Seamus Hoyne

05-04-00 Cost structure in systems Odd Biomass Fractions

As outlined in Chapters 01-04, 02-04, 03-04 and 04-04 the sourcing and conversion to energy of the biomass fraction of odd or waste derived fuels is a complex process. The source and type of fuel dictates the costs associated with

- Collection of materials (RDF or SDF basis)
- Separation of materials to allow for use for energy production
- Certification of fuels for use under relevant National and EU legislation
- Scale and type of plant (combustion/incineration, gasification, pyrolysis, biological treatment) and energy output (heat, heat & power etc)
- Handling of residues from energy process (ash)
- System O&M costs

05-04-01 Elements important for the cost of the substrate

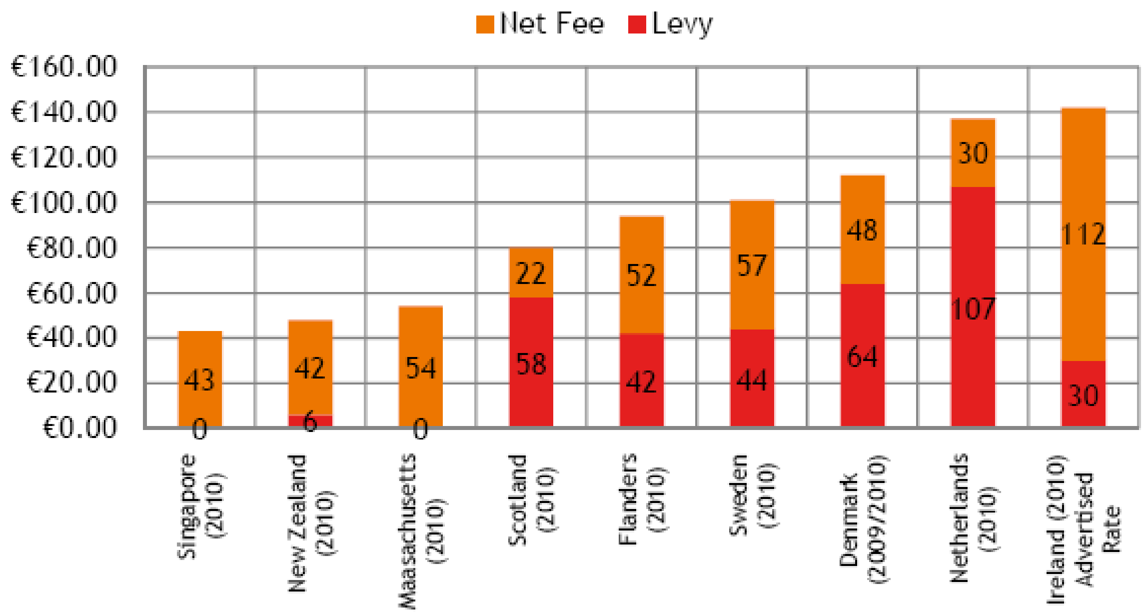
As outlined in the Chapters 02-04 and 03-04 the range of sources of RDF and SDF presents significant challenges in relation to the collection and sorting of materials so that it can be made available for use as an energy source.

The variety of materials available involved in the 'other waste' category means that it is difficult to give specific details per item which may be utilised as an energy resource. Some data is available for some resources

Wood waste (construction and packaging waste): A study was completed by for the Council for Forestry Research and Development (COFORD) in Ireland in 2006 which reviewed the potential for use of wood waste for energy. In order to estimate the cost of wood waste as a fuel, data on three cost components was assembled. These costs are: the avoided cost of landfilling the wood waste; transport cost from source to energy user; and comminution cost. An example landfill cost for 2003 is €125 per tonne (as advertised by Laois County Council). The Wood Waste project report gives a transport cost of €4.30 per tonne of timber for a 40 kilometre distance. A comminution cost of €7.65 per tonne is assumed. The total 'cost' for wood waste transported 40 kilometres and then chipped by the user in a large scale comminution facility is therefore -€112, equivalent to -€7.4 / GJ NCV. Clearly the use of waste wood has major cost advantages over other types of wood fuel. However, the cost of segregation/separation needs to be added to the above cost, an analysis of such follows.

