Title: Improving the consumer experience at public chargepoints **IA No:** DfT00433 **RPC Reference No:** **Lead department or agency:** DfT **Other departments or agencies:** N/a	**Impact Assessment (IA)** **Date: 25 March 2022** **Stage: Final** **Source of intervention:Domestic** **Type of measure: Secondary Legislation** **Contact for enquiries:** consumerofferconsult@ozev.gov.uk

Summary: Intervention and Options

RPC Opinion: Green

Cost of Preferred (or more likely) Option (in 2019 prices)			
Total Net Present Social Value	**Business Net Present Value**	**Net cost to business per year**	**Business Impact Target Status**
-£510m	-£936m	£109m	Qualifying Provision

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

To address the harmful impacts caused by emissions from petrol and diesel vehicles and to meet legally binding targets for reducing emissions, we are phasing out petrol and diesel cars and vans from 2030. From 2035 all new cars and vans sold will be zero emission at the tailpipe. To achieve this, the UK will need a well-developed network of charging infrastructure for electric vehicles (EVs) that the public can use simply and trust. A public charging network of high quality will make switching to EVs as seamless as possible and encourage EV uptake. Currently, many drivers who switch to an EV report issues and frustrations with recharging their vehicle on the public charging network.

What are the policy objectives and the intended effects?

The Government's aim is to ensure that recharging an EV is as simple and hassle-free as possible to encourage people to make the switch to EVs to meet our Net Zero targets. The regulations intend to make chargepoints easier to use, addressing problem areas we have identified through engagement and research. As a result of these regulations, paying for a charge will be easier, prices will be more comparable across charging networks, chargepoints will be more reliable, and drivers will be able to find chargepoints more easily.

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

Policy packages: The policy packages presented below combine the preferred options from each of the policies outlined here. Policy package 1 assumes we do not mandate roaming or 99% reliability on chargepoints under 50kW from 2024. Policy package 2 assumes we do mandate these additional measures from 2024. This depends on the extent of voluntary action.

Minimum payment methods: This policy requires public chargepoints to have a minimum payment method (i.e. a payment method that does not require a smartphone, such as contactless). We have considered four policy options where a minimum payment method is required on chargepoints of different charging power. The preferred option (option 1.2) requires a minimum payment method available on site for new chargepoints above 7 kilowatts (kW) and retrofit at sites with 50kW+ chargepoints. We are not requiring a minimum payment method below 8kW chargepoints because installing e.g. contactless on these chargepoints is less commercially viable. More detail in section 2.

Payment roaming: This policy requires payment roaming, which will enable consumers to pay to charge their EV through one app or membership card. The preferred option (option 2.1) is to take non-regulatory action, then mandate payment roaming from 2024 if no progress is made. This aims to incentivise a market-led roaming solution. More detail in section 2.

Price transparency: This policy requires all chargepoints to use pence per kilowatt hour (p/kWh) as the standard metric for a unit of electricity. More detail in section 2.

Reliability: This policy requires public chargepoints to meet 99% reliability and have a 24/7 helpline. We have considered four policy options where this is required on chargepoints of different charging power. The preferred option (option 4.3) requires 99% reliability on 50kW+ chargepoints and a 24/7 helpline on all public chargepoints. We will mandate 99% reliability on chargepoints below 50kW from 2024 if no progress is made. 99% reliability has not been extended to chargepoints below 50kW yet as evidence suggests 50kW+ chargepoints are less reliable. More detail in section 2.

Open data: Require chargepoint data, such as location, availability, etc., to be shared openly and mandate a data standard. More detail in section 2.

Will the policy be reviewed? It will be reviewed. **If applicable, set review date:** 12/2023

Does implementation go beyond minimum EU requirements?		N/a		
Is this measure likely to impact on international trade and investment?		Yes		
Are any of these organisations in scope?	**Micro** Yes	**Small** Yes	**Medium** Yes	**Large** , but Yes
What is the CO_2 equivalent change in greenhouse gas emissions? (Million tonnes CO_2 equivalent)		**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 Minister: Jesse Norman Date: 10/07/23

Summary: Analysis & Evidence Policy package 1

Description: This sheet combines the preferred options under minimum payment methods (option 1.2), payment roaming (option 2.1), price transparency (option 3.1), reliability (option 4.3) and open data (option 5.1), **assuming we do not mandate roaming or 99% reliability on chargepoints below 50kW from 2024**. We will be monitoring market progress on roaming and reliability between now and 2024, so the preferred policy package has not been selected at this point.

FULL ECONOMIC ASSESSMENT

Price Base Year 2021	PV Base Year 2022	Time Period Years 10	Net Benefit (Present Value (PV)) (£m)		
			Low: -129	**High:** -243	**Best Estimate:** -190

COSTS (£m)	Total Transition (Constant Price)	Years	Average Annual (excl. Transition) (Constant Price)	Total Cost (Present Value)
Low	7		38	**316**
High	26		154	**1278**
Best Estimate	17		79	**661**

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

Minimum payment methods – contactless hardware costs, transaction costs, and operating costs to business.
Payment roaming – no costs as this package assumes we do not mandate payment roaming in 2024.
Price transparency – software costs to adopt p/kWh and revenue loss to business.
Reliability – replacement chargepoint hardware and installation costs, software costs to improve internet connectivity, maintenance costs and labour costs to business.
Open data – software costs to business.
We expect the above costs will fall mainly on chargepoint operators (CPOs). They will also incur familiarisation costs, which have been monetised. Key monetised costs to government are enforcement costs and data maintenance.

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

We do not expect any non-monetised costs as a result of this policy package.

BENEFITS (£m)	Total Transition (Constant Price)	Years	Average Annual (excl. Transition) (Constant Price)	Total Benefit (Present Value)
Low	0		23	**187**
High	0		129	**1036**
Best Estimate	0		58	**471**

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

Minimum payment methods – time savings to EV drivers due to avoided helpline calls and avoided app downloads.
Payment roaming - no benefits as this package assumes we do not mandate payment roaming in 2024.
Price transparency – cost savings to consumers (EV drivers).
Reliability – time savings and electricity savings due to avoided helpline calls and avoided journeys to a second chargepoint when the first is out of service.
Open data - time savings and electricity savings due to avoided helpline calls and avoided journeys to a second chargepoint when the first is out of service, in use by another driver, or could not be located.

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

Emissions savings to society is a key non-monetised benefit of all policies. Higher consumer confidence in public charging and reduced range anxiety will likely remove barriers and encourage EV uptake, replacing internal combustion engine (ICE) vehicles earlier than without the intervention. There is limited evidence to establish a direct relationship between the policy package and EV uptake, therefore these benefits are non-monetised and monetised benefits are likely to be underestimated. This has resulted in a negative NPV for the minimum payment methods, price transparency and reliability policies, but we estimate an increase in new battery electric vehicle (BEV) and plug-in hybrid electric vehicle (PHEV) sales of 2.1%, 0.01% and 0.5% (percentage points), respectively, would generate a positive NPV, in line with this policy option of assuming we do not extend the reliability policy to chargepoints below 50kW from 2024. See section 3.5 and 8.3 for more detail.

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

Key assumptions include baseline assumptions, chargepoint projections, chargepoint speed and cost inputs, which have been tested through sensitivity analysis. Where possible, cost inputs have been sense-checked, but many have been provided by businesses that will incur the cost of compliance. A key risk is that, where the policy applies to chargepoints of a certain speed, these regulations may distort supply of chargepoints that are more heavily regulated.

BUSINESS ASSESSMENT (Policy package 1)

Direct impact on business (Equivalent Annual) £m:			**Score for Business Impact Target (qualifying provisions only) £m:**
Costs: 76	**Benefits:** 0	**Net:** 76	330

Summary: Analysis & Evidence — Policy package 2

Description: This summary sheet combines the preferred options under minimum payment methods (option 1.2), payment roaming (option 2.1), price transparency (option 3.1), reliability (option 4.3) and open data (option 5.1), assuming **we do mandate payment roaming from 2024 and mandate 99% reliability on chargepoints below 50kW from 2024**. We will be monitoring market progress on roaming and reliability between now and 2024, so the preferred policy package has not been selected at this point.

FULL ECONOMIC ASSESSMENT

Price Base Year 2021	PV Base Year 2022	Time Period Years 10	Net Benefit (Present Value (PV)) (£m)		
			Low: -313	**High:** -1,136	**Best Estimate:** -584

COSTS (£m)	**Total Transition** (Constant Price)	Years	**Average Annual** (excl. Transition) (Constant Price)	**Total Cost** (Present Value)
Low	10		62	**509**
High	91		286	**2386**
Best Estimate	39		134	**1120**

Description and scale of key monetised costs by 'main affected groups'
Minimum payment methods – contactless hardware costs, transaction costs, and operating costs to business.
Payment roaming – labour costs, legal costs and roaming agreement fee costs to business.
Price transparency – software costs to adopt p/kWh and revenue loss to business.
Reliability – replacement chargepoint hardware and installation costs, software costs to improve internet connectivity, maintenance costs and labour costs to business.
Open data – software costs to business.
We expect the above costs will fall mainly on chargepoint operators (CPOs). They will also incur familiarisation costs, which have been monetised. Key monetised costs to government are enforcement costs and data maintenance.

Other key non-monetised costs by 'main affected groups'
The payment roaming policy may result in loss of advertising revenue under some business models. No attempt has been made to monetise this cost as we expect the number of CPOs operating under this business model to be small.

BENEFITS (£m)	**Total Transition** (Constant Price)	Years	**Average Annual** (excl. Transition) (Constant Price)	**Total Benefit** (Present Value)
Low	0		24	**196**
High	0		156	**1250**
Best Estimate	0		67	**536**

Description and scale of key monetised benefits by 'main affected groups'
Minimum payment methods – time savings to EV drivers due to avoided helpline calls and avoided app downloads.
Payment roaming – time savings to EV drivers due to avoided helpline calls and avoided app downloads.
Price transparency – cost savings to consumers (EV drivers).
Reliability – time savings and electricity savings due to avoided helpline calls and avoided journeys to a second chargepoint when the first is out of service.
Open data - time savings and electricity savings due to avoided helpline calls and avoided journeys to a second chargepoint when the first is out of service, in use by another driver, or could not be located.

Other key non-monetised benefits by 'main affected groups'
Emissions savings to society is a key non-monetised benefit of all policies. Higher consumer confidence in public charging and reduced range anxiety will likely remove barriers and encourage EV uptake, replacing internal combustion engine (ICE) vehicles earlier than without the intervention. There is limited evidence to establish a direct relationship between the policy package and EV uptake, therefore these benefits are non-monetised and monetised benefits are likely to be underestimated. This has resulted in a negative NPV for minimum payment methods, payment roaming, price transparency and reliability policies, but we estimate an increase in BEV and PHEV sales of 2.1%, 1.0%, 0.01% and 2.0% (percentage points), respectively, would generate a positive NPV. More detail in section 3.5 and 8.3.

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

Key assumptions include baseline assumptions, chargepoint projections, chargepoint speed and cost inputs, which have been tested through sensitivity analysis. Where possible, cost inputs have been sense-checked, but many have been provided by businesses that will incur the cost of compliance. A key risk is that, where the policy applies to chargepoints of a certain speed, these regulations may distort supply of chargepoints that are more heavily regulated.

BUSINESS ASSESSMENT (Policy package 2)

Direct impact on business (Equivalent Annual) £m:			**Score for Business Impact Target (qualifying provisions only) £m:**
Costs: 125	**Benefits:** 0	**Net:** 125	544

Summary: Options and analysis

The summary sheets above present the costs and benefits of the package of policies, combining the preferred options under minimum payment methods (option 1.2), payment roaming (option 2.1), price transparency (option 3.1), reliability (option 4.3) and open data (option 5.1). Policy package 1 presents the costs and benefits if we do not mandate payment roaming from 2024 or mandate 99% reliability on chargepoints below 50kW from 2024. Policy package 2 presents the costs and benefits if we do mandate these from 2024. Policy package 2 is included in the 'Intervention and Options' summary sheet since this is the most likely outcome, whether compliance is achieved voluntarily or through further regulation. We will be monitoring the non-regulated progress of the market in these areas between now and 31 December 2023 before deciding whether these powers will come into effect in 2024. Given that this is a package of five policy areas with multiple options within each, a more granular summary is provided in table 1.

As there is limited evidence to establish a direct relationship between the policies and new EV sales, emissions savings and revenue benefits due to increased EV uptake are non-monetised and so the monetised benefits are likely to be underestimated. This has resulted in a negative net present value (NPV) for the minimum payment methods, payment roaming, price transparency and reliability policies. The final column of table 1 indicates the percentage-point increase in projected new electric car and van sales that would be required for the preferred option under each policy to generate a net benefit to society. An example of a 1 percentage-point increase would be if the proportion of new car and van sales that were BEVs/PHEVs increased from 14% to 15%. It is likely that, for each of the policies with a negative NPV, the increase in new EV sales will be large enough to offset the negative NPV.

In addition to increasing new EV sales, carbon benefits are likely to be realised in drivers choosing to switch petrol or diesel miles to electric miles. For example, in a PHEV where petrol or electric miles can be driven, or in households that own both an internal combustion engine (ICE) vehicle and an EV. More detail on this assessment is provided in sections 3.5, 4.6, 5.5 and 6.5. This is also included in sensitivities (section 8.3).

Table 1: Option summaries for all policies (2021 prices, 2022 PV base, £ million)

Option	Description	Net benefit (Present Value)	Direct cost on business (Equivalent Annual)	Increase in EV sales required for a net benefit (percentage points)
Minimum payment methods				
Option 1.1	Require, at minimum, a payment method that does not require a smartphone (e.g. contactless) on new and existing chargepoints with a charging power of 50 kilowatts (kW) and above (50kW+).	-11	3	
Option 1.2 (preferred)	Require, at minimum, a payment method that does not require a smartphone (e.g. contactless) on new chargepoints with a charging power 8kW and above and existing chargepoints with 50kW+ charging power.	-214	33	2.1%
Option 1.3	Require, at minimum, a payment method that does not require a smartphone (e.g. contactless) at sites with new public chargepoints and existing chargepoints with 50kW+ charging power.	-463	71	

Option 1.4	Require, at minimum, a payment method that does not require a smartphone (e.g. contactless) on all new and existing public chargepoints.	-488	74	
Payment roaming				
Option 2.1 (preferred)	Non-regulatory action, mandate roaming from 2024 if no progress is made, which will enable consumers to pay to charge their electric vehicle through one app or membership app, regardless of which public charging network they use.[1]	-107	27	1.0%
Option 2.2	Mandate payment roaming from 2022, which will enable consumers to pay to charge their electric vehicle through one app or membership card regardless of which public charging network they use.	-111	29	
Price transparency				
Option 3.1 (preferred)	Mandate pence per kilowatt hour (p/kWh) as the standard metric for a unit of electricity, akin to pence per litre which is currently used for fuel	-1	36	0.01%
Reliability				
Option 4.1	Mandate a 24/7 helpline at all chargepoints and monitor chargepoint reliability data to understand the reliability of the public charging network	-29	3	
Option 4.2	Mandate a 99% reliability standard for chargepoints with 50kW+ charging power and a 24/7 helpline at all chargepoints	-49	7	
Option 4.3 (preferred)	Mandate a 99% reliability standard for chargepoints with 50kW+ charging power and a 24/7 helpline at all chargepoints, if no progress is made on chargepoints with a charging power under 50kW, regulate from 2024.[2]	-209	33	2.0%
Option 4.4	Mandate a 99% reliability standard and a 24/7 helpline across entire public network	-226	35	
Open data				
Option 5.1 (preferred)	Mandate chargepoint data, such as location, availability, prices, etc., to be shared openly and mandate a data standard to ensure the data is consistent across charging networks.	85	0.4	
Total				
Policy package 1	Combines the preferred option under each policy, assuming no additional regulation from 2024.	-190	76	1.8%
Policy package 2	Combines the preferred option under each policy, assuming additional regulation from 2024.	-584	125	5.6%

[1] The estimates are calculated assuming payment roaming is mandated from 2024.
[2] The estimates are calculated assuming 99% reliability on chargepoints below 50kW is mandated from 2024.

Contents

1 Policy Rationale

1.1 Policy background

1. The Government has committed to phase out new petrol and diesel cars and vans in 2030, with all new cars and vans fully zero emission at the tailpipe from 2035. The move to zero emission vehicles is essential to meet our legally binding carbon targets. In 2019, the government committed the UK to meet net-zero greenhouse gas emissions by 2050, to ensure the UK ends its contribution to climate change. Transport is now the largest sector for UK greenhouse gas emissions. Cars and vans alone represent 19% of all domestic emissions. The transition to zero-emission vehicles is therefore vital to realising our net-zero ambitions.

2. There are now over 500,000 ultra-low emission vehicles registered in the UK[3] and over 24,000 public electric vehicle (EV) chargepoints installed.[4] The government has committed £2.8 billion to support this transition.

3. EV chargepoint installation and operation is a relatively new and growing market. We want to encourage and leverage private sector investment to build and operate a self-sustaining public chargepoint network that's affordable, reliable and accessible for all consumers.

4. This impact assessment focuses on policies to improve the consumer experience at public EV chargepoints only. However, this is just one component of the Government's policy intentions to support the transition to a net zero transport sector. The government's EV infrastructure strategy, due to be published later this year, will set out the strategy for chargepoint rollout to ensure consumers have adequate charging infrastructure on a national and local scale. Government's grants and funding to support chargepoint rollout continues to be provided. Following the 2020 spending review, these include a new, additional £90 million fund to support local electric vehicle infrastructure rollout (LEVI Fund) and £950 million towards rapid charging (Rapid Charging Fund).

5. However, a key barrier to electric vehicle adoption that continuously emerges through surveys, industry and consumer body discussions remains consumer frustrations while using the public charging network. The Competition and Markets Authority recently emphasised concerns with a lack of trust in the public charging network as part of their electric vehicle market study.[5] The policies in this impact assessment are a crucial step in addressing this wider issue, as part of Government's overarching strategic approach.

6. As charging technology and infrastructure evolves and expands, new consumer offers will continue to emerge. We want to enable innovative charging approaches while ensuring that all consumers can charge their vehicle in a way that is as straightforward and reliable as refuelling a traditional vehicle. This is essential, not only for existing EV drivers but for giving people who are more reluctant to switch the confidence to do so.

7. Regulations on payment and reliability will be enabled through the Autonomous and Electric Vehicles Act (AEVA) 2018, Section 10. Regulations opening up data will be enabled through the AEVA, Section 13 and 14. Regulations requiring charging to be sold in pence per kilowatt hour will be enabled through the Prices Act 1974 Section 4.

8. For this impact assessment, evidence has been gathered through bilateral meetings with 17 key EV charging stakeholders which included 11 chargepoint operators (CPOs) accounting for 54% of existing chargepoints. This covered all CPOs with over 1% of existing chargepoints and some small and micro businesses. In addition, we included an 'Impact assessment' section in the published

---

[3] Department for Transport, Vehicles statistics, Ultra-low emissions vehicles (ULEVs), VEH0130, Q2 2021, https://www.gov.uk/government/statistical-data-sets/all-vehicles-veh01

[4] Electric vehicle charging device statistics, July 2021, https://www.gov.uk/government/statistics/electric-vehicle-charging-device-statistics-july-2021/electric-vehicle-charging-device-statistics-july-2021

[5] Competition and Markets Authority, Electric vehicle charging market study: Final report, https://www.gov.uk/government/publications/electric-vehicle-charging-market-study-final-report

consultation document, which set out high-level impacts and invited evidence and challenge.[6] Finally, we ran a workshop with 30 EV charging stakeholders including CPOs, manufacturers, eMobility Service Providers (eMSPs) and Internet of Things (IoT) providers to test costs, benefits and assumptions, refining these further where necessary.

9. To support our policy development, we have worked closely with industry forums and stakeholders to continually test our policies and assumptions. We have closely engaged with the EV energy taskforce[7], made up of cross-sector stakeholders, through their first and second phases of work. They have strongly supported our consumer experience workstream. We have also worked closely with the Competition and Markets Authority on their EV charging market study[8] who tested similar policy options to our consumer experience consultation. Their final outcomes fully align with our final policies in the government response.

1.2 Problem under consideration

10. In order to encourage drivers to make, and stick to, the switch to EVs from petrol or diesel vehicles, the experience of charging an EV must be equal to or better than refuelling a petrol or diesel vehicle.[9] Findings from existing research and stakeholder engagement highlight that the current experience of using the public charging network can be challenging. According to a recent EVA England survey of EV drivers in England, only 7% said they were satisfied with the current state of public charging infrastructure.[10] A 2020 Delta-EE report states that the experience of accessing the UK public charging network is one of the least simple when compared to other European countries.[11] Moreover, current experience has an impact on consumers' confidence using their EVs. A recent AA-Yonder survey found that 54% of EV users interviewed would use their EV more if public charging was easier, and 49% stated they don't feel confident taking long journeys.[12]

11. Current EV drivers are reasonably confident with technology and able to cope with a certain level of inconvenience. As EV use expands beyond innovators and early adopters, these problems are expected to become more prominent. Therefore, it is essential to simplify using the charging network in order to encourage EV adoption among the wider motorist population.[13] Existing research suggests charging infrastructure is a key barrier to EV adoption among non-EV drivers. According to a recent study by Transport Focus, of road users unlikely to purchase an EV in the next 5 years, 44% were concerned about where to charge and 42% were concerned about how far they could drive before needing to recharge.[14] Whilst non-EV drivers do not have first-hand experience of issues using the public charging network, research with non-EV drivers without off-street parking suggests they are concerned about charging difficulties as well.[15] Both EV and non-EV drivers appear to value dependability of chargepoints even more than proximity to chargepoints. Research finds that they would accept driving a longer distance to have guaranteed charging, over being left stranded and unable to charge.[16] In addition, a 2021 study by Hardman & Tal finds that, in California, 20% of Plug-in Hydrid Electric Vehicle (PHEV) owners and 18% of Battery Electric Vehicle (BEV) owners discontinue purchasing EVs due to dissatisfaction with the convenience of

---

6 The consumer experience at public chargepoints, Impact assessment, https://www.gov.uk/government/consultations/the-consumer-experience-at-public-electric-vehicle-chargepoints

7 https://evenergytaskforce.com/

8 https://www.gov.uk/cma-cases/electric-vehicle-charging-market-study

9 Driving and accelerating the adoption of electric vehicles in the UK, https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/914111/driving-and-accelerating-the-adoption-of-electric-vehicles-in-the-uk.pdf

10 https://www.evaengland.org.uk/wp-content/uploads/2021/04/EVA-England-Consumer-Charging-Survey-Report.pdf

11 Delta-EE (2020) – How do EV owners use public charging networks. A survey of 428 BEV & PHEV owners across key markets.

12 AA-Yonder Driver Poll (12th and 20th January 2021). Base for this question: 432 EV drivers who have used public chargepoints

13 Transport Focus, Electric vehicles: User experiences and attitudes, 2021

14 Transport Focus, Electric vehicles: User experiences and attitudes, 2021

15 DfT, Public EV charging infrastructure deliberative research, 2021 (not published yet)

16 Emerging findings from DfT research

charging.[17] This demonstrates that being able to access a functioning and reliable charging infrastructure is considered an essential requirement to the viability of EV ownership.

12. Whilst the charging sector is delivering infrastructure quickly with rapid innovation, there are issues that have been identified by social research, correspondence and consultation. These issues are categorised into the four areas below. The regulations to address these problems will apply to public chargepoints, which include on-street residential, destination and rapid chargepoints. These regulations will not apply to private chargepoints, which include workplace and off-street residential chargepoints.

Payment methods (minimum payment methods & roaming)

13. There is no common method of payment across charging networks, requiring consumers to have multiple smartphone apps or membership cards to access the entire network. This results in a more complicated experience than that enjoyed by petrol or diesel vehicle refuelling. In the same AA-Yonder survey cited above, 62% of EV drivers agreed that too many apps are required to pay, whilst 7% disagreed.

14. There is no simple payment method that allows businesses with fleets to monitor and manage payments centrally rather than relying on the individual driver to pay and expense this or working with the minority of operators that are willing to work with payment platforms. This discourages fleets from transitioning to EVs.

Price transparency

15. A unit of electricity at public chargepoints is priced using a range of different metrics across charging networks (i.e. some networks use £/hour, £/minute or a flat rate per charging session whilst the majority used pence per kilowatt hour (p/kWh)). AA-Yonder data indicate that 56% of EV drivers agreed that the price of charge at public chargepoints is unclear and confusing, whilst 10% disagreed. Lack of a standard pricing metric prevents consumers from easily comparing prices across charging networks. Evidence suggests consumers are confused by the lack of comparability of pricing information.

Open data

16. Chargepoint data such as location, power rating, and availability can be incomprehensive, inaccurate or not openly provided. This can result in consumers having problems locating chargepoints or arriving at chargepoints to find they are in use, leading to a poor consumer experience. According to EVA, 72% of EV drivers are either often or sometimes concerned about finding a chargepoint.

Reliability

17. The number of chargepoints out of service or partially in service is currently too high, at 9% in August 2020 according to Zap-Map. Almost 1 in 2 EV drivers (47%) agreed that too many public chargepoints are out of service or inaccessible, only 9% disagreed, according to AA-Yonder. An unreliable public charging network undermines consumer confidence and can put people's safety at risk if they are left stranded and unable to charge their vehicle. This results in a poor consumer experience which is likely to hinder the transition to EVs.

1.3 Rationale for intervention

18. The overarching rationale behind government action to decarbonise road transport is to correct negative externalities of emissions. Government intervention is needed to address the social cost of emissions from the private consumption of road transport from petrol and diesel vehicles. Petrol

[17] Hardman & Tal, Understanding discontinuance among California's electric vehicle owners, 2021, https://www.nature.com/articles/s41560-021-00814-9

and diesel vehicles will be over-consumed due to the private costs of their purchase being lower than the social costs which include pollution costs are borne by wider society.

