Falkland Islands Energy Strategy

Falkland Islands Government

2023

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Version	Date	Authors
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INTRODUCTION

In order to fulfil the ambitions of the Falkland Islands Environment Strategy 2021 – 2040 and Islands Plan 2022 - 2026, provide for durable energy security, cut pollution risk, and avoid tens of millions of pounds in diesel fuel costs, the Falkland Islands aspires to a fully renewable energy supply by 2045, starting with a significant increase in renewable power provision and battery storage by 2030. This Energy Strategy sets out the intended path forward, and is a key document that will guide the energy priorities over the next 20 years.

This strategy reflects our aspiration for the Falkland Islands to thrive in the emerging global energy environment. A global energy transition is seeing many countries rapidly moving away from fossil fuels to forms of clean, zero-carbon energy by investing in and deploying renewable technologies[1]. These technologies reduce energy-related greenhouse gas (GHG) emissions to mitigate climate change and they typically have better outcomes for public and environmental health by removing the pollution associated with the burning of fossil fuels. These renewable technologies also reduce exposure to volatility in global fuel price and supply, an issue that has been drawn into sharp focus in recent times. The Falkland Islands is at the end of supply chains and dependent on fossil fuel imports to meet its energy needs; to increase energy security and independence it is clear that planning should address fossil fuel and import dependency via concrete infrastructure investments.

This strategy has been developed against a global backdrop of increased fuel costs, elevated cost of living pressures, a need and desire for increased energy independence and security and a global shift towards decarbonisation required to avoid a climate catastrophe[2]. This global context finds its local expression in growing energy security challenges here in the Falklands. Some of our key infrastructure is nearing the end of its useful life, with the Sand Bay wind turbines expected to reach the end of their planned use between 2027 and 2030. Without action, power supply in Stanley will become entirely dependent upon diesel generation in the next decade, at the same time that global fossil fuel costs and risks are growing. Meanwhile, the existing Stanley Power Station has greatly exceeded its intended lifespan. The Falkland Islands Government proposes to address these infrastructure needs, with a focus on a phased build-out of wind and solar generation and battery storage, in a planned and staged way to meet growing demand, providing secure, affordable, clean and sustainable energy to our Islands' community. While a new diesel-fuelled power station is planned, it is intended as a transitional source of back-up power and as a site for battery storage, to be operated consistent with renewable power expansion. It is essential for energy security and will also be cleaner, safer, more energy efficient and away from the populated centre of Stanley than the current power station. Initial plans are under consideration to increase wind energy generation alongside this.

If implemented as proposed, this strategic direction will enhance life in the Falklands by replacing aging and polluting infrastructure with modern facilities – and as renewable power increases, will also generate steadily growing savings in foregone fuel imports. This shift can be complemented by upgrades across our built infrastructure, including increasing the weather-readiness of private and public building stock, replacing aging kerosene and gas appliances with electric appliances that improve indoor air quality, and supporting uptake of electric vehicles as these become the dominant global technology.

[1] Information on global context provided in Appendix 1.
[2] The UN have stated that global CO_2 emissions must be halved by 2030 to avoid climate catastrophe. Source: WEO, I., 2022. Near-Term Macroeconomic Impact of Decarbonization Policies.

Increased relative affordability of innovative renewable technologies can effect positive change for energy security, inclusiveness and sustainability within the energy sector. Globally, investment in clean energy now exceeds investment in fossil fuel-based energy. This trend of growth in renewable energy is expected to accelerate[3]. Every aspect of national energy systems worldwide will continue to be affected by changes in policy, financing, technological advancement and shifts in the supply and demand of energy. It's therefore important that this strategy remain a 'live' document. FIG will periodically update the strategy to reflect changes in emerging technologies, economic and market aspects, and to reflect the findings of analysis in a number of areas where work is ongoing.

Members of the Legislative Assembly 2022-2026

[3] Source: World Energy Transitions Outlook, IRENA (International Renewable Energy Agency), 2022. Accessed at https://www.irena.org/Digital-Report/World-Energy-Transitions-Outlook-2022

1. OUR VISION FOR THE FUTURE

Our energy infrastructure is aging and in urgent need of replacement and demand will keep growing. This creates the opportunity for changing how we do things to create the future we want.

OUR VISION FOR 2045

independent * secure * sustainable * affordable * healthy * resilient

The Falkland Islands has energy independence and security by producing energy through renewable means in a way that builds resilience and reduces external risks. Our energy generation, distribution, storage and use continue to be affordable, equitable and locally relevant. It supports existing and future sustainable development, while fostering positive outcomes for the environment by reducing pollution and using renewable energy systems.

Our people reliably and affordably power their thermally efficient homes and businesses with renewable energy and use sustainable heating, cooking and transport solutions.

TARGETS

Electricity	Energy Efficiency	Heating	Transport	
Primary energy source 100% renewable by 2045	100% of new buildings & 80% of existing (pre-2027) are thermally efficient to identified standards by 2045	100% of new builds and at least 80% of existing builds with sustainable heating solutions by 2045	All new vehicles are zero emission vehicles by 2045	<20% fossil fuel vehicles in fleet by 2045

To achieve an energy transition that accomplishes this vision by 2045 we need to start by:

- Installing 4.6 MW onshore renewable power (wind turbines) by 2030
- Installing 8 MWh of battery storage by 2030
- Building a new power station by 2025
- Upgrade power grid arrangements to maximise efficiency of power transmission and use
- Developing a building standard to make all new homes thermally efficient so as to allow effective operation of sustainable heating by 2025
- Retrofitting 200 existing homes to be thermally efficient by 2027

For how we intend to implement our vision turn to Section 6 and see the Energy Strategy Implementation Plan for a full list of actions.

2. PURPOSE & SCOPE OF THE STRATEGY

To fulfil the ambitions of the Environment Strategy 2021-2040[4] and Islands Plan 2022-2026[5], the Energy Strategy sets out the Falkland Islands' energy priorities. It contains recommendations for the necessary infrastructure upgrades related to energy generation, distribution, storage and use sufficient to advance renewable goals in the Islands Plan and Environment Strategy. It is intended to guide infrastructure planning, investment and yearly procurement planning and budgeting over the next 20 years, as well as development of the proposed National Infrastructure Plan, public investment and developments (e.g. power station replacement) and private-public initiatives and schemes (e.g. those administered through FIDC, implementation of the housing strategy). It is intended to work together with the Pollution and Waste Management policy to reduce pollution resulting from the generation, storage and use of energy.

The Energy Strategy provides a clear, cohesive plan to deliver the vision of this strategy and meet its objectives, including mechanisms for review and update. It provides a clear direction of travel to co-ordinate and accelerate work already underway in government and across the community.

This energy strategy considers multiple aspects of energy: power, heating, and transport. The greatest focus is on the power sector, as renewable transport and heating could be increasingly reliant on this sector in future. It considers all of the Islands: Camp and Stanley. It applies to government investments, developments and schemes, including those achieved through subvention bodies or arrangements with the private sector.

3. OBJECTIVES

We aim to:

1. Provide energy that is reliable, affordable and sustainable to the inhabitants of the Falkland Islands;
2. Ensure our energy security, independence and resilience: reducing our reliance on energy imports like fossil fuels, improving our ability to generate, store and distribute power within the Islands, building resilience to climate change impacts and market shocks on our energy sector;
3. Deliver infrastructure at pace and scale to handle increased capacity as electrification grows;
4. Protect the health of our people and the environment, including by transitioning to cleaner energy sources, increasing energy efficiency and transitioning to cleaner, renewable heating and cooking technologies, especially in our homes;
5. Support the transition to renewable technologies, including by upskilling our community and workforce and by investing in renewable energy generation for our electricity provision and
6. Support sustainable development and economic growth, boosting growth and innovation through our green energy transition.

