Burning Wood for Power Generation

The Key Issues Explained

Summary

Burning wood for electricity generation in new power stations and existing coal-fired plant is about to grow rapidly in response to a generous new subsidy regime. Government projections suggest that it will increase twelve-fold over the next five years, with many coal stations considering full-scale conversion of their boilers to wood. This briefing paper looks at some of the key facts around the sustainability of 'biomass power', specifically:

1) There is a growing wealth of evidence from academia and Governments – including the Department for Energy and Climate Change – that suggests that burning wood in power stations can be worse for the climate than fossil fuel alternatives.
2) Burning waste wood, forestry residues and arisings for electricity offers potential emission savings, but they are a very limited resource compared to overall ambition in this sector. This wood is also in demand from other industries, and even if all forestry residues and offcuts in the UK were used for electricity they would only generate 1.3% of our electricity supply.
3) Government's proposed requirement that wood-fired electricity delivers an emission reduction of 60% is ineffective as it does not count two of the main sources of emissions, including the CO_2 emissions that are released when the wood is burnt.
4) Combined Heat and Power is a considerably more efficient way of using a limited resource, whilst Carbon Capture and Storage offers the potential for genuine emission reductions or even 'negative' emissions.
5) A domestic bioenergy industry could still play a very important role - the Climate Change Committee estimates that by 2050 the sustainable domestic available resource will be sufficient to supply 8% of the UK's energy needs.
6) Government's proposed sustainability standards for biomass will not rule out the use of wood from forests where management regimes cause problems for biodiversity.

Introduction

Subsidies for burning wood in power stations through the Renewables Obligation and the support mechanisms being introduced in the Energy Bill will lead to an unprecedented increase in the amount of wood used for power generation. By 2017, DECC expect about 6GW of biomass power to be online (compared to 0.5GW currently), which will need the equivalent of up to 30 million tonnes of oven-dried wood. That's about six times the entire UK forest harvest.

This briefing outline key reasons as to why more scrutiny is urgently needed of Government policy in this area to ensure the UK is not locked into financially supporting an industry that results in increasing greenhouse gas emissions and other serious sustainability issues.

Fact 1 - Burning wood in power stations is not carbon neutral

When wood is burnt in a power station CO_2 is released into the atmosphere, just as it is with fossil fuels. This CO_2 is not counted in Government's proposed greenhouse gas standard even though it is the single largest emission associated with bioenergy. This is justified by the assertion that the CO_2 is immediately neutralised by regrowth in the forest from which the wood was harvested.

This goes against common sense as well as a growing body of academic evidence. For example:

- Hudiburg et al.'s (2011)[1] study of 80 forest types on the US West Coast showed "that fire prevention measures and large-scale bioenergy harvest in US West Coast forests lead to 2–14% higher emissions compared with current management practices over the next 20 years".
- Bernier & Paré (2013)[2] model the net CO_2 emissions from harvesting a Canadian boreal forest for bioenergy and calculate that they are neutralised by regrowth only after ninety years.
- McKechnie et al. (2011)[3] performed an integrated life-cycle and forest carbon analysis for wood harvested from a Canadian forest. They conclude "electricity generation from pellets reduces overall emissions relative to coal, although forest carbon losses delay net GHG mitigation by 16–38 years, depending on biomass source (harvest residues/standing trees)."

In effect, what actually happens is that wood is harvested and burnt, emitting CO_2 into the atmosphere and creating a 'carbon debt'. This debt may be repaid by sequestration from regrowth and from growth in the wider forest, but depending on the sequestration rate it may take many years for the end of pipe emissions to be neutralised. In a review of the evidence in 2011, the European Environment Agency[4] concluded that:

"*Producing energy from biomass is meant to reduce GHG emissions. But burning biomass increases the amount of carbon in the air if harvesting the biomass decreases the amount of carbon stored in plants and soils, or reduces ongoing carbon sequestration [...] legislation that encourages substitution of fossil fuels by bioenergy, irrespective of the biomass source, may even result in increased carbon emissions*"

Fact 2 – Residues and wastes are a very limited resource

In response to evidence that the use of whole trees results in more greenhouse gas emissions than coal, DECC argued that[5]:

"*The NGO report gives the impression that our policy is simply to divert whole, mature trees from construction and manufacturing and turn them into energy. It isn't. We don't think this is sustainable, and it is not what our Bioenergy Strategy suggests. The evidence gathered for*

[1] Hudiburg, T., et al. (2011) "Regional carbon dioxide implications of forest bioenergy production" *Nature Climate Change* 1 pp419-423
[2] Bernier & Paré (2013) "Using ecosystem CO2 measurements to estimate the timing and magnitude of greenhouse gas mitigation potential of forest bioenergy" *GCB Bioenergy* Vol. 5 pp67-72
[3] Mckechnie et al. (2011) "Forest Bioenergy or Forest Carbon? Assessing Trade-Offs in Greenhouse Gas Mitigation with Wood-Based Fuels" *Environ. Sci. Technol.*, 2011, 45 (2), pp789–795
[4] European Environment Agency (2011) "Opinion of the EEA Scientific Committee On Greenhouse Gas Accounting in Relation to Bioenergy"
[5] DECC Blog by Bernie Baulkin (2012) "Using wood for bioenergy"

that Strategy shows that the current typical practice of taking the residues from timber production deliver greater GHG benefits than leaving the forest unmanaged."