19. The electrification of road transport is necessary to decarbonise transport and to meet Net Zero 2050 targets. With announced 2030 commitments for all new cars and vans to be fully zero emission at the tailpipe from 2035 and our current proximity to this date, the most likely alternative-fuelled vehicle available for cars and vans is going to be battery electric. Therefore we know with relative certainty that a well-developed network of charging infrastructure that the public can trust and use simply will be required over the next 10 years in which this policy is appraised.

20. **Externalities -** This is a large scale systemic transition driven primarily by government targets due to the failure of the market to adequately factor in the cost of emissions. Due to market uncertainty in this transition, regulation and other measures must be employed by the government to build consumer confidence in a reliable UK charging infrastructure network, required to meet ambitious carbon reduction targets.

21. The government aims to build trust in, and improve, the public charging infrastructure by introducing regulation to simplify and harmonise payment methods, standardise a p/kWh metric for a unit of electricity, open up chargepoint data to make it easier for drivers to locate chargepoints, and ensure a reliable charging network.

22. In 2020, only 1.3% of all cars on the road and 0.4% of all vans on the road were plug-in hybrid electric vehicles (PHEV) or battery electric vehicles (BEV)[18], therefore current demand for chargepoints is limited. Where chargepoint utilisation rates are low, public charging networks have a little incentive to incur costs in order to improve the consumer experience. This is because, given current low levels of EV consumers, chargepoint operator (CPO) costs of improving the consumer experience outweigh the limited and uncertain CPO revenue benefits expected from additional consumers, creating a positive externality. Whilst the market may deliver a solution to this problem and an improved consumer experience over time, in the context of meeting Net Zero 2050 targets, intervention is required.

23. **Coordination –** Finally, to incentivise consumers to switch and stick to EVs, an improvement across the entire network is needed, requiring CPOs to coordinate and align their decision-making, as a single CPO's actions are unlikely to substantively change wider consumer perception. As charging networks do not coordinate their decision-making, a sub-optimal consumer experience is delivered, leading to EV uptake and subsequent revenue being lower than optimal. Below outlines further reasons we do not expect the market to arrive at socially optimal outcomes without government intervention for each of the policy areas.

- **Payment methods – positive externality:** There are currently numerous different payment methods across public charging networks. This creates inconvenience for consumers as they need multiple apps or membership cards to access the entire network. Given current low numbers of EVs on the road, public charging networks are less likely to face revenue increases as a result of the convenience benefits a universal payment method delivers to consumers. In addition, universal payment methods would remove opportunities to generate advertising revenue through network-specific apps. This is a positive externality as wider consumer benefits outweigh CPO benefits. Therefore, in the absence of government intervention and in the context of low EV uptake, universal payment methods are likely to be under-provided.

- **Minimum payment methods – equity:** Currently, paying for charge often requires a smartphone. This raises equity concerns given 12% of the UK population do not personally use a smartphone and an additional 6% do not personally use a mobile phone.[19] Moreover, use of smartphones is significantly lower among people aged 55+ (60% compared to 95% among 16-54s) and with lower household incomes. In the absence of a minimum payment

[18] https://www.gov.uk/government/statistical-data-sets/all-vehicles-veh01

[19] https://www.ofcom.org.uk/__data/assets/pdf_file/0037/194878/technology-tracker-2020-uk-data-tables.pdf

method (i.e. a payment method that does not require a smartphone), this section of society could be excluded from parts of the electric vehicle charging network, causing not only an unequitable outcome, but also potential under-consumption of electric vehicles from this section of society. The market may deliver a solution to this problem in the future, however, CPOs do not have a direct incentive to provide accessible payment options to generate equitable outcomes.

- **Price transparency – information failure:** Market forces provide limited incentive for CPOs to ensure pricing is consistent and comparable across networks. As a result, in some instances different metrics for a unit of electricity are used across networks (i.e. some networks use £/hour or a flat rate per charging session whilst the majority use pence per kilowatt hour (p/kWh)). This means consumers have imperfect information when selecting a charging network as it is challenging to compare the pricing offer across networks and select the best available price, providing potential advantage to a chargepoint operator. This may result in consumers making choices they otherwise would not have done, had they received all the information. In addition, if consumers choose to stick to using networks with pricing metrics they are familiar with, this may result in insufficient competition between charging networks, leading to allocative inefficiency.
- **Open data – positive externality:** In the absence of mandatory data sharing standards and incentives, market forces provide limited incentive for CPOs to freely and openly share and maintain data such as: chargepoint ID; owner/operator location; operating hours; power; connector type; payment method; cost of obtaining access; parking enforcement arrangements; disabled access; availability; state of repair; and the pricing offer. However, all this information provides benefits to consumers using the charging network when making their consumption decisions. Because CPOs will not fully factor in these external benefits to their decisions on data provision, in the absence of intervention, open data is likely to be under-provided.
- **Reliability – positive externality:** Given current low chargepoint utilisation rates, public charging networks have a low incentive to incur costs for repairs or replacements. This incentive is reduced further when there is an opportunity cost of installing new chargepoints that may have higher utilisation rates and attract more capital investment. In addition to this, electric vehicle charging is a developing technology, leading to the proportion of chargepoints that are out of service being too high, recorded at 7.3%[20] in August 2020 according to Zap-Map. Where chargepoints are out of service, the consumer risks either running out of charge or having to wait for a chargepoint to become available, resulting in time loss. In areas where chargepoint utililisation is low, public charging networks are less likely to face revenue increases as a result of the time and reliability benefits a reliable charging network delivers to consumers. This is a positive externality, as consumer benefits outweigh CPO benefits. Therefore, in the absence of intervention and in the context of low utilisation, market forces are unlikely to be strong enough to incentivise the market to provide optimal levels of reliability.

1.4 Policy objective

24. The objective of this set of policies is to encourage the switch to EVs from petrol and diesel vehicles by improving the consumer experience at public chargepoints. There is a significant risk that if government does not employ measures to improve consumer confidence in the public charging network, EV uptake may be lower than that required to meet our legally binding carbon targets. Policy objectives for each of the four areas are set out below.

[20] This is the proportion of chargepoints that were classed as ‘out of service’ on Zap-Map in August 2020. We expect there are additional chargepoints that consumers are unable to successfully charge from, but are not classed as ‘out of service’ and so are not captured in this figure. Therefore, we expect this to be an underestimate of total reliability.

Payment methods (minimum payment methods & roaming)

25. The objective of this policy is a smooth, hassle-free process for consumers to pay for charge across the entire public network, regardless of who operates the individual chargepoint. In addition, businesses with fleets should have access to a simple payment method that allows the company to monitor and manage payments centrally, akin to petrol and diesel fuel cards used for fleets.

Price transparency

26. This policy aims for consumers to easily compare the cost of charging between different networks, helping drive competition and bring down prices.

Open data

27. The objective of this policy is for consumers to locate and access chargepoints with ease by accessing a range of software solutions that provide them with comprehensive and accurate chargepoint data.

Reliability

28. The policy objective here is a well-maintained public charging network that consumers can trust and will not leave drivers stranded.

1.5 Interactions with investment in charging infrastructure

29. This section sets out the interactions between policies to improve the consumer experience at public chargepoints (policies assessed in this IA) and incentives to invest in new chargepoint installations to ensure consumers have adequate charging infrastructure. Policies to improve the consumer experience are likely to impose costs on CPOs (see sections 3-8 for cost-benefit analysis), which may disincentivise investment in new chargepoint installations. Whilst this is considered a risk (see section 9), the purpose of the policies in this IA is to increase the number of EVs on the road by improving the consumer experience at public chargepoints. More EVs on the road supports the commercial viability of chargepoint installations.

30. Chargepoint supply and EV demand are interdependent. The viability of EV ownership depends on a widespread, functioning charging network being in place, but the commercial viability of that network depends on the number of EVs on the road. Given the current low number of EVs on the road, CPOs are currently making a loss with the expectation of significant future returns when mass-market adoption is reached. Literature suggests the EV charging market is expected to become profitable only when EVs make up at least 5% of vehicles on the road, or about 2 million units.[21] We estimate the 5% threshold will be reached by 2025 for cars and by 2029 for vans.[22] In 2020, only 1.3% of all cars on the road and 0.4% of all vans on the road were PHEV or BEV.[23] As a result, in 2020 there was an average of 0.46, 0.52 and 1.48 charging events per day on slow, fast and rapid chargepoints, respectively.[24]

31. Whilst an increase in costs may push the 5% profitability threshold out and extend the period before returns on investment are realised, the profitability threshold may also be reached sooner as a result of these policies given they are expected to increase EV sales. More detail on the investment tipping point is provided in the small and micro businesses assessment (section 10.2), but overall,

---

[21] Hurry up and… wait, The opportunities around electric vehicle charge points in the UK, Deloitte, 2019, page 1, https://www2.deloitte.com/content/dam/Deloitte/uk/Documents/energy-resources/deloitte-uk-Electric-Vehicles-uk.pdf

[22] Transitioning to zero emission cars and vans: 2035 delivery plan, page 5, https://www.gov.uk/government/publications/transitioning-to-zero-emission-cars-and-vans-2035-delivery-plan

[23] https://www.gov.uk/government/statistical-data-sets/all-vehicles-veh01

[24] Zap-Map report, 2020

and coupled with other government policies targeted at increasing chargepoint rollout (see section 1.1), these policies are not expected to have a substantial impact on incentives to invest in charging infrastructure. However, the level of chargepoint provision will be actively monitored, enabling further action if the rate of roll out is not sufficient.

2 Policy options considered

32. The summary sheets above present the costs and benefits of the policy packages, combining the preferred options under minimum payment methods (option 1.2), payment roaming (option 2.1), price transparency (option 3.1), reliability (option 4.3) and open data (option 5.1). Policy package 1 presents the costs and benefits if we do not mandate payment roaming from 2024 or mandate 99% reliability on chargepoints below 50kW from 2024. Policy package 2 presents the costs and benefits if we do mandate these from 2024. We will be monitoring the progress of the market in these areas between now and 31 December 2023 before deciding whether these powers will come into effect in 2024. Below sets out the non-regulatory options considered and the options within each policy.

2.1 Non-regulatory options considered

33. Non-regulatory options have been considered. Over the last two years, we have worked with industry to voluntarily improve the consumer experience in each of these policy areas. However, sufficient progress has not been made. Our non-regulatory engagement to encourage industry solutions include:

- An announcement by the Secretary of State in April 2019[25] that all rapid chargepoints should have contactless payment installed by April 2020. However, less than half of rapids currently have contactless.
- Publication of the Electric Vehicle Energy Taskforce proposals[26] supported by government in January 2020 which highlighted the need for open data and a reliable working network. The working groups have continued to engage with industry however consumers are still not able to find all UK chargepoints and confidence in the infrastructure remains low.
- We published behavioural research in September 2020[27] which highlighted the need for consumers to have confidence in the charging network and understand the information and price offered at public chargepoints.
- Ahead of the consultation publication, in September 2020 we held industry workshops to highlight the key pain points facing consumers we would consult on.

2.2 Minimum payment method options

34. **<u>Option 0 - Do nothing:</u>** In the baseline scenario, we assume 58% of new rapid chargepoints, 1% of new fast chargepoints and 1% of new slow chargepoints will have a minimum payment method such as contactless payment. This is based on Zap-Map data showing contactless availability on new devices over the last three years between 2018 and 2020. We also assume that existing chargepoints will not be retrofit with a minimum payment method in the absence of the regulation.

35. **<u>Option 1.1 – New and existing (50kW+) chargepoints:</u>** Require new and existing 50kW+ chargepoints to have a minimum payment method such as contactless payment. Under this option the regulation would not apply to chargepoints under 50kW.

[25] https://www.gov.uk/government/news/all-new-rapid-chargepoints-should-offer-card-payment-by-2020
[26] https://es.catapult.org.uk/report/ev-energy-taskforce-moving-from-proposals-to-actions/
[27] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/914111/driving-and-accelerating-the-adoption-of-electric-vehicles-in-the-uk.pdf

36. **Option 1.2 – New chargepoints 8kW + existing 50kW+ chargepoints (preferred):** Require new chargepoints 8kW and above to have a minimum payment method such as contactless payment available on site and require retrofit on existing 50kW+ chargepoints. Under this option the regulation would not apply to all chargepoints below 8kW and existing chargepoints below 50kW.

37. **Option 1.3 – All new chargepoints + existing 50kW+ chargepoints:** Require sites that have all new chargepoints and existing 50kW+ chargepoints to have a minimum payment method such as contactless payment. Under this option the regulation would not apply to existing chargepoints below 50kW.

38. **Option 1.4 – All new and existing public chargepoints:** Require all new and existing public chargepoints to have a minimum payment method such as contactless payment.

2.3 Payment roaming options

39. **Option 0 – Do nothing:** In the baseline scenario, we assume CPOs will not open their networks without discrimination to any third party eMobility Service Provider or each other. However, we do expect roaming agreements to occur where there is mutual benefit.

40. **Option 2.1 – Non-regulatory action, regulate from 2024 if no progress is made (preferred):** Take the powers to mandate payment roaming now, then monitor the market and set a deadline of 31 December 2023 for the powers to come into effect if insufficient progress has been made by industry. Government will work with industry to showcase best practise and name and shame providers who do not work with other industry participants.

41. **Option 2.2 – Mandate payment roaming:** Require CPOs to open their network to any third-party eMobility Service Provider (eMSP) or each other without discrimination. Under this option, there would be payment interoperability across all networks, enabling access to all public chargepoints, including lower-powered chargepoints, through one membership card or smartphone app. This would deliver a solution for both fleets and consumers.

2.4 Price transparency options

42. **Option 0 – Do nothing:** We assume the 47 networks that already present their prices in p/kWh on Zap-Map have already incurred costs to adopt a p/kWh metric, therefore these costs are sunk and are excluded from the analysis. In the baseline scenario, we assume the 15 charging networks that do not present their prices in p/kWh on Zap-Map have not adopted p/kWh and will not do so in the absence of the regulation.

43. **Option 3.1 – Mandate p/kWh (preferred):** Require all public charging networks to adopt a p/kWh metric for a unit of electricity sold under pay-as-you-go (PAYG) models. This will enable consumers to easily compare prices across the public charging network and select the best available price. All prices must be offered in p/kWh and other pricing models must be removed under PAYG offers. Bundles for services can be offered however an equivalent p/kWh price must be stated alongside the bundle.

2.5 Reliability options

44. **Option 0 – Do nothing:** In the baseline scenario, we assume devices that are 'out of service' will not be replaced. We also assume 15% of devices have signal boosters, 93% of devices have a multi-network SIM, 62% of devices have maintenance contracts, and 90% of devices have a 24/7 helpline, based on a survey shared with 29 EV charging stakeholders which received 12 responses.

45. **Option 4.1 – Mandate a 24/7 helpline and monitor reliability data:** Use reliability data gathered through the open data policy to name and shame CPOs who have poor reliability, with penalities for CPOs who display reliability data incorrectly. Require CPOs to provide a 24/7 helpline to assist consumers who are struggling to access a chargepoint.

46. **<u>Option 4.2 – Mandate a 99% reliability standard for 50kW+ chargepoints and a 24/7 helpline for all:</u>** Require CPOs to meet a 99% reliability standard per chargepoint on 50kW+ chargepoints. We will monitor chargepoints under 50kW, naming and shaming those with poor reliability. In addition, require CPOs to provide a 24/7 helpline for all chargepoints to assist consumers who are struggling to access a chargepoint.

47. **<u>Option 4.3 – Mandate a 99% reliability standard for 50kW+ chargepoints and a 24/7 helpline for all, if no progress is made on chargepoints under 50kW, regulate from 2024 (preferred):</u>** Require CPOs to meet a 99% reliability standard per chargepoint on 50kW+ chargepoints. We will monitor chargepoints under 50kW, naming and shaming those with poor reliability. In addition, take the powers in 2023 to mandate a 99% reliability standard on chargepoints under 50kW now, then monitor the market and set a deadline of 31 December 2023 for the powers to come into effect if insufficient progress has been made by industry. In addition, require CPOs to provide a 24/7 helpline for all chargepoints to assist consumers who are struggling to access a chargepoint.

48. **<u>Option 4.4 – Mandate a 99% reliability standard and 24/7 helpline for all:</u>** Require CPOs to meet a 99% reliability standard per chargepoint across all chargepoints. In addition, require CPOs to provide a 24/7 helpline for all chargepoints to assist consumers who are struggling to access a chargepoint.

2.6 Open data options

49. **<u>Option 0 – Do nothing:</u>** In the baseline scenario, we assume CPOs will not make all data types freely, openly available. However, we do expect CPOs to share some data types (e.g. location, power and pricing) through commercial agreements with aggregators such as Zap-Map and through their network apps. In addition, we assume 60% of CPOs have already adopted Open Charge Point Interface (OCPI) as their data standard, based on a survey shared with 29 EV charging stakeholders which received 12 responses.

50. **<u>Option 5.1 – Mandate open data (preferred):</u>** Require CPOs to provide the following data types: Chargepoint ID; owner/operator location; location; operating hours; power; connector type; payment method; cost of obtaining access; parking enforcement arrangements; disabled access; availability; state of repair; and pricing offer. How these data types are provided will be determined by a data discovery concluding in November 2021. In addition, require CPOs to implement a data standard called Open Charge Point Interface (OCPI) throughout their system. This is a global and freely available standard that will specify the format the data should be provided in, data types and maintenance requirements.

3 Costs and benefits: Minimum payment methods

3.1 Summary

51. This section outlines monetised and non-monetised costs and benefits of the minimum payment method options and the methodology and assumptions used to monetise them. Cost and benefits are consistent across all four options as options only differ in terms of the power rating (kW) the regulation applies to. The analysis focuses on contactless as in most cases we expect CPOs will select this as their minimum payment method, based on our engagement with the market and consultation responses.

52. The appraisal period is 10 years (2022-2032). Costs and benefits are presented in 2021 prices and discounted at 3.5%.

53. Under each policy option, a minimum payment method would be required on:

- Option 1.1: New and existing 50kW+ chargepoints

- Option 1.2: Sites which have new chargepoints above 8kW, retrofit 50kW+ chargepoints only (preferred)
- Option 1.3: All new public chargepoints, retrofit 50kW+ chargepoints only
- Option 1.4: All new and existing 50kW+ chargepoints

54. **<u>Monetised costs</u>**

- Hardware costs for a contactless terminal, including costs to integrate the payment system and chargepoint management system (direct, ongoing)
- Installation costs to install a contactless terminal, incurred only if retrofit is required (direct, one-off)
- Transaction costs (direct, ongoing)
- Operating costs (direct, ongoing)
- Familiarisation costs (direct, one-off)
- Enforcement costs (direct, ongoing)

55. **<u>Unmonetised costs</u>**

- None expected.

56. **<u>Monetised benefits</u>**

- Time savings for consumers as a result of simplified payment methods, monetised using data on avoided helpline calls and app downloads (direct)

57. **<u>Unmonetised benefits</u>**

- Emissions savings to society as a result of increased EV uptake (indirect)

58. Table 2 summarises the costs and benefits of all minimum payment methods options. We estimate that a 2.1% increase in EV sales will be required to offset the negative NPV and our assessment suggests the increase due to this policy is not unreasonable (see section 3.5). For a summary of why option 1.2 is preferred, see section 8.1. This IA further assumes that the minimum payment method is applied per chargepoint. However, in the preferred option, it can be offered per charging site, potentially reducing the cost to business. In turn, our cost estimates could be overestimated in which case a smaller increase in EV sales would be needed to offset the negative NPV. Section 8.3 presents sensitivity analysis on how costs could change if the payment method was to be adopted on a per site basis rather than per charging point.

Table 2: Summary of costs and benefits (2021 prices, 2022 PV base, £ million)			
Option	**Low**	**Central**	**High**
Costs			
Option 1.1	16	28	52
Option 1.2 (preferred)	136	281	635
Option 1.3	309	611	1,357
Option 1.4	334	642	1,393
Benefits			
Option 1.1	4	18	42
Option 1.2 (preferred)	14	67	202
Option 1.3	32	149	440
Option 1.4	33	154	451
Net present value			
Option 1.1	-11	-11	-10
Option 1.2 (preferred)	-122	-214	-433

Option 1.3	-277	-463	-918
Option 1.4	-301	-488	-942

3.2 Evidence base

59. Costs were identified through bilateral meetings with 17 key EV charging stakeholders which included 11 CPOs accounting for 54% of existing chargepoints.

60. In addition, we gathered cost data through the published consultation document. We included a section which set out high level impacts and invited evidence and challenge.

61. Finally, we ran a workshop with around 30 EV charging stakeholders including CPOs, manufacturers, eMobility Service Providers (eMSPs) and Internet of Things (IoT) providers to test our cost inputs and assumptions, refining these further where necessary.

62. Table 3 provides a summary of cost items and unit costs identified through stakeholder engagement for the minimum payment methods policy. We expect uniform costs across chargepoints of different speeds, unless specified otherwise. The costs presented in table 3 and discussed in section 3.3 and 3.4 are based on the minimum payment method being applied per chargepoint rather than per charging site. There is currently limited evidence on how these unit costs would change if the payment methods were instead applied at the per site level. A more detailed cost assessment is provided in Annex 1.

Table 3: Minimum payment method unit costs

Cost item	Description	Unit costs
Hardware cost: Contactless terminal	Hardware cost per chargepoint for a contactless terminal, including the cost to integrate the payment system and the chargepoint management system. A few stakeholders stated lower costs as they purchased the contactless terminal separately and integrated the payment system and the chargepoint management system in-house. We expect the majority of stakeholders will outsource this integration.	Low: £900 Central: £1,000 High: £1,100
Installation costs	Installation cost per chargepoint to retrofit the contactless terminal to existing chargepoints. This cost will be incurred only where a contactless retrofit is required.	Low: £170 Central: £335 High: £500
Transaction fee	Transaction fee charged by the payment provider for each charging event paid for via contactless.	Low: 2% Central: 3.5% High:5%
Operating costs	Costs per chargepoint per year to operate the contactless terminal, which may include a monthly service fee, a financial gateway or a SIM.	Low: £108 Central: £120 High: £132

3.3 Monetised costs

Monetised cost 1: Hardware and installation costs for a contactless terminal on existing chargepoints

63. Hardware costs for a contactless payment terminal and installation costs are likely to be borne by CPOs and chargepoint owners. The methodology and assumptions used to monetise this cost are set out below.

64. In the baseline scenario, the analysis assumes CPOs will not retrofit existing chargepoints with a contactless terminal. This assumption is supported by Zap-Map data and our engagement with the market.

65. In the intervention scenario, the analysis assumes 1,769 existing 50kW+ chargepoints do not have contactless and will require the site to be retrofited under options 1.1, 1.2 and 1.3 and 18,125 public chargepoints do not have contactless and will require retrofit under option 1.4 (see Annex 2).[28] The analysis excludes proprietary networks whose chargepoints are restricted to one specific car manufacturer and car dealership forecourts which are for customer use, as per the Alternative Fuels Infrastructure Regulations (AFIR) 2017 guidance.[29]

66. These volumes are multiplied by unit costs to provide the present value costs shown in table 4.

Table 4: Hardware and installation costs for existing chargepoints (2021 prices, 2022 PV base, £ million)

Option	Low	Central	High
Option 1.1	2	2	3
Option 1.2 (preferred)	2	2	3
Option 1.3	2	2	3
Option 1.4	19	24	29

Monetised cost 2: Hardware costs for a contactless terminal on new chargepoints

67. In the baseline scenario, we assume 58% of new 50kW+ chargepoints, 1% of new chargepoints 8kW and above and 1% of new below 8kW chargepoints will be contactless and we assume this remains constant over the appraisal period. This baseline assumption is tested in sensitivities. In the intervention scenario, 100% of chargepoints will be contactless.

68. Chargepoint projections are used to calculate the volume of new chargepoints that will incur hardware costs over the appraisal period (see Annex 1). We assume 14.7% of rapids, 0.1% of destination chargepoints and 0% of on-street residential chargepoints are proprietary networks whose chargepoints are restricted to one specific car manufacturer and car dealership forecourts which are for customer use, based on Zap-Map data from 2020 and 2021 (YTD).[30] This proportion is removed from the chargepoint projections as the policy will not apply to these chargepoints as per the AFIR 2017 guidance.[31] Volumes used to calculate new chargepoint hardware costs for each option are set out in Annex 2.

69. The volumes set out in Annex 2 are multiplied by unit costs in both the intervention and baseline scenarios. Present value costs (intervention minus baseline) are provided in table 5.

Table 5: Hardware costs for new chargepoints (2021 prices, 2022 PV base, £ million)

Option	Low	Central	High
Option 1.1	2	6	16
Option 1.2 (preferred)	68	148	373
Option 1.3	166	339	823
Option 1.4	166	339	823

Monetised cost 3: Transaction costs

70. The payment provider will charge a transaction fee (2-5%) for each charging event paid for via contactless payment. We expect this cost to be borne by the CPO initially but assume this will be passed onto the consumer in the form of higher prices. This is supported by Zap-Map data which illustrates that prices for charging when paid for via contactless are higher than prices for charging

[28] Zap-Map data as at 4th January 2021

[29] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/959909/Guide-to-alternative-fuels-infrastructure-regulations-2017.pdf

[30] A key caveat of this assumption is that, in future, these proprietary networks may 'open-up' in which case these regulations will apply and these networks will incur compliance costs.

[31] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/959909/Guide-to-alternative-fuels-infrastructure-regulations-2017.pdf

when paid for via membership cards or apps. The methodology and assumptions used to monetise this cost are set out below.

71. As above, in the baseline scenario we assume 58% of new 50kW+ chargepoints, 1% of new chargepoints 8kW and above and 1% of new chargepoints below 8kW will be contactless and we assume this remains constant over the appraisal period. Annual electricity demand projections (kWh) for rapids, destination chargepoints and on-street residential chargepoints are used to calculate transaction costs (see Annex 1). These projections are multiplied by the market average price for charge (22p/kWh for non-rapids and 31p/kWh for rapids);[32] the transaction fee (2-5%); and the proportion of payments made via contactless where contactless is available (48%).[33] The assumption that 48% of payments are made via contactless is tested in sensitivities given uncertainty arising from a small survey sample size. Volumes used to calculate transaction costs for each option are outlined in Annex 2.

