Title: Changes to Combined Heat and Power Quality Assurance (CHPQA) under the Contracts for Difference scheme	**Impact Assessment (IA)**
IA No: BEIS021(F)-17-CE	**Date:** 11/12/2017
RPC Reference No: N/A	**Stage:** Consultation
Lead department or agency: Department for Business, Energy and Industrial Strategy	**Source of intervention:** Domestic
	Type of measure: Secondary Legislation
Other departments or agencies: None	**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**
£336m – £393m	£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)

Three policy options have been developed for consultation:

- **Option 1 (preferred)** – Increase the minimum overall efficiency for CHP plants greater-than-or-equal-to 25MWe to 70% and increase the minimum overall efficiency of CHP plants below 25 MW in size to either:
  (a) 70%;
  (b) 60%; or
  (c) 50%.
- **Option Alternative 1** – Increase the minimum overall efficiency threshold for plants greater-than-or-equal-to 25MWe to 70%. For schemes below 25MWe in size there would be no new overall efficiency threshold requirement.
- **Option Alternative 2** – Increase the overall efficiency for CHP plants greater-than-or-equal-to 25MWe to 70% and increase the overall efficiency for CHP plants below 25MW in size to either:
  (a) 70%, of which a minimum of 25% must come from heat;
  (b) 60%, of which a minimum of 20% must come from heat;
  (c) 50%, of which a minimum of 15% must come from heat.

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

The government prefers Option 1 (a), 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 – <-0.01**	**Non-traded: -0.08 to -0.09**	

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: Richard Harrington Date: 11/12/17

Summary: Analysis & Evidence

Policy Option 1(a)

Description: Increase minimum overall efficiency to 70% for plants greater-than-or-equal-to 25MWe and 70% for plants below 25MWe

FULL ECONOMIC ASSESSMENT

Price Base Year 2012	PV Base Year 2025/26	Time Period Years 25	Net Benefit (Present Value (PV)) (£m)		
			Low: 351	**High:** 393	**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		0	0
Best Estimate	0		N/A	N/A

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

None have been monetised. The proposal may have an impact on the generation costs of plants being awarded a CfD. The government does not hold evidence on the relationship between plants' generation costs and their heat and electrical efficiencies, and it is uncertain whether the proposed increase in minimum efficiencies would increase costs or mean more efficient plants receive support in place of less efficient plants. Given these uncertainties, the potential costs identified have not been monetised at this stage and the government welcomes evidence on changes in generation costs as part of this consultation.

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		22	351
High	0		25	393
Best Estimate	0		N/A	N/A

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

The proposal will mean that only CHP plants with higher overall efficiencies (coming from increase in electrical and heat efficiencies) will 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 - £22m) 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 £161m - £195m) and carbon emissions savings (PV £163m - £198m).

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

The proposal 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 proposal 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 welcomes evidence from industry on these impacts.

Key assumptions/sensitivities/risks **Discount rate (%)** 3.5 (years 1-30), 3.0 (>30 years)

- 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

Summary: Analysis & Evidence

Policy Option 1(b)

Description: Increase minimum overall efficiency to 70% for plants greater-than-or-equal-to 25MWe and 60% for plants below 25MWe

FULL ECONOMIC ASSESSMENT

Price Base Year 2012	PV Base Year 2025/26	Time Period Years 25	Net Benefit (Present Value (PV)) (£m)		
			Low: 345	**High:** 384	**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		0	0
Best Estimate	0		N/A	N/A

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

None have been monetised. The proposal may have an impact on the generation costs of plants being awarded a CfD. The government does not hold evidence on the relationship between plants' generation costs and their heat and electrical efficiencies, and it is uncertain whether the proposed increase in minimum efficiencies would increase costs or mean more efficient plants receive support in place of less efficient plants. Given these uncertainties, the potential costs identified have not been monetised at this stage and the government welcomes evidence on changes in generation costs as part of this consultation.

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		22	345
High	0		25	384
Best Estimate	0		N/A	N/A

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

The proposal will mean that only CHP plants with higher overall efficiencies (coming from increase in electrical and heat efficiencies) will 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 - £22m) 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 £158m - £191m) and carbon emissions savings (PV £160m - £193m).

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

The proposal 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 proposal 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 welcomes evidence from industry on these impacts.

