Switched On Scotland: A Roadmap to Widespread Adoption of Plug-in Vehicles

TRANSPORT SCOTLAND
CÒMHDHAIL ALBA

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Ministerial Foreword

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The Scottish Government has committed to almost complete decarbonisation of the road transport sector by 2050. That means a transformation in moving people and goods around and moving away from current dependence on fossil-fuelled vehicles. This transformation will not be easy, but it is absolutely vital.

Vital because of Scotland's ambitious climate change legislation and targets. Reducing the transport sector's contribution to greenhouse gas emissions is a priority and the latest Report on Proposals and Policies makes clear Government's ambitions.

Vital, to improve local air quality with a resultant improvement in public health and wellbeing. And, a vital component of the drive to energise Scotland's economy through opportunities for flourishing green technology industries.

Set in the context of firm commitments to wider sustainable transport policies, the major element of this transformation will be a shift towards the electrification of road transport.

This Roadmap looks specifically at electric vehicles powered entirely by batteries and at plug-in hybrid electric vehicles, collectively referred to as plug-in vehicles. These are best placed to make the most immediate impact in helping to achieve the required transformation. Other technologies, such as hydrogen fuel cell electric vehicles, will complement these in the future and many of the challenges and opportunities set out in this Roadmap will remain relevant.

Scotland's proud history as a nation of inventors and innovators is widely acknowledged, and our pioneering history in this technology is no exception:

- Around 1837, a Scotsman Robert Davidson is credited with inventing the first electric carriage, powered by non-rechargeable primary cells.
- Electric cars were being manufactured Edinburgh in 1897 by Douglas Neale.
- And in the mid-1960s, a small electric concept city car – "The Scamp" was designed by Scottish Aviation. A concept which has proved to have been well ahead of its time.

But the plug-in vehicles available today offer a standard of performance and economy that could only have been dreamed of by those pioneering designers from Scotland's past. The range of models available is increasing at pace, with most major motor manufacturers considering plug-in vehicles a key market sector.

A sustainable Scottish fleet of plug-in vehicles aligns with Scotland's investment in a renewable energy sector that is harnessing our vast natural resources, with a quarter of Europe's tidal and offshore wind potential and a tenth of its wave power, as well as the legacy of our traditional energy industries.

Excellent progress is being made towards the ambitious target for the equivalent of all of Scotland's electricity needs to come from renewables by 2020, one of the most demanding anywhere in world. The increasing availability of renewable energy in times of low consumer demand can be put to good use by storing it for use as a transport power source, making investments in renewables work even harder for the people of Scotland.

Momentum is building around the take-up of plug-in vehicles, however Government cannot do this in isolation. What is required is commitment to a shared vision through a strong partnership approach. This has already been evident in the production of this Roadmap, both at a series of workshops and through input from an EV Strategic Board of experts in their fields. Achieving the required transformation necessitates action by all stakeholders across several key areas, ranging from stimulating the growth of the early market for plug-in vehicles to the need for communications and education to promote widespread adoption.

All partners are encouraged to offer their support. The challenges ahead to revolutionise Scotland's road transport sector are great; the status quo is not a sustainable option; and the multiple benefits from the move to plug-in vehicles are very much worth the effort.

Executive Summary

This Roadmap sets out a vision that by 2050 Scottish towns, cities and communities will be free from the damaging effects of petrol and diesel fuelled vehicles. It builds on the Scottish Government's existing commitment to the almost complete decarbonisation of road transport by 2050 and establishes the ambition that, from 2040 almost all new vehicles sold will be near zero emission at the tailpipe, and that by 2030 half of all fossil-fuelled vehicles will be phased-out of urban environments across Scotland.

Analysis is presented which illustrates that electric and plug-in hybrid electric vehicles (EVs /PHEVs) will make a substantial contribution to this ambition. This will be motivated by Scotland's world-leading climate change targets and commitments to improve local air quality and noise pollution. The potential economic opportunities and the contribution of plug-in vehicles to Scotland's renewable energy targets are also recognised.

Scotland has already begun to make progress in encouraging the adoption of plug-in vehicles, supporting the early market through purchase incentives and deployment of recharging infrastructure. However, to realise the Roadmap vision will require an ambitious transformation which extends beyond what Government alone can achieve. This Roadmap draws on an extensive consultation to establish what needs to be done across all relevant stakeholders in Scotland. Figure 1 identifies a series of goals and enabling measures which are comprehensively outlined across seven key areas:

1	POLICY FRAMEWORKS	Plug-in vehicles are embedded in all relevant areas of policy and advance progress on climate change, air quality, renewables, energy security and public health.
2	MARKET DEVELOPMENT	Plug-in vehicles become more desirable than fossil-fuelled alternatives.
3	RECHARGING	Targeted, convenient and safe recharging infrastructure is deployed across Scotland to meet the changing needs of the market.
4	SUSTAINABLE TRANSPORT	Plug-in vehicles promote more sustainable transport systems rather than adding to existing problems.
5	ENERGY SYSTEMS	Scotland's electricity grid supports market growth of plug-in vehicles and is made smarter by controlled charging and distributed energy storage.
6	ECONOMIC OPPORTUNITY	Early leadership in advancing plug-in vehicles creates jobs and makes Scottish businesses more competitive.
7	COMMUNICATION & EDUCATION	Increased awareness and confidence in plug-in vehicles encourages widespread adoption.

The next steps and actions for Government to support and facilitate this change are identified throughout these seven areas. These individual actions collectively contribute to a series of cross-cutting objectives for Government to drive the necessary long-term transformations across all relevant stakeholders. Some of the key commitments under each of these objectives are summarised below.

Providing public sector leadership

- The preparation of legislation to implement a new permitted development right for off-road charge points.
- The installation of charge points at all main Government buildings.
- To replace Scottish Government vehicles with plug-in vehicles, where appropriate, as part of the ongoing vehicle replacement cycle.
- Support for public sector fleet operators to access evidence-based analysis to create new opportunities for the deployment of plug-in vehicles.

Making strategic investments

- Over £14 million of Government investment over the next two years to support work across the low carbon vehicle agenda, including further support for the Scottish Green Bus Fund.
- The deployment of rapid charge points at intervals of at least 50 miles on Scotland's primary road network to enable extended all-electric journeys.
- Support for the promotion of shared plug-in vehicles through the Developing Car Clubs in Scotland programme.

Promoting incentives

- The development of a national framework for local incentives to progress opportunities to use local planning, parking and traffic management powers to encourage adoption of plug-in vehicles.
- 100 per cent funding for the installation of home charge points.
- Funding to incentivise businesses and major employers to install workplace recharging.
- Working with partners to undertake a study into the development of a national framework for establishing low emission zones.

Mobilising key stakeholders

- The creation of multi-stakeholder groups to review the challenges and opportunities related to recharging, fleets and energy systems, and the preparation of necessary guidance and advice for public and private sector organisations.
- Continued work with energy suppliers to encourage the deployment of tariffs and technologies to manage recharging behaviours and maximise the emission reduction benefits across Scotland.

Outreach and education

- The development of an outreach and education strategy for plug-in vehicles.
- Development of a plug-in vehicle marketing campaign to raise awareness, promote incentives and communicate benefits of plug-in vehicles.
- Working with industry, Skills Development Scotland and other key stakeholders to quantify and determine the nature and demand for plug-in vehicle education and skills, reviewing and revising provision accordingly.

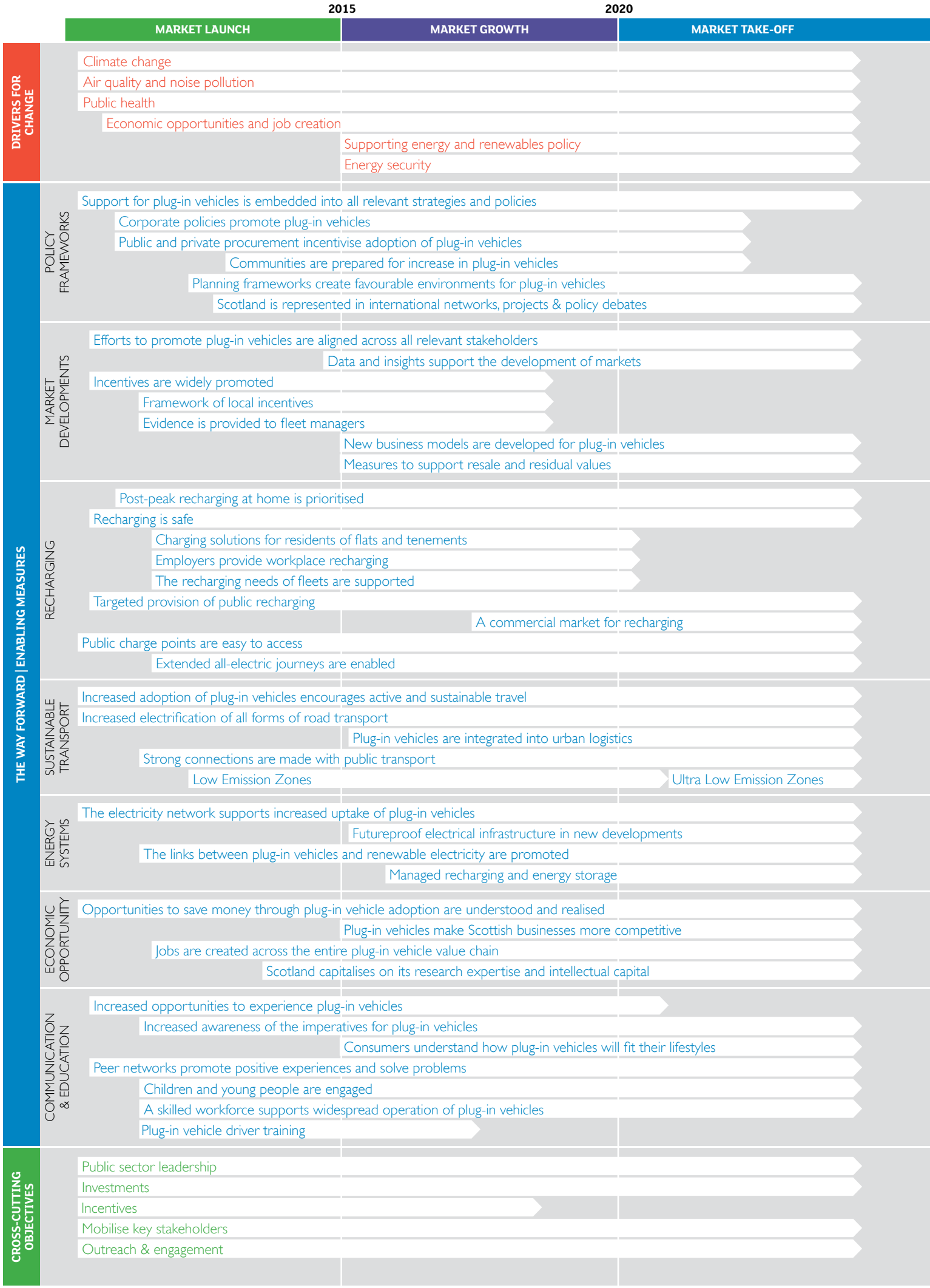

Figure 1: Overview of the goals and the key enabling measures outlined in the Roadmap

By 2050 Scottish towns, cities and communities will be free from the damaging emissions of petrol and diesel fuelled vehicles

Plug-in vehicles are embedded into all relevant areas of policy and advance goals on climate change, air quality, renewables, energy security and public health

Plug-in vehicles become more desirable than fossil-fuelled alternatives

Targeted, convenient and safe recharging infrastructure is deployed across Scotland to meet the changing needs of the market

ChargePlace Scotland
electric vehicle charging

Plug-in vehicles promote more sustainable transport systems rather than adding to existing problems

Scotland's electricity grid supports increased adoption of plug-in vehicles and is made smarter by managed recharging and distribution energy storage

Early leadership in advancing plug-in vehicles creates jobs and makes business more competitive

Increased awareness and confidence in plug-in vehicles encourages widespread adoption

Actions by all relevant stakeholders promotes awareness and incentives for adoption, as well as delivering the necessary infrastructure, skills and business models to drive long-term growth

Contents


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1 Introduction

1.1 Roadmap Purpose and Structure

This Roadmap establishes Scotland's vision for advancing electric and plug-in hybrid electric vehicles (EVs/PHEVs) and sets out the key challenges and enabling measures that will bring about this transformation.

The Roadmap commences by setting out a *Vision*, which establishes the ultimate ambition that by 2050 Scottish towns, cities and communities will be free from the damaging emissions of petrol and diesel fuelled vehicles (Chapter 2). The *Landscape* of trends and drivers are then explained, highlighting the policies that are motivating change and reviewing the progress that has been achieved to date (Chapter 3).

The following chapters then outline *The Way Forward*, providing a comprehensive overview of the factors that will influence the rate of adoption and use of plug-in vehicles. This is structured by discussion of seven key areas, for which corresponding goals are set, as well as individual actions for the Scottish Government (Chapters 4 to 11). These seven areas are shown as interlinking cogs in Figure 2, illustrating the integrated nature of these developments and highlighting the importance of sustained progress on each of these fronts.

The final chapter draws together all of the actions set in the Roadmap to provide a summary of the levers that Government will use to help drive the necessary long-term transformations across all relevant stakeholders (Chapter 12). This explains that these actions can be grouped and shown to contribute to one of the following *Cross-Cutting Objectives* for Government.

1. Providing public sector leadership
2. Making strategic investments
3. Promoting incentives
4. Mobilising key stakeholders
5. Outreach and education

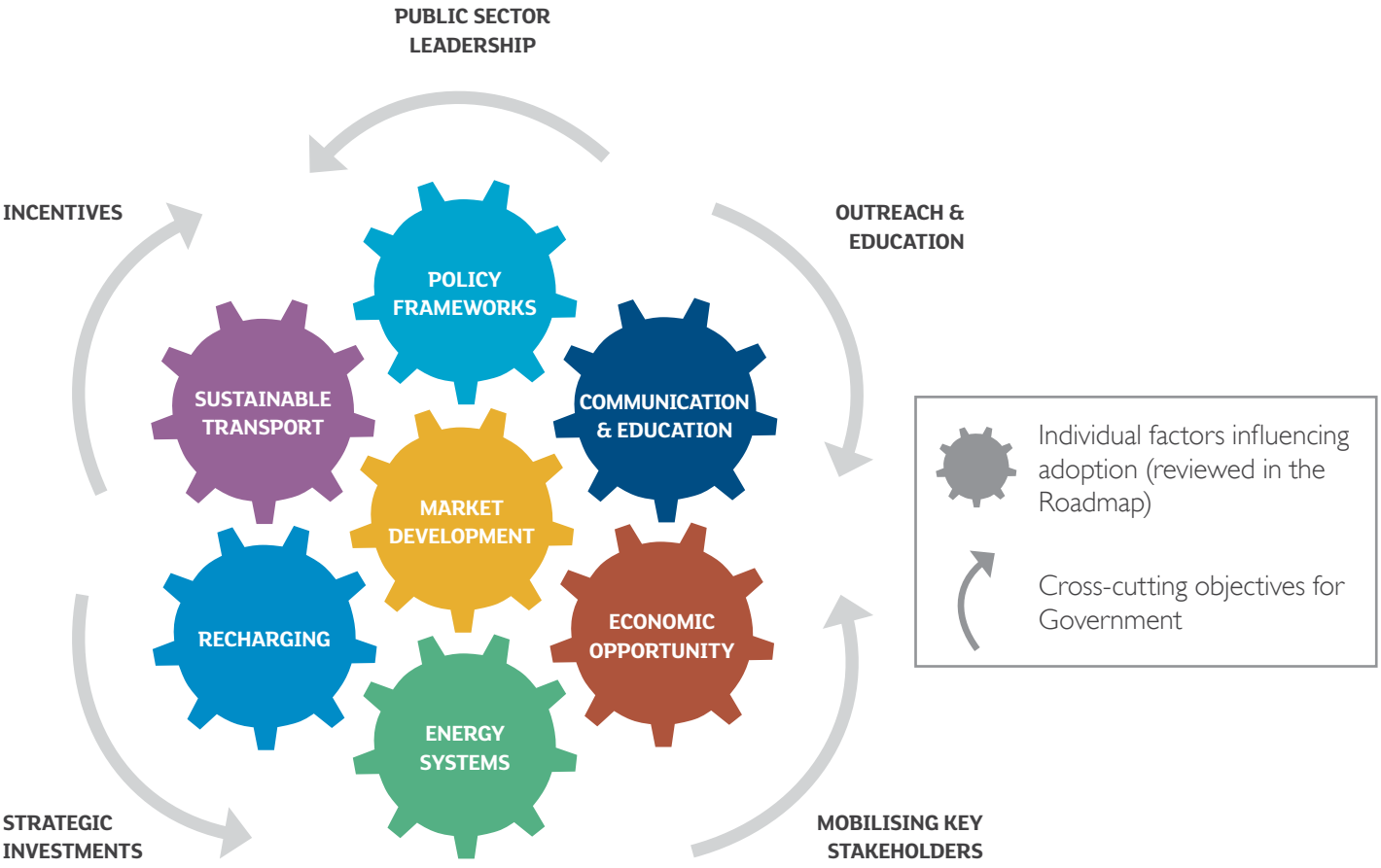

Figure 2: The cross-cutting objectives that will be used by Government to drive sustained progress in each of the seven inter-linked areas reviewed in the Roadmap

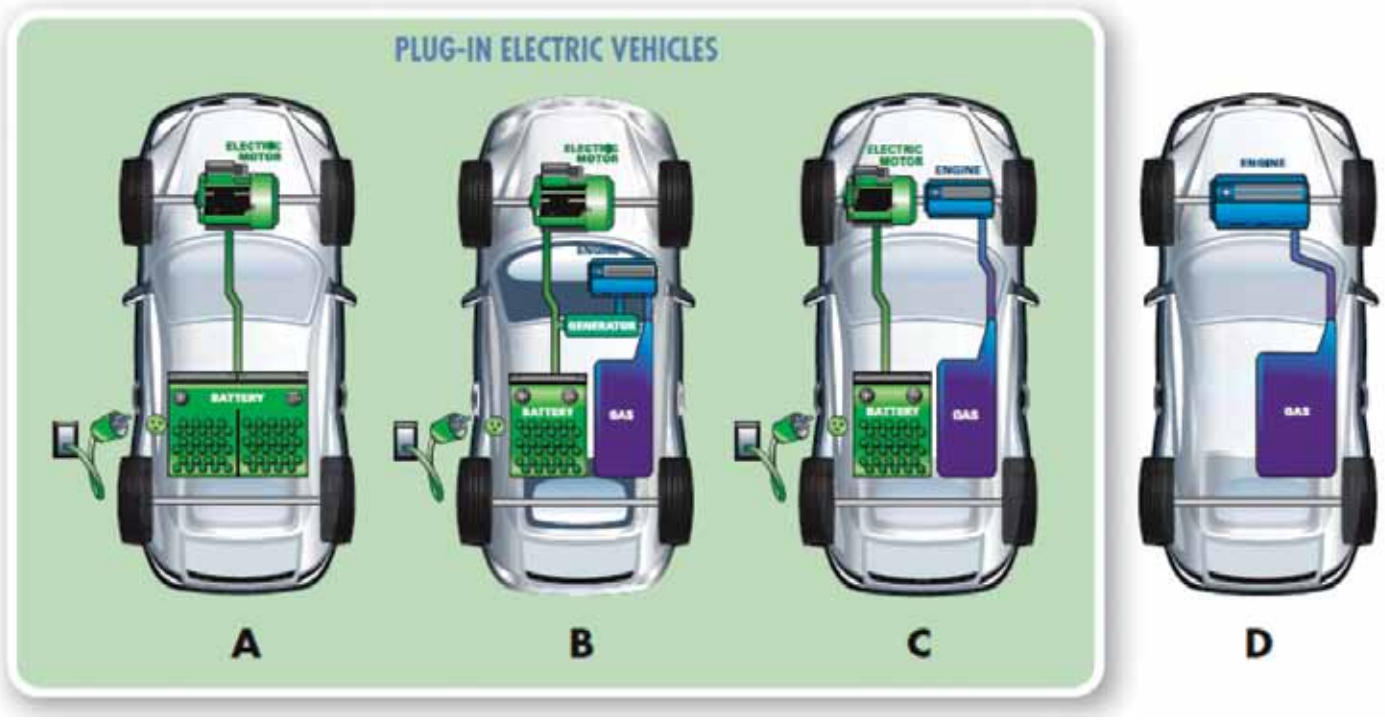

Figure 3: Plug-in vehicle configurations – (A) battery EV; (B) series plug-in hybrid; (C) parallel plug-in hybrid; and (d) internal combustion engine vehicle (source: Southern California Edison)

1.2 Roadmap Scope

The Roadmap focuses on the measures to promote the adoption and use of EVs and PHEVs, which are collectively referred to as *plug-in vehicles*.

An EV or *battery electric vehicle* runs entirely on electricity, with a rechargeable battery pack powering an electric motor as a substitute to an internal combustion engine (ICE). However, in a PHEV, an ICE is combined with a battery pack and electric motor. PHEVs can either be in a series configuration, where only the electric motor drives the wheels and the ICE acts as a back-up generator (sometimes referred to as an *extended range electric vehicle*), or *parallel* where both the ICE and electric motor can directly power the wheels. A key point is that these vehicles are able to be plugged into mains electricity, unlike a conventional hybrid which relies on regenerative braking to generate electricity.

The Roadmap considers a broad range of factors that will influence the rate of adoption and use of plug-in vehicles. This includes developments in markets, products, services and technologies, as well as the requirements for underpinning resources, capabilities and partnerships. However, emphasis is placed on the areas that can be most influenced by the Scottish Government and other key stakeholders from across the public and private sectors.

1.3 Methodology

The Roadmap is a synthesis of the outputs of four workshops held between March and December 2012 by the E-cosse partnership[1], which brought together over 120 different experts from 78 organisations. Each of these workshops assessed opportunities and challenges related to different aspects of the plug-in vehicle ecosystem and related priority actions to advance adoption and use of EVs and PHEVs[2].

A further workshop focussed on how to encourage individuals to purchase plug-in vehicles rather than fossil fuel vehicles, using the Scottish Government's ISM[3] (Individual, Social and Material) approach to influencing low carbon behaviours. The actions and key enabling measures outlined in the Roadmap are very much in line with an ISM approach to influencing behaviours, i.e. a range of co-ordinated actions which span the individual, social and material contexts.

The workshops were supplemented by additional consultation with stakeholders from across Scotland and beyond. This included detailed input from the EV Strategic Board, established as part of the E-cosse partnership, which comprises senior representatives of a number of public and private organisations with a key role in advancing plug-in vehicles in Scotland. A full list of all Board members and workshop participants is included in the Acknowledgements section of this Roadmap.