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[4] One Environment Strategy action is to increase our reliance on renewable energy, with Stanley's primary electrical supply being 100% renewable by 2050. Key objectives of the Environment Strategy include: i) to reduce our carbon emissions through transitioning to using renewable (low carbon) energy sources for power generation, ii) to increase our use of renewable energy sources, with a focus on reliable and appropriate energy with low environmental impacts, iii) to promote energy efficiency and savings, slowing down and stabilising the consumption of energy while ensuring that the needs of people are met, iv) to consider whole of life impacts of measures intended to reduce energy use or of transitioning to renewable forms of energy.

[5] One Islands Plan 2022-26 commitment is to develop and implement infrastructure plans for key utilities, including renewable energy, power supply, water and sewage. It included key actions to implement new sources of power generation, to enable and increase use of renewable energy and energy conservation throughout Stanley and Camp, and to create this Energy Strategy.

4. ENERGY IN THE FALKLAND ISLANDS

Currently, the Falkland Islands rely heavily on imported fossil fuels for energy. There have been good successes in an early start to the transition to renewable energy, such as 30% of Stanley's electricity supplied by wind turbines and the vast majority of rural households generating their primary electricity from renewable sources.[6] However, planned investment is needed to build on these successes. Without this, aging infrastructure and growing demand will cause increased reliance on fossil fuels. Such reliance presents key risks to energy security (e.g. reliance on diesel imports), affordability (effect of fuel price shocks) and environmental pollution (emissions from combustion and potential fuel spills). With energy prices increasing, a volatile petrochemical market and the threat of climate change, switching to cleaner and cheaper energy alternatives that are less dependent on long supply chains is a priority for the Falklands.

To implement the vision of this strategy, section 4 details the current situation, providing the rationale and direction of travel (see also section 6 and the Implementation Plan). In summary:

Investment for Stanley's energy infrastructure should focus on wind energy (and potentially some solar), with back-up battery storage and back-up diesel generation to compensate respectively for both short and long periods without significant wind and sun. Essential to our energy security and to reduce health and safety risks, a new power station will replace the existing aged one. It will be more efficient and use less fuel, rely on newer technology that is cleaner and safer for workers and the public, and be located away from the residential areas, hospital and school in the centre of Stanley. It is intended that the new station will be incrementally phased out from primary generation to essential back-up power. Over four MW of wind turbines should be installed by 2030 to replace existing turbines that age out of use that year, with more incrementally installed to meet 100% renewable primary supply by 2045. This energy transition will need significant investment, but without it, energy security is at risk and continued reliance on diesel is likely to generate fuel costs of over £100 million by 2045 (section 4.1.1; 4.1.2).

Stanley's aging distribution network and energy storage should be expanded and updated to enable growth in and changes to electricity supply. Changes and formalisation of how private users interact with Stanley's electricity grid are also needed, e.g. current inability to support private individuals feeding back into the grid, planning for unexpected private demand (4.1.2). Battery storage is the best initial storage investment that can provide energy sufficient to cover short periods without wind. We will continue to monitor development of emerging storage technologies (like hydrogen) for their potential as practical and cost-effective local solutions (4.1.3.).

Choices will need to be evaluated on how Stanley's energy transition is delivered. Provisioning of electricity is currently fully public, but privatisation or private-public partnerships offer trade-offs in terms of the speed of implementation, reliability and cost (4.4). Irrespective of the delivery mechanism, skilled labour will be critical. Upskilling, retention and future-planning for people who will be able to operate and service an increasingly renewable system will be needed (4.5).

In Camp and Stanley, heating and cooking are quite dependent on fossil fuels. Combustion poses an indoor air pollution risk, and draughty or poorly insulated buildings can mean a greater use of fuels to maintain a comfortable temperature. Retrofitting properties for thermal efficiency or renewable heating is likely to take time, because of limited labour on the Islands (section 4.2). As such, a sharp

[6] A detailed report of baseline information related to energy in the Falkland Islands is provided in Appendix 2.

focus should be on an initial target to improve thermal efficiency and cleaner heating and cooking in new builds – stopping the problem at source. At the same time, existing properties can start to gradually be retrofitted to improve thermal efficiency (with lowered energy use and costs) through insulation and draft-proofing before installing less-polluting, more energy-efficient heating and cooking technologies. Financial mechanisms, like FIDC grant schemes for private sector and FIG investment in its housing stock, will help to support this. Targeting of finances to focus on least-efficient buildings or businesses and lower income households first, should aim benefits in costs and health at those who need it most.

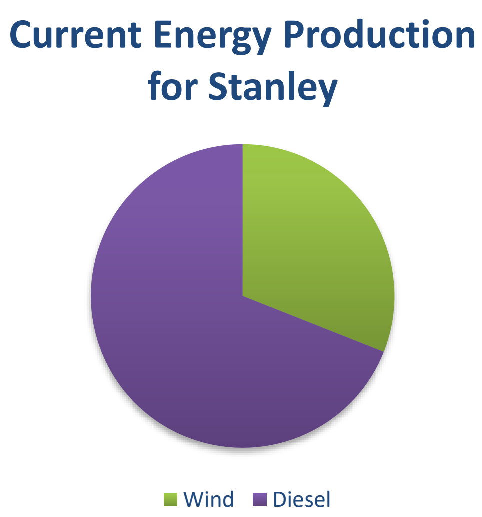
Almost all Falklands' vehicles and plant (machinery) rely on petrol and diesel. A global shift in markets, including the UK's ban on new internal combustion engine vehicle sales from 2035[7], means that uptake of electric and non-combustion vehicles and plant over time is inevitable. In Stanley, the grid cannot currently support fast charging. Public charging stations will also need to be carefully sited to avoid burden on the grid. Smart metering or another mechanism will likely be needed in the longer term to encourage charging at certain times to smooth electricity demand. In addition to facilitating uptake of electric vehicles, efforts to promote alternatives to driving offer potential savings on carbon emissions and cost of living – reducing fuel and vehicle costs – alongside public health gains (Section 4.3). In the short term this includes encouragement of active transport, such as cycling (or e-bikes) and walking, and longer-term consideration of public transport in Stanley, such as an e-bus on regular routes,

