

Small Isles Energy Audit

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1. Executive Summary

The energy supply within the Small Isles relies on natural resources and/or the transport of common fuels by ferry to the Islands. There is a great mix of different fuels and energy sources being used as the table below depicts.

Fuel Types and Energy Sources Being used within the Small Isles
Coal
Peat
Wood (Logs)
Wood Pellets
Wood Briquettes
Kerosene (Burning Oil)
Diesel
Petrol
Fuel Oil (Marine Oil)
Peat
Wind
Water
Solar Radiation
Propane Gas (LPG)
Electricity
Wind Energy
Solar Energy
Hydro Energy

This diverse range of fuels and energy sources ensures a more reliable energy supply which is important due to the varied weather conditions effecting transport and generation.

The major fuel being consumed within the Small Isles is Fuel Oil used in transport ferries. This is also the most significant cost and ensures the Transport sector is the highest energy consumer. Approximately £570,000 a year is spent on Fuel Oil within the Transport Sector; while £27,000 is spent on diesel and petrol within the transport sector each year.

Approximately £96,000 a year is spent on liquid fuels (kerosene, diesel and petrol) in the Domestic and Commercial sectors each year with almost £74,000 being spent on Diesel.

There is potential for fuel switching from liquid fossil fuels within the transport sector. Most of the Islands within the Small Isles have isolated grid systems (and within the near future all Islands may have their own power grid). This gives scope for electric cars to be charged.

Biomass energy accounts for over 6% of the energy consumption within the Small Isles and kerosene, propane gas and coal accounts for just over 5.3%. The fossil fuels here could be reduced with more properties taking up biomass energy as the major space and water heating energy source.

2. Energy Audit Introduction

This report looks at the overall energy consumption of the Small Isles with a breakdown by sector and energy type. It is hoped that the information in this report will provide baseline data for sustainable energy planning in the near future.

The initial stage of the energy audit process was as follows:

- listing of energy consumers by sector
- listing main consumers
- researching basic information on islands current history
- gathering email contact addresses for each if the Islands or Eigg, Rum, Muck and Canna
- A spreadsheet for each homeowner to complete was created
- Main energy supplies were contacted to gather information
- Major energy users were contacted to gather information
- Major transport services were contacted for information
- Domestic energy usage was collected
- All data was then analysed and graphically represented

3. The Small Isles Energy Mix

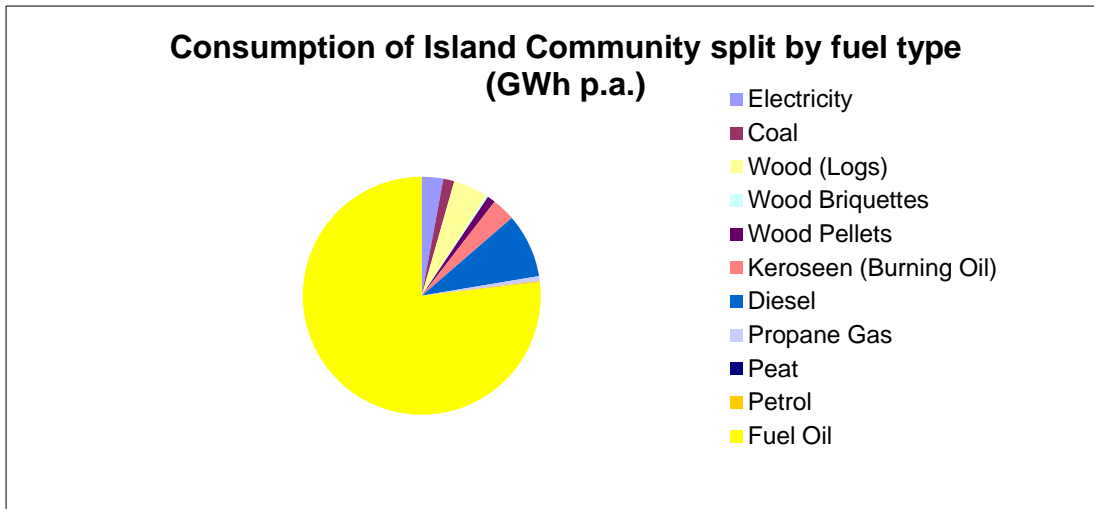
The Small Isles consumes a diverse range of fuels. The Table below depicts the fuel range with uses and suppliers.

Fuel Type	Use	Supplier(s)
Coal	Space and water heating within buildings	Isle of Eigg Shop, NTS, F G Whyte, Tobermory, Fergusons, Nobles
Peat	Space and water heating within buildings	Isle of Eigg Shop (there is no peat extraction in any of the islands)
Wood (Logs)	Space and water heating within buildings	IEHT, Self, Island Farm
Wood Pellets	Space and water	Isle of Eigg Shop, Arbuthnott

