Title: Non-residential charging infrastructure provision **IA No:** DfT00411 **RPC Reference No:** **Lead department or agency:** DfT **Other departments or agencies:** MHCLG	**Impact Assessment (IA)** **Date:** 24/06/2019 **Stage:** Consultation **Source of intervention:** EU **Type of measure:** Secondary legislation **Contact for enquiries:** alec.desimone@dft.gov.uk, harsimran.arora@dft,gov.uk

Summary: Intervention and Options

RPC Opinion: RPC Opinion Status

Cost of Preferred (or more likely) Option (in 2016 prices)			
Total Net Present Social Value	**Business Net Present Value**	**Net cost to business per year**	**Business Impact Target Status**
-£255.9m	-£255.9	£15.8m	Non-qualifying provision

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

To address the external cost to society caused by emissions from Internal Combustion Engine (ICE) vehicles the Government has set the ambition that all new cars and vans sold will be effectively zero emission by 2040. To achieve this, the UK will need a well-developed network of charging infrastructure for Electric Vehicles (EVs). The Energy Performance In Buildings Directive (EPBD) sets out requirements for minimum provision of charging infrastructure in new and existing non-residential buildings. The Government is currently consulting on the transposition of these requirements into UK law.

What are the policy objectives and the intended effects?

The policy aims to implement the minimum requirements for charging infrastructure in new and existing non-residential buildings. Updating the Building Regulations to include provisions for electric vehicle charging infrastructure will ensure that workplaces and retail car parks have the necessary EV charging infrastructure to support future EV uptake. It is expected that if chargepoints become readily available in key destinations, a significant barrier to purchasing an EV will be removed, helping to support further uptake of EVs.

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

The EU Energy Performance in Buildings Directive (EPBD) sets minimum requirements for charging infrastructure in new and existing non-residential buildings, which the UK is required to transpose. This assessment looks at the impact of transposing these provisions into UK law without any variation in implementation, as there is limited evidence to suggest there is value in intervention above direct transposition of the requirement. Specifically, the requirements of the EPBD are that (1) all new non-residential car parks with over 10 spaces in England are fitted with at least one chargepoint and ducting for one in five parking spaces; and (2) all existing car parks with over 20 parking spaces in England are fitted with at least one chargepoint by 1st Jan 2025. Given the diversity of different non-residential buildings, it does not seem appropriate to set prescriptive requirements above the minimum. This option is compared to a baseline where infrastructure is not installed at the point of construction, but is retrofitted at a later date. Alternatives to mandating this through regulation includes continued support through grants such as the Workplace Charging Scheme and other investment-based policy.

Will the policy be reviewed? It will be reviewed. **If applicable, set review date:** 04/2025

Does implementation go beyond minimum EU requirements?	No				
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:**	**Non-traded:**			

I have read the Impact Assessment and I am satisfied that, given the available evidence, it represents a reasonable view of the likely costs, benefits and impact of the leading options.

Signed by the responsible SELECT SIGNATORY: ______________________ Date: ______________________

Summary: Analysis & Evidence Policy Option 1

Description: Transposition of rules set out in the EU Energy Performance in Buildings Directive: installing one chargepoint and ducting to route cables in for 1 in 5 spaces in new non-residential car parks with more than 10 spaces and one chargepoint for every existing car park with more than 20 spaces.

FULL ECONOMIC ASSESSMENT

Price Base	PV Base	Time Period	Net Benefit (Present Value (PV)) (£m)		
Year 2019	**Year** 2020	**Years** 31	**Low: -£78.7m**	**High: -£433.1m**	**Best Estimate: -£255.9m**

COSTS (£m)	**Total Transition** (Constant Price)	Years	**Average Annual** (excl. Transition) (Constant Price)	**Total Cost** (Present Value)
Low	£1.2m	1	Optional	**£78.7m**
High	£3.7m		Optional	**£433.1m**
Best Estimate	£2.5m		£8.2m	**£255.9m**

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

EPBD requirement costs have been monetised for the installation of one chargepoint per car park and additional ducting for 1 in 5 parking spaces during construction of car parks associated with new non-residential buildings, and one chargepoint for all existing non-residential buildings/car parks compared to a counterfactual in which one chargepoint per car park is retrofitted. These requirements yield a net cost of £255.9m which is expected to fall on car park owners. This includes familiarisation costs, which are estimated at £2.5m over the appraisal period, and hardware replacement costs which are estimated at £41.5m.

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

There may be some costs to existing car park owners as a result of disruption during the process of installing charging infrastructure. There will also be some maintenance costs to car park owners to ensure the continued functionality of the chargepoint hardware.

BENEFITS (£m)	**Total Transition** (Constant Price)	Years	**Average Annual** (excl. Transition) (Constant Price)	**Total Benefit** (Present Value)
Low	Optional		Optional	
High	Optional		Optional	
Best Estimate	N/A		N/A	**N/A**

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

There are no monetised benefits associated with this policy, as any potential savings in installation costs through installing chargepoints up front are outweighed by an extra requirement for ducting which is not present in the baseline, and because baseline installations occur later (and so are discounted more heavily).

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 in retrofitting chargepoints, such as the digging of trenches. Improved access to charging is correlated with sales of ULEVs; it can be expected that this policy will result in some ULEV 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 the existing car park stock is in line with a 2013 British Parking Association estimate, and that the volume of new builds will be 565 each year (1% of the current total). All of these car parks are assumed to be in scope (have more than 10 spaces). In new build developments, developers take advantage of cost savings through economies of scale, but in retrofit installations, single unit costs are applied. Impacts are relative to a baseline which assumes the same number of retrofit installations over the appraisal period. Degradation of materials is assumed to happen in line with CIBSE economic life estimates.

BUSINESS ASSESSMENT (Option 1)

Direct impact on business (Equivalent Annual) £m:			Score for Business Impact Target (qualifying provisions only) £m: 0
Costs: £15.8m	**Benefits: N/A**	**Net: -£15.8m**	

Evidence Base (for summary sheets)

Contents

1. Background

1. The Energy Performance of Buildings Directive (EPBD) is the European Union's (EUs) main legislation for improving energy performance and delivering cost effective Green House Gas (GHG) emission reductions from buildings, across the EU.
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 takes place at home and in private parking areas.
3. Consequently, a number of 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.
4. **The requirements are that ducting[2] (tubing which allows for the easy rooting of cabling at a later date) be installed in every new residential building with more than 10 parking spaces, and for non-residential developments, there should be at least one chargepoint and ducting for one in five parking spaces for new buildings and that at least one chargepoint should be installed in every existing car park with more than 20 parking spaces by 2025.**
5. **This IA focusses specifically on the impact of non-residential charging provisions, but there is a separate IA that covers the residential provision.**
6. Transposition of the EBPD requirements will be done in line with the guiding transposition principles[3]. On 23 June 2016, the EU referendum took place and the people of the United Kingdom voted to leave the European Union. Until exit negotiations are concluded, the UK remains a full member of the European Union and all the rights and obligations of EU membership remain in force. During this period the Government will continue to negotiate, implement and apply EU legislation. The outcome of these negotiations will determine what arrangements apply in relation to EU legislation in future once the UK has left the EU

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[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 the any conduit for routing cables from the power supply to the chargepoint. These can include cable trays and subsurface trenches.

[3] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/682752/eu-transposition-guidance.pdf

Table 1 - EPBD charging infrastructure requirements for buildings			
Requirement	**Residential New Buildings**	**Non-Residential New Buildings**	**Non-Residential - Existing Building**
Chargepoints	None	1x Chargepoint for each new or majorly renovated non-residential car park with >10 parking spaces	1 x Chargepoint installed for every non-residential car park with >20 parking spaces
Ducting	Ducting for all parking spaces where a car park has >10 parking spaces	Ducting for one in 5 parking spaces for car parks with >10 parking spaces	No additional ducting
Timing	From date regulation comes into force	From date regulation comes into force	By 1st Jan 2025

2. Problem under consideration

7. The electrification of road transport, particularly in 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 the Road to Zero strategy[4], the Government set the ambition that by 2030 50%-70% of new cars and vans would be to be Ultra-Low Emission Vehicles (ULEVs) and by 2040 all new cars and vans will be effectively zero emission.

8. The transition from Internal Combustion Engine Vehicles (ICEs) to ULEVs will require a widespread deployment of charging infrastructure; and it is expected that Government intervention will be necessary to support this for a number of reasons, including so that charging infrastructure is installed at a pace which supports the uptake of ULEVs in line with Government targets through reduction of ‘range anxiety. It is also important that cost savings in achieving this are realised where possible.

9. There are currently more than 200,000 ULEVs on UK roads and the UK was the second largest market for ULEVs in the EU in 2017. However, ULEVs still represent just 2.4% of new car sales (average for 2018). A perceived lack of an accessible and convenient charging infrastructure is repeatedly cited in consumer surveys as a barrier to purchasing an electric car[5]. 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[6] is therefore crucial if we are to meet our Road to Zero uptake ambitions in the coming years.

