EU Transport GHG: Routes to 2050?

Information to raise awareness and instruments to stimulate innovation and development: Paper 9

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19 November 2009

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The project is funded by the European Commission's Directorate-General Environment

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Suggested citation: Brannigan, C. et al (2009) *Information to raise awareness and instruments to stimulate innovation and development: Paper 9* Paper produced as part of contract ENV.C.3/SER/2008/0053 between European Commission Directorate-General Environment and AEA Technology plc; see website www.eutransportghg2050.eu

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Executive Summary

In recent years the GHG emissions from the transport sector in Europe have continued to rise whilst the GHG emissions from other sectors have stabilised or begun to fall. Unless action is taken, transport GHG emissions alone will exceed an 80% reduction target for all sectors or make up the vast majority of a 60% reduction target. This illustrates the scale of the challenge facing the transport sector given that it is unlikely that GHG emissions from other sectors will be eliminated entirely. In this context the overarching aim of the project is to provide guidance and evidence on the broader policy framework for controlling greenhouse gas (GHG) emissions from the transport sector.

The main objective of Paper 9 is to consider policy measures including the provision of information to raise awareness and the use of instruments to stimulate innovation and development, both with the aim of reducing Greenhouse Gases (GHG) from the main motorised non-road transport modes in the short term (i.e. until 2020) and the longer term (i.e. between 2020 and 2050). It forms part of a suite of papers covering the full range of technical and non-technical options for reducing GHG from transport.

Paper 9 covers a range of transport sectors and utilises data and analysis from existing studies rather than undertaking new research. As well as considering the magnitude of the GHG emissions savings that could be achieved by each option the paper also reviews the evidence on costs, timescales for implementation, barriers and secondary benefits where information is available. A draft version of paper was presented to stakeholders during a technical focus group in September 2009. Stakeholders' comments have been taken account in this revised version.

In terms of provision of information, the following policy instruments were considered:

- Travel planning;
- Personalised travel planning;
- General/other awareness campaigns;
- Public transport information;
- Information for vehicle operators;
- Encouraging fuel efficient driving through driver training; and
- At point of sale (e.g. CO_2 labelling).

In terms of the additional measures to stimulate technological innovation and development, the following were considered:

- Green public procurement;
- Research and Design (R&D); and
- Fleet tests, demonstration and pilot programmes.

The paper found that such instruments have had varying success in the past with some only managing to raise awareness about the emissions impact of travel or vehicle purchasing choices, and others achieving a reduction in greenhouse gases. Looking to 2020 and beyond, it is unlikely that instruments discussed in this paper will have any substantial role to play in GHG reduction when implemented alone.

However, as it is likely that there will be substantial use of other instruments and options (policy and technical) in terms of reducing emissions of greenhouse gases from the transport sector, the use of the type of instruments discussed in this paper will be important in terms of supporting them. The majority of those instruments discussed here are enabling instruments, rather than those directly impacting the emissions of greenhouse gases from transport. In particular, these instruments are most likely to complement the implementation of other policy instruments discussed in Paper 6 – regulation for vehicles and energy carriers; paper 7 – economic instruments; and paper 8 – infrastructure, spatial policy, speed and traffic management.

Whilst the majority of the policy instruments discussed in this paper are relatively low cost to implement, the main barriers associated with them relate to the reliance on the implementation of

additional policy instruments or technological options in order to achieve a substantial or sustained impact on the reduction of greenhouse gases. However, one of the main information gaps relating to these policy instruments is the longer-term potential for greenhouse gas emission reductions – these have been estimated for the purposes of this paper.

Awareness of greenhouse gas emissions and climate change linked to all areas of life will become increasingly important over the next few decades. Therefore the information-related policy instruments discussed in this paper will be of importance in ensuring that information regarding transport's role in increasing greenhouse gas emissions and associated impacts will continue to be highlighted – therefore information will play a crucial role.

1 Introduction

1.1 Topic of this paper

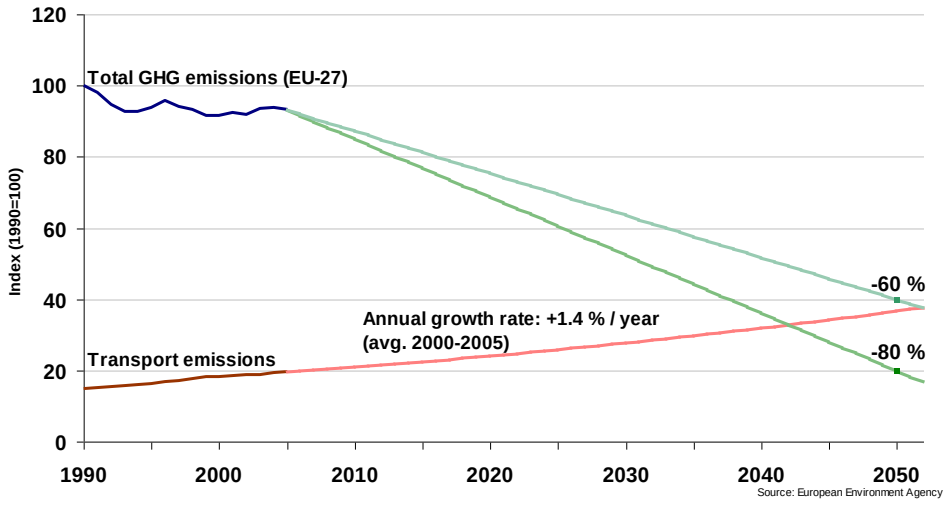
This paper is one of four policy papers drafted under the *EU Transport GHG: Routes to 2050?* Project. These papers review the policy instruments that could be used to stimulate the application and take up of the technical and non-technical options that could contribute to reducing transport's GHG emissions, both up to 2020 and in the period from 2020 to 2050. This paper focuses on information-related policy instruments and so covers provision of information (travel awareness campaigns, energy and CO_2 labelling, carbon footprinting), fuel-efficient driver training, CO_2 procurement, research and development (R&D), and fleet tests, demonstration and pilot projects. The papers aim to provide a high-level summary of the evidence based on existing studies.

This paper will be presented in draft form to a Technical Focus Group meeting (at which stakeholders will be present) to be held on 24 September 2009 after which it will be updated on the basis of any comments and further evidence received.

1.2 The contribution of transport to GHG emissions

The EU-27's greenhouse gas (GHG) emissions from transport have been increasing and are projected to continue to do so. The rate of growth of transport's GHG emissions has the potential to undermine the EU's efforts to meet potential, long-term GHG emission reduction targets if no action is taken to reduce these emissions. This is illustrated in Figure 1 (provided by the EEA), which shows the potential reductions that would be required by the EU if economy-wide emissions reductions targets for 2050 of either 60% or 80% (compared to 1990 levels) were agreed and if GHG emissions from transport continued to increase at their recent rate of growth. The figure is simplistic in that it assumes linear reductions and increases. However it shows that unless action is taken, by 2050 transport GHG emissions alone would exceed an 80% reduction target for all sectors or make up the vast majority of a 60% reduction target. This illustrates the scale of the challenge facing the transport sector given that it is unlikely that GHG emissions from other sectors will be eliminated entirely.

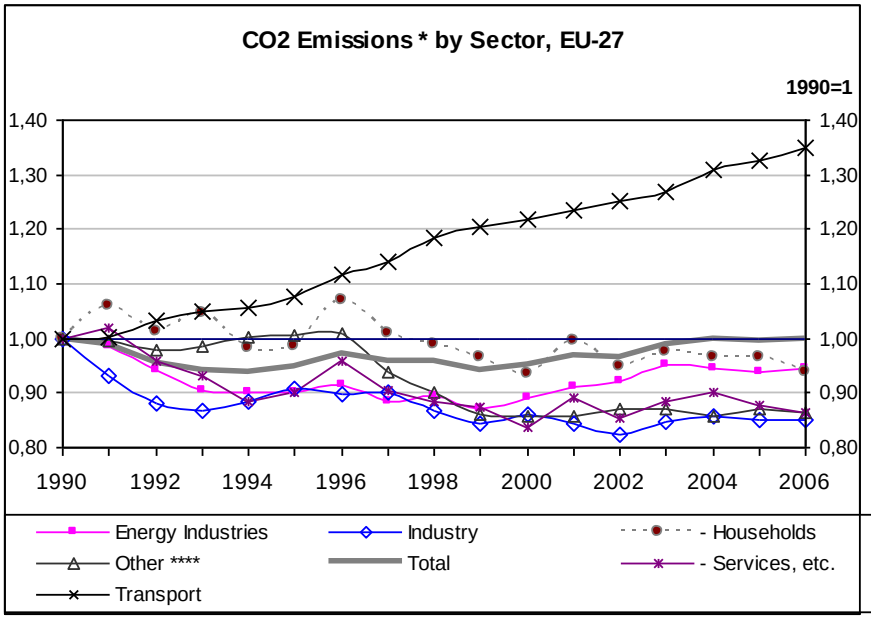
Figure 1: EU overall emissions trajectories against transport emissions (indexed)[1]



[1] Graph supplied by Peder Jensen, EEA

The extent of the recent growth in transport emissions is reinforced by Figure 2, which presents a sectoral split of trends in CO_2 emissions over recent years. Whilst the CO_2 emissions from other sectors have levelled out or have begun to decrease, transport's CO_2 emissions have risen steadily since 1990. It should be noted that whilst Figure 2 is presented in terms of CO_2 emissions, very similar trends are evident for GHG emissions (in terms of CO_2 equivalent) since CO_2 emissions represent 98% of transport's GHG emissions.

Figure 2: Carbon dioxide emissions by sector EU-27 (indexed)[2]



Notes:

i) The figures include international bunker fuels (where relevant), but exclude land use, land use change and forestry

ii) The figures for transport include bunker fuels (international traffic departing from the EU), pipeline activities and ground activities in airports and ports

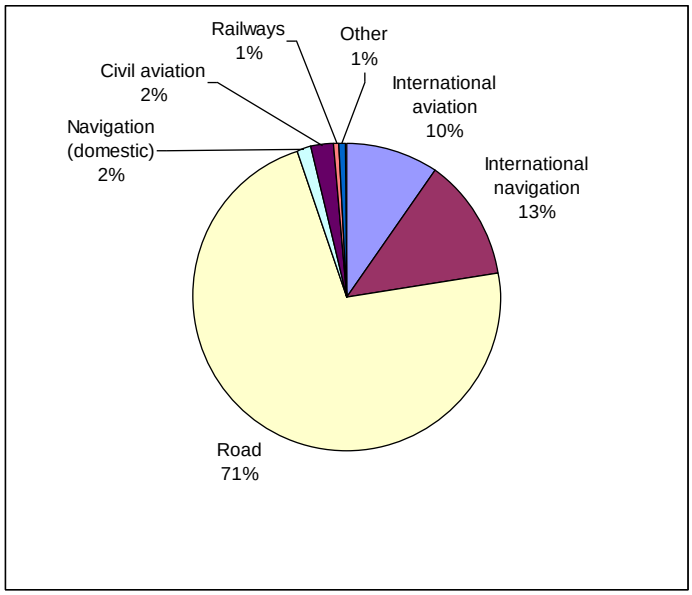
iii) "Other" emissions include solvent use, fugitive emissions, waste and agriculture

The vast majority of European transport's GHG emissions are produced by road transport, as illustrated in Figure 3, while international shipping and international aviation are other significant contributors.

Recent trends in CO_2 emissions from transport are also expected to continue, as can be seen from Table 1 below. Between 2000 and 2050, the JRC (2008) estimates that GHG emissions from domestic transport in the EU-27 will increase by 24%, during which time emissions from road transport are projected to increase by 19% and those from domestic aviation by 45%. It is important to note that these projections do not include emissions from international aviation and maritime transport, which are also expected to increase due to the growth in world trade and tourism.

[2] Graph based on figures in DG TREN (2008) *EU energy and transport in figures 2007-2008: Statistical Pocketbook* Luxembourg, Office for Official Publications of the European Communities.

