Title: **Removal of equipment containing Polychlorinated biphenyls (PCBs) by 2025** IA No: RPC Reference No: **RPC-DEFRA-4455(1)** Lead department or agency: **Department for Environment, Food and Rural Affairs** Other departments or agencies: **Environment Agency**	**Impact Assessment (IA)** Date: **21/02/2020** Stage: **Final** Source of intervention: **Domestic** Type of measure: **Secondary Legislation** Contact for enquiries:

Summary: Intervention and Options

RPC Opinion: GREEN

Cost of Preferred (or more likely) Option (in 2016 prices)			
Total Net Present Social Value -£28.3m	**Business Net Present Value** -£28.3m	**Net cost to business per year** £1.6m	**Business Impact Target Status** Non Qualifying provision

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

Polychlorinated biphenyls (PCBs) are man-made organic compounds which pose risks to human/animal health, such as cancer and reproduction problems, due to their toxic and bioaccumative properties. The damage these substances cause has been recognised globally since 2004, with an international commitment to remove all PCBs from use by the end of 2025. PCBs were used to improve performance in electrical transformer oil. Existing domestic regulation allows contaminated transformer equipment to be used until the end of its life, which can be as long as 60 years. Government intervention is necessary to bring forward the removal of such equipment in accordance with our international comittments and retained UK law.

What are the policy objectives and the intended effects?

The policy objectives are to comply with the requirement of the UN Stockholm Convention and retained UK law by removing PCB contaminated equipment. It aims to do this by introducing a deadline of 31 December 2025 for holders of equipment, contaminated with more than permitted levels (0.005%/0.05dm^3) of PCBs, to remove such equipment from use. Achieving this will avoid the potential for leaking in aging equipment and subsequent impacts to the environment and human health that could be caused by their continued use.

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

The international requirement to safely remove all PCB contaminated equipment from use by the end of 2025 is reflected in retained UK law. This obligation has been in place internationally since 2004. There is no evidence that holders of this equipment, 99% of whom are the energy distribution companies, have taken sufficient voluntary measures to achieve the 2025 target. Options considered included the Government bearing the cost or providing a subsidy but these were rejected in keeping with the polluter pays principles accepted across Europe and the OECD. The proposal is therefore to introduce a legally binding requirement on holders to remove this equipment from use by the 2025 deadline through secondary legislation.

Will the policy be reviewed? It will be reviewed. **If applicable, set review date:** Month/Year

Does implementation go beyond minimum EU requirements?		No		
Is this measure likely to impact on international trade and investment?		No		
Are any of these organisations in scope?	**Micro** Yes	**Small** Yes	**Medium** Yes	**Large** Yes
What is the CO_2 equivalent change in greenhouse gas emissions? (Million tonnes CO_2 equivalent) *Carbon savings from energy efficiency*		**Traded:** N/A	**Non-traded:** N/A	

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 Rebecca Pow Date: 5th May 2020

Summary: Analysis & Evidence

Policy Option 1

Description:

FULL ECONOMIC ASSESSMENT

Price Base Year 2019	PV Base Year 2020	Time Period Years 27	Net Benefit (Present Value (PV)) (£m)		
			Low: -123.6	**High:** -22.7	**Best Estimate:** -33.3

COSTS (£m)	**Total Transition** (Constant Price)	Years	**Average Annual** (excl. Transition) (Constant Price)	**Total Cost** (Present Value)
Low	0.1		0.0	**24.6**
High	0.0		0.0	**125.6**
Best Estimate	0.0		0.0	**35.2**

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

The primary costs to businesses are the brought forward cost of testing, removing and replacing contaminated equipment before the end of their useful life, estimated at £35.2m. Based on the Environment Agency (EA) PCB inventory for England and Wales, most of the costs will be borne by 11 Energy Distribution Companies (EDCs) who hold the majority of the equipment (>99%). A very small number of units are held by businesses of varying sizes and public bodies.

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

This Impact Assessment does not attempt to monetise the cost of general compliance such as meetings held by businesses to meet the requirements of the new regulation. These costs are considered to be small and have been excluded from the assessment.

BENEFITS (£m)	**Total Transition** (Constant Price)	Years	**Average Annual** (excl. Transition) (Constant Price)	**Total Benefit** (Present Value)
Low	0.0		0.1	**2.0**
High	0.0		0.1	**2.0**
Best Estimate	0.0		0.1	**2.0**

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

The majority of benefits have not been quantified in light of evidence gaps. We have captured cost savings of £2m for holders of equipment no longer having to pay annual fees after deregistering equipment on the PCB register.

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

Most of the benefits are avoided environmental and health risks to wider society from PCBs being released into the atmosphere or through oil spillages. These are difficult to reflect in monetised terms. If released to the environment, there is clear evidence that PCBs bioaccumulate and can produce a wide spectrum of adverse effects in animals and humans, such as cancer, reproductivity and impairing the functions of the body's immune system. Environmental benefits expected from reducing PCBs emitted into the atmosphere, include avoided damage to biodiversity and human health, particularly through reduced levels of PCB accumulation in mammals.

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

The key assumption made is that cohorts of contaminated equipment can be identified and that not all equipment will need to be tested and replaced before 2025. We have produced sensitivity analysis around differing rates of testing and replacement by 2025, which have been agreed with the Environment Agency, and are considered below in Annex A. The analysis also assumes full compliance with the regulation by holders of contaminated equipment.

BUSINESS ASSESSMENT (Option 1)

Direct impact on business (Equivalent Annual) £m:			**Score for Business Impact Target (qualifying provisions only) £m: 7.4**
Costs: 2.0	**Benefits:** 0.1	**Net:** 1.9	

Evidence Base (for summary sheets)

Contents

1. Introduction

Polychlorinated Biphenyls (PCBs) are man-made organic compounds, primarily used to improve the performance of electrical equipment oils in transformers. They are recognised globally as a threat to human health and the environment and are banned internationally, as one of the original 'dirty dozen' under the Stockholm Convention on Persistent Organic Pollutants (POPs) in 2004. The Stockholm Convention has set a deadline of 2025 for the removal of all PCB contaminated equipment above 0.005% contamination.

The revised EU Persistent Organic Pollutant (POPs) regulation (EU 2019/1021) came into force on the 15th July 2019 and reflects this international commitment, requiring member states to remove equipment containing more than 0.005% and volumes greater than $0.05dm^3$ of PCBs, as soon as possible and by no later than 31 December 2025. No impact assessment was undertaken.

The existing domestic regulations, The Environmental Protection (Disposal of Polychlorinated Biphenyls and other Dangerous Substances) (England and Wales) Regulations 2000 came into force as a result of an EU Directive and allows holders of lower level contaminated transformer equipment (i.e below 0.5% contamination) to use it until the end of its useful life. This needs to be amended to meet the Stockholm Convention commitment that will now be in retained law. The regulations are in scope for England and Wales, but Scotland and Northern Ireland will be amending their legislation and we expect them to take a similar approach.

Any holder of PCB equipment in England and Wales is required to register contaminated equipment or equipment at risk of being contaminated, on the Environment Agency PCB inventory. As of 30th September 2019 there were 62 holders of PCB equipment with a total of around 273k items of equipment registered in England and Wales. More than 99% of these equipment are held by the 11 Energy Distribution Companies (EDCs). Less than 1% are held by 51 holders comprised of businesses of varying sizes and public bodies such as universities or prisons. Only 11 of these holders are classed as either small or micro, and in total they hold 29 units between them (less than 0.01%).

The EDCs do not know which of their equipment is contaminated with PCBs as they were often not told that they had been added to the mix of oils in their transformers. In accordance with the Environment Agency (EA) policy all equipment at risk of being contaminated is listed on the inventory. As equipment is taken out of service, through natural attrition, it is tested for PCB contamination.This is reported back to the Environment Agency. This testing has shown that the number of contaminated units represents less than 1% of those taken out of service. The number of affected units is therefore very substantially lower than 273k. The challenge has been in identifying which units are likely to be contaminated and removing the non-contaminated units from the register, something the EDCs are now making progress on.

The Energy Network Association (ENA) and its members are proactively working towards removing PCB contamination from transformers with a clear objective of compliance with the amended regulatory requirements. A number of meetings have been held with the ENA and a representative of the EA sits on the ENA technical group looking at ways to identify and remove PCB equipment by the deadline. To achieve this, significant effort has been made by the EDCs over the past year to identify low or no risk transformer equipment.They have so far identified 17-20% of clean equipment for removal from the inventory when it is next revised in September 2020 and they expect to deregister many more as cohort information improves.

The EA has assessed the statistical modelling for this work and their support for its use is included in a regulatory position statement (RPS) that is currently being drafted. This sets out what the EA expect PCB holders to do to ensure PCB contaminated equipment is identified, deregistered and disposed of safely.

We have engaged with the EA, Department of Business, Energy and Industrial Strategy (BEIS) and Ofgem to provide information and verification of costs and have worked together on key and assumptions, as well as addressing evidence gaps used for the cost benefit analysis. Our assessment is reflective of the best evidence base available at this point in time, given the information we have been able to obtain.

This is a final stage Impact Assessment (IA), which provides an assessment of the main impacts of the amended regulation. A consultation stage IA has not been undertaken as the requirements of the updated EU regulations are clearly defined and there is limited scope for considering alternative options for meeting this. We are in the fairly unique position of knowing every organisation/person affected by this proposed change in regulation through their registration of equipment on the inventory. Government has engaged with the EDCs via the Energy Network Association (ENA) concerning the new regulation. It has also contacted 16 other holders, focussing on the small and micro enterprises and public bodies, sending them a short survey to understand the implications for them and this information is reflected in the IA. Having directly contacted the main parties involved, we have deemed it disproportionate to undertake a full public consultation.

The IA is a non-qualifying regulatory provision as the equivalent annual net direct cost to business (EANDCB) falls well below the £5m de-minimis threshold. This measure appears to be very expensive at a first glance because of the large number of transformer units on the PCB inventory, but the additional costs of the intervention per annum are below the EANDCB threshold. An IA has been produced to be transparent and demonstrate that costs are not as significant as they might appear to be. Furthermore, the EANDCB captures the net direct cost to business per annum over a large time horizon, whereas the additional costs from intervention are incurred in earlier years between 2020-2025 due to the deadline of 2025. The appraisal approach is explained in further detail under section 6.1 – 'Key assumptions'.

