Wood Energy and Community Enterprise:

A Guide

WDC
WESTERN DEVELOPMENT COMMISSION
COIMISIÚN FORBARTHA AN IARTHAIR

What is a community enterprise?

Community enterprise refers to enterprises that are community owned and controlled legal entities, e.g. co-operatives and companies limited by guarantee. Typically these enterprises aim to support their community members to develop new initiatives, manage commercial and social projects, and run local commercial businesses. There is no one form or function that community enterprise takes, rather it is better described as a particular approach and ethos for getting things done with typical core aims being: to create and hold wealth for the community; to create social and economic benefit for the community; to empower and create confidence of members; and to provide resources to the community members in order that they may establish their own activities and gain benefit.

Contents

A project by the Western Development Commission and Údarás na Gaeltachta

Abbreviations

CHP	Combined Heat and Power
CO_2	Carbon Dioxide
ESCO	Energy Services Company/Contract
kW_e	Kilowatts of electrical power
kW_{th}	Kilowatts of thermal heat
LPG	Liquid Petroleum Gas
MC	Moisture Content
MW_e	Megawatts of electrical power
MWh	Megawatt hour
MW_{th}	Megawatts of thermal heat
ODT	Over Dried Tonne
SEI	Sustainable Energy Ireland
WDC	Western Development Commission

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SOME EXPLANATIONS

What is biomass energy?

Biomass fuels provide 'bioenergy' and refer to fuel sources such as:

- wastes streams including residues from forestry and related industries
- recycled wood
- agricultural residues, manures and agrifood effluents
- the organic fraction of municipal solid waste
- separated household waste and sewage sludge
- purpose grown energy crops including short rotation forestry, miscanthus grass, etc

What is a kW or MW?

The kilowatt-hour (kWh) is the amount of energy used by a 1,000 watt appliance in one hour. 1,000 watt-hours = 1 kilowatt-hour (kWh); 1,000 kilowatt-hours = 1 megawatt-hour (MWh). For example a 2.5 kW appliance e.g. electric fire operating for two hours will consume 5 kWh.

Overview

This guide was published to share the information gathered during the joint project of the Western Development Commission and Údarás na Gaeltachta on community enterprise opportunities in the wood energy sector. The project established that community enterprises have the potential to act as significant drivers of development in the sector. Community groups and enterprises typically have the required community network and expertise to bring potential wood fuel producers, e.g. private forest owners, and heat users, e.g. local industries, hotels, together, and thereby progress the development of wood energy installations. The project involved consultation with community co-operatives in the Gaeltacht area and a review of relevant projects from EU countries.

In the wood energy sector the main community enterprise opportunities are in the supply of woodchip fuel to commercial, industrial and public sector heat users. In simple terms community enterprises could produce and sell wood fuel or organise the installation and operation of woodchip boiler systems. They could also do both at the same time and this may well offer the most practical approach, especially if they can identify local partners who are willing to consider conversion to wood fuel heating.

This introductory guide on wood energy is of interest to local community and development groups, and the support agencies and organisations that work with them. It is hoped that the guide will provide direction to communities who wish to assess if the wood energy sector presents their locality and its members with potential enterprise options.

The guide looks at the following topics:

- wood energy fuels and markets, and identifies the wood heat market as the main opportunity for community enterprise
- woodchip fuel production costs, and woodchip fuel costs as compared to the costs of different fossil fuels
- the basic models for the production and sale of wood fuels namely a woodchip supply contract, a wood heat supply agreement and energy services contracts
- wood heat technology and issues to consider in regard to woodchip installations
- three examples of woodchip heat systems including a hotel, a secondary school and an energy services contract
- community enterprise options along the woodchip fuel supply chain and the main issues to consider
- key questions to answer when assessing the potential for a wood energy project in your community

The development of a wood energy business by a community company or co-operative will not follow a single model and the opportunities are dependent on a set of factors specific to that community, including: the potential local fuel resource; profile of the local heat market; and capacity of the group itself to progress with enterprise development. Each community will have to identify and design an enterprise suitable to their conditions and profile.

Communities will need an appropriate framework of support to realise the enterprise opportunities and enter the wood energy sector. Within Europe **the public sector** such as local authorities, have played a significant role in actively supporting community enterprise. The WDC *Wood Energy Strategy and Action Plan* presents a framework through which to support community enterprise development to progress the wood energy sector.

1.0 Introduction

The Western Region[1] has abundant natural resources with significant potential for the development of the renewable energy sector. The Western Development Commission[2] (WDC) has been working to identify how the value of these resources to address regional and national energy needs can best be captured. Wood fuel as an energy source has considerable potential in the Western Region. The region has 40% of Ireland's afforested land, forestry thinnings and residues being a potentially major source of woodchip fuel.

This guide presents basic information about wood energy markets and the supply chain for woodchip fuel. It is based on the findings of a project by the WDC and Údarás na Gaeltachta[3]. This project assessed the wood energy enterprise opportunities for community co-operatives in the Gaeltacht area and was a recommended action under the *Wood Energy Strategy and Action Plan, (WDC, 2007)*[4]. The full project report *Wood Energy Development through Community Enterprise Models* is available for download at www.wdc.ie

This guide is intended as a practical overview on the wood energy sector for community groups and enterprises who wish to assess if the sector presents their locality with potential enterprise opportunities.

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1 The Western Region consists of counties Donegal, Sligo, Leitrim, Roscommon, Mayo, Galway and Clare.

2 The WDC was established as a statutory agency in 1999, with responsibility for promoting economic and social development in the Western Region.

3 Údarás na Gaeltachta is the regional authority responsible for the economic, social and cultural development of the Gaeltacht.

4 The full *Wood Energy Strategy and Action Plan* is available for download at www.wdc.ie

2.0 Wood energy sector

2.1 Wood energy in context

Across Europe over 65%, (Eurostat 2006) of all renewable energy used is derived from biomass, with wood fuels being the dominant fuel in the biomass sector. In Ireland, biomass provides the majority (nearly 68%) of the renewable energy used and as in Europe, wood energy dominates the biomass sector. The *Bioenergy Action Plan*[5] *(2007)* sets an ambitious national renewable heat target of 12% of the energy market by 2020. By growing the wood energy sector, the Western Region would be aligned with international market trends, be able to adopt commercialised technology and support national energy policy.

