Biofuel ExChange:
Pursuing change in biofuels policy and developing alternatives

Institute for European Environmental Policy

ALTERNATIVE MEANS OF REDUCING CO2 EMISSIONS FROM UK ROAD TRANSPORT TOWARDS 2020 AND BEYOND

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1 INTRODUCTION

The objective of this briefing is to provide an overview for non-transport specialists of the potential options and policy instruments that might be introduced in the UK specifically to reduce carbon dioxide (CO_2) emissions from road transport. It also discusses the issues and challenges associated with these, in the context of the wider policy framework, including that in place at the EU level. The briefing focuses on cars, although reference is made to vans, heavy goods vehicles (HGVs) and buses, where appropriate.

Both the UK and the EU are working towards long-term policy objectives in relation to climate change that are guiding the development of relevant policies in a number of sectors including transport. The UK's Climate Change Act 2008[1] requires that by 2050 the UK's emissions of greenhouse gases (GHGs) should be at least 80 per cent lower than they were in 1990. Similarly, at the EU level, the European Commission's 2011 low carbon road map[2] sets out a high level strategy for delivering a reduction in the EU's GHG emissions of between 80 and 95 per cent by 2050 compared to 1990 levels[3].

The GHG emissions from the UK transport sector are increasing both in absolute terms and as a proportion of the overall national GHG emissions. Between 1990 and 2010, transport's GHG emissions increased by 11 per cent, while total GHG emissions in the UK fell by 21 per cent. Hence, transport's GHG emissions have increased from 18 per cent of the UK's total in 1990 to 26 per cent in 2010 (DfT, 2012)[4]. The UK does not have a target for the GHG emission reductions required in the transport sector. However, the Committee on Climate Change (CCC), which was established by the 2008 Act and advises the Government on climate change policy, estimates that GHG emission reductions of more than 90 per cent will be needed from surface transport[5] by 2050 in order to meet the Climate Change Act's 80 per cent reduction target (CCC, 2010). Hence, the transport sector will have an important role in meeting the UK's long-term GHG reduction targets, as will many other sectors of the economy.

In this briefing, we refer to both transport's GHG emissions and to the CO_2 emissions from transport. When talking about transport's direct GHG emissions, these terms are often used interchangeably, as the vast majority of transport's direct GHG emissions arise in the form of CO_2. For example, it has been estimated that CO_2 emissions make up 98.7 per cent of transport's direct GHG emissions (EEA, 2011). However, when discussing transport's indirect GHG emissions, for example in relation to biofuels or emissions from electricity generation, it is more accurate to talk about transport's GHG (rather than CO_2 emissions) as indirect emissions are more likely to include a higher proportion of other GHGs. Hence, when discussing transport's direct GHG emissions, we tend to refer to CO_2 emissions, but when discussing more generally we refer to transport's GHG emissions.

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[1] See Climate Change Act 2008 at http://www.legislation.gov.uk/ukpga/2008/27/section/1

[2] COM (2011) 122 *A Roadmap for moving to a competitive low carbon economy in 2050*, Brussels, 8.3.2012; see http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2011:0112:FIN:EN:PDF

[3] Both of the UK and EU targets reflect the conclusions of IPCC's fourth assessment report that developed countries will need to reduce their GHG emissions by between 80 and 95 per cent by 2050 (IPCC, 2007).

[4] This figure includes international aviation and international shipping.

[5] 'Surface transport' is the term used by the CCC to designate transport that is not international aviation or international shipping.

Broadly, there are three ways to reduce transport's GHG emissions, which are addressed in turn in the following sections:

- Options for decarbonising transport fuels, ie options for reducing the carbon intensity of fuels used by vehicles in ways that do not involve unsustainable biofuels.
- Improving the energy efficiency of vehicles.
- Policies that influence the way in which vehicles are used, thus reducing CO_2 emissions.

