Title: Changes to Combined Heat and Power Quality Assurance (CHPQA) under the Contracts for Difference scheme IA No: BEIS015(F)-18-CE **RPC Reference No:** N/A **Lead department or agency:** Department for Business, Energy and Industrial Strategy **Other departments or agencies:** None	**Impact Assessment (IA)** **Date:** June 2018 **Stage:** Final **Source of intervention:** Domestic **Type of measure:** Secondary Legislation **Contact for enquiries:** BEISContractsForDifference@beis.gov.uk

Summary: Intervention and Options

RPC Opinion: Not applicable

Cost of Preferred (or more likely) Option				
Total Net Present Value	**Business Net Present Value**	**Net cost to business per year** (EANDCB in 2014 prices)	**One-In, Three-Out**	**Business Impact Target Status**
£97m – £409m	£N/A	£N/A	N/A	N/A

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

Electricity generation accounts for over 20% of UK greenhouse gas emissions and without government intervention market incentives are not sufficient to meet the UK's climate change commitments. The Contracts for Difference (CfD) scheme is the government's primary means of supporting low carbon power generation, and in order to be eligible for support Dedicated Biomass and Energy from Waste plants must deploy with Combined Heat and Power (CHP). Current efficiency standards for renewable CHP plants are relatively low, and intervention is required in order to ensure that support only goes to plants demonstrating the best technology and application of CHP. The government is therefore proposing to increase the efficiency requirements.

What are the policy objectives and the intended effects?

The objective of this policy is to encourage the deployment of the best available CHP technologies and best application of renewable CHP by ensuring that subsidy is directed only towards schemes which deliver high levels of overall efficiency and make best use of biomass resources. To achieve this, this policy is designed to increase the overall efficiency of all CHP plants qualifying in future CfD allocation rounds.

What policy options have been considered, including any alternatives to regulation? Please justify preferred option (further details in Evidence Base)

Following consultation the final policy option is:

- **Option 1 (preferred)** – Increase the minimum overall efficiency for CHP plants of any size to 70%.

All schemes under each option would be expected to continue to meet a minimum primary energy saving of 10%.

The Government's final position is Option 1, as it results in only the most efficient plants being supported – regardless of size – while retaining the flexibility for generators to determine the most efficient balance between heat and power efficiency.

Will the policy be reviewed? It will not be reviewed. **If applicable, set review date:** N/A

Does implementation go beyond minimum EU requirements?	Yes			
Are any of these organisations in scope?	**Micro** Yes	**Small** Yes	**Medium** Yes	**Large** Yes
What is the CO_2 equivalent change in greenhouse gas emissions? (Million tonnes CO_2 equivalent)	**Traded:** **<-0.01**		**Non-traded:** **-0.09 to -0.10**	

I have read the Impact Assessment and I am satisfied that, given the available evidence, it represents a reasonable view of the likely costs, benefits and impact of the leading options.

Signed by the responsible Minister: Claire Perry Date: 01.06.18

Summary: Analysis & Evidence

Final Government Position

Description: All plants (both above and below 25MWe) that must deploy with CHP under the CfD scheme to achieve an overall minimum efficiency of 70%.

FULL ECONOMIC ASSESSMENT

Price Base Year 2012	PV Base Year 2025/26	Time Period Years 25	Net Benefit (Present Value (PV)) (£m)		
			Low: 97	**High:** 409	**Best Estimate:** N/A

COSTS (£m)	**Total Transition** (Constant Price)	Years	**Average Annual** (excl. Transition) (Constant Price)	**Total Cost** (Present Value)
Low	0		0	0
High	0		16	268
Best Estimate	0		N/A	N/A

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

The policy decision could, for some future projects, require higher capital investment than would otherwise be the case. This is uncertain, as some projects may potentially be able to meet the requirements without further investment, while others may need to invest. The government did not receive evidence during the consultation on how the proposals might affect capital costs, therefore an illustrative range has been included (PV £0 to £268m).

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

It is possible that any requirement to increase electrical and heat efficiencies could affect both the capital and operating costs faced when building and operating CHP plants. This may, for example, be in the form of more efficient turbines or additional infrastructure required in distributing any additional heat created as a result of higher heat efficiencies.

BENEFITS (£m)	**Total Transition** (Constant Price)	Years	**Average Annual** (excl. Transition) (Constant Price)	**Total Benefit** (Present Value)
Low	0		23	365
High	0		26	409
Best Estimate	0		N/A	N/A

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

The policy decision will mean that only CHP plants with higher overall efficiencies (coming from increases in electrical and heat efficiencies) may receive support. A potential increase in electrical efficiency may reduce the amount of biomass fuel required by CHP plants to generate a given amount of electricity. This potential reduction in fuel consumption in generating electricity may result in benefits in terms of: fuel resource cost savings (PV £0 - £21m) and carbon savings (PV £0 - £5m). A potential increase in heat efficiency would increase heat output, resulting in benefits to society from: fuel resource cost savings (PV £174m - £209m) and carbon emissions savings (PV £165m - £199m).

