Title: Residential charging infrastructure provision **IA No:** DfT00412 **RPC Reference No:** RPC-DfT-4408(2) **Lead department or agency:** DfT **Other departments or agencies:** MHCLG	# Impact Assessment (IA) **Date:** 24/09/2021 **Stage:** Final **Source of intervention:** EU **Type of measure:** Secondary legislation **Contact for enquiries:** EV-Infrastructure@dft.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**
£1231m	-£2394m	£128m	Qualifying provision

To address the harmful impacts caused by emissions from Internal Combustion Engine vehicles (ICEs) and meet legally binding targets for reducing Green House Gas (GHG) emissions, the Government has set the ambition that all new cars and vans sold will be effectively zero emission by 2030. To achieve this, the UK will need a well-developed network of charging infrastructure for Electric Vehicles (EVs), delivered at least cost. Charging at home and overnight is currently preferred by EV owners due to convenience and lower costs and it is anticipated that this form of charging will continue to be the preferred mode of charging in the future for most consumers where possible. However, we do not expect that housebuilders will install the necessary charging infrastructure during construction, which would be cheaper than retrofitting charging infrastructure at a later date. Without regulation, there is limited incentive for builders to install this infrastructure during construction, meaning higher and avoidable retrofit costs to consumers at a later date.

What are the policy objectives and the intended effects?

The policy is intended to reduce the cost of EV transition by ensuring chargepoint-enabling infrastructure (ducting, cabling and grid connection) is installed more cheaply during the construction of new residential buildings as opposed to retrofitting post-construction. The policy goes further by ensuring installation of chargepoints in order to increase the confidence of consumers in EV purchasing and use. Updating the Building Regulations to include provisions for electric vehicle charging infrastructure will ensure that homes have the necessary Electric Vehicle (EV) charging infrastructure to support future EV uptake. It also aims to impact the likelihood of homeowners purchasing EVs, to help support the government's EV uptake ambitions.

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

The EU Energy Performance in Buildings Directive (EPBD)[1] sets minimum requirements for charging infrastructure in new residential and non-residential buildings and some properties undergoing major renovation. Whilst the UK is no longer bound by EU law or the requirements of this directive, the Government believes it is within England's interests to proceed with these policy measures to support the transition to EVs. This IA considers the impacts of three options, costed against a 'Do nothing' baseline:

i. Option 1 (Regulations match the EPBD requirements): Transposition of rules set out in the Directive requiring ducting (channels for under-floor cables) be installed in all parking spaces of new or majorly renovated buildings which have over 10 parking spaces.
ii. Option 2 (Ducting and cabling): Cabling to be installed for all parking spaces in all new buildings and those undergoing major renovation, including ducting, cabling and grid connection.
iii. Option 3 (Full charging infrastructure) **preferred**: Charging infrastructure to be installed in all new buildings and those undergoing major renovations, including ducting, cabling and at least one chargepoint per dwelling. Properties with more than 10 parking spaces will require cable routes in all parking spaces without chargepoints.

Option 3 is preferred as it is expected to promote the uptake of EVs, consistent with wider government policy. Alternatives to mandating this through regulations include continued support through existing grants and other investment-based policy, however incentive-based schemes will not guarantee the required outcome, when compared to compulsion through regulation.

Will the policy be reviewed? It will be reviewed. **If applicable, set review date: 04/2025**				
Does implementation go beyond minimum EU requirements?		Yes		
Is this measure likely to impact on trade and investment?		No		
Are any of these organisations in scope?	**Micro** Yes	**Small** Yes	**Medium** Yes	**Large** Yes
What is the CO_2 equivalent change in greenhouse gas emissions? (Million tonnes CO_2 equivalent)		**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 SELECT SIGNATORY: [signature] Date: 06/12/21

[1] Directive (EU) 2018/844 of the European Parliament and of the Council of 30 May 2018 amending Directive 2010/31/EU on the energy performance of buildings and Directive 2012/27/EU on energy efficiency.

Summary: Analysis & Evidence — Policy Option 1

Description: Regulations match the EPBD requirements: Transposition of requirements set out in the EU Energy Performance in Buildings Directive: installing ducting to route cables in residential new build developments and properties undergoing major renovation, with more than 10 car parking spaces. **Only the costs to the residential sector are considered in this impact assessment.**

FULL ECONOMIC ASSESSMENT

Price Base Year	PV Base Year	Time Period Years	Net Benefit (Present Value (PV)) (£m)		
2019	2022	29	**Low:** £29m	**High:** £199m	**Best Estimate:** £114m

COSTS (£m)	**Total Transition** (Constant Price)	Years	**Average Annual** (excl. Transition) (Constant Price)	**Total Cost** (Present Value)
Low	£2.1m	1	£0.0m	**£2.1m**
High	£6.2m		£0.0m	**£6.2m**
Best Estimate	£4.1m		£0.0m	**£4.1m**

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

The cost of installing ducting to route cables for residential new building developments in car parks with more than 10 spaces is expected to fall on housebuilders. They are also expected to incur an estimated familiarisation cost of £4.1m in year 1. Ducting is replaced after 30 years which falls outside the appraisal period, we do not consider ducting replacement costs.

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

There are no additional non-monetised costs associated with this option.

BENEFITS (£m)	**Total Transition** (Constant Price)	Years	**Average Annual** (excl. Transition) (Constant Price)	**Total Benefit** (Present Value)
Low	0		£2.2m	**£31m**
High	0		£14m	**£205m**
Best Estimate	0		£8.0m	**£118m**

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

Over the 29-year appraisal cycle, it is assumed that homeowners will need to install chargepoints. As retrofitting is more expensive than fitting during construction, there are net savings to society by legislating to require chargepoints to be fitted during construction – most likely enjoyed by purchasers or occupants.

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

Cost savings from installation during construction could also extend to the avoidance of disruption costs/inconveniences caused to the public or building occupants from works involved, such as the digging of trenches. Improved access to charging is key to overcoming consumer range anxiety around the sales of EVs; it can be expected that this policy will result in EV purchases which carry a benefit to society in terms of GHG emissions reductions.

Key assumptions/sensitivities/risks — **Discount rate** 3.5%

It is assumed that levels of ducting linked to new builds will be delivered in volumes in line with OBR forecasts and with the same level of parking provision as the existing housing stock. In multi-occupancy developments, developers take advantage of cost savings through economies of scale, but in single unit dwellings, single unit costs are applied. Impacts are relative to the baseline which assumes almost the same number of retrofit installations over the appraisal period. Installation costs are assumed to be borne by home builders since there is little evidence to support the level to which costs can be passed on to purchasers. We assume Electric Vehicles are the dominant zero emission replacement for petrol and diesel vehicles.

BUSINESS ASSESSMENT (Option 1)

Direct impact on business (Equivalent Annual) £m:			Score for Business Impact Target (qualifying provisions only) £m:
Costs: £3.1m	**Benefits: N/A**	**Net: £3.1m**	£15m

Summary: Analysis & Evidence — Policy Option 2

Description: Ducting and cabling: Installation of ducting, route cables and grid connections per dwelling in all new residential dwellings and dwellings undergoing major renovations, with associated parking.

FULL ECONOMIC ASSESSMENT

Price Base Year 2019	PV Base Year 2022	Time Period Years 29	Net Benefit (Present Value (PV)) (£m)		
			Low: £704m	**High:** £2,981m	**Best Estimate:** £1,842m

COSTS (£m)	**Total Transition** (Constant Price)	Years	**Average Annual** (excl. Transition) (Constant Price)	**Total Cost** (Present Value)
Low	£2.1m	1	£4.1m	**£51m**
High	£6.2m		£12m	**£154m**
Best Estimate	£4.1m		£8.3m	**£103m**

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

Housebuilders are expected to incur familiarisation costs of £4.1m in year 1. Replacement costs for charging infrastructure will be incurred by homeowners, amounting to £98m, relative to the baseline, with ducting, cabling and grid connections installed sooner than in the baseline. The policy installation costs are estimated to be £1,134m, however, when combined with the baseline retrofit installation costs this results in a net benefit, so is captures in the benefits section below.

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

There are no additional non-monetised costs associated with this option.

BENEFITS (£m)	**Total Transition** (Constant Price)	Years	**Average Annual** (excl. Transition) (Constant Price)	**Total Benefit** (Present Value)
Low	0		£51m	**£755m**
High	0		£220m	**£3,135m**
Best Estimate	0		£136m	**£1,945m**

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

The sole monetised benefit for this option is the cost saving against the baseline scenario where ducting, cabling and grid connections are retrofit into existing properties, this is an efficiency saving to society likely to be enjoyed by the occupants of residences.

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

There are also crucial non-monetised benefits to society in terms of the emissions savings resulting from the expected increase in EV uptake due to the ease/lower cost associated with expansion of the access to home charging for consumers who live in a new-build property. It is difficult to quantify the degree to which this policy will increase EV uptake, but an impact on purchasing decisions is expected. Indicative figures have been provided to give a sense of the scale of the benefits in various uptake scenarios.

Key assumptions/sensitivities/risks — **Discount rate** 3.5%

As well as the assumptions listed for policy option 1, there is a risk of stranded assets, if there are structural changes to car ownership, or if charging technology becomes obsolete. Impacts are relative to the baseline which assumes almost the same number of retrofit installations over the appraisal period. Installation costs are assumed to be borne by housebuilders. We assume Electric Vehicles are the dominant zero emission replacement for petrol and diesel vehicles.

BUSINESS ASSESSMENT (Option 2)

Direct impact on business (Equivalent Annual) £m:			Score for Business Impact Target (qualifying provisions only) £m:
Costs: £61m	**Benefits: N/A**	**Net: £61m**	£285m

Summary: Analysis & Evidence Policy Option 3 (Preferred Option)

Description: Installation of one chargepoint per dwelling in all new residential properties and properties undergoing major renovation, with associated parking. Properties with more than 10 parking spaces to have cable routes in all spaces without chargepoints.

FULL ECONOMIC ASSESSMENT

Price Base Year	PV Base Year	Time Period Years	Net Benefit (Present Value (PV)) (£m)		
2019	2022	29	**Low:** £361m	**High:** £2,276m	**Best Estimate:** £1,318m

COSTS (£m)	Total Transition (Constant Price)	Years	Average Annual (excl. Transition) (Constant Price)	Total Cost (Present Value)
Low	£2.1m	1	£13m	**£232m**
High	£6.2m		£40m	**£697m**
Best Estimate	£4.1m		£27m	**£465m**

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

Housebuilders are expected to incur familiarisation costs of £4.1m in year 1. Replacement costs for charging infrastructure will be incurred by home owners or occupants, amounting to £461m, relative to the baseline, with charging infrastructure installed sooner than in the baseline. The policy installation costs are estimated to be £2,560, however, when combined with the baseline retrofit installation costs this results in a net benefit, so is captured in the benefits section below.

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

There are no additional non-monetised costs associated with this option.

BENEFITS (£m)	Total Transition (Constant Price)	Years	Average Annual (excl. Transition) (Constant Price)	Total Benefit (Present Value)
Low	0.0		£56m	**£593m**
High	0.0		£224m	**£2,973m**
Best Estimate	0.0		£140m	**£1,783m**

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

The sole monetised benefit for this option is the cost saving against the baseline scenario where ducting, cabling and grid connections are retrofit into existing properties, this is an efficiency saving to society likely to be enjoyed by the occupants of residences.

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

There are also crucial non-monetised benefits to society in terms of the emissions savings resulting from the expected increase in EV uptake due to an expansion of the access to home charging for consumers who live in a new-build properties. It is difficult to quantify the degree to which this policy will increase EV uptake, but an impact on purchasing decisions is expected. Indicative figures have been provided to give a sense of the scale of the benefits in various uptake scenarios.

Key assumptions/sensitivities/risks | **Discount rate** | 3.5%

As well as the assumptions listed for policy option 1, there is a risk of stranded assets, if there are structural changes to car ownership, or if charging technology (including chargepoint hardware) becomes obsolete. Impacts are relative to the baseline which assumes almost the same number of retrofit installations over the appraisal period. Installation costs are assumed to be borne by housebuilders.

BUSINESS ASSESSMENT (Option 3)

Direct impact on business (Equivalent Annual) £m:			Score for Business Impact Target (qualifying provisions only) £m:
Costs: £137m	**Benefits: N/a**	**Net: £137m**	£641m

Contents

1. Background

1. The Energy Performance of Buildings Directive (EPBD) is the European Union's (EU's) main legislation for improving energy performance and delivering cost effective Green House Gas (GHG) emission reductions across the EU from buildings.
2. A review of the EPBD in 2016 concluded, among other things, that buildings legislation could be used to achieve broader objectives in 'contributing to (the) decarbonisation of the Transport' sector as well as fill a regulatory gap in EU infrastructure legislation to support the deployment of charging infrastructure in non-publicly accessible spaces[1]; considered essential given a significant proportion of charging for electric vehicles (EVs) takes place at home and in private parking areas.
3. Consequently, proposals were made to extend the provisions in the EPBD, including the addition of minimum requirements for charging infrastructure in new residential and non-residential buildings. The requirements were that ducting[2] be installed in every parking space in new residential buildings and residential buildings undergoing major renovation, with more than 10 parking spaces. In new non-residential developments, and those undergoing major renovation, with more than 10 parking spaces, the EPBD set a requirement for at least one chargepoint and ducting for one in five parking spaces.
4. On 23 June 2016, the EU referendum took place and the people of the United Kingdom voted to leave the European Union. The UK remained a full member of the EU while exit negotiations took place and all obligations remained in force. The UK left the EU on 31 January 2020 with a transition period until the EU-UK Trade and Cooperation Agreement (TCA) took effect from 1 January 2021. The UK is therefore no longer bound by EU law or the requirements of this Directive. However, the Government believes it is within England's interests to proceed with these policy measures to support the transition to electric vehicles in line with our ambitious commitments to address climate change.
5. This IA looks specifically at provisions for charging infrastructure for residential new buildings, as well as buildings undergoing major renovations. Only residential new builds with associated off-street parking are in scope. The issues covered within the IA are devolved and therefore the scope of the IA applies to England only. A separate IA will assess the implications for non-residential buildings.
6. The Government had carried out a consultation[3] on amending The Energy Performance of Buildings Directive (EPBD). The consultation focussed specifically on requirements for the installation of chargepoint infrastructure in associated parking spaces of new residential dwellings and those undergoing major renovations. Having considered responses to the consultation, the government now proposes to move forward in line with the guiding principles of the provisions from the EPBD and go further in requiring installation of one chargepoint per dwelling in all new residential dwellings and dwellings undergoing major renovations, into law. This Impact Assessment (IA) builds upon the consultation stage IA[4]

---

[1] http://www.legislation.gov.uk/uksi/2017/897/pdfs/uksi_20170897_en.pdf Alternative Fuels Infrastructure Directive covers public charging provision

[2] Ducting is considered to be any conduit for routing cables from the power supply to the chargepoint. These can include cable trays and subsurface trenches.

[3] https://www.gov.uk/government/consultations/energy-performance-of-buildings-changes-to-the-energy-performance-of-buildings-regulations-2012-no-3118

[4] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/817071/impact-assessment-non-residential.pdf

for residential building requirements by considering, where possible, improved evidence and analysis derived from and since the consultation

2. Problem under consideration

7. The electrification of road transport, particularly for cars and vans, is regarded as a crucial component in meeting legally binding CO2 reduction targets set out in the Climate Change Act (2008). In 2018, Government set out the Road to Zero strategy, our first detailed plan to decarbonise road transport. This set out ambitions for 50%-70% of new cars and vans to be Ultra-Low Emission Vehicles (ULEVs) by 2040 and all new cars and vans to be effectively zero emission by 2050. However, Government is going further and faster to decarbonise transport and announced in 2020 that it would phase out the sale of new petrol and diesel cars and vans by 2030, and, from 2035, require all new cars and vans must be zero emissions at the tailpipe.

8. With Electric Vehicles (EVs) expected to be the most cost effective zero emission alternative to Internal Combustion Engine Vehicles (ICEs) for cars and vans, this transition will require a widespread deployment of charging infrastructure; and it is expected that government intervention will be necessary to support this so that charging infrastructure is installed at a pace which supports the uptake of EVs in line with Government targets. This intervention will help to overcome consumer barriers and attitudes to EVs and ensure that cost savings to society are realised.

9. The transition to zero emission has started; in 2020 there were more than 400,000 ultra-low emission vehicles (ULEVs) registered in the UK[5] and the UK has one of the largest markets for EVs in the EU[6]. However, in 2020 ULEVs represented just 1% of all registered vehicles in the UK. A perceived lack of an accessible and convenient charging infrastructure is repeatedly cited in consumer surveys as a barrier to purchasing an electric car[7]. Addressing this barrier by making it as easy as possible for consumers to charge at home, their workplace, destinations (e.g. supermarkets, train stations), on roadsides and on the strategic road network[8] is therefore crucial if Government EV uptake ambitions are to be met in the coming years.

3. Policy Objective and Context

10. The policy objective is to prepare for the transition to ZEVs by ensuring a suitable provision of charging infrastructure in new residential dwellings where appropriate; as well as to facilitate the transition to ZEVs by raising awareness and the visibility of charging infrastructure.

11. Both public and private access to chargepoints is crucial for the transition to ZEVs. A widespread public chargepoint network is important for drivers who do high mileage, travel long distances and/or have no access to chargepoints at home or work. Government funding and leadership, alongside private sector investment has supported the installation

---

[5] Department for Transport, Vehicles statistics, Ultra-low emissions vehicles (ULEVs), VEH0130, Q4 2020, https://www.gov.uk/government/statistical-data-sets/all-vehicles-veh01

[6] https://www.statista.com/topics/2298/the-uk-electric-vehicle-industry/

[7] In a recent Go Ultra Low Attitudinal tracking survey When asked why you wouldn't consider buying an EV, 64% of respondents said lack of chargepoints.