The various options and policy instruments discussed in this report are found in the GHG mitigation strategies for the transport sector in various Member States, including the UK (see ITF/OECD, 2008). The final report of the first *'EU Transport GHG: Routes to 2050'* project covered all major transport modes in Europe and tried to quantify the contribution of these different categories of options. It concluded that in order to reduce transport's GHG emissions by 2050 by about 90 per cent, emissions reductions would need to be relatively evenly split between options that decarbonise transport fuels, options that improve vehicle efficiency and options that affect the way in which vehicles are used (Skinner *et al*, 2010)[6].

[6] See Figure 21; note that the report used the term 'system efficiency' to cover these measures.

2 OPTIONS FOR DECARBONISING TRANSPORT FUELS

In the EU, the main policy driver for the uptake of biofuels and other potentially renewable energy sources for transport, such as electricity and hydrogen, in the transport sector is the 2009 Renewable Energy Directive (RED)[7]. The RED requires that a minimum of 10 per cent of the proportion of final energy consumption used by transport should come from renewable sources by 2020. This works in conjunction with another item of EU legislation, the Fuel Quality Directive (FQD)[8]. Following amendments in 2009 this includes a target for the reduction of the lifecycle GHG emissions of fuels covered by the Directive of at least six per cent by the end of 2020 (compared to 2010)[9]. The requirements of these two Directives overlap to some extent, but there are differences in their respective coverage. For example, 'sustainable' biofuels that are used in the maritime and aviation sectors are included in the calculation of transport energy from renewable sources in the RED, but these cannot be taken into account to meet the GHG savings target of the FQD (Skinner and Kretschmer, 2010).

2.1 Biofuels

Biofuels (including both bioliquids and biogas) are being promoted as one of the options for decarbonising transport fuels; the other main renewable options are considered to be electricity and, in the longer-term, hydrogen[10]. If such fuels are to contribute to reducing transport's GHG emissions significantly, biofuels need to be produced with low lifecycle emissions (including land use change emissions), while electricity and hydrogen need to be produced from low carbon energy sources (see for example King, 2007). Liquid biofuels have advantages over both electricity and hydrogen as they can be blended with petrol or diesel and used in conventional vehicles[11]. In this respect, they are often compatible with existing fuel supply infrastructure. Furthermore, for certain modes of transport such as long-distance road freight, certain modes of shipping and aviation, biofuels generally are the only viable option, at least in the short-term, as a result of the general properties of the respective fuels (see for example Ogden, 2012). Whether the use of biofuels does in fact decrease transport's GHG emissions depends on a range of factors, such as the feedstock from which they are produced and the use of associated by-products, as well as the impacts of direct and indirect land use change (ILUC) (see for example E4Tech, 2010; Laborde, 2011).

[7] See Article 3(4) of Directive 2009/28/EC on the promotion of the use of energy from renewable sources; see http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2009:140:0016:0062:EN:PDF.

[8] Directive 98/70/EC relating to the quality of petrol and diesel fuels; as amended by Directive 2009/30/EC; see http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2009:140:0088:0113:EN:PDF

[9] Additionally, in order to potentially increase this figure to 10 per cent, there are two indicative targets of 2 per cent that can be achieved through, for example, the use of carbon, capture and storage or through the use of credits purchased through the Kyoto Protocol's Clean Development Mechanism.

[10] Both electricity and hydrogen are more accurately described as being an 'energy source' rather than a fuel. However, within this briefing, we use the term 'fuel' for the sake of simplicity. Another potential alternative fuel suggested by some is compressed natural gas (CNG). This is used for the purposes of transport in several countries to varying degrees. Although lower in its carbon content than petrol or diesel, it is still a fossil fuel so is usually not considered to be a long-term decarbonisation option. Hence, it is not considered in this briefing.

[11] This is true up to relatively low blends for current biofuels, e.g. 10 per cent for ethanol and 7 per cent for biofuels, beyond which there are technical issues that need to be addressed, e.g. engines need to be modified. In principle, more advanced biofuels could be used in higher blends.

In the UK, the uptake of biofuels in the road transport sector is governed by the Renewable Transport Fuel Obligation (RTFO). This sets an obligation on road transport fuel suppliers to use a proportion of biofuels in their fuels that will amount to five per cent by volume (or four per cent by energy) in 2013/14 (DfT *et al*, 2012). The UK is implementing both the RED and FQD requirements by amending the RTFO; the RED's transport requirements were transposed in December 2011[12], whereas the FQD requirements have not yet been transposed[13].

