Islay Energy Systems Options Appraisal

Executive Summary







Wood Group UK Limited – January 2021

Executive summary

Purpose of this report

The Scottish Government, Highlands and Islands Enterprise (HIE) and Argyll and Bute Council (A&BC) are working with Local Energy Scotland (LES) to explore where a joint approach to the development of local energy systems on Islay can add value. Islay, as with other island communities, faces multiple challenges in meeting power, heat and transport energy needs for the benefit of all members of the community.

The report provides an overview of current energy requirements and explores opportunities for change. These opportunities are set out in four high-level scenarios that describe what is technically possible and identify many of the challenges and restrictions that may exist. Each scenario shows ways in which power, heat and transport energy needs could be met as part of a 'whole systems' approach. This approach can support delivery of sustainable (low carbon and affordable) energy for the whole community.

The four high-level scenarios do not seek to provide a single answer to Islay's future energy system, nor limit the list of options that can be explored. The scenarios simply provide ideas for what is possible and identify many of the actions that will be required. It is intended that the study will help inform individual, community, public and private stakeholders as they consider the future development of energy systems on Islay (and on surrounding islands) and inform future public and private investment. There is, for example, an energy project investment specifically for Islay within the proposed Argyll and Bute Rural Growth Deal (RGD).

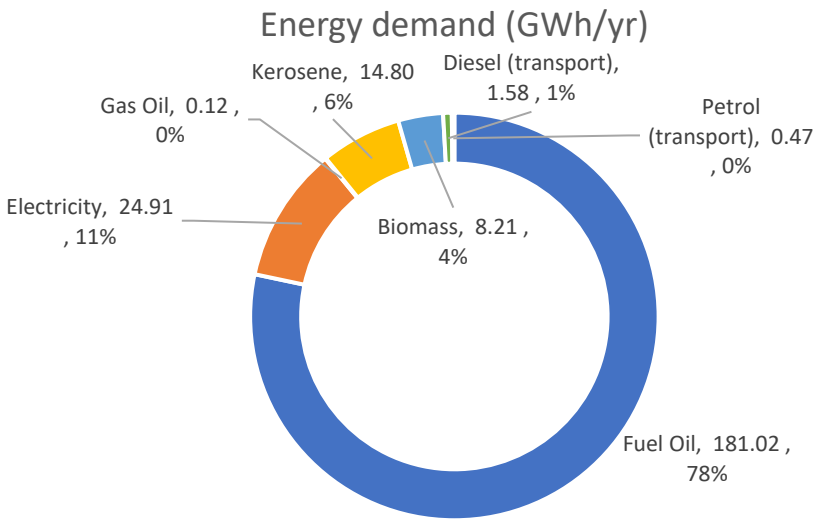
Why change the existing energy systems?

The majority of current energy is imported to the island – mainland generated electricity, fuel oil for steam production, heating oil for homes, petrol and diesel for vehicles. This means:

- Base costs of energy (for heat, power or transport) are higher than for mainland consumers
- Power supply is vulnerable to lengthy disruption due to damage to pylons, overhead lines or sub-sea cable failure. Back-up systems rely on diesel-fuelled generators (imported fuel)
- The existing electrical network cables and sub-stations on the island cannot accommodate larger amounts of local renewable generation without expensive upgrade works
- Poor sailing conditions directly affect the ability to bring heating and transport fuel on to the island. Importing fuel means berths on ferries are filled with tankers and lorries
- Current energy use is heavily reliant on fossil fuels (heating oil, petrol, diesel). These are likely to become harder to purchase and more expensive over time due to changes in the wider economy

Islay: Pathway to a sustainable energy system

Current energy demand across the island is dominated by heating fuels (fuel oil and kerosene account for around 80% of total energy demand). The GHG emissions associated with fuel oil use alone amount to around 48,000 tCO_{2e} per year. Argyll & Bute Council's total reported GHG emissions for their activities throughout their local authority area in 2018/19 were 34,738 tCO_{2e}. Given the Scottish Government's commitment to achieve net-zero emissions by 2045, this underlines the significant changes in how energy is generated, stored, and used, that will be required on Islay as well as nationally.



