Title: – New legislative powers for ULEV infrastructure **IA No:** DfT00376 **RPC Reference No:** RPC-3567(1)-DfT **Lead department or agency:** Department for Transport	**Impact Assessment (IA)** **Date:** 20/12/2016 **Stage:** Final **Source of intervention:** Domestic **Type of measure:** Primary legislation **Contact for enquiries:** Alex Philpott
Summary: Intervention and Options	**RPC Opinion:** GREEN

Cost of Preferred (or more likely) Option				
Total Net Present Value	**Business Net Present Value**	**Net cost to business per year** (EANDCB in 2014 prices)	**One-In, Three-Out**	**Business Impact Target Status**
NQ	NQ	NQ	In scope	Qualifying provision

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

The UK has an ambitious goal for the uptake of ultra low emission (electric) vehicles - that all new cars and vans should be zero emission by 2040. This is essential to meet Government's legal carbon reduction goals under the Climate Change Act, and an even faster transition is desirable to help meet statutory air quality targets, and to secure the continued strength and competitiveness of the UK automotive industry. The UK has been the largest market for ULEVs in the EU in 2016, and already has more than 11,000 publicly accessible chargepoints. However, only 1-2% of new car sales are currently ULEVs, and the current consumer experience of charging a vehicle can be complicated and confusing. Private investment and innovation is developing the market, but Government regulation may be necessary to further support the consumer and so bring forward the entry of ULEVs into the mass market. A technologically neutral approach is being proposed that facilitates innovation without constraining the market to a particular technology. The measures proposed therefore cover both electric and hydrogen infrastructure.

What are the policy objectives and the intended effects?

The policy objective (and the rationale for taking primary powers) is to improve provision of electric vehicle infrastructure, in three ways: (1) by improving the consumer experience through the provision of open data on chargepoint location and availability, and technical interoperability and easy access between chargepoint networks; (2) by ensuring there is some provision of fuel for electric vehicles at motorway service areas and large petrol stations; and (3) by achieving 'smart' capabilities of new chargepoints so that supply and demand on the electricity grid can be intelligently balanced. The intended effect is a widespread and convenient chargepoint network that is easy to use, and which ultimately increases the uptake of EVs and helps minimise costs for users of EVs. A further effect will be a network which is prepared for the future energy system.

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

The proposal in question is to take primary powers which could then be implemented as regulations through secondary legislation at a later date, if Government deems that intervention in the market is necessary. A number of options will therefore remain open in terms of which powers are exercised and when, and the detail of their implementation. The key option at this stage is therefore whether or not Government should take such powers. An option not to take such powers has been considered (Option 1). Although the private sector, with the support of government funding, is growing the UK's chargepoint network and delivering improving services to users, the next 5-10 years will be a critical period when electric vehicles will need to enter the mass market. It may be appropriate for Government regulation to support this, if the market is not improving provision for consumers fast enough.

Will the policy be reviewed? It will be reviewed. If applicable, set review date: 12/2026

Does implementation go beyond minimum EU requirements?		N/A		
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:** NQ	**Non-traded:** NQ	

I have read the Impact Assessment and I am satisfied that (a) it represents a fair and reasonable view of the expected costs, benefits and impact of the policy, and (b) that the benefits justify the costs.

Signed by the responsible MINISTER: **Date :** 09 February 2017

Summary: Analysis & Evidence

Policy Option 1

Description: **Take primary powers to enable regulation which improves the provision of ULEV infrastructure**

FULL ECONOMIC ASSESSMENT

Price Base Year: N/A	PV Base Year: N/A	Time Period Years: Insert	Net Benefit (Present Value (PV)) (£m)		
			Low: NQ	**High:** NQ	**Best Estimate:** NQ

COSTS (£m)	Total Transition (Constant Price)	Years	Average Annual (excl. Transition) (Constant Price)	Total Cost (Present Value)
Low	NQ	NQ	NQ	**NQ**
High	NQ		NQ	**NQ**
Best Estimate	NQ		NQ	**NQ**

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

A Bill will provide primary powers to create the secondary legislation required to further support ULEV infrastructure, meaning the regulations causing any impacts will not be on the face of the bill. When any secondary legislation is enacted, the costs will fall primarily on infrastructure providers, motorway services areas and/or large fuel-retailers, and come from the modification or purchase of infrastructure and/or services and software, alongside the additional administrative burden imposed from having to meet the regulatory requirements. Where possible, we have set out a range of scenarios. The exact costs will depend on the detail of the regulations, (currently at a pre-consultation stage), and therefore a full economic assessment has not been possible at this stage. Fuller analysis will be undertaken at the consultation and regulation stages of any secondary legislation.

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

Costs will be incurred in addition to the upfront infrastructure costs, including from the regulation administration, maintenance, the fines and enforcement structure, and transfers between businesses.

BENEFITS (£m)	Total Transition (Constant Price)	Years	Average Annual (excl. Transition) (Constant Price)	Total Cost (Present Value)
Low	NQ	NQ	NQ	**NQ**
High	NQ		NQ	**NQ**
Best Estimate	NQ		NQ	**NQ**

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

When any secondary legislation is enacted, the benefits will fall primarily on consumers and wider society through an increase in the use of electric vehicles. New consumers of EVs will see a reduction in their fuel costs from the use of electricity rather than petrol or diesel. Existing EV owners will also see benefits through increased access to charging points and improved information on the location and price of charging. There would be significant wider societal benefits from a reduction in CO_2 emissions, reductions in noise and increases in air quality as a result of increased use of electric vehicles.

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

Taking these primary powers at this time sends a message about the importance Government attaches to the transition to ULEVs, which in turn could facilitate progress towards a self-supporting market for ULEVs. Support for a strong domestic ULEV market can potentially have wider industrial benefits on the UK's automotive industry, which are difficult to quantify. There are also likely to be benefits to some fuel retailers who would be able to leverage chargepoints to increase revenue in non-fuel activities. The use of hydrogen in vehicles is at such an early stage that the growth of the market and its benefits are harder to quantify.

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

The full impact of the regulations to business is entirely dependent on the detail of the regulations that will be the subject of future Impact Assessments. The costs presented in the evidence base are at a very high level and make a number of assumptions, but aim to provide an indication of the scale of costs alongside the main sensitivities. Full details in relation to the actual regulations taken will be presented in the IAs for any secondary legislation.

BUSINESS ASSESSMENT (Option 1)

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

Evidence Base (for summary sheets)

Contents

1 Background

The Modern Transport Bill (the Bill) was announced at the Queen's Speech 2016, with the aim of "ensuring the UK is at the forefront of technology for new forms of transport, including ... electric vehicles". This impact assessment looks specifically at those measures relating to the provision of infrastructure for electric vehicles. These powers would allow Government to introduce regulation: (1) to improve the consumer experience of infrastructure by making live data on location and availability openly available, ensuring interoperability between different privately-run networks, and requiring common technical standards; (2) to mandate provision of suitable infrastructure at specified fuel retailers and motorway service areas; and (3) to ensure charging infrastructure is ready for the "smart" electricity grid.

These measures support the Government's goal of an infrastructure for electric cars that better meets the needs of motorists today, as well as encouraging its future development in a way that allows innovation to flourish with improved efficiency and user experience driving an increased uptake of ultra low emission vehicles (ULEV).[1]

The powers have been drawn up by the Office for Low Emission Vehicles (OLEV). OLEV is a team working across government to position the UK at the global forefront of ULEV development, manufacture and use. Its goal is a Government manifesto commitment that by 2050 nearly all cars and vans should be zero emission vehicles, which will mean all new cars and vans should be zero emission vehicles by 2040. OLEV has funding of more than £600m between 2015 and 2020, supplemented by a further £270m announced at Autumn Statement 2016, and a portion of this is used to provide targeted support for the infrastructure needed for electric vehicles. There are already over 11,000 chargepoints in the UK network, with the largest network of rapid chargepoints in Europe. Grant schemes are in place to encourage the installation of chargepoints at homes, at workplaces, on residential streets and on the strategic road network. There is also dedicated support for bus and taxi infrastructure. For the refuelling of hydrogen fuel cell electric vehicles, an initial network of hydrogen refuelling stations will be completed by the end of 2016.

2 Problem under consideration

There is a range of quantitative evidence, backed up by Government discussions with key stakeholders, to suggest that electric vehicle infrastructure – which is a fundamentally different consumer and commercial proposition to the infrastructure for conventional vehicles – is a key barrier to greater uptake of electric vehicles.

Recent statistics from the ONS Opinions and Lifestyle Survey have shown that the two most important reasons why people are deterred from buying an electric vehicle relate to the provision of supporting infrastructure.[2] It details that 45% of driving license holders are deterred by recharging facilities, and 39% deterred by the battery size and distance travelled on a charge. Of those reporting recharging as a deterring factor, the most important recharging factors were around the availability of charging points, including lack of charging points in their area, and lack of knowledge of where charging points are. These two factors are now weighted of greater or equal importance in deterring purchases of electric vehicles, compared to results from 2015 and 2014, suggesting that the issue is not improving, and/or that it is becoming more critical as other challenges like cost and awareness decrease with the growing market.

Similarly, after cost concerns, battery/distance travelled on charge (19%) and convenience of recharging (19%) are the factors *most* likely to persuade driving license holders to buy an electric car. These issues have stayed equal in public perceptions of importance, whilst cost has decreased as a motivator.

As ULEV uptake increases, so too does the importance of ensuring consumers can rely on a publically accessible, affordable network of chargepoint and refuelling stations right across the UK, and help to mitigate and manage the current concerns. Infrastructure is the most significantly different feature of

[1] The Office for Low Emission Vehicles has considered ultra low emission vehicles (ULEVs) to be new cars or vans that emit less than 75 grams of CO2 from the tailpipe per kilometre driven. These will be 'plug-in' vehicles which need to be connected to mains electricity, including battery electric vehicles (BEVs) and plug-in hybrid vehicles (PHEVs); or fuel cell electric vehicles (FCEVs) which are refuelled with hydrogen. For brevity, ULEVs are sometimes

[2] www.gov.uk/government/statistics/public-attitudes-towards-electric-vehicles-2016

electric vehicles compared to familiar petrol and diesel vehicles, as the vehicles themselves are being developed and improved by vehicle manufacturers to meet and exceed customer expectations in every other way.