10. There is a circular relationship between the deployment of charging infrastructure and ULEV uptake; on the one hand charging infrastructure is a necessary precondition to ULEV uptake, and at the same time without ULEV uptake there is insufficient incentive for the market to deliver charging infrastructure and without Government intervention to correct this ‘coordination failure’ there may be insufficient deployment of charging infrastructure, and uptake of ULEVs could stall.

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[4] Road to Zero strategy https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/739460/road-to-zero.pdf

[5] 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 charge points.

[6] 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

11. Furthermore, recent evidence gathered (from paragraph 43) shows that the cost of installing charging infrastructure in car parks associated with non-residential buildings - specifically the cost of installing ducting, cabling and charging infrastructure after a building or construction is completed, is higher than installation during construction. Which means that without an incentive to install infrastructure during construction, a less cost-effective deployment of charging infrastructure will take place.

3. Policy Objective and Context

12. The objective of charging infrastructure policy is to promote the installation of charging infrastructure to facilitate the transition to ULEVs at least cost.
13. The Government has intervened a number of times to promote the installation of chargepoints in both public and private spaces. 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 of more than 17,000 public chargepoints[7]. This includes over 1,700 rapid chargepoints - one of the largest networks in Europe.
14. An important part of the public network is the destination charging market. Destination chargers largely comprise of 3, 7 and 22 kW AC chargers in public locations where cars are parked for more than an hour.
15. 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.

4. Rationale for Intervention

16. Alongside the need to comply with EBPD requirements, the overarching rationale behind government action to decarbonise road transport is to address the social cost of emissions from the private consumption of road transport through use of ICE vehicles. Supporting the transition to ULEVs to tackle this problem requires further action to address market failures which, without intervention, would likely prevent the transition to ULEVs at the pace required to meet targets and at least cost. The non-residential charging infrastructure requirements set in the EPBD aim to address:
    i. **Supporting ULEV uptake (Negative Externality):** A negative externality exists with the consumption of transport through traditional internal combustion engine (ICE) vehicles. Pollution from these vehicles imposes costs on those not using ICE vehicles (such as pedestrians and cyclists), meaning the true cost to society is higher than the cost that individual using the ICE vehicle has to bear. In this case, ICE vehicles will be over-consumed and ULEV take-up will be slower than if the individual had to bear the full costs of their ICE consumption decisions. ULEV adoption removes or heavily reduces this negative externality, as there are zero or low emissions at the point of use (discussion about EV emissions savings is made from paragraph 91). There is therefore evidence of market failure in the

[7] Figures taken from ZapMap, and amended to reflect the volume of chargepoints that could be used simultaneously - https://www.zap-map.com/statistics/ (April 2019)

consumption of road transport. Given this negative externality, it is necessary to make the transition towards the decarbonisation of transport. EV uptake is also likely to form a key part of the Emission Reduction Plan, which will be set out in the Government's strategy for meeting the 5th Carbon Budget.

ii. **Coordination failure**: There are currently a low number of ULEVs on the road so current demand for chargepoints is limited. At the same time ULEV demand is largely influenced by consumers' perceived access to charging. This interdependence between charging infrastructure and ULEV purchasers means that ULEV purchasers and charging infrastructure providers suffer a 'first mover disadvantage'; whereby charging infrastructure provision incurs a risk of underutilisation from a lack of ULEVs on the road and ULEV purchasers risk having a lack of accessible charging infrastructure, leading to a potentially suboptimal level of charging infrastructure provision and ULEV uptake at a pace which means that targets for ULEV uptake are not met.

4.1 Options

17. For new and existing car parks associated with non-residential buildings, there is limited evidence to support additional options for intervention above direct transposition of the directive, this IA considers the impact of transposing these provisions, without additional requirements. The impacts are costed by comparison with a 'do nothing' scenario in which no policy is implemented.

18. <u>Do nothing (baseline):</u> The baseline against which the alternative policy options are compared is a scenario in which carpark owners retrofit chargepoints at a rate that rises in line with the forecast % of ULEVs, as a share of total car stock, such that the installation rate reaches 100% in 2050 (at least one chargepoint in every car park), in line with previously announced policy intentions of a 2040 end to ICE sales. The methodology behind establishing this baseline, and the installation distribution is discussed in detail from paragraph 48 and in figures 1 and 2.

19. <u>Option 1 (do minimum):</u> This option has two elements stemming from the requirements for new non-residential car parks and existing non-residential car parks with associated car parking spaces, set out in the EPBD. These requirements refer to non-residential car parks that are attached to an associated building.

   i. **New car parks:** To require the installation of one chargepoint and ducting for 1 in 5 spaces for all new non-residential car parks with more than 10 spaces.
   ii. **Existing car parks**: To require the installation of one chargepoint in every car park with more than 20 spaces.

20. For both car park types, this represents the minimum requirement under the EPBD directive. For cost modelling purposes, chargepoints are assumed to be 'smart', but this will not be an explicit requirement in the Building Regulations.

21. The decision to include only one option for this assessment is due to there being a necessity to transpose the minimum EPBD requirements. However, given the diversity of different non-residential buildings, it does not seem appropriate to set prescriptive requirement above the minimum. This would serve to be an unnecessary burden to businesses where additional charging infrastructure above minimum compliance would mean an oversupply. Furthermore, alternatives policies such as continued support through grants such as the Workplace Charging Scheme and other investment-based policy already in place, but these are insufficient for meeting the minimum requirements set out in EPBD rules.

4.2 Preferred Option

22. Option 1 is the preferred and only option, and is intended to ensure that places like workplaces and retail parks are able to accommodate growing volumes of ULEVs. Non-residential chargepoints are also a necessary component of the UK's charging infrastructure network and enable ULEV uptake, particularly for those who do not have access to residential chargepoints. If chargepoints become readily available in key destinations, a key barrier to purchasing an EV is removed, which is likely to enhance uptake. This reflects a minimum provision – and developers are able to go further depending on the building use.

5. Evidence Base

23. The implementation of the policy option discussed above will mean the installation of charging infrastructure in **new non-residential sites** at the point of construction, as well as the retrofitting of charging infrastructure in **existing non-residential sites**. In order to monetise impacts of this regulation, assumptions have been made around the number of installations forecast, and the associated cost, both with and without the policy in both types of sites.

24. This section outlines what these impacts are and the methodology and assumptions used to monetise them. Assumptions on charging infrastructure costs have been gathered from consultant-led research and stakeholder engagement; which are applied to forecasts of installations which are derived from public car park data for non-residential sites.

25. There are a number of further impacts which are necessarily not monetised given a lack of appropriate methodology, however evidence which supports these impacts are also outlined in this section. There are six impacts considered in this IA, four of which are monetised and two of which are non-monetised impacts.

Monetised impacts include;

(i) A net cost of installing one chargepoint and ducting for five parking spaces in new non-residential car parks, compared to a counterfactual where one chargepoint is installed at a later point; and;

(ii) A net cost of installing one chargepoint in existing non-residential car parks, compared to a counterfactual where one chargepoint is installed at a later point; and;

(iii) Familiarisation costs, incurred by developers to familiarise themselves with the new processes for installing the relevant infrastructure; and;

(iv) Material replacement costs as a result of hardware and component degradation.

Non-monetised impacts include

(v) Impacts on ULEV uptake and subsequent emissions savings – it is not possible to estimate exactly how many additional ULEVs would be bought by consumers over the period as a result of implementing the policy, though evidence exists to suggest that availability and visibility of charge points contributes favourably to ULEV purchase decisions and;

(vi) Avoided disruption costs as a result of the chargepoint installations that take place at the point of construction rather than whilst occupants/customers are present.

26. Because of the long-term nature of the transition to ULEVs which these measures are aimed at supporting, and the long useful life of the infrastructure installed, an appraisal period of 31

years is necessary to accurately capture the full process of this transition (with 2050 the year ULEV share is expected to reach 100%). A shorter appraisal period would mean that fewer retrofit installations are captured in the baseline relative to the policy options, which would have a negative effect on the NPV. The risks of technological obsolescence do also increase with long appraisal periods. This risk is discussed in more detail in paragraph 133.

27. All costed impacts are discounted using a 2020 base year and a discount rate of 3.5% (in line with Green Book guidance) and deflated using a 2019 price base year.
28. In estimating the total cost of charging infrastructure, an understanding of what charging infrastructure would be covered by the option considered, and the relevant unit costs is required.

