Powering the Island through Renewable Energy

Background Analysis For

A Renewable Energy Strategy for the Isle of Wight to 2010

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List of acronyms and abbreviations

Abbreviation	Meaning
GOSE	Government of the South East
RES	Renewable Energy System
BWEA	British Wind Energy Association
IRESSI	Integrated Renewable Energy Systems for Small Islands
ETSU	Energy Technology Support Unit
SERE	South East Renewable Energy Study
UDP	Unitary Development Plan
SRB	Single Regeneration Budget
AONB	Area of Outstanding Natural Beauty
GEA	Gotland Energy Agency
NFU	National Farmers Union
EA	Environment Agency
SSSI	Site of Special Scientific Interest
NETA	New Electricity Trading Arrangements
GHG	Greenhouse Gas
RDF	Residue Derived Fuel
IPC	Integrated Pollution Control
EF	Ecological Footprint (study)
CCP	Climate Change Programme (UK Government)
RO	Renewables Obligation
CCL	Climate Change Levy
CHP	Combined Heat and Power
NFFO	Non-Fossil Fuel Obligation – the previous UK government guaranteed price scheme for renewable energy generators
AD	Anaerobic digestion
BFF	Best Foot Forward (who carried out the EF study)

1 Executive Summary

1. This report is part of a project to prepare a renewable energy strategy for the Isle of Wight, and is part of a larger project called "IRESSI" – Integrated Renewable Energy Systems for Small Islands. The project is being 50% funded by the EC ALTENER programme, with matched funding coming from the Isle of Wight County Council, and SRB funds. The report presents:

- an overview of the socio-economic context for renewables on the Island;
- an assessment of current energy demand and supply;
- an overview of the different renewable energy sources available on the Island;
- the potential contribution that different renewable energy systems (RES) technologies could make to meeting Island energy consumption by 2010. This potential is based on technical and commercial viability.

2. This work is within a national context of the UK government's commitment to supplying 10% of the UK's electricity from renewable sources by 2010. This forms part of the government's Climate Change Programme, which aims to cut UK emissions of CO_2 to 20% below 1990 levels, by 2010. Furthermore, it follows on from, and draws heavily on, the South East Renewable Energy Study (SERE), which was completed in January, 2001. SERE was commissioned by the UK government as part of a positive strategic approach to planning for renewable energy at a regional level. SERE recommended GOSE to adopt a target of achieving 6.6% of current electricity generation capacity within the region from renewable sources by 2010. Furthermore, it recommended GOSE to adopt a target to increase electricity generation for RES to equivalent of 10% of the region's generation as soon as practicable, after 2010.

3. In order to help meet the 10% target, the UK has introduced a raft of new grant funds, and policy instruments that will improve the economic viability of a range of renewable energy technologies over the next few years. There are also possibilities for part-funding renewable energy projects through government DEFRA grants for rural diversification and development.

4. Within the Island context, this study follows on from the Island Agenda 21 strategy and Ecological Footprint Study, and so forms part of efforts to promote sustainable development on the Island. In particular, the Council is keen to explore and maximise the opportunities that making use of the Island's renewable energy resources can have for the Island Community. This is not just in terms of reducing environmental impact, but also for economic development and regeneration, diversification of rural incomes, and promoting the idea of the island as a centre for "Green Tourism".

5. With the information available, the Island current energy demand is estimated to be **3264GWh** per year. This is for heat as well as electricity, and includes transport fuel. The current demand for electricity is estimated to be **545GWh**, which is 17% of the total. This is 41 times the output of the island's existing waste-to energy plant, or equivalent to 3.4 times the annual output of a 50MW windfarm. For comparison, the total electricity demand for the Council is about 20GWh, or 3.7% of the total electricity demand.

6. In terms of types of fuel used, 56% of total energy demand is currently met by piped gas, from the mainland, 26% comes from petrol and diesel used for transport, and 16% comes from electricity imported from the mainland. There is a lack of data relating to the use of heating oil on the Island. The waste-to-energy (RDF) plant on the Island meets 0.4% of total energy requirements.

7. Total energy demand is projected to grow by 1.26% to **3307GWh** by 2010. This growth is due mainly to a predicted 5% increase in transport energy demand. Electricity demand is expected to grow by 2.4% to **558GWh** by 2010, in line with estimates for the south-east region.

8. The analysis of the socio-economic context highlights the following issues to be the main opportunities and/or threats for development of RES on the Island:

- High number of environmental designations on the Island, such as Heritage Coast and AONB's
- Economic under-development relative to the rest of the south-east region
- Decline in the agricultural sector, and therefore a need to diversify farm incomes
- High number of tourists visiting the Island in the summer months

9. The analysis covered a full range of renewable energy sources and technologies. The potential contribution of each of these is summarised in the table below.

Table: Summary of potential contribution of different renewable energy options for meeting electricity and total energy demand on the Isle of Wight, by 2010

Type of Renewable Energy	Practicable Resource (MW)		Practicable Annual Energy Output Electricity (GWh)		Practicable Annual Energy Output Heat (GWh)		% Achievable Contribution to 2010 Electricity Demand		% Achievable Contribution to 2010 Total Energy Demand	
	LB	UB	LB	UB	LB	UB	LB	UB	LB	UB
Wind										
on-shore wind	12.0	18.0	30.0	44.9	n/a	n/a	5.1%	7.7%	0.9%	1.3%
off-shore wind	0.0	50.0	0.0	159.9	n/a	n/a	0.0%	27.2%	0.0%	4.6%
Biomass:										
Anaerobic digestion using dairy cow manure	0.2	0.5	1.7	4.3	0.5	1.3	0.3%	0.7%	0.1%	0.2%
Centralised CHP Plant, using SRC and forestry residues as fuel	2.8	5.3	21.0	39.3	31.5	59.0	3.6%	6.7%	1.5%	2.8%
OR Up to 5 decentralised heat only biomass systems, using forestry residues and SRC	1.5	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Tidal Currents	0.0	3.0	0.0	9.4	n/a	n/a	0.0%	1.6%	0.0%	0.3%
Existing RDF/CHP Plant	1.7	1.7	6.6	6.6	not used	not used	1.1%	1.1%	0.2%	0.2%
Liquid biofuel (biodiesel)	n/a	n/a	n/a	n/a	0.0	21.9	n/a	n/a	0.0%	0.7%
Solar water heating	n/a	n/a	n/a	n/a	0.2	0.5	n/a	n/a	0.01%	0.01%
PV	0.0	0.1	0.0	0.1	n/a	n/a	0.00%	0.02%	0.00%	0.00%
Totals	**18.2**	**78.6**	**59.3**	**264.6**	**32.2**	**82.7**	**10.1%**	**45.1%**	**2.6%**	**10.0%**

LB = LOWER BOUND
UB = UPPER BOUND
n/a = not applicable

10. Based on economic and near economic options, the lower bound of estimates is that the Island could meet 10% of its electricity requirements by 2010, coming primarily from on-shore wind, biomass CHP, and the existing waste-to-energy plant.

11. Of the options considered, on-shore windpower is the main option for a new renewable energy development on the Island that is commercially viable in the near term. The range of achievable contribution to electricity demand by 2010 is estimated to be 5-8%. This could take the form of 2-3 small wind clusters, of 4-6 machines in each.

12. The waste-to-energy plant on the Island currently produces about 13GWh of electricity per year, which equates to just over 2% of 2010 electricity demand. There are no plans to expand the plant. However, under the latest government guidelines, only 50% of the plant's output can be considered to be renewable, when assessing contributions to the 10% government target.

13. Options that are close to being economic, and could become economic by 2010, and that could make a significant contribution to meeting Island energy demand are: biomass heat and power production, using energy crops (most likely short rotation coppice) and forestry residues

as feedstock; anaerobic digestion, both farm-scale and centralised; biodiesel production as a substitute for diesel fuel for transport; and off-shore wind. These technologies will most likely require grants or some form of price support in the short term to make them economic.

14. The possible contributions from these near economic technologies (see also summary table) are as follows:

- A centralised 5MW CHP biomass facility, burning forestry residues and energy crops, to generate heat and electricity. This would meet about 7% of 2010 electricity demand, and 3% of total energy demand. This would require about 10% of agricultural land on the island to be planted with energy crops – most likely short rotation coppice poplar or willow.
- A biodiesel production plant, making use of waste vegetable oil, and rapeseed grown on set aside land, could produce 2.4 million litres of biodiesel per year. This would provide enough diesel to meet the needs of the Island Waste Services, Wightbus, and Southern Vectis diesel fleet. This would meet about 3% of 2010 transport energy demand, and 0.7% of total energy demand.
- There are estimated to be 5500 dairy cows on the Island. The slurry from these animals could be anaerobically digested to produce methane, to power a CHP engine. This could either be in a single centralised plant, or in a number of smaller, farm based units. This could meet 0.3-0.7% of 2010 electricity demand.
- One off-shore wind farm, 50MW capacity, would meet 27% of 2010 electricity demand, and 5% of total energy demand.

15. Of these, the contribution of a single, off-shore wind farm would make the largest contribution to electricity and total energy demand. However, it is also the option over which the Island community has the least degree of control or influence over, and for this reason, is probably the least likely to be realised. This is due to the large investments required, the fact that planning is controlled by the Crown Estate, and that there may be other, more suitable sites on the South Coast.

16. Solar water heating is another well proven, mature technology that can make a small, but valuable contribution to meeting heat demand on the Island, for domestic, and institutional water heating, as well as for heating outdoor swimming pools. The main constraint for this technology are the relatively long payback times, which are unlikely to decrease much, with current energy prices, due to the mature nature of the technology.

17. Photo-voltaic (PV) technology (also known as solar panels) are another relatively well demonstrated technology that can also make a small, but valuable contribution to meeting the electricity demand of domestic as well as commercial buildings. However, the current relatively high capital costs of these systems will limit their degree of penetration by 2010. But cost reductions are foreseen for this technology, particularly with building-integrated PV, which could increase its economic viability beyond 2010. Both PV and solar water heating both have the advantage that they are readily suited to urban environments, and therefore can be introduced without many of the planning constraints associated with other types of renewables technologies.

18. There is one further RES option possible for the Island, which is still at an R&D stage. This is tidal stream, or marine current turbines, which make use of tidal currents to generate electricity. The Island is one of the few sites in the UK with suitable resource. Although it is not certain as to whether this technology will be commercially viable by 2010, there is an opportunity for a demonstration installation of up to 3MW off the coast of the Island. This could provide about 1.6% of 2010 electricity demand, with an annual energy output similar to the existing waste-to-energy plant. If this technology did prove to move technically and commercially viable, then there could be opportunities for wider deployment of this technology off the Island's coast in the longer term.

19. Based on the analysis, a number of exemplar, or “flagship”projects are identified, which could be submitted for grant funding, and would act as important pilot and demonstration projects for renewable energy on the Island. These are:

- A community wind project
- A biomass CHP or heat-only scheme, providing energy for a large end-user
- Zero energy housing development, incorporating a combination of different RES and energy efficiency measures.
- Farm based anaerobic digestion
- A biodiesel production plant
- Demonstration marine current turbine

2 Introduction

2.1 Purpose of this report

This report presents the results of a background analysis of the potential for implementing renewable energy projects on the Isle of Wight, by the year 2010. The report is aimed primarily at the Isle of Wight Council staff, and the EC project co-ordinators, and partners. However, it is also intended that relevant extracts will be circulated to key stakeholders, both on and off the Island.

The report is divided into 3 main parts. These are:

1. Assessment of socio-economic conditions on the Island – this is in effect an assessment of the political, economic, social, technological and environmental trends and issues that may have a bearing on the implementation of Renewable Energy Systems (RES) on the island by 2010. It analyses both conditions specific to the Island, as well as the wider UK context.

2. Present Energy Status and Projection to 2010 – this presents an analysis of current annual energy demand on the Island, broken down by end-uses, sectors, and fuel types. It also estimates likely energy demand by the year 2010.

3. RES Potential – this gives an overview of the different renewable energy sources available on the Island, and of the different technology options available. It also estimates the potential contribution each of these options could make to island energy demand by the year 2010, based on estimates of commercial viability, and within the constraints of the previous two sections.

   This section includes a discussion and presentation of ideas for possible "exemplar" projects that could be submitted for further funding.

This report is designed to lay the foundation for the next phase of the project, which will be to prepare a renewable energy strategy for the Island. This will set out some targets for the contribution of renewable energy to meeting island energy demand by the year 2010. It will also identify the key strategic actions to be taken by the Isle of Wight Council, and other stakeholders, if these targets are to be met.

2.2 Project Description

The analysis contained in this report has been prepared as part of the IRESSI project, which stands for Integrated Renewable Energy Systems for Small Islands. The project is being 50% funded by the EC ALTENER programme, which falls under the EC Directorate of Energy and Transport. The ALTENER programme, and this project, form part of the EC Campaign for Take Off, which aims to kick start the implementation of renewable energy in Europe, in order to achieve the target of meeting 12% of EU energy demand from renewable energy sources by 2010.

The IRESSI project aims to prepare a renewable energy strategy for the Isle of Wight, and more specific renewable energy feasibility studies for 3 islands owned by the National Trust, namely, Lundy, The Farnes and Brownsea island. As well as funding from the EC, the IRESSI project is being match funded by the National Trust, and the Isle of Wight County Council.

The IRESSI project is being managed by Intermediate Technology Consultants (ITC). The project partners are the Isle of Wight County Council, and the Isle of Gotland Energy Agency (GEA). GEA is acting in an advisory capacity, to assist the Isle of Wight in producing a renewable energy strategy. This is because Gotland already has considerable experience with implementing renewable energy projects. As well as producing a renewable energy strategy, for the Isle of Wight, the project also aims to produce pre-feasibility studies for 5 renewable energy projects on the Island, which will form the basis for bids for funding to implement them.

A renewable strategy forms a fundamental first step in creating an enabling framework for the development of renewable energy projects on the Isle of Wight.

The IRESSI project has also involved MSc students from The Centre for Renewable Energy Systems Technology (CREST), at Loughborough University, and the Energy Group at Reading University. Charlotte Bruton, at the Energy Group, has completed an MSc thesis on the feasibility of using biodiesel for transport on the Isle of Wight.

The IRESSI project is part of a larger cluster of 3 projects, all looking at Renewable Energy in Islands. The overall cluster is being co-ordinated by ISLENET, of which the Isle of Wight is a member. ISLENET is a network of European Island Authorities which promotes sustainable and efficient energy and environmental management. It actively promotes the adoption of local energy saving strategies and renewable energy projects.

The project began in April 2001, and is due to be completed by September, 2002.

2.3 Renewable Energy and Islands

There is a lot of interest in renewable energy systems on Islands for the following reasons:

- Islands tend to suffer from economic under-development when compared to the mainland, due to a "severance" effect – therefore, renewable energy presents an opportunity for islands to make use of local, natural resources for local development
- Energy costs for fossil-fuels are often higher on islands, due to the costs of transportation from the mainland – these make renewable energy more economically attractive
- Islands tend to have some of the best renewable energy resources – e.g. wind
- Islands can act as a model for greater implementation of RES on the mainland
- Island populations form a distinct "community" – which can facilitate the process of setting and achieving renewable energy targets

2.4 Background

2.4.1 Isle of Wight

This study of renewable energy for the Isle of Wight, follows on from the Ecological Footprint (EF) analysis for the island that was completed in November 2000. This was carried out by Best Foot Forward and Imperial College, with support from the Biffa Award, and the Isle of Wight County Council. This study identified that if the island was to be self sufficient or bio-regionally sustainable, then to support its current population, and current lifestyles, it would require a land area of 2 ¼ times the actual land area. Furthermore, the study shows that about 11% of the size of the footprint comes from energy use on the Island.

