ENERGY DELIVERY PLAN

Version 2.1
January 2024

Version Control

Version	Date	Status	Author
1	April 2023	Version approved by Board	
1.1	September 2023	Draft circulated for Connect review to address: • Updated electricity generation and consumption data (Section 2) • Consideration of use of hydrogen power (Section 5.2) • Consideration of use of hydroelectric power (Section 5.2) • Outcome of the Grid Impact Assessment (Section 7.1) • Updated information on Modelling and Design Consultancy (Section 7.10) • Revised timelines within the Action Plan (Appendix 3)	JL
2	September 2023	Revisions adopted by Board of Directors of Connect Saint Helena Ltd	JL
2.1	January 2024	Version 2 redacted for publication Updated electricity production and consumption figures (earlier drafts included preliminary)	JL

Contents

1. Introduction

This document sets out a plan for phased delivery of improvements in the energy sector on St Helena, particularly to support plans for energy transition on St Helena.

The Energy Delivery Plan recognises that globally countries are making every effort to reduce electricity generation from diesel, both for purposes of cost reduction in light of the global energy crisis and also for the environmental benefits from energy transition.

The Plan is a roadmap for improvements within the energy sector on St Helena. It is intended as a tactical rather than strategic document. Whilst the focus is on increased electricity generation from renewables, the Plan also considers other longer-term opportunities that could provide benefits for electricity consumers on St Helena.

The Energy Delivery Plan provides a summary of the key issues in the energy sector at this time, particularly in relation to energy transition, and recommends a phased approach to address these that form the basis of detailed technical design and planning.

The Energy Delivery Plan is a live document which is fully intended to evolve over time: it will be subject to regular review and update.

2. Background & Context

2.1 Overview

Connect Saint Helena Limited (Connect) is the sole utilities provider on St Helena. Connect was established on 1 April 2013, following divestment of utilities from the St Helena Government (SHG).

The electricity grid services almost all residents on the Island. Very few properties are off grid, with the 2021 Census recording that only 0.1% of households do not use electricity for lighting purposes (this being used as a proxy for those properties that are not connected to the grid).

In 2022/23, Connect generated 10,457 MWh of electricity of which 9,240 MWh was billed to 2,724 active electricity consumers.

2.2 Electricity Generation Capacity

Diesel Generation

The primary source of electricity generation on St Helena is from diesel generation, which generates around 80% of the Island's electricity. The Power Station in Rupert's has a firm diesel generating capacity of 5.6MW from 4 diesel generators, as shown in the table below.

Table 1: Diesel Generating Capacity

Generator Number	Manufacturer/Model	Capacity	Year Installed
1	Caterpillar 3516B	1.6MW	2012
2	Caterpillar 3516B	1.6MW	2012
3	Caterpillar 3516B	1.6MW	2012
5[1]	Caterpillar 3508B	0.8MW	2012

Renewable Energy Generation

A wind farm is located at Deadwood Plain. This comprises 12 WES80 wind turbines, each rated at 80KW giving a total potential generating capacity of 960kW.

A solar farm is located at Half Tree Hollow together with solar panel arrays at the Community Care Complex, the Power Station and the Connect complex in Jamestown.

The combination of wind and solar energy gives a total potential generating capacity from renewable energy sources of 1.65MW. Operationally, however, this is not realised. This is due to:

- The intermittent nature of these renewable energy technologies: both wind and solar energy generation are variable renewable energy sources (VRE) as the energy generated is dependent on weather conditions.

- The need to manage load stability: The requirement to use diesel generation as a stable base means that renewable energy needs to be curtailed when the demand for electricity is low. In such cases, diesel generation continues to provide the base whilst to avoid excess generation from renewable energy sources, these are switched off and prevented from feeding into the grid.

  The requirement to maintain a minimum level of diesel generation means that as overall demand for electricity reduces (see below), the percentage that is generated from renewables also decreases. There is currently no battery storage system that would enable storage of the excess energy that could be generated from the existing renewable energy sources.

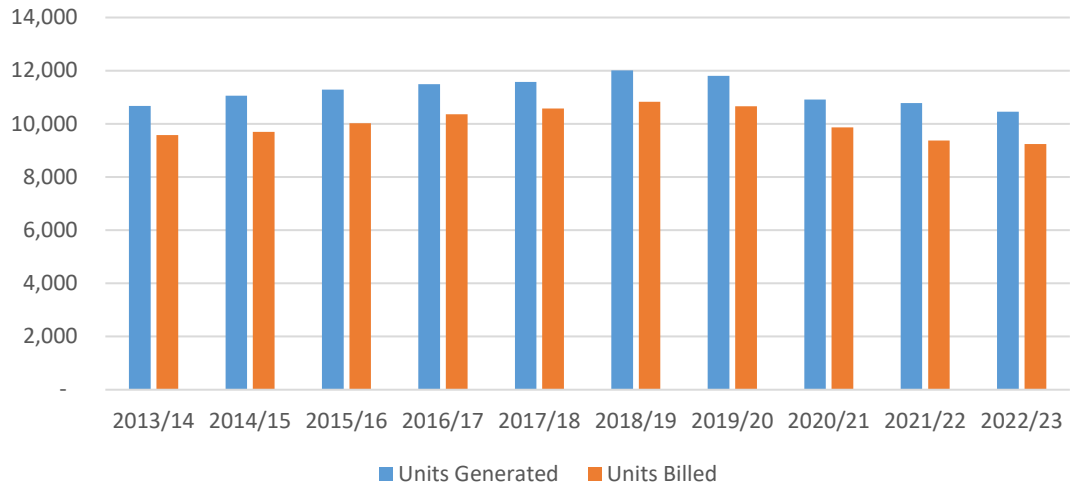
- Ageing infrastructure: Three of the twelve wind turbines have exceeded their useful life whilst a further three wind turbines are nearing end of life. There are increasing challenges around maintaining and operating the existing wind turbines. In 2022, Connect averaged five fully operational wind turbines at any point in time. This is discussed further in the section on Wind Turbine Condition Assessment below.

2.3 Electricity Consumption Data

The figure below shows electricity generation and consumption over the period 2013/14 – 2022/23.