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

The policy decision may have an impact on CfD operators' revenues, particularly from the generation of greater levels of heat for which generators would likely receive payments. These are not valued here as they are a transfer between energy consumers and generators. The resource savings that may result from the proposal are a benefit to society and are described under 'key monetised benefits' above. The policy decision could lead to air quality improvements through a reduction in biomass consumption and a reduction in the amount of gas required to generate heat from additional sources. The government did not receive evidence during the consultation on which to change the approach to assessing these impacts.

Key assumptions/sensitivities/risks **Discount rate (%)** 3.5

- Carbon accounting: it is uncertain whether fuel use savings occur in the traded or non-traded sector. Values for both have been used to show the full range of possible impacts.
- Increases in electrical and heat efficiencies: the balance between electrical and heat efficiencies, as well as potential to increase them, is uncertain. High and low assumptions have been applied to demonstrate the range of impacts.
- Ability to meet minimum efficiency requirements: the extent to which plants are able to achieve the proposed standards, and therefore the likelihood of being successful in future CfD rounds is affected, is uncertain.

BUSINESS ASSESSMENT (Option 1(a))

Direct impact on business (Equivalent Annual) £m:			**Score for Business Impact Target (qualifying provisions only) £m:**
Costs: £0	**Benefits:** £0	**Net:** £0	N/A

1. Problem under consideration

In November 2016 the government launched a Call for Evidence[1] on fuelled technologies, which included questions on CHP technologies eligible for a CfD. Respondents raised a number of issues. Some alluded to the difficulty in identifying a heat off-taker. Other respondents suggested that the requirements for CHP schemes are not fulfilling policy ambition. Following the Call for Evidence, the government launched a consultation on proposed amendments to the scheme,[2] the Government Response to which accompanies this Impact Assessment. The consultation document set out a range of changes that the government proposed to make ahead of the third CfD allocation round.

In order to be eligible for a CfD, Dedicated Biomass and Energy from Waste schemes must deploy with combined heat and power (CHP). However the current requirements mean that it is possible for CHP schemes to qualify for CfD support whilst producing a low level of useful heat, and consequently achieving low levels of overall efficiency.

The government also intends to clarify how CHP projects are treated under the CfD scheme. In particular, the government proposes that the requirements relating to CHP efficiency should not apply to technologies that have the option to deploy without CHP. The government is also proposing that applicants in respect of those technologies which must deploy with CHP (currently Dedicated Biomass and Energy from Waste) confirm at the point of application that they intend to comply with relevant CHP quality assurance requirements.

2. Rationale for intervention

Electricity generation accounts for over 20% of UK greenhouse gas emissions[3] and without government intervention market incentives are not sufficient to meet the UK's climate change commitments. These are set out in detail in previous Electricity Market Reform impact assessments.[4]

The specific intervention considered in this Impact Assessment (IA) follows a review of responses to the call for evidence, the government's own analysis, and consideration of performance across Europe. The government is concerned that the current requirements are no longer sufficient to ensure only sufficiently good quality CHP receives support. Currently, renewable CHP schemes can qualify for a CfD whilst producing a low level of useful heat and consequently achieving low levels of overall efficiency. Without intervention it is likely that the government objective to ensure that CfD subsidy is directed towards the following types of generation will not be met in future CfD Allocation Rounds:

- Best available technology and application of renewable CHP, and;

[1] Call for Evidence – Contracts for Difference: A call for evidence on fuelled and geothermal technologies in the CfD scheme, November 2016. Available here: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/566356/Call_for_Evidence_fuelled_techs_in_CfD_FINAl.pdf

[2] Contracts for Difference for Renewable Electricity Generation – Consultation on proposed amendments to the scheme, December 2017. Available here: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/668382/Contracts_for_Difference_for_Renewable_Energy_Consultation_on_proposed_Amendments.pdf

[3] HM Government (2017). The Clean Growth Strategy: Leading the way to a low carbon future. Available here: https://www.gov.uk/government/publications/clean-growth-strategy

[4] For example see Section 2 of the January 2013 EMR Delivery Plan Impact Assessment, available here: http://www.parliament.uk/documents/impact-assessments/IA13-002.pdf

- Schemes which deliver high levels of overall efficiency and make the best use of biomass resources.

3. Policy objectives

The overall objective is to increase the efficiency requirements of plants being subsidised by the government through future CfD allocation rounds. Biomass is a scarce resource and should be utilised in the most efficient manner regardless of the size of plant. There is evidence in the form of performance of current plant reporting under the CHPQA (Combined Heat-and-Power Quality Assurance) guidance note 44[5] that some plants which could be eligible for CfD payments only produce a very small proportion of heat and have low overall efficiencies. It is intended that by increasing the overall efficiency requirement for CHP plants then better quality CHP projects, which make better use of available biomass sources, will receive support.

4. Policy options

4.1. Policy Option 0 – the 'Do Nothing' option

Under this option there is no change to the efficiency requirements for Dedicated Biomass and Energy from Waste schemes which must deploy with CHP to qualify for CfD support. CHP schemes producing a low level of useful heat and achieving low levels of overall efficiency will continue to be eligible for CfD support.

This option represents the counterfactual against which the costs and benefits of the government's final position are assessed.