During the IRESSI study, more data on gas demand was obtained, that was not available to the EF study team. After allowing for this, which is by far the fuel in greatest use on the Island, the total energy demand is found to be 2.25 times that given in the EF study, which increases the contribution of energy to the size of the footprint to 25%.

Therefore, the renewable energy strategy builds on the work of the EF, by facilitating the implementation of renewable energy projects on the island, which would make a significant contribution to reducing the size of the Island's ecological footprint.

Related to this, this project also builds on the Agenda 21 Strategy – a strategy for sustainable development - that was developed on the Island in 2000. Another important aspect of the local context is the relatively high levels of unemployment on the Island, and economic under-development in relation to the rest of the UK south east region. This means that there is a high level of interest in options and opportunities for sustainable development and regeneration on the Island.

The idea for the project came out of a concern that if unco-ordinated development of renewable energy on the Island, particularly windpower, were to take place, it could create significant public opposition. If this happened, it could hamper the opportunities for renewable energy development on the Island in the medium and longer term. This could cause the Island to lose out on the potential developmental and environmental benefits that renewable energy offers in enabling the Island to usefully harness natural local resources.

Therefore, a renewable energy strategy, prepared through a process of consultation and active participation of the Island community, was felt to be an essential step in creating an enabling framework for the development of RES on the Island, that would maximise the opportunities for sustainable development.

2.4.2 UK Context

In 1999, as part of its Climate Change Programme, the UK government set a target of meeting 10% of UK electricity supply from renewable sources by the year 2010.

As part of the range of measures required to meet the 10% target, the government has adopted a positive strategic approach to planning for renewable energy at a regional level. Each region is responsible for identifying the contribution it can make to the national 10% target, based on its renewable energy resources. As part of this regional planning process, GOSE commissioned ETSU and Terence O'Rourke Plc to undertake a study entitled "Development of a Renewable Energy Assessment and Targets for the South East". This study is now complete.

The findings of the study are intended to inform the new Regional Planning Guidance for the South East, as well as the Regional Sustainable Development Framework. This study will be referred to throughout this report as the SERE (south east renewable energy) study.

The result of this study was that ETSU recommended GOSE to adopt a target of achieving 6.6% of current electricity generation capacity within the region, from renewable sources by 2010. ETSU considered this a "challenging, yet achievable" target. Furthermore, GOSE was recommended to adopt a target to increase electricity generation for RES to equivalent of 10% of the region's generation as soon as practicable.

The process of setting this target involved consultation with a wide range of stakeholders. As part of this process, a community workshop was held at Cowes, on the Isle of Wight, in October, 2000. A summary of the key findings from SERE and the output from the Cowes workshop are given in annex 2.

The IRESSI project aims to build directly on the work carried out under SERE. The latter study explicitly states that targets at the sub-regional level can be fine tuned to suit local needs and preferences, and this is what the Isle of Wight Renewable Energy Strategy will aim to do.

2.5 Methodology

Much of the data for the analysis in this report has drawn heavily on data collected by the Best Foot Forward team, during the Ecological Footprint analysis. Where possible, gaps in the data on energy supply and demand have been filled by gathering further data from energy suppliers (Transco and Scottish & Southern), and from larger end-users.

The section on socio-economic context has drawn heavily on other existing Council plans, namely: the Unitary Development Plan, Agenda 21 Strategy, Local Transport Plan, Ecological Footprint Study.

The section on RES potential, as mentioned above, has drawn heavily on previous ETSU studies and the SERE. Telephone discussions were also held with several key stakeholders, namely: Council staff, ETSU, NFU, EA, Island Waste Services, Southern Water, Isle of Wight Grain Storage and the Forestry Commission. The section on biodiesel was based largely on the research carried out by Charlotte Bruton for her MSc thesis at Reading University. Discussions were also held with renewable energy companies and technology suppliers.

2.5.1 Electricity vs. Energy

Throughout this report, the terms **electricity** and **energy** have separate and very distinct meanings, and should not be confused with one another. There are two separate issues here.

The first is when referring to fuel types. Electricity is a type of fuel. But total energy supply also includes non-electricity fuels, such as gas, oil, petrol and diesel.

The second is to do with demand. When the term "energy" demand is used, as opposed to electricity demand, this refers to total energy demand, including non-electricity demand, e.g. for transport, or for heating.

2.5.2 Renewable Energy vs. Energy Efficiency

This report does not recommend specific energy efficiency measures, as this is outside the scope of the project. However, the assumption throughout is that energy efficiency measures should go hand-in-hand with development of renewable energy systems. The discussion of energy projections to 2010 highlights the importance of energy efficiency measures – the more the energy demand on the island can be reduced, then the higher the proportion of its energy demand the Island can meet from its own natural, renewable resources.

3 Analysis of socio-economic conditions

The purpose of this section is to identify non-energy issues that may affect the degree of penetration of RES on the island.

3.1 Island Economy

3.1.1 Main sectors of economic activity, and contribution to Island GDP

The Island is predominantly rural, with mixed farming over most of its area and intensive horticulture in the Eastern Yar valley. Upper Yar valley is most intensively farmed.

Tourism and leisure industry are dominant in the Island's economy. The tourist industry provides 20% of all jobs and 24% of GDP. This is over 3 times the national average figure[1]. Cowes and the Solent have an international reputation for yachting and watersports.

Tourism is a major industry on island and a major employer – since Victorian times, it has been an important destination for seaside holidays.

There is a strong tradition on the island of self-employment and enterprise. Over 6,000 people are self-employed, working as sole traders, with no employees. In 1993, there were 3,239 registered firms on the island. 95% of businesses employ less than 25 people, and 85% employ 10 people or less. Only 14 businesses employ more than 200 people.

In economic terms, the island can be divided into 3 broad areas:

1. the Ryde, Cowes, Newport area – the main location for residential, and commercial development on the island, and has the greatest concentration of services, infrastructure and facilities
2. south east coastal resorts, stretching from Ventnor to Sandown – these rely heavily on the holiday trade, and are shaped by tourism
3. the remainder of the island, which is by far the greatest land area, and is characterised by open countryside, punctuated by small villages, and quieter settlements – e.g. Freshwater, Yarmouth and Bembridge. Agriculture, rural tourism and small-scale enterprises are the important economic activities

A major problem for the island is a lack of inward investment. For example, no new hotels have been built since WWII, and the level of population has been too low for provision of some services and facilities[2].

3.1.2 Demographic analysis

The population of the Island has grown steadily since WWII. Census records show a rate of growth of 7.5% between 1981 and 1991, which is approx. 900 people/annum. The Office of National Statistics (ONS) predicts that by 2011, the population will have increased to 129,900. [3] On the basis of this, the current population (2001) is about 127,000 people.

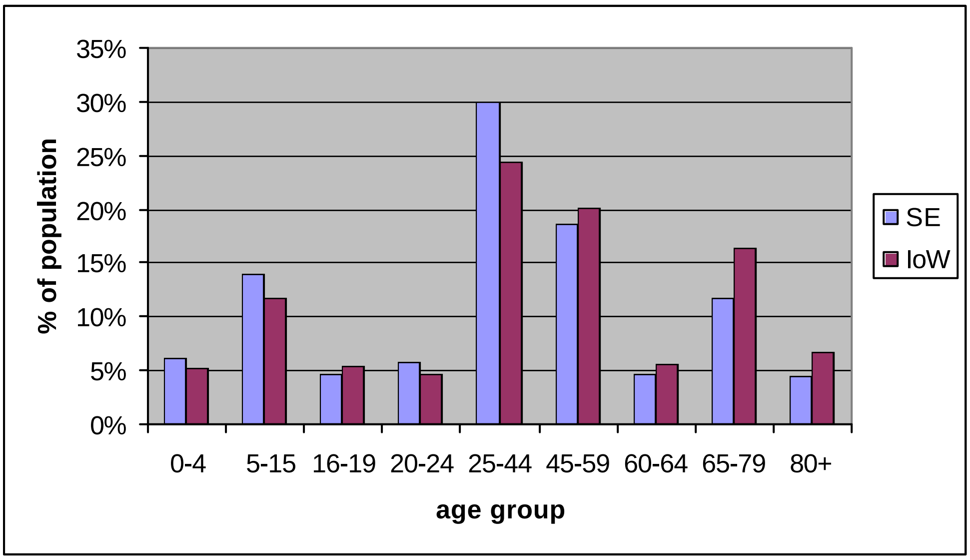
During the summer months, the population roughly doubles, due to the influx of tourists.[4]

The Island has the highest proportion of older people (over 75 years old) of any Local and Health Authority in the South East. This is because the island is a popular retirement area. The number of

[1] Local Transport Plan
[2] see UDP, 2.17, p.9
[3] UDP, p. 7-8
[4] EA LEAP, p.6

retired persons on the island is predicted to rise to over 36,000 by year 2005 – this is about 28% of the Island population. A breakdown of age groups on the Island compared to the South east averages are shown in the figure below:

Figure 1. Graph comparing the breakdown by age group of the island with the average for South East region



Some notable statistics are:

- deaths constantly exceed births on the island
- the population growth on the island is entirely due to net in-migration
- there is a 35% net outward migration of young people, due to lack of accommodation and jobs

There are currently just over 51,000 active households (that is, permanently occupied households) on the Isle of Wight[5].There are predicted to be 58,000 households by 2011. The Council UDP (1997) identifies the need for at least 8,000 extra housing units up until 2011, when it predicts there will be 58,000 households. [6]

3.1.3 Unemployment and living standards

The Isle of Wight suffers a paradox – the many number of tourists who visit the Island are attracted by its natural beauty and the perceptions of a slower pace of the life, and the "ambience" of the Island. However, for the people who actually live and work on the Island, there is a different reality. Although the Isle of Wight is part of the prosperous South East region of England, it does not share this prosperity. The average per capita GDP for the Island is £8,088, compared to the South east average of £11,455, and a UK national average of £10,711.[7] The reasons for this can be atrtributed to the "severance" effect of being an Island. The Island is physically and economically separated from the rest of the region, and the ferry crossings are among the most expensive in the UK. Studies have demonstrated the negative impact of this on the socio-economic development of the Island.[8]

The Island suffers from high and seasonally fluctuating unemployment levels – the unemployment level on the Island was 4.8% in August and 8.4 % in January compared to a South East average

[5] from BFF data
[6] EA LEAP, p.11
[7] Island Voices – the Agenda 21 Strategy for the isle of Wight
[8] UDP, sec. 2.1.5

level of 2.3% in 1999. The Island has the highest proportion of registered long-term unemployed in the South East – with 34.4% of unemployed people having been so for more than 12 months

Other economic indicators also show the disparity between the Island economy and the rest of the Region, namely:

- The second lowest average gross weekly earning in the South East, and 19.2% below the national average
- A reliance on seasonal and part-time work in the tourism sector
- 9.1% of Island households in receipt of income support

One of the Council's Plans describes the situation thus:

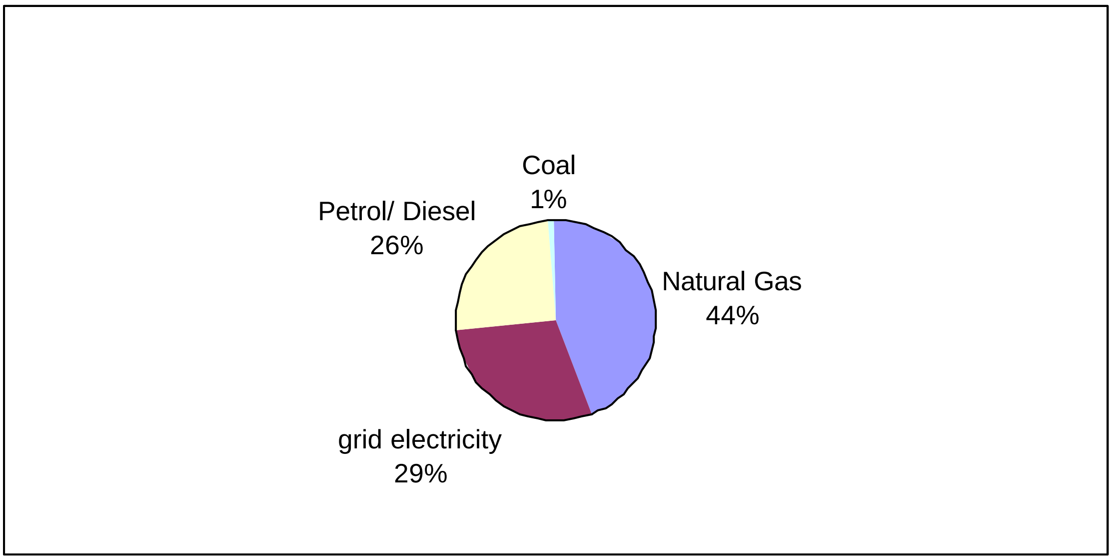
There are some clear distinctions between this environment and that of many other local authorities. The Island has a relatively elderly population and high level of unemployment. The combination of low wage rates, isolation from the mainland and high numbers of part time and seasonal jobs have created a situation where many people find it hard to secure employment opportunities which can bring them above unemployment benefit level[9]

3.1.4 Environmental impacts of current energy production and consumption on Island

Data from the Isle of Wight Council indicates that air quality is generally good. Data measurements for nitrogen doixide, and benzene have all shown levels to be within the national standard. There are 4 "Part A" processes[10] on the Island, which are covered by the IPC, and 3 of which relate to energy production, namely the Cowes gas Turbine Power Station, and the RDF plant. The Environment Agency do not consider these to be the cause of any breaches to air quality standards[11].

The CO_2 equivalent emissions from the fuels consumed on the Island are calculated to be **806,000** tonnes per year. This is equivalent to 6.35 tonnes for each person on the Island. A breakdown of the proportion of emissions from each fuel type (based on the energy analysis of section 3) are shown in the figure below:

Figure 2. Breakdown of annual CO_2 emissions by fuel type on the Island



[9] Isle of Wight transport plan p.1
[10] Industrial processes are divided into Part A processes, authorised under the remit of IPC by the EA, and part B processes, authorised under the remit of Local Authority Air Pollution Control by the Council. The Part A processes the Agency authorises in order to "prevent, minimise and render harmless potential emissions made to all environmental media)
[11] Local Environment Agency Plan, March 1999

The proportions shown in figure 2 are based on delivered energy to end-users.

3.1.5 Environmental aspects and designations

The Island has a total land area of 381km^2, or 38,100 ha. The length of coastline is about 96km (60 miles).

