INNER HEBRIDES WHOLE SYSTEM UNCERTAINTY MECHANISM

29th February 2024

Scottish & Southern Electricity Networks

AGENDA

- Welcome and introductions
- Setting the scene
- Overview of the HOWSUM process
- Recent insights – DFES analysis
- Next steps
- Q&A

SSEN OVERVIEW

OUR DISTRIBUTION NETWORK AT A GLANCE

Over **3.9million** homes and businesses

More than **888,000** customers on our Priority Services Register

Over **128,000km** of overhead lines and underground cables

Over **460km** of subsea cables powering our island communities

Over **4,100** employees across the country

Figures as at October 2023

SHEPD overview

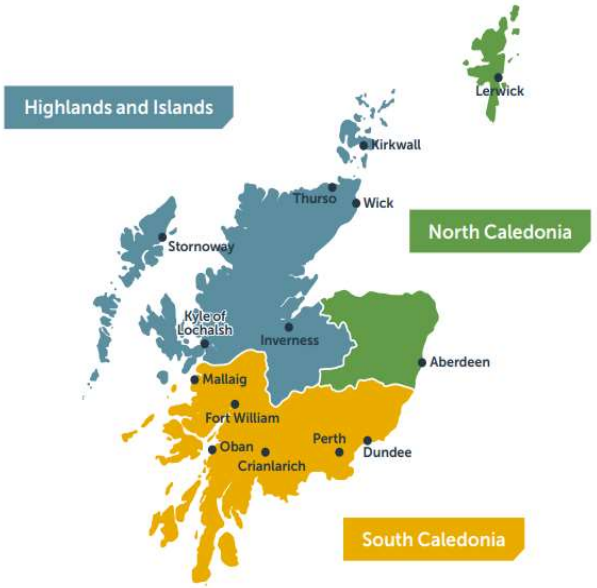
Underground cables
18,943km

Overhead lines
30,209km

Customers
782,787

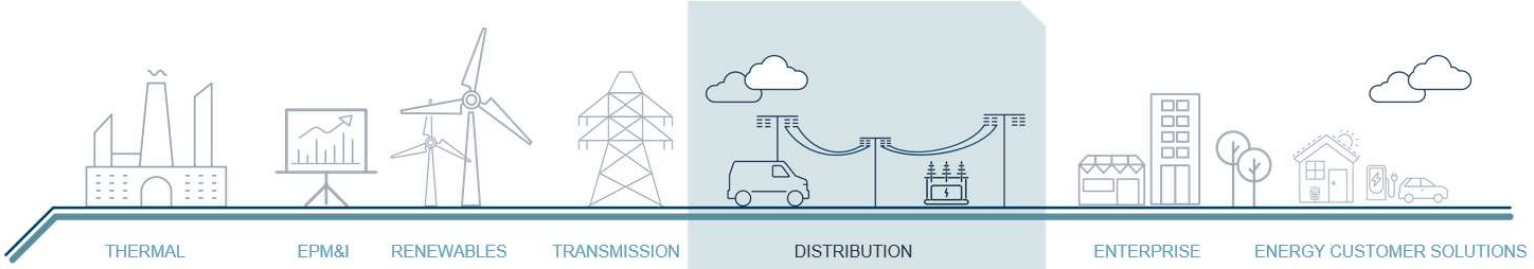
PSR customers
177,823

Island communities
60 islands served by 111 subsea cables



SHEPD
Scottish Hydro Electric Power Distribution Plc

SEPD
Southern Electric Power Distribution Plc



HOUSEKEEPING

- We're using Slido today to capture some of your thoughts and feedback.
- Please feel free to ask questions throughout the session in the Teams chat
- Today's session will be recorded

Video/webcams off
Please only turn your video on for the discussion in break-out rooms

Mics on mute
Please stay on mute unless you are asking a question

Technical queries
If you have any technical questions let us know

Slido

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What is your dream holiday destination?

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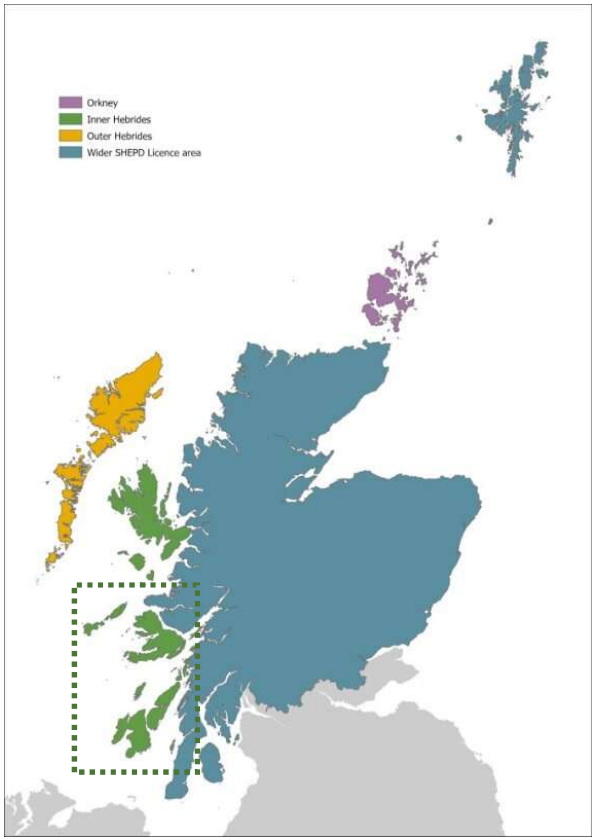
SETTING THE SCENE

Landel Johnston, Head of RIIO-ED2 Non-Load, CBRM Lead

Scottish & Southern Electricity Networks

HOWSUM RECAP

- The Hebrides and Orkney Whole System Uncertainty Mechanism (HOWSUM) provides SSEN with a funding route to improve the capacity, reliability and resilience of these key island routes.
- This needs to be supported by strategic analysis looking at future whole system requirements out to 2045 and beyond.
- At our last webinar we introduced our work on the Inner Hebrides, the drivers for our work, and our proposed approach and next steps.
- We also offered the opportunity for bilateral conversations with either ourselves or Regen who are working with us to understand the future island needs for the Inner Hebrides.

