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STRATEGIES TO ENCOURAGE USE OF ELECTRIC, HYBRID ELECTRIC AND GAS VEHICLES VEHICLES IN NORTHERN AND CENTRAL EUROPE

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1 INTRODUCTION

This report considers how the use of electric, hybrid and gas vehicles can be encouraged. These vehicles, together with hydrogen vehicles, are widely regarded as the solution to volatile oil prices, poor air quality and particularly, reducing carbon dioxide (CO_2) emissions from road transport. Hydrogen vehicles are not considered in this report as their adoption is considered to be some years away, whereas battery electric vehicles (BEV), hybrid electric vehicles (HEVs) and gas vehicles are already on the market, albeit only a small number of models are available compared to the number of gasoline and diesel models.

Traditionally electric motors have been considered best suited to light duty vehicles (i.e. cars and vans), as the electricity demand of heavy duty vehicles (HDVs) is generally considered to be too great to be satisfied without a very large number of batteries which adds significant weight to the vehicle. However diesel electric hybrid and pure electric buses are beginning to be used in a number of cities, and with improvements to battery performance, heavy goods BEVs are considered potentially feasible within a decade (Boer et al., 2013).

Trials are taking place of wireless recharging technology for buses to enable battery electric buses to have comparable performance as a diesel bus. For example, eight electric buses started operation in Milton Keynes, England, in 2014. The buses are charged using an induction coil buried in the road and a second coil on the bus. Ten minutes parked over a coil replenishes approximately two thirds of the energy consumed by the bus along its route. The induction coils are placed at three locations and the buses are also charged during the layover time at the ends of the route. The UK Highways Agency has also announced a study into the feasibility of induction charging for EVs on the move on the UK motorway network; Korea already has a demonstration project along 12 km of motorway.

Gas is considered to be the best alternative fuel for heavy duty vehicles (HDVs), particularly long-distance delivery vehicles in the short to medium term, but is also used in light duty vehicles, particularly in Italy.

Electric vehicles (EVs) have a long history, with the first appearing towards the end of the 19th century. By the 1930s the internal combustion engine (ICE) had replaced EVs, and it was not until the 1990s that BEVs briefly reappeared on the market. However, in the last decade there has been a renewed interest in the technology, driven largely by the need to reduce carbon dioxide (CO_2) emissions. These vehicles have zero exhaust emissions at the point of use, but their life-cycle emissions depend on the fuel used at the power station, and until power generation is decarbonised these will not be truly zero emission vehicles. There will also remain some non-exhaust emissions of particulate matter (PM) due to break, tyre and road surface wear and the re-suspension of deposited dust on the road.

Intelligent charging strategies are being developed that will enable EVs to be recharged whilst managing electricity demand and the fluctuations inherent in renewable electricity generation, particularly wind energy. A ‘smart grid’ can allow BEVs to be charged according to electricity production patterns, but requires a completely new way of organising the interface between the transport and energy sectors.

Limited production of HEVs started in Japan in 1997, and plug-in HEVs (PHEVS) in 2004. BEVs were first introduced for general sale by a mass car manufacturer in Europe in 2011 (Al-Alawi and Bradley, 2013), although there were a few niche products from small manufacturers available in certain EU countries prior to this date. The vast majority of Europe's new cars are powered by gasoline or diesel motors, and this is likely to continue to be the case for many years. All other technologies together amounted to less than 4% of EU new car sales in 2014. Most of these were gas (1.9%), HEVs (1.6%), with BEVs contributing just 0.3% of EU new car registrations (International Council on Clean Transportation, 2015a).

The use of gas for road vehicles has a similar long history, with the first trials also dating back to the 19th century. These vehicles were used in the first and second world wars as an alternative to gasoline, which was in short supply. Very large gas 'bags' were placed on the roof of vehicles, but because it was not compressed the vehicle range was short. Today liquid petroleum gas (LPG) is the most widely used alternative fuel in Europe. Its market share was 3% of motor fuels, and about 6 million cars in the EU were running on it in 2013 (European Commission, 2013). The LPG refuelling infrastructure is well established, with about 28,000 filling stations in the EU but these are unevenly distributed. Compressed natural gas (CNG) vehicle technology is also mature, with over 1 million vehicles on the road in Europe and around 3,35000 filling stations in the EU. However, these stations are also unevenly distributed across member states, with more than half located in Germany and Italy (European Commission, 2013).

Poland and Italy have the highest proportion of natural gas cars in the EU with approximately 2.5 million and 1 million vehicles respectively. In Poland many of the cars are old gasoline cars that have been retrofitted to run on LPG, although a range of new LPG car models are available

Gas vehicles are more widely used in certain South American and Asia countries, particularly countries that have a good supply of natural gas. However in most European countries government policies promote EVs (and HEVs) over the use of gas (Engerer & Horn, 2010).

There are significant market barriers to the use of BEVs, PHEV and gas vehicles. Depending on the fuel, these include:

- Vehicle purchase price
- Running costs i.e. the cost of replacement batteries
- Fuel/charging infrastructure
- Driving range
- Charging time
- Limited choice of models
- Limited consumer acceptance

Acceptance, and consequently sales, of alternative fuelled vehicles is generally low in Europe, although there are some limited exceptions. These are BEVs in Norway, HEVs in the Netherlands, natural gas in Italy, and ethanol in Sweden. France has higher sales of EVs than Norway, but a much smaller market share. In each of these countries government policies have influenced consumer choice (International Council on Clean Transportation, 2015b). However, even in these markets these vehicles are relatively rare compared to Japan, where

over 20% of new cars are HEVs. If the Japanese unique 'kei' class of cars (light-weight cars with engines less than 0.66 litre capacity) are excluded, HEV are over 30% of the conventional new car market (International Council on Clean Transportation, 2015c). This high market share is also due to government subsidies and other fiscal incentives (Alhulail and Takeuchi, 2014). A survey of consumer attitudes to BEVs and HEV in six EU countries, conducted by the European Commission's Joint Research Centre, found that car drivers considered that public incentives are necessary to increase market share (Thiel et al., 2012).

The Californian experience of mandating EVs suggests that the use of fiscal and other incentives is the best approach to increasing market share of low emission vehicles. In 1990 the California Air Resources Board (CARB) mandated 2% of vehicles on sale in California in 1998 and 10% in 2003 be zero emission vehicles. In 1996 CARB removed the 1998 requirement and in 2001 reduced the 10% requirement to 2% hydrogen fuel cell or electric vehicles, 2% HEVs and 6% ultra-clean gasoline vehicles. Then in 2003 CARB changed the requirements yet again to a complex system of banking credits, and finally in 2008 the regulations changed to promote the development of PHEVs (Union of Concerned Scientists, 2015).