Key assumptions/sensitivities/risks **Discount rate (%)** 3.5 (years 1-30), 3.0 (>30 years)

- 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 2(b))

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

Summary: Analysis & Evidence

Policy Option 1(c)

Description: Increase minimum overall efficiency to 70% for plants greater-than-or-equal-to 25MWe and 50% for plants below 25MWe

FULL ECONOMIC ASSESSMENT

Price Base Year 2012	PV Base Year 2025/26	Time Period Years 25	Net Benefit (Present Value (PV)) (£m)		
			Low: £338	**High:** £375	**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		0	0
Best Estimate	0		N/A	N/A

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

None have been monetised. The proposal may have an impact on the generation costs of plants being awarded a CfD. The government does not hold evidence on the relationship between plants' generation costs and their heat and electrical efficiencies, and it is uncertain whether the proposed increase in minimum efficiencies would increase costs or mean more efficient plants receive support in place of less efficient plants. Given these uncertainties, the potential costs identified have not been monetised at this stage and the government welcomes evidence on changes in generation costs as part of this consultation.

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		22	338
High	0		24	375
Best Estimate	0		N/A	N/A

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

The proposal will mean that only CHP plants with higher overall efficiencies (coming from increase in electrical and heat efficiencies) will 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 - £22m) 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 £155m - £186m) and carbon emissions savings (PV £157m - 189m).

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

The proposal 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 proposal 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 welcomes evidence from industry on these impacts.

Key assumptions/sensitivities/risks **Discount rate (%)** 3.5 (years 1-30), 3.0 (>30 years)

- 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 3c)

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

Summary: Analysis & Evidence

Policy Option Alternative 1

Description: Increase minimum overall efficiency to 70% for plants equal-to-or-greater-than 25MWe

FULL ECONOMIC ASSESSMENT

Price Base Year 2012	PV Base Year 2025/26	Time Period Years 25	Net Benefit (Present Value (PV)) (£m)		
			Low: 346	**High:** 378	**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		0	0
Best Estimate	0		0	0

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

None have been monetised. The proposal may have an impact on the generation costs of plants being awarded a CfD. The government does not hold evidence on the relationship between plants' generation costs and their heat and electrical efficiencies, and it is uncertain whether the proposed increase in minimum efficiencies would increase costs or mean more efficient plants receive support in place of less efficient plants. Given these uncertainties, the potential costs identified have not been monetised at this stage and the government welcomes evidence on changes in generation costs as part of this consultation.

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		22	346
High	0		24	378
Best Estimate	0		N/A	N/A

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

The proposal will mean that only CHP plants with higher overall efficiencies (coming from increase in electrical and heat efficiencies) will 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 - £17m) and carbon savings (PV £0 - £4m). A potential increase in heat efficiency would increase heat output, resulting in benefits to society from: fuel resource cost savings (PV £162m - £188m) and carbon emissions savings (PV £164m - £190m).

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

The proposal 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 proposal 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 welcomes evidence from industry on these impacts.

Key assumptions/sensitivities/risks **Discount rate (%)** 3.5 (years 1-30), 3.0 (>30 years)

- 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 Alternative 4)

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

Summary: Analysis & Evidence

Policy Option Alternative 2(a)

Description: Increase minimum overall efficiency to 70% for plants greater-than-or-equal-to 25MWe; for plants below 25MWe increase overall efficiency to 70% with a 25% minimum heat efficiency for plants of all size

FULL ECONOMIC ASSESSMENT

Price Base Year 2012	PV Base Year 2025/26	Time Period Years 25	Net Benefit (Present Value (PV)) (£m)		
			Low: 351	**High:** 393	**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		0	0
Best Estimate	0		0	0

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

None have been monetised. The proposal may have an impact on the generation costs of plants being awarded a CfD. The government does not hold evidence on the relationship between plants' generation costs and their heat and electrical efficiencies, and it is uncertain whether the proposed increase in minimum efficiencies would increase costs or mean more efficient plants receive support in place of less efficient plants. Given these uncertainties, the potential costs identified have not been monetised at this stage and the government welcomes evidence on changes in generation costs as part of this consultation.

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		22	351
High	0		25	393
Best Estimate	0		N/A	N/A

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

The proposal will mean that only CHP plants with higher overall efficiencies (coming from increase in electrical and heat efficiencies) will 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 - £22m) 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 £161m - £195m) and carbon emissions savings (PV £163m - £198m).

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

The proposal 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 proposal 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 welcomes evidence from industry on these impacts.

