PORT ANN AND CARRADALE GRID SUPPLY POINTS: STRATEGIC DEVELOPMENT PLAN

Our network serving communities in the Kintyre Peninsula, Islay/Jura/Colonsay Archipelago and Arran

Draft for consultation

November 2024

Scottish & Southern Electricity Networks

CONTENTS

1. EXECUTIVE SUMMARY

SSEN is taking a strategic approach in the development of its distribution networks. This will help to enable the net zero transition at a local level to the homes, businesses, and communities we serve.

Our strategic development plans take the feedback we have received from stakeholders on their future energy needs through to 2050 and translate these requirements into strategic spatial plans of the future distribution network needs. Strategic spatial plans help us transparently present our future conceptual plans and facilitate discussion with Local Authorities and other stakeholders on how these could be translated in the local power systems of the future. To that end these are living plans reviewed as and when stakeholders tell us of changes to their future requirements.

These plans become blueprints for our future plans, shaped by stakeholder feedback. On an annual basis, or as parties seek to connect or change their power use, we will use the strategic development plans to guide our more detailed development works through the Distribution Network Options Assessment (DNOA)[1] process. Through the DNOA process, we typically look at detailed development of options for additional capacity up to seven years ahead of need. This approach ensures that our projects and flexibility opportunities are developed as part of an overall strategic design of our networks.

To that end this strategic development plan carries a number of recommended interventions that we believe need to be progressed through the DNOA process. These will be further developed in 2024, and the detailed project proposals published in a forthcoming DNOA outcomes report. This report will also provide context on the timescale for delivery of infrastructure works or use of flexibility services.

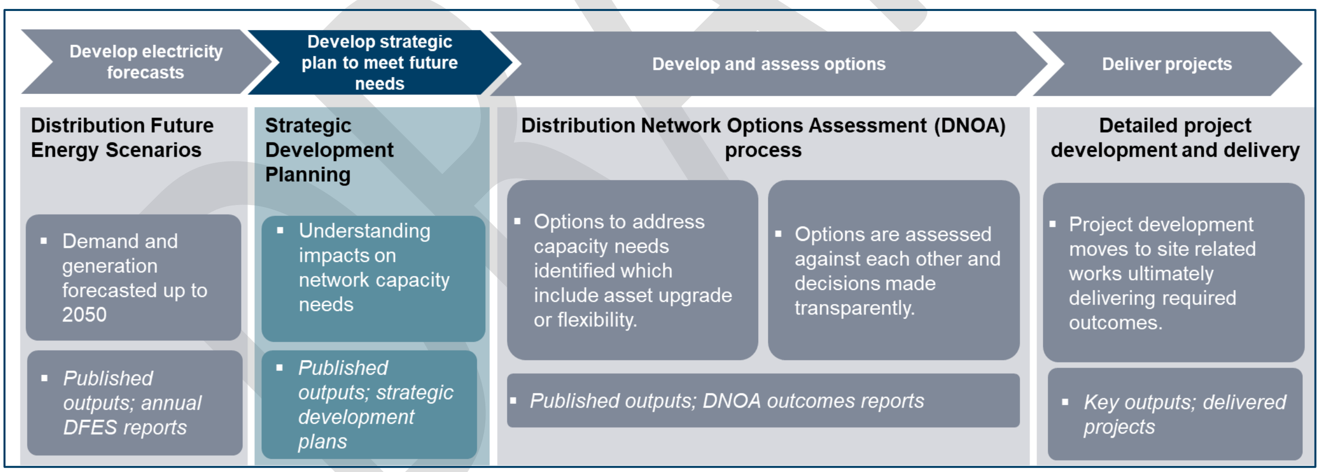

Figure 1 Overview of SSEN's Strategic Planning Process.

The overall strategic planning process is summarised above. We adopt a neutral facilitator role throughout our strategic planning process exploring flexibility options alongside network investment needs. Flexibility is a key component in the transition to Net Zero, both assisting in earlier connection of customers as well as helping to optimise the timing of decisions around future investment needs.

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1 Earlier this year we published our first Distribution Network Options Assessment (DNOA) methodology describing how we are making transparent decisions over flexibility and network investment options. The DNOA methodology forms a key component of our Net Zero strategic planning process. https://www.ssen.co.uk/globalassets/about-us/dso/consultation-library/distribution-network-options-assessment-dnoa---making-decisions-on-the-future-use-of-flexibility.pdf

We operate our local distribution networks across a range of voltage levels as power is transformed down to reach individual homes and businesses. Our Net Zero strategic plan considers networks through these voltage levels and is tailored to the specific needs and challenges of each level.

This report focuses on the Port Ann and Carradale Grid Supply Points (GSPs). A GSP is an interface point with the national transmission system where SSEN then take power to local homes and businesses within a geographic area. The specific geographic area is shown in Figure 2 below. This area covers the local authorities of Argyll and Bute Council and North Ayrshire Council.

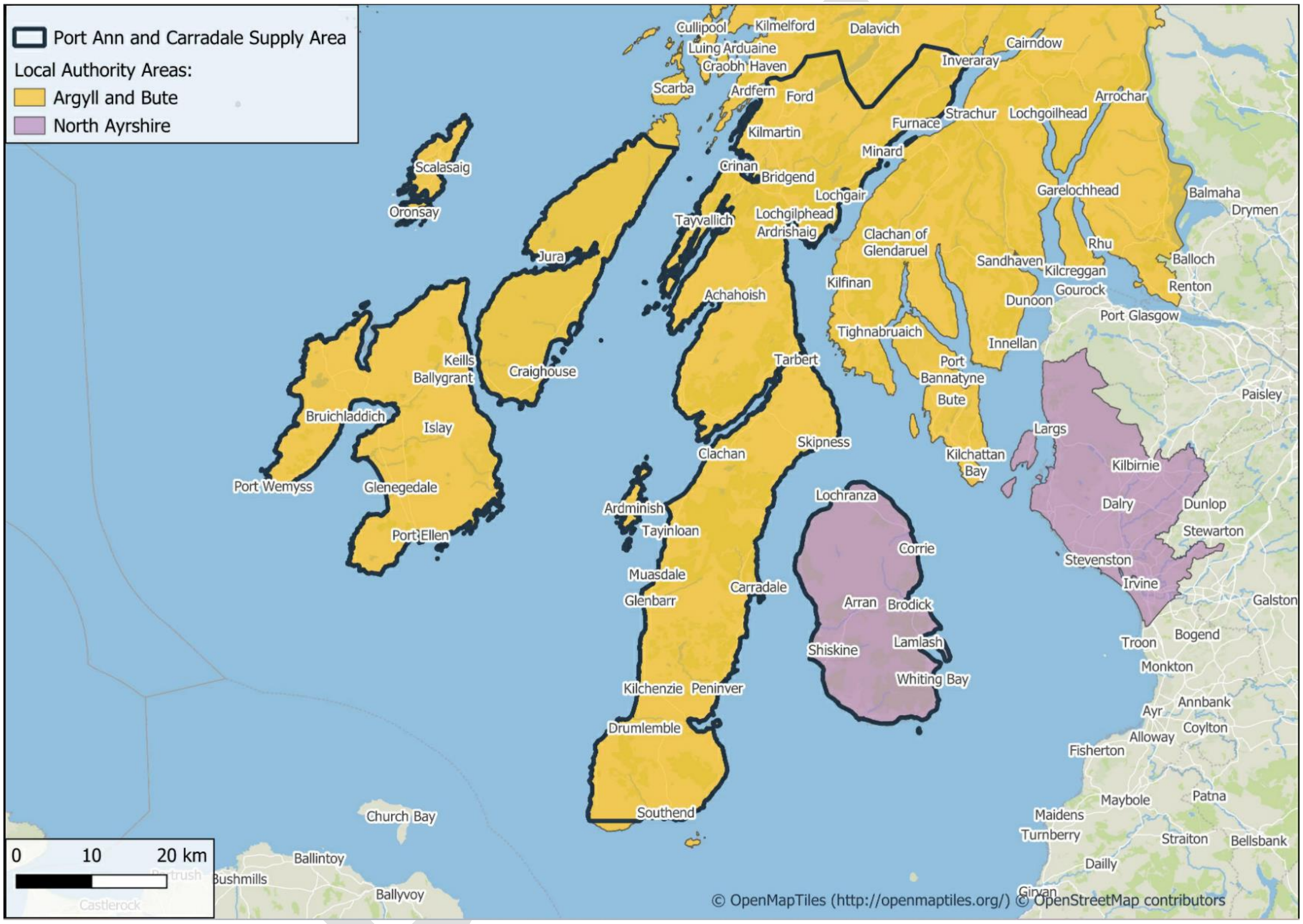

Figure 2 Geographic area covered by this report.

This geographic area of Argyll and Bute is within the scope of the 'Hebrides and Orkney Whole System Uncertainty Mechanism' (HOWSUM). This is a regulatory mechanism, forming part of our current price control period agreement with Ofgem, which provides SSEN with a route to apply for additional funding to deliver whole system solutions for net zero and to support the security of supply in the Scottish Islands.

In the report, we provide an overview of critical aspects that will shape our future network development and planning. This includes an analysis of the evolving demand and generation requirements, as well as the impacts on our electricity networks:

The future demand and generation requirements for the Port Ann and Carradale areas. Much of this information is drawn from our work with Regen to develop the 2023 DFES. However, we also consider additional information from connection request activities in the area and local stakeholder insight. This includes insights gained from our recent islands focused work with Regen[2] as well as subsequent engagement with the whisky industry.

The impacts of these requirements on our electricity networks. In this report we describe how future requirements affect both our higher voltage networks and also the lower voltage circuits feeding individual homes and businesses. From this we develop spatial plans of future network needs at key time intervals through to 2050.

The 2050 spatial plan for our Extra High Voltage (EHV) network is shown below in

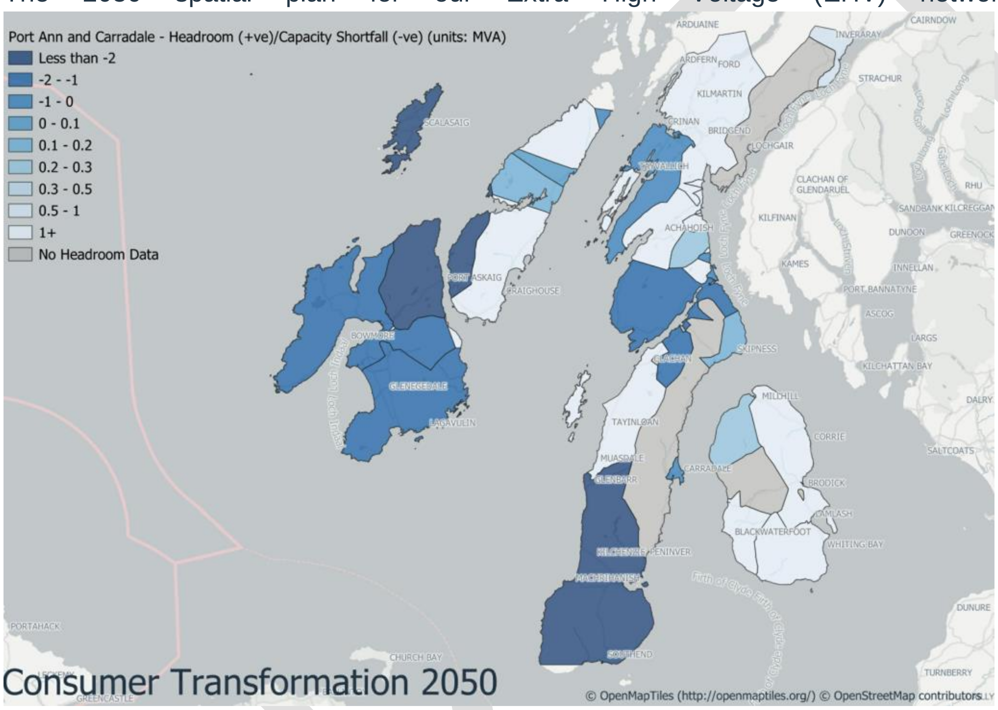

Figure 3. This shows us of potential areas of capacity need around Port Askaig, and Bowmore and Port Ellen primaries by 2050. Likewise, in Carradale GSP, there is forecast capacity need around Campbeltown with marginal headroom on areas of the Isle of Arran.

2 Whole system energy solutions for the Scottish Islands - SSEN

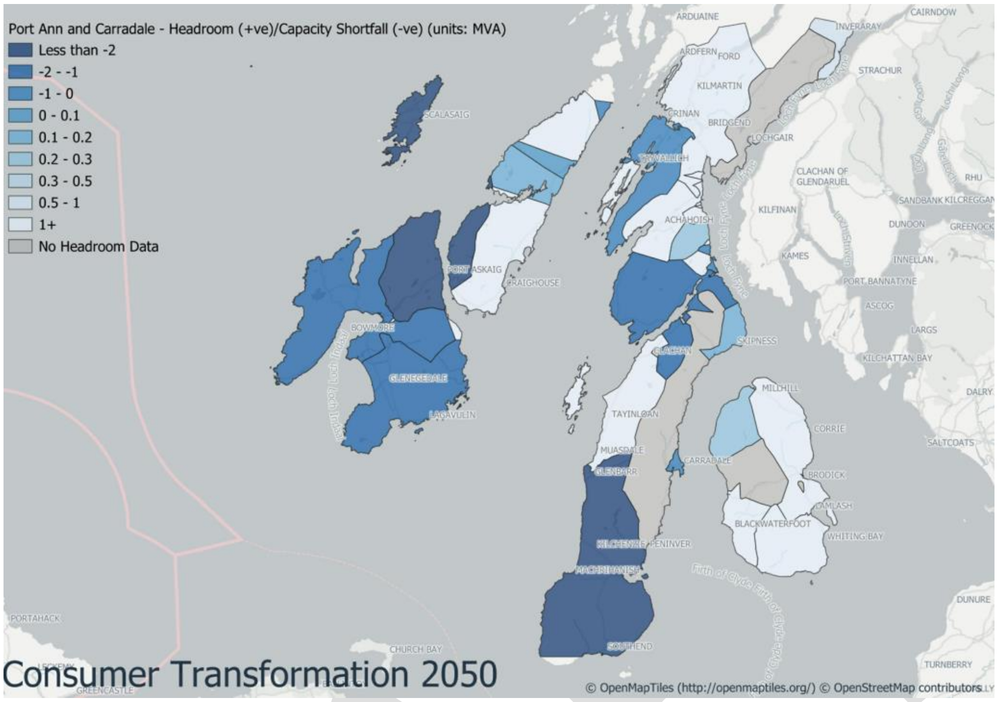

Figure 3 Port Ann GSP 2050 EHV network spatial plan CT Scenario

The 2050 spatial plan for our High Voltage/Low Voltage (HV/LV) networks is shown in Figure 4. This plan shows the specific load driven requirements of different local communities and a need to take a bespoke approach to reinforcement of these networks and/or use of flexibility.

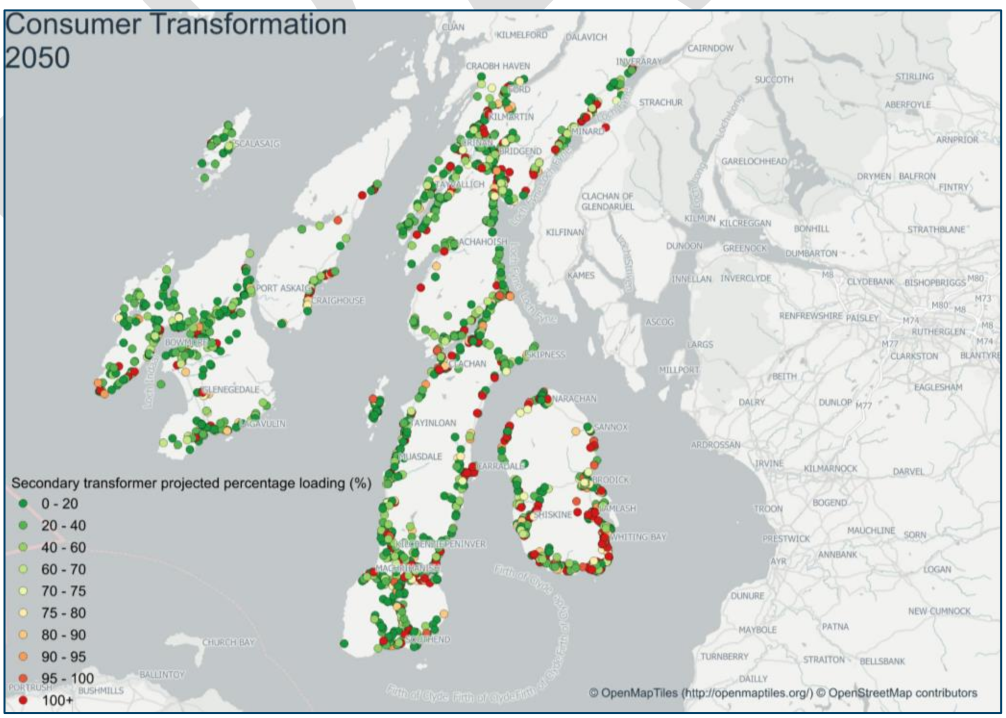

Figure 4 Port Ann and Carradale GSPs 2050 HV/LV network spatial plan CT Scenario

Proposed activities to resolve the system needs highlighted in the spatial plans. In the report we provide an overview of work that we have already progressed through the DNOA process and initial proposals for projects that we recommend are developed further through the DNOA process. These are generally projects that we believe are needed within the next seven years. We also provide outline thoughts on longer term needs to 2050 with a view to further discussions with local stakeholders.

The pathways to decarbonisation and Net Zero are not always clear and our use of four DFES backgrounds in the report recognises these future uncertainties. Whilst the Port Ann and Carradale Net Zero strategic plan provides a best view of both our spatial needs and required activities, this is subject to change. This plan is therefore a living document that we will update annually reflecting changes from our updated DFES as well as insights gathered from local stakeholders.

This Strategic Development Plan is published as a draft report, and we welcome your feedback to shape both the form and content. We will use your feedback to inform both our final published Strategic Development Plan and also future publications. Please submit any feedback to us through our inbox at: Whole.System.Distribution@sse.com

2. INTRODUCTION

The goal of this report is to demonstrate how local, regional, and national targets link with stakeholder views in the area to provide a robust evidence base for load growth out to 2050 across the Port Ann and Carradale GSPs. Further context for the area this represents is shown above in **Figure 2**.

To identify the future requirements of the electricity network, SSEN commissioned Regen to produce the annual Distribution Future Energy Scenarios (DFES). The DFES analysis is based on the National Grid Energy System Operator (NESO) Future Energy Scenarios (FES) while accounting for more granular stakeholder insights and new demand and generation connection applications. The DFES provides a forward-looking view of how demand and generation may evolve under four different scenarios as we move towards the national 2050 net zero target. These scenarios are summarized in Figure 5. SSEN use Consumer Transformation as the central case scenario following stakeholder feedback during the RIIO-ED2 development process. This position is reviewed annually.

Where new customer connection information has not been captured in the DFES, we aim to consider it as part of our studies to ensure that the projected load more accurately reflects what we expect to see in the future.

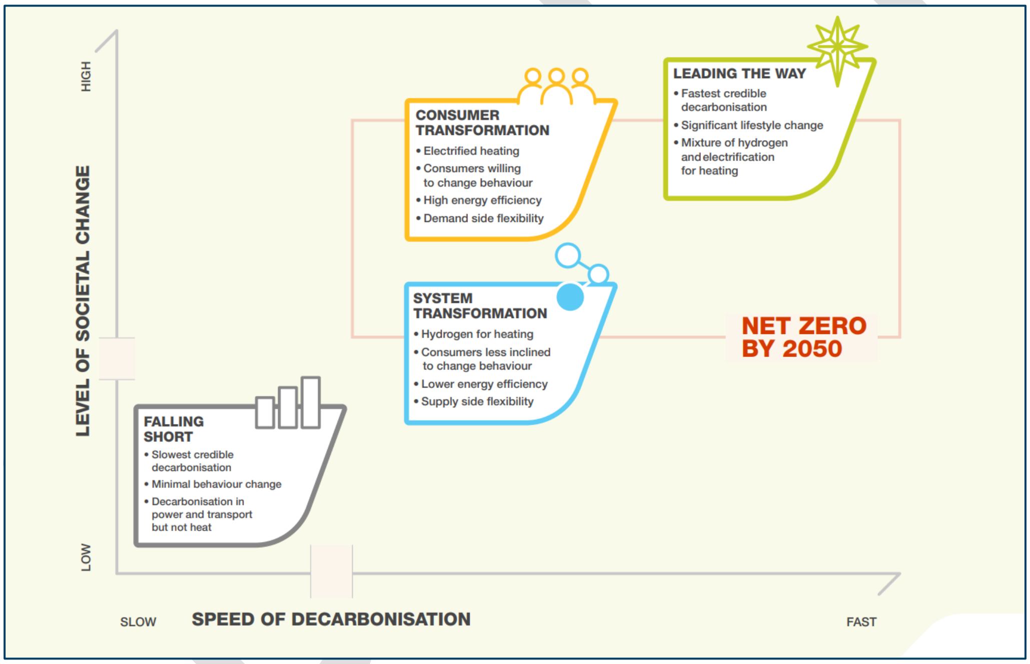

Figure 5 The 4 Future Energy Scenarios adopted for the DFES. *Source: ESO FES2023*

Using the DFES, power system analysis has been carried out to identify the future system needs of the electricity network. These needs are summarized by highlighting the year the need is identified under each of the four scenarios, and the projected 2050 load. Here, system needs are identified through power system analysis using the Consumer Transformation (CT) scenario (aligning with our RIIO-ED2 business plan), with sensitivities carried out as part our high-level analysis on the other three scenarios to ensure we capture when these needs arise.

Once the preliminary system analysis is completed, and a list of reinforcement options to resolve the system needs is identified, our strategic plans are shared with stakeholders for review. After this, we begin the DNOA process which will provide more detailed optioneering for each of these reinforcements, improving stakeholder visibility of the strategic planning process. Opportunities for procurement of flexibility will also be highlighted in the DNOA, to cultivate the flexibility markets, and to align with SSEN's flexibility first approach.

Further details on our strategic development planning process can be found in our published methodology document [3].

3 PowerPoint Presentation (ssen.co.uk)

3. STAKEHOLDER ENGAGEMENT AND WHOLE SYSTEM CONSIDERATIONS

1.1. Local Authorities and Local Area Energy Planning

A large part of the area supplied by Port Ann and Carradale GSPs falls within the Argyll and Bute Council area, while the Isle of Arran, although supplied from Carradale GSP, falls within the North Ayrshire Council area as shown in **Figure 6.** The development plans for these local authorities will have a significant impact on the potential future electricity load growth on SSEN's distribution network. As such, it is vital for SSEN to engage with these plans when carrying out strategic network investment.

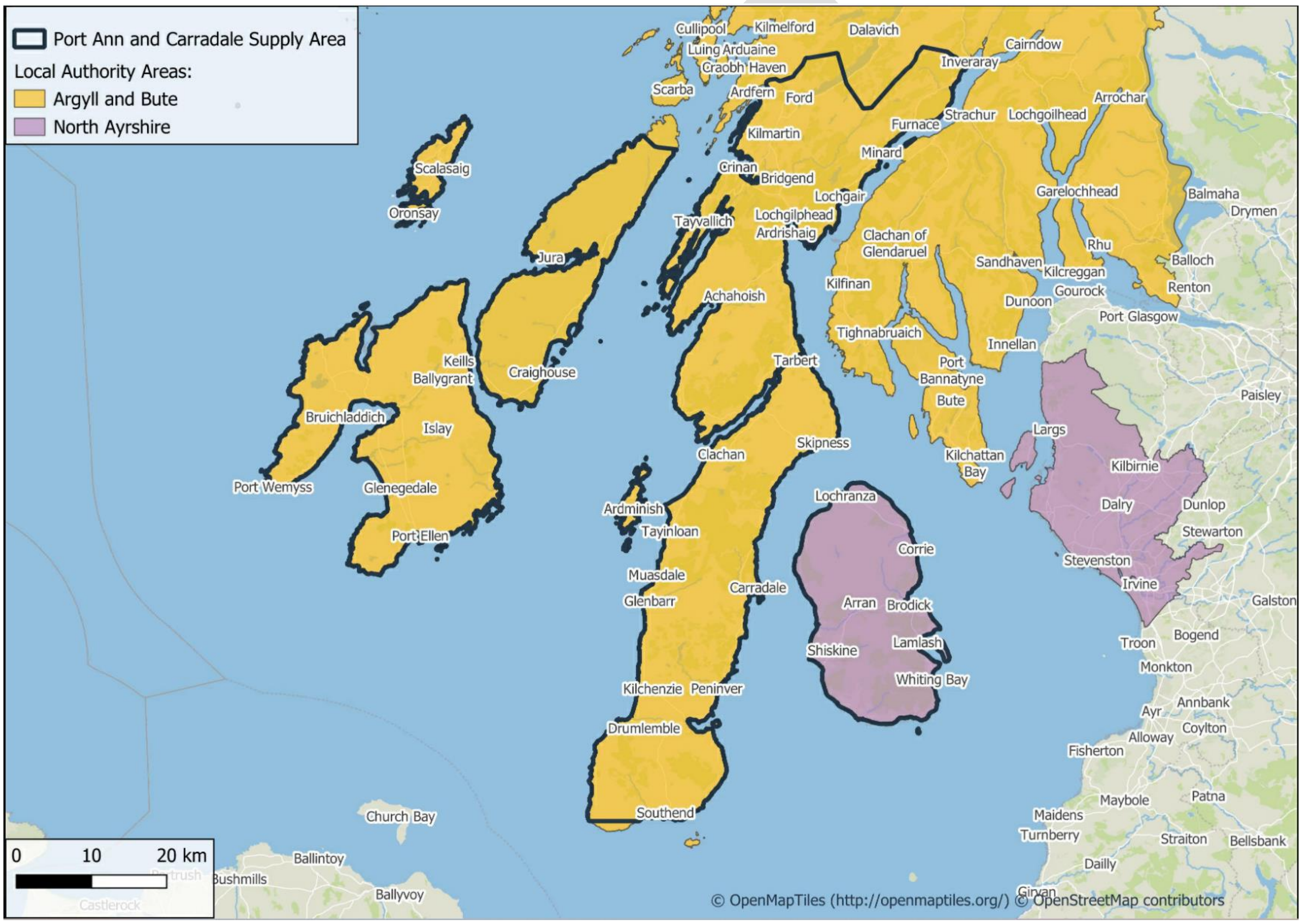

Figure 6 Port Ann GSP Supply Area and Local Authority Boundaries

1.1.1. Argyll and Bute Council

The 2022 Census enumerated the population of Argyll and Bute at around 86,000. The National Records of Scotland (NRS) more recent mid-year estimates calculated Argyll and Bute's population to be 87,920 (NRS' 2022 based Mid-Year Estimates)[4]. Argyll and Bute council has the 27th highest population out of all 32 council areas in

4 Argyll-bute.gov.uk, May 2024, Population: Where We Live.

Scotland and covers the second-largest administrative area of any Scottish council, making up almost 9% of the countries land mass. It has the fourth sparsest population of the 32 Scottish local authorities, with an average population density of 13 persons per hectare. There are 23 inhabited islands in Argyll and Bute (Census 2011). These are: Bute, Coll, Colonsay, Danna, Easdale, Eilean da Mheinn, Erraid, Gigha, Gometra, Inchtavannach, Innischonan, Iona, Islay, Jura, Kerrera, Lismore, Luing, Mull, Oronsay, Seil, Shuna, Tiree and Ulva. Argyll and Bute's inhabited islands, at the time of the 2011 Census, had a total population of 15,105. This equated to 17.1% of the total population for Argyll and Bute. The area has a diverse and vibrant economy, driven primarily by tourism, aquaculture, forestry, distilleries, and renewable energy.

Argyll and Bute Council has committed to become a Net Zero organisation by 2045 in alignment with national targets. In their 2022-2025 Decarbonisation Plan, the Council states that they endeavour to install more solar PV on council buildings, identify further opportunities for renewable energy sourcing, and produce an Electric Vehicle Infrastructure Strategy. The Council is expanding the electric vehicle charge point network via funding secured from Scottish Government. Through March 2026, residents in rural areas can take advantage of ECO Grants to install heat pumps and insulation in their homes.

The network on Islay specifically has seen a sharp increase in new connection activity in recent years due to the expansion and decarbonisation of the local whisky distilleries and the development of new housing to support this. Exponential load growth is expected in the area as a result, which is reflected in the 6.03MVA of contracted demand schemes awaiting connection. SSEN are working closely with Argyll and Bute Council to gain further insight on their housing strategy on Islay, in terms of demand requirements and timeline for connection, to ensure that our reinforcement proposal for the Island aligns. In addition, SSEN are also working with the Scotch Whisky Association (SWA) and Islay Energy Trust to gain a better understanding of the distillery process, demand profile, and likely future demand requirements on Islay. This will assist in establishing whether there is flexibility, in terms of managing this process during periods of high demand, and if there is potential to release network capacity for contracted demand customers ahead of reinforcement intervention.

1.1.2. North Ayrshire Council

The 2022 Census enumerated the population of North Ayrshire at around 134,220[5]. The council has the 15th highest population out of all 32 council areas in Scotland and it covers an area of around 886km^2. The main settlements are Irvine, Kilwinning, Ardrossan, Saltcoats, Stevenston, Beith, Dalry, Kilbirnie, Largs, Dreghorn, Springside, West Kilbride, Seamill, Fairlie, Skelmorlie, Brodick and Millport. There are a few inhabited islands in the North Ayrshire which include isles of Arran and Cumbrae.

North Ayrshire Council aims to achieve net zero by 2030. The Council's Local Heat and Energy Efficiency Strategy details potential pathways for decarbonising heat and improving energy efficiency to reduce rates of fuel poverty. To this end, the associated delivery plan identifies one key workstream through 2026 as trialling heat pumps. The Council has launched a £350,000 Community Net Zero Carbon Fund to support local residents and organisations looking to install renewable energy generation. In the Council's Local Development Plan, they state an aim to build 4,000 new homes across North Ayrshire between 2019 and 2029.

5 National Records of Scotland - North Ayrshire Council Area Profile.

1.2. Whole System Considerations

We have worked closely with local stakeholders, customers, market participants government bodies and transmission organisations to build on our engagement prior to RIIO-ED2 and develop an enduring Whole System solution to meet the future energy needs of the areas supplied from Port Ann and Carradale GSPs and to enable the region to support the transition to net zero through its extensive natural resource potential.

We are supported in this process by the Hebrides and Orkney Whole System Uncertainty Mechanism (HOWSUM). This regulatory mechanism facilitates exploration of the long term strategies for decarbonisation and future resilience requirements for relevant island groups and the strategic development plans form a key stage in HOWSUM. We will be using high level options generated from this report and stakeholder feedback to produce detailed proposals that will be submitted to the Regulator in January 2025.

Through our whole system considerations, several options have been identified for future use in the local area, some based on specific feedback from island stakeholders. It should be noted that some of these elements are not sufficiently mature today, however, potentially form part of our longer-term strategic plans:

1. **Traditional Distribution elements:** We have considered how future network needs could be met with additional Distribution investment. It is generally recognised that all islands will need to remain connected to the mainland GB system so there is a definite need for continued Transmission and / or Distribution circuitry and capacity;
2. **Traditional Transmission elements:** We have worked closely with SSEN Transmission to understand their future requirements around diversions of Port Ann GSP and could investigate the potential for a 132kV connection to the islands in the future based on the DFES projections;
3. **Use of new technologies:** We have discussed and will assess the use of new technologies such as hydrogen and other forms of storage to help resolve some of the drivers for change;
4. **Use of flexibility:** We see flexibility as potentially being required as part of all the developed options. For load related drivers, it can help optimise the timing of future investment needs;
5. **Repowering of diesel generators:** The potential to repower our diesel generators at Bowmore with green alternatives is being considered as an option to help decarbonise the Scottish islands.

1.2.1. Network Resilience Policy for Island Groups connected by subsea cables

1.2.1.1. Background

SSEN own and operate 446.5km of Distribution (33kV & 11kV) Submarine Cables, across 60 Islands within the Scottish Hydro Electric Power Distribution (SHEPD) licence area covering the north of Scotland. As part of SHEPD's distribution Standard Licence Condition (SLC) 24 and the Distribution Code there is an obligation on SSEN to ensure that certain levels of security are in place as per Engineering Recommendation P2 (ER P2). SLC 24 also requires SHEPD to demonstrate that the requirements of ER P2 are being met to provide demand centres with resilience in the event of network faults.

Subsea cable faults are rare events but can have a big impact on our island communities. Due to the nature of the environment in which they operate, fault location and repair on a subsea cable can take significant periods of time. Therefore, there is an understanding within the SSEN business that island communities served by our subsea cable assets require additional levels of resilience due to these prolonged outage times.

Given the uniqueness of the SSEN subsea network to the UK, Engineering Recommendation P2/8 [6] does not account for the operational realities of faults on the subsea cable networks and as such, a different resilience standard is required. This enhanced resilience standard takes the form of SSEN's newly developed Resilience policy for island groups connected by subsea cables which is explained further below.

Achieving these future resilience levels is the long-term ambition for our island groups and will be considered in any strategic planning of the island networks. Please note, this is an enhancement to the existing P2 planning requirements and does not have retrospective application to our existing network.

We have assessed the level of resilience we currently provided to each of our island groups fed from sub-sea cables and developed this policy based on the demand group sizes stated within P2/8. **Table 1** below summarises the enhanced resilience standard developed for our Resiliency policy for Island Groups connected by subsea cables:

<table>
<tr><th>Group demand</th><th>Relevant 2050 P2-8 Category</th><th>Net Zero Resilience Policy for Island groups fed via subsea cables</th></tr>
<tr><td>Over 60MW and up to 300MW</td><td>D</td><td rowspan="2">Group demand secured for sustained long duration
N-2 condition through a combination of network assets and local generation (including third party).</td></tr>
<tr><td>Over 4MW And up to 60MW</td><td>C</td></tr>
<tr><td>Over 1MW And up to 4MW</td><td>B</td><td rowspan="2">Group demand secured for sustained long duration
N-1 condition through a combination of network assets and local generation (including third party).
N-2 condition managed through use of portable generation or use of existing generation on island if available.</td></tr>
<tr><td><1MW</td><td>A</td></tr>
</table>

Table 1 SSEN Group Demand sizes for Island Groups fed via subsea cables

6 Engineering Recommendation ER P2 sets out six levels of system security and each class is determined by the group demand of the primary substation and circuits that customers are connected to. The ER P2/8 Table 1 defines the various demand categories and the required level of security. ENA EREC P2 Issue 8 (dcode.org.uk)

1.2.2. Diesel Embedded Generation (DEG) Decarbonisation

SSEN currently has 6MW of diesel embedded generation available at Bowmore Power Station on Islay, to provide network resilience in the unlikely event of a subsea cable fault or planned outages.

SSEN has developed a 2050 strategy for the decarbonisation of its Diesel Embedded Generation (DEG) fleet. This will contribute to SSEN achieving its Science Based Targets (SBTs) by 2033 and our Net Zero ambition by latest 2045 as outlined in the RIIO-ED2 business Plan. Further details can be found in our Sustainability Strategy[7].

This strategy will allow us to meet Scottish Government's forthcoming final position on NOx emissions from embedded plant. Specifically this will mean our achieving 190mg/Nm3 NOx emissions by 2033 (for planned system outages) and 2039 (for unplanned system outages).