The designations that apply to the Island are as follows:

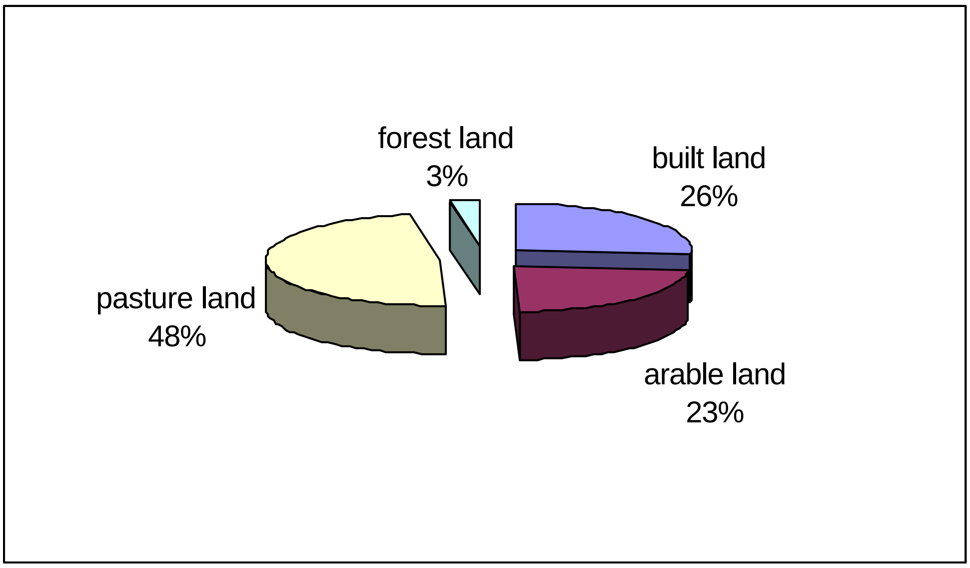
Areas of Outstanding Natural Beauty (AONB's) = 189km^2 (i.e. 49.6% of total land area!)
20 Sites of Special Scientific Interest (SSSI's) (wetland interest), covering 11% of the Island
42km (28 miles) of the 90km of coast line are designated as Heritage Coast
4 Special Areas of Conservation
1 special protection area
1 Ramsar site
300+ sites of importance for Nature Conservation

The Island is a microcosm of SE England and is unusually rich in species and habitats compared to other similar areas on mainland. The chalk grasslands, maritime cliffs and slopes and estuaries are particularly important, not only in the regional context, but also on a national and international scale. The Island has more that 10% of the SE region's chalk grassland, and it has some of the best examples of undeveloped estuaries and intertidal and off-shore reefs.[12]

3.1.6 Land use

The breakdown of land use of the Island's 38,100ha is shown in figure 3. This shows clearly that the Isle of Wight is primarily a rural environment. A major trend on the Island has been an increasing concentration of farm sizes. For example, in 1986 there were 200 dairy farms on the Island, in 2000, there were only 20[13]. The UDP mentions plans to remove 25% of productive land in the near future. Certainly the UK decline in the agricultural sector, exacerbated by foot and mouth, and BSE will have an impact on land use on the Island. This points to a need to diversify rural and farming incomes on the Island, confirmed in discussions with island NFU representatives.

Figure 3. Proportions of land use on the Island



[12] LTP, p. 63

[13] From "Island Voices" Agenda 21 Strategy

3.1.7 Legal and Financial Aspects

Legislative and policy frameworks

UK

The UK government has set a domestic goal of cutting UK emissions of carbon dioxide by 20% below 1990 levels by 2010. From the Kyoto summit, UK government's target is to cut GHG emissions by 12.5% below 1990 levels by 2008-2012.In order to help achieve these targets, the UK government set out a comprehensive ***Climate Change Programme (CCP)***, in 2000. A summary of the different elements of this programme, which include energy efficiency improvements and emissions reductions in the industrial, services/business, public, transport and agriculture sectors, as well as stimulating energy supply from renewable sources, are presented in annex 1.

The result of the CCP is that the "climate" for renewable energy development in the UK is more promising than it has been for many years, and presents some real opportunities.

Some of the key instruments that will have an impact on developing RES on the Island are covered below.

UK domestic target for renewable energy

In 1999, the UK government set an ambitious target of 10% of UK's supply to come from renewable energy by the year 2010.

It should be noted that renewable energy technologies that produce only heat energy (e.g. solar water heaters) are not included in this target. In fact, no specific targets for heat generation have been set.

Liberalisation of UK electricity market and green electricity

Throughout the1990's, the UK electricity industry was privatised, and by 1999, the market was fully liberalised. This meant that any electricity consumer, of any size, could choice whom to buy their electricity from. This change has meant not only a profusion of new suppliers, but also of electricity "products", one of which has been green electricity.

The Climate Change Levy

This took affect from April, 2001. It is a levy to be paid on fossil fuels bought by non-domestic energy consumers (excluding non-business use by charities, farms are also exempt). This levy amounts to 0.43p/kWh on electricity, and 0.2p/kWh on gas. In effect, this adds 10-15% to the cost of energy in the business and public sectors. Exempt from the levy are renewable energy sources of energy, and good quality CHP. However, CHP sources are only exempt if the energy is generated on the site of the user, or is connected to the user via dedicated lines. The CCL is expected to increase the demand for renewable energy by non-domestic consumers.

New Electricity Trading Arrangements (NETA)

NETA is not part of the CCP, but may have an impact (not necessarily positive) on renewable energy generators. The NETA, which were introduced in February, 2001, is a mechanism to avoid price fixing by large generators and to ensure lower prices for electricity consumers. However, there is some concern that it may undermine some parts of the renewables sector. This is because the arrangement, as it stands, means that intermittent renewables, such as wind, which cannot be predicted, are in effect penalised, and only receive a discounted price for the electricity they produce. However, some analysts believe that such plants may be able to sell the "green" part of their electricity separately, on the green certificates market, which would enable them to get a better price for the electricity they produce.

The Renewables Obligation

This piece of legislation, enshrined in the Utilities Bill, is due to come into force early in 2002. The RO will require that UK electricity suppliers will have to provide 3% of their electricity from renewable sources by March, 2003, and 10% by the year ending March 2011. The DTi has said that "even more ambitious targets may be set" for the longer term.[14]

Significantly, in the latest proposals, mass burn incineration will be excluded entirely from the RO. Waste pyrolysis, gasification and anaerobic digestion will be eligible, but only energy recovered from the biodegradeable fraction of industrial and municipal waste will count as "renewable". This would mean that the Island's RDF plant is not eligible as "renewable energy" under the new scheme.

It would appear that only energy generated from the biodegradeable fraction of waste-to-energy plants – which is now regarded as 50% of the output from incinerators[15] - is regarded as contributing to the UK target of 10% by 2010.

It is significant that the latest proposals also allow for biomass co-firing to be eligible under the RO – that is, where biomass is burned alongside fossil fuels in existing plant.

There are some signs that the RO may provide the long term contracts, and hence security for investment, that renewables developers are looking. This is because electricity suppliers will be looking to the longer term, knowing the RO will increase after 2010, therefore, they will be keen to place 10-15 year contracts with renewable energy generators.

Regional RES targets: South East Renewable Energy Study (SERES)

As part of the range of measures required to meet the 10% target, the government has adopted a positive strategic approach to planning for renewable energy at a regional level. Each region is responsible for identifying the contribution it can make to the national 10% target, based on its RES resources. As part of this regional planning process, GOSE commissioned ETSU and Terence O'Rourke Plc to under take a study entitled "Development of a Renewable Energy Assessment and Targets for the South East". This study is now complete. [16] The findings of the study are intended to inform the new Regional Planning Guidance for the South East, as well as the Regional Sustainable Development Framework. Several of the findings of the study are of great importance to this IRESSI project, and they are summarised in annex 2. The recommended targets for from the SERE are given in the introduction to this report.

<u>Local</u>

To a certain extent, the Island Local Authority has the potential to influence renewable energy development on the Island. The extent to which this can be done is a rapidly changing area, as the government rolls out a more pro-active regional approach to planning for RES development. The specific measures that the Council may take in this regard are to be explored as part of this study.

3.1.8 Existing Funding Mechanisms

Enhanced capital allowances (ECA)

This scheme was introduced in March, 2001. It basically allows private sector businesses to off-set energy-saving technologies against corporation tax. In effect, this can mean a saving of 30% of the capital cost of the equipment. This is relevant to renewables, in that ***biomass boilers*** are eligible under this scheme. However, public sector organisations, or other charities that do not pay tax cannot benefit from this scheme.

DTI Capital Grants, and the New Opportunities Fund

[14] From Renew, NATTA newsletter, issue 133
[15] ENDS report, issue 319, August 2001
[16] see www.etsu.com/sere-study

In order to help achieve the 10% target, the UK Department for Trade and Industry (DTI) has announced that £39 million will be made available directly from the DTI to support off-shore wind projects.

In addition, the Department for Media and Sports (DCMS) will provide a further £50 million in grants through its New Opportunities Fund (NOF). Of this, at least £10 million will be committed to offshore wind; £33 million for energy crops and at least £3 million for small-scale biomass/CHP projects. These grants will be distributed through the "Transforming Communities" tranche of the NOF. Funding will be delivered to identify best practice and provide support to reduce costs and risks, towards the point where projects are able to compete without support. Projects will need to clearly demonstrate the public good that would result from funding. The details of this funding scheme are still being finalised, but it is due to be up and running by early 2002.

Grants for Energy Crops
DEFRA is offering grants for the planting of short rotation coppice (SRC) – usually willow and poplar – and miscanthus (elephant grass), for use as energy crops. The grants on offer are £1600/ha for SRC on grazing land, £1000/ha for SRC on arable land, and £900/ha for miscanthus on arable land. In order to qualify for the grant, the landowner must have a letter of intent from an end-user for the crop, to show that the equipment will be used to generate heat/power.

Emissions Trading Scheme (ETS)
This is a key component of the CCP. The government has committed £215 million to fund incentives for the scheme over the first 5 years, from 2002-2006. All UK based legal entities, including public bodies such as Councils and Housing Associations, are entitled to enter the ETS. The way the ETS will work is that organisations will take on binding emissions reduction targets, and in return, they will receive a payment from the scheme for each tonne of CO_2 reduced against a baseline. An alternative to taking on a binding emissions target is to establish "projects" that generate emission reductions. The deadline for registering for this scheme is the end of December, 2001. [17]

The Carbon Trust
This Trust will recycle the around £130 raised by the Climate Change Levy (annually?), by developing a range of programmes to promote low carbon research and development. It includes the funding for the ECA. In the short term, the Trust will focus on support to business to save energy. But in the longer term, it may also provide funding for some renewable energy measures.

Green Electricity Funds
There are now several green electricity purchasing schemes available for domestic and business consumers in the UK, where consumers pay a premium for green electricity. For business users, this premium is now off-set by the CCL, from which green electricity is exempt. Some of these schemes pay the premium into a fund to support development of new renewable energy supplies.

European Funds
Funding is available to support the "soft"costs of renewable energy development under the EC ALTENER/SAVE programme. Funds to support the capital costs of RES project are available under the EC 5th Framework funding programme.

3.2 Prospects for RES

3.2.1 Existence of technical support for RES exploitation

There are several existing RES manufacturing, service and information/education organisations on the Island. These include:

- The Wight Green Centre – the Isle of Wight's Environment Centre, provides advice on energy efficiency.

[17] For more information, see www.uketg.com

- Aerolaminates – a world leader in the manufacture of wind turbine blades, and a part of the Danish wind turbine manufacturing group, NEG-Micon. Aerolaminates work closely with SP Systems, who are composite materials specialists.
- Ambient Energy Systems – manufacturer and install endothermic heating and cooling –making use of heat pumps.
- Rainbow Trading Post – suppliers and installers of small wind and solar systems
- Isle of Wight College – the Wight Green Centre have organised DIY classes in building solar water heaters

In addition, within the south east region, the following organisations are also available to provide support:

- Southampton Environment Centre
- Thames Valley Energy Agency
- Reading University, Energy Group

3.2.2 Public attitudes

Generally, there is a high level of environmental awareness on the Island, which was highlighted during the process of public consultation that produced the Island's Agenda 21 strategy. The strategy document has this to say:

> *"Their love for the Island's environment, both urban and rural….is tempered by concerns about how it is being maintained and developed. The debate which followed the surveys revealed worries about planning and planning policies, concerns about the management of the countryside and countryside access, and a particular worry about the incidence of litter and other waste".*

In recent times, attempts to initiate wind power developments have met some vocal opposition from local residents at proposed sites. This is largely to do with the high landscape value of the Island, and the fear that the visual impact of wind turbines would detract from that.

Also, in the recent past, public concern has been expressed about plans to increase the amount of rapeseed grown on the Island. This concern has been to do with the visual impact, impact on biodiversity, and impact on hayfever sufferers.

This re-inforces the point in the SERE report, which recommends that initial renewable energy developments should focus on the "community" scale of project, where introduction can be expected to be less contentious and indeed highly beneficial for local communities and groups, through various methods of buy-in or ownership.

4 Present Energy Status and Projections to 2010

4.1 Energy demand

4.1.1 Methodology and comment on accuracy of data

One of the advantages of working with an island for this sort of study, is that there is a clear physical boundary between the island and the mainland, across which energy flows, and can be measured. Electricity and mains gas are supplied to the Island via an underwater cable, and a pipeline, respectively. Other fuels, such as coal, fuel oil, diesel and petrol, LPG, have to be brought in by boat, and so are recorded in the harbour import data.

The majority of fuel use data has been collected direct from the suppliers. The gas supply data has come from the gas carrier, Transco. This is a bulk supply figure, and gives all of the gas delivered to the Island, regardless of who the individual suppliers may be. The electricity consumption data, based on that for 1999, has come from Scottish and Southern, the electricity supplier to the Island.

The gas and electricity supply figures are believed to be accurate, as are the import figures for diesel and petrol. The sole gap in the figures is for fuel oil data, as it was not possible to get import figures for this. The only oil data available was for Council property services and the Island's hospitals. For this reason, the heat demand figures (fuel oil is only used for heating) for the 3 sectors of domestic, services and industry are likely to be under-estimates. However, proxy UK data has not been used, as it is also likely that the fuel oil consumption on the Island is likely to be less than that on the mainland, as it has to be brought in by boat, which would make it more expensive.

The breakdown of energy use by the non-transport sector is based on the sector breakdowns given by the gas and electricity suppliers. The transport sector energy consumption is based on the petrol/diesel import figures.

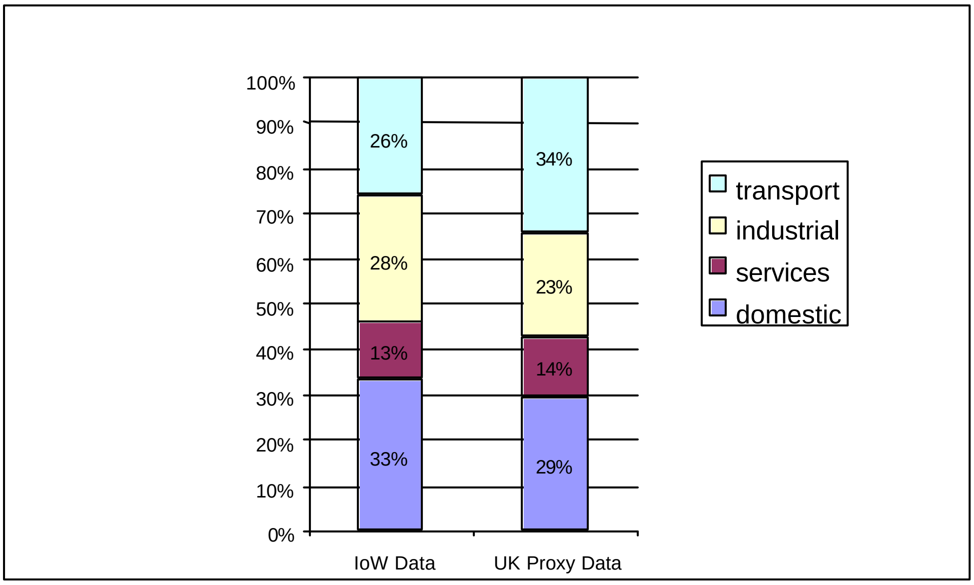
For more information on the methodology used and assumptions made for this section, see annex 3.

4.1.2 Overview

The total current annual energy consumption on the Island, across all sectors, is estimated to be **3264 GWh**[18]. To put it in perspective, this is about 240 times the annual energy output of the RDF/CHP plant.

The % distribution of annual total energy use between sectors is show in figure 3. This graph also compares the actual data obtained for the Island, with UK national data, adjusted by population size.

