Supplementary note: Biomass power and GHG sensitivities

Introduction

1. As part of the Biomass Electricity and Combined Heat & Power plants – Value for money and affordability consultation, and specifically in the context of the proposal to limit dedicated biomass, respondents raised a number of queries in regards to the methodology used to calculate the relative cost effectiveness of biomass technologies presented in the Bioenergy Strategy[1]. This note aims to address the issues raised, and test our conclusions, by building on the cost effectiveness calculation included in the Bioenergy Strategy.

Summary

2. For the purposes of the Bioenergy Strategy and wider decision-making on the sustainability of bioenergy, it is important to consider the full greenhouse gas (GHG) lifecycle emissions attributable to bioresources as far as possible, including emissions occurring outside the UK. However, calculating full lifecycle emissions can be challenging and significant data limitations exist.

3. Illustrative carbon cost effectiveness analysis[2] undertaken for the Bioenergy Strategy showed that if lifecycle emissions as currently captured under the Renewable Energy Directive are taken into account, new dedicated biomass electricity plants can, at current support levels, be more expensive in terms of cost of carbon abatement compared to other renewables. Therefore, while a small amount of it is affordable and cost-effective within the framework of the overall RO package, it becomes increasingly less attractive in the longer term and at larger volumes, even taking account the ambition for higher sustainability standards.

4. When analysing the possible GHG emissions savings from switching from fossil fuels to bioenergy, it is possible to take a range of approaches regarding which elements are included within the lifecycle assessment, which counterfactual is used, and what the practical impacts will be of setting a mandatory sustainability target in practice. This note provides further explanation on the choice of counterfactual fuels during the RO period and analyses the sensitivities around the carbon cost effectiveness calculations included in the Bioenergy Strategy, by taking into account that:

   (i) biomass plants are likely to operate at a margin (headroom) below emission standards set by Government in order to secure finance and eligibility of payments; and
   (ii) fossil fuels will also incur emissions alongside their supply chain.

5. The analysis concludes that the cost effectiveness relativities presented in the Bioenergy Strategy, which help inform the biomass policy proposals under the Renewables Objective, remain valid when lifecycle fossil fuel emissions and operating headroom are included in the calculations. When considering cost effectiveness estimates, it is important to note that the relative carbon cost effectiveness of technologies can change over time due to changing technology characteristics and relative economics, and the analysis here presents just one

[1] http://www.decc.gov.uk/en/content/cms/meeting_energy/bioenergy/strategy/strategy.aspx
[2] See Bioenergy Strategy - Box 14, Section 4, page 47.

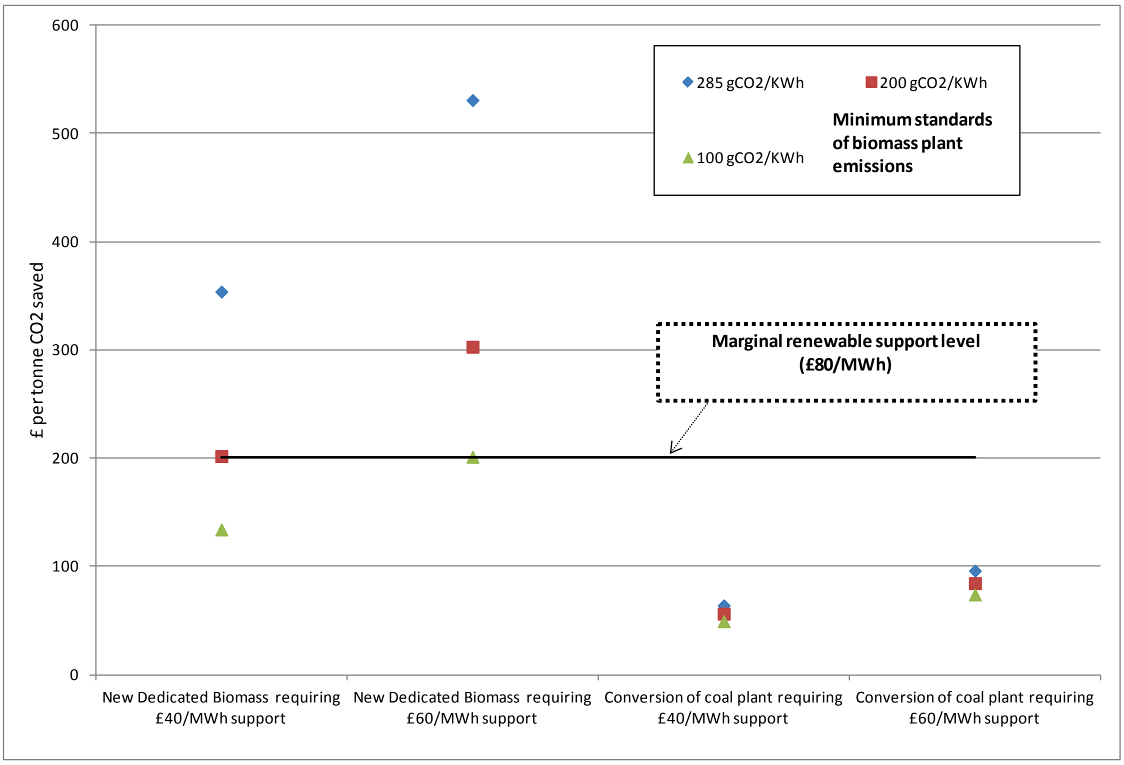
scenario. It is also important to consider the wider benefits of developing a balanced energy mix, such as security of supply.

