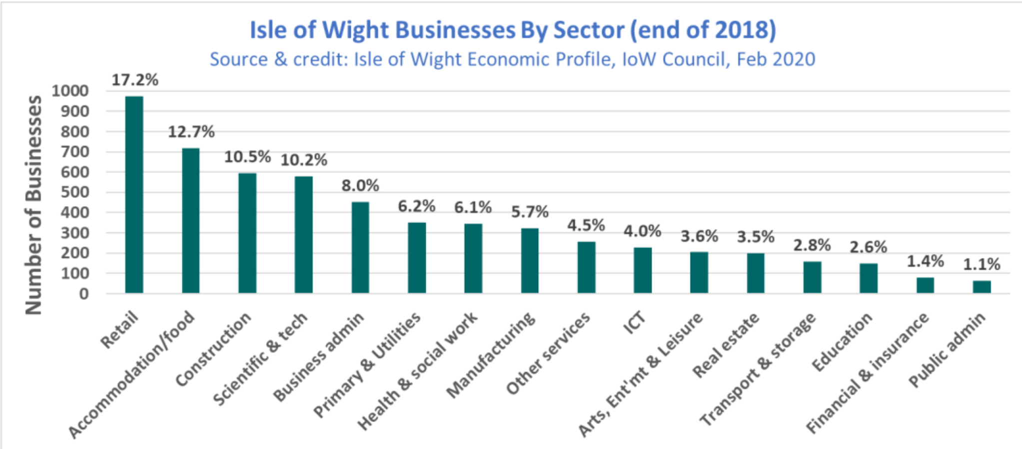


Figure 5: Breakdown of Isle of Wight businesses by sector in 2018
Source & credit: Isle of Wight Economic Profile, Isle of Wight Council, Feb 2020

Based on heat mapping analysis undertaken in 2010[6], there are a moderate number of commercial and industrial buildings across the Island with notable energy demand. Most of these are located in Newport, Cowes or Ryde (see Figure 6). Examples of C&I users, their building heat demand and average electricity demand (at the time) are shown in Table 7.

Table 7: Examples of Isle of Wight commercial and industrial energy consumers in 2010

Commercial Premises	Location	C&I Category	Peak Heat Demand in 2010 (kW)	Average Electricity Demand in 2010 (kW)
A J Wells & Sons	Newport	Industrial	267	Not available
GKN Aerospace	East Cowes	Industrial	1,177	Not available
SP Systems Ltd	Newport	Industrial	405	Not available
Trucast Ltd	Ryde	Industrial	163	Not available
Tesco	Ryde	Retail	370	1,156
Marks & Spencer	Newport	Retail	212	661
Pyle Street Retail	Newport	Retail	210	655
Morrisons	Newport	Retail	188	588
Sainsburys	Newport	Retail	102	571
Morrisons	Sandown	Retail	128	400
Broadlands House	Newport	Office	260	262
Cineworld	Newport	Entertainment	1,252	256
B&Q	Newport	Retail	330	218
Matalan	Newport	Retail	64	136
Shanklin Theatre	Shanklin	Entertainment	138	24

[5] See *Isle of Wight Economic Profile 2019*, Isle of Wight Council, Feb 2020: https://www.iow.gov.uk/azservices/documents/1433-Isle-of-Wight-Economic-ProfileFinalFebruary2020.pdf

[6] See *Isle of Wight Heat Mapping Study*, Grontmij, August 2010: https://www.iow.gov.uk/documentlibrary/view/heat-mapping-study

A number of these buildings and businesses are looking into alternative sources of heating (including the installation of non-domestic heat pumps). Many will also be investigating the opportunity to deploy onsite rooftop PV generation to mitigate increasing electricity costs and also seeking to electrify their transport fleets and install associated EV chargers.

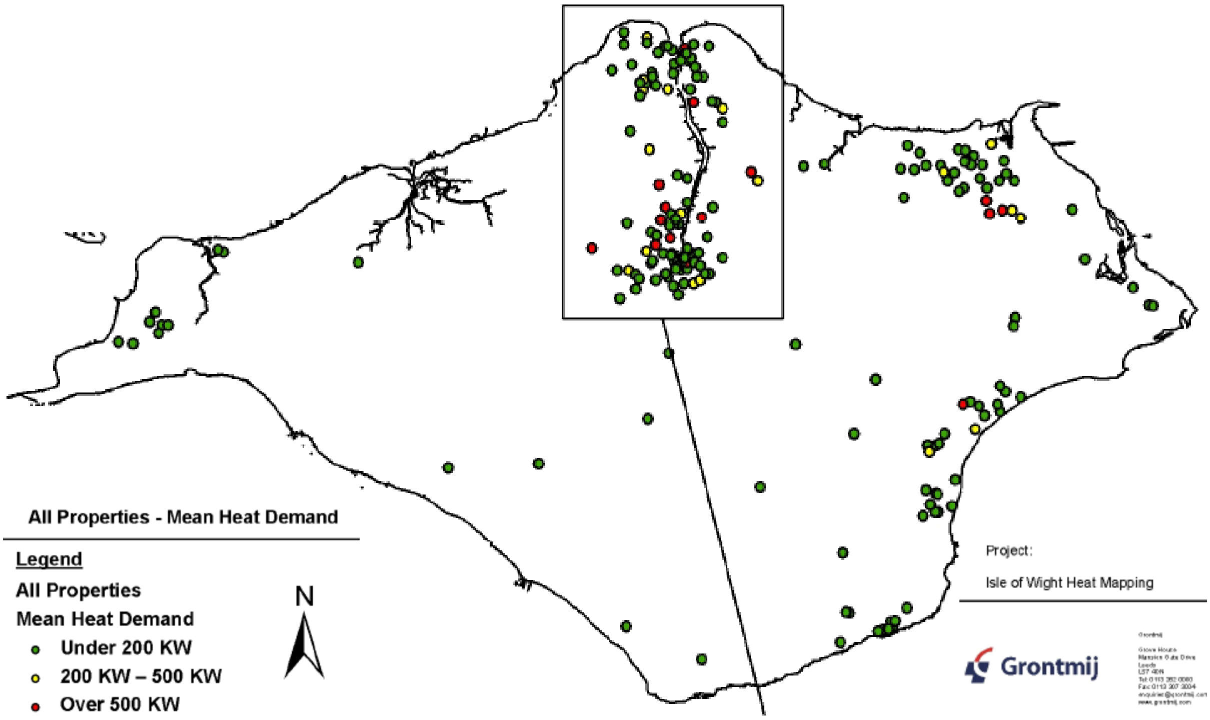


Figure 6: Location of individual building heat demand on the Isle of Wight in 2010
Source and credit: Isle of Wight Heat Mapping Report, Grontmij, August 2010

Isle of Wight transport infrastructure

Public transport around the Island is dominated by road, with an active bus fleet and road network connecting all areas of the Island, see Figure 7 and Figure 8. The future uptake of electrified road transport is discussed in a subsequent section of this report.

Figure 7: Overview of the Isle of Wight road network | *Source and credit: Isle of Wight Council*

Figure 8: Isle of Wight bus route map | *Source and credit: Southern Vectis*

The Island's rail network is limited, with a single 8½ mile line on the east of the Island, operated by Island Line (a brand of South Western Railway), running from Ryde to Shanklin, see Figure 9. The existing rolling stock is all newly upgraded battery trains[7], manufactured by Vivarail. This suggests that additional electricity load from rail is unlikely in the near-term.

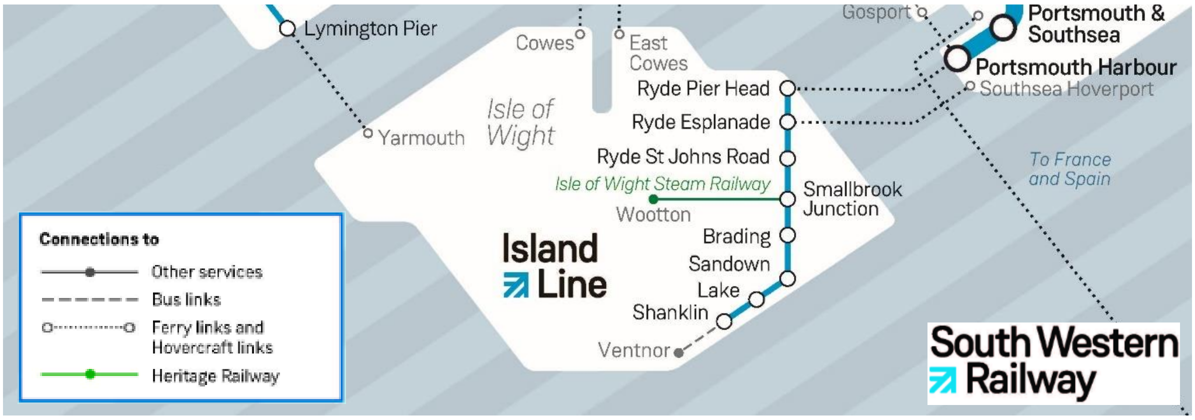


Figure 9: Isle of Wight rail services line map | *Source and credit: Island Line website*

[7] See Vivarail article showing new battery trains launched in 2021: https://vivarail.co.uk/one-of-our-emission-free-suite-of-trains/

As an Island community and tourist destination, arguably the most significant transport sector and associated infrastructure is for marine transport, heavily linked to the Island's ferry services across the Solent. The Isle of Wight has three ferry operators, Wightlink, Red Funnel and Hovertravel, with connections at different locations along the south coast of England to the north side of the Island (see Figure 10). The potential for the future electrification of ferries operated by these companies, and the associated additional Island electricity demand that could be created, is explored in more detail in the future transport demand electrification section of this report.

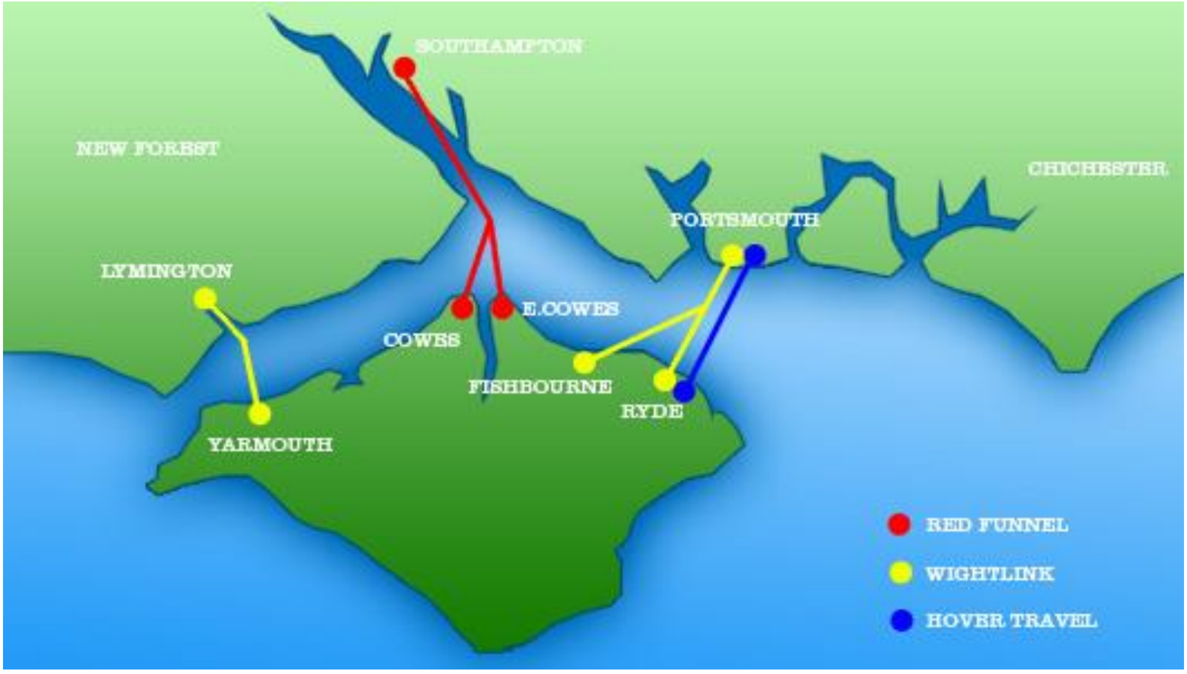


Figure 10: Map of Isle of Wight ferry links | *Source and credit: Welcome to the Island travel info*

Alongside this, there are a number of active harbours and marinas on the Isle of Wight with potentially hundreds of leisure boats and other private vessels visiting and mooring at various locations. As a further source of potentially significant electrification, shore power is a crucial area for further analysis for the Island's electricity system.

Isle of Wight net zero strategy

Following their climate emergency declaration in July 2019[8], in September 2021 the Isle of Wight Council published *Mission Zero*, a climate and environment strategy for the Island, covering the period of 2021 to 2040[9]. This strategy set out the council's aspirations and targets to achieve net-carbon zero for its own operations and also across the wider Island.

The strategy defined a number of targets to achieve net zero carbon emissions:

- For the Isle of Wight Council's operations by 2030 (which make up less than 1% of the Island's total carbon emissions)
- For Isle of Wight school operations by 2035
- For emissions across the wider Island by 2040

The strategy is focused on emissions reductions, minimising the use of offsets to no more than 15%. This net zero target requires significant action across a number of sectors, aiming to reduce carbon emissions across space heating, commercial and industrial users, road transport, marine transport, agriculture & livestock and electricity generation. See Figure 11.

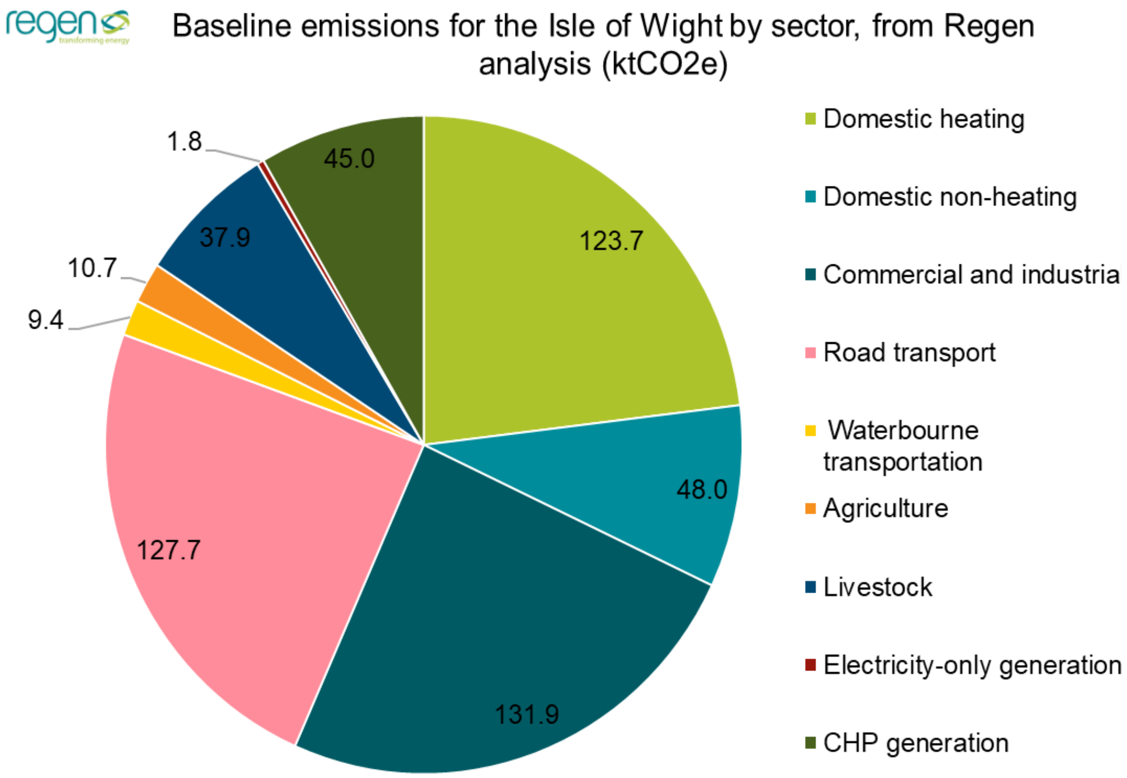


Figure 11: Isle of Wight 2019 carbon emissions, by sector

Source: Isle of Wight Net Zero energy analysis, Regen, 2019

[8] See Isle of Wight Council Climate Change web page: https://www.iow.gov.uk/Residents/environment-planning-and-waste/Future-Energy-Initiatives/Climate-Change/Climate-Change-and-the-IWC

[9] See *Mission Zero – Climate and Environment Strategy 2021-2040*: https://www.iow.gov.uk/azservices/documents/2570-Mission-Zero-Climate-and-Environment-Strategy-2021-2040-final.pdf

The *Mission Zero* strategy outlined a climate and environment action plan, which includes a number of strategic outcomes and outputs from the established Isle of Wight Energy Hub.

> ***"The Isle of Wight Council will seek projects and partnerships to maximise energy efficiency and renewable energy generation through a smart energy network."***
> Isle of Wight climate and environment action plan, Sep 2021

There are specific outputs included to address the network constraints. See Figure 12.

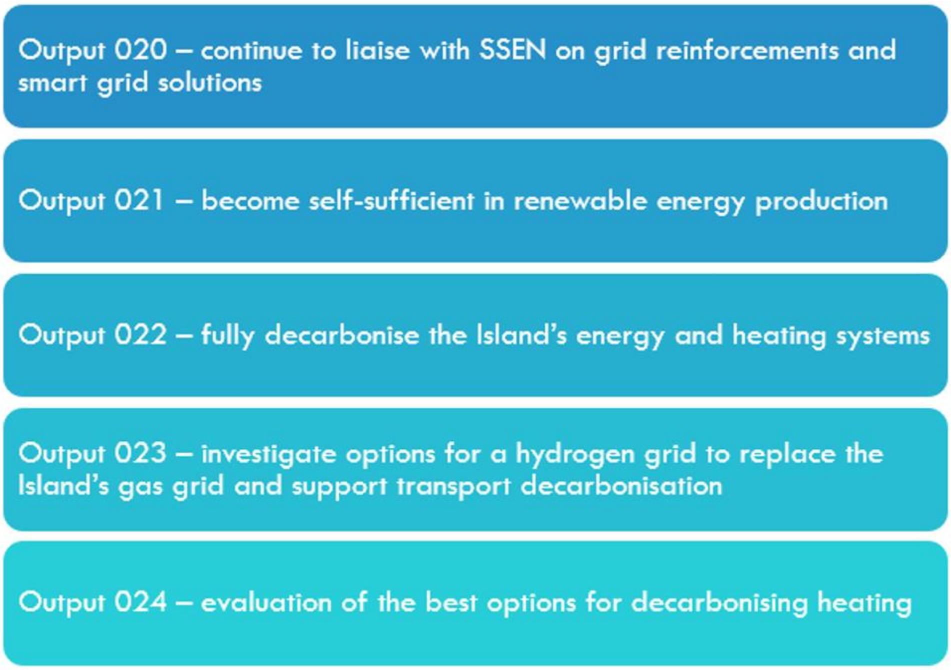


Figure 12: Energy outcomes from Isle of Wight Mission Zero strategy
Source & credit: Isle of Wight Council

Alongside these commitments, Regen's work with the Isle of Wight Council in 2020 highlighted a number of potential sectoral pathways to achieve net zero by 2030 and 2040. In order to align with a target of Island-wide net zero emissions by 2040, the pathway and uptake rates proposed for transport, heat and power at the time are summarised in Table 8. Whilst these figures provide one potential view of sectoral net zero pathways, it is recognised that a number of factors have changed since the analysis, such as renewable energy development, interest in battery storage projects and low carbon technology adoption. These pathways, however, remain a useful basis for this evidence case to build upon.

Output 021 of the Isle of Wight net zero strategy seeks to have full self-sufficiency on energy from on-island renewables. This will need to involve significant renewable generation deployment, flexibility (i.e. storage, DSR) deployment and more granular forecasts for all sources of electricity demand. The sectoral pathways shown in Table 8 are a view of meeting 70% of known demand, as an example of the scale of generation that could be seen by 2030/40. It understood that additional capacity beyond this could be seen at distribution and potentially transmission level, plus some residual grid-imports from the mainland.

Table 8: Energy sector pathways to achieve net zero emissions on the Isle of Wight by 2040

Sector	Pathway/uptake rate to achieve net zero by 2040
Electricity generation	The existing 140 MW unabated diesel oil OCGT site at Cowes would need to be decommissioned by 2030. An additional 278 MW of solar PV and 24 MW of onshore wind or other renewables operational by 2040, enabling 70% of electricity demand to be met by on-Island renewables.
Road transport	An average of 83 electric vehicles (EVs) would need to be registered per week from April 2020 to December 2030, displacing ICE vehicles.
Marine transport	Considerable electrification, green hydrogen or other low carbon fuel conversion would needed for the ferry fleet by 2040, with marine transport emissions stabilising at 5 kTtCO$_2$/Year.
Domestic heating	An average of 50 heat pumps would need to be installed per week from April 2020 to December 2040. An average of 40 EPC D-G homes would also need to be retrofitted to EPC A-C per week from April 2020 to December 2030, alongside additional improvements to existing EPC A to C homes. This would result in a c.22% decrease in domestic electricity demand for domestic space and water heating by 2040.
Commercial and industrial	Overall, energy demand from commercial and industrial buildings would need to fall by 31% by 2030. This would include a 16% improvement in energy efficiency, coupled with c.60% of fossil gas fired processes switching to electrified solutions, including efficient heat pumps.

Economic impact and development

Island businesses, and the Island as a whole, have suffered economic impacts from the lack of firm connection availability since 2012. It has felt the impact of this in numerous ways:

- Fewer jobs in the construction of renewable energy projects
- Fewer jobs in the repair and maintenance of renewable energy equipment
- Delayed development of tidal energy, a new industrial sector for the Island
- An inability to connect embedded generation, for example rooftop PV, resulting in higher energy costs and reduced competitiveness for Island businesses.

Many other organisations, across the public and voluntary sectors, including schools, hospitals and community buildings, have also suffered from the inability to connect renewable energy systems and the missed energy cost savings that these would have provided. It is understood that multiple megawatts of embedded generation capacity have been lost/stalled. Farmers have also suffered from the inability to connect solar and wind projects, reducing rental income and increasing energy costs in the sector.

Turning this around, there are key economic benefits from jobs, supply chains and cost reductions in various sectors, from re-enabling renewable energy development on the Island. The route to enable this is through investment in the electricity network, unlocking constraints and getting the pipeline of commercial and grid scale projects flowing again.

Conclusion 1: The Isle of Wight Council's climate emergency declarations and net zero pathway analysis suggest the need for significant levels of new renewable energy capacity, alongside aspirations to decarbonise road transport, marine transport, domestic heating and commercial processes on the Island. These conclusions all increase the need for a significant investment in the Island's distribution network infrastructure. This could also enable a number of wider economic benefits for the Island.

In addition to the headroom created and already utilised through the implementation of the existing ANM scheme, investment in the network will be needed to unlock additional generation headroom capacity and to create further demand capacity to meet future transport and heat electrification.

Recommendation 1:

SSEN should consider the evidence presented in this report and how it builds on the council's Mission Zero strategy, to ensure that the Isle of Wight's electricity network can meet the demand for new renewable generation, storage and load growth in the near term and enable the connection of up to (or potentially in excess of) c.300 MW of new renewable energy capacity, required to meet the Island's net zero targets, in the longer term.

The Isle of Wight electricity system

Existing electricity network infrastructure

The Isle of Wight's electricity system is supplied by a meshed 132 kV network, fed by three 132 kV subsea cables from the Fawley Grid Supply Point (GSP) in Southampton. Two of these 132 kV circuits (and associated subsea cables) are fed from Fawley GSP to Wootton Common Bulk Supply Point (BSP), via the Langley BSP in Southampton. The third 132 kV subsea cable from Fawley GSP is fed directly to Cowes BSP and is utilised by Cowes Power Station, a 140 MW fossil-fuel open-cycle gas turbine (OCGT) power plant operated by RWE[10].

Two additional 132 kV link cables are present on the Isle of Wight, connecting Cowes BSP and Wootton Common BSP to each other – enabling the meshed network structure. An overview of the network cable connections is shown in Table 9.

The on-Island 33 kV electricity network then distributes power across the Island to various 33-to-11 kV substations (see Figure 13), including:

- Newport, Gurnard and Cowes on the north of the Island
- Freshwater and Shalfleet on the west side of the Island
- Binstead, Ryde St Johns and Rowborough on the east side of the Island
- Sandown, Shanklin and Ventnor on the south side of the Island.

The associated 11 kV and LV network infrastructure then distributes electricity at lower voltages to all connected customers across the Island, including coverage in rural and lesser populated areas, as can be seen in Figure 14.