The Western Region contains a sustainable and growing resource of wood fuel in its large private forest estate[6]. The emergence of a wood energy market would be beneficial to the forest sector, creating new enterprise and market opportunities based on this sustainable local energy resource. The WDC's *Wood Energy Strategy and Action Plan* estimated that if wood fuel supplied 11% of the regional heat market, by 2020 over 900 jobs would be created, €15 million per annum would be added to the regional economy and CO_2 emissions would be reduced by over 600,000 tonnes per annum[7].

2.2 Wood fuel resource

In EU countries the majority of wood fuel is sourced from commercial forestry. In the Western Region the predominance of young conifers indicates that much of the harvest in the next 20 years or so will be for the smaller diameter (and lower value) markets. This forestry will only be harvested if the existing or new wood markets demand it. The forests can to some extent remain un-harvested.

In the Western Region the estimated sustainable harvest from private forestry of pulpwood and related supply of co-product is forecast to be 516,000 tonnes per annum by 2020[8]. The transport costs associated with moving this wood to the distant existing markets impacts negatively on the economic viability of carrying out harvesting operations. The problem is further compounded by the small plantation sizes in the region, resulting in proportionately higher harvesting costs[9]. The emergence of a local wood energy market would provide the growers with a solution to these problems of distant markets and small plantations. Wood energy would be produced from low value small diameter wood, processing it in a purpose made fuel wood chipper and selling it to local energy customers. This would avoid transport to distant markets and if forest owners worked together to pool smaller plantations into clusters the costs of harvesting and production could be reduced.

Wood pellets are also a viable wood fuel source, however, the production of wood pellets typically requires large volumes of sawdust feedstock and large scale investment in a pellet mill. The difficulties of accessing sawdust and the high investment costs would be likely to preclude community enterprises from becoming involved in fuel supply in this area.

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5 The Bioenergy Action Plan is available from the Department of Communications, Energy and Natural Resources. www.dcenr.gov.ie

6 The region has 40% of the national forestry, with 11.5% of the region under forestry.

7 For further information see the Wood Energy Strategy and Action Plan available for download at www.wdc.ie

8 For further information see the Wood Energy Strategy and Action Plan available for download at www.wdc.ie. In the strategy only private sector forestry and its co-products have been considered in the resource estimate. It is acknowledged that over time new fuel streams will increase e.g. potential of energy crops.

9 Plantations of 10 hectares or less make up 30,671 hectares, with an average size of 5.8 hectares. This is estimated to be approximately half the total private resource.

2.3 Wood fuel markets

1. Power generation for renewable electricity

Straight power generation from biomass involves significantly large scale investment and is almost always in the form of using waste streams as the fuel input, although wood can be part of the fuel mix. These are commonly referred to as 'waste to energy' projects. Domestic and commercial refuse, animal and food wastes[10] are all used as fuel for power generation. The scale and complexities of this market suggest that there would not appear to be any scope for community enterprises to become involved in fuel supply in this area.

2. Combined Heat and Power (CHP)[11]

In conventional electricity generation, heat is produced as a by-product and usually released into the atmosphere as a waste. CHP systems channel this extra heat to useful purposes so that usable heat and electricity are generated in a single process. CHP usually involves the burning of fossil fuels, but heat and electricity are also produced from wood biomass (including biogas and waste). Like power generation, most CHP projects are large in scale and cost.

In Ireland, small scale biomass CHP appears to be commercially challenging and the limited availability of commercialised technology under 5MW (electrical) is evidence that this sector has not been well developed to date. There are some indications that policy and prices are creating opportunities for smaller scale CHP and this may be an area where community enterprise could play a role in the longer term.

3. Co-firing

The national target for co-firing biomass fuels in peat fired power stations is set at 30% of fuel input by 2015[12]. Millions of tonnes of fuel will be required to service this market. There are no peat plants in the Western Region therefore it is unlikely for there to be any scope for community enterprises to become involved in fuel supply in this area.

4. Wood heating

In Ireland, the heat market is the largest single use of energy. Wood fuel heating systems are an alternative to either oil, liquid petroleum gas (LPG), coal or gas fired heating systems. They can operate as independent boilers or installed in series with fossil fuelled boilers. Most of the boilers are fully controllable and automatic, and can be seamlessly incorporated into new or existing buildings' heating systems. Wood heat systems can run on pellets or woodchips.

Wood heating systems are significantly more expensive to install than fossil heating systems. However, they are much cheaper to operate as the cost of wood fuel is lower than fossil fuels. For commercially viable paybacks to be achieved, the price of wood fuel must be significantly lower than fossil fuel prices. Wood heating will gain market share where fuel savings justify the capital investment. Therefore it is only typically financially viable for larger heat users such as hospitals, leisure centres, schools, offices, retail outlets, industrial and commercial sites. Large heat users can also include district heating systems where separate buildings are connected to and heated by one central boiler through an underground piping network.

[10] Often mixed with fossil fuels such as coal.

[11] For further information on CHP see the report *Assessment of biomass CHP market potential in the Western Region* available for download at www.wdc.ie.

[12] This target appears to be based upon the technical capacity of the plants to accommodate biomass fuels without significant investment.

2.4 Wood heat market – an opportunity for community enterprise

The WDC/Údarás na Gaeltachta project identified the enterprise opportunities associated with woodchip production for supply into the commercial/industrial heat market as the most appropriate market for community enterprise. This guide examines the relevant market and fuel issues, and discusses the enterprise opportunities presented by the woodchip heat sector.

In summary, there are five main reasons why the woodchip heat market is suitable for community enterprise.