2. Problem under consideration

All POPs, including PCBs, have long been recognised as posing a threat to the environment, wildlife and human health. Some of the very properties which make PCBs useful (i.e. stability and resistance to degradation), also make them more environmentally damaging because they are not easily broken down and tend to accumulate in the fatty tissues of animals and humans. Mammals, such as cetaceans and humans, are at the greatest risk of accumulating large concentrations of these substances due to their longevity. This affects their ability to reproduce, which has been demonstrated by the impact PCBs has had on a UK pods of orcas, found in Scotland, who have have high levels of PCBs in their blubber and have not bred in many years[1]. Research into the levels of PCBs in cetacean blubber indicated an initial decline following the European ban on use and production of PCBs in the mid- 1980s but these levels have now plateaued. Recent research has indicated that the levels of PCB in the deep sea ocean are higher than the levels in the most polluted rivers in China[2].

The UK has been proactive in the identification of PCB contaminated equipment and has been successful in ensuring the safe disposal of equipment contaminated with more than 0.5% PCB, mostly found in electrical capacitors; a requirement set out in the PCB Directive and The Environmental Protection (Disposal of Polychlorinated Biphenyls and other Dangerous Substances) (England and Wales) Regulations 2000. Many of these were removed prior to the end of their useful life.

The international Stockholm Convention on POPs expect Parties to to safely remove and dispose of equipment, essentially electrical transformers, with less PCB contamination i.e. between 0.005%/0.05dm^3 and 0.5% of PCBs. This has not happened in the UK, mainly because there was no domestic legal requirement to do so. Electrical transformers have a very long lifespan and in the absence of intervention, they could remain in situ for decades.

3. Rationale for intervention

1 https://www.bbc.co.uk/news/science-environment-39738582
2 https://www.nature.com/articles/s41559-016-0051

Government intervention is necessary to hasten the removal of contaminated equipment to prevent potential adverse impacts to human health and the environment.

The recent recast of the EU POPs regulation requires member states to remove equipment, which is contaminated with PCBs above defined thresholds (0.005%/0.05dm^3) by the deadline of the end of 2025. The current domestic PCB regulation allows this equipment contaminated with less than 0.05% contamination to remain in use to the end of its useful life. The PCB Regulation will therefore need to be amended to implement this change.

When humans or the environment are exposed to PCBs, the resulting damage can be permanent. PCBs are classified as human carcinogens and produce a wide spectrum of adverse effects in animals and humans, including infertility, malformations in the fetus, child development and the immune system. PCBs can accumulate in humans and animals through food consumption, ingestion of particles from air, ingestion of contaminated soil and skin absorption. Food consumption accounts for 90% of exposure. The highest level of PCBs are generally found in fish but humans also take in PCBs through meat, eggs and milk, as well as products made from these foods. It can also be present in plant based foods but generally at lower levels.

Damage occurring as a result of the continued existence of contaminated equipment or from exceptional spillages of PCB oils, can be classed as a negative externality, as those costs would be borne by wider society, instead of the manufacturers and operators of contaminated equipment who are responsible for their existence.

It is important to note that many of these toxic effects caused by exposure to PCBs have no safe level or no safe minimum dose where effects are not observed. The Stockholm Convention sets out the aim of eliminating or restricting the use of POPs, including PCBs. Due to the long service life of transformer equipment, without intervention, PCBs are likely to remain in use for many more years. The continued usage of PCBs in existing transformers, and the reluctance of equipment holders to voluntarily accelerate removal, is also perhaps indicative that the current perception of risk for operators of equipment, and wider society is insufficient with regards to health outcomes, in particular relating to longer term health risks.

4. Policy objective

The policy objective is to ensure that all relevant PCB contaminated equipment (contamination below 0.05% but above 0.005%/ 0.05dm^3)s safely removed from use by the legal deadline. This will ensure that we adhere to the law, fufil our international commitment and safely remove the possibility of further damage to the environment and human health.

The Stockholm Convention asks member states to remove equipment contaminated with more than 0.005%/0.05dm^3 PCBs by 2025, with all contaminated oils destroyed by the end of 2028. This was reiterated at the last Conference of Parties in April 2019[3].

The current domestic PCB regulation, based on an EU PCB Directive that pre-dates the Stockholm Convention, allows holders of this equipment with less than 0.5% PCB contamination to use such equipment until the end of its useful life. The 0.5% threshold is significantly higher than our commitment to the Stockholm Convention.

The EU recognised the need for stronger action to meet the 2025 deadline in the Convention and, has created an obligation for member states to remove all equipment at levels above 0.005% in the revised POPs regulation. This requirement will be retained law at the end of the transition period.There is some discretion in the regulations as to how member states can achieve this target.

We have considered the option of subsidising the cost of removing this equipment. However, we consider it reasonable and proportionate and in accordance with the ‘polluter pays’ principle[4] that the equipment holders should bear the cost of replacing this equipment. EDCs and others holding equipment

[3] http://chm.pops.int/Implementation/IndustrialPOPs/PCB/Decisions/tabid/692/Default.aspx decision 9/3

[4] Supported by HMT guidance on ‘moral hazards’.

on the PCB inventory, have known for many years that the equipment is possibly contaminated with PCBs and that leaks or failure to dispose of the contaminated oils properly, could cause harm to the environment and human health. Although the equipment is still serviceable, it was paid for over a 20 year period some time ago. Any costs to consumers, as a result of this requirement to replace the contaminated equipment, will be smoothed over a 45 year period which is how long assets on the transmission network are paid for according to the most recent Ofgem price control mechanism. In addition, it is assumed that businesses would have faced the cost of replacing and testing equipment in the future as the equipment fails. The costs of this regulatory measure are therefore brought forward, rather than additional costs.

5. Policy options considered

5.1. Policy Option 0 - Do Nothing Scenario

Under this option we would not implement the retained law on POPs. Equipment containing PCBs will therefore be used until it reaches the end of its useful life, potentially another 30 years. This would contravene an international commitment as well as retained law to remove them all by the end of 2025. Even though we have left the EU we may still be subject to infraction procedures and possibly fines from the European Courts because the legislation was in place before we left. Legal proceedings could also be pursued in the UK or, if a new environmental body, the Office of Environmental Protection, has been set up as proposed in the Environment Bill, we could be called to account through this. There are also material reputational risks both to Government and the holders of this equipment. As the equipment ages, there is an increasing risk of contaminated oil entering the environment through leakage. This option has therefore been ruled out, but will be used as a baseline for analysis against other available options.

5.2. Policy Option 1 – Final Government Position

All holders of equipment above 0.005%/0.05dm^3 PCB contamination to remove all the equipment at their own expense by 31 December 2025. This option is our final option, based on the polluter pays principle that those who produce pollution should bear the costs of dealing with it in order to prevent damage to human health and/or the environment.

5.3. Alternatives to regulation

Under the Stockholm Convention it has been an international requirement to make all reasonable efforts to remove equipment containing PCBs since 2004, but there is no evidence that holders of equipment have gone beyond replacing equipment that is no longer serviceable. This is based on the ENA's records which shows that over the last 10 years, equipment has not been voluntarily taken out of service before the end of its useful life. The EDCs do not have clear records of which equipment is contaminated and given the long life of some of this equipment, we assume that in the absence of regulation, businesses would still not voluntarily remove them before the end of their useful life.

Voluntary measures have therefore been ruled out as a comprehensive approach, but where possible, the EA will support holders of PCB equipment, with dedicated PCB officers working with them to ensure they have a plan in place to safely remove and dispose of contaminated equipment.

6. Risks and assumptions

This section sets out the key assumptions and risks that have been considered in our analysis. We have accounted for the highest risk assumptions in close collaboration with BEIS and Ofgem on our approach and through carrying out sensitivity analysis. It should be noted that the estimates provided in this IA are conservative, in particular relating to the profile of asset replacement which is detailed below.

6.1. Key Assumptions

6.1.1. Appraisal methodology

The costs and benefits for the options considered are expressed in 2019 real prices, and discounted from a present value base year of 2020. We have used a discount rate of 3.5% to reflect social time preferences in line with the HMT Green Book Supplementary Guidance[5]. The costs and benefits are appraised from 2020-2046. Although the new regulations will require the removal of contaminated equipment by 2025, in the counterfactual, equipment can remain in use for the remaining duration of the asset's lifetime. It is estimated the last equipment will come to the end of its life in 2046.

6.1.2. Asset Life

We have assumed an average asset lifetime of 60 years. This is based on the ENA's estimate that the asset life is between 50 to 60 years. Different types of transformer units will have different lifetimes depending on size, load, location. There will be a volume of transformers operating below capacity and past the 60 year service life. PCBs were banned from production in Europe in 1987. We assume the last equipment containing PCBs will therefore come to the end of their useful life at a constant rate until 2046. This assumption has been agreed with Ofgem and BEIS.

6.1.3. Profile of asset replacement

Under the policy intervention, we have made an assumption that units that are contaminated or remain at risk of being contaminated will need to be replaced by the end of 2025 at a constant rate every year. It is possible that businesses may choose to replace more equipment earlier or towards 2025 but this is not currently known. In the counterfactual, we have assumed that units replaced between 2020-2025 is at the rate agreed by EDCs under Ofgem's price control[6]. This is based on the EDC's best estimate of how many units will be replaced under natural attrition. In the absence of a replacement profile for future years, we have assumed the remaining units will be replaced at a constant rate between 2026-2046.

The distribution of when assets approach their end of life under the counterfactual has implications for how expensive the policy is. If more assets were installed towards 1986, they would be expected to last longer and therefore replacement would be more premature. We have assumed an equal distribution for the profile of asset replacement which has been agreed with Ofgem and BEIS. We believe this estimate to be conservative as we expect fewer units to last up to 2046.

