URBAN TRANSPORT:
OPTIONS FOR PROPULSION SYSTEMS
AND INSTRUMENTS FOR ANALYSIS

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UTOPIA

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Summary

Cleaner vehicles and alternative fuels can help to achieve Europe's goals for air quality, carbon savings and security of energy supply. However, there are many barriers to the introduction of these new technologies, such as high capital and lifetime costs and a lack of refuelling infrastructure.

Certain niche applications such as public sector fleets can provide a way of lowering some of the barriers, and demonstration projects are important in developing market acceptance. City authorities, national governments and the European Community have a vital role to play, both in funding projects and in establishing a strong framework of supporting policies.

Therefore the UTOPIA project aimed to provide decision-makers with the necessary information base, tools and guidelines to support the introduction of promising urban transport solutions based on cleaner vehicles.

The primary audiences for these outputs are:

- policy-makers and planners in cities who can change the local market conditions;
- people involved in planning and implementing specific schemes, at pilot or full scale;
- national and European policy-makers who control the policy context.

In addition, the project outputs are intended to help build a consensus among other stakeholder groups regarding the potential of these transport solutions – notably the vehicle and fuel suppliers and vehicle operators.

A consortium of 25 partners carried out the project. This included organisations representing a variety of stakeholder groups and ambitions:

- national institutions responsible for testing and promoting the use of cleaner vehicles;
- national institutions responsible for providing support to city authorities;
- a major vehicle manufacturer;
- associations promoting specific vehicle fuels;
- organisations involved in large-scale demonstration projects;
- research organisations and universities;
- organisations involved in the development of decision support systems.

Four major outputs have been developed:

- An assessment of the most promising applications for cleaner vehicles and supporting measures, from a city perspective.
- Recommendations on policy actions at the European and national levels to promote or facilitate market introduction and demonstration.
- A good practice guide to setting up and running pilot and demonstration projects, aimed at potential project champions.
- A software framework ("NAVIGATE UTOPIA") which provides information and assessment methodologies in a user-friendly form. This is primarily to support people at the local level (such as city transport planners) in pre-screening options and building the arguments in favour of a local initiative.

These are available on the web at http://utopia.jrc.it/. Other project outputs are available at http://www.utopia-eu.com/.

Is there a need for alternative and renewable transport fuels?

Yes, for the following reasons:

- Fossil fuels are finite. Over the short term, expanding the range of road fuels will extend the availability of gasoline and diesel. For the long term, renewable fuels such as bio-fuels and hydrogen from renewable electricity are essential.
- Europe is facing a high dependence on oil imports (especially from less stable regions). Transport is such an important element of the economy that diversifying the range of fuels and reducing the dependence on other countries (price instability etc.) is highly desirable.
- We need to reduce CO_2 emissions, but improvements in vehicle efficiency will be inadequate to deliver all of the required savings, and changing consumer behaviour is difficult.
- Alternative fuels can provide a moderately cost-effective means of reducing CO_2 emissions and improving air quality (especially for urban "hotspots").
- It is worth stimulating market demand for a portfolio of energy sources, so that industry then has the incentive to make them commercially viable through economies of scale and improvements in productivity.
- Bio-fuels may meet less than 10% of needs, but this will still extend the availability of fossil fuels. Moreover, with the enlargement of the EU, it will be important to have a constructive use for the potential large increase in arable production, to avoid problems for the Common Agricultural Policy.
- Recycling of e.g. waste vegetable oil, municipal waste and woody residues to make transport fuels are ways of pursuing sustainable development.

Which technologies are of interest?

- *Natural gas* and *liquefied petroleum gas* can improve air quality.
- *Bio-fuels* (methanol, ethanol, fatty acid methyl esters, gas) are notable for low CO_2 emissions over the fuel life-cycle.
- *Battery electric* and *hybrid* propulsion can reduce both local and global pollutants.
- *Fuel cells* are seen as a key technology for a hydrogen economy based on renewably generated electricity.
- These technologies are not cost-competitive at present with gasoline and diesel vehicles (on a pre-tax basis). Also, most of them involve some loss of utility for the consumer.
- Some or all of these fuels might become commercially viable once a sufficient market is established. Fleet applications such as buses are usually the most promising initial market.
- Nevertheless, *improved gasoline and diesel technologies* can be expected to dominate the market for many years, with significant environmental gains.

Natural gas bus, France

How should the take-up of alternative fuels be stimulated?

- The most important measures are *fiscal incentives*. A distinction is needed between incentives to kick-start the market for individual fuels, and efficient and durable incentives in the longer term that are not technology-specific (e.g. differential rates of fuel taxation based on external costs). However, reducing fuel tax fails to differentiate between "pollution hotspots" and rural areas.
- *Demonstration projects* have an important role in testing technologies, stimulating the market and raising consumer awareness.
- *Eco-labelling* and *green fleet certification schemes* are important, especially where the label remains on the vehicle in everyday use. This allows the consumer or fleet operator to show they have green values, and develops family/peer pressure to switch to greener options.
- *Green procurement* by Governments, whether voluntary or mandatory, can be significant in creating an initial market for new fuels and providing a signal to private consumers that these fuels are serious.
- *Standards* for vehicles and fuels are important in creating a unified market and ensuring consumer confidence.
- *Low emission zones* that allow city centre access only for clean vehicles, and *Quality Contracts and Partnerships* between local authorities and fleet operators, are new powerful tools for encouraging cleaner vehicles at a local level. Governments may need to provide the regulatory framework for their implementation and enforcement.
- It is important for Governments to assess short-term actions in relation to a longer-term strategy. The aim must be to minimise the risk of non-acceptance by the consumer. This reduces the risk for investors and allows economies of scale and learning to be reaped.

Bio-gas bus, Sweden

What should be the priorities for EU action?

LPG bus, UK

- Develop *common standards and regulations* (e.g. for vehicles, fuels and refuelling infrastructure).
- Develop a methodology for *vehicle environmental labelling and rating* schemes that show clearly the benefits of cleaner vehicles, and encourage a common or harmonised approach across Member States.
- *Communicate developments* with cleaner vehicles. For example, facilitate the exchange of information between cities, disseminate R&D results, provide technology forecasts, and stimulate the co-ordinated supply of information from the European supplier base to Member State markets.
- *Lead by example*, e.g. in making procurement decisions for transport services and own vehicle fleets.
- Develop and disseminate an *EU transport fuels policy/strategy/analysis*, aimed at influencing the expectations of consumers and suppliers and promoting consistency between national policies. In part, this will be informed by the results of pilot and demonstration projects, evaluated at a European level.
- Propose *guidelines for tax policies* that reflect the relative environmental damage of vehicle options and encourage harmonisation within a European market.
- Provide *funding for R&D, for pilot and demonstration projects*, and for evaluation tools (such as the assessment of external costs) to guide the market actors and national/local policy-makers.
- Provide *guidelines for Low Emission Zones, green procurement mandates, green fleet certification and Quality Contracts* – particularly concerning the avoidance of barriers to cross-border trade and mobility.
- Clarify the *rules on State Aid* concerning the use of short-term subsidies to stimulate the market for cleaner vehicles.

What local actions are needed?


Hybrid bus, Italy

- *Use demonstration projects* to promote the uptake of cleaner vehicles. Good practice includes:
  - *hitting the target* - target the project at the most suitable fuels, applications, technologies and users;
  - *working with stakeholders* – ensure that all relevant stakeholders are included from the start of the project;
  - *packaging measures together* – introduce cleaner vehicles in parallel with supporting measures such as low emission zones, bus priority measures, information systems etc.;
  - *getting the image right* - ensure that clean vehicles are also fast, frequent (for public transport), comfortable, stylish, easy to use and highly visible;
  - *exiting gracefully* – have a strategy for making the transition from a supported demonstration project to commercial use.
- *Infrastructure support* is vital. Ensure the provision of refuelling, recharging and maintenance infrastructure, either by direct

funding at local, national or EU level or in partnership with fuel and vehicle suppliers.