2.2 Electricity and hydrogen

If electricity and hydrogen are to contribute significantly to decarbonising transport in the longer-term both would have to be produced in ways that emit zero, or at least very low levels of GHGs. Otherwise, the use of electric vehicles, which emit zero CO_2 emissions from the tailpipe while in use, would simply result in tailpipe emissions being replaced by upstream emissions, ie those emitted at the power generation plant. This means that the electricity supply sector would also have to virtually decarbonise its operations. In the UK, the carbon intensity of the electricity supply sector was 544gCO_2/kWh[14] in 2008; this would have to decline to around 50gCO_2/kWh by 2030 for the UK to be on course to meet its long-term GHG reduction targets (CCC, 2010)[15]. The impact of the emissions levels of the UK's electricity supply sector can be illustrated with the example of the Nissan Leaf. This electric car has zero tailpipe CO_2 emissions, but is projected to effectively have CO_2 emissions of 114g/km in the UK in 2015 when upstream emissions are also taken into account. The impact of the way in which electricity is generated can be demonstrated as the emissions of the same electric vehicle used in France would only be 20gCO_2/km in 2015, as a result of that country's less carbon-intensive electricity supply industry (ICCT, 2012a)[16]. Hydrogen is not yet used for transport on a significant scale and is unlikely to make a significant contribution to powering road transport before 2020[17].

There are a number of other challenges in relation to putting these vehicles on the market and in persuading consumers to buy them. Presently the cost of electric vehicles is substantially higher than that of conventional vehicles, even with the present government subsidy which is partially due to the high costs of the battery (the costs of hydrogen vehicles are higher still). There are also potential resource availability issues, for example lithium, platinum and other rare earth metals, that are needed in the production of alternative vehicles, as well as the added complication of the need to recycle and dispose of more complex vehicles, including their batteries. The relatively short range of electric vehicles at present and the times required for charging are also an issue although improvements are

[12] The Renewable Transport Fuel Obligations (Amendment) Order 2011, Statutory Instrument 2011 No. 2937. Available at: http://www.legislation.gov.uk/uksi/2011/2937/contents/made

[13] The Renewable Transport Fuel Obligations (Amendment) Order 2013, Draft Statutory Instrument. Available at: http://www.legislation.gov.uk/ukdsi/2013/9780111532713/introduction

[14] 'kWh' stands for kilowatt-hour; it is a unit of energy that is equal to the total energy consumed at a rate of 1,000 watts for one hour (CCC, 2012)

[15] This is the figure under the "Medium Abatement" scenario (effectively the central case) in CCC (2010).

[16] Reducing the carbon-intensity of the UK's electricity supply is likely to require investment in a range of non-fossil fuel alternatives. For example, the CCC argues that this needs to be delivered through more renewables, nuclear and carbon capture and storage (CCS) attached to fossil fuel power stations (CCC, 2010). These options can all be controversial in their own right.

[17] However, there are some trials with hydrogen, eg for buses in London. Available at: http://www.tfl.gov.uk/corporate/projectsandschemes/8444.aspx

occurring in both respects. More broadly, there will be a need to develop and implement policies that promote the necessary infrastructure for the use of electric vehicles and, potentially, in the longer-term for hydrogen vehicles. This is important in order to enable markets for these vehicles to be developed and that potential users are not put off by difficulties with refuelling (Smokers *et al*, 2012).

In order for vehicles using low carbon electricity (or hydrogen) to contribute significantly to decarbonising the transport sector, they will have to constitute a significant proportion of the fleet and so of the total vehicles sold in the coming years. In this respect, the rate of fleet renewal needs to be taken into account. Even if all new cars sold in 2020 were electric, it would still be another decade before the vast majority of the entire fleet would be electric. For example, in its 'Medium Abatement' scenario the CCC foresees that in 2030 60 per cent of new cars could be electric, but they would not yet account for more than 31 per cent of the total fleet (CCC, 2010)[18].

