Proposals to enhance the sustainability criteria for the use of solid and gaseous biomass feedstocks under the Renewables Obligation (RO)	**Impact Assessment (IA)**
IA No: DECC0134	**Date: 29/07/2013**
Lead department or agency: DECC	**Stage:** Final
Other departments or agencies: Defra, Forestry Commission, BIS and HM Treasury	**Source of intervention:** Domestic
	Type of measure: Secondary Legislation
	Contact for enquiries: jackie.honey@decc.gsi.gov.uk caroline.season@decc.gsi.gov.uk

Summary: Intervention and Options

RPC Opinion: N/A (policy proposals fall under the Renewables Objective)

Cost of Preferred (or more likely) Option				
Total Net Present Value	**Business Net Present Value**	**Net cost to business per year** (EANCBon 2009 prices)	**In scope of One-In, One-Out?**	**Measure qualifies as**
£240m	N/A	N/A	No	N/A

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

The use of biomass for electricity generation carries both large 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 power generators using solid and/or gaseous biomass 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 CO_{2eq}/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 intends to formally link meeting the criteria with eligibility for Renewables Obligation Certificate (ROC) support and require an independent audit for plants above 1 MWe, following a statutory consultation. This consultation, which was open between 7 September and 30 November 2012, also included proposals to address increased concerns on global deforestation and the need for the Greenhouse Gas (GHG) target to tighten over time reflecting UK ambitions on carbon reductions post-2020. Therefore, the Government Response to the consultation sets out improvements to the criteria including the addition of a sustainable forest management approach for woodfuel, and setting a reducing GHG trajectory with steps in 2020, and also potentially in 2025.

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.

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:

Policy option 0 – Maintain existing sustainability criteria(Status Quo)		285 kg CO_2eq/MWh for Dedicated Biomass and Conversions & Co-firing.		
		From April 2014	From April 2020	From April 2025
Policy option 1 (**Preferred final option to be implemented**)	Dedicated Biomass accredited after April 2013	240 kg CO_2eq/MWh	200 kg CO_2eq/MWh	180 kg CO_2eq/MWh
	Dedicated Biomass accredited before April 2013	285 kg CO_2eq/MWh	200 kg CO_2eq/MWh	180 kg CO_2eq/MWh
	Conversions & Co-firing	285 kg CO_2/MWh	200 kg CO_2eq/MWh	180 kg CO_2eq/MWh
Policy option 2 (Preferred Consultation option)	Dedicated Biomass accredited after April 2013	240 kg CO_2eq/MWh	200 kg CO_2eq/MWh	No set target
	Dedicated Biomass accredited before April 2013	285 kg CO_2eq/MWh	200 kg CO_2eq/MWh	No set target
	Conversions & Co-firing	285 kg CO_2/MWh	240 kg CO_2eq/MWh	No set target

These options are subject to notification to the Commission and subject to any mandatory standards that are adopted by the EU or internationally.

In additional to the options above for GHG savings:

- addition of sustainable forest management criteria based on existing forestry standard schemes
- requirement for independent verification

Will the policy be reviewed? No, unless EU legislation on Sustainability standards requires amendments					
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	

**Carbon savings are explained in paragraph 52 and tables 4 and 5.*

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: Edward Davey Date: 29 July 2013

Summary: Analysis & Evidence

Policy Option 1

Description:

		From April 2014	From April 2020	From April 2025
Policy option 1 (Preferred final option)	Dedicated Biomass accredited after April 2013	240 kg CO_2eq/MWh	200 kg CO_2eq/MWh	180 kg CO_2eq/MWh
	Dedicated Biomass accredited before April 2013	285 kg CO_2eq/MWh	200 kg CO_2eq/MWh	180 kg CO_2eq/MWh
	Conversions & Co-firing	285 kg CO_2/MWh	200 kg CO_2eq/MWh	180 kg CO_2eq/MWh

(Preferred Final option)

FULL ECONOMIC ASSESSMENT

Price Base	**PV Base**	**Time Period**	**Net Benefit (Present Value (PV)) (£m)**		
2012	2012/13	**Years**18	**Low:-110**	**High:**600	**Best Estimate:**240

COSTS (£m)	**Total Transition** (Constant Price) Years		**Average Annual** (excl. Transition) (Constant Price)	**Total Cost** (Present Value)
Low				-470
High				150
Best Estimate				-160

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

Tighter sustainability standards could reduce the amount of biomass in electricity generation, which would have to be replaced by other technologies to meet renewable and GHG targets. The resource cost/ benefit is uncertain and depends on the cost of alternative generation (e.g. onshore and offshore wind). If bioenergy is displaced by onshore wind there is assumed to be a resource benefit, if offshore wind is the counterfactual there is an overall resource cost. The range of costs reflects the range of counterfactual costs. Costs recorded here 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.

BENEFITS (£m)	**Total Transition** (Constant Price) Years		**Average Annual** (excl. Transition) (Constant Price)	**Total Benefit** (Present Value)
Low				30
High				130
Best Estimate				80

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

Key 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 2012 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 52).

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. Setting a clear GHG trajectory for the period to 2027 provides certainty to biomass generators in the context of long term feedstock contracts. There could be indirect impact on the economy of changes to prices and bills, however these are highly uncertain and will depend on the cost of 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.

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:

		From April 2014	From April 2020	From April 2025
Policy option 2 (Preferred Consultation option)	Dedicated Biomass accredited after April 2013	240 kg CO_2eq/MWh	200 kg CO_2eq/MWh	No set target
	Dedicated Biomass accredited before April 2013	285 kg CO_2eq/MWh	200 kg CO_2eq/MWh	No set target
	Conversions & Co-firing	285 kg CO_2/MWh	240 kg CO_2eq/MWh	No set target

(Preferred option at Consultation)

FULL ECONOMIC ASSESSMENT

Price Base 2012	**PV Base** 2012/13	**Time Period Years**	**Net Benefit (Present Value (PV)) (£m)**		
			Low: -70	**High: 39**0	**Best Estimate:** 160

COSTS (£m)	**Total** (Constant Price)	**Transition** Years	**Average Annual** (excl. Transition) (Constant Price)	**Total Cost** (Present Value)
Low				-310
High				90
Best Estimate				-110

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

Tighter sustainability standards could reduce the amount of biomass in electricity generation, which would have to be replaced by other technologies to meet renewable and GHG targets. The resource cost/ benefit is uncertain and depends on the cost of alternative generation (e.g. onshore and offshore wind). If bioenergy is displaced by onshore wind there is assumed to be a resource benefit, if offshore wind is the counterfactual there is an overall resource cost. The range of costs reflects the range of counterfactual costs.

Costs recorded here 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.

BENEFITS (£m)	**Total** (Constant Price)	**Transition** Years	**Average Annual** (excl. Transition) (Constant Price)	**Total Benefit** (Present Value)
Low				20
High				80
Best Estimate				50

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

Key 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 2012 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 52).

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. Setting a clear GHG trajectory for the period to 2027 provides certainty to biomass generators in the context of long term feedstock contracts. There could be indirect impact on the economy of changes to prices and bills, however these are highly uncertain and will depend on the cost of 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.

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)

1. On 7th September 2012 the **Biomass Electricity & Combined Heat & Power plants – ensuring sustainability and managing costs** consultation was launched[1]. The Consultation was divided into two sections: (A) proposed improvements to the sustainability criteria that apply to the use of biomass for electricity generation under the Renewables Obligation (RO); and (B) proposals addressing biomass value for money and affordability under the RO. Section A and B are related in that they all impact on biomass power generation supported through the RO, however they can be considered as standalone policy options. The final proposals for section (B) were published in December 2012[2]. The Sustainability criteria proposals were subject to a longer consultation period, which closed on 30th November 2012. This Impact assessment (IA) contains the impact analysis for the Government Response to the consultation on biomass sustainability criteria.

