

Enabling ULEV uptake by market segment – international leading practice

Paul Blakeman, Kate Palmer and Gary McRae
Urban Foresight
November, 2019

Executive summary

Aims

This report aims to highlight leading practices in supporting the adoption of ultra-low emission vehicles (ULEVs) across different market segments and, based on these, make recommendations on interventions that could be taken in Scotland. Through a series of international case studies and a detailed analysis of what has been effective, the report draws out key areas for action in terms of policy, legislation, investment collaboration and support which could be enacted in the Scottish context. The analysis considered the likelihood of Scotland being able to take a leading role in terms of either ULEV uptake in certain market segments or supply chain development in relation to particular ULEV markets.

Since the launch of its *Switched On Scotland Roadmap* in 2013, the Scottish Government has taken a co-ordinated approach to enabling organisations and individuals to switch to using electric vehicles. Many of the interventions set out in the Roadmap and since implemented have been inspired to some extent by international best practice. Several years on, and in light of the Scottish Government's target of phasing out the need for fossil fuelled vehicles by 2032, this report seeks to take a fresh look at international best practice to see what approaches other countries and regions are taking – as well as identifying areas where best practice has yet to be established and where Scotland has the opportunity to lead.

Findings

The UK Department for Transport's vehicle licensing statistics¹ suggest that a total of 7,831 plug-in vehicles will have been registered in Scotland by the end of the first quarter of 2018. The ongoing development of one of the most comprehensive charging networks in Europe has sought to match the increased demand from EV uptake. During 2019 Scotland hit the milestone of installing over 1000 publicly available EV charge points. Currently, the average distance between any given location to the nearest public charging point is just 2.78 miles in Scotland – compared to 3.77 miles in England².

EVs feature heavily in Scottish Government policy such as in the Scottish Government's '*Climate Change Plan*' as well as the ambitious '*Scottish Energy Strategy*'. Local authorities have also played a

¹ [Department for Transport \(2019\). Vehicle Licensing Statistics.](#)

² [Transport Scotland \(2019\). Over 1,000 electric vehicle charge points in Scotland.](#)

key role in the progress that has been made to date. Successful local authorities have recognised how the introduction of EVs in their area can tackle a number of local issues, such as poor air quality in cities.

Sections 3 to 12 of this report set out ten short briefings which summarize leading practice in key vehicle segments. Within these briefings, the policies and interventions that lead to best practice are discussed, along with case studies of success in these areas and the transferability of this to the Scottish context. Table E.1 below provides a high-level assessment of where, with the right policy interventions, Scotland could potentially take a global leadership role in terms of either ULEV uptake or commercial opportunities offered by the ULEV market:

Table E1: Summary of ULEV Uptake and Market opportunities across different vehicle segments.

	ULEV Uptake		Market Opportunity			
	Relative progress in ULEV uptake	Opportunity for global leadership	Vehicle (Design & Manufacture)	Supply Chain	Infrastructure	Services
New cars (private, urban)	Low	Low	Low	Medium	Medium	Low
New cars (private, rural)	Low	Medium	Low	Medium	Medium	Low
Used cars and vans	n/a	Medium	n/a	High	Medium	Low
Taxis	High	High	Low	Medium	Medium	Low
Car share vehicles (car and vans)	Medium	High	Low	Medium	Medium	Medium
Public sector fleets (cars and vans)	Medium	High	Low	Medium	Medium	Medium
Private sector fleets (cars and vans)	Low.	Medium	Low	Medium	Medium	Low
Buses	Low.	Medium	Low	Medium	Low	Medium
HGVs and Large Service Vehicles (Private)	n/a	Medium	Medium	Medium	Low	Medium
HGVs and Large Service Vehicles (Public)	n/a	High	Low	Medium	Low	Low

Recommendations

There are several segments which are relatively underdeveloped and which Scotland has an opportunity to compete for a global leadership position in terms of ULEV uptake. These relate to vehicles which are usually heavily utilised but which make up a relatively small proportion of the total vehicle mix, such as taxis, car share vehicles and public sector fleets. With the right policy and investment interventions Scotland can move forward with transitioning to high levels of ULEV penetration ahead of other countries. This could particularly be the case in terms of taxis, where Dundee's ULEV taxi fleet has already achieved international recognition.

In terms of market opportunity, not having its own sizable automotive industry, it would be challenging for Scotland to take a global leadership role in the supply of ULEVs in any market segment (with the possible exception of private sector Heavy Goods Vehicles (HGVs) and Large Service Vehicles, these opportunities will be explored in Section 11 and 12 of this report). The ULEV battery market, however, is still maturing and there is significant space for innovation.

The lack of capacity in battery manufacturing across the globe is currently recognised as a major supply issue effecting the uptake of electric cars. There is an opportunity for Scotland to look at bringing a battery manufacturing facility to Scotland through a partnership with one or more of the well-established battery manufacturing companies, subject to a more detailed market analysis. The new Michelin Scotland Innovation Parc could potentially be a suitable location for such a facility.

Battery end-of-life management is an important practice to reduce the need for critical raw materials and to limit risks of shortages. There are opportunities for the facilities for recycling or repurposing of batteries to be located in Scotland. A large-scale operation recycling/repurposing batteries at a site is likely to lead to a number of spin off opportunities for organisations to be at the cutting edge of what is set to be a major part of the automotive industry.

There are two other areas within the ULEV supply chain identified here where Scotland has the potential for global leadership:

- While there has been significant development of charging infrastructure to date there is a real opportunity to further develop this line of work through the design and manufacture of fully integrated charging solutions that encompass on-site generation and battery storage solutions as well as incorporating innovative charging techniques.
- To date the majority of countries exhibiting leading practice in the ULEV space have been successful in promoting one or two categories of vehicles only and as yet a fully developed holistic approach to the electrification of transport has not been implemented to scale successfully. In conjunction with Transport Scotland's Mobility as a Service initiative, there is an opportunity for Scotland to be one of the first to deliver a fully integrated low carbon solution that encompasses all vehicle types.

Contents

1	Introduction.....	2
2	Overview market segments.....	3
3	Privately bought new cars (urban).....	4
4	Privately bought new cars (rural).....	6
5	Used cars and vans	9
6	Taxis.....	12
7	Car share vehicles	14
8	Public sector fleet vehicles.....	16
9	Private sector fleet vehicles	18
10	Buses.....	19
11	Private Sector HGVs and Large Service Vehicles	21
12	Public Sector HGVs and Large Service Vehicles	24

1 Introduction

Earlier this year ClimateXChange, on behalf of Transport Scotland, commissioned two reports seeking to understand how to stimulate the uptake of ultra-low emission vehicles (ULEVs) in Scotland to meet national targets. These studies aim to analyse the makeup of the current vehicle market in Scotland and learn lessons from other regions which are succeeding in some respect.