Key assumptions/sensitivities/risks **Discount rate (%)** 3.5 (years 1-30), 3.0 (>30 years)

- 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 2a)

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

Summary: Analysis & Evidence

Policy Option Alternative 2(b)

Description: Description: Increase minimum overall efficiency to 70% and minimum heat efficiency to 25% for plants greater-than-or-equal-to 25MWe; for plants below 25MWe increase overall efficiency to 60% with 20% minimum heat efficiency

FULL ECONOMIC ASSESSMENT

Price Base Year 2012	**PV Base Year** 2025/26	**Time Period Years** 25	**Net Benefit (Present Value (PV)) (£m)**		
			Low: £345	**High:** £384	**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		0	0
Best Estimate	0		0	0

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

None have been monetised. The proposal may have an impact on the generation costs of plants being awarded a CfD. The government does not hold evidence on the relationship between plants' generation costs and their heat and electrical efficiencies, and it is uncertain whether the proposed increase in minimum efficiencies would increase costs or mean more efficient plants receive support in place of less efficient plants. Given these uncertainties, the potential costs identified have not been monetised at this stage and the government welcomes evidence on changes in generation costs as part of this consultation.

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		22	345
High	0		25	384
Best Estimate	0		N/A	N/A

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

The proposal will mean that only CHP plants with higher overall efficiencies (coming from increase in electrical and heat efficiencies) will 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 - £22m) 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 £158m - £191m) and carbon emissions savings (PV £160m - £193m).

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

The proposal 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 proposal 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 welcomes evidence from industry on these impacts.

Key assumptions/sensitivities/risks **Discount rate (%)** 3.5 (years 1-30), 3.0 (>30 years)

- 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 2b)

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

Summary: Analysis & Evidence

Policy Option Alternative 2(c)

Description: Description: Increase minimum overall efficiency to 70% and minimum heat efficiency to 25% for plants greater-than-or-equal-to 25MWe; for plants below 25MWe increase overall efficiency to 50% with 15% minimum heat efficiency

FULL ECONOMIC ASSESSMENT

Price Base Year 2012	**PV Base Year** 2025/26	**Time Period Years** 25	**Net Benefit (Present Value (PV)) (£m)**		
			Low: 338	**High:** 375	**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		£0	0
Best Estimate	0		£0	0

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

None have been monetised. The proposal may have an impact on the generation costs of plants being awarded a CfD. The government does not hold evidence on the relationship between plants' generation costs and their heat and electrical efficiencies, and it is uncertain whether the proposed increase in minimum efficiencies would increase costs or mean more efficient plants receive support in place of less efficient plants. Given these uncertainties, the potential costs identified have not been monetised at this stage and the government welcomes evidence on changes in generation costs as part of this consultation.

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		22	338
High	0		24	375
Best Estimate	0		N/A	N/A

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

The proposal will mean that only CHP plants with higher overall efficiencies (coming from increase in electrical and heat efficiencies) will 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 - £22m) 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 £155m - £186m) and carbon emissions savings (PV £157m - £189m).

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

The proposal 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 proposal 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 welcomes evidence from industry on these impacts.

Key assumptions/sensitivities/risks **Discount rate (%)** 3.5 (years 1-30), 3.0 (>30 years)

- 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 2c)

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

1. 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 identifying a heat off-taker. Other respondents suggested that the requirements for CHP schemes are not fulfilling policy ambition. Further detail is available in the Annex to the consultation document that accompanies this Impact Assessment.

2. 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. This means that in future there is a risk of supporting projects which share certain characteristics with technologies which are ineligible for the CfD.

3. 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

4. Electricity generation accounts for over 20% of UK greenhouse gas emissions[2] 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.[3]

5. The specific interventions considered in this Impact Assessment (IA) follow 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 likely that following government objectives will not be met in future CfD Allocation Rounds:

    - Best available technology and application of renewable CHP, and;
    - Schemes which deliver high levels of overall efficiency and make the best use of biomass resources.

[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] 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

[3] 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

3. Policy objectives

6. 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[4] 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 proposals and options analysis

Options under consideration

7. A total of three policy options have been developed in order to improve the overall efficiency of renewable CHP plants qualifying for support in future CfD allocation rounds. 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.

Preferred approach

8. The government's preferred approach is for all large plants that must deploy with CHP under the CfD scheme to achieve an overall minimum efficiency of 70%, but welcomes views on the threshold that should be applied to plants below 25MWe. As such, the government's preferred range of proposals are:

    - **Option 1 (a)** – Overall efficiency threshold, for schemes of 25MWe and over set at 70% net calorific value (NCV); overall efficiency threshold for schemes below 25MWe set at 70%; or
    - **Option 1 (b)** – Overall efficiency threshold, for schemes of 25MWe and over set at 70% net calorific value (NCV); overall efficiency threshold for schemes below 25MWe set at 60%; or
    - **Option 1 (c)** – Overall efficiency threshold for schemes of 25MWe and over set at 70% net calorific value (NCV); overall efficiency threshold for schemes below 25MWe set at 50%.