- As explained earlier, the power generation, CHP and co-firing markets require large scale capital investment, deal with high volumes of wood fuel and are typically complex in terms of technology, financial package and project management. These markets are more suited to large scale developers and energy utilities.
- The commercial/industrial heat market is the **most economically viable market segment** at present, i.e. boilers > 50kW. This market is readily suited to the use of woodchip based heating systems. The domestic market using log and pellets is presently not as economically attractive as the commercial/industrial user.
- The economic viability of the heat market is based on **local demand and supply loops**; typically woodchip fuel is not transported more that 40km from source to end user.
- The fuel volumes of the commercial/industrial heat market are of a **scale** more suited to local enterprise development where the investment and technical requirements are more readily accessible to community enterprises.
- Woodchip fuel derived from forestry resources is a more readily **accessible fuel stream** for community enterprises and requires moderate levels of investment. Wood pellet production is a more capital intensive production process and requires access to sawdust feed stocks.

3.0 Wood fuel pricing

Commercially viable paybacks are achieved with wood heat systems due to the price of wood fuel being lower than fossil fuels; these issues are discussed in this section.

3.1 Wood fuel production costs

The price of wood fuel is based on a series of costs. These comprise: the costs of harvesting, chipping, haulage and the need for forest owners and contractors involved in harvesting and chipping to secure a reasonable profit. The following range of prices for pulpwood would allow the first thinning to be undertaken on a commercially attractive basis in the region. (Prices are based on woodchip at 50% moisture content [MC]).

price to grower	**= €1.5 to €5 per tonne at 50% MC**
harvesting costs	**= €23 to €34 per tonne at 50% MC**
haulage to wood fuel process depot	**= €6 to €10 per tonne at 50% MC**
chipping into energy fuel	**= €7 to €10 per tonne at 50% MC**
haulage to boiler	**= €6 to €10 per tonne at 50% MC**
overheads and admin costs	**= €8 to €10 per tonne at 50% MC**

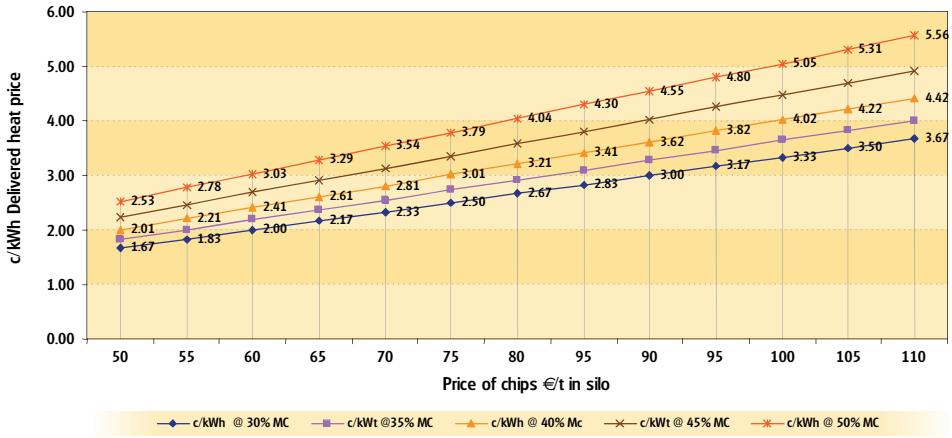
Overall it is possible to conclude that a price for delivered woodchip fuel in the range of €51.50 to €79.00 per tonne would make it commercially viable to undertake harvesting[13]. The actual price of delivered woodchip fuel would always need to be estimated on a case-by-case basis. The specification of the required fuel, the volumes required, the term of the supply contract and the delivery distance will all have significant impacts on the actual contract price.

In terms of the selling price, moisture content of woodchip is a critical factor. The drier the wood fuel the greater its energy content. The following table illustrates the cost of heat for differing wood fuel moisture contents at differing prices per tonne of woodchips[14].

[13] These price estimates were based on market conditions in September 2008.

[14] The analysis is based on market information complied by DARE Ltd from tenders during 2007 and 2008.

Delivered heat price at heat meter



As moisture content is a key factor, the purchase of woodchips is typically based on what is termed 'over dried tonne' (ODT). This means that fuel is purchased based on its energy content. For instance, one tonne of woodchips at 60% moisture content contains much less energy than one tonne of woodchips at 30% moisture content. Therefore, and as shown by the table above, the lower the moisture content, the higher the energy content and the higher the price. While woodchip fuel will always have some level of moisture, fuel buyers agree to a woodchip fuel price based upon the weight of fuel as if it was being supplied with no moisture content, i.e. ODT.

3.2 Market prices of fuels

A further price factor is the cost of competing fuels. The table below shows the prices of different fuels[15].

Comparative fuel costs 2007

Fuel	Cost of delivered heat in cents\kWh
electricity	6.8 to 14 cents
LPG	7.8 to 8 cents
oil at 54 cents litre	5.3 cents
gas	3.4 to 4.6 cents
wood at €55.5\tonne	2.8 cents
wood at €75\tonne	3.8 cents
wood (typical market price)	3.2 cents

For a community enterprise seeking to enter the wood energy market, volatility in the oil price does not necessarily create an exact market impact. Some energy users will be attracted to the price stability afforded by wood fuels; however, some energy users may feel unable to invest in wood energy until they feel they can predict the longer term cost of staying with oil (as this affects the payback they would achieve).

Ultimately however, if the price of oil heating is high, the market for wood energy will be strong. Higher oil prices do create better conditions for a community enterprise entering the market as a supplier of fuel or equipment.

[15] This table is based upon the *Fuel Cost Analysis Report* by Enercomm International Consultants Ltd for WDC, October 2007. The prices shown are based upon commercial and industrial purchasers of oil, gas, LPG and electricity. It is likely that the price for smaller commercial and domestic energy users will be higher.

4.0 Fuel supply options

There are three basic models for the production and sale of wood fuels. These are the options to consider when reviewing potential community enterprises in the wood energy sector.