- Use *urban planning controls*. For example, low emission zones where all but the cleanest vehicles are banned from city centres can be a highly effective tool for promoting the use of cleaner vehicles.
- Encourage *green procurement*. Set a good example by buying green vehicles for local authority fleets, and encourage other fleet operators to green their fleets using tools such as Quality Contracts and Partnerships, or by supporting Green Fleet and Green Commuter programmes. Joining with other cities to form a procurement consortium can be effective in persuading manufacturers to reduce prices and extend the range of vehicles available.
- *Lobby for national support*. Supporting policies at national and EU level are vital. These may include a long-term fuel tax regime which recognises the environmental benefits of cleaner fuels, subsidies to offset the high cost of vehicle purchase in an immature market, and legislation to enable local governments to use tools such as low emission zones and green procurement.

Electric bus, Italy

UTOPIA project partners

EST	Energy Saving Trust (co-ordinator)	UK	CO
ADEME	French National Energy Agency	FR	AC
AEAT	AEA Technology plc	UK	C
AMOR	Austrian Mobility Research	AT	C
AVERE	European Electric Road Vehicle Association	BE	AC
BTSA	Barcelona Tecnologia SA	ES	AC
CERTU	Technical Department of French Ministry of Public Works	FR	C
CETE-Lyon	Technical Department of French Ministry of Public Works	FR	AC
CETE Nord-Picardie	Technical Department of French Ministry of Public Works	FR	AC
CGFTE	Praxitèle project, St Quentin-en-Yvelines	FR	AC
CityCar	CityCar project, Martigny	CH	AC
CSST	Centre for Transport System Studies	IT	AC
DITS	University of Rome La Sapienza, Department of Transport	IT	C
DM	Design Management AS	NO	AC
ENGVA	European Natural Gas Vehicle Association	NL	AC
IER	University of Stuttgart, Institute of Energy Research	DE	AC
InfoVEL	Mendrisio electric vehicle fleet test	CH	AC
INSEAD	European Institute of Business Administration	FR	AC
Intelmark	Intelmark	FR	AC
JRC	EC Joint Research Centre	BE	C
KFB	Swedish Transport and Communications Research Board	SE	C
TNO	Netherlands Organisation for Applied Scientific Research	NL	C
UTwente	University of Twente, Department of Philosophy of Science and Technology	NL	AC
VTT	Technical Research Centre of Finland	FI	AC
VW	Volkswagen AG	DE	C

CO *Co-ordinator*
C *Contractor*
AC *Associated contractor*

Contents

Abbreviations, acronyms and symbols

The following abbreviations and acronyms are used in the text.

AFV	alternative fuelled vehicle
C_6H_6	benzene
CNG	compressed natural gas
CO	carbon monoxide
CO_2	carbon dioxide
EC	European Community
EEV	Environmentally Enhanced Vehicle
EU	European Union
EV	electric vehicle
FCV	fuel cell vehicle
GDP	gross domestic product
HEV	hybrid electric vehicle
HGV	heavy goods vehicle
IEA	International Energy Agency
LEZ	low emission zone
LGV	light goods vehicle
LNG	liquefied natural gas
LPG	liquefied petroleum gas
NGV	natural gas vehicle
NO_x	nitric oxides
OECD	Organisation for Economic Co-operation and Development
PM_{10}	particulate matter
PNGV	Partnership for a New Generation of Vehicles
R&D	research and development
RME	rape methyl ester
VOCs	volatile organic compounds
ZEV	zero emission vehicle

Section 1. Introduction

1.1 Urban transport problems

Problems affected by the increasing number of vehicles using our cities include:

- local air quality and health;
- regional pollution and acid rain;
- climate change;
- noise;
- land use and congestion;
- social problems.

Local air quality and health

More than 70% of Europe's citizens live in urban areas. They face transport pollution that contributes significantly to health problems. In 70 to 80% of European cities with over half a million inhabitants, World Health Organisation guidelines for one or more pollutants are breached at least once a year. Traffic bans are regularly enforced in some southern European cities.

Three of the main pollutants are particulate matter, sulphur dioxide and ground level ozone, which is formed by the reaction of nitrogen oxides (NO_x) with volatile organic compounds (VOCs) in the presence of sunlight. These pollutants cause respiratory problems. In addition several transport pollutants are carcinogenic, including benzene and 1,3-butadiene. The impacts of these local air pollutants are particularly severe in busy city centres, where congestion creates queues of traffic pumping out exhaust fumes onto streets crowded with pedestrians.

Technology improvements offset by increasing demand…

Although improvements in vehicle technologies, particularly the introduction of catalytic converters, have led to steady reductions in emissions of volatile organic compounds and nitrogen oxides since 1990, the decrease has been slower than expected due to the ever-increasing transport demand. Transport still accounts for over half of EU NO_x emissions and a third of non-methane VOC emissions.

Regional pollution and acid rain

The impact of urban air pollution is not confined to cities. Plumes of pollution can drift out into surrounding rural areas, particularly during long spells of warm weather. Acidic emissions of sulphur dioxide and NO_x cause acid rain in neighbouring countries, damaging forests, lakes, crops and buildings.

Climate change

Transport accounts for 28% of man-made carbon dioxide emissions in the European Union and urban traffic is responsible for around half of these emissions.

Heavier cars offset fuel efficiency improvements…

Although the fuel efficiency of vehicles has been increasing, this has been outweighed by the demand for heavier and more powerful vehicles and greater use of auxiliary power e.g. for air conditioning. Together with decreasing occupancy rates and load factors this means that energy use per passenger and per tonne of freight has shown little or no improvement since the early 1970s. By 2010, transport is expected to be the largest single contributor to EU greenhouse gas emissions. This may jeopardise the EU's achievement of its greenhouse gas emissions reduction target under the Kyoto Protocol.

Noise, land use and congestion

Traffic noise is a key urban problem. It is estimated that over 30% of people in the EU are exposed to levels of road-traffic noise which cause serious annoyance (>55 dB) and 5 to 15% of the population suffer serious noise-induced sleep disturbance.

Transport infrastructure, including roads, refuelling stations and car parks, takes land which is in demand for other uses such as housing, business, leisure and open space. Typically roads take up 10 to 15% of the area of large European cities, but in some cities the proportion is as high as 35%.

Time lost due to congestion is estimated to cost around 2% of GDP. Traffic speeds have declined by 10% over the last ten years in major OECD cities. Congestion increases pollution and fuel consumption, and promotes the shift to out-of-town locations, which increases road traffic still further.

Social issues

The trend towards out-of-town developments is leading to increasing dependency on car use, as it is difficult to serve scattered peripheral developments with a good public transport network. This leads to accessibility problems for people without cars, especially when accompanied by the decline of local services and city centres. Increasing car use also tends to accelerate the decline of public transport services, worsening the problem.

In addition, busy roads can act as barriers, causing the severance of communities and making journeys by foot or bicycle hazardous. This leads to still further car use and increases the isolation of non-car owners.

1.2 Urban transport solutions

Transport pollution can be reduced in three main ways:

- *reduce transport demand*, e.g. through tele-working, tele-shopping or urban planning to reduce travel distances;
- *use vehicles more efficiently*, e.g. through optimising travel routes, improving freight logistics, car-sharing or shifting from private car use to mass transport, bicycles or walking;
- *reduce vehicle emissions*, e.g. through end-of-pipe technologies, lighter and more aerodynamic vehicles, improved driving techniques and vehicle maintenance, cleaner and more efficient conventional engines or new propulsion systems and fuels.

A combination of these options will be required to achieve a significant reduction in transport emissions. Within this broad perspective, the European Commission's UTOPIA project has focused on how to facilitate the introduction of *cleaner vehicles using new propulsion systems and fuels*. The new propulsion systems attracting the greatest interest are electric vehicles, hybrid vehicles, fuel cells and engines designed for alternative fuels (such as natural gas) and renewable fuels (such as bio-ethanol). These compete with advanced conventional propulsion systems such as direct injection diesel and gasoline engines.

New propulsion systems and fuels have the potential to reduce both local and global pollution and improve fuel security. The benefits of cleaner, quieter vehicles are particularly valuable in crowded, congested towns and cities. However, a variety of barriers hinder their introduction to the market. Some of these barriers are technical, e.g. the limited range of electric vehicles. Others are institutional, e.g. the lack of refuelling infrastructure. Most notably, higher capital and lifetime costs may be a critical problem.