Since the launch of its *Switched On Scotland Roadmap* in 2013, the Scottish Government has taken a co-ordinated approach to enabling organisations and individuals to switch to using electric vehicles. Many of the interventions set out in the Roadmap and since implemented have been inspired to some extent by international best practice. Several years on, and in light of the Scottish Government's target of phasing out the need for fossil fuelled vehicles by 2032, this report seeks to take a fresh look at international best practice to see what approaches other countries and regions are taking – as well as identifying where there is a lack of best practice.

The '[ULEV Market Segmentation in Scotland](#)' report was completed by Element Energy (2019) splitting the vehicle market into 15 segments by factors such as vehicle size, ownership type, and charging location. This report identified the key barriers to electric vehicle (EV) adoption in each segment, indicating which policies could address those barriers and help meet the Scottish Government's target of phasing out the need for fossil fuelled vehicles by 2032.

The 'Identifying International Leading Practice in Relation to Enabling ULEV Uptake' report completed by Urban Foresight (2019) details insights from case studies relating to different measures of success. In this report, learning is gathered primarily from seven different case studies from across the world. The scope covers different use cases, ownership types, and vehicle types to capture lessons learned across the road transportation sector.

This report draws on these two earlier studies, using the market segments as a basis for identifying and presenting best practice examples from around the world. By bringing these two reports together, this short report guides policy recommendations in a Scottish context by market segment with learning from different aspects of international case studies.

The report consists of ten short briefings which summarise leading practice in key market segments. Within these briefings, the policies and interventions that lead to best practice are discussed, along with case studies of success in these areas and the transferability of this to the Scottish context. It identifies and investigates international best practice which could support Transport Scotland in this next stage of development of the electrification of the transport sector. It draws out areas in which Scotland can take a leading role globally and thereby support opportunities for economic growth.

Defining ULEVs

ULEVs are defined as vehicles which have tailpipe emissions of less than 75 g CO₂/km and have an all-electric range of greater than 10 miles.³ Throughout this report we will primarily focus on the Battery and Plug-In Hybrid Electric Vehicle market. Vehicles using alternative fuels such as hydrogen are highlighted where appropriate but, at present, the EV market is considerably more developed and therefore is the dominant technology discussed.

³ [Society of Motor Manufacturers & Traders \(2019\). Ultra-Low Emission Vehicles.](#)

2 Overview market segments

The segmentation used in the ‘ULEV Market Segmentation in Scotland’ report categorises the market in terms of factors such as vehicle size, parking arrangements and mileage. However, national and regional governments tend to consider automotive policies more in terms of the purpose, ownership and operating context of vehicles. Hence, in order to effectively look at international leading practice in relation to market segments a simple mapping has been necessary as set out in Table 1 below.

Table 1: Mapping of market segments (Note that the order of the rows is optimised for readability of the table).

	New cars (private, urban)	New cars (private, rural)	Used cars and vans	Taxis	Car share vehicles (car and vans)	Public sector fleets (cars and vans)	Private sector fleets (cars and vans)	Buses	HGVs and Large Service Vehicles (Private)	HGVs and Large Service Vehicles (Public)
3. Car commuters who park on-street										
4. Private buyers of new cars and vans who park on-street, and do not use their vehicle to commute	●	●								
1. Private buyers of new cars and vans who can park off-street at home	●	●		●						
5. Depot-based cars and vans with relatively low daily mileage										
6. Company vans which are stored on-street, with relatively low daily mileage				●		●	●			
7. Depot-based vans with relatively high daily mileage										
2. Company cars and vans which can park off-street at home				●	●	●	●			
8. Private buyers of used cars and vans who can park off-street at home										
9. Private buyers of used cars and vans who park on-street, and do not use their vehicle to commute			●	●						
10. Private buyers of used cars who park on-street, and use their vehicle to commute			●							
12. Medium & Large Rigid Segment Barriers and Recommendations								●	●	●
13. Very Large Rigid Segment Barriers and Recommendations										
11. Small Rigid Segment Barriers and Recommendations										
14. Small & Large Articulated Segment Barriers and Recommendations									●	●
15. Waste Collection Vehicles Barriers and Recommendations										

These groupings lend themselves more easily to considering both the evidence gathered from the International Leading Practice study and pertinent policy recommendations for Scotland. Each one is explored in turn in Sections 3 to 12 below.

3 Privately bought new cars (urban)

Segment description

The market for new cars and vans bought or leased by private consumers living in urban areas. This includes car drivers who commute, as well as drivers who park on-street or off-street.

Leading practice for this segment

Fiscal incentives can encourage adoption of EVs and are a common policy lever at a national level. Supply side policies (e.g. policies that mandate vehicle manufacturers sell a certain percentage of low emission vehicles) support both suppliers and consumers; these have been shown to influence the market more than financial subsidies. Many countries have introduced policies which aim to reduce the capital cost of purchasing a vehicle; however, research has shown that reductions in annual vehicle taxation rates are a more effective mechanism in stimulating adoption of EVs⁴, especially when most cars in Scotland are purchased on Personal Contract Purchase (PCP) or loan schemes. It should be noted, however, that setting vehicle taxation rates is a reserved power for the UK Government which the Scottish Government has no direct influence over.

There is a clear link between the availability of public charging infrastructure and the uptake of EVs. Research has shown that once EVs constitute more than 5% of the vehicle registrations then charging infrastructure availability has been shown to have the strongest impact on further uptake⁵. Charge points need to be well maintained, available and appropriate for the requirements. A range of solutions are typically required to accommodate diverse driver habits and domestic accommodation types, for example, those without access to off-street parking.

Other incentives such as access to bus lanes, high occupancy vehicle lanes, or parking discounts have been shown to have a positive impact on adoption of EVs. These policies can be more cost efficient to implement with high values of Willingness to Pay for consumers.

‘Best in class’ location for this segment: Charge point coverage in The Netherlands

The key success of The Netherlands has been the rapid deployment of the most comprehensive EV charging infrastructure of any European country; The Netherlands has more charge points installed per head of population than any other country in Europe. It also has the most charge points per EV registered. This has removed one of the most significant barriers to private EV ownership - the reliable availability of charging infrastructure. The infrastructure that has been installed has mainly been fast (3-7kWh) chargers in cities where there is very little private parking. This has led to the situation where there is a ratio of public chargers to electric vehicles of 1:7⁶.

The key to this success has been the large-scale adoption of standardisation for public charging in The Netherlands. This has been achieved through a focus on the interoperability across charging operators which allows for competition within the market while retaining a degree of control. It also ensures that the end user receives a consistent experience.

⁴ Hardman, S., Chandan, A., Tal, G. and Turrentine, T. 2017. The effectiveness of financial purchase incentives for battery electric vehicles – A review of the evidence. Renewable and Sustainable Energy Reviews. 80 (March), pp.1100–1111

⁵ [The International Council on Clean Transportation \(2017\). Emerging Best Practices for Electric Vehicles Charging Infrastructure.](#)

⁶ [The International Council on Clean Transportation \(2017\). Emerging Best Practices for Electric Vehicles Charging Infrastructure.](#)

The ability to make this happen was down to the early creation of the Central Interoperability Register which has been in place in 2011 and was created with the support of the Dutch Government.⁷ This set the standard for current and future operators, providing a consistency and stability to the market. The Netherlands has also benefitted from a number of the utility companies having an early engagement in the installation and maintenance of charging infrastructure across the country. This initial deployment kickstarted the market.