The penetration of electric vehicles in the UK market is relatively low at present. For example, in 2011 just over 1,000 new pure electric[19] vehicles were registered. While this was an increase of over 500 per cent on 2010, it was still only 0.6 per cent of the total number of new car registrations in 2011 (SMMT, 2012). The government is stimulating the purchase of low carbon cars and vans through the Plug-in Car and the Plug-in Van Grants. The purchasers of electric, plug-in hybrid[20] and hydrogen-fuelled vehicles are eligible for the grant, which amounts to 25 per cent of the cost of an eligible car (up to a maximum of £5,000) and 20 per cent of the cost of an eligible van (to a maximum of £8,000). Between 2010 and 2015, the Government has set £300 million aside to support such incentives and is spending over £100 million supporting research and development and the installation of infrastructure[21]. The incentives aim to directly address the issue of the higher costs associated with such vehicles and thus encourage consumers to buy them. Additionally, it is hoped that increasing consumer demand in this way will support the development of the technology, with the aim that overall costs will begin to decline and that technical innovation will overcome the existing challenges.

[18] Under the same scenario, a similar proportion of new vans would be electric, while the uptake of hydrogen is limited to buses. The CCC believes that the potential for widespread use of electric HGVs is limited, and therefore note that biofuels are important to decarbonise HGVs.

[19] Ie excluding hybrid vehicles

[20] A plug-in hybrid vehicle has both a conventional engine and an electric battery, which can be charged from the grid. Its battery is smaller than that of an electric vehicle, but is larger than that of a hybrid vehicle. The latter also has conventional engine and an electric battery, but the battery cannot be charged from the grid. Both hybrid vehicles and plug-in hybrid vehicles do not have some of the problems associated with pure electric vehicles, eg in relation to range and charging, and so are seen as complementary to electric vehicles.

[21] www.gov.uk/government/publications/plug-in-car-grant and www.gov.uk/government/news/cash-boost-for-electric-van-man

3 IMPROVING THE ENERGY EFFICIENCY OF VEHICLES

Transport's CO_2 emissions can also be reduced by improving the fuel efficiency of vehicles using conventional engines. Options include technical improvements to existing engines or to other aspects of vehicles, particularly using lighter materials for cars[22]. For new cars, a target for improved vehicle efficiency is set in the 'passenger car CO_2 Regulation'[23] to be met by manufacturers. This requires that the average CO_2 emissions across the whole new car fleet in the EU should be reduced to 130gCO_2/km by 2015 and a target of 95gCO_2/km has been proposed for 2020. In 2011, the latest year for which official data are available, the average EU-wide CO_2 emissions from new cars was 135.7gCO_2/km (EEA, 2012)[24]. Equivalent targets also exist for new vans of 175gCO_2/km by 2017 and a proposed target for 2020 of 147gCO_2/km[25]. Stricter standards for cars and vans are expected in the longer-term, potentially for 2025 and 2030, while the European Commission is considering what action to take to reduce the CO_2 emissions of buses and trucks[26].

In 2012, the Commission formally proposed that both the car and van targets for 2020 should be confirmed in legislation[27, 28]. These decisions were based largely on two studies – one for cars and one for vans – undertaken to explore the modalities of the 2020 targets. Both reports estimated that the costs of meeting the 2020 target were lower than had previously been estimated (Smokers *et al*, 2011; 2012). Other work, using a different methodology, has suggested that the costs for cars might be lower still[29]. Even if the more conservative cost estimates from Smokers *et al* (2011) are used, analysis suggests that there would be a net benefit to consumers and society of meeting the 2020 car efficiency target (Skinner and Smokers, 2012)[30].

For 2025, Ricardo-AEA (2012) concluded that a target of 60gCO_2/km for cars would be possible if more 'advanced powertrains', such as pure electric and plug-in hybrid cars, made up around 24 per cent of new cars in 2025, which was in 'the middle of the range of credible market projections'. Such a target would increase the cost of a vehicle by around €2,500, which Greenpeace and Transport and Environment (2013) estimated would be paid back as

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[22] Different improvements are also potentially important for other types of vehicles, such as aerodynamic improvements for HGVs, eg AEA and Ricardo (2011)

[23] Regulation (EC) No 443/2009 setting emission performance standards for new passenger cars as part of the Community's integrated approach to reduce CO_2 emissions from light-duty vehicles

[24] This is slightly lower than the equivalent figure for UK, which was 138.1gCO_2/km. However, for the purpose of compliance with the Regulation, it is the EU level figure, and the way that this is broken down by manufacturers, that is important rather than Member State-specific numbers.

