Energy and Climate Change Select Committee: Bioenergy call for evidence.

Response from the Centre for Energy Policy and Technology, Imperial College London (ICEPT)

08/05/2013

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Covering note

ICEPT is an interdisciplinary research centre focused upon the interaction of technology and policy. From its base at Imperial College, the centre is uniquely placed to gather insights into technological and scientific developments relevant to contemporary debates in energy policy. ICEPT is funded by a wide range of bodies, including UK research councils, industry, the EU, and NGOs. It is independent and does not exist to promulgate any particular agenda related to bioenergy, renewables or energy policy more widely. The centre also has policy analysis expertise, drawing upon a wide range of system modelling, scenario and technology assessment techniques. ICEPT runs the Technology and Policy Assessment function of the UK Energy Research Centre (www.ukerc.ac.uk). The reports it produces have been widely cited by select committees and in policy documents.

Dr Raphael Slade is a Research Fellow at ICEPT and a leading specialist is bioenergy systems analysis. He has undertaken extensive work on biomass resource estimation, policy, and technology development. Dr Gross has undertaken extensive research in a wide range of energy policy areas, specialising in innovation policy, and is a Co-Director of the UK Energy Research Centre (www.ukerc.ac.uk).

This submission is based upon their combined knowledge of the global biomass sector. It is structured in accordance with the list of questions put forward by both committees in the evidence call.

Introduction.

Bioenergy sits in a hugely complex policy landscape, cross-cutting through energy security, carbon goals, renewables targets, heat, power, transport, forestry & timber, food & farming, waste, air quality, rural development, and impacts on other biomass users. Nevertheless, bioenergy technologies are fully commercial, proven at scale, and can deliver the full range of energy services: power, heat and transport fuel. The debate around bioenergy is not about whether bioenergy is effective, rather it is around the scale of the contribution that is desirable, and ensuring that the positive impacts predominate.

There are many novel bioenergy technologies being developed and currently being demonstrated, for example biofuels from lignocellulosic material. In our view these technologies will broaden the feedstock base and lead to increased conversion efficiencies, thereby providing incremental improvements in the economics and environmental performance of bioenergy. The contribution that biomass can make to the UK's decarbonisation 2020 targets, however, will be through the deployment of proven and commercially available technology.

What contribution can biomass make towards the UK's decarbonisation and renewable energy targets? Are the Government's expectations reasonable in this regard?

DECC's 2011 renewable energy roadmap indicates that the role of biomass could be 32-50TWh biomass electricity and 36-50TWh biomass heat. To provide this would require 19-30 million tonnes of biomass pellets for electricity production, and 10-13 million tonnes for heat[1] .

In 2010 we undertook a detailed analysis of estimates of UK domestic biomass production potential. We found that estimates range from ~24-65 million tonnes. It is important to note that the higher estimate requires all constraints (including economic) to be removed or overcome and this would be extremely challenging. For this reason imports of pellets are expected to play an important role in biomass provision, particularly for electricity production[i].

In 2012 we undertook a limited survey of UK pellet producers. At this time they expressed limited interest in providing pellets for co-firing, preferring to focus on the domestic heat market. This supports the idea that imports will be required[ii].

Total global pellet production has grown rapidly from ~10Mt in 2007 to ~18Mt in 2011 (annual growth rate 17%). Currently 2/3[rds] of all pellet imports to the EU are from North America (Canada and US) 90% of which are consumed in six countries: UK (0.9Mt), Netherlands (0.7MT), Belgium (0.3Mt), Italy (<0.1Mt), Denmark (<0.1Mt), and Sweden (<0.1Mt). The remainder is mainly sourced from Russia and goes to Sweden and Denmark. The vast majority of pellets are sold via long term bilateral contracts.

Numerous reports have attempted to estimate EU consumption of wood pellets in 2020 and estimates range from 23-80 million tonnes[iii]. **From this comparison It can be seen that the UK's co-firing ambitions will result in the UK becoming a major player in the growing international trade in pellets. It should also be recognised that this market will continue to develop with, or without, UK participation. Participation by the UK provides the opportunity to shape the market as it develops, and may be a pre-requisite to securing access to these energy resources.**

How well have the Government's bioenergy principles (set out in the 2012 Bioenergy Strategy) been translated into policy?

The international trade in bioenergy products is young and still developing. The standards and best practice required to ensure that these supply chains are sustainable need to co-evolve as the market grows. For this reason we broadly welcome the Government's bioenergy principles, and consider that the approach is pragmatic and has the potential to give the flexibility required. Monitoring and evaluating supply chains as they are developed is essential. Waiting until every aspect of every supply chain can be unequivocally proven to be better than the alternative is a recipe for paralysis and limits the opportunity to learn what works and what doesn't.