Most EU countries currently use fiscal incentives based on a vehicle's CO_2 emissions or fuel consumption to encourage the purchase and/or use of vehicles with lower emissions. This policy is generally part of a package of measures to reduce national CO_2 emissions to meet European Union (EU) and other emission reduction targets. The widespread use of EVs and gas vehicles in urban areas would also have a benefit in terms or air quality. However, there is broad consensus that these vehicles will continue to be a small proportion of the total vehicle sales for at least the next decade and that gasoline and diesel vehicles will continue to dominate (e.g. Beltramello, 2012), despite the published ambitions of some Governments. For example, to meet the German and UK published targets would require EV sales in 2020 to be 1 million and 750,000 respectively (Elkins and Potter, 2010). Current annual new car sales are around 3 million (Germany) and 2.5 million (UK) (International Council on Clean Transportation, 2015a).

Evidence from the US, Japan and Norway suggests that fiscal incentives are effective in increasing the market share of EVs. For example Gallagher & Muehlegger (2011) studied the relative efficacy of US state sales tax waivers, income tax credits and non-tax incentives of increasing HEV sales, and found that state tax waivers were the most effective incentive, even where the income tax credits were more generous. They estimated that sale tax waivers are associated with more than a ten-fold increase in HEV sales relative to income tax credits.

There is also evidence that non-fiscal benefits, in certain circumstances, can be effective in increasing the popularity of EVs. Gallagher & Muehlegger (2011) found that in general allowing single occupancy HEVs to drive in high occupancy vehicle (HOV) lanes did not increase HEV sales with one exception. In Virginia, however, access to HOV lanes is associated with a 92% increase in HEV sales, consistent with anecdotal evidence that HEV owners in the state use these lanes to travel to and from Washington DC. Similar evidence is available in Norway of bus lane access increasing BEV sales around Oslo. Both areas are highly congested, and being able to drive in the HOV/bus lanes provides a significant time incentive.

Whilst taxation policy tends to be decided nationally, other fiscal and non-fiscal incentives

can be applied at the regional or local level. These include exemptions from parking and toll chargers, access to bus lanes, and reduced parking restrictions.

The purchase of a new car is a major decision. Consumers are typically sceptical of new automotive technologies due to the high purchase costs and are generally cautious when making their new vehicle choice. For example, they want to be reassured of the resale value. It tends to take some years for new technologies to become widely accepted. For example, it took six years for the sales of the Toyota Prius HEV to start to take off globally after its initial launch (Beltramello, 2012). In general, new automotive technologies are introduced at the luxury end of the market before filtering down over time. The EV market has been different because these vehicles are generally replacing smaller and cheaper cars. Purchasers in this market may be less willing to risk purchasing unknown technology than at the upper end, and therefore it may take longer for these vehicles to be accepted. This may change, however, with the launch of the first premium mass market EV in 2012 (Figenbaum & Kolbenstvedt, 2013). The Tesla Model S which can accelerate from 0-60 mph in 4.2 seconds became Norway's top selling car at the end of 2013.

In 2014 the manufacturers that sold the most EVs were Renault-Nissan (26% of world market), Mitsubishi (12%), and Tesla (10%). These companies each sold more than 30,000 vehicles in many regions of the world. General Motors, Ford, and Toyota are next, with 6%-8% each of global sales, mostly from sales of PHEV in the US market (International Council on Clean Transportation, 2015a).

The success of the Tesla may be due to dealers understanding how to sell their product. A consumer survey has shown that the best EV purchase experience was with this company. Evidence from California suggests that conventional car dealers are poor at selling EVs and do not provide sufficient information for potential purchasers. EV buyers expect more from dealers than conventional buyers, but the profits from the sale of these vehicles may not be sufficient to convince more dealers to take on the greater demands of selling these vehicles (Cahill et al., 2014).

Most European car drivers are unaware of the performance characteristics of BEVs, which differ significantly from internal combustion engines, and demonstration projects are needed to increase public awareness (Thiel et al., 2012). A large scale BEV trial in the UK, involving 349 vehicles, showed that drivers found the current generation of BEVs to be fun to drive, smooth and were highly rated for their acceleration. Over a third of the drivers said that their EV had superior performance to their normal car, 80% could imagine replacing one of their vehicles with an BEV, and 50% intended to purchase an BEV on completion of the trial, but 60% indicated that they would still own a conventional vehicle as a backup. Factors that influenced the drivers intentions to purchase a BEV included the price, which they expected to be the same as a conventionally fuelled car, residual values, the second-hand market, insurance, battery life, maintenance costs and how quickly the current technology would be surpassed (Carroll et al., 2013).

Another perceived barrier to BEVs and PHEVs is an adequate recharging network (Thiel et al., 2012). While a large part of the infrastructure exists, i.e. through the existing electricity grid, a good network of charging points remains to be developed. It has been estimated that at the end of 2012 there were around 26,080 private and 29,800 public dedicated charging points in the EU. France has the most with approximately 28,000. Based on public announcements,

the network of charging points is expected to increase significantly in France with 4,400,000 charging points by 2020. In the rest of EU, only 600,000 points are expected to be deployed by 2020 (European Commission, 2013). A new EU Directive (2014/94/EU) on the deployment of alternative fuels infrastructure was adopted in October 2014, which aims to encourage the development of fuelling/recharging networks.

Experience in Norway shows that few BEV drivers actually use the public charging network, preferring to re-charge their vehicle batteries at home or work (Haugneland and Kvisle, 2013). In the UK trial 75% of the BEV drivers said that they prefer charging their vehicle to going to a petrol station, due to the freedom of being able to re-charge at home. Prior to the trial 87% of the private drivers (i.e. not corporate drivers) said that public charging infrastructure is necessary, but this reduced to 71% after three months, even though 79% of the drivers said that they could complete their journeys without a public charging infrastructure. It was also found that the distance driven between charging increased over time as drivers became more confident of the battery capacity (Carroll et al., 2013).