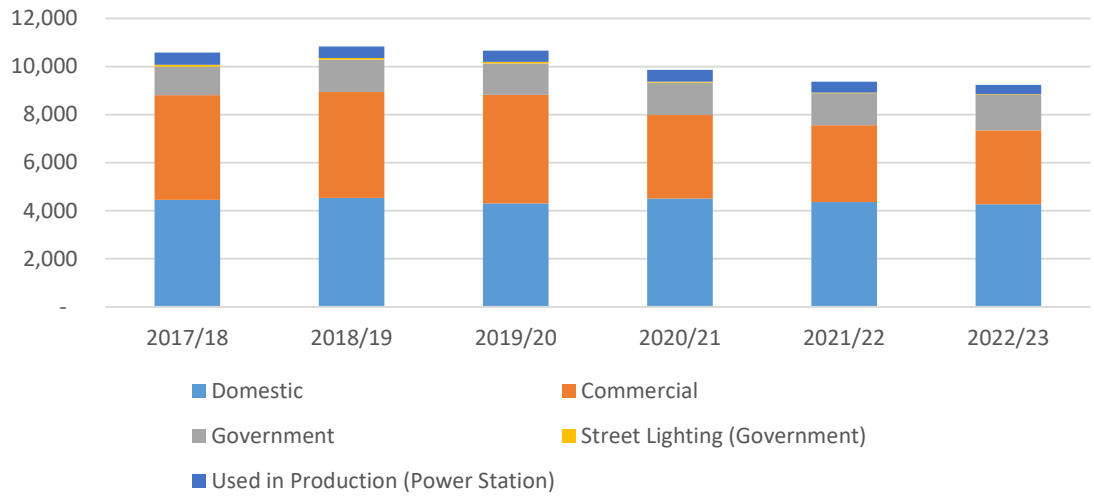
[1] Note that Generators 4 and 6 have been decommissioned.

Figure 1: Electricity Generation & Consumption (MWh)



It is clear that electricity consumption has declined during this period, from 10,576 MWh in 2017/18 to less than 9,240 MWh in 2022/23, a decrease of circa 13%. Current levels of electricity consumption are the lowest in the previous 10 year period. This is explored further in Figure 2 below which shows electricity consumption by consumer type over the period 2017/18 – 2022/23.

Figure 2: Electricity Consumption 2017/18 - 2022/23 (MWh)



The reasons for the decrease in consumption are complex but likely include:

- declining population;
- reduced commercial demand, particularly from the tourism sector due to travel restrictions during the COVID-19 pandemic;
- increased use of private photovoltaic (PV) systems;
- changing consumption habits in response to general inflationary pressures.

2.4 Electricity Generation Data

As noted above, the decreasing levels of consumption have impacted electricity generation patterns. Figure 1 above shows that whilst the level of diesel generation is almost consistent over this period as a result of needing to maintain a stable load, the contribution from renewables has decreased. In 2017/18, 25% of electricity generation was from renewables whilst this decreased to 21% in 2021/22 and 19% in 2022/23.

The World Energy Transitions Outlook 2023 (IRENA, 2023) states that the share of renewables in electricity generation worldwide is 28%. Whilst St Helena is not far from this global benchmark, there is more that could be done with our renewable energy sources if the constraint around maintaining load stability from diesel could be addressed.

2.5 Diesel Consumption

In 2022/23, 2,063 Kilolitres of diesel were consumed in the generation of electricity. During the same year, petrol and diesel prices on the Island increased by 50% and 49% respectively, this follows recent global trends.

The cost of diesel for electricity generation is currently the most significant cost for Connect. The forecast price per litre of diesel in 2023/24 is £1.26 per litre. An allocation of £2.93m has been made in Connect's 2023/24 budget towards fuel for electricity generation (or 67% of the total costs related to the electricity sector).

This in turn represents 42% of the Company's forecast expenditure in 2023/24.

The significant cost of diesel generated electricity as well as the environmental concerns around ongoing use of fossil fuels necessitate a transition to increased renewable energy generation on St Helena.

2.6 The Work to Date…

In 2017 SHG and Connect commenced procurement for a provider to supply long-term renewable energy to St Helena under a Power Purchase Agreement (PPA). A contract was signed between Connect and Sustainable Energy 1 Limited, a subsidiary of PASH, in May 2020. However, following a period of negotiation and planning, amidst changing circumstances worldwide, particularly in light of the COVID-19 pandemic, the PPA was terminated in November 2021.

Discussion then took place with the reserve bidder under the original 2017 procurement. However, despite all best efforts, in July 2022 it was again concluded that the circumstances were substantially different from when bids were originally submitted in 2017 and it would not be possible to proceed. The 2017 procurement for a renewable energy project was therefore concluded in July 2022.

In July/August 2022, Connect commenced work on plans for energy transition to significantly increase electricity generation from renewable energy sources. This has resulted in the development of this Energy Delivery Plan whilst various feasibility studies have commenced in parallel.

3. Link to Policy Principles

3.1 The Purpose of the Energy Delivery Plan

The Energy Delivery Plan takes forward the earlier work planned under the 2017 procurement (see above). The purpose of the Energy Delivery Plan is to develop a programme of improvements in the energy sector on St Helena, focusing on energy transition from primarily diesel generated electricity to the majority of electricity generation being from renewable energy sources.

The anticipated benefits are:

- Environmental benefits, particularly in relation to reduced use of fossil fuels for electricity generation, thereby contributing to climate change targets within the Paris Agreement.
- Financial benefits through reduced diesel usage in electricity generation.
- Improved energy security through reduced reliance on diesel.

3.2 Link to the Sustainable Development Goals

The Energy Delivery Plan will contribute to the following UN Sustainable Development Goals:

Ensure access to affordable, reliable, sustainable, and modern energy for all (Sustainable Development Goal 7).

"*Take urgent action to combat climate change and its impacts"* (UN Sustainable Development Goal 13).

3.3 Link to the Vision for St Helena

The Vision for St Helena is "*…a sustainable island environment that creates opportunity and inspires social and economic progress, ensuring a better quality of life for all"* (SHG Vision 2022).