The barriers can be reduced by introducing cleaner vehicles into *niche applications* for which they are particularly suited. For example, alternative fuelled vehicles can be introduced into urban fleets where the refuelling infrastructure is located at a central depot. Other applications include car rental, shared car ownership or public transport – these transfer the risk of ownership of a vehicle with a new propulsion system away from the private citizen.

Once established, these niche applications can help to raise the profile of the new technology, increase public acceptance, and provide opportunities for feedback which can lead to technology improvement. Eventually the technology may become commercially viable in its niche market and could even expand into wider markets. In the short term, however, government support may be necessary. Policy makers are therefore interested in the viability of these applications and in the tools available to promote them. These include funding for pilot and demonstration projects, changes to fuel and vehicle taxation, establishment of low-emission zones in urban centres, and establishment of standards or labelling schemes.

1.3 UTOPIA project objectives

The UTOPIA project aimed to provide decision-makers with the necessary information base, tools and guidelines for hastening the market introduction of promising urban transport solutions based on new propulsion systems.

Major outputs for external audiences

Accordingly, four major outputs have been developed:

- An assessment of the most promising applications for cleaner vehicles and supporting measures, from a city perspective.
- A good practice guide to setting up and running pilot and demonstration projects, aimed at potential project champions.
- Recommendations on policy actions at the European and national levels to promote or facilitate market introduction and demonstration.
- A software framework ("NAVIGATE UTOPIA") which provides information and assessment methodologies in a user-friendly form. This is primarily to support people at the local level (such as city transport planners) in pre-screening options and building the arguments in favour of a local initiative.

Web location

These are available on the web at http://utopia.jrc.it/.

Section 2 of this report summarises the advice to the city level, based on the first and last of these four outputs. Next, *Section 3* gives the key points of the guidelines for demonstration projects. In *Section 4* we review the lessons for the national and European policy levels. Finally in *Section 5* we present overall conclusions.

The full set of project Deliverables is listed at the end of this report.

On-site studies

The findings are based on extensive surveys of stakeholder views and experiences. Some of the main inputs came from previous projects involving cleaner vehicles and new transport concepts. Around 50 demonstration projects were studied in detail through a structured questionnaire. Subsequently, 13 projects were selected for further study through on-site interviews. These were:

- Le Touc electric shuttle service, Toulouse and Belle-Ile, France;
- Self-service electric cars, Martigny, Switzerland;
- Large-scale fleet test with lightweight electric vehicles, Mendrisio, Switzerland;
- Hybrid cars, Erlangen, Germany;
- NGV buses, France;
- Self-service electric cars, Praxitele project, St Quentin en Yvelines, France;
- Hybrid buses, Bologna, Italy;
- Electric buses, Bristol, UK;
- Bicycle Lift, Trondheim, Norway;

- Electric vehicles, Malmo, Sweden;
- Biogas buses, Linkoping, Sweden;
- LPG bus, Chester, UK;
- Guided busway, Leeds, UK.

Section 2.
Cleaner vehicles in cities

Promising fuels and applications

Barriers to cleaner vehicles with new fuels

Best practice for demonstration projects

Important supporting measures

2.1 Promising fuels and applications

Go to http://utopia.jrc.it/ to download the publication on "Cleaner Vehicles in Cities".

The road transport system at present is geared to the needs of the internal combustion engine running on gasoline or diesel. The dominant transport technology in the short term will be an evolution of this: advanced, cleaner conventional engines in combination with end-of-pipe treatments such as particulate traps and catalytic converters. However, there are various alternatives, each with its advantages and disadvantages.

The UTOPIA project focused on those alternative systems that are likely to reach some level of commercial viability in the next decades:

- electric battery vehicles;
- vehicles running on natural gas, LPG, bio-diesel or (bio-) alcohols;
- hybrid vehicles;
- fuel cell vehicles running on gasoline, alcohols, natural gas or hydrogen. (*These were studied to a lesser extent since there are few practical experiences to date*.)

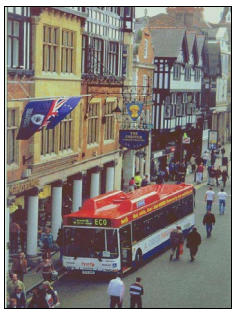
In general, alternative fuelled vehicles can offer significant benefits in terms of emissions and noise levels by comparison with conventional vehicles, but often at an increased price and with limited range, lower baggage or passenger capacity and perhaps reduced comfort or performance levels.

In the short term, alternative fuelled vehicles will have limited impact because market introduction is slow. However, in the long term alternative fuels will be needed particularly to reduce greenhouse gas emissions and to replace finite fossil fuels.

In this Section we summarise the most promising fuel options and transport applications for alternative vehicle technologies.

Most promising fuel options

- Modern purpose-built **LPG** vehicles typically meet EURO IV standards. They offer almost zero particulate emissions and low emissions of other local pollutants (NO_x, VOCs, CO and hydrocarbons), yielding major pollution reductions when replacing older diesel systems, e.g. in bus fleets. Purpose-built LPG vehicles are generally cleaner and more efficient than converted vehicles, and are expected to be a little cleaner than the equivalent gasoline vehicles. There are around 2 million LPG vehicles (cars, buses and trucks) in Europe, most of which are in Italy and the Netherlands. LPG is distributed by tanker and refuelling infrastructure is fairly inexpensive. Vehicle performance, refuelling times and CO_2 emissions are comparable to conventional vehicles, and vehicle noise is lower, although larger fuel tanks are required to give the same driving range.



LPG bus, Chester, UK

- **CNG** (compressed natural gas) offers similar benefits to LPG, although particulate emissions and life-cycle CO_2 emissions are lower. Refuelling infrastructure is more expensive although distribution costs are lower (assuming that a pipeline system exists), so in the short term CNG seems better suited to large depot-based fleets. There are over 380,000 CNG vehicles in Europe, mostly in Italy.

CNG bus, France

- **Bio-fuels** include ethanol, methanol, bio-diesel and bio-gas. They are derived from energy crops or organic waste, and therefore offer a more sustainable option in the long term than fossil fuels. Carbon dioxide emissions over the fuel life cycle are much lower than with fossil fuels, and there are also reductions in local air pollutants. The main experience with bio-fuels in Europe is with bio-gas and bio-ethanol trucks and buses in Sweden, bio-diesel in Germany, Italy and Austria and bio-fuel blends in France.

- **Battery electric vehicles** are best suited to urban use, particularly in sensitive or historic areas. They have zero emissions at the point of use, although some emissions are created at the power station when electricity is generated. They are quiet and give smooth driving in stop-go traffic conditions. Overnight recharging is typical, giving a driving range that is usually adequate for the next day's urban journeys. Some 30,000 electric vehicles (buses, trucks, cars and scooters) are in operation in European cities.

Electric car, Switzerland

- **Hybrid electric vehicles** combine electric propulsion with an auxiliary motor, generally gasoline or diesel. Some designs offer the advantage of electric vehicles for zero-emission driving in city centres, with the conventional engine available for longer journeys. Fuel efficiency can be high relative to conventional engines. Hybrid buses and trucks are being demonstrated in several European cities, and hybrid cars have just become commercially available.

- **Fuel cell vehicles** are not yet commercially available but offer a very promising option for the longer term, with low CO_2 emissions and almost zero local pollutant emissions. Several demonstration projects are underway with buses or trucks.

Experimental fuel cell car

- **Advanced gasoline and diesel technologies** will remain competitive for many years, particularly where lifetime cost is the main consideration. From an environmental perspective, Euro3 and Euro4 standards are reducing the gap between conventional and alternative fuels, while new diesel technologies are highly fuel-efficient. Nevertheless, alternative fuels continue to attract particular interest in urban areas with air quality problems where minimising emissions is a priority. *Renewable* alternative fuels also offer CO_2 emissions benefits and enhanced sustainability.

