

## Chapter 11: Changing how we use our Transport System

### Summary

- **Transport is a major contributor to Scottish energy demand and greenhouse gas emissions.**
- **It is crucial that we improve the energy efficiency of our transport system, through the introduction of new technologies, improving the fuel efficiency of fossil fuelled vehicles, and actively reducing the absolute levels of fuel consumed.**
- **We need to manage better the demand for travel, and to encourage change in attitudes to travel if the resultant efficiency savings are not to be lost through additional journeys or the purchase of additional vehicles.**
- **We also need to encourage people to walk, cycle and use public transport more often.**

### Overview

11.1 An efficient transport system is essential in delivering the Scottish Government's overarching purpose of sustainable economic growth. The Scottish Government recognises that mitigating the effects of climate change is a global challenge and that transport services, vehicles and fuels are internationally traded. This chapter details the impact government can have on transport energy efficiency and emissions through domestic policies and actions. As part of the National Conversation on Scotland's constitutional future, we are considering what a future Scottish Government could do in relation to transport policy if it had further devolution or independence.

11.2 Transport as a sector accounts for over a quarter of the total energy consumed in Scotland.<sup>175</sup> Approximately 99% of the energy consumed in the transport sector comes directly from oil-based fuels, such as petrol and diesel, with the remaining 1% from electricity. There is a strong link between our work to improve energy efficiency in transport and that to reduce subsequent greenhouse gas emissions. It is, therefore, crucial that we improve the energy efficiency of our transport system, through the introduction of low-carbon technologies, improving the fuel efficiency of fossil-fuelled vehicles and actively reducing the absolute levels of fuel consumed.

11.3 Transport in 2006 consumed 51.5 TWh of energy, with road transport accounting for the largest proportion of energy consumed in the transport sector (85%), followed by 8% in national navigation, 5% in domestic civil aviation, and 2% in rail.<sup>176</sup> Fuel consumption in road transport in Scotland increased by 1.1% (from 3,110.7 million tonnes to 3,144.1 million tonnes) between 2005 and 2006, with vehicle kilometres travelled increasing by 3% over the same period.

11.4 The European Commission has indicated that a transport fuel reduction of 26% is possible by 2020.<sup>177</sup> It considers that it is technically and economically feasible to deliver this saving on top of what would be achieved by price effects and structural changes in the economy, natural replacement of technology, and existing fuel efficiency measures. Nonetheless, vehicle kilometres travelled in Scotland continue to increase, offsetting fuel efficiency improvements.

<sup>175</sup> Scottish Executive, 'Scottish Energy Study, Volume 1: Energy in Scotland, Supply and Demand', 2006.