[25] Regulation (EU) 510/2011 setting emission performance standards for new light commercial vehicles as part of the Union's integrated approach to reduce CO_2 emissions from light-duty vehicles

[26] As yet, the Commission has not published the details of any policy measures for these vehicles. However, one of the initiatives in the Commission's 2011 Transport White Paper was to develop appropriate standards for the CO_2 emissions of vehicles in all modes; COM (2011) 144 *Roadmap to a Single European Transport Area – Towards a competitive and resource-efficient transport system. Available at:* http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2011:0144:FIN:en:pdf

[27] Proposal amending Regulation (EC) No 443/2009 to define the modalities for reaching the 2020 target to reduce CO_2 emissions from new passenger cars, COM (2012) 393, Brussels

[28] Proposal amending Regulation (EC) No 510/2011 to define the modalities for reaching the 2020 target to reduce CO_2 emissions from new light commercial vehicles, COM (2012) 394, Brussels

[29] http://www.theicct.org/blogs/staff/assembling-vehicle-technology-cost-data-european-market

[30] This is even the case if it is assumed that consumers only take account of short-term fuel cost savings; for a discussion see Section 3.6 of Skinner and Smokers (2012)

a result of reduced fuel costs in just over two years. For vans, the additional costs of meeting a 100gCO_2/km target in 2025 would be paid back in just under three years. Meeting such standards would have a major positive impact on both fuel efficiency and emissions and is more easily monitored than the results of several other measures. This is therefore one of the most robust policy options to pursue decarbonisation.

Improvements in vehicle efficiency have the benefit that they lock-in future CO_2 emissions reductions, ie a new car emitting 120gCO_2/km will continue to emit similar amounts of CO_2 throughout its lifetime (the impacts of poor maintenance are considered to be relatively small). This is in contrast to many of the policy instruments targeting car use (see below). However, the passenger car CO_2 Regulation does not act in isolation. While the Regulation ensures that lower CO_2 emitting vehicles are put on the market, it does not necessarily ensure their purchase. Hence, other policies, such as labelling and fiscal incentives (or disincentives), are important in stimulating demand for low emission vehicles (IEA, 2012).

In accordance with EU Directive 1999/94/EC[31], the UK requires that all new cars be labelled to inform potential buyers of the respective fuel efficiency and CO_2 emissions of the vehicle. The UK (in common with a number of other Member States) has gone beyond the requirements of the Directive in order to make labelling more effective and more relevant to consumers (AEA *et al*, 2011). Annual road taxation (ie vehicle excise duty) is now linked to a car's CO_2 emissions as presented on the label and is lower for lower emitting vehicles. This was considered to be an example of good practice in a recent report comparing sustainable transport policies in different EU Member States (CE Delft, 2012).

However, there are reasons to believe that different car taxation regimes could be introduced which would be more effective at reducing the CO_2 emissions of the UK car fleet and also help to secure tax revenues from vehicles, which are anticipated to decline over time. For example, Leunig (2012) argued for a CO_2-based registration charge, as the academic literature suggests that upfront registration charges are more effective than annual road taxes at incentivising the purchase of low CO_2 emitting cars. For similar reasons, Fergusson (2012) argued for the introduction of a 'feebate scheme' for the UK[32]. If applied to cars and CO_2, a fee would be levied on cars with high CO_2 emissions and the revenues would be used to provide a rebate on cars with low CO_2 emissions. The aim would be to increase the price incentives for low CO_2 emitting vehicles and also help to overcome the higher costs associated with alternative, cleaner technologies, such as electric vehicles. Either scheme might replace the existing vehicle tax system and be designed to be revenue-neutral or revenue-raising.