The application of this strategy will be tailored to each island group, recognizing both the needs of the island communities and also the status of the existing DEG infrastructure. We will consider how DEG decarbonization can be most efficiently enacted for that island group which could be through;

- Bringing forwards additional network resilience from our 2045 vision to reduce probability of operation (e.g. advancement of investment/reinforcement project delivery to provide additional network resilience);
- Use of flexibility solutions as an alternative to running DEG;
- Repowering DEG with alternative fuel sources such as Hydrotreated Vegetable Oil (HVO);
- Full review of the impact and management of our NOx emissions

1.2.3. Transmission Interactions

Port Ann GSP forms part of the overall SSEN Transmission Argyll and Kintyre 275kV Strategy. We have seen a significant increase in generator connection applications in Argyll and Kintyre, predominantly in renewable generation supporting the country's drive towards net zero. The Argyll and Kintyre 275kV Strategy consists of three projects:

- Creag Dhubh to Dalmally 275kV Connection;
- Creag Dhubh to Inveraray 275kV Connection;
- Argyll and Kintyre 275kV Substations.

The Creag Dhubh to Dalmally 275kV connection project includes the creation of a new 275kV substation at Creag Dhubh, facilitating the tie-in of the existing 132kV line (from Inverary to Taynuilt GSP) to the wider 275kV transmission network.

The Port Ann GSP is currently served via 2 x 132/33kV 30MVA Grid Transformers. There is a planned diversion of Port Ann GSP triggered by SSEN transmission which will comprise relocation of the substation and upgrading the transformers with larger units.

7 SSEN Sustainability Strategy

SSEN Transmission have begun the delivery of an overhead line project from Port Ann to Crossaig as part of a multi-million-pound programme of investment in the region, upgrading and replacing the network to strengthen the power supply for those living and working in the area and help to reduce the impact of severe weather events[8]. SSEN Distribution are working closely with Transmission to understand how strategic investment in the network can be deployed for the benefit of our customers.

1.3. Ongoing third party developments in the region

ScottishPower Renewables(SPR) is in the early stages of developing an offshore wind farm (Machair Wind) in the waters north-west of Islay and west of Colonsay. Due to the scale of the development, the grid connection location will be determined by National Grid ESO and will connect into the transmission network in south-west Scotland. As the project is still in the early stages of development, any potential impacts this wind farm could have on the electricity network on the Isles of Islay, Colonsay and Jura cannot be fully ascertained at this time, therefore we will continue to engage with SPR regarding their development plans. This document will be reviewed on an annual basis and the wind farm's potential interaction with these islands will be provided at a later stage.

1.4. Flexibility Considerations

Through its innovative Constraint Managed Zone (CMZ) initiative in 2016, SSEN was the first UK DNO to introduce Flexibility Services in their current commercial format. We are continuing to lead the way in this development resulting in over 700MW of Flexibility Services being procured in the 23/24 Financial Year.

SSEN uses Flexibility Services to manage areas on our network that would otherwise have power flow that exceeded the network capacity. Flexibility Services are a key tool in the design and operation of the network and is used to support our network investment programme by enabling outages to go ahead; optimising the build programme and delaying reinforcement where economical to do so.

SSEN procures Flexibility Services from owners, operators, or aggregators of Distributed Energy Resources (DERs), which can be generators, storage, or demand assets. Services are typically needed at specific locations and times of day where high power flows are expected to occur.

There is an existing Flexibility Service contract on Islay (provided by Inver Hydro) which has supported the network during faults and planned outages on the Island, reduced the use of diesel generation during these circumstances. Additionally other flexible services have been procured in the Argyll and Bute council area.

In September 2024, we launched a Request for Information (RFI) to identify new Flexibility Service Participants in a selection of island communities and establish routes to market in this geographical location. The consultation closed on the 20th September and we are continuing conversations with participants as we develop our procurement strategy in these locations.

8 Port Ann to Crossaig project edges closer to completion as SSEN Transmission constructs the final steel tower - SSEN Transmission (ssen-transmission.co.uk)

4. EXISTING NETWORK INFRASTRUCTURE

1.5. Port Ann Grid Supply Point context

The Port Ann GSP supplies a rural area with approximately 9,030 customers. The breakdown of each substation within the GSP is shown in **Table 2**. The network on the islands of Islay and Jura supplies approximately 2,950 customers.

Substation Name	Site Type	Number of Customers Served	Transformer number / MVA rating	2024 Substation Maximum MVA (Season)
ISLAY & JURA AREA (ISLAND SUBSTATIONS)				
BOWMORE	Primary Substation	1,580	2x8MVA	3.31 (Winter)
LUSSAGIVEN	Primary Substation	13	1x0.1MVA	0.03 (Winter)
PORT ASKAIG	Primary Substation	463	2x2.5MVA	1.15 (Winter)
PORT ELLEN	Primary Substation	866	1x4MVA	3.17 (Winter)
TARBERT JURA	Primary Substation	10	1x0.2MVA	0.02 (Winter)
PORT ANN GSP (MAINLAND SUBSTATIONS)				
PORT ANN GSP	Grid Supply Point	9,000	2x30MVA	19.32 (Winter)
AIRIGH-NA-BRODAIG	Primary Substation	28	1x0.315MVA	0.06 (Winter)
CRINAN	Primary Substation	421	1x1MVA	0.83 (Winter)
CROMALT	Primary Substation	263	1x2.5MVA	0.84 (Winter)
INVERNEIL	Primary Substation	389	1x6.3MVA	0.83 (Winter)
LOCHGILPHEAD	Primary Substation	3,197	2x12/24MVA	6.96 (Winter)
STONEFIELD	Primary Substation	19	1x0.315MVA	0.04 (N/A)
TARBERT LOCH FYNE	Primary Substation	1,186	2x2.5MVA	2.05 (Winter)

Table 2 Customer number breakdown and substation peak demand readings (2024)

1.6. Carradale Grid Supply Point Context

The Carradale GSP supplies a rural area with approximately 9,750 customers. The breakdown of each substation within the GSP is shown in **Table 3.**

Substation Name	Site Type	Number of Customers Served	Transformer number / MVA rating	2024 Substation Maximum MVA (Season)
CARRADALE GSP	Grid Supply Point	9744	4 x 120MVA	19.1 (Winter)
BALLIEKINE	Primary Substation	229	1x1MVA	0.55 (Winter)
BALLURE	Primary Substation	511	1x2.5MVA	1.17(Winter)
BRODICK	Primary Substation	2210	2x8MVA	5.02(Winter)
CAMPBELTOWN	Primary Substation	4413	2x15MVA	7.31(Winter)
CLAONAIG	Primary Substation	74	1x0.3MVA	0.16(Winter)
DIPPEN	Primary Substation	339	1x1MVA	0.76 (Winter)
MACHRIE	Primary Substation	579	1x2.5MVA	1.76(Winter)
WHITING BAY	Primary Substation	1085	1x8MVA	2.12 (Winter)

Table 3 Customer number breakdown and substation peak demand readings (2024)

1.7. Current EHV Network Topology

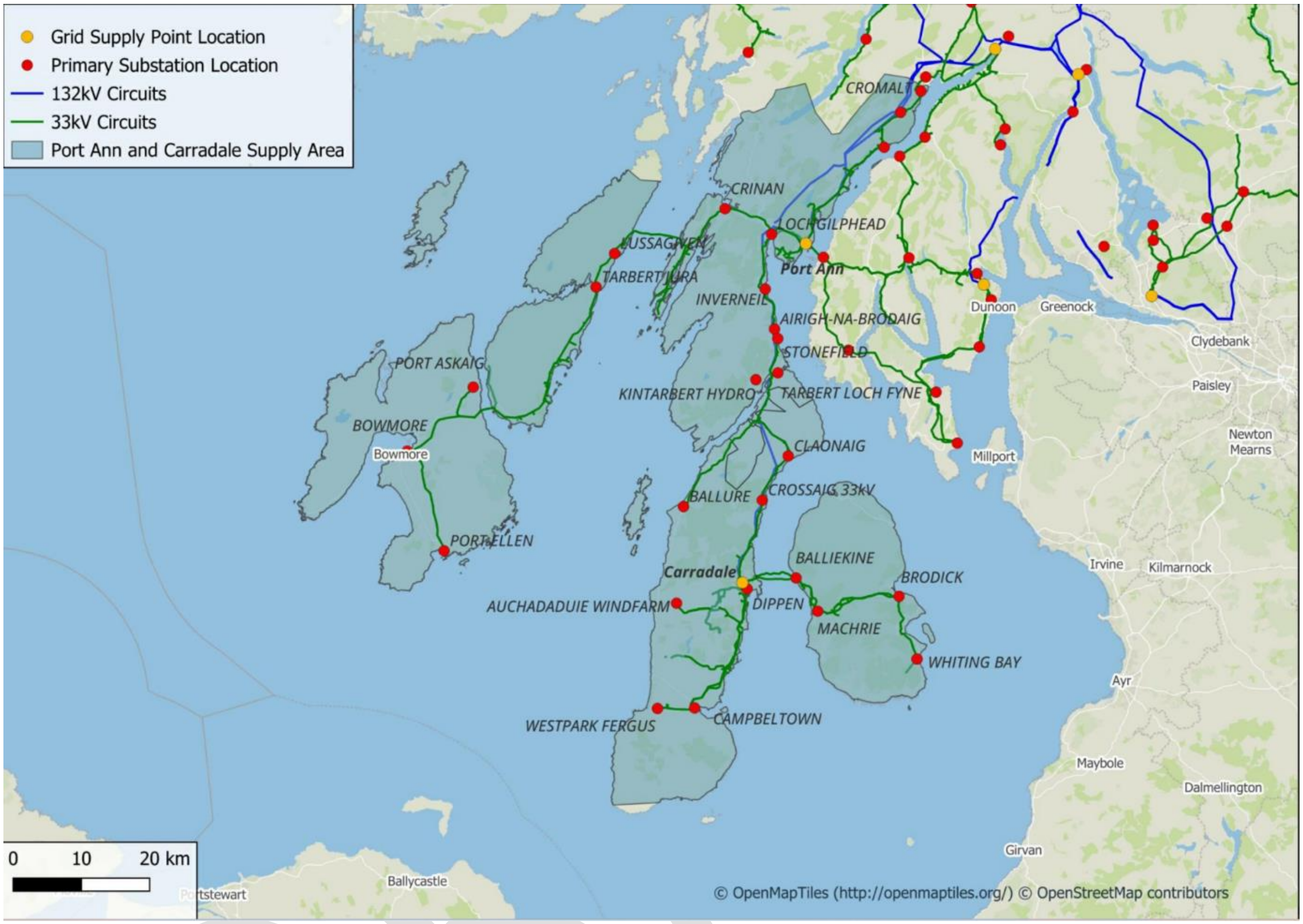

Figure 7 Port Ann and Carradale GSP Geographic Information System (GIS) View

1.8. Network Schematic

The networks shown in **Figure 8** and **Figure 9** depict the current state of the network for Port Ann and Carradale GSPs respectively.

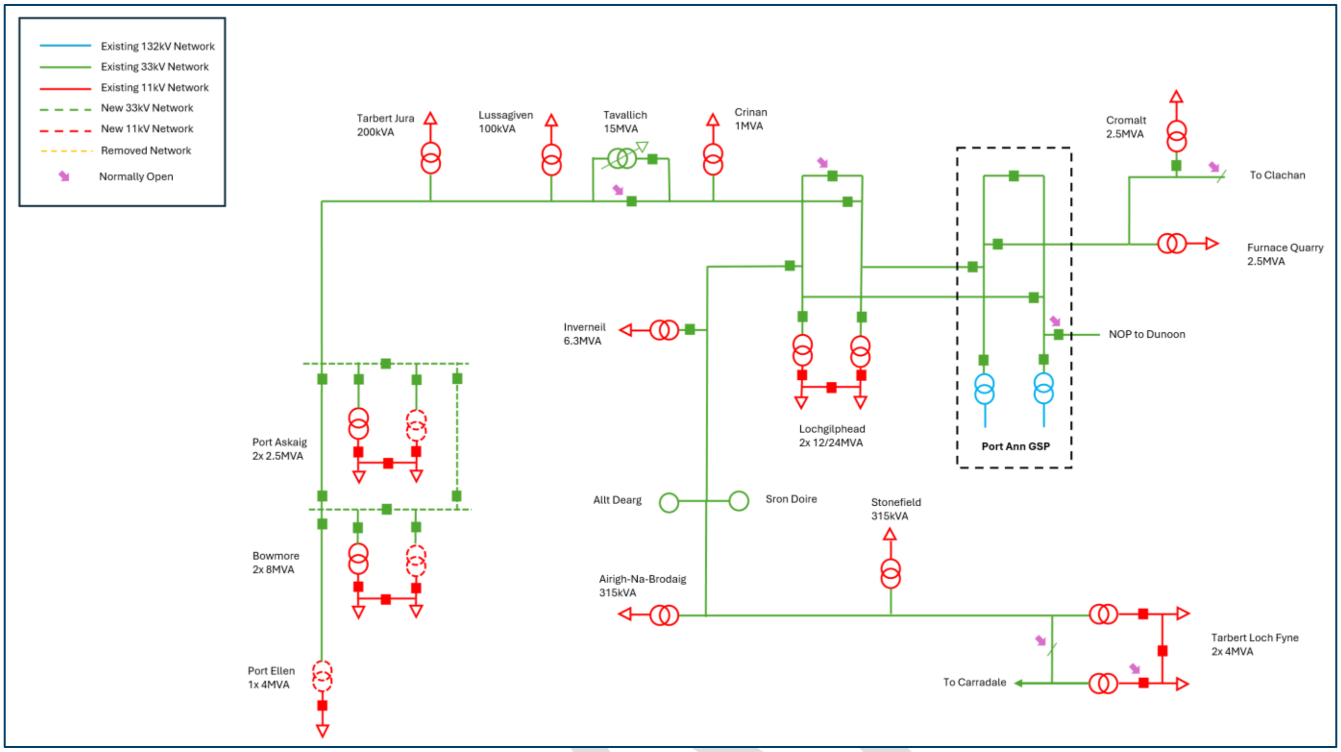

Figure 8 Port Ann GSP network schematic – current running arrangement – transformer nameplate ratings

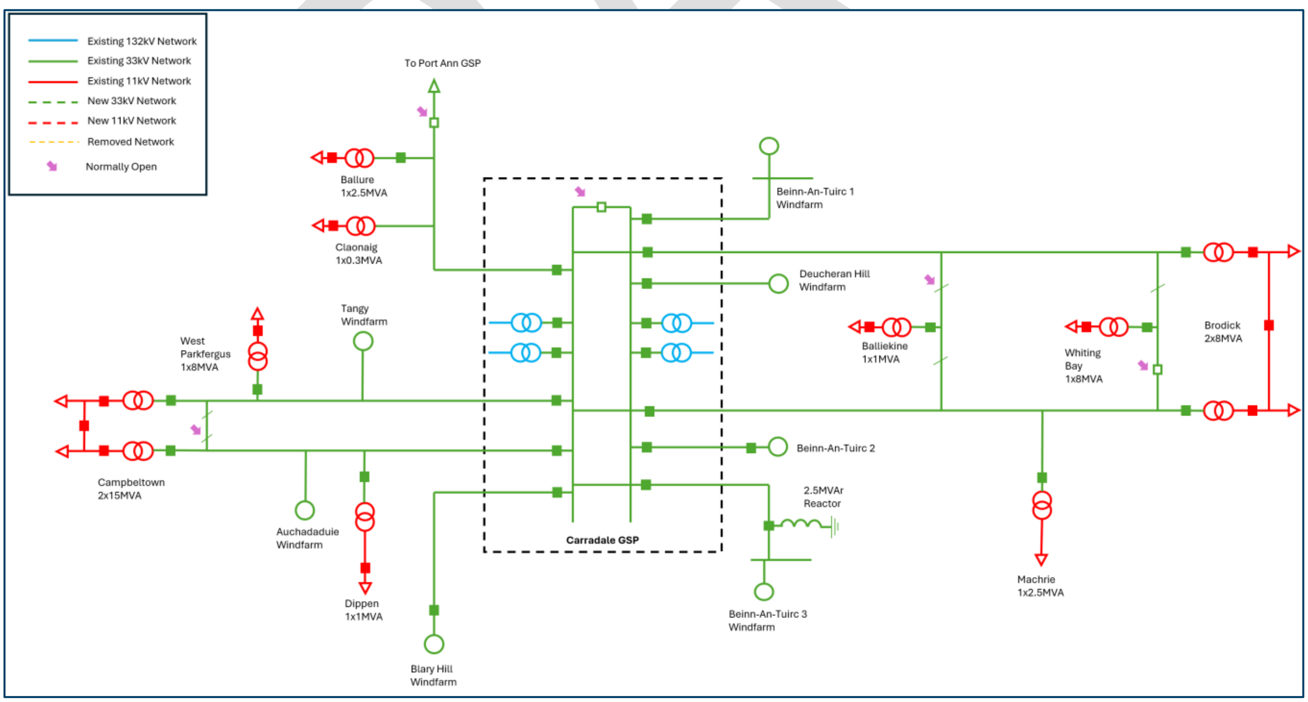

Figure 9 Carradale GSP network schematic – current running arrangement – transformer nameplate ratings

5. ELECTRICITY FORECASTS AT PORT ANN AND CARRADALE GSPS

The following section details load growth across the technologies projected in the Distribution Future Energy Scenarios. Where megawatt (MW) values are presented in this section, they represent total installed capacity. When conducting network studies these values are appropriately diversified to represent the coincident maximum demand of the entire system rather than the total sum of all demands. The projections presented here are the outputs from the most recent DFES 2023 analysis.

Individual DFES technology forecasts, along with connections data and insights from specific stakeholders are then assessed to develop profiled forecasts of demand and generation. These profiles can be found in section 5.6 of this report with further context in the appendix to this report.

1.9. Distributed Energy Resource

Port Ann GSP

1.9.1.1. DFES Projections

1.9.1.1.1. Generation

The baseline value for Hydropower is 11.23MW, Marine is 0.15MW, Onshore Wind is approximately 16.7MW and Solar PV is approximately 1.29MW. Based on the DFES projections, under the Consumer Transformation scenario, distributed renewable generation across Port Ann GSP group will increase significantly from 35.61MW in the currently connected baseline to 194.86MW in 2050 (as shown in Figure 10). We see decarbonisation of Diesel generation ahead of 2035, with Onshore Wind and Solar PV accounting for most of the distributed generation increase from 2025 onwards.

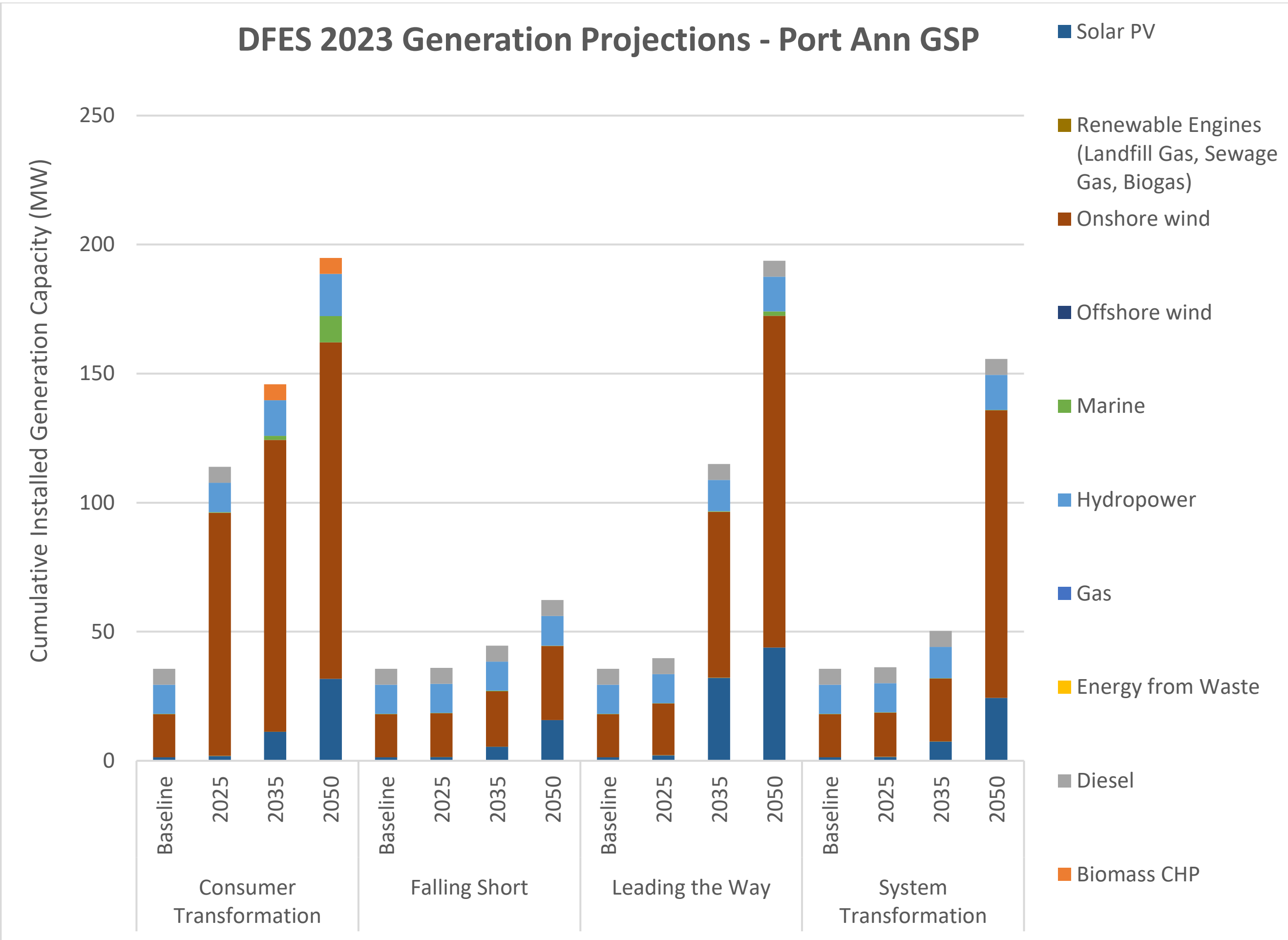

Figure 10 Projected Cumulative Distributed Generation Capacity Port Ann GSP (MW). Source: SSEN DFES 2023

1.9.1.1.2. Storage

While multiple storage technologies have their projected uptake modelled in the DFES, in the Port Ann GSP supply area we see a significant increase in the installation of domestic storage, co-location storage and high energy user storage. The domestic storage refers to those 1-15kW in scale, designed to enable households to increase the self-consumption of domestic solar PV, as well as acting as a backup power supply to households in more rural locations. A cumulative storage capacity of approximately 7.27MW is projected by 2050 under the Consumer Transformation scenario. The co-location generation refers to a system where battery storage is located with renewable generation, and this has a cumulative storage capacity of approximately 2.25MW projected by 2050 under the Consumer Transformation scenario.

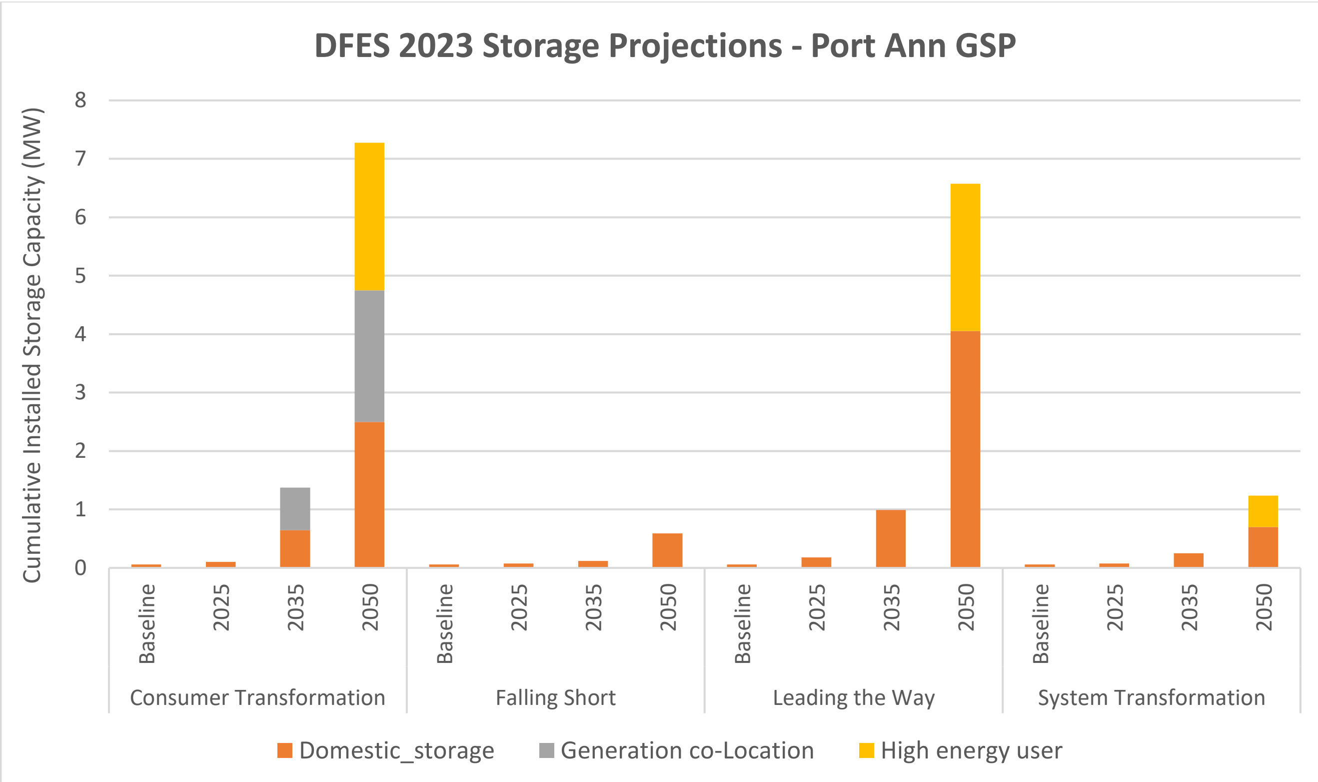

Figure 11 Projected Cumulative Storage Capacity Port Ann GSP (MW). Source: SSEN DFES 2023

The standalone network services have been excluded from Figure 11 above as this only features in Leading the Way scenario at a projected capacity of 49.9MW.

1.9.2. Carradale GSP

1.9.2.1. DFES Projections

1.9.2.1.1. Generation

The baseline value for Hydropower is 4.3MW, Onshore Wind is approximately 199.9MW and Solar PV is approximately 1.4MW. Based on the DFES projections, under the Consumer Transformation scenario, distributed renewable generation across Carradale GSP group will increase significantly from 205.6MW in the currently connected baseline to 562.8MW in 2050 (as shown in

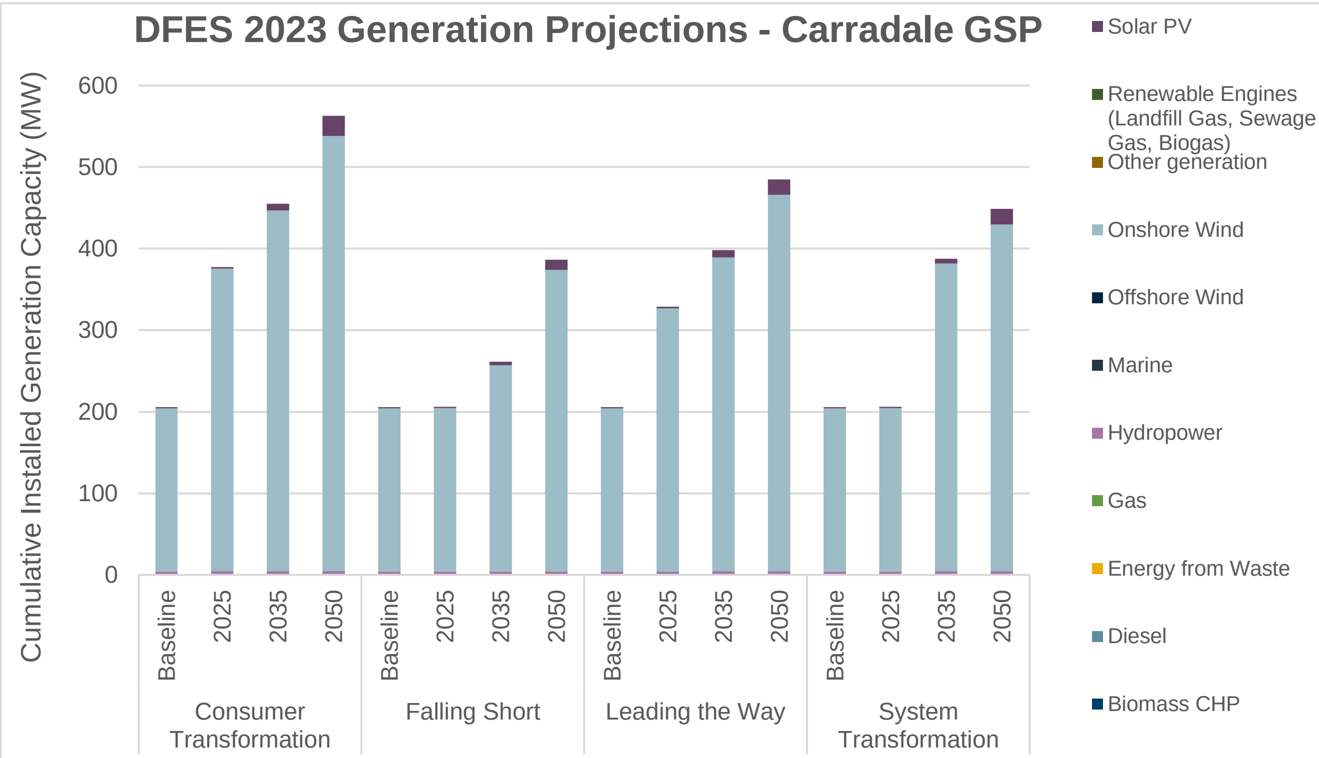

Figure 12). We see the highest increase in Onshore Wind with a 167% increase in cumulative installed capacity by 2050.

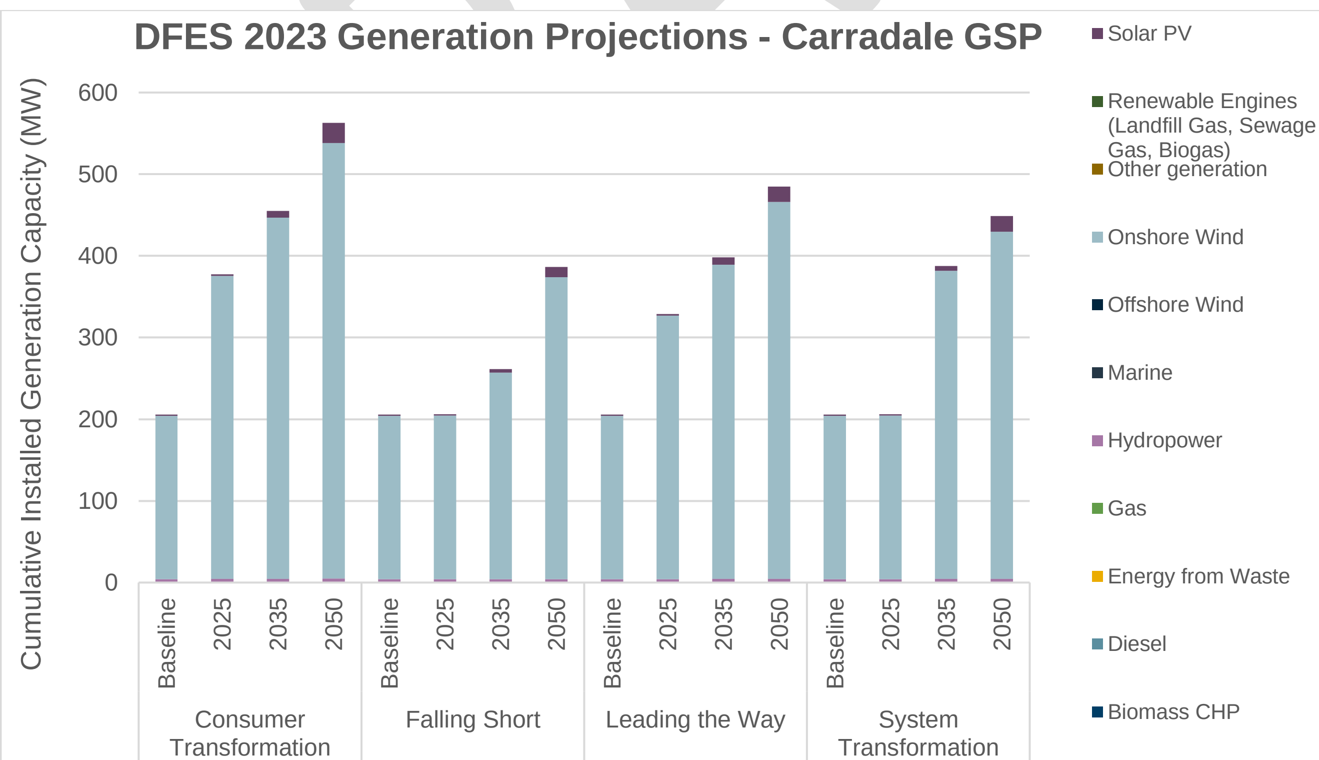

Figure 12 Projected Cumulative Distributed Generation Capacity Carradale GSP (MW). Source: SSEN DFES 2023

1.9.2.1.2. Storage

A cumulative storage capacity of approximately 7.4MW is projected by 2050 under the Consumer Transformation scenario. The co-location generation refers to a system where battery storage is located with renewable generation, and this has a cumulative storage capacity of approximately 2.19MW projected by 2050 under the CT scenario with domestic storage and high energy user storage at 2.73MW and 2.49MW respectively under CT scenario by 2050.

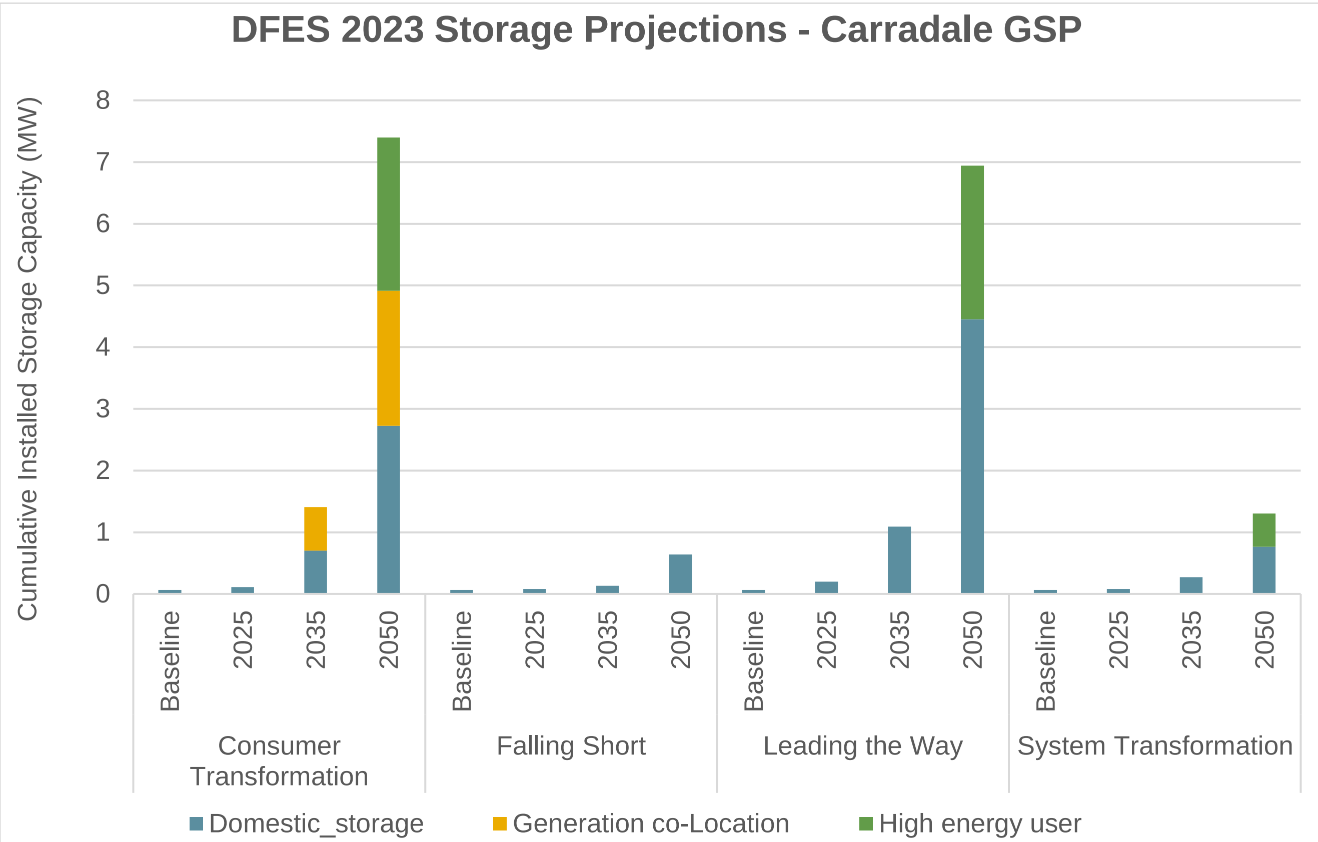

Figure 13 Projected Cumulative Storage Capacity Carradale GSP (MW). Source: SSEN DFES 2023

The standalone network services have been excluded from Figure 13 above as this only features in Leading the Way scenario at a projected capacity of 49.9MW.