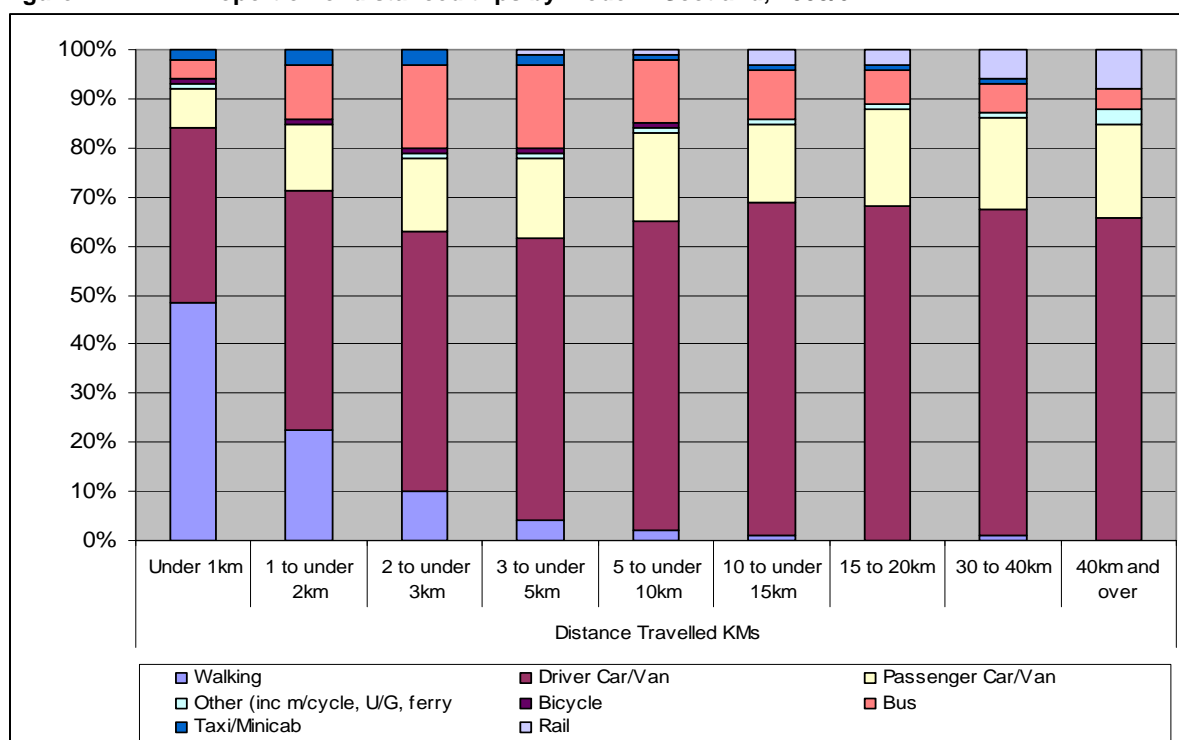
<sup>176</sup> Scottish Government, 'Scottish Transport Statistics', 2008; and Department for Environment and Climate Change (DECC), 'Greenhouse Gas Policy Evaluation and Appraisal in Government Departments', 2008.

<sup>177</sup> European Commission, 'Action Plan for Energy Efficiency: Realising the Potential', 2006 ([http://ec.europa.eu/energy/action\\_plan\\_energy\\_efficiency/doc/com\\_2006\\_0545\\_en.pdf](http://ec.europa.eu/energy/action_plan_energy_efficiency/doc/com_2006_0545_en.pdf)).

11.5 Reducing the amount of travel while increasing fuel efficiencies offers the greatest potential for reducing energy demand in the longer term in a cost-effective manner. Policies that promote walking, cycling and improving the urban environment to make non-motorised modes of transport safer, quicker and more attractive are important in managing the demand for motorised transport.<sup>178</sup> In London, a variety of measures have been introduced in recent years to achieve modal shift, including congestion charging alongside improvements to public transport, walking and cycling facilities. Measures to make better use of existing transport infrastructure by increasing the people-carrying, rather than vehicle-carrying, capacity of Scotland's networks are being developed.

11.6 Figure 11.1 illustrates that most trips over 1km are made by drivers of cars or vans in Scotland. For trips from under 1km up to 5km, more journeys could potentially be undertaken by walking and cycling. For trips above this range, there may be scope for modal shift from car and van use to bus or rail.

**Figure 11.1 Proportion of distanced trips by mode in Scotland, 2005/6**



Source: Scottish Household Survey, Statistical Bulletin, Transport Series, 2008

11.7 Scotland's National Transport Strategy (NTS) introduced the three strategic outcomes of: improved journey times and connections; reduced emissions; and improved quality, accessibility and affordability.<sup>179</sup> The NTS Delivery Plan sets out the actions that we are taking, within the context of the national performance framework, to support this Government's purpose and to meet the three NTS strategic outcomes.<sup>180</sup>

11.8 This consultation sets action to tackle energy use in transport through land-use planning, measures targeted at personal and business travel, and the adoption and development of technological solutions. It should be seen in the context of the Climate

<sup>178</sup> European Conference of Ministers of Transport, 'Review of CO<sub>2</sub> Abatement Policies for the Transport Sector', 2006.

<sup>179</sup> Scottish Executive, 'National Transport Strategy', December 2006.

<sup>180</sup> Scottish Government, 'National Transport Delivery Plan', updated March 2009 ([www.scotland.gov.uk/Topics/Transport/NTS/deliveryplan](http://www.scotland.gov.uk/Topics/Transport/NTS/deliveryplan)).

Change Delivery Plan, the National Transport Strategy Delivery Plan, and our transport Energy Pledges (see Box 11.1).