Table 9: Table of minimum capacity ratings and length of 132 kV circuits feeding the isle of Wight

Circuit	Min Rating (MVA)	Cable Length (km)
Fawley-to-Wootton Common 1	99	19.17
Fawley-to-Wootton Common 2	99	19.41
Fawley-to-Cowes	120	17.43
Cowes-to-Wootton Common 1	122	5.34
Cowes-to-Wootton Common 2	122	5.34

[10] See Cowes Power Station overview, Wikipedia: https://en.wikipedia.org/wiki/Cowes_Power_Station

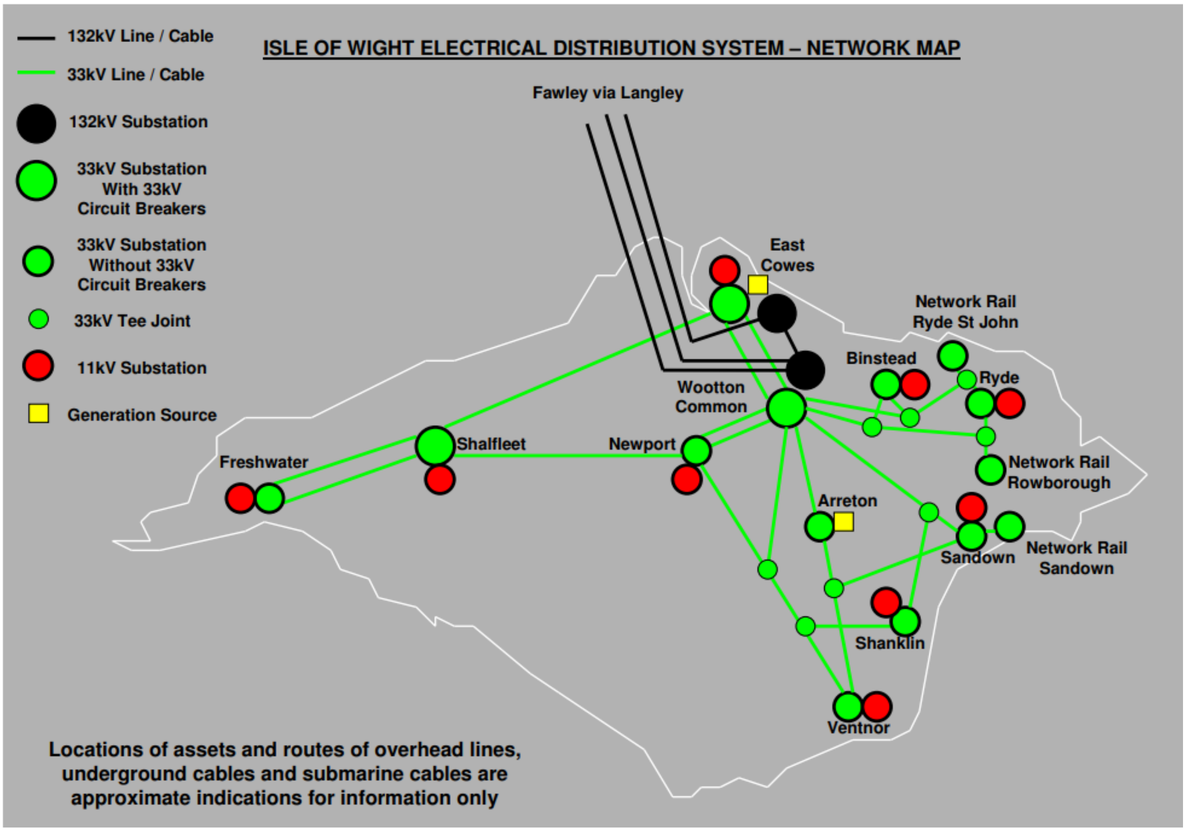


Figure 13: Map of Isle of Wight electricity network infrastructure | *Source and credit: Grontmijj*

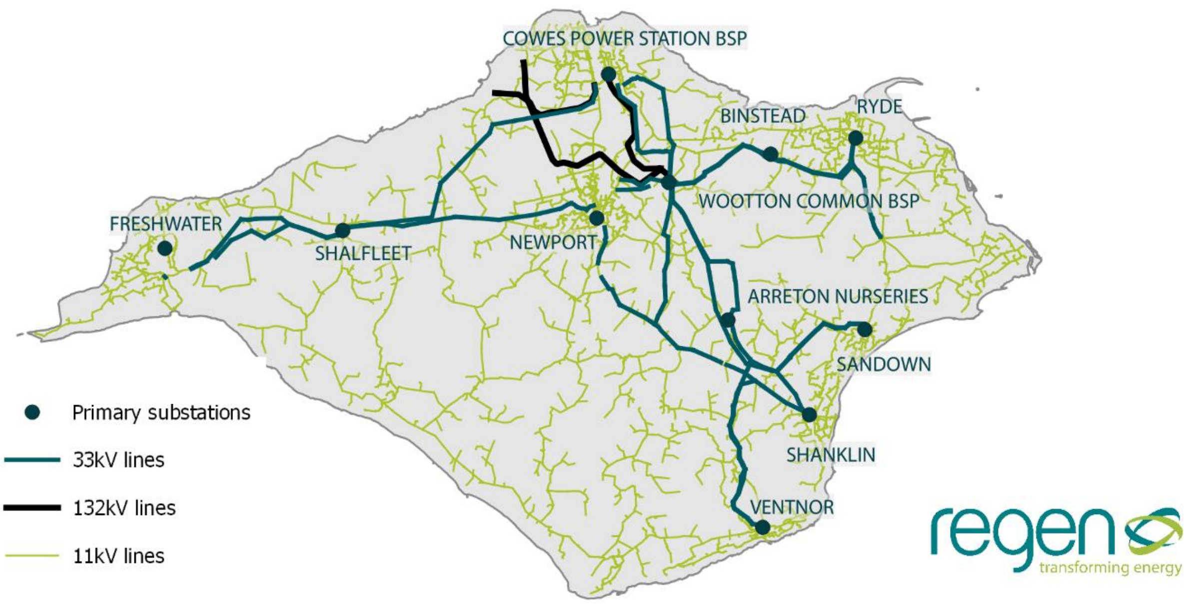


Figure 14: Isle of Wight network route map, showing primary substation and 132, 33 and 11 kV network lines

Electricity generation on the Isle of Wight

As of October 2022, there are currently c.20 large-scale generation sites and over 3,100 small-scale solar arrays connected to the electricity distribution network on the Isle of Wight, these collectively total 252 MW. This is dominated by fossil-fuel generation, with the large 140 MW Cowes Power Station (gas-oil OCGT) and c.22 MW of gas CHP (2 sites) operating on the Island. However, there is also 66 MW of solar PV and 3.5 MW of waste/bioenergy generation in operation. From available data, the Island also hosts c.3,100 small-scale solar PV arrays (many domestic), totalling an additional c.17.5 MW. See Table 10.

Table 10: Breakdown of distributed electricity generation connected and operating on the Isle of Wight, by technology (Oct 2022)

Generation Technology	Number of sites	Capacity (MW)	Data Source
Fossil fuel OCGT (marine diesel)	1	140	SSEN connection data
Fossil gas CHP	2	22	SSEN connection data
Solar PV (>1 MW)	13	66	SSEN connection data
Solar PV (<1 MW)	3,133	17.5	Ofgem solar PV MCS & ROOFIT datasets
Biogas / anaerobic digestion	4	2.7	SSEN connection data
Waste fired generation	2	3.5	SSEN connection data
Total	**3,155**	**252**	

Most of the existing rooftop solar PV is located on the west of the Island and in the central PO30 postcode area. A considerable amount is also concentrated around Yarmouth, as can be seen in Figure 15.

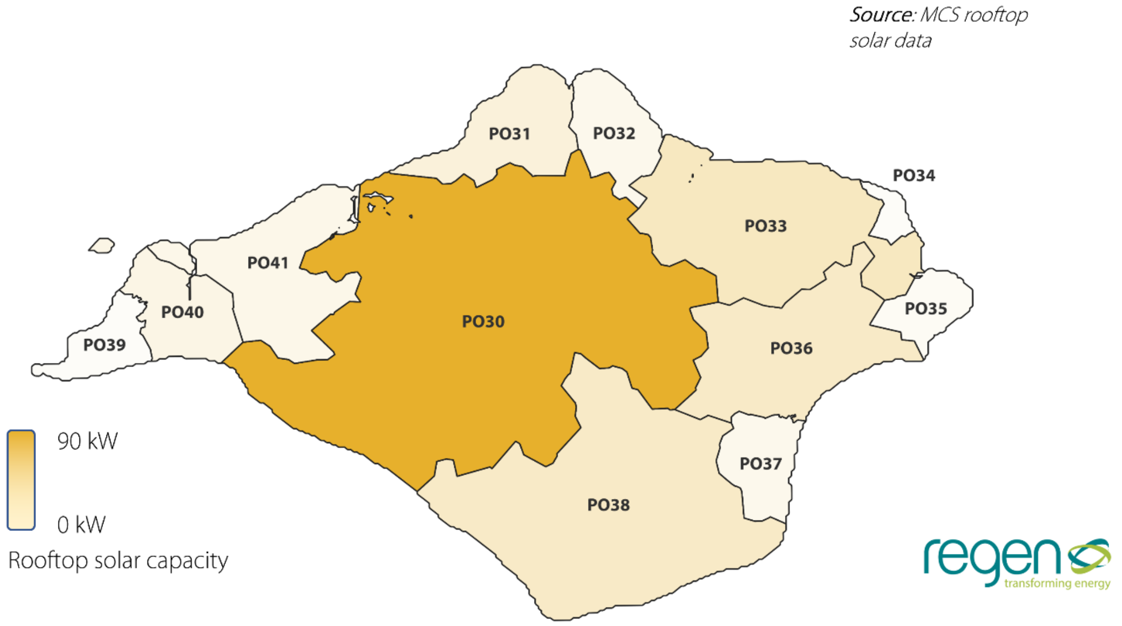


Figure 15: Map of existing connected rooftop solar PV on the Isle of Wight, by postcode

Part of the reason for the significance presence of solar projects and rooftop arrays on the Island is the high levels of solar irradiance in the region, amongst the highest in England, as can be seen in Figure 16.

However, existing network constraints are preventing solar developers and businesses from exploiting the high solar resource on the Island. Engagement with the Isle of Wight Council indicated that c.230 MW of rooftop PV could be deployed across the Island.

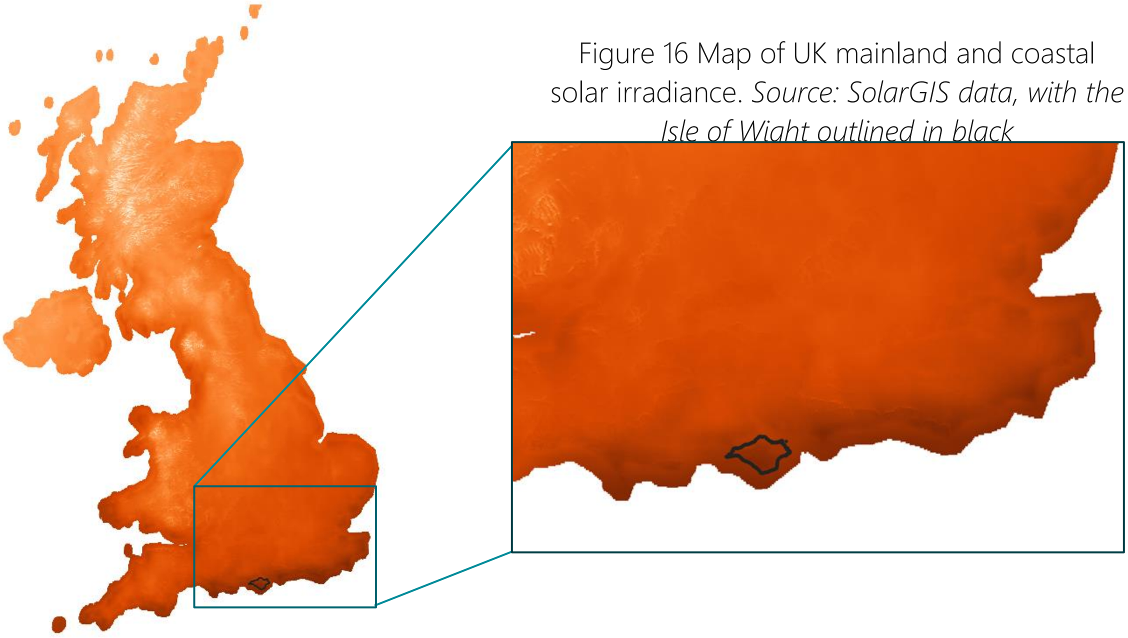


Figure 16 Map of UK mainland and coastal solar irradiance. *Source: SolarGIS data, with the Isle of Wight outlined in black*

Isle of Wight network operation, constraints and reinforcement

As part of SSEN's underlying responsibilities as the network operator, they are required to develop plans to prepare for and, if needed, respond to a number of network events. These include the loss of supply or availability of the in-situ 132 kV network substation assets, associated subsea cable connection and other voltage tier infrastructure (i.e. so-called N-1 loss events). These events will result in constraints being applied to various parts of the network, including on the Isle of Wight.

In order to plan for these events, SSEN has developed and is implementing strategies to mitigate the existing constraints that are being applied to the various Isle of Wight network assets. These mitigation strategies are summarised below.

Distribution Generation Automatic Disconnection (DGAD)

DGAD was introduced by SSEN in April 2015 to automatically trip existing generation assets when the 140 MW Cowes Power Station ramps up. The first generation site was connected to the DGAD system in December 2015.

Active Network Management (ANM)

The DGAD system was replaced by the Isle of Wight ANM scheme, commissioned by SSEN. This dynamic monitoring system measures power flows in real-time at three monitoring points on the network (one for each subsea cable) see Figure 17.

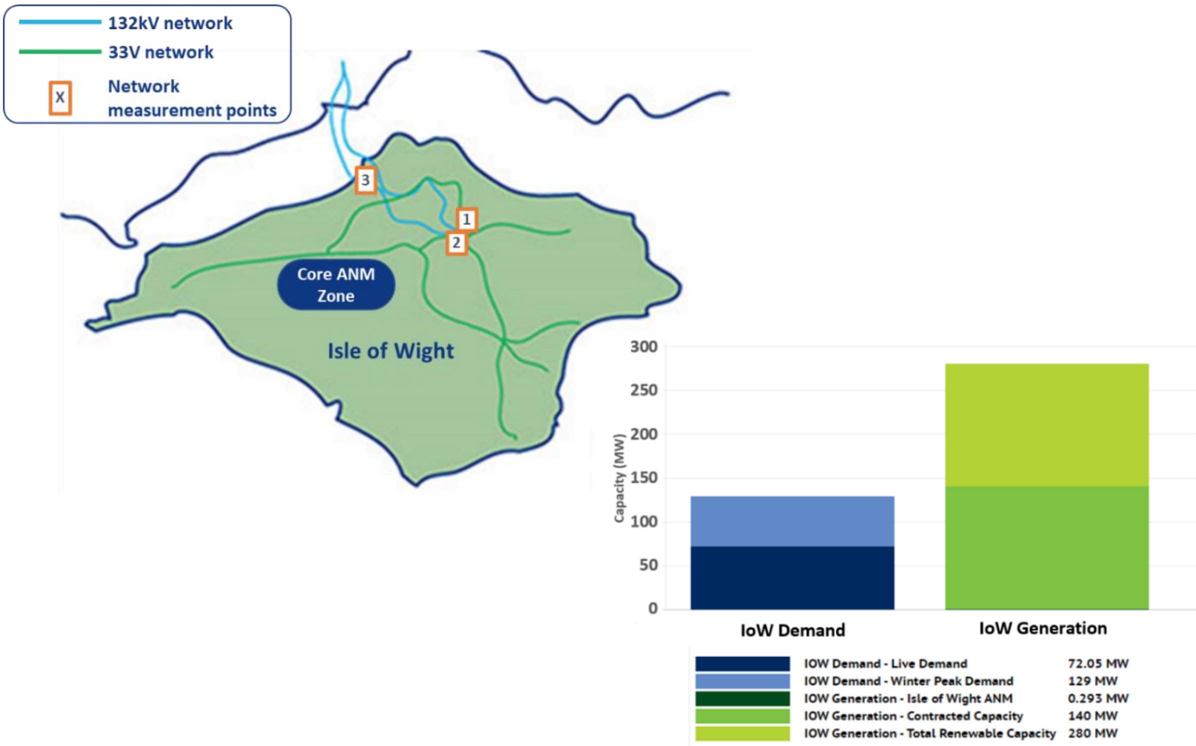


Figure 17: Overview of the SSEN Isle of Wight Active Network Management Scheme

This ANM system sends control signals to curtail (i.e. ramp-down) multiple renewable energy generators that are part of the scheme, based on a combination of real-time power flow measurements and specific pseudo set point values coded into the ANM' control philosophy.

Active Network Management – Primacy rules and Cowes Power Station

The Isle of Wight ANM control philosophy includes a specific setpoint that presumes Cowes Power Station is available to fully export (140 MW) at all times. This setpoint relates to primacy rules[11] for generators that are connected to the distribution network, but also commercially contracted with National Grid ESO to deliver ancillary services, such as STOR, the Balancing Mechanism or the Capacity Market. This has driven the design of the Isle of Wight's ANM control system to 'reserve' 140 MW at the associated subsea cable connection point for Cowes, as it is has a firm connection agreement with SSEN and is contracted under a number of commercial services, including a long-term Capacity Market contract (transferred from RWE's now decommissioned Aberthaw site[12]), the Balancing Mechanism and Black Start.

As can be seen in Figure 18 and Table 11, Cowes Power Station generates intermittently across the year, showing an average load factor of 0.08%, generating 4 GWh and only operating 63.5 hours across 40 days since Jan 2019. This suggests that there is a large proportion of each year that other generation sites could utilise the 140 MW of export capacity, when Cowes is not contracted to be available for a balancing service ahead of dispatching and actually generating.

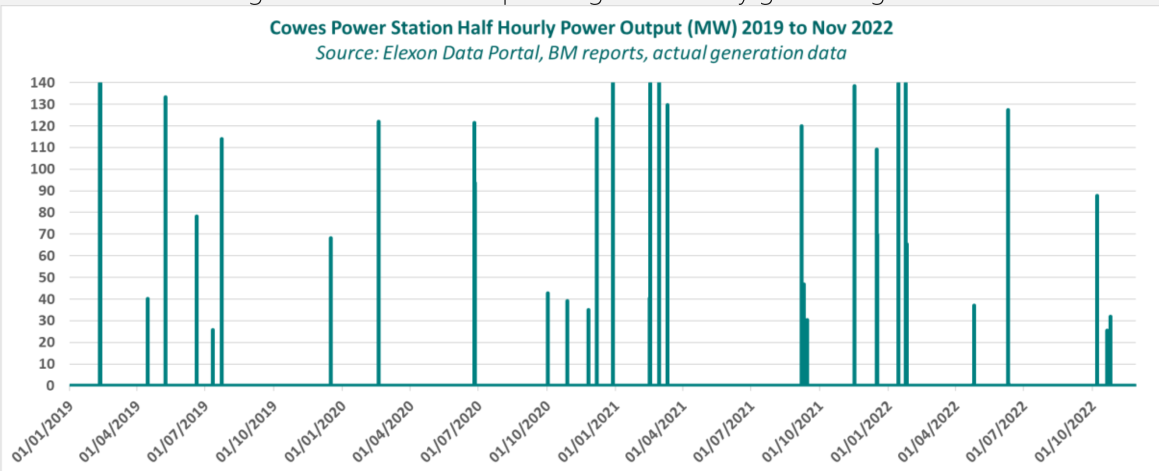


Figure 18: Half hourly power output (MW) of Cowes Power Station 2019 to Nov 2022

Table 11: Cowes Power Station operating statistics 2019 to Nov 2022

	2019	2020	2021	2022	Average
Total volume of generation (MWh)	521	583	1537	1334	994
Number of hours generating	10	11	29	14	16
Average load factor	0.04%	0.05%	0.13%	0.10%	0.08%

Through ongoing work under Open Networks Workstream 1A, the ENA is assessing how primacy rules could be adapted and how measures such as ANM could be based on more dynamic monitoring of balancing auction results and specific availability windows. We understand that further decisions and results of the ENA's analysis are to be published in early 2023.

Since coming into operation, the Island's DGAD and ANM schemes installed by SSEN have enabled a number of new generation sites to be contracted to connect on the Isle of Wight. However, even with this monitoring and control in place, generation headroom has been fully consumed through recently contracted offers, and the Island is again 'full', preventing new generation from connecting without significantly high upstream connection costs and likely long reinforcement timescales.

[11] See ENA Open Networks Primacy Rules Draft Update, April 2022: https://www.energynetworks.org/industry-hub/resource-library/on22-ws1a-p5-primacy-draft-rules-increment-1-(28-apr-2022).pdf

[12] See article summarising transfer of part of Aberthaw Power Station Capacity Market Capacity Agreement to Cowes Power Station in 2019: https://www.spglobal.com/commodityinsights/en/market-insights/latest-news/electric-power/080919-uks-peterhead-west-burton-take-on-aberthaw-cm-obligation

Conclusion 2: The method by which, under primacy rules, the existing Isle of Wight Active Network Management system applies a fixed set point simulating that Cowes Power Station is available to export at full capacity 24/7, is not reflective of the actual operation of the site. Whilst it is understood that Cowes is contracted with the ESO under a number of critical system balancing services, this assumption is potentially acting as an unintended barrier to some additional renewable energy capacity from applying to connect under the existing ANM scheme. However, there is uncertainty around what proportion of the year would be 'uncapped' if a more dynamic market-linked availability measurement approach was implemented as part of the ANM control system. If multiple availability windows need to remain reserved to reflect Cowes Power Station's participation in multiple balancing services, this could result in a significant number of days of the year being unavailable for other generators to utilise the 140 MW headroom created. This could be detrimental to the business case for a new solar PV project or multiple projects and prevent any projects from going ahead, despite a more dynamic method of applying ANM control on the Island.

Recommendation 2: SSEN should stay closely engaged with the outcomes and recommendations of ENA's Open Networks Workstream 1a Product 5, which is looking at primacy rules and ANM assumptions.

Modifying the ANM control system to uncap 140 MW for a proportion of the year could enable some new generation projects to be developed and to operate, until wider network capacity headroom is created.

Demand headroom - upstream network reinforcement

As described in Figure 13, the Isle of Wight's electricity system is fed via subsea cables that connect to the transmission network at Fawley Grid Supply Point (GSP) substation near Southampton. In mid-2022, a third supergrid transformer (SGT) was successfully installed and commissioned at Fawley GSP. This has resultantly increased overall import/demand capacity headroom for the Isle of Wight to c.**160 MVA**. However, more import capacity is available for customers connecting at bulk supply point (33-to-132 kV) or directly to the 132 kV network, as local capacity headroom across the Island is limited to the operational limits of the 11 kV (primary) substations and circuits, and upstream 33 kV assets. Table 12 summarises demand headroom and constraints associated with the primary substations across the Island.

Table 12: Summary of the import capacity headroom on the Isle of Wight primary substations

Primary Substation	Import Headroom	Associated Constraint
Newport	5 MVA	Upstream 33 kV circuits
Cowes	10 MVA	Primary transformers
Shalfleet	7 MVA	Primary transformers
Freshwater	7 MVA	Primary transformers
Binstead	9 MVA	Primary transformers
Ryde	13 MVA	Primary transformers
Sandown	3 MVA	Upstream 33 kV circuits
Shanklin	3 MVA	Upstream 33 kV circuits
Ventnor	12 MVA	Primary transformers

Generation headroom - network reinforcement

Whilst there is currently notable import/demand headroom on the Island's electricity system, and the operational ANM scheme has released some additional export/generation headroom, the Island is currently totally constrained on generation. These constraints are at both the local 11 kV and 33 kV circuit levels, as well as at the upstream 132 kV level, and are preventing any additional distributed generation from connecting without triggering significant and costly network reinforcement.

The SSEN Network Planning Team have identified the network infrastructure reinforcements that would be needed to unlock additional generation headroom capacity and thus enable new renewable energy (or other generation and storage) projects to connect cost-effectively.

These reinforcements can be segmented into three network areas:

1. **Reinforcement to on-Island 11 kV, 33 kV and 132 kV assets**
2. **Reinforcement to 132 kV subsea network infrastructure**
3. **Reinforcement to on-mainland 132 kV assets connecting to Fawley GSP**

The phased delivery of potential reinforcements can also be categorised as follows:

1. **Existing works being progressed on the Isle of Wight network assets**
2. **The first phase of onshore network infrastructure reinforcement**
3. **Upgrade of subsea and upstream network infrastructure**

Existing reinforcement works are being progressed by SSEN to tackle generation constraints. These existing works are currently ongoing and are due to be completed by 2024/25. See summary in Table 13.

Table 13: Table of existing network reinforcement activities on the Isle of Wight

Existing reinforcement work	Cost	Due to be completed
Wootton Common BSP transformers load blinder reinforcement	£65k	By 2024
Upgrade to Cowes BSP 33 kV circuit breakers	£1m	By 2024
Upgrade to Newport primary 11 kV circuit breakers	£1.1m	By 2024
Ventnor-to-Newport 33 kV overhead line circuit reinforcement	TBC	By 2024
Upgrade to Wootton Common BSP 33 kV circuit breakers	TBC	By 2025

These existing reinforcement activities are already fully funded by SSEN, but do not alleviate the existing generation constraints. In addition to these actions, Table 14 provides an overview of the £55m of additional phased strategic network reinforcement required, to release up to 150 MVA of generation headroom. The real costs to undertake these reinforcement works would be subject to variable material and labour costs, and a more accurate figure would require SSEN to source direct quotes from contractors and suppliers. But £55m is an indicative estimate for the types of works required on the Island, on the mainland and on the subsea cabling.