[8] The strategic road network in England is around 4,300 miles long and is made up of motorways and trunk roads, the most significant 'A' roads

of more than 22,700 public chargepoints[9]. This includes over 4,200 rapid chargepoints - one of the largest networks in Europe.

12. An important part of the public network is the destination charging market. Destination chargers largely comprise of 3 - 50 kW AC chargers in public locations where cars are parked for more than an hour.

13. Early public installations were supported by the Plugged in Places Scheme. These networks were initially owned and run by consortia largely led by local authorities. Over time ownership of many of the publicly available/destination parts of these networks have shifted to industry. Today, the majority of public chargepoints are financed by the private sector. The Government provides support for the installation of workplace charging through the Workplace Charging Scheme (WCS). The Government has also provided £40m of funding via the Go Ultra Low city scheme to eight cities across the UK to support uptake of ultra-low emission vehicles in those cities. To date, over 300 chargepoints have been installed as part of this scheme. Additional charging hubs are being installed across the country– including in York and Milton Keynes.

14. In terms of domestic charging, the Government has supported the installation of almost 100,000 domestic chargepoints in the UK, and currently offers a £350 grant through the Electric Vehicle Home-charge Scheme (EVHS) for those with off-street parking. For residential areas without access to off-street parking, the Government provides funds to local authorities to install infrastructure through the On-Street Residential Charging Scheme (ORCS).

15. Excluding installation costs, evidence shows charging at home is generally more convenient and cheaper than using the public network. For example, using Zap Map's charging calculators[10], the comparative cost of a Nissan Leaf charged by at a 7kW home and public chargepoint is £4.48 and £9.60 respectively. A number of studies show that the vast majority of current electric car owners charge their car at home and that this is key to EVs being a more convenient and cost-effective way to refuel[11]. Many current drivers report never using the public network if they have access to a chargepoint at home given the convenience and low cost (around 3p a mile). 98% of journeys in the UK are less than 50 miles12, which is well within the range of a modern electric vehicle. While current day owners of EVs are expected to be more likely to have off street parking to enable home charging, it is still expected that a large amount of electric vehicle charging will continue to happen at people's homes, due to convenience and lower costs.

16. Longer term, charging at home is also likely to be preferable when it comes to managing the electricity system; as charging at home, overnight will mean less addition to peak electricity demand during the day, and allow the realisation of potential benefits from Demand Side Response (DSR) and other load management technologies.

---

[9] Department for Transport, Electric vehicle charging statistics, April 2021, https://www.gov.uk/government/statistics/electric-vehicle-charging-device-statistics-april-2021/electric-vehicle-charging-device-statistics-april-2021

[10] ZapMap: public charging calculator https://www.zap-map.com/tools/public-charging-calculator/ (April 2019)

[11] Scott Hardman, et.al, 'A review of consumer preferences of and interactions with electric vehicle charging infrastructure', Transportation Research Part D: Transport and Environment (Volume 62), July 2018, pp.508-523.

[12]DfT (2017). National Travel Survey

4. Rationale for Intervention

17. 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 ICE vehicles. ICE vehicles will be over-consumed due to the private costs of their use being lower than the social costs, as the majority of pollution costs are borne by society.

18. The electrification of road transport is necessary to decarbonise transport and to meet Net Zero 2050 targets. As mentioned in the 'Background' section, the Government is currently expected to end the sale of ICE vehicles by 2030. Given our current proximity to this date, the most likely alternative-fuelled vehicle available for cars and vans is going to be battery electric. This means we know with relative certainty, a transformation in chargepoint infrastructure provision will be required over the next 29 years in which this policy is appraised.

19. This is a large scale systemic transition driven primarily by government targets due to the failure of the market to adequately reflect the cost of emissions to society in the price of ICE vehicles. Due to market uncertainty in this transition, regulation and other measures must be employed by the government otherwise there will be a failure to mitigate avoidable costs to society from this transition.

20. As discussed fully in this impact assessment below, the retrofitting of chargepoints and the relevant infrastructure (e.g. ducting, cabling) is more costly than installing at the point of construction. Due to the market failures discussed below, without intervention, we expect the market to install chargepoints in the future, when it is demonstrably costlier (even accounting for time preference) than installing them at the point of construction. The market failures can be characterised as follows:

    - **Network externalities and first mover disadvantage:** Chargepoint supply and EV demand are interdependent. With low or uncertain future EV take-up, chargepoint infrastructure is unprofitable for the market to install. Conversely without adequate provision of chargepoint infrastructure, consumer demand for Electric Vehicles won't materialise. This interdependence between charging infrastructure and EV purchasers means that EV purchasers and charging infrastructure providers suffer a 'first mover disadvantage'. This is where the first movers in building chargepoint infrastructure (or buying EVs) contribute to EV demand (or chargepoint infrastructure supply), but these first movers do not see the benefit of the market they're helping to develop. Therefore, they cannot fully recover the cost of their investment and society benefits from their first-move – creating a positive externality. This means, without intervention, EV uptake and chargepoint infrastructure deployment will be occur below the socially optimal level.
    - **Information failures:** The above network externalities and first-mover disadvantage explains why house buyers are not currently demanding chargepoints in their new developments based on their current circumstances. However, with perfect information, given our position that EV uptake is almost certain and it is more cost effective (even accounting for time preference) to install them at the point of construction, we may expect them to be demanding chargepoints in anticipation of this future cost. However, there is no evidence this is taking place and it was not raised at consultation. Therefore, we conclude that imperfect information is preventing the housing market from demanding chargepoint infrastructure. Without this demand, developers would be reluctant to provide chargepoints as a default in new builds, as it

will represent a construction cost they are unable to charge a premium for. This means we can expect without intervention there will be an under provision of chargepoints.

4.1 Options

21. Three options are therefore considered for the residential new build and major renovation provisions in the EPBD, including the ‘do minimum’ or minimum compliance option, all of which are costed against a ‘do nothing’ baseline in which no regulations are brought in to require installation of charging infrastructure during construction.

22. **Do nothing baseline:** In the baseline, we assume that homeowners gradually retrofit chargepoints as EVs become more popular, with 100% of off-street parking having chargepoints by 2050. This is in line with the ending of new ICE car and van sales by 2030. The methodology behind establishing this baseline and the installation distribution is discussed in detail from later in this IA.

23. **Option 1 – Regulations match the EPBD requirements:** To require ducting to be installed in all parking spaces in residential new builds and properties undergoing major renovations with more than 10 parking spaces, to allow easier chargepoint installation in the future. This is in line with the EPBD minimum requirement and indicates the minimum cost of compliance.

24. **Option 2- Ducting and Cabling:** To require ducting and cabling to be installed for all parking spaces associated with new builds and properties undergoing major renovation

25. **Option 3 – Ducting, Cabling and Chargepoint (Preferred):** To require the installation of at least one chargepoint (minimum 7KW) as well as the necessary cabling and ducting for every dwelling with an associated parking space and in new residential properties and those undergoing major renovation. Properties with more than 10 parking spaces should have cable routes in ever car parking space without a chargepoint. The reason this is preferred is detailed below.

4.2 Preferred Option

26. Option 3 would enable fulfilment of the policy objective to ensure chargepoints are installed in every new home in England, where appropriate. This option not only provides a cost saving to society through the avoidance of higher retrofit costs, but materially is expected to support EV uptake ambitions. If chargepoints become readily available in homes and at key destinations, a key barrier to purchasing an EV (consumer confidence) is addressed, which is likely to enhance EV uptake/support the transition to zero emission road transport.

27. In terms of **monetised impacts** the preferred option does **not represent the highest net present value of options considered**, however we expect that the unmonetised benefits from regulating the installation of chargepoints would go some way to mitigating this additional cost. We expect that the early roll out of chargepoints will facilitate the uptake of EVs by decreasing the cost to purchase an EV (since chargepoints are a part of the perceived cost of purchasing an EV) and improving confidence and awareness among consumers around the use and availability of chargepoints. Overcoming consumer barriers around infrastructure as a whole is a necessary step in the critical path to a complete transition to zero emission road travel and the realisation of significant carbon and fuel savings, air quality improvements as well as other factors which contribute to consumer surplus.

5. Evidence Base

28. The implementation of any of the policy options discussed above will mean the installation of charging infrastructure in new residential dwellings at the point of construction. Monetised impacts require the number of installations and the associated cost to be forecast, both with and without the policy.

29. This section outlines what these impacts are and, where possible, the methodology and assumptions used to monetise them. The methodology centres around charging infrastructure costs gathered from consultant-led research and stakeholder engagement; which are applied to forecasts of installations, derived from residential dwelling completion and parking provision data for residential sites.

30. There are further impacts which are necessarily non-monetised given a lack of appropriate methodology, however evidence which supports these impacts are also outlined in this section. There are five impacts considered in this IA, three of which are monetised and two of which are non-monetised.

31. International evidence was sought to help inform potential benefits and limitations to the preferred policy option, however no substantive evidence was found in spite of there being clear implementation of similar policies in other countries; we provide examples of these policies in this section.

Monetised impacts include:

(i) An expected cost saving **(benefit)** from requiring installation of charging infrastructure during construction at lower cost compared to retrofitting after construction. Likewise, homeowners are expected to receive a cost saving as housing developers are assumed to bear the cost of installation.

(ii) Familiarisation **costs**, incurred by builders to familiarise themselves with the new processes for installing the relevant infrastructure.

(iii) Material replacement **costs,** incurred by homeowners when components of the charging infrastructure require replacement.

Non-monetised impacts include:

(iv) Impacts on EV uptake and subsequent **benefits** – it is not possible to estimate exactly how many EV purchases will be brought forward as a result of implementing the policy, however evidence exists to suggest that availability and visibility of chargepoints contributes favourably to ULEV purchase decisions.

(v) Avoided disruption **costs,** which may be present during retrofit installations.

32. The appraisal period selected for this IA is 29 years (2022-2051) as the options considered in this IA propose the installation of cabling and other hardware with useful lives of up to 30 years. The UK is committed to end its contribution to global warming by 2050 so this timeframe also captures the longer-term expected transition to ZEV cars and vans (as we expect the car/van fleet is expected to almost entirely zero emission by 2050). An appraisal period of 29 years is therefore deemed appropriate to capture the costs and benefits associated with this policy. There are risks that arise with long appraisal periods, and these are discussed later in this IA.

33. All costed impacts are discounted to in line with Green Book suggested discount rate of 3.5% and presented in 2019 prices.

34. Costs of charging infrastructure components themselves have been developed through a consultant-led study supplemented with discussions between DfT and relevant stakeholders (see below).

5.1 Costs of Charging Infrastructure – Evidence Gathered

35. DfT commissioned consultants, Steer, to research the costs of elements of charging infrastructure. Through desk research and stakeholder engagement they were able to identify and provide approximate estimates for four elements of charging infrastructure which are relevant to the proposed policy options, '**Ducting**', '**Cabling**', '**Hardware**' and '**Grid Connection**' costs.

36. Costs were gathered in a three stage process, first through literature review, then through initial interviews with relevant trade bodies, and finally through detailed interviews and/or data gathering from 14 stakeholders who represented electricity network operators (such as National Grid or UK Power Networks), entities engaged in procuring or having chargepoint infrastructure installed (such as Greater London Authority and Berkley Homes), and Chargepoint installers (such as Podpoint and Chargemaster).

37. For each cost component, estimates were captured for upfront installation (during construction) and retrofit installation (after construction) for four types of parking location associated with private houses, and buildings which have multiple occupancy parking;

- **'Off-street private'** – for example, a driveway
- **'Multi-occupancy surface'** – a surface level carpark with multiple spaces
- **'Multi-occupancy underground'** – an underground carpark with multiple spaces
- **'Multi-occupancy multi-storey'** – an above ground multi-storey car park

38. In order to capture economies of scale from multiple installations, Steer provided high/low estimates for each cost category on a cost 'per unit', and a cost 'per 100x units' basis; with the 'per 100x unit' costs factoring in economies of scale.

39. Costs gathered are summarised in cost summary tables which were provided by Steer and amended by DfT analysts through consultations (see annexes). A number of assumptions were applied to derive 'unit costs' from cost data to apply them to each option ('option-costs'), these are set out in the costs section and in further detail in the 'option-cost summaries' in the annexes. A summary table is provided below.

40. During the consultation phase, the majority of respondents stated they had no comment on the costs. Several respondents remarked that costs looked 'lower than expected' but provided no further evidence to support this, resulting in no firm evidence to justify altering current cost estimates. Some respondents with relevant experience showed support of cost assumptions used. Nevertheless, given costs contain a degree of uncertainty which cannot be mitigated at this stage they will be monitored through a number of channels (see monitoring and evaluation) and reviewed during the post-implementation review.

41. It was further considered that optimism bias should be taken into account; however the works undertaken in chargepoint installation are standardised, replicable and testing of these costs with stakeholders, many of whom have incurred the cost of installation numerous times, indicates that they are correct. We believe that uncertainty in the costs is reflected well in the ranges used and that consultation responses sufficiently support this. Furthermore, application of a standard optimism bias % uplift to the cost of retrofitting chargepoint infrastructure and installing in a new build would exacerbate the difference in cost and increase the risk that we overstate the benefits of this policy.

42. Since publication of the consultation stage impact assessment we have gathered primary cost information on per-unit chargepoint installation costs for kerb-side residential chargepoints, these include grid connection costs which are absorbed into the unit costs. Due to commercial sensitivity, this data cannot be published, however we were able to use the data to validate costs provided by Steer and confirm that the high/low cost ranges

capture the range of uncertainty. We have therefore opted to keep costs as they were at the consultation stage, with no changes.

43. For modelling purposes, it is assumed all chargepoints installed will have 7kW speed. This aligns with the minimum requirement set in the proposed regulation.

5.2 Monetised Impacts

44. This section looks at monetised impacts (i-iii) set out above, explaining the evidence used to monetise these impacts, the methodology, risks and sensitivities.

5.2.1 Monetised Impact (i) Net-cost saving from residential installation during construction

(i.i) Overview of methodology

45. This IA considers three options for regulating the installation of chargepoints the construction stage for new buildings.

46. A net cost saving for each of these options is estimated by applying infrastructure costs from Steer, alongside estimated trajectories of annual 'installations' of charging infrastructure both with and without the proposed policy interventions from 2022-2050.

47. The cost saving arises from the difference between upfront and retrofit costs of installation; with retrofit costs being higher. Without implementation of the policy, it is assumed that all installations are retrofitted into new builds proportionate to the level of BEV ownership across the wider population. Work was done to test this assumption since the consultation stage , however in the absence of further evidence, it was concluded that this was the most reasonable approach. In reality, retrofitting of infrastructure may be higher or lower than expected, this is a **risk** which cannot be mitigated and so we assess the impact of this in the sensitivity analysis.

48. As a result, it is assumed that the total number of installations are the same over the appraisal period both in the policy on and policy off scenario. In the do nothing scenario, annual installations are lower in the first half of the appraisal period reflecting the time-lag between construction and residents' willingness to pay to retrofit chargepoints as a result of electrification of the vehicle fleet towards 2050.

49. An implicit assumption here is that consumers ultimately purchase and install almost the same volume of charging infrastructure because they (a) do transition entirely to EVs and (b) they prefer to charge at home. If this does not happen, then there may be an over-installation of charging infrastructure leading to '**stranded assets'** (see **risks and sensitivities**).

(i.ii) Forecasting the number of new residential installations

50. The Government is committed to delivering 300,000[13] homes a year by the mid-2020s and has announced a range of plans to provide the homes that communities need. The number of chargepoint installations will depend on the number of off-street parking spaces added to the existing stock through completions of new residential dwellings each year.

51. At the consultation stage, in order to predict the annual number of new build residential developments Office for Budget Responsibility (OBR) forecasts for private enterprise

[13] UK Parliament (Apr 2020); https://commonslibrary.parliament.uk/research-briefings/sn06416/

residential dwelling completions in the UK in the short-term were used[14]. These forecasts do not however capture residential dwellings that have undergone a material change of use which might reflect where significant renovation has taken place.

52. Following consultation feedback and guidance received from MHCLG we opted to improve on this by using the OBR's forecast net additions[15] to the housing stock forecast. The new data capture buildings that have undergone material change of use into residential dwellings, which is the best available (albeit still imperfect) proxy for major renovations. This has been confirmed through engagement with stakeholders.

53. The OBR estimate net additions by multiplying the completions forecast by a factor informed by the historical ratio between private sector completions and net additions. Net additions include private and public new housing completions, the net effect of other increases in the number of dwellings, which include changes in use of existing buildings (e.g. from offices to housing) and conversions (e.g. from houses to flats, increasing the number of dwellings in each number of buildings), and reductions in the number of dwellings due to demolitions.

54. Based on past net additions data from MHCLG, demolitions and conversions make up a small proportion of net addition figures, therefore the net additions forecast should be more representative of the number of dwellings impacted by this policy than the previously used private enterprise completions forecast.

55. Housing stock forecasts are particularly difficult to forecast over the longer term due to the uncertainties around policy, macro-economic effect and demographic trends which may affect housebuilding. A simplifying assumption has been made to hold the final year forecast for 2025 constant going forward until 2050 meaning there is a risk that by holding this constant the volume of new builds in that period are being under or overestimated. Consultation with MHCLG has confirmed that this is an appropriate approach to projecting housing stock growth, which is tied to numerous macro-economic variables such GDP, interest rates and employment.

56. To understand how stock growth may vary from our assumed trajectory and validate this approach, we tested this assumption against historic trends. It is possible to see that net additions to the housing stock fluctuate year on year but within a relatively narrow bound. Over the last 15 years, average annual net additions have been around 220,000 with a standard deviation of approximately 45,000.[16] Based on this, feedback from relevant stakeholders and the Government's commitment to housebuilding we deem this assumption appropriate.

57. These UK forecasts are adjusted to represent England using the average proportion of house completions in England relative to the UK over the last 3 years to 2019 (82.3%[17]).