Leadership Opportunities for Scotland

Table 2: State of global leading practice, relative progress in Scotland, and opportunities for Scotland for the privately bought new car (urban) segment.

ULEV Uptake		
State of global leading practice	Relative progress in ULEV uptake	Opportunity for global leadership
The global leader (Norway) is currently at 60.2% of market share. Supported through significant fiscal incentives, as well as other policies such as bus lane access and priority parking.	Low. EV market share in Scotland is currently at 1.6% albeit with ambitious targets for growth to 2032.	Low. Even with significant intervention this is a challenging segment in which to achieve global leadership.

Table 3: Market Opportunities for the privately bought new car (urban) segment.

Market Opportunity			
Vehicle (Design & Manufacture)	Supply Chain	Infrastructure	Services
Low. Scotland's presence in the automotive market is very low. Significant investment would be required to attract businesses.	Medium. There is an opportunity for countries looking to support battery development industries. With significant investment and a supported eco-system, this is an area that Scotland could grow in. An ideal project could be initiated as part of the Michelin Scotland Innovation Parc. This would be subject to a more detailed market analysis.	Medium. There is an opportunity to develop innovative charging infrastructure, particularly for on-street solutions, such as wireless charging or technology that reduces street clutter.	Low.

⁷ [World Electric Vehicle Journal \(2018\). Advancing e-roaming in Europe: towards a single "language" for the European charging infrastructure.](#)

Not having its own sizeable automotive market, it would be challenging for Scotland to become a market leader in the design and manufacturing of ULEVs in this or any other segment. The EV battery market, however, is still maturing and there is significant scope for innovation; across all markets segments there is a potential opportunity, with the appropriate level of investment, to compete for a global leadership position in elements of this market.

There is currently a global supply issue for electric cars which has predominantly been caused by the lack of capacity in battery manufacturing across the globe. This is being further squeezed as other groups of vehicles such as buses and refuse collection vehicles chose batteries as their preferred option. A major investment in battery manufacturing could help position Scotland as a future market leader. The Scottish Government could investigate the possibility of realising this ambition through bringing one or more battery manufacturing facilities to Scotland in collaboration with some of the well-established battery manufacturing companies.

Identification of the key recommendations for Scotland to succeed in this segment.

- Outline and publish anticipated stages of growth to meet 2032 target, particularly in terms infrastructure required.
- Provide financial assistance to Local Authorities to support the delivery of innovative EV charging infrastructure projects.
- Investigate the feasibility of creating a battery development and manufacturing facility in Scotland and estimate the financial support which could be required.
- Co-ordinate and deliver a communication and education programme that promotes the shift to low carbon transport while providing specific guidance on benefits of EV ownership to the individual and their community⁸.

4 Privately bought new cars (rural)

Segment description

The market for new cars and vans bought or leased by private consumers living in rural areas. This includes car drivers who commute, as well as drivers who park on-street or off-street.

Leading practice for this segment

While range anxiety is a common concern for all consumers, it is a particular challenge for those living in rural areas; best practice aims at addressing this, through ensuring comprehensive and reliable charging networks with interoperability and standardisation.

Installing charging infrastructure in rural areas often associated with connecting to the grid. Therefore, leading practice in rural areas could involve integrated charging solutions that encompass on-site

⁸ Note that most of the recommendations given in this report are detailed in the original report 'Identifying international leading practice in relation to enabling ULEV uptake'. Please see Table 2 in this report for the potential impact, time horizon and costs/dependencies of each of these recommendations.

energy generation and battery storage solutions as well as incorporating innovative charging techniques. To date only smaller pilot projects have considered integrated energy systems and those usually being in urban centres.

‘Best in class’ location for this segment: Vehicle Electrification in Norway

Norway is renowned for being the world leader in electric mobility with current levels of EV sales exceeding those of most other countries by a considerable margin. The current figures show that levels of new car registration in the country have reached a 30% share in 2018.⁹ While not explicitly addressing EV deployment in rural areas, it is one of the few locations in the world where electric vehicles are being adopted both in urban centres as well as in rural locations; EV market share exceeds 20% in 15 out of the 17 counties¹⁰ and it is clear that the network of public charging infrastructure, as well as the tax incentives have enabled the electrification of the rural car fleet.

There have been three significant factors in Norway achieving their position as world leaders: making EVs cheap to buy; enabling EVs to be cheap to use, and; making them practical and convenient for the end user (for example, by allowing access to bus lanes).¹¹ The Norwegian government has implemented the world’s most generous program of incentives as well as through early, comprehensive and consistent policies that not only tackle the difficult upfront cost associated with electric vehicles but have focussed on all aspects of the switch to ULEVs including focusing the ease of use.¹²

Analysis has found a high degree of support and acceptance of electric mobility from both the political establishment and the general public and industry. Norway EV Association have played a key role in supporting the uptake of electric vehicles through their outreach programmes and by providing a key link between EV users and the government.

Leadership Opportunities for Scotland

Table 4: State of global leading practice, relative progress in Scotland, and opportunities for Scotland for the privately bought new car (rural) segment.

ULEV Uptake		
State of global leading practice	Relative progress in ULEV uptake	Opportunity for global leadership
Generally, poorer uptake in rural areas; Norway also lead in this area.	Low. Rural uptake is likely be at a lower level than Scotland’s overall level of ULEV market share at 1.6%.	Medium. No countries/regions are currently tackling this in an outstanding way. Scotland’s Electric A9 and North Cost 500 initiatives are good examples of work already underway.

⁹ [Norsk elbil forening \(2019\) Norwegian EV market.](#)

¹⁰ [Berman \(2019\). Lessons from Norway: Dispatch from Electric Car revolution. Inside EVs.](#)

¹¹ [Kester, Sovacool \(2018\). Policy mechanisms to accelerate electric vehicle adoption: A qualitative review from the Nordic region. Renewable and Sustainable Energy Reviews 94 pp. 719-731.](#)

¹² [Norsk elbil forening \(2019\). Norwegian EV policy.](#)

Table 5: Market Opportunities for the privately bought new car (rural) segment.

Market Opportunity			
Vehicle (Design & Manufacture)	Supply Chain	Infrastructure	Services
Low. Scotland's presence in the automotive market is very low. Significant investment would be required to attract businesses.	Medium. There is an opportunity for countries looking to support battery development industries. With significant investment and a supported eco-system, this is an area that Scotland could grow in. An ideal project could be initiated as part of the Michelin Scotland Innovation Parc. This would be subject to a more detailed market analysis.	Medium. Opportunity to lead on the development of integrated charging solutions which utilise dedicated on-site renewables and battery storage capacity.	Low.