1 E-cosse , a partnership of Scottish Government, industry, WWF Scotland and other key stakeholders to advance adoption of plug-in vehicles in Scotland: www.e-cosse.net

2 Reports from the workshops are available at: http://www.e-cosse.net/downloads

3 The ISM approach recognises that communication and education is required to influence people's beliefs, attitudes and feelings about plug-in vehicles, provide easy to understand information on the costs and benefits of purchasing and driving such vehicles, as well as addressing any skills gaps (Individual). This is required to realise the benefits of investment in recharging infrastructure and incentives for purchasing plug-in vehicles (Material), as well as the efforts of stakeholder groups and opinion leaders in promoting and sharing experience in purchasing and using plug-in vehicles (Social).

2 Vision

2.1 Roadmap Vision

The following vision statement establishes the ultimate objective for the Roadmap. It builds on the Scottish Government's existing commitment to achieve almost complete decarbonisation of road transport by 2050, and emphasises that all relevant public and private stakeholders can play an active role in facilitating this transition.

By **2050**, Scottish towns, cities and communities will be free from the damaging emissions of petrol and diesel fuelled vehicles. A significant reduction in greenhouse gas emissions will be accompanied by marked improvements in local air quality, noise pollution and public health. Scotland will also enjoy increased energy security and new economic opportunities through leadership in sustainable transport and energy technologies.

A key ambition is that by **2040** almost all new car sales will be near zero emission at the tailpipe and that by **2030** half of all fossil-fuelled vehicles will be phased-out of urban environments across Scotland. Plug-in vehicles running on Scotland's abundant green electricity will make a substantial contribution to this. Electric and plug-in hybrid electric vehicles will be widely used as part of a sustainable transport system and will support progress towards a cleaner and smarter energy grid.

Actions taken in the early market up to **2020** will see increasing adoption of plug-in vehicles and establish foundations for long-term growth. This will be delivered through the commitments of all relevant public and private stakeholders and driven by increased awareness and confidence in the technology. Change will be made actionable through promotion of the opportunities and incentives for adopting plug-in vehicles, as well as developments in the necessary skills and business models.

Progress will be further supported by having a network of recharging infrastructure in place across Scotland by **2015**, which will develop to meet the needs of the market.

2.2 Outlook

As a developing market, progress towards this vision will come in three phases. As shown in Figure 4, this will see provisions made to support the *Launch*, *Growth* and *Take-off* of markets for plug-in vehicles. This requires that different strategies, support and actions are deployed over time to respond to the changing requirements of the market and to sustain adoption and use of plug-in vehicles.

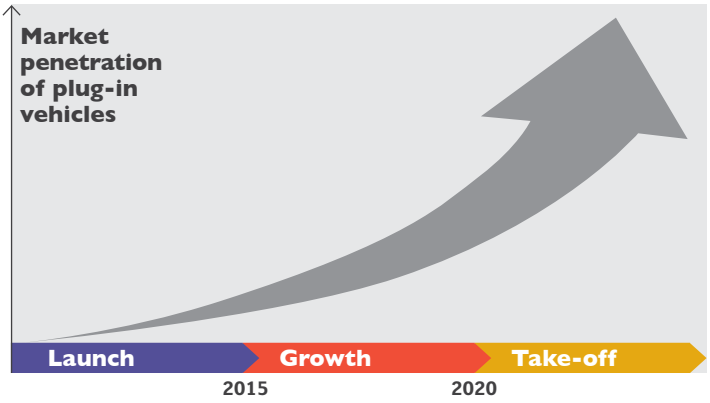

Figure 4: Three phases of market penetration of plug-in vehicles

Figure 5 outlines a market growth scenario which would achieve the Roadmap vision, and the associated vision contained in Low Carbon Scotland: Meeting the Emissions Reduction Targets 2013-2027: The Second Report on Proposals and Policies (RPP2)[4], namely almost complete decarbonisation of road transport by 2050. Under this scenario, fossil-fuels will gradually be phased-out over time, with all new car sales being near zero carbon at the tailpipe from 2040.

The scenario also shows that a mix of low emission propulsion technologies will contribute, for example hydrogen fuel cell vehicles. This reflects the Scottish Government's technology neutral position on low emission vehicle solutions. However, plug-in vehicles are

[4] Scottish Government (2013): Low Carbon Scotland: Meeting the Emissions Reduction Targets 2013-2027: The Second Report on Proposals and Policies (RPP2): http://www.scotland.gov.uk/Topics/Environment/climatechange/scotlands-action/lowcarbon/meetingthetargets

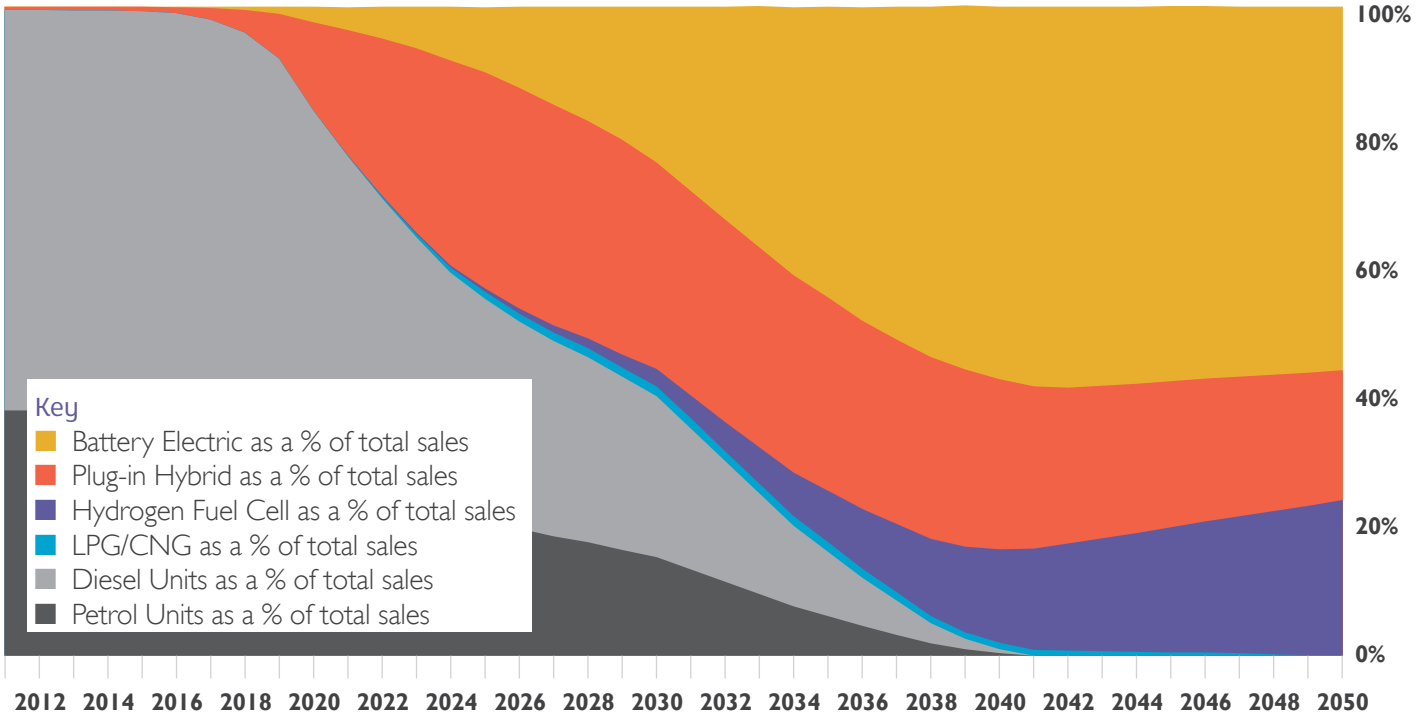

Figure 5: Outlook for new car sales in Scotland[5]

seen as the technology capable of making the most immediate impact in helping to achieve the key policy driver of Scotland's 2020 emissions reductions targets and are expected to be the majority technology for light duty vehicles in the lead up to 2050.

In the shorter term, the precise rate of growth in the use of plug-in vehicles will be influenced by a range of different factors, significantly the relative price of the vehicles and the rate at which they are brought to market. By way of reference, and as included in RPP2, the UK Committee on Climate Change suggested in 2010[6] that 16 per cent of new car sales by 2020 would need to be plug-in vehicles in order to provide critical mass for subsequent roll-out. The scenario outlined in Figure 5 would also see Scotland achieve the vision set by the European Commission in its 2011 Transport White Paper[7], which establishes a timeline of objectives to:

- Halve the use of 'conventionally-fuelled' cars in urban transport by 2030;
- Phase them out in cities by 2050;
- Achieve essentially CO_2-free city logistics in major urban centres by 2030.

5 Analysis by Transport Scotland 2013 – using outturn sales data, economic growth and population projections.

6 UK Climate Change Committee (2010): The Fourth Carbon Budget – reducing emissions through the 2020s: http://www.theccc.org.uk/publication/the-fourth-carbon-budget-reducing-emissions-through-the-2020s-2/

7 European Commission (2011) White Paper Roadmap to a Single European Transport Area – Towards a competitive and resource efficient transport system/COM/2011/0144 final/: http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2011:0144:FIN:EN:PDF

Source: Nissan

3 Landscape

3.1 Introduction

The mass introduction of plug-in vehicles to replace fossil-fuelled vehicles in Scotland has the potential to support the achievement of aims across a number of different policy areas. This section explores these areas and some of the progress to date in measures to assist the take up of plug-in vehicles in Scotland.

3.2 Drivers for Change

3.2.1 Climate Change

The Climate Change (Scotland) Act 2009[8] sets world-leading emissions reductions targets. The Act sets an interim target of a 42 per cent reduction in greenhouse gas emissions for 2020, on the way to the ultimate goal of achieving at least an 80 per cent reduction by 2050.

Transport emissions make up just over a quarter of Scotland's total emissions, with more than two thirds of these emissions coming from road transport. The Scottish Government is therefore committed to the 2050 road sector decarbonisation target identified in RPP2.

The transport chapter of RPP2 focuses on the broad approach of how to reduce emissions from transport, setting out four core packages of proposals around decarbonising vehicles; encouraging behaviour change and promoting sustainable communities; engaging with businesses around sustainable transport; and ensuring efficient use of the road network.

3.2.2 Air Quality

Reductions in emissions of air pollutants have been largely due to policies targeted at cleaner technologies and fuels. However there has been a shift in the dominant sources of air pollutants. Twenty or thirty years ago, these were industry and domestic heating, today transport is the dominant source, as well as large combustion plants, (particularly those used for power generation).

There is evidence of significant negative health effects and environmental damage caused by emissions of air pollutants. The UK Environmental Audit Committee estimated that poor air quality reduces the life expectancy of everyone in the UK by an average of seven to eight months and up to 50,000 people a year may die prematurely because of it[9].

Increased adoption of plug-in vehicles can make a significant contribution to local air quality, with a resultant improvement in public health and quality of life, whilst also helping to mitigate the possibility of multi-million pound fines from the European Commission for failing to comply with air quality legislation.

This will be particularly important in Air Quality Management Areas (AQMA) in Scotland[10] where pollutants are above acceptable levels and action plans must be produced by local authorities to outline how they intend to tackle identified issues. The Scottish Government is reviewing the Local Air Quality Management system during 2013[11], providing an opportunity to determine the important role plug-in vehicles can play in improving local air quality.

Many of the AQMA in Scotland are in city centre locations where the establishment of low or even ultra-low emission zones could be an effective mechanism to deter access for the most polluting vehicles, and incentivise the use of ultra-low emission vehicles such as EVs and PHEVs. The Scottish Government is working with local partners to assess the challenges and opportunities associated with the establishment of such zones.

8 Scottish Government (2009) Climate Change (Scotland) Act 2009: http://www.scotland.gov.uk/Topics/Environment/climatechange/scotlands-action/climatechangeact

9 Environmental Audit Committee (2010) – Fifth Report Air Quality: http://www.publications.parliament.uk/pa/cm200910/cmselect/cmenvaud/229/22902.htm

10 Air Quality in Scotland: http://www.scottishairquality.co.uk/laqm.php?a=l&la_id=i

11 Scottish Government (2013): Consultation on review of Local Air Quality Management in Scotland: http://www.scotland.gov.uk/Publications/2013/06/5955

3.2.3 Economic Opportunity

The move to widespread plug-in vehicle use in Scotland presents a significant economic opportunity for Scottish businesses involved in all aspects of the change – from the manufacturing sector to the developers of new technology and services, such as specialised software to optimise EV use in fleets. The Low Carbon Economic Strategy[12] estimates a potential market of £0.5 billion being generated around low carbon vehicles in Scotland – a huge opportunity for Scottish businesses to succeed and create quality new jobs. Companies such as Alexander Dennis, Allied Vehicles and Axeon, are already leading the way.

The expansion of Scottish-based companies to support the development of plug-in vehicles also has the potential to attract investment and employment to Scotland, building on the Scottish Government's Purpose to promote sustainable economic growth.

With their lower running and maintenance costs, switching to plug-in vehicles could provide financial savings for individuals and a competitive advantage for businesses in Scotland in the longer term. Furthermore, forward thinking businesses have an opportunity to promote their environmental values through early market adoption of plug-in vehicles and the provision of charge points.

In addition, academic institutions such as St Andrews, Strathclyde and Dundee Universities, Edinburgh College and the Transport Research Institute at Napier University have been and continue to be at the forefront of developing and testing new plug-in vehicle technology in Scotland.

3.2.4 Noise

Excessive noise created by road traffic can have a significant impact on people's daily lives. In addition to reducing general quality of life, excessive noise can damage health and harm the environment. Noise can also have economic impacts by potentially affecting tourism, learning and workplace productivity.

As plug-in vehicles make up an increasing percentage of the vehicles on our roads, their quieter operation compared to internal combustion engine-powered vehicles will mean that a major source of noise in our society will decrease.

3.2.5 Renewable Energy

The Scottish Government is committed to decarbonising the power sector. Today, over a third of the UK's total renewable electricity output comes from Scotland and there is a commitment to achieve the equivalent of 100 per cent of Scotland's electricity demand from renewables by 2020.

The abundance of green electricity in Scotland to power plug-in cars and vans will not only maximise the carbon reduction benefit of these vehicles, but also support increased generation from renewable sources. In particular, coordinating the recharging of plug-in vehicles with the fluctuating levels of generation from renewable sources will help to utilise green electricity that may not otherwise be used.

[12] Scottish Government (2010): A Low Carbon Economic Strategy for Scotland: Scotland – A Low Carbon Society: http://www.scotland.gov.uk/Publications/2010/11/15085756/0

Source: Toyota/National Theatre of Scotland

3.3 Progress to Date in Scotland

3.3.1 Plug-in Vehicle Adoption

As shown in figure 6, sales of plug-in vehicles in the early market are still relatively low, however take up has been steadily increasing in recent years.

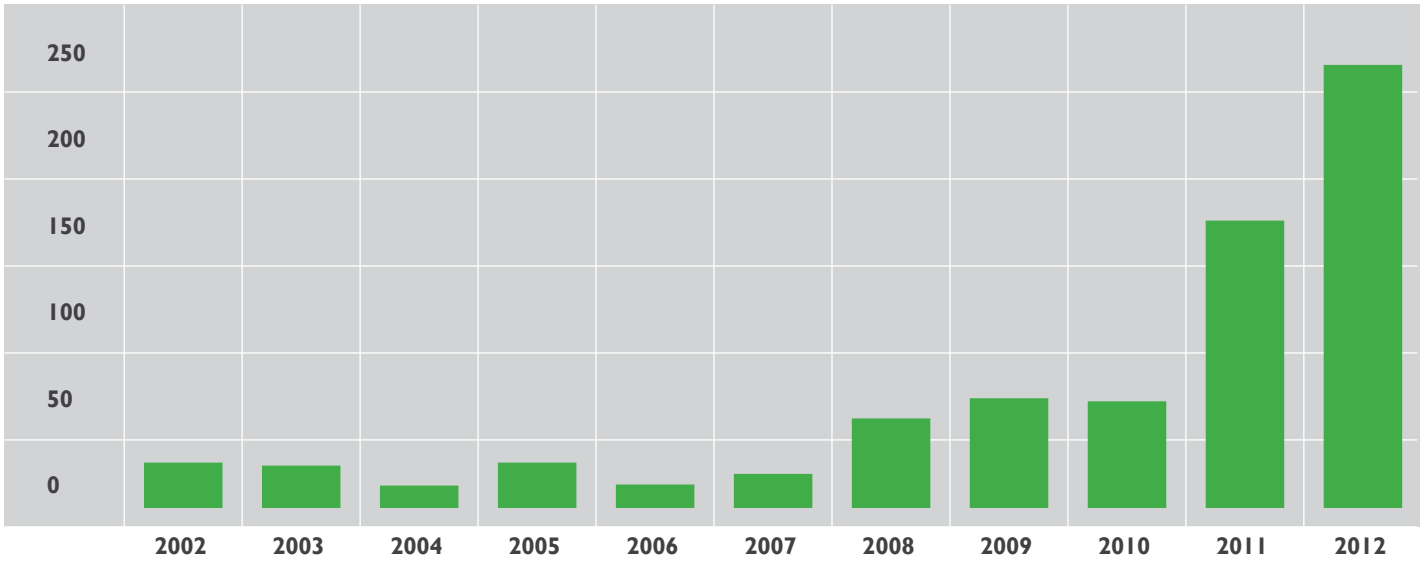

Figure 6: New vehicle registrations of electric and plug-in hybrids in Scotland[13]

3.3.2 E-cosse

In March 2012, Keith Brown MSP, the Minister for Transport & Veterans, launched E-cosse, a partnership of Scottish Government, industry, WWF Scotland and other key stakeholders to advance adoption of plug-in vehicles in Scotland.

The creation of the E-cosse partnership has facilitated engagement with a range of stakeholders from across the low emission vehicle community, which has supported the development of this Roadmap. The partnership is led by E-cosse Director Dr David Beeton.

An EV Strategic Board was established as part of the E-cosse initiative. Co-chaired by the Minister for Transport & Veterans and Gordon McGregor, Director of Energy & Environment at ScottishPower, the Board is a high-level forum of leaders from industry, Government, academia and other stakeholders to provide leadership, strengthen key policy objectives and investments in the provision and support for plug-in vehicles in Scotland. The Board has played a key role in overseeing and guiding the production of this Roadmap.

3.3.3 Low Carbon Vehicle Activity in Scotland

Transport Scotland will invest over £14 million over the next two years to take forward work across the low carbon vehicle agenda.

Through the Low Carbon Vehicle Procurement Support Scheme and membership of the Office for Low Emission Vehicles' (OLEV) Plugged in Places Scheme, Transport Scotland has already invested over £8 million in low carbon vehicles and recharging infrastructure since 2010. This has enabled Scotland's public services to purchase around 270 low carbon vehicles, including electric cars and vans and to install over 300 charging points across the country.

Transport Scotland has continued to engage with local authorities to work towards increasing the number of charge points to over 500 during 2013, with approximately 300 available to the public. Plans include the provision of rapid charging points at least every 50 miles on Scotland's primary road network, at ferry terminals and to support the use of plug-in vehicles at the Commonwealth Games in Glasgow.

Through investment provided by Transport Scotland, motorists can also apply to the Energy Saving Trust for 100 per cent funding to install a home charge point for their plug-in vehicle. Private organisations can also claim up to 100 per cent of the cost of fitting a charge point at their premises.

[13] Department for Transport vehicle licensing data (vehicles licensed for use on the road excluding mobility vehicles).

Transport Scotland has also developed and launched "ChargePlace Scotland"[14] on the GreenerScotland website to provide the public with advice on plug-in vehicles and access to a map showing charge point locations. The ChargePlace Scotland branding will also allow easy recognition of Scottish charge points.

Transport Scotland also funds the Energy Saving Trust's Low Carbon Transport Loan Fund through which Scottish-based businesses can access an interest-free loan of up to £50,000 for EVs, with a repayment term of up to 6 years.

3.3.4 Scottish Green Bus Fund

Transport Scotland has worked closely with the Scottish bus industry to promote the use of environmentally friendly low carbon buses with the aim of improving air quality and encouraging greater use of public transport. The introduction of the Scottish Green Bus Fund increases demand for low carbon buses, encouraging bus manufacturers to develop and invest in the technology and achieve economies of scale. Over time, this investment will contribute to reductions in the overall cost of producing these vehicles, improve their commercial viability and encourage investment by bus operators.

Bids to the Fund have been received from both large and small bus operators and a Regional Transport Partnership. Approved funding totalling some £7.7 million over the three rounds to date will see a total of 94 new low carbon buses introduced into the Scottish Bus Fleet. Seventy of these environmentally friendly buses are already in operation on Scotland's roads. A further 24 buses approved for funding under the latest round will come into operation by 31 March 2014.

3.3.5 Sustainable Transport

Plug-in vehicles will be a vital component in decarbonising the transport sector in Scotland, but it is important that the increased adoption of these vehicles complements other measures to promote sustainable transport. The uptake of plug-in vehicles should be as a replacement for, not additional to, petrol and diesel vehicles, thereby not increasing the total number of miles driven and adding to problems such as congestion.

Transport Scotland is investing more than £1 billion per year to encourage people to use public transport and walk and cycle more. This includes facilitating the transition to low-carbon transport through key rail projects, such as the Edinburgh-Glasgow Improvements Programme. Furthermore, the Borders Railway, scheduled to open in 2014, is expected to take 60,000 peak trips off roads in the Scottish Borders and Midlothian each year.

Bus travel is promoted by providing operators annually with £50 million of investment, which keeps down fare levels and provides support for the bus network. In addition, since 2007, the Scottish Government/Transport Scotland has invested £113 million in active travel, over £8 million in low carbon vehicles and over £9 million in freight facilities.

Furthermore, £15 million has been invested in the Smarter Choices Smarter Places project – a Scottish Government/ Transport Scotland partnership with COSLA designed to increase active travel and public transport use and tackle transport emissions in seven communities. The funding has supported a range of interventions including: improvements to walking, cycling and bus infrastructure; personal travel planning; and promotion and marketing.

Transport Scotland and key stakeholders are also committed to the shared vision that by 2020, 10 per cent of everyday journeys will be by bike. To support this, Transport Scotland published the updated Cycling Action Plan for Scotland in June 2013, which amongst other issues, highlights the need for mutual respect between all road users and better integration with public transport.

3.3.6 Car Clubs

The Developing Car Clubs in Scotland (DCCS) programme was launched in October 2010. Facilitated by Carplus and funded by Transport Scotland, the programme aims to reduce private car dependency, improve energy efficiency and support carbon reduction in transport in Scotland. Carplus is working with a range of stakeholders and providing technical and financial resources to kick-start the development of car clubs in urban and rural communities across Scotland, such as, Anstruther, Dunbar, Aberdeen and Dundee.

Car clubs can provide drivers with affordable access and invaluable experience of driving plug-in vehicles. The not-for-profit car club operator Co-wheels provides its members with access to four plug-in vehicles in Aberdeen and one plug-in vehicle in Dundee as part of a range of vehicles available for hire in each city. Through the DCCS programme Transport Scotland aims to provide continued support for the electrification of the Scottish car club network.

