Title: Proposed regulation of the sales, distribution and marketing of house coal and wet wood (>20% moisture) sold in units up to 2m^3 and limits on sulphur content of smokeless fuels **Lead department or agency:** Department for Environment, Food and Rural Affairs **Other departments or agencies:**	Impact Assessment (IA) **Date:** May 2018 **Stage: Pre-Consultation Draft IA** **Source of intervention:** Domestic **Type of measure:** Secondary legislation
Summary: Intervention and Options	**RPC Opinion: Green rating**

Cost of Preferred (or more likely) Option				
Total Net Present Value	**Business Net Present Value**	**Net cost to business per year**	**In scope of One-In, Three-Out?**	**Measure qualifies as**
£2,327m	-£30.18m	£2.6m	Out of Scope	

What is the problem under consideration? Why is government intervention necessary?
The UK is obligated under the National Emissions Ceilings Directive (NECD) to reduce emissions of particulate matter with a diameter of 2.5 micrometers or less ($PM_{2.5}$) alongside other key pollutants, to protect its citizens and environment from the resultant damage. Domestic burning of solid fuels accounts for approximately 39% of Particulate Matter (PM) emissions. Coal and wet wood emit far more $PM_{2.5}$ than low sulphur smokeless fuels or dried wood. There is a strong body of evidence linking increased mortality to long term exposure to PM. The market does not currently take into account this negative externality. Sulphur dioxide is another key pollutant under NECD and in recent years we have seen an increase in cheap high sulphur smokeless fuels on the market. The government is taking action to protect the public and the environment from the damage caused by exposure to these pollutants and to help meet its emission reduction commitments under the NECD.

What are the policy objectives and the intended effects?

- A cleaner, healthier urban and rural environment, benefiting people and the economy
- Reduce the impact on health and the environment from PM and SO_2 pollution (including increased mortality from cardiovascular and respiratory diseases and from lung cancer)
- Address the lack of information whereby consumers are un-knowingly purchasing and burning fuels which are bad for their health and the environment.
- Contribute towards achieving our 2020 and 2030 Gothenburg Protocol emissions ceilings for $PM_{2.5}$ and SO_2
- Make enforcement easier for Local Authorities by regulating at point of sale, rather than point of use

What policy options have been considered, including any alternatives to regulation? Please justify preferred option (further details in Evidence Base)
Option 0: Baseline/Do nothing approach – continue with current voluntary arrangements but introduce no further interventions. This is the baseline against which the other options are assessed
Option 1 – Voluntary approach –a government communications campaign alongside continued support for voluntary industry schemes promoting the sale of cleaner fuels.
Option 2 (preferred option) – regulating the sale, distribution and marketing of bituminous coal and wet wood (>20% moisture) sold in units up to two meters cubed and limits on sulphur content of smokeless fuels, alongside an information campaign to raise public awareness of highly polluting fuels. This delivers the best balance between realising the air quality and health benefits as soon as possible and managing the impact on households, businesses and local authorities.
Other options considered: **a) Regulating the sale of fuels in urban areas only**: approximately 50% of PM pollution comes from outside a local area, restricting legislation to urban areas would deliver less air quality benefits across the country; **b) modifying existing legislation** on smoke control areas but these do not allow for a nationwide approach **c) taxation** was felt not to deliver change at the pace needed to meet our legal obligations and **d) stove scrappage scheme** which had prohibitively high costs as compared with the proposed option.

Will the policy be reviewed? Yes **If applicable, set review date:** 12/2025						
Does implementation go beyond minimum EU requirements?			No			
Are any of these organisations in scope? If Micros not exempted set out reason in Evidence Base.	**Micro** Yes	**< 20** Yes	**Small** Yes	**Medium** Yes	**Large** Yes	
What is the CO_2 equivalent change in greenhouse gas emissions? (Million tonnes CO_2 equivalent)			**Traded:**	**Non-traded: 177**		

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 SELECT SIGNATORY: ..... Date: .....

Summary: Analysis & Evidence Policy Option 2

Description: Regulation of the sales, distribution and marketing of bituminous coal and wet wood (>20% moisture) sold in units up to 2m^3 and limits on sulphur content of smokeless fuels

FULL ECONOMIC ASSESSMENT

Price Base Year 2017	PV Base Year 2020	Time Period Years 11	Net Benefit (Present Value (PV)) (£m)		
			Low: 848	**High:** 6,289	**Best Estimate:** 2,327

COSTS (£m)	Total Transition (Constant Price)	Years	Average Annual (excl. Transition) (Constant	Total Cost (Present Value)
Low	0.0	1	49.5	466
High	0.0		50.3	473
Best Estimate	0.0		50.0	471

Description and scale of key monetised costs by 'main affected groups' There will be costs to fuel manufacturers/producers as a result of implementing Option 2. While some enforcement and administration costs will fall to the regulatory body, they will be recovered by the regulatory body from fuel manufacturers through the levy of registration charges and fuel testing fees paid by the manufacturer. The monetised costs reported comprise of the costs of getting fuels approved, monitoring, reporting and ensuring fuel manufacturers comply with the regulation. For fuel manufacturers required to comply with the regulations, the present value (PV) administration costs associated with the regulation of wet wood are estimated at approximately £12m and for regulation on the sale of bituminous coal £0.19m in our central scenario. There will be monitoring costs incurred by the regulatory body which will be passed on to businesses. These costs are estimated at £18m and £0.4m in present value terms for the wood and coal measures respectively. The switch from bituminous coal to solid smokeless fuel (SSF) will lead to an increase in non-traded CO_2 emissions at a present value cost of £11m. There may be costs to households from switching fuels, these costs will depend on the appliance in which the fuel is burned. While those households with 'modern' closed stoves which burn wood more efficiently will benefit from burning dry wood and may see a fall in their heating costs (it is cheaper and more efficient to burn dry wood in a closed stove than it is to burn wet wood), households with open stoves may experience higher costs – reflecting the higher price of dry wood relative to wet wood. Assuming a one for one switch between fuels and not adjusting for differences in appliances, we estimate household costs arising from the measure to be £423 million in present value terms. There are some costs to government accruing from an information campaign to promote safer and cleaner fuels burning habits (£2m pa for 3 years).

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

Restrictions on the sulphur content of solid smokeless fuels will have an impact on business and households. Due to a lack of data, we have not been able to quantify these impacts in this IA. Some in the industry have suggested that as much as 20% of solid fuels sold are high sulphur. This will be tested at consultation stage.

BENEFITS (£m)	Total Transition (Constant Price)	Years	Average Annual (excl. Transition) (Constant	Total Benefit (Present Value)
Low	0.0	N/A	142	1,313
High	0.0		730	6,762
Best Estimate	0.0		302	2,798

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

The proposed regulation will reduce emissions of $PM_{2.5}$ resulting in an improvement in air quality for everyone and in particular for people living in households which burn wet wood and bituminous coal. The analysis uses the UK damage cost valuation approach to estimate the benefits of reducing $PM_{2.5}$ emissions as set out in the Green Book supplementary guidance for valuing changes in air quality. We use the latest damage cost values based on advice from COMEAP. These are likely to underestimate the benefits of the proposed regulation as they do not fully capture impacts on chronic illness or the environment from air pollution. We estimate the central present value benefits from the associated reductions in $PM_{2.5}$ to be £2,798million over the appraisal period and to be significantly higher than the costs of the regulation.

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

The monetised benefits are likely to substantially underestimate the full social benefit. Reducing emissions of air pollutants will benefit natural ecosystems, biodiversity and the wider environment which cannot be monetised. The health impacts captured by the damage costs primarily set out the impact on mortality; however we know that there is also a significant societal cost arising from morbidity and environmental damage which are largely missed from the damage cost approach taken. Other secondary impacts that have not been monetised include supporting innovation in abatement equipment/green technologies. There will also be benefits to society from the reduction in other pollutants such as nitrogen dioxide and sulphur dioxide which have not been present in this impact assessment.

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

There is uncertainty around the scale of health benefits from improved air quality (damage costs) as well some uncertainty around the business costs. Due to a lack of data on high sulphur fuels, impacts related to this have not been quantified. The high NPV combines low business costs with high damage cost valuation (high benefits), and the low NPV combines high business cost with low damage cost valuation.

BUSINESS ASSESSMENT (Option 2)

Direct impact on business (Equivalent Annual) £m:			Score for Business Impact Target (qualifying provisions only) £m: Non qualifying provision
Costs 2.6	**Benefits: 0.0**	**Net: -2.6**	

Summary: Analysis & Evidence Policy Option 1

Description: Regulation of the sales, distribution and marketing of bituminous coal and wet wood (>20% moisture) sold in units up to 2m^3 and limits on sulphur content of smokeless fuels

FULL ECONOMIC ASSESSMENT

Price Base Year 2017	PV Base Year 2020	Time Period Years 11	Net Benefit (Present Value (PV)) (£m)		
			Low: 35.2	**High:** 247.1	**Best Estimate:** 97.2

COSTS (£m)	Total Transition (Constant Price)	Years	Average Annual (excl. Transition) (Constant	Total Cost (Present Value)
Low	0.0	1	2.0	19.5
High	0.0		2.0	19.7
Best Estimate	0.0		2.0	19.6

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

The monetised business costs under Option 1 pertain to those businesses which voluntarily subscribe to the Ready to Burn scheme. The scheme currently covers less than 1 percent of businesses in the market although it should be noted this includes the biggest fuel manufacturers in terms of the tonnage of domestic fuel sold on the market. The costs to business will vary should the number of businesses that choose to subscribe to the voluntary scheme. There are also costs to government from the public information campaign. We have assumed the government will set aside £2 million a year for the campaign for the first three years i.e. from 2020 to 2022.