58. There is little evidence to support what the level of parking provision would be in new build dwellings; the most credible source identified, which allows insight into the level of parking provision in existing housing is the 2018/19 English Housing Survey[18]. Key information from the report is outlined in Table 1; which shows the % of dwellings by type (detached,

---

[14] Consultation Stage IA, DfT 2019; https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/817069/impact-assessment-residential.pdf

[15] OBR Economic and Fiscal Outlook, 2020; https://obr.uk/efo/economic-and-fiscal-outlook-march-2020/

[16] MHCLG Live Tables, Table 208 Perm Dwellings by Country (Discontinued from 2019, but deemed adequate for an averaging assumption since average is stable over historic data.

[17] MHCLG Live Tables, Table 208 Perm Dwellings by Country (Discontinued from 2019, but deemed adequate for an averaging assumption since average is stable over historic data.

[18] English Housing Survey Live Tables: https://www.gov.uk/government/statistical-data-sets/amenities-services-and-local-environments

flats etc.) and the % of each of these types which have a 'garage' and 'other off-street' parking.

59. Since 2008/09 there has been a growing proportion of houses compared to flats completed yearly[19]. Without further evidence if this trend will persist, and confirmation from MHCLG that it is the most appropriate approach to take, we assume that dwelling completions going forward maintain the same splits illustrated in table 1, with the associated proportions having parking provision – for example 28% of houses completed will be terraced, of which 50% have off-street parking (18% garage and 32% other off-street).

Table 1: English Housing Survey 2018/19 % of dwellings by parking provision

Dwelling type	Garage	Other-off street
Terraced	18%	32%
Semi-Detached	47%	38%
Detached	82%	16%
Bungalow	56%	26%
Flats	7%	26%

60. Splits in Table 1 are used to estimate the number of completions belonging to each category, and the number of these which will have garage or off-street parking. In the absence of further information, **it is assumed these splits remain constant over the appraisal period for all new buildings.** No further evidence on this was presented at consultation; due to uncertainties around this assumption, we readdress this in our sensitivity tests.

61. To map these dwelling categories onto charging infrastructure cost categories developed by Steer, it is assumed that installations for houses (terraced, semi-detached etc.) will correspond with 'off-street private'; and flats will correspond with costs for multi occupancy surface, underground and multi storey. There is currently no evidence to support or deviate from this and none was received through the consultation process.

62. **For flats identified as having garage parking by the English Housing Survey (EHS), it is assumed that these are split in equal proportions between 'multi-occupancy underground' and 'multi-occupancy multi-storey'**, for the purposes of cost aggregation. This is an unevidenced assumption as no data is available to determine the extent to which parking can be provided in each of these forms in new builds and nothing was presented at consultation. It is considered the proportion of flats identified as having 'other off-street' parking fall into the 'multi-occupancy surface' category. The risk to cost totals for underground and multi-storey categories is limited as the cost rates for these parking types are the same, but are higher for surface car parks.

63. **All flats identified as having off-street parking by EHS, are assumed to have one parking space per flat**. Data was sought to test this assumption with no feedback received during the consultation stage. According to a report produced by Transport for London, parking provisions in new builds vary significantly depending on location. For example, purpose-built flats in outer London with parking around 52% have 1 space, and 48% have more than 1; however for flats in inner London 77% have up to 1 space per unit[20]. This the

[19] MHCLG: Table 254 - Housebuilding: permanent dwellings completed, by house and flat, number of bedroom and tenure. https://www.gov.uk/government/statistical-data-sets/live-tables-on-house-building

[20] TfL, 2016, 'Residential Parking Provision in New Developments' p.17; assuming dwellings with 0-0.5 spaces have 0 spaces http://content.tfl.gov.uk/residential-parking-provision-new-development.pdf

only supporting evidence found, and given the variability in parking provision, and the lack of challenge received at consultation stage we expect that assuming one space per flat-unit is an adequate assumption for the purpose of this IA.

64. **It is assumed the distribution of the number of flats in a block will be the same for new builds as it is in the existing stock**, as outlined in EHS 2010[21] which was the most recent data that could be found on flat volumes by building/block. 37.2% of flats were identified as falling in blocks with 10 flats or fewer, with 62.8% falling in blocks of 11 flats or more.

65. Table 2 shows the proportions of new dwellings in each parking provision category forecast for the following years.

Table 2: Annual parking category proportion forecast based on EHS	**2020**	**2021**	**2022**	**2023**	**…**	**2050**
Off-Street Private	89.3%	89.3%	89.3%	89.3%	…	89.3%
Multioccupancy surface	7.9%	7.9%	7.9%	7.9%	…	7.9%
Multioccupancy underground	1.4%	1.4%	1.4%	1.4%	…	1.4%
Multioccupancy multistorey	1.4%	1.4%	1.4%	1.4%	…	1.4%

66. **New build dwelling types are assumed to be delivered in the same proportion as the existing stock,** as outlined in the 2016 EHS stock condition report[22]. The key distinction for our purpose is the proportion of dwellings that are considered houses and the proportion considered flats. 21% of the housing stock were flats in 2016[23] and this fits with 20%[24] of the 2017/18 new builds which were identified as flats.

(i.iii). Forecasting Baseline Residential Installations

67. The baseline against which the different policy options are compared is a scenario where there is no intervention and consumers face higher retrofit costs when they require chargepoint installation in the future. **For this scenario, it is assumed that chargepoints will be installed in almost the same volumes over the appraisal period as the case in which their installation is required in new builds**. The volume of installations in the early years is however significantly lower in the baseline, with the rate of installation increasing overtime in line with the percentage of Battery Electric Vehicles (BEVs) as a share of total car stock.

68. Around 24% of households do not own a car[25] and around 34% of households do not have off-street parking[26]. It might be expected that a portion of house purchasers might buy homes with off-street parking that would never install chargepoints due to a lack of car ownership. For the purpose of this IA, we still assume that all residences in the baseline will ultimately install chargepoints, this is because parking spaces in new builds add a

[21] EHS 2010 is the latest published version to look at number of flats in blocks; EHS 2010, https://www.gov.uk/government/statistical-data-sets/stock-profile

[22] EHS stock condition dataset https://www.gov.uk/government/statistics/english-housing-survey-2016-stock-condition (p.9)

[23] The most recent published data set on this from the EHS is from 2018; we have reviewed this and the proportions have not changed in any material way.

[24] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/743650/House_Building_Release_June_2018.pdf (p.10)

[25] National Travel Survey NTS table: NTS9902

[26] RAC Foundation: Spaced Out - Perspectives in parking policy 2012 https://www.racfoundation.org/wp-content/uploads/2017/11/spaced_out-bates_leibling-jul12.pdf

premium to the price of a home[27], making it less likely that houses with off-street parking will be bought by non-car owning households.

69. Residential charging is more convenient and in many cases more cost effective for the consumer than public charging[28], so it is assumed that where possible, a consumer's preference will be for home charging. It therefore seems likely that residential chargepoints will become more important as BEV ownership increases, as the percentage of BEVs as a share of total car stock increases. For that reason, it is assumed that if chargepoints are not installed in a property at the point of construction, that they will be retrofitted when the occupant purchases a BEV. There may be instances where this does not happen, and we cover this in sensitivity analysis below.

70. The baseline installation rate is modelled on an ambitious BEV stock share scenario that reflects the recent announcement of an end to ICE sales by 2030. This scenario was used to model the percentage of BEVs as a share of the total car stock and the assumption was made that the percentage of dwellings built during the appraisal period with off-street parking that install chargepoints will rise in line with this figure. These assumed baseline installation volumes were then multiplied by the retrofit chargepoint installation costs provided by Steer, to establish the total cost of the baseline scenario.

71. Crucially, the distribution of costs is different for retrofit and newbuild installation scenarios. For retrofit installations, the cost of installation is borne by the consumer, whereas for installation at the point of construction, the cost is borne by the housebuilder**.**

72. **It is assumed that absent of intervention, no chargepoints are installed at the point of construction**. This is a simplifying assumption made in part ensure that we do not underestimate costs to business. There is limited evidence at this stage to contradict this assumption. We tested this during consultation and found some instances where installation during construction is happening where Local Authorities (LAs) have existing requirements for chargepoint installation (though this is not widespread). Additionally, during consultation several small and medium builders indicated that they already installed chargepoint infrastructure during construction; however most respondents would not reveal any plans to install during construction this due to commercial sensitivity.

73. Given the significance of this assumption we would expect that this it would have been challenged at the consultation stage if it were incorrect i.e. we would receive comment from developers that it is common practice to install infrastructure during construction; however none of the major developers told us this, and only two small builders explained that they do install chargepoints during construction – we consider the scale of this too small to substantively contradict the assumption, especially since major developers are responsible for 90% of new builds.

74. However, if builders did currently install chargepoints during construction we could expect that this regulation would be less impactful in driving this behaviour and subsequently the NPV from this regulation would be lower. We will test and monitor developer attitudes toward installation of chargepoint infrastructure post implementation of these regulations to develop the understanding of the value of this regulation, and further explore this impact in sensitivities.

---

[27] Research performed by Direct Line, 2016 shows that parking spaces add around 5% premium on a property https://www.directline.com/media/archive-2016/expensive-parking-spaces

[28] There are a number of studies which support the preference of EV users for charging at home, and linking home charging to EV acceptance among consumers such as (Skippon and Garwood, 2011; Neaimeh et al. 2017)

(i.iv). Application of charging infrastructure costs to forecast volumes; and assumptions:

75. The costs and assumptions used in each option are set out in this section; providing additional detail on what the costs contain, and how/why they vary between 'high' and 'low' as well as 'new build' vs. retrofit.

Deriving unit costs for Option 1: Ducting installed for buildings with > 10 parking spaces:

76. Ducting is considered as any conduit for routing cables from the power supply to the chargepoint. These can be cable trays or subsurface trenches.

77. The largest driver of variability in cost between the new build and retrofit scenario comes from the costs of civil works[29] in surface level car parks, where trenching is required to install cables underground. In retrofit installations, the costs of having to trench and resurface are high. In other locations, alternative (cheaper) approaches are available which do not require trenching/digging up surfaces, such as wall/ceiling mounted cabling and chargepoints.

78. The difference between the low and high cost scenarios is largely because of the volume of ducting and/or trenching required, driven by assumed distances from the power supply to the charging infrastructure location.

79. Table 3 presents cost per parking space for installing ducting for each property where ducting is fitted during construction ('New Build') and where it is installed post-construction ('Retrofit').

Table 3: Option 1 per-unit cost summary (Steer)

	New Build		Retrofit	
Parking Type	**Low**	**High**	**Low**	**High**
Off-street private	£33	£167	£33	£167
Multi-occupancy surface	£187	£600	£467	£2,500
Multi-occupancy underground	£67	£200	£167	£500
Multi-occupancy multi	£67	£200	£167	£500

Deriving unit costs for Option 2: Cost of ducting, cabling and grid connection per parking space

80. As with ducting in Option 1, the cost differences for cabling between categories are driven by the length of cabling required. Where infrastructure is retrofitted post-construction, it is assumed that an entirely new cable from the distribution board to the chargepoint is required in all situations, which drives the higher cost.

81. Another significant driver of cost is the electrical equipment required. For off-street private parking, the chargepoint will only require a single miniature circuit breaker (MCB) in an existing distribution board which can be easily retrofitted. However, when 100 connections are installed together (in multi-storey or underground car parks), multiple moulded case circuit breakers of different current ratings will be required to supply electricity to the chargepoints, which brings a higher cost.

82. At surface level, chargepoints will be supplied from a feeder pillar, which can serve multiple chargepoints.

[29] Considered to be work involving amendments to physical public structures.

83. Grid connection costs associated with chargepoint connections vary significantly depending on location and the level of available network capacity at the nearest grid connection point, and hence it is difficult to establish a representative unit cost for installations. Annex B identifies the assumptions that have been built into these cost profiles. Most respondents to the consultation did not provide further evidence on alternative assumptions to inform grid costs, whilst those that did, provided costs for highly specified scenarios/sites which are not easily applied to an average example. As discussed previously in the IA, based on unit installation costs gathered through a government scheme which include connection costs, we are content that the range we have used captures the variability in grid connection costs. Based on this and the lack of challenge during consultation we have not altered our assumptions, but will continue to monitor cost data to use in ex-post evaluation of the regulation.

84. For multioccupancy installations, the low range costs reflect a scenario where a larger transformer[30] is required (relative to a situation where no chargepoint is installed), whilst the high range costs reflect a scenario where an additional transformer is required. For retrofit installations, the high range cost is more likely as the existing transformer will either need to be replaced, or an additional one built.

85. For a single installation, either new build or retrofit, it is assumed that there would be sufficient power capacity to supply the chargepoint, so there are no additional grid reinforcement costs (unless a dedicated supply was installed). These costs are shown in table 4 below.

Table 4: Option 2 per-unit cost summary (Steer) –Cabling and grid connection provision

	New		Retro	
Parking Type	**Low**	**High**	**Low**	**High**
Off-street private	£100	£600	£467	£1,900
Multi-occupancy surface	£372	£2,344	£880	£6,860
Multi-occupancy underground	£280	£2,120	£650	£5,300
Multi-occupancy multi	£280	£2,120	£650	£5,300

Deriving unit costs for Option 3: Cost of ducting, cabling, grid connection and a chargepoint per parking space

86. The preferred option will also include ‘hardware costs’ for chargepoints installed for every parking space. This is the physical chargepoint unit/outlet that connects an EV to the power source. These units can be either wall or ground-mounted. Costs are based on a 7kW smart chargepoint with additional data connectivity costs that are relevant for the multi-occupancy underground and multi-storey cost categories where it is assumed that data connectivity may not be available. Whilst chargepoints are assumed to be ‘smart’, this will not be an explicit requirement in the Building Regulations but will become a requirement through smart charging regulations.

87. Multi-occupancy surface car parks are assumed to require a ground-mounted chargepoint which carries an additional cost (due to the larger physical structure), whilst the other parking categories are assumed to require a wall mounted chargepoint.

[30] A static device which transfers electrical energy from one circuit to another through the process of electromagnetic induction.

88. Cost differences between new build and retrofit are solely driven by assumed bulk buy discounts gained on new build developments where chargepoint hardware can be purchased in large volumes. These costs are show in table 5 below.

Table 5: Option 3 per-unit cost summary (Steer) – full chargepoint provision				
	New		Retro	
Parking Type	**Low**	**High**	**Low**	**High**
Off-street private	£615	£1,115	£982	£2,415
Multi-occupancy surface	£975	£2,947	£2,230	£8,210
Multi-occupancy underground	£812	£2,652	£1,640	£6,290
Multi-occupancy multi	£812	£2,652	£1,640	£6,290

i.v. Other key cost assumptions

89. **Only multi-occupancy developments can take advantage of economies of scale cost reductions**. Costs were provided based on a single unit cost and a 100x unit cost, under the assumption that for multi-occupancy buildings, there will be economies of scale savings made as some fixed costs will be shared across the units. Evidence received through the consultation has confirmed the estimates of the single unit cost to be appropriate for all off-street private dwellings. There is a risk that this over estimates costs as housing developers would be able to achieve economies of scale savings on multiple single occupancy developments (e.g. on housing estates), but it has not been possible to find the granularity of data necessary to inform this given the nascent stage of the market.

90. **All multi-occupancy developments are costed using the 100-installation unit cost.** For multi-occupancy dwellings, the 100 x unit costs were broken down to a per unit basis and multiplied by the volume of dwellings in each parking provision category. This does not perfectly capture the degree to which economies of scale reduce cost per unit based on different multi-occupancy building sizes, but given the limited breakdown of fixed and variable costs, it was not possible to identify this.

91. **Only new build installations benefit from economies of scale savings.** Cost differences arise between new build and retrofit options through the assumption that where possible, multi-occupancy new build developments will be able to take advantage of economies of scale to gain reduced unit costs, whilst retrofit installations will always be done on a single unit basis and therefore will not achieve the discounted rates.

92. **For all options, construction firms experience familiarisation costs**. We tested the need to integrate and disseminate information on regulations. We have adopted a simplified approach and have tested this with stakeholders with no further comment. A body representing small builders explained that costs might not be as substantial where there is small headcount and informal processes, such as familiarisation in spare time by business owners.

93. **Technological learning/cost reduction rates have not been modelled due to a lack of data to inform this.** Whilst most respondents to the consultation agreed that there will be technological improvements over the appraisal period. There was no indication as to how much this could impact hardware costs, if at all. Over time existing models will become cheaper whilst new technology enters the market at a higher price. Depending on consumer demand they may prefer a cheaper model that meets their basic needs or be willing to pay for a more expensive model that has more functions. If overall hardware costs were to decrease overtime, this would have a negative effect on the NPV, as a greater

proportion of retrofit installations happen later in the appraisal period. This is tested out in sensitivity analysis section below.

Summary of retrofit cost avoidance benefit

94. Where full chargepoint infrastructure installation takes place during construction, the cost of installation is passed from home owners who would otherwise retrofit the infrastructure, to housing developers who install infrastructure at a lower cost – resulting in a net saving to society. We assume that costs are not passed from builders to purchasers after this, however even if they were, the net savings would remain. Therefore the modelled impacts of the regulation show a transfer of costs from private individual to business, where individuals enjoy benefits.

95. Table 6 shows the present value installation cost savings across the whole of society for all options. The first section of the table shows what the cost of a particular installation component would be under a retrofit installation, with the second part showing what the new build cost would be, and finally the benefits section showing the difference between these figures.