One of the constraints to increasing the market share has been the few models on the market. In 2001 only two HEV models were offered in the EU (Toyota Prius and Honda Civic), and only 2,200 were sold. Now 30 HEV and PHEV models are available and more than 200,000 are sold. However these vehicles make up only 1.6% of new vehicle sales in the EU. A quarter of all new Toyotas sold in the EU were HEVs (International Council on Clean Transportation, 2015a).

The European car market is highly segmented, with purchasers often deciding the category (ranging from small to sports and luxury) before the make and model. The current supply of HEV, PHEVs, BEVs and gas vehicle models remains limited in terms of vehicle segments and brands. The choice of vehicle segment is related to the consumer requirements for size, comfort and practicality, whereas brand choice reflects more emotional factors such as brand attachment, perceived reliability and vehicle image. The model diversity however varies across vehicle segments and alternative fuel types.

2 EUROPEAN INITIATIVES

There are a number of European policy initiatives to support the development of alternative fuelled vehicles, particularly EVs. One of the aims of the EU Transport White Paper "Roadmap to a single European transport area – towards a competitive and resource efficient transport system" is to halve the use of conventionally-fuelled cars used in urban areas by 2030; and phase them out completely in cities by 2050 (European Commission, 2011). This is part of the European Commission's commitment to reduce CO_2 emissions by 60 per cent from the transport sector by 2050.

Directive 2009/33/EC promotes clean and energy efficient vehicles through procurement contracts. It applies to the public sector and private sector companies that provide public services, such as utilities companies and public transport operators, and requires the energy and environmental impacts to be considered during the procurement process. This Directive is expected to result in a progressive improvement in the energy and environmental performance of the whole vehicle fleet.

EC Regulations 443/2009 and 333/2014 sets standards for average CO_2 emissions from new passenger cars registered in the EU. These are 130 g km^{-1} by 2015 and 95 g km^{-1} from 2020. The 2015 target was achieved two years early, in 2013 (European Environment Agency, 2014). The regulations provide incentives for alternative fuelled vehicles by treating these vehicles favourably when calculating average CO_2 emissions from a manufacturer.

In 2014 a Directive on the development of infrastructure for alternative fuels across Europe was adopted which contains common technological specifications for recharging and refuelling points. Member States have to set binding targets for the development of public recharging/refuelling stations. In urban and suburban area the EV recharging network is to be constructed by 2020, ideally with a minimum of one recharging point per ten EVs. For liquefied natural gas (LNG) Member States have to ensure a sufficient number of publicly accessible refuelling points, with common standards, on the TEN-T core network, ideally every 400 km, to be built by end-2025. For compressed natural gas (CNG) Member States have to ensure a sufficient number of publicly accessible refuelling points, with common standards, to allow the circulation of CNG vehicles, both in urban and sub-urban areas as well as on the TEN-T core network, ideally every 150 km, to be built by end-2025. The Directive also requires clear consumer information to facilitate use including on the recharging and refuelling stations themselves, as well as comparison of prices for the different automotive fuels.

3 TAXATION POLICY

3.1 Introduction

In the early to mid-2000s a number of EU member states began introducing taxes based on a vehicle's CO_2 emissions. Previously vehicle taxation was typically based on horsepower, weight or engine capacity (Klier & Lin, 2012). Vehicles are subject to a purchase/registration tax or an annual circulation tax or often both. In most EU countries one or both of these taxes are now based on CO_2 emissions. According to Rubik & Mityorn (2011) there were 18 EU countries with CO_2 based vehicle taxation system in 2011 including Germany, Sweden, France, Denmark and the Netherlands. This has increased to 20 EU member states (ACEA, 2015). In addition there are 18 EU member states which apply fiscal incentives for electric vehicles (ACEA, 2015).

Vehicle price tends to be the most important factor influencing vehicle choice, and therefore, while alternative fuelled vehicles remain more expensive than conventional vehicles, incentives are required. Consumers show high discounting rates for future spending and therefore most car buyers perceive the potential running cost savings offered by EVs as insufficient to offset the additional capital (Gallagher & Muehlegger, 2011).

The following sections provide examples of some tax incentives and their impacts on new vehicle registrations. It should be noted that vehicle taxation is complicated and that tax incentives include purchase/registration tax, annual circulation tax, company car tax and capital allowances for businesses that reduce the tax they are required to pay. This section focuses on incentives provided to encourage motorists to purchase alternative fuelled vehicles through the use of differential vehicle purchase/registration and annual taxes. It does not

include Governmental financial support for research and development into ultra-low emission vehicles, which can also over the medium to long term influence the vehicle fleet.

The International Council on Clean Transportation's (2014) global comparison of fiscal incentives concluded that national fiscal policy is a powerful mechanism to reduce the effective total cost of car ownership and entice vehicle consumers to purchase EVs. It notes that incentives for company cars tend to be larger than for private cars.

Table 1 summarises the incentives offered by EU member states to encourage the purchase of EVs compiled by the European Environment Agency (2014) and includes data on the percent of EV and PHEV sales of new cars.

Table 1: Fiscal incentives for electric vehicles in EU countries (European Environment Agency, 2014)

Country	Annual/ monthly circulation vehicle tax	Purchase/ registration subsidy or tax	Fuel tax	Company car taxation	Business incentives	Other	EV + PHEV market share (%)[c]
Austria [a]			■				0.6
Belgium [b]	■	■		■			0.4
Czech Republic					■		N/a
Germany	■						0.4
Denmark		■					0.9
Finland		■					0.4
France		■		■			0.7
Greece	■	■				■	0.1
Hungary	■	■					N/a
Ireland		■					0.2
Italy	■						0.1
Latvia		■					N/a
Netherlands	■	■					6.8
Portugal	■	■					0.2
Romania		■					N/a
Sweden	■	■		■			1.6
UK	■	■		■	■		0.6

Notes:
[a] Some local incentives also provided
[b] regional variations, information provided for Flanders
[c] 2014 data from International Council on Clean Transportation, 2015a.
N/a = data not available .