4.1 POWER

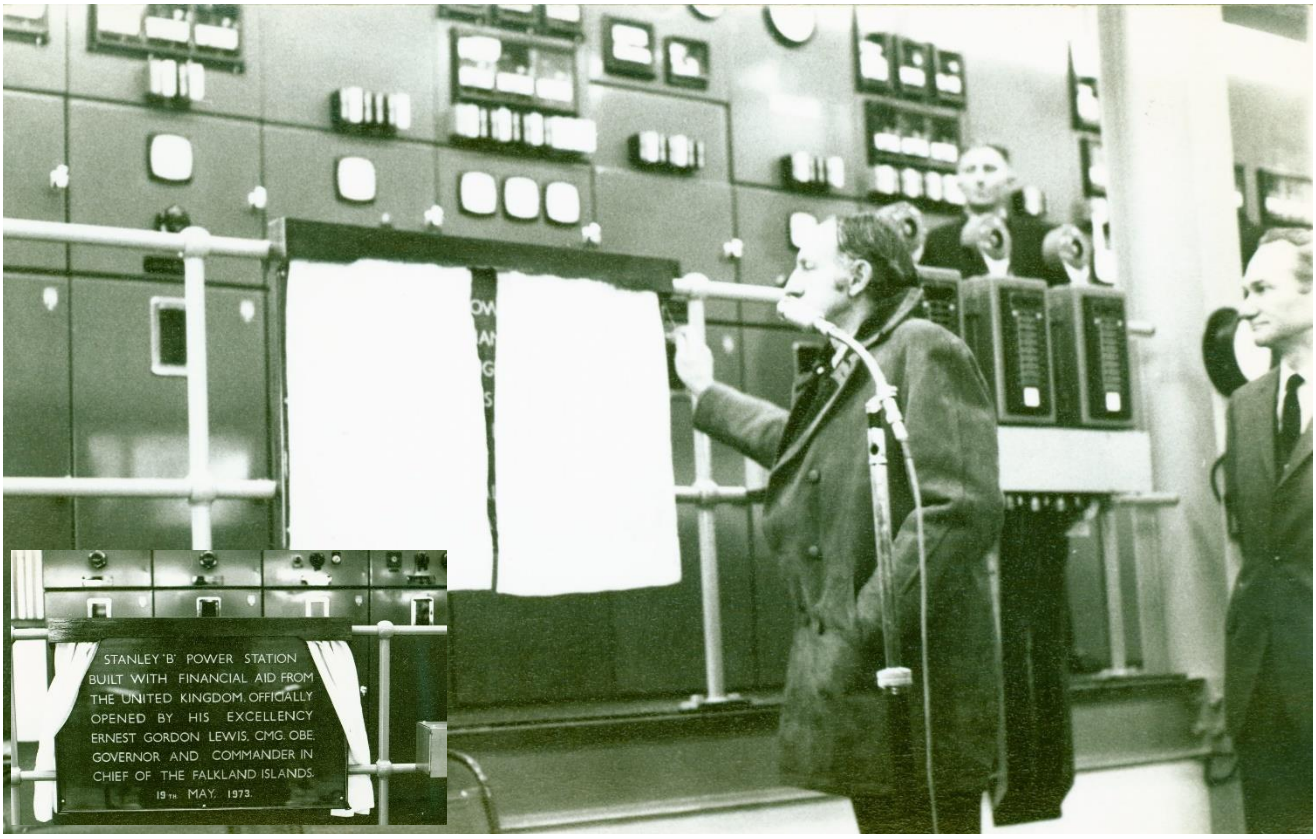
The following sections focus on power in Stanley and Camp (see Appendix 2 for details). Especially in the case of Stanley, there are four points that are critical to consider for a successful development and transition of electricity provision: 1) generation, 2) storage, 3) distribution and 4) skilled people to support and implement electricity provision. Planning and implementation will also need to consider single points of failure, with prioritisation to reduce or eliminate these based on a risk-impact approach.

4.1.1 Energy Generation in Stanley

Current energy generation infrastructure in Stanley is outdated, posing energy security and human health risks. The current power station has been in operation since 1973, exceeding its original planned lifespan, and is intended for urgent replacement with a new power station. Wind turbines at Sand Bay wind farm are newer (Phase 1 2007; Phase 2 2010), but still are approaching end of life in 2027 and 2030, and will need to be replaced. This means planning and budgeting for replacement of existing infrastructure and expansion of renewables to meet future demand is critical to both energy security and to avoid increasing reliance on diesel imports for electricity



[7] 80% of new cars and 70% of new vans sold in Great Britain are set to be zero emission by 2030 and 100% by 2035. Source: https://www.gov.uk/government/news/government-sets-out-path-to-zero-emission-vehicles-by-2035



Power Station 'B' was opened in Stanley in 1973. Having recently celebrated it's 50^{th} anniversary it has performed remarkably well, having exceeded its original intended lifespan. However, it is due urgent replacement. Photo credit: Historic Dockyard Museum.

generation. It will also help to swiftly reduce and remove polluting sources such as emissions from combustion and potential diesel spills, leading to notable benefits for human and environmental health.

Work on reducing reliance on fossil fuel imports, replacing old infrastructure, increasing energy security and reducing emissions, while meeting future demand is already in train. Due to advances in technology over the last 50 years, a new power station, though diesel-powered, will be more efficient, less polluting and designed with space and connections necessary for battery storage to support the expansion of renewable power sources. The new power station is intended to gradually take a back-up generation role. Work was commissioned from specialist consultants[8] on alternative renewable energy generation and storage options for Stanley and the findings of this have informed plans to date and have been incorporated into the current strategy.

The Sand Bay wind turbines are also rapidly approaching their end of life – 2027 for Phase 1 and 2030 for Phase 2.

Electricity provision needs to meet demand drawn at any one time (the load) and the total amount used throughout the year. Energy demand is highest in autumn and winter and between 7

[8] 2020. Ramboll. Falkland Islands Government power station energy feasibility study.

am and 9 pm, with peaks around "Smoko" (morning tea break) and lunch time. From 2017/18 data, total load peaked at 3.29 MW. Throughout the year around 18,000 MWh of power was produced and delivered – a daily average of around 50 MWh. Further, it has been observed that demand has increased over time. When wind speeds are favourable (there's wind >2.5 m/s, but not too much <28 m/s), electricity is generated from the Sand Bay Wind Farm – 5,504 MWh generated per year in 2017/18, around 30% of the total for Stanley.

Future projections (Figure 1) show a continuing growth in both maximum load (instantaneous demand) and overall consumption through the year (total annual demand). Future demand includes growth in the number of houses (infill and new residential developments like Bennet's Paddock), larger infrastructure developments such as the waste management facility and could include new opportunities which are yet to be explored, like cold ironing (shore to ship power).

In order to meet growing demand, there will need to be an increase in both the electricity available throughout each day to meet consumer needs at any given moment (e.g. when everyone in Stanley turns on their kettles, or 50 freezer shipping containers are suddenly plugged in and switched on, or a new development goes live), as well as enough electricity generated throughout the year. Having redundancy is important, because if major energy users like the quarry or FIMCO come online at the same time demand can exceed supply, overloading the system.

In short, this means that existing electrical infrastructure needs to not only be replaced, but also extended to accommodate growing needs and keep pace with developments and economic opportunities.

Figure 1: Demand on Stanley's electricity infrastructure is expected to continue to grow through time; to meet it we will need to replace and expand on existing, old infrastructure, and expand it. This is going to mean significant investment in generation, storage and distribution infrastructure. Power station production shows past growth, with a linear regression (with high R2 – i.e. goodness of fit) suggesting future demand, alongside Ramboll's (2020) projections based on 3% annual growth.