Electric vehicles will bring significant new demand for electricity. When, where and at what power vehicles require recharge could have profound impacts on the electricity system. Work is already underway to ensure the electricity system can best take advantage of new smart technologies that could increase the flexibility of electricity supply and demand, and there is considerable potential for EVs to play a key role in this transition. Charging that can flex to grid pressures could not only avoid adding to existing peak, but could also provide new valuable options for balancing demand and supply for energy suppliers, network operators and the System Operator. This value could be translated to consumers in the form of lower energy bills and/or additional benefits for owning an EV. In order for EV charging to partake in the smart grid of the future, infrastructure must be capable of communicating and acting on information from third parties. There are currently no requirements for this functionality and so weaker motives for the investment and innovation which could benefit consumers.

2.1 Rationale for intervention

The provision of electric vehicle charging infrastructure is growing strongly, thanks to Government support for the early market and increasing levels of private investment. This innovative new sector is exploring different ways to serve electric vehicle drivers and develop profitable business models. This sustainable and private sector-led provision is desirable to Government, but may develop and improve too slowly to support rapidly growing numbers of electric vehicle drivers, and to encourage many more to make the transition.

The Government is committed to achieving an all zero emission fleet of cars and vans by 2050, which will require significant growth in market share during the 2020s. Government even more urgently, wishes to increase uptake rapidly in the near term, to improve urban air quality and to take advantage of the industrial opportunity the global transition to ultra-low emission vehicles presents. Given the importance of maintaining and accelerating the transition to ULEVs, and the importance of new infrastructure to that transition, there is a strong rationale for intervention.

2.1.1 Why new legislative provisions are required.

There is currently no regulation or legal powers in place to allow Government to shape the development of electric vehicle charging or refuelling infrastructure. Although improvements are being pursued by the Office for Low Emission Vehicles through targeted provision of funding, as described above, this can only influence certain aspects of the market's development and only those areas where government funding is involved. In order to accelerate the deployment of infrastructure, and share the costs with other market players, legislation on the mandatory provision of charging and refuelling infrastructure is needed. In order to ensure that privately funded infrastructure serves the need of current and future consumers, it may be appropriate for Government to regulate aspects of its design and operation. Regulation may also be appropriate to ensure that privately funded infrastructure also supports Government's vision for a "smart" electricity grid with all the associated cost benefits that will bring about.

The powers taken will not create any of this regulation. Secondary legislation, which would be preceded by further consultation and impact assessment, would be needed in order to introduce any of the envisaged regulations. The Government recognises that market-driven solutions would be preferable, and is encouraged by the progress being seen. However, it may prove necessary to introduce regulation to compel faster improvements for the benefit of consumers and keep sales growth on track. The proposed legislative provisions would enable the future creation of such regulation, and give a clear early signal to the market of Government's vision for electric vehicle infrastructure. Any secondary legislation would involve industry in developing the detailed provisions.

2.2 Risks and assumptions

Other than the risks of not taking the powers as set out below in the counterfactual policy option, there are a number of other risks which will potentially lower the benefits or increase the costs. These include the risk of slower than expected technological advancement in terms of the potential for cost reductions for infrastructure or electric vehicles. There are also risks around the potential for some of the changes to have impacts in competition that have not been considered. The value for money of any measures

implemented using the powers established in the measures set out in this Impact Assessment will be assessed according to such developments, in advance of secondary legislation. Such regulations would also be reviewed constantly once in place, to understand and allow mitigation of any such risks.

3 Policy Objective

The main objective behind these powers is to give Government the power to ensure:

- That electric vehicle infrastructure is convenient and easy to use for consumers, within an innovative and growing private sector market
- That provision of electric vehicle infrastructure expands to meet the needs and expectations of growing numbers of electric vehicle drivers – in particular at motorway service areas and large fuel retailers
- That electric vehicle charging infrastructure can support a "smart" electricity grid, affording flexibility to manage growing electricity demand, and incentivising intelligent charging

4 Policy Options

This section sets out the policy options and the high-level envisaged enforcement approach.

4.1 Base Case – Do nothing (the counterfactual)

This is the base case scenario, which involves *not* taking any of the powers in question, and so represents a counterfactual to their introduction into law.

If powers are not taken, private sector investment and innovation could deliver the desired results of its own accord. However, there would be a strong risk that progress in the market does not deliver satisfactory charging and refuelling infrastructure for growing numbers of electric vehicle drivers, leaving Government with only weak levers (eg. conditions on grant funding (which will end by 2020)) to improve the situation and bring vehicle uptake back on target. These risks – including dissatisfaction with navigating multiple chargepoint membership schemes, incompatibility between cars and some chargepoints, and a lack of definitive easy information on chargepoint location and availability – could in combination become a significant break on vehicle uptake. Any slower market growth would provide a significant challenge to the commitments around having all new cars and vans being zero emission by 2040. This trajectory is an essential component of the UK's plans to meet legal carbon reduction targets under the Climate Change Act, and in turn international agreements including the Paris Declaration 2015. The transition to electric vehicles is also an essential element of Government's plan for reducing air pollution and ensuring compliance with UK and EU law on air quality.

4.2 Option 1 – Take Powers as set out in a Bill

This option describes a scenario where all proposed powers are taken, and where all are then implemented through secondary legislation. This will give an assessment of the maximum costs and benefits achievable as a result of the primary legislation. The details of any secondary legislation would be determined at that stage following further consultation, and so a range of reasonable assumptions have been made about the most likely form of regulation to give an indication of the potential impacts. These impacts will be managed through the secondary legislation stages if required to strike the right balance between costs to business, government and benefits to consumers. In reality, not all the powers may be used, and those that are used through secondary legislation may be implemented and introduced to differing timescales.

The next three sections therefore describe the powers being proposed. Each section covers the primary policy objectives and sets out the powers being taken to support the policy objectives and how these powers will help deliver the objectives.

4.2.1 Consumer Experience

The consumer experience of electric vehicle infrastructure is particularly important, as it will deter potential electric vehicle users if it is challenging and inconvenient in comparison to their familiar experience of refuelling a conventional vehicle. The proposed powers here would allow Government to address some of the key difficulties faced by motorists in using the emerging electric vehicle infrastructure network.

Usage of these powers would depend on whether or not infrastructure operators continue to make technology and service improvements, and whether or not the convenience of charging remains a significant concern for existing and potential electric vehicle users.

Open data on chargepoint location and availability:
This power would allow the government to require operators of publicly accessible chargepoints and hydrogen refuelling stations, and networks, to provide data in an open source format on the geographical location and live availability of charging and refuelling infrastructure.

Accessibility:
This power would allow the government to require operators of publicly accessible chargepoints and hydrogen refuelling stations, and networks, to ensure consumers can use them without the need for multiple memberships.

Design standards:
This power would allow the government to specify minimum standards of design and functionality for new publicly accessible chargepoints and hydrogen refuelling stations and networks.

4.2.2 Provision of infrastructure

A majority of electric vehicle charging is carried out at home and overnight (and to a lesser extent at work), when vehicles are parked for a long duration.[3] This is not expected to change significantly as the market grows. However, widespread provision of public charging infrastructure is still very important. It allows drivers to make longer distance journeys in a similar fashion to today and recharge whilst away from home or work – and promotes electric vehicles to potential buyers and reassures them of the options for recharging.[4] Public infrastructure is also important for hydrogen fuel cell electric vehicles as it is not likely to be available privately (although given those vehicles' longer range there is likely to be less need for dense provision).

The proposed powers would allow Government to boost provision of infrastructure at motorway service areas and fuel retailers – which are very familiar, convenient and visible locations for motorists to stop at and use infrastructure for refuelling.

Usage of these powers would depend on the progress made to grow provision of public infrastructure – both in terms of the number, type and distribution of charging facilities, and the commercial arrangements which could underpin the growth of a sustainable network suitable for mass-market EV uptake.

Minimum provision at motorway services:
This power would allow the government to require that operators of motorway service areas (MSAs) ensure a minimum provision of electric and hydrogen fuels for ULEVs at MSAs.

Minimum provision at fuel retailers:
This power would allow the government to require a minimum provision of electric and hydrogen fuels for ULEVs at large fuel retailers.

4.2.3 Provision of smart charging infrastructure

As the take up of plug-in vehicles grows, so too will the demand for electricity to charge them. When and where this demand arises will have implications for our energy system. To date, owners tend to charge their vehicles at home and overnight, or at work and during the day. As they may be plugged in for long

[3] *Uptake of Ultra Low Emission Vehicles in the UK: A Rapid Evidence Assessment for the Department for Transport* (Brook Lyndhurst, 2015), p. 22.
[4] Ibid, p. 50.

periods, EVs hold great potential to “smart charge” - not only receiving the necessary amount of electricity required by the user within the time required, but providing balancing services to the electricity system. This could involve reducing or increasing the power of a charge to balance the system’s frequency, or timing charging to take advantage of off-peak periods. These functions could hold benefits to a range of parties, including consumers, energy suppliers and network operators. Many of these functionalities have the potential to hold commercial value that could be transferred to consumers, including through lower energy bills.

This power would enable to government to require infrastructure installed for the purposes of charging EVs to have 'smart' functionality to receive, understand and respond to signals sent by energy system participants (e.g. Distribution Network Operators (DNOs), energy suppliers, National Grid or other third parties). This would be for the purposes of balancing energy supply and demand, and to require any technological functionality in EVs necessary to ensure ‘smart’ functionality. It would also enable requirements to ensure that standards and communication protocols used to ensure smart functionality are made openly accessible to enable interoperability, so that consumers are not locked into any one particular product type or service provider to access the smart functionality.

Usage of these powers would depend on the development of a wider Government policy on a smart energy system, and the latest assessment of costs and practicality at that time.