1.10. Transport Electrification

Future electricity demand from transport could come from three different transport sectors that are on very different timelines. EV charging is likely to see rapid adoption to meet demand from residents and visitors. The development of shore power charging for ferries is already being explored with SSEN at key port locations; other vessels may increase future capacity requirements at these locations. Commitments from Loganair and Airtask who operate flights at the three island airports are pushing for the electrification on on-ground assets, vehicles, and a longer-term view for aircraft decarbonisation.

1.10.1. Port Ann GSP

1.10.1.1. DFES Projections

According to SSEN's 2023 DFES analysis, there could be just over 6,886 (CT)EV cars and light goods vehicles (LGVs) registered in the Port Ann GSP area by 2050. As the network operator, it is important for SSEN to understand the impact on network driven by the electricity demand of EVs. To do this we can use the projected EV charger capacity (MW) from SSEN's DFES analysis. The SSEN DFES forecasts indicate that the total connected EV charge point capacity under Port Ann GSP, excluding off-street domestic chargers, could total 8.05MW (LW) by 2035 (as shown in Figure 14) increasing to 11.08MW by 2050. The forecast data for CT scenario indicates 7MW by 2035 increasing to 8.91MW by 2050.

The uptake of domestic off-street chargers follows a similar trend. By 2035, there could be as many as 4,067(LW) domestic off-street chargers installed under Port Ann GSP with this increasing to approximately 4,263 (LW) by 2050. The forecast also indicates 4,351 (CT) by 2050.

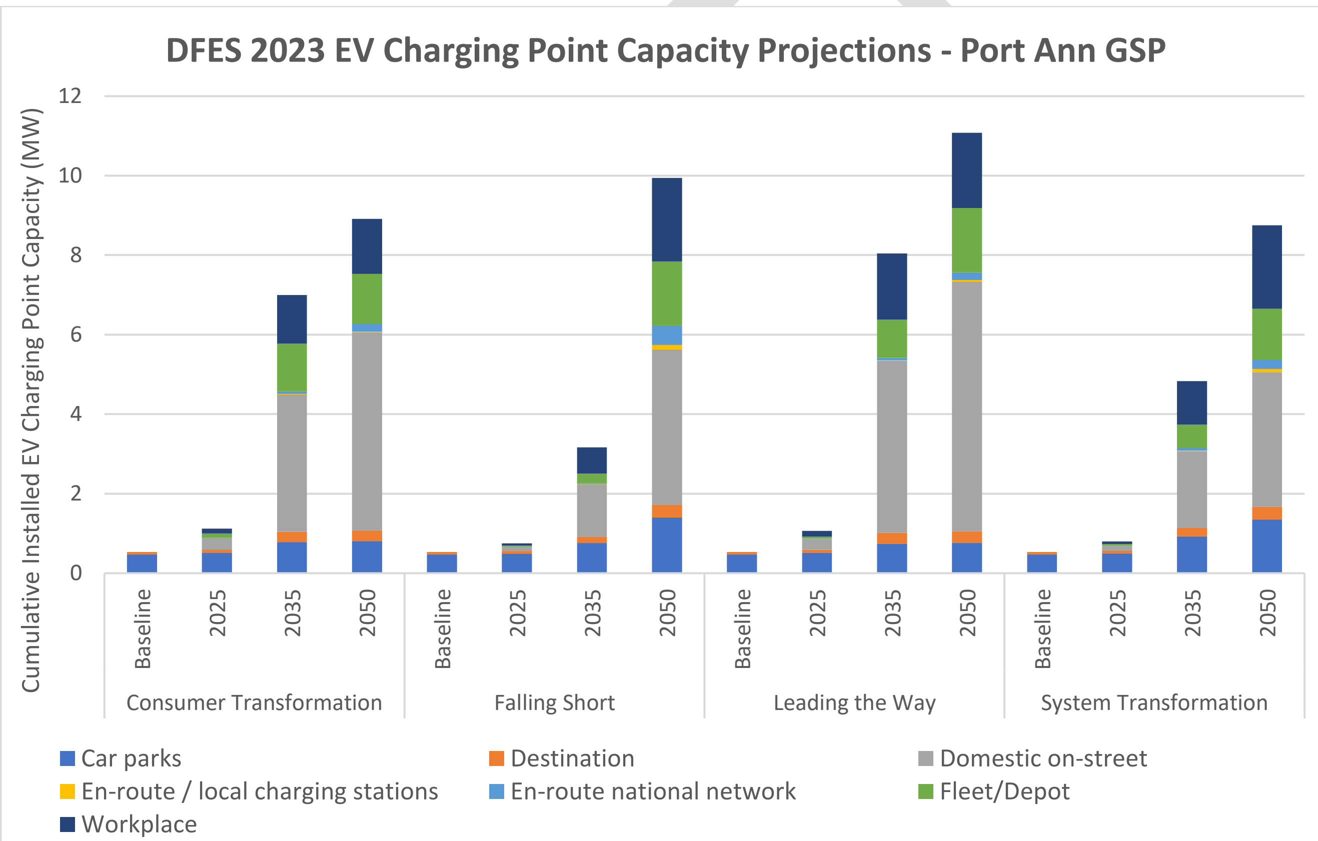

Figure 14 Projected Cumulative EV Charging Point Capacity Projections Port Ann GSP (MW). Source: SSEN DFES 2023

1.10.2. Carradale GSP

1.10.2.1. DFES Projections

According to SSEN's 2023 DFES analysis, there could be just over 24,242 (CT) EV cars and light goods vehicles (LGVs) registered in the Carradale GSP area by 2050. As the network operator, it is important for SSEN to understand the impact on network driven by the electricity demand of EVs. To do this we can use the projected

EV charger capacity (MW) from SSEN's DFES analysis. The SSEN DFES forecasts indicate that the cumulative connected EV charge point capacity under Carradale GSP, excluding off-street domestic chargers, could total 8.52MW (LW) by 2035 (as shown in Figure 15) increasing to 11.71MW by 2050. The forecast data for CT scenario indicates 7.65MW by 2035 increasing to 9.51MW by 2050.

The uptake of domestic off-street chargers follows a similar trend. By 2035, there could be as many as 4,399(LW) domestic off-street chargers installed under Carradale GSP with this increasing to approximately 4,536 (LW) by 2050. The forecast also indicates 4,620 (CT) by 2050.

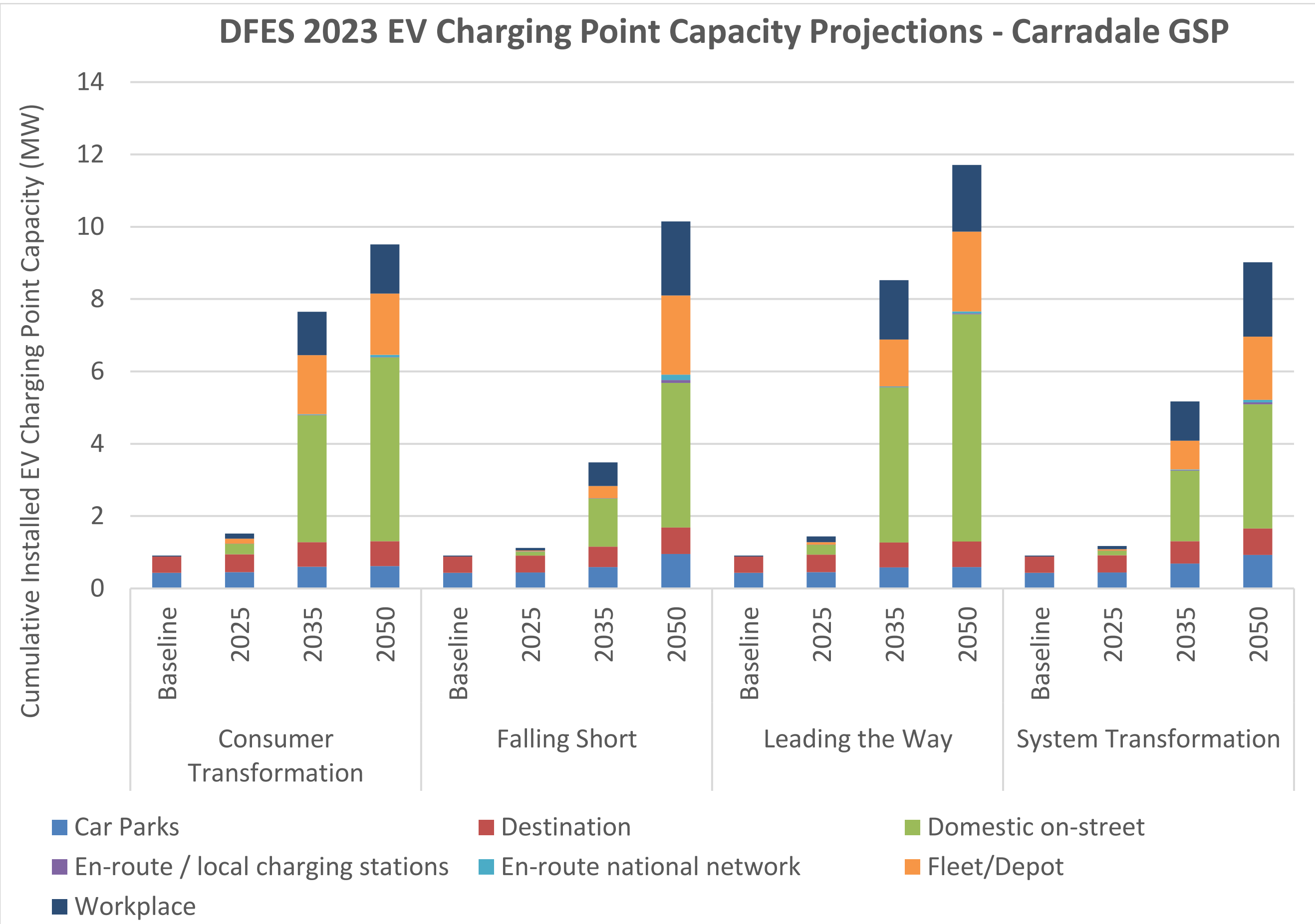

Figure 15 Projected Cumulative EV Charging Point Capacity Projections Carradale GSP (MW). Source: SSEN DFES 2023

1.11. Electrification of heat

The decarbonisation of space heating technologies in homes and businesses will have a significant impact on the future energy system. Historically in Scotland, central heating is mainly attributable to mains gas & oil (80%) and to electric heating (11% including storage heaters).[9] Government legislation, including the publication of local

9 Scottish House Condition Survey: 2021.

authorities' Local Heat and Energy Efficiency Strategies (LHEES)[10], and consumer behaviour are just two of many factors that will impact the future electricity demand arising from space heating.

1.11.1. Port Ann GSP

1.11.1.1. DFES Projections

The electrification of heat could create significant new electricity load in Port Ann GSP, with the adoption of heat pumps and next generation night storage. The air source heat pumps (domestic and non-domestic) and direct heater units could increase by up to 7,650 (CT) in 2035 steadily rising to 8,812(CT) by 2050. This excludes air conditioning load which accounts for a total of 775 units by 2050. This is highlighted in Figure 16 below.

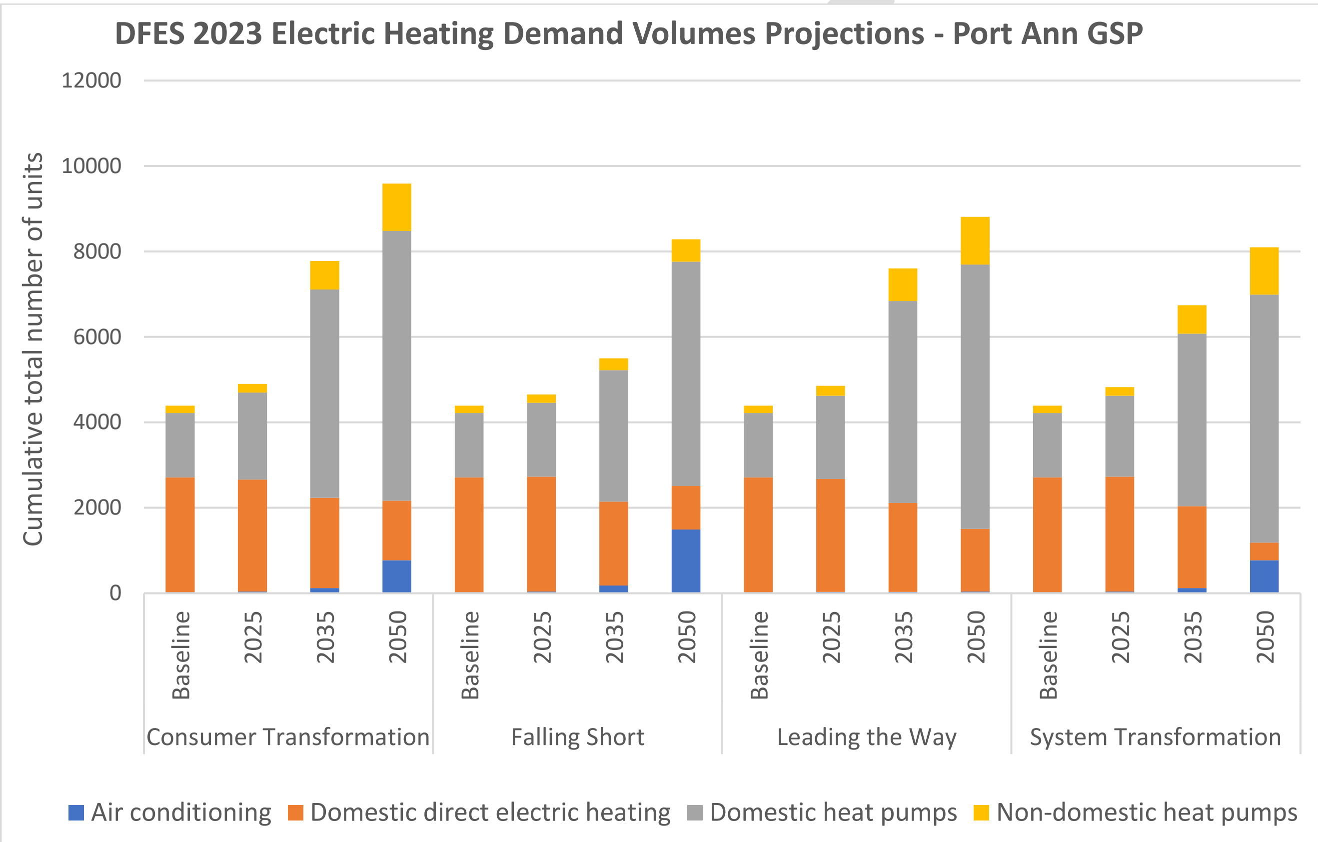

Figure 16 Projected Cumulative Electric Heating Demand Volumes Projections Port Ann GSP (units). Source: SSEN DFES 2023

1.11.2. Carradale GSP

1.11.2.1. DFES Projections

The electrification of heat could create significant new electricity load in Carradale GSP, with the adoption of heat pumps and next generation night storage. Under the CT scenario, air source heat pumps (domestic and non-domestic) and direct heater units could increase by up to 6,652 in 2035 steadily rising to 8,571 by 2050. This excludes air conditioning load which accounts for a total of 470 units by 2050. This is highlighted in **Figure 17** below.

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10 Local heat and energy efficiency strategies and delivery plans: guidance - gov.scot (www.gov.scot)

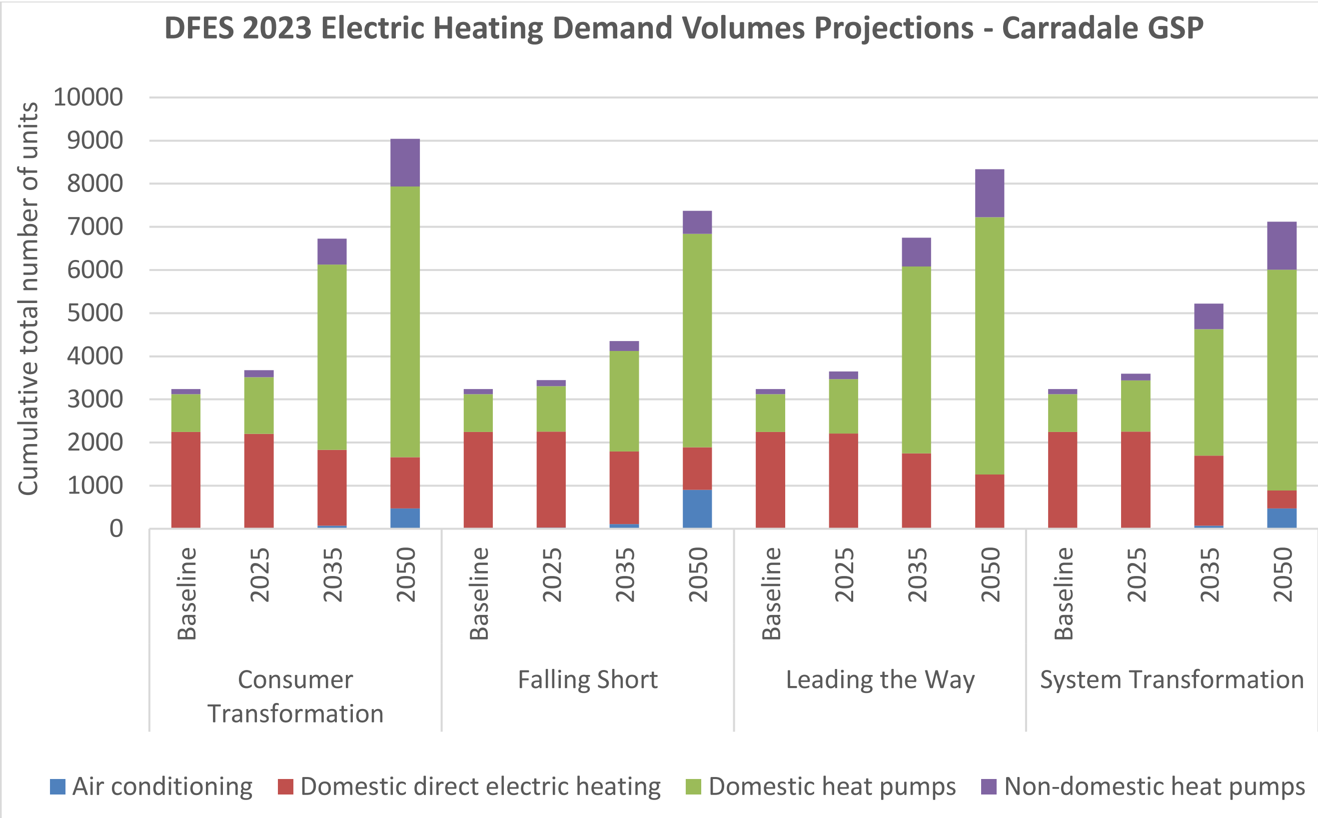


Figure 17 Projected Cumulative Electric Heating Demand Volumes Projections Carradale GSP (units). Source: SSEN DFES 2023

1.12. New building developments

To produce the SSEN DFES, Regen undertook engagement with local authorities to understand local authority development plans across our licence areas.

1.12.1. Port Ann GSP

1.12.1.1. DFES Projections

For Port Ann GSP, the DFES forecasts the cumulative floorspace of non-domestic new developments. Figure 18 shows that the two building classifications contributing to the largest floorspace growth are factory and warehouse developments (44,821 m^2 by 2050 in all scenarios), and new office space (21,582 m^2 by 2050 in all scenarios). The domestic cumulative number of homes is expected to rise from 326 in 2035(CT and ST) to 333 in 2050(CT and ST). The data is similar for the LW scenario with increase from 309 in 2035 to 334 in 2050.

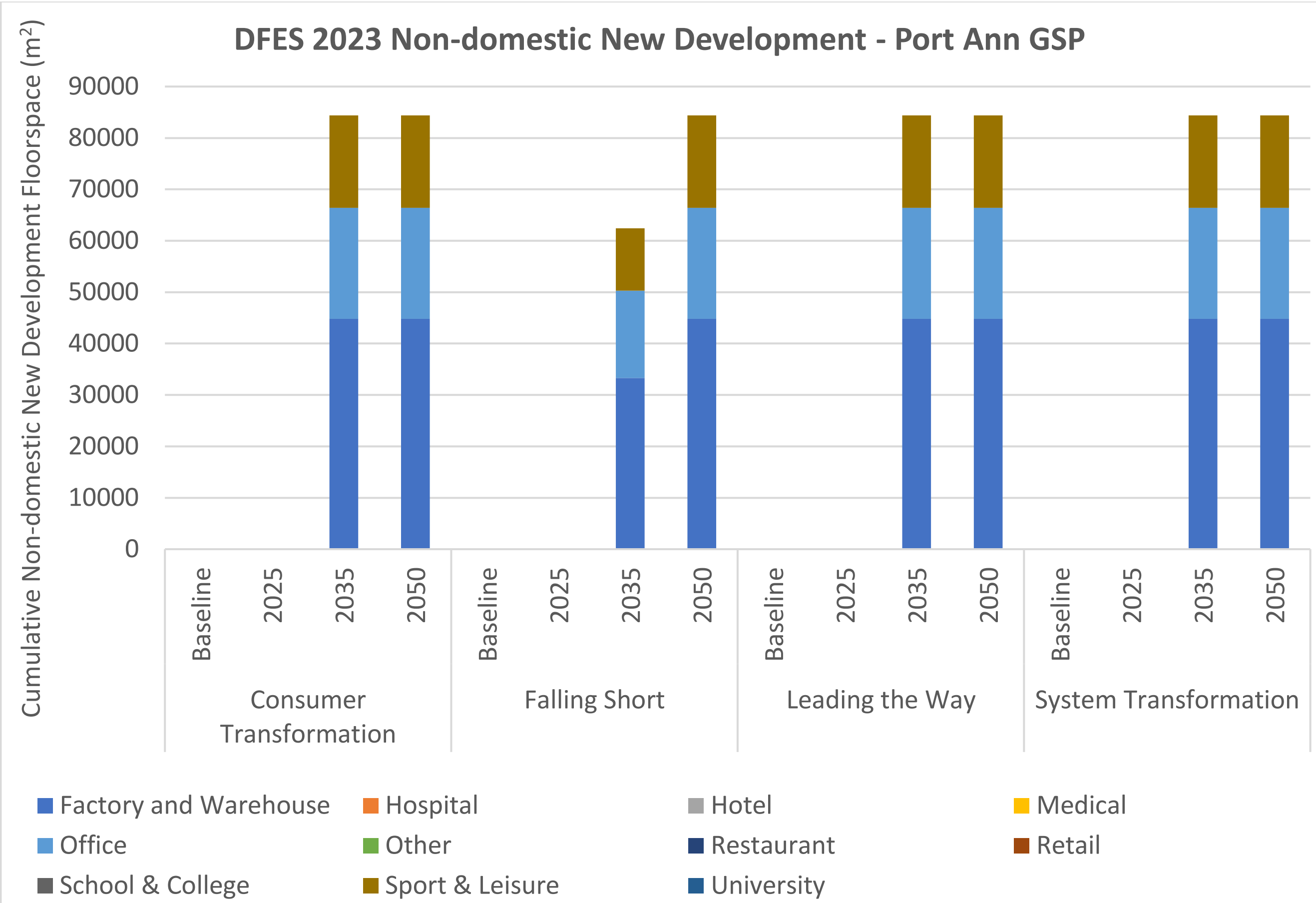


Figure 18 Projected Cumulative Non-Domestic New Building Developments Port Ann GSP (Floorspace m²). Source: SSEN DFES 2023

1.12.2. Carradale GSP

1.12.2.1. DFES Projections

For Carradale GSP, the DFES forecasts the cumulative floorspace of non-domestic new developments. Figure 19 shows that the two building classifications contributing to the largest floorspace growth are factory and warehouse developments (4,167 m^2 by 2050 in all scenarios), and new office space (2,273 m^2 by 2050 in all scenarios). The domestic cumulative number of homes is expected to rise from 92 in 2035(CT and ST) to 97 in 2050(CT and ST). The data is similar for the LW scenario with increase from 93 in 2035 to 96 in 2050.

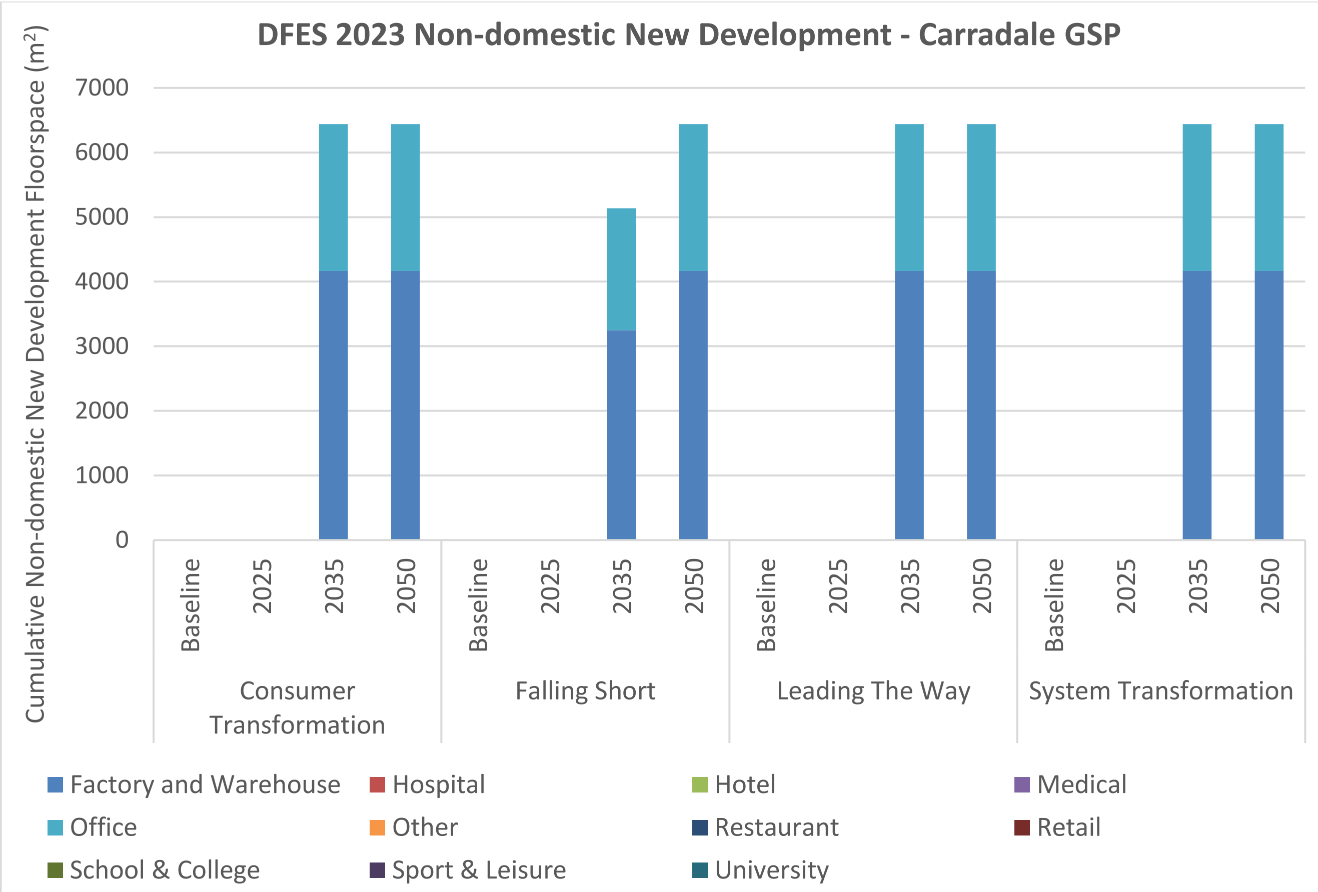


Figure 19 Projected Cumulative Non-Domestic New Building Developments Carradale GSP (Floorspace m^2). Source: SSEN DFES 2023

1.13. Commercial and industrial electrification

We recently commissioned Regen to explore more deeply the decarbonization of demand on Scottish Islands. The detailed analysis conducted by Regen regarding the decarbonization of industries specific to Northern Scotland (i.e. whisky distilleries, fish and seaweed farming) and broader industries (e.g. agriculture and other commercial businesses) indicate there could be a range of potential electrification outcomes affecting the Inner Hebrides. Further information can be obtained from the Regen Inner Hebrides - Net Zero Load Growth Evidence Summary report[11]. We have identified distilleries and ports as areas of significant future industrial demand growth for the Inner Hebrides. Below we summarize these findings and the impacts on our analysis work.

1.13.1. Distilleries

Based on the Regen analysis, the current and future energy demand of the distilling industry on Islay is expected to grow significantly. If distilleries seek to electrify, the demand capacity on the distribution network could become one of the largest sources of electricity demand in the region. This is particularly relevant for Islay which currently hosts nine whisky distilleries (not including Port Ellen which re-opened in March 2024) with a total production capacity of around 22 million Litres of Pure Alcohol (LPA) annually. There are five distilleries currently supplied from Carradale GSP, three on the mainland and two on the Isle of Arran.

11 Inner Hebrides: Net Zero Load Growth Evidence Summary

The distilling process has significant and constant high-temperature heat demand which is largely met by fossil fuel combustion at present. The wider whisky industry has made progress towards decarbonization, with non-fossil fuels making up 20% of its energy use in 2018, up from only 3% in 2008[12]. Regen engagement with the Scotch Whisky Association (SWA) highlighted that their 2023-25 strategy includes commitments to achieving net zero emissions in their own operations by 2040[13]. A Ricardo report commissioned by the SWA in 2019 investigated how carbon reduction in the distillery industry could be achieved[14]. The Regen analysis provided qualitative information on the distilleries. However, we are in the process of developing a methodology to forecast the electrical demand for distilleries within Port Ann and Carradale GSPs which will form part of the system needs in future analysis.

1.13.2. Port industry within Inner Hebrides

The timeframe of possible electricity load growth is heavily linked to the timeline of individual vessel propulsion systems being changed/replaced. This timeline is currently difficult to quantify due to uncertainties around technology readiness. However, partial/hybrid or full electrification at some scale (as opposed to ammonia or biomethane) is being considered, particularly for smaller-scale roll-on/roll-off ferries.

Ferries are one of the primary modes of maritime transport across the Inner Hebrides. As such, the associated use of shore power to charge these vessels could equate to a significant load at each of the relevant ferry terminals. In addition to their shore power requirements, the ferries charging profiles and ports' abilities to charge EVs will be major considerations for any network reinforcement.

1.14. Generation and Demand Forecast Summary

The data presented in sections 5.1-5.5 of this report is utilized in the development of profiled forecasts of demand and generation on our networks. These are shown in further detail in Appendices A and B whilst in this section we summarise the information presented.

1.14.1. Forecast Generation Capacity for Port Ann and Carradale

Appendix A shows the forecast generation capacity relate to the cumulative capacity (MW) of distribution connected generation projects across both Port Ann and Carradale GSPs. The charts are broken down into technology types expected to connect across the network and do not relate to coincident peaks for each technology.

Table 4 below summarises the cumulative forecast generation capacity from today to 2050 for Port Ann and Carradale GSPs.

12 Heriot Watt University, 2021. Distilleries need blend of green energy and storage for net zero.

13 Scotch Whisky Association, 2021. The Scotch Whisky Industry Sustainability Strategy.

14 Scotch Whisky Association (Ricardo), 2020. Scotch whisky pathway to net zero.

Substation	CT Scenario (in MW)				LW Scenario (in MW)			
	2024	2028	2040	2050	2024	2028	2040	2050
Port Ann GSP	36.86	121.05	170.71	194.86	37.25	46.37	176.56	193.79
Islay and Jura	9.40	11.92	29.11	32.93	9.54	11.83	18.31	21.39
Carradale GSP	329.18	437.75	500.74	562.83	206.8	333.41	435.95	484.93
Substation	**ST Scenario (in MW)**				**FS Scenario (in MW)**			
	2024	2028	2040	2050	2024	2028	2040	2050
Port Ann GSP	35.99	38.83	136.35	155.71	35.93	37.24	50.90	62.25
Islay and Jura	9.22	9.93	13.71	16.48	9.21	9.49	11.53	12.88
Carradale GSP	205.9	255.55	411.76	448.60	205.84	254.40	355.31	386.27

Table 4 Forecast Generation Capacity for CT, LW, ST and FS scenarios in Port Ann GSP, Island Group (Islay and Jura) and Carradale GSP

1.14.2. Demand Forecasts for Port Ann and Carradale

Appendix B shows forecast demands for each DFES scenario through to 2050. These forecasts are taken as winter peak demand at each primary with any effect of embedded generation netted off. Information relating to industrial decarbonization impacts will be added to these values in any detailed analysis undertaken. This information is summarized for the demand at Port Ann, within the Islands of Islay and Jura and at Carradale GSP in **Table 5** below.

Substation	CT Scenario (in MW)				LW Scenario (in MW)			
	2024	2028	2040	2050	2024	2028	2040	2050
Port Ann GSP	19.32	22.38	31.60	32.94	19.30	21.95	32.30	33.92
Islay and Jura	7.68	8.69	11.99	12.55	7.67	8.56	12.24	12.91
Carradale GSP	18.96	24.10	39.49	46.83	18.95	29.55	52.38	71.39
Substation	ST Scenario (in MW)				FS Scenario (in MW)			
	2024	2028	2040	2050	2024	2028	2040	2050
Port Ann GSP	19.30	20.66	29.70	30.87	19.24	19.95	27.07	31.23
Islay and Jura	7.67	8.14	11.59	12.32	7.66	7.94	10.55	12.20
Carradale GSP	18.93	22.91	38.93	58.09	18.88	20.45	30.23	35.80

Table 5 Demand Forecast for CT, LW, ST and FS scenarios in Port Ann GSP, Island Group (Islay & Jura) and Carradale GSP

6. PROJECTS IN PROGRESS

1.15. Ongoing works in Port Ann and Carradale GSPs

Network interventions can be caused by a variety of different drivers. Examples of common drivers are load-related growth, specific customer connections, and asset health. Across Port Ann and Carradale GSP these drivers have already triggered network interventions that have now progressed to detailed design and delivery. For this report, these works are assumed to be complete, with any resulting increase in capacity considered to be released.