Table 6: Installation cost savings vs baseline (millions, 2019 prices, 2022 base year)

Option	Low	Central	High
Baseline installation costs			
1. Ducting	£57m	£172m	£288m
2. Ducting and cabling	£1,071m	£3,079m	£5,086m
3. Ducting, cabling and chargepoint	£2,336m	£4,343m	£6,351m
Policy Option Installation costs			
1. Ducting	£26m	£55m	£83m
2. Ducting and cabling	£316m	£1,134m	£1,952m
3. Ducting, cabling and chargepoint	£1,742m	£2,560m	£3,377m
Cost saving benefits			
1. Ducting	**£31m**	**£118m**	**£205m**
2. Ducting and cabling	**£755m**	**£1,945m**	**£3,135m**
3. Ducting, cabling and Chargepoint	**£593m**	**£1,783m**	**£2,973m**

96. The above costs for baseline and policy options come from a simple multiplication of annual volumes of new build properties with parking.

5.2.2 Monetised Impact (ii) Familiarisation costs

97. In addition to installation costs, there will be some time costs to construction firms as they familiarise themselves with the new regulations. These costs include the time taken to read the regulations and to formulate a plan in response but do not include logistic expensive. Whilst there is a great deal of uncertainty around exactly how long it would take, it is assumed that the impact will be greatest for construction firms as they will have to accommodate the new requirements in their construction processes. We would expect procurement activity around chargepoints infrastructure to not add materially to time taken as such processes will largely be in place.

98. For construction firms it is assumed that 10% of non-construction staff[31] (56,584 for domestic construction and 1,856 for non-domestic) will spend around 8 hours reading and implementing the regulations. These time and staff requirement estimates are unevidenced and no further evidence was presented at consultation. ASHE 2019 hourly

[31] Non-construction staff assumed to represent 22% of total staff Using information from the ONS Census 2011 (table: CT0144, SIC F construction). Total staff found using 2017 Business Register and Employment Survey table 2, SIC 4120

wage data for 'Production managers and directors in construction' gives a rate of £24.17[32] per hour, which comes to £30.58 per hour including a non-wage labour uplift of 26.5%[33]. The overall familiarisation costs that occur in year 1 only are around £4.1m (2019 prices). We tested this at the consultation stage with no challenge received. The only relevant information received was from a trade body that such regulations are dealt with by small builders 'on site' whilst construction is being overseen and by small business owners during non-work hours.

99. The low and high scenarios in the table below represent a situation where familiarisation takes 50% and 150% of the time identified in the central scenario. No further information was received at consultation to develop these assumptions further.

Table 7: familiarisation costs (millions, 2019 prices, 2022 base year)			
Option	**Low**	**Central**	**High**
1. Ducting	£2.1m	£4.1m	£6.2m
2. Ducting and cabling	£2.1m	£4.1m	£6.2m
3. Ducting, cabling and Chargepoint	£2.1m	£4.1m	£6.2m

5.2.3 Monetised Impact (iii) Material Replacement costs

100. This section highlights how these material replacement costs have been modelled based on the economic life of the components. These costs arise as infrastructure installed over the course of the appraisal period requires replacement due to wear.

101. The CIBSE Guide M – engineering and management[34] gives the estimated economic life of various building services items. The CIBSE guides are well respected and widely used by the building services profession. Guide M defines economic life as:

'*The estimated number of years until that item no longer represents the least expensive method of performing its function'*.

102. The economic life estimates are based on assumptions, including maintenance, installation and hours of operation. Variation factors may be appropriate if, for example, the equipment will be utilised less than the assumptions used to inform the Guide.

103. Indicative economic life expectancy is given in Appendix 13. A1 of CIBSE Guide M. There are no specific guidelines for electric vehicle charging infrastructure, but during the consultation stage key stakeholders were asked based on their experience what the lifespan could which largely supported our assumptions, apart from comment received on useful life for the Electric Vehicle Supply Equipment (EVSE) outlet which is 10 years, and was consequently adjusted to 10 year in our analysis. Table 8 shows different infrastructure components considered in this IA, the analogous component considered in the CIBSE Guide M and corresponding economic lifespan.

Table 8: Indicative economic lifespan of equipment		
Equipment type	**Multi-occupancy car park**	**Private off-street parking**
Cables	30 years[1]	25 years[6]

[32] https://www.ons.gov.uk/employmentandlabourmarket/peopleinwork/earningsandworkinghours/datasets/occupation4digitsoc2010ashetable14 ASHE table 14.6a, wage rates are uplifted by 30% to reflect overheads such as: training, equipment, pension contributions and National Insurance Contributions.

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

[34]Guide from BRE https://www.breeam.nl/sites/breeam.nl/files/hulp/CIBSE%20Guide%20M.pdf

Feeder pillars, base units etc	30 years[2]	N/A
Ducting	30 years[3]	30 years[3]
Distribution boards	20 years[4]	20 years[4]
EVSE outlet	10 years[5]	10 years[5]

References from CIBSE Guide M, Appendix 13. A1 & Stakeholder Feedback

Distribution of LV electricity from main switchgear to area distribution boards:

1. HV and LV cables and wiring etc (thermoplastic) – 30 years
2. Fuse pillars, base units, poles and accessories etc – 30 years
3. Conduits and cable trunking plus supports etc – 30 to 35 years
4. LV switch gear and distribution boards – 20 years
5. Based on stakeholder feedback

Power installations:

1. Socket outlets, fuse connection units, etc – 10 years
2. General LV power installations – 25 years

104. Based on the equipment lifespans presented in the table above, and assuming baseline and policy option volumes of installations outlined earlier, the costs in table 9 have been generated for the appraisal period. The baseline total replacement costs are lower than for each option as installations occur later, and so fewer components require replacement during the appraisal period. For each of the options it is assumed that any aspect of the installation not installed at the point of construction would later be retrofitted at the same time as it would have been in the baseline. Total replacement costs for each option are presented as well as the costs relative to the baseline. It is expected that these costs fall on end users of dwellings, either directly or through charges placed on occupants by owners.

Table 9: Material/hardware replacement costs, central (millions, 2019 prices, 2022 base year)

Component	Baseline	Option 1	Option 2	Option 3
EVSE outlet	£442m	£442m	£442m	£805m
Distribution boards	£3m	£3m	£18m	£18m
Cables	£2m	£2m	£85m	£85m
Ducting and feeder pillars	£0m	£0m	£0m	£0m
Total Costs	£447m	£447m	£546m	£908m
Cost relative to baseline	-	**£0m**	**£98m**	**£461m**

105. Whilst these costs are quite significant, these represent what are likely to be an upper bound for replacement costs. This is because in the early years, charging infrastructure installed in the policy options is likely to be underutilised. As level of use/hours of operation negatively impacts the economic life of charging equipment, it is possible that hardware installed in the early years would last longer than the estimates provided. This would result in lower replacement costs for the options relative to the baseline, but would be most pronounced for option 3 (as the physical chargepoint hardware is the largest component of replacement costs).

106. These costs are based on a 'central' cost scenario. It is assumed that these costs are 50% lower/higher for the low and high cost scenarios, and no further basis for creating a range was found during consultation.

5.3 Non-monetised Impacts

5.3.1 Non-monetised Impact (iv) Emissions Savings

107. As lack of awareness and perceived access to charging is a barrier to EV adoption, with increased residential chargepoint installation comes the potential for the rate of EV adoption to increase over the short to medium term thus increasing emissions savings over the longer term – with EVs displacing tailpipe CO2-emitting ICEs sooner. Whilst the number of chargepoints identified in the baseline and option 3 are the same over the appraisal period, the installation rate is much higher in the early years in option 3 so it seems likely that there will be benefits associated with increased EV adoption, particularly in the early years under this scenario. As EVs displace ICE vehicles, there are monetisable benefits to society through emissions savings and air quality improvements. 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 virtuous cycle of induced EV demand.

108. Increasing the perception of access to overnight charging is a key way to increase the feasibility of EV ownership. Access to chargepoints is correlated with EV uptake and it is acknowledged that low perceived availability is an inhibitor to adoption (supported by numerous studies, including a 2018 study by the European Commission– see below). By providing charging infrastructure in new and renovated buildings, it is less likely consumers will bear financial, logistical and time cost of installation. At the very least, interventions that increase the perception of access to charging improve consumer confidence and awareness and remove a barrier to adoption. It is anticipated that for some people, this will be the marginal factor that tips the balance towards EV purchase sooner. Crucially, we would expect the salience of a chargepoint being present on a property and in car parks to increase the perception of access to charging and help with the normalisation of Electrified road transport.

109. For public charging infrastructure, the European Parliament's TRAN committee report[35] has reviewed the available literature and assesses that whilst there is a positive correlation between public chargepoint provision and EV uptake, and that charging infrastructure roll-out is critical in the early stages of market development - it is unclear exactly the scale of impact that the provision of infrastructure has, and how it interacts with other factors affecting uptake such as model availability, financial incentives etc.

110. Behavioural biases may also play in part in nudging consumers towards EV purchase because of chargepoint ownership. The endowment effect is an example of a behavioural bias that results in individuals placing a disproportionately high valuation on items that they own[36]. Homeowners endowed with a chargepoint might over-value it to the degree where there is a higher perceived saving on purchasing an EV, leading to increased EV uptake. Furthermore, network or 'neighbouring' effects from chargepoints in new homes which are visible may drive EV purchase in nearby residences.

111. Whilst it has not been possible to identify the degree to which chargepoint provision will increase EV uptake, the sensitivities section provides analysis to illustrate the potential order of magnitude of the value of potential emissions savings as a result of additional EV uptake.

---

[35] Tran Committee Research, European Parliament, Sections 3.1 & 3.2, 2018: http://www.europarl.europa.eu/RegData/etudes/STUD/2018/617470/IPOL_STU(2018)617470_EN.pdf

[36] Endowment Effect Explanation: https://www.behavioraleconomics.com/resources/mini-encyclopedia-of-be/endowment-effect/

112. A possible methodology for quantifying the effect on EV uptake was considered using internal DfT modelling to identify EV uptake based on different input scenarios. The impact of increased access to residential charging was modelled by subtracting the chargepoint installing cost from the purchase price of an EV. The resulting increase in demand relative to the baseline inputs was considered to be attributable to the additional chargepoint access.

113. There are however a number of limitations with this approach, which is why benefits as a result of EV uptake are not included in the NPV.

- The model only captures the impact on demand as a result of not having to include the cost of chargepoint installation in an EV purchase decision. This accounts only for the financial consideration but none of the additional behavioural factors that might impact an EV purchase decision as a result of chargepoint ownership.
- This methodology does not account for the notion that the financial benefit of already owning a chargepoint should only be realised for the first EV purchase a household makes. As the model does not account for which individual makes the purchase, and given that the average vehicle turnover rate is 4 years[37], the financial benefit per household is likely being counted multiple times as individuals purchase additional vehicles.
- The benefit of an existing chargepoint in a household should also be realised on the first EV purchase every time a new occupier moves in, but it has not been possible to identify the rate at which this would happen, or how to capture this in the model.

5.3.2 Non-monetised Impact (v) Avoided disruption costs

114. An additional non-monetised benefit may be generated through avoiding any disruption costs that could arise as a result of construction work taking place during a retrofit installation. When installation takes place at the point of construction, there are no occupants in the property who can be inconvenienced by the work taking place. During a retrofit installation, where occupiers are likely to be present at the property, disruption costs could include: disruption to the electricity supply; property access issues; parking disruption; noise; road closures. This will be most acute when an installation involves car park resurfacing, such as those taking place in multi-occupancy surface car parks. These disruption costs are not likely to be significant however, and no attempt to quantify them (and consequently the benefit from avoiding them) has been made. No evidence was presented during consultation to evidence disruption costs and so these remain non-monetised.

5.4 International Evidence

115. Other European countries are implementing the EPBD but it is too early to obtain evidence of potential lessons and benefits of the different options considered, and whilst there have been implementations of changes to building codes and regulations in a number of places, we have not found any published evidence in support of these policies. Some examples of where similar policies have been enacted or recommendations made are listed below.

116. In the 2016 report, Charging Infrastructure for Electric Vehicles in Germany: Progress Report and Recommendations, the German National Platform for Electric Mobility (NPE)

---

[37] RAC Foundation – Car Ownership in Great Britain https://www.racfoundation.org/wp-content/uploads/2017/11/car-ownership-in-great-britain-leibling-171008-report.pdf

concluded that 'both the private and publicly accessible charging infrastructure require more private investment and public-sector incentive funding'. In order to encourage the deployment of charging infrastructure, the following policies were recommended amongst others:

- Parking place provisions of regional planning regulations to be amended to include obligations for setting up charging infrastructure or cabling during new-build or conversion projects;
- A commitment to establish charging infrastructure at car parks and multi-storey car parks that are owned by the state, e.g. railway stations, airports, housing complexes, motorway service stations etc.;
- Residential property law should be amended so the costs incurred for the installation of private charge points are regulated

117. **The Ministry of Economic Affairs, Netherlands (2017),** similarly concluded that it 'seems sensible to devote more attention to charging infrastructure in the built environment since relatively small investments will be involved and the costs for subsequent installation could be substantial'. With regards to charging at home, the Association of Netherlands Municipalities recommends that every EV driver is given the right to a charge point, thus ensuring landlords do not prevent the roll out of charging infrastructure, although this is not officially included in legislation. However, a resolution to do more in charging infrastructure in the built environment has been reached in the Netherlands, with ongoing consultations between the Ministry of Economic Affairs and the Ministry of Interior and Kingdom Relations on the issue.[38]

118. **Vancouver, Canada:** In 2008, 2009, and 2014 Vancouver amended their by-laws to become the first North-American municipality to mandate Electric Vehicle Supply Equipment (EVSE)-ready electrical installation in all new residential and commercial construction. The by-law amendments were as follows:

- Single-Family Dwellings: Vancouver Building By-law No. 9691 (2008), which requires each dwelling unit to be constructed with a cable raceway capable of supporting level 2 charging infrastructure; and
- Multifamily Dwellings: Vancouver Building By-law No. 9936 (2009), which requires 20% of the parking stalls in multifamily construction (three or more dwelling units) to be equipped with a receptacle to accommodate EVSE use. [39]

119. **Oregon, US:** Oregon amended the state-wide electrical code to streamline processes for charging station installations[40], by introducing the State's minor labels programme. Minor labels are inexpensive permits for minor electrical and plumbing installations. Inspections are only required in one of ten installations. This enables quicker and more cost-effective installation of EV charging stations. Their recent EV strategy also quotes the development of EV-ready requirements for new building construction as an upcoming action for the area[41].

---

[38] Ministry of Economic Affairs (2017), *Vision on the charging infrastructure for electric transport*, p.28-29

[39] Transportation and Climate Initiative (2012), *EV Ready Codes for the Built Environment,* p.30 http://www.transportationandclimate.org/sites/default/files/EV-Ready_Codes_for_the_Built_Environment_0.pdf (Accessed: 21/02/2018)

[40] City of Portland Oregon (n.d), *The Portland Strategy At a Glance,* https://www.portlandoregon.gov/shared/cfm/image.cfm?id=309915 (Accessed: 21/02/2018)

[41] City of Portland Oregon (2017), *2017 City of Portland Electric Vehicle Strategy*, https://www.portlandoregon.gov/bps/article/619275 (Accessed: 21/02/2018)

120. **Atlanta, US:** In November 2017, the city of Atlanta passed "EV Ready" ordinance into Law. This requires:

- 'All new residential homes and public parking facilities to accommodate [EVs]';
- For '20 per cent of the spaces in all commercial and multifamily parking structures to be EV ready'; and
- For 'the development of all residential homes to be equipped with the infrastructure needed to install EV charging stations, such as conduit, wiring and electrical capacity'[42].

121. **California, US:** California introduced a state-wide requirement in California's Green Building Standards Code (2015) for 3 per cent of all parking spaces in commercial buildings to include "make-ready" infrastructure for EV charging stations, including dedicated panel and circuit capacity[43]. Los Angeles and San Francisco have built upon these foundations supporting EVs in the built environment with area-wide policies. In Los Angeles, single-family homes now require a dedicated 240 V outlet and circuit 31 capacity for a Level 2 charger[44], and in April 2017, San Francisco introduced a new law so that as of January 2018:

122. Some relevant evidence from Norway which has experienced large progress in electromobility could provide some useful insight into charging preferences for consumers at home. In 2017, electric vehicles (EVs) made up almost 40% of newly registered passenger cars in Norway[45]. The Norwegian EV Association finds that charging at home is still the favoured option among consumers with the ratio of EVs to public chargepoints increasing overtime. Some reasons could be, that it's cheaper to charge at home since users pay a private rate charged to electricity bills rather than a commercial rate paid at a public location, it is possible to charge over-night and benefit from lower electricity tariffs and because it is convenient.

6. Results

6.1 Evidence Summary and preferred option

123. This section presents the results of the analysis outlined above and discusses the key risks and sensitivities around monetised impacts, as well as at how these impacts are likely to fall on different groups, including small and medium businesses.

124. Impacts have been monetised using the best available information on charging infrastructure costs and a transparent forecasting methodology, as outlined in previous sections. Table 10 shows the costs and benefits to society as a whole under each option.

Table 10: societal cost/benefit summary (millions, 2019 prices, 2022 base year)

	Option 1	Option 2	Option 3

[42] City of Atlanta (2017), *City of Atlanta Passes "EV Ready" Ordinance into Law*, https://www.atlantaga.gov/Home/Components/News/News/10258/1338?backlist=%2F (Accessed: 21/02/2018)

[43] The International Council on Clean Transportation (2017), *Emerging Best Practices for Electric Vehicle Charging Infrastructure*, https://www.theicct.org/sites/default/files/publications/EV-charging-best-practices_ICCT-white-paper_04102017_vF.pdf (Accessed: 26/02/2018)

[44] The International Council on Clean Transportation (2017), *Emerging Best Practices for Electric Vehicle Charging Infrastructure*, https://www.theicct.org/sites/default/files/publications/EV-charging-best-practices_ICCT-white-paper_04102017_vF.pdf (Accessed: 26/02/2018)

[45] Policy Department for Structural and Cohesion Policies, European Parliament - Charging infrastructure for electric road vehicles: https://www.europarl.europa.eu/RegData/etudes/STUD/2018/617470/IPOL_STU(2018)617470_EN.pdf

Costs (discounted)			
Familiarisation	£4.1m	£4.1m	£4.1m
Net replacement costs	£0m	£98m	£461m
Policy installation costs	£55m	£1,134m	£2,560m
Total costs	**£59m**	**£1,236m**	**£3,025m**
Benefits (discounted)			
Baseline installation costs (cost savings to residents)	£118m	£1,945m	£1,783m
Total benefits	**£118m**	**£1,945m**	**£1,783m**
Summary			
Net Present Value	**£114m**	**£1,842m**	**£1,318m**

6.2 Sensitivity Analysis

125. There are a number of uncertainties in the above estimates which need to be tested through sensitivities. The most important overarching uncertainties are the level to which retrofit installations occur in the baseline and the split of between types of new dwellings which we otherwise hold constant. Where there are fewer retrofit installations in the baseline the NPV will be lower.