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

No further costs to the business or household sector are anticipated under this scenario.

BENEFITS (£m)	Total Transition (Constant Price)	Years	Average Annual (excl. Transition) (Constant	Total Benefit (Present Value)
Low	0.0	N/A	5.9	54.7
High	0.0		28.8	267
Best Estimate	0.0		12.6	116.8

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

Under Option 1 the benefits of reduction in air pollution arise as a result of a fall in the consumption of wet wood and bituminous coal as a result of the communications campaign. We use the UK damage cost valuation approach to estimate the benefits of reducing $PM_{2.5}$ emissions as set out in the Green Book supplementary guidance for valuing changes in air quality and have assumed the communication campaign results in a 2 percent reduction in the tonnage of wet wood which is purchased and burned wet and the burning of bituminous coal relative to solid smokeless fuel coal. We estimate the central present value benefits from the associated reductions in $PM_{2.5}$ to be 117million in present value terms.

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

The monetised benefits are likely to substantially underestimate the full social benefit. Reducing emissions of air pollutants will benefit natural ecosystems, biodiversity and the wider environment which cannot be monetised. The health impacts captured by the damage costs primarily set out the impact on mortality; however we know that there is also a significant societal cost arising from morbidity and environmental damage which are largely missed from the damage cost approach taken. Other secondary impacts that have not been monetised include supporting innovation in abatement equipment/green technologies. There will also be benefits to society from the reduction in other pollutants such as nitrogen dioxide and sulphur dioxide which have not been present in this impact assessment.

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

Low and high benefits represent the uncertainty in health benefits from improved air quality (damage costs). The high NPV combines low business costs with high damage cost valuation (high benefits), and the low NPV combines high business cost with low damage cost valuation.

BUSINESS ASSESSMENT (Option 1)

Direct impact on business (Equivalent Annual) £m:			Score for Business Impact Target (qualifying provisions only) £m: Non qualifying provision
Costs 0.0	**Benefits: 0.0**	**Net: 0.0**	

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1. Executive summary

Poor air quality is a significant environmental risk to human health and causes long-lasting harm to the natural environment.

Long term exposure to poor air quality reduces life-expectancy through increased risk of mortality from cardiovascular and respiratory illnesses and from lung cancer. Short-term exposure to poor air quality carries a morbidity burden over a wide range of cardiorespiratory health conditions.[1] It can cause harm to the natural environment resulting in reductions in yields of key food crops caused by ozone damage and changes to delicate nutrient balances causing some aspects of the ecosystem to thrive at the detriment of others.[2]

The Government is firmly committed to improving air quality and reducing harmful emissions. In recognition of the damage caused by air pollution, the UK has signed up to the National Emissions Ceilings Directive (NECD) which has been transposed into UK law. The NECD sets ceilings on total national emissions of five key air pollutants i.e. nitrogen oxides (NO_x), sulphur dioxide (SO_2), particulate matter ($PM_{2.5}$), non-methane volatile organic compounds (NMVOC) and ammonia (NH_3) for 2020 and emission reduction commitments (ERCs) for the same pollutants for 2030. The reductions are set relative to emissions in 2005, the baseline year. The UK is meeting its current NECD targets and has done since the ceilings were first introduced in 2010.

According to the latest 2016 National Atmospheric Emissions Inventory (NAEI) projections, the government is set to miss its legally binding targets for $PM_{2.5}$ for 2030 by 30.7 kilotonnes if no further action is taken. It is therefore imperative that government takes action to reduce emissions. There are many sources of $PM_{2.5}$ emissions including transport and industry, however whilst emissions from these sources have reduced, the emissions from domestic burning are increasing and now account for the largest single contributing source. The proposed intervention will make a significant contribution towards our legal obligations.

Based on the NAEI, domestic burning of solid fuels accounts for approximately 39% of $PM_{2.5}$ emissions. Emissions from domestic burning can be reduced by improving the installation and maintenance of stoves, by upgrading the appliance e.g. from an open fire to a stove or by burning cleaner fuels. Government has assessed all these options in discussion with stakeholders and considers that taking action on fuels is one of the most expedient and cost effective approaches to reducing $PM_{2.5}$ emissions.

Whilst $PM_{2.5}$ is our primary target pollutant it is essential that any intervention does not shift consumers to another equally polluting fuel. Stakeholders have flagged that in recent years we have seen an increase in cheap high sulphur smokeless fuels on the market. SO_2 is also harmful to health and appliances and a target pollutant under the NECD. As such government will consider applying sulphur standards to these fuels. Due to a lack of data on fuel sales this intervention has not been quantified in this impact assessment and information will be sought in the consultation process. Its restriction would result in the removal of very low cost smokeless fuels from the market and therefore have costs to businesses and households. However, there will be benefits from their removal in terms of improved health as well as reduced maintenance costs for stoves and chimneys which we would expect to outweigh the costs. Further data will be collected at consultation to enable us to quantify the costs and benefits from reductions in both $PM_{2.5}$ and SO_2 in the final IA.

[1] COMEAP (2010) The Mortality Effects of Long-Term Exposure to Particulate Air Pollution in the United Kingdom. Committee on the Medical Effects of Air Pollutants. Available from: https://www.gov.uk/government/publications/comeap-mortality-effects-of-long-term-exposure-tohttps://www.gov.uk/government/publications/comeap-mortality-effects-of-long-term-exposure-to-particulate-air-pollution-in-the-ukparticulate-air-pollution-in-the-uk

[2] RoTAP (2012) Review of Transboundary Air Pollution: Acidification, Eutrophication, Ground Level Ozone and Heavy Metals in the UK. Contract Report to the Department for Environment, Food and Rural Affairs. Centre for Ecology & Hydrology.

[3] For NOx, SO2, $PM_{2.5}$ and NMVOC, the implied emission reduction quoted in this table are reductions *in addition* to the 2030 BAU emissions level as contained in the EEP2015-NAEI (2014) emissions projections. For NH3, the implied emission reduction is *in addition* to the 2030 BAU emissions level as contained in NAEI (2015).

This impact assessment considers various options to shift consumers towards burning cleaner fuels in their homes. It sets out the government's assessment of the impacts associated with restrictions on the sale of wet wood in volumes/packaging of 2 metres cubed or less (volumes that are likely to be purchased wet and burned wet at home) and bituminous coal/solid fuels with a high sulphur content. Due to data limitations we have not analysed the impacts of introducing regulation on the sulphur content of fuels which would likely have an impact on businesses and households. As such we are likely to underestimate the benefits and costs associated with the regulation.

We will be collecting information on the sulphur content of solid smokeless fuels at the consultation stage to inform the policy analysis, some in industry suggest that as much as 20% of solid fuels sold are high sulphur. Legislation on sulphur content will be necessary to avoid unintended consequences of consumers switching to another highly polluting fuel. Given that high sulphur fuels destroy fire grates and chimneys we expect that, over the long term, buying these cheaper fuels is not cost beneficial for consumers. This assumption will be analysed in the final IA.

A range of options were considered for this analysis as set out in section 5. The two main options focused on were:

- **Option 1:** A communications campaign targeted at raising the public's awareness of the negative health and environmental impacts of burning wet wood, bituminous coal and high sulphur smokeless fuels alongside continued support for voluntary industry schemes promoting the sale of cleaner fuels. We estimate the communications campaign to result in a 2% reduction a year in the tonnage of bituminous coal which is burned relative to solid smokeless fuel and the tonnage wet wood purchased which is burned wet relative to dry wood. This impact is likely to be an underestimate as we believe public awareness of the damage caused by burning polluting fuels is low.

- **Option 2:** Regulating the sale of wet wood, bituminous coal and solid smokeless fuels with a high sulphur content, coupled with an awareness raising campaign.

The analysis reveals the largest reductions in emissions are achieved under Option 2. We estimate that restrictions on the sale of wet wood (only) to abate 56 kilo tonnes (kt) of $PM_{2.5}$ emissions between 2020 and 2030 and the restrictions on the sale of bituminous coal (only) to abate 12kt of $PM_{2.5}$ under Option 2. Approximately 2.84kt of $PM_{2.5}$ emissions are abated from both wood and coal under Option 1.

The proposed regulation will contribute to government meeting its 2030 NECD Emission Reduction Commitments (ERCs) through the abatement of approximately 6kt of $PM_{2.5}$ (Option 2) and 0.25kt (Option 1) in the year 2030 relative to the baseline i.e. the do nothing scenario. The regulation will also result in emissions reductions for other pollutants such as SO_2 and NO_x. These reductions are not presented in this analysis due to (I) the uncertainty in their emission factors particularly pertaining to wet wood and bituminous coal and (II) the significantly lower levels of abatement achieved relative to $PM_{2.5}$ from switching fuels.