A whole system approach aligns with the Scottish Government Energy Strategy that underpins efforts to meet national greenhouse gas (GHG) reduction targets. By addressing the challenges set out in this study, a future energy system for Islay can use a range of technologies to meet the energy needs of homes and businesses. For Islay (and the surrounding islands) it is important that any changes to the energy system supports inclusive economic growth as an objective that all can benefit from. There are several challenges that this presents in terms of:

- Increasing security of supply by reducing reliance on imported power and fuels to the island. This includes smarter systems of delivery that more closely match local generation and demand
- Sustainable energy supply that maximises the use of natural resources to reduce reliance on high carbon fossil fuels (fuel oil, diesel and petrol for example) and their carbon intensive supply chains
- Reducing energy costs through developing affordable sources of low carbon energy that are suitable for power, heat and transport use
- Increasing the efficiency of energy use in residential and non-domestic buildings across Islay
- Use of alternative fuels for vehicles on Islay and supporting low carbon transport connections to the mainland (air and ferries)

High Level Scenarios

Each of the scenarios look at how to address the challenges set out in the previous section. With current energy demand for heat representing 80% of the total energy demand, the scenarios focus on how alternative sources of heat can be used. Changing the sources of energy used to provide heating, opens routes to change how power and transport energy needs are met. This means that while heat generation is the starting point, it leads into related changes that enhance the sustainability of the overall energy system on Islay.

Actions such as fuel switching are relatively fast to complete, where no significant change to boilers or other equipment is required. Developing offshore electricity generation, on the other hand, takes much longer due to the process of obtaining planning consent and time to build out equipment and cabling. Some technologies are readily available to buy now; others are less mature and are still developing. These factors

influence how quickly changes can be made and the logical order in which they might occur. This also has a major impact on the financial costs of investment and the scale of funding required.

What can change?

At the core of the present energy system is imported energy – mainland generated electricity, fuel oil for steam production, heating oil for homes, petrol and diesel for vehicles.

Development of offshore electricity generation can provide a local source of energy that replaces the need for large volumes of imported fuel and heating oil. Tidal generated power, located in the Sound of Islay, can come into operation by the mid-2020s if action is taken now. This provides power for domestic oil users to switch to electric systems of heating and supports wider use of electric vehicles. Dependent on suitable market incentives being in place, this capacity could be increased again between 2025 – 2030. Offshore wind power, operational by early 2030s could provide the volume of power needed to help distilleries move to wider use of electric heating systems, supported with hydrogen generated via electrolysis locally. Hydrogen can also provide an alternative to diesel fuel for heavy goods vehicles (HGVs) and agricultural vehicles as these vehicles are replaced over time.

The heat required to raise steam for use in distilleries is the major source of heat demand on the island. Substitution of fuel oil by either hydrotreated vegetable oil (HVO) or compressed natural gas (CNG) offers a short-term reduction in GHG emissions, though does nothing to reduce reliance on fuel imports. No single system solutions can meet distillery requirements; however, a combination of anaerobic digestion and biomass can provide part of a solution in the medium term to late 2020s. Electric-led systems, either using high temperature heat pump systems or combined with hydrogen-fuelled boilers, become more feasible as a greater amount of offshore power generation becomes available.

By 2030 emerging fuelling needs for ferries and aircraft may require local fuelling stations at harbours (either battery storage capacity or hydrogen fuelling) and at the airport.

How would this look within the community?

Initial work among distilleries would see anaerobic digestion and biomass fuelled energy systems emerge by mid 2020s. Community engagement with potential tidal power developers would enable tidal power supply by mid-2020s. This would mean oil heating systems could be replaced with electric alternatives (this could be heat pumps, electric radiant heating or electric-led wet heating depending on the dwelling or building). Extending electric vehicle (EV) charging infrastructure would allow more electric vehicles to operate on the island (including visitors). Direct vehicle ownership could be supported (or replaced) by smart rental, vehicle share and other emerging operating models. Short term Government incentives may also apply.

Offshore wind generation, assisted by local community knowledge and relevant development skills, would provide the scale of power needed to support wider uptake of electric heating solutions across domestic and non-domestic users on the island. It would provide enough power to charge large battery storage capable of acting as primary system back-up instead of the existing diesel generators.

A reduction in the fuel oil required by distilleries, as well as reducing volumes of petrol and diesel used in transport, would mean far fewer fuel deliveries by late 2020s. This enhances supply security and increases capacity on ferries for local passengers and others (with fewer fuel vehicles required). It will also reduce fuel delivery vehicle movements to distilleries across the island.