As above, the Energy Delivery Plan will also contribute to the high level environmental and economic goals within the Vision for St Helena.

3.4 Link to the SHG Energy Strategy

The St Helena Energy Strategy (2016) contributes directly to that Vision. The Energy Strategy states *"St Helena's energy strategy will aim to improve the social and economic well-being of its population, and minimize the impact on the environment. It will increase the production of energy through renewable sources, and reduce the island's reliance on imported fuels, increase fuel security and price stabilization".*

3.5 Link to the SHG Renewable Energy Policy

SHG approved a Renewable Energy Policy in August 2023. Connect was a member of the Working Group that developed Options for Renewable Energy Policy (REP) and therefore the Energy Delivery Plan is aligned to the REP. The REP states:

The rationale for the [REP] is primarily driven by cost – to provide access to affordable, reliable, sustainable modern energy - and also by the desire to develop green tourism (green marketing of hotels and other services) and to contribute to the reaching of the Paris Agreement goal of 2016 to limit global warming to well below 2, preferably to 1.5 degrees Celsius, compared to pre-industrial levels.

This document speaks to the Strategic Outcomes

a) Effective Infrastructure: we live in well-designed sustainable places where we can all access the amenities and services we need.
b) Altogether Greener: we value and enjoy our built and natural environment and protect and enhance it for future generations.

3.6 Link to the Connect Strategic Plan 2023/24 – 2027/28

Aligned with all of the above, the Connect Strategic Plan 2023/24 – 2027/28 affirms our commitment:

- to the environment (including the Paris Agreement).
- to our customers through striving for improved cost efficiency and affordability.

We recognise that the energy sector generally and St Helena in particular have evolved since the Energy Strategy was published. The advancement in the renewable energy sector and reaffirmed commitment from countries around the world to addressing climate change and the global energy crisis give rise to opportunities that were not present in 2016.

The Connect Strategy sets the specific target of reaching 80% electricity generation from renewables by 2027/28.

In practical terms this means that we wish to ensure safe, effective and reliable electricity services for the island which are generated primarily through the use of renewable energy sources.

Recommendation 1:
The Energy Delivery Plan is adopted as a roadmap to deliver energy transition and related reforms, targeting 80% electricity generation from renewable energy sources by 2027/28.

Version 1 of the Energy Delivery Plan adopted in April 2023.
Version 2 adopted in September 2023.

4. Constraints and Challenges

The key challenges within the energy sector on St Helena at this time that have a bearing on the Energy Delivery Plan are:

- Longer lead in times for procurement
  The specialist nature of the equipment under consideration coupled with disruptions to supply chains following COVID-19 as well as generally increased demand in the renewables sector have the potential to increase procurement timeframes. For example, Connect has struggled even with trusted suppliers to obtain timely responses and procurement times for even basic supplies have almost doubled in length. Whilst all involved in the Energy Delivery Plan would wish to deliver increased generation from renewables at the earliest opportunity, there may be few options to accelerate the programme.

- Diseconomies of scale
  In light of supply chain challenges, it must be recognised that St Helena will be competing with numerous nations around the world who are seeking to make the transition to net zero (or at the very least increase their proportion of electricity generation from renewables). Whilst St Helena is seeking to expand its renewable energy infrastructure, this is in terms of megawatts of generating capacity where other nations will be considering investing in gigawatts. This places St Helena at a disadvantage.

- Remoteness/Impact on Logistics
  St Helena's remote location poses various supply chain challenges. Whilst there are various reports that indicate that the cost of renewable infrastructure is reducing in comparison to fossil fuels (IRENA 2022) such benefits could easily be eroded by increased shipping and delivery costs to the island.

  Setting aside cost factors, the logistical challenges of delivery and installation to a remote territory such as St Helena need to be carefully planned.

  Finally, St Helena's physical remoteness requires a level of contingency to ensure that the island can continue to supply electricity to its consumers with minimal disruption. This again requires careful design and planning.

- Ageing infrastructure
  Unlike the 2017 procurement which was timed so that implementation took place as existing assets came up for replacement, there is now the additional challenge that certain critical assets have exceeded or are near to exceeding their expected lifespan (6 of the existing wind turbines being case in point). Given expected timeframes for procurement, this creates the challenge of finding options to extend the lifespan of these assets in the short-term until a long-term solution can be put in place under the Energy Delivery Plan.

- Can we reach 100% generation from renewables?
  The SHG Energy Strategy (2016) set a target of moving towards 100% electricity generation from renewables. However, this is unlikely to be technically feasible.

  Various case studies show that small island states transitioning to 100% renewables may

retain diesel generators as contingency: this may be an important consideration for St Helena given our remote location. In other cases, small island states may have undersea cable connections to the mainland, thereby managing spinning and load stability issues through this route. This is not an option for St Helena. It will therefore likely be necessary to retain some percentage of diesel generation in order to maintain load stability.

This is a key design factor to be assessed at the detailed planning stages under this Plan from the perspective of:

- Understanding the potential benefits that accrue from increased use of renewables, impact on electricity pricing, etc.
- Planning practical integration of the increased renewables into operations.

Until such detailed designs are complete, Connect will target 80% generation from renewable energy sources by 2027/28, as per the Connect Strategic Plan 2023/24 – 2027/28.

- <u>Forecast Demand</u>

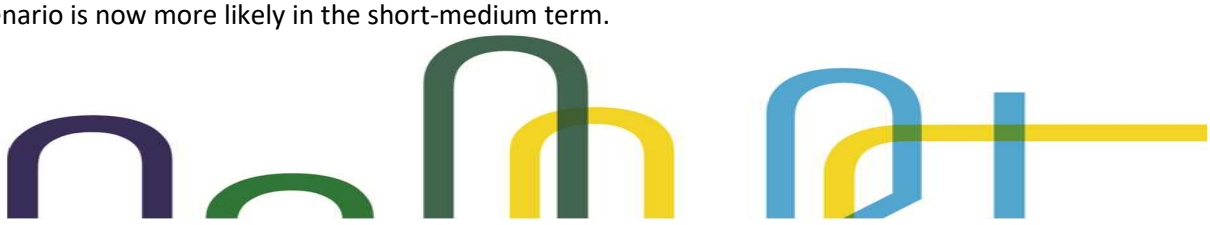
  In order to develop a plan for the energy sector that meets the long-term needs of the island, it is essential to have an understanding of the changing context in which we are working. It is clear that the situation has evolved since the 2017 procurement, not least in terms of the decline in electricity consumption between 2017/18 and 2022/23.