72. The volumes set out in Annex 2 are multiplied by unit costs in both the intervention and baseline scenarios. Present value costs (intervention minus baseline) are provided in table 6.

Table 6: Transaction costs (2021 prices, 2022 PV base, £ million)			
Option	**Low**	**Central**	**High**
Option 1.1	9	16	23
Option 1.2 (preferred)	20	35	51
Option 1.3	32	57	81
Option 1.4	33	58	83

Monetised cost 4: Operating costs

73. Operating costs, such as a monthly service fee, a financial gateway or a SIM, will likely fall on CPOs. The methodology and assumptions used to monetise this cost are set out below.

74. As above, in the baseline scenario we assume 58% of new 50kW+ chargepoints, 1% of new chargepoints 8kW and above and 1% of new chargepoints below 8kW will be contactless and we assume this remains constant over the appraisal period.

75. Chargepoint projections are used to calculate the volume of chargepoints that will incur operating costs. Volumes used to calculate operating costs under each option are set out in Annex 2.

76. In the baseline scenario, volumes are multiplied by the proportion of chargepoints we expect to be contactless in the absence of the intervention (58% rapids, 1% fast and 1% slow) and the cost data gathered through stakeholder engagement.

77. The volumes set out in Annex 2 are multiplied by unit costs in both the intervention and baseline scenarios. Present value costs (intervention minus baseline) are provided in table 7.

Table 7: Operating costs (2021 prices, 2022 PV base, £ million)			
Option	**Low**	**Central**	**High**
Option 1.1	2	3	9
Option 1.2 (preferred)	45	95	208
Option 1.3	108	213	450
Option 1.4	115	220	458

Monetised cost 5: Familiarisation costs

78. There will be time costs to EV charging companies to familiarise themselves with the new regulations, including time taken to read the regulations and formulate a plan to respond to them. We expect this cost to fall mainly on CPOs and chargepoint manufacturers.

[32] Zap-Map Pricing Report, 2019

[33] Based on a survey with EV charging companies. Survey question: For this question, please focus only on chargepoints in your network that offer contactless. What percentage of all the payments made at these chargepoints are contactless?

79. To calculate these costs, we assume both the Chief Executive Officer (CEO) and the Chief Technical Officer (CTO) (2 people) in each EV charging company will each require 2.5 hours for familiarisation.[34] There is uncertainty around exactly how long this would take, but this has been tested with stakeholders.

80. We assume a mean hourly wage for 'Chief executives and senior officials' of £49.75 (2021 prices)[35] and a non-wage labour uplift of 26.5%[36] to arrive at £62.93 (2021 prices) per hour per person. We assume there are 47 public CPOs[37] and 90-100 chargepoint manufacturers active in the market[38] who will need to be familiar with the regulations. This data is multiplied by 2.5 hours and 2 people per business to arrive at a total cost of £44,682.

81. Given that this set of policies will be packaged into one guidance document, we assume these costs are spread evenly across all policies and will not fluctuate with policy options. Table 8 provides present value familiarisation costs for each of the minimum payment method policy options.

Table 8: Familiarisation costs (2021 prices, 2022 PV base, £ million)			
Option	**Low**	**Central**	**High**
Option 1.1	0.007	0.009	0.011
Option 1.2 (preferred)	0.007	0.009	0.011
Option 1.3	0.007	0.009	0.011
Option 1.4	0.007	0.009	0.011

Monetised cost 6: Enforcement costs

82. There will be costs to government to enforce this set of policies. We expect costs to setup the enforcement to be £240,000-£360,000 RDEL and £800,000-£1,200,000 CDEL in 2022. For the remainder of the appraisal period (2023 to 2032), we expect enforcement to require two Grade 6/7 Civil Servants and two HEO/SEO Civil Servants per year at a salary of £57,098 and £35,785 (2021 prices) [39] respectively, with a non-wage labour uplift of 26.5%. From this, we calculate a total of £3m enforcement costs over the appraisal period for the set of policies.

83. We assume enforcement costs are spread evenly across all policies and will not fluctuate with policy options. Table 9 provides present value enforcement costs for each of the minimum payment method policy options.

Table 9: Enforcement costs (2021 prices, 2022 PV base, £ million)			
Option	**Low**	**Central**	**High**
Option 1.1	0.5	0.6	0.7
Option 1.2 (preferred)	0.5	0.6	0.7
Option 1.3	0.5	0.6	0.7
Option 1.4	0.5	0.6	0.7

34 Based on information from the Office for Product Safety and Standards (OPSS), who out lined they would typically have a 1.5 hour call with the CEO and CTO to explain new regulation, and expect an additional 1 hour reading time.

35 Annual Survey for Hours and Earnings (AHSE), earnings and hours worked, occupation by four-digit SOC, table 14.6a, hourly pay excluding overtime, 2020, 'all' tab, https://www.ons.gov.uk/employmentandlabourmarket/peopleinwork/earningsandworkinghours/datasets/occupation4digitsoc2010ashetable14

36 TAG unit A4.1 social impact appraisal, para. 2.2.4, https://www.gov.uk/government/publications/tag-unit-a4-1-social-impact-appraisal

37 https://www.zap-map.com/charge-points/public-charging-point-networks/

38 Electric vehicle smart charging impact assessment, page 6, https://www.gov.uk/government/consultations/electric-vehicle-smart-charging

39 Civil Service Statistics, 2020, page 14, https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/940284/Statistical_bulletin_Civil_Service_Statistics_2020_V2.pdf

3.4 Monetised benefits

Monetised benefit 1: Time savings due to simplified payment methods

84. Consumers are likely to save time due to the minimum payment methods policy as this will simplify paying for charge. This hypothesis was supported during a workshop with around 30 EV charging companies and has also been supported through consumer research. In an AA-Yonder survey, 5% of EV drivers experienced having to call a helpline in the last 12 months in order to make a payment, as the chargepoint/app was faulty.[40] In addition, 62% of EV drivers agreed that too many apps are required to pay, whilst 7% disagreed.[41] Therefore, it is expected that avoided helpline calls and avoided app downloads will be the main sources of time savings and monetise time savings using data on this.

85. To monetise this benefit, a value of time assumption of £8.05 per hour in 2022 is used, increasing to £9.26 per hour in 2031 (2021 prices).[42] In addition, a value of time multiplier has been applied as there is consistent evidence that people will pay more to save time spent in certain conditions, compared to 'average' conditions.[43] Given that having to call a helpline or download an app at the point of charging is an unexpected delay, values of lateness for rail is used as a proxy for the value of time multiplier. This represents a value of time multiplier of 3.14, which is a weighted average across travel purposes.[44] Given the degree of uncertainty in using this value of time multiplier as a proxy, this is tested in sensitivities. The methodology and assumptions used to monetise time savings due to avoided helpline calls and avoided app downloads is set out below.

Time savings due to avoided helpline calls

86. An average helpline call duration of 6.9 minutes and average hold duration of 1.5 minutes is used.[45] We then assume 17% of these helpline calls are due to issues paying for charge.[46] We assume this proportion of helpline calls will not be required in the intervention scenario and therefore this time is saved as a result of this policy. Finally, we assume there are 43 helpline calls per chargepoint per year and assume this remains constant over the appraisal period.[47]

87. There is significant uncertainty in these assumptions. First, the survey data is limited as it is a small sample size; the survey was shared with 29 electric vehicle charging companies and received 10 responses to these questions. Second, there is uncertainty in the assumption that all helpline calls will be saved as a result of this policy. For example, a helpline call may still be required if a contactless terminal required under the minimum payment methods policy is not working. Given this uncertainty, assumptions are tested in sensitivities.

88. Chargepoint projections are used to calculate the volume of this benefit. The volumes used to calculate this benefit are set out in Annex 2.

89. Finally, we deduct the baseline proportion of chargepoints that already have a minimum payment method (see section 3.3) and multiply the volumes by the data above to arrive at the present value benefits presented in table 10.

Table 10: Time savings due to avoided helpline calls (2021 prices, 2022 PV base, £ million)

[40] AA-Yonder Poll, November 2020, EV Ownership

[41] AA-Yonder Poll, January 2021, EV Ownership

[42] TAG data book, A1.3.2. Time values differ between transport mode and travel purpose, so a weighted average value of time is calculated.

[43] Transport Appraisal Guidance, Unit 1.3, Section 4.4, Value of time multipliers, https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1007443/tag-unit-A1.3.pdf

[44] Department for Transport, Provision of market research for value of time travel savings and reliability, 2015, Table 8.2, https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/470231/vtts-phase-2-report-issue-august-2015.pdf

[45] Based on a survey with EV charging companies. Survey question: What is the average call duration and hold duration when an EV driver calls your helpline?

[46] Based on a survey with EV charging companies. Survey question: What percentage of helpline calls are due to issues payment for charge?

[47] Based on a survey with EV charging companies. Survey question: How many helpline calls do you have on average per year?

Option	Low	Central	High
Option 1.1	0.1	1	4
Option 1.2 (preferred)	3	22	101
Option 1.3	7	50	218
Option 1.4	7	52	221

Time savings due to avoided app downloads

90. We assume an average of 3.8 minutes[48] per app download in the central scenario and an average of 6 app downloads per EV driver.[49] [50] Given the small sample sizes, these assumptions are uncertain and so we test these in sensitivities.

91. Scenarios for new EV sales are used to estimate the volume of these benefits.[51] We assume existing EVs will have already downloaded these apps, so estimates for new sales are used as opposed to scenarios for EV stock. We assume 92% of EV drivers use the public charging network and so this proportion of EV sales will benefit from these time savings.[52] Annex 2 sets out assumptions used to estimate the benefits for each option.

92. Finally, the time savings data, time values, EV sales estimates and proportions mentioned above are multiplied to arrive at the present value benefits presented in table 11.

Table 11: Time savings due to avoided app downloads (2021 prices, 2022 PV base, £ million)

Option	Low	Central	High
Option 1.1	4	17	38
Option 1.2 (preferred)	11	45	101
Option 1.3	25	99	222
Option 1.4	26	102	230

3.5 Unmonetised benefits

Unmonetised benefit 1: Emissions savings due to increased EV uptake

93. The policy package will have an indirect benefit to society of emissions savings. This hypothesis was supported during a workshop with around 30 EV charging companies. We expect simplified payment methods will increase EV uptake due to increased ease in using the public charging network, giving consumers the confidence to make the transition to an EV. As mentioned above, a recent AA-Yonder survey found that 54% of EV users interviewed would use their EV more if public charging was easier. In addition, this policy will enable the section of society who do not use a smartphone (12%) or a mobile phone (6%) to access electric vehicles.

94. If internal combustion engine (ICE) vehicles are displaced by EVs sooner due to this policy, there will be emissions savings as ICE vehicles emit CO2 from their tailpipe whilst, conversely, EVs have no tailpipe emissions. Furthermore, as EV uptake increases, the incentive for businesses to invest in public charging infrastructure increases, which can lead to further increases in EV uptake. This multiplier effect can therefore lead to a cycle of induced EV demand.

---

48 Based on a team of three people downloading five charging network apps each and adding payment details to the point of being able to pay for charge, recording the time taken to do this for each app.

49 Based on data gathered through an EV driver forum. Forum question: How many charging network apps do you have?

50 EVA England, Improving drivers' confidence in public EV charging, 2021, https://www.evaengland.org.uk/2021/05/19/improving-drivers-confidence-in-public-ev-charging/

51 Transitioning to zero emission cars and vans: 2035 delivery plan, page 5, https://www.gov.uk/government/publications/transitioning-to-zero-emission-cars-and-vans-2035-delivery-plan

52 EVA England, Improving drivers' confidence in public EV charging, Research report on the consumer experience at public electric vehicle chargepoints in England, 2021, page 2, https://www.evaengland.org.uk/wp-content/uploads/2021/04/EVA-England-Consumer-Charging-Survey-Report.pdf

95. Whilst emissions savings are a monetisable benefit, it has not been possible to identify the degree to which this policy will increase EV uptake and therefore this benefit is unmonetised. Instead, we illustrate the potential impact through a hypothetical scenario where this policy leads to a percentage point increase in EV sales. See below for the methodology and assumptions used to illustrate this hypothetical scenario.

96. First, we assume 2.071 kg and 2.420 kg of CO2 are emitted per litre of petrol and diesel, respectively.[53] Fuel consumption parameter values are then used to estimate CO2 emissions per km, at 0.123 kg and 0.125 kg of CO2 emissions per km in a petrol and diesel car, respectively.[54] An average annual mileage of around 12,500 km per car is used[55], alongside a non-traded value of £253 per tonne of CO2 emissions in the central scenario (2021 prices).[56] This results in an estimate of emissions savings worth £393.09 (2021 prices) per car per year, for every ICE vehicle displaced.

97. When combined with the unmonetised revenue benefits outlined below, we estimate that there would need to be a 2.1% increase (percentage points) in new EV sales due to the minimum payment methods policy to generate a positive NPV. An example of a 1 percentage-point increase would be if the proportion of new car and van sales that were BEVs/PHEVs increased from 14% to 15% in 2022. An annual 1 percentage-point increase in cars and van sales that are BEVs/PHEVs represents an increase by c. 30,000 per year. Sense-checking this against internal consumer choice modelling indicates that this scale of impact can be reasonably achieved, given this policy will enable the section of society who do not use a smartphone (12%) or a mobile phone (6%) to access EV charging, and 96% of EV drivers stated that contactless payments at all public chargepoints would make it easier to charge.[57] The impact on the NPV if these benefits were included is set out in sensitivities (section 8.3).

98. In addition to increasing new EV sales, carbon benefits are likely to be realised in drivers choosing to switch petrol or diesel miles to electric miles. For example, in a PHEV where petrol or electric miles can be driven, or in households that own both an ICE vehicle and an EV. We carry out a further sense check to understand whether emissions savings benefits are likely to offset the negative NPV by estimating the emissions savings benefits if a proportion of total mileage shifts from petrol or diesel miles to electric miles. We find that this further supports our assessment that emissions savings benefits from this policy are likely to outweigh the negative NPV.

4 Costs and benefits: Payment roaming

4.1 Summary

99. This section outlines monetised and non-monetised costs and benefits of the roaming option and the methodology and assumptions used to monetise this. Cost and benefits are consistent across both options as options presented below only differ in terms of the year the regulation comes into force. Under the preferred option, we will take the power to mandate payment roaming through industry-led solutions from 2024 only if insufficient progress is made by industry between now and 31 December 2023 will further intervention be required through government designated roaming solutions. This has implications for the policy packages in the summary sheets above. Policy package 1 assumes we do not mandate payment roaming from 2024 whilst policy package 2 assumes we do mandate payment roaming from 2024.

---

[53] TAG data book, Table A3.3, https://www.gov.uk/government/publications/tag-data-book

[54] TAG data book, Table A1.3.8, https://www.gov.uk/government/publications/tag-data-book

[55] Road traffic forecasts, calculated by dividing total mileage (km) by the total number of cars, https://www.gov.uk/government/publications/road-traffic-forecasts-2018

[56] Valuing greenhouse gas emissions in policy appraisal, Annex 1, https://www.gov.uk/government/publications/valuing-greenhouse-gas-emissions-in-policy-appraisal

[57] Zap-Map panel survey 2019

100. Payment roaming options are provided below. See section 2.2 for more detail.

- Option 2.1: Mandate government designated roaming from 2024 if no progress is made (preferred)
- Option 2.2: Mandate roaming immediately

101. **Monetised costs**:

- Labour costs to set up a roaming agreement (direct, one-off)
- Legal costs to set up a roaming agreement (direct, one-off)
- Roaming agreement fees (direct, ongoing)
- Familiarisation costs (direct, one-off)
- Enforcement costs (direct, ongoing)

102. **Unmonetised costs**:

- Loss of advertising revenue under some business models (direct)

103. **Monetised benefits**:

- Time savings for consumers as a result of simplified payment methods, monetised using data on avoided helpline calls and app downloads (direct)

104. **Unmonetised benefits**:

- Emissions savings to society as a result of increased EV uptake (indirect)

105. Table 12 summarises the costs and benefits of all payment roaming options. We estimate that a 1% increase in EV sales will be required to offset the negative NPV and our assessment suggests this increase due to this policy is not unreasonable (see section 4.6). For a summary of why option 2.1 is preferred, see section 8.1.

Table 12: Summary of costs and benefits (2021 prices, 2022 PV base, £ million)

Option	Low	Central	High
Costs			
Option 2.1 (preferred)	110	235	490
Option 2.2	117	249	520
Benefits			
Option 2.1 (preferred)	23	128	406
Option 2.2	25	138	434
Net present value			
Option 2.1 (preferred)	-87	-107	-84
Option 2.2	-92	-111	-86

4.2 Evidence base

106. Section 3.2 outlines how evidence was gathered for this impact assessment. Table 13 provides a summary of cost items and unit costs identified through stakeholder engagement for the roaming policy. We expect uniform costs across chargepoints of different speeds, unless specified otherwise. A more detailed cost assessment is provided in Annex 1.

Table 13: Roaming unit costs

Cost item	Description	Unit costs
Labour costs to set up a roaming agreement	One-off labour cost per CPO per roaming agreement, such as admin and developer time, to set up a roaming agreement.	Low: £1,000 Central: £3,000 High: £5,000

Legal costs to set up a roaming agreement	One-off legal cost per CPO per roaming agreement to set up the roaming agreement.	Low: £1,000 Central: £10,000 High: £20,000
Roaming agreement fee	An on-going fee charged by the eMSP for any charging event that is paid for via that roaming agreement. This is tested in sensitivities given the high degree of uncertainty.	Low: 5% Central: 10% High: 20%

4.3 Monetised costs

Monetised cost 1: Labour costs

107. There will be labour costs, such as admin and developer time, to set up roaming agreements, which we expect will fall on CPOs and eMSPs. The methodology and assumptions used to monetise this cost are set out below.

108. In the baseline scenario, we assume chargepoint operators will not open their networks without discrimination to any third party eMSP or each other. Whilst we do expect roaming agreements to occur where there is mutual benefit, this is not captured in the analysis. Given the uncertainty, this is tested in sensitivities.

109. In the intervention scenario, we assume there are 47 public chargepoint operators[58] and assume this remains constant across the appraisal period. We assume there will be 10, 30 and 50 eMSPs in the low, central and high scenarios respectively and assume this remains constant across the appraisal period.[59] This is highly uncertain as this is a small sample size and is based on speculation from stakeholders on how the market would emerge if roaming were mandated, which received a wide range of perspectives. This uncertainty is reflected in the wide range of scenarios and is tested in sensitivities.

110. Finally, we multiply the 47 networks by the expected number of eMSPs by the unit costs to provide the present value costs shown in table 14.

111. For option 2.1, we assume 0% voluntary action up to 2024 then assume costs are incurred in 2024 as this is when the regulation is expected to come into force. For option 2.2, we assume costs are incurred in 2022 as this is when the regulation is expected to come into force.

Table 14: Labour costs (2021 prices, 2022 PV base, £ million)			
Option	**Low**	**Central**	**High**
Option 2.1 (preferred)	0.4	4	11
Option 2.2	0.5	4	12

Monetised cost 2: Legal costs

112. There will be legal costs to set up roaming agreements, which we expect will fall on CPOs and eMSPs. Depending on whether this can be completed in-house and whether the two parties agree, this cost can vary hugely. The methodology and assumptions used to monetise this cost are set out below.

113. The assumptions on the baseline scenario, number of CPOs (47) and the number of eMSPs (10-50) are the same as above. Here, these are multiplied by the legal unit costs to provide the present value costs shown in table 15. As above, the assumption on the number of eMSPs is highly uncertain and is tested through sensitivity analysis.

[58] https://www.zap-map.com/charge-points/public-charging-point-networks/

[59] Based on a survey with EV charging companies. Survey question: If roaming was mandated, how many eMSPs would you expect to emerge?

114. For option 2.1, we assume 0% voluntary action up to 2024 then we assume costs are incurred in 2024 as this is when the regulation is expected to come into force. For option 2.2, we assume costs are incurred in 2022 as this is when the regulation is expected to come into force.

Table 15: Legal costs (2021 prices, 2022 PVbase, £ million)			
Option	**Low**	**Central**	**High**
Option 2.1 (preferred)	0.4	13	44
Option 2.2	0.5	14	47

Monetised cost 3: Roaming agreement costs

115. Depending on the roaming agreement, the eMSP may add a margin to any charging event that is paid for via that roaming agreement. For example, if a consumer uses an eMSP's app to pay for charge and pays 25p/kWh, the eMSP may receive 10% of this (2.5p/kWh), with the CPO receiving 22.5p/kWh. The CPO may choose to absorb this cost if the eMSP's platform has increased their users. Alternatively, the CPO may increase their price to 27.5p/kWh to pass this cost onto the consumer. We expect this will be at the CPO's discretion and will depend on the roaming agreement. We expect this fee (%) to vary with the roaming agreement and in some instances this may be 0%. Given the high degree of uncertainty, this is tested in sensitivities. The methodology and assumptions used to monetise this cost are set out below.

116. As above, in the baseline scenario, we assume chargepoint operators will not open their networks without discrimination to any third party eMSP or each other and test this in sensitivities.

117. Annual electricity demand projections (kWh) for public chargepoints are used to calculate these costs (see Annex 1). These projections are multiplied by the market average price for charge (22p/kWh for non-rapids and 31p/kWh for rapids);[60] the roaming fee (5-20%); and the proportion of payments made via roaming where roaming is available (48%).[61] The assumption that 48% of payments are made via roaming is tested in sensitivities given uncertainty arising from a small survey sample size and lack of historical data on roaming payments. Present value roaming agreement costs are provided in table 16.

118. For option 2.1, we assume 0% voluntary action up to 2024 then we assume costs are incurred from 2024 as this is when the regulation is expected to come into force. For option 2.2, we assume costs are incurred from 2022 as this is when the regulation is expected to come into force.

Table 16: Roaming agreement costs (2021 prices, 2022 PV base, £ million)			
Option	**Low**	**Central**	**High**
Option 2.1 (preferred)	109	217	434
Option 2.2	115	230	460

Monetised cost 4: Familiarisation costs

119. Section 3.3 outlines the methodology used to monetise familiarisation costs. Table 17 provides present value familiarisation costs for each of the roaming policy options.

Table 17: Familiarisation costs (2021 prices, 2022 PV base, £ million)			
Option	**Low**	**Central**	**High**
Option 2.1 (preferred)	0.007	0.009	0.011
Option 2.2	0.007	0.009	0.011

---

60 Zap-Map Pricing Report 2019, 2021 prices

61 This is assumed to be the same as the proportion of payments made via contactless and is based on a survey with EV charging companies. Survey question: For this question, please focus only on chargepoints in your network that offer contactless. What percentage of all the payments made at these chargepoints are contactless?

Monetised cost 5: Enforcement costs

120. Section 3.3 outlines the methodology used to monetise enforcement costs. Table 18 provides present value enforcement costs for each of the roaming policy options.

Table 18: Enforcement costs (2021 prices, 2022 PV base, £ million)			
Option	**Low**	**Central**	**High**
Option 2.1 (preferred)	0.5	0.6	0.7
Option 2.2	0.5	0.6	0.7

4.4 Unmonetised costs

Unmonetised cost 1: Loss of advertising revenue under some business models

121. Where charging networks generate advertising revenue through their network smartphone app, this revenue may be lost as a result of this policy if users switch from these network apps to a universal, roaming app that covers all chargepoints. This distrupts business models that generate revenue through advertising and provide electricity free of charge at their chargepoints and may result in an increase in cost for consumers. No attempt has been made to quantify this impact as we expect the number of networks who operate under this business model to be small.

4.5 Monetised benefits

Monetised benefit 1: Time savings due to simplified payment methods

122. Consumers are likely to save time due to the payment roaming policy as this will simplify paying for charge. As with minimum payment methods, we expect avoided helpline calls and avoided app downloads to be the main sources of time savings. Section 3.4 sets out the evidence to support this and the methodology and assumptions used to monetise the minimum payment methods benefits. The same methodology is used for the payment roaming policy, with the few differences outlined below.

123. First, the baseline is not deducted as for this policy we assume chargepoint operators will not open their networks without discrimination to any third party eMSP or each other in the baseline scenario. Second, we assume each driver will still require one app under this policy given the purpose of roaming is to enable consumers to pay for charge using one app, regardless of the network. Third, since roaming will impact all chargepoints, cumulative projections for all public chargepoints are used for both options.

124. In option 2.1, benefits accrue from 2024. In option 2.2, benefits accrue from 2022. The present value benefits due to avoided helpline calls are set out in table 19 and the present value benefits due to avoided app downloads are set out in table 20.

Table 19: Time savings due to avoided helpline calls (2021 prices, 2022 PV base, £ million)			
Option	**Low**	**Central**	**High**
Option 2.1 (preferred)	7	50	217
Option 2.2	8	53	230

Table 20: Time savings due to avoided app downloads (2021 prices, 2022 PV base, £ million)			
Option	**Low**	**Central**	**High**
Option 2.1 (preferred)	16	78	188
Option 2.2	17	85	204

4.6 Unmonetised benefits

Unmonetised benefit 1: Emissions savings due to increased EV uptake

125. We expect payment roaming will increase EV uptake as this will enable fleets, in particular, to transition to EVs more easily. This will allow businesses with fleets to monitor and manage payments for charge centrally, rather than relying on the individual driver to pay and expense this or working with the minority of operators that are willing to work with payment platforms. This is supported through our engagement with fleets, who identified that lack of a roaming solution is a key barrier to them transitioning to EVs. Therefore, there will be non-monetised benefits from emissions savings.

