Northern & Western Isles
Energy Efficiency Advice Centre

Orkney Energy Audit

Energy production and use in Orkney 2003-04

Orkney Energy Audit

1 Introduction

This is the third Orkney energy audit to be carried out. The original audit took place in 1991 and referred to data for the year 1990. The second audit was carried out in 1996 and again drew on data collected for the preceding year. The purpose of the audit is to identify the main fuel sources consumed within the Orkney Islands group quantifying local energy production and then identifying the balance of energy supplies imported from outwith the county. All the data used in this report refers to the year 2002-03.

For the purpose of comparison all energy figures have been quoted in Giga Joules GJ (10^9 Joules) this quantity has been calculated from the Gross Calorific Values for the various different fuel types, see Appendix 1. The energy values quoted do not take into account the plant efficiencies of the fuel consuming equipment and are therefore gross energy values rather than useful energy output. Each fuel type also has a figure associated with the quantity of Carbon Dioxide produced by the combustion process. Carbon Dioxide is considered to be the major green house gas and EU, UK and Scottish Executive legislation and strategies relating to the climate change programmes use the quantity of CO_2 emissions as the primary measure of compliance. To this end a section has been included within the report to quantify the CO_2 emissions and compare the figures with those derived from the previous audits data.

2 Energy Sources

Orkney does not at present have a large capacity in terms of indigenous energy production. The development of renewable energy projects offers an opportunity for Orkney to increase the proportion of energy consumed that can be generated within the county. However at present the county relies heavily on the import of fuel.

2.1.1 Petroleum Products

Orkney is in the unusual position of exporting a far greater quantity of oil products than are used in the county. The Flotta oil terminal operated by Talisman Energy was constructed in the 1970's and since then has been an important player in the Orkney economy employing in excess of 200 personnel in the operation and maintenance of the facilities.

The terminal has been receiving crude oil and LPG gas via a fixed pipeline from the Piper oil field network since production commenced in 1976. In addition to the North Sea Piper network, Flotta also receives crude oil by shuttle tanker from the Fionaven fields that lie 190km west of Shetland. The Fionaven production is either transferred to shore base storage or transferred ship to ship for onward delivery to refineries.

	Piper LPG	Piper Crude	Foinaven Crude
2000	75,736	8,378,325	3,738,240
2001	63,471	6,824,998	3,775,666
2002	39,650	6,380,383	5,280,691
2003	19,740	5,329,571	4,071,672
Average	**49,649**	**6,728,319**	**4,216,567**

Table 1 – Export figures for Flotta terminal 2000 to 2003 (Tonnes)

The development of the Tweedsmuir fields 100miles North East of Aberdeen is currently underway with production due to commence in 2006. The production from this field will be processed through the Piper Bravo platform and the Flotta terminal securing future production for Flotta for the foreseeable future.

As the oil passing through the Flotta terminal is not in a directly usable form the energy value of this fuel will not be included in the energy balance for Orkney. The terminal does however use a large quantity of energy in the transfer and processing of crude oil and this energy usage will be identified later in this report.

The Oil products consumed within Orkney are imported to the county by two main distributors. Robertson's Fuels, based in Kirkwall and Highland Fuels based at the Scapa Terminal. All oil products are imported by sea. A network of local filling stations exists within the mainland and islands for road transport. All oil products for heating systems are delivered by bulk road tanker using the RoRo ferry service for access to the island areas.

2.1.2 Solid Fuels

The use of solid fuel within Orkney although becoming less important still contributes approximately 9% to the total energy use. There is no domestic production of coal within Orkney and all coal products are imported. There are four main coal importers still operating within Orkney and between them they import on average over 5000 tonnes of coal per year. Most of the coal is brought to Orkney by sea with distribution by road. The introduction of the RoRo ferry services to the Northern Isles has resulted in far less information relating to the quantity and type of solid fuel being re-distributed to the island areas, As a result it is only possible to identify the total quantity of fuel imported to the county with no further breakdown by community possible.

Peat is also still used as a fuel in Orkney and although peat cutting has declined in recent years it is still an essential fuel required for the whisky industry. Highland Park Distillery continues to cut peat for use in the whisky making process.