**Box 11.1 Transport Energy Pledges**

- We will develop and deliver more sustainable transport to improve efficiency and reduce transport emissions in the longer term.
- We will promote the development, uptake and use of electric and other low carbon vehicles, in addition to using improvements in vehicle engineering which are already available.

**National planning policy for Transport**

11.9 The way that we use land impacts significantly on our demand for transport. The promotion of compact settlements, of mixed-use development, effective walking and cycling networks, and efficient public transport systems can all play an important part in reducing our need for car-based commuting and form an important part of our energy efficiency activity.

11.10 National planning policy emphasises that the planning system should support a pattern of development that reduces the need to travel, contributing to reduced emissions and energy demands from transport. It states that travel by public transport, freight movement by rail or water, and safe and convenient opportunities for walking and cycling should be facilitated. National planning policy on transport is currently set out in SPP 17 'Planning for Transport'. The SPP series, including SPP 17, is being consolidated with the NPPG series into a single, shorter SPP that will be published at the end of 2009. The second National Planning Framework (NPF2), published in June this year, plays a key role in co-ordinating policies with a spatial dimension and aligning strategic investment priorities (see Chapter 10 for broader discussion of planning issues). Projects designated as national developments in NPF2 include a high-speed rail link to London and enhancements at airports to improve surface access by public transport.

**Designing Streets**

11.11 The recent consultation on "Designing Streets" gives greater weight to creating residential streets with a higher emphasis on place and on ensuring that design, infrastructure and layout encourage and facilitate walking, cycling and use of public transport above cars. The final policy document will be published later this year.

**Reducing energy consumption of roadside electrical equipment.**

11.12 Some of our existing roadside assets consume high levels of electricity. Current consumption in the Trunk Road Lighting Network is estimated at 18.3 MWh. Transport Scotland is therefore investigating, testing and implementing new technologies through a number of public lighting schemes. In addition, it has incorporated energy reducing measures within the requirements for all new major projects. The projected energy usage reductions arising from these new technology initiatives for selected schemes will be available in early 2011.

11.13 Currently, Transport Scotland's use of renewable energy is limited, in part, to the commitment from local energy suppliers. However, it uses solar energy for some of its traffic monitoring facilities. In addition, it is currently investigating a number of microgeneration options for localised and hybrid energy generation from wind, sun and water. These, along with efficient energy storage technologies, would result in a distributed renewable energy system to supply roadside electrical equipment, or to link to the national grid for onward transmission and utilisation of energy elsewhere.

### Scottish Sustainable Communities Initiative

11.14 The Scottish Sustainable Communities Initiative (SSCI) was launched in June 2008 to encourage the creation of places, designed and built to last, where a high quality of life can be achieved. The initiative identified eleven exemplar projects across Scotland considered best capable of demonstrating how sustainable communities can be delivered within the Scottish planning system. The Scottish Government is currently working with each of these projects to provide support in the delivery of best practice in sustainable development. Part of this support involves assistance towards the delivery of sustainable transport measures, including Masterplan and transport design advice, assistance in the creation of sustainable transport plans, and the promotion of green walking and cycling networks. This support will involve collaboration with project teams, local authorities, government agencies, and external organisations.

### **Improving Energy Efficiency for Personal Travel**

#### Walking and Cycling

11.15 As already noted, walking and cycling are viable alternatives to many short car journeys. More than a third of car trips in Scotland are journeys of less than 2 miles. As well as reducing energy use, walking and cycling can reduce emissions and congestion, improve health and local air quality, and make towns and cities more pleasant to live and work in.

11.16 The Scottish Government continues to provide funding to Local Authorities for cycling, walking and 'Safer Streets' projects, and to Sustrans for the promotion and delivery of infrastructure at schools. Cycling Scotland aims to establish cycling as an acceptable, attractive and practical lifestyle option. Earlier this year, the Scottish Government launched its consultation on a Cycling Action Plan for Scotland. This set a target of 10% of all journeys made in Scotland being by bicycle by 2020. If this target is reached, replacing all car journeys of under 1.5 miles with bicycles, the carbon saving would be at least 150-200 ktCO<sub>2</sub> (0.61 – 0.82 TWh) per annum. Delivering on this target will make transport more energy efficient and contribute to the delivery of the National outcome, 'We live longer, healthy lives'.