Table 14: Phased network reinforcement to unlock generation headroom on the Isle of Wight

Phasing	Description of reinforcement activity	Cost	Cumulative export capacity headroom
Phase one	Upgrade onshore sections of Fawley-to-Cowes 132 kV circuit	£42m	+100 MVA
	Construction of one new Fawley-to-Cowes 132kV circuit, following the existing route, which includes an additional, 4th, submarine cable		
Phase two	Upgrade onshore Fawley-to-Wootton Common 132 kV sections	£13m	+50MVA
Total reinforcement		**£55m**	**150 MVA**

This shows a benchmark figure of **c.£367,000/MW** of network capacity delivered. This is a higher cost per MW than some other network reinforcement schemes. However, due to the submarine cable and coastal landing nature of the Isle of Wight's network infrastructure, a higher capital cost per MW delivered is to be expected.

Whilst a direct comparison is difficult to identify, there are other Island cable connections that provide context.

At transmission network level:

- The Shetland HVDC link releasing 600 MVA of capacity at a cost of £642m[13] - a cost benchmark of c.£1m/MW
- The initial Western Isles Transmission Project proposed a transmission cable from Arnish-to-Beauly, releasing 600 MVA of capacity at a cost of £623m – a benchmark of c.£1m/MW. This has been superseded by the recently announced 1.8 GVA link to the Western Isles by SSEN-Transmission, confirmed by the ESO and approved by Ofgem[14]. The full cost of this reinforcement is unknown.

At distribution network level:

- The Pentland Firth East 33 kV connection between Orkney and the Scottish mainland (enabling c.10 MW) at a cost of £30m.[15]
- The installation of a 33 kV subsea cable between the Isles of Scilly and the Cornish mainland, enabling 5.5 MVA of firm capacity at a cost of £7m.[16]
- The 90 kV subsea cable from Douglas Head on the Isle of Man to the 132 kV network at Bispham in Blackpool, creating 40 MVA of on-Island capacity.[17]

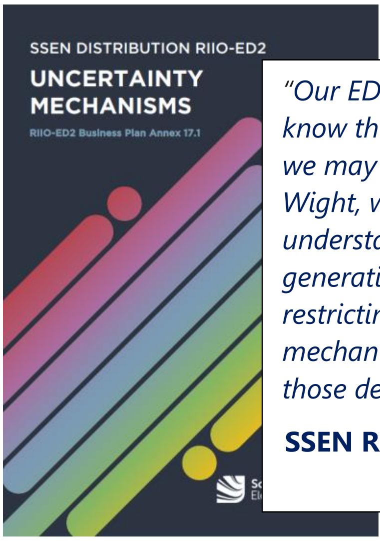
[13] See Ofgem final decision on Shetland HVDC link, November 2021: https://www.ofgem.gov.uk/sites/default/files/2021-11/Shetland%20Link%20Project%20Assessment%20Decision%20FINAL.pdf
[14] See article summarising a number of subsea cable connections in the North of Scotland: https://www.sse.com/news-and-views/2022/12/ofgem-approves-transmission-investments-required-for-2030-government-targets/
[15] See: https://www.nsenergybusiness.com/news/sse-replaces-submarine-electricity-cables-scotland/
[16] See: http://wpehs.org.uk/wp-content/uploads/2020/04/Sup048IoSElectrification.pdf
[17] See: https://www.gov.im/media/1363407/ch-61-cables-pipelines.pdf

The Isle of Wight in SSEN's RIIO-ED2 business plan

No strategic network reinforcement was included for the Isle of Wight as part of SSEN's final RIIO-ED2 business plan submission to Ofgem[18], based on the evidence available at the time. However, as part of the ED2 planning process, SSEN committed to completing a specific study to gain a more granular understanding of potential future load growth on the Island[19]. The study's aim was to assess if the relatively low pipeline of contracted projects seen in SSEN's DFES 2020 analysis was representative of the true level of demand/project activity that could be seen if network headroom was created. The key output of the study was a body of evidence around potential future load growth, enabling SSEN to consider what could be funded under the ED2 Uncertainty Mechanism. See commitments in the main business plan (Figure 19) and in Annex 17.1 - Uncertainty Mechanisms (Figure 20).

> *"The Isle of Wight local authority has asked that we work closely together to understand how net zero will affect our network on the Island. Our business plan is just the first step in our planned ongoing engagement with local authorities throughout RIIO-ED2. We have also proposed a distinct net zero Islands study in the Isle of Wight in early 2022 to gain a more granular understanding of potential generation in the area, working with the council, developer community and local stakeholders, to understand what activities will be funded through our uncertainty mechanism."*
>
> **SSEN RIIO-ED2 business plan, "Co-creating our DFES"**

Figure 19: SSEN RIIO-ED2 business plan submission to Ofgem



> *"Our ED2 baseline was constructed from scenarios developed in 2020. We know that these can evolve over time; for example, a key use case of how we may use this uncertainty mechanism in the ED2 period is on the Isle of Wight, where we will continue to work with local stakeholders to understand enduring investment requirements. Should growth in load or generation exceed our forecasts and to avoid system constraints from restricting local aspirations in achieving net zero, the uncertainty mechanism would enable us to invest in system upgrades in addition to those detailed within our plan."*
>
> **SSEN RIIO-ED2 business plan – Annex 17.1 Uncertainty Mechanisms, "Working with stakeholders to understand the future"**

Figure 20: SSEN RIIO-ED2 business plan - Annex 17.1 document on Uncertainty Mechanisms

[18] See *Powering Communities to Net Zero*, SSEN, August 2022: https://ssenfuture.co.uk/
[19] See SSEN ED2 final business plan, "1.2.1 Co-creating our DFES", p.96: https://ssenfuture.co.uk/wp-content/uploads/2021/12/24645-SSEN-ED2-Final-Business-Plan-Website.pdf

Future electricity load growth on the Isle of Wight

Future distributed electricity generation and storage capacity on the Isle of Wight

Electricity generation and storage pipeline

There is an existing baseline of **252 MW** of distributed generation operating on the Island today (see Table 10 and Figure 21). This is dominated by three fossil fuel generation sites and a small number of operational large-scale solar projects.

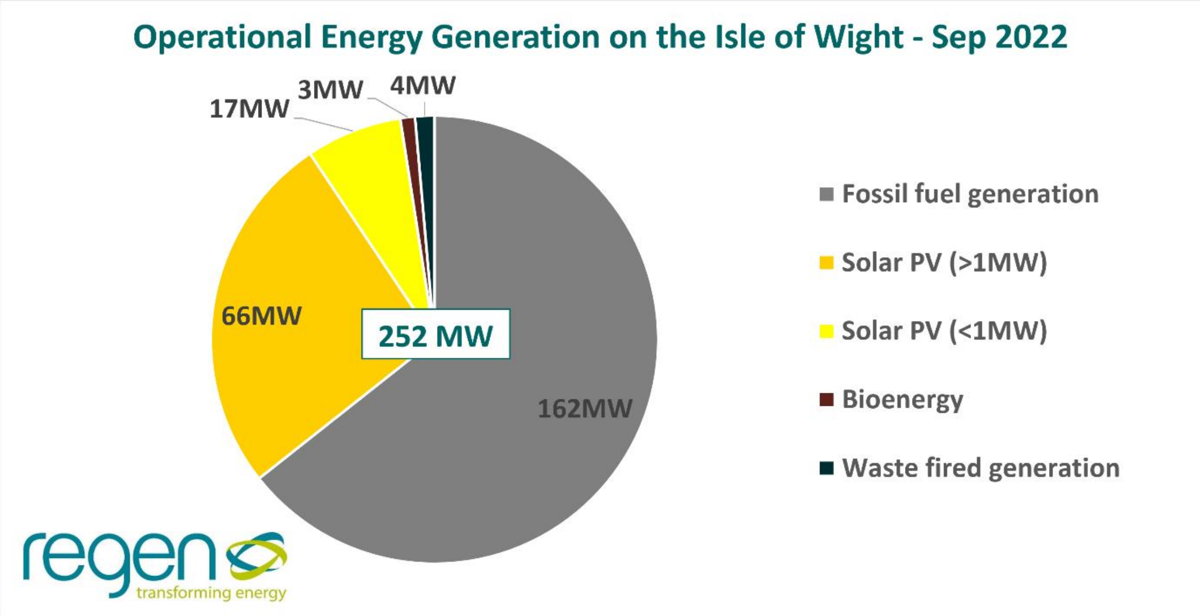


Figure 21: Pie chart of operational electricity generation on the Isle of Wight

The larger generation sites are mostly located on the north side of the Island, avoiding the Island's area of outstanding natural beauty (see Figure 22).

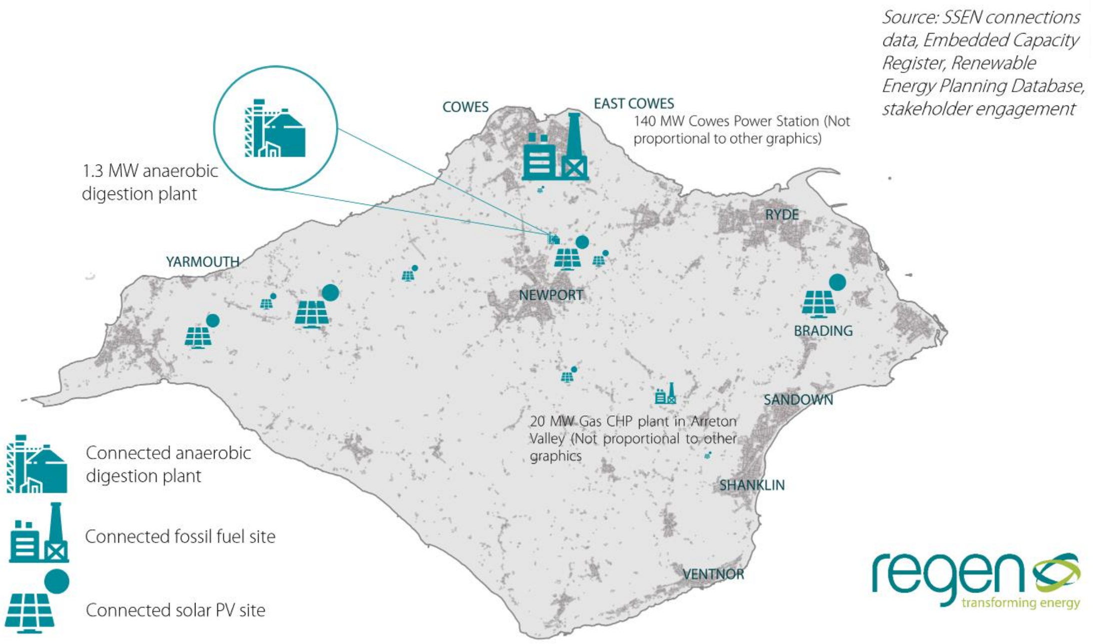


Figure 22: Map of baseline electricity generation sites on the Isle of Wight

DFES projections for generation and storage on the Isle of Wight

Regen has been developing Distribution Future Energy Scenarios (DFES) projections for SSEN's North of Scotland and Southern Central England licence areas since 2018. The DFES 2020 analysis showed only a limited pipeline of contracted/active generation projects and no battery projects on the Island.

In the DFES 2020, under the Leading the Way scenario, Cowes Power Station and other gas CHP sites were assumed to be rapidly decommissioned, alongside a moderate projection of new renewable energy and battery storage capacity, see Figure 23. Compared to the 2019 baseline of 77 MW, this projection equated to total additional renewable energy capacity of:

- 19 MW by 2030
- 153 MW by 2040
- 214 MW by 2050

As well as the development of c.18 MW of battery storage by 2050.

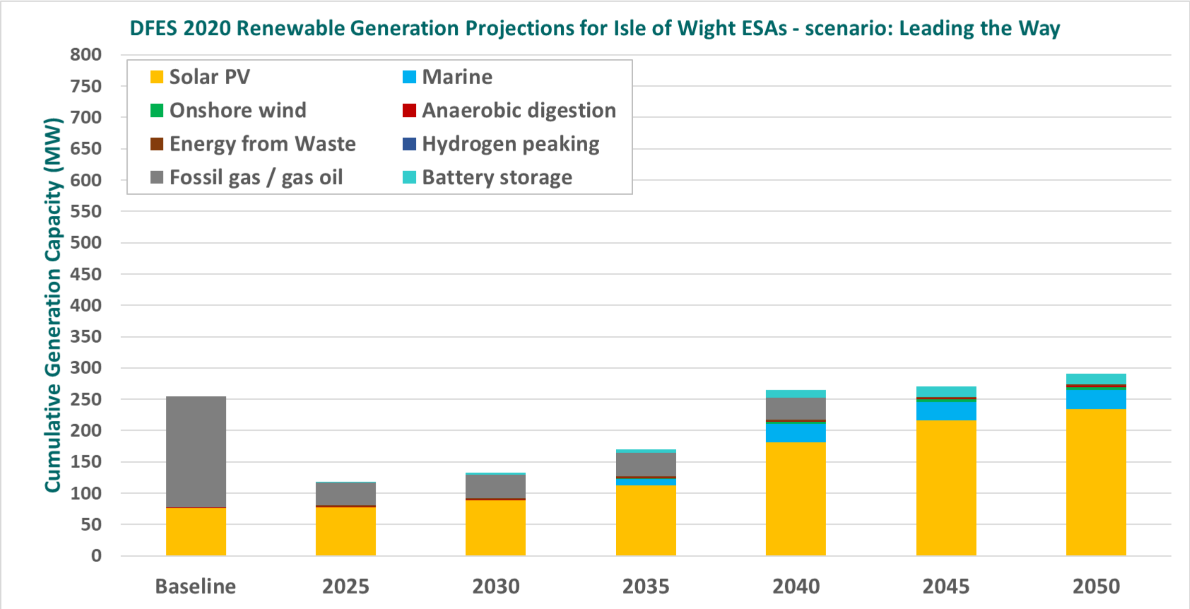


Figure 23: SSEN DFES 2020 projections for cumulative distributed generation and storage capacity on the Isle of Wight out to 2050 under the Leading the Way scenario

To support the DFES 2021 analysis, Regen held a targeted engagement workshop with key representatives from the Isle of Wight. This engagement was used to inform and shape the projections associated to the 11 kV primary substation areas on the Island.

The engagement provided feedback that the 2020 projection of renewable energy generation did not sufficiently reflect the council's net zero commitments and sectoral pathways for generation (see Table 8), nor the known developer interest in new renewable energy projects. The DFES 2021 also considered the potential for Cowes Power Station to convert to a low carbon hydrogen fuelled generator, either produced on site or through a future evolution of SGN's gas distribution network in the south of England.

As a result of this engagement, and a more detailed assessment of historically abandoned/ stalled solar and battery connection offers, a more accelerated near-term deployment of new renewable energy generation and battery storage capacity was projected under Leading the Way, alongside the repowering of Cowes Power Station as a hydrogen fuelled generation site by the mid-2030s, see Figure 24.

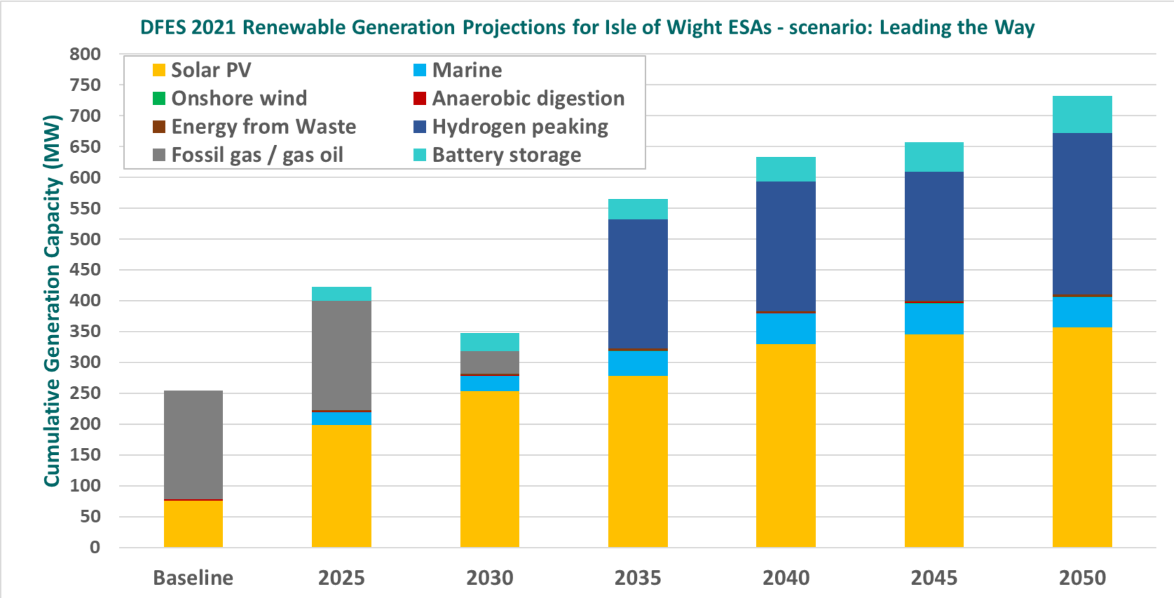


Figure 24: SSEN DFES 2021 projections for cumulative distributed generation and storage capacity on the Isle of Wight out to 2050 under the Leading the Way scenario

This revised analysis suggested that, compared to a 77 MW baseline, additional solar, tidal, onshore wind, bioenergy and battery storage capacity on the Island could total:

- 233 MW by 2030
- 345 MW by 2040
- 392 MW by 2050

In addition to a full repowering of the existing 140 MW Cowes Power Station and other existing fossil gas CHP sites, to larger capacity low carbon hydrogen generation assets.

This resulted in a total distributed generation and storage capacity operating on the Island of **633 MW by 2040,** rising to **731 MW by 2050**.

Through engagement with RWE, the assumption of Cowes Power Station converting to a hydrogen-fuelled electricity generation plant has not been confirmed. The site has recently included the proposed addition of a 7-10 MW battery storage system and a 20MVAr shunt reactor, to enable the site to deliver Black Start services to the System Operator[20]. Therefore, there remains some uncertainty around the future of the 140 MW Cowes site.

[20] See *Aurora Power Consulting*: https://aurora-power.co.uk/cowes-power-station-black-starting-synthetic-inertia/

Updated 2022 generation and storage pipeline information

Based on analysis of SSEN's latest connection data, planning information and wider online research, the study has determined a summary view of the current near-term pipeline of generation and storage projects on the Isle of Wight.

In addition to the 252 MW baseline, there is a pipeline of some **178 MW** of large-scale generation sites seeking to connect to the network. Some recently contracted sites fell under the existing ANM scheme, consuming the headroom that was created by its implementation.

In addition to this, based on an updated view of historic connection enquiries that have expired or have not been pursued (due to very high connection costs), there is a historically abandoned pipeline of **146 MW** that could be revisited, if network capacity was unlocked.

Lastly, an additional **21 MW** of sites were found to have had planning applications that have either expired or been refused, the former of which could also be related to high connection costs. An overview of this pipeline of active and historic sites is shown in Table 15.

Table 15: Summary of active and historic pipeline generation sites on the Isle of Wight

Connection Status	Technology	Number of Sites	Capacity (MW)
Accepted to connect	Solar PV (>1 MW)	1	15
	Battery storage	1	29
	Marine (tidal)	1	20
In development	Battery storage	2	50
	Solar PV (>1 MW)	3	54
	Marine (tidal)	1	10
	Total active pipeline	**9 sites**	**178 MW**
Abandoned/quote expired	Battery storage	1	20
	Onshore wind	1	9
	Solar PV (>1 MW)	5	117
Planning expired/refused	Solar PV (>1 MW)	1	2
	Onshore wind	2	19
	Total historic pipeline	**10 sites**	**167 MW**

Therefore, connection and planning data from mid-2022 shows that there is **up to 344 MW** of additional generation and storage projects that could move through to development, should generation headroom be unlocked on the Island and developer appetite remains (see summary in Figure 25). The majority of these prospective generation and storage sites are located in the east and north of the Island (see Figure 26).

In addition to large-scale projects, microgeneration is also a potential source of future capacity. Engagement with Isle of Wight Council suggests that there is interest in micro wind turbines[21] (<100 kW), which could provide benefit to agricultural customers and small commercial premises. These scale turbines are more positively supported in planning and could be economically viable. However, there is no current significant pipeline evidence for these assets as yet.

[21] See example of 20kW turbines manufactured by Britwind: https://www.britwind.co.uk/

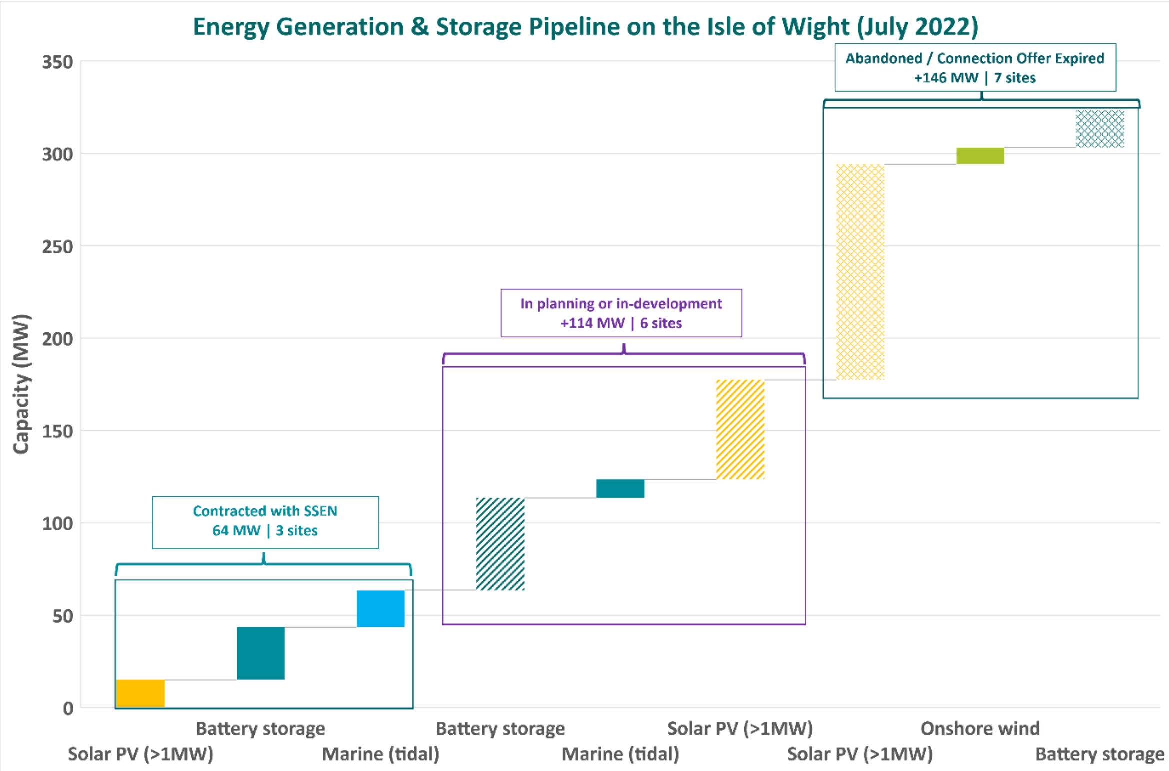


Figure 25: Active and historic pipeline of generation and storage projects on the Isle of Wight

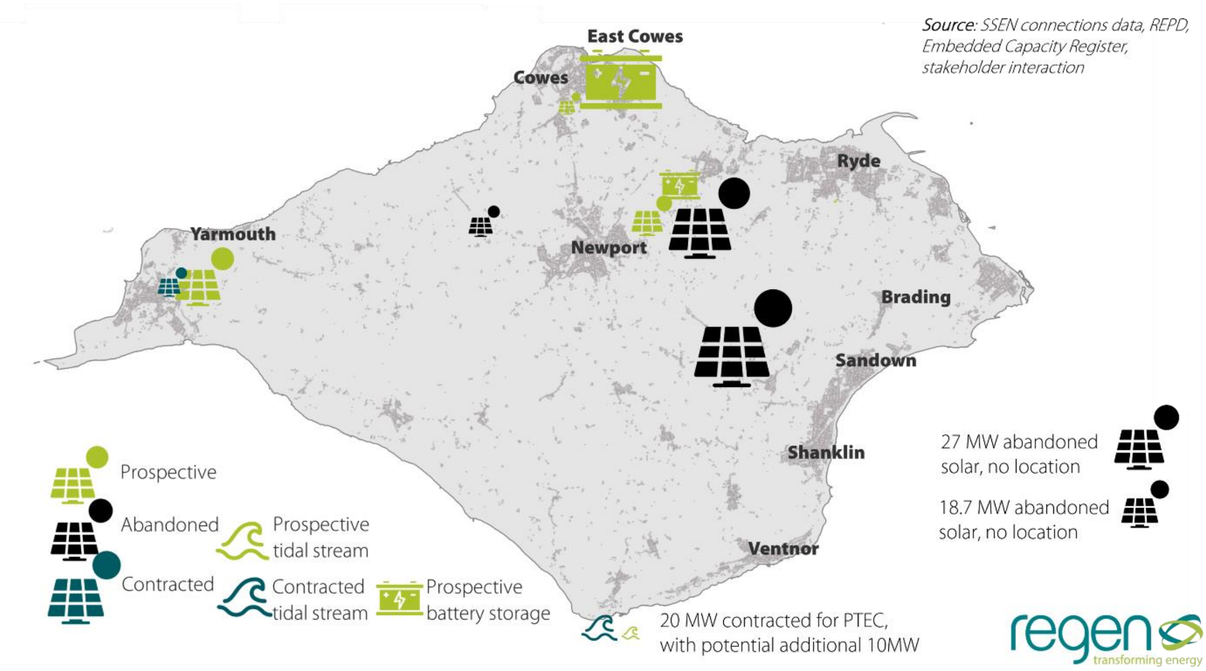


Figure 26: The current and historic Isle of Wight electricity generation and storage pipeline mapped on the island

Stakeholder engagement – distributed generation and storage

To inform the evidence case, across 2022, the project team spoke with representatives from a number of leading UK renewable energy project developers and asset operators. Some of these organisations either own generation assets on the Island, have historically sought to develop energy generation/storage projects or are currently assessing the potential for a new project under the in-place ANM scheme. An overview of the renewable energy developer organisations engaged to inform this study, is shown in Table 16.