2. The evidence base is set out as follows:

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

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

1. Problem under consideration

3. 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[3], published in April 2012, 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 bioenergy is (i) genuinely low carbon and (ii) 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, beyond possible reputational issues as Ofgem publish the sustainability data from each generator online. In addition, the current criteria do not specifically address 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 consultation included proposals to enhance sustainability criteria.

4. 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

[1] www.gov.uk/government/uploads/system/uploads/attachment_data/file/66519/6339-consultation-on-biomass-electricity--combined-hea.pdf
[2] www.gov.uk/government/uploads/system/uploads/attachment_data/file/66525/7328-renewables-obligation-banding-review-for-the-perio.pdf
[3] www.decc.gov.uk/en/content/cms/meeting_energy/bioenergy/strategy/strategy.aspx

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[4] 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 $kgCO_2eq/MWh$ compared to 712 $kgCO_2eq/MWh$), 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 peatland. 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. The European Commission plans to publish an updated report on the requirements for sustainability criteria for solid and gaseous biomass later this year.

5. 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 to take account of 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, reinforcing 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 a barrier to 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 robust sustainability standards in order to clearly demonstrate their sustainability credentials.

2. Rationales for intervention

6. Under global accounting rules the use of 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. However, there are other emissions to be considered across the full bioenergy lifecycle, including 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.

7. 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

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

making investment decisions.

3. Policy objectives

8. 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 accompanying benefits for increased security of supply and green jobs. 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.

9. 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 the 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 electricity generation.

10. 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[5], 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 lignocellulosic 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.

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

11. 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.

[5] The Government has introduced complementary sustainability criteria to the Renewable Heat Incentive as to the Renewables Obligation. On 27 February 2013 the Government Response to the consultation on the Non-Domestic Renewable Heat Incentive was published. This confirmed that a mandatory greenhouse gas lifecycle target and land criteria would be brought into the Renewable Heat Incentive. The land criteria would be the same as those which would be brought in for the Renewables Obligation and with respect to woodfuel will draw on established sustainable forestry schemes.

12. The European Commission'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. Direct 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 recommended approach does not directly address social issues, such as land use rights, nor include specific criteria for sustainable forest management. These issues are considered within this Impact Assessment.

4. Description of options considered

Consultation options

13. The Consultation included two options for tightening GHG emission targets, which were considered an appropriate range to consult on given the feedback received through the RO Banding Review consultation, specifically highlighting the 200 kg CO_2eq/MWh minimum emissions threshold for the RO recommended by the Committee on Climate Change (CCC) in its 2011 report on bioenergy[6]. The two options were:

Policy option 0 – Maintain existing sustainability criteria		285 kg CO_2eq/MWh for Dedicated Biomass and Conversions & Co-firing.		
		From October 2013	From April 2020	From April 2025
Policy option 1 (Preferred consultation option)	Dedicated Biomass accredited after April 2013	240 kg CO_2eq/MWh	200 kg CO_2eq/MWh	No set target
	Dedicated Biomass accredited before April 2013	285 kg CO_2eq/MWh	200 kg CO_2eq/MWh	No set target
	Conversions & Co-firing	285 kg CO_2/MWh	240 kg CO_2eq/MWh	No set target
Policy option 2	Dedicated Biomass accredited after April 2013	200 kg CO_2eq/MWh	200 kg CO_2eq/MWh	No set target
	Dedicated Biomass accredited before April 2013	285 kg CO_2eq/MWh	200 kg CO_2eq/MWh	No set target
	Conversions & Co-firing	240 kg CO_2/MWh	240 kg CO_2eq/MWh	No set target

14. GHG trajectory options took into account that existing plants (accredited before April 2013) may have feedstock contracts already in place and therefore require a different trajectory towards 2020 compared with plants accredited after April 2013. A differentiated approach to the tightening of sustainability standards was proposed in the consultation for conversions and co-firing and dedicated biomass power. GHG standards for co-firing and conversions were set lower reflecting the relatively greater cost effectiveness of biomass conversions from coal compared to new dedicated biomass (the expected counterfactual technology for conversions is coal whereas for new dedicated biomass it is gas CCGT[7]), as well as their shorter expected operating lifetimes. In the consultation DECC proposed that a target would be set to apply from 2025 subject to suitable evidence being available to underpin the decision.

[6] http://downloads.theccc.org.uk.s3.amazonaws.com/Bioenergy/1463%20CCC_Bio-TP2_supply-scen_FINALwithBkMks.pdf
[7] Combined Cycle Gas Turbine (CCGT)

Final options

15. Taking into account responses during the consultation and industry's ability to respond to tightening GHG standards, the Government has decided to bring in robust sustainability controls for solid biomass and biogas which will be amongst the most stringent applied not only in the EU, but internationally. Many of the power generators operating in the UK are already recognised as industry leaders on biomass sustainability, so are considered well-placed to work with their supply-chains, certification bodies and others to meet these ambitious and stretching targets.

16. The National Non-Food Crops Centre (NNFCC) research[8] indicated that the majority of supply chains with feedstock sourced from overseas should be capable of achieving a further 30% reduction in emissions (compared to current levels) by 2030[9] with many of the supply chains achieving this reduction by 2025. Supply chains with feedstock sourced from the UK may achieve additional emissions reductions of up to 20% by 2025 and up to 26% by 2030[10], with exception of sawmill residues where reductions may be more than 60% by 2030[11].

17. NNFCC evidence indicates that most supply chains analysed in their report could potentially reduce their carbon intensity to below 150 kg CO_{2eq}/MWh by 2020[12] with the exception of wood pellet sourced from US short rotation forestry. Although, it is important to note that generators have indicated that the margin required between target GHG emissions and contracted supply chain values can be around 10 - 25% in order to accommodate associated risks (i.e. unintended changes in supply chain logistics) with meeting GHG targets and ensuring access to finance.

18. Given this evidence of potential emission efficiencies, the final proposal to be implemented strengthens the preferred option at Consultation stage, by setting the GHG criteria at 200 kg CO_2eq/MWh from 2020, and 180 kg CO_2eq/MWh from 2025 for all biomass technologies (i.e. conversion & co-firing and dedicated biomass). Analysis undertaken by NNFCC on the life cycle emissions associated with feedstocks used for conversion & co-firing and dedicated biomass indicated no significant difference between the two technologies in terms of carbon intensity. Plus the target will now be applied as an annual average (subject to a ceiling to ensure any single consignment delivers reasonable GHG emissions savings) to provide generators with greater flexibility to better manage the risks associated with meeting a tougher target from 2020.

19. Moreover, the introduction of a non-legislative cap of 400MW on new dedicated biomass capacity, means that conversion and co-firing are expected to provide the majority of new biomass power generation and hence new biomass feedstock demand coming forward under the RO. Therefore, a less stringent approach for conversions and co-firing was no longer considered justified from 2020. A step approach remains prior to 2020 to reflect the need to honour existing feedstock contracts.

20. In addition, it has been decided that the sustainability criteria will be fixed to 1 April 2027 (with the proviso that the UK will take account of EU and international legislation, but not act unilaterally), therefore providing greater certainty to biomass developers coming forward under the RO (which closes to new generation in March 2017) when signing long term feedstock contracts.

[8] NNFCC (2013) RO Sustainability Standards https://www.gov.uk/government/consultations/ensuring-biomass-affordability-and-value-for-money-under-the-renewables-obligation

[9] Reductions compared to NNFCC estimates of 2012 greenhouse gas emissions. For example, USA and Europe forestry residue pellets assumed to be 182 kg$CO_{2\ eq}$ /MWh and 115 kg$CO_{2\ eq}$ /MWh in 2012, respectively.

[10] Reductions compared to NNFCC estimates of 2012 greenhouse gas emissions. UK forestry residue pellets, SRF, and SCR assumed to be approximately 82 kg$CO_{2\ eq}$ /MWh in 2012.