126. Section 3.5 outlines why this benefit is non-monetised and the methodology used to illustrate the impacts of a hypothetical scenario. For the payment roaming policy, we estimate that there would need to be a 1% increase (percentage points) in new EV sales due to this policy to generate a positive NPV. Section 3.5 provides an example of what is meant by a 1 percentage-point increase. Sense-checking this against internal consumer choice modelling indicates that this scale of impact can be reasonably achieved, given fleets have outlined lack of roaming as a key barrier to transitioning to EVs. In addition, 87% of EV drivers stated that having access to all public charging networks via a single smartphone app would make it easier to charge.[62] The impact on the NPV if these benefits were included is set out in sensitivities (section 8.3).

127. In addition to increasing new EV sales, carbon benefits are likely to be realised in drivers choosing to switch petrol or diesel miles to electric miles. For example, in a PHEV where petrol or electric miles can be driven, or in households that own both an ICE vehicle and an EV. We carry out a further sense check to understand whether emissions savings benefits are likely to offset the negative NPV by estimating the emissions savings benefits if a proportion of total mileage shifts from petrol or diesel miles to electric miles. We find that this further supports our assessment that emissions savings benefits from this policy are likely to outweigh the negative NPV.

5 Costs and benefits: Price transparency

5.1 Summary

128. This section outlines monetised and non-monetised costs and benefits of the price transparency measure and the methodology and assumptions used to monetise this.

129. Price transparency options are provided below. See section 2.3 for more detail.

    - Option 0: Do nothing
    - Option 3.1: Mandate a pence per kilowatt hour (p/kWh) metric for a unit of electricity (preferred)

130. **Monetised costs**

    - Software costs to adopt a pence per kilowatt hour (p/kWh) metric (direct, one-off)
    - Revenue loss for CPOs as a result of consumers paying for charge on a p/kWh basis rather than a £ per hour basis (direct, ongoing)
    - Familiarisation costs (direct, one-off)
    - Enforcement costs (direct, ongoing)

131. **Unmonetised costs**

---

[62] Zap-Map panel survey 2019

- None expected

132. **Monetised benefits**

- Cost savings for consumers as a result of paying for charge on a p/kWh basis rather than a £ per hour basis (direct)

133. **Unmonetised benefits**

- Emissions savings to society as a result of increased EV uptake (indirect)

134. Table 21 summarises the costs and benefits of the price transparency option. We estimate that a 0.01% increase in EV sales will be required to offset the negative NPV and our assessment suggests this increase due to this policy is not unreasonable (see section 5.5). For a summary of why option 3.1 is preferred, see section 8.1.

Table 21: Summary of costs and benefits (2021 prices, 2022 PV base, £ million)

Option	Low	Central	High
Costs			
Option 3.1 (preferred)	154	308	462
Benefits			
Option 3.1 (preferred)	154	307	461
Net present value			
Option 3.1 (preferred)	-1	-1	-1

5.2 Evidence base

135. Section 3.2 outlines how evidence was gathered for this impact assessment. Table 22 provides a summary of cost items and unit costs identified through stakeholder engagement for the price transparency policy. We expect uniform costs across chargepoints of different speeds, unless specified otherwise. A more detailed cost assessment is provided in Annex 1.

Table 22: Price transparency unit costs

Cost item	Description	Unit costs
Software cost to adopt p/kWh	One-off software cost per CPO to adopt a p/kWh metric for a unit of electricity, such as developer time to update the system.	Low: £5,000 Central: £7,500 High: £10,000

5.3 Monetised costs

Monetised cost 1: Software costs to adopt p/kWh

136. There will be a one-off software cost for CPOs to adopt p/kWh, such as developer time to update the system. The methodology and assumptions used to monetise this cost are set out below.

137. First, we assume the 47 networks that already present their prices in p/kWh on Zap-Map have already incurred software costs to adopt a p/kWh metric, therefore these are sunk costs and excluded from the analysis. Therefore, the analysis focuses only on the 15 charging networks that do not present their prices in p/kWh on Zap-Map.

138. In the baseline scenario, we assume that networks will not adopt a p/kWh metric if they haven't already. Therefore, the analysis assumes no networks incur software costs in the absence of the regulation.

139. The best available evidence from Zap-Map shows 4 of the 15 networks present their prices in £/hour. The electricity metric is unknown for the other 11 networks. For conservatism, we assume these 11 networks are non-compliant and will also incur software costs to adopt a p/kWh metric.

Therefore, in the intervention scenario we assume 15 networks will incur software costs. Given uncertainty around the number of networks that will incur this cost, this is tested in sensitivities.

140. Finally, we multiply the 15 networks by the cost data gathered through stakeholder engagement to provide the present value costs shown in table 23.

Table 23: Software costs to adopt p/kWh (2021 prices, 2022 PV base, £ million)			
Option	**Low**	**Central**	**High**
Option 1 (preferred)	0.1	0.1	0.2

Monetised cost 2: Revenue loss to businesses

141. We expect there will be revenue losses for CPOs as a result of the price transparency policy. This will be transferred to consumers in the form of cost savings. The methodology and assumptions used to monetise this benefit are outlined below.

142. Annual electricity demand projections (kWh) are used to calculate revenue over the appraisal period (see Annex 1). To calculate revenue if these networks charge on a p/kWh basis, these projections are multiplied by the market average price for charge (22p/kWh for non-rapids and 31p/kWh for rapids)[63] and the proportion of chargepoints that have not adopted p/kWh (2% of rapids, 38% of destination chargepoints and 12% of residential on-street chargepoints).[64]

143. To calculate revenue if these networks charge on a £ per hour basis, annual electricity demand projections (kWh) are divided by average speeds (50kW for rapids, 14.5kW for destination and 5kW for residential on-street chargepoints) to estimate total hours of charging. This is then multiplied by the average cost (£3.32 for non-rapids and £6.06 for rapids)[65] and the proportion of chargepoints that have not adopted p/kWh (2%, 38%, 12%) to arrive at the total estimated revenue.

144. Revenue when charging on a £ per hour basis is then deducted from revenue when charging on a p/kWh basis to arrive at the present value revenue loss presented in table 24.

Table 24: Revenue loss (2021 prices, 2022 PV base, £ million)			
Option	**Low**	**Central**	**High**
Option 3.1 (preferred)	154	307	461

Monetised cost 3: Familiarisation costs

145. Section 3.3 outlines the methodology used to monetise familiarisation costs. Table 24 provides present value familiarisation costs for the price transparency policy.

Table 25: Familiarisation costs (2021 prices, 2022 PV base, £ million)			
Option	**Low**	**Central**	**High**
Option 3.1 (preferred)	0.007	0.009	0.011

Monetised cost 4: Enforcement costs

146. Section 3.3 outlines the methodology used to monetise enforcement costs. Table 25 provides present value enforcement costs for the price transparency policy.

Table 26: Enforcement costs (2021 prices, 2022 PV base, £ million)			
Option	**Low**	**Central**	**High**
Option 3.1 (preferred)	0.5	0.6	0.7

[63] Zap-Map Pricing Report, 2019

[64] Zap-Map data as at 4th Jan 2021.

[65] Zap-Map Pricing Report 2019, 2021 prices

5.4 Monetised benefits

Monetised benefit 1: Cost savings to consumers

147. The revenue loss outlined above will transfer to consumers in the form of cost savings. The methodology and assumptions used to monetise this benefit are identical to that used to monetise the revenue loss. Present value cost savings to consumers are identical to the present value revenue loss to businesses (see table 24).

5.5 Unmonetised benefits

Unmonetised benefit 1: Emissions savings due to increased EV uptake

148. We expect having a consistent metric for electricity across the entire network will increase EV uptake due to increased ease in using the public charging network, giving consumers the confidence to make the transition. As referenced above, AA-Yonder data indicate that 56% of EV drivers agreed that the price of charge at public chargepoints is unclear and confusing, whilst 10% disagreed. Therefore, unmonetised emissions savings set out in section 3.5 are also likely to occur as a result of this policy. The impact on the NPV if these benefits were included is set out in sensitivities (section 8.3).

149. Section 3.5 outlines why this benefit is non-monetised and the methodology used to illustrate the impacts of a hypothetical scenario. For the price transparency policy, we estimate that there would need to be a 0.01% increase (percentage points) in EV sales due to this policy to generate a positive NPV. Section 3.5 provides an example of what is meant by a 1 percentage-point increase. Given the small increase in EV sales required to offset this negative NPV and given the evidence outlined above, we expect this policy will be welfare enhancing overall. The impact on the NPV if these benefits were included is set out in sensitivities (section 8.3).

150. In addition to increasing new EV sales, carbon benefits are likely to be realised in drivers choosing to switch petrol or diesel miles to electric miles. For example, in a PHEV where petrol or electric miles can be driven, or in households that own both an ICE vehicle and an EV. We carry out a further sense check to understand whether emissions savings benefits are likely to offset the negative NPV by estimating the emissions savings benefits if a proportion of total mileage shifts from petrol or diesel miles to electric miles. We find that this further supports our assessment that emissions savings benefits from this policy are likely to outweigh the negative NPV.

6 Costs and benefits: Reliability

6.1 Summary

151. This section outlines monetised and non-monetised costs and benefits for the 99% reliability policy and the methodology and assumptions used to monetise this. The monetised costs are items we expect may be required in order to meet the 99% reliability standard, but these items are not a requirement and will vary between chargepoints and networks depending on what is causing poor reliability. There is a large amount of uncertainty around what causes chargepoints to be unreliable, but the methodology below sets out a best estimate based on key themes from stakeholders. Cost and benefits are consistent across all four options as options only differ in terms of the power rating (kW) the regulation applies to and the year the regulation comes into force.

152. Under the preferred option, we will mandate a 99% reliability standard on chargepoints below 50kW from 2024 only if insufficient progress is made by industry between now and 31 Decemeber 2023. This has implications for the policy packages in the summary sheets above. Policy package 1

assumes we do not mandate 99% reliability on chargepoints under 50kW from 2024 whilst policy package 2 assumes we do mandate 99% reliability on chargepoints below 50kW from 2024.

153. Under each policy option, a 99% reliability standard would be required on:

- Option 4.1: No chargepoints. 24/7 helpline only.
- Option 4.2: 50kW+ chargepoints. 24/7 helpline on all chargepoints.
- Option 4.3: 50kW+ chargepoints until 2024. All chargepoints from 2024 if no progress is made. 24/7 helpline on all chargepoints (preferred)
- Option 4.4: All public chargepoints. 24/7 helpline on all chargepoints

154. **Monetised costs**

- Hardware and installation costs to replace existing out of service chargepoints (direct)
- Hardware and installation costs to install signal boosters on all chargepoints (direct)
- Software costs for a multi-network SIM (direct)
- Maintenance costs (direct)
- Labour costs to run a 24/7 helpline (direct)
- Familiarisation costs (direct)
- Enforcement costs (direct)

155. **Unmonetised costs**

- None expected.

156. **Monetised benefits**

- Time savings for consumers as a result of a reliable charging network (direct)

157. **Unmonetised benefits**

- Emissions savings to society as a result of increased EV uptake (indirect)

158. Table 27 summarises the costs and benefits of the reliability options. We estimate that a 2% increase in EV sales will be required to offset the negative NPV and our assessment suggests this increase due to this policy is not unreasonable (see section 6.5). For a summary of why option 4.3 is preferred, see section 8.1.

Table 27: Summary of costs and benefits (2021 prices, 2022 PV base, £ million)

Option	Low	Central	High
Costs			
Option 4.1	6	29	91
Option 4.2	18	60	164
Option 4.3 (preferred)	102	285	783
Option 4.4	111	306	828
Benefits			
Option 4.1	0	0	0
Option 4.2	5	12	27
Option 4.3 (preferred)	13	76	311
Option 4.4	14	81	327
Net present value			
Option 4.1	-6	-29	-91
Option 4.2	-14	-49	-138
Option 4.3 (preferred)	-89	-209	-472

Option 4.4	-97	-226	-501

159. See section 8.1 for a summary of why option 4.3 is preferred.

6.2 Evidence base

160. Section 3.2 outlines how evidence was gathered for this impact assessment. Table 28 provides a summary of cost items and unit costs identified through stakeholder engagement for the reliability policy. We expect uniform costs across chargepoints of different speeds, unless specified otherwise. A more detailed cost assessment is provided in Annex 1.

Table 28: Reliability unit costs

Cost item	Description	Unit costs
Hardware cost: AC charger replacement	Hardware cost per chargepoint to replace 'out of service' alternative current (AC) 3-22kW chargepoints.	Low: £1,200 Central: £2,600 High: £4,000
Installation cost: AC charger replacement	Installation cost per chargepoint to replace 'out of service' AC 3-22kW chargepoints.	Low: £250 Central: £400 High: £900
Hardware cost: DC charger replacement	Hardware cost per chargepoint to replace 'out of service' direct current (DC) 50kW+ chargepoints.	Low: £20,000 Central: £36,500 High: £53,000
Installation cost: DC charger replacement	Installation cost per chargepoint to replace 'out of service' direct current (DC) 50kW-150kW chargepoints.	Low: £1,000 Central: £11,500 High: £22,000
Hardware cost: Signal booster	Hardware cost per chargepoint for a signal booster to improve connectivity. To calculate the cost per chargepoint, we assume one signal booster covers 10, 7.5 and 5 chargers in the low, central and high scenarios respectively.	Low: £30 Central: £90 High: £150
Installation cost: Signal booster	Installation cost per chargepoint for a signal booster to improve connectivity. To calculate the cost per chargepoint, we assume one signal booster covers 10, 7.5 and 5 chargers in the low, central and high scenarios respectively.	Low: £18 Central: £52 High: £120
Software cost: Multi-network SIM	Software cost per chargepoint per year for a multi-network SIM that switches between networks to improve connectivity.	Low: £12 Central: £24 High: £36
Maintenance cost for non-rapids	Labour cost per non-rapid chargepoint per year for a maintenance contract which may include preventative maintenance, repairs, software updates, etc.	Low: £200 Central: £280 High: £360
Maintenance cost for rapids	Labour cost per rapid chargepoint per year for a maintenance contract which may include preventative maintenance, repairs, software updates, etc.	Low: £550 Central: £700 High: £800
Labour cost: 24/7 helpline	Labour cost per chargepoint per year for a 24/7 helpline for drivers to call.	Low: £50 Central: £150 High: £250

6.3 Monetised costs

Monetised cost 1: Hardware and installation costs for replacement chargepoints

161. To meet the 99% reliability standard, it's likely there will be replacement costs for chargepoints that are regularly out of service. We expect this cost to fall on CPOs and, in some instances, chargepoint owners. The methodology and assumptions used to monetise this cost are set out below.

162. In the baseline scenario, we assume devices that are 'out of service' will not be replaced. This is supported by Zap-Map data which shows an increase in the number of 'out of service' devices between August 2018 and August 2020.

163. In the intervention scenario, we assume all devices that were 'out of service' in August 2020 will need replacing to meet the 99% reliability standard (7.3% of total devices). Where the regulation applies to all chargepoints (options 4.3 and 4.4), we assume 81% of these devices are alternative current (AC) chargepoints and 19% are direct current (DC) chargepoints.[66] Volumes used to calculate replacement hardware and installation costs for each of the options are set out in Annex 2.

164. The volumes set out in Annex 2 are multiplied by unit costs to arrive at the present value costs provided in table 29.

Table 29: Hardware and installation costs to replace existing out of service chargepoints (2021 prices, 2022 PV base, £ million)

Option	Low	Central	High
Option 4.1	0	0	0
Option 4.2	5	11	18
Option 4.3 (preferred)	7	15	23
Option 4.4	7	16	26

Monetised cost 2: Hardware & installation costs for signal boosters

165. To meet the 99% reliability standard, there may be costs to install a signal booster where poor connectivity is causing the charger to be unreliable. We expect this cost will fall mainly on CPOs, but may also fall on manufacturers if they are installed at the point of manufacture. The methodology and assumptions used to monetise this are set out below.

166. In the baseline scenario, we assume 15% of devices have signal boosters and assume this remains constant over the appraisal period.[67] This assumption is tested in sensitivities due to uncertainty arising from a small sample size.

167. In the intervention scenario, we assume 100% devices will require signal boosters to meet the 99% reliability standard. This is based on engagement with stakeholders who have achieved 99.9% reliability and have stated that signal boosters were required for them to meet this. Volumes used to calculate hardware and installation costs for signal boosters are set out in Annex 2.

168. The volumes set out in Annex 2 are multiplied by unit costs in both the intervention and baseline scenarios. Present value costs (intervention minus baseline) are provided in table 30.

Table 30: Hardware and installation costs for signal boosters (2021 prices, 2022 PV base, £ million)

Option	Low	Central	High
Option 4.1	0	0	0
Option 4.2	0.4	2	9

---

[66] National Chargepoint Registry (NCR) as at 23rd February 2021.

[67] Based on a survey with EV charging companies. Survey question: What percentage of your chargepoints have a signal booster?

Option 4.3 (preferred)	8	40	168
Option 4.4	9	45	182

Monetised cost 3: Software costs: Multi-network SIM

169. Where poor connectivity is causing reliability issues, to meet the 99% reliability standard there may be annual software costs for a multi-network SIM that can switch between networks to improve connectivity. We expect this cost to be borne by CPOs. The methodology and assumptions used to monetise this are set out below.

170. In the baseline scenario, we assume 93% of devices have a multi-network SIM and assume this remains constant over the appraisal period.[68] This assumption is tested in sensitivities due to uncertainty arising from a small sample size.

171. In the intervention scenario, we assume 100% of devices will require a multi-network SIM to meet the 99% reliability standard. This is based on engagement with stakeholders who have achieved 99.9% reliability and have stated that multi-network SIMs were required for them to meet this. Volumes used to calculate hardware and installation costs for signal boosters are set out in Annex 2.

172. The volumes set out in Annex 2 are multiplied by unit costs in both the intervention and baseline scenarios. Present value costs (intervention minus baseline) are provided in table 31.

Table 31: Software costs for a multi-network SIM (2021 prices, 2022 PV base, £ million)			
Option	**Low**	**Central**	**High**
Option 4.1	0	0	0
Option 4.2	0	0.1	0.4
Option 4.3 (preferred)	1	3	9
Option 4.4	1	3	9

Monetised cost 4: Maintenance costs

173. To meet the 99% reliability standard, it's likely there will be maintenance costs to ensure chargepoints are available 99% of the time. This may include preventative maintenance, repairs, software updates, etc. We expect this cost will fall mainly on CPOs, but may also fall on manufacturers if repairs are required and if they are investing to develop chargepoints that are more reliable. The methodology and assumptions used to monetise this are set out below.

174. In the baseline scenario, we assume 62% of devices have a maintenance contract and assume this remains constant over the appraisal period.[69] This assumption is tested in sensitivities due to uncertainty arising from a small sample size.

175. In the intervention scenario, we assume 100% devices will require maintenance contracts to meet the 99% reliability standard. This is based on engagement with stakeholders who have achieved 99.9% reliability and have stated that maintenance contracts were required for them to meet this. Volumes used to calculate hardware and installation costs for signal boosters are set out in Annex 2.

176. The volumes set out in Annex 2 are multiplied by unit costs in both the intervention and baseline scenarios. Present value costs (intervention minus baseline) are provided in table 32.

Table 32: Maintenance costs (2021 prices, 2022 PV base, £ million)			
Option	**Low**	**Central**	**High**

[68] Based on a survey with EV charging companies. Survey question: What percentage of your chargepoints have a multi-network SIM?

[69] Based on a survey with EV charging companies. Survey question: What percentage of your chargepoints maintenance contracts?

Option 4.1	0	0	0
Option 4.2	7	18	47
Option 4.3 (preferred)	81	198	493
Option 4.4	88	213	520

Monetised cost 5: Labour cost for a 24/7 helpline

177. There will be labour costs to run a 24/7 helpline for drivers, which we expect will fall mainly on CPOs. The methodology and assumptions used to monetise this cost are set out below.

178. In the baseline scenario, we assume 90% of devices have a 24/7 helpline and assume this remains constant over the appraisal period.[70] This assumption is tested in sensitivities due to uncertainty arising from a small sample size.

179. In the intervention scenario, 100% devices are required to have a 27/4 helpline and all options require all chargepoints to have a 24/7 helpline. Volumes are the same for all options and these are set out in Annex 2.

180. The volumes set out in Annex 2 are multiplied by unit costs in both the intervention and baseline scenarios. Present value costs (intervention minus baseline) are provided in table 32.

Table 33: Labour costs for a 24/7 helpline (2021 prices, 2022 PV base, £ million)			
Option	**Low**	**Central**	**High**
Option 4.1	5	28	90
Option 4.2	5	28	90
Option 4.3 (preferred)	5	28	90
Option 4.4	5	28	90

Monetised cost 6: Familiarisation costs

181. Section 3.3 outlines the methodology used to monetise familiarisation costs. Table 34 provides present value familiarisation costs for the reliability policy.

Table 34: Familiarisation costs (2021 prices, 2022 PV base, £ million)			
Option	**Low**	**Central**	**High**
Option 4.1	0.007	0.009	0.011
Option 4.2	0.007	0.009	0.011
Option 4.3 (preferred)	0.007	0.009	0.011
Option 4.4	0.007	0.009	0.011

Monetised cost 7: Enforcement costs

182. Section 3.3 outlines the methodology used to monetise enforcement costs. Table 35 provides present value enforcement costs for the reliability policy.

Table 35: Enforcement costs (2021 prices, 2022 PV base, £ million)			
Option	**Low**	**Central**	**High**
Option 4.1	0.5	0.6	0.7
Option 4.2	0.5	0.6	0.7
Option 4.3 (preferred)	0.5	0.6	0.7
Option 4.4	0.5	0.6	0.7

[70] Based on a survey with EV charging companies. Survey question: Do you have a 24/7 helpline?

6.4 Monetised benefits

Monetised benefit 1: Time savings due to increased reliability

183. Consumers are likely to save time due to the reliability policy as they will be less likely to arrive at a chargepoint to find they are unable to charge. This hypothesis was supported during a workshop with around 30 EV charging companies and has also been supported through consumer research. In an AA survey, 18% of EV drivers experienced arriving at a chargepoint to find it out of order in the last 12 months. In the same survey, 16% of EV drivers experienced arriving at a charger, but only discovered it was faulty when they tried to use it. In addition, 12% of EV drivers experienced having to call the helpline in the last 12 months to get a chargepoint working.[71] Therefore, we expect avoided helpline calls and avoided journeys to a second chargepoint to be the main sources of time savings and so we monetise time savings using data on this. This was deemed a more robust approach to monetise this benefit than requesting consumers to attempt to estimate their future time savings as a result of this policy through consumer surveys.

184. The values of time and the value of time multiplier set out in section 3.4 also apply here. The methodology and assumptions used to monetise time savings due to avoided helpline calls and avoided journeys to a second chargepoint are set out below.

Time savings due to avoided helpline calls

185. Section 3.4 sets out assumptions on the average call and hold duration for helpline calls. For this policy, in the central scenario we assume 24% of helpline calls are due reliability issues.[72] We assume this proportion of helpline calls will not be required in the intervention scenario and therefore this time is saved as a result of the reliability policy.

186. Section 3.4 sets out assumptions on the number of helpline calls per chargepoint per year, which also apply here. These assumptions are tested in sensitivities due to the uncertainties set out in section 3.4.

187. Chargepoint projections are used to calculate the volume of this benefit. The volumes for each option are set out in Annex 2.

188. Finally, we assume 99% of benefits are realised given the policy sets a 99% reliability standard and multiply the volumes set out in Annex 2 by the data above to arrive at the present value benefits presented in table 36.

Table 36: Time savings due to avoided helpline calls (2021 prices, 2022 PV base, £ million)

Option	Low	Central	High
Option 4.1	0	0	0
Option 4.2	0	3	14
Option 4.3 (preferred)	10	69	301
Option 4.4	11	74	317

Time savings due to avoided journeys to a second chargepoint

189. The analysis assumes an average journey time between neighbouring chargepoints of 71 seconds across all chargepoints and 201 seconds for rapids. The corresponding distance is 546 metres across all chargepoints and 1,971 metres for rapids.[73] We assume this remains constant across the appraisal period, but test this through sensitivities given the high degree of uncertainty.

190. 26% of EV drivers are assumed to either experience arriving at a chargepoint to find it is out of order or experience arriving at a chargepoint but only discover it is faulty when they attempt to

71 AA Survey, November 2020, Table 2

72 Based on a survey with EV charging companies. Survey question: What percentage of helpline calls are due to issues with reliability?

73 Generated using a combination of DfT journey time software and linear analysis, based on Zap-Map data as at 1st July 2021.

charge, every year.[74] This survey data is limited as it does not capture how many times per year EV drivers experience this and so we assume this is experienced once per year. This assumption is tested in sensitivities given the high degree of uncertainty. We also assume that, when this occurs, EV drivers must drive to a second chargepoint in order to charge their vehicle. We test this assumption in sensitivities given the high degree of uncertainty around whether there may be an alternative, working chargepoint in the same location.

191. Scenarios for EV uptake are used to estimate the volume of these benefits.[75] EV stock estimates are used rather than EV new sales projections as the data indicates that 26% of EV drivers experience this every year. Assumptions to estimate benefits for each of the options are set out in Annex 2.

192. Finally, we assume 99% of benefits are realised given the policy sets a 99% reliability standard and multiply volumes by the data above to arrive at the present value benefits presented in table 37.

Table 37: Time savings due to avoided journeys to a second chargepoint (2021 prices, 2022 PV base, £ million)

Option	Low	Central	High
Option 4.1	0	0	0
Option 4.2	4	8	12
Option 4.3 (preferred)	3	7	10
Option 4.4	3	7	10

Monetised benefit 2: Electricity savings due to avoided journeys to a second chargepoint

193. The EV drivers who benefit from time savings due to an avoided journey to a second chargepoint will also benefit from electricity savings due to the avoided journey.