The Bioenergy Strategy – Carbon cost effectiveness analysis

6. The Bioenergy Strategy set out illustrative carbon cost effectiveness analysis of subsidy payments[3] for biomass in power (not using waste as the feedstock), including new build dedicated plants and the conversion and co-firing of existing coal plants to use biomass. Figure 1 below, from the Bioenergy Strategy, illustrates the relative cost effectiveness of these technologies, taking into account different carbon emission standards[4] and different levels of required generation support. For new dedicated biomass plants, the carbon savings are calculated by comparison to Combined Cycle Gas Turbine (CCGT) plants, whilst for conversion plants, the comparison is made to coal power plants.

7. The chart includes an estimated cost effectiveness of the marginal support of large scale electricity under the renewables obligation, assuming around £80/MWh higher renewable generation cost against a CCGT counterfactual. The graph illustrates that under different assumed emissions standards and cost levels, conversions of coal plants can offer significantly better value for money in carbon abatement terms when compared to dedicated biomass plants.

Figure 1: Carbon cost effectiveness of non-waste biomass in power (new build dedicated plants and conversions/co-firing)



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[3] Illustrative £/MWh support scenarios are assumed for dedicated biomass and conversion technologies.

[4] Under the Government's current support mechanisms biomass power generators are required to report against a maximum lifecycle emission of 285 kg CO2 /MWh. The Government has recently consulted on proposals for an enhanced sustainability criteria trajectory, and will announce its policy intent in the new year.

8. Consultation responses suggested that a CCGT plant at the Emissions Performance Standard (EPS)[5] (450g/kWh or 495g/kWh if assume 10% lifecycle emissions) would be more appropriate counterfactual for both dedicated biomass and conversions and co-firing. It was suggested that such a counterfactual would allow the maximum tailpipe emissions for gas, adjusted to full lifecycle, to be compared to the maximum GHG emissions for biomass (i.e. as set out by the sustainability levels).

9. Recognising that actual emissions from biomass are likely to be lower than the maximum required levels, as developers build in a margin to secure finance and eligibility of payments, this note incorporates in the cost effectiveness analysis sensitivities on the potential response from industry to a mandatory emission standard. This approach is considered more appropriate than opting for using the EPS level for plants that are operating below this maximum level[6].

10. However, given that conversions/co-firing are expected to be a relatively short term technology, existing coal plants, at 909g/kWh emission (1000g/kWh including 10% lifecycle) is considered the correct counterfactual for the RO period[7]. No adjustments have therefore been made on this counterfactual assumption. Only if conversions/co-firing became a longer term technology option, involving new build plants, would it be appropriate to switch the fossil fuel counterfactual technology to CCGT.