4.3 Enforcement of Regulations

The following approach to enforcement is envisaged, although the details of implementation would be determined at the secondary legislation stage, to take account of the details of the regulations and costs of compliance at that stage:

- The Secretary of State for Transport would be designated as responsible for enforcing the regulatory requirements, and an executive agency of DfT will be identified to manage and administer enforcement of the regulations including regular compliance checking.
- The infrastructure installer, retailer, operator, fuel retailer and motorway service operator would be subject to a penalty if any of the requirements set out in the Statutory Instrument arising out of the powers are not met
- Non-compliance would result in a formal written warning and a limited time in which to correct the issue
- The next stage would see a civil penalty notice issued. This would take the form of a financial penalty, the size of which would be scaled according to the cost of purchasing the particular infrastructure equipment subject to the penalty notice, and the degree of negative impact non-compliance is likely to have on consumers, where a breach relates to the accessibility of data a suitable calculation to determine the level of civil penalty would be determined
- Fines would be paid to the Consolidated Fund, with a specified deadline in which to pay or object
- Upon payment of a civil penalty, compliance would be re-checked. Should it be found that the necessary remedial action has not been taken a new penalty notice would be issued and the process will start again. Offenders would have the opportunity to object to the administrating agency against any penalties in the first instance, and then on appeal to the High Court

5 Consultation

The Office for Low Emission Vehicles has a close and constant dialogue with vehicle manufacturers, infrastructure providers, technology companies and other stakeholders. The legislative measures proposed were informed by that understanding of the current industry and its anticipated future development. In order to capture views on the specific powers proposed, and to ensure a broad section of interests are taken into account, a consultation document – setting out the proposed powers and rationale, and inviting responses to a number of specific questions – was published on 24 October. The consultation document made clear that the proposed powers were reserved powers and would only bring impacts if enacted at a later date. The consultation invited evidence on the costs and benefits of the proposed measures. The consultation ran for four weeks, until 23 November, and attracted 171 formal responses including from 81 different organisations. In addition, several bilateral meetings and 2 stakeholder events were hold to discuss the consultation whilst it was open. We received responses from chargepoint manufacturers and operators, hydrogen suppliers, electricity networks and companies,

fuel retailers and motorway service companies, local/regional transport authorities, vehicle manufacturers, trade associations, technology companies and environmental organisations, as well as many members of the public.

In general, respondees were supportive of Government's ambition for the uptake of electric vehicles, and agreed with its vision of widespread and easy to use infrastructure provision, with 'smart' grid capabilities. Respondees who would see most benefits (eg. electric vehicle drivers and fleets, technology developers and car companies]) were more supportive of a possible regulatory approach to achieving this vision, whereas those which might have to bear a direct share of the costs (eg. chargepoint networks and fuel retailers) were more cautious of regulation and in favour of market-driven approaches. A range of helpful evidence and suggestions were made to help ensure the Bill's provisions are successful in delivering Government objectives. The consultation also yielded some useful quantitative and qualitative information on costs and benefits.

6 Illustrative Benefits

For the consumer, purchasing a ULEV rather than an ICE brings significantly reduced fuel costs, lower maintenance costs and an improved driving experience. It will bring significant benefits for the UK in terms of reduced carbon emissions. A high ambition for ULEV uptake in the medium term is likely to form a key part of the Government's strategy for meeting the 5th Carbon Budget (set by Parliament in June 2016). ULEV uptake will also improve air quality, particularly in urban areas where this problem is most acute, as zero emission vehicles have no tailpipe emissions. Vehicle noise will also be significantly reduced, particularly in urban areas as engine noise is dominant over tyre noise at lower speeds. Noise can be damaging to health and wellbeing, and the effect is greater in urban areas where higher population density means a larger number of people are exposed to the noise from vehicles. The transition to ULEVs will also improve the UK's energy security because of the potential for powering road transport with diverse, sustainable and domestic energy sources. Mass uptake of ULEVs in the UK is also being pursued by the Government as part of its plan to support the thriving UK automotive industry and put the UK at the forefront of technology development for the ULEV market. Smart charging of EVs would hold significant value in terms of future electricity network upgrades avoided due to smoothing of peak demand, increases to generating capacity, and new options for balancing the electricity system. It would also promote off-peak charging and could facilitate greater utilisation of renewable electricity generation, which unlike non-renewable energy, cannot necessarily be scaled up and down according to load on the network.

6.1 Benefits Methodology

This section sets out how we can calculate a high-level estimate of the benefits which would come about from the new ULEV powers if brought into force. The key benefits that come from improved consumer experience and increasing the provision of chargepoints is an overall increase in the accessibility of essential charging infrastructure. This increase in accessibility would firstly make it more attractive for consumers to consider and then purchase ULEV's. In addition, the increased accessibility of chargepoints would also have benefits to existing owners of ULEVs.

This increase in the uptake of ULEVs and changes in accessibility to existing ULEV owners itself has a number of key benefits that we can monetise following standard WebTAG and Green Book guidance. Benefits will accrue to consumers themselves but there are also significant levels of wider social benefits.

We can break down the key benefits into two areas:

Consumers: new ULEV purchasers will see a net reduction in fuel costs due to the lower cost of electricity to refuel the car. New and existing ULEV users will see an increase in the welfare benefits (consumer surplus from the perceived cost of buying an electric vehicle) that come about from the increased level of infrastructure.

Social costs and benefits: the transition to ULEVs will bring about a reduction in CO_2 emissions (primarily non-traded), improvements in air quality from reductions in NO_X and particulate matter, and reductions in noise due to the much quieter electric motors used compared to internal combustion engines. There are some social costs to this, primarily reductions in government tax revenue under the current tax structure

due to preferential rates of Vehicles Excise Duty and other motoring taxes for ULEVs, and a reduction in tax revenues from fuel duty. These net off the benefits following standard guidance.

The Department for Transport has developed models to understand the benefits of increased ULEV uptake for the purposes of the OLEV programme business case. These models have been used here to provide high-level estimates of the benefits that could be available. The key model in this process is a consumer choice model which applies policy, infrastructure and other assumptions to estimate the costs motorists perceive of owning different vehicle types in future, and in turn uses these to forecast future levels of ULEV uptake. The model predicts consumers' choice of vehicle by comparing different vehicles' ownership costs over a four year period. This model can therefore be used for this Impact Assessment to help determine the potential benefits of the proposed powers by improving the accessibility to infrastructure assumptions, understanding the impact in terms of ULEV uptake in the future, and noting consequences for monetisable benefits.

This set of models, used for the OLEV business case, provides benefits and some indication of costs over the time period of the model which is from 2015-2050. It provides these benefits and costs to government in 2015 prices which have been discounted to 2015. We have retained this price base and appraisal year throughout the costs and benefits sections for consistency. .

The inputs to the model around chargepoint infrastructure are quite high-level, with the ability to look only at a change in the proportion of consumers with access to chargepoints over the baseline assumptions at a national level. This means that the assessment of benefits are limited to providing a high-level indication of the benefits available.

All the proposed ULEV powers for the Bill – except those relating to 'smart' electricity – also cover the provision of hydrogen refuelling infrastructure, which is necessary for hydrogen fuel cell electric vehicles. Assessing the benefits of increasing the level of hydrogen refuelling infrastructure is not possible at this time due to the very early stage of the hydrogen for transport market and the current very low number of vehicles both available on the market and currently purchased in the UK. There is also an overall lack of evidence around potential for uptake and likelihood of uptake of hydrogen vehicles in the general market due to this early market nature.

To provide an estimate of all costs and benefits in this Impact Assessment we need to make a number of assumptions about when secondary legislation would be laid. However, as described above the timing and nature of any regulation to be introduced under the new powers will only be determined in light of market developments in coming years, given its rapid pace of change. For the purposes of the analysis presented here, we have used an assumption that secondary legislation would be initially laid and have an IA developed from 2019, coming into force in 2020. This scenario is speculative but reflects the need to continue monitoring developments in the market before and after the Bill becomes law, alongside the likely need for new non-financial measures to support ULEV uptake as the current Government grant is gradually withdrawn over coming years. The benefits provided give an estimated range of benefits from low to high. The quantified estimates of benefits for the scenarios presented are not directly comparable with the quantified estimates of costs presented in this Impact Assessment due to the difficulty in linking the percentage of accessibility used in the benefits modelling to direct numbers of chargepoints. However, the ranges presented do provide an estimate of the potential benefits from changes in accessibility.

6.2 Option 1 – benefits

6.2.1 Consumer Experience

As discussed in the methodology section, we would expect that the changes to enhance the consumer experience would increase the ability of consumers to better access supporting infrastructure. We would expect accessibility to have an impact on both rapid chargepoints and local, slow and fast, chargepoints.

To provide an indication of the potential benefits that such changes could make we have looked at two scenarios of increased level of accessibility: that these changes would increase the accessibility of rapid and fast (up to 22KWh) chargepoints by 1% over the current assumptions; and by 3% over current assumptions. These are small percentages but would represent an improvement on current provision.

The table below sets out this range of benefits and gives an idea of the potential magnitude of the benefits that such additional access could provide.

Consumer benefits for ULEVs (excluding hydrogen)

		NPV -2050	
Carbon Savings		**1% Increase in rapid and local accessibility**	**3% Increase in rapid and local accessibility**
New ULEVs	Carbon Savings (tonnes CO_2)	707,909	913,820
	Carbon Savings (£s)	£43,623,560	£56,514,661
Additional Impacts			
New ULEVs	Air Quality	£513,091	£653,552
	Noise	£369,438	£474,365
Consumer savings			
	Consumer Fuel Savings	£126,236,462	£160,387,212
	Consumer Electricity Costs	-£44,520,949	-£56,973,124
	Net Gain to Consumers	£81,715,513	£103,414,088
Welfare benefits to existing and new consumers[5]			
	Total	£101,687,180	£131,189,366
Marginal Depreciation of ULEV over ICE vehicles			
	Total Marginal ULEV Depreciation	-£33,858,998	-£41,936,503
	Total	£194,049,784	£250,309,530

This table sets out the level of benefits from each area, with the biggest benefits coming from net fuel savings to consumers and the welfare benefits to consumers from the increase in accessibility. The welfare benefits are as calculated for the OLEV business case, and represent the additional benefits that accrue to existing and new ULEV users from the improved accessibility. The air quality measure uses current webTAG guidance. This is lower than recently published interim guidance from Defra on valuing the damage caused by NOx emissions, which implies significantly higher damage costs than are currently published in webTAG. The air quality benefits set out here may therefore be an under-estimate.

The next table sets out the overall costs to government, with the biggest contribution to these costs coming from the loss of indirect tax from fuel duty.