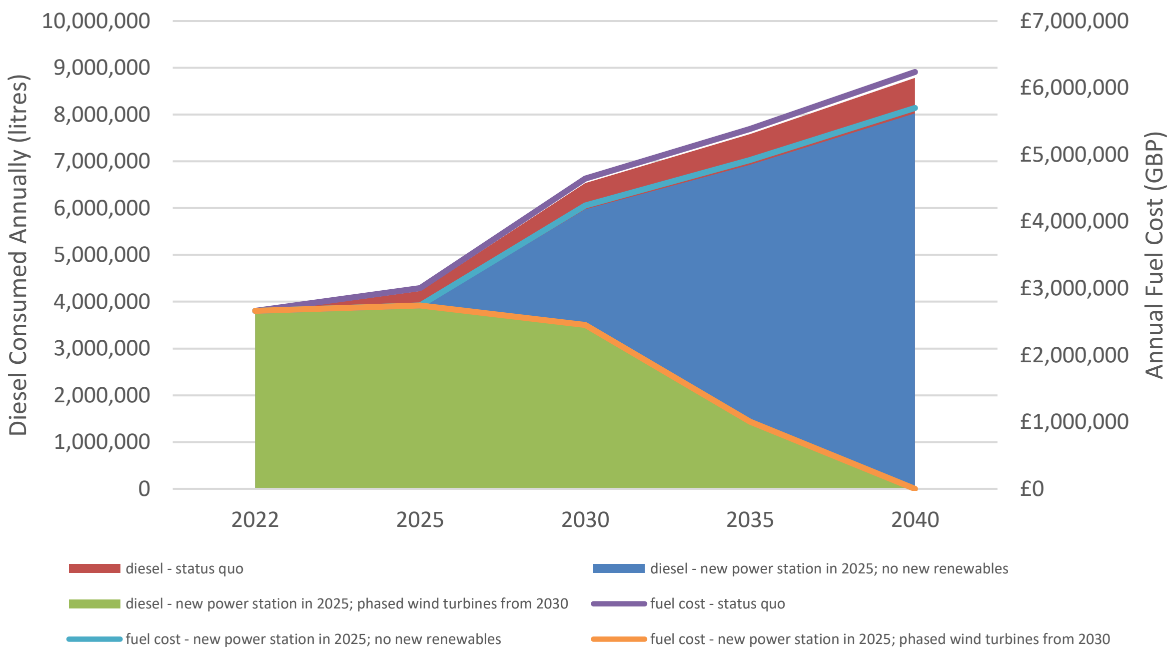


Figure 2: Without transitioning to greener energy forms, diesel use will continue to grow in future. This also bears a significant cost. If no new renewable generation technologies, e.g. wind turbines, are built, the current wind turbines will reach end of life by 2030 and diesel consumption will increase. In this scenario, assuming a fixed cost of 71 p per litre of diesel (price in August 2023), then £110 million could be spent on diesel alone by 2045[9]. Fuel price will not remain fixed, and there are other variables, so this value is for illustrative purposes only. *Status quo*: no new power station is built; fuel consumption remains inefficient. In reality, the existing power station would not be able to meet future project demand growth. *New power station in 2025*: assumes a new, more efficient power station is built to replace the existing power station, however no further investment is made in renewables. *New power station in 2025; phased wind turbines from 2030*: a new power station is built and additional wind turbines are installed as per the phased approach suggested in Ramboll's 2020 report. In all scenarios, existing wind turbines reach end of life by 2030.

Wind, Sun or something else?

The next logical questions are: 1) when should these electrical infrastructure upgrades happen and 2) should they be additional wind turbines, solar (photovoltaic – PV) panels, fossil-fuel based generators, or something else? The answers, as the following section details, are as soon as possible and wind turbines. The next steps should be to, as soon as practicable, 1) assess the best available wind technology suitable for the Falklands before the procurement of new turbines to replace the capacity that will be lost due to turbines reaching end of life in 2030[10], 2) to assess the condition of the current turbines and the possibility to extend their life, and 3) consequently plan for Phase 4 purchase and installation of wind turbines (possibly with solar) to expand current generation capacity, i.e. increase the amount of electricity we get from wind turbines. Without investment in renewable technologies, diesel consumption will vastly increase by 2030 when current wind turbines reach end of life, and will continue to grow with increasing energy demand. Apart from increasing dependence on diesel imports and increased emissions, there is also a large cost to diesel consumption, which adds up over time (over £100 million by 2045, with several million pounds per year more in diesel cost where wind turbines are not replaced and phased in; Figure 2). Renewable energy infrastructure has significant up-front capital costs, as do new diesel generators, but renewable energy will save on fuel costs and emissions and boost energy independence with a reliance on occasional parts and specialist maintenance rather than monthly fuel imports.

[9] Based on Ramboll 2020's future energy demand scenario.
[10] Proposals have been taken to ExCo in November 2023, alongside the creation of this strategy.

A variety of renewable energy sources exist globally (Appendix 3). The choice of which proven technology to invest in must be based on whether they are feasible and practical for the Falkland Islands and how well the energy they produce matches demand through time. A good fit between supply and demand means electricity is available when it's needed and less money needs to be spent on storage (e.g. batteries). Wind and solar energy are proven technologies. Wind turbines have successfully provided significant power to Stanley for almost twenty years while solar and wind have worked well in Camp. A trial of solar PV panels is currently planned for installation at Sand Bay, which will allow the opportunity to test its integration with the existing system.

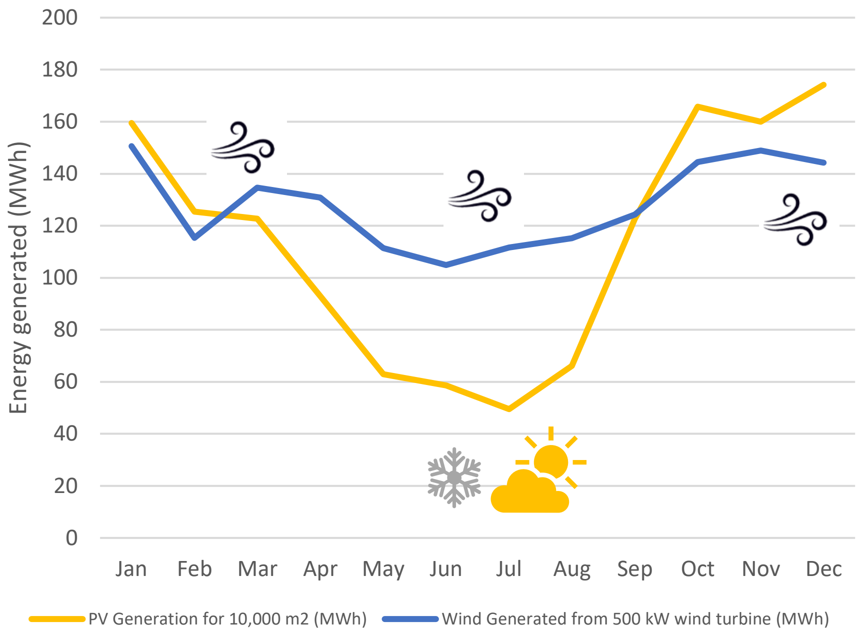


Figure 3: Wind energy generation (blue) is consistent across the year, while there is a major drop in solar energy generation (yellow) in the darker 6 months of the year as there is little light. This makes wind a better fit to consistently meet demand.

Solar radiation varies strongly through the year, with winter sunlight levels only 12.5% of what is available in summer; an almost eight-fold variance between summer and winter. This requires a much greater number of panels to be installed (with associated high relative up-front capital investment) to produce sufficient energy in winter to meet demand. By comparison, wind generation is much more consistent across the year irrespective of season (Figure 3), with a variance of only about 20%[11] between the best and worst days. Wind speeds are estimated to be too high to produce renewable energy (storm conditions) for only around 500 hours per year and too low (calm conditions) for around 1,500 hours per year[12]. Potential production through wind generation could meet demand for about 75% to 95% of the year, meaning that storage needs are more likely to be short term (battery led).

However, the infrastructural challenges related to installing and maintaining the wind turbines available on the global market which have been increasing in physical size) are greater than to install and maintain solar (PV) panels. And more specialist personnel are required for wind turbines than solar panels. This might make a mixed approach attractive over the long run, with early adoption and probable continued dominance of wind energy.

A proposal for phase 3 that takes account of wind generation, associated battery and other needs has been proposed by the power station manager. This also takes account of the fact that wind turbines for the Falkland Islands need to be of a type engineered to cope with the local wind conditions.

