Biomass Electricity and Combined Heat & Power plants – ensuring sustainability and managing costs	**Impact Assessment (IA)**
	Date: 07/09/2012
	Stage: Consultation
IA No: DECC0120	**Source of intervention:** Domestic
Lead department or agency: DECC	**Type of measure:** Secondary Legislation
Other departments or agencies: Defra, Forestry Commission, BIS and HM Treasury	**Contact for enquiries:** alexis.raichoudhury@decc.gsi.gov.uk caroline.season@decc.gsi.gov.uk

Summary: Intervention and Options

RPC Opinion: N/A

Cost of Preferred (or more likely) Option				
Total Net Present Value	**Business Net Present Value**	**Net cost to business per year** (EANCB on 2009 prices)	**In scope of One-In, One-Out?**	**Measure qualifies as**
£1350m	N/A	N/A	No	N/A

What is the problem under consideration? Why is government intervention necessary?

The use of biomass resources for electricity generation carries both opportunities and significant risks, and there is a role for government to navigate the development of the market around these risks. Ensuring that bioenergy is genuinely low carbon is one of the key parameters of the framework for future bioenergy policies set out in the 2012 UK Bioenergy Strategy.

There is currently a requirement on biomass power generators under the Renewables Obligation (RO) to provide sustainability reports on the biomass that they use. This includes reporting on (i) a GHG lifecycle analysis for the biomass power generated with a target maximum level of 285 kg CO2/MWh, and (ii) information on land use. The requirement is to provide a report to the best of their knowledge, but there is no formal sanction, as yet, for reporting that the criteria has not been met.

Therefore, as announced at the time of the introduction of this reporting requirement, DECC intend to formally link meeting the criteria with eligibility for ROC support for plants above 1MWe, following a statutory consultation. However, this also provides an opportunity to address increased concerns on global deforestation and to address the need for the GHG target to tighten over time reflecting UK ambitions on carbon reductions post-2020. Therefore, DECC are also proposing improvements to the criteria including the addition of a sustainable forest management approach for virgin woodfuel, and setting a reducing GHG trajectory with steps in 2020 and 2025.

In addition, DECC intends to take action to ensure value for money and affordability and that proposals reflect the new UK Bioenergy Strategy's principles, including real, cost-effective carbon reductions and consider economy-wide impact. Therefore, DECC are also consulting on a proposed cap on generation from new dedicated biomass plant, phasing out the energy crop uplift for co-firing and proposed reduction in support levels for standard co-firing (SCF).

What are the policy objectives and the intended effects?

The formal linkage of enhanced sustainability criteria with eligibility for support under the RO would aim to:
- ensure that growth in bioenergy also delivers on the UK's wider carbon and energy security ambitions;
- remove uncertainty to enable investment in new UK generation and biomass feedstock supplies;
- promote good practice on sustainable feedstock sourcing and drive innovation and improvement; and
- help secure the support of local government, NGOs and public to proposed new bioenergy developments.

The addition of controls on how much new dedicated biomass power comes forward, the removal of the energy crop uplift for standard co-firing and reduction of support for standard co-firing aim to ensure:
- the growth in bioenergy is in line with a pathway that delivers longer term cost-effective carbon emission reduction; and
- the RO remains within budget.

What policy options have been considered, including any alternatives to regulation?

Section A – Sustainability Criteria

For solid and gaseous biomass, the 3 sustainability criteria options considered are:
(i) Policy option 0:
- Maintain existing criteria - i.e. sustainability criteria with target remaining at 285 kg CO_2eq/MWh (60% CO_2e saving compared to average EU power) for Dedicated Biomass and Conversions & Co-firing.

(ii) Policy option 1: (Preferred option)
- For Dedicated Biomass accredited after April 2013: tighten target to 240 kg CO2eq/MWh (66% saving) from October 2013 to 2020, and 200 kg CO2eq/MWh (72% saving) from April 2020.
- For Dedicated Biomass accredited before April 2013: maintain standards to 285 kg CO2eq/MWh (60% saving) to 2020, and reduce it to 200 kg CO2eq/MWh (72% saving) from April 2020.
- For Conversions & Co-firing: maintain standards to 285 kg CO2/MWh (60% saving) to 2020, tighten target to 240 kg CO2eq/MWh (66% saving) from April 2020.

(iii) Policy option 2:
- For Dedicated Biomass accredited after April 2013: tighten target to 200 CO2eq/MWh (72% saving) from October 2013.
- For Dedicated Biomass accredited before April 2013: maintain standards to 285 kg CO2eq/MWh (60% saving) to 2020, and reduce it to 200 kg CO2eq/MWh (72% saving) from April 2020.
- For Conversions & Co-firing: tighten target to 240 CO2eq/MWh (66% saving) from October 2013.

All these options are subject to notification to the Commission and subject to any minimum standards that are adopted by the EU or internationally.

In additional to the options above for GHG savings:
(v) addition of sustainable forest management criteria based on exisiting forestry standard schemes
(vi) requirement for independent verification

Section B – Value for money and affordability
Dedicated Biomass Cap:
(i) Do nothing, i.e. new capacity unrestricted
(ii) Restrict capacity to 800 MW
(iii) Restrict capacity to 1 GW (Preferred option)

Energy Crops Uplift:
(i) Do nothing, i.e. energy crop uplift continues to be available for standard co-firing
(ii) Maintain the energy crop uplift in the standard (low-range) co-firing band until April 2019 for existing energy crop contracts only (Preferred option)
(iii) Retain the energy crop uplift in standard (low-range) co-firing only for generators who are already claiming the energy crop uplift until 2019
(iv) Retain the Energy Crop uplift for use with standard (low-range) co-firing band until 2019

Reduction in support for Standard Co-firing:
(i) Do nothing, i.e. SCF support remains at 0.5 for the whole period
(ii) Reduction from 0.5 to 0.3 in 2013/14 and 2014/15 (0.5 in 2015/16 and 2016/17) (Preferred option)

Will the policy be reviewed? Yes, 07/2015					
Does implementation go beyond minimum EU requirements?			Yes		
Are any of these organisations in scope? If Micros not exempted set out reason in Evidence Base.	**Micro** No*	**< 20** No	**Small** Yes	**Medium** Yes	**Large** Yes
What is the CO_2 equivalent change in greenhouse gas emissions? (Million tonnes CO_2 equivalent)			**Traded:** n/a	**Non-traded:** n/a	

I have read the Impact Assessment and I am satisfied that (a) it represents a fair and reasonable view of the expected costs, benefits and impact of the policy, and (b) that the benefits justify the costs.

Signed by the responsible Minister: Charles Hendry Date: 28 August 2012

** Microgenerators are not in scope of sustainability criteria proposals in Section A, or Standard Co-Firing support and energy crop proposals in Section B. However, microgenerators are assumed to be impacted by the dedicated biomass cap in Section B.*

Summary: Analysis & Evidence — Policy Option 1

Description:

- For Dedicated Biomass accredited after April 2013: tighten target to 240 kg CO2eq/MWh (66% saving) from October 2013 to 2020, and 200 kg CO2eq/MWh (72% saving) from April 2020.
- For Dedicated Biomass accredited before April 2013: mainatain standards to 285 kg CO2eq/MWh (60% saving) to 2020, and reduce it to 200 kg CO2eq/MWh (72% saving) from April 2020.
- For Conversions & Co-firing: no change to 2020, tighten target to 240 kg CO2eq/MWh (66% saving) from April 2020.

(Preferred option)

Note: NPV costs and benefits do not include Section B proposals on value for money and affordability.

FULL ECONOMIC ASSESSMENT

Price Base	**PV Base**	**Time Period**	**Net Benefit (Present Value (PV)) (£m)**		
2011	2012/13	**Years** 18	**Low:** -1680	**High:** 4370	**Best Estimate:** 1350

COSTS (£m)	**Total Transition** (Constant Price)	Years	**Average Annual** (excl. Transition) (Constant Price)	**Total Cost** (Present Value)
Low				-2370
High				2500
Best Estimate				70

Description and scale of key monetised costs by 'main affected groups'

The key monetised costs represent the impact of introducing tighter sustainability criteria in the large scale electricity sector. Tighter sustainability standards could reduce the amount of biomass in electricity generation, which would have to be replaced by other technologies to meet the RES 2020 target. Costs relate to resource costs of alternative renewable generation (i.e. onshore and offshore wind). Costs include estimated administration costs on biomass suppliers and operators.

Other key non-monetised costs by 'main affected groups'

Tightening sustainability standards could lead to indirect land use changes (and associated GHG emissions) which are not known. There could be indirect costs on the economy of increased prices and bills, however these are highly uncertain and will depend on the counterfactual technology. The scale of these is likely to be minimal in the central scenario, where the impact on resource costs is relatively small.

BENEFITS (£m)	**Total Transition** (Constant Price)	Years	**Average Annual** (excl. Transition) (Constant Price)	**Total Benefit** (Present Value)
Low				820
High				2000
Best Estimate				1410

Description and scale of key monetised benefits by 'main affected groups'

The monetised benefits consist of the value of higher GHG saving accruing due to the introduction of tighter GHG saving thresholds. GHG savings are estimated on a lifecycle basis and valued using the traded price of carbon (low to high IAG 2011 prices used to provide range).

Carbon savings represent total carbon savings associated with tighter sustainability standards applied to imported and UK sourced bioresources, based on a lifecycle analysis approach. **The majority of carbon savings accrue to bioresources originating from overseas (see paragraph 47).**

Other key non-monetised benefits by 'main affected groups'		
Other non-monetised benefits could occur due to tighter sustainability standards, such as the preservation of biodiversity, water and soil quality gains, protected areas and areas of high carbon stock. These are indirect benefits which are not possible to quantify. There could be indirect land use changes and associated impacts on GHG emissions which are currently not known.		
Key assumptions/sensitivities/risks	**Discount rate (%)**	3.5%
Key assumptions include the lifecycle analysis (LCA) for bioresource pathways, and assumed bioresource availability now and in the future – both of which are highly uncertain. Key uncertainties include how the supply and prices of biomass feedstocks will respond to different sustainability criteria, costs and options for counterfactual technologies (that replace biomass), and future electricity and carbon prices.		

Summary: Analysis & Evidence — Policy Option 2

Description:

- For Dedicated Biomass accredited after April 2013: tighten target to 200 kg CO2eq/MWh (72% saving) from October 2013.
- For Dedicated Biomass accredited before April 2013: maintain standards to 285 kg CO2eq/MWh (60% saving) to 2020, and reduce it to 200 kg CO2eq/MWh (72% saving) from April 2020.
- For Conversions & Co-firing: tighten target to 240 kg CO2eq/MWh (66% saving) from 2014.

Note: NPV costs and benefits do not include Section B proposals on value for money and affordability.

FULL ECONOMIC ASSESSMENT

Price Base 2011	**PV Base** 2012/13	**Time Period Years**	**Net Benefit (Present Value (PV)) (£m)**		
			Low: -2430	**High:** 5540	**Best Estimate:** 1560

COSTS (£m)	**Total Transition** (Constant Price) Years	**Average Annual** (excl. Transition) (Constant Price)	**Total Cost** (Present Value)
Low			-3210
High			3420
Best Estimate			100

Description and scale of key monetised costs by 'main affected groups'

The key monetised costs represent the impact of introducing tighter sustainability criteria in the large scale electricity sector. Tighter sustainability standards could reduce the amount of biomass in electricity generation, which would have to be replaced by other technologies to meet the RES 2020 target. Costs relate to resource costs of alternative renewable generation (i.e. onshore and offshore wind). Costs include estimated administration costs on biomass suppliers and operators.

Other key non-monetised costs by 'main affected groups'

Tightening sustainability standards could lead to indirect land use changes (and associated GHG emissions) which are not known. There could be indirect costs on the economy of increased prices and bills, however these are highly uncertain and will depend on the counterfactual technology. The scale of these is likely to be minimal in the central scenario, where the impact on resource costs is relatively small.

Tightening sustainability standards from 2013 (as opposed to the step approach in Option 1) could lead to costs incurred by generators and biomass suppliers in regards to existing contracts and investments in place, or in the pipeline, no longer meeting sustainability criteria. This is inconsistent with the policy intention to ensure sustainability criteria changes are implemented in a way that minimises disruption to industry whilst ensuring the use of biomass is put on a ambitious GHG trajectory.

BENEFITS (£m)	**Total Transition** (Constant Price) Years	**Average Annual** (excl. Transition) (Constant Price)	**Total Benefit** (Present Value)
Low			990
High			2330
Best Estimate			1660

Description and scale of key monetised benefits by 'main affected groups'

The monetised benefits consist of the value of higher GHG saving accruing due to the introduction of tighter GHG saving thresholds. GHG savings are estimated on a lifecycle basis and valued using the traded price of carbon.
Carbon savings represent total carbon savings associated with tighter sustainability standards applied to imported and UK sourced bioresources, based on a lifecycle analysis approach. **The majority of carbon savings accrue to bioresources originating from overseas (see paragraph 47).**

Other key non-monetised benefits by 'main affected groups'

Other non-monetised benefits could occur due to tighter sustainability standards, such as the preservation of biodiversity, water and soil quality gains, protected areas and areas of high carbon stock. These are indirect benefits which are not possible to quantify. There could be indirect land use changes and associated impacts on GHG emissions which are currently not known.

Key assumptions/sensitivities/risks	Discount rate (%)	3.5%
Key assumptions include the lifecycle analysis (LCA) for bioresource pathways, and assumed bioresource availability now and in the future – both of which are highly uncertain. Key uncertainties include how the supply and prices of biomass feedstocks will respond to different sustainability criteria, costs and options for counterfactual technologies (that replace biomass), and future electricity and carbon prices.		

Evidence Base (for summary sheets)

3. This evidence base contains the impact analysis for the proposals that will be included in the **Biomass Electricity & Combined Heat & Power plants – ensuring sustainability and managing costs.** The consultation is divided into two sections: (A) Sustainability criteria; and (B) Value for money and affordability. Section A and B are related in that they all impact on biomass power generation supported through the Renewables Obligation (RO), however they can be considered as standalone policy options. Given this, it is not appropriate to bundle Section A and B options to form overall NPV ranges on the summary pages, these ranges refer to Section A only. Section B contains policy options to minimise the risk of breaching the RO budget and ensure that cost-effective carbon reductions are delivered.