While Scotland currently has an all-encompassing Energy Strategy these fully integrated energy systems that have EVs at their heart are still in early stages of development and there are opportunities to develop a full range of integrated energy solutions from small scale for individual properties to significant industrial scale projects including.

The ReFLEX (Responsive Flexibility) project in Orkney will demonstrate a Virtual Energy System (VES) interlinking local electricity, transport, and heat networks into one controllable, overarching system.¹³ The project will demonstrate flexible energy balancing technologies through a software platform control generation and demand. The project will include domestic batteries, large-scale batteries, Vehicle-to-Grid (V2G) chargers, increase in EVs, electric bus and e-bike deployment, flexible heating system and a hydrogen fuel cell.

While there has been significant development of charging infrastructure in Scotland to date, there is a real opportunity to further develop this line of work. With tourist numbers growing, and the number of tourists travelling with electric vehicles rising, there is an opportunity for Scotland to support rural EV development.

At present there are a number of related technologies being together around EV charging solutions. Subject to a full business case, there is an opportunity to design and manufacture fully integrated charging solutions that encompass on site generation and battery storage solutions as well as incorporating innovative charging techniques. These solutions will become increasingly important for rural and island communities where there are significant costs associated with upgrading the grid in remote locations.

¹³ [The European Marine Energy Centre \(2019\). Press release: Energy system of the future to be demonstrated in Orkney.](#)

Identification of the key recommendations for Scotland to succeed in this segment.

- Encourage UK Government to support interoperability across infrastructure back offices (e.g. the operating systems that enable fee collection, system monitoring and customer service provision for drivers and fleet operators alike) to enable certainty for electric vehicles needing to charge in rural locations.
- Implement a Scotland-wide guidance framework for tariffs to create certainty for electric vehicles needing to charge in rural locations.
- Publish guidance for the deployment of integrated EV and energy systems in new rural housing developments.
- Build a business case for fully integrated charging hubs.

5 Used cars and vans

Segment description

The market for cars and vans bought or leased by private consumers on the second-hand market. This includes private car drivers who commute, as well as drivers who park on-street or off-street.

Leading practice for this segment

With the EV market still to reach maturity, the second-hand market is limited. However, as the HEV and EV markets mature, there is some indication as to how HEVs and EVs depreciate. Initial research has found that in the second-hand EV market in California in 2015 different EV models held value differently, ranging from 43% (the short-range 2011 Nissan Leaf) to 99% (2014 Toyota Prius plug-in)¹⁴. Another study found that EVs retained resale value as well as their fossil fuelled counterparts¹⁵. Guo and Zhou (2019) found that long-range, high-performance Tesla BEV models hold value better than other classes of vehicle. Currently there are waiting times for consumers attempting to purchase an electric vehicle. Because of this, many electric vehicle owners are keeping their cars for a longer ownership period. This in turn increases the value of EVs on the second hand market.

'Best in class' location for this segment: Long term support for vehicle electrification in California (USA)

The high number of electric vehicles and the associated supply chain activities in California are mainly down to a three-legged strategy from the state government: supply side policy, incentives for both business and consumers, and infrastructure provision and accessibility.¹⁶ Over 20 years ago ZEV (Zero Emission Vehicle) mandates were introduced in the region with the aim of improving urban air quality by forcing vehicle manufacturers to produce a defined number of low emission vehicles. This was implemented for manufacturers who were producing over 20,000 units annually. These mandates

¹⁴ Tal, G., Nicholas, M.A. and Turrentine, T.S. (2017). First Look at the Plug-in Vehicle Secondary Market, No. UCD-ITS-WP-16-02.

¹⁵ Schoettle, B. and Sivak, M. (2018). Resale Values of Electric and Conventional Vehicles: Recent Trends and Influence on the Decision to Purchase a New Vehicle (No. SWT- 2018-4).

¹⁶ Palmer, K., Tate, J., Wadud, Z., and Nellthorp, J. (2018). Total Cost of Ownership of Electric Vehicles. Applied Energy, 209 pp 108-119.

were regularly readdressed by the California Air Resources Board (CARB) to continue to direct manufacturers to innovate beyond current low emission technology. This policy is seen as a cost-effective way of increasing the sales of electric vehicles in a region. It is most effective when introduced in conjunction with offering financial incentives to the purchaser. The 2nd part of the strategy was to offer fiscal incentives to the end user to stimulate the demand for the product. The vehicle rebate project offered up to \$7000 for the purchase or lease of a new and eligible ULEV. The final part of the strategy in California is centred around the deployment of infrastructure in the region to support the large-scale adoption of electric vehicles.¹⁷

The CARB has been instrumental in delivering a series of interventions known as ZEV Mandates that have successfully led to an increase in electric vehicle activity. This organisation is a Public Board that is made of several political figures and industry experts and is nominated by the Governor of California. The organisation forms part of the California Environmental Protection Agency and is responsible for regulating emissions of local pollutants and greenhouse gases in California. The California Energy Commission and The Public Utilities Commission have played key roles.¹⁸

The long-term support for low emission vehicles in California has led to successful second-hand market. Historically, non-fiscal incentives such as access to Higher Occupancy Vehicle lanes for low-emission vehicles have increased resale values for these vehicles, as evidenced in California.¹⁹

Leadership Opportunities for Scotland

Table 6: State of global leading practice, relative progress in Scotland, and opportunities for Scotland for the used cars and vans segment.

ULEV Uptake		
State of global leading practice	Relative progress in ULEV uptake	Opportunity for global leadership
On the whole, the used car market is yet to be established in a significant way.	n/a	Medium. Will be linked to uptake of ULEVs in new car market.

Table 7: Market Opportunities for the used cars and vans segment.

Market Opportunity			
Vehicle (Design & Manufacture)	Supply Chain	Infrastructure	Services
n/a	High. There is an opportunity to develop an industry for battery	Medium. There is an opportunity to develop innovative charging	Low.

¹⁷ [ICCT \(2019\). Overview of global zero-emission vehicle mandate programs.](#)
[ICCT \(2019\). Regulatory pathways for zero-emission vehicle mandates.](#)

¹⁸ Information in this case study was provided by stakeholder interviews.

¹⁹ Shewmake, S. and Jarvis, L. (2014). Hybrid cars and HOV lanes. Transportation Research Part A: Policy and Practice. 67, pp.304–319

	recycling and 2 nd life battery applications within Scotland.	infrastructure for those without access to off-street parking, such as wireless charging or technology that reduces street clutter.	
--	--	---	--

The majority of vehicle purchases in Scotland are through the second-hand car market (646,671 changed hands in Scotland in 2018¹). The Scottish Government’s Low Carbon Transport Loan is going to be expanded to include used EVs in recognition of the vitally important role that this market segment has in widespread EV adoption. As with all the promotion activities detailed so far it is important to fully understand how used-vehicle customers engage with the EV purchasing process and to recognise that many of the reasons affecting the decision to switch to electric are dependent on local factors. Therefore, it is a key to provide the main players in vehicles sales with the information and tools to help convince customers to make that change.