Figure 3: Greenhouse gases emissions by transport mode (EU-27; 2005)[3]



Note: The figures include international bunker fuels for aviation and navigation (domestic and international)

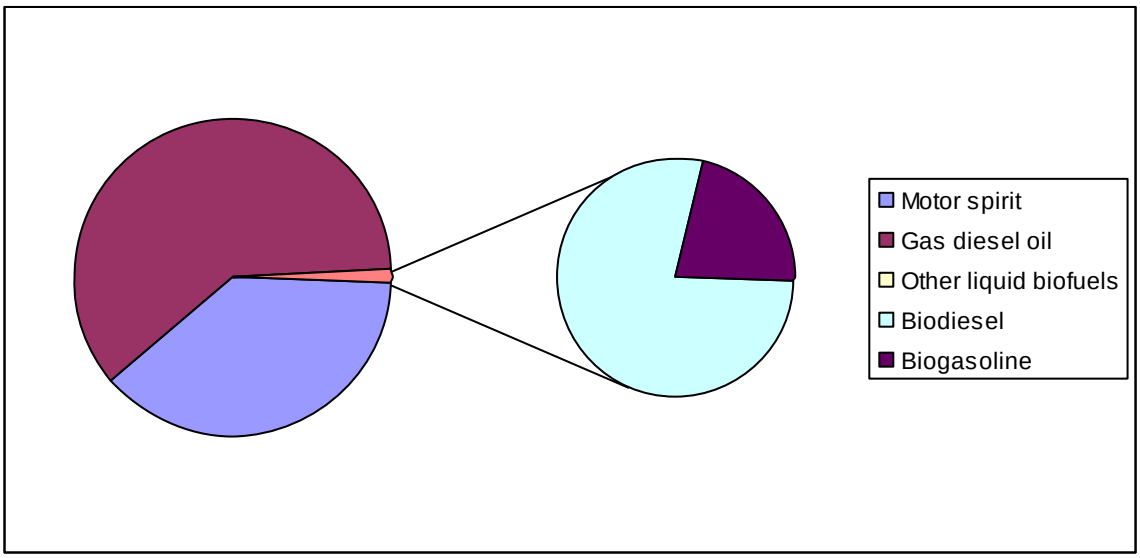
Table 1: CO_2 emissions projection for 2050 by end-users in the EU-27, in Millions tonnes of Carbon[4]

End user Category	1990	2000	2010	2020	2030	2050
Road transport	695	825	905	980	1002	1018
Rail	29	29	27	27	21	20
Domestic Aviation	86	134	179	206	237	244
Inland navigation	21	16	16	17	17	17
Total	**810**	**988**	**1110**	**1213**	**1260**	**1299**

Figures from the EEA (2008), illustrate the recent growth in GHG emissions from international aviation, as they estimate that these increased in the EU by 90% (60 Mt CO_2e) between 1990 and 2005; international aviation emissions will thus become an ever more significant contributor to transport's GHG emissions if current trends continue. Furthermore, the IPCC has estimated that the total impact of aviation on climate change is currently at least twice as high as that from CO_2 emissions alone, notably due to aircrafts' emissions of nitrogen oxides (NO_x) and water vapour in their condensation trails. However, it should be noted that there is significant scientific uncertainty with regard to these estimates, and research is ongoing in this area.

[3] Graph based on figures in EEA (2008) *Climate for a transport change – TERM 2007: Indicators tracking transport and environment in the European Union* EEA Report 1/2008, Luxembourg, Office for Official Publications of the European Communities.
[4] Taken from JRC (2008) *Backcasting approach for sustainable mobility* Luxembourg, EUR 23387/ISSN 1018-5593, Office for Official Publications of the European Communities.

Figure 4: Final transport energy consumption by liquid fuels in EU-27 (2005), ktoe[5]



The principal source of transport's GHG emissions is the combustion of fossil fuels. Currently, petrol (motor spirit), which is mainly used in road transport (e.g. in passenger cars and some light commercial vehicles in some countries), and diesel, which is used by other modes (e.g. heavy duty road vehicles, some railways, inland waterways and maritime vessels) in various forms, are the most common fuels in the transport sector (see Figure 4). Additionally, liquid petroleum gas (LPG) supplies around 2% of the fuels for the European passenger car fuel market (AEGPL, 2009[6]), while the main source of energy for railways in Europe is electricity, neither of which are included in Figure 4. While, alternative fuels are anticipated to play a larger role in providing the transport sector's energy in the future, currently they only contribute 1.1% of the sector's liquid fuel use.

1.3 Background to project and its objectives

The context of the *EU Transport GHG: Routes to 2050* is the Commission's long-term objective for tackling climate change, which entails limiting global warming to 2°C and includes the definition of a strategic target for 2050. The Commission's President Barosso recently underlined the importance of the transport sector in this respect be noting that the next Commission "needs to maintain the momentum towards a low carbon economy, and in particular towards decarbonising our electricity supply and the transport sector"[7]. There are various recent policy measures that are aimed at controlling emissions from the transport sector, but these measures are not part of a broad strategy or overarching goal. Hence, the key objective of this project is to provide guidance and evidence on the broader policy framework for controlling GHG emissions from the transport sector. Hence, the project's objectives are defined as to:

- Begin to consider the long-term transport policy framework in context of need to reduce greenhouse gas (GHG) emissions economy-wide.
- Deal with medium- to longer-term (post 2020; to 2050), i.e. moving beyond recent focus on short-term policy measures.
- Identify what we know about reducing transport's GHG emissions; and what we do not.
- Identify by when we need to take action and what this action should be.

[5] Graph based on figures in DG TREN (2008), page 206
[6] European LPG Association (2009) *Autogas in Europe, The Sustainable Alternative: An LPG Industry Roadmap,* AEGPL, Brussels. See http://www.aegpl.eu/content/default.asp?PageID=78&DocID=994
[7] http://ec.europa.eu/commission_barroso/president/pdf/press_20090903_EN.pdf

Given the timescales being considered, the project will take a qualitative and, where possible, a quantitative approach. The project has three Parts, as follows:

- Part I ('Review of the available information') has collated the relevant evidence for options to reduce transport's GHG emissions, which was presented in a series of Papers (1 to 5), and is in the process of developing four policy papers (Papers 6 to 9) that outline the evidence for these instruments to stimulate the application and up take of the options.
- Part II ('In depth assessment and creation of framework for policy making') involves bringing the work of Part I together to develop a long-term policy framework for reducing transport's GHG emissions.
- Part III ('Ongoing tasks') covers the stakeholder engagement and the development of additional papers on subjects not covered elsewhere in the project.

As noted under Part III, stakeholder engagement is an important element of the project. The following meetings were held:

- A large stakeholder meeting was held in March 2009 at which the project was introduced to stakeholders.
- A series of stakeholder meetings (or Technical Focus Groups) on the technical and non-technical options for reducing transport's GHG emissions. These were held in July 2009.
- A series of Technical Focus Groups on the policy instruments that could be used to stimulate the application of the options for reducing transport's GHG emissions. These were held in September/October 2009.
- Two additional large stakeholder meetings at which the findings of the project were discussed.

As part of the project a number of papers have been produced, all of which can be found on the project's website, as can all of the presentations from the project's meetings.

1.4 Background and purpose of the paper

This paper is one of four policy papers (Papers 6 to 9) being developed under the *EU Transport GHG: Routes to 2050* project. The aim of these papers is to review the policy instruments that could be used to stimulate the application and take up of the technical and non-technical options that could contribute to reducing transport's GHG emissions, both up to 2020 and in the period from 2020 to 2050. For the purpose of the project, we are using the following definitions:

- **Options** deliver GHG emissions reductions in transport – these can be technical, operational or modal shift.
- **Policy instruments** may be implemented to promote the application of these options.

The options were reviewed in a series of papers developed earlier in the project, i.e.:

1. Technical options for fossil fuel based road transport.
2. Alternative energy carriers and powertrains.
3. Technical options for non-road transport modes.
4. Operational options for all modes.
5. Modal split and decoupling.

These "options" papers are in the process of being revised to take into account comments received at an earlier set of stakeholder meetings (in early July 2009), as well as any additional evidence that has been supplied by stakeholders since those meetings. It is anticipated that revised versions of the options papers will be put on the project's website in early October.

This paper is the fourth of a series of "policy" papers that review the policy instruments for reducing CO_2 emissions from transport between 2010 and 2050. These papers cover:

6. Regulation of vehicles and energy carriers.
7. Economic instruments.
8. Infrastructure and spatial policy, speed and traffic management.
9. Information, R&D, pilots, voluntary agreements.

All of these papers use evidence from existing studies to assess each of these instruments against a number of key criteria. The paper will be presented in draft form to a Technical Focus Group meeting (at which stakeholders will be present) to be held on 24 September 2009. After this meeting, the paper will be the subject of consultation on the project's website until 16 October. In finalising the paper, we are happy to take on board any evidence that we have not yet considered. Hence, stakeholders are free to submit any additional evidence via the email address on the project website.

The revised version of the paper will be uploaded on to the project's website.

1.5 Structure of the paper

This paper is structured in the following way:

- Impacts of policy instruments
- Provision of information
- Additional measures to stimulate technological innovation and development
- Summary of key findings and issues for discussion/research

2 Impacts of policy instruments

The summary table below provides an overview of the relationship between the information-related policy instruments (discussed further in the remainder of this paper) and emission reduction options.

Table 2: Impacts of Policy Instruments

Policy Instrument	Reduced car-ownership	More fuel efficient vehicles	Shift to low-carbon energy carriers	Fuel efficient driving/sailing/flying	Reduced vehicle-kms due to higher vehicle utilisation	Modal shift to low-carbon modes	Limiting overall transport growth (reduced vehicle kms)
Provision of Information - Travel planning	↓				↓	↓	↓
Provision of Information - Personalised Travel planning	↓				↓	↓	↓
Provision of Information - General/other awareness campaigns	↓	↓		↓	↓	↓	↓
Provision of Information – Public transport information	↓				↓	↓	
Provision of Information – Information for vehicle operators		↓		↓			↓
Provision of Information - Encouraging fuel efficient driving through driver training				↓			↑
Provision of Information – At point of sale (e.g. CO_2 labelling)		↓					
Provision of Information – Carbon footprinting		↓					↓
Additional measures to stimulate technological innovation and development - Green public procurement		↓	↓				↑
Additional measures to stimulate technological innovation and development - Research and design (R&D)		↓	↓				
Additional measures to stimulate technological innovation and development - Fleet tests, demonstration and pilot programmes		↓	↓				

Key:

↓	**Policy instrument leads to GHG reduction at the long term by inducing this reduction option**
↑	Rebound effect: Policy instrument leads to GHG increase by negative impact on this reduction option

The inter-linkages between each of the policy instruments and emission reduction options are discussed in more detail in each of the subsequent sections.

3 Provision of Information

3.1 Introduction

With climate change at the top of the political agenda of most European countries, policy instruments for soft measures such as travel awareness campaigns and public transport information are becoming more commonplace. The key aim of the provision of information is to raise awareness of the key impacts (e.g. greenhouse gas emissions etc) of travel, vehicle purchasing or other choices, and to encourage the uptake of alternative, more sustainable modes. The provision of quality information on sustainable modes of transport is now commonplace in Europe, and shows increasing sophistication. A wide variety of different types of information campaign are used around the world to enable, and encourage, the use of public transport, cycling and walking, and to discourage journeys by single occupancy vehicle. It is impossible to place an absolute value on the direct impact of such campaigns or the effectiveness of information provision, as effectiveness is closely related to the quality and variety of the journey options they present. However, there are numerous examples that demonstrate that they can be successful, several of which are highlighted below.

Despite the difficulty in predicting their exact impact in any particular context, their widespread use is recommended for two reasons:

- They are usually low-cost compared to infrastructure and public transport improvements, and can add considerable value to these improvements by making sure they are well used.
- They are one of only a few measures that have the potential to manage journey demand, as opposed to reducing carbon emissions per journey (in addition to measures such as road pricing, spatial planning). Unless the growth in journey demand is managed, it will eventually offset any cuts in absolute emissions made through efficiency gains.

The large amount of funding available from the European Union for soft measure programmes indicates a real commitment towards soft measures from the European Union. Programmes such as MAX, ASTUTE, EPOMM, MOST and TAPESTRY advance the knowledge base of these type of programmes and strengthen evidence of effectiveness. Greenhouse gas emissions from transport represent 21 per cent of total UK domestic emissions, decarbonising transport is therefore a UK government priority. DfT has recently developed a new carbon reduction strategy, which includes policies and measures that will be applied in the transport sector to reduce CO_2 emissions from the sector as a whole. Residential and business travel plans can be required as a condition attached to planning approval for a new development in the UK.

3.2 Types of information provision

3.2.1 Information or awareness ‘campaigns’

Information campaigns or travel awareness campaigns can take various forms, including:

- National information campaigns;
- Mode specific campaigns, e.g. for cycling or buses, or against car use;
- Information provided about accessing a specific destination or area; or
- Information provision aimed at specific origins, i.e. residents in a particular area.

At the highest level there are national travel awareness campaigns such as ‘Travelwise’ in the UK and ‘Ik Kyoto’ in Belgium (‘I Kyoto’ in English). Ik Kyoto is a large Flemish campaign that focuses on sustainable commuter traffic. Campaigns for specific modes include ‘Bike it UK’, a cycling campaign aimed at the 9-12 years age group which intends to increase the number of children cycling to school, thereby improving the health of children in the UK. The German ‘Bikes + Business’ project promotes the use of bicycles in commuting to and from work in the Frankfurt/Rhein-Main region.