5.1 Costs of Charging Infrastructure – Evidence gathered

29. DfT commissioned consultants, Steer, to estimate 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, **'Ducting'**, **'Cabling'**, '**Hardware**' and **Grid Connection** costs.
30. For each of these, estimates were captured for up-front installation (during construction) and 'retrofit' installation (after construction) for four types of parking location;

- **'Off-street private'** – for example, a private off-street parking space
- **'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

31. 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.
32. Costs gathered are summarised in cost summary tables provided by Steer (provided in the Annex B). A number of assumptions were applied in using these costs to estimate the final costed impacts for this IA; these are set out in the following section 5.2.2. Where possible, the assumptions used to derive these estimates are included in the option cost summaries (from paragraph 37).
33. Costs and supporting information received from Steer was supplemented with information supplied by relevant industry stakeholders (i.e. developers and chargepoint companies). DfT will be inviting views on our cost estimates from stakeholders during consultation.

5.2 Monetised Impacts

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

<u>5.2.1 Monetised Impact (i) Net cost from new non-residential residential installations</u>

(i.i) Overview of methodology – new non-residential

35. The minimum requirement for car parks attached to new non-residential buildings is the installation of at least one chargepoint, and ducting for 1 in 5 spaces.

36. A net installation cost for this option is estimated by applying infrastructure costs from Steer, with some adjustments, to an estimated forecast number of annual ‘installations’ of charging infrastructure both with and without the proposed policy interventions from 2020-2050.

37. For new-build installations, there is a per unit cost saving that arises from the difference between up front and retrofit costs of installation; with retrofit costs being higher. There is however an overall net cost for this impact, due to the additional ducting requirement for 1 in 5 spaces. There is no additional ducting requirement captured in the baseline, as it is assumed unlikely that car parks owners would retrofit large volumes of ducting absent of any policy intervention. However, a sensitivity has been run to identify possible installation cost savings as a result of additional chargepoint installation where ducting is pre-installed (see paragraph 116).

38. Without implementation of the policy, it is assumed that all installations are retrofitted into new builds in line with what is the expected trajectory of ULEV uptake, if Government targets for ULEV uptake are met, and all vehicles are Electric Vehicles (EVs) by 2050. The process of establishing the baseline is discussed in detail from paragraph 48.

39. As a result, it is assumed that the total number of installations are the same over the appraisal period, but without policy intervention, annual installations are lower in the first half of the appraisal period. An implicit assumption here is that car park owners ultimately purchase and install the same volume of charging infrastructure because there is a full transition to ULEVs, which means that: (a) there are opportunities to generate revenue by providing charging services, and (b) the provision of charging services may be necessary to attract customers to their establishments. If this does not happen, then there could be an over installation of charging infrastructure leading to ‘stranded assets’ (see risks and sensitivities).

40. It is possible that some aspects of the installation costs may be considered transfers, as the purchase of hardware components by developers will result in chargepoint manufacturers profiting from increased business. If these elements are to be considered transfers, then the net costs would be lower than outlined in this assessment.

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

41. The number of installations will depend on the number of car parks added to the existing stock through completions of new non-residential dwellings each year.

42. Non-residential car parks cover both publicly accessible car parks such as supermarkets, hospitals and retail parks, but also non-publicly accessible car parks such as workplaces. Whilst there is a reasonable amount of data on the existing stock of the former, there is very little on the latter.

43. Crucially, only car parks associated with a building are in scope of the EPBD requirements. This means that only a subset of these car parks should be considered in volume estimates. Given the lack of granularity in the data however, it has not been possible to identify what proportion of the total car parks this applies to. For this reason, all car parks are considered in scope for the purpose of this assessment. This is a conservative assumption that will likely to lead to an overestimation of costs, as there are likely fewer car parks that would come under the scope of this requirement than have been assumed in this assessment.

44. It has also not been possible to identify a reliable way of identifying the volume of car parks added to the existing stock, which makes forecasting new car parks difficult. For this reason, an attempt has been made to identify the existing stock of car parks, and then an unevidenced assumption that 1% of the existing stock would built/renovated each year was used to identify 565 car parks per year. This figure is held constant throughout the appraisal period, and as such there is huge uncertainty around this volume estimate.

45. To establish the existing stock of public car parks, data from Parkopedia[8] (the world's largest parking service provider) was used, which identified 20,370 car parks in the existing publicly accessible stock.

46. For the non-publicly accessible stock, a report by BPA in 2013[9] was used which provides an estimate for the total stock of non-residential parking, giving a figure of 8-11m total spaces. By taking the midpoint for this and using data from Parkopedia for average number of spaces per car park, a combined figured of around 56,000 car parks was generated.

Question 1: What evidence can you provide for an alternative estimate or methodology for identifying the volume of new build non-residential car parks with an associated building?

Table 2: yearly volume of in scope new build car parks							
Car park type	**2020**	**2021**	**2022**	**2023**	**2024**	**…**	**2050**
New build	565	565	565	565	565	…	565

47. Due to lack of data, it has not been possible to disaggregate this by type of car park (i.e. multi-storey/underground/surface).

48. It is assumed that the average number of spaces per public car park found in the Parkopedia data (171) is the same for all car parks. This means that all car parks are assumed to have over the 10 parking spaces required to be in scope of the requirements. Based on this volume of spaces, table 3 below shows the yearly and appraisal period total volumes of ducting and chargepoints required. This is also a conservative assumption that will likely lead to an overestimation of costs.

Table 3: Infrastructure volumes required for new build car parks		
Component	**Yearly**	**Total (31 year)**
Ducting (spaces)	19,307	598,503
Chargepoints	565	17,500

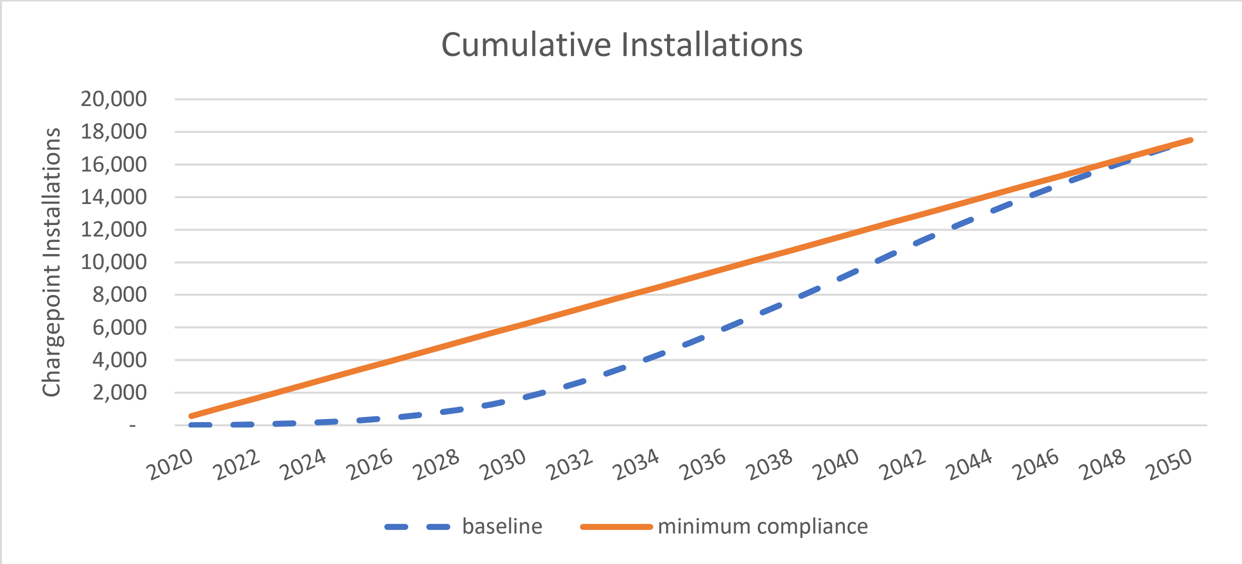
(i.iii). Forecasting Baseline Residential Installations

49. The baseline against which the different policy options are compared to is a scenario where there is no intervention and cark park owners face higher per-unit retrofit costs when they require chargepoint installation in the future. For this scenario, it is assumed that chargepoints will be installed in the same volumes over the appraisal period as the case in which their installation is mandated in new builds. The volume of installations in the early years is however significantly lower, with the rate of installation increasing overtime in line with the percentage of ULEVs as a share of total car stock. This is identified in the cumulative installation charts below.

[8] Parkopedia website, accessed March 2019 https://en.parkopedia.com/

[9] BPA UK parking sector report (p.2) https://www.britishparking.co.uk/write/documents/library/reports%20and%20research/bpa_uk_parking_sector_report_awweb.pdf

Figure 1: Cumulative new car park charge point installations – baseline and option 1.



50. It is difficult to identify the volume of non-residential installations, as decisions for car park owners to install charging infrastructure depends on commercial viability which varies greatly by location and car park type. It does however seem likely that the decisions for owners to invest in infrastructure will rise with the proliferation of ULEVs.