[11] Reductions compared to NNFCC estimates of 2012 greenhouse gas emissions. UK sawmill residue assumed to be approximately 34 kg$CO_{2\ eq}$ /MWh in 2012.

[12] Assuming a 33% conversion efficiency

21. This Impact Assessment considers the following three options:

Policy option 0 – Maintain existing sustainability criteria		285 kg CO_2eq/MWh for Dedicated Biomass and Conversions & Co-firing.		
		From April 2014	From April 2020	From April 2025
Policy option 1 (Preferred final option to be implemented)	Dedicated Biomass accredited after April 2013	240 kg CO_2eq/MWh	200 kg CO_2eq/MWh	180 kg CO_2eq/MWh
	Dedicated Biomass accredited before April 2013	285 kg CO_2eq/MWh	200 kg CO_2eq/MWh	180 kg CO_2eq/MWh
	Conversions & Co-firing	285 kg CO_2/MWh	200 kg CO_2eq/MWh	180 kg CO_2eq/MWh
Policy option 2 (Preferred Consultation option)	Dedicated Biomass accredited after April 2013	240 kg CO_2eq/MWh	200 kg CO_2eq/MWh	No set target
	Dedicated Biomass accredited before April 2013	285 kg CO_2eq/MWh	200 kg CO_2eq/MWh	No set target
	Conversions & Co-firing	285 kg CO_2/MWh	240 kg CO_2eq/MWh	No set target

5. Analysis of options

(i) Scope of the scheme in biomass production sources

22. The 2010 EC report on the requirement for sustainability criteria for solid and gaseous biomass recommends that the scope of any member state's Scheme is similar to that the EU mandated for bioliquids and biofuels under the EU Renewable Energy Directive (RED). 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 peatland 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.

23. Current UK policy is set within the context of the principles set out above; however the final GHG trajectory and reporting requirements proposal set out in this Impact Assessment aims to ensure the UK adheres to the policy intent more fully. In particular that the concerns relating to sustainable forest management are different to those of sustainable agriculture.

24. 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.

25. 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

26. EC 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.

27. The UK has decided 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 and would reduce the administrative burden on these operators by around £10,000 per annum using the RTFO estimates noted in paragraph 61.

28. Above 1 MWe the UK has decided 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 expect to receive per year.

(iii) GHG savings performance criteria

29. The European 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 $kgCO_2/MWh$[13]). Although these levels represent an important saving against the EU average grid intensity they are more modest when compared to the UK electricity sector carbon intensity.

30. For example, the EC's recommended 35% saving against the EU comparator implies 463 $kgCO_2/MWh$, when the UK long term marginal emission factor is already lower at 394 $kgCO_2/MWh$. 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% saving against the UK marginal electricity carbon intensity. Performance against the existing 60% criteria must be reported to Ofgem by UK generators, and where is not met the generator is required to explain why it was used rather than biomass that would meet the GHG target, however, meeting the current criteria is not mandatory.

[13] EC estimate February 2010 http://ec.europa.eu/energy/renewables/bioenergy/sustainability_criteria_en.htm top report in list
Report on sustainability requirements for the use of solid and gaseous biomass sources in electricity, heating and cooling [COM/2010/11]

31. Table 1 below shows the different GHG standards that have been considered 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 appropriate given the feedback received from industry during the consultation (i.e. realistic ambition given current practices and contracts in place), specifically highlighting the 200 kg CO_2eq/MWh figure recommended by the Committee on Climate Change (CCC) in its 2011 report on bioenergy[14]. The CCC considers 200kg CO_2eq/MWh to represent a significant enough saving relative to UK gas generation (as opposed to the higher EU grid average carbon intensity), taking into account the risks associated with emissions due to possible indirect deforestation or other indirect impacts.

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 kgCO_2/MWh	69%	60%	28%
240 kgCO_2/MWh	74%	66%	39%
200 kgCO_2/MWh	78%	72%	49%
180 kgCO2/MWh	80%	75%	54%

33. Tightening the sustainability target for solid biomass for new dedicated biomass power (with or without CHP) to 240 kgCO_2/MWh from April 2014 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%. For biomass conversions and co-firing the most appropriate counterfactual over the short to medium term is considered to be coal[15], given this technology is decarbonising existing coal plants. Against this maintaining a 285 kg CO_2eq/MWh standard would equate to a 69% saving. However, taking into account evidence on the potential carbon intensity of feedstocks for biomass technologies, and providing that the target will be applied as an annual average, it is considered appropriate to subject all biomass power to the same ambitious targets from 2020: 200 kg CO_2/MWh from 2020, and 180 kg CO_2/MWh from 2025.

[14] 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 the Commission.

[15] 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.

34. The analysis in this Impact Assessment assumes all feedstocks must pass the set criteria. However, responses during the consultation consistently reported the risk that a single feedstock consignment could breach the GHG target due to unforeseen circumstances. Therefore, the Government has decided that the target will represent an annual average, with the provision that any one consignment of solid or gaseous biomass feedstocks must not exceed an appropriate ceiling (please see Government Response[16] for further details). As the GHG standard tightens it increases the risk that unintentional events such as a ship being diverted to another port could lead to consignments failing the target by a narrow margin. Allowing an annual average, whilst setting out clear minimum standards for each individual consignment, mitigates the risk of these unintended consequences, whilst maintaining the robustness of the tightening GHG trajectory.

Costs and Benefits

Updates to methodology and assumptions since Consultation stage Impact Assessment

35. The following updates have been made to the methodology and assumptions in this Impact Assessment compared to the analysis undertaken for the Consultation stage Impact Assessment published in September 2012[17]:

- Life Cycle Analysis – estimates of the emissions associated with the lifecycle of biomass feedstocks has been updated to take into account research undertaken by NNFCC[18]. This analysis is summarised in Annex A. Evidence gathered during the consultation indicated that the key feedstock used by generators would be imported woody pellets from forestry residues. Given this, it has been assumed that the total imported feedstock available will be from forest residues (rather than a split between forestry residue, energy crops and agricultural residues as in Consultation analysis). The exact feedstock mix utilised in the future is subject to considerable uncertainty, and it is possible that as sustainability standards tighten generators may look to alternative feedstocks, such as cocoa husks (see paragraph 72), to meet GHG standards. However, due to the relatively long term feedstock supply contracts generators are required to sign, the assumption that imports will be from forestry residues is considered reasonable for this analysis.

  Life cycle analysis, using the RED methodology, suggests that a higher proportion of imported forestry residue feedstocks would pass GHG standards compared to imported energy crops; therefore, by assuming that a larger proportion of total imported supply comes from forestry residues, this leads to an increase in the total amount of feedstock passing the GHG standards. However, this LCA method does not consider all carbon impacts associated with using land for bioenergy, e.g. Indirect Land Use Change and carbon debt associated with counterfactual land use, therefore DECC is working to improve evidence in this area (see Annex A on what is and is not included in the LCA methodology).

  The level of imported biomass and of domestic biomass resources that may be available to the UK in the future is highly uncertain, and supply assumptions in this analysis are used purely to construct pass rates rather than predict what level of resource will be available to

[16] DECC (2013) Government Response to the consultation on proposals to enhance the sustainability criteria for biomass feedstocks under the RO https://www.gov.uk/government/consultations/ensuring-biomass-affordability-and-value-for-money-under-the-renewables-obligation
[17] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/66520/6342-impact-assessment-biomass-electricity-and-combined.pdf
[18] NNFCC (2013) RO Sustainability Standards https://www.gov.uk/government/consultations/ensuring-biomass-affordability-and-value-for-money-under-the-renewables-obligation

the UK. See paragraph 40 for further information on supply assumptions. For a wider discussion of biomass resource supply see the Bioenergy Strategy and accompanying Analytical Annex[19].