Table 16: Renewable energy project developers engaged to inform the Isle of Wight network investment evidence case

Contact(s) Engaged	Organisation	Overview
Wesley Robinson Asset Manager	ib vogt	https://www.ibvogt.com/ IB Vogt has been involved in solar project development since 2002 and operates an existing 5 MW solar farm on the Isle of Wight. Vogt manages the entire downstream solar value chain for a number of clients.
Laurie Tennant Director	Wight Community Energy	https://iowcommunityenergy.org/ WCE is a community benefit society set up to deliver community-owned renewable energy projects on the Isle of Wight. They operate a 4 MW solar array, built in 2015 by Anesco.
Alex Howison Head of Grid Origination (UK)	low carbon	https://www.lowcarbon.com/ Low Carbon is a UK investment and asset management company founded in 2011. They invest, develop, operate and manage renewable energy assets across the UK, with 1 GW in operation (including five projects on the Isle of Wight) and a 5 GW pipeline.
Trung Tran - Head of Interconnection (UK) **Tara Reale -** Head of Business Development (UK & Ireland)	lightsource bp	https://www.lightsourcebp.com/ Lightsource BP is a leading international solar business. They develop, finance, build and operate utility-scale solar projects, with 5.7 GW developed across 19 countries. They do not currently operate any sites on the Island.
Patrick Smart - Energy Networks Director **Konstantinos Bistolakis** - Grid Engineer (Solar & BESS)	res	https://www.res-group.com/en RES is the world's largest independent renewable energy company, with a 40-year development portfolio of 23 GW and 10 GW of operational projects supported. RES has not developed, nor do they currently own or operate any assets on the Isle of Wight.

Marjorie Neasham CEO **Jonny Murphy** Project Manager	RIDGE CLEAN ENERGY	https://ridgecleanenergy.com/ Ridge Clean Energy is a UK-based clean energy company, developing wind and solar projects since 2003. They do not currently own any operational projects on the Isle of Wight but are pursuing a solar/battery storage hybrid site.
Rob Stevens Chairman	PERPETUUS tidal energy centre	https://perpetuustidal.com/ PTEC is an independent company working with the European Marine Energy Centre and leading marine turbine operators to deliver a tidal stream project on the Isle of Wight.
Ben Willis Strategy Manager **Jon Paige** Head of Asset Development **Peter Harvester** Manager	RWE	https://uk-ireland.rwe.com/locations/ocgt-power-plants-and-gas-engine-power-plants RWE is a large power producer, operating a fleet of wind, hydro, biomass and fossil gas sites across the UK. RWE operate the largest generation site on the Isle of Wight, a 140 MW marine diesel OCGT in East Cowes.

These developer organisations were asked to share views on the following topics:

- Any existing electricity generation assets they operate on the Isle of Wight and their interaction with the network and the existing ANM scheme.
- Options for the co-location of other technologies with existing sites.
- Any future project generation or storage opportunities being pursued.
- Views around the existing network constraints on the Isle of Wight and the unlocking of headroom from future investment in the network.
- Wider views on Isle of Wight's net zero ambitions and the role of the network.
- Specific views from RWE around the future strategy for Cowes Power Station.

A summary of the responses received from stakeholders is summarised below.

i) The existing network constraints are acting as a barrier to the operation of existing renewable sites and the development of new sites

Constraints have affected existing solar asset operators on the Island for a few years, with the Island being constrained on generation since c.2012. At an existing solar site, 40-50% of output was lost in peak summer season just over 3-4 years ago. Another developer also highlighted that they have a number of generation sites that are connected to SSEN's DGAD (pre-ANM) system, which is pretty rudimentary and restrictive on solar yield.

Large international solar developers have also been deterred from developing projects, with one highlighting that they have steered clear of the Isle of Wight, as their site searching methodology showed a lack of network capacity. Another developer has sought to establish solar sites on the Island, but have been held back by the in-place constraints and high connection costs. Developers indicated that they tend look where there is grid capacity first when identifying new sites, this essentially discounts the Isle of Wight at the moment.

ii) The Isle of Wight could be a positive location for new solar PV development, should network constraints be alleviated and generation headroom created

Across the board, there was a unanimous view that the Isle of Wight is a key area for future renewable energy development. One developer highlighted strong solar irradiance levels, positive landowner relationships and limited high-grade agricultural land/few brownfield sites as key factors that could prioritise the Isle of Wight as an area for new solar projects. In short, if they were made aware that grid capacity was unlocked, they would get a number of grid applications in with SSEN very quickly. In addition to this, two other developers were of the view that there is a positive spatial planning environment on the Island, suggesting that the Isle of Wight Council's net zero plans, and ambitious aims to host more renewables on the Island, enables a positive planning environment for new solar projects. It was highlighted that there is generally a positive public opinion of solar PV development on the Island and an appetite for sites of significant scale on the Island. A number of the developers we spoke to are looking at multiple connections in the range of 15-50 MW that could be fast tracked should network capacity be unlocked. In addition to this, developers highlighted the opportunity to re-establish a pipeline of smaller, commercial-scale solar arrays (>30kW), as these have also been abandoned at assessment phase, due to grid connection costs.

The opportunity of repowering existing generation sites in the future with higher efficiency/ higher yield solar panels was also highlighted, potentially upping the generation capacity for the same land footprint. This would be reliant on landowner negotiations and planning, but the network capacity would be a primary consideration to unlocking the additional generation potential of repowering existing solar sites on the Island.

iii) There are opportunities to develop other technologies on the Island if network headroom is created

Alongside solar PV, a number of stakeholders highlighted the potential to develop other technologies, given the right conditions. A number of developers highlighted that the co-location of battery storage is an area they are actively pursuing in other parts of the UK, though the business case is challenging. One highlighted that the current constrained network does make the Isle of Wight even more challenging than other locations where they are exploring battery storage. Some developers suggested they would consider looking at new hybrid sites or retrofitting batteries to existing solar projects if network headroom was made available and the businesses case stacked up. Multi-MW scale solar and battery projects are being pursued by some developers on the Isle of Wight currently, which likely falls under the ANM scheme.

Specific engagement with PTEC suggested that the live distribution network connection they have with SSEN is crucial to their offshore project. They also highlighted the potential for further expansion in the future, thus suggesting that additional generation capacity is similarly crucial to access untapped offshore generation on the Island.

iv) There are wider benefits to reviving renewable development on the Island

Alongside the shared view that the Isle of Wight is a potential hub for solar projects, developers highlighted that new solar and battery projects would bring more skilled work and jobs to the Island and provide an opportunity to upskill local employment. It was noted that discussions have been held around the opportunity of using ground-mounted solar farm sites as grazing land for local farmers. Stakeholders also highlighted that more investment in the island's network would be a positive step towards wider Isle of Wight decarbonisation and net zero aspirations.

v) The future of Cowes Power Station is unclear, but will almost certainly be different to today's unabated fossil fuel operation

As part of the Oversight Group meeting and engagement workshop in Newport in August 2022, the project team heard from members of the senior management team and the Cowes Power Station operations team at RWE. They commented that RWE, as a wider group, is aiming to be zero carbon by 2035 and strategic sites like Cowes Power Station fall under that wider commitment.

The Cowes site is currently fuelled by marine gas oil. Therefore feedback suggested that its decarbonisation may be linked to the future decarbonisation pathway for the marine and marine fuel industries in the UK and specifically marine vessel fuelling on the Isle of Wight.

It was highlighted that Cowes Power Station is currently under commercial contracts with National Grid ESO, including Short Term Operating Reserve, the Capacity Market, and Black Start, alongside operating in the Balancing Mechanism. As can be seen in Figure 18 and Table 11, as a result of participating in these ancillary services, the site's annual operating hours and annual generation output are very limited, but it needs to be available to be called on all year round.

The wider RWE group also has a green hydrogen division which is aiming to leverage and explore business models with RWE's offshore wind fleet and develop in the green hydrogen space in the UK. However, there are no current public plans for green hydrogen production or green hydrogen use at Cowes Power Station specifically. RWE would be interested in revisiting the options for grid connection sharing with other generators.

Electricity generation and storage load growth - conclusion

When considering this active and historic pipeline, the existing baseline and uncertainties around the decommissioning of Cowes Power Station, the total generation and storage capacity on the Island could exceed projections from both DFES 2020 and 2021, should network capacity be unlocked, see Figure 27.

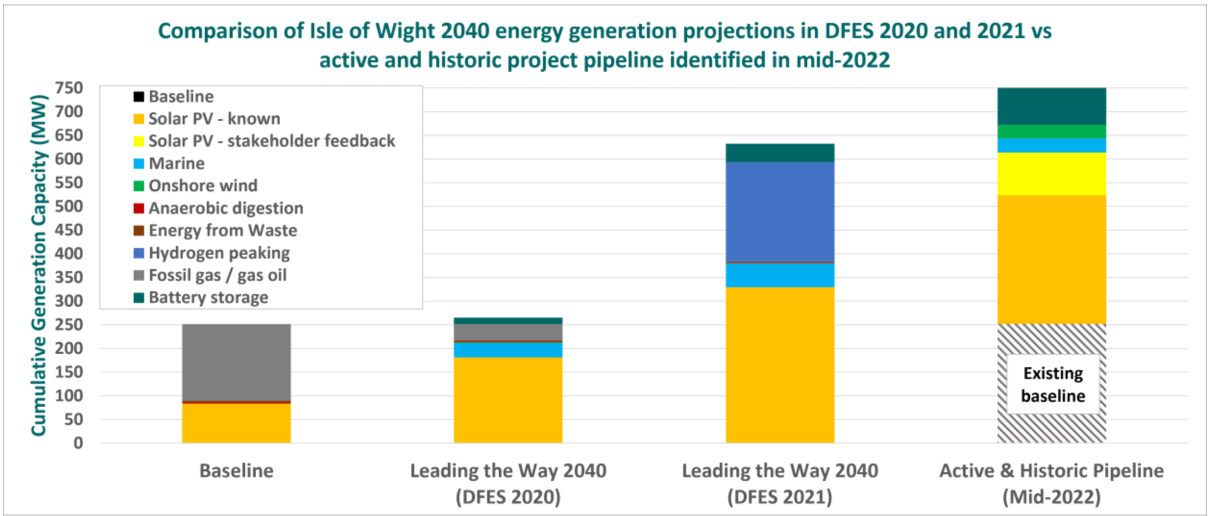


Figure 27: Comparison of Isle of Wight 2040 energy generation projections in DFES 2020 and 2021 vs active and historic project pipeline identified in mid-2022

Network charging - Access Significant Code Review

Ofgem announced its final decision around reforms to network access and forward-looking charging in May 2022. This decision included changes to the charging boundaries for generation and demand projects seeking to connect to the distribution network and reforms to the 'high-cost cap' charging limits for individual generation and demand sites.

	Extension assets	Reinforcement assets at connection voltage	Reinforcement assets at connection voltage +1
Current arrangements	Connecting customer pays 100%	Connecting customer pays a proportion of the reinforcement costs	Connecting customer pays a proportion of the reinforcement costs
New arrangements (Demand)	Connecting customer pays 100%	Fully funded by the DNO via DUoS	Fully funded by the DNO via DUoS
New arrangements (Generation)	Connecting customer pays 100%	Connecting customer pays a proportion of the reinforcement costs	Fully funded by the DNO via DUoS

Figure 28: Ofgem illustration of changes to the distribution connection charging boundary

Source & credit: Access & Forward-Looking Charges Significant Code Review Final Decision, May '22

For the constrained network on the Isle of Wight, with reinforcement costs above the connection voltage level being socialised through SSEN's DUoS charges, this could drive some project developers to re-look at opportunities on the Island from 1st April 2023 onwards.
However, reinforcement that is triggered through new demand capacity connections will be fully socialised through DUoS charges, up to a high-cost cap of £1,720/kW. Therefore, any reinforcement costs triggered via an individual future demand connection above 35-40 MW would be fully funded through DUoS charges up to c.£60m. The potential future electrification of transport and heat on the Island, in addition to other disruptive demand technologies, is quite a significant consideration for wider network reinforcement costs and funding routes.

Conclusion 3: Analysis of active generation pipeline projects and historically abandoned connection enquiries has been combined with evidence from SSEN's DFES 2020 and 2021 projections, and regulatory reforms to connection charging boundaries being implemented in early 2023. This evidence suggests a strong potential for distributed generation and storage development to be brought back into consideration on the Isle of Wight across the next decade, should network capacity be made available to connect it.

This is supported by engagement with a number of leading UK renewable energy developers, who align on the view that should network capacity be unlocked through investment, they would seek to develop new energy projects on the Island as a strong solar resource and land area for development.

Developers also suggested wider economic and net zero benefits to enabling network investment on the Island. Operators of existing solar assets on the Island felt that current constraints and ANM control are also notably restricting generation yield.

Recommendation 3a: SSEN should continue engaging with existing asset operators as the ANM control system is developed, to ensure any change in levels of curtailment or available capacity headroom for new connections is clearly communicated.

Recommendation 3b: SSEN should use the project pipeline and stakeholder feedback in this study as evidence of potential future solar PV, tidal stream and battery storage project development

Recommendation 3c: Isle of Wight asset operators and developers should engage with RWE and SSEN to explore options for grid connection sharing at Cowes.

Energy system modelling for the Isle of Wight and impact of tidal stream

An academic study looking at the future Isle of Wight energy system has recently been published. This study, produced by a consortium of representatives from the University of Plymouth, University of Edinburgh and marine energy development organisations, looked at the impacts of different renewable energy generation mixes, by varying levels of tidal stream power, solar PV and offshore wind.

The study concludes that around **1.1 TWh/year** of total electricity consumption on the Island could be seen by 2050 and that this could be met by an optimum mixture of **150 MW** of **offshore wind**, **150 MW of solar PV** and **120 MW of tidal stream**. This mixture minimises both annual energy shortages and surpluses by at least 10%, compared to other energy mixes. The comparison to a mix of just solar and tidal shows 50% more shortages/surpluses, highlighting potential the importance of incorporating offshore wind into the Island's energy generation in the near future. This could be a significantly different network infrastructure challenge, as larger-scale offshore wind farms would likely seek to be of a scale that connects (partially or wholly) at distribution extra-high voltage or transmission network voltages, and as can be seen in Figure 13, there is no 132kV or transmission network infrastructure on the south side of the Island. The development of a new grid supply point or bulk supply point on the south side of the Island would require a more detailed assessment involving both SSEN and National Grid Electricity Transmission.

Regardless of the energy mix and challenges for large-scale offshore wind connections, the study suggests that around double the generation capacity that is currently operating on the Island is considered to be needed.

Table 17: Isle of Wight energy system performance based on a scaled power demand profile
Source & credit: Impacts of tidal stream power on energy system security: An Isle of Wight case study, January 2023.

Capacity case (with energy storage)	Installed capacities			Annual energy shortage	Annual energy surplus
	Solar	Wind	Tidal		
1: Solar + wind + tidal	150 MW	150 MW	120 MW	143 GWh	121 GWh
2: Solar + wind	100 MW	250 MW	-	180 GWh	158 GWh
3: Solar + tidal	250 MW	-	275 MW	215 GWh	180 GWh

Perpetuus Tidal Energy Centre

Located off of the coast of Ventnor on the south coast of the Isle of Wight, Perpetuus Tidal Energy Centre (PTEC) is, at 30 MW, one of the largest consented tidal stream energy projects in the UK. PTEC plan to operate several different tidal energy turbine technologies in an area 2.5km^2 off the coast near St Catherine's Point. The energy generated is to be supplied to the Island through a new distribution network substation located at Flowersbrook in Ventnor, with any excess energy designated to produce Green Hydrogen.

Figure 29: Photo of Orbital Marine's O2 tidal turbine
Source & credit Orbital Marine

Of the 30MW currently being targeted, PTEC have secured a grid connection offer for 20 MW from SSEN, with an application for the remaining 10 MW to be requested at a later date. Beyond this project, a recent study has shown there is considerably more potential for tidal generation capacity to the south of the Island and along the South coast of the mainland. It is easily exploitable, but would be very dependent on the Island's network infrastructure at both distribution and transmission levels.

Sunny Oaks Renewable Energy Park

Ridge Clean Energy are currently in the planning process for a renewable energy park just to the south-west of Wootton Common, consisting of a 20 MW solar farm and the potential to host up to 28.5 MW of battery storage. From engaging the Project Lead at Ridge Clean, the site is part of a portfolio of renewable energy projects across the UK, and could specifically be the first of two or three similar projects on the Island, should generation capacity headroom be unlocked.

Ridge Clean are also placing a strong focus on the environmental and community benefits from their projects. They are aware of an established supply chain of ecologists and site surveyors on the Island for whom the site could provide work, and, once operational, the park will provide a Community Benefit Fund for local initiatives. Sunny Oaks also intends to provide a considerable net gain in habitat and biodiversity on the host land. Ridge Clean see similar benefits and approaches could be unlocked through other projects that could be developed on the Island.

Figure 30: Map of planned site for Sunny Oaks Renewable Energy Park
Source and credit: Ridge Clean Energy, https://ridgecleanenergy.com/sunnyoaks/

Future electricity demand growth on the Isle of Wight

Isle of Wight historic electricity demand

Electricity usage on the Isle of Wight has not significantly changed over the years but has seen a slow-but-steady decline since 2005. Usage is also very evenly split between domestic and non-domestic consumers, hovering around 50%/50% in recent years.

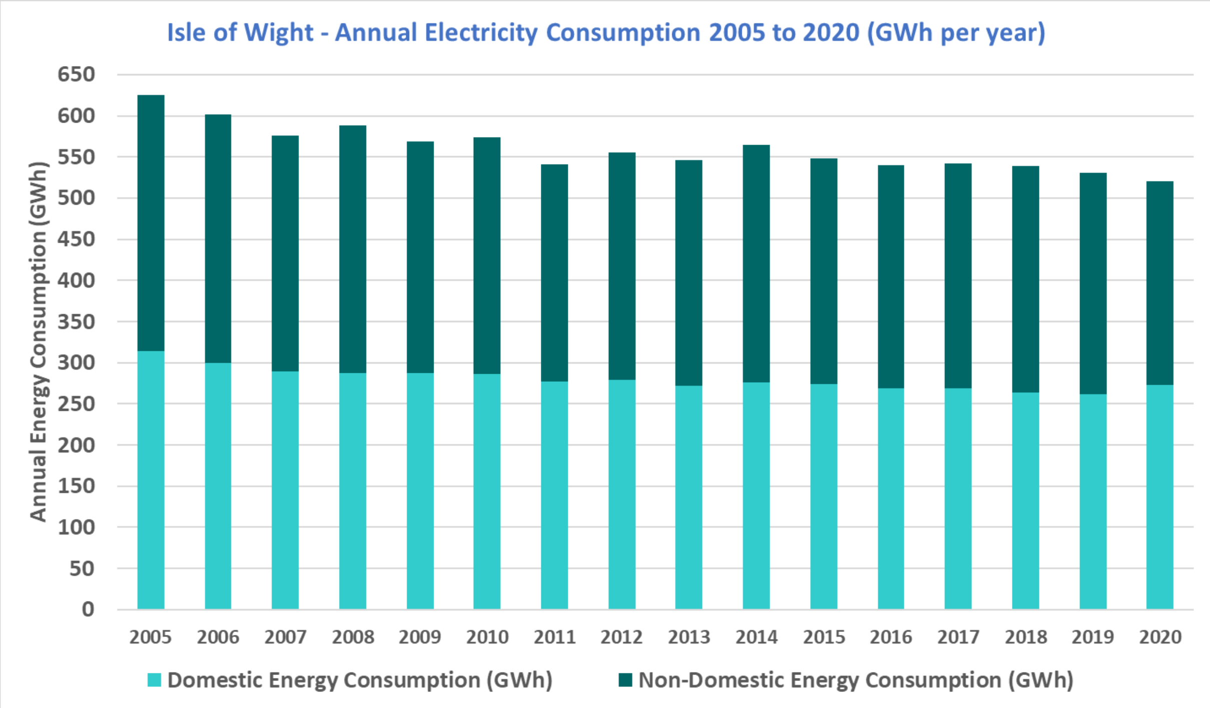


Figure 31: Annual electricity usage on the Isle of Wight, 2005 to 2020
(Source: *Regional and local authority electricity consumption statistics*, BEIS)

However, there is expected to be a notable increase in domestic and non-domestic electricity demand in the next decade, through the electrification of transport, heat and potentially other sectors.

This section outlines the evidence gathered for how future electricity load could evolve on the Island, through transport and heat electrification and other sources of disruptive demand that could connect to the distribution network on the Island out to 2050. This is driven predominantly by an analysis of SSEN's DFES 2021 projections, but supported by engagement with a number of Isle of Wight transport companies and businesses.

Future electrification of transport - summary

Transport is currently a high energy use sector on the Isle of Wight. As a potential source of future electricity demand, transport can be categorised into four main areas:

- Private road vehicles (EV cars, motorbikes, LGVs etc.)
- Public road vehicles (buses and coaches)
- Marine transport (Isle of Wight ferry and hovercraft companies)
- Rail transport (existing battery electric trains - no future load increase expected)

A detailed analysis of electric charging infrastructure and associated diversification of vehicle charging profiles is not within the scope of this assessment. However, a summary of the potential vehicle numbers and a view of the associated undiversified charging capacity that could be seen on the Island has been summarised.

Road transportation

As of the end of September 2022, there are **c.92,000** road vehicles registered on the Isle of Wight. Of this, the majority are petrol and diesel-fuelled privately owned cars and light goods vehicles; see Figure 32. To date, there has been a steady but modest uptake of ultra-low emissions vehicles (ULEVs) across the Island, totalling over 1,100 vehicles (c.1% of all road vehicles). This has been dominated by battery EVs and plug-in hybrids (see Figure 33).

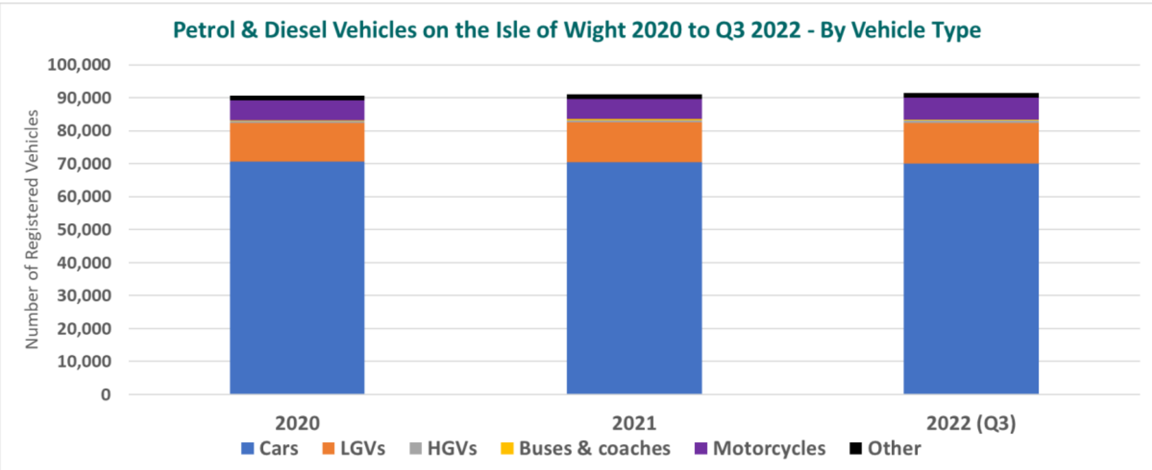


Figure 32: Petrol and diesel vehicles registered on the Isle of Wight 2020 to Q3 2022

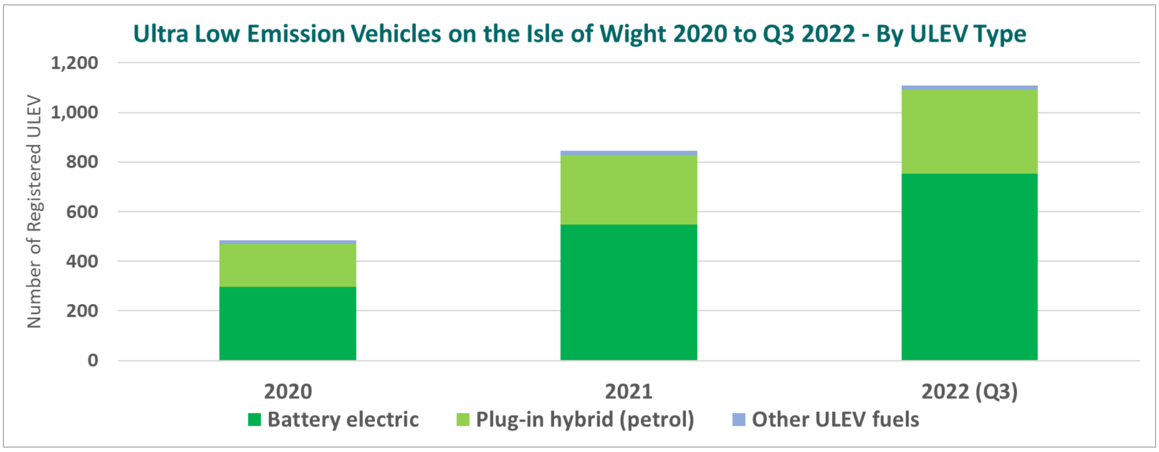


Figure 33: ULEV registrations on the Isle of Wight 2020 to Q3 2022

Based on Regen's DFES 2021 analysis for SSEN, there could be over **92,000** EV cars and LGVs within the 2040s (see Figure 34). This reflects an accelerated adoption of battery EV cars between 2025 and 2035 in all scenarios, and only the hardest-to-electrify vehicles, such as HGVs, remain fuelled by petrol or diesel. The uptake of EVs slows, and overall the number of vehicles reduces across the late 2040s due to increased use of public transport, active travel and autonomous vehicles under this scenario. The uptake of Plug-in Hybrids slows and then reduces in Leading the Way across the period to 2050, as a result of an assumed restriction on their sale in the early 2030s, with policies favouring full battery EVs.