There are other factors that may impact on the life of the equipment. The move to decarbonise heat and transport, in particular, will put greater stress on the existing electricity network and require the upgrading of assets, possibly including those covered by this IA. For example, pole-mounted transformers typically supply electricity to properties located in rural areas, which are more likely to use oil and are also likely to be off the gas grid. It is probable that such properties will move to electric heating as reliance on carbon fuels reduces. It is not possible to say with certainty the current loading of pole-mounted transformers, the degree that future increased electricity demand will be moved away from peak times, or the deployment rate of alternative solutions to new network infrastructure such as electricity storage. However, given the scale of change required to meet our legally-binding decarbonisation commitments,

[5] HMT Green Book 2018 - https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/685903/The_Green_Book.pdf

[6] Ofgem's price control (RIIO-ED1) sets the outputs the EDCs need to deliver for their consumers and the associated revenues they are allowed to collect for the eight-year period from 1 April 2015 to 31 March 2023. The expected number of transformer replacement under the price control has been agreed with Ofgem.

it is likely that a proportion of transformers would need replacing post-2025, ahead of their otherwise useful asset life, to accommodate increased demand for electricity.

6.1.4. Profile of asset repayment

Capital expenditure for new assets on the distribution network under the most recent price control RIIO ED-1 is paid for over a 45 year depreciation rate. This reflects the average expected economic life of the asset base (assets on the distribution network including transformers). This leads to a much smoother profile of charges to consumers than would otherwise be the case (i.e. paying the charges over 45 years rather than a single year). For simplicity, our modelling has captured the costs of asset removal, replacement, and disposal into a single year whereas in reality costs will be spread over a longer time horizon. For example, the costs of assets replaced in 2025 will be fully paid for in 2070. The impacts considered in our analysis are therefore overestimates and we anticipate pass through costs to consumers would be much lower per annum.

6.1.5. % Replacement/Testing

There is considerable uncertainty around the number of units that will need to be tested and replaced before the end of 2025 and towards the end of their useful life. This is because the EDCs do not know which units are contaminated and the extent to which contaminated cohorts can be identified. We have produced 3 scenarios to set out how many units are tested and replaced before the 2025 deadline and between 2026-2046. This sensitivity analysis and the assumptions we have made is set out in more detail in Annex A.

We have also assumed that the EDCs will replace transformer units on a like for like basis but it is possible that different numbers and types of units could be installed based on future demand and in anticipation of new commitments.

6.1.6. Residual costs from replacing assets earlier

We have assumed that the value of equipment installed before 1987 is sunk and so have not accounted for the residual value lost over replacing equipment before the end of the asset’s lifetime. All assets on the distribution network deployed pre-2015 on transmission were paid for over 20 years. This means that the costs of the last equipment installed in 1986 will have been paid for by consumers in 2006. Currently, consumers would only be paying operational and maintenance costs for these assets, which they would continue to pay irrespective of existing or new equipment.
For transparency, we have calculated the loss of the residual value of sunk investments in Annex B. This is, however, not included in socio-economic assessment and NPV estimate.

6.1.7. Compliance

The analysis assumes full compliance with the regulations. The Environment Agency has employed additional resources to support holders of contaminated equipment, advising on their plans for the safe removal of PCB equipment and ensuring compliance with current PCB regulations. This has been funded by the increased cost of registering equipment on the inventory and is not directly related to this proposal. It should be noted that there are potentially a small number of businesses who have contaminated equipment but are not on the PCB register. We have excluded these unknowns from our assessment.

6.2. Risks

The ENA and BEAMA, which is a UK trade association for manufacturers and providers of energy infrastructure technologies have raised some concerns around the abilities of transformer manufacturers to meet a step change in demand for transformers, and for contractors to service the demand for installation, should large numbers of transformers need to be replaced by the deadline. The UK supply chain is planning to take steps to build adequate capacity for any replacement plan, provided this is formulated well in advance through close coordination with industry regarding full capacity requirements.

An additional 1% replacement rate would be manageable but this relies on identifying the right equipment.

The ENA has also suggested that a compressed programme for replacing a significant number of units is out of phase with the natural rhythm of network development and maintenance. This could mean that replacing units results in power outages with potential impacts on customers.The ENA has not provided evidence to support these concerns.

The ENA had originally provided an estimate of costs that significantly differed to Government's analysis. Their initial estimate ranged from between £600m and £1.2bn. This was based on a replacement of all transformers in an age range that may have PCBs. It excluded the ability to identify clean cohorts of equipment, which they are gradually achieving. The current work undertaken by the ENA will remove 17-20% of equipment from the inventory this year and they hope to remove many more, at low or no risk, by 2025.

It also did not consider a counterfactual where they will need to replace units as they approach the end of their useful life. This means that the purchase of a new asset is treated as a new cost rather than as a brought forward cost. We believe this approach was not methodologically sound. We have assumed costs are 'brought forward' rather than additional costs, as units will eventually need to be replaced under natural attrition.

7. Monetised and non-monetised costs of each option

Option 0 (Do nothing)

The counterfactual scenario defines a state of the world that we deem most likely to have occurred in the absence of any Government intervention. We subtract the costs and benefits that would have occurred in the counterfactual from the policy intervention to calculate the additional impact of the regulation. Annex A sets out the number of equipment that is tested and replaced every year in the counterfactual against the policy interventions.

Option 1 – Final Government position

7.1. Monetised costs

7.1.1. Overall costs to businesses

There are approximately 273k units that are registered on the PCB inventory, which are at potential risk of being contaminated by PCBs. However, the vast majority of units are expected to be PCB free as a highly precautionary approach has been taken to registering equipment. Based on the records from the ENA, they have identified that out of 46k units that have been replaced under natural attrition over the last 10 years, less than 1% are in fact contaminated by PCBs above the allowed threshold (0.005%/0.05dm^3).

The average lifetime of the majority of PCB equipment is approximately 60 years. This equipment was installed over a number of years until 1987, when they were banned from being manufactured. The youngest possible assets were installed by 1986 and are expected to come to the end of their useful life in 2046. We have chosen an appraisal period of 27 years between 2020 and 2046 to cover the costs and benefits of all registered assets' lifetime.

The costs included in scope for option 1 include: replacing, testing and disposing of units before the end of their useful life, admin costs associated with the new regulations and emission costs associated with incinerating PCBs.

Total cost - £35.2 million (At 2019 prices, 2020 present value base year).

This is comprised of:

- £35.2m for testing, replacing and disposing of equipment
- £25.1k for admin costs

- £1.9k for air quality emissions

A breakdown and further explanation of the costs are presented below in 2019 real prices and in discounted terms. These costs are summarised in table 9.

7.1.2. Replacement and testing costs

Table 1 - No of units that will be tested and replaced[7]

Asset Type	Number of units tested	Number of asset replacement
Easily Accessible	111,446	111,446
Not Easily Accessible	161,061	161,061
Total	272,507	272,507

The assets are broken down into easily accessible units (ground mounted) which can readily be tested for PCBs and not easily accessible units (pole mounted) which need to be destroyed in order to be tested. In the counterfactual (option 0) and under the intervention (option 1), we assume the same number of units are tested and replaced. This is because the analysis considers assets over a long time horizon where all assets will eventually need to be tested and replaced when they approach the end of their useful life. The only difference between the scenarios is that under option 1, more units will need to be tested and replaced earlier (by 2025 rather than over 2020-2046).

Table 2 - Weighted Average Cost per Unit[8] (2019 prices)

Asset Type	Average testing cost per unit	Average asset replacement, removal and disposal cost per unit
Easily Accessible	£375	£26,667
Not Easily Accessible[9]	£375	£3,875

A wide range of unit costs for removing and disposing of old equipment, replacing and installing new equipment, across different transformer units was provided to Defra by the ENA on behalf of the EDCs. These costs were average costs across different types of units and ranged from £000s to hundred of £000s, but for simplicity and on the grounds of commercial sensitivity, Table 2 reflects a weighted average cost across different units. The range of costs for ground mounted (easily accessible) units are considerably higher than for pole mounted (non easily accessible) units as they are typically larger and service more densely populated urban areas whereas pole mounted transformers are often used in rural areas.

For easily accessible units, the ENA suggested that an oil replacement would suffice for the majority of units which is signficantly cheaper than a full asset replacement. A unit can be removed from the PCB register if replacing the oil removes PCBs to a level below the acceptable threshold ((0.005%/0.05dm^3). Oil replacements are approximated to cost £3.7k on average. The ENA are not certain on the amount of units for which an oil replacement is serviceable, but this is likely to be a large proportion of easily accessible units. In the absence of evidence, we have therefore taken a conservative approach and assumed there will be a full asset replacement for the very small number of easily accessible units that are contaminated (as explained below).

[7] Total number of units are from the EA Register (2019) and the proportion of different unit types are based on data from the Energy Network Association. These proportions have been applied in table 1

[8] Energy Network Association (2018)

[9] We have not been able to obtain a cost for testing non-easily accessible units so we have assumed that the testing costs are the same as for easily accessible units.

In the counterfactual we expect all units to be removed and tested for PCBs at the end of their useful life in order to determine their disposal method. Under option 1, we assume that some testing will be carried out earlier (as described below) and that PCB contaminated units will be replaced by 2025. This is not a new cost but a brought forward cost as the same number of units will eventually need to be replaced and tested. In undiscounted terms, costs are the same in both scenarios, but in discounted terms the policy intervention is more expensive reflecting social time preferences as costs will be incurred earlier.

Table 3 - % of units tested and replaced under option 0 and option 1

Scenario	Unit type	Units tested by 2025	Units replaced by 2025	Units tested by 2026-2046	Units replaced by 2026-2046
Option 0 (Do Nothing)	Easily accessible	14%	14%	86%	86%
	Non Easily accessible	14%	14%	86%	86%
Option 1: Central	Easily accessible	100%	15%	0%	85%
	Non Easily accessible	20%	20%	80%	80%

Table 3 sets out the % of total units that are replaced under our central case for option 1 and the counterfactual between 2020-2025 and between 2026-2046.

Under option 0 we assume:

- Testing and asset replacement: We assume approximately 14% of units will be tested and replaced from 2020-2025 as they approach the end of their useful life. This is based on the EDCs assumption that they are planning to replace approximately 9% of total units by 2023 under Ofgem's current price control allowance. We have prorated this to 14% by 2025. For the remaining 86% we have assumed they are replaced between 2026-2046 at a constant rate per annum.