4. The evidence base is set out as follows:

1) Problem under consideration
2) Rationale for intervention
3) Policy objective

Section A – Sustainability criteria

4) Description of options considered
5) Analysis of options
6) Impacts of each option
7) Criteria covering other sustainability issues such as indirect land use change and social issues
8) Wider impacts
9) Summary and preferred option with description of implementation plan

Section B – Value for money and affordability

10) Dedicated Biomass Cap
11) Energy Crops Uplift
12) Reduction in support for Standard Co-firing

Annex A - GHG Life Cycle Analysis
Annex B - Cost and benefit summary of Option 2 (Section A)

1. Problem under consideration

5. The UK is committed to ensuring that the biomass used in the UK is sustainably sourced and delivers real carbon savings. The UK Bioenergy Strategy[1], published in April, highlights that clear, enforceable, transparent sustainability criteria have a key role to play in distinguishing between bioenergy which is consistent with the UK's aims and that which is not. It also sets out that ensuring that bioenergy is genuinely low carbon and cost-effective will be two of the four core principles for future government policy on bioenergy. However, currently there is no formal sanction for not meeting the existing sustainability criteria set under the RO. In addition, these criteria do not include the need for good sustainable forestry management practices, nor do they address the need for carbon savings to improve over time to reflect the UK's tougher carbon emissions targets post 2020 and out to 2050. Therefore, the intention is to consult on enhanced sustainability criteria.

6. Biomass is expected to make a significant contribution to the energy mix supported by the RO. It is

[1] http://www.decc.gov.uk/en/content/cms/meeting_energy/bioenergy/strategy/strategy.aspx

therefore important to ensure support levels and resulting bioenergy deployment reflect the new UK Bioenergy Strategy's principles within the available RO budget, including real, cost-effective carbon reductions and considering wider impacts. Therefore, the intention is to consult on a proposed cap on generation from new dedicated biomass plant, phasing out the energy crop uplift for co-firing and reductions in support for standard co-firing.

Section A – Sustainability criteria

7. The EU mandated the sustainability criteria to be used for bioliquids and transport biofuels under the Renewable Energy Directive. However, the EU left the introduction of sustainability criteria for solid biomass and biogas used for electricity and heat to the discretion of each member state, subject to compliance with EU Treaty rules, such as the internal market. The European Commission only gave non-binding recommendations for potential criteria as outlined in their 25th February 2010 report[2] and recommended that criteria for solid biomass & biogas should be similar in most aspects to the criteria mandated for transport biofuels and bioliquids under the EU Renewable Energy Directive. In April 2011, the UK introduced reporting against sustainability criteria for solid biomass and biogas under the RO. These consisted of a minimum 60% Greenhouse Gas ("GHG") lifecycle emission saving for electricity generation using solid biomass or biogas relative to the EU electricity grid average (285 kg CO2eq/MWh compared to 712 kg CO2eq/MWh), and reporting on whether or not materials were sourced from land with high biodiversity or carbon stock value such as primary forest, protected areas, wetlands and peatlands. Generators were required to report annually to Ofgem on their performance against these criteria. The sustainability criteria apply to the use of imported as well as domestic biomass and biogas for electricity generation but do not apply to waste or biomass wholly derived from waste.

8. When introducing these criteria the Government made clear its intention to formally link meeting the criteria with eligibility for support under the RO, with an expected start date of April 2013. It also set out its intention to leave the criteria without grandfathering, so that the UK approach to sustainability could be tightened in future across all power plants to reflect learning, innovation and good practice, and the UK's renewable electricity generation ambition out to 2030 and 2050. The need to move to tighter sustainability criteria was also set out in the Bioenergy Strategy, re-enforcing the policy proposal not to grandfather the standards. However, this lack of grandfathering and hence lack of certainty over future sustainability standards created an additional risk for UK industry in sourcing fuel supplies and through releasing the necessary debt finance to develop biomass plants. Public support for proposed new bioenergy plants, both at a local and national level, is weakened by criticisms that the current sustainability standards need to be tougher and broader, and be better aligned to UK intention to decarbonise the grid significantly by 2030. Industry feedback suggests that generators welcome sustainability standards in order to clearly demonstrate their sustainability credentials.

Section B – Value for money and affordability measures

9. DECC must take action to ensure that RO spent towards bioenergy delivers cost-effective carbon reductions within the agreed RO budget. This includes targeting support to the more cost effective enhanced co-firing and conversions and controlling other aspects of the RO bioenergy support, such as new dedicated biomass and standard co-firing, that risk diverting significant funding away from these.

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[2] http://ec.europa.eu/energy/renewables/bioenergy/sustainability_criteria_en.htm

2. Rationales for intervention

10. While biomass is treated as being ‘zero carbon’ at the point of its use for energy because the emissions on combustion should be matched by the carbon taken up by replanting or regrowth, there are other emissions to be considered across the full bioenergy lifecycle. They include emissions from the cultivation, harvesting, processing and transport of the feedstock. These other emissions could potentially exceed the savings from avoided fossil fuel use, for example if the feedstock were to be transported inefficiently over very long distances.

11. The particular market failure being addressed by enhanced sustainability criteria is that there are insufficient market mechanisms to ensure that the feedstocks used in power generation deliver cost-effective GHG savings on a full life-cycle basis. Market failures may also occur because of potentially negative impacts on biodiversity, water, and soils are not reflected in market prices. The proposed measures should help ensure that GHG mitigation activities in the UK electricity market through biomass generation do not lead to carbon leakage elsewhere, and give industry greater certainty in making investment decisions.

12. In addition DECC must ensure overall costs are kept within the RO agreed budget, and that it delivers cost-effective carbon reductions. Coal to biomass conversions are one of the lowest cost sources of renewable electricity, since taking coal out of the power mix provides significant carbon emissions savings[1] and converting existing coal plants is relatively low cost. Dedicated biomass in contrast is a relatively expensive technology. While a small amount of it is affordable and cost-effective at the chosen support level within the RO, it becomes increasingly unaffordable in larger volumes. Although tighter sustainably standards can improve the cost effectiveness of dedicated biomass DECC believes that its cost of carbon abatement will stay relatively high through 2020 and beyond. In order to prevent too much dedicated biomass coming forward we propose to cap the number of ROCs which suppliers can submit for dedicated biomass accredited after April 2013.

3. Policy objectives

13. The introduction of enhanced sustainability criteria aims primarily to optimise GHG savings and prevent adverse land use change such as deforestation, thus ensuring biodiversity and other environmental impacts are protected. Other important objectives are to ensure industry are given the certainty over investment conditions (regarding new UK generation and biomass feedstock supplies) they need in order to meet the 2020 renewable energy targets, and to deliver the security of supply and green jobs benefits that these imply. The intention is to set out an ambitious but feasible pathway for GHG standards that can steer the sustainable expansion of the UK and global biomass market, while providing the certainty needed for investment.

14. Setting out a clear plan for tightening sustainability criteria will also promote good practice on sustainable feedstock sourcing and drive innovation in the supply chain, and help secure the support of local government, NGOs and public for proposed new bioenergy developments. Further aims are to ensure that indirect adverse impacts are minimised – for example on global food supplies and indirect land use change – which can also help to garner public support for the use of biomass in

[1] DECC analysis for the RO takes into account the economic lifetime of coal plants and operating restrictions owing to regulatory constraints e.g. LCPD. In this Impact Assessment, DBM plants are compared to a CCGT counterfactual.

electricity generation.

15. In addition it is important to ensure UK policy for sustainability is consistent wherever possible across different biomass types and different energy uses, whether heat[2], electricity or transport, and reflects the approach set out in the EU Renewable Energy Directive. This is particularly important to ‘future proof’ the criteria, as in the longer term ligno-cellulosic production methods could lead to the use of forestry and agricultural residues for advanced biofuels and bioliquids, as well as in combustion and digestion technologies. This means that sustainability criteria will need to be closely aligned across the heat, electricity and transport sectors.

16. The introduction of value for money and affordability measures aims to ensure that the RO delivers cost-effective carbon reductions while remaining within the agreed overall RO budget.

[2] Renewable Heat Incentive: providing certainty and improving performance – consultation. Announced July 2012. The proposed sustainability criteria set out in the RHI consultation are complementary to those set out in this IA, including the addition of sustainable forest management and the GHG lifecycle assessment methodology.
http://www.decc.gov.uk/en/content/cms/consultations/rhi_cert_perf/rhi_cert_perf.aspx (closes 14 September).

Section A - Sustainability criteria

17. This section outlines the options considered for improved sustainability criteria. Options for value for money and affordability measures are covered in Section B, paragraph 74.

4. Description of options considered

Option 1 – Maintain existing criteria

18. This option would leave the sustainability criteria target unchanged at 285 kg CO2eq/MWh for all biomass used in the electricity sector.

Option 2 – Improving carbon cost effectiveness of dedicated biomass – by introducing tighter GHG emissions targets

19. Regarding a sustainability scheme for solid biomass and biogas, the following elements of the scheme need to be considered:

    (i) The scope of the scheme in terms of production of biomass and which sources of biomass or biogas are covered;

    (ii) Reporting requirements, whether the scheme should be voluntary or compulsory and coverage in terms of which end users are required to comply with the scheme;

    (iii) GHG savings performance criteria; and

    (iv) Criteria covering other sustainability issues such as indirect land use change and social issues.

20. The EU's recommend approach for solid biomass and biogas, based on the mandatory criteria for bioliquids, focuses on GHG lifecycle emission reductions relative to fossil fuel use, and protection of lands with high biodiversity or high carbon sink value. Land use change is considered within the GHG lifecycle assessment, and the general restrictions preventing the use of materials from certain specified land types including primary forest and peatlands. The EU's recommend approach does not directly address social issues, such as land use rights, nor include specific criteria for sustainable forest management.

21. These issues are considered within this Impact Assessment. In particular, the following tighter GHG emission targets have been considered:

Option 1: (Preferred option)

- For Dedicated Biomass accredited after April 2013: tighten target to 240 kg CO2eq/MWh (66% saving relative to the EU average electricity carbon intensity) from October 2013 to 2020, and 200 kg CO2eq/MWh (72% saving) from April 2020.
- For Dedicated Biomass accredited before April 2013: maintain standards to 285 kg CO2eq/MWh (60% saving) to 2020, and reduce it to 200 kg CO2eq/MWh (72% saving) from April 2020.
- For Conversions & Co-firing: no change to 2020, tighten target to 240 kg CO2eq/MWh (66% saving) from April 2020.

Option 2:

- For Dedicated Biomass accredited after April 2013: tighten target to 200 CO2eq/MWh (72% saving) from October 2013.
- For Dedicated Biomass accredited before April 2013: maintain standards to 285 kg CO2eq/MWh (60% saving) to 2020, and reduce it to 200 kg CO2eq/MWh (72% saving) from April 2020.
- For Conversions & Co-firing: tighten target to 240 kg CO2eq/MWh (66% saving) from 2014.

22. The tighter GHG emission targets above, are considered an appropriate range to consult on given the feedback received through the RO Banding Review consultation, specifically highlighting the 200 kg CO2eq/MWh figure recommended by the Committee on Climate Change (CCC) in its 2011 report on bioenergy[1].

5. Analysis of options

(i) Scope of the scheme in biomass production sources

23. The 2010 EU report on the requirement for sustainability criteria for solid and gaseous biomass recommends that the scope of the Scheme is similar to that mandated for bioliquids and biofuels. In particular it specifies that biomass sources should be controlled through:

- A restriction on the use of raw materials obtained from land with high biodiversity value, including primary forest, areas designated for nature protection purposes, and highly bio-diverse grassland.

- A restriction on the use of raw material obtained from land with high carbon stock, this is defined as from wetlands or continuously forested areas, where after the removal the land no longer has that status. There is also a restriction on the use of raw material obtained from land that was peatlands in January 2008. Limited exceptions apply to the above restrictions. For example, where it is shown that the harvesting of the raw material is necessary to preserve grassland status.

24. Current UK policy moves in the direction of the principles set out above, however the intended proposals on tighter sustainability standards and reporting requirements set out in this impact assessment aim to ensure the UK adheres to the scope fully.

25. In addition the Commission recommends that use of waste is exempt from these sustainability criteria. This reflects both the routinely high greenhouse gas emissions savings achieved and the challenge of setting default values for the wide range of possible waste feedstocks.

26. It is important to have consistency of methodology and application across the EU on these issues in order to protect areas of high carbon stock or biodiversity and to provide bioenergy suppliers clear and consistent signals as to the sources that are excluded.

(ii) Reporting requirements, whether the scheme should be voluntary or compulsory, and coverage by end user

[1] http://downloads.theccc.org.uk.s3.amazonaws.com/Bioenergy/1463%20CCC_Bio-TP2_supply-scen_FINALwithBkMks.pdf

27. EU recommends that small-scale users of biomass (less than 1MWe capacity) be exempt from the sustainability reporting standards. In the UK electricity market, this would exempt around 10% of the biomass schemes currently in planning, representing a total generating capacity of around 1% of the overall capacity in planning. This would reduce the administrative burden on these operators by around £10,000 pa using the RTFO estimates noted in paragraph 53.

28. It is proposed that these generators – excluding microgeneration – are required to provide reports, but we do not formally link meeting the criteria with eligibility for RO support, nor require independent verification. In addition we allow these generators to use simple default GHG values set under the ROO 2009 that cover whole lifecycles of common feedstocks. This greatly reduces the complexity of producing a GHG assessments, This would reduce the administrative burden on these operators by around £10,000 pa using the RTFO estimates noted in paragraph 53.

29. Above 1 MWe it is proposed to link formally meeting the sustainability criteria with eligibility for support, and require independent verification. We consider the costs associated with this are acceptable, reflecting the typical support that a biomass plant of 1MWe may receive per year.

(ii) GHG savings performance criteria

30. The Commission recommends that Member States have, or introduce, sustainability schemes for solid and gaseous biomass and that these are as far as possible in line with the criteria as laid down in the RED, which aims to ensure consistency and equal treatment across bioenergy uses. Article 17(2) sets out the following minimum criteria for biofuels and bioliquids: GHG savings values of 35%, rising to 50% in 2017 and 60% from 2018 for installations in which production started on or after 1 January 2017. The comparator against which the GHG savings are recommended to be measured for biomass power is the EU-wide average grid electricity (712 kg CO2/MWh). Although these levels represent an important saving against the EU average grid intensity they are limited when compared to the UK electricity sector carbon intensity. For example, the Commissions recommended 35% saving against the EU comparator implies 463.3 KgCO2/MWh, when the UK long term marginal emission factor is already lower at 393.9 kgCO2/MWh. Therefore the UK government decided to go further than the RED minimum recommendation and implement 60% GHG savings from 1 April 2011. A 60% GHG saving represents a 28% savings against the UK marginal electricity carbon intensity. Performance against the existing 60% criteria must be reported to Ofgem by UK generators, however, meeting the current criteria is not mandatory.