11.17 It is important that, as individuals, we think about when, where and how we travel and transport goods. For many, more energy efficient modes may already exist and be attractive. However, our current lifestyles are built around the car, and for the last ten years increasing numbers of households have had access to one or more cars.<sup>181</sup> The rate of increase in households with two or more cars has been higher than households with one car.<sup>182</sup> This has resulted in an increase in the number of single occupancy vehicles,<sup>183</sup> which can be an inefficient way of moving people and contribute to increased congestion. It is therefore important that we seek ways to move people out of their cars, where possible, on to public transport or to walking and cycling. This may be, for example, through investments in infrastructure that contribute to the efficiency of transport activity or modal shift, which can include the provision of Park & Ride facilities and demand management through measures such as congestion charging or workplace parking levies as introduced by Nottingham City Council.

<sup>181</sup> Scottish Government Statistical Bulletin, Transport Series: Household Transport in 2007, Table 1.

<sup>182</sup> See <http://www.scotland.gov.uk/About/scotPerforms/indicators/publicTransport>.

<sup>183</sup> Scottish Government Statistical Bulletin, Transport Series: Household Transport in 2007, Table 12.

### Provision of information

11.18 The National Transport Strategy commits to providing high quality travel information to travellers in Scotland. Transport Scotland provides four travel information services to the travelling public in Scotland: Traveline Scotland (TLS); Transport Direct; Traffic Scotland; and Freight Scotland. TLS plays a key role in encouraging travellers to choose public transport for journeys within Scotland, while Transport Direct provides a similar service for journeys across Great Britain and is developing a route planner for cycling. Cycling route maps for Edinburgh are also currently being developed on <http://edinburgh.cyclestreets.net>, whilst Sustrans provides information on the National Cycle Network. Information on walking routes for some Scottish cities are available from [www.walkit.com](http://www.walkit.com).

11.19 Traffic Scotland helps to ensure that the trunk road and motorway network operates in the most efficient manner. It utilises a wide range of leading-edge technologies to allow the collection and distribution of real-time traffic information for travellers, reducing journey times and congestion. Freight Scotland provides a similar service for the freight haulage industry.

11.20 The **GoGreener campaign** (see Chapter 5) provides information and practical advice to the public on how they can help prevent climate change and protect the environment. For transport, this includes advice on reducing overall travel and choosing more active and sustainable modes of travel. The GoGreener campaign and Transport Direct provide advice on alternatives to flying when sustainable alternatives are available.

### Car Sharing

11.21 Car sharing happens when two or more people share a car and travel together. It increases the efficiency of car use per head and can reduce congestion. With Scottish Government funding, the seven Regional Transport Partnerships, in association with their constituent Local Authorities, have set up branded car sharing databases. Most can create private user groups for employers to increase confidence and confidentiality for employees. In the north-east, 52% of members are finding a suitable car-share match. Across the whole of Scotland, membership of Liftshare and its schemes increased by 76% between October 2007 and February 2009 to over 15,800 people.<sup>184</sup>

11.22 In 2007, the Scottish Household Survey asked a sample of respondents about car sharing when travelling to work or education. Around one in ten respondents were involved in a car share agreement with people outside of their household.

### Eco-Driving

11.23 Efficient driving, also known as **eco-driving** ([www.ecodrivescotland.com](http://www.ecodrivescotland.com)), involves the adoption of a range of techniques, including shifting to a higher gear as soon as possible, anticipating road conditions, and driving slower than your normal speed, especially on motorways, to increase fuel efficiency of the vehicle. Average fuel efficiency can be improved immediately by 10-15%, though long-term gains may be much less.<sup>185</sup>

11.24 The Scottish Government has commissioned the Energy Saving Trust (EST) to provide eco-driving advice to over one million drivers on eco-driving over three years, starting in early 2009. The Energy Saving Scotland advice centre network provides advice

<sup>184</sup> See 'Car-sharing in Scotland – An update', *Scottish Transport Review*, Issue 44, June 2009 (<http://www.stsg.org/str/str44.pdf>).