Figure 4. Distribution of total annual Island energy consumption between sectors, and comparison with UK proxy data

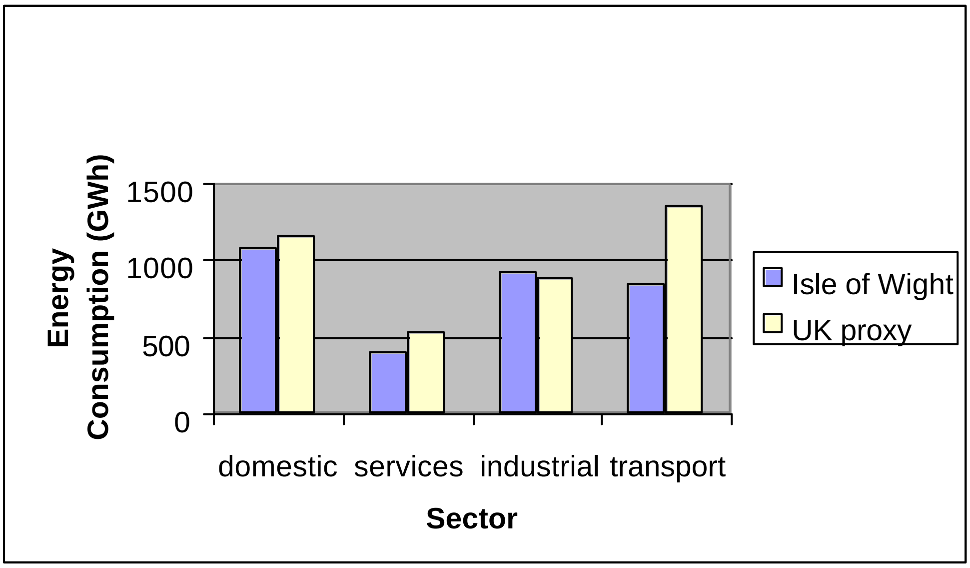


- Services includes: all commercial buildings, agriculture, all public administration and buildings, street lighting
- Domestic is all household energy consumption
- Transport is just for all diesel and petrol imported to the Island.

From this it can clearly be seen that the domestic/ household sector is the largest consumer of energy, accounting for just over a third of total energy demand. The graph below shows a comparison between the Island's annual energy demand, using available data, and what would be given by using proxy data from the UK average, adjusted by population size:

[18] Note that this data excludes wood that may have been used for domestic space and water heating in rural households.

Figure 5. Comparison of Island annual energy consumption, by sector, with UK proxy data



This shows a close match with industrial demand, and slightly lower demand for domestic and services. This could perhaps be explained by the relatively dry and warm climate on the Island, compared to the rest of the UK, despite the high numbers of tourists in the summer months. This is because, from UK data, space and water heating account for over 80% and 65% of total energy use in the domestic and service sectors respectively.

The most striking difference is in the transport sector. Determining a figure for transport consumption was more problematic than the other sectors. This was because transport use could include plane journeys, (national and international) and ferries, which both re-fuel on the mainland. It could include travel by Islanders on the mainland. It could also include a share of the UK transport demand for freight, which would be involved in supplying goods to the Islanders.

However, the decision was made to just consider the fuel actually purchased from service stations on the Island, as measured by import data. This was because this was felt to be the easiest figure to understand and for people to relate to. It is also only this part of transport demand that the Island community can have any real influence over, when it comes to meeting it from renewable sources.

This is one reason why the transport energy demand for the Island appears lower in figure 4 than the UK proxy. Another possible reason could be due to the lower than average number of households that own a car on the Island.
This differs also from the UK average, in that normally the demand for transport is the highest, with 34% of the total, and the domestic sector is second, with 29% of the total.

4.1.3 Peak electricity demand

The peak electricity demand for the Island is about 120MW. The total annual electricity consumption for the Island (1999) was 545GWh, giving an average electricity load of 62MW. The total electricity consumption per person on the Island equates to 4290kWh per year, or just under 12kWh per day.

4.1.4 Seasonal Variations in energy demand

Gas variation

From Transco gas data, the lowest demand occurs during August (just under 1GWh per day), and the highest in December (just under 7GWh per day). Based on the total annual figure, the average daily gas demand is 5GWh.

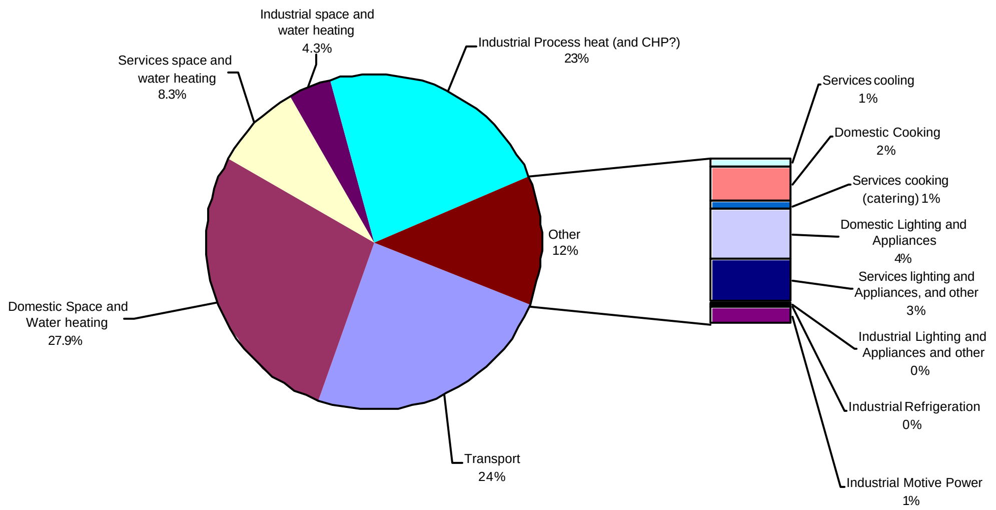
Electricity variation

The actual variation in electricity demand for the Island is not known in detail. However, UK proxy data can be used. From load research data from the Electricity Association, the largest variation is for Economy 7 domestic households. For this case, the greatest average demand is for the month of January, and the lowest is for the month of August. The demand in this case in January is 2.23 times the demand in August.

4.1.5 Breakdown of energy demand by end-use

Figure 6 clearly shows that the largest sectoral end-use as a percentage of total energy consumption is domestic space and water heating, which consumes just over a quarter of all energy. This is closely followed by transport, and industrial process heat, which both consume just under a quarter of the total energy.

Figure 6. Breakdown by sector, and by end-use, of total annual Island energy consumption



4.1.6 Recent trends in energy use and projections to 2010

Unfortunately, no data was available for energy consumption on the Island in past years – data was only available for the year 1999. Therefore, any trends have to be deduced from proxy data for the UK as a whole.

Over the last 10 years (1990-1999), UK total energy consumption has risen by about 6.5%. The largest rise has been in the domestic sector, at 13%, followed by services, at 11.5%, and transport, at just under 11 %. Industrial energy consumption has actually fallen by just over 8%.[19]

In the SERE study, a scenario was assumed where the government's Climate Change Programme was moderately successful, and total electricity consumption rises by only 2.4% from 1999 to 2010. The same scenario is used for this study.

[19] UK Energy in Brief, Dti, November 2000

Transport

As stated above, energy consumption in transport has grown steadily over the last 10 years, and shows no sign of slowing down. Given the large numbers of visitors and tourists who visit the Island in the summer months, there is a limit to what the Council can do to limit transport energy demand. The Local Transport Plan sets a target of limiting the growth of traffic to an average of 1% per annum over the period 2000-2010, on roads in the major urban areas of the North east of the Island, and the Coastal Areas. Assuming that the Council will succeed with many of its aims set out in the Transport strategy to promote alternative forms of transport, and allowing for further improvements in engine efficiency over the period, a rough estimate is made that the growth in transport energy demand will be limited to 5% over the period. This projection has been confirmed with the Council's transport officer.

Population trends

The projected population for 2001 is 126.6 thousand, and for 2011, 129.9 thousand. This represents an increase of 2.6% over the period.[20] This will be due to net in-migration.

Under the Home Energy Conservation Act (HECA), which was passed in 1995, Council's are urged to "make substantial progress" towards achieving a 30% reduction in household energy consumption within 10-15 years, against a 1996 baseline. From discussion with the Island's Housing Initiatives Officer, a rough estimate of the likely achievable target for the Island by 2010 will be an 18% reduction in the average annual energy consumption per household. The saving since 1996 to date is reported as just over 8%, in terms of the average per household. The Act does not specify which forms of energy consumption this applies to, therefore it is taken to refer to total household energy consumption.

However, this needs to be offset by the fact that the number of households on the Island will increase between now and 2010. The number of active households on the Island in 1999 was slightly over 51,000[21]. This is expected to increase to 58,000 by 2011[22]. This represents an increase of just over 12%. Therefore, for the purposes of this study, it is roughly assumed that any savings in total domestic energy consumption due to implementing strategies under HECA will be off-set by the growth in the number of households. ***This demonstrates the imperative for designing in energy efficiency measures as part of a programme of RES development.***

As part of the Local Agenda 21 strategy, the Council has made a commitment to reducing Council energy consumption by 5% over a 5 year period, from 2000-2005. This amounts to a saving of 4.5GWh, which is 1.1% of total services energy consumption, and 0.14% of total energy consumption. This will do a lot to hold back growth in the services' energy consumption on the Island.

Therefore, based on the above information, the assumption is made that the total energy consumption in 2010 for the industry, services and domestic sector will be the same as the 1999 level. But the consumption of electricity will increase by 2.4% over the period, meaning that consumption of natural gas, for space and water heating, will actually fall by about 0.8% in order to keep total energy consumption at the same level.

Therefore, the projected total energy demand by 2010 is 3307GWh, and increase of 1.2% on the 1999 figure, caused by a 5% increase in transport energy demand.

The projected total electricity demand figure for 2010 is estimated to be 558GWh, based on a 2.4% increase over the 1999 figure.

[20] UDP, p.47.
[21] From BFF data, taken from "Focus on the South East"
[22] From UDP

4.2 Energy Supply

4.2.1 Present energy mix

The physical isolation of the Island from the mainland means that perhaps local consumption has favoured consumption of gas, which is piped from the mainland, and electricity, for which there is an undersea cable, over solid fuels such as oil and coal, which have to be shipped over.

Figure 7 clearly shows that natural gas is the fuel providing the majority of the energy consumed on the Island, followed by petrol and diesel for transport, which provides just under a quarter. Electricity is the third largest provider of energy, and the waste-to-energy plant on the Island provides 2.5% of the total electricity consumed.

Figure 7. Chart showing breakdown of current Island annual energy consumption by fuel type

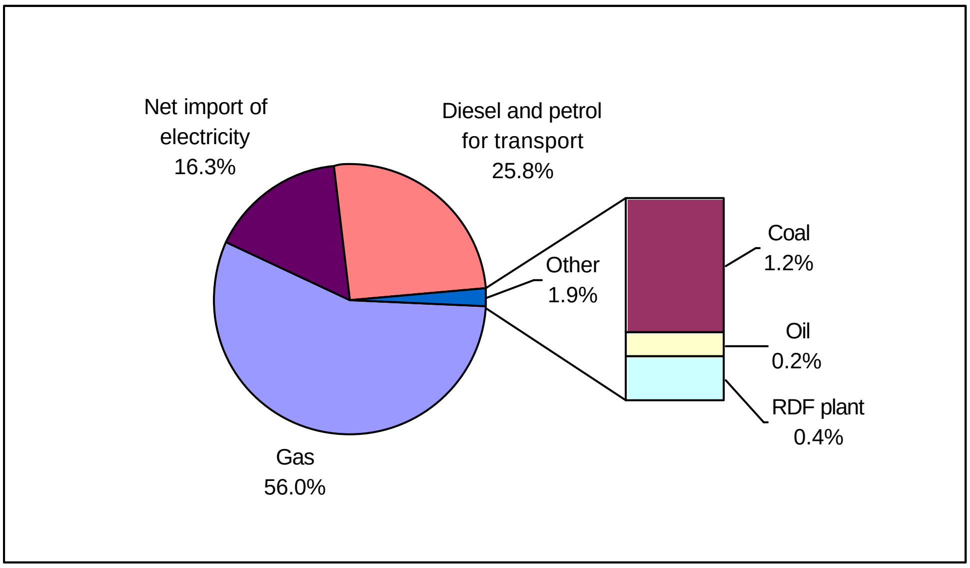
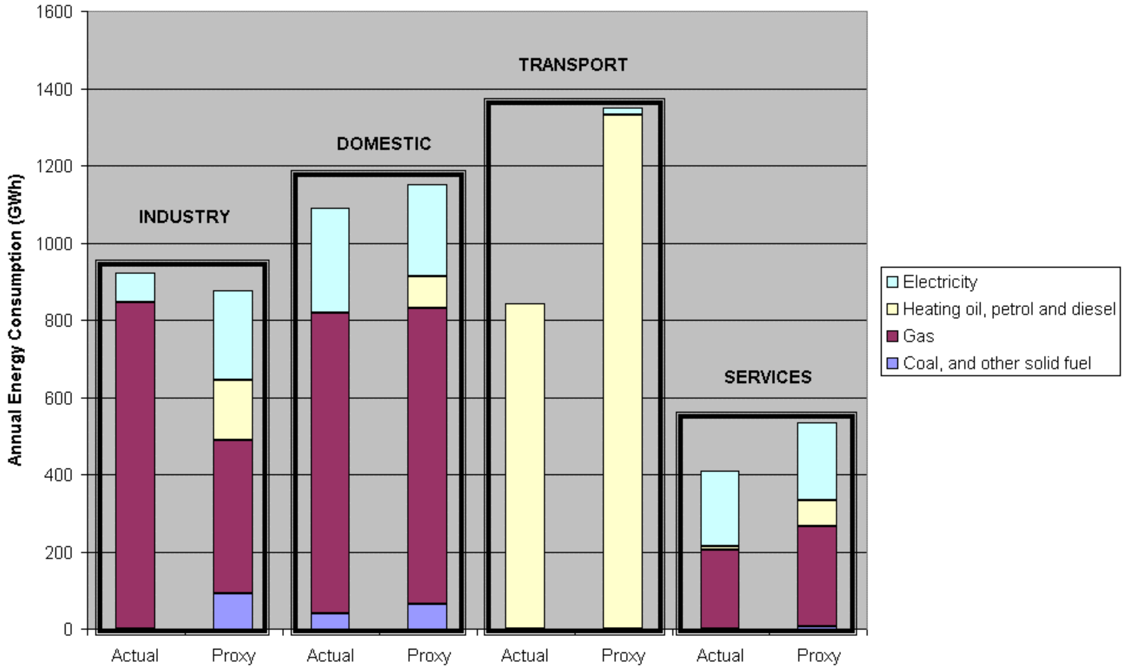


Figure 8 below gives an estimated breakdown of the types of fuel used in each sector. The figure shows 4 types of information – a) the relative proportions of each fuel type used to meet the energy demand of each sector, b) the total energy demand for each sector, c) a comparison between sectors of the energy demand, and d) a comparison of actual Island values for these categories with what would be obtained using UK proxy figures – i.e. a similar breakdown for average data the UK as a whole, adjusted to the population size of the Island.

This clearly shows the marked discrepancy in use of heating oil. As mentioned in section 4.1.1 this is in part due to inadequate data, but may also reflect that the Island uses less heating oil than the mainland, due to the additional cost of transporting it by sea. Furthermore, figure 8 clearly shows that gas meets the majority of energy needs for the industry and domestic sectors.

Figure 8. Estimated breakdown of actual annual Island Energy consumption by fuel type, and comparison with UK proxy



4.2.2 Existing waste-to-energy plant

The existing waste-to-energy plant on the island was built in 1991, and initially received a NFFO 1 guaranteed price for its electricity output, until 1998, when it reverted to the electricity pool price. The net electricity power output of the waste-to-energy (RDF) plant on the island is about 2.0MW, and produces about 13 GWh per year of energy[23]. Although the RDF plant is a CHP facility, producing heat as well as electricity, the net output of heat, or the use to which it is put, is not available to this study.