51. There are some qualitative sources support the notion that there will be an increase in the volume of chargepoints that will be installed in non-residential car parks. Examples of the companies that have pledged to increase the provision of chargepoints include Tesco[10], the pub chain Marstons[11] and AA hotels and B&Bs[12]. Given these pledges, it seems likely that over the course of the appraisal period, there will be appetite for car park operators to retrofit chargepoints into some of the car parks that come under the scope of this policy. It is however very difficult to identify a reliable forecast for the rate at which these chargepoints will be installed.

52. It has also been observed that in car parks where charging infrastructure is installed, multiple installations are the average. Data from a Parkmark sample[13] identifies that of the car parks that currently have chargepoint provision, the average number of chargepoints is 4.8[14]. Crucially however, the scope of this IA only covers the first chargepoint installed in each car park.

53. The baseline installation rate is modelled based on a ULEV stock share forecast that reflects the EV uptake ambition level set out in the Road to Zero strategy[15]. This forecast was used to model the percentage of ULEVs as a share of the total car stock and the assumption was made that the percentage of new-build car parks that install chargepoints would 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.

54. **It is assumed that absent of intervention, no chargepoints are installed at the point of construction**. This is an oversimplification as there are some Local Authorities (LAs) with requirements for chargepoint installation, but this is not widespread and it varies significantly between LAs. For the moment it seems clear that this is an appropriate assumption to estimate

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10 BPA UK parking sector report (p.2) https://www.britishparking.co.uk/write/documents/library/reports%20and%20research/bpa_uk_parking_sector_report_awweb.pdf

11 Marstons News: Marstons partners with Engenie http://www.marstons.co.uk/news/marstons-rolls-out-rapid-EV-chargers.aspx

12 ZapMap news: Chargemaster chargepoint offer for AA venues https://www.zap-map.com/chargemaster-charge-point-offer-for-aa-venues/

13 ParkMark data request – accessed 20/02/2019 http://www.parkmark.co.uk/,

14 This is based on a sample of 4,601 car parks, with 3.5% having some volume of chargepoints.

15 This trajectory aligns with government targets for the displacement of ICEs with ULEVs (more specifically EVs) https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/739460/road-to-zero.pdf;

the regulatory impact as there is no visible incentive, without regulation, for builders to install during construction. In assuming this, there is a possibility the baseline costs are overstated, as if developers choose to install at the point of construction (which may be likely in later years), they will be able to achieve cost savings.

Question 2: What evidence can you provide to identify the volume of non-residential car parks with an associated building, that had a chargepoint installed at the point of construction?

55. Over the course of the consultation, additional information will be sought to identify the likely rate of new build installation absent of intervention – to more accurately inform the cost of baseline installations.

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

56. For both ducting and chargepoints, installation costs are taken from Steer and require a number of assumptions in order to apply them appropriately to the volumes of installations estimated. The costs used in each option and further assumptions are set out in this section for each option; providing additional detail on what the costs contain, and how/why they vary between 'high' and 'low' as well as 'New Build' vs. Retrofit.

57. As DfT do not have data on the type of car park (surface/multi-storey/underground) in order to map these volumes onto our charging infrastructure cost categories, it is assumed that the lowest low unit cost of the 3 categories is relevant for the low scenario and the highest cost for the high scenario. These costs are shown in the table below.

Table 4: per-unit costs charging infrastructure costs (Steer)

	New build		Retrofit	
Component	**Low**	**High**	**Low**	**High**
Ducting	£67	£600	£167	£2,500
Chargepoint	£1,182	£6,463	£1,640	£8,210

58. The assumptions relevant for each component of installation are identified below, as well as general methodological assumptions. Cabling, grid connection and chargepoint hardware are all required for full chargepoint installation.

Ducting

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

60. The largest driver of variability in cost between the new build and retrofit scenario comes from the costs of civil works[16] in surface level car parks, where trenching is required. In retrofit installations, the cost of having trench and resurface is very expensive.

61. The difference between the low and high cost scenarios is driven by the volume of ducting/trenching required, which depends on the assumed distances from the power supply to the charging infrastructure.

Cabling

62. Cabling is considered to capture any electrical cables that are required for connection between the power supply and the chargepoint.

[16] Considered to be work involving amendments to physical structures.

63. As with ducting, the cost differences for cabling between categories are driven by the length of cabling required. 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.

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

Grid connection

65. Grid connection costs capture any costs involved in upgrading the grid capacity of a site to allow for chargepoint installation.

66. Grid connection costs associated with chargepoint connections vary significantly depending on location, and hence it is difficult to establish a representative cost for installations. Whilst there is a great deal of uncertainty surrounding these figures, and it has not been possible to fully capture the distribution of costs in the cost summaries, annex B sets out the assumptions chosen to arrive at these cost profiles.

67. The low range costs reflect a scenario where no additional capacity is required, so there is no grid connection cost, whilst in the high range scenario a larger transformer[17] is required (relative to the situation where no chargepoint is installed). For retrofit installations this would require the existing transformer to be replaced, whilst for new build installations, the cost would reflect the difference between the smaller and larger transformers.

Question 3: What evidence can you provide to support the use of alternative assumptions to inform grid connection costs?

Chargepoint hardware

68. Hardware costs cover the physical chargepoint unit/outlet that connects an EV to the power source These costs include the cost of a 7 kW '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. The installation of 7 kW chargepoints reflects minimum compliance, but in some cases

69. 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.

i.v. Other Key cost assumptions

70. **All chargepoint installations are costed according to the single unit cost.** Whilst it is possible (likely) that when car park owners would install multiple chargepoints (and so benefit from economies of scale cost savings) the scope of this assessment only considers the first chargepoint installed in each car park, and so the single unit installation cost is applied.

71. **The ducting requirement for new build car parks are costed using the 100-installation unit cost**. This is because the assumed volume of ducting required in the average car park is for 34 spaces. The 100 x unit costs provided by Steer were broken down to a per unit basis and multiplied by the volume of car park spaces required. This does not perfectly capture the degree to which economies of scale reduce cost per unit based on different car park sizes, but given the limited breakdown of fixed and variable costs, it was not possible to identify this.

72. **Technological learning rates have not been modelled due to a lack of data to inform this.** It could be assumed that the hardware costs of chargepoints will decrease over the appraisal period, but this has not explicitly been modelled as it has not been possible to find sufficient evidence to inform the rate of decrease. If hardware costs were to decrease

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

overtime, this would have a slight negative effect on the NPV, as a greater proportion of retrofit installations happen later in the appraisal period.

Question 4: What evidence can you provide to support how technology learning rates will contribute to chargepoint cost reduction over time?

73. **For every aspect of installation, there is a reduced cost when installations take place at the point of construction,** compared to when chargepoints are retrofitted into existing buildings. For each option, it is assumed that whatever aspect of the installation is installed at the point of construction, brings a benefit to society in terms of the cost reduction relative to the retrofit cost. In the baseline scenario, it is assumed that for non-residential car parks a chargepoint is installed, but not the additional ducting. This means that the impact of the ducting policy requirement gives a net cost as there is an additional volume of ducting captured in the option 1 but not in the baseline. Given however that additional ducting is provided in option 1, any future additional chargepoint installations would achieve an installation cost saving as a result of this ducting having been installed.

74. Table 5 shows the present value net cost for this impact, separated out by component. The first part of the table shows what the cost of a particular component would be under a retrofit installation, with the second part showing what the new build cost would be, and finally the net cost section showing the difference between these figures. There is an overall net cost for all aspects except for the low scenario chargepoint component.

Table 5: New build Installation costs vs baseline (millions, 2019 prices, 2020 base year)

Component	Low	Central	High
Retrofit installation costs			
Ducting	£0	£0	£0
Chargepoint	£10.6	£32.0	£53.3
Total	**£10.6**	**£32.0**	**£53.3**
Option 1 installation costs			
Ducting	£19.6	£98.2	£176.7
Chargepoint	£10.2	£32.9	£55.7
Total	**£29.8**	**£131.1**	**£232.4**
Net cost			
Ducting	£19.6	£98.2	£176.7
Chargepoint	-£0.5	£1.0	£2.4
Total	**£19.2**	**£99.1**	**£179.1**

5.2.2 Monetised Impact (II) Existing non-residential installation net cost

(i.i) Overview of methodology – existing non-residential

75. In addition to the requirement for new non-residential car parks, there is a requirement for existing car parks. This requirement is only for one chargepoint, and there is no additional ducting requirement.

76. The methodology follows a similar format as outlined in the establishing the new installation impact.

(i.ii) Forecasting the number of existing non-residential installations

77. Establishing the volume of the existing non-residential car park stock was done as outlined in paragraph 45.

78. Given the 2025 implementation date, there is a very short period for car park owners to achieve compliance. There is little information to inform the likely point that installation will take place, so an arbitrary assumption was made that 20% of the stock of car parks will install each year from 2020 to 2024. This is shown in table 6. While there is a great deal of uncertainty as to the installation rate, the only difference the point of installation has on the NPV is through differences in inter-temporal discounting.