- Resource costs of renewable technologies – updated to reflect DECC's latest published levelised cost estimates[20], and assuming counterfactual costs (i.e. coal and gas CCGT) consistent with Dynamic Dispatch Model (DDM).

- Bioenergy generation in the power sector – updated to be consistent with DECC's latest Dynamic Dispatch Model (DDM) generation projections, which is consistent with the generation assumptions assumed in the Electricity Market Reform (EMR) Impact Assessment[21] published in July this year. To note that latest projections for dedicated biomass and conversions are lower than those supporting the consultation – leading to a lower overall cost impact.

- Value of carbon saved due to tightening sustainability standards – the majority of carbon savings accrue to a reduction in life cycle bioresource emissions felt overseas, and are valued using the IAG 2012 traded sector price. This is consistent with the approach adopted in the appraisal of international cases, where the traded price is considered to be the best estimate available for a shadow price that will incentivise markets to undertake abatement action. The 2012 traded price is significantly lower than the 2011 series, before converging towards £76/t CO_2 in 2030. This has resulted in carbon savings being valued significantly less than in the Consultation Impact Assessment, and therefore lowers the monetised benefits, and narrows the overall potential NPV range considerably.

Methodology

36. 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[22], conversions and co-firing are based on the Dynamic Despatch Model (DDM) reference case, which is consistent with the generation assumptions assumed in the EMR impact assessment published 31 July 2013.

37. The potential impact of tighter sustainability criteria on the electricity sector depends on the projections of future biomass resource supply, the level of bioenergy use in the power sector, and the lifecycle emissions of the feedstocks that comprise the supply curves. The analysis in this IA is based on the assumption that the tighter sustainability criteria reduce the availability of supply, which reduces the amount of generation using biomass. This leaves a generation 'gap' which is replaced by another 'counterfactual' renewable generation (in order to meet the renewable energy target). This is a stylistic approach, as in practice there is likely to be a dynamic effect on prices and supply due to tighter standards. The potential impact on biomass prices is considered separately in Box 1 below. We do not have data to model the more dynamic approach, and the impacts estimated in this impact assessment are an indication of the range of impact.

[19] https://www.gov.uk/government/publications/uk-bioenergy-strategy
[20] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/65713/6883-electricity-generation-costs.pdf
[21] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/73257/contracts_for_difference_ia.pdf
[22] Dedicated Biomass CHP generation is included in the overall Dedicated Biomass generation figures.

38. There are a number of steps taken to determine the size of the generation 'gap':

   a. Estimate the bioresource supply scenario that the UK will face in 2020.
   b. Estimate GHG Life Cycle Analysis (LCA) to determine the emissions associated with each feedstock.
   c. Estimate the proportion of bioresource supply that will pass the tighter standards given the associated LCA.

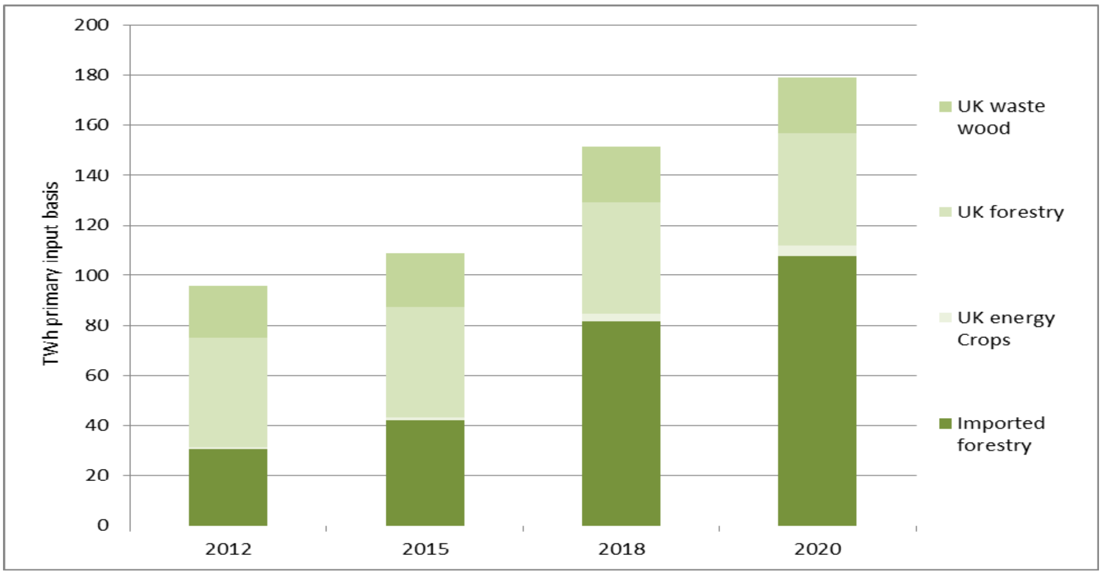
39. These steps are outlined below.

Biomass resource supply

40. The supply assumptions shown in Figure 1 are consistent with the central biomass resource scenario set out in the Bioenergy Strategy[23], but are adjusted downwards to take into account the estimated feedstock that would pass the baseline GHG standards (285 $kgCO_{2eq}$ /MWh). This scenario illustrates the level of biomass feedstocks assumed to be available for use in the UK for the purposes of modelling feedstock pass rates. The scenario is derived from AEA analysis[24] 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. For further information on DECC biomass resource supply assumptions see the Bioenergy Strategy and accompanying Analytical Annex.

41. The supply scenario shown in Figure 1 includes those feedstocks assumed to be utilised by biomass conversions and co-firing and dedicated biomass in the power sector, it excludes those feedstocks used predominantly in the transport sector such as imported and UK biofuels, and other biomass feedstocks such as waste, landfill gas and sewage sludge.

Figure 1: Illustrative bioresource supply scenario



Source: DECC analysis based on AEA research

[23] https://www.gov.uk/government/publications/uk-bioenergy-strategy
[24] AEA 'UK and Global Bioenergy Resource' (March 2011)

To note: Feedstocks are available for all bioresource use, however for modelling purposes it is assumed all the feedstocks in Figure 1 can be utilised by the power sector.

42. Feedback during the Consultation indicated that biomass generators plan to use imported forestry residue pellets as the predominant feedstock. Given this, it has been assumed for pass rate modelling purposes that the total imported supply will come from forestry residues; whereas, in the Consultation IA it was assumed that imports would be made up of forestry residues, energy crops and agricultural residues. It is challenging to forecast the level of resource that will be available to the UK from overseas in the future, and it is uncertain whether this level of imports can be sourced purely from forestry residues. However, the total imported supply is approximately consistent with the Bioenergy Strategy 'high' bioresource scenario for imported forestry residues and is therefore a reasonable assumption for modelling purposes.

43. The Consultation Impact Assessment (Annex A) showed that imported energy crops had a higher range of associated lifecycle emissions compared to imported forestry residue pellets (using the RED methodology). Therefore, by assuming that all imports are from forestry residues (and therefore none are imported energy crops) the overall 'pass rates' for imports increase, as forestry residues have lower associated lifecycle emissions and therefore pass GHG standards more easily. In this analysis this results in the TWh 'gap' figures (see table 5) being relatively lower compared to those in the Consultation Impact Assessment, and therefore narrowing the overall impact and NPV range.

GHG lifecycle analysis

44. 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, using the RED methodology. 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

45. 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_{2eq} emissions of 712 kg CO_{2eq}/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.

46. Tables 2 and 3 below show the pass rate assumptions based on the LCA analysis undertaken. Central pass rates assume the range of lifecycle emissions are weighted evenly over the range (from low to high), 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).