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

9. 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,

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

and ensure efficient use of available biomass resources, while retaining flexibility for schemes to balance their output between heat and power.

10. 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 place.

11. 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.

Alternative Options

12. The government has also considered two alternatives to the preferred range of proposals. Views and evidence are welcomed on both of these as part of the consultation.

Alternative 1

- An overall efficiency threshold for plants sized 25MWe and over set at 70% NCV;
- No minimum efficiency threshold for plants sized under 25MWe;
- All schemes to continue to deliver a minimum 10% heat efficiency and 10% primary energy saving.

13. This is the minimum action the government considers necessary. This option increases the overall efficiency requirements for future renewable CHP plants under the CfD scheme in line with those qualifying under the CHPQA standard.

14. This option does not encourage higher efficiency from schemes below 25MWe, and could provide a perverse incentive for new schemes to size themselves below 25MWe.

Alternative 2

15. The second alternative is to set an overall efficiency threshold for schemes of 25MWe and over at 70% NCV and a minimum heat efficiency threshold for schemes of 25MWe and over, set at 25%. The alternatives below are proposed for schemes below 25MWe (and The government welcomes views on which would be most appropriate):

- Alternative 2(a) - 70% overall efficiency, 25% of which must come from heat; or
- Alternative 2(b) - 60% overall efficiency, 20% of which must come from heat; or
- Alternative 2(c) - 50% overall efficiency, 15% of which must come from heat.

- All schemes continue to be required to achieve a primary energy saving of 10%.

16. This approach is similar to the government's preferred one, in that the overall efficiency of all schemes is increased, but it goes further by also increasing the minimum heat efficiency above the current 10% requirement. It could support the best available technology and use of biomass resources, but appears to have a limited additional benefit beyond the preferred approach provided the overall efficiency levels are sufficiently high for all sizes of plant. Increasing the minimum heat efficiency may also place an additional burden on developers and limit their ability to balance heat and power outcomes effectively.

5. Impact of shortlisted options

5.1. Options Appraisal

17. In assessing each of the options proposed we have chosen to monetise 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.

18. 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 each proposal 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.

19. 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 proposals would only affected dedicated biomass.

20. The rest of this section summarises the results by each key component of the cost-benefit analysis.

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
1(a)	0	565,000	140,000	470,000
1(b)	0	555,000	140,000	460,000
1(c)	0	545,000	140,000	450,000
Alternative 1	0	545,000	110,000	470,000
Alternative 2(a)	0	565,000	140,000	470,000
Alternative 2(b)	0	555,000	140,000	460,000
Alternative 2(c)	0	545,000	140,000	450,000

21. We have modelled the impact of higher overall efficiencies 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.

22. 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.

23. 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.

24. Increases in plants' heat output is greatest in options with the highest overall efficiency requirements (for example option 1a results in higher heat output gains than option 1b which has a lower overall plant efficiency target).

Value of change in carbon emissions

25. Tables 2 and 3 set out the estimated impact of the proposals on carbon emissions and their resulting value. The government's preferred option (Option 1), variant 1(a) offers the highest NPV to society. This is because option 1(a) places the highest efficiency requirement on generators and, unlike in Alternative 1, requires a greater number of plants (both generators greater-than-or-equal to 25MW and generators smaller than 25MW) to increase their efficiencies. This results in a higher level of energy output compared to the 'do nothing' baseline, thereby displacing the highest amount of carbon emissions from alternative sources of heat generation.

Table 2: Monetised carbon impacts for policy options, 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)
1(a)	0	0	198
1(b)	0	0	193
1(c)	0	0	189
Alternative 1	0	0	190
Alternative 2(a)	0	0	198
Alternative 2(b)	0	0	193
Alternative 2(c)	0	0	189

Table 3: Monetised carbon impacts for policy options, 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)
1(a)	5	5	163
1(b)	5	5	160
1(c)	5	5	157
Alternative 1	4	4	164
Alternative 2(a)	5	5	163
Alternative 2(b)	5	5	160
Alternative 2(c)	5	5	157

26. Options 2(a), 2(b) and 2(c) (in which the minimum heat efficiency is increased from 10%) offer the same NPV to society as Option 1 (where the minimum heat efficiency remains at 10%). This is a result of the minimum heat efficiencies not 'biting' because the overall

minimum efficiency requirement is expected to lead to a greater than required heat efficiency improvement.

27. 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 have a lower social NPV.

28. 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.