Another key element of used electric cars and vans is the consideration of batteries when these vehicles reach the end of their usable life. Battery end-of-life management is an important practice to reduce the need for critical raw materials and to limit risks of shortages, through either reuse or recycling. Battery recycling is still at a very early stages of its development. To date this has been a relatively small market as the 1st generation of EVs have generally lasted significantly longer than was first estimated and are only just coming to the end of their life. A number of the 2nd life batteries have also been used to support battery storage solutions and other developing industries. There are currently processes being developed across Europe to try and increase the recycling rate for li-ion batteries from 35% to 85%, these processes are still in the early stages. This provides opportunities not only for academic organisations to be involved but the physical recycling of the batteries or repurposing to be located in Scotland.

Identification of the key recommendations for Scotland to succeed in this segment.

- Provide new and used car dealers with the knowledge, information and resources on the local benefits of transitioning to electric vehicles. This could contribute to the material already generated by the Electric Vehicle Association Scotland by adding information specific to regions.
- Co-ordinate and deliver a communication and education programme that promotes the shift to low carbon transport while providing specific guidance on benefits of EV ownership to the individual and their community.
- Implement the regulatory conditions that would support the recycling of batteries from end of life EVs²⁰.

²⁰ Waste battery regulation is devolved to the Scottish Government, see [Waste Battery \(Scotland\) Regulation 2009 for details](#).

6 Taxis

Segment description

The market for vehicles sold or leased to be used as taxis or private hire vehicles. These vehicles can be kept both on-street or off-street. These vehicles can also charge overnight but would need additional charges during the working shift.

Leading practice for this segment

Scotland needs only to look towards Dundee City’s success in taxi electrification. There are now 129 electric taxis in the city across several companies. This has been down to combination of partnership working with Dundee City Council, initial leadership by the 203020 Private Hire company, proactive provision of charging infrastructure, and incentives in relation to licensing, vehicle testing, parking and free charging.²¹

Ensuring taxis can charge quickly and conveniently is part of what constitutes best practice in this segment. Therefore, there must be charge points that are well maintained, available and appropriate for the requirements.

Consumer awareness programs with reliable costings can also support uptake. Policies can support this by involving stakeholders which can work with taxi companies and drivers.

‘Best in class’ location for this segment: Electrification of Lyft Ride Hailing Cars in Atlanta and Seattle (USA)

In Atlanta and Seattle, the ride sharing company Lyft has started to electrify its ride-hailing fleet. The electric vehicles mainly comprise of Chevy Volts which have been offered to Lyft drivers alongside conventional vehicles. Initial deployment consisted of 100 vehicles through Lyft’s week-by-week rental programme, but this is fast expanding. As part of the value proposition Lyft pays for electricity, but capital cost is still prohibitively high for many drivers. There is a high retention rate among Lyft drivers who have opted for electric vehicles.

The key success of this deployment has been the immediate increase in utilization of the fast charging network. This has supported growth in charge points across the cities, by city authorities and private companies. By electrifying ride hailing or taxi fleets this can guarantee utilization of charge points. Lyft is planning similar schemes in other cities in the USA.²²

Leadership Opportunities for Scotland

Table 8: State of global leading practice, relative progress in Scotland, and opportunities for Scotland for the taxi segment.

ULEV Uptake		
State of global leading practice	Relative progress in ULEV uptake	Opportunity for global leadership
Good examples in places.	High. Dundee is an example of international best practice.	High. If Dundee’s example is followed throughout the country.

²¹ Information in this case study was provided by stakeholder interviews.

²² Information in this case study was provided by stakeholder interviews.

Table 9: Market Opportunities for the taxi segment.

Market Opportunity			
Vehicle (Design & Manufacture)	Supply Chain	Infrastructure	Services
Low. Scotland’s presence in the automotive market is very low. Significant investment would be required to attract businesses.	Medium. There is an opportunity for countries looking to support battery development industries. With significant investment and a supported eco-system, Scotland could take advantage of this opportunity. An ideal project could be initiated as part of the Michelin Scotland Innovation Parc. This would be subject to a more detailed market analysis.	Medium. There is an opportunity to lead on developing innovative charging infrastructure for taxis, particularly on-street solutions such as wireless charging and integrated charging hubs.	Medium. Sustained investment and support to the Mobility as a Service (MaaS) market could help Scotland to become a leader in this space.

Other Scottish cities can gain knowledge and learning from Dundee City in electrifying their taxi fleets along similar pathways. As well as full control over their own fleet of vehicles each local authority has direct control over the taxis and private hire vehicles operating in its region through the licensing conditions attached to the issuing of a taxi plate. At present there is a different regime in each of the local authorities with different organisations operating across the region. The electrification of this sector represents an economic opportunity in which Scotland can become a global leader.

Identification of the key recommendations for Scotland to succeed in this segment.

- Co-ordinate and deliver a communication and education programme that promotes the shift to low carbon transport while providing specific guidance on costs and benefits of EV ownership.
- Deliver similar types of charging hubs across every town and city in Scotland. Set guidelines and standardisation for charging hubs in Scotland to fully support electrification of the taxi industry.

7 Car share vehicles

Segment description

The market for vehicles sold or leased to be used within car club or car share schemes. These vehicles typically park in designated bays when they are not in use.

Leading practice for this segment

Best practice in this segment concerns the integration of car share vehicles into the wider transport system. There should be collaboration between local authorities and private companies to support roll-out as well as other measures to discourage private car mileage. Ensuring adequate coverage of vehicles across an area, ease of use and fair pricing are all important factors in leading practice. Integrating car share vehicles with other transit modes, particularly through Mobility as a Service (MaaS) applications, as well as utilising integrated energy systems support best practice in this segment.

'Best in class' location for this segment: Car Share Scheme in Shanghai (China)

Shanghai has delivered one of the largest electric vehicle car sharing schemes in the world with over 7,700 electric vehicles to serve a population estimated to be over 26 million people.²³ The introduction of car sharing schemes is becoming a key part of any city's transport network and the majority of these are looking to include at least some electric vehicles. Shanghai currently uses the EVCARD service which is now being used by 38 other cities in China and there are other companies competing in this space in China including United Journey in Shenzhen.

The EVCARD program was first launched in 2014 and is a membership based self-service scheme. This scheme attracted central government support as one of the first car share schemes in China, it started with a single Chinese vehicle model and has now expanded to more than 20 cities with a fleet of 8,400 electric vehicles made up of a number of different EV models.²⁴

In February 2016, the Shanghai local government set the targets for car-sharing to have 6,000 locations throughout the city with 20,000 new energy vehicles (NEV) and 30,000 charging points by 2020. This was enhanced by offering free parking spaces to car-sharing operators.²⁵ The local government is looking to influence all aspects of electric vehicle car sharing; therefore, subsidies were granted for platform development and charging infrastructure development, as well as the operation of car sharing schemes.