  The most recent study that explores electricity demand is the 2030 Vision & Infrastructure Plan/SHG Capital Programme (2020-2030) (John Cox, May 2020) [hereafter the Infrastructure Plan.] This considers three population growth scenarios developed by the SHG Statistics Office and resulting electricity demand. The Infrastructure Plan concludes that the existing generation capacity is sufficient to meet current needs and that the expanded capacity planned under the 2017 procurement would be ample for these scenarios. Sections 4 and 5 of the Infrastructure Plan refer.

  Based on this, at this point in time the assumptions within the Request for Proposals (RPF) for Renewable Energy on the Island of St Helena, (SHG and Connect, July 2017) remain in effect. The RFP called for 2 MW of renewable energy generation capacity within 24 months of operation, and 5 MW within 15 years of operation.

  The current population numbers are consistent with the low population growth scenario but prospects for increased visitor numbers lead to an assumption that at best we might be on a trajectory for the medium growth scenario over the short-medium term. With this lower starting point and a medium growth scenario, the original requirement for 2MW renewable generating capacity remains valid.

  However, notwithstanding the above, the changing context must be considered. For example, calls for increased use of private PV systems could further reduce demand. It is too early to estimate the pace at which tourism growth might take place or what offsetting impact it might contribute against factors such as increased private PV usage and changing consumption habits. The declining trend in electricity demand over the past 5 years can only partly be attributed to the impacts of the COVID-19 pandemic: further investigation is required to determine whether a low growth (or even declining) electricity demand scenario is now more likely in the short-medium term.



In light of this, proceeding purely on the basis of the information gathered up to 2020 without factoring in the changing context could result in over-engineered solutions and the opportunity cost of investing in greater generation capacity than might actually be required.

This necessitates demand forecasting and scenario planning as soon as more information is available to facilitate development of detailed technical designs.

Recommendation 2:
Assumptions within the 2017 RFP are applied as an interim measure but it is a requirement that electricity demand modelling is undertaken to prepare long-term forecasts. The outcome should be used to facilitate development of detailed technical designs.

Recommendation adopted in April 2023. No changes proposed at this time.

- Funding availability

  Funding is a critical constraint. It is clear that Connect does not have sufficient funding at its disposal to implement the Energy Delivery Plan. Funding options that could be explored include:

Table 2: Potential Funding Modalities

Option	Pros	Cons
Power Purchase Arrangement (PPA)	Leverages new money. Would not call on St Helena's resources. Brings knowledge/skillset from a partner already working in the industry which can be used to expand local knowledge. Long-term price security. A Renewable Energy PPA owner would likely have access to multiple specialist skills, which are challenging for Connect to secure.	Needs to be carefully planned and contingency built in. Element of risk if the provider pulls out. The isolation and small scale of St Helena's energy requirements (a mini grid) means St Helena is less appealing to financiers of Renewable Energy PPAs. There are far more opportunities worldwide now than in 2017 and St Helena is very small scale compared to other projects that might be taking place. Testing the market and then negotiating price takes time (lesson learnt from the 2017 procurement). Unlikely to be a timely solution. The converse of long-term price security is that St Helena would be locked into this arrangement

Option	Pros	Cons
		– would need to be designed to have some flexibility. Sensitive to changes in demand. Could be subject to inflationary pressures and changes in interest rates which could undermine the business case and weaken profitability
Private investment/ Partnership/ broker type arrangements	Similar to the PPA above but brings in an industry specialist to facilitate arrangements. Likely to have industry contacts with suppliers as well as funders/donors.	As above and adds an additional layer of decision making
Loans	Could potentially be a timely route	Long-term financial commitment but offset through potential savings made from reduced use of diesel. Would Connect need SHG to stand as a guarantor?
Grants/Donor funding	Global interest in moving to net zero. More options available now than in 2017.	Likely to be competitive. Timing uncertain.
Any combination of the above	See above.	See above.

The strategic importance of the Energy Delivery Plan suggests that no funding option should be ruled out at this stage. By breaking down the Energy Delivery Plan into a series of components, there may be funding options that are more appropriate to a particular component. This will need to be assessed component by component and business cases prepared as needed.

Recommendation 3:
No funding option to be ruled out. All available options to be explored.

Recommendation adopted in April 2023. No changes proposed at this time.

5. Moving Forward: Assumptions and Methodology

5.1 Design Principles

In designing the Energy Delivery Plan, Connect has adopted the following design principles (not in a particular order of priority):

- Efficiency
  Efficient production of electricity to meet demand in the long-term.

- Reliability
  Continuous and reliable electricity supply with minimal interruption to our consumers.

- Environmentally friendly
  Options for the provision of electricity in ways that minimise potential environmental impacts and which are consistent with our environmental policy i.e. which reduce reliance on diesel and therefore contribute to mitigating climate change.

- Affordability
  Provision of electricity at prices that are affordable to the residents of St Helena.

- Timeliness
  Even in advance of the 2030 target for net zero aligned to the Paris Agreement, there is growing concern around energy security and potential cost escalation following the global energy crisis and increased costs of diesel.

  Therefore there is a timing imperative on the Energy Delivery Plan to deliver change within the energy sector on St Helena.

- Future Proofed
  Options for the provision of renewable energy solutions should consider not only current but future requirements. Any option adopted under the Energy Delivery Plan should be appropriately sized to meet future needs, give consideration to economies of scale, and should not preclude expansion at a future stage.

5.2 Renewable Energy Sources

The Energy Strategy (2016) outlines a number of renewable energy sources that could be applied in St Helena. It recommends that *"the focus should be on the generation and storage of energy based on Anaerobic Digestion, Wind Power, Solar Power and Bio Fuel"* (para 23, Energy Strategy, 2016). The Energy Strategy envisaged a mixed supply approach.