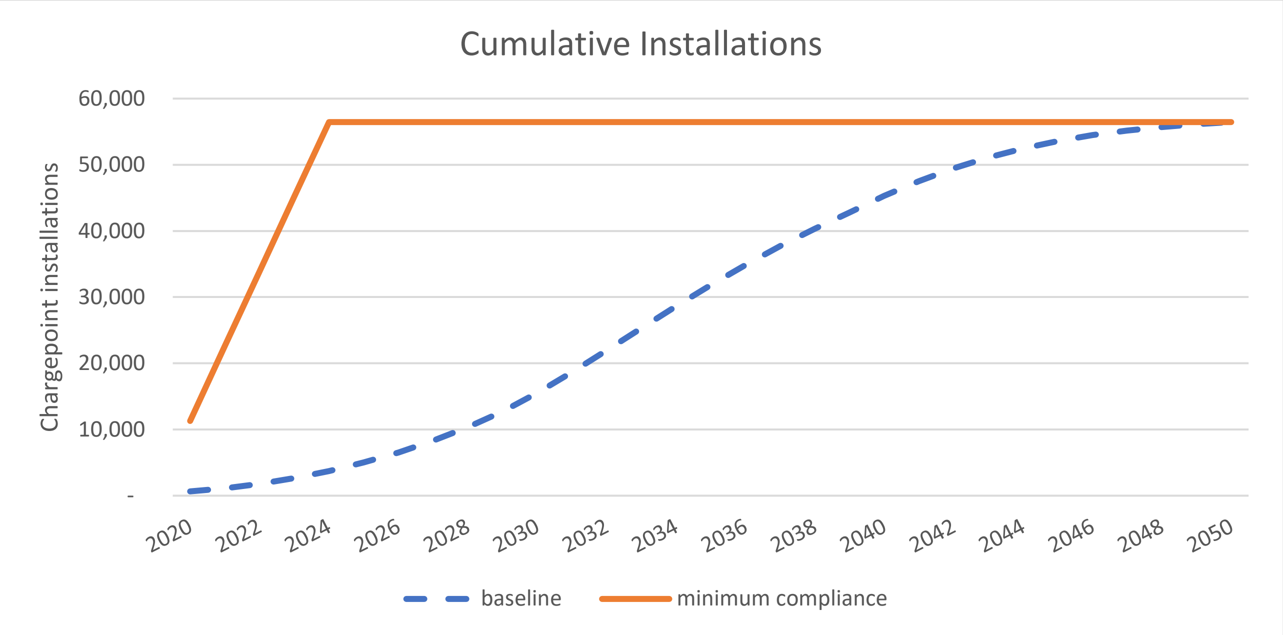
Table 6: yearly volume of in scope car parks

Car park type	2020	2021	2022	2023	2024
Existing	11,290	11,290	11,290	11,290	11,290

(i.iii). Forecasting baseline existing non-residential installations

79. The methodology for establishing the baseline installation trajectory is the same as for the new-build baseline. This installation trajectory is shown in figure 2. For option 1, compliance requires all installations to take place before 2025.

Figure 1: Cumulative existing car park charge point installations – baseline and option 1.



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

80. The methodology for applying costs was the same as for new non-residential car parks, except that the retrofit cost scenario is relevant for all installations in both option 1 and the baseline, as the scope of this impact is existing car parks alone, so installation is not possible at the point of construction. For that reason, the unit costs used in option 1 are the same as in the baseline.

Question 5: What evidence can you provide for an alternative estimate or methodology for identifying the volume of existing non-residential car parks with an associated building?

81. As such, the following cost table is relevant for this impact.

Table 7: per-unit costs charging infrastructure costs (Steer)		
Component	**Low**	**High**
Chargepoint	£1,640	£8,210

(i.v). Other Key cost assumptions

82. No additional cost assumptions are relevant for this impact.

Table 8: Existing Installation costs vs baseline (millions, 2019 prices, 2020 base year)			
Component	**Low**	**Central**	**High**
Retrofit installation costs			
Total	**£44.3**	**£133.0**	**£221.8**
Option 1 installation costs			
Total	**£81.9**	**£245.8**	**£409.8**
Net cost			
Total	**£37.6**	**£112.8**	**£188.0**

5.2.3 Monetised Impact (iii) Familiarisation costs

83. In addition to the installations costs, there will be some time costs to car park owners and chargepoint installers as they familiarise themselves with the new regulations. These costs include the time taken to read the regulations and to formulate a plan to respond to them. Whilst there is a great deal of uncertainty around exactly how long it would take, it has been assumed that the impact will be greatest for construction firms as they will have to accommodate the new requirements in their construction processes, whilst chargepoint installers can continue to operate in a similar way.

84. For car park owners it has been assumed that 1 member of staff for each car park will spend around 2 hours reading and implementing the regulations, whilst 5 staff at each chargepoint installer (200) will spend around 2 hours for this. These time and staff requirement estimates are unevidenced. Using ASHE hourly wage data for 'Property, housing and estate managers' and 'Production managers and directors in manufacturing' gives rates of £22.35 and £28.99 respectively[18]. The overall familiarisation costs that occur in year 1 only are around £1.6m (2019 prices).

85. 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.

Table 9: Familiarisation costs (millions, 2019 prices, 2020 base year)			
	Low	**Central**	**High**
Option 1	£1.2	£2.5	£3.7

[18] https://www.ons.gov.uk/employmentandlabourmarket/peopleinwork/earningsandworkinghours/datasets/occupation4digitsoc2010ashetable14 ASHE table 14.6a, wage rates are uplifted by 30% to reflect overheads.

5.2.4 Monetised Impact (iv) Material replacement costs

86. 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.

87. The CIBSE Guide M – Maintenance engineering and management[19] 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'*.

88. The economic life estimates are based on a number of 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.

89. Indicative economic life expectancy is given in Appendix 12.A1 of CIBSE Guide M. There are no specific guidelines for electric vehicle charging infrastructure, but reasonable inferences could be made based on general electrical equipment. From this, the figures in Table 10 can be inferred.

Table 10: Indicative economic lifespan of equipment

Equipment type	Multi-occupancy car park	Private off-street parking
Cables	30 years[1]	25 years[6]
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]
ULEVSE outlet	15 years[5]	15 years[5]

References from CIBSE Guide M, Appendix 12.A1

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

Power installations:

5. Socket outlets, fuse connection units, etc – 15 years
6. General LV power installations – 25 years

90. Based on the equipment lifespans presented in the table above, and assuming baseline and policy option volumes of installations as presented above, the costs in table 11 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.

[19] CIBSE guide M https://www.breeam.nl/sites/breeam.nl/files/hulp/CIBSE%20Guide%20M.pdf

Table 11: Material/hardware replacement costs (millions, 2019 prices, 2020 base year)		
Component	**Baseline**	**Option 1**
EVSE outlet	£13.3	£37.1
Distribution boards	£0.1	£0.6
Cables	£1.0	£12.3
Ducting and feeder pillars	£0.3	£6.2
Total Costs	£14.8	£56.3
Cost relative to baseline	-	**£41.5**

91. 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.

92. 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. This is an unevidenced assumption.

5.3 Non-monetised Impacts

5.3.1 Non-monetised Impact (v) ULEV uptake

93. As perceived lack of access to charging is a barrier to EV adoption, with increased non-residential chargepoint installation comes the potential for the rate of EV adoption to increase. Whilst the number of chargepoints identified in the baseline and option 1 scenarios are the same over the appraisal period, the installation rate is much higher in the early years in option 1, so it seems likely that will be benefits associated with increased EV adoption, particularly in the early years under this scenario.

94. As ULEVs displace ICE vehicles, there are monetisable benefits to society through emissions savings. 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.

95. Increasing the perception of access to charging is a key way to increase the feasibility of large scale EV ownership. Access to chargepoints is correlated with EV uptake, and it is acknowledged that low availability is an inhibitor to adoption. By providing charging infrastructure, the necessity to bear the financial, logistical and time cost of installation is taken away from the consumer. At the very least, interventions that increase the perception of access to charging remove a barrier to adoption, but it follows that for some people, this will be the marginal factor the tips the balance towards EV purchase. Crucially, as the salience of a chargepoint being present in car parks increases the perception of access to charging.

96. For public charging infrastructure, the European Parliament's TRAN committee report[20] 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 impact that the

[20] http://www.europarl.europa.eu/RegData/etudes/STUD/2018/617470/IPOL_STU(2018)617470_EN.pdf Sections 3.1 & 3.2

provision of infrastructure has, and how it interacts with other factors affecting uptake such as model availability, financial incentives etc.