4.2. Policy Option 1 – the Government's Final Position

The government believes that increasing the overall efficiency requirements of CHP plants supported under the CfD scheme is deemed to be the most appropriate way to improve the quality of plants as this allows some flexibility for plants to choose the proportion of power and electricity they produce.

The government's final position is for all plants (both above and below 25MWe) that must deploy with CHP under the CfD scheme to achieve an overall minimum efficiency of 70%.

Requirements for all schemes to deliver a minimum 10% heat efficiency and 10% primary energy saving will remain in place.

Under this approach, all CHP schemes supported under the CfD scheme in future allocation rounds would need to meet a higher overall level of efficiency requirements. This should incentivise the use of the best available technology and application of 'good quality' CHP, and ensure efficient use of available biomass resources, while retaining flexibility for schemes to balance their output between heat and power.

The government considers that renewable CHP schemes of all sizes are capable of achieving a 70% Net Calorific Value (NCV) of overall efficiency, provided an appropriate heat off-taker is in

[5] Available at: https://www.gov.uk/guidance/chpqa-guidance-notes

place. As a result schemes would need to be located at a site where there is an economic demand for heat produced, and be sized in proportion to that demand.

5. Impact Analysis

5.1 Options Appraisal

In assessing the impact of the government's final position we have monetised the following benefits of an increase in heat output, and a reduction in fuel consumption, as a result of changes to electrical and heat efficiencies of renewable CHP projects:

- **Value of change in carbon emissions.** Any reduction in the amount of biomass required to generate a given amount of electricity may reduce carbon emissions. Similarly, any additional heat generated by CHP plants may reduce the amount of carbon emissions from alternative heat sources.
- **Change in resource costs to society.** Reductions in the amount of biomass required to generate electricity may also reduce the cost to society of generating a given amount of electricity. Similarly, additional heat generated as a result of higher heat efficiencies reduces the cost of sourcing heat from alternative sources.
- **Potential increase in capital costs.** Following the consultation uncertainty remains over the extent to which future CHP plants may need to invest more in order to achieve the overall efficiency standards set out here. For some, it may be that securing an appropriate heat off-taker would be sufficient, and thereby achieving the standard without significant further investment. For others, it may require procuring higher cost capital equipment than otherwise would have been the case. To reflect this uncertainty, we estimate a range of capital cost impacts.

Annex A sets out the details of the analytical approach and key assumptions made in undertaking the monetisation of costs and benefits, and the resulting cost-benefit analysis. In order to illustrate the potential impact of the final policy decision it has been necessary to assume a level of deployment of biomass CHP in future under the CfD scheme. This is inherently uncertain and subject to the outcome of future allocation rounds. For the purposes of illustration it has been assumed that a similar level of capacity comes forward as in past allocation rounds (see Annex A for more detail). This results in around 86MW of capacity coming forward in all of the scenarios assessed in this IA.

Further, for simplicity, the scenarios modelled have assumed all the capacity is dedicated biomass CHP, rather than energy from waste – this is a simplifying assumption and should not be interpreted that the policy decision would only affected dedicated biomass.

5.2 Evidence base updates

Since the publication of the consultation stage IA, BEIS has published updated data series for valuing energy use and greenhouse gas emissions (IAG values)[6]. In addition BEIS has published an updated extract of the Renewable Energy Planning Database (REPD)[7]. These updated data sources have been used to assess the impacts, costs and benefits of the policy intervention.

5.3 Biomass fuel consumption and heat output

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[6] Available at https://www.gov.uk/government/publications/valuation-of-energy-use-and-greenhouse-gas-emissions-for-appraisal

[7] Available at https://www.gov.uk/government/collections/renewable-energy-planning-data

Table 1: Estimated change in biomass fuel consumption and heat output

Option	No increase in electrical efficiency		Increase in electrical efficiency	
	Reduction in biomass fuel consumption (MWh)	**Increase in heat output (MWh)**	**Reduction in biomass fuel consumption (MWh)**	**Increase in heat output (MWh)**
Final Government Position	0	570,000	140,000	470,000

Modelling has been undertaken to estimate the impact of a higher overall efficiency on heat output and the amount of biomass fuel required to generate a given amount of electricity. These impacts are set out in Table 1 above.

Where we have assumed no increase in electrical efficiency, the amount of biomass required to generate a given amount of electricity is the same as in the 'do-nothing' scenario and there is an increase in heat output as plants are assumed to meet their overall efficiency targets through an increase in heat output alone.

Where we have assumed an increase in electrical efficiency, plants are able to produce the same amount of electrical output with a lower amount of biomass fuel input. As plants are assumed to increase their electrical efficiencies, they do not need to increase their heat efficiencies by the same amount as the scenario where we have assumed no increase in electrical efficiency. This results in a smaller increase in heat output in the 'do-something' scenario compared with the variant of our analysis where we have assumed no increase in electrical efficiency.

5.4 Value of change in carbon emissions

Tables 2 and 3 set out the estimated impact of the government's final position on carbon emissions and their resulting value.