Change in resource costs to society

29. The policy proposals are 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 policy options 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)
1(a)	0	195
1(b)	0	191
1(c)	0	186
Alternative 1	0	188
Alternative 2(a)	0	195
Alternative 2(b)	0	191
Alternative 2(c)	0	186

Table 5: Monetised change in resource costs for policy options 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)
1(a)	22	161
1(b)	22	158
1(c)	22	155
Alternative 1	17	162
Alternative 2(a)	22	161
Alternative 2(b)	22	158
Alternative 2(c)	22	155

30. The government's preferred option (Option 1), variant 1(a) offers the highest NPV to society. This high NPV figure is driven by the higher efficiency requirements across a greater number of generators leading to the greatest resource savings.

31. Options 2(a), 2(b) and 2(c) offer the same NPV to society as option 1. Again this is due to the minimum heat efficiencies not 'biting' due to the overall efficiency requirements leading to significant increases in heat output.

32. The NPV of a change in resource costs from government intervention is higher where we have assumed no increase in electrical efficiency. The scenario where we have assumed an increase in electrical efficiency reduces heat output compared with the scenario where we have assumed no increase in electrical output. As the resource cost of generating domestic heat is assumed to be higher than the resource cost of biomass, any scenario in which heat output is reduced in order to increase electrical efficiency (thereby reducing biomass consumption at the expense of heat output) will reduce the societal resource cost savings NPV.

Administrative burden on business

33. The policy proposals covered within this Impact Assessment require generators to meet more stringent efficiency targets compared with current standards. As the proposals only modify current regulations and do not impose new regulations on business, our assessment is that the proposals covered in this IA will not have an impact on the administrative burden faced by businesses. However, as part of this consultation, we welcome views and evidence from stakeholders on the impact that higher efficiency requirements might have on their administrative costs.

Summary of results

34. Table 6 shows the NPVs of the different proposed policy options, assuming no change in electrical efficiency from the 'do-nothing' scenario.

Table 6: Total NPV for each policy option under consideration, assuming no change in electrical efficiency as a result of intervention

Option	Change in fuel consumption			Change in heat production		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					
1(a)	0	0	0	198	195	393	393
1(b)	0	0	0	193	191	384	384
1(c)	0	0	0	189	186	375	375
Alternative 1	0	0	0	190	188	378	378
Alternative 2(a)	0	0	0	198	195	393	393
Alternative 2(b)	0	0	0	193	191	384	384
Alternative 2(c)	0	0	0	189	186	375	375

35. As we have assumed no increase in electrical efficiency, 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.

36. The preferred option (1) offers the highest NPV to society, as these proposals included in this option cover the widest range of plants (both plants greater-than-or-equal-to 25MW as well as plants below 25MW in size).

37. Option 1 and Option Alternative 2 both result in the same NPV. This is because despite Option Alternative 2 requiring that plants below 25MW in size meet minimum heat efficiency requirements, the overall plant efficiencies proposed are sufficiently high-enough that plants must meet a higher heat efficiency target in both Option 1 and Option Alternative 2 than is required as a minimum in policy Option Alternative 2.

Table 7: Total NPV for each policy option under consideration, assuming an increase in electrical efficiency as a result of intervention

Option	Change in fuel consumption			Change in heat production		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					
1(a)	5	5	22	163	161	351	352
1(b)	5	5	22	160	158	345	345
1(c)	5	5	22	157	155	338	338
Alternative 1	4	4	17	164	162	346	346
Alternative 2(a)	5	5	22	163	161	351	352
Alternative 2(b)	5	5	22	160	158	345	345
Alternative 2(c)	5	5	22	157	155	338	338

38. Table 7 shows the NPVs of the different proposed policy options, assuming that generators increase both their heat and electrical efficiencies from the 'do nothing' scenario.

39. 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) all options in table 9 show positive NPVs resulting from lower fuel consumption and higher heat output.

40. The government's preferred option (1) has the highest societal NPV. The proposals under this option affect the widest range of generators (both plants greater-than-or-equal-to 25MW and plants less than 25 MWe in size) which means that there is a higher societal NPV than under Option Alternative 1, which only affects plants greater-than-or-equal-to 25MWe in size.

41. As in the scenario in which we have assumed no increase in electrical efficiencies, Option 1 and Option Alternative 2 both result in the same NPV. This is because despite Option Alternative 2 requiring that plants below 25MWe in size meet minimum heat efficiency requirements, the overall plant efficiencies proposed are sufficiently high-enough that plants must meet a higher heat efficiency target in both Option 1 and Option Alternative 2 than is required as a minimum in policy Option Alternative 2.