Production of biobutanol and bioethanol from early 2020s would be a route to low carbon fuels for vehicles operating on the island. This would make it possible to run existing vehicles with little or no engine modifications required. Alternatively, fuel cell vehicles fuelled with hydrogen (produced using local electricity) could reduce vehicle exhaust GHG emissions across the island. Hydrogen is more likely to provide an

alternative fuel for agricultural vehicles and HGVs (during existing cycles of vehicle replacement), with electric batteries used in passenger cars, taxis, vans and buses. A phased cycle of new vehicles could be achieved.

Balancing the power generated offshore with the demands for its use onshore (power and heat in buildings, power in charging vehicles and potentially in producing hydrogen) would become more important in reducing the reliance on power generated on the mainland. This would mean greater real time data showing all users the balance of generation and demand. It may also mean a change to more time of use charging, where users are encouraged to adjust their demand to suit the balance of supply.

Enabling actions

Community engagement – Community involvement is crucial in a number of roles:

- **Raising awareness** among the community regarding the challenges and opportunities that meeting energy needs on the island poses. If community members understand the challenges of maintaining secure, affordable and sustainable energy needs on the island then they can better engage with proposals for change. They will also better understand what might change and how this will impact the way they use and consume energy for power, heat and transport
- **Building local understanding of electric/hydrogen-based solutions** for heat and transport and developing skills to support future systems. This will enable Islay to play a wider role in supporting similar work across the Mid Argyll, Kintyre and the Islands (MAKI) region. This enhances the resilience of the energy system for Islay via its links with the mainland and supporting infrastructure both for residents and visitors to the island.
- **Engaging with developers**, commenting on proposed connections and supporting cost effective designs through sharing knowledge from previous proposed schemes and direct development work / studies (as applicable). Islay Energy Trust has engaged with developers looking at tidal and offshore wind development for several years and continues to do so. The local knowledge that this brings is important in helping to shape proposals for development. This includes promoting the benefit of using offshore generated power on Islay and local co-ordination of surveys and relevant studies supporting supply chain needs in build out.
- **Supporting discussions with developers** regarding power purchase agreements (PPAs) and agreement for use of generated power to support investor confidence in offshore schemes
- **Assisting use of funding routes** not directly open to commercial developers and exploring how local skills and expertise can be built into operation of generating schemes. Some funding routes are specifically linked to community engagement; other opportunities could exist in match funding private sector investment.

Energy efficiency – Effective decarbonisation of heat demand on the island needs a continued focus on efficiency of energy use across all sectors of the community. Continued investment support should be sought for all sectors via sources such as:

- Non-domestic – Industrial Energy Transformation Fund (IETF), Scottish Manufacturing Advisory Service (SMAS), HIE support for economic growth through investment in R&D and Innovation, Energy Efficient Business Support, future Scottish/UK Government funding streams
- Domestic – Social landlords (driven by targets set by Scottish Government), Home Energy Scotland (owner occupiers and private landlords) and future emerging funding streams

For non-domestic users this is driven, in part, by cost savings associated with reduced energy use. An increase in locally generated energy will reduce supply risks associated with disruptions to imported fuel supplies to the island. While social landlord investment will continue across dwellings, driven by Scottish

Government targets, these properties are only 20% of the total stock on the island. Support for owner occupiers and private landlords is therefore crucial in enabling a transition from oil to electric heating.

The Islay Energy Trust (IET) has previously supported energy efficiency programme of works for some households. A future role assisting sourcing of funding (potentially supplementing with community benefit funds) and helping administration of works could be beneficial. There is a role for Argyll & Bute Council as well as other public agencies in signposting and supporting householders and businesses in access to relevant funding streams available from Scottish and UK Government programmes.

Network management – Electricity grid management and control at present supports a limited number of small generators. If large scale (multi-MW) offshore generation becomes available to Islay this will need a suitable management system. This means some battery storage capacity and control system so that offshore generated power is prioritised for local use instead of mainland sources. It also needs to ensure that the local grid network across Islay, Jura and Colonsay remains stable. The recently developed Constraint Managed Zone (CMZ) provides an example of how local generation sources (in this case hydro) can be managed to prioritise their output and reduce reliance on diesel standby generation. While connection to the grid remains an integral part of the power system, smarter use of local generation via protocols used elsewhere in automated network management systems, is important in enhancing system resilience and encouraging development of further low carbon generation. The network operator (DNO) has an important role in collaborating with future renewable energy generation and bringing innovation from other parts of the UK electricity network to use productively on Islay. This role is becoming more important as regulations for how network operators work are updated.