[14] Scottish Government – Greener Scotland: http://www.greenerscotland.org/greener-travel/electric-vehicles/chargeplace-scotland

3.3.7 Strategic Action on Air Quality

Transport Scotland has joined with SEPA to form the Scottish Transport Emissions Partnership (STEP). This group is developing a strategic approach to practical actions that will help manage the issue of poor air quality in Scotland. STEP aims to seek and share technical ideas and solutions, both to address existing AQMA and prevent further AQMA from being declared.

3.3.8 Smart, Sustainable Cities

Cities are responsible for approximately 80 per cent of the world's greenhouse gas emissions, and many suffer from areas of poor air quality. The Scottish Cities Alliance is delivering the ambitions set out in the Government's Agenda for Cities, published in December 2011. It is focusing on attracting new investment into the cities and creating the conditions to promote economic growth in cities and their regions to benefit the whole Scottish economy. A key theme is making Scotland's cities more sustainable and the Alliance includes low carbon transport amongst its workstreams.

3.3.9 2020 Transport Sub Group

Transport Scotland supports the work of the 2020 Climate Group's Transportation Sub-Group. This is a collection of businesses and organisations whose remit is 'to help reduce carbon emissions from transport in Scotland by helping ensure all organisations have access to relevant information that allows them to make the right behavioural or technology choices to reduce their carbon footprint and to inspire them to make positive change'.

The group has set a 2020 Transport Challenge which requires signatories to pledge action on four topics, including one of 'promoting the uptake of electric vehicles – to trial one or more of a range of electric vehicles for commercial use at almost no cost'. Transport Scotland has signed up to this Challenge and is working with the group to encourage other organisations to join.

3.3.10 Scottish Government Fleet

The Scottish Government has a number of low emission diesel and electric vehicles within the core fleet. The Government is committed to greening the fleet as far as possible and will, as part of the ongoing vehicle replacement cycle, replace fossil-fuelled vehicles with plug-in vehicles, where appropriate.

Source: Dundee City Council

4 The way forward

4.1 Realising Scotland's Ambition

Achieving the Roadmap vision requires an ambitious long-term transformation that extends to 2050. The following chapters set out the important changes that will need to occur for towns, cities and communities across Scotland to be free from the damaging emissions of petrol and diesel fuelled vehicles.

This has been informed by a series of workshops and consultations that were undertaken by the E-cosse partnership. The workshops brought together a wide range of stakeholders to identify the barriers that need to be overcome, as set out in Table 1, and the measures that will enable this change. This process established that progress is needed in seven key areas, for which corresponding goals have been set.

The following chapters outline the important developments identified in the consultation which would enable Government and wider stakeholders to achieve these seven goals. In addition to describing these necessary long-term changes, each section also identifies short-term actions that the Scottish Government will take to help enable this change. Chapter 12, explains how these short-term actions can be grouped and shown to contribute to cross-cutting objectives for Government to guide long-term progress.

1	POLICY FRAMEWORKS	Plug-in vehicles are embedded in all relevant areas of policy and advance progress on climate change, air quality, renewables, energy security and public health.
2	MARKET DEVELOPMENT	Plug-in vehicles become more desirable than fossil-fuelled alternatives.
3	RECHARGING	Targeted, convenient and safe recharging infrastructure is deployed across Scotland to meet the changing needs of the market.
4	SUSTAINABLE TRANSPORT	Plug-in vehicles promote more sustainable transport systems rather than adding to existing problems.
5	ENERGY SYSTEMS	Scotland's electricity grid supports market growth of plug-in vehicles and is made smarter by controlled charging and distributed energy storage.
6	ECONOMIC OPPORTUNITY	Early leadership in advancing plug-in vehicles creates jobs and makes Scottish businesses more competitive.
7	COMMUNICATION & EDUCATION	Increased awareness and confidence in plug-in vehicles encourages widespread adoption.

Table 1: Key barriers to plug-in vehicle adoption

Barrier	Description
High purchase cost	EVs and PHEVs retail at higher prices than comparable ICE models.
Limited range of EVs and range anxiety	Drivers place a high utility on the ability to drive long distances, even if such trips are rare.
Availability of recharging infrastructure	Perceptions of the public recharging infrastructure network, the time required to recharge and issues associated with 'range anxiety'.
Ability to value whole-life running costs of vehicles	Consumers mainly concentrate on the purchase price as opposed to the whole-life benefits such as lower maintenance and fuel costs.
Residual value	Uncertainty about the extent to which EVs will retain their value for resale and the effects of depreciation of batteries.
Lack of public awareness and knowledge	The current level of public awareness and knowledge of EVs is low, with the average consumer having little understanding about their operation, driving experience and potential benefits. Furthermore, improvements in EV performance and efficiency are only of use if consumers are aware of them.
Aversion to new technology	Consumers can be cautious and prefer familiar and trusted technologies.
Performance and choice of vehicles	EVs will possibly not be suitable for all applications and there is a limited choice in the early market for consumers.
Lifespan of batteries	Questions about the longevity of batteries, how this will affect performance and residual value.
Capacity of local distribution networks	Large numbers of drivers recharging at similar times will place significant pressure on the local electricity distribution network.
Backing the wrong technology	Perceptions that EVs may ultimately be superseded by other technologies such as hydrogen fuel cell vehicles.
Green credentials	The carbon intensity of electricity generation, concerns about the whole-life impact of EVs and the sustainability of materials required for battery production.
Lack of allocated parking for domestic recharging	The ability to recharge an EV at home is dependent on the availability of allocated and ideally off-street parking.
Lack of aftersales support networks	Uncertainty about the availability of support and necessary skills at dealerships, garages and breakdown services.
Business models	The long-term commercial viability of business models associated with the provision of EVs and recharging infrastructure.
Risk of lack of standardisation and interoperability	The lack of common standards for plugs, sockets, access keys and ICT systems could impact the confidence of consumers and manufacturers.
End of life of batteries	The capital and environmental cost of disposing of batteries once they have reached the end of their natural life.


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5 Policy frameworks

The Scottish Government, the wider public sector and industry decision-makers will all individually and collectively need to establish the necessary policy frameworks to both guide and accelerate the widespread adoption of plug-in vehicles. Embedding plug-in vehicles into relevant national, local and organisational policies and strategies will motivate the required support, funding and commitments to change. It will also help to realise the full potential for plug-in vehicles to contribute to advances in related policy objectives.

5.1 Support for plug-in vehicles is embedded into all relevant strategies and policies

As the benefits of advancing plug-in vehicles span a number of different policy areas, support will be required across the Scottish Government, local authorities and the wider public sector. Specifically, all responsible departments and agencies across the public sector should be encouraged to embed relevant commitments to advance plug-in vehicles in their respective policy instruments and strategies. This includes, but is not restricted to, climate change, air quality, environmental protection, health, education, planning, taxation, economic development, renewables and energy security.

Action 1	Transport Scotland to continue to engage with colleagues across Government and the wider public sector to promote the inclusion of plug-in vehicles in relevant policies and strategies	Ongoing

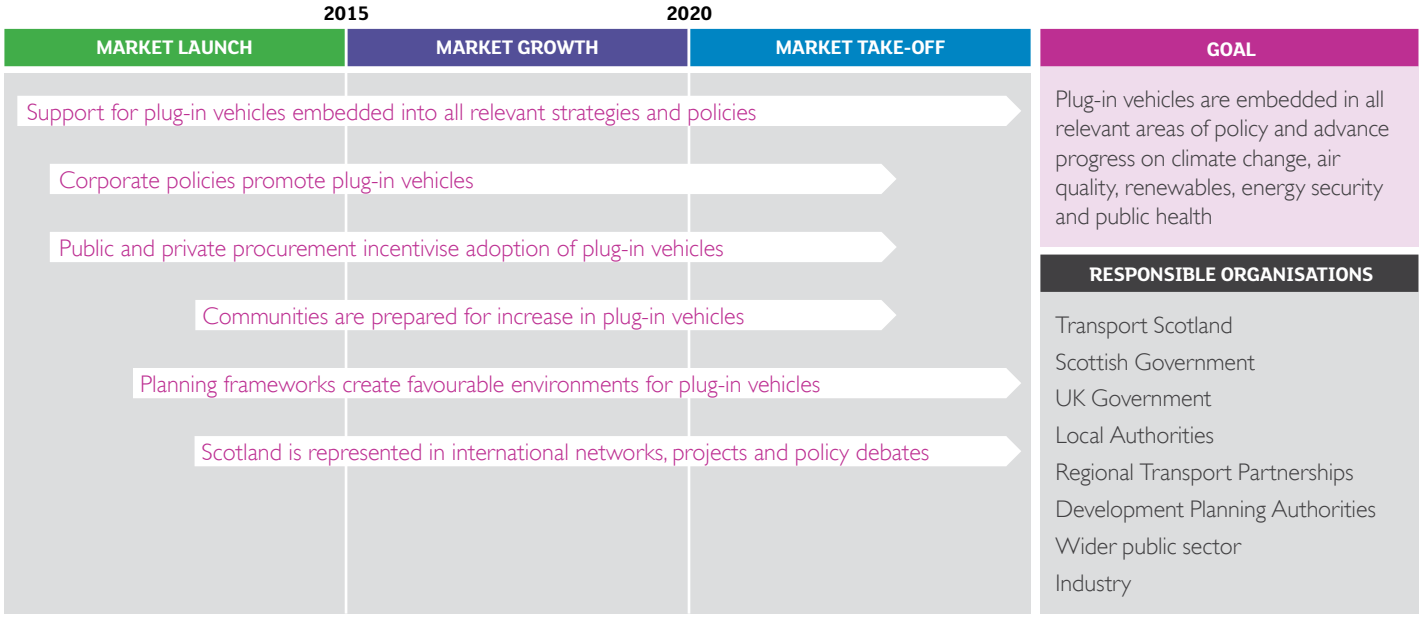


Figure 7: Policy frameworks timeline of key developments and enabling measures

Through the RPP and RPP2, the Scottish Government has already made progress in quantifying the climate change imperatives for reducing road transport emissions. Further analysis will be needed to support polices based on air quality, noise pollution and energy security. In addition, quantifying the potential economic opportunities and the role of plug-in vehicles in supporting Scotland's renewable energy policies will further strengthen commitments to accelerating market adoption.

This will be supported by a robust evidence base and clear statements on the potential for EVs and PHEVs to contribute to all relevant policy goals. These statements should be directly related to existing legally binding targets for carbon reduction and health-based EU limit values and domestic objectives for air pollutants from road transport. They should also establish a clear economic rationale, quantifying the associated costs to the environment, human health and taxpayers that would result if compliance is not achieved.

Action 2	Transport Scotland to review the existing evidence base and identify needs for new research or data to support the development of policies which impact on plug-in vehicles, such as air quality, health and energy	Ongoing
Action 3	Scottish Government to determine the role plug-in vehicles can play in Air Quality Action Plans as part of the review of Local Air Quality Management in Scotland	2013-14

5.2 Corporate policies promote plug-in vehicles

Corporate policies and practices across the public and private sector will need to make provision to promote plug-in vehicles as part of the wider agendas for sustainable transport and energy efficiency.

Many organisations in Scotland have initiated environmental management systems and sustainability policies and should be encouraged to consider opportunities to use these frameworks to promote plug-in vehicles. The link between air pollution from road transport and public health is also likely to be an important motivation. In particular, organisations whose mission and brand are focused on improving health or the environment should be encouraged to consider the impacts of their transport operations and the imperatives for adopting low emission vehicles.

Action 4	Scottish Government, as part of ongoing vehicle replacement cycle, to replace fossil-fuelled vehicles with plug-in vehicles, where appropriate	Ongoing
Action 5	Transport Scotland to work with Energy Saving Trust and other stakeholders to prepare guidance on the actions that can be taken to promote plug-in vehicles	2013-14

CASE STUDY:
INVESTMENTS IN ELECTRIC VEHICLES AT DUNDEE CITY COUNCIL

Plug-in vehicles are a vital part of Dundee City Council's plans for a modern and efficient fleet, delivering carbon reduction targets and placing Dundee at the forefront of developing a national infrastructure and creating a cleaner, healthier city. Through a strategic and focused approach the Council has become a public sector early adopter of plug-in vehicles and has worked closely with partners to provide investment that has delivered real savings as well as benefits to the environment by improving air quality, cutting emissions and reducing noise pollution.

In summer 2013, Dundee had 39 plug-in vehicles on the road, with a mixture of cars and vans which are used across many disciplines from corporate laundry, joiners, painters, supervisors and pool cars. This is supported by an increasing recharging infrastructure which currently includes two rapid chargers (with this number set to increase to four in the near future).

Dundee has already opened up their charge points to the public through working closely with the Electric Vehicle Association Scotland and its members. The points will also be connected to Transport Scotland's "ChargePlace Scotland" Pay-As-You-Go network, which is being rolled out in 2013/14.

The next stage for Dundee City Council is to fully maximise the use of the vehicles and ensure that the Council meets a target of 300,000 miles per year travelled in them. This will be achieved by ensuring full utilisation through a central booking facility and extending the use of the vehicles by working with out-of-hours services and taking full advantage of the rapid charging facilities.

5.3 Public and private procurement incentivise adoption of plug-in vehicles

Procurement policies can support adoption of plug-in vehicles. This applies across the public and private sector. Procurement should balance the environmental and social aspects of vehicles as well as considering value for money on a whole-life basis. This should extend across supply chains, with organisations working with suppliers to reduce emissions. For the public sector, such opportunities are currently framed in The Public Contracts (Scotland) Regulations 2012[15] and The Cleaner Road Transport Vehicles (Scotland) Regulations 2010[16].

Collaboration between organisations will also offer considerable benefit in leasing and buying plug-in vehicles. This has already proven to be the case in the public sector, with the Low Carbon Vehicle Procurement Support Scheme enabling Scotland's community planning partnerships (CPPs) to access Transport Scotland funding for plug-in vehicles and recharging infrastructure on behalf of local authorities, emergency services, health trusts, national parks and other public contracting authorities.

To support this process, best practice should be shared amongst the procurement community. CPPs and fleets will also further benefit from additional support to plan for and enact cost-effective procurement of plug-in vehicles.

Action 6	Transport Scotland to establish a multi-stakeholder group on fleets to review the challenges and opportunities for wider adoption and prepare necessary guidance and advice for public and private sector organisations	2013-14

[15] The Public Contracts (Scotland) Regulations 2012: http://www.legislation.gov.uk/ssi/2012/88/made
[16] The Cleaner Road Transport Vehicles (Scotland) Regulations 2010: http://www.legislation.gov.uk/ssi/2010/390/made

5.4 Communities are prepared for increased adoption of plug-in vehicles

Many of the policy levers and practical challenges to support plug-in vehicle adoption are local rather than national. This places towns, cities and communities at the frontline of efforts to deploy recharging infrastructure, initiate local incentives and other practical measures to support plug-in vehicle adoption.

A key consideration is that the imperatives and opportunities to support plug-in vehicles are different across Scotland and potential developments will necessarily relate to local circumstances. For example, while cities such as Glasgow and Edinburgh are motivated to improve urban air quality, it is likely that a rural community in the Highlands would be more attracted to opportunities to promote tourism. Moreover, it is also necessary that the needs of both urban and rural communities are understood and supported to realise the potential benefits of advancing plug-in vehicle adoption across the whole of Scotland.

It is therefore essential that local stakeholders are given the necessary support and encouragement to advance plug-in vehicles. Building on the network developed by the Low Carbon Vehicle Procurement Support Scheme, local authorities, CPPs and other local champions would benefit from appropriate guidance and assistance to develop and implement plans to establish favourable conditions for plug-in vehicle adoption.

It would be helpful for key players such as the Scottish Cities Alliance and relevant community planning partners to work towards identifying opportunities for promotion of plug-in vehicle uptake both within and between Scottish cities. This could be in the form of demonstration projects, accelerating infrastructure or linking to smarter city initiatives.

It is also important that plug-in vehicles complement existing Scottish Government commitments for safer road travel and further reductions in the number of fatalities and injuries on Scotland's roads. Plug-in vehicles are quieter than fossil-fuelled vehicles which has raised some concerns that they may pose a risk to pedestrians, especially the visually impaired. Powers to introduce a requirement for plug-in vehicles to carry safety devices are currently reserved to the UK Government, and the issue is under discussion at a European Commission level. The Scottish Government will continue to liaise with the UK Government as these discussions progress.

Action 5	Transport Scotland to work with Energy Saving Trust and other stakeholders to prepare guidance on the actions that can be taken to promote plug-in vehicles	2013-14

5.5 Planning frameworks create favourable environments for plug-in vehicles

Scotland's planning system offers important opportunities to promote the provision of recharging infrastructure. For example, the introduction of permitted development rights for off-road charge points will simplify and expedite the process for installation of infrastructure by removing the requirement to apply for approval from a planning authority. Furthermore, planning authorities should be encouraged to adopt policies that request plug-in vehicle recharging infrastructure be incorporated into new domestic and commercial developments.

Planning policy also influences where people live, work and travel for leisure activities. Accordingly, for out-of-town residential and commercial developments, consideration should be given to the resulting travel patterns and whether these are aligned with Scotland's ambitions to promote plug-in vehicle adoption and decarbonise road transport.

Action 7	Scottish Government to prepare legislation to implement a new permitted development right for off-road charge points	2013-14

5.6 Scotland is represented in international networks, projects and policy debates

A number of European and international networks have been established to disseminate emerging best practice and collaboratively solve problems associated with advancing plug-in vehicles and supporting infrastructure. Engaging with these networks provides the opportunity to access valuable experience and expertise. It will also serve to promote Scotland in the international community and attract further funding for initiatives to encourage adoption of plug-in vehicles.

A key area for engagement is the development of standards for recharging infrastructure. These standards are largely being driven by industry and are being coordinated at the European level. The Scottish Government can offer any necessary support to this process and secure the best interests of plug-in vehicle drivers in Scotland.

Action 8	Scottish Government and its partners to continue to engage with international plug-in vehicle networks and projects to attract funding and support policy debates	Ongoing

Source: Raymond Okoński


THE
FLEET
EVENT
FOR
SCOTLAND

6 Market development

The transition from early to mainstream markets represents a considerable challenge. Past experience of introducing new technologies to the market has shown that strategies to promote EVs and PHEVs need to respond to the requirements of different consumer groups beyond early-adopters. Promoting mainstream adoption requires a move away from the historical emphasis on pilots and trials. This creates a perception that EVs are a novel, niche or experimental technology. Strategies now need to be focused on supporting commercialisation and stimulating market growth. The ultimate objective is to promote plug-in vehicles as more desirable than fossil-fuelled alternatives.

6.1 Efforts to promote plug-in vehicles are aligned across all relevant stakeholders

The Scottish Government recognises its key role in co-ordinating the launch and ramp-up of plug-in vehicles. This is essentially a process of aligning the efforts of the various stakeholders involved, including: the automotive industry, electric utilities, local authorities, NGOs and academic researchers. Increased co-ordination and communication between stakeholders is seen as crucial in helping to facilitate a quick and smooth market uptake of EVs and PHEVs.

Action 9	Transport Scotland to continue to co-ordinate partnership working and promote communication across the plug-in vehicle stakeholder community	Ongoing

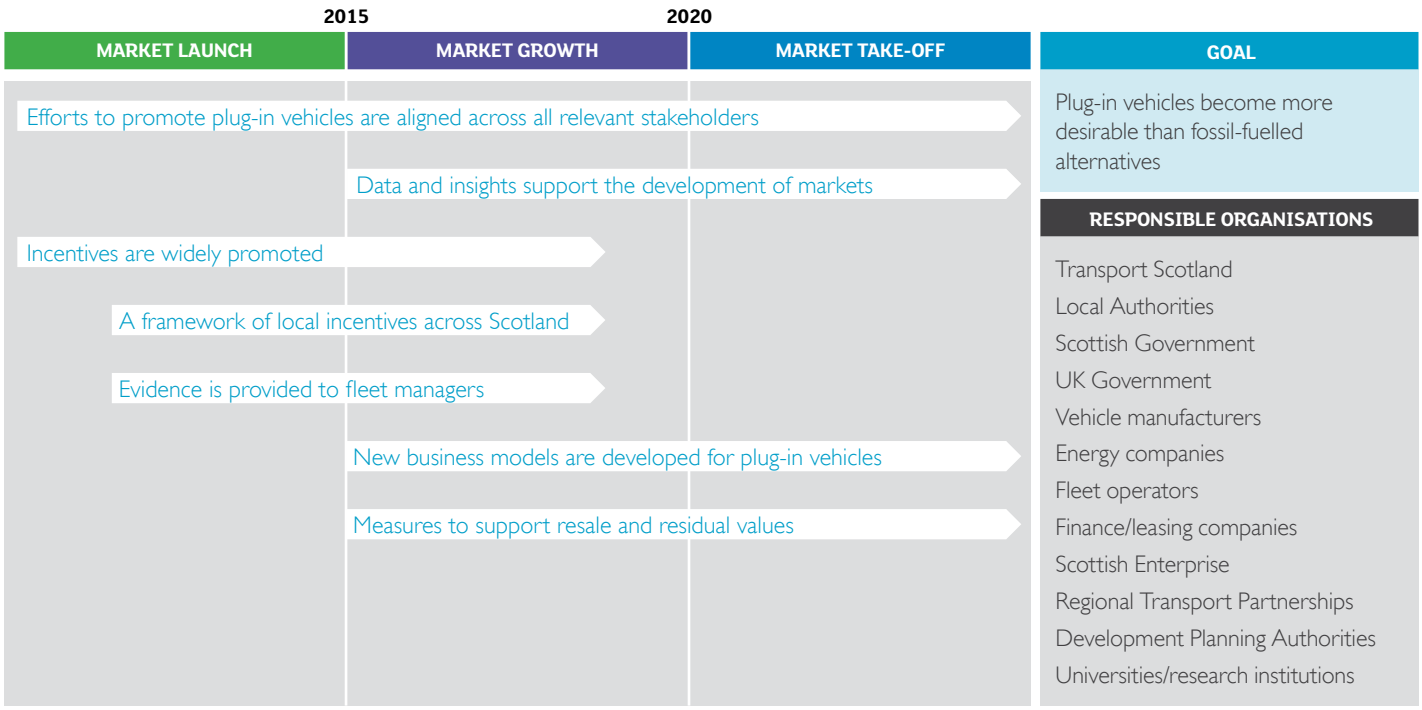


Figure 8: Market development timeline of key developments and enabling measures

6.2 Data and insights support the development of mainstream markets

A comprehensive understanding of the needs, behaviours and preferences of different consumers will be fundamental in realising the market potential of plug-in vehicles and in identifying opportunities for private sector investment.

The changing needs of consumers should be prominent in all efforts to advance plug-in vehicles. This can be supported by involving plug-in vehicle drivers in the planning processes of Government and industry. In particular, lines of communication that allow early adopters to provide feedback will help optimise the provision of recharging and other plug-in vehicle related services.

The collation and analysis of data on markets and consumer behaviour will also provide valuable insights. For example, demographics and daily driving distances will enable identification of potential early adopters and help characterise the needs of mainstream consumers. In addition, data collected from Plugged in Places and in trials of EVs and PHEVs across Scotland will provide insights into driving and recharging behaviours.