Under option 1 we assume:

- Testing: We assume all units that are PCB contaminated will be determined through testing 100% of easily accessible units and 20% of not easily accessible units by 2025. For easily accessible units, we have taken a conservative estimate that all units will be tested if industry adopt a risk-based approach. For non-easily accessible units it is not possible to test units without destroying them. We assume through testing 20% of units, the EDCs will be able to determine characteristics of different models via sampling (manufacturer, year installed, and other characteristics) to identify clean cohorts of equipment[10]. If the EDCs remove their equipment from the register on the basis that it is part of a 'clean cohort' they will still be required to test the equipment at the end of its useful life[11]. We therefore assume the remaining 80% of non easily accessible units, deemed to be clean, will be tested between 2026-2046 when they come to the end of their useful life.

- Asset replacement – We assume 15% of easily accessible units are replaced before 2025 as all the contaminated equipment will be identified. This is an additional 1% compared to the counterfactual, and is based on data provided by the ENA which sets out that of 46k units that were previously replaced based on natural attrition, less than 1% were contaminated with PCBs.We assume that 20% of non easily accessible units will need replacing by 2025 as they are destroyed when they are tested. We assume the remaining 85% of easily accessible units and 80% of non easily accessible units are replaced between 2026-2046 when they come to the end of their useful life.

[10] The ENAs cohort working group has so far established that 17-20% of equipment on the register are at very low risk of being contaminated through statistical sampling. These are expected to be taken off the register next year.

[11] The identification of 'clean cohorts' will need to be agreed with the EA before they are removed from the register.

The testing and replacement assumptions have been agreed by Defra and the Environment Agency. There is however considerable uncertainty around these figures. The ENA are trying to develop a 'sniffer tool' which allows for detection of levels of chlorine, present in PCBs, in the gas vapour being released via the transformers breathing tube for non easily accessible units, without destroying the units. It is therefore possible that replacement rates will be lower. Conversely, in the absence of this tool and if the cohort working group are unable to successfully identify cohorts, the replacement rate could be higher. We have produced additional sensitivity scenarios to test this, which are considered in Annex A below.

Table 4 –Total cost of testing and replacement,removal and disposal (discounted ~ Central case)

Asset Type	Cost of testing (£m)	Cost of asset replacement, removal and disposal (£m)
Easily Accessible	£11.9	£9.8
Not Easily Accessible	£1.2	£12.4
Total	£13.1	£22.2

Table 4 sets out the total costs of bringing forward the testing, removal, replacement, and disposal of transformer units before the end of their useful life. An annual breakdown of the number of units tested and replaced and disposed of, under the counterfactual and option 1 is provided in Annex A. This also includes annual costs expressed in undiscounted and discounted terms to provide transparency on how Table 4 was calculated.

7.1.3. Admin costs

There is expected to be a one-off cost for holders of potentially PCB contaminated equipment to familiarise themselves with the new regulations and procedures. There will be also be admin costs for holders to source a company to test and dispose of their equipment. Larger businesses will have contracts in place to deal with disposal concerning contaminated units, although smaller businesses are likely to be unfamiliar with the process. We think it is reasonable to assume that it will take no longer than two full working days or 15 hours to familiarise with the regulation and source a company to test and dispose of contaminated equipment.

There are 62 businesses or public bodies who have registered their equipment on the PCB inventory. Typically, the type of employee who will deal with the equipment would be a health & safety manager or an environment services manager. We have assumed the value of time for a holder is estimated to be the wage of an environmental services manager[12]. The costs to businesses is increased by 30% to factor non-wage costs (NI contribution and other employment costs).

- Admin costs: 62 businesses x 15 hours x £20.80 gross hourly pay x 1.3 (non-wage costs) = £25,147

There is a possibility that admin costs could be greater than estimated, but this is expected to be negligible in comparison to the capital investment and labour costs related to replacing and testing transformers.

7.1.4. Air quality emission costs

There are expected to be emission costs associated with disposing PCB oils found in contaminated units through high temperature incineration. These costs are very small and are brought forward costs as the cost of disposing PCB oils will be incurred when they come to the end of their useful life.

[12] ONS ASHE, PROV - Occupation SOC10 (4) Table 14.5a Hourly pay - Gross 2019

We have not been able to obtain data concerning which air pollutants and in what volumes are emitted by burning PCB oils. We have therefore used the emissions associated with burning tonnes of chemicals in hazardous waste incineration as a very rough proxy. These include nitrogen oxides (NO_x expressed as NO_2), sulfur dioxide (SO_x), and particulate matter < 2.5µm ($PM_{2.5}$).

We expect there to be a central air quality emission cost of £11,074 in discounted terms between 2020 to 2025, resulting from incinerating and disposing of the PCB oils found in the contaminated units.

This is based on approximately 720 tonnes of PCB oil requiring incineration[13]. To calculate the emission costs associated with incinerating these PCB oils, we have followed Defra's Air Quality guidance[14]. We have used a range of sensitivities when estimating emission costs, to attain a central, low, and high estimate. The low and high estimates we calculated were £1,363 and £40,041 respectively. For comparative purposes, we also monetised the emission costs that we estimated would be incurred in the counterfactual, which was £9,214. This demonstrates that under our central scenario, the air quality damage costs are expected to be £1,860 larger than in the counterfactual. We have provided a more detailed breakdown of the specific costs associated with each air pollutant in the table below.

Table 5 – Air quality emission costs

Air Pollutant	Baseline Damage Costs	Central Damage Costs	Low Damage Costs	High Damage Costs
Nitrogen Oxides (NOx expressed as NO2)	£7,499	£9,013	£922	£33,662
Sulfur Dioxide (SOx)	£31	£37	£9	£105
PM2.5 (Particulate Matter < 2.5µm)	£1,685	£2,025	£432	£6,273
Total	£9,214	£11,074	£1,363	£40,041

7.2. Non monetised costs

7.2.1. General compliance costs

We have not included the costs associated with businesses holding meetings concerning general compliance with the regulations. For example, the ENA have set up a cohort working group to determine clean cohorts of equipment. There will be staffing and meeting costs dedicated to identifying contaminated units. It is not certain over what time horizon staff will continue to work on identifying clean cohorts. The ENA expect these costs to be insignificant in comparison to testing and replacement costs. In light of this, and the absence of robust information, we have chosen not to monetise these costs.

8. Monetised and non-monetised benefits of each option

Option 0 (Do nothing)

The counterfactual scenario defines a state of the world that we deem most likely to have occurred in the absence of any Government intervention. We calculate the additional benefits of the regulation through assessing the avoided costs in the counterfactual as a result of the regulatory measure.

Option 1 – Final Government position

13 The litres of oil that need disposing of are based on rough approximations from the ENA for the average amount of litres across easily accessible and non easily accessible units.

14 https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/770576/air-quality-damage-cost-guidance.pdf

8.1. Monetised benefits

8.1.1. Overall benefits to businesses

The benefits included in scope for option 1 are avoided registration costs for holders of potentially PCB contaminated equipment no longer paying a fee to register their equipment, and some small avoided carbon costs. Other benefits have been considered but we have not been able to monetise them.

Total benefits - £ 2.0 million (At 2019 prices, 2020 present value base year) is comprised of avoided registration costs.

A breakdown and further explanation of the benefits is presented below.

8.1.2. Avoided registration costs

We have monetised the avoided registration costs for equipment holders no longer being required to pay an annual fee when they register their equipment on the Environment Agency's PCB register. Currently holders of PCB contaminated equipment or equipment at risk of being contaminated must register themselves every year and pay a fee until they stop holding contaminated equipment. In the counterfactual we expect fees to be paid until the end of the equipments useful life (between 2020-2046) whereas under the proposed regulation, all holders are expected to be come off the register by 2025 and will no longer be required to pay the fee.

The Environment Agency's PCB register provides a breakdown of registration fees by four bands (A, B, C, and D) depending on how many equipment are held. Charges for 2019-20 are banded under the following way:

- Band A (holders that possess a single item)
- Band B (holders that possess less than 150 items on 5 or less sites)
- Band C (holders that possess less than 150 items on more than 5 sites)
- Band D (holders that possess more than 150 items)
- Welsh holders (holders with sites in Wales)

Table 6 - Registration costs and number of registrants across bands

Band Registration information	Band A	Band B	Band C	Band D	Welsh holders
Registration Costs	£2,600	£2,905	£3,983	£7,785	£155
Number of Registrants	15	26	3	11	7

The table above summarises the registration costs and number of registrants within each band[15].Costs can be calculated by multiplying the number of businesses within each band by the respective charges. We have captured the avoided registration costs from 2026-2046.

It is expected that some registrants will come off the register earlier than the deadline of 2025, but we have taken a conservative approach and assumed that avoided costs will only be realised after 2025.

In the counterfactual we expect businesses to incur registration costs until the equipment comes to the end of its useful life. We do not, however, know when this is expected to be across different holders. For larger holders (Band D), we assume that due to number of equipment held by them, that some of their equipment will live up to 2046, and so they will have to pay fees until 2046. For smaller holders (Band A,B & C) and Welsh holders, it is possible that some of these holders will come off the register earlier

[15] Information provided within the Environment Agency's PCB holder 2019 inventory.

than 2046 depending on when their equipment comes to the end of its life. We have made an assumption that these holders will only pay registration fees on average until 2035[16]. There is expected to be some businesses that will come off the register earlier and later than 2035.

Avoided costs per annum have been calculated as follows:

- Avoided costs to holders in Band D (£7,785*11) = £85,635 per annum (2025-2046)
- Avoided costs for holders in Band A (£2,600*15) + Band B (£2,905*26) + Band C (£3,983*3) + Welsh holders (£155*7) = £127,564 per annum (2025-2035)

Table 7 - Summary of registration costs (£m)

Registration Costs (£m)	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	..	2046	Total
Band D	£0.1	£0.1	£0.1	£0.1	£0.1	£0.1	£0.1	£0.1	£0.1	£0.1	£0.1		£0.1	£1.8
Band A, B & C + Welsh	£0.1	£0.1	£0.1	£0.1	£0.1	£0.1	£0.1	£0.1	£0.1	£0.1	£0.0		£0.0	£1.3
Total undiscounted	£0.2	£0.2	£0.2	£0.2	£0.2	£0.2	£0.2	£0.2	£0.2	£0.2	£0.1		£0.1	£3.1
Total discounted	£0.2	£0.2	£0.2	£0.2	£0.2	£0.2	£0.1	£0.1	£0.1	£0.1	£0.1		£0.0	£2.0

Total benefits from avoided registration costs is estimated at £2.0m in discounted terms over the period 2026-2046. This figure could be higher if holders come off the register earlier than 2025 under the proposed regulation or if businesses equipment last longer than we have assumed under the counterfactual.