It is very difficult to estimate the extent of private peat cutting for domestic use. It is thought that this has decreased to almost zero.

The peat producing company on Eday is no longer trading; however, the last of the stock was still being sold during 2003, so appears within the figures for solid fuel consumption. Total peat cutting in the islands has decreased from over 900 tonnes in 1992 to just over 150 tonnes by 2003.

2.1.3 Electricity

Orkney imports the vast majority of its electrical power via the two submarine cables from Caithness. Together the cables have a transfer capability of 39MW. With the maximum winter demand currently averaging 33MW the sub sea cable is capable of supporting the island group with no additional generation capacity. Orkney does however have a number of additional electrical power sources including the power stations at Kirkwall and Flotta. Also several renewable energy sources.

The Kirkwall Station was the main power source for Orkney prior to the installation of the first submarine cable in the early 1980's The station comprises of four diesel engine units capable of supporting 15.5MW of demand, The station is now a standby option should there be an interruption on the submarine cables. The station is now only run for maintenance purposes and contributes little to the overall energy demands.

Orkney, as previously mentioned, has a number of renewable energy generators throughout the island group. The following table shows the locations and the estimated capacity for each of the sites. All of the existing wind turbine installations are based on-shore. However the European Marine Energy Centre (EMEC) in Stromness that opened this year will, in future, be contributing small amounts of energy from the production testing of wave and tidal devices.

Renewable Production	Burgar Hill (1)	Burgar Hill (2)	Stronsay	Sanday	Burray
Technology	Onshore Wind	Onshore Wind	Onshore Wind	Onshore Wind	Onshore Wind
Capacity (MW)	4.25	1.30	2.70	4.50	0.85
Energy Production (GJ)	63,663	19,473	40,445	0	0
CO_2 (Tonnes)	**0**	**0**	**0**	**0**	**0**

Table 2.1.3 – Renewable Energy Production 2003

From the above table we can see that at present the current installed capacity of 8.25MW contributes an estimated 22% of the electrical consumption within Orkney. The installations on Sanday and Burray although construction is now complete, have not been fully commissioned and therefore have not contributed to the overall renewable energy production for the period covered by this report.

3 Energy Consumption

The following section looks at the consumption of fuel in Orkney and attempts to identify trends in energy consumption. The data used in this section has been supplied by the various fuel importers and power supply companies.

3.1 Petroleum Based Fuels

Petroleum products are used primarily for transport purposes, however with the absence of a Natural Gas network in Orkney, Gas Oil and Kerosene are extensively used for heating of domestic and commercial premises.

3.1.1 Oil

Oil based products account for the majority of the energy consumption of Orkney with over 66% of the total energy derived from this source. Over the course of the previous energy audits the proportion of fuel use has altered slightly, as can be seen from the figures in the table below

Trend	Diesel DERV	Diesel Red	Jet A1	Av Gas	Kerosene	Pink Paraffin	Fuel Oil	Motor Spirit
2004	197	132	202	76	210	0	53	68
1995	147	152	155	63	114	23	26	84
1990	100	100	100	100	100	100	100	100

Table 3.1.1a – Index figures by fuel type. Base year 1990

The main trend identified above is the dramatic increase in the quantity of DERV Diesel. Over the past decade the consumption figure has almost doubled. This figure can be partly explained by the trend towards diesel engine private cars. The proportion of diesel fuel car sales has increased from 15% in 1990 to 55% in 2003[1]. The overall number of cars on the road over the same period has also increased dramatically with an increase of 27% over the period 1990 to 2003[2]

Red Diesel Sales have also undergone a large swing in demand over the period 1990 to 2003 with a 52% increase to 1995 then falling back to an overall increase of only 32% on the 1990 figure. Red Diesel is the primarily the fuel for the Agricultural and Fishing industries. Both the fishing and agricultural sectors demonstrated growth over the period 1990 to 1995 however since 1995 both have undergone sustained decline[3].

Aviation fuel use has also changed over the period 1990 to 2003 with Jet A1 quantities more than doubling while Av Gas use has fallen by almost a quarter. From information supplied by Highlands and Islands Airports Limited the number of aircraft movements over this period has remained relatively constant with and average of 12,700 aircraft movements each year handling 105,000 passengers. The change in the fuel use must result from alterations to the refuelling strategies of the aircraft operators.