<sup>185</sup> Department for Transport, 'Impact assessment of the carbon reduction strategy for transport' (<http://www.dft.gov.uk/pgr/sustainable/carbonreduction/>).

and support on energy efficiency and sustainable personal transport (see Chapter 5 for detail). Emissions from vans may be accessed from the Business Gateway website.

11.25 With the Department of Transport, the Scottish Government is negotiating an Energy Efficiency Agreement with fuel retailers to provide and promote fuel efficiency measures to their customers. Similar to the energy labels found on white goods, car labels provide information on emissions to consumers and businesses purchasing new vehicles. The labels were updated in 2009 to reflect the new Vehicle Excise Duty bands and now appear in most UK car showrooms.

### Improving the Bus Fleet

11.26 The Scottish Government is committed to facilitating the upgrade of the public sector bus fleet by 2020. We are also developing proposals to change the Bus Service Operators Grant Scheme to encourage increased investment in lower emission and higher quality vehicles in the commercial sector. Improving the quality of vehicles may help to attract new users, thus increasing the occupancy rates on more services and in turn increasing the operating efficiency of buses.

### Smarter Choices, Smarter Places

11.27 The Smarter Choices, Smarter Places programme provides funding to support improved transport infrastructure and behaviour change initiatives in seven demonstration communities. A key theme is reducing reliance on fossil fuels, delivered through a diverse and integrated package of measures, including personalised travel planning and infrastructure provision to support walking and cycling (see Box 11.2). The Sustainable Travel Demonstration Towns programme in England reported reductions in local car trips of between 7 and 9% in Darlington, Peterborough and Worcester between 2004 and 2009. The Smarter Choices, Smarter Places programme anticipates that it will deliver up to 70 ktCO<sub>2</sub> (0.29 TWh) savings per annum. The programme results will be transferable across Scotland

#### **Box 11.2: Smarter Choices Smarter Places**

The seven Scottish project areas selected for the Smarter Choices Smarter Places demonstration programme vary widely in car ownership, ranging from 88% in Lenzie to 27% in Glasgow's East End. This means that the challenge in some areas will be to divert existing journeys to sustainable modes, while in others the main aim is to prevent the build up of car usage for short local journeys.

All projects will improve local facilities and promote walking, cycling and public transport use in settings ranging from island communities to inner cities, each with distinct local issues. For example, in Orkney, the initial intention is to reduce car kilometres from 99.2 million vehicle kilometres to 92.7 million vehicle kilometres (a 6.5% reduction), resulting in a reduction of almost 3,500 tonnes of CO<sub>2</sub>/year (0.01 TWh). This will be accomplished through a diverse package of measures aiming to address barriers, alongside promoting behaviour change and improving the provision of travel information.

We will monitor and evaluate the impact of this work in each of the seven project locations. The lessons from Smarter Choices, Smarter Places will help local authorities throughout Scotland to identify successful and cost-effective ways to deliver transport-focused behavioural change programmes. These programmes will deliver energy efficiency and carbon savings, and improve health by increasing the amount of active travel.

### Electrification of the Rail Network

11.28 Scottish Ministers are pursuing a rolling programme of electrification of the rail network in Scotland, including delivery of the new Airdrie to Bathgate rail link as part of the

Edinburgh to Glasgow Rail Improvement Programme. Electrification provides opportunities for further energy efficiency through improvements in technologies such as regenerative braking. Transport Scotland will continue to strive for greater energy efficiency through its partnership work across the rail industry and with the Department for Transport as part of the Sustainable Rail Programme.

## **Improving Energy Efficiency for business travel**

### Flexible Working

11.29 Technological innovations are allowing many people to work outside their formal workplace. The evidence on total energy usage subsequent upon such changes is not always clear (as e.g. domestic energy consumption can increase), and further work is required in this area. A travel plan (see below) can help organisations to assess the environmental, social and economic impact of the various types of flexible working.

### High Speed Rail

11.30 The National Planning Framework designates a High Speed Rail link to London as a national development. It is believed that a journey time of under three hours between the Scottish Central Belt and London would help to make the train a more attractive alternative to short-haul flights for such journeys. The introduction of a high speed rail service will also allow connections to direct high speed rail services to the Continent.