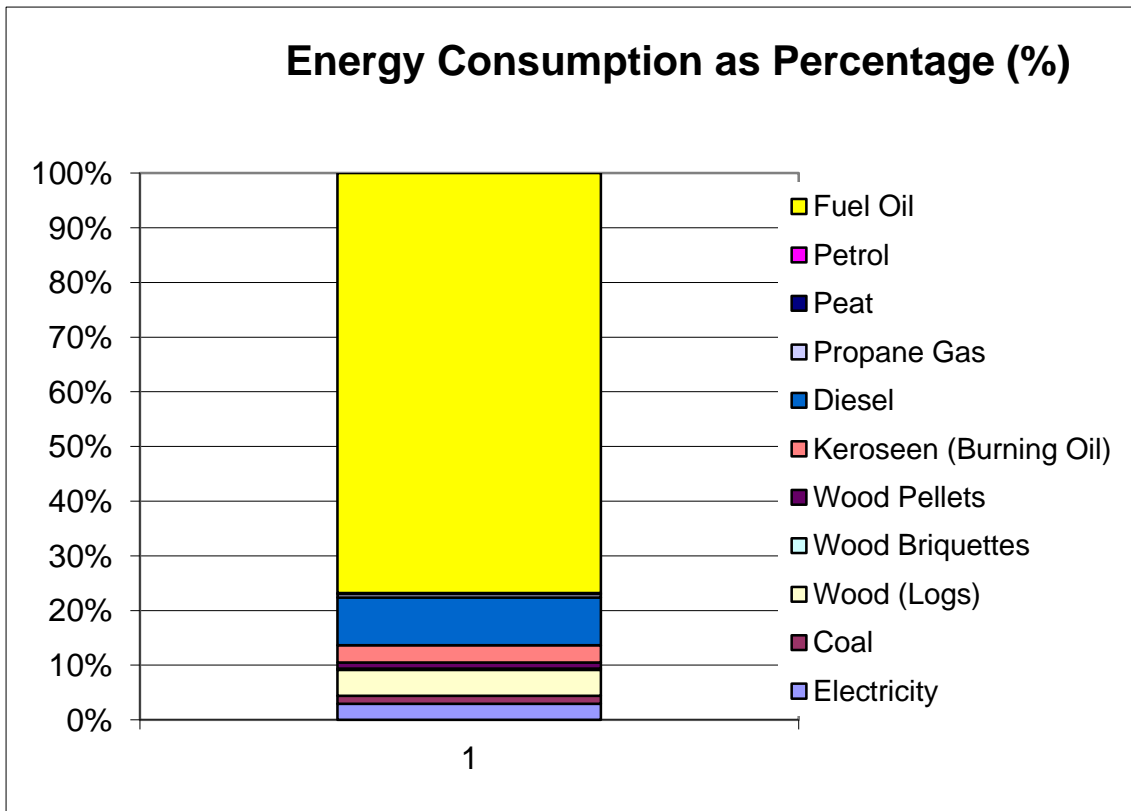
	heating within buildings	Wood,
Wood Briquettes	Space and water heating within buildings	Verdo Renewables
Kerosene (Burning Oil)	Space and water heating within buildings	Johnsons Brothers, NTS, Gleaner Fuels
Diesel	Vehicles, Power generation	Johnsons Brothers
Petrol	Vehicles, machinery (chainsaws etc...)	Johnsons Brothers
Fuel Oil (Marine Oil)	Boats	
Wind	Power generation through Wind Generation	Eigg Electric , Muck Community Company,
Water	Power generation through Hydro Generation	Eigg Electric , Rum Community Trust
Solar Radiation	Water and space heating through Photovoltaic Panels and Solar Thermal tubes/panels	Eigg Electric, Muck Community Company.
Propane Gas (LPG)	Cooking, Space heating	Johnson Brothers, West Highland Gas, IRCT

This table shows that the Small Isles utilise a varied mix of fuel sources, with often a number of suppliers for the same energy fuel source.

4. Energy Supply



The Pie Chart above shows that the majority of the energy consumption for the Small Isles comes from Fuel Oil, which is burnt in boats. This amounts to just under 77% of the total energy consumption for the Small Isles. The next largest fuel source used is wood in the form of logs at just under 5%.