[11] 2020. Ramboll. Falkland Islands government power station energy feasibility study; based on 2017-18 data.
[12] 2023. FIG Power station manager.

4.1.2 Energy Distribution in Stanley

The distribution network of the current power station stretches from Stanley Airport to the base of Mount Kent and includes the Pony's Pass quarry and Falkland Islands Meat Company abattoir. Electricity that is generated by the power station and wind farm is distributed throughout Stanley in one of the three ring circuits. The network and planned future changes to it are designed to minimise the impact of line faults on supply. The distribution network also includes step-up transformers and ninety-six substations that distribute and regulate the electricity generated from the power station around Stanley (see Appendix 2 for details).

In addition to ongoing maintenance and replacement of parts, Stanley's aging distribution network ("the grid") will need significant upgrade and expansion alongside changes to generation and storage to meet growing demand. For example, to accommodate the move of the power station or connection of new wind turbines. Our grid is going to need to be sufficiently flexible to work with new technologies (e.g. renewable generation) and their particular constraints and requirements. For example, after a power failure, substations need to first be magnetised before electricity delivery can restart. Currently larger diesel generator sets accomplish magnetization of the substations, but alternative technologies will be needed to accomplish this as diesel generation is phased out over time.

These upgrades are likely to unlock opportunities for improved grid operation and potentially cost savings. Older transmission networks very often experience various inefficiencies, such as "line loss" between generation and use that can create the need to generate more power than is actually needed, raising fuel and infrastructure costs. Grid upgrades can often eliminate or reduce these inefficiencies. This reduces costs over time, while also affording opportunities to operate the grid more effectively. For instance, storage capacity, improved transmission lines and other tools can help store and use renewable power effectively, while likely improving user experiences. As such, ongoing support for planning and grid improvements are explicitly part of this strategy to support the overall transition and unlock savings where possible.

Changes and formalisation of how private users interact with Stanley's electricity grid are also needed.

There are challenges related to the connection of new users or significant developments. The grid has limited ability to support additional demand in some areas. This impacts, for example, where it's currently possible to support and therefore site electric vehicle charge points or support large energy users.

The distribution network is also not able to support the connection of private individuals to feed into or sell back to the grid, e.g. installing solar panels on their house to create electricity while connected to the grid. This is because unpredictable and significant fluctuations in electrical supply or demand can 1) impact the safety of workers, 2) cause damage to infrastructure and personal property, and 3) lead to increased power cuts (for full details see Appendix 2). These challenges are not insurmountable with modern metering and home interconnections, but questions remain on the best use of limited capital to invest and practicalities like who will carry out all the inspections to make sure these are done appropriately to ensure safety of workers, given the challenges of labour shortage.

4.1.3 Energy Storage in Stanley

Battery storage is a widely used form of energy storage for renewable systems and anticipated to be the initial form of energy storage for Stanley. Photo credit: Wikipedia.

Being able to store excess energy generated from renewable sources would allow more of Stanley's electricity to be provided by renewable means, reducing our reliance on fossil fuels. Energy storage enables a consistent supply of energy which can be quickly ramped up or reduced as users' power demand changes and the supply from renewables fluctuates. The amount of storage will need to be increased over time in tandem with renewable generation to provide electricity for periods where wind and sun energy production are low, such as windless nights or periods during the winter when both sunlight and wind are low. It is likely that for prolonged periods of low wind and sun, back-up power will still need to be provided by the diesel power station, but increasing storage means this should happen less frequently.

There are many storage technologies, from batteries to hydrogen to gravity-based storage (see Appendix 3 for details). In the short-term, battery storage makes the most sense and is what FIG intends to invest in for Stanley. However, it is important to periodically investigate other options as part of the periodic integrated resource planning process, as this is an area where technology is rapidly evolving.

There are several potential sites to be considered for battery storage, including the wind farm and the new power station. Other battery storage sites will also be considered at various points of battery systems increase. For example, Falkland Islands Meat Company (FIMCo), where a battery could help to smooth the load by preventing FIMCo from drawing on the grid suddenly during high use times or allowing the battery to re-power the grid when it is not drawing power. Similarly, Pony's Pass quarry should be considered as another potential site for battery storage. Upgrades to transmission systems to these relatively remote but high-power demand locations should also be considered, which would make battery storage easier to use overall for the grid as a whole, and could also help reduce the loss of power transmitted to and from these sites, cutting emissions and costs.

4.1.4 Electricity Generation, Distribution and Storage in Camp

In Camp transition to renewable power sources has been successful with a high uptake (Figure 4), largely as a result of past government-driven incentive programmes operated through the FIDC, e.g. the rural energy grant and the thermal grant. Aside from the Fox Bay settlement, which has electricity provided by the government through diesel-based generation, energy in Camp is largely generated, distributed and stored privately using wind turbines, and solar panels, with battery storage and diesel generators for back-up.

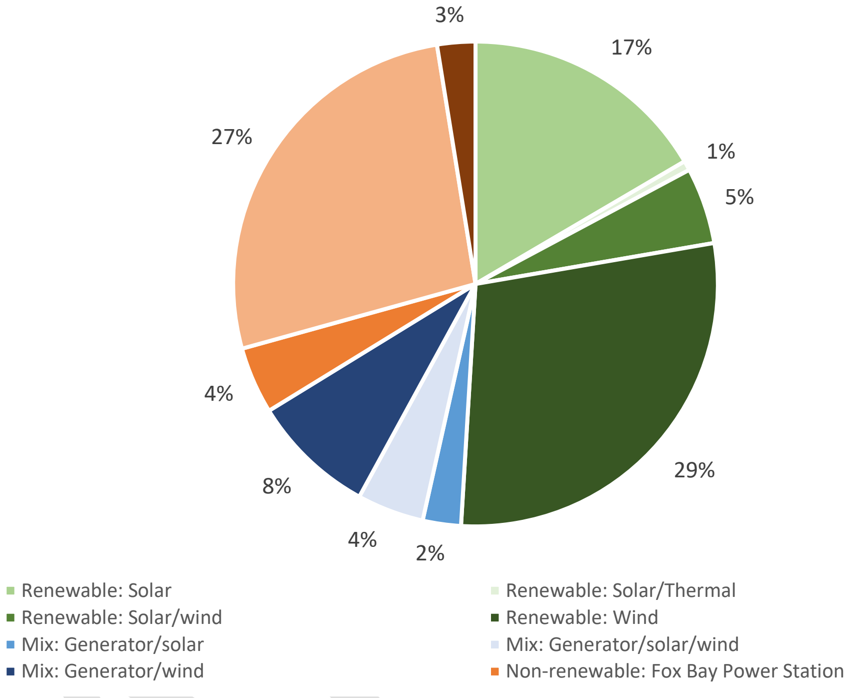


Figure 4: Proportion of energy sources used in Camp based on 2021 Census data. Around 70% of individuals reported relying on renewable energy.

This is quite different to the situation in the early 1990's when electricity in Camp was mainly provided through the use of diesel generators. These were costly to run and only provided power for a few hours a day. The initial drive for renewable transition in Camp was to improve the quality of life in Camp though the provision of affordable 24-hour power, reduced imported fuel reliance, energy savings and electrical system maintenance and safety (ExCo 203-15). The FIG-funded FIDC grants, begun in 1996, were well received with a strong initial uptake by many Camp properties in the early years of the grant scheme (Figure 5).

Renewable energy installations were begun in Camp during the 1990s. They were very successful early adoption of renewable energy to provide secure, 24-hour power. However, many of these installations are now quite aged.