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[1] Conversion from TWh to metric tonnes assumes a conversion efficiency of 35% for electricity, 80% for heat and a lower heating value of 17 GJ/tonne.

Are genuine carbon reductions being achieved?

In 2012 we looked at a number of illustrative supply chains that could supply co-firing plants in the North East UK with ~4 million tonnes of imported pellets per year using the UK Biomass and Biogas Calculator. The results are shown in Figure 1 below. Overall the results (65-140 gCO2e per KWh) compare favourably with the current Ofgem limit of 285gCO2e per KWh.

Figure 1. Lifecycle greenhouse gas emissions and percentage GHG saving for each supply chain calculated using Biomass and Biogas Carbon Calculator developed by E4tech and Concepto for DECC

Route	**Average Fuel Carbon Intensity (incl. land use change) (g CO2e per MJ)**	**Average Final Electricity Carbon Intensity (incl. land use change) (g CO2e per MJ)**	**Average Final Electricity Carbon Intensity (incl. land use change) (g CO2e per kWhe)**	**GHG Saving (%)***
British Columbia to Vancouver to North East UK	13.9	38.8	139.68	80.2
Ontario to Port of Belledune, Eastern Canada to North East UK	13	36.2	130.32	81.7
Waycross Georgia to North East UK	8.4	23.4	84.4	88.2
British Columbia to Vancouver to East Scotland	13.5	30.5	109.80	84.6
Ontario to Belledune, Eastern Canada to East Scotland	7.92	17.9	64.5	91
Waycross Georgia to Savannah to East Scotland	8	18.2	65.52	90.8

GHG saving is relative to the EU recommended comparator value for EU-wide fossil fuel electricity of 712.8 kg CO2/MWh[ii].

Although it is relatively easy to compute supply chain GHG emissions and conclude that the supply chains are sustainable since they are within the maximum emissions limit values, the reality of creating and implementing these sustainable supply chains requires significant effort, particularly in terms of time. **It takes several years to build up relationships with potential suppliers, convince producers of the merits of sustainable practices and visit pellet production sites and raw material locations in order to understand the supply chain**. Assessing sustainability factors such as biodiversity, soil and water quality, and socio-economic impacts requires a similar investment in monitoring.

Is bioenergy making a cost effective contribution to carbon emission objectives?

For the illustrative supply chains above, we found that approximately 4 Mt of wood pellets could be procured from nine North American producers for use in UK power generation; 2.3 million from five Canadian and 1.7 million from four U.S. southeast producers. Industrial wood pellets can be purchased on long term contracts, duration ranging from 2-15 years and delivered prices ranging from 22.50 to 26.50 £/MWh (primary energy basis). Supplies sold on long-term contracts beginning in 2015 are being finalised today, and project realisation requires at least three years[2].

In 2012 we also spoke with the four largest UK wood pellet manufactures and a major distributor. This discussion provided the following insights:

- The four largest UK wood pellet manufacturers target the heat market and only occasionally sell to the large scale power market.
- Greater margins can be achieved by selling their pellets to the heat sector, where they are cost competitive with substitute products such as oil and gas.
- UK wood pellet manufacturers favoured exporting excess wood pellet output to European heat markets rather than selling to UK power markets due to better profit margins. As a result, no producer was interested in supplying new co-firing facilities.
- Wood pellet manufacturing in the UK is limited by raw material availability; the largest producers are co-located with the raw material sources.
- Competition with the animal bedding sector for raw materials is increasing production costs. (Wood pellets are replacing shavings and straw as animal bedding material of choice, particularly amongst horse owners. This is due to cost increases brought about by shortages in shavings due to the downturn in construction activity since 2008)
- UK suppliers are beginning to seek alternative raw materials such as solid recovered wood, but all suppliers contacted were dismissive of energy crops as a supply source in the short and medium term (5-10 years).

Is support for bioenergy maximising the overall benefit to the economy?

At an abstract level there is good agreement about which features of bio-energy pathways are desirable. A viable substitute for fossil fuels it is argued, should:

- have superior environmental benefits over the fossil fuel it displace;
- be economically competitive with fossil fuels;
- be producible in sufficient quantities to make a meaningful impact on energy demands; and,
- should provide a net energy gain over the energy sources used to produce it.

Yet, when it comes to comparing individual pathways there is little agreement about which performance metrics best capture all the relevant information. In 2011 we undertook a review of metrics used to compare bioenergy pathways and concluded that.