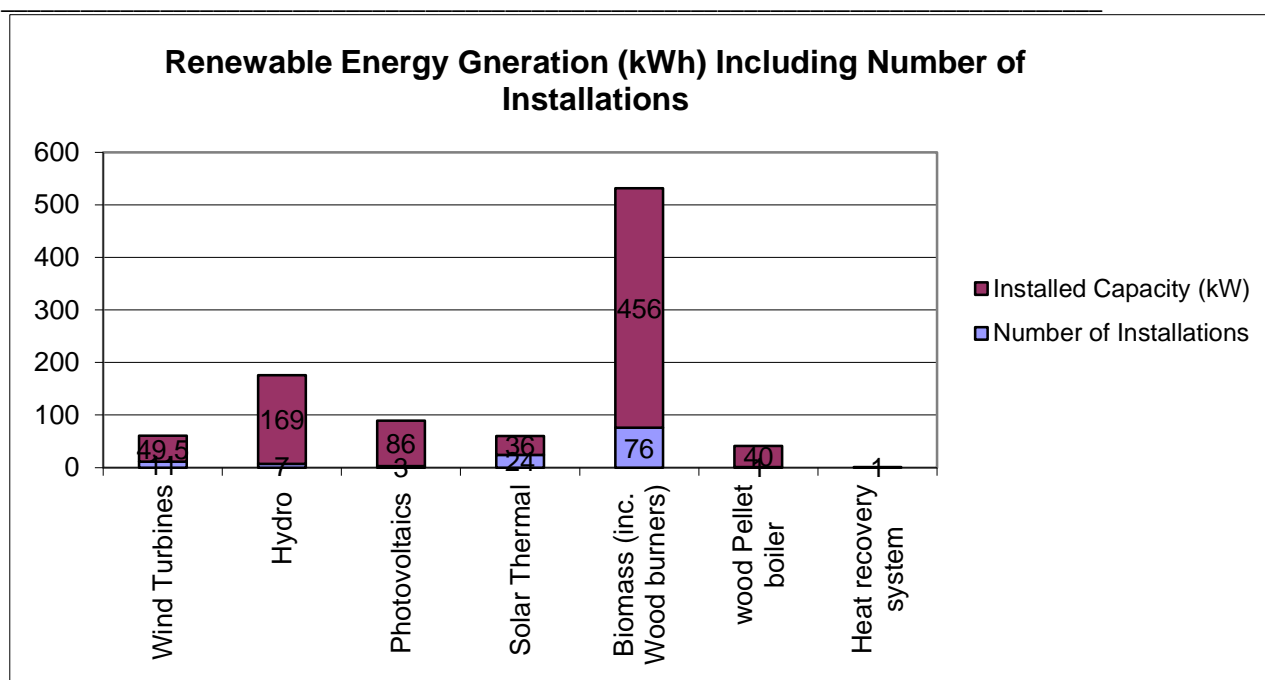


There is a substantial presence of renewable energy systems installed within the Small Isles. Eigg has led the way with a pioneering island grid powered by wind, sun and water with a Diesel generator back up. Muck has now a similar system installed based on wind and sun, whilst Rum makes use of its hydro-power capacity. Canna is currently looking at installing a similar system to Muck.

The table below depicts the type and number of renewable energy systems along with the installed capacity for each Energy System.

Type of Renewable Energy System	Number of Installations	Installed Capacity (kW)
Wind Turbines	11	49.5
Hydro	7	169
Photovoltaic Panels	3	86
Solar Thermal	24	36
Biomass (inc. Wood burners)	76	456
Wood Pellet boiler	1	40
Total	123	836.5

The table above demonstrates the total installed capacity for renewable energy, which is just under 840kW. However when you consider that the total energy consumption for the Small Isles (neglecting transport) is just over 2GWhs, the installed capacity of renewable energy is quite significant.



The vast majority of domestic dwellings, as well as some business premises, have installed a wood-burning stove of some description, which accounts for Biomass being the largest of the renewable energy fuel sources. Wood pellets is the fuel of choice for the Housing association houses on Eigg and for a large Guesthouse on Muck, but locally produced logs still represent the largest amount of biomass used. The Table below illustrates the different fuel types with the totals supplied.

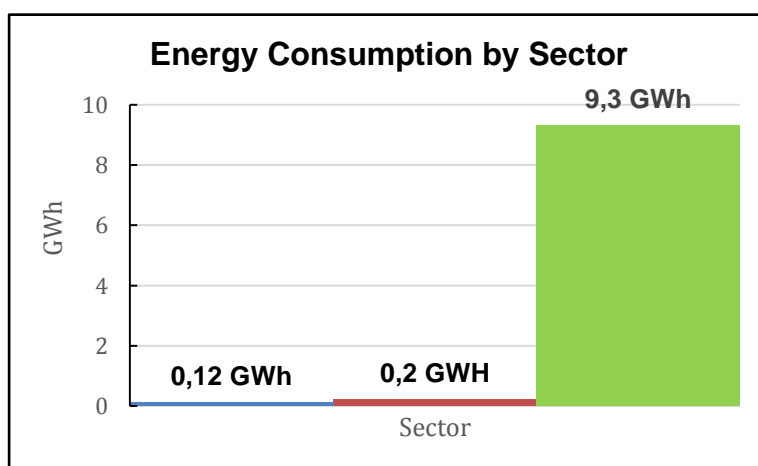
Fuel Type	Total Supplied
Coal	22735 (kg)
Wood (Logs)	141500 (kg)
Wood Pellets	26250 (kg)
Wood Briquettes	6048 (kg)
Kerosene (Burning Oil)	35001 (kg)

Diesel	90931 (l)
Petrol	2180 (l)
Fuel Oil (Marine Oil)	745701 (l)
Peat	200 (kg)
Propane Gas (LPG)	5628 (kg)