By working together, industry, Government and the wider public sector can assemble quality data on markets and consumer behaviours to establish metrics for market potential. Making this data publicly available will highlight emerging opportunities for investment.

Action 10	Transport Scotland to work with OLEV to share data and insights from the Plugged in Places project	2013-14
Action 2	Transport Scotland to review the existing evidence base and identify needs for new research or data to support the development of policies which impact on plug-in vehicles, such as air quality, health and energy	Ongoing

Source: Edinburgh College

CASE STUDY:
EDINBURGH COLLEGE
eCAR PROJECT

In 2011, Jewel & Esk College and Stevenson College embarked on a project with the support of SEStran and other partners to acquire and operate a small fleet of plug-in vehicles with the aim of evaluating them from a real-life user's perspective, and integrating their technology with the curriculum for the benefit of students.

Starting with four cars, the vehicles were used for intra-campus transport and other journeys that would have normally been carried out in staff members' own cars – the so called 'grey fleet'. To provide necessary infrastructure to support the operation of the plug-in vehicles, college students planned, designed and manufactured 3kW, single-phase charging posts which were then installed at each campus.

College staff also designed and developed a system to manage eCar bookings and administer the vehicle activity. It is now a college-wide database with well over 300 registered staff users. The vehicles have proved popular with the staff, in many cases positively changing people's opinion of plug-in vehicles.

The use of the vehicles is monitored through the booking system plus GPS tracking units that each car is fitted with. These come courtesy of 'www.TrackYou.co.uk' and allow vehicles to be tracked in real-time, create monthly reports on the mileage travelled, the number of trips, and longest trip each month.

The eCar Project was a success from the outset and expanded in 2012, as the separate colleges merged to become Edinburgh College. More vehicles were added and now the college operates a fleet of six plug-in vehicles plus monitor the data for another four operated by East Lothian Council.

6.3 Incentives are widely promoted to encourage plug-in vehicle adoption

The Scottish and UK Governments already have a number of incentives in place to reduce the cost of purchasing plug-in vehicles and installing recharging infrastructure. This includes purchase grants, fiscal incentives, and local benefits such as the provision of free electricity or parking.

All of these incentives are currently planned to run until 2015, and the Scottish Government will continue to work with the UK Government to assess the future provision of incentives and the most effective way to support the developing markets for plug-in vehicles. This will include participation in OLEV's 'call for evidence' to inform the development of a package of support, including incentives, as set out in 'Driving the future today: a strategy for ultra low emission vehicles in the UK', which was published in September 2013.

To maximise the influence of these measures, it is essential that they are promoted to as wide an audience as possible, with the associated benefits and opportunities clearly explained. Education and outreach activities are required to connect with individuals and organisations across Scotland to ensure that every potential plug-in vehicle buyer is aware and takes advantage of these incentives.

Action 11	Scottish Government to develop a plug-in vehicle marketing campaign as part of wider Greener Scotland activity, to raise awareness, promote incentives and communicate benefits of plug-in vehicles	2013-14
Action 12	Energy Saving Trust to continue to promote its support for Scottish businesses to adopt plug-in vehicles through EV Awareness Raising Workshops, Sustainable Transport Advice Service and Interest Free Low Carbon Transport Loans and FuelGood driver training	Ongoing
Action 13	Scottish Government to work with the UK Government to assess the future provision of incentives and the most effective way to support the developing markets for plug-in vehicles	Ongoing

6.4 A framework to implement and align local incentives across Scotland

Local authorities and development planning authorities have a range of planning, parking and traffic management powers that could help promote the use of plug-in vehicles. Such local incentives could ultimately make it more convenient and cost effective to use an EV or PHEV. This includes the provision of preferential or free parking, free electricity for recharging and access to bus lanes or high-occupancy lanes.

Glasgow City Council is set to become one of the first local authorities in the UK to implement such measures, with a planned trial to offer free parking for plug-in vehicles at a number of on-street locations in the city centre.

Providing access to bus lanes is perceived to offer a potential advantage of reducing journey times for plug-in vehicle drivers. This, however, is a complex area and initial discussions have identified concerns amongst local authorities relating to the potential impact to bus networks and difficulties with enforcement. It is therefore recommended that local authorities are supported in further assessing opportunities to implement such policies through provision of necessary analysis, data and advice.

An overarching objective is that local incentives across Scotland are coherent and coordinated. A patchwork of measures in different local authority areas that change across boundaries will be confusing to the public and will be less effective in stimulating plug-in vehicle markets. To avoid this, a national framework for local incentives would provide local authorities with necessary analysis, data and advice to support in the planning and implementation of measures and help to ensure alignment across regions.

Action 14	Transport Scotland to work with local authorities, planning authorities and COSLA to develop a national framework for local incentives	2014-15

6.5 Evidence is provided to fleet managers to support investments

More than half of all new cars in the UK are bought by fleets[17]. Engaging with fleet decision-makers is therefore an important requirement in achieving mainstream adoption of plug-in vehicles. Positive experiences of driving plug-in vehicles in the workplace will also help accelerate deployment amongst private consumers.

Integrating plug-in vehicles into fleets offers organisations opportunities to achieve real financial, operational and reputational benefits. Quantifying these opportunities is central to advancing fleet adoption of EVs and PHEVs.

In the short term, organisations may gain some marketing capital from purchasing plug-in vehicles. However, achieving mainstream adoption requires identification of the most practical applications of these vehicles. This necessitates a planned and evidence-based approach to establish how plug-in vehicles can satisfy operational requirements and deliver real benefits to fleets.

The ability to adopt a plug-in vehicle will largely depend on how the vehicles are used by an organisation. Operational analysis and route scheduling is used by fleet operators to increase revenues, reduce emissions and save money. It can also be used to create new opportunities for plug-in vehicles. Instead of judging plug-in vehicles as a like-for-like replacement for fossil-fuelled equivalents, fleet managers should be encouraged to change the way that they operate vehicles to optimise efficiencies and create a broader base of applications for EVs and PHEVs.

[17] Energy Saving Trust (2013) Plugged in Fleets Initiative: Charging Forward: http://www.energysavingtrust.org.uk/Publications2/Transport-fleets/Guides-and-information/Plugged-in-Fleets-Initiative-charging-forward

The public sector can show leadership here by helping to build demand in the early market. A number of public sector fleets in Scotland have made good progress in lowering their average emissions and there are opportunities to sustain and broaden this progress by providing expert analysis and guidance on how plug-in vehicles can be introduced into fleets and save organisations money. Fleet analysis could also change operational policy on vehicles by targeting the grey fleet. This is where employees travel for business in their own cars and are reimbursed at approved mileage rates. Many organisations substitute this mileage with pool car provision, which could potentially be a promising area for plug-in vehicles as the calculated cost per mile is likely to be competitive with privately run vehicles.

Purchase price is currently the biggest factor for buyers of fleet vehicles. However, the costs of owning an EV or PHEV are very different to those associated with a fossil-fuelled vehicle. For example, while the upfront capital costs (purchase price) tend to be higher for a plug-in vehicle than a petrol and diesel equivalent, running costs (fuel, maintenance, car tax) tend to be lower. Accordingly, in determining viable opportunities for adoption of plug-in vehicles, there is an imperative to encourage valuations based on the whole-life costs.

Action 15	Transport Scotland to provide funding and work with partners to support evidence-based analysis of public sector fleets to create new opportunities for the deployment of plug-in vehicles	2013-15
Action 5	Transport Scotland to work with Energy Saving Trust and other stakeholders to prepare guidance on the actions that can be taken to promote plug-in vehicles	2013-14

CASE STUDY:
SOFTWARE TO OPTIMISE OPPORTUNITIES FOR PLUG-IN VEHICLES IN FLEETS

Livingston based Route Monkey develop and sell software that optimises the use of fleet vehicles through complex algorithms and inputs which are set to match the requirements of a fleet manager. The Route Monkey software was developed originally around the unique requirements of plug-in vehicles which are range, charging rates and duty cycles. The software focuses on getting the best from the vehicle in terms of energy consumption and then planning in charging opportunities whether they are the main overnight charge or a short top-up charge during the working day to ensure the duty cycle can be met or even extended.

Route Monkey does this through looking at the routes and optimising load against route. Obviously operational requirements are the key driver, but when these have been met, optimising the route to minimise energy consumption is the right approach.

Another benefit is the scheduling of the charging route within the route plan. An opportunity of a half hour stop within a schedule could change the whole pattern of usage and make battery electric vehicles viable.

The key is for a fleet to consider how much they are willing to make changes to their operation in order to move to plug-in solutions. Change of operation does not have to mean a loss of efficiency, quite the contrary, it could be a long-term improvement in working practice and vehicle utilisation while reducing energy use and costs.

CASE STUDY: THE ECO TRAVEL NETWORK

The Eco Travel Network (ETN) is a not-for-profit company which operates a hire and charging network for ultra-low energy electric vehicles in the Brecon Beacons National Park. Launched in 2012, it currently has a fleet of seven Renault Twizys. The aim is to enable visitors and residents to move around using far less energy but having far more fun.

The vehicles are funded, hosted and hired out by ETN member businesses – typically accommodation businesses – who keep any hire revenue. Members pay an annual ETN service charge for battery rental, insurance and administration. Their hire revenue covers this. The ETN model spreads the significant capital cost and risk across its members to make it more manageable for all. The ETN and its members promote each other.

The ETN has an additional 40 businesses (pubs, restaurants, visitor attractions and activity providers) who welcome and re-charge visiting Twizys. This creates a "virtuous circle" where the hosting businesses and the charge-points promote each other *and* low energy transport.

Aims are to expand the network across the National Park and explore alternative funding models for small businesses (e.g. campsites) who cannot afford the upfront cost of purchasing a vehicle. Having won the inaugural Green Transport Prize in May 2013[18], the ETN are also looking to strengthen the concept of ultra-low energy vehicles for rural areas by investing in design alternatives to the Twizy and researching new applications for such vehicles on Scottish islands.

[18] Eco Travel Network: http://www.ecotravelnetwork.co.uk/ETN-News/eco-travel-network-wins-green-transport-prize

6.6 New business models are developed for plug-in vehicles

Mainstream adoption of plug-in vehicles will also be fostered by new business models and service offerings which meet the needs of fleets and individuals. Leasing and financing models can offset the high purchase cost of plug-in vehicles, address concerns over battery degradation, residual values, and offer greater certainty on costs. For example, a number of vehicle manufacturers have separated the ownership of an EV and the battery. This sees manufacturers lease the battery to buyers, providing guaranteed levels of performance and removing any potential risks associated with this technology.

Rental companies can also provide solutions to organisations and individuals where the majority of their needs would be met by an EV, but occasionally find it necessary to have access to a car or van to drive longer distances, or to carry more people or payload. The flexibility and potential cost savings of such an approach could make it particularly appealing. Similarly, developments in the offerings of car clubs will increase the options available to individuals and organisations in Scotland.

Such flexible schemes may ultimately form the basis of alternative ownership models. Instead of buying single vehicles, individuals and organisations may prefer to access flexible mobility services that are tailored to their specific needs.

Action 16	The Scottish Government, Scottish Enterprise and partners in the public and private sector to promote Scotland as an attractive location to introduce new consumer offerings and mobility services for plug-in vehicles	Ongoing

6.7 Measures to support the resale and residual values of plug-in vehicles

Measures to support the residual and resale values of plug-in vehicles and batteries will help encourage investments and reduce the overall cost of owning EVs and PHEVs. Manufacturers of plug-in vehicles have stated that they expect batteries to last approximately eight to ten years before they are no longer able to hold sufficient charge to adequately power a vehicle. However, a key concern for consumers is the potential for degradation in battery performance.

A possible way to reassure second hand buyers and support markets for used vehicles would be for industry to develop an official measure of how a battery is performing throughout the life of the vehicle. This could be in the form of a certificate or official rating that would give an indication of the remaining expected life in the battery.

Once the battery has reached the end of its usable life for powering plug-in vehicles, it is still possible that they can be deployed for other applications. This includes stationary power units for storage of surplus capacity from centralised renewables and microgeneration technologies. Identifying and developing a second-life market for such applications could have the benefit of increasing the residual value of batteries and hence support investments in plug-in vehicles. This will demand research into stationary energy storage units or other uses to ensure batteries maintain residual value.

Once the battery is no longer suitable for primary or secondary applications, measures also need to be in place to ensure safe recycling and recovery of valuable materials to minimise any environmental impact.

Action 17	Scottish Government to continue working closely with industry to meet the changing needs of the plug-in vehicle market	Ongoing

ChargePlace Scotland

electric vehicle charging

7 Recharging

A major advantage of plug-in vehicles compared to other alternatively-fuelled transport solutions is that the majority of infrastructure is already in place in the form of a nationwide electricity grid. The key task is therefore to ensure that the final elements of this infrastructure, namely the charge points, are safely deployed to meet the changing needs of the market.

Supporting growth in markets for plug-in vehicles does not require the provision of charge points on every street corner across Scotland. This would be both unnecessary and uneconomic. Furthermore, underutilised charge points could actually damage public confidence. Accordingly, the task is to ensure that charge points are provided in the places in which they are most needed. This relates to both the locations in which they will be most used and also where recharging will enable plug-in vehicle drivers to achieve the journeys that they wish to make.

7.1 Overnight recharging at home is prioritised

It is widely expected that the majority of plug-in vehicles will be recharged at home and overnight. The convenience that this affords is a much appreciated benefit of plug-in vehicles, with drivers no longer needing to make special journeys or detours to refuel. Furthermore, using off-peak electricity offers the greatest cost, environmental and energy system benefits. Measures to support the provision of home recharging should be given priority in all relevant strategies and policy instruments to promote convenient and desirable recharging behaviours.

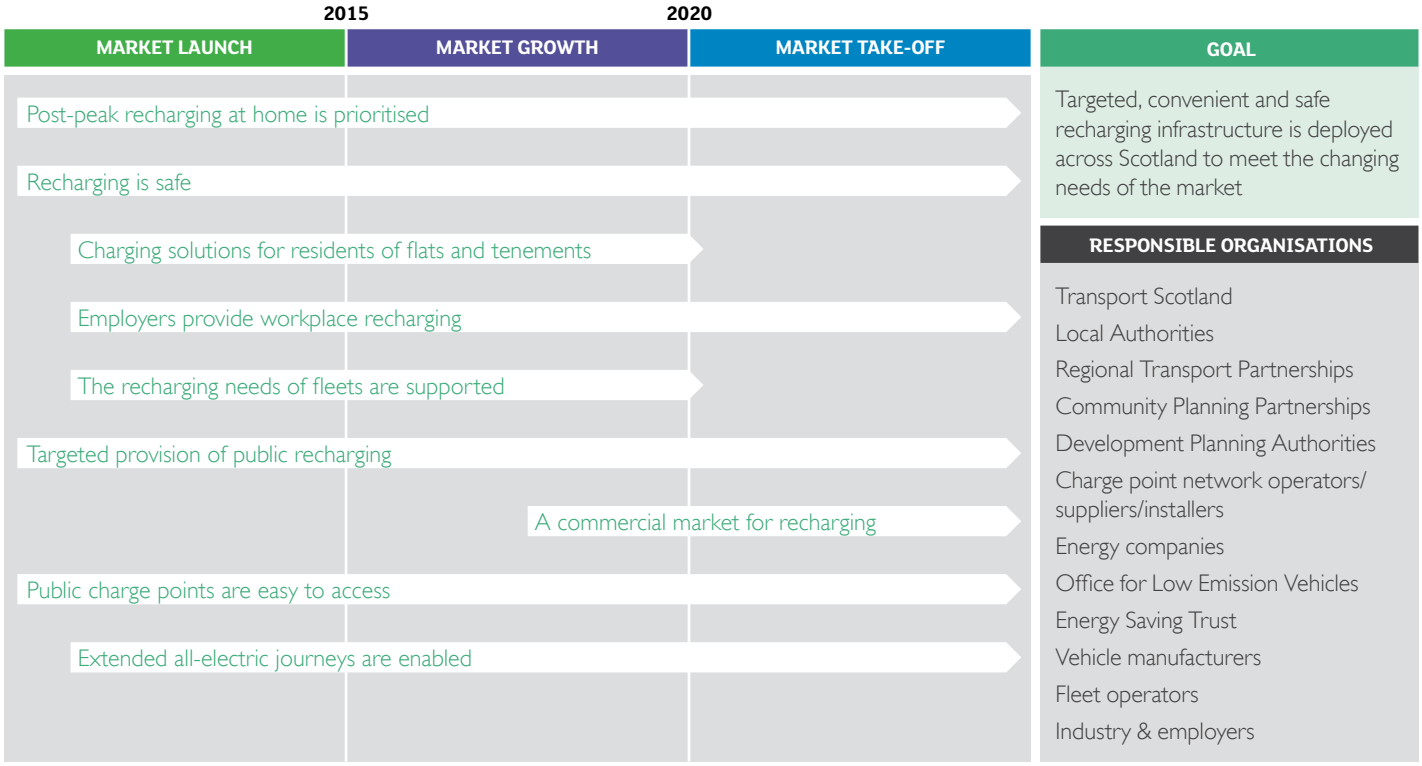


Figure 9: Recharging timeline of key developments and enabling measures

A related objective is to ensure that the installation of home recharging units is as straightforward as possible. Homeowners should not have to separately liaise with vehicle manufacturers, charging equipment suppliers, electricians, inspectors, permit providers and utilities. Accordingly, as the plug-in vehicle market grows, industry and Government should continue to work together to ensure such installations are straightforward and convenient.

Action 18	Transport Scotland to continue to provide funding for the safe and convenient installation of domestic, workplace and en-route charge points	2013-15

7.2 Recharging is safe

A key requirement is to ensure that recharging is safe. Household appliances do not typically exceed 2 kilowatts, while a plug-in vehicle may charge at 3 or 7 kilowatts. Consumers therefore need to be made aware of the risks of handling such equipment to ensure responsible recharging through a domestic electrical system which complies with the UK national wiring regulations (BS 7671). Guidance offered by the Institution of Engineering and Technology recommends that EVs and PHEVs are plugged into a charging unit on a dedicated circuit similar to those required for other appliances such as power showers and electric cookers[19]. This requires installation by a qualified professional and has the advantage of enabling faster recharging rates.

To encourage such installations Transport Scotland is providing grants to cover the total cost of installing domestic charge points for owners of plug-in vehicles and will continue to work closely with industry to ensure responsible and safe recharging of plug-in vehicles in domestic properties, workplaces and public locations across Scotland.

Action 18	Transport Scotland to continue to provide funding for the safe and convenient installation of domestic, workplace and en-route charge points	2013-15

[19] IET (2012) Code of Practice for Electric Vehicle Charging Equipment Installation: http://www.theiet.org/resources/standards/ev-charging-cop.cfm

7.3 Charging solutions are developed for residents of flats and tenements

Home recharging is undoubtedly most straightforward at residences with dedicated parking. In Great Britain, 63 per cent of vehicles are parked overnight in a garage or private off-street property[20]. Across Scotland as a whole, over two thirds of homes are houses or bungalows and therefore many of these residents are also likely to have access to dedicated parking[21]. However, in Edinburgh and Glasgow, 60 and 66 per cent respectively of households are flats, tenements or other multi-dwelling unit buildings[21].

There are a number of possible solutions for residents of such properties. For the early plug-in vehicle market, the most straightforward is likely to be the provision of on-street recharging points for people who buy EVs and PHEVs. Workplace recharging might also provide a practical solution for these individuals and offers a further imperative to encourage employers to provide charge points. Another possible solution is to broker access to private car parks in city centres which have available capacity overnight and could be used by residents that live nearby. This requires engagement with offices, businesses and other organisations with suitable car parking facilities. Furthermore, wider provision of rapid charging across towns and cities may also be beneficial for drivers who cannot recharge at home.

It is likely that a combination of solutions will provide the necessary recharging infrastructure for multi-dwelling unit properties, with much of this depending on the specific circumstances in a given street or locality. Local authorities that have a high proportion of multi-dwelling unit properties will need support to develop recharging solutions for residences across their respective towns and cities. Guidance and support should also be offered to landlords to encourage the provision of necessary charge points.

Action 19	Transport Scotland to establish a multi-stakeholder group on recharging to review the challenges and opportunities and prepare necessary guidance and advice for public and private sector organisations	2013-14

[20] National Travel Survey (2011) Table NTS0908 Where vehicle parked overnight by area type: Great Britain, 2010 https://www.gov.uk/government/statistical-data-sets/nts09-vehicle-milage-and-occupancy

[21] Scottish Household Survey Annual Report 2009/2010 Web Tables – Housing (2011) Table 3.2.8 Property Type by local authority http://www.scotland.gov.uk/Topics/Statistics/16002/Tables0910Housing

Action 18	Transport Scotland to continue to provide funding for the safe and convenient installation of domestic, workplace and en-route charge points	2013-15

7.4 Employers are encouraged to provide workplace recharging

Recharging at work is widely expected to be the second most common charging location after the home. This will serve both fleet vehicles and company employees.

The provision of recharging points by employers provides a significant and highly visible statement of an organisation's environmental policy. The provision of recharging points should therefore be promoted as an integral factor in corporate sustainability strategies, the design of sustainable buildings and the environmental assessment of workplaces.

The provision of workplace recharging also encourages employees to consider adoption of plug-in vehicles. This could be further encouraged by incentives such as giving plug-in vehicles access to preferential parking locations or discounts where parking charges are applied.

The ability to recharge at work will be especially important for EV drivers who commute long distances or have no designated location for overnight recharging. It will also be greatly beneficial in maximising the environmental and economic benefits of PHEVs, enabling commuters to complete a greater proportion of a journey in all-electric mode.

A limitation of workplace charging is that it does not encourage off-peak energy use. Accordingly, in the long-run, strategies to minimise peak demand may be required such as variable tariffs and pricing signals.

It is also important that where businesses' emissions are subject to the Carbon Reduction Commitment, any subsequent increase in electricity consumption resulting from workplace charging is discounted and does not result in additional costs.

A further consideration is the need to avoid modal shift away from public transport. On this basis it is recommended that charge points are targeted at workplaces where employees already commute by car.

There is an overarching requirement to promote the benefits of providing facilities for recharging at work as well as addressing the challenges and questions of employers. An outreach programme to inform and encourage workplace recharging jointly initiated by Government, regional planning authorities, public and private sector employers, and other representative bodies would greatly help in this regard.

Action 20	Transport Scotland to install charge points at all main Scottish Government buildings	2013-14
Action 21	Transport Scotland to develop an outreach and education strategy for plug-in vehicles	2013-15
Action 18	Transport Scotland to continue to provide funding for the safe and convenient installation of domestic, workplace and en-route charge points	2013-15
Action 19	Transport Scotland to establish a multi-stakeholder group on recharging to review the challenges and opportunities and prepare necessary guidance and advice for public and private sector organisations	2013-14

CASE STUDY: WORKPLACE RECHARGING AT CARNEGIE COLLEGE

Carnegie College in Dunfermline has received Transport Scotland funding to install recharging facilities, enabling staff, students and members of the public to recharge plug-in vehicles at the College.

