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12th August 2010

Second interim statement on sustainability research being conducted on potential biomass fuel supply and demand for Forth Energy

SISTech has been commissioned by Forth Energy to carry out a lifecycle carbon assessment of four biomass renewable energy plants (REPs) being proposed in Dundee, Grangemouth, Rosyth and Leith. Initial results for the Dundee REP have found that the plant would save 89-91% of the carbon emissions caused by equivalent electricity generation using coal, even when the carbon emissions associated with production and shipping of the biomass fuel are taken into account. Central to this saving is the sourcing of a sustainable, secure supply of biomass fuels. Since increased demand from biomass energy applications across the UK is likely to put a strain on the market for indigenously sourced wood fibre, it will be necessary to consider the availability of biomass fuel in a global context.[1] Imported materials will initially make up 80-90% of the biomass used by the plants. It is thus crucial that the global availability of biomass is comprehensively addressed.

It is important to put into context the scale of Forth Energy's plans. Forecasts suggest that that the energy produced by biomass across the EU will reach between 200 and 360 TWh annually by 2020.[1,2] Forth Energy's plans are for four plants with a combined electrical capacity of 500 MW and capacity to produce 320 MW of renewable heat. These plants are expected to produce around 3.72 TWh of electricity annually. Assuming a fairly homogenous level of efficiency across EU plants this indicates that the Forth Energy REPs will produce between 1.00% and 1.86% of the electricity produced from biomass across the EU. On a global scale, the International Energy Agency's Reference Scenario projects that 860 TWh of electricity will be produced from biomass annually by 2030.[2] Therefore the Forth Energy plants would represent less than 0.5% of the global demand for biomass for electricity production. It is reasonable to assert then, that the impact of the Forth Energy REPs on global demand will be small.

Given the relative size of this impact, it is unlikely that the Forth REPs will distort the global demand for biomass to any significant degree. Forth Energy's intended use of biomass, therefore, needs to be seen in the context of a global supply and demand dynamic. The pertinent question is whether there is the potential for an adequate supply of sustainable biomass to meet global demand, a demand to which the Forth Energy REPs would make a small contribution.

Electricity would be generated from four sources of fuel in the proposed plants. These are forestry products and by-products, energy crops, agricultural residues and reclaimed wood. SISTech's research to date has been a high-level analysis of the potential global availability of biomass from these sources and it has revealed particularly significant potential for forestry products, energy crops and agricultural residues to contribute to global demand for electricity from biomass.

[1] John Clegg Consulting Ltd. Wood fibre availability and demand in Britain 2007 to 2025; 2010.
[2] EURELECTRIC. Sustainability Criteria for Solid & Gaseous Biomass: In reaction to EC COM (2010)11 final; 2010.

Forestry would likely be the primary source of fuel for the Forth Energy REPs and there have been a number of reports that address its availability. One particularly thorough approach to estimating future supply and demand is to calculate the surplus stocks after industrial use of roundwood and use of wood as a traditional fuel source have been taken into account. A 2007 study by Smeets and Faaj applied stricter criteria, by defining the available timber as surplus forest *growth,* that is, the wood that could be logged whilst allowing for a constant standing stock (this is calculated using the Gross Annual Increment data supplied by the Food Agricultural Organisation).[3] Their process also takes into account the fact that some forest areas are economically unsuitable for logging and also ensures that biodiversity is protected by not using undisturbed old forest (that is, forest which has not previously been cut down or used for commercial purposes.) Even after applying these fairly exhaustive criteria they estimate that 5.1 EJ (1400 TWh) of energy will be available from surplus forest growth and logging residues alone.[4] In itself, this source equates to over 160% of the International Energy Agency's anticipated demand for electricity from biomass.[5]

The Forth Energy REPs would also be able to utilise plants grown specifically for energy production, such as eucalyptus and miscanthus. The central concern associated with energy cropping is that it can displace agricultural land, leading to threatened food supplies and deforestation in sensitive areas. There are also concerns about the impact of energy cropping on biodiversity.