Fuel Oil quantities have dropped by 47% over the period 1990 to 2003. Fuel Oil is used by Highland Park Distillery for steam production however the production quantities from the distillery have remained relatively constant over the period. The Scapa Distillery will have contributed to the reduced fuel use over the period the plant was out of commission, however with production now recommencing demand will again increase.

[1] Ford Motor Company
[2] DVLA Vehicle Licensing Statistics 2003 Table 9.1 – Motor Vehicles Licensed: 1950-2003 (1990-2003)
[3] OIC Department of Development & Protective Services – Orkney Economic Review 1990 to 2003

Heavy Fuel Oil was previously used in Kirkwall power station as the main running fuel. With the installation of the sub sea cable under the Pentland Firth the need to run the station has reduced considerably resulting in a far lower consumption of fuel. The generator engines were started from cold using gas oil and when hot the engine is changed over to burn heavy fuel oil for extended running periods. As the station is now in the standby mode only gas oil is stored and used on site.

Kerosene is used primarily as a commercial and domestic heating fuel. The quantity of this fuel sold over the period has increased by 110%. The increased number of households installing oil fired central heating systems may explain this increase. 70% of all households in Orkney surveyed in 2002[4] had a full central heating system. This figure compares with only 55% recorded in the 1998 survey and 40% in 1991[5]

2003	Diesel DERV	Diesel Red	Jet A1	Av Gas
Total Consumption (Litre)	4,695,936	17,915,599	635,000	216,000
GCV (MJ/Litre)	38.4162	38.4162	36.9305	33.8583
Energy (GJ)	**180,400**	**688,249**	**23,451**	**7,313**
CO_2 Emission Factor (Kg CO_2/GJ)	69.44	69.44	66.66	66.66
CO_2 (Tonnes)	**12,528**	**47,795**	**1,563**	**488**

Table 3.1.1b Oil based fuel sales for 2003

2003	Kerosene	Pink Paraffin	Fuel Oil	Motor Spirit
Total Consumption (Litre)	7,294,442	0	1,585,000	6,236,900
GCV (MJ/Litre)	37.0192	36.9000	43.2111	34.5815
Energy (GJ)	**270,035**	**0**	**68,490**	**215,681**
CO_2 Emission Factor (Kg CO_2/GJ)	66.66	66.66	72.22	66.66
CO_2 (Tonnes)	**18,002**	**0**	**4,946**	**14,379**

Table 3.1.1c Oil based fuels sales for 2003

Table 3.1.1c shows that pink paraffin has now been withdrawn. Pink Paraffin was traditionally used in portable room heaters but with the increased availability and improved safety of compact LPG room heaters this fuel has now become obsolete.

3.1.2 Liquid Petroleum Gas

Liquid Petroleum Gas LPG is used primarily for cooking and operating room heaters in both the domestic and commercial sectors. There are very few full central heating systems using this fuel source. The reasons for this are, the cost of the fuel, which is relatively high in comparison with oil, and the availability of bulk LPG supplies. At present, there are no distributors in Orkney who will replenish bulk fuel tanks and households and commercial operations rely on bottled supplies delivered by local suppliers. This situation will shortly be resolved with the reintroduction of bulk deliveries scheduled to commence in the first quarter of 2005 by Gleaner Oil Limited in conjunction with the Esso depot in Scapa.

No accurate figures are available for the quantities of LPG delivered to the county. The sole supplier Calor is reluctant to release commercial details of their operation in Orkney however suggest that the contribution to the overall energy balance is likely to be less than 1%. Calor did confirm the quantity of LPG delivered to Orkney has remained relatively constant over the period 1990 to 2003.

[4] Scottish House Condition Survey 2002 – Communities Scotland
[5] Orkney Islands Council – Local House Condition Survey 1998 and 1991

The following table gives an estimate of the quantity of LPG gas consumed in Orkney. The estimate is based on the approximate number of full central heating systems within commercial and domestic premises and on an assessment of the catering fuel load. The figures are included for information only.