8.1.3. Avoided carbon costs

There are expected to be carbon costs associated with disposing PCB oils found in contaminated units through high temperature incineration. These costs are brought forward costs as the cost of disposing PCB oils will be incurred when they come to the end of their useful life. The price of carbon is expected to increase in the future such that bringing forward incineration (and the associated carbon costs) under the intervention results in a small saving[17].

We have not been able to obtain data concerning the carbon emitted from burning PCB oils. We have therefore used the emissions associated with burning naphtha oil which is an insulant typically used in transformers. This is used as a rough proxy to illustrate the magnitude of costs.

Table 8 Carbon emission savings (£) discounted[18]

Carbon emissions	Low	Central	High
Baseline costs	80,754	161,507	242,261
Intervention costs	76,454	152,908	229,362
Savings (baseline less intervention)	4,300	8,599	12,899

Table 8 sets out the carbon costs associated with incinerating 723 tonnes of PCB oils. We have followed Green Book supplementary guidance for valuation of energy use and greenhouse gas

[16] We have chosen 2035 for when smaller holders are expected to come off the register on average as that is the midpoint between 2025-2046

[17] The increasing value of carbon in the future reflect the costs required to limit global temperature increases to 2 degrees centigrade above pre-industrial levels. This is line with Green Book Guidance.

[18] Green Book supplementary guidance: valuation of energy use and greenhouse gas emissions for appraisal https://www.gov.uk/government/publications/valuation-of-energy-use-and-greenhouse-gas-emissions-for-appraisal

emissions. The range of sensitivities represents the price of carbon under different scenarios. In the central case we estimate carbon costs of £162k in the baseline and costs of £153k under the intervention, which derives a small saving of £9k.

8.2. Non-monetised benefits

8.2.1. Environmental and health benefits

PCBs are globally recognised to cause substantial harm to human health and the environment. As a result, the Stockholm convention has set out the aim of eliminating or restricting POPs such as PCBs. The human health benefits expected from removing contaminated equipment include reduced risk of human exposure to carcinogenic substances, and reduced risk of reproductive system damages (reduced level of contraception and live births, reduced birth weights and reduced sperm counts)[19]. The effects of long term exposure to PCBs that have been reported also include: neurological effects (reduced neurological development), endocrine disrupting effects (disruption to the hormone system including decreased thyroid hormone levels), and immune system effects (decreased size of the thymus, reduced immune system response, and reduced resistance to viral and other infestious agents). It is important to note that many of these toxic effects caused by exposure to PCBs have no safe level or no safe minimum dose where effects are not observed.

There have been many incidents where humans have been exposed to PCBs in large scale contamination events. For example, there was PCB-contaminated rice oil in Japan in 1968 and in 1978 in Taiwan, the effects reported included pigmentation of nails and mucous membranes and swelling of the eyelids, along with fatigue, nausea and vomiting. In Taiwan, children born up to seven years following the incident were reported to exhibit developmental delays and behavioural problems[20].

Environmental benefits expected from reducing PCBs emitted into the atmosphere, include avoided damage to biodiversity, particularly through reduced levels of PCB accumulation in mammals. There are many case studies across literature investigating the effects of PCBs in the animal population. A few examples of some of the effects observed are provided below.

In the UK between 1989 and 2002 harbour porpoises found to have died from infectious diseases were compared to harbour porpoises that were otherwise healthy but had died following traumatic injury such as being caught in a fishing net. Both groups of animals had PCBs present, however the ones that had died of infectious disease had significantly higher levels of PCBs than those that had died from physical trauma. Higher levels of PCB contamination in harbour porpoises in the north-east Atlantic have been associated with reproductive failure and lower pregnancy rates than populations in less contaminated areas suggesting that reproductive dysfunction in UK porpoises may be related to PCB exposure (Murphy et al., 2015). Further evidence of the impact of PCBs on cetaceans was found in a study on killer whales in 2018. The study used a population model alongside global data on PCB concentrations and predicted that current concentrations are likely to cause declines across the globe. Moreover, killer whales feeding near industrialised regions (including the UK and Strait of Gibraltar) are at a high risk of total population collapse (Desforges et al., 2018).

It is not straightforward to monetise health and environmental impacts associated with PCBs. The variation in exposure, accumulation of a variety of chemical pollutants in the body and the impact of individual DNA means there are inevitable evidence gaps. Firstly, data which sets out health statistics (e.g. incidence and prevalence rates of certain diseases associated to PCBs) is needed from a UK perspective. This will then need to be isolated to the PCBs emitted from transformer units. Lastly, values for the monetisation of the benefits such as avoided medical treatment costs and willingness-to-pay values are not possible to obtain for several of the health and environmental issues caused by PCBs.

For illustrative purposes however, we have set out below the costs associated with cancer treatment to demonstrate the magnitude of potential avoided costs.

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[19] In 2015, the International Agency for Research on Cancer (IARC) announced their evaluation on PCBs and they had classified both PCBs and dioxin-like PCBs as carcinogenic to humans (Group 1) (IARC, 2015).

[20] UNEP.: The 12 initial POPs under the Stockholm Convention. http://chm.pops.int/TheConvention/ThePOPs/The12InitialPOPs/tabid/296/Default.aspx

Between 2010 to 2015, over 250,000 people in England were newly diagnosed with cancer per annum, and around 130,000 died per annum as a result of the disease. Annual NHS costs for cancer services were estimated at around £5 billion, but the cost to society as a whole – including costs for loss of productivity was estimated at around £18.3 billion[21]. In 2018, there were a total of 316,680 new diagnoses and costs were expected to be significantly higher[22]. A marginal reduction in cancer incidents could save more than tens of millions in treatment costs alone.

A research study commissioned by the European Chemicals Agency (ECHA) estimates the willingness-to-pay (WTP) values for a range of health endpoints commonly associated with exposure to hazardous substances. The WTP values are used to assess the economic value of preventing specific health endpoints (intangible costs) and opportunity costs to account for the resources spent on medical treatment and health care (treatment costs) as well as for productivity losses and other non-healthcare related costs associated with specific health endpoints. The WTP to avoid cancer morbidity and very low birth weight were estimated at €410k (central value) and between €125k-€405k for each individual (in 2012 prices)[23].

The potential health costs associated with PCBs in the counterfactual is highly uncertain and irrespective of the ability to determine this, the UK, EU and parties of the Stockholm Convention have taken a risk and moral based approach to eliminate PCBs >0.005%/0.05dm^3 in existing equipment.

8.2.2. Efficiency savings of replacing transformers

The ENA has suggested that there is limited scope for energy efficiency and carbon emission savings associated with replacing old transformers with new equipment. BEIS engineers agree that this is likely to be the case for pole mounted units (non-easily accessible), but consider there to be scope for energy savings in ground mounted units (easily accessible). This is because the materials used in pole mounted transformers are essentially the same as 60 years ago and so replacing the transformer would not increase efficiency. For ground-mounted transformers, where weight and size can be increased, new materials and designs are available that will increase the energy efficiency over what was possible 60 years ago. Pole-mounted transformers cannot make use of these new materials due to the need to keep the weight and size down to fit onto the pole.

In light of the evidence gaps on possible savings from replacing ground mounted units and because the number of ground mounted units we expect to be replaced by 2025 is low, we have chosen not to monetise any efficiency savings. These savings are expected to be small.

8.2.3. Avoided costs of treating PCB oil spillages

There are cases when transformer units fail (i.e. are struck by lightning) and the PCB leaks into the environment through oil spillages. In such cases, the EDCs have processes in place to ensure the environment and soil are treated. We have not monetised the avoided costs of treating spillages between 2026-2046 from such failures. This will depend on the number of expected incidences and the cost of treatment on which we have not been able to gather information.

9. Summary of costs and benefits

The table below summarises the additional costs and benefits of the regulatory measure from the baseline in discounted terms in £m. The admin, air quality emission, and avoided carbon costs are included in the social NPV figure.These are in the £000s so would appear as £0m when rounded. The low scenario represents the scenario with the lowest net benefit or highest cost, whereas the high scenario represents the scenario with the highest net benefit or lowest cost. We have captured annual

[21] 2010 to 2015 government policy: cancer research and treatment

[22] Cancer registration statistics, England: first release, 2018 https://www.gov.uk/government/publications/cancer-registration-statistics-england-2018/cancer-registration-statistics-england-first-release-2018

[23] Willingness-to-pay values for various health endpoints associated with chemicals exposure (ECHA, 2017) https://echa.europa.eu/documents/10162/13637/seac_reference_wtp_values_en.pdf/403429a1-b45f-4122-ba34-77b71ee9f7c9

costs of testing and replacement in discounted and undiscounted terms in Annex A. The additional cost of intervention for the testing and replacement costs can be calculated by subtracting the baseline costs (table 12.1) from the intervention (table 12.2, 12.3, 12.4) for the respective central, low and high scenarios.

Table 9 - Summary of costs and benefits discounted

	Discounted costs and benefits of each Intervention from baseline (£m)		
Present Value (PV)	**Central**	**Low**	**High**
Testing (Easily accessible)	11.9	11.9	11.9
Testing (Not easily accessible)	1.2	9.2	1.2
Asset replacement (Easily accessible)	9.8	9.8	9.8
Asset replacement (Not easily accessible)	12.4	94.7	1.7
Admin costs	0.0	0.0	0.0
PCB sniffer tool development costs	0.0	0.0	0.1
Air quality emission costs	0.0	0.0	0.0
Registration cost savings	2.0	2.0	2.0
Avoided carbon costs	0.0	0.0	0.0
Total Costs	35.2	125.6	24.7
Total Benefits	2.0	2.0	2.0
Net benefit	-33.3	-123.6	-22.7

The differing rates for testing and replacement assumptions which results in different costs for each scenario is explained in further detail in Annex A. For the high scenario, we have included the initial cost of development for a PCB sniffer tool.The ENA are investing in developing a tool to test non-easily accessible units without destroying them, resulting in fewer replacements being needed by 2025. This tool is currently at a proof of concept stage and it is highly uncertain as to whether it will work. In light of this uncertainty, we have only included the sniffer tool costs under the high scenario, as this is the scenario where fewer brought forward replacement of non easily accessible units would occur. This cost has been excluded from the low and central case scenarios as we have not included the benefit of testing non-easily accessible units without destroying them.This is explained in further detail in Annex A.