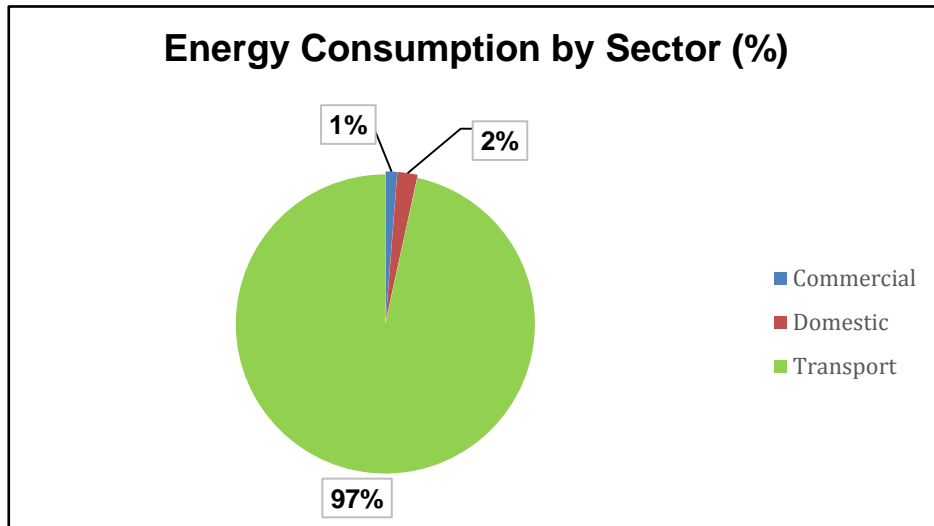
5. Total Energy Consumption

The residential and transport sectors account for the majority of numbers of properties and vehicles on the Islands. Only 50 years ago the primary sector would have been the major economic sector, however the integration of new communication services and infrastructure allows businesses in the tertiary sector, other than accommodation provision, to start up.

The above figure is only a graphic representation of the *number* of businesses within each sector; the following graph shows the energy consumption by sector, with the major energy consumer in the transport sector. Further details about MV Loch Nevis transport ferry which is a lifeline service for the Small Isles. are found under section 9 of this report.

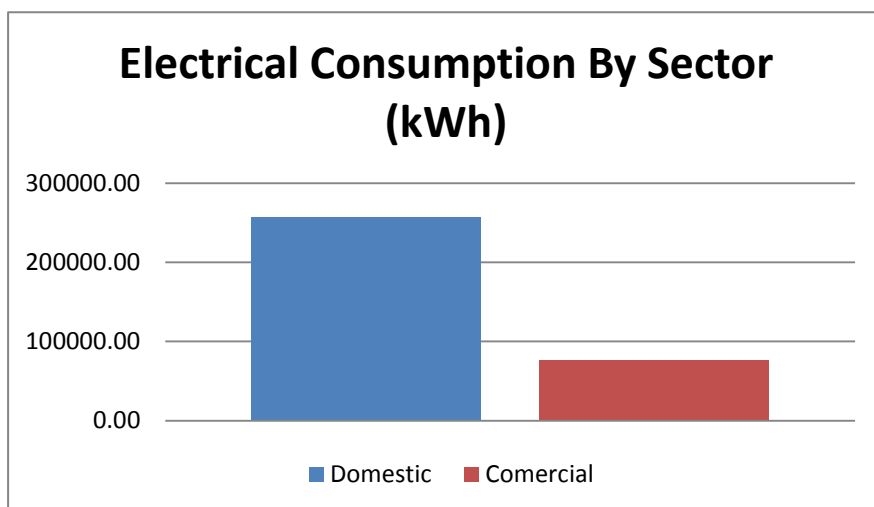


The pie chart below depicts the Energy Consumption by sector as a percentage where it shows the transport sector accounts for a huge 97% of the energy consumed within the Small Isles.



6. Electrical Energy Consumption

It is not easy to separate the domestic and commercial electrical consumptions due to accommodation providers often sharing an electrical supply for both private and customer use. However the above is a fairly accurate breakdown for the two sectors. The domestic sector is responsible for 77% of the electrical consumption and the commercial sector 23%.



Major commercial stakeholders mostly include farms, fish farm and hostels. Apart from the fish farm run by Marine Harvest on Muck, there is no industry as such in the Small Isles.

Major domestic stakeholders include Family homes, usually connected with B&B's. ¹

7. Domestic Consumption

The estimated domestic energy consumption is 0.21 GWh

Non-Electric Consumption in Domestic Sector	
Fuel Type	Energy Consumption (kWh)
Coal	19 335
Wood (Logs)	10 6000
Wood Briquettes	6 048
Wood Pellets	2 1250
Kerosene (Burning Oil)	2 8500
Diesel	23 552
Propane Gas (LPG)	4 570.5
Peat	200
Petrol	1 100

The table above shows the domestic energy consumption of the various fuel types within the Small Isles.

8. Public & Commercial consumption

Estimated energy consumption for commercial sector is 0,12 GWh. The table below breaks down the non-electric consumption per fuel type in

the commercial sector. Diesel and wood (logs) account for the highest individual energy consumption by some distance.

Non-Electric Consumption in Commercial Sector	
Fuel Type	Energy Consumption (kWh)
Coal	2 300
Wood (Logs)	35 500
Wood Briquettes	0
Wood Pellets	5 000
Kerosene (Burning Oil)	6 501
Diesel	67 379
Propane Gas (LPG)	1 057
Peat	0
Petrol	1 580

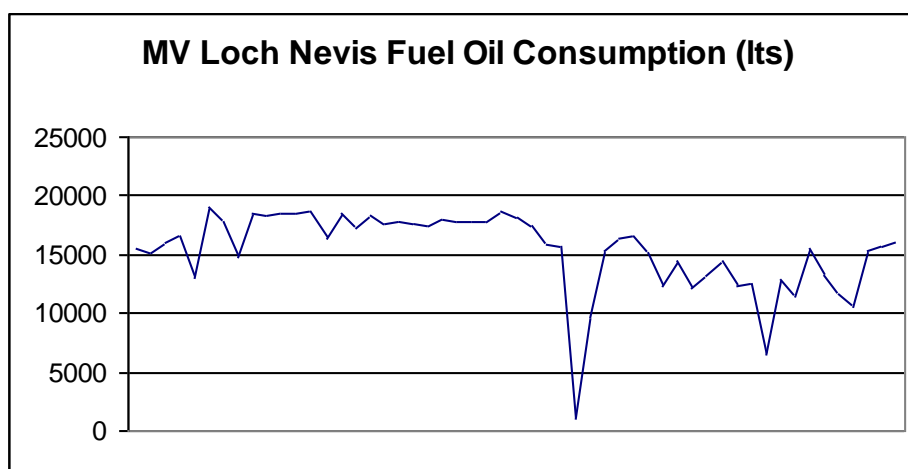
Major stakeholders include generators used for Island power supply (Canna & Eigg). Of all power consumed on Eigg, approximately 10% is generated by diesel generators. Canna uses 52,000L of diesel per annum for Island power supply. The school on Eigg is heated using a log biomass boiler and uses 100,000 tonnes of logs per annum and other log burners are installed within businesses as a source of heating and hot water.