Table 2: Monetised carbon impacts for the government's final position, assuming no change in electrical efficiency as a result of intervention

Option	NPV of reduction in biomass fuel consumption (£m; £2012) using traded carbon values	NPV of reduction in biomass fuel consumption (£m; £2012) using non-traded carbon values	NPV of increase in heat output (£m; £2012)
Final Government Position	0	0	199

Table 3: Monetised carbon impacts for the government's final position, assuming higher electrical efficiency as a result of intervention

Option	NPV of reduction in biomass fuel consumption (£m; £2012) using traded carbon values	NPV of reduction in biomass fuel consumption (£m; £2012) using non-traded carbon values	NPV of increase in heat output (£m; £2012)
Final Government Position	5	5	165

In the variant of our analysis where we have assumed no increase in electrical efficiency, the overall NPV from carbon savings is higher. This is because this scenario results in a higher level of heat output at the expense of potential reductions in biomass fuel use and we have assumed that gas (which additional heat displaces) has a higher carbon intensity factor than biomass. Therefore any scenario which lowers heat efficiency at the expense of higher electrical efficiency has a lower social NPV.

Two scenarios have been modelled – one in which carbon savings from a reduction in biomass consumption are valued using non-traded carbon values, and another in which these savings are valued using traded carbon values. Using non-traded carbon values results in a slightly higher (c. £0.2m) NPV as non-traded carbon values are higher in our assumed plants' initial years of operation before non-traded carbon values converge with traded carbon values from 2030 onwards. This difference is not apparent in the tables above as we have chosen to round figures to the nearest £1m.

5.5. Change in resource costs to society

The policy decision is likely to affect the levels of biomass needed to generate the same amount of electricity and the levels of fossil fuels (assumed to be gas) needed to meet future heat demands. As earlier in this section the following two tables (4 and 5) show the estimated value of the resource savings where we assume no increase in electrical efficiency and all improvements come from heat (Table 4) and where we assume an increase in both electrical and heat efficiencies (Table 5).

Table 4: Monetised change in resource costs for government's final position in the 'do-something' scenario, assuming no change in electrical efficiency as a result of intervention

Option	NPV of reduction in biomass fuel consumption (£m; £2012)	NPV of increase in heat output (£m; £2012)
Final Government Position	0	209

Table 5: Monetised change in resource costs for government's final position in the 'do-something' scenario, assuming higher electrical efficiency as a result of intervention

Option	NPV of reduction in biomass fuel consumption (£m; £2012)	NPV of increase in heat output (£m; £2012)
Final Government Position	21	174

The NPV resulting from the change in resource costs due to government intervention is higher where we have assumed no increase in electrical efficiency. This is because in this scenario all the improvements come from increased heat efficiency, resulting in higher heat output compared to the scenario where there is an increase in both electrical efficiency (which reduces biomass consumption) and heat efficiency. Since the assumed resource cost of generating domestic heat (i.e. domestic gas prices) is higher than the resource cost of biomass on a £/kWh basis, scenarios which maximise heat efficiency relative to electrical efficiency will have higher NPVs for societal resource cost savings.

5.6. Potential change in capital costs

At consultation stage the uncertainty around possible impacts on capital investment from introducing a higher minimum efficiency standard were not quantified, and the government welcomed any evidence that consultees could provide. No further robust evidence was received during the consultation, and consequently significant uncertainty remains about the possible impacts on capital costs.

For some future plants there may be no or negligible impacts, for example where the original plant design would enable sufficient heat production and securing an appropriate off-taker would be sufficient to achieve the minimum efficiency standard. For others, to achieve the standard may mean further capital investment. The scale of this potential increased capital cost remains highly uncertain.

To reflect the range of possible cost impacts, the following approach has been taken:

- In scenarios where the minimum standard is achieved through improvements in heat efficiency alone we assume zero increase in capital costs.
- In scenarios where the minimum standard is achieved through improvements in both electrical and heat efficiency, we assume that capital costs increase, with the increase estimated (illustratively) to be the difference between 'central' and 'high' capex estimates for Dedicated Biomass with CHP in the BEIS 2016 Generation Costs Report.[8] This adds £26/MWh (in 2012 prices) for every unit of electricity generated.

While significant uncertainty remains, following this approach captures a wide range of potential costs. Table 6 outlines the aggregate impacts.

Table 6: Present value of potential change in capital costs, as a result of intervention

Option	Scenarios where only heat efficiency improves (£m; £2012)	Scenarios where electrical and heat efficiency improves (£m; £2012)
Final Government Position	0	268

5.7. Administrative burden on business

The policy decision covered within this Impact Assessment requires generators to meet a more stringent efficiency target compared with current standards. As the decision only modifies current regulations will amend the standards against which prospective CHP generators are assessed, rather than impose a regulatory burden on business. Our assessment is that the decision covered in this IA will not have an impact on the administrative burden faced by businesses. The government did not receive evidence during the consultation on which to change this assumption made at consultation stage.

5.8. Summary of results

Table 7 shows the NPV of the government's final position, assuming no change in electrical efficiency from the 'do-nothing' scenario.