There are also campaigns against specific modes such as the international Car Free Cities who promote the possibility of a future design for cities that excludes cars. They promote a series of events including the annual World Car-free Day.

Information campaigns focussed on specific destinations are generally called travel plans or mobility management plans and are usually provided for new office, commercial or leisure development. They are now widespread in most European countries, and in the UK they can be required as a condition attached to planning approval for new development. An extension of travel plans for single buildings are the area wide information campaigns that have been developed by the Highways Agency and Transport for London in the UK.

Information campaigns focussed on specific origins are usually called residential travel plans and their popularity in the UK has increased in the last few years. They are usually linked to public transport information provided to new residents of a development. Sometimes they are also linked to actual physical public transport and walking and cycling improvements in the area. In the UK, they can be required as a condition to a planning application.

Another type of information campaign focussed on origins is personalised travel planning. This is a targeted marketing technique providing travel advice to households based upon personal trip patterns. This technique was first trialled in Australia with the Travel Blending campaign but is now also common in Europe with over 30 projects in the UK, the largest one in the London borough of Sutton. Some projects take PTP a step further. In Belgium, **'**Mobiel 21: civil contract on short distance trips' provided PTP but also asked residents to sign up to a citizens contract to "experiment temporarily with their travel behaviour and give feedback about the experience in return for a reward from the municipality and a commitment that their input would lead to local infrastructure improvements".

MAX is the EU's latest framework research project on Mobility Management and Travel Awareness in transport. MAX aims to bring new perspectives, to critically review and enrich the work accomplished so far by linking Mobility Management and Travel Awareness and exploiting their synergies. The website includes a state of the art report.

Information and awareness campaigns may also focus on other issues, such as health and physical fitness. Such campaigns often demonstrate the linkages between the issue of poor health and physical fitness and promoting the use of walking, cycling and public transport as part of the solution. This link was recently demonstrated in the Commission's Green Paper on promoting healthy diets and physical activity, where it was stated that physical activity could be integrated into the daily routine, including walking or cycling instead of using motorised transport, in order to get to school. The paper also identified the need for further measures to be implemented to support this transition towards 'active travel', such as ensuring the provision of safe walking and cycling paths to reduce the barriers to uptake (EC, 2005).

Campaigns can also be aimed at schools, such as the 'Safer Routes to Schools' campaigns in the UK. The 'Safer Routes to Schools' campaign focuses on school travel and travel plans, aiming to inspire and support safe, sustainable and healthy school journeys (Sustrans, 2009). Such campaigns can have a formative impact with long-term benefits, as information regarding more sustainable modes of transport is passed onto children at an early age.

3.2.2 Public Transport Information

Public transport information has made a significant leap within the last decade. Public transport information is now much more than a paper timetable. Most European countries have an online national transport information service such as Transport Direct in the UK or 9292 in The Netherlands. Public transport information kiosks, where public transport information can be obtained using a computer, are available in most European city centres and at airports.

A Mobility Centre is a publicly accessible office, such as a town centre shop or office, from where information and advice about transport decisions can be given and where awareness raising and

educational activities can be based. An example is the GMPTE Travelshop at Piccadilly Gardens in Manchester. Real time information on bus, rail and light rail services is now commonplace in most large European cities.

There is also a great deal of interest in the potential of using new technologies, particularly mobile phones and other hand-held devices, in this field. Public transport operators, information providers and phone companies are all stakeholders, and there are a number of ongoing projects across Europe in both the public and private sector.

3.2.3 Information for vehicle operators

In addition to targeting the public, information can also be provided to businesses, such as companies that operate vehicles. Schemes include 'best practice' campaigns, such as those aimed at the freight sector in the UK, which is funded by the UK government (Department for Transport). Freight Best Practice provides a range of free advice and information for the freight industry on fuel efficiency, developing skills, equipment and systems, operational efficiency and performance management. The Energy Saving Trust (EST) in the UK also targets travel and driving, and delivers training courses for companies and their employees to learn smarter driving techniques to reduce fuel consumption and save money (see also Section 3.2.4 - fuel efficient driving).

3.2.4 Driver training (e.g. Ecodriving)

There are a number of potential policy instruments that could help to achieve a widespread shift in driver behaviour towards more fuel efficient driving, including the following:

- Changes to driver training standards, both the standard driving test and training requirements for commercial drivers, to require an understanding of how driving style affects fuel efficiency.
- Changes in vehicle standards to require devices such as gear change indicators and mpg readout.
- Requirements for commercial fleets to audit fuel consumption more fully, potentially as part of other GHG reporting requirements – this will have the effect of making more companies aware of the extent of their fuel costs.

Eco-driving is the name often given to driving techniques that drivers can use to optimise their car fuel economy. Eco-driving is seen as a quick win solution to carbon reduction as it achieves personal cost savings as well as environmental benefits. It is therefore much easier to convince people of the positive effects of eco-driving compared to, for example, sustainable travel modes (Eco-driving is also considered in Paper 4 – Operational options for all modes).

There are a large number of eco-driving programmes in Europe. Some examples are as follows:

ECO DRIVEN - ECODRIVEN is a synchronised European-wide eco-driving campaign aiming at drivers of passenger cars, delivery vans, lorries and buses in 9 EU countries. During a one-year campaigning period end-users will be regularly presented with Eco-driving activities within their familiar social environment, which will stimulate them to reflect on and optimise their driving behaviour in a safe and energy-efficient manner. The campaign is based on a bottom-up approach through European-wide local and regional collaborations of the ECODRIVEN consortium with relevant national and local stakeholders such as car dealers, fuel companies, touring clubs, drivers' associations, driving schools, municipalities, SMEs and hauliers etc. who will support campaign activities and disseminate campaign material.

Motiva, Finland - The national campaign "Malttia ja viisautta teille" started in 2005 and lasted for two years. It was co-financed by nine stakeholders including the Ministry of Transport and Communications. Eco-driving has been promoted in Finland for nearly a decade and is nowadays an obligatory part of the training for new drivers. In addition there are four training networks in Finland offering special eco-driving courses for drivers who already have a driving licence.

Het Nieuwe Rijden, The Netherlands - This Dutch programme promotes more efficient driving methods to car drivers and professional drivers.

SAFED, UK - SAFED (Safe and Fuel Efficient Driving) is a UK government eco-driving programme specifically for van, HGV, and bus and coach drivers. SAFED is a one-day complementary driver development course, consisting of driver training and assessment. It intends to improve the safe and fuel efficient driving skills of commercial drivers.

3.2.5 Labelling and provision of information at point of sale

Another form of information provision may be through energy or CO_2 labelling, often associated wit the purchase on new vehicles. The European Union has enforced the publication on the fuel economy and CO_2 emissions of new passenger cars with Council Directive 1999/94/EC. The purpose of the Directive is to ensure that information is offered at point of sale or lease in the Community in order to enable consumers to make an informed choice when purchasing a vehicle. This fuel economy information scheme is part of the Community's wider strategy to reduce average CO_2 emissions from new passenger cars to 120g/km by 2010, compared to the 1998 estimated average level of 186g/km. It is designed to support and complement the other strands of this strategy. These include the voluntary agreements that were held with the European, Japanese and Korean automobile manufacturers to reduce average CO_2 emissions from new passenger cars to 140g/km by 2008 and other fiscal measures.

Key legislation in this area is Directive 1999/94/EC relating to the availability of consumer information on fuel economy and CO_2 emissions in respect of marketing new passenger cars. One of the key purposes of the Directive is " to ensure that information relating to the fuel economy and CO_2 emissions of new passenger cars offered for sale or lease in the Community is made available to consumers in order to enable consumers to make an informed choice". Information that is currently required to be provided to the consumer includes:

- A fuel economy label for all new cars to be displayed at the point of sale
- A poster (or a display) showing the official fuel consumption and CO_2 emission data of all new passenger car models displayed or offered for sale or lease at or through the respective point of sale
- A guide on fuel economy and CO_2 emissions
- All promotional literature must contain the official fuel consumption and specific CO_2 emission data for the passenger car model to which it refers

More recently, the Commission has been revising the Labelling Directive as part of the renewed Community Strategy on CO_2 from cars. It is anticipated that the proposal to revise CO_2 from cars labelling Directive will be adopted towards the end of 2009. This is due to reports that Member States have not found the impact of the Directive to be visible, and quality of labels produced varying across Member States. The revised Directive is anticipated to include a more harmonised approach to the design of labels, the introduction of energy efficiency classes to better raise consumer awareness at time of car purchase, and widening the scope of the scheme to light-commercial vehicles.

3.2.6 Carbon footprinting

'Carbon footprinting' is a process whereby the total greenhouse gas emissions caused directly by an individual, organisation, event or product is calculated. Carbon footprinting can therefore be viewed as a useful tool in terms of the provision of information, including that based on freight transport operations, urban transport, and transport systems.

An example of how this has been used in the transport sector is that of DHL Express UK, run over 5,000 delivery vans each day. In order to reduce the environmental impact of the firm's operations, carbon footprinting was undertaken, focussing on the organisations premises and road transport fleet. This exercise, and resultant information, has enabled the firm to prioritise opportunities to reduce the carbon impact of operations (DHL, 2008).

3.3 GHG Reduction potential

It is inherently difficult to quantify the potential of information campaigns to reduce GHG for three reasons:

- The quality of such campaigns can vary enormously, as can their scope and budget. Although it is possible to refer to best practice, this is essentially an open-ended question.
- Information campaigns can only achieve a change in travel behaviour if travel alternatives exist – in a sense they are essentially a mechanism to support, and get best value from, other initiatives.
- Even if alternatives exist, and an information campaign persuades some travellers to reduce/substitute car journeys, these changes usually need to be 'locked in'. If congestion is the de facto limiting factor on car trips then the road-space that is freed up is likely to be taken up by another traveller 'switching' the other way. Therefore in such circumstances genuine carbon savings are only likely to be achieved if modal shift is accompanied by a reduction in overall road-space (e.g. by introducing bus or cycle lanes), or by congestion/parking charges – which lock-in the modal shift achieved.

However, to justify investment in soft measures, efforts have been made to quantify the effects of these measures in some way. The information below provides a snapshot of the evidence currently available that soft measures, such as information campaigns and public transport information, are effective in reducing car trips. Reductions in GHG will be closely related to these reductions, although quantifying the exact relationship would require more evidence on whether the car trips were eliminated, or substituted with other modes and the carbon emissions from those modes.

3.3.1 Effects of Information or awareness campaigns

Travel Planning

Evidence on best practice in 20 organisations indicated an average reduction in car driver trips of 18%, equivalent to 14 fewer cars arriving per 100 staff (making travel plans work, lessons from UK case studies 2005).

Effects of PTP

DfT concludes that "The effects of PTP on travel behaviour in terms of modal shift are hard to measure due to the aim being to support a wider agenda of increasing awareness and knowledge of transport issues in the environment "(A review of the effectiveness of personalised journey planning techniques, DfT, 2005). Nevertheless, significant research has been conducted to quantify the effects of PTP campaigns. The information below shows that results vary, but there is general agreement that there is a definite positive effect.

The DfT Personalised Travel Planning pilots showed reductions in the number of car driver trips between 4% and 13% with an average of 11% (Making personal travel planning work, a research report "DfT, 2007). Cost per vehicle kilometre reduced ranged from £0.02 to £0.28 (€0.023 – €0.32) for the pilot studies (Making personal travel planning work, a research report "DfT, 2007). International experience of cost–benefit analysis of PTP has demonstrated that, over a 10-year period, PTP offers a £30 (€34.5) return for every £1 (€1.15) invested (Making personal travel planning work, Summary report DfT, 2007) although this is mainly based on health and time saving returns rather than reductions in GHG.

The Travel Blending Personalised Travel Planning study in Adelaide, Australia showed a 10% reduction in car driver kilometres (Rose & Amt 2001). Satoshi Fuji and Ayako Taniguchi (2006) found that travel feedback (PTP) programmes in Japan reduced CO_2 emissions by about 19% and car use by about 18%, while increasing the use of public transport by about 50%. **'**Mobiel 21: civil contract on short distance trips' produced very good results. An average of 335 kilometres

per person was reduced over the three-month trial and a total of 75,000 car kilometres were reduced through the pilot. After the pilot a total of 98% of the participants continued to walk and cycle.