Most promising applications

- **Buses** offer a number of advantages for demonstrating the use of new fuels. In particular, they run on short, regular routes and return to a central depot for refuelling, so the limited availability of refuelling infrastructure is not usually a problem. In addition, public ownership or funding often facilitates the payment of a cost premium in return for a better environment in the city centre.

- **Fleet vehicles** share with buses the advantage of returning to a depot for refuelling and maintenance. These include both public fleets such as refuse collection vehicles or police services, and private fleets such as local taxis, couriers or delivery vans.

- **Rental vehicles** are also depot-based, which simplifies maintenance, although refuelling will also take place outside the depot. By renting a vehicle, the user eliminates the risks of ownership of a novel technology. As rental vehicles have many users per vehicle, they are ideal for raising awareness of new technologies – but this requires additional effort for driver instruction. Alternative-fuelled vehicles are being used in some novel transport schemes such as self-hire vehicles and car-sharing schemes, although other schemes have avoided them because the users lack the experience to cope with new fuels.

Bicycle lift, Trondheim

- **Innovative two-wheeler systems** can offer opportunities for introducing cleaner vehicles. Electric bikes and scooters are cheaper to purchase and quicker to re-charge than larger electric vehicles, and generally have less problems with daily range. Perhaps the most novel of all the technologies considered here is the electric bicycle lift pioneered in Trondheim, which assists cyclists in going up hills.

- Although the barriers to new propulsion systems in the **private car** market are significant (especially high vehicle cost and lack of public refuelling infrastructure), the uptake of cleaner vehicle technologies for private cars will have the greatest benefits in terms of pollution reduction in cities in the long term. As new vehicle technologies are introduced in niche applications such as buses, barriers to other applications such as private cars will decrease. For example, awareness of the technologies will increase, confidence will increase, refuelling opportunities will increase, improvements may be made to the technologies and production costs will decrease. There are already cases where this market is significant, e.g. LPG cars in Italy and the Netherlands.

2.2 Barriers to cleaner vehicles with new fuels

Vehicles running on new fuels can offer reduced environmental impacts. In many cases fuel costs are lower. However, these vehicles also have certain disadvantages compared with conventional fuels, creating barriers to market entry.

Technical barriers

There may be limits on vehicle performance, such as:

- limited range;
- heavy and bulky tanks or batteries;
- long recharging or refuelling time.

Economic barriers

Economic barriers include:

- higher initial vehicle cost for most clean-fuelled vehicles;
- business risks due to the uncertainty in vehicle life-time costs (e.g. depending on tax rates and resale values).

Market barriers

Some of these barriers can be reduced by further research and development. However, even in cases where a clean-fuelled vehicle is potentially competitive with a conventional vehicle, a further set of barriers arise which inhibit the introduction of novel technologies to the established market. These "market barriers" include:

- lack of information on the real-life performance of new technologies and a lack of confidence among potential users;
- lack of confidence among manufacturers and vehicle and fuel suppliers concerning the viability of markets for new technologies;
- high manufacturing costs before economies of scale are achieved;
- lack of supporting infrastructure for refuelling, recharging, retail supply and maintenance (resulting in part from the lack of confidence).

The main market barriers tend to be "chicken and egg" problems, i.e. they would be eliminated if the technology was sufficiently widespread, but this cannot happen until the problems are overcome! The solution lies in introducing cleaner vehicles into promising niche applications where the barriers are less significant. Supporting measures include information campaigns and demonstration projects, and tax incentives, subsidies and other regulations designed to kick-start the market. Measures that can be developed at the local level are discussed in the next two Sections.

2.3 Best Practice for demonstration projects

In setting up demonstration projects with cleaner vehicles, the following factors are essential for success:

- *Hitting the target* – addressing local priorities and aiming the project at the right fuels, applications, technologies and users.
- *Packaging measures together* – integrating measures into a coherent transport strategy.
- *Getting the image right* – giving new technologies a positive, clean, innovative image.
- *Working with stakeholders* - building strong teams and networks.
- *Exiting gracefully* – managing the transition from demonstration to commercial use.

The following sub-sections expand on each of these five factors in turn.

Hitting the target

- *Address the local priorities.* The objectives of the project should be clear and simple. Typical objectives might include:
  - reducing congestion in the town centre;
  - reducing high levels of particular pollutants which are causing a problem;
  - catering for tourist traffic whilst still achieving a cleaner, quieter town centre;
  - reducing CO_2 emissions from transport as part of the local Agenda 21 programme;
  - introduction of a greener transport system, and raising awareness of environmental issues amongst the public.

- *Which applications?* In general it is best to target the most promising markets and applications first (as discussed in Section 2.1). For example, urban bus fleets are particularly suitable for introducing new fuels. It is important not to target the private car market too early, before adequate refuelling and maintenance infrastructure is in place, as this can lead to disappointment and adverse publicity.

  However, local priorities for action might also suggest which applications to focus on. For example, there might be a problem with an old, dirty bus fleet, a large number of heavy goods vehicles using the town centre, congestion from commercial van deliveries at peak times, or excessive use of commuter cars due to inadequate public transport.

- *Which fuels?* Fuel choice depends on several issues:
  - local availability of the fuel type;
  - availability of a fuel supplier who is willing to fund infrastructure;
  - availability of national/EU grants and incentives e.g. fuel tax;
  - availability of a suitable range of vehicles;
  - suitability for the application, e.g. the required range, vehicle size and refuelling infrastructure. For example:

Electric vehicles are ideally suited for short urban journeys and are particularly suitable for tourist areas where their quiet, smooth, clean operation is highly valued. Performance may be a problem in very hilly areas.

If longer out-of town trips may be required (e.g. for taxis) or the area is very hilly then *hybrid vehicles* may be more appropriate.

CNG refuelling pumps are expensive, so in the absence of widespread refuelling infrastructure CNG is mainly suitable for large fleets. However, if there is a refuelling infrastructure (as exists in Italy and growing in Germany), then NGVs are also suitable for commuter or small fleet applications. Almost all of the Italian vehicles are commuter vehicles, plus buses in fleets; in Germany, CNG is targeted on commuters, small fleets (under five vehicles that use public fuelling) and larger bus and taxi fleets.

LPG is suited for many vehicles and refuelling infrastructure is relatively cheap, but emissions reductions are not as great as with some other fuels.

Fuel cells (when available) are likely initially to be better suited to large vehicles such as buses and heavy goods vehicles (HGVs).

- *Pick the right product.* Premature use of immature technologies and products can lead to public rejection. Many demonstration projects have concluded that they should have tested their technologies more thoroughly before releasing them to public view! It is important to use fairly mature technologies for large applications such as fleets or car sharing, or for very visible projects such as buses. Less mature technologies can be tested using smaller demonstration projects in collaboration with universities or research boards.

  It has repeatedly been found that dedicated new fuel vehicles are much cleaner than conversions, which may offer little emission reduction compared to conventional vehicles. However, converting old, dirty buses to a cleaner fuel such as LPG can be a cost-effective way of achieving emission reductions in the short term, especially where funds for new vehicle purchases are limited. Also, bi-fuel conversions are a good way of expanding experience with a new fuel whilst avoiding the problems of lack of refuelling infrastructure.

  Many projects have had difficulty finding a vehicle to match their needs from the limited range currently on offer. Some cities have taken the innovative step of commissioning a vehicle direct from the suppliers, as with the hybrid midi-bus in Bologna. It is also

possible to persuade suppliers to offer a greater range of vehicles, or to offer vehicles in countries where they were nor previously available, through joining or setting up a purchasing consortium.

- *Target the right users.* "Leading-edge" users who particularly value the benefits of innovations should be targeted first. This allows critical learning and economies of scale to be developed before acceptance by more conservative "average" users is sought. Leading edge users might include students or young professionals, especially those working in technical fields, or companies that wish to promote an environmental image.

Packaging measures together

Demonstration projects will be more successful when set up as part of an integrated transport policy which includes a variety of supporting measures. These might include both "carrots" to encourage the use of cleaner transport solutions, such as free parking for cleaner vehicles, and "sticks" to restrict more polluting options, such as access restrictions in the city centre.

