MWESCO business options appraisal
North West Mull Community Woodland Company Ltd

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Please note that all financial, energy and cost estimates in this report are prepared in good faith using recent information but are indicative only and may require further detailed work before action is taken.

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Executive Summary

North West Mull Community Forestry Ltd commissioned North Energy Associates Ltd to undertake cost modelling of a potential wood heating Energy Supply Company for Mull, to be known as the Mull Wood Energy Supply Company (MWESCO).

It is proposed that the MWESCO should be kick-started by a partnership with West Highland Housing Association (WHHA) who plan to build new housing in Tobermory and a Progressive Care Centre (PCC) for the elderly at Craignure. The purpose of the cost modelling is to show:

a) how the MWESCO would perform over time both with the WHHA properties only and

b) with a larger portfolio of properties requiring heating and

c) how working with MWESCO and installing wood fired district heating would benefit the WHHA and their tenants.

All the developments are at an early stage and it has been necessary to roughly estimate both the capital costs of various heating systems and the heat used by the occupiers of the properties. On the basis of such information as is available a set of spreadsheets has been prepared to show: the cost of producing heat from wood chip compared to alternative fuels, oil and electricity: cashflows for an ESCO business selling heat from both wood and for comparison, oil: and to assist the WHHA, looking at Net Present Value by comparing the installation and long term costs of wood heating compared with use of electric water heating boilers in the housing.

The capital cost estimates show that in the first year the development at Shilling Hill would cost around £186,000 with the cost being split between MWESCO, £135,000 and the WHHA, who would pay for the district heating pipework, £51,000. The PCC would cost around £98,000 in total. The running cost for Shilling Hill in the first year has been estimated at £7,359. This works out at about 7.6p/kWh. This high cost is due to the low heat load and the high operation and maintenance costs of district heating. As the PCC comes on board, the overall operational costs should reduce. It has been assumed that the tenants of WHHA would pay about 6p/kwh for wood heat. This is less that the tenants would pay for electricity Economy 10, estimated at an average cost of about 7-8p/kWh.

If the cost of electricity rises, and the price to the tenant remains stable, wood heat should provide an even better deal for the tenant.

The electric boiler systems are estimated at £4,500 per household, including the wet radiator system. The total cost to the WHHA for Shilling Hill would be around £78,000. This compares with the cost to the WHHA of wood heat of £52,000 in the first year. As well as the higher initial capital cost of the electric boilers, they would need to be replaced after 15 years or so. As the MWESCO would be responsible for the maintenance and replacement of the wood-fired system, the WHHA would be relieved of any further investment, except when more district heating network are installed in new developments.

Because of the difference in production costs to that heat sales the MWESCO would make a loss in the first year. This loss can be mitigated by the introduction of a standing charge of £1.50 per meter paid by the WHHA to the MWESCO. This standing charge would be lower than the cost of repairs, maintenance and replacement of the electric boilers that the WHHA would fit to their properties in the event that wood-fired heating was not considered a viable option.

The tenants would pay for the woodheat via a prepayment system which would reduce the amount of admin to the MWESCO and provide a secure cashflow.

From consideration of the cashflow and the NPV spreadsheets, it appears that the best option for the MWESCO would be the wood-fired scheme with the early inclusion of the PCC and the swimming pool (or other source of heat sales). Provided that the capital costs can be met by at least 50% grant funding with the difference being met via a mix of other funds, including interest free loans. If any repayments of borrowing could be deferred until the MWESCO has been in operation for several years to ease the cashflow in the early stages.

The WHHA would benefit from the wood heating as the capital costs would be less and they would not have the responsibility of maintaining the system.

The tenants of the WHHA would benefit by paying a lower price for their heat than they otherwise might by using electricity.

The possibility to expand the MWESCO should betaken forward to include other buildings not within the remit of WHHA as, particularly those that do not include a district heating network, they would provide a more lucrative source of income. Commercial properties could be charged at a higher rate that 6p/kWh. This assumes that funds will be available to cover the capital costs of such installations.

The setting up of the MWESCO would be beneficial to the Mull economy by using local fuel and timber suppliers, thus creating and/or ensuring jobs and by the recirculation of expenditure on heating within the local economy.

Contents

1 Introduction

1.1 Background

North West Mull Community Woodland Co. Ltd (NWMCWCL) sent out a consultants' brief requiring a project appraisal for the purpose of setting up a Woodfuel Energy Supply Company (MWESCO) to supply heat firstly to two developments on the Isle of Mull, with an aspiration to expand to heat many other buildings on the island. The key partners to the project are NWMCWCL, the West Highland Housing Association (WHHA), the Mull Wood Energy Supply Company (MWESCO), and Crannich Wood Fuel (CWF), and the team are advised by Highlands and Islands Community Energy Company (HICEC) and the Forestry Commission (FC).

1.2 The brief

The following is reproduced from the consultants' brief:

There are two key pieces of research.

- To study the requirements of the first potential customer – West Highland Housing Association (also the lead partner in the Progressive Care Centre (PCC) Partnership). Its energy needs and equipment needs for the housing schemes and the PCC.

- To evaluate the economics of a MWESCO supplying heat to the WHHA using different models of capital investment.

These will result in a report which lists two or more options for establishing a MWESCO to meet the energy needs of the two projects highlighted.

- A business plan will then be produced for the model which is most 'grant efficient', sustainable and most likely to meet the needs of the client.

1.3 The response

In response to the above North Energy made the following suggestions in its tender:

1.3.1 *Assessing and meeting the exact requirements of the first customer*

- Work with WHHA to assess and agree energy needs of all buildings to be included in the first phase to ascertain heat load for the projects
- Assessment of wood fuel requirement to meet this heatload, and of the necessary storage area necessary, and determine in discussion with client team, which fuel type is most appropriate
- Assess and recommend the most appropriate biomass boiler technology for two sites, and suitable suppliers and installers
- Assess back-up options
- Provide budget costings and finance options for the equipment identified, including purchase and leasing

1.3.2 *Economic assessment of MWESCO*

- Evaluate a funding options appraisal – including sources of primary finance sources and grant support available

- Explain options for community ownership and possibility for share issues (Energy4All)
- Obtain delivered costs for local woodfuel
- Evaluate system running costs, fuel maintenance etc, including comparison with alternative fuels (oil and LPG) (Economy 10 electricity was also added)
- Consider alternatives for commercial and community partnerships
- Indentify the likely power purchase agreements, and appraise methods for customer payment
- Identify risks to MWESCO business.

1.4 Source information

The report is based on data provided by the various partners to the project and their contacts and on outline quotations from boiler equipment suppliers. If any of these parties change there is a strong likelihood that the MWESCO could perform differently and the figures will need to be re-worked in that event. The figures used will also need to be firmed up and brought up to date at the time of implementation of the project. Information sources include:

Crannich Wood Fuel – fuel supply price and method of delivery

Architects (Campbell and Morris Associates) – information on the draft proposals for the housing and PCC.

Alan Parker – information on other potential heat loads on the island

Boiler suppliers, Hi RES, HWE and 3G - budget quotes for boiler plant

Iggersund Forestry – timber prices long term

Paul Phare – HICEC

Neil Worstall, Corrie Plumbing and Heating - information and costings on electric heating sytems.

1.5 Format of this report

This report seeks to address the above points by setting out the methods employed to:

- estimate the heatload
- calculate the amount of woodfuel needed
- calculate the running costs of the MWESCO
- estimate the cost of wood heat to the tenants of the WHHA
- obtain the capital expenditure of the equipment needed to run the wood-fired heating scheme
- estimate the possible costs to the WHHA and to the MWESCO
- produce a simple cashflow showing expenditure and sources of income to the MWESCO
- produce a spreadsheet showing the NPV of the scheme over 25 years to the MWESCO and the WHHA
- compare the cost of wood heat with a fossil fuelled alternative to the tenant and to the WHHA
- discuss risks to both the MWESCO and the WHA and how to minimise them.

In order to facilitate the development of the MWESCO and ensure its survival long term, the report also looks at a slow incremental growth of wood heat supply on Mull with a second set of spreadsheets being produced to show how a longer term business plan for the MWESCO might perform. This should also serve to give WHHA confidence in the supply of wood heat to their tenants for the foreseeable future.

2 Introduction to district heating systems

A district heating system is one that supplies heat to a number of buildings from a central boiler plant.

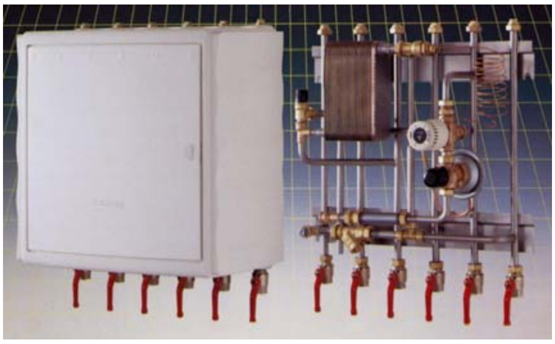
2.1 Key components

The components of the district heating system are:

- A large capacity boiler plant (one or more boilers) able to support the total heat demand of the buildings connected to the system and located strategically in the heat network.
- Pumps, pressurisation vessels, controls and other equipment to operate the system.
- A network of insulated pipes usually in the form of a twin ring main of insulated hot water pipe with branches to distribute the hot water to all the buildings in the network.
- Plate heat exchangers. These replace conventional boilers in each building connected to the network and allow the building's central heating system to take the heat it needs from the main heat distribution network. They act in the same way as a domestic boiler providing heat as and when it is required. Often separate heat exchangers are provided for the central heating and the hot water.
- Heat meters. Usually each property (or in some cases each unit within a property) is fitted with a highly accurate heat meter which is used to measure heat for billing purposes. Modern heat meters are highly accurate, reliable, solid-state, electronic devices and are often networked to a central computer so that the bills can be issued automatically and any faults in the system quickly diagnosed and repaired.

2.2 Technical information

The district heating network operates on a constant flow temperature principle. The hot water leaving the boiler house is always at the same temperature, around 90°C, and flows out through one main and back through another. The flow through the mains is always maintained to provide enough heat to every consumer.



Domestic heat exchanger photo Alstrom

At the consumer's property the district heating water flows through separate parts of the heat exchanger from the water in the consumer's central heating system so that the two fluids never mix. The temperature of the district heating water drops as it passes through the heat exchanger according to the amount of heat energy being used by the customer. The temperature of the consumer's central heating water increases as it passes through the heat exchanger, in a similar way to the temperature increase created by a domestic central heating boiler. The consumer's central heating and domestic hot water are thermostatically controlled so that safe temperatures are experienced at all times. Usually central heating water will be at 70ºC and hot water at 55ºC to reduce the chance of scalding.

The heat meter measures this difference in temperature and flow though the heat exchanger and hence calculates the heat energy used. The consumer is charged for this energy use. The data from the heat meter can also be fed back to a central control so that if there is a sudden drop in temperature or flow an alarm is raised and the matter can be dealt with urgently if required.

In district heating schemes, best practice is to ensure that the temperature of the cooler water returning to the boiler is considerably lower than the outward flow water. To achieve this means installing underfloor heating or larger radiators in the buildings.

2.3 Efficient running of wood fired district heating systems

There are three key elements to technical efficiency and success in a wood fired district heating scheme.

- high quality fuel supply delivering a consistent fuel at agreed moisture content on a regular basis
- careful maintenance and setting of boilers to run to maximum efficiency levels
- automated leak detection on heating mains and immediate response to leaks, and installation of warning matting above the heat mains to avoid damage by other utilities.

In order to achieve these elements the simplest solution is for the whole operation, control of the boilerhouse, fuel supply, maintenance and billing, to be under the control of one organisation with a significant vested interest in the success of the scheme. In this case it would be the MWESCO.

2.4 Payment methods

There are two basic methods of paying for heat, the prepayment method or billing and payment in arrears. A variation of this would be to set up a direct debit and take a set amount out of the bank every month with a settling-up every so often.

2.4.1 *Heat metering*

Heat meters can be read remotely either by hard-wire to a control unit in the boilerhouse or wireless technology. Both of these methods save having to enter a property to read a meter, although this is an option it uses more manpower. If wireless, the readings can be gathered on a drive-by basis.

2.4.2 *Prepayment*

Based on smart card technology, every property has a domestic credit unit (DCM) installed alongside the heat exchanger. Each household is issued with a smart card which is charged at a prepayment unit, usually installed at a local shop or petrol station. The credit is then transferred from the card via the slot in the DCM. If both the credit in the unit and the emergency credit are exhausted, a motorised valve in the heat exchanger will shut down the heat supply. In this way the MWESCO is assured

Photo Vital Energi

that the customer cannot default in its payments. From the customer's point of view, there is the opportunity to save up credit on the card through the summer months when demand for heat is less.

2.4.3 *Billing and invoicing*

The householder is sent a bill, in the same way as for other utilities, which can be paid by direct debit, or by cheque. This has the drawback that if the customer elects to pay by cash or cheque from a bill, the payment is technically in arrears and the MWESCO has to bear the cost of producing the heat before payment is received.

It may be, however, that it is not practical for some tenants to go to a point of sale for a top-up on a card, and these people may be better served by paying by direct debit, unless a more acceptable method of top-up can be found.

The direct debit method of payment would involve estimating the amount of heat that would be bought, say over a year, and splitting it over 12 monthly periods. The direct debit can then be adjusted at the end of the year (or other period) to take account of the actual heat used. To be safe during the first period, the MWESCO would need to overestimate the heat demand to endure that its costs were covered.

It is unlikely that commercial companies using the MWESCO would use the prepayment method.

There are various companies which offer a billing and/or prepayment service and quotations should be sought to find the most appropriate package from the service provider.

3 Estimating the heatload

3.1 The buildings

WHHA are proposing a number of new housing developments in Tobermory over the coming five or six years. In addition WHHA are lead partners in a joint project with the NHS to develop a Progressive Care Centre for the elderly/community hospital facility at Craignure. The housing sites are known as Shilling Hill and Balascate and it is as yet uncertain exactly how many units will be involved in total although there are some indicative drawings. Information regarding the number and size of the properties currently proposed at Shilling Hill and Balascate was obtained from Paul Phare and by email and phone call to the architect. The heatload of each type of property was ascertained using the Carbon Mixer software developed by Bobby Gilbert and Associates in partnership with BRE. This software uses The Building Regulations 2000 Part L 2006 in conjunction with the degree days for North West Scotland.