Costs to Government

Change in taxes (VED/Fuel Duty			
	Total	-£119,747,592	-£125,939,606

6.2.2 Provision of Infrastructure

The proposed measures to improve the provision of infrastructure is more likely to have a much greater impact on the accessibility of chargepoints by increasing the overall number available. The benefits modelling undertaken in this section is independent of the analysis undertaken for the consumer experience measures.

[5] Consumer surplus resulting from the generalised cost of the change in infrastructure provision.

6.2.2.1 Motorway service areas

This power would allow Government to require the provision of infrastructure at motorway service areas (MSAs). At present the existing network of MSAs nearly all offer at least some provision of rapid chargers. However, within this is a variety of plug types available and numbers of chargepoints per MSA, and all are currently supplied by a single chargepoint network. To get an idea of the potential benefits from this power, we have considered the impacts of a 1% and 3% increase in accessibility for rapid chargers. The more impactful scenario would represent requirements for a higher level of infrastructure provision. A 1% increase in accessibility for 2020 increases the overall national level of accessibility of rapid chargers from 90% to 91%.

Consumer benefits - Motorway Service Areas - excluding hydrogen

		NPV -2050	
Carbon Savings		**1% Increase in rapid charging accessibility**	**3% Increase in rapid charging accessibility**
New ULEVs	Carbon Savings (tonnes CO_2)	649,336	741,182
	Carbon Savings (£s)	£39,907,459	£45,532,306
Additional Impacts			
New ULEVs	Air Quality	£474,430	£540,710
	Noise	£340,580	£389,554
Consumer savings			
	Consumer Fuel Savings	£117,132,299	£133,818,861
	Consumer Electricity Costs	-£41,047,243	-£46,801,394
	Net Gain to Consumers	£76,085,056	£87,017,467
Welfare benefits to existing and new consumers			
	Total	£93,026,750	£105,869,148
Marginal Depreciation of ULEV over ICE vehicles			
	Total Marginal ULEV Depreciation	-£31,828,391	-£36,192,387
	Total	£178,005,884	£203,156,798

Costs to Government

Change in taxes (VED/Fuel Duty			
	Total	-£110,368,436	-£125,939,606

6.2.2.2 Large Fuel Retailers

Regulation to improve the provision of chargepoints at major fuel retailers could bring a much more significant change in accessibility of chargepoints. To give an indication of the potential benefits that could be seen here we have looked at two scenarios to provide an indicative range. The first assumes that the regulations focused on both rapid chargers and fast chargers, and that an increase of these across the country would lead to a 5% increase in accessibility over the baseline assumptions

(increasing from 90% accessibility in 2020 to 95% for rapid chargers, and from 10% to 15% for fast chargers). The second scenario looks at the impact on local chargepoint accessibility and looks at the impact of assuming that the powers will double the accessibility of local chargepoints (from 10% to 20%) over the existing level. This produces a much greater impact overall as the assumptions around rapid chargers in particular are high to start with.

These scenarios are designed to give an indication of the range of potential benefits envisaged at this stage. The secondary legislation, and the real world impacts this would have on consumer behaviour and subsequent ULEV uptake, will significantly influence the actual benefits generated. Further work on assessing on how accessibility will be changed as a result of secondary legislation and how this feeds through into our infrastructure assumptions for modelling purposes will be investigated before any secondary legislation.

Consumer benefits - fuel retailers - excluding hydrogen

		NPV -2050	
Carbon Savings		**5% Increase in rapid and local charging accessibility**	**Doubling of local chargepoint accessibility**
New ULEVs	Carbon Savings (tonnes CO_2)	1,093,888	5,780,482
	Carbon Savings (£s)	£67,817,104	£368,091,895
Additional Impacts			
New ULEVs	Air Quality	£775,877	£3,771,357
	Noise	£565,306	£2,832,676
Consumer savings			
	Consumer Fuel Savings	£189,870,585	£886,310,050
	Consumer Electricity Costs	-£67,845,548	-£340,195,162
	Net Gain to Consumers	£122,025,037	£546,114,888
Welfare benefits to existing and new consumers			
	Total	£157,265,563	£848,585,180
Marginal Depreciation of ULEV over ICE vehicles			
	Total Marginal ULEV Depreciation	-£48,924,434	-£190,746,291
	Total	£299,524,454	£1,578,649,706

Costs to Government

Change in taxes (VED/Fuel Duty			
	Total	-£182,792,700	-£918,899,182

Overall, this assessment of benefits shows how potentially influential such a policy could be on the market. Significant benefits are seen for an increase of just 5% in accessibility, and the impact were the ability to access local chargers doubled is particularly high. This is consistent with the evidence showing that the provision of infrastructure is a key determinant of the take-up of EVs, which in turn benefit the consumer and society through lower costs and improved environmental outcomes.

Provision of smart charging infrastructure

The benefits of legislating this power are related to the avoidance of large electricity network and generation costs arising from the additional energy system requirements with growing ULEV uptake. Benefits may also arise through enabling of new options for grid balancing and system operation.

Without intervention, growing levels of ULEVs in the UK are likely to require additional network costs such as reinforcement of local networks and potentially wider system electricity generation capacity, which will impose costs to household consumers and businesses. Smart technology within chargepoints will help to avoid these potential growing costs attributed to ULEVs into the future, and provide new options for grid balancing and system operation, and thus could result in significantly lower consumer bills.

Lower costs to electricity consumers may actualise in the form of directly reduced bill costs, demand side response payments or through another contractual structure which has yet to be evolved by the electricity market. Depending on the outcome of market development in this area, benefits could be variable to electricity consumers.

It is difficult to estimate the magnitude of benefits of legislating this power, as the counterfactual scenario and degree to which ULEVs will add to energy system stress are unknown at such an early point in the market. For example, charging patterns in a scenario where ULEVs break in to the mass market have little evidence around them. There are also difficulties in estimating the degree to which ULEVs will add to whole system peak demand. However a study conducted for the Energy Networks Association by Imperial College[6] has attempted to estimate net present values of distribution network 'smartening', which would enable the shifting of ULEV charging load to outside of peak times and avoid network reinforcement costs. Under a very low electric vehicle uptake scenario of 10% in 2030, they estimate an NPV range of £0.25-1bn (between 2020-2030) from avoiding these reinforcement costs alone.

Further benefits from smart charging will be in the form of increased capability to manage the entire transmission network including outage requirements and regional system balancing, potentially reduced generation capacity requirements and a greater capability for the energy system to accommodate more intermittent low carbon generation. Further work is being undertaken on smart charging opportunities with BEIS energy teams.

6.3 Other benefits not modelled

The above provides an assessment of some of the benefits, however there are some wider benefits that we have been unable to assess at this time. These are described below:

- The early and very limited nature of the current market in hydrogen for transport makes it difficult to assess the benefits that might come about from the regulation of the provision of hydrogen infrastructure and the regulation of the consumer experience. However, given that hydrogen fuel cell electric vehicles have the same zero tailpipe emissions as battery electric vehicles, we would expect to see the same sorts of benefits – in proportion to the extra uptake of vehicles. There may be less of a role to support the consumer experience – if the providers match the offering on conventional vehicles fuels – but any extra provision of refuelling infrastructure could bring significant benefits in allowing faster uptake of hydrogen vehicles.
- The global transition to ULEVs represents a unique opportunity for the UK to attract inward investment and strategically position the UK automotive sector at the forefront of the new global market, with benefits for decades to come. The Government is taking a holistic approach to the sector – supporting research and development, supply and demand of vehicles, and provision of infrastructure – and examples, such as the £300m investment by Geely in manufacturing electric taxis in Coventry to support demand from London and other UK cities, demonstrate the benefits this approach can bring. Nevertheless, it is difficult to model these industrial benefits, and

[6] www.energynetworks.org/assets/files/electricity/futures/smart_meters/Smart_Metering_Benerfits_Summary_ENASEDGImperial_100409.pdf

specifically the potential benefits from the improvement in chargepoint accessibility and provision which these measures could bring. To provide a sense of proportion on the size of the overall industry, the current automotive industry adds around £11.6bn a year to the UK economy, and is the UK's number one high-tech manufactured export. 147,000 people are directly employed in vehicle manufacture, and a further 300,000 in the wider manufacturing supply chain. Given that the transition to ULEVs is global, with leading markets across the world making financial and regulatory interventions, the Government's programme of support – including this new legislation – will play an important role in protecting and growing that industry.

- Motorway service areas currently only have a single chargepoint supplier, the power to mandate provision at motorway service areas may increase competition at these locations, if it opens opportunities for other suppliers, and thus bring benefits to the consumer. Consumer benefits could include improved service and lower prices, however we have not been able to assess the level of these potential benefits at this stage.
- Increased levels of charging activity as a result of any regulations made under these powers, could bring benefits for retailers or other service providers who can take advantage of the driver's dwell time at a particular location. We have been unable to assess this potential additional revenue as a result of the extended charging time. This would be especially important to chargepoints located at supermarkets, motorway service areas, and fuel retailers with a convenience store.

7 Indicative Costs to Business

The primary costs of these Bill measures, if implemented through secondary legislation, would come about from the additional costs that business will incur due to either modifying their existing infrastructure or services/software; or the required purchase of new infrastructure or services/software, alongside the additional administrative burden imposed from having to meet the regulatory requirements. There will also be a one-off familiarisation cost to business.

The costs focused on in this section apply to businesses and also include the regulatory burden costs to government and businesses. Wider impacts to the Exchequer from tax impacts are covered in the benefits section, in line with standard guidance. In terms of business costs, it would be for each business to determine the best way to achieve compliance. As the Bill only provides the initial powers, which cannot be enacted without recourse to secondary legislation, we look specifically in this analysis at a number of potential scenarios for each theme (and where appropriate, powers within a theme). The scenarios in this section therefore aim to provide a range of potential costs. Please note that the quantified estimates of costs in the scenarios illustrated in this section do not directly align with the quantified estimates of benefits presented earlier in this Impact Assessment, due to the difficulty of linking a percentage accessibility to a specific number of chargepoints. Before secondary legislation is taken, a final proposal for regulation will be developed which will allow a more accurate understanding, coupled with the latest evidence about ULEV uptake and technology costs. It is the intention of these scenarios to provide an indicative range of costs, with at least one high scenario aiming to indicate the more costly type of regulation that could be enacted. Government would look to minimise costs to business through careful design of any regulation, and so we do not expect that the 'worst case' scenario for every power to be representative of a likely scenario. As previously emphasised, regulations may not be introduced for all powers, and may not be introduced all at the same time.