47. 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 being assumed to have different plant efficiencies. However, assumptions made on feedstocks used by plants will also 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			75% saving		
	Low	central	high	Low	central	high	Low	central	high
UK									
Forestry	100%	100%	100%	100%	100%	100%	100%	100%	100%
Energy crops	54%	68%	82%	36%	48%	60%	26%	40%	54%
Straw	100%	100%	100%	100%	100%	100%	85%	90%	95%
Wastes	100%	100%	100%	100%	100%	100%	100%	100%	100%
Imports									
Forestry	85%	88%	94%	75%	80%	88%	71%	76%	85%

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

	66% saving			72% saving			75% saving		
	Low	central	high	Low	central	high	Low	central	high
UK									
Forestry	100%	100%	100%	100%	100%	100%	100%	100%	100%
Energy crops	70%	60%	90%	70%	30%	90%	60%	20%	80%
Waste	100%	100%	100%	100%	100%	100%	100%	100%	100%
Imports									
Forestry	87%	91%	96%	74%	80%	86%	74%	80%	86%

6. Impacts of GHG emission standard options

48. 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 uses scenario analysis around reductions in biomass supply, and assumes prices stay constant. The potential impact on biomass prices due to tighter sustainability criteria has been considered separately (see Box 1 below).

49. 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.

50. 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 biomass resources, based on a lifecycle analysis approach.

51. Tables 4 and 5 below shows the generation 'gap' for the dedicated biomass and conversions/co-firing final proposal assuming central pass, and the associated carbon savings. The TWh gap has been based on forecasts of generation consistent with latest estimates consistent with the 31 July Energy Market Reform impact assessment.

Table 4: Generation gap and carbon savings for Dedicated Biomass

	TWh 'gap'				Carbon savings (m t CO2)			
Dedicated Biomass	2015	2020	2025	2030	2015	2020	2025	2030
Preferred option Final (central pass rates)	0.1	0.5	0.5	0.4	0.01	0.1	0.1	0.05
Preferred option Consultation (central pass rates)	0.1	0.5	0.4	0.35	0.01	0.1	0.05	0.05

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

Conversions & co-firing	TWh 'gap'				Carbon savings (m tC02)			
	2015	2020	2025	2030	2015	2020	2025	2030
Preferred option Final (central pass rates)	0	2.6	2.5	0	0	0.4	0.4	0
Preferred option Consultation (central pass rates)	0	1.2	1.1	0	0	0.2	0.2	0

52. 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[25]. Carbon savings represent total carbon savings associated with tighter sustainability standards applied to imported and UK sourced biomass resources, based on a lifecycle analysis approach. **The majority of carbon savings accrue to biomass resources originating from overseas, given the relatively large proportion of imports compared to UK woody bioresources in the supply scenario. This is despite the additional emissions associated with international transport**. 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. UK biomass resources account for around 10% - 15% of the reduction in bioresource supply, whereas imports account for around 85% - 90% (depending on biomass technology and sustainability standard).

[25] Central IAG 2012 traded price of carbon used to calculate carbon benefits. Summary page benefits ranges calculated using low to high estimates for traded price of carbon.https://www.gov.uk/government/policies/using-evidence-and-analysis-to-inform-energy-and-climate-change-policies/supporting-pages/policy-appraisal

53. 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 current 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.

54. To estimate the change in resource costs 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 UK Renewable Energy Target is reached. This analysis presents two assumptions as to the alternative technology: onshore and offshore wind. This gives a range for potential impacts: replacing biomass with onshore wind leads to a significant saving in resource costs, whereas replacing biomass with offshore wind leads to an overall resource cost. This result is indicative: actual resource savings will depend on the timing of any potential displacement, and the actual displaced technology. In this analysis it is assumed that onshore and offshore wind have zero carbon emissions.

55. Tables 6 and 7 below summarise the range of resource cost and carbon savings impact associated with the different sustainability options, compared to the current sustainability standard of 285 kg CO_2eq per MWh, and show how the results are sensitive to the assumption made on which renewable technologies are deployed instead of biomass, and the assumption on feedstock pass rates. The highest costs assume low pass rates and offshore wind as the counterfactual technology replacing biomass that is no longer deployed. The highest benefits accrue from assuming low pass rates and onshore 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 greatest costs and savings. 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.

56. Table 6 shows the cost benefit analysis for options 1 and 2 for dedicated biomass accredited after April 2013 in 2020 and cumulative to 2030, compared to the current sustainability standard of 285 kg CO_2eq per MWh

Table 6: Cost Benefit Analysis of different GHG threshold scenarios - <u>Dedicated Biomass</u> (2012 prices)

Dedicated Biomass	In 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% from 2014, 72% from 2020, 75% from 2025 GHG savings threshold relative to EU comparator (preferred Final option)						
Resource cost £m	-20	0	-10	0	-10	0
Carbon benefit £m	0	0	0	0	0	0
Net cost (-) benefit (+) £m	20	0	10	0	10	0
Option 2: 66% from 2014, 72% from 2020 GHG savings threshold relative to EU comparator (preferred						

Consultation option)						
Resource cost £m	-20	0	-10	0	-10	0
Carbon benefit £m	0	0	0	0	0	0
Net cost (-) benefit (+) £m	20	0	20	0	10	0

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: 66% from 2014, 72% from 2020, 75% from 2025 GHG savings threshold relative to EU comparator (preferred Final option)						
Resource cost £m	-190	0	-150	0	-90	0
Carbon benefit £m	20	20	20	20	10	10
NPV £m	210	20	170	20	100	10
Option 2: 66% from 2014, 72% from 2020 GHG savings threshold relative to EU comparator (preferred Consultation option)						
Resource cost £m	-170	0	-140	0	-80	0
Carbon benefit £m	20	20	20	20	10	10
NPV £m	190	20	150	20	90	10

57. Table 7 shows the cost benefit analysis for options 1 and 2 for conversion and co-firing in 2020 and cumulative to 2030:

Table 7: Cost Benefit Analysis of different GHG threshold scenarios – <u>Conversion & Co-firing</u> (2012 prices)

Conversions & co-firing	In 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: No change from 2014, 72% from 2020, 75% from 2025 GHG savings threshold relative to EU comparator (preferred option Final)						
Resource cost £m	-50	20	-40	20	-30	10
Carbon benefit £m	0	0	0	0	0	0
Net cost (-) benefit (+) £m	50	-20	40	-20	30	-10
Option 2: No change from 2014, 66% from 2020 GHG savings threshold relative to EU comparator (preferred option Consultation)						
Resource cost £m	-30	10	-20	10	-10	0
Carbon benefit £m	0	0	0	0	0	0

Net cost (-) benefit (+) £m	30	-10	20	-10	10	0

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: No change from 2014, 72% from 2020, 75% from 2025 GHG savings threshold relative to EU comparator (preferred option Final)						
Resource cost £m	-300	130	-250	110	-160	70
Carbon benefit £m	60	60	50	50	30	30
NPV £m	360	-70	300	-60	190	-40
Option 2: No change from 2014, 66% from 2020 GHG savings threshold relative to EU comparator (preferred option Consultation)						
Resource cost £m	-160	70	-120	50	-50	20
Carbon benefit £m	30	30	20	20	10	10
NPV £m	190	-30	140	-30	60	-10

Notes for Table 6 and 7:

- *Costs above do not include administration costs, which are included in NPV ranges on Summary sheets and in Table 8 below.*
- *Carbon benefits in tables above use central traded price of carbon. This differs from the range given in the summary sheet above where the low NPV assumes a low carbon price, and the high NPV assumes a high carbon price.*

Administrative costs

58. As noted above, sustainability reporting was introduced in the RO in 2009, which required generators to provide a range of profiling information on the biomass feedstocks they used. This included such data as tonnage, biomass type and format, and country of origin. Using this information and other evidence, the UK brought in sustainability criteria from April 2011 requiring operators to assess their lifecycle greenhouse gas emissions saving relative to fossil fuel, taking into account the energy conversion efficiency of their particular plant and to report on land use criteria. The decision is to go further than this, in imposing a mandatory requirement on generators of 1MWe capacity and above to demonstrate meeting the criteria in order to receive ROC support as well as being required to report. 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

59. The EU has a Standard Cost Model to estimate the cost of chain of custody certification. This suggests a cost of between £700-2,620 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-£500 pa per biomass producer for GHG certification. Assuming approximately

350 biomass producers[26], this implies annual costs between £0.024m – £0.184m (2012 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 Net Present Value (NPV) ranges to ensure all additional impacts are accounted for[27].