It should be noted however that until the housing scheme is designed in detail it is impossible to accurately assess the heat load. This will need to be done by the WHHA's mechanical and electrical consultants and supplied to the boiler supplier at the time when quotes are obtained for boiler systems. Without the client supplying the heat load figures it is unlikely that the boiler supplier will guarantee the suitability of his boiler for the job.

The wood heating schemes are to be phased in over a number of years. The currently expected number and type of properties in each scheme are shown below.

Shilling Hill

Property type	MWh/yr per property (as carbon mixer)	No of properties of this type	Total MWh/yr
1 bed flat	3.7	12	44.4
2 bed semi	6.7	8	53.6
3 bed detached	9.9	6	59.4
Total		**26**	**157.4**

Balascate Phase 1

Property type	MWh/yr per property (as carbon mixer)	No of properties of this type	Total MWh/yr
1 bed flat	3.7	8	29.6
2 bed semi	6.7	12	80.4

3 bed detached	9.9	9	89.1
Total		**29**	**199.1**

Balascate Phase 2

Property type	**MWh/yr per property (as carbon mixer)**	**No of properties of this type**	**Total MWh/yr**
1 bed flat	3.7	8	29.6
2 bed semi	6.7	6	40.2
Total		**14**	**69.8**

The heatload for the Progressive Care Centre at Craignure was estimated by examining the drawings sent by the architect and the good practice energy benchmarks for residential care homes and cottage hospitals in the BSRIA 'Guidelines for Business Services. As the printout of the drawings was not to scale, the sizing is approximate and may need to be recalculated once more detailed information is known. The staff housing was estimated by using the dimensions provided in the architects' drawings and the Carbon Mixer software. The results are shown below:

Property type	**Area of building**	**Total MWh/yr heat and hot water**
PCC including residential accommodation and treatment rooms etc	2,000 sq metres	911.44
1 bed semi detached house	61.85 sq metres	5.3
2 bed terrace house	75 sq metres	5.7
3 bed semi detached house	693.19 sq metres	8
Total PCC		**930.44**

There is a new swimming pool with attendant facilities opening in February at the hotel in Craignure which could be supplied with heat by the MWESCO. It has been estimated that the fuel for the current two new oil boilers would cost around £20,000 per year. At 41.5p per litre, this represents around 493MWh per year.

3.2 Sizing the boilers

Using the heatloads calculated above, an estimate of the peak load was calculated. The calculation is shown in Appendix 1. Assumptions have been made regarding the average amount of time that the system is expected to run. The highest demand is likely to occur in January i.e. 699kWh average per day. The peak load has been calculated by assuming that 20% of the daily demand will be reached between 6.30 and 7.30 in the morning, as these are the times when central heating and hot water systems are mostly likely to be programmed to come on in January. This would produce a peak load of around 134kW. The boiler should be sized to cope with this load. There is another peak in the evening but this is much less than the morning peak. A 150kW boiler should be sufficient to cover this. At Balascate, the peak load is higher at 169kW, but this too could be met by a 150kW boiler. As there is a different mix of property at this development, it is possible that this is an underestimate. The second Balascate development is much smaller at 60kW.

A back-up oil boiler could be installed to provide 'peak lopping' if the wood-fired boiler should prove to be insufficient.

The PCC would need a boiler rated around 200kW. Because of the nature of the building it has been assumed that the load is more evenly spread throughout the day. This means that, although the heatload is much higher than for the housing developments, the peak demand is not, in relation to the heat demand, as great.

To avoid the extra costs involved in erecting a purpose built boilerhouse with fuel store, a containerised boiler with integral fuelstore can be installed in each phase of development. The costs are shown in the section below.

It is not yet known where the containerised boilers are to be situated and so it is assumed that Shilling Hill and Balascate Phase 1 and 2 will have independent boilers. Depending on the location of the Balascate developments, it may be possible that Balascate Phase 2 will share the boiler with Phase 1. In this instance, the boiler at Balascate Phase 1 should be sized accordingly.

Containerised Turbomatic system
Photo Highland Wood Energy

4 Wood chip fuel

4.1 Fuel supply and cost

The cost of supplying wood chip to the MWESCO has been calculated by Crannich Wood Fuel at £82 per tonne and this amount has been used to calculate the running costs of the wood chip system. Crannich have also stated that the wood chip would be supplied at 30% moisture content (MC). A description of wood chip fuel and the importance of supplying fuel at the correct MC is shown in Appendix 2. The amount of wood chip needed for each project is shown below. The total at the bottom at the bottom of the table is the annual amount of fuel that would be needed once all the buildings are buying heat from the MWESCO in year 6.

	kWh	**Tonnes wood chip 30% MC**	**Volume cu metres**	**Tonnes wet wood 55% MC**
Shilling Hill	168,000	59	208	108
Balascate Phase 1	200,000	133	467	244
Balascate Phase 2	70,000	26	91	48
PCC	930,440	328	1149	601
Swimming pool	493,480	174	610	319
Total	**1,861,920**	**720**	**2525**	**1320**

Crannich is the preferred supplier for fuel for the MWESCO but a list of other wood fuel suppliers in the West Highlands is also included in Appendix 3, though it may be difficult to find a supplier that would deliver to Mull if this is ever necessary.

4.2 Fuel storage

The containerised boiler also has its own fuel store measuring 20 to 56 cu metres, depending upon the system chosen. This should be sufficient to hold enough wood chip to supply the boiler for two weeks during the winter months. Crannich has a


Integral fuel store with top opening
Photo Highland Wood Energy

secondary fuel store situated at the farm but a larger one is desirable and it could prove more economic to have a large store near Tobermory once all the phases of housing are complete.

4.3 Fuel delivery methods

The wood chip is normally delivered by Crannich using a tractor and trailer. As the containerised fuel store will need to be filled from the top, Crannich's scissor lift trailer is ideal though if a large store is available near any of the sites a tractor with a foreloader could be used to raise the fuel to the delivery point.

5 Capital costs

5.1 Capital cost MWESCO

The capital costs of the wood-fired boilers and plant, accumulator tanks, containers, pipes and other associated equipment have been provided by Simon Wakefield of Highland Renewable Energy Solutions Ltd and by Highland Wood Energy and are shown as an example of what the MWESCO might have to pay. It is advisable to get quotes from other suppliers before deciding which supplier to use. A list of possible equipment suppliers is included in Appendix 4. These costs are approximate as a full survey of the site will need to be carried out when more is known about the sizes and energy rating of the properties. The cost of the prepayment system for charging domestic tenants for heating has been obtained from Switch2.

The estimated capital costs are split between West Highland Housing Association (WHHA) and the MWESCO as below:

Shilling Hill	**Paid for by MWESCO**	**paid for by WHHA**
150kW UTSK boiler in container with fuel store and associated controls inc delivery and offloading	£123,500	
District heating mains (pipework installed from the boilerhouse to the heat exchanger the cost of trenching is not included in this figure as it is likely to be a minimal cost added to trenching of other services in the development)		£34,100
Hydraulic control board, 26 @ £550 each (heat exchanger etc)		£14,300
Electric controls inc programmer 26 @ £120 each		£3,120
Heat meter 26 @ £150 each	£3,900	
Prepayment system includes prepayment unit with smart card 26 @ £205 each, point of sale unit £1,950, database set up £490	£7,770	
Total capital cost for Shilling Hill	**£135,170**	**£51,520**

Progressive Care Centre (PCC)	**Paid for by MWESCO**	**paid for by WHHA**
150kW UTSK boiler in container with fuel store and associated controls inc delivery	£123,500	

Price to be confirmed once exact size of boiler known		
District heating mains		N/A
Hydraulic control board, 16 @ £550 each (heat exchanger) ie 12 flats, 3 staff houses plus exchanger for the clinic		£8,800
Electric controls inc programmer 16 @ £120 each		£1,920
Heat meter 16 @ £150 each	£2,400	
Prepayment system includes prepayment unit with smart card 16 @ £205 each,	£3,280	
Total capital cost for PCC	**£129,180**	**£10,720**

Balascate Phase 1	**Paid for by MWESCO**	**paid for by WHHA**
Boiler in container with fuel store and associated controls inc delivery. The cost is not known, but has been assumed on a capital expenditure per property basis, based on Phase 1 29 @ £4,750	£137,750	
District heating mains assumed on a capital per head as above		£38,035
Hydraulic control board, 29 @ £550 each (heat exchanger)		£15,950
Electric controls inc programmer 29 @ £120 each		£3,480
Heat meter 29 @ £150 each	£3,900	
Prepayment system includes prepayment unit with smart card 29 @ £205 each	£5,945	
Total cost for Balascate Phase 1	**£148,045**	**£57,465**

Balascate Phase 2	**Paid for by MWESCO**	**paid for by WHHA**

Boiler in container with fuel store and associated controls inc delivery. The cost is not known, but has been assumed at capital expenditure per property basis, 14 @ £4,750	£66,5000	
District heating mains assumed on a capital per head as above		£18,362
Hydraulic control board, 14 @ £550 each (heat exchanger)		£7,700
Electric controls inc programmer 14 @ £120 each		£1,680
Heat meter 14 @ £150 each	£2,100	
Prepayment system includes prepayment unit with smart card 14 @ £205 each,	£2,870	
Total cost for Balascate Phase 2	**£71,470**	**£27,742**

An oil boiler could be added to the wood-fired heating for back-up for around £8,000.

The cost of installing a boiler for the swimming pool at the hotel would be borne by the MWESCO. It has been estimated that it would be in the region of £90,150.

5.2 Capital cost oil ESCO

For the sake of comparison, the cost of installing an oil-fired district heating scheme has been considered. The main difference between the above wood fired systems and an oil-fired system is that the cost of the heating mains would not be paid for by the WHHA. The boiler costs are also greatly reduced. The average cost of an oil boiler capable of supplying Shilling Hill for example is in the region of £8,000 including the oil storage tank and installation. The heat meters, heat exchangers and prepayment costs are the same. Because oil boilers do not last as long as wood boilers, they would need to be replaced after 15 years. This cost is not shown in the table below, but forms a part of the cashflow and Net Present Value calculations discussed later in this report. The summary of original capital costs is shown below:

Oil-fired ESCO capital costs	**Shilling Hill**	**PCC**	**Balascate Phase 1**	**Balascate Phase 2**
MWESCO	£53,770	£13,680	£56,330	£31,332
WHHA (heat exchangers only)	£17,420	£10,720	£19,430	£9,380
Total cost	**£71,190**	**£24,400**	**£75,760**	**£49,712**

In the event that the heat exchangers are to be paid for by the ESCO, the total cost should be taken into account.

It can be seen from the above that the capital costs of the oil-fired district heating are less than half of the wood-fired heating. However, this is offset by having to replace the boilers after 15 years, whereas the life of a wood boiler is around 25 years, and the higher cost of fuel. The results of this are shown in the cashflow and NPV spreadsheets given in Appendix 5 and 6.

5.3 Capital costs, electric water heating systems - WHHA funded

As an alternative to district heating, it is likely that the WHHA would consider installing electric water heating systems with wet radiators into the housing projects, particularly as they have done so previously on Mull. The PCC, however, would be more likely to run on an oil boiler in the main building with electric heaters installed in the staff houses.

The cost of each system has been estimated by Neil Worstall at Corrie Plumbing & Heating at £4,500 including radiators, £3,000 for boiler, tank and controls. The radiators would the difference at £1,500. Because the wet radiator systems are common to both wood-fired and electric systems and would be included as part of the building costs, the capital costs have been calculated on £3,000 per property.

The electric boilers would need replacing after 15 years at an estimated cost of £2,200 allowing for increases in cost over time. These costs have been taken into account in the NPV calculations. The current cost of installing electric heating to the WHHA compared with the capital cost of wood-fired heating is shown below:

	Shilling Hill	**PCC**	**Balascate Phase 1**	**Balascate Phase 2**
Electric boilers with controls and tanks	£78,000	£9,000	£87,000	£42,000
Oil boiler		£8,000		
Total cost to WHHA of electric heating	**£78,000**	**£17,000**	**£87,000**	**£42,000**
Total cost to WHHA of wood district heating	**£51,520**	**£10,720**	**£57,465**	**£27,742**

6 Running costs

6.1 Operation and maintenance (O&M)

In addition to the cost of the wood chip fuel, the running costs of the MWESCO include the operation and maintenance of the district heating and vary for each project in the MWESCO portfolio.

6.1.1 *Boiler servicing*

The boiler will need to be serviced annually. This means that the boiler should be allowed to cool so that the interior can be cleaned and checked safely. The flue should be swept once a year. Some boilers need an interim service based upon the 'running hours' about every 800 running hours with a full service at 2400 hours. The full and interim services should also include checking, cleaning and greasing the feed mechanisms. Allowance has been made for one annual service with one interim service.

6.1.2 *Replacements and repairs*

The boiler and wood fuel feed mechanisms would normally be covered by suppliers' guarantees during the first year of operation. The annual running costs described below do not include a figure for repairs as there should be surplus in the budget to cover them in following years. In general, well-maintained sturdy wood boilers do not breakdown readily and repairs are unlikely. Unless the district heating pipes have been badly laid and fitted, the network should not give trouble and should not leak or need replacing in the early years.

6.1.3 *Electricity*

Electricity is used to pump water around the district heating network, power the feed auger and controls, supply the modem and prepayment meters and provide power for lighting and general maintenance.

As a result of information obtained from Vital Energi, it has been estimated that Shilling Hill, for example would use about half the electricity used to power the system at Lochgilphead. The number of kWh consumed has not been disclosed so half of the cost to Vital Energi has been taken as an example of the possible cost to the MWESCO. The actual cost of this electricity would depend upon the supplier chosen and is subject to change unless a guaranteed long term rate can be negotiated.

6.1.4 *Maintenance staff costs*

This figure is for de-ashing and checking of the boiler and, according to information received from several boiler suppliers, should take no longer than 30 minutes per week, but extra time has been allowed for contingencies. It involves emptying the ash box under the grate and emptying the main ash bin before it gets too heavy to move. The boiler supplier should give instructions for this and it does not require anything other than basic training. A cost of £10 per hour has been allowed, but it is possible that in the early stages, the de-ashing could be carried out on a voluntary basis by a willing local person.