194. To calculate this benefit, we assume an electricity consumption value of 0.19 kWh per km.[76] We assume an average cost of 22p/kWh for non-rapids and 31p/kWh for rapids.[77] We use the same volumes and journey distance as above.

195. Finally, we assume 99% of benefits are realised given the policy sets a 99% reliability standard and multiply the volumes by the data above to arrive at the present value benefits presented in table 38.

Table 38: Electricity savings due to avoided journeys to a second chargepoint (2021 prices, 2022 PV base, £ million)

Option	Low	Central	High
Option 4.1	0.0	0.0	0.0
Option 4.2	0.3	0.6	0.8
Option 4.3 (preferred)	0.2	0.4	0.5
Option 4.4	0.2	0.3	0.5

6.5 Unmonetised benefits

Unmonetised benefit 1: Emissions savings due to increased EV uptake

196. We expect increased reliability will increase new EV uptake due to higher consumer confidence in the public charging network. As referenced above, almost 1 in 2 EV drivers (47%) agreed that too

[74] AA Survey, November 2020, Table 2. Given these two events are not mutually exclusive, 26% is the midpoint of the chance of the first event occurring (18%) and the sum of the chance of the two events occurring (34%).

[75] Transitioning to zero emission cars and vans: 2035 delivery plan, page 5, https://www.gov.uk/government/publications/transitioning-to-zero-emission-cars-and-vans-2035-delivery-plan

[76] Electric Car Consumer Model (ECCo)

[77] Zap-Map Pricing Report 2019, 2021 prices

many public chargepoints are out of service or inaccessible and only 9% disagreed, according to AA-Yonder. Therefore, there will be non-monetised benefits from emissions savings.

197. Section 3.5 outlines why this benefit is non-monetised and the methodology used to illustrate the impacts of a hypothetical scenario. For the reliability policy, we estimate that there would need to be a 2% increase (percentage points) in EV sales due to this policy to generate a positive NPV. Section 3.5 provides an example of what is meant by a 1 percentage-point increase. Sense-checking this against internal consumer choice modelling indicates that this scale of impact can be reasonably achieved, given reliability was ranked as the most important factor for a public network.[78] Perceptions of poor reliability can deter EV uptake and EV mileage through range anxiety. The impact on the NPV if these benefits were monetised is set out in sensitivities (section 8.3).

198. In addition to increasing new EV sales, carbon benefits are likely to be realised in drivers choosing to switch petrol or diesel miles to electric miles. For example, in a PHEV where petrol or electric miles can be driven, or in households that own both an ICE vehicle and an EV. We carry out a further sense check to understand whether emissions savings benefits are likely to offset the negative NPV by estimating the emissions savings benefits if a proportion of total mileage shifts from petrol or diesel miles to electric miles. We find that this further supports our assessment that emissions savings benefits from this policy are likely to outweigh the negative NPV.

7 Costs and benefits: Open data

7.1 Summary

199. This section outlines monetised and non-monetised costs and benefits of the open data measure and the methodology and assumptions used to monetise this.

200. Open data options are provided below. See section 2.5 for more detail.

- Option 0: Do nothing
- Option 5.1: Mandate open data and an OCPI data standard (preferred)

201. **Monetised costs**

- Software costs to share the required data types (direct, ongoing)
- Software costs to adopt Open Charge Point Interface (OCPI) as a data standard (direct, one-off)
- Government costs to setup and maintain the data architecture (direct, ongoing)

202. **Unmonetised costs**

- None expected.

203. **Monetised benefits**

- Time savings for consumers as a result of open data, enabling them to locate chargepoints more easily and know their availability and reliability prior to arrival (direct)

204. **Unmonetised benefits**

- Emissions savings to society as a result of increased EV uptake (indirect)
- Integration of chargepoint data into existing navigation apps and opportunities for app development (direct)

[78] Zap-Map panel survey 2019

Table 39: Summary of costs and benefits (2021 prices, 2022 PV base, £ million)			
Option	**Low**	**Central**	**High**
Costs			
Option 5.1 (preferred)	7	12	16
Benefits			
Option 5.1 (preferred)	19	97	373
Net present value			
Option 5.1 (preferred)	12	85	357

1. See section 8.1 for a summary of why option 5.1 is preferred.

7.2 Evidence base

2. Section 3.2 outlines how evidence was gathered for this impact assessment. Table 40 provides a summary of cost items and unit costs identified through stakeholder engagement for the open data policy. We expect uniform costs across chargepoints of different speeds, unless specified otherwise. A more detailed cost assessment is provided in Annex 1.

Table 40: Open data unit costs		
Cost item	**Description**	**Unit costs**
Software cost to share the data	Ongoing software cost to share the required data types. The unit cost provided is the cost to provide the data to an Application Programming Interface (API). This is subject to change following the outcome of the data discovery concluding in November 2021, which will determine exactly how the data is shared.	Low: £1,000 Central: £1,500 High: £2,000
Software cost to adopt Open Charge Point Interface (OCPI)	One-off software cost per CPO to build a data engine to adopt OCPI.	Low: £15,000 Central: £157,500 High: £300,000

7.3 Monetised costs

Monetised cost 1: Software cost to share the data

3. There will be ongoing software costs to share the required data types, which we expect will fall on CPOs. The way in which this data is shared and subsequently the cost of sharing data is subject to change following the outcome of the data discovery concluding in November 2021. The data discovery will determine how to open data in the best technical way and will outline costs, benefits and risks. The data discovery will be completed with the input of consumers, CPOs, innovators, other DfT data workstreams, the Modernising Data Energy Access (MEDA) and the Electric Vehicle Energy Taskforce to ensure user needs of industry participants and consumers are met.

4. For this IA, we have monetised the cost of sharing this data through an Application Programming Interface (API). The methodology and assumptions used to monetise the cost of sharing data through an API are set out below.

5. In the baseline scenario, it is assumed CPOs will not incur costs to share data through an API as the API would not exist in the absence of the intervention.

6. An assumption of 47 public chargepoint operators is used, based on Zap-Map and is kept constant over the appraisal period.[79] In the intervention scenario, all CPOs are assumed to incur costs to

[79] https://www.zap-map.com/charge-points/public-charging-point-networks/

share data to an API. Therefore, we multiply the 47 CPOs by unit costs to arrive at the present value costs provided in table 41.

Table 41: Software costs to share data (2021 prices, 2022 PV base, £ million)			
Option	**Low**	**Central**	**High**
Option 5.1 (preferred)	0.4	0.6	0.8

Monetised cost 2: Software cost to adopt Open Charge Point Interface (OCPI)

7. There will be a one-off software cost to build a data engine to adopt OCPI as a data standard, which we expect will fall on CPOs. The methodology and assumptions used to monetise this are set out below.

8. We assume 60% of chargepoint operators have already adopted OCPI, therefore these costs are sunk and are excluded from the analysis.[80] This assumption is tested in sensitivities due to uncertainty arising from a small sample size.

9. We assume there are 47 public chargepoint operators based on Zap-Map and assume this remains constant over the appraisal period.[81] We assume 28 of these (60%) have already adopted OCPI and exclude these from the analysis. In the baseline scenario, we assume the remaining 19 chargepoint operators (40%) will not adopt OCPI in the next year in the absence of the regulation. In the intervention scenario, all 19 chargepoint operators will incur costs to adopt OCPI.

10. Finally, we multiply the 19 CPOs by unit costs to arrive at the present value costs provided in table 42.

Table 42: Software costs to adopt OCPI (2021 prices, 2022 PV base, £ million)			
Option	**Low**	**Central**	**High**
Option 5.1 (preferred)	0.3	3	6

Monetised cost 3: Government costs to setup and maintain the data architecture

11. There will be costs to government to setup and maintain the data architecture. We expect costs to setup the data architecture to be £1.2m-£1.8m RDEL and £2m-£3m CDEL in 2022. For the remainder of the appraisal period (2023 to 2032), we expect data maintenance to require two Grade 6/7 Civil Servants and two HEO/SEO Civil Servants per year at a salary of £57,098 and £35,785 (2021 prices) [82] respectively, with a non-wage labour uplift of 26.5%. In addition to this, we expect a capital cost of £160,000-£240,000 per financial year. The total present value government costs to setup and maintain the data architecture are provided in table 43.

Table 43: Government costs (2021 prices, 2022 PV base, £ million)			
Option	**Low**	**Central**	**High**
Option 5.1 (preferred)	6	7	9

Monetised cost 4: Familiarisation costs

12. Section 3.3 outlines the methodology used to monetise familiarisation costs. Table 44 provides present value familiarisation costs for the open data policy.

Table 44: Familiarisation costs (2021 prices, 2022 PV base, £ million)			
Option	**Low**	**Central**	**High**
Option 5.1 (preferred)	0.007	0.009	0.011

[80] Based on a survey with EV charging companies. Survey question: Have you adopted Open Charge Point Interface (OCPI)?

[81] https://www.zap-map.com/charge-points/public-charging-point-networks/

[82] Civil Service Statistics, 2020, page 14, https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/940284/Statistical_bulletin_Civil_Service_Statistics_2020_V2.pdf

Monetised cost 5: Enforcement costs

13. Section 3.3 outlines the methodology used to monetise enforcement costs. Table 45 provides present value enforcement costs for the open data policy.

Table 45: Enforcement costs (2021 prices, 2022 PV base, £ million)			
Option	**Low**	**Central**	**High**
Option 5.1 (preferred)	0.5	0.6	0.7

7.4 Monetised benefits

Monetised benefit 1: Time savings due to open data

14. Consumers are likely to save time due to the open data policy as they will be able to locate chargepoints more easily and see in advance whether a chargepoint is in use by another driver or out of service, and select a different chargepoint before arrival. This hypothesis was supported during a workshop with around 30 EV charging companies and has also been supported through consumer research. According to EVA, 98% of EV drivers agree that having access to real-time data would save them time.[83] We expect avoided helpline calls and avoided journeys to a second chargepoint to be the main sources of time savings and so we monetise time savings using data on this. This was deemed a more robust approach to monetise this benefit than requesting consumers to attempt to estimate their future time savings as a result of this policy through consumer surveys.

15. The values of time and the value of time multiplier set out in section 3.5 also apply here. The methodology and assumptions used to monetise time savings due to avoided helpline calls and avoided journeys to a second chargepoint are set out below.

Time savings due to avoided helpline calls

16. Section 3.4 sets out assumptions on the average call and hold duration for helpline calls. For this policy, in the central scenario we assume 2% of helpline calls are due issues locating a chargepoint.[84] We assume this proportion of helpline calls will not be required in the intervention scenario and therefore this time is saved as a result of the open data policy.

17. Section 3.4 sets out assumptions on the number of helpline calls per chargepoint per year, which also apply here. These assumptions are tested in sensitivities due to the uncertainties set out in section 3.4.

18. Chargepoint projections are used to calculate the volume of this benefit. Given that helpline calls are per chargepoint per year and this policy applies to all chargepoints, cumulative projections are used for all public chargepoints. Present value benefits are presented in table 46.

Table 46: Time savings due to avoided helpline calls due to issues locating a chargepoint (2021 prices, 2022 PV base, £ million)			
Option	**Low**	**Central**	**High**
Option 5.1 (preferred)	1	7	30

19. Given that open data will allow consumers to see in advance whether a chargepoint is out of service and select a different chargepoint before arrival, when considering these policies in isolation the reliability time savings benefits due to avoided helpline calls should be counted here too. Section 6.4 sets out the methodology to monetise this benefit. The only difference here is that we assume

[83] EVA England, Improving drivers' confidence in public EV charging, Research report on the consumer experience at public electric vehicle chargepoints in England, 2021, page 26, https://www.evaengland.org.uk/wp-content/uploads/2021/04/EVA-England-Consumer-Charging-Survey-Report.pdf

[84] Based on a survey with EV charging companies. Survey question: What percentage of helpline calls are due to issues locating a chargepoint?

this applies to all chargepoints and do not apply the 99% assumption. Table 47 sets out the present value benefits.

Table 47: Time savings due to avoided helpline calls due to reliability issues (2021 prices, 2022 PV base, £ million)			
Option	**Low**	**Central**	**High**
Option 5.1 (preferred)	11	74	320

Time savings due to avoided journeys to a second chargepoint

20. Section 6.4 sets out assumptions on the average journey time between chargepoints, which also applies here. We assume 18% of EV drivers experience arriving at a chargepoint to find it is being used by another EV driver annually and we assume 7% of EV drivers experience not being able to locate a chargepoint annually.[85] This data is limited as it does not capture how many times per year EV drivers experience this and so we assume this is experienced once per year. This assumption is tested in sensitivities given the high degree of uncertainty. We also assume that, when this occurs, EV drivers must drive to a second chargepoint in order to charge their vehicle. We test this assumption in sensitivities given the high degree of uncertainty around whether there may be an alternative, working chargepoint in the same location.

21. As above, scenarios for EV stock are used to estimate the volume of these benefits.[86] Below are the present value benefits due to avoided journeys to a second chargepoint when the first is being used by another EV driver (table 48) and when the first chargepoint could not be located (table 49).

Table 48: Time savings due to avoided journeys to a second chargepoint when the first is being used by another EV driver (2021 prices, 2022 PV base, £ million)			
Option	**Low**	**Central**	**High**
Option 5.1 (preferred)	2	5	7

Table 49: Time savings due to avoided journeys to a second chargepoint when the first could not be located (2021 prices, 2022 PV base, £ million)			
Option	**Low**	**Central**	**High**
Option 5.1 (preferred)	1	2	3

22. As above, reliability time savings benefits due to avoided journeys to a second chargepoint should be counted here too. Section 6.4 sets out the methodology to monetise this benefit. The only difference here is that we assume this applies to all chargepoints and do not apply the 99% assumption. Table 50 sets out the present value benefits.

Table 50: Time savings due to avoided journeys to a second chargepoint when the first is out of service (2021 prices, 2022 PV base, £ million)			
Option	**Low**	**Central**	**High**
Option 5.1 (preferred)	3	7	10

Monetised benefit 2: Electricity savings due to avoided journeys to a second chargepoint

23. The EV drivers who benefit from time savings due to an avoided journey to a second chargepoint will also benefit from electricity savings due to the avoided journey. Section 6.4 sets out assumptions on the electricity consumption value and average cost per kWh, which also apply here.

[85] AA Survey, November 2020, Table 2

[86] Transitioning to zero emission cars and vans: 2035 delivery plan, page 5, https://www.gov.uk/government/publications/transitioning-to-zero-emission-cars-and-vans-2035-delivery-plan

24. We use the same proportion of drivers, volumes and journey distance as above. Below are the present value electricity savings benefits due to avoided journeys to a second chargepoint when the first is being used by another EV driver (table 51) and when the first chargepoint could not be located (table 52).

Table 51: Electricity savings due to avoided journeys to a second chargepoint when the first is being used by another EV driver (2021 prices, 2022 PV base, £ million)

Option	Low	Central	High
Option 5.1 (preferred)	0.4	0.8	1.2

Table 52: Electricity savings due to avoided journeys to a second chargepoint calls when the first could not be located (2021 prices, 2022 PV base, £ million)

Option	Low	Central	High
Option 5.1 (preferred)	0.1	0.3	0.4

25. Again, reliability benefits from electricity savings should also be counted here. Section 6.4 sets out the methodology to monetise this benefit. The only difference here is that we assume this applies to all chargepoints and do not apply the 99% assumption. Table 53 sets out the present value benefits.

Table 53: Electricity savings due to avoided journeys to a second chargepoint when the first is out of service (2021 prices, 2022 PV base, £ million)

Option	Low	Central	High
Option 5.1 (preferred)	0.6	1.1	1.7

7.5 Unmonetised benefits

Unmonetised benefit 1: Emissions savings due to increased EV uptake

26. We expect access to open data will increase EV uptake due to increased ease in locating an available chargepoint. As referenced above, according to EVA, 72% of EV drivers are either often or sometimes concerned about finding a chargepoint. Therefore, the emissions savings unmonetised benefit set out in section 3.5 are also likely to occur as a result of this policy. The impact on the NPV if these benefits were included is set out in sensitivities (section 8.3).

27. In addition to increasing new EV sales, carbon benefits are likely to be realised in drivers choosing to switch petrol or diesel miles to electric miles. For example, in a PHEV where petrol or electric miles can be driven, or in households that own both an ICE vehicle and an EV.

Unmonetised benefit 2: Integration of chargepoint data into existing navigation apps and opportunities for app development

28. We expect the open data regulations will enable chargepoint data to be integrated into existing navigation apps more easily and may generate opportunities for new apps to be developed to locate chargepoints. This may generate knock-on benefits and opportunities to consumers and businesses, including offers to consumers for bundled products such as paying for parking and charging. No attempt has been made to monetise this benefit.

8 Costs and benefits: Results

29. This section presents the results of the analysis outlined above, sensitivity analysis for the preferred option and the business impact target (BIT) calculations.

8.1 Results

30. The results of the analysis outlined above are presented in this section. Impacts have been monetised using the best available information on unit costs and a transparent chargepoint projections methodology as outlined in Annex 1. Tables 54-59 summarise the costs and benefits of each of the policies.

Table 54: Minimum payment methods summary of costs and benefits (2021 prices, 2022 PV base, £ million)				
Option	**Option 1.1**	**Option 1.2 (preferred)**	**Option 1.3**	**Option 1.4**
Costs				
Contactless hardware (existing devices)	2	2	2	24
Contactless hardware (new devices)	6	148	339	339
Transaction costs	16	35	57	58
Operating costs	3	95	213	220
Enforcement costs	1	1	1	1
Familiarisation	0.01	0.01	0.01	0.01
Total costs	**28**	**281**	**611**	**642**
Benefits				
Time savings: Avoided helpline calls	1	22	50	52
Time savings: Avoided app downloads	17	45	99	102
Total benefits	**18**	**67**	**149**	**154**
Net present value				
Net present value	**-11**	**-214**	**-463**	**-488**

31. Whilst option 1.1, which applies to 50kW+ chargepoints only, has the highest NPV, option 1.2, which applies to new chargepoints 8kW and above and existing 50kW+ chargepoints, is the preferred option. This is because the policy objective of a smooth, hassle-free payment process across the entire network would not be met if a minimum payment method was required at sites with 50kW+ chargepoints only.

32. The preferred option was not extended further to chargepoints that are below 8kW as these are typically on-street residential chargepoints and we recognise that installing a contactless terminal on these chargepoints is less commercially viable. In addition, where these chargepoints are streetlight or bollard chargers, installing a contactless terminal is not feasible.

Table 55: Payment roaming summary of costs and benefits (2021 prices, 2022 PV base, £ million)		
Option	**Option 2.1 (preferred)**	**Option 2.2**
Costs		
Labour costs	4	4
Legal costs	13	14
Roaming agreement costs	217	230
Enforcement costs	1	1
Familiarisation	0.01	0.01
Total costs	**235**	**249**
Benefits		

Time savings: Avoided helpline calls	50	53
Time savings: Avoided app downloads	78	85
Total benefits	**128**	**138**
Net present value		
Net present value	**-107**	**-111**

33. Option 2.1 has the highest NPV and is the preferred option. This option assumes 0% voluntary action up to 2024 then assume costs are incurred from 2024 as this is when the regulation is assumed to come into force. This is preferred to option 2.2, where the regulation would come into force immediately, as option 2.1 aims to incentivise the market to deliver a market-led roaming solution between now and 2024.

Table 56: Price transparency summary of costs and benefits (2021 prices, 2022 PV base, £ million)	
Option	**Option 3.1 (preferred)**
Costs	
Software costs	0.1
Revenue loss to businesses	307
Enforcement costs	0.6
Familiarisation	0.009
Total costs	**0.7**
Benefits	
Cost savings to consumers	307
Total benefits	**307**
Net present value	
Net present value	**-1**

34. Option 3.1 is the preferred option. This option will require all public charging networks to adopt a p/kWh metric for a unit of electricity sold under PAYG models. This is preferred to the do nothing option as option 3.1 achieves the policy aim of consumers being able to easily compare the the cost of charging between different networks.

Table 57: Reliability summary of costs and benefits (2021 prices, 2022 PV base, £ million)				
Option	**Option 4.1**	**Option 4.2**	**Option 4.3 (preferred)**	**Option 4.4**
Costs				
Replacement chargepoint hardware	0	11	15	16
Signal booster hardware	0	2	40	45
Multi-network SIM software	0	0	3	3
Maintenance costs	0	18	198	213
Helpline costs	28	28	28	28
Enforcement costs	1	1	1	1
Familiarisation	0.01	0.01	0.01	0.01
Total costs	**29**	**60**	**285**	**306**
Benefits				
Time savings: Avoided helpline calls	0	3	69	74

Time savings: Avoided journeys to a second chargepoint	0	8	7	7
Electricity savings: Avoided journeys to a second chargepoint	0	0.6	0.4	0.3
Total benefits	**0**	**12**	**76**	**81**
Net present value				
Net present value	**-29**	**-49**	**-209**	**-226**

35. Whilst option 4.1, which mandates a helpline only, has the highest NPV, option 4.3, which mandates a 99% reliability standard on 50kW+ chargepoints until 2024 then extends this to all chargepoints, is the preferred option. This is because requiring a helpline only will not meet the policy objective, or bring about the unmonitised carbon benefits, of a well-maintained network that consumers can trust.

36. Given the high estimated cost of this policy, the preferred option has not been extended to all chargepoints at this point as available data suggests 50kW+ chargepoints are less reliable, with 1 in 10 rapid chargepoints being out of service at any given time on average, compared to 1 in 25 total chargepoints.[87] We will be monitoring the reliability of chargepoints below 50kW between now and 31 December 2023 before deciding whether to extend this regulation to all chargepoints.

Table 58: Open data summary of costs and benefits (2021 prices, 2022 PV base, £ million)

Option	**Option 5.1 (preferred)**
Costs	
Software costs to share data	0.6
Software costs to adopt OCPI	3
Government costs for the data architecture	7
Enforcement costs	0.6
Familiarisation	0.009
Total costs	**12**
Benefits	
Time savings: Avoided helpline calls due to issues locating a chargepoint	7
Time savings: Avoided helpline calls due reliability issues	74
Time savings: Avoided journeys to a second chargepoint when the first is out of service	7
Time savings: Avoided journeys to a second chargepoint when the first is in use by another EV driver	5
Time savings: Avoided journeys to a second chargepoint when the first could not be located	2
Electricity savings: Avoided journeys to a second chargepoint when the first is out of service	1
Electricity savings: Avoided journeys to a second chargepoint when the first is in use by another EV driver	1
Electricity savings: Avoided journeys to a second chargepoint when the first could not be located	0.3
Total benefits	**97**
Net present value	
Net present value	**85**

[87] https://www.gov.uk/government/publications/electric-vehicle-charging-market-study-final-report/final-report

37. Option 5.1 is the preferred option. This option will require CPOs to share the required data types and adopt OCPI as the data standard. This is preferred to the do nothing option as option 5.1 achieves the policy aim of consumers being able to easily locate and access chargepoints by accessing a range of software solutions that provide them with comprehensive and accurate chargepoint data.

38. The table below combines the preferred options from the tables above to form policy packages. Policy package 1 combines option 1.2, option 2.1, option 3.1, option 4.3 and option 5.1 and assumes we do not mandate payment roaming from 2024 or mandate 99% reliability on chargepoints below 50kW from 2024. Policy package 2 also combines option 1.2, option 2.1, option 3.1, option 4.3 and option 5.1, but the key difference here is that this package assumes we do mandate payment roaming from 2024 and mandate 99% reliability on chargepoints below 50kW from 2024. We will be monitoring the progress of the market in these areas between now and 31 December 2023 before deciding whether these powers will come into effect in 2024. Therefore, the preferred policy package has not been selected at this point. In some instances, the figures below differ from the corresponding table above. This is to remove double-counting and is explained in the footnotes linked to these figures.

Table 59: Package of policies costs and benefits (2021 prices, 2022 PV base, £ million)

Option	Package of policies 1[88]	Package of policies 2[89]
Costs		
Minimum payment methods preferred option costs (option 1.2)	281	281
Roaming preferred option costs (option 2.1)	0[90]	235
Price transparency preferred option costs (option 3.1)	308	308
Reliability preferred option costs (option 4.3)	60[91]	285
Open data preferred option costs (option 5.1)	12	12
Total costs	**661**	**1,120**
Benefits		
Minimum payment methods preferred option benefits (option 1.2)	67	4[92]
Roaming preferred option benefits (option 2.1)	0[93]	128
Price transparency preferred option benefits (option 3.1)	307	307

88 This package assumes we do not mandate payment roaming from 2024 or mandate 99% reliability on chargepoints below 50kW from 2024.

89 This package assumes we do mandate payment roaming from 2024 or mandate 99% reliability on chargepoints below 50kW from 2024.

90 This differs from the total costs for option 2.1 outlined in table 55 because under policy package 1 we assume we do not mandate roaming from 2024 (i.e. we do nothing in 2024 meaning there are no costs).

91 This differs from the total costs for option 4.3 outlined in table 57 because under policy package 1 we assume we do not mandate a 99% reliability standard on chargepoints below 50kW from 2024 (i.e. 99% reliability is mandated on 50kW+ chargepoints only so costs are equal to option 4.2 costs).

92 This differs from the total benefits for option 1.2 outlined in table 54 to avoid double-counting of the minimum payment methods and roaming benefits. When the minimum payment methods and payment roaming policies are considered in isolation, all benefits should be taken into account. When these are summed, minimum payment methods are included for 2022 and 2023 only before the roaming policy comes into force.

93 This differs from the total benefits outlined in table 55 for option 2.1 because under policy package 1 we assume we do not mandate roaming from 2024 (i.e. we do nothing in 2024 meaning there are no benefits).