3.2 Norway

Norway's position as having the world's highest proportion of BEVs cars (12.6% of new car sales in 2014, International Council for Clean Transportation, 2015a) is due to a number of factors. There have been BEVs in Norway for the past two decades albeit in small numbers, helped by two of the early BEV manufacturers, Think and Pure Mobility, being based in the country, and long term fiscal incentives from the Government. In the 1990s the first incentives were introduced, which included BEVs being exempt from vehicle registration tax, free parking, and reduced tax on company cars. The Norwegian EV policy has been to make EVs as attractive as possible, and incentives have been added one at a time until the market finally responded with increased sales. From 2001 BEVs were also exempted from VAT (25% on the new car price), from 2003 BEVs were allowed in bus lanes nationwide, from 2005 the annual tax on BEVs was reduced, and from 2009 they were given reduced rates on the main coastal ferries and exemption from road tolls. According to Figenbaum & Kolbenstvedt (2013), the most successful incentives are the VAT exemption, access to bus lanes, free access to toll roads and free parking. Haugneland & Kvisle (2013) have suggested that the VAT exemption is the most important because it results in new BEVs being only marginally more expensive than a comparable gasoline car. The price difference can be as low as €1,000.

The main EV market in Norway is in the greater Oslo/Akershus region, where BEV drivers can save time driving in bus lanes, and €600-€1,000 per year on road tolls. However the incentives have also produced high BEV sales on some small islands where there are very high tolls on tunnels connecting them to the mainland. These are areas where the air quality is good, and the application of incentives in these areas has been describes as 'wasteful' by Figenbaum & Kolbenstvedt (2013).

Other incentives have been less successful in increasing the EV sales. The zero registration tax for BEVs is no longer considered effective as most cars less than 1,540 kg are also exempt, and the differential in the annual tax is not sufficient to be a real incentive (Figenbaum & Kolbenstvedt, 2013). With the introduction of premium models to the market, company drivers may become interested in BEVs, and the reduced tax on company cars may become more of an incentive in the future. In Norway electricity is cheap due the extensive use of hydro-electricity, while gasoline is among the most expensive in the world. This may also be an incentive to use BEVs (Haugneland & Kvisle, 2013).

Few BEVs were available in Norway until 2010/11 when four mass market motor manufacturers (Mitsubishi, Peugeot, Citroën and Nissan) launched models. The BEV market expanded rapidly to about 3% of new vehicle sales by the end of 2012. This growth in the market caused price competition, and the niche Norwegian manufactures were forced out of the market (Figenbaum & Kolbenstvedt, 2013).

Consumer research undertaken by the Norwegian Electric Vehicle Association suggests that the combination of the benefits of driving a BEV compensates for the limited range and uncertain re-sell value. The Norwegian Government has guaranteed that the purchase incentives will continue until 2018 or 50,000 EVs are sold. There were 38,652 EVs BEVs in Norway in 2014 (Statistics Norway, 2015).

A survey of BEV owners in Norway, when asked what they think is necessary to get more people to purchase BEVs, identified longer range (29%) as being the most important factor together with predictable Government policy on BEVs. Nissan recognises that the limited range inhibits using BEVs for long distance journeys, and offers its customers 20 days hire of a conventional car free of charge in the first three years after purchase. The survey shows that most drivers use their BEVs for their daily commute, re-charge the cars at night or at work, and infrequently use public charging stations. They believe that fast charging is important to extend the BEV range, and fast chargers should be located between cities (Haugneland & Kvisl, 2013).

3.3 The Netherlands

The Netherlands has the highest market share of EVs in the EU; almost 6% in 2013, with the vast majority being PHEVs. The reason for the relatively high proportion is the Dutch vehicle taxation scheme with has significant savings for very low CO_2 emitting vehicles (International Council on Clean Transportation, 2015a).

There are two vehicle taxes: (1) a registration tax (Belasting van Personenauto's e Motorrijwielen, known as BPM); and (2) an annual tax (motorrijuigenbelasting). The BPM is based on the vehicle list price, the CO_2 emissions and a diesel disincentive (Belestingfienst, 2014). From 2006 to 2008 the CO_2 component was only levied on the most polluting vehicles. Since 2008 the CO_2 emissions have been an increasing component of the tax. At the end of 2013, however, the tax was modified, with less benefits for low emitting vehicles, which resulted in fewer PHEVs being sold in 2014 (see Table 2). The annual tax varies depending on the region where the vehicle is registered as well as its weight and fuel used to power the vehicle.

In 2014 gasoline cars, with emissions below 88 g km^{-1}, and diesel cars below 85 g km^{-1} were exempt from the BPM and cars with emissions less than 50 g km^{-1} were exempt from the annual tax. The Dutch registration and annual tax taxation on, for example, a diesel VW Golf with 119 g km^{-1} emissions was approximately €8,800. Therefore there was a significant incentive to purchase a car with emissions below the BPM and annual tax thresholds. In the UK, there is no purchase/registration tax and a car with 119 g km^{-1} emissions pays no annual tax. Both countries apply VAT on the purchase price; at 20% in the UK and 21% in the Netherlands.

Table 2 shows the market in alternative fuelled cars in the Netherlands and the UK since 2003. In the Netherlands the market share increased from 0.8% in 2007 to 2.5% in 2008 when the tax system changed, and by 2014 the market share of new PHEVs and BEVs was nerly 7%. In the UK, where the vehicle tax system provides less favourable incentives for low CO_2 cars the market share was 2.1% in the same year. This is despite the availability of grants for the purchase of PHEV and BEVs. Interestingly the market in gas vehicles was greater in 2004 in the UK than a decade later.

Table 2 Alternative Fuel Market Share (%) of New Passenger Cars in the Netherlands and the UK (International Council on Clean Transportation, 2015a)

Year	Market share of new passenger cars (%)							
	Netherlands				UK			
	Hybrid	Natural Gas	Flexi Fuel	Electric (including PHEVs)	Hybrid	Natural Gas	Flexi Fuel	Electric (including PHEVs)
2003	0	0	0	0	0	0.1	0	0
2004	0.2	0	0	0	0.1	0.1	0	0
2005	0.6	0	0	0	0.2	0	0	0
2006	0.7	0	0.1	0	0.4	0	0	0.0
2007	0.7	0	0.1	0	0.7	0	0	0.0
2008	2.4	0	0.1	0	0.7	0	0	0.0
2009	4.2	0	0	0	0.7	0	0	0
2010	3.3	0.4	0	0.	1.1	0	0	0.0
2011	2.7	1.1	0.1	0.2	1.2	0	0	0.1
2012	4.5	1.8	0.1	0.2	1.2	0	0	0.1
2013	5.7	0.6	0	5.4	1.3	0	0	0.2
2014	3.7	1.0	0	4.0	1.5	0	0	0.6

For vehicles registered in 2014 the company car tax in the Netherlands treats a percentage of the Dutch list price as salary depending on the car's CO_2 emissions as follows :

- 25% - diesel greater than 111 g km^{-1} and other vehicles 117 g km^{-1} .
- 20% - diesel vehicles 85 to 111 g km^{-1}, and for other vehicles 88 to 117 g km^{-1}.
- 14% - diesel vehicles 51 to 85 g km^{-1}, and for other vehicles 51 to 88 g km^{-1}.
- 7 % - new vehicles less than 50 g km^{-1}.
- 4% - EVs.