The feed screw and other controls are monitored remotely and so do not need to be checked regularly.

6.1.5 *Metering*

A description of the prepayment system appears elsewhere in this report, but the charge of £45 per year per meter that Switch2 would make includes the following:

- administration of the point of sale equipment
- monitoring the computerised automatic reading of the meters
- billing where necessary
- call-out to investigate problems with the metering
- repairs and replacements.

It is unlikely that the MWESCO could provide a similar service for the same cost, should the prepayment system not be installed, as meter reading, billing and collection of payments would probably have to be done by a paid staff member. There are suppliers similar to Switch2 that may charge a cheaper rate for the service and this should be investigated before choosing a prepayment system.

6.1.6 *Rates*

District heating schemes have a rating liability, but as NWMCWCL are a charitable organisation, and presumably the MWESCO would be too, mandatory and discretionary rate relief can be claimed up to 100% of the rating liability of the boilerhouse. The relief on the heating network itself can be claimed by WHHA. The forms to claim this relief can be obtained from Argyll & Bute Council.

6.1.7 *Insurance*

The insurance figures shown below are for example only. The exact figure can be ascertained once the extent of the scheme is known and quotes can be obtained from insurers. In general the insurance should cover things like breakdown of the system and the cost of providing alternatives to the heating in the event of breakdown, public liability and employers' liability.

6.1.8 *Admin staff costs*

Because of the small scale of the first year Shilling Hill development, and the admin of the prepayment system being performed by the prepayment supplier, it has been assumed that there would not be a necessity for paid admin staff during the first year. It is possible that grant money could be found to finance employing staff and if this is the case, then it may be possible to employ someone for a few hours a week. In the second year, when the PCC is included in the scheme, a sum of £4,160 has been included for a part-time worker. It is also assumed that this worker would not increase their hours once the Balascate developments are included. For this reason the cost of the worker is not shown in the running costs for these schemes. The cashflow and the NVP spreadsheets show cumulative figures for the operation and maintenance and these will include the admin staff cost for the WESCO.

6.1.9 *Contingency*

A 10% of the total running cost has been added to cover any unforeseen circumstances that may arise. The costs below include this figure.

These estimated yearly costs are listed below and regarded as conservative.

Operation & Maintenance per year	**Shilling Hill**	**PCC**	**Balascate Phase 1**	**Balascate Phase 2**
Annual and interim service average cost for wood-fired boiler obtained from suppliers	£1000	£1000	£1000	£1000
Electricity	£2,500	£500	£2,500	£2,500
Staff costs	£520	£520	£520	£520
Metering	£1,170	£720	£1,305	£630
Rates assumed to be zero				
Insurance Possible cost	£1,500	£1,000	£1,500	£1,000
Admin staff costs		£4,160		
Contingency @ 10%	£669	£790	£683	£565
Total	**£7,359**	**£8,690**	**£7,508**	**£6,215**

The operation and maintenance costs for the proposed installation for the swimming pool have been guesstimated at £1,000 per year. Because of the installation being part of the hotel, there would be no district heating but a heat meter and boiler servicing would still be needed. The insurance may be covered by the hotel. Further information would be needed to more accurately calculate the costs.

As the MWESCO grows, it may be necessary to take allocate more staff time to handle enquiries, marketing, fuel ordering. This would add to the running cost and the heat price may need to be re-assessed.

The estimated operation and maintenance costs may be found to be too low in practice and once the first phases have been running for a while this also may require a change in the heat price to enable the MSWECO to survive.

6.2 Running cost calculations

A series of running costs calculators for each project within the scheme have been produced and are shown in Appendix 7. The price per kWh has been compared with that of electricity using the latest prices obtained by Paul Phare in February 2008 from Scottish Hydro Economy 10. The amount paid for electricity per year by the tenants varies according to the size of the property they occupy. This is due to the standing charge per day that Scottish Hydro charge. The charges are shown in Appendix 8. A comparison has also been done against oil for the PCC and the swimming pool. The cost to the MWESCO for each project is shown below. The figures in the calculators assume the following:

- the wood boilers run at 85% efficiency
- the wood fuel is supplied at 30% moisture content
- the wood fuel is £82 tonne delivered
- there are 5% pipework heat losses
- the operation and maintenance costs are as shown above
- the oil price is 42.5p/litre
- the oil boiler runs at 90% efficiency
- the electricity price is based upon 75% cheap rate 25% standard rate (this is the most commonly used way of estimating usage)

The expected running costs to the MWESCO are shown below:

	Wood fired heating p/kWh inc O&M	**MWESCO cost inc O&M for wood heating pa**	**Oil-fired heating p/kWh inc O&M**	**Annual total cost for oil heating ESCO**	**Scottish Hydro total cost p/kWh per property**
Shilling Hill	7.64p/kWh	£12,221	8.16p/kwh	£13,060	1 bed flat 7.94p/kWh 2 bed house 7.10p/kWh 3 bed house 6.77p/kwh
Balascate Phase 1	6.79p/kWh	£13,585	7.59p/kWh	£15,190	
Balascate Phase 2	11.92p/kwh	£8,342	9.48p/kwh	£6,634	
PCC	3.83p/kWh	£35,616	5.5p/kWh	£51,175	
Swimming pool	3.10p/kWh	£15,281	4,26p/kWh	£21,000	

The large difference in the price per kWh between Shilling Hill and Balascate Phase 2 is due to the very small heatload at Balascate. Although the fuel cost will be low, the O&M greatly increases the unit cost per kWh. If it became possible to run this Phase from the Phase 1 boiler there would be some O&M savings which would reduce the cost per kWh at Phase 2. For example, there would only be one boiler to service.

It would be necessary when deciding on the site for the Balascate Phase 1 boiler to bear in mind the housing in Phase 2 and, if possible, size the boiler to take account of the increased heat load. This would also have the effect of increasing the capital expenditure in that year, but decrease the expenditure for Phase 2.

7 Summary of cost estimates

The following table is a summary of the costs detailed above that have been prepared for the MWESCO. The capital cost does not include that paid by the WHHA. Please note that all the calculations are performed on rough figures provided by suppliers etc and are subject to survey and consequent amendment. They do not generally include utility service connections or civils as these are deemed to be part of the total development costs of the housing and the PCC. More detailed discussions will be needed when firming up a cost split between WHAA and MWESCO once the schemes are being fully designed, to make sure that the MWESCO does not have to bear significant extra costs due to the detailed design of the project and location of the Energy Centre.

Time of installation	**Project**	**Heatload kWh**	**Capital cost**	**Running cost pa inc O&M**	**Cost p/kWh**
Year 1	Shilling Hill	160,000	£135,170	£12,221	7.64
Year 2	PCC	930,440	£129,180	£35,616	3.83
Year 3	Swimming pool	493,482	£90,150	£15,281	3.10
Year 5	Balascate Phase 1	200,000	£148,045	£13,585	6.79
Year 6	Balascate Phase 2	70,000	£71,470	£8,342	11.92
Total		**1,853,922**	**£574,015**	**£85,045** **(per year from year 6 onwards)**	

The higher running costs of the housing phases compared to the PCC and swimming pool takes into account the operation and maintenance of the heating mains and the prepayment metering. ~This is also reflected in the price per kWh.

8 Cashflow forecasts

A series of 25 year ESCO cashflow forecasts, shown in Appendix 5 has been produced for the following options:

- MWESCO with WHHA projects and private swimming pool
- MWESCO with WHHA projects only
- Oil-fired ESCO with WHHA projects only.

8.1 Assumptions for the cashflow forecast

The following assumptions have been:

- the fuel and running costs are as discussed in the previous sections
- Shilling Hill is the first project in year 1 with the PCC added in year 2, the swimming pool in year 3, Balascate Phase 1 in year 5 and Balascate Phase 2 in year 6
- 50% of the capital cost will be grant funded except for the oil-fired heating
- the remainder of the cost is met by interest free loans to be paid back throughout the 25 years of the life of the boilers
- the oil-fired heating is not eligible for a grant and this cost is met by a commercial loan of 8% interest paid over 25 years (however, it is unlikely that a loan would be made over such a long period; a shorter repayment period would make the oil-fired scheme even more uneconomic to run)
- an index linking of 3% per year has been included to cover increases in supplier costs. This percentage has also been applied to the price of heat sales per kWh
- any profit made attracts interest of 3.5%
- the heat sale per kWh has been set at 6p as this is deemed to be acceptable by WHHA and is lower than the price that the tenants would pay for their electric heating . It is however less than the running costs of the MWESCO which means that the MWESCO would make a loss without some means of making up the difference. In this case, it is suggested that the WHHA pay a standing charge. 6p/kwh is more than the PCC would pay for oil heating, but as oil prices are set to increase this may not be the case for long
- a standing charge of £1.50 per meter per week is paid to the MWESCO by the WHHA. This is based on a rough estimate of the depreciation charge on the replacement cost of electric heaters. It is, however, less than the cost of servicing and repairs to electric boilers, estimated at £100 per year per boiler. This should help to make up the shortfall between running costs to the MWESCO and the heat sales and is important to the viability of the MWESCO

- all the projects are charged the same rate for heat. (In practice it may prove possible to charge commercial projects more than housing projects.)

To break even in the first year, the MWESCO, buying 30%MC fuel at £80 would need to charge 7.64p/kWh. This is still competitive with the cost of electricity for the smaller units. If fuel can be supplied at lower price, or the O&M costs can be brought down this could be reduced to a figure nearer to the desired heat sale price of 6p/kWh.

It is hoped that funding could be found to cover this shortfall in the early period of the MWESCO's operation until the PCC is online.

An alternative scenario might be that the swimming pool can be brought online at the same time as Shilling Hill. Because the swimming pool installation does not involve any heating mains the running costs are low and although 6p/kWh is more than they would pay for oil at current prices, the hotel is saving the cost of future boiler replacements. A price to them of 6p/kWh would be more than enough to make up the shortfall in the cashflow of the ESCO.

It may be possible to charge commercial companies a different rate to domestic customers, by negotiation, if this would encourage them to use the MWESCO. The danger is that in doing so, the MWESCO does not cover its costs. The alternative, that of charging a higher price than the customer pays for its current fuel may act as a disincentive unless the MWESCO can show other benefits such as boiler servicing, repairs and eventual replacement.

8.2 Cashflow summary

The following table is based on the longer 25 year tables in Appendix 5 and shows selected years from the cashflows. The Appendix includes three comparative sheets showing how the MWESCO would perform under three scenarios.

Scenario 1 – wood chip heating for the WHHA housing, the PCC and the swimming pool.

Scenario 2 – wood chip heating for the WHAA housing only

Scenario 3 – for comparison purposes an oil heated ESCO

The table below shows these three scenarios and the years in which capital expenditure is expected to occur. The profit/loss figures are cumulative and represent a capital reserve to the MWESCO unless a loss is stated.

End of cumulative period	**MWESCO inc swimming pool**	**MWESCO with WHHA projects only**	**Oil-fired ESCO WHHA projects only**
Year 1	Loss of £3,296	Loss of £3,296	Loss of £6,654
Year 2	£12,093	£12,093	Loss of £70,140
Year 3	£57,693	£28,549	Loss of £135,375

Year 4	£106,376	£46,124	Loss of £202,412
Year 5	£138,468	£62,514	Loss of £215,706
Year 6	£168,047	£75,363	Loss of £232,953
Year 15	£535,796	£237,253	Loss of £390,486
Year 16	£590,065	£261,360	Loss of £411,337
Year 19	£772,454	£342,983	Loss of £465,604
Year 20	£840,295	£372,956	Loss of £486,261
Year 25	£1,240,081	£552,316	Loss of £568,726

By looking at the above table, it can be seen that the MWESCO would be successful with the WHHA projects alone provided the assumptions listed above are adhered to, and funding can be found to cover the running cost shortfall in year 1.

The oil-fired ESCO incurs losses throughout the cashflow. This is because of the lack of grant funding and the likelihood of needing a commercial loan to cover 50% of the capital cost. There is also the cost of installing new boilers after 15 years rather than 25 years for wood-fired boilers.

A level of pre-financing may also be needed to cover items like the loan repayments in the first year and the capital costs until grant funding is received. A summary of first year costs and income is shown below:

Year 1 only expenditure **Shilling Hill 160,000 kWh**	**MWESCO inc swimming pool**	**MWESCO with WHHA projects only**	**Oil-fired ESCO WHHA projects only**
Capital cost	£135,170	£135,170	£53,770
Fuel cost	£4,862	£4,862	£7,923
O&M cost	£7,359	£7,359	£4,862
Interest free loan repayments	£2,703	£2,703	£2,703
Commercial finance			£2,519
Total first year cost	**£150,094**	**£150,094**	**£71,777**

Year 1 only Income **Shilling Hill 160,000 kWh**	**MWESCO inc swimming pool**	**MWESCO with WHHA projects only**	**Oil-fired ESCO WHHA projects only**
Heat sales @ 6p/kWh	£9,600	£9,600	£9,600
Standing charge from WHHA	£2,028	£2,028	£2,028
50% grant	£67,585	£67,585	
Interest free loan	£67,585	£67,585	£26,885
Commercial finance			£26,885
Total first year income	**£146,798**	**£146,798**	**£65,398**

8.3 Capital reserves

The figures reached by year 25 can be looked upon as either a sinking fund, or capital reserve. In practice some of this capital is likely to be used to finance the installation of further new wood boilers at other sites, thus making the MWESCO more profitable over time. The boilers and some other equipment would need replacement by the end of 25 years and sufficient capital would need to be accumulated to cover this cost.

There are items of expenditure that might crop up during the course of the 25 years that are not accounted for, for example, flushing of the heat exchangers to ensure that they are operating efficiently would take place about every 5 years. Repairs to the fuel store feed mechanism and to the fabric of the container that houses the boiler are also excluded. A contingency of 10% has been added to the operation and maintenance to cover this and some unforeseen circumstances. Any expenditure other than that shown in the cashflow spreadsheets would reduce the capital reserve.

It may be possible to defer payment of the loans, for 3 – 5 years say, until after the PCC has started to pay for heat. This would enable a build up of capital in the early years and prevent the shortfall in the first year.