31. Table 1 below shows the options considered in this IA for tighter sustainability criteria relative to the higher EU-wide fossil fuel electricity factor and relative to the UK electricity sector, in order to improve the carbon cost effectiveness of biomass electricity generation.

32. The tighter GHG emission targets below, are considered an appropriate range to consult on given the feedback received from industry through the RO Banding Review consultation (i.e. realistic ambition given current practices and contracts in place), specifically highlighting the 200 kg CO2eq/MWh figure recommended by the Committee on Climate Change (CCC) in its 2011 report on bioenergy[2]. The CCC considers 200 kg CO2eq/MWh a significant enough saving relative to UK gas generation (as opposed to the higher EU grid average carbon intensity) to account for the risks associated with indirect deforestation. However, the considerable uncertainty surrounding the correct target for sustainability criteria in the future is recognised and will be further considered throughout

[2] http://downloads.theccc.org.uk.s3.amazonaws.com/Bioenergy/1463%20CCC_Bio-TP2_supply-scen_FINALwithBkMks.pdf CCC figure based on considering 60% GHG saving against UK grid average counterfactual (as opposed to EU wide average grid electricity recommended by Commission.

the consultation period.

Table 1: Options for tighter sustainability criteria (in 2020) relative to the EU-wide average electricity carbon intensity and those for selected UK electricity generation.

Options for tighter GHG emissions savings	% saving compared to UK coal power generation (909 kgCO2/MWh)	% saving compared to EU-wide average electricity (712.8 kgCO2/MWh)	% saving compared to UK marginal electricity of gas CCGT (393.9 kgCO2/MWh)
Baseline: 285 kgCO2/MWh	69%	60%	28%
240 kgCO2/MWh	74%	66%	39%
200 kgCO2/MWh	78%	72%	49%

33. Consulting on proposals to tighten the sustainability target for solid biomass for new dedicated biomass power (with or without CHP) to 240 kg CO2/MWh from October 2013 reflects the principles set out in the UK Bioenergy Strategy including delivering cost-effective GHG reductions and focusing our policies on the low risk pathways. Compared to CCGT, the expected counterfactual technology for new dedicated biomass, this tighter standard would represent a saving of 39%.

34. For biomass conversions and co-firing the most appropriate counterfactual over the short to medium term is considered to be coal[3]. Against this maintaining a 285 kg CO2eq/MWh standard would equate around 69% saving. This relatively greater cost effectiveness of biomass conversions from coal compared to new dedicated biomass, as well as their shorter expected operating lifetimes, allows for a differentiated approach to the tightening of sustainability standards.

Costs and Benefits

Methodology

35. The starting point for estimating the impact of different sustainability thresholds in the UK electricity market is to estimate the potential level of generation and costs of biomass that is expected to be deployed at the current 60% sustainability criteria and RO support levels and then compare this with the costs associated with implementing tighter criteria options as outlined in Table 1 above. Baseline bioenergy generation from dedicated plants, conversions and co-firing are based on the lead scenario presented in the Impact Assessment accompanying the Government Response to the RO Banding Review Consultation, and assume indicative deployment of bioenergy from 2016/17 to 2020/21 based on illustrative Contracts for Difference (CfD) support levels. Given the uncertainty around bioenergy deployment post 2020, no bioenergy new build post 2020 has been assumed in the analysis presented in this Impact Assessment.

36. The potential impact of tighter sustainability criteria depends on the projections of future bioresource supply, and the lifecycle emissions of the feedstocks that comprise the supply curves. The analysis in

[3] DECC analysis for the RO takes into account the economic lifetime of coal plants and operating restrictions owing to regulatory constraints e.g. LCPD. In this Impact Assessment, DBM plants are compared to a CCGT counterfactual.

this IA assumes tighter criteria reduce the availability of supply, hence leaving a generation ‘gap’ which is replaced by the counterfactual technology. In practice there is likely to be a dynamic effect on prices and supply due to tighter standards, however the data is not available to allow this to be modelled. In order to estimate the ‘gap’ it is necessary to estimate the proportion of bioresource supply that will pass the tighter standards given their associated lifecycle emissions. These steps are outlined below.

Bioresource supply

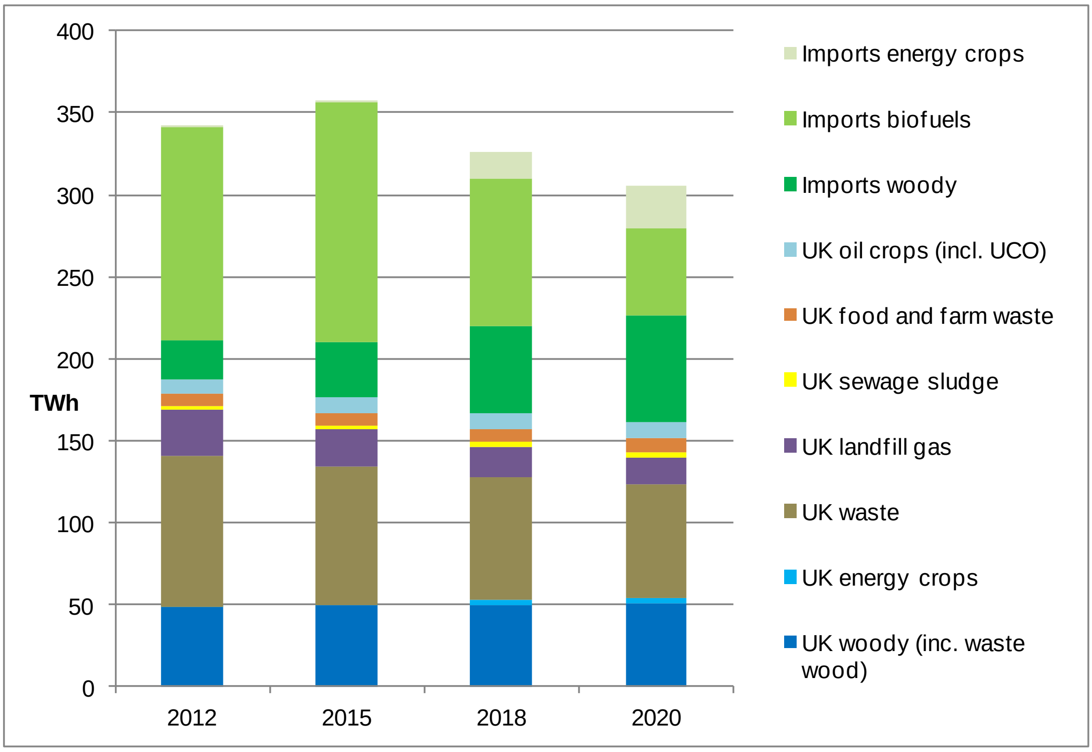
37. The supply scenario shown in Figure 1 below illustrates the levels of biomass feedstocks assumed to be available to the UK in the RO modelling. The scenario is derived from AEA analysis which modelled scenarios of biomass supply from UK sources and imports that could be available to generators in the UK at different price points and allowing for varying levels of constraints to the development of the market. This analysis assumed that food and other competing land uses would be met first, therefore attempting to minimise any possible impacts on competing uses. However, in practice this is clearly very uncertain. It is worth noting that the RO scenarios are different to the Bioenergy Strategy[4] scenarios due to the following three amendments:

- Sustainability constraints (consistent with baseline 60% GHG savings threshold) are applied to solid biomass (reduces availability of woody biomass)
- Estimates are converted to net calorific basis (reduces estimates overall)
- Updated waste estimates are used (increases estimates for residual waste)

38. This supply scenario (60% GHG savings) is expected to be sufficient to satisfy forecast bioresource use from the heat and power sector, however, when tighter GHG criteria is imposed the feedstock constraint could become binding[5].

[4] The Bioenergy Strategy and accompanying Analytical Annex[4] set out the considerable uncertainties surrounding future bioresource supply to the UK, and how future supply depends critically on the extent current market constraints can be overcome and the level of future prices.
[5] For further information on this see IA for Government Response to the RO Banding Review Consultation, page 25.

Figure 1: Central bioresource supply assumed in Government Response to the RO Banding Review Consultation modelling



Source: DECC analysis using AEA Bioenergy modelling (derived from medium supply scenario used in Bioenergy Strategy analysis)

GHG lifecycle analysis

39. In order to estimate GHG lifecycle analysis (LCA) of the feedstocks that make up the assumed supply curve shown in Figure 1 above, the GHG emissions associated with each relevant feedstock have been estimated, from cultivation through to combustion. This information is used to estimate what proportion of the feedstock is likely to pass the GHG thresholds at different levels (referred to below as 'pass rates'). See Annex A for full details on this analysis.

Pass rates

40. Comparing the LCA emissions (see Annex A) with the emissions factors for different sustainability criteria (e.g. 66% lower than the EU-wide average electricity grid CO_2e emissions of 712 kg CO_2e/MWh) enables the calculation of overall pass rates for feedstocks, i.e. the proportion of total feedstock supply that is likely to pass the tighter sustainability criteria. These pass rates are used to estimate the potential shortfall in bioresource supply, holding all other factors constant, including, the supply response to higher sustainability standards from the market.

41. Tables 2 and 3 below show the pass rate assumptions based on the LCA analysis undertaken. Central pass rates assume an even distribution over the range of lifecycle emissions, whereas low pass rates are based on a distribution weighted towards the higher end of the emissions range, leading to a lower proportion of the feedstock meeting the required thresholds (and therefore a larger 'gap' to fill by the counterfactual – leading to greater costs/savings depending on the technology). High pass rates assume a distribution weighted towards the lower end of the emissions range, leading to a higher proportion of the feedstock meeting the required thresholds (and therefore a smaller 'gap' to fill by the counterfactual – leading to greater costs/savings depending on the technology).

42. Pass rates are different for dedicated biomass on the one hand and conversions and co-firing on the other. This is largely due to these technologies having different plant efficiencies. However the assumptions made on feedstocks used by plants will impact overall pass rates, for example, it is assumed here that straw will only be used as a feedstock for dedicated biomass and is not suitable for co-firing.

Table 2: Analysis of overall bioresource pass rates under different GHG standards (Dedicated Biomass)

	66% saving			72% saving		
	Low pass rate	Central pass rate	high pass rate	Low pass rate	central pass rate	high pass rate
UK						
Forestry	100%	100%	100%	100%	100%	100%
Energy crops	54%	68%	82%	36%	48%	60%
Straw	40%	60%	80%	20%	40%	60%
Wastes	100%	100%	100%	100%	100%	100%
Imports						
Agricultural residue	15%	30%	45%	15%	30%	45%
Woody	100%	100%	100%	100%	100%	100%
Energy crops	18%	36%	54%	16%	32%	48%

Table 3: Overall bioresource pass rates (Co-firing)

	66% saving			72% saving		
	Low pass rate	central pass rate	high pass rate	Low pass rate	central pass rate	high pass rate
UK						
Forestry	100%	100%	100%	100%	100%	100%
Energy crops	55%	70%	85%	38%	50%	63%
Waste	100%	100%	100%	100%	100%	100%
Imports						
Agricultural residue	10%	20%	30%	10%	20%	30%
Woody	100%	100%	100%	100%	100%	100%
Energy crops	25%	45%	65%	20%	35%	50%

6. Impacts of GHG emission standard options

43. As explained previously, tightening sustainability criteria could impact supply or prices, or both. The data and evidence required to model how the market may react, and therefore the extent of these possible changes, is not available. Given this, the cost analysis is based on scenario analysis around reductions in biomass supply. The potential impact on biomass prices due to tighter sustainability criteria has been considered separately (see Box 1 below).

44. Using the feedstock overall pass rates (see table 2 and 3 above) it is possible to estimate the resulting restriction in biomass supply when compared to the forecast level of biomass included in the baseline. The generation ‘gap’ is left due to resources that would have been available for use in bioenergy in the power sector becoming unavailable due to not being able to pass tighter sustainability criteria. This methodology assumes that the supply curve is fully utilised and that there is no supplier or price response from the market when tighter sustainability standards are introduced.

45. The size of the generation 'gap' to be filled by the counterfactual technology impacts on the associated resource costs (or savings), and the magnitude of any carbon savings from switching from biomass generation to the counterfactual technology. The pass rate assumptions (low, central, high), the sustainability criterion (e.g. 66% or 72% savings), and traded price of carbon assumptions will impact on the carbon savings for each scenario. It is important to note that carbon savings here represent total carbon savings associated with tighter sustainability standards applied to imported and UK sourced bioresources, based on a lifecycle analysis approach (see paragraph 47 for further detail).

46. Table 4 and 5 below shows the generation 'gap' for the dedicated biomass and conversions/co-firing proposals assuming central pass, and the associated carbon savings.

Table 4: Generation gap and carbon savings for Dedicated Biomass

	TWh 'gap'			Carbon savings (m tC02) central price		
	2015	2020	2025	2015	2020	2025
Preferred option (central pass rates)	0.7	4.5	5.4	0.2	1.6	1.9
72% from 2014 (central pass rates)	0.7	4.5	5.4	0.3	1.6	1.9

Table 5: Generation gap and carbon savings for Conversions and Co-firing

	TWh 'gap'			Carbon savings (m tC02)		
	2015	2020	2025	2015	2020	2025
Preferred option (central pass rates)	0.0	7.2	7.3	0.0	2.5	2.5
66% from 2014 (central pass rates)	5.3	7.2	7.3	1.8	2.5	2.5

47. The monetised benefits consist of the value of higher GHG saving accruing due to the introduction of tighter GHG saving thresholds. GHG savings are estimated on a lifecycle basis and valued using the traded price of carbon in line with IAG guidance[6]. Carbon savings represent total carbon savings associated with tighter sustainability standards applied to imported and UK sourced bioresources, based on a lifecycle analysis approach. **The majority of carbon savings accrue to bioresources originating from overseas, given the additional emissions associated with international transport, and the relatively large proportion of imports compared to UK woody bioresources in the supply scenario**. The proportion of UK or imported resources contributing to the overall supply reduction (due to tighter sustainability standards) can be used to estimate the split between UK and overseas carbon benefits. This split will be different for dedicated biomass and conversions and co-firing given the different estimates from lifecycle analysis. For dedicated biomass, UK

[6] Central IAG 2011 traded price of carbon used to calculate carbon benefits. Summary page benefits ranges calculated using low to high estimates for traded price of carbon. http://www.decc.gov.uk/en/content/cms/about/ec_social_res/iag_guidance/iag_guidance.aspx. To note: for analysis purposes the overseas carbon savings have been valued using the EU allowance (EUA) price, this would not be the case in practice as bioresources are imported from countries outside the EU emissions trading scheme, and therefore would not necessarily face the same carbon price.

bioresources account for between 10 – 15% of the reduction in bioresource supply, whereas imports account for between 90 – 85%, for 66% and 72% GHG savings respectively. For conversions and co-firing, UK bioresources account for between 2 – 3% of the reduction in bioresource supply, whereas imports account for between 98 – 97%, for 66% and 72% GHG savings respectively.