As a consequence, though, many installations are now nearing the end of their lifespan. At 25 to 30 years old, they are in need of significant maintenance or replacement. Although it could be argued that cost savings in fuel over the years should be reinvested into replacement and maintenance of systems, in some cases farms have changed hands with new owners inheriting the cost burden of aging infrastructure. Lower wool prices and other costs have also put pressure on margins in recent years.

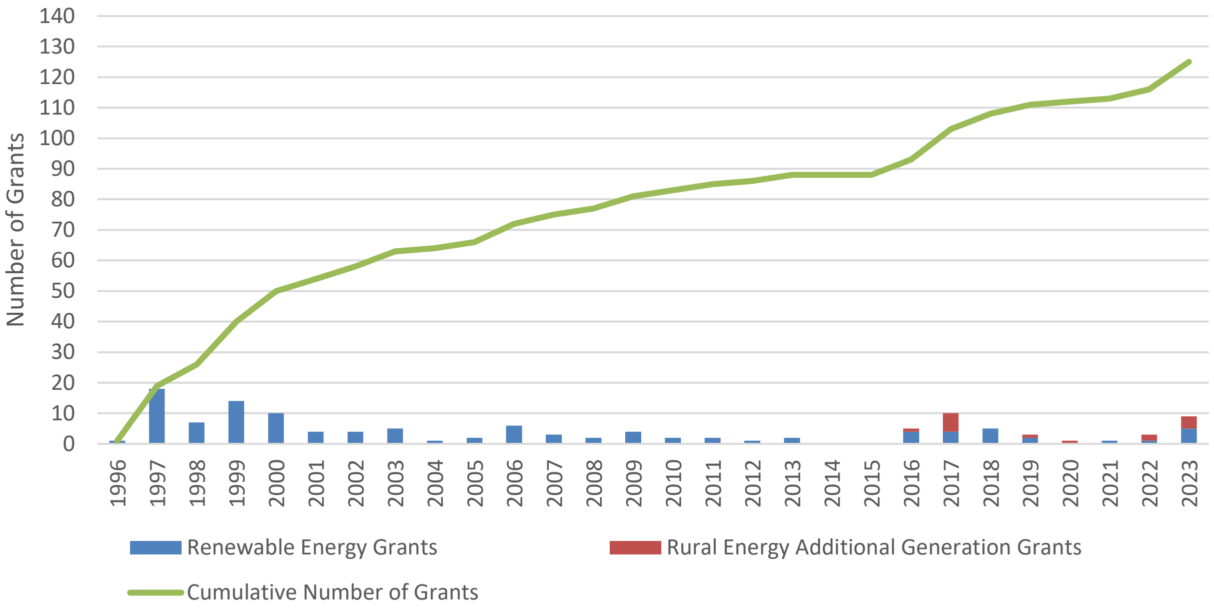


Figure 5: Renewable Energy Grants and the more recent Rural Energy Additional Generation (REAG) Grants have been well taken up in Camp, with a strong initial uptake as many properties converted in the 1990s. REAG grants are for businesses that previously benefited from the RE Grant Scheme and wanted to expand their generation capacity by diversifying into other types of renewables (e.g. adding solar panel arrays to properties that already had wind turbines).

A further challenge will be increasing energy generation and storage demands of business diversification into tourism in Camp and to power renewable heating solutions, such as heat pumps. Without those living and working in Camp reinvesting in renewable energy solutions, there is a risk of increased reliance on diesel generation as a primary rather than back-up source of power. To this end, the Rural Energy Additional Generation Grant scheme and Green Loans[13] are presently available to help fund expansion and replacement of energy systems in Camp. A sensible approach to help finance this transition may be to consider zero or low interest loans to fund replacement and expansion of systems up to a determined threshold, with the repayments reinvested by FIG to fund future replacement and/or expansion once the new systems reach their end of life in 25 to 30 years.

Beyond grant schemes, Falkland Landholdings Corporation (FLH) historically installed wind turbines in their four settlements to supply power to around 40 homes (ExCo 198-15). Some individuals or businesses, have also opted to privately fund renewable power-based systems, such as the recent wind turbine installation at Port Howard. Finally, Fox Bay settlement has public power provision through diesel-based generation. At present, work is underway by FIG to determine options for converting to a renewable power system with battery storage and an updated distribution network.

[13] Green Loans serve as a low-interest, debt-based funding mechanism to help carry out maintenance, upgrade or newly install renewable infrastructure and are available for both businesses and individuals. For a full list of grants and schemes currently available under the FIDC see www.fidc.co.fk.

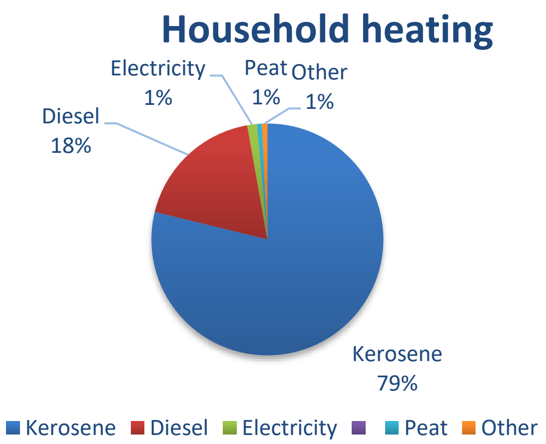
4.2 HEATING AND COOKING

Currently most heating and cooking in both Camp and Stanley is provided through the combustion of fossil fuels (Figure 6).

There are multiple benefits to reducing reliance on fossil fuels including fewer emissions and pollutants from the burning of fossil fuels, including reduced carbon emissions, and less potential for spills that can pollute water and the environment. One of the chief benefits is an improvement in public health outcomes. Burning fossil fuels releases particulates and other by-products that negatively impact health, including increased risk of cancers and respiratory health issues. Particularly where boilers or cookers are located in homes, where people spend a lot of time, shifting to alternative means of heat provision and cooking can have marked benefits for public health (Appendix 4).

There are different ways to reduce fossil fuel usage, improve heating of homes and improve living conditions and health at the same time. There is a large potential for increasing the thermal efficiency of homes given the existing building standard in the Falkland Islands compared to that of the UK. Checking the level of insulation in homes could be done through engineering studies which use techniques like thermal imaging to check for leaks in the housing structure. This can then inform home improvements for better thermal efficiency. Further, increasing the efficiency of existing heating and cooking technologies means that the same results are achieved using less power. Finally, replacing fossil fuel-based technologies with technologies, such as air source or ground source heat pumps and solar thermal heating[14] that rely on electricity will eliminate indoor air pollution from these sources.

Transitioning home heating and cooking will take time and investment. One of the biggest challenges in the Falkland Islands is that there are a limited number of skilled workers able to carry out insulation measures or install new technologies like heat pumps. Critically, technologies like air-source heat pumps use electricity, so it's also important to make sure that adoption of these technologies doesn't outpace the ability of Stanley's future electrical installations to supply electricity.



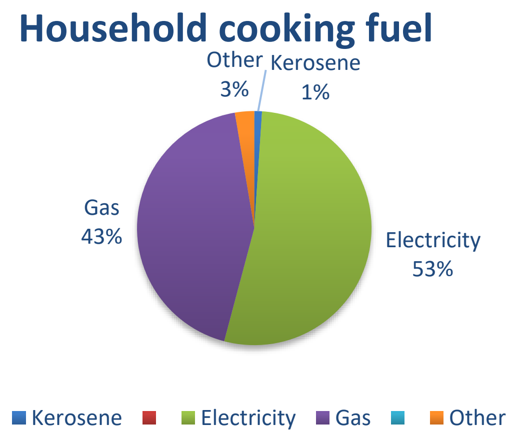


Figure 6. The percentage of households in Stanley by fuel source used for heating (left) and by fuel source used for cooking (right). Source: Census data; 2021.