60. 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.

Costs to biomass electricity generators

61. It is estimated that the verification procedure for biomass generators could imply annual costs of £15,730 for large operators and £1,570 for small operators[28], in line with RTFO estimates[29]. Assuming approximately 7 generators are classed as small and 63 are classed as large, this implies annual costs of approximately £1m (2012 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

62. 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.

---

[26] Based on generators having on average 5 suppliers each

[27] NPV range will include administration costs only in those years that the tighter standards will apply.

[28] Based on information received from industry, analysis assumes approximately 7 generators are classed as small, and 63 would be classed as large.

[29] 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. Tables (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 delivered using feedstocks 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**

Dedicated Biomass	Option 1 - 5% price premium		Option 2 - 10% price premium	
	In 2020	to 2030	In 2020	to 2030
Resource cost £m	10	110	20	210
Carbon benefit £m	0	20	0	30
NPV £m	10	90	20	180

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
Resource cost £m	30	190	60	380
Carbon benefit £m	0	40	0	80
NPV £m	30	150	60	300

To note: 5% and 10% scenarios above are applied to total bioenergy resource costs, not just the fuel component.

5. Under the higher biomass price assumptions, the Net Present Value indicates an overall cost; because at 2012 traded sector carbon prices the value of the carbon saving accrued from using more sustainable biomass feedstocks does not outweigh the price impact on resource costs. However, this is highly uncertain, and the overall effect will depend on relative price premiums for certain feedstocks and the carbon price assumed.

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

63. Neither the initial consultation nor the final proposals specifically include indirect land change (ILUC) within the scope of the criteria. However, the importance of ensuring that forest and woodlands are sustainably managed and that deforestation and environmental degradation is prevented is recognised. Therefore the final proposal is to introduce sustainable forest management criteria based on the UK Timber Public Procurement Policy (UK-TPP) which draws on established sustainable forestry certification schemes which include consideration of sustainable harvesting and restocking rates, biodiversity and social issues including land use rights.

64. The Government 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.

65. The Government already has agreed policy on the public procurement standards for sustainable wood, including sourcing woodfuel supplies - the UK Timber Public Procurement Policy (UK-TPP). This offers 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. The UK-TPP draws upon existing sustainable forestry standards including the Forest Stewardship Council (FSC) and the Programme for the Endorsement of Forest Certification schemes (PEFC), as well as allowing for other equivalent evidence to be used.

66. Therefore, in order to improve the effectiveness and efficiency of the policy, and also to provide coherence across our different biomass policies, for woodfuel the land criteria will be based on the UK-TPP principles. Similarly, energy crops that have met the requirements under the Energy Crops Grant Scheme for England will be considered to have met 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

67. 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.

68. 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[30] 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.

69. The security of supply impacts of the sustainability measures are likely to be relatively small (for example under the preferred option the potential range of reduced biomass deployment is estimated to around 1.6TWh in 2020 for dedicated biomass and around 2.8 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

70. 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. Assumptions from DECC's Dynamic Dispatch Modelling (DDM) have been used to inform cost assumptions, but these are uncertain and changes in relative costs of offshore/onshore wind compared with biomass generation costs will impact on overall results.

71. Further, onshore and offshore wind has 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.

72. 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[31] as a means of improving their GHG performance. If this occurred to a significant degree, current LCA could present an overestimate of emissions.

73. 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

[30](http://ec.europa.eu/dgs/jrc/index.cfm?id=1410&obj_id=11270&dt_code=NWS&lang=en)
[31] Cocoa husks are classified as residues and therefore their emissions can be zero at the point of collection.

than available 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.

9. Summary and preferred option

74. The final option to be implemented is:

		From April 2014	From April 2020	From April 2025
Policy option 1 (Preferred final option to be implemented)	Dedicated Biomass accredited after April 2013	240 kg CO_2eq/MWh	200 kg CO_2eq/MWh	180 kg CO_2eq/MWh
	Dedicated Biomass accredited before April 2013	285 kg CO_2eq/MWh	200 kg CO_2eq/MWh	180 kg CO_2eq/MWh
	Conversions & Co-firing	285 kg CO_2/MWh	200 kg CO_2eq/MWh	180 kg CO_2eq/MWh

75. These changes would apply to all power generating plants of 1MWe and above using solid biomass and biogas feedstocks. This option would steer the market to achievable improvements to 2025 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.

76. Table 8 below summarsies the resource savings, carbon benefits, and overall NPV best estimate for the preferred option 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 we show options with low pass rates – which gives the maximum impact on deployment and carbon. This is combined with high carbon prices and onshore wind counterfactual (cf) to illustrate the greatest benefit and low carbon prices and offshore wind counterfactual to give greatest cost. Total resource cost impact is based on resource cost impact in tables 6 and 7, plus administration costs outlined from paragraph 58. 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[32].

[32]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 option (showing extreme range, assuming low pass rates) used for NPV range on IA Summary sheets

All figures discounted		Cumulative to 2030		
		High benefit (onshore cf)	Low benefit (offshore cf)	
Resource cost (exc. carbon saved)	Dedicated Biomass	-170	10	
	Conversions/co-firing	-300	140	
Value of carbon saved	Dedicated Biomass	40	10	
	Conversions/co-firing	90	20	
NPV (Inc. carbon saved)	Dedicated Biomass	210	0	
	Conversions/co-firing	390	-110	
		High benefit (onshore cf)	Low benefit (offshore cf)	Best estimate
Total resource cost range		-470	150	-160
Total carbon benefit range		130	30	80
Total NPV range		600	-110	240

77. Our decision on the final option balances higher GHG savings, through setting an ambitious GHG trajectory, with the risk to biomass generators in terms of supply constraints and potential price premiums for more sustainable feedstocks (see box 1 which provides illustrative price impacts). Feedback during the consultation suggested that a 200 kg CO2eq per MWh target was achievable longer-term, providing flexibility was permitted for the GHG performance of a single individual consignment to allow for possible events beyond the generator's control, and that necessary certainty was provided by setting the GHG trajectory to cover the full RO period to April 2027. Although the GHG trajectory from 2020 is considered ambitious, many of the power generators operating in the UK are already recognised as industry leaders on biomass sustainability, so are well-placed to work with their supply-chains, certification bodies and others to meet these ambitious and stretching targets.

78. In addition to the responses to the consultation DECC commissioned a study from the NNFCC[33] on potential GHG trajectories for biomass power, this showed that wood pellets made from sawmill or forestry management residues, which are expected to provide a significant proportion of the UK's biomass feedstock demand out to 2030, should be able to make further emission savings over this period. The most significant reductions are expected to result from improvements in the shipping industry due to greater efficiencies and lower carbon fuels. The other key area will be reducing the use of fossil electricity in the processing and drying stage, either by investing in biomass CHP locally, or by decarbonisation of the grid at national level. But these will be modest, and the more the target reduces below 200kg CO2eq per MWh, the larger the risk of constraining feedstock supplies. Therefore the move to the use of an annual average is essential to make this work in practice.

79. The proposals represent a gradual approach to improving the sustainability criteria, recognising the potential constraints generators and biomass suppliers operating in the market could face, given the

[33] NNFCC (2013) RO Sustainability Standards

contracts and investments already in place. The proposals also 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.

80. 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 CO2/MWh by 2020 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.

81. These criteria would be introduced via the RO Order for April 2014, with the intention that the criteria will become mandatory, that is generators of 1MWe and above will need to demonstrate meeting the criteria to be eligible for financial support.

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 (of 1MWe capacity and above) and should not distort competition within the sector. The standards should 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.