Similarly, the industry have argued that they will principally use "residues and offcuts". There are a number of problems with this assertion:

1) Government's own statistics show whole trees were burnt in power stations last year

Ofgem publish statistics reported to them by power companies about what wood is burnt where. Reporting on the type of wood that is burnt is not required, but in 2011/2, 135,000 tonnes of roundwood (i.e. the tree trunk) was self-reported to have been burnt in power stations.

2) US wood pellet companies use whole trees

The Dogwood Alliance, a US based NGO dedicated to the conservation of the Southern forests, have documented evidence of US pellet plants that supply the UK using whole trees[6]. The report finds that Georgia Biomass – a wholly owned subsidiary of RWE Innogy that provides Tilbury coal power plant with biomass takes in "more than 1 million metric tons of logs annually". In another example, Enviva, who supply Drax amongst others, talk about using "round logs to produce our product". Images from the report are shown in Figure 1 and Figure 2.

Figure 1 Aerial view of the log yard at Georgia Biomass, a company owned by RWE Innogy[7]

[6] Dogwood Alliance (2012) "The use of whole trees in wood pellet manufacturing"
[7] From Dogwood Alliance (2012)

Figure 2 Green Circle Bio Energy's wood pellet facility in Florida – Green Circle sell pellets to the UK market[9]

3) Residues, wastes and 'low quality wood' are a limited resource

The use of forestry arisings, offcuts and organic wastes such as olive pips offers real greenhouse gas emission reductions, but they are an extremely limited resource. For example, a maximum of 1.3% of UK electricity could be generated if all residues and offcuts from UK forestry are used for electricity generation, the impact this would have on the environment and other wood-using industries aside. Similarly, US forestry residues (including tree tops and branches) are estimated to be about 46mn oven dried tonnes if they were all collected (although this could have a significant environmental impact). This could generate electricity the equivalent of 1.7% of US electricity consumption[8], and compares to the ~30mn tonnes needed by UK electricity generators in 2017.

Energy generators have also stated they intend to use sawmill co-products and "low quality timber" for their power stations, and that "good quality wood" will not be used[9]. According to the wood panel industry, however, this wood is used to produce the majority of kitchens, furniture for homes and offices, flooring and wooden panels used in construction, in the UK. The wood panel industry sources 1/3 of its material from small roundwood, one third from sawmill co-products, and one third from recycled wood. This is an already heavily subscribed market place, and using this virgin timber for construction materials and furniture, rather than simply burning it for electricity, ensures the carbon is locked up for decades.

The IEA note that whilst sawdust from sawmills is the main source of wood for pellets used in the energy sector, this is changing because of limitations and fluctuations in the availability of this feedstock. They note that:

"*Difficulties in sourcing feedstock at competitive prices are an important factor [...] As a consequence, a need for a more stable and secure supply of feedstock has emerged and, therefore, the interest of producers in the supply of alternative feedstock such as round-wood and forest residues is growing.*"[10]

[8] Based on 2008-2011 FAOStat Forestry Production data; Energy consumption from CIA World Factbook
[9] E.g. http://www.draxgroup.plc.uk/biomass/fourthsource/biofilm/
[10] IEA Bioenergy (2012) "Global wood pellet industry market and trade study" pg 7

Fact 3 – Government's proposed sustainability standards will not ensure actual emission reductions

Government are proposing that biomass electricity generators must meet two standards in order to receive public subsidy, but unfortunately neither addresses the major sources of emissions from wood harvested from forests and used for energy – the net reduction in the carbon sink as a result of wood removal and combustion minus any sequestration, and indirect emissions as a result of using wood that would otherwise have been used in other industries.

The first requirement is for generators to use a carbon calculator administered by Ofgem to demonstrate a lifecycle emission reduction of 60% compared to the average grid must be achieved (=285gCO_2/kWh). The calculator estimates emissions from harvesting, transporting and processing wood but it counts the emissions that are released on combustion of the wood as zero rather than calculating the actual change in carbon stock. Furthermore, the calculator assumes that any wood used for energy had no alternative use and that there are thus no indirect emissions. DECC's new prototype 'Biomass Emissions and Counterfactual Model' (BEAC) account for both of these sources of emissions and demonstrate the huge significance of ignoring them, however DECC have not yet published these findings.

The second requirement is for generators to ensure that any wood used should meet the Government procurement sustainability standards. This includes ensuring traceability as well as, ideally, accreditation under a sustainability certification scheme. Whilst these schemes can be useful in their own right they have little to do with carbon emissions from biomass electricity as they do not affect either of the major emission sources – carbon debt or indirect emissions.