The local governments in the pilot cities have been key to this adoption of electric car-sharing vehicles by making it easier and less expensive to receive a licence for an EV. They have also set some stringent targets for the introduction of electric car sharing schemes.²⁶

²³ [The International Council on Clean Transportation \(2018\). Electric vehicle capitals of the world: Accelerating the global transition to electric drive.](#)

²⁴ [The International Council on Clean Transportation \(2017\). Electric vehicle capitals of the world: What markets are leading the transition to electric.](#)

²⁵ [Arthur D Little \(2017\). Car sharing in China: another storm in city mobility.](#)

²⁶ [The Economist \(2018\). Why a licence plate costs more than a car in Shanghai.](#)

Leadership Opportunities for Scotland

Table 10: State of global leading practice, relative progress in Scotland, and opportunities for Scotland for the car share vehicles segment.

ULEV Uptake		
State of global leading practice	Relative progress in ULEV uptake	Opportunity for global leadership
Good examples in places, e.g. Shanghai.	Medium. Car club roll-out is mixed but generally low, and particularly low in terms of EVs. The Plugged In Households initiative is likely to improve this somewhat.	High. With an effective intervention, this is an area that could experience high levels of deployment.

Electric car share schemes are currently in place in some locations across Scotland. Success in this segment can go hand in hand with the implementation of LEZs in cities across Scotland. This can support the delivery of world leading LEZs that not only tackle the issues in Scotland cities but provide flexibility to support local economic requirements. To enable this the Scottish Government would provide financial support to local authorities in providing free parking and other incentives to ULEVs.

Table 11: Market Opportunities for the car share vehicles segment.

Market Opportunity			
Vehicle (Design & Manufacture)	Supply Chain	Infrastructure	Services
Low. Scotland's presence in the automotive market is very low. Significant investment would be required to attract businesses.	Medium. There is an opportunity for countries looking to support battery development industries. With significant investment and a supported eco-system, this is an area that Scotland could grow in. An ideal project could be initiated as part of the Michelin Scotland Innovation Parc. This would be subject to a more detailed market analysis.	Medium. There is an opportunity to lead on developing innovative charging infrastructure for taxis, particularly on-street solutions such as wireless charging and integrated charging hubs.	Medium. Sustained investment and support to the Mobility as a Service (MaaS) market could help Scotland to become a leader in this space.

Identification of the key recommendations for Scotland to succeed in this segment.

- Co-ordinate and deliver a communication and education programme that promotes the shift to low carbon transport while providing specific guidance on benefits of EV ownership to the individual and their community.
- Deliver financial and regulatory frameworks to facilitate electrification of services within Mobility as a Service implementation.

8 Public sector fleet vehicles

Segment description

The market for cars and vans bought or leased by public sector organisations to be used in service provision or as pool vehicles. Some of these vehicles are kept on-street or off-street, other vehicles are kept in designated bays or car parks.

Leading practice for this segment

Leading practice in this segment involves setting medium to long term targets for local authority fleet decarbonisation. Policy frameworks which include financial incentives for public sector fleets are an effective encouragement. Information and education programs for employees can support success.

‘Best in class’ location for this segment: Public Fleets in Sweden

The Swedish government has announced that Sweden will be one of the world’s first fossil-free nations, and that in the long-term their energy system will be based on 100% renewable energy. Sweden has indicated that the transport sector will be challenging to decarbonise. Electric vehicles are expected to play a key role in this, and government fleets can act as an early adopter.²⁷ Apart from general incentives, promoting environmentally friendly and electric vehicles, the Swedish government has launched incentives directed towards governmental fleets. An example of this is that governmental agencies are forced to consider the environmental aspect in the procurement of vehicles, by purchasing electric vehicles or by using biofuels. The Swedish government is also looking at decarbonising its bus fleets. It recently launched a subsidy for electric buses used in public transport: Public transport agencies will receive up to 700,000 SEK for each electric bus and up to 350,000 SEK for each plug-in hybrid bus.²⁸

²⁷ [International Energy Agency \(2018\). Global EV Outlook.](#)

²⁸ [Natural Resources Canada \(2018\). Greening Government Fleets.](#)

Leadership Opportunities for Scotland

Table 12: State of global leading practice, relative progress in Scotland, and opportunities for Scotland for the public sector fleet vehicles segment.

ULEV Uptake		
State of global leading practice	Relative progress in ULEV uptake	Opportunity for global leadership
Good examples in places.	Medium. Transport Scotland funding has funded the electrification of public sector fleets for several years through the ‘Switched on Fleets’ programme.	High. If the 2025 target to phase out need for new petrol and diesel cars and LCVs in public fleets is met.

Table 13: Market Opportunities the public sector fleet vehicles segment.

Market Opportunity			
Vehicle (Design & Manufacture)	Supply Chain	Infrastructure	Services
Low. Scotland’s presence in the automotive market is very low. Significant investment would be required to attract businesses.	Medium. There is an opportunity for countries looking to support battery development industries. With significant investment and a supported eco-system, this is an area that Scotland could grow in. An ideal project could be initiated as part of the Michelin Scotland Innovation Parc. This would be subject to a more detailed market analysis.	Medium. There is an opportunity to lead on developing innovative charging infrastructure for taxis, particularly on-street solutions such as wireless charging and integrated charging hubs.	Low.

Scotland can set targets to electrify local authority fleets. Coupling regulation and fiscal incentives together can drive the decarbonisation of public sector fleets paving the way for the private market to follow. Dundee has led the way with the adoption of electric vehicles within its fleet with the assistance of Transport Scotland Grants.

Identification of the key recommendations for Scotland to succeed in this segment.

- Develop policy guidance to support all aspects of procurement through local and Scottish government to include measures to drive the uptake of ULEVs.

- Deliver an official exemplar city or region to focus efforts and achieve maximum international recognition.

9 Private sector fleet vehicles

Segment description

The market for cars and vans bought or leased by private or third sector organisations to be used in service provision or as pool vehicles. Some of these vehicles are kept on-street or off-street, other vehicles are kept in designated bays or car parks.

Leading practice for this segment

Leading practice in this segment involves de-risking investment for private sector fleet managers. Policy frameworks which include financial incentives for private sector fleets are an effective encouragement. Information and education programs for employees can support success.

‘Best in class’ location for this segment: Electrification of DHL fleet (Germany)

DHL is leading the charge into electrified delivery vehicles in Germany with its acquisition and integration of StreetScooter.²⁹ DHL have the goal of zero emissions by 2050. The push for zero emission delivery led the company to adopt and integrate cargo bikes for urban deliveries and eventually to purchase StreetScooter to build up its own fleet of fully electric, zero-emission delivery vehicles in 2014. By 2025, the company aims to increase its carbon efficiency by 50% compared to 2007 levels, operate 70% of its own first and last mile services with clean pick-up and delivery solutions, such as bicycles and electric vehicles, have more than 50% of its sales incorporate Green Solutions and certify 80% of its employees as GoGreen specialists. In 2019, nearly 30 percent of DHL’s new vehicles will be alternative fuel. In their experience so far, the larger vehicles do not yet have enough range for all of DHL’s needs at a price that is competitive, but that will continue to improve over time.³⁰

Leadership Opportunities for Scotland

Table 14: State of global leading practice, relative progress in Scotland, and opportunities for Scotland for the private sector fleet vehicles segment.