Effects of general travel awareness campaigns

Compared to research in PTP, there is not much evaluation information available on general awareness campaigns. However, some information was available on the effect of the "Choose Another Way" campaign in Scotland. 36% of respondents who usually drive recalled recent advertising that encouraged them to make use of non-car transport although only 14% specifically remembered Choose Another Way. Respondents were asked how successful the advertising was in making them consider alternatives to taking the car. 15% of respondents who drive a car and had seen advertising to encourage them to use sustainable modes stated that the advertising had a positive effect (Travel Awareness Home Omnibus Results November 2003 for Scottish executive, Office of chief researcher 2003).

3.3.2 Effects of public transport information improvements

Even less information is available on the car reduction potential of public transport information improvements. A study that assessed the effects of the introduction of a public transport telematics system in Helsinki indicated reductions of 1% to 5% in fuel consumption and exhaust emissions after introduction. However, the implementation also included priorities at traffic signals so the increases in patronage are the result of improved PT punctuality as well as increased information provision. The lack of research in this area shows that it is difficult to evaluate the effects of improved public transport information separately from the actual public transport provision.

3.3.3 Effects of energy or CO_2 labelling

Information provided in passenger car labels at point of sale has a role in raising consumer awareness of fuel efficiency and CO_2 emissions (Smokers et al. 2006). However, assessment of the effectiveness of labeling suggests that labels have not yet significantly contributed to actual reductions in emissions. It has also been suggested that where labels are used as part of a package of measures (e.g. linking vehicle taxation directly to the label's categories), there are likely to be potential synergies.

A review conducted by ADAC (2005) investigated the effectiveness of labeling schemes in different countries. Questionnaires, reviews and interviews were carried out in Austria, Belgium, Denmark, Finland, the Netherlands, Portugal, Spain, the UK, Sweden and Ireland. It should be noted however, that the effectiveness of the Directive in terms of reducing CO_2 emissions is difficult to assess independently due to the wide range of other incentives and initiatives currently in operation, such as emission related vehicle taxation etc.

Whilst most consumers were cited as preferring labeling that enables direct comparison of the fuel efficiency of various passenger cars, the guide on fuel economy and CO_2 is perceived to be the most useful and informative information tool which includes background information and an overview of all models. A label without an energy efficiency rating system is in general less influential, as the provision of numerical information without any meaning or context for the consumer does not include any comparative terms. Provision of a poster/display in addition to the promotional literature were considered to be generally ineffective.

The evidence suggests that awareness of the impact of cars on climate change is growing at a slow rate and labels have not yet significantly contributed to actual emission reductions. According to the ADAC (2005) the major factors influencing consumer decisions are:

- Car reliability;
- Safety qualities;
- Comfort; and
- Cost/price.

Size, engine power and manufacturers' image are also listed as being important, whilst fuel consumption is considered to be important in terms of cost savings, rather than environmental benefits.

It also appears that manufacturers' marketing strategies are often at odds with, and overshadowing, the message that the label is trying to project. As the respective budgets for car advertising versus the label are currently heavily skewed towards the message portrayed by the former, it is arguable that more attention needs to be given to influencing the manufacturer's message. This should therefore be recognised as a barrier to the effectiveness of the labeling.

As mandatory CO_2 emission targets come into force for passenger cars, energy and CO_2 labelling will play less of a role in encouraging the purchasing of lower polluting vehicles other than raising awareness, and is therefore unlikely to have a significant impact on long term greenhouse gas emissions reduction potential.

3.3.4 Effects of driver training

The potential for reducing fuel use, and thus GHG emissions, through changing driver behaviour is substantial. The exact savings potential for each vehicle varies depending on the driver's current style, the vehicle and the drive cycle. However, it is possible to estimate average savings. Some examples of documented savings are listed below.

- The average savings in the eco-drive courses in Finland have been 12-15% (eco-drive website).
- Research in The Netherlands showed eco-driving results in CO_2 reduction of 7% for petrol cars and 8% to 10% for Diesel cars (R.J Vermeulen 2006).
- The SAFED programme delivers a one day training course with accurate 'before and after' readings of fuel use. In the case of van drivers, this showed an average 16% reduction in fuel use immediately after the training with a sample size of several thousand drivers (results obtained direct from programme managers).

The real challenge for fuel-efficient driving is to embed the messages in the driving culture of a country. The savings potential is well understood, but drivers who receive training tend to drift back into their old driving habits unless the messages are reinforced or embedded in some way. Adding fuel-efficient techniques to the driving test, combined with changes in vehicle design (including an mpg readout on the dashboard as standard) and other applications of telematics could all help to achieve a more widespread culture shift.

In a study by Smokers et al (2006), it was found that the assessment of fuel-efficient driving in terms of CO_2 and cost savings is extremely sensitive to the methodology used. The study assumes that the long term effect of fuel-efficient driving could result in a fuel consumption reduction of 3% (which could be increased to 4.5% with the aid of GSI). It is assumed that new drivers who are taught eco-driving can achieve these effects for 40 years. However, for existing drivers who follow a dedicated course, the average duration of the effect is assumed to be 25 years.

The study concluded that the total GHG reduction potential of fuel-efficient driving depends strongly on the way the measure is implemented or promoted and on the assumed effectiveness of such promotion measures. Indicative calculations for EU-15 show the following results:

- If eco-driving is included in the lessons for new drivers, then a total reduction of 1.8 Mtonne/y could be achieved in 2012, increasing to 5.5 Mtonne/y in 2020;
- The total effect of mounting GSI systems on new vehicles is estimated at 1.5 Mtonne/y in 2012 and 4.4 Mtonne/y in 2020;
- For a combination of measures promoting the application of eco-driving by existing drivers the overall reduction potential is estimated at 4.0 Mtonne/y in 2012 growing to 9.1 Mtonne/y in 2020.

- If GSI is used to assist these drivers in maintaining a fuel-efficient driving style these values increase to 6.0 Mtonne/y in 2012 and 13.7 Mtonne/y in 2020 (Smokers et al, 2006).

The reduction in fuel consumption that can be achieved by following an eco-driving course, in the current vehicle fleet, ranges from 5 to 25 % directly after the course (TNO, 2006). The magnitude of the effect is strongly dependent on the original driving style of the driver – the more uneconomic the behaviour was to start with, the greater the effect. On average the impact is about 10 % (TNO 2006, ECOdriven 2008). The fuel savings typically outweigh the costs, making this a very cost effective measure. For heavy duty vehicles the effects a year or more after the training are estimated at 5% (TNO 2006) to 7% (ECN 2007). The results, however, slowly diminish over time as the drivers revert to their original driving style. For passenger cars drivers, the effects a year or more after the training course are estimated at 3% (TNO, 2006). About half of the effect of eco-driving is due to maintaining the correct tyre pressure – see the next paragraph. Using assisting technology (such as a gear change indicator) can add a further 1.5% to the effect (TNO, 2006). The European Climate Change Programme (ECCP) has calculated the reduction potential of CO_2 emissions from eco-driving to be in the region of 50 million tones by 2010 (ACEA, 2007).

As vehicle technology progresses more and more aspects of fuel economic driving will be automated. Changes in technology will also require changes in eco-driving techniques, perhaps even different courses for different subtypes of vehicles. A number of the rules will apply regardless of technology (reducing weight by limiting unused luggage, improving aerodynamics by removing unused roof racks, not using the air-conditioning). Maintaining the correct tyre pressure is an important feature of eco-driving. With the oncoming introduction of tyre pressure monitoring systems (see the next paragraph) this will no longer be an issue. In any case, as the effect of training diminishes over time, regular (periodic) courses seem to be necessary to reach the full potential of fuel efficient driving techniques.

3.4 Cost

The cost obviously depends on the size and type of the campaign or information provision. General awareness campaigns and travel plans are cheap compared to personalised travel planning projects. Depending on the type of campaign/information, costs will be borne by a range of parties, including government (central, regional or local), business or vehicle manufacturers.

3.4.1 Costs of travel planning

Usually the cost of producing and implementing a residential or company travel plan is primarily staff time and can be as low as a few days work. Software is widely available to assist companies with producing a travel plan. Therefore the costs of travel planning often fall to the companies implementing the travel plans, but there is often assistance available from local authorities or other government-sponsored organisations.

3.4.2 Costs of PTP

Personalised travel planning costs on average between £20 and £38 (€23 and €43.7) per participant and projects usually have a budget of £70,000- £200,000 (€80,500 – €230,000) a year (information from various DfT funded and other UK projects). These costs are typically borne by governments (central, regional or local).

3.4.3 Costs of public transport information

The cost of a public transport information project is obviously dependent on the size of the project and the amount of infrastructure needed. However, the costs are low compared to public transport improvements. Providing accurate timetable information online is simple at a basic level,

but experience suggests that to make this information widely accessible requires a more co-ordinated web service at a regional or national level. However, the cost of providing such a service is still relatively low, and there is usually a strong enough business case for public transport operators to pay for it.

The cost of implementing real-time information in buses is still considerably higher, with significant infrastructure required. One US study put it between 600 and 8,000 US dollars per vehicle. (Carol L. Schweiger, 2003). In the UK, public transport operators and information service providers are increasingly providing this kind of information via text-messaging to mobile phones, which may prove to be more cost effective in the short term. There are also likely to be costs for public transport service providers.

3.4.4 Costs of labelling

Costs for labelling will typically fall to car manufacturers and new car dealers, and national governments. Car dealers are likely to be responsible for the costs associated with shoeing labels on the cars they have on display, whereas costs for manufacturers will be related to the provision of promotional material. UK research has shown that estimated production and distribution costs for a typical vehicle manufactures could be around £24,000 (€27,600) per year for the label and £12,200 (€14,030) for the poster. The total cost to the UK Government, industry and businesses of producing and distributing labels, posters, guidebooks and promotional literature has been estimated at £1,832,600 (€2,107,490) per year (DfT, 2006).

3.4.5 Costs of driver training

The cost of fuel efficient driver training is often relatively low. Driver training is not expensive (in the order of €100 per training) but training driving instructors to teach new drivers fuel efficient behaviour is even more cost efficient. Driving instructors can be taught to teach eco-driving in a day (TNO 2006, ECOdriven 2008) and will then pass on their knowledge to thousands of new drivers. There are no infrastructure changes needed, only increased information and potentially changes to vehicle standards and driving training standards. Given that these changes in behaviour are likely to result in demonstrable financial savings for most drivers and organisations, it may well be possible to find politically acceptable ways to pass some or all of the costs involved onto the drivers that benefit. TNO estimates for cost efficiency of fuel-efficient driving are up to 128 euro per tonne CO_2 saved, demonstrating a negative cost to society (cost savings) (ACEA, 2007),

3.4.6 Other issues related to costs

Soft measures such as information campaigns and public transport information are typically funded from revenue budgets rather than capital budgets – their funding is therefore less reliable and under continual political pressure.

Providing information on new infrastructure, such as additional bus services or cycle routes, can add significantly to its uptake and thereby the benefits derived. Therefore a sensible approach would be to require a small percentage of capital allocated to transport infrastructure to be transferred into a dedicated transport information fund.

3.5 Co-benefits

There are a number of co-benefits to public information campaigns around transport options:

- Simply creating an awareness of a genuine choice of transport options can increase people's sense of control, and may facilitate genuine cost savings for many.
- Information campaigns themselves, or the techniques learned from implementing them, may help local authorities communicate other public interest messages.

- In the case of information campaigns explicitly aimed at reducing single occupancy vehicle trips, and trips overall, there are potential benefits to congestion, air quality, individual time gained and the public realm.

There are a variety of co-benefits to achieving a widespread shift to more fuel-efficient driving (driver training). Besides fuel consumption and CO_2 emission benefits, empirical evidences also suggests that ecodriving can increase safety, significantly lowering accident rates (Ecodriven, 2008). The emphasis on a calmer driving style, with greater anticipation on the road ahead and the advice to avoid excessive speeds leads to a saver driving style. Financial savings due to reduced servicing, maintenance and repair costs that result from reduced wear and tear on components such as brakes, tyres and clutch are also expected (Ecodriven, 2008). Studies have shown that ecodriving does not generally increase journey times, as may be expected from a calmer driving style (Ecodriven, 2008). Environmental benefits, including reduction in emissions (improved air quality) and reduced noise (due to smoother driving style), may also be achieved through ecodriving.

3.6 Barriers

The principle barriers to implementing information campaigns and public transport information improvements include:

- Tight revenue budgets in transport
- Poor co-ordination with infrastructure development and overall demand management
- Variable quality of the projects
- No proper implementation of the demand management plans once they have been developed.

In addition, the benefits of information campaigns are less tangible than those for an infrastructure project or a technology improvement. They rely on a complex interplay of factors, and the evidence base for their derived benefits is therefore less robust. As a result, there is, as noted above, a continual political pressure on resources allocated to them.