126. The cost benefit analysis presented in this IA is most sensitive to the assumption that without the preferred regulatory change, retrofit of chargepoints and enabling infrastructure would occur in proportion to the increasing % of the car fleet which are Battery Electric Vehicles (BEVs).

127. This assumption was tested and unchallenged with no alternative put forward by stakeholders at the consultation stage. In reality, similar to the level of uptake or long-term car ownership patterns, the rate at which chargepoint infrastructure is retrofitted into buildings is uncertain. This is a theme which sits across infrastructure interventions in the decarbonisation programme as discussed briefly in the rationale for intervention.

128. DfT have developed scenarios to project changes in the vehicle composition of the fleet for the 10 point plan, these reflect an intention for sales of ICE vehicles to end in 2030.

129. Baseline installations falling below the assumed rate would mean a lower NPV, because installations would happen in excess of market demand leading to ‘stranded-assets’. There could be a number of reasons this might happen. For example, illustratively, in the short-term consumers might stick to traditional power outlets instead of chargepoints, tolerating a lower speed of charging as they are unwilling to incur the ‘hassle cost’ of installation. Over the longer term charging technology might change meaning retrofit costs come down or it might be found that there are reductions car ownership through car sharing/modal shifts, or changes in zero emission vehicle costs/preferences (such as a shift to hydrogen) may alter the demand for retrofit installation in buildings.

130. Alternatively, consumers may shift to alternative low carbon modes which do not require at- home charging, such as car sharing, public transport, or hydrogen powered vehicles, we explore some of the details around these reasons below through some illustrative examples.

131. We focus on downside sensitivities since the key risk around this policy is stranded assets which will occur where the assets installed as a result of this policy become underutilised.

Examples of why there may be lower than predicted baseline installations

132. **Lower than expected car ownership:** at the moment we expect that cars and vans still remain the primary mode of road transport and that demand for cars and vans will continue

to grow in line with national income and population. Whilst we expect this to be the case, there is increasing evidence to show that car ownership growth is diminishing/reaching a plateau with any number of factors contributing, from increased urbanisation leading to reduced perceived need for cars to changing demographics[46], with lower than expected car ownership growth we might expect less demand for residential chargepoints.

133. **BEV uptake is below the trajectory set out in the baseline due to shift in technology/preference/modes:** the baseline BEV uptake trajectory is based on scenarios set out in the DfT scenarios aligned with a 2030 phase out of ICE vehicle saves, and assumes consumers shift primarily to BEVs over alternatives. If this were not the case, then BEV uptake could be below the assumed trajectory, leading to fewer than expected residential chargepoints. Given the relative technology readiness of BEVs relative to, for example hydrogen as an alternative, the proximity of the phase out date, a rapidly expanding EV market, and reducing EV costs, a substantial alternative technology to BEVs is highly unlikely in the absence of supply constraints.

134. **Cars are not parked at home because of increased Shared Mobility or higher than expected cost of charging at home:** it may be the case that car ownership reduces without usage decreasing, if shared car ownership becomes the norm. There is evidence to suggest that car sharing is gaining in popularity as a lower cost means of having access to a vehicle. In 2018, there were 'at least 48 car sharing schemes' and these seem to be growing in both use and popularity[47]**.**

135. There are a number of other uncertainties and risk which will have to be monitored and are detailed in Risks and Uncertainties.

Testing the sensitivity of the NPV to reductions baseline levels of retrofit

136. We rely on scenarios which illustrate how the NPV would change if the risks outlined above were realised. These scenarios focus on variations in BEV uptake and how that would impact on the demand for retrofit chargepoint installations (and subsequently the utility of this regulation). The scenarios are described as follows.

(1) **No ending of new ICE sales:** This scenario is modelled using car choice modelling, assuming no petrol/diesel vehicle end date of new sales and that the transition to zero emission vehicles does not fully occur because ICE vehicles do not become a cost effective alternative. This scenario results in 50% of installations occurring in the baseline, which leads to a substantially negative NPV of -£846m.

(2) **Scenarios where baseline installations are constrained to 40% and 80%:** constraining baseline retrofit installation to 40% and 80% of the stock of new builds illustrates a scenario where less consumers charge at home, for example if consumers prefer to charge at work or publicly or if is a market reduction in car ownership. At the lower end we chose the 40% constraint as previous years have seen around 40% of ULEV (Ultra Low Emission Vehicle) purchasers take up the Electric Vehicle Home Charging Scheme (EVHS) grant. It can be inferred that, at least in the short term, chargepoint infrastructure may be retrofitted by as little as 40% of those who purchase a ULEV[48]. It is also similar to levels of car ownership tested in the National Grid Future

---

[46] http://sro.sussex.ac.uk/id/eprint/69143/1/1-s2.0-S1361920917300536-main%20%284%29.pdf

[47] Government Office for Science , Future of Mobility Evidence Review (Page 54.) https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/773676/passengerroadtransport.pdff

[48] The EVHS can be awarded to plug in hybrid users who are less likely to need to charge; and also may not be taken up because people may install charging infrastructure without claiming the EVHS; this is why it is useful as a lower bound but in reality it is likely that the rate of chargepoint retrofit for BEV owners will be higher

Energy Scenarios (FES), where car ownership falls to 40% of the baseline level by 2050[49]. Therefore, 40% is considered a good minimum/lower bound; with an illustrative 80% shown as the midpoint. The results of these sensitivities for all options are summarised in the table below.

Table 11 – Baseline Retrofit Sensitivities

Retrofit scenario	% New households which have retrofitted by 2050	NPV Preferred Option
Car ownership cap (chosen baseline) - End of ICE sales in 2030 in accord with the TDP central scenario	95%	£1.1bn
All residences retrofit	100%	£1.2bn
80% of new residences retrofit in the baseline, meaning 15% of installations are stranded	80%	£573m
Low uptake of Battery Electric Vehicles constrains retrofit demand in the baseline meaning 45% of installations are stranded	50%	-£847m
Only 40% of dwellings are retrofitted in the baseline meaning 55% installations are stranded	40%	-£1.3bn

137. There are a number of reasons we do not expect a lower than predicted level of retrofitting, some of which are outlined below. In spite of these reasons however, it is clear that factors which reduce the need for residential retrofit of chargepoints must be monitored over the duration of the policy in order to ensure that it continues to be fit for purpose. In our monitoring plan we set out how we will go about monitoring and evaluating these regulations in order to determine at set intervals whether the regulation will lead to stranded assets.

Reasons we expect there to be substantial growth in BEV uptake and Residential Charging Infrastructure Demand

138. **Existing and future regulatory environment**: The EU has introduced mandatory passenger car emissions reduction targets, that require the average emissions of new cars in a manufacturer's fleet to be below 95g of CO2/km by 2021[50], the UK has been in accord with these regulations to date. Failure to meet this requirement results in very large penalties to manufacturers. This legislation is driving supply-side change, encouraging manufacturers to develop and produce EV models (and ICE efficiency improvements), to reduce their average fleet emissions to within these limits. This investment from manufacturers in developing and producing new models helps contribute to the declining EV capital costs. This is evidenced by VW pledging to invest $50bn in developing ULEVs

49

50 EU: reducing emissions from passenger cars https://ec.europa.eu/clima/policies/transport/vehicles/cars_en

by 2023[51], and Ford pledging to invest £11bn by 2022[52]

139. **Announced expectation of ending the sale of ICE vehicles from 2030**: In addition to various policies currently in force, the government has committed to legally binding targets for emissions reductions. More recently Government has given a strong signal to manufacturers to invest in EV production, with the commitment to phase out the sale of new petrol and diesel cars and vans by 2030, and, from 2035, require all new cars and vans must be zero emissions at the tailpipe. These announcements add further pressure on vehicle manufacturers to ensure that they are equipped to operate in an automotive market that is dominated by ULEVs as soon as possible. At the moment there is little evidence to show that resource and manufacturing supply constraints will be a long-term problem for electric vehicle production, however supply constraints and the extent to which they are being addressed though innovation and investment is something that will continue to be monitored as a part of this and wider government policies.

140. In summary, the value for money of the policy is very dependent on the degree to which baseline installations follow the expected trajectory. If the installation rate falls below 70%, then a negative NPV is realised. The uncertainty around his is highlighted by the range of sensitivity scenarios and the resulting NPVs, which are presented graphically below.

Testing Sensitivity of VfM to variations in housing types built

141. **Split of residence types:** In estimating the volumes of new builds, the split of new build flats to houses was kept constant over the appraisal period. From 1991 - 2019 the average proportion of new builds that were flats was 21%, whilst 79% were houses. This are the splits used in the appraisal of the options. But this split fluctuates over time, for example during the years leading up to 2009 new builds gradually became an 50/50 split of flats and houses. To test and demonstrate the sensitivity of the NPV to this assumption of a constant split between flats and houses, two illustrative scenarios are presented below alongside the split used in the appraisal of the options. The first scenario is based on the potential of an equal split of new builds being flats and houses. Whilst the second scenario is based on the highest proportion of new builds bring houses (85% and flats 15%). The results shown for all options are in table 12 below.

Table 12: Split of types of residence sensitivity scenarios (£ millions)	
Scenario	**NPV Option 3 (Central cost)**
50% of new built dwellings are houses, 50% are flats.	£2.8bn
79% of new built dwellings are houses, 21% are flats.	£1.3bn
85% of new built dwellings are houses, 15% are flats	£1.8bn

Testing the sensitivity of the NPV to technology learning rates

142. We assume in this IA that there are no cost reductions over time due to technology and production maturity. This is because cabling and ducting are well developed and established activities with clear resource costs and an extensive history of manufacture and installation. Chargepoint hardware is an evolving technology which will have both downward and upward cost pressures. This could be through improvements in the efficiency of production and demand for higher specifications.

---

[51] CNN: VW to spend $50bn on electric car ‘offensive’ https://edition.cnn.com/2018/11/16/business/volkswagen-electric-cars/index.html

[52] Reuters: Ford plans $11bn investment, 40 electric vehicles by 2022 https://uk.reuters.com/article/us-autoshow-detroit-ford-motor/ford-plans-11-billion-investment-40-electrified-vehicles-by-2022-idUKKBN1F30YZ

143. Chargepoint costs are more uncertain going forward and so we test the impact of reducing chargepoint costs over time. Typically learning rates are applied to technologies such that costs reduce by a percentage for every ‘doubling of demand’. Without access to global forecasts of chargepoint demand, sensitivity testing is conducted through cost reductions for chargepoint hardware by 10%, 20%, and 50% every 10 years. The results of this analysis are presented below. Reduction in chargepoint costs improve the NPV of this policy.

Table 13: Summary of costed impacts	
Cost reduction scenario	**NPV (£m, 2019)**
NPV of Policy	£1,318m
10% Cost reduction every 10 years	£1,251m
20% Cost reduction every 10 years	£1,193m
50% Cost reduction every 10 years	£1,073m

144. As the learning rate increases, retrofitting becomes more attractive as installation costs are incurred later than in the policy option, benefitting more from the learning rate-induced lower costs. The decrease in baseline installation costs (benefits) is larger in magnitude than the decrease in policy installation costs (costs), meaning the NPV reduces as the learning rate increases.

Testing the sensitivity of the NPV to Emissions Savings

145. As mentioned in the non-monetised impacts section, emissions savings are a key benefit that have not been included in NPV estimates. Whilst it was not appropriate to include this in the NPV estimates due to a number of limitations with the methodology, we demonstrate the impact on the sensitivity of the NPV through hypothetical scenarios.

146. We assume average tailpipe CO2 emissions for a ‘Segment C’ ICE vehicle are 123g/km and multiply this by average annual mileage (km) to arrive at an estimate of annual tailpipe emissions per vehicle (conversely a BEV has zero tailpipe emissions). We assume a value of £71.30/tonne of CO2[53]. Table 14 shows the impact on the NPV if the introduction of 88,000 additional chargepoints annually led to 1000, 2000 or 3000 additional BEV purchases that would have otherwise not been made.

Table 14: Summary of costed impacts	
Cost reduction scenario	**NPV (£m, 2019)**
NPV of Policy	£1,318m
1000 additional annual EV purchases	£1,321m
2000 additional annual EV purchases	£1,325m
3000 additional annual EV purchases	£1,328m

147. This is a conservative, hypothetical illustration. In reality the emission impacts of this policy could be significantly higher if the roll out of chargepoints is a critical part of the pathway to transitioning to low emission vehicles in time to meet legally binding government targets. That is, if it is a prerequisite for the transition (subsequently more emissions impacts might be attributed to it). Table 14 shows that, as expected, the NPV increases as the number of additional EV purchases increases.

[53] TAG data books, DfT: https://www.gov.uk/government/publications/tag-data-book, Data table A3.4 non-traded values 2021, price year 2019

6.3 Risks and Uncertainties

148. The sensitivities section outlines a number of factors which may result in the policy causing 'overprovision' of chargepoint infrastructure. Here we look at a number of other factors which in a number of cases cannot be mitigated and therefore will guide our approach to monitoring the effectiveness of the policy. Here we discuss the key risks that will require monitoring or mitigation, and go further to discuss policy interactions, both with the non-residential part of this policy and wider building regulations

149. **Cost Differences Over-estimated:** The VfM of this policy is highly dependent on the difference in cost between installation during and post-construction. If this cost difference is over-estimated then this could have significant impacts on the VfM of the policy. We have taken care to ensure that the current costs are accurate, through extensive stakeholder engagement and a consultant-led study/survey of costs sourced direct from providers; and have ensured that the uncertainty is represented in a wide range – therefore we believe this uncertainty is adequately accounted for. Additionally, exemptions are in place to protect against excessive cost from the most uncertain components (connection costs). Nevertheless, we might expect that such cost differences would drive innovation to bring down the cost of retrofit. As it will remain an uncertainty, *we will seek to monitor chargepoint infrastructure costs and review how the difference between retrofit and in-construction installation evolves through gathering evidence from ongoing government infrastructure policies and continued stakeholder engagement.*

150. **Housing Supply/Demand:** Literature reviewed for this IA suggests that the price elasticity of demand for housing is between -0.5 to -0.8[54]. With the average house price being around £240k in the UK[55], we would expect that the regulatory impact on housing demand would be relatively small even if the entire cost of chargepoint hardware were passed onto consumers (in the region of a 1% impact). It is unclear, however whether these costs would be passed to consumers. To illustrate how costs might be absorbed by developers, we estimate that an average cost-to-build for a dwelling is £150k (based on build cost in London of a medium sized house of £2,045/sqm[56] and an average house size of 85sqm[57]); comparing this against the average house price it is feasible that this cost could be absorbed in the profit margins of developers.

151. After consulting with MHCLG, it is clear the magnitude of the impact on housing supply/demand is uncertain and could vary depending on timeframe considered. It is not possible to establish with any certainty the likelihood of this occurring. Illustrative scenarios might be as follows;

- In the **short run** the increases in cost to house builders may lead to a reduction in housing supply. When purchasing land, housebuilders will offer lower prices to landowners to offset the increase in building costs. Therefore, the cost of the policy will be transferred to landowners. Not all landowners may accept a lower price, resulting in lower levels of land sales and consequently fewer homes being built.
- In the long run as ULEV ownership grows, consumers' willingness to pay for new housing for the availability of ULEV infrastructure will increase. If housebuilders can

[54] Malpezzi, S & Wachter, S (2012), 'Housing demand', International Encyclopedia of Housing and Home

[55] UK house price index – Land Registry https://landregistry.data.gov.uk/app/ukhpi

[56] Property data website https://propertydata.co.uk/construction-costs

[57] Research undertaken by LABC Warrantee

increase the house prices to reflect the increased willingness, they can spend more on land purchases, increasing housing supply.

152. *These scenarios are illustrative as mentioned; at present the regulation cost-impact on building is under research and so we will monitor and gather evidence around the impact of this regulation on both housing demand and supply – with this being a key consideration in the post implementation review.*

153. **Chargepoints currently being installed at point of construction**: If consumers were willing to pay for enabling active chargepoint infrastructure in dwellings, we could expect that developers would install infrastructure during construction, without the need for regulation as they would be incentivised to make dwellings more attractive to consumers. We do not know how many chargepoints are currently being installed during construction and how this will evolve over time; and little information on this was forthcoming during consultation. We have had some direct feedback from small developers that installation of charging infrastructure does already take place during construction, however it is unclear how prevalent this is. ***We will therefore continue to engage with stakeholders to assess the need for this regulation up until the post implementation review.***

154. **Technology change and obsolescence:** Given the long time-horizon, there is a chance that changes in the vehicle or chargepoint market results in chargepoint infrastructure that are installed under these regulations becoming obsolete. This could be because of;

- Technology changes, for instance wireless charging, which results in "older" type chargers not being required. In this case the enabling cabling and ducting would still be necessary. It is unlikely that chargepoints themselves will alter substantially over the next few years, however if chargepoints in their current form become redundant, the government will be able to alter regulations to cover such technology developments. **This is important for the preferred option, but less so for options 1 and 2 which do not require installation of a chargepoint.**
- Car ownership changes, where there is a shift towards less car ownership/more car sharing, means cars will decreasingly be kept at home meaning charging infrastructure is underutilised. This is explored in sensitivities.
- Alternative zero emission propulsion technology such as Hydrogen. This is a risk that exists across the 'Net Zero' policy landscape; which must be dealt with through appropriate monitoring.