- The diversity of bio-energy feedstocks and conversion technologies means that there is unlikely to be a one-size-fits-all best use of biomass.
- All commonly used metrics involve a high level of subjective judgement. Metrics that aspire to measure the social and ecological impacts of bio-energy development inherently involve value judgements. They may also require ongoing monitoring.

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[2] Only four North American suppliers were willing to provide indicative prices, primarily due to the commercial sensitivity of long term contracts.

- Using a single metric – e.g. *cost-per-tonne-of-carbon-saved* – risks oversimplification and is best avoided[iv].

Is sufficient attention being given to potential impacts in other areas, such as food security and biodiversity?

The attention given to the consequential impacts of bioenergy development is arguably greater than the attention given to the expansion of existing industrial and agricultural practices which are known to be environmentally damaging. For example, oil production from tar sands, or increasing soy production to meet increasing demand for animal feed.

A heightened level of scrutiny is justified on two counts. Firstly, public support is required to develop bionergy supply chains (at least in the short term) and this support is predicated on the overall impact being positive. Secondly, creating new links between the energy, food, and materials sectors could increase competition, the results of which might be undesirable, or unpredictable.

A core argument against co-firing is that it might deplete standing biomass thereby leading to net carbon emissions compared to a scenario where there was no increase in demand for forest biomass. The risks of a "carbon debt" being incurred by certain forest management options have been appreciated for at least 20 years[v]. Whether a debt arises depends on the balance between the natural disturbance regime (fire, pests, storms, etc.) and the human imposed regime (harvesting).

Important factors that can influence whether carbon is sequestered or emitted at a landscape level include the choice of management regime, the frequency of natural disturbance, and the age structure of the forest[vi]. The timescale over which the question in framed is also important: sustainably managed forest may be harvested in a rotation >60 years and this meshes poorly with the much shorter timeframe over which policy targets are set and reviewed.

The report "*Dirtier than Coal?*" [vii] compares a scenario in which forest biomass is harvested with one in which it is assumed that no harvesting occurs and the forest matures to maximise the carbon content of the landscape. This comparison is an oversimplification because it ignores the impact of episodic natural disturbances that mean that the theoretical maximum carbon content of the landscape is never attained in practice. Making such a comparison exaggerates the apparent size of any carbon debt that might occur.

What challenges are there to scaling up the use of biomass in the UK (i.e. regulation, feedstocks, sustainability, supply chain and financing)?

At present most industrial wood pellets are traded under long-term bi-lateral contracts. The length of long term contracts varies from 18 months to 15 years depending on individual client requirements. The average long-term contract length is now thought to be in the region of 10-14 years[viii].

Many biomass fuel supply risks can be traced back to counterparty risk i.e. seller insolvency and supplier credit worthiness. There is also a disparity between supplier and off-taker expectations of resource and supply chain risk management. In particular, long term contracts for raw materials are not traditionally very common in the forest residues sector. Sectors competing for this wood fibre, such as the pulp and panel-board industries traditionally do not purchase material more than a few weeks or months in advance. The strategy adopted by RWE (owners of Tilbury) to mitigate these risks is to invest in wood pellet production plant[3].

Industrial wood pellets have recently started being traded in the major global commodities exchange ports of Amsterdam, Rotterdam and Antwerp (ARA). At the moment the spot market is not large enough to support a large co-firing development.

References

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[ii] Buckley, D. The potential supply of sustainable solid biomass for large-scale power generation in the UK, MSc Thesis, Imperial College London. 2012

[iii] See for example:

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[iv] Slade, R., Bauen, A., Gross, R., (2010) Prioritising the best use of biomass resources: conceptualising trade-offs. UK Energy Research Centre (UKERC), Ref: UKERC/WP/TPA/2010/003

[v] Marland, G. and Marland, S. (1992) Should We Store Carbon in Trees? Water, Air, and Soil Pollution, 64, 181-195.

[vi] Carbon budget implications of the transition from natural to managed disturbance regimes in forest landscapes. 1998. Kurz, W.A.; Beukema, S.J.; Apps, M.J. Mitigation and Adaptation Strategies for Global Change 2(4): 405-421.

[vii] Dirtier than coal? Why Government plans to subsidise burning trees are bad news for the planet. *www.rspb.org.uk/Images/biomass_report_tcm9-326672.pdf*

[viii] Hawkins-Wright (2011) *Forest Energy Monitor.* Issue 13 – May 2011. Bingham, J. (2012) *Biopower generation: some thoughts on the outlook for co-firing and conversion* [Presentation] Hawkins-Wright, Rotterdam, 14 March 2012.

[3] RWE has built a 750,000 metric tonnes per year pellet plant, in Waycross, Georgia, in the southeast US. It began operating in late 2011.