Details of energy consumption by categories per island

	<u>Diesel</u> (l)	<u>Kerosene (l)</u>	<u>Gas</u> (kg)	<u>Coal</u> (kg)	<u>Wood (ton)</u> logs/pellets/briquettes
Eigg	27 611	15 901	3016	5605	10

Muck	5 000	5 300	247	6 000	14.5
Rum	6 320	13 800	2 021	480	10
Canna	52 000	2 000	344	1 100	2

9. Transport consumption



The figure above shows the Fuel Oil consumption in a year. The graph shows data from February to February. The low consumption figures in September are due to the vessel undertaking its annual dry-docking. (Many thanks to John Reid, Chief Engineer, MV Loch Nevis)

The estimated energy consumption for the transport sector is 9.3GWh.

Major stakeholders include: Caledonian Macbrayne and the Loch Nevis ferry, operating all year round from Mallaig . Other transport boats include MV Sheerwater, operating from Arisaig in the summer months.

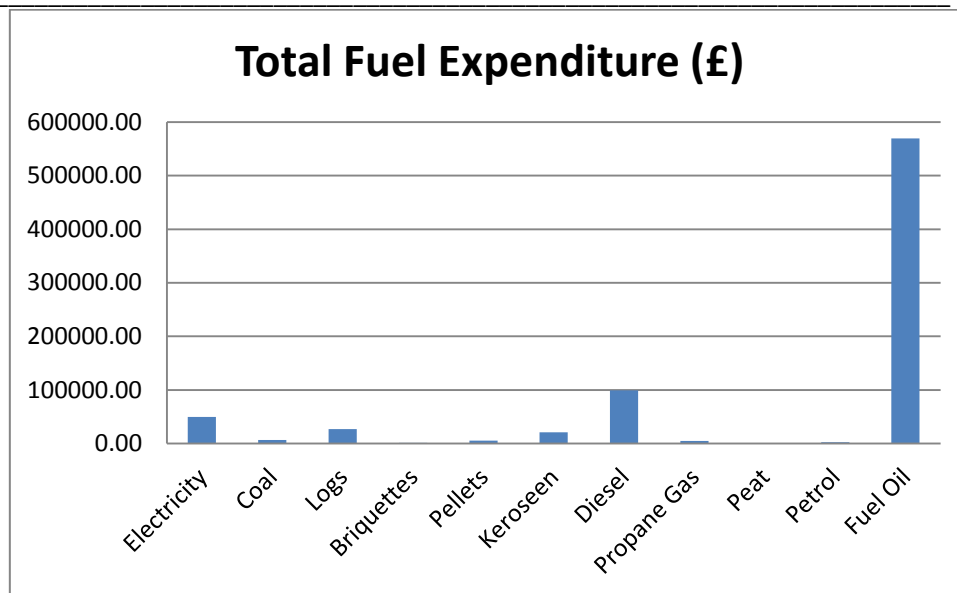
The majority of households own a car within the Small Isles, with over half of these families owning a main land vehicle as well. This contributes to the diesel consumption for the sector.

The estimated number of Island vehicles is 83 island vehicles, and 40 mainland vehicles.

10. Cost data and expenditure

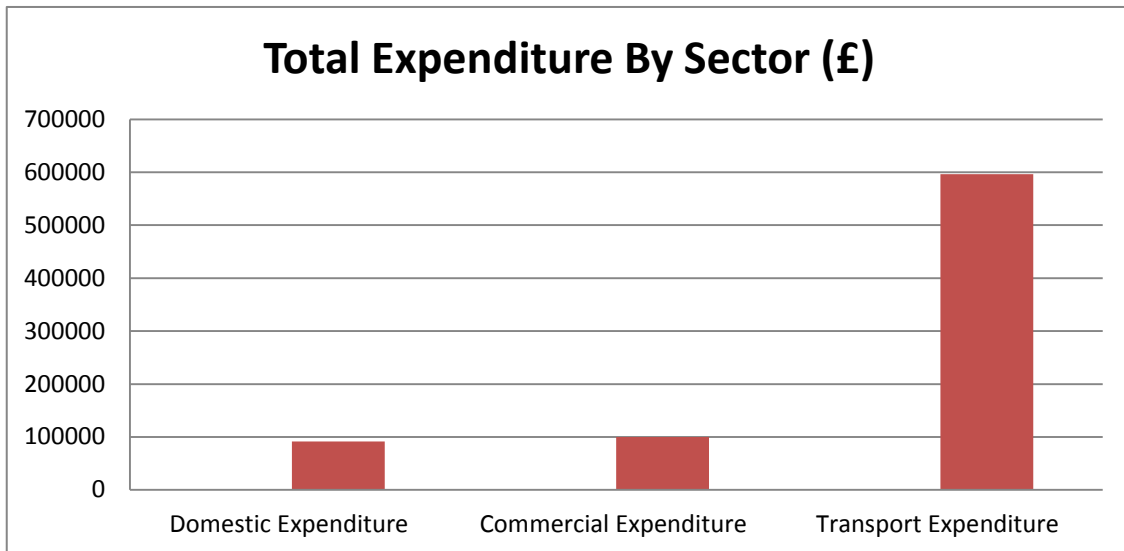
The Table below shows the total expenditure by fuel type calculated using a p/kWh conversion factor.