The College replaced two Ford Focus diesel vehicles with Nissan LEAFs, with the purpose of advocating carbon reduction and showing its importance to the community. John Buchan, Head of Estates, is not only happy with the vehicle's "exquisite ride and feel" but would also happily lease more vehicles and "absolutely recommends these vehicles to others as they have had lots of positive feedback from a whole array of stakeholders." There are also additional educational benefits for the College as the vehicles can be used for internal training purposes.

7.5 The recharging needs of fleets are supported

Fleet operators of plug-in vehicles have specific recharging requirements that need to be supported to encourage increased adoption of plug-in vehicles. For example, many fleet vehicles are parked at the driver's residence overnight and are therefore subject to the same requirements for dedicated parking and recharging facilities as with individual drivers. Employers will potentially need support in understanding the issues associated with providing infrastructure to such individuals.

Even when vehicles are based in depots and can be reliably recharged overnight, additional charging may be required during the working day to extend the range achievable. The key issue for fleet operators is to ensure completion of required business, which demands guaranteed access to recharging facilities at a desired location and time. Accordingly, some operators of electric fleet vehicles may find it necessary to deploy their own recharging infrastructure networks, adding a considerable cost to organisations wishing to invest in EVs.

A more efficient long-term solution to support fleets would be the provision of shared public infrastructure. This would require faster charging technologies, real time information on the availability of charge points and a facility to make reservations.

Further analysis is needed to better understand the recharging needs of fleets operating plug-in vehicles across Scotland. Government and charge point operators will therefore need to engage with public and private fleet managers to establish usage patterns, the types of recharging infrastructure required and develop appropriate models of infrastructure provision.

Action 15	Transport Scotland to provide funding and work with partners to support evidence-based analysis of public sector fleets to create new opportunities for the deployment of plug-in vehicles	2013-15
Action 19	Transport Scotland to establish a multi-stakeholder group on recharging to review the challenges and opportunities and prepare necessary guidance and advice for public and private sector organisations	2013-14

7.6 Targeted provision of public recharging

It is widely expected that charge points in public places will generally be used to provide non-essential top-ups to EV and PHEV batteries, with relatively fewer charging events to help extend journeys or support owners who do not have access to off-street parking. Analysis for WWF Scotland[22] reported that public charge points represent a more expensive solution than recharging at home and workplaces (on the basis of £/kWh of electricity delivered) and that while visible charge points have a role to play in sending out signals to end-users, public recharging may generally have a relatively low utility because of the short duration that cars are typically parked. It is therefore imperative that the provision of public charge points is targeted at the locations where they are most likely to be used. This includes supermarkets, retail outlets, leisure centres, tourist destinations and car parks, including park and ride facilities.

A number of businesses across Scotland have installed charge points at their own expense to provide top-up charges to customers and visitors. This provides a highly visible statement of corporate environmental policies and encourages increased patronage and dwell time among the growing community of plug-in vehicle drivers. Further engagement and support for these organisations will encourage greater provision of charge points across Scotland.

The overarching requirement for this public infrastructure and all future deployment is that priority is given to locations where it is most needed as opposed to addressing perceived needs. This should be informed by the local knowledge of key stakeholders in towns and cities across Scotland, including local authorities, CPPs, businesses and plug-in vehicle drivers. Transport Scotland has provided resources and support to Scotland's CPPs in 2012/13 and 2013/14 for the targeted provision of public charge points. This support will continue into 2014/15.

Action 18	Transport Scotland to continue to provide funding for the safe and convenient installation of domestic, workplace and en-route charge points	2013-15
Action 19	Transport Scotland to establish a multi-stakeholder group on recharging to review the challenges and opportunities and prepare necessary guidance and advice for public and private sector organisations	2013-14

[22] WWF Scotland (2010): Watt Car: http://assets.wwf.org.uk/downloads/evs_report_web2.pdf

CASE STUDY:
ASDA SUPERMARKET INSTALLING CHARGE POINTS AT STORES ACROSS SCOTLAND

Asda is installing EV recharging points for electric cars in car parks for customers who want a cheaper and greener alternative to fossil fuels. Eight charge points have already been installed at stores in Scotland and the scheme will be rolling out to more stores in the near future. To gain access to the charge points, customers sign up to an EV recharging scheme such as Polar, with each of the charging posts providing helpline number details for customers to request support.

Julian Walker-Palin, Head of Corporate Sustainability at Asda, commented: "Asda recognises that electric cars are one of the cheapest ways to travel when compared to a standard car. However in the past there has been a case of chicken and egg with customers not wanting to buy an electric car until charging is more widespread but at the same time companies not wanting to install charging facilities until uptake was higher. Asda already has the highest number of electric car charging points of any UK retailer in an attempt to break this cycle and support cash-strapped Scottish customers. We will also be analysing usage data, allowing us to keep our finger on the pulse to ensure that we continue to provide the right facilities for all of our shoppers."

7.7 A commercial market for plug-in vehicle recharging

A key objective in the provision of public charge points is to avoid creating an infrastructure that is continually dependent on public subsidy. Private sector investments will be required to support the future provision of public charge points, which will ultimately be dependent on the potential to realise sufficient revenue from this infrastructure.

Consumer preferences will largely determine the business models for charge point operation. However, Government clearly has a role to play in facilitating the development of this market and will need to continue to work closely with industry to support this process, while ensuring that provision is made for the needs of plug-in vehicle drivers across the whole of Scotland and not just in the most profitable locations.

Action 22	Transport Scotland to commission a review of the opportunities to transition infrastructure provision in Scotland from a Government-funded pilot to a private sector-led initiative that meets Scotland's long-term needs for recharging infrastructure	2014-15

Action 19	Transport Scotland to establish a multi-stakeholder group on recharging to review the challenges and opportunities and prepare necessary guidance and advice for public and private sector organisations	2013-14

7.8 Public recharging points are easy to access

There are a number of elements to providing easy access to public charge points. The first is to ensure that it is easy to locate opportunities to recharge. This can be achieved through simple measures such as the provision of signage, accurate maps and geo-information linked to navigation systems.

A related issue is to communicate the status of a charge point. For example, if a charge point has been taken out of service due to a fault or maintenance, this information should be available to plug-in vehicle drivers before they arrive to recharge. As the market develops further, real-time information on the status and availability of charge points could be a valuable service to plug-in vehicle drivers.

Once the charge point is located, drivers should then be able to easily obtain access. This requires that where a publicly available charge point is in a restricted location, such as certain local authority car parks, necessary arrangements are in place to enable drivers to easily gain access. It is also necessary to ensure that any parking spaces at charge points are limited to plug-in vehicles which are actively recharging through clear stipulation and enforcement of parking restrictions. It may also be necessary to limit the duration of parking and recharging in some locations. This will ensure that charge points experience turnover and are available to potential users throughout the day.

Making payment for charging/parking as straightforward as possible is also an important element in providing easy access. To support this, Transport Scotland, under the ChargePlace Scotland brand, is rolling out a network of publicly available pay-as-you-go charge points in Scotland. This negates the need for membership of different charge point schemes or numerous specialist access keys.

Drivers of plug-in vehicles are a valuable source of information on issues related to access to charge points. Accordingly, relevant feedback mechanisms should be established to enable easy reporting of any issues as they emerge and they should be met with a rapid response by the responsible operator of the charge point.

Action 23	Transport Scotland to continue to develop the electric vehicle content on the Greener Scotland website to provide information on plug-in vehicles, recharging and respond to the needs of EV and PHEV drivers	2013-14
Action 24	Transport Scotland to roll out a network of pay-as-you-go charge points in Scotland – making payment for charging/ parking as straightforward as possible for plug-in vehicle drivers	2013-14
Action 19	Transport Scotland to establish a multi-stakeholder group on recharging to review the challenges and opportunities and prepare necessary guidance and advice for public and private sector organisations	2013-14

7.9 Extended all-electric journeys are enabled

The majority of journeys undertaken in Scotland are well within the driveable range of an EV. Ninety-four per cent of journeys in Scotland are under 40km, with the average trip length in a car being only 12.1km[23]. For many, ownership of an EV is unlikely to be a constraint on their ability to make longer distance journeys. For example, in 2010 the National Travel Survey showed that 37 per cent of households in Scotland with regular access to a car also had access to a second vehicle[24], which would allow the use of a fossil-fuelled vehicle for longer journeys. Also, as explained in section 6.6, a range of innovative business models are being developed to enable EV drivers to access different vehicles to meet specific needs, such as a requirement to undertake a longer journey. Furthermore, rail travel will also continue to present a viable alternative to the car for many people.

For drivers who regularly undertake longer journeys or place a high importance on being able to do so, PHEVs could provide a viable option. These vehicles use a petrol or diesel fuelled internal combustion engine to enable longer journeys.

All-electric journeys in EVs and PHEVs offer the greatest emissions reduction and therefore should be facilitated as much as possible. Transport Scotland plans to deploy a network of rapid chargers at intervals of least every 50 miles on Scotland's primary road network. These rapid chargers will enable an EV such as the Nissan LEAF, which has a 24 kilowatt hour battery, to be recharged to 80 per cent of capacity in under 30 minutes.

Transport Scotland will continue to have a role in ensuring that a suitable recharging infrastructure is in place to enable extended all-electric journeys to both meet the changing needs of the market and support widespread adoption of plug-in vehicles.

Action 25	Transport Scotland to deploy rapid charge points at intervals of at least 50 miles on Scotland's primary road network to enable extended all-electric journeys	2013-15

[23] Transport Scotland (2012) Scottish Household Survey: Travel Diary Results – All Editions, available at: http://www.transportscotland.gov.uk/analysis/statistics/publications/shs-travel-diary-results-previous-editions

[24] Scottish Transport Statistics, table 1.18, p. 60 (source National Travel Survey) http://www.transportscotland.gov.uk/files/STS_2012.pdf

8 Sustainable transport

An efficient and sustainable transport system is essential for Scotland's economy, communities, environment, health and general wellbeing. Accordingly, measures to promote plug-in vehicles will need to advance improvements in the overall quality and sustainability of Scotland's transport system rather than adding to existing problems.

8.1 Increased adoption of plug-in vehicles encourages active and sustainable travel

Efforts to advance plug-in vehicles need to be aligned with strategies to promote active and sustainable travel. This includes smarter working, walking, cycling, public transport, and responsible car use. Plug-in vehicles should replace existing petrol and diesel cars and be aligned with the overall ambition to reduce car use in Scotland, thereby not resulting in increased congestion, greater traffic numbers, reduced road space for cyclists or a decrease in the use of public transport.

A key opportunity for alignment is the behaviour change ambitions of active and sustainable travel campaigns. Promoting the thoughtful use of plug-in vehicles offers the wider benefit of educating individuals and organisations to consider the economic and environmental costs of how they work and travel. This in turn could support an overarching ambition of helping to reduce the total number of vehicle miles travelled on Scotland's roads.

Action 11	Scottish Government to develop a plug-in vehicle marketing campaign as part of wider Greener Scotland activity, to raise awareness, promote incentives and communicate benefits of plug-in vehicles	2013-14
Action 21	Transport Scotland to develop an outreach and education strategy for plug-in vehicles	2013-15

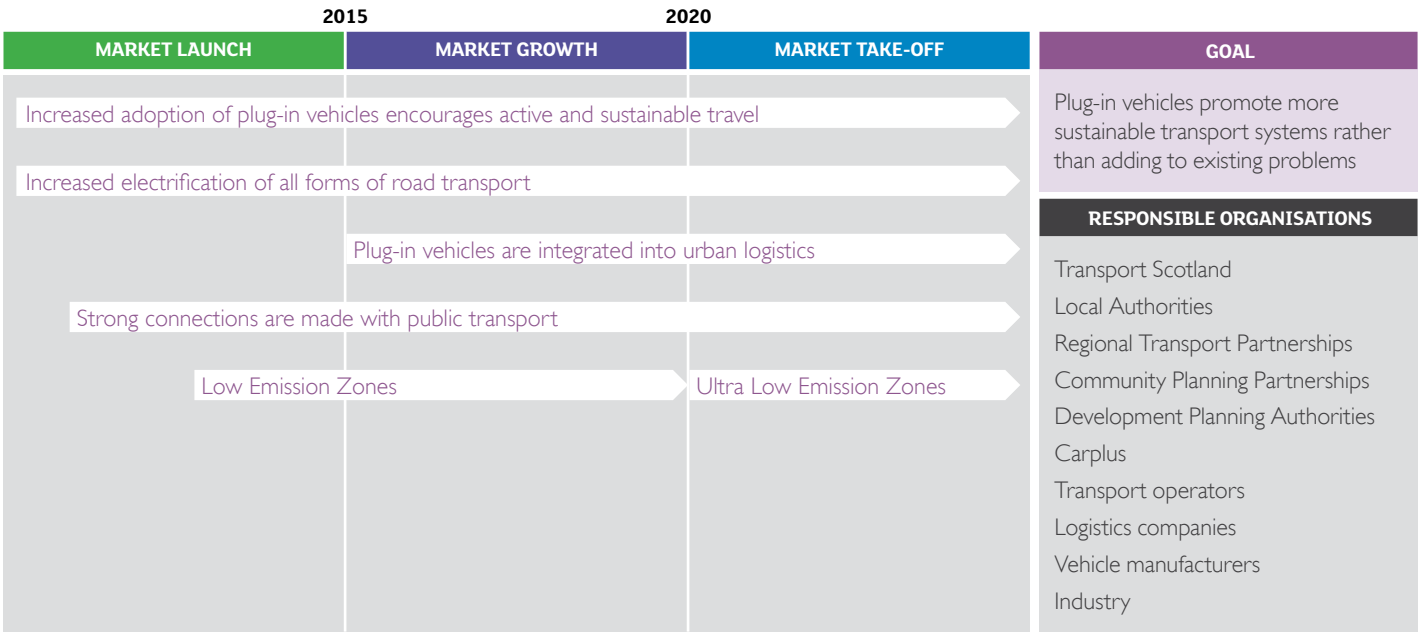


Figure 10: Sustainable transport timeline of key developments and enabling measures

Source: Toyota/National Theatre of Scotland

CASE STUDY: HYBRID ELECTRIC BUSES SAVE FUEL AND INCREASE PASSENGER NUMBERS

In September 2011 Lothian Buses introduced fifteen Alexander-Dennis Ltd (ADL) diesel-electric series hybrid buses to the route 10. These buses were purchased with support from Scottish Green Bus Fund and made up the first double-deck hybrid bus fleet in Scotland. The service 10 was selected for their introduction because of its high proportion of car commuters and because it passes through two local Air Quality Management Areas. The executive design of the buses and features such as free on-board Wi-Fi and audio-visual stop announcements was aimed at encouraging modal shift from car to bus commuting.

A significant increase in passenger numbers has been observed on the service 10 since the introduction of the hybrid buses. The introduction of the hybrid buses has seen the company experience fuel savings of 59 per cent, compared to a diesel vehicle on the same route, saving some 600 Tonnes per year of carbon emissions.

Following this success, ten Volvo parallel hybrid single-decker buses were introduced to the company's fleet in April 2013. These were purchased with financial assistance from the second round of the Fund. For the first time engine-off at idle technology will be used to significantly cut air and noise pollution in the city centre. They are expected to have a carbon footprint around 40 per cent smaller than a diesel bus.

Falkirk-based ADL have supplied 58 of the buses bought to date through the Fund, and are well placed to benefit from any further rounds. ADL has credited the Fund and similar initiatives with enabling it to become established as one of Europe's leading suppliers of low carbon hybrid-electric buses, supporting 900 jobs in Falkirk and a further 2,000 across its wider supply chain network.

CASE STUDY:
ADL'S INDUCTIVE ELECTRIC HYBRID BUS CHARGING PILOT PROJECT

A proposal being developed by a partnership of ADL, SSE, Axeon, BAE Systems and Strathclyde University, and supported by funding from Transport Scotland and Scottish Enterprise seeks to demonstrate in Glasgow, the viability of a modified ADL hybrid bus with expanded battery capacity, capable of running for some of its route purely on battery power thus cutting engine tailpipe emissions to zero during those periods.

The system will utilise novel "inductive charging plates" embedded in the road (or depot floor) at strategic points on the bus route. These can rapidly charge the batteries at points when the bus is stationary over the plate, without the need to plug in to a charge point. This allows charging at times that the bus would be stationary anyway as part of its routine. Thus topped up, the bus will run for more of the route on batteries alone, with greater range accessed via use of the charging diesel engine as required.

The pilot scheme will allow pure electric-running of the bus within dense urban parts of the journey, helping to address the serious air quality problems from which some central Glasgow streets currently suffer.

8.2 Increased electrification of all forms of road transport

Beyond passenger cars and vans, there are also opportunities to achieve emissions savings through electrification of other forms of road transport.

The Scottish Government's Green Bus Fund has already invested over £7.7 million to support the deployment of 94 hybrid electric buses. Continued deployment of these vehicles is important in achieving necessary emissions reductions and improvements to local air quality.

Action 26	Scottish Green Bus Fund to continue to support the wider roll-out of low emission buses across Scotland	Ongoing

The increasing popularity of car clubs provides opportunities for multiple individuals and business users to experience driving plug-in vehicles. This is being supported through the DCCS programme, with funding from Transport Scotland providing financial and technical assistance to encourage the adoption of shared plug-in vehicles in car club fleets.

Action 27	Support for the promotion of shared plug-in vehicles through the Developing Car Clubs in Scotland programme	Ongoing

There are also over 20,000 taxis and private hire cars in Scotland[25] which could offer further potential for increased adoption of plug-in vehicles. This requires engagement with drivers and the provision of necessary recharging infrastructure to support such operations.

In summary, opportunities for door-to-door electrification and hybridisation of all forms of transport should be encouraged where meaningful emissions savings can be achieved.

Action 6	Transport Scotland to establish a multi-stakeholder group on fleets to review the challenges and opportunities for wider adoption and prepare necessary guidance and advice for public and private sector organisations	2013-14

[25] Scottish Government (2011) Scottish Transport Statistics No 31 – Datasets, Table 1.4: Taxi, private hire cars and drivers licensed by local authority http://www.transportscotland.gov.uk/analysis/statistics/TablesPublications/scottish-transport-statistics-2012-datasets

Source: Carplus

CASE STUDY: SHARED ELECTRIC VEHICLES IN SCOTLAND'S CAR CLUB NETWORK

Scotland has a network of commercial and not-for-profit car clubs which provide access to pay-as-you-drive vehicles in rural and urban communities across the country. Car clubs provide their members with access to vehicles available for hire on an hourly or daily basis, 24 hours a day, 7 days a week. Car club vehicles tend to be parked in dedicated and clearly marked parking spaces close to the homes and workplaces of car club members.

The car clubs cover all the costs of owning and operating the vehicles, such as insurance, tax, fuel, cleaning and servicing. Members usually pay an annual membership fee to be part of a car club and then pay an hourly charge to hire a vehicle and a mileage charge to cover fuel costs and vehicle wear and tear. Members can join and book vehicles online or over the phone and access vehicles via a personal smart card or by a key, accessible via a key safe.

Car clubs can provide drivers with affordable access and invaluable experience of driving EVs. The not-for-profit car club operator Co-wheels provides its members with access to four EVs in Aberdeen and one EV in Dundee as part of a range of vehicles available for hire in each city. Through the DCCS programme Transport Scotland aims to provide continued support for the electrification of the Scottish car club network.

8.3 Plug-in vehicles are integrated into urban logistics

Medium and heavy-duty freight and delivery vehicles offer opportunities for both hybridisation and electrification. Such vehicles are increasingly being used by delivery companies, supermarkets and other businesses across Scotland and the UK.

The use of low emission trucks can be optimised by better organisation of the interface between long-distance and last-mile freight transport. Initiatives that focus on the last mile of deliveries, which is the most inefficient part of the journey in terms of fuel consumption and emissions, aim to limit individual deliveries to the shortest possible route.

Local authorities can also contribute to reductions in traffic emissions through management of the municipal vehicle fleet. This not only includes cars and vans operated by local authorities but also other municipal vehicles such as road sweepers and refuse collection trucks.

Local authorities, CPPs and other relevant local actors, such as freight quality partnerships, will need support and encouragement to show leadership in the adoption of plug-in vehicles and to advance measures that will reduce damaging fossil fuel emissions in towns and cities across Scotland.

Action 6	Transport Scotland to establish a multi-stakeholder group on fleets to review the challenges and opportunities for wider adoption and prepare necessary guidance and advice for public and private sector organisations	2013-14

8.4 Strong connections are made with public transport

For plug-in vehicles to be integrated into wider public transport infrastructure, efforts should be made to encourage EV and PHEV drivers to use car parks that enable easy connections to public transport. This includes park-and-ride sites as well as other transport interchanges such as train stations and bus stations.

CASE STUDY:
LAMILO FREIGHT CONSOLIDATION CENTRE IN PERTH

Plans for a freight consolidation centre outside of Perth will see individual consignments or part-loads grouped at a logistics facility and then delivered by an EV to retail and office premises in the city centre. The EV would run up to four deliveries per day, with additional services also being considered including collection and recycling of waste and packaging materials. The operation would work 24/7, be free of charge to users initially to encourage uptake and participation will be voluntary.

Funding was made available for a feasibility study and detailed development of a proposal through Scottish Government Air Quality Grant. Additional funds have also been approved through a European INTERREG project which will provide 50 per cent funding for a period from 2012-2015.

CASE STUDY:
ELECTRIC ROAD SWEEPERS IN SOUTH LANARKSHIRE

In 2012 South Lanarkshire Council introduced two Electric Compact Sweepers to its fleet through the Low Carbon Vehicle Procurement Support Scheme operated by Transport Scotland. The sweepers, made by Tennent Green Machines in Falkirk, were deployed within the Council's town centres and precincts, replacing the previous diesel powered sweepers and are used on a daily basis.

Although initially sceptical over ability and battery performance, feedback from the employees using the electric sweepers has been very positive and all comment on the reduced noise and emissions allowing the units to operate at times the previous diesel powered units could not. Members of the public have often commented on the use of the electric sweepers and the improvement this has made to the local environment. Although heavier diesel powered sweepers are still required, the introduction of the electric sweeper has allowed these to concentrate on the more demanding areas improving the already high standard of South Lanarkshire's public footpaths.

Central to this is to ensure that charge points are installed at these locations and promoted to plug-in vehicle drivers. Transport Scotland has already begun this with charge points being installed at park-and-ride sites at Hermiston and Straiton Park in Edinburgh in 2013.

Action 28	Transport Scotland to continue the deployment of charge points at park and ride sites and other transport interchanges	2013-15
Action 29	Transport Scotland to encourage the deployment of electric vehicle charging points at railway stations with bidders for the new ScotRail Franchise	2013-15
Action 19	Transport Scotland to establish a multi-stakeholder group on recharging to review the challenges and opportunities and prepare necessary guidance and advice for public and private sector organisations	2013-14

8.5 Development of ultra low emission zones

A low emission zone is a geographically defined area where the most polluting vehicles are restricted, deterred or discouraged from access and use. Low emission zones have been successfully implemented and run for a number of years in various places, including Sweden, Japan, the Netherlands and London. A number of cities across Scotland are also currently assessing the potential to implement low emission zones.