7.1 Costing Methodology

As mentioned, the exact regulatory scope of each power is currently undefined and will be specified through secondary legislation. For each power, the costs can be broken down to a number of specific areas – not all of which will apply to each theme and/or power. The main areas of costs are as follows:

- Cost of infrastructure changes: This cost refers to the cost to modify, change or purchase new infrastructure to comply with the regulations. This will also cover the cost where applicable to setup data exchanges and the technological links to facilitate data exchanges etc. This significantly differs dependent on the regulation requirements.

- Cost of Regulatory Burden: The cost both to government for the setting up and on-going management of the regulation, and the cost to business from the compliance with regulation and the management of that compliance. These will depend on how many of the powers are taken which will define the size of teams required to manage this within government and industry.
- Familiarisation Costs: It is possible that the regulatory framework could to be complex, so businesses may need to spend time familiarising themselves with the rules and requirements. These costs are driven by the number of people that need to familiarise themselves with the regulations, their wage rates and the complexity of the requirements. These factors will all be considered for each individual regulation and requirement generated using the powers taken in these primary regulations.

The following section will go through each policy theme in turn and provide an assessment of the cost to businesses of several plausible scenarios within each theme, and where appropriate each separate power. It is important to state that the scenarios that feature in the following section have been modelled to provide a range of potential indicative costs. The scenarios are illustrative examples of how the power could in theory be specified in secondary legislation.

7.2 Option 1 – Costs

The UK market for ULEVs such as Battery Electric Vehicles (BEVs) and Plug-in Electric Vehicles (PHEVs) has grown considerably in recent years and has been supported by the increase in the number of publically available chargepoints in town centres, cities and motorway service areas (MSAs). Conversely, the market for fuel cell vehicles, fuelled by liquid hydrogen, is at a much earlier stage of development and the provision of hydrogen refuelling infrastructure across the country is far more limited. It is estimated that there are approximately 11,000 publically accessible electric chargepoints at around 4,500 locations and only 13 publically accessible hydrogen refuelling stations in the UK today7.

The purpose of this collection of regulatory powers is to ensure that existing and new electric/hydrogen charging/refuelling infrastructure meets the needs of ULEV motorists. In addition to this, these powers will ensure that as uptake of ULEVs increases, a sufficient level of charging and refuelling infrastructure is provided.

7.2.1 Consumer Experience

The purpose of the following 4 powers is to enhance the consumer experience of using electric charging and hydrogen refuelling infrastructure.

7.2.1.1 Open data on chargepoint location and availability

The UK currently has a number of EV chargepoint networks, using different methods for access and payment, and providing varying levels of data informing drivers of their location and live availability. The availability of reliable and comprehensive open source data on public chargepoint and refuelling type, location and access could improve the charging offer to the consumer. This could include the provision of live (dynamic) data.

There are a number of cost components associated with mandating network operators to provide data on chargepoint location, connector type and status on an open format. Costs include; data acquisition, data validation and data tracing in order to prevent hacking. In addition to this, there are costs associated with establishing and maintaining a data platform as well as some potential for lost revenue to network operators if they could otherwise charge customers or other businesses for provision of data.

There is limited information regarding the exact cost to business of implementing this power due to the wider mix of options for the power, and the difficulty in estimating the costs of the data exchanges required for the more complex options. The lowest cost option would concern the provision of static data from a central entity that would be responsible for manually maintaining the database – OLEV's National Chargepoint Registry contains much but not all of these at present and may form the central core of such

[7] Source: https://www.zap-map.com/live/

a database. This is the less expensive option but could be prone to error. A more costly option would be a system whereby all network operators provides a central entity with real-time data.

At this stage it has not been possible to provide indicative costings for the implementation of this power due to the uncertainty over the type of system that would be developed and the associated costs. Feedback from the consultation suggests that either of the above options are possible and could be delivered at minimal cost to business. Based on the costs listed above it is expected that the overall cost to business would be in the region of thousands of pounds, on the basis of the consultation responses received. However, with the data currently available we are unable to provide more accurate costings, and this is an area where we will endeavour to gather evidence in order to provide full costings as any regulatory approach is developed. It is likely that this would be achieved via further engagement with industry.

With respect to hydrogen refuelling infrastructure, the market for hydrogen infrastructure is at a much earlier stage of development. It is unclear whether this power would be required for hydrogen infrastructure given that the market for electric chargepoint infrastructure has evolved naturally into one which support many different operators. It is unlikely that this will be the case for hydrogen refuelling. exist.

7.2.1.2 Accessibility

At present, there is no UK-wide market solution providing interoperable access to electric chargepoint infrastructure. Under the EU's Alternative Fuels for Infrastructure Directive the UK is required to mandate ad-hoc accessibility, but not the access method. The new powers give us the opportunity to shape how this element develops, through solutions such as defining a specific payment method, or requiring operators to reach commercial agreements to enable data sharing using a platform model.

The total cost of implementing this power will vary significantly depending on what payment method is applied. Below are two examples of how this power could be implemented in practice;

- Roaming platform – A commercial agreement is reached between the 8 largest chargepoint operators so that data can be transferred between operators.
- Mandating specific payment method at each chargepoint – for example mandating every publically available chargepoint to implement the infrastructure necessary to facilitate chip and pin payments.

A number of responses from the consultation suggested that a roaming platform could be setup for an upfront cost of £10,000 with a monthly recurring cost of £2000. On the assumption remains constant for the period we are considering in this IA (up to 2050), then this would have a cost of around £315,000 present value.

The cost of mandating of a specific payment method would be highly dependent on the payment method or methods chosen. We have considered the potential cost of mandating that all publically accessible chargepoints are retrofitted (at a cost of £500 per chargepoint) within 1 year to support chip and pin payment.

Table – Electric chargepoint illustrative accessibility costs

Scenario	Description	Direct cost to business (£/2016)
Roaming Platform	In 2020, within 3 years of the regulation enforcement date, all CPO are required to install IT software that enables data sharing, monthly recurring costs are assumed	£ 274,664

Chip and Pin	In 2018, 100% of all publically available chargepoints are to be retrofitted to support chip and pin payment within 1 year.	£ 2,536,516

*2016 prices, discounted at 3.5%.

It is uncertain how the market for hydrogen refuelling infrastructure will evolve to the extent that it is not possible to provide a list of potential payment options specific to hydrogen refuelling. It is also difficult to translate the costs above to hydrogen refuelling infrastructure. For example, the roaming platform is a specific solution to electric charging infrastructure as the market has evolved into one that supports a number of chargepoint operators. Similarly, the costs of retrofitting refuelling stations to have facilitate chip and pin do not apply as there are only 13 publically accessible hydrogen refuelling stations.

7.2.1.3 Design standards

Publically accessible chargepoints offer different outlets and connectors to meet the needs of different ULEVs. AFID imposes a degree of harmonisation, but further powers to ensure minimum technical specifications of EV chargepoint infrastructure may be important as the market develops. This could help to ensure physical interoperability to enable all EVs, regardless of connector type, to be able to charge on the public networks. It is important, however, to ensure that any minimum specifications are sufficiency flexible to accommodate emerging technologies, and to consider the impacts on business of legislating for minimum standards. It is intended that this measure will provide the flexibility necessary to build upon the level of standardisation mandated by the AFID.

The following power is designed to specify minimum standards of design and functionality for new publically accessible electric chargepoints and hydrogen refuelling stations. The cost to business will therefore manifest itself as the marginal difference in cost between installing a standard charge/refuelling point/stations and one that meets the minimum design and functionality standard. Applying this only to new chargepoints would mean that the cost to business of mandating a specific requirement will be minimal.

7.2.1.4 Administrative Burden

We would expect these powers to have an associated level of administrative burden both on the chargepoint industry and on government. This will be entirely dependent on the level of regulation taken and the provisions required to manage this. At a high level though, if to manage and enforce these regulations at the high end would require a government team of 3 people and each provider between 0.25 and 1 person dependent on size, we would expect the costs of administration to be around £2m PV. When compared to the overall potential cost of the high scenarios this is a relatively small proportion of total costs and we would expect this to scale down accordingly for the central and low scenarios.

7.2.2 Provision of Infrastructure

The purpose of this power is to help ensure that as uptake of ULEVs increases, the provision of charging and refuelling infrastructure meets the needs ULEV motorists. MSAs and large fuel retailers are considered to be locations where EV infrastructure might be expected, given the familiarity of drivers in using these facilities to refuel their vehicles, and the dependence of these businesses in serving the needs of motorists.

A ‘minimum provision’ of electric chargepoint and hydrogen refuelling infrastructure has not yet been specified and will be defined through secondary legislation. As the market for charging and refuelling infrastructure is growing rapidly, the specificities of the regulation, such as exact type of infrastructure mandated, will be largely determined by when the regulation is enforced.

Given this uncertainty, and the need for secondary legislation to fully regulate, this impact assessment will support a scenario based approach in order to assess the impact of this regulation. Detailed information on the analytical assumptions used for this analysis can be found in Annex A.

7.2.2.1 Minimum provision at Motorway Service Areas (MSAs)

Owing to uncertainty surrounding an exact definition, an official list of motorway service areas (MSAs) in the UK does not exist. For the purpose of this impact assessment we have defined MSAs as all motorway service stations located strictly on motorway highways. Based on a list of all MSAs in the UK complied by MotorwayServices.info, there are 129 MSAs in the UK that meet this definition.[8] According to chargepoint installation data, electric chargepoint infrastructure is well established across the vast majority of MSAs in the UK. Out of the 129 MSAs situated in the UK, only 7 (5%) are not equipped with at least one rapid chargepoint. As discussed, the market for fuel cell vehicles is not as advanced and currently hydrogen refuelling infrastructure is not provided at any MSAs.