155. **Types of homes delivered**: the cost of installing charging infrastructure could result in housebuilders reducing the size of homes built and number of parking spaces to reduce the costs of the development. The consultation did not support this as a risk and housebuilders suggesting overall supply might be affected rather than the types of the houses and parking supplied. ***We do not expect, from the feedback, that this is something that will require significant monitoring – however it will be revisited when the policy is reviewed, particularly in the context of other building regulations***.

How this policy fits in with wider policies (Policy Interactions)

156. The other charging infrastructure provisions in the EPBD set out requirements for non-residential developments. At the moment, there is no evidence to indicate that regulation for residential and non-residential building developments would interact to mean that costs are either more or less than the sum total of the costs outlined in the impact assessments for both parts of these regulations**.**

157. The proposal for non-residential regulation is for the regulations to match the EPBD requirements, without amendment. This requires installing one chargepoint and ducting to route cables for 1 in 5 spaces in new non-residential car parks with more than 10 spaces.

The enforcement of the non-residential regulation of chargepoints in car parks should not hinder the demand and therefore use of the chargepoints installed due to regulations for residential buildings.

158. The current working hypothesis of most studies such as that from the CCC[58] on chargepoint requirements is that charging at non-residential sites is for the purpose of 'Topping-Up' as opposed to fully charging Electric Vehicles (which is what we would expect from residential chargepoints). This is based on the premise that at most non-residential sites, individuals will not be parked long enough to fully charge up their vehicles (for example at commercial sites where people stop to shop).

159. Should consumers park long enough at non-residential sites to fully charge their vehicles, the cost would likely be higher given that (a) public chargepoints could charge higher rates, either because they are operated by commercial chargepoint companies, or because users would only be able to park during commercial/operating hours meaning no access to off peak rates. We believe it a logically robust statement to say that chargepoints at non-residential sites would be typically used for different purposes to residential chargepoints and so there would be no or little competition between the two. Therefore, the driving of chargepoint installation at non-residential sites is unlikely to result in less value ascribed to residential charging and vice-versa.

COVID-19 Impacts

160. There are no immediate, obvious and direct impacts on the efficacy or necessity of this policy caused by the COVID-19 pandemic. At the time of assessing the impact of these regulations, there is insufficient evidence on how the pandemic may affect housebuilding and electric vehicle take-up in the long-run, however there is a comprehensive monitoring and evaluation in place that would capture these effects.

7. Distributional Impacts

161. Whilst infrastructure installation during construction presents an opportunity to avoid higher costs of retrofit, there is uncertainty as to who bears the cost, and who precisely gains from the cost avoidance. 'Who pays' and 'who benefits' will depend on the ability of builders to pass on the costs to landowners or buyers. We have consulted with industry as well as colleagues in MHCLG to understand the incidence of costs from building regulations with little evidence provided, highlighting that this is an evidence gap which will require further investigation.

162. This section looks at the mechanisms by which groups might be impacted; then we discuss the direct costs to business and finally we look at the potential impacts on Small and Micro Businesses (SMBs) as well as electricity networks.

7.1 Groups potentially impacted and cost incidence

163. There are three major groups which may be impacted by this regulation; landowners, housebuilders and buyers.

164. In our analysis we expect that businesses (i.e. home builders) bear the cost of regulation and the consultation responses revealed no evidence to contradict this. When asked, house builders stated they were unsure as to where the cost burden would fall. For this

[58] Committee on Climate Change (2018) - 'Plugging the Gap': An analysis of chargepoint requiremenst to 2030 https://d423d1558e1d71897434.b-cdn.net/wp-content/uploads/2018/01/Plugging-the-gap-Assessment-of-future-demand-for-Britains-EV-public-charging-network.pdf

reason – in our Small and Micro Business Assessment we assume businesses incur 100% of the cost to avoid under-estimating impacts on business.

165. Nevertheless, housebuilders could potentially pass on costs to either landowners, through lower prices offered on land, or to home buyers if they are willing to pay/can absorb the extra cost. Without evidence to show the extent of cost pass-through; we explore below the mechanisms by which costs might be passed through based on consultation with MHCLG.

Cost pass through to landowners

166. The 'Site Value' for housebuilders is the residual left after deducting the expected sale value of a development from the costs of development. New build house valuations are mostly determined by local second-hand market prices plus a new-build premium. If housebuilders don't expect consumers will pay more for new builds with pre-installed chargepoint infrastructure, then they may try to pass costs to landowners through reduced bid prices offered on land to maintain their profit margins. The only publicly available MHCLG analysis on this suggests that this is the only alternative to developers bearing the cost in the longer run[59].

167. Housebuilders have flexibility, and some bargaining power since they can build on the land stock they already own if land prices are not adjusted downwards. This regulation applies to all housebuilders alike, potentially reducing the aggregate demand in the land market. In this situation landowners will bear the infrastructure cost up until the point that prices fall below what they are willing to supply land at i.e. the value received from current land use is greater than what would be received from sale (for example if a factory sits on the land). Costs can therefore be passed to landowners where a reduction in price received still exceeds the value of expected cash flows from the ownership of land over the landowners chosen time horizon.

Cost pass through to purchasers

168. House builders may also pass on costs to consumers through increased house prices which can happen directly or indirectly. As mentioned above, as the building costs make some land unviable to develop at an acceptable price for landowners, housebuilders may resort to building on the limited land they already own or not building the number of dwellings they otherwise might have. This will not only affect their profits but more so overall housing supply. A fall in aggregate housing supply relative to demand could put upward pressure on house prices, shifting the cost from housebuilders to consumers. If demand is less price elastic in some sectors; for example, where there is cheap debt, then costs may be directly passed to consumers which could impact some more vulnerable purchasers (see below).

169. In the long run the increase in ownership of BEVs could result in an increase in demand for homes that already have the charging infrastructure. Not all consumers would currently be willing to pay more for new homes due to having charging infrastructure. In 2019, BEV vehicles made up 2.7% of new car registrations in Great Britain[60], with the number of BEVs sold nearly tripling in 2020; so whilst the market is developing it remains unclear if the market is shifting to the extent that consumers are willing to pay higher purchase costs for new buildings which have had this infrastructure installed.

Specific Consumer Groups Impacted

---

[59] MHCLG Future Homes Standard Impact Assessment (2019) – states that landowners 'may ultimately bare the cost' but has no detail on the likelihood; other impact assessments reviewed said the same and a wider literature review proved inconclusive

[60] Vehicle Licensing Statistics: Annual 2019, https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/882196/vehicle-licensing-statistics-2019.pdf

170. Whilst no evidence was forthcoming at the consultation stage of specific groups being disproportionately impacted by these policies; we consider first time buyers might be impacted for the purpose of this IA.

171. If costs are passed on to consumers, it is possible that first time buyers who do not benefit from having owned appreciating assets may be disproportionately impacted since they arrive at purchasing new homes with typically less money to purchase properties. Subsequently new build properties would be less affordable. Data from the English Housing Survey can be used to give an idea as to the potential distributional impact of the new builds policy. This reported that there were 653,000 first time buyers across England in 2015-16, which is the most recent publication of this data[61]. This was the equivalent of around 5% of all owner occupiers. Around 15% of first-time buyers belonged to a minority ethnic group and 9% reported at least one individual in the household as having a disability or long-term illness.

172. The average house price for new builds in the England was approximately £256,000 as of July 2020[62]. Therefore, even if the whole cost of installing a chargepoint was passed on to consumers through higher prices; it would be a relatively small proportion of the total cost, which could be mitigated by support on offer from the government for first-time buyers.

173. Maintenance costs for chargepoints needing upkeep and repair were considered for inclusion in this impact assessment, but there was no evidence that these costs would be incurred by homeowners as a result of chargepoint installation from this policy. This is due to maintenance costs being linked to chargepoints experiencing higher utilisation and wear e.g. public chargepoints with high use rates and those needing higher support services. Maintenance costs will be revisted at the post implementation review stage.

174. As little information was available through consultation on the impact on specific groups of this policy, we will seek to undertake further monitoring and research to assess the impact of this policy on groups ex-post (see evaluation and monitoring).

Exemptions

175. There are a number of exemptions from the requirements. Most of these exemptions apply to the chargepoint and cable only and ducting is still required in these cases. We expect the impact of these exemptions to be negligible and so have not included these in the analysis to avoid underestimating costs to business. Annex C sets out the exemptions and the evidence to support impacts being negligible.

7.2 Direct costs and benefits to business calculations

176. In order to establish the direct costs to business we identify that there are four key businesses/commercial entities which could be impacted – namely house builders, landowners and chargepoint manufacturers and installers. This section summarises the key businesses impacted and presents the Equivalent Annualised Direct Cost to Business (EANDCB).

177. Four types of businesses who would be directly affected by this regulatory change have been identified:

- **Housebuilders** are assumed to incur familiarisation costs as it is likely that construction processes will have to be adapted to account for chargepoint installation.

[61] DCLG First Time Buyers Report, 2015-16, p3: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/626887/First_Time_Buyers_report.pdf

[62] ONS UK 'House Price Index', 2020: Link

As explained previously, housebuilders are not assumed to receive direct benefit from this policy and are assumed to incur the cost of installation without the ability to pass costs on (see above for scenarios where this may not be the case). All costs to housebuilders are considered to be direct.

- **Landowners**: Housebuilders would see increased building costs and reduced willingness to pay for land. In this case, landowners could take the brunt of the costs in the short term with no direct benefits from the policy – though there is no evidence for this and no evidence was presented at consultation. This cost has not been monetised due to the lack of evidence. If this were to happen in reality, we would see no effect on the net present value, but it may reduce the EANDCB as we would see a transfer from private individuals (a proportion of landowners) to businesses (housebuilders). Not monetising this impact ensures we do not underestimate the impact to business of this regulatory provision.
- **Manufacturers/Installers:** We expect that installers will face little to no additional cost to comply with this regulation. There could be some small familiarisation costs, but they are already fully equipped to carry out installations as technical standards outside of their usual operating are not being imposed. They will likely experience an expansion in demand which would come as a benefit to them, however this is a competitive market with a large number of players and relatively low barriers to entry meaning they will likely continue to earn normal profits in return for supplying chargepoint infrastructure at the opportunity cost. Therefore, there are no costs or benefits attributed to this group for the purposes of the Business Impact Target.

178. As a consequence of the key assumption that businesses bear installation and familiarisation costs, there is a significant negative NPV in relation to the costs/benefits to business. This is highlighted in the table below. In reality, we would expect that as demand for chargepoint infrastructure increases over time, housebuilders will increasingly be able to pass through these costs to landowners or house-buyers.

Table 14: Direct cost/benefit to business qualifying for the Business Impact Target summary (millions, 2019 prices, 2022 base year)	**Option 1**	**Option 2**	**Option 3**
Costs (discounted)			
Familiarisation	£4.1m	£4.1m	£4.1m
Residential Installation	£55	£1,134m	£2,560m
Total costs	**£59m**	**£1,138m**	**£2,564m**
Benefits (discounted)			
Cost savings	-	-	-
Total benefits	**-**	**-**	**-**
Summary			
Net Present Value	**-£59m**	**-£1,134m**	**-£2,564m**

179. The estimated annual net direct cost to business (EANDCB) for each option is identified in table 15. The total cost is divided by the annuity rate of 18.7 associated with a 29-year appraisal period and a discount rate of 3.5%.

Table 15: Estimated annual net direct cost to business (EANDCB) (millions, 2019 prices, 2022 base year)	**Option 1**	**Option 2**	**Option 3**
EANDCB	£3.1m	£61m	£137m

7.3 Small and Micro Business Assessment:

Small and Micro Business (SMB) market share and impacts

180. To understand the impact on SMB home builders of this policy, an SMB definition is required which reflects the businesses most affected. Small businesses are usually defined by the number of employees (<50 employees for small and <10 for micro). According to the Business Population Estimates, using the Standard Industrial Classification (SIC) code for the 'Construction of residential and non-residential buildings' (412), there were 33,090 enterprises in 2020; of which almost all (98.2%) were small and micro businesses[63]. Unfortunately the revenue for micro businesses is not disclosed in the data so the revenue share of these small and micro businesses is unknown.

181. However, due to the inclusion of subcontracting businesses in this SIC code which would not be impacted by this policy, using this definition would cause us to overestimate the number of SMBs relevant for this assessment. Additionally, headcount and the number of firms in a given segment by headcount do not bare any resemblance to actual market share. For example, the relatively few large construction firms (~18) are responsible for a large proportion of housing completions. We propose a more suitable approach is to define SMB house builders as those which produce fewer than 100 new homes per year, which is a definition used by the House Building Federation (HBF)[64].

182. The National House Building Council (NHBC) publishes statistics that show the proportion of new housing starts by size of builder, which they measure in terms of new home starts per annum[65]. They suggest that around 10% of new home starts were by small builders in 2017, i.e. those that built less than 100 homes per year.

183. The NHBC also publishes the number of construction firms by size, indicating that that around 92% of all construction firms (around 1,740 enterprises) were small, excluding firms with zero 'new starts' (i.e. firms which did not begin a building project in the year). It should be noted that the NHBC does not cover all construction activity, though they represent around 80% of the industry so it is still a reasonable representation and it might be inferred from this that the total SMB population is comprised of ~2,100 enterprises if we include businesses which have zero 'new starts' in the year. **We therefore estimate that the population of SMB enterprises is 2,100.**

184. This can be sense checked with data from the Federation of Master Builders (FMB) which looks at the number of new builds per year per SMB. The FMB predicts that the number of 'in-scope' new-build dwellings being constructed in 2021 is around 140k and 10% of construction will be by SMBs. This means SMBs would construct around 14,000 buildings (140k x 10%). If we are correct in our assertion that there are around 2,100 SMBs, this would mean **on average** 7 new builds per year on per SMB. This is in line with the FMB that reports small businesses **on average** produce eight new build homes per year[66].

185. The potential impact on SMBs can be estimated by multiplying the average upgrade cost with the number of new builds per SMB (note that only developments with an associated parking space are of interest, or multi-occupancy developments with at least 10 parking

---

[63] https://www.gov.uk/government/collections/business-population-estimates

[64] HBF SME report 2017 https://www.hbf.co.uk/documents/6879/HBF_SME_Report_2017_Web.pdf

[65] Housing Market Report 2018 https://www.catesbyestates.co.uk/uploads/files/HM%20Report%20April%202018.pdf

[66] Federation of Master Builders Home Builders Survey, 2020 https://www.fmb.org.uk/media/56838/fmb_house_builders_survey_2020_final.pdf

spaces for option 1). This assumes the proportion of new builds by parking provision level in the baseline is the same for SMBs as it is for all builders.

Table 16: Average Annual costs to SMBs			
	Option 1	Option 2	Option 3
Number of SMBs	2,100	2,100	2,100
New builds per year	262,015	262,015	262,015
Relevant new builds	9,490	141,313	141,313
Of which by SMBS (10%)	949	14,131	14,131
Total cost Incurred by SMBs – Year 1	£307,963	£6,406,572	£14,461,277
Average Annual Cost per SMB	£147	£3,051	£6,886

186. The above table presents our estimate of the cost to a typical SMB. The average annual cost per SMB for the preferred option of ~£6,900 is commensurate with the costs incurred over approximately two residences with off street private parking. This fits well with data from the FMB that shows the vast majority of SME builders build 1-3 units per year (see ref 75). The above provides a sense of the average cost per SMB, however it does not show whether the costs are proportionately more difficult to bear for SMBs.

Consideration of disproportionate impacts

187. SMBs will likely be unable to benefit from the economies of scale which can be enjoyed by larger developers through larger scale purchases and installation of chargepoint infrastructure.

188. To some degree the cost burden may be less significant with SMB builders due to the market they compete in having different characteristics to the wider home building market which means they can pass on costs more easily. This is elaborated on in cost mitigations, however the NHBS report states that SMBs do not operate or compete in the same space as larger developers. It also confirmed that they typically build higher cost residences where they seek to distinguish themselves through design and additional functionalities.

189. Intelligence gathered from trade bodies indicates that familiarisation costs would not disproportionately fall on small developers/contractors due to size and the typical flexibility shown by SMB builders in familiarising themselves with new regulations outside of work hours.

190. It is also unlikely that much upskilling will be needed (which would normally impact SMBs disproportionately) because we assume chargepoints will be fitted by external companies who already have the necessary skills based on engagement around how CPOs operate. The cost of contracting specific chargepoint companies is already included in the estimates and the inability of SMBs to benefit from economies of scale in these contracts is noted above.

Consideration of exemptions

191. SMBs make up approximately 10% of market share, subsequently exempting them would mean retaining the majority of monetised benefits. However, we believe that maximising the roll out of chargepoints is a necessary part of what is an unprecedented systemic transition. It is considered, in this case that 10% of market share is still a significant portion of the market, even if it is the minority share.

192. If it is the case that costs cannot be readily passed through to end users, we expect that costs from implementation of our preferred option are likely to adversely impact Small and Micro Businesses (SMBs). The assumption of no cost pass-through is maintained to avoid

underestimating the potential impact on all businesses involved in the construction of domestic buildings including SMBs, which according to the Home Builders Federation (HBF) and Federation of Master Builders (FMB) are increasingly suffering issues around insolvency.

193. However, as stated previously, there are good reasons to believe that costs can be passed on to end users (see also cost mitigations), so it is not certain that businesses will bear these costs; and if costs can be entirely passed on then there will be no substantive impact on SMBs. Additionally, there are mitigations in place in terms of Government support to enable financing for Small and Medium Enterprise (SME) builders that SMB builders can engage with to mitigate risks such as insolvency.