1. A simple woodchip supply contract

In this model the customer owns and maintains the wood fired boiler plant and purchases wood fuel similar to how they would purchase oil. As described earlier, woodchips are bought by per oven-dried tonne (ODT) at a fixed price per ODT. The fuel would need to comply with the boiler's warranties in terms of chip dimensions, moisture content and being free from contamination. Generally, wood fuel purchasers seek supply contracts where the supplier delivers fuel to an agreed price per ODT over a 12 to 36 month period. Presently the market seems able to offer a fuel index of approximately 4% to 5% per annum over a typical three year supply contract.

2. A wood heat supply agreement

In this model, the customer owns and maintains the wood fired boiler plant and a wood heat supplier provides the fuel. In this case, the customer pays for heat used (heat tariff in € per kWh is measured at the heat meter). In some cases there is also a standing charge for the fuel supplier to maintain the plant.

This model can be varied to suit the customers' needs in regard to the term of the contract and the extent to which maintenance is carried out. Typically one to three year deals are offered and this appears to be the most attractive option for both suppliers and users. For energy users, the main advantage is that the purchase of fuel is simplified as they see what they are paying for, the energy used, and avoid the need to monitor the volume, weight and moisture content of the fuel loads. For suppliers, it creates an incentive to deliver good quality and consistent fuel, as this maximises the energy the fuel provides through the boiler. It also gives the supplier the choice about how to prepare and deliver their fuel.

3. An Energy Services Contract (ESCO)[16]

This model is different from the two other options as the fuel supplier also supplies the woodchip boiler. The supplier finances, owns and operates a wood fuel boiler plant on behalf of the energy customer. There is a higher heat tariff (or a separate fixed finance charge) to allow for payback of the capital cost of the boiler plant. In this model, the customer avoids any upfront capital cost. This model typically suits customers who cannot finance the heating plant and where operational savings are a lower priority. This model requires great confidence on behalf of the supplier that the wood heat customer is reliable, long term and will still be purchasing heat in five to ten years.

[16] The ESCO model is looked at in more detail in the report *Wood Energy Market Development through Community Enterprise Models* available for download at www.wdc.ie.

5.0 Wood heat technology

Wood heat technology can be categorised based on the fuel used, scale of heat generated and market application[17]. The main categories are:

- log boilers – domestic and small scale applications with range of approximately 10kW to 60kW
- pellet central heating boilers - generally for single buildings such as large houses or small offices with some potential to serve small district heating systems, with range of approximately 10kW to 150kW
- woodchip boilers for larger applications – all commercial/industrial and large scale public sector applications in the range of 50kW to 5000kW

The following section discusses woodchip technology for commercial, industrial and large scale public sector heat users as these are the markets of relevance to community enterprise development.

5.1 Woodchip heat systems

A typical woodchip energy system is comprised of a boiler, accumulator tank, controls and a fuel store containing a mechanical device to automatically move chips to the feed auger (this is usually a stirrer). Automated woodchip boilers are usually only available in sizes > 40kW, i.e. most applications are in the commercial/industrial and public sector heat sectors.

Fuel storage is a key issue for users. Less reloading of fuel is required the larger the fuel store. A fully automated system typically has a fuel store of at least twice the size of the delivery vehicle (delivery vehicle loads in the range of six to 20 tonnes are typically available) to give the fuel supplier reasonable flexibility in timing of fuel deliveries and to ensure the supplier can deliver full loads.

Woodchip systems less than approximately 500kW are usually purchased pre-fabricated and fully installed in shipping containers. They come with all components, including a fuel silo. All that is required is that they are placed onto a concrete plinth, plumbed in and connected with mains power. Such systems tend to be less expensive than those constructed onsite as most of the works can be completed in factory conditions. However, they do not necessarily provide the optimum solution in terms of the fuel storage. The fuel must be delivered into the silo from above using a blower, conveyor, clam-grab arm or other arrangement. This is time consuming and less efficient than direct tipping of fuel into an underground silo.

5.2 Sizing of boilers – heat loads

Well-specified woodchip systems will operate automatically and with the same degree of usability as fossil fuel boilers. However, because they use a solid fuel their operation and design is different to oil or gas systems. Fossil fuel boilers can respond quickly to changes in demand for heating. Wood boilers cannot reach full output quickly and operate less efficiently if the heating load has frequent peaks and troughs, i.e. frequent swings between high and low heat demand. If woodchip boilers operate less efficiently, due to a variable load, they will use more wood fuel, reducing the operational costs saved by switching fuels.

To overcome the factor of variable loads, woodchip boilers are fitted with a large hot water storage tank. This allows the wood boiler to charge the hot water tank and provide hot water to smooth the load on the boiler. This has the further advantage of allowing the sizing of the wood boiler to be based on the average annual heat

[17] For further information see the report *Wood Energy Market Development through Community Enterprise Models* available for download at www.wdc.ie.

load and not the peak load, i.e. maximum heat demand possible. This means the boiler will be smaller and less expensive to install.

This characteristic of woodchip boilers means that buildings with high, stable heat loads, e.g. swimming pools, tend to show a quicker return on the investment.

Woodchip systems can be installed in a new build project or retro-fitted into an existing building that already has gas or oil boilers. There is usually an advantage in retro-fitting because it means the existing boilers can be retained to provide a back-up system and to provide 'peak load' heat. This would help manage modulating demand on the woodchip system.

If a woodchip system is being installed in a new build situation it is usual to install a stand-by fossil fuel boiler at the same time. This replicates the situation in retro-fit where the existing boiler performs a peak load and back-up role.

5.3 Types of boilers – fuel characteristics

There is an enormous variety of wood boilers on the market[18]. Most are fully automated and have sophisticated controls. Specifying the correct mix of features and selecting the best supplier is a specialist task. In principal there are two basic choices:

- an underfed hearth system
- a moving grate system

Underfed hearth systems tend to be smaller and less expensive. They can only use wood fuel up to 35% moisture content as there is no system of pre-drying prior to combustion. For most systems under approximately 500kW it is usually more cost effective to select underfed hearth boilers.

Moving grate designs shunt wood fuel along the combustion chamber and allow it to be dried prior to combustion. This means the boilers are larger and slightly more expensive. However, this allows the use of 'wetter' fuels with up to 55% moisture content possible in some boiler models.