In the UK the tax on company cars is also based on the vehicle list price and the CO_2 emissions. There is a 3% surcharge for diesel vehicles to reflect their greater adverse effect on urban air pollution, and zero tax on EVs until April 2015. For cars with emissions in the range 1-75 g km^{-1} the tax is 5% of the list price, 76-94 g km^{-1} 10%, and then the tax increases by 1% for every 5 g km^{-1} up to 215 g km^{-1} (HMRC, 2014).

There are likely to be other factors affecting motorists' new car purchase decisions in each country. In the UK companies lease a significant proportion of new cars. The leasing companies tend to favour conventional vehicles with well understood reliability and maintenance costs.

Cambridge Econometrics (2013) have estimated that the CO_2-based vehicle taxation in both the Netherlands and the UK contributed to reductions in new-vehicle CO_2 emissions. The contribution was larger in the Netherlands, (-6.3 g km^{-1}), than it was in the UK (-3.6 g km^{-1}). This compares to the total reductions of 46.8 g km^{-1} in the Netherlands and 32.5 g km^{-1} in the UK. The authors concluded that other factors, such as pan-European vehicle supply, have a larger effect than vehicle taxation.

3.4 France

France had the largest EU market for BEVs in 2012 and 2013, but was overtaken by the Netherlands and Denmark in 2014.

In 2013 approximately 9,000 BEVs were sold in France, more than in Germany (3,000) or Norway (2,500), although these vehicles represent a very small market share (less than 1%). The supply of BEVs vehicles by French manufacturers, particularly Renault-Nissan, has played an important role in increasing the sales of these vehicles in France (France Diplomatie, 2014).

Prior to 2008, France imposed vehicle purchase tax largely on the basis of vehicle power, but from the beginning of 2008 introduced a CO_2 emissions based vehicle purchase tax with subsidies for the least polluting vehicles. The aim of the system was to be revenue neutral. The rebates/taxes reduce/increase in discrete steps from a subsidy of €5,000 for vehicles below 60 g km^{-1} up to €2,600 tax for vehicles above 250 g km^{-1}. In the first year the programme incurred a debt of €225m, which was widely attributed to an unexpectedly large consumer response, and the Government responded by modifying the subsidies and taxes (Klier & Lin, 2012). The tax has been modified several times with a significant increase introduced in 2013. Today, BEVs are exempt from registration tax, and the Government provides a purchase subsidy of up to €7,000.

Klier & Lin (2012) found that the change in tax accounted for nearly all the observed reduction in average CO_2 emissions from new cars between 2007 and 2008, and that the effect was greater than the effect of the annual taxes, which increase linearly with emissions, introduced in Germany and Sweden.

3.5 Italy

Italy has the highest sales of new natural gas vehicles in Europe, with these vehicles representing 14.3% of car sales in 2014 (International Council on Clean Transportation, 2015a). The country has a long history of supporting the use of natural gas for road transport, dating back over 80 years, which has resulted in there being more approximately 1 million gas vehicles in Italy in 2014; 75% of the total European natural gas vehicles. In April 2012 there were about 1,170 filling stations, mainly located in the northern Italy, where the regional governments subsidise the installation costs (Natural Gas Vehicle Association, 2014).

The Italian Government promotes natural gas use in vehicles both directly and indirectly. It provides a subsidy of €700 to purchasers of CNG cars while some manufacturers offer further discounts to develop their CNG car market. Fiat in particular has invested heavily in the development of gas vehicles, rather than in development of HEVs and BEVs. Another incentive for gas vehicles is that CNG is 2 to 4 times cheaper than gasoline and diesel due to the high taxation on conventional fuels in Italy (Natural Gas Vehicle Association, 2014).

The availability of more new car models is helping the growth of the natural gas vehicle market. On the commercial vehicle side, Italy has 1,200 CNG trucks, mainly operating in refuse collection services, and 2,300 urban buses (Natural Gas Vehicle Association, 2014).

At the end of December 2013 the Italian Government announced plans to promote the use of bio-methane in the gas grid for transport and electricity generation.

3.6 Manufacturers Response

Klier & Lin (2012) investigated the manufacturers' long term response to the new tax regime in France. Because the subsidy/tax system uses discrete cut-offs, they compared the emissions of vehicles close to the cut-offs before and after the tax change. They found no evidence that manufacturers had responded by improving the emissions of individual models.

Mock (2015), however, found that manufacturers do optimise their vehicle model ranges to take account of vehicle taxation schemes. Manufactures cannot optimise vehicles for the taxation schemes in all EU member states simultaneously, and therefore there is a compromise between making the vehicle's CO_2 emissions attractive in as many countries as possible whilst also taking account of engineering and cost limitations. If the tax for a vehicle is significantly reduced because a small change in CO_2 takes the vehicle into the next lower tax bracket then CO_2 reduction is relatively expensive due to the reduced tax revenue for a small reduction in emissions.

4 CONSUMER SUBSIDIES

Some countries offer direct subsidies for low emitting vehicles. In this section the UK and Spanish schemes are discussed. However, it should be noted that several other member states, also give a subsidies for low emitting vehicles.

4.1 United Kingdom

In January 2011 the UK Government launched the Plug-in Car Grant, which offers a £5,000 (€6,000) subsidy (up to 25% of the cost of the vehicle[1]) for the purchase of an EV or PHEV car. To qualify, these vehicles must emit less than 75 g km^{-1}, have a top speed of more than 60 mph, and meet specified vehicle range and battery warranty criteria. This incentive was accompanied by a public education campaign, named 'Go Ultra Low' to promote the benefits

[1] It has since been increased to 35% of the purchase price of the vehicle, including VAT.

to consumers and £9.3m investment programme in the recharging infrastructure. In February 2012 the Plug-in Van Grant was launched which offers 20% or up to £8,000 (€10,000) off the price of an eligible van (Department for Transport, 2014).