In developing the Energy Delivery Plan, the following renewable energy sources were considered:

- On-shore Wind Power
  This is currently being implemented in St Helena and has proven effective.

- Solar Power
  This is currently being implemented in St Helena and has proven effective.

- Biomass and Energy from Waste
  Reference is made to the Infrastructure Plan Options Report – Energy, EConnect, 2009. At the time these options were recommended against due to "high operational and maintenance burden" (section 2.2.6 of the report). Whilst recent Island Innovations case studies indicate that energy from waste has become more established, further in-depth feasibility studies would be required in order to pursue this option.

- Tidal Power
  Reference is made to the Marine Renewable Energy Status of the Industry Report For St Helena, Ti-Up, January 2012. This report states that with a mean spring tidal range of 0.9m, St Helena is unlikely to be suitable for tidal range projects. Reference is also made to the ocean depth and coastal conditions (shallower water leading to shelves that drop into deep water) that would make installation challenging.

- Ocean Thermal Energy Conversion (OTEC)
  Reference is made to the Marine Renewable Energy Status of the Industry Report For St Helena, Ti-Up, January 2012 as well as the OTEC Siting and Feasibility Report for St Helena, IT Power, March 2012.

  Both reports concluded that potentially OTEC could be applied in St Helena but that this should not be pursued until a later date due to the cost of investment, the need for the technology to become established (this being very new technology at the time) and technical constraints (limited sites on the coast where this could be applied). The ocean depth and coastal conditions were noted.

  The Ti-Up Report recommended that OTEC be revisited at a later date to see if the technology became established and decreased in cost. In comparison, wind energy was a preferred option through being proven on St Helena.

- Offshore Wind Power
  Reference is made to the Marine Renewable Energy Status of the Industry Report For St Helena, Ti-Up, January 2012. Section 5.3 of the report states:

  St Helena has an excellent wind resource, but the water depth and seabed conditions mean that offshore wind turbines would currently be expensive to install in the waters around St Helena. The size of offshore wind turbines would also mean that at even a single unit could be excessive for St Helena‟s current energy demands (requiring frequent power shedding), making this an expensive option. Unless land constraints are a problem, further development of St Helena‟s onshore wind resource would be a cheaper option for the present.

  This option was ruled out in 2012 in light of the ongoing feasibility of onshore wind energy and has not been explored further.

- Green Hydrogen
  The World Energy Transitions Outlook, 2023 (IRENA) places increasing emphasis on clean hydrogen and its derivatives, estimating that 14% of global renewable energy could be derived from this source by 2050.

  From a St Helena perspective, this is a new technology that, unlike wind and solar, is not tried and tested on-island. Whilst use of this technology has not been ruled out, given the target to reach 80% generation from renewables by 2027/28, it is recommended that the current focus is placed on proven technology on St Helena.

- Hydroelectric Power
  This was one of the options considered under the Infrastructure Plan (2006). The concept was explored further in an Environmental Screening Note (ESN 4 – Energy Storage, 2008). The aim was to provide an energy storage installation which could store the equivalent of several days' island energy consumption. Pumped storage hydro generation is a well-established and reliable technology with a potential lifetime of decades. It makes use of large volumes of water which are transferred between upper and lower reservoirs in order to store and generate energy as required by the electrical power system.

  This scheme was ruled out at pre-feasibility stage due to potential negative environmental impacts at the shortlisted sites. Separately, concerns were raised regarding the variability in water levels during the year (notwithstanding the potential for drought).

  Hydroelectric pumped storage was therefore not pursued at the time. Funding was instead allocated for the current Wind Farm and Solar Farm.

Having considered the above, Connect recommends that within the lifespan of the Energy Delivery Plan the focus is on wind and solar renewable energy solutions. This is because the use of these renewable energy sources is successfully tried and tested on St Helena. Expanding these renewable energy sources on-island allows for ease of technical implementation, as supported by earlier design studies. It avoids the scenario that we might need to start from scratch to understand the technical feasibility of using an alternative renewable energy source on St Helena.

Notably all bidders under the 2017 procurement focussed on wind and solar energy, likely for the above reasons.

This does not negate the potential to incorporate additional renewable energy sources into the supply mix in the longer-term. However, there are advantages to focussing the limited resource available at this time (both financial and technical) into areas that are already delivering.

Adopting known technology is in keeping with the design principles of simplicity, efficiency, reliability and timeliness.

Recommendation 4:
The Energy Delivery Plan should focus on increasing renewable energy generation through increased use of wind and solar energy sources.

Recommendation adopted in April 2023. No changes proposed at this time.

5.3 Procurement Modality

The Energy Delivery Plan will necessitate a procurement exercise similar to that conducted in 2017. There are two potential approaches i.e. SHG led, as was the case in 2017, or Connect led procurement.

It is recommended that Connect leads the implementation of the Energy Delivery Plan, including associated procurement:

- As the Utilities Provider, Connect is fully immersed in the sector.
- The Energy Delivery Plan is a strategic priority for Connect, as per the Connect Strategic Plan 2023/24 – 2027/28.
- Connect has a robust Procurement Policy and appropriate governance arrangements in place, equivalent to those in SHG, to manage procurement of this scale.

Recommendation 5
Connect to lead on implementation of the Energy Delivery Plan, including leading necessary procurement exercises.

Recommendation adopted in April 2023. No changes proposed at this time.

6. Programme of Works

6.1 A Phased Approach

An Action Plan is shown at Appendix 3 of this document. Three phases have been identified within the Energy Delivery Plan.

Phase 1 – Design Feasibility

The objectives in the short-term are as follows:

- At minimum, to maintain existing levels of electricity generation from renewable energy sources.
  This is essential in light of concerns around the ageing infrastructure. As discussed above, three of the existing wind turbines have exceeded their useful life whilst three others are approaching this. The SCADA system is nearly 10 years old and due for either major upgrade or replacement in the next financial year.