In order to address these concerns, there has been much attention focused on the potential for energy crops to be grown in areas not currently utilised for agriculture. Specifically, much research has been done into the potential of agricultural land abandoned due to farming relocation and land unsuitable for agriculture due to over intensive farming in the past. There is an estimated 385-472 MHa of this land globally, with large areas in the eastern United States, Latin America, and the former USSR of particular relevance to Forth Energy's operations.[6,7] From this degraded, abandoned or otherwise unutilized agriculture land somewhere between 9,000-11,000 TWh could be supplied annually in the form of bioenergy (7%-8% of the world's energy demand) so clearly there is great potential for it to be used as a source of fuel for electricity production.[6,8]

Certain modelling studies have suggested that the amount of available abandoned land could increase radically from current levels, as agricultural efficiency would allow food needs to be met with a smaller amount of agricultural land.[9] This is a somewhat contentious claim however, and agencies such as the United Nations Food and Agriculture Organization (FAO) have suggested that there may be an increased demand for cultivated areas, particularly in developing countries, over the next two decades.[10]

Use of this abandoned land in this way does not have the same biodiversity implications associated with deforestation for monoculture agriculture, since it would not be displacing more varied forestry. Additionally, it can increase carbon stocks in the soil as a result of root sequestration.[11]

Agricultural residues also have the potential to make a large contribution to global supply of electricity derived from biomass. Various studies have suggested a yield of up to 9.7 MWh per cultivated hectare,

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[3] UNECE/FAO. Forest Resources of Europe, CIS, North America, Australia, Japan and New Zealand. New York and Geneva: United Nations; 2000.
[4] Smeets E, Faaij A. Bioenergy potentials from forestry in 2050. Climatic Change 2007;81(3):353-390.
[5] International Energy Agency (IEA). World Energy Outlook 2008. Paris: OECD/IEA; 2008.
[6] Field CB, Campbell JE, Lobell DB. Biomass energy: the scale of the potential resource. Trends in Ecology & Evolution 2008;23(2):65-72.
[7] Wolf J, Bindraban PS, Luijten JC, Vleeshouwers LM. Exploratory study on the land area required for global food supply and the potential global production of bioenergy. Agricultural Systems 2003;76(3):841-861.
[8] Campbell JE, Lobell DB, Genova RC, Field CB. The Global Potential of Bioenergy on Abandoned Agriculture Lands. Environmental Science & Technology 2008;42(15):5791-5794.
[9] Hoogwijk M, Faaij A, Eickhout B, de Vries B, Turkenburg W. Potential of biomass energy out to 2100, for four IPCC SRES land-use scenarios. Biomass and Bioenergy 2005;29(4):225-257.
[10] FAO. World agriculture towards 2015/2030: Summary report. Rome; 2002.
[11] Tilman D, Hill J, Lehman C. Carbon-Negative Biofuels from Low-Input High-Diversity Grassland Biomass. Science 2006;314(5805):1598-1600.

which could yield over 4000 TWh of energy annually by 2050.[12,13] It should be noted that these figures represent the potential for production of energy not specifically electricity, therefore the availability will be less for electricity alone. Nevertheless this demonstrates the large potential of agricultural waste to contribute to electricity from renewable sources.

SISTech's analyses of biomass research suggests a general consensus among the research that there is theoretically ample supply of biomass to meet anticipated demand, without the risk of endangering food supply or primary uses of timber. The crucial issue is whether the production of biomass will be undertaken in an environmentally and socially sustainable fashion. It is thus of vital importance that Forth Energy's sourcing of woody biomass is done in a responsible way. Internationally accepted sustainability certification schemes can be significant in ensuring this is done. Forth Energy has committed to obtaining certified forest products but there are also grounds for suggesting that biomass certification systems such as the *Green Gold Label* should also be adhered to. These are stricter in their biodiversity considerations and deal, to an extent, with protecting the long term sustainability of energy crop projects.[14]

Although the initial findings presented here suggest that there will be ample global supplies of biomass to meet anticipated energy demand, it seems likely that there will be regional shortfalls.[15] With this in mind, SISTech's ongoing research focuses on a lower level regional analysis, in order to establish which geographical areas may be able to supply the Forth Energy REPs in a sustainable fashion.

[12] Fischer G, Schrattenholzer L. Global bioenergy potentials through 2050. Biomass and Bioenergy 2001;20(3):151-159.
[13] Heinimö J, Junginger M. Production and trading of biomass for energy - An overview of the global status. Biomass and Bioenergy 2009;33(9):1310-1320.
[14] Englund O. An overview of biomass certification systems. Gothenburg: University of Gothenberg; 2010.
[15] Smeets E, Faaij A. Bioenergy potentials from forestry in 2050. Climatic Change 2007;81(3):353-390.