Adjusted carbon cost effectiveness - Biomass GHG emissions and Lifecycle emissions for fossil fuels

11. The carbon cost effectiveness analysis in the Bioenergy Strategy (see Figure 1 above) does not include lifecycle emissions for fossil fuels. This is consistent with the current carbon accounting methodology. In principle wider carbon cost effectiveness calculations should capture full lifecycle emissions whether the fuel is renewable or fossil. In this note estimates of lifecycle emissions for fossil fuel comparators have been included in the calculations illustrated in Figure 2 below. These include a: 10%[8] increase in tailpipe emissions for gas (total lifecycle emissions of 433 gCO2/KWh) and a 10% increase in tailpipe emissions for coal (total lifecycle emissions of 1000 gCO2/KWh).

12. It is also recognised that developers and plant operators are likely to design and deliver better than the minimum GHG emission standards set under Government support mechanisms in order to secure finance and to protect their future income under the RO. Industry sources have indicated that these margins will typically need to plan to be about 10%-20% lower than the

[5] The EPS will provide a regulatory back stop on the amount of emissions that new fossil fuel power stations – whether coal, gas or oil - can emit. This will help deliver the Government's commitment to preventing unabated coal-fired power stations being built, meaning that while coal can continue to make an important contribution to security of supply, it must do so in a manner consistent with the UK's decarbonisation objectives. For further information see: http://www.decc.gov.uk/assets/decc/11/policy-legislation/EMR/5350-emr-annex-d--update-on-the-emissions-performance-s.pdf

[6] Gas CCGT plants in the UK are already operating within the EPS standard of 450g/kWh; the performance of new gas plants now coming forward are expected to be the same or better reflecting technological improvements. Therefore, for new dedicated biomass power DECC considers CCGT (433g/kWh including 10% lifecycle) the appropriate counterfactual. This is below the EPS plus 10% for lifecycle emissions (495g/kWh), therefore a better counterfactual to use when comparing to new build dedicated biomass operating with an approximate 15% headroom under set emission standards.

[7] Existing coal plants that 'opted in' to the Large Combustion Plant Directive (LCPD), can continue to operate after 31 December 2015. There are 17 existing UK coal and oil plants that the Environment Agency regulates, 10 of the 17, including the 2 largest UK coal plants, chose to opt-in. Therefore if those plants intend to convert or co-fire the appropriate counterfactual is 909g/kWh (1000g/kWh including 10% lifecycle).

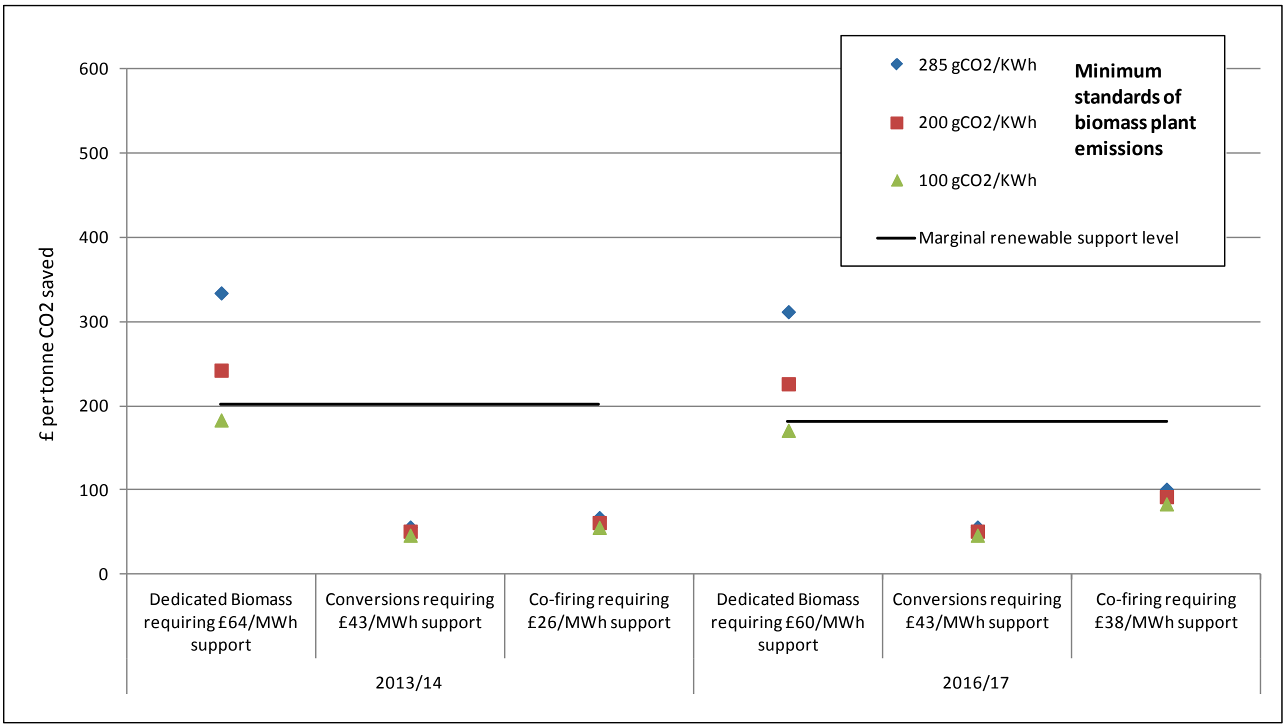
[8] Illustrative DECC estimate based on industry information.