ULEV Uptake		
State of global leading practice	Relative progress in ULEV uptake	Opportunity for global leadership
Good examples in places.	Low.	Medium. There are opportunities to introduce incentives to target private sector fleets such as a focused information scheme like the Fleet Revolution programme deployed in the North East of England.

²⁹ [Reuters \(2019\). DHL to debut zero-emission electric delivery vans in U.S. cities.](#)

³⁰ [CleanTechnica \(2019\). DHL Express pushes into a sustainable, electrified future – Clean Technica interview.](#)

Table 15: Market Opportunities the private sector fleet vehicles segment.

Market Opportunity			
Vehicle (Design & Manufacture)	Supply Chain	Infrastructure	Services
Low. Scotland's presence in the automotive market is very low. Significant investment would be required to attract businesses.	Medium. There is an opportunity for countries looking to support battery development industries. With significant investment and a supported eco-system, this is an area that Scotland could grow in. An ideal project could be initiated as part of the Michelin Scotland Innovation Parc. This would be subject to a more detailed market analysis.	Medium. There is an opportunity to lead on developing innovative charging infrastructure for taxis, particularly on-street solutions such as wireless charging and integrated charging hubs.	Medium. MaaS has applications in the coordination and optimisation of the logistics sector. Sustained investment and support to MaaS could help Scotland to be a leader in this space.

Scotland can incentivize the electrification of private sector fleets. Regulation can be introduced to ensure that companies with many vehicles comply with an electrification pathway. Coupling regulation and fiscal incentives together can drive the decarbonisation of the private sector fleets. Private fleets such as car club schemes could support MaaS, which is a key opportunity in Scotland.

Identification of the key recommendations for Scotland to succeed in this segment.

- Deliver a series of financial incentives aimed at public sector fleets that support economic opportunities to meet the ULEV targets of 2032.
- Set guidelines and standardisation for charging hubs in Scotland to fully utilise on-site energy generation and storage, this would support adoption of ULEVs in private fleets.

10 Buses

Segment description

The market for bus and coach vehicles. This includes buses and coaches of all sizes, both public and private fleets. These would most likely park overnight in designated bays, but additional charging may be required depending on daily use and route choice.

Leading practice for this segment

There are a number of possible long-term solutions for zero-emission buses, particularly through the use of hydrogen fuel cells. As for plug-in EVs - the focus of this study - there has been limited deployment to date across Europe, with some notable exceptions such as in Eindhoven. However, in other cities there has been large scale success. Leading practice in this segment involves de-risking high capital costs. Other important factors include supporting building and locating charging infrastructure. Knowledge sharing on the optimization of logistics for charging infrastructure would support success in this segment.

‘Best in class’ location for this segment: Electric bus fleet in Shenzhen (China)

The city of Shenzhen in China was the first city in the world to fully electrify its entire bus fleet. This was completed by the end of 2017 when all 16,359 of its buses were replaced, notably without increasing the overall number of buses in the fleet.³¹

Managing the complete transition of a city’s bus fleet to electric-only has been underpinned by a long-term plan with full buy-in from all parties. To incentivise the three major bus operators in the city to make the transition, each was provided with an annual subsidy of 500,000 yuan (approximately £58,000) for each vehicle. This was made up of 400,000 yuan from the local Shenzhen authorities and 100,000 yuan from the central government in China. To be eligible for the subsidies, an electric bus must travel more than 60,000 km per year, encouraging high utilisation.³²

One of the key challenges that the bus operators had to overcome was the ability to charge all their electric buses efficiently. This was achieved by ensuring that the majority of buses were charged overnight whilst taking advantage of the lower energy tariffs. More than 80% of the electric buses that have been deployed have been supplied by BYD, a key factor in achieving bus fleet electrification was that the bus manufacturers’ headquarters are based in the city of Shenzhen.³³

The success of this project in Shenzhen has been made possible by the clear direction that was given by the central Chinese government. This was initially evident in the introduction of pilot city projects in relation to their New Energy Vehicle (NEV) programme,³⁴ then followed through by long term strategies.

Leadership Opportunities for Scotland

Table 16: State of global leading practice, relative progress in Scotland, and opportunities for Scotland for the bus vehicle segment.

ULEV Uptake		
State of global leading practice	Relative progress in ULEV uptake	Opportunity for global leadership
Good examples in places, e.g. Shenzhen and Eindhoven	Low.	Medium

³¹ [World Resources Institute \(2018\). How did Shenzhen, China build world’s largest electric bus fleet?](#)

³² [The Guardian \(2018\). Shenzhen’s silent revolution: world’s first fully electric bus fleet quietens Chinese megacity.](#)

³³ Information in this case study was provided by stakeholder interviews

³⁴ [The International Council on Clean Transportation \(2018\). China’s new energy vehicles mandate policy.](#)

Table 17: Market Opportunities the bus vehicles segment.

Market Opportunity			
Vehicle (Design & Manufacture)	Supply Chain	Infrastructure	Services
Medium. ADL (based in Larbert) made 2,500 buses last year and are in partnership with BYD in the Netherlands. This industry could grow if Scotland committed significant investment to ULEV bus deployment.	Medium. The modular design of batteries in large vehicles means opportunities for battery recycling and 2 nd life applications are applicable in this context too.	Low. These sectors require specialist charging infrastructure in many cases, which are in much more mature state of deployment elsewhere in the world.	Medium. Going forward, ULEV buses are likely to become part of integrated MaaS solutions. Sustained investment and support to MaaS could help Scotland to be a leader in this space.

Bus electrification is an opportunity for cities across Scotland. This aligns with the implementation of LEZs in urban centres. Scotland unlikely to be in a leadership position due to progress made in other countries. Costs could be high but could be a co-investment with bus companies and public transport operators if staged to align with natural turnover of vehicles.

Identification of the key recommendations for Scotland to succeed in this segment.

- Phase in regulation requiring ULEV buses and provide long term financial support for the private transport industry to make the transition.
- Implement Scotland-wide framework policies that supports EV adoption in relation to LEZs and are flexible to the differing needs in particular regions (including parking and use of bus lanes).

11 Private Sector HGVs and Large Service Vehicles

Segment description

The market for heavy goods vehicles and large service vehicles. This concerns both rigid and artic HGVs of different sizes.

Leading practice for this segment

There are a number of possible long-term solutions for zero-emission HGVs particular through the use of hydrogen fuel cells. As for plug-in EVs - the focus of this study - there has been limited deployment to date in this segment. However, to stimulate adoption in this segment it is important to reduce financial risk through adopting innovative business models. Knowledge sharing on the optimization of logistics for charging infrastructure would support success in this segment.