[31] Directive 1999/94/EC relating to the availability of consumer information on fuel economy and CO2 emissions in respect of the marketing of new passenger cars, Brussels, 18.1.2000, OJ L 12/16

[32] The word is 'feebate' derived from the words 'fee' and 'rebate', which suggests the two elements of such a scheme.

4 POLICIES THAT INFLUENCE THE WAY IN WHICH VEHICLES ARE USED

Many policies influence the way in which vehicles are used. These include measures that influence how vehicles are driven, such as fuel efficient driving and speed limits, measures that encourage cars to be used less often and measures to encourage shorter journeys, such as land use and planning policies. All of these have the potential to contribute to reducing transport's CO_2 emissions. However ensuring that this is realised in practice is less straightforward than it is for the more technical options discussed in previous sections. In addition, economic instruments, such as congestion charging and road user charging more generally, can also be used to provide incentives for different patterns of car use and an overall reduction in mileage travelled.

The potential CO_2 emissions reductions that could be achieved by measures to stimulate more fuel efficient car driving or **'eco-driving'** appear to be around 10 per cent (UK ERC, 2009). Similarly for the freight sector, experience with the English Freight Best Practice programme delivered an average of five per cent savings for the companies adopting such behaviour (AEA and Ricardo, 2011). The term 'eco-driving' covers a wide range of measures that focus on improving fuel economy by driving habits and styles. This includes driving at appropriate speeds, using appropriate acceleration, braking and gear changing, maintaining tyre pressure at appropriate levels and removing unnecessary weight and impediments to good aerodynamics, such as roof racks (CCC, 2010; Kampman *et al*, 2009). For freight transport, measures such as improved maintenance, real-time route planning and better capacity management, are also important (AEA and Ricardo, 2011). In theory, as eco-driving would save on fuel costs there is an economic incentive for drivers to take up such behaviour, especially in the freight sector.

One particular challenge is how to make drivers aware of the benefits of eco-driving. For example, a study has suggested that an eco-driving information campaign in the Netherlands only reached 1.5 per cent of drivers (UK ERC, 2009). In this respect, training could be a more effective means of engaging drivers. However, the challenge remains as to how to convince drivers to undertake such training. For new drivers, making eco-driving an element of the practical driving test is a potential option, while freight transport drivers can be required to undergo training as part of their job (CCC, 2012). Another challenge is to ensure that once trained, drivers maintain their fuel efficient behaviour (UK ERC, 2009). In this respect, it is more difficult to ensure, or 'lock-in', emissions reductions, compared to the more technical options discussed previously.

The ***enforcement of existing speed limits***, particularly on motorways, has been recommended by the CCC, which also has considered the impact of reducing the maximum speed limit in its longer-term, ambitious reduction scenario (CCC, 2010; 2012). It has been estimated that a rigorous enforcement of existing speed limits on major roads could deliver annual CO_2 emissions reductions of around two to three per cent of total transport emissions (UK ERC, 2009). The rationale behind enforcing maximum speed limits, and of potentially reducing these, is linked to the fact that the energy efficiency of vehicles varies by speed. For cars the most efficient speeds from a CO_2 emissions perspective are between 50km/h (around 31mph) and 90km/h (56mph), above and below which CO_2 emissions per kilometre increase rapidly (Ligterink, 2011).

The range of measures commonly referred to as ***'smarter choices'*** also has the potential to deliver CO_2 reductions, including those that aim to reduce travel or to stimulate the use of public transport, cycling and walking (Cairns *et al*, 2004)[33]. Under their high intensity scenario, Sloman *et al* (2010) estimate that the potential traffic reductions from such measures could reach seven per cent for off-peak, non-urban traffic and 21 per cent for peak, urban traffic. The CCC has estimated that the Government's main means of rolling out smarter choices, the Local Sustainable Transport Fund, would be able to fund smarter choices programmes covering 25 per cent of the UK by 2015. The CCC has called on the Government to set out an approach for rolling out smarter choices across the whole country by 2020 (CCC, 2012).