Table 7: Total NPV for the government's final position, assuming no change in electrical efficiency as a result of intervention, £m, 2012 prices

Option	Change in fuel consumption			Change in heat production		Change in capital costs (PV)	Total NPV (traded values)	Total NPV (non-traded values)
	Carbon benefits NPV		Change in biomass resource costs (PV)	Carbon benefits (PV)	Change in gas resource costs (PV)			
	at traded values	at non-traded values						
Final Government Position	0	0	0	199	209	0	409	409

8 Available here: https://www.gov.uk/government/publications/beis-electricity-generation-costs-november-2016

As we have assumed no increase in electrical efficiency in this scenario, plants are assumed to require the same amount of biomass fuel input in order to produce a given amount of electricity. This means that there are no carbon savings or changes in the resource cost of electricity generation from changes in fuel consumption under each of the policy options. The increase in heat production to meet the minimum standard, however, produces value as it displaces the need for heat production elsewhere in the economy (assumed to be from gas). This produces a resource cost saving (avoided gas use) and a reduction in carbon emissions (from avoided use of gas).

Table 8: Total NPV for the government's final position, assuming an increase in electrical efficiency as a result of intervention

Option	Change in fuel consumption			Change in heat production		Change in capital costs (PV)	Total NPV (traded values)	Total NPV (non-traded values)
	Carbon benefits NPV		Change in biomass resource costs (NPV)	Carbon benefits (NPV)	Change in gas resource costs (NPV)			
	at traded values	at non-traded values						
Final Government Position	5	5	21	165	174	268	97	98

Table 8 shows the NPV of the government's final position, assuming that generators increase both their heat and electrical efficiencies from the 'do nothing' scenario. As we have assumed both an increase in electrical efficiency (therefore a reduction in biomass fuel consumption) as well as an increase in heat efficiency (therefore an increase in heat output which displaces gas generation) the impact is a positive NPV resulting from lower fuel consumption and higher heat output. Under this scenario we assume an increase in capital costs in order to meet the minimum efficiency standard, which offsets some of the carbon and resource cost savings. However, the overall NPV remains positive.

5.9. Risks and Uncertainties

The analysis presented in this IA has been based upon the best information available to the government at the time of publication. The government did not receive evidence during the consultation on which to improve our evidence base on the feasibility and impacts of the proposed policy changes, and so the assumptions remain the same as those made at consultation stage, but they remain an area of uncertainty.

Ability to meet the minimum efficiency requirements

The government has consulted, examined the CHPQA guidance and compared against efficiency standards in other similar countries, however there is uncertainty over the extent to which future projects that may bid for a CfD intend or are able to achieve the minimum efficiency levels set out here. For illustrative purposes this Impact Assessment assumes the same level of CHP capacity deploys as in previous CfD allocation rounds, and this drives the positive net benefits summarised in the previous section. However, there is a risk that few or no projects can achieve these standards, in which case they would not be fully supported under the scheme, with support likely going to other forms of low carbon generation instead.

Generation costs

At consultation stage the potential change in generation costs from possible additional capital investment in order to meet the minimum standard was not monetised. The government did not receive additional robust evidence as part of the consultation, and as a result a wide range of potential costs have been illustratively estimated from zero to up to £268m (2012 prices, present value).

To further test the bounds of the uncertainty, we have estimated how much generation costs would have to rise in total in order for the NPV of the government's final position to be zero. At the top end of the NPV range, where net benefits are estimated at £409m, generation costs would have to increase by £42/MWh in order for the NPV to be zero. At the lower end of the NPV range, where net benefits are estimated at £97m including an assumed increase in capital costs of £26/MWh, capital costs would have to increase by a further £12/MWh (£38/MWh in total). At both ends of the NPV this implies that generators being awarded a CfD in future would need to face substantially higher generation costs in order for the policy decision to result in net costs to society. £42/MWh and £38/MWh are also significantly above the 'high capex' estimate for dedicated biomass with CHP published in the 2016 BEIS generation costs report.

Our analysis assumes that c. 86MW of dedicated biomass with CHP capacity could deploy in a future CfD allocation round. This assumes that any potential net increase in generation costs could compete with other technologies in a CfD auction. There remains a risk (unquantified) that potential increases in generation costs could reduce the amount of CHP capacity deployed through future CfD allocation round, thereby reducing the potential benefits estimated in this IA. However, because of the competitive nature of CfD allocation rounds, reductions in future CHP deployment would likely arise only due to more competitive bids from other technologies, which should give rise to benefits that may more than compensate for any reduction in renewable electricity generation capacity.

Increases in electrical and heat efficiencies

The balance between electrical and heat efficiencies, as well as potential to increase them, is uncertain. The scenarios considered in this Impact Assessment consider high and low assumptions to demonstrate the potential range of impacts. The government did not receive evidence during the consultation on which to change the approach taken at consultation stage, therefore the assumptions have remain unchanged from consultation stage.

Carbon accounting

It is uncertain whether fuel use savings occur in the traded or non-traded sector. Values for both have been used to show the full range of possible impacts in this assessment.