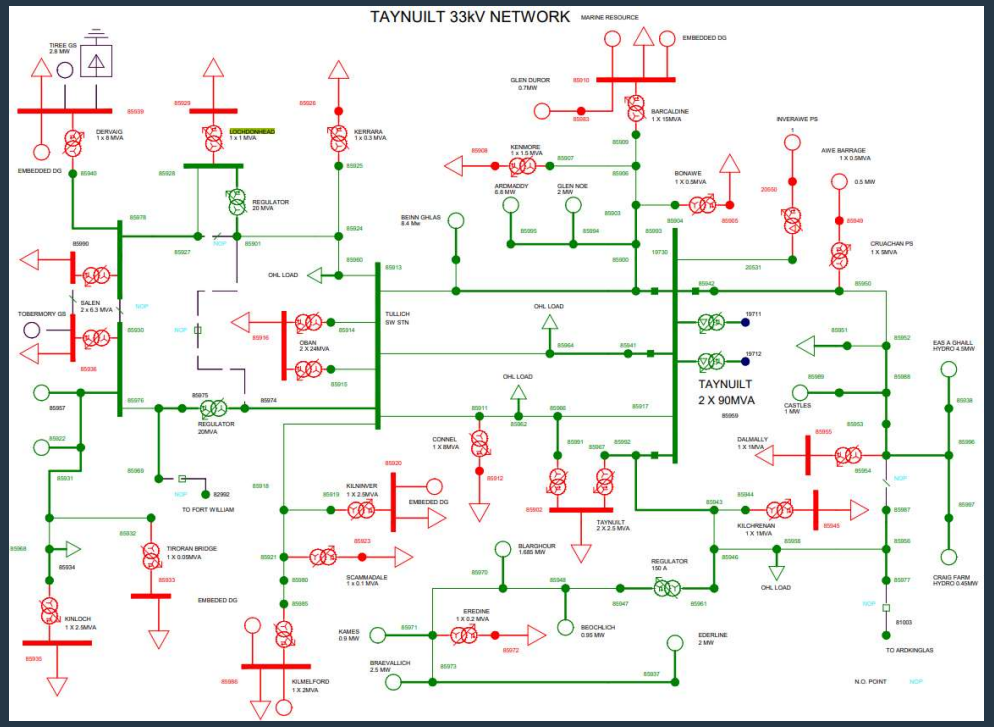


CURRENT NETWORK – MULL & TIREE ARCHIPELAGO

- The islands of Kerrera and Mull, are supplied from the Taynuilt GSP by SSEN's Distribution network via two 33kV circuits from Tullich Switching Station, near Oban.
- The 33kV circuits consist of overhead lines, underground cables and subsea cables.
- There is also a third 33kV supply to the islands that connects to the Fort William network, acting as a back-up supply in fault scenarios.
- There is no Transmission network on the island group.

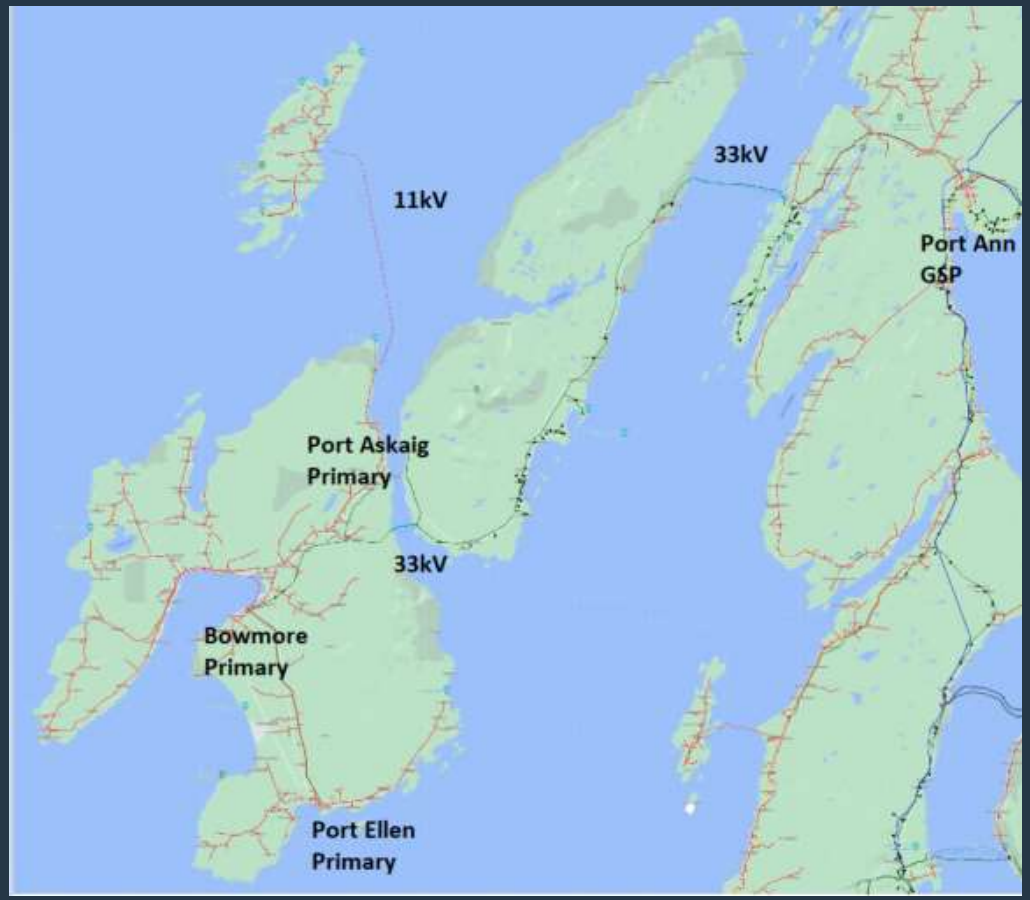
CURRENT NETWORK – MULL & TIREE ARCHIPELAGO

- A 33kV ring operates on the isle of Mull which supports a number of Primary substations (Lochdonhead, Salen, Dervaig, & Kinloch). These in turn support the isles of Iona, Ulva, Coll and Tiree via the 11kV network.
- These networks are radially fed, and similarly consist of overhead lines, underground cables and subsea cables.
- SSEN Distribution also own and operate a 2.7MW Diesel Power Station on Tiree to support the Tiree and Coll in the event of a fault on the 11kV network.



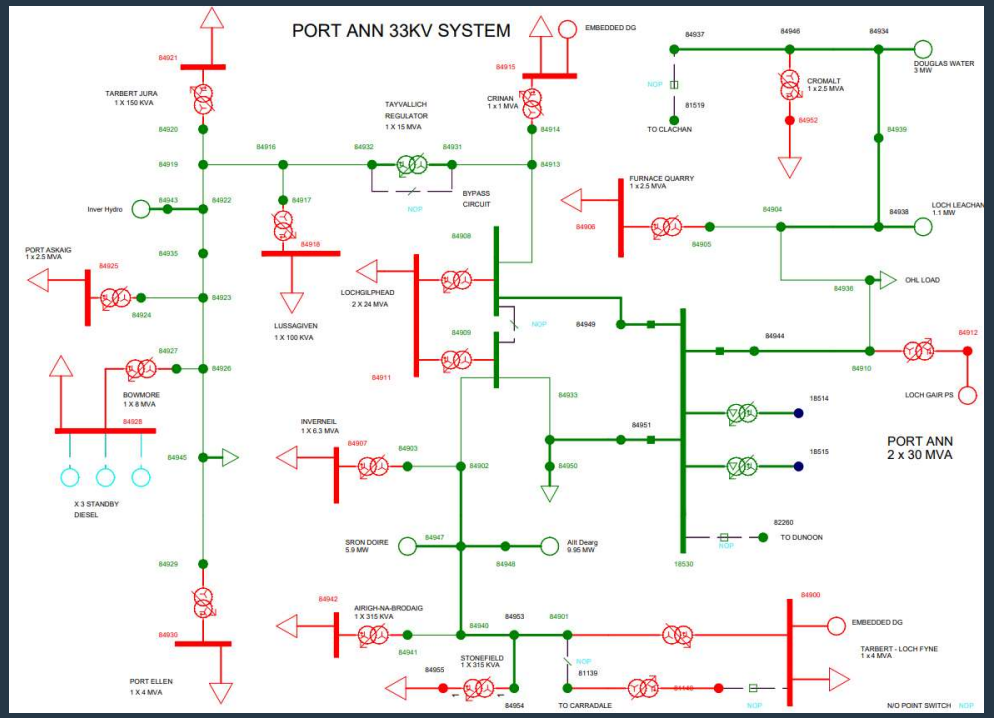
CURRENT NETWORK – ISLAY & JURA ARCHIPELAGO

- The isles of Jura and Islay are supplied by SSEN's Distribution network from Port Ann GSP by a single 33kV circuit out of Lochgilphead switching station.
- This radial circuit consists of overhead lines, underground cables and subsea cables.
- The isle of Colonsay is supplied by a single 11kV circuit out of Port Askaig Primary.
- There is no transmission network on the island group.