Reliability preferred option benefits (option 4.3)	12[94]	76
Open data preferred option benefits (option 5.1)	85[95]	21[96]
Total benefits	**471**	**536**
Net present value		
Net present value	**-190**	**-584**

8.2 Business impact target (BIT) calculations

39. Direct costs to business are outlined in this section. The net present value (NPV) to business is lower than the NPV to society because all monetised benefits are expected to accrue to consumers rather than businesses. There may also be an indirect benefit to EV charging businesses of increased revenue if these policies increase EV uptake and subsequenty the number of people using the public charging network. However, this will also cause a decrease in revenue for businesses selling fuel for ICE vehicles, this has not been included in the analysis. Direct costs and the likelihood of passing costs onto consumers for each of the policies are outlined below. Familiarisation costs are also expected to be a direct cost to business.

- **Minimum payment methods** – CPOs are expected to be most impacted by this policy as they will bear the minimum payment method hardware costs, operating costs, and transaction costs. Whilst we expect many of these costs, especially transaction costs, will be passed onto the consumer, we assume 100% of these costs are direct costs to business as per the Regulatory Policy Committee guidance.[97] We expect chargepoint manufacturers and installers to be impacted through an increase in demand for hardware, software and support packages that facilitate a minimum payment method.

- **Payment roaming** – CPOs and eMSPs are exected to be most impacted by this policy as they will bear the cost of setting up roaming agreements. Ongoing roaming agreement fees are likely to be bourne by the CPO initially but may be passed onto the consumer, depending on the roaming agreement and the level of price competition. Again however, we assume 100% of these costs are direct costs to business.

- **Price transparency** –This policy is expected to have the largest impact on CPOs as they will bear the software cost to adopt a p/kWh metric. We assume 100% of these costs are direct costs to business.

- **Reliability** – This policy is expected to have the largest impact on CPOs as they will bear the cost of the updates required to meet the 99% reliability standard. Chargepoint manufacturers may also bear some of this cost through investment to improve the quality of chargepoints. Whilst some of these costs may be passed onto consumers, we assume 100% are direct costs to business.

- **Open data** – CPOs are expected to be most impacted by this measure as they will bear the cost of making their data openly available and adopting OCPI. We assume 100% of these costs are direct costs to business.

---

[94] This differs from the total benefits outlined in table 57 for option 4.3 because under policy package 1 we assume we do not mandate a 99% reliability standard on chargepoints below 50kW from 2024 (i.e. 99% reliability is mandated on 50kW+ chargepoints only so benefits are equal to costs for option 4.2).

[95] This differs from the total benefits outlined in table 58 to avoid double-counting of the reliability and open data benefits. When the reliability and open data policies are considered in isolation, all benefits should be taken into account. When these are summed, to avoid double-counting, all reliability benefits are taken into account, then only open data benefits additional to this are included here.

[96] This differs from the total benefits outlined in table 58 to avoid double-counting of the reliability and open data benefits. When the reliability and open data policies are considered in isolation, all benefits should be taken into account. When these are summed, to avoid double-counting, all reliability benefits are taken into account, then only open data benefits additional to this are included here.

[97] https://www.gov.uk/government/publications/rpc-case-histories-direct-and-indirect-impacts-march-2019

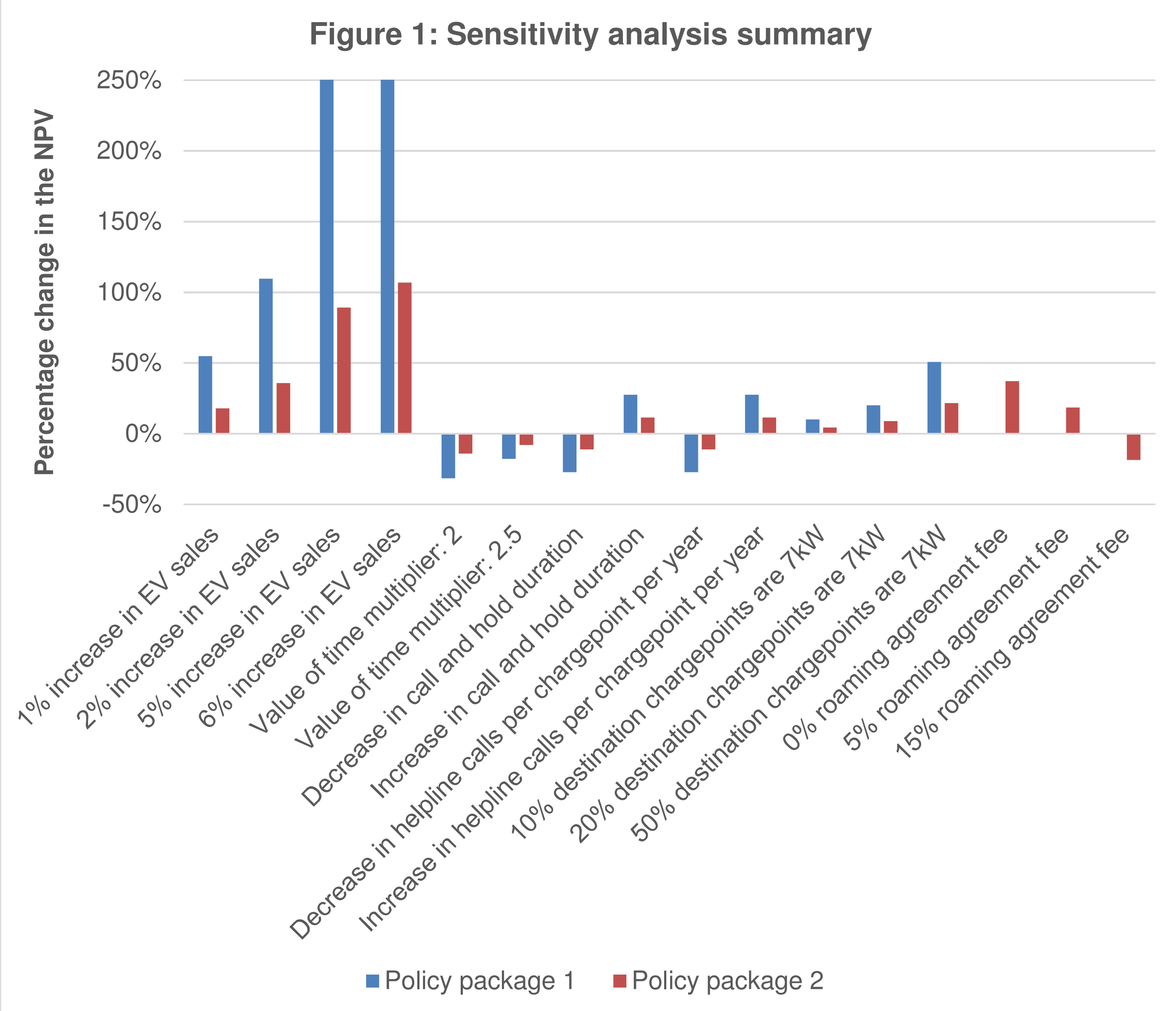
40. The estimated annual net direct cost to business (EANDCB) of each of the policies is outlined below.

Table 60: Option summaries for all five policies (2021 prices, 2022 PV base, £ million)	
Option	**Estimated annual net direct cost to business (EANDCB)**
Minimum payment methods	
Option 1.1	3
Option 1.2 (preferred)	33
Option 1.3	71
Option 1.4	74
Payment roaming	
Option 2.1 (preferred)	27
Option 2.2	29
Price transparency	
Option 3.1 (preferred)	36
Reliability	
Option 4.1	3
Option 4.2	7
Option 4.3 (preferred)	33
Option 4.4	35
Open data	
Option 5.1 (preferred)	0.4
Total	
Package of policies 1	76
Package of policies 2	125

8.3 Sensitivity analysis

41. The analysis outlined above relies upon several assumptions to quantify and monetise the impact of the policy packages. Assumptions are supported by the best available evidence, but there are several key uncertainties which are tested through sensitivities.The most important sensitivity tests, which have the largest impact on the NPV, are outlined below, whilst Annex 3 outlines sensitivity tests that have been undertaken but have not been reported as the impact on the NPV is small (under £15m).

42. The NPV is most sensitive to the inclusion of emissions savings benefits (sensitivity 1). Including these monetised benefits creates a change in the NPV of 55% to 328% for policy package 1 and 18% to 107% for policy package 2. The NPV is also sensitive to changes in the value of time multiplier (sensitivity 2), changes to the helpline call and hold duration (sensitivity 3), changes to the number of helpline calls per chargepoint per year (sensitivity 4), changes in the proportion of destination chargepoints that are below 8kW and therefore fall out of scope of the minimum payment methods policy (sensitivity 8), and changes to the roaming agreement fee (sensitivity 10). These sensitivities create a change in the NPV of over 25% for policy package 1 and over 10% for policy package 2. Overall, the sensitivity analysis suggests the NPV represents an underestimate given that emissions savings are not monetised for the reasons outlined in section 3.5. Figure 1 shows the percentage change for each of the sensitivities listed above that have the largest impact on the NPV.



Benefits sensitivities

Sensitivity 1: Testing changes to the NPV if emissions savings benefits are monetised

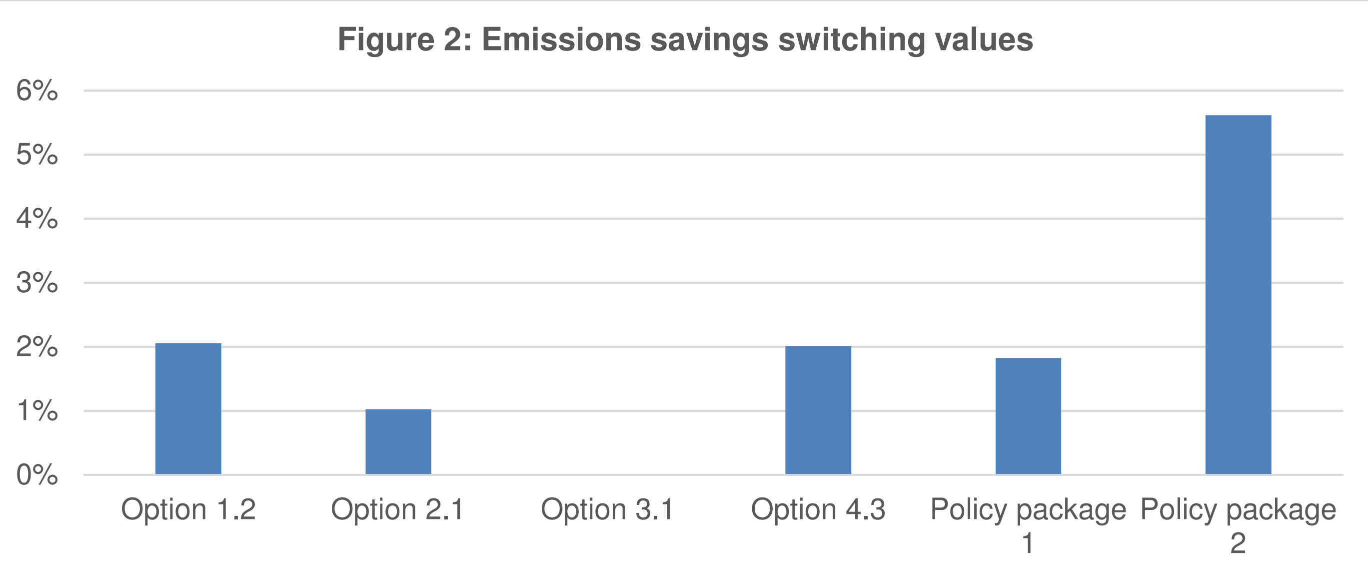
43. As mentioned in section 3.5, emissions savings are non-monetised as there is limited evidence to establish a direct relationship between the policies and EV uptake. Instead, we illustrate the impact on the NPV if electric car and van sales increased by 1%, 2%, 5% and 6% (percentage points). Section 3.5 sets out the methodology and assumptions used to monetise this and what is meant by a 1 percentage-point increase. Table 61 presents the results of this analysis.

Table 61: Testing the impact if potential emissions savings and revenue benefits are monetised (2021 prices, 2022 PV base, £ million)

Sensitivity scenario	Policy package 1 NPV	Policy package 2 NPV
NPV of policy	**-190**	**-584**
Increase in EV sales: 1% (pp)	-86	-480
Increase in EV sales: 2% (pp)	18	-376
Increase in EV sales: 5% (pp)	330	-64
Increase in EV sales: 6% (pp)	434	40

44. As new EV sales rise, the NPV improves as more ICE vehicles are displaced and there are more EVs using the public charging network, resulting in higher emissions savings benefits. Within these policy packages, minimum payment methods has the lowest NPV and this policy would need to

cause a 2.1% increase in EV sales to generate a positive NPV. Figure 2 illustrates the switching value for each of the policies with a negative NPV and section 3.5 sets out the likelihood of this.



Sensitivity 2: Testing changes to the value of time multiplier

45. The analysis assumes a value of time multiplier of 3.14. Given the uncertainty in using values of lateness for rail as a proxy for the value of time multiplier, we test the sensitivity of the NPV to a value of time multiplier of 2 and 2.5. Table 62 presents the results of this analysis.

Table 62: Testing changes to the value of time multiplier (2021 prices, 2022 PV base, £ million)

Sensitivity scenario	Policy package 1 NPV	Policy package 2 NPV
NPV of policy	**-190**	**-584**
Value of time multiplier: 2	-250	-667
Value of time multiplier: 2.5	-224	-631

46. As the value of time multiplier decreases, time has a lower monetary value. Therefore, benefits decrease whilst costs remain constant, therefore the NPV worsens.

Sensitivity 3: Testing changes to the helpline call and hold duration

47. The analysis assumes an average helpline call duration of 6.9 minutes and an average hold duration of 1.5 minutes. Given the uncertainty in this assumption due to a small sample size, we test the sensitivity of the NPV to a 50% change in the helpline call duration and hold duration. We test the impact on the NPV if the call duration was 3.5 minutes and 10.4 minutes, and if the hold duration was 0.7 minutes and 2.2 minutes. See table 63 for the results of this analysis.

Table 63: Testing changes to the helpline call and hold duration (2021 prices, 2022 PV base, £ million)

Sensitivity scenario	Policy package 1 NPV	Policy package 2 NPV
NPV of policy	**-190**	**-584**
Call duration: 3.5 mins, hold duration: 0.7 mins	-242	-650
Call duration: 10.4 mins, hold duration: 2.2 mins	-138	-518

48. The higher the call and hold duration, the larger the time savings benefits. The lower the call and hold duration, the smaller the time savings benefits. Given that costs remain constant, as call and hold duration increase, the NPV improves. As call and hold duration decrease, the NPV worsens.

Sensitivity 4: Testing changes to the average number of helpline calls per chargepoint per year

49. The analysis assumes an average of 43 helpline calls per chargepoint per year and assumes this remains constant across the appraisal period. The number of helpline calls per chargepoint per year is highly uncertain; this may be lower going forward if consumers become more practised in EV charging, or it may be higher if the number of EVs on the road increases at a faster rate than charging infrastructure. Therefore, we test the sensitivity of the NPV to a 50% change in the number of helpline calls per chargepoint per year; we test the impact if there were 21.5 and 64.4 helpline calls per chargepoint per year. See table 64 for the results of this analysis.

Table 64: Testing changes to the number of helpline calls per chargepoint per year (2021 prices, 2022 PV base, £ million)

Sensitivity scenario	Policy package 1 NPV	Policy package 2 NPV
NPV of policy	**-190**	**-584**
Helpline calls per chargepoint per year: 21.5	-242	-650
Helpline calls per chargepoint per year: 64.4	-138	-518

50. As the number of helpline calls per chargepoint per year increases, time savings benefits increase whilst costs remain constant. As a result, the NPV improves as the number of helpline calls increases and worsens as the number of helpline calls decreases.

Sensitivity 5: Testing changes to the percentage of helpline calls due to issues paying for charge, reliability issues and issues locating a chargepoint

51. In this IA, we assume 17%, 24% and 2% of helpline calls are due to issues paying for charge, reliability issues and issues locating a chargepoint, respectively. This is highly uncertain given the small sample size. Therefore, we test the sensitivity of the NPV to a 50% change in these percentages; we test the impact if 9% and 26% of helpline calls were due to issues paying for charge, 12% and 36% of helpline calls were due to reliability issues, and if 1% and 3% of helpline calls were due to issues locating a chargepoint. See table 65 for the results of this analysis.

Table 65: Testing changes to the number of helpline calls per chargepoint per year (2021 prices, 2022 PV base, £ million)

Sensitivity scenario	Policy package 1 NPV	Policy package 2 NPV
NPV of policy	**-190**	**-584**
Helpline calls due to payment issues: 9%	-201	-610
Helpline calls due to payment issues: 26%	-179	-559
Helpline calls due to reliability issues: 12%	-227	-621
Helpline calls due to reliability issues: 36%	-153	-547
Helpline calls due to issues locating: 1%	-194	-588
Helpline calls due to issues locating: 3%	-187	-581

52. When the proportion of helpline calls due to each issue is lower than the central case, time savings are lower resulting in benefits falling whilst costs remain constant. As a result, the NPV worsens. Conversely, when the proportion of helpline calls due to each issue is higher than the central case, the NPV improves because time savings increase whilst costs remain constant.

Sensitivity 6: Testing changes to the number of app downloads per driver

53. The analysis assumes an average of 6 app downloads per EV driver to pay for the networks they use. Given the uncertainty in this assumption due to a small sample size and potential sample bias, we test the sensitivity of the NPV to a 50% change in the number of app downloads per driver. We test the impact on the NPV if, on average, EV drivers downloaded 3 and 9 apps. See table 66 for the results of this analysis.

Table 66: Testing changes to the number of app downloads per driver (2021 prices, 2022 PV base, £ million)		
Sensitivity scenario	**Policy package 1 NPV**	**Policy package 2 NPV**
NPV of policy	**-190**	**-584**
App downloads per driver: 3	-213	-633
App downloads per driver: 9	-168	-536

54. This sensitivity impacts the minimum payment methods and payment roaming policies only. When the number of apps per driver is higher than the central scenario, the NPV improves. When the number of apps per driver is lower than the central scenario, the NPV worsens. This is because, as the number of apps per driver increases, time savings from these two policies increase whilst costs remain constant.

Sensitivity 7: Testing changes to the time taken to download an app

55. The analysis assumes an average of 3.9 minutes per app download. Given the uncertainty in this assumption due to a small sample size, we test the sensitivity of the NPV to a 50% change in the time taken to download an app. We test the impact on the NPV if, on average, the time taken to download an app is 1.9 minutes and 5.7 minutes. See table 67 for the results of this analysis.

Table 67: Testing changes to the time taken to download an app (2021 prices, 2022 PV base, £ million)		
Sensitivity scenario	**Policy package 1 NPV**	**Policy package 2 NPV**
NPV of policy	**-190**	**-584**
Time taken to download an app: 1.9 minutes	-213	-625
Time taken to download an app: 5.7 minutes	-168	-543

56. This sensitivity impacts the minimum payment methods and payment roaming policies only. When the time taken to download an app is higher than the central scenario, the NPV improves. When the time taken to download an app is lower than the central scenario, the NPV decreases. This is because, as the time taken to download an app increases, time savings from the payment method policies increase whilst costs remain constant.

Costs sensitivities

Sensitivity 8: Testing the impact if a proportion of destination chargepoint projections are below 8kW and therefore do not fall in scope of the minimum payment methods preferred option

57. The preferred minimum payment methods option requires contactless at sites with new chargepoints 8kW and above retrofitting at sites with existing 50kW+ chargepoints. To estimate this, the analysis uses chargepoint projections for destination and rapid chargepoints and therefore assumes that destination chargepoints are 8kW and above. This is because the policy aims for all chargepoints, except for on-street residential chargepoints, to have a minimum payment method. Given that some destination chargepoints may be below 8kW, we test the sensitivity of the NPV to a proportion of destination chargepoints being removed from the projections. Table 68 shows the impact on the NPV of 10%, 20% and 50% of destination chargepoints being removed from the projections.

Table 68: Testing the impact if a proportion of destination chargepoints are below 8kW (2021 prices, 2022 PV base, £ million)		
Sensitivity scenario	**Policy package 1 NPV**	**Policy package 2 NPV**
NPV of policy	**-190**	**-584**
10% destination chargepoints are 8kW	-171	-559
20% destination chargepoints are 8kW	-152	-533
50% destination chargepoints are 8kW	-94	-458

58. This sensitivity impacts the minimum payment methods policy only. As the proportion of destination chargepoints that are below 8kW increases, costs and benefits of the minimum payment methods policy decrease as a larger portion of chargepoints fall out of scope of this policy. Because the decrease in costs is larger than the decrease in benefits in absolute terms, the NPV improves as the proportion of destination chargepoints that are below 8kW increases.

Sensitivity 9: Testing changes to the proportion of payments made via contactless

59. To calculate contactless transaction costs in this IA, we assume 48% of payments are made via contactless where contactless is an option and assume this remains constant across the appraisal period. We test the sensitivity of the NPV to this assumption as the proportion of payments that will be made via contactless going forward and how this will change over the appraisal period is highly uncertain.

60. We test the impact on the NPV if 24% and 72% of payments were made via contactless (a 50% change from the central scenario). We also test the sensitivity of the NPV to a 5% annual increase and a 5% annual decrease in the proportion of payments made via contactless. The annual increase tests a scenario where the proportion of payments made via contactless increases as EV uptake increases because the demographic of consumers shifts from innovators to early adopters and mainstream consumers. The annual decrease tests a scenario where the proportion of payments made via contactless decreases as EV uptake increases due to increased ability to pay via one smartphone app. The results of this analysis are presented in table 69.

Table 69: Testing changes to the proportion of payments made via contactless (2021 prices, 2022 PV base, £ million)

Sensitivity scenario	Policy package 1 NPV	Policy package 2 NPV
NPV of policy	**-190**	**-584**
Proportion of payments made via contactless: 24%	-172	-566
Proportion of payments made via contactless: 72%	-208	-602
Annual increase in contactless payments: 5%	-203	-597
Annual decrease in contactless payments: 5%	-181	-575

61. This sensitivity tests impacts of the minimum payment methods policy only. As the proportion of payments made via contactless decreases, the NPV increases as transaction costs fall, whilst benefits remain constant. Conversely, as the proportion of payments made via contactless increases, the NPV decreases because transaction costs increase whilst benefits remain constant. Similarly, an annual decrease in the proportion of contactless payments improves the NPV whereas an annual increase in the proportion of contactless payments decreases the NPV.

Sensitivity 10: Testing changes to the costs for minimum payment method per charging site rather than per chargepoint

62. In this IA we assume minimum payment method requirements apply per chargepoint. However in the preferred option for minimum payment method, the minimum payment be offered per charging site rather than per chargepoint. There is currently limited evidence with regards to the impact of this offer on costs per sites and the number of sites for which one payment terminal would be a viable minimum payment method for multiple chargepoints.

63. We test the impact on the NPV if this represented a 10% and 20% reduction in cost to businesses. Hardware cost for a contactless terminal, including the cost to integrate the payment system and the chargepoint management system, as well as installation costs and operating costs all usually apply per chargepoint. The results of this analysis are presented in table 70.

Table 70: Testing changes due to lower costs for minimum payment method per charging site (2021 prices, 2022 PV base, £ million)

Sensitivity scenario	Policy package 1 NPV	Policy package 2 NPV
NPV of policy	**-190**	**-584**
Cost reduction: 10%	-162	-556
Cost reduction: 20%	-134	-528

64. The sensitivity impacts the minimum payment method policy only. As the costs for implementing minimum payment method reduces with requirement per bank or site rather than per chargepoint the NPV increases, whilst benefits remain constant.

Sensitivity 11: Testing changes to the roaming agreement fee

65. In this IA we assume a roaming agreement fee of 10% per transaction in the central scenario. This is highly uncertain given limited data and given we expect this to vary depending on the roaming agreement. The NPV is highly sensitive to this assumption. Therefore, we test the sensitivity of the NPV if the roaming agreement cost was 0%, 5% and 15% per transaction. The results of this analysis are presented in table 71.

Table 71: Testing changes to the roaming agreement fee (2021 prices, 2022 PV base, £ million)

Sensitivity scenario	Policy package 1 NPV	Policy package 2 NPV
NPV of policy	**-190**	**-584**
Roaming agreement fee: 0%	-190	-367
Roaming agreement fee: 5%	-190	-476
Roaming agreement fee: 15%	-190	-693

66. This sensitivity impacts the payment roaming policy only. As policy package 1 assumes we do not mandate roaming from 2024, this sensitivity has no impact on the NPV for this policy package. For policy package 2, as the roaming agreement fee falls, total costs fall whilst benefits remain constant. As a result, the NPV improves when the roaming agreement fee is under 10% and worsens when the roaming agreement fee is above 10%.

Sensitivity 12: Testing changes to the proportion of payments made via roaming

67. To calculate roaming agreement fee costs in this IA, we assume 48% of payments are made via roaming and assume this remains constant across the appraisal period. We test the sensitivity of the NPV to this assumption as the proportion of payments that will be made via roaming going forward and how this will change over the appraisal period is highly uncertain.

68. We test the impact on the NPV if 24% and 72% of payments were made via contactless (a 50% change from the central scenario). We also test the sensitivity of the NPV to a 5% annual increase and a 5% annual decrease in the proportion of payments made via contactless. This tests two scenarios; one where the proportion of payments made via roaming increases as EV uptake increases due to increased ability to pay via one smartphone app; and and one where the proportion of payments made via roaming decreases because the demographic of consumers shifts from innovators to early adopters and mainstream consumers who may prefer to pay via contactless. The results of this analysis are presented in table 72.

Table 72: Testing changes to the proportion of payments made via roaming (2021 prices, 2022 PV base, £ million)

Sensitivity scenario	Policy package 1 NPV	Policy package 2 NPV
NPV of policy	**-190**	**-584**
Proportion of payments made via roaming: 24%	-190	-476
Proportion of payments made via roaming: 72%	-190	-693
Annual increase in roaming payments: 5%	-190	-639
Annual decrease in roaming payments: 5%	-190	-540

69. This sensitivity impacts the payment roaming policy only. Because policy package 1 assumes we do not mandate roaming from 2024, this sensitivity has no impact on the NPV of this policy package. For policy package 2, as the proportion of payments made via roaming decreases, the NPV increases as transaction costs fall whilst benefits remain constant. Conversely, as the proportion of payments made via roaming increases, the NPV decreases because transaction costs increase whilst benefits remain constant. Similarly, an annual decrease in the proportion of roaming payments improves the NPV whereas an annual increase in the proportion of roaming payments decreases the NPV.