For this report, there are some capital works ongoing to meet the demand requirements for the Isles of Islay & Jura. These are summarised in **Table 6**[15] below:

15 Forecast completions are cited at the time of publication and are subject to change.

Substation	Description	Driver	Forecast completion	Fully resolves future strategic needs to 2050?	Relevant GSP
Knocklearach/Port Askaig/ Bowmore/Port Ellen	*New 33kV overhead lines Port Askaig – Bowmore - Port Ellen and new primary transformers at each substation. Install a new switching station at Knocklearach. This will include 3x4Mvar STATCOMs and facilitate installation of 33kV ring on Islay*	*North of Scotland resilience project to improve security of supply on the Island of Islay*	*2025*		**Port Ann**
Jura/Islay	*Replacement of cable between Jura & Islay*	*Asset replacement for asset health related works*	*2024-25*		**Port Ann**
Cromalt-Inveraray Network Reinforcement	*33/11kV reinforcement works at Cromalt & Inveraray*	*DNOA process*	*2033*		**Port Ann**
Lochgilphead 1L5 and Carradale 5L5 Circuit Reinforcement	*33kV works on Lochgilphead 1L5 and Carradale 5L5 to resolve thermal and voltage issues*	*DNOA process*	*Stage 1 - 2025* *Stage 2 –2027-28*		**Port Ann**
Port Ann diversion to Craig Murrail	*Relocate Port Ann GSP to Craig Murrail (including associated substation and cable works)*	*Triggered by SHET*	*2027*		**Port Ann**
Brodick and Machrie reinforcement	*Install 2x4Mvar STATCOMs at a new Brodick 33kV switching station and a 2nd 33/11kV transformer at Machrie substation*	*DNOA process*	*2028*		**Carradale**
Brodick – Balliekine 33/11kV reinforcement (New Lochranza primary)	*Install new primary at Lochranza to split and interconnect the current Brodick - Balliekine 11kV and tee-off the 33kV network*	*DNOA process*	*2027*		**Carradale**

Table 6 Works already triggered through customer connections and the DNOA process

Where the above works are marked as not providing sufficient capacity for 2050 peak demands, it is important to note that this relates to the individual primary substation's firm capacity. When considering the further works identified in this report, the holistic plans provide capacity across the GSP for 2050.

Alongside these asset solutions being deployed, flexibility solutions are also being used to release additional capacity.

1.16. Network Schematic and GIS View (following completion of above works)

The network considered for long-term modelling is shown in Figure 20 and Figure 21.

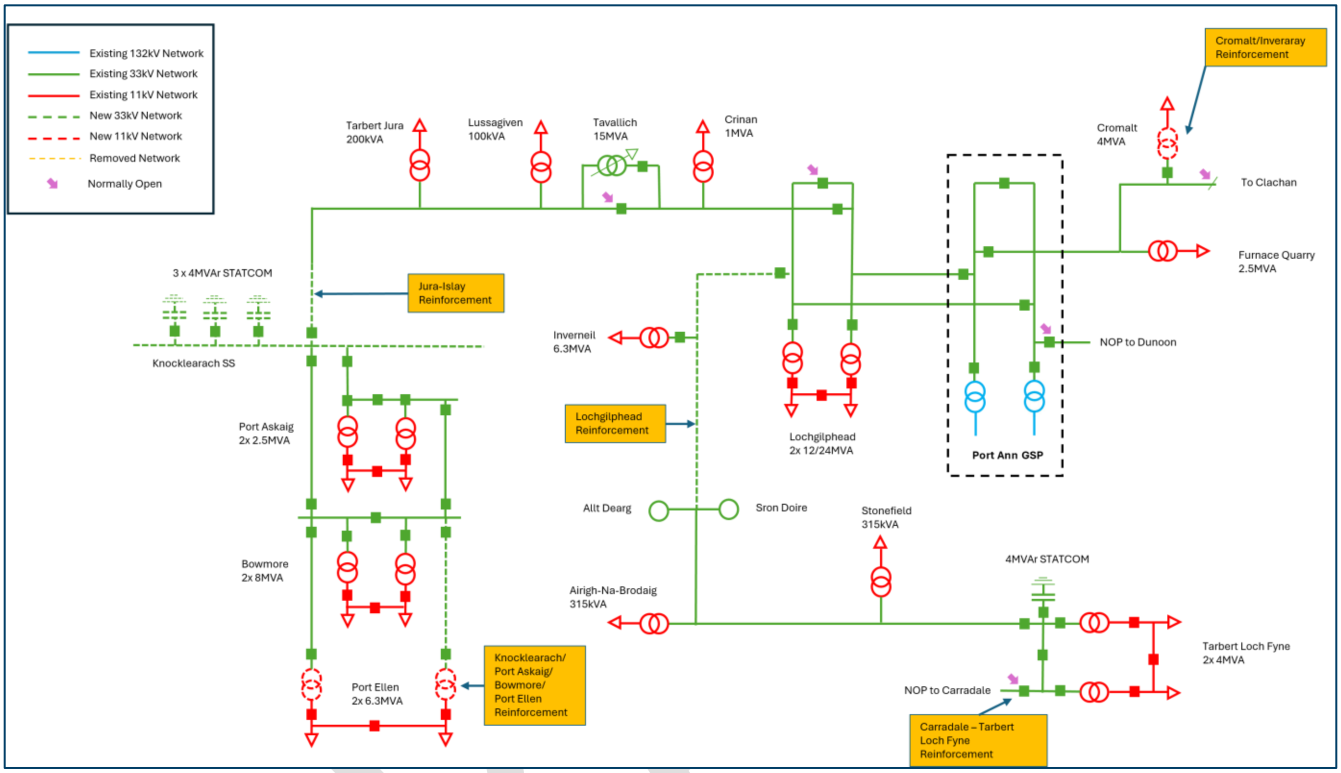


Figure 20 Future Network Development around Port Ann GSP

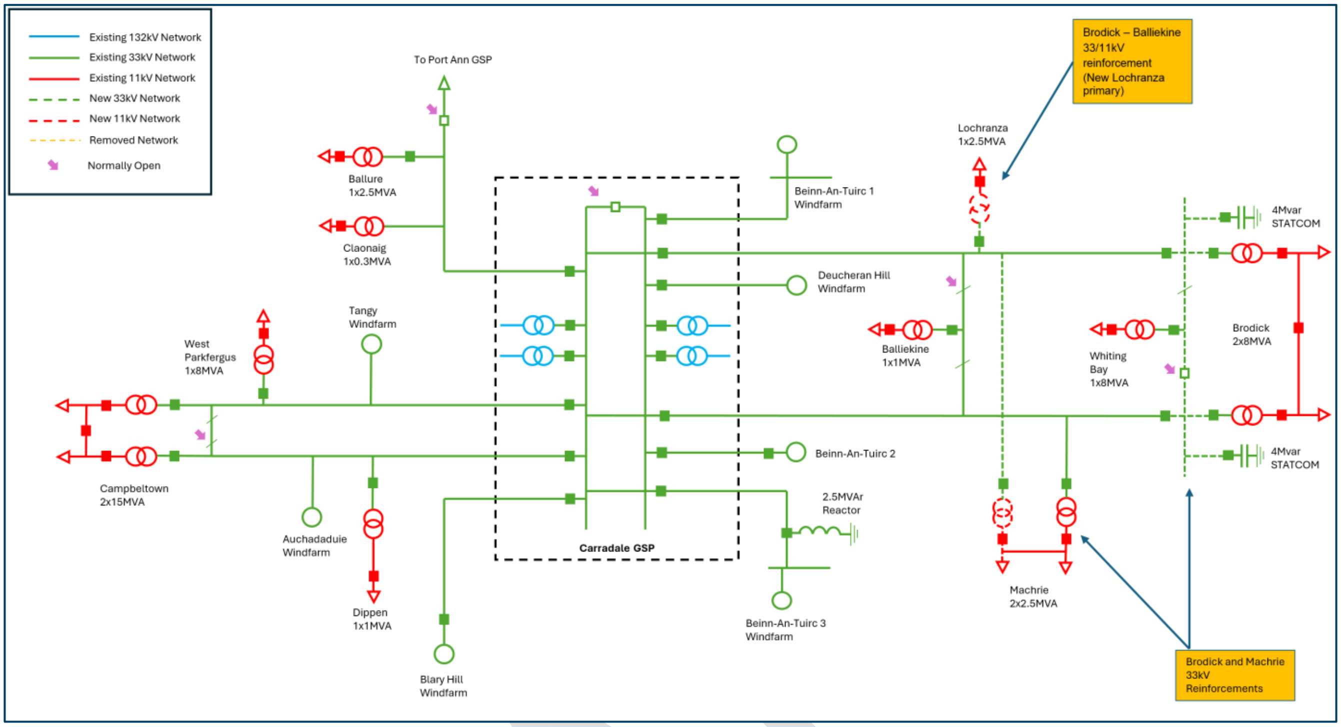


Figure 21 Future Network Development around Carradale GSP

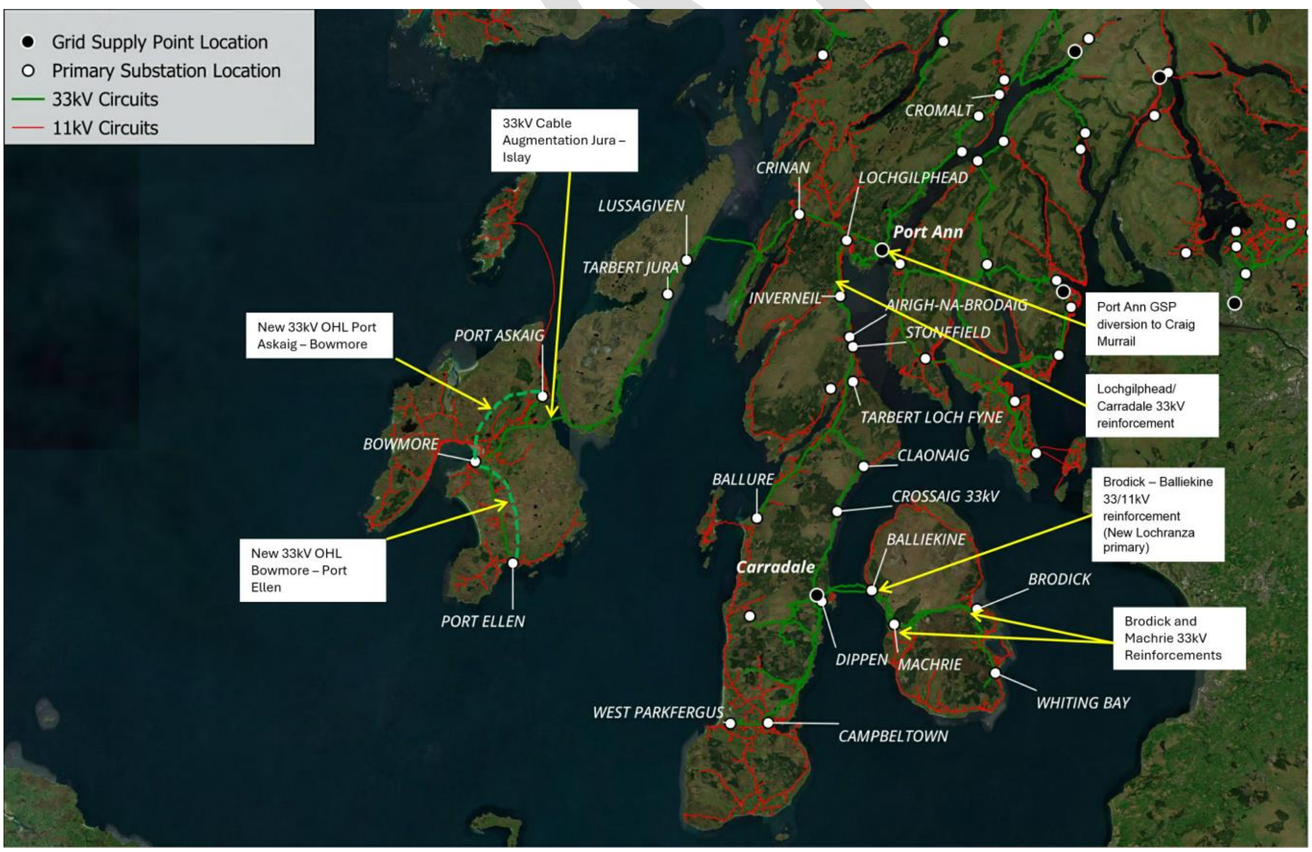


Figure 22 GIS View of Works in Progress and system needs annotated

7. FUTURE SYSTEM NEEDS

In the previous sections we discussed the Regen DFES Demand and Generation forecasts for Port Ann and Carradale GSPs. We have used this information to understand what this means for the local networks. Initially this is developed through the creation of a spatial plan of future system demand needs looking at periods of maximum demand with minimum generation. These will be augmented in the future to include spatial plans of low demands with high generation output.

We have created spatial plans at a primary substation level (33/11kV) and secondary substation level (11kV/LV). Snapshots are provided for 2028, 2033, 2040, and 2050 enabling clear visualisation of future distribution system needs beyond the current network capacity. They are currently based on the 2023 DFES.

These spatial plans consider the distribution network requirements to capacity requirements. They do not account for the enhanced network resilience policy for island groups fed by sub-sea cables nor do they account for any needs arising from the transmission system.

1.17. Extra High Voltage/High Voltage Spatial Plans for Demand Future Needs

The EHV spatial plans for the four DFES 2023 scenarios are highlighted in **Figure 23**, **Figure 24**, Figure 25 & Figure 26 for CT, LW, FS and ST respectively.

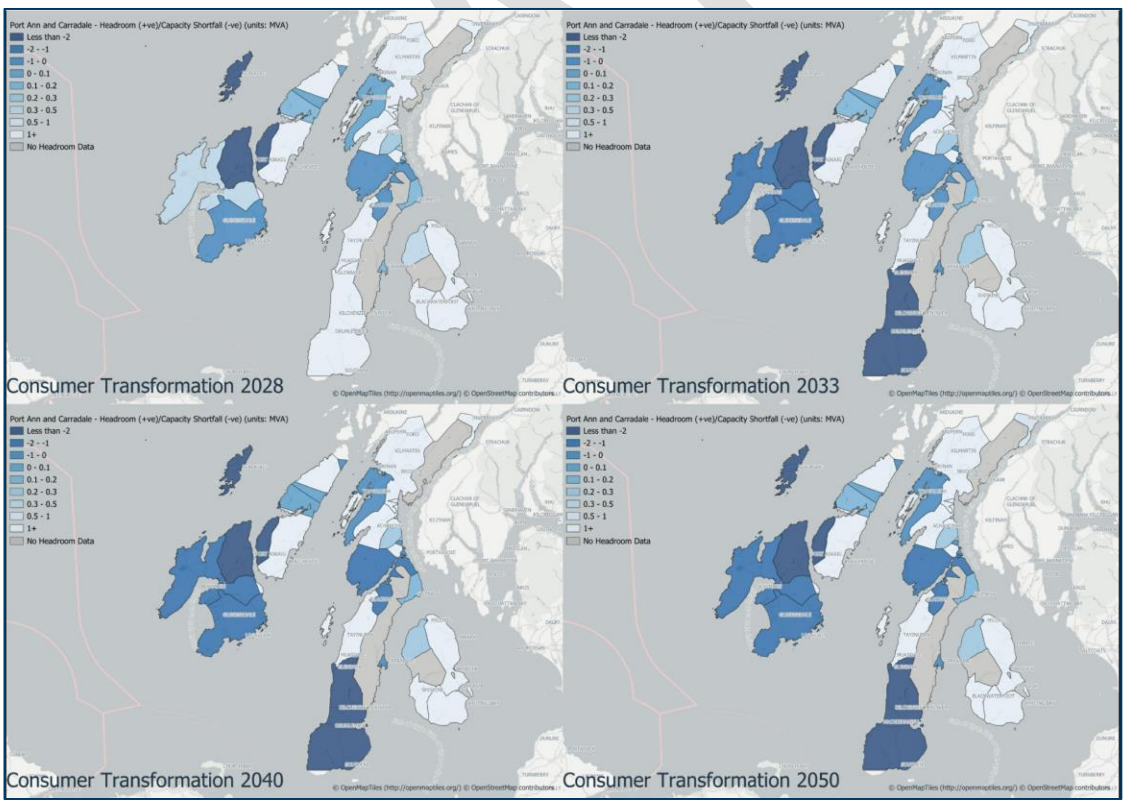


Figure 23 Port Ann and Carradale GSPs EHV spatial plans for CT 2028, 2033, 2040, and 2050

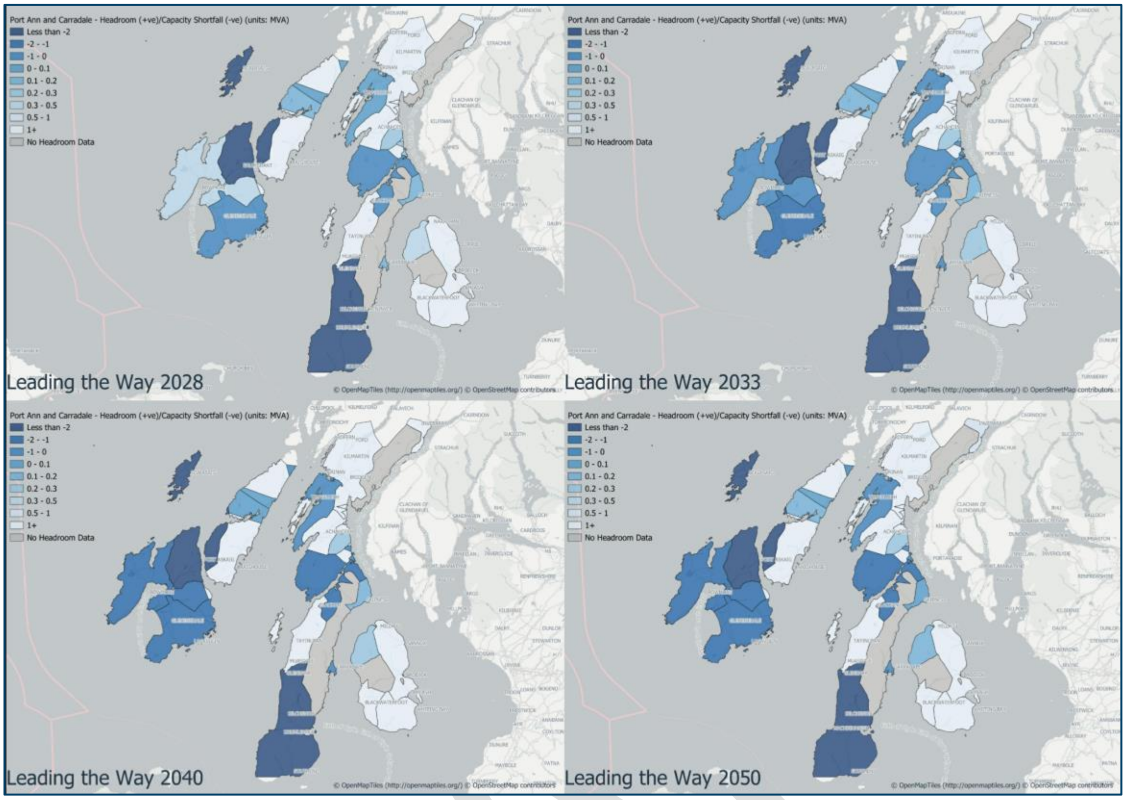


Figure 24 Port Ann and Carradale GSPs EHV spatial plans for LW 2028, 2033, 2040, and 2050

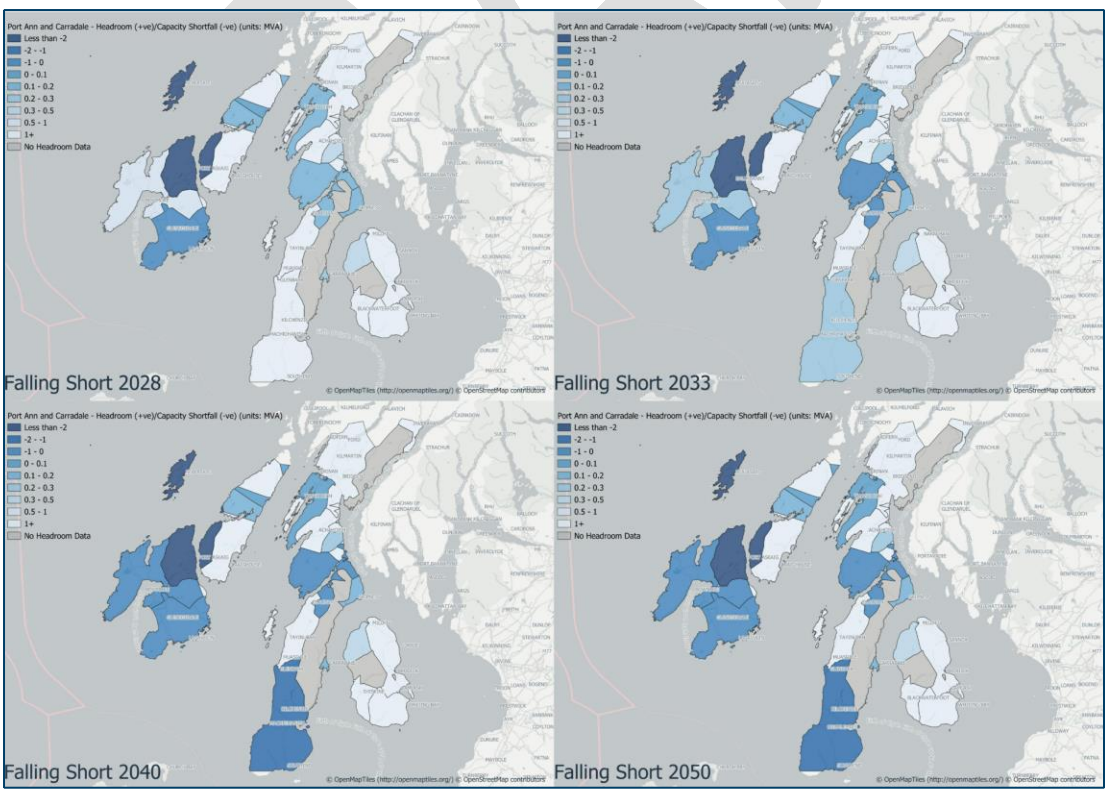


Figure 25 Port Ann and Carradale GSPs EHV spatial plans for FS 2028, 2033, 2040, and 2050

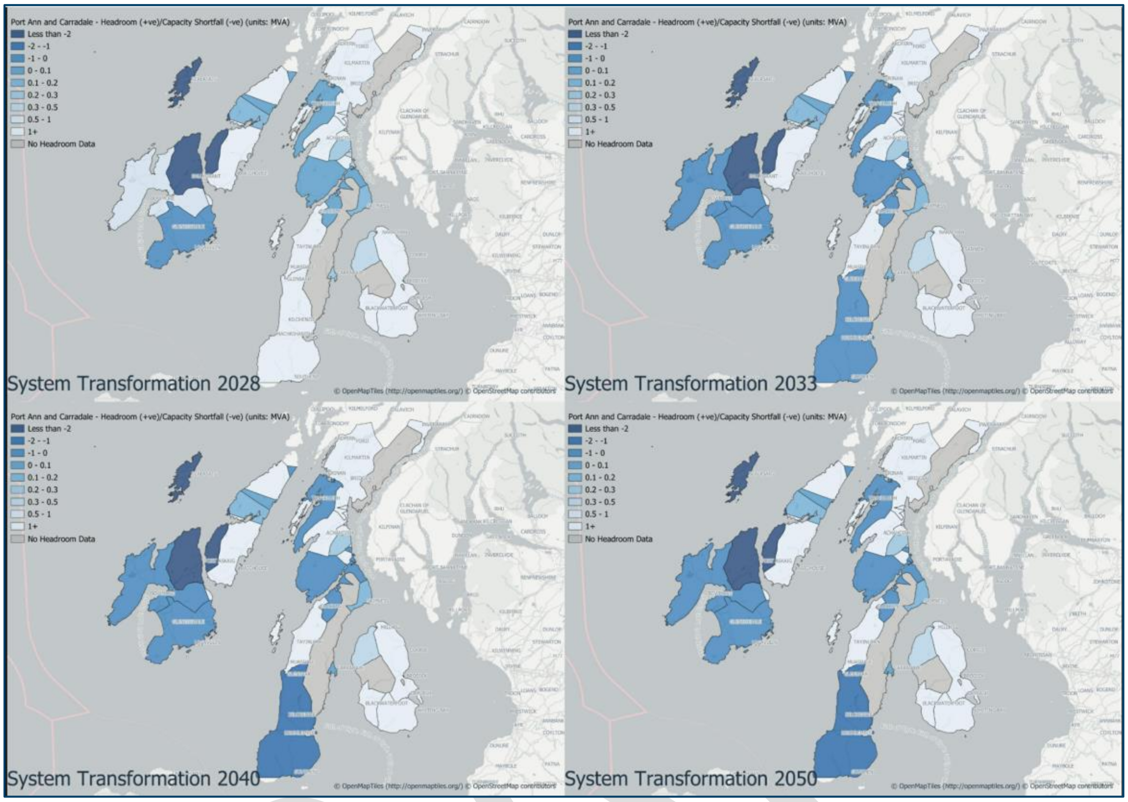


Figure 26 Port Ann and Carradale GSPs EHV spatial plans for ST 2028, 2033, 2040, and 2050

1.18. Extra High Voltage Specific System Generation Needs

There will be an increase level of generation on both Port Ann and Carradale GSPs, most significantly with the onshore wind farm uptake in the region. This volume of generation will likely drive the need for both distribution and transmission reinforcement (carried out by SHET) which would include new 33kV circuits between existing substations or potentially new GSPs to accommodate the level of generation connections. These needs are assessed in detail in Section 8 .

1.19. Extra High Voltage Specific System Demand Needs

1.19.1. Port Ann GSP

There will be a need to carry out reinforcement works around Port Ann GSP specifically at primary substation levels where the existing transformers cannot accommodate the projected increase in demand under system intact and N-1 conditions. These primaries include Crinan, Port Askaig and Tarbert Loch Fyne where the demand increases moderately up to 2050 and at Stonefield where the demand increases significantly over that timeframe.

1.19.2. Carradale GSP

There will be a need to carry out reinforcement works around Carradale GSP specifically at primary substation levels where the existing transformers cannot accommodate the projected increase in demand under N-1 conditions. These primaries include Campbeltown, Brodick and Dippen where the demand increases significantly by 2050. There will also be a need to carry out N-1 and N-2 network resilience reinforcement works on the subsea cables supplying the Isle of Arran by 2038 based on DFES CT scenario forecast. This will ensure compliance with P2/8 and our enhanced resilience policy for island groups supplied via subsea cables.

1.20. HV/LV demand spatial plans

To understand, where load is growing at a lower voltage levels, we have used information from the SSEN load model. The secondary transformer projected percentage loadings for each of the four DFES scenarios are highlighted in Figure 27, Figure 28, **Figure 29** and Figure 30 for CT, LW, FS and ST respectively. As shown in the legend, the points are coloured based on their percentage loading with green being low percentage loading and darker reds being higher percentage loading (see legend for detail on loading bands and colouring).

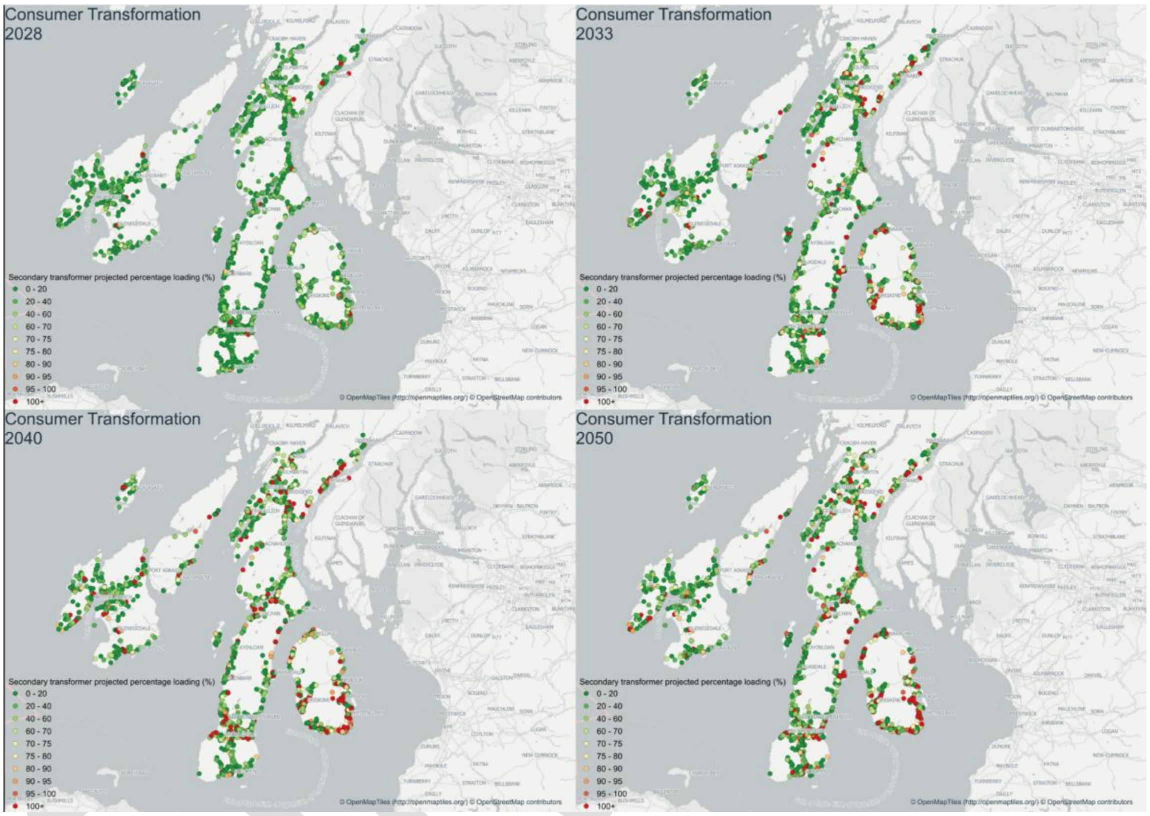


Figure 27 Port Ann and Carradale GSPs HV/LV CT spatial plans for 2028, 2033, 2040, and 2050

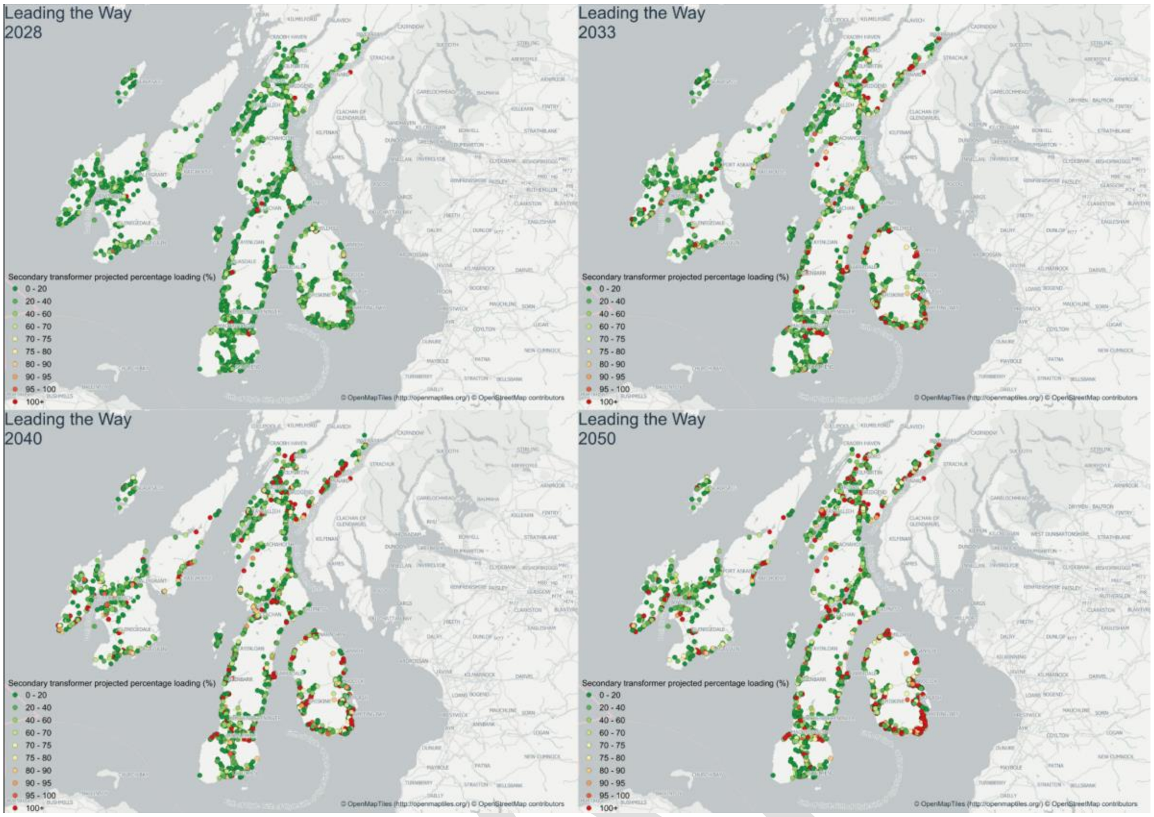


Figure 28 Port Ann and Carradale GSPs HV/LV LW spatial plans for 2028, 2033, 2040, and 2050

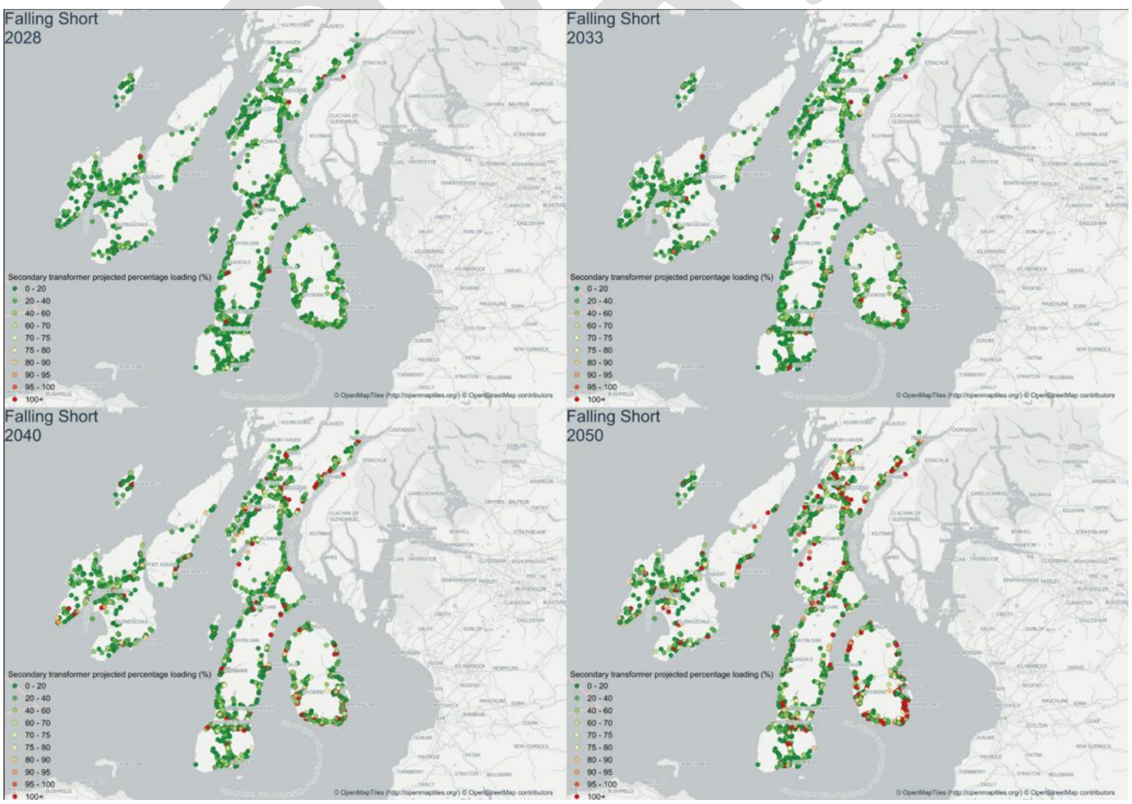


Figure 29 Port Ann and Carradale GSPs HV/LV FS spatial plans for 2028, 2033, 2040, and 2050

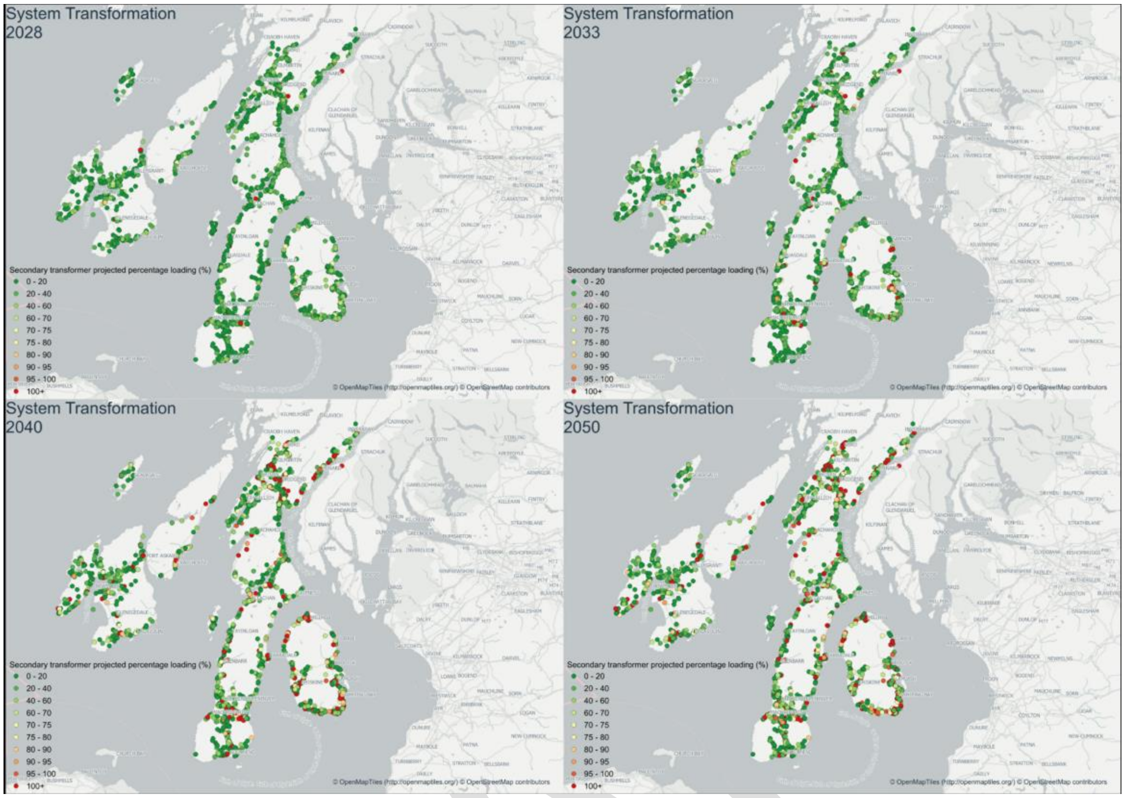


Figure 30 Port Ann and Carradale GSPs HV/LV ST spatial plans for 2028, 2033, 2040, and 2050

8. OPTIONS TO RESOLVE

1.21. Options Consideration

The relevant spatial plans provide us with a strategic view of future system needs. We have reviewed this through thermal power system analysis to understand the specific requirements of our EHV networks through to 2050. This analysis has been based on the insights developed from the 2023 DFES alongside other information including known connection applications. Initial needs have been identified using the DFES Consumer Transformation background with sensitivity analysis undertaken against the other three DFES backgrounds.