CURRENT NETWORK – ISLAY & JURA ARCHIPELAGO

- The 33kV radial circuit on the island group supports five 11kV Primary substations. Lussagiven and Tarbet Primaries on Jura and Port Askaig, Bowmore and Port Ellen Primaries on Islay.
- This network is made up of a composition of underground cables and overhead lines.
- SSEN Distribution also own and operate a 6MW Diesel Power Station at Bowmore on Islay to support demand on the island and provide redundancy in the event of a fault on the 33kV / 11kV network.

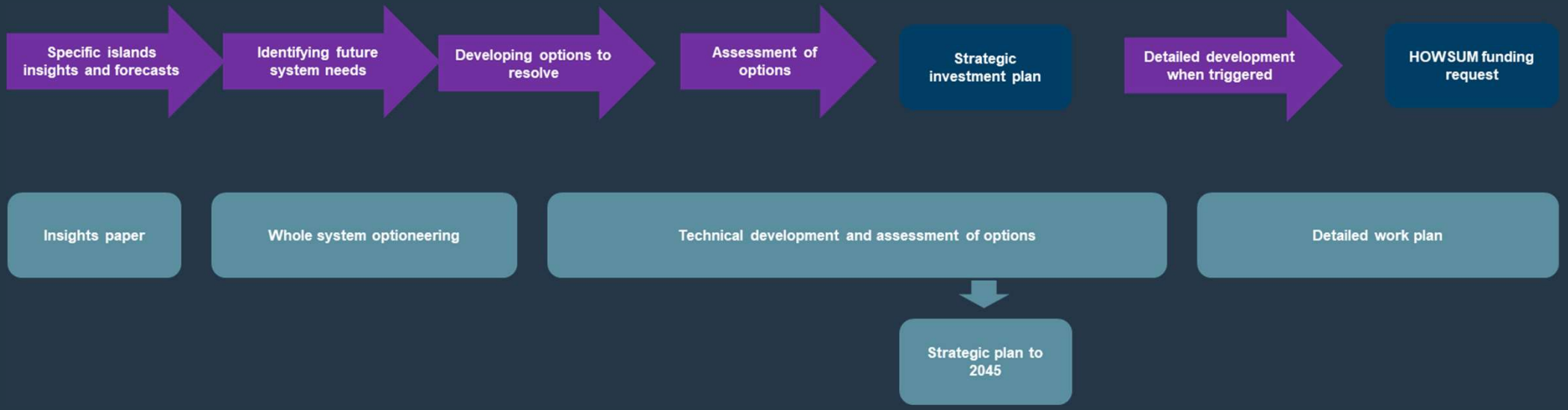


OVERVIEW OF THE HOWSUM PROCESS

Andy Wainwright, Whole System Manager

Scottish & Southern Electricity Networks

HOWSUM PLANNING PROCESS

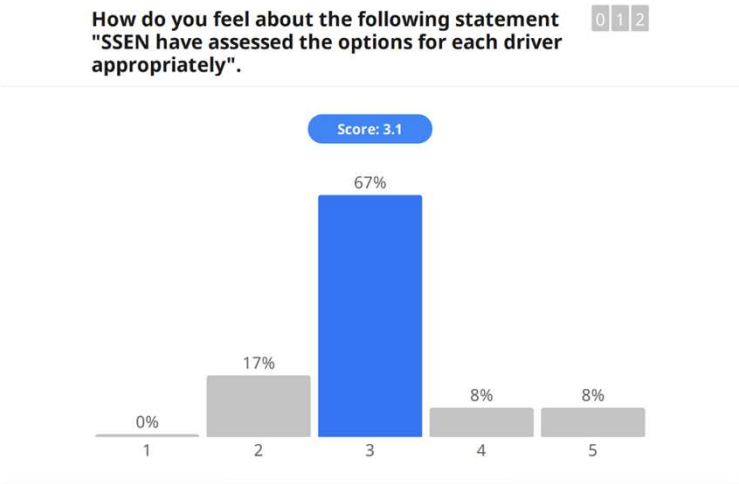


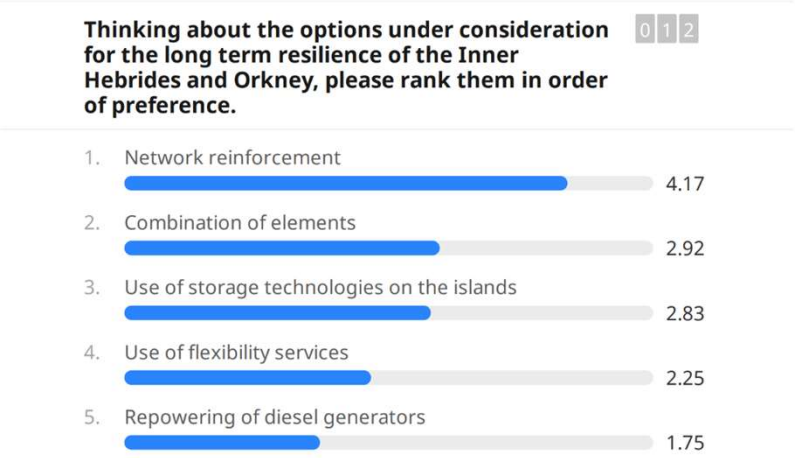
DRIVERS FOR CHANGE

Future demand and generation requirements for the islands	*Subsea cable asset condition*	*Continued island resilience*	*Decarbonisation of our diesel generation fleet*
• We need to ensure our networks are appropriately sized to meet the requirements of parties who wish to connect to and use our assets. • We have assessed future needs against our DFES forecasts through to 2050 and worked with Regen to gain further specific insights.	• A key driver for our works is to maintain and, as needed, replace our submarine cables. • These cables exist in extreme environmental conditions and a cable that fails can take many months to locate and repair or in worst case scenarios completely replace.	• Resilience conditions for Scottish islands are unique given the geographies and potential lengthy system outages in the unlikely event of a subsea cable fault. • We have developed a specific net zero policy for the treatment of island groups fed by subsea cables recognising the impacts of decarbonisation on electrification of heat and transport.	• This is a significant source of carbon emissions for SHEPD when required to run for long periods of time. • Emissions reached 2238.49tCO_2-e in 2022/23 across the fleet, and we must reduce these to meet our 1.5^{o}C Science Based Target (SBT).

WEBINAR FEEDBACK

- You were broadly in agreement that we have assessed the options for each driver appropriately.
- The potential for both network reinforcement and storage technologies was supported, potentially in combination. We will be looking further into this option this year.





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Thinking about the feedback from the previous webinar, has anything changed since then? Are there any other drivers or factors we need to consider in the development of longer-term needs for the Inner Hebrides?