### Green Fleet Reviews & Travel Plans

11.31 Free Green Fleet Reviews are provided by the Energy Saving Trust to organisations with over 20 vehicles. These reviews provide advice based on an assessment of business need, fuel data and fleet management to enable fleet managers to achieve energy, carbon and cost savings. The Scottish Government is undertaking a benchmarking review of the public sector fleet in Scotland.

11.32 A Travel Plan is a tailored action plan to meet the specific needs of an organisation, its staff, clients and visitors. It is an integrated package of measures designed to promote more sustainable and energy efficient transport choices. The overall aim is to reduce the impact of transport activity on the environment and deliver cost and time savings as well as productivity benefits. Advice on developing, implementing and monitoring Travel Plans is provided through the on-line resource at [www.chooseanotherway.com](http://www.chooseanotherway.com), by the Energy Saving Trust, and by the appointed travel plan officers in each Regional Transport Partnership.

### Movement of Goods

11.33 The Freight Best Practice Scotland programme provides advice on improving the operational efficiency of the freight sector. It provides operators with free access to a range of guides; case studies; software and seminars on topics such as saving fuel; skills development; equipment and systems; and operational efficiency and performance management tools, both at the fleet manager and driver levels. The tools and guides are available on line at [www.freightbestpractice.org.uk](http://www.freightbestpractice.org.uk).

11.34 Progressive tightening of emission standards for engines under the Heavy-Duty Vehicle Emission Regulations, together with improvements in fuel quality, is leading to a significant reduction in pollution from heavy diesels as existing HGV fleets are renewed.

11.35 Freight Scotland provides a similar service as Traffic Scotland, tailored to the needs of freight haulage industry. By collecting and distributing real-time traffic information on incidents and events that take place on the trunk road network, it enables travellers to make better informed decisions about their journeys and allows Transport Scotland to manage the strategic network more efficiently.

#### SAFED for HGVs

11.36 From 2005-2007, the Scottish Government funded Safe and Fuel Efficient Driving (SAFED) training to improve HGV driving skills and so lower fuel consumption. The programme demonstrated an average mpg improvement of 9.8% and, if improvements were maintained, potential average fuel cost savings of £2,031 per annum per participant. Since April 2007, training has been available on a purely commercial basis from various outlets at a cost of approximately £175 per driver.

#### SAFED for Vans

11.37 The Scottish Government is funding a small scale SAFED for Vans training project. This will support the establishment of a network of instructors, who will then provide SAFED training on a commercial basis. Drivers taking part are expected to achieve fuel savings of up to £500 a year.

#### Modal Shift

11.38 The Scottish Government operates four freight grant schemes. These all have the aim of encouraging the transfer of freight from road to rail or water where the road option is cheaper, thereby resulting in more sustainable freight movement. Freight grants totalling over £68 million have been awarded in Scotland over the last 10 years. Freight grant funded projects have removed over 120 million lorry miles from our roads over the same period. These projects will continue to remove many more lorry miles from Scotland's roads in the future.

### **Low Carbon Technologies**

11.39 In June this year we published a consultation document to help establish how the development and uptake of Low Carbon Vehicles (LCVs) in Scotland might best be accelerated.<sup>186</sup> The consultation outlined the technological options that are currently available and likely to come on stream in the future. As a starting point for discussion, it sought views on a potential target for the public sector fleet to be entirely comprised of LCVs by 2020, and that 95% of all new vehicles purchased in 2020 might be LCV. Both of these are in line with the 'stretch ambition' scenario produced by the UK Committee on Climate Change. The consultation period closed on 2 October 2009.

11.40 Currently, nearly all road vehicles are powered by internal combustion engines, fuelled by either petrol or diesel. In a DfT review of the innovation system for low carbon technologies, it was suggested that over the next 10 to 15 years, continued incremental improvements in fuel efficiency could be achieved in the road vehicle industry through additional refinements to the standard petrol and diesel internal combustion engines. These technologies relate to both improving the efficiency of the powertrain directly and also to non-propulsion elements. Examples of potential enhancements to the powertrain include variable valve actuation, direct injection and turbo charging, whilst non-propulsion

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<sup>186</sup> Scottish Government, 'Consultation on Low Carbon Vehicles', 2009 ([www.scotland.gov.uk/Publications/2009/06/25103442/13](http://www.scotland.gov.uk/Publications/2009/06/25103442/13)).

developments include friction reduction, regenerative braking, low rolling resistance tyres and lightweight materials.