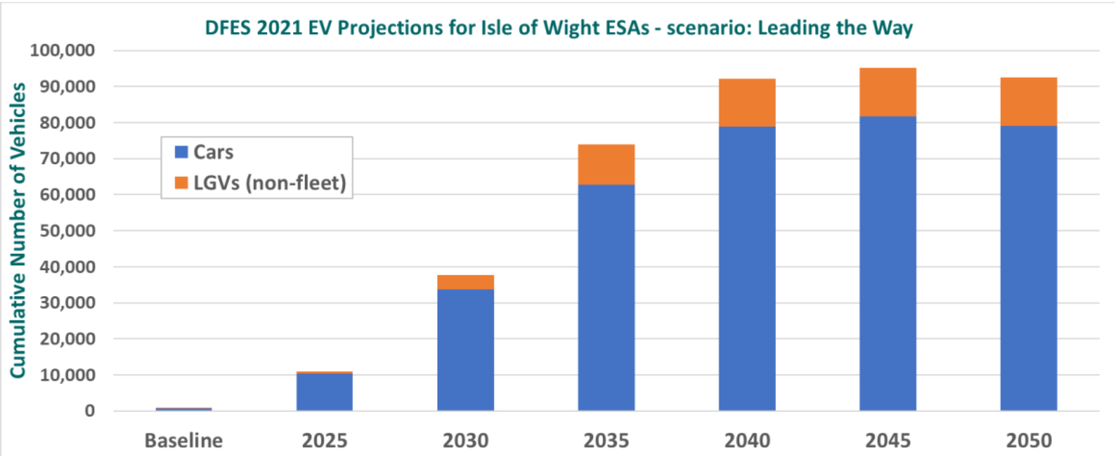


Figure 34: SSEN DFES 2021 projections for EV cars and LGVs on the Isle of Wight under the Leading the Way scenario

In terms of the additional electricity demand that this EV adoption could create on the Island, this is expressed through the DFES projections of EV charger capacity in MW. Using the projections of vehicles, an analysis of mileage and consideration of a number of different EV charger archetypes, the total connected EV charger capacity across the Island could total **210 MW by 2030** and **400 MW by 2050**. This includes over **47,000** domestic off-street EV chargers (see Figure 35) and a number of non-domestic EV charger archetypes, such as those located at car parks, workplaces, fleet depot locations and en-route locations (see Figure 36).

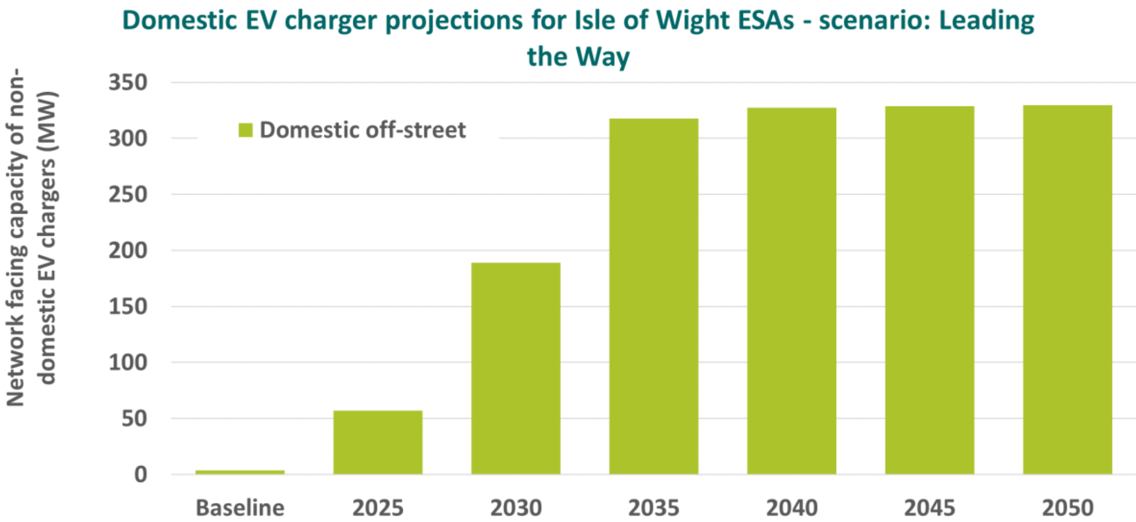


Figure 35: Domestic off-street EV charger capacity on the Isle of Wight (Leading the Way scenario)

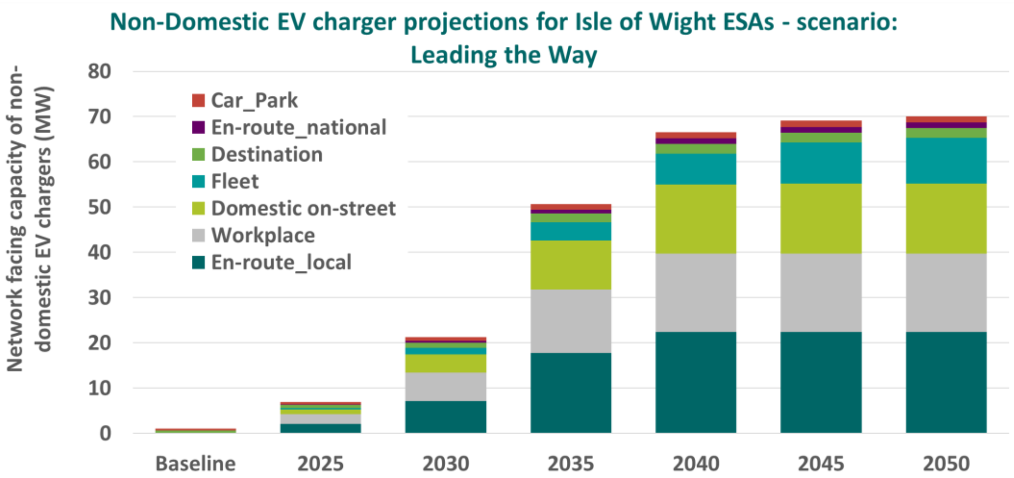


Figure 36: Non-domestic EV charger capacity on the Isle of Wight, by EV charger archetype (Leading the Way scenario)

When considering the various potential EV charging behaviours that could be adopted by drivers on the Isle of Wight, the actual diversified peak EV charging demand that could be seen on SSEN's LV network is unknown.

A variety of factors would affect the calculation of an amalgamated diversified charging profile and peak demand. These factors include the types of car (large family, medium hatchback, small sports car etc.), their location on the Island, their use (commuting or leisure), the type of property with which they are associated and incentive-driven behaviour such as the adoption of an Isle of Wight EV tariff or similar. These factors could all significantly affect the charging profiles that could be used to determine a diversified peak demand from transport.

Irrespective of the potential diversification, the evidence is clear that under any scenario, the electricity demand from road transport will significantly increase out to 2030 and 2050 on the Island, potentially above and beyond the demand capacity headroom of the 11 kV substations shown in Table 12, specifically those substations in population centres such as Newport, Cowes, Ryde and Shanklin.

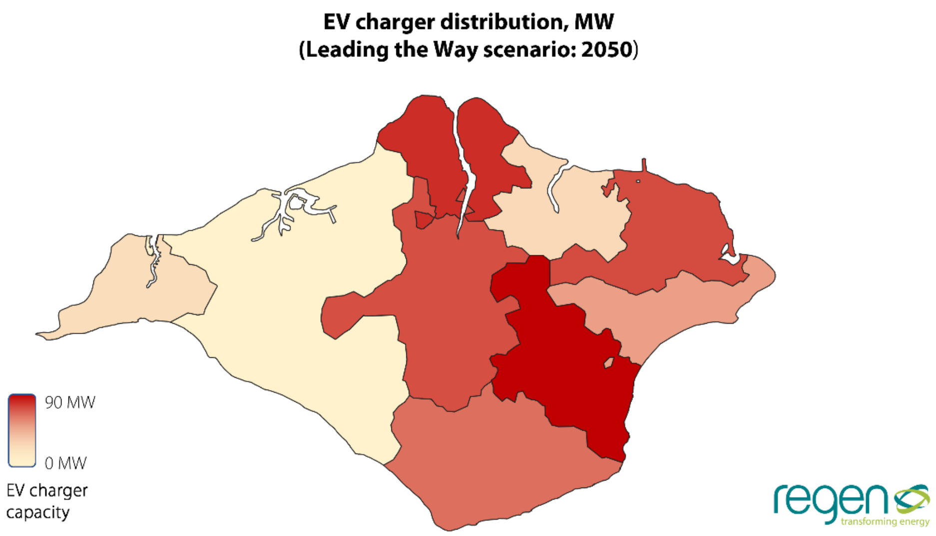
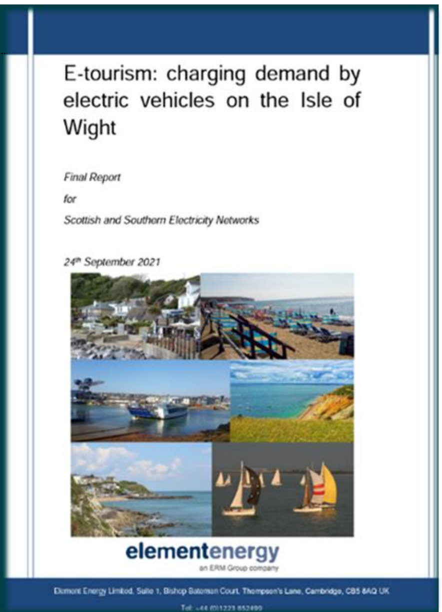


Figure 37: EV charger capacity distribution under the Leading the Way scenario in 2050

The impact of tourism on Island transport load

A key aspect of the Isle of Wight's future load growth to be accounted for is the considerable number of tourists each year to the Island. In 2019 alone there were over 2 million visitors to the Island, almost 16 times the number of permanent residents.

A report by Element Energy for SSEN, funded through Network Innovation Allowance programme, looks at the potential impact tourist influx could have on the Island's energy system, with a focus on future tourist EV charging load on the Island. The impact is assessed in four case studies areas; **the Southampton ferry terminal**, **the East Cowes ferry terminal**, **the Woodland Resort** and **Shanklin**, and three use cases; **ferry terminals**, **daytime tourist attractions** and **overnight tourist attractions**, all of which are expected to attract high EV charging demand. The report synthesizes existing data on tourist behaviour and distribution network load conditions, as well as future projections for EV usage. A prediction of network constraint days can be seen in Figure 39.


E-tourism: charging demand by electric vehicles on the Isle of Wight

Final Report

for

Scottish and Southern Electricity Networks

24th September 2021

elementenergy

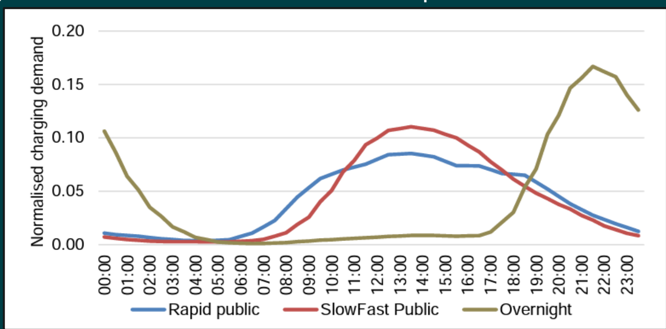
an ERM Group company

Figure 38: Element Energy e-tourism report

Case study	Secondary substation	Current network status	Days of constraint expected in 2030	Days of constraint expected in 2030 with smart charging
Southampton Ferry Terminal	French Quarter		0	0
East Cowes Ferry Terminal	Waitrose		0	0
Woodland Resort	Lucketts		161	52
Shanklin[1]	Regent Street		0	0

Figure 39: Summary of constraints on each of the substations in the four case studies

The report expects the projected annual EV charging demand on the Island to exceed **200 MWh** by 2030, and though primary substations will remain largely unaffected, it is expected that charging demand is likely to cause network constraints at tourist resorts and attractions in more rural areas on the Island. In particular, the Woodland Resort area is expected to potentially exceed available headroom capacity in 2030, due to the smaller secondary substation currently installed there. Demand on secondary substations in Shanklin are also expected to push close to transformer ratings, as a result of future EV charger demand by 2030, but no thermal limits are predicted to be exceeded.



Bus fleet electrification

Southern Vectis, part of the Go-Ahead Group transport company, run the 86-strong bus fleet on the Isle of Wight. Currently, none of this fleet is fully electric, but the Group as a whole have a target for a zero emissions fleet by **2035**, suggesting changes to the Island's fleet can be expected in the imminent future.

Figure 41: Southern Vectis bus operating on Isle of Wight

Based Regen's analysis, the electric charging for a fully electric bus fleet could require in the realm of **5 MW** of charger capacity across the Island. This would be a small proportion of the Island's total demand in comparison to the wider uptake of electric vehicles, with almost **370 MW** of EV charging capacity expected to be in place by 2035 under the Leading the Way scenario.

Regardless, the electrification of the Isle of Wight's bus fleet remains a key part of the council's Mission Zero strategy and will contribute to some additional future demand in the major population centres of Newport, Yarmouth and Shanklin.

Marine transport

As shown in Figure 10, the Isle of Wight has three ferry companies that operate 16 vessels across six routes between the north side of the Island and the south coast of the mainland. Diesel use from ferry operations comprises c.2% of all Island-wide annual carbon emissions.

Baseline fuel data analysis puts current energy usage the region of **c.160 GWh** across the ferry companies. Wightlink has published that they are investigating options for rapid decarbonisation of their operations and that the short routes between the Island and mainland align well with the potential for battery electric vessels (see).

Whilst a more detailed analysis and business case assessment around the location and size of the shore power infrastructure would be required, the electrification of the ferries operating to and from the Isle of Wight could potentially create additional charging demand on the north side of the Island and the associated primary substations. Analysis would need to determine and quantify the necessary power capacity, physical infrastructure, location and cost, but an estimate of the shore power demand could be in the region of **20-30 MW**. Battery electric is potentially less suitable for hovercraft due to the ballast the batteries would bring. Therefore, Hovertravel may be pursuing other low carbon fuel sources.

Shore power requirements beyond the ferries could also be important to consider; an additional load can be expected from the not-insignificant number of private and domestic boats that visit and moor on the island's harbours and marinas.

Data from the Cowes Harbour Commission suggests as many as **44** larger ships use the harbour annually.. Based on analysis of fuel data, this could equate to around **1-2 MW** of shore power capacity, but this could be spread over multiple charge points. There are also numerous other harbours around the island, so charging capacity for private vessels will inevitably be higher than this figure. A detailed assessment of shore power is a crucial area for further analysis for the island's electricity system.

Wightlink Isle of Wight Ferries – Future Vision

Wightlink operate three ferry routes from Portsmouth to Ryde and Fishbourne and Lymington to Yarmouth. As part of their future decarbonisation pathway, Wightlink have outlined plans to remove 25,000 tCO_2e by 2030 through their ***Future Vision*** strategy, see https://www.wightlink.co.uk/community/environment#future-vision.

This strategy will include:

- The launch of the UK's first large fully-electric plug-in vehicle ferry.
- The creation of the first zero emission small vehicle ferry service between Lymington and Yarmouth.
- The installation of shore power charging infrastructure that will use existing and future renewable electricity on the Island, to enable zero carbon electric ferries.
- Building a new all-electric high speed catamaran, aiming to be the first all-electric fast passenger ferry in the UK (to also be built on the Isle of Wight).

These commitments reinforce the strong likelihood of additional future electricity demand from shore power before 2030 on the north side of the Island, as well as driving the need and aim for additional on-Island renewable electricity.

Conclusion 4: The study has assessed the combined potential of EV uptake, on-Island EV charging across residential car ownership, tourist population influx and plans to convert the on-Island bus fleet to battery electric. This analysis shows that a considerable additional network demand capacity could be required by 2030, 2040 and 2050 to meet future road vehicle EV charging needs. Added to this is strong evidence for the future potential need for shore power charging infrastructure for the Isle of Wight ferry boat companies, as well as domestic and private boats around the island, specifically on the north side at Cowes, Ryde and Yarmouth.

With the existing eastern rail network already battery electric and uncertainties around the potential future additional branch lines, additional electricity load from rail transport on the Island is uncertain.

In order for the Island to ensure that the proposed levels of electrified transport continue to be low carbon and actively contribute to carbon reduction and net zero targets, demand will need to be met by a continually reducing grid emissions factor, as well as potentially notable amounts of additional on-Island renewable electricity generation capacity.

Recommendation 4a: Through the DFES process and broader ongoing engagement, SSEN should continue to engage Isle of Wight stakeholders to identify the substation areas that may experience the highest near-term levels of EV charger uptake. This should also be linked to the potential exploration of an Isle of Wight EV car club or time-of-use tariff tailored to make use of Island solar generation.

Recommendation 4b: SSEN should continue to engage and work with Wightlink and Red Funnel to gain a more detailed understanding of the amount of shore power capacity that will be needed to charge Isle of Wight ferries. This could expand to a broader study of shore power requirements to include domestic and private boats as well; their proposed locations, potential charging profiles and the timescale of their possible implementation.

Future electrification of heat

Alongside transport, the electrification of heat on the Island is a potentially significant area of electricity demand growth. Predominantly space heating for domestic properties and commercial premises could be, under some scenarios, a significant source of electricity demand as households and businesses buy and install heat pumps (air source or ground source) or potentially alternative electric heating solutions such as next-generation night storage heaters or direct electric radiant heaters.

Overall heat pump deployment in the UK remains slow, but based on data from the recent Census 2021 data release[22], 948 properties on the Isle of Wight have "renewable energy" as their sole or part of their central heating systems (see Table 18 and Figure 43). Note that renewable energy central heating accounts for both households with heat pump and solar thermal installations; however, it can be considered that the vast majority of the total numbers shown will be heat pump installations due to lower adoption of solar thermal.

Table 18: Number of households on the Isle of Wight with renewable energy central heating systems | Source and credit: Census 2021 data, https://www.ons.gov.uk/census

Local Authority	Central Heating Category		Number of Households
E06000046 Isle of Wight	8	Renewable energy only	432
	12	Two or more types of central heating (including renewable energy)	525
	All households with renewable energy central heating systems		**957**

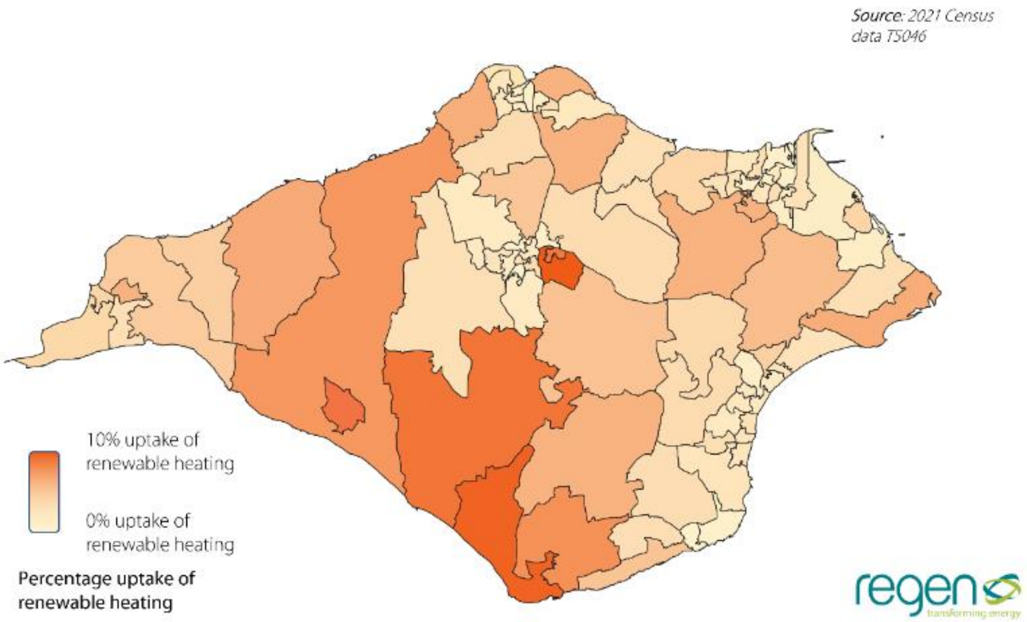


Figure 43: Map of renewable heating technology uptake on the Isle of Wight to date, by LSOA
Source: Census 2021 data release

[22] See Census 2021, January 2023: https://census.gov.uk/census-2021-results

SSEN's DFES 2021 analysis highlighted that under a Leading the Way scenario, there could potentially be **c.35,000 heat pumps by 2030** (which includes both hybrid and standalone, domestic and non-domestic variants), growing to over **70,000 by 2050**. See Figure 44.

This scenario reflects an accelerated adoption of heat pumps to align with:

- The UK government's 2025 ban on boilers in new build houses.
- The UK government's target of 600,000 heat pump installations per year by 2028.
- The Isle of Wight Council's *Mission Zero* aims for an average of 50 heat pumps to be installed per week from April 2020 to December 2040.

In addition to these targets, BEIS announced additional policy support in 2022 that could drive further uptake of heat pumps across the UK. These policy support mechanisms came in the form of the Boiler Upgrade Scheme[23] , and as part of the British Energy Security Strategy, a £30 million Heat Pump Investment Accelerator Competition[24] was announced, targeted to increase British manufactured heat pumps and reduce demand for natural gas.

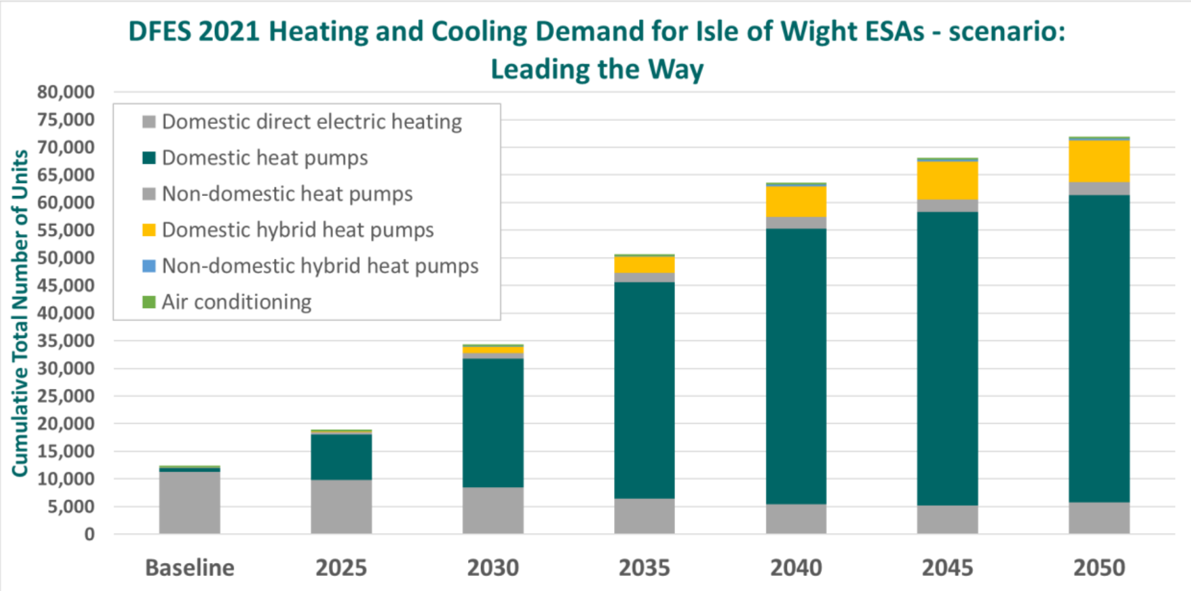


Figure 44: SSEN DFES 2021 projections for heat pumps (all types) on the Isle of Wight under the Leading the Way scenario

The potential uptake of domestic heat pumps also considers the visibility of future housing developments across the Island. This is based on an analysis of the Isle of Wight Council's new developments registers and annual housing build-out projections; see Figure 45.