sustainability standards (i.e. at GHG levels of 240 g CO2/kWh the actual biomass emissions will be 190-215 g CO2/kWh). This expected overshooting of the GHG emission standards has been included in the calculations below assuming 15% lower biomass lifecycle emissions compared to maximum GHG standards (e.g. 285 gCO2/kWh assumed to result in 242 gCO2/kWh standard).

13. Figure 2 also assumes:

- Dedicated biomass counterfactual = gas, conversions and co-firing counterfactual = coal, offshore wind counterfactual = gas
- Marginal ROC support levels assumed in 2013/14 and 2016/17 are consistent with those set out in the Government Response to the RO Banding Review[9], and
- Co-firing is assumed to be at 50%

Figure 2: Carbon cost effectiveness of dedicated biomass, conversions and co-firing, including fossil fuel lifecycle emissions (central DECC assumptions) and taking required sustainability standard headroom into account, in 2013/14 and 2016/17



Note: This chart is based on Bioenergy Strategy analysis, but incorporates lifecycle emissions for fossil fuel counterfactuals, and assumes biomass technologies achieve 15% below emission standard scenarios set out in chart. Subsidy levels are consistent with the Government Response to the RO Banding Review.

14. Figure 2 shows that even after incorporating these adjustments support for dedicated biomass remains less cost effective in terms of carbon saving when compared with biomass conversions and co-firing. The revised analysis therefore supports the conclusion set out in the Bioenergy Strategy on the relative costs effectiveness of dedicated biomass versus conversions and marginal large scale electricity generation.

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[9] 1.5 ROCs for dedicated biomass in 2013/14 (1.4 ROCs in 2016/17), 1 ROC for conversions, 0.6 ROCs for 50% co-firing in 2013/14 (0.9 ROCs in 2016/17), and 2 ROCs for offshore wind in 2013/14 (1.8 ROCs in 2016/17). This analysis assumes a ROC price of £43/MWh.

15. It is important to note that these carbon cost effectiveness calculations present illustrative comparisons, and are based on subsidy cost of carbon calculations that take into account non-UK emissions[10], rather than the social cost of carbon calculations set out in Interdepartmental Analyst Group (IAG)[11] guidance. The latter focuses on the assessment of proposals leading to an increase/decrease in energy use or GHG emissions in the UK, for example, in the context of carbon budgets and EU ETS – this requires emissions to be split out into traded and non-traded, and UK, EU and rest of world (and does not require lifecycle emissions to be counted).

[10] Non-UK emissions associated with the cultivation, processing and transportation of non-domestic biomass feedstocks are taken into account in the life cycle analysis (LCA) used in the cost effectiveness calculations.
[11] http://www.decc.gov.uk/en/content/cms/about/ec_social_res/iag_guidance/iag_guidance.aspx