PTP has found to be effective for those residents open for change. However, finding those residents is the challenge. The actual number of participants can be as small as 10% of the number of people originally targeted and even then drop out rates of participants are high. **'**Mobiel 21: civil contract on short distance trips' found that out of the 400 participants that were initially interested 150 dropped out.

The principle barrier to achieving significant GHG reductions through driver training is the basic resistance of any population to a change in culture, and the particular sensitivity often shown around state attempts to manage drivers. However, the arguments for this type of change to driving style are generally in line with the tide of public opinion in most countries, as they draw on the arguments for individual cost saving, increased safety, and indeed environmental benefit. Other barriers may include the time taken to train drivers, and the lack of an individual or team within an organisation with responsibility to implement it. If the full potential of this approach is to be realised, it will require a diverse programme of measures to be sustained over a substantial time period.

Barriers to carbon footprinting include the methodologies used in the undertaking of the calculations.

3.7 Interaction with other GHG reduction instruments and options

Table 2 (in Section 2) showed the impacts of the range of policy instruments discussed in this paper on greenhouse gas emissions (e.g. decrease, increase). Provision of information as a policy instrument will generally lead to a reduction in GHG emissions through inducing a number

of the reduction options, namely reduced car ownership; purchase/use of more fuel efficient vehicles; fuel efficient driving; reduced vehicle km due to higher vehicle utilisation; modal shift to low-carbon modes; and limiting overall transport growth (reduced vehicle kms).

However, such policy instruments are only likely to achieve a short-term (pre-2020) decrease in GHG emissions when implemented in isolation, unless in conjunction with other policy instruments and options. The interactions between the provision of information and other types of instruments and options required are discussed in more detail below.

While the evidence base directly linking information campaigns to specific levels of GHG reduction is inherently poor, their role in supporting certain types of infrastructure improvement is clear. For example, a new cycle lane will undoubtedly have more cyclists using it if there is a concerted effort to tell local people that it exists – and given the relatively low cost of providing such information, it is perhaps disproportionate to expect a full ROI case to be made for providing that information. Likewise, where carbon footprinting calculations are undertaken, for example for an organisation's fleet, this information can then be used to stimulate further actions to be taken to reduce the GHG impacts, such as a move to more fuel-efficient vehicles and adoption of 'cleaner' technologies (where they exist, which also may require input from industry in the longer term in terms of R&D), a review of business travel, or provision of driver training.

Travel planning (including personalised travel planning) and public transport information aim to provide individuals and businesses with the appropriate information regarding alternative low-carbon modes with the aim of encouraging mode shift or a reduction in trips. However, it is necessary to ensure that these instruments are supported through the provision of safe pedestrian and cycling infrastructure and reliable and accessible public transport services to encourage uptake of these modes. Such instruments are also likely to be more effective in the longer term (post-2020) if demand management and land use planning instruments are also implemented to stimulate this shift or reduction in travel.

With regards to labelling, in the short term (pre-2020) there are potential synergies if labelling is used as part of a package of measures, e.g. linking vehicle taxation directly to the label's categories. Also further dissemination of vehicle energy efficiency information to the public/operators could be accomplished through an EU-based, or coordinated, 'Consumer Guide to Cleaner Vehicles' website. This could include *inter alia* information on CO_2 emissions and energy efficiency of different vehicles, as well as additional information on how to reduce emissions and improve energy efficiency whilst driving. For example, labels/posters could include information on eco-driving, including links to courses, information regarding tyres (e.g. the importance of properly inflating them) as well as information on the products that can improve energy efficiency, (e.g. which lubricants and tyres, for example, are better in this respect) and relevant CO_2 regulation. There is a rationale for improving the labelling format, e.g. along the lines suggested by ADAC (2005). Several Member States are already developing their respective labels along these lines, but the current approach is leading to diverse and disparate responses. Therefore the Commission should consider the harmonization of the approach to labeling based on the experience from those Member States who have gone beyond the requirements of the current Directive. Moreover it has been suggested that, as a minimum, the consideration of a code of conduct for advertising on environment and sustainability grounds should be considered. This could take the form of something similar along the lines of the voluntary French code for safety or the EACA initiative, or it could be more prescriptive. Given that there is already legislation concerning how information regarding the CO_2 emissions and fuel efficiency of passenger cars is communicated to the public, i.e. Directive 1999/94, the option of expanding the scope of this Directive should be considered. Currently this Directive focuses on the provision of information at the point of sale to which potential buyers are only exposed at the end of their decision making process. Consequently, to ensure that potential car buyers are more aware of the climate impact of their purchasing decision, consideration should be given to ensuring that information on CO_2 emissions and fuel efficiency is given wherever and whenever cars are promoted. In other words, thought should be given to expanding the scope of Directive 1999/94 to cover car advertising in all media, i.e. including TV and radio, as well as newspapers and magazines.

Encouraging fuel-efficient driving through the provision of driver training is likely to have a positive impact on GHG emission reductions in the short term (pre-2020) through increased fuel efficient driving. However, the provision of driver training is likely to have a limited impact on longer-term (post 2020) GHG emission reductions. As with all interventions that have the capacity to increase the fuel efficiency, and therefore decrease the cost per mile, of vehicles, there is the potential for a rebound effect – drivers translating the cost saving into extra mileage (unsuccessful in limiting overall transport). Such a rebound is likely to be less pronounced in the case of modified driver behaviour, as compared to buying a more fuel-efficient vehicle, as drivers will not have made an additional capital investment. The potential for greenhouse gas emissions reductions relating to ecodriving is also expected to decrease due to the implementation of CO_2 related regulation, including the use of Tyre Pressure Monitoring Systems, hybridisation due to CO_2 regulation, and other measures. Other modes already incorporate a range of efficient operating practices, such as in the aviation and maritime sectors. These are discussed in more detail in Paper 4 (operational options for all modes). In summary, training of crew (both aviation and maritime) in environmental issues and how their actions can help to reduce the level of emissions will have a positive effect on performance. This training helps to underpin a number of other operational options, including air traffic management, aircraft performance, airport operations (aviation, and voyage optimisation, ship energy management, and optimisation of fleet (including improved maintenance, reductions in speed, electricity in ports etc) (maritime).

3.8 Summary and outlook

Provision of information, information campaigns and raising awareness can only go so far in terms of the environmental implications of personal and business travel choices, and is therefore likely to be most beneficial pre-2020. Instruments such as the introduction of eco-driving for individuals and organisations are likely to have a positive effect on the reduction of GHG emissions. It is likely to be an important part of the learning package for new drivers and also covers experienced drivers. However, there will come a point where awareness and understanding of the benefits of eco-driving will reach a peak, after which further improvements are unlikely. This will be coupled with technological developments in the transport field, with vehicles becoming continually more fuel efficient, likewise with the introduction of hybrid and electric technology.

Schemes and initiatives could become widespread across Europe, constantly raising awareness, although there will rapidly come a point where information will have to be supported by a range of other instruments and measures to ensure benefits (in terms of GHG emission reduction) into the longer term (post 2020), including those relating to demand management, provision of attractive and accessible infrastructure (footways, cycleways, public transport etc) so people are able to make practical changes in the way they travel. Land use and spatial planning is also an important instrument in terms of reducing the need to travel and enabling the use of more sustainable modes.

Whilst energy and CO_2 labelling of vehicles at point of sale can help to increase awareness of the potential environmental implications of a new purchase, the evidence suggests that this measure is unlikely to have any direct impact on reducing emissions of GHGs, particularly when implemented in isolation, as car buyers base their purchasing decisions on many other criteria. Supporting measures include those already beginning to be implemented in EU Member States related to vehicle taxation, which will further encourage the purchase of vehicles with lower GHG emissions in the short term (pre-2020). However, as mandatory CO_2 emission targets come into force for passenger cars, energy and CO_2 labelling will play less of a role in encouraging the purchasing of lower polluting vehicles, and will complement the legislation through raising awareness and ensuring comparable and independent information for consumers.

The responsibility for provision of information, information campaigns and raising awareness is likely to be at a variety of levels of government, from European to the local level depending on the key messages. In any case, support from the EC and national governments in terms of best practice is required. Implementation is often more likely to be at a local or regional level. With

regards to labelling, the responsibility for stimulating best practice should largely lie at the European level, in order to overcome some of the inconsistency issues that currently arise with existing legislation between countries. Implementation of legislation is the responsibility of vehicle manufacturers, vehicle dealers and national governments.

With regards to driver training, the overall long-term (post 2020) reduction potential is hard to estimate especially due to the distribution of technologies in the vehicle fleet by 2050 is unknown. Vehicle technology is expected to automate more and more of the eco-driving techniques, reducing the potential benefits of these operational measures. The current generation of hybrids already automate gear changes, retrieval of brake energy and preventing unnecessary idling, and tyre pressure monitoring that will automatically warn drivers if tyres need to be inflated (or inflate them automatically) will become compulsory in the future, as will be discussed in the next section. It is also likely that different vehicle technologies require different efficient driving rules. For instance, a hybrid drive might benefit from driving methods that are based on the optimal utilisation of the electric buffer, and electric cars might require other techniques than cars running on hydrogen-fuel cells or hybrids. Depending on the distribution of technologies in the fleet a single Eco-driving training might no longer have the desired effect. The responsibility for the promotion of eco-driving activities (i.e. through sharing of good practice) and the implementation of appropriate legislation should lie with the EC and national governments. They will be supported by vehicle operators in ensuring that training is provided to drivers working in the transport industry.

Ultimately it should be recognised that there are strong interlinkages between information instruments and other technology/policy instruments and options, as demonstrated earlier in this paper. However, whilst these instruments provide context and information, they will mostly rely on the implementation of other instruments to incite change.

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http://www.mobiel21.be/

http://www.ikkyoto.be/

http://www.bikeandbusiness.de/projekt_en.htm

http://www.sustrans.org.uk/what-we-do/bike-it

http://www.carfree.com/

http://www.dft.gov.uk/consultations/aboutia/ria/newpassengercarsinformationo5541

http://campaigns2.direct.gov.uk/actonco2/home/on-the-move/top-10-fuel-efficient-cars.html

http://campaigns2.direct.gov.uk/actonco2/home/on-the-move.html

http://campaigns2.direct.gov.uk/actonco2/home/on-the-move/car-emission-comparison-tools.html

http://ec.europa.eu/energy/intelligent/index_en.html

http://www.ecodrive.org/

http://www.hetnieuwerijden.nl/

http://www.motiva.fi/en/

http://www.safed.org.uk/

4 Additional measures to stimulate technological innovation and development

4.1 Introduction

Many instruments potentially contribute to stimulating technical innovation and development (although indirectly). For example, many instruments that potentially reduce GHG emissions, potentially indirectly stimulate technical innovation/development, for exmple, regulation to tighten emission limits; or fiscal instruments raising the cost of vehicles/journeys. However, they are generally more likely to be relevant for near market technologies.

The instruments that are considered in this section directly target technologies at earlier stages of development, for example Green Public Procurement (GPP); fleet tests and demonstration programmes; and research and development. Figure 5 shows the technology readiness levels (TRLs) of these measures.

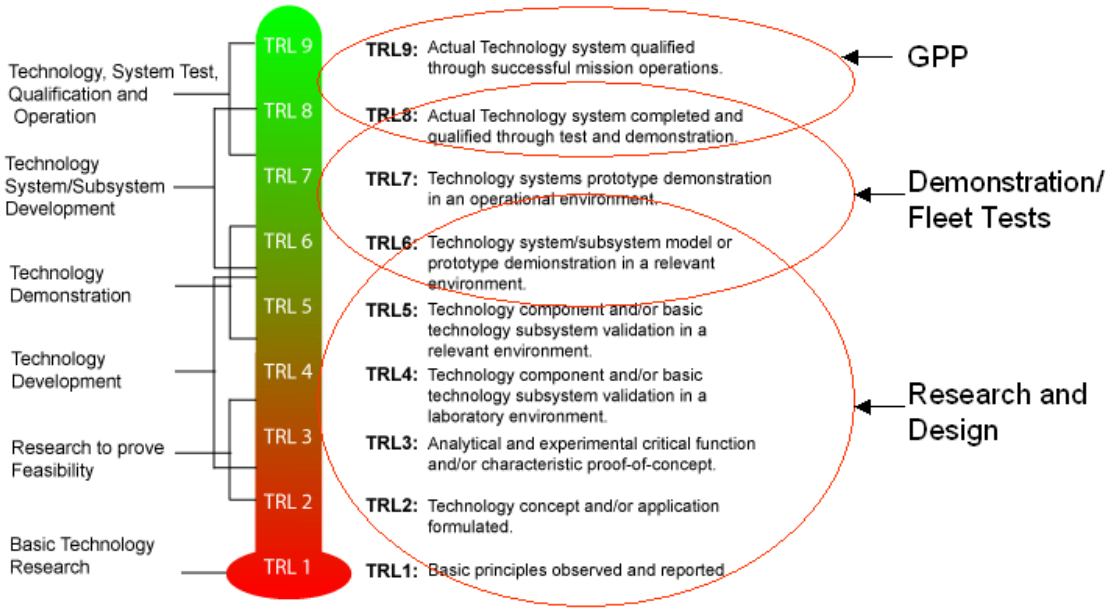

Figure 5: Instruments targeting different Technology Readiness Levels (TRLs) (UK MoD (2008)http://www.aof.mod.uk/aofcontent/tactical/techman/content/trl_applying.htm)

4.2 Types of measures to stimulate technological innovation and development

4.2.1 CO_2 and Green public procurement

Public procurement refers to the purchase by public authorities of goods, services or works, which are governed by a series of national and European rules. This is to ensure as far as possible that taxpayers' money is well spent, preventing fraud and discrimination and ensuring equal treatment of bidding. 'Green' public procurement (GPP) therefore refers to the procurement process when contracting authorities use additional environmental criteria when deciding whom to purchase goods or services from.