Typical measures might include:

- restrictions on general traffic, e.g. low-emission zones in city centres, parking restrictions and higher parking charges;
- free parking or reserved parking spaces for cleaner vehicles;
- free recharging points for electric vehicles;
- measures to encourage cycling and walking, such as cycle paths, cycle racks, bicycle lifts, pedestrian routes;
- improved public transport services;
- establishment of park and ride schemes using cleaner buses;
- integrated land-use and travel planning.

The 1996-99 EC-funded CENTAUR project concluded that the package approach is *essential*. Switching to public transport is the most effective way of reducing urban transport pollution and congestion, and this will only work if there are good alternatives to car use. Also, infrastructure measures such as bus priority systems can help to maximise the benefits to the transport operator and thus compensate for the high cost of cleaner vehicles.

Getting the image right

It is important to promote cleaner technologies with a positive image, which emphasises their environmental benefits but also presents them as new, innovative, stylish and modern. Cleaner vehicles should be well designed and clearly labelled to educate the public about their environmental benefits. A clean technology with a positive image will not only be more attractive to users, but can help to raise revenue through advertising. (For example, the City Bike schemes in Trondheim and Copenhagen have been funded through advertising revenue.)

Reliability is important

Public transport offers a good niche for introducing cleaner vehicles, but it often suffers from an image of old, dirty, inefficient vehicles. It is important for cleaner fuelled vehicles to be reliable, to avoid a loss of public confidence caused by repeated breakdowns or failure of buses to arrive on time. The technology should be well tested, and there should be contingency plans to deal with breakdowns or problems with fuel availability (e.g. a back-up fuel supply and reserve vehicles). Service and maintenance should be carefully planned, either by asking the vehicle manufacturer to provide service and maintenance as part of the purchase contract, or by asking the manufacturer to provide training for local mechanics. Inadequate training often leads to problems such as mechanics re-tuning engines as if they were gasoline or diesel engines, instead of optimising them for the alternative fuel. Drivers should also receive appropriate training, as driving style can have a big impact on fuel efficiency, emissions and breakdowns.

Offer an improved service

For maximum impact, the introduction of new public transport options such as cleaner fuelled buses should be accompanied by service improvements. These might include:

- increased *service frequency*;
- *better connections* between services and between modes, e.g. bus and train;
- *public transport priority*, e.g. bus lanes, guided buses, bus priority at junctions;
- *improved timetable and information services*, e.g. real-time information on the next bus or train arrivals displayed at bus stops and train stations; one-stop travel centres offering advice and tickets for all transport modes; up-to-the-minute internet-based timetable information;
- *easier ticketing*, e.g. payment for all stages of a multi-modal journey at once, or on-board payment with a smart card or credit card;
- *more comfortable buses*, e.g. low-floor buses to permit easier access by the disabled or parents with pushchairs;
- improved *security*;
- *distinctive design and labelling* to emphasise that a clean fuel is being used and promote a stylish image;
- *innovative services* such as door-to-door service using shared taxis or on-demand buses;

The French NGV bus programme found that the positive image of the buses amongst users was more heavily influenced by the improved comfort and convenience of the low-floor buses than the fact that they ran on natural gas. The positive image was also stronger and awareness of the environmental benefits was greater in cities where the buses had been clearly labelled, and where the label included a description of the benefits and not just a statement that gas fuel was used.

High visibility increases impact

Provided that the service is reliable and stylish, the impact of the demonstration project can be greatly enhanced by promoting a high visibility of the demonstration vehicles. Frequent sightings of a new technology will lead to increased public familiarity and acceptance,

and increased confidence. Examples of how this can be achieved include:

- *Distinctive labelling and design/colouring* for the demonstration vehicles and refuelling infrastructure, including information on the environmental aspects of the new fuel
- *Siting* demonstration vehicles and infrastructure in obvious places, e.g. fleets of electric self-hire vehicles at rail stations, buses in city centres, refuelling pumps at intensively used stations, clearly labelled reserved parking places on city centre streets.
- Using *high profile applications*, e.g. alternative fuelled taxis. Not only are taxis frequently used by members of the public, but taxi drivers are often assumed to have an expert knowledge of vehicles, and thus association with alternative fuels can be seen as an endorsement.
- Providing *opportunities for test driving*, e.g. by allowing members of the public to test drive vehicles at motor shows or exhibitions. Vehicles can also be lent or leased to companies for short periods to enable them to assess their suitability. The city of Stockholm lends vehicles from its own fleet to local companies who wish to evaluate them. Vehicles can be loaned for up to two weeks. Companies pay a small administration fee and in return they fill in a questionnaire about their experience with the vehicles.
- *Publicity* through the media and events such as seminars for potential users. It is also important to react immediately to correct any mis-information which appears in the media which could spread a poor image of alternative fuelled vehicles, e.g. reporting of accidents involving alternative fuelled vehicles which unfairly blame the fuel type used.

Working with stakeholders

- *Involve all appropriate stakeholders from the start of the project.* Stakeholders may include:
  - users;
  - transport service providers;
  - vehicle fleet operators;
  - vehicle, fuel and other technology suppliers (both manufacture and retail);
  - local authorities;
  - regulatory authorities;
  - motorist and passenger groups;
  - business associations;
  - local residents and traders;
  - representatives of affected organisations (such as vehicle maintenance, vehicle breakdown, emergency services and insurance companies);
  - project sponsors, national governments and the EU.

  For a particular local project, it can be helpful to approach the most influential stakeholder first, because their presence can help

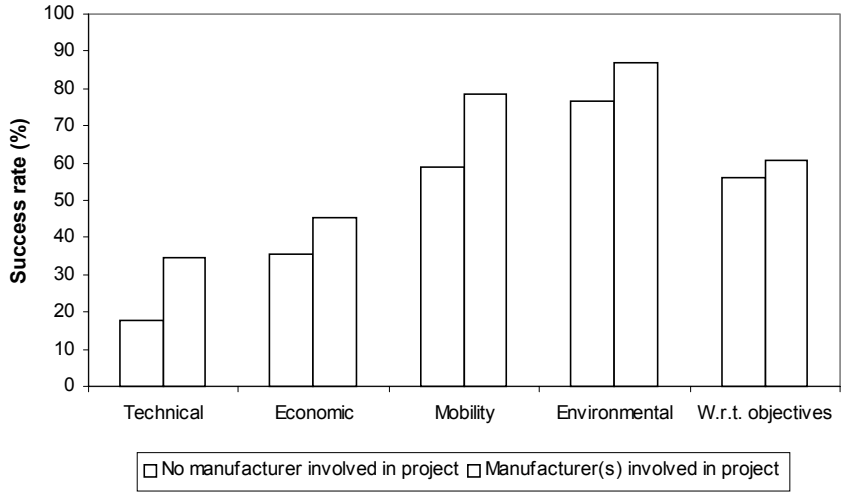
to persuade others to join in the project. Objections from stakeholders should be treated seriously, and dealt with before the next stakeholder is approached.

Although not all projects are big enough to require all the above stakeholders, it is wise to obtain support from as many institutions as possible in order to reduce potential opposition.

Stakeholders and sponsors should be allowed to contribute in the way they prefer: this could be financial support, loan of equipment or venues for events, publicity, political support, etc. However, stakeholders should if possible be encouraged to have a financial stake in the project, however small, to ensure their commitment.

- *Involve manufacturers.* Manufacturer involvement helps to solve problems as they crop up. The UTOPIA research showed that involvement by vehicle manufacturers significantly increases the success rates of projects against a range of criteria (see Figure 2.1).

Figure 2.1 Effect of involving manufacturers on project success



- *Build networks*. It is important to encourage co-operation and build partnerships between players, e.g. local authorities and transport operators. This may involve breaking down institutional and cultural barriers. Good networks for sharing information are vital, including sharing experience with other countries and other cities. This can save both time and money.

- *Consult local transport operators.* Operators of transport services in the region should be consulted whether or not they are involved directly in the project. This can help to ensure that possible synergies with other modes of transport are fully exploited (e.g. optimising bus and train connections or integrating timetable and ticketing services). Also it can allay fears that new modes will reduce custom for existing modes.