Fuel Type	p/kWh	Total Expenditure per Fuel (£)
Electricity	15.0	49911.8
Coal	4.0	6820.5
Peat	5.4	10.8
Wood (Logs)	5.04	27142.8
Wood Pellets	4.4	5544.0
Wood Briquettes	3.5	1037.2
Kerosene (Burning Oil)	5.8	20926.7
Diesel	10.0	99243.3
Petrol	12.0	2459.8
Fuel Oil (Marine Oil)	6.5	569387.1
Propane Gas (LPG)	6.5	4979.7



Fuel oil has the most significant cost associated with it compared to all other fuels. The table and graph below show the total expenditure per sector.

Fuel	Total Expenditure per Sector (£)		
	Domestic	Commercial	Transport
Electricity	38532.7	11379.0	0
Coal	5800.5	690.0	0
Logs	20333.1	6809.6	0
Briquettes	1037.2	0	0
Pellets	4488.0	1056.0	0
Kerosene	17039.84096	3886.8	0
Diesel	0	73538.3	25704.9
Propane Gas	4044.0	935.6	0
Peat	0	0	0
Petrol	0	1782.8	1241.2
Fuel Oil	0	0	569387.1
Total	91275.5	100078.4	596333.3



The fuel oil consumed by transport ferries ensures that the transport sector incurs the highest cost per sector.

11. Assessment of the Potential for Fuel Switching

At island level, Canna's switch from diesel generation to renewables through a wind and sun scheme similar to Muck will significantly bring down the overall consumption of diesel in the Small Isles.

Progress in hydrogen generation and Marine renewables may also see a total decrease in the amount of fuel used as back up for the islands renewable systems.

At the domestic level, the use of solar water heaters for new housing or for retrofitting existing ones would certainly allow the consumption of domestic fuel to go down by a significant proportion in the summer months. The inclusion of solar panels on new or existing buildings has not yet been looked into, mostly for reasons of costs, but as costs go down, it

may provide a welcome boost for the local electricity generating companies.

A widespread use of electric vehicles on the islands would bring down the high fuel consumption in the transport sector. However, the right EV vehicles need to be identified before a switch can be made, as they need to compare favourably with landrovers for farm use in particular. EV Community transport could certainly be developed and would enable a good use of surplus power, when the renewable system produce more than can be used by domestic and business consumption.

Use of biogas in the Small Isles remains to be studied, but the potential of combining seaweed and domestic refuse to produce biogas locally is currently being investigating by Shearwater Consulting as part of a pilot project on the Circular Economy for the Scottish government.

Current Biomass usage could be be higher if the quality of the logs produced would improve, as the local wood supply is not always sufficiently dried before usage as evidenced in some of the islands. Provision of a drying shed such as in Knoydart and a more rational programme of extraction would contribute to a better quality supply and therefore a diminution of coal imports.

In the maritime transport sector, it is difficult to identify where progresses can be made. It will depend mostly on new ferry designs, and with another 20 years before MV Loch Nevis is replaced, this is unlikely to be happening in the short term. However, short distance hybrid ferries now running in Scotland and biogas ferries which are being developed in Sweden and other Scandinavian countries show that the issue of maritime

transport high fuel consumption is starting to be addressed, mostly through use of biogas.

12. Island Community / Island background

The Small Isles are situated south of the Isle of Skye on the West coast of the Scottish Highlands. There are four Islands, Eigg Rum, Muck and Canna.

Rum was the home of Scotland's First Settlers in approximately 7500 BC. Mesolithic man settled at the head of Loch Scresort to fashion bloodstone, which is a rare source of flint-like material, into arrow heads. These were then traded far and wide.

In the Dark ages, the islands were at the western frontier of the Pictish kingdom. When the Vikings took the Small Isles over as a base for their raiding enterprises in the 7th and 8th century AD, they left their mark in the islands' place-names.

In medieval times, when each island had to provide a galley of sixteen oars for armed service to the Lords of the Isles in Islay, Rum provided deer hunting for the Lordship. Known in Gaelic as the Kingdom of the Royal Forest, it abounds with deer traps high in the hills. It was also in the Small Isles parish church situated on Eigg, that Ranald, the Stewart of the Isles, gave the lordship to his half-brother Donald – the founder of Clan Donald in the presence of the Bishop of the Isles whose lands also included Muck.

In the 17th century, dispossessed members of Clan Donald in Ardnamuchan took over Muck, amongst whom was the famous warrior Colkitto, whilst Eigg became the rallying point for two rebellious attempts

to restore Gaeldom's power, whilst on Canna, Clanranald showed his power by building a castle at Corroghon.