11.41 The King Review suggested that adopting a selection of the most cost-effective technologies could achieve a 30% fuel efficiency saving for the average new vehicle within the next 5-10 years.<sup>187</sup> The cost of these measures depends very much on the scale on which they can be rolled out. If rolled out on a sufficiently large scale, King estimates that the additional production cost could be around £1,000 to £1,500 per vehicle.

### **Alternative fuels**

11.42 Notwithstanding the benefits of reducing emissions from petrol and diesel engines, alternative fuels are likely to become increasingly important due to the finite availability, and security issues, of fossil fuels.

#### Biofuels

11.43 Biofuels are liquid fuels that are derived from organic matter, currently feedstock such as oilseeds and sugar cane. They offer potential for reducing CO<sub>2</sub> emissions relative to fossil fuels because their carbon is absorbed from the atmosphere as the source plants grow, rather than being released from underground storage as is the case with fossil fuels. Current biofuels are bio-diesel and bio-ethanol, which can be blended with petrol or diesel and used in a conventional combustion engine, with modifications only required for blends with a high proportion of biofuel (greater than 10%).

11.44 The King Review highlighted that, in the longer term, biofuels have the potential to make a significant contribution as an energy source in the transport sector. While acknowledging the issues of life-cycle emissions and threat to biodiversity associated with some unsustainable biofuels, the Gallagher Review reported that biofuels, particularly second-generation biofuels, could make a contribution to a sustainable transport system.<sup>188</sup> Biofuels continue to evolve, and research and development of 'second generation' biofuels from sea-algae or waste offer potential. The challenge in making such fuels commercially available will be to demonstrate the sustainability, energy efficiency and emission reduction benefits of such fuels while making them affordable.

#### Hybrids

11.45 Hybrid vehicles combine an internal combustion engine that burns petrol, diesel or biofuels with an electric battery powertrain.

11.46 Plug-in hybrid electric vehicles (PHEVs) not only use the main engine to recharge, but can also be plugged into a charging station to augment their range. To do this, they have greater battery capacity than other hybrids. Such vehicles may be an attractive option for consumers due to their extended range and the fact that the costs of running a vehicle on electricity alone are likely to be considerably lower than refuelling with liquid fuels.

11.47 Hybrid vehicles are currently available on the market, though they are still constrained in their commercial viability against standard vehicles. The key constraint is battery capacity, particularly in the full hybrid vehicles. In many of these vehicles, the capacity of the pure electric range is typically less than 2km. A further constraint is the additional cost of full hybrid vehicles, which has been reported to be in the order of £2,000-£4,000 more than for equivalent conventional vehicle types. Similarly, although PHEVs offer a partial solution to

<sup>187</sup> HM Treasury, 'The King Review of Low-Carbon Cars', Parts I and II: Recommendations for Action, 2008.

<sup>188</sup> Renewable Fuels Agency, 'The Gallacher Review of the Indirect effects of Bio-Fuels Production', 2008.

battery capacity constraints, the additional batteries required for these vehicles (compared with other hybrids) currently add a cost increment of approximately £6,500 for a 45km range.

### Electric Vehicles (EVs)

11.48 Full electric vehicles are a further advancement on the hybrid concept. They only incorporate a battery and do not have internal combustion engines. These batteries tend to have larger capacities than the hybrid vehicles and are, therefore, able to undertake longer journeys in purely electric mode.

11.49 EVs are currently not available in significant numbers. One of their clear advantages is that they have zero emissions at point of use. Moreover, if electricity as a transport fuel is produced from low-carbon sources such as renewables, it can have low or even negligible emissions over its life cycle. As electricity is distributed via a grid in most areas, the underlying components required for a charging infrastructure are predominantly in place. Partly because of these advantages, a number of other countries, including Germany, Sweden and Israel, are setting ambitious targets for the uptake of EVs.