Fact 4 – Combined Heat and Power and CCS offers a better use of biomass

Combined heat and power is a considerably more efficient use of a limited resource than generating electricity only either in new power stations or existing coal plants. In fact, CHP can achieve efficiencies of 65-75%, compared to 20-25% for more traditional biomass plant where the surplus heat is effectively wasted. CHP plants are generally smaller too as their size has to be commensurate with the size of local heat demands, be they domestic or industrial. A requirement that biomass power plants use CHP therefore helps ensure that the overall size of the biomass power sector keeps to sustainable limits. Furthermore, smaller plants are more able to use local supplies of biomass, reducing the overall carbon footprint and delivering local economic benefits that are lost when using imported wood.

The Scottish Executive have recognised this, and have introduced a requirement that all plant larger than 15MW must be CHP if they want to claim public subsidy[11], citing the need to respect the fact that there is 'a finite supply of wood' as their principle justification[12]. The CHP requirement achieves this by making large scale plants that would demand unsustainable levels of wood impractical and less economically attractive, and by ensuring that where development does take place it is either CHP or relatively small in scale, reflecting the limited availability of sustainable wood.

[11] Scottish Executive (2012) Summary of Supplementary Consultation Outcome (Parts B – D) and Scottish Government Response

[12] http://www.scotland.gov.uk/News/Releases/2013/02/RO7213

15MW is an appropriate threshold because any plant of this size or larger is a commercial operation designed to generate electricity for wholesale rather than a community project or to supply a specific site such as a school, university or hospital. A 15MW plant would generate enough electricity to supply over 20,000 homes.

CCS on biomass power stations can result in low or even 'negative' emissions. The Climate Change Committee[13] highlighted this as key if the biomass industry is to play a long-term role in helping the UK meet its climate commitments. Hence it seems appropriate that any major investment in converting coal power stations to biomass, for example, should be linked to CCS demonstration.

Fact 5 – Bioenergy can still play an important role in delivering low carbon energy

Bioenergy from wastes and certain sustainably managed feedstocks can deliver significant and genuine greenhouse gas emission reductions and can still play a significant role in meeting the UK's renewable energy and climate commitments. The Climate Change Committee estimates that by 2050 the sustainable domestic available resource will be sufficient to supply 8% of the UK's energy needs. This includes waste wood, organic wastes, sewage, agricultural by-products, some energy crops, and forestry arisings.

Limiting the role of biomass power based on wood therefore needs to be accompanied by much greater support for producing, processing and using sustainable domestic feedstocks for efficient energy generation.

Fact 6 - Wood used in power stations will not necessarily be from sustainable sources

Government and industry promise that wood will be legal and certified as sustainable. Government have proposed that this should be delivered by applying the categories for its own procurement to define the 'legality' and 'sustainability' of timber – the Central Point of Expertise on Timber (CPET) Categories A and B. Whilst this is a useful standard for ensuring traceability, the evidence criteria used for compliance with these standards may not guarantee sustainability. This is particularly true for the evidence required to demonstrate compliance with CPET Category B, which does not offer assurances that forest management does not harm important biodiversity, particularly when the wood/timber is from non-UK sources.

CPET Category A evidence is also problematic and offers limited biodiversity assurances as it includes the less environmentally credible Programme for Endorsement of Forest Certification (PEFC) system as well as the more environmentally valid Forest Stewardship Council (FSC) system. FSC fully includes environmental, social as well as economic stakeholders in policy making, standard setting, site audit, and complaint processes, has compliance audit protocols that are at site rather than regional level, and includes key biodiversity principles and criteria for sustainable forest management. PEFC fails on these counts, and as a result environmental problems arise. A 2011 investigative report[14], for example, revealed a series of case studies of PEFC certified forest managements that had caused damage and/or destruction to ecosystems, valuable wildlife habitats and endangered species.

[13] The CCC (2011) Bioenergy review
[14] Climate for Ideas et al. (2011) *On the ground: the controversies of PEFC and SFI*

Due to the likely volumes of timber and wood products that large-scale biomass electricity generation in the UK will require, the majority of this material is likely to come from CPET Category B, rather than Category A material, and from non-UK sources. This means that there will be significant risks that the wood will be from less environmentally credible forest management that harms important biodiversity.

Even from UK grown material, CPET Category B does not always guarantee environmentally sustainable forest management. This is because the key mechanism used as evidence of CPET compliance is the UK Government and devolved administrations' minimum mandatory sustainable forest management standard - UK Forestry Standard. Unfortunately this standard was not designed to meet sustainability sourcing criteria and its implementation does not have robust enough audit, surveillance and compliance procedures to detect and rectify problems even within the main forestry/woodland management consenting regimes. The UK Forestry Standard is also not fully applied to all woodland planting, felling and management, for example it is seldom required for agricultural and land use planning system consented woodland work.

Examples of unsustainable practices in the UK that may still be covered by CPET Category B include the felling of ancient semi-natural woodlands for development, the inappropriate location of new woodland planting on high biodiversity value wading bird habitats, semi-natural grassland and peatland on agricultural land, and biodiversity inappropriate management of existing native woodland on farms.

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