Estimated LPG Consumption	Propane and Butane
Total Consumption (Tonne)	114
GCV (MJ/kg)	26.7996
Energy (GJ)	**5,632**
CO_2 Emission Factor (kg CO_2/GJ)	58.33
CO_2 (Tonnes)	**329**

Table 3.1.2 Estimated LPG usage in Orkney 2003

3.1.3 Flotta Terminal

The oil terminal in Flotta as discussed earlier is also a major consumer of energy within the Orkney area. When crude oil arrives at the terminal by pipeline or ship, the product is cold. In order to process the oil effectively the crude oil must be heated. The Oil, which is delivered from the Piper field, contains a proportion of Liquid Petroleum Gas within the mix, This LPG is separated from the crude oil and the Propane component is stored and re-shipped as a usable product. The remaining fractions of the gas, mostly Methane and Ethane, are used within the terminal for product heating and electrical generation. The surplus gas is flared off.

The following table details the energy consumption of the terminal averaged over the years 2000 to 2003. The energy consumption of the terminal far exceeds the total energy consumption of all other energy consumers in Orkney. As this energy is expended in the processing of crude oil that is exported from the island group, it will be excluded from the overall energy balance. The one exception to this will be the generation of electricity. The power station within the Flotta oil terminal is connected to the Orkney local grid and contributes around 12% of Orkneys electrical consumption. The fuel used in this electrical generation will be included within the CO2 emission figures.

Flotta Production	Electricity Production	Flair	Crude Oil Processing
Total Consumption (Tonne)	8416	15968	79305
GCV (MJ/kg)	47.20	47.20	47.20
Energy (GJ)	397,235	753,674	3,743,212
CO_2 Emission Factor (kg CO_2/GJ)	55.55	55.55	55.55
CO_2 (Tonnes)	**22,069**	**41,871**	**207,956**

Table 3.1.3 Energy Consumption by Flotta Terminal 2003

3.2 Solid Fuel

Although solid fuel consumption has dropped from approximately 15% of the overall energy requirement in 1990 to only 9% in 2003 this still represents a substantial component of the counties energy usage.

3.2.1 Coal

Coal as a domestic heating fuel is gradually being replaced by Oil and Electricity as householders opt for the installation of central heating systems in preference to the use of

open fires. It is anticipated that the use of solid fuel will continue to fall over the coming years; however, a small residual supply will undoubtedly remain for many years to come.

Coke is still used by Highland Park Distillery as part of the whisky production process. Coke is used to provide rapid drying of the grain.

3.2.2 Peat

Peat as a fuel is an integral part of the whisky manufacturing process and the figure quoted in table 3.2.2 reflects the quantity of peat harvested by Highland Park Distillery for the grain flavouring process.

Peat is still cut for domestic use, however there are no accurate records of quantities harvested from private peat banks and as the practice has been in steady decline for many years the quantities used are anticipated to be virtually zero. No estimate of the quantities has been made.

Solid Fuel	Coal	Smokeless	Dross	Coke	Peat
Total Consumption (Tonne)	5,618	574	45	283	153
GCV (MJ/kg)	31.0000	33.8000	31.0000	29.8000	12.8000
Energy (GJ)	**174,154**	**19,417**	**1,380**	**8,443**	**1,961**
CO_2 Emission Factor (kg CO_2/GJ)	83.33	83.33	83.33	102.77	107.3
CO_2 (Tonnes)	**14,513**	**1,618**	**115**	**868**	**210**

Table 3.2.2 Solid Fuel Use 2003

3.3 Electricity

Electricity accounts for a quarter of all energy consumption within the county. Electricity is used for lighting power and heating in both domestic and commercial premises. Consumption has increased by 41% over the period 1990 to 2003 this increase can be partly explained by the increase in the number of households, which have risen by 11% over the last ten years. The increase in the number of electric storage heating systems, which are classified as central heating systems, will also have a considerable impact on the electrical consumption.