Annex A: Appraisal Methodology and Key Assumptions

Overview of appraisal methodology

Choice of technologies affected

The aim of this policy is to increase the overall efficiency (heat and electrical efficiencies), of CHP schemes participating in future CfD allocation rounds. Therefore this policy will only affect developers of technologies that must deploy with CHP in order to be eligible for CfD support, which currently are:

- Dedicated biomass with CHP
- Energy from Waste with CHP

It is not possible to predict the how the policy decision will affect each technology specifically, as it is not possible to predict the outcomes of future CfD allocation rounds with certainty. Therefore, in appraising the impact that this policy decision might have on CHP technologies, we have examined the impact that the government's final position would have had, if they had applied to the same technology mix and capacities secured in the second CfD allocation round. We have therefore appraised the impact of this policy on 85.64MW of biomass CHP capacity. As this scenario is for illustrative purposes it does not prejudice future decisions on technology eligibility, strike prices, the introduction of minima and maxima or budgets available for future CfD allocation rounds.

Choice of monetised and non-monetised costs and benefits

The higher expected heat and electrical efficiencies resulting from this policy should serve to both reduce the amount of biomass needed to generate a given amount of electricity, and should also increase the amount of heat generated by CHP plants. A reduction in the amount of fuel required by biomass CHP plants, and an increase in their heat output as a result of this policy could have the following impacts:-

Table A1: Monetised impacts arising from higher efficiency requirements

Reduction in the amount of fuel required by biomass CHP plants to generate a given amount of electricity	Increase in volume of heat generated by CHP plants thereby reducing the amount of heat produced through alternative means[9]
• Reduction in carbon emissions. • Reduction in the resource cost to society from generating electricity from biomass CHP. • Potential increase in capital costs of achieving higher efficiencies.	• Reduction in carbon emissions. • Reduction in the resource cost to society of generating heat.

As a result of this policy we would expect CHP plants to benefit from a reduction in fuel costs and an increase in heat revenue. It may also be reasonable to assume that higher levels of investment are required by developers in order to meet more ambitious heat and electrical efficiency targets.

At consultation stage no quantified estimate was made of the potential increase in capital costs faced by future projects if achieving the minimum efficiency requirements. Significant uncertainty remains about the extent to which future projects may face extra capital costs in order to meet the efficiency requirements, therefore a range of costs has been included in the cost-benefit analysis, based primarily on the difference between the 'central' and 'high' capex

[9] For the purpose of this analysis, we have assumed that additional heat produced by biomass CHP plants replaces heat which would otherwise have been produced by a household boiler.

estimates of the generation per MWh for projects commissioning in 2025 from the BEIS 2016 Generation Costs Report.[10]

While we have not modelled the impact on generators from lower fuel costs and higher heat revenue, additional heat output and reduced fuel consumption still represent benefits to society as it reduces the resource cost of heat and electricity production. We have therefore included in this appraisal the benefits of a reduction in the resource costs of generating heat and electricity to society.

It is possible that the policy decision could have an impact on air quality. This is because the proposed policy will lead to a reduction in the amount of biomass needed to generate a given amount of electricity and because higher levels of heat produced by CHP plants has the potential to reduce the amount of gas consumed in order to generate heat in the absence of the proposed policy change. The government did not receive evidence during the consultation on which to change our approach to assessing air quality impacts that may result from the proposed policy, and so the assessment remains qualitative in this IA.

Modelling approach and overview of assumptions

This appraisal looks at the net impact of introducing more ambitious efficiency requirements for CHP generators. In doing so we have modelled both a 'do-nothing' scenario in which CHP efficiency standards remain unchanged as well as the 'do-something' scenario representing the government's final position, which has a higher efficiency requirement than in the 'do-nothing' scenario. The net impact of intervention is defined as the difference in costs and benefits between the 'do-something' and the 'do-nothing' scenario.

<u>'Do-nothing' scenario</u>

The government's final position includes the same requirements for plants less than 25MWe in size as for plants equal-to-or-greater-than 25MWe in size. However, for the purpose of assessing impacts of these requirements, we have split the 85.64MW of biomass CHP capacity assumed to be affected by the proposed policy, using the February 2018 version of BEIS's Renewable Energy Planning Database (REPD)[11]. This approach accounts for potential differences in electrical efficiencies achievable by the different plant sizes, and is consistent with the approach taken at consultation stage.

To assess the future pipeline of projects, and therefore split of project by size, we have identified those biomass CHP projects in Great Britain which could apply for CfD support in the future. This pipeline of projects consists of those which have been granted planning permission or had their planning application appeal granted, and are awaiting construction.

Of a total 930MW of biomass CHP which could participate in future allocation rounds, 884MW or 95% of capacity is greater-than-or-equal-to 25MWe in size and 47MW or 5% of capacity is less than 25MWe in size. In applying these proportions to the illustrative 85.64MW of biomass CHP plants we have hypothetically assumed that 4.3MW of plants below 25MWe and 81.3MW of plants equal-to-or-greater-than 25MW could be affected by the proposed changes.