4.2.3 Existing Energy Infrastructure

As mentioned above, the electricity supply comes mainly from the mainland, via an underwater cable. The main grid on the Island is at 132kV. Whether or not the grid would be strong enough to take input from renewable energy generators at specific points would require further detailed study, on a case-by-case basis.

Similarly, natural gas supplies come from the mainland via an underwater pipeline.

All other liquid and solid fuels (excluding locally produced firewood) are brought onto the Island via sea freight.

4.2.4 Recent trends and projections to 2010

There has been a steady decline in coal consumption in all the sectors (apart from transport). Over the 1990's there has also been significant growth in the use of gas for space and water heating in both the domestic and service sectors.

It is assumed that trends on the Island will have mirrored the UK national trends, which have seen a growth in the importance of the use of gas for space and water heating, at the expense of coal and oil. Also, it is likely that there will be several CHP plants that would have been established on

[23] from BFF data, and discussion with Island Waste Services

the Island, that would burn gas to provide electricity and heat for large industrial and service users. It is known, for example, that there is a CHP scheme at St Mary's hospital, which produced 0.44GWh of electricity in 1999.

5 RES Potential

5.1 Solar

5.1.1 Solar water heating (SHW – solar hot water)

Solar water heating (or "active" solar as it is also known), involves collecting the sun's heat in highly absorbent collectors, and transferring the heat to water. This type of technology provides heat only, and does not produce electricity.

The most common types of applications in the UK are for providing domestic hot water for houses, and for heating swimming pools. However, there is also the possibility of institutional end-uses, such as providing hot water for hotels, and district heating.

It is not known at present how many solar water heating systems are installed on the Island.

There has recently been a reduction in VAT on solar water systems from17.5% to 5%. The economics for SHW are best where they displace the use of electricity for water heating, as electricity is about 3 times as expensive as gas. The average property requires about 3000kWh[24] of energy per year for domestic hot water. Up to 50% of this can be met from SHW. However, without capital grants, SWH for domestic hot water are not particularly cost-effective. Over a lifetime of 20 years they will just about pay for themselves, if they displace electricity use – a typical installed cost, for an individual house is £2500-£3000. This cost can be reduced through DIY schemes, and group purchasing. An additional benefit is that they can add to the value of a property. As the STA say themselves, individuals invest in SWH for environmental reasons or personal interest rather than for economic reasons.

This said, systems for outdoor swimming pools can be more cost-effective, as lower grade heat is required, and they can use a simpler, and therefore less expensive type of solar collector.

Using the SERE estimates, based on Solar Trade Association (STA) scenarios, a realistic target for the Island would be to have 325 SWH systems installed by 2010. The estimated annual heat energy output from this is 0.49GWh.

Excluding flats, which would be unsuitable for SWH, there are about 41,600 households on the Island[25]. Assuming that only 50% of these would have a south-facing roof, then 325 SWH systems would represent a market penetration of 1.6%. STA themselves have said that they would like to see a 2% market penetration by 2010, which would represent a 10-fold increase over current levels.

5.1.2 Photo-voltaic (PV) systems

Electricity can be generated directly from photo-voltaic panels, which can be mounted on roofs or walls of domestic and commercial buildings.

Although the costs of PV panels have been coming down over recent years, they are still an expensive technology. Therefore, their degree of penetration will be small in comparison to some of the other technologies covered in this report. However, PV does have the advantage that it can readily be used in an urban context, and at a small-scale, which makes it attractive for individuals and commercial operations wishing to display "green credentials".

[24] Solar Trade Association
[25] from BFF data

A typical size of system for a UK house is 1.5kW$_p$ to 3kW$_p$ (the p means "peak", which means the system will deliver this amount of power only at noon, on a sunny day). The average, over a year, of the daily insolation, which is a measure of the amount of solar energy landing on a panel, is for London about 2.5kWh/m^2/day, which is equivalent to 2.5 peak sunshine hours per day. A 3kW$_p$ system will, on average over a year, generate about 7.5kWh of electricity per day. This is about half of the average daily electricity requirement of a house on the Island.

It is not known how many PV systems are already installed on the Island. The SERE presents 2 scenarios, a "business as usual" scenario and an "accelerated uptake scenario". This shows a range of from 10 to 39 domestic systems on the Island by 2010,. With a potential energy contribution of 0.01 to 0.05 GWh per year.

For a commercial building, the typical size of installation might be 50kW$_p$. A realistic target is that one such system might be in place by the year 2010, as part of some new-build development. This would give an annual energy contribution of about 0.05GWh.

Thus the upper bound for the contribution of PV to energy demand on the Island is about 0.1Gwh/year. This, of course, is very small when compared to the other renewable energy options. This is summarised in figure 9.

Figure 9. Table showing potential energy contribution from PV

	no. of systems by 2010	installed capacity (kWp) by 2010	annual energy output (GWh) by 2010
business as usual	10	15	0.01
accelerated uptake	39	58.5	0.05

In order to realise this upper bound, additional incentives will be required, including the following:

1. Proactive development policy by the Council – for example, this could include insistence that new building developers give sufficient attention to the introduction of PV
2. "Net-metering" – this applies only to grid-connected PV systems, where PV generated electricity is supplied to the grid at times when it is surplus to building demand. At the end of the month, the customer is charged by the utility only for the net amount of electricity they have imported from the grid. In effect, this means that the PV produced electricity has a price equivalent to that paid by the consumer. This is considerably higher than the price that would be given to a straightforward electricity generator. A net-metering arrangement for PV has been introduced by TXU Energy, with the involvement of Greenpeace.
3. Capital subsidies
4. Funding support for clusters of installations

Apart from (2), these incentives apply equally as well to solar water heating.

There is also considerable potential to deploy the technology in new-build houses and commercial buildings, which is more cost-effective.

5.1.3 Passive solar design (PSD)

PSD is a mature technology where buildings are designed in such a way that they maximise the use of natural solar radiation, and natural ventilation to minimise the amounts of additional energy required for space heating and cooling and lighting. Although it is not really possible to set targets for such technology, there is the possibility for the Island that, as with the SHW and PV options above, PSD principles could be incorporated into a new housing or commercial building development on the Island.

It is very significant to note that the Council has an important role to play in encouraging the incorporation of all three of these forms of solar energy (SHW, PV and PSD) in new-build developments, domestic or commercial. In the words of the South East Renewable Energy Study, a key role would be "a greater presumption on the part of Local Authorities that decisions on development proposals within their remit should take account of the extent to which developers have given significant attention to the introduction of [these features]".

5.2 Biomass

The phrase "biomass" covers many different types of renewable energy technologies and sources of feedstocks. Also, unlike other forms of renewables, such as wind, or PV panels, biomass energy can supply just heat only, or electricity and heat together, in what are known as Combined Heat and Power (CHP) plants. Liquid biofuels, which can be used as substitutes for diesel and petrol for transport, are treated in a separate section. This section will consider the quantities of feedstocks that may be available from different processes, and hence the amounts of energy that may be generated.

It should be noted that the Island does not have the advantage of areas on the mainland, where energy crops can be commercially transported to a generation plant within a radius of 40km. The resource is limited by the biomass that can be harvested on the island itself.

5.2.1 Farmyard manure (FYM)

Animal manures can be anaerobically digested (that is, without air), to produce biogas (methane). This process is referred to as AD, for short. This biogas can then be burnt to generate heat alone, or, for larger plants, the biogas is combusted in a diesel engine to produce electricity and heat (CHP). Practically, only manures from animals kept housed can be readily collected, so this means suitable manures are chicken litter, pig manure, and manure from dairy cows.

From discussion with the NFU contact on the Island, there are only one or two large pig farms, and these animals are kept in the open. The progeny are sent to the mainland for fattening up, which is the intensive part of the process. This means this is not a viable source of biomass.

As far as is known, there are no intensive hen battery farms on the Island, this this excludes broiler waste. Although there is also a sizeable beef herd on the Island (2,600 animals) they tend to be kept in less intensive conditions on straw based systems, which would make collection of the manure unviable.

This leaves only dairy cow manure as a viable source. There are about 20-25 dairy farms on the Island, the largest of which has about 700 cows, and the average size is about 150 animals. From agricultural census data (1999), there are about 5500 dairy cows on the Island. Typically, for AD, there are 3 scales of system that can be used: either on-site generation, by a single farm; a co-operative grouping of several farms, or a large centralised plant which would take input from many farms, and possibly also feedstock from other sources, such as non-toxic household and industrial waste.

If it is assumed that only the manure from the dairy herd can be used, then if all the available manure could be converted to biogas, the energy generation potential, for a centralised CHP plant would be about $0.5MW_e$ (electrical) and $0.3MW_{th}$[26] (thermal), using manure alone. The thermal output is after allowing for the heat required to maintain the digestion process. This would produce an annual output of about 4.3GWh electric and 2.7 GWh thermal. If individual, on site plants were to be developed instead, then the amount of resource harnessed would be less.

[26] based on figures from "Anaerobic digestion in the UK - a review of current practice", ETSU, B/FW/00239/REP, 1993

An alternative target might be to aim for 5 on-site AD's, each using CHP engines, producing in the range of 30-50kW electrical. The total annual output would be in the range of 0.4GWh electric, and 0.25GWh thermal.

From discussion with NFU, there are other benefits from this type of project, in that farmers are already very familiar with the technology and the biological processes involved.

5.2.2 Straw and Agricultural residues

The 1994 ETSU study suggested a small potential for the combustion of straw, in the region of 0.2MW. This was based on residues from wheat, barley and rape. However, from discussion with the NFU representative on the Island, it seems that due to the balance between arable and livestock farming on the Island, most of the available straw is used for agricultural purposes. In fact, this year, there is a real shortage of straw on the Island. Therefore, this resource is considered to be negligible.

5.2.3 Forestry Residues

During the course of this study, several discussions were held with Forest Enterprise (FE) staff on the Island, and in the FE South East Divisional office.

The total size of the Forest Enterprise landholding on the Isle of Wight is currently 1191ha. Of this, 995ha is classed as forestry plantation, which is 2.6% of the total land area of the Island. Most of this wood is sold to a single contractor, Mendip Forestry, who transport the logs off to the mainland for processing. 40% of this 995ha is productive conifer/ softwood plantation.

The contractor is required to completely clear an area of forest which means they have to remove the poor quality timber/ thinnings, as well as the useful logs. The local FE ranger feels that this depresses the price for the timber that FE is able to get from the contractor. At present, there is little local demand on the Island for softwood.

There is scope here for converting the softwood thinnings to woodchip, which could then be burnt in a biomass boiler, to provide heat (and possibly electricity as well), for an institutional user – e.g. school or hospital. In practice, the way this would work is that when the forestry contractor cleared a stand, a user would pay for the softwood thinnings to be transported to their site, where they would be chipped and stored for drying, to be burnt later. As well as providing a source of renewable energy, this would also assist in FE being able to possibly negotiate a higher price with the forestry contractor. It would also be an example of "closing the loop", whereby thinnings grown on the Island would be usefully used on the Island, rather than being transported to the mainland.

The FE forecasts for softwood thinning volumes on the Island estimate that the green volume of thinnings for 2002-2006 will be $1326m^3$, and for 2007-2011, $1196m^3$. From FE data, $1m^3$ of green softwood weighs about 1 tonne, and has a moisture content (by weight) of 150%. Using the latter figure for thinning volume, and assuming that only 50% of this total could realistically/economically be used, then about 300 tonnes of woodchip from softwood thinnnings could be produced per year (assuming 25% moisture content), or the equivalent of about 225 oven dry tonnes per year.

Assuming that this was used for heating only, in a biomass boiler, and heat was only required for 6 months of the year, then this would support a boiler with an average output of around $200kW_{thermal}$. This would be enough to provide base-heating for a school, for example. The total annual energy output would be around 0.9GWh.

A useful comparison is Woebley School, in Herefordshire. Here, they have installed a 350kW wood-fired boiler, which meets the base-heating load of a primary school and the secondary school on an adjoining site. The boiler takes its fuel both from woodland thinnings, and from willow and poplar short-rotation crops. The boiler requires from 150 to 300 tonnes of wood chip per year, depending on the heat demand.

Another possible end-use, as suggested by the Island's FE ranger, could be to use the thinnings to provide heat for the prisons and adjoining hospital complex, in Newport, which represents a considerable concentrated heat load.

A point that shouldn't be overlooked is that the thinnings do not have to be the sole biomass feedstock to a boiler – they can be used in conjunction with specially grown short rotation coppice, as in the Woebley school example. This would enable use of a larger boiler than that possible with just the woodchip from thinnings.

As well as the FE land, there are some other small amounts of woodland on the Island, owned by the National Trust, Woodland Trust, the Council, and private owners. In total, this is roughly estimated to be around 20ha. It is possible that small amounts of thinnings could also be obtained from management of these woodlands. The existing Woodland Forum would be a useful avenue for exploring this possibility.

5.2.4 Sewage Sludge

The anaerobic digestion of sewage sludge has been widely used by water utilities to stabilise and disinfect sewage sludge prior to recycling to land, or disposal to sea.

This process is to be used in Southern Water's new sewage treatment works and recycling centre to be built at Sandown, as part of the "Seaclean Wight" initiative. The sewage sludge which is removed during the treatment process will go to a recycling centre. Here it is anaerobically digested, and methane gas will be generated. But all of the gas generated will be burnt to provide heat for pasteurising the "cake" that is produced during the process, which can then be used as soil conditioner. There will not be any excess gas available for additional energy generation.

5.2.5 Energy Crops – Short Rotation Coppice and Miscanthus

An alternative to the above sources is to specifically grow crops that will be combusted in a biomass plant. The most accepted way of doing this is to grow willow or poplar which is coppiced on a short rotation, every 3 years (called SRC – short rotation coppice, for short).

A conservative figure is that about 500ha of SRC are required for a biomass power station of 1MW electrical output[27]. This equates to about 4500-5000 oven dry tonnes of wood per MW.

From the DEFRA data for agricultural holdings, 2000, the total agricultural land area on the Island is 24,668ha. The quantity of set aside land for the same year was 1,226ha.

Discussion with the NFU on the Island suggests that there is definitely potential for growing SRC on the Island, especially in the north of the Island, in an area bounded by Freshwater, Ryde and the northern coast. This is because these are pre-dominantly livestock areas, where there is a large amount of non-ploughable, heavy soils. This, of course, would also be closest to the points of maximum energy demand, which is beneficial from the point of view of minimising transport cost of the wood fuel.

The table below shows the different amounts of energy that could be produced for different % use of agricultural land:

[27] from DTi leaflet ERE-WF2 "Wood Fuel for Electricity & Heat"

Figure 10. Table showing potential for biomass energy from energy crops

Total agricultural land on IoW (ha)	Generation Capacity at 5% use for energy crops (MWe)	Generation Capacity at 10% use for energy crops (MWe)	Generation Capacity at 25% use for energy crops (MWe)	Generation Capacity if use all set aside (MWe)
24,668	2.47	4.93	12.33	2.45

The figure of 25% is significant, as this is the proportion of land that it is suggested in the UDP could be taken out of productive use in the future.

5.3 Liquid Biofuels

The production of biodiesel involves processing a vegetable oil, (which can come from rapeseed, linseed, or sunflower seeds), to remove the glycerine, as well as other refinement. This makes it less viscous, and removes impurities, thereby making it suitable for use in a diesel engine. The source of oil may also come from waste vegetable cooking oil, collected from restaurants, hotels, and institutions such as schools. This source is referred to as RVO (recycled vegetable oil) for short.