Sensitivity 13: Testing changes to the proportion of chargepoints that have signal boosters, multi-network SIMs, maintenance contracts and a 24/7 helpline in the baseline scenario

70. In the baseline scenario, we assume 15% of chargepoints have a signal booster, 93% of chargepoints have a multi-network SIM, 62% of chargepoints have a maintenance contract and 90% of chargepoints have a 24/7 helpline. We assume this remains constant over the appraisal period. The proportion of chargepoints that will have these measures going forward and how this will change over the appraisal period is uncertain, so we test this through sensitivities.

71. Table 71 sets out the sensitivity tests that were undertaken. For each of the measures, we test the impact on the NPV of an increase and decrease in the baseline proportion of chargepoints that have these measures (20% to 50% change either side of the central scenario depending on the degree of uncertainty). We then test the impact on the NPV of an annual increase in the proportion of chargepoints that have these measures. The results of this analysis are presented in table 73.

Table 73: Reliability baseline sensitivities (2021 prices, 2022 PV base, £ million)		
Sensitivity scenario	**Policy package 1 NPV**	**Policy package 2 NPV**
NPV of policy	**-190**	**-584**
Signal booster sensitivities		
Baseline chargepoints with a signal booster: 8%	-190	-588
Baseline chargepoints with a signal booster: 23%	-190	-580
Annual increase in signal boosters per year: 10%	-190	-580
Multi-network SIM sensitivities		
Baseline chargepoints with a multi-network SIM: 74%	-190	-592
Baseline chargepoints with a multi-network SIM: 100%	-190	-581
Annual increase in multi-network SIMs per year: 1%	-190	-582
Maintenance contract sensitivities		
Baseline chargepoints with a maintenance contract: 49%	-196	-648
Baseline chargepoints with a maintenance contract: 74%	-184	-520
Annual increase in maintenance contracts per year: 5%	-178	-448
24/7 helpline sensitivities		
Baseline chargepoints with a 24/7 helpline: 72%	-241	-635
Baseline chargepoints with a 24/7 helpline: 100%	-162	-556
Annual increase in 24/7 helpline per year: 1%	-172	-566

72. This sensitivity impacts the reliability policy only. When the baseline proportion of chargepoints that have each of these measures falls, the reliability costs increase as more chargepoints will incur costs for each of these measures, whilst benefits remain constant. As a result, the NPV decreases. The opposite happens when we test a higher baseline. As the baseline proportion of chargepoints that have these measures increases over the appraisal period, costs fall as fewer chargepoints will incur costs due to the policy, whilst benefits remain constant. As a result, the NPV improves. The

NPV is most sensitive to changes in the baseline proportion of chargepoints with maintenance contracts as maintenance is the highest cost. Policy package 1 is less sensitive to these changes than policy package 2 as the former applies to rapids only, with fewer chargepoints being impacted by these sensitivities.

9 Risks and unintended consequences

73. There are several potential risks that have been considered in relation to the legislation. These include:

- **Efficacy and enforcement** – ensuring that regulations are enforceable has been a consideration for government and potential enforcement bodies when developing the policy approach. Enforcement of the regulations are reliant on accurate and up to date open data. We have mitigated this risk by commencing a data discovery to understand how we meet these needs and sought advice from the Office for Product and Safety Standards (OPSS) which delivers enforcement under the existing AFIR 2017 regulations.
- **Lack of regulation for consumer facing products** – as open data becomes more accessible, third parties entering the market who are not regulated will likely develop and provide consumer facing services to locate working and available chargepoints. There is a risk that information will be provided to the consumer that is not up to date or information is incorrectly interpreted and presented back to the consumer. To mitigate this risk, as part of our data discovery in Autumn 2021 we are working with industry stakeholders to understand how to open data alongside technical documents and guidance for interpreting the data. We will continue to monitor the sector and the consumer behaviours and experience at public chargepoints, however we do not deem this to be a significant risk.
- **Technology change and obsolescence** – mandating open public EV chargepoint data, the mechanism by which we open the data, and a minimum payment method relies on technologies which will evolve over the next decade and risk the charging network becoming out of date through its reliance on technology specified in legislation. We will not specify technologies within legislation; we will supply technical guidance documents developed with industry and innovators which enables the technology to evolve as new versions or technologies emerge. This guidance will be developed alongside DfT's data discovery into open public EV chargepoint data.
- **Disincentivising the roll out of 50kW+ chargepoints** – as these regulations apply to 50kW+ chargepoints with a lower reliability record and without a minimum payment method, additional maintenance and contactless hardware will be required to meet the requirements, creating an additional cost. This may disincentivise the roll out of rapid chargepoints relative to lower speed chargepoints. However, through our engagement with industry we understand that rapid chargepoints generate higher revenue and so we expect there will continue to be incentive to supply these in the UK. We will continue to monitor this as part of the post implementation review (PIR).
- **Distorting the supply of chargepoints around the 8kW and 50kW thresholds** – because these regulations require a minimum payment method on chargepoints at 8kW and above and require 99% reliability on chargepoints above 50kW, there is a risk of distorting supply at these thresholds (i.e. the regulations may create an incentive to supply 49kW chargepoints). We expect this risk to be small at the 50kW threshold because the speed of rapid charging is increasing as technology develops. Whilst many rapids are currently 50kW-100kW, this is likely to be much higher in the future. We also expect this risk to be small at the 8kW threshold as the market typically offers around 7kW, 11kW or 22kW chargepoints. Given that the minimum payment methods policy applied to new chargepoints 8kW and above, it is unlikely 11kW and 22kW chargepoints would be dialled

down below 8kW to avoid the regulation as this delivers a different service. In addition, voltages from the grid are in discrete intervals depending on the socket being used for the EV, making it more challenging to dial down the speed of the charger. We will continue to monitor this as part of the post implementation review (PIR).

- **Reducing the viability of investment in low utilisation areas** – the reliability policy may reduce the viability of investment in chargepoints as this policy increases the lifetime cost of chargepoints without a matched increase in lifetime benefits. This may be more prominent in areas where chargepoints have lower utilisation (e.g. rural areas). We will monitor this as part of the PIR.
- **Slower installation of new chargepoints** – CPOs may be required to divert resources away from installing new chargepoints in order to retrofit existing chargepoints with a contactless terminal, setup roaming agreements, transition to a p/kWh metric, update existing hardware to improve their reliability, and to transition to OCPI. This may slow-down the roll-out of charging infrastructure. If this does impact the roll-out of charging infrastructure, we expect this to be short term as this would take place only in the 1-year lead time to comply with these policies. However, in some instances CPOs may have capacity to make these updates whilst continuing to install new chargepoints at their original pace.
- **Disincentivising proprietary networks from opening their network** – these regulations do not apply to proprietary networks whose chargepoints are restricted to one specific car manufacturer as per AFIR 2017 guidance.[98] Therefore, there is a risk that these regulations may incentivise proprietary networks to remain closed. To mitigate this risk, where these networks do open-up to become public networks, there will be lead times to comply with the regulations assessed on a case-by-case basis by both the Office for Zero Emission Vehicles (OZEV) and the enforcement body.

10 Wider impacts

10.1 Innovation test

74. The public charging market is growing and maturing at pace. There is a high rate of innovation by operators and manufacturers to deliver chargepoints that are more affordable and consumer friendly.

75. There are a wide range of consumer friendly innovations to suit different needs. For example, low cost solutions have developed that compliment existing street furniture such as street lights and bollards to aid those without off-street parking. We want to encourage operators and manufacturers to consider the consumer experience at every level. These regulations provide a baseline for those considerations, ensuring those who innovate to go above and beyond are not financially penalised relative to others. The regulations also provide certainty over which technologies will be required as a minimum, allowing market participants to go beyond.

76. Maintaining innovation in the chargepoint market is crucial to keep the installment of infrastructure at the current pace. We have considered innovation at every step of the policy making process, whilst considering the best outcome for consumers. We have worked closely with operators and manufacturers to reach a balance between consumers' current needs and enabling future technological changes.

[98] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/959909/Guide-to-alternative-fuels-infrastructure-regulations-2017.pdf

77. To enable innovative solutions, the regulations specify the minimum requirements needed to deliver a good consumer experience whilst avoiding being overly prescriptive about how operators must deliver this. Below sets out how innovation has been considered for each policy area.

- **Payment methods** – the regulation will be non-specific, e.g. it will not explicitly mention one payment type, to allow for innovation and new technologies to arise without needing to change regulation.
- **Price transparency** – the regulation will require operators to display the pricing metric in a clear way, but will not specify how this should be displayed to enable innovative solutions.
- **Reliability** – the regulation will not state 99% as the standard (instead it will refer to guidance which states 99% as the standard), enabling the 99% standard to be updated without having to change the regulation. In addition, the regulation will not outline how the operator is required to meet the 99% reliability standard, enabling operators to choose how they meet this standard and allowing innovative solutions to develop.
- **Open data** – the regulation will ensure technical requirements around open data and OCPI can be updated without needing to change the regulation.

78. We have monitored the market closely, engaging with operators and consumer groups regularly to ensure our approach delivers a good consumer experience whilst enabling innovation. We acknowledge that technologies such as plug-and-charge and wireless charging are likely to deliver an improved consumer experience in the future. The regulations are designed to ensure the introduction of these technologies is not impacted.

10.2 Small and micro businesses assessment

79. This section identifies the anticipated impact of the package of policies on small and micro businesses (SaMBs). The scale of the impact is assessed before disproportionate impacts and possible measures to mitigate these costs are discussed. The assessment focuses on CPOs as, across the EV charging value chain, we expect they will be most impacted by the set of policies. A key finding of this assessment is that the majority of SaMBs are subsidiaries of large, parent companies or are backed by large investment funds, who may support in meeting the requirements of the regulations.

Market share and the scale of impact on small and micro businesses

80. CPOs are registered under many different Standard Industrial Classification (SIC) codes, the most common being production of electricity (3511), trade of electricity (3514) and electrical installation (4321).[99] This suggests there is not an allocated SIC for EV charging as this is still a new, emerging market. Across all SIC codes under which CPOs were found to be registered, on average 97.5% of businesses had under 50 employees and 97.5% of businesses had under £10 million annual turnover in 2020.[100] This is similar to the market composition of operators of fuel filling stations, akin to what the electric vehicle charging market may look like once matured. ONS statistics for retail sale of automotive fuel in specialised stores (4730) identify that 95.3% of businesses had under 50 employees and 94.3% of businesses had under £10 million annual turnover in 2020.

81. The above analysis suggests SaMBs make up a large portion of businesses in these sectors, but only provides a high-level picture of their market share. To understand this in more detail, we look into the business size of each of the CPOs listed on Zap-Map individually. From this, we estimate the number of SaMBs likely to be impacted by each policy, the number of devices operated by SaMBs and the proportion of devices operated by SaMBs. A key finding of this analysis is that the

[99] https://find-and-update.company-information.service.gov.uk/search

[100] https://www.ons.gov.uk/businessindustryandtrade/business/activitysizeandlocation/datasets/ukbusinessactivitysizeandlocation

majority of SaMBs are subsidiaries of large, parent companies or are backed by large investment funds.

82. To understand the scale of the impact, we apply the proportion of devices operated by SaMBs to the central cost estimates to calculate the anticipated cost to SaMBs in year 1 and ongoing costs. Upfront costs are assumed to be incurred in year 1 and ongoing costs are assumed to be spread evenly across the 10 year appraisal period. The impact of the set of policies depends on the extent to which SaMBs and the devices they operate already meet the requirements in the regulations. In the absence of detailed data on this, we assume the same baseline as the central analysis to calculate the impact on SaMBs. The results of this analysis are presented in tables 74-79. Results are rounded to the nearest thousand.

Table 74: Minimum payment methods small and micro business impacts

Option	Option 1.1	Option 1.2 (preferred)	Option 1.3	Option 1.4
Number of SaMB in scope of this policy	28	28	28	28
Number of devices operated by SaMB	5,033	5,033	5,033	5,033
Proportion of devices operated by SaMB	23%	23%	23%	23%
Total year 1 cost to SaMBs	£1,647,000	£7,406,000	£14,949,000	£19,199,000
Total annual ongoing costs to SaMBs	£577,000	£6,336,000	£13,879,000	£14,073,000
Year 1 cost per SaMB	**£59,000**	**£265,000**	**£534,000**	**£686,000**
Annual ongoing costs per SaMB	**£21,000**	**£226,000**	**£496,000**	**£503,000**

Table 75: Payment roaming small and micro business impacts

Option	Option 2.1 (preferred)	Option 2.2
Number of CPOs expected to incur costs from this policy	47	47
Of which are SaMB	28	28
Total year 1 cost to SaMBs	£15,152,000	£16,177,000
Total annual ongoing costs to SaMBs	£4,952,000	£5,252,000
Year 1 cost per SaMB	**£541,000**	**£578,000**
Annual ongoing costs per SaMB	**£177,000**	**£188,000**

Table 76: Price transparency small and micro business impacts

Option	Option 3.1 (preferred)
Number of CPOs expected to incur costs from this policy	15
Of which are SaMB	3
Total year 1 cost to SaMBs	£6,167,000
Total annual ongoing costs to SaMBs	£6,143,000
Year 1 cost per SaMB	**£2,056,000**
Annual ongoing costs per SaMB	**£2,048,000**

Table 77: Reliability small and micro business impacts

Option	Option 4.1	Option 4.2	Option 4.3 (preferred)	Option 4.4
Number of SaMB in scope of this policy	28	28	28	28
Number of devices operated by SaMB	5,033	5,033	5,033	5,033
Proportion of devices operated by SaMB	23%	23%	23%	23%
Total year 1 cost to SaMBs	£650,000	£3,669,000	£9,483,000	£10,317,000
Total annual ongoing costs to SaMBs	£648,000	£1,104,000	£6,153,000	£6,598,000
Year 1 cost per SaMB	**£23,000**	**£131,000**	**£339,000**	**£368,000**
Annual ongoing costs per SaMB	**£23,000**	**£39,000**	**£220,000**	**£236,000**

Table 78: Open data small and micro business impacts

Option	Option 5.1 (preferred)
Number of CPOs expected to incur costs to share data	47
Of which are SaMB	28
Number of CPOs expected to incur costs to adopt OCPI	19
Of which are SaMB	11
Total year 1 cost to SaMBs	£1,805,000
Total annual ongoing costs to SaMBs	£36,000
Year 1 cost per SaMB	**£64,000**
Annual ongoing costs per SaMB	**£1,000**

Table 79: Total impact on small and micro businesss

Option	Preferred options
Total year 1 cost to SaMBs	£40,013,000
Total annual ongoing costs to SaMBs	£23,620,000
Year 1 cost per SaMB	£1,429,000[101]
Annual ongoing costs per SaMB	£844,000[102]

83. The above analysis provides a sense of the average cost per SaMB in year 1 and annual ongoing costs per SaMB. Given that a SaMB is defined as having under 50 employees and an annual turnover under £10m, the cost per SaMB in year 1 is at least 14% of their annual turnover. Ongoing costs after year 1 are estimated to be lower, at £844,000 per SaMB per year (8% annual turnover). Whilst these costs are large, parent companies may support in providing funds to meet these requirements. Still, we consider profitability impacts, the ability of SaMBs to pass costs onto consumers, disproportionate impacts and outline exemptions below.

84. In addition, the SaMBs incurring the costs of these regulations may benefit from increased revenue due to increased EV uptake as outlined in section 8.2, as long as they do not sell fuel for ICE vehicles, where revenue is expected to decline. Whilst the above analysis provides a sense of the average cost per SaMB in year 1 and annual ongoing costs per SaMB, it does not show whether the costs are proportionately more difficult to bear for SaMBs. The sections below assess the

[101] Total year 1 cost to SaMBs divided by the 28 SaMBs.

[102] Total annual ongoing cost to SaMBs divided by the 28 SaMBs.

impact on profitability of SaMBs, the ability of SaMBs to pass costs onto consumers and disproportionate impacts on SaMBs.

Assessment of the impact on profitability of SaMBs

85. Given the current low number of EVs on the road, CPOs are currently making a loss with the expectation of significant future returns when mass-market adoption is reached. This is supported by our engagement with CPOs, including CPOs that are SaMBs. In addition, literature suggests the EV charging market is expected to become profitable only when EVs make up at least 5% of vehicles on the road, or about 2 million units.[103] We estimate the 5% threshold will be reached by 2025 for cars and by 2029 for vans.[104] In 2020, only 1.3% of all cars on the road and 0.4% of all vans on the road were PHEV or BEV.[105] As a result, in 2020 there was an average of 0.46, 0.52 and 1.48 charging events per day on slow, fast and rapid chargepoints, respectively.[106] Therefore, to assess the impact on profitability of SaMBs, we use the turnover analysis above as a proxy but also assess the impact of these cost increases on the investment viability of SaMBs.

86. Deloitte analysis suggests that in the 10 years to 2030, between £8 billion and £18 billion investment in EV charging infrastructure will be required.[107] Taking the mid-point of these estimates (£13 billion) and assuming 23% of this investment will be in SaMBs (given 23% of chargepoints are currently operated by SaMBs), it suggests approximately £3 billion will be invested in SaMBs in the 10 years to 2030. As a result of these policies, we estimate costs of £142 million (policy package 1) and £253 million (policy package 2) will fall on SaMBs over the 10 year appraisal period. This suggests that, as a result of these policies, a 5% (policy package 1) and 9% (policy package 2) increase in investment in SaMBs will be required. This provides a sense of the scale of the increase in investment required. Given that the EV charging market is expected to become profitable only when EVs make up at least 5% of vehicles on the road, these higher costs may increase this threshold to 5.5% (a 9% increase in the 5% threshold). However, given that these policies are expected to increase EV sales, the point at which the profitability threshold is reached may come sooner as a result of these policies.

Assessement of the ability of SaMBs to pass costs onto consumers

87. There is evidence to suggest that all CPOs (not just SaMBs) that already offer contactless have passed contactless costs onto consumers as the average non-contactless pay-as-you-go (PAYG) tariff is 30p/kWh whilst the average contactless tariff is 33p/kWh (11% higher).[108] Further engagement with small CPOs showed that any cost increases would be passed directly onto the consumer. This was apparent in recent months when UK PPA prices increased dramatically and CPOs increased the cost to the consumer. This suggests that, whilst businesses will incur compliance costs initially, these are likely to be recovered through higher prices for consumers, regardless of the size of the CPO. Because we expect all CPOs (not just SaMBs) will pass costs onto consumers, this also reduces the risk of SaMBs becoming relatively more expensive as a result of the regulation and exiting the market as their prices are not competitive.

88. To support this assessment, we consider the impact of higher prices on demand. First we outline the price elasticity of fuel given electricity is akin to fuel for EVs. Literature suggests that fuel is

---

[103] Hurry up and… wait, The opportunities around electric vehicle charge points in the UK, Deloitte, 2019, page 1, https://www2.deloitte.com/content/dam/Deloitte/uk/Documents/energy-resources/deloitte-uk-Electric-Vehicles-uk.pdf

[104] Transitioning to zero emission cars and vans: 2035 delivery plan, page 5, https://www.gov.uk/government/publications/transitioning-to-zero-emission-cars-and-vans-2035-delivery-plan

[105] https://www.gov.uk/government/statistical-data-sets/all-vehicles-veh01

[106] Zap-Map report, 2020

[107] UK EV charging infrastructure update (part 2): Show me the money, Deloitte, https://www2.deloitte.com/uk/en/pages/energy-and-resources/articles/uk-ev-charging-infrastructure-update-show-me-the-money.html

[108] Zap-Map pricing report, 2019, 2021 prices

relatively price inelastic, with most studies finding a fuel cost (price) elasticity for cars within the range of -0.1 to -0.5, meaning that a 10% increase in the cost of fuel reduces car miles driven by 1-5%.[109] DfT analysis suggests a car fuel elasticity of -0.24 (falling over time), meaning that a 10% increase in the cost of fuel reduces car miles driven by 2.4%.[110] This suggests that vehicle mileage changes relatively little in response to fuel price changes. Given that electricity is akin to fuel for EVs, from this we can infer that electricity, in the context of EVs, is likely to also be inelastic. In addition, literature suggests electricity demand itself is inelastic.[111] This suggests CPOs will be able to pass costs onto consumers with relatively small changes in electric mileage.

89. Another relevant consideration is the relative price of petrol and diesel car use, as this is a substitute for EV use. As mentioned above, ongoing costs per SaMB per year are estimated to be c.8% of annual turnover. Given that electric cars cost from 1p per mile and ICE cars cost 10p per mile[112], even if the cost to charge an electric car increases by 8% (i.e. all costs are passed onto consumers), electric cars will still be much cheaper to run than ICE cars (1.08p per km for electric cars vs. 10p per km for ICE cars). This suggests there is significant headroom for SaMBs to pass these costs onto consumers without the running costs for EVs exceeding the running costs for ICE vehicles.

Consideration of disproportionate impacts

90. Disproportionate impacts on SaMBs have been considered throughout the policy making process. In the consultation document, we asked "Are there any groups you expect would be uniquely impacted by these proposals, for example small businesses or people from protected categories?" and received no responses regarding disproportionate impacts on SaMBs. We have also engaged directly with SaMBs, including them in the cost data gathering exercise. SaMBs raised no concerns of additional costs reducing their viability and incentivising their exit from the market or disincentivising chargepoint provision. During engagement, SaMBs have been supportive of the policies as they recognise they will support in reaching the EV uptake required for EV charging to become profitable. An assessment of disproportionate impacts for each of the policies is set out below, including a consideration of whether these charges vary with the number of chargepoints or are fixed (which may lead to a disproportionate impact on SaMBs).

- **Minimum payment methods** – Contactless hardware costs for new chargepoints, transaction costs and operating costs are ongoing costs per chargepoint. Therefore, we would not expect these to have a disproportionate impact on SaMBs as costs will be relative to the number of chargepoints each SaMB operates. The one-off cost to retrofit existing 50kW+ chargepoints with contactless may have a higher burden on SaMBs as these costs may require specific skills (e.g. retrofit installation). Again, however, this cost will be relative to the number of chargepoints each SaMB operates. As mentioned above, we expect SaMBs will be able to recover costs by passing the increased cost of contactless to consumers in the form of higher prices. SaMBs may also be able to recover costs if the policy package increases EV uptake and therefore the number of people using the public charging network, increasing revenue.
- **Payment roaming** – Roaming agreement costs are ongoing costs per transaction, so we would not expect these to have a disproportionate impact on SaMBs as these costs will vary with the number of transactions. Transaction costs will be relative to the number of chargepoints each SaMB operates. The one-off costs to set up the roaming agreements may result in a higher burden for SaMBs than for large businesses as these are fixed, per

109 Road traffic demand elasticites: Rapid evidence assessment, https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/395119/road-traffic-demand-elasticities.pdf
110 Transport appraisal guidance
111 The price elasticity of demand in the United States: A three dimensional analysis, 2017, https://cama.crawford.anu.edu.au/sites/default/files/publication/cama_crawford_anu_edu_au/2017-08/50_2017_burke_abayasekara_0.pdf
112 Transitioning to zero emission cars and vans: 2035 delivery plan, page 6, https://www.gov.uk/government/publications/transitioning-to-zero-emission-cars-and-vans-2035-delivery-plan

network costs, so they will make up a larger portion of their cost base. However, our engagement suggests payment roaming will be more beneficial for SaMBs as this enables them to expand their number of users, suggesting costs can be recovered through increased revenue.

- **Price transparency** – One-off software costs to adopt a p/kWh metric may have a disproportionate impact on SaMBs as this is a fixed, per network cost that does not vary with the number of chargepoints being operated, therefore it will make up a larger portion of their cost base. However, given that many SaMBs have already adopted a p/kWh metric and the estimated cost per SaMB is relatively low, we do not expect SaMBs to face any additional barriers to adoption and do not expect this to impact their investment viability.
- **Reliability** – Ongoing costs for maintenance, a multi-network SIM, a 24/7 helpline and signal boosters vary with the number of chargepoints being operated, suggesting SaMBs would not be disproportionately impacted. However, SaMBs may be disadvantaged as larger businesses may be able to benefit from economies of scale for some of these measures. One-off costs to replace existing out of service chargepoints may have a higher burden on SaMBs where they have had less capacity to maintain existing chargepoints, where more are out of service and require a replacement. In addition, SaMBs may be less able to find innovative solutions to meet the 99% reliability standard. However, as mentioned above, we expect SaMBs will be able to recover costs by passing costs onto consumers.
- **Open data** – One-off software costs to adopt OCPI and ongoing costs to share the required data types may have a disproportionate impact on SaMBs as this is a fixed, per network cost that does not vary with the number of chargepoints being operated. However, given that many SaMBs have already adopted OCPI, we do not expect SaMBs to face any additional barriers to adoption and do not expect this to impact their investment viability.

Mitigations considered

91. Below is a list of mitigations that have been considered for SaMBs.

- **Full, partial and temporary exemptions and an extended transition period** – given that 23% of the public charging network is operated by SaMBs, a full, partial, temporary exemption or extended transition period for SaMBs is not viable. A consistent market wide approach is needed to achieve the policy objectives of a simple payment experience, comparability of pricing between networks, a reliable, well-maintained network, and a network where chargepoints can be located and accessed with ease. In addition, exemptions may create perverse incentives for large, parent companies to setup smaller satellite companies to avoid the regulations.
- **Different requirements by firm size** – as per the full exemption we will not have different requirements for SaMBs. The legislation will apply to all chargepoint operators.
- **Information** – we will continue to work with SaMBs to develop the technical guidance documents that sit alongside the legislation. We have considered the implementation date for the legislation to enable all businesses including SaMBs to ensure compliance with the new regulations.
- **Financial aid** – there are existing grants from central government provided through local authorities that could be levied such as the On-street Residential Charging fund which provides funds for local authorities to install charging infrastructure[113].