The options consider scenarios for both summer and winter to ensure the varying demand and support from local generation combinations were all accounted for. Contingency N-2 considerations for islands supplied by subsea cables will also be undertaken.

In this section we propose initial options to resolve these needs. These will be further developed through the HOWSUM and DNOA processes, where they will be considered alongside the potential for flexibility.

The section is split into three parts:

- Network dependencies, risks and mitigations – These summarise the overall dependencies between works proposed and different criteria such as network output delivery and flexible network services. They also include the potential risks and mitigation measures in relation to the dependencies identified;
- 2050 high level options for EHV network – There is a greater degree of uncertainty of outcomes in this time frame. This also provides more opportunity to work with stakeholders to develop a strategic plan and our outline solutions reflect this initial phase of the work as we look to engage with interested parties. For needs within the next seven years we will recommend these are progressed through the DNOA process. These needs are more certain and therefore we have more clearly defined options to meet the requirements. In all cases we are proposing solutions that meet the projected requirements for 2028. We also provide a summary of more strategic elements that also need to be considered in these timeframes. For EHV system needs to 2040, we are proposing solutions that meet the projected requirements for 2040. We also provide a summary of more strategic elements that also need to be considered in these timeframes. For EHV system needs between 2040 - 2050, we have highlighted these areas of reinforcement to be considered;
- Specific options required for all four scenarios – These summarise the specific options that are required through the DNOA process. These specific options combined with the HOWSUM options will improve the whole network resilience and system security up to 2050.

1.22. Overall dependencies, risks, and mitigations

There are a number of overarching risks to the delivery of our strategic plan. Below we list these alongside proposed mitigating actions. We will work with stakeholders to develop these mitigating actions further.

Network Output Delivery

Dependency**:** Works proposed here are dependent on the supply chain required to deliver the project. It has been tested through delivery of RIIO-ED1 projects. This has shown that the supply chain is able to provide the capacity and skills required to deliver these projects. As we continue works in RIIO-ED2 with the increased amount of CAPEX delivery required it is important for us to ensure that the supply chain can continue to deliver.

Risks: Works delay potential interventions downstream and/or cannot deliver the subsea cable on time.

Mitigation: In response to this we have commenced early market engagement with subsea cable installation contractors to ensure that the capacity and skills to deliver this project are available.

Flexibility Services

Dependency: Procurement of flexible services to defer reinforcement where possible and economically viable.

Risks: Insufficient flexibility in the relevant area to resolve system need.

Mitigation: Flexibility service procurement carried out ahead of time with signposting of future needs. Last build date identified to allow time for traditional reinforcement if flexibility not viable.

1.23. 2050 High Level Options for EHV Network

This section provides more detail on the high-level options to resolve in the period through to 2050. Additional system needs have been identified here which our forecasts have indicated need addressing ahead of 2050. These have been identified through thermal power system analysis and the impact on all four DFES scenarios has been considered.

Section 8.3.1 summarises high level options developed through the HOWSUM process that will facilitate the requirements of island communities in the Inner Hebrides. The remaining tables show more specific options that fall outside the HOWSUM process and will be progressed through the DNOA process.

The options listed in Table 7 outline potential approaches to address individual constraints on the network through 2050.A combination of these options will be required to meet system needs out to 2045. Going forward, detailed analysis of these proposed options will be required to ensure that there is a comprehensive and cost-effective solution, which aligns with a whole-system approach to ensure maximum value for our customers whist meeting the demand and generation needs of the network.

1.23.1. 2050 High level EHV options within HOWSUM scope

Table 8 below summarises the system options we have identified through the HOWSUM process. These are needs relating to future requirements for the infrastructure from Port Ann GSPs to the relevant Inner Hebridean islands. The options shown form alternative potential solutions that will be tested further through detailed system analysis as part of the HOWSUM process. Sections 8.3.2-8.3.4 break these options down further into the potential time periods for their need.

Option	Description	Driver	System Needs being resolved
Install auto-close scheme at Bowmore 33kV substation	Establish auto-close scheme the Bowmore – Port Ellen double circuits	Demand	Improves N-1 resilience for Island Group
Carradale – Port Ellen	33kV reinforcement works including new 33kV circuit from Carradale GSP to Islay network.	Demand	Improves N-1 resilience for Island Group
Port Ann – Port Askaig(via Knocklearach)	33kV reinforcement works including new 33kV circuit from Port Ann GSP to Islay network.	Demand	Improves N-1 resilience for Island Group
Additional 33kV circuit between Carradale GSP – Port Ellen	Establish 2nd Carradale GSP – Port Ellen 33kV circuit	Demand	Improves N-2 resilience for Island Group
Additional 33kV circuit between Jura – Islay	Establish 2nd Jura – Islay 33kV circuit and split at PMCB on Jura to create two circuits	Demand	Improves N-2 resilience for Island Group
New 132kV circuit from Crossaig 132kV substation to North Islay	Establish 132kV circuit from Crossaig 132kV substation to Islay. Establish 132/33kV transformer connected to Knocklearach with auto-close on Port Ann circuits	Demand	Improves N-2 resilience for Island Group
New 66kV circuit from a new Crossaig 132/66kV transformer to North Islay	Establish new 132/66kV substation around Crossaig and install 66kV circuit towards Islay. Install 66/33kV transformer at Knocklearach with auto-close scheme on Port Ann circuits	Demand	Improves N-2 resilience for Island Group
Additional Port Ann to Port Askaig 33kV circuit	Install 3rd circuit between Port Ann and Islay	Demand	Improves N-2 resilience for Island Group
New 132kV circuit from Crossaig 132kV substation to South Islay	Establish 132kV circuit from Crossaig 132kV substation to South Islay. Establish 132/33kV transformer connected to Port Ellen 33kV substation	Demand	Improves N-2 resilience for Island Group
New 66kV circuit from Crossaig 132kV substation to South Islay	Establish new 132/66kV substation around Crossaig and install 66kV circuit towards Islay. Install 66/33kV transformer at Port Ellen 33kV substation	Demand	Improves N-2 resilience for Island Group

Upgrade existing Lochgilphead – Jura 33kV subsea cable	Upgrade the existing Lochgilphead – Jura 33kV subsea cable to 30MVA	Demand	Improves N-1 resilience and reduces network losses by utilising a larger conductor

Table 8 High Level Options to resolve EHV system needs to 2050

1.23.2. EHV Options 2024-2028 within HOWSUM scope

This section summarises the options to resolve the network constraints in the period through to 2028. The options are show in **Table** 9 and **Figure 31**.

Option	CT Year of need	ST Year of need	LW Year of need	FS Year of need	Description	System Needs being resolved	Schematic Reference
Install auto-close scheme at Bowmore 33kV substation	2028	2028	2028	2028	Establish auto-close scheme the Bowmore – Port Ellen double circuits	Increased capacity. May be required in conjunction with other options	1
Carradale – Port Ellen	2027	2027	2027	2027	33kV reinforcement works including new 33kV circuit from Carradale GSP to Islay network.	Additional demand requirements. Also provides additional resilience.	2

Table 9 Options to resolve system needs between 2024-2028

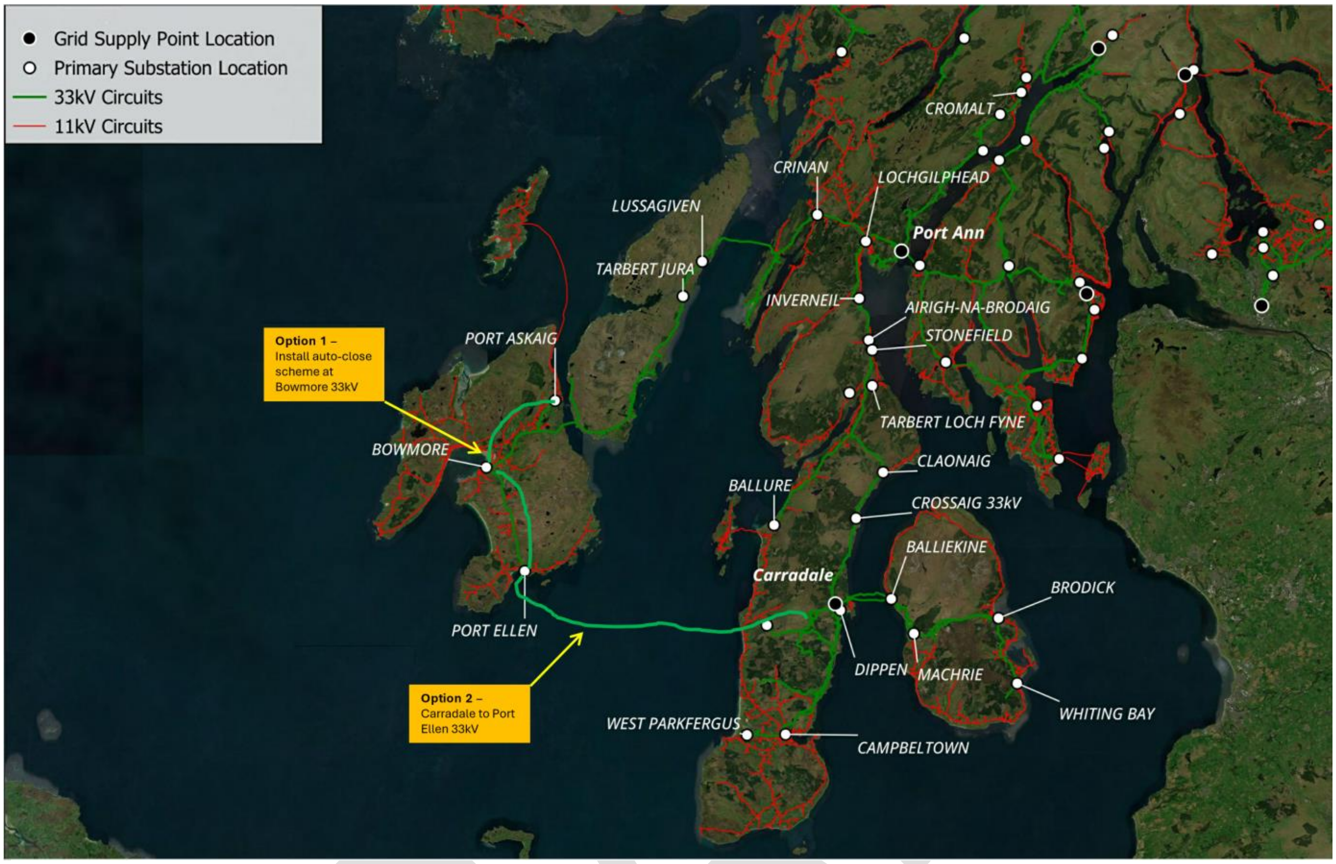


Figure 31 GIS view of network with works in progress and additional reinforcement options by 2028(Options 1 & 2)

1.23.3. EHV Options 2029-2040 within HOWSUM scope

This section summarises the options to resolve the network constraints in the period through to 2040. The options are shown in **Table** 10 and Figures 30 – 39 below.

Option	CT Year of need	LW Year of need	ST Year of need	FS Year of need	Description	System Needs being resolved	Schematic Reference
Port Ann - Port Askaig (via Knocklearach)	2030	2030	2030	2030	33kV reinforcement works including new 33kV circuit from Port Ann GSP to Islay network.	Additional demand requirements. Also provides additional resilience.	3
Additional 33kV circuit between Carradale GSP – Port Ellen	2030	2030	2030	2030	Establish 2nd Carradale GSP – Port Ellen 33kV circuit	Improves N-2 resilience for Island Group and meets demand growth to 2040	4

Additional 33kV circuit between Jura – Islay	2030	2030	2030	2030	Establish 2nd Jura – Islay 33kV circuit and split at PMCB on Jura to create two circuits	Improves N-2 resilience for Island Group	5
New 132kV circuit from Crossaig 132kV substation to North Islay	2030	2030	2030	2030	Establish 132kV circuit from Crossaig 132kV substation to Islay. Establish 132/33kV transformer connected to Knocklearach with auto-close scheme on Port Ann circuits	Improves N-2 resilience for Island Group and introduces 132kV voltage level to the Islay network	6
New 66kV circuit from a new Crossaig 132/66kV transformer to North Islay	2030	2030	2030	2030	Establish new 132/66kV substation around Crossaig and install 66kV circuit towards Islay. Install 66/33kV transformer at Knocklearach with auto-close scheme on Port Ann circuits	Improves N-2 resilience for Island Group and introduces 66kV voltage level to the Islay network	7
Additional Port Ann to Port Askaig 33kV circuit	2030	2030	2030	2030	Install 3rd circuit between Port Ann and Islay	Improves N-2 resilience for Island Group and avoids wayleave issues south of Jura	8
New 132kV circuit from Crossaig 132kV substation to South Islay	2030	2030	2030	2030	Establish 132kV circuit from Crossaig 132kV substation to Islay. Establish 132/33kV transformer connected to Port Ellen 33kV	Improves N-2 resilience for Island Group and introduces 132kV voltage level to the Islay network	9
New 66kV circuit from a new Crossaig 132/66kV transformer to South Islay	2030	2030	2030	2030	Establish new 132/66kV substation around Crossaig and install 66kV circuit towards Islay. Install 66/33kV transformer connected to Port Ellen 33kV	Improves N-2 resilience for Island Group and introduces 66kV voltage level to the Islay network	10

Table 10 Options to resolve system needs between 2029-2040

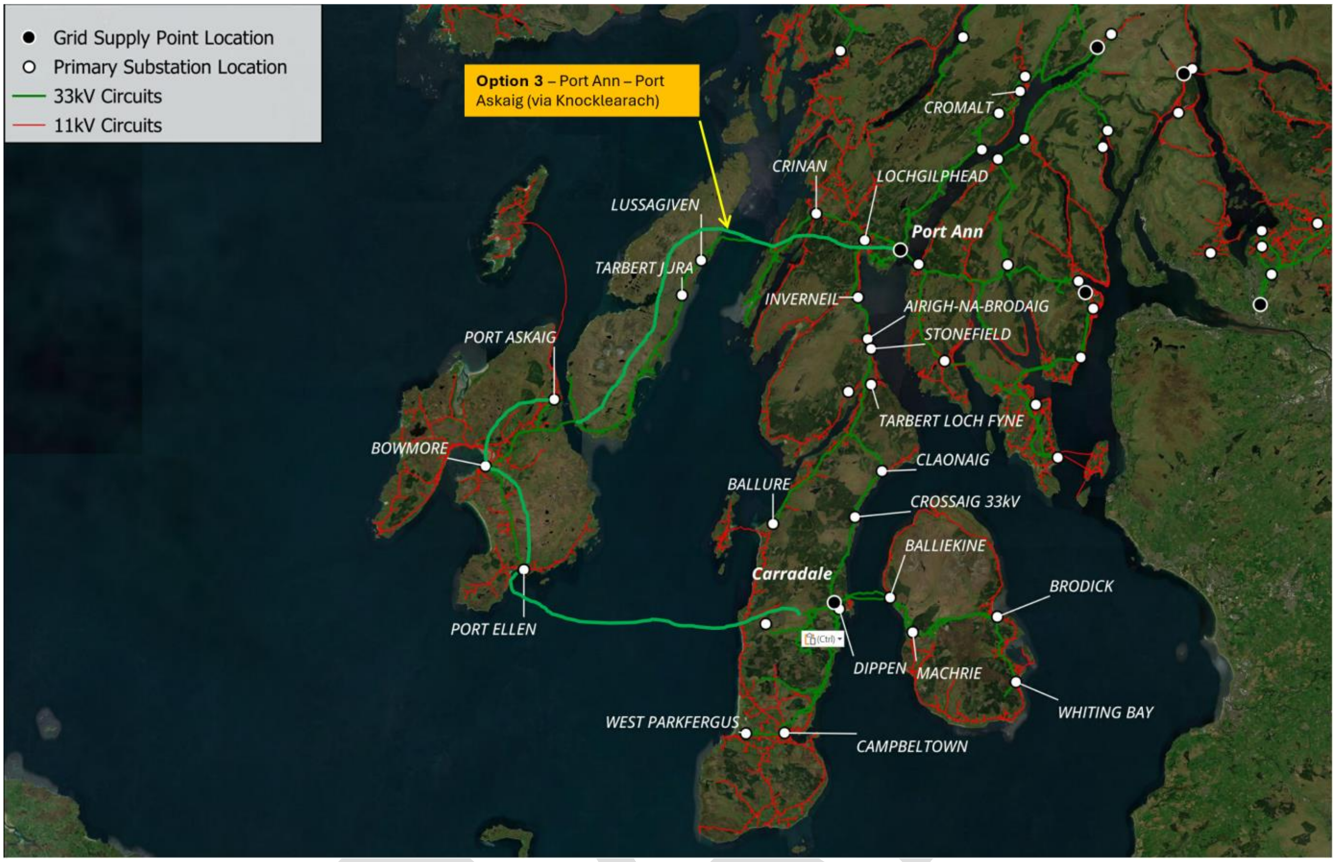


Figure 32 GIS view of network with works in progress and additional reinforcement options by 2040 (Option 3)

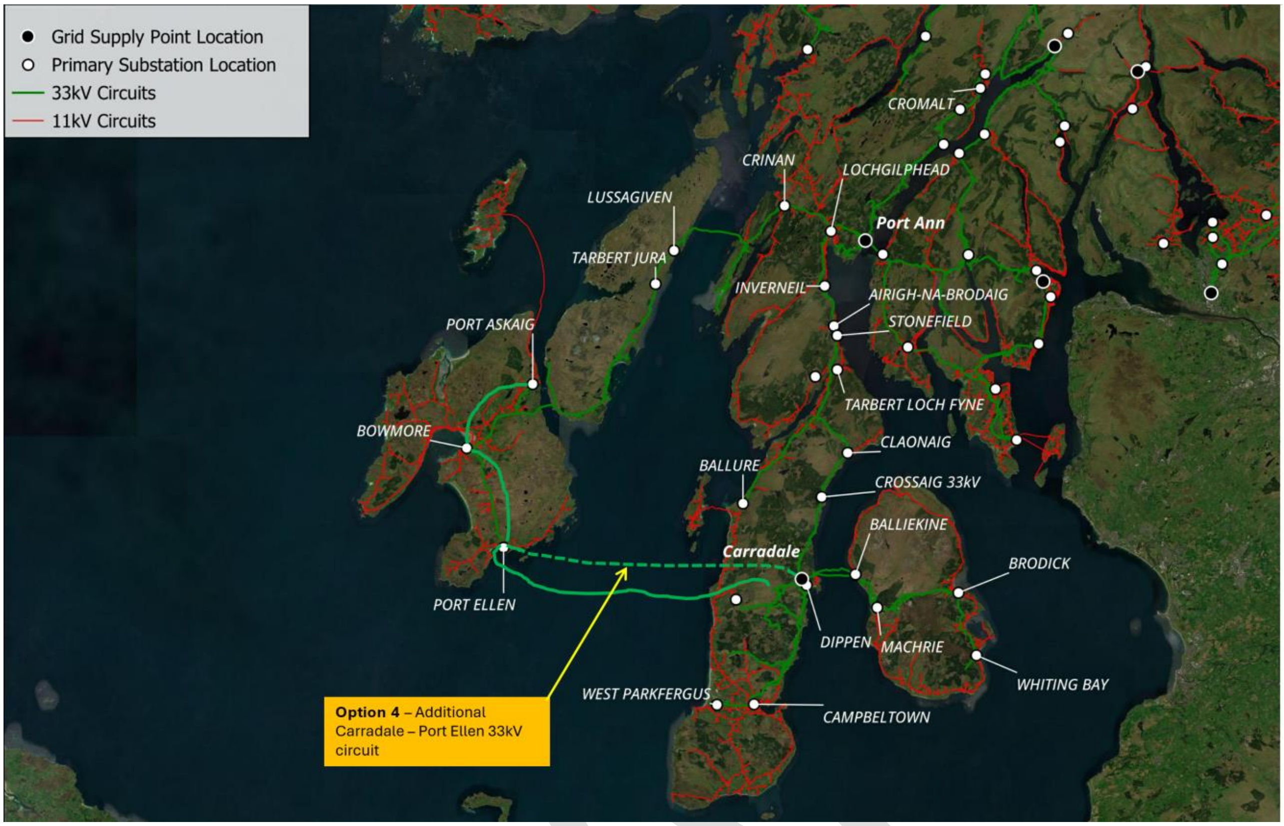


Figure 33 GIS view of network with works in progress and additional reinforcement options by 2040 (Option 4)

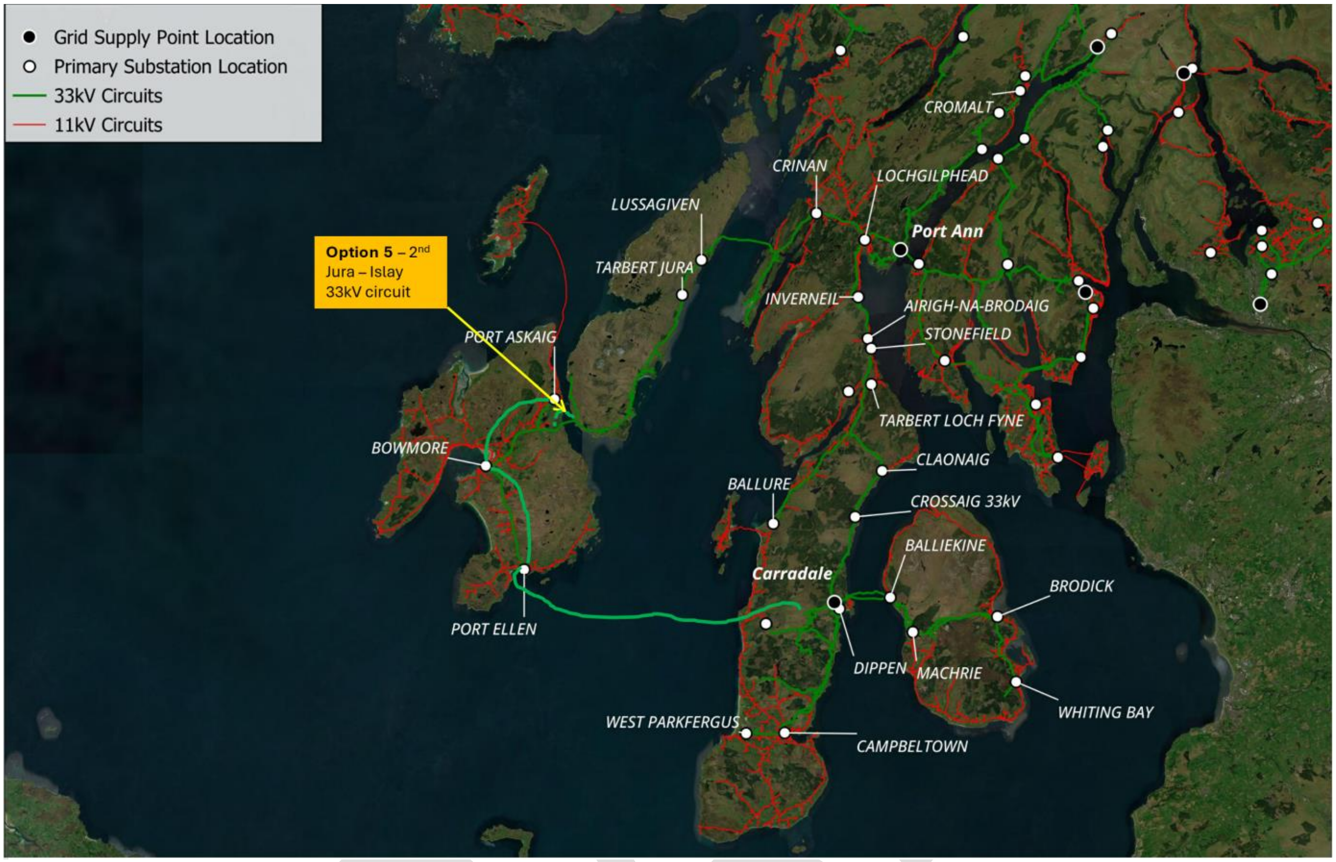


Figure 34 GIS view of network with works in progress and additional reinforcement options by 2040 (Option 5)

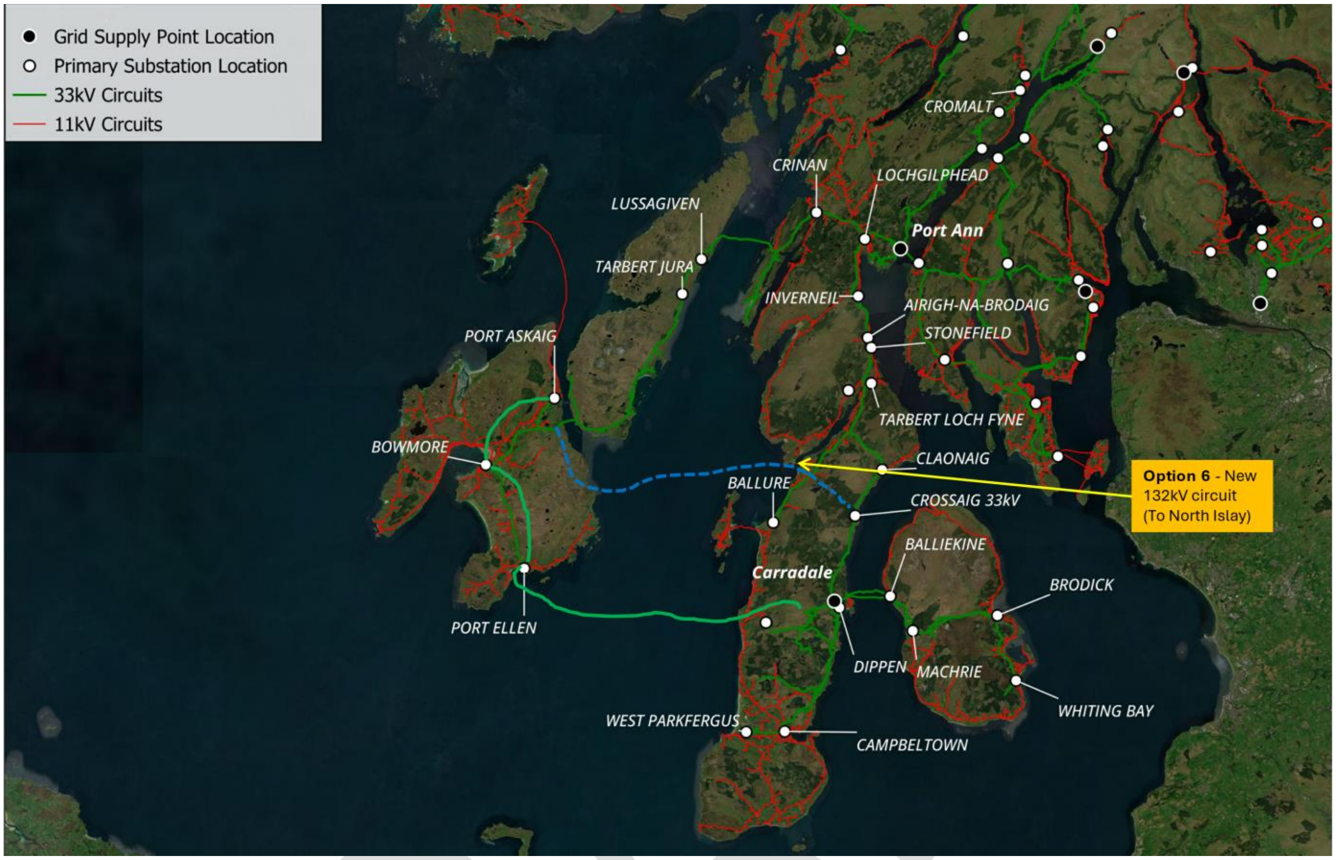


Figure 35 GIS view of network with works in progress and additional reinforcement options by 2040 (Option 6)

Figure 36 GIS view of network with works in progress and additional reinforcement options by 2040 (Option 7)

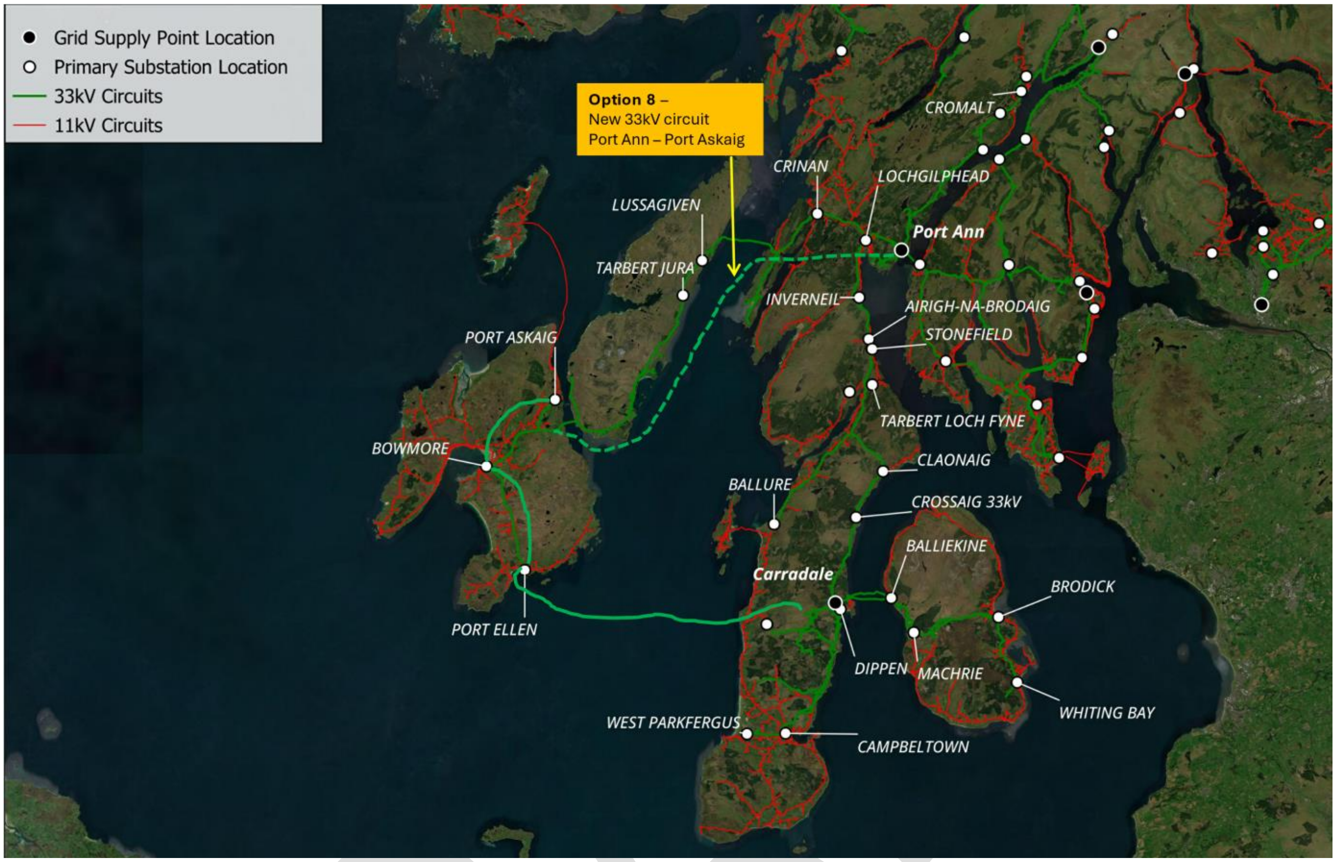


Figure 37 GIS view of network with works in progress and additional reinforcement options by 2040 (Option 8)