10. Rationale and evidence to justify the level of analysis

Most of the evidence used across the IA has been gathered from the data provided by the ENA on behalf of the EDCs who hold more than 99% of the equipment. We have consulted with small and micro businesses via a short survey. The evidence used reflects the best possible evidence we could obtain without significantly burdening businesses to collect more information.

We have taken a simplistic and proportionate approach in applying the same testing assumptions and replacement assumptions across all businesses, including smaller businesses and public bodies. It is expected that these parties will not have a large amount of equipment or will be able to identify cohorts, but as they reflect less than 1% of the total equipment registered, we have not made any exceptional changes to our assumption as the overall impact on total costs to industry would be marginal. We have carried out a separate assessment of small and micro-businesses below.

The largest evidence gap concerns the number of equipment that will require testing and replacing by 2025. There is considerable uncertainty around the number of units that will need to be tested and replaced before the end of 2025 and towards the end of their useful life. This is because the EDCs do not know which units are contaminated and the extent to which contaminated cohorts can be identified. We have produced 3 illustrative scenarios to set out how many units are tested and replaced before the 2025 deadline and between 2026-2046. This sensitivity analysis and the assumptions we have made is set out in more detail in Annex A. These assumptions have been tested and agreed by Defra and the Environment Agency.

Assumptions concerning the assets life expectancy and profile of asset replacement remain uncertain, but the approach we have used has been agreed with BEIS and Ofgem.

The analysis is based on the number of contaminated equipment on the EA PCB register. It reflects a snapshot of the number of contaminated units in September 2019. It is possible that equipment will have come off the register since then, but will not be reflected in our assessment.

11. Direct costs and benefits to business calculations

The regulatory measure is a non-qualifying regulatory provision (NQRP) which will need to be listed in the annual Business Impact Target (BIT) report. The administrative exclusion applies as the regulatory provision falls under the de minimis threshold, for having an Equivalent Annual Net Direct Cost to Businesses (EANDCB) of less than ±£5 million.

The Regulatory Policy Committee (RPC) scrutiny is optional for measures that fall below the threshold of ±£5m EANDCB. Given the considerable uncertainty around how many units will need to be tested and replaced before 2025, the costs to businesses differ considerably between our central and high case. In light of this, we have opted for independent RPC scrutiny on the quality of the analysis and evidence in the IA, as well as the robustness of the EANDCB estimate.

The EANDCB for the proposed measure in 2016 prices and discounted to a 2017 present value base year is £1.6m for option 1 (central case). The business net present value is estimated at -£28.3m. For the BIT analysis we included the following costs and benefits to business:

- Admin costs (occurring only in the transition year)
- Sniffer tool development cost (in the Low sensitivity scenario only)
- Testing costs for easily accessible and non easily accessible units
- Replacement costs for easily accessible and non easily accessible units
- Registration cost savings

Emission cost are considered as costs to wider society and not direct costs to businesses and so are not included within scope of the EANDCB. Additionally, we have not included the residual value of assets lost from replacing them earlier than the end of their useful life. These costs have been paid for several years ago and are not considered to be additional direct costs to businesses.

12. Wider impacts

We have considered the impact of the regulation on small businesses, public bodies and manufacturers of transformer equipment.

12.1. Small and micro business assessment

Small and micro businesses (SMBs) that are listed on the Environment Agency's register possess roughly 0.01% of total units, with the EDCs, medium sized businesses and public bodies holding the remaining 99.9%. SMBs have been included in scope for the regulatory measure to comply with the Stockholm Convention and in line with the polluter's pay principle. There are no exemptions that have been considered as that would undermine the policy objective of removing all PCB contaminated units above the threshold from use by 2025.

The Environment Agency has two PCB officers who are able to support small businesses by advising them of the law and helping them to develop plans for the removal of PCBs or the contaminated equipment from their premises. This may help reduce the administrative burden of meeting the regulatory requirements.

We have done a further assessment of the impact of the regulation imposed on SMBs. Defra requested the EA to send a survey to the relevant English and Welsh businesses, and public bodies which we identified would be impacted by the proposed legislation. This survey was sent to 11 businesses which were identified as SMBs and 5 public bodies across England and Wales, which were identified from the EA PCB register[24]. There were 5 respondents in total (a 30% response rate) and these spanned across universities and small businesses.

The survey considered what each organisation's plans were with regards to testing and replacement under no intervention and under the amended regulations. It also considered the potential cost implications and benefits for each organisation.

The estimated costs imposed by the regulation varied across each organisation. Only three organisations provided details concerning costs, estimated at £30k, £50k, and £100k. These costs are well within the range provided by the ENA for pole mounted and ground mounted units.

The benefits small businesses identified included:

- Reduced risks of leaks and failure
- Reduced energy costs
- Greater efficiency
- More controllable systems.

To illustrate the total burden imposed on SMBs, we have calculated an estimate of the costs to all the SMBs who collectively possess 29 units on the PCB register.

We do not know what type of transformers are held by these businesses so we have applied the same proportional split of easily and non easily accessible units held by the ENA, to the 29 units. We summed the testing and asset replacement costs provided by the ENA for both easily and non easily accessible units to calculate the cost estimate for SMBs. Using this approach we have estimated a cost of £405k across all SMBs. These costs would still be incurred under the baseline when the equipment comes to the end of its useful life so it is only a brought forward cost.

Approximately 75% of businesses who responded have tested their equipment for PCBs or know their equipment contains PCBs from their manufacturer. This suggests that many SMBs will not have to incur additional testing costs, as a result of the regulatory measure. Furthermore, our estimates are potentially overstated as we have included the full cost of asset replacement whereas an oil replacement, which is significantly cheaper, will suffice in most cases for holders of ground mounted units.

We have separately carried out an assessment of the costs on the 5 public bodies who hold 70 units in total. Using the same methodology as described above, the total testing and replacement costs are approximated to be £976k.

12.2. Impacts on suppliers of transformer equipment

Suppliers of transformers equipment may need to produce more transformer units to meet the additional demand, which generates value to industry if they have sufficient capacity to meet demand. The ENA

[24] We used Company House to identify SMBs using HMRC's definition of small businesses - https://www.gov.uk/annual-accounts/microentities-small-and-dormant-companies

and a UK trade association (BEAMA) have raised concerns around the abilities of transformer manufacturers to meet a step change in demand for transformers, and for contractors to service the demand for installation should large numbers of transformers need to be replaced by the deadline. The UK supply chain is planning to take steps to build adequate capacity for any replacement plan, provided this is formulated well in advance, through close coordination with industry regarding full capacity requirements.

13. Summary of the potential trade implications of measure

This measure concerns the removal of legacy equipment that are contaminated with PCBs. We do not envisage any potential trade implications as the scope of the policy is strictly domestic. The only issue concerns potential capacity constraints for suppliers in meeting the increased demand for new equipment between now and 2025, particularly if significantly more transformers need replacing than anticipated. In such a scenario, demand could be catered for through importing equipment from abroad, which may adversely impact domestic suppliers.

14. Summary of preferred option and implementation plan

If approved, The Environmental Protection (Disposal of Polychlorinated Biphenyls and other Dangerous Substances) (England and Wales) Regulations 2000 England and Wales will be amended through a negative statutory instrument to reflect the requirements of the EU Persistent Organic Pollutant (POPs) regulation (EU 2019/1021) to remove equipment containing more than 0.005% and volumes greater than $0.05dm^3$ PCBs, as soon as possible and by no later than 31 December 2025. It is expected to be in force in the summer of 2020.

This will require holders of transformer equipment to remove any units contaminated with PCBs by the deadline, at their own expense, in line with the ‘polluter pays’ principle. This will be overseen by the EA, who can also agree to the removal of equipment from the PCB registry if they are satisfied that the risk of contamination is very low.

15. Monitoring and Evaluation

The EA’s current regulatory position statement requires all holders of equipment on their inventory to test equipment registered for PCBs when they are taken out of use and report whether they contained PCBs. This will continue under their new regulatory position statement and we will therefore be able to monitor how much contaminated equipment is removed and when.

The expectation is that all equipment will be removed from the inventory by the end of 2025, either because it has been established that there is a very low risk of it containing PCBs or the equipment has been removed from use. This EA will collect information concerning why the equipment has been removed from the register which will enable it to monitor and track costs incurred due to replacement. This will allow for evaluation of the success of the cohort working group and the actual burden imposed on businesses.

The EA will report progress on a regular basis and communications with the ENA, BEIS and Ofgem will be maintained to support achieving this objective.

16. Annex A

16.1. Sensitivity scenarios for testing and replacement

There is considerable uncertainty around the amount of units that will need to be tested and replaced before 2025 and towards the end of it’s useful life. We have therefore produced additional sensitivity scenarios. The low scenario represents the scenario with the lowest net benefit or highest cost, whereas the high scenario represents the option with the highest net benefit or lowest cost

Table 10 – Replacement and testing assumed under each scenario

Scenario	Unit type	Units tested by 2025	Units replaced by 2025	Units tested by 2026-2046	Units replaced by 2026-2046
Option 0 (Do Nothing)	Easily accessible	14%	14%	86%	86%
	Non Easily accessible	14%	14%	86%	86%
Option 1: Central	Easily accessible	100%	15%	0%	85%
	Non Easily accessible	20%	20%	80%	80%
Option 1 Low	Easily accessible	100%	15%	0%	85%
	Non Easily accessible	60%	60%	40%	40%
Option 1 High	Easily accessible	100%	15%	0%	85%
	Non Easily accessible	20%	15%	80%	85%

Option 0:- Baseline

Testing and asset replacement: We assume approximately 14% of units will be tested and replaced from 2020-2025 as they approach the end of their useful life. This is based on the EDCs assumption that they are planning to replace approximately 9% of total units by 2023 under Ofgem's current price control allowance. We have prorated this to 14% by 2025. For the remaining 86% we have assumed they are replaced between 2026-2046 at a constant rate per annum.