Innovation investment – Innovation investment will be needed short term to support electric/hydrogen solutions for process heat and vehicle supply in particular. Use of funding streams such as the Green Distillery Fund, Low Carbon Infrastructure Transition Programme (LCITP) and future Energy Efficient Scotland programme funding could assist. Integrated heat/transport system solutions may be supported by advanced power purchase agreements and forward vehicle orders to develop local demand. All groups in the community can support access to these sources of investment and wider efforts to encourage inward investment to the island.

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Scenarios 'at a glance'

Scenario 1 – **Low Carbon Oil and Gas**

- Distillery heating needs use electricity and hydrogen long term (2030+); medium term use is HVO (instead of fuel oil) and biogas (from AD)
- Increasing amount of offshore generation supports electrification of heating for non-domestic and domestic users (medium to long term)
- Reliance on mainland power sources is reduced by tidal/offshore generation; battery storage and hydro replace diesel generation as back-up
- Cars, taxis and vans become electric powered long term; hydrogen is the alternative fuel for buses, HGVs and agricultural vehicles

Scenario 2 – Low Carbon Gas

- Distillery heating needs use electricity and hydrogen long term (2030+); medium term use is CNG (instead of fuel oil) and biogas (from AD)
- Increasing amount of offshore generation supports electrification of heating for non-domestic and domestic users (medium to long term)
- Reliance on mainland power sources is reduced by tidal/offshore generation; battery storage and hydro replace diesel generation as back-up
- Cars, taxis and vans become electric powered long term; hydrogen is the alternative fuel for buses, HGVs and agricultural vehicles

Scenario 3 – Electric

- Distillery heating needs uses electricity long term (2030+); medium term use is HVO (instead of fuel oil) and electric
- Increasing amount of offshore generation supports electrification of heating for non-domestic and domestic users (medium to long term)
- Reliance on mainland power sources is reduced by tidal/offshore generation; battery storage and hydro replace diesel generation as back-up
- Cars, taxis and vans become electric powered long term; biodiesel is the alternative fuel for buses, HGVs and agricultural vehicles

Scenario 4 – **Biomass and biogas**

- Distillery heating needs uses electricity, hydrogen, biogas (from AD) and biomass long term (2030+); short term use is HVO (instead of fuel oil)
- Increasing amount of offshore generation supports electrification of heating for non-domestic and domestic users (medium to long term)
- Reliance on mainland power sources is reduced by tidal/offshore generation; battery storage and hydro replace diesel generation as back-up
- Cars, taxis and vans become electric powered long term; biodiesel is the alternative fuel for buses, HGVs and agricultural vehicles

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Now			Short Term (2020 – 25)	Medium Term (2025 – 30)	Long Term (2030+)
Fuel Oil	S1	Heat (Distilleries)	HVO/Biogas	HVO /Biogas / Electric	Electric / Hydrogen
	S2		CNG / Biogas	CNG / Biogas / Electric	Electric / Hydrogen
	S3		HVO	HVO / Electric	Electric
	S4		HVO/Biogas	HVO /Biogas / Biomass / Electric	Electric / Hydrogen / Biomass
Oil / Electric / Biomass	S1-4	Heat (Non-domestic)	Limited switch to electric;	Electric heating; some heat pumps; biomass	Electric heating; some heat pumps; biomass
Oil / Electric		Heat (Domestic)	Fuel switch oil to electric	Extend use of heat pumps, electric heating	Mainly electric; small scale heat networks
Grid / Wind Diesel (standby)	S1-4	Power	Tidal / Grid / Wind CMZ (Diesel/Hydro)	Tidal / Offshore / Other CMZ (Battery/Hydro)	Tidal / Offshore / Other CMZ (Battery/Hydro)
Diesel / Petrol	S1	Transport	EV / Diesel	EV / Diesel / Hydrogen	EV / Hydrogen
	S2		EV / Diesel	EV / Diesel / Hydrogen	EV / Hydrogen
	S3		EV / Diesel	EV / Diesel / Biodiesel	EV / Biodiesel
	S4		EV / Diesel	EV / Diesel / Biodiesel	EV / Biodiesel
100%		Carbon Emissions	50 – 70%	30 – 50%	10 – 30%
		Security of supply	Reliant on national grid On-island biogas & fuel import	Local generation eases reliance on national grid Low import of fuel (heat/transport)	Largely Self-sufficient generation Low fuel import