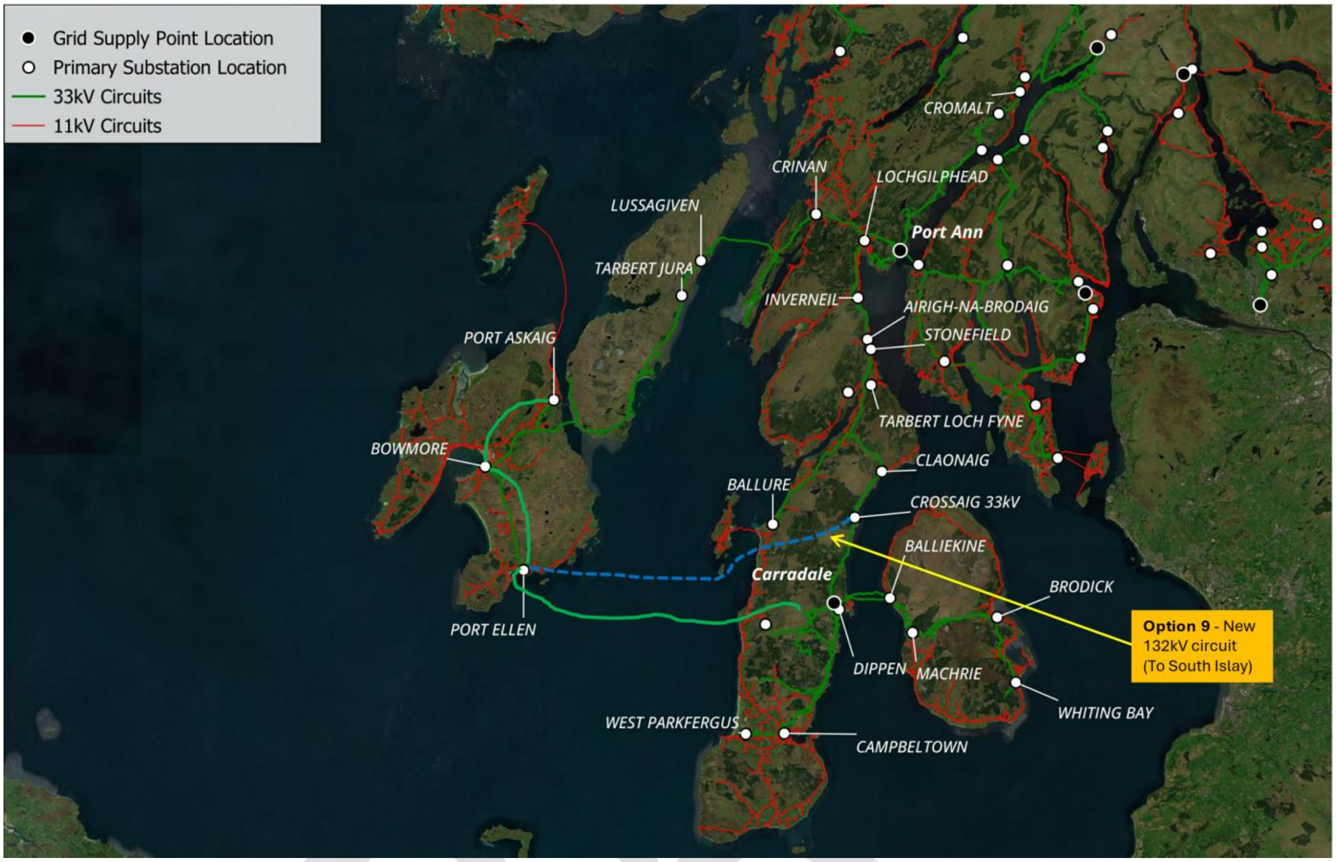


Figure 38 GIS view of network with works in progress and additional reinforcement options by 2040 (Option 9)

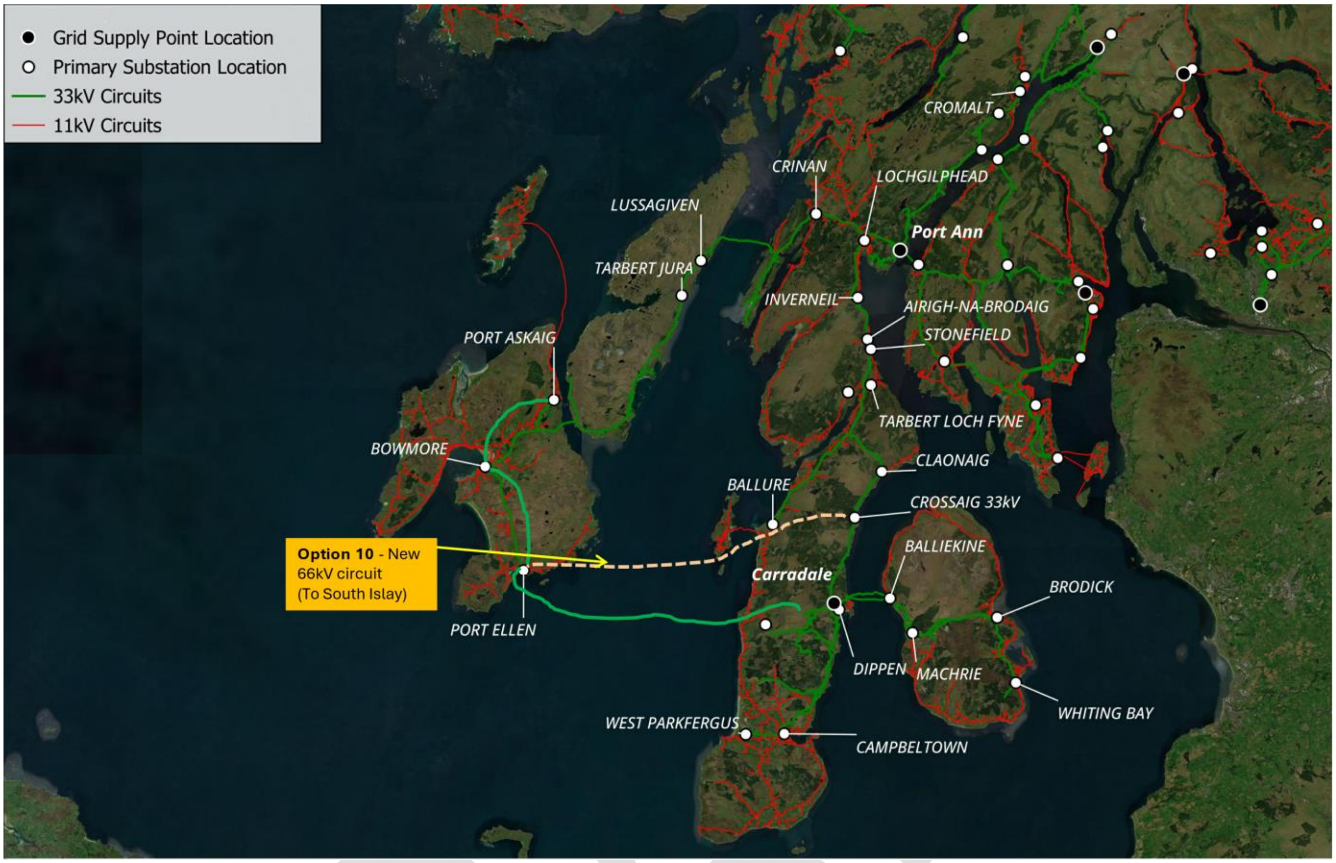


Figure 39 GIS view of network with works in progress and additional reinforcement options by 2040 (Option 10)

1.23.4. EHV options 2041-2050 within HOWSUM scope

The network issues triggered between 2041 and 2050 are covered in this section. Table 11 below shows the list of schemes and the triggered year to resolve the network constraints.

Option	CT Year of need	LW Year of need	ST Year of need	FS Year of need	Description	System Needs being resolved	Schematic Reference
Upgrade existing Lochgilphead – Jura 33kV subsea cable	2045	2045	2045	2045	Upgrade the existing Lochgilphead – Jura 33kV subsea cable to 30MVA	Improves N-1 resilience and reduces network losses by utilising a larger conductor	11

Table 11 Options to resolve system needs between 2041-2050

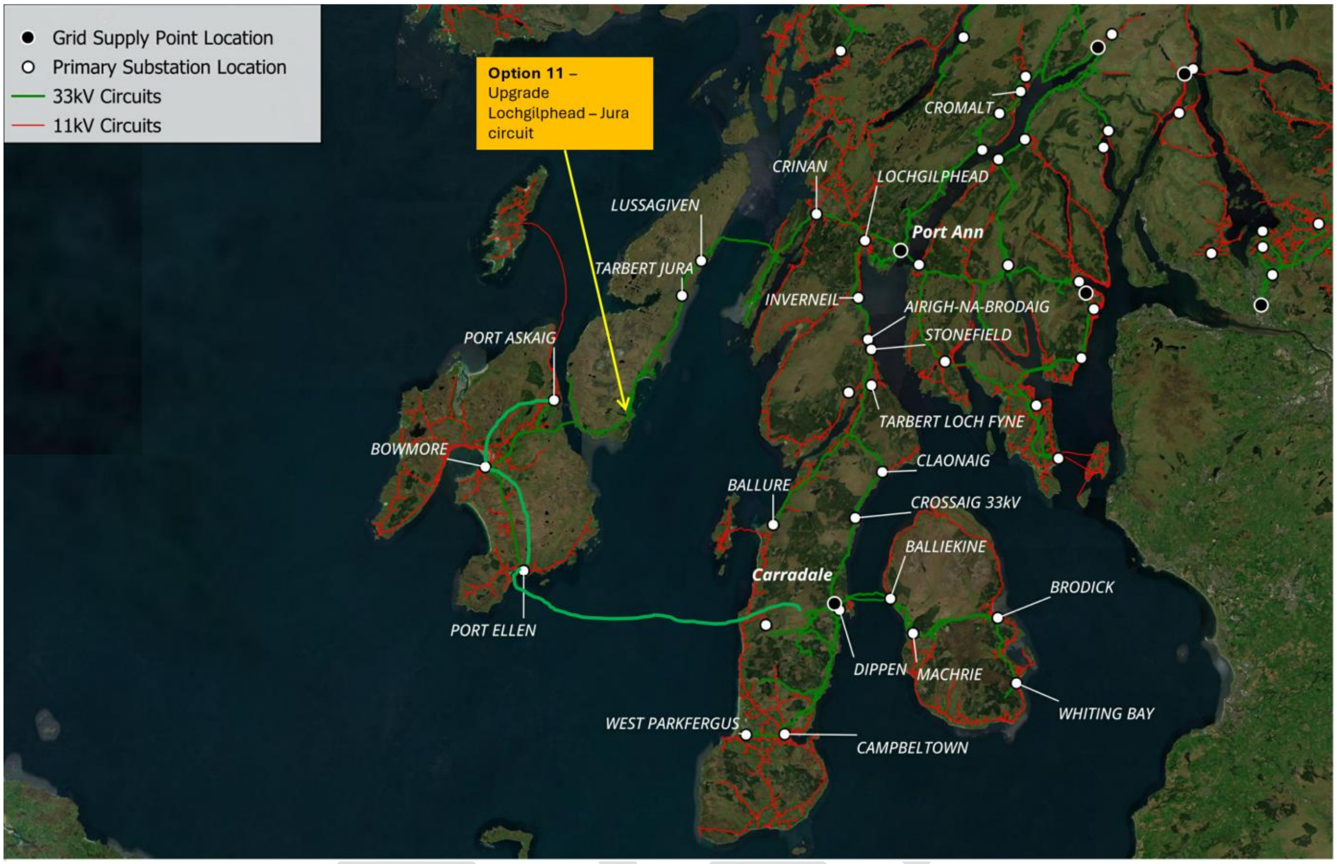


Figure 40 GIS view of network with works in progress and additional reinforcement options between 2041-2050 (Option 11)

1.24. Specific Options Required Outside HOWSUM scope

This section focuses on the specific needs of Port Ann and Carradale GSPs which are outside the geographic scope of the HOWSUM process but will improve network resilience and system security of supply up to 2050. The list in Table 12 refers to high level options that can be implemented in the future to resolve future network constraints and ensure the network remains compliant as distribution grid transitions to net zero.

Option	Description	Driver	System Needs being resolved Benefits
33 and 11kV reinforcement at Campbeltown	Upgrade the Campbeltown primary transformers from 2x7.5/15MVA to 2x20/40MVA and upgrade the 33kV circuits to higher ratings to allow connection of larger demand connecting around Campbeltown	Demand	Improves N-1 resilience for Campbeltown primary substation. Relevant from 2027(CT)

33/11kV reinforcement at Brodick primary substation	Replace the existing 2x4/8MVA transformers with 2x7.5/15MVA units	Demand	Improves N-1 security and voltage compliance issues for Brodick primary substation. Required in 2040(CT) and 2037(LW) 2046(ST) and 2049(FS)
33/11kV reinforcement at Dippen primary substation	Install 2nd 1MVA transformer and interconnect 11kV network	Demand	Improves system intact & N-1 security at Dippen primary substation. Relevant from 2030(CT, LW) 2035(ST), 2039(FS)
33/11kV reinforcement at Crinan primary substation	Replace the existing 1x1MVA transformer with 1x2.5MVA unit	Demand	Improves system intact security at Crinan primary substation. Relevant from 2028(CT, LW), 2031(ST) and 2037(FS).
Install 3rd subsea cable circuit between Carradale and Arran	Install 3rd subsea cable circuit between Carradale and Arran. This will require turning-in all three 33kV circuits into a new substation close to Balliekine	Demand	Improves N-1 and N-2 resilience to Isle of Arran as part of our enhanced resilience policy

Table 12 Options for specific system needs 2024-2050 outside of the HOWSUM scope

1.25. Future requirements of the High Voltage and Low Voltage Networks

Our HV/LV spatial plans indicate that there is no clear pattern to future demands on these lower voltage networks. We are therefore planning on a forecast volume basis and this section provides further context on this work for both the Port Ann and Carradale GSPs high voltage and low voltage network needs to 2050.

1.25.1. High Voltage Networks

As well as the EHV system needs identified in the previous section, increased penetration of low carbon technologies (LCTs) connecting to the distribution network will result in system needs on the High Voltage (HV) and Low Voltage (LV) networks. To provide a view on the impact of these technologies on the distribution network here we have used the load model that is produced by SSEN's Data and Analytics team.[16]

The load model is a machine learning product which estimates a half-hourly annual demand profile for each household based on a series of demographic, geographic and heating type factors. This enables us to estimate capacity on the electricity network while protecting individual customers data privacy by using modelled data. These views are then aggregated up the network hierarchy based on the combinations of customers associated with each asset. This view is supplemented with the DFES to highlight the projected impact of LCTs on the network.

For the twenty primary substations supplied by Port Ann and Carradale GSPs, the percentage of secondary substations where projected peak loading exceeds the nameplate rating of the secondary transformer was taken

16 SSEN Open Data Portal, 2023, SSEN Secondary Transformer – Asset Capacity and Low Carbon Technology Growth.

from the load model data. **Error! Reference source not found.** demonstrates how this percentage changes under each DFES scenario from now to 2050.

To satisfy these requirements a variety of solutions will need to be investigated. It is likely that a combination of flexibility and asset replacement will be employed to resolve the projected HV system needs. It is important to note that for HV needs, flexibility is likely to be provided through Distributed Energy Resources (DER), Consumer Energy Resources (CER), and domestic/commercial Demand Side Response (DSR). One of the challenges associated with procuring flexibility to High Voltage and Low Voltage system needs is that only a small number of customers can provide a flexible service due to the requirement to be supplied by a specific secondary transformer. As the role of aggregators develops, we may see a shift in the potential for flexibility in an area. Where the magnitude of an overload is too large for flexibility to be feasible, addition of new assets or asset replacement will be necessary.

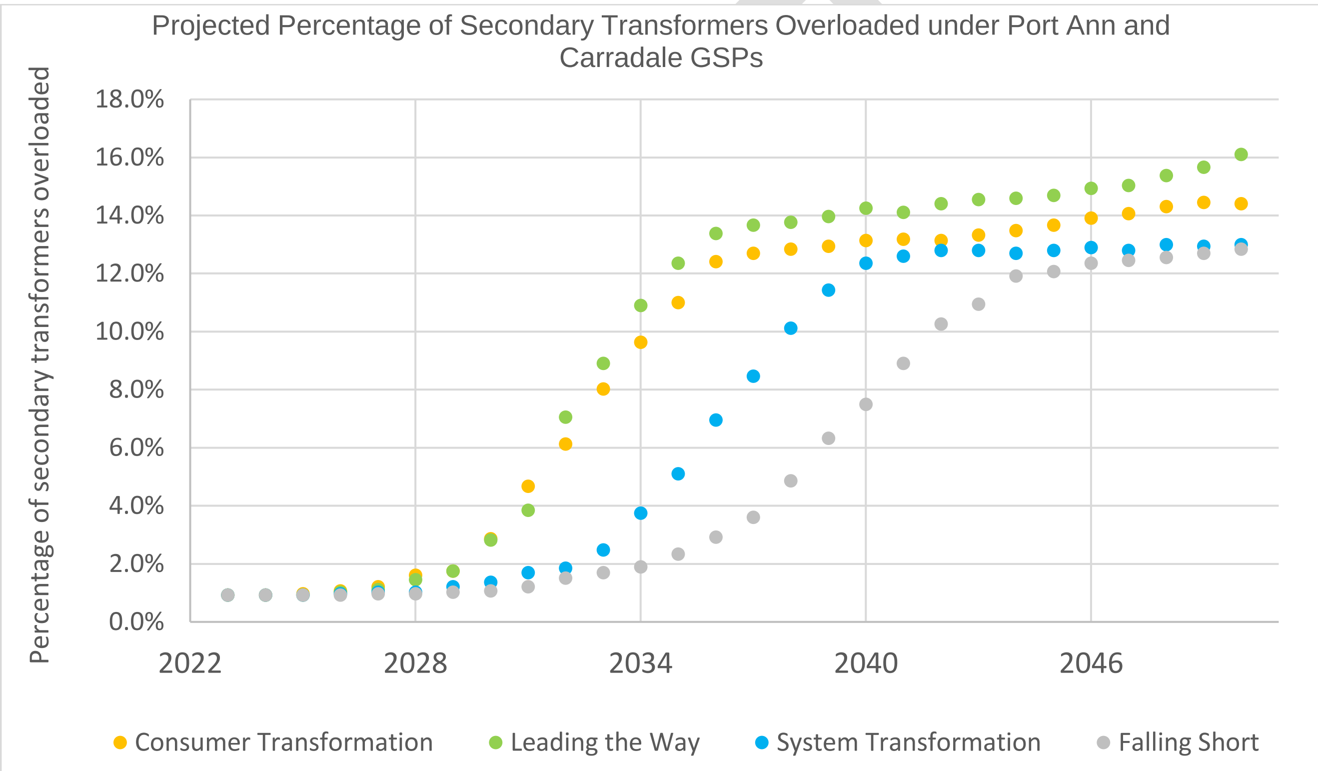


Figure 41 Port Ann and Carradale GSPs Projected Secondary Transformer Loading. *Source: SSEN Load Model*

1.25.2. Low Voltage Networks

Drivers for interventions in low voltage networks may be either capacity related or be driven by voltage requirements. We are progressing options to resolve both of these drivers. From a network perspective the solution typically involves upgrading the number of LV feeders to split/ balance the load and improve voltage or to install another substation at the remote end of the LV network to balance load and improve voltage. In both instances, flexibility at a local level, especially voltage management products linked to battery export and embedded generation such as solar is likely to be required alongside traditional reinforcement.

We are leveraging recent innovation work through Project LEO (Local Energy Oxfordshire) and My Electric Avenue to inform this strategy. Enhanced network visibility through Smart meter data analytics and low-cost substation feeder monitoring is also necessary to enable appropriate dispatch of services and network reconfiguration.

Capacity driven needs – Thermal constraints tend to materialise in the sections of cable leading to the substation (transformer) where multiple customer loads join together. We are modelling requirements out to 2050 leveraging low voltage monitoring and metering equipment combined with analytical techniques. This will demonstrate how the magnitude of the system need of the LV network changes for remote rural communities including those on Scottish Islands across scenarios and years out to 2050.

Voltage driven needs – Generally, connection of Low Carbon Technology and large loads such as heat pumps is limited by voltage constraints before thermal constraints when located more than around 150m from the local secondary transformer. Increased loading on our low voltage networks can reduce the voltages to consumer premises. This is a non-linear relationship and as such requires more complex analysis. We are currently undertaking analysis to better understand the extent of this future need.

Initial analysis indicates that 3.2% of low voltage feeders may need intervention by 2035 and around 4% by 2050 under the CT scenario as shown in Figure 41. This is based on data from remote rural areas across the North of Scotland. The need is unlikely to be triggered until 2028 onwards. The need is unlikely to be triggered until 2028 onwards. However, due to the timeline to grow workforce, with jointing skills taking typically 4 years to be fully competent, it is necessary to start recruitment and initiate programmes ahead of need to be able to deliver the required volumes from 2028 onwards.

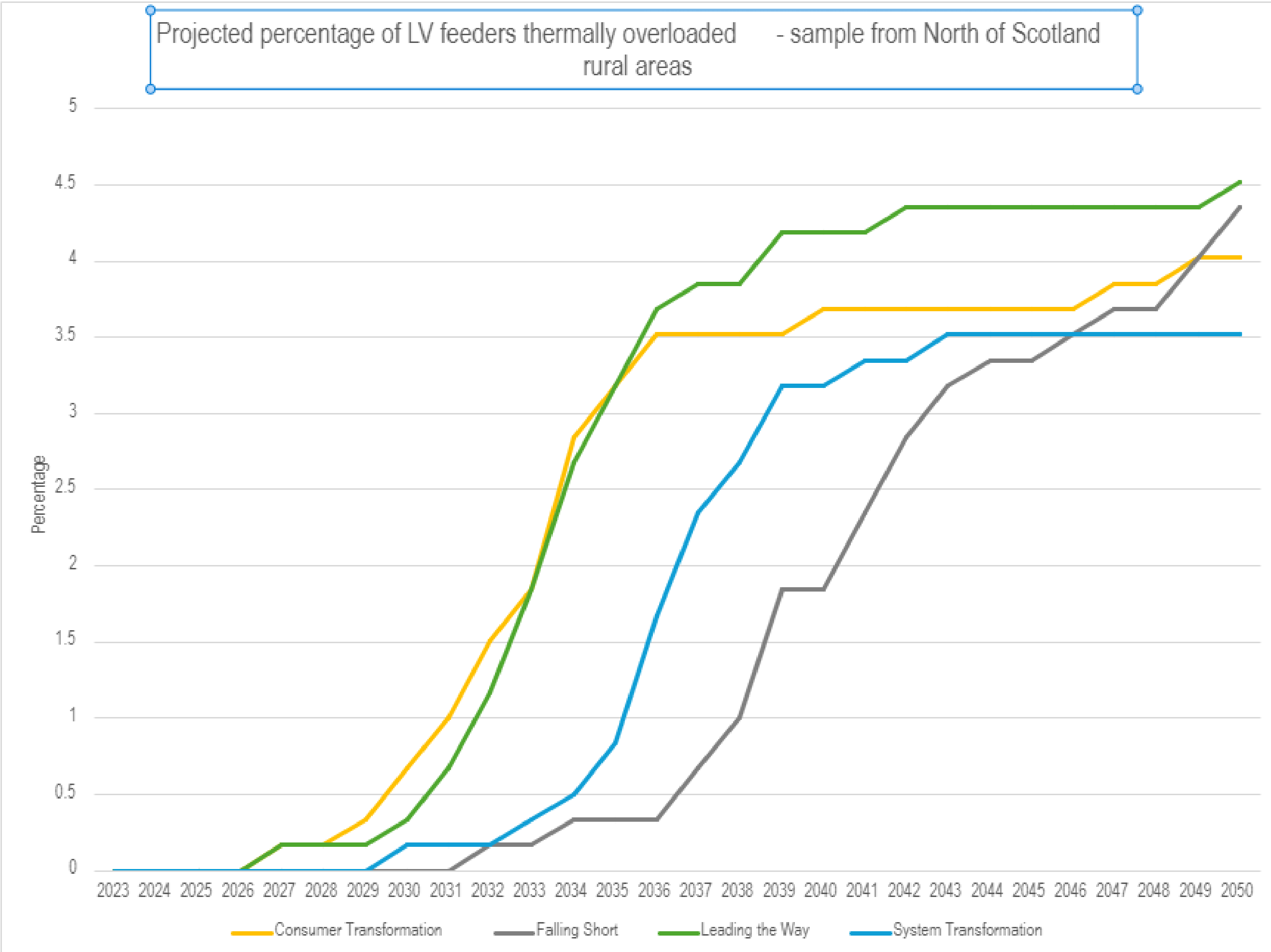


Figure 42 Percentage of LV feeders projected to be overloaded in Northern Scotland remote rural areas

9. RECOMMENDATIONS

The review of stakeholder engagement and the SSEN 2023 DFES analysis provides a robust evidence base for load growth across Port Ann and Carradale GSP groups in both the near and longer term. Drivers for load growth across Port Ann and Carradale GSPs arise from multiple sectors and technologies. These drivers impact not only our EHV network but will drive system needs across all voltage level. They are driven by both demand and generation needs and detailed optioneering will need to consider both scenarios.

Across Port Ann GSP and Carradale groups, a variety of works have already been triggered through the DNOA process and published in the DNOA Outcomes Report. These are driven by customer connections and system needs that will arise this decade but are being developed to meet 2050 needs.

The findings from this report have provided evidence for 5 key recommendations:

- Proposed works to resolve the system needs projected in the short and medium term should be assessed through the DNOA methodology.[17] This will allow for a variety of solutions to be considered and the viability of flexibility solutions to be assessed. The DNOA process will then provide insight on the solution to the system need that provides the most benefit to customers;
- The 2050 EHV high level plans affecting the Inner Hebridean islands should be developed and refined further through the HOWSUM process. This can allow for a robust case for works to be undertaken in the near future to improve the infrastructure to Islay and Jura to facilitate decarbonisation. Given the whole system nature of HOWSUM this needs to include a wide range of drivers including asset condition and future resilience, particularly given the increasing reliance of the island communities on electricity for heating, transport and industry. A wide range of solutions should also be considered including the use of flexibility
- The connection of low carbon technologies across the HV and LV networks will result in significant demand growth. Where it has been identified that there are overloads projected, mitigations will need to be put in place. There is no clear pattern to low voltage load growth in Port Ann and Carradale GSPs, so we are taking a volume driver approach. This needs to be based on strategic modelling of LV networks to understand the volume of work needed;
- SSEN should continue to proactively engage with key stakeholders to scope longer term works that have been signposted in this document including plans to decarbonise operations. This could take the form of input from Local Area Energy Plans (LAEPs), or more specific engagement on the details of individual projects. This needs to include discussions on related activities such as land availability and usage.
- SSEN should continue to actively engage with specific large customers in Port Ann GSP and Carradale GSP with the aim of refining its demand forecast methodology for industries such as distillery and ports which will play a major role in both local decarbonisation and driving future network needs;

Actioning these recommendations will allow SSEN to develop a network that supports local net zero ambitions. By doing so, contributing to net zero targets at a national level.

17 https://www.ssen.co.uk/globalassets/about-us/dso/consultation-library/distribution-network-options-assessment-dnoa---making-decisions-on-the-future-use-of-flexibility.pdf

APPENDIX A – GLOSSARY

ACRONYM	DEFINITION
ANM	Active Network Management
BAU	Business as Usual
CER	Consumer Energy Resources
CMZ	Constraint Managed Zone
CT	Consumer Transformation
DEG	Diesel Embedded Generation
DER	Distributed Energy Resources
DFES	Distribution Future Energy Scenarios
DGAD	Distributed Generation Automatic Disconnection
DNO	Distribution Network Operator
DNOA	Distribution Network Options Assessment
DSR	Demand Side Response
EHV	Extra High Voltage
EJP	Engineering Justification Paper
ER P2	Engineering Recommendation P2
ESO	National Grid Energy System Operator
EV	Electric Vehicle
FES	Future Energy Scenarios
FS	Falling Short
GSPs	Grid Supply Points
HV/LV	High Voltage/Low Voltage
HOWSUM	Hebrides and Orkney Whole System Uncertainty Mechanism
HVO	Hydrotreated Vegetable Oil
LAEP	Local Area Energy Planning
LENZA	Local Energy Net Zero Accelerator
LW	Leading the Way
OHL	Overhead Line

PV	Photovoltaic
MW	Megawatt
MVA	Mega Volt Ampere
NRS	National Records of Scotland
RIIO-ED1/2	RIIO Electricity Distribution Price Control periods 1 and 2
SBTs	Science Based Targets
SDP	Strategic Development Plan
SHEPD	Scottish Hydro Electric Power Distribution
SLC	Standard Licence Condition
SSEN	Scottish and Southern Electricity Network
ST	System Transformation
SWA	Scottish Whisky Association
WSC	Worst Served Customers

APPENDIX B – GENERATION CAPACITY FORECASTS

This annex shows aggregated forecast generation capacity of distribution connected projects within Port Ann and Carradale GSPs.

Port Ann GSP

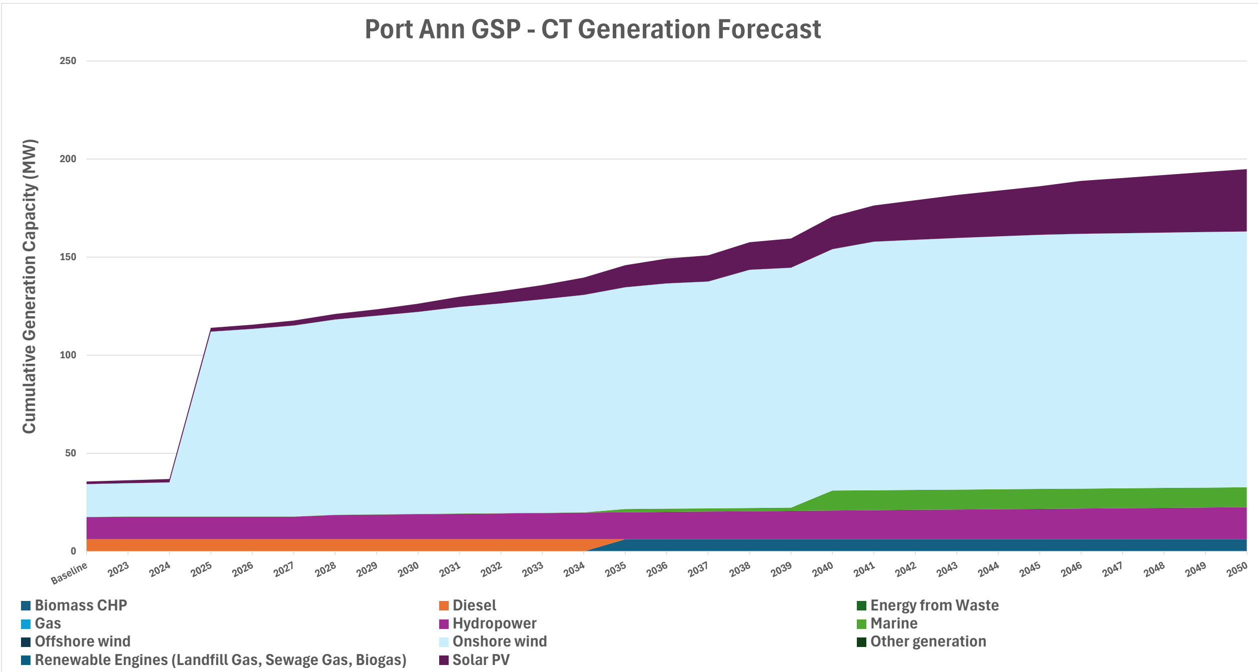


Figure 43 Generation Capacity Forecast by Technology for Port Ann GSP – CT Source: SSEN DFES 2023

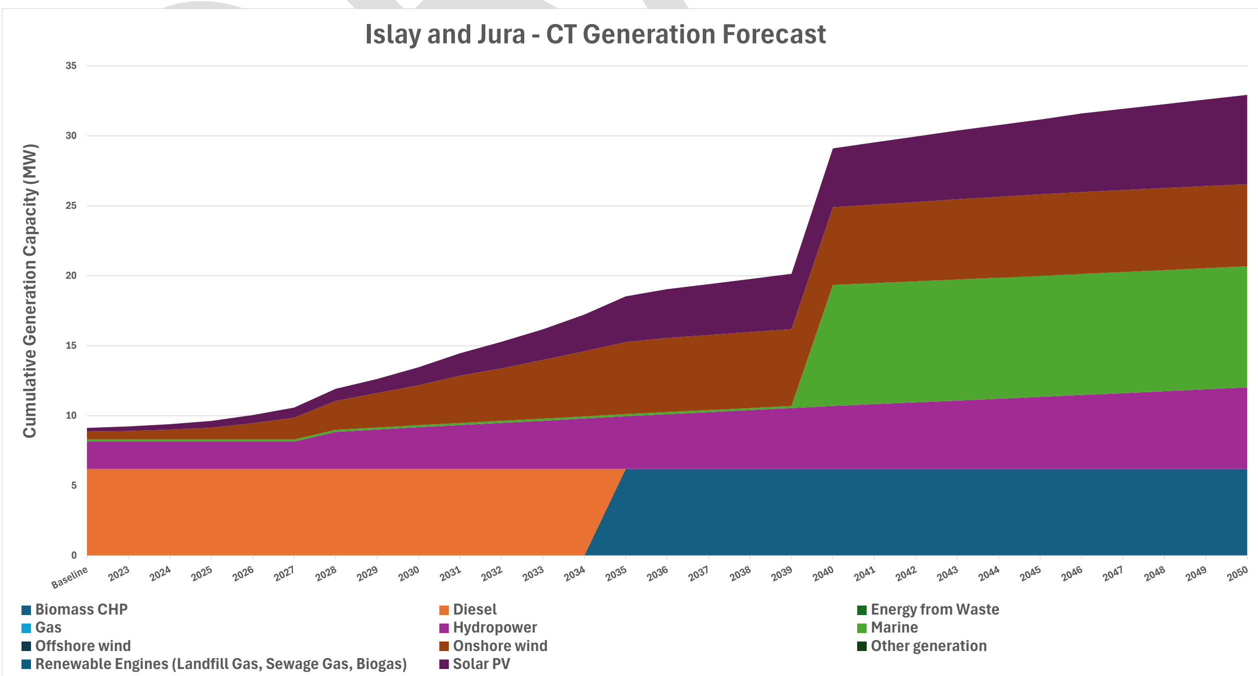


Figure 44 Generation Capacity Forecast by Technology for Islay and Jura – CT Source: SSEN DFES 2023

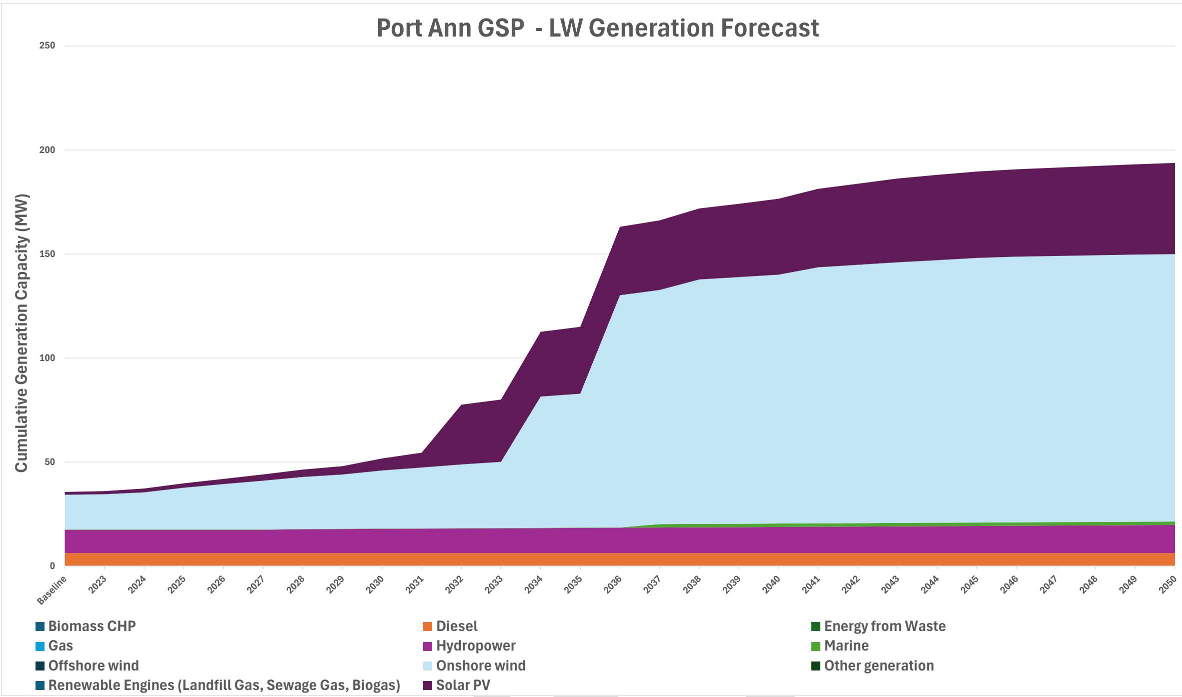


Figure 45 Generation Capacity Forecast by Technology for Port Ann GSP – LW. Source: SSEN DFES 2023