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CONTINUED ISLAND RESILIENCE AND DECARBONISATION OF OUR DIESEL GENERATION FLEET

Some drivers for change for Scottish islands are consistent with those that apply more widely on the mainland.

These include asset condition, load growth and the potential for additional generation connections. However, stakeholders have identified further drivers with material relevance for Scottish islands:

- *Diesel generator decarbonisation* – this is a significant source of carbon emissions for SHEPD and developing long term solutions to eliminate reliance on diesel-based DEG is crucial to remaining on the pathway to net zero to 2045.

- *System resilience* – repairs or replacements of cable faults can take a significant period of time and there is a need to ensure we are able to keep the lights on to island communities, particularly as diesel generators are phased out.

Island Group fed by subsea cable[21]	DFES (CT) Forecast 2050 island group demand	Relevant 2050 P2-8 Category	Net Zero Resilience Policy for island groups fed solely by subsea cables
Shetland	95MVA	D	Group demand secured for sustained long duration N-2 condition through a combination of network assets and local generation (including third party).
Orkney	61MVA	D	
Lewis & Harris	45MVA	C	
Uists, Benbecula, Eriskay & Barra	15MVA	C	
Mull, Coll & Tiree	13MVA	C	
Islay, Jura & Colonsay	13MVA	C	
Barra	3MVA	B	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 potentially managed through use of portable generation or use of existing generation on island if available.
Tiree & Coll	3MVA	B	
Colonsay	>1MVA	A	

Table 8: Summary of SHEPD Island Net Zero Resilience Policy

CONTINUED ISLAND RESILIENCE

- Resilience conditions for Scottish islands are unique given the geographies and potential lengthy system outages in the unlikely event of a subsea cable fault.
- We have developed a specific net zero policy for the treatment of island groups fed by subsea cables recognising the impacts of decarbonisation on electrification of heat and transport.
- Our policy aligns with the GB standard for network design requirements which is based on areas of demand (P2/8).
- Specifically we are interested in securing supplies for the ‘N-2’ condition which would occur in the unlikely event of the loss of two in feeding cables to the island group.
- For larger island groups this will be through a combination of network assets and local generation.
- For smaller island groups with peak demand less than 4MW the use of portable generation would also be considered.

Example - Proposed Future Resilience Outer Hebrides 2035 onwards

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On a scale of 1-5, where 1 is not at all and 5 is very, how supportive are you of SSEN Distributions Net Zero policy for island groups fed by subsea cables?

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RECENT INSIGHTS

Becky Fowell, Energy Market Analyst, Regen

Scottish & Southern Electricity Networks

Future electricity load growth – Inner Hebrides

Supporting SSEN's HOWSUM application

Becky Fowell – Energy Market Analyst

February 2024

SSEN Distribution Future Energy Scenarios

Regen has been supporting SSEN with their long-term load forecasting since 2017/18.

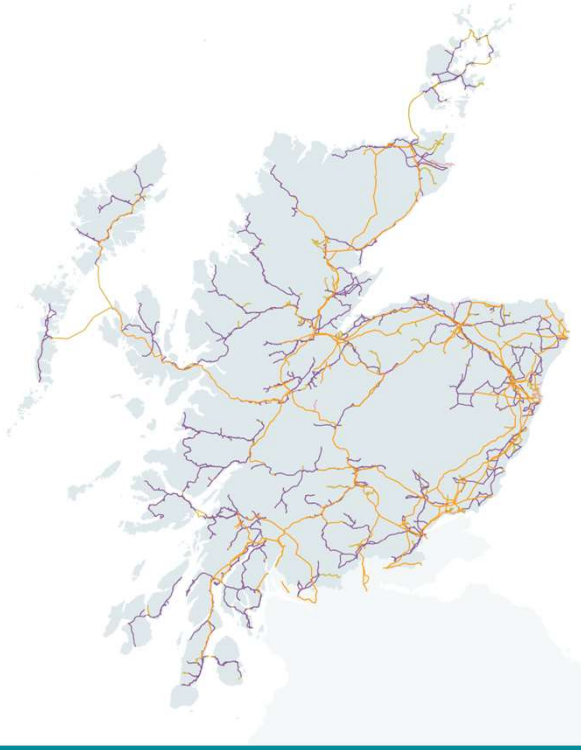
Load growth projections to 2050 are produced using:

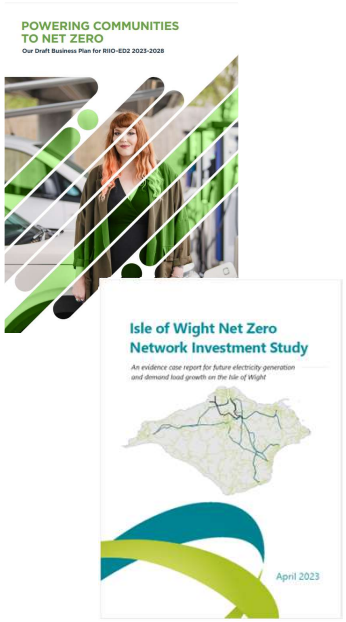
- **Online research**
- **Stakeholder engagement**
- **Analysis and modelling**

Annual projections and associated data for each licence area (North of Scotland and Southern England) are issued to the SSEN Network Planning team to aid future network planning, investment and reinforcement.

Regen is also supporting SSEN's wider work on ED2 business planning and uncertainty mechanism re-openers:

- Isle of Wight
- Outer Hebrides
- Orkney
- **Inner Hebrides**





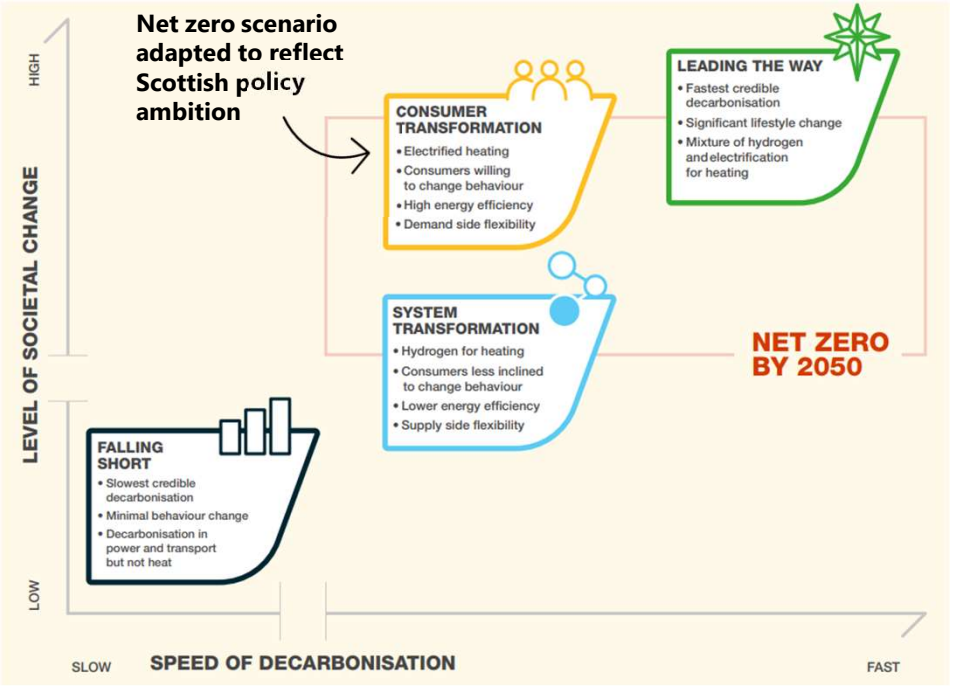
ESO Future Energy Scenarios (FES) Framework

The DFES adopts the National Grid ESO annual FES as its overarching framework and long-term projections.