  Given the anticipated timing to deliver the Renewable Energy Project, consideration needs to be given to extending the lifespan of some of the existing infrastructure to ensure that there is no reduction in current levels of generation from renewable sources.

- Complete Design Feasibility for the Renewable Energy Project
  The situation, not only in the renewable energy sector but also in St Helena, has evolved since the original tender process in 2017/18. It is therefore important to complete the assessments needed to update the Request for Proposals prior to tendering.

  Additionally, as much of the planning required for the implementation should be considered during design feasibility stage. A lesson learnt from the 2017 procurement exercise is that upon completion of the procurement exercise there was still significant planning required prior to delivery on the ground. Front loading this planning does not extend the timetable for delivery but seeks to make the best possible use of resource in the lead-up to procurement.

Recommendation 6:
Planning for implementation to be frontloaded within the action plan, as part of the design feasibility stage.

Recommendation adopted in April 2023. No changes proposed at this time.

Phase 2 – Implementation

The objective in Phase 2 is to deliver the final design, procurement, installation and commissioning of a minimum of 2MW of generating capacity from renewables.

Phase 3 – Longer term Initiatives

In the longer-term, attention is focussed on initiatives that enhance the energy sector and provide improvements to our customers.

7. Phase 1 – Design Feasibility

The following components make up Phase 1 of the Energy Delivery Plan.

7.1 Grid Impact Assessment

Background
A Grid Impact Assessment was commissioned in 2022 and was completed in 2023. This assesses the potential for connection of private PV systems to the electricity grid. The Grid Impact Assessment assessed the hosting capacity of the electricity grid, whether private PV systems could be connected and potential for a feed-in tariff scheme.

There are different approaches to Customer Owned Renewable Energy (CORE) Systems amongst Small Island States. The Falkland Islands and Montserrat, for example, prohibit the connection of CORE systems to the grid to avoid frequency fluctuations and grid stability issues. The Cayman Islands and Turks and Caicos Islands have both had planned CORE programmes but only following detailed assessments to determine the capacity of the electricity grid to support these and with a defined limit to what can be hosted.

This work is critical to understand the feasibility of integrating CORE systems into the electricity grid. The advantages of additional electricity generated through renewable energy sources are clear but consideration must also be given to the risks unmanaged feed-in can present to the stability of a micro-grid like that in St Helena.

Determining whether it is technically feasible to integrate private PV systems into the grid and the potential use of private PV systems is an important factor in 'sizing' the additional renewable energy generation capacity that is required. Increasing interest in private PV systems could have a significant impact on forecast demand from the grid.

Findings from the GIA
Redacted – Connect is in the process of conveying detailed findings to key stakeholders before communicating with the general public.

Next Steps:

Of critical import to the wider Energy Delivery Plan are the findings:

- The focus should be on utility scale renewables, rather than private PV systems.
- There can be no export to the grid from grid connected private PV systems. This effectively rules out all potential for feed-in systems. This means that the expansion of utility scale renewables can be sized accordingly.

The above recommendations have been built into the Modelling and Design Consultancy (see below).

7.2 Assessment of Existing Wind Turbines

Background
Connect commissioned WES (Wind Energy Solutions) to undertake an assessment of the

existing wind turbines to determine (a) remaining lifespan and (b) detailed maintenance regime for the period (estimated 3 years) until a renewable energy solution is in place.

Findings from the Wind Turbine Assessment
The first draft report from WES was returned in late August 2023. WES produced a detailed condition assessment and maintenance programme for each of the wind turbines. WES found that all 12 wind turbines were in very good condition and with investment of around redacted in a major overhaul, each of the wind turbines would have at least a further 10 years expected lifespan.

This finding will be used to guide decision-making on the degree of investment in maintenance/upgrades of the existing wind turbines that is cost justified in the short-term.

Consideration is currently being given to directing the current wind turbine maintenance budget and funding within the current capital programme to undertaking the major overhaul.

7.3 Ongoing Maintenance of Existing Wind Turbines

There is an ongoing maintenance programme for the existing wind turbines. This is essential to ensure there is no reduction in generation capacity. This maintenance programme is not without issue as maintenance requirements are increasing given the age of the assets.

The recommendations from the WES assessment of the existing wind turbines (see above) will provide an updated maintenance programme going forward.

Note that maintenance of the solar farm is also ongoing but this is somewhat newer and the maintenance regime is relatively simple.

7.4 Battery Energy Storage System – Assessment and Design

Background
Connect commissioned WES to undertake the detailed design for a Battery Energy Storage System (BESS). A BESS is a logical solution for storage of excess energy generated from renewables.

A key part of the design and assessment was to determine whether a phased approach could be adopted i.e. whether it is possible to procure the BESS at an earlier point than the increased renewables planned in Phase 2. It has been suggested that a BESS will have a shorter procurement time and could offer benefit when used in connection with the existing renewables.

A key consideration will be whether the combination of the existing wind turbines and BESS would enable the quantity of electricity that must be generated through diesel generation in order to maintain load stability to be reduced. This would increase the percentage of electricity generated by renewable energy sources even in advance of expanded renewable energy generation capacity.

Findings from the WES BESS Study

Unsurprisingly, WES found that the gains of adding more renewable generation are quickly not effective if there is no energy storage added. The inclusion of BESS is therefore an essential component of any proposal for energy transition on St Helena as this will increase the usage of the available energy sources, and result in less requirement for curtailment of renewable energies.

WES proposed a number of options, from a smaller interim solution in the short-term, to a larger BESS which would become grid-forming, rather than using diesel generation for grid stability. Each of these options is being costed and a separate business case is being prepared to make recommendations for investment.

7.5 Building In-House Capacity

The strategic importance of the Energy Delivery Plan and the ambitious timetable set by Connect, particularly for Phase 1, requires additional resource to support delivery. It is therefore planned to recruit a Senior Renewable Energy Engineer to join the Electricity Team. It is anticipated that recruitment will be completed in late 2023.

Alongside this, it is recognised that the Electricity Generation Manager post is currently a single point of failure. There is a need to build capacity in this section to address this, primarily through providing an additional engineer for the section. It is anticipated that recruitment will be completed in late 2023. The training planned during Phase 2 (see below) will also contribute to building capacity.

