<u>ENERGY FROM BIOMASS</u>

CURRENT USE AND FUTURE PROJECTIONS

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INTRODUCTION

The energy resource of biomass is anything that is derived directly or indirectly from photosynthesis, including plants, animal waste and wastes from sectors like agriculture, forestry and any others involving food or wood. On the human side biomass can apply to sewage sludge and municipal waste.

Use of biomass was far more widespread before the exploitation of fossil fuels but it still supplies a considerable amount of energy today, 12% of world energy needs are met through the use of fuel wood, animal dung and charcoal (Energy Paper 60). This is mainly in the developing world but schemes are being set up in the U.S, Europe and other developed world countries to exploit this carbon neutral fuel, which has a potential resource of 170 billion tons world wide, of which we only now utilise around 1% (IEA, 1987).

In the UK 3% of our energy is currently produced from renewable resources and of this 87% is from biomass sources such as landfill gas, 33%, and waste combustion, 14%, (DTI) equivalent to around 150 PJ (DTI), with the UK total energy consumption being 9914.8 PJ in 2003.

As EU directives on waste and pollution may well reduce the potential of landfill gas, waste and sewage incineration (Environment Post, 2005), the future plans rely mainly on agricultural and forestry waste and energy crop utilisation.

In this report I will look first at the current status of these sources, followed by the methods used to utilise the energy and opposition it has faced. To conclude I will set out projections for the future and steps that need to be taken to reach these targets.

AGRICULTURAL AND FORESTRY WASTE

In the UK nearly 80% of the land is involved in agriculture and forestry (Palz & Chartier, 1980) with a relatively large amount of waste being created from it.

In the case of agriculture an estimated 7 million tons of straw alone is burnt in the field or ploughed back into the soil (Flood, 1986). In addition to this there is green waste such as roots and leaves and waste from the husbandry of animals like poultry, pigs, cattle and sheep including slurry and litter, feathers and body parts not used in food production e.g. heads and guts in the case of chickens.

Some of this waste, particularly straw, is already utilised but mainly on a small scale such as “in house” heaters for farms to keep animals warm, which are mainly only 1 – 5 MW facilities, though there are some facilities that use chicken waste in particular that are larger.

In the forestry sector as with agriculture a large proportion of biomass is “left behind” such as branches, leaves, bark and the stump and roots of the tree, once the wood of value is removed. This can account for 50% of the original biomass and is usual left to decompose or burnt on site (ETSU, 1994).

Additional supplies of wood can also come from the furnishing industry in the form of sawdust and off cuts.

Currently these again are used on a small scale for heating individual buildings like forestry offices, near by farms or in furniture factories, which produce the waste in the first place.

ENERGY CROPS

These differ from using biomass like straw and other agricultural wastes because they are grown solely for use in energy generation where as the others are almost a by product.

Currently the main forms of energy crop are fast growing wood plants like willow and poplar, which have growing cycles between 3 and 5 years (ETSU, 1994) when they can be coppiced, cut down to the ground and left to re-grow for the next cycle.

In addition is the use of C4 grasses like Miscanthus (ETSU, 1994), which can be grown in similar ways to the coppice wood, used in the same facility and due to the time of harvest, in the winter, the grasses actually have a higher yield of 15 – 30 dry tons/ha as opposed to 10 – 15 for the wood (ETSU, 1994).

When a decision is taken to better utilise this resource it is likely that land used to grow the energy crops will be from set aside rather than displacing food cropland. Under guidelines from the C.A.P to set aside certain percentages of land to reduce surplus food production, it is predicted that up to 5.5 million hectares could be available by 2010 (ETSU, 1994).

FUTURE RESOURCES

New research from Aberdeen University has shown that a naturally occurring plant, bracken, could be a future energy crop. It already covers 2 million acres of countryside and is increasing by 3% a year (Environment Post, 2004). The added advantages to using bracken would be that it does not require fertiliser, it's poisonous to livestock so many farmers are willing to get rid of it and the ash that remains from its combustion can be used as potassium rich fertiliser.

As the future for fossil fuels becomes a little more uncertain, large oil companies like Shell are taking more interest in the prospect of renewables as a way of keeping hold of some kind of market.
Shell have just set up a new division of their group, Shell International Renewables, which has $500 million to invest in solar and biomass technologies such as forestry and coppicing which they already have 20 years of experience in through research and development projects.

One further possible development is the increased research and development of GM crops, which could be modified to produce higher calorific values when they are combusted. However with the controversy, which already surrounds GM it is unlikely at the moment that there will be significant advances here.