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[10] Available here: https://www.gov.uk/government/publications/beis-electricity-generation-costs-november-2016

[11] Available here: https://www.gov.uk/government/publications/renewable-energy-planning-database-monthly-extract

Table A2: REPD analysis of pipeline split by size

Size	Pipeline capacity (MW)	Proportion of pipeline (%)
Less than 25MWe in size	46.6	5%
At and above 25MWe in size	883.6	95%
Total	**930.2**	**100%**

For our ‘do-nothing’ scenario, we have assumed heat and electrical efficiencies and heat-to-power ratios set out in Table A3. This is based on data provided to BEIS by Ricardo-AEA on the electrical and heat efficiencies of plants (both those operational and planned) which are required to notify under GN44 arrangements.

Electrical output is based on the deployment of 85.64MW of biomass CHP and a load factor assumption of 80%. Fuel consumption has been calculated by dividing electrical output by the assumed electrical efficiency and heat output has been calculated by multiplying electrical output by the heat-to-power ratio.

Table A3: Assumed ‘do-nothing’ electrical and heat efficiencies, heat-to-power ratios, electricity and heat output, deployment split and fuel consumption

	Plants less than 25MWe in size	Plants equal-to-or-greater-than 25MWe in size
Proportion of potential pipeline	5%	95%
Assumed capacity (MW)	4.3	81.3
Electrical efficiency (NCV; %)	26%	31%
Heat efficiency (NCV; %)	27%	9%
Heat-to-power ratio	1.06	0.31
Electrical output (MWh)	30,000	575,000
Heat output (MWh)	30,000	175,000
Fuel consumption (MWh)	115,000	1,855,000

Policy scenario

Tables A4 and A5 set out the electrical and heat efficiencies of plants under two scenarios, one where we have assumed no change in electrical efficiency between the ‘do-nothing’ and the ‘do-something’ scenario, and one where we have assumed an increase in electrical efficiency compared to the ‘do-nothing’ scenario.

It is uncertain to what extent generators will choose to increase their electrical efficiency versus increasing their heat efficiency in the ‘do-something’ scenario in order to meet the overall efficiency target of 70%[12]. Therefore we have chosen to model two scenarios in each of the ‘do-something’ decision – one in which plants’ electrical efficiencies do not increase and plants’ achieve their overall plant efficiency target purely by increasing their heat efficiency, and another scenario in which plants increase both their electrical and heat efficiencies in order to meet their overall efficiency target. The results of these scenarios are shown in Tables A4 and A5.

[12] The overall plant efficiency is defined as the sum of a plant’s electrical and heat efficiencies.

Table A4: Assumed electrical and heat efficiencies, heat-to-power ratios, fuel consumption and heat output for plants in the 'do something' scenario assuming no change in electrical efficiency between the 'do-nothing' and the 'do-something' scenario

Option	Plant size	Overall efficiency requirement	Assumed electrical efficiency	Assumed heat efficiency	Heat-to-power ratio	Fuel consumption (MWh)	Heat output (MWh)
Final Government Position	<25MWe	70%	26%	44%	1.7	115,000	50,000
	>=25MWe	70%	31%	39%	1.3	1,855,000	725,000

Table A5: Assumed electrical and heat efficiencies, heat-to-power ratios, fuel consumption and heat output for plants in the 'do something' scenario assuming an increase in electrical efficiency between the 'do-nothing' and the 'do-something' scenario

Option	Plant size	Overall efficiency requirement	Assumed electrical efficiency	Assumed heat efficiency	Heat-to-power ratio	Fuel consumpti on (MWh)	Heat output (MWh)
Final Government Position	<25MWe	70%	35%	35%	1.0	85,000	30,000
	>=25MWe	70%	33%	37%	1.1	1,745,000	650,000

In each of the 'do-something' scenarios we have run two variants on our analysis. The first of these assumes electrical efficiencies under the 'do-something' scenario are no higher than under the 'do-nothing' scenario. In this scenario, the electrical efficiencies are assumed to be 26% for plants below 25MWe and 31% for plants greater-than-or-equal-to 25MWe. These assumptions are based on calculating the average electrical efficiency of plants which may deploy in the near-future using data provided by Ricardo-AEA.

In second variant on this analysis, we have assumed that plants could achieve higher electrical efficiencies under each of the proposed policy options. We have assumed a maximum electrical efficiency of 35% for plants below 25MWe, and 33% for plants greater-than-or-equal-to 25MWe, again using data provided by Ricardo-AEA.

In each of the 'do-nothing' scenarios we have assumed a heat efficiency of 27% for projects smaller than 25MWe in size and a heat efficiency of 9% for projects equal-to-or-greater-than 25MWe in size[13]. This gives an assumed heat-to-power ratio of 1.06 for projects smaller than 25MWe in size and an assumed heat-to-power ratio of 0.31 for projects equal-to-or-greater than 25MWe in size.

The government's final position requires an increase in overall efficiency for plants both equal-to-or-greater-than 25MWe, and less than 25MWe in size. For plants equal-to-or-greater than 25MWe in size, an increase in the electrical efficiency of plants to 33% means that they need to achieve a heat efficiency of 37% in order to meet the overall efficiency target. These assumptions result in a heat-to-power ratio of 1.1. As this heat-to-power ratio is greater than the heat-to-power-ratio of 0.31 assumed in the 'do-nothing' scenario, we expect a higher level of heat output in the 'do something' scenario for plants greater-to-or-equal-to 25MWe where we have modelled an increase in plants' electrical efficiencies.