The resulting fuel, which is called either Fatty Acid Methyl Ester (FAME) when it comes from RVO, or Rapeseed Methyl Ester (RME) when it comes from rapeseed, can be used as a substitute for diesel fuel used for transport vehicles. Assuming it meets the appropriate quality standard, biodiesel can be used as a 100% substitute for diesel, with minimal engine modifications. Alternatively, it can be sold as a blend with ordinary diesel – a 5% blend is sold in France.

However, due to higher production cost, biodiesel is not an economic substitute for heating oil. Similarly, as discussed below, it cannot economically be used in vehicles that run on red (duty free) diesel, such as ferries, and agricultural vehicles, as the red diesel would be cheaper.

Research into the feasibility of using biodiesel as an alternative to fossil diesel for transport on the Island was carried out by Charlotte Bruton, of the Energy group, at Reading University, as the subject of her MSc thesis.

Her study[28] showed that about 1.7 million litres of waste cooking oil is produced on the Island each year. Presently, about 250,000 (15% of total) litres per year is collected for recycling[29]. The recycling process currently takes place on the mainland, so the waste oil is has to be transported off the Island. If 50% of the waste oil produced on the Island could be recycled, then this could be converted into 680,000 litres of biodiesel.

To put this in perspective, the current annual diesel consumption of the combined fleets of Wightbus, Southern Vectis and Biffa waste collection vehicles is about 2.4 million litres per year. So, the RVO could meet about 28% of this demand. The remainder could come from rapeseed and linseed to be grown on the Island. Currently, there is 570ha of rapeseed grown on the Island (1999), and 621ha of linseed. If all the oil for these crops were converted into biodiesel, it would produce about 1.9 million litres of fuel. This, together with the RVO, would meet the fleet demand mentioned above, without planting any additional oil crops to those already grown on the Island.

To produce 2.4 million litres of biodiesel per year would require a production facility with an output capacity of 2000 tonnes per annum.

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[28] A Feasibility Study Into The Use Of Biodiesel On The Isle Of Wight, MSc Thesis, Charlotte Bruton, Energy Group, Reading University, September, 2001

[29] Personal communication, A&B Oils, Southampton

Larger amounts of biodiesel could be produced, by either planting more oil crops on the Island, using set aside land, or importing vegetable oil from the mainland. If the former option is chosen, there may well be a conflict of land use between growing wood biomass, such as SRC, for biomass energy generation plant, and growing oil crops for biodiesel. There is an argument that in terms of biodiversity, and visual impact, the former is to be preferred, and this seems to be the preferred option currently on the Island

Island Waste Services regard the disposal of waste cooking oil on the Island as a problem area, and they are keen to implement a waste oil collection scheme in conjunction with biodiesel production, as a way of positively recycling this problem waste. Further, they have already expressed interest in using biodiesel in their collection vehicles. Southern Vectis have also expressed interest.

A major barrier to the development of biodiesel in the UK at present is that it is taxed at the same rate as standard diesel, namely 52p per litre. However, the 2002 budget will give a tax break to biodiesel, such that it will be taxed at 20p per litre less than standard diesel. But for production of biodiesel to be economic in the small quantities envisaged for the Island, then , from recent research[30], it seems that the fuel duty will need to be reduced to the level currently levied on other alternative transport fuels, such as LPG and CNG, which is 9.8p/litre.

5.4 Wind

5.4.1 Off-shore Wind

The UK government anticipates that 1.8% of its 10% target of electricity from renewables by 2010 will come from off-shore wind[31]. The government has allocated £49 million of funding for off-shore wind, which will be allocated in the form of one-off grants.

Off-shore wind turbines will generally be placed in shallow water, of less than 30m depth. This is due to technical limitations on construction of foundations for such turbines. BWEA guidelines suggest, that for visual reasons, the windfarms should be placed no closer than 5km to the shore, although some proposals are less than 2km, and the pilot project at Blyth Harbour, Northumberland, which is a single 2MW machine, is 1 km off-shore.

The SERE identified that the SE Coast is likely to be an attractive area for the first, relatively near shore wind farms that will be built between now and 2010. In April, 2001, the Crown Estate announced the 18 developers, spread over 13 sites (some with more than one developer) who had successfully pre-qualified for a lease of seabed for development of offshore wind farms. It is significant that none of these are on the South Coast. Each developer has pre-qualified for an option of 10km^2 for a maximum of 30 machines, and a minimum capacity of 20MW. It is expected that those projects that proceed to obtaining full consents will be operational by 2005. These sites range from 1.5 to 10km off-shore, the closest one being in Teeside.

In the SERE, the conclusion for off-shore wind was that an appropriate upper target would be one off-shore windfarm for the coastal sub-region of Hampshire and Isle of Wight, with a typical size of 50MW (based on 25 2MW machines). This would generate typically around 160GWh/year. Therefore, there is an opportunity for this wind farm to be off the coast of the Isle of Wight, and to feed into the Island's grid system. Initial discussions with Scottish & Southern, who are in charge of the grid on the Island, suggest that this would be possible, although some local strengthening of the grid may be required.

5.4.2 Onshore Wind Linked to Electricity Grid

[30] "Financial and Environmental Impact of Biodiesel as an Alternative to Fossil Diesel in the UK", ECOTEC Research and Consulting Ltd, November, 1999

[31] BWEA website www.offshorewindfarms.co.uk

In the 1994 Southern Region Renewable Energy Planning Study, the practicable wind energy resource for the Isle of Wight is put at an installed capacity of 8.0MW. The energy output from this is estimated as 15.5GWh.

Modern machines typically have a maximum installed capacity of 1.5MW, at a hub height of 60-70 metres. The maximum number of machines that can be fitted on one site will depend on the site, but a figure used by ETSU is a maximum density of 9MW/km^2 – this implies a maximum of 6 turbines per km^2.

The SERE study identified that only individual wind farms smaller than 12MW (this is 8 machines or less, based on 1.5MW machines) could be accommodated in the south east region, based on the following assumptions:

- No wind farms in designated areas (National Parks, AONB's, National Nature Reserves, SSSI's) or areas of greenbelt.
- Centres of wind farms are at least 7km apart

Based on this, the SERE gives a resource for the Hampshire and Isle of Wight region of 33MW. Assuming a similar split in the resource between the two counties, as for the 1994 study, this suggests a resource of about 12MW for the Isle of Wight. This represents an increase over the 8MW in the 1994 report – however, this is reasonable given the improvements in technology and cost reductions since then. Using 1.5MW machines, this would equate to either 1 wind cluster of 8 machines, or could be 2 smaller wind clusters, each with 4 machines.

However, the potential resource, if controlled deployment within designated areas is allowed, would be far greater. The Isle of Wight has one of the best wind resources in the South East region, but also has a large proportion of its land area covered by designations. A challenging target for limited deployment in designated areas would be 18MW of installed capacity, which would in practice likely mean 1 additional small wind cluster.

It is noteworthy that this size of development, of the order of up to 5 machines, fits well with a **community-scale wind project**, where there is a high degree of community involvement in the wind project. This can take the form of the community having equity stakes in the project, or even ownership. In the rest of Europe, it is generally accepted that wind projects have some form of community involvement, usually financial. A recent report prepared for the Countryside Agency[32] suggests a suitable model for the UK could be clusters of about 5 turbines, with a total capacity of some 3MW.

5.4.3 Wind Power for On-site Use

This category relates to wind power which is not connected to the electricity grid, but supplies electricity direct to an end-user to meet their electricity needs, e.g. for a supermarket, farm, manufacturing plant, or some other relatively large user. This would involve the use of single machines, with a power output in the range of 20-300kW. Such schemes would not necessarily present conventional commercial propositions, but could be attractive to "community" or institutional groups who would perceive more than just economic benefits.

5.4.4 Wind Power for off-grid properties

This last category is for small wind-powered battery charging systems, that can provide stand-alone power for off-grid properties, or telecommunications, for example. The size of such systems is in the range of a few hundred Watts, to a few kilo-watts. It is likely that there will be several opportunities for such systems – and they may provide good opportunities for environmental education – e.g. such a scheme is proposed for the Medina Valley Centre. However, although important form the perspective of education and awareness raising, such scheme will not make a significant contribution to meeting energy demand on the Island.

[32] "Community Based Renewable Energy: Delivering Projects in the English Countryside", Final Report, March, 2001

5.5 Tidal Power

There are essentially two forms of harnessing tidal energy. The first is to build a barrage which retains water behind, to create a difference in water level across the barrage, as the tide goes out. The water can than be released through turbines to generate electricity. However, the mean tidal range of the region does not make tidal barrage technology viable. Furthermore, the environmental, navigational and planning constraints in the Medina estuary, which would be the most likely site, are very severe.

The other method is to exploit *tidal or marine currents*. This technology is akin to an underwater wind turbine, except the fluid is water, propelled by underwater currents, rather than air. Although the speed of tidal currents is much lower than typical wind speeds, this is more than compensated for by the fact that water is a thousand times more dense than air.

A recent DTI report[33] states "It is clear that tidal stream devices can be made to work; it is not yet demonstrated that they can be made to work at economically attractive prices for the cost of energy they would generate".

The same report goes on to state that the most advanced tidal stream generator is that proposed by Marine Current Turbines Ltd (MCT).

Of all the technologies being considered in this report, tidal stream technology is the one which is still at an R&D stage, and is not market ready. Therefore, any possible contribution from this technology by 2010 has to be treated with a good deal of circumspection. However, it is included here because the Isle of Wight is one of about 40 possible sites in the UK that are suitable, and could be used as a site for demonstration installation of the technology.

For economic exploitation, peak spring tide velocities need to be in the order of 4 to 5 knots[34] (2 to 2.5m/s), with depths of water between 20 and 35m. Admiralty Tidal Stream Atlas charts show a peak spring tide flow of 4.4 knots for the Hurst narrows, and 3.8 knots off St. Catherine's Point, which indicates that these could both be possible sites.

MCT have plans to test a 300kW prototype off the North Devon, in the summer of 2002. EC funding is already in place to support the cost of this project. ***If this prototype testing is successful*** then MCT have plans to develop a further demonstration tidal farm of 3-5MW capacity, by 2004-2005. There is an opportunity, should the prototype testing be successful, for this demonstration farm to be sited off the coast of the Isle of Wight, if the necessary permissions can be obtained, and funding attracted.

5.6 Waste to energy

As stated in the earlier section, the new government line is that only the bio-degradeable proportion of the waste processed in a waste-to-energy plant can be considered as contributing to the 10% target. Following the current government estimates that the bio-degradeable fraction accounts for only 50% of electricity from incinerators[35], only 50% of the output from the existing RDF/CHP plant on the Island is taken to contributing to the 10% target.

The ETSU SERE study included an analysis of the potential for generating energy from the green waste fraction of municipal solid waste, and from this analysis, suggested a target 0-0.5MW of installed capacity for the Hampshire and Isle of Wight sub-region. This would require separation of

[33] "Technology Status Report – Tidal Stream", A report by ETSU as part of the DTI's Renewable Energy Programme, June, 2001
[34] according to MCT
[35] ENDS report, August 2001, Issue 319

the "wet" fraction of the green waste, from the wood biomass component. The former is suited to biological treatment, such as composting and aneorobic digestion, for porducing biogas, and the latter for thermal treatment, where it is combusted in a biomass plant.

Currently, Island Waste Services process each year about 11,500 tonnes of organic green waste, through their two aerobic composting plants, together with about 3000 tonnes of fines from the RDF plant. The 11,500 tonnes is made up of 2555 tonnes collected from households, 1040 tonnes collected from commercial sources (e.g. restaurants), and 7,950 tonnes collected from civic amenity sites (CA). The precise breakdown of this waste between wet and woody is not known. However, a rough estimate (following ETSU) would be to say 20-40% of the CA waste is suited to thermal treatment – taking 20% as rough estimate, this would mean 1590 tonnes/year.

As mentioned above, an alternative to aerobic digestion is to have anaerobic digestion, which produces methane gas (biogas). This gas can be burnt to produce heat and to generate electricity in a CHP plant. This process still produces compost as a by-product. However, the fact that IWS have invested in the aerobic composting plant precludes this option. One option that could be considered is to separate the woody biomass component, and burn it in a biomass plant, rather than going to composting. However, it is likely that this woody component is needed for the composting process.

For the above reasons, the use of green wastes for energy generation is not considered viable.

5.7 Other

5.7.1 Hydro

Given the low annual average rainfall for the Island, there is no significant potential for economically generating electricity from hydro-electricity, even at a small-scale. There may be potential for some micro schemes (less than 100kW), at low head sites (less than 5m drop). Economic generation of hydropower from low head, run-of-river sites, is generally only possible where use can be made of existing control structures and weirs, and where the level drop is more than 2m, with a substantial flow. Analysis of the EA LEAP data does not suggest that any such sites are available on the Island.

However, there may be opportunities for low head "micro" scale machines, in the range of 0.1-10kW, say, that, on old mill sites.The EA LEAP does list a small water turbine in use at Brighstone Mill, which generates power for grinding flour. As with the micro-scale wind machines, such sites could prove useful for public education and awareness raising, but would not make a significant contribution to meeting the Island energy demand.

5.7.2 Wave

A recent government report concludes that wave power levels on the UK eastern and southern coasts are regarded as having wave power levels too low for commercial exploitation[36].

5.7.3 Geothermal

The South east is home to a geothermal aquifer heating scheme at Southampton, since 1986. It operates alongside gas fired CHP generators, and provides heat to the city's district heating scheme. The aquifer which supplies the heat, called the "Wessex Basin" does extend out to include the Isle of Wight. However, it is very doubtful that drilling down to the aquifer would prove to be economically viable.

[36] "A brief review of wave energy", ETSU, TW Thorpe, a report produced for the UK Dti, May 1999.

Under this section, Heat Pump technologies should also be considered – the most common form of which is **Ground Source Heat Pumps (GSHP)**. To give a very simple explanation, these basically work like a refrigerator in reverse. A fridge pumps heat from inside the cold space (source) to the outside (sink). A heat pump pumps heat from the outside, (the source can be the air, or a lake, or underground) to inside of a building. The most common form of GSHP uses electricity to drive its compressor. Although this is not a totally renewable form of energy, when grid electricity is used to drive the compressor, on average, 3 times as much heat is produced, compared to electricity consumed. In environmental terms, this is a more efficient method of heating than even a gas-fired condensing boiler. GSHP can be used to meet building space heating requirements (domestic and commercial).

5.8 Summary of total possible contribution of RES on the Island to energy consumption

A summary is shown in *Figure 11.,* below:

Note	Type of Renewable Energy	Practicable Resource (MW)		Practicable Annual Energy Output Electricity (GWh)		Practicable Annual Energy Output Heat (GWh)		% Achievable Contribution to 2010 Electricity ~~DEMAND~~		% Achievable Contribution to 2010 Electricity ~~SUPPLY~~		% Achievable Contribution to 2010 Total Energy Demand	
		LB	UB	LB	UB	LB	UB	LB	UB	LB	UB	LB	UB
	Wind												
1	on-shore wind	12.0	18.0	30.0	44.9	n/a	n/a	5.1%	7.7%	5.4%	8.1%	0.9%	1.3%
2	off-shore wind	0.0	50.0	0.0	159.9	n/a	n/a	0.0%	27.2%	0.0%	28.7%	0.0%	4.6%
	Biomass:												
3	Anaerobic digestion using dairy cow manure	0.2	0.5	1.7	4.3	0.5	1.3	0.3%	0.7%	0.3%	0.8%	0.1%	0.2%
4	Centralised CHP Plant, using SRC and forestry residues as fuel	2.8	5.3	21.0	39.3	31.5	59.0	3.6%	6.7%	3.8%	7.1%	1.5%	2.8%
5	**OR** Up to 5 decentralised heat only biomass systems, using forestry residues and SRC	1.5	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
6	**Tidal Currents**	0.0	3.0	0.0	9.4	n/a	n/a	0.0%	1.6%	0.0%	1.7%	0.0%	0.3%
7	**Existing RDF/CHP Plant**	1.7	1.7	6.6	6.6	not used	not used	1.1%	1.1%	1.2%	1.2%	0.2%	0.2%
8	**Liquid biofuel (biodiesel)**	n/a	n/a	n/a	n/a	0.0	21.9	n/a	n/a	n/a	n/a	0.0%	0.7%
9	**Solar water heating**	n/a	n/a	n/a	n/a	0.2	0.5	n/a	n/a	n/a	n/a	0.01%	0.01%
9	**PV**	0.0	0.1	0.0	0.1	n/a	n/a	0.00%	0.02%	0.00%	0.02%	0.00%	0.00%
	Totals	**18.2**	**78.6**	**59.3**	**264.6**	**32.2**	**82.7**	**10.1%**	**45.1%**	**10.6%**	**47.4%**	**2.6%**	**10.0%**

LB = LOWER BOUND
UB = UPPER BOUND
n/a = not applicable

Notes on table.