In order to assess the impact of implementing this regulation we have adopted a scenario based approach which aims to provide a range of cost estimates in relation to the following analytical question; *What is the cost to business of mandating the provision of x number of electric/hydrogen charge/refuelling points at y% of MSAs within z years of the regulation being enforced?*

The total cost to business of implementing this power depends on different factors that will be specified in secondary legislation. These key factors are explained below;

- **Number of charge/refuelling points required** – The total number of charge/refuelling points required will be determined by how 'minimum provision' is defined. This will influence the number of MSAs in scope of the regulation and the number of charge/refuelling stations required at each MSA. The greater the number of charge/refuelling points that are mandated at each MSA, the higher the cost to business.
- **Type of charge/refuelling points required** – There is currently a range of different types of electric chargepoints on the market which vary widely by cost and performance. It is therefore expected that mandating the installation of relatively inexpensive AC 'fast' chargepoints would impose less cost on business than more expensive DC 'rapid' chargepoints.
- **Regulation enforcement date** – It is currently unclear when the regulation would be enforced. The cost of chargepoints is expected to fall over time as the market develops meaning that the further into the future the regulation is imposed, the lower the cost of purchasing and installing chargepoints is for MSAs.
- **Compliance period**- It is likely that once the regulation is announced, MSAs will be given a period of time to upgrade their infrastructure in order to comply with the regulation. The longer the compliance period the lower the cost to the MSA. The reason for this is twofold, firstly the cost of electric chargepoints is expected to fall over time as the market develops, and therefore a longer compliance period means that MSAs can purchase chargepoints further into the future. Secondly, future costs are discounted at the social rate of time preference meaning that costs that occur in the future are valued less than those costs occurred in the present.

The electric chargepoint infrastructure scenarios below will consider the impact of mandating the provision of varying levels of 'Triple Output' 50kW DC rapid chargepoints at all MSAs. This particular type of electric chargepoint is capable of charging an electric vehicle to 80% in 20-30 minutes, support Type 2, CHADEMO and CCS connectors and cost approximately £23,000 per unit .We assume that the unit cost of this chargepoint falls over time as economies of scale are realised owing to the development of the supply chain. 'Dual Output' 50kW DC rapid chargers are not considered in this assessment as they do not support CCS connectors and it is highly likely that all MSAs will have this type of charger installed by the time the regulation is enforced. . 'Super rapid' chargers (50kW+) have also been considered in this assessment, however we have been unable to cost this particular chargepoint due to their limited commercial availability.

Table - Minimum provision of electric chargepoint infrastructure at MSAs

Scenario	Description	Direct cost to business (£/2016)

[8] Detailed information of MSAs included in this sample provided in the analytical annex.

Low	In 2020, all MSAs are required to have at least 1 'Triple Output' 50kW DC rapid electric chargepoint within 3 years	£	2,296,604
Central	In 2019, all MSAs are required to have at least 2 'Triple Output' 50kW DC rapid electric chargepoints within 2 years	£	15,660,020
High	In 2018, all MSAs are required to have at least 5 'Triple Output' 50kW DC rapid electric chargepoints within 1 year	£	82,660,248

Our central scenario assumes that in 2019, all MSAs are required to have at least 2 'Triple Output' 50kW DC rapid electric chargepoints within 2 years of the regulation being enforced. The scenarios above represent the cost of all MSAs installing and maintaining enough chargers to meet the mandated provision up to 2050. As shown in the table above this scenario would impose a cost to business in total of **~£15m**. £8m of this cost would be accrued in 2021 and covers the installing of chargepoints, the additional £7m reflects the cost of maintaining and replacing[9] each charger once it requires renewal at the end of its lifetime[10].

Our low and high scenarios show the lower and upper bounds of our cost estimates. Given that currently no MSAs provide any more than 2 'Triple Output' 50kW DC rapid chargers, the most costly scenario mandates all MSAs in 2018 to provide at least 5 'Triple Output' 50kW DC chargers within 1 year. The lowest cost option mandates all MSAs in 2020 to provide at least one 'Triple Output' 50kW DC rapid chargepoints within 3 years.

The costs provided above have been generated through exploring a number of potential illustrative scenarios. We expect that estimates provided above reflect the upper bound of what would be realised in practice. Firstly, the analysis assumes that rather than having the ability to modify existing chargepoints each additional rapid charger installed by an MSA faces the full cost of installation (~£50,000) which includes the cost of the charging unit itself (~£23,000) and the installation (e.g. grid upgrades) (~£30,000)[11]. In addition to this, due to uncertainty regarding the timing of the regulation we have assumed that the current level of infrastructure provided at MSAs remains constant over time. In reality, we expect the level of infrastructure provision at MSAs will be very different to what it is now, with supply already outstripping demand in some places, and reports of queuing.

The market for hydrogen refuelling infrastructure in the UK is at a very different stage of development compared to electric chargepoint infrastructure. Due to the very limited number of existing hydrogen vehicles, and the comparatively earlier stage in commercial development it is harder to assess the costs of hydrogen provisions. As a result, there are two important distinctions that exist between the electric and hydrogen infrastructure scenarios assessed.

Firstly, unlike electric chargepoints, it is less likely we will need all MSAs will be required to comply with the minimum standards regulation. We have therefore assumed that only 50% of MSAs are mandated to provide a minimum level of hydrogen refuelling infrastructure. Due to the infancy of the market, we also assume that this power would be enforced at a later date than the electric chargepoint provision.

Table - Minimum provision of hydrogen refuelling infrastructure at MSAs

[9] The replacement assumption assumes a cost of an identical replacement charger and does not include any installation costs.

[10] A large proportion of the maintenance cost is from replacement.

[11] The cost of installation will vary enormously between locations and is dependent on a number of variables such as the amount of ground work required and whether the grid would require strengthening. This value is an average taken from data from previous OLEV support schemes.

Scenario	Description	Direct cost to business (£/2016)
Low	In 2027, 25% of MSAs are required to provide hydrogen refuelling within 4 years	£ 39,261,973
Central	In 2025, 50% of MSAs are required to provide hydrogen refuelling within 3 years	£ 81,272,283
High	In 2023, 75% of MSAs are required to provide hydrogen refuelling within 2 years	£ 126,175,220

*2016 prices, discounted at 3.5%, cost of installing new refuelling infrastructure.

Our central scenario assumes that 64 MSAs (50%) are required to provide hydrogen refuelling infrastructure to its customers. It is expected that this power is taken in 2025 by which MSAs would be given 3 years to comply. The upfront cost to business would be expected to be in the region of **£80m** (central scenario). Due to the current lack of hydrogen refuelling stations, any maintenance costs are currently unknown and have therefore not been included in the costs.

Our high scenario assumes that 75% of MSAs are required to meet the regulation. In this scenario, MSAs experience 25% higher capital costs and have only 2 years to comply with the regulation. In reality, we do not expect this number of MSAs to be covered by the regulation. In addition to this it is highly unlikely that the capital cost of hydrogen refuelling infrastructure would increase from today's price as the market develops.

The low scenario assumes that only 25% of MSAs are required to meet the regulation. In this scenario, MSAs experience 25% lower capital costs and have 4 years to comply with the regulation.

As with the electric chargepoint scenarios, we expect the costs provided to reflect the upper bound of what would be expected. Although it is likely to vary significantly across installations, we expect the capital cost of hydrogen refuelling infrastructure to fall significantly as the market evolves and becomes commercially viable. Due to data limitations, this effect is not captured in our analysis.

7.2.2.2 Minimum provision at large fuel retailers

Data from Experian Ltd shows that there are currently 8,490 publically accessible refuelling stations in the UK. The current provision of electric chargepoints and hydrogen refuelling stations at fuel retailers is not certain but is significantly less advanced than at MSAs. The assumption in this Impact Assessment is that currently there are no chargepoints or refuelling stations provided at any fuel retailers. It should be noted however that some major fuel retailers are considering trialling provision of chargepoints on their forecourts in 2017, and such developments might be expected to continue until the point of any regulation.

In line with the power to require minimum provision of infrastructure at MSAs, the total cost to business of implementing this power depends on the number of charge/refuelling points required, the type of charge/refuelling points, the year in which the regulation is enforced and the compliance period. In order to understand the amount of infrastructure upgrade that is necessary, we are required to make an assumption on the number of fuel retailers that are covered by the regulation. Unlike MSAs, 'large fuel retailers' has not yet been defined. Given the variety of businesses currently retailing vehicle fuel it has been proposed that this regulatory power would only apply to a number of 'large' fuel retailers. For the purpose of this impact assessment we have considered the impact of enforcing the provision on 3 groups of fuel retailers;

- 3 largest fuel retailers by market share – number of outlets; 2,789
- 6 largest fuel retailers by market share – number of outlets; 4,415
- 8 largest fuel retailers by market share – number of outlets; 5,521

We will make an additional assumption for the proportion of outlets owned by the large fuel retailers, given the expectation that Government would focus any regulations on larger outlets rather than small or rural outlets. This assumption is further complicated by the fact that it is likely to differ depending on the type of infrastructure being mandated (electricity or hydrogen).

Therefore to assess the impact of implementing this regulation we have adopted a scenario based approach which aims to provide a range of cost estimates in relation to the following analytical question; *What is the cost to business of mandating the provision of x electric/hydrogen charge/refuelling points at y% of retail outlets owned by large fuel retailers (LFRs) within z years of the regulation being enforced?*

For the purpose of assessing the impact of mandating a minimum provision of electric chargepoint infrastructure, two types of chargers are considered; a 50kW DC rapid charger (as per the MSA provision) and a 22kW 'Ground Mount' Fast chargepoints which are less expensive (~£4,000), but offer longer charging speeds of around 1-2 hours.

Table – Minimum provision of electric chargepoint infrastructure at LFRs

Scenario	Description	Direct cost to business (£/2016)
Low	In 2020, the 10% of the 3 largest LFRs are required to have at least 1 'Ground Mount' 22kW AC fast electric chargepoint within 3 years	£ 11,258,062
Central	In 2019, 30% of the 6 largest LFRs are required to have at least 1 'Triple Output' 50kW DC rapid electric chargepoints within 2 years	£ 132,906,647
High	In 2018, 50% of the 8 largest LFRs are required to have at least 2 'Triple Output' 50kW DC rapid electric chargepoints within 1 year	£ 570,187,325

Our central scenario assumes that in 2019 30% of outlets owned by the 6 largest LFRs are required to install at least 1 50kW 'Triple Output' DC rapid charger. The scenarios above represent the cost of installing and maintaining enough chargers to meet the mandated provision up to 2050. As shown in the table above the central scenario would impose a cost to business in total around **£130m** present value costs. £64m of this cost would be accrued in 2021 and covers the initial installation of chargepoints. The additional £68m reflects the cost of maintaining and replacing each charger once it requires renewal at the end of its lifetime until the end of the appraisal in 2050.