An ultra low emission zone sets even more ambitious emissions thresholds to incentivise the use of ultra low emission vehicles such as EVs and PHEVs. It was recently announced that London intends to implement such a scheme and is currently investigating the feasibility of having this in place during working hours from the year 2020[26].

In addition to supporting necessary improvements in local urban air quality, ultra low emission zones offer significant potential to promote the use of EVs and PHEVs in preference to fossil-fuelled vehicles. Such schemes will also provide important benefits in promoting active and sustainable travel.

To help local authorities identify the need and opportunities for ultra low emission zones, necessary support and technical assistance will need to be provided to investigate the potential for these schemes in towns and cities across Scotland. Where local authorities identify that such zones can and should be implemented, the Scottish Government will offer support to help expedite their establishment and achieve necessary improvements in air quality to limit adverse health impacts and damage to ecosystems and the wider environment.

Action 30	Scottish Government to work with partners to undertake a study into the development of a national framework for establishing low emission zones	2014
Action 3	Scottish Government to consider the role plug-in vehicles can play in Air Quality Action Plans as part of the review of Local Air Quality Management in Scotland	2013-14

[26] http://www.london.gov.uk/media/mayor-press-releases/2013/02/mayor-of-london-announces-game-changer-for-air-quality-in-the

CASE STUDY:
LOW EMISSION ZONES FOR GLASGOW 2014

Glasgow City Council plans to establish Low Emission Zones at each of the 14 venues in the 2014 Commonwealth Games. These zones will be managed by using the functions specifically employed for the duration of the Games to ensure that the increased activity at the venues does not lead to an unacceptable increase in air pollution.

The zone boundaries will be defined by the Organising Committee's footprint for each venue and will employ a strict security cordon which will be dependent on temporary road closures. The cordon will restrict access to all logistical and non-logistical vehicles subject to a controlled permit system. Permits will only be issued based on the appropriateness of vehicles that comply with the Euro-5 category which has been designated by the council as the minimum standard for the zones.

9 Energy systems

A key advantage of plug-in vehicles is that much of the infrastructure to support their operation is already in place in the form of the national electricity grid. However, as increasing numbers of vehicles enter the market it is essential to ensure that the grid is sufficiently robust and well-managed to accommodate any changes in demand. A further key opportunity is to fully realise the potential of plug-in vehicles to support the development of a cleaner and smarter energy system.

9.1 The electricity network supports increased uptake of plug-in vehicles

At the grid level, the absolute increase in electricity demand from the growing uptake of plug-in vehicles is expected to be manageable. Research on behalf of the European Commission showed that even a complete electrification of the European fleet would only result in additional demand in the order of 10-15 per cent[27]. It is therefore expected that existing and planned generating capacity in Scotland will be able to meet the additional demand in the short to medium term.

[27] Van Essen, H. and Kampton, B. (2011) Impacts of Electric Vehicles – Summary Report, commissioned by European Commision, available at: http://ec.europa.eu/clima/policies/transport/vehicles/docs/summary_report_en.pdf

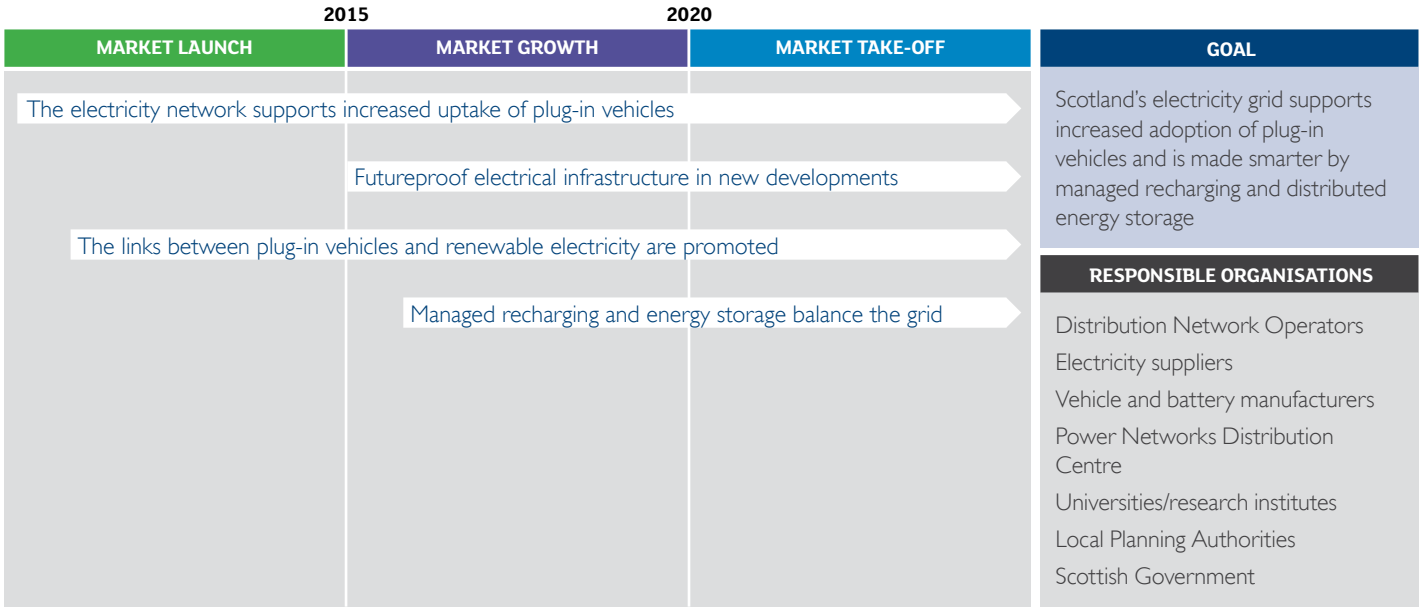


Figure 11: Energy systems timeline of key developments and enabling measures

CASE STUDY: RESEARCH INTO THE IMPACT OF PLUG-IN VEHICLES ON THE GRID

Scottish & Southern Energy (SSE) has been involved in EV trials, case studies and academic research into the impact of EVs on the electricity network. The key conclusions from these studies are that 90 per cent of EV charging is expected to take place at home, with the balance in work places or public charge points.

Because domestic recharging predominates, the research carried out by the University of Strathclyde concentrated on the effects on the low voltage (LV) domestic supply networks. These studies found that the existing LV networks can support up to around 30 per cent penetration of EVs, even with 32 Amp charging, provided that the bulk of the charging is done overnight when there is spare capacity on the network. When drivers are provided with simple controls and beneficial tariffs to recharge overnight, the vast majority of the charging is done at that time.

Conversely, in the absence of these incentives, drivers tend to plug in their vehicles on arriving home from work, creating additional demand in the early evening. This coincides with existing peaks on the network and even low penetrations of EV could cause overloads on the low voltage network.

To cope with even higher demand from EVs, smarter charging methods need to be developed to spread the load over the whole of the off peak period. SSE is carrying out further work with EA Technology into control mechanisms for EV charging that can maximise the potential of the existing networks.

CASE STUDY: MY ELECTRIC AVENUE

The My Electric Avenue project aims to test the monitoring and control technology by recruiting 'clusters' of EV users, both residential and business; all people in a cluster must be fed by the same local electricity substation feeder. The 'cluster trials' will aim to simulate a 2030 network; these clusters will be in both residential situations (charging at home) and in business situations (fleet cars charging at work).

The project will provide essential learning about managing the strain on the electricity distribution network from the anticipated increased uptake of electric vehicles. It will also deliver a cost-effective solution to Distribution Network Operators, that reduces the need for network reinforcement and allows a faster uptake of EVs. The project will also monitor EV users as individuals rather than clusters ('social trials') for behavioural and socio-economic data – i.e. their driving and charging habits will be recorded.

EA Technology has developed monitoring and control technology that offers a solution to reduce network reinforcement, and to support EV market growth. This solution will delay, and in some cases avoid, the need for additional electrical infrastructure – which would be costly and disruptive, as well as taking significant time – to accommodate the forecast increase in EVs.

The results of these trials will be communicated to the DNO community in Great Britain, to Government, to the energy industry and to the general public. This will advance understanding of what an 'EV ready' street of the future may look like, and what the implications might be for the electricity network.

However, at the level of local networks and sub-stations, it will be necessary to ensure that appropriate provisions are made for increased uptake of plug-in vehicles. Distribution Network Operators (DNOs) will need to plan for and manage any changing patterns of demand resulting from the anticipated growth in plug-in vehicles. This will be supported by Government and industry working together to provide necessary market data and forecasts.

Action 31	Transport Scotland to establish a multi-stakeholder group on energy systems to review the challenges and opportunities and prepare necessary guidance and advice for public and private sector organisations	2013-14

9.2 Futureproof electrical infrastructure in new developments

The growth in markets for plug-in vehicles will both demand and be supported by appropriate provision of the necessary wiring and electrical infrastructure for recharging in new residential and commercial developments. Ideally this would see the routine installation of dedicated circuits and charging units in developments. However, as a minimum, developers should be encouraged to ensure that service conduits are appropriately sized to accommodate future necessary electrical infrastructure for recharging.

In the design phase of large new developments, consideration should also be given to the potential for on-site energy generation, energy storage, and energy management systems. Such systems would reduce or eliminate the need for improvements to the local grid resulting from increased adoption of plug-in vehicles.

Scotland's planning regime has a central role to play in encouraging this and the Scottish Government will seek to strengthen guidance to planning authorities on these issues as part of a review of the Scottish Planning Policy in 2013-14. Developers, building owners and architects should also be engaged and shown how making such provisions in the construction or substantial redevelopment of facilities can significantly reduce the cost of installing charge points and other necessary electrical infrastructure.

Action 32	Scottish Government to consider how best to strengthen guidance for planning authorities relating to plug-in vehicle charge point provision in new developments as part of a review of Scottish Planning Policy	2013-14

Action 31	Transport Scotland to establish a multi-stakeholder group on energy systems to review the challenges and opportunities and prepare necessary guidance and advice for public and private sector organisations	2013-14

9.3 The links between plug-in vehicles and renewable electricity are promoted

Plug-in vehicles recharged with green electricity offer significant opportunities to achieve carbon reduction benefits. Scotland is especially well placed on this front, with over a third of the UK's total renewable electricity output coming from Scotland and a commitment to achieve 100 per cent of Scotland's electricity demand from renewables by 2020. The Scottish Government's commitment to decarbonise the power sector and promote a 100 per cent renewable future should therefore feature prominently in messaging to promote plug-in vehicle adoption.

A further important area is the link to micro renewables. Through the Home Renewables Loan Scheme[28], the Scottish Government is actively working to increase the number of homes, offices and many other buildings that generate their own electricity from wind turbines and solar photovoltaic panels. In addition, the UK Government's Feed in Tariff Scheme is open to homeowners, businesses and organisations in Scotland. The profiles of the individuals and businesses that are receptive to such technologies are likely to match those of early-adopters of plug-in vehicles. Furthermore, recharging with electricity from micro renewables will reduce the running costs of plug-in vehicles, creating a compelling incentive for owners to generate their own electricity.

Given the complementarities and mutual reinforcing benefits, there should be active cross-promotion of micro renewables and plug-in vehicles.

Action 21	Transport Scotland to develop an outreach and education strategy for plug-in vehicles	2013-15

Action 31	Transport Scotland to establish a multi-stakeholder group on energy systems to review the challenges and opportunities and prepare necessary guidance and advice for public and private sector organisations	2013-14

[28] Energy Saving Trust: Home Energy Scotland renewables loan scheme: http://www.energysavingtrust.org.uk/scotland/Take-action/Find-a-grant/Home-renewables-loan-scheme

CASE STUDY: ELECTRIC VEHICLES RUNNING ON GREEN ELECTRICITY

Michael Davis, owner of Tetro Energy Ltd sees a strong connection between EVs and his business of developing sites for commercial wind turbines. Having purchased a Peugeot iOn with an Energy Saving Trust's Low Carbon Transport Loan, Michael now plans to utilise a 4kW domestic solar photovoltaic system and a 50kW on-site wind turbine to ensure that his EV is powered as much as possible by renewable energy. Living in Insch in Aberdeenshire, the area already has a number of commercial wind turbines, so EV owners in the region are already benefitting from increased renewable generation. Michael will also be receiving 100 per cent grant funding for a domestic charging point, which will reduce charging time by around a third in comparison to using a standard domestic socket.

"Since taking delivery of the iOn in early March 2013, we have clocked up over 1600 miles. The vehicle is ideal for return journeys of up to 50 or so miles. Charging the car from our own renewable generation makes this a virtually zero emission vehicle, the only CO2 resulting from its use being that embedded in the vehicle and consumable items such as tyres. Whilst reduced carbon emissions are very welcome we are also delighted with the reduced fuel costs resulting from the use of this vehicle. Overall purchase of the car has been a sound business decision."

CASE STUDY: POWER NETWORKS DEMONSTRATION CENTRE

The Power Networks Demonstration Centre (PNDC) in Cumbernauld, is a collaborative venture between Scottish and Southern Power Distribution, Scottish Power Energy Networks, Scottish Enterprise and the University of Strathclyde, to develop and accelerate the introduction of novel technologies into the electricity market.

The Centre is part of the Faculty of Engineering based in Glasgow and therefore staff are often required to undertake a considerable amount of commuting to attend face-to-face meetings with colleagues. In March 2013 the PNDC and the Faculty of Engineering invested, with support from Transport Scotland, in the introduction of two electric chargers, one at each location. These will serve two distinct purposes, reduce the carbon footprint of the interactions between both geographically separated locations and allow for unique testing of these technologies to take place and demonstrate the functionality and economics of vehicle to grid integration.

For this purpose, the operation of these charging platforms and the connection to the grid will be monitored continuously. In addition, the charging post at PNDC will have the option of connection to the demonstration network. This will allow real-time testing of vehicle to grid interactions and the development of expertise to allow the prediction of the effect of electric vehicle integration to the grid. The vehicles used will be sensorised in order to understand and improve the vehicle's energy usage such as thermal management.

9.4 Managed recharging and advanced energy storage help balance the grid

There are a number of important reasons to manage and influence recharging behaviours. Firstly, it enables the greatest carbon reduction benefits, whereby recharging at times of low overall demand makes it more likely that renewable energy sources will provide most of the electricity. In contrast peak surges in demand are currently met by switching on high-carbon coal or gas generators.

Managed recharging can also support increased electricity generation from wind turbines and other renewable sources. The recharging of plug-in vehicles can be matched to the fluctuating levels of generation from renewable sources, helping to balance energy systems and charge with green electricity that might not otherwise be used.

Smart and controlled recharging will also limit the requisite need for grid reinforcement and avoid overloading local networks at times of peak demand. Moreover, plug-in vehicles could ultimately reduce peak generation requirements. In the short to medium term this is most likely to be in the form of vehicle-to-home applications, with surplus capacity in plug-in vehicle batteries used to run domestic appliances. However, in the longer term, vehicle-to-grid applications may enable plug-in vehicles to export electricity back to the grid, although this is expected to be some way off.

The central measure to regulate or incentivise recharging at specified times will be new consumer energy packages and tariffs which promote recharging at the most optimal electricity price for the day. This will help reduce the operating costs of plug-in vehicles and may also enable large fleets to agree terms with energy providers where there is a mutual benefit in specific tariffs. In addition to advancing plug-in vehicle adoption, new ways of supplying electricity and associated product offerings could represent an entrepreneurial opportunity for Scottish companies.

Developments in bi-directional communications will enable remote control of plug-in vehicle recharging. Smart meters will also be a key enabling technology to manage recharging behaviours and support dynamic tariffs, which change in response to real-time demand. The UK Government has stated that every home in Scotland should be offered smart meters by 2019. Accordingly, the energy companies that are responsible for this roll-out should be encouraged to consider how these smart meters can support controlled recharging of plug-in vehicles.

In summary, by working together, Government and industry can progress opportunities for managed recharging and advanced energy storage. This should specifically focus on the necessary technologies, infrastructure, business models, operational frameworks and network design required to support such developments. It should also evaluate potential concerns about the increased cycling of batteries for grid stabilisation and the associated impact on performance and residual values.

Action 33	Scottish Government to continue to work with energy suppliers to encourage the deployment of tariffs and technologies to manage recharging behaviours and maximise the emission reduction benefits across Scotland	**Ongoing**
Action 31	Transport Scotland to establish a multi-stakeholder group on energy systems to review the challenges and opportunities and prepare necessary guidance and advice for public and private sector organisations	**2013-14**

10 Economic opportunity

Advancing plug-in vehicles not only offers the potential to limit the effects of climate change and poor air quality, but also to capitalise on the economic opportunities that arise from these actions. The benefits to Scotland will accrue in the form of a secure domestic economy which is underpinned by sustainable low carbon activity and the development of new goods and services. This in turn will enhance Scotland's reputation as a key destination for low carbon investment. Furthermore, at the operational level, advancing plug-in vehicles also offers potential to make Scottish companies more efficient, profitable and competitive.

10.1 Opportunities to save money through plug-in vehicle adoption are understood and realised

Investing in plug-in vehicles will provide opportunities for individual users to save money and enable many public and private sector organisations to maximise profits. These opportunities already exist in applications of the currently available technologies and will become increasingly prevalent as the cost of plug-in vehicles further decreases and fossil fuels continue to become more expensive.

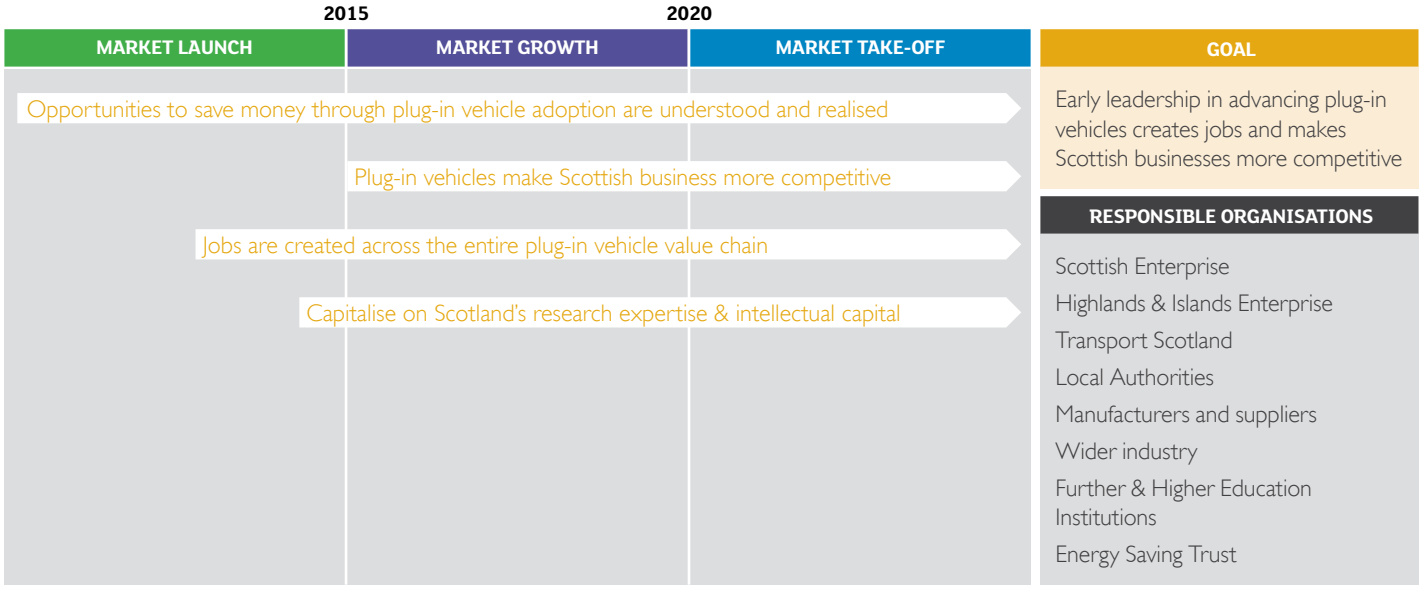


Figure 12: Economic opportunity timeline of key developments and enabling measures

Many companies will therefore have compelling opportunities to save money by investing in plug-in vehicles. However, instead of judging EVs or PHEVs as a like-for-like replacement for fossil-fuelled vehicles, companies should be encouraged to consider ways to optimise the efficiency of their operations to reduce costs and broaden the potential applications for plug-in cars and vans.

The future potential for low-cost operation of plug-in vehicles could also help alleviate the increasing financial burden on Scottish households of running fossil-fuelled vehicles.

Action 12	Energy Saving Trust to continue to promote its support for Scottish businesses to adopt plug-in vehicles through EV Awareness Raising Workshops, Sustainable Transport Advice Service and Interest Free Low Carbon Transport Loans and FuelGood driver training	Ongoing
Action 15	Transport Scotland to provide funding and work with partners to support evidence-based analysis of public sector fleets to create new opportunities for the deployment of plug-in vehicles	2013-15
Action 21	Transport Scotland to develop an outreach and education strategy for plug-in vehicles	2013-15

10.2 Plug-in vehicles make Scottish business more competitive

Plug-in vehicles provide an opportunity to improve the competitive positioning of businesses. For example, significant marketing capital can be gained by both small and large businesses through early market adoption of plug-in vehicles and provision of charge points. This provides a point of differentiation from competitors and a clear communication of an organisation's values.

In the longer term, it will be important to consider the potential competitive costs for businesses that fail to make this transition. Fossil fuel prices are not only expected to continue to increase but also to become more volatile. This will leave organisations exposed to fluctuations in global markets and create uncertainty on financial returns. Moreover, companies that fail to adjust their operations and business models to meet changing consumer expectations could run the risk of losing customers.

Scottish businesses therefore need to be made aware of the commercial arguments for investing in plug-in vehicles and supported in making this transition.

Action 12	Energy Saving Trust to continue to promote its support for Scottish businesses to adopt plug-in vehicles through EV Awareness Raising Workshops, Sustainable Transport Advice Service and Interest Free Low Carbon Transport Loans and FuelGood driver training	Ongoing

Source: Urban Foresight Limited

10.3 Jobs are created across the entire plug-in vehicle value chain

Scotland is home to a number of businesses that are directly involved in the manufacture and production of electric and hybrid vehicle technologies. This includes advanced batteries made by Axeon in Dundee, plug-in vans produced by Allied Vehicles in Glasgow, and Falkirk is home to both Tennent Green Machines' electric road sweepers and Alexander Dennis' hybrid electric buses.

Scotland also has the skills and supply chains to support successful industries in the design, development and production of high value products, for example, Artemis Intelligent Power design and manufacture hybrid car and truck transmissions in Edinburgh.

There will be further job creation opportunities beyond the manufacture of vehicles and batteries. This includes the design, manufacture, installation and maintenance of recharging technologies.

New business models and innovations will also be required in the provision of plug-in vehicles and charge points. Opportunities will arise in areas including sales, servicing, finance and insurance. There will be a growth in services linked to the operation of charge points, the provision of parking and the retail of electricity.

Many of these developments will require new software and administrative services for functions such as billing, account management and systems integration. Moreover, there will be related customer-focused opportunities in the provision of information, advertising and related digital services.