194. During the consultation the question of exemptions was raised with respondents. Over half of the consultation responses received, particularly by private individuals and local authorities, were in favour of regulations being applied without exemption due to general support for chargepoint roll out to support transport decarbonisation. The support by private individuals may also indicate that current and potential homeowners desire EV charging infrastructure in their properties.

195. We currently believe that full, partial or different requirements, such as optional chargepoint installation, would be contrary to the policy intention of ensuring chargepoints are rolled out as quickly as possible to support the policy of transition to Zero Emission Vehicles. For a similar reason, we do not believe that an extended transition period or temporary exemption would be appropriate as they would slow the rate of chargepoint deployment – again contradicting the government's policy intention.

196. Based on this, the Government's preferred approach is to not grant exemptions for SMBs.

Mitigating costs

197. We have considered that there are a number of ways that costs may be mitigated, through either government support, or due to characteristics of the market which may allow SMBs more price-setting power. The government has a track record of supporting SME builders to meet costs through direct award of grants and financing support.

198. *Investment - Home Building and ENABLE Funds:* The Government's £4.5 billion Home Building Fund is designed to be a flexible source of loan funding open to small developers and housebuilders. Infrastructure projects that lead to the development of new housing are in scope, although it can only be accessed by SMEs who build homes that otherwise would not have been developed. A case study shows how the fund can be utilised to provide investment for infrastructure[67]. Although only a limited number of developers would be able to use this fund, there may be other similar investment options. The governments 'ENABLE build programme'[68] administered by the British Business Bank has also begun guaranteeing loans for small, local businesses to support the construction of homes by small builders.

199. More recently Homes England launched a lending programme (a 'revolving fund of £25m) to support small builders with costs over the next 7 years.[69]

---

[67] Homes Community Agency (2016), 'Westward UK Ltd - French Fields, St Helens' https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/559041/Westward__U K__Ltd_-_French_Fields__St_Helen_s__Merseyside.pdf

[68] Announcement of this fund can be found here https://www.gov.uk/government/news/housing-secretary-confirms-1-billion-of-finance-to-support-small-and-medium-sized-builders

[69] MHCLG press release, 2020, https://www.gov.uk/government/news/homes-england-and-invest-fund-launch-7-year-lending-partnership-to-support-small-builders

200. *Passing on costs:* As all housebuilders are subject to the same regulations, they can influence landowners to reduce the asking price, otherwise they to have the possibility to pass on additional costs to consumers. The NHBC reports[70] that:

"Small housebuilders and developers are not generally concerned about competition from the larger, volume housebuilders. Their interest is in building a local reputation for developing smaller sites, typically those that would not be viable for high-volume operations. They are keen to promote individual, bespoke new home environments and carry this philosophy through into their building, differentiating their homes with individual features and special materials, finishes and appliances. Their target buyer is someone who wants a more distinctive product, is prepared to pay a premium for it and may be less inclined to live on a very large development."

201. This principle of differentiating through quality of product could be applied to chargepoint provision. It appears smaller developers recognise a requirement to provide high quality, sometimes bespoke, homes. It follows then that slightly increased costs to provide chargepoint connections is something that smaller developers' clients may prioritise and be willing to pay for.

7.4 Electricity Network:

202. Where electricity peak demand exceeds a local electricity distribution networks' capacity to deliver electricity, costs of upgrading the network may be incurred. These costs can include the laying of new cables, new electricity capital such as transformers and the upgrade of systems. Typically these upgrades and reinforcements are paid for in part by the entity requesting a new connection and in part recovered through electricity bills from consumers. Whilst it is true that cars parked at home could add to peak demand, based on research and consultation with electricity networks modellers we believe that this policy alone will not trigger connection costs to the degree that it is proportionate to examine the impacts on the Electricity Network in close detail.

203. The UK is moving away from the use of fossil fuels as a primary source of energy across transport and heat, with electrification expected to be the primary method for achieving decarbonisation targets in these sectors. This is likely to require significant investment in the Transmission and Distribution of electricity. A study performed by Imperial University for the CCC estimated that up to £50bn extra investment in networks could be required up to 2035[71] for the electrification of EVs and heat pumps which provides a measure of the scale of investment required for overall electrification.

204. If it is the case that the existing stock of houses will ultimately be retrofitted with charging infrastructure, as well as have necessary upgrades to accommodate heat electrification, then the relative contribution of this policy to connection costs is likely to be small.

205. During consultation we reviewed evidence related to electricity networks as well as modelling approaches. The modelling of potential network costs and impacts is complex; with drivers of network costs being highly localised. These costs can be mitigated to a significant degree by 'demand shifting' behaviour and technology which moves EV electricity demand away from peak times so that consumers can benefit from cheaper rates when they charge overnight. Based on this, the wider context of the Net Zero transition and the fact that this policy will impact the equivalent of approximately 1% of the housing

---

[70] 5 NHBC (2017), 'Small housebuilders and developers' https://www.nhbcfoundation.org/wp-content/uploads/2017/04/NF76_WEB.pdf

[71] CCC, Vivid Economics & Imperial University, 2019 p.28, https://www.theccc.org.uk/wp-content/uploads/2019/05/CCC-Accelerated-Electrification-Vivid-Economics-Imperial.pdf note: this is one scenario of many set out in this paper; there is significant uncertainty around such estimates, consequently we provide this figure for context around the potential scale of cost but note the cost could be lower.

stock annually, it was confirmed to us that that bespoke analysis for this IA would be disproportionate. However, it is expected that a broader programme of work will be carried out to test the impact of charging infrastructure in residential locations for existing and new buildings on the system prior to post implementation review; subsequently we expect to be able to test specifically the impact of this policy at that point.

7.5 Monitoring and Evaluation:

206. Risks and uncertainties are identified in this IA which we propose to address through a monitoring framework. Many of these risks hold true for policies across government interventions to transition the UK to a ‘Net-Zero’ emitter as they require potentially drastic technology investment under conditions of uncertainty. There is also a requirement to act before these uncertainties can be mitigated.

207. The characteristic uncertainties in the low carbon transition are to do with societal preferences for technologies, technology costs and innovation in new technologies; a framework for monitoring is therefore needed to monitor how these evolve and to support ex-post evaluation.

208. There is likely to be a broad set of interventions aimed at addressing the need for charging infrastructure for EVs; for residential charging as well as other types, such as destination, workplace etc. Consequently, a monitoring and evaluation programme is in development to understand the effectiveness across these potential schemes. Here we outline the variables we think we will need to monitor, the data sources we will attempt to use and the analysis that will go into evaluation in a Post Implementation Review (PIR) five years after regulations come into force.

209. Given this policy is likely to continue past the 5-year review mark; we would expect a further framework for monitoring and evaluation to be proposed during a detailed PIR, based on what is known at that time and the most important uncertainties to be addressed. At that time we would also expect a timeline for a further PIR to be set.

210. We anticipate requiring a combination of qualitative and quantitative data and methods to evaluate the effectiveness of this policy,

211. Below we revisit key uncertainties and how we will attempt to mitigate them through specific monitoring activity as well as how we will use data gathered for further analysis. We then outline key research questions we will look at in evaluation, and the data monitoring that will occur, where possible relating specific data sources that we can use or expand upon.

Uncertainties and monitoring

212. **Cost:** chargepoint infrastructure costs are central to determining VfM across EV infrastructure policy; consequently, data gathering on costs is ongoing through existing government schemes which make the provision of relevant data a condition to the receipt of government support, as well as through studies which are likely to be implemented. We currently gather cost data from schemes which have been used to validate our current cost assumptions; we anticipate receiving more data from further schemes to be implemented. During evaluation, we will be able to use this to understand the difference in cost between retrofit and upfront installation to test whether the cost difference is significant enough to warrant continuation of this policy.

213. **Consumer and Business Impacts/Preferences:** we expect to use a combination of direct interview and survey based social research to gain closer insight into consumer/business impacts and preferences. For example, through direct engagement we can test residential consumer preferences for charging their vehicles, developer preferences for installing

chargepoints during construction and potentially the capacity for developers to pass on costs to consumers. An example of where we have done this recently is with an informal evidence/consultation exercise on the EVHS where we have, among other things, requested information from landlords on the cost of chargepoint installation[72].

214. **Technology Changes Leading to Obsolescence:** technology changes could mean that chargepoints become obsolete, either because of the way people own and use cars (due to car sharing, for instance) or because another technology such as hydrogen fuel cells becomes a primary mode of road transport. These are common risks to decarbonisation policies; consequently, they will be monitored as they pose a significant wide (although low probability) risk to our policies. We regularly gather data on vehicle technology costs for input into our evidence base.

215. **Provision of Parking:** provision of parking may drop due to this policy. DfT will look to monitor this through the English Housing Survey, which will include looking at how the proportions of different types of dwellings are changing. This would be a difficult thing to attribute solely to the policy in question - so we anticipate using data on net additions to the housing stock, parking provision and social research to determine whether or not this is a key driver. Where parking provision is evidenced as being impacted by this policy we will look to understand the costs of this to society; currently we do not expect this to be the case since parking spaces raise the value of property as explained earlier in this IA.

216. **Policy Interactions:** DfT will work with MHCLG to determine the extent to which this policy in conjunction with other cost inducing regulations are impacting building development choices.

217. **International Comparisons:** this IA presents a large number of comparative international government interventions and it is expected this is a policy which will be implemented across Europe to varying degrees. We are engaged with a number of countries implementing these and other policies and expect to be able to share data and analysis to test the efficacy and need of this policy.

218. **Business impacts:** we will look to understand the level of cost pass-through in building regulations, and the impacts on business through continuing to review the literature and engaging with stakeholders. The PIR will consider the impacts on SMBs, including the extent to which this policy has been difficult to implement/altered behaviour. Where it is clear that cost mitigations are not sufficient to protect SMBs from adverse consequences, exemptions may be considered in the future. This monitoring can be done through direct informal consultation, as well as through partnering with the evaluation of other schemes designed to support small and micro builders. We work closely with trade bodies representing the sector and expect to be able to use direct industry insight on the impact of regulation as a whole; however it was not available at the time of this IA.

219. **Unintended consequences:** we expect that stakeholder engagement over the life of this policy, as well as related infrastructure policies, alongside data monitoring will alert us to any unintended consequences. There has been an extensive consultation, with post-consultation engagement to test the policy with stakeholders; we therefore expect that we have covered off the key impacts of this policy.

220. There is a statutory requirement to conduct a post implementation review, consequently we will be required to perform a full evaluation of the policy and, should evidence support changes, make an amendment. We will directly monitor key performance metrics according to questions which we currently expect to answer in that review. These include:

---

[72] Announcement of DfT consultation in trade press, 2021: https://www.fleetnews.co.uk/news/latest-fleet-news/electric-fleet-news/2021/02/15/government-reveals-electric-vehicle-charge-point-plans

- Has the policy been successful in installing electric vehicle chargepoints in new build developments?
- Is the rationale for intervention still valid? For instance, whether the information failures that exist between chargepoints installers, developers, house buyers and consumers remain.
- How have installation costs changed over time?
- Business impacts - what were the overall impacts on business?
- Direct and indirect impacts - did the assumed impacts occur and were there others that were not identified both direct and indirect?
- Small and micro businesses - Did the approach taken to mitigate the impact on small businesses work? What was the eventual impact of the policy on small developers?
- Assessment of compliance and enforcement - Did stakeholders comply, if not, how did Government respond to ensure adherence to the policy?
- Market structure impacts - was there any impact on the market structures of developers and chargepoint installers?
- Chargepoint utilisation – how much are chargepoints utilised, and how does this vary between location?
- Technological compatibility – are developments in chargepoint technology being reflected in installations as a result of this requirement?

221. In terms of specific data we will monitor, these may include, but are not limited to, the following;

- Number of housing completions, types of housing and parking provision (English Housing Survey/OBR data if relevant data is available)
- Volume of chargepoints installed in new builds, where possible; the specification of chargepoints and associated costs of installation
- Volume of chargepoints installed in existing properties
- Number and type of new build non-residential car parks
- Volume of chargepoints installed new car parks
- Volume of chargepoints installed in existing car parks
- EV uptake rates (to establish the likelihood of the policy having impact on uptake)
- Consumer attitudes, including preferences for charging at home vs. other locations
- Business attitudes, including housebuilders
- Technology alternatives such as the relative cost of hydrogen as an alternative means of transport propulsion

8. Summary & Conclusion:

222. This impact assessment has considered three options for increasing the level of ULEV charging infrastructure provision in new residential buildings, and one option for new non-residential car parks. These options are summarised in the table below.

Table 17: option summaries (2019 prices, 2022 base year)		
Option	**NPV**	**EANDCB**
Option 1 (Ducting only)	£114m	£3.1m
Option 2 (Ducting and cabling)	£1,842m	£61m
Option 3 (Ducting, cabling and chargepoint)	£1,318m	£137m

223. In summary, the preferred option is to recommend the installation of a minimum 7 kW chargepoint in all residential new build dwellings with a parking space associated with the building.

224. This IA concludes, based on an assessment of the evidence that Option 3 is preferable, even with a lower monetised benefit than Option 2. This is because it aligns with Government ambitions for net zero carbon emissions by 2050, through the intention of increasing consumer confidence in EV purchases. This option tackles a major consumer barrier to EV uptake in chargepoint infrastructure accessibility and awareness. The benefits of this impact cannot be monetised for the purpose of this IA due to a lack of evidence, however the potential scale of impact has been presented through sensitivity analysis.

225. The net benefit has changed significantly since the consultation IA because previously we assumed that costs did not rise with inflation over time so in real terms they decreased. We have revised this assumption so that costs remain flat in real terms, but analyse the impact of technology learning, which would reduce costs over time in the sensitivities section.

226. We have taken the step of assuming the costs of compliance fall directly on housebuilders without a possibility of pass-through to consumers to ensure that there is no underestimation of the cost to business since there was no conclusive evidence to suggest that businesses (in this case house builders) would be able to pass on costs of compliance. We will monitor this and conduct further analysis to test cost pass-through in a post implementation review.

227. The proposed policy carries with it a number of uncertainties which are characteristic of interventions in technology transitions. We will aim to address these uncertainties through a monitoring programme which will be succeeded by a post implementation review; at which amendments to proposed regulations may be made in accord with the latest evidence available at that point.

Annexes:

Annex A: Steer cost tables

228. The following cost summary tables are taken from costs reported by Steer to DfT and were used for the derivation of costs for the relevant options.

229. These costs were compiled by Steer from direct quotes from a number of sources and cannot be presented in a more disaggregated or non-anonymised format due to commercial sensitivity.

230. The costs were developed in a 3-stage process. First, costs were gathered and scrutinised from the UK and internationally through desk research. Secondly, the relevant questions to stakeholders were tested with an initial list of respondents which comprised of builders, network and transmission network operators and chargepoint installers. Finally, a full consultation was held with stakeholders across these groups with costs quotes being compiled and sent to DfT. In total 9 in depth interviews were held and 5 data sets received.

231. Throughout, interviewees were required to present information and rationales which underpinned cost quotes. After this process, DfT analysts directly engaged with a number of relevant stakeholders to further validate these costs. Finally, costs were tested against commercially sensitive cost data gathered by DfTC through the Onstreet Residential Charging Scheme (ORCS) which allowed us to confirm that the range of costs captured a

significant portion of the variability, allowing us to deem these costs adequate for the purpose of this IA.

Annex A1: Steer - Wiring and Installation costs for single chargepoint

Wiring and Installation costs					
Building type	**Cost group**	**New Build**		**Retrofit**	
		Low	**High**	**Low**	**High**
Off-Street Private	Cabling + Ducting	£100	£500	£500	£500
	Electrical Equipment	£0	£100	£0	£100
	Civils	£0	£0	£0	£0
	Total	£100	£600	£500	£600
Multioccupancy surface	Cabling + Ducting	£500	£1,500	£500	£1,500
	Electrical Equipment	£80	£360	£80	£360
	Civils	£300	£1,000	£300	£2,000
	Total	£880	£2,860	£880	£3,860
Multioccupancy underground	Cabling + Ducting	£500	£1,500	£500	£1,500
	Electrical Equipment	£150	£800	£150	£800
	Civils	£0	£0	£0	£0
	Total	£650	£2,300	£650	£2,300
Multioccupancy multi-storey	Cabling + Ducting	£500	£1,500	£500	£1,500
	Electrical Equipment	£150	£800	£150	£800
	Civils	£0	£0	£0	£0
	Total	£650	£2,300	£650	£2,300

Annex A2: Steer – Wiring and Installation costs for 100 chargepoints

Wiring and Installation costs					
Building type	**Cost group**	**New Build**		**Retrofit**	
		Low	**High**	**Low**	**High**
Off-Street Private	Cabling + Ducting	£8,000	£40,000	£8,000	£40,000
	Electrical Equipment	£0	£8,000	£0	£8,000
	Civils	£0	£0	£0	£0
	Total	£8,000	£48,000	£8,000	£48,000
Multioccupancy surface	Cabling + Ducting	£20,000	£60,000	£20,000	£60,000
	Electrical Equipment	£3,200	£14,400	£3,200	£14,400
	Civils	£12,000	£40,000	£12,000	£80,000
	Total	£35,200	£114,400	£35,200	£154,400
Multioccupancy underground	Cabling + Ducting	£20,000	£60,000	£20,000	£60,000
	Electrical Equipment	£6,000	£32,000	£6,000	£32,000
	Civils	£0	£0	£0	£0
	Total	£26,000	£92,000	£26,000	£92,000
Multioccupancy multi-storey	Cabling + Ducting	£20,000	£60,000	£20,000	£60,000
	Electrical Equipment	£6,000	£32,000	£6,000	£32,000
	Civils	£0	£0	£0	£0
	Total	£26,000	£92,000	£26,000	£92,000

Annex A3: Steer – Grid Connection costs for single chargepoint

Grid connection 1 x point				
Building Type	**New Build**		**Retrofit**	
	Low	**High**	**Low**	**High**
Off-street private	£0	£0	£0	£1,300
Multioccupancy surface	£0	£3,000	£0	£3,000
Multioccupancy underground	£0	£3,000	£0	£3,000
Multioccupancy multi-storey	£0	£3,000	£0	£3,000

Annex A4: Steer – Grid Connection costs for 100 chargepoints

Grid connection 100 x point				
Building Type	**New Build**		**Retrofit**	
	Low	**High**	**Low**	**High**
Off-street private	£5,000	£40,000	£5,000	£80,000
Multioccupancy surface	£2,000	£120,000	£5,000	£120,000
Multioccupancy underground	£2,000	£120,000	£5,000	£120,000
Multioccupancy multi-storey	£2,000	£120,000	£5,000	£120,000

Annex A5: Steer and Chargepoint Installer – Hardware costs

Charge point Hardware Costs		
Building Type	**x1**	**x100**
Off-street private	£515	£46,003
Multioccupancy surface	£1,350	£120,536
Multioccupancy underground	£580	£51,786
Multioccupancy multi-storey	£580	£51,786

Annex A6: Steer – Data connectivity costs

Cost item	**Cost**	**Additional Information**
Charge point modem	£410	Single modem can be used for multiple chargepoints
Data Cabling (inc. labo	£1,000	Cost for 100 chargepoints

Annex B: Option Cost summaries

232. This section presents in greater detail some of the underlying assumptions and drivers that inform the component costs used in this assessment.