9 Net Present Value

9.1 NPV method

In addition to the simple cashflows discussed in the previous chapter, the study has also considered heating the proposed projects by using Net Present Value (NPV) methodology. NPV is based on whole life costing and is a method used by organisations such as local authorities to decide which of a range of options to implement. The method is described in the Treasury Green Book and Financing Community Energy Schemes Annex A - Performing Whole Life Costing - published by the Energy Saving Trust 2003.

The direct costs and revenue, ie income generated, are projected forward by the life of the project. For the MWESCO this would be 25 years, which is the life of the boiler.

In theory, all costs that might occur over the 25 years should be taken into account and all anticipated revenue.

The cashflow in each year, ie the running costs less the revenue, is multiplied by a ‘discounting rate’. This discounting rate is set by the government at 3.5%. There are tables for long-term projects of 25 years in the Treasury Green Book which show the multiplication factor to be used for each year of the project. This discounted cashflow is accumulated over the 25 years. The discounted cashflow is added to the capital costs to give the NPV.

The capital costs are treated as a negative number so when the discounted cashflow is added to it each year, a profit in the year will move the NVP in a positive direction, a loss in the year will increase the negative NVP.

Grant funding and other financing is excluded as the NVP should give an indication of the amount of funding needed.

The NPV spreadsheets in Appendix 6 contain the same information as the cashflows (Appendix 5) for the first year and also the same capital costs. The difference is in the omission of funding information and the way in which the spreadsheets operate.

The outcome in year 25 in the NPV spreadsheets is the figure used to compare the different options. The option with the least negative outcome is the one that would be chosen.

It is also possible to include social costs and other items which can be given a notional cost or value. For example, the government has allocated a value for the social cost of CO_2 for local authorities to use and this can be taken into account in the calculations. As the MWESCO is an economic entity, we have concentrated on directly quantifiable figures.

9.2 NPV summary

There are four NPV spreadsheets, shown in Appendix 6.

- MWESCO with the swimming pool

- MWESCO with WHHA projects only

- oil-fired ESCO
- WHHA (this shows only the costs and savings attributable to the WHHA)

A summary of the NPV spreadsheets is shown below

	Total capital costs	**Running cost per year (all projects)**	**Income per year (all projects)**	**NPV after 25 years**
MWESCO with swimming pool	£574,016	£85,044	£117,865	Minus £77,084
MWESCO with WHHA projects only	£483,866	£59,812	£88,256	Minus £178,772
Oil-fired ESCO	£171,112	£80,383	£88,256	Minus £131,648
WHHA wood heating	£147,447	£6,630		Minus £240,828
WHHA electric boilers	£394,500	£8,500		Minus £512,220

Looking at the above table, none of the schemes are positive in year 25. It should be remembered that no grant income or loans are included in the above calculations. The minus amounts are a reflection of the necessity for grant funding. The cashflows, which have this included along with interest payable and received, would give a more realistic view of the situation for all the scenarios.

The NVP comparison also shows that an oil-fired ESCO appears to produce a more favourable outcome than the MWESCO, but it would not be eligible for as many grants, assuming that grants are available. It is also more likely that the cost of oil would rise at a far steeper rate than that assumed in the discounting rate and this would push the final outcome even further into the red.

It would be advisable to expand the MWESCO to include as many properties as possible, preferably independent of the district heating network.

9.3 NVP and the WHHA

No cashflow has been produced for the WHHA as there is no revenue income. The NVP alone is deemed to be sufficient for the WHHA to decide which would be the best value, economically speaking.

The WHHA expenditure in the wood-fired heating scheme consists of the standing charge of £1.50 per meter per week which is paid to the MWESCO. This amount being based upon the replacement value of electric boilers (which would be the alternative heating systems if wood district heating is not used) and is less than the WHHA would pay for annual servicing and repairs to electric boilers, which form the running cost of the spreadsheet for the electric boiler installations.

The electric boiler installations have a NPV almost double that of the contribution that the WHHA makes to the district heating by purchasing the heating mains and paying a standing charge to the MWESCO. This reflects the much larger initial capital cost involved. The electric boilers are replaced after 15 years and this extra capital cost is included in the NPV calculations.

10 Carbon dioxide savings

Although wood heating is carbon neutral, CO_2 savings can be calculated by working out the amount of fossil fuel that the wood heating replaces.

For example, the swimming pool would replace the oil that it currently uses with wood and the savings worked out per litre of oil saved. This works out at 137 tonnes of CO_2 each year.

For the WHHA properties, it is likely that the electricity supplier would be Scottish Hydro or another green energy company. In this instance there would be little or no carbon savings. However, the calculation has been done on the assumption that ordinary grid electricity rather than electricity from a green supplier is used.

The calculation factor for converting kWh to tonnes CO_2 is taken from the UK Guidelines on Company Reporting.

	Estimated kWh consumed each year l	**CO_2 saved per year compared to electric boilers**	**CO_2 saved per year compared to oil boilers**	**Total CO_2 saved per year**
Shilling Hill	186,667	98 tonnes		98 tonnes
Balascate Phase 1	233,333	123 tonnes		123 tonnes
Balascate Phase 2	81,667	42 tonnes		42 tonnes
PCC	1,033,822	12 tonnes	253 tonnes	265 tonnes
Swimming pool	548,313 pa		137 tonnes	137 tonnes
			Total projects	665 tonnes

11 Extending the MWESCO

To give a viable business it is desirable to forecast the effect of adding some of the other potential heat users that might benefit from the MWESCO's services over the following years.

Adding even one boiler a year of a size similar to that of the swimming pool and selling the heat at more than the running cost, providing that the capital costs of installing the boiler can be met, would increase the chances of the MWESCO surviving.

Other developments may include for example:

A large guest house

A primary school

A secondary school

A group of say four holiday cottages

Examples of typical heatloads for various types of buildings are shown below:

Type of Building	**Brief Description**	**Heat Load - kWh**	**Equivalent wood chip - tonnes at 35%**	**Equivalent wood chip - cu m**
Semi-detached house	Loft insulation only. Solid walled	27,000	Not suitable for chip	n/a
Small primary school	Stone, traditional Victorian, solid walls	141,100	51	205
Medium primary school	1960s built, flat roof	638,000	232	928
Comprehensive school	1960s built, flat roof	967,150		
Large community centre	Large, brick, built	101,740	37	148
Small village hall	Single room + kitchen etc	5,000	2	7
Large farm house & visitor centre	Stone built	55,000	20	80
Four holiday cottages	Refurbished traditional worker's stone cottages	41,250	35	140

Small manor house	Victorian stone built house	282,690	103	411
Medium manor house & extensive ancillary buildings	Georgian stone/brick with extensions, house and staff accommodation	687,500	250	1000

It may be more appropriate for those buildings with small heat loads, for example the small village hall and the semi-detached house, to install a log or pellet boiler rather than a wood chip boiler. These systems take up less room on site, because of the fuel storage and handling needed with wood chip, and can be manually fed when needed.

It would be advisable for the MWESCO when considering installing a boiler into a premises, that the heatload is estimated as accurately as possible and both the running and capital costs are taken into account before contractual arrangements for supply are made.

12 Ownership Options Energy4All

Energy4all were requested to supply information on how the MWESCO might finance its operations. Their response is reproduced below:

The Dilemma

Any energy project which is instigated and run by a community and designed to benefit that community faces a dilemma when it comes to actual ownership of the assets.

This dilemma arises because the ownership of an asset normally rests with whoever invested in the project and controls the shares (equity). The requirement for control and a financial return is likely to be greater if the investment includes 'risk money' which the investor stood to lose if the project failed to progress. Hence a community faces a conflict between the desire for 'community ownership' and the practical reality that it often does not have risk capital to invest, and investors from outside are reluctant to offer money without a share of the equity and some control over the assets. The dilemma is made worse by the fact that most investors require a financial return, reducing benefits to the community.

The Ideal Solution

Hence for most small-scale community projects the ideal solution is to find investors who are prepared to put in their money without requiring control or a commercial return. This means finding sources of grants and or soft loans which the provider is willing to make available to a representative community body (or to a trading company established by the community whose profits are donated to a Community Trust, for example). Professional business management is essential for this to be a realistic possibility. If it can be done, a community can retain control of the project while not itself having to raise the finance to establish and run it, though it may still have to repay borrowed capital and meet other expectations of the financier.

The prime provider of small-scale support for community energy in the Highlands and Islands is HICEC which can provide both risk funding and preference share funding to suitable projects.

Unfortunately sufficient grants and soft finance is not always available, particularly on larger projects.

Alternatives

If sufficient soft finance is not available, the community has to raise capital in some other way, while retaining 'community control' of the project. Commercial borrowing may well be available for community projects on reasonable terms but (as with a domestic mortgage) lenders will expect the community to put in some equity. Raising this investment within the community can be difficult.

Various business models are available and specialist advice should be taken on the most appropriate.

The best-established model in the UK is the co-op. Energy4All has specialised in the 'true' co-op model, where members invest via a public share offer controlled under FSA regulations. The advantage of this structure is its ability to raise substantial sums due to its ‘approved’ status, and its suitability for delivering a degree of community involvement in large-scale commercial projects. Its disadvantage is that it is probably an uneconomic way to raise less than £1m. It also transfers a degree of ownership away from the whole community in favour of the members who have invested, who expect a return on their money. Variations on this model can be used, to limit members’ benefits for example, but the ability to raise finance may be reduced by such measures.

On a smaller scale, there have been recent innovative examples of communities using a ‘Ben. Comm. Co-op’ (a Co-op for the Benefit of the Community). Such a model cannot offer such attractive rewards to members and hence is less suitable for raising large sums. However if sufficient investors can be found to put in finance on these terms, then this may be a low cost option.

There are other innovative approaches to raising community equity. Community assets can be mortgaged or invested directly in the project (capital, land, etc). Less obvious is the investment of so-called ‘sweat-equity’ where the members of a community invest their time and effort to make a project happen. Lenders may accept sweat-equity as an investment on the basis that it has increased the value of the project.

Whatever form of equity is raised, the community will normally then seek to use it to secure commercial borrowing which may be available on attractive terms for small scale projects with a sound business plan. The lender will need to be convinced of the professional management skills of the community team.

Conclusion

Community ownership of renewable energy projects is in its infancy in the UK, so to some extent any community seeking to establish a ‘community owned’ project is taking on a pioneering role. Models do exist, however, and even if a community is not in a position to fund its project from grants and soft finance, a significant level of community control is still possible. None of the available options is easy, but organisations such as HICEC and Energy4All can support communities with aspirations in this direction. Which route a community decides to go will depend on the size and nature of the project and the wishes of the community.

Energy4All

The summary above is based on the experience of Energy4All, a social enterprise company dedicated to community ownership of renewables in the UK. Energy4All is best known for its success in using the co-op model to raise substantial sums to finance community wind projects, and is not dependent on public funding. Visit www.energy4all.co.uk for further information, or ring 01229 821028.

13 The Energy Supply Company (ESCO) model

13.1 Energy supply companies

The term ESCO (elsewhere in this report referred to as the MWESCO) is used to describe an organisation which delivers a heat supply service. This in effect provides a vertically integrated operation where the operator is able to control and therefore make savings and efficiencies in the running of the whole plant and its fuel supply chain. Under such an agreement the client pays for heat measured by a heat meter at the point where the heat enters the property. Usually the charge is split into a standing charge and pence per kWh charge, and the contract covers the range of matters including in some cases part or all of the capital cost.

ESCO type contracts have advantages for both the fuel supplier and the heat client. The client gets the benefit of not having the responsibility of operation and maintenance for the plant. The client has only a bill according to actual heat consumed along the lines of other energy and utility bills. In the case of solid fuels such as biomass this is particularly attractive as the heat consumer is able to get the benefits of wood heat and avoid the labour element.

The ESCO / fuel supplier has a contracted income stream against which to invest in the fuel processing and delivery equipment. The client also benefits because it is in the fuel supplier's interest to ensure that the plant is operating at its optimum performance at all times. The supplier will ensure that only the best quality fuel is delivered and that maximum efficiency is maintained by keeping the boilers well maintained.

Many models of ESCO exist, some typical ones are:

1. The ESCO may have a simple contract to carry out operation and maintenance of a plant, source and purchase fuel and deliver heat to one or more buildings.
2. The ESCO may be contracted to supply heat by taking over full responsibility (but not ownership) of an existing heating installation, running the heat system, arranging fuel purchase or in the case of biomass, actually carrying out the fuel supply (this model is used in public sector sites with multiple buildings).
3. The ESCO may take over ownership of the heating infrastructure and plant, maintain it on a day-to-day basis, provide fuel, carry out trouble shooting and deliver heat to one or a number of buildings. In this model the ESCO might well also be responsible for the long term replacement or upgrading of the infrastructure.
4. The ESCO provides the capital, designs and installs the plant, owns and runs it on a day-to-day basis throughout its lifetime. It is responsible for the eventual replacing or upgrading of plant and in the case of biomass would have a strong stake in the fuel supply side. The ESCO is fully responsible for the site and the heating scheme. In this case the ESCO would make a higher charge for heat to cover its own investment as well as the operating costs.

Given that the WHHA and other users may want to avoid long term responsibility for the heat system, models 3 or 4 are most likely to be attractive.

13.2 Biomass ESCOs in the UK

There are a number of organisations currently offering either an operation and management service for biomass heat systems or fully financed Energy Supply services, in which case they provide the financing for the biomass system, own and operate it. All the projects of which we are aware are to heat social housing and publically owned facilities. The fully financed ESCO service has only thus far been applied to converting existing council owned district heating systems (mainly in Barnsley and Sheffield), where the pipework infrastructure was already in place. The organisation concerned quotes in its Newsletter July '06:

"**Financed biomass energy services** - Econergy and Scottish and Southern Energy PLC have signed an agreement to deliver biomass energy services to major customers. Econergy already has five long term energy service contracts in operation across England and Wales with public sector customers. The oldest of these is a 700KW heat supply contract for Worcestershire County Hall which has now completed its fourth winter of operation, with a near 100% service factor. This extends Econergy's ability to offer long term fully financed heat service contracts to the public sector and large private sector clients."

Other schemes run by Econergy include blocks of 300 flats in Barnsley and 97 houses in Sheffield.