[14] See Appendix 3 for a breakdown and description of some common renewable technology options

Therefore, the initial focus for Camp and Stanley should be on setting standards for new builds to improve thermal efficiency and to employ cleaner heating and cooking technology as far as possible, which would avoid the need for future more costly and inconvenient retrofitting. At the same time, existing properties can start to gradually be retrofitted to improve thermal efficiency (with lowered energy use and costs) through insulation and draft-proofing before installing less-polluting, energy-efficient technologies. Green loans, grants or other financial schemes could help private individuals to adopt these new technologies so that everyone, irrespective of their financial means, can access improvements in heating their homes and reducing indoor air pollution. This could be achieved for the private sector by aligning FIDC grant schemes with this strategy. FIG investment in improving its own housing stock, will also help to support this. Targeting of public and private finance to focus first on the least energy-efficient buildings or business premises and lower income households should help get the greatest return on investment and ensure those who most need assistance will benefit.

Heatpumps are a sustainable heating option, but work best where buildings have first been properly insulated. Photo credit: Wikipedia.

In Stanley, the electrical demands of homes and businesses with installed heat pumps and other electrical cooking or heating technology should be measured for early adopters as is currently being done with FIG heat pump installations (e.g. flats on Brandon Road). This will allow the future electrical demand for new and retrofitted homes to be better estimated so that we can plan for Stanley's electricity supply to meet future needs.

4.3 VEHICLES

The majority of the more than 1000 vehicles in the Falkland Islands are currently run off of fossil fuels (mainly diesel, some petrol). In 2022, there were only nine electric vehicles in use. Numbers will almost certainly grow in future through transition of technology and consequent availability at a global level. The UK, for example, has banned the sale of new internal combustion engine vehicles from 2035, with an interim target of 80% of new cars and 70% of new vans set to be zero emission by 2030[15] . Where powered by renewable sources, zero emission vehicles (e.g. electric cars) offer significant emissions reductions and reduce release of pollutants to the atmosphere.

Electric vehicle use is growing globally. This will place additional demands on 'the grid' that must be planned for. Photo credit: Wikipedia.

Future planning to generate, store and distribute electricity in Stanley will need to consider growing numbers of zero emission (electric) vehicles. For example, the UK's average daily driving distance of 19 km results in a demand of around 1300 kWh per year[16]. Even using conservative estimate of a quarter to a half of this, given the shorter distances in Stanley, could lead to a demand of 325 – 650

[15] Source: https://www.gov.uk/government/news/government-sets-out-path-to-zero-emission-vehicles-by-2035
[16] Source: https://evbox.com/uk-en/how-much-electricity-does-an-electric-car-use

kWh per car, or an annual consumption of 487.5 MWh to 975MWh for a fleet of around 1,500 vehicles. Electric HGVs and plant would have larger demands.

Promotion of active transport, including e-bikes, within Stanley will help to reduce dependence on fossil fuels or the grid, have side health benefits and reduce traffic congestion around areas like the school. Longer term, public transport options within Stanley could be considered. Photo credit: Wikipedia.

The distribution network cannot currently sustain dedicated public electric vehicle charge points in areas where there is already high demand on the grid. This includes built up parts of town or areas where businesses draw significant power. This is particularly true of the centre of Stanley that currently operates at 3.3kV and experiences a high demand for power.[17] Rapid charging is not currently possible, because it requires a high voltage DC input which the network cannot support. This means that in the short- to medium-term the siting of public fast charge points on the Stanley network will be limited.

Future planning for works on and upgrades to the distribution network will need to identify initial sites for public charge points outside of high demand areas and consider growing future demands for both domestic vehicles as well as HGVs and plant. In Camp, landowners and businesses will need to plan for the likelihood of growing opportunities of electric vehicles and plant in future and consider this as they consider expanding their renewable generation capability or when they replace aging technology, e.g. aging vehicles, aging solar or wind turbines. Electric vehicles offer the option of additional battery storage on days of excess renewable yield.

Alternative transport options within Stanley may be worth exploring to reduce the potential number of electric vehicles that may rely on the grid in future, given the small travel distances. In the short term, a focus on encouragement of increased active transport options, like cycling (including e-bikes) and walking could have benefits for public health, fuel and energy savings. Longer-term consideration of public transport in Stanley, such as an e-bus on regular routes, offer potential savings on carbon emissions and cost of living – reduced fuel and vehicle costs, alongside public health gains.

4.4 Options for Provision

Fully public (energy) provision, as for Stanley's electricity supply at present, is only one model to provide power, "green" or alternative heating, storage and other technological solutions related to energy. Private provision or private-public partnerships are alternatives. For example, the private sector has taken advantage of business opportunities around "green" energy technologies like the provision of solar PV installations or

[17] Upgrading the East 3.3kV ring of Stanley to 11kV to support greater power demand would require replacement of existing infrastructure, including power lines and substations, with substantial capital costs, diversion of labour from other critical tasks and disruptive works, such as digging up roads and gardens in the centre of Stanley.

domestic wind turbines in Camp. All options have their advantages and disadvantages (see Appendix 5 for detailed comparison).

Currently, Stanley's electricity provision is fully public. An alternative model might offer possibilities to get renewable energy online faster or be more reliable. However, changing to another model should be critically evaluated, particularly through the lenses of energy security, affordability and the potential impacts of any offshore ownership/stakes in critical public services.

4.5 Labour

Capable and skilled personnel are essential to all elements of electricity provision, to meeting the objectives and vision of this strategy and, in simple terms, to keeping the lights on.

The skilled labour needed ranges from engineers and specialists to site workers and electricians. This includes people who can plan and assess options for future upgrades and ensure that these happen seamlessly, those who carry out works in often dangerous and complex situations many metres up a wind turbine, and those who connect new users to the grid, swiftly resolve a power cut or fault in the system and work unsociable hours with little public recognition. As in many jobs in a small remote community like the Falkland Islands, these professionals must not only have the skills to do specialist jobs, but also be able to cope with filling a range of different roles and finding creative solutions to a myriad of challenges on the job.

A fundamental challenge for the continued provision of power and implementation of this strategy is to secure and retain the right personnel and promote training of the next generation of people who can fulfil the needs of maintaining an electricity system that is increasingly renewable, and the new challenges and opportunities that brings.

5. FINANCING OPTIONS

Significant capital investment in Stanley's electricity generation, storage and distribution systems will be needed first and foremost to ensure energy security, to replace infrastructure already past or nearing its end of life, and to meet Stanley's growing power demand and this strategy's objectives. Funds should be targeted towards investing in the move away from imported and polluting fossil fuels toward larger scale renewable energy projects and energy efficiency.

A large part of the transition to renewables relies on the generation of capital to support new clean energy infrastructure. The need for cohesive, staged investment with regular evaluations is required in order to avoid future issues in energy infrastructure. A key element of this approach will be planning and investing early so that energy security is maintained and infrastructure will develop and adapt as and when required, rather than relying on energy infrastructure past the intended lifespan as in the past. Therefore, designing long-term capital projects to generate funding is essential for developing green infrastructure. In addition to standard government funding mechanisms, alternative funding such as green bonds for renewable projects could be considered to help fund large-scale public infrastructure and encouraging inward investment.