- *Build purchasing consortia*. Grouping together users to increase purchasing power can be successful in stimulating manufacturers to produce cleaner vehicles, and bringing down purchase costs.

- *Get feedback*. To maximise learning opportunities, it is important to get as much feedback as possible from those involved in the project, through surveys of users, drivers, mechanics, local residents, etc. This can help to iron out teething problems and design successful follow-up projects. Also it increases user commitment as they feel that their views are important and are being listened to. Feedback should also be given to users and stakeholders, e.g. through a project newsletter. It is useful to maintain a permanent point of contact for users to deal with any problems or queries.

- *Disseminate* critical data to potential users and suppliers (e.g. on technology costs). Also disseminate successful project results, to ensure that stakeholders obtain prestige for their participation.

Exiting gracefully

At some point it will be necessary to make the transition from demonstration to wider commercial use. This should be done with care.

- *Phase out* subsidies and incentives gradually as the need for support falls. Alternatively, *move the goalposts*, i.e. progressively change the rules to favour newer cleaner technologies. For example, the criteria for access to low emission zones or entitlement to free parking can be revised as vehicle technologies improve.

- *Say goodbye to leading edge users.* Recognise that pioneers are more enthusiastic than the general public. As schemes expand a more professional organisation is required and broader appeal must be cultivated.

- *Explore green procurement opportunities.* The transition from demonstration projects to commercial use can be aided by green procurement strategies, i.e. including environmental criteria in tendering for new vehicles. For example, Chester City Council adopted a dual tendering approach where they asked all suppliers to quote for both diesel buses and LPG buses in their tenders.

2.4 Important supporting measures

Menu of policy options

Demonstration programmes are crucial for the successful introduction of clean vehicles, but they are much more likely to succeed within a strong framework of supporting policies and measures at the local, national and EU-level.

Novel policy approaches are needed to introduce clean vehicles in new applications, because radical changes in the behaviour of users and suppliers are often necessary. For example, car sharing requires users to drastically change their transport habits, but the admission of car-share vehicles to low emission zones within a city can compensate for this.

Table 2.1 lists the possible policy options. These include:

- local actions (marked L);
- direct actions at the EU and/or national levels (marked N, E or N/E);
- actions which can be carried out either at the local or national/EU levels (marked L/N or L/N/E);
- actions at the local level which require or would benefit from an enabling framework of national/EU legislation. (marked L-N/E). For example, national governments can pass legislation to enable local governments to set up low emission zones in city centres.

The Table focuses on those options which can be used to promote cleaner vehicles, although some of the policies listed can also be used to address transport problems in other ways, e.g. through promoting greater use of public transport or through traffic management measures.

Here we discuss some of the most important actions which can be undertaken *at the local level*. These include:

- infrastructure support;
- urban planning measures, road pricing and parking charges;
- low emission zones;
- green procurement;
- lobbying for national and EU support.

Table 2.1 Menu of policy options to promote cleaner vehicles

Type of policy	Type of measure	L/N	Specific examples
Pricing policies	Road pricing	L	Area licensing by vehicle emissions category
		L	Cordon pricing by vehicle emissions category
	Public transport subsidies	L/N	Subsidies for early introduction of cleaner buses
		L	Subsidies for operating costs
	Parking charges	L	Preferential charges for cleaner vehicles
	Scrappage, purchase and retrofit incentives	N	Purchase subsidies for new cleaner vehicles
		N	Subsidy for retrofitting cleaner engines
Taxes	Fuel taxes	N/E	Differential fuel tax (by fuel type)
	Vehicle taxes	N	Differential annual vehicle tax (by fuel type, technology, emissions category)
	Energy and carbon taxes	N/E	Differential tax on energy use or CO_2 emissions rate (e.g. by vehicle model)
	Taxation of parking (private non-residential)	L-N	Introduction/change of parking tax favourable to new transport solutions
Regulation	Zone access control/ Environmental zoning	L-N/E	City centre restriction to clean vehicles, Low Emission Zones
	Parking regulation	L	Limits on parking spaces and times, possibly with preferential treatment for cleaner vehicles
	Standardisation and new standards	N/E	Fuel quality standards
		N/E	Recharging/refuelling system design standards
		N/E	Emissions testing standards
		N/E	Designation of labels for vehicles meeting specific environmental standards ULEV, SULEV
	Safety regulations	N/E	Homogenisation of safety standards across the EU
	Type Approval regulations	E	Introduction of Type Approval regulations for new technologies such as fuel cell vehicles
	Vehicle recycling regulations	N/E	Battery recycling requirements
	Urban planning regulations	L	Changes in urban delivery restrictions depending on vehicle emissions and noise
		L-N	Approvals for alternative fuel refuelling stations
	Public procurement mandates	N	Purchase requirements for cleaner vehicles by public administrations
	Requirements on vehicle sales	N/E	California ZEV mandate
Investment	RTD support	N/E	Funding for market research and technology development
	Demonstration	L/N/E	Funding and management of demonstration projects for new propulsion systems
	Infrastructure	L/N	Public refuelling/recharging infrastructure
		L	Modal interchanges to cleaner vehicles/modes (e.g. Park & Ride sites)
		L	Cycle paths/facilities
		L	Bicycle lift
		L	Public transport lanes (e.g. for cleaner buses operating Park & Ride services)
	Quality standards and partnerships for public transport contracts	L-N/E	Public-private contracts or agreements requiring investment in cleaner vehicles
Information and public awareness initiatives	Best practice campaigns	N	Greener fleet guides
	Targeted awareness initiatives	L/N	Public transport information
		L/N	Green commuter plans

Air quality is dominant as a local concern. The focus for air quality policy is now seen to be local actions to deal with local hotspots. These actions may be based on non-technical measures, such as low emission zones, or technical measures such as replacing or modifying older vehicles *in the local area.*

Action may be directed towards selected pollutants, such as NO_x and PM, reflecting specific problems with air quality target compliance and public concern over smoky vehicles. This is arguably better targeted by local measures than a more uniform national support for new propulsion systems. For example, Paris has introduced 200 NGV buses, and has also retrofitted 2,500 diesel buses with particulate traps.

Infrastructure support

Lack of refuelling infrastructure is a major barrier to the introduction of cleaner fuelled vehicles. Even in cases where the vehicle can normally be refuelled at a central depot or at the user's home (such as overnight charging for electric cars), the lack of widespread public infrastructure acts as a psychological barrier to potential vehicle purchasers. For example, in the Mendrisio project, users cited the provision of public recharging infrastructure as the most important support measure, even though this infrastructure was rarely used in practice. There is also a problem with lack of servicing, maintenance and breakdown facilities. Provision of public refuelling, recharging and maintenance infrastructure is therefore one of the most important supporting actions a local or national government can take.

- *Ensure infrastructure is in place* before commencing a project, otherwise the project can fail.
- *Consider public support* for infrastructure as a short-term measure to overcome market barriers. Local governments may be able to obtain funds for infrastructure investments from national governments or the European Community.
- *Encourage private sector investment.* It is often possible to persuade fuel suppliers to fund fleet refuelling facilities. They can recoup their investment costs through a long-term fuel supply contract. For example, local energy companies own and operate recharging stations in Copenhagen and Stockholm. Fleet operators generally prefer to avoid the responsibility and investment risk of installing, maintaining and operating an unfamiliar refuelling facility, and are happy to pay a small surcharge on the fuel price to the fuel supplier for this service. Cleaner fuels are generally cheaper than conventional fuels anyway, due to favourable taxation policies.
- *Encourage third-party use* of fleet refuelling infrastructure, to spread the investment cost over a higher throughput and to attract a wider market. Consider the potential for public access in the long term.
- Impact can be heightened by making refuelling sites *highly visible.* For example, in Palermo a recharging station for electric vehicles is sited prominently at the central railway station.

Other types of infrastructure investment can also encourage uptake of alternative fuels. These include measures to promote more efficient public transport, when implemented in conjunction with the introduction of cleaner buses, such as bus priority lanes, real-time timetable information, bus priority traffic signals and park-and-ride facilities. Local authorities have a significant role to play here.