For any user it is critical to investigate the availability and characteristics of fuels locally before selecting a boiler system. While moving grate designs allow greater choice of fuel suppliers, they do require a higher capital investment. Such issues must be assessed as part of a feasibility study for a wood energy system.

[18] Lists of installers are available on such websites as www.sei.ie and www.ccwep.ie.

6.0 Examples of woodchip heat systems

The most viable wood heat markets for community enterprise are small to medium scale woodchip heating systems (> 50kW) with typical applications including but not limited to:

- large hotels
- care homes
- hospitals
- leisure centres
- secondary schools
- shopping centres
- airports
- commercial glasshouses
- cement and chemical works
- large offices

In these markets woodchip systems can potentially achieve payback within two years and currently the typical payback tends to be within three to four years. The following section presents three examples of woodchip installations in a hotel, a secondary school and an energy services contract.

6.1 A large hotel

This example is based upon an actual hotel in the Western Region in 2007. It illustrates the economic and market conditions that positions the commercial\industrial heat user as a key market segment for the region.

Fuel costs

The hotel's cost of heating with gas was approximately €110,000 per annum. It was this gas bill that was to be directly replaced with cheaper wood fuel. The wood boiler was sized so that the existing gas boilers were retained as back-up for infrequent peak loads (such as on very cold days with high hotel occupancy). This avoided the need to size the wood boiler on the peak load and thereby reduced the capital cost of the system. It was assumed that 90% of the gas use was replaced by wood fuel use. The future heat energy bills of the hotel were estimated as follows:

- €11,000 per annum on gas use for peak load top-up via the two main existing plants
- €43,750 per annum on wood fuel based upon a fuel requirement of 625 tonnes per annum at €70 per tonne delivered[19]

This estimate indicated that conversion to a wood fuel system would result in an annual total gas and wood fuel bill of €54,750. When compared to a current gas bill of €110,000, the annual saving was €55,250. As the cost of gas rises the annual savings would increase.

Boiler costs

An approximately 500kW rated wood fired system was needed to meet 90% of the hotel's heat load. The total estimated installed cost was €230,000. The boiler costs less than €100,000, and the storage silo, civil engineering and plumbing costs represented the larger proportion of the capital cost. The SEI[20] capital grant of 30% for eligible costs was estimated at €52,500, and thereby reduced the total capital cost to €177,500. This cost estimate was based upon a turn-key solution where a specialist wood energy installer would undertake the complete work.

Payback

With an annual saving of €55,250, the simple payback was estimated at 3.2 years excluding the cost of finance.

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19 Approximately 2,200,000 kWh per annum being replaced with wood fuel.

20 Information on SEI's grant programmes is available at www.sei.ie.

6.2 A secondary school

This example is an actual 2008 assessment of technical and commercial options for installing a wood energy heating system at a secondary school with approximately 550 pupils.

Fuel costs

The school used LPG to generate heat for hot water and space heating. The school had annual use of 45,000 litres of LPG. The average LPG unit price was estimated at 50 cents per litre excluding VAT. Therefore the annual fuel cost was €22,500, excluding VAT.

As one litre of LPG contains approximately 7kWhs of energy, the school purchased approximately 315,000kWhs of energy per annum (45,000litres x 7kWhs). This energy was converted into hot water in the existing boilers. The LPG boilers operated at approximately 80% efficiency with a remaining 20% of the energy purchased lost in conversion. This means the site used approximately 252,000kWhs of energy (315,000kWhs x 80%).

As a wood energy boiler operates at approximately 90% efficiency, an estimated 280,000kWhs (315,000kWhs x 90%) of wood fuel energy was required to replace all the LPG used.

As one tonne of wood fuel at 30% moisture content contains approximately 3,500kWhs of energy, the school required approximately 80 tonnes of wood fuel per annum (280,000kWhs ÷ 3,500kWhs).

Commercially supplied wood fuel at this location cost was between €95 and €115 per tonne delivered. Based upon a price of €105 per tonne the price of heating the school with wood fuel was €8,400 per annum. This meant the school could save approximately €14,000 per annum on heating bills.

Boiler costs

The capital cost of installing a new wood energy system was relatively high. The system would need an approximately 100kW rated boiler capacity. It would also need a fuel store, and a building or structure to house the boiler and store. While the ideal way of storing fuel is underground, in this case the building costs were prohibitive. The lowest cost solution was to install a complete containerised system supplied pre-fabricated in a shipping container. The estimated cost was €90,000 to €100,000 supplied and installed. Such units can be supplied to look visually attractive, however, this will add to the cost.

The main drawback of this solution is that fuel must be dropped into the fuel silo rather than tipped into an underground silo. Therefore the fuel supplier must have, or purchase specialist equipment such as a blower or clam-grab arm for delivery, and loading the fuel will take slightly longer. Despite these operational issues, given the small annual wood fuel demand of the school, the capital cost savings (of an above-ground store) are probably worth achieving[21].

The system would be connected to the existing LPG boilers. The LPG boilers would be retained as back-up and to meet peak loads of heating in the winter.

Payback

As the project was eligible for the 30% SEI capital grant, the final estimated capital cost was €70,000. At annual savings of €14,000, the simple payback on this investment would be five years excluding the cost of finance. Given the very substantial annual energy savings this is a reasonably attractive investment. In addition, the longer term cost of wood fuel would be stable, whilst the costs of LPG may continue to rise.

[21] The fuel suppliers will probably seek a longer term of supply contract to deliver above ground. This means that a three to five year supply contract would be the most likely outcome for the school. A one year contract is possible with underground deliveries. The reason for this is that fuel suppliers may need to purchase a blower and this would not be worthwhile if the contract was small in value i.e. one or two years.