One of the challenges with smarter choices, as with eco-driving, is ensuring that the changes in behaviour, and lower levels of traffic that result, are maintained. If some people use their car less as a result of smarter choices measures, this will free up road space that might be used by other drivers, thus undermining the benefits of the measures. In this respect, it will be important to lock in the traffic reductions using complementary measures that control traffic, which could include user charging (see below) or a reallocation of road space away from cars in favour of other modes, such as public transport, cycling or walking. This underlines the need for coordinated measures at the local level to address CO_2 emissions as well as more strategic national policy measures.

Local ***land use and planning policies*** also have an important role to play in delivering CO_2 reductions from transport. While the relationship between land use and transport's CO_2 emissions is complex, elements of a lower CO_2-intensive urban environment can be identified. These include: preferring higher densities of development; favouring urban brown field development over green field development; making local communities active and attractive; and placing amenities in walking distance of homes, or in locations that are well served by public transport (Goodwin, 2009). Transport infrastructure can also be designed to provide incentives for less CO_2-intensive modes, for example lanes for buses, cycles and shared cars, bus and pedestrian priority, etc. In this respect, integrated land use and transport planning strategies are often seen as the best means of delivering such developments (Transport for Quality of Life, 2011). The importance of such policies for reducing transport's CO_2 emissions has also been highlighted by the CCC (2012). The Government has recently amended planning policy by introducing the new National Planning Policy Framework, which aims to contribute to sustainable development, including moving towards a low carbon economy. The Framework notes that local planning authorities should plan developments in locations and ways that reduce GHG emissions and should support transport measures that deliver GHG reductions (DCLG, 2012). The way in which this is implemented in practice is critical; particularly as there is also a strong emphasis on promoting economic growth in the current policy framework.

Finally, ***road pricing and congestion charging schemes*** have been shown to be successful in reducing car use, and therefore CO_2 emissions, with experience from London, Stockholm and Milan suggesting that such schemes can deliver reductions in car use of between 15 and

[33] Cairns *et al* (2004) included the following as elements of smarter choices: workplace travel plans; school travel plans; personalised travel planning; public transport information and marketing; car clubs; car sharing schemes; teleworking; teleconferencing; and home shopping.

20 per cent (Hajer *et al*, 2012). Application in other cities has been limited, partly because of concerns about the public and business acceptability of the measure, based on concerns about the potential impact on trade for local businesses and the impact on individual mobility. Such barriers can be overcome *inter alia* through the design of the scheme, complementary policies, such as improvements to public transport, and early and frequent engagement and communication with all those concerned (Smokers *et al*, 2012). The CCC has suggested that in the UK road pricing should be 'seriously considered' between 2020 and 2030, as it would bring economic, fiscal and environmental benefits (CCC, 2010).

5 RECOMMENDATIONS FOR REDUCING TRANSPORT'S GHG EMISSIONS TO 2020

In the period to 2020 greater use of renewable electricity is the leading alternative to biofuels as an option to reduce the carbon intensity of transport fuels with respect to cars and railways. It is unlikely that hydrogen – renewably produced or otherwise – will make a significant contribution to powering transport by 2020. Another potential renewable energy source for transport, which is relevant in a number of other EU Member States, is biogas, but again this is unlikely to make a significant contribution in the UK to 2020, as a result of the low number of gas-powered vehicles in the country[34].

While the number of electric vehicles can be expected to increase in the next decade, on their own they are unlikely to reach a level that will enable the UK to meet its 10 per cent RED transport target using renewable electricity. As an illustration, in order for the 10 per cent target to be met by road transport solely from renewable electricity, one-third of the *vehicles* on the road in the UK would have to be pure electric or plug-in hybrid vehicles in 2020[35]. As a comparison, the CCC (2010) is only considering a possible five per cent of *cars* being electric or plug-in hybrid by 2020, which would mean that no more than 1.5 per cent of the total energy from transport would be from renewable electricity[36]. At the EU level, CE Delft (2013) estimated that meeting the 10 per cent target EU-wide would require more than 40 per cent of the cars on the road to be electric and plug-in hybrid.