As 'greener' goods are often relatively new on the market, they do not enjoy economies of scale and price is often an inhibitor to their uptake. However, through the use of public procurement, demand could be increased sufficiently to enable them to expand and therefore enjoy lower unit costs, aiding technologies that are not currently commercially viable to move into mainstream markets. In terms of the transport sector, this is likely to include biofuels, hydrogen, natural gas or LPG, and electric or hybrid vehicles. This could therefore mean faster adoption of such resource-saving products across the economy, subsequently having positive environmentally related benefits including the reduction of energy consumption and energy imports, whilst boosting the EU industry's ability to compete in global environmental product markets.

Existing legislation is currently in place which deals with environmental considerations in public procurement. Directive 2004/18/EC on the coordination of procedures for the award of public works contracts, public supply contracts and public service contracts came into force in 2004. This Directive takes account of environmental and social aspects of public procurement, including the following:

- Relevant environmental and social requirements may be specified but must be defined sufficiently precisely to allow bidder to understand the requirement and to allow award of contract; and
- Production process standards and eco label criteria can be references but alternatives which demonstrate equivalence must be considered.

In April 2009, EC Directive on the promotion of clean and energy efficient road transport vehicles (EC 2009/33/EC) was approved[8]. One of the main aims of the Directive is to require '"contracting entities as well as certain operators to take into account lifetime energy and environmental impacts, including energy consumption and emissions of CO_2 and if certain pollutants when purchasing road transport vehicles with the objectives of promoting and stimulating the market for clean and energy efficient vehicles and improving the contribution of the transport sector to the environment, climate and energy policies of the Community".

4.2.2 Research and Development (R&D)

Research and Development (R&D) is a key part of efforts to develop low carbon technologies. There are various types of R&D in a transport context including:

- Fundamental research;
- Development for transport applications; and
- Commercialisation.

Fundamental research aims to develop new technologies, processes or materials at their most basic level. These novel technologies, processes or materials often need to be developed or packaged in a certain manner for transport applications. Finally, further research is often required to reduce the production cost to ensure the new technology is commercially viable. A good example is new battery chemistries such as lithium-ion. Research into lithium-based batteries began in 1912[9] but it took until the early 1990's for lithium-ion (li-ion) batteries to be developed for consumer electronics. It is only in the last few years that they are being refined sufficiently for use in the next generation of electric vehicle applications. There is still much development work needed before the cost of li-ion batteries is reduced to an acceptable level.

An overview of some of the more relevant recent research programmes from FP7 is provided in Box 1.

[8] http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2009:120:0005:0012:en:pdf
[9] http://www.buchmann.ca/Article5-Page1.asp

Box 1: Transport and GHG FP7 research programmes

GHG-TransPoRD: Reducing greenhouse-gas emissions of transport beyond 2020: linking R&D, transport policies and reduction targets (Fraunhofer-ISI, 24 months) - In early 2007 the EU adopted the objective to limit climate change to 2 degrees Celsius. More specific, the European leaders defined a target to reduce greenhouse gases by at least -20% until 2020, or -30% if an international agreement is achieved, compared with the emission levels of 1990. Until 2050 the reductions of the EU emissions should reach -60 to -80%. Transport currently contributes about 30% of the total EU greenhouse gas (GHG) emissions. In a baseline scenario this share is expected to grow due to continued strong growth of transport demand, in particular of freight transport and air passenger transport, and slower efficiency improvements than for other GHG emitting sectors. The existing GHG reduction targets do not include the transport sector, though for specific modes like air transport the planned inclusion into the European emissions trading scheme (EU-ETS) will indirectly impose targets for these modes in a few years. Thus it is obvious that in the future (1) the transport sector will have to contribute to GHG emission reductions such that (2) reduction targets for the different transport modes have to be anticipated and (3) aligned research strategies and transport policies have to be developed to efficiently and effectively meet these reduction targets for the medium to long term. The GhG-TransPoRD proposal aims to contribute to the development of a research strategy for the EU to reduce the GHG emissions of the different transport modes (road, rail, air and shipping) linking this research strategy with the available policy measures. Thus the proposal supports the FP7 objective to develop integrated, "greener" and smarter transport systems.

REACT: Supporting Research on Climate-friendly Transport (Coventry University Enterpriises Ltd, 24 months) - React project scope is to act as a driving force for coordinating, supporting and strengthening the RTD area on climate-friendly transport and mobility so as to avoid spillage of funding resources and achieve integration of funding opportunities at European level, in relation to mitigation of greenhouse emissions from transport. React project has the following concrete aims: 1.Exchange of experience among research program managers in the Member States, Associated States and EC. Identification of the national and regional initiatives and research programs on climate-friendly transport and mobility, in to identify opportunities for stakeholders and researchers. 2.Articulate a long term vision and a Strategic Future Research Agenda on climate-friendly transport that will contribute to the development of a European strategy on the issue. 3.To improve synergies between Member States, Associated States and EU RTD Agenda on climate-friendly transport and mobility by enhancing coordination of funded research initiatives among EC and national agencies. 4.Organise a set of focused dissemination activities that will enhance the impact of research outcomes from EC funded projects to the highest degree. Coordination with the activities of ERANET-Transport. 5.To develop a common set of indicators for the carbon impact of the transport research.

TOSCA: Technology Opportunities and Strategies towards Climate-friendly transport (University of Cambridge, 24 months) - The EU has committed to reducing GHG emissions by at least 20% based upon the 1990 level by 2020 and further reductions are expected beyond that timeframe. However, realizing this and subsequent targets may become increasingly challenging, given the past growth and future projections of transportation GHG emissions. The proposed activity enables the EU to obtain a better strategic perspective as to what contribution future transportation technologies and fuels could make to reduce GHG emissions. The project presented here assesses the technical feasibility, economic affordability, and social acceptability of technology policies that would lead toward a lower climate-impact transport system within the EU under different scenario conditions. The project is organized around three major workshops, which include important stakeholders from academia, industry, government, NGOs, and key participants from relevant existing and former EU projects. In order to enable informed and focused discussions at each workshop, participants are provided with supporting studies well before each workshop. The workshops and supporting studies cover (1) a techno-economic assessment of major transport modes (automobiles, buses, trucks, aircraft and railways) and of alternative transportation fuels for reducing GHG emissions; (2) an integration of these technologies in scenarios of European transportation futures; and (3) an estimate of the penetration of future low-GHG emission technologies and fuels for promising policies under the different scenario conditions, along with an assessment of the societal implications of these policies.

4.2.3 Fleet tests, demonstrations and pilot programmes

Testing and demonstration is a critical part of the R&D cycle. Significant issues can be exposed by subjecting the vehicle to 'real world' conditions, which must be resolved before the vehicle or process is production-ready. This is particularly the case in the transport sector where real-world conditions can differ significantly from test cycles. For instance, when cars are driven by the general public acceleration can be a lot faster, breaking a lot harsher and engine revs a lot higher than would be ideal, all of which stresses the key components such as the engine much more than bench tests using standard duty cycles.

In the context of this project, tests, demonstrations and pilot programmes can be employed as policy tool to stimulate the uptake of low carbon technologies. Case studies from well-run trials involving reputable organisations can be a powerful means of generating interest in a technology and ultimately accelerating it's uptake. After all, in the transport sector 'low carbon' often equates to significant fuel cost savings, which can be one of the largest operating costs for a company operating a sizeable fleet of vehicles depending on the sub-sector. For instance, fuel makes up a large proportion of the costs of road freight operators but is less significant for the rail sector.

4.3 Benefits

4.3.1 CO_2 and Green Public Procurement

A number of benefits have been identified associated with GPP. DG ENV has identified these key benefits to include aiding the EU to achieve its environmental goals more cheaply than other available policy instruments; cutting costs for users through the introduction of more resource-efficient products; and stimulating innovation, therefore helping to consolidate the international position of EU industry. In the European Union, 16% of GDP (approximately 2,000 billion) can currently be attributed to public spending. GPP rules at EU and national level is therefore viewed as a way of substantially reducing unsustainable production and consumption patterns and could serve to place new environmental technologies in the market.

Using fiscal measures and green public procurement has been recommended by the Commission in order to aid the achievement of GHG reduction targets. In the review of the strategy to reduce CO2 emissions from passenger cars and light commercial vehicles (EC, 2007), it was noted that the progress achieved went some way towards the 140g CO_2/km target by 2008/09 for passenger cars. However, it was anticipated that the EU objective of 120g CO_2/km would not be met by 2012 in the absence of additional measures. This is still the case. It was therefore recommended that a legislative approach at the EU and Member State level should be taken to ensure that emissions reduction were kept on track, through measures such as fiscal incentives and green public procurement[10]. In determining a way forward, the Commission identified a number of measures that should be employed in order to achieve the 2012 target. These included:

- Supply orientated measures (technological requirements by vehicle manufacturers)
- Demand/behaviour orientated measures (additional efforts by other means of road transport, by MSs and by the consumers).

It is the Member States action that could include use of public procurement in order to encourage the reduction of emissions from vehicles.

4.3.2 Research and Development (R&D)

There are a range of co-benefits to investing in R&D either directly or via the policies outlined in this section. Firstly, at a local level jobs can be created which has wider benefits for communities

[10] EC (2007) Results of the review of the Community Strategy to reduce CO_2 emissions from passenger cars and light-commercial vehicles, COM(2007) 19 final. Available at URL: http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2007:0019:FIN:EN:PDF

in the vicinity by helping to sustain local services or make the case for new services. In a similar vein there can also be indirect benefits for local communities through an increased demand for the services of suppliers to the organisations undertaking the R&D. At a higher level, investment in R&D can bring unexpected benefits in terms of discovering applications for new technologies or processes in addition to those for which they were originally designed.

4.3.3 Fleet tests, demonstration and programmes

Whilst there are clear benefits to both manufacturers and operators in undertaking trials there are also some important barriers. Firstly there is the issue of funding the test, demonstration or pilot programme. Although, trials tend to involve a modest number of vehicles, the cost of each of these prototype vehicles tends to be much higher than the full production vehicle. This is because neither the economies of scale nor the opportunity to optimise the manufacturing process are realised for prototypes. Secondly, it can be difficult to persuade certain operators to take part in trials. Many organisations with fleets of vehicles manage their deployment carefully to ensure they are able to fulfil their commitments to customers whilst allowing sufficient time for maintenance. Therefore, anything that interferes with this scheduling can be perceived as an unnecessary distraction. In addition, there may be (justified) concerns regarding the reliability of the new vehicle or technology. Since any breakdowns could impact on the operator's reputation for timely delivery this is clearly a sensitive issue.

Furthermore, in sub-sectors such as aviation there are a raft of safety considerations and regulations to bear in mind when trialling a new technology or fuel. For instance, the relevant national aviation regulators, such as the Civil Aviation Authority in the UK, must be consulted. Discussions would also need to take place with the aircraft and engine manufacturers. Therefore, in certain sub-sectors setting up a trial can involve a significant administrative burden, which itself can be a barrier.

Two of the main policies that can be put in place by Governments to facilitate fleet tests and pilot programmes are grants or tax credits. As highlighted above one of the key barriers is funding the cost of the trials, particularly in view of the high cost of prototype vehicles. Therefore, direct grants from Governments could be used to cover some or all of the cost of the tests or pilot programme. Alternatively, tax credits could be used to offset some of the costs against the manufacturer's or operators tax bill. By setting the grant or tax credit at an appropriate level it ought to be possible to incentivise fleet tests and pilot programmes whilst maintaining a good level of interest from all stakeholders. One option would be to taper the support so the first companies to launch trials received the greatest support.