Option 1 - Central case:

- Testing: We assume all easily accessible units that are PCB contaminated will be determined through testing 100% of easily accessible units and 20% of not easily accessible units by 2025. For easily accessible units, we have taken a conservative estimate that all units will be tested if industry adopt a risk based approach. For non-easily accessible units it is not possible to test units without destroying them. We assume through testing 20% of units, the EDCs will be able to determine characteristics of different models via sampling (manufacturer, years installed and other characteristics) to identify clean cohorts of equipment. If the EDCs remove their equipment from the register on the basis that it is part of a 'clean cohort' they will still be required to test the equipment at the end of its useful life. We assume the remaining 80% of non easily accessible units are tested between 2026-2046 when they come to the end of their useful life.

  Asset replacement – We assume 15% of easily accessible units are replaced before 2025 as all the contaminated equipment will be identified. This is an additional 1% compared to the counterfactual, and is based on data provided by the ENA which sets out that of the 46k units that were previously replaced based on natural attrition, only 1% were contaminated with PCBs. We assume that 20% of non easily accessible units will need replacing by 2025 as they are destroyed when they are tested. We assume the remaining 85% of easily accessible units and 80% of non easily accessible units are replaced between 2026-2046 when they come to the end of their useful life.

Option 1 - Low Case:

- Testing: For easily accessible units our assumptions remain the same as the central case that 100% of units will be tested. However, for not easily accessible units we assume that significantly more units ~ 60% will need to be tested before the EDCs are able to identify clean cohorts of equipment. This is a very pessimistic assumption that we have presented as a worst case scenario. The cohort working group to date has already identified that approximately 17-20% of non easily accessible units are at very low risk of being contaminated. Therefore, at the very most, 80% of non easily accessible units are potentially at risk of being contaminated. We approximate that under the worst case scenario the cohort working group will only identify an additional 20% of units that are safe from contamination without testing them. This assumption was agreed with the EA and illustrates the large uncertainty around the success of the cohort working group.

- Asset: We assume 15% of easily accessible units are replaced by 2025 as all the contaminated equipment will be identified. This is an additional 1% compared to the counterfactual, and is based on data provided by the ENA which sets out that of the 46k units that were previously replaced based on natural attrition, only 1% were contaminated with PCBs. We assume that 60% of non easily accessible units will need replacing by 2025 as they are destroyed when they are tested. We assume the remaining 85% of easily accessible units and 40% of non easily accessible units are replaced between 2026-2046 when they come to the end of their useful life

Option 1 - High Case:

- Testing: We assume the same number of units are tested as in the central case for easily accessible units and non-easily accessible units. We also assume that it will be possible to test non-easily accessible units without destroying them. This assumption is based on the ENA's efforts for working towards building a PCB sniffer tool which is currently at an innovative proof of concept stage. Their aim is to deliver a testing device that can detect levels of PCB in the gas vapour being released via the transformers breathing tube. The ambition is to detect specific levels of PCB in non-easily accessible units without destroying them (i.e. detect PCB parts per million or at least a binary detection if the oil contains or does not contain chlorine). The solution is currently at proof of concept stage and the ENA is not able to state whether this is likely to be successful or not. In the event this solution is developed, the ENA have suggested that it may not be possible to detect PCBs in every unit, depending on the make of the transformer. We have assumed that the ENA will continue to identify clean cohorts, but the units that they are able to test will not be destroyed. It should be noted that if they are able to test 100% of non easily accessible units, then costs would exceed the central case scenario.
- Asset/Oil replacement: We assume 15% of easily accessible units are replaced before 2025 as all the contaminated equipment will be identified. We also assume that 15% of non easily accessible units are replaced. This is below the 20% of non-easily accessible units that are tested as we assume the PCB sniffer tool will be developed to allow for testing of units without destroying them. The 15% that are replaced consists of: a) 14% of units that are replaced in the counterfactual as they approach the end of their useful life; and b) the 1% which are deemed to be contaminated. The remaining 5% which will be tested will not need to be destroyed or replaced.

16.2. Calculation of replacement, removal and disposal costs under sensitivity scenarios

The tables below can be used to understand the different rates of units that are tested and replaced under each scenario and the associated costs. Tables 10.1, 10.2, 10.3, and 10.4 capture the number of units tested and replaced under each scenario.

The undiscounted costs are calculated by multiplying the number of units in tables 10 by the weighted average costs in table 2. It should be noted that total costs in undiscounted terms are the same regardless of the scenario, as we consider testing and replacement to be brought forward costs rather than new costs.

The undiscounted costs are discounted at a rate of 3.5% in line with HMT Greenbook guidance, which are captured under tables 11.

The low scenario represents the scenario with the lowest net benefit or highest cost, whereas the high scenario represents the option with the highest net benefit or lowest cost.

The replacement costs set out in the summary table presented in Table 9 can be derived by subtracting the baseline discounted costs from the discounted costs under intervention.

Table 10.1 Annual profile of testing and asset replacement (Baseline)

No. of Units	2020	2021	2022	2023	2024	2025	2026	2027	2028	..	2046	Total
Units Tested (Easily Accessible)	2,600	2,600	2,600	2,600	2,600	2,600	4,564	4,564	4,564		4,564	111,446
Units Tested (Not Easily Accessible)	3,758	3,758	3,758	3,758	3,758	3,758	6,596	6,596	6,596		6,596	161,061
Asset Replacement (Easily Accessible)	2,600	2,600	2,600	2,600	2,600	2,600	4,564	4,564	4,564		4,564	111,446
Asset Replacement (Not Easily Accessible)	3,758	3,758	3,758	3,758	3,758	3,758	6,596	6,596	6,596		6,596	161,061

Table 10.2 Annual profile of testing and asset replacement (Option 1 Central)

No. of Units	2020	2021	2022	2023	2024	2025	2026	2027	2028	..	2046	Total
Units Tested (Easily Accessible)	18,574	18,574	18,574	18,574	18,574	18,574	0	0	0		0	111,446
Units Tested (Not Easily Accessible)	5,369	5,369	5,369	5,369	5,369	5,369	6,136	6,136	6,136		6,136	161,061
Asset Replacement (Easily Accessible)	2,786	2,786	2,786	2,786	2,786	2,786	4,511	4,511	4,511		4,511	111,446
Asset Replacement (Not Easily Accessible)	5,369	5,369	5,369	5,369	5,369	5,369	6,136	6,136	6,136		6,136	161,061

Table 10.3 Annual profile of testing and asset replacement (Option 1 High)

No. of Units	2020	2021	2022	2023	2024	2025	2026	2027	2028	..	2046	Total
Units Tested (Easily Accessible)	18,574	18,574	18,574	18,574	18,574	18,574	0	0	0		0	111,446
Units Tested (Not Easily Accessible)	5,369	5,369	5,369	5,369	5,369	5,369	6,136	6,136	6,136		6,136	161,061
Asset Replacement (Easily Accessible)	2,786	2,786	2,786	2,786	2,786	2,786	4,511	4,511	4,511		4,511	111,446
Asset Replacement (Not Easily Accessible)	3,974	3,974	3,974	3,974	3,974	3,974	6,534	6,534	6,534		6,534	161,061

Table 10.4 Annual profile of testing and asset replacement (Option 1 Low)

No. of Units	2020	2021	2022	2023	2024	2025	2026	2027	2028	..	2046	Total
Units Tested (Easily Accessible)	18,574	18,574	18,574	18,574	18,574	18,574	0	0	0		0	111,446
Units Tested (Not Easily Accessible)	16,106	16,106	16,106	16,106	16,106	16,106	3,068	3,068	3,068		3,068	161,061
Asset Replacement (Easily Accessible)	2,786	2,786	2,786	2,786	2,786	2,786	4,511	4,511	4,511		4,511	111,446
Asset Replacement (Not Easily Accessible)	16,106	16,106	16,106	16,106	16,106	16,106	3,068	3,068	3,068		3,068	161,061

Table 11,1 Annual profile of undiscounted costs (Baseline, £m)

Total costs undiscounted	2020	2021	2022	2023	2024	2025	2026	2027	2028	..	2046	Total
No. Units Tested (Easily Accessible)	1.0	1.0	1.0	1.0	1.0	1.0	1.7	1.7	1.7		1.7	42
No. Units Tested (Not Easily Accessible)	1.4	1.4	1.4	1.4	1.4	1.4	2.5	2.5	2.5		2.5	60
Asset Replacement (Easily Accessible)	69.3	69.3	69.3	69.3	69.3	69.3	121.7	121.7	121.7		121.7	2,972
Asset Replacement (Not Easily Accessible)	14.6	14.6	14.6	14.6	14.6	14.6	25.6	25.6	25.6		25.6	624

Table 11.2 Annual profile of undiscounted costs (Option 1 Central, £m)

Total costs undiscounted	2020	2021	2022	2023	2024	2025	2026	2027	2028	..	2046	Total
No. Units Tested (Easily Accessible)	7.0	7.0	7.0	7.0	7.0	7.0	0.0	0.0	0.0		0.0	42
No. Units Tested (Not Easily Accessible)	2.0	2.0	2.0	2.0	2.0	2.0	2.3	2.3	2.3		2.3	60
Asset Replacement (Easily Accessible)	74.3	74.3	74.3	74.3	74.3	74.3	120.3	120.3	120.3		120.3	2,972
Asset Replacement (Not Easily Accessible)	20.8	20.8	20.8	20.8	20.8	20.8	23.8	23.8	23.8		23.8	624

Table 11.3 Annual profile of undiscounted costs (Option 1 High, £m)

Total costs undiscounted	2020	2021	2022	2023	2024	2025	2026	2027	2028	..	2046	Total
Units Tested (Easily Accessible)	7.0	7.0	7.0	7.0	7.0	7.0	0.0	0.0	0.0		0.0	42
Units Tested (Not Easily Accessible)	2.0	2.0	2.0	2.0	2.0	2.0	2.3	2.3	2.3		2.3	60
Asset Replacement (Easily Accessible)	74.3	74.3	74.3	74.3	74.3	74.3	120.3	120.3	120.3		120.3	2,972
Asset Replacement (Not Easily Accessible)	15.4	15.4	15.4	15.4	15.4	15.4	25.3	25.3	25.3		25.3	624