CONVERSION TECHNOLOGY

Once the biomass has been obtained either from waste or energy crops there is a variety of ways the energy can then be used or extracted depending on the nature of the biomass.
For dry biomass like straw, manure, chicken litter, bark, coppice wood, grass or bracken, it can either be directly combusted producing electricity and/or heat for space heating or industrial use or heated in pyrolysis or gasification to produce

varying proportions and qualities of charcoal or gas (IEA, 1987), which in turn can be used to generate electricity in conventional or closed circuit gas turbines or heat.

For all other biomass with higher moisture content like slurry, which cannot be efficiently combusted, pyrolised or gasified, it can either be processed in a fermentation or anaerobic digestion system.

In fermentation acid or enzymes are used to hydrolyse cellulose to sugar, then yeast or bacteria ferment the sugar to ethanol, which can be used on its own or mixed with conventional diesel to power road vehicles (IEA, 1987).

In anaerobic digestion systems bacteria break down the biomass into high methane gas and stable solids, which are much reduced in volume from their original form. These contain high levels of nitrogen, phosphorous and potassium, which make them ideal for fertiliser (IEA, 1987).

The biogas produced which can have a calorific value of 25 MJ/ cu.m (ETSU, 1994) can either be combusted to produce electricity and/or heat for a number of applications.

OPPOSITION

Despite the wide range of useful applications biomass could provide in electricity and heat generation, fuel for road transport and high nutrient fertiliser, there appears to be high levels of public opposition to the development of biomass facilities.

In many cases the opposition seems to be similar to that of other renewable energy like wind and waste disposal like incineration, as people cite issues like ruining the landscape and local amenity or odour as a reason for opposition (Upretia & Horst, 2004).

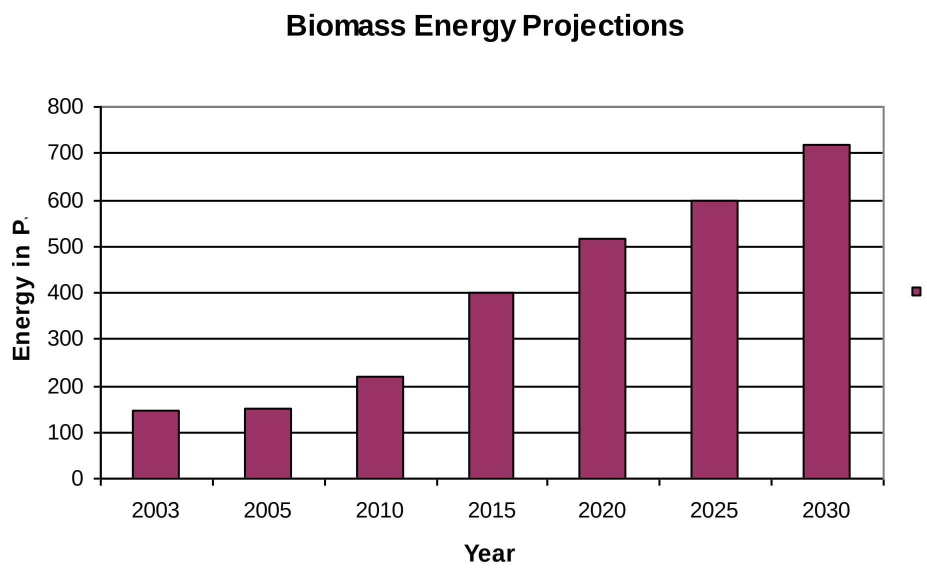
In addition to this is an increasing distrust in government and other public bodies, which means any suggestions they make to alter the status quo such as not landfilling waste or moving away from fossil fuels is automatically opposed instead of rejecting it after consideration of individual principals and possible environmental benefits.

With regards to more technical aspects, some people oppose the use of energy crops as a renewable resource because they are only carbon neutral rather than not producing any carbon. This is due to the fact that they require fertiliser to grow and machinery to harvest and transport them, which all produce greenhouse gases.

FUTURE PROJECTIONS AND CONCLUSIONS

As biomass already accounts for a considerable amount of renewable energy in the UK I believe it is likely this domination will continue and develop to the 600 – 650 PJ (Flood, 1986) mark suggested in previous studies by 2020 - 2025, though the composition of where the energy will come from is likely to change from landfill gas and waste incineration to agricultural and forestry waste and energy crops.

As development to this point has been slow as suggested by Horst “Developments in biomass energy in the UK in the last decade have been disappointing” (Horst, 2005) and public opposition is also currently high, growth in the next five years or so maybe low but after this particularly when more set aside land becomes available and large corporations like Shell develop more interest, growth has the potential to be much better.



These projections include some assumptions such as crop yield, conversion efficiency and prices willing to be paid for the energy.

The tasks for the government now is to raise public understanding of all environmental issues so their opposition to biomass and other renewables are reduced and also to invest more in biomass to take it out of small scale, un-commercial farm use to large scale, commercial city, regional or national use as it is able to achieve with proper organisation.

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