‘Best in class’ location for this segment: HGV development

Private sector electric HGVs are currently in their early stages of deployment, therefore it could be argued that there is no location that is the ‘world leader’ in HGV deployment. DAF is the latest lorry maker to start making pure-electric HGVs.³⁵ Mercedes-Benz began delivering its eActros truck to clients in September 2018,³⁶ and Tesla and Volvo have already confirmed they’re working on their own pure-electric cargo carriers — with Volvo claiming trials of its “VNR Electric” will begin in North America in 2020.³⁷

The DAF CF Electric will begin hauling cargo for the supermarket chain Jumbo, in The Netherlands, as part of “large-scale field test projects” before the heavy goods vehicle (HGV) enters full-scale production.

Tesla have announced the Semi is due to be released in 2020. The Semi, with the 600-mile claimed range, costs \$180,000 (£132,720 at today's rate) in the US. A lower-spec variant with a 300-mile range will be priced from \$150,000 (£110,565). Prices for diesel lorries in Britain start at about £85,000 by comparison. The Semi's energy recovery systems are claimed to be capable of recovering 98% of kinetic energy to the battery. For regular charging, the lorry can be connected to Tesla Megachargers – a new high-speed DC charging solution – that are said to add about 400 miles in 30 minutes and can be installed at origin or destination points, much like the existing Superchargers.³⁸

The key challenge in electrification of large vehicles is the size and weight of the batteries required. Manufacturers such as Denis Eagle utilize the same battery packs as electric cars (specifically Nissan Leaf car batteries), linking these packs together to form the higher capacity systems needed. Therefore, as battery technology advances with investment stemming from greater EV deployment across the globe, the capability for deployment in this sector becomes more feasible.³⁹

³⁵ [The Sunday Times \(2019\). DAF Truck’s first electric lorry delivered to supermarket chain.](#)

³⁶ [Electrek \(2018\). Mercedes-Benz delivers first 10 eActros all-electric heavy-duty trucks.](#)

³⁷ [FreightWaves \(2019\). Volvo rolls out electric “urban” trucks in Europe.](#)

³⁸ [Tesla \(2020\). Tesla Semi.](#)

³⁹ Information in this case study was provided by stakeholder interviews.

Leadership Opportunities for Scotland

Table 18: State of global leading practice, relative progress in Scotland, and opportunities for Scotland for the private sector HGVs and large service vehicles segment.

ULEV Uptake		
State of global leading practice	Relative progress in ULEV uptake	Opportunity for global leadership
Beyond a few small deployments, there is yet to substantial uptake anywhere.	n/a	Medium.

Table 19: Market Opportunities the private sector HGVs and large service vehicles segment.

Market Opportunity			
Vehicle (Design & Manufacture)	Supply Chain	Infrastructure	Services
Low. Scotland's presence in the automotive market is very low. Significant investment would be required to attract businesses.	Medium. The modular design of batteries in large vehicles means opportunities for battery recycling and 2 nd life applications are applicable in this context too.	Low. These sectors require specialist charging infrastructure in many cases, which are in much more mature state of deployment elsewhere in the world.	Low.

The Scottish Government has the opportunity to support private electrification of the private sector HGV and Large Service Vehicle fleets. Providing financial support and de-risking purchasing segment can stimulate the market. However, capital costs are still prohibitively high, as this market segment is still technologically immature.

Identification of the key recommendations for Scotland to succeed in this segment.

- Support innovative business models that can de-risk investment into HGVs and large service vehicles.
- Implement Scotland-wide framework policies that supports EV adoption in relation to LEZs and are flexible to the differing needs in particular regions (including parking and use of bus lanes).

12 Public Sector HGVs and Large Service Vehicles

Segment description

The market for heavy goods vehicles and large service vehicles. This concerns both rigid and artic HGVs of different sizes. Large service vehicles mainly concern bin lorries which can either be retrofitted to run on electricity or designed for this purpose.

Leading practice for this segment

To date there has been limited deployment in this segment. However, to stimulate adoption in this segment it is important to reduce financial risk through adopting innovative business models. Knowledge sharing on the optimization of logistics for charging infrastructure would support success in this segment.

‘Best in class’ location for this segment: Bin Lorry trial in Sheffield (UK)

Sheffield City Council is set to trial the world’s first electric bin lorries powered by the waste they have collected. The two lorries have been refitted with batteries powered by energy generated from residual waste burned at the city’s Energy Recovery Facility (ERF) in Bernard Road. The lorries’ updated engines will emit zero carbon emissions and produce no air pollution. In addition, the vehicles have regenerative braking and weigh less than normal collection vehicles, so particulate emissions from brakes and tyres will be reduced.⁴⁰

By using expertise from Sheffield-based electric vehicle firm, Magtec, which designed the battery-powered system that will drive the lorries, the aim is to provide local jobs as well as contributing to a healthier city. By putting the vehicles into service, the project will conduct a research and development scheme over two years to fully test the vehicles for durability, performance and cost effectiveness. Sheffield has been chosen for its hilly terrain as well as its unique access to the ERF.⁴¹

Note that a similar trial is currently taking place with two similar vehicles in the borough of Westminster.

Leadership Opportunities for Scotland

Table 20: State of global leading practice, relative progress in Scotland, and opportunities for Scotland for the public sector HGVs and large service vehicles segment.

ULEV Uptake		
State of global leading practice	Relative progress in ULEV uptake	Opportunity for global leadership
Beyond a few small deployments, there is yet to substantial uptake anywhere.	n/a	High.

⁴⁰ [The Guardian \(2019\) Westminster and Sheffield trial upcycled electric bin lorries.](#)

⁴¹ [MAGTEC \(2019\). Magtec launches UK’s first 7.5t electric truck.](#)

Table 21: Market Opportunities the public sector HGVs and large service vehicles segment.

Market Opportunity			
Vehicle (Design & Manufacture)	Supply Chain	Infrastructure	Services
Low. Scotland's presence in the automotive market is very low. Significant investment would be required to attract businesses.	Medium. The modular design of batteries in large vehicles means opportunities for battery recycling and 2 nd life applications are applicable in this context too.	Low. These sectors require specialist charging infrastructure in many cases, which are in much more mature state of deployment elsewhere in the world.	Low.

This is a segment at market immaturity, therefore, deployment is challenging. Large capital investment in bin lorries is possible, with high benefits for urban communities. There are a number of HDV conversion companies in Scotland that are interested in retrofitting; however, many of the companies developing HGVs and Large Service vehicles are already well established within the industry, therefore it would be challenging for Scotland to take a leading role in the development of vehicle types in this segment.

Identification of the key recommendations for Scotland to succeed in this segment.

- Provide financial assistance to Local Authorities to support the purchase of HGVs and Large service vehicles.
- Support Local Authorities in developing charging infrastructure which can support a fleet of Large EVs.