Advancing plug-in vehicles as part of a smart, sustainable and integrated transport system could also create new opportunities for Scottish businesses. A particular area of strength in Scotland is Intelligent Transport Systems. Developments in this sector will deliver valuable technologies and services to plug-in drivers, such as tracking and telemetry, mobile information, smart and integrated payment technologies, and cooperative systems to enable communication between vehicles and with infrastructure.

Developments in plug-in vehicles will be part of the wider transformation of how energy grids are developed and operated. This will create new opportunities and innovations in the supply, metering and management of energy systems. Ancillary services will be developed to support and maintain the reliable operation of the interconnected transmission system. This will create a range of revenue generating opportunities with advances in demand response, vehicle-to-grid, energy storage and other grid support services.

To realise the job creation potential afforded by increased adoption of plug-in vehicles, Scottish businesses should be engaged and given appropriate support. This includes the provision of training, guidance and advice to ensure that these organisations can access the necessary skills to grow their workforce and, if necessary, diversify to capitalise on emerging commercial opportunities.

Action 34	Scottish Enterprise to unite, understand, support and strengthen Smart Mobility activity including (but not limited to) Transport Systems, Informatics and Energy Companies from which economic benefits flow. This will include growing capability and capacity around Smart Mobility, stimulating projects, realising benefits and expanding global reach	2013-14
Action 16	The Scottish Government, Scottish Enterprise and partners in the public and private sector to promote Scotland as an attractive location to introduce new consumer offerings and mobility services for plug-in vehicles	Ongoing

CASE STUDY:
R.B. GRANT DIVERSIFY INTO CHARGE POINT INSTALLATION

Fife-based Electrical Contractors, R.B. Grant, recognised the economic and staff development opportunities for their business by diversifying into the installation of recharging points. Owner Ronnie Grant explains:

"I have been watching the rise of the electric vehicle market for a few years now as both a lover of motors and energy efficient products. When I became aware that the Scottish Government would facilitate the deployment of EV charging infrastructure it was with some joy that I realised our company could become involved with installation works. Working closely with a charging point manufacturer we have installed a number of charging points which will be added to Scotland's EV charging network. This is of course had economic benefits to the company but more importantly a training exercise for our employees including our young apprentices. This training will give us a head start into what I think will be a rising market with charging points hopefully being installed in most homes and places of work."

10.4 Scotland capitalises on its research expertise and intellectual capital

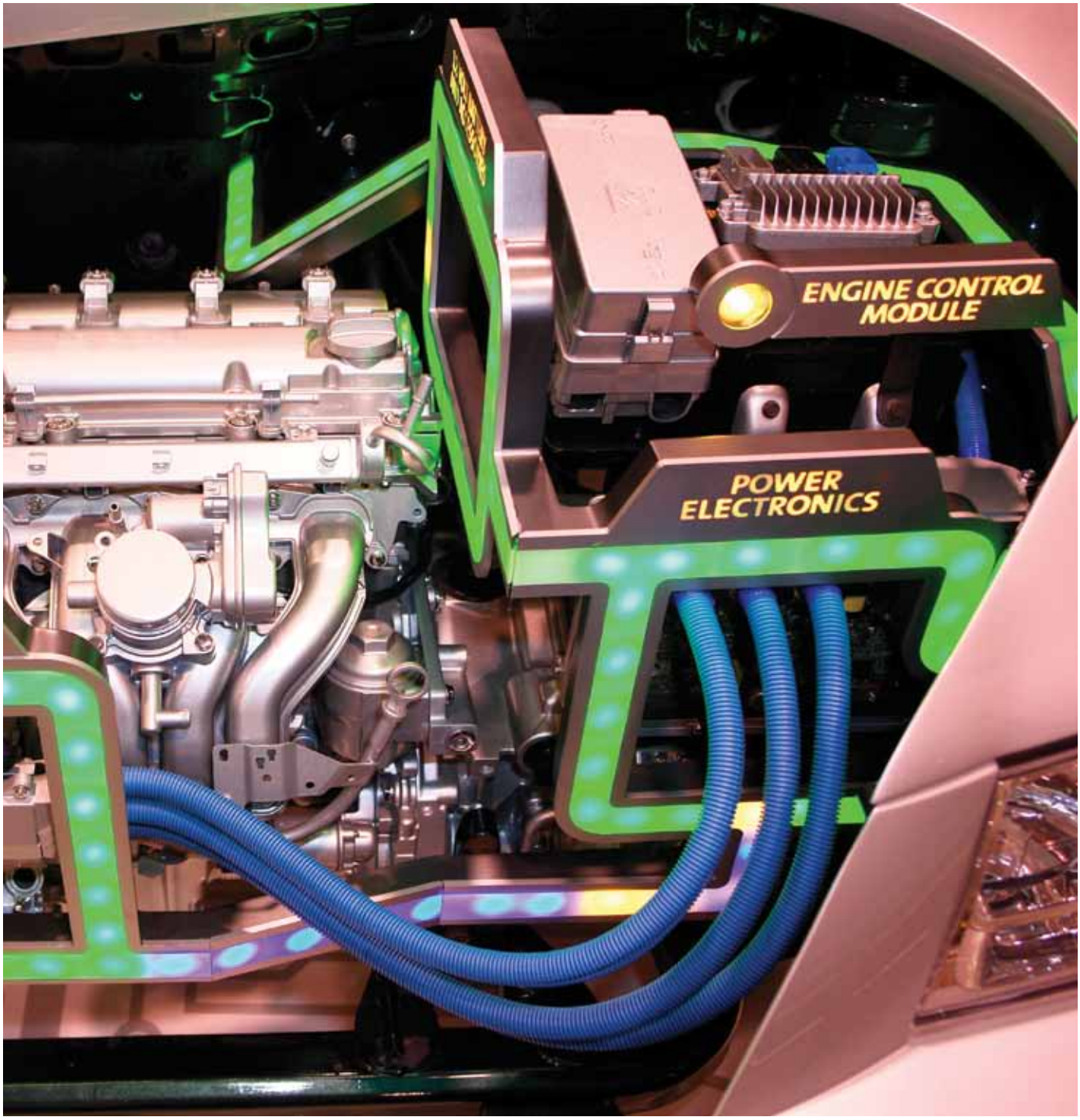
The intellectual capital in Scottish businesses, universities, colleges and research institutions offers significant potential to advance plug-in vehicles and related technologies. This expertise can also help shape future policy, business models and deliver a qualified workforce to support this growing industry.

Scotland's business support landscape offers opportunities to support commercialisation and innovation across the entire value chain of products and services related to plug-in vehicles. Existing grants and support services should be targeted to enable the development and demonstration of emerging plug-in vehicle technologies, as well as innovations in related transport and energy services.

Research applications and funding should be encouraged in areas that will help solve problems and create new economic opportunities for Scotland. Collaboration across the public, private and academic sectors should be facilitated to ensure that research is targeted at the most crucial areas and to provide a pathway to implementation and commercialisation.

Organisations across Scotland should also be encouraged to submit relevant projects to European Framework programmes and UK funders such as the Technology Strategy Board. In particular, participation in collaborative projects will provide access to international expertise and a forum to promote Scotland as a leading location for research and investments.

Action 8	Scottish Government and its partners to continue to engage with international plug-in vehicle networks and projects to attract funding and support policy debates	Ongoing
Action 16	The Scottish Government, Scottish Enterprise and partners in the public and private sector to promote Scotland as an attractive location to introduce new consumer offerings and mobility services for plug-in vehicles	Ongoing
Action 34	Scottish Enterprise to unite, understand, support and strengthen Smart Mobility activity including (but not limited to) Transport Systems, Informatics and Energy Companies from which economic benefits flow. This will include growing capability and capacity around Smart Mobility, stimulating projects, realising benefits and expanding global reach	2013-14



CASE STUDY:
ST. ANDREWS BATTERY RESEARCH COULD BOOST EV RANGE

Research at St. Andrews University in Lithium-air battery research could enable EVs to travel much further and faster than current models. Professor Peter Bruce of St. Andrews University said:

"New generations of rechargeable lithium batteries could extend the range of electric vehicles enabling them to travel further than current models before needing recharged, making them a more realistic option for drivers who wish to travel greater distances. They could also help to balance the intermittent supply of electricity from renewable sources – such as wind and wave power – with consumer demand, a key challenge in making renewable energy viable and which would provide enormous potential for Scotland which has an increasing emphasis on renewable energies."

Source: Edinburgh College

11 Communication & education

To encourage widespread adoption of plug-in vehicles, it will be essential to complement the measures highlighted in previous sections by promoting increased awareness and influencing attitudes and skills in order to build confidence in purchasing and using plug-in vehicles. This requires engagement with individuals, organisations and key influencers in the public and private sector.

11.1 Increased opportunities for the public to experience plug-in vehicles

A low level of awareness and understanding of plug-in vehicles amongst the general public will undoubtedly temper demand. For an individual to consider investing in an EV or PHEV they first need to be aware that this is a potential option. This requires active education and promotion efforts to create an informed public that understands the costs, benefits and opportunities of investing in plug-in vehicles.

Central to this will be to provide first-hand experience of plug-in vehicles, enabling consumers to touch, feel, drive and recharge them. This will allow individuals to experience the performance and capabilities of plug-in vehicles, as well as helping to dispel any prior negative misconceptions or concerns.

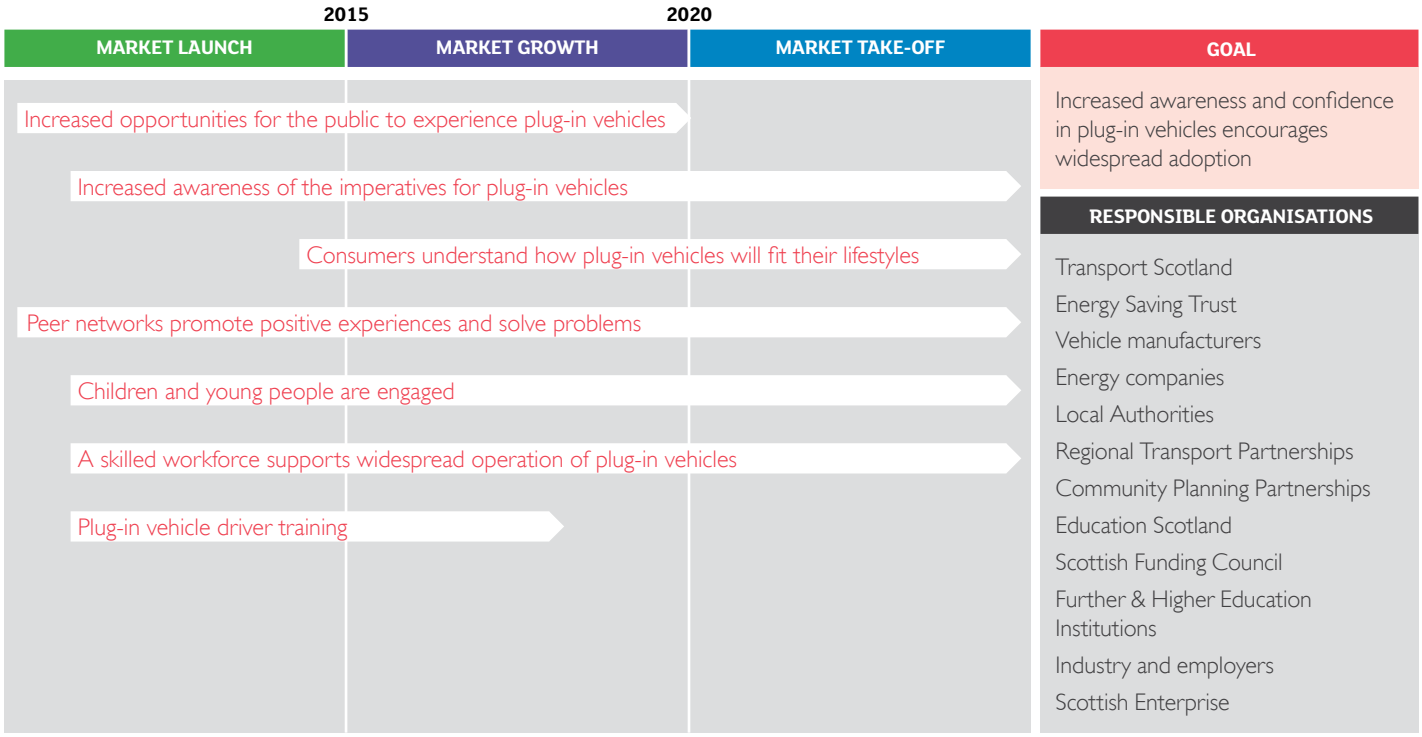


Figure 13: Communication & education timeline of key developments and enabling measures

As a first step, the Energy Saving Trust, supported by funding from Transport Scotland, will launch an Electric Vehicle Network Tool in 2013, to provide those people interested in adopting plug-in vehicles with all the information they need to make an informed decision. By allowing them to ask questions of current owners they can get the real-life experience of owning a plug-in vehicle. The network will be an online tool on Energy Saving Trust's website for people to search for both private and business owners of electric vehicles and dealerships offering test drives.

Vehicle manufacturers also have a key role and should be supported in finding opportunities to engage with consumers in Scotland. Fleet operators of plug-in vehicles should also be encouraged to demonstrate their vehicles and share their experiences with members of the public. Beyond "ride-and-drive" events, this can also be achieved by related efforts to encourage plug-in vehicle adoption by businesses, taxis, car clubs and rental fleets.

Action 35	Energy Saving Trust to launch an electric vehicle network tool for individuals and organisations to allow them to speak to current plug-in vehicle owners and experience plug-in vehicles first hand at their local dealerships	2013
Action 21	Transport Scotland to develop an outreach and education strategy for plug-in vehicles	2013-15
Action 27	Support for the promotion of shared plug-in vehicles through the Developing Car Clubs in Scotland programme	Ongoing

CASE STUDY: SCOTTISH BORDERS EV ROADSHOW

Scottish Borders Council held an EV roadshow over five days in towns across the Borders in April 2013. The roadshow enabled local people to speak to Council staff and vehicle manufacturers to find out more about EVs, how they are charged and whether such a vehicle would be beneficial for them.

A selection of electric vehicles from Vauxhall, Renault, Citroen and Nissan were available to test drive and information was offered to members of the public and businesses on:

- The different types of EVs available
- Battery charging speeds
- Fitting home sockets for charging, and the associated grants available
- The national charging network across Scotland and into Northumberland
- Public rapid chargers, such as the ones at Scottish Borders Council's Headquarters and in Peebles
- Leasing electric vehicles
- Insurance

Councillor Gordon Edgar, Executive Member for Roads and Infrastructure, said: *"The roadshows offered a great opportunity for local people to come along and find out more about EVs and whether they would be practical and cost-effective for them."*

Councillor Ron Smith, Executive Member for Planning and Environment, added: *"The national network of Government-funded charging points is being extended, giving Borderers a real opportunity to reduce emissions, save the planet and save ourselves some money into the bargain. This network extension is essential if motorists are to have increased confidence in these 'green' vehicles."*

11.2 Increased awareness of the imperatives for plug-in vehicles

Widespread understanding of the imperatives for adopting plug-in vehicles will be important to encourage growth in markets. Much of this comes down to connecting with the different motivations for action. For example, at the level of individuals, messaging on energy security, economic opportunities and potentially climate change is arguably too abstract and distant from most personal experiences. However, raising awareness of the damage to human health caused by road transport emissions may have a greater resonance as it has a more local and immediate impact.

This should be taken forward at a number of levels. Government has a key role to play in ensuring that EVs and PHEVs are not solely promoted as low carbon vehicles, but as a means to improve public health and advance economic opportunities that will benefit Scotland. For organisations that are involved in marketing and promoting plug-in vehicles, it is recommended that messaging is aligned and reinforced to achieve the maximum impact. At the level of individuals, consistent, credible and targeted messages need to be delivered through multiple communication channels.

Action 11	Scottish Government to develop a plug-in vehicle marketing campaign as part of wider Greener Scotland activity, to raise awareness, promote incentives and communicate benefits of plug-in vehicles	2013-14
Action 21	Transport Scotland to develop an outreach and education strategy for plug-in vehicles	2013-15
Action 23	Transport Scotland to continue to develop the electric vehicle content on the Greener Scotland website to provide information on plug-in vehicles, recharging and respond to the needs of EV and PHEV drivers	2013-14

11.3 Consumers understand how plug-in vehicles will fit their lifestyles

Further to promoting general awareness of plug-in vehicles, there is also a requirement to help people understand how an EV or PHEV would fit with their lifestyle and how they would go about making such a change. At the basic level this requires the provision of necessary information on issues such as vehicle use, vehicle options, range, incentives, recharging, costs and potential savings.

Accordingly, the task is to find innovative ways to engage, inform and enthuse consumers across Scotland. Achieving this will require cooperation between public and private stakeholders to initiate a broad based programme of activity that both understands people's beliefs and attitudes about plug-in vehicles, including any concerns, and communicates with people in order to help positively influence purchase and use.

Action 11	Scottish Government to develop a plug-in vehicle marketing campaign as part of wider Greener Scotland activity, to raise awareness, promote incentives and communicate benefits of plug-in vehicles	2013-14
Action 21	Transport Scotland to develop an outreach and education strategy for plug-in vehicles	2013-15

CASE STUDY:
SSE HYDRO CENTRE

In the heart of Glasgow, SSE has developed a state of the art exhibition featuring innovative demonstration models of EVs, exhibits showing how various forms of renewable energy are generated and a free electric car charging and test drive facility. Since opening in March 2012 the centre has received approximately 6,500 visitors, offered 122 fast charges, 67 standard charges and over 330 test drives.

The Hydro Centre has also held events in conjunction with the Energy Saving Trust to provide advice on topics such as efficient driving techniques and on the range of vehicles and incentives available.

11.4 Peer networks promote positive experiences and solve problems

Peers and trusted advocates are often key in influencing people's behaviours and therefore are likely to be a valuable asset in encouraging further adoption of plug-in vehicles. This will be particularly important in supporting organisations that are considering investing in plug-in vehicles and the provision of charge points. Connections with similar organisations that have prior experience of implementing such initiatives will make it easier to confidently invest and improve the chances of successful implementation. Structured fora are required to facilitate these dialogues, share positive experiences and collaboratively solve any problems that may arise.

This process will also be supported by collecting case studies and positive experiences from the growing community of organisations and individuals adopting plug-in vehicles across Scotland. Such insights and experiences should be widely promoted to demonstrate how to take positive action in adopting plug-in vehicles and the benefits that can be achieved.

Action 6	Transport Scotland to establish a multi-stakeholder group on fleets to review the challenges and opportunities for wider adoption and prepare necessary guidance and advice for public and private sector organisations	2013-14
Action 19	Transport Scotland to establish a multi-stakeholder group on recharging to review the challenges and opportunities and prepare necessary guidance and advice for public and private sector organisations	2013-14
Action 35	Energy Saving Trust to launch an electric vehicle network tool for individuals and organisations to allow them to speak to current plug-in vehicle owners and experience plug-in vehicles first hand at their local dealerships	2013

CASE STUDY:
ELECTRIC VEHICLE ASSOCIATION SCOTLAND

Private motorists that have made an independent decision to have an EV as their next car are invariably enthusiastic about the benefits and driving experience that it brings. As it became possible to purchase an EV from mainstream car manufacturers the number of owners has grown and an 'electric community' developed amongst drivers. Those early adopters saw that there was a pool of shared real world experience that would benefit and endorse the efforts of Government to reduce emissions from transport and more than that, help direct policy to overcome barriers to EV ownership.

As a result the EV Association Scotland was formed in early 2012 and has grown into a wide organisation of EV drivers and drivers that are considering an EV as their next car. The association takes an active part in Government led development of public infrastructure as well as promoting the new technology of modern EVs to the public.

Activities of the EV Association Scotland range from members simply being prepared to talk to passers-by when questioned about their EV in the supermarket car park, to presentations at local community events and national conferences. When drivers see EVs being used in practical every day situation this helps swing opinion from scepticism to interest to active. The growth of the EV Association Scotland is testament to benefits of this type of grass roots communication.

11.5 Children and young people are engaged

Scotland's ambitions to decarbonise road transport extend beyond 2030 and out to 2050. Accordingly, much of this progress will ultimately be driven by the present generation of children and young people. It is possible that many of them will never drive a fossil-fuelled vehicle and will reject petrol and diesel engines as being expensive, outmoded and damaging to both human health and the environment.

Curriculum for Excellence is preparing young people in Scottish schools for a rapidly changing world of the 21st century. It is important that children and young people are given an opportunity to engage with technological developments, such as plug-in vehicles. Education Scotland has developed resources to support learning in this context. These can offer exciting, meaningful, challenging and relevant contexts for learning in schools and provide an opportunity for learners to think critically, tackle complex moral, ethical, environmental and ethical issues and develop informed opinions and possible solutions.

Beyond supporting mainstream adoption, there are also opportunities to use the burgeoning interest in plug-in vehicles to promote science, technology, engineering and maths (STEM) skills within schools to ensure leaners are equipped with the skills to access careers in these sectors but also to ensure they develop as scientifically-literate citizens able to support developments that will make Scotland one of the leading low-carbon societies in the world.

Action 36	The Scottish Government and industry bodies to work with Education Scotland to review existing resource provision for schools relating to plug-in vehicles and develop further where appropriate	2013-15

11.6 A skilled workforce supports widespread operation of plug-in vehicles

Scotland will need new skills to support the growing market for plug-in vehicles and to adapt to the new challenges that this will bring.

Technical professionals will need to be equipped with the necessary knowledge to repair and maintain plug-in vehicles. This includes mechanics, service technicians, fleet managers, breakdown services and other related professions.

Technical skills will also be required by personnel responsible for the installation, maintenance, servicing and inspection of different recharging technologies. It is also essential that vehicle dealerships and sales personnel are sufficiently knowledgeable to promote plug-in vehicles as a viable option to prospective customers.

Another important area is first responders, such as police, paramedics, fire fighters and hazard response teams. It is important that these professions are trained in how to safely respond to road traffic accidents or other incidents involving plug-in vehicles and related infrastructure.

Education and outreach activities will therefore need to connect with all relevant professions to provide the necessary skills for safe and successful operation of plug-in vehicles. Coordination with industry will also be important to determine the scale of demand. In addition, engagement is required with education and training providers across Scotland to ensure that they are positioned to meet the emerging demand for these new skills.

Use should also be made of existing funding mechanisms to assist in the attainment of these skills. The Low Carbon Skills Fund[29], for example, could assist employers to train their workforce in areas such as maintenance, servicing and repair of low carbon vehicles.

The Further Education sector in Scotland has been pro-active in developing training for plug-in vehicles, with both Edinburgh College and Motherwell College, for example, already offering awards on topics such as EV repair and maintenance.