Similarly, where we have assumed no increase in electrical efficiency as a result of the policy intervention, plants greater-than-or-equal to 25MWe need to increase their heat efficiencies to 39% in order to meet their overall efficiency targets. These assumptions result in a heat-to-power ratio of 1.3. As these heat-to-power ratios are greater than the heat-to-power-ratio of 0.31 assumed in the 'do-nothing' scenario, we expect a higher level of heat output for plants greater-

[13] These efficiencies are Net Calorific Values

than-or-equal-to 25MWe in size in the 'do something' scenario for each of the options considered where we have modelled an increase in plants' electrical efficiencies.

The heat and electrical efficiencies assumed for plants smaller than 25MWe in size in the 'do-nothing' scenario give a heat-to-power ratio of 1.06 for plants of this size.

In the variant of our analysis where we assume no increase in electrical efficiency from the 'do-nothing' to 'do-something' scenarios, the 'do-something' heat-to-power ratio is 1.7 for plants smaller than 25MWe. This results in higher heat output from plants smaller than 25MWe compared with the 'do-nothing' scenario.

In the variant of our analysis where we assume an increase in electrical efficiency as a result of intervention, the do-something heat-to-power ratio for plants smaller than 25MWe is 1.0. This heat-to-power ratio is marginally lower than the 'do-nothing' scenario, resulting in a very slight decrease in heat output from plants smaller than 25MWe in size in this variant of our analysis (this difference is not observed in the tables due to rounding).

Table A6 provides a summary of the modelled change in fuel consumption and heat output by plant size for each of the 'do-something' scenarios.

Table A6: Change in fuel consumption (MWh) and change in heat output (MWh) under the government's final position compared with 'do-nothing' scenario

Option	Plant size	No change in electrical efficiency		Increase in electrical efficiency	
		Reduction in fuel consumption (MWh)	Additional heat output (MWh)	Reduction in fuel consumption (MWh)	Additional heat output (MWh)
Final Government Position	<25MWe	0	20,000	30,000	Less than -5,000
	>=25MWe	0	550,000	110,000	475,000
	Total	**0**	**570,000**	**140,000**	**470,000**

Change in carbon emissions

In monetising the impact of changes in carbon emissions as a result of the policy intervention in the 'do-something' scenarios we have used both non-traded and traded carbon prices set out in the government's supplementary guidance on the valuation of energy use and greenhouse gas emissions[14].

We have deflated the IAG values into £2012 values using GDP deflators from Table 19 of the IAG data tables and converted the IAG values into financial years. Traded carbon values used in our analysis range from around £41 per tonne of CO2e to around £205 per tonne of CO_2e over the appraisal lifetime. Non-traded carbon values used in our analysis range from around £69 per tonne of CO_2e to around £205 per tonne of CO_2e over the appraisal lifetime.

Biomass used for electricity generation results in carbon emissions during the processes of cultivating, transporting and processing the fuel source and these processes fall within both the traded and non-traded carbon sectors. We do not have sufficient information from which to determine the proportion of carbon emissions from biomass combustion which should be apportioned to the traded and non-traded sectors.

[14] https://www.gov.uk/government/publications/valuation-of-energy-use-and-greenhouse-gas-emissions-for-appraisal

For this reason, we have valued the carbon benefits from a reduction in biomass consumption as a result of higher electrical efficiencies using both non-traded and trade carbon values to create a range.

In monetising the benefits from a reduction in carbon emissions due to an increase in heat production by CHP plants, we have used non-traded carbon values on the assumption that additional heat produced by CHP plants has the potential to displace heat generation by household boilers, emissions from which are currently included in the non-traded sector.

Change in resource costs to society

The government's final position has the potential to both reduce the amount of biomass needed to produce a given amount of electricity (through potentially higher electrical efficiencies) and also increase the amount of heat produced from a given amount of biomass fuel input.

However, while we have not modelled changes in revenues and costs faced by generators, a reduction in biomass fuel costs and increase in heat production has the potential to reduce the resource costs to society of energy production and for this reason we have modelled these potential societal benefits.

To monetise the resource cost benefits from a reduction in the amount of biomass required to produce a given amount of electricity, we have use biomass costs provided to BEIS by ARUP during the Department's most recent exercise to update generation costs[15]. The assumed cost of biomass is £9.33 per MWh in £2012 prices.

Our analysis assumes that additional heat produced by CHP plants as a result of the policy intervention displaces heat that would otherwise have been produced by household boilers in the absence of intervention. We have therefore used the long-run variable cost (LRVC) values of domestic gas production set out in BEIS's supplementary Green Book guidance[16]. The LRVC of domestic gas generation ranges from 1.93p/kWh in 2025/26 to 2.29p/kWh in 2049/50 in £2012 values.

[15] https://www.gov.uk/government/publications/arup-2016-review-of-renewable-electricity-generation-cost-and-technical-assumptions

[16] https://www.gov.uk/government/publications/valuation-of-energy-use-and-greenhouse-gas-emissions-for-appraisal