2003	Cable Link	Flotta	Kirkwall Power Station	Renewable
Total Consumption (GWh)	102	19	2	34
% Contribution	65%	12%	1%	22%
GCV (MJ/kWh)	3.6	3.6	3.6	3.6
Energy (GJ)	**367,200**	**69,984**	**7,200**	**122,400**
CO_2 Emission Factor (kg CO_2/GJ)	119.44	83.33	119.44	0.0000
CO_2 (Tonnes)	**43,860**	**5,832**	**860**	**0**

Table 3.3 Electricity consumption for year 2003

4 Orkneys Carbon Footprint

The UK commitment under the Kyoto Protocol is to reduce its greenhouse gas emissions by 12.5% below the 1990 base year's levels by 2008-2012. In addition, the UK government has a domestic goal to reduce its carbon dioxide emissions by 20% by 2010, that was first set out in the UK Climate Change Programme published in 2000.

From the table below it can be seen that although the energy consumption in Orkney has increased by 16% over the period 1990 to 2003 the increase in CO2 resulting from the combustion of this fuel has only risen by 8%. The improvement in CO2 emission is primarily due to the changing mix of fuels used. The use of grid electricity and oil products in preference to solid fuel results in a reduction in emission.

2003	Petroleum	LPG	Solid Fuel	Electricity	Totals
Primary Energy Consumption	1,453,618	5,632	205,356	566,784	2,231,390GJ
% Total Demand	65%	0.25%	9%	25%	100%
CO_2 (Tonnes)	**99,701**	**329**	**17,324**	**50,552**	**167,906Tonnes CO_2**

1995	Petroleum	LPG	Solid Fuel	Electricity	Totals
Primary Energy Consumption	1,393,608	5,632	312,920	445,464	2,157,624GJ
% Total Demand	65%	0.26%	15%	21%	100%
CO_2 (Tonnes)	**95,657**	**329**	**26,367**	**46,216**	**168,569Tonnes CO_2**

1990	Petroleum	LPG	Solid Fuel	Electricity	Totals
Primary Energy Consumption	1,209,899	5,632	312,421	402,264	1,930,215GJ
% Total Demand	63%	0.29%	16%	21%	100%
CO_2 (Tonnes)	**83,075**	**329**	**26,313**	**45,167**	**154,884Tonnes CO_2**

The Orkney CO_2 emissions do not reflect the overall Scottish level of a 5.6% fall over the period 1990 to 2002[6]. The reasons for this are varied but include such considerations as:

- The provision of essential air transport links
- The reliance on mainland and inter isles ferry service
- No access to natural gas network
- Heavy reliance on fuel intense agriculture and fishing industries

The new wind farm developments will help reduce the counties CO_2 production levels. The development of wave and tidal devices at the European Marine Energy Centre in Stromness offers potential for future developments that may produce considerable CO_2 savings over the medium to long term.

The reduction of CO_2 emissions delivered by the use of renewable energy sources is unlikely to achieve sustained success in isolation. Energy efficiency must be considered as the key to achieving large saving in emissions. The promotion of energy efficiency in Scotland is devolved to the Scottish Parliament and several initiatives have been launched to address energy efficiency in the Scottish built environment.

[6] The Greenhouse Gas Inventories for England, Scotland, Wales and Northern Ireland: 1990-2002

Fuel Poverty Targets

The Scottish executive has set targets for the reduction of fuel poverty in Scottish homes by 30% by 2006 with the complete elimination by 2016. These targets will be achieved through the Warm Deal Insulation Programme and the Central Heating Programme.

Building Standards

The Scottish building standards system is currently under review and the new system, which will be applicable to both domestic and non-domestic buildings, is due to be operational by May 2005. This review will assist with the implementation of the EU Energy Performance of Buildings Directive that will specify minimum energy performance standards in both new and existing buildings where renovation works are planned. The legislation also introduces regular inspection of boiler plant and air conditioning systems. The legislation also requires the supply of energy performance certificates where buildings are constructed, sold or rented. For public buildings over 1000m^2 it will be necessary for the certificate to be on public display. This legislation offers the potential for considerable public awareness raising of the energy efficiency of buildings and should result in purchase / rental choices being informed by the energy efficiency levels and anticipated operating costs.

The Scottish Housing Quality Standard

The announcement of the Scottish housing quality standard includes a minimum thermal efficiency level of all local authority and registered social landlords. The legislation also includes a raft of minimum energy efficiency measures to be achieved in all the social housing stock by 2015

Public Sector Energy fund.