Looking beyond Stanley's electricity provision, financial incentives and disincentives should be considered as tools to facilitate a transition of domestic and commercial properties to reduce energy loss, increase efficiency and adopt cleaner technologies for heating and cooking throughout the Islands. Existing incentive schemes and any future schemes should be aligned with this strategy to ensure a cohesive staged transition that meets the Falkland Islands' long-term energy objectives, such as providing affordable, clean energy to all citizens.

The timing and capacity of renewable electricity generation, storage and distribution will need to be aligned with the increasing demands of sustainable home heating and electric vehicles, and the schemes that accelerate these. This will help minimise risk of mismatches between electricity supply and demand, with a staged approach where electricity continues to be available when we need it.

6. THE WAY FORWARDS

An engineering-derived estimate of future projections and needed interventions, 'the base case' (Figure 7) has shaped our understanding of necessary interventions until 2030, with 4.6 MW of wind turbines installed by 2030 (wind Phase 3), as well as 8 MW of battery storage and other essential infrastructure to enable expansion of the wind farm, as well as a new power station by 2030 to ensure energy security.

In order to build the energy future we want we will:

- Improve our infrastructure to meet future electricity demand and to embrace renewable energy;
- Improve the energy efficiency of our buildings;
- Heat our buildings in a healthier and more environmentally friendly way;
- Leverage our energy transition to promote healthier and environmentally friendly transport;
- Value our people and promote skills to support the energy transition; and
- Update governance processes to support our energy transition.

We will achieve this through the actions of the Energy Strategy Implementation Plan, which details the main steps of our energy transition to 2030 and beyond.

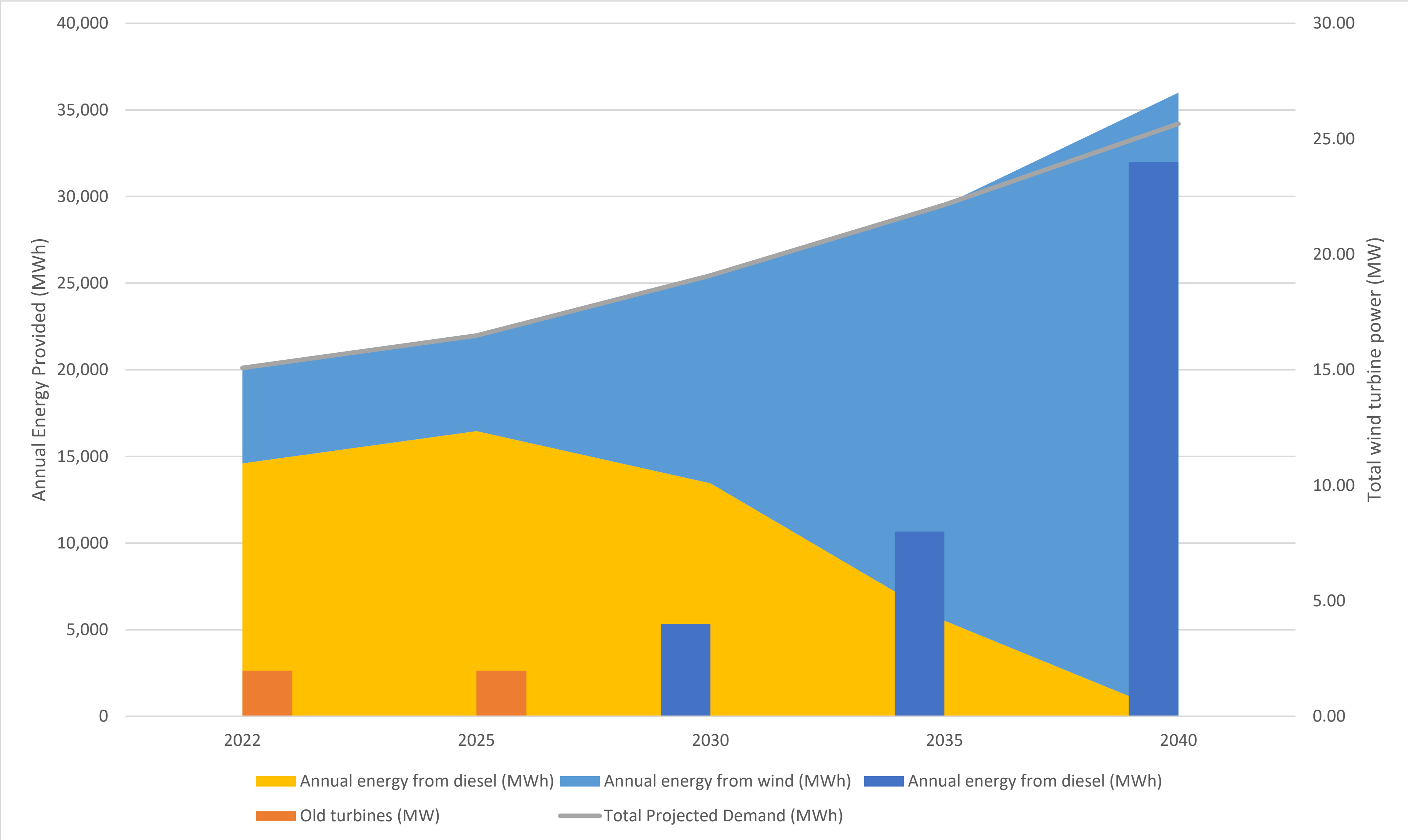


Figure 7: Installation of additional wind turbines (or other renewables) through time should result in full displacement of primary fossil fuel energy production by 2045. Newer, more efficient and less polluting diesel generators will continue to provide back-up power for long periods of time with unsuitable wind speeds. This will require investment in a new power station by 2025, and additional, new wind turbines (renewable sources) installed and running by 2030, 2035 and 2040. Projected demand is difficult to estimate, and so review should be made at strategic intervals of at least every three years, starting at 2027.

The roadmap visualises some of the major steps of the Implementation Plan and includes key periods for review, where we'll be able to check the map against where our community has gotten to on this energy journey.

As part of the review process, it will also be possible to assess whether the route ahead still makes sense or needs a bit of course adjustment. This requires a mechanism to check-in regularly and update our future projections and Implementation Plan to make sure we're on track to the energy future we want. Review is critical because it is hard to predict future energy demand with exact precision, particularly in the Falkland Islands where a few developments that are small by international standards could have a massive impact on future energy needs. Technology is also evolving at pace, and options that are currently unfeasible may become feasible in future, whereas others may become obsolete or less attractive. For these reasons it is necessary to regularly re-evaluate and update projected energy demands and how these will be met, so that we continue to do the best for our Islands.

Using the approach of integrated resource planning, review will take place every 3 years, starting in 2027 by an energy review group set up by the Chief Executive. It is anticipated that the group will include relevant technical experts from FIG Public Works, Development and Commercial Services, and Environment.

Review will include examination of whether projected demand and generation has aligned with reality (e.g. real load, real generation of Stanley's electricity) over the intervening years, and projections and best means to meet these over the following five to ten years will be updated. Review should also include examining whether additional technologies for electricity generation, storage and distribution have advanced, making them attractive going forwards, or whether some technologies have proven to be ineffectual. Plans and schemes can then be adjusted accordingly. To aid this, a suite of key performance indicators and metrics will be collected on an ongoing basis. Review in 2027 will ensure planning for Phase 4 (2035) is real demand-adjusted and considers the most up-to-date information.

Summary reporting will be to the Environment Strategy Programme Board and incorporated into the Environmental Strategy progress reports, as appropriate.

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