48. To estimate the carbon benefits, the assumption is made that the full lifecycle emissions of the feedstocks that fail to meet the tighter GHG threshold are saved, irrespective of where biomass would have been grown - this is consistent with carbon accounting methodology. This excludes emissions associated with Indirect Land Use Change (ILUC), but is consistent with how biomass emissions should be counted on a life cycle basis. However, it is important to note that in practice the feedstocks that do not pass the GHG threshold could still be produced and used for different purposes across the global market where sustainability criteria is not applied, and therefore carbon savings could be an overestimate.

49. To estimate the cost of bridging the TWh generation 'gap' assumptions need to be made about which renewable technologies are deployed in the place of a reduced level of generation from biomass operators, in order to ensure the RES target is reached. This analysis presents two assumptions: low estimates are based on additional onshore wind, and high estimates are based on additional offshore wind. These were chosen as they present a range for potential cost impacts: replacing biomass with onshore wind leads to a saving in resource costs, whereas replacing biomass with offshore wind leads to an additional resource cost. In this analysis it is assumed that onshore and offshore wind have zero carbon emissions.

50. Table 6 and 7 below summarise the range of costs (and savings) associated with the different sustainability options, and show how the results are sensitive to the assumption made on which renewable technologies are deployed instead of biomass in order to ensure the RES target is reached. Lower bound costs (savings), for dedicated biomass and conversions and co-firing, assume low pass rates and onshore wind as the counterfactual technology replacing biomass that is no longer deployed. The higher bound costs, for dedicated biomass and conversions and co-firing, assume low pass rates and offshore wind as the counterfactual technology replacing biomass that is no longer deployed. Low pass rates result in the largest possible reduction in biomass supply, therefore provide the extremes of the range when you change the counterfactual technology assumption. Onshore wind is cheaper than biomass therefore leads to savings, offshore wind is more expensive therefore leading to higher costs. The carbon savings depend on pass rate assumptions, i.e. carbon saved will be the same for central pass rates whether onshore of offshore wind is assumed to be the counterfactual.

51. Table 6 shows the cost benefit analysis of the following options for dedicated biomass accredited after April 2013 in 2020 and cumulative to 2030:

- 72% GHG savings threshold relative to EU comparator from October 2013; and
- 66% from October 2013 to 2020, 72% from 2021 GHG savings threshold relative to EU comparator (preferred option).

Table 6: Cost Benefit Analysis of different GHG threshold scenarios - Dedicated Biomass (2011 prices)

Dedicated Biomass	2020					
	Low pass rates		Central pass rates		High pass rates	
(-ve indicates saving)	Onshore counterfactual	Offshore counterfactual	Onshore counterfactual	Offshore counterfactual	Onshore counterfactual	Offshore counterfactual
Option 1: 72% GHG savings threshold relative to EU comparator						
Resource cost £m	-100	100	-80	80	-60	60
Carbon benefit £m	50	30	30	30	30	30
NPV £m	-150	70	-120	50	-90	40
Option 2: 66% from 2014 to 2020, 72% GHG savings threshold relative to EU comparator (preferred option)						
Resource cost £m	-100	100	-80	80	-60	60
Carbon benefit £m	50	30	30	30	30	30
NPV £m	-150	70	-120	50	-90	40

Dedicated Biomass	To 2030 (cumulative)					
	Low pass rates		Central pass rates		High pass rates	
(-ve indicates saving)	Onshore counterfactual	Offshore counterfactual	Onshore counterfactual	Offshore counterfactual	Onshore counterfactual	Offshore counterfactual
Option 1: 72% GHG savings threshold relative to EU comparator						
Resource cost £m	-1340	1330	-1090	1080	-830	830
Carbon benefit £m	1130	450	660	660	510	510
NPV £m	-2460	880	-1740	420	-1340	320
Option 2: 66% from 2014 to 2020, 72% GHG savings threshold relative to EU comparator (preferred option)						
Resource cost £m	-1330	1320	-1070	1060	-810	810
Carbon benefit £m	1120	450	650	650	500	500
NPV £m	-2450	870	-1720	410	-1320	310

52. Table 7 shows the cost benefit analysis of the following options for conversion and co-firing in 2020 and cumulative to 2030:

- 66% from October GHG savings threshold relative to EU comparator; and
- No change to 2020, 66% from 2021 relative to EU comparator (preferred option).

Table 7: Cost Benefit Analysis of different GHG threshold scenarios – Conversion & Co-firing (2011 prices)

Conversions & co-firing	2020					
	Low pass rates		Central pass rates		High pass rates	
(-ve indicates saving)	Onshore counterfactual	Offshore counterfactual	Onshore counterfactual	Offshore counterfactual	Onshore counterfactual	Offshore counterfactual
Option 1: 66% GHG savings threshold relative to EU comparator						
Resource cost £m	-150	160	-130	140	-100	110
Carbon benefit £m	70	40	50	50	40	40
NPV £m	-220	120	-180	90	-140	70
Option 2: No change to 2020, 66% from 2021 GHG savings threshold relative to EU comparator (preferred option)						
Resource cost £m	-150	160	-130	140	-100	110
Carbon benefit £m	70	40	50	50	40	40
NPV £m	-220	120	-180	90	-140	70

Conversions & co-firing	**To 2030 (cumulative)**					
	Low pass rates		Central pass rates		High pass rates	
(-ve indicates saving)	Onshore counterfactual	Offshore counterfactual	Onshore counterfactual	Offshore counterfactual	Onshore counterfactual	Offshore counterfactual
Option 1: 66% GHG savings threshold relative to EU comparator						
Resource cost £m	-1890	2070	-1580	1730	-1270	1390
Carbon benefit £m	1210	540	750	750	610	610
NPV £m	-3100	1530	-2330	970	-1880	770
Option 2: No change to 2020, 66% from 2021 GHG savings threshold relative to EU comparator (preferred option)						
Resource cost £m	-1060	1160	-890	970	-710	780
Carbon benefit £m	880	370	750	750	610	610
NPV £m	-1940	790	-1640	210	-1330	160

Notes for Table 6 and 7:

- *Proposals will be implemented in October 2013, however calculations in this IA assume policy will impact in 2014 due to lack of granularity in the modelling.*
- *Costs above do not include administration costs, which are included in NPV ranges on Summary sheets and in Table 8 below.*
- *Carbon benefits for low pass rate scenarios use low (for onshore counterfactual) to high (for offshore counterfactual) estimates for traded price of carbon to estimate extreme points of range. Central and high pass rate scenarios use central estimates for traded price of carbon.*

Administrative costs

53. As noted above, sustainability reporting was introduced in the RO in 2009, which required generators to verify the source of their biomass and to report voluntarily on any land use change impacts. The

proposal is to go further than this, in imposing a mandatory requirement on operators to assess their lifecycle greenhouse gas emissions saving relative to fossil fuel, taking into account the energy conversion efficiency of their particular plant. In addition generators will be required to confirm to the regulator that any materials other than wastes are not sourced from raw materials obtained from land important on carbon or biodiversity grounds. The impact on administration costs arises predominantly from the proposal to make reporting mandatory, rather than the level of the sustainability target.

Costs to biomass supply chain participants

54. The EU has a Standard Cost Model to estimate the cost of chain of custody certification. This suggests a cost of between £680-2,560 per year for individual biomass producers. They suggest that when operators have to show actual GHG savings, costs could be 10-20% higher, implying an additional cost of £70-£510 pa per biomass producers for GHG certification. Assuming approximately 350 biomass producers[7], this implies annual costs between £0.024m – £0.179m (2011 prices). A proportion of biomass producers will already be engaged in voluntarily certification, and therefore tightening the standards will not lead to any additional costs, however these costs are included in the overall NPV ranges to ensure all additional impacts are accounted for[8].

55. The EU calculates that there will be higher operating costs for those involved in the bio-energy chain with processors, manufacturers, traders and producers costs of assessing life-cycle GHG emissions increasing by 60-70% compared with current reporting standards. There is insufficient information on which to base an industry wide estimate of this as DECC have no data on the number of such firms in this part of the supply chain. Revised estimated of the administrative costs for supply chain participants will be provided on the final policy IA subject to the information provided during the consultation.

Costs to biomass electricity generators

56. It is estimated that the verification procedure for biomass generators could imply annual costs of £15,350 for large operators and £1,530 for small operators[9], in line with RTFO estimates[10]. Assuming approximately 7 generators are classed as small and 63 are classed as large, this implies annual costs of approximately £0.978m (2011 prices). Similarly to biomass producers certification costs, a proportion of generators will already be voluntarily reporting to Ofgem, however as DECC are proposing to make the verification procedure mandatory this cost will now impact all biomass generators above 1MWe. These costs are included in the overall NPV ranges to ensure all additional impacts are accounted for.

Costs to the regulator

57. The regulator (Ofgem) would have incurred additional verification and administrative costs when the sustainability reporting was introduced in the RO in 2009. These were estimated at around £1m initial IT and staff costs for implementing that scheme. Although there could be an increased volume of generators reporting to Ofgem under a mandatory requirement, this is not expected to incur significant additional costs.

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[7] Based on generators having on average 5 suppliers each
[8] NPV range will include administration costs only in those years that the tighter standards will apply.
[9] The analysis assumes approximately 7 generators are classed as small, and 63 would be classed as large. Based on information received from industry.
[10] http://www.opsi.gov.uk/si/si2007/draft/em/ukdsiem_9780110788180_en.pdf

Box 1: Illustrative price impact

Illustrative price impact

1. As previously mentioned, the costs estimated above do not take into account any market response in terms of availability of supply and price changes. Given the immaturity of the global biomass feedstock market we do not have the data or evidence available to make robust assumptions regarding the likely market response to a tightening in sustainability criteria, or the potential for productivity improvements associated with less carbon intensive production processes. In the longer term biomass prices could increase or decrease in response to tightening sustainability criteria depending on the relative supply and demand conditions and the long run marginal costs faced by generators and biomass suppliers.

2. Nevertheless, in order to present an illustrative price impact, it has been assumed that increased demand for more sustainable feedstocks in the UK would be met by international supply chains, but would incur a price premium. This assumption is based on feedback from industry in the current market.

3. Table (a) and (b) below illustrates potential costs associated with a price premium attached to feedstocks that met higher sustainability standards. This assumes the same level of biomass generation occurs as in the baseline, but it is available at a higher price. It is not possible to predict the scale of this price increase accurately given the uncertainties associated with the supply response under different criteria, and because the biomass electricity market is currently dominated by a few large operators without full transparency on how biomass prices are set. Feedback from industry during the RO Banding Review consultation indicated that an estimated 10% price premium could be paid for sustainable biomass feedstock.

4. The risk of higher biomass prices is likely to rise as sustainability criteria becomes stricter. Therefore the tables below assume a larger impact on price will be felt when there are larger carbon savings, i.e. where tighter sustainability standards lead to increased carbon savings. Option one shows a 5% price premium occurring where carbon savings associated with a 66% GHG savings threshold are felt (assuming central pass rates), and option 2 shows a 10% price premium occurring where carbon savings associated with a 72% GHG savings threshold occur (assuming central pass rates). Although this analysis assumes biomass generation remains at the same levels, carbon savings occur as the proportion of biomass feedstocks that would have been knocked out by the tighter thresholds now conform to the required standards. In practice, this may not be possible and the generation gap could be filled with a mix of sustainable but higher priced resources and alternative technologies.

Table Box 1 (a): Cost Benefit impact of higher biomass prices - **Dedicated Biomass**

	Option 1 - 5% price premium		Option 2 - 10% price premium	
Dedicated Biomass	In 2020	to 2030	In 2020	to 2030
Levelised cost £m	10	170	30	350
Carbon benefit £m	30	620	30	660
NPV £m	-20	-450	-10	-310

Table Box 1 (b): Cost Benefit impact of higher biomass prices - **Conversion & Co-firing**

Conversions & co-firing	Option 1 - 5% price premium		Option 2 - 10% price premium	
	In 2020	to 2030	In 2020	to 2030
Levelised cost £m	20	150	40	300
Carbon benefit £m	50	750	50	800
NPV £m	-30	-610	-10	-500

5. Under the higher biomass price assumptions, the Net Present Value indicates an overall saving, because at these price levels the carbon saving accrued from using more sustainable biomass feedstocks dominates the price impact on resource costs. However, this is highly uncertain, and if higher price premiums were felt for certain feedstocks the carbon saving could be outweighed by higher resource costs. Assuming the same scenario's for DBM and CCF as in table (a) and (b) above, if prices were to rise by around 20% and 30% respectively the impact of higher resource costs would outweigh the value of the carbon savings.

7. Criteria covering other sustainability issues such as indirect land use change and social issues

58. As set out in the consultation, the proposals do not introduce criteria covering indirect land use change (ILUC). We consider the risk of ILUC with respect to the use of woody biomass residues and wastes is relatively low. Forests can produce timber and woodfuel while remaining forests; and the value of agriculture residues such as straw will not by itself drive land use change. However, the importance of ensuring that forest and woodlands are sustainably managed is recognised – so that carbon stocks are preserved, ideally growing year on year. In addition good management practices will help reduce the risk of forest fire or disease, that could see large carbon stores being released rapidly. Therefore the proposal is to introduce sustainable forest management criteria based on the UK Timber Public Procurement Policy. This would offer a wide range of benefits, whilst controlling additional costs. Importantly, since 2010 it has included consideration of social issues such as land use rights with respect to forests and local people.

59. The Government has received significant feedback from the forestry industry that reporting against the land criteria specified in the EU Renewable Energy Directive is proving difficult and costly. Moreover, there are concerns that the RED land criteria – though relevant and effective for agricultural feedstocks and farming – do not target the key sustainability issues regarding land use and management when considering woodfuel and forestry. The farming industry has also questioned the appropriateness of these criteria when applied to perennial energy crops whose production is subject to the sustainability requirements set under the Energy Crops Grant Scheme for England.

60. The Government already has agreed policy on the public procurement standards for sustainable wood, including sourcing woodfuel supplies. This draws upon existing sustainable forestry standards including the Forest Stewardship Council (FSC) and the Programme for the Evaluation of Forest Certification schemes (PEFC), as well as allowing for other evidence to be used where suitable.