7.6 Specialist Renewable Energy Design Input

This item has been overtaken by 7.10 – see below.

7.7 SCADA – Assessment and Design

The Supervisory Control and Data Acquisition (SCADA) System manages the interface between the Power Station and the different forms of electricity generation (diesel, wind and solar). An upgraded or even new SCADA will be required in Phase 2 but in the interim there is a requirement to extend the lifespan of the existing SCADA. This requires additional maintenance and additional training for staff at the Power Station.

The options considered were:

Option	Pros	Cons
1. Do nothing – continue with minimal maintenance	No additional cost	Cannot guarantee that the existing SCADA will be fully effective in the interim up to Phase 2 of the Energy Delivery Plan
2. Do the minimal – remote consultation on maintenance of the SCADA	Minimal cost whilst still obtaining advice on maintenance of the SCADA	No on-island visit taken during the past 10 years. Runs the risk that the remotely designed

Option	Pros	Cons
		maintenance and training programme is not as effective as if the SCADA specialist was hands on
3. On-island visit by SCADA specialist	Hands on visit by specialist to assess the functioning of the SCADA, design and implement maintenance and design a training programme for on-island staff	Highest cost option

Based on the above, Option 3 is the preferred option.

7.8 Power System Study

This item has been overtaken by 7.10 (see below).

7.9 Review of Regulatory and Policy Framework

There are 3 aspects to this component. In no particular order of priority:

- Regulatory environment on St Helena
  The Electricity Ordinance was published in 1961, with the accompanying Electricity Regulations published in 1995. Both are considerably outdated, having been published prior to the use of renewable energy on St Helena. It is important that the legislation is updated to reflect the present circumstances.

  Key considerations include:
  - An update of the current provisions, particularly with respect to provisions around regulating standards within the energy sector (this is particularly important in relation to private systems to ensure safety and compatibility).
  - Specific provisions related to renewable energy.

  There have been initial discussions with SHG in relation to this which will be pursued during the course of 2023/24.

- Policy initiatives
  In order to prioritise the environmental benefits and contribution to net zero that arise from efficient energy use, regardless of source, it is recommended that consideration be given to policy initiatives that promote this agenda, for example, reduced customs rates for energy efficient goods. A separate paper is being prepared with suggestions based on case studies from other small island states.

- Engaging at an international level
  Energy transition is a global issue. St Helena's commitment to this is reflected in the Energy Strategy (2016) and accompanying documents (see Section 3 above). There is

opportunity to promulgate this at an international level whether at St Helena Government level or at UK level through the policies extended to the OTs, or even at international level through bodies such as the International Renewable Energy Agency (IRENA). There is potential for positive publicity by joining other small island states that have given the same commitment but also potential to access other funding sources designed to support the transition.

7.10 Modelling and Design Consultancy

This project seeks to engage an experienced technical provider to develop the final modelling and design of a cost effective and reliable renewable energy hybrid solution for St Helena. It will build on earlier studies developing detailed demand (and thus generation) forecasting models, and will be used to appropriately size requirements for additional renewable energy generation capacity to deliver on Connect's target of 80% electricity generation from renewable energy sources by 2027/28.

Previously, this had been broken down into two separate studies:

- Specialist Renewable Energy Input
- A Power Systems Study

Combining these into a single study provides a more streamlined approach intended to accelerate the Energy Delivery Plan.

The Modelling and Design Consultancy will deliver detailed designs and support the process to procure, install and commission the additional renewable energy infrastructure through a future Renewable Energy Project. Specifically, the Consultancy will undertake the following:

<u>Phase 1: Modelling and Design</u>

a) Demand modelling
b) Measurement and data acquisition
c) Resource assessment and energy yield prediction
d) Project sizing and design optimisation
e) Final design and preparation of tender documents

In preparing the above, the Consultant will incorporate findings from the pre-feasibility studies made available by Connect, including the WES Review of the Existing Wind Turbines, the WES Battery Energy Storage Assessment, the Grid Impact Assessment, and the SCADA Review.

<u>Phase 2: Support to Procurement Process</u>

f) Support with tender evaluation and contracting arrangements.

8. Phase 2 – Implementation

The key components in Phase 2 are outlined below. Pending the detailed demand modelling and design planned in Phase 1, current planning is based on the capacities specified under the 2017 procurement (also reviewed under the 2020 Infrastructure Plan). The anticipated total cost of the scheme is circa Redacted but this is subject to detailed design.

8.1 2MW Wind Turbines

It is recommended that additional wind turbines are procured and installed to provide 2MW generating capacity.

The capacity is in keeping with that specified in the 2017 RFP. The use of wind energy to deliver this capacity is based on earlier feasibility work carried out under the 2017 procurement. It is acknowledged that detailed design is required and this is therefore subject to change.

The key considerations relate to the best mode for delivering this. For example should we consider 2 x 1MW wind turbines or a greater number of smaller rated wind turbines (e.g. 8 x 250kW).

Option	Pros	Cons
2 x 1MW	Purchase price is expected to be cheaper due to economies of scale	
		Delivery cost is potentially high – earlier feasibility studies involved chartering a special vessel to ship the wind turbines to the island and hiring a large capacity crane to undertake the installation
	Economies of scale when carrying out maintenance	Larger crane required for maintenance
	Cheaper installation cost – only 2 foundations and connections to grid to be made	
Combination of smaller rated wind turbines		Purchase price is expected to be more expensive than Option 1 due to diseconomies of scale. However, this might be offset by the number of wind turbines ordered at one time.
	Installation likely to be achievable with current shipping and existing crane. Prior experience with installing 80kW wind turbines	
	Maintenance can be carried out with existing crane	Diseconomies of scale – multiple wind turbines to maintain instead of 2
		More expensive installation costs – multiple foundations and connections to the grid

The preferred option can only be determined nearer to the procurement process as the costs prevailing will likely be the determining factor.

8.2 500kW Solar Farm

It is recommended that the additional wind turbines are augmented by an additional 500kW solar farm. This replicates the existing solar farm.

This recommendation is based on design feasibility undertaken through the 2017 procurement. Again, detailed design will be necessary and it is recognised that this is subject to change.