But… Regen develops bottom-up local evidence driven projections for each technology and then reconciles these to the FES at GSP level.

How does DFES use the FES?

- DFES adopt the same scenario framework, building blocks and key assumptions
- For some technologies DFES uses the FES regional view data for its top-down distribution
- For other technologies DFES uses the FES to provide a benchmark for regional scenario projections
- For all technologies Regen provides a reconciliation back to the FES highlighting differences
- Feedback to the FES team which has helped to improve alignment over time.

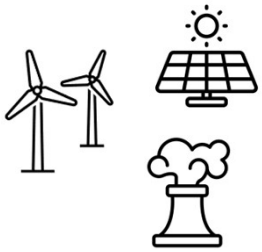


DFES modelling method

The DFES follows a four-stage process for each of the technologies in-scope:

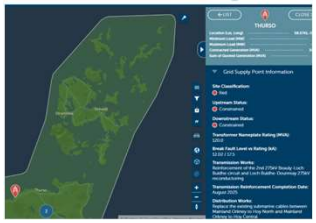
Stage 1

Determine the historic, existing baseline (operational projects).



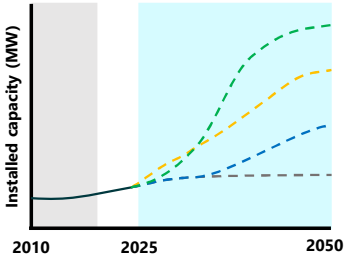
Stage 2

Assess the near-term pipeline (connection offers/planning applications).



Stage 3

Develop medium- and long-term projections out to 2050.



Stage 4

Geographically distribute these technologies/capacities within the licence areas

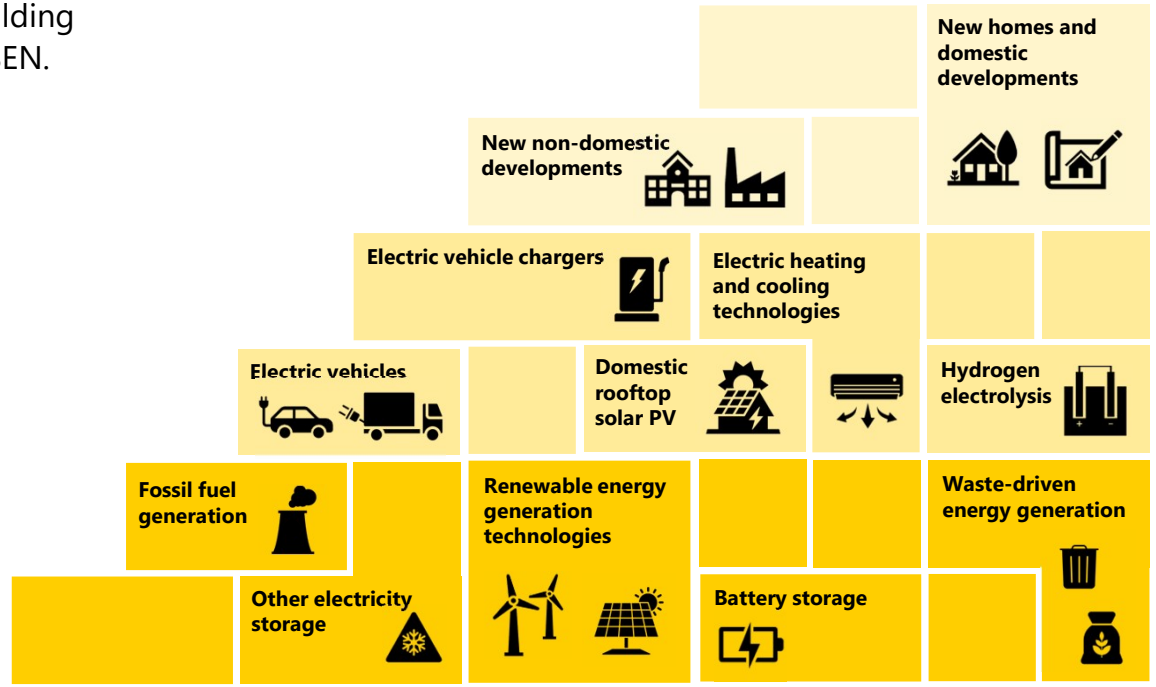
Disruptive load growth

The DFES includes an agreed set of technology building blocks. These are assessed by all DNOs, not just SSEN.

New property developments

Key low carbon technologies and new disruptive sources of future electricity demand

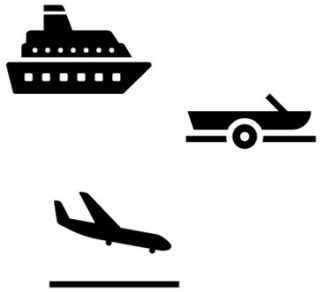
Distributed electricity generation and storage technologies connecting at/above 11 kV



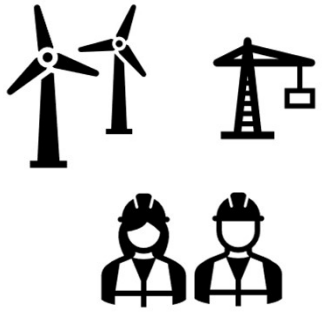
Additional sectors

Analysis into additional sectors established other significant future electricity load growth potential in the Scottish islands.

Non-road transport



Offshore wind sector



Local industry decarbonisation

Local authority plans and development

Future electricity load growth – Inner Hebrides

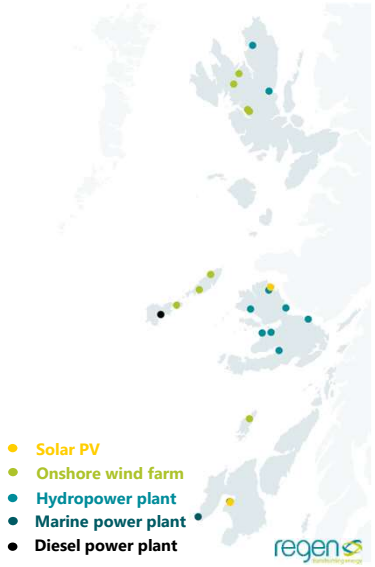
Sector analysis

Renewable electricity generation

Baseline and pipeline

Baseline and pipeline distributed electricity generation connected and expected to connect in the Inner Hebrides
Source: SSEN 2023 connections data

Generation technology	Number of installed sites	Installed capacity (MW)	Number of pipeline sites	Pipeline capacity (MW)
Battery storage	-	-	1	0
Fossil fuel (diesel)	2	9	-	-
Hydropower	12	40	1	0.1
Marine	1	0.2	1	10
Onshore wind	11	31	6	135
Solar PV	2	0.1	-	-
Total	28	80	8	145



Distributed generation projects - 2023 baseline
Source: SSEN connections data

Distributed generation projects - 2023 pipeline
Source: SSEN connections data

Renewable electricity generation

Projected future scenarios

Strong renewable energy projections:

471 MW
onshore wind
by 2050

43 MW
marine energy
by 2050

Strong policy support from Scottish Government, The Highland Council and Argyll and Bute Council – net zero by 2045 target.