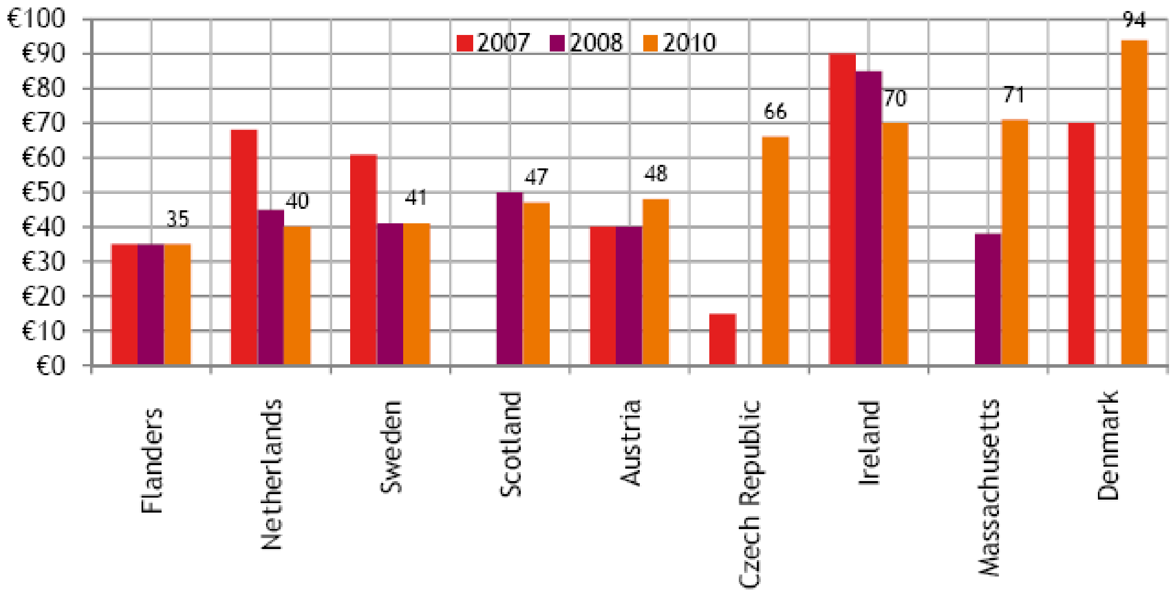
Household waste: The process of collection and disposal of household wastes has been outlined in detail previously. It can be estimated that the cost for disposal to landfill 'gate fees' is a good indication of costs for collection of such waste. The main additional cost which needs to be added to this cost if this waste is to be used for energy will be cost of segregation to deal with relevant environmental regulations. In Ireland, a study was published in 2010 (Waste Management in Ireland - Benchmarking Analysis and Policy Priorities: Update 2010; Forfas 2010) which benchmarked gate fees for disposal of waste to landfill and also for biological treatment centres. Figures 1 and 2 present this data below.

Figure 1: Advertised Gate Fees for Landfill, 2010 prices (€/tonne)



Source: RPS[20]

Figure 2: Advertised Gate Fees for Biological Treatment, 2010 prices (€/tonne)



Source: RPS[26]

It can be seen that the waste cost ranges from €50 to €160/tonne depending on the end use and country.

Agricultural wastes: In most cases the costs for the potential energy sources from agricultural (straw, manure etc) have been covered in previous chapters (02-04, 03-04, 04-04) and will not be repeated here.

A report from a consortium led by EuNomia Consulting for the EU Commission in 2002 (Costs for Municipal Waste Management in the EU) presents significant information from a number of EU Countries on the costs for collection, separation and treatment of different waste streams. A particular point of note from this report in relation to residual waste is that the cost measure needs to be considered carefully. A particular extract from the reports notes *"At the Peer Review Meeting, one view put forward by the team in this study was that the typical indicator of costs for collection . "Costs per tonne" was misleading. This is especially true in the case of residual waste collections. Consider the following: it is cheaper to collect residual waste where it arises in larger quantities per collection point than in cases where each collection point delivers only a small quantity of the same material. The costs per tonne will be far lower in the former case where more of the same material is collected more quickly and in moving a shorter distance. Where collection schemes look to separately collect materials dry recyclables and materials for composting, and where they also seek (through charging mechanisms, encouraging home composting etc.) to reduce the overall quantity of material collected, it is highly likely that the amount of residual waste collected per household will fall, often quite dramatically over short periods of time. The per tonne costs for residual waste collection in such cases may be higher than in the case where no attempt is made to reduce the residual waste collected per household. Similarly, in terms of total collection system costs, per tonne costs can mask the benefits of certain approaches which deliberately set out to ensure that the waste collected in the collection system is kept to a minimum. The per tonne costs may well be lower in cases where more waste is collected per household. "*

Also this report also noted that there is a cost associated with the education and provision of information to householders and businesses in relation to segregation of wastes into different fractions. The costs per household quoted for such provision ranged from €5-10/household.

Simon Rawlinson and Matthew Hicks of Davis Langdon weigh up the costs and the risks of treatment solutions

05-04-02 Elements making up the total cost

Costs for combustion and anaerobic digestion plants and projects have been outlined in details in previous chapters. This section will focus specifically on waste treatment systems. Such systems are typically large scale (50,000 to 600,000 tonnes per annum throughput) and involve treatment of a range of waste materials.