Other wood heat companies, notably Wood Energy Ltd have now set up ESCO operations and are operating them for single buildings. Wood Energy has recently partnered with NaREC and Groundwork South Tyneside to form the North East Sustainable Energy Company and plans to offer ESCO services at the large scale, but mainly to large industrial heat users with a regular, large base load. In addition a community organisation in North East England, CoRE (Community ownership of Renewable Energy) is exploring the operation of renewable systems including biomass heating as a social enterprise. Social enterprises have access to low interest financing and may be able to obtain finance for projects that would not be viable using commercial financing.

A Danish firm, Vital Energi has designed, built and operates several district heating schemes in Scotland. The largest is fired with municipal waste but the rest are biomass-fired. The company has considerable expertise in district heating but it is unclear whether they offer financing – our impression is that they offer a turnkey design and build contract followed by a management and maintenance contract.

The developments at Whitegates in Lochgilphead and Glenshellach in Oban are run by Vital Energi, although the Whitegates district heating was not installed by them.

14 Benefits and risks to the MWESCO and how to minimise them

14.1 Commercial benefits

14.1.1 *Income from heat sales*

District heating has the potential to create a business opportunity for an ESCO. The pace of electricity and oil price increases and the consequent level of heat charges hold the key to the level of financial success of the scheme. Keeping the charges to the tenants and other parties at a level that is below that of fossil fuels should prove a cost benefit to users of the MWESCO.

14.1.2 *New builds*

There is a considerable saving to be had in installing a district heating scheme as the properties are being built, rather than fitting one into existing dwellings. The pipework can be laid along with other services, and there is no wastage of existing boilers. This is of direct benefit to the WHHA and indirectly to the MWESCO as the WHHA would be contractually obliged to use the MWESCO to provide heat for the tenants.

14.1.3 *Legislative benefits*

The Government's planning policy is increasingly in favour of renewable energy being incorporated in new developments. Planning Policy Statement 22 (PPS22) paragraph 8 encourages local authorities to develop policies requiring that a percentage of the energy to be used in new residential, commercial or industrial buildings should come from renewable sources. The environmental and economic benefits of renewable energy, whatever the scale, must be taken into account by planning authorities in considering new proposals (PPS22 principle (iv), and Building Regulations Part L and planning legislation currently in the pipeline).

14.2 Environmental benefits

14.2.1 *Air quality, carbon savings and climate change*

Wood fired district heating helps to avoid further climate change by avoiding increases to the amount of CO_2 in the atmosphere. Wood is a carbon neutral fuel and all CO_2 produced is re-cycled again by growing trees. Emissions from modern wood boilers of this scale are negligible - less than one coal fire! Replacement tree planting helps to lock up the CO_2 again.

14.2.2 *Wildlife and conservation*

The proper management of woodland and forestry has great benefits for wildlife and ecology. Substituting arable farming with energy crops is also recognised to improve bio-diversity and to increase the number of bird and mammal species as well as providing new field margins for a wide variety of plants. Thinning woodland enables more light to penetrate and has similar effects.

14.3 Social benefits

14.3.1 *Developing the local economy*

Changing from a bought in fuel to a locally produced fuel has spin-offs in the local economy with the creation of direct and indirect jobs. A healthy economy benefits all businesses. A study in North East England by the New Economics Foundation showed that for every £1 spent in the local economy, another £3 of expenditure is generated. This known as LM3 – Local Multiplier Three.

14.3.2 *Avoiding fuel poverty*

Electricity is expected to rise in price over the life of houses built today. Energy is destined to become a greater proportion of household expenditure and the risk of fuel poverty[1] will therefore increase with time. Wood fuel heating schemes will use a low priced product with stable inputs to the supply chain. The supply is secure and costs are expected to be stable and to deliver heat below electricity and oil prices as the scheme gets underway.

14.4 Commercial risks

14.4.1 *Cutting edge*

Breaking into an established market with a new product is always risky. District heating is not a widely recognised solution to heating needs in the UK and large scale wood heat is practically unheard of among the general public. The British are notoriously unwilling to be "guinea pigs" and the risk is that the proposed users, for example the hotel with the swimming pool, could fail to be convinced of the robustness of the proposal to allow the MWESCO to install a wood heating boiler and supply the fuel. Typically they will want to see the MWESCO operating successfully for some time before committing to it.

14.4.2 *Electricity and oil prices*

The commercial viability of the scheme depends on being able to generate heat more cheaply from wood than from electricity or oil. If electricity or oil prices, contrary to expectations, fall for long periods, the project would have difficulty in competing with the price and may have difficulty surviving. The risk is that the back-up oil boilers would be used instead of the wood-fired boilers. However, the projects that have the wood boilers installed would have to bear the cost of replacing the boilers, if oil boilers were not already installed. The fuel cost figures used in the costing estimates are deliberately conservative and err on the high side. This should give some reassurance that the scheme will succeed. However, a thorough and more detailed analysis of risks and specialist cost modelling is an essential requirement.

14.5 Management risks

14.5.1 *Need for project champion*

For a complex proposal like this to succeed it is essential that an efficient project champion with adequate time to spare is appointed to take the project forward, to become thoroughly acquainted with the technology and the issues and to be the first point of contact in the company and for other contractors.

14.5.2 *Project management*

Designing and building the heat scheme is likely to involve a number of subcontractors working together. During the detailed design and quotations stage, as well as throughout the building process, it is essential that a skilled and well experienced project manager is given the responsibility of making sure the project goes smoothly. We strongly advise that during the construction phase a highly experienced project manager oversees both the construction of the dwellings and the heat supply infrastructure as well as the installation of the containerised boiler or Energy Centre. This will avoid difficulties between the range of contractors and blame shifting between them when issues arise. High quality workmanship is a prerequisite for

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[1] Fuel poverty is a term used to describe households spending more than 10% of household income on energy.

district heating and many other projects in the UK, both recently and historically, have fallen foul of poor supervision during construction.

Finding the right person could be difficult due to lack of experience of district heating and wood energy, but is essential to the smooth running of the project.

14.6 Financial risks

14.6.1 *Funding*

The SCHRI funding and the Scottish Biomass Support Scheme both close in March 2008, although it is hoped that replacement funding schemes will be forthcoming. However, funding from the Bio-energy Capital Grants scheme can still be accessed through a number of biomass equipment suppliers and some existing Energy Supply Companies (ESCOs). This should provide between 20-30% of the biomass equipment costs, but is unlikely to contribute to the cost of the district heating network. Additional public funding may be available from the Low Carbon Buildings Programme and from funds described in Appendix 9, but it will be limited. There is however considerable funding available for social enterprises and this needs to be explored further by NWMCFC and MWESCO.

14.6.2 *Enhanced Capital Allowances*

If carbon saving equipment, such as wood heating, is installed and run by a profit making company there is potential for Enhanced Capital Allowances (full write off against tax in the first year). The way the ECA system is currently set up mitigates against ESCOs as they do not make the carbon savings - their clients do. There is pressure for this to be changed which hopefully may be achieved in the near future. As a charitable body, this may not apply to the MWESCO.

14.6.3 *Maintaining heat demand*

It is unlikely that WHHA properties connected to the district heating, and having no other form of heating, will change to another supplier, indeed a contractual agreement should be drawn up to give security to the MWESCO and to the WHHA. A danger to the long term success of the scheme is that other customers of the MWESCO, including private individuals and companies, decide to disconnect from the wood heating and run their own oil boilers. This could affect the economic viability of the MWESCO as running costs will remain similar but income from heat sales will drop. The level of usage could theoretically drop below that required for sustainable operation of the MWESCO. This is, however, unlikely if the heat price is right and the operator of the plant delivers heat consistently and reliably. It would be advisable to add properties to the MWESCO to increase the heat demand by installing more wood boilers, or by encouraging those that already have wood-fired boilers to install heat meters and use the MWESCO to supply heat.

14.7 Legislative risks

14.7.1 *Rating*

It is unlikely that the containerised boilerhouse would be charged rates as mandatory and discretionary rate relief would apply, however, our research has shown that district heating schemes are allotted a ratable value but only the larger ones (eg Lerwick) are actually charged rates. It appears that the local authorities have a discretion whether or not to actually demand a rate payment. As it would be installed on a concrete base, the Energy Centre may be treated as a permanent structure. The additional cost of rates would adversely affect heat sale prices and thus the financial viability of the heating scheme. It appears that the whole district heating scheme including the pipework may also be rated - though this needs to be confirmed. The cost of this has not been included in the running cost calculations as part of the overheads of the system. The responsibility for paying for any rates for the Energy Centre will most likely belong to the MWESCO, with the heating pipes being responsible for the rates, however the WHHA would also be eligible for 100% rate relief. There is a considerable risk here if for example a change of political power locally or nationally affects the charging of rates on small district heating schemes.

14.7.2 *Compliance with environmental health legislation*

New boilers must comply with current clean air legislation. Depending on scale, the Environmental Health Officer or Scottish Environment Protection Agency (SEPA) is usually consulted formally during the planning process. Approval should be only a matter of time as wood fired heat plant is extremely clean burning and meets all EU emissions legislation. However, evidence of clean burning will have to be provided by the supplier of the boilers at the detailed design stage.

14.7.3 *Planning consent*

Consent for the entire heating system is required and should be incorporated as part of application for the housing development. It will require statutory consultation procedures and timetable.

14.7.4 *Public perception*

This could be a problem during the planning consultation phase as buildings with chimneys tend to provoke public disquiet. The chimney on the smaller sized schemes will be relatively short – one metre above the ridge of the boilerhouse building, unless sited close to a tall building or trees. It should be noted that a properly running modern biomass district heating boiler of under 500kW produces less harmful emissions than a single open coal fire. The boilers that would be installed on Mull would be much smaller than this. Other wood heat schemes have run into opposition when the public are suspicious that the site may be used as an incinerator rather than simply a boiler house burning clean fuel. Promotional work should make absolutely sure not to mention the word "waste" (even if recycled or recovered wood is to be used) and to concentrate on referring to wood and recovered wood or wood products, and their environmental benefits.

The number of movements caused by fuel deliveries may also be perceived as a problem by the public or the planning authority. The impact of these could be reduced by careful siting of the boiler houses so that lorries do not travel through the housing area to get to them.

14.8 Environmental risks

14.8.1 *Visibility, activity and noise*

Fuel stores and boilerhouses will inevitably be the source of a certain amount of activity due to fuel deliveries. There is a risk that the proximity of the building to the housing will be seen to be damaging the residential environment. Careful design and siting, along with screen planting and landscaping, should enable these impacts to be ameliorated.

14.9 Technical risks

14.9.1 *Breakdowns*

Breakdown of boilers or feed system would prevent heat being supplied but an oil boiler, designed for back-up for peak-load times and any boiler down-time, would be able to supply the site with heat. Purchase of high quality reliable boilers (e.g. Kob, KWB, Binder etc) should avoid this and it is important to buy equipment from companies who offer a full local support and call-out service. The large heat stores (accumulator tanks) will provide short-term back-up heat supply.

Leaks in the heat main could cause serious economic, as well as practical, problems. The solution is to ensure that the installation is made by an experienced district heating company and that a modem-connected leak detection system is installed so that any repairs can be notified and carried out immediately. Specialist matting should also be laid in the trench, above the heat pipe, to alert other utilities to its position.

14.9.2 *Estimation of heat demand*

Heat loads upon which the plant sizing and fuel use calculations have been carried out are best estimate only, but the economics of the heat supply MWESCO depend upon them. There is no real-life information on the heat use of the houses. If the buildings are much more or less efficient than predicted or they are occupied by non-typical users of energy there could theoretically be a mismatch between the plant and the heat load.

A slow and phased development and the use of containerised boilers actually mitigates against this risk. It means that in the early days monitoring of the heat use and the plant in Phase 1 can be undertaken. If it proves that the plant is too small a larger boiler could be put in. or the entire container replaced with a larger one.

15 Conclusions

Wood energy on Mull seems a sensible way to go – Mull has timber resources and a supplier of high quality wood fuel is poised to increase its output. Local people have got together to take the idea of wood heating forward and are working with the West Highland Housing Association to make sure that the proposal is viable.

This study has taken the early information available on the new developments and attempted to predict how a wood energy supply company, the Mull Wood Energy Supply Company, would perform over 25 years.

From looking at the cashflow and NPV spreadsheets, provided that the developments occur in a similar pattern to the one modelled, the MWESCO would be viable on the basis of the WHHA housing alone, provided that 50% grant funding can found to cover the capital cost, the remainder being a soft or interest free loan. In order to keep heat price compatible with alternative heat costs a heat price of 6p/kWh would be charged to the tenants of the WHHA. This is less than the running cost to the MWESCO in Year 1, so there would be a loss in the first year, but this could be covered either by bringing forward the installation of either the PCC or the Craignure swimming pool, or installing wood boilers at the sites of other heat users. Both of these installations do not involve district heating mains and so have lower running costs as well as a higher heatload than the Phase 1 Shilling Hill housing development. This means that, at 6p/kWh, the heat price exceeds the running cost at the non-domestic sites. If the fuel supply cost could be brought down in the early stages this would improve the profitability of the MWESCO. Alternatively grant aid to help with running costs could be forthcoming for a social enterprise during its first year(s) of operation.

The WHHA would also gain by installing a district heating system instead of electric water heaters and benefit from it being run by MWESCO. The WHHA would not have the responsibility of the upkeep of the equipment, although they would be expected to contribute to the running cost by means of a standing charge of £1.50 per meter. This is still cheaper than paying for service and repairs to the electric boiler. They would not have to replace the boiler or equipment as it reaches the end of its life.

As fossil fuel costs rise, the tenants would have the security of a price for their wood heat which is lower than they would have to pay for either electricity or oil.

The setting up of the MWESCO would be beneficial to the Mull economy by using local fuel and timber suppliers, thus creating and/or ensuring jobs and by the recirculation of expenditure on heating within the local economy.

Once further details of the housing schemes and the PCC emerge it will be possible to firm up the figures used in this report, but as things look at present there seems a good opportunity to set up a viable locally based business to provide wood heating for a range of buildings. Once established this service can be expanded to other heat users which will in turn ensure the long term economic success of the MWESCO.