Small firms impact test

3. 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

4. The estimated 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 biomass resources, based on a lifecycle analysis approach. The majority of carbon savings accrue to biomass resources originating from overseas (see paragraph 52 for further detail on the split between UK and overseas carbon savings).

Wider Environmental Impacts

5. 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

6. 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. However, the large-scale combustion of biomass is tightly controlled through the environmental permitting regime addressing emissions from large combustion plants.

7. 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.

8. 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

9. 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 carbon reductions and help the UK to address 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

10. 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' Greenhouse Gas (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. The Renewable Energy Directive (RED) methodology was employed in determining the LCA emission ranges for different feedstocks. No land-use change emissions are accounted for as it is assumed that any additional biomass resource will either be grown on land of low carbon stock which has been abandoned due to increased food crop yields, or will be a forestry residue which does not cause land use change. In line with current EU methodology, indirect land use (ILUC) change emissions are also not considered.

3. Owing to uncertainties and the early stage of research in the area, the possible carbon sequestration of the counterfactual land use and any carbon stock changes from intensification of forestry have not been accounted for in the analysis. However, DECC is currently performing research in this area to help inform our bioenergy evidence base. Early results indicate that these factors may have a significant effect on overall carbon impacts, emphasising the importance of further work in this area. This work may potentially feed into the UK's future negotiations at an EU and international level with respect to global accounting and future energy and decarbonisation targets.

4. 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:

    - NNFCC: RO Sustainability Standards, March 2013[34].
    - ADAS: carbon impacts of using biomass in bio-energy and other sectors - energy crops, 2011[35]
    - 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.
    - The Biomass Environmental Assessment Tool (BEAT2), provided by Defra, the Biomass Energy Centre and the Environment Agency.

5. The ADAS report was the main source of data for UK energy crops. 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

[34] NNFCC (2013) RO Sustainability Standards
[35] http://www.decc.gov.uk/en/content/cms/meeting_energy/bioenergy/strategy/strategy.aspx#

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).

6. 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.

7. The NNFCC report, commissioned for this consultation, was the main source of LCA data for forestry and agricultural residues. The report used the UK Biomass and Biogas Carbon Calculator as the data source, with estimated emissions including those associated with cultivation, harvesting, chipping, processing (including transport to storage, bulk/batch drying and storage, milling and pelletising (if appropriate)) and transport of biomass to end of life. Ranges of LCA emissions for each feedstock between 2013 and 2020 were considered, taking into account projected future reductions in transport and processing emissions. The NNFCC report provided more robust LCA ranges than in the previous Impact Assessment performed for the consultation, and were therefore used.

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. 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.

10. 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 delivered energy)		
	Low	Central	High
UK Forestry Residues Chips	22	40	58
UK Forestry Residues Pellets	84	126	168
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	65	70	75
Straw Pellets	109	150	191
Short Rotation Forestry Pellets	74	106	137
Saw mill Residue Pellets	49	88	127

Table 2: Imported Dedicated Biomass feedstock lifecycle emissions

	Emission range (kg CO_2e /MWh delivered energy)		
	Low	Central	High
N. America Forestry Residue Chips	76	174	273
N. America Forestry Residue Pellets	106	196	286
Europe Forestry Residues chips	28	63	97
Europe Forestry Residues pellets	85	137	188
N. America SRF pellets	170	260	349
Europe Short Rotation Forestry Pellets	81	123	165
Brazil Short Rotation Forestry pellets	104	131	158
Brazil Short Rotation Forestry chips	82	115	147
N. America Sawmill residues	72	159	246
Europe Sawmill residues	50	99	148