The figures given are for the practicable resource – this is based on best estimates of what is likely to be commercially viable between now and 2010. However, it needs to be modified by what will be acceptable to the Island Community, in terms of likelihood of achieving planning consents, etc.

In converting from energy output to contribution to energy demand, where applicable, a de-rating of 5% has been used to allow for transmission losses.

Practicable heat contribution from biomass systems is assumed to be only 50% of maximum, as can only be usefully used to meet heating demand in winter months.

The figure for contribution to demand is lower than for contribution to supply, due to allowing for distribution losses, where applicable. The reason for showing the supply figure, is because the SERE report, and its recommendations, are based on contribution to supply, rather than to demand.

Key to notes in table:

1. Lower bound based on no development in designated areas; upper bound assumes controlled development of 1 wind farm in designated area
2. Based on typical installation of 25 x 2MW machines
3. Lower Bound is based on 5 decentralised, farm-scale units, each about 40kWe. Upper Bound is based on 1 centralised unit
4. Lower bound is using 5% of agricultural land, 1233ha, for growing SRC as energy crop. Upper Bound is using 10% of agricultural land
5. This is thermal output
6. Upper Bound based on MCT proposal for demonstration installation
7. Following latest government guidelines, only 50% of output is taken to be a renewable contribution
8. Assuming production of 2.4 million litres, using recycled waste vegetable oil, and rapeseed currently grown on set aside land
9. Lower bound is for business as usual, upper bound for accelerated uptake

5.9 Summary of Advantages and Disadvantages of different Renewable Energy Technology Types

Figure 12.

Description of Type of Technology	Advantages	Disadvantages
On-shore wind	• Isle of Wight has good resource • Technology is proven and market ready • Good synergy with technology expertise already on Island • Opportunities for local communities to receive revenue from schemes	• Mainly visual impact – contentious from point of view of planning
Off-shore wind (25-50MW single wind farm)	• Less visual impact – 2-5km off-shore	• Technically and economically still at a demonstration stage • May be issues with shipping/ navigation • Less scope for community involvement? Not a “community-scale” project
Biomass – Short Rotation Coppice grown as energy crops – burnt in single centralised Combined Heat and Power (CHP) plant	• Diversify farming incomes to grow energy crops • Biomass CHP plants offer continuous power, unlike wind turbines, which produce power intermittently. • Biomass CHP plants also make significant contribution to heat demand on Island, as well as electricity	• Technically and economically still at a demonstration stage • More complex to implement as need to establish fuel supply chain • Environmental impact of transporting biomass “fuel” • Environmental impacts of growing energy crops – visual and environmental/biodiversity (although less an issue if grown on former grazing land)
Forestry Residues – used as fuel for either a heat only boiler, or can be fed into same centralised CHP plant, as above	• Makes use of waste product – may enable Forestry Enterprise to obtain higher price for timber	
Tidal Current turbines	• Minimal visual impact, as devices located	• Technology still at an R&D stage.

Either the Marine Current Turbine or the Imperial College Venturi device	underwater. • Island is one of the few sites in UK with a good resource • Opportunity for Isle of Wight to be a leader in demonstrating the technology	• May be issues with shipping/ navigation
Biodiesel for transport Produced from a combination of recycled waste vegetable oil collected on Island, and rapeseed crops grown on Island	• Makes use of a nuisance waste product • Opportunity to make significant renewable contribution to transport energy demand • Valuable by-products from process – glycerine, lecithin, & Vitamin E	• The economics of production in UK are still very unsure, although well proven in other countries such as Austria and France. Depends on fuel duty – Government to reduce by 20p/litre in April, 2001. • Visual/biodiversity impact of growing rapeseed
Biogas – anaerobic digestion of dairy cow manure, to produce biogas. Biogas then burnt to produce either heat, or in a CHP plant, to produce both electricity and heat Option to have either one centralised CHP plant, or several smaller, farm-scale CHP units	• Treats farm slurry which is a problem waste • Produces fibre compost and fertiliser as by-products • Diversification for farm incomes	• Uncertainty of farming incomes and livelihoods may hamper willingness of farmers to invest
Solar water heating	• Technology well established • Suited to community-scale/ urban areas	• No major disadvantages • Long payback time
Solar electricity – Photo-voltaics (PV)	• Suited to community-scale/ urban areas • Can be incorporated into building fabric – Building Integrated PV (BIPV)	• Still limited commercial viability – which will limit deployment to 2010, except for remote areas away from electricity grid

5.10 Outline ideas for some specific RES projects on the Island

From the above analysis, several ideas for outline "exemplar" RES projects on the Island emerge. The objective of this ALTENER project is to identify 5 such ideas, as far as a pre-feasibility stage. These can then be submitted for further funding to take to a feasibility stage and then to implementation. These are:

1. Biodiesel – there is an opportunity for a biodiesel plant to be constructed on the Island. The capacity of this could be limited just to the recycling of waste vegetable oil, or a larger plant could be constructed, which would also take vegetable oils from oil crops grown on the Island. Initially, the output from the plant could be used by the fleets of Island Waste Services, Southern Vectis, and Wightbus.

2. Community Wind Project - This would involve the construction of a small wind cluster, of say 3-5 turbines, together with a high level of involvement, and "buy-in" of the local community. This would include substantial community consultation and awareness raising from the early stages. The community would also be involved financially in the project, for example, by owning shares, and/or receiving free electricity from the turbine(s), or some form of revenue for community projects. Such a concept could be developed with the support of Keith Boxer of Gotland Energy Agency.

3. Demonstration installation for the MCT marine current turbine concept. This is dependant on the successful testing of the 300kW MCT prototype at Lynmouth, in Devon, over the course of the next year. If successful, then there is an opportunity for the Island to be pro-active in attracting MCT to install a demonstration scheme, of around 3MW capacity, either in the Hurst Narrows, or off St. Catherine's Point. The Council, and Island stakeholders can play a key role in helping to secure grant funding towards this, and obtaining the necessary permissions for such an installation in what is likely to be a Heritage Coast area. Such a project would enable the Island to be seen as a leader in the field of renewable energy, as well as making a significant contribution to meeting energy demand from renewable sources.

4. A Zero Energy Housing Development – as mentioned in the UDP, 8000 new housing units will need to be built on the Island by 2011. In its role of development planning and control, there is an opportunity for the Council to work with developers, and use its influence, in the creation of an exemplar housing development that would incorporate renewable energy features. Such a development could include high levels of energy efficiency, and passive solar design, to minimise the amount of additional energy input required. Part of the energy could then be met by solar water heating, for domestic hot water, and PV for electricity. Alternatively, electricity could be provided by a single, on-site wind turbine. Another option would be to use a biomass fired CHP plant to provide electricity and heat, via a district heating scheme. Or, there could be a heat-only biomass fired boiler, to provide space heating.

5. Farm based anaerobic digestion for dairy farms – there is an opportunity to develop a farm based CHP unit, fired by biogas. Alternatively, the potential for a single, centralised grid-connected CHP plant could be explored, which would take manure from several dairy farms to generate heat and electricity. An alternative to supplying the grid/electricity supplier would be for the plant to sell all its output to a large heat and electricity user on the Island, wheeling the electricity over the local distribution system.

6. Biomass CHP, or heat-only scheme, using forestry residues and wood chip from SRC. It will be important to demonstrate the precedence of growing energy crops on the Island, if the biomass potential is to be realised. The Council has a key role to play in exploring the

feasibility of installing biomass boilers in one, or several properties with a substantial heat and/or electricity load. Initially, such a plant could be fired using forestry residues. Then, assuming that SRC is planted in the first year, then energy crops could be harvested from the third year in onwards, which would free up the forestry residues to be used in another biomass plant.

Other ideas, or different permutations and combinations of the above may emerge during the remainder of the project.

6 Conclusions and Recommendations for next phase

1. Given the current UK government policy and funding support for the development of increased renewable energy supply, there are substantial opportunities for the Isle of Wight to explore possibilities for sustainable development on the Island through harnessing the Island's natural, and local renewable energy resources. As well as contributing to the reduction of the Island's ecological footprint, these opportunities could also lead to increased inward investment, increased fuel security, employment opportunities and diversification of rural and farming incomes.

2. Based on lower bound estimates, which excludes tidal, and off-shore wind, there is the potential for RES to meet about 10% of **electricity** demand on the Island by 2010. This will be met primarily through on-shore wind and biomass. For the same scenario, RES would meet about 2.6% of the total energy demand for the Island.

3. Therefore, the resources of the Island are such that it has the potential to achieve the target of meeting 6.6% of gross electricity consumption from renewable sources by 2010 established in the SERE (note, the electricity figures in figure 12, above, are for ***delivered energy*** which allows for transmission losses, so the contribution to supply will be slightly higher). The Island stakeholders need to decide whether to accept this lower target or to aim for a higher target of say 10, or even 15%. Either way, they also need to decide on the combination of options to meet this target that will best meet their needs. They may also decide to set separate targets for transport and heat, in addition to electricity supply.

4. Of all the possible renewable energy resources considered, the one that can make the greatest contribution to meeting the Island's energy demand is wind. The potential for on-shore wind can be considered to be the most "firm". On-shore wind is now a mature technology, with an established market, and, technically and economically, (although not necessarily from the perspective of planning) would be the most straightforward to implement.

5. The potential for off-shore wind is far less certain. There is the potential for 1 offshore windfarm to be built by 2010, which could supply power to the Island. However, off-shore wind is still in a demonstration phase, and technically, and economically, there are still many risks. In addition, the Isle of Wight was not among the 13 sites which have been initially put up by the Crown Estate for lease to wind farm developers. Therefore, in this sense, the Island will be playing "catch-up". However, if an off-shore wind farm were to be constructed, this would make the largest contribution to meeting total energy demand on the Island, up to 4.6%, for a 50MW wind farm.

6. This is true to an even greater extent for the tidal current machines. These are still at an R&D phase – there is as yet no certainty as to whether the technology will prove to be technically or economically viable. This is not likely to become clear before 2005. However, there is the potential for the Isle of Wight to play a lead role in helping to demonstrate this technology. The contribution shown for this technology is based on a 3MW demonstration installation. The Isle of Wight is one of the few sites in UK with a good tidal current resource. Therefore, potentially, if the technology is proved successful, this could make a greater contribution. However, as the technology is still at a prototype stage, no firm targets can be set at this stage.

7. There is the potential for a centralised biomass CHP scheme, from 2.5-5MW, which would generate heat and electricity using Short Rotation Coppice (SRC) grown as an energy crop. This has the potential to meet 3.6% of Island electricity demand by 2010 for a smaller scheme and 6.7% for a larger scheme. The lower bound is based on using 5% of agricultural land for growing energy crops, and the upper bound is based on 10%.

8. However, as with off-shore wind, this sort of biomass plant is still at the demonstration phase in the UK. Also, there is considerable complexity in establishing SRC fuel supply chain. With biomass CHP, it also necessary to contract with farmers to supply the SRC energy crop. There will also be a lead time of 2-3 years for SRC energy crops to become established on the Island before they can begin to supply a biomass facility. However, the government appears determined for this technology to develop, and has made establishment grants available for energy crops, and is promising grants to support the capital costs of projects. Therefore, there is no reason why these complexities cannot be overcome, given the will to proceed.

9. An alternative to a centralised CHP scheme would be to have several smaller heat only biomass plants, using woodchip from SRC as the fuel. This could also make use of forestry residues from Forestry Commission sites.

10. Biodiesel. Although this technology is well established on the Continent, the economics in UK are not yet favourable, due to fuel duty on biodiesel at same level as on fossil diesel. This is due to be reduced by 20p in April 2002, but uncertainties over economics remain. However, assuming that some grant funding is possible, biodiesel has potential to make a valuable contribution to meeting transport energy demand on Island. Based on using recycled waste vegetable oil, and quantities of rapeseed already grown on Island, could produce 2.4 million litres of biodiesel/year. This would make a significant contribution to meeting total energy demand on Island (including heat and transport – not just electricity) of about 1%.

11. In many ways, of the technologies with the greatest potential contribution, wind energy will be the easiest technology to implement. This is not just because it is the most mature, but it is also contractually simpler than biomass plants. For wind, it is only necessary to contract to sell the electricity output.

12. Solar water heating is another well proven, mature technology that can make a small, but valuable contribution to meeting heat demand on the Island, for domestic, and institutional water heating, as well as for heating outdoor swimming pools. The main constraint for this technology are the relatively long payback times, which are unlikely to decrease much, with current energy prices, due to the mature nature of the technology.

13. Photo-voltaic (PV) technology (also known as solar panels) are another relatively well demonstrated technology that can also make a small, but valuable contribution to meeting the electricity demand of domestic as well as commercial buildings. However, the current relatively high capital costs of these systems will limit their degree of penetration by 2010. But cost reductions are foreseen for this technology, particularly with building-integrated PV, which could increase its economic viability beyond 2010. Both PV and solar water heating both have the advantage that they are readily suited to urban environments, and therefore can be introduced without many of the planning constraints associated with other types of renewables technologies.

14. In line with the SERE report, in order to achieve targets, a ***package of actions are recommended***. ***Local partnerships are essential*** between public, private and voluntary sectors, in order to best understand local circumstances, and to engage ***with local environmental champions***.

15. Of the options presented, on-shore wind energy is arguably the most contentious technology, due to the visual impact. However, a tidal power project, or a biomass project that requires the growing of energy crops has the possibility to be equally contentious, due to the environmental sensitivities of the Islanders. For this reason, local community based solutions offer a sensible, and well received way forward. These would help to maximise the wider benefits for the Island in terms of Sustainable Development – helping

to create jobs and income, greater social cohesion, and opportunities for “Green” Tourism, as well as the wider benefits of reduced emissions.

16. Again, as also suggested by the SERE, in order to catalyse wider implementation of RES, “flagship” or lead demonstration projects are required. In particular, these should focus on the “community” scale of project, where introduction can be expected to be less contentious and indeed highly beneficial for local communities and groups, through various methods of buy-in or ownership. Considerable emphasis should be placed on educating and preparing communities for this sort of involvement.

17. There is a lot that the Council may be able to do, in terms of shaping renewable energy developments on the Island. These include:

    - Purchasing energy from producers of green energy on the Island – the most apparent way for the Council to do this would be to look at the potential for installing biomass boilers, or biomass CHP on some of their large energy consuming buildings – e.g. prisons, hospitals. The Council could sign supply contracts with farmers to grow energy crops, or with Forest Enterprise, to supply wood chip from forestry residues.
    - Pro-active planning policies – e.g. supplementary planning guidance for renewable energy, and design briefs for new-build developments
    - Address planning constraints
    - Information provision and awareness raising
    - Establishing targets, and taking a lead in demonstrating the application of RES
    - Acting as a “broker” to bring together key stakeholders, and attract grant funding for projects

6.1 Further Work for Next Phase of ALTENER project on Island

- Explore costs and benefits of the various options – in particular – what will be environmental impacts, in terms of visual, biodiversity. What will be benefits in terms of employment, local incomes, social cohesion, tourism. Also, what will be benefits for environment in terms of net reduction in CO_2 emissions?