Action 37	Scottish Government to work with industry, Skills Development Scotland and other key stakeholders, such as the Scottish Funding Council, to quantify and determine the nature and demand for plug-in vehicle education and skills and review and revise provision accordingly	2013-15

[29] http://www.skillsdevelopmentscotland.co.uk/our-services/low-carbon-skills-fund/

11.7 Plug-in vehicle driver training

Training new and potential drivers of plug-in vehicles offers an important way to increase confidence in the technology and reduce the risk of any negative events, such as miscalculating the driveable range or failing to correctly charge a vehicle. In particular, organisations that provide electric pool cars or other fleet vehicles should ensure that their staff are given appropriate instructions and training.

More advanced training in efficient driving techniques will also increase the driveable range of plug-in vehicles. This could expand the potential application for these vehicles, save organisations money and promote greater awareness of the benefits of fuel efficient driving.

A number of organisations including the Energy Saving Trust provide specialist driver training for plug-in vehicles. Scottish organisations should therefore be encouraged to access these opportunities.

Action 6	Transport Scotland to establish a multi-stakeholder group on fleets to review the challenges and opportunities for wider adoption and prepare necessary guidance and advice for public and private sector organisations	2013-14
Action 12	Energy Saving Trust to continue to promote its support for Scottish businesses to adopt plug-in vehicles through EV Awareness Raising Workshops, Sustainable Transport Advice Service and Interest Free Low Carbon Transport Loans and FuelGood driver training	Ongoing

Source: Johnson Matthey Battery Systems

12 Cross-cutting objectives

12.1 Introduction

The previous chapters set out the way forward by identifying the necessary future progress across all stakeholders in Scotland and specific actions that will be taken by the Scottish Government to help establish the market for plug-in vehicles.

Achieving the Roadmap vision will require sustained action in each of the seven areas outlined with failure to do so making progress slow and inefficient. Delivery also requires a long-term strategic approach that results in cross-cutting actions and not isolated initiatives. The following sections summarise and further clarify the Government actions set out in this Roadmap and explain how they can collectively drive progress. They are grouped into five cross-cutting themes of: public sector leadership; making strategic investments; promoting incentives; mobilising key stakeholders; and outreach and education.

12.2 Public Sector Leadership

Transport Scotland will work with colleagues across Government and the public sector to support the development of policy frameworks that encourage the adoption of plug-in vehicles (Action 1). An initial area of focus will be to further incentivise the deployment of recharging infrastructure by preparing legislation to implement a new permitted development right for off-road charge points during 2013-14 (Action 7) and consideration of how best to strengthen guidance for planning authorities relating to plug-in vehicle charge point provision in new developments, as part of the review of Scottish Planning Policy (Action 32).

The public sector can also show leadership by helping to build demand in the early market. A number of public sector fleets in Scotland have made good progress in lowering their average emissions. To sustain and broaden this progress, Transport Scotland proposes to work with CPPs to outline timelines for reducing emissions across the entire public sector fleet. The results of the Plugged-in Fleets Initiative[30] showed that differences in the way that fleets operate mean that it will be necessary to do this on a case-by-case basis rather than as a single quantitative target. Support will therefore be offered in the form of analysis, guidance and advice to develop actionable plans for fleets and to optimise the levels of ambition, with this work phased over 2013-15 (Action 15). As part of this commitment, the Scottish Government will realise appropriate opportunities to replace fossil-fuelled vehicles with plug-in cars and vans as part of the ongoing replacement cycle of its fleet (Action 4).

Additional actions and opportunities to show leadership will also be advanced. In particular, public sector employees will be encouraged to adopt plug-in vehicles through the provision of workplace recharging, with charge points installed at all main Government buildings by the end of 2014 (Action 20).

12.3 Making Strategic Investments

Promoting widespread use and adoption of plug-in vehicles requires that investments are targeted at transformational activities that will contribute to each of the seven goals of the Roadmap.

In addition to over £8 million of funding that has already been invested in recharging infrastructure deployment through Plugged in Places and the introduction of 270 plug-in vehicles to the public sector fleet, Transport Scotland has committed over £14 million over the next two years to take forward work across the low carbon vehicle agenda.

[30] Energy Saving Trust (2013) Plugged in Fleets Initiative: Charging Forward http://www.energysavingtrust.org.uk/Publications2/Transport-fleets/Research-and-statistics/Plugged-In-Fleets-Initiative-Charging-Forward

Part of this funding will support the ongoing development of a national recharging infrastructure for Scotland. Transport Scotland has provided resources and support to Scotland's CPPs in 2012/13 and 2013/14 in order to achieve this aim. This support will continue into 2014/15 (Action 18).

Funding for recharging infrastructure will be targeted to meet the changing needs of the market. Priorities include the provision of 100 per cent funding for the installation of home charge points, funding to incentivise businesses and major employers to install workplace recharging (Action 18), the installation of charge points at park and ride sites and other transport interchanges (Action 28 and Action 29) and the deployment of rapid charge points at intervals of at least every 50 miles on Scotland's primary road network (Action 25). There will also be a focus on making the use of charge points as convenient as possible through the provision of a pay-as-you-go network (Action 24).

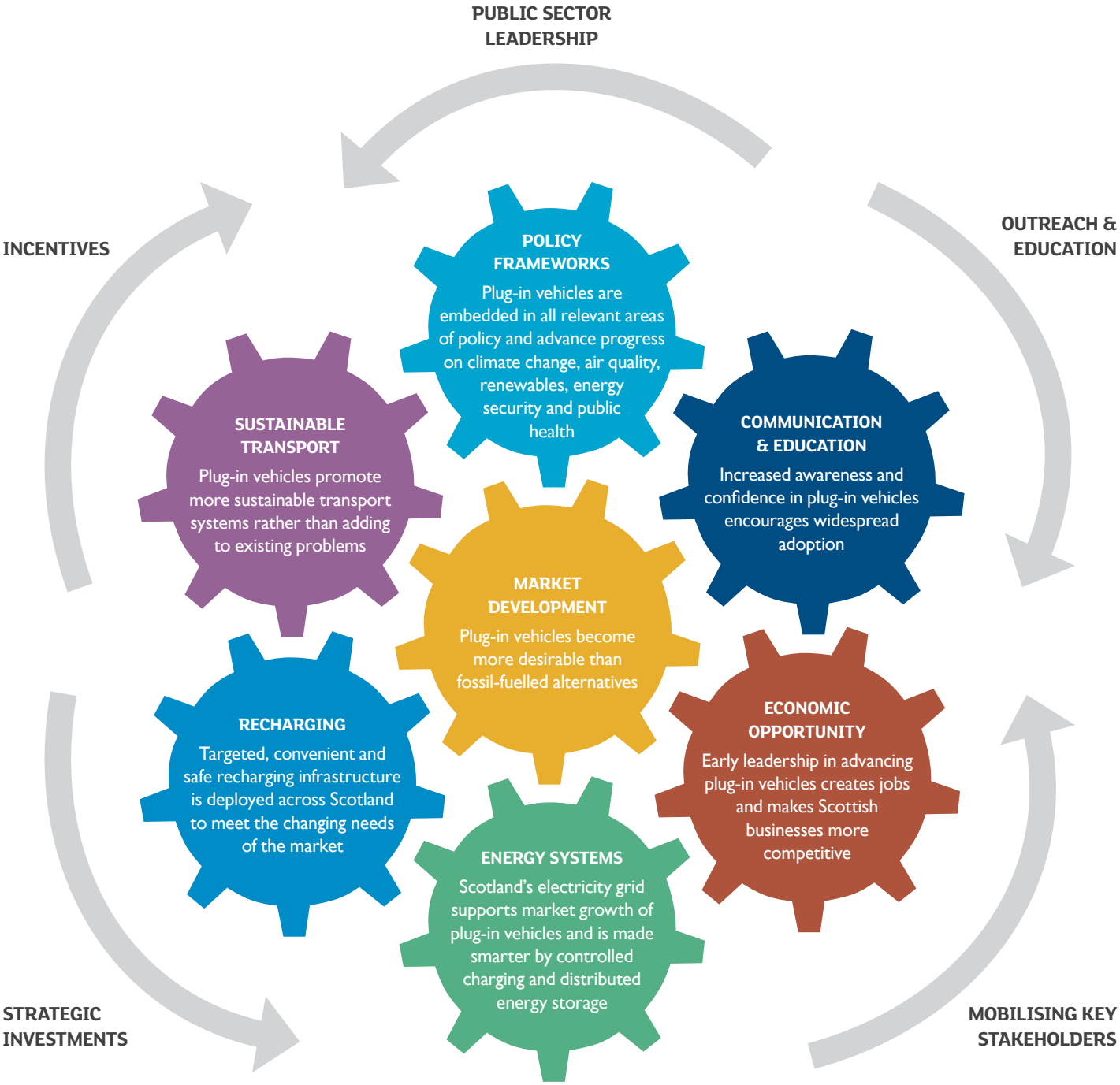


Figure 14: Cross-cutting objectives for Government to drive long-term progress on each of the goals set in the Roadmap

Transport Scotland will also undertake a study on transitioning infrastructure provision from a Government-funded pilot project to a private sector-led initiative that meets Scotland's long-term needs for recharging infrastructure (Action 22).

To extend the reach of Government funding, priority will be given to collaborative projects which engage key stakeholders and support private sector investment. This will be complemented by the Scottish Government, Scottish Enterprise and partners in the public and private sector working to attract investments and to promote Scotland as an attractive location to introduce new consumer offerings and mobility services for plug-in vehicles (Action 16). It will also be supported by continued engagement with international plug-in vehicle networks and projects to access both the additional funding and expertise that such initiatives offer (Action 8).

Other Transport Scotland funded initiatives will also support the implementation of the Roadmap. For example, the DCCS Programme is providing financial and technical assistance to support the introduction of shared plug-in vehicles in car club fleets (Action 27). Furthermore, the Green Bus Fund will continue to support the wider roll out of low emission buses across Scotland (Action 26).

Government also recognises the importance of a comprehensive and robust evidence base to support widespread investments in plug-in vehicles. Transport Scotland will therefore work with OLEV to share data and insights from the Plugged in Places project (Action 10) and work to promote any important findings arising from projects undertaken in Scotland or elsewhere. Transport Scotland will also continue to review the existing evidence base and identify any needs to commission new research (Action 2).

An overarching objective for all investments made in plug-in vehicles and supporting infrastructure is alignment with the Roadmap's goal to realise the economic opportunity presented by early leadership in this market. To better understand this potential, and ensure that necessary investments are made and supported, Scottish Enterprise will focus on growing capability and capacity around Smart Mobility, including a key focus on transport systems (Action 34).

12.4 Promoting Incentives

The Roadmap establishes an overarching market development goal of promoting plug-in vehicles as being more desirable than fossil-fuelled alternatives. Therefore a key focus for implementation will be to maximise the value proposition of plug-in vehicles, ensuring that the benefits exceed the perceived costs.

Many of the developments to reduce the whole-life and purchase costs of plug-in vehicles will be driven by industry through innovation, more efficient production and new business models. Accordingly, the Scottish Government will continue to work closely with industry to meet the changing needs of the plug-in vehicle market (Action 17).

However, in the early market this will also be supported by government incentives. The Plug-in Car and Van Grants offer direct purchase incentives to reduce the cost of EVs and PHEVs. Furthermore, a range of fiscal incentives are also in place in the UK to make ownership of plug-in vehicles more cost effective. As all of these incentives are currently planned to run until 2015, the Scottish Government will work with the UK Government to assess the future provision of incentives and the most effective way to support the developing markets for plug-in vehicles (Action 13).

Transport Scotland will also work with local authorities and planning authorities to progress opportunities to use local planning, parking and traffic management powers to promote plug-in vehicles. This will see the development of a framework for local incentives across Scotland during 2014-15 (Action 14). This will review all possible measures, provide implementation guidance and establish a basis to align developments across different regions.

Businesses and employers will also be encouraged to advance a range of measures to make ownership of plug-in vehicles more convenient and cost effective. This includes company car provision, salary sacrifice schemes for purchasing vehicles, free or preferential parking and provision of workplace recharging. Transport Scotland will work with the Energy Saving Trust and other stakeholders to prepare guidance on the actions that can be taken to promote plug-in vehicles, with a view to publishing in 2014 (Action 5).

The final category of incentives is measures to make plug-in vehicles more convenient than fossil-fuelled cars and vans. The Scottish Government will therefore determine the role that plug-in vehicles can play in Air Quality Action Plans as part of the review of LAQM during 2013-14 (Action 3) and work with partners to undertake a study into the development of a national framework for establishing low emission zones (Action 30).

12.5 Mobilising Key Stakeholders

Many of the necessary actions to advance plug-in vehicle markets are outside of the direct influence of the Scottish Government. Implementation of these actions will therefore require that responsible stakeholders are engaged and given necessary support. The Scottish Government's principal method for achieving this will be through continuing to co-ordinate partnership working and promoting communication across the plug-in vehicle stakeholder community (Action 9).

In the process of developing the Roadmap, representatives of 78 different organisations contributed insights and support. To ensure that these organisations and individuals remain engaged and play an active role in implementing the Roadmap, Transport Scotland will establish multi-stakeholder groups in 2013-14. This will bring together experts, peers and champions that are actively working to advance plug-in vehicles. These groups will aim to highlight best practice, share lessons learned, solve problems and broaden opportunities for plug-in vehicle adoption. Three groups will initially be established to provide support on fleets (Action 6), recharging (Action 19) and energy systems (Action 31).

The EV Strategic Board established through the E-cosse partnership will also have a role in mobilising additional resources and expertise to advance plug-in vehicles. This group of senior leaders from across the public and private sector was specifically established to develop shared commitments to action across Government and industry, promote private sector investments and work to attract additional funding.

The energy sector will represent a key area of engagement. Government will work with Distribution Network Operators and energy suppliers to plan for increased adoption of plug-in vehicles and develop opportunities to advance smarter grids. Similarly Government will work with energy suppliers to encourage the deployment of tariffs and technologies to manage recharging behaviours and maximise the emission reduction benefits across Scotland (Action 33).

12.6 Outreach and Education

Effective outreach and education initiatives will be essential to advance the adoption of plug-in vehicles, the deployment of recharging infrastructure and to create the necessary behaviour changes to penetrate mainstream markets.

At the basic level, this requires that individuals and organisations understand the imperatives for plug-in vehicles and how they can support, participate and benefit from this change. Also, once individuals and organisations have made the transition to plug-in vehicles, there is then a requirement to sustain and embed this behaviour. This requires continued promotion of the benefits and efforts to maximise consumer satisfaction.

There is no single way to connect with and influence all relevant stakeholders in Scotland. Furthermore, this will not happen overnight. Therefore, to ensure that available resources and means are most effectively deployed, Transport Scotland will develop an outreach and education strategy for plug-in vehicles during 2013-15 (Action 21).

This strategy will build on the Energy Saving Trust's continued support for Scottish businesses in adopting plug-in vehicles through Sustainable Transport Advice Service, Interest Free Low Carbon Transport Loans, EV Awareness Raising Workshops and FuelGood driver training (Action 12) as well as a new driver network tool to allow individuals and organisations to speak to current plug-in vehicle owners and experience plug-in vehicles first hand at their local dealerships (Action 35). It will also encompass a marketing campaign as part of the Scottish Government's wider Greener Scotland activity (Action 11) as well as continued development of the EV and PHEV content on the Greener Scotland website (Action 23). This will seek to provide a comprehensive range of relevant information, guidance and evidence to promote adoption of plug-in vehicles. It will also highlight best practice, testimonials and educational materials, as well providing links to other relevant internet resources. The strategy will also include strands to support and maintain satisfaction amongst existing plug-in vehicle drivers. This will include relevant information on the location of charge points and feedback mechanisms to help inform future plans and ensure that any inconveniences or difficulties can be quickly addressed.

To encourage the development of the necessary skills to support widespread adoption of plug-in vehicles, the Scottish Government will continue to work closely with industry to ensure that future needs are anticipated. This will include working with employers as well as children and young people to promote awareness and future employment opportunities. This will see the Scottish Government and industry bodies work with Education Scotland to review existing resource provision for schools relating to plug-in vehicles (Action 36). The Scottish Government will also work with Skills Development Scotland and other key stakeholders to determine the nature and demand for plug-in vehicle education and skills and review and revise provision accordingly (Action 37).

12.7 Review and Evaluation

The rapid pace of change in technologies and markets for plug-in vehicles raises the expectation that new challenges and opportunities will emerge. The implementation of the Roadmap will therefore be an iterative process in which adjustments are made to respond to any such changes. Accordingly, an implementation review will be undertaken in 2015 to assess progress and identify any areas in which further action is required.

Summary of actions for Government

PUBLIC SECTOR LEADERSHIP

ACTION 1	Transport Scotland to continue to engage with colleagues across Government and the wider public sector to promote the inclusion of plug-in vehicles in relevant policies and strategies	Ongoing
ACTION 4	Scottish Government, as part of ongoing vehicle replacement cycle, to replace fossil-fueled vehicles with plug-in vehicles, where appropriate	Ongoing
ACTION 7	Scottish Government to prepare legislation to implement a new permitted development right for off-road charge points	2013-14
ACTION 15	Transport Scotland to provide funding and work with partners to support evidence-based analysis of public sector fleets to create new opportunities for the deployment of plug-in vehicles	2013-15
ACTION 20	Transport Scotland to install charge points at all main Scottish Government buildings	2013-14
ACTION 32	Scottish Government to consider how best to strengthen guidance for planning authorities relating to plug-in vehicle charge point provision in new developments as part of a review of Scottish Planning Policy	2013-14

STRATEGIC INVESTMENTS

ACTION 2	Transport Scotland to review the existing evidence base and identify needs for new research or data to support the development of policies which impact on plug-in vehicles, such as air quality, health and energy	Ongoing
ACTION 8	Scottish Government and its partners to continue to engage with international plug-in vehicle networks and projects to attract funding and support policy debates	Ongoing
ACTION 10	Transport Scotland to work with OLEV to share data and insights from the Plugged in Places project	2013-14
ACTION 16	The Scottish Government, Scottish Enterprise and partners in the public and private sector to promote Scotland as an attractive location to introduce new consumer offerings and mobility services for plug-in vehicles	Ongoing
ACTION 18	Transport Scotland to continue to provide funding for the safe and convenient installation of domestic, workplace and en-route charge points	2013-15
ACTION 22	Transport Scotland to commission a review of the opportunities to transition infrastructure provision in Scotland from a Government-funded pilot to a private sector-led initiative that meets Scotland's long-term needs for recharging infrastructure	2014-15
ACTION 24	Transport Scotland to roll out a network of pay-as-you-go charge points in Scotland – making payment for charging/parking as straightforward as possible for plug-in vehicle drivers	2013-14
ACTION 25	Transport Scotland to deploy rapid charge points at intervals of at least 50 miles on Scotland's primary road network to enable extended all-electric journeys	2013-15
ACTION 26	Scottish Green Bus Fund to continue to support the wider roll-out of low emission buses across Scotland	Ongoing
ACTION 27	Support for the promotion of shared plug-in vehicles through the Developing Car Clubs in Scotland programme	Ongoing
ACTION 28	Transport Scotland to continue the deployment of charge points at park and ride sites and other transport interchanges	2013-15
ACTION 29	Transport Scotland to encourage the deployment of electric vehicle charging points at railway stations with bidders for the new ScotRail Franchise	2013-15
ACTION 34	Scottish Enterprise to unite, understand, support and strengthen Smart Mobility activity including (but not limited to) Transport Systems, Informatics and Energy Companies from which economic benefits flow. This will include growing capability and capacity around Smart Mobility, stimulating projects, realising benefits and expanding global reach	2013-14

INCENTIVES

ACTION 3	Scottish Government to determine the role plug-in vehicles can play in Air Quality Action Plans as part of the review of Local Air Quality Management in Scotland	2013-14
ACTION 5	Transport Scotland to work with Energy Saving Trust and other stakeholders to prepare guidance on the actions that can be taken to promote plug-in vehicles	2013-14
ACTION 13	Scottish Government to work with the UK Government to assess the future provision of incentives and the most effective way to support the developing markets for plug-in vehicles	Ongoing
ACTION 14	Transport Scotland to work with local authorities, planning authorities and COSLA to develop a national framework for local incentives	2014-15
ACTION 17	Scottish Government to continue working closely with industry to meet the changing needs of the plug-in vehicle market	Ongoing
ACTION 30	Scottish Government to work with partners to undertake a study into the development of a national framework for establishing low emission zones	2014

MOBILISING STAKEHOLDERS

ACTION 6	Transport Scotland to establish a multi-stakeholder group on fleets to review the challenges and opportunities for wider adoption and prepare necessary guidance and advice for public and private sector organisations	2013-14
ACTION 9	Transport Scotland to continue to co-ordinate partnership working and promote communication across the plug-in vehicle stakeholder community.	Ongoing
ACTION 19	Transport Scotland to establish a multi-stakeholder group on recharging to review the challenges and opportunities and prepare necessary guidance and advice for public and private sector organisations	2013-14
ACTION 31	Transport Scotland to establish a multi-stakeholder group on energy systems to review the challenges and opportunities and prepare necessary guidance and advice for public and private sector organisations	2013-14
ACTION 33	Scottish Government to continue to work with energy suppliers to encourage the deployment of tariffs and technologies to manage recharging behaviours and maximise the emission reduction benefits across Scotland	Ongoing

OUTREACH AND EDUCATION

ACTION 11	Scottish Government to develop a plug-in vehicle marketing campaign as part of wider Greener Scotland activity, to raise awareness, promote incentives and communicate benefits of plug-in vehicles	2013-14
ACTION 12	Energy Saving Trust to continue to promote its support for Scottish businesses to adopt plug-in vehicles through EV Awareness Raising Workshops, Sustainable Transport Advice Service and Interest Free Low Carbon Transport Loans and FuelGood driver training	Ongoing
ACTION 21	Transport Scotland to develop an outreach and education strategy for plug-in vehicles	2013-15
ACTION 23	Transport Scotland to continue to develop the electric vehicle content on the Greener Scotland website to provide information on plug-in vehicles, recharging and respond to the needs of EV and PHEV drivers	2013-14
ACTION 35	Energy Saving Trust to launch an electric vehicle network tool for individuals and organisations to allow them to speak to current plug-in vehicle owners and experience plug-in vehicles first hand at their local dealerships	2013
ACTION 36	The Scottish Government and industry bodies to work with Education Scotland to review existing resource provision for schools relating to plug-in vehicles and develop further where appropriate	2013-15
ACTION 37	Scottish Government to work with industry, Skills Development Scotland and other key stakeholders, such as the Scottish Funding Council, to quantify and determine the nature and demand for plug-in vehicle education and skills and review and revise provision accordingly	2013-15

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Gordon McGregor	Energy and Environment Director (Co-Chair)	ScottishPower
Mark Bonnor-Moris	Head of Electromobility UK and Europe	Siemens
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British Gas

CarbonJet Ltd.
Carplus Trust
Chargemaster plc
City Car Club
City of Edinburgh Council
Clackmannanshire Council
COSLA

Dundee City Council

East Lothian Council
East Renfrewshire Council
Edinburgh Centre for Carbon Innovation
Edinburgh College
Edinburgh Computer Services (Scotland) Ltd
Edinburgh Napier University
Electric Vehicle Association Scotland
Elektromotive Ltd
Energy Saving Trust
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