There is also an opportunity for Government to play a leadership role in initiating the trials by announcing the call for proposals for grants alongside a broader framework for supporting low carbon transport technologies. For example, technologies that qualified for a grant for demonstration programme could be supported in reaching widespread uptake. This could be through an ongoing tax credit for operators to cover part of the additional capital cost, incentives for operators to install refuelling infrastructure for the new technology (e.g. charging points or hydrogen refuelling pumps) or making the refuelling infrastructure part of the regulated asset base. In designing these incentives it will be important for Government to work closely with both manufacturers and operators. This will help to ensure that the Government's strategic objectives (for example, moving low carbon transport technologies closer to commercial viability) are met whilst putting in place measures that are tailored to the needs of the organisations involved.

In some circumstances there may also be a role for Government to introduce manufacturers who wish to demonstrate or test their technology to operators who are willing to participate in a trial. Therefore there maybe scope for Government's to set up a networking programme, particularly aimed at smaller manufacturers who may not have a large sales team nor a broad network of contacts.

4.4 GHG emission reduction potential

4.4.1 CO2 and Green Public Procurement

A study by Smokers et al (2006) considered the effectiveness of public procurement in reducing greenhouse gas emissions. A cost-benefit assessment undertaken as part of the study indicated that the measure would produce a net benefit of €30 million for passenger cars and €36 million for LDVs compared to the 'no policy' option, over the timescale of the study. These benefits appear to be largely derived from a change in vehicle technology (from conventionally fuelled to LPG, CNG, electric and hybrid) and some improvement in overall fuel efficiency. These results are based on the assumptions that the external costs of GHG emissions are valued at €0.02 per kilogram and that the voluntary agreement will result in a 15% reduction in vehicle energy consumption to 2010, with a further 6% reduction from 2010 to 2015.

A more specific example where GPP has been used in the transport sector and been successful in stimulating reduced environmental impact and R&D activity is the procurement of public railcars with particle filters for the Taunusbahn in Germany between 2004 and 2005 (ICLEI, 2007[11]). Following concerns regarding high emission levels of particulate matter in cities such as Munich and Frankfurt/Main, local politicians decided to take measures to reduce particulate matters from urban transport. This influenced the tendering of railcars for the 'Taunusbahn'. It was decided that a tendering process that supports the introduction of particle filters in railcars would be undertaken. The green tender requirements were as follows:

- Noise levels referring to ISO 3095 (L_{Amax} = 90dBA)
- Avoidance of specific toxic materials (e.g. arsenic, chrome)
- Lowest fuel consumption possible
- Emission standards based on the Directive 97/68/EG Stage IIIa.

10% of the selection criteria were related to fuel consumption. Additional green criteria were included into the technical specification parts of the tender documents following a consultation round. These focused on engines that can use low sulphur content fuel (<0.005%) and on the requirement to equip engines with particle filters or developing an obligatory retrofitting concept. This requirement to equip engines with particle filters stimulated the further development of new Eco-Technology ad assisted with bringing it onto the market. Therefore, the Taunusbahn tendering process not only stimulated research and development to produce eco-solutions, but was also responsible for providing a business case that ended in a breakthrough of Econ-Technology (with an objective of reducing emissions through improving engine technologies) on international markets (ICLEI, 2007).

Key outcomes identified that technical solutions are available to be adapted to the specific demands of railcar engines, but the demand until 2005 did not permit series production. Through awarding the contract to the most economically efficient, but also ambitious concept to include particle filters, a key result of the procurement process was to increase the demand for particle filters. The particle filter used in the Taunusbahn can be seen as an important step in making technical solutions available on the market, whilst pushing forward the possibilities to retrofit old railcars with particle filters to meet future EU emission standards prior to 2012. Further developments are being undertaken which aim to meet higher emission standards of the whole stage III coming into force in 2012. Therefore this case study has helped to increase pressure on this technological development demonstrating the market demand and economic efficiency. The success of the tender has been cited as the political backup resulting from discussions regarding particulate matters and air quality in the region (ICLEI, 2007).

[11] ICLEI (2007) Costs and Benefits of Green Public Procurement in Europe: Sustainable Procurement of Public Railcars with the Eco-Technology 'particle filters' for the Taunusbahn, Germany, Local Governments for Sustainability, EC. Available at URL: http://www.iclei-europe.org/fileadmin/template/projects/procuraplus/New_website/Case_Studies/Taunusbahn_Germany.pdf

In April 2009, UK Government published 'Addressing the environmental impact of Government Procurement' (NAO, 2009[12]). The report focuses on four procurement categories that have significant environmental impacts, including energy, information and communications technology, office supplies and vehicle fleets. It has been found that collaborative procurement of energy and vehicle fleets has delivered the highest financial savings and reductions in carbon emissions.

4.4.2 Research and Development (R&D)

R&D will play a key role in reducing GHG emissions from transport before 2050. This is because many of the technologies that could deliver the biggest cuts (such as electric vehicles, fuel cell vehicles and other alternative fuels) still require significant further research to ensure they become commercially viable.

4.5 Costs

4.5.1 CO_2 and Green Public Procurement

There are likely to be potentially higher initial costs associated with green public procurement, as this is one of the catalysts in encouraging GPP (e.g. to stimulate economies of scale), but this is dependant on the vehicle/technology in question. With regards to purchase costs of vehicles, it is thought that the inclusion of the consideration of lifetime costs for fuel, CO_2, NO_X, non-methane hydrocarbons and particulate matter would considerably push up the costs of conventional vehicles. For example, this would increase the overall price of a normal bus from around €150,000 to €594,030 (including the lifetime costs), although the commission anticipates that the gap will be made up by improved fuel efficiency (EurActive, 2008). This implies that it would be more worthwhile to pay a higher upfront cost for a cleaner and more fuel-efficient vehicle with lower fuel energy consumption and emissions.

4.5.2 Research and Development (R&D)

The cost of the measures outlined in this section, and indeed R&D itself, could vary enormously according to the scale on which they are implemented. Consequently, the overall cost of the policies will depend on prioritisation, both in terms of the importance placed on R&D versus other demands on Government budgets and with regards competing research interests. In a similar vein the carbon savings from policies to support R&D are very difficult to calculate. Assumptions must be made on where to set the boundaries for prior contributory research and whether to take account of research that didn't yield the anticipated results.

4.5.3 Fleet tests, demonstration and programmes

The cost of fleet tests, demonstration and pilot programmes is clearly heavily linked to the number of vehicles participating in the test and the unit cost of the technology in question. For example, in the UK the Technology Strategy Board, which is funded by the UK Government, is making £20 million (€23m) of funding available for an Ultra Low Carbon Vehicle Demonstrator. The programme will fund 250 cars with tailpipe CO_2 emissions of less than 50g/km. It is intended that each vehicle will be exposed to multiple drivers and drive cycles to understand driver perception/concerns and identify challenges with infrastructure interfaces (Technology strategy Board, 2009)[13].

Several European countries have been involved in testing hydrogen fuel cell vehicles through the HYFLEET: CUTE project. The objectives of the project were to:

- develop hydrogen powered bus technology
- develop efficient means of generating hydrogen

[12] NAO (2009) Addressing the environmental impact of Government Procurement, National Audit Office, UK. Available at URL: http://www.nao.org.uk/publications/0809/addressing_sustainable_procure.aspx
[13] http://www.innovateuk.org/ourstrategy/innovationplatforms/lowcarbonvehicles/ultralowcarbonvehicledemonstrator.ashx

- research the technology and development needs to establish a hydrogen refuelling infrastructure
- inform key decision-makers about the potential advantages of a hydrogen-based transport system and how they can help to develop it.

With an overall budget of 43.19 million Euro[14] the project involved 31 partners from Government, academia and industry based on 3 continents[15]. The project has demonstrated 47 hydrogen powered buses made up of 33 hydrogen fuel cell powered buses in 9 cities (including Amsterdam, Barcelona, Hamburg, London and Madrid) and 14 hydrogen powered internal combustion engine buses in Berlin.

Fleet tests and demonstrations will not themselves produce significant carbon savings since they only ever involve a modest number of vehicles. However, if successful they can unlock a raft of potential savings depending on the extent to which the prospective technology is lower carbon. Therefore, in view of these uncertainties the carbon savings associated with fleet tests, demonstrations and pilot programmes are best described as the *potential* savings that could arise under specific circumstances.

4.6 Barriers

4.6.1 CO_2 and Green Public Procurement

There has been much discussion surrounding the issue of use of GPP and its associated impacts on the environment and economy. An article published on Euractive discusses the various opinions of organisations and groups in Europe on the use of GPP[16]. EU Employers' lobby BusinessEurope agrees that public procurement can be used to meet certain environmental policy goals. However, it insists that environmental benefit should be weighed against the economy, and that there is no need for new legislation on GPP. It is suggested that higher environmental standards within the EU compared to non-EU countries could lead to serious impacts on the cost of EU products, meaning that further GPP legislation beyond the 2004 public procurement directive may be counterproductive.

Concern has also been raised regarding the issue of suggested targets for GPP. It is feared that if costs targets are applied indiscriminately, they may be damaging to the economy, as whilst some procurement is likely to have major positive environmental effects that could potentially be beneficial, others will not have such an effect. Through including delivery transport under the scope of GPP, it may be harmful to the operation of the single market, as it would discriminate against more geographically distant suppliers.

The effect on some SMEs and other companies has been raised, in particular the possibility that they could be excluded from the procurement process, due to the fact that they may not possess the resources to provide complex and costly lifecycle calculation or expensive certificates. The GPP initiatives also risk having limited effects as they are based on the assumption that public entities can all afford vehicles' newest generation.

It has been suggested by the International Association for Public Transport (UITP) that GPP may impose higher costs onto the system related to buying, maintenance and operation of public transport vehicles. It is suggested that higher ecological standards for public transport vehicles should be financed from different sources than the existing public transport budget, as public budgets supporting public transport are currently in decline, and therefore the necessary additional financial resources required could come from revenues from the internalisation of external costs.

[14] http://www.h2moves.eu/regions/berlin.html
[15] http://www.global-hydrogen-bus-platform.com/
[16] EurActive (2008) *Public Procurement: Buying Green?,* EurActive, 21st October 2008. Available at URL: http://www.euractiv.com/en/sustainability/public-procurement-buying-green/article-117505

4.6.2 Research and Development (R&D)

There are a range of barriers to this research taking place. Firstly, it can be difficult for manufacturers to justify the investment in R&D when there can often be a time lag of several years or even decades before the new technology or process begins to generate revenues. Secondly, there is no guarantee that the R&D will deliver viable technologies – certain research programmes will inevitably fail to deliver the desired outcomes. Thirdly, R&D often requires considerable investment to cover costs such as equipment, premises and staff. There can be difficulties in gaining access to necessary funds, particularly for small or medium sized organisations. This is particularly the case in the current economic climate where business loans are hard to obtain. When combined with the fact that R&D by its very nature, is unlikely to deliver a quick return on investment, it is easy to see how funding becomes a major barrier.

Another key challenge associated with R&D is ensuring that the R&D undertaken is consistent with the aims and objectives of key stakeholders, namely Governments, the EC and industry. In other words R&D should be part of a coherent roadmap or strategy where there are clear linkages between the EC and Governments overarching policy goals and the technologies and processes needed to deliver them.

In view of these barriers and challenges there is clearly a potential role for the public sector at a European, national and regional level with regards facilitating R&D. There are a range of policies or measures that can be implemented, which include:

- Offering research grants;
- Creation of technology platforms;
- Tax breaks or tax credits;
- Loan guarantees;
- Incubator support; and
- The creation of technology clusters.

Many of the larger Member States such as Germany, Spain, France and UK have developed their own transport research programmes, which distribute research grants. For example, in France the members of the research and innovation platform, 'Predit 4', (it was preceded by 3 similar programmes) will distribute approximately 400 million Euros between 2008 and 2012. National programmes of this nature are complemented by the EU's Seventh Framework Programme for Research and Technological Development (FP7), which seeks to bring together all the EU's research related activities with the aim of meeting its growth, competitiveness and employment goals[17]. Over a seven-year period FP7 will distribute 50 billion Euros. By providing research grants, whether to cover part or all of the cost of the research, national Governments and the EU are seeking to address the barriers associated with gaining access to funds.

So called technology or innovation 'platforms' play a key role in determining the types of the R&D that should be undertaken as well as awarding the funds to appropriate bodies. The aim of transport technology 'platforms' is to bring together the key stakeholders from the transport sector (Governments, the EC, manufacturers, operators, consumer groups etc) to agree the strategic research agenda. In other words, reaching a consensus on the technologies and processes that most warrant R&D investment. In addition to forming part of the committee that makes up a technology or innovation platform, Governments can also create them in the first instance. It would be beneficial for such research councils at the European and national level to set their agendas within the framework of the GHG reduction needed from the transport sector.