A study comparing costs of a number of combustion, pyrolysis and gasification plants was completed in 2005 by MC O'Sullivan (Feasibility Study of Thermal Waste Treatment/Recovery Options in the Limerick/Clare/Kerry Region; MC O'Sullivan, 2005).

This provides a range of information on the operational costs of a number of different treatment technologies

Table 1: Indicative Capital and Operating Costs for Waste Combustion with Energy Recovery

Capacity (tonnes/annum)	Typical Capital Costs (€)	Typical Operating Costs (€)
50,000	32.25 million	2,232,500 p.a.
100,000	55 million	3,765,000 p.a.
200,000	109.8 million	6,600,000 p.a.
500,000	180.8 million	14,276,000 p.a.

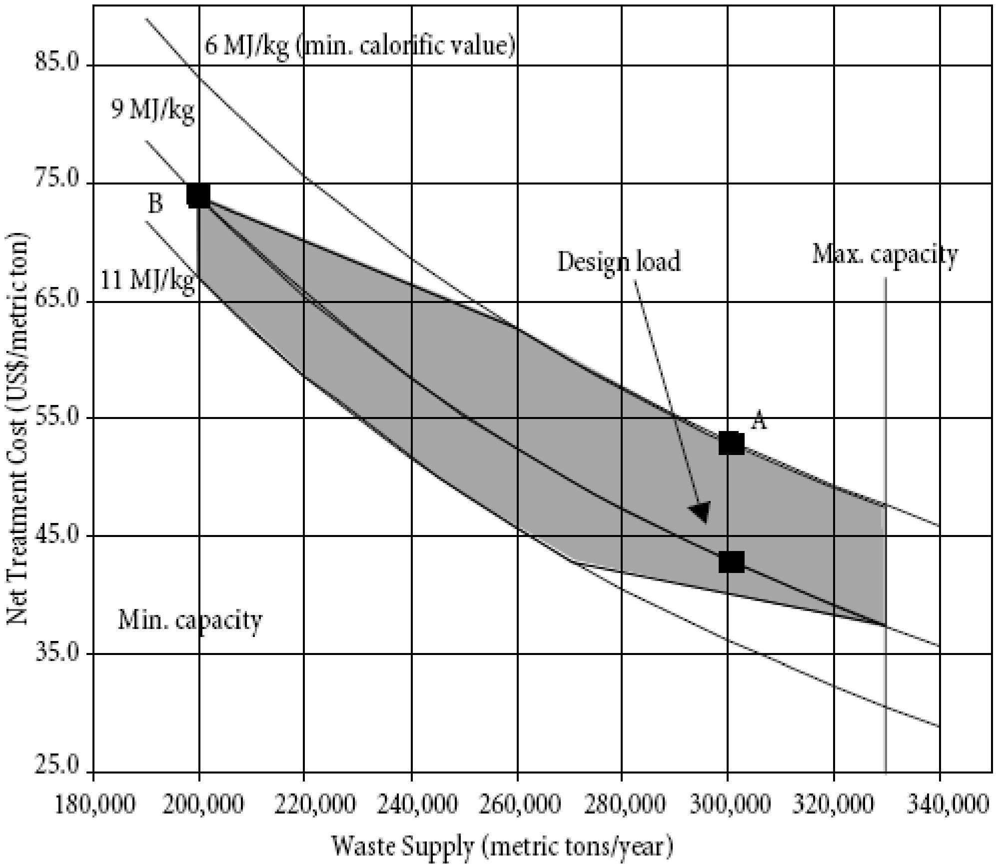
Table 2: Indicative Capital and Operating Costs for Pyrolysis/Gasification Plant

Capacity (tonnes/annum)	Typical Capital Costs (€)	Typical Operating Costs (€)
50,000	19.05 million	2,560,000 p.a.
100,000	43.75 million	3,800,000 p.a.
200,000	73.20 million	6,700,000 p.a.
500,000	112.10 million	10,400,000 p.a.

It can be noted that the capital costs for combustion plant are higher than that for pyrolysis/gasification plant but operating costs are similar.

The World Bank produced a document called "Decision Makers' Guide to Municipal Solid Waste Incineration" (World Bank, 2000) which includes a specific graph to indicate the relationship between waste energy value, plant capacity and treatment costs. Waste with a lower calorific value will be more expensive to process in the plant. Also, as the throughput of material through the plant reduces treatment costs also reduce.

Figure 3: Sensistivity of Treatment Costs



05-04-02a Planning Aspects

The major concern when considering a waste incineration plant is that of the socio economic one.