Risks and Uncertainties

42. The analysis presented in this IA has been based upon the best information available to the government at the time of publication. However, we recognise there may be areas where the evidence base could be strengthened. As part of this consultation, the government welcomes further evidence from consultees on the feasibility and impacts of the proposed policy changes

Ability to meet the minimum efficiency requirements

43. The government does not currently have evidence on the extent to which future projects that may bid for a CfD intend or are able to achieve the minimum efficiency levels set out in these proposals. For illustrative purposes this Impact Assessment assumes the same level of 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.

Generation costs

44. The government does not hold information on the impact that changes to CHP efficiency standards might have on CHP generation costs and for this reason our modelling does not account for any potential increase in either CHP generation costs or revenue to CHP generators. In order to identify how sensitive the results of our analysis is to potential increases in CHP generation costs, we have calculated the extent to which generation costs would need to increase in order to reduce the NPV of each policy option below zero.

45. The scenario which has the highest NPV is the policy option 1(a) where we have assumed an increase in electrical efficiency. This option has an NPV of £798m. In this scenario, from a societal point-of-view, generation costs would need to be £82 per MWh higher in order for the NPV of the policy to be zero. We have also calculated that generators' costs would need to increase by £39 per MWh in the scenario with the lowest NPV (£381m; option 1c assuming no increase in electrical efficiency). This implies that generators being awarded a CfD in future would need to face substantially higher generation costs in order for the proposals to result in net costs to society.

46. However, from generators' point-of-view, the additional costs of more efficient generating equipment may be partially or fully offset by additional revenue from heat and reduced fuel costs. We have used resource costs to society from fuel savings associated with lower biomass consumption and lower gas-based heat generation, as a proxy for the fuel savings and additional heat revenue that generators might achieve with more efficient equipment. We have calculated that in the scenario with the highest NPV, generation costs would need to be £19 per MWh higher in order to offset potential fuel savings and additional heat revenue based on our proxy calculations.

47. Resource costs savings are similar (£19 per MWh) in the scenario with the lowest NPV, (where we have assumed no increase in electrical efficiency), as a reduction in biomass fuel savings is almost fully offset by an increase in gas-fuel resource cost savings.

48. Our analysis assumes that c. 86MW of biomass 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 (currently 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 set out in the IA of the proposed policy changes.

49. Some of the scenarios proposed by the government place lower overall efficiency requirements on plants smaller than 25MW in size than for plants greater-than-or-equal-to 25MW. This offers the potential for plants which are greater-than-25MW to reconfigure to a smaller generating capacity in order to avoid higher efficiency requirements. The effect of plants downsizing may be to reduce the benefits presented in this IA.

Increases in electrical and heat efficiencies

50. 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, however the government would welcome further evidence from consultees.

Carbon accounting

51. 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, and we will seek to refine these estimates ahead of the final stage Impact Assessment that will accompany the government response to this consultation.

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 particular proposals 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 proposal might have on CHP technologies, we have examined the impact that the proposed policy options 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[5]
• Reduction in carbon emissions. • Reduction in the resource cost to society from generating electricity from biomass CHP.	• 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.

We have explicitly chosen not to model the impact of higher efficiency requirements on generators' costs for two reasons. Firstly, BEIS does not currently hold sufficient evidence on the relationship between efficiencies and generation costs and so it is not possible to estimate the additional cost to generators as a result of meeting more ambitious efficiency targets. Secondly, it is possible that any increase in costs is partially or fully offset by an increase in

[5] 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.

revenues. However, given the uncertainty around the impact of higher efficiency requirements on costs, we have chosen not to model any offsetting increase in revenue to generators.

As part of this consultation, the government welcomes evidence from stakeholders on how the proposed policy changes may affect generation costs.

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 in 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 proposed policies 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.

IAG guidance recommends that where air quality impacts assessed using the damage cost approach exceeds £50m the impact-pathway approach to valuing air quality impacts should be used. The government therefore welcomes further evidence from industry on the potential air quality impacts that may result from the proposed policy options.

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 a series of 'do-something' scenarios representing each of the policy options proposed by the government, each of which have higher efficiency requirements 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 preferred policy include the same requirements for plants less than 25 MW in size as for plants equal-to-or-greater-than 25 MW in size. However several of the alternatives include lower requirements for plants below 25MW in size. In order to isolate the impact that the alternative policies might have on plants that fall into each of these two categories we have split the 85.64 MW of biomass CHP capacity assumed to be affected by the proposed policy, using the August 2017 version of BEIS's Renewable Energy Planning Database (REPD)[6].

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 not been abandoned, not had their planning application appeal refused, not withdrawn their planning application, not had their planning application refused, are not under construction and are not operational.