6.3 An energy services contract

An interesting model that could be developed by a community enterprise is the Energy Services Contract (ESCO) model. This model is used in many countries and is beginning to be applied in Ireland. The basic idea of the contract is that an energy services company, e.g. the community enterprise, designs, installs, owns and operates a wood fired heating plant at a customer's site. The customer simply buys energy in the form of metered heat. The main attraction is that the customer avoids any upfront capital charge as that is financed by the ESCO provider. This opens up a significant market as the main restraint on many energy users is the high capital costs of wood boilers.

Recent prices for commercial ESCOs in the Western Region show that for energy users spending in excess of approximately €140,000 on oil for heating the ESCO will represent an attractive option. The table below shows a typical set of figures, based upon tender prices in 2008[22].

Breakdown of items	Costs
existing annual spend on oil (210,000 litres at 67cent per litre)	€140,000
capital cost of 400kW Woodchip boiler – in purpose built plant room	€200,000
approximate annual cost of ESCO over seven years (capital and fuel)	€100,000
annual energy savings of ESCO at year one	€40,000
Cumulative savings over seven years ESCO v oil	**€400,000 +**

This table highlights that for certain energy users an ESCO contract would offer annual savings on oil bills with no capital outlay. Generally ESCO contracts work at the larger commercial scale, e.g. hospitals, care homes, major leisure centres and hotels.

A community enterprise/co-operative would need to address a number of key issues if it was to successfully deliver an ESCO contract, namely:

- obtain capital finance in the form of a commercial loan
- obtain the technology, and design and installation of the heating plant equipment
- undertake servicing and maintenance of the equipment
- supply and deliver the wood fuel

[22] This information has been sourced by Steve Luker Associates and DARE Ltd through related project work during 2008.

7.0 Community enterprise options

Community groups and enterprises typically have the required community network and expertise to bring potential fuel producers, e.g. private forest owners, and end users, e.g. local industries, hotels, together, and thereby progress the development of new wood energy installations. This section gives an overview of the supply chain for woodchip fuel to commercial/industrial heat users and highlights the main issues to consider when assessing the possible feasibility of the various enterprise options in your community.

7.1 Wood energy enterprises

Based on a review of European examples and the WDC/Údarás na Gaeltachta project, the following enterprise options were identified as relevant to community enterprise development. These options and project examples are discussed in more detail in the report *Wood Energy Market Development through Community Enterprise Models* available for download at www.wdc.ie.

The wood energy sector presents five enterprise options to communities.

- **Community enterprises as wood fuel suppliers**: a community enterprise/co-operative could set up a wood fuel production and supply business. Each company or co-operative considering such an idea would need to evaluate the local market opportunities to sell and supply wood fuel, carrying out an indepth feasibility study to progress to a full business plan. The proposal to set up a business to supply wood fuel can act as a catalyst for local demand to emerge.
- **Wood fuel supply producer groups**: a community enterprise and its members may have the necessary skills and experience to develop a wood fuel supply business. Wood fuel producers' groups have proved an effective model in other areas, e.g. North East England's NEWfuels project (www.newfuels.org.uk). Local producer groups can be established with the aim of becoming fuel supply companies. A community enterprise/co-operative can be well placed to establish long term relationships with local private forest owners given their typical links and visibility within local communities.
- **Community enterprises as ESCO providers**: this is an interesting model that could be developed by a community enterprise. This model is used in many countries and is currently starting to be more widely used in Ireland. Within Europe there are examples of community enterprises that offer an ESCO contract to energy users that are 'predisposed' to working with a community company, e.g. public sector.
- **Community enterprises as district heating entrepreneurs**: this is a distinct idea that is somewhat different from a community enterprise/co-operative developing an ESCO. However, it may well encompass the ESCO model. The main idea is that local people would co-operate to supply heat energy to a communal heating plant. The heating plant would probably be developed by a public body such as a county council, to provide heat energy to public buildings. This is a well-established model in Austria and Finland.
- **Community enterprises as combined heat and power (CHP) entrepreneurs**: a final area that might be assessed are combined heat and power plants. In the past, CHP projects have not been viable at the regional and local scale that would be relevant to community enterprises. However, the rise in energy prices and the direction of policy support indicates smaller scale CHP is becoming viable.

7.2 Issues in fuel supply

This section highlights the key issues to consider at each stage in the supply chain and identifies the main equipment and infrastructural requirements. Section 3 outlined the current price structure at each of these stages in the supply chain. This section presents introductory information only, therefore a community enterprise would require a wood energy expert to develop a full business plan.

The fuel supply chain involves a process of:

- harvesting round wood from woodlands
- storage and drying of round wood
- chipping and chip storage
- haulage and delivery

It is critical to state that wood fuel quality and standards underpin each stage in the process[23]. This is a specialist area of expertise in the wood energy sector and fuel suppliers must design and implement processes to best suit their particular conditions and markets. A woodchip fuel supply process operated by a community enterprise must be capable of producing the high standard of woodchip fuel required for small to medium scale woodchip heating systems.

7.2.1 Harvesting, chipping and ancillary equipment

Firstly, a wood fuel production and supply business requires investment to provide a drying shed. Secondly, a detailed business plan is required to organise a series of sub-contractors to undertake the main elements of the supply chain: harvesting, chipping and the delivery of woodchips. If the business expands and the economies of scale allow, then chipping and delivery equipment can be purchased. At set-up phase the main requirement is a dry ventilated shed and a fuel supplier can hire equipment and contractors to minimise the initial capital investment.

Forest harvesting is carried out by specialist contractors on behalf of forest owners. Private forest owners can sell the timber into a number of markets, including pulpwood, thinnings, sawlog, palletwood and stakewood. As noted in Section 2, woodchip fuel is generally produced from the low value small diameter wood by processing it in a purpose made fuel wood chipper and selling it to local energy customers. Any dead standing timber or seasoned windblown material sourced during forestry operations can also be used in the woodchip supply chain.

Key factors affecting the economic viability of carrying out harvesting operations include the market price available for timber and the plantation size. A local wood energy market avoids transport of wood to distant markets, and if forest owners work together to bring smaller plantations into clusters, the costs of harvesting and production can be reduced.