The low scenario assumes that in 2020, 10% of fuel outlets owned by the 3 largest LFRs are required to provide at least 1 'Ground Mount' 22kW AC fast charger. Our high scenario estimates that in 2018, 50% of outlets owned by the 8 largest fuel retailers are required to provide at least 2 'Triple Output' 50KW DC rapid chargers within 1 year.

For the purpose of assessing the impact of mandating a minimum provision of hydrogen refuelling infrastructure we have assumed that a lower proportion of total outlets owned by large fuel retailers are required to meet the provision regulation. This is reflective of the expected state of the market, the location of outlets and the fact that many outlets would be restricted by space.

Table – Minimum provision of hydrogen refuelling infrastructure at LFRs

Scenario	Description	Direct cost to business (£/2016)
Low	In 2027, the 3 largest fuel retailers are required to have a hydrogen refuelling station at 1% of their outlets within 4 years of the regulation enforcement date	£ 26,309,539
Central	In 2025, 5% of refuelling outlets owned by the 6 largest fuel retailers are required to provide a hydrogen refuelling station within 3 years of the regulation enforcement date	£ 287,888,163
High	In 2023, the 8 largest fuel retailers are required to have a hydrogen refuelling station at 10% of their outlets within 2 years of the regulation enforcement date	£ 931,517,903

The total cost to business of implementing this power could vary significantly depending on how the power is defined in secondary legislation. Our scenario assessment above estimates that the costs of implementing this power could range from ~£35m to ~£1.2bn. Our central scenario assumes that in 2025, 5% of refuelling outlets owned by the 6 largest fuel retailers (220 in total) are required to provide hydrogen refuelling infrastructure within 3 years giving business an upfront cost of **~£290m** in total. Again, as mentioned in the MSA costs, we have no indication of maintenance costs and therefore these have not been costed.

7.2.2.3 Sensitivity analysis

The two most significant variables that influence the cost of implementing the provision powers are the capital cost of charging/refuelling infrastructure (especially hydrogen) and the number of MSAs/fuel retailers that are covered by the regulation. Relative to these two variables, varying the year from which regulation takes effect has a minimal impact on the total cost of the regulation.

The administrative burden of the infrastructure provision regulation for fuel retailers will, in a similar way to the MSA provision, be dependent on the minimum provision assumptions used and the number of businesses to which the regulations will apply. We would expect the cost to be in the region of £1m-£2.5m.

An additional factor that we have not been able to quantify in this assessment is the financial impact on fuel retailers and MSAs from motorists purchasing electricity and hydrogen instead of traditional fuels (petrol/diesel). Due to the fact that ULEVs currently only make up a very small share of the UK vehicle fleet, we would not expect any mandated electric and hydrogen refuelling installations to replace existing petrol/diesel refuelling pumps in the short term. It is therefore highly likely that sales of electricity or hydrogen fuel would be in addition to the sales of traditional fuels which would remain largely unchanged.

In the longer term we can expect that ULEVs will make up an increasingly significant share of the UK vehicle fleet. It is only at this point in time that a sales of hydrogen and electricity will start to noticeably replace traditional fuels, and these new powers are only likely to be one of many factors bringing on that transition. The financial impact on fuel retailers and MSAs will be determined by the difference in profitability between the fuels and the potential ability for wider retailing opportunities from the likely increased dwell time for electric vehicles. It could be that with a growing mass market of electric vehicles, retailing of electricity or hydrogen becomes the more lucrative and sustainable option. In summary, we do not expect sales of electricity and hydrogen to replace traditional fuels in the near future, therefore any cost/benefit from a sales transition will be heavily discounted.

7.2.3 Provision of smart charging technology

The cost of smart technology being installed as a result of any potential implementation of the powers proposed will vary depending on the type of technology being required. Additional total costs are difficult to quantify due to the unknown counterfactual of installation of smart charging technology. Costs are also likely to be driven by the precise details of the standards set out in secondary legislation. Furthermore, it is likely that use of smart charging by businesses and consumers will bring corresponding electricity bill reduction incentives, therefore it is challenging to pinpoint the level of additional impact the regulations may have.

Total costs of smart charging requirements will also depend on the total number of new chargepoints installed if and when powers are enforced. To give an indicative scale of potential cost: there are currently around 11,000 public and 70,000 domestic chargepoints[12] in the UK with around 1% of new car sales being low emission vehicles. Annual domestic chargepoint installations totalled around 13,000 in 2015/16, however annual installations are likely to rise with ULEV market expansion.

Capital costs for smart technology components of chargepoints are also quite uncertain, as such technology has not been rolled out to scale, and the value is likely to be affected by the precise detail of the functional requirements. The recent consultation suggests that, whilst some major UK players already produce products that could meet smart standards (and therefore may not incur any additional costs), smart charging technology could add between around £150[13] - £300 per chargepoint when compared with a "dumb" chargepoint equivalent. Where all smart charging technology occurs as a result of regulations put in place and as a result of financial incentives, direct costs to businesses could be around £65m[14] out to 2050[15]. The potential benefit to consumers in terms of lower electricity costs resulting from smart charging technology are discussed further in the benefits section of this IA.

There is a potential cost arising from the risk that the additional requirements of smart technology could reduce the level of chargepoint investment by installers due to the additional cost. This would incur wider inconvenience costs on ULEV drivers. However, it is not known what the impact on the number of chargepoint installations as a result of these additional capital costs might be.

7.3 Other costs not estimated

Although we have provided a number of scenarios and example costs to business throughout this section – there have been some costs that apply to all powers ,which we have been unable to estimate at this time. These are as follows:

- The main costs we have been unable to estimate relate to fines where we have not looked at the potential costs from fines should businesses not comply with the regulation. This is difficult to estimate until the actual detail of the regulation is known and the penalty structure is defined.
- As already stated, it is possible that the regulatory framework could to be complex, so businesses may need to spend time familiarising themselves with the rules and requirements. These costs are driven by the number of people that need to familiarise themselves with the regulations, their wage rates and the complexity of the requirements. These factors will all be considered for each individual regulation and requirement generated using the powers taken in these primary regulations.
- The costs of chargepoints assumes that any mandated EV chargepoints at fuel retailers can be accommodated within the current fuel retailers' land-take and would not require additional land purchases. At this time it is not foreseeable that Government would make any requirements which would force retailers to acquire additional land.

[12] Based on data from OLEV's Electric Vehicle Homecharge Scheme.

[13] Over three years where an operator is maintaining back office functions.

[14] Assuming a £300 cost per unit.

[15] Assuming enactment and implementation from 2020.

8 Additional Impacts

8.1 Direct costs and benefits to business calculations

Given that the legislation is for primary powers only, and that decisions on the introduction and detail of any secondary legislation will be taken at a later date in light of the development of the market, the EANDCB of the package is therefore 0. EANDCB of individual measures will be quantified and scored at the point when any regulations, which would then bring about impacts to business, are introduced in secondary legislation. We would expect, in line with the illustrative costs, that there would be some level of cost to business. Regulations will be designed to minimise these costs to business as far as possible.

8.2 Equalities impact test

Not applicable

8.3 Justice impact test

Not applicable

8.4 Competition impact test

This Bill is unlikely to restrict competition for chargepoint infrastructure, and in some instances is intended to provide or promote competition. For example, the 'consumer experience' powers to set out open data and allowing universal access to all chargepoints would aid competition between suppliers. Further consideration of competition impacts will need to be undertaken at the secondary legislation stage subject to the full details of the proposed legislation.

8.5 Small firm impact test

A full small and micro business assessment will be undertaken as part of any secondary legislation. This section highlights the current view in a rapidly changing marketplace.

Consumer experience powers
The existing chargepoint market is a mixed market with a number of the larger chargepoint providers being medium sized businesses which continue to grow and in some cases buy-out the smaller providers. An assessment of the number of business in the overall market is that at the present time there is in the region of 10 chargepoint providers, of which 4 are medium and the remaining small businesses, with a correspondingly smaller number of chargepoints in existence. A number of these smaller providers have a very regionally specific set of chargepoints which if excluded could potentially lead to regional disparities in the infrastructure offering.

Provision of infrastructure powers
The regulations covering the provision of infrastructure has been specifically limited to motorway service stations and 'large' fuel retailers including supermarkets with the intention of avoiding unreasonable burdens on small firms. None of these businesses fall within the bounds of small and micro businesses, the wider fuel retailer regulation is also targeted to not have an impact on small and micro businesses by aiming for large or high throughput retailers.

Smart Charging powers
Due to the nature of the smart charging requirements, and the likelihood that this may also impact home installations as well as on-street chargers, the way this will need to be managed is different. The regulations would need to include the small and micro business installers to avoid the situation where UK product standards are undermined by installation of imported units. Inclusion of restrictions on the same of non-smart chargepoints would ensure that chargepoints sold directly to consumers and businesses are also in scope, avoiding loopholes. Although the requirement to sell and install only those chargepoints that met a particular "smart" standard would fall on the small and micro businesses, the

cost to modify and produce chargepoints to these requirements would still fall to manufacturers. As such both the benefits of this policy would be undeliverable without the regulation applying to small and micro businesses, but also the overall cost impact on them should be negligible as the primary cost of the additional smart charging equipment will fall to the consumer and manufacturer of the chargepoints.

8.6 Greenhouse gases impact test

The benefits described above demonstrate the significant potential for greenhouse gas reductions resulting from the uptake of ultra-low emission vehicles, and the direct emissions reductions which can be predicted as a consequence of enhancing and increasing the supporting infrastructure. The scenarios here suggest that measures to improve provision of infrastructure at large fuel retailers and motorway service areas could bring greenhouse gas savings into several million tonnes of CO_2. There is also the potential for smart charging to improve the utilisation of renewable generation, thus avoiding existing peaks of demand which are largely met through fossil-fuelled generation.