The Executive has set aside funding for all local Authorities to fund low cost energy efficiency measures in the public building stock. The fund will pay for the measures and the money recovered from the energy cost savings that result from the measures. In this way the fund will be self-financing and will achieve year on year improvements.

Carbon Trust and EST

The Scottish Executive also supports the local delivery of assistance to the Scottish business and public sector by funding the Scottish Energy Efficiency Office (SEEO) programme and the domestic sector through the Energy Savings Trust activities. The Executive also funds an additional programme called Loan Action Scotland. This provides loan funds for small to medium sized enterprises for energy efficiency measures. This programme is not available nationally under the Action Energy Programme.

The Energy Efficiency Advice Centre Network also provides local services to businesses and the public on both energy efficiency and renewable energy. The Northern and Western Isles EEAC has been operating form the Kirkwall Office for 10 years and has achieved a high level of public awareness. The centre provides free, practical and impartial advice through its programmes of home visits, educational trips and events. The centre also provides a drop in facility for general queries on energy efficiency and renewable energy. The centre receives 230 calls a month. They are also the call centre for Scotland under the Scottish Communities Household Renewables Initiative and deal with 130 applications a month.

Through the above Scottish Executive and UK national programmes such as the transport energy initiative Power Shift and the Clear Skies (SCHRI) Renewable Energy Programme, it is anticipated that significant changes can be made to the patterns of energy use and overall reduction in both energy use and carbon emissions can be achieved.

Appendix 1
Gross Calorific Values and CO_2 Emission Factors for various fuels

Fuel Type	Gross Calorific Value[7]	CO_2 Factor[8] Kg CO_2/GJ
Diesel DERV	38.42MJ/Litre	69.44
Diesel (Red) Gas Oil	38.42MJ/Litre	69.44
Jet A-1	36.93MJ/Litre	66.66
Av Gas	33.86MJ/Litre	66.66
Kerosene	37.02MJ/Litre	66.66
Pink Paraffin	36.90MJ/Litre[9]	66.66
Heavy Fuel Oil	43.21MJ/Litre	72.22
Motor Spirit	34.58MJ/Litre	66.66
Crude Oil	38.34MJ/Litre	
Refinery Gas	47.20MJ/Kg	55.55
Coal	31.00MJ/Kg	83.33
Smokeless Coal	33.80MJ/Kg	83.33
Dross	31.00MJ/Kg	83.33
Coke	29.80MJ/Kg	102.77
Peat	12.80MJ/Kg[10]	107.30
LPG Propane	49.40MJ/Kg	58.33
LPG Butane	49.40MJ/Kg	58.33
Electricity (UK Grid Mix)	3.60MJ/kWh	119.44
Electricity (Flotta)[11]	3.60MJ/kWh	83.33
Electricity (Renewable)	3.60MJ/kWh	0.00
Electricity (Kirkwall PS)	3.60MJ/kWh	119.44

[7] Digest of United Kingdom Energy Statistics 2004 - Table A.1 Estimated average gross calorific values for fuels
[8] UKETS(1)05rev2 Defra Guidelines for the reporting of emissions – Table A1 CO_2 emission factors
[9] Pink Paraffin no longer commercially available, Kerosene figures used for purpose of comparison.
[10] Average effective calorific values for different fuels, Ekono 1981
[11] CO2 factor for Flotta terminal calculated from refinery gas consumption figures supplied by Talisman Energy

Appendix 2
Historic Energy Data, 1990 and 1995 Audit Data

Solid Fuel

1995	Coal	Smokeless	Dross	Coke	Peat
Total Consumption (Tonne)	9,704				906
GCV (MJ/Tonne)	31.0000	33.8000	31.0000	29.8000	12.8000
Energy (MJ)	**300,824**	**0**	**0**	**0**	**12,096**
CO_2 Emission Factor (kg CO2/kWh)	83.33	83.33	83.33	102.77	107.3
CO_2 (Tonnes)	**25,069**	**0**	**0**	**0**	**1,298**

1990	Coal	Smokeless	Dross	Coke	Peat
Total Consumption (Tonne)	9,704				945
GCV (MJ/Tonne)	31.0000	33.8000	31.0000	29.8000	12.8000
Energy (MJ)	**300,824**	**0**	**0**	**0**	**11,597**
CO_2 Emission Factor (kg CO2/kWh)	83.33	83.33	83.33	102.77	107.3
CO_2 (Tonnes)	**25,069**	**0**	**0**	**0**	**1,244**