The existing solar farm consistently contributes 10% of electricity generation. Operational costs are minimal with maintenance requirements managed by existing teams on-island.

The combination of enhanced wind and solar energy is slightly above the capacity required for the medium-term but the additional solar energy capacity provides contingency so that we would not be wholly reliant on wind energy and we would have additional capacity should demand outpace the current expectation (i.e. should we enter a high growth scenario instead of the envisaged medium growth scenario).

8.3 BESS

A grid forming BESS will be a critical part of increasing renewable energy generating capacity. The BESS will enable excess energy to be stored and used. This will be a key part of operations, given the intermittent nature of renewables.

Pre-feasibility assessments for the BESS are being undertaken in Phase 1, with procurement anticipated in Phase 2.

8.4 SCADA

An upgraded or upgraded interface between the Power Station and the different sources of generation will be required. Essential servicing of the existing SCADA is planned in Phase 1 with upgrade/replacement planned in Phase 2.

8.5 Training

Consideration must be given to the integration of the renewables with the Power Station. As part of this, training will be required for local personnel together with annual service contracts.

8.6 Key Considerations

There appears to be an expectation that Phase 2 of the Energy Delivery Plan will result in radically reduced electricity prices. Whilst expanded generation from renewables will reduce requirements for diesel generation, thereby reducing the costs of electricity generation, Connect would caution that we also need to factor in that:

- There will still be a requirement for some diesel generation for load stability or contingency purposes.

- There will be additional maintenance requirements, including specialist visits for the wind turbines, BESS and SCADA. Future maintenance and operational costs should not be compared with the present when the current wind turbines are at or nearing end of life.

A key part of Phase 2 will therefore be financial appraisal of each of the bids received, not only from an initial capital investment perspective but to understand ongoing costs and the impact on the price per unit of electricity.

9. Phase 3 – Longer term Initiatives

In the longer-term, attention is focussed on initiatives that enhance the energy sector and provide improvements to our customers. This phase is more conceptual at this point in time but will be developed over the course of the Energy Delivery Plan.

So far, two key areas have been identified:

- Installation of a smartgrid (including smart metering)
  In addition to the technical efficiencies that a smartgrid would deliver, the benefit likely to be of most interest to the consumer relates to the smart metering aspect whereby it would then be possible to offer off-peak usage rates or other preferential billing schemes.

- Facilitation of Electric Vehicles
  Off-peak usage rates will be one aspect that could facilitate the usage of electric vehicles on St Helena but other practical steps (e.g. the introduction of EV charging stations) are also worthy of consideration in the longer-term.

10. Summary and Recommendations

The Energy Delivery Plan takes forward the earlier work planned under the 2017 procurement (see above). The purpose of the Energy Delivery Plan is to develop a programme of improvements in the energy sector on St Helena, focusing on energy transition from primarily diesel generated electricity to the majority of electricity generation being from renewable energy sources.

The anticipated benefits are:

- Environmental benefits, particularly in relation to reduced use of fossil fuels for electricity generation, thereby contributing to climate change targets within the Paris Agreement.
- Financial benefits through reduced diesel usage in electricity generation.
- Improved energy security through reduced reliance on diesel.

The key recommendations that informed the design of the Energy Delivery Plan are that:

1. **The Energy Delivery Plan is adopted as a roadmap to deliver energy transition and related reforms, targeting 80% electricity generation from renewable energy sources by 2027/28.**

2. **Assumptions within the 2017 RFP are applied as an interim measure but it is a requirement that electricity demand modelling is undertaken to prepare long-term forecasts. The outcome should be used to facilitate development of detailed technical designs.**

3. **No funding option to be ruled out. All available options to be explored.**

4. **The Energy Delivery Plan should focus on increasing renewable energy generation through increased use of wind and solar energy sources.**

5. **Connect to lead on implementation of the Energy Delivery Plan, including leading necessary procurement exercises.**

6. **Planning for implementation to be frontloaded within the action plan as part of the design feasibility stage, rather than following procurement.**

The Energy Delivery Plan is not intended to be static but is a live document that will evolve over time as plans for energy transition and wider improvements are developed. It is recommended that the accompanying Action Plan (redacted) is used to track changes to and progress against this initial version of the Energy Delivery Plan.

Appendix 1: Acronyms and Abbreviations

BESS	Battery Energy Storage System
Connect	Connect Saint Helena Ltd
IRENA	International Renewable Energy Agency
KWh	Kilowatt hour
MW	Megawatt
MWh	Megawatt hour
OTEC	Ocean Thermal Energy Conversion
PV	Photovoltaic
REP	Renewable Energy Policy
SCADA System	Supervisory Control and Data Acquisition System
SHG	St Helena Government
VRE Sources	Variable Renewable Energy Sources
WES	Wind Energy Solutions

Appendix 2: References

- St Helena 2021 Population and Housing Census, St Helena Statistics Office, 2021
- Quarterly Billing Statistics, Connect, March 2023
- Electricity Generation Data Report , Connect, March 2023
- Request for Proposals for Renewable Energy on the Island of St Helena, (SHG and Connect, July 2017) https://www.sainthelena.gov.sh/wp-content/uploads/2012/08/RFP-Renewable-Energy-FINAL-180717.pdf
- World Energy Transitions Outlook 2023: 1.5°C Pathway, International Renewable Energy Agency, 2023
- St Helena Energy Strategy, St Helena Government, 2016
- St Helena Government Vision and Strategy, April 2022 – March 2025
- Options for Renewable Energy Policy, draft Version 230307, SHG
- Renewable Energy Policy, August 2023, SHG
- 2030 Vision & Infrastructure Plan and SHG Capital Programme (2020-2030), John Cox, May 2020
- Marine Renewable Energy Status of the Industry Report For St Helena, Ti-Up, January 2012
- OTEC Siting and Feasibility Report for St Helena, IT Power, March 2012.
- Infrastructure Plan Options Report – Energy, EConnect, 2009.
- Environmental Screening Note E4: Energy Storage Scheme, 2008.

Appendix 3: Action Plan

Redacted.