The fuel production process requires a high output chipper capable of screening to the appropriate particle size. Initially it is viable for a supplier to hire a contractor to chip at periodic intervals. The cost of contract chipping depends on a number of factors, including: the volume of logs to be chipped, access to the logs and the size of the chipper. Currently, costs range from €8 to €12 per tonne of chips based on an eight hour hire. For example, a chipper can be hired in and produce 150 tonnes of chips per day. This means a business producing 1,500 tonnes of woodchip per year could hire a chipper for 10 days a year. A chipper of the required specifications (namely sufficient output, in-feed diameter, consistent chipping quality and screening ability) has an estimated cost of €75,000, including engine and crane feed.

[23] Additional information on wood fuel standards and specifications is available at www.woodenergy.ie.

The critical operating capacity for a woodchip storage facility/depot is approximately 5,000 tonnes per annum. At this scale of operation, typically a tele-handler with front end loader, or equivalent machinery, is required permanently onsite for the handling of the fuel in the shed and the loading of delivery vehicles, etc.

7.2.2 Drying methods[24]

Generally, the required moisture content of the woodchip fuel can be achieved by air drying timber in anticipation of chipping. A planned programme of sourcing and stacking wood fuel in advance will ensure a continual supply of seasoned woodchip fuel. Ideally logs must be down to 35% moisture content before chipping and this can take between 12 and 18 months to achieve. The drying process used will aim to minimise the labour and energy input required.

In the drying process, round logs are usually hauled to and stacked outside a wood fuel depot. The log piles are then covered with a reinforced paper or other appropriate material to prevent rain wetting the logs. The logs are stored in the round until the required moisture content is achieved. There are a range of storage methods possible. The fuel supplier must research and implement the optimum method based on the characteristics of the depot site, facility and fuel standards required for the market.

Typically, small to medium scale boiler systems accept moisture content of between 25% and 35%, with some larger commercial boilers being able to tolerate moisture content of 50%. A typical production target is a maximum of 35% and an average of 30%, ensuring that as wide a range of boilers as possible can be supplied.

7.2.3 Monitoring and grading equipment

Suppliers of woodchips must be able to demonstrate that the woodchips supplied meet the standards set by the boiler manufacturers. To provide a fuel quality guarantee to the market, monitoring of the drying timber is necessary. The following equipment is required:

- round wood moisture meter - to determine and monitor the moisture content of round logs during the drying process prior to chipping
- woodchip moisture meter - to measure and record the moisture content of woodchips at the time of delivery. This meter can be linked to a printer and/or downloaded to a software package that can then be used for invoicing. It provides a hardcopy record of the moisture content for both supplier and end user
- woodchip grader - to monitor the particle size of the chips and ensure that the chips comply with the boiler requirements. Sampling is used to ensure that the contractor is chipping to the correct standard at the time of chipping

7.2.4 Fuel storage and yard

A large well ventilated dry shed is required by a fuel supplier. Fuel storage issues are similar for both the fuel supplier's depot and large commercial users. Factors to consider in the design and operation of a depot include: maintaining moisture content and quality of fuel; fuel handling and transportation issues; inventory and delivery patterns; and the prevention of overheating/corruption/damage of the fuel. Each fuel supplier must design a storage facility based on such issues as the depot site, fuel quality, equipment available and fuel volumes delivered. Specialist expertise and assessment is necessary to design effective, efficient facilities.

For example, a commercial heat user's storage sheds are approximately 15 metres by 30 metres with partial block side walls to a height of two metres. Storage sheds are generally enclosed by a weatherproof screen that can be opened to enable the chips to be blown directly from the timber pile into the shed, thus reducing the handling costs and allow for ventilation. The gables should be fitted with doors of sufficient size to allow access for loaders

[24] More information is available at www.woodenergy.ie and www.coford.ie.

and trailers. The shed should have a storage capacity of approximately 1,500m^3 loose volume (approximately 400 tonnes of woodchips at 35% moisture content). At this moisture content the woodchips must be stored to a depth not exceeding 3.5 metres to prevent heating.

To enable indoor loading during wet weather an area of 150m^2 should be kept clear of woodchips to allow a loader and trailer access to the shed. This would reduce the storage capacity of the shed to approximately 275 tonnes of woodchip and also allow the woodchips to be turned should heating be detected.

7.2.5 Delivery of fuel

The method of delivery of the woodchip fuel to the customers will be determined by the nature of onsite storage and reception system available.

The most simple and efficient means of delivery is to bulk tip the fuel into an underground woodchip storage bunker, as this may be carried out by a standard bulk tipper. However, the difficulty with this system is the increased cost to the client for installation of the underground bunker.

For above-ground storage silos, where gravity filling is not possible, alternative means of delivery include: bulk bagged delivery using a vehicle with a crane, loading with a clam-grab bucket or using a woodchip blower vehicle.

Delivering the woodchip fuel in bulk bags involves using a standard flatbed lorry with a crane, which may be co-opted for other uses, however, the significant increased handling and equipment required for bagging the fuel, and loading and unloading the delivery vehicle will impact on the delivered cost of fuel to the client.

The decision on how to plan and achieve delivery of woodchips to boilers must be based on specification of actual contracts. It is viable to contract hire haulage vehicles at the start of a business.

7.3 Support service enterprises

In addition to fuel supply and installation enterprise options, community enterprises are typically positioned to deliver other functions to support the development of the sector such as business management skills and delivery of training courses. The potential target groups for such support services include:

- farmers and foresters – who may require business skills and basic training in the supply chain including chipping, drying schedules and simple boiler maintenance
- hauliers – who may require support to develop a greater level of knowledge in terms of fuel handling and delivery systems
- engineers and plumbers – who will require skills in terms of design, installation and system operational and running

Across the supply chain, community enterprises are positioned to provide a range of support services to assist in the development of the local wood energy sector. These services could include: market awareness actions with potential end users and fuel producers; delivery of training programmes; provision of business development and marketing services to the players along the supply chain.