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Appendix 1 Heat load calculations

Shilling Hill heatload profile calcs							
NW Scotland (region 18)				half-hourly data			
Degree days				Time	% use	kW0.5h	kW
Jan	316	13%		05.30		0.00	
Feb	295	12%		06.00	7.5	50.18	
Mar	297	12%		06.30	10.00	66.91	
Apr	242	10%		07.00	10.00	66.91	133.81
May	189	8%		07.30	7.50	50.18	
Jun	121	5%		08.00	5.00	33.45	
Jul	79	3%		08.30	5.00	33.45	
Aug	72	3%		09.00	2.00	13.38	
Sep	111	4%		09.30	1.00	6.69	
Oct	184	7%		10.00	1.00	6.69	
Nov	256	10%		10.30	1.00	6.69	
Dec	316	13%		11.00	0.50	3.35	
Total	2478	20 year average		11.30	0.50	3.35	
				12.00	0.50	3.35	
				12.30	0.50	3.35	
	kWh			13.00	0.50	3.35	
	monthly	daily (av)		13.30	0.50	3.35	
Jan	20,072	669		14.00	0.50	3.35	
Feb	18,738	625		14.30	0.50	3.35	
Mar	18,865	629		15.00	1.00	6.69	
Apr	15,372	512		15.30	1.00	6.69	
May	12,005	400		16.00	5.00	33.45	
Jun	7,686	256		16.30	5.00	33.45	66.91
Jul	5,018	167		17.00	5.00	33.45	
Aug	4,573	152		17.30	4.00	26.76	
Sep	7,051	235		18.00	3.50	23.42	
Oct	11,687	390		18.30	3.50	23.42	
Nov	16,261	542		19.00	3.50	23.42	
Dec	20,072	669		19.30	3.50	23.42	
total heatload	157400			20.00	3.50	23.42	
				20.30	3.50	23.42	
				21.00	2.00	13.38	
				21.30	2.00	13.38	
				22.00		0.00	
				22.30		0.00	
				23.00		0.00	
				total	**100.00**	**669.07**	

Balascate 1 heatload profile calcs							
NW Scotland (region 18)				half-hourly data			
Degree days				Time	% use	kW0.5h	kW
Jan	316	13%		05.30		0.00	
Feb	295	12%		06.00	7.5	63.47	
Mar	297	12%		06.30	10.00	84.63	
Apr	242	10%		07.00	10.00	84.63	169.26
May	189	8%		07.30	7.50	63.47	
Jun	121	5%		08.00	5.00	42.32	
Jul	79	3%		08.30	5.00	42.32	
Aug	72	3%		09.00	2.00	16.93	
Sep	111	4%		09.30	1.00	8.46	
Oct	184	7%		10.00	1.00	8.46	
Nov	256	10%		10.30	1.00	8.46	
Dec	316	13%		11.00	0.50	4.23	
Total	2478	20 year average		11.30	0.50	4.23	
				12.00	0.50	4.23	
				12.30	0.50	4.23	
	kWh			13.00	0.50	4.23	
	monthly	daily (av)		13.30	0.50	4.23	
Jan	25,390	846		14.00	0.50	4.23	
Feb	23,702	790		14.30	0.50	4.23	
Mar	23,863	795		15.00	1.00	8.46	
Apr	19,444	648		15.30	1.00	8.46	
May	15,186	506		16.00	5.00	42.32	
Jun	9,722	324		16.30	5.00	42.32	84.63
Jul	6,347	212		17.00	5.00	42.32	
Aug	5,785	193		17.30	4.00	33.85	
Sep	8,919	297		18.00	3.50	29.62	
Oct	14,784	493		18.30	3.50	29.62	
Nov	20,569	686		19.00	3.50	29.62	
Dec	25,390	846		19.30	3.50	29.62	
total heatload	199100			20.00	3.50	29.62	
				20.30	3.50	29.62	
				21.00	2.00	16.93	
				21.30	2.00	16.93	
				22.00		0.00	
				22.30		0.00	
				23.00		0.00	
				total	**100.00**	**846.32**	

Progressive Care Centre

Boiler size	150kW	200kW
Annual energy use	657,926kWh	877,235kWh

Assumptions:

Floor areas		
Treatment rooms	675m^2	790m^2
Residential units	785m^2	895m^2
Hub area	300m^2	315m^2
Total	1,750m^2	2,000m^2
Ceiling height (av.)	2.7m	2.7m
Building type	Light construction	Light construction
Internal temp	23ºC	23ºC
External temp	-1ºC	-1ºC

The floor areas have been estimated from the ground floor plan that was printed in a "not to scale" format.

Energy consumption figures based "Good practice" energy benchmarks for residential care homes and cottage hospitals from the BSRIA "Guidelines for Building Services".

heating demand PCC	**877235**	**kWh pa**
heating demand 3 staff houses	19000	kWh pa
hot water @ 35L per person per day	34205	kWh pa
Total	**930440**	**kWh pa**
assumptions		
45 persons		
24 hour occupancy		
cold water laundry facilities		

Staff houses PCC						
heat load calculation						
					heat&hot water	
	ground	1st	total sq m		MWh	
semi 1 bed	39.00	22.85	61.85		5.3	
tce 2 bed	37.50	37.50	75.00		5.7	
semi 3 bed	54.26	38.94	93.19		8	
		total	230.04		19.00	

Appendix 2 Wood chip specification

NOTE IT WAS ANNOUNCED IN FEBRUARY THAT NEW CEN STANDARDS ARE BEING ADOPTED – BUT THIS GIVES GOOD GUIDE FOR NOW

Wood quality

Feedstock must be clean and free from contaminants such as paint, preservatives or varnishes, melamine coatings, or tramp material such as string and plastics. If these occur they will cause corrosion of the boilers and emissions problems. The Environmental Health officer will want to be reassured from day one that clean wood only will be used.

Wood can be either hard or softwood but should not contain bark because it will lead to a high proportion of ash and can foul up the boiler.

Moisture content

Ideal moisture content at 25% but 35% is acceptable without seriously de-rating the boilers. Many boilers will burn at up to 55% moisture but this will require a larger boiler and fuel store and more wood as heat has to be used to drive off the moisture. Crannich have stated that they can supply wood chip with 30% MC as they have drying facilities. The boilers installed on Mull will be calibrated to this specification.

Size of particle

Wood chip size grades are important. Wood chip burning plant will generally operate best on material between 2 and 25mm maximum dimension. However, it is accepted that fuel production methods do produce a wider range of particle sizes than this. Very fine dusty material can upset combustion in a boiler, and large chunks and long stringy material can block feed systems, so any grading system will put limits on these constituents.

British BioGen (now part of Renewable Energy Association REA) undertook consultation with fuel suppliers and boiler manufacturers and produced a retail grading system which reflects the variation in fuel tolerance of different combustion systems. They expect to review the grading system periodically and an EU standard, CEN 335, is now being prepared which will supersede the British BioGen standard. Wholesale suppliers and purchasers may wish to agree different specifications to suit their particular needs.

Retail wood chip is described by three grades; **Super**, **Fine** and **Coarse.**

Size	<2mm	2 – 25 mm	25 – 50mm	50 - 100mm	100 – 200 mm
Description	*Dust*	*Small*	*Medium*	*Oversize*	*Slivers*
Super	<15%	Any	0%	0%	0%
Fine	<15%	Any	10%	2%	0%
Coarse	<15%	Any	Any	<30%	<2%

Other requirements

Maximum of 5% tramp material is permitted with no stones >25mm.

Oversize and sliver material is assumed to be "long and thin" and below the length allowed for each grade– material greater than 50mm square is unacceptable.

Super Grade Wood Chip: This is a very tightly defined wood chip, with a total absence of larger material to avoid blockages in certain types of equipment. Specialised chipping and screening facilities will be required for its production.

Fine Grade Wood Chip: This is likely to be the most widely used retail chip grade, being suitable for the majority of small-medium scale woodfuelled equipment. This grade is achievable with selected chippers and/or basic screening.

Coarse Grade Wood Chip: This grade is likely to be popular in the self-supply sector and in some retail sectors. Most automatic plant will operate acceptably on this grade, however occasional blockages can be expected. The lower price of this readily produced fuel will compensate for the extra intervention required. A wide range of chipping equipment including many mobile chippers can produce fuel to this grade without screening.

Appendix 3 Woodfuel suppliers

The list below does not imply any preference on the part of North Energy and is not exhaustive. Further information can be got from the woodenergy website www.usewoodfuel.co.uk and from the National Energy Foundation www.nef.org.uk/**logpile**.

Robin Sedgewick Crannich Woodchip Supplies Tel: 01680 300495	Crannich Farm Glen Aros Isle of Mull PA72 6JP	Chips
Richard Livett Greenwood Tel: 01972 500702	Ardslignish Acharacle Argyll PH36 4JG	Chips
Woodtherm Fuels Tel: 07775 625839 woodthermfuels@virgin.net	Tigh Sgoile Onich Fort William PH33 6RY	Chips Pellets
Alex Thomson Tel: 01807 580 431	Hillview 107 Main Street Tomintoul AB37 9EX	Chips
Alvie Farm Partnership Tel: 01540 651 255 peter@alvie-estate.co.uk	Alvie Estate Office Kincraig Kingussie Inverness-Shire PH21 1NE	Chips
Anderson Woodfuel Tel: 07709 376 442	3 Blackpark Broadford Isle of Skye IV49 9DE	Chips
Highland Wood Energy Tel: 01397 773 000 www.highlandwoodenergy.co.uk	Unit 2 Old Mart Industrial Estate Corpach Fort William PH33 7NN	Chips Pellets
Sylvestrus Ltd Tel: 01463 237 812 treeman@tesco.net	1a Broadstone Park Inverness IV2 3JZ	Logs,chips and pellets. Can organise fuelwood harvesting and woodland management

Appendix 4 Wood boiler suppliers

The list below does not imply any preference on the part of North Energy and is not exhaustive. Further information can be got from the woodenergy website www.usewoodfuel.co.uk and from the National Energy Foundation www.nef.org.uk/**logpile**.

3G Energi Tel: 01835 824201	Allesudden Charlesfield St Boswells Melrose TD6 OHH	Kunzel Kob Pellet-Heizkessel
Buccleugh Bioenergy Tel: 0131 524 0910	27 Silvermills Court Henderson Place Lane Edinburgh EH3 5DG	Also ESCO
Econergy Tel: 0117 377 5606	69 Hampton Park Redland Bristol BS6 5LQ	Veto Compte KWB Froling
Fuelwood Harvesting Tel: 01361 840251	Weirburn House Abbey St Bathans Duns TD11 3TX	Veto (cheap and cheerful boilers but not highly efficient)
Highland Wood Energy Tel: 01397 773 000 www.highlandwoodenergy.co.uk	Unit 2 Old Mart Industrial Estate Corpach Fort William PH33 7NN	
Highland Renewable Energy Solutions Ltd Tel: 01349 877 859 www.hi.-res.ltd.com	Units 2 & 4 Inverbreakie Industrial Estate Invergordon IV18 0QR	
Wood Energy Ltd	Pinkworthy Barn Oakford, Tiverton Devon EX16 9EU	Binder Primdal & Haugeson

Appendix 5 Cashflow spreadsheets

An explanation of the assumptions and methods used in putting together these spreadsheets has been providing within the main text of this report.

Mull simple indicative cashflow wood district heating WHHA bldgs only												
		kWh pa	**kWh pa**	**kWh pa**	**kWh pa**	**kWh pa**	**kWh pa**					
Heatload		**160,000**	**1,090,440**	**1,090,440**	**1,090,440**	**1,290,440**	**1,360,440**					
Expenditure		**year 1**	**year 2**	**year 3**	**year 4**	**year 5**	**year 6**	**year 9**	**year 10**	**year 11**	**year 12**	**year 13**
Unit fuel cost p/kWh		3.04	3.13	3.22	3.32	3.42	3.52	3.85	3.96	4.08	4.21	4.33
Total fuel costs		4,862	34,128	35,152	36,206	44,132	47,922	52,366	53,937	55,555	57,222	58,938
Operation & maintenance		7,359	16,270	16,758	17,261	25,286	32,259	35,251	36,308	37,398	38,520	39,675
Capital cost		135,170	129,180	0	0	148,045	71,470					
loan repayments	0%	2,703	5,287	5,287	5,287	8,988	10,775	10,775	10,775	10,775	10,775	10,775
Total expenditure		**150,094**	**184,865**	**57,197**	**58,754**	**226,451**	**162,427**	**98,392**	**101,020**	**103,727**	**106,516**	**109,388**
Income												
Heat sales		9,600	67,389	69,411	71,493	87,144	94,627	103,402	106,504	109,699	112,990	116,380
Grants for boiler + plant	50%	67,585	64,590	0	0	74,023	35,735	0	0	0	0	0
other funds		67,585	64,590	0		74,023	35,735					
standing charge from WHHA		2,028	3,276	3,276	3,276	5,538	6,630	6,630	6,630	6,630	6,630	6,630
Total income		**146,798**	**199,845**	**72,687**	**74,769**	**240,727**	**172,727**	**110,032**	**113,134**	**116,329**	**119,620**	**123,010**
Difference this year		-3,296	14,981	15,490	16,015	14,276	10,301	11,640	12,114	12,602	13,104	13,622
Interest earned	3.5%	0	409	965	1,560	2,114	2,549	4,040	4,606	5,208	5,849	6,531
Cumulative difference		**-3,296**	**12,093**	**28,549**	**46,124**	**62,514**	**75,363**	**119,482**	**136,202**	**154,012**	**172,965**	**193,117**
Assumed index linking			3%	3%	3%	3%	3%	3%	3%	3%	3%	3%
Heat sales p per kWh		**6.00**	**6.18**	**6.37**	**6.56**	**6.75**	**6.96**	**7.60**	**7.83**	**8.06**	**8.31**	**8.55**
Expenditure		**year 14**	**year 15**	**year 16**	**year 17**	**year 18**	**year 19**	**year 22**	**year 23**	**year 24**	**year 25**	
Unit fuel cost p/kWh		4.46	4.60	4.73	4.88	5.02	5.17	5.65	5.82	6.00	6.18	
Total fuel costs		60,706	62,528	64,403	66,335	68,326	70,375	76,901	79,208	81,584	84,032	
Operation & maintenance		40,865	42,091	43,354	44,655	45,994	47,374	51,767	53,320	54,920	56,567	
loan repayments		10,775	10,775	10,775	10,775	10,775	10,775	10,775	10,775	10,775	10,775	
Total expenditure		**112,347**	**115,394**	**118,532**	**121,765**	**125,095**	**128,524**	**139,443**	**143,303**	**147,279**	**151,374**	
Income												
Heat sales		119,871	123,467	127,171	130,986	134,916	138,963	151,849	156,405	161,097	165,930	
Grants												
other funds												
standing charge from WHHA		6,630	6,630	6,630	6,630	6,630	6,630	6,630	6,630	6,630	6,630	
Total income		**126,501**	**130,097**	**133,801**	**137,616**	**141,546**	**145,593**	**158,479**	**163,035**	**167,727**	**172,560**	
Difference this year		14,155	14,704	15,269	15,851	16,451	17,069	19,036	19,732	20,448	21,186	
Interest earned	3.5%	7,255	8,023	8,838	9,702	10,618	11,587	14,842	16,052	17,329	18,677	
Cumulative difference		**214,526**	**237,253**	**261,360**	**286,914**	**313,983**	**342,639**	**438,892**	**474,675**	**512,453**	**552,316**	
Assumed index linking		3%	3%	3%	3%	3%	3%	3%	3%	3%	3%	
Heat sales p per kWh		**8.81**	**9.08**	**9.35**	**9.63**	**9.92**	**10.21**	**11.16**	**11.50**	**11.84**	**12.20**	