The scale of future electricity demand that this level of heat pump adoption could create on the Island could be significant. Using industry average capacity ratings for household and non-domestic heat pumps, the total connected heat pump capacity across the Island could reach **485 MW by 2030** and **970 MW by 2050** (see Figure 46).

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

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

The actual diversified demand and peak winter day demand from all heat pumps operating across the Island's electricity network would be less than these 'rated' capacity figures. However, under all net zero scenarios in the DFES analysis, significant uptake of heat pumps is likely on the Island and heat, alongside transport, will be a considerable future source of additional electricity demand over the next decade and beyond.

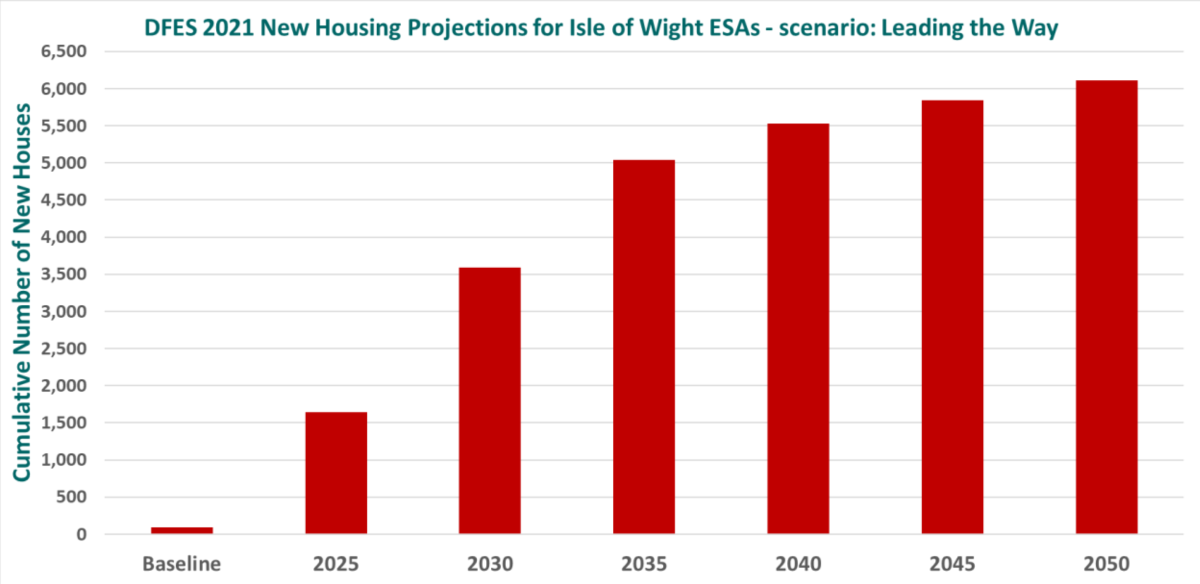


Figure 45: SSEN DFES 2021 projections for the number of new houses developed out to 2050

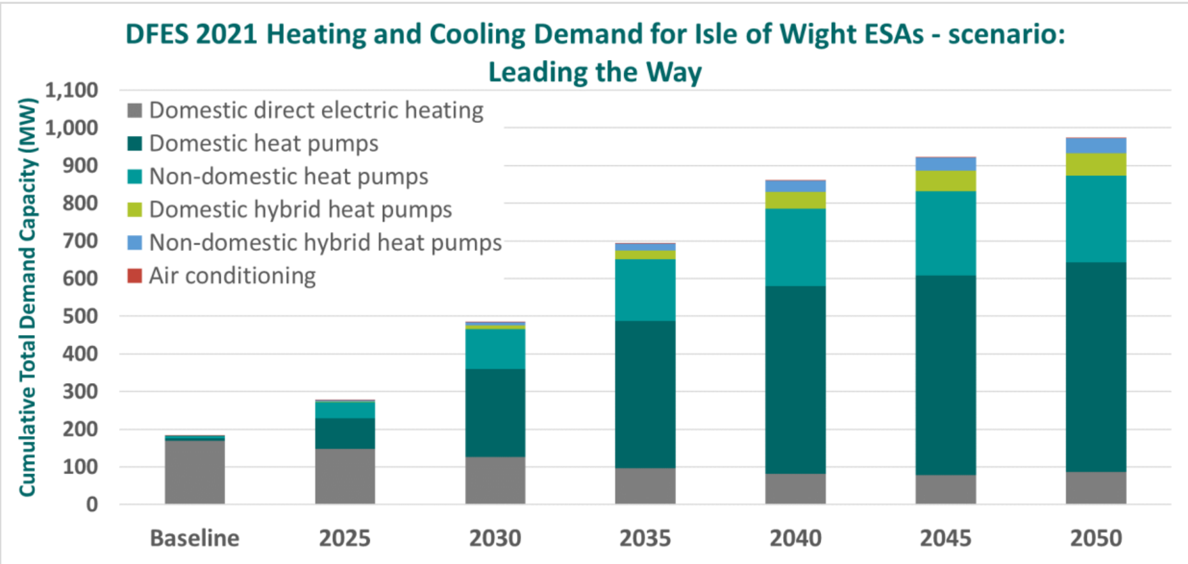


Figure 46: SSEN DFES 2021 projections for installed heat pump capacity (all types) on the Isle of Wight under the Leading the Way scenario

To further support the potential adoption of heat pumps on the Isle of Wight suggested in the DFES projections, some examples of active low carbon heating initiatives in non-domestic buildings on the Island are summarised in Table 19.

Table 19: Summary of known heat pump and heat storage initiatives on the Isle of Wight

Organisation(s)	Overview of initiative
	Isle of Wight College was awarded £288k from Phase 2 of BEIS' Public Sector Decarbonisation Scheme to replace old gas boilers with air source heat pumps across 5 of their college buildings on the Island.[25]
	Isle of Wight Council has a target to replace 60% of their existing gas and oil boilers across their estate with heat pumps by 2030. This target has been directly supported by securing c.£700k of funding from phase 3a of BEIS' Public Sector Decarbonisation Scheme[26] in November 2022, to reduce emissions from the County Hall office building by replacing the existing gas boiler with an air source heat pump.
	Wight Community Energy partnered with **Mixergy** on a grant-funded innovation project to test the energy-saving potential of internet-enabled hot water tanks in hotels across the Island.[27]

Hydrogen for heating

It is well known that the definitive pathway for the decarbonisation of space heating in the UK has not yet been firmly established. There are a number of levels of detail and regional characteristics that will mean the actual pathway and energy system solution for low carbon heat will be multi-faceted. However, a bisection of low carbon heating technology pathways can be summarised as the electrification of heating (predominantly through heat pumps) vs the conversion of the existing national fossil-gas system and boilers (predominantly through significant low carbon hydrogen production and hydrogen boiler replacements).

The project team engaged with SGN, the gas distribution network company that supplies the Isle of Wight currently. As part of their RIIO-GD2 business plans, SGN has stated commitments to actively look at increasing the levels of green gas (low carbon hydrogen and biomethane) in their network and to enable their network (in Scotland and Southern England) to be 100% hydrogen-ready demonstration networks[28]. SGN commissioned a whole system assessment of the energy system on the Isle of Wight, focusing on green gas options. The outcomes of this study are to be published, and SSEN is in dialogue with SGN.

[25] See BEIS Phase 2 Public Sector Decarbonisation Scheme: project summaries: https://www.gov.uk/government/publications/public-sector-decarbonisation-scheme-phase-2-closed-to-applications/phase-2-public-sector-decarbonisation-scheme-project-summaries

[26] See BEIS Phase 3a Public Sector Decarbonisation Scheme: project summaries: https://www.gov.uk/government/publications/public-sector-decarbonisation-scheme-phase-3/phase-3a-public-sector-decarbonisation-scheme-project-summaries

[27] See Wight Community Energy Smart Hot Water Project overview, 2022: https://iowcommunityenergy.org/projects/power-to-change/smart-hot-water/

[28] See *A plan for our shared future,* SGN RIIO-GD2 business plan, Dec 2019: https://www.sgn.co.uk/sites/default/files/media-entities/documents/2022-07/SGN-RIIO-GD2-Business-Plan.pdf

As can be seen in Figure 47, even under a scenario where hydrogen boilers are prioritised as the main space heating technology to meet net zero (System Transformation), there are still significant numbers of electrified heating technologies modelled to be operating in homes and businesses on the Isle of Wight by 2030 and 2050. Under this scenario, this includes a higher proportion of direct electric heaters staying online, as well as a moderate uptake of heat pumps. With direct electric heaters being significantly less efficient than heat pumps, electricity demand from electrified heating could still see a notable increase out to 2030 and 2050, reaching c.300 MW by 2030 and 620 MW by 2050, see Figure 48.

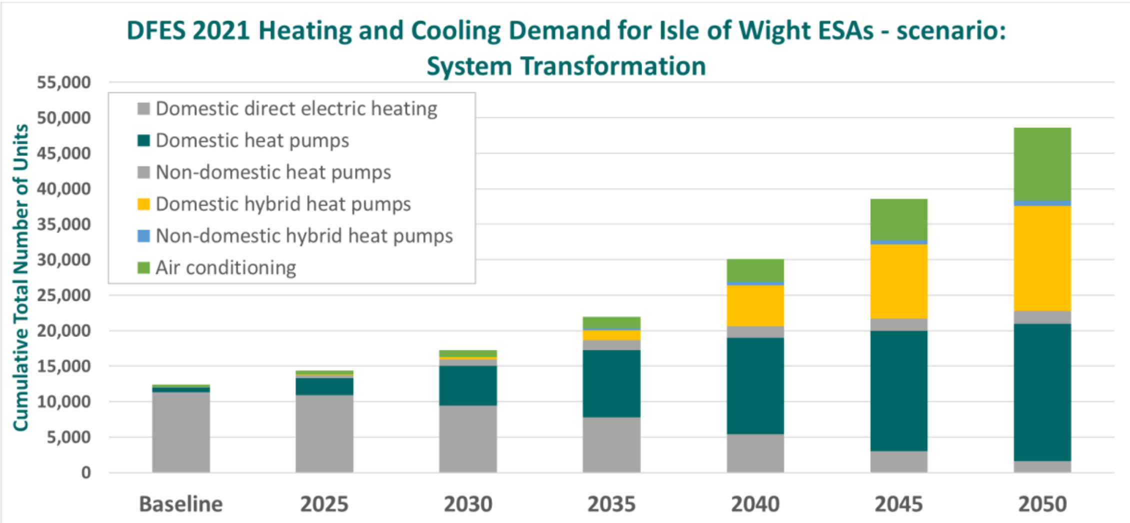


Figure 47: SSEN DFES 2021 projections for heat pumps (all types) on the Isle of Wight under the System Transformation scenario

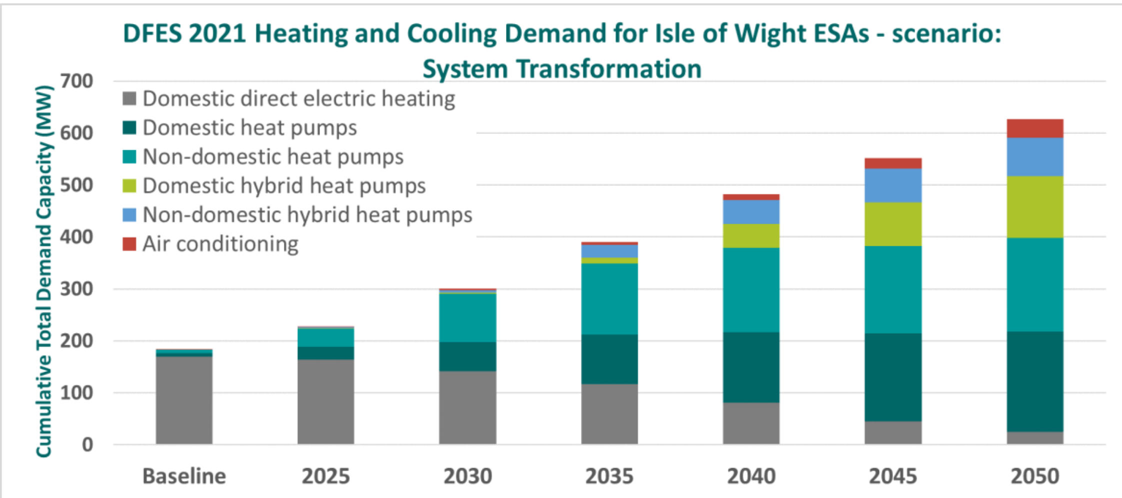


Figure 48: SSEN DFES 2021 projections for installed electric heating and cooling capacity (all types) on the Isle of Wight under the System Transformation scenario

The maps in Figure 49 below show a comparison of the distribution of heat pumps in 2050 in both the System Transformation scenario (left) and the Leading the Way scenario (right). Though there are considerably more heat pumps in the Leading the Way scenario, under System Transformation, they will remain a significant heating technology on the Island.

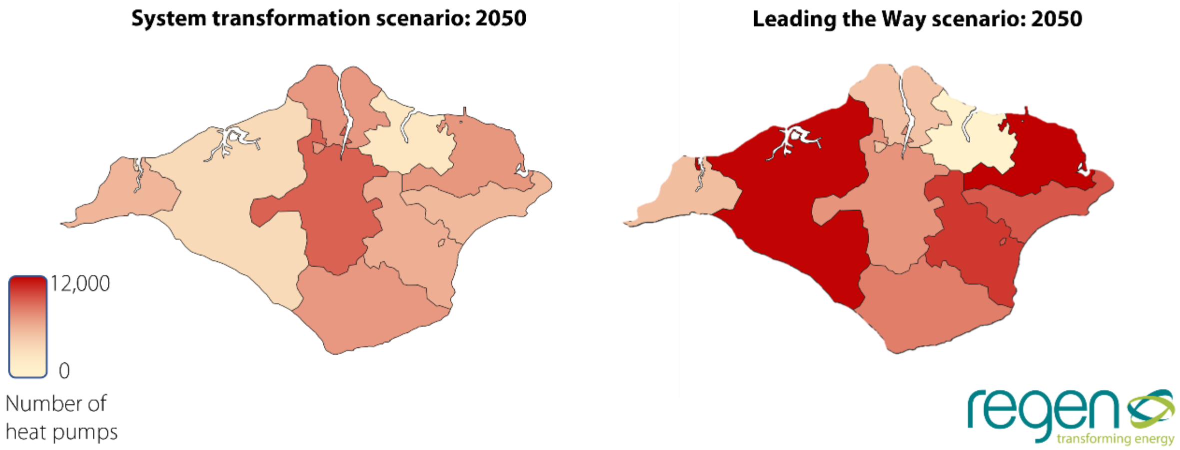


Figure 49: A comparison of the distribution of heat pumps around the Island in 2050 in both the Leading the Way scenario and the System Transformation scenario

Conclusion 5: Through analysis of existing decarbonisation targets, known initiatives being rolled out on the Island and feedback from stakeholders, the decarbonisation of space heating in homes and businesses on the Island is likely to be heavily focused around heat pumps. When combined with the potential future additional electricity demand from electrified transport, the demand headroom currently present on the primary substations across the Island could potentially be breached in the future.

Even under a hydrogen boiler-heavy scenario, demand from electrically fuelled heating technologies could still see a significant increase out to 2030 and 2050.

Recommendation 5a: SSEN and Regen should make use of Census 2021 data, updated views of the Isle of Wight Council's new housing build out plans and wider heat decarbonisation policy reforms, to inform SSEN's DFES 2022 heat pump projections for the Isle of Wight electricity supply areas.

Recommendation 5b: SSEN and Isle of Wight Council should continue to engage with SGN to combine the findings of this assessment, SSEN's DFES 2022 analysis and SGN's study, to determine a shared vision of the Island's future energy system.

Recommendation 5c: Ahead of these additional analyses, the evidence shown in this report should be considered a clear indication that network reinforcement to meet future heat and transport electrification demand capacity, as well as distributed generation capacity, is likely to be required.

Isle of Wight Businesses

As shown in Figure 5, there is a range of different commercial businesses and industrial companies operating on the Isle of Wight. Outside of the electrification of transport and space heating, details around other potential new sources of electricity demand from commercial and industrial organisations on the Island are unclear. There are also examples of some commercial organisations, such as Parkhurst Prison and St Marys Hospital, that rely on onsite back-up generation in instances of outages. So the future of the electricity network on the island is crucial to continuing critical services and operations at a number of businesses.

Through desktop research and direct engagement, the study has highlighted three examples of energy-intensive businesses operating on the Island and the potential shift in their future energy use, as part of their decarbonisation and net zero commitments.

Southern Water

Southern Water is a regional water and wastewater utility company covering 2.5 million customers across Sussex, Kent, Hampshire and the whole of the Isle of Wight. As part of its net zero plan[29], Southern Water has made the following pledges:

- To buy 100% fully accredited, renewable-backed power from their retail energy suppliers from April 2021.
- They aim to generate 24% of their own renewable energy by 2025.
- They seek to transform their company vehicles by electrifying the fleet or introducing alternative low carbon fuels by 2030.
- To aim for nature-based solutions and work in partnership with other organisations.
- To report progress and company emissions annually in a transparent way.
- To support collaborative research, development and innovation.

Southern Water's main operational site on the Isle of Wight is Sandown Sewage Treatment Works, which consumes 6.2 GWh of electricity per year.

Figure 50: Aerial view of Sandown Sewage Treatment Works | *Credit: Island Echo, September 2021*

[29] Southern Water Net Zero Plan, https://www.southernwater.co.uk/our-story/our-plans/net-zero-plan

Engagement with Kirsten Abbott, the Commercial Energy Manager at Southern Water, highlighted that the site currently operates a 360kW sewage gas CHP engine (installed in 2013). All of the energy generated from this asset is self-consumed on-site. It was also highlighted that the development of a new 600 kW solar array to directly supply additional renewable energy to the site was assessed, but stalled due to significantly high network connection costs offered by SSEN. They are keen to re-apply soon to assess the business case, so as to align with their 24% by 2025 self-generation target across the wider business.

In addition to this, there are aims for the wider business to convert their transport fleet to electric vehicles and low carbon fuels, through a phased approach. The significant replacement of company vans operating on the Island will trigger the need for EV charging to be installed on sites like Sandown Sewage Works. It was suggested that this was more likely to happen in the next water industry operating period (AMP 8, which starts in 2025).

Southern Water is also interested in looking at other technologies in the future, such as battery storage and hydrogen electrolysis. The latter could be linked to non-potable water resources that Southern Water has abundant access to.

In general, it was highlighted that mitigating the constraints present on the electricity network on the Isle of Wight would be directly beneficial to Southern Water's decarbonisation plans at Sandown Sewage Works and for their vehicle fleet.

Isle of Wight NHS Trust

The NHS's main site on the Isle of Wight is St Mary's Hospital in Newport. This site comprises 45 buildings and is the main patient treatment facility on the Island. There are other smaller off-site buildings located in Shanklin and Ryde. As part of the NHS' broader Greener NHS programme[30], there are specific objectives for the NHS to be the world's first net zero national health service[31], setting the following targets:

- **For directly controlled emissions ("NHS Carbon Footprint"):** to reach net zero by 2040, with an ambition to reach an 80% reduction by 2028 to 2032
- **For the emissions that can be influenced ("NHS Carbon Footprint Plus"):** to reach net zero by 2045, with an ambition to reach an 80% reduction by 2036 to 2039.

Historically, energy in the NHS has been managed on a trust-by-trust basis and by regional Integrated Care Systems (ICS regions). However, both the NHS Greener and Net Zero NHS programmes have promoted a more strategically coordinated approach to energy measures.

The Isle of Wight NHS Trust is exploring a number of initiatives looking at energy use and carbon emissions at their main St Mary's site. The project team engaged Tom Milne, the Head of Capital Projects in the Estates & Facilities Division of the Isle of Wight NHS Trust.

[30] See Greener NHS: https://www.england.nhs.uk/greenernhs/
[31] See Delivering a Net Zero NHS: https://www.england.nhs.uk/greenernhs/a-net-zero-nhs/

This engagement provided insight into the Trust's work looking at future decarbonisation and electrification options.

No renewable energy generation has been installed to date. However, the large sprawling estate with multiple buildings at St Mary's Hospital provides a strong potential for rooftop solar PV. Funding is difficult to unlock, so costly connections may be a challenge to enabling projects, with other estates also looking at solar. The Trust is aware of the network capacity headroom/constraint issues on the Island. However, it was fed back that wider Net Zero NHS commitments mean that creating headroom for solar PV should be seen as a priority area.

The Trust operates a number of diesel generators across its estate, predominantly for mains failure backup. Their operating hours are low, mainly limited to outages and maintenance run time. The Trust is interested in all and any alternative technologies to unabated diesel engines, mentioning battery storage, bioenergy and biodiesel.

The Trust (like many other NHS sites) uses a lot of heat, and this is almost entirely currently supplied by onsite gas boilers. Tom highlighted that a study is currently being undertaken by GE looking at alternative heating solutions for the St Mary's site. Tom suggested that the study is very likely to recommend air source heat pumps as the preferred solution, aiming to replace gas boilers across the next 2-5 years, creating notable near-term additional load.

For decarbonising transport, the Trust is also focused on 100% EVs in the future. They operate a couple of hybrid vehicles so far, but have no EVs or EV charging on site. However, Tom fed back that all-electric ambulances are also in-scope and that they will be aiming to replace all of their other vehicles, patient transport cars (PTCs), paramedic cars, pool cars and minibuses with 100% EVs by 2030. They will have to implement EV charging on-site to meet this new EV demand. It was highlighted that the Trust can't delay implementing its plans and need to meet wider NHS targets. As such, Tom stressed that the electricity network could not be a barrier when looking to progress the Trust's solar, heat pump and EV initiatives.

GKN Aerospace

GKN AEROSPACE

GKN Aerospace are an international aerospace manufacturing and technology innovation company. GKN have a 105,000 sqm facility at East Cowes on the north side of the Isle of Wight[32]. This facility provides design, manufacture, testing, certification and aftermarket services, including the design and manufacture of nacelles, wings and empennage structures.

As part of their broader *Sustainable GKN Aerospace* programme, the company have made a commitment to Net Zero. This includes aims to achieve net zero GHG emissions by 2050, sourcing 100% renewable electricity, and to be involved at the forefront of sustainable aerospace technology design, to manufacture aircraft that emit net zero life-cycle GHG emissions by 2050. This could mean that industrial electricity demand at East Cowes could evolve over time, and GKN is likely to also be considering solar, EVs and low carbon heat.

[32] See https://www.gknaerospace.com/en/about-gkn-aerospace/locations/gkn-aerospace-in-europe/cowes/

Conclusion 6: Engagement with businesses on the Island reinforces the evidence for potential future electricity load growth on the Island. Engagement suggests an appetite for both behind-the-meter and larger-scale renewable energy generation (in the form of rooftop and ground-mounted solar PV) and behind-the-meter battery storage to provide energy management services or as an alternative to back-up diesel generation. It also highlights the potential for additional electricity demand at key operational sites on the Island, from the planned adoption of heat pumps and EV chargers to meet the uptake of a range of EV types.

Recommendation 6: SSEN and the Isle of Wight Council should consider establishing a broader energy working group for the Island, potentially as part of or an extension to the existing Isle of Wight Net Zero Energy Hub or the Working Group that has supported this study. This group could work with SSEN to explore some of the recommendations of this report and may include representatives from some commercial businesses or major energy users across the Island.

Smart grid and energy flexibility solutions

Smart grid and flexibility solutions - overview

Outside of traditional network reinforcement options, there are a number of other potential solutions to mitigate the impact of network constraints and future load growth, as well as enabling smarter uses of energy at a regional and local level.

A number of emerging smart grid and energy flexibility approaches are being explored, trialled and implemented to reduce the impact of network constraints and influence customer behaviour to enable more use of renewable energy at a local level.

The following section of this report provides a high-level summary of some of the smart grid and flexibility solutions that are being investigated and their indicative suitability and impact on the Isle of Wight's electricity system and the constraints being experienced.

Table 20 shows a summary of some solutions that have been identified. These solutions have been considered under two ratings: the **level of impact** the solution could potentially have on the Isle of Wight's existing network constraints, and the **viability of the implementation** in terms of technical potential and a very high-level view of cost-benefit.

The **level of impact** is rated as follows:

High impact: Could have a direct impact on releasing network capacity on the Island
Medium impact: Could have an indirect impact or mitigate some of the constraints.
Low impact: Unlikely to impact the Island's network constraints of future capacity.

The **viability of implementation** is rated as follows:

Readily viable: Could be readily implemented or has already been implemented.
Partially viable: Could be implemented in the near future, but high effort is needed.
Unviable: Unlikely to be implemented or potentially prohibitively costly.

The overview provided in this section is intended to be a high-level summary of some of the options that are currently being explored in the industry. However, the project has not sought to undertake any in-depth assessment of implementation, associated costs and financial benefits or technical specification for any of these solutions on the Isle of Wight.