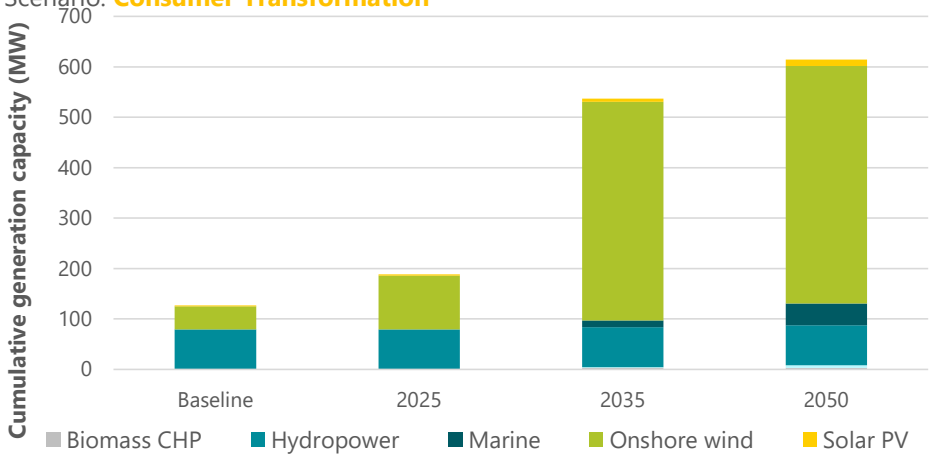
Strong potential and appetite to repower existing operational onshore wind farms (aged 6 – 20 years old).

Potential for offshore generation:

- **Nova Innovation developing 3 MW tidal project** between Islay and Jura to power whisky distilleries.

DFES 2022 renewable generation projects - the Inner Hebrides

Scenario: **Consumer Transformation**



Projected cumulative distributed generation and storage capacity for the Inner Hebrides

Source: SSEN DFES 2022 projections – Consumer Transformation scenario

Battery storage

Currently no operational batteries across the Inner Hebrides.

Very large regional and national pipeline elsewhere in Scotland and rest of UK, yet only one single site holds a connection offer with SSEN in the Inner Hebrides:

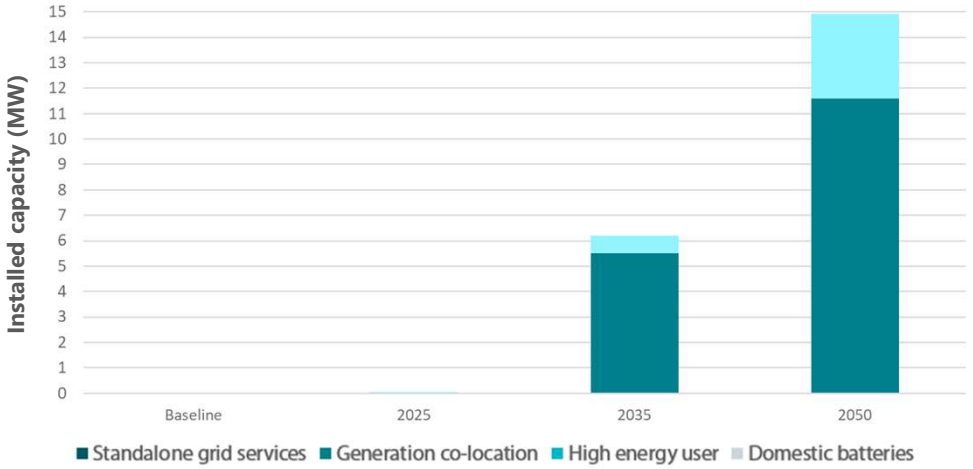
- **Drynoch Resilience as a Service (RaaS) project** on the Isle of Skye. The capacity of battery storage assets aiming to connect to this substation is unclear.

DFES projections show:

15 MW battery storage capacity
by 2050

Significant onshore wind generation projected for Inner Hebrides could become significant incentive for co-location – potential future business model for the island group.

DFES 2022 battery storage capacity in the Inner Hebrides
Scenario: **Consumer Transformation**



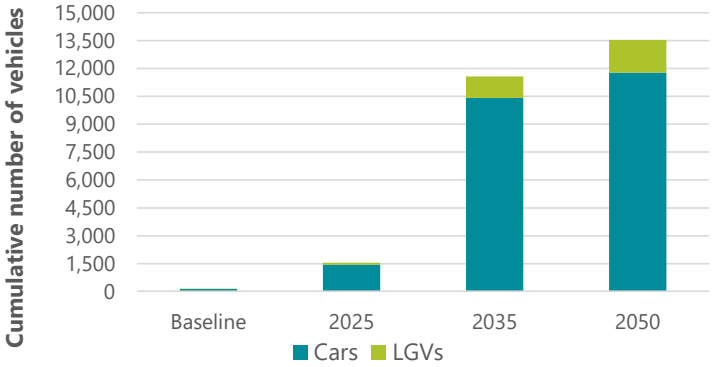
Projected cumulative battery storage capacity in the Inner Hebrides
Source: SSEN DFES 2022 projections – Consumer Transformation scenario

Electrification of road transport

< 150
EVs currently registered

13,500
EVs by 2050

DFES 2022 EVs for the Inner Hebrides
Scenario: **Consumer Transformation**

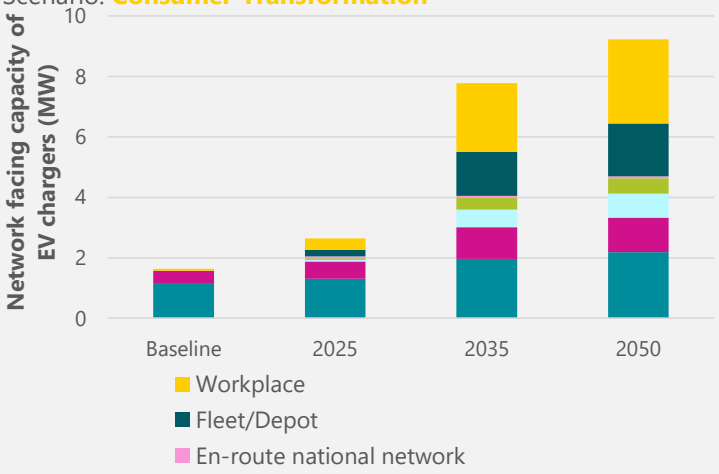


Projected cumulative number of EV cars and LGVs in the Inner Hebrides
Source: SSEN DFES 2022 projections – Consumer Transformation scenario

9.2 MW
non-domestic EV charging capacity by 2050

10,000
off-street domestic EV chargers by 2050

DFES 2022 EV chargers across the Inner Hebrides
Scenario: **Consumer Transformation**



Projected cumulative EV charger capacity in the Inner Hebrides
Source: SSEN DFES 2022 projections – Consumer Transformation scenario

Ambitions are already in place for decarbonising road transport including EV chargers and electric fleets