61. In order improve the effectiveness and efficiency of the policy, and also to provide coherence across our different biomass policies, the Government proposes that for woodfuel the land criteria will be as set under the UK public procurement policy for wood. Similarly, it is proposed that energy crops that have met the requirements under the Energy Crops Grant Scheme for England will be considered to meet the land criteria. It is expected that the price differential between food crops and perennial energy crops will prevent change in land use except where the land is low quality and is unsuitable for food crops use.

8. Wider impacts

62. Sustainability criteria on biomass in the UK or more generally across the EU could lead to indirect impacts which are difficult to value. These include benefits to bio-diversity, protection of areas of high carbon stock and/or nature reserves which, as well as safeguarding carbon sinks could have positive recreational or conservation benefits.

63. There could also be a range of indirect effects not captured above. It is also possible that demand for sustainable biomass could displace agricultural production onto uncultivated areas with impacts on food prices, biodiversity and land use change. Such indirect impacts are very difficult to model due to the complex nature of agricultural markets, the uncertainties involved in assessing the cause and

effect interactions and pathways, and the difficulties in projecting to the future. Whilst the cost benefit analysis above assumes substitution away from biomass into other renewable technologies, risks on indirect land use change factors remain. The Commission has recently consulted[11] on the likely relevance of the indirect land use change problem and on potential ways of addressing it. None of the above estimates takes account of possible costs and benefits associated with Indirect Land Use Change (ILUC) impacts.

64. The security of supply impacts of the sustainability measures are likely to be small as other renewable technologies would fill the generation gap (for example under the preferred option the potential range of reduced biomass deployment is estimated to around 5 TWh in 2020 for dedicated biomass and around 7 TWh for conversions and co-firing – see Tables 4 and 5). It is also important to note that the range of generation gaps shown in Table 4 and 5 above do not take into account the full market response, i.e. it is likely that higher sustainability standards would be met with a supply and price response (more sustainable resource could potentially be available on the global market at a given price). The measures could also impact on biomass related employment – for example in biomass related services - but the effects are likely to be small given UK feedstocks are more likely to pass the tighter sustainability standards (they do not incur emissions associated with international transport for example).

Risks and Sensitivities

65. As outlined above, the starting point for estimating the possible impacts of sustainability criteria in the RO, is the amount of biomass generation expected under central assumptions, and the costs of technologies that could be needed to replace any shortfall in biomass generation. These assumptions are subject to considerable uncertainty. Information from the RO modelling[12] has been used to for cost assumptions, but these are uncertain and changes in relative costs of offshore/onshore wind compared biomass generation costs will impact on overall results.

66. Further, onshore and offshore wind have been used to represent alternative counterfactual technologies to fill a biomass generation gap. However, this abstracts from practical considerations regarding additional availability and potential changes to support required in order to incentivise sufficient additional potential of different technologies. The generation gaps considered in this analysis are likely to be over estimates given they do not account for a potential supply responses (i.e. more sustainable feedstocks available at any given price), but the counterfactual technologies should still be considered as illustrative rather than realistic additional potential.

67. Another source of uncertainty is the precise level of lifecycle GHG emission that will be saved under the different thresholds. Whilst the coverage of feedstocks for which LCA information is available is quite extensive, uncertainty around how the supply side will develop and whether in practice operators will choose feedstocks in line with our assumptions on the LCA remains to be seen. A potential impact is that generators could consider increasing their use of relatively cheap imported residues such as cocoa husks[13] as a means of improving their GHG performance. If this occurred to a significant degree, current LCA could present an overestimate of emissions. In addition, 'best practice' LCA assumptions have been used for imports, which avoid the worst land use change impacts. If worst case values were incorporated, for example where energy crops would have been

[11] (http://ec.europa.eu/dgs/jrc/index.cfm?id=1410&obj_id=11270&dt_code=NWS&lang=en)

[12] Review of the generation costs and deployment potential of renewable technologies in the UK: a study report by Arup http://www.decc.gov.uk/en/content/cms/consultations/cons_ro_review/cons_ro_review.aspx

[13] Cocoa husks are classified as residues and therefore their emissions can be zero at the point of collection.

grown on land previously used for forests, then the value of any carbon saved would be dwarfed by any higher generation costs (see Annex A for further information on LCA).

68. The analysis assumes that the whole resource supply curve is being utilised and that pass rates determine the proportion of the supply curve that will meet tighter standards. The percentage excluded is assumed to directly reduce biomass generation and therefore to determine the gap that the counterfactual technology must fill. Clearly, if forecast bioresource use was significantly lower than supply, potentially tightening the sustainability criteria could have zero impact if the proportion of the supply curve passing the standards was enough to satisfy demand. The implied bioresource fuel use from the RO deployment forecast shows that the majority of woody bioresources are utilised from the supply curve, and therefore the assumption that the whole resource supply curve is being utilised is reasonable for this analysis.

9. Summary and preferred option

69. The preferred option is:

- For Dedicated Biomass accredited after April 2013: tighten target to 240 kg CO2eq/MWh (66% saving) from October 2013 to 2020, and 200 kg CO2eq/MWh (72% saving) from April 2020.
- For Dedicated Biomass accredited before April 2013: mainatain standards to 285 kg CO2eq/MWh (60% saving) to 2020, and reduce it to 200 kg CO2eq/MWh (72% saving) from April 2020.
- For Conversions & Co-firing: no change to 2020, tighten target to 240 kg CO2eq/MWh (66% saving) from April 2020.

70. These changes would apply to all power generating plants of 1MW and above. This option would steer the market to achievable improvements to 2020 by ensuring that the growth in biomass heat and electricity delivers significant and cost-effective carbon savings while making a significant contribution to achieving the UK's target of 15% renewable energy by 2020.

71. Table 8 below summaries the resource costs, carbon benefits, and overall NPV best estimate for the preferred options for dedicated biomass and conversion and co-firing relative to the do nothing option. See Annex B for summary of option 2. In order to show the widest potential impacts low pass rates are assumed, this leads to the maximum saving or cost dependent on the counterfactual technology because it implies the largest generation 'gap' to fill. Total resource costs and NPV figures include costs and benefits reported in tables 6 and 7, plus administration costs outlined from paragraph 53. Administration costs to biomass producers for GHG certification and costs to generators for verification reporting lead to approximately £1.0m to £1.2m per year[14].

[14] Assumes between £0.024m and £0.179m for biomass producers GHG certification, and approximately £0.978m for generators seeking verification. Administration costs will only factor in those years where the tighter standards are introduced according to the proposal.

Table 8: Summary of preferred scenario (extreme range, assuming low pass rates) used for NPV range on IA Summary sheets

All figures discounted (£m 2011)		Cumulative to 2030		
		Low (onshore)	High (offshore)	
Resource cost (exc. carbon saved)	DBM	-1310	1330	
	CCF	-1050	1170	
Value of carbon saved	DBM	1120	450	
	CCF	880	370	
NPV (inc. carbon saved)	DBM	-2440	880	
	CCF	-1940	800	
		Low (onshore)	High (offshore)	Best estimate
Total cost range		-2370	2500	70
Total benefit range		2000	820	1410
Total NPV range		-4370	1680	-1350

Note: minus figures represent saving (benefit)

72. Our decision on the preferred option balances higher GHG savings with the risk of higher biomass prices as set out above. At the same time it would limit the impact on smaller generators and small feedstock producers, who would struggle to engage with a complex sustainability scheme which would have a disproportionate impact on their costs. The preferred option represents a gradual approach to improving the sustainability criteria, recognising the potential constraints generators and biomass suppliers operating in the market could face, given the contracts and investments already in place. As set out in the Government Response to the RO Banding Review and the Government's Bioenergy Strategy, the intention is to ensure sustainability criteria changes are implemented in a way that minimises disruption to industry whilst ensuring the use of biomass is put on a sufficiently ambitious GHG trajectory. The optimum GHG trajectory is subject to considerable uncertainty, however a target of 200 kg CO_2/MWh is considered suitably ambitious given our current understanding. A step approach to reaching this target is considered appropriate given the uncertainty involved, feedback from industry, and the additional changes to sustainability reporting that will be made concurrently.

73. These criteria would be introduced via the RO legislation for October 2013.

Section B – Value for money and affordability

74. This section outlines the consultation proposals and expected impacts for measures intended to ensure that the RO delivers cost-effective carbon reduction while remaining within its agreed budget. It includes the following proposals:

- A cap on the number of ROCs which suppliers can access for Dedicated Biomass;
- Removal of the energy crop uplift for standard co-firing; and
- Reduction in support from 0.5 to 0.3 for standard co-firing in 2013/14 and 2014/15 (0.5 in 2015/16 and 2016/17).

75. It is important to note that accurately forecasting deployment under the RO support bands is very challenging and subject to considerable uncertainty. Therefore, the estimated deployment figures quoted in this section should be considered within this context.

Dedicated Biomass cap

76. As set out in the Government Response to the RO Banding Review Consultation[15], the government's intention is to focus the deployment of biomass electricity over the banding review period on the cheaper and transitional technologies of conversion and co-firing (i.e. coal replacement). Coal replacement can be lower cost compared to other renewables (since it involves use of existing assets) with significant carbon savings as it replaces high carbon intensive coal[16]. Its shorter operating lifespan compared to new build dedicated biomass also makes it attractive in terms of avoiding significant feedstock lock-in beyond the late 2020's. In contrast, new dedicated biomass can be less attractive in terms of renewable generation and carbon abatement costs compared to other renewables. While a small amount of it is expected to be affordable and cost-effective at the support level under the RO, it becomes increasingly unaffordable in larger volumes. In order to safeguard against significant expansion of new dedicated biomass the intention is to cap the number of ROCs which suppliers can access for dedicated biomass.

10. Description of options considered

77. Given the intended cautious approach to Dedicated Biomass (DBM) deployment in the future energy mix, an upper limit to the total DBM generation would provide a safety net to ensure additional RO spend post 2030 is minimised. A cap is proposed for the number of ROCs which suppliers can access for DBM accredited after March 2013[17]. The intention in setting a cap is to maintain value for money for consumer subsidies while also maintaining investor confidence and to not stop the small number of dedicated biomass projects that are near shovel ready from proceeding, notably those UK projects that can reach financial close this year.

78. Modelling undertaken for the Government Response to the RO Banding Review Consultation

[15] http://www.decc.gov.uk/assets/decc/11/consultation/ro-banding/5936-renewables-obligation-consultation-the-government.pdf

[16] DECC analysis for the RO takes into account the economic lifetime of coal plants and operating restrictions owing to regulatory constraints e.g. LCPD. In this Impact Assessment, DBM plants are compared to a CCGT counterfactual.

[17] Each year, when the level of the Obligation is set, the level of the dedicated biomass cap will be set as a percent of the total obligation equivalent to the expected generation from 1GW capacity of new build biomass power.

document suggested only plants below 50MW would be brought forward at the proposed level of subsidy[18], leading to approximately 250 MW deployment in 2015/16. This is the central modelled estimate which takes account of financial and other barriers. As noted previously, the precise technology mix that will come in under the RO is very uncertain, and evidence from pipeline data suggests that there is potential for other projects to come on under the RO, but timing and deployment levels are very uncertain. Additional potential could be as high as 800 MW by 2017[19], although it is considered unlikely that all these projects will materialise or be built within the banding review period, it demonstrates the high level of interest that exists in dedicated biomass, which DECC will continue to monitor.

79. Taking this additional potential deployment into account, the preferred approach is to set a cap at the generation from 1 GW of capacity, as a level that limits deployment while providing sufficient headroom for generators to ensure that advanced projects are able to come forward over the banding review period at the support level provided – given the level of uncertainty in estimating future deployment. The aim is to set the cap at a level that will not disrupt this potential deployment, and mitigate the uncertainty that setting a cap can impose on the market. The cap will not apply to DBM with CHP nor to DBM generation accredited before April 2013 (with or without CHP). It is proposed to apply the cap to all DBM generation without CHP, irrespective of feedstock used. CHP is identified in the Bioenergy Strategy as one of our low risk, priority pathways for biomass. Biomass CHP offers more cost-effective carbon abatement than electricity only. Moreover, the number and capacity of the CHP plants that could come forward is limited by the need for a site with a suitable heat load.

80. An alternative cap level could be an equivalent of 800 MW of deployment in 2016/17. This option would be more constraining for deployment but could create higher market uncertainty, impeding some projects in the pipeline. Doing nothing is not considered to be a viable option as it does not provide the control mechanism required for dedicated biomass under the RO.

How the cap will work

81. It is proposed that the cap will be a supplier cap on the total renewable electricity generation from dedicated biomass (similar to the working of the existing co-firing cap). The cap would be set on the percentage of their obligation that suppliers can meet with that technology. The only dedicated biomass plants exempted from the cap will be biomass CHP plants for reasons of greater efficiency.

82. The level of the cap must be fixed in advance in the legislation, whereas the size of each suppliers renewables obligation will vary from year to year. Based on a 90% load factor, and maximum 1 GW annual capacity, the percentages of a suppliers renewables obligation in each year of the banding review period would be: 19/17/14/12%. This implies annual maximum generation at 8 TWh.

83. The intention is for the cap to come into effect from 1 April 2013.

[18] Government Response support for new dedicated biomass power is set at 1.5 ROCs per MWh until 31 March 2016, reducing to 1.4 ROCs per MWh for new accreditations (and additional capacity added) after 31 March 2016.
[19] This estimate is based on information provided as part of the RO Banding Review consultation, together with analysis of the DECC Renewable Energy Planning Database (REPD), and is subject to considerable uncertainty.

11. Impact of options

84. Given the long lead times between final investment decisions and the point at which dedicated biomass plants are commissioned (approx 3 to 4 years) a cap that genuinely bites on the planned projects will create uncertainty in the market. This uncertainty is expected to be greater for larger plants which will require greater headroom in order to have the guarantee that they will make it in the cap (this could lead to under deployment relative to the maximum limit imposed by any cap). A cap could also affect the ability of plants to access finance as it may raise concerns over the risk of the cap being breached, especially for plants which start generating later in the RO banding review period so undermining the value of the dedicated biomass ROC. The magnitude of this impact will depend on the level at which the cap is set.

85. In addition a cap could create a constrained market for selling dedicated biomass ROCs depressing their value and affecting the economics of dedicated biomass projects[20]. As generation starts to reach the level of the cap, the market will become even more of a “buyers’ market”, giving suppliers the power to buy ROCs at a greater than usual discount and limiting the return for generators. The level of discounting will depend on the level of the cap compared to deployment as well as wider market developments.