Therefore, alongside the consideration that is given to investment in network reinforcement, a more detailed assessment of some of the potentially higher impact or more readily implementable options could be considered as a follow-up piece of work. This could potentially be led by the Isle of Wight Council Net Zero Energy Hub or SSEN, depending on the solutions pursued.

Table 20: Overview of smart grid and flexibility solutions that could have an impact on the Isle of Wight's electricity system constraints

Smart / flex solution area	Description	Level of impact	Viability of implementation
Alternative connections	Alongside traditional 'firm' connections, a suite of alternative network connection options is also offered to generators. These include export limitation, intertripping and future iterations of active network management (ANM), such as the existing schemes on the Isle of Wight and Orkney.	**High impact** The available capacity to be released by the existing ANM scheme has reached its limit. However, revisions to the assumptions that underpin the Island's ANM system could have significant impacts on the network headroom.	**Partially viable** Modifications to the ANM scheme's control philosophy are viable, but would be subject to the availability of dispatch data for Cowes Power Station and the conclusions of the Open Networks workstream looking at primacy rule.
Strategic deployment of flexibility technologies	The coordinated deployment of flexibility technologies such as battery storage, power-to-x (i.e. hydrogen electrolysers), EV vehicle-to-grid, commercial demand side response (DSR) and residential level flexibility.	**High impact** More use of on-Island generation through flexible technologies could result in less curtailment for sites under the ANM scheme.	**Partially viable** Flex technologies are being deployed across the UK. A joined-up approach to Isle of Wight flexibility would be beneficial but would require commercial investment, developer appetite and an Island-wide deployment plan.
Commercial local flexibility markets	Flexibility services are procured by National Grid and DNOs to financially incentivise the flexing of energy demand and generation in response to system needs. Local flexibility markets operated by DNOs are looking at procuring services in specific geographic areas known as constraint management zones (CMZs). However, these services are currently focused on demand constraints and outage management support.	**Medium impact** No Isle of Wight CMZs currently exist, though flexibility could mitigate future demand constraints. Flexibility services to tackle generation constraints would have a direct impact, but demand turn-up services/incentives are largely untested to date as part of local flex markets.	**Partially viable** SSEN could target one or more CMZs on the Isle of Wight and trial the procurement of demand turn-up services to mitigate generation constraints. Such a trial would need strong financial incentives and notable flexibility capacity. It is also unclear how flexibility dispatches would align with the Island's existing ANM operations.

Smart energy solutions	A broad range of smart energy solutions is being tested across the UK. This encompasses smart/local retail supply tariffs that can incentivise customer behaviour, the smart management of EV charging and other types of smart demand management and dynamic energy control technology.	**High impact** Options such as an Island solar/EV time-of-use tariff and/or EV car club with associated collective charging control could have a material impact on network constraints. Broader DSR or 'smart town' approaches could also shift some demand to match PV.	**Partially viable** Isle of Wight Council is already considering the potential for an EV tariff for the Island. To act as evidence to release network headroom, a year of data would be required. Wider smart demand management needs more in-depth research and analysis.
Power purchase agreements and peer-to-peer arrangements	PPAs are contractual and financial instruments that 'match' energy consumers with generators and enable financial and reputational benefits. Examples include synthetic PPAs, virtual PPAs, consortium sleeving pools and peer-to-peer transactional arrangements. PPAs can sometimes also be associated with direct private wire connections between demand sites and adjacent renewable energy generation assets.	**Low impact** PPAs are decoupled from the physical network and don't materially impact physical capacity or network headroom. They are long-term financial contracts. The connection of private wires between user and generator could materially affect local network capacity calculations.	**Partially viable** By nature, private wire connections are hyper-localised with demand customers connecting to generation projects on nearby land areas. Generation capacity also needs to be well-matched with the site's demand profile. As such, well-matched opportunities are likely to be very limited on the Isle of Wight.
Strategic energy efficiency deployment	Whilst not a truly smart grid solution, a coordinated approach to increase the deployment of energy efficiency measures in a region has been trialled in some areas as a means to reduce future electricity demand peaks. An existing innovation project, *Solent Achieving Value from Efficiency* (SAVE), is seeing a notable reduction in peak energy use across the wider Southern England licence area. A targeted future iteration of this approach could be looked at for the Isle of Wight.	**Medium impact** Depending on the efficiency measure, a strategic Island-wide rollout could reduce measured power demand peaks and thus associate with the Island's ANM control and wider network headroom calculations. However, in the near term, this could also compound generation constraints, with lower demand available at peak generation times.	**Partially viable** Energy efficiency rollout programmes are being investigated, and BEIS is looking to accelerate energy efficiency across GB. A coordinated energy efficiency campaign for the Isle of Wight, backed by SSEN, would need to be assessed and funded and would need to be widely promoted and involve domestic installers and notable administration.

Alternative flexible connections

Alongside standard connection arrangements, most DNOs offer, in network-constrained areas, a suite of alternative (i.e. non-firm) connections. These flexible connections provide the DNO with a greater level of control and management of loads, to ensure the network operates within operational limits, whilst still making it possible for customers to connect. Flexible connections tend to require the installation of additional equipment, some of which needs to be witness tested by DNO engineers, and may also limit the output of generation assets. This adds additional cost to a project and an additional risk of lower generation yields. The main types of alternate connections offered by SSEN are summarised in Table 21.

Table 21: Summary of alternative and flexible connections offered by SSEN[33]

Flexible connection	Description
Intertripping	Generators will be automatically disconnected if a network circuit running in parallel to the point of connection trips.
Timed connections	Generators are limited to exporting during certain periods of the day/year, based on local network impact analysis.
Export limitation	Assessed on a case-by-case basis, generation customers are provided with an export capacity limit that they cannot export beyond – this is often less than the total 'plated' generation capacity of the generation asset.
Contractual flexibility	Generators can export a portion of their full agreed supply capacity whilst network reinforcement works are completed.
Active network management (ANM)	Single generator ANM: This is offered to the first generator in a constrained network area. A full ANM system is then applied once there is a second generator seeking to connect.
	Third-party ANM – shared capacity: where a consortium export limitation is applied across multiple customers.
	Third-party ANM – demand management: A generator acts to secure additional demand to ensure the export limit is 'met' through localised demand turn-up services.

SSEN operates ANM systems on both the Islands of Orkney and Shetland in north Scotland and on the Isle of Wight. The operation of this scheme is described in the *Isle of Wight network operation, constraints and reinforcement* section of this report on page 32.

Third-party demand management connection offers are potentially of interest for new generators that may be constrained or unable to connect to the Island's ANM system. This provides the option for a generator to issue a proposal to increase the minimum demand, such as by changing gas boilers to electric boilers on the same circuit as the constrained generation site asset. The generator then ensures that if the export limit is breached, that suitable demand is brought onto the network. SSEN would have a backup system so that in the event the customers' guaranteed demand turn-up fails, the generator is disconnected.

33 See SSEN alternative and flexible connections overview: https://www.ssen.co.uk/our-services/flexible-solutions/flexible-connections/

Strategic deployment of flexibility technologies

There are a number of technologies that could provide flexibility services to the distribution network on the Island. In order to mitigate generation constraints in a specific network area through commercial flexibility markets or other price signals, the deployment and availability of dispatchable technologies that can provide dispatch services is a first crucial step.

Some flexible energy technologies can be categorised as follows:
i) Battery storage (categorised by a set of different asset classes/business models)
ii) Non-battery storage
iii) Dispatchable low carbon generation
iv) Power-to-x conversion technologies

i) Battery storage
A range of asset classes, including grid-scale, those co-located with large-scale generation, or behind the meter co-located with large energy users and domestic customers.

As highlighted by several project developers engaged as part of this study, there is notable potential for battery storage projects of varying scales to be developed on the Isle of Wight. Several of the existing proposed future solar PV sites could be potential co-location sites for battery storage, providing 'peak-shaving' or 'time-shifting' functions for individual solar assets, reducing the potential for curtailment. The deployment of standalone battery storage projects, leveraging a number of national commercial services procured by National Grid ESO, could also enable the delivery of flexibility dispatch services at a local Isle of Wight network level. How battery storage will be treated under connection regulatory reforms (such as the Access and Forward-looking Significant Code Review), could also heavily influence the level of deployment that could be seen on the Isle of Wight and across the wider distribution network in the future. Currently, storage is treated as generation under connection policy and the associated costs to connect. This means that the lack of capacity headroom impacts battery deployment as it does solar and other renewables. However, if this is reformed and battery storage is treated as its own asset class or considered 'network neutral' (as is being considered by the transmission operator), battery storage projects could be able to connect to the network in the future and provide flexibility services that could mitigate both the existing and future constraints for renewable energy generation projects on the Island and help to meet demand peaks.

ii) Non-battery storage
Solid-state batteries are the dominant storage technology being pursued in the UK. However, there are also other electricity storage technologies such as pumped hydropower, compressed air, liquid air, gravitational storage and other more novel storage technologies being pursued.

Due to the Island's topography, established non-battery technologies such as pumped hydro are unlikely to see deployment. Whilst some other novel and longer-duration storage technologies being developed in the UK are less restricted by locational or resource factors, it can be considered that the Isle of Wight will not be a priority area for some novel storage technologies due to practical, logistical limitations and low energy demand.

iii) Dispatchable low carbon generation

Whilst solar PV, wind, hydropower and marine generation can be classified as variable renewable generators, there is also the potential for low carbon dispatchable generation. This could include biomethane/bioenergy-fired generation, or in a future scenario where an abundance of low carbon hydrogen is available, hydrogen-fuelled electricity generation could displace some fossil-gas-fired generation operating today.

As shown in Figure 22, there is a small amount of anaerobic digestion generation operating on the Island currently. The future potential for additional bioenergy is likely to be fairly limited, with the DFES 2021 projections suggesting that more energy from waste could come online within the next decade.

As discussed earlier in this report, the future of the 140 MW marine diesel generation site at Cowes is unclear. The potential for this to be converted into a hydrogen-fuelled generator in the mid-2030s has been assumed under the Leading the Way scenario in the DFES 2021 analysis. However, engagement with the asset owners RWE highlighted that there were no current plans for this to be converted to hydrogen in the near term.

iv) Power-to-x

Includes the conversion of electricity to other energy vectors, such as hydrogen electrolysis (power to H_2), thermal storage (power to heat) and conversion to other chemical vectors.

The deployment of hydrogen electrolysis on the Island is highly uncertain. SSEN's DFES analysis suggests that, depending on the scenario, electrolyser deployment could be very limited by 2050 or under scenarios where SGN's gas network is converted to deliver 100% low carbon hydrogen or where there is localised demand from end use sectors such as marine vessels or industry, multiple electrolyser assets could connect to the Island. DFES analysis suggests c.60 MW by 2050. See Figure 51. This would rely on a number of local/regional hydrogen offtakers. In 2020, Wight Community Energy partnered with EMEC and Ricardo to investigate the potential viability for solar-powered green hydrogen production on the Island[34]. This RCEF project did not progress past the preliminary phase, however, so no clear conclusions or recommendations for green hydrogen use are available.

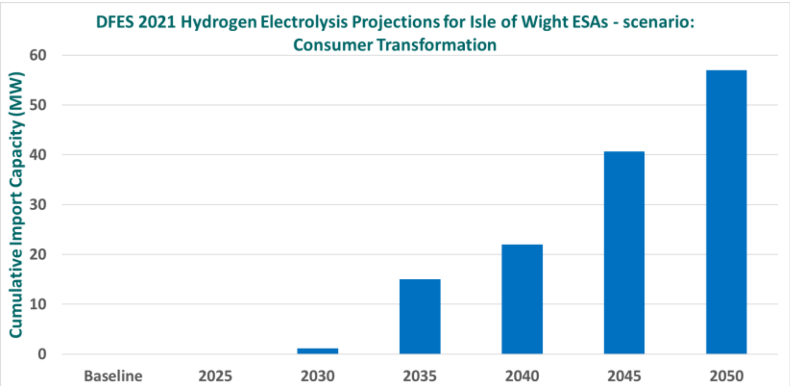


Figure 51: DFES 2021 projections for hydrogen electrolysis capacity on the Isle of Wight under a Consumer Transformation scenario

[34] See article summarising hydrogen production trial on the Isle of Wight, Ricardo, June 2020: https://ricardo.com/news-and-media/news-and-press/ricardo-and-emec-team-up-to-support-isle-of-wight-hydrogen-production

Local commercial flexibility markets

As a key aspect of the Distribution System Operator (DSO) function, local flexibility services (and the markets that are designed to commercially procure them) are considered by both DNOs and Ofgem as an interim alternative to traditional network reinforcement.

Since 2017/2018, when the first trial auctions were issued by a number of DNOs, the GB marketplace for local flexibility services has notably grown (see Figure 52).

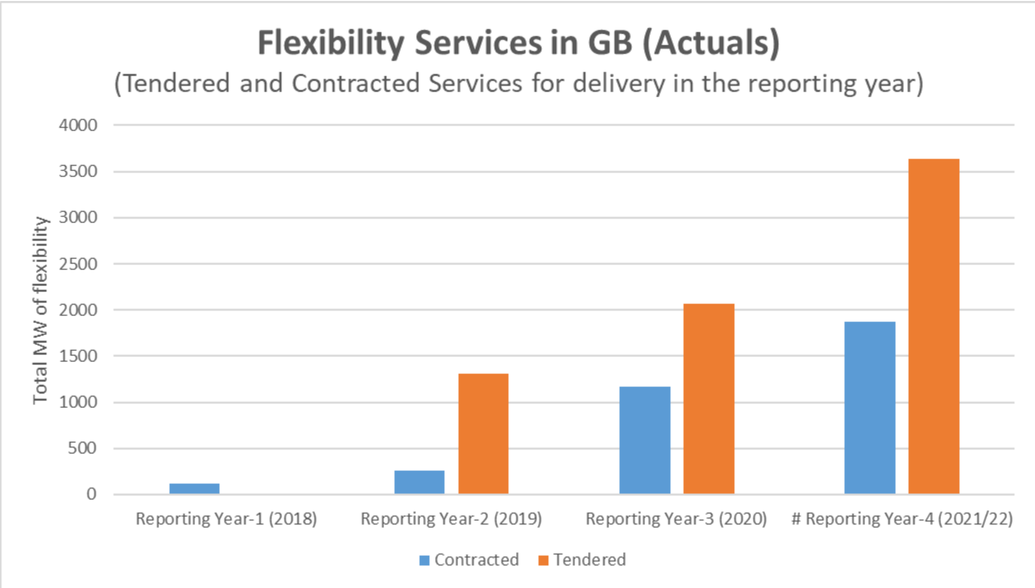


Figure 52: Annual tendered and contracted flexibility capacity across GB DNOs 2018 to 2021/22, *Source & credit: ENA Flexibility Figures, August 2022*

Unlike national balancing services procured by National Grid ESO, local flexibility markets seek to procure a set of specific services in very specific locations. These locations are centred around constraint management zones (CMZs), tethering to DNO primary substation supply areas. Currently, the flexibility services procured by the DNOs are heavily centred around demand constraints and support during outages on the network (see Table 22).

Table 22: Summary of the main local flexibility services procured by DNOs

Flexibility service	High-level flexibility service description
Sustain	Support during forecast demand peaks.
Secure	Support during planned network downtime.
Dynamic	Support during likely planned outages.
Restore	Support during unplanned outages.

The commercial incentive around these flexibility services includes financial payments for availability (i.e. retainer payment) and responding to service calls (i.e. dispatch payment). Due to the nature of these services, dispatchable generation, battery storage, and commercial businesses providing demand-side response actions are the natural parties bidding to secure contracts to deliver 'generation turn-up' and 'demand turn-down' flexibility services.

SSEN have procured flexibility services through multiple auctions for a selection of CMZs across their north of Scotland and southern England licence areas. See example in Figure 53.

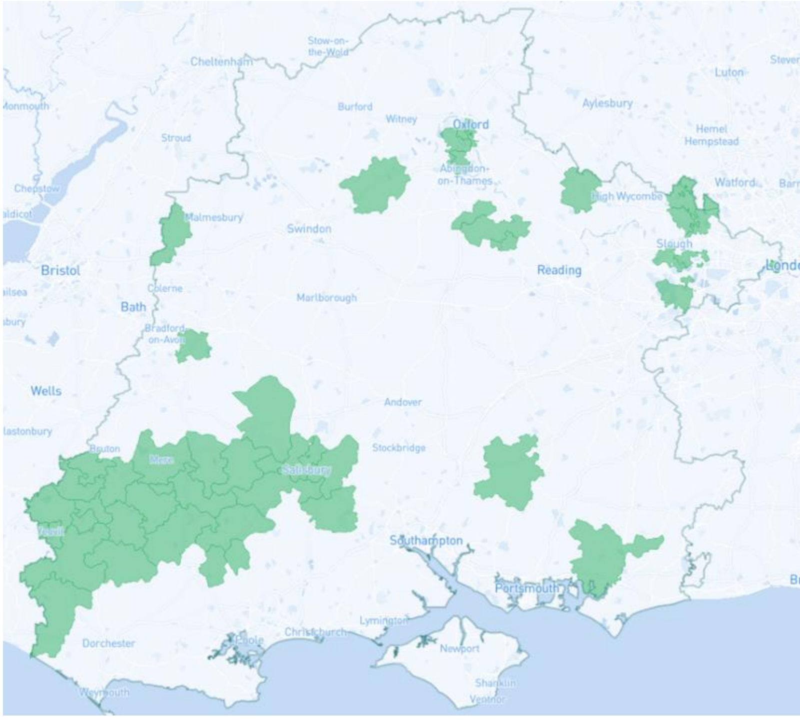


Figure 53: Example of SSEN constraint management zones in the southern England licence area

Due to there being notable demand headroom on the primary substations on the Isle of Wight, no flexibility or CMZs have been identified or tendered on the Island to date. Equivalently, due to the way connection charging is currently applied to distributed generators, the implementation of specific flexibility services as a method of mitigating generation constraints by SSEN and other DNOs has been very limited to date.

National Grid ESO did implement their demand flexibility service over the winter of 2022 and saw a positive uptake, with more than one million households and businesses signing up and an anticipated savings of close to £3 million.[35] So the appetite for demand side response when strongly incentivised and promoted can be clearly seen.

There are also examples of generation constraint management services being trialled at the distribution network level. The **Demand Shift** trial that SPEN is running in partnership with Octopus Energy enables customers to receive proportional payments for increased energy usage.[36] On Orkney, the **Project TraDER** trial ran from 2019 to 2021, exploring the possibility of a flexibility exchange on a neutral market platform, as opposed to a DNO/DSO run platform[37]. The two products offered were a Demand Turn-Up service to reduce generator curtailment and customer bills and an "ANM Flex" product, which attempted to enable assets contracted under ANM connections, to provide ancillary services to the ESO, to improve their business models and wider revenue stacks.

Some of the other leading and active examples of innovation in local commercial flexibility markets are summarised in Table 23.

[35] Over 780Mh of demand reduction seen across first DFS tests, Current News, Dec 2022
[36] Scottish customers use energy to help grid AND cut bills in UK-first trial, Jun 2022
[37] See Energy Systems Catapult, Project TraDER: https://es.catapult.org.uk/report/project-trader/

Table 23: Three examples of ongoing innovation in the commercial flexibility market space

Local flexibility market example	Description
Crowdflex	https://smarter.energynetworks.org/projects/10037410/ NGESO's Crowdflex aims to establish domestic flex as a key balancing mechanism. With a predicted potential UK-wide resource of 7GW of turn-down and 10GW of turn-up flexible capacity, NGESO hopes to bring together energy system partners (the likes of SSEN, Octopus, Element Energy and more) to drive innovation in the domestic flexibility space and clarify how to incentivise it most effectively.
Re-Heat	https://smarter.energynetworks.org/projects/nia-spen-0057/ A trial project delivered by SPEN, aimed at mitigating both the increased demand from domestic electrical heating and increasing curtailment of renewable generation, essentially by matching electric heating demand to constrained energy generation in specific areas.
HOMEflex	https://smarter.energynetworks.org/projects/nia_ssen_0061/ Though not a trial that will directly impact headroom, SSEN's HOMEflex is an important step towards achieving a fair, inclusive and transparent marketplace, focusing on establishing a code of conduct for domestic flexibility services. Delivering a better customer experience is a key step in engaging more customers on the concept of flexing their energy use.

There is the potential for SSEN to work with Isle of Wight stakeholders on a trial of a tailored set of CMZ flexibility auctions that could mitigate generation constraints. The compatibility of flex services with the Island's existing ANM scheme would need to be assessed in detail.

Conclusion 7: At present, the Isle of Wight has very limited levels of accessible, dispatchable energy flexibility. Whilst approaches such as ANM, dynamic supply tariffs, and conventional network reinforcement could unlock network capacity, the network infrastructure on the Island and the wider UK electricity system would benefit from a coordinated deployment of incentivised flexibility assets operating to mitigate constraints across the Island. SSEN could provide a market signal through an Isle of Wight CMZ tender.

Recommendation 7a: Isle of Wight Council could work with SSEN to develop an Isle of Wight Energy Flexibility Strategy, exploring the optimum levels of electricity storage, (at multiple voltage tiers), demand side response and other sources of energy flexibility on the Island to maximise generation use and reduce constraints. This could be a complimentary analysis to the proposed renewable energy generation rollout. Funding for this could be through linkages with existing Local Area Energy Planning delivery funding.

Recommendation 7b: Working with Isle of Wight stakeholders, SSEN could implement trial constraint management zones on the Island via an associated tender process and promotion campaign. This would seek to procure commercial flexibility services specifically designed to tackle generation constraints on the Island, through demand turn-up or generation turn-down services.

Smart energy solutions

Smart and local tariffs

Legacy supply tariffs for off-gas properties such as Economy 7 (day/night) have remained part of retail supply offerings for many years. However, we are beginning to see the evolution of smarter, more dynamic tariffs, seeking to match consumer demand to align closer to variable renewable energy generation output and price signals.

Time-of-use retail electricity supply tariffs have moved from innovation trials (such as the *Sunshine Tariff* in Wadebridge in 2017[38]) to commercial tariffs offered to everyday retail customers (such as the *Octopus Go* tariff for EV drivers[39]). Locationally driven supply tariffs and localised markets for energy are also being explored, seeking to increase or better match demand to localised generation asset(s). Examples of some of the local tariff arrangements being investigated currently are shown in Table 24.

Table 24: Examples of local supply tariff arrangements being assessed in the UK

Example local supply tariff	Description
Energy Local	https://energylocal.org.uk/about-us Matching local generation to a cooperative of local demand customers through an 'Energy Local Club' portfolio approach. A licenced supplier is involved to facilitate the purchase of electricity and to supply any residual electricity that is needed to the energy club customers. 14 clubs are currently in operation in the UK, with another 13 being developed.
sonnenCommunity	https://sonnengroup.com/sonnencommunity/ Smart home battery operation to enable individual customers to have access to a portfolio of solar PV generation assets, through a community membership approach.
ReFLEX Orkney	https://www.reflexorkney.co.uk/home/tariffs As part of the wider ReFLEX Orkney innovation programme, up until August 2021 the scheme offered a one-year fixed rate 100% renewable electricity tariff to participating customers, provided by retail supplier Shell Energy. As a tariff incentive alongside flexibility dispatch services.
Devon renewable electricity tariff	https://www.regen.co.uk/project/devon-renewable-electricity-tariff/ Regen and Devon County Council are working with a number of licensed suppliers to offer new community-owned generation projects a power purchase agreement that provides financial stability to enable them to be built. The proposed approach is to have a simple, flat tariff that is marginally higher than current market prices, in return for the ability to buy 100% of their annual energy from local renewable energy generators, through a bespoke PPA arrangement.

[38] See Sunshine Tariff project overview, Regen, 2017: https://www.regen.co.uk/project/sunshine-tariff/
[39] See Octopus Go tariff overview, Octopus Energy, 2023: https://octopus.energy/go/

Postcode specific tariffs	https://cms.goodenergy.co.uk/our-energy/our-wind-farms/delabole-wind-farm/ Good Energy's Delabole Local Tariff was launched in 2013, providing around 170 households local to the Delabole Wind Farm with 100% renewable energy at a rate 20% lower than a standard Good Energy retail tariff. https://www.octopusenergygeneration.com/fan-club/ Octopus Energy has set up a similar scheme, giving customers in certain postcodes 50% off of their electricity when wind speeds are above a certain speed and their local wind farm is generating.

The Isle of Wight Council has been looking at the principle of an Island-specific tariff as part of the wider Net Zero Energy Hub:

"As an Island, a smart tariff could be something that is operating at an energy system level or through a peer-to-peer arrangement. We are interested in exploring both options to benefit our pathway to net zero.

Time of Use Tariffs are a key mechanism for shifting demand to better match generation (demand turn up as well as a reduction). Trials such as the one piloted by Octopus Energy has shown that financial rewards for responses may be as effective as incentivising customers to avoid higher price periods.

By localising a market of flexibility response through smart tariffs, we think we can achieve greater value for the Island and reduce energy costs. This will require a suitable commercial and regulatory framework, high-accuracy energy monitoring of generation assets and demand consumers and sophisticated control systems (possibly through the use of artificial intelligence or learning algorithms) to ensure that smart tariffs achieve their intended aim."