The CCC has estimated that even for electric cars to achieve five per cent of the total fleet by 2020, support for their purchase would have to be double the £400 million currently set aside by the Government (CCC, 2010). It is recognised that, in a time of fiscal austerity, finding more resources to support the purchase of low carbon vehicles might prove to be difficult. However, ***the UK Government should monitor the effectiveness of the existing incentives and the uptake of low carbon vehicles more generally. If this suggests that the existing level of support is insufficient, the Government should find more resources to support the uptake of the vehicles, eg under the existing Plug-in Grants***.

Progress in reducing CO_2 emissions from new cars and vans has been relatively good, as a result of EU legislation. Given that the latest analysis suggests that there would be a net benefit to consumers and society, the ***UK Government should support the confirmation of the 95gCO_2/km target for cars and the 147gCO_2/km for vans in 2020***, as proposed by the European Commission. Additionally, the UK Government should work with the Commission and other Member States to ensure that subsequent targets for new cars and vans are sufficiently stringent to ensure that the recent progress in reducing CO_2 emissions

[34] For example, in the UK new registrations of gas-powered vehicles (which could use non renewable natural gas or biogas) have been even lower than those of electric cars in recent years. For example, figures from the SMMT quoted by the ENDS Report (2013) suggest that only 60 new gas powered freight vehicles were registered for the first time in 2012, compared with 33 in 2011. The article also noted that there were a number of projects trialling gas-powered vehicles in the UK involving companies such as John Lewis and Tesco.

[35] This i) assumes that 30 per cent of the UK's electricity is produced from renewable sources by 2020, which is in line with the figures in the lead scenario quoted in the HMG (2010); ii) assumes that this proportion can be applied to the electricity used by road transport; and iii) ignores the potential use of renewable electricity by the rail sector. Under these assumptions, even if 100 per cent of vehicles on the road were electric in 2020, only 30 per cent of road transport's energy would be from renewable sources. Hence, for the 10 per cent target, one-third of vehicles (ie 10/30) would need to be electric.

[36] Using the same assumptions as in footnote 35: if only 5 per cent of cars were electric in 2020, then only 30 per cent of this electricity (ie 1.5 per cent) would be from renewable sources

continues. The implications of targets of 60gCO_2/km for cars and 100gCO_2/km for vans in 2025 should be explored in more detail, as these appear to be beneficial for users, although achieving the necessary uptake of pure electric and plug-in hybrid cars would still be challenging, as discussed above.

While the existing tax incentives in favour of lower CO_2 emitting cars have been beneficial, other vehicle taxation systems have the potential to be more effective in incentivising the purchase of low CO_2 emitting cars and might also be designed to provide revenue. Hence, the ***UK Government should explore the potential benefits for, and implications of, reforming the existing car tax system to better incentivise the purchase of low CO_2 emitting cars***, for example to replace the current annual car tax by a tax at the point of purchase or registration.

Finally it is recognised that a number of different policy measures will be needed to reduce transport's CO_2 emissions. Therefore, ***the UK Government should review the suite of options that have the potential to reduce transport's CO_2 emissions by changing the way in which vehicles are used, many of which are not currently realising their potential***. In particular, the Government should:

- Explore ways of communicating the benefits of eco-driving more widely.
- Include eco-driving as an element of the practical driving test.
- Explore means of ensuring the better enforcement of existing speed limits.
- Develop a strategy for ensuring the wider roll out of smarter choices programmes.
- Monitor the impacts of the latest planning reforms on transport's CO_2 emissions and produce further guidance, if appropriate.

It is important to note that improving the efficiency of vehicles and reducing CO_2 emissions from using vehicles differently would also contribute to meeting the RED's 10 per cent target for transport by reducing the total amount of energy used by the transport sector. This would mean that the same amount of renewable energy used by transport would be a higher proportion of the total energy use and thus make it easier to meet the RED's transport target. For example, CE Delft (2013) estimated that if there was a 20 per cent reduction in energy used by transport, the amount of renewable electricity needed to meet the 10 per cent target would decline by around 15 per cent (from around 460 petajoules (PJ) to around 390 PJ).

All of the options discussed in this report have a potential role to play both in meeting the RED target and in reducing transport's GHG emissions in the context of the long-term GHG emissions reductions targets. Action is needed at both the national and EU levels, many of which can act in a complementary fashion to reduce transport's GHG emissions.

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