Annex B1 - Option 1: Ducting

233. For this option, these costs are only relevant for buildings with 10 or more parking spaces as this is in line with the minimum EPBD requirement. As data on the distribution of flats per block was broken down into block size ranges, it is assumed that blocks of 11 or more flats are appropriate for this option.

234. Itemised costs were used to disaggregate the costs of cabling and ducting which were combined in the wiring and installation cost summaries provided by Steer. The relevant cost drivers for the low cost and high cost scenarios are identified in table B1 below.

235. The primary driver of cost differences between categories for this option is whether cabling can be routed using ducting (as with off-street private and multi-occupancy underground

and multi-storey) or whether underground trenching is required (as with multi-occupancy surface car parks). This is primarily due to the significant labour costs involved which typically represent around 70% to 80% of the total costs of trenching. Furthermore, undertaking trenching to replace or lay new cables in a retrofit environment can cause disruption to the building users until the surface is reinstated. This disruption cost has not been estimated as part of this assessment.

236. For single installation there is little variability in the costs between retrofit and new build. The only variability comes from the costs of civils works for and surface level multi-occupancy car parks. The difference between the low and high cost scenarios is driven by the volumes of ducting/trenching required, depending on the distances from the power supply to the chargepoint.

Annex B2 - Option 2: Cabling + Grid connection

Cabling

237. As with the ducting option, the cost differences for cabling between categories are driven by the length of cabling required. These costs are also shown in the tables above. For retrofit options, it is assumed that an entirely new cable from the distribution board to the chargepoint is required in all situations, which drives the higher cost.

238. Another significant cost sensitivity is the electrical equipment required. For off-street private parking, the chargepoint will only require a single miniature circuit breaker (MCB) in an existing distribution board which can be easily retrofitted. This is the case regardless of the quantity of chargers installed as each building will have its own distribution board. This is also true for a single installation in multi-occupancy basement or multi-storey parking. However, when 100 connections are installed together, multiple moulded case circuit breakers of different current ratings will be required to supply electricity to the chargepoints. At surface level chargepoints will be supplied from a feeder pillar, which can serve multiple chargepoints.

239. The cost for 100 connections would be inclusive of new transformers and distribution network cabling. This cost will be absorbed by either the developer or socialised depending on the development type and whether it is new build or retrofit. The factors influencing the costs of wiring and installation are highlighted below; unless the parking provision is stated, the costs are applicable to all parking types.

Table B1: wiring and installation cost drivers

Factor	Low Scenario	High Scenario
Electrical Equipment Distribution board Array controller Single installation Multi-installation	N/A N/A N/A N/A N/A	 Required Required MCB, RCD, PME MCCB, 400A, RCD, PME
Cabling and Ducting Cabling Ducting Connection Traffic management	 6mm/3 core (1 Phase) N/A Single Outlet, 7kw N/A	 25mm/5 core (3 Phase) 300mm cable tray Twin Outlet, 22kw Permitting fees (one off) Design fees (m²) Labour costs
Civils Labour	 Electrician Day rate	 Electrician and Civils day rate

Trenching and Reinstatement (Multi-occupancy surface) Excavation Materials e.g. tarmac Waste removal	N/A N/A N/A	Cost per m Cost per m Cost per m
Fire prevention (multi-occupancy)		
General Project management Commissioning (NICEIC)	N/A Per chargepoint	Fee for managed installations Per chargepoint

Grid Connection

240. The costs associated with chargepoint connections vary significantly depending on location, and hence it is difficult to establish general figures for installations. The reason for this is because the costs associated with providing a connection are based on factors including: the type of network in that area (rural, suburban, urban); the type of property and hence the type of connection (including whether it is retrofit or new build; whether the connection is flexible or not; the age of the connection point and associated network; the voltage of the connection point). Whilst there is a great deal of uncertainty surrounding these figures, and it has not been possible to capture the full extent of this variability in the cost summaries, the following section identifies the assumptions that have been built into these cost profiles.

241. For both retrofit and new build, the cost of grid connection will be affected by the peak power required to meet the maximum charging demand of vehicles in the development. This is influenced by the diversity of demand (e.g. the amount of energy the vehicles require whilst parked and the dwell time of the vehicles at that location). The amount of energy required will vary based on the usage patterns of the vehicle (e.g. vehicles in rural areas may be driven further therefore may require more charging) and the charging behaviours of the vehicle owner/ user (e.g. does the user have a chargepoint at home therefore require less charging in other locations). The dwell time will be influenced by what the parking is provided for (e.g. residential/ workplace/ shopping).

242. Additionally, for retrofit installations, the cost associated with the grid connection will be influenced by; the capacity of the existing connection, and the after diversity maximum demand (ADMD) of existing loads on the connection (after diversity maximum demand – i.e. the typical maximum power demand based on the amount of power required from each load and when each load is used over a typical day).

243. The connection and cabling costs can also be mitigated by the use of smart charging although will still be influenced by the above factors. The costs provided do not currently account for this reduced peak power demand requirement with smart chargers or any associated load management system. For multi-occupancy, the high range costs assume that the connection can accommodate 22kW chargepoints. As the proposed regulations only require 7kW chargepoints, this is not applicable. There is however uncertainty surrounding this managed load scenario and what the actual power demand for charging may be when wide-scale EV adoption occurs.

244. A further factor influencing the connection cost is the type of electrical earthing the building's power supply (grid connection) has. Often in the UK, buildings use a protective multiple earth (PME) power supply which may no longer be suitable if a chargepoint is installed. The use of PME supplies is dependent on the type of structure the parking is located in. This primarily concerns if the parking location for charging vehicles, the chargepoint, and the supply (grid connection point) are contained within the same structure

(e.g. multi-story or basement carpark); or the parking and supply are located separately (e.g. in an open-air surface level carpark). Additionally, parking located within a steel framed building (or buildings attached to a steel framed building), may not use a PME supply. For individual residential buildings certain relaxations to the wiring standards may apply.

245. The impact will be biggest for retrofit where a PME supply is no longer appropriate. Alteration to the supply, additional electrical works, or a separate supply will be required. For new builds, there may be an increase in cost associated with not being able to use a PME supply. However, this is assumed to be marginal compared to retrofit.

246. For a single installation, either new build or retrofit, it is assumed that there would be sufficient spare power capacity to supply the chargepoint. Therefore, there are no additional grid connection costs, unless a dedicated supply was installed.

247. For multi-occupancy car parks, the need for grid upgrades upstream of the dedicated building transformer is assumed to be minimal. However, for both the upstream (HV) distribution network and the national grid transition network, the aggregate effects of multiple developments installing multiple chargepoints certainly would have an impact and incur significant cost, although these have not been considered within this assessment.

Table B2: Grid connection cost drivers

Factor	Low Scenario	High Scenario
Residential off-street (retrofit)		
Alteration of connection of individual house to LV distribution grid. 1. Service alteration to increase supply power capacity 2. Alteration to PME supply for vehicles used on driveway.	 N/A N/A	 Required (assumed 10m able) - Highest cost for overhead supply alteration. Required.
Upstream grid reinforcement (Where multiple charge points installed on the same distribution network) 1. Cabling (4x200m) 2. Transformer	 N/A Required	 Cost per m Cost dependent on capacity (kWs)
Residential off-street (new build)		
Single Installation	N/A	N/A
Multi-occupancy Car Park – Basement/ Multi-storey (Retrofit) *Assumed no cost for 1 x installation*		
1. Cabling (100m) 2. Transformer 3. Alteration of PME supply	Cost per m Cost dependent on capacity (kWs) N/A	Cost per m Cost dependent on capacity (kWs) Required
Multi-occupancy Car Park – Basement/ Multi-storey (New build) *Assumed no cost for 1 x installation.*		
1. Service connection 2. Cabling (100m) 3. Transformer	Required (fixed cost) Cost per m Cost dependent on capacity (kWs)	Required (fixed cost) Cost per m Cost dependent on capacity (kWs)

Annex B3 - Option 2: Chargepoint

248. These costs include the hardware costs of a 7kW ‘smart’ chargepoint and the data connectivity costs that are relevant for the multi-occupancy underground and multi-storey categories where it is assumed that data connectivity may not be available. These costs are identified in annex table A6. Multi-occupancy surface car parks are assumed to require a ground mounted chargepoint which carries an additional cost, whilst the other parking categories are assumed to require a wall mounted chargepoint.

249. Chargepoint power is the biggest single factor in influencing the cost of a charger. Given that it will be a functional requirement for chargepoints to have power of at least 7kW, we have assumed that a 7kW chargepoint is appropriate for all parking categories. The costs used were derived from a combination of the cost summaries provided by Steer as well as direct engagement with a range of chargepoint operators. A range has not been provided as we understand that many high range costs reflect the inclusion of a number of optional extras that are not essential to the functionality of the chargepoint. The bulk-buy unit costs for 100 chargepoints was found using the same ratios as identified by Steer for the wall mounted unit, meaning that for a 100 chargepoints, the unit cost is 89% of the cost of a single unit.

250. There are many additional factors that affect the cost of chargepoint hardware, such as the number of sockets, the type of mount and payment/authorisation. We have assumed the relevant costs for a base model chargepoint. The costs are applicable whether the installation is within a retrofit or new build environment, but bulk costs means that multi-occupancy new build developments are able to take advantage of lower unit costs.

251. Although we expect the cost of hardware to fall over time, we have not included this in the analysis as we do not have sufficient data to inform the rate of reduction. This option includes the costs outlined in option 2 and applies to all dwellings with an associated parking space.

Annex C: Exemptions

252. The Government will not extend the proposed requirements to properties with ‘enclosed’ car parks (e.g. basement and multistorey car parks) until a review of current fire safety regulations is complete. The review will establish if current fire safety regulations are sufficient to ensure enclosed car parks have the measures needed to withstand and mitigate EV fires and protect firefighters. Assuming the exemption is in place for 5 years from 2022-2026, we estimate the volume of chargepoints not installed as a result of this exemption is 0.5% of total installations across the appraisal period. Given this, we expect the impact of this exemption to be negligible and so have not included this in the analysis to avoid underestimating costs to homeowners.

253. Residential buildings undergoing major renovation work for fire safety remediation purposes will be exempted from these requirements. This will protect homeowners and tenants who may have faced significant challenges in light of the Grenfell tragedy from further costs. Our analysis suggests that the number of properties affected by the overall exemption is likely to be limited; most properties that require cladding remediation will not fall under the definition of a major renovation[73] and so will not trigger these requirements. MHCLG further advised that the number of properties undergoing other fire safety remediation work that would constitute a major renovation is likely to be small too. Given that we expect the relative impact to be negligible, this exemption has not been included in the analysis to avoid underestimating costs to homeowners and tenants.

[73] Defined as more than 25% of the surface area of the building envelope going under renovation.

254. The Government will introduce an exemption from the requirement to install a chargepoint in a property where this would increase grid connection costs by more than £3,600 per chargepoint. However, the Government will still require cable routes to be fitted where this exemption is granted. Grid connection costs used in the analysis are £1,200 per chargepoint in the high scenario.[74] Given the threshold for the exemption is 3x the high cost assumption scenario, we expect the impact of this exemption to be negligible and so have not included this in the analysis to ensure costs to business are not underestimated.

255. The Government will transpose article 8.6 of the EPBD, which permitted an exemption from the requirements where electric vehicle charging infrastructure exceeds 7% of the total cost of the major renovations. Residential properties undergoing major renovation will be exempt from installing chargepoints where the cost of chargepoints and cable routes exceed 7% of the total cost of the renovations. Cable requirements will still apply unless the cost of installing the cable routes alone exceeds 7% of the total cost of the renovation. For off-street private properties, the unit cost for full chargepoint provision is £865 in the central scenario, so a major renovation would have to be under £12,400 for the exemption to apply. For multi-occupancy properties, the unit cost for full chargepoint provision is £1,961 per dwelling in the central scenario, leading to a major renovation needing to be under £28,014 per dwelling for the exemption to apply. Online sources suggest the average cost for a major renovation of a residential property is £52,175[75], which suggests there is a low likelihood of charging infrastructure exceeding 7% of the total cost of the major renovation. Given this, we expect the impact of this exemption to be negligible and so have not included this in the analysis to avoid underestimating costs to homeowners.

256. The Government will introduce an exemption for buildings undergoing material change of use for listed buildings, buildings in conservation areas and buildings included in schedule of monuments where the installation of an electric vehicle chargepoint would lead to unacceptably altering the character or appearance of the building or its surrounding. There are approx. 400,000 listed buildings in England[76], approx. 20,000 scheduled monuments[77] and approx. 10,000 conservation areas.[78] Given that there are 26.7m buildings in England (24.7m dwellings[79] and 2.003m non-domestic properties[80]), this suggests 1.6% of total buildings are listed buildings, scheduled monuments or in conservation areas. There were 26,930 dwellings resulting from material change of use in 2019-20 in England.[81] Assuming 1.6% of these are listed buildings, scheduled monuments or buildings in conservation areas suggests the impact of this exemption is small (approx. 430 properties per year). Therefore, we have not included this in the analysis to avoid underestimating costs to homeowners.

257. Where a property undergoes a material change of use to create dwellings, the Government will only require the number of chargepoints to be installed that can be accommodated with the existing power supply. There were 26,930 dwellings resulting from changes to

---

[74] DfT commissioned consultants, Steer, to research EV Charge Point Wiring.

[75] https://www.checkatrade.com/blog/cost-guides/cost-renovating-house/

[76] https://historicengland.org.uk/advice/hpg/has/listed-buildings/

[77] Schedule monuments policy statement, Annex 3, https://www.gov.uk/government/publications/scheduled-monuments-policy-statement

[78] https://historicengland.org.uk/advice/hpg/has/conservation-areas/

[79] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/987564/Dwelling_Stock_Estimates_31_March_2020_Release.pdf

[80] NDR Stock of properties tables, 2021, Table SOP1.2, Column I, https://www.gov.uk/government/statistics/non-domestic-rating-stock-of-properties-including-business-floorspace-2021

[81] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/938198/Live_Table_120.ods

residential use in 2019-20 in England.[82] Given that properties with a typical 60 – 100 amp fuse can support a maximum load of 14kW – 24kW[83] and the average maximum power demand (excluding any EVs and electric heating demand) is typically around 7kW,[84] this suggests many of these properties undergoing material change of use to create dwellings will be able to install a 7kW charger per dwelling within the existing power supply. However, this is highly dependent on the specific characteristics of the building that is being converted – what it was used for before and its existing electricity supply. Given the lack of available data, we cannot quantify the impact of this exemption and so have not included this in the analysis.

258. Where a residential property undergoes major renovation and the chargepoint requirements are triggered, the Government will only require the number of chargepoints to be installed that can be accommodated with the existing power supply. There are 24.7m dwellings in England[85] and, using the proportions set out in table 1 in this IA, 16.3m of these are estimated to have associated parking. Assuming residential dwellings undergo major renovations every 20-50 years[86], we estimate there could be 330k – 810k major renovations each year. Given that residential properties with a typical 60 – 100 amp fuse can support a maximum load of 14kW – 24kW[87] and the average maximum power demand (excluding any EVs and electric heating demand) is typically around 7kW,[88] this suggests many of these residential properties undergoing major renovation will be able to install a 7kW charger per dwelling within the existing power supply. However, this is highly dependent on the specific characteristics of the property and its existing electricity supply. Given the lack of available data, we cannot quantify the impact of this exemption and so have not included this in the analysis.

---

[82] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/938198/Live_Table_120.ods

[83] This can be calculated using the formula P(W) = I(A) × V(V), or power = current × voltage, where voltage is assumed to be 230 V.

[84] UK Household Energy Survey (2012), https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/208097/10043_R66141HouseholdElectricitySurveyFinalReportissue4.pdf

[85] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/987564/Dwelling_Stock_Estimates_31_March_2020_Release.pdf

[86] This assumption is illustrative as according to MHCLG, there is an evidence gap around number of major renovations each year. We have tested this assumption against literature on the useful life of buildings and with MHCLG to see that it is reasonable; however there is still a degree of uncertainty which cannot be mitigated.

[87] This can be calculated using the formula P(W) = I(A) × V(V), or power = current × voltage, where voltage is assumed to be 230 V.

[88] UK Household Energy Survey (2012), https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/208097/10043_R66141HouseholdElectricitySurveyFinalReportissue4.pdf