The market has taken several years to take-off. In 2011 only 1,056 cars qualified for the grant, but in 2014 over 14,000 PHEV and BEVs were sold, albeit this is only 0.6% of the new cars sold (Society of Motor Manufacturers and Traders, 2015). Recently the UK Government has announced that the incentives will remain in place until at least March 2016.

According to the International Council on Clean Transportation (2014) the fiscal incentives offered by the UK Government are among the most generous in the EU, second only to the Netherlands, yet in 2013 BEVs had a much smaller market share in the UK than several other markets in northern Europe, including Germany where the government provides less generous incentives to purchase BEVs and PHEVs. It appears that other factors influence purchase decisions in some markets.

The UK Government also has the Green Bus Fund which currently is funding 213 new low carbon buses. The government is paying up to half the price difference between diesel-hybrid and biomethane gas buses and the diesel equivalent (UK Government, 2015). This fund aims to cut greenhouse gas emissions and encourage bus operators and local councils to make the switch to more environmentally-friendly buses. In total £87 million will be provided with the aim of delivering more than 1200 new low carbon buses in England.

4.2 Spain

In May 2011 the Spanish Government approved a €72 m fund to promote electric vehicles. The incentives include direct subsidies for the acquisition of new electric cars of up to 25 percent of the purchase price, before tax, to a maximum of €6,000 per vehicle, and 25 percent of the gross purchase price for other electric vehicles such as buses and vans, with a maximum of €15,000 or €30,000 depending on the range and type of vehicles (KMPG, 2014).

In 2014 0.1% of new cars purchased were BEVS. More new gas cars (0.3%) than BEVS are sold in Spain (International Council on Clean Transportation, 2015a).

5 LOCAL INCENTIVES

5.1 Introduction

Whilst tax incentives and direct subsidies to reduce the purchase price of new HEVS, PHEVS, BEVs and gas vehicles are very important for the development of the alternative vehicle market, local initiatives have a complementary role to play.

The types of incentive local and regional governments can provide include:

- Free/discounted parking;
- Provision of refuelling infrastructure;
- Exemption/discount from road/bridge tolls/congestion charges;

- Promotion of car clubs using alternative fuelled vehicles;
- Procurement of EVs, HEV and gas vehicles to promote their use; and
- Requiring new developments to include appropriate refuelling infrastructure

A large number of projects have been undertaken at the local level through schemes such as the EU's Civitas programme. This European Commission initiative was started in 2002 to enable EU cities to demonstrate cleaner and better transport in cities. The measures that the programme finances are practical or policy-related. Further information is available at http://www.civitas.eu.

There is little quantified information available on the effectiveness of local measures to encouraging motorists to drive EVs and gas vehicles and no evidence has been found that local initiatives, on their own, make a significant impact on new vehicle sales.

The International Council on Clean Transportation (2014), in its report on fiscal incentives, concluded that a comprehensive study is needed to understand the impact of the full portfolio of policy actions used to accelerate the EV market. It notes that Germany has a much lower level of fiscal incentives than many of other markets but that that there was a very high growth rate, albeit from a small starting point, between 2012 and 2013. They postulate that it could have been due to the motor manufacturers releasing a number of EV models in 2013 and that the companies registered a large number of the EVs themselves for testing and marketing activities. However, they note that the relatively high registration of EVs tend to occur around major cities where policies such as access to HOV lanes may provide an additional incentive to purchase these vehicles.

This section provides examples of local incentives used in northern and Central Europe to increase alternative fuel use. It is not intended to be comprehensive.

5.2 Car sharing

EV car sharing schemes provide motorists with first-hand experience of driving an EV, which can be used to make an informed purchase decision, and overcome the knowledge barrier to the use of these vehicles. In addition, the more EVs on the road, the more likely that motorists will regard them as viable alternatives to conventionally fuelled vehicles.

Car2go (car2go.com) is a joint venture between Daimler and Europcar which uses Smart Cars for its car sharing schemes in Europe and North America. It operates in 12 European cities including, Hamburg, London, Madrid and Vienna. In Amsterdam only electric Smart Cars are used. This was the first European scheme to operate a fully electric fleet. The EVs can be hired without pre-booking or a predestined pick-up or drop-off point, and the cars can be recharged at any of Amsterdam's street charging points. Customers can use Car2go to drive anywhere, however, they must return the car within the 80 km^2 Car2go area. Smarts may be parked either in regular parking bays or in one of Amsterdam's street charging stations. It is also possible to park the cars in one of 36 designated Car2go parking spaces in the city's six car parks operated by Q-Park.

Autolib' is an electric car sharing scheme in the City of Paris and neighbouring municipalities in the Ile-de-France region established in 2011 (www.autolib.eu). It has a number of rates ranging from an annual charge of €120 to a no daily charge. Usage is changed per half hour

with costs varying from €5.50 (annual) to €9.00 (daily) depending on the length of the rental period. Similar French schemes include L'Auto bleue" in Nice, "Sunmoove" in Lyon and "Bluecub" in Bordeaux.

EV car clubs have also been launched in a number of UK cities (The E-Car Club and Autoli'). DriveNow is an international car club providing BMWs including the electric iMini in five German cities, London, Copenhagen, Stockholm and Vienna. Zipcar is another car club operating in both the Europe (Spain and the UK) and North America, but does not currently offer EVs.

5.3 Battery/Vehicle Leasing Schemes

Renault-Nissan

Renault-Nissan was the first car manufacturer to offer a battery leasing scheme to its BEV customers. The aim is to reduce the purchase price of the vehicle, increase the residual value and reduce anxieties about battery life. As battery performance increases it allows the battery to be upgraded without upgrading the car. Research by the UK Consumers Association shows that the cost per kilometre over three years of the Renault ZE, with a leased battery, would be about two thirds of that of the Nissan Leaf which does not have a battery lease option. The aim is to get the purchase price of the EV, taking into account the government subsidies/tax incentives, to be similar to an equivalent petrol or diesel car (Consumers Association, 2014). Renault is currently the motor manufacturer with the highest new EV sales in the EU.

Better Place

Better Place was established in 2008 to provide a new business model for the provision of EVs in Israel and Denmark. The company charged based on the distance driven in a similar manner to mobile phone minutes. The initial cost of the vehicle was subsidised by the ongoing per-distance revenue contract. Better Place's goal was to enable EVs to sell for $5,000 less than the price of an average gasoline car, by selling the car separately from the batteries in the same way that conventional cars are sold separately from their fuel. The scheme used the Renault Fluence Z.E. cars, a family salon electric car.