Electrification of maritime vessels

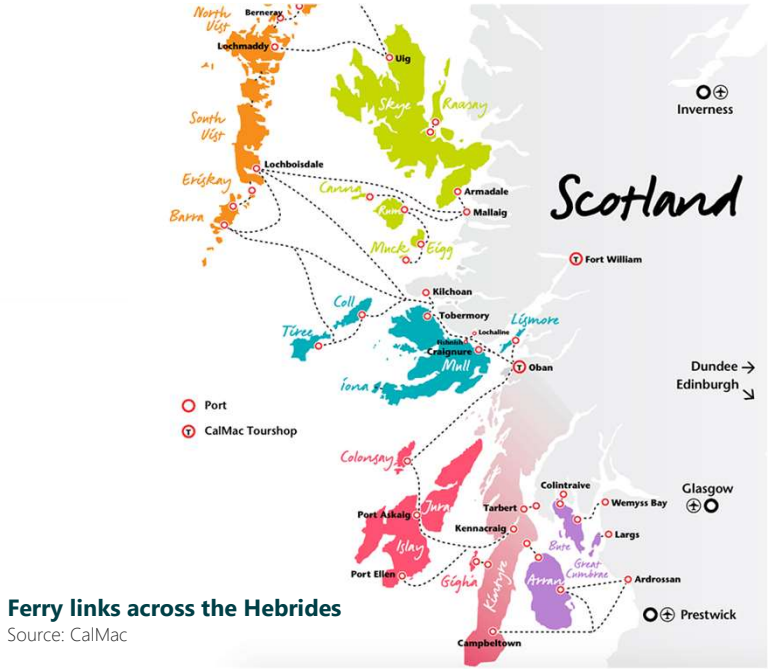
Caledonian MacBrayne (CalMac) currently operates 33 ferries spanning 30 routes across the West Scotland region.

Caledonian Maritime Assets (CMAL) – the owner of the vessels and operators of the piers – has committed to decarbonising through several measures:

- **Electric/hybrid ferries to be introduced** as early as 2025 across short routes as part of The Small Vessel Replacement Programme.
- **Shore power projects** and associated port locations are currently being discussed with SSEN.

Decarbonisation of other maritime transport will also be key, although load requirements and future fuels need a more detailed assessment:

- **Recreational sailing**
- **Cargo/freight transportation**
- **Cruises**



Ferry links across the Hebrides
Source: CalMac

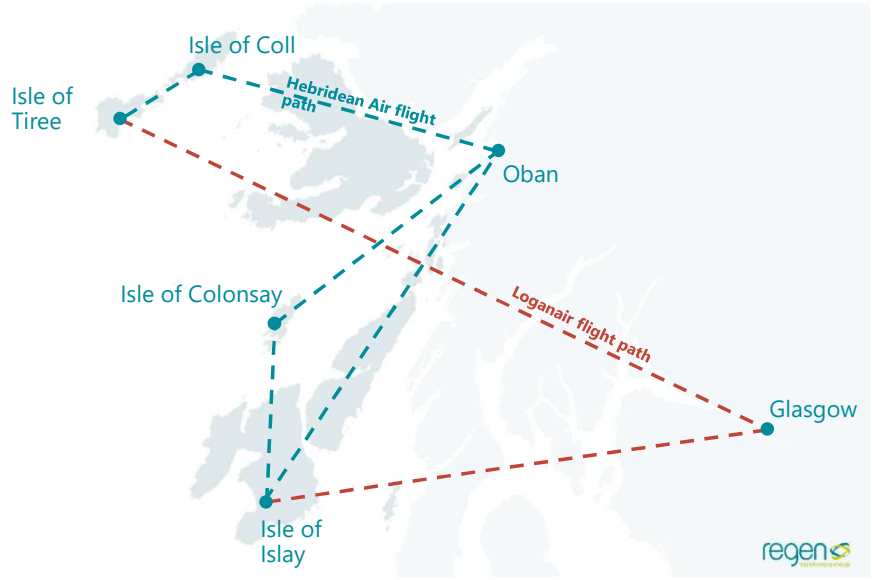
Electrification of aviation

Scottish Government and the Highlands and Islands Airports Limited (HIAL) have committed to creating the world's first zero emission aviation region.

Current initiatives:

- **Airtask** – assessing hydrogen and electric options for short-haul flights.
- **Loganair** – committed to net zero by 2040. Aim to decarbonise aircraft across their operations.
- **Electric aircraft turnaround –** potential for significant loaf growth. Includes full electrification of ground-power units and aircraft transport systems. Currently being looked at across island airports.

Electrification of thrust/drive systems, particularly for long-haul flights will be a longer-term consideration – closer to 2045.



Airfields across the Inner Hebrides

Heat decarbonisation

As of the 2022 census, Inner Hebrides houses over 20,000 residents.

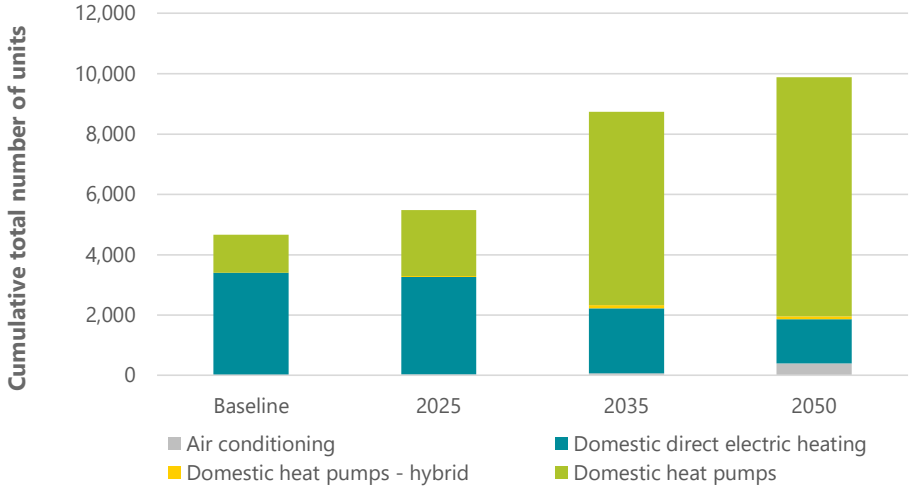
Predominant heating source for domestic properties is electricity, although some properties currently rely on oil and LPG.

The consumer transformation scenario projects:

7,900
domestic heat pumps by 2050

reduction in properties using direct electric heating in favour of heat pumps

DFES 2022 heating demand for the Inner Hebrides
Scenario: **Consumer Transformation**



Projected cumulative number of heat pumps in the Inner Hebrides
Source: SSEN DFES 2022 projections – Consumer Transformation scenario of

Commercial and industrial decarbonisation

Whisky distilleries

Distilleries are a significant industry sector and energy consumers in the Inner Hebrides, largely from the heat required for distilling

- **Scotch Whisky Association estimates 8kWh/litre pure alcohol (LPA)**

c.22m
LPA currently produced in Islay

equates to
c.176 GWh+ other fuel use
demand on Islay

Stakeholder engagement suggests a pipeline of new distilleries on Islay could cause energy demand to increase to 224 GWh by 2025. Primary fuel source for distilleries across Inner Hebrides is oil, kerosene and other fossil fuels.