86. Introducing a cap on one technology under the RO, meaning the annual supply of these ROCs could potentially exceed the number that generators can use in meeting their Obligations, could lead to a reduced Power Purchase Agreement (PPA) market demand for the ROCs associated with these plants. Setting a cap makes the ROCs less relevant to the overall obligation that a supplier is required to meet, and therefore less of tradable commodity between suppliers. Once a cap has been imposed a DBM ROC is intrinsically not as valuable as an 'all-purpose' ROC to the supplier community. The cap is not a target and if the suppliers can source ROCs from other technologies to meet their obligation more economically they will do so and (given the limitation on the value of a capped DBM ROC) they are only likely to seek to contract with DBM projects if there is an enhanced discount to the general PPA ROC discount.

87. It is important to note that all the impacts above are highly dependent on the level that the cap is set at. In order to minimise these adverse impacts the intention is to set the cap at a level that provides sufficient headroom above the level that allows consented projects that can reach financial close and complete construction and commission during the RO banding period to be accommodated within the cap.

12. Wider impacts

88. Limiting the deployment of DBM (and therefore use of bioresources) may have wider environmental impacts which are difficult to value. These include benefits to bio-diversity, protection of areas of high carbon stock and/or nature reserves which, as well as safeguarding carbon sinks could have positive recreational or conservation benefits. There are also potential benefits from reduced impact on air quality, land use and feedstock competition. However, these impacts are expected to be relatively small compared to those noted in the IA for the Government Response to the RO Banding Review

[20] As generation starts to reach the level of the cap, the market will become increasingly a “buyers’ market”, giving suppliers the power to buy ROCs at a greater than usual discount and limiting the return for generators.

Consultation.

13. Summary and preferred option

89. The intention is to bring forward only the most cost and carbon-effective plants which can contribute in the short to medium term to GHG reduction and to avoid lock-in of biomass to uses which are sub-optimal in the long term. Therefore the proposal is to impose a cap equivalent to 1 GW (new capacity)[21], providing sufficient headroom to allow projects which are advanced in their development, to come forward but constraining future biomass deployment at levels which we consider are unsustainable. Although the level of deployment at which the cap is set is not expected to be met, the cap provides an upper limit on the new dedicated biomass generation and associated funding under the RO. This approach, combined with our intention to improve the GHG performance of dedicated biomass will avoid long-term lock-in of feedstocks into technologies with lesser carbon performance compared to alternative uses of biomass. This will become more critical towards 2030.

90. Based on the available market information a lower cap of 800MW or below is believed to be too restrictive to deployment, leading to the loss of shovel-ready projects and to small projects whose PPAs for electricity supply would be adversely affected.

Energy crop uplift

91. Currently, under the RO, the government provides an extra 0.5 ROCs/MWh support in addition to prevailing ROC support for use of purpose-grown crops, such as Miscanthus, willow and poplar, in either co-firing or in dedicated biomass (up to a ceiling of 2 ROCs/MWh total support). The extra support for energy crops was provided to help development of the supply chain and to overcome cost hurdles faced during establishment. For example, the market for energy crops is relatively immature and energy crops can take three to five years to establish and require additional infrastructure and development costs compared to established forestry and annual crops used in biofuel production.

92. Under the new RO Bands the Government decided not to extend the energy crops uplift to biomass conversions and enhanced co-firing as no cost evidence was provided to support the extension, and analysis indicated that the provision of the uplift could lead to pressure on the RO budget post 2017. This decision creates an anomaly on the relative rewards for standard co-firing and enhanced co-firing/conversion: SCF with energy crops could be rewarded with 1ROC while enhanced co-firing is rewarded with 0.6 – 0.9 ROCs. Although difficult to predict, this anomaly risks potentially skewing generation in favour of SCF instead of ECF, which is the focus of government policy.

93. Therefore in order to take a consistent approach to all co-firing bands, and limit the future potential costs to energy consumers, it is proposed to bring the uplift for the standard (low-range) co-firing band to an end. It is however recognised that energy crops are currently being used by co-firers who will have committed to long-term contracts for feedstock supply. The next section outlines the options DECC intends to consult on that allow the removal of the energy crop uplift from standard co-firing while taking into account generators existing contracts.

[21] This assumes support is provided via the RO for 2016/17 deployment (i.e. potential additional deployment in 2016/17 is factored in to the cap level).

14. Description of options considered

Option 0: Do nothing

94. This would mean the uplift for energy crops in either standard co-firing or in dedicated biomass would continue, whilst no such uplift would exist for energy crop use in enhanced co-firing and conversions. This option is not recommended as it does not address the inconsistent approach to co-firing bands, and the risk of future potential costs to energy consumers.

Option 1: Maintain the energy crop uplift in the standard (low-range) co-firing band until April 2019 for existing energy crop contracts only

95. The energy crop uplift would continue only for those standard co-firing generators who could demonstrate to Ofgem that they have in place existing contracts for the supply of energy crops for SCF. These contracts would have to be signed and operational before 7th September 2012[22], and the uplift would only be available for electricity generated using energy crops supplied under those contracts. The Generators would need to show the contract to Ofgem and provide information about the start date, duration and volume of energy crops that each contract is expected to supply. The generator will need to submit evidence that the energy crops used to generate the electricity by standard co-firing were supplied under the grandfathered contract.

96. It is expected that once the additional costs of planting and processing (typically 3-7 years) are overcome, energy crops could become cost competitive with other solid biomass feedstocks such as wood[23]. For example, the proposed end date of 2019 would allow one cycle of energy crop planting with 4 years of harvesting for Miscanthus, during which time all specialist investment in the supply chain should have been made. It is possible that some existing contracts may be longer than 7 years, but it is expected that such contracts are the exception rather than the norm.

97. This option is preferred as it would deliver the highest degree of certainty to the Government over the future cost of the uplift. However it is recognised that this option could have a higher administrative burden for generators and Ofgem than other options, and potential difficulties in monitoring and enforcement. The risk that contracts are entered into specifically to take advantage of the transitional arrangements is mitigated as contracts will need to have been signed and to have come into effect before 7th September 2012. The cut off date of 31 March 2019 also ensures that these transitional arrangements do not continue indefinitely.

98. It is recognised that the Government Response to the RO Banding Review decision to not extend the energy crop uplift to the enhanced co-firing bands creates a potential anomaly whereby standard co-firing may be eligible for the uplift but not enhanced co-firing. This could potentially lead to standard co-firing with energy crops receiving a higher level of support than enhanced co-firing (enhanced co-firing is rewarded with 0.6 – 0.9 ROCs). The preferred approach to removing the energy crop uplift from standard co-firing provides the greatest opportunity to limit this potential and ensure policy consistency.

[22] Launch date of Biomass Electricity and Combined Heat & Power plants – ensuring sustainability and managing costs consultation.

[23] Domestic Energy Crops; Potential and Constraints Review, Project Number: 12-021, NNFCC, April 2012, http://www.decc.gov.uk/assets/decc/11/meeting-energy-demand/bio-energy/5138-domestic-energy-crops-potential-and-constraints-r.pdf

Option 2: Retain the energy crop uplift in standard (low-range) co-firing only for generators who are already claiming the energy crop uplift until 2019

99. Generators who have been eligible for the co-firing with energy crops uplift between April 2009 and April 2013 can continue to claim the energy crop uplift for standard co-firing until April 2019; after which all electricity produced from co-firing of energy crops will receive the same rate as co-firing of regular biomass.

100. This option provides a way in which generators already using energy crops and having existing contracts in place can continue to live out these contracts until 2019, but without the administrative burden of the preferred option. This option carries little additional administration burden beyond business as usual. However, this option could have higher spend risk compared to the preferred option as it allows new contracts to be put in place by existing or past users of energy crops, thereby allowing a future increase in the volume of energy crops. It can also be seen as providing a differential advantage across generators operating in the same market, beyond that required to provide transitional arrangements for existing contracts.

Option 3: Retain the Energy Crop uplift in the standard (low-range) co-firing band until 2019

101. This option is a policy commitment to maintain the energy crop uplift for standard (low-range) co-firing until 31st March 2019. After this date, any energy crops which are burnt by new, or by existing stations, in a low-range co-firing unit will be offered the same rate as regular biomass feedstocks. Some obligated electricity suppliers currently have in place long term contracts for the supply of energy crops on the basis of receiving the energy crop uplift. However, the evidence available indicates that most contracts currently in place do not extend beyond 2019. By setting a clear end date, the aim is to enable these contracts to continue to the end of their natural life.

102. This option would deliver the least level of certainty to the Government over the future cost of the uplift, and risks an increase in numbers of new long term contracts and the associated risk to the RO budget. However, it has the advantage of a clear policy intent on which to base investment decisions, with no additional administrative burden for the RO.

15. Impacts of removing energy crop uplift for standard co-firing

103. Accurately forecasting deployment under the RO support bands is very challenging and subject to considerable uncertainty, however, it is expected that removing the energy crop uplift for SCF could lead to lower forecast deployment and associated RO spend, as less deployment is incentivised at lower support levels. Table 9 below shows the total forecast deployment and RO spend associated with SCF with energy crops set out in the RO Banding Review Consultation lead scenario (i.e. without reduced rate of support for SCF in 2013/14 and 2014/15). The maximum impact on modelled deployment and RO spend due to removing the uplift is to reduce deployment and associated spend to zero (this assumes no grandfathering or phasing out - all planned deployment stops when the uplift is removed). If grandfathering or phasing were to occur, positive deployment could be expected up to the amount shown in table 9.

Table 9: SCF with energy crops deployment and RO spend (assuming SCF support remains at 0.5 ROCs)

Standard Co-firing (energy crops)	2013/14	2014/15	2015/16	2016/17
Generation (TWh)	0.50	0.50	0.50	0.46
RO spend (£m 2011/12 prices)	23	23	23	21

Note: No deployment modelled for dedicated biomass with energy crops

104. Table 10 shows the total forecast deployment and RO spend associated with SCF with energy crops assuming support for SCF reduces in 2013/14 and 2014/15 to 0.3 ROCs/MWh (increasing to 0.5 ROCs/MWh in 2015/16 and 2016/17) in line with proposals set out below from paragraph 107. As above, the maximum impact of the energy crop uplift removal would be to reduce forecast deployment and spend to zero, however, where SCF support has reduced in 2013/14 and 2014/15 deployment is already forecast at zero (so there would be no additional impact).

Table 10: SCF with energy crops deployment and RO spend (assuming SCF reduction in support in 2013/14 and 2014/15 to 0.3 ROCs/MWh)

Standard Co-firing (energy crops)	2013/14	2014/15	2015/16	2016/17
Generation (TWh)	0	0	0.50	0.46
RO spend (£m 2011/12 prices)	0	0	23	21

Note: No deployment modelled for dedicated biomass with energy crops

105. Modelling undertaken for the RO assumes that all deployment of SCF with energy crops (see tables 9 and 10 above) originates from existing plants rather than new build, i.e. it is not expected that the energy crop uplift would be claimed by any generator that had not already claimed this previously. Under the preferred option the energy crop uplift will remain available until 2019, therefore allowing for continuous use of energy crops in standard co-firing during the RO period, in line with RO modelling. Therefore this policy proposal is not expected to have material impact on the estimated RO cost set out in the IA for the Government Response to the RO Banding Review Consultation[24].

106. However, it is important to note that the RO modelling undertaken by Poyry assumes a step supply curve, i.e. the first step on the supply curve is associated with 20% of potential deployment coming forward for that technology at given support levels. Reducing support levels for SCF to 0.3 ROCs/MWh in 2013/14 and 2014/15 does not incentivise deployment sufficiently to get to the first step on the modelled supply curve, however the modelling assumptions and methodology are subject to considerable uncertainty, and in reality at 0.3 ROCs/MWh you may see small levels of deployment which are financially viable.

Standard Co-firing support

107. The Government Response to the RO Banding Review Consultation set out the new biomass conversion band and differentiated support for different levels of co-firing[25], thus changing the concept of standard co-firing. Standard co-firing is now defined as representing combustion at less than 50% biomass by energy content in a unit. Poyry modelling and in house analysis undertaken for

[24] http://www.decc.gov.uk/assets/decc/11/consultation/ro-banding/5945-renewables-obligation-government-response-impact-a.pdf

[25] Low range (standard) (up to 50% co-firing), medium range (up to 85% co-firing), and high range (up to 100% co-firing).

the Impact Assessment for the Government response estimated that there could be approximately 14 TWh potential for conversion and co-firing (standard and enhanced co-firing) in 2013/14, rising to around 17 TWh in 2014/15 and 19 TWh in 2015/16. If such a level were to occur in 2013/14, it would have serious budgetary implications and risks breaching the Levy Control Framework and the intention to control the impact of the RO on consumers' bills.

108. Given the new support bands for conversion and co-firing and the potential budgetary risks noted above, the government response announced the limit to support for high-range co-firing in 2013/14 at 0.7 ROCs/MWh, with support increasing from 1 April 2014 to 0.9 ROCs/MWh, and in addition, the intention to consult on reducing the standard co-firing support level from its current 0.5 ROCs/MWh to 0.3 ROCs/MWh in 2013/14 and 2014/15 (rising back to 0.5 ROCs/MWh from 1 April 2015).

109. Cost analysis undertaken for the Government Response to the RO Banding Review Consultation estimates that the costs of standard co-firing are significantly lower than for enhanced co-firing and biomass conversion, as relatively little adaptation is required to enable plant to burn small amounts of biomass alongside coal[26]. Given this, and the objective to find savings within the RO budget, it is considered reasonable to lower the support levels in these years. Reducing support to zero in these years was discounted due to the potential adverse impact on those generators in transition from standard co-firing to enhanced co-firing. The RO modelling suggested that support above 0.3 ROCs/MWh would risk bringing forward new deployment, therefore 0.3 ROCs/MWh is considered the appropriate support level. However, as noted in paragraph 106, there is significant uncertainty surrounding deployment figures under the RO given the complexity of the investment decisions and the modelling approach used.

16. Description of options considered

Option 1: Do nothing – retain 0.5 ROCs/MWh for SCF

110. This option involves retaining the 0.5 ROCs/MWh over the whole period. As noted in Section 17 below, this does not address the RO budgetary risks, and therefore is not a recommended option.

Option 2: 0.3 ROCs/MWh in 2013/14 and 2014/15, increasing from 1 April 2015 to 0.5 ROCs/MWh

111. This option lowers the support level for co-firing to 0.3 ROCs/MWh in 2013/14 and 2014/15, increasing to 0.5ROCs/MWh from 2015/16. In response to evidence showing a much greater potential deployment of enhanced co-firing (ECF), the recommended option changes the support level to ensure only the most economic plant comes on, allowing RO spend to remain within the Levy Control Framework of the overall RO scheme. This option is consistent with the approach taken for mid-range co-firing (set at 0.6 ROCs/MWh), and support for high-range co-firing (set at 0.7 ROCs/MWh in 2013/14, rising to 0.9 ROCs/MWh from 2014/15), which were announced in the Government Response to the RO Banding Review Consultation.