A century later the men of Canna and Eigg joined the Clanranald chief in the Jacobite uprisings of 1715 and 1745 with disastrous consequences for all involved.

On Muck and Rum, owned by the Protestant MacLeans of Coll, tenants had to give up the Catholic religion or leave. In the turmoil that followed the defeat at Culloden, emigration to Canada and America equally affected all four islands.

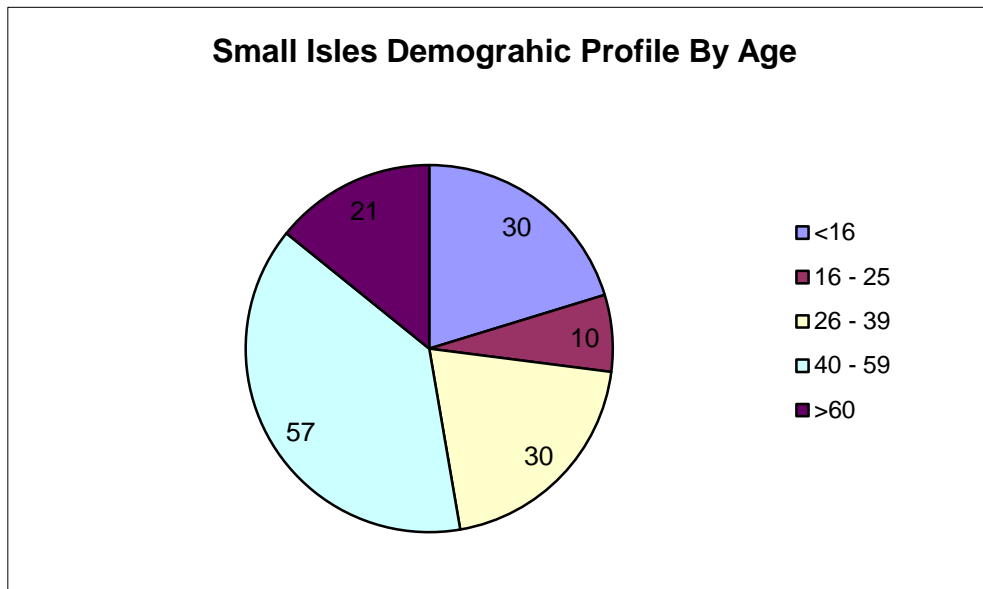
Muck, Rum and Canna saw all or most of their populations cleared for sheep in the early 19th century, whilst on Eigg, clearances followed the widespread famine caused by the 1847 potato blight. Poverty and disease were the crofters' lot for those who remained in the Small Isles, but the fight for Crofters' rights ensured better conditions by 1886.

In the Victorian and Edwardian periods, each of the Small Isles were in the hands of wealthy landowners, who used their island estate for shooting or hunting as in Rum and Eigg, and build themselves stately mansions. WW2 put an end to such extravagance and encouraged emigration to the city for young islanders.

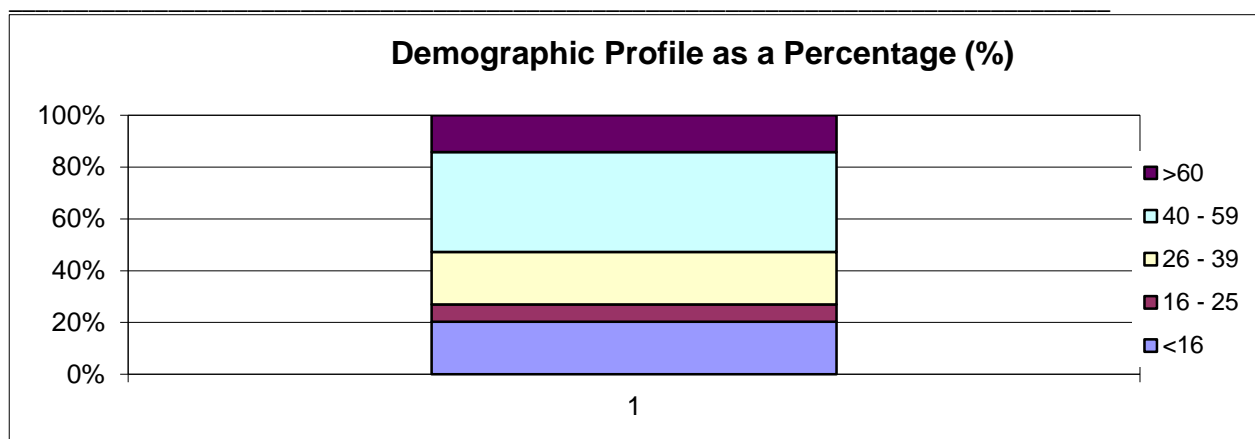
Today, the islands are firmly in the hands of the people that live on the islands, whether through a Community Trust on Eigg, a family trust on Muck or a partnership between the islanders and a nationwide organisation such as the National Trust of Scotland on Canna or Scottish Natural Heritage on Rum, where a Community Trust is now running part of the island. Stewardship of the land and its rich natural and cultural

heritage is now in the hands of the people who live there, not all of them native to the islands, but equally passionate about island life and island living.