97. Whilst it has not been possible to identify the degree to which chargepoint provision will increase EV uptake, the following analysis is provided to give an indication of the value of emissions savings that come as a result of switching from ICE vehicles to ULEVs.

98. It is assumed that average emissions of 123g/km of CO_2 and 0.095g/km of NOX for cars and an average annual 12,553km/year. WebTAG valuations of emissions damage costs are used, with £70.55/tonne[21] for CO_2 and £33,705/tonne[22] for NOX.

99. Using these figures gives an estimate for the value of emissions savings as a result of displacing an ICE vehicle, at around £150 per car in 2020. It has not however been possible to robustly evidence the impact that this volume of chargepoint installations will have on the perception of access to charging (and consequently EV uptake), so this benefit remains non-monetised and is not included in the NPV.

5.3.2 Non-monetised Impact (vi). Avoidance of disruption costs (non-monetised)

100. 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/customers in the car park who can be inconvenienced by the work taking place. During a retrofit installation, where customers are likely to be present at the property, disruption costs could include: disruption to the electricity supply; property access issues; parking disruption. This will be most acute when an installation involves car park resurfacing, such as those taking place in surface car parks. These disruption costs are likely to be determined by individual car park circumstances e.g. size and type and are not likely to be significant, therefore they have not been quantified (and consequently the benefit from avoiding them has not been defined).

5.3.3 Non-monetised Impact (vi). Future installation cost savings (non-monetised)

101. With the additional ducting requirement in option 1, there comes the possibility for future chargepoint installations to realise installation cost savings, as the ducting component will already be present. With the costs for ducting installation at the point of construction £67 - £600, and for retrofit installation £167 - £2500 (as set out in table 4), depending on the volume of installations, there are substantial cost savings that could be generated as a result of the additional ducting in option 1. This has not however been quantified as there is little indication of what an appropriate volume of chargepoint installations car parks may deem appropriate to install. Particularly as there are a wide variety of car park types.

6. Results

102. This section presents the cost and benefit summaries, starting with the baseline and then showing summaries for each policy option, as well as capturing the direct costs to business. The proportionality of the approach used in this assessment is discussed, as well as the risks associated with the analysis, and the implications of these risks. **The impacts of both the new-build and existing car park requirements have been combined to give total impacts for option 1.**

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[21] https://www.gov.uk/government/publications/tag-data-book, Data table A3.4 non-traded values 2020, price year 2019

[22] https://www.gov.uk/government/publications/tag-data-book, Data table A3.2 marginal abatement costs 2020, price year 2019

6.1. Evidence summary

6.1.1. Summary of monetised impacts

103. The below tables identify the relevant cost and benefit components for each scenario, first establishing what the baseline costs are, followed by total costs for option 1.

104. Table 12 highlights the installation costs faced by consumers in the baseline scenario. There are no familiarisation costs as there is no policy intervention with which businesses must familiarise themselves. There are also no benefits considered in the baseline.

Table 12: Baseline cost/benefit summary (millions, 2019 prices, 2020 base year)	
	Baseline
Costs (discounted)	
Installation in new car parks	£32.0
Installation in existing car parks	£133.0
Replacement costs	£14.8
Total costs	**£179.8**
Benefits (discounted)	
Cost savings	-
Total benefits	**-**

105. Table 13 shows the costs and benefits to society as a whole for option 1. The net costs are shown relative to the baseline. There are no cost savings benefits from this option, and no other monetised benefits, so the negative NPV captures only the net cost of this option. The negative NPV for this option is driven by:

    i. The additional ducting requirement for 20% of all spaces that is present in option 1, but not in the baseline and;

    ii. That most of the baseline installations occur much later in the appraisal period, and so experience a greater degree of discounting.

Table 13: Societal cost/benefit summary (millions, 2019 prices, 2020 base year)	
	Option 1
Costs (discounted)	
Familiarisation	£2.5
Net new Installation	£99.1
Net existing Installation	£112.8
Net replacement costs	£41.5
Total costs	**£255.9**
Benefits (discounted)	
Cost savings	-
Total benefits	**-**
Summary	
Net Present Value	**-£255.9**

106. There is a large negative NPV for this option, however this would be significantly higher if the ULEV uptake benefits were considered, and if the additional ducting requirement resulted in further chargepoint installation at a lower installation cost.

107. As all of the costs for this option are borne by business, the direct cost to business impacts are the same as in table 13.

6.1.2. Sensitivity Analysis:

108. This section highlights the assumptions upon which the NPV is most dependent, outlines the rationale behind the chosen assumptions, and then presents the results of various sensitivity scenarios that have been run to test the variability of the NPV.

109. The primary assumptions that the NPV of this policy is most sensitive to are that baseline installations will rise in line with target ULEV uptake, and that this will occur at a rate that is set out in the Road to Zero (RtZ). Baseline installations falling below this rate could occur for two main reasons:

i. **Baseline installation rate does not rise in with EV uptake:** A lower number of baseline installations could occur for a number of reasons that are discussed in the risk section below, such as (i) there is a structural shift in the way cars are used (e.g. car sharing increases and car ownership drops) (ii) a structural shift in the way chargepoints are used (e.g. preferences focus on residential charging).

ii. **ULEV uptake is below the trajectory set out in the baseline:** The baseline ULEV uptake trajectory is based on ambitions set out in the Road to Zero. This trajectory assumes that there is a continued decrease in the cost of ULEVs; manufacturers continue to shift production towards ULEVs and there is a continued rise in consumer preference for ULEVs. Were this not to be the case, then it would be possible the EV uptake could be below the chosen trajectory. Given however that there is strong evidence of a rapidly expanding EV market, the Road to Zero trajectory has been chosen for modelling purposes. This decision is based on a number of factors and sources of evidence that are discussed below:

- **EU manufacturer CO2 regulations:** 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[23]. Failure to meet this requirement results in very large penalties to manufacturers. This legislation is driving supply-side change, encouraging manufactures to develop and produce EV models, such that they are able 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 by 2023[24], and Ford pledging to invest £11bn by 2022[25]**.**
- **Total cost of ownership parity:** Whilst the up-front cost of ULEVs is currently higher than for ICE vehicles, the cost of operating an EV is lower than for ICE vehicle, so on a total cost of ownership (TCO) basis, the costs are much closer – and in a few cases ULEVs can be cheaper to own. As manufacturers produce more ULEVs at scale and continue to invest in R&D, the purchase cost of ULEVs is continuing to decline. Many forecasts identify that the point at which widespread price parity will be reached on a TCO basis is very close, and once that happens, it is expected that there will be a marked expansion in the EV market. BloombergNEF analysis suggests that unsubsidised purchase price parity will start from 2024, and UBS suggest that widespread TCO parity will happen in Europe from 2023[26]. This further supports the view that the transition to a dominant EV market is underway.
- **Commitment to end the sale of ICE vehicles from 2040:** A strong signal to manufacturers to invest in EV production has come from the Government, following the announcement of a commitment to end the sale of ICE vehicles in the UK from 2040. This announcement adds further pressure on vehicle manufacturers to ensure that they are equipped to operate in an automotive market that is dominated by ULEVs.

110. This will however be monitored over the course of the consultation to identify if a more appropriate installation rate trajectory could be used. This is discussed in more detail in the monitoring and evaluation section.

111. In order to test and demonstrate the sensitivity of the NPV to these assumptions, two baseline installation cap sensitivities have been run to highlight the differences in NPV that arise if baseline installations are lower than in option 1. These sensitivities reflect scenarios where there are 80% and 60% of the volume of installation in the baseline relative to option 1.

Table 14: baseline installation rate sensitivities (millions, 2019 prices, 2020 base year)

Sensitivity	Low	Central	High
80% baseline	-£89.3	-£288.0	-£486.7
60% baseline	-£100.2	-£321.0	-£541.7

112. In addition to assumptions about the baseline installation rate, the NPV is sensitive to assumptions about the relative costs of the baseline and policy option. It is possible that the cost of the baseline could be lower relative to the policy option, if the assumption that there are no technology learning rates does not hold.

[23] EU: Reducing CO2 emissions from passenger cars https://ec.europa.eu/clima/policies/transport/vehicles/cars_en

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

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

[26] EVfleetworld: cost of ownership for ULEVs to hit parity from 2018 https://evfleetworld.co.uk/cost-of-ownership-for-ULEVs-to-hit-parity-from-2018/

- **Technology learning rates reduce future cost of hardware:** The area that could be most sensitive to cost reductions would be if there are significant hardware cost reductions in later years through high technology learning rates, then the baseline installations (which happen later) would become relatively cheaper than those installed early in the appraisal period. These have not been modelled as it is unclear the degree to which learning rates might arise. Furthermore, as it is possible (likely) that additional chargepoint functionality requirements will be introduced over the course of the appraisal period, and that this would counteract any cost reductions that may be realised.