[26] The ROCs required range for SCF is based on full range of biomass costs, whereas the ROCs required for ECF/conversion uses a best estimate of fuel costs.

17. Impacts of each option

112. The impact of reducing the support rate for SCF from 0.5 ROCs/MWh to 0.3 ROCs/MWh in 2013/14 and 2014/15 will have an impact of deployment and associated RO spend. This impact has been estimated using the modelling approach set out in the Impact Assessment accompanying the Government Response to the RO Banding Review Consultation[27]. Tables 11 and 12 below show the impact in the RO modelling when this change occurs: expected generation in 2013/14 and 2014/15 is reduced from approximately 3.7TWh and 3TWh to zero in each year. This saves approximately £99m and £83m in 2013/14 and 2014/15 respectively. Table 13 shows the total impact on electricity bills (before the impact of other policies) of the RO, assuming SCF support remains at bands announced in Government Response to the RO Banding Review Consultation and where SCF support is reduced in 2013/14 and 2014/15 to 0.3 ROCs/MWh.

113. Generation from SCF is estimated at the same level in 2015/16 irrespective of the support level provided in 2013/14 and 2014/15. This is because no investment is required to increase the deployment of SCF, it is just necessary to compensate for the additional fuel operating costs. Assuming generators have foresight of the proposal to lower support in those years, they can switch fuels accordingly without incurring any additional investment or technology costs.

Table 11: Total standard co-firing deployment and RO spend (assuming SCF support remains at 0.5 ROCs)

Standard Co-firing	2013/14	2014/15	2015/16	2016/17
Generation (TWh)	3.73	3.03	3.48	2.76
RO spend (£m 2011/12 prices)	99.09	82.69	93.24	75.23

Table 12: Total standard co-firing deployment and RO spend (assuming SCF reduction in support in 2013/14 and 2014/15 to 0.3 ROCs/MWh)

Standard Co-firing	2013/14	2014/15	2015/16	2016/17
Generation (TWh)	0.00	0.00	3.48	2.76
RO spend (£m 2011/12 prices)	0.00	0.00	93.24	75.23

Table 13: Electricity bill impacts before policies

£2011/12 prices	2013/14	2014/15	2015/16	2016/17
RO bands except SCF at 0.5 in all years	39	43	50	53
RO bands SCF at 0.3 in 2013/14 & 2014/15 (and 0.5 in 2015/16 & 2016/17)[28]	38	42	50	53

114. Changes in the level of support for biomass standard co-firing will also affect the levels of support for standard co-firing with bioliquids and biomass CHP. As set out in our Government Response to the RO banding Review consultation, co-firing with bioliquids will receive one level of support, whether standard or enhanced (up to 99% biomass). Therefore, co-firing of bioliquids will also

[27] http://www.decc.gov.uk/assets/decc/11/consultation/ro-banding/5945-renewables-obligation-government-response-impact-a.pdf
[28] This is the lead scenario in the IA for the Government Response to the RO Banding Review Consultation.

receive the proposed co-firing ROC rate; lowering to 0.3ROCs/MWh in 2013/14 and 2014/15, increasing back to 0.5ROCs/MWh from 2015/16. Standard co-firing with CHP will also receive lower level of support for co-firing with 0.8ROCs/MWh in 2013/14 and 2014/15 or 0.3ROCs/MWh plus the RHI. From 1 April 2015, CHP support will be available at 0.5ROCs/MWh plus RHI. Based on the modelling analysis, very limited deployment of standard co-firing with CHP or bioliquids are expected to come forward during 2013-2017 at current support levels. Therefore, the proposal to reduce support levels for these technologies is not expected to have significant impact on the deployment of standard co-firing with CHP or bioliquids, or on the associated cost to the RO budget from these technologies. However, it should be noted that accurately forecasting deployment under the RO support bands is very challenging and estimates are subject to considerable uncertainty.

18. Summary and preferred option

115. The preferred option is to reduce the level of support from 0.5 ROCs/MWh to 0.3 ROCs/MWh in 2013/14 and 2014/15, increasing from 1 April 2015 to 0.5 ROCs/MWh. This option meets the policy objective to limit adverse impact on those generators in transition from standard co-firing to enhanced co-firing, whilst minimising the incentive for new deployment.

Specific Impacts Tests

Statutory Equality Duties Impact Assessment

1. This policy has no significant bearing on protected characteristics, including age, disability, gender reassignment, pregnancy and maternity, race, religion or belief, sex and sexual orientation.

Competition Assessment

2. The same set of sustainability criteria will apply to all biomass installations equally (above 1MWh) and should not distort competition within the sector. The potential different criteria for solid and gaseous feedstocks might be similar in terms of ambition and required effort on the generators. The standards might instead encourage a more level playing field by setting an agreed market standard for 'sustainable biomass' across the UK and thereby create a more unified market for sustainable supplies. This would make it easier for smaller generators to source biomass that they can be confident is sustainable.

3. Retaining the energy crop uplift for generators already claiming the energy crop uplift for SCF could result in creating a competitive advantage compared to those generators who have not claimed the energy crop uplift before April 2013 or do not have existing contracts in place.

Small firms impact test

4. Whilst the total amount of subsidy received depends on the amount of generation, the compliance costs covered above would not be expected to vary with the size of the operator to the same degree. This would represent a potential disadvantage for small firms who could face similar costs in return for less overall support compared to larger operators. The magnitude of costs related to administration and verification outlined above would, however, not appear to be unreasonably high when compared to the likely amount of ROC support that even small installations would be entitled to.

Carbon Assessment

5. The value of carbon savings from the different options for sustainability criteria are shown in tables 4 and 5 in this Impact Assessment. Carbon savings represent total carbon savings associated with tighter sustainability standards applied to imported and UK sourced bioresources, based on a lifecycle analysis approach. The majority of carbon savings accrue to bioresources originating from overseas (see paragraph 46 for further detail and approximate split between UK and overseas carbon savings).

Wider Environmental Impacts

6. Combustion of biomass will have implications for local air quality and will need to be addressed through suitable remedial actions, such as the application of filters or scrubbers within the plant design. This and other local environmental impacts of new biomass plants, on local soil, water, air, land, biodiversity and amenities will be considered within the existing planning and permitting process. The RO provides the Government's support scheme for renewables electricity generation. It incentivises investment in renewables projects which help to move the UK away from fossil fuel dependency towards a low carbon economy with consequential carbon savings from displaced fossil fuel generation. Individual projects supported under the RO that are deemed to have the potential to cause significant adverse impacts are required to undertake an Environmental Impact Assessment (Directive 85/337/EEC) as part of the planning process.

Social Impacts

7. As mentioned above, the combustion of biomass will have implications for local air quality, which could impact on ***health and well-being***. Detailed determination of such impacts is complex and site specific. If the sustainability criteria reduce the level of biomass or bioliquid generation, then such impacts could be positive. In addition, pollution abatement technologies can be applied to reduce emission if required. and there is insufficient information on which to base an assessment.

8. On ***Human Rights Impacts***, if the proposals for sustainability criteria engage article 1 protocol 1 of the ECHR (protection of property) then we consider the proposals are compliant because (a) they will be implemented through legislation (b) they pursue a legitimate aim (that bioenergy should be sustainable) (c) they are necessary (as the only way to ensure the RO only supports bioenergy that meets the criteria) (d) they are proportionate (the sustainability criteria do not go further than necessary to achieve the aim). No other convention rights are considered to be potentially engaged by the proposals. In terms of ***Justice Impacts***, the proposals increase the legislative complexity of the RO. Lack of clarity in the provisions of the Renewable Energy Directive setting the bioliquid sustainability criteria may create potential scope to challenge decisions applying those sustainability criteria. These risks should be reduced by guidance from the Commission, Ofgem and DECC. Therefore, the proposal is not considered likely to increase the volume of cases going through the courts.

9. In terms of ***rural proofing***, a large proportion of biomass and bioliquid feedstocks are produced by the farming and forestry sectors, and therefore support business and job opportunities in rural areas as part of the UK biomass supply chain. Although there has been no separate or explicit assessment of the needs of rural areas, these proposals are set within this wider policy context and aim to ensure that the impacts on consumers and their bills are reasonable.

Sustainable Development

10. The addition of expanded sustainability reporting requirements for the use of solid biomass and biogas in electricity generation, will ensure that the growth in biomass electricity also delivers minimum carbon reductions and helps tackle dangerous climate change. In addition, the restrictions on use of materials that have been produced through negative land use change, will help protect lands important on carbon or biodiversity grounds.

Security of Supply

11. Biomass generation is ‘dispatchable’ so, unlike the majority of renewables, can be used to provide both base load and peak load power. This means that biomass electricity can perform a critical grid balancing role as larger amounts of intermittent power, such as onshore and offshore wind, comes online. However, growth in biomass electricity cannot take place without public support for new plants being built. Credible sustainable criteria will help support both an effective, timely planning process, and reduce the associated risks for developers and investors.

Annex A – GHG Life Cycle Analysis

1. Lifecycle analysis (LCA) in this context involves calculating the 'cradle to grave' GHG emission impacts associated with every stage in the generation of useful energy from biomass feedstocks, from cultivation to combustion for bioenergy purposes. LCA can help ensure the full emissions associated with a bioresource are taken into account when taking decisions regarding the best allocation of bioresources and alternative fuel sources.

2. No land-use change emissions are accounted for as it is assumed that any additional biomass resource will be grown on land of low carbon stock which has been abandoned due to increased food crop yields. The analysis underpinning the Bioenergy Strategy shows that there is enough land available for this to be the case. Therefore, the conversion of this land to grow biomass for bioenergy is assumed to have no carbon implications. Indirect land use (ILUC) change emissions are also not considered; however, risks of ILUC remain. The potential carbon sequestration of the counterfactual land use is also not considered in this analysis.

3. For the purposes of this analysis the GHG lifecycle emissions associated with power sector biomass feedstocks have been calculated with reference to the following sources:

   - ADAS: carbon impacts of using biomass in bio-energy and other sectors - energy crops, 2011[29]
   - Forestry Commission: Forest Research and North Energy Associates: carbon impacts of using biomass in bioenergy and other sectors - forests, 2012 (available from same link as above)
   - Environment Agency: Biomass: Carbon Sink or Sinner. April 2009.
   - AEA: Carbon Factor for Wood Fuels for the Supplier Obligation. January 2009.
   - The UK Biomass and Biogas Carbon Calculator. Developed by E4 Tech.
   - BEAT 2. The Biomass Environmental Assessment Tool. Provided by Defra, the Biomass Energy Centre and the Environment Agency.

4. The ADAS report was the main source of data for UK energy crops and straw agricultural residues. The estimated emissions include all activities up to the farm gate encompassing the stages of cultivation and harvesting and chipping, farm gate to end of processing (including transport to storage, bulk/batch drying and storage, milling and pelletising (if appropriate)) and transport of crop to end of life (including transport to plant, combustion, plant, start-up fuel, ash disposal and lime displacement). This report provided a range of emissions for each bioenergy pathway, representing 'best' and 'worst' practices; for example, different typically employed drying methods and transport distances were considered, as well as varying yields. The emissions per MWh of electrical energy are dependent on the assumed energy efficiency of the technologies; these efficiencies were brought in line with those assumed by the RO modelling (31 – 36% efficiency based on net heating value for dedicated bio-power, and 35.5% - 36.5% for co-firing).

5. The Environment Agency, AEA report, UK Biomass and Biogas Carbon Calculator and BEAT2 were used to sense check and compare estimates with ADAS. The emission factor ranges determined from the ADAS report were found to correspond well to other sources, apart from power from straw, where the ADAS emission factors were found to be significantly larger than those reported in the UK Biomass and Biogas Carbon Calculator, and default BEAT2 values. It was determined that this was

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[29] http://www.decc.gov.uk/en/content/cms/meeting_energy/bioenergy/strategy/strategy.aspx#

due to the chosen method of agricultural burden allocation[30], where different methods were employed. A wide range of emission factors for power from straw was therefore assumed for the calculations, covering the reported emission factors of the different sources.

6. Assumed UK forestry emissions were based on Forestry Commission and AEA data, and cover emissions from wood which originates from forestry currently under management. The emissions associated with forestry which is currently under management are significantly lower than forestry which is newly brought into management, as the act of bringing forest under management results in a reduction of the long-term carbon stock of the forest (e.g. the Forestry Commission report calculated emissions for power only generation from managed broadleaf forests to be 59 kg CO_2e/MWh, whilst if 'neglected' broadleaf forests are brought into management, emissions are 667 kg CO_2e/MWh, although these emissions are highly uncertain and dependent on the silvicultural approaches adopted). It is clear that separate estimates need to be made for these types of forestry resource. At present, UK forestry resource is from forests which are already under management, therefore the lower emission factors are assumed.

7. The Forestry Commission and AEA data includes GHG emissions associated with forest operations (including ground preparation, tree planting, herbicide application, and tree protection), wood harvesting and extraction, wood transport, wood processing (including drying, storage, pelletising (if appropriate), and end of life emissions (combustion, plant construction, start-up fuel etc.). As with the emissions factors for energy crops, technology energy efficiencies were taken to be the same as those assumed for the RO modelling. Data from the AEA report for forestry currently under management were found to be comparable to the Forestry Commission data, therefore a range combining data from both reports was employed.

8. For this analysis we have assumed that UK wastes have zero LCA emissions, and therefore will pass all tighter sustainability standard thresholds. In reality, wastes are likely to be transported and may undergo processing to prepare them for use in bioenergy.

9. In order to calculate LCA for imported feedstocks, estimates of international transport have been added to the emission factors calculated for UK feedstocks (as described above). Transport emissions are calculated from low to high estimates for distance covered by 40 te truck and 65,000 te bulk carrier ship (and associated grams of CO_2 equivalent per tonne per km by feedstock):

   - Low additional transport emissions are based on imports from The Netherlands with minimal road transport: 100 km truck distance, 500 km shipping distance.
   - High additional transport emissions are based on imports from North America with long distance road transport: 600km truck distance, 6000 km ship distance.