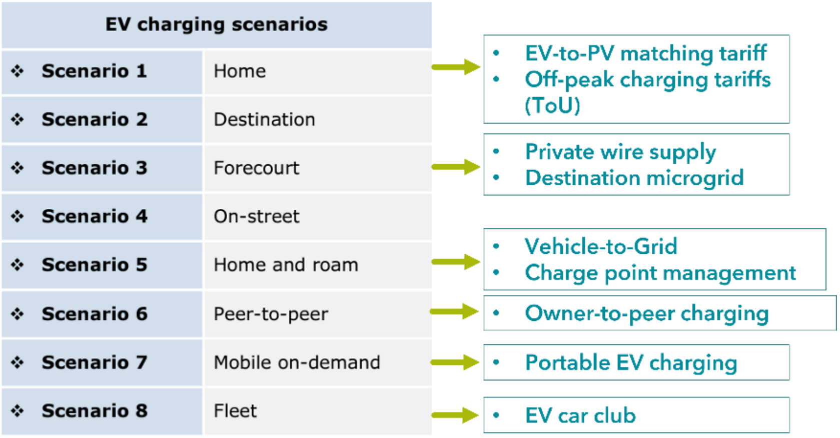
Jim Fawcett, Low Carbon Projects Principal Officer, Isle of Wight Council

When considering the impact of commercial supply tariffs as price signals to incentivise demand to consume when generation is high, the direct impact on network capacity is difficult to quantify definitively. Engagement with the SSEN network planning team suggests that for a tariff to act as material evidence to release network headroom, a year of monitoring data would be needed to show that it is having a direct impact on generation constraints and enabling more on-Island generation to be locally consumed. Therefore, whilst this is a long lead time, the Isle of Wight Council could look to engage a willing retail supplier to investigate the viability of an Isle of Wight flexible tariff, linked to EVs and solar PV development on the Island.

Smart EV management

As outlined in Figure 34, a significant uptake of EVs and the associated EV charger capacity that could be present on the Island in the future will bring online a significant, variable load across the Island. The smart/dynamic management of EV charging could be crucial to avoiding significant network demand peaks and operational issues.

A number of different EV charging archetypes and associated charging scenarios could be seen across the Island, such as 'at home', 'on-street', 'on forecourts', 'fleet locations' and more. These various charging scenarios promote the need to consider a range of different EV charging management approaches or demand-shifting incentives, summarised in Figure 54.



Sources: Taking charge, Ofgem, 2022,
The role of Electric Vehicles in a Smart Grid, Regen, 2018

Figure 54: EV charging scenarios and EV charger management approaches, Regen analysis

Off-peak charging tariffs and private wire supply mechanisms are already in use and available across the UK. The coordinated management of charging of EV fleets is also being looked at and adopted through 'EV car clubs'. The Isle of Wight currently has two EV car clubs in operation, managed by Co-Wheels[40] and Enterprise.

EV charging specifically managed by DNOs is also being investigated through a number of innovation projects, where DNOs are seeking to not only provide information for where optimal locations of EV chargers could be, but also gathering EV charging data to understand how smart charging could reduce network constraints in particular areas. In the future, this could progress to DNOs looking at physical control equipment to send signals to manage EV charging in areas of their networks where unmanageable peaks may occur.

Vehicle-to-grid (V2G) schemes, whereby bi-directional EV charge points enable EVs to export electricity to the grid as well as import, could enable EVs to provide demand-side-response type services to the local network. The implementation of a V2G scheme on the Island is potentially a little further off, as trials continue to run on a national level.

[40] See Isle of Wight Council overview of Isle of Wight EV car club: https://www.iow.gov.uk/Residents/environment-planning-and-waste/Future-Energy-Initiatives/Energy-Initiatives/Car-Club

From the DFES 2021 projections, 92,000 EV cars and LGVs could be registered on the island by 2040, equating to c.400 MW of EV charger capacity. There is a potential scope for these EVs to be used as an aggregated source of controllable flexibility, incentivised by the right price signals, such as from SSEN's local flexibility tenders.

Some examples of relevant smart EV charging trials and initiatives are shown in Table 25.

Table 25: Examples of smart EV charging initiatives and trials

Managed EV charging trial	Description/relevance to the Isle of Wight
Orkney ReFLEX	https://www.reflexorkney.co.uk/home/electric-vehicle-chargers Smart and scheduled EV charging through use of the myenergi app.
Optimise Prime	https://www.optimise-prime.com/trials-overview A consortium of organisations, involving both SSEN and UKPN, monitoring commercial vehicle charging at a number of chargepoints, to determine how to mitigate the impact of commercial EV charging on local network constraints.
Kaluza V2G trial	https://www.kaluza.com/case-studies/case-study-kaluza-enabled-vehicle-to-grid-v2g-charging/ Kaluza and the Office for Zero Emissions Vehicles are running a number of trials showing that V2G services offered could open up as much as 22 TWh of flexible EV energy across the UK by 2030.
CHARGE Project	https://www.spenergynetworks.co.uk/pages/charge.aspx Seeking to accelerate the deployment of public charging infrastructure by bringing together expertise from transport planning, electricity network planning and EV charging companies. The project has developed an online tool to understand optimum locations for EV chargepoints based on user needs, network headroom and how EV charging will impact the electricity network.
Electric Nation	https://electricnation.org.uk/ The project was operated in 2 phases, led by (then) WPD: Phase 1 (2016-19) secured EV charging data from 673 EV owners, concluding that well-designed EV tariffs plus smart chargers can save money and help DNOs plan for peak domestic EV charging periods. Phase 2 (2020-22) recruited 100 EV owners to trial domestic V2G smart charging, in order to understand how V2G charging could work with electricity network operation. This will allow DNOs to see what V2G looks like as a service in the future, by helping to balance variations in national energy production and consumption. The resources from the project are soon to be released.
BEIS EV charging plan	https://www.gov.uk/government/publications/electric-vehicle-smart-charging-action-plan In January 2023, BEIS and Ofgem announced a new joint plan to identify the steps to unlock the potential of smart EV charging and V2G. The EV Smart Charging Action Plan seeks to support projects, including a street lamppost capable of charging electric vehicles and selling power back to the grid, through a share of a new £16 million funding scheme.

Conclusion 8: At present, domestic and commercial energy consumption is not incentivised to match the Island's current or future solar PV generation. This mismatch is contributing to the constraints being experienced on the Island, with a notable amount of solar generation being exported to the mainland and some of the existing operational solar sites on the Island being constrained.

The implementation of a well-designed and promoted time-of-use tariff could increase the amount of solar generation that is consumed by homes and businesses on the Island. The future management of EV charging could be a very important factor for more urban areas of the Island's energy system. With BEIS promoting the adoption of smart charging and the development of an existing EV car club, there are opportunities for the Isle of Wight to further develop its EV strategy.

Recommendation 8a: Ahead of the deployment of more solar capacity and the electrification of heat and transport across the Island, Isle of Wight Council should seek industry partners to design, test and implement a set of tailored Isle of Wight time-of-use tariffs. Working with SSEN, this tariff could be designed to act as a source of evidence to influence the assumptions behind generation constraints currently being applied.

Recommendation 8b: SSEN and the Isle of Wight Council should seek to implement a trial of smart EV charging across the Island to work alongside any dynamic tariffs, potentially looking at the BEIS EV Smart Charger Action Plan funding options.

Power purchase agreements

Power Purchase Agreements (PPAs) and peer-to-peer arrangements are essentially financial instruments designed to enable generators and consumers to directly contract with each other. Whilst potentially providing some financial benefit for both parties and reputational benefits for the demand customer (which could also benefit some variants of scope two emissions reporting), they remain decoupled from network infrastructure considerations and are mostly not tethered to any physical connection arrangements.

Strategic energy efficiency deployment

Energy efficiency improvements would perhaps not typically be considered smart solutions that could materially impact generation constraints on the network. Instead, they are a crucial first step to mitigating both fuel poverty and largely related to reducing heat loss in residential buildings. Low carbon technologies such as heat pumps will require energy efficiency upgrades to be deployed in a number of homes and businesses to ensure they can perform cost-effectively during cold days.

The strategic, coordinated deployment of energy efficiency could see an increased uptake of measures in some areas of the network. Examples of such coordinated efficiency deployment campaigns have already been seen in SSEN's southern licence area through Solent Achieving Value from Efficiency (SAVE) programme, which trialled measures such as dynamic pricing, community energy coaching and efficiency incentives to increase participation and energy efficiency uptake. See Figure 55.

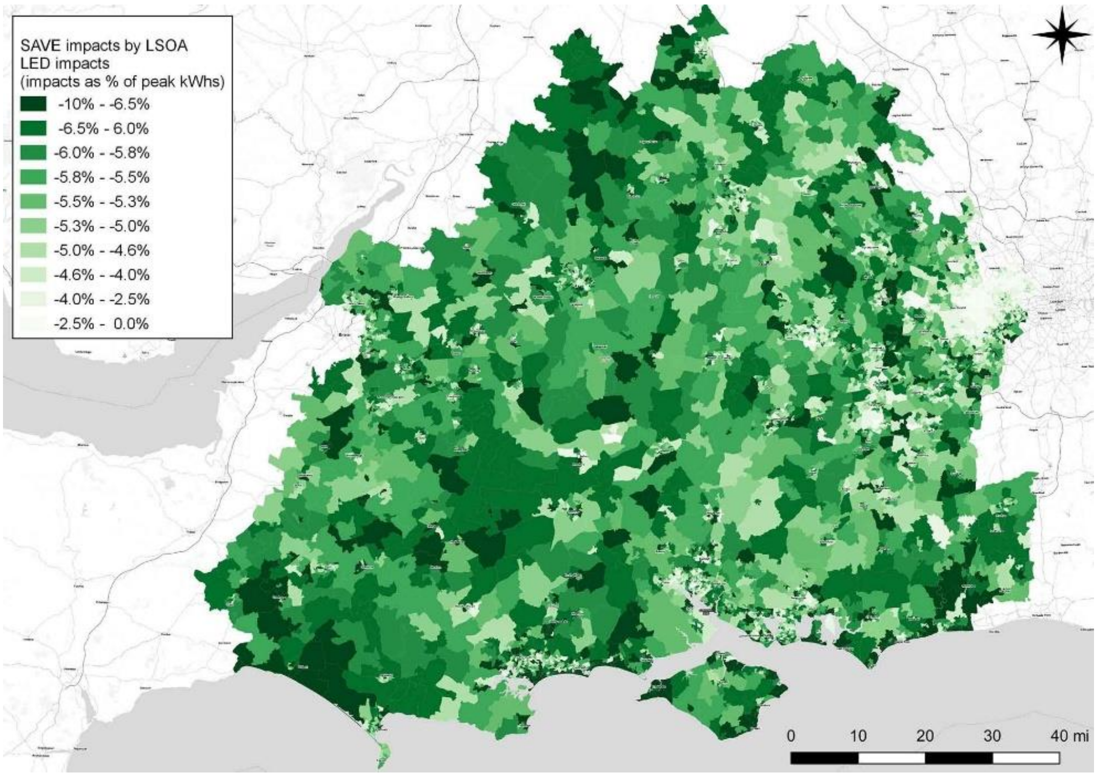


Figure 55: Impact on energy usage during peak hours, as a result of LED lighting uptake, under SSEN's SAVE campaign in the Southern England licence area, by LSOA. | *Source: SSEN*

With over 60% of the Isle of Wight's buildings being rated EPC D or lower[41], a coordinated energy efficiency incentivisation programme could be a viable option to pursue by the Isle of Wight Council and SSEN. It can be considered that the Island's network is experiencing generation constraints, and thus a rapid energy efficiency deployment reducing diversified peak demand across the Island could compound these constraints.

However, with the majority of the Island's operational generation and renewable energy resource being focused on standalone solar PV, domestic energy efficiency measures are unlikely to have a material effect on the Island's generation constraints. It would also pave the way for accelerated uptake of heat pumps and mitigate the compound impact of peak EV charging demand. Irrespective of this, such a deployment could also be seen as a positive consideration for supporting fuel-poor homes, where as many as 30% of households are predicted to be in fuel poverty by the end of 2023.[42] Smart domestic heating technologies like heat pumps and smart hot water tanks could also enable a layer of residential flexibility.

Conclusion 9: Whilst not directly impacting existing generation constraints and depending on the efficiency measure, a strategic Island-wide rollout of energy efficiency could notably reduce demand peak and thus influence ANM control and wider network headroom calculations. Energy efficiency rollout programmes are being widely considered to tackle rising energy costs, and BEIS is looking to accelerate energy efficiency across the UK. A coordinated energy efficiency rollout campaign for the Isle of Wight, backed up by SSEN, would need to be assessed and funded, and any uptake would need to be widely promoted and involve domestic installers and a notable level of administrative support.

Recommendation 9: Working with SSEN, Isle of Wight Council could consider a strategic approach to energy efficiency rollout and how it could be a viable option to mitigate future demand peaks across the Island.

Digital twin – Isle of Wight demonstration project

The project team has been made aware of the Isle of Wight as a demonstrator for the BEIS National Digital Twin Programme (NDTP) across 2022 and 2025. Digital Twins are designed to allow government, the broader public sector and other service organisations to test decisions before they are implemented through a digital modelling environment.
The Isle of Wight Council intends to use digital modelling tools to test the Island's energy demand, use and supply and wider infrastructure resilience. This presents an opportunity to explore and assess the viability of some of the smart grid, flexibility and reinforcement options highlighted in this report.

Recommendation 10: Isle of Wight Council should consider if some of the conclusions and recommendations from this study could be trialled, tested or verified through the Isle of Wight Digital Twin demonstrator.

[41] Energy Performance of Buildings Data, England and Wales, Department for Levelling Up, Housing & Communities Found at: https://epc.opendatacommunities.org/domestic/search
[42] Energy Helpmates sought by Footprint Trust as fuel crisis grows, The Footprint Trust, Sep 2022

Conclusion and recommendations

Alongside establishing the supporting working group, the core purpose of this study was to build a body of evidence and undertake a review of planned and aspirational future electricity load growth across the Isle of Wight.

The study has outlined a detailed vision of the scale of potential electricity load growth that could be seen, if the existing network constraints were unlocked and new network capacity headroom was released.

There is clear evidence that electricity load growth could be significant on the Island. There is significant potential and market interest in renewable energy development, whilst the electrification of transport, heat and other sources of demand from businesses operating on the Island will drive increased demand in the future.

Key recommendation: SSEN should develop the most cost-effective solution to release generation capacity headroom and to prepare the Isle of Wight's electricity network for the level of demand electrification that the net zero transition will likely bring.

There are also a number of other areas that SSEN and Isle of Wight Council could explore further. Evidence has been collated, and a number of associated conclusions and recommendations have been categorised by energy system area (see Table 26).

Table 26: Summary of key conclusions and recommendations, categorised by energy system area

Conclusions and recommendations
Area 1: Isle of Wight Net Zero commitments and strategy
The Isle of Wight Council's climate emergency declarations and net zero pathway analysis suggest the need for significant levels of new renewable energy capacity, alongside aspirations to decarbonise road transport, marine transport, domestic heating and commercial processes on the Island. These conclusions all increase the need for a significant investment in the Island's distribution network infrastructure. This could also enable a number of wider economic benefits for the Island. In addition to the headroom created and already utilised through the implementation of the existing ANM scheme, investment in the network will be needed to unlock additional generation headroom capacity and to create further demand capacity to meet future transport and heat electrification.
Recommendation 1: **SSEN should consider the evidence presented in this report and how it builds on the council's Mission Zero strategy, to ensure that the Isle of Wight's electricity network can meet the demand for new renewable generation, storage and load growth in the near term and enable the connection of up to (or potentially in excess of) c.300 MW of new renewable energy capacity, required to meet the Island's net zero targets in the longer term.**
Area 2: Isle of Wight electricity system management
The method by which, under primacy rules, the existing Isle of Wight Active Network Management system applies a fixed set point simulating that Cowes Power Station is available to export at full

capacity 24/7, is not reflective of the actual operation of the site. Whilst it is understood that Cowes is contracted with the ESO under a number of critical system balancing services, this assumption is potentially acting as an unintended barrier to some additional renewable energy capacity from applying to connect under the existing ANM scheme. However, there is uncertainty around what proportion of the year would be 'uncapped' if a more dynamic market-linked availability measurement approach was implemented as part of the ANM control system. If multiple availability windows need to remain reserved to reflect Cowes Power Station's participation in multiple balancing services, this could result in a significant number of days of the year being unavailable for other generators to utilise the 140 MW headroom created. This could be detrimental to the business case for a new solar PV project or multiple projects and prevent any projects from going ahead, despite a more dynamic method of applying ANM control on the Island.
Recommendation 2: **SSEN should stay closely engaged with the outcomes and recommendations of ENA's Open Networks Workstream 1a Product 5, which is looking at primacy rules and ANM assumptions.** **Modifying the ANM control system to uncap 140 MW for a proportion of the year could enable some new generation projects to be developed and to operate, until wider network capacity headroom is created.**
Area 3: Evidence of future energy generation load growth
Analysis of active generation pipeline projects and historically abandoned connection enquiries has been combined with evidence from SSEN's DFES 2021 projections and regulatory reforms to connection charging boundaries being implemented in early 2023. This evidence suggests a strong potential for distributed generation and storage development to be brought back into consideration on the Isle of Wight across the next decade, should network capacity be made available to connect it. This is supported by engagement with a number of leading UK renewable energy developers, who align on the view that should network capacity be unlocked through investment, they would seek to develop new energy projects on the Island, as a strong solar resource and land area for development. Developers also suggested wider economic and net zero benefits to enabling network investment on the Island. Operators of existing solar assets on the Island felt that current constraints and ANM control are also notably restricting generation yield.
Recommendation 3a: **SSEN should continue engaging with existing asset operators as the ANM control system is developed, to ensure any change in levels of curtailment or available capacity headroom for new connections is clearly communicated.** **Recommendation 3b:** **SSEN should consider the project pipeline and stakeholder feedback as evidence of potential future solar PV, tidal stream and battery storage project development.** **Recommendation 3c:** **Isle of Wight asset operators and developers should engage with RWE and SSEN to explore options for grid connection sharing at Cowes.**
Area 4: Evidence of future electrified transport load growth
The study has assessed the combined potential of EV uptake and on-Island EV charging across residential car ownership, tourist population influx and plans to convert the on-Island bus fleet to

battery electric. This analysis shows that a considerable additional network demand capacity could be required by 2030, 2040 and 2050 to meet future road vehicle EV charging needs. Added to this is strong evidence for the future potential need for shore power charging infrastructure for the Isle of Wight ferry boat companies, as well as domestic and private boats around the island, specifically on the north side at Cowes, Ryde and Yarmouth.

With the existing eastern rail network already battery electric and uncertainties around potential future additional branch lines, additional load from rail transport on the Island is uncertain.

In order for the Island to ensure that the proposed levels of electrified transport continue to be low carbon and actively contribute to carbon reduction and net zero targets, demand will need to be met by a continually reducing grid emissions factor, as well as potentially notable amounts of additional on-Island renewable electricity generation capacity.

Recommendation 4a:

Through the DFES process and broader ongoing engagement, SSEN should continue to engage Isle of Wight stakeholders to identify the substation areas that may experience the highest near-term levels of EV charger uptake. This should also be linked to the potential exploration of an Isle of Wight EV car club or time-of-use tariff tailored to make use of Island solar generation.

Recommendation 4b:

SSEN should continue to engage and work with Wightlink and Red Funnel to gain a more detailed understanding of the amount of shore power capacity that will be needed to charge Isle of Wight ferries. This could expand to a broader study of shore power requirements to include domestic and private boats as well; their proposed locations, potential charging profiles and the timescale of their possible implementation.

Area 5: Evidence of future electrified heat load growth

Through analysis of existing decarbonisation targets, known initiatives being rolled out on the Island and feedback from stakeholders, the decarbonisation of space heating in homes and businesses on the Island is likely to be heavily focused around heat pumps.

When combined with the potential future additional electricity demand from electrified transport, the demand headroom currently present on the primary substations across the Island could potentially be breached in the future.

Even under a hydrogen boiler-heavy scenario, demand from electrically fuelled heating technologies could still see a significant increase out to 2030 and 2050.

Recommendation 5a:

SSEN and Regen should make use of Census 2021 data, updated views of the Isle of Wight Council's new housing build out plans and wider heat decarbonisation policy reforms, to inform SSEN's DFES 2022 heat pump projections for the Isle of Wight electricity supply areas.

Recommendation 5b:

SSEN and Isle of Wight Council should continue to engage with SGN to combine the findings of this assessment, SSEN's DFES 2022 analysis and SGN's Isle of Wight whole system study, to determine a shared vision of the Island's future energy system.

Recommendation 5c:

Ahead of these additional analyses, the evidence shown in this report should be considered a clear indication that network reinforcement to meet future heat and transport electrification demand capacity, as well as distributed generation capacity, is likely to be required.

Area 6: Decarbonisation strategy for Isle of Wight commercial businesses
Engagement with businesses on the Island reinforces the evidence for potential future electricity load growth on the Island. Engagement suggests an appetite for both behind-the-meter and larger-scale renewable energy generation (in the form of rooftop and ground-mounted solar PV) and behind-the-meter battery storage to provide energy management services or as an alternative to back-up diesel generation. It also highlights the potential for additional electricity demand at key operational sites on the Island, from the planned adoption of heat pumps and EV chargers to meet the uptake of a range of EV types.
Recommendation 6: **SSEN and the Isle of Wight Council should consider establishing a broader energy working group for the Island, potentially as part of or an extension to the existing Isle of Wight Net Zero Energy Hub or the Working Group that has supported this study. This group could work with SSEN to explore some of the recommendations of this report and may include representatives from some commercial businesses or major energy users across the Island.**
Area 7: Energy flexibility services
At present, the Isle of Wight has very limited levels of accessible, dispatchable energy flexibility. Whilst approaches such as active network management, dynamic supply tariffs, and conventional electricity network reinforcement could unlock network capacity, the network infrastructure on the Island and the wider UK electricity system would benefit from a coordinated deployment of incentivised flexibility assets operating to mitigate constraints across the Island. SSEN could provide a market signal through an Isle of Wight CMZ tender.
Recommendation 7a: **The Isle of Wight Council could work with SSEN to develop an Isle of Wight Energy Flexibility Strategy, exploring the optimum levels of electricity storage, (at multiple voltage tiers), demand side response and other sources of energy flexibility on the Island to maximise generation use and reduce constraints. This could be a complimentary analysis to the proposed renewable energy generation rollout. Funding for this could be through linkages with existing Local Area Energy Planning delivery funding.** **Recommendation 7b:** **Working with Isle of Wight stakeholders, SSEN could implement trial constraint management zones on the Island via an associated tender process and promotion campaign. This would seek to procure commercial flexibility services specifically designed to tackle generation constraints on the Island, through demand turn-up or generation turn-down services.**
Area 8: Smart tariffs and smart EV charging
At present, domestic and commercial energy consumption is not incentivised to match the Island's current or future solar PV generation. This mismatch is contributing to the constraints being experienced on the Island, with a notable amount of solar generation being exported to the mainland and some of the existing operational solar sites on the Island being constrained. The implementation of a well-designed and promoted time-of-use tariff could increase the amount of solar generation that is consumed by homes and businesses on the Island. The future management of EV charging could be a very important factor for more urban areas of the Island's energy system. With BEIS promoting the adoption of smart charging and the development of an existing EV car club, there are opportunities for the Isle of Wight to further develop its EV strategy.

Recommendation 8a: **Ahead of the deployment of more solar capacity and the electrification of heat and transport across the Island, Isle of Wight Council should seek industry partners to design, test and implement a set of tailored Isle of Wight time-of-use tariffs.** **SSEN and the Isle of Wight Council should seek to implement a trial of smart EV charging across the Island to work alongside any dynamic tariffs, potentially looking at the BEIS EV Smart Charger Action Plan funding options.** **Recommendation 8b:** **SSEN and the Isle of Wight Council should seek to implement a trial of smart EV charging across the Island to work alongside any dynamic tariffs, potentially looking at the BEIS EV Smart Charger Action Plan funding options.**
Area 9: Energy efficiency deployment
Whilst not directly impacting existing generation constraints and depending on the efficiency measure, a strategic Island-wide rollout of energy efficiency could notably reduce demand peak and thus influence ANM control and wider network headroom calculations. Energy efficiency rollout programmes are being widely considered to tackle rising energy costs, and BEIS is looking to accelerate energy efficiency across the UK. A coordinated energy efficiency rollout campaign for the Isle of Wight, backed up by SSEN, would need to be assessed and funded, and any uptake would need to be widely promoted and involve domestic installers and a notable level of administrative support.
Recommendation 9: **Working with SSEN, Isle of Wight Council could consider a strategic approach to energy efficiency rollout and how it could be a viable option to mitigate future demand peaks across the Island.**
Area 10: Digital Twin – Isle of Wight energy system demonstrator
The project team has been made aware of the Isle of Wight as a demonstrator for the BEIS National Digital Twin Programme (NDTP) across 2022 and 2023. The Isle of Wight Council intends to use digital modelling tools to test the Island's energy demand, use and supply and wider infrastructure resilience. This presents an opportunity to explore and assess the viability of some of the smart grid, flexibility and reinforcement options highlighted in this report
Recommendation 10: **Isle of Wight Council should consider if some of the conclusions and recommendations from this study could be trialled, tested or verified through the Isle of Wight Digital Twin demonstrator.**