13. Island Demographics and Population



The above figure shows the number of people in the different ages bracket currently living in the Small Isles. The largest group is the 40-59 bracket which describes the 'baby-boomer' generation and so is not particularly surprising. However the really promising thing from this information is the number of people under the age of 16 living in the Small Isles. The next age bracket of 16-25 is the smallest group which might be explained due to children leaving to go to further education or to start a job or career. But the telling piece of data here is the large number of people within the 26-39 bracket which is a sign of counter urbanisation at least in this area. (Matched in the rest of the highlands?)



This graph depicts the demographic profile with age brackets in ascending order showing the population in a proportionate manner.

14. Local Economy

Sector				
Residential	Primary	Secondary	Tertiary	Transport
85 Domestic Dwellings	4 Agricultural Farms	Rubbish collection	4 Primary Schools	MV Lock Nevis
	13 Working Crofts	Construction Business	4 Cafes	Arisaig Marine's MV Sheerwater
	1 inshore Fisherman	Building maintenance and cleaning	2 Restaurants	83 Island Vehicles
	Wood extraction and processing		4 Craft Shops	40 Mainland Vehicles
	Game Shooting		2 Grocery Shops	
	Oyster Farm		3 food Businesses	

	Fish farm		27 Accommodation providers	
			Estate Management and Maintenance	
			IT Business	
			Web Development	
			2 Taxi Services	

15. Appendix 1: maps

Isle of Eigg Map



Isle of Canna Map



Isle of Rum Map



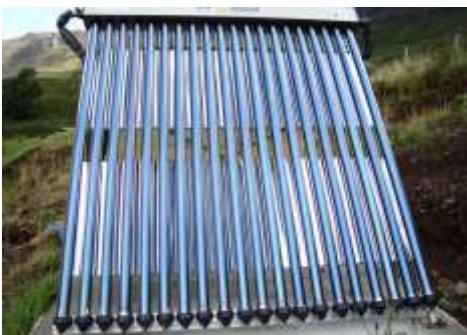
Isle of Muck Map



16. Appendix 2: Photographs



These four wind turbines on the Isle of Eigg have a combined installed capacity of 24kW. They are sited where they have minimal visual impact.



This is an example of a 20 evacuated tube solar hot water system. There have been several of these types of installations within the Small Isles providing domestic and commercial hot water.



These are the batteries that power the Eigg energy grid; they are charged up by the various sources of energy generation on the Island. There is enough spare capacity to run the island for 24hrs.



This is the solar PV array for the Isle of Muck. It feeds into the isolated energy grid to provide 24hr power to homes and businesses.



This is Kinloch Castle on the Isle of Rum. It is a grade A listed Edwardian building, build originally as a hunting lodge. Today the community on Rum is using the castle's upgraded hydro-scheme.

17. Appendix 3: Contacts database

Major Stakeholders such as Councils, Councillors, MP's/ MSP's/Euro MP's, Community organisations, utility companies, NHS, Public/ Community Transport providers, Estates etc.

	Associated Area	Contact
Isle of Eigg Heritage Trust (IEHT)	Eigg	The Pier, Isle of Eigg, PH42 4RL
Scottish National Heritage (SNH)	Rum	Great Glen House Leachkin Road, INVERNESS, IV3 8NW Tel: 01463 725000 Fax: 01463 725067
CAMAS (Community Action on Muck for All Seasons)	Muck	Isle of Muck, By Mallaig, Inverness-shire, PH41 2RP, Isle of Muck Farms, 01687 462362
Isle of Rum Community Trust (IRCT)	Rum	Isle of Rum, PH43 4RR, 01687 462404
Isle of Canna Community Development Trust	Canna	The Square Isle of Canna PH44 4RS 01687 462589
Eigg Electric	Eigg	Eigg Electric Ltd, An Laimhrig, Isle of Eigg. PH42 4RL or Maggie Fyffe, Secretary, 01687 482486 / 01687 482476
Caledonian Macbrayne	Eigg, Muck, Canna, Rum	Caledonian MacBrayne Ferry Terminal Gourock PA19 1QP 01475 650100
Arisaig Marine	Eigg, Muck, Canna, Rum	The Harbour, Arisaig, PH39 4NH 01687 450224
Highland Council	Highland	communication.support@highland.gov.uk 01349 886650
Scottish Islands	Highland, Argyll	info@scottish-islands-federation.co.uk

Federation	&Bute, North Ayrshire, Western Isles, Orkney and Shetland	
Scottish Hydro	Scotland wide	SSE Scottish Hydro Inveralmond House 200 Dunkeld Road Perth PH1 3AQ
Bill Clark, Highland Councillor, SNP	Ward 12: Caol and Mallaig	Lochaber House High Street Fort William PH33 6EL 01397 707231
Allan Henderson, Highland Councillor, Independent	Ward 12: Caol and Mallaig	Lochaber House High Street Fort William PH33 6EL 01397 707231
Ben Thompson, Highland Councillor Independent	Ward 12: Caol and Mallaig	Lochaber House High Street Fort William PH33 6EL. 01397 707231
Dave Thompson MSP, SNP	Skye, Lochaber and Badenoch	Thorfin House Bridgend Business Park Dingwall IV15 9SL
Alyn Smith, MEP, SNP	Highlands and Islands	3 Gentle's Entry, Edinburgh EH8 8PJ 0131 525 8926