10. Agricultural residues are likely to be imported in the form of pellets, rather than bales, as pellets have a much higher density and thus lower transport cost than bales. To determine the range of emission factors for agricultural residues pellets, for the low end of the range it was assumed that the feedstock would be a residue which would be removed from the field at the same time as the primary crop, therefore no agricultural burden was allocated (e.g. sunflower seed husk). For the high end of the emission range, the agricultural burden was estimated to be similar to the high emission factor for

[30] The purpose of allocation is to determine, rationally, how a particular environmental burden, e.g. greenhouse gas emissions, should be shared amongst products and co-products. For example, to determine what proportion of the greenhouse emissions caused by the cultivation and harvesting of wheat grain and straw should be allocated to the wheat straw.

the agricultural burden of straw baling in the UK (from the ADAS report). Emissions for pelletising of the agricultural residues were assumed to be similar those arising from pelletising miscanthus bales, therefore the ADAS report values were employed. Here, electricity from the grid was assumed to power the pelletising process. As with other imported feedstock, emissions from the international transport were also included to determine a range of overall emission factors.

11. The analysis assumes a linear trajectory from the low emissions range to the high, and it has been assumed that there is an even distribution of emissions across this range. Further work will be undertaken during the consultation period to investigate whether in reality emissions follow a normal distribution or are more likely to be clustered at certain ends of the ranges.

12. Tables 1 to 4 below show the LCA emissions estimated for biomass feedstocks, separated by UK and imports, and by Dedicated Biomass plant and Co-firing plant (these technologies will have different plant efficiencies which account for the differences in the LCA range for the feedstocks). It has been assumed that straw will only be used as a feedstock for dedicated biomass and is not suitable for co-firing.

Table 1: UK Dedicated Biomass feedstock lifecycle emissions

	Emission range (kg CO_2e /MWh)		
	Low	Central	High
UK Forestry	44	54	63
UK forestry pellets	83	109	135
Miscanthus Chips	87	185	282
Miscanthus Bales	84	137	190
Miscanthus Pellets	210	263	315
SRC chips	64	206	347
SRC pellets	73	222	371
Straw Bales	82	222	363

Table 2: Imported Dedicated Biomass feedstock lifecycle emissions

	Emission range (kg CO_2e /MWh)		
	Low	Central	High
Miscanthus bales	106	255	403
Miscanthus chips	100	253	406
Miscanthus pellets	218	298	377
SRC chips	77	274	470
SRC pellets	81	258	434
Ag Res Bales	68	322	576
Ag Res pellet	176	388	600
Forestry	54	100	146
Forest pellet	91	145	198

Figure 1: UK and Imported Dedicated Biomass feedstock lifecycle emissions compared to EU comparator and UK grid average

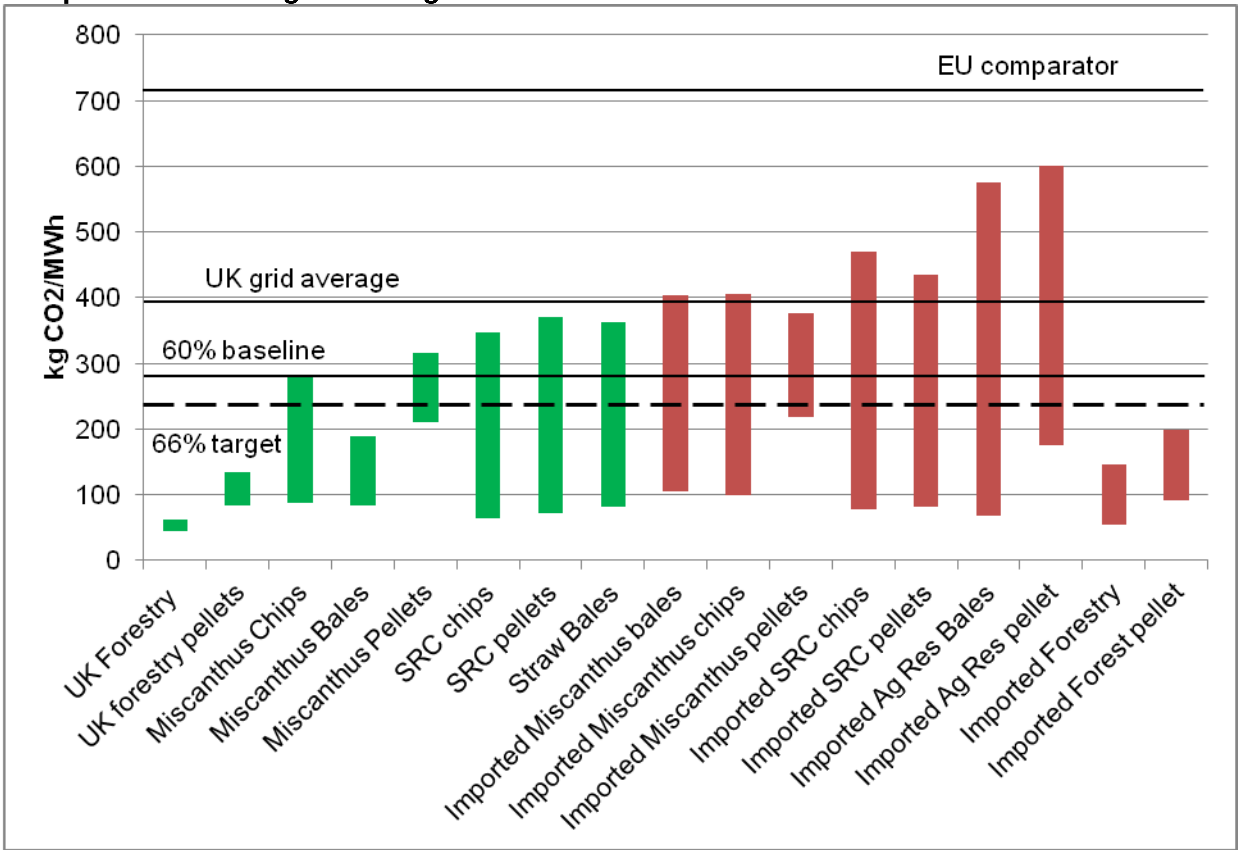


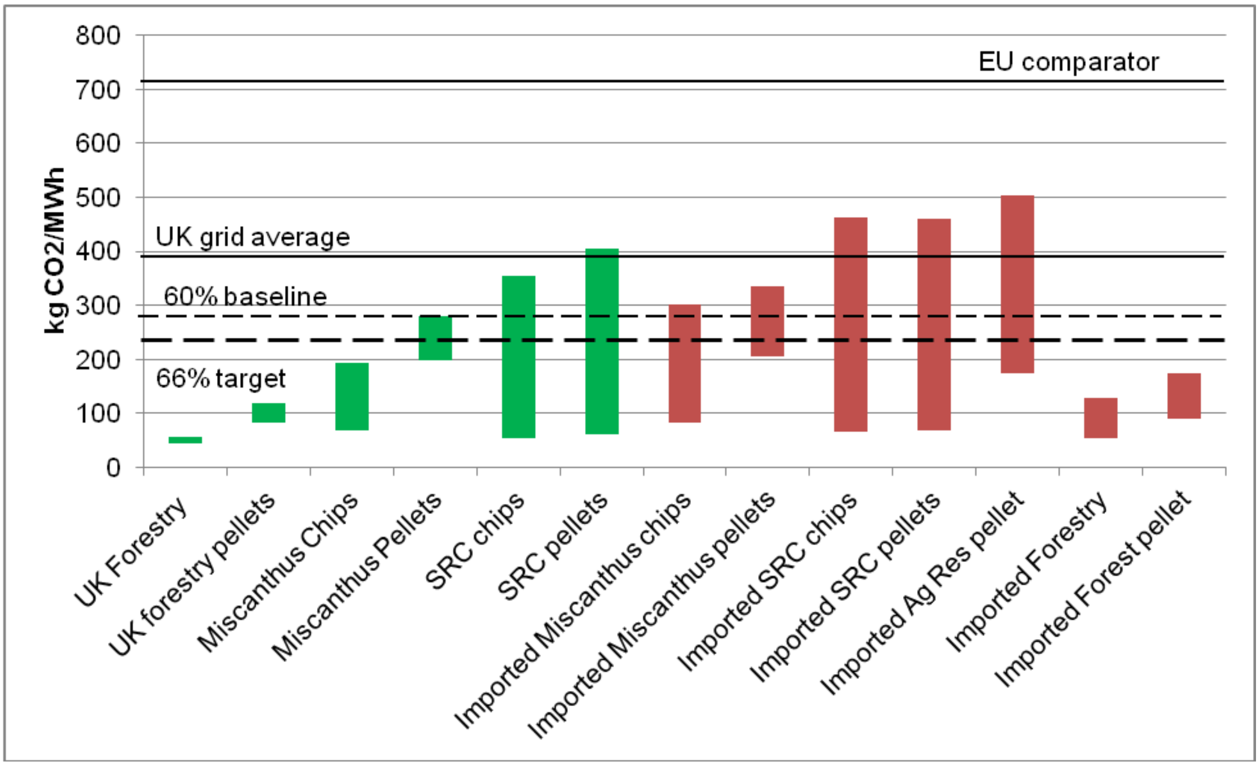
Table 3: UK Biomass feedstocks for Co-firing lifecycle emissions

	Emission range (kg CO_2e /MWh)		
UK Forestry Residues	44	50	55
UK forestry pellets	82	100	118
Miscanthus Chips	69	132	194
Miscanthus Pellets	197	238	279
SRC chips	53	204	355
SRC pellets	61	234	406

Table 4: Imported Biomass feedstocks for Co-firing lifecycle emissions

	Emission range (kg CO_2e /MWh)		
Miscanthus chips	82	192	302
Miscanthus pellets	205	270	334
SRC chips	66	265	463
SRC pellets	69	265	461
Ag Res pellet	175	340	504
Forestry	53	90	127
Forest pellet	90	132	173

Figure 2: UK and Imported Co-firing feedstock lifecycle emissions compared to EU comparator and UK grid average



Calculating pass rates

13. Comparing the LCA emissions estimated in tables 1 to 4 above with the acceptable emissions factors for different sustainability criteria (e.g. 60% lower than the EU-wide average electricity grid CO_2e emissions of 712 kg CO_2e/MWh) enables you to calculate overall pass rates for feedstocks, i.e. the proportion of total feedstock supply that is likely to pass the tighter sustainability criteria. These pass rates are used to estimate the potential shortfall in bioresource supply, holding all other factors constant, for example, the supply response to higher sustainability standards from the market.

14. Wastes – such as landfill gas, sewage gas, recovered wood - are exempted from the criteria to reflect that significant carbon benefits will accrue where the alternative route would be disposal to landfill. Landfilled biomass releases methane – a powerful GHG – as it decays. The analysis indicates that UK forestry resources and wastes are expected to pass all the sustainability standards considered in this IA, whether used for Dedicated Biomass or Co-firing. A significant proportion of UK straw could potentially not pass the 66% threshold; this is for cases where low yields are achieved, hence high emissions per tonne of straw are associated with harvesting. However, the straw emissions are dependent on the allocation method used to determine the agricultural burden; further work will be undertaken during the consultation period to determine the most appropriate emission factor range for UK straw.

15. Tables 5 and 6 below show the pass rate assumptions based on the LCA analysis undertaken. These savings are the proportion of a feedstock that will meet the tighter GHG threshold (given its estimated lifecycle emissions) compared to the EU electricity average. Central pass rates assume an even distribution over the range of lifecycle emissions (see range in table 1 to 4 above), whereas low pass rates are based on a distribution weighted towards the higher end of the emissions range, leading to a lower proportion of the feedstock meeting the required thresholds. High pass rates

assume a distribution weighted towards the lower end of the emissions range, leading to a higher proportion of the feedstock meeting the required thresholds. Pass rate scenarios are all applied to the same bioresource supply assumptions.

Table 5: Overall bioresource pass rates (Dedicated Biomass)

	66% saving			72% saving		
	Low	central	high	Low	central	high
UK						
Forestry	100%	100%	100%	100%	100%	100%
Energy crops	54%	68%	82%	36%	48%	60%
Straw	40%	60%	80%	20%	40%	60%
Wastes	100%	100%	100%	100%	100%	100%
Imports						
Agricultural residue	15%	30%	45%	15%	30%	45%
Woody	100%	100%	100%	100%	100%	100%
Energy crops	18%	36%	54%	16%	32%	48%

Table 6: Overall bioresource pass rates (Co-firing)

	66% saving			72% saving		
	Low	central	high	Low	central	high
UK						
Forestry	100%	100%	100%	100%	100%	100%
Energy crops	55%	70%	85%	38%	50%	63%
Waste	100%	100%	100%	100%	100%	100%
Imports						
Agricultural residue	10%	20%	30%	10%	20%	30%
Woody	100%	100%	100%	100%	100%	100%
Energy crops	25%	45%	65%	20%	35%	50%

Annex B – Cost and benefit summary of Option 2 (Section A)

1. Table 1 below summaries the resource costs, carbon benefits, and overall NPV best estimate for option 2 for dedicated biomass (DBM) and conversion/co-firing (CCF), as set out in the Summary pages of this IA. Option 2 relates to the following proposals:

   - For Dedicated Biomass accredited after April 2013: tighten target to 200 kg CO2eq/MWh (72% saving) from October 2013.
   - For Dedicated Biomass accredited before April 2013: maintain standards to 285 kg CO2eq/MWh (60% saving) to 2020, and reduce it to 200 kg CO2eq/MWh (72% saving) from April 2020.
   - For Conversions & Co-firing: tighten target to 240 kg CO2eq/MWh (66% saving) from 2014.

2. In order to show the widest potential impacts low pass rates are assumed, this leads to the maximum saving or cost dependent on the counterfactual technology because it implies the largest generation 'gap' to fill. Total resource costs and NPV figures include costs and benefits reported in tables 6 and 7 in main IA, plus administration costs outlined from paragraph 53. Administration costs to biomass producers for GHG certification and costs to generators for verification reporting lead to approximately £1.0m to £1.2m per year[31].

   Table 1: Summary of option 2 (extreme range, assuming low pass rates) used for NPV range on IA Summary sheets

		Cumulative to 2030		
All figures discounted		Low (onshore)	High (offshore)	
Resource cost (exc. carbon saved)	DBM	-1330	1350	
	CCF	-1880	2080	
Value of carbon saved	DBM	1130	450	
	CCF	1210	540	
NPV (inc. carbon saved)	DBM	-2450	890	
	CCF	-3090	1540	
		Low (onshore)	High (offshore)	Best estimate
Total cost range		-3210	3420	110
Total benefit range		2330	990	1660
Total NPV range		-5540	2430	-1560

Note: minus figures represent saving (benefit)

[31] Assumes between £0.024m and £0.179m for biomass producers GHG certification, and approximately £0.978m for generators seeking verification. Administration costs will only factor in those years where the tighter standards are introduced according to the proposal.