Urban planning measures

Urban planning has a very important role to play in a cleaner transport strategy. It has recently been recognised that travel demand can be greatly reduced by moving towards a compact town plan built around an efficient public transport network and by restricting out-of-town developments. The aim should be to locate businesses, shops, schools and housing close together so that many journeys can be made by foot, bicycle or public transport.

A range of urban planning measures can help the introduction of cleaner fuelled vehicles. Perhaps the most promising measure is the introduction of low emission zones in city centres, discussed in the next sub-section. Changes to traffic regulations, parking charges and road pricing schemes can also be useful.

Reducing restrictions on movement

Cleaner fuelled vehicles can be encouraged by changing urban planning and traffic regulations to reflect the benefits of cleaner, quieter vehicles. Examples include:

- in *the Netherlands,* restrictions on night-time deliveries to supermarkets have been relaxed for alternative fuelled heavy goods vehicles;
- in *Monaco,* only electric vehicles for postal delivery are allowed to circulate in pedestrian areas;
- in the *UK,* Marks & Spencer has a fleet of natural gas vehicles for delivering to a supermarket in a residential area of London. It is allowed to deliver early morning and later in the evening because the vehicles are quieter. This has meant Marks & Spencer need fewer delivery vehicles, which has cut delivery costs.
- In *Athens* and *Palermo*, zero and low emission vehicles are allowed to drive in bus or car-pool lanes.

Road pricing

Traditionally road pricing has been based on simple road tolls, usually for inter-city routes and often aimed at recovering the costs of road construction. These are not usually relevant to urban transport. However, new approaches based on charging for entry to a central urban area have recently appeared, such as toll rings and cordon pricing. These systems depend on the availability of new technology for automatic vehicle recognition and automatic vehicle debiting.

The idea behind road pricing is to link costs more strongly to vehicle use, i.e. instead of paying a single high charge (e.g. for vehicle purchase tax) the user will pay according to the distance travelled or type of vehicle used. The main environmental benefits of road

pricing will come from an increase in vehicle occupancy and a switch to public transport. Congestion can also be reduced, especially if charging is related to the time of day. However pricing also presents an opportunity to encourage cleaner vehicles, by setting the price based on the vehicle emissions category. This has not yet been done in the EU, although the German government plans to introduce a distance-based highway charge with emissions components for commercial vehicles.

Road pricing: unpopular, unfair and unwise?

Road pricing schemes face certain obstacles:

- They are generally unpopular with the public, who are understandably reluctant to pay for something which has always been free.
- They can encourage out-of-town developments, which increase car use.
- They can be regressive, i.e. poorer road users will be penalised unfairly.

These problems can be mitigated by certain precautions.

- Public hostility can be reduced by earmarking the revenue for environmental transport projects and public transport investment.
- Strong planning regulations will be needed to discourage out-of-town developments.
- Social policies should aim to compensate poorer road users, e.g. by providing extra allowances or cheap public transport.

Parking charges

Offering preferential parking charges for cleaner vehicles can be an effective means of compensating users for the added cost and inconvenience of a cleaner fuelled vehicle, in recognition of their environmental benefits. Some examples:

- Some *Swedish cities* offer free parking to electric vehicles and also provide designated spaces with recharging facilities. The city of *Gothenberg* offers free parking for any vehicle meeting the Environmentally Enhanced Vehicle (EEV) standard.
- In *Copenhagen*, where finding a place to park may be difficult in the inner city, special designated parking places for electric vehicles including free charging facilities have been built.

Low emission zones

Low emission zones (LEZs) are typically set up in city centres and allow access only to vehicles meeting certain emissions criteria. They are widely seen as a key tool for encouraging cleaner vehicles in urban areas and dealing with local air quality problems in a cost-effective way.

The vision for a low emission zone is of a clean, safe, quiet environment which will be pleasant and attractive for residents, traders and visitors, leading to rejuvenation of the city centre. LEZs are suited to any city centre with congestion or pollution problems. They are particularly valuable for historic cities where tourism is important and narrow or twisted streets lead to congestion and pollution problems. However they are not suitable for peripheral areas where benefits are lower and traffic will simply be diverted to adjacent roads.

The concept of low emission zones has evolved from restricted access zones (or Clear Zones), where access is restricted to certain categories of users, usually including public transport, local residents, traders, emergency services and the disabled. Clear Zones can be used to promote cleaner vehicles in two ways. Firstly the access criteria can be expanded to include low emission vehicles. Secondly the introduction of a restricted access zone provides a good opportunity to replace public transport vehicles with cleaner technologies. This helps to reinforce the environmental motives behind the introduction of the Clear Zone, and increases public acceptance.

An important finding from the CENTAUR project is that cleaner vehicles are more readily introduced once a local authority has implemented general traffic restraint measures.

LEZs can face opposition from local residents and traders. Care is needed to avoid diverting business away from the centre, so it is vital to provide plenty of high-quality alternatives to private car use. Additional traffic management measures may be necessary to ensure that congestion and pollution problems are not diverted to the area just outside the zone. LEZs therefore work best as part of a package of measures including traffic management, provision of clean, accessible public transport and promotion of cycling and walking. It is also vital to involve local stakeholders right from the start of the project, to increase acceptance of the scheme.

A wide variety of access restriction schemes are in place in EU cities, although few of these qualify as true low emission zones. Many cities in Southern Europe enforce access restrictions only on certain days when pollution levels are particularly high. Of the schemes with permanent restrictions, most aim simply to reduce traffic flow by diverting through traffic or restricting access to certain essential users. Although several cities have complemented their access restrictions by introducing a handful of cleaner vehicles (e.g. buses or waste disposal trucks), the goal of restricting access *only* to clean vehicles is generally a longer-term aim. However, hundreds of towns across Europe are now committed to introducing both low emission zones and cleaner vehicles as part of the ALTER initiative (described later), and many feasibility studies are underway.

Examples of current schemes include:

- *Nottingham* in the UK is introducing a central zone accessible only to buses, cycles, taxis and disabled badge holders during core times. A second phase requires buses to meet strict emission standards, and there are plans to extend this to delivery vehicles, taxis and council vehicles. An express tram service will be introduced from 2003 and bus services are being improved through quality partnerships.
- *The London Borough of Camden* has introduced a Clear Zone in the south of the borough. The borough plans to introduce eight car-free housing areas in this zone. Ultimately the zone will be restricted to admit only essential low emission vehicles.
- *Stockholm, Gothenburg, Malmo and Lunds* in Sweden restrict city centre access for heavy vehicles and buses unless they meet certain environmental criteria.
- *Bologna* in Italy has restricted daytime city centre access to buses, taxis, emergency services, residents, traders, delivery vehicles (at set times) and hotel guests. This has been accompanied by the introduction of hybrid electric buses.
- *The City of Florence* in Italy plans to extend its restricted traffic zone and permit only electric vehicles in the historical centre. This is part of a whole package of measures including:
  - parking restrictions
  - introduction of gas and electric buses,
  - conversion of council vehicles, police cars and taxis to natural gas,
  - a free bicycle lending service,
  - plans for an integrated freight delivery service using gas or electric vans,
  - incentives for purchase of electric bikes, motorbikes and other vehicles
  - promotion of cycling, walking and bus use[1].
- In *Palermo* the city centre is closed to traffic each Sunday from February to May, but electric vehicles are allowed to enter.

Designing a low-emission zone

The following issues need to be addressed when designing a low emission zone.

- *Location and extent.* LEZs are most appropriate for compact city centres. They are not suitable for peripheral areas where benefits are lower and traffic will simply be diverted to adjacent roads. The extent of the zone may be determined by natural boundaries such as ring roads, rivers or railways. In order to assist enforcement, there should not be too many possible entry and exit points. Although this problem can be solved by sealing off minor roads which cross the boundary, this may be unpopular with local residents. The zone should allow diversion of through traffic onto a suitable alternative route, e.g. a ring road or bypass. Also the boundary should include suitable interchanges where the visitor can transfer from private car to public transport, e.g. park and ride sites or rail stations.