11.50 Currently, initial purchasing costs are relatively high in comparison to traditional vehicles (although lower fuel costs and zero Vehicle Excise Duty may help reduce these differences over the vehicle lifetime). The key barrier is the battery capacity currently available. At the moment, electric vehicles can travel only a limited range of distances before needing to be re-charged; present electric vehicles are estimated to have a range of approximately 100-150km. Additionally, the charging process is relatively slow, and recharging a battery may require an overnight charge. Fast charging technology has the potential to reduce charging times significantly and is currently being trialled in a number of locations, including in Japan.

11.51 In the longer term, the widespread adoption of electric vehicles could significantly increase demand for electricity. To illustrate the implications, it is estimated that if 100% of Scottish cars were full electric vehicles, it would require an additional 5TWh of electrical energy per annum (equivalent to approximately 15% of projected Scottish demand by 2020). To deliver the energy efficiencies that might be hoped for, this electricity would need to come from renewables such as wind and wave.

11.52 However, in the case of both EVs and PHEVs, this extra electricity usage may not require the construction of additional capacity if vehicles are predominantly charged during off-peak hours. This could be facilitated via the implementation of an electric pricing system that is linked to levels of demand, for example, a two-tier tariff where electricity is cheaper at night than during the day, or flexible smart metering to encourage use of generating capacity at peak production periods, such as from renewable sources. Furthermore, vehicles charged during periods of low demand may also provide a market for surplus electricity that is produced from renewable sources where production can be intermittent. Despite these factors, it is still likely that, where significant local clustering occurs, some local grid reinforcement may be required.

### Hydrogen

11.53 Like electricity, hydrogen has potentially attractive properties as an energy source for vehicles. Hydrogen offers reductions in CO<sub>2</sub> emissions relative to conventional petrol and diesel engines because the only significant emission is water vapour. If hydrogen is made from low-carbon energy sources, very low lifecycle emissions are a possibility, although some ways of producing hydrogen (e.g. using coal-fired electricity) are significantly less energy efficient.

11.54 Hydrogen powered vehicles are not currently available on the mass market. The key prototypes are models in which hydrogen is either burnt in an internal combustion engine or by generating electricity in a fuel cell. There are some challenges to hydrogen vehicles becoming commercially available, e.g. there continue to be difficulties in storing hydrogen in an energy-dense form, which would be required if it is to be used as a road transport energy source and as there are no natural sources of hydrogen, it has to be specifically produced. At present, the process for doing this is relatively energy intensive and expensive.<sup>189</sup> However, progress is being made, and it is likely that hydrogen vehicles will be part of the transport energy mix in the medium to long term.

#### Uptake of low carbon technologies and fuels

11.55 Due to major uncertainties around rates of technological development and energy prices, forecasting the future of fuels with any confidence is extremely difficult. This highlights the importance of adopting an approach that ensures flexibility remains for the market to respond to changing circumstances. However, it may be likely that, in the medium-to long-term, a range of different fuels will be in operation simultaneously. This is because:

- fully electric, plug-in hybrids, or hydrogen powered cars are still a long way from achieving significant market penetration;
- biofuels may be unlikely to represent the dominant part of a fuel mix as a result of land and other constraints;
- different fuels may suit different purposes. For example, the current range and recharging times of EVs may make them better suited to short city trips, whilst larger vehicles may be able to accommodate the larger tanks required for gaseous fuels such as hydrogen; and
- the niche availability of energy sources may make some fuels better suited to certain geographic areas. For example, areas where there is a surplus of renewable energy, including wind and hydro, might find that it is more cost-effective to convert this into hydrogen for road transport uses.

11.56 To conclude, while an efficient transport system is key to Scotland's future economic success, it is also a key user of finite energy resources and a major contributor to greenhouse gas emissions and climate change. It is vital then that steps are taken by Government, by the public and private sectors, and by society more generally not only to improve the energy efficiency of transport, but also to change our fundamental attitudes to travel and our transport modes.

**Q 50: What more can we do to encourage people to reduce the amount of travel, e.g. through behavioural change or modal shift in their daily lives?**

**Q 51: What partnerships do we need to create to enable more sustainable infrastructure and networks and develop new technologies and fuels, e.g. with the transport industry, manufacturers and business users?**

<sup>189</sup> Scottish Government, 'Consultation on Low Carbon Vehicles'.