The monthly payment would cover the battery costs including electric power, battery life, degradation, warranty problems, maintenance, capital cost, quality, technology advancement and anything else related to the battery. The per-distance fees would cover the battery leasing, charging and battery-swap infrastructure. The QuickDrop battery switch system would enable the battery to be swapped in approximately three minutes at dedicated battery exchange stations.

The Better Place electric car charging infrastructure network was based on a smart grid, the first of its kind in the world, and enabled the company to manage charging a large number of electric cars simultaneously by automatically time-shifting recharging away from peak demand hours of the day, preventing overload of the grid. The aim was to provide electricity for millions of electric cars without needing to add electricity generation or transmission capacity.

Unfortunately Better Place went bankrupt in 2013, due to a number of factors including the

high cost of the infrastructure and the lower market penetration of EVs than originally anticipated.

ElectroDrive

ElectroDrive was established in Salzburg, Austria in December 2009, to develop a public EV charging network, install appropriate domestic recharging facilities and provide suitable vehicles. It partners with local electricity supply companies to provide renewable electricity at public charging stations. ElectroDrive offers a diverse product range including electric cars, electric bicycles, electric scooters and Segways (ElectroDrive, 2014).

ElectroDrive also works in a similar way to a mobile phone contract. For a fixed monthly price customers can lease an EV. The rental-system removes the purchase cost barrier for customers, although customers do also have the option to purchase the vehicles either new or at the end of their contract. Monthly prices start at €40.90 for a Pedelec (an electric bike), €67.90 for a scooter and €199.00 for a Segway. An all-in-package can be purchased consisting of the vehicle, service and maintenance, collision damage waiver and liability insurance, as well as the electricity from a certified green supplier. A more basic package is also available that excludes the service and maintenance. Three e-bike models and one e-scooter model are currently offered.

ElectroDrive also operates in Burgenland (eastern Austria), and Bern (Switzerland).

5.4 Public Awareness Campaigns

Stuttgart

Stuttgart has a developed EV charging infrastructure with more than 300 charging points for two- and four-wheeled vehicles; however, the use of these vehicles remains low. The municipality has undertaken a decentralised public awareness campaign on the benefits of EVs to encourage their use. It included public information events in selected city districts and for target groups (elderly people, students, migrants). At these events information was provided about EVs as well as car and bike sharing schemes. At every event there was the opportunity to test a Pedelec. This decentralised approach, with a strong focus at the neighbourhood level, is thought to be better at increasing awareness and the use of EVs than an more centralised approach.

In addition the Stuttgart Municipality used a mobile exhibition for the promotion of EVs, developed as part of the national Schaufenster Elektromobilität project (www.schaufenster-elektromobilitaet.org/programm) for three months. It is used in different towns of the federal state of Baden-Württemberg.

To promote EVs to school children a specially designed electric powertrain demonstration was developed. It fits on a car trailer and was taken around schools to familiarise pupils with the EVs.

Electromobile City Trophy

The French “Electromobile City Trophy” is an award presented every year to regional and local authorities that are committed to promoting sustainable transport, especially EVs. This

provides publicity for EVs.

EV Charge Point Websites/Apps

There are a very large number of websites that provide information on the location of EV charging points. The first two sites, both launched in 2010, was ChargeMap (www.chargemap.com), which initially covered France, Belgium and Switzerland, but has since been expanded to cover most of Europe as well as some non-European countries, and Berlin based PlugSurfing (www.plugsurfing.com) which also covers the whole of Europe, parts of Asia and Austrialia. PlugSurfing members are able to see location, availability and payment information for more than 16,000 charging points. It has 22 apps and website services in 16 languages. OpenChargeMap (www.openchragemap.org) is a free web-based service that lists public or semi-public charging points for EVs worldwide. The charging points are updated daily and the information is accessible via a phone app. There are also a number of local or national websites and car manufacturers' apps that provide the location of charging points.

Lilley et al. (2013) have reviewed the websites in the North Sea Region, and concluded that the majority of the charge point websites do not contain all the information that an EV driver would need to locate and use a charging point. They recommend that the following information is required: A good sized interactive map which includes a search facility for relevant change points by location (including address), charger type, charger power, cost, public or private, other facilities available, the number of charge points and live data on availability

5.5 EV Charging Network

Financial support for public charging stations and the provision of fast charging station is thought to have had only limited success in developing the EV market. However it does increase the visibility of EVs and enables EV drivers to use their vehicles for longer trips. Fast charging increases the EV miles driven and encourages fleets and taxis firms to used EVs (Figenbaum & Kolbenstvedt, 2013).

The Mobility House

The Mobility House installs private and public EV charging facilities within homes and workplaces in 15 European Counties. For example, it works with BMW to provide new owners of an i3 electric car a safe and convenient recharging unit using the domestic power supply under its ElectroDrive brand (also see section 5.3). It is independent of the vehicle manufacturers.

Source London

Source London (www.sourcelondon.net), launched in 2011, was the UK's first citywide electric vehicle charging network and membership scheme. The Mayor of London's aspiration is for London to have 25,000 charging points by 2015, including a network of rapid charging sites; 500 on-street, 2,000 in off-street public car parks and station car parks; and 22,500 to be located in employers' car parks and at retail/leisure facilities (Mayor of London, 2009). By May 2014 there were over 1,400 public charging points.

Annual membership of Source London is £10, enabling cardholders to recharge their batteries at any Source London point. From October 2012 Source London members had assess to Source East charging points, thus enabling EV drivers to travel greater distances and charge up across London and the East of England.

UK National Scheme

The UK Government announced in 2014 its "Plugged in Places" scheme which provides £30m matched funding for electric charging infrastructure in 8 locations in the UK including the east of England, Greater Manchester, Midlands, Scotland, Northern Ireland, North East England, London and Milton Keynes. Charging points are also being installed by some councils across the UK and by private sector providers.

Brighton and Hove

Brighton and Hove Council, on the south coast of England, installed eight on-street electric vehicle charging points to test if this would increase take-up of electric vehicles in the city. It was the first project of its type in the UK, with the first charging point commissioned in September 2009. Incentives were initially provided to encourage the use of the charging points, such as free registration and free use of the facilities during the start-up period. Evaluation of the project showed that 35% of registered users used the Council's charging points at least once a week, with other registered users charging their vehicles at home. The shortage of charging points was identified as the single factor that users liked least about using EVs. The project evaluation also identified that the charging points were not all located in ideal places, and to improve users experience they should be relocated to where they would be most useful for potential users.