- Establish vision for RES on the Island with stakeholders

- Need to establish with stakeholders some criteria by which to assess different options – develop these criteria on basis of consensus.

- Council to establish some outline targets for the amount of energy demand to be met from RES by 2010, and perhaps to set targets for different types of RES.

- Develop projects ideas in more detail, to a pre-feasibility stage.

Annexes

Annex 1: Summary of the UK Government's Climate Change Programme

The climate change programme sets out a substantial, integrated package of policies and measures to:

- improve business' use of energy, stimulate investment and cut costs:
  - the climate change levy package, which includes challenging improvement targets for energy intensive sectors through climate change agreements, and additional support for energy efficiency measures in the business sector;
  - a domestic emissions trading scheme, with Government support of £30 million in 2003-2004 to kick start the scheme by providing a financial incentive for companies to take on binding emission reduction targets;
  - establishment of a new Carbon Trust, which will recycle £130 million of climate change levy receipts to accelerate the take up of cost effective, low carbon technologies and other measures by business and levy payers;
  - exemption of good quality CHP (combined heat and power) and renewable sources of electricity from the climate change levy;
  - energy labels, standards and other product-related measures designed to deliver 'market transformation' in the energy efficiency of lighting, appliances and other key traded goods; and
  - Integrated Pollution Prevention and Control.
- stimulate new, more efficient sources of power generation:
  - electricity suppliers will be obliged to increase the proportion of electricity provided by renewable sources to 10% by 2010, subject to the cost to consumers being acceptable; and
  - a target to at least double the UK's CHP capacity by 2010.
- cut emissions from the transport sector:
  - European-level agreements with car manufacturers to improve the average fuel efficiency on new cars by at least 25% by 2008-2009, backed up by changes to vehicle excise duty and the reform of company car taxation; and
  - the 10 Year Plan: £180 billion of investment and public spending on transport over the next ten years to cut congestion and reduce pollution.
- promote better energy efficiency in the domestic sector, saving householders money:
  - a new Energy Efficiency Commitment (successor to the Energy Efficiency Standards of Performance), through which electricity and gas suppliers will help their domestic customers, particularly the elderly and those on low incomes, to save energy and cut their fuel bills;

  - the New Home Energy Efficiency Scheme in England, similar schemes for Wales and Northern Ireland and, in Scotland, the Warm Deal Initiative;
  - an Affordable Warmth Programme developed in conjunction with Transco to facilitate the installation of efficient gas central heating systems and insulation in a million homes;
  - the promotion of new community heating and upgrading of existing systems; and
  - more efficient lighting, heating and other appliances.
  - improve the energy efficiency requirements of the Building Regulations;

- continue cutting emissions from agriculture by:
  - better countryside management;
  - cutting fertiliser use;
  - protecting and enhancing forests; and
  - better energy efficiency.

- ensure the public sector takes a leading role by:

  – new targets for improving energy management of public buildings;

  – energy efficiency targets for local authorities, schools and hospitals; and

  – developing green travel plans.

Annex 2: Summary of Some Key Findings from SERE report

- GOSE recommended to adopt a target for RE electricity installed generation capacity of 750MW for year 2010. This represents 6.6% of current electricity generation capacity within the region, and is considered a "challenging, yet achievable" target.

- Recommend GOSE to adopt a target to increase electricity generation for RES to equivalent of 10% of region's generation as soon as practicable.

- A regional target should be based on consumption rather than generation capacity – stakeholder interest in this measure was very high.

- On-shore wind energy is arguably the most contentious technology, but local community based solutions offer a sensible, and well received way forward.

- The challenge will be to integrate renewables with all related Regional strategies, including: waste, transport, redevelopment, rural development, and environmental and climate change.

- In order to catalyse wider implementation of RES, "flagship" or lead demonstration projects are required. In particular, these should focus on the "community" scale of project, where introduction can be expected to be less contentious and indeed highly beneficial for local communities and groups, through various methods of buy-in or ownership. Considerable emphasis is placed on educating and preparing communities for this sort of involvement. With this in mind, the SERE sets out targets at the sub-regional level which can be fine tuned to suit local needs and preferences.

- Of all technologies and resources discussed with stakeholders, by far the greatest support was given to encouraging the wide scale adoption of PV within the region. **New housing developments** are seen as a particular target for attention given the rapid increase in domestic units across the region.

- In order to achieve the ambitious targets, a ***package of actions are recommended***. ***Local partnerships are essential*** between public, private and voluntary sectors, in order to best understand local circumstances, and to engage ***with local environmental champions***.

Results of Cowes consultation:

Planning

It is significant that Elected Council members, who ultimately make decisions regarding planning permission, require education concerning renewable energy. Workshops on the impacts and advantages that renewable energy schemes can have are particularly important.

Community

- General desire for transparency on the energy input/output ratios of different options
- Biomass – concerns expressed over the environmental impact of SRC
- Concern that limited mention of wave or tidal energy with 60 miles around the coast
- View that the IOW should promote a mix of renewable energy options as it would be difficult to get the community to choose an individual strategy

Annex 3: Assumptions and Methodology for Energy Demand Assessments

Terminology

Throughout this section, GWh (giga-watt hours – 1 GWh is 1 million kWh) have been used as the common unit for expressing energy consumption. This follows the convention adopted by the Royal Commission on Environmental Pollution , in their report "Energy- The Changing Climate"[37]. This allows the consumption of different fuels, e.g. electricity, gas, petrol, to be easily compared.

Use of Proxy UK data

Wherever proxy data has been used, this is based on the Isle of Wight population being 1/463 of the total UK population for 1999. This is the figure used in the EF study.

The UK Proxy data is based on final energy consumption for 1999, taken from UK Energy in Brief, November 2000.

Breakdown by Fuel Type

Gas data
Information on the consumption of mains gas, for the year from October 1999 to September 2000, was obtained from Transco, who supplied data broken down by postcode, and into the 3 sectors of domestic, commercial and industry. The data was supplied by Transco in kWh – the content of the fuel is based on the gross calorific value.

Commercial corresponds to "services". This includes non-manufacturing businesses, public buildings, such as schools and hospitals, and street lighting. From discussion with the Council's energy brokers, Team Analysis, the industrial sector generally covers only manufacturing. Agriculture is included under the heading of commercial.

Transco is the gas carrier, and is not a supplier. Therefore, the Transco gas data represents the total supply of gas to the Island, which could be coming from a number of different gas suppliers.

Electricity Data
Information on electricity supply to the Island comes from Scottish and Southern Energy Plc, and is for the 12 month period of 1st January 1999 to 31st December, 1999. This consumption is based on the electricity actually delivered to consumers, and therefore does not allow for transmission losses.

Scottish and Southern (S&S) is also responsible for the grid on the Island, and is therefore the "carrier" for electricity on the Island, in the same way that Transco is the carrier for gas. However, unlike Transco, S&S were unable to supply a bulk supply figure for electricity to the Island. This is because they don't monitor total energy demand, only instantaneous/peak demand. Therefore, the data from S&S only covers their customers, in 1999. However, at this time, industrial and commercial users with greater than 100kW connections were free to choose other suppliers. The only way to obtain this data would be to contact larger users directly. This was done, although the response was limited. However, additional data for GKN Westland was obtained, which is one of the largest industrial users on the Island. Data from Public buildings is also available, and at that time, 100% of their supply came from S&S. For this reason, the electricity data for the commercial and industrial sectors used in this report is likely to be a slight underestimate for the actual total in 1999.

[37] Published by HMSO, June 2000.

Other fuels

- Coal – a figure of 4750 tonnes has been used, based on import data from the BFF study.
- Heating/Fuel Oil – it has not been possible to get data on the total quantity of imports of this fuel. The only data that is available is from the Council, in the EF study, although the Council buildings, hospitals and schools will actually be some of the largest users of fuel oil. Therefore, the figure for fuel oil consumption used in the analysis is likely to be a considerable under-estimate of the true figure. To give a comparison, the UK proxy figure would be about 300GWh, for services, domestic and industry combined. If just the Council data is used, this is 7.4GWh. This difference represents about 9% of the total energy demand. However, due to the need to transport the oil to the island, it is likely that the actual demand will be less than the proxy demand.
- Diesel and petrol – the data for consumption of these fuels is based on the import data from EF study, which gives a figure of 65,578 tonnes of petrol and diesel imported to service stations on the Island. The split between the two is not known. There is a slight difference in gross calorific value for the two fuels, so the average has been used to calculate the kWh energy content (see sector section below for further discussion about transport fuels).
- LPG bottled gas – it has not been possible to get a figure for the quantity of LPG imported to the Island. As this is likely to be only a very small part of the total, it has been left out of the analysis.
- Wood – it is likely that there would be a quantity of firewood grown on the Island that is being burnt in rural households. This can be regarded as a form of renewable energy (biomass). However, this data would be difficult to collect, and would only form a small part of the total, and therefore this fuel type has not been accounted for in the analysis.

Calorific values

In converting volume and mass quantities of fuels, the gross calorific values have been used. This follows the practice used in the UK Energy Statistics. The gross calorific values have been taken from the Digest of UK Energy Statistics (see next page).

A.1 Estimated average gross calorific values of fuels

	GJ per tonne
Coal:	
All consumers (weighted average) *(1)*	27.0
Power stations *(1)*	26.0
Coke ovens *(1)*	30.4
Low temperature carbonisation plants and manufactured fuel plants	30.3
Collieries	29.6
Agriculture	29.2
Iron and steel	30.7
Other industries (weighted average)	26.8
Non-ferrous metals	25.1
Food, beverages and tobacco	29.5
Chemicals	28.7
Textiles, clothing, leather etc.	30.4
Paper, printing etc.	28.7
Mineral products	28.5
Engineering (mechanical and electrical engineering and vehicles)	29.3
Other industries	30.2
Domestic	
House coal	30.9
Anthracite and dry steam coal	33.6
Other consumers	29.2
Imported coal (weighted average)	28.0
Exports (weighted average)	31.8
Coke (including low temperature carbonisation cokes)	29.8
Coke breeze	24.8
Other manufactured solid fuel	30.8

	GJ per tonne
Renewable sources:	
Domestic wood *(2)*	10.0
Industrial wood *(3)*	11.9
Straw	15.0
Poultry litter	8.8
Meat and bone	17.3
General industrial waste	16.0
Hospital waste	14.0
Municipal solid waste *(4)*	9.5
Refuse derived waste *(4)*	18.6
Short rotation coppice *(5)*	10.6
Tyres	32.0
Petroleum:	
Crude oil (weighted average)	45.7
Petroleum products (weighted average)	45.8
Ethane	50.7
Butane and propane (LPG)	49.4
Light distillate feedstock for gasworks	47.7
Aviation spirit and wide cut gasoline	47.3
Aviation turbine fuel	46.2
Motor spirit	47.0
Burning oil	46.2
Gas/diesel oil (DERV)	45.6
Fuel oil	43.1
Power station oil	43.1
Non-fuel products (notional value)	43.8
	MJ per cubic metre
Natural gas *(6)*	39.4
Coke oven gas	18.0
Blast furnace gas	3.0
Landfill gas	38.6
Sewage gas	38.6

(1) Applicable to UK consumption - based on calorific value for home produced coal plus imports and, for "All consumers" net of exports.
(2) Based on a 50 per cent moisture content.
(3) Average figure covering a range of possible feedstock.
(4) Average figure based on survey returns.
(5) On an "as received" basis. On a "dry" basis 18.6 GJ per tonne.
(6) The gross calorific value of natural gas can also be expressed as 10.936 kWh per cubic metre. This value represents the average calorific value seen for gas when extracted. At this point it contains not just methane, but also some other hydrocarbon gases (ethane, butane, propane). These gases are removed before the gas enters the National Transmission System for sale to final consumers. As such, this calorific value will differ from that readers will see quoted on their gas bills.

Note: The above estimated average gross calorific values apply only to the year 2000. For calorific values of fuels in earlier years see Table A.2 and previous issues of this Digest. See the notes in Chapter 1, paragraph 1.75 regarding net calorific values. The calorific values for coal other than imported coal are based on estimates provided by the main coal producers. The calorific values for petroleum products have been calculated using the method described in Chapter 1, paragraph 1.49. The calorific values for coke oven gas and blast furnace gas are provided by the Iron and Steel Statistics Bureau (ISSB).

Data reported in this Digest in 'thousand tonnes of oil equivalent' have been prepared on the basis of 1 tonne of oil equivalent having an energy content of 41.868 gigajoules (GJ), (1 GJ = 9.478 therms) - see notes in Chapter 1, paragraphs 1.46 to 1.49.

Breakdown by Sector

The breakdown of energy consumption by sector has been derived from considering the consumption of each fuel type by the different sectors, and then summing to give an estimate of the total for each sector. In the case of gas and electricity consumption, the data providers have already broken down the data into the 3 sectors of domestic, industrial and services. The oil data that is available is known to all be for services.

The distribution of coal by sector is not known. For this study, it has been assumed that all of the coal is for domestic use. This represents less than 4% of the total annual domestic energy consumption, and therefore is not a high risk assumption.

Determining a figure for transport consumption was more problematic than the other sectors. This was because transport use could include plane journeys, (national and international) and ferries, which both re-fuel on the mainland. It could include travel by Islanders on the mainland. It could also include a share of the UK transport demand for freight, which would be involved in supplying goods to the Islanders.

However, the decision was made to just consider the fuel actually purchased from service stations on the Island, as measured by import data. This was because this was felt to be the easiest figure to understand and for people to relate to. It is also only this part of transport demand that the Island community can have any real influence over, when it comes to meeting it from renewable sources.

The annual transport energy demand is assumed to be entirely met by diesel and petrol. A small proportion of the transport demand is met from the electric Island Line rail service. However, this figure is not known, and therefore it is not accounted for in this analysis.

The choice of the 4 sectors – transport, industry, services and domestic – is based on that used in the UK Department of Trade and Industry Energy Statistics.

Breakdown by End-Use

Domestic

The breakdown of domestic end-use is based on BRE[38] data, as in table 1 below:

Table 1: Breakdown of UK domestic energy use

End Use	% of total
space heating	56.60%
water heating	25.30%
cooking	7.30%
lighting and appliances	10.90%

Services

Breakdown taken from non-domestic building energy fact file, DETR, BRE, Jan 1998, as shown in table 2.

[38] Buildings Research Establishment, taken from BRE Domestic Energy Fact File, 1992

Table 2: Breakdown of services energy use

End Use	%
space heating	54.85%
water heating	9.58%
cooking	4.07%
lighting and appliances, and other	25.21%
cooling	6.30%

Industry
The breakdown of electricity is use that as given in the Energy and Environment Research Unit (EERU) Paper No. 70, "The Pattern of Delivered Energy Use in the UK", 1990. Industrial motive power covers both motors and drives, and compressed air. This is shown in table 3.

Table 3: Breakdown of industrial electricity use

End Use	% of total electricity used
Motors and Drives	54.0%
Compressed Air	7.5%
Lighting & Appliances	8.0%
Refrigeration	5.0%
Other uses	2.0%
Space and Water Heating	2.5%
Process Heat	22.0%

The space and water heating is taken to be 15% of total industrial energy use, again, as given in EERU paper 70.

Industrial process heat, which includes any heat from CHP, is taken to be the total industrial energy use, minus the other energy uses (space and water heating, motive power, refrigeration, lighting and appliances).