Mull simple indicative cashflow district heating												
WESCO inc swimming pool												
		kWh pa	**kWh pa**	**kWh pa**		**kWh pa**	**kWh pa**					
Heatload		**160,000**	**1,090,440**	**1,583,922**		**1,783,922**	**1,853,922**					
Expenditure		**year 1**	**year 2**	**year 3**	**year 4**	**year 5**	**year 6**	**year 7**	**year 10**	**year 11**	**year 12**	**year 13**
Unit fuel cost p/kWh		3.04	3.13	3.22	3.32	3.42	3.52	3.63	3.96	4.08	4.21	4.33
Total fuel costs		4,862	34,128	35,152	36,206	61,009	65,305	67,264	73,502	75,707	77,978	80,317
Operation & maintenance		7,359	16,270	17,758	18,291	26,347	33,352	34,353	37,538	38,664	39,824	41,019
Capital cost		135,170	129,180	90,150	0	148,045	71,470					
loan repayments	0%	2,703	5,287	7,541	7,541	11,242	13,029	13,029	13,029	13,029	13,029	13,029
Total expenditure		**150,094**	**184,865**	**150,600**	**62,038**	**246,643**	**183,156**	**114,646**	**124,069**	**127,400**	**130,831**	**134,365**
Income												
Heat sales		9,600	67,389	100,823	103,848	120,469	128,952	132,821	145,137	149,491	153,976	158,595
Grants for boiler + plant	50%	67,585	64,590	45,075	0	74,023	35,735	0	0	0	0	0
other funds		67,585	64,590	45,075		74,023	35,735					
standing charge to WHHA		2,028	3,276	3,276	3,276	5,538	6,630	6,630	6,630	6,630	6,630	6,630
Total income		**146,798**	**199,845**	**194,249**	**107,124**	**274,052**	**207,052**	**139,451**	**151,767**	**156,121**	**160,606**	**165,225**
Difference this year		-3,296	14,981	43,649	45,086	27,409	23,896	24,805	27,698	28,721	29,775	30,860
Interest earned	3.5%	0	409	1,951	3,597	4,682	5,683	6,750	10,386	11,754	13,208	14,750
Cumulative difference		**-3,296**	**12,093**	**57,693**	**106,376**	**138,468**	**168,047**	**199,602**	**307,116**	**347,592**	**390,575**	**436,185**
Assumed index linking			3%	3%	3%	3%	3%	3%	3%	3%	3%	3%
Heat sales p per kWh		**6.00**	**6.18**	**6.37**	**6.56**	**6.75**	**6.96**	**7.16**	**7.83**	**8.06**	**8.31**	**8.55**
Expenditure		**year 14**	**year 15**	**year 16**	**year 17**	**year 18**	**year 19**	**year 20**	**year 23**	**year 24**	**year 25**	
Unit fuel cost p/kWh		4.46	4.60	4.73	4.88	5.02	5.17	5.33	5.82	6.00	6.18	
Total fuel costs		82,727	85,209	87,765	90,398	93,110	95,903	98,780	107,940	111,178	114,513	
Operation & maintenance		42,250	43,517	44,823	46,167	47,552	48,979	50,448	55,126	56,780	58,483	
loan repayments		13,029	13,029	13,029	13,029	13,029	13,029	13,029	13,029	13,029	13,029	
Total expenditure		**138,005**	**141,754**	**145,616**	**149,594**	**153,691**	**157,910**	**162,257**	**176,094**	**180,986**	**186,025**	
Income												
Heat sales		163,353	168,253	173,301	178,500	183,855	189,371	195,052	213,138	219,533	226,118	
Grants												
other funds												
standing charge to WHHA		6,630	6,630	6,630	6,630	6,630	6,630	6,630	6,630	6,630	6,630	
Total income		**169,983**	**174,883**	**179,931**	**185,130**	**190,485**	**196,001**	**201,682**	**219,768**	**226,163**	**232,748**	
Difference this year		31,978	33,129	34,315	35,536	36,794	38,090	39,425	43,674	45,176	46,723	
Interest earned	3.5%	16,386	18,119	19,954	21,896	23,950	26,122	28,416	36,093	38,937	41,935	
Cumulative difference		**484,548**	**535,796**	**590,065**	**647,497**	**708,242**	**772,454**	**840,295**	**1,067,310**	**1,151,423**	**1,240,081**	
Assumed index linking		3%	3%	3%	3%	3%	3%	3%	3%	3%	3%	
Heat sales p per kWh		**8.81**	**9.08**	**9.35**	**9.63**	**9.92**	**10.21**	**10.52**	**11.50**	**11.84**	**12.20**	

Mull simple indicative cashflow oil fired district heating WHHA buildings only												
		kWh pa	kWh pa			kWh pa	kWh pa					
Heatload		160,000	1,090,440			1,290,440	1,360,440					
Expenditure		**year 1**	**year 2**	**year 3**	**year 4**	**year 5**	**year 6**	**year 7**	**year 10**	**year 11**	**year 12**	**year 13**
Unit fuel cost p/kWh		4.95	5.10	5.25	5.41	5.57	5.74	5.91	6.46	6.66	6.85	7.06
Total fuel costs		7,923	55,619	57,288	59,006	71,924	78,100	80,443	87,902	90,539	93,255	96,053
Operation & maintenance		5,137	12,584	12,962	13,350	19,036	22,204	22,871	24,991	25,741	26,513	27,309
Capital cost		53,770	13,680	0	0	56,330	31,332	0	0	0	0	0
Commercial loan repayment	8%	2,519	3,159	3,159	3,159	6,028	7,624	7,624	7,624	7,624	7,624	7,624
other repayments	0%	2,703	5,287	5,287	5,287	8,988	10,775	10,775	10,775	10,775	10,775	10,775
Total expenditure		**72,052**	**90,330**	**78,696**	**80,803**	**162,306**	**150,034**	**121,712**	**131,292**	**134,679**	**138,167**	**141,760**
Income												
Heat sales		9,600	9,888	10,185	10,490	87,144	94,627	97,466	106,504	109,699	112,990	116,380
Grants for boiler + plant	0%	0	0	0	0	0	0	0	0	0	0	0
Commercial loan	50%	26,885	6,840	0	0	28,165	15,666	0	0	0	0	0
interest free loan	50%	26,885	6,840	0	0	28,165	15,666	0	0	0	0	0
standing charge from WHHA		2,028	3,276	3,276	3,276	5,538	6,829	7,034	7,686	7,917	8,154	8,399
Total income		**65,398**	**26,844**	**13,461**	**13,766**	**149,012**	**132,788**	**104,500**	**114,190**	**117,616**	**121,144**	**124,778**
Difference this year		-6,654	-63,486	-65,235	-67,037	-13,294	-17,247	-17,212	-17,102	-17,063	-17,023	-16,982
Interest earned	3.5%	0	0	0	0	0	0	0	0	0	0	0
Cumulative difference		**-6,654**	**-70,140**	**-135,375**	**-202,412**	**-215,706**	**-232,953**	**-250,165**	**-301,583**	**-318,646**	**-335,670**	**-352,651**
Assumed index linking			3%	3%	3%	3%	3%	3%	3%	3%	3%	3%
Heat sales p per kWh		**6.00**	**6.18**	**6.37**	**6.56**	**6.75**	**6.96**	**7.16**	**7.83**	**8.06**	**8.31**	**8.55**
Expenditure		**year 14**	**year 15**	**year 16**	**year 17**	**year 18**	**year 19**	**year 20**	**year 23**	**year 24**	**year 25**	
Unit fuel cost p/kWh		7.27	7.49	7.72	7.95	8.18	8.43	8.68	9.49	9.77	10.07	
Total fuel costs		98,935	101,903	104,960	108,109	111,352	114,692	118,133	129,087	132,960	136,949	
Operation & maintenance		28,128	28,972	29,841	30,736	31,658	32,608	33,586	36,701	37,802	38,936	
capital cost		0	4,000	4,000	0	0	4,000	4,000	0	0	0	
commercial loan repayment		7,624	7,624	7,624	7,624	7,624	7,624	7,624	7,624	7,624	7,624	
other repayment		10,775	10,775	10,775	10,775	10,775	10,775	10,775	10,775	10,775	10,775	
Total expenditure		**145,461**	**153,273**	**157,199**	**157,243**	**161,409**	**169,699**	**174,118**	**184,186**	**189,160**	**194,283**	
Income												
Heat sales		119,871	123,467	127,171	130,986	134,916	138,963	143,132	156,405	161,097	165,930	
Grants												
Commercial loan												
Capital investment												
standing charge from WHHA		8,651	8,910	9,177	9,453	9,736	10,028	10,329	11,287	11,626	11,975	
Total income		**128,522**	**132,377**	**136,349**	**140,439**	**144,652**	**148,992**	**153,462**	**167,692**	**172,723**	**177,904**	
Difference this year		-16,939	-20,896	-20,851	-16,804	-16,756	-20,707	-20,656	-16,495	-16,438	-16,379	
Interest earned	3.5%	0	0	0	0	0	0	0	0	0	0	
Cumulative difference		**-369,591**	**-390,486**	**-411,337**	**-428,141**	**-444,897**	**-465,604**	**-486,261**	**-535,909**	**-552,347**	**-568,726**	
Assumed index linking		3%	3%	3%	3%	3%	3%	3%	3%	3%	3%	
Heat sales p per kWh		**8.81**	**9.08**	**9.35**	**9.63**	**9.92**	**10.21**	**10.52**	**11.50**	**11.84**	**12.20**	

Appendix 6 NVP spreadsheets

An explanation of these spreadsheets is given in the main text.

Mull District Heating Net Present Value				**Shilling Hill**		**160,000**	**kWh**	**tonnes**	**59.29**	**price/T**	**£82.00**		
WESCO				**Balascate Phase 1**		**200,000**	**kWh**	**tonnes**	**74.11**	**price/T**	**£82.00**		
				Balascate Phase 2		**70,000**	**kWh**	**tonnes**	**25.94**	**price/T**	**£82.00**		
WHHA owned buildings only				**PCC**		**930,440**	**kWh**	**tonnes**	**328.36**	**price/T**	**£82.00**		
Discount factor	**3.50%**		0.97	0.93	0.90	0.87	0.84	0.81	0.78	0.75	0.73	0.41	
		capital cost											
Expenditure		**year 0**	**year 1**	**year 2**	**year 3**	**year 4**	**year 5**	**year 6**	**year 7**	**year 8**	**year 9**	**year 25**	
capital equipment installed		135,170	129,180			148,045	71,470						
fuel costs			4,862	31,788	31,788	31,788	37,865	39,992	39,992	39,992	39,992	39,992	
operation & maintenance			7,359	16,049	16,049	16,049	23,557	29,772	29,772	29,772	29,772	29,772	
Total expenditure			**12,221**	**47,837**	**47,837**	**47,837**	**61,421**	**69,763**	**69,763**	**69,763**	**69,763**	**69,763**	
revenue													
Heat sales	6.00	p/kWh	9,600	65,426	65,426	77,426	81,626	81,626	81,626	81,626	81,626	81,626	
standing charge from WHHA			2,028	3,276	3,276	3,276	5,538	6,630	6,630	6,630	6,630	6,630	
Total income			**11,628**	**68,702**	**68,702**	**80,702**	**87,164**	**88,256**	**88,256**	**88,256**	**88,256**	**88,256**	
cashflow			-593	20,866	20,866	32,866	25,743	18,493	18,493	18,493	18,493	18,493	
Discounted cashflow			**-572**	**19,431**	**18,751**	**28,501**	**21,543**	**14,934**	**14,411**	**13,907**	**13,420**	**7,589**	
NPV			**-135,742**	**-245,491**	**-226,741**	**-198,240**	**-324,742**	**-381,278**	**-366,867**	**-352,960**	**-339,540**	**-178,772**	

Mull District Heating Net Present Value				**Shilling Hill**		**160,000**	**kWh**	**tonnes**	**59.29**	**price/T**	**£82.00**			
				Balascate phase 1		**200,000**	**kWh**	**tonnes**	**74.11**	**price/T**	**£82.00**			
WESCO inc swimming pool				**Balascate phase 2**		**70,000**	**kWh**	**tonnes**	**25.94**	**price/T**	**£82.00**			
				PCC		**930,440**	**kWh**	**tonnes**	**328.36**	**price/T**	**£82.00**			
				pool		**493,482**	**kWh**	**tonnes**	**174.16**	**price/T**	**£82.00**			
Discount factor	**3.50%**		0.97	0.93	0.90	0.87	0.84	0.81	0.78	0.75	0.73	0.44	0.43	0.41
Expenditure	**capital cost**	**year 0**	**year 1**	**year 2**	**year 3**	**year 4**	**year 5**	**year 6**	**year 7**	**year 8**	**year 9**	**year 23**	**year 24**	**year 25**
capital equipment installed		135,170	129,180	90,150		148,045	71,470							
fuel costs			4,862	31,788	46,068	46,068	52,146	54,273	54,273	54,273	54,273	54,273	54,273	54,273
operation & maintenance			7,359	16,049	17,049	17,049	24,557	30,772	30,772	30,772	30,772	30,772	30,772	30,772
Total expenditure			**12,221**	**47,837**	**63,117**	**63,117**	**76,702**	**85,044**	**85,044**	**85,044**	**85,044**	**85,044**	**85,044**	**85,044**
Revenue														
Heat sales	6.00	p/kWh	9,600	65,426	95,035	95,035	107,035	111,235	111,235	111,235	111,235	111,235	111,235	111,235
standing charge from WHHA			2,028	3,276	3,276	3,276	5,538	6,630	6,630	6,630	6,630	6,630	6,630	6,630
Total income			**11,628**	**68,702**	**98,311**	**98,311**	**112,573**	**117,865**	**117,865**	**117,865**	**117,865**	**117,865**	**117,865**	**117,865**
cashflow			-593	20,866	35,194	35,194	35,871	32,821	32,821	32,821	32,821	32,821	32,821	32,821
Discounted cashflow			**-572**	**19,431**	**31,626**	**30,519**	**30,018**	**26,504**	**25,577**	**24,682**	**23,818**	**14,464**	**13,958**	**13,469**
NPV			**-135,742**	**-245,491**	**-304,015**	**-273,495**	**-391,522**	**-436,488**	**-410,911**	**-386,229**	**-362,412**	**-104,511**	**-90,553**	**-77,084**