8.7 Health and wellbeing impact test

The uptake of ultra low emission vehicles will have a direct benefit to human health and wellbeing, due to the reductions (to zero in the case of zero emission vehicles) in pollutant emissions from road transport. The Committee on the Medical Effects of Air Pollutants has identified that the evidence associating exposure to NO2 with health effects has strengthened substantially in recent years. It has made an estimate of an effect on mortality equivalent to 23,500 deaths annually in the UK has on the basis of NO2 concentrations. Many of the sources of Nox, including vehicles with an internal combustion engine, are also sources of particulate matter (PM). The impact of exposure to small particulate matter pollution (PM2.5) is estimated to have an effect on mortality equivalent to nearly 29,000 deaths in the UK. There may be overlap between these two estimates of mortality, but the combined impact of these two pollutants is a significant challenge to public health. The use of electric motors in place of engines in road vehicles, helps eliminate these types of tailpipe emissions. These benefits have been monetised according to webTAG guidance in the section covering benefits. However, Defra have published interim guidance on valuing the damage caused by Nox emissions which implies significantly higher damage costs than are currently published in webTAG – implying that the air quality benefits assessed here are conservative.

8.8 Human rights impact test

Not applicable.

8.9 Rural proofing impact test

The mandating of electric vehicle infrastructure in non-geographically specific locations such as motorway service areas and fuel retailers could help increase provision of charging infrastructure in rural areas faster than the market would otherwise achieve. The intended omission of smaller fuel retailers (which is likely to include many in rural areas) will ensure that this measure does not come at the expense of the viability of small fuel retailers.

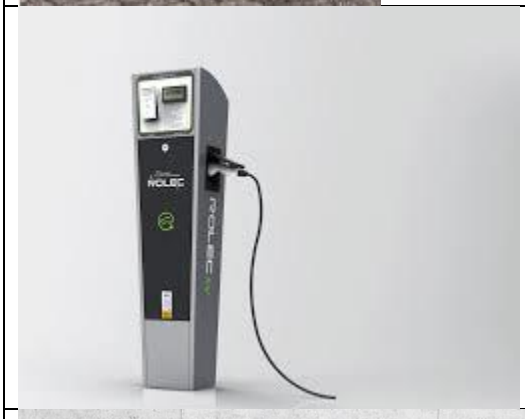
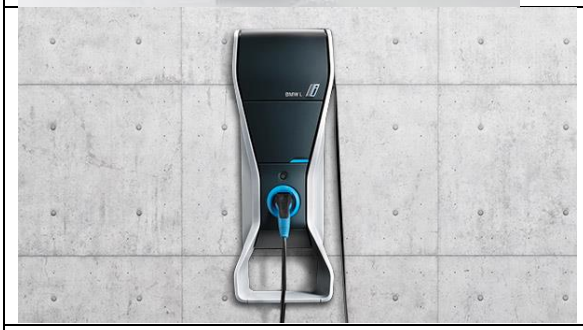
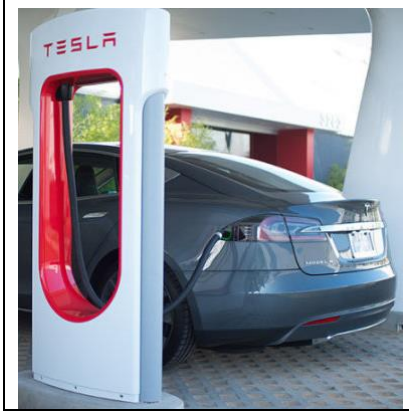
9 Summary

Option 1 is the Government's preferred Option to support the further development of the EV market. This option provides a number of enabling powers, all of which would require secondary legislation if a Government wishes to bring effect to the powers. This Impact Assessment sets out the current understanding of the potential impacts of these powers if enacted. It also sets out the potentially significant benefits of the powers to increase ULEV uptake and consequently reduce CO_2 emissions, improve air quality and reduce noise. Consumers will benefit directly from cheaper fuel costs. There are potential costs to businesses which will be dependent on the level of regulation ultimately taken at secondary legislation. An assessment of the broad range of potential costs is provided in this IA –

however these costs estimates will be improved and refined once the full regulation is known and can be assessed at the point that secondary legislation is produced.

Annex 1 Technical Glossary

Charging technologies

	Type: Rapid DC 50kw and AC **43kw** (100kw are beginning to come to market). Rate of charge: 80% in 20-30 mins. Use: for extending the range of vehicles for longer journeys – used in Motorway Service Areas, and increasingly in urban areas
	Type: Fast 7kw – 22kw (1 or 3 phase, 32 amps) Rate of charge: 1-5 hours depending on battery capacity Use: on street public networks (e.g. Source London), destination and increasingly residential and workplace
	Type: Slow 3kw. Rate of charge: 6 – 8 hours depending on battery capacity Use: residential or workplace
	Tesla Supercharger Tesla have a network of superchagers across the UK and Europe which charge a Tesla at 120kw.

Annex 2 Model Assumptions

Benefits:

Consumer choice model used: ECCo – the Electric Car Consumer choice model development by Element Energy – used to forecast uptake of electric vehicles. Inputs for the plug-in car grant and other variables setup as for the OLEV business case.
Social cost benefits analysis: Values from WebTAG November 2015.

Assumptions log:

Infrastructure cost assumptions

Assumption	Unit	Description	Source	Scenario	2016
Capital cost – 50kW (rapid) DC 'Triple Output' chargepoint	£	Price represents the cost of the charging unit and excludes VAT, delivery, installation. Model spec – RFID card, Contactless Payment Card reader and/or chip and pin enabled, display + LED status indicators, GPRS modem, Mode 3. Cost is expected to fall over time.	2016 value (UKEVSE), 2017+ (Delta-ee)	Central	£ 23,000
Capital cost – 7-22kW (fast) AC 'Ground Mount' chargepoint	£	Price represents the cost of the charging unit and excludes VAT, delivery, installation. Model spec – RFID card, Contactless Payment Card reader and/or chip and pin enabled, display + LED status indicators, GPRS modem, Mode 3. Cost is expected to fall over time.	2016 value (UKEVSE), 2017+ (Delta-ee)	Low	£ 3,000
				Central	£ 4,000
				High	£ 5,000
Installation Cost	£	This assumption captures the costs associated with installing an electric chargepoint (e.g. ground works). This cost is highly variable dependent on the location of the chargepoint. This cost is assumed the same for all chargepoints and is not expected to fall in the future.	OLEV's National Infrastructure Grant Schemes		£ 30,000
Total cost – Hydrogen refuelling station	£ per station	This assumption captures the total cost of installing (capital and installation) a 200kg hydrogen refuelling station. This cost is highly uncertain and would vary	Market Intelligence	Low	£ 1,200,000
				Central	£ 1,600,000

		significantly between location. Due to insufficient evidence at this stage no cost reductions are assumed over time.		High	£ 2,000,000

General assumptions – Various sources

Assumption	Unit	Description	Source	Scenario	
Proportion of MSAs that are required to provide a minimum level of electric chargepoint infrastructure	%	It is assumed in any scenario that all MSAs are required to provide a minimum level of electric chargepoint infrastructure.	Policy Assumption	Low	100%
				Central	100%
				High	100%
Proportion of MSAs that are required to provide a minimum level of hydrogen refuelling infrastructure	%	It is assumed that only x% of all MSAs are required to provide a minimum level of provision of refuelling infrastructure.	Policy Assumption	Low	25%
				Central	50%
				High	75%
Proportion of outlets owned by large fuel retailers that are required to provide a minimum level of electric chargepoint infrastructure	%	Only x% of outlets owned by LFR are expected to provide a minimum level of electric chargepoint infrastructure	Policy Assumption	Low	10%
				Central	30%
				High	50%
Proportion of outlets owned by large fuel retailers that are required to provide a minimum level of hydrogen refuelling infrastructure	%	Only x% of outlets owned by LFR are expected to provide a minimum level of hydrogen refuelling infrastructure. This proportion is lower than for electric chargers due to the current stage of development of the hydrogen vehicle market, the locations of LFRs and spatial restrictions	Policy Assumption	Low	1%
				Central	5%
				High	10%
Minimum provision of electric chargepoints at MSAs	Number	This assumptions states the minimum amount of 50kW 'rapid' chargepoints required at MSAs	Policy Assumption	Low	1
				Central	2
				High	5
	Number	It is assumed that 7-22kW fast chargers and 50kW rapid chargers	Policy Assumption	Low	1

Minimum provision of electric chargepoints at large fuel retailers		could meet the minimum level of provision at LFRs. The Low scenario requires one 7-22kW 'fast' chargepoint. The central and high scenarios mandate one or two 50kW 'rapid' chargepoints		Central	1
				High	2
Minimum provision of hydrogen refuelling infrastructure at MSAs	Number	If the MSA is covered by the regulation, only X hydrogen refuelling stations are required	Policy Assumption	Low	1
				Central	1
				High	1
Minimum provision of hydrogen refuelling stations at large fuel retailers	Number	If the LFR is covered by the regulation, only X hydrogen refuelling station are required	Policy Assumption	Low	1
				Central	1
				High	1
Regulation enforcement date - Electric chargepoint infrastructure	Date	The assumed date the regulation is enforced	Policy Assumption	Low	2020
				Central	2019
				High	2018
Regulation enforcement date - Hydrogen refuelling infrastructure	Date	The assumed date the regulation is enforced. This is further into the future for hydrogen given the infancy of the market	Policy Assumption	Low	2027
				Central	2025
				High	2023
Compliance years - Electric chargepoint infrastructure	Number	The number of years MSAs/LFR have to comply with the regulation	Policy Assumption	Low	3
				Central	2
				High	1
Compliance years - Hydrogen refuelling infrastructure	Number	The number of years MSAs/LFR have to comply with the regulation. This is longer than electric chargepoints due to the length of time for installation	Policy Assumption	Low	4
				Central	3
				High	2

Factor/market price conversion	Number	Used to convert to market prices	WebTAG	1.19
Discount Rate	%	All costs are discounted at the social rate of time preference	HMT Green Book	3.5%

List of fuel retailers:

forecourttrader.co.uk/files/Fuel_Market_Review/Fuel_Market_Review_2015.pdf