<u>Low EV uptake trajectory</u>

113. To complement the installation rate sensitivity above, an additional sensitivity has been run using an alternative EV uptake trajectory to highlight that (assuming the installation rate is dependent on uptake) the NPV is sensitive to the uptake rate. This uptake trajectory has been modelled using an internal car choice model, under a scenario that assumes no additional policy intervention from 2020 and that a full transition to ULEVs does not happen in spite of the evidence listed above. The negative NPVs that are generated as a result of this uptake trajectory are highlighted in the table below. It is however important to note, that in scenarios where the baseline installation rate is lower than the installation rate in the policy option, then the non-monetised EV uptake benefit would be more profound. This is not captured in the NPV however.

Table 15: Low EV uptake trajectory (millions, 2019 prices, 2020 base year)

Sensitivity	Low	Central	High
Option 1	-£111.0	-£370.4	-£587.4

<u>Five chargepoints per car park in the baseline</u>

114. Given that for car parks with chargepoints installed, the average number of chargepoints is 4.8 (see paragraph 52), a sensitivity has been run to capture the NPV if every car park installed 5 chargepoints, in both the baseline and under option 1. For this sensitivity the following conditions hold:

- In the baseline, 5 chargepoints are installed per car park, but under the same installation rate trajectory as the original baseline
- Option 1 reflects the same EPBD requirements at the point of construction, but a further 4 chargepoints are retrofit under the same installation rate trajectory as the baseline
- For the new car parks, these additional chargepoints achieve an installation cost saving relative to baseline installations, as the ducting has been pre-installed at the point of construction.

115. This sensitivity is intended to capture the installation cost saving that can be achieved due to the additional ducting component. The more chargepoints that are installed in the baseline, the more positive the impact on the NPV, which is highlighted in the table below.

Table 16: 5 chargepoints installed per car park (millions, 2019 prices, 2020 base year)

Sensitivity	Low	Central	High
Option 1	-£74.4	-£221.3	-£368.2

6.2. Equity considerations

6.2.1. Distributional Impacts

116. This section discusses possible scenarios for where the final cost burden for any policy intervention is likely to fall. In doing so, the uncertainty surrounding these scenarios is highlighted.

117. Three scenarios have been identified for where the final cost burden of this policy could fall. These are most relevant for new-build installations, as for existing installations, it seems likely that the car park owner will bear the full cost of installation.

  i. **Non-residential developers:** In cases where developers find buyers following the construction process, they will have to bear the cost of installing charging infrastructure in the first instance. They may then be able to pass these costs on to the buyer through higher prices, or choose to absorb the costs.

  ii. **Car park owners:** It seems likely that most of the costs of this policy will ultimately fall on car park owners. As the cost of chargepoint installation is likely to represent a very small fraction of the price of non-residential building, developers are expected to be able to pass on these costs to car park owners (for new build developments). For existing car parks, the expectation is that car park owners will always bear the cost. There are likely to be a wide range of car park owners, that include but are not limited to: supermarkets, retail parks, fitness centres, schools, hospitals, universities etc.

  iii. **Landowners:** If developers face higher build costs as a result of this policy, it seems possible that they may indirectly pass costs onto landowners when they are purchasing land for development. Given that some of their profit margins will be under pressure due to the higher costs, there may be downward pressure on land prices, which would lead to landowners ultimately bearing the cost for this policy

118. Under the assumption that the cost burden will likely be borne by car park owners, the following distributional impacts are identified.

Rural car park owners

119. As this policy does not discriminate between infrastructure requirements based on location, there is a chance that car park owners in rural locations will be disproportionately impacted by this requirement, as ULEV ownership is likely to be lower in rural areas, particularly in the earlier stages of ULEV market development. This is based on DfT vehicle licensing statistics[27] which and ONS urban-rural classifications[28]. For England, rural areas had 29% of registered ULEVs, whilst urban areas had 71%. If this distribution continues, then utilisation rates are likely to be lower in rural areas and car park owners in regional areas may be less able to generate revenue from providing charging services.

Car park types

120. Given that this requirement covers all types of car parks irrespective of function, it seems likely that some types of car park will be disproportionately impacted. Small businesses are likely to be impacted more greatly by an additional cost burden (although possible SaMB exemptions are discussed from paragraph 128). Car parks are likely to benefit from the provision of charging services where they are able to (i) generate revenue from providing charging services

[27] https://www.gov.uk/government/statistical-data-sets/all-vehicles-veh01: VEH0131 - Licensed plug-in cars, LGVs and quadricycles by local authority: United Kingdom

[28] https://www.ons.gov.uk/methodology/geography/geographicalproducts/ruralurbanclassifications/2011ruralurbanclassification: Assuming that classifications 1-3 are considered rural and 4-6 are considered urban.

(ii) attract customers to other aspects of the business (iii) for workplaces, attract employees by providing a better working environment. For some car park types, it will not be possible to realise any of these benefits, and as such there cost of provision is imposed on them without the possibility to cover these costs.

> **Question 6:** What evidence can you provide to suggest additional groups that would be impacted by this policy?

6.2.2. Small and Micro Business Assessment:

121. This section identifies the anticipated impact of any policy intervention on small and micro businesses. The scale of the impact is assessed, along with the assumptions used to establish the impact, before possible measures to mitigate these costs are discussed.

122. The recommended policy option of providing full chargepoint installation will apply to small and large car park owners in the same way, as they will all have to comply with these regulations. There is however the chance the SME car park owners will be affected to a greater degree if they are unable to absorb any cost increases. Whilst chargepoint installers are typically small firms, it seems unlikely they will be impacted other than through an increase in demand for their products.

Scale of impact on SaMBs

123. To establish the scale of the impact on SaMBs, attempts have been made to identify the volume of SaMBs in the construction and car park sectors.

Non-residential developers

124. ONS construction stats identify that in 2017, ~ 40%[29] of the value of work done in construction firms with fewer than 50 employees. Assuming that 40% of the new build car parks are completed by SaMBs, this would be 226 of the 565 annual developments. The data also suggests that ~99% of construction firms have fewer than 50 employees[30], however headcount is an imperfect metric for gauging firm size in construction industry due to the prevalence of sub-contracting. **It is assumed therefore that 40% of the builds are completed by SaMBs and that each car park is developed by a different SaMB.**

Table 17: Annual cost to SaMB developers	
	Option 1
Number of SaMBs	226
New builds per year	565
Of which by SaMBS (40%)	226
Total cost in year 1	
Total cost	£3,372,556
Cost per SaMB	£14,936

Car park owners

125. As data on the volume of car parks is so limited, it has not been possible to identify the firm size of car park owners. It seems likely that relatively few of the public car park owners that

[29] https://www.ons.gov.uk/businessindustryandtrade/constructionindustry/datasets/constructionstatisticsannualtables table 2.9
[30] Firms with fewer than 50 employees are typically considered to be SaMBs.

come in scope of this regulation are SaMBs given that these include supermarkets, retail parks and hospitals. For the non-publicly accessible car parks, it seems more likely that some of these will be SaMBs. Given the lack of data, car park owners have not been included in the SaMBA. During the course of the consultation, evidence will be sought to inform a more accurate SaMBA.

Mitigating costs

126. It is assumed that developers will be able to pass costs onto car park owners, but should this not be the case, specific mechanisms through which SaMBs can mitigate these costs have not been identified. During the consultation process, advice on possible avenues for cost mitigation will be sought.

127. **Currently the only exemption being considered is full exemption for SaMB car park owners from the requirement for existing car parks**. A list of additional possible exemptions for SaMBs are considered below. Although It is not currently recommended that these exemptions be applied, DfT are interested to hear wider views through the consultation process.

Table 18: SaMB exemption considerations

Factor	Consideration
Full exemption	We are consulting on whether to exempt SaMB car park owners from the requirement for existing car parks.
Partial exemption	We also believe a partial exemption would not achieve the aim of increasing the level of chargepoint provision. We have not identified any specific requirements within the proposals from which we would be able to exempt SaMBs.
Extended transition period	We do not believe an extended transition period for SaMBs is compatible with achieving a large part of the intended benefits. We will ensure that a sufficient transition period is in place for all developers and that there is sufficient time for a well-supported process of familiarisation and transition.
Information	We do believe an information pack (designed for all companies) with a specific focus on smaller firms would be a viable consideration. We will explore what any information pack could look like during consultation.

Proportionality Approach

128. This approach is proportionate for this stage of policy development, particularly as the preferred option reflects minimum compliance with a mandatory directive. Evidence will be sought to add complexity to this approach by the final stage Impact Assessment, as cost estimates are refined and consultation responses suggest possible exemptions.