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

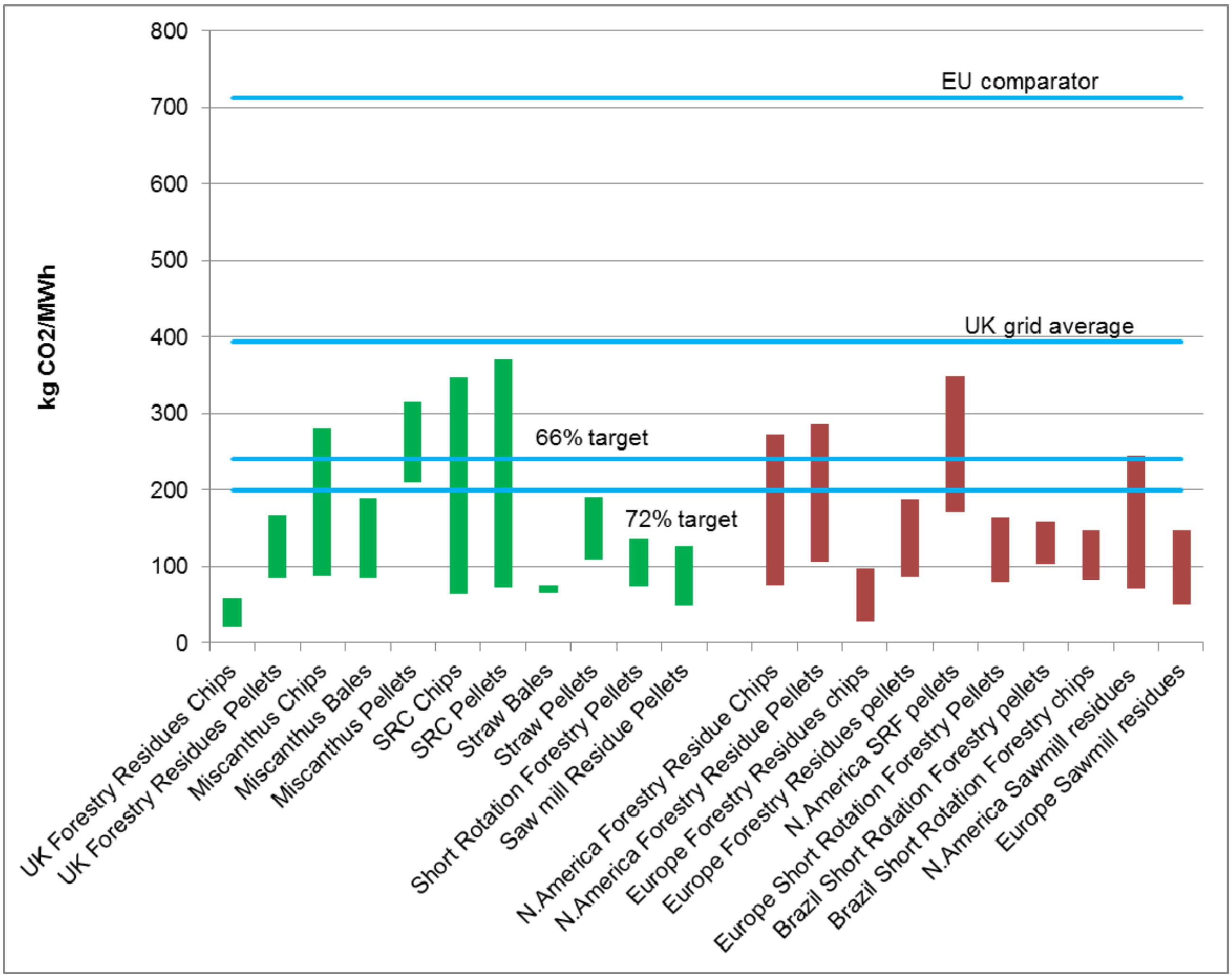


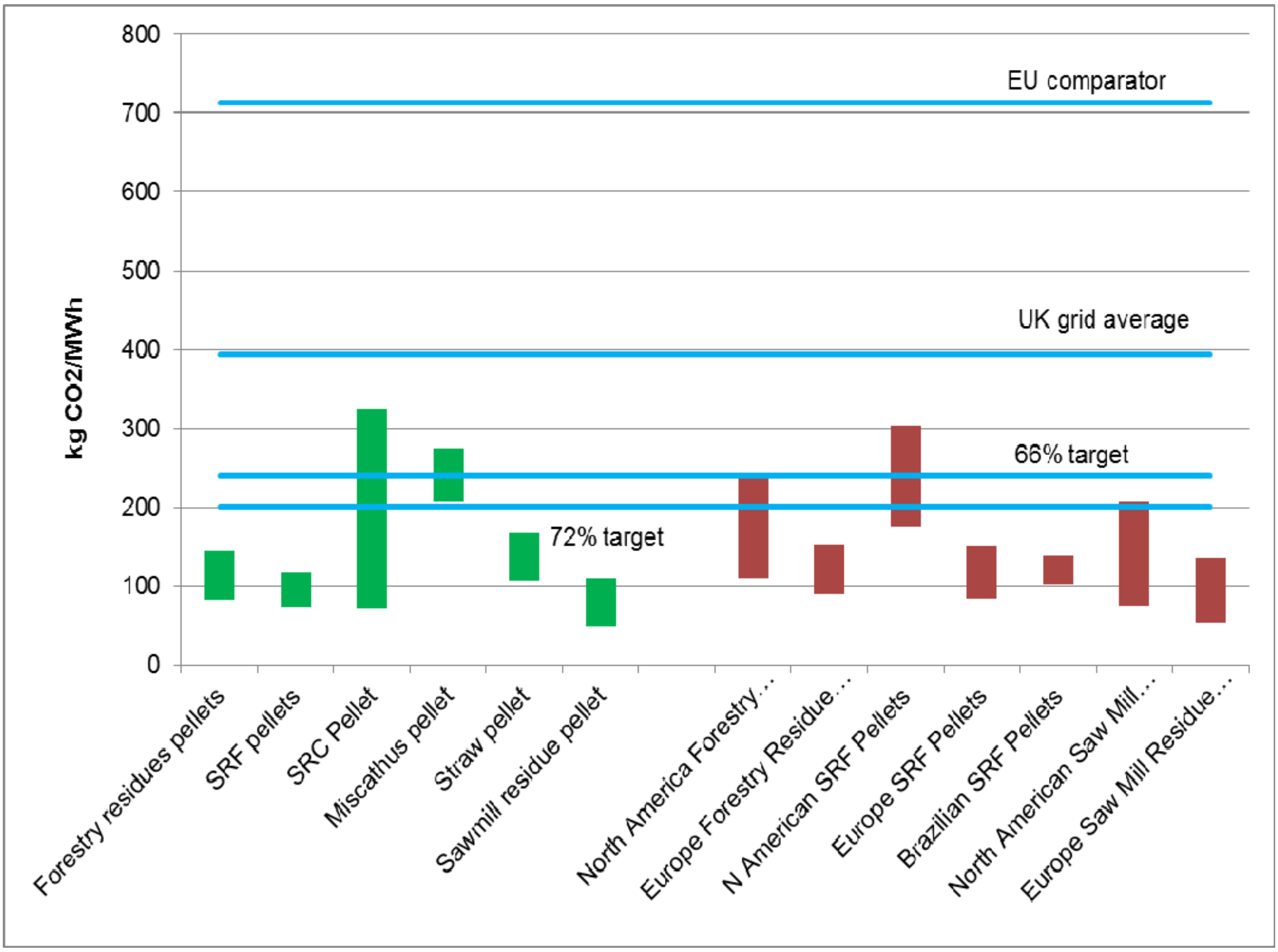
Table 3: UK Biomass feedstocks for Co-firing lifecycle emissions

	Emission range (kg CO_2e /MWh delivered energy)		
	Low	Central	High
UK Forestry Residues Pellets	83	114	145
UK Short Rotation Forestry Pellets	73	96	118
SRC Pellets	72	198	324
Miscanthus Pellets	207	241	275
Straw pellets	107	137	167
Sawmill Pellets	49	79	109

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

	Emission range (kg CO_2e /MWh delivered energy)		
	Low	Central	High
North America Forestry Residue Pellets	110	176	242
Europe Forestry Residue Pellets	89	120	152
N American SRF Pellets	175	239	303
Europe SRF Pellets	84	118	151
Brazilian SRF Pellets	102	120	138
North American Saw Mill Residue Pellets	75	140	206
Europe Sawmill Residue Pellets	53	94	135

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



Calculating pass rates

11. 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_{2eq} emissions of 712 kg CO_{2eq}/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.

12. Wastes – such as landfill gas, sewage gas, and recovered wood (e.g. construction wood or used pallets) - are exempt from the criteria to reflect that significant carbon benefits will accrue where the alternative route is disposal to landfill. Landfilled biomass releases methane – a powerful GHG – as it decays in wet conditions. 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.

13. 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			75% saving		
	Low	central	high	Low	central	high	Low	central	high
UK									
Forestry	100%	100%	100%	100%	100%	100%	100%	100%	100%
Energy crops	54%	68%	82%	36%	48%	60%	26%	40%	54%
Straw	100%	100%	100%	100%	100%	100%	85%	90%	95%
Wastes	100%	100%	100%	100%	100%	100%	100%	100%	100%
Imports									
Forestry	85%	88%	94%	75%	80%	88%	71%	76%	85%

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

	66% saving			72% saving			75% saving		
	Low	central	high	Low	central	high	Low	central	high
UK									
Forestry	100%	100%	100%	100%	100%	100%	100%	100%	100%
Energy crops	70%	60%	90%	70%	30%	90%	60%	20%	80%
Waste	100%	100%	100%	100%	100%	100%	100%	100%	100%
Imports									
Forestry	87%	91%	96%	74%	80%	86%	74%	80%	86%

Conclusion

14. In conclusion, the LCA data from the previous Impact Assessment has been updated for forestry feedstocks and residues, providing more robust data which takes into account projected future reductions in transport and processing emissions. In determining the carbon emissions associated with each feedstock, the Renewable Energy Directive (RED) Life Cycle Analysis (LCA) methodology has been employed, consistent with the EU Methodology. However, this methodology does not consider all potential impacts of bioenergy use, such as indirect land use change and the forgone carbon sequestration of land counterfactuals. DECC is therefore currently performing research in this area to help inform our bioenergy evidence base.

Annex B – Cost and benefit summary of Option 2

1. Table 1 below summaries the resource costs, carbon benefits, and overall Net Present Value (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:

		From April 2014	From April 2020	From April 2025
Policy option 2 (Preferred Consultation option)	Dedicated Biomass accredited after April 2013	240 kg CO_2eq/MWh	200 kg CO_2eq/MWh	No set target
	Dedicated Biomass accredited before April 2013	285 kg CO_2eq/MWh	200 kg CO_2eq/MWh	No set target
	Conversions & Co-firing	285 kg CO_2/MWh	240 kg CO_2eq/MWh	No set target

2. In order to show the widest potential impacts we show options with low pass rates – which gives the maximum impact on deployment and carbon. This is combined with high carbon prices and onshore wind counterfactual to illustrate the greatest benefit, and low carbon prices, and offshore wind counterfactual to show the greatest cost. Total resource cost impact is based on resource cost impact in tables 6 and 7, plus administration costs outlined from paragraph 58. 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[36].

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

All figures discounted		Cumulative to 2030		
		High benefit (onshore cf)	Low benefit (offshore cf)	
Resource cost (exc. carbon saved)	Dedicated Biomass	-160	10	
	Conversions/co-firing	-150	70	
Value of carbon saved	Dedicated Biomass	30	10	
	Conversions/co-firing	50	10	
NPV (Inc. carbon saved)	Dedicated Biomass	190	0	
	Conversions/co-firing	200	-60	
		High benefit (onshore)	Low benefit (offshore)	Best estimate
Total resource cost range		-310	90	-110
Total benefit range		80	20	50
Total NPV range		390	-70	160

[36] 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.