Alternative fuels are being explored by several distilleries and the Scotch Whisky Association:

- **Electricity (i.e. high-temperature electric boilers)**
- **Hydrogen**
- **Biomass/bioenergy**

Scale of electrification is entirely dependent on grid investment.

Operational whisky distilleries in the Inner Hebrides

Commercial and industrial decarbonisation

Whisky distilleries

Electrification of associated operations is also being explored:

- **Bottling plants**
- **Distribution and export**
- **Onsite decarbonisation (e.g. shops and offices, EV chargers)**

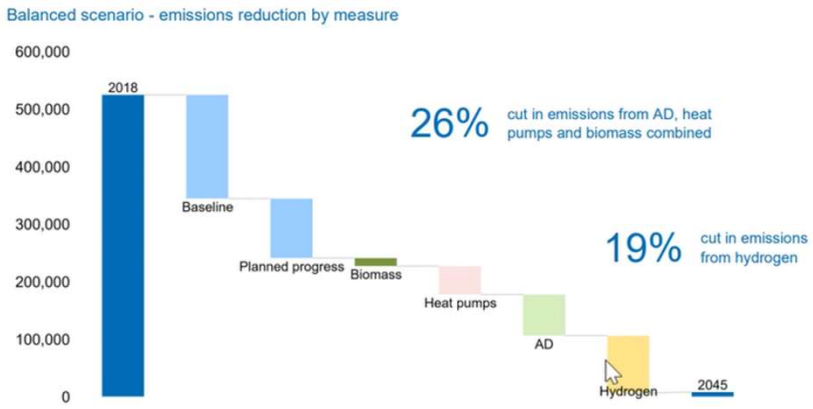
Electrification could include solar PV or wind farm connections; however, site-specific characteristics and current grid constraints are a challenge.

Some sites are using direct diesel generation to support operations.

Engaged stakeholders:

Pernod Ricard, Edrington, Diageo, Islay Energy Trust, Scotch Whisky Association

Grid constraints are a significant limitation for future distillery decarbonisation, specifically electrification and site expansion across the Inner Hebrides.



Emissions reductions in the Scotch Whisky industry by measure

Source: Scotch Whisky Association

Commercial and industrial decarbonisation

Agriculture

Agriculture is a significant commercial sector in the Inner Hebrides and is an important contributor to local economy.

High energy demand comes from:

- **Heating animal sheds**
- **Drying grain**
- **Powering heavy machinery**

Fossil fuels are the primary source of fuel in the sector. Fuels include **Road fuel (petrol and diesel), LPG** and **Kerosene.**

Decarbonisation pathway for farm machinery is unclear – could include electrification or alternative fuels (e.g., ammonia, hydrogen and biofuels).

Electrification of processing centres and heavier livestock transportation will increase demand load growth; however, the scale of electrification is unclear.

Scottish Government undertaking 'Decarbonisation of mobile agriculture machinery in Scotland' study.

Decarbonisation of mobile agricultural machinery in Scotland
Source: ClimateXChange

Load growth in the Inner Hebrides

Key points

Renewable electricity generation – to remain significant source of future generation load growth in the Inner Hebrides (particularly onshore wind). There is potential for some solar PV and marine energy to be installed.

Battery storage – no projects have yet been developed, but with strong renewable generation development, co-location business models could be developed in the future. Home battery uptake could be seen to provide a level of electricity supply resilience in some areas of the Inner Hebrides.

Transport – potentially significant source of future electricity demand from road, maritime and aviation. Tourism and commercial freight distribution (particularly whisky) could be a significant contributor for electrified transport charging infrastructure.

Heat – space heating could create significant new electricity load across the Inner Hebrides as heat pumps adopted to replace some fossil fuel heating systems.

Commercial and industrial decarbonisation – decarbonisation of key island industries (e.g., whisky distilleries) and broader industries (e.g., agriculture and other commercial businesses) could drive a range of potential electrification outcomes. The decarbonisation of the whisky industry could be a significant area of future electricity load growth if the network capacity is enabled.

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Are there any further energy insights we need to consider?

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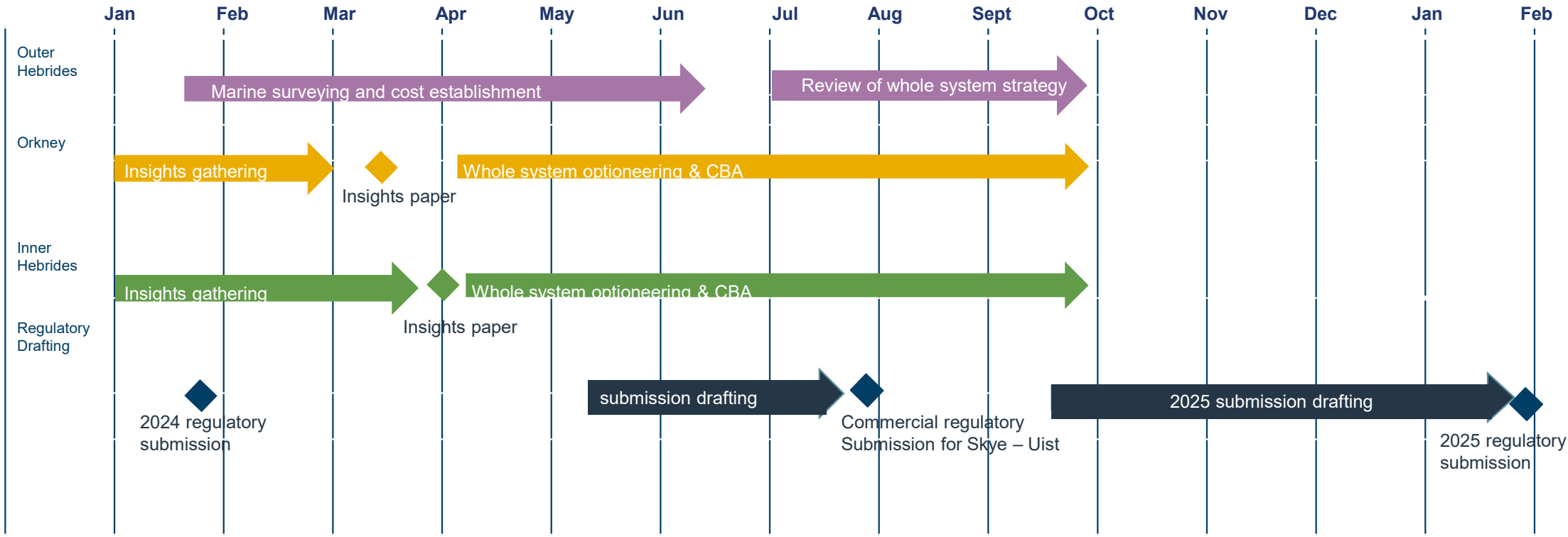
NEXT STEPS

Andy Wainwright, Whole System Manager

Scottish & Southern Electricity Networks

2024 DRAFT PROGRAMME OF WORKS



Q&A

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YOUR FEEDBACK

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Where 1 is strongly disagree and 5 is strongly agree, how do you feel about the following statement - “I feel more informed about the whole system energy options for the Inner Hebrides after attending this webinar”?

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How frequently would you like to be updated on the whole system energy solutions for the Inner Hebrides?

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How would you like us to keep you informed?

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THANK YOU

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