In Ireland there have been many efforts to develop such projects that have failed at planning certification stage due to public concern and anxiety.

One cannot underestimate the cost involved in obtaining approval from the relevant bodies to construct such a plant. For this reason, when this is considered it is likely that all investments in waste to energy plants will be at a regional rather than local level.

05-04-03 Case studies

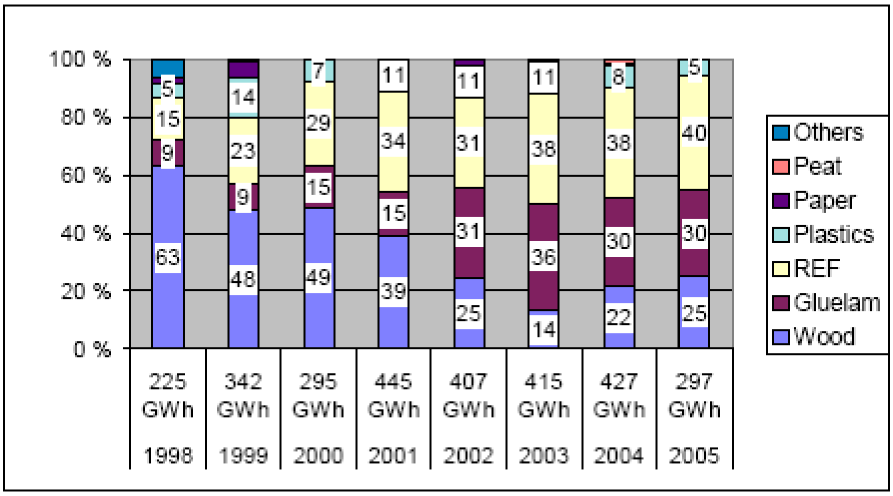
05-04-03a Waste and Biofuels Gasification Plant, Finland

http://www.fwc.com/publications/tech_papers/files/TP_PC_05_05.pdf

Foster Wheeler has been to the forefront in the development of waste treatment technology. A case study by Juha Palonen et al "The Foster Wheeler gasification technology for biofuels: refuse-derived fuel (RDF) power generation" in 2005 outlines a range of examples of plants which have been operating or technologies being developed. Of particular interest is a Combined Fluidized Bed (CFB) gasification unit in Lahti Finland. The first Foster Wheeler CFB gasifier connected to a PC boiler was constructed in 1997 at the Kymijärvi power plant of Lahden Lämpövoima Oy. The Kymijärvi power plant produces electric power (167 MWe) and district heat (240 MW) for the city of Lahti, Finland. The Lahti gasifier was connected to a 20-year-old Benson-type once-through boiler, the steam data of which are 125 kg/s, 540 °C/170 bar/540 °C/40 bar. The boiler was converted from heavy-oil-firing to coal-firing in 1982, and typically it operates about 7,000 h/a, depending on the heat demand and electricity prices.

The Lahti gasifier started commercial operation in 1998 and initially used biofuels such as bark, wood chips, sawdust and uncontaminated wood waste. Other fuels have also been tested subsequently, including in-origin classified waste fuel (REF), railway sleepers and shredded tyres. As a result of availability and price changes, the share of REF fuel has gradually increased at the expense of cleaner biofuels. The gasifier has operated well with varying fuel mixes, with availabilities of 96 % or higher. Figure 2 shows the fuels used and energy produced in 1998–2005 and Table 2 the annual availabilities 1998-2001 (not calculated since 2001).

Figure 4: Waste Mixtures in Lahti Power Plant



05-04-03b Premier Green Energy

The area of thermal treatment of biomass and waste derived fuels is an every changing one with new technology suppliers emerging. A new company, Premier Green Energy, has been established in Ireland to produce a range of pyrolysis units.

Premier Green Energy (PGE) manufactures and markets a range of superior waste-to-energy converters called Prima Units. Prima Units are efficient, flexible, cost effective and environmentally friendly technology that produces high energy yields from waste and biomass materials.

Prima Units have been designed and manufactured to provide a commercially viable technology to produce continuous efficient power. A 3 Tonne unit has been design, developed, tested and evaluated at their manufacturing unit in Ireland. PGE aim to recycle the char produced by the plant and to use it to provide heat for the pure pyrolysis chamber, generating virtually zero waste.

Prima Units accept a diverse range of waste materials and biofuels making them a flexible solution to manage the wide range of wastes that arise globally in society. The pilot plant has been tested on biomass, MSW and a range of other residues. The first commercial plant is due to be completed in 2013. Figure 5 shows the key components of the plant.

Figure 5: Key components of Prima Unit.