Mull District Heating Net Present Value					**Shilling Hill**	**160,000**	**kWh**	**litres**	**19,092**	**price/L**	**£0.42**					
Oil fired ESCO NVP					**Balascate Phase 1**	**200,000**	**kWh**	**litres**	**23,865**	**price/L**	**£0.42**					
					Balscate Phase 2	**70,000**	**kWh**	**litres**	**8,353**	**price/L**	**£0.42**					
					PCC	**930,440**	**kWh**	**litres**	**105,739**	**price/L**	**£0.42**					
Discount factor	**3.50%**		0.97	0.93	0.90	0.87	0.84	0.81	0.78	0.75	0.73	0.61	0.59	0.53	0.51	0.41
Expenditure	**capital cost**	**year 0**	**year 1**	**year 2**	**year 3**	**year 4**	**year 5**	**year 6**	**year 7**	**year 8**	**year 9**	**year 14**	**year 15**	**year 18**	**year 19**	**year 25**
capital equipment installed		53,770	13,680	0	0	56,330	31,332	0	0	0	0	4,000	4,000	4,000	4,000	0
fuel costs			7,923	51,805	51,805	51,805	61,709	65,176	65,176	65,176	65,176	65,176	65,176	65,176	65,176	65,176
operation & maintenance			5,137	12,430	12,430	12,430	17,716	20,884	20,884	20,884	20,884	20,884	20,884	20,884	20,884	20,884
Total expenditure			**13,060**	**64,235**	**64,235**	**64,235**	**79,425**	**86,059**	**86,059**	**86,059**	**86,059**	**86,059**	**86,059**	**86,059**	**86,059**	**86,059**
revenue																
Heat sales	6.00	p/kwh	9,600	65,426	65,426	65,426	77,426	81,626	81,626	81,626	81,626	81,626	81,626	81,626	81,626	81,626
standing charge from WHHA			2,028	3,276	3,276	3,276	5,538	6,630	6,630	6,630	6,630	6,630	6,630	6,630	6,630	6,630
Total income			**11,628**	**68,702**	**68,702**	**68,702**	**82,964**	**88,256**	**88,256**	**88,256**	**88,256**	**88,256**	**88,256**	**88,256**	**88,256**	**88,256**
cashflow			-1,432	4,467	4,467	4,467	3,540	2,197	2,197	2,197	2,197	2,197	2,197	2,197	2,197	2,197
Discounted cashflow			**-1,382**	**4,160**	**4,014**	**3,874**	**2,962**	**1,774**	**1,712**	**1,652**	**1,595**	**1,334**	**1,288**	**1,157**	**1,117**	**902**
NPV			**-55,152**	**-64,672**	**-60,658**	**-56,784**	**-110,151**	**-139,708**	**-137,996**	**-136,344**	**-134,749**	**-127,576**	**-130,288**	**-130,689**	**-133,573**	**-131,648**

Mull District Heating Net Present Value WHHA											
Wood fired											
Discount factor	**3.50%**	0.97	0.93	0.90	0.87	0.84	0.61	0.59	0.53	0.51	0.41
	capital cost										
Expenditure	**year 0**	**year 1**	**year 2**	**year 3**	**year 4**	**year 5**	**year 14**	**year 15**	**year 18**	**year 19**	**year 25**
capital equipment i	51,520	10,720	0	0	57,465	27,742					
standing charge from WHHA		2,028	3,276	3,276	3,276	5,538	6,630	6,630	6,630	6,630	6,630
Total expenditure		**2,028**	**3,276**	**3,276**	**3,276**	**5,538**	**6,630**	**6,630**	**6,630**	**6,630**	**6,630**
Income											
		0									
Total income		**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
cashflow		-2,028	-3,276	-3,276	-3,276	-5,538	-6,630	-6,630	-6,630	-6,630	-6,630
Discounted cashflow		**-1,957**	**-3,051**	**-2,944**	**-2,841**	**-4,634**	**-4,026**	**-3,885**	**-3,491**	**-3,369**	**-2,721**
NPV		**-53,477**	**-67,248**	**-70,192**	**-73,033**	**-135,131**	**-204,836**	**-208,721**	**-219,580**	**-222,949**	**-240,828**
Electric boiler heating											
Discount factor	**3.50%**	0.97	0.93	0.90	0.87	0.84	0.61	0.59	0.53	0.51	0.41
	capital cost										
Expenditure	**year 0**	**year 1**	**year 2**	**year 3**	**year 4**	**year 5**	**year 14**	**year 15**	**year 18**	**year 19**	**year 25**
capital equipment i	78,000	17,000	0	0	87,000	42,000	57,200	18,700	63,800	30,800	0
servicing & repairs		2,600	4,200	4,200	4,200	7,100	8,500	8,500	8,500	8,500	8,500
Total expenditure		**2,600**	**4,200**	**4,200**	**4,200**	**7,100**	**8,500**	**8,500**	**8,500**	**8,500**	**8,500**
Income											
		0									
Total income		**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
cashflow		-2,600	-4,200	-4,200	-4,200	-7,100	-8,500	-8,500	-8,500	-8,500	-8,500
Discounted cashflow		**-2,509**	**-3,911**	**-3,774**	**-3,642**	**-5,941**	**-5,162**	**-4,981**	**-4,476**	**-4,320**	**-3,488**
NPV		**-80,509**	**-101,420**	**-105,194**	**-108,837**	**-201,778**	**-297,577**	**-359,758**	**-392,379**	**-460,499**	**-514,220**

Appendix 7 Running cost calculators

	Shilling Hill			
oil				
boiler efficiency	90%			
required heat output per year	160,000	kWh		
plus 5% losses in pipework	8,000	kWh		
total heat output	168,000	kWh		
net calorific value	0.035	GJ/litre	9.78	kWh/litre
estimated fuel consumption	19092	litres	186,667	kWh
price per litre of oil	41.5	p/litre		
oil cost per year	**7923.29**	**£**		
price of fuel per kWh	4.95	p/kWh		
estimated O&M cost pa	5137.00	£		
total cost	**13060.29**	**£**		
cost per kWh inc maintenance	**8.16**	**p/kWh**		

	Balascate Phase 1			
oil				
boiler efficiency	90%			
required heat output per year	200,000	kWh		
plus 5% losses in pipework	10,000	kWh		
total heat output	210,000	kWh		
net calorific value	0.035	GJ/litre	9.78	kWh/litre
estimated fuel consumption	23865	litres	233,333	kWh
price per litre of oil	41.5	p/litre		
oil cost per year	**9904.11**	**£**		
price of fuel per kWh	4.95	p/kWh		
estimated O&M cost pa	5285.50	£		
total cost	**15189.61**	**£**		
cost per kWh inc maintenance	**7.59**	**p/kWh**		

	PCC			
oil				
boiler efficiency	90%			
estimated boiler output per year	930,440	kWh		
net calorific value	0.035	GJ/litre	9.78	kWh/litre
estimated fuel consumption	105739	litres	1,033,822	kWh
price per litre of oil	41.5	p/litre		
oil cost per year	**43881.81**	**£**		
price of fuel per kWh	4.72	p/kWh		
estimated O&M cost pa	7293.00	£		
total cost	**51174.81**	**£**		
cost per kWh inc maintenance	**5.50**	**p/kWh**		

	Balascate Phase 2			
oil				
boiler efficiency	90%			
required heat output per year	70,000	kWh		
plus 5% losses in pipework	3,500	kWh		
total heat output	73,500	kWh		
net calorific value	0.035	GJ/litre	9.78	kWh/litre
estimated fuel consumption	8353	litres	81,667	kWh
price per litre of oil	41.5	p/litre		
oil cost per year	**3466.44**	**£**		
price of fuel per kWh	4.95	p/kWh		
estimated O&M cost pa	3168.00	£		
total cost	**6634.44**	**£**		
cost per kWh inc maintenance	**9.48**	**p/kWh**		

Mull Shilling Hill		
running cost calculator		
Woodchips		
moisture content	30	% mc
calorific value	12	GJ/tonne
boiler seasonal efficiency	85%	
boiler output inc efficiency	2,834	kWh/tonne
required heat output per year	160,000	kWh
plus 5% losses in pipework	8,000	kWh
total heat output	168,000	kWh
woodchip consumption	208	cu m
woodchip consumption	59.29	tonnes
delivered cost of woodchips	82.00	£/tonne
woodchip cost per year	£4,862	
cost of fuel per delivered kWh	3.04	p/kWh
estimated O&M cost	£7,359	
Total cost inc O&M	**£12,221**	
cost per kWh inc maintenance	**7.64**	**p/kWh**

	PCC	
Woodchips		
moisture content	30	% mc
calorific value	12	GJ/tonne
boiler seasonal efficiency	85%	
boiler output inc efficiency	2,834	kWh/tonne
required heat output per year	930,440	kWh
plus 5% losses in pipework	0	kWh
total heat output	930,440	kWh
woodchip consumption	1149	cu m
woodchip consumption	328.36	tonnes
delivered cost of woodchips	82.00	£/tonne
woodchip cost per year	£26,926	
cost of fuel per delivered kWh	2.89	p/kWh
estimated O&M cost	£8,690	
Total cost inc O&M	**£35,616**	
cost per kWh inc maintenance	**3.83**	**p/kWh**
heating demand PCC	877235	kWh pa
heating demand 3 staff houses	19000	kWh pa
hot water @ 35L per person per day	34205	kWh pa
Total	**930440**	**kWh pa**

Mull Balascate Phase 1		
running cost calculator		
Woodchips		
moisture content	30	% mc
calorific value	12	GJ/tonne
boiler seasonal efficiency	85%	
boiler output inc efficiency	2,834	kWh/tonne
required heat output per year	200,000	kWh
plus 5% losses in pipework	10,000	kWh
total heat output	210,000	kWh
woodchip consumption	259	cu m
woodchip consumption	74.11	tonnes
delivered cost of woodchips	82.00	£/tonne
woodchip cost per year	£6,077	
cost of fuel per delivered kWh	3.04	p/kWh
estimated O&M cost	£7,508	
Total cost inc O&M	**£13,585**	
cost per kWh inc maintenance	**6.79**	**p/kWh**

Mull Balascate Phase 2		
running cost calculator		
Woodchips		
moisture content	30	% mc
calorific value	12	GJ/tonne
boiler seasonal efficiency	85%	
boiler output inc efficiency	2,834	kWh/tonne
required heat output per year	70,000	kWh
plus 5% losses in pipework	3,500	kWh
total heat output	73,500	kWh
woodchip consumption	91	cu m
woodchip consumption	25.94	tonnes
delivered cost of woodchips	82.00	£/tonne
woodchip cost per year	£2,127	
cost of fuel per delivered kWh	3.04	p/kWh
estimated O&M cost	£6,215	
Total cost inc O&M	**£8,342**	
cost per kWh inc maintenance	**11.92**	**p/kWh**

Swimming pool etc				
info from Sam Sedgewick Crannich				
Oil boiler				
boiler efficiency	90%			
estimated boiler output per year	493,482	kWh		
calorific value	0.041	GJ/litre	11.38	kWh/litre
estimated oil consumption	48193	litres	548313.25	kwh
price per litre of oil	41.5	p/litre		
oil cost per year	**20,000.00**	**£**		
price of fuel per kWh	4.05	p/kWh		
estimated O&M cost pa	1000.00	£		
total cost	**21000.00**	**£**		
cost per kWh inc maintenance	**4.26**	**p/kWh**		
carbon dioxide savings for oil	**137.08**	**tonnes CO2**		
Woodchips				
moisture content	30	% mc		
calorific value	12	GJ/tonne		
boiler seasonal efficiency	85%			
boiler output inc efficiency	2,834	kWh/tonne		
required heat output per year	493,482	kWh		
woodchip consumption	610	cu m		
woodchip consumption	174.16	tonnes		
delivered cost of woodchips	82.00	£/tonne		
woodchip cost per year	£14,281			
cost of fuel per delivered kWh	2.89	p/kWh		
estimated O&M cost	£1,000			
Total cost inc O&M	**£15,281**			
cost per kWh inc maintenance	**3.10**	**p/kWh**		

Appendix 8 Scottish Hydro charges

Scottish Hydro Economy 10		
price from Paul Phare		
1 bed flat		
required output at cheap rate	2775	kwh
required output at standard day rate	925	kwh
unit cost at off peak	4.7	p/kWh
unit cost at standard day rate	10.2	p/kWh
daily rate	18.9	p/kWh
Total cost of electricity	**293.76**	**£**
average cost per kWh	**7.94**	**p/kWh**
2 bed semi		
required output at cheap rate	5025	kwh
required output at standard day rate	1675	kwh
unit cost at off peak	4.7	p/kWh
unit cost at standard day rate	10.2	p/kWh
daily rate	18.9	p/kWh
Total cost of electricity	**476.01**	**£**
average cost per kWh	**7.10**	**p/kWh**
3 bed detached		
required output at cheap rate	7425	kwh
required output at standard day rate	2475	kwh
unit cost at off peak	4.7	p/kWh
unit cost at standard day rate	10.2	p/kWh
daily rate	18.9	p/kWh
Total cost of electricity	**670.41**	**£**
average cost per kWh	**6.77**	**p/kWh**