Reducing air pollution yields benefits in terms of improvements to public health and healthier eco-systems. The resultant benefits are associated with the improvements in air quality from the reduction in $PM_{2.5,}$ emissions are estimated using the damage cost approach as recommended under the Green Book supplementary guidance for valuing changes in air quality.[4] This approach consists of multiplying the total reduction in the emissions of a pollutant by the associated damage cost. We use the latest available damage costs figures, accounting for the most recent recommendations of the Committee on the Medical Effects of Air Pollutants (COMEAP) to estimate the benefits.

[4] The damage costs mainly reflect the mortality effects of air pollution and some of its impacts on morbidity, ecosystems and productivity.. We damage costs will be updated this year to reflect a greater number of health impacts.

The benefits accruing from a reduction in $PM_{2.5}$ under the proposed regulation range are estimate to range from £1,313 million in the low scenario to £6,762 million in the high scenario over the period 2020 to 2030. Three sets of damage costs values are used to develop high, central and low scenarios. The variation in the damage costs reflects uncertainty in the evidence about the lag between exposure and the associated health impacts. We use higher damage costs where the lag between exposure and the health impacts is assumed to be shortest. The damage costs do not fully account for the health impacts and the environmental damage that arises from pollution and therefore likely to underestimate the benefits to society from reducing pollution.

There are costs linked to the proposed regulation. Both dry wood and low sulphur solid smokeless fuel (SSF) are more expensive on an energy adjusted basis relative to wet wood and bituminous coal. Assuming a direct substitution, there will be costs incurred to households from switching fuels. However, these costs vary considerably between households depending upon the appliance used and the fuel type. Households with modern efficient stoves will benefit from efficiency gains (dry wood burns better than wet wood in modern stoves) which outweighs the increase in price while for those with open stoves may see their fuel costs increase from switching to a more expensive fuel. There are also costs associated with the monitoring of the scheme. The cost to fuel manufacturers from the regulation are primarily associated with monitoring and enforcement. We estimate the likely costs to industry from the regulation using data from the 'Ready to burn' scheme, a voluntary industry scheme supported by government which promotes the sale of dry wood. In all three scenarios, we find the benefits arising from the implementation of the measures to significantly outweigh the costs for the preferred option.

Table 1: Present value costs and benefits of Option 2 (£m, discounted)

	Low scenario	High scenario	Central scenario
Costs to regulatory body and fuel suppliers			
Monitoring and administration costs[5]	25	33	30
CO2e non-traded	11	11	11
Household costs	423	423	423
Government costs	6.3	6.3	6.3
Total costs	466	473	471
Benefits from emission reductions			
Air quality pollutants	1,313	6,762	2,798
NPV	**848**	**6289**	**2327**

2. Problem under consideration

Many everyday activities essential for supporting lives and livelihoods can cause air pollution. Particulate matter emitted from the burning of domestic fuels such as wood enters the bloodstream and has been found in internal organs resulting in long term damage to human health as well as having more immediate impacts for some people such as breathing problems or asthma attacks. The UK has made a commitment under the NECD to reduce emissions of five key pollutants including $PM_{2.5}$, with the goal of halving negative health impacts from air pollution.

Domestic burning is the single largest source of harmful $PM_{2.5}$ emissions in the UK, accounting for 39%[6] of the total emissions in 2016. This compares with industrial combustion and road transport which account for (16%) and (12%) $PM_{2.5}$ emissions respectively. The restoration of open fires and installations

[5] Monitoring costs are the costs incurred by the regulatory body in monitoring fuel manufacturers to ensure that they comply with the proposed regulation. These costs will be passed to fuel manufacturers in the form of registration and fuel testing charges.

[6] 39% is based upon the calculations in the National Atmospheric Emissions Inventory for 2016, which is the most recent year available. This data is uncertain given the difficulties in accurately estimating the extent and nature of domestic burning, however it is the best available evidence and is informed by a wide range of data sources, including data from BEIS and the stove and wood fuel industries. Of the 39% approximately 34% is domestic wood. http://naei.beis.gov.uk/data/

of wood-burning stoves has risen in popularity in recent years.[7] They are now an additional form of heating for many households; for a minority they may be the sole heat source. This has seen a significant increase in the amount of wood burned domestically. In contrast the burning of coal and smokeless fuels for domestic heating remains in decline and is projected to continue declining.

The Clean Air Act 1993 gave local authorities (LAs) the power to declare smoke control areas (SCAs) where it is illegal to emit dark smoke emissions from domestic or industrial chimneys unless you are burning authorised fuels or using exempt appliances. It also regulates the sulphur content of solid smokeless fuels which can be burned in smoke control areas to 2% sulphur. The legislation, designed in the 1950s when most fuel was delivered by coal merchants, restricted what fuels could be delivered to addresses within SCAs. While this worked well at the time, the domestic fuel landscape has changed since then and today most fuel is purchased through shops, making it difficult to enforce SCAs as the retailer does not know where the fuel will be burned and therefore whether they can legally sell it. This leaves LAs with the difficult challenge of enforcement at point of use. The preferred option addresses these limitations to deliver greater health benefits and emissions reductions by:

- Regulating harmful fuels at point of sale at a national level.
- Increasing the effectiveness of smoke-control areas.

While domestic burning and other emissions have reduced significantly since the 1950s, the evidence on the adverse health impacts from air pollution has also grown during that time, showing that even at today's lower levels significant harm can be caused. We also have a better understanding of how pollution travels through the atmosphere and the negative externalities from air pollution. Given the negative impacts of burning wet wood and the limitations of SCAs, further action on domestic burning is required if the government is to meet its commitments. There are a number of manufactured solid fuels which are not authorised for use in SCAs, where the sulphur content can be significantly higher (in some cases up to 6%). In general these products use high sulphur petroleum coke as their base material which not only contains high sulphur but also other harmful metals such as vanadium and nickel. There is no requirement to label products with their sulphur content therefore consumers find it hard to identify these when purchasing fuel. High sulphur content fuels are harmful to human health and the environment. In addition they can also cause damage to stoves and chimneys due to the high concentrations of sulphuric acid produced when they are burned.

The government wishes to ensure that regulation on one fuel such as bituminous coal will not lead to consumers switching to another low cost polluting fuel. To mitigate this risk government will consider applying sulphur standards to smokeless fuels and test this proposal at consultation. This intervention will also protect consumers from purchasing fuels that are harmful to both their health and their stoves and chimneys. As highlighted above, we do not have sufficient data to quantify this intervention at this stage.

The preferred option considers restrictions on the sale, distribution and marketing of the most polluting fuels including:

- Restriction on the sale of bituminous coal (purchased in any volume/weight) and wet wood (purchased in volumes up to two metres cubed – this is a pallet packaged two metres high or a large 'dumpy' bag) and limits on the sulphur content of smokeless fuels (although these have not been quantified at this stage due to a lack of data).

In setting an upper limit for the legislation on wood our objective was to set it high enough to avoid people buying in larger volumes to avoid the legislation, but still allowing people with space to purchase cheaper wet wood and season it at home. Our target is wood sold in bags through retailers, however in order to avoid retailers and consumers circumventing the regulation by selling in larger quantities we consulted with wood suppliers and through our Call for Evidence on a sensible limit. Responses from

[7] HETAS the industry oversight body that approves appliances and fuels advised us that stove registrations increase 10 fold between 2004 and 2014 from 12,000 to 130,000, whilst this doesn't capture the entire market it does capture a sense of the scale of the increase. This has plateaued at 2014 but remains in the order of 100,000s.

the Call for Evidence were mixed with a third supporting a $2m^3$ limit but almost half suggesting that all wood wet wood should banned from sale. Our direct consultation with the main wood suppliers also suggested a $2m^3$ limit. This will be further reviewed at the consultation stage, our concern with a ban on all wet wood is that it would not be proportionate as it represents a cheaper and perfectly sensible option for those people who have the space to season wood themselves. It could also lead to unintended consequences of an increase in foraging or burning waste.

3. Rationale for intervention

Air pollution is the classic negative externality. It imposes costs on people who are external to the transaction (in this instance the sale and purchasing of fuel). Without government intervention the market will not correct for the costs incurred by third parties from the purchasing and burning of fuels which are highly pollutant. Regulating the sale of these fuels has health benefits for those households burning these fuels as well as for the communities in which they live. The proposed regulation would be implemented in conjunction with an information campaign to raise awareness of the health impacts associated with burning the specified fuels. At present labelling on solid fuels is confusing making it difficult for consumers to assess which fuels are less polluting and more efficient.

From the Call for Evidence, fuel retailers have indicated they have limited capacity to engage with another voluntary initiative, emphasizing that a regulatory approach is required to deliver a level playing field and the required change at scale. Large suppliers have also indicated a preference for legislation to deliver the speed and scale of change needed.

The restrictions will deliver on Defra's wider objective for a cleaner, healthier environment, benefiting people and the economy and contribute to government achieving its 2030 NECD emission reduction commitments.

4. Policy objectives

The overarching policy objective of the proposed regulation is to reduce emissions of pollutants emitted from burning of solid fuels for domestic burning purposes. At present many consumers are unaware of the impact on both their health and air quality from burning these fuels. Over the longer term the objective is to shift consumers away from burning the most polluting of fuels in the home towards cleaner forms of heating. Table 2 sets out the main solid fuels burned in homes and their estimated corresponding $PM_{2.5}$ emissions in grams per tonne of fuel consumed.

Table 2: The main solid fuels burned in the home. More detail on the uncertainties associated with these figures can be found in Section 8.

Fuel	Description	$PM_{2.5}$ emissions in grams per tonne of fuel consumed[8] **Note:** *significant uncertainty around these figures although they represent current best evidence*
House coal (or bituminous coal)	A naturally occurring mined product. $PM_{2.5}$ emissions are higher per unit energy than from smokeless fuels.	9.14
Smokeless coal (or anthracite)	A form of naturally occurring, mined, high-purity coal, authorised for use in smoke control areas	1.84
Manufactured solid fuels	Fuels manufactured from coal products with other ingredients that have low smoke emissions, however some do have high SO_2 emissions	1.60
Wet wood	A naturally occurring product. Newly felled wood has a high moisture content and creates a lot of smoke when burned, it has over double the emissions of seasoned or kiln dried wood.	30.28
Seasoned wood	wood that has been left for up to 2 years to naturally air dry	7.58
Kiln dried wood	wood that has been kiln dried to below 20% moisture	

The policy will need to particularly consider any impact on consumers:

- Who have the capacity to dry wood in bulk before burning it; or
- Have no access to other forms of domestic heating;
- Are fuel poor for whom wet wood or bituminous coal are the cheapest source of heating

The government seeks to regulate the sale of smaller quantities of wood (more likely to be used immediately) i.e. wood sold in bags of less than 2 metres cubed, to ensure that people are not inadvertently burning wet wood while also allowing scope for consumers who have the capacity to purchase wet wood and dry it to continue to do so. The government will consult on the distributional impacts of the proposed regulation and on the impact of regulating the sale of wet wood in volumes of two meters cubed or less with a view to fully understanding any unintended consequences.

The regulation should result in improvements in public health; long term exposure to $PM_{2.5}$ even at relatively low concentrations can shorten life expectancy, especially for people who are vulnerable to the effects of pollution due to existing respiratory and heart conditions. The Committee for the Medical Effects of Air Pollutants (COMEAP) has estimated that the burden of anthropogenic air pollution in the UK had a mortality impact equivalent to 29,000 deaths in 2008. The burden can also be represented as an average loss of life expectancy from birth of approximately six months.

Evidence from a similar approach in Ireland on coal (but not wood) found that the restrictions on bituminous coal led to a significant reduction in respiratory problems and premature deaths from the effects of burning smoky coal in the existing 'Low Smoke Zones'. The original restrictions in Dublin are widely cited as a successful policy intervention. It is estimated that in the region of 10,000 premature mortalities have been averted in Dublin since the introduction of the smoky coal ban back in 1990.

[8] Source for all emission factors, except wet wood: EMEP/EEA air pollutant emission inventory guidebook 2016. Source for wet wood: preliminary study carried out by the University of Leeds and the University of Manchester.

5. Policy options considered

This section reviews all the policy options that have been considered and explains the rationale for selecting the most viable options for a full cost-benefit analysis. The policy development process has drawn on advice from industry representatives and wider stakeholders through a Call for Evidence. The proposed measures are for England and not the UK as air quality policy is devolved. This is likely to mean that implementation of the regulation in the localities in England that border Scotland or Wales may be weaker if there is asymmetry in regulation between the home countries.

Stakeholder engagement

The government issued 'A Call for Evidence' in January 2018. The purpose of this was to signal government thinking and seek further evidence and input from both businesses and consumers who might be impacted by any potential policy interventions. We received over 300 responses from a broad range of stakeholders including those with health impacts as a result of others' burning, from householders, LAs, chimney sweeps, appliance retailers, fuel retailers, wood and coal suppliers and others. This also showed a distinction between urban and rural burning practices, a north/south split and differences between affluent (secondary burn) and low income (primary heating) sectors. These findings have been analysed and fed into the proposals of this IA. Stakeholder meetings have also been held with wood and coal suppliers, coal merchants, HETAS[9], Woodsure and the Stove Industry Alliance[10].

Policy options

5.1 Option 0 (Baseline): Do nothing more.

The baseline option maintains the existing Ready to Burn voluntary approach with industry on wood to shift consumers from burning wet wood to dry wood. There is no regulation on the sale of fuels or government action to promote the sale of cleaner fuels.

5.2 Option 1: A voluntary approach promoting the sale of cleaner fuels

This option maintains the Ready to Burn scheme. In addition government promotes the burning of cleaner fuels through a publicity campaign to deliver maximum behaviour change and engages with retailers and suppliers to consider a similar voluntary code on coal and high sulphur smokeless fuels to increase awareness. We will work with LAs to increase compliance in existing smoke control areas.[11]

5.3 Option 2: Regulating the sale of fuels for domestic heating.

Option 2 considers the impact of legislation to phase out the sale, distribution and marketing of bituminous coal (sold in any volume) and wet wood (>20% moisture) sold in units up to two meters cubed or less alongside an information campaign to raise public awareness of highly polluting fuels and limits on the sulphur content of smokeless fuels. The regulation would apply to fuel manufacturers and would be implemented through an industry led certification scheme similar to the Ready to Burn scheme. Under this option retailers are given a transition period of one year to use up existing stocks. The government will consider during the consultation stage whether a longer transition for coal might be appropriate. For the purposes of this IA, a one year transition period is assumed for both fuels.

[9] HETAS is the industry oversight body that approves appliances and fuels

[10] Stove Industry Alliance is an association of stove manufacturers, distributors representing the stove industry with government.

[11] Voluntary approaches for coal and smokeless fuels have not yet been tested however some in the industry feel that, as with wood, unless the entire market follows the same rules then there would always be those who chose not to.

5.4 **Other options considered but not quantified:**

Regulation as with option 2 limited to urban areas only

Due to the population density, air quality is a bigger concern in urban areas in terms of health impacts and population exposure. For this reason the benefits are higher for measures that focus on urban areas. We sought evidence from Ireland where a coal ban has been implemented solely in urban areas. Ireland has now extended the restrictions nationwide due to significant problems with people travelling outside the area of the ban to purchase fuel, hereby weakening the impact of the legislation and making it much harder to enforce. It should also be noted particulate matter moves and as such rural emissions can still travel to urban areas; approximately 50% of $PM_{2.5}$ pollution is transboundary (i.e. from outside a local area).

Restricting the regulation to urban areas would deliver less air quality benefits across the country. There were mixed views in the Call for Evidence on this subject with some respondents for a nationwide approach and others against. Many rural residents highlighted that nuisance burning is not just an urban issue.

Existing legislation on smoke control areas

Anecdotal evidence would suggest that awareness of and compliance with smoke control area legislation in these areas is low and that many perceive the problem of domestic burning to no longer be an issue with regards to pollution.

Revising and updating this current legislation was considered as an option. As an immediate step Defra is supporting Local Authorities to raise awareness of SCAs and the impacts of domestic burning to improve compliance where they already exist[12]. Some LAs are considering extending their existing areas. However it was concluded that action would have a faster more widespread impact through a nationwide approach similar to that taken in Ireland using secondary legislation. If unchanged SCAs do provide some benefit however enforcement at the household level is difficult and LA officers must provide evidence of the offence which is often very hard to capture as such this did not meet our objective of making enforcement easier for Local Authorities.

Taxation

A further option considered was taxation rather than regulation to shift consumers towards cleaner fuels. Given the substantial health benefits from the proposed regulation, and the easy substitution with less polluting fuels, it was felt that taxation would not take us far enough or quickly enough to meet our legal requirements.

Stove scrappage scheme

The emissions from domestic burning are influenced by three factors, the fuel used, the appliance and its installation, and the user. The focus of this intervention is on fuels. Government also considered a stove scrappage scheme however whilst this could deliver good emissions benefits as compared with open fires or old stoves, the cost of replacing stoves is in excess of £2,000 per household making the costs significantly higher than taking action on fuels. The benefits of proper installation, regular maintenance and modern efficient appliances will be promoted as part of any communications campaign.

6. Methodology

The following section sets out the methodology used to assess the impacts of implementing legislation on the sale of wet wood and bituminous coal. The impacts are split into the categories summarised

[12] Defra has produced this guide for all Local Authorities to distribute to households https://uk-air.defra.gov.uk/assets/documents/reports/cat07/1712041200_171010_open_fires_wood_burning_stoves_FINAL.pdf

below, which are detailed fully in the remainder of this section. We assess the impact of the proposed legislation over 11 years commencing from 2020 when the regulation is intended to come into effect and the first costs related to it incurred. The benefits are estimated over the same period although they would last beyond the 11 years. The impacts are assessed based on information collected through discussions with industry and information from the Call for Evidence published in January 2018. The following impacts are considered:

- **Household costs:** these are costs incurred by households that switch from purchasing and burning wet wood to dry wood and from bituminous coal to solid smokeless fuel.

- **Monitoring and compliance costs:** these are costs incurred by the regulatory body in enforcing the regulation. These costs will cover the costs of regular inspections and testing of fuels to ensure the fuels sold on the market are compliant with the required standards. The incurred monitoring and compliance will ultimately be passed onto fuel manufacturers through fuel testing charges and annual registration fees to ensure that the monitoring scheme is sustainable. The costs to the manufacturers are likely to be passed onto consumers through higher prices.

- **Administrative costs:** these are costs incurred by the fuel manufacturer as part of the inspection. They typically represent the cost of the time spent by the manufacturer's quality control manager with the regulatory body assessing the fuel production and quality control records – including analysing the fuel mix and its content. These costs will be incurred by all manufacturers that sell wood or coal as a fuel for domestic heating.

- **Carbon costs**: these reflect the increase in carbon emissions, valued according to Green Book guidance

- **Capital costs:** these will be the costs to manufacturers from no longer being able to sell wet wood (which is cheaper to produce than dry wood). Some fuel manufacturers may need to purchase drying kilns or covered space for seasoning so as to be able to dry out their wood and make it fit for sale. These costs are not analysed in the IA due to information constraints. We'll collect evidence at the consultation stage on the likely compliance costs to fuel manufacturers from the proposed regulation.

- **Information campaign:** these are government costs related to a public campaign aimed at increasing the public awareness of the damage caused by highly polluting fuels.

Benefits to the environment and human health

- **Monetised Benefits:** the regulation will result in health benefits from the reduction in $PM_{2.5}$ emissions for not just the households burning cleaner fuels, but to wider society reflecting the lower levels of pollutants emitted.

- **Non-monetised benefits:** we have not monetised the benefits that arise from a reduction in emissions of other pollutants such NO_x and SO_2. The $PM_{2.5}$ damage costs used do not fully capture some morbidity impacts (such as asthma, diabetes, lung cancer and chronic heart diseases) and wider damage to the ecosystem e.g. increased acidification and eutrophication of soils.

The benefits of the proposed regulation are estimated as the reduction in emissions from the implementation of the regulation relative to the baseline, defined as the business as usual case without any government intervention. The baseline emissions for both fuels are outlined in section 6 below.

For wood we assume that compliance amongst the large suppliers will be good as it is building upon the existing voluntary Ready to Burn scheme which 60% of large suppliers (accounting for approximately 11% of market sales) have already signed up to. However there are also 1000s of small disparate wood suppliers for whom changing their business may be more difficult and against whom enforcement will be harder. As such we have assumed compliance rates of 40% in 2020, rising to 60% by 2022. This is to reflect the more varied and informal sources through which consumers can acquire wood fuel. For coal we have assumed full compliance due to the small number of large suppliers.

6.1 Projected estimates of coal and wood consumption

Baseline

Option 0: The baseline option represents business as usual approach. In this scenario government works with industry on voluntary initiatives, which promote the sale of dry wood through the Ready to Burn certification scheme.

Estimated baseline (wood)

The options assessed in this document are aimed at regulating the sale of wet wood that is purchased rather than wood that is sourced through informal channels. The BEIS survey estimated that as much as 50% of wood burned is sourced via informal routes[13]. Whilst the primary focus of the proposed legislation is on the sale of wood, we expect that the accompanying communications campaign will have a "collateral benefit" on those who obtain wet wood through other channels, who are likely to be exposed to our messaging. We do not have sufficient data to analyse this effect and so it is likely that the benefits from the proposed policy may be larger than estimated in this impact assessment.

2030 wood baseline projection

The baseline wood projection is based on growth rates of projected wood burning activity taken from the NAEI, which reports annual estimates of pollutants emitted based on the Digest of UK Energy Statistics 2017 (DUKES), produced by (BEIS) and the Energy and Emissions Projections (EEP), which projects future energy use and greenhouse gas emissions in the UK.

The projected tonnage of wet wood consumed is estimated by applying growth rates from scaling the historic NAEI wood consumption data using a trend drawn from the EEP 2015 activity data to the aforementioned derived estimate of wet wood burned.[14] Using this methodology we estimate the total tonnage of wet wood purchased and burned wet for domestic heating purposes to rise from 374,651 tonnes in 2020 to 385,805 tonnes by 2030 in the absence of any government intervention.

Estimated baseline (coal)

The estimated baseline for coal burned is based on outturn data of domestic coal consumed under DUKES. The outturn data is scaled for England. DUKES estimates the domestic use of coal based on reported deliveries to merchants. The data reveals domestic consumption of coal in England declined by 10% between 2005 and 2016 falling from, 485,133 tonnes to 434,208 tonnes over the period. These estimates include coal which is supplied free of charge through the National Concessionary Fuel Scheme estimated at 35,000 tonnes 2016.

2030 coal baseline projection

The methodology used to estimate the baseline projection of bituminous coal burned by the domestic sector is similar to that used above for the '2030 wood burning baseline projection'. We use data on coal burning activity taken from the NAEI, itself based on DUKES, and estimated emission projections as reported in the EEP 2015. Table 3 reports the projected tonnages of wet wood and bituminous coal that is purchased and burned for domestic heating between 2020 and 2030. The tonnage of wet wood burned is projected to rise while the tonnage of coal burned for domestic heating purposes is projected to decline in line with a fall in the use of coal for energy generation both between the household and industrial sector.

[13] https://www.gov.uk/government/publications/summary-results-of-the-domestic-wood-use-survey

[14] The EEP does not have a specific field for solid smokeless fuel or wood. We have used 'Other Solid Fuel' as a proxy for SSF and 'Biofuels' as a proxy for Wood.

Table 3: Projected tonnages (000s) of purchased wet wood and coal burned in England (2019 – 2030)

	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Tonnage projections baseline											
wood	374.65	376.33	378.01	379.69	381.38	383.06	383.61	384.16	384.71	385.26	385.81
Coal	257.92	230.58	203.24	175.90	148.56	121.22	112.36	103.50	94.64	85.78	76.92
Tonnage projections voluntary approach with communications campaign (Option 1)											
wood	367.16	368.81	370.45	372.10	373.75	375.39	375.93	376.47	377.01	377.55	378.09
Coal	252.76	225.97	199.18	172.38	145.59	118.79	110.11	101.43	92.74	84.06	75.38
Tonnage projections regulatory approach with communications campaign (Option 2)											
Wood	220.29	184.40	148.18	148.84	149.50	150.16	150.37	150.59	150.80	151.02	151.24
Coal	-	-	-	-	-	-	-	-	-	-	-

Communications campaign

Under both option 1 and 2, we adjust the baseline for the impact of the communications campaign. The campaign is intended to raise the public's awareness of the health and environmental impacts of burning the most polluting fuels. Its impact will depend on the existing level of public awareness as to the damage caused by burning polluting fuels. If public awareness is high and consumers still to choose to burn polluting fuels, then a communications campaign is unlikely to result in any behavioural change. However, if public awareness is low, there is scope for such a campaign to have an impact. Initial evidence on public awareness as to how harmful burning wet wood/bituminous coal and high sulphur fuels is to human health and the environment suggests that awareness is low. In the absence of robust information, we assume a conservative 2% reduction a year in the tonnage of wet wood which is purchased and burned wet. We assume those consumers/households who change their consumption habits in response to the campaign do not switch back to consuming highly polluting fuels after the campaign. The Ready to Burn scheme is collecting data from suppliers to assess the level of change as a result of this campaign. Whilst this is not yet available it should be in time to inform assumptions in the final IA.

Emission calculations

We use emission factors to estimate $PM_{2.5}$ emissions emitted from burning the fuels under analysis. The emission factors are applied to fuel burning activity to estimate the emissions emitted from burning fuel. We use emission factors used in the NAEI which are primarily taken from the EMEP/EEA[15] guidebook that contains internationally-agreed upon emission factors for a wide range of activities and pollutants. It contains emission factors for wood, coal and solid smokeless fuel but not for wet wood. To estimate the emissions from burning wet wood, we have used emission factors which were experimentally determined by a joint study by the University of Leeds and the University of Manchester. The research team burned wood in a representative stove and undertook a wide range of measurements on the emissions. We have used the emission factors calculated from the experiments as an indicative estimate of the emission factor for burning wet wood. The uncertainties associated with emission factors are explored in greater detail in Section 8, below.

Table 4 below sets out estimated $PM_{2.5}$ emissions arising from burning purchased wet wood and bituminous coal for domestic heating purposes over the projected period under the different scenarios.

[15] EMEP: European Monitoring and Evaluation Programme, a body of the Convention on Long-Range Transboundary Air Pollution. EEA: European Environment Agency, a European Union body.

Table 4: Emission projections in kilo tonnes of $PM_{2.5}$ related to burning of wet wood that is purchased and bituminous coal; England 2020-2030.

	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Emission projections baseline											
Wood	11.34	11.39	11.44	11.50	11.55	11.60	11.61	11.63	11.65	11.66	11.68
Coal	2.36	2.11	1.86	1.61	1.36	1.11	1.03	0.95	0.86	0.78	0.70
Emission projections voluntary approach with communications campaign (Option 1)											
Wood	11.12	11.17	11.22	11.27	11.32	11.37	11.38	11.40	11.41	11.43	11.45
Coal	2.31	2.06	1.82	1.57	1.33	1.09	1.01	0.93	0.85	0.77	0.69
Emission projections regulatory approach with communications campaign (Option 2)											
Wood	7.78	6.98	6.17	6.20	6.23	6.25	6.26	6.27	6.28	6.29	6.30
Coal[16]	0.41	0.37	0.33	0.28	0.24	0.19	0.18	0.17	0.15	0.14	0.12

6.2 Household costs

The Call for Evidence highlighted a significant correlation in the type of fuels burned and the socio economic status of consumers. The household impacts arising from a switch in fuels will vary considerably depending upon the appliance used and the fuel type, for some households it may be cost beneficial for some households – modern eco stoves burn dry wood more efficiently than wet wood, an improvement in efficiency that outweighs the higher price of dry relative to wet – whilst some households will experience an increase in their heating costs reflecting the switch to more expensive fuel.

Based on data from the Call for Evidence, we find the price of dry wood to be 3% more expensive on an energy density basis than wet wood. Solid smokeless fuels is also assessed to be more expensive to burn on an energy density basis relative to bituminous coal. Introducing the regulation will result in consumers either switching to dry wood (which is more expensive) or turning to informal routes to source their fuel. Price sensitive consumers who are not willing to pay the price increase we assume will source their fuel from the informal market.

We have assumed that all consumers who comply with the regulation will substitute to the cleaner fuel under consideration and not alternative fuels e.g. electricity. Based on this we estimate the costs to the household sector of £423 million in present value terms over the period and find these costs to be lower than the monetised benefits in all three scenarios.[17] We assume full compliance with the regulation for coal given the limited number of fuel suppliers, but a lower compliance rate of 40% in 2020 rising to 60% by 2023 for wood given the high number of small suppliers which will make it harder to enforce. Notwithstanding we have developed sensitivities around the compliance rate to model various impacts. A 10 percentage point reduction in the compliance rate assumed in each year between 2020 and 2023, lowers the estimated benefits by approximately £109 million over the period and vice versa.

6.3 Monitoring and compliance costs

The costs to business of restrictions on the sale of wet wood and coal are associated with monitoring and enforcement of these measures. The costs are estimated based on the 'Ready to burn' scheme, a voluntary industry scheme supported by government which promotes the sale of dry wood and cleaner solid fuels. The scheme, introduced in September 2017 is still in its infancy and is operated by Woodsure, a not-for-profit organisation. The costs associated with the scheme include an annual registration fee to cover the cost of inspection and fees for testing new fuels. We have been provided with data by Woodsure on the fee structure, the operational costs of the scheme and the likely size of the market. The costs have been scaled up in central and upper scenario to avoid any underestimation of the likely costs to business as the scheme is still in its infancy and does not cover the full market. The low scenario takes the cost estimates provided by Woodsure, the central scenario inflates the Woodsure

[16] The emissions related to coal under option 2, reflect the switch from bituminous coal to solid smokeless fuel.

[17] We estimate this cost household by switching tonnage of wet wood burned to dry wood adjusted for a compliance rate and multiplying it by the price of dry wood.

costs by 20% and the high scenario by 30% to be conservative in our estimates of the likely impacts on the business sector.

We estimate the implementation of legislation on the sale of wet wood will result in total monitoring costs to the industry that range from £15 million in the low scenario and £19 million in the high scenario in present value terms over the 11 year assessment period for the preferred option. The monitoring costs associated with regulating the sale of bituminous coal are estimated to range from approximately £0.34 million in present value terms in the low scenario to £0.44 million in the high scenario for the preferred option.

6.4 **Administration and familiarisation costs to business**

These are costs of the manufacturer's time related to understanding the new requirements and the inspection and monitoring of fuels by the regulatory body. The costs are a valuation of the time spent by the manufacturer's quality control manager familiarising themselves with the new requirements and spending time with the regulatory body assessing the fuel contents and quality control records.

Based on discussions with industry, we assume an average salary for a quality control manager of £50,000 and estimate he or she would be required to spend a day and half each year, in preparing for and participating in the inspection, at a cost of £288 a day. Based on this, we estimate the administrative and familiarisation costs to businesses (£288 * the number of businesses (3,706)[18] to range between £9 million in the low scenario to £13 million in the high scenario in present value terms over the period 2020 to 2030 for the proposed measure to regulate the sale of wet wood in our preferred scenario. The same figures for bituminous coal are £0.16 million in the low scenario and £0.21 million in the high scenario.

In addition there may be costs to suppliers from no longer being able to sell wet wood. Some suppliers, who can easily switch to kiln dried or seasoned wood, will see a benefit as these products have a higher profit margin. Others may need to make a capital investment for example to purchase drying kilns or covered space for seasoning or will choose to switch to selling in volumes over the $2m^3$ threshold. These suppliers may incur a cost, although this may be recouped over time due to switching to a higher value product. These benefits or costs have not been quantified as it is very difficult to accurately estimate what suppliers will do. From the Call for Evidence 40% of wood suppliers said that their businesses could adapt to the proposed regulation immediately.

6.5 **Government costs**

In line with our objective to minimise burdens on LAs the main compliance requirement will be through the industry led certification scheme which will be enforced in partnership with Trading Standards officers. Implementation will be explored further at consultation. For the purposes of this analysis we are assuming a one off cost of £500,000 based on discussions with the Local Government Association to cover staff training.

In addition, any legislation would be accompanied with a government communications campaign to raise awareness of the impacts of burning solid fuels and what residents can do to minimise the impact. It is estimated that this would run over 3 years at an approximate cost of £2 million per annum[19].

[18] This is an estimated taken from the industry representative bodies we have met with.

[19] The estimate of £2 million per annum for 3 years for a communications campaign is based upon advice from our communications department and would deliver a digital campaign, radio, press, posters and digital banners. This could be scaled up or down depending upon available funds but is used as a central estimate for the purposes of this IA.

6.6 **Monetised benefits**

The beneficial impacts of the measures are considered in terms of the damage avoided if emissions reductions are achieved. This 'damage' avoided is calculated in money terms using the damage cost approach. The damage cost approach is part of the official government Green Book guidance on valuing impacts from Air Quality. The damage costs predominantly capture the health benefits from reduced emissions. The analysis in this IA is based on recent advice from COMEAP and are consistent with those used in support of the government's recently published 'Air quality plan for nitrogen dioxide'. The damage costs values used are standardized to 2017 prices (using GDP deflators) and uplifted by 2% per annum, in line with Green Book guidance. The uplift captures the higher willingness to pay of the population, and therefore value of health benefits as incomes (economic growth) rises.

Three sets of damage costs have been developed for the high, central and low scenarios. The variation reflects uncertainty about the lag between exposure and associated health impacts. The damage costs are higher in the 'High Range' where the lag between the associated health impacts and benefits is assumed to be shortest. The monetised benefits are also impacted by the compliance rates assumed i.e. how many people currently burning highly polluting fuels substitute to the cleaner fuels under discussion.

We estimate compliance effects by multiplying the baseline tonnage by the compliance rate. Full compliance is assumed with the proposed measure to regulate coal based on the small number of coal suppliers and the long term decline in the tonnage of coal burned. We use a lower compliance rate for wood fuel, 40% in 2020 rising to 60% by 2023. This is to reflect the more varied and informal sources through which consumers can acquire wood fuel. The reduction in emissions from a switch in fuels is estimated by taking the difference between the total emissions generated from burning wet wood and bituminous coal relative to dry wood and solid smokeless fuel respectively.

Adjusting for compliance we assume perfect substitutability between wet wood and dry wood and bituminous coal and solid smokeless fuels. In practice, not all consumers burning wet wood will shift to dry wood. Some consumers may stop burning wood, substitute away to alternative cleaner sources of fuel. On an energy adjusted basis, it is cheaper to heat homes using electricity or 'gas oils' relative to wood.[20] Some consumers may also take to purchasing greater volumes wood to bypass the proposed regulation on the sale of wet wood in bags of less than two meters cubed. These impacts have not been quantified in this IA, however, we will use the consultation to fully understand the implications of setting a threshold under which consumers cannot purchase wet wood and the likelihood of consumers switching to alternative fuels not discussed here.

6.7 **Greenhouse Gases (GHGs) and climate change impacts**

An increase in greenhouse gas emissions was also calculated from the change in fuel burned. We have monetised the environmental of changes in CO_2 as a result of the proposed regulation by applying the central BEIS non-traded carbon values to the estimated carbon emission impact. These impacts could be mitigated by following the Irish example and pushing industry to increase the biomass content of manufactured solid fuels. This will be consulted upon and considered for the final IA.

6.8 **Other non-monetised benefits**

It is important to note when applying and interpreting damage cost functions, a number of impacts are not taken into account in the quantification; these include impacts on ecosystems (associated with reductions in soil and surface water contamination, reducing acidity) and cultural heritage and many of the morbidity impacts arising from air pollution. Burning solid fuel is a significant source of black carbon, which is a strong positive climate forcer, resulting in a significant warming impact. Reduction of $PM_{2.5}$

[20] http://www.nottenergy.com/energy_cost_comparison/

emissions from solid fuel burning, which have a large black carbon component, will therefore have a cooling impact, akin to reducing carbon dioxide emission. Unlike carbon dioxide and other greenhouse gases, black carbon is not monetised, therefore we have been unable to monetise this benefit. We have similarly not monetised the benefits arising from a reduction in other pollutants such as SO_2 and NO_X primarily due to uncertainty around emission factors.

7. Results

7.1 Key costs and benefits of implementing legislation on the sale of wet wood and smoky coal

This section details the estimated costs and benefits that are likely to result from restrictions on the sale of wet wood and bituminous coal. The results present analysis for an 11 year assessment period commencing in 2020, when the first costs will be incurred. From 2030 onwards, the impacts are assumed to be similar in the absence of any changes to legislation. A discount rate of 3.5% is used in present value cost and benefit estimate as per Green Book guidance with all costs and benefits reported in 2017 prices. We use 2020 for the NPV baseline. In the remainder of this section, the monetised impacts is discussed in more detail.

7.2 Monetised benefits to the environment and human health

The main benefits that accrue from the proposed regulation on the sale of wet wood and bituminous coal relate to the reduction in air pollutant emissions and in particular $PM_{2.5}$ which can result in higher mortality rates for people with cardiovascular and respiratory diseases. We estimate the proposed regulation on the sale of wet wood and bituminous coal to lower $PM_{2.5}$ emissions by 68.18 kilo tonnes (kt) in our preferred option, Option 2 over the period 2020 to 2030 as detailed in Table 5 below. This compares to 2.85kt abated in Option 1.

Table 5: Total emission reductions of $PM_{2.5}$ (in kt) of air pollutants from 2020 to 2030 compared to baseline

	Option 1	Option 2 (preferred option)
Wood	2.54	56.05
Coal	0.29	12.14
Total	2.85	68.18

Progress towards UK's legally binding air pollution reduction commitments

The UK is legally required, under the National Emissions Ceilings Regulations 2018, to reduce our $PM_{2.5}$ emissions in 2030 by 69kt from 2005 levels.

Table 6 below shows progress of this measure towards these targets. Our emission projections show that without further intervention, we are expected to miss our 2030 emission reduction commitment for $PM_{2.5}$ by 30.7kt.[21] Option 1 is assessed as delivering 0.25 kt of $PM_{2.5}$ emission reductions in 2030, and Option 2 delivering 6kt. Other measures beyond this proposed policy will therefore be required to achieve the 2030 emissions reduction commitments.

[21] For further information, see the UK Informative Inventory Report (1990 to 2016): https://uk-air.defra.gov.uk/assets/documents/reports/cat07/1803161032_GB_IIR_2018_v1.2.pdf

Table 6: Projected emissions reductions from the baseline in 2030

	Option 1 $PM_{2.5}$ (kt)	Option 2 (preferred) $PM_{2.5}$ (kt)	Projected gap between baseline and NECD $PM_{2.5}$ emission reduction commitments for 2030
Wood	0.23	5.38	
Coal	0.01	0.58	
Total	0.25	5.96	30.70*

* This is the amount by which we are projected to miss our 2030 emission reduction commitment without further intervention.

Monetised benefits

Table 7 below sets out the combined indicative annual benefits related to regulation on the sale of wet wood and bituminous coal. The benefits are estimated by applying the damage cost functions to the reduction in emissions.

The ranges (high, low and central) present the uncertainty associated with the damage costs. The sensitivity in damage costs captures the uncertainty surrounding the valuation of health benefits for a given level of emission reductions. It is one the main sensitivities presented in Section 8. It should be noted that in all three scenarios the level of emissions reduction does not change.

Table 7: Year-on-year breakdown of $PM_{2.5}$ emissions benefits (£m, 2017 prices, discounted) Central damage cost values

Year	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Option 1											
Wood	10.03	9.93	9.83	9.73	9.63	9.53	9.41	9.28	9.16	9.04	8.92
Coal	2.08	1.84	1.59	1.36	1.13	0.91	0.83	0.75	0.68	0.61	0.54
Option 2											
Wood	157.40	192.28	226.45	224.16	221.89	219.63	216.76	213.93	211.13	208.37	205.64
Coal	85.94	74.23	64.48	55.00	45.77	36.81	33.62	30.52	27.51	24.57	21.71

Greenhouse gas monetised benefits

Carbon dioxide (CO_2) contributes to climate change, so anything that can be done to help reduce the amount of CO_2 in the atmosphere can help us to tackle climate change. Burning fossil fuels such as coal, gas and oil releases their stored carbon into the air as CO_2. By contrast burning wood is considered to be largely carbon neutral, with the CO_2 absorbed as young trees grow compensating for that released by burning. Table 8 sets out the estimated CO_2 emissions from burning coal. Solid smokeless fuel emits higher CO_2 emissions than bituminous coal. The proposed regulations would lead to an increase in CO_2 emissions, however, this increase is not large enough to offset the benefits associated with the measure. As highlighted in the non-monetised benefits section, this intervention will reduce black carbon which has well known climate effects, but is not assigned a CO2e value, therefore it has not been quantified in this Impact Assessment.

Table 8: Total CO_2e emission increase by 2030, non-traded

Fuel	CO_2e emission increase (kt) Option 1	CO_2e emission increase (kt) option 2
Coal	4	177
Wood	0	0
Total	4	177

Damage cost sensitivity

The damage costs used are a key sensitivity which is covered in Section 8. The key driver behind the differences in the figures below is the differences in valuing human health in the damage cost calculations, where the high and low scenarios in Table 9 represent the uncertainty around the central range.

Table 9: PV per environment and human health benefits (2020 – 2030); legislation on the sale of wet wood and bituminous coal (Option 2)

Sensitivity			Best estimate
Pollutant	Low benefit	High benefit	Central
Wood $PM_{2.5}$	1,076	5,537	2,298
Coal $PM_{2.5}$	238	1,225	500
Total	1,313	6,762	2,798

7.3 Summary of the results

In all three scenarios the benefits of the preferred option are assessed to outweigh the costs for the measure related to restrictions on the sale of wet wood and coal. The NPV is considerably higher than that estimated for Option 1 ((£35m to £247m with a best estimate of £97m)

Table 10: Present value benefits and costs of restrictions on the sale of wet wood and coal over a 11 year period (2020 – 2030 in 2017 prices, £ millions) for Option 2

	Low scenario	High scenario	Central scenario
Costs to regulatory body and fuel suppliers			
Monitoring and administration costs[22]	25	33	30
CO2e non-traded	11	11	11
Household costs	423	423	423
Government costs	6.3	6.3	6.3
Total costs	466	473	471
Benefits from emission reductions			
Air quality pollutants	1,313	6,762	2,798
NPV	**848**	**6289**	**2327**

8. Risks, assumptions and uncertainties

There is significant uncertainty in the data on which the analysis for this impact assessment relies. In order to minimise this uncertainty as much as possible, we have used a wide variety of data sources and issued a Call for Evidence into domestic solid fuel burning. Whilst the majority of responses to the Call for Evidence were qualitative, we did receive some further quantitative evidence to validate our analysis. The key uncertainties are set out below. Where there is variation between different estimates, in most

[22] Monitoring costs are the costs incurred by the regulatory body in monitoring fuel manufacturers to ensure that they comply with the proposed regulation. These costs will be passed to fuel manufacturers in the form of registration and fuel testing charges.

cases we have based our analysis on the more methodologically conservative estimate to ensure that this IA does not overestimate the potential benefits.

- **Emissions factors** – emission factors used in this analysis are aggregated from the internationally-accepted emission factors published jointly by the European Environment Agency (EEA) and the UNECE European Monitoring and Evaluation Programme (EMEP). The EEA/EMEP emission factors are quoted for different appliance types, and applied to the UK technology mix as assessed by Defra's NAEI contractor. The EEA/EMEP emission factors are based on experimental measurements of the burning of dry wood. No published emission factors were available for the preparation of this Impact Assessment, and so we used a comparison between the EEA/EMEP emission factor for dry wood and an emission factor for wet wood measured by the Universities of Leeds and Manchester. There is significant uncertainty in this comparison because of the different appliance types used. We understand that a more in-depth study will be carried out by the teams at the Universities of Leeds and Manchester and will seek to update this analysis should those data be made available.

- **Volumes of wood sold**: estimating the total amount of wood sold in the UK is highly challenging because of the nature of the market, with a large number (in the thousands) of small sales. The official Government estimate relies on the 2015 BEIS domestic wood survey, which asked people how long they use their stove for and then back-calculated the total volume of wood needed for the reported level of operation. The total figure (*ca.*6 million tonnes) is viewed with scepticism in the wood industry, as well as by the Forestry Commission. For context, the entire tonnage of wood harvested in the UK each year is in the region of 11 million tonnes, meaning that over half of the UK wood harvest would need to be used as wood fuel. This is unlikely given the high volume of furniture, construction material and other wood product use. Working with stakeholders in the wood industry, and the Forestry Commission, we collected sales data for wood in 2017 (*ca.* 2.3 million tonnes.) We worked with Kings College London and Imperial College London to validate this figure by applying the wet / dry split (discussed below) and the emission factors for wet and dry wood (discussed above) to determine total emission of $PM_{2.5}$. The emission total was then distributed across the UK according to wood burning activity estimates used in the NAEI[23], and entered into UKIAM[24], to establish an expected atmospheric concentration. This was compared with experimentally measured concentrations carried out by KCL, which showed a good level of agreement. Therefore, based on the agreement between modelled and measured concentration levels, we assess the total level of emission to have an acceptable level of certainty.

- **Whether that wood is burned wet or dry**: Analysis from the 2015 BEIS Domestic Wood Survey data suggests that approximately 22% of wood is burned wet in the UK, but it is recognised that there are methodological issues with the survey approach. Through engagement with stakeholders, we have established that this figure is considered highly unlikely by the wood industry, who estimate that the figure is closer to 80%. We attempted to validate either assumption with the Forestry Commission, who advised that they considered the figure to be in the region of 50%. It has not been possible at this stage to establish a greater level of certainty around this estimate. Defra is conducting primary research into domestic burning behaviour which will investigate to the extent of wood which is burned wet in greater detail, with a more robust survey methodology. However, the results of this survey are not expected to be available before the second half of 2019 at the earliest. We have chosen to use the 22% figure calculated from interviews carried out in the course of the BEIS Domestic Wood Survey. Our reasoning is that this will provide a conservative estimate of the benefits against which we can assess the costs of the policy. Increasing the proportion of wood that is burnt wet increases the health benefits in a proportionate manner.

- **Number of households burning**: There is significant uncertainty in not only the number of households burning solid fuel, but in how to characterise them. For example, does a household which burns one small bag wood per year, perhaps at Christmas, count towards the total? There is also uncertainty around how to categorise households which burn both coal and wood,

[23] For further details, see "UK Emission Mapping Methodology 2015", the most recent NAEI mapping report.

[24] UK Integrated Assessment Model – a model for assessment of the impacts of air pollution

sometimes on the same appliance at the same time. In order to assess the costs to households, we have used the estimated household numbers as reported in the Call for Evidence. We are seeking more highly constrained estimates in the primary research into domestic combustion behaviour detailed in the paragraph above.

- **Damage cost functions**: When measuring the impact of emissions, an impact pathway approach is preferred in some circumstances. An impact pathway approach models the spatial distribution of changes in emission from a specific source. This approach is time consuming and costly. In the case of the measures under consideration, such an approach is disproportionate. For this impact assessment, damage costs were used to calculate the indicative impact of emission changes. Damage costs are standardised average values of the impact to society of a given change in emissions. Damage cost values are published in the Green Book guidance, and are used as standard practice throughout government. A limitation is that damage costs are a UK average, and not specific to the geographical source of emissions change. For example, they don't adjust for the site specific population exposure to the pollution, where reductions in pollutants in a more densely populated region would generate greater benefits. Moreover, damage costs are an underestimate for two reasons. Firstly, they capture partial health impacts, such as those to mortality (cost of life years brought forward) but largely not to those on morbidity (short-term impacts). Secondly, they do not explicitly capture the full impacts to ecosystems and cultural heritage.

9. Measurement of the impact on micro and small enterprises

Small and micro-businesses can be affected disproportionately by the burden of regulation. New regulatory proposals are designed and implemented in a manner aiming to mitigate disproportionate burdens where appropriate. As such, the default assumption set in the Better Regulation Framework Manual (June 2013) is that there will be a legislative exemption for small and micro-businesses where a large part of the measure can be achieved without including small and micro-businesses within the scope of the policy proposal.

The Better Regulation Framework Manual defines micro and small businesses according to a staff headcount. Micro-businesses are those employing up to 10 full time employees as staff members while small businesses employ between 11 and 49 FTE staff. The manual provides guidance on Small and Micro-business Assessment including a range of potential mitigation measures if the proposed policy option does have an impact on small and micro-businesses.

The impact of the proposed measures on micro and small enterprises relates to whether the operators are able to meet and absorb the costs of compliance i.e. the administrative costs associated with the regulation (including compliance (inspection) and monitoring). The impacts of any measure is assessed by assessing the ratio of costs per firm relative to the financial resources available to the firm.

While we have information on the costs to business, we do not have data on the proportion of income (gross operating surplus) derived firms in the sector to be to assess the impact of the measures on small and micro enterprises in the sector, which we know account for the majority of data in the sector.

Evidence collected from our Call for Evidence suggests that most businesses selling fuels are small to micros businesses and as such to exempt them would impact significantly on the benefits delivered through this policy proposal. As such we have assumed for the purposes of this IA that there will be no exemptions. The question of potential exemptions will be explored during consultation to inform the final policy.

10. Competition assessment

The competition assessment guidelines[25] set out four questions to establish whether a proposed policy is likely to have an effect on competition. In particular, the assessment needs to establish whether the requirement to comply with the measures would affect the market by:

[25] OFT http://www.oft.gov.uk/shared_oft/reports/comp_policy/Quick-Guide1-4.pdf

- Directly limiting the number or range of suppliers?
- Indirectly limiting the number or range of suppliers?
- Limiting the ability of suppliers to compete?
- Reducing suppliers' incentives to compete vigorously?

A brief summary of the four questions and a response considering the requirement is presented in the table below.

Competition assessment filter questions

Do the proposed measures	Response	**Comment**
Q1. …directly limit the number or range of suppliers?	No	The proposed measures legislation on the sale of wet wood and bituminous coal do not seek to directly limit the number of suppliers.
Q2. …indirectly limit the range of suppliers?	No	The proposed measures may limit the range of suppliers. The proposed requirement does not prevent entry or exit from the market for any firm. For coal some of the suppliers have a long established supply chain which will be slow to adapt to change we will explore this impact at consultation. For wood where a supplier does not have the space or kiln drying facilities to dry wood or the distribution network to only deliver in large volumes this could impact upon their businesses. In some areas government grants are available to support the transition. The majority of wood businesses responding to our Call for Evidence suggested that they could adjust. The wood fuel market consists of five medium sized firms and a number of small and medium sized enterprises. While administration and monitoring cost are likely to be a larger cost for smaller businesses, they are unlikely to be large enough to push new firms out of the market, or provide a disincentive for new firms to enter the market. We estimate the average annual present value cost to business from the proposed legislation on the sale of wet wood to be less than £800 a year and on the measure to phase out the sale of bituminous coal to be less approximately £300 a year.
Q3. …limit the ability of suppliers to compete?	No	The proposed regulation would mean that all domestic fuel manufacturers have to comply with the existing voluntary schemes on 'ready to burn' and 'mineral fuels'. The intervention should not limit the ability of suppliers to compete.
Q4. …reduce suppliers' incentives to compete rigorously?	No	The proposed requirement does not seek to limit the incentives for suppliers to compete. In particular, application of the rules across the board would impose similar constraints on all operators.

Overall, the proposed measures for existing fuel suppliers and new market entrants could have a small impact on competition in the short term. The administrative and monitoring costs that companies across different sectors would be facing are unlikely to result in significant burden affecting profitability and commercial viability of these enterprises. The associated costs will be imposed across the board for those firms that are not already part of the 'ready to burn' and 'mineral fuels scheme'.

11. Distributional impacts

Fuel poverty occurs where a low income household is living in a home which cannot be kept warm at reasonable cost. These households often live in older homes with poor levels of insulation and inefficient heating.

Fuel poverty is a devolved issue and each nation has a separate measure of fuel poverty, with an associated strategy to tackle the issue. It is estimated that approximately 4 million households in the UK live in fuel poverty.

The fuel poverty statistics for England show that homes which are not heated by mains gas, or are 'off-grid', are more likely to be fuel poor and where off-grid households are fuel poor then they are more likely to be severely fuel poor[26].

The BEIS fuel poverty households' dataset reports there were 22,000 households in fuel poverty burning solid fuels in 2015. It is unclear what proportion of these households burn wood. Solid smokeless fuel is assessed to be more expensive to burn on an energy density basis relative to bituminous coal and low income household more likely to use coal for heating purposes. Further information on the household impacts will be assessed as part of the evidence collect at the consultation stage.

Through the Call for Evidence we found that there is clear segmentation and regional split of those burning solid fuels in the homes. The majority are burning wood as secondary heating and would not be considered fuel poor. The minority who would be more price sensitive to any policy interventions were burning coal on open fires as their main form of heating. It is this latter group that we will investigate more at consultation and through stakeholder meetings to consider an approach that will minimise the impact of any intervention on these households.

[26] https://www.gov.uk/government/statistics/fuel-poverty-detailed-tables-2017