Petroleum Products

1995	Diesel DERV	Diesel Red	Jet A1	Av Gas
Total Consumption (Litre)	3,489,993	20,550,931	486,690	178,400
GCV (MJ/Litre)	38.4162	38.4162	36.9305	33.8583
Energy (MJ)	**134,072**	**789,488**	**17,974**	**6,040**
CO_2 Emission Factor (Kg CO_2/GJ)	69.44	69.44	66.66	66.66
CO_2 (Tonnes)	**9,311**	**54,826**	**1,198**	**403**

1995	Kerosene	Pink Paraffin	Fuel Oil	Motor Spirit
Total Consumption (Litre)	3,961,134	27,420	769,900	7,666,400
GCV (MJ/Litre)	37.0192	36.9000	43.2111	34.5815
Energy (MJ)	**146,638**	**1,012**	**33,268**	**265,116**
CO_2 Emission Factor (Kg CO_2/GJ)	66.66	66.66	72.22	66.66
CO_2 (Tonnes)	**9,776**	**67**	**2,403**	**17,674**

1990	Diesel DERV	Diesel Red	Jet A1	Av Gas
Total Consumption (Litre)	2,381,413	13,548,317	314,800	282,959
GCV (MJ/Litre)	38.4162	38.4162	36.9305	33.8583
Energy (MJ)	**91,485**	**520,475**	**11,626**	**9,581**
CO_2 Emission Factor (Kg CO_2/GJ)	69.44	69.44	66.66	66.66
CO_2 (Tonnes)	**6,353**	**36,144**	**775**	**639**

1990	Kerosene	Pink Paraffin	Fuel Oil	Motor Spirit
Total Consumption (Litre)	3,468,941	120,317	2,981,267	9,110,420
GCV (MJ/Litre)	37.0192	36.9000	43.2111	34.5815
Energy (MJ)	**128,418**	**4,440**	**128,824**	**315,052**
CO_2 Emission Factor (Kg CO_2/GJ)	66.66	66.66	72.22	66.66
CO2 (Tonnes)	**8,561**	**296**	**9,304**	**21,003**

Electricity

1995	Cable Link	Flotta	Kirkwall PowerStation	Renewable
Total Consumption (GWh)	73	46	3	2
GCV (MJ/GWh)	3.6000	3.6000	3.6000	3.6000
Energy (GJ)	**261,288**	**166,356**	**9,576**	**8,244**
CO_2 Emission Factor (kg CO_2/GJ)	119.44	83.33	119.44	0.0000
CO_2 (Tonnes)	**31,209**	**13,863**	**1,144**	**0**

1990	Cable Link	Flotta	Kirkwall PowerStation	Renewable
Total Consumption (GWh)	91	17	2	2
GCV (MJ/GWh)	3.6000	3.6000	3.6000	3.6000
Energy (GJ)	**328,716**	**60,984**	**6,876**	**5,688**
CO_2 Emission Factor (kg CO_2/GJ)	119.44	83.33	119.44	0.0000
CO_2 (Tonnes)	**39,263**	**5,082**	**821**	**0**

LPG

No data available for LPG consumption from previous audits, however the main supplier has stated that the quantities of deliveries have remained relatively constant over the period 1990 to 2003.

ACKNOWLEDGEMENTS

Grateful thanks must go to the many individuals and companies who provided all the extensive data. For commercial sensitivity reasons many of them have requested not to be mentioned. However, I can mention those who compiled the report as they all worked for the Northern and Western Isles Energy Efficiency Advice Centre,

Eric Baster (Edinburgh University)

Alistair Morton (Local Authority Support Project)

Sharon Wylie (Senior Energy Advisor)

Trish Casey (Energy Advisor)

Richard Holmes (Scottish Energy Efficiency Office)

Funding for the Orkney Energy Audit was provided by the Orkney Islands Council and the Energy Saving Trust (Local Authority Support Programme). Without their support, the audit would never have taken place.

Ken C Ross (Centre Manager)

March 2005.