[113] https://www.gov.uk/government/publications/grants-for-local-authorities-to-provide-residential-on-street-chargepoints/grants-to-provide-residential-on-street-chargepoints-for-plug-in-electric-vehicles-guidance-for-local-authorities

- **Opt-in and voluntary solutions** – every aspect of the legislation will be mandatory with no opt-ins or voluntary solutions. We will work with SaMBs to develop the technical documents which will sit alongside the legislation. Two areas of our policies will be determined by market-led improvements over the next two years. We will only intervene to mandate roaming if by the end of 2023 the consumer experience for those paying through apps has not improved and industry has not developed roaming solutions. We will mandate 99% reliability at all 50kW+ chargepoints, however we will monitor the reliability across the entire network to determine whether the 99% should apply to all chargepoints.

10.3 Trade impact

92. The minimum payment methods policy is the only policy we expect may have trade impacts as this is a technical specification. Payment roaming, price transparency, reliability and open data are all service requirements which will not impact chargepoint manufacturers trading with the UK, but will impact international CPOs as they must comply with these regulations to operate in the UK.
93. As a result of the minimum payment methods policy, chargepoints that are below 8kW and do not have a minimum payment method can no longer be used on the UK public charging network. This may have implications for chargepoint manufacturers that currently export non-compliant chargepoints that are below 8kW to the UK for public use. These manufacturers will no longer be able to sell non-compliant chargepoints to the UK, unless the CPO is prepared to install a minimum payment method themselves before this is used as part of the public charging network. We do not expect the trade impact to be significant as the regulation is based on internationally recognised standards, whilst other countries are introducing similar regulations.
94. With regards to UK exports, the minimum payment methods policy does not prevent the sale of non-compliant chargepoints to foreign markets. This means that UK-based manufacturers that currently sell chargepoints internationally may not be adversely affected by these regulations even if they do not comply with UK regulations. However, without a domestic market to sell to this may be less profitable.
95. In summary, the minimum payment methods policy may have consequences for chargepoint manufacturers who import chargepoints to the UK as they must now adhere to the new regulation unless the CPO is prepared to install the minimum payment method themselves. However, given that the minimum payment methods policy is based on international standards, we do not expect this to lead to significant implications for the value or volume of imports. Instead, this may present a future export opportunity for UK-based chargepoint manufacturers as the rollout of EVs gathers pace internationally.

11 Post implementation review

1. **Review status:** Please classify with an ‘x’ and provide any explanations below.

	Sunset clause		Other review clause		Political commitment	x	Other reason		No plan to review

Regulations to be reviewed every five years to ensure continued suitability. In the short term, on-going reviews will be necessary ahead of the five-year standard review cycle to monitor progress – particularly on payment roaming and reliability standards (by 31 Dec 2023). This is to ensure the legislation remains aligned with policy objectives.

2. **Expected review date** (month and year, xx/xx):

0	3	/	2	7	Five years from when the Regulations come into force

3. **Rationale for PIR approach:**

Will the level of evidence and resourcing be low, medium or high? (See Guidance for Conducting PIRs)

- High

What forms of monitoring data will be collected?

- This can be found in the section below.

What evaluation approaches will be used? (e.g. impact, process, economic)

- This can be found in the section below.

How will stakeholder views be collected? (e.g. feedback mechanisms, consultations, research)

- This can be found in the section below.

Key Objectives, Research Questions and Evidence collection plans			
Key objectives of the regulation(s)	**Key research questions to measure success of objective**	**Existing evidence/data**	**Any plans to collect primary data to answer questions?**
Minimum payment method: The objective of this regulation is a smooth, hassle-free process for consumers to pay for charge across the entire public network, regardless of who operates the individual chargepoint.	Metrics may include, but are not limited to: • Type of minimum payment method implemented by CP operators • Proportion of existing 50kW+ chargepoints offering a minimum payment method • Proportion of newly installed chargepoints 8kW and above offering a minimum payment method • Data on the price for charge when paid for via a minimum payment method • Number of chargepoints installed 8kW and above vs. below 8kW, to monitor whether this has distorted supply of more heavily regulated chargepoints. • Consumers' & businesses' perceptions / satisfaction with payment methods	Data available from ZapMap on contactless provision at chargepoints. Some baseline evidence available via existing consumers' surveys.	ZapMap data on payment method available at chargepoints. Additional evidence will be collected via surveys of EV drivers.

Payment roaming: This objective of this policy is to provide businesses with fleets access to a simple payment method that allows the company to monitor and manage payments centrally, akin to petrol and diesel fuel cards used for fleets. This policy is also an alternative way to achieve a smooth, hassle-free process for consumers to pay for charge across the entire public network, regardless of who operates the individual chargepoint.	Metrics may include, but are not limited to: • Number of roaming agreements per charging network • No. of chargepoints covered by roaming agreements • Consumers' & business' perceptions / satisfaction with payment roaming • No. of apps required by consumers and businesses to operate the entire network • No. of eMobility Service Providers	Baseline evidence available via stakeholder engagement, industry analysis, engagement with business organisations.	To monitor the impact on businesses with fleets, evidence will be collected through regular engagement with industry and surveys with businesses with fleets. To monitor the impact on consumers, additional evidence will be collated via surveys with EV drivers.
Price transparency: This regulation aims for consumers to easily compare the cost of charging between different networks, helping drive competition and bring down prices.	Metrics may include, but are not limited to: • No. of chargepoints / charging networks offering a p/kWh payment metric • Consumers' perceptions / satisfaction with price metric and price transparency	Data available from ZapMap / engagement with CPOs. Some baseline evidence available via existing consumer surveys.	Evidence will be collected through engagement with chargepoint operators. Additional evidence will be collected via surveys of EV drivers / engagement with consumers' groups.
Open data: The objective of this regulation is for consumers to locate and access chargepoints with ease by accessing a range of software solutions that	Metrics may include, but are not limited to: • No. of charging networks that have provided each of the required data types. • Type of data available • No. of data variables available • No. and types of software solutions providing chargepoint data	Data available from ZapMap / industry analysis on chargepoint available data. Some baseline evidence available via existing consumers' surveys.	Evidence will be collected through engagement with industry. Additional evidence will be collected via surveys of

provide them with comprehensive and accurate chargepoint data.	• No. of charging networks that have implemented OCPI • No of charging networks with each version of OCPI • Consumers' perceptions / satisfaction with availability of chargepoint data • Consumers' perceptions / satisfaction with their ability to locate an available chargepoint		EV drivers / engagement with consumers' groups.
Reliability: This regulation aims to ensure a well-maintained public charging network that consumers can trust and will not leave drivers stranded.	Metrics may include, but are not limited to: • The number of attempted charges vs. successful charges for 50kW+ chargepoints (further metrics to be identified through the data discovery) • The number of out of service 50kW+ chargepoints and the length of time they are out of service (further metrics to be identified through the data discovery) • The number of attempted charges vs. successful charges for chargepoints below 50kW, with a distinction between chargepoints above and below 8kW (further metrics to be identified through the data discovery) • The number of out of service chargepoints below 50kW and the length of time they are out of service, with a distinction between chargepoints above and below 8kW (further metrics to be identified through the data discovery) • Availability of a 24/7 helpline service • Number of chargepoints installed above 50kW vs. below 50kW, to monitor whether this has distorted supply of more heavily regulated chargepoints. • Consumers' perceptions / satisfaction with charging network reliability	Data available from ZapMap / CP operators on chargepoint reliability and helpline availability. Some baseline evidence available via existing consumers' research.	Purchase data on chargepoint reliability, engagement with chargepoint operators from Zap-Map. Additional evidence will be collected via surveys of EV drivers / engagement with consumers' groups.

Annexes

Annex 1: Assumptions log

Chargepoint scenarios

96. The chargepoint scenarios used in this analysis are derived from an excel-based modelling tool that has been developed. This tool takes a 'top down' approach, using assumptions around EV uptake, future charging behaviours and the development of chargepoint and vehicle technology to estimate the number of chargepoints required in different charging locations to support a given number of EVs on the road in the UK forpr any given year. The table below contains information on the key assumptions used.

Assumption	Description	Confidence	Source
EV Uptake	Number of EVs (by year, vehicle type, powertrain)	Medium	Transitioning to zero emission cars and vans: 2035 delivery plan
Access to Off-street Parking	Proportion of EV owners with access to off-street parking (by year, classification)	Medium	National Travel Survey (2018)
Likelihood of installing a dedicated residential CP	Proportion of EV owners with access to off-street parking that install a dedicated CP (by year, vehicle type, powertrain)	Medium	Delta-EE's EV Owners Survey – 'Who is the EV owner and how do they charge?'
Multiple EV ownership	Proportion of households with more than one vehicle. Likelihood of household currently without a CP buying a first CP with their second EV. Likelihood of household currently with a CP buying a second CP with their second EV.	Low	Delta-EE – European Chargepoint Forecast (2020)
Driver charging preferences	Proportion of total charging demand supplied (by year, vehicle type, powertrain, location)	Low	ICCT (2021) – Charging Gap UK
EV mileage	Average annual mileage (by year, vehicle type, powertrain)	Medium	DfT Licencing Statistics & National Travel Survey (2018)
Battery efficiency	Average battery efficiency (by year, vehicle type, powertrain)	Medium	Electric Car Consumer Model (ECCo)
Electric mode	Proportion of total miles in electric mode (by year, vehicle type) – applicable to PHEVs only.	Medium	Electric Car Consumer Model (ECCo)
Plug-in start time	Proportion of total charging events starting (by hour, location)	Low	DfT (2017) – Electric Chargepoint Analysis
Plug-in duration	Median plug-in duration per charging event (by year, vehicle type, powertrain, location)	Low	DfT (2017) – Electric Chargepoint Analysis
Charge supplied	Median charge supplied per charging event (by year, vehicle type, powertrain, location)	Low	DfT (2017) – Electric Chargepoint Analysis

Replacement cycle	Lifetime of the CP	Medium	Delta-EE – European Chargepoint Forecast (2020)

Annual electricity demand projections

97. In order to estimate contactless transaction costs, roaming agreement costs and price transparency benefits, the BEIS Dynamic Dispatch Model (DDM) is used.[114] Within the model EV charging demand is allocated to 6 different charging locations; residential off-street, workplace, residential on-street, destination, rapids and depot based upon assumptions on consumers charging preferences. Demand at each location is then distributed across the day based on assumptions of when EV drivers are expected to charge their vehicle. Annual electricity demand projections for residential on-street, destination and rapids are then used to estimate contactless transaction costs, roaming agreement costs and price transparency benefits.

Cost assessment

Assumption	Description	Confidence	Source
Minimum payment methods			
Contactless hardware	Contactless hardware is £1,000 per unit and remains constant across the appraisal period	Medium - it was not possible to sense check this directly with suppliers, but the majority of stakeholders provided this input.	Provided by 9 anonymous EV charging businesses. Tested in a workshop attended by c. 30 EV charging businesses, no objections raised.
Contactless installation	Contactless retrofit is £335 per unit and remains constant across the appraisal period	Medium - it was not possible to sense-check this directly with installers, but the low, central, high scenarios capture the range of cost inputs provided by stakeholders.	Provided by 6 anonymous EV charging businesses. Tested in a workshop attended by c. 30 EV charging businesses, no objections raised.
Transaction costs	Transaction costs are 2-5% per transaction and remain constant across the appraisal period	High - this has also been sense-checked using websites of payment providers.	Provided by 8 anonymous EV charging businesses. Tested in a workshop attended by c. 30 EV charging businesses, no objections raised.
Operating costs	Operating costs are £120 per year per unit and remain constant across the appraisal period	Medium/Low - small sample size and stakeholder engagement suggested not all stakeholdes will incur these.	Provided by 3 anonymous EV charging businesses. Not included in the original assumptions tested at the workshop as only 3 stakeholders mentioned these. These were added following the workshop given feedback to include these.
Payment roaming			
Labour	Assume labour costs to onboard an eMSP are £3,000.	Medium/Low – small sample size, but all were in a similar ball-park. It was not possible to sense-	Provided by 4 anonymous EV charging businesses. Tested in a workshop attended by c. 30 EV charging businesses,

[114] For further background information on the DDM please see: https://www.gov.uk/government/publications/dynamic-dispatch-model-ddm

		check this against e.g. figures provided online.	no objections raised but only moderate agreement.
Legal	Assume legal costs to onboard an eMSP are £10,000.	Medium - small sample size and wide range. Legal fees can vary hugely depending on whether this can be completed in-house and whether the two parties agree.	Provided by 4 anonymous EV charging businesses. Tested in a workshop attended by c. 30 EV charging businesses, no objections raised but only moderate agreement.
Roaming agreements	Assume roaming costs are 10% per transaction. Assume this remains constant.	Low - Small sample size and wide range. This can vary hugely depending on the roaming agreement and in some instances may be 0%.	Provided by 4 anonymous EV charging businesses. Tested in a workshop attended by c. 30 EV charging businesses, no objections raised but only moderate agreement.
Price transparency			
Price transparency software	Assume software costs to adopt p/kWh are £7,500 per network.	Medium - small sample size but tested in workshops and during 1:1s, gaining broad agreement.	Provided by 1 anonymous EV charging businesses. Tested in a workshop attended by c. 30 EV charging businesses, no objections raised and broad agreement.
Reliability			
Chargepoint hardware (AC)	Assume hardware costs to replace an AC charger are £2,600.	High - significant ORCS data, a stakeholder pricelist and figures all in the same ball-park.	On-street residential charging scheme (ORCS) data and 2 anonymous stakeholders. Tested in a workshop attended by c. 30 EV charging businesses, no objections raised.
Chargepoint installation (AC)	Assume installation costs for an AC charger are £400.	High - ORCS data, a stakeholder pricelist and figures all in the same ball-park.	ORCS data and 2 anonymous charging businesses. Tested in a workshop attended by c. 30 EV charging businesses, no objections raised.
Chargepoint hardware (DC)	Assume hardware costs to replace a DC charger are £36,500.	Medium - ranges are large as they cover 50kW-150kW chargepoints. Unknown which speed businesses will select for replacements. Pricelists provided by two anonymous businesses.	Provided by 4 anonymous EV charging businesses. Tested in a workshop attended by c. 30 EV charging businesses, amended following feedback initial costs were too low and further evidence provided.
Chargepoint installation (DC)	Assume installation costs for an DC charger are £11,500.	Medium/Low - ranges are large as they cover installation for 50kW-150kW. Unknown which speed businesses will select for replacements. Pricelists provided by one anonymous business.	Provided by 4 anonymous EV charging businesses. Tested in a workshop attended by c. 30 EV charging businesses, amended following feedback initial costs were too low and further evidence provided.
Signal booster hardware	Assume signal boosters are £90 per charger, which	Medium/Low - signal boosters are likely to cover more than one chargepoint so there is	Provided by 2 anonymous EV charging businesses and sense-checked with online

	includes an assumption that there is 1 signal booster for every 7.5 chargers.	uncertainty around the cost per chargepoint. Stakeholder feedback suggests a signal booster could typically cover 5-10 chargepoints.	sources. Tested in a workshop attended by c. 30 EV charging businesses, no objections raised.
Signal booster installation	Assume signal booster installation is £52 per charger, which includes an assumption that there is 1 signal booster for every 7.5 chargers.	Medium - small sample size. Signal boosters are likely to cover more than one chargepoint so there is uncertainty around the cost per chargepoint. Stakeholder feedback suggests a signal booster could typically cover 5-10 chargepoints.	Provided by 2 anonymous EV charging businesses. Tested in a workshop attended by c. 30 EV charging businesses, no objections raised.
Multi-network SIM software	Assume multi-network SIMs are £24 per charger per year.	High - small sample size but tested with a large portion of the EV charging market.	Provided by 2 anonymous EV charging businesses. Tested in a workshop attended by c. 30 EV charging businesses, no objections raised.
Maintenance (rapids)	Assume rapids are £700 per charger per year.	Medium - small sample size but tested with a large portion of the EV charging market.	Provided by 3 anonymous EV charging businesses including a price list. Tested in a workshop attended by c. 30 EV charging businesses, no objections raised.
Maintenance (non-rapids)	Assume slow+fast chargers are £280 per charger per year.	Medium – small sample size but provided directly from suppliers and online sources.	Provided by 4 anonymous EV maintenance providers.
Helpline	Assume 24/7 helpline costs are £150 per charger per year.	Medium - small sample size but tested with a large portion of the EV charging market.	Provided by 4 anonymous EV charging businesses. Tested in a workshop attended by c. 30 EV charging businesses, no objections raised.
Open data			
Software costs (OCPI)	Assume software costs to build an OCPI engine are £157,500 per network.	Medium - this cost can vary depending on how bespoke the OCPI engine is. This cost may be per chargepoint if CPOs outsource to a SaaS provider who does not support OCPI.	Provided by 5 anonymous EV charging businesses. Tested in a workshop attended by c. 30 EV charging businesses, no objections raised.
Software costs (sharing data)	Assume software costs to share the required data types are £1,500.	Medium/Low – this cost is likely to change following the data discovery concluding in November 2021.	Provided by 6 anonymous EV charging businesses. Tested in a workshop with c. 30 EV charging businesses and amended following feedback.

Benefits analysis

Assumption	Description	Confidence	Source
Electric vehicle sales projections	This comes from DfT projections and modelling	Medium – there is significant uncertainty in many areas,	Transitioning to zero emission cars and

	and is aligned with other government policies.	but this projection is aligned with other government policy.	vans: 2035 delivery plan
Electric vehicle stock projections	This comes from DfT projections and modelling and is aligned with other government policies.	Medium – there is significant uncertainty in many areas, but this projection is aligned with other government policy.	Transitioning to zero emission cars and vans: 2035 delivery plan

Annex 2: Volumes

98. This annex outlines the volumes used to estimate the number of chargepoints that will incur each of the costs and benefits outlined in the tables below. These volumes are multiplied by unit costs and benefits inputs to derive a best estimate for total costs abnd total benefits over the appraisal period.

Minimum payment methods

Cost / benefit	Option 1.1 volumes	Option 1.2 volumes	Option 1.3 volumes	Option 1.4 volumes
Contactless hardware costs (existing chargepoints)	1,769[115]	1,769	1,769	18,125
Contactless hardware costs (new chargepoints)	Annual chargepoint projections for rapid chargepoints.	Annual chargepoint projections for rapid and destination chargepoints.	Annual chargepoint projections for all public chargepoints (rapid, destination and residential on-street).	Annual chargepoint projections for all public chargepoints (rapid, destination and residential on-street).
Transaction costs	Annual electricity demand projections for rapid chargepoints.	Annual electricity demand projections for rapid and destination chargepoints. Electricity demand from existing destination chargepoints is deducted.	Annual electricity demand projections for all public chargepoints (rapid, destination and residential on-street). Electricity demand from existing destination and residential on-street chargepoints is deducted.	Annual electricity demand projections for all public chargepoints (rapid, destination and residential on-street).
Operating costs	Cumulative chargepoint projections for rapid chargepoints.	Cumulative chargepoint projections for rapid and destination chargepoints. Existing fast chargepoints are deducted.	Cumulative chargepoint projections for all public chargepoints (rapid, destination and residential on-street). Existing fast and slow chargepoints are deducted.	Cumulative chargepoint projections for all public chargepoints (rapid, destination and residential on-street).
Time savings: Avoided helpline calls	Cumulative chargepoint projections	Cumulative chargepoint projections for rapid and destination	Cumulative chargepoint projections for all public chargepoints (rapid, destination and	Cumulative chargepoint projections for all public

[115] Zap-Map data as at 4th January 2021. This data has been used for all options.

	for rapid chargepoints.	chargepoints. Existing fast chargepoints are deducted.	residential on-street). Existing fast and slow chargepoints are deducted.	chargepoints (rapid, destination and residential on-street).
Time savings: Avoided app downloads	Assume 16% of app downloads are avoided given 84% of existing chargepoints are non-rapids.[116]	Assume 32% of app downloads are avoided in 2022, increasing to 45% in 2031 as existing slow chargepoints are replaced.[117]	Assume 76% of app downloads are avoided in 2022, increasing to 100% in 2031 as existing slow chargepoints are replaced.[118]	Assume 100% of app downloads will be avoided.

Reliability

Cost / benefit	**Option 4.1 volumes**	**Option 4.2 volumes**	**Option 4.3 volumes**	**Option 4.4 volumes**
Replacement chargepoint hardware & installation costs	0	234[119]	1,430[120]	1,430[121]
Signal booster hardware & installation costs	0	Annual chargepoint projections for rapid chargepoints plus existing rapids.	Option 4.2 volumes are used for 2022 and 2023 and option 4.4 volumes are used from 2024.	Annual chargepoint projections for all public chargepoints (rapid, destination and residential on-street) plus existing chargepoints.
Multi-network SIM software costs	0	Cumulative chargepoint projections for rapid chargepoints.	Option 4.2 volumes are used for 2022 and 2023 and option 4.4 volumes are used from 2024.	Cumulative chargepoint projections for all public chargepoints (rapid, destination and residential on-street).
Maintenance costs	0	Cumulative chargepoint projections for rapid chargepoints.	Option 4.2 volumes are used for 2022 and 2023 and option 4.4 volumes are used from 2024.	Cumulative chargepoint projections for all public chargepoints (rapid, destination and

116 Zap-Map data as at 4th Jan 2021.
117 Estimated by calculating cumulative projections for destination and rapid chargepoints as a proportion of all public chargepoints.
118 Estimated by calculating all new public chargepoints as a proportion of total public chargepoints (i.e. remove existing slow chargepoints).
119 Zap-Map data as at 4th Jan 2021. The proportion of out of service chargepoints (7.3%) is applied to total rapids.
120 Zap-Map data as at 4th Jan 2021. The proportion of out of service chargepoints (7.3%) is applied to total rapids in 2022 then total slow and fast chargepoints in 2024.
121 Zap-Map data as at 4th Jan 2021. The proportion of out of service chargepoints (7.3%) is applied to total public chargepoints.

				residential on-street).
24/7 helpline	Cumulative chargepoint projections for all public chargepoints (rapid, destination and residential on-street).	Cumulative chargepoint projections for all public chargepoints (rapid, destination and residential on-street).	Cumulative chargepoint projections for all public chargepoints (rapid, destination and residential on-street).	Cumulative chargepoint projections for all public chargepoints (rapid, destination and residential on-street).
Time savings: Avoided helpline calls	0	Cumulative chargepoint projections for rapid chargepoints.	Option 4.2 volumes are used for 2022 and 2023 and option 4.4 volumes are used from 2024.	Cumulative chargepoint projections for all public chargepoints (rapid, destination and residential on-street).
Time savings: Avoided journeys to a second chargepoint	0	Assume 16% of journeys to a second chargepoint are avoided given 84% of existing chargepoints are non-rapids.[122] Assume there are 2.74 rapid charging events for every non-rapid charging event and so these benefits occur 2.74 times more often.[123]	Option 4.2 volumes are used for 2022 and 2023 and option 4.4 volumes are used from 2024.	Assume 100% of journeys to a second chargepoint will be avoided.

Annex 3: Additional sensitivity analysis

99. This annex outlines the sensitivity tests that have been undertaken but have not been reported in section 8.3 as they have a small impact on the NPV (under £15m). The bullets below outline these sensitivity tests.

- **Technology learning rates** – we tested the impact on the NPV of a 10%, 20% and 50% reduction in contactless hardware costs over 10 years due to technology and production maturity. The impact on the NPV was small (under £10m).
- **Baseline proportion of contactless chargepoints** – we tested the impact on the NPV of a 50% change in the baseline proportion of chargepoints with contactless, and tested the impact if this increased over time rather than remaining constant over the appraisal period. The impact on the NPV was small (under £10m).
- **Baseline proportion of CPOs who roam without discrimination** – we tested the impact on the NPV if 5%, 10% and 20% of CPOs roam without discrimination, where this proportion

122 Zap-Map data as at 4th Jan 2021.

123 Zap-Map Report, August 2020

of costs would be incurred without the regulation and so is excluded from the analysis. The impact on the NPV was small (under £10m).

- **Number of roaming agreements per CPO** – we tested the impact on the NPV if 15, 45, 60, 90 and 120 roaming agreements were required per CPO as this quantity of eMSPs emerged. The impact on the NPV was small (under £10m).
- **Number of charging networks that have not already adopted a p/kWh metric** – we tested the impact on the NPV if 7.5 and 22.5 networks have not already adopted p/kWh as their electricity metric (a 50% change to the central scenario). The impact on the NPV was negligible (under £1m).
- **Number of charging networks that have not already adopted OCPI** – we tested the impact on the NPV if 9.5 and 28.5 networks have not already adopted OCPI. The impact on the NPV was small (under £3m).
- **Journey time and distance between chargepoints** – we tested the impact on the NPV if the journey time between neighbouring chargepoints was 36 seconds for all chargepoints and 101 seconds for rapids for the lower bound (50% change to the central scenario). For the upper bound, we tested the impact if the journey time between neighbouring chargepoints was 107 seconds for all chargepoints and 302 seconds for rapids (50% change to the central scenario). The impact on the NPV was small (under £10m).
- **Drivers experiencing issues multiple times per year** – we tested the impact on the NPV if drivers experience an out of service chargepoint, a chargepoint being used by another EV driver, or not being able to locate a chargepoint 2, 5 and 10 times per year. The impact on the NPV was small (under £15m).
- **Consumers drive to a second location when they experience issues only a percentage of the time** – we tested the impact on the NPV if consumers drive to a second location 75%, 50% and 25% of the time they experience arriving at a chargepoint to find it is out of service, arriving at a chargepoint to find it is being used by another EV driver, or not being able to locate a chargepoint. The impact on the NPV was small (under £10m).