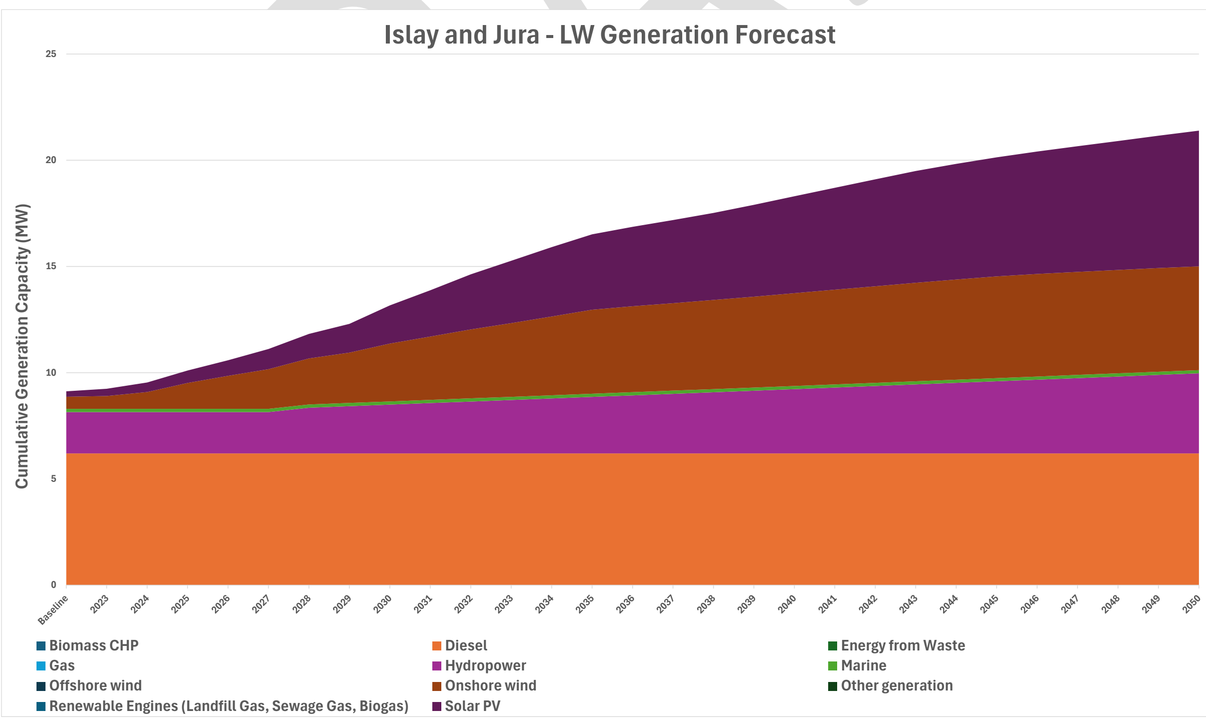


Figure 46 Generation Capacity Forecast by Technology for Islay and Jura - LW. Source: SSEN DFES 2023

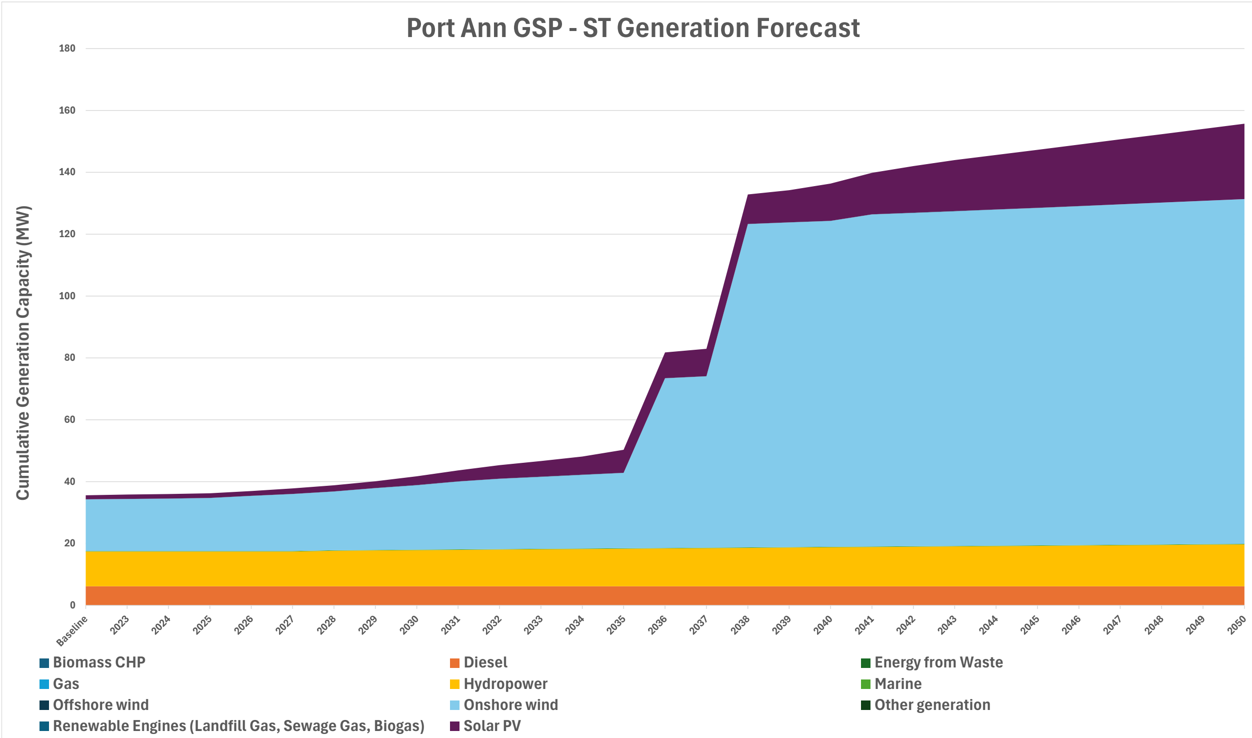


Figure 47 Generation Capacity Forecast by Technology for Port Ann GSP - ST. Source: SSEN DFES 2023

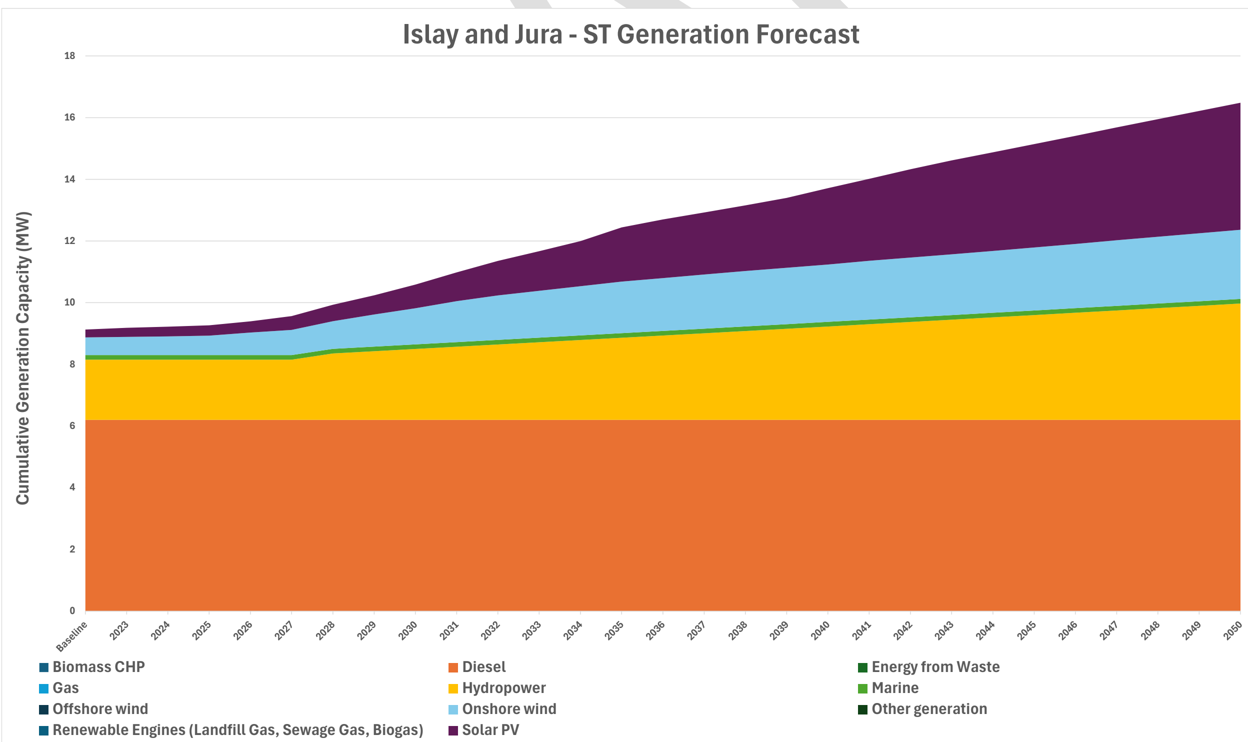


Figure 48 Generation Capacity Forecast by Technology for Islay and Jura - ST. Source: SSEN DFES 2023

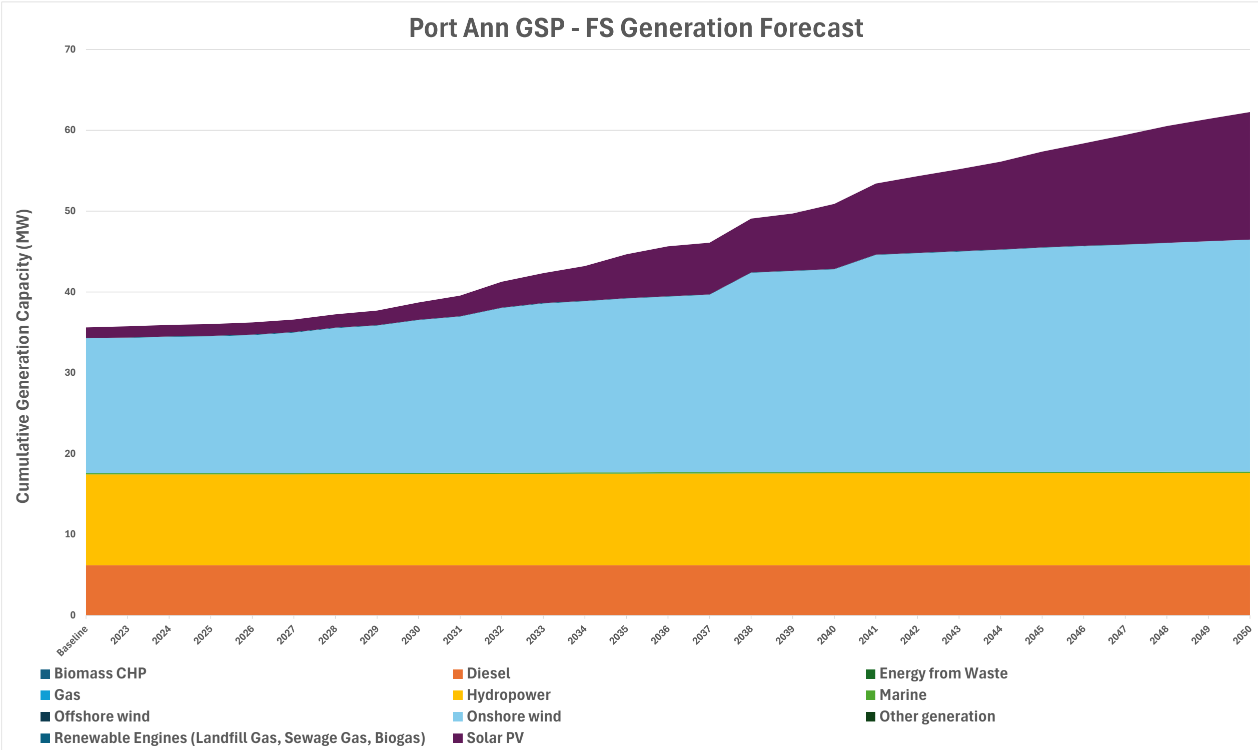


Figure 49 Generation Capacity Forecast by Technology for Port Ann GSP - FS. Source: SSEN DFES 2023

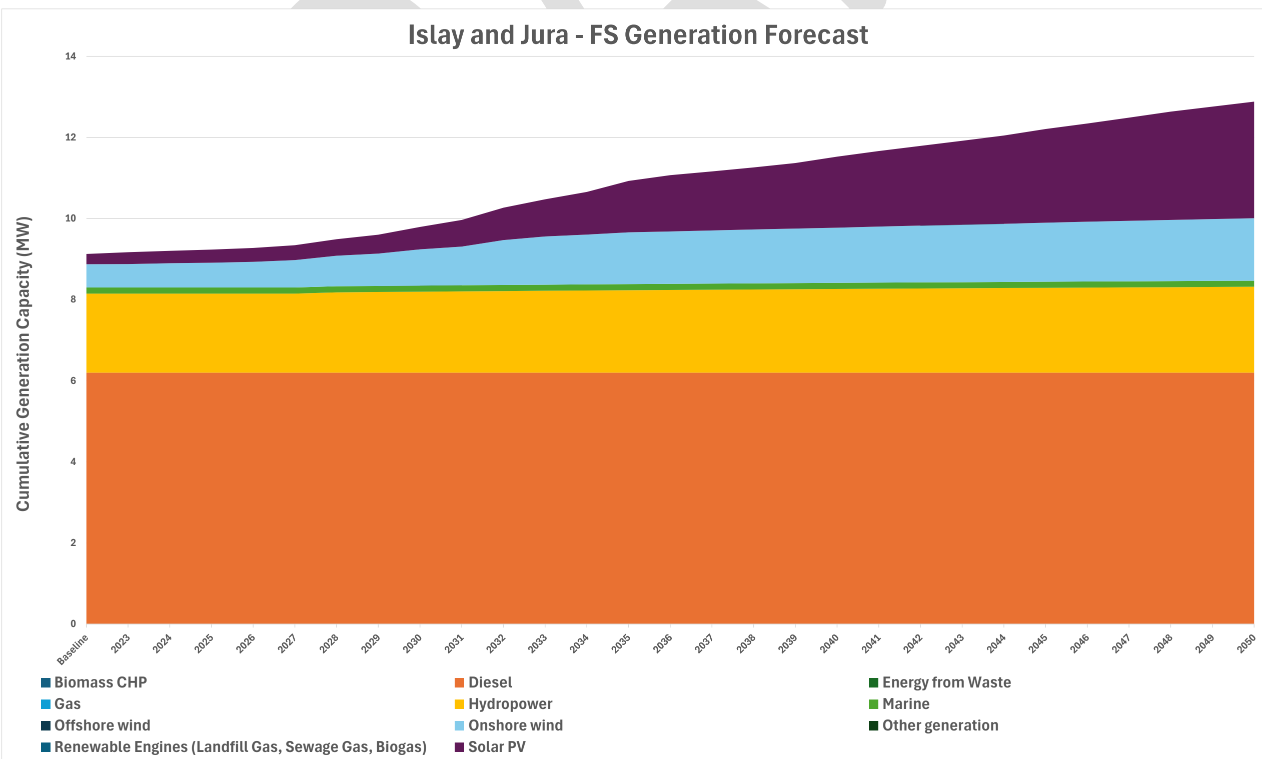


Figure 50 Generation Capacity Forecast by Technology for Islay and Jura - FS. Source: SSEN DFES 2023

Carradale GSP

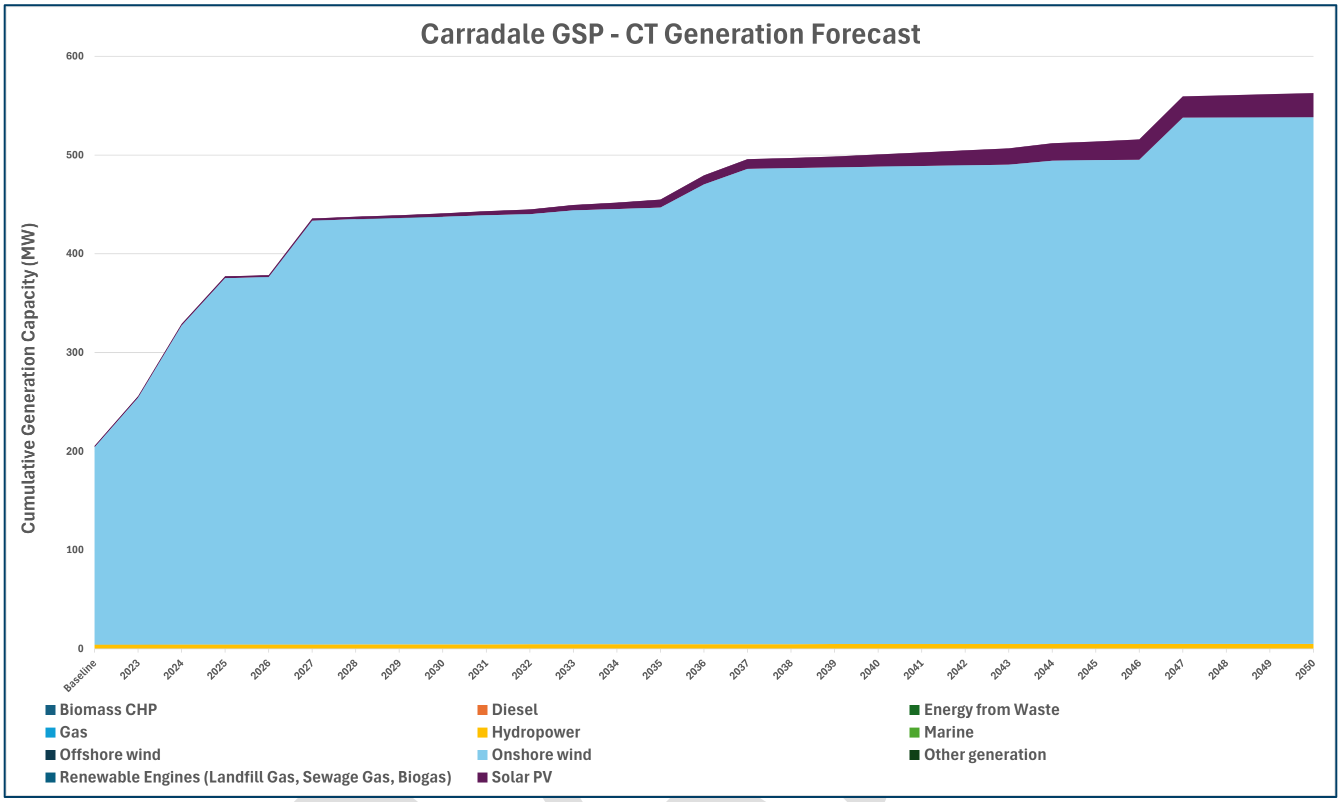


Figure 51 GenerationCapcity Forecast by Technology for Carradale GSP - CT. Source: SSEN DFES 2023

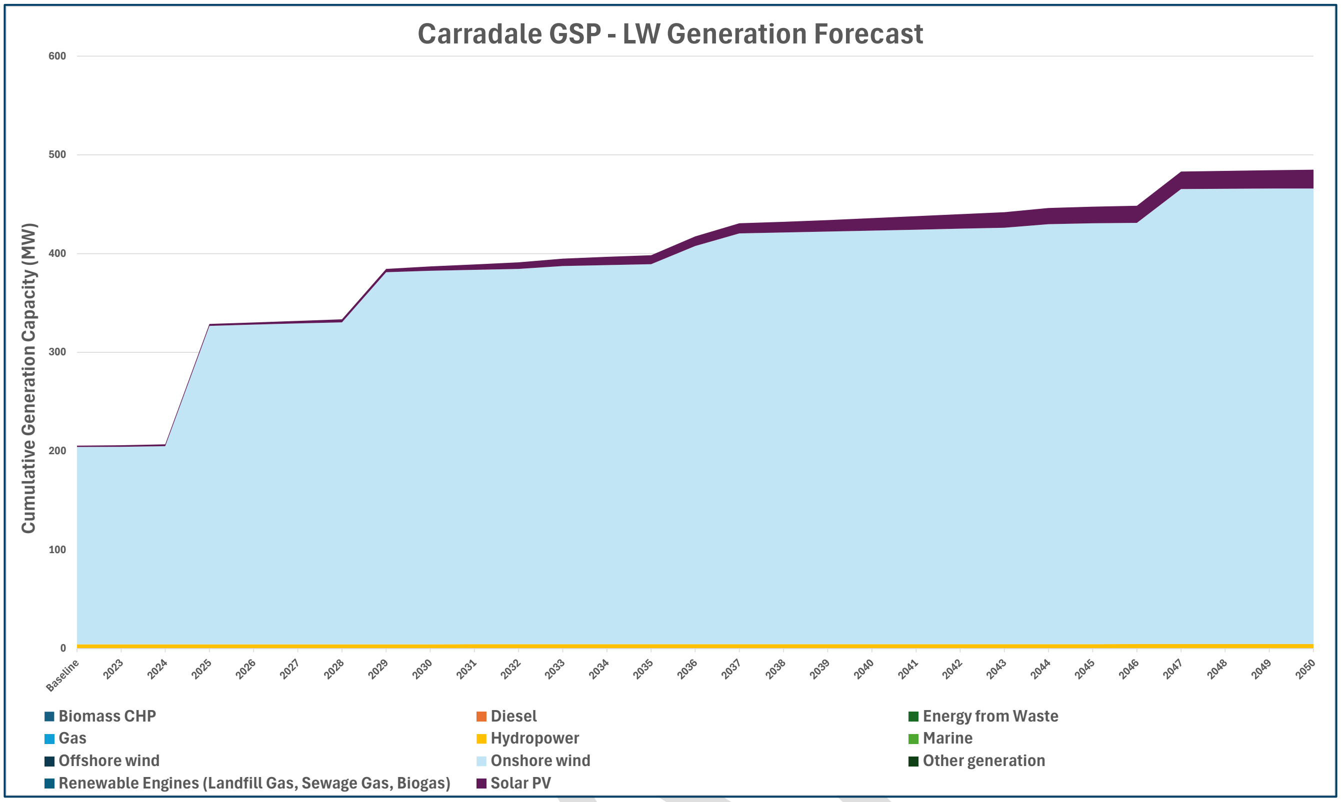


Figure 52 Generation Capacity Forecast by Technology for Carradale GSP - LW. Source: SSEN DFES 2023

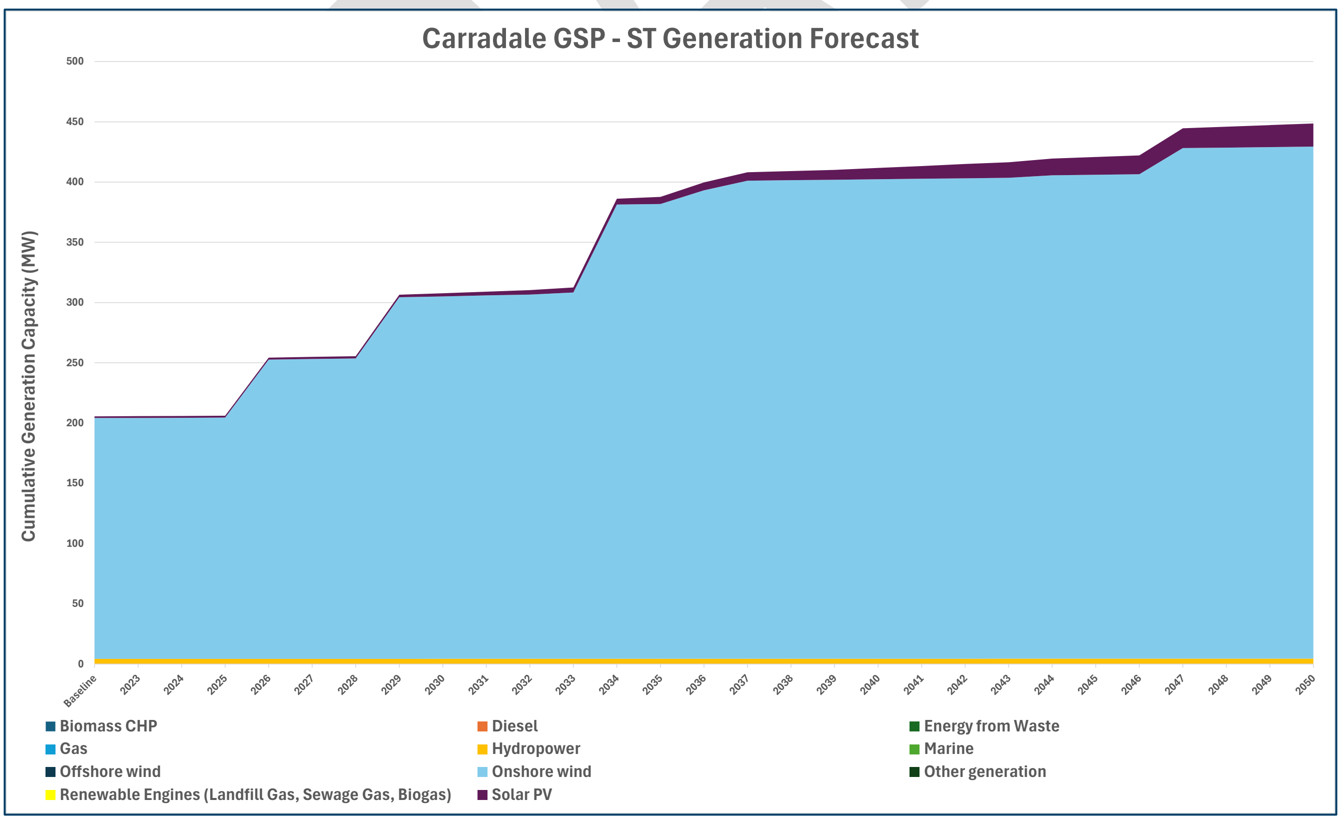


Figure 53 Generation Capacity Forecast by Technology for Carradale GSP - ST (MW). Source DFES 2023

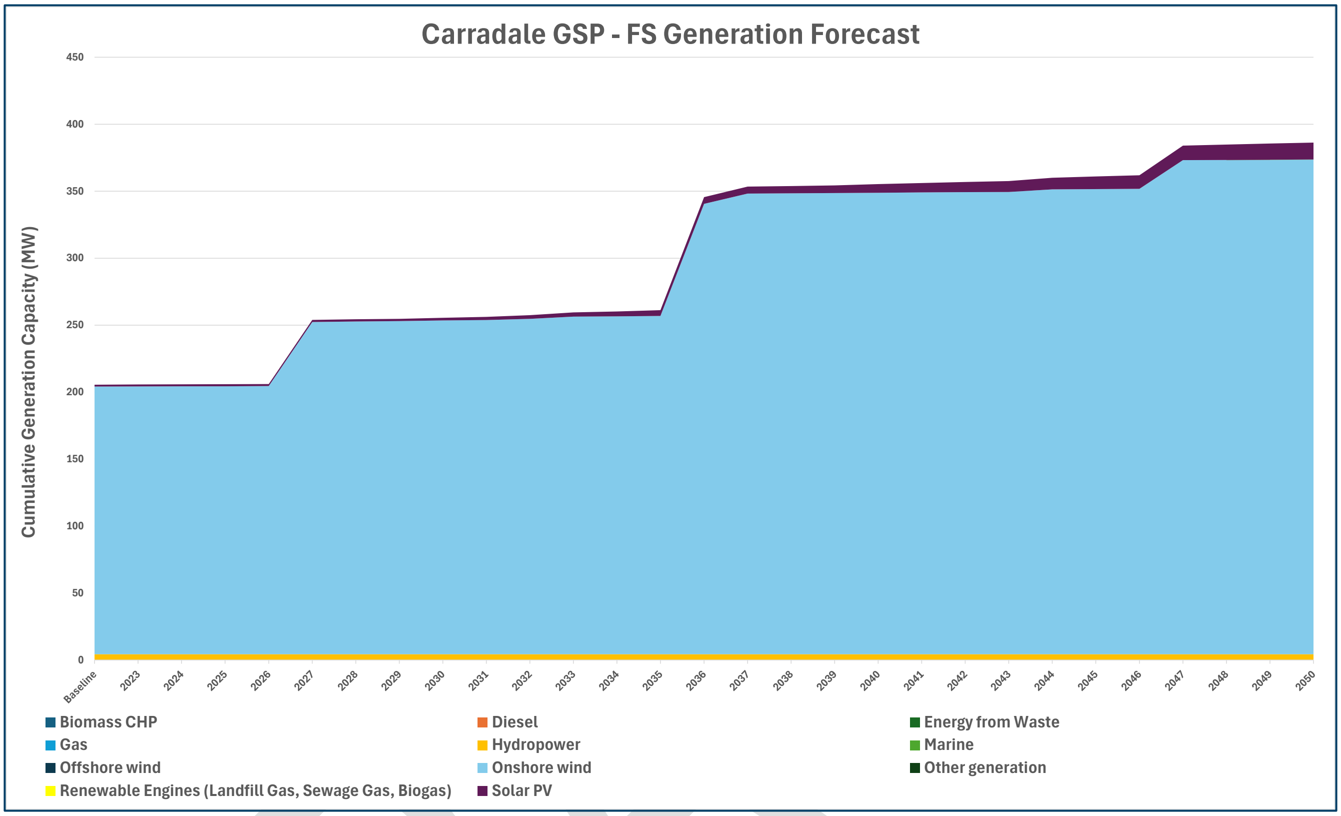


Figure 54 Generation Capacity Forecast by Technology for Carradale GSP - FS (MW). Source DFES 2023

APPENDIX C – Demand Forecasts

This annex shows the winter peak forecast demand for primary substations within Port Ann and Carradale GSPs. This data is forecast demand net of embedded generation output.

Port Ann GSP

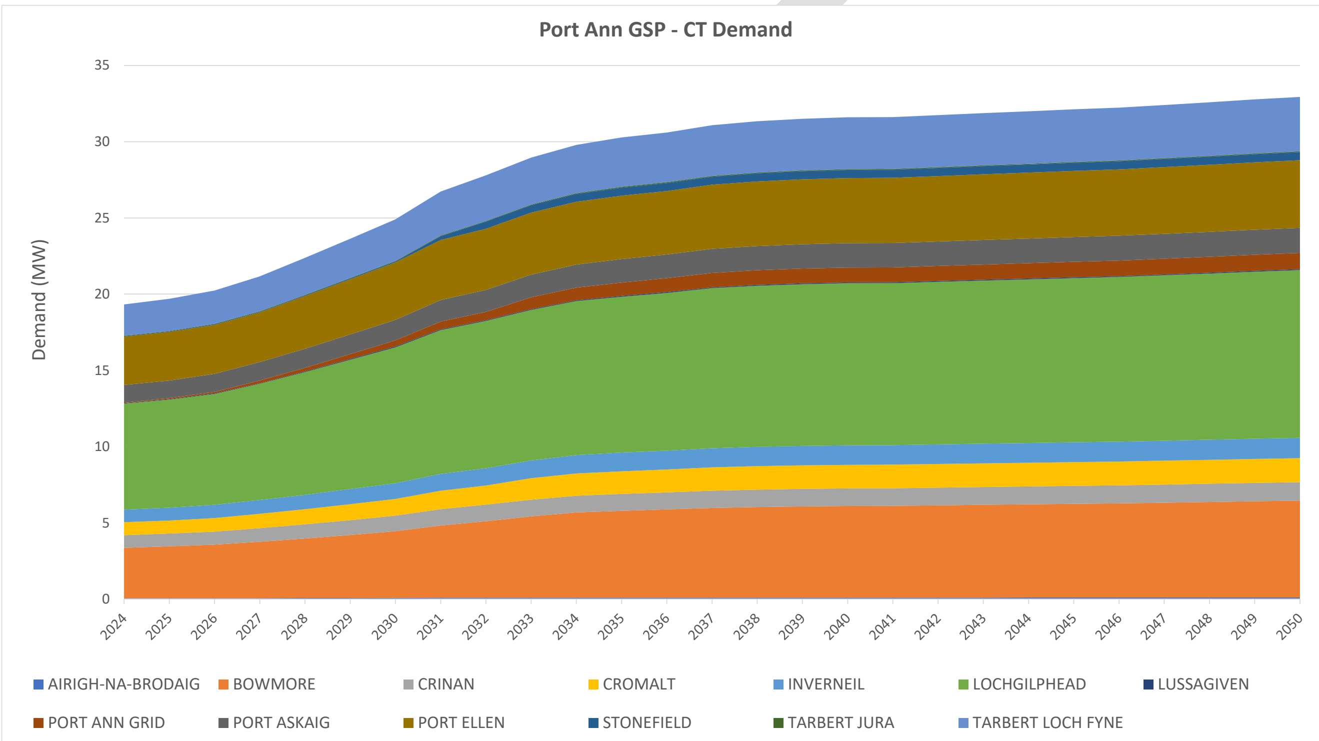


Figure 55 Demand Forecast for Port Ann GSP – Breakdown by Primaries - CT (MW). Source DFES 2023

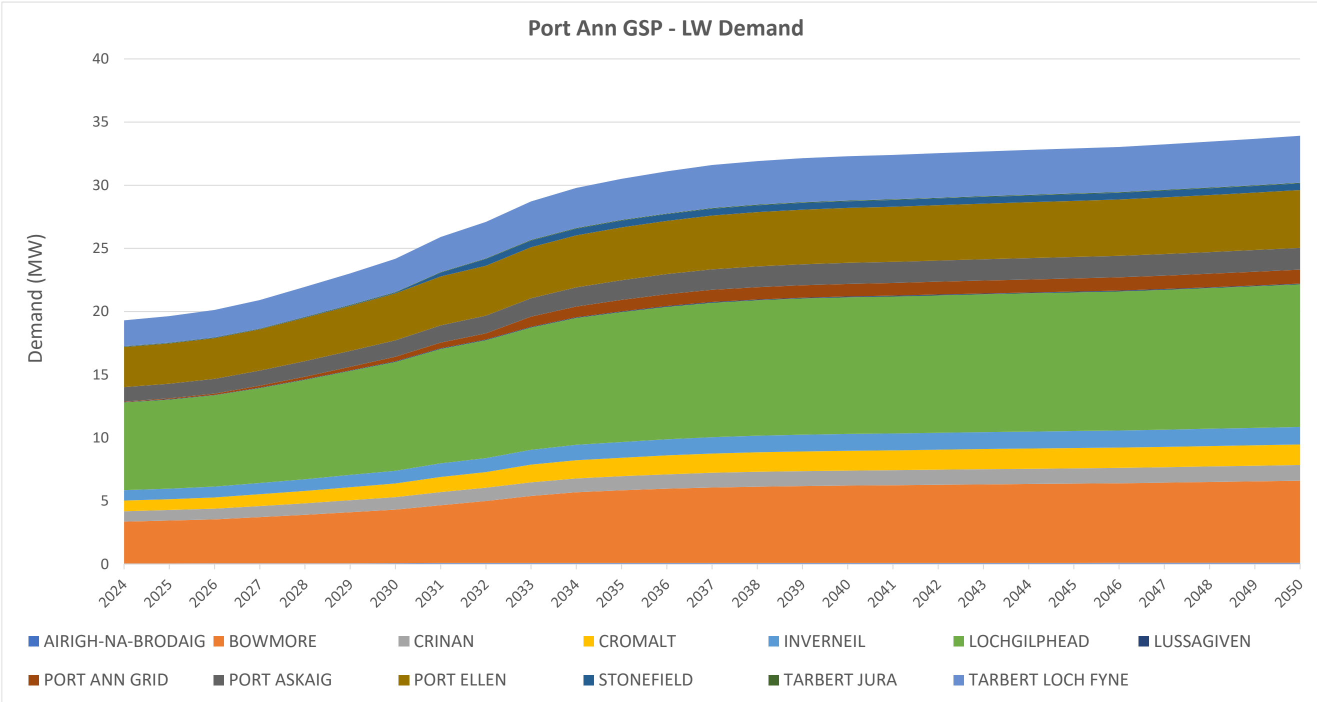


Figure 56 Demand Forecast for Port Ann GSP – Breakdown by Primaries - LW (MW). Source DFES 2023