Free Residential Charging Units

A joint venture between British Gas and ChargeMaster in the UK installed free of charge, 3 kW EV charging units on the driveway or garage of residential properties until 31 March 2015. A 7 kW unit is also available for a small additional charge of £95 including VAT. Most electric car manufacturers do not recommend the use of a standard domestic socket for charging EVs at home for safety reasons. The unit is fully waterproof and therefore may be installed either inside a garage or on an outside wall. The scheme is funded by the Government's Office for Low Emission Vehicles. It also provides free access to the POLAR public charging network.

POLAR

POLAR is ChargeMasters' privately funded charging network in the UK. Membership gives drivers access to 4,000 charging points in 100 towns and cities; an iPhone / iPad app showing charge point locations and availability; and a range of other member benefits including discounts on parking, hotels and restaurants. Access to the POLAR network is via a monthly subscription, which was initially £24.50 (€30), plus a payment of £0.9 (€1) per charging unit. This provides "fuel" for up to 100 miles of electric car driving. Other tariffs are available for business users, as well as for private subscribers who solely charge at home or at public points. POLAR is intended to complement the Government's charging network.

5.6 Free Parking

From 2001 to 2008, the City of London (a small part of central London) issued free on-street and off-street parking passes to about 1,000 EV drivers. However, the scheme was stopped in 2009 because commuters were adding to congestion by using their cars instead of walking, cycling or travelling by public transport. The cost for existing off-street parking permit holders was gradually increased over three years. Existing permit holders had to pay £2,000 for an annual permit in 2009, £4,000 in 2010 and up to £6,396, the standard rate, in 2011. No new free on-street parking permits for electric cars were issued, although those with existing permits were allowed to continue to use them.

Several other local authorities in England continue to give priority parking to EVs. Examples include:

- Islington, Westminster, Newcastle, and Brighton and Hove Councils give free residential parking permits to EV owners.
- Glasgow City Council allows EVs to be parked free of charge while charging
- Sunderland Council and Milton Keynes Council offered free parking to drivers of EVs connected to charging points, but now charge.
- Wandsworth Council offers a reduced residential parking rate for EV owners, but does not offer any benefits to EV drivers visiting Wandsworth.

In Norway free parking for EVs is not considered to have been effective because only a relatively small number of parking spaces are available and many have a time limit Figenbaum & Kolbenstvedt (2013).

5.7 Road Charging

Within the London Congestion Zone in central London motorists are charged £10 each day for driving a vehicle between 07:00 and 18:00, Monday to Friday. However, a 100% discount is given for cars or vans which emit less than 75 g CO_2/km and meet at least the Euro 5 emission standard, or are an EV or a PHEV. This can save motorists up to about £2,000 (€2,500) per annum (Transport for London, 2014).

According to Figenbaum & Kolbenstvedt (2013) the Norwegian incentive of free use of toll roads for EVs is considered to be one of the most important in encouraging the use of EVs, but only where the charges are high. In some areas the tolls for a commuter can be more than €2,500 per year. In these areas there has been a significant impact on EV use.

5.8 Access to Bus Lanes

EV access to bus lanes in Norway, and to HOV lanes in the US, has been shown to be an important local incentive in highly congested areas. The Asker municipality outside Oslo, which suffers the greatest congestion in Norway, has seen high EV sales (Figenbaum & Kolbenstvedt, 2013), and there is evidence that HOV access in the US state of Virginia is associated with a large increase in HEV sales (Gallagher & Muehlegger, 2011).

However, there is a risk that increased EV use of bus lanes will delay the buses/high occupancy vehicles.

5.9 City Planning

Some cities encourage the development of alternative fuel refuelling infrastructure though the local land-use planning system. For example, in Stuttgart developers are encouraged to integrate recharging infrastructure into new residential and commercial developments at an early stage of the development process.

In London there is a mandatory requirement to provide electric charging points within new developments. The Spatial Development Strategy for Greater London requires residential and commercial developments to provide 20% of car parking spaces with an electrical charging point to encourage the uptake of electric vehicles (Greater London Authority, 2011).

6 SUMMARY AND CONCLUSIONS

Currently there are few BEV, PHEV and gas vehicles in use in the EU. Although in 2014 there was a large increase in the number EVS sold, the numbers remain low. Experience suggests that this is unlikely to change until the cost of these vehicles is at least equivalent to conventionally fuelled vehicles, and even then it will take some time for consumer acceptance of these technologies to grow. It is only in those countries with a long and consistent incentive programme i.e. Italy (gas), Norway (EVs) and Japan (HEVs) that have a significant (i.e. greater than around 5%) market share of non-conventional vehicles. Experience from California suggests that mandating a fixed market share can be problematic.

For electric and gas vehicles is it necessary to ensure an appropriate charging/fuelling infrastructure exists. This exists for gas vehicles in Germany and Italy, but not elsewhere. The refuelling infrastructure outside these countries needs further development. The EV recharging infrastructure is growing particularly across France, Germany and the UK, and is likely to grow further to achieve the requirements of the EU Directive on the deployment of recharging/refuelling infrastructure.

Standardised private charging points are required for both private (home and workplace) and public recharging. In addition, fast charging stations are necessary to provide a quick solution for users of electric vehicles at motorway service stations, in public car parks, and at selected major road junctions. The private sector is beginning to develop this infrastructure albeit generally with the support of public funds.

New systems for charging for the electricity used are being developed, so that drivers can effectively monitor their motoring fuel costs. However, roaming systems, similar to mobile phones systems, for charging for the electricity used at public charging points, need to be developed. In addition, motorists should be able to pay directly for the electricity at the charging point.

In some EU countries national legislation needs to be amended to remove the bureaucracy involved in setting up recharging facilities to speeding up approval processes and implementation times.

Local governments can provide incentives such as use of bus lanes and access to restricted areas, preferential parking spaces and/or free or reduced parking rates. However, in most cases these measures are unlikely to be sufficient to result in a significant increase in BEV, HEV, PHEV and gas vehicle use until the initial vehicle cost is reduced thorough tax incentives or direct subsidies.

Local government has a role to play in promoting these vehicles, and educating the public on the benefits and performance characteristics of these vehicles, such as EV test drive events to increase pubic acceptability.

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