Table 11.4 Annual profile of undiscounted costs (Option 1 Low, £m)

Total costs undiscounted	2020	2021	2022	2023	2024	2025	2026	2027	2028	..	2046	Total
Units Tested (Easily Accessible)	7.0	7.0	7.0	7.0	7.0	7.0	0.0	0.0	0.0		0.0	42
Units Tested (Not Easily Accessible)	6.0	6.0	6.0	6.0	6.0	6.0	1.2	1.2	1.2		1.2	60
Asset Replacement (Easily Accessible)	74.3	74.3	74.3	74.3	74.3	74.3	120.3	120.3	120.3		120.3	2,972
Asset Replacement (Not Easily Accessible)	62.4	62.4	62.4	62.4	62.4	62.4	11.9	11.9	11.9		11.9	624

Table 12.1 Annual profile of discounted costs (Baseline, £m)

Total costs discounted	2020	2021	2022	2023	2024	2025	2026	2027	2028	..	2046	Total
No. Units Tested (Easily Accessible)	1.0	0.9	0.9	0.9	0.8	0.8	1.4	1.3	1.3		0.7	27

No. Units Tested (Not Easily Accessible)	1.4	1.4	1.3	1.3	1.2	1.2	2.0	1.9	1.9		1.0	38
Asset Replacement (Easily Accessible)	69.3	67.0	64.7	62.5	60.4	58.4	99.0	95.7	92.4		49.8	1,889
Asset Replacement (Not Easily Accessible)	14.6	14.1	13.6	13.1	12.7	12.3	20.8	20.1	19.4		10.5	397

Table 12.2 Annual profile of discounted costs (Option 1 Central, £m)

Total costs discounted	2020	2021	2022	2023	2024	2025	2026	2027	2028	..	2046	Total
No. Units Tested (Easily Accessible)	7.0	6.7	6.5	6.3	6.1	5.9	0.0	0.0	0.0		0.0	38
No. Units Tested (Not Easily Accessible)	2.0	1.9	1.9	1.8	1.8	1.7	1.9	1.8	1.7		0.9	40
Asset Replacement (Easily Accessible)	74.3	71.8	69.4	67.0	64.7	62.6	97.9	94.5	91.4		49.2	1,898
Asset Replacement (Not Easily Accessible)	20.8	20.1	19.4	18.8	18.1	17.5	19.3	18.7	18.1		9.7	409

Table 12.3 Annual profile of discounted costs (Option 1 High, £m)

Total costs discounted	2020	2021	2022	2023	2024	2025	2026	2027	2028	..	2046	Total
Units Tested (Easily Accessible)	7.0	6.7	6.5	6.3	6.1	5.9	0.0	0.0	0.0		0.0	38
Units Tested (Not Easily Accessible)	2.0	1.9	1.9	1.8	1.8	1.7	1.9	1.8	1.7		0.9	40
Asset Replacement (Easily Accessible)	74.3	71.8	69.4	67.0	64.7	62.6	97.9	94.5	91.4		49.2	1,898
Asset Replacement (Not Easily Accessible)	15.4	14.9	14.4	13.9	13.4	13.0	20.6	19.9	19.2		10.4	398

Table 12.4 Annual profile of discounted costs (Option 1 Low, £m)

Total costs discounted	2020	2021	2022	2023	2024	2025	2026	2027	2028	..	2046	Total
Units Tested (Easily Accessible)	7.0	6.7	6.5	6.3	6.1	5.9	0.0	0.0	0.0		0.0	38
Units Tested (Not Easily Accessible)	6.0	5.8	5.6	5.4	5.3	5.1	0.9	0.9	0.9		0.5	48
Asset Replacement (Easily Accessible)	74.3	71.8	69.4	67.0	64.7	62.6	97.9	94.5	91.4		49.2	1,898
Asset Replacement (Not Easily Accessible)	62.4	60.3	58.3	56.3	54.4	52.6	9.7	9.3	9.0		4.9	491

17. Annex B

17.1. Calculation of residual value of assets lost from earlier replacement

We have assumed that the value of equipment installed before 1987 is sunk and so have not accounted for the residual value lost over replacing equipment before the end of the asset's lifetime. All assets on the distribution network deployed pre-2015 on transmission were paid for over 20 years. This means that the costs of the last equipment installed in 1986 will have been paid for by consumers in 2006. Nonetheless we have captured this residual value lost to ensure there is transparency.

The residual value of assets is equal to the number of years lost from replacing an asset between 2020-2025 rather than over 2020-2046 mutliplied by the value of the asset. We have estimated this to be approximately £13.4m (in discounted terms) for the central case. Costs are approximately £6.9m and £63.1m in the respective high and low scenarios.

Our estimates for the residual value of assets is likely to be overestimated. Firstly, we have not been able to obtain data on the value of assets installed before 1987. We have used the values provided by the ENA in 2018, which include the value of disposal and removal. The sole value of the asset alone which is appropriate for this calculation has not been possible to obtain. Furthermore, we have not accounted for capital depreciation of assets in our analysis, which would result in the market value of equipment being lower than we have estimated. It is expected that assets that have lived for at least 30 years to be less valuable than brand new equipment.

The methodology used to calculate these figures has been reviewed by an Ofgem analyst and engineer who have deemed it a sensible approach in light of the evidence we have. The residual value across assets will differ depending on the market value of the equipment when it is replaced. Our analysis uses age as the determining factor for assessing value, but in reality the value of equipment will depend on other factors such as how much the transformer is being used and the frequency of maintenance.

The tables and calculations below demonstrate how our estimates have been derived.

Table 13.1 - Value of asset life remaining

Years of life remaining	1	2	3	4	5	6	7	8	9	10	11	12	13	14
% of asset lifetime remaining	2%	3%	5%	7%	8%	10%	12%	13%	15%	17%	18%	20%	22%	23%

Years of life remaining	15	16	17	18	19	20	21	22	23	24	25	26	27
% of asset lifetime remaining	25%	27%	28%	30%	32%	33%	35%	37%	38%	40%	42%	43%	45%

Table 13.1 captures the residual value of an asset before it comes to the end of its lifetime. For example, a unit that is replaced in say 2024 would have 5 years of its life remaining since the beginning of the appraisal period which is 2020.To capture this residual value we divide the 5 years by the total lifetime of the asset which is 60 years to arrive at 8%. If we multiply the asset value by 8%, this would represent the value of the equipment lost if it was replaced in 2020 rather than 2024.

Table 13.2 - Additional no of units replaced (central less baseline)

No. of Units	2020	2021	2022	2023	2024	2025	2026	2027	2028	..	2046	Total
Asset Replacement (Easily Accessible)	186	186	186	186	186	186	-53	-53	-53		-53	0
Asset Replacement (Not Easily Accessible)	1,611	1,611	1,611	1,611	1,611	1,611	-460	-460	-460		-460	0

Table 13.2 captures the units that are replaced in the intervention (central case) less the baseline scenario. In total the number of units replaced in the baseline and intervention are the same. The only difference is that in the policy scenario we require more units to be replaced by 2025. The negative numbers post 2025 represent the number of units that are replaced in 2020-2025 but would have otherwise been replaced in later years. For example, in 2031 we can assume 53 easily accessible units would remain operational up to 2031 in the baseline but were replaced between 2020-2025 under the intervention.

Of those 53 units we do not know which year between 2020-2025 those units were replaced so we can assume an average of 2023. Therefore if the unit was replaced in 2031, we will be capturing the value of the equipment between 2023-2031, which is 8 years. The residual value of the asset lost from replacing it earlier is therefore 8/60 * asset value.

The calculation in the table below captures the residual value for replacing equipment earlier than their end of life.

Table 13.3 – Residual value of assets lost

	2026	2027	2028	2029	2030	2031	2032	2033	2034	..	2046	Total
Years of life remaining on average	3	4	5	6	7	8	9	10	11		23	
% of asset lifetime remaining	5%	7%	8%	10%	12%	13%	15%	17%	18%		38%	
EA sunk costs (£m)	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.2	0.3		0.5	6.4
NEA sunk costs (£m)	0.1	0.1	0.2	0.2	0.2	0.2	0.3	0.3	0.3		0.7	8.1

Table 13.3 captures the residual value of assets lost due to the policy intervention, which is approximated at £6.4m for easily accessible units and £8.1m for non easily accessible in undiscounted terms .

We have not been able to obtain asset costs which are split out from the removal and disposal costs. We requested this information from Ofgem and the ENA but it is not straightforward to obtain as costs are bundled together when reported for the price control. Consequently, we have chosen to include disposal and removal costs as part of the residual value lost, which results in an overestimate of costs. These costs are the same as those presented in table 2.

To illustrate how costs are captured for a given year we have provided an example for the year 2031.

Asset life remaining in 2031 * Easily accessible unit costs * units that would have been replaced in 2031 = Residual value lost
13% * £26,667 * 53 = £0.19m

Table 13.4 Residual value lost in undiscounted and discounted terms

Residual value lost £m	2020	2021	2022	2023	2024	2025	Total
Easily accessible (undiscounted, £m)	1.1	1.1	1.1	1.1	1.1	1.1	6.4
Non easily accessible (undiscounted, £m)	1.4	1.4	1.4	1.4	1.4	1.4	8.1
EA Residual value lost (discounted, £m)	1.1	1.0	1.0	1.0	0.9	0.9	5.9
NEA Residual value lost (discounted, £m)	1.4	1.3	1.3	1.2	1.2	1.1	7.5

We have captured the residual value of assets lost over the period between 2020-2025 which is when the equipment will replaced under the intervention. Costs are then expressed in discounted terms.

Total costs are approximated at £13.4m in discounted terms for the central case scenario. Total costs for the respective high and low scenarios are approximated to be £6.9m and £63.1m. The costs for the high and low scenario can be derived through applying the same principles used for the central case but with the tables provided in sensitivity analysis in Annex A.

For transparency we have calculated the EANDCB for the central case scenario including the residual value of assets lost. The EANDCB for the proposed measure in 2016 prices and discounted to a 2017 present value base year is £2.2m. This is still under the de minimis threshold of less than ±£5 million and is therefore a non qualifying regulatory provision.