Of a total 845MW of biomass CHP which could participate in future allocation rounds, 799MW or 94% of capacity is greater-than-or-equal-to 25MW in size and 47MW or 6% of capacity is less than 25MW in size. In applying these proportions to the illustrative 85.64MW of biomass CHP

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

plants we have hypothetically assumed that 5MW of plants below 25MW and 81MW of plants equal-to-or-greater-than 25MW could be affected by the proposed changes.

Table A2: REPD analysis of pipeline split by size

Size	Pipeline capacity (MW)	Proportion of pipeline (%)
Less than 25MW in size	46.6	6%
At and above 25MW in size	798.6	94%
Total	**845.2**	**100%**

For our 'do-nothing' scenario, we have assumed heat and electrical efficiencies and heat-to-power ratios set out in Table A2. 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 25 MWe in size	Plants equal-to-or-greater-than 25 MWe in size
Proportion of potential pipeline	6%	94%
Assumed capacity (MW)	4.7	80.9
Electrical efficiency (NCV; %)	26%	31%
Heat efficiency (NCV; %)	27%	10%
Heat-to-power ratio	1.06	0.32
Electrical output (MWh)	35,000	570,000
Heat output (MWh)	35,000	185,000
Fuel consumption (MWh)	130,000	1,845,000

Policy scenarios

All of the policy options under consideration propose minimum overall plant efficiency requirements. Some policy options under consideration also require minimum heat efficiencies. Each of the policy options results in higher heat efficiencies compared with the 'do-nothing' scenario, irrespective of whether a minimum heat efficiency requirement has been specified. This is because our analysis assumes that plants can achieve a maximum electrical efficiency between 26% and 35% for plants less than 25MW and between 31% and 33% for plants greater-than-or-equal-to in the 'do-something' scenarios and therefore plants must increase their heat efficiencies in order to achieve a higher overall plant efficiency.[7]

Tables A4 and A5 set out the electrical and heat efficiencies of plants under each of the policy scenarios.

It is uncertain to what extent generators will choose to increase their electrical efficiency versus increasing their heat efficiency in the 'do-something' scenario. Therefore we have chosen to model two scenarios in each of the 'do-something' proposals – one in which plants' electrical efficiencies do not increase and plants' achieve their overall plant efficiency target purely by

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

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.

In the scenario in which we assume plants' electrical efficiencies increase as a result of the policy, we have based our electrical efficiency assumptions on data received from Ricardo-AEA on the maximum electrical efficiency achievable by plants which may deploy in the near-future.

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

Option	Plant size	Overall efficiency requirement	Assumed electrical efficiency	Assumed heat efficiency	Heat-to-power ratio	Fuel consumption (MWh)	Heat output (MWh)
1(a)	<25MW	70%	26%	44%	1.7	130,000	55,000
	>=25MW	70%	31%	39%	1.3	1,845,000	720,000
1(b)	<25MW	60%	26%	34%	1.3	130,000	45,000
	>=25MW	70%	31%	39%	1.3	1,845,000	720,000
1(c)	<25MW	50%	26%	24%	0.9	130,000	30,000
	>=25MW	70%	31%	39%	1.3	1,845,000	720,000
Alternative 1	>=25MW	70%	31%	39%	1.3	1,845,000	720,000
Alternative 2 (a)	<25MW	70% (25% heat)	26%	44%	1.7	130,000	55,000
	>=25MW	70%	31%	39%	1.3	1,845,000	720,000
Alternative 2 (b)	<25MW	60% (20% heat)	26%	34%	1.3	130,000	45,000
	>=25MW	70%	31%	39%	1.3	1,845,000	720,000
Alternative 2 (c)	<25MW	50% (15% heat)	26%	24%	0.9	130,000	30,000
	>=25MW	70%	31%	39%	1.3	1,845,000	720,000

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

Option	Plant size	Overall efficiency requirement	Assumed electrical efficiency	Assumed heat efficiency	Heat-to-power ratio	Fuel consumption (MWh)	Heat output (MWh)
1(a)	<25MW	70%	35%	35%	1.0	95,000	35,000
	>=25MW	70%	33%	37%	1.1	1,735,000	645,000
1(b)	<25MW	60%	35%	25%	0.7	95,000	25,000
	>=25Mw	70%	33%	37%	1.1	1,735,000	645,000
1©	<25MW	50%	35%	15%	0.4	95,000	15,000
	>=25MW	70%	33%	37%	1.1	1,735,000	645,000
Alternative 1	>=25MW	70%	33%	37%	1.1	1,735,000	645,000
Alternative 2 (a)	<25MW	70% (25% heat)	35%	35%	1.0	95,000	35,000
	>=25MW	70%	33%	37%	1.1	1,735,000	645,000
Alternative 2 (b)	<25MW	60% (20% heat)	35%	25%	0.7	95,000	25,000
	>=25MW	70%	33%	37%	1.1	1,735,000	645,000
Alternative 2 (c)	<25MW	50% (15% heat)	35%	15%	0.4	95,000	15,000
	>=25MW	70%	33%	37%	1.1	1,735,000	645,000

The assumed electrical efficiencies under the 'do nothing' scenario are 26% for plants less than 25MW in size and 31% for plants equal-to-or-greater-than 25MW in size.