- *Time of operation.* The access restrictions may be permanent or may operate only at peak hours, only during weekdays or only during pollution episodes. For example, some schemes operate six days a week and only at set times, allowing goods deliveries

to be made in the early morning or afternoon. This helps acceptance of the scheme by local traders. The best solution will depend on the traffic pattern of the particular site, and the severity of the pollution and congestion problems at different times. There will be a balance between the effectiveness of the zone in terms of emission reductions and the need to achieve public acceptance of the zone.

- *Admission criteria.* There will need to be exemptions, e.g. for local residents and traders, the disabled, emergency vehicles and utility vehicles. Other vehicles could be banned completely or only vehicles satisfying certain emissions criteria could be allowed in.

  In the long term there will be a need for national or EU-level agreement on the entry criteria and vehicle labelling to be applied, to allow free movement of traffic within the EU and avoid excessive costs to transport operators. Local flexibility could be built into the system, for example by allowing cities to choose from a limited set of emission standards of different levels. For example, a banding system could comprise the four EURO standards, the new environmentally enhanced vehicle (EEV) standard (currently half of EURO IV emissions) and a ZEV standard. However very good driver information systems and signage would have to be in place to clarify which vehicles were allowed into which cities. Alternatively, access could be restricted by vehicle type, e.g. if heavy goods vehicles are the major polluters then these could be banned and deliveries could be carried out by a fleet of cleaner delivery vehicles operating from a freight transfer station on the edge of the zone.

  The use of a banding structure based on common standards would allow a high degree of flexibility to individual cities. For example, cities could design schemes with a core area restricted to pedestrians, cyclists and ZEVs, with lesser restrictions in the outer area. Or tighter restrictions could be applied to buses or goods vehicles (which often cause the majority of the pollution and are also easier to target) than to private cars.

- *Access and enforcement infrastructure.* A variety of enforcement methods are possible. Some methods currently deployed include:

  - visual identification of authorised vehicles by means of a windscreen disc or number plate marking, with enforcement carried out by traffic wardens;
  - bollards which physically prevent access but can be lowered by means of an access card (this method is installed in over 30 Spanish cities and 10 Dutch cities);
  - cameras installed at entry points with automatic video number plate recognition, with penalties issued to non-authorised vehicles by post;
  - an electronic tag within the vehicle which either operates an access barrier or triggers an automatic number plate recognition camera to photograph non-authorised vehicles.

  The automatic methods involve more capital investment but have lower operating costs, and will reduce non-compliance[2]. However this will also reduce revenue from fines! Systems involving

physical barriers at the zone boundary can create queues, but also give the opportunity for on-the-spot testing of tailpipe emissions if non-compliance is a major problem. Electronic tags in conjunction with camera enforcement will permit free flowing traffic but this is the most expensive system. In the long term it will be necessary to have EU level agreement on standards to ensure that different access, identification and enforcement systems are compatible.

- *Provision of alternatives.* A good, clean public transport system is essential for the success of the scheme, with transfer points such as park and ride schemes on the zone boundary. Services should be frequent, fast, comfortable and modern, allowing easy access for the disabled and parents with small children, and possibly with real-time information services and smart ticketing. There should also be provision for delivery of goods to shops and businesses, perhaps using a freight transfer station. Other innovative transport services may help LEZs to function effectively, e.g. a service to deliver goods purchased by shoppers to park and ride sites, a car sharing scheme for local residents, and green commuter plans for local businesses.

- *Traffic management* measures will be needed to minimise impacts just outside the zone. Through traffic should be diverted to suitable alternative routes with clear signage, and traffic calming may be needed on smaller roads near the zone to prevent "short-cuts".

- *Consultation* with local residents and traders is vital right from the design stage of the scheme, to minimise opposition and to tackle any adverse effects on local businesses or reduction of mobility for residents on lower incomes. It would even be possible to run the zone through a board comprising representatives of all stakeholder groups[7].

- *Phasing in* of restrictions may be useful. For example, it may be easiest to target buses and fleets first, and also these often contribute most to pollution. In Westminster (UK), buses and HGVs contributed 59% of particulate and 56% of NO_x emissions, compared to 16% particulate and 24% NO_x from cars and 10-12% from LGVs.

- *Funding.* It is necessary to consider how the costs involved in setting up and running a LEZ can be covered: e.g. from central or local government funds, from fining non-compliant vehicles, from charging vehicles for access, from charging local businesses or transport operators or from looking for voluntary sponsorship. This needs full consideration of socio-economic issues, and the risks of damaging public acceptance of the scheme by imposing further financial penalties on local residents or traders who may already be inconvenienced to some extent by the scheme. It is important to avoid businesses re-locating outside the zone. In the short term it may be necessary to provide subsidies, e.g. for public transport, to encourage use of the zone and help public acceptance.

Green procurement

There are a variety of approaches to green procurement, i.e. the deliberate purchase of cleaner vehicles. These include:

- public procurement mandates: compulsory purchase of cleaner vehicles for Government and local authority fleets;
- voluntary public procurement agreements, e.g. ALTER (see below);
- Quality Contracts and Quality Partnerships between local authorities and public transport operators;
- Green Fleet initiatives aimed at private fleets.

As well as achieving air quality improvements, green procurement can help to overcome "chicken and egg" type barriers, by:

- stimulating the market for cleaner vehicles and encouraging manufacturers to produce a greater range of models;
- helping to bring down prices, thus opening up the market further;
- helping to establish refuelling, service and maintenance infrastructure which can subsequently be used by other users;
- getting more vehicles "on the road" and therefore raising the profile of cleaner vehicles, especially if they are clearly labelled.

Purchasing consortia

If large numbers of users band together to form *purchasing consortia*, the effect can be greatly enhanced. In the early stages, this can encourage manufacturers to seriously consider introducing prototype models of alternative fuelled vehicles into their ranges. With larger scale procurement programmes, genuine economies of scale can be achieved, allowing manufacturers to reduce their costs and prices significantly. This approach was pioneered by the ZEUS project and will be continued by the ALTER initiative (see below).

Public procurement mandates

There are both voluntary and mandatory approaches to encouraging the procurement of greener vehicles. The *mandatory approach* generally requires a certain number of cleaner vehicles to be incorporated into public sector fleets, usually by buying cleaner vehicles as older ones become due for replacement. Mandatory schemes are operating in France (requiring 20% clean vehicles in public fleets), Italy (requiring 50% clean vehicles in public fleets by 2003) and the Netherlands.

The voluntary approach - ALTER

A *voluntary approach* to procurement of cleaner vehicles is underway with the ALTER programme – a major European initiative involving over 150 local authorities (see box).

Example: ZEUS – the power of the purchasing consortium[3]

The ZEUS project was an EC-funded project which ran from 1996 to 2000. Eight European cities formed a consortium to purchase over 1000 zero and low emission vehicles, including buses, trucks, vans and cars. The vehicles included HEVs, electric vehicles, and vehicles running on LPG, CNG, bio-ethanol, RME and biogas.

Key benefits:
The formation of a large consortium gave sufficient purchasing power to negotiate favourable prices with vehicle manufacturers. In one case the price offered was the same as the diesel equivalent. An initial contract for 225 electric vehicles at reduced prices gave the option for third parties to purchase further vehicles at the same price. Some 150 extra vehicles were purchased using this option. Even this comparatively small number of vehicles had an impact on suppliers – it sent a signal that purchasers had a serious long-term interest in the market, and some suppliers were able to permanently reduce their prices as a result.

Follow-on:
Because of the relatively small number of cities involved, the scale of ZEUS was limited. Only one type of technology (electric vehicles) benefited from the purchasing consortium, and the project influenced the manufacturers only at the prototyping stage. However, the lessons learnt from ZEUS are to be applied to the ALTER agreement – a much larger scale exercise which should be able to reap the benefits of volume production.

Example: The ALTER initiative (Alternative Traffic in Towns)[4]

ALTER is a voluntary agreement by 150 European cities and local authorities to increase the demand for clean vehicles by:
- renewing their own vehicle fleets on a low emission basis;
- converting where feasible to cleaner fuels and power systems;
- introducing and progressively extending low emission or clean zones.

In return, ALTