Title: Amendments to environmental permitting regulations to improve air quality by transposition of the Medium Combustion Plant Directive	Impact Assessment (IA)
IA No: DEFRA2039	**Date:** December 2017
Lead department or agency: Department for Environment, Food and Rural Affairs	**Stage: Final IA**
Other departments or agencies: Department for Business, Energy, & Industrial Strategy, Welsh Government	**Source of intervention:** EU
	Type of measure: Secondary legislation
Summary: Intervention and Options	**RPC Opinion: Green (fit for purpose)**

Cost of Preferred (or more likely) Option				
Total Net Present Value	**Business Net Present Value**	**Net cost to business per year** (EANCB 2014 prices)	**In scope of One-In, Three-Out?**	**Measure qualifies as**
£806.8m	-£209.8m	£15.9m	Out of Scope	Non-qualifying provision

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

Poor air quality is the largest environmental risk to public health in the UK, exacerbating the impact of pre-existing health conditions, especially for the elderly and children. Government has legal obligations on air quality including reducing emissions of pollutants; meeting limits on local concentrations of pollutants; and implementing regulations on particular pollutant sources. The Medium Combustion Plant Directive (MCPD), "the Directive" will apply emission controls to combustion plants between 1 and 50MW (medium combustion plants, MCPs). MCPs are a major source of air pollutants which can cause harm to human health and at present are largely unregulated in the UK. Government intends to implement the Directive to deliver cost-effective emission reductions which will improve air quality (reducing overall emissions and local concentrations of pollution), and to avoid infraction and any associated fines.

What are the policy objectives and the intended effects?

The objective of the measures proposed is to improve air quality. These measures will reduce emissions and concentrations of key pollutants harmful to human health and the environment. We intend to ensure that the directive is fully transposed as this will make a valuable contribution to the UK complying with the legal obligations to meet EU and internationally agreed maximum emission levels. In doing so we will also ensure that unnecessary regulatory burdens, including reporting and other compliance arrangements, are minimised.

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

Option 0 - Do nothing: Continue with unrestricted use of MCPs, resulting in high levels of emissions

Option 1- Transpose the MCPD into domestic legislation, making use of available flexibilities and exemptions where appropriate, and adopt a risk based approach to permitting, compliance and enforcement. Option 1 is preferred as it will deliver significant benefits to public health and the environment - avoiding potential breach of EU and international air quality limits and standards.

Will the policy be reviewed? Yes **If applicable, set review date:** 12/2019

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:** 0.03	**Non-traded:** 0.6	

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 1

Description: Transposition of Medium Combustion Plant Directive (MCPD)

FULL ECONOMIC ASSESSMENT

Price Base Year 2014	PV Base Year 2018	Time Period Years 15	Net Benefit (Present Value (PV)) (£m)		
			Low: 178.60	**High:** 2367.21	**Best Estimate:** 806.80

COSTS (£m)	Total Transition (Constant Price)	Years	Average Annual (excl. Transition) (Constant	Total Cost (Present Value)
Low	0.4	1	10.7	**114.8**
High	0.4		40.7	**435.2**
Best Estimate	0.4		19.5	**211.2**

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

For the implementation of Option 1 proposals, all monetised costs in this assessment are treated as direct costs to business. While some enforcement and administration costs will fall to regulators, we propose that they recover costs from operators through permitting and subsistence fees. Monetised costs comprise costs of making plant compliant with emission limits (abatement costs), emissions monitoring, reporting and permitting and annual enforcement fees. The full impact of MCPD applies from 2030, when all plant must meet its requirements and all Emission Limit Values (ELVs) are in force. For operators required to comply with emission limits, the present value (PV) abatement cost over the assessment period is £138.0m (2018-2032). For all MCPs within scope (also including those exempt from ELVs) additional costs faced over the assessment period include administration (£30.4m, PV), and inspections and monitoring (£42.8m, PV).

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

For some impacts evidence is not available or collecting it would be disproportionately costly. These include transitional costs such as communications, guidance, training of regulators and operators, and creating tools for permitting and monitoring. The costs are considered to be relatively small and uncertain so are not monetised.

BENEFITS (£m)	Total Transition (Constant Price)	Years	Average Annual (excl. Transition) (Constant	Total Benefit (Present Value)
Low	0.0	N/A	59.0	**613**
High	0.0		238.4	**2483.0**
Best Estimate	0.0		97.7	**1018.0**

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

The Directive will reduce emissions of air pollutants resulting in an improvement in air quality for everyone, given that air pollution travels, and particularly for those living or working close to medium combustion plants. Monetised benefits represent the benefits of improved air quality on human health and from reduced greenhouse gas emissions. The central PV benefit is £1018m over the whole appraisal period, capturing benefits from reduced emissions of NOx (£346.7m), particulate matter known as PM or dust (£439.1m) and Sulphur dioxide (SO2) (£193.6m), and greenhouse gases namely carbon dioxide (CO2) £35.5m). Benefits relate to plants within scope of this IA (England and Wales only), but implementation of the Directive across the rest of the EU will also improve air quality in England and Wales.

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. It is not possible to monetise all health impacts either. The health impacts included here purely set out the impact on mortality; however we know that there is also a significant societal cost arising from morbidity, which is largely missed from the damage costs used in the analysis. Other secondary impacts that have not been monetised include supporting innovation in abatement equipment/green technologies and revenue for monitoring companies.

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

Plant numbers are uncertain: low and high estimates indicate the associated uncertainty in total compliance costs. Low and high benefits represent the uncertainty in health benefits from improved air quality (damage costs). The high NPV combines low plant numbers (low cost) with high damage cost valuation (high benefits), and the low NPV combines high plant numbers with low damage cost valuation. Full compliance with the Directive by operators is assumed.

BUSINESS ASSESSMENT (Option 1)

Direct impact on business (Equivalent Annual) £m:			Score for Business Impact Target (qualifying provisions only) £m: 0.0
Costs 16.0	**Benefits: 0.1**	**Net: -15.9**	

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ANNEX **52**

1. Executive Summary

Poor air quality is the largest environmental risk to public health in the UK, exacerbating the impact of pre-existing health conditions, especially for the elderly and children. Long term exposure reduces life-expectancy, mainly due to increased risk of mortality from cardiovascular and respiratory causes and from lung cancer. COMEAP's research notes that short-term exposure to NO_2 has been linked to some direct effects on morbidity while long term effects suggest impacts on respiratory and cardiovascular mortality, children's respiratory symptoms and lung function.[1] Air pollution also damages biodiversity and reduces crop yields.

The Government has a legal commitment to improving the air we breathe and reducing the emissions and concentrations of harmful pollutants. The Government's plan to improve air quality by reducing nitrogen dioxide levels in the UK published in July 2017 includes measures to achieve this objective.

The Medium Combustion Plants Directive ("the Directive"), which came into force in December 2015 introduces measures to reduce emissions from combustion plants with thermal rated inputs between 1 and 50MW (MCPs). These are a currently largely unregulated source of emissions of air pollutants (Oxides of Nitrogen- NO_x, PM, Sulphur dioxide- SO_2. Implementation of the Directive will reduce the levels of air pollution from such plants, improving environmental and human health. Plant owners will have to fit technology to abate emissions from their plants and will be required to regularly test emissions from their plants to ensure standards are maintained. However, we expect some plants to switch to the use of cleaner fuels instead of fitting technology to reduce emissions from their plants. The UK negotiated a number of important flexibilities to ensure no disproportionate impacts on operators and we have taken advantage of some of these where appropriate.

This impact assessment considers options for transposing the Directive. Scotland, Northern Ireland and Gibraltar are laying equivalent legislation. We have compared the baseline where no emission controls are introduced with Option 1 where the MCPD is transposed making use of available flexibilities and exemptions where appropriate and adopting a risk-based approach to permitting, compliance and enforcement.

Following the responses received on the consultation and further analysis, Option 1 is chosen as the preferred option as this will introduce the necessary level of environmental and public health protection whilst avoiding any disproportionate impacts on operators and industry. The impact assessment has been updated since the consultation to reflect the impact of changes announced by the Ofgem to the payments and exemptions they provide to embedded generators and latest advice from COMEAP on the damage costs associated with air pollutants.

There will be no transitional arrangements for biomass and district heating. In the consultation we proposed to allow transitional arrangements until 2030, but the vast majority of responses objected to this approach, pointing out that the savings to operators were much smaller than the damage to air quality caused by the additional emissions. BEIS agreed to this approach and is reviewing the impact of MCPD implementation on uptake of the Renewable Heat Incentive (RHI) and viability of existing plants under the RHI.

Plants which operate on average no more than 500 hours per annum will be exempt from compliance with emission limit values but will be required to notify the regulator if they exceed 500 hours of operation in any given year. This will have a negligible additional cost to operators and assist regulators in ensuring compliance.

The Environment Agency is appointed as the regulator in England. There was a similarly strong level of support between options A where the regulator role was split between the EA and Local Authorities, and option B, where the EA would be the sole regulator. However, we have considered that option B provides greater clarity on roles, consistency in implementation and greater flexibility for regulating mobile plants and multiple sites with a single operator. For the higher risk plants, where the impact on local air quality must be assessed to determine permit conditions, Local Authorities will be consulted. EA will consult on fees and charges to recover their costs.

The rationale for choosing Option 1 as well as the methodology used are discussed in detail in sections 6 and 7.

We intend to transpose the Directive by amending the Environmental Permitting (England and Wales) Regulations 2016[2] (EPR) which will result in over 10,000 plants becoming subject to emission limits. The EPR currently regulates some medium combustion plants, including those over 20MW and will therefore offer an approach to implementation, which is already well understood thus providing clarity for operators.

New plants will be required to comply with emission controls from 20 December 2018. Plants already in operation by that date will be given longer to comply with the ELVs recognising the high number of plants affected and to allow operators time to make the necessary changes. We will also allow later compliance dates for gas compressor plants supporting the national grid, where earlier retrofitting will be very difficult to achieve. We will exempt from

[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-to-particulate-air-pollution-in-the-uk

[2] https://www.legislation.gov.uk/uksi/2016/1154/contents/made

ELVs plants which operate up to on average 500 hours per annum, because they are responsible for a very small proportion of emissions and in many cases the costs of abatement would not be justified by the emissions reduction achieved. We will also extend this exemption to 1000 hours for plants operating in an emergency when providing support for remote islands. We tested the application of the 1000h exemption in the event of exceptionally cold weather during the consultation and the findings indicate that it is prudent to retain the ability to apply this exemption where it is justified by extreme meteorological conditions; however it will not be required on a regular basis. We will be applying the flexibility for a higher NO_x ELV for engines operating between 500-1500 hours; however these engines are subject to emission controls assessed in a separate IA.

This impact assessment has been updated in light of consultation responses. The analysis has also been amended to reflect (I) updates to the damage costs associated with air pollutants from the Committee on Medical Effects of Air Pollutants (COMEAP), (II) reductions in payments (of embedded benefits) that Ofgem provide to diesel generators for supporting the national grid during peak times and (III) measures to simplify capacity market auctions by the Department for Business, Energy and Industrial Strategy. The updated damage costs result in lower health benefits from reductions in air pollutants than was previously assumed. The Ofgem change means that few diesel generators are included in our baseline compared to the pre-consultation impact assessment reducing monitoring costs.

Results for the preferred option (Option 1)

The forecasted reductions in emissions from a national level as a result of these controls are presented for the preferred option in Table 1.1, below.

Table 1.1 Emission reductions delivered in 2030 by proposals assessed in the impact assessment, in kilotonnes (Kt and as a percentage of total UK emissions.

Kt (%)	SO_2	NO_x	PM	CO_2
Option 1	14.5 (12%)	16.9 (3%)	2.6 (3%)	109

The full costs and benefits are presented in Table 1.2.

Table 1.2 Costs and benefits of Option 1 (£m, discounted)

2018-2032	LOW (£m)	HIGH (£m)	CENTRAL (£m)
Costs (cost to operators)			
Abatement costs	285.6	73.9	138
Administration costs	61.2	18	30.4
Monitoring costs	90.7	23.2	42.8
Total	437.5	115.1	211.2
Benefits (emissions reductions)			
Air Quality pollutants	595.3	2,429.30	982.4
CO2 (Traded)	0.7	2.3	1.4
CO2 (Non-Traded)	17	51.6	34.1
Total	613	2,483.20	1,018.00
NPV	175.5	2,368.10	806.8

*Please note any differences due to rounding.

Table 1.2 presents the costs and benefits that have been monetised. However, while as far as practicable all the impacts have been quantified and monetised, some impacts have not been quantified. The key impacts which were not quantified are the wider environmental societal benefits through improvements to ecosystems due to the reduction in emissions and some impacts on human health.

2. Introduction

Poor air quality is the largest environmental risk to public health in the UK, exacerbating the impact of pre-existing health conditions, especially for the elderly and children. Some of the health effects caused by exposure to elevated levels of pollution are outlined in Table 2.1.

Table 2.1 Health effects for very high levels of pollutant emissions

Pollutant	Health effects at very high levels
Nitrogen Dioxide (NO_2),	Collated research by COMEAP into the health impacts of NO_2 has shown that it is reasonable to associate NO_2 in outdoor air with adverse effects on health, including reduced life expectancy. As part of this report, it was established that there were likely to be short term and long term effects as short-term exposure to NO_2 has been linked to some direct effects on respiratory morbidity, while studies of long-term exposure to NO_2 report associations with all-cause, respiratory and cardiovascular mortality, children's respiratory symptoms and lung function.
Sulphur Dioxide (SO_2) and Ozone (O_3)	Sulphur Dioxide and Ozone are respiratory irritants that can cause constriction of the airways, inflammation of the respiratory tract and irritation of the eyes, nose and throat, potentially exacerbating asthma in susceptible people.
Particulates (PM, which includes PM_{10} and $PM_{2.5}$)	Fine particulate matter can penetrate deep into the lungs and other tissues, including the brain. Research in recent years has strengthened the evidence that both short-term and long-term exposure to $PM_{2.5}$ are linked with a range of negative health outcomes including shortening the lives of susceptible individuals through cardiovascular disease, stroke, cancers, respiratory and other diseases.

Air pollution is measured and regulated in two different ways: by concentrations and total emissions. The Ambient Air Quality Directive (AAQD) sets limits for both short term and annual pollution concentrations. The AAQD is already transposed into law in England by the Air Quality Standards Regulations. Total emissions were first regulated by the 1999 Gothenburg Protocol, under which States agreed to cap their annual emissions of certain pollutants by 2010 as a reduction from 1990 levels. The Protocol amendment of May 2012 set more stringent targets for reducing emissions and added new limits for other airborne pollutants, as a percentage of 2005 levels by 2020.

Air quality has improved significantly over recent decades through action taken by successive governments and newer technologies. From the 1970s onwards, regulatory controls, and the development of cleaner technologies, have seen significant reductions in the main air pollutants, and national emissions of nitrogen oxides (NO_x) reduced by over 19% between 2010 and 2015.

However more action is needed to meet the UK's legal obligations to reduce emissions under the National Emissions Ceiling Directive and to meet the statutory limit values for NO_2 concentrations. In July the Government published "The UK Plan for Tackling Roadside Nitrogen Dioxide Concentrations" and announced an additional £255m for local councils to accelerate their air quality plans. Whilst the Plan notes that the dominant source of NO_2 at roadsides is emissions from road vehicles, it included transposition of the Medium Combustion Plants Directive as one of the measures that will protect public health by tightening emissions from medium combustion plants. We will also be publishing a Clean Air Strategy for consultation in 2018. This will set out how we will work towards our air quality goals, including our ambitious targets to reduce emissions of five damaging air pollutants by 2020 and 2030.

Because pollution travels with the wind, air quality is a transboundary issue which needs to be addressed at an international level, by reducing emissions from all sources. The Directive will reduce the risk to the public of being exposed to emissions from MCPs which are currently largely unregulated as these plants fall between the scope of Industrial Emissions Directive (which regulates plants and sites over 50MW) and the Eco-design Directive (which applies to certain combustion appliances not exceeding 500KW).

The EU National Emissions Ceilings (NEC) Directive is the European legislation that implements the limits agreed under The Gothenburg Protocol. The Directive initially set annual limits for each pollutant, including NO_x, which Member States had to achieve by 2010. The NEC Directive was amended in 2016 by setting 2020 ceilings (in accordance with the revision to the Gothenburg Protocol) and additional 2030 emissions ceilings - the continuing aim being to reduce the significant impacts air pollution can have by reducing domestic and transboundary emissions. The NEC Directive must be transposed by mid-2018.

The Medium Combustion Plants Directive is supported by the UK as it will introduce cost effective reductions in pollutant emissions as well as improving public health. As an indication, it will provide an estimated 39% of the action needed to reduce SO_2, 17% to reduce NO_x emissions, and 7% to reduce PM emissions to meet the 2030 national emission ceilings. The Directive also provides important flexibilities and exemptions where costs are deemed to be disproportionate, overly burdensome or pose a risk to energy security. Implementing the Medium Combustion Plants Directive will make a significant contribution towards the reductions in emissions required to meet our emissions ceilings.

Existing legislation and controls (see Figure 2.1 for overview)

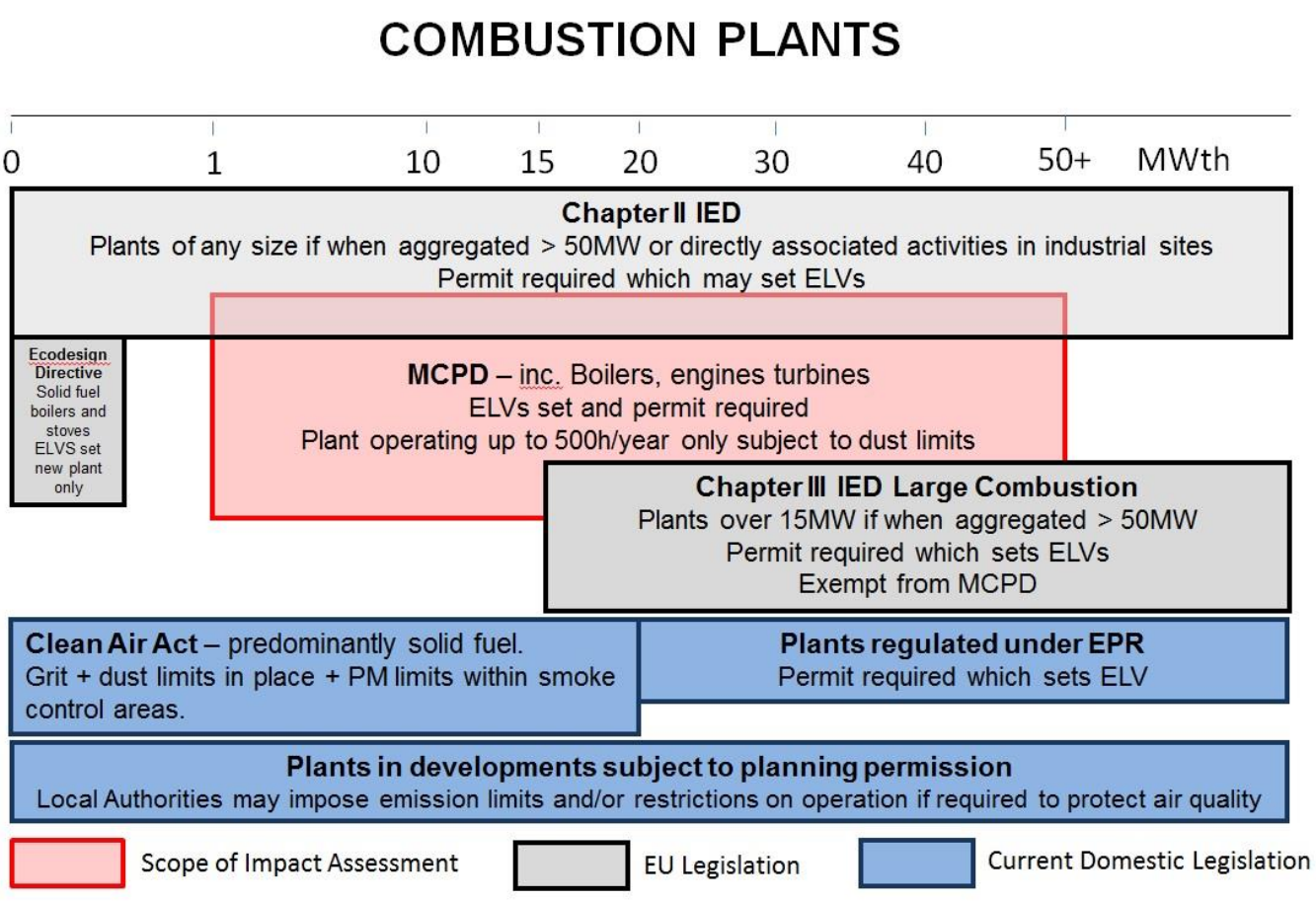
Combustion activities are a large source of air pollution and so are already subject to some emission controls. Figure 2.1 demonstrates how the proposals considered in this impact assessment fit within current EU and domestic emission controls.

Emissions from some combustion plants, including all those over 20MW, are currently regulated under the Environmental Permitting (England and Wales) Regulations 2016 (EPRs). These regulations transpose the Industrial Emissions Directive which applies to industrial sites including all sites where combustion plants have an aggregated power over 50MW, and implement domestic provisions for plant between 20 and 50MW. The EPRs requires all plants in scope to have a permit, which set controls on emissions to air and requires operators to regularly test emissions and be subject to regular inspections.

The Clean Air Act 1993 controls the emission of dark smoke and places restrictions on the type of fuel and appliance which can be used in smoke control areas. The Act also specifies minimum stack heights for some plant.

In addition, installation of combustion plants may be subject to planning permission, where their impact to local air quality is assessed. If the assessment indicates that air pollutant concentrations at a sensitive receptor (e.g. a location where people are likely to be present or a sensitive habitat) are likely to exceed those set in the Ambient Air Quality Directive, local authorities may require these plants to mitigate their impact on local air quality.

Figure 2.1 Regulatory landscape for Combustion Activities



New proposal

MCPD

The Directive (*Annex I*) will introduce a system of registration/ permitting for 1-50MW plant, emission limits for nitrogen oxides, sulphur dioxide and particulate matter and mandatory periodic monitoring of emissions by operators. MCPs typically provide power or heating for industrial sites and large buildings (offices, schools, prisons, hospitals) and include boilers, engines, turbines. Through negotiations, the UK secured a number of exemptions and flexibilities e.g. for offshore plant, remote islands when connection to the power grid fails, gas compressors supporting the National Grid and the smaller most prolific plant, to minimise burdens and mitigate impacts on energy security. The Directive also allows an exemption from emission limits for plants which operate less than 500 hours a year, given that abatement costs may outweigh the benefits provided by the small emission reduction due to the limited operating hours. In addition the Directive allows Member States to establish National systems and rules for managing permitting, enforcement and compliance.

Permitting will be required for operation of all plants in scope of the Directive. From 20 December 2018 all new plants will need a permit and from 1 January 2024 existing plants over 5MW and from 1 January 2029 existing plants between 1 and 5MW must be permitted. All plants operating on solid fuels and those which operate on average more than 500 hours per annum will be required to comply with emission limits - from 20 December 2018 for new plants, from 1 January 2025 for existing plants over 5MW and from 1 January 2030 for existing plants between 1 and 5MW. Periodic emissions monitoring will be required for all plants – for carbon monoxide and for the pollutants where emission limits apply. Several flexibilities and exemptions apply to certain types of plants, as presented on Table 6.3.

Proposed legislative approach

Option 0 is the baseline: In this scenario there is no implementation of the Directive. However, this will not result in the realisation of the health benefits expected as a result of its implementation.

Option 1: we intend to transpose the Directive by amending the existing EPRs to include a new schedule for MCPs and address any overlapping requirements in the main body of the Regulations.

Amendments to the EPRs will be designed to comply with requirements of the Directive, and plant operators will be required to hold a permit for plants which fall within the scope of the Directive.

Devolved Administrations

This Impact Assessment covers joint amendment of the EPRs by England and Wales to transpose the Directive. Scotland, Northern Ireland and Gibraltar are laying their own legislation to transpose the Directive.

2.1 Definitions

Described below are the definitions of key terms used through this document. A full glossary of terms can be found in Annex F.

New and existing plant - Definitions for new and existing plants are provided in Article 3 of the Directive. These are important as the emission limit values that apply to each, and date of application, differ between the two.

- ***An existing combustion plant*** is defined as one that is "*put into operation before 20 December 2018 or for which a permit was granted before 19 December 2017 pursuant to national legislation provided that the plant is put into operation no later than 19 December 2018.*"
- ***A new combustion plant*** is defined as any plant other than an existing combustion plant i.e. any plant put into operation after 19 December 2018.

Plant type: Articles 6(3) and 6(8) allow for different treatment of plant that operates fewer than 500 hours per annum. However within this hourly limit plants can be broadly split into 2 categories based on their role for energy security and overall contribution to total emissions, so for the purpose of this assessment plants have been identified as follows.

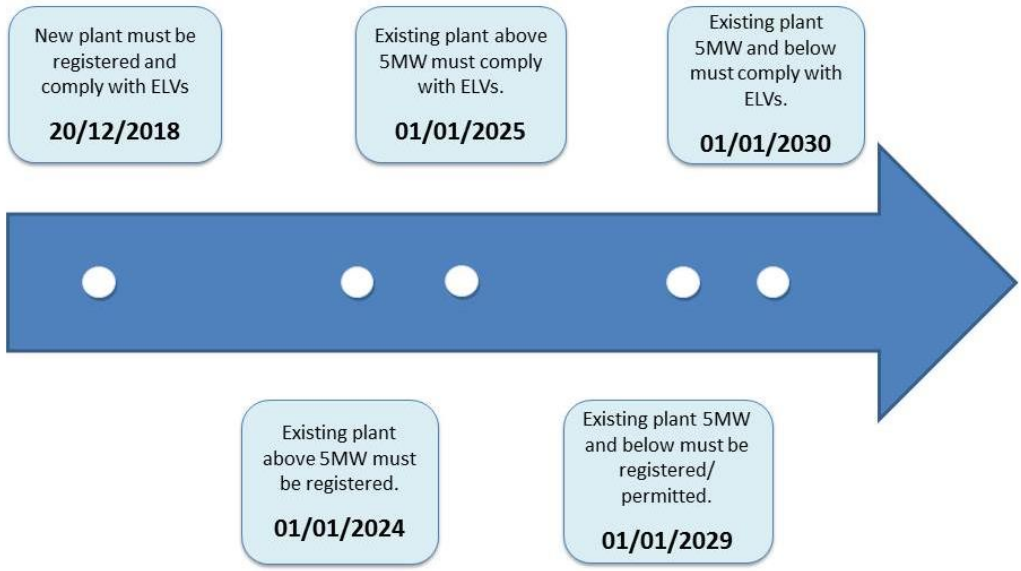
- ***Working plant*** = those operating on average more than 500 hours per year which are subject to compliance with emission limits.
- ***Stand-by plant*** = plant installed alongside working plant to provide for additional demand at peak times or in case of shut down of the main working plant, and operating fewer than 500 hours per year.
- ***Back-up plant*** = plant installed to provide emergency electricity generation in times of interruption to supply of mains grid electricity, operating rarely and normally much less than 500 hours per year (assumed to be less than 50 hours).

Abatement technology refers to techniques and technologies used to reduce pollutant emissions. Primary abatement prevents formation of pollutants and includes a switch to fuels which result in lower emissions, retrofitting of existing plant (e.g., by changing the burners) and selection of new plant with lower emission technology (e.g., lean burn engines). Secondary abatement removes pollutants from the exhaust gases, such as filters for dust or selective catalytic reduction to destroy NO_x.

MW; Megawatts – in this Impact Assessment unless otherwise stated this refers to Mega Watts of thermal input.

2.2 Directive Key Dates

Figure 2.2 Timescale for implementation of the Directive



2.3 Key Obligations

2.3.1 Operator

Operators are required to:

- Obtain permits for plants by set deadlines and update them as required; monitor emissions within four months of registration/permitting dates. An existing permit (e.g., issued under Chapter II of IED) can be updated or combined to include Directive requirements.
- Monitor emissions at a set frequency, ensure plants meet ELVs and keep non-compliance to a minimum.
- Record information regarding operation of plants.
- Keep records or information proving the effective continuous operation of secondary abatement.
- Keep start up and shut down periods as short as possible.
- Report certain non-compliances with ELVs to the regulator, and cease operation if requested by the regulator, when plants are causing significant degradation to local air quality.

2.3.2 Regulator

Regulators are required to:

- Set up a system for permitting or registration of combustion plants.
- Determine which permit conditions apply based on plant characteristics. Update or combine existing permits. Update the permit notified by the operator of any planned change to MCP which would affect the applicable emission limits.
- Establish a regime of compliance checks to enforce the Directive
- Publish, including on the web, a register with information about combustion plants permitted.
- Require operator to take any measures necessary to ensure that compliance is restored without undue delay.
- Order suspension of plant operation when non-compliance with emission limits is causing a significant degradation to air quality.

- Report data to Defra as required and to enable meeting reporting requirements to the Commission.
- Judge whether multiple new plants on an installation should be aggregated.
- Deal with reports from operators (e.g. lack of low sulphur fuels, non-compliance due to equipment faults) and set conditions for continued operations (e.g. adjustments to reduce emissions, time-bound exemption from compliance with ELVs).
- Set out a system for requesting data and information held and retained by operators for compliance with the Directive and in response to access to information requests by the public.

2.3.3 Member State

Member states are required to:

- Implement the Directive, and make decisions on whether and how to apply the flexibilities and exemptions allowed.
- Submit reports to the Commission with estimates of annual pollutant emissions from MCPs in 2021 (CO only) 2026 and 2031 (all pollutants).
- Report use of derogations from compliance with emission limits.
- Assess the case for applying stricter emission limits in zones which are non-compliant with the Ambient Air Quality Directive (following the provision of a report by the Commission for which no date has been set).

2.4 Plant numbers

By 2030, up to 9,400 working plants are expected to need to comply with emissions limits under the Directive with around 90% in the 1-5MW range, running in the main on natural gas, but also solid and liquid fuels, including biomass and biogas. In addition, up to 5000 plants are estimated to be stand-by and up to 9,000 backup plant, both of which are mostly exempted from Directive emission limits but nonetheless required to carry out some administrative tasks limited emission monitoring and undergo enforcement measures.

3. Problem under consideration

Addressing air pollution and its attendant health and environmental impacts requires action at local, national and international level, to address both hotspots and background pollutant concentrations. Indeed, about one third of air pollution is transboundary which requires joint action across Europe. Existing domestic legislation already places emission limits on medium combustion plants, mostly those above 20MW, while EU Ecodesign legislation applies emissions standards for some combustion plant up to 500KW. The controls assessed in this document are designed to deliver cost-effective emission reductions for plants with thermal input above 1MW and less than 50MW which will deliver improved air quality and public health benefits by introducing emission controls and driving a move towards low emissions technology.

The vast majority of plants that will fall within scope of the Directive are plant in the 1-5MW range, a significant proportion of which are low risk gas boilers with low levels of emissions.

The Directive should be transposed in a way which maximises benefits to air quality and public health. This will require plant operator's to comply with their permit conditions, while avoiding disproportionate costs to operators and regulators. In transposing Directive Member States are required to:

a) Decide whether to implement the exemptions provided.

b) Implement National systems or approaches in terms of permitting, enforcement and compliance.

Our proposed approach to transposition is presented in Section 6, including application of the allowed exemptions and flexibilities.

4. Rationale for Intervention

Combustion plants emit air pollutants (NO_x, SO_2, and PM) that can have a harmful impact on human health and the environment. However, plant operators are often not aware of or, necessarily impacted by these impacts. This is known as a negative externality. If combustion plants were impacted by the true cost of their operations (i.e. taking account of the cost of the pollution), they might operate in a manner more likely to benefit the environment and public health.

One of Defra's key objectives for 'Creating a Better Place for Living' is to ensure a cleaner and healthier environment, including cleaner air. In July the Government published "The UK Plan for Tackling Roadside Nitrogen Dioxide Concentrations". The rationale for intervention is reflected by the drive to deliver health and environment benefits through cost-effective improvements to air quality, ensuring operators of medium combustion plants have sufficient time to make the transition to comply with controls on their plants. In order to ensure that emissions from these plants continue to protect human health, Article 6 of the Directive requires Member States to ensure that plant operators carry out monitoring of emissions as a minimum in accordance with the requirements set out in Annex III. The health impacts are discussed in further detail in section 7.5.

Some plants, mostly those with capacities above 20MW are already subject to emission controls in the UK and in the future solid fuel plants up to 500KW will be subject to the requirements of the EU Ecodesign Directive. However, this will leave a wide regulatory gap which the Directive aims to plug. Emission controls under the UK Clean Air Act are focused on burning solid fuels in urban areas only, which is relevant only for a small minority of MCPs. Furthermore as the original Clean Air Act is now 60 years old, with the exception of smaller wood burners, the limits are such that most modern plants easily meet the requirements and therefore are not driving change towards cleaner emissions technologies. Regulation is therefore required to apply appropriate emission controls for this important source of air pollution in order to incentivise the development and uptake of cleaner technology and protect public health.

5. Policy Objectives

The policy objective is to improve air quality across the UK and protect public health. This assists in meeting both the requirements of the Ambient Air Quality Directive, which is already transposed into law in England by the Air Quality Standards Regulations, and the revised National Emissions Ceilings Directive, which we will be transposing by 1st July 2018.

Effective transposition of the Directive will also reduce the risk of infraction and, due to transboundary impacts, implementation by the rest of the EU will further improve air quality in the UK. The Directive allows a number of flexibilities, which Member States may choose to apply. It also allows Member States to determine the appropriate approach towards enforcement, monitoring and permitting. We intend to apply a number of exemptions and flexibilities to ensure transposition is not disproportionate for our operators to ensure they remain competitive with operators in other countries (our approach to applying the flexibilities is set out in Table 6.3). We will also adopt a risk based approach to enforcement and permitting to keep costs and burdens to a minimum whilst still protecting public health by improving air quality. Operators demonstrating compliance with the requirements will benefit from a light touch approach, whilst operators who fail to comply with their obligations will be subject to more stringent controls. We have consulted widely with stakeholders on our proposed approach to implementing the Directive. A summary of consultation responses and actions taken is presented in Annex E.

6. Analysis of Options

This section describes option 0 (baseline) and option 1 (Implementation of the MCP Directive in England and Wales). Under option 1, the detailed implementation approach is described, and where alternative approaches were possible, the approach selected is justified with the analysis (presented in section 8), informed by the responses to the public consultation (presented in Annex E).

6.1 Option 0: Baseline

A baseline scenario in which there is no implementation of the Directive is estimated. It is relative to this baseline that the implementation impacts are assessed. The detailed methodology for estimating the number of plants and their emissions in the baseline scenario can be found in Section 7.1, but a summary of estimated plant numbers in 2011, 2018 and 2030 is presented in Table 6.1 below.

Table 6.1 Estimated numbers of working, standby and back-up combustion plants

Plant type	2011	2018	2030
Working	9,930	9,983	9,414
Standby	4,891	5,856	5,413
Backup	8,940	8,940	8,936

The table above shows that an overall reduction in number of working plants is expected under business as usual between 2011 and 2030. This reduction reflects assumptions in the projections of energy efficiency improvements and a shift to renewable energy in line with the UK Carbon Budgets.

6.2 Option 1: Implementation of the MCP Directive in England and Wales

Under this option, the MCP Directive is implemented in England and Wales.

Error! Reference source not found. **Scope of MCPD**

Table 6.2 set out the scope and requirements in the Directive. Many of the requirements are fixed and will simply be 'copied out' into domestic transposing legislation. However as noted in Section 3, there are a number of exemptions to the directive requirements which Member States may choose to apply and areas of flexibility where Member States can implement a national system or scheme. In this section we will present the implementation approach and explain how we will be dealing with exemptions and flexibilities provided in the Directive and the rationale behind this approach. The implementation approach was informed by public consultation – we present a summary of the feedback received in the consultation and changes made to the approach in the Annex E. Other sub-options that were considered are presented and discussed in the Annex A.

Table 6.2 MCPD operator requirements and timescale of application

Average Annual Operating Hours	Plant age	Plant Size (MW)	Permit needed for operation	Applicable ELVs and deadline for compliance **(see Annex II of the Directive and table 6.4 for exceptions)**		Monitoring **Need for CO and pollutant for which ELVs apply within 4 months of permitting and then:**
Up to 500hours	New	1-5	From 20/12/2018	Only plants using solid fuels must comply with ELVs,	From 20/12/2018	Every 1,500h of operation, or at least every 5 years.
		5-20				
		20-50				Every 500h of operation, or at least every 5 years.

	Existing	1-5	From 1/01/2029	and for dust only.	From 1/01/2030	Every 1,500h of operation, or at least every 5 years.
		5-20	From 1/01/2024		From 1/01/2025	
		20-50				Every 500h of operation, or at least every 5 years.
More than 500hours	New	1-5	From 20/12/2018	As set out on Annex II of the Directive	From 20/12/2018	Every 3 years
		5-20				
		20-50				Annually
	Existing	1-5	From 1/01/2029		From 1/01/2030	Every 3 years
		5-20	From 1/01/2024		From 1/01/2025	
		20-50				Annually

In presenting the preferred approach we have grouped the requirements into 4 key themes:

1) Abatement costs – costs incurred by operators which employ abatement techniques to comply with the emission limits set out in the Annex II of the Directive for both new and existing plant
2) Administrative costs – costs incurred by regulators and operators for plant permits, data reporting, maintaining and updating data records.
3) Compliance checks –costs incurred by the regulator and operator when carrying out compliance checks.
4) Emissions monitoring – costs incurred by operators to meet the emission monitoring requirements in the Directive.

6.2.1 Abatement costs

The abatement costs for operators are determined according to the emission limit values (ELVs) applied and when these come into force. The Directive presents a number of options where Member States can implement ELVs that are less stringent or only apply at a later date for specific sub-categories of MCP. Our approach is to transpose all ELV flexibilities (except the cold weather, solid biomass and district heating exemptions) as set out in Table 6.3, and the impact of applying these flexibilities is presented in Table 8.15.

Table 6.3 Proposed approach for application of ELV flexibilities allowed in the MCP Directive and how they are included in the Impact Assessment

Flexibility	Proposed approach and rationale	Incorporated in analysis?
1) Exemption from Annex II ELVs for existing plant operating up to 500 hours per year as a five year rolling average	Applied in full – in line with government policy. For most plant operating a limited number of hours, compliance with ELVs is not proportionate considering the limited emission reductions achieved. If an operator exceeds 500h of operation in any year, this must be notified to the regulator.	Yes
2) Extension of time exempted in 1) above to 1000h for plant supplying heating in exceptionally cold weather.	Retain ability for Ministers to grant this flexibility in exceptional circumstances, but not expected to be used regularly. Only limited anecdotal of the need for this flexibility was received in the consultation, so it is prudent to retain the flexibility to apply it but in a way which will not make compliance checks more difficult and onerous.	No - no data is available on numbers or types of plants which will benefit from this exemption, but expected to be small and infrequent.

3) Extension of time exempted in 1) above to 1000h for plants in islands when the power supply is interrupted.	Applied in full – this is expected to be a very rare event where additional flexibility in the exemption from compliance to ELVs may be needed to allow power supply to be restored.	No – very rare event so probability and impact have not been quantified.
4) Delay in requirements for existing plant in Small and Micro Isolated Systems (SIS and MIS)	Applied in full – this would mainly concern small islands not connected to the grid and operating MCPs. We consulted with stakeholders who confirmed there are a very small number of such plants in England and Wales. The flexibility enables plants in such difficult locations longer time to achieve compliance.	No - disproportionate to estimate costs and benefits.
5) Delay in requirements for certain existing plant supplying heat to public district heating networks	Not applied – this will affect a low number of plants which would at best benefit from a 5 year delay in investment to comply with emission limits, but in return be subject to higher permitting costs. So the saving to operators would be very small and disproportionate to the impacts on air quality.	Yes
6) Delay in requirements for certain plant firing solid biomass	Not applied – this will affect very few plants which would at best benefit from a delay in investment to comply with emission limits, but in return be subject to higher permitting costs. So the saving to operators would be very small and disproportionate to the impacts on air quality.	Yes
7) Delay in requirements for certain plant used to drive compressor stations in national gas transmission system	Applied in full – this flexibility is required to allow enough time for upgrading the national gas grid, but impacts a very small number of plants (around 30). UK argued strongly for this requirement during negotiations.	No - disproportionate to estimate costs and benefits.
8) Exemption from Annex II ELVs for new plants operating up to 500 hours per year as a 3 year rolling average	Applied in full, – in line with government policy. For most plant operating a limited number of hours, compliance with ELVs is not proportionate considering the limited emission reductions achieved. If an operator exceeds 500h of operation in any year, this must be notified to the regulator.	Yes
9) Increase in NO_x ELV for new engines operating between 500-1500 hours provided they are applying primary abatement measures	Applied in full, in line with government policy (to note that this will be superseded by the additional controls on high NO_x generators, assessed in a separate IA).	Yes

Abatement technology requirements excluded from the analysis

It has been necessary to exclude some requirements relating to abatement technologies from the analysis as described below:

- The less stringent ELVs or later application of ELVs for plants firing solid woody biomass, straw, coke oven gas, heavy fuel oil, blast furnace gas, biogas; gas turbines operating less than 70% load; plant in Micro Isolated Systems (MIS) or Small Isolated Systems (SIS)[3] and slow speed engines (<1200 rpm) were not incorporated into the analysis as the baseline plant estimates do not distinguish these sub-categories of plant and given that the numbers of such plant are considered to be low the impact of these exceptions is anticipated to be negligible (well within the wider uncertainties and more likely to be within the rounding differences of the results) and the resources required to incorporate these into the analysis is disproportionate. The exclusion of these exceptions means the results will very slightly over state the compliance costs and the emission reductions (benefits) of the Directive.
- The Directive requires that Member States assess the need to apply more stringent ELVs in zones or parts of zones where air quality limits are exceeded. Application of such ELVs will be informed by a report to be produced by the European Commission for which there is no publication date. Government is implementing a plan for reaching compliance with air quality limits within the shortest possible time. As a result, the number

[3] Defined in Directive 2009/72/EC concerning common rules for the internal market in electricity as:
'small isolated system' means any system with consumption of less than 3 000 GWh in the year 1996, where less than 5 % of annual consumption is obtained through interconnection with other systems;
'micro isolated system' means any system with consumption less than 500 GWh in the year 1996, where there is no connection with other systems;

of plants potentially subject to more stringent ELVs will decrease over time and it is not possible to estimate the impact of this provision. Therefore it was excluded from the analysis.

- Application of fuel consumption weighted ELVs when plants use multiple fuels are excluded from analysis due to the uncertainty and complexity in establishing the range of possible fuel mixes, resulting emissions and ELVs applicable. The results of the analysis could under or over-state the compliance costs and benefits as a consequence of this are not being considered.
- Some MCPs are already subject to environmental permitting in the UK, either because they come in scope of the Industrial Emissions Directive or because they are regulated under domestic provisions (20-50MW plant) - for all these plants, there is a requirement to apply the Directive ELVs as a minimum. Plants regulated under IED are estimated to represent 5% of total MCPs but emission controls applied depend on type of industrial installation and where they are located, how they are used and number of operating hours, so it was disproportionate to review what current controls are being applied and as a result the analysis is likely to overestimate costs and benefits of implementing the MCPD.
- For plants regulated under domestic provisions (around 100 at present) it is proposed that any stricter limits currently applied for existing plant be retained because they have been proven cost effective and plant are already in compliance. For new plant, the emission limit for dust in biomass plant is slightly more stringent in domestic provisions than in the Directive, so we intend that these plants will require bespoke permits to allow application of the most appropriate ELV. All other Directive ELVs are more stringent than those currently required under domestic provisions. Due to the small number of plant, the costs and benefits of this approach have not been quantified.

6.2.2 Administrative costs

Choice of regulator and cost recovery

Member States are required to determine the regulators or competent authorities for the Directive. We consulted on whether this should be shared between EA and LAs to maintain the current status quo i.e. high risk plant regulated by EA and lower risk plant by LAs. Following the consultation we have decided that the sole-regulator will be the EA. This will result in lower transitional costs for training and development of tools to implement the Directive as well as provide greater consistency in implementation and clarity on who is the regulator.

In line with other sectors regulated under EPR, we expect that regulators will recover most of their costs from the operators in the form of permitting and subsistence fees. Costs have been estimated for this assessment however the actual fees and charges to be applied will be developed in discussion with the regulator, and subject to consultation with stakeholders. In addition, the regulator will have the following costs which cannot be recovered from operators and are not quantified in this assessment:

a) Setting up costs – staff training and development of guidance to operators and systems for permitting, managing compliance checks and publication of the public on line register of plant as required by the Directive.

b) Dealing with non-compliance – the proposals are designed to maximise compliance and so the costs associated with non-compliance are not quantified.

Approach to permitting

The Directive allows for a registration or permitting system to be adopted. Following consultation with regulators, we propose that MCPs will be subject to environmental permitting since this enables cost recovery in the form of a permitting charge and subsistence fees. However, we will follow a risk based-approach where, for the large majority of plants (including those exempted from compliance with ELVs), the permitting process will involve submission of the information specified in the Directive, which will automatically determine the permit conditions needed to comply with the Directive requirements. This permitting approach is not expected to create an additional burden in relation to a registration approach (other than the collection of enforcement fees) and provides clarity to operators regarding their obligations. For a small number of high risk plant, permits with bespoke conditions will be required to ensure their conditions protect local air quality. This goes beyond minimum requirements of the Directive for high risk plant but is required for compliance with air quality standards and to enable application of domestic emission controls already in force for 20-50MW plant where they are stricter than those applied under the MCPD. Where a plant in scope of the MCPD is already covered by a permit issued by the EA, the permit will be amended to ensure compliance with the MCPD. Where a plant in scope of the MCPD is already covered by a permit issued by a LA, the LA permit conditions applicable to the plant will cease to apply and the operator will be required to apply to the EA for a new permit.

6.2.3 Compliance check costs

Member States must set up a system of environmental inspections or other measures to ensure compliance with the Directive. Based on consultation with operators and regulators, routine site inspections were deemed unnecessary to enforce the Directive for all but the high risk 20-50MW (which are already subject to this type of inspection under the EPRs). During desk-based compliance checks regulators will be expected to check data and documentation submitted by the operator covering emissions testing, operation of abatement equipment and reporting of operating hours. Compliance check frequency will be tailored to plant risk, as is currently the case for activities already regulated under EPR. For the purpose of the impact assessment, assumptions were made ahead of development of the risk categorisation, which will be part of enforcement guidance and done in discussion with stakeholders.

The following 2 compliance check scenarios have been analysed:

- Scenario 1: all MCPs are subject to scheduled compliance checks supported by mandatory reporting of data to enable the checks;
- Scenario 2: all MCPs are subject to random compliance checks for which regulators request operators to submit data;

The frequency of compliance checks under both scenarios is presented on Table 6.4. Random compliance checks are assumed to be more effective to promote compliance, therefore the frequency of checks is reduced under Scenario 2. The risk categorisation and frequency of checks may be adjusted to reflect eventual certification schemes developed by industry. This is tested for Option 1 in Section 8.4 as this is a key impact of implementing the MCPD (Scenario 1 was selected as the preferred option which was used for estimating implementation costs).

Non-compliance

The burden for regulators and operators from non-compliance with the Directive is not estimated; non-compliance may result in operators moving to a higher risk category, which will lead to more frequent compliance checks, recovered through annual fees. The legislation will contain powers for criminal prosecution, but it is anticipated that these will act as a deterrent and be used only in very rare instances where operators persistently fail to achieve compliance with the Directive, particularly when this impacts on local air quality.

Member states are required to specify when non-compliance with ELVs must be reported by operators to the regulator, and how. This provision is required to enable regulators to order a plant to cease operation if it is causing significant degradation to air quality. We will restrict reporting of non-compliances with ELVs only to those which may cause a problem to local air quality. These are expected to be rare events, so its administrative cost has not been estimated.

Table 6.4 Frequency[4] of compliance checks for the two scenarios

Checks per annum[5]	High risk[6] 1 working plant[7]	Medium risk 1104 working plants	Low risk 8079 working plants (plus those defined as back-up/stand-by)
Scenario 1 – scheduled compliance checks			
Plant required to comply with ELVs	20-50MW 1 site inspection 1-20MW 1 remote check	20-50MW 1 remote check 1-20MW 0.3 remote check	20-50MW 0.5 remote check 1-20MW 0.3 remote check
Plant exempt from compliance with ELVs (to note the current proposal is to deem all low risk)	20-50MW 1 remote check 1-20MW 0.5 remote check	20-50MW 0.5 remote check 1-20MW 0.3 remote check	20-50MW 0.3 remote check 1-20MW 0.2 remote check
Scenario 2 – random compliance checks[2]			
Plant required to comply with ELVs	20-50MW 0.5 site inspection 0.5 remote check 1-20MW 0.5 remote check	20-50MW 0.5 remote check 1-20MW 0.3 remote check	20-50MW 0.2 remote check 1-20MW 0.17 remote check
Plant exempt from compliance with ELVs (to note the current proposal is to deem all low risk)	0.17 remote check		

6.2.4 Emissions Monitoring Costs

Operators are required to monitor emissions every three years for 1-20MW plants and every year for plants over 20MW. The Directive also allows Member States to lower frequency of monitoring for plants which are exempt from compliance with Annex II ELVs and we intend to apply this flexibility as these plants will be operating less than 500 hours as standby only and therefore their risk to air quality will be low. Member states are required to determine the monitoring standards and we are working with industry and regulators to establish a suitable approach. For the purpose of this impact assessment the cost of emissions monitoring is estimated based on monitoring standards currently applied to plant over 50MW in the UK i.e. MCERTs. However, for the majority of MCPs (those using natural gas and gas oil) which are only required to monitor NO_x and CO emissions this standard is considered disproportionate. Therefore we are working with industry to agree less burdensome methods possibly utilising existing plant maintenance systems. For the purpose of this impact assessment we have assumed that MCERTs is required for all plant and therefore the monitoring costs are significantly overestimated.

Member States must also decide whether to require continuous monitoring. Continuous monitoring was considered expensive by stakeholders and it was felt it should not be required. However, where operators choose to use continuous monitoring it will be considered an acceptable alternative.

[4] Frequencies are indicative

[5] 0.5 = one check every two years; 0.3 = one check every 3 years; 0.2 = 1 check every 5 years; 0.17 = 1 check every 6 years.

[6] For the purpose of this assessment, 20-50MW plant operating on solid fuels were assumed high risk, remaining plant using solid and liquid fuels other than gas oil were assumed medium risk, and all other plant (those using gas oil and gaseous fuels) were assumed low risk.

[7] Number of operating plants in 2030

7. Methodology

The controls on combustion plants aim to achieve beneficial impacts for the environment and human health. The intended benefits of these controls would be delivered via reductions in emissions of air pollutants, and the costs would fall mainly on operators.

The following section sets out the methodology used to assess the impacts of implementing the MCPD. The impacts can be split into the categories summarised below, which are detailed fully in the remainder of Section 7.

The Impact Assessment has a 15 year assessment period which begins in 2018, when the first costs arising from implementation of the Directive will be incurred (transitional costs to set up the register), and involves a calculation of the total net present value for the period. This 15 year appraisal period is needed to cover full implementation of the Directive (complete in 2030). A longer assessment period was not selected due to the uncertainty in future technologies and the remaining operating life of existing plant.

From 2030 onwards, all plant in scope of the Directive will be subject to permitting and compliance with emission limit values and monitoring, so the impacts will have reached a steady state and in future years will differ only as a result of new plants replacing existing plants on reaching the end of their operating life. As such, a 2030 annualised steady state figure is presented to indicate the potential impact in subsequent years beyond the appraisal period.

Regulator costs were estimated based on the activities required for enforcement, in dialogue with the regulator– the Environment Agency.

COST IMPACTS

- **Emission Abatement Costs** – These are the costs that will be incurred by plants which will require abatement to meet the emission limits - for purchasing, fitting and operating abatement technology. (see **Section 7.2**)
- **Administrative, Monitoring and Compliance Costs** will consist of permitting, reporting, monitoring and compliance checks (inspections). These costs will fall to both plant operators and regulators; however, most of these costs will be recovered from operators. These costs will be incurred by all plants falling in scope of the MCPD and vary by type, size and complexity of the plant (see **Sections 7.3** and **7.4**). Costs relating to start-up (registration process, raising awareness for new regime), training of regulators and some of the costs of non-compliance cannot be recovered and will be funded through Defra's delivery budget.

Under the MCPD, working plants would need to comply with ELVs if necessary, and complete all of the administrative and compliance requirements. Plant exempt from ELVs (predominantly back-up and stand-by plant) will need a permit (under administration costs), monitor emissions for carbon monoxide (CO) only and be subject to compliance (inspection) checks. The distinction between new and old, and size of plant governs the date from which they have to carry out requirements (as set out in Section 6.2).

BENEFITS TO THE ENVIRONMENT AND HUMAN HEALTH

- **Monetised Benefits –** The emissions limits will reduce air pollution from MCPs. This provides monetised benefits to society, mainly as improved human health. There are also co-benefits between air quality and (GHGs) greenhouse gases (CO_2) which have been monetised and included.
- **Non-monetised benefits –** Damage costs do not capture all health benefits so there are additional health impacts that are non-monetised. In particular, morbidity impacts are largely not included within the damage costs. Furthermore, there are also wider environment benefits from reduced emissions such as improvements to ecosystems but these benefits are not possible to monetise.

The costs and benefits from changes in emissions are calculated as the difference between the implementation of the MCPD against a baseline where the Directive is not implemented. The baseline is introduced in section 6.1 and the methodology for its calculation is explained in Section 7.1. This policy ensures operators comply with relevant ELVs, fitting abatement technology where needed.

7.1 Baseline

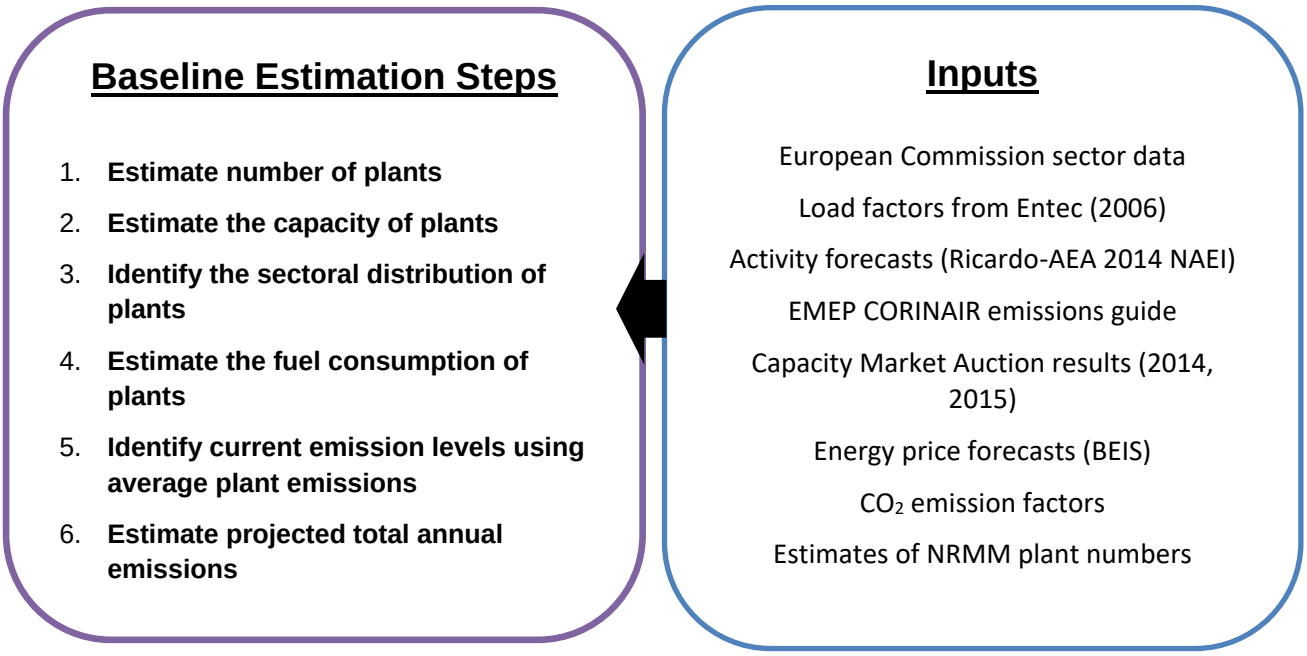
As the plants under consideration are not generally regulated at present (unless connected to an IED regulated installation or in the range 20-50MW), numbers and type of plant had to be estimated.

The estimation is based on fuel consumption and projections from the NAEI/BEIS, incorporating assumptions about size, technology type (boiler, engine, turbine), and operating hours from EU averages, supplemented by estimates of NRMM plant numbers. The majority of the analysis is based on data gathered and/or derived for the Commission MCPD study (Amec Foster Wheeler, 2014). The assumptions and data are based upon the best available evidence (Figure 7.1), however it must be noted that it came from a diverse range of sources, which introduces some uncertainty. The baseline is also adjusted to take into consideration reductions in payments (known as embedded

benefits) that Ofgem make to small diesel generators for producing electricity at peak times and BEIS measures to improve capacity markets.

The remainder of this subsection details the estimation process.

Figure 7.1 Baseline steps and corresponding inputs



Step 1: Estimate number of plants

A baseline scenario in which there is no implementation of the MCPD is estimated. It is relative to this baseline that the impacts of implementing MCPD are assessed.

The baseline scenario was created through estimation of the number of MCPs currently operating in England and Wales, with associated capacity, sectoral distribution, average operating hours and unabated emissions. National fuel consumption data and average plant size and working hours per sector were used to estimate plant numbers per fuel.

The estimated plant numbers and assumptions about operating hours and unabated emissions by plant type, size and fuel used were used to estimate total emissions from 2011 through to 2030, against which the emission reductions achieved by transposing the MCPD were calculated. Sections below detail the methodology used to calculate the base year and projected baseline demonstrated in Table 7.1. Please note that this table presents the number of plants in scope of the regulation at a given point in time; therefore, the increase in years 2024 and 2029 correspond to timings of the MCPD.

Table 7.1 Plant numbers by capacity size and category

Number of plants	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Plant numbers by capacity and age															
Existing 1-5 MW	-	-	-	-	-	-	1,155	1,110	1,071	1,031	992	953	914	875	837
Existing 5-50 MW	-	-	-	-	-	-	-	-	-	-	-	15,140	14,757	14,146	13,534
New	-	662	381	1,256	2,132	3,007	3,883	4,515	5,156	5,798	6,439	7,081	7,721	8,360	8,999
Total	**-**	662	381	1,256	2,132	3,007	5,037	5,625	6,227	6,829	7,432	23,174	23,393	23,381	23,370
Plant number by category															
Working	0	267					2,316	2,534				9,191	9,414	9,406	9,398
Stand-by	0	146					1232	1354				5,047	5,043	5,039	5,036
Back-up	0	248					1,489	1,738				8,936	8,936	8,936	8,936

Total	**0**	662			5,037	5625		23,174	23,393	23,381	23,370

2011 baseline

Table 7.2 provides a summary of the number of plants for the 2011 baseline estimate in scope of the MCPD in England and Wales, with a summary of the estimated emissions from these plants in 2011. From 2018, when MCPs start to register, more accurate plant numbers will become available, which will be utilised for subsequent post implementation assessments.

There is reasonable data on current plants over 20MW because they are already subject to environmental permitting in the UK and registered under the EU Emissions Trading Scheme, however these represent a small number of the plants in scope. Data on number and location of plants smaller than 20MW was very incomplete and so the number was estimated following the methodology described in this report. Additionally, much of the dataset used in this study has been based upon the Impact Assessment which underpinned the Commission MCP Directive Proposal (Amec Foster Wheeler, 2014). The public consultation was used to address the uncertainty in plant numbers, however no significant evidence was collected from stakeholders. It appears at this stage that aggregated data on the number of plants smaller than 20MW is not available, and that the assumptions presented are based on the best available evidence.

Table 7.2 Summary of England and Wales baseline dataset (estimation for 2011)

Source	Number	Total Capacity (MWth)	Fuel consumption (PJ)	SO_2 emissions (t)	NO_X emissions (t)	PM emissions (t)
Working plants	**9,930**	31,102	370	31,123	38,950	5,813
Standby	**4,891**	15,319	9	818	1,023	153
Backup	**8,940**	21,233	2	723	1,550	194

2030 baseline projection

Using supplementary data from the NAEI team and European data (Amec Foster Wheeler, 2013), it was possible to split plants into size category (capacity class) by fuel type (gas, oil, solid fuels and biomass).

Less information was available for plants running shorter hours, which are categorised as standby plants. Although they are exempt from compliance with ELVs under the MCPD, these plants will face administrative and monitoring costs. Therefore, following consultation with National Grid on the capacity available in existing energy balancing market revenue streams (600MWe), specifically short run hour streams such as STOR (Short Term Operating Reserve), the figures from the European data were deemed too low for diesel and gas plants, and were updated accordingly. This existing capacity was sense checked with results of 2014 and 2015 Capacity Market auctions where plants bidding identified as existing or new build. The vast majority of these are assumed to be 1-5MW, which is typical of plants with shorter operating hours.

The total number of plants in operation was projected to 2032 using growth figures for each fuel type derived from data provided by the NAEI team (in 2013). A growth threshold of 10% was assumed; meaning that a change in activity less than 10% could be met by the existing number of plants as part of the flexibility in their working output capacities. A change beyond the threshold would result in a decrease or increase in number of plants needed.

Whilst the main dataset has been derived for three main capacity classes, data from the NAEI team was used to help categorise the plants. The number of gas and diesel engines in the capacity market in 2018 and 2019 was estimated using auction data from 2014 and 2015 and the model's assumptions on the proportion of plants in each size category (i.e. 1-5MW, 5-20MW, 20-50MW) and on the average plant size in each of these categories.

Plant growth for 2020 was estimated using BEIS's (then DECC) assumptions on the future growth of the capacity market (central scenario). These assumptions were produced before the OFGEM embedded benefits announcements and BEIS changes to the capacity markets.

The decision to reduce the embedded benefits will affect the generation mix of new capacity over the assessment period. As a result, the growth of diesel and gas engines in the capacity market has been revised down. This impact is estimated based on the difference between the 'status quo' (i.e. the current arrangement) and the announced change. The new capacity of reciprocating diesel and gas engines were revised down by 70% up to 2026 and 90% thereafter (2027-2032) relative to the estimates published in the consultation IA. The BEIS change to the capacity markets is likely to have a much smaller impact. The number of new gas and diesel engines in the capacity market has been further adjusted to reflect the policy change.

In addition, further analysis was performed on non-road mobile machinery (NRMM) plants, as it was identified that some of them would not be captured by estimations of plant numbers based on NAEI fuel consumption data. This led to the addition of 230 working plants in the 1-5MWth category in 2030, 90% of these plants being projected to be diesel engines.

Incorporating the evidence specified and with additional consultation with stakeholders, it is therefore estimated that in 2019, there will be around 146 standby plants in scope of the regulation, which increases to around 5, 000 by 2030.

It is also estimated that by 2030 there will be up to 8,936 back-up plants based on industry consultation throughout the appraisal period.

Under this regulation, back up and standby plants will need a permit, face monitoring for CO and will be subject to compliance (inspection) checks. The rest are assumed to be working plants.

The projected number of plants and their age was based on estimating the renewal rate associated with an estimated lifetime of 36 years. Lifetime was assumed to be twice the average plant age (18 years) as indicated by data from the consultation. This approach resulted in an estimation of 33% of plants classified as new and 67% as existing in 2030 for working plants as categorised by the MCPD definition.

The forecast dataset for working plants for 2030 is presented in Table 7.3 separating the number of new and existing plants.

Table 7.3 Summary of England and Wales baseline working plant dataset (projection for 2030)

Numbers of existing plants	Numbers of new plants	Total Capacity (MW)	Fuel consumption (PJ)	SO_2 emissions (t)	NO_X emissions (t)	Dust emissions (t)	CO_2 emissions (t)
6,353	**3,061**	29,133	346	23,047	39,491	4,521	18,567,224

This table shows that an overall reduction in number of working plants and emissions is expected under business as usual between 2011 and 2030. This reduction reflects assumptions in the projections of energy efficiency improvements and a shift to renewable energy in line with the UK Carbon Budgets.

Step 2: Estimate the capacity of plants

The estimation of the total capacity of combustion plants has been undertaken using the EU average capacity per plant shown in Table 7.4 below[8], multiplied by the numbers of projected plants in 2030. The average plant size in each capacity class was determined from complete data gathered from Member States both on numbers of plants and the capacity per plant in Amec Foster Wheeler (2012) and the more recent study published in February 2014 from the European Commission. The EU averages and data sets include Member States who already regulate MCPs.

Table 7.4 Assumed average capacity per plant

Capacity Class	Assumed EU average plant capacity (MW)
1-5MW	2.4
5-20MW	9.5
20-50MW	29.5

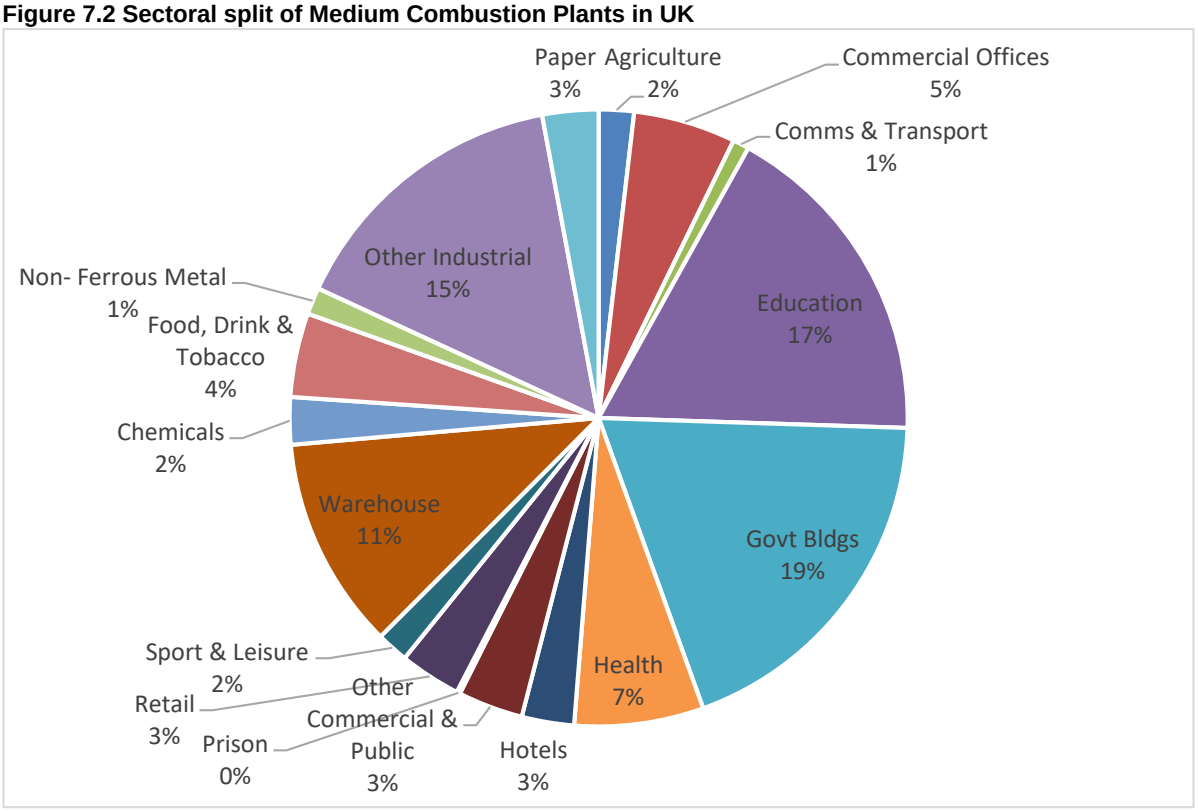
For working plants, an additional sensitivity scenario has been performed to demonstrate the impact of varied numbers of plants. An upper estimate for plant numbers is estimated by applying the bottom end of each capacity range (i.e. 1, 5 and 20MW) as more plants would be needed to keep the capacity consistent. The lower estimate for plant numbers has been estimated by applying the top end of each capacity range (i.e. 5, 20 and 50MW) as higher capacity per plant would result in fewer numbers of overall plants. This is presented towards the end of the results section.

Step 3: Identify the sectoral distribution of plants

Information on the number of MCPs operating in the UK across different business sectors was developed in collaboration with Ricardo; this is illustrated in Figure 7.2. This information was used to develop the assessment on distributional effects, as presented later in this report. Section 11 details the business impact assessment.

[8] Amec Foster Wheeler (2012)

Figure 7.2 Sectoral split of Medium Combustion Plants in UK



Source: Ricardo-AEA, 20 October 2014.

Step 4: Estimate the fuel consumption of plants

Total fuel projections and capacity etc. are used to estimate plant numbers as above. Once plant numbers are estimated, their fuel consumption must be estimated in order to calculate emissions.

Fuel consumption has been estimated by using:

- Projected number of plants as estimated above, average capacity data from the Commission study, and;
- An assumed average load factor of 37% under 8,760 hours i.e. 3,241 hours per year

The average load factors were calculated using the same data regarding utilisation of MCPs in different industrial sectors used by Ricardo to derive the initial plant numbers. This approach assumes the emission factors remain constant over time as there is no reason for this to change under business as usual (BAU).

Step 5: Identify current emission levels

Current annual emissions from MCPs in the UK have been derived based on assumed operating hours and emission rates from these plants. These emissions are based on a combination of the “general case” ELVs developed and applied in the Commission study (essentially the maximum values applied to national legislation across Europe), emission factors derived from the EMEP CORINAIR emissions guidebook (primarily for biomass SO_2 emissions) and data that have been returned by stakeholders as part of the informal consultation for this study.

It should be noted that natural gas boilers are the largest and most common contributors to NO_x emissions from MCPs. As existing and new plants have different ELVs, the split was done for these two categories separately. Information is based on real plant performance, and what percentages of each type of plant (new/old and size) have BAU emission levels already below the MCPD ELVs. The data was collated in 2014, and assumed to apply for all years 2018-2032 as without MCPD. Annex B provides the number of each abatement technology actually fitted by 2030 to plant that need to abate in order to meet ELVs and the scale of how many are already compliant with emissions limits. This is also introduced further in section 7.2.

Additionally, consultation with industry identified that for gas standby plants; there are many examples of plants operating higher than the base case ELV proposed in the MCP Directive. In order to correct for this, 20% of gas engines and turbines are assumed to have higher base case emission of 1500mg/Nm^3. This is a conservative approach as on average, gas emissions are typically lower.

Step 6: Estimate total annual emissions

Base case emissions have been estimated based on projected fuel consumption, the emission levels described above and application of specific flue gas volumes.

These basecase emissions are demonstrated in Table 7.5 below.

Table 7.5 Basecase emissions of all plants under the MCPD

	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Quantity SO_2 (t/yr)	23,862	22,342	22,050	21,757	21,464	21,172	20,879	20,893	20,893	20,893	20,893	20,620	23,316	23248	23,180
Quantity NO_x (t/yr)	37,183	36,605	36,222	35,839	35,456	35,074	34,691	34,427	34,254	34,081	33,908	33,735	39,581	39408	39,236
Quantity PM (t/yr)	4,460	4,186	4,127	4,069	4,010	3,952	3,893	3,888	3,878	3,867	3,856	3,846	4,576	4565	4,554

The results section presents the impact of the controls on combustion plants on emissions reductions. This impact is additional to existing legislation such as the Gothenburg Protocol, EU legislation and UK legislation.

7.2 Abatement Costs

The base case emission levels for each capacity class, fuel and combustion plant type are compared against the scenario limit values to determine the required emission reductions. This indicates whether additional abatement measures would need to be implemented in order to meet the scenario limit values.

Abatement costs come from the best available evidence sourced by Amec Foster Wheeler, which includes the recent Amec Foster Wheeler study for the Commission (Amec Foster Wheeler, 2014). The modelling identifies the most suitable abatement measure for each sub-group of plant. Suitability for each sub-group depends on the necessary emissions reduction required for each pollutant, the type of combustion plant technology (boiler, engine, or turbine), whether it is new or old, and its fuel type and capacity class. The study considers both primary abatement (such as cleaner burners or fuel switch) and secondary abatement measures (e.g. SCR, SNCR, etc.). Annex B presents the methodology in further detail with the list of abatement measures and associated uptake frequency. The summary in the results section presents this on a per plant basis.

Plants that are required to change their behaviour in order to comply with MCP have all been assumed to fit the most cost-effective abatement technologies or switch to cleaner fuel to meet ELVs. Please see Annex D for details supporting this assumption. The number of MCPs potentially affected is presented in Table 7.6. Not all of the plants will need to fit abatement or switch fuel as some are able to comply with the MCP ELVS already under business as usual, so for those plants the compliance costs are zero in the averages and year-on-year impacts (Annex B details the estimated scale). As discussed in the remainder of this section, they will nonetheless incur admin (registration, reporting etc.) and monitoring costs.

It is possible for plants (and units) with an input of less than 50MW to be covered by the IED in situations where the aggregated capacity on site is more than 50MW or if they are "directly associated activities with a technical connection" to other IED activities. Exact data on the numbers that are “directly associated” in the UK are not readily available. We have included an approximate estimate based on findings in Amec Foster Wheeler (2013) (5% of 1-5MW, 10% of 5-20MW and 40% of 20-50MW) for use in the administrative burdens assessment as it is assumed that they will incur lower costs due to the plant already being covered by a permit. (See impacts for administration burden in section 7.3).

Table 7.6 Number of MCPs affected by size and type and their share as IED installations (2030)

Capacity	Turbines	Engines	Boilers	Total	Share of total	Proportion of MCPs that are directly associated to an IED installation	Number of IED associated plants
1-5 MW	41	15,199	10,965	26,204	95%	5%	1,310
5-20 MW	57	323	1,101	1,482	5%	10%	148
20-50 MW	2	1	13	16	<1%	40%	7
Total	100	15,523	12,079	27,702			1,465

However, abatement costs are assumed to still be incurred as, whilst a plant may be included in a permit, it does not necessarily have to meet any minimum ELVs. If there are instances where directly associated MCPs are set ELVs then the results of the analysis may be over-estimated, depending how strict those ELVs are.

Some types of plant, namely natural gas boilers are assumed to reach compliance with the ELVs set and therefore do not face the cost of abatement. For a small number of plants, they can meet limits by just switching fuel. The cost of the switch is included in the analysis.

Annex B lists the cost of abatement technology considered in this study, along with the number of working plants that will need to fit each abatement technology in 2030 to comply with MCP. Section 8.3 in the results section presents the associated present value costs.

7.3 Administrative costs

Administrative burden

The permitting, compliance check and reporting elements set out in Articles 5, 8 and 11 of the Directive will result in a range of one-off and recurring activities by regulators and MCP operators. Costs associated with different elements of administrative burden will depend on the actions required, the number of MCPs affected for each action, and the associated timing, frequency and level of expertise (tariff per hour) required in those actions.

Plants that are estimated to need a bespoke permit include:

- 20-50MW plant using solid fuels
- Plants in non-compliant zones or part of zones

All other plants need a standard permit. MCPs that fall under the 500 operating hours' exemption are required to record hours of operation. The administrative cost of this has been considered in all scenarios run by the model.

The complexity and consequent time estimated for issuing a bespoke permit is higher than standard registration. The costs are therefore higher for bespoke permits.

In instances where existing MCPs are already covered by an IED permit, costs associated with record keeping and compliance check requirements are assumed to be covered under the business as usual administrative costs. For permitting related activities, 70% of costs are assumed to be covered by business as usual administrative burdens, as the majority of the information required in the Annex I would have been already provided in the permit and so be readily available.

When available, assumptions on administrative costs are based on estimates provided by the Environment Agency, the appointed regulator. In other cases, costs are based on estimated time required to carry out the tasks (Amec Foster Wheeler estimates) and tariffs per hour estimates.

Key assumptions used to calculate tariff per hour are summarised in Table 7.7 and have been validated with regulators. These have been uplifted to 2014 prices using the GDP deflators available from HM Treasury. Non-wage costs include all costs that companies pay when they employ staff in addition to the wage (e.g. pension contributions, benefits in kind paid by the employer etc.). Overhead costs are other costs such as office space, laptops, equipment, etc.

Table 7.7 Tariff per hour (2014 prices)

Elements of total tariff	Public administration	Energy sector	Source
Hourly wage	15.34 £/h	16.93 £/h	ONS UK. Patterns of Pay: Results from the Annual Survey of Hours and Earnings (ASHE), 1997 to 2012; table: Full-time employees' pay by industry sector (SIC 2007)c, United Kingdom, April 2008 - 2012; data: Median hourly earnings excluding overtime (£); sector - Public administration and defence; compulsory social security and Electricity, gas, steam and air conditioning supply, 2012p
Overhead costs per hour	30%	30%	Amec Foster Wheeler assumption and ASHE
Non-wage costs per hour	30%	30%	Amec Foster Wheeler assumption[9]
Total tariff per hour	**£24.25**	**£26.76**	

[9] Based on Eurostat (2015): Labour cost, wages and salaries, direct remuneration (excluding apprentices) - NACE Rev. 2 [lc_ncost_r2]. According to this, in the UK 2012 total labour cost was higher than wages and salaries by 27% in the electricity, gas, steam and air conditioning supply sector and by 29% in public administration and defence; compulsory social security.

A list of activities associated with administrative burden imposed on operators and regulators by the Directive including estimated time required to carry out the tasks is detailed in Annex C of this document, where the key categories of activity per plant are listed.

Where ranges are presented, the specific hours within the range depend upon whether bespoke or standard, size, and whether new or old plant.

One-off (costs provided by the EA)

- Permitting: notification to the EA by operator and production of a permit, depending on plant type and risk category (costs per plant):
    - High risk plants (bespoke permit including dispersion modelling): **£5,500**
    - Low risk plants (standard permit): **£412**
    - Back-up and stand-by plants (exemption permit): **£113** and **£169**
- Development of the MCP register by the Environment Agency: **£380k**. This is considered a transitional cost in the analysis.

Recurring (costs based on Amec Foster Wheeler estimates)

- Data reporting[10]. **2.5 – 50 hours for operators, and 1-25 hours for regulators.**
- Record keeping. **7.5 hours for operators.**
- Reporting: three reports to the Commission (2021, 2026 and 2031). **Regulator 37.5 hours.**

The Directive requires three reports to be submitted to the European Commission over the course of 10 years. Associated costs were assumed to be spread equally over this time period. No explicit cost estimates were developed for notifications of malfunctions and planned changes, as the potential number of MCPs affected is highly uncertain. However, in both instances the additional administrative burden costs are likely to be very small and will fall to Defra and the regulator.

Additional administration estimation assumptions:

The administrative costs are based on a paper-based communication channel between the regulator and operator. It is likely that an online system would be in operation which is likely to be less costly and therefore the costs included in this assessment should be considered the maximum (worst case). If an operator is responsible for multiple MCPs of the estimated average size, the administrative costs would scale up proportionately.
The regulator may seek to develop a centralised and digital based central portal by the time the MCP directive comes into force. This approach would make data more readily available, to meet publication and reporting requirements in the Directive. This approach would deliver savings in administration costs for regulators when processing permit applications, and may reduce administration costs for industry.

Compliance Checks

In the context of compliance checks (i.e. inspections) administrative burden was estimated in accordance with different approaches:

- Approach 1: all MCPs are subject to scheduled compliance checks supported by mandatory reporting of data to enable the checks;
- Approach 2: all MCPs are subject to random compliance checks for which regulators request operators to submit data;

Non-compliance

The burden for regulators and operators from non-compliance with the Directive is not estimated; non-compliance may result in operators moving to a higher risk category, which will lead to more frequent compliance checks, recovered through annual fees. The legislation will contain powers for criminal prosecution, but it is anticipated that these will act as a deterrent and be used only in very rare instances where operators persistently fail to achieve compliance with the Directive, particularly when this impacts on local air quality.

Member states are required to specify when non-compliance with ELVs must be reported by operators to the regulator, and how. This provision is required to enable regulators to order a plant to cease operation if it is causing significant degradation to air quality. We will restrict reporting of non-compliances with ELVs only to those which may cause a problem to local air quality. These are expected to be rare events, so its administrative cost has not been estimated.

[10] The directive requires record keeping for at least 6 years and data reporting will be required for compliance checks.

Table 6.4 in Section 6.2 outlines the compliance (inspection) check approach, and how it depends on the risk categorisation of the plant. The underlying assumptions on hours and activities are set out in the table in Annex C. After consultation, scheduled compliance checks (Approach 1) were selected as the preferred approach.

Summary of administration and compliance check costs

Table 7.8 presents total one-off upfront costs of administration and compliance (inspection costs). Of these costs, 61% are incurred by the operator while 39% are directly paid by the regulator. The regulator may recover the costs incurred through fees and charges levied on the operator.

Table 7.8 One-off administrative costs to operators and regulators for working and standby plants (£k, 2014 prices)

One-off administrative burden costs, £k 2014			Equivalent annual costs 2030, £k 2014		
MCP operators	Regulators	**Total**	MCP operators	Regulators	**Total**
2,560	1,705	4,265	222	148	370

Table 7.9 and Table 7.10 show the recurring, annualised administration cost faced by each plant size in 2030, when the legislation is fully in place. Table 7.9 presents the costs of inspections and remote checks for each scenario, based on the previous assumptions on frequency, required time and tariff per hour. Table 7.10 presents the other administration costs that contribute to the total overall admin burden by plant size.

Table 7.9 Annualised inspections and remote checks costs in 2030 by plant size (£k, 2014 prices, discounted).

	Annual inspections and remote checks burden - Approach 1			Annual inspections and remote checks burden - Approach 2		
Capacity (MW)	**MCP operators**	**Regulators**	**Total**	**MCP operators**	**Regulators**	**Total**
1-5	0	1,064	1,064	0	457	457
5-20	0	64	64	0	24	24
20-50	0	1	1	0	0	0
Total	**0**	**1,128**	**1,128**	**0**	**481**	**481**

Table 7.10 Annualised other administrative costs (without inspections and remote checks) in 2030 by plant size (£k, 2014 prices, discounted)

	Annual administrative burden (without inspections and remote checks)		
MCPs size	**MCP operators**	**Regulators**	**Total**
1-5 MW	4,594	675	5,269
5-20 MW	297	43	341
20-50 MW	3	1	4
Total	**4,894**	**720**	**5,614**

The preferred inspection approach is scheduled checks i.e. Approach 1. This approach imposes an administrative burden on the regulator which may be passed on to operators in the form of higher charging and permitting fees.

Please note that the average includes all plant (working, back-up and standby in 2030). As such, back-up and stand-by plant which are exempt from compliance with ELVs would pay below the average, working plant requiring a standardised permit a small multiple above the average, and plants requiring a bespoke permit potentially a multiple of the average. This is because of the level of complexity and consequent effort for compliance checks, reporting, and other administration differs by plant category.

We propose charging operators appropriate fees to recover regulator costs, which is consistent with the Environmental Permitting Regulations and other cost recovery schemes, thus avoiding additional burdens on public finances.

As an indication, the authority will charge an upfront and annual subsistence fee; to recover the regulator costs outlined above, where up front could cover the one-off and annual subsistence the recurring amount. The specifics of the charges will fall under the remit of a separate review Defra is conducting into local authorities recharging structures.

For the estimation in this impact assessment, all costs to regulators are considered direct costs to business as per BEIS guidance on fees and permitting. This is detailed in the EANCB section (Section 11.3).

The one-off cost of setting up the register is considered transitional and outlined in the front sheets. The other transitional costs are not quantified in this impact assessment as it was deemed disproportionate to conduct primary research and obtain estimates given the relatively small expected impact. They include communications, guidance, training of regulators and setting up tools for permitting and carrying out compliance checks.

Guidance will be developed by the EA as part of their role in support of Defra policy, and we are working with trade bodies and regulators to raise awareness, and familiarity, and ensure operators are aware of the requirements and guidance.

7.4 Monitoring costs

In order to ensure that plants would comply with the advised ELVs and continue to protect human health, Article 6 of the Directive requires Member States to ensure that MCP operators carry out monitoring of emissions in accordance (as a minimum) with the requirements set out in Annex IV. We are applying the monitoring frequencies as set out in **Table 6.2,** which meet the requirements of Annex IV of the Directive.

The proposed monitoring costs are estimated based on the number of MCPs affected, pollutants monitored and data on monitoring costs. The type of pollutants to be monitored by MCP operators depends on whether an ELV is set down in Annex II for the plant concerned. Overall:

- Natural gas fired plants (engines, gas turbines and other plants) are required to monitor NO_x emissions only;
- Plants fired by gaseous fuels other than natural gas are required to monitor NO_x and SO_2 emissions only; and
- Plants using other fuels (liquid or solid depending on the type of MCP) are required to monitor NO_x, SO_2 and particulate matter.
- Standby plants using biomass and other solid fuels are required to monitor PM only
- CO monitoring is required for all plants including those exempt from meeting emissions limits under MCP.

Information on the number of MCPs estimated to be affected per capacity band, type and frequency of monitoring required is summarised in Table 7.11.

Table 7.11 Monitoring requirements and assumptions (number of plants in 2030)

Capacity	CO and NO_x emissions (natural gas fired plants)	CO, NO_x and SO_2 emissions (plants firing gaseous fuels other than natural gas)	CO, NO_x, SO_2 and PM emissions (plants firing other liquid and solid fuels)	Frequency	CO and PM emissions (biomass and other solid fuels standby and back-up)	CO emissions (gaseous and liquid fuels standby and back-up)	Frequency
1-5 MWth	6,792	60	1,647	Every 3 years(1)	210	17,726	Every 5 years(1)
5-20 MWth	774	7	123	Every 3 years(1)	36	541	Every 5 years(1)
20-50 MWth	9	0	1	Annually	0	5	Annually*

*Biannually and triennially will be considered for the final implementation.

Information on the costs of monitoring and meeting MCERTS was provided by an MCERTS accredited monitoring consultancy (anonymous for commercial confidentiality) and was deemed reasonable by regulators and operators engaged. MCERTS is the UK Monitoring Certification Scheme for Environment Agency of England (EA) & Natural Resource Wales (NRW). It provides the framework for businesses to meet quality requirements. Compliance with MCERTS gives the EA confidence in the monitoring of emissions to the environment.

The monitoring costs cover the sampling by an accredited UK monitoring company and provision of an emissions monitoring report to the operator. These monitoring costs and the main underlying assumptions are detailed in Table 7.12.

Table 7.12 Monitoring cost data and assumptions (£)

Capacity (MW)	NO_x, SO_2 & PM monitoring costs (£, 2014 per activity)*	NO_x & SO_2 monitoring: share in total costs**	NO_x & SO_2 monitoring costs (£, 2014 per activity)	NO_x monitoring: share in total costs***	NO_x monitoring costs (£, 2014 per activity)	Additional costs of monitoring CO (£, 2014 per activity)****	Assumptions
1-5	£2,133	75%	£1,600	50%	£1,066	£600	Assumed average plant size of 3MW, 1 hour of measurements for NO_x and SO_2, 3 samples for dust and

							other parameters also measured (oxygen, temperature and pressure).
5-20	3,555	75%	£2,666	50%	£1,777	£600	Assumed average plant size of 12.5MW, 2 hours of measurements for NO_x and SO_2, 3 samples for dust and other parameters also measured (oxygen, temperature and pressure).
20-50	6,297	75%	£4,723	50%	£3,198	£600	Assumed average plant size of 35MW, 4 hours of measurements for NO_x and SO_2, 3 samples for dust and other parameters also measured (oxygen, temperature and pressure).

* Independent estimate (2013). Figures provided by MCERTS accredited monitoring consultancy (anonymous for commercial confidentiality).
**Plants fired by gaseous fuels other than natural gas are required to monitor NO_x and SO_2 emissions, in which case 75% of the costs are assumed.
***For natural gas fired plant only monitoring of NO_x is necessary, in which case only 50% of the costs is assumed.
****Amec Foster Wheeler assumption - refers to the cost of monitoring CO simultaneously with the monitoring of the other pollutants.
The plants already covered under an IED permit are assumed to still be required to carry out emissions monitoring activities under the Directive as they do not necessarily have to be monitored under business as usual.

The figures should be interpreted as a maximum cost, because MCERTS was developed for larger, more complex plants than those under consideration in this impact assessment. At present there is no viable alternative however. industry may seek to develops lower cost methods which are acceptable to meet standards under the requirements of MCPD.

The monitoring costs also reflect the fact that most plant will determine SO_2 emissions from fuel sulphur content rather than monitoring.

Table 7.13 below demonstrates the annualised monitoring costs for each plant type. These costs are from 2030 when all stages of the MCP Directive are implemented. All working plants would be affected, whereas standby and backup plants are required to monitor for CO, and only standby plants fired with solid fuels are required for PM as well as CO emissions.

Table 7.13 Total annual monitoring costs to operators including CO for 2030 (£k, 2014 prices)

Capacity (MW)	Working natural gas fired plants, CO and NO_x	Working plants fired by gaseous fuels other than natural gas, CO, NO_x and SO_2	Working plants fired by other solid or liquid fuel, CO, NO_x, SO_2 and PM	Standby plants firing solid fuels CO and PM	Standby plants firing gas and liquid fuels, CO	Backup plants firing gas and liquid fuels, CO	Total
1-5 (1)	3,735	43	1,485	70	1,055	1,072	7,461
5-20(1)	607	7	169	17	65	0	866
20-50	36	0.4	10	1	1.6	0	48
Total	4,378	51	1,664	88	1,121.60	1,072	8,374

Monitoring costs occurrence frequency assumed to be 0.33 per year for working plants sized 1-20MW and 1 for working plants sized 20-50MW. For standby and backup plants, the frequency is assumed to be 0.2 per year for plants sized 1-20MW and 0.5 for plants sized 20-50MW. Table 7.14 presents this per plant on an annualised basis.

Table 7.14 Per plant annual monitoring costs from 2030 to operators including CO (£k, 2014 prices)

Capacity (MW)	CO and NO_x emissions (natural gas fired plants)	CO, NO_x and SO_2 emissions (plants firing gaseous fuels other than natural gas)	CO, NO_x, SO_2 and PM emissions (plants firing other liquid and solid fuels)	CO and PM emissions (biomass and other solid fuels standby)	CO emissions (gaseous and liquid fuels standby and back-up)	Frequency
1-5	0.5	0.7	0.9	0.3	0.1	Every 3 years(1)

5-20	0.8	1.1	1.4	0.5	0.5	Every 3 years(1)
20-50	3.8	5.3	6.9	1,9	0.3	Annually

7.5 Benefits to the Environment and Human Health

Emission Reductions

Total emissions reduced for SO_2, NO_x and PM are estimated by applying abatement efficiencies to the fuel specific emissions.

The abatement efficacies are those from the specific abatement measures selected in the compliance modelling. Specifically, the model compares the baseline (unabated) emission concentration for the plant type against the relevant MCPD ELV to determine if a reduction in emission concentration is required, and if so, what percentage reduction is needed. The model then selects the relevant measure to achieve the required reduction; for example, if a reduction of 50% is needed and there are measures suitable for that category of plant able to achieve 40% reduction or 70% reduction, then the measure achieving 70% reduction is applied to ensure compliance. Consequently, the emission reduction modelled is higher than would be needed purely to comply. For most abatement measures, this is a realistic situation. A small number of measures (FGD, SCR and SNCR) could in practise be set up to only achieve the required reduction without an overshoot, and reduce slightly the operational costs.

Monetised Benefits - Air Quality

The beneficial impact is considered in terms of the damage avoided if emissions reductions are achieved. This 'damage' avoided is calculated in money terms using a damage cost. The IGCB damage cost functions form official government Green Book guidance on valuing impacts from Air Quality. They predominantly capture the health benefits from reduced emissions. The analysis in this IA is based on forthcoming updated damage costs by the COMEAP which reflect the latest advice and takes a consistent approach to that used in support of the government's recently published 'Air quality plan for nitrogen dioxide'.

As damage costs are sensitive to factors such as geographic location of emission sources and meteorology, there are damage cost functions for particulate matter (PM) and NO_x that are categorised by geographic area. For the purpose of the MCP analysis, we have calculated a weighted average damage cost specific to each pollutant that is based on the sectors involved (based on sectoral split as per Figure 7.1). This is to enhance representativeness of damage costs in relation to specific MCP impacts.

Table 7.15 below presents the damage cost weighted by the average of the sectors involved.

Table 7.15 Damage Cost Functions for SO_2, NO_x and PM (£2014 per tonne of pollutant reduced)

	Central Estimate	Low Central Range [b]	High Central Range [b]
NO_x [c]	£4,269	£3,546	£11,762
SO_2	£2,375	£1,208	£5,053
PM [c]	£29,470	£13,885	£70,775

a) Based on IGCB damage cost functions (IGCB, 2012 for SO_2 and PM – Defra, 2015 for NO_x).
b) Variation between the central values reflects uncertainty about the lag between exposure and the associated health impact.

The damage cost functions have been inflated to 2014 prices (using GDP deflators), and additionally uplifted by 2% per annum until 2014. In years beyond 2014, they are only uplifted by 2% per annum when applied to future year emission reductions. The uplift captures the higher willingness of the population to pay, and therefore value of health benefits as incomes (economic growth) rises. The variation between the damage costs reflects uncertainty about the lag between exposure and associated health impacts. The damage costs are higher in the 'High Central Range' where the lag between the associated health impacts and benefits is assumed to be shortest.

Greenhouse Gases (GHGs)

A change in greenhouse gas emissions was also calculated from a change in fuel consumption. The implementation of abatement also results in the abatement of greenhouse gases, mainly carbon dioxide. We have monetised the environmental benefit of reduced CO_2 using the central BEIS traded and non-traded carbon values to calculate the impact. The traded value is used for larger plants over 20MW that fall into the scope of the EU Emissions Trading System, while the non-traded value of carbon is used for smaller plants.

Non-monetised Benefits

It is important to note when applying and interpreting damage cost functions that a number of impacts are not taken into account in the quantification; this includes impacts on ecosystems and cultural heritage. The damage costs largely exclude morbidity impacts arising from air pollution. Therefore, the benefits estimated through the application of damage cost functions may be underestimated.

Not all impacts can be fully monetised; there are additional benefits that are non-monetised associated with reductions in soil and surface water contamination, reducing acidity. The monetised air quality health impacts also do not include all benefits to human health. Therefore there are also additional impacts to human health not captured in monetised benefits.

7.6 Operating hour exemption

Article 6(3) and (8) of the Directive includes exemption from ELVs for existing and new MCPs operating less than 500 hours per year unless firing solid fuel. In order to assess the impact of this exemption, we estimated how many plants would be above and below 500 hours on average per year. We have estimated that up to 8,936 plants will be back-up and standby by 2030 (see section 7.1), in both cases operating fewer than 500 hours per year, and thereby exempt.[11]

7.7 Further assumptions and uncertainties

The analysis assumes that most working plants operating in England and Wales will have to meet the standard ELVs for existing and new MCPs as set out in Annex II of the Directive and otherwise (see Section 6.2). Footnotes to these tables in the directive have been reflected in the model where different ELVs are set for the size-fuel-plant type categories used within the model. Other footnotes present different ELVs for specific fuel or plant types which form a sub-section of the categories within the model. Those have not been reflected in the analysis given the uncertainty in the number of plants which fall into such sub-categories. Therefore, in some cases further separate analysis has been performed to consider some of these footnotes and incorporate them into the results presented in this report.

A more comprehensive discussion on key risks and assumptions is discussed in Section 9, along with results from sensitivity testing key assumptions. Section 9 also presents a full assumptions log.

7.8 Quality Assurance

Quality assurance refers to processes which can help ensure the analysis' inputs and outputs meet its quality requirements, manage risk of errors and ensure the analysis is fit-for-purpose. It is a key means of ensuring analysis is robust. A high level of quality assurance was considered proportionate for the modelling supporting this analysis. As such, the process set out in the official HM Treasury Aqua Book was fully completed. This involved checks throughout the analytical life cycle by analysts, commissioners of analysis, those supporting the assurance effort, and stakeholders. Specific checks performed for this analysis include:

(a) *Specification Confirmation* - Defining what a piece of analysis should deliver, the deadlines and quality requirements, along with recording any changes to scope.

(b) *Developer Testing (including validation and verification)* - Reviewing and checking of the analysis during development, primarily by the analytical team.

(c) *Input Data Checks* - An understanding of the data needed to shape the development process. Its definition, availability, timeliness, quality and quantity

(d) *Input Assumptions Checks* - Ensuring that all assumptions are transparent, clearly understood and are agreed by stakeholders.

(e) *Independent Validation* - Validation was focussed on checking that the analysis will meet the customer's actual needs. I.e. that we are doing the right analysis.

(f) *Independent Verification* - Reviewing, inspecting, testing, checking, auditing, or otherwise establishing, and documenting, whether the analysis conforms to the specified requirements. I.e. checking we doing the analysis right.

(g) *Documentation* – The resources (including this IA) that assist in recording the problem, the analysis and the associated uncertainty to other analysts and customers.

(h) *Communicating Uncertainty* - Disseminating analytical risks and unknowns in a piece of analysis and its outputs to decision makers. This includes the details of section 9 of this IA and the high/low scenarios presented throughout.

[11] However, there are emissions controls for PM for plant firing solid fuel running below 500 hours, which is included in this assessment.

8. Results

8.1 Overview

Table 8.1 demonstrates the total impacts of the MCPD implementation. Monetised health and environmental benefits across the 15 year appraisal period, relative to do nothing (Baseline option) are £1,018m, against costs of £211m, in present value (today's terms). The next subsection 8.2 summarises each cost and benefit category.

Table 8.1 Cost and benefits for Option 1 (£m, PV)

2018-2032	Low Scenario (high costs/low benefits) (£m)	High Scenario (low costs/high benefits) (£m)	CENTRAL (£m)
Costs (costs to operators)			
Abatement costs	285.6	73.9	138.0
Administration costs	61.2	18.0	30.4
Monitoring costs	90.7	23.2	42.8
Total	437.5	115.1	211.2
Benefits (emission reductions)			
Air Quality pollutants	595.3	2,429.3	982.4
CO_2	17.7	53.9	35.5
Total	613.0	2,483.2	1,018.0
NPV	175.5	2,368.1	806.8

*Please note any differences due to rounding.

8.2 Key costs and benefits of implementing the MCP Directive

Overview

This section details the estimated costs, emission reductions and wider administrative requirements for MCPs in England and Wales following the implementation of the MCP Directive. The results present the outcome over a 15 year assessment period. The assessment begins in 2018, when the first costs will be incurred, and ends in 2032, where it would be anticipated that the MCP Directive will have been implemented in full.

Year-by-year results (i.e. annualised costs for individual years) are presented throughout this section, to show the staging of the MCP directive requirements on different types of plant. However, from 2030 onwards, the impacts will be similar for future years given that there are no further changes to MCP Directive requirements from that year - the only changes will be as a result of the closure of existing plants on reaching the end of their operating life and opening of new plants, and changes in the projected use of different fuel types. As such, a 2030 annualised[12] steady state figure is presented throughout this section to indicate the potential impact in subsequent years beyond the appraisal period.

The main ranges around the central estimate represent the two key sensitivities. The first is the number of plants, which due to the lack of data, is the main sensitivity surrounding the total cost impacts of the directive. The second is the variation in the damage cost values attributed to benefits reduced emissions. It is standard HMT Green Book practise to present the uncertainty in valuing human health. It should be noted that the benefits range is independent to plant numbers as it is assumed that total emissions reductions are the same in all plant number scenarios, they are just spread over more or less plants. Alongside these key sensitivities, further assumptions and flexibilities are sensitivity tested where presented but are not included in the main ranges. For example, the results of two inspection

[12] Total annualised cost = annualised CAPEX + annual OPEX
Where:
Annualised CAPEX = CAPEX x (discount rate / (1-((1+discount rate)^-lifetime))
Where:
discount rate = 3.5% (Green Book)
lifetime = 15 years (assumed for all measures)
To calculate the total annualised cost for 2030, we identify what abatement measures are required in 2030 and sum up the total annualised cost. This is known as the equivalent annual cost (EAC). It is the cost per year of owning and operating an asset over its entire lifespan, and is appropriate to compare against annual benefits in a specific year to determine the economic cost effectiveness.

options are presented in the inspection section, but only the preferred option is carried forward in all other headline figures.

All prices are in 2014, and a 3.5% discount rate has been used in present value figures as per Green Book guidance. The base year for the NPV is 2018.
In the remainder of this section, each of the following monetised impacts is discussed in more detail:

COSTS

- **Emissions abatement costs for plant operators –** Compliance with the MCP will lead to additional costs for plants between 1-50MW if they need to fit abatement in order to reduce their NO_x, PM and SO_x emissions to meet the ELVs set in the MCP. These costs will vary depending on the plant type and the age of the plants with the most cost effective abatement measure chosen. This will result in an additional cost to operators of between £73.9m and £285.6m in present value terms over the first 15 years. Our central estimate is this will lead to an additional cost of £138m in present value terms for businesses.
- **Administrative and Compliance costs –** These costs include operator and regulator time and effort for processing an environmental registration/permit, compliance (inspection) checks, and data reporting (the costs borne by regulators are anticipated to be mostly passed on to operators). The Directive is flexible in how these inspection requirements are carried out so a range of options were sensitivity tested. We estimate the implementation of the MCP Directive will result in an administrative cost to business of between £18.0m and £61.2m in present value terms over the first 15 years. Our central estimate is this will lead to an additional cost of £30.4m in present value terms.
- **Monitoring costs –** The costs include the fees for an accredited consultant to conduct the monitoring surveys and prepare a monitoring survey report to the operator annual or tri-annually in order to meet the Directives monitoring requirements. This will result in an additional cost to operators of between £23m and £91m in present value terms over the appraisal period. Our central estimate is this will lead to an additional cost of £42.m NPV for businesses.

MONETISED BENEFITS TO THE ENVIRONMENT AND HUMAN HEALTH

- **Monetised air quality benefits –** The main benefit of the implementation of the MCP directive will arise from the reduction in air pollutant emissions. By reducing the number of plants operating without abatement, encourage investment in lower emission plants capable of meeting emission limits, and ensuring that these plants are monitored for their emission levels, this will improve air quality and benefit human health and the environment. We estimate human health benefits in terms of emissions reduced of NO_x, SO_2, and PM of between £595.3m and £2,429.3m in present value terms, with a central estimate of £982.4m for England and Wales. This figure captures the reduction in both chronic mortality effects (which consider the loss of life years due to air pollution) and morbidity effects (which consider changes in the number of hospital admissions for respiratory or cardiovascular illness).
- **Monetised Green House Gas (CO_2 Emissions) Benefits** – Certain measures intended to reduce emissions of air quality pollutants also affect CO_2 emissions from UK plants. As some of the larger plants would fall into the scope of the EU Emissions Trading System (ETS), the reduction in costs to UK businesses of purchasing extra EU ETS allowances from abroad is assessed. Therefore, any change in CO_2 emissions in the UK is valued using the traded cost of carbon. Smaller plants will fall under the non-traded value of carbon, where although they are not traded as part of the EU ETS, the emissions still contribute to the global carbon value and need to be considered and as other industries may not need to abate as much as a result. We estimate that total reduction in CO_2 emissions will lead to additional present value benefits of between £17.7m and £53.9m, with a central estimate of £35.5m.

8.3 Abatement costs

The abatement costs to plants consist of the cost of abatement technology needed to meet the ELVs within the MCP Directive. As outlined in Section 7.2, the abatement costs represent a collation of best available data on the cost of abatement equipment in order to meet the conditions in the MCP Directive. As this varies depending on data source, a range was created to combine the different estimates. As set out in section 7.2, for working plants that are already compliant with MCP ELVs under business as usual, the abatement costs are set to zero – i.e. only the relevant costs compared to the baseline are included.

The central year on year breakdown is shown in Table 8.2 where the annual total cost of abatement increases over the appraisal period as each stage of the MCP Directive is introduced. The table below also demonstrates where stages with a greater number of plants are impacted (2025, 2029) come into effect, as shown by the higher cost. The final column presents the total cost over the appraisal period in discounted, present value terms.

Table 8.2 Year on year cost of abatement for working plants (£m, 2014 prices, discounted)

Year	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	Total NPV
Central Cost																
£m	0.00	3.92	3.96	4.14	4.31	4.45	19.14	6.22	6.11	6.10	6.09	50.02	8.04	7.84	7.67	**138.01**
Low Cost																
£m	0.00	1.87	1.89	1.98	2.05	2.12	9.16	2.97	2.92	2.92	2.91	31.54	3.96	3.86	3.77	**73.9**
High Cost																
£m	0.00	8.68	8.78	9.17	9.52	9.84	37.72	13.27	13.04	13.06	13.05	98.78	17.31	16.90	16.53	**285.6**

Note: any differences in totals due to rounding. Low cost plant numbers are halved and in high cost plant numbers are doubled.

Sensitivity of the central cost estimate

The table above also presents differences in totals if the number of plants is changed. The assumptions used in these sensitivity tests are one of the two key sensitivities covered in Section 9 on risks and assumptions.

Table 8.3 below also provides an additional source of uncertainty compared to the central scenario and is separate to the uncertainty on plant numbers. In Table 8.3, the same plant numbers are in all three scenarios, where high and low are presented in the range in brackets. The range illustrates the uncertainty on abatement costs, and demonstrates the abatement cost from various, alternate information sources. It is presented as the average annualised impact from when the full set of ELVs comes into effect (from 2030). The range of total annual abatement costs is between £11.4m and £27.7m annually from 2030, with a central estimate of £19.5m. From this figure, £11.7m is expected from existing plants and £7.8m from new plants. Costs detailed below are annualised and shown separately for existing plants, new plants and total plants across pollutants.

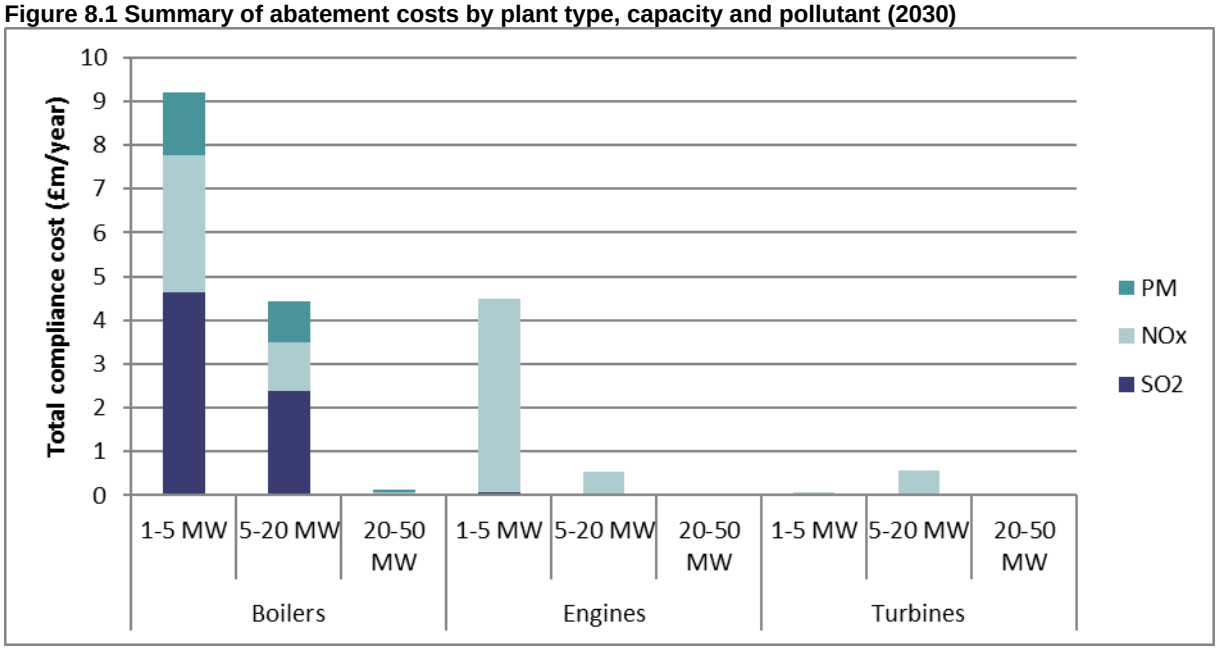
Table 8.3 Average annualised abatement costs in 2030 for existing, new and total plants (£m, 2014 prices, low-high range presented in brackets for totals)

	SO_2	NO_x	PM	Total
Existing plants	4.7 (4.6-4.7)	5.0 (0.8-9.3)	2.0 (1.5-2.5)	11.7 (6.9-16.5)
New plants	2.5 (2.5-2.5)	4.9 (1.6-8.1)	0.4 (0.3-0.5)	7.8 (4.5-11.2)
All plants	7.2 (7.2-7.2)	9.9 (2.4-17.4)	2.4 (1.8-3.0)	19.5 (11.4-27.7)

The numbers in the table above reflect all working plants and those standby plants with ELVs.

Figure 8.1 further demonstrates the compliance costs by plant type, capacity and pollutant. Note a large proportion of costs are associated with 1-5MW boilers as this is the most common category of MCPs.

Figure 8.1 Summary of abatement costs by plant type, capacity and pollutant (2030)



8.4 Administrative and Compliance (Inspection) costs

The administration costs faced by plants are for operator and regulator time and effort for processing an environmental registration/permit, inspection, and reporting. Registration/permitting, compliance (inspection) checking and reporting activities required under the Articles 5, 8 and 11 of the Directive will result in a range of one-off and recurring costs to regulators and MCP operators. Permitting costs[13] will affect both working and standby and back up plants. Recurring costs are lower for standby plants, being limited to record keeping, reporting operating hours and light touch compliance (inspection) checks.

The central year on year breakdown is shown in Table 8.4, where the annual total administrative cost increases over the appraisal period as each stage of the MCP Directive is introduced. The final column presents the total cost over the appraisal period in discounted, present value terms.

Table 8.4 Year on year administrative costs for all plants (£m, 2014 prices, discounted)

Year	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	Total NPV
Central Cost																
£m	0.38	0.54	0.66	0.86	1.05	1.22	1.63	1.81	1.86	1.92	1.97	3.37	4.49	4.38	4.24	**30.4**
Low Cost																
£m	0.38	0.25	0.33	0.45	0.56	0.67	0.94	1.05	1.07	1.12	1.16	2.08	2.75	2.69	2.60	**18.0**
High Cost																
£m	0.38	1.28	1.49	1.91	2.30	2.66	3.34	3.65	3.76	3.87	3.97	6.60	8.95	8.70	8.42	**61.2**

Low cost plant numbers are halved and in high cost plant numbers are doubled.

Sensitivity on the number of plants

The key driver behind the differences in the scenarios in Table 8.4 above is the differences in the number of plants. The assumptions used in these sensitivity tests are one of the two key sensitivities covered in Section 9 on risks and assumptions.

Inspection scenario sensitivity tests

Alongside the one-off costs stated in section 7.3, MCP operators and regulators will incur recurring costs associated largely with compliance check and reporting requirements. The MCP Directive does provide flexibility for the EU member state to set the number of inspections required in order to meet the reporting requirements, therefore the sensitivity in Table 7.8 presents total one-off upfront costs of administration and compliance (inspection costs). Of these costs, 39% is directly incurred by the regulator. The higher costs may be passed on to the operator in the form of higher charging and permitting fees.

Table 7.9 in the methodology section demonstrates estimates of administrative costs for operators and regulators under two different inspection scenarios in order to demonstrate the impact of varying the number of inspections.

8.5 Monitoring costs

The monitoring costs are the costs faced by operators to conduct the monitoring annually or tri-annually in order to meet the Directives monitoring requirements. This may be done in house or via an independent test house. Compliance with the monitoring requirements set out in the Directive would result in costs of £42.8m (NPV, in 2014 prices as shown in Table 8.5). The estimated costs include the fees for an accredited consultant to conduct the monitoring surveys and prepare a monitoring survey report to the operator. Depending on the size and type of MCP, monitoring surveys differ in terms of their frequency and pollutants monitored. The final column presents the total cost over the appraisal period in discounted, present value terms.

[13] The permitting and reporting costs are based on a worst case scenario. The administrative costs include a paper based communication channel between the regulator and operator. The environment agency intends to develop a central portal that will reduce costs from digitising and automating parts of the process. Therefore, the costs included in this assessment should be considered the maximum (worst case).

Table 8.5 Year on year monitoring costs (2014 prices, discounted)

Year	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	Total NPV
Central Cost																
£m	0	0.34	0.72	1.07	1.4	1.7	1.98	2.06	3.05	3.96	4.81	5.6	5.54	5.36	5.18	**42.79**
Low Cost																
£m	0	0.18	0.37	0.55	0.72	0.88	1.03	1.07	1.62	2.13	2.61	3.05	3.08	2.98	2.88	**23.16**
High Cost																
£m	0	0.77	1.54	2.27	2.94	3.57	4.15	4.32	6.45	8.44	10.28	11.98	11.71	11.32	10.94	**90.68**

a) In low cost plant numbers are halved and in high cost they are doubled.

Sensitivity on the number of plants

The key driver behind the differences in the scenarios in Table 8.5 above is the difference in the number of plants. The assumptions used in these sensitivity tests are one of the two key sensitivities covered in Section 9 on risks and assumptions.

8.6 Monetised Benefits to the Environment and Human Health

The main benefit of the implementation of the MCP directive will arise from the reduction in air pollutant emissions. By reducing the number of plants operating without abatement and ensuring that these plants are monitored for their emission levels, this will improve air quality and have a positive impact on human health and the environment (including greenhouse gases).

Emissions reductions of air pollutants

Fitting abatement will reduce the level of emissions from each MCP as detailed in Table 8.6 below where, in the year 2030, 14.5kt SO_2, 16.9kt NO_x, 2.6kt PM and 109.1kt CO_2 are estimated to be reduced compared to the baseline. The table shows the total estimated annual emission reductions in 2030 by plant type, which represents the impact when all stages of the MCP have been implemented.

Table 8.6 Total annual emission reductions (kt) from 2030

	SO_2			NO_x			PM			CO_2		
	Existing plants	New plants	Total	Existing plants	New plants	Total	Existing plants	New plants	Total	Existing plants	New plants	Total
Total	9.17	5.29	14.46	11.33	5.54	16.87	1.72	0.87	2.59	75.28	33.81	109.10

Combined contributions from both standby and working plant

Carbon emissions

While the fitting of abatement will directly impact the reduction in SO_2, NO_x and PM, CO_2 is reduced largely due to improved efficiencies associated with well managed low NO_x burners (such as fuel efficiencies). Table 8.6 in the previous section summarises CO_2 emissions reduction in 2030.

Table 8.7 shows the disaggregation by fuel and plant type to demonstrate that the vast majority of the CO_2 emission reduction is achieved in boilers using natural gas. The emission reductions achieved by this measure are partially offset by other abatement measures that use parasitic energy, such as Selective Catalytic Reduction (SCR), and therefore increase CO_2 emissions.

Table 8.7 Annual CO2 emissions reduction in 2030, by plant type and fuel

Emissions change (kt)						
	Biomass	**Other solid fuels**	**Gas oil**	**Other liquid fuels**	**Natural gas**	**Other gaseous fuels**
Boilers	0.0	-1.5	-4.9	-5.6	123.4	-0.3
Engines	0.0	0.0	-3.4	0.0	0.0	0.1
Turbines	0.0	0.0	-0.0	0.0	1.3	0.0
Total	0.0	-1.5	-8.4	-5.6	124.7	-0.2

Damage costs

The impact of the reduction in emissions due to the implementation of the MCP Directive has been valued in line with best practice as set out in Green Book Supplementary guidance[14].

The Green Book guidance recommends the impact pathway approach in many circumstances when impacts are above £50m annually. While the bespoke impact pathway approach was considered, however, in this circumstance, the uncertainty around the spatial distribution of plants and their operating patterns meant that damage costs are more appropriate. The damage costs used in these assessments are detailed in the methodology section.

(1) Monetised benefits – Air Quality

Table 8.8 provides a total of the estimated indicative annual benefits associated with the MCP Directive. It is based upon applying the damage cost functions to the volume of emissions reduced over the time period. The range presents the uncertainty associated with valuing health benefits in the damage costs. It is one the two key sensitivities as presented in Section 9 (the other key sensitivity is the number of plants). Please note that in all three scenarios the level of emissions reduction does not change. The sensitivity captures the uncertainty surrounding the valuation of health benefits for a given level of emissions reduction. The benefits are also independent on plant numbers. This is because total emissions reduced are the same in all three plant number scenarios; they are just spread over more or less plants.

Table 8.8 Indicative annual benefits for existing, new and total plants in 2030 (£m, 2014 prices, low-high range presented in brackets for totals)

Totals	SO_2	NO_X	Dust	Total
Existing plants	24 (19-27)	176 (70-281)	74 (58-84)	274 (147-392)
New plants	14 (11-16)	86 (34-138)	38 (30-43)	138 (75-197)
All plants	38 (30-43)	262 (105-419)	112 (87-127)	411 (222-589)

The full year on year breakdown is provided in Table 8.9 where the profile of the emission reduction benefits can be seen as each stage of the MCP Directive comes into effect. The table also illustrates that benefits increase across the appraisal period until 2030, where they are largely constant, and subsequently affected only by a reduction in plant in the baseline. The final column presents the total cost over the appraisal period in discounted, present value terms.

Table 8.9 Year-on-year breakdown of emissions benefits (£m, 2014 prices, discounted) Central damage cost values

Year	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	Total NPV
SO_2	0.0	1.2	2.4	3.4	4.4	5.4	6.2	15.3	15.8	16.2	16.6	16.9	30.6	30.2	29.7	**194**
NO_X	0.0	2.1	4.3	6.3	8.2	10.0	11.6	20.1	21.5	22.8	24.0	25.1	64.1	63.9	63.7	**347**
PM	0.0	2.5	4.9	7.1	9.1	11.0	12.7	37.4	38.1	38.6	39.1	39.5	68.0	66.7	65.5	**440**
Total	**0.0**	**5.9**	**11.5**	**16.8**	**21.7**	**26.3**	**30.5**	**72.8**	**75.3**	**77.7**	**79.8**	**81.6**	**162.7**	**160.8**	**158.9**	**982**

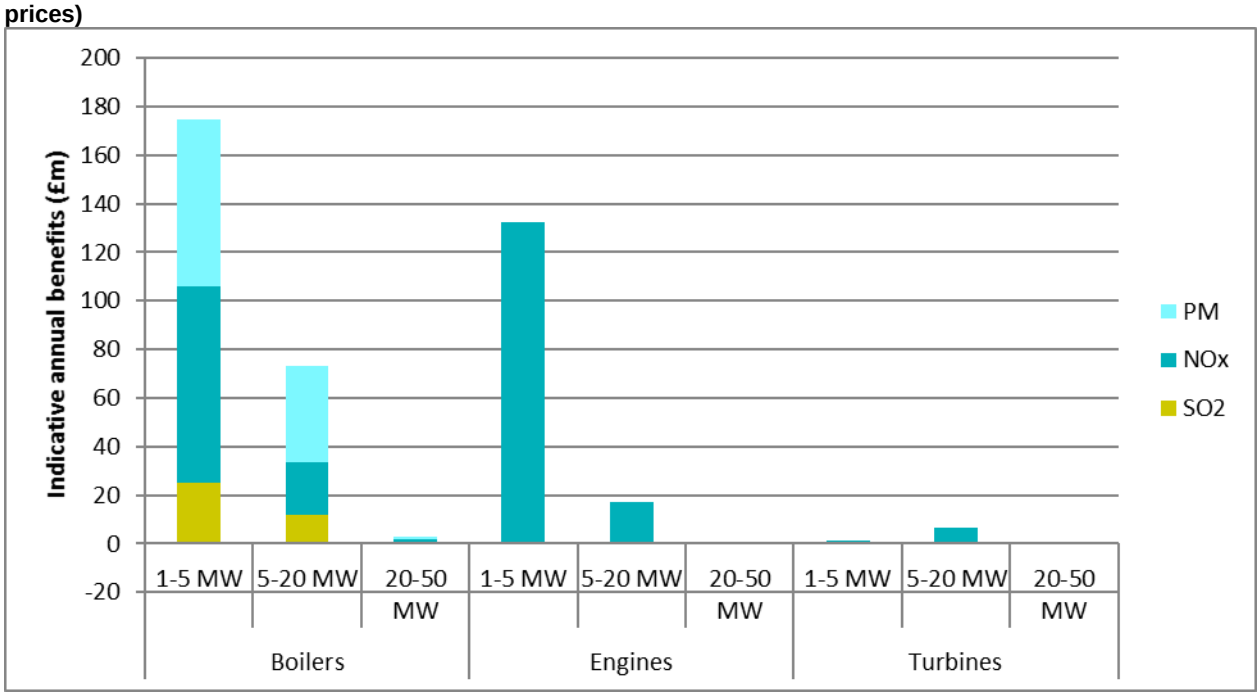
*Any difference in totals due to rounding

The largest volume of air pollutant emissions reduction in 2030 comes from SO_2 as seen in Table 8.6, although the monetised health impact is the lowest. This is because health impacts differ between pollutants as presented in previous tables. It must be noted, however, the absolute volume of emissions reduction makes an important contribution to national emissions ceilings.

Figure 8.2 summarises the benefits for each capacity class disaggregated by pollutant and technology. It can be observed that the majority of benefits are associated with plants ranging 1-5MW, due to the majority of plants being included in this category (as was the case for costs, presented on Figure 8.1). It also highlights how the benefits associated to SO_2 only represent a small proportion of the indicative total benefits.

[14] **Damage cost guidance** - http://www.defra.gov.uk/environment/quality/air/air-quality/economic/damage/

Figure 8.2 Annual benefits in 2030 disaggregated by technology, pollutant and capacity class (£million per year, 2014 prices)



(2) Greenhouse gas monetised benefits

This section breaks the carbon impacts down into traded/non-traded. Table 8.10 and Table 8.11 present year-on-year monetised greenhouse gas benefits, for traded and non-traded respectively. Table 8.12 presents the total of traded and non-traded.

Table 8.10 Traded carbon benefits, discounted (£m, 2014 prices)

Year	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	Total NPV
Central Benefit																
£m	-	0.00	0.00	0.01	0.01	0.02	0.02	0.08	0.09	0.10	0.11	0.13	0.26	0.28	0.29	1.4
Low Benefit																
£m	-	-	-	0	0	0	0	0	0	0	0.1	0.1	0.1	0.1	0.1	0.7
High Benefit																
£m	-	0.00	0.01	0.02	0.03	0.04	0.05	0.14	0.15	0.17	0.18	0.20	0.40	0.42	0.44	2.2

Table 8.11 Non-Traded carbon benefits, discounted (£m, 2014 prices)

Year	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	Total NPV
Central Benefit																
£m	-	0.18	0.35	0.50	0.66	0.81	0.95	2.66	2.71	2.74	2.78	2.81	5.37	5.69	5.92	34.1
Low Benefit																
£m	-	0.1	0.2	0.3	0.3	0.4	0.5	1.3	1.4	1.4	1.4	1.4	2.7	2.8	3.0	17.1
High Benefit																
£m	-	0.27	0.52	0.76	0.99	1.21	1.43	3.98	4.06	4.13	4.17	4.23	8.12	8.54	8.92	51.3

Table 8.12 Total carbon benefits, discounted (£m, 2014 prices)

Year	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	Total NPV
Central Benefit																
£m	-	0.2	0.3	0.5	0.7	0.8	1.0	2.7	2.8	2.8	2.9	2.9	5.6	6.0	6.2	35.5
Low Benefit																
£m	-	0.09	0.18	0.25	0.34	0.41	0.49	1.35	1.40	1.44	1.44	1.49	2.82	2.99	3.14	17.8
High Benefit																
£m	-	0.28	0.53	0.78	1.01	1.25	1.48	4.12	4.21	4.30	4.35	4.43	8.52	8.96	9.36	53.6

Damage cost sensitivity

The assumptions used in these sensitivity tests are one of the two key sensitivities covered in Section 9 on risks and assumptions. 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 in Table 8.13 below represent the uncertainty around the central range.

Table 8.13 NPV per environmental and human health benefits

NPV over 15 years (2018 - 2032)			
	Sensitivity		**Central Estimate**
Pollutant	***Low Benefit***	***High Benefit***	***Best***
Carbon (traded and non-traded cost saving)	17.8	53.9	35.5
NO_x	289.0	958.7	347.9
SO_2	98.8	413.3	194.2
PM	207.4	1,057.4	440.3
Total	**613.0**	**2,483.2**	**1,018.0**

*Any differences due to rounding

8.7 ELV flexibilities scenarios

As detailed in Section 6.2, the Directive includes several flexibilities for Member States to apply less stringent ELVs for specific plants. Table 6.3 sets out which flexibilities are being implemented and have therefore been included in the headline costs and benefits. However, the impact of not applying each flexibility has been considered, to see the impact this would have on the costs and benefits of the MCP Directive. The costs and benefits presented in this section are additional to those presented in the main analysis.

The main flexibility is the 500hr exemption which enables those MCPs operating for less than 500 hours per year to be exempt from meeting the ELVs set in the MCP. With an estimated 13,975 plants (back-up and standby) in 2030 affected by this flexibility, there is a significant impact if it is not applied.

If the 500 hour exemption is not implemented (i.e. all standby AND backup plant are required to comply with the ELVs), costs will increase by approximately 300% whereas the benefits (emission reductions) will increase by only 5%. The increase in benefits is very low as these plants only run for a small amount of time and therefore have low emissions. This is predominantly true of back-up plants which are thought to operate for very few hours per year (20 hours or less). The increase in costs is high as there are a large number of such plants that would be required to fit abatement to meet the ELVs, monitor and be subject to reporting and more frequent compliance (inspection) checks. The increase in cost is slightly higher than realistic as the costs are based on an average plant, as opposed to reflecting the characteristics of standby and backup plants. Additionally, costs to the operator are purely incorporated as the full abatement costs with no consideration given to the capacity of some plants generating sufficient revenue to absorb these costs.
Due to the lack of information about these plants, it was deemed disproportionate to fully adjust the costs.

Table 8.14 demonstrates the impact in 2030. For example, total abatement costs would increase by 98.2m,in additional to the 2030 figures for the main scenario in Table 8.18.

Table 8.14 Impact on costs without 500hr exemption in 2030

Change in costs without 500 hour exemption					
Capacity class	**Total abatement costs (£m/yr)**	**Total admin burden (£m/yr)**	**Total monitoring cost (£m/yr)**	**Total costs (£m/yr)**	**Total monetised benefits (£m/yr)**
1-5 MW	95.4	1.8	9.3	106.6	14.2
5-20 MW	2.7	0.1	0.3	3.1	4.5
20-50 MW	0.1	0.0	0.0	0.1	0.2
1-50 MW	**98.2**	**1.9**	**9.7**	**109.8**	**18.9**

There are additional flexibilities which member states may choose to implement and have a smaller impact. Consideration has been given to what the additional compliance costs and monetised benefits would be if these flexibilities were not adopted. The results are presented in Table 8.15 below. In interpreting the impact and context, reference should be made to Section 6.2, which explains the flexibilities further and identifies those which will be applied in England and Wales.

Table 8.15 Impact on costs and benefits of not applying some of the flexibilities[4]

Flexibility not applied	Year[1]	Number of plants affected[2]	Increase in total compliance costs (£m/year)	Increase in total monetised benefits (£m/year)	Reduction in emissions (ktpa)		
					NO_x	**SO_2**	**PM**
District Heating*	2025	22 - 133	0.1 – 0.37	1.8 – 7.1	0-0.2	0.1 -0.4	0 - 0.14
Solid biomass	2025	~40	0.1	1.3 (1.1 – 1.7)	-	-	0.04
NO_x ELV flexibility for engines fitted with primary abatement operating 500 – 1500 hours per annum[3]	2025	~120	0.7	12.6	0.9	-	-

1) No significant difference between 2025 and 2030 as plant numbers change by <1%
2) There is a high uncertainty in projected plant numbers for these specific sub-categories, which is the main sensitivity for the impact of these specific ELVs
3) In this assessment we are applying this flexibility in full. However it will be superseded by the additional controls on high NO_x generators, assessed in a separate IA
4) Each of the other flexibilities is assessed independently
*Includes solid biomass plants providing district heating and located in AQMAs, since they cannot benefit from the less stringent flexibility applied to biomass plants

8.8 Summary of results

Table 8.16 Present value of central costs and benefits over 15 year appraisal period (2018 – 2030), £m 2014 prices

£m, 2015	Sensitivity		Best estimate
	Low Scenario	High Scenario	Central
PV Costs	437.5	115.1	211.2
PV Benefits	613.1	2,482.80	1018
NPV	175.6	2,367.70	806.8

In all three scenarios, low, high and central, the preferred option for compliance (inspection) and other admin costs is presented. The difference in costs between scenarios is due to different assumed plant numbers, and the difference in benefits due to differences in the valuation of human health for a given level of emissions reduction. The high scenario NPV combines low cost with high benefits, and the low scenario NPV vice versa (high costs and low benefits). A breakdown of the compliance and emissions benefits contribution is provided below.

Costs

The full costs to MCP operators in England and Wales is demonstrated in the table below with a central estimate of £211.0m. Varying the number of plants, we can see the range around this central figure is £115.1m - £437.5m. Fuel consumption is unchanged, and therefore emissions (benefits) would remain constant between scenarios.

Table 8.17 NPV of costs and benefits for the low, high and central scenarios of total plant number

Scenario	Total number of working plants (2030)*	NPV compliance costs (£m)	NPV administrative costs (£m)	NPV monitoring costs (£m)	Total Costs (£m)
Low Costs	4,597	73.9	18.01	23.16	115.09
Central Costs	9,414	138.0	30.4	42.8	211.2
High Costs	21,617	285.6	61.20	90.68	437.53

*The scenarios also increase the number of back-up/stand-by plant. Their impact is smaller as they are exempt from ELVs.

Table 8.18 below presents this on an annualised basis in 2030, when the MCP is fully in place. Table 8.19 presents this on a per plant basis.

Table 8.18 2030 annualised costs and benefits (central scenario) (2014 prices, undiscounted)

Capacity Class	Total abatement cost (£m/yr)	Total admin burden (£m/yr)	Total monitoring cost (£m/yr)	Total costs (£m/yr)	Total monetised benefits (£m/year)
1-5MW	13.8	6.3	7.5	27.6	174.3
5-20MW	5.6	0.4	0.9	6.8	68.8
20-50MW	0.2	0	0	0.2	2.7
1-50MW	19.5	6.7	8.4	34.6	245.8

Table 8.19 Average annualised 2030 cost per plant (2014 prices, undiscounted)

Capacity Class	Number of plants with ELV (working plants+non-wp with ELV)	Average total cost per working plant (inc. compliance, admin burden and monitoring) £k/yr*	Number of all plants	Average total cost per plant (inc. compliance, admin burden and monitoring) £k/yr**
1-5MW	8,709	2.5	32,102	0.86
5-20MW	940	7.0	1,643	4.1
20-50MW	11	21.0	17	14.2
1-50MW	**9,660**	**2.9**	**33,762**	**1.0**

Please note that averages do not include permitting fees and charges that will be recovered by regulators as set out in Section 7.4

*Column presents average costs for plants required to meet ELVs. For working plants that are already compliant with ELVs under business as usual, the abatement cost is zero.

** Column presents average costs for all plants, including those required and not required to meet ELVs.

The analysis of the impact on Micro and Small Enterprises carried out in section 11 shows that costs incurred by businesses generally represent a small percentage of Gross Operating Surplus (GOS). For the main analysis, it has therefore been assumed that costs will be funded through internal finances, and additional financial costs e.g. borrowing costs were not assessed. However, in practice, some firms would have to fund some of the upfront CAPEX through external financing. Costs as a function of a firm's ability to finance is given consideration in the distributional impacts assessment in section 10.

Devolved Authority Disaggregation

The original analysis was produced for a UK perspective. However, this impact assessment presents plant numbers for England and Wales, emissions reductions and consequent costs and benefits, and not those of the UK. The disaggregation from the UK results was based on 84% of plants being located in England, 7.5% in Scotland, 5.2% in Wales and 3.1% in Northern Ireland. It was assumed that plants are distributed equally regardless of capacity, technology and fuel type.

9. Risks & assumptions

9.1 Key Sensitivities

Key uncertainties and sensitivities are listed below. The quantitative impact of these sensitivities is presented in section 8, where, for each impact category, high and low scenarios are presented in addition to the central estimate in order to reflect the uncertainty.

Plant capacity, and therefore fuel consumption and associated total emissions, are based on mean plant capacity data from EU averages. The same average capacity is assumed for every plant within the same size category, regardless of fuel or technology type. This results in total emission reduction and associated benefits being highly influenced by this assumption.

Number of Plants

Prior to MCP Directive implementation, operators of plants below 20MW have not been required to register the type of their plant or their activities e.g. operating hours. The limited information on the number of plants below 20MW is therefore a key sensitivity in estimating the impact of the implementation of the MCP Directive. When the MCP directive takes effect and plants start to register and permit, the estimations may be improved for the post implementation review.

The number of plants is the basis of the analysis. In general, the overall costs to operators move in proportion to working plant numbers. The share of each plant type in the total also influences the results. The central scenario in the analysis includes 9,414 working plant in 2030. To present impact of the assumptions, the low scenario includes 4,707 working plants – i.e. it halves the number, while the high scenario includes 18,828 plants i.e. it doubles the number. The scenarios also increase/decrease the number of back-up/stand-by plant but their impact is smaller as they are exempt from ELVs.

Relatively limited data was received from stakeholders so the majority of the analysis is based on data gathered and/or derived for the Commission study and estimations in number of plants and projections in activity data from the NAEI.

For the baseline, the main limitation relates to current total emissions by plant type, size and fuel. As these plants are generally not regulated at present (unless connected to an IED regulated installation), in many cases emissions are not monitored. The levels assumed in the baseline influence what further actions are assumed to be required to meet the ELVs (i.e. abatement measure selection and associated costs) and emissions reductions achieved, and therefore the results are significantly influenced by the chosen values. For NO_x emissions from natural gas boilers (which represent a high proportion of total NO_x emissions from MCPs) it was possible to derive emission levels from actual data. However, for the rest non-factual information from consultation with experts and stakeholders was used as a proxy, which increases the level of uncertainty.

The parameter for the current total emissions by plant type, size and fuel emissions is based on fuel consumption which, in turn, is based on assumptions on load factors and a single set of average plant capacity data from EU averages. The same average capacity was therefore assumed for every plant within the same size category, regardless of fuel or technology type. This will be further refined following the registration of these plants as there will be a full data set of number of plants, running hours and emission levels.

The number of back-up plant is less influential because of exemptions applicable to them.

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 MCP Directive, 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 impacts to ecosystems and cultural heritage.

It should be noted the damage costs used to inform this IA have been amended since the consultation. In particular, the damage costs associated with NOx have been revised down by 63% in our central estimate reflecting the latest advice from the COMEAP.

9.2 Other sensitivities

Abatement measures

Plants are grouped into status categories. Each status category is a specific combination of plant characteristics, such as new/existing, capacity class, technology, fuel and pollutant(s) under consideration. For example, one status category would be existing, 1-5MWh, boiler, natural gas, and NO_x. For each status category, the model is only able to choose one abatement measure; therefore, one abatement measure is selected and applied to all plants within each status category.

In practice, plants that fall within a status category will have different emissions reductions needed to meet an ELV, and therefore a different level of abatement effort, and associated cost than assumed. As a result of averaging and aggregating, the impacts on emissions and compliance cost estimated per plant are expected to be modest. However, in some circumstances, as operators will choose abatement measures which are the most cost effective for their specific plants, costs could be an overestimate.

During consultation we gathered further information which has enabled the quantification of many of these uncertainties. A summary of responses and actions taken is presented in Annex E.

Current emission levels

Assumptions had to be made about current emissions since data available is limited. An average emissions level of each category and type of plant is assumed as individual data on existing plants is not available. Therefore if the actual plants are cleaner or more polluting, the benefits would vary accordingly.

10. Distributional Effects

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 FTE 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.

10.1 Sectors affected

MCPs are found in a broad range of industrial, commercial, public and non-industrial sectors.

Industrial Sectors

For some of the industrial sectors, Eurostat Structural Business Statistics (SBS) provides data on enterprise size categories thus allowing for a preliminary assessment of Small and Micro Business Assessment (SMBA)-relevance to be made. The key sectors where SMB may be affected include metals, pulp and paper, chemical industry, textiles, food production, car manufacturing etc.

However, a number of factors limited the possibility of a full sectoral mapping by enterprise size:

- Eurostat SBS does not provide sectoral enterprise size data for some sectors (in particular, a number of non-industrial sectors – see below), thus limiting the analysis;
- For those sectors where Eurostat provides enterprise size categories, it is extremely unlikely that the sector-wide average proportion of micro-size enterprises (i.e. 59% to 87%) would be observed for 1-50 MW combustion plants. It is anticipated that this high proportion of micro enterprises relate to much smaller combustion plants (i.e. <1MW) which are outside of the scope of the Directive. Furthermore, in a number of cases, such combustion plants are typically a part of a bigger complex requiring more than 9 employees to maintain and operate, and therefore it is highly unlikely that any micro-size enterprises would operate them. For example, in non-industrial sites, a 1MW boiler would supply space heating and hot water for a building of around 12,500 m^2 – i.e. an office for about 2,500 people.
- In addition, whilst the dataset developed in this study is based on numbers of individual MCPs, in many cases an enterprise will own and operate more than one MCP. However, no data is available on the average spread of numbers of individual plants by enterprise. This may mean that the numbers of SMEs potentially affected is likely to be overstated. The remainder of this section covers the major sectors where the largest impact is expected.

A number of the plants within 1-50MW are directly associated to an IED regulated installation (particularly the larger ones), which are unlikely to be an SME and are assumed to be large-size enterprises. Furthermore, 20-50MW plants (aggregate level) are already captured under the EU ETS and are unlikely to be micro or small enterprises.

Based on these arguments, it can be, therefore, assumed that no plant operators are micro-sized enterprises, although some of the installations could fall within the small enterprise category. If the assumption doesn't hold, such cases are expected to be so rare that it isn't proportionate to assess further.

Non-industrial and commercial sectors

1-50MW plants can also be found in a very wide range of non-industrial sectors such retail trade and warehousing, hotels, commercial services and telecommunications. Over 28% of the total estimated numbers of MCPs operating in the UK are assumed to operate in these sectors.

Data available suggests that higher proportion of micro enterprises are within these sectors, when compared to manufacturing industries. However, commercial, retail and warehousing properties hosting MCPs larger than 1MW are unlikely to be micro-sized enterprises, although some could potentially fall within the small enterprise category.

Education and health

24% of the total estimated number of MCPs operate in education and health sectors (hospitals, universities, schools etc.) with the large majority of these being public sector entities financed from state budget (e.g. NHS). Furthermore, such organisations typically employ a large number of employees and educational or health premises with a combustion plant on site are likely to be larger than on average.

In some cases, these installations (also those in the private ownership) are operated and owned by specialist companies providing such services. As such, the size of the organisation(s) using the output of a combustion plant (e.g. a hospital) may not be the same as the size of the enterprise operating it. In addition, in many cases, an enterprise owns and operates more than one MCP. It is unlikely that any of these plant operators are micro-sized enterprises although some could potentially fall within the small enterprise category.

Public sector

About 19% of the MCPs operate in government buildings. Operation of these MCPs is not associated with private businesses and the operations are financed from the state budget.

If the building is government occupied rather than government owned we would expect the cost to be passed through by the energy service company or landlord to the tenant (government) so the cost is ultimately borne by the state budget. (The explanation within the health and education section above is also applicable here).

Agricultural sector

Only an estimated 2% of MCPs are operating in the agricultural sector[15]. On average, agricultural sector in the UK is characterised by a 4.7 employee per agricultural enterprises. However, agricultural holdings hosting a MCP of 1MW and above are likely to be larger than average enterprises, and therefore more labour intensive. In particular, relevant activities in agricultural sector include heating large poultry farms and horticulture (greenhouses growing salad, tomatoes, cucumbers, peppers and ornamentals), which employ a large number of pickers.

As micro business is defined as having less than 11 employees, the above examples where an MCP would be used wouldn't fit into this employment category due to the labour intensity implied by farms large scale of activities associated with the use of MCPs.

There are, however, estimates of a large number of on-farm driers in cereals production. It is expected that Small and Micro businesses that uses driers, a majority would operate less than 500h per annum on average so would be exempt from the MCPD. Operates exceeding 500h per annum would be expected to be larger enterprises.

10.2 Distribution of health impacts

Benefits are derived from the reduction of emissions to air and associated avoided costs for reduction of damage to society. For this reason it isn't meaningful to distribute these benefits across sectors. The IGCB damage cost functions "*include estimates of the health impacts (both deaths and sickness) of all four pollutants. The PM_{10} and SO_2 estimates, in addition, include the impact of building soiling and the impact on materials respectively". (Defra, 2013, Valuing impacts on air quality: Supplementary Green Book guidance)* so those vulnerable to respiratory and heart disease, i.e. old, young, those with existing conditions, and people living in areas with higher ambient air pollutant concentrations (urban areas) will be more adversely affected and therefore the damage avoided is higher from reducing emissions.

[15] Annual Business Survey (ABS) (2012). SECTION A (PART) - AGRICULTURE, FORESTRY AND FISHING

11. Measurement of the Impact on Micro and Small Enterprises

The impact of the Directive on micro and small enterprises relates to whether the operators are able to meet and absorb the costs of compliance i.e. costs associated with meeting the ELVs as well as the administrative costs associated with the regulation (including compliance (inspection) and monitoring). These costs can then be assessed by comparing the compliance and administrative cost per plant against the level of financial resources available to the operator for investment. Average estimated costs per MCP (annualised) range between £2,400 for each of the MCPs 1-5MW up to £21,000 per 20-50MW MCP (working MCPs and standby MCPs using solid fuel with ELV).

The impact on micro and small enterprises in terms of total costs per plant compared to gross operating surplus (GOS) per operator[16] is assessed. The assessment suggests that in the case of small enterprises (10-49 FTE), the expected annual compliance and administrative cost per enterprise in manufacturing sector when assuming 1 MCP per company ranges from 0% to 3% of GOS for the MCPs of 1-20MW. For the 20-50MW size band, the share increases from 1% to 9% with casting of metals being the most affected sector. Assuming 3 MCPs per small enterprise in manufacturing sectors results in the range of 0% to 9% of GOS (for the MCPs of 1-20MW). For the 20-50MW size band, the share increases to 4% to 27% with casting of metals being the most affected sector.

For commercial sectors the share of total annual costs within GOS is between 0%- 4% (for the MCPs of 1-20MW). For the 20-50MW size band, the share increases from 2% to 11% with retail trade and hotels being the most affected sectors. Similarly, assuming a larger number of MCPs per company (3 MCPs per small enterprise) results in a higher range of 0% to 12% of GOS (for the MCPs of 1-20MW). For the 20-50MW size band, the share increases to 7% to 34% with retail trade and hotels being the most affected sectors.

As would be expected, all of these values increase significantly when 9 MCPs are assumed per enterprise (reaching 103% of GOS for some sectors). However, it must be noted that an enterprise with this many MCPs is very unlikely to qualify as a small enterprise. Whilst the values are relatively high for the 20-50MW MCPs, it is considered extremely unlikely that any of these plants would be operated by small enterprises given total number of such MCPs.

Consideration has been given to excluding small and micro businesses from the scope of the policy however doing so would reduce the benefits of the policy (perhaps by around 15%, based on the market share) and the analysis suggests that this policy will not place a disproportionate burden on these businesses.

Guidance and communications will be developed for plant operators which will be expected to reduce and further minimise any impacts for micro and small business impacts.

11.1 Key sectors

Education, health and public sector

Environmental compliance cost in the public sector, including MCPs operated in the government buildings, prisons, public educational and health care facilities are likely to be covered from the operating and maintenance budgets of these organisations.

Agricultural sector

When considering the average net farm income in England and Wales, compliance cost in agricultural sector would constitute one fifth to six times the average net annual income, suggesting significant burden. It should be noted, however, that agricultural enterprises operating MCPs larger than 1MW are likely to be larger than the average farming companies in the UK.

Furthermore, the absolute majority of the MCPs falling within the scope of the Directive are gas fired boilers and engines of 1-5MW (accounting for 94% of the total number of the MCPs). In this case, the share of the total annual compliance costs in the net farm income for poultry and horticultural farms is 3% and 5% respectively (assuming one MCP per farm). When considering the costs for gas fired engines and boilers within the relevant size band specifically (as opposed to the average annual costs across all plant types and fuels), the share decreases to 2% of the average farm impact.

11.2 Financial and Affordability

While the assessment considers the average annual costs per enterprise, compliance costs would involve upfront capital costs that need to be financed either through own or borrowed resources. If firms seek to spread the upfront

[16] GoS = capital available to companies after paying operating expenses from income, which allows them to repay their creditors, to pay taxes and eventually to finance all or part of their investment. Considering that GOS can be used for financing investment, total cost per plant are compared against GOS per operator to assess the economic impacts of proposed regulation. However, the GOS does not take into account depreciation or amortisation. The implication is that GOS may slightly overestimate the funds available for new investment for companies with high existing capital intensity.

capital costs over a number of years, they will have an additional cost of capital financing. This cost is not included in the average annual cost.

11.3 Direct Costs and Benefits to Business Calculations (following One-In-Three-Out methodology)

Following the EANCB requirements, costs and benefits calculated here use a 2014 price base year and a 2015 PV base year. Consistent with the EPR (Environmental Permitting Regime), and other cost recovery schemes, we envisage charging operators appropriate fees to recover regulator costs, thus avoiding additional burdens on public finances. (Please see Section 7.3 for details). As such, the costs to business include all abatement, administration, compliance (inspection) and monitoring costs associated with the MCPD.

The equivalent annual cost to business is estimated to be £15.9m, with only £0.1m equivalent annual benefits to business estimated (in traded carbon reductions). Overall this gives an EANCB of -£16m, a net cost to business. As this is EU driven regulation, and the implementation doesn't go beyond the minimum EU requirement, it is out of scope of 'One-in, Three-out' in accordance with the current methodology.

All costs and benefits have been assessed at 2015 prices and uplifted to 2018 PV base year. However the Equivalent Annual Net Cost to Business (EANCB) figure is calculated at 2014 (real) prices and 2015 Present Value base year. Methodology is consistent with the Green Book and supplementary guidance.

12. Competition assessment

The competition assessment guidelines[17] 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 emission limit values for the plants with a thermal input of 1-50MW would affect the market by:

- 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 Table 12.1.

Table 12.1 Competition Assessment Filter Questions

Do the proposed requirement to carry out a CBA	Response	**Comment**
Q1. …directly limit the number or range of suppliers?	No	The proposed requirement to comply with the proposed ELVs does not seek to directly limit the number of suppliers
Q2. …indirectly limit the range of suppliers?	No	The proposed requirement to comply with the proposed ELVs is not likely to limit the range of suppliers. In particular, the proposed requirement does not prevent entry or exit from the market for any of the sectors affected, e.g. Electricity Supply Industry (ESI), refineries, iron and steel, chemical industry, commercial and public sector entities etc. Furthermore, anticipated compliance and administrative costs are driven by the size of the MCP (1-5MW, 5-20MW and 20-50MW) and apply same requirements across different sectors and ownership models. In terms of suppliers of abatement technologies aiming to reduce pollutant emissions, these are manufactured by a range of companies ranging from the engineering or chemical companies to the energy specialist. For example, the energy giants Siemens (DE), Hitatchi (DE) and Alstom (FR) all provide multiple abatement techniques for various pollutants (NO_x, SO_x, PM and others). Other leading engineering European companies such as ABB (CH), Andritz (AT) and Fluor (UK) provide a wide range of abatement technologies such as SCR, FGD and electrostatic precipitators (ESP). Some manufacturers are more specialised. For instance, Howden (UK) is a leading provider of rotary regenerative heat exchangers which are used for FGD and SCR. The British company Johnson Matthey is a leader in providing chemical catalysts. Whilst a majority of the abatement technologies manufacturers are large companies, there is a significant number of SMEs involved in the installations or the fitting of these technologies. Moreover, some more specific (specialist) technologies, particularly relevant for combustion engines, may be developed by smaller manufacturers. Overall, there is no one dominant supplier or dominant approach across the installations affected by the proposed regulation. Furthermore, the requirement to comply with the proposed ELV does not specify application of any particular abatement technology leaving the choice to the operators.
Q3. …limit the ability of suppliers to compete?	No	The proposed regulation would bring smaller scale combustion processes in line with regulation for combustion plants greater than 50MW, thereby reducing any (potential) perverse effect on these installations at the threshold above and below 50MW.
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 requirement to comply with the ELVs for existing and new MCPs with a thermal input of 1-50MW is unlikely to have adverse impacts on competition.

Additional compliance and administrative costs that companies across different sectors would be facing may result in significant burden affecting profitability and commercial viability of these enterprises. However, application of the new requirements for the MCPs between 1-50MW would impose similar constraints on all operators across the board.

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

13. Social impact assessments

In general terms, when an operator is faced with additional compliance and administrative costs, a range of potential responses exist ranging from absorbing the additional cost through reduction of profit margins up to fully passing these on within the prices of products and services. The companies could also aim to reduce their cost base, for instance, by cutting labour and/or other production costs.

13.1 Distributional impact on households

Implementation of this Directive will affect a wide range of manufacturing sectors, such as metal production and processing, chemical industry and manufacturing of refined petroleum products, commercial sector including retail, hotels, warehousing among other sectors and agriculture.

Enterprises faced with additional annual compliance and administrative costs will be aiming to pass on these costs to the fullest extent possible through the prices of their products and services. Potential impacts on electricity and consumer product prices would be of particular relevance to consider.

First of all, it should be noted that the absolute majority of the plants falling within the scope of the Directive are gas fired boilers and engines with the capacity of 1-5MW (working and standby plants). In relative terms, this group of MCPs accounts for 94% of the total number of plants. In practice, these plants will be hosted across a multitude of sectors generating energy for a business' own consumption and acting as standby plants as opposed to being part of the national grid and indirectly affecting electricity prices.

Furthermore, it should be noted that annual compliance and administrative costs as a proportion of GOS for the MCPs between 1 and 5MW range from 0% to 2% (1 MCP per company), 1% to 6% (3 MCPs per company) and 2% to 18% (9 MCPs per company) in the case of manufacturing and commercial sectors.

13.2 Employment and Labour Markets

Overall, implementation of the regulation may have positive secondary impacts on the level of employment in abatement technology suppliers, while potentially having adverse primary impacts in sectors that will incur additional compliance and administrative costs. Secondary impacts (costs and benefits) have not been explicitly monetised in this assessment but primary costs have.

Implementation of regulations requiring fitting of abatement technology will lead to costs for the firms affected whilst also representing income for firms that manufacture and install these technologies. When considering supply of abatement technologies, the UK and EU as a whole has a well-established abatement technology supply chain as the majority of the technologies currently being applied by LCPs are also relevant for these smaller plants. The counter argument is that while the operators of MCPs are expected to be able to pass (some of) the costs of installing necessary equipment on to consumers, additional abatement costs might result in adverse impacts on employment.

It is unclear how these two effects will reach a balance but it might be a reasonable assumption that the effect will in aggregate be fairly neutral. The effects of additional costs on firms might be more pronounced in sectors open to international competition such as metal processing, food production, chemical industries etc. The relative scale of combustion plant within the total operations of the enterprise (and costs) constitutes another important factor that will affect the ability of enterprises to absorb additional costs. Distributional sector analysis suggests that in the case of a company operating one MCP, the proportion of annual compliance and administrative costs within the enterprise's GOS, depending on the size of the MCP, ranges from 1% to 9% in the metal production and chemicals sectors.

14. Conclusions

Poor air quality is the largest environmental risk to public health in the UK, exacerbating the impact of pre-existing health conditions, especially for the elderly and children. Long term exposure reduces life-expectancy, mainly due to increased risk of mortality from cardiovascular and respiratory causes and from lung cancer. COMEAP's research notes that short-term exposure to NO_2 has been linked to some direct effects on morbidity while long term effects suggest impacts on respiratory and cardiovascular mortality, children's respiratory symptoms and lung function. Air pollution also damages biodiversity and reduces crop yields[18].

Combustion plants in the 1-50MWth range (Medium Combustion Plants, MCPs) are a significant, largely unregulated source of emissions of Oxides of Nitrogen- NO_x, PM, Sulphur dioxide- SO_2) which impact on air quality. An important tool for controlling emission from this source- the MCPD came into force in December 2015 and must be transposed within 2 years. The legislation was fully supported by UK during negotiations as it represents a cost effective way of controlling emissions and offers a number of important exemptions and flexibilities necessary to keep burdens on business low and any impacts on energy security to a minimum. Furthermore as AQ is transboundary, effective controls across Europe will benefit to UK population.

This impact assessment has assessed the transposition of the MCPD into domestic legislation, making use of available flexibilities and exemptions where possible and adopting a risk-based approach to permitting, compliance and enforcement. Emissions growth from high NO_x emitting generators continues and has to be dealt with through future policy to avoid non-compliance with emission ceilings and AAQD limit values.

The results of the analysis are presented in Table 14.1 below:

Table 14.1 Central NPV of each impact (2018-2032)

2018-2032	(£m, PV)
Costs (cost to operators)	
Abatement costs	138.1
Administration costs	30.4
Monitoring costs	42.8
Operational/capital cost of technology switch	
Total	211.2
Benefits (emissions reductions)	
Air Quality pollutants	982.4
CO2 (Traded)	1.4
CO2 (Non-Traded)	34.1
Total	1,018.00
NPV	806.8

*Please note any differences due to rounding.

The impacts assessed within the document are based on the best available knowledge of the current MCPs active within the UK along with the assumed behaviour of these plants when faced with these restrictions. We have consulted widely on our assumptions and have refined the analysis accordingly (see Annex E). The remaining uncertainties around the modelling and the implementation and delivery of our preferred option are clearly set out in section 9. We will monitor the effectiveness of the controls primarily through the Environment Agency's implementation plan.

[18] 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-to-particulate-air-pollution-in-the-uk

Annex

A. Additional options considered for transposition of the MCPD

In addition to the options presented in Table 6.3, Section 6, alternative options for transposing the MCPD could involve (1b) applying controls earlier than required by the directive for new and/or existing plants; and (1c) setting stricter emissions limits than the directive. The options are assessed in the table below.

Annex Table 1 Option selection

Option	Discussion
Apply earlier emission controls for new plant	The MCPD requires new plants to be permitted and in compliance with ELVs from 20 December 2018, one year after the deadline for transposition. This timescale is justified to allow sufficient time for transposition, to develop the processes and guidance required for implementing the Directive, and to raise awareness of the requirements for plant operators, many of which may have not prior experience with environmental permitting. It was therefore considered that earlier application of emission controls for new plants would not be appropriate.
Apply earlier emission controls for existing plant	Application of earlier emission controls to existing plants could deliver earlier improvement to air quality. However, there are a very large number of existing plants (particularly 1-5MW plants) which will require permitting, retrofitting to achieve compliance with ELVs and possibly modifications to the flue to allow monitoring emissions, so a long timescale for implementation is helpful. In addition, this timescale will promote decommissioning of older plants before the deadline for compliance with ELVs and their replacement with new plants using cleaner technology, which typically have to comply with more stringent ELVs.
Application of stricter ELVs	The MCPD ELVs were selected to provide a minimum emission standard which can be applied to the wide variety of combustion plants in scope of the Directive. Application of stricter ELVs would deliver greater emission reductions but they may not be achievable in all situations, and so would require a more bespoke approach to setting emission limits, which would increase permitting costs. However, for existing 20-50MW plant subject to emission controls under domestic provisions which are more stringent than those required by the MCPD, the domestic provisions will be retained because plant are already in compliance. The MCPD states that the European Commission will produce a report on the emission levels achievable applying best available technology, and associated costs, which will have to be considered when setting emission limits for plants in zones or parts of zones non-compliant with the Ambient Air Quality limits. This report will allow reviewing the case for applying stricter ELVs.

B. Abatement measures and Costs methodology

The impact assessment model is based on an abatement matrix which details abatement measures for each pollutant (NO_x, SO_2 and PM), technology type (boiler, engine and turbine), fuel and capacity class, alongside its abatement efficiency and costs. After entering the set of ELVs, the model compares these against baseline emission levels (projected into the relevant year) and calculates the necessary emission reduction needed to achieve the ELVs. Given the reduction needed, the model selects the most cost effective measures and calculates total emission reduction and costs. These figures are based on the data from the abatement matrix, multiplied by the number of plants applying those measures. The process is done separately for new and existing plants. It is done separately because an adjustment factor has been applied to the costs of the abatement measures to reflect the lower cost of installing abatement as part of installation of a new plant when compared to the higher cost of retrofitting a measure to an existing plant.

Compliance costs for potential abatement measures are based on the abatement matrices developed by Amec Foster Wheeler for the Commission in recent studies. A number of literature sources were reviewed in order to compile information on possible abatement measures for MCPs and associated pollution abatement efficiencies and costs. The following sources were reviewed:

- JRC (2007) Small combustion installations: Techniques, emissions and measures for emission reduction. Joint Research Centre;
- AEA (2007) Assessment of the benefits and costs of the potential application of the IPPC Directive (EC/96/61) to industrial combustion installations with 20-50MW rated thermal input. Final Report to the European Commission;
- (Summary of) Best Available Techniques in Small 5-50MW Combustion Plants in Finland;
- EGTEI (2010) Options for limit values for emissions of dust from small combustion installations < 50MW;
- VITO (2011) Beste Beschikbare Technieken (BBT) voor nieuwe, kleine en middelgrote stookinstallaties, stationaire motoren en gasturbines gestookt met fossiele brandstoffen;
- ECN (2008) Onderbouwing actualisatie BEES B: Kosten en effecten van de voorgenomen wijziging van het besluit emissie-eisen stookinstallaties B;
- Amec Foster Wheeler's multi pollutant abatement measures database.

The majority of the costs are taken from VITO (2011), with some additional costs taken from AEA (2007) and Amec Foster Wheeler (2013). Figures are inflated to 2014 prices in all cases[19]. The literature sources include a range of costs for measures, which represent the uncertainty around the cost estimates for the abatement measures and variation in installation specific variables, and so a low and high range of costs are used in this analysis. A list of abatement measures is provided on Annex Table 2. For some abatement measures, the low and high costs are the same, which is assumed to reflect a single underlying cost data source; whilst for other abatement measures (SCR and SNCR in particular) there is a significant difference between the low and high costs.

The abatement measure for the reduction of SO_2 emissions from the combustion of other gaseous fuels is assumed to be as per the installation of end of pipe SO_2 treatment at liquid-firing plants (wet and dry FGD). It is known however that some of the plants firing other gases will be at refineries and steelworks where it may be more cost effective to desulphurise fuel feedstock's rather than fit end-of-pipe SO_2 abatement. As such, for this measure, the assumed costs that have been assumed may be an overestimate, and should be considered as conservative.

Identify the abatement measures

Abatement measures and their associated emission reduction efficiencies are based on the abatement matrices developed by Amec Foster Wheeler for the Commission in recent studies (Amec Foster Wheeler, 2014). Annex Table 2 lists a consolidated version of the abatement measures considered in the MCPD Impact Assessment as well as their abatement efficiency and the technologies and fuels affected. Where a range is shown for abatement efficiency this indicates different efficiencies are expected when the measure is applied to different size-fuel-technology type categories. Abatement efficiencies presented are an indication of the emission reduction that the measure can achieve on average and are therefore suitable for modelling the impact across groups of plant; the reduction realised in individual plant could be slightly higher or lower depending on site specific features.

Annex Table 2 List of measures considered in the MCPD IA and their associated abatement efficiency

	Technologies that can fit this measure	Fuels affected	NO_X abatement efficiency	SO_2 abatement efficiency	PM_{10} abatement efficiency

[19] Capital (CAPEX) and operational (OPEX) costs have been identified in the reference sources to allow for flexibility in annualising the data; default values of a 3.5% discount rate and an annualisation period of 15 years have been used in the central case. Costs have been presented in 2014 prices using the GDP deflators available from HMT (ONS June 2015).

Combustion modification - assumed EGR (Exhaust gas recirculation)	Boilers	Biomass, Other solid fuels, Liquid fuels.	30%	-	-
Cyclone	All technologies	Biomass, Other solid fuels, Liquid fuels.	-	-	65%
Dry FGD (flue gas desulphurisation)	All technologies	Other solid fuels, Liquid fuels, Other gaseous fuels	64% - 80%	-	-
ESP (Electrostatic precipitator)	Engines and turbines	Liquid fuels, Natural gas	-	-	97%
Fabric filter	All technologies	Biomass, Other solid fuels, Liquid fuels	-	-	95% - 99%
Fuel switch to 0.1%S Liquid fuels	All technologies	Liquid fuels	-	90%	50%
Fuel switch to natural gas	Boilers	Other solid fuels	50%	100%	99%
Low NO_x burner	Boilers	Natural gas, Other gaseous fuels	30%	-	-
Low NO_x burner / Advanced lean burn	Engines and turbines	Natural gas, Other gaseous fuels	40% - 50%	-	-
SCR (Selective catalytic reduction)	All technologies	All fuels	70% - 90%	-	-
SNCR (Selective non-catalytic reduction)	All technologies	All fuels	35% - 45%	-	-
Water injection	Engines and turbines	Liquid fuels, Natural gas	60%	-	-
Wet FGD	All technologies	Biomass, Other solid fuels, Liquid fuels, Other gaseous fuels	-	94%	99% - 100%

Annex Table 3 List of measures considered in the MCPD IA and their associated uptake frequency

Pollutant	Measure	Number fitted in 2030	
		New	Existing
NO_x	Lean burn / low NO_x burners	1,742	1,325
	water injection	297	4
	EGR	7	308
	SCR	237	325
	SNCR	175	318
SO_2	WFGD	272	304
	DFGD	0	205
	Fuel switch	7	13
PM	Total cyclone	71	243
	Filters	51	205

Please note the number of fitted is not the number of plants. Some plants need to fit multiple abatement technology to meet ELVs for multiple pollutants. Some plants required to meet emissions limits are already compliant under BAU and therefore do not need to fit abatement technology.

A summary of this information is presented in the abatement matrices (Annex Table 3) for each of the 1-5MW, 5-20MW and 20-50MW capacity classes, for boilers, engines and turbines above. Expanded versions of these abatement matrices are used within the model to automatically identify which abatement measure would be required to achieve compliance with the scenario ELVs. Given that to date the majority of MCPs have not been regulated, there has been no driver to optimise emissions performance. A threshold has been set at 10% emission reduction. Below 10%, it is assumed modifications to existing equipment and operating practice can be implemented to achieve the necessary reduction with minimal additional cost[20]. If an emission reduction of greater than 10% is required, then the lowest cost measure that can achieve the required reduction is selected.

An adjustment factor has been applied to the costs of the abatement measures to reflect the lower cost of installing abatement as part of installation of a new plant, compared to the higher cost of retrofitting a measure to an existing plant. For primary measures, this premium is assumed to be 60%, consistent with Amec Foster Wheeler's recent modelling for the Commission's impact assessment. For secondary measures, the premium is 40%. This is 60%/40% adjustment is for CAPEX only. The CAPEX/OPEX distinction matters for some measures such as pure fuel switch, where there is no CAPEX in some applications.

Some types of plant, namely natural gas boilers are assumed to reach compliance with the ELVs set and therefore do not face the cost of abatement. As this is also the most frequent type of plant it has been assessed and presented in Annex Table 4.

[20] An assumption consistent with the Commission study

Annex Table 4 NO_X average emission level, proportion of plants and relative contribution of NO_X emissions from natural gas boilers already compliant or non-compliant with MCPD.

Capacity Class	Emission Levels (mg/Nm^3)		Proportion of plants		Relative contribution (NO_X)	
	Compliant	Non-compliant	Compliant	Non-compliant	Compliant	Non-compliant
Existing plants						
1-5 MW_{th}	120	280	70%	30%	49%	51%
5-20 MW_{th}	130	230	80%	20%	69%	31%
20-50 MW_{th}	150	280	60%	40%	45%	55%
New plants						
1-5 MW_{th}	70	190	20%	80%	8%	92%
5-20 MW_{th}	80	170	30%	70%	17%	83%
20-50 MW_{th}	70	200	10%	90%	4%	96%

The values in the table above are based on information on real plant performance and what percentages of those have BAU emission levels below the MCPD ELVs. The figures are for data collated in 2014 and assumed to apply for all years 2018-2032 as without MCPD.

C. Administration and compliance activities

Annex Table 5 List of administrative activities considered

Administrative activities	Type of activity	Frequency	Affected party	Time required per operator or regulator per activity (hours) by type of permit	Assumptions*
Permit application to CA by operator (new plants)	one-off		Operators : (per MCP)	Standard: 3.5 Bespoke: 45	Assumed to be electronic and based on readily available information
Permitting: CA to start permitting process within 1 month (new plants)	one-off		Regulator (per MCP)	Standard: 2 Bespoke: 20	Assumed to be electronic and does not include corrections/revisions of submitted information
Permitting: notification to CA by operator (existing plants WHERE annex I information has not been provided before)	one-off		Operators : (per MCP)	Standard: 3.5 Bespoke: 45	Assumed to be electronic and based on readily available information
Permitting: development of the MCP register by CA	one-off		Regulator (total)	15,673	Assumed to cover development of the register template by the CA either as a spreadsheet to be posted on-line (from scratch). It excludes any specific IT costs in this case
Permitting: data reporting	recurring	Variable	Operators (per MCP)	Standard: 2.5 Bespoke: 50	Assumed to be electronic and concise
Permitting: data reporting	recurring	Variable	Regulator (per MCP)	Standard: 1 Bespoke: 25	Assumed to be electronic and does not include corrections/revisions of submitted information
Record keeping (for at least 6 years)	recurring	Once per year	Operators (per MCP)	7.5	Assumed to be electronic using an existing record keeping system (to an extent part of a day-to-day installation management)
Compliance check: environmental inspection	recurring	High risk: (1) once per year (2) once every two years	Regulator (per MCP)	15	Assumed to involve a site visit (with limited travel time). Does not include corrective actions and follow ups/ checks.
Compliance check: environmental inspection	recurring	High risk: (1) once per year (2) once every two years	Operators (per MCP)	7.5	Assumed to involve a site visit. Does not include addressing any corrective actions and follow ups.
Approach 1, Approach 2 - Compliance check: remote check	recurring	Low risk: (1) once every 3 years (2) once every 10 years Medium risk: 1-20MW: once every 3 years, 20-50MW: (1) once per year (2) once every 2 years	Regulator (per MCP)	7.5	
Compliance check: recording of malfunctions	recurring	Once every 5 years	Operators (per MCP)	1	Assumed to be electronic using an existing record keeping tool (to an extent part of a day-to-day installation management)
Reporting: three reports to the Commission (2021, 2026 and 2031)	recurring	As required by reporting year	Regulator (per report)	37.5	Assumed to be based on compilation of readily available information received and stored by the CA. Does not include data checks and corrections (assumed to be part of daily operation)

* It is assumed within the activities set out above, the costs associated with the collection of annual fees is covered.

D. Behavioural response assumptions

The behavioural assumption is supported by a demand for heat by the majority of operators, combined with the fact that boilers will remain the primary supply. This is because district heating systems are not widespread in the UK and it is therefore unlikely to be a viable alternative option for the representative operator to connect to a network to provide their primary heat needs. That is to say, technical barriers matter as well as economic considerations.

For engines and turbines generating electricity, there could be two alternatives to fitting abatement:

1. Stop auto-generating electricity and switch to buying from the grid. This will result in higher cost per unit of electricity and may also require an upgrade to the supply contract and/or physical connection, also at additional cost.

2. To purchase or hire portable gensets, which do not fall under the MCPD but instead have emission limits under NRMM standards. Given the low number of expected cases of such a switch, a comparison of the costs and benefits of the MCPD against the NRMM standards has not been performed.

For engines and turbines operating as cogeneration, the above considerations for heat and electricity both apply. For all plant types nearing the end of their operational life, an alternative to fitting abatement may be early closure and replacement with new compliant plant. This would come with the associated cost premium for compliance with MCPD new plant ELVs and the early write off of remaining asset value. Technological changes that may alter incentives over time would not be anticipated until after the appraisal period of this assessment either.

In specific circumstances, where one of the outlined alternative options is lower in cost than fitting abatement, the option may be taken and therefore the behavioural response for some operators may be different than the one assumed to be representative of the vast majority of operators. Due to the relative small scale and uncertainty it was not considered further.

E. Summary of consultation responses and actions taken

Annex Table 6 Summary of consultation responses and actions taken

Question	Summary of responses	Action taken
Do you agree with the general approach to permitting that is proposed?	*Using Environmental Permitting regulations and modifying existing permits was deemed the most straightforward implementation approach. Clear guidance needed alongside the legislation.*	*Proceed with proposed approach that operators will be required to obtain an environmental permit under the Environmental Permitting Regulations in order to operate an MCP.*
Do you agree with the proposed approaches set out in Table 1? ***If not, why not?***	*Strong feeling that biomass and district heating should not be exempt to allow equal playing field. Clear guidance needed to clarify scope of flexibilities.*	*Proceed with proposed approaches for the flexibilities except for District heating and biomass.*
What are the practical problems with applying the 3-year and 5-year rolling averages? ***Should a yearly maximum be applied?***	*Responses split between considering the rolling averages should be allowed to allow maximum flexibility and those who felt it would be too flexible and difficult to enforce. Annual reporting was proposed as a solution.*	*Apply rolling average in full; require operators to notify the regulator if 500h exceeded on any calendar year.*
Do you have specific examples where applying the extension to exempted hours in exceptionally cold weather is justified?	*Majority agreed with the proposal not to apply this flexibility. Some suggested it would be prudent to have flexibility for exceptional circumstances.*	*Allow Ministers discretion to apply exceptionally cold weather exemption.*
For biomass and district heating plants which qualify for later application of Annex II emission limits, do you have views on how emission limits should be set which ensure that no significant pollution is caused and that a high level of protection of the environment as a whole is achieved?	*Strong feeling that biomass and district heating should not be exempt to allow a level playing field.*	*Do not allow late application of ELVs, since MCPD timescale provides very cost effective reduction in pollutants.*
What are the practical difficulties with applying the MCPD to compression ignition engines within the MCPD size range which are not used in the propulsion of a vehicle, ship or aircraft and are not subject to 'placing on the market' emission standards under the Non-Road Mobile Machinery Directive?	*Respondents asked for clarity on what plants would be in scope and who is responsible for compliance with the directive.*	*Use existing EPR provisions for mobile plants: operator is responsible for permit.*
What approach for compliance checks to you prefer: ***a) Random compliance checks as described above*** ***b) Scheduled compliance checks as described above*** ***c) Other – please describe***	*There was strong support for developing approaches which enable a reduction in frequency, rather than a standard random or scheduled approach.*	*IA will be amended to assume worst case scenario of scheduled inspections, and we will develop a regime in consultation on guidance with stakeholders and the regulator*
Do you agree with the proposed approach for monitoring plants? ***If not, what are your concerns?***	*It was widely agreed that continuous monitoring would be excessively costly and disproportionate. Some were concerned the monitoring frequency was too low and other felt in parts it was too onerous.*	*Proceed with proposed approach that operators are required to monitor pollutant emissions periodically.*
Do you have any suggestions for monitoring methods which could be applied to MCPs as an alternative to MCERTs?	*Some suggested alternatives to MCERTs could be developed; others suggested that MCERTs could be developed to include standards proportionate to the risk posed by smaller plant.*	*Proceed with proposed approach on IA; monitoring standards will be developed in guidance.*
Do you foresee any challenges to using the Environmental Permitting Regulations for implementing the MCPD and controls on generators?	*The majority felt it was right to use the Environmental permitting regulations but where concerned on complexity. There were also lots of concerns around fees and charging if Local Authorities were the regulator.*	*Proceed as proposed by using the Environmental Permitting Regulations.*
We will ensure duplicating and conflicting controls are removed whilst ensuring that the current level of environmental protection is maintained. ***Do you agree with this approach?*** ***If not, please explain***	*Most agreed it would reduce burden on industry as long as it was clear what the replacing provision is, what it removes and why.*	*Proceed as proposed: no changes needed for Sulphur Content of Liquid Fuels Directive; retain Clean Air Act provisions on emission of stack heights and emission of dark smoke.*
Which of the following approaches do you consider to be the best option for choice of the regulator: ***A) Plants where regulator must determine the permit conditions to safeguard local air quality and those in Part A1 installations are regulated by EA***	*It was a close split between the Environment agency and a combination of the Environment Agency and Local authorities. It was asked that whoever was the regulator they provide further clarity.*	*Option B - EA regulates all plants in England and NRW regulates all plants in Wales. Part B plant permits to be transferred to EA.*

in England and NRW in Wales, and other plants are regulated by LAs ***B) EA regulates all plants in England and NRW regulates all plants in Wales*** ***C) LAs regulate all plants***		
Are there any situations where you consider the identity of regulator needs to be further clarified?	*Some asked for further clarity on mobile plants. Another issue was the overlap with waste permits.*	*Need to consider situation of waste sites in guidance.*
Do you agree with the assumptions made/ evidence provided in the policy analysis and associated impact assessment e.g. number of plants, operating hours, emissions? ***If not, please provide details.***	*Some noted that some areas where omitted from the impact assessment such as mobile generators.*	*Amend the IA to reflect changes of proposals described in this table, and impact on mobile generators.*

F. Glossary

Terminology	Definition
Abatement technology	*In this report* refers to techniques and technologies used to reduce pollutant emissions, Primary abatement prevents formation of pollutants and includes a switch to fuels which result in lower emissions, retrofitting of existing plant (e.g., by changing the burners) and selection of new plant with lower emission. Secondary abatement refers to technology which removes pollutants from the exhaust gases, such as filters for dust or selective catalytic reduction to destroy NO_x.
Amec Foster Wheeler	Amec Foster Wheeler Foster Wheeler plc is a British multinational consultancy, engineering and project management company headquartered in London, United Kingdom that provided analysis for this impact assessment
AQ	Air quality
AQMAs	Air Quality Management Areas
Back-up plant	Plant installed to provide emergency electricity generation in times of interruption to supply of mains grid electricity, operating rarely and normally much less than 500 hours per year (assumed to be less than 50 hours).
BEIS	Department of Business, Energy and Industrial strategy
CA	Competent Authority
Capacity Market	The Capacity Market is Government's key policy tool to bring forward sufficient reliable electricity capacity to ensure we maintain a secure supply of electricity.
CAPEX	Capital Expenditure
CO	Carbon Monoxide
CO_2	Carbon Dioxide
Combustion plant	Any technical apparatus in which fuels are oxidised in order to use the heat thus generated
Cyclone	A type of filtration system fitted to abate pollution impacts of Biomass, Other solid fuels, Liquid fuels.
DEFRA	Department for Environment Food and Rural Affairs
DRGD	Dry Flue gas Desulphurisation
EA	Environment Agency
EANCB	Equivalent Annual Net Cost to Business
EGR	Exhaust Gas Recirculation
ELVs	Emission Limit Values; means the permissible quantity of a substance contained in the waste gases from a combustion plant which may be discharged into the air during a given period
EMEP CORINAIR	Emission Inventory Guidebook

Energy Market	Energy market is the trade and supply of energy
EPR	Environmental Permitting Regulations
ESI	Electricity Supply Industry
ESP	Electrostatic Precipitators
ETS	Emissions Trading Systems
FGD	Flue gas Desulphurisation
Filters	Form of abatement where different materials are fitted to plants to filter out particulate pollution
FTE	Full time Equivalent
GB	Great Britain
GHGs	Greenhouse gases
Government	Defra and Welsh Government
GOS	Gross Operating Surplus
IED	Industrial Emissions Directive
IGCB	Interdepartmental group on costs and benefits
Installation	(a) a stationary technical unit where one or more activities are carried on, and (b) any other location on the same site where any other directly associated activities are carried on,
Kt	Kilo tonne
KW	Kilowatt
LA	Local Authority
LCP	Large Combustion Plant
Lean burn/low NO_X burners	A form of abatement using larger quantities of air in the fuel mix for internal combustion engines.
MCERTS	Monitoring Certification Scheme
MCP	Medium Combustion Plant
MCPD	Medium Combustion Plant Directive
Member states	Members of the European Union
mg/Nm^3	Milligrams per normalised meter cubed
MIS	Micro Isolated Systems
MS	Member State

MW	Megawatt - a unit of power equal to one million watts Unless otherwise stated the use of MW in this report refers to MW thermal
MWth	Thermal rated input in MW – the maximum fuel energy rate of the combustion plant.
MWe	Megawatts electric - electric output of a power plant in megawatt. The relationship between thermal input and electrical output of a generator depends on its efficiency – an engine that is 33% efficient would have a thermal input 3 times greater than its electrical output.
NAEI	National Atmospheric Emissions Inventory
NO_2	Nitrogen Dioxide
NO_X	Nitrogen Oxide
NPV	Net present value
ONS	Office of National Statistics
OPEX	Operating expense
PJ	Peta joules
PM	Particulate Matter
PM_{10}	Particulate Matter 10 micrometres or less in diameter
$PM_{2.5}$	Fine particulate matter (2.5 micrometres or less in diameter)
PV	Present Value
Rpm	Revolutions per minute
SBS	Structural business statistics
SCR	Selective catalytic reduction
SIS	Small isolated systems
SMBA	Small and micro business assessment
SME	Small and medium sized enterprises
SNCR	Selective non-catalytic reduction
SO_2	Sulphur Dioxide
Solid Fuels	Refers to fuel made of solid substance, typically coal or wood
SO_X	Oxides of Sulphur
Stand-by plant	Plant installed alongside working plant to provide for additional demand at peak times or in case of shut down of the main working plant, and operating fewer than 500 hours per year.
STOR	Short Term Operating Reserve

t	Tonnes
TRIAD	The Triads are defined as the three half-hours of highest demand on the Great British electricity transmission network between November and February each year. The triad charging system is a tool used by National Grid to smooth demand for electricity at peak times and is used to recover the costs of building and maintaining the electricity transmission network. The cost of electricity for large industrial and commercial users of electricity whose consumption is half hourly metered is determined by their demand during the Triads. Large users of energy therefore have an incentive to reduce their demand during the Triads by running their generators to avoid drawing power from the transmission network during Triads (this is known as Triad avoidance). Generators connected at the distribution level are paid to produce power during the Triad peaks. Some generator operators are contracted by large energy users (or third parties on their behalf) to run during periods when triads are likely. Triads are declared by National Grid retrospectively so generators are run whenever the operator believes a triad is likely to occur.
UK IAM	UK integrated assessment model (UKIAM) he UK integrated assessment model (UKIAM), has been developed using Defra funding by Imperial College London to investigate cost effective strategies for reducing UK emissions which maximise improvements in environmental protection in the UK while complying with future UK emission ceilings imposed to reduce transboundary air pollution in Europe. UKIAM brings together information on projected UK emissions of SO_2, NO_2, NO_x, NH_3, CO_2, N_2O, CH_4, PM_{10} and $PM_{2.5}$ to calculate the simultaneous effect of abatement measures on a combination of pollutants, and comparison of future scenarios. This includes calculating the effects with respect to changes in greenhouse gas emissions as well as human exposure to air pollution, urban air quality, and the natural ecosystems.
WFGD	Wet Flue gas Desulphurisation
Working plant	Operating on average more than 500 hours per year which are subject to compliance with emission limits.