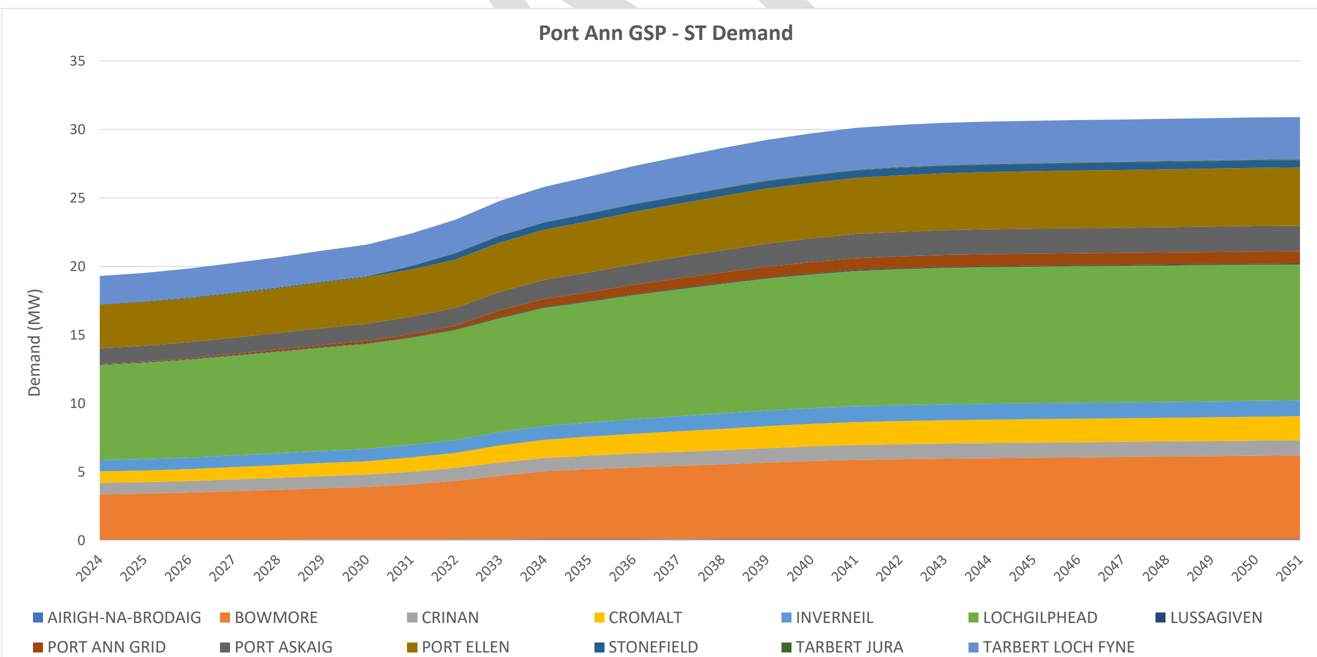


Figure 57 Demand Forecast for Port Ann GSP – Breakdown by Primaries - ST (MW). Source DFES 2023

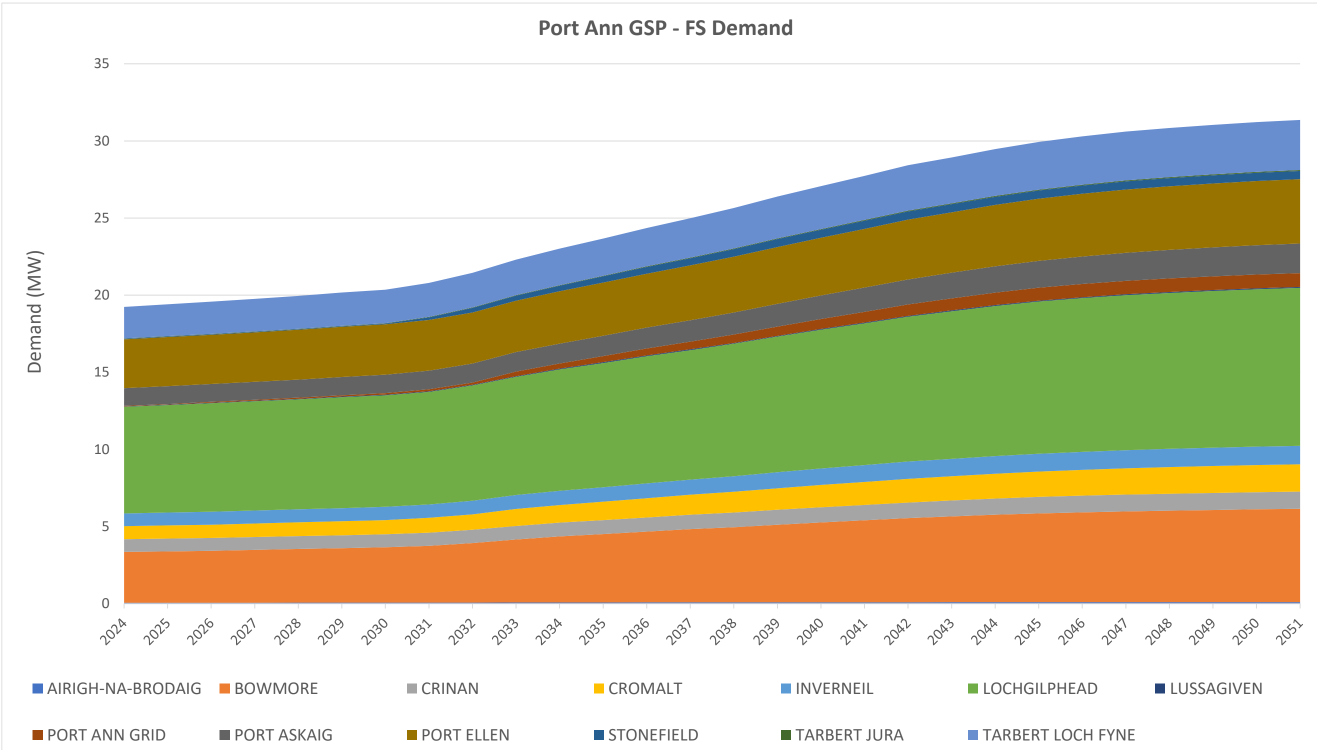


Figure 58 Demand Forecast for Port Ann GSP – Breakdown by Primaries - FS (MW). Source DFES 2023

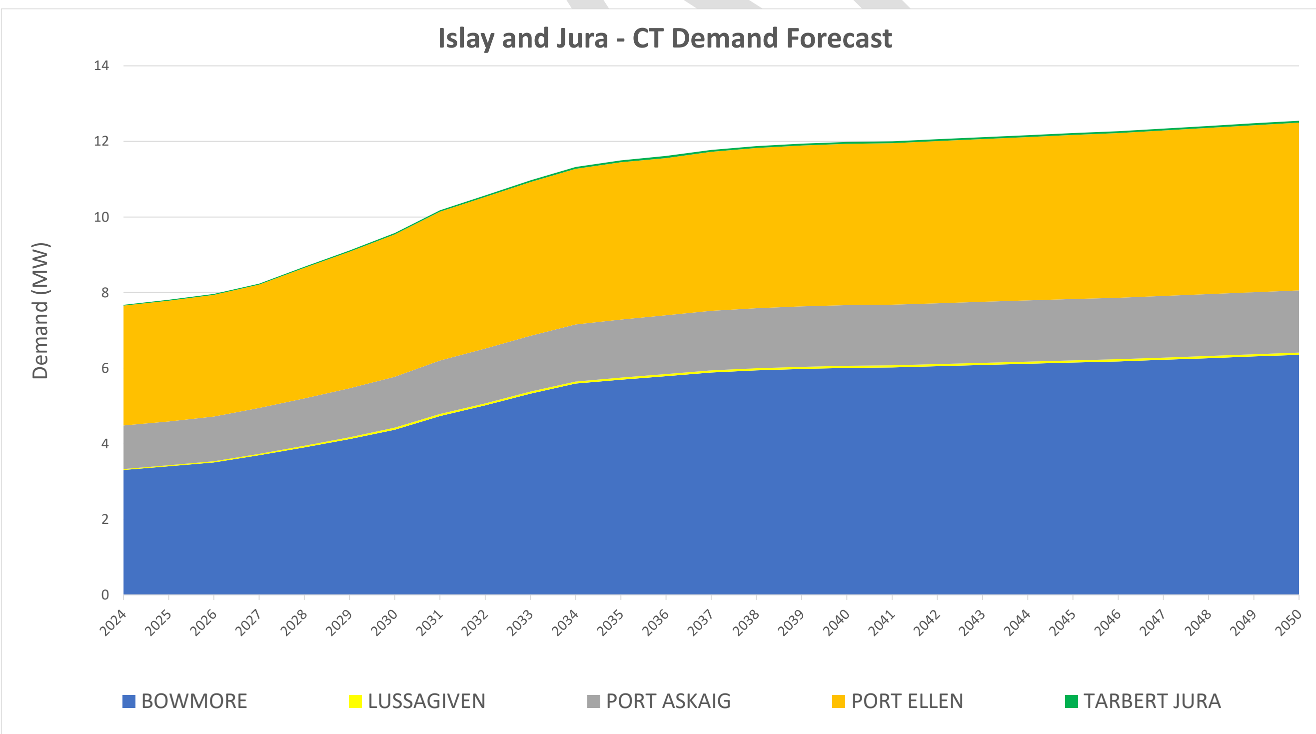


Figure 59 Demand Forecast for Islay and Jura – Breakdown by Primaries – CT (MW). Source DFES 2023

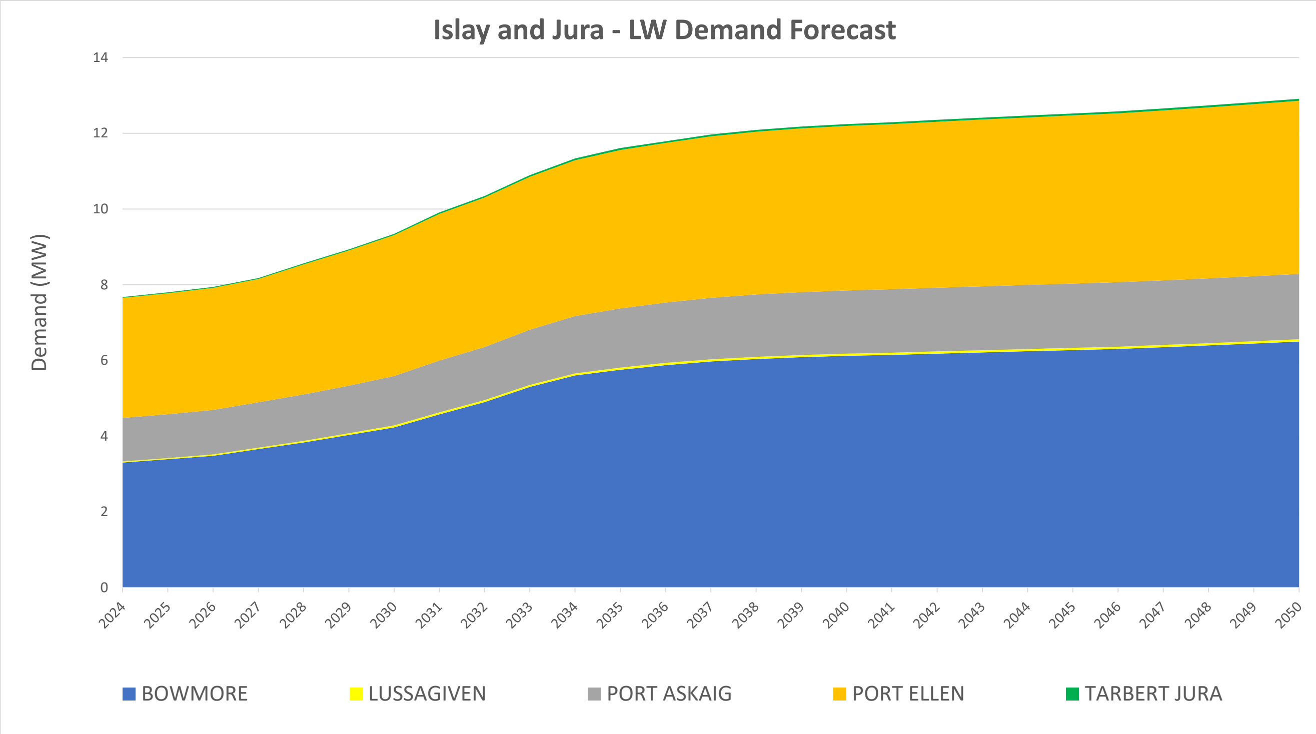


Figure 60 Demand Forecast for Islay and Jura – Breakdown by Primaries – LW (MW). Source DFES 2023

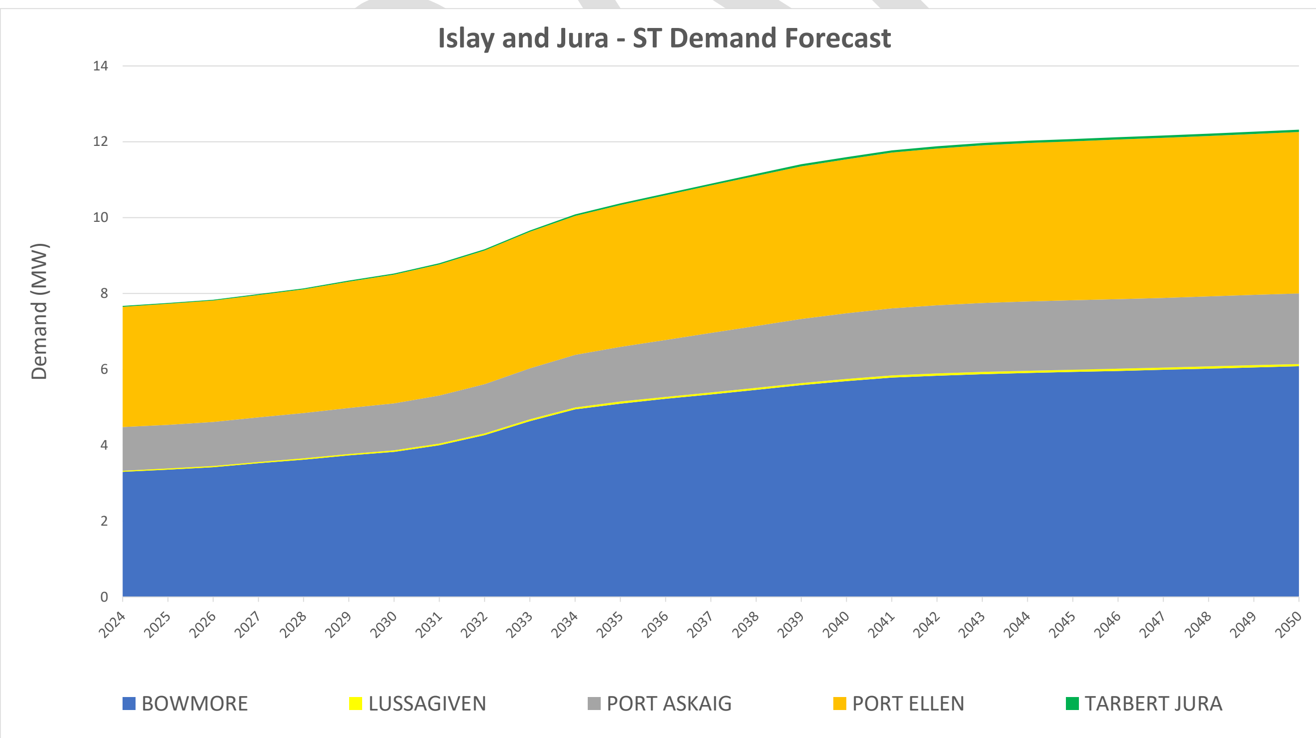


Figure 61 Demand Forecast for Islay and Jura – Breakdown by Primaries – ST (MW). Source DFES 2023

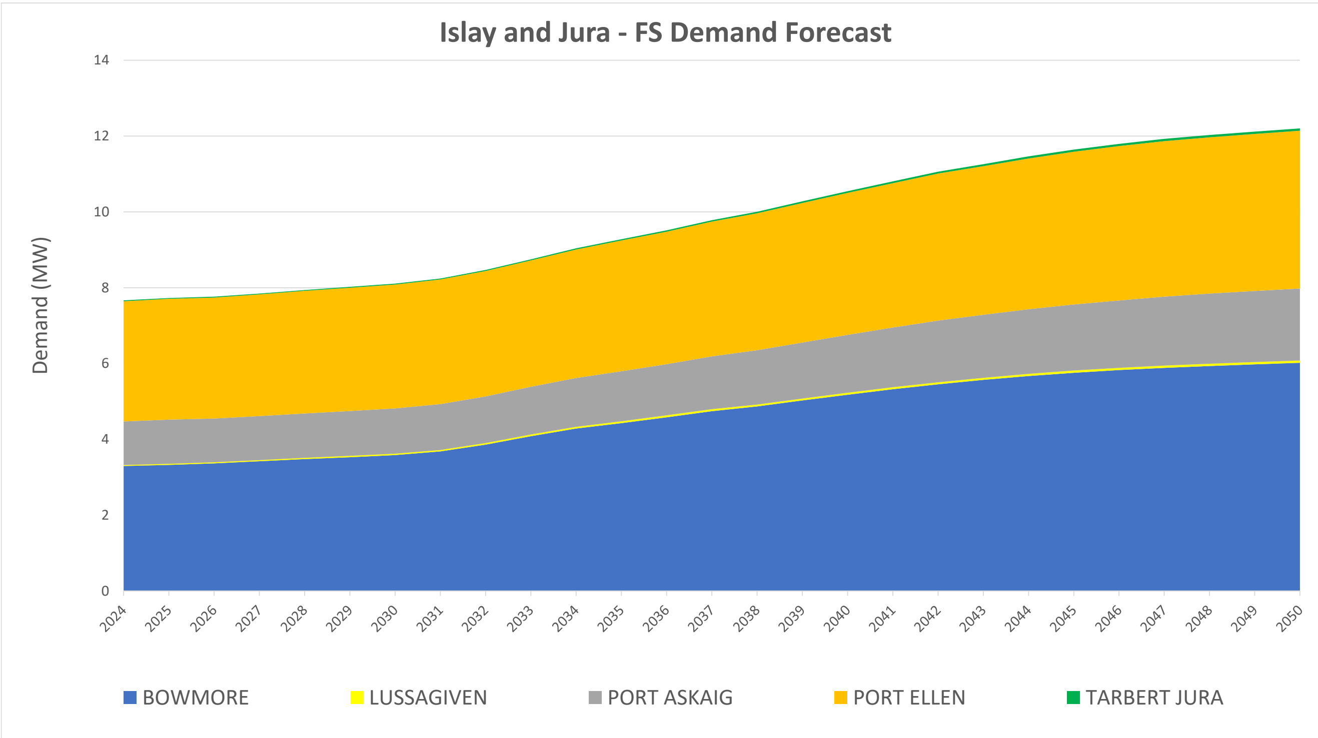


Figure 62 Demand Forecast for Islay and Jura – Breakdown by Primaries – FS(MW). Source DFES 2023

Carradale GSP

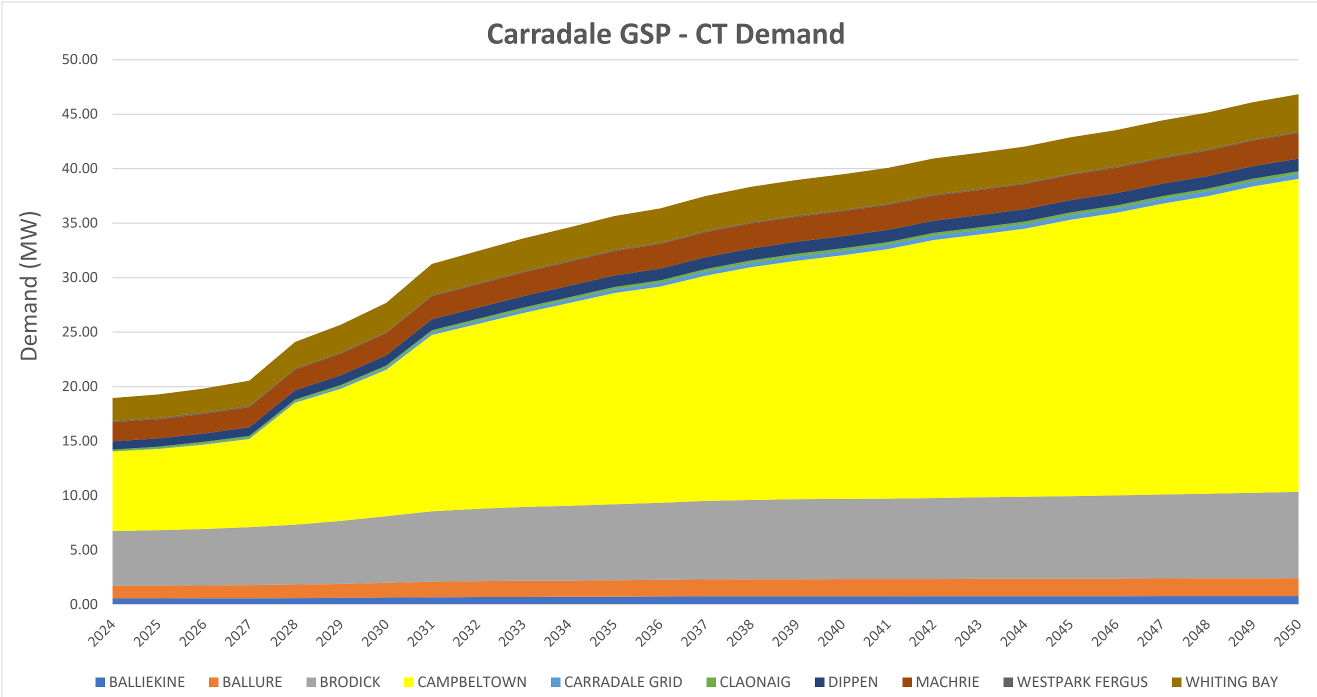


Figure 63 Demand Forecast for Carradale GSP – Breakdown by Primaries - CT (MW). Source DFES 2023

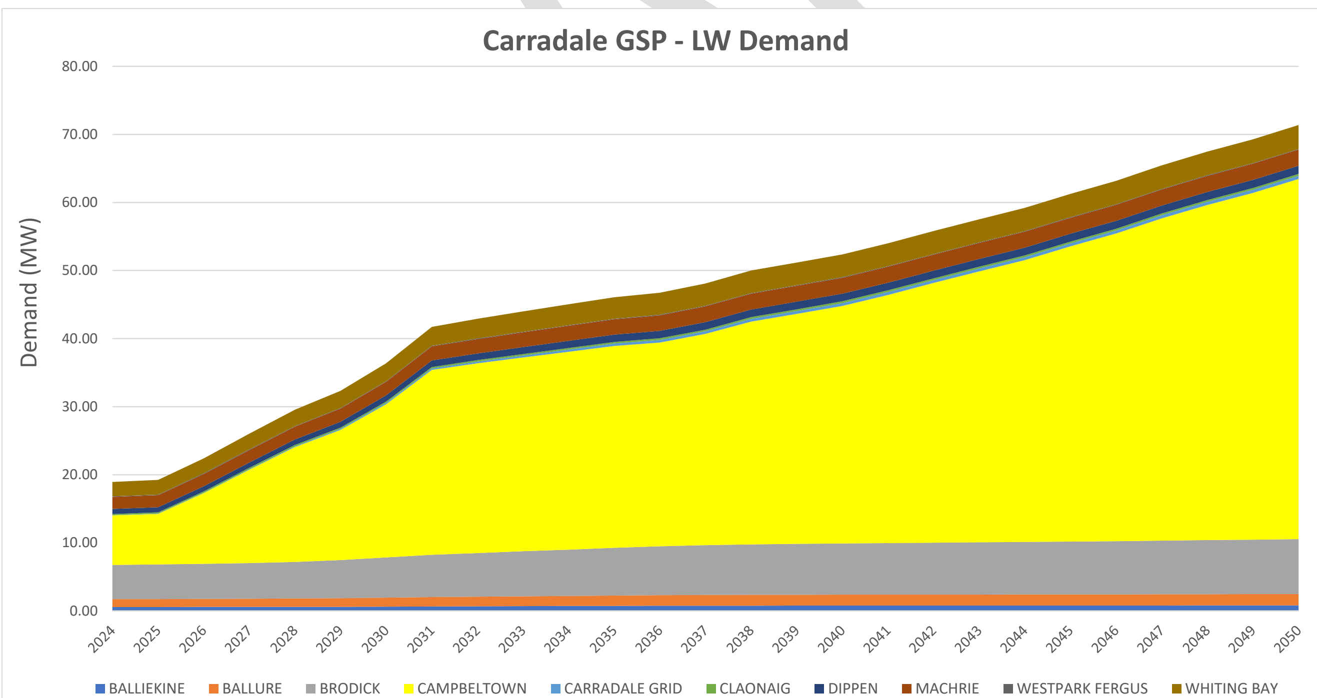


Figure 64 Demand Forecast for Carradale GSP – Breakdown by Primaries - LW (MW). Source DFES 2023

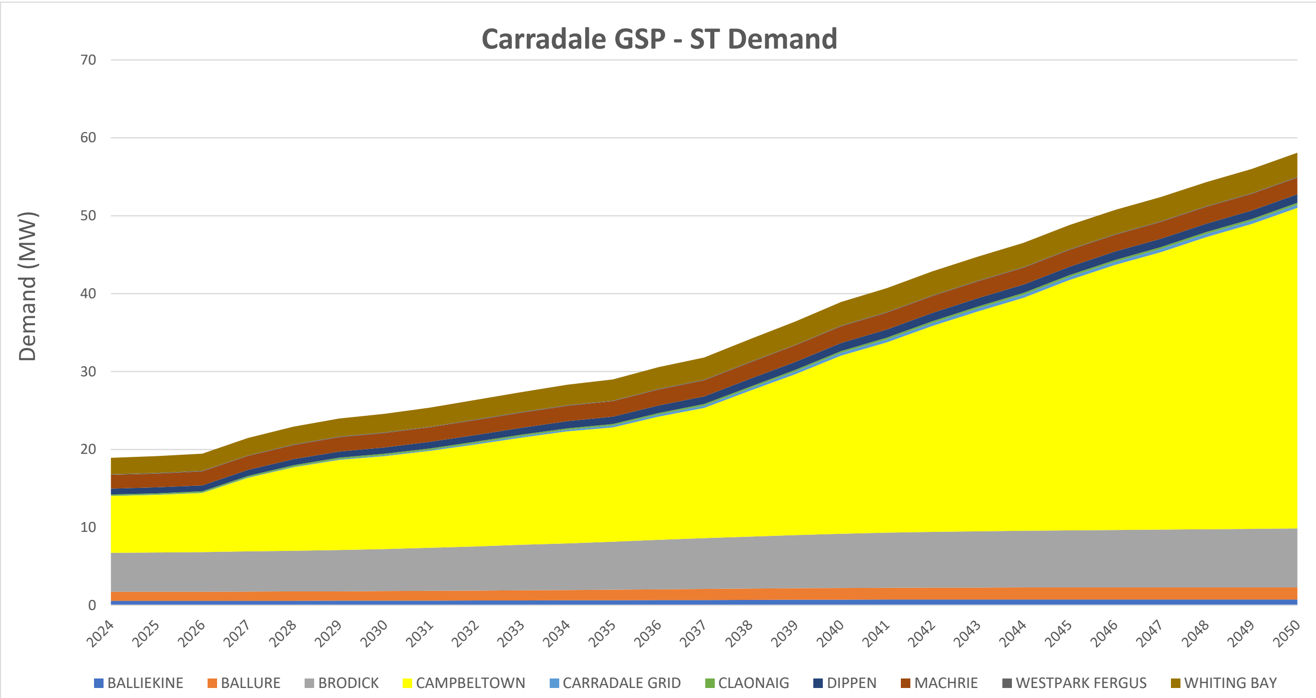


Figure 65 Demand Forecast for Carradale GSP – Breakdown by Primaries - ST (MW). Source DFES 2023

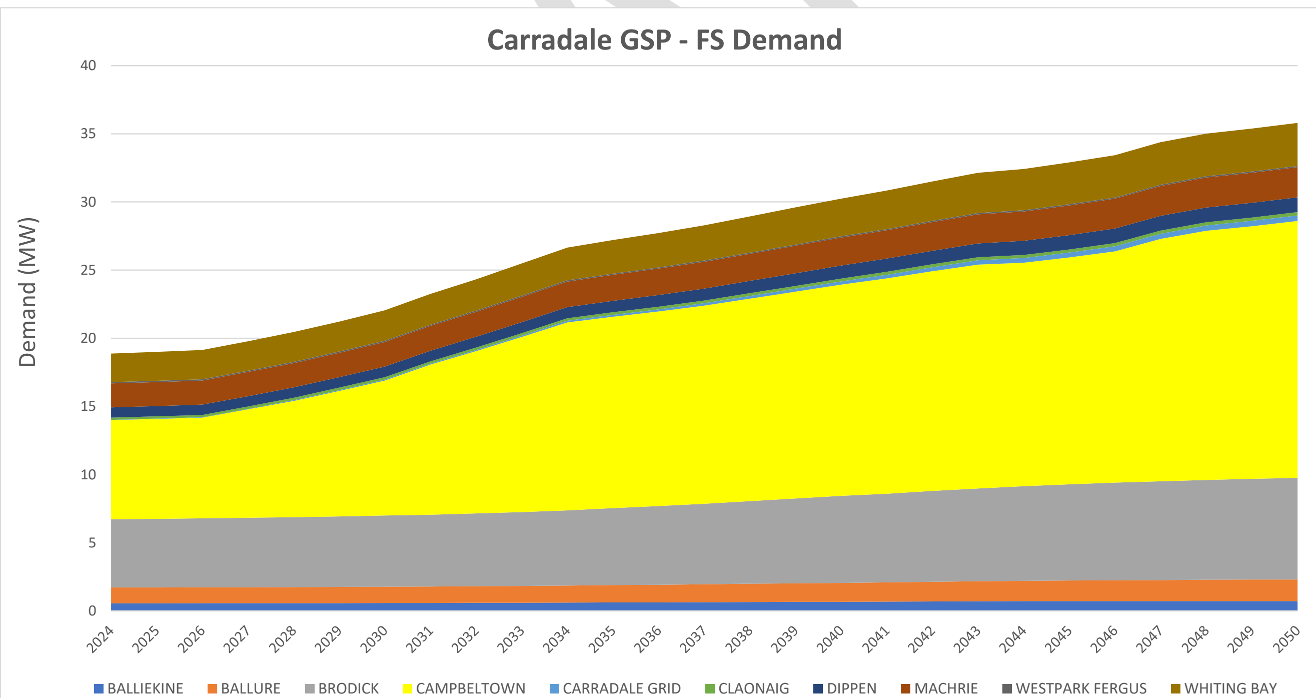


Figure 66 Demand Forecast for Carradale GSP – Breakdown by Primaries - FS (MW). Source DFES 2023

APPENDIX D – Relevant DNOA Outcome Reports

Machrie/Whiting Bay 11kV Network

DNOA Outcome Report

Scheme description

- Machrie and Whiting Bay Primary sub stations are located on the Isle of Arran, which falls within the South Caledonia region of the SHEPD licence area
- Load Related - Low volts during operational scenarios between Machrie and Whiting Bay Primary Substation

Proposed option

- Proposal to reinforce the 11kV Network between Machrie and Whiting Bay Primary sub stations by installing voltage regulating equipment.
- This is the most efficient and economical solution. Flexibility solution is not viable for solving the voltage issue
- Capacity released: 1.09MVA

System need requirement

J	F	M	A	M	J	J	A	S	O	N	D

DNOA History

2023/24	2024/25	2025/26	2026/27	2027/28
Initial assessment				

Indicative flexibility price (if available):

- N/A

Reinforcement timeline

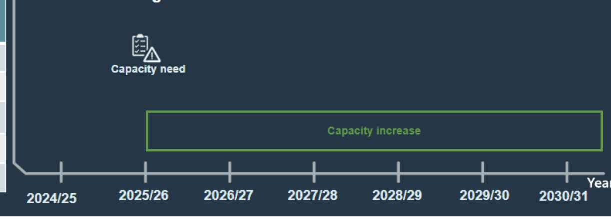
- Reinforcement delivered by 2025/26

Estimated peak MW outside firm capacity under each scenario

Grey text relates to estimated peak MW without reinforcement delivery

	2024/25	2025/26	2026/27	2027/28	2028/29	2029/30	2030/31
CT	-	-	-	-	-	-	-
ST	-	-	-	-	-	-	-
LTW	-	-	-	-	-	-	-
FS	-	-	-	-	-	-	-

Constraint management timeline



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DNOA Outcome Report

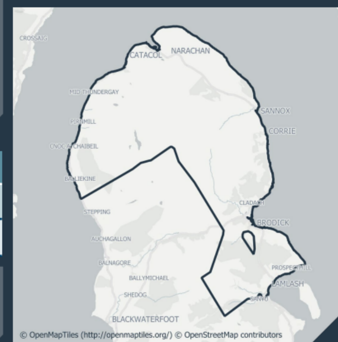
Isle of Arran (Brodick & Balliekine PSS) Ref. 0724-11

Scheme description

- Brodick and Balliekine primary substations are located on the Isle of Arran, Scotland. Postcode(s): KA27 , PA23.
- Load Related– Low Voltage issues under FCO conditions and then thermal overloading under network intact conditions due to forecasted demand growth.

Proposed option

- Addition of new primary substation at Lochranza, including 11kv overhead line reinforcement between Brodick-Balliekine.
- Construction of new 33kv overhead line from Balliekine-Lochranza to split the existing network and resolve FCO Thermal and Voltage issues.
- Capacity released: 2.3MVA (New Lochranza primary substation)



System need requirement

J	F	M	A	M	J	J	A	S	O	N	D

DNOA History

2024/25	2025/26	2026/27	2027/28	2028/29
Initial assessment				

Indicative flexibility price (if available):

- Availability: N/A
- Utilisation: N/A

Reinforcement timeline

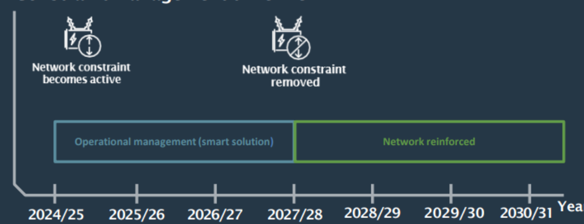
- Network constraint will be operationally managed to ensure voltage compliance, until reinforcement delivery.
- Reinforcement delivery completed by the end of 2026/27.

Estimated peak MW outside firm network capacity under each scenario

Grey text relates to estimated peak MW without reinforcement delivery

	2024/25	2025/26	2026/27	2027/28	2028/29	2029/30	2030/31
CT	-	-	-	- (2.08)	- (2.38)	- (2.58)	- (2.88)
ST	-	-	-	- (1.68)	- (1.68)	- (1.78)	- (1.98)
LTW	-	-	-	- (2.18)	- (2.28)	- (2.48)	- (2.68)
FS	-	-	-	- (1.68)	- (1.78)	- (1.78)	- (1.88)

Constraint management timeline



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CONTACT

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