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 25MW and 31% for plants greater-than-or-equal-to 25MW.

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

In each of the ‘do-nothing’ scenarios we have assumed a heat efficiency of 27% for projects smaller than 25MW in size and a heat efficiency of 10% for projects equal-to-or-greater-than 25MW in size. This gives an assumed heat-to-power ratio of 1.06 for projects smaller than 25MW in size and an assumed heat-to-power ratio of 0.32 for projects equal-to-or-greater than 25MW in size.

Each of the proposals requires an increase in overall efficiency for plants equal-to-or-greater-than 25MW in size. An increase in the electrical efficiency of plants to 33% means that plants equal-to-or-greater-than 25MW in size need to achieve a heat efficiency of 37% in each of the policy options in order to meet their overall efficiency targets. These assumptions result in a heat-to-power ratio of 1.1 for plants equal-to-or-greater-than 25MW in size. As these heat-to-power ratios are greater than the heat-to-power-ratio of 0.32 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 25MW each of the options considered 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 25MW 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 for plants equal-to-or-greater-than 25MW in size. As these heat-to-power ratios are greater than the heat-to-power-ratio of 0.32 assumed in the ‘do-nothing’ scenario, we expect a higher level of heat output for plants greater-than-or-equal-to 25MW 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 25MW 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 ratios ranges are 0.9, 1.3 and 1.7 for plants smaller than 25MW. The latter two of these results in higher heat output from plants smaller than 25MW compared with the ‘do-nothing’ scenario while the first of these results in lower heat output from plants smaller than 25MW in size.

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 ratios for plants smaller than 25MW are 0.4, 0.7 and 1.0 for options requiring an overall plant efficiency of 50%, 60% and 70% respectively. Each of these heat-to-power ratios are lower than the ‘do-nothing’ scenario, resulting in lower heat output from plants smaller than 25MW in size in this variant of our analysis.

Table A6 overleaf provides a summary of the modelled change in fuel consumption and heat output by plant size for each of the policy options considered in the ‘do-something’ scenarios.

Table A6: Change in fuel consumption (MWh) and change in heat output (MWh) in each policy option 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)
1a	<25MW	0	20,000	30,000	470,000
	>=25MW	0	545,000	110,000	Less than -5,000
	Total	0	565,000	140,000	470,000
1b	<25MW	0	10,000	30,000	-10,000
	>=25MW	0	545,000	110,000	470,000
	Total	0	555,000	140,000	460,000
1c	<25MW	0	-5,000	30,000	-20,000
	>=25MW	0	545,000	110,000	470,000
	Total	0	540,000	140,000	450,000
Alternative 1	>=25MW	0	545,000	110,000	470,000
Alternative 2 (a)	<25MW	0	20,000	30,000	Less than -5,000
	>=25MW	0	545,000	110,000	470,000
	Total	0	565,000	140,000	470,000
Alternative 2 (b)	<25MW	0	10,000	30,000	-10,000
	>=25MW	0	565,000	110,000	470,000
	Total	0	575,000	140,000	460,000
Alternative 2 (c)	<25MW	0	-5,000	30,0000	-20,000
	>=25MW	0	545,000	110,000	470,000
	Total	0	540,000	140,000	450,000

Change in carbon emissions

In monetising the impact of changes in carbon emissions as a result of options proposed 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[8].

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 £40 per tonne of CO2e to around £204 per tonne of CO_2e over the appraisal lifetime. Non-traded carbon values used in our analysis range from around £68 per tonne of CO_2e to around £204 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.

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.

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

Change in resource costs to society

The proposed policy options have 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.

We have chosen not to model the impact on generators from a reduction in fuel costs and increase in heat revenue from a rise in heat and electrical efficiencies as any increase in revenue and reduction in fuel costs may be partially or fully offset by an increase in capital costs. As part of this consultation, the government welcomes evidence from stakeholders on the impact that the proposed policy options might have on capital and operating costs of plants affected by the changes.

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[9]. 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 proposed policy interventions 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[10]. The LRVC of domestic gas generation ranges from 1.7p/kWh in 2025 to 2.16p/kWh in 2049/50 in £2012 values.

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

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