129. To the best of our knowledge, the best data available at the time of writing has been used in this assessment. On the volumes side, accurate estimation is constrained by an absence of data, which has been confirmed through communication with a number of industry stakeholders. Any errors in volume estimation will however affect the policy options and the baseline to the same degree, with smaller overall cost impacts only arising as a result of discounting.

130. On the cost side, indicative costs have been obtained by Steer through engagement with a number of stakeholders to give usable ranges. These capture a large variability in cost of chargepoint installation in different environments, but the approach to costing grid connection is limited. There is a risk that the degree to which economies of scale impact labour costs has not been accurately captured, as it seems feasible that housebuilders would be able to

capitalise on combined labour day-rates. If the degree to which the cost savings arise through economies of scale is greater than is captured in the assessment, then there will be a positive impact on the NPV.

6.2.3. Risks

131. **Chargepoints under-utilised:** There is a risk that the benefits of chargepoint provision are not realised in a particular dwelling if the transition to ULEVs does not happen in the expected manner. In such a case, the chargepoint may go through the duration of its expected lifecycle being under-utilised – which would not represent good value for money.

132. **Cost under-estimated:** If costs have been significantly under-estimated, then the total cost of the policy would be higher. In particular, if the cost of new build installations relative to retrofit installations is under-estimated, then this may alter the value for money of this policy. Given however that such a large range of costs has been provided, it is unlikely that there would be a significant impact on the overall relative cost of option 1. Costs have also been checked with industry stakeholders on numerous occasions, with no significant issues raised.

133. **Chargepoints becomes obsolete**: Given the long time-horizon, there is a chance that changes in the vehicle or chargepoint market results in the chargepoints that are installed under these regulations become obsolete over the course of the appraisal period. This could be because the chargepoint technology changes, for instance through the introduction of wireless charging, which results in "older" type chargers becoming obsolete. This can be mitigated to an extent by not being prescriptive in the type of chargepoint mandated under the regulations (although for existing car parks, the installations would take place before 2025 so there is not much scope for flexibility). It seems possible that changes to technology are likely to be centred around chargepoints getting increasingly more 'smart' and sophisticated in the way they deliver power. Chargepoints could however become obsolete if there are large structural shifts in the way people use personal transportation, for instance an increase in car sharing and automated vehicle use could mean that car ownership drops significantly. This could mean that people do not need chargepoints in certain types of locations and existing chargepoints could become redundant. If the demand for chargepoints at certain destinations failed to be realised or declined in the future, it is likely that there would be a review of whether the requirement should continue to be included in the Building Regulations.

134. **Impact on fuel sector jobs:** With a large expansion in the number of ULEVs and ULEV charging infrastructure, there will likely be a significant reduction in the need for ICE vehicle fuelling infrastructure, and certain jobs associated with this sector. Any impacts are likely to have occurred anyway, but policies such as this serve to bring the transition forward. The net impact is also uncertain, as with the advent of ULEVs, comes the need for an expansion in public charging facilities. In particular, it seems possible that rapid charging hubs could replace many of the existing fuelling stations – and many of the jobs could transfer. There may also be economic savings as a result of fuel no longer having to be transported around the country in lorries. Additional jobs may also be created through an increased need for chargepoint maintenance and management services (although such jobs will require some re-training costs). There may also be wider impacts such as on jobs in the electrical grid and distribution sectors as a result of increased demand for electricity, but these impacts are also very uncertain.

6.2.4. Direct costs and benefits to business calculations

135. All costs captured in this assessment are direct costs to business. Three types of businesses that would be directly affected by this regulatory change have been identified:

- **Manufacturers/Installers:** Our assessment is that installers will face little to no additional cost to comply with this regulation. There will 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. As of April 2019, around 17,000 public chargepoints had been installed[31]. This policy would require around 60,000 additional charge points by 2025.

- **Non-residential developers:** Non-residential developers also face a cost burden in the first instance as the costs of ducting and chargepoint installation for the new build requirements are levied on developers of non-residential car parks. They will also face similar familiarisation costs. It seems likely that they will be able to pass costs on to car park owners in their entirety though.
- **Car park owners:** It is likely that car park owners will face the full cost burden of this requirement, even if developers face the cost in the first instance. Existing car park owners will face some familiarisation costs, but they may be able to achieve benefits through revenue from providing charging services, or increased customers to their establishments.

6.3. Monitoring and Evaluation:

136. As part of this policy, a Post Implementation Review (PIR) will be conducted five years after implementation. Some of the research questions that are proposed in order to assess impact include:

- Has the policy been successful in installing electric vehicle chargepoints in new build and existing car parks?
- Is the rationale for intervention still valid? For instance, whether the information failures that exist between chargepoints installers, developers, car park owners and consumers remain.
- 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 charge point installers?
- Chargepoint utilisation – how much are chargepoints utilised, and how does this vary between location/car park type?

137. To successfully answer these questions, monitoring the following (provisional) key indicators would be necessary, though the list is not exhaustive. The consultation phase may also identify alternative indicators and methods of data collection

- Number of housing completions with off-street parking
- Type of parking provision
- Volume of chargepoints installed in new builds
- Volume of chargepoints installed in existing properties
- Number and type of new build non-residential car parks

[31] Figures taken from ZapMap, and amended to reflect the volume of chargepoints that could be used simultaneously - https://www.zap-map.com/statistics/ (April 2019)

- Volume of chargepoints installed new car parks
- Volume of chargepoints installed in existing car parks
- ULEV uptake rates (to establish the likelihood of this policy having any impact on uptake)

7. Summary:

138. This impact assessment has considered one option for increasing the level of EV charging infrastructure provision non-residential car parks. The preferred option (which reflects minimum compliance with EPBC) is to recommend the installation of one chargepoint in all residential new build and existing non-residential car parks (attached to an associated building).

139. The NPV and the EANDCB for this option are shown in the table below.

Table 19: Option summary (millions, 2019 prices, 2020 base year)

	NPV	EANDCB
Option 1	-£255.9	£15.8

140. The analysis has shown that there is a net cost for this option relative to the baseline, which is driven largely by the additional ducting requirement for new build car parks, but also by future installations in the baseline being discounted to a greater degree.

141. As discussed in the SaMBA section, additional exemptions will be consulted upon. Implementation will also be considered to give stakeholders sufficient lead in time.

Annexes:

Annex A: Steer cost tables

The following cost summary tables were used for the derivation of costs for the relevant options.

Annex A1: Steer - Wiring and Installation costs for single charge point

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 charge points

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 charge point

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 charge points

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

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

Annex B1 - Ducting

2. 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.

3. The primary driver of cost differences between categories for this option is whether cabling can be routed using ducting (as with 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 cable 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.

4. 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 charge point.

Annex B2 - Cabling + Grid connection

Cabling

5. 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.

6. Another significant cost sensitivity is the electrical equipment required. For a single installation in multi-occupancy basement or multi-storey 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, multiple moulded case circuit breakers of different current ratings will be required to supply electricity to the charge points. At surface level charge points will be supplied from a feeder pillar, which can serve multiple charge points.

7. 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	N/A	Required
Array controller	N/A	Required
Single installation	N/A	MCB, RCD, PME
Multi-installation	N/A	MCCB, 400A, RCD, PME
Cabling and Ducting		
Cabling	6mm/3 core (1 Phase)	25mm/5 core (3 Phase)
Ducting	N/A	300mm cable tray
Connection	Single Outlet, 7kw	Twin Outlet, 22kw
Traffic management	N/A	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)	N/A	Cost per m
Excavation	N/A	Cost per m
Materials e.g. tarmac	N/A	Cost per m

Waste removal		
Fire prevention (multi-occupancy)		
General Project management Commissioning (NICEIC)	 N/A Per charge point	 Fee for managed installations Per charge point

Grid Connection

8. 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 a number of 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.

9. 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 charge point 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).

10. 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).

11. 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 22 kW charge points. As the proposed regulations only require 7 kW 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.

12. 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 charge point 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.

13. 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.

14. 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.

15. 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 charge points 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 - Chargepoint

16. 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 charge point.

17. 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.

18. 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.

19. 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.

Annex C: Consultation questions

- **Question 1:** What evidence can you provide for an alternative estimate or methodology for identifying the volume of new build non-residential car parks with an associated building?
- **Question 2:** What evidence can you provide to identify the volume of non-residential car parks with an associated building, that had a chargepoint installed at the point of construction?
- **Question 3:** What evidence can you provide to support the use of alternative assumptions to inform grid connection costs?
- **Question 4:** What evidence can you provide to support how technological learning rates will contribute to chargepoint cost reduction over time?
- **Question 5:** What evidence can you provide for an alternative estimate or methodology for identifying the volume of existing non-residential car parks with an associated building?

- **Question 6:** What evidence can you provide to suggest additional groups that would be impacted by this policy?