Governments can support industry's investment in R&D through tax breaks or tax credits. For instance, in the UK so called 'Research and Development Tax Credits' allow a company to partially offset their expenditure on R&D against their tax bill at a rate of £24 (€27.6) for every £100 (€115) of R&D expenditure. The offset amount can include expenditure on salaries, consumables, power, fuel and computer software. The benefit of this approach is that it provides a significant contribution to the cost of the research whilst ensuring the company's interest in the research is genuine.

[17] http://cordis.europa.eu/fp7/understand_en.html

Loan guarantees are being an increasing popular means of Government supporting companies all of sizes. Whilst in principal a bank or financial institution might be willing to lend an organisation the money it is seeking to fund R&D, the stumbling block can be a lack of collateral or guarantor for the loan. This issue has become more prevalent in recent times due to a shortage of capital and tighter lending conditions. There are a range of schemes in place to provide loan guarantees to car manufacturers. For instance, the European Investment bank loaned Jaguar Land Rover and Nissan 366million Euros and 400million Euros respectively on the basis of loan guarantees provided by the UK Government.

For start-up companies, 'incubator' support can prove very valuable indeed during the first few years of a company's existence. This support can take a number of forms. It might entail providing premises at a reduced rate or offering discounted access to specialist services such as legal or patent advice. Incubator support can also take the form of training, particularly in areas such as commercial awareness and accounting. This ensures that start-up companies are equipped with a broad skill set to give them the best possible chance of making a success of their business. Finally, an often overlooked element of incubator support involves providing access to existing networks of potential clients and partners. Introductions of this nature can prove invaluable to start up companies who may not necessarily have an especially broad network of contacts.

Helping to create technology clusters is another option for policy makers to support investment in R&D. A pool of skilled workers can develop by encouraging companies or organisations that share research interests to locate in a particular region. Prospective employees are more likely to be willing to relocate to an area if there are other employment opportunities within the same sector close by. The economies of scale associated with technology clusters have a range of other benefits. For instance, it may allow training courses or qualifications to be offered by colleges or universities that might not otherwise be affordable. Furthermore, a cluster of research organisations is more likely to be able to support a specialist supply chain. Finally, close geographical proximity may increase the likelihood of collaboration on new initiatives or products.

4.6.3 Fleet tests, demonstration and programmes

Whilst there are clear benefits to both manufacturers and operators in undertaking trials there are also some important barriers. Firstly there is the issue of funding the test, demonstration or pilot programme. Although, trials tend to involve a modest number of vehicles, the cost of each of these prototype vehicles tends to be much higher than the full production vehicle. This is because neither the economies of scale nor the opportunity to optimise the manufacturing process are realised for prototypes. Secondly, it can be difficult to persuade certain operators to take part in trials. Many organisations with fleets of vehicles manage their deployment carefully to ensure they are able to fulfil their commitments to customers whilst allowing sufficient time for maintenance. Therefore, anything that interferes with this scheduling can be perceived as an unnecessary distraction. In addition, there may be (justified) concerns regarding the reliability of the new vehicle or technology. Since any breakdowns could impact on the operator's reputation for timely delivery this is clearly a sensitive issue.

Furthermore, in sub-sectors such as aviation there are a raft of safety considerations and regulations to bear in mind when trialling a new technology or fuel. For instance, the relevant national aviation regulators, such as the Civil Aviation Authority in the UK, must be consulted. Discussions would also need to take place with the aircraft and engine manufacturers. Therefore, in certain sub-sectors setting up a trial can involve a significant administrative burden, which itself can be a barrier.

Two of the main policies that can be put in place by Governments to facilitate fleet tests and pilot programmes are grants or tax credits. As highlighted above one of the key barriers is funding the cost of the trials, particularly in view of the high cost of prototype vehicles. Therefore, direct grants from Governments could be used to cover some or all of the cost of the tests or pilot programme. Alternatively, tax credits could be used to offset some of the costs against the manufacturer's or operators tax bill. By setting the grant or tax credit at an appropriate level it

ought to be possible to incentivise fleet tests and pilot programmes whilst maintaining a good level of interest from all stakeholders. One option would be to taper the support so the first companies to launch trials received the greatest support.

There is also an opportunity for Government to play a leadership role in initiating the trials by announcing the call for proposals for grants alongside a broader framework for supporting low carbon transport technologies. For example, technologies that qualified for a grant for demonstration programme could be supported in reaching widespread uptake. This could be through an ongoing tax credit for operators to cover part of the additional capital cost, incentives for operators to install refuelling infrastructure for the new technology (e.g. charging points or hydrogen refuelling pumps) or making the refuelling infrastructure part of the regulated asset base. In designing these incentives it will be important for Government to work closely with both manufacturers and operators. This will help to ensure that the Government's strategic objectives (for example, moving low carbon transport technologies closer to commercial viability) are met whilst putting in place measures that are tailored to the needs of the organisations involved.

In some circumstances there may also be a role for Government to introduce manufacturers who wish to demonstrate or test their technology to operators who are willing to participate in a trial. Therefore there maybe scope for Government's to set up a networking programme, particularly aimed at smaller manufacturers who may not have a large sales team nor a broad network of contacts.

4.7 Interaction with other CO_2 measures

Table 2 (in Section 2) showed the impacts of the range of policy instruments discussed in this paper on greenhouse gas emissions (e.g. decrease, increase).

4.7.1 CO_2 and Green Public Procurement

Green public procurement is likely to initially lead to a reduction in GHG emissions in the short term (pre-2020) through increasing the purchase/proportion of more fuel-efficient vehicles and a shift to low-carbon energy carriers. However, its impacts are limited when implemented in isolation, as further developments in terms of technology and the availability of low-carbon options will also be required in the longer term (post 2020). Therefore, instruments such as research and development (R&D – see Section 6) will be required alongside GPP to stimulate the development of more fuel-efficient or alternatively fuelled vehicles to meet increasingly stringent standards.

There is also the possibility of a rebound effect occurring associated with the use of GPP, whereby a policy instrument leads to GHG emission increase through a negative impact on a reduction option, in this case: limiting overall transport growth (e.g. through reduced vehicle kms). This may occur in organisations where the cost saving achieved as a result of GPP is translated into extra mileage. Such a rebound may be more pronounced in this case, as compared modifying driver behaviour (see Section 4), organisations will have made an initial capital investment. This policy instrument will therefore produce the best results in terms of GHG emission reductions when implemented as part of a much larger package of instruments and options, including demand management and fiscal incentives to reduce overall vehicle kms.

4.7.2 Research and Development (R&D)

Research and design (R&D) is likely to initially lead to a reduction in GHG emissions in the short term (pre-2020) through increasing the availability of fuel-efficient and alternatively fuelled vehicles. The emission reduction options positively affected are likely to include more fuel-efficient vehicles and a shift to low-carbon energy carriers. However, its impacts are limited when implemented in isolation, as further instruments and options are required to encourage individuals and businesses to purchase these lower carbon modes, particularly as their capital purchase costs are likely to be higher than higher polluting counterparts. This may be in the form of Green

Public Procurement (GPP) aimed at the public sectors (see Section 5); the development and implementation of legislation; and fiscal policy instruments aimed at individuals and businesses (e.g. taxation). R&D also clearly has strong linkages with the technological options discussed in papers 1 to 5.

4.7.3 Fleet tests, demonstration and programmes

Fleet tests, demonstration and pilot programmes are likely to initially lead to a reduction in GHG emissions in the short term (pre-2020) through increasing awareness of fuel-efficient and alternatively fuelled vehicles, but also aiding their future development. This is likely to have a positive effect on more fuel-efficient vehicles and a shift to low-carbon energy carriers as emission reduction options.

Where testing is undertaken, opportunities arise to further refine vehicles, possibly through R&D, to ensure that the most effective GHG reduction results are achieved. Where vehicles/fleets are demonstrated and piloted, awareness is raised among individuals and industry, which may stimulate increased purchase/uptake of a particular model/vehicle. However, it is likely that uptake and subsequent reductions in GHG emissions will be increased in the longer term (post 2020) when other policy instruments are implemented and options available. These are likely to include provision of information (general awareness campaigns, CO_2 labelling, carbon footprinting), green public procurement, fiscal incentives (e.g. taxation) and implementation of regulation and legislation. Fleet tests, demonstration and pilot programmes also clearly have strong linkages with the technological options discussed in papers 1 to 5.

4.8 Summary and outlook

The main achievement of **green public procurement policies** and practices is likely to aid the advancement of technologies (sometimes through stimulating increased R&D) that are not currently commercially viable to move into mainstream markets. This may lead to a shift in the distribution of vehicle efficiency in the procured fleet, but may also accelerate the introduction and availability of more fuel-efficient vehicle types in the short term (pre-2020).

As mandatory fuel efficiency requirement are implemented, similar impacts are likely to be achieved to those being sought after through the use of GPP (through fleet turnover in the procured fleet and developments in fuel efficient vehicle types). Therefore in the longer term (post-2020), the impact of GPP and associated legislation will diminish overtime unless requirements continue to become more stringent.

The introduction and implementation of GPP legislation and uptake is ultimately the responsibility of the EC and national governments. Its uptake should be supported by various levels of government and the public sector, but also to the private sector in terms of ensuring that the appropriate fuel-efficient technology is being developed.

Research and development is essential in delivering technical improvements in the transport sector. Mandatory requirement developments and the implementation of new legislation, such as that discussed relating to Green Public Procurement, are likely to be the key drivers of future R&D. Research and development can be a way of advancing technology and ensuring that energy/fuel efficiency (and other desired goals) can be achieved, but also as a mechanism to deliver the desired goal at a lower cost. However, it should be ensured that R&D is actively focused on the right technologies – e.g. aiding the achievement of targets, but understanding any subsequent implications for the transport or other sectors (e.g. economic or societal impacts etc). The responsibility for the undertaking of R&D activities is likely to fall to vehicle manufacturers and industry to undertake, with support from national governments or the EC.

In summary, fleet tests, demonstration and pilot programmes serve to benefit manufacturers through gauging customer opinion and subsequently refining products, and operators through gaining an insight into how current operations may support new vehicles or technology.

Due to the uncertain and wide ranging nature of **fleet tests, demonstration and pilot programmes**, it is difficult to determine the exact contribution that they may make to reductions in greenhouse has emissions. This is particularly due to the fact that they are often in support of other practices or developments taking place within the sector, so their individual contribution cannot be determined. However, where vehicle and fuel efficiency technology is developed and uptake is widespread, it is likely that emission reductions will be achieved in the short term (pre-2020), but the extent to which they are achieved depends on the nature of the technology. They may usefully be used as a mechanism to support the development of much needed technologies, accelerating market introductions and more efficient design (particularly in conjunction with R&D).

Fleet tests, demonstrations and pilot programmes are largely likely to fall to vehicle manufacturers, operators and industry to implement, with support from national governments or the EC.

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5 Summary of key findings and issues for discussion

This paper has highlighted a range of 'softer' policy instruments aimed at the provision of information or training with the purpose of changing travel, driving or purchasing behaviour, or additional measures aimed at stimulating technological innovation and development.

Such instruments have had varying success in the past with some only managing to raise awareness about the emissions impact of travel or vehicle purchasing choices, and others achieving a reduction in greenhouse gases. Looking to 2020 and beyond, it is unlikely that instruments discussed in this paper will have any substantial role to play in GHG reduction when implemented alone. However, as it is likely that there will be substantial use of other instruments and options (policy and technical) in terms of reducing emissions of greenhouse gases from the transport sector, the use of the type of instruments discussed in this paper will be important in terms of supporting them. The majority of those instruments discussed here are enabling instruments, rather than those directly impacting the emissions of greenhouse gases from transport. In particular, these instruments are most likely to complement the implementation of other policy instruments discussed in Paper 6 – regulation for vehicles and energy carriers; paper 7 – economic instruments; and paper 8 – infrastructure, spatial policy, speed and traffic management.

Whilst the majority of the policy instruments discussed in this paper are relatively low cost to implement, the main barriers associated with them relate to the reliance on the implementation of additional policy instruments or technological options in order to achieve a substantial or sustained impact on the reduction of greenhouse gases. However, one of the main information gaps relating to these policy instruments is the longer-term potential for greenhouse gas emission reductions – these have been estimated for the purposes of this paper.

Awareness of greenhouse gas emissions and climate change linked to all areas of life will become increasingly important over the next few decades. Therefore the information-related policy instruments discussed in this paper will be of importance in ensuring that information regarding transport's role in increasing greenhouse gas emissions and associated impacts will continue to be highlighted – therefore information will play a crucial role.

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