7.4 Overview of the supply chain

Supply Chain Stages ~ Some issues to consider

Harvesting

- generally a fuel supplier would purchase round wood from an existing forestry company/owners
- specialist contractors carry out the harvesting
- no equipment is required
- suppliers to manage buying and market prices
- must ensure a sustainable availability of round wood
- drying process is critical as harvested logs can be 60% wet

Round wood storage

- a large yard is required to stockpile round wood
- need access to a tractor and forwarding trailer to move and handle stockpiled logs
- estimated cost of equipment (new) is tractor €75,000 and trailer €20,000
- drying and monitoring process are critical, equipment is required
- basic manual handling and ability to operate a tractor is needed
- as the scale of production may grow over time, space to expand must be considered

Chipping

- chipping can be carried out by a contractor. Currently costs are in the range of €8 to €12 per tonne of chips based on an eight hour hire
- estimated cost of a chipper is €75,000
- ideally logs must be down to 35% moisture content before chipping which can take from 12 to 18 months

Chip storage

- a tractor and bucket is required to move and load chipped fuel from the shed into delivery wagons
- a large ventilated dry shed is required for storage
- basic manual handling and ability to operate a tractor is needed

Haulage/delivery

- generally a fuel supplier contracts a haulage firm to deliver woodchips
- woodchips are normally delivered in loads of 6 to 7.5 tonnes using a tractor and modified grain trailer
- loads are either tipped directly into underground silos or into a reception bin from where the chips are either conveyed or blown into above-ground silos
- for large deliveries articulated trucks with curtain-siders equipped with walking floors are used
- supplier must be effective business manager with awareness of market prices
- investment in delivery wagon is dependent upon the volume of sales

8.0 Issues to consider for community enterprises

In the wood energy sector the main community enterprise opportunities are in the supply of woodchip fuel to commercial, industrial and public sector heat users. In simple terms community enterprises could produce and sell wood fuel or organise the installation and operation of woodchip boiler systems. They could also do both at the same time and this may well offer the most practical approach, especially if they can identify local partners who are willing to consider conversion to wood fuel heating.

However, the development of a wood energy business by a community company or co-operative will not follow a single model and the opportunities are dependent on a set of factors specific to that community, including: the potential local fuel resource; profile of the local heat market; and capacity of the group itself to progress with enterprise development. Each community will have to identify and design an enterprise suitable to their conditions and profile.

Based on the WDC/Údarás na Gaeltachta project a number of key questions were identified that any community must answer to assess the potential for a wood energy project in their locality.

1. Local heat demand

Do you own and/or lease buildings with a commercial heat demand? Are you in a position to identify other potential energy users?

- Community enterprises with large heating bills based in a complex of nearby buildings of other heat users might present an opportunity for woodchip heating systems, e.g. complexes including enterprise centre, medical centre, county council offices. If a community enterprise could bring together a cluster of like-minded energy users who are willing to convert to wood fuel they would be very well placed to explore wood energy development opportunities through a district heating system.

Are you involved with energy users who might require wood fuel energy on a commercial basis?

- This may include supply into public buildings and large energy users such as leisure centres, care homes, etc. The development of a wood energy business is fundamentally based upon a commercial demand for wood fuel and without this demand no business can be developed. There may be potential users such as county councils who are open to working with community enterprise.

2. Potential fuel resource

Is there a sufficient forestry resource within the catchment area that could be assessed for potential wood fuel supply?

- The distribution of commercial forestry plantations is not evenly spread across the Western Region and does not always correspond to the best locations for its processing, production and use as wood fuel. Community groups with access to suitable round wood from forestry who have the potential to bring this resource to nearby energy markets will be well placed to explore wood energy development opportunities.

Resource supply and inventory

Do you have access to or knowledge about local forestry resources suitable for wood fuel chipping?

- No single forest owner is likely to have a sufficient long term wood resource upon which to base a viable wood fuel enterprise. Therefore fuel supplies usually emerge from a cluster of forest owners brought together in a reliable co-operative/producer group supply chain.

3. Depot site

Do you have access to a site on which to locate a potential fuel supply depot?

- A fuel depot may be the central investment a community enterprise can make within the supply businesses. This type of facility requires a large agricultural shed, some farm\forestry equipment and outside storage areas to stockpile round logs. A community enterprise will be well placed to explore wood energy development opportunities if it can develop a fuel supply depot.

4. Fuel supply partners

Do you have relationships with or access to the partners and stakeholders involved in (or capable of learning about) farming, forestry and road haulage?

- These are the basic areas of wood fuel production, usually based around a large agricultural shed. The stages include harvesting, storage, chipping, haulage and delivery. All processes must adhere to the required quality standards.

5. Installation partners

Do you have relationships with or access to partners and stakeholders involved in (or capable of learning about) heating, plumbing and engineering, and maintenance?

- There are opportunities to manage and maintain wood energy systems and this requires some basic skills. These can be acquired by short training courses with equipment suppliers in the sector.

6. Community interest and commitment

Do the community and/or company board have a stated interest in supporting renewable energy developments?

- The commitment of the board of the community enterprise, at a strategic level is required, as project development will require effort and resources over a sustained period.

7. Investment capital

Do you have access to investment capital to set up a business?

- Wood energy development requires investment capital, either for the fuel supply chain or the woodchip boilers or both. Many energy users do not have access to investment capital or are not in a position to use this capital for meeting their site energy needs. However, all energy users pay for their energy and this creates an income stream that can fund capital investment. A community enterprise could act as the catalyst for wood energy projects by securing capital investment based upon this income stream.

8. Business and management skills

Do you have the necessary enterprise development experience and skills available?

- Business development lies at the core of any wood energy development opportunity. Skills in financial planning, business management and planning, and procurement will be required either through the board or staff.

9. Staff resource

Do you have staff available to research and progress project ideas?

- Staff resources capable of designing, planning and financing a new business are critical to drive any project. The creation of a new wood energy business is a significant commercial undertaking and will require a long term commitment. A community company does not need to have existing expert skills in wood fuel processing or boiler installation as these are specialisms that can be contracted in, however, they will need staff to bring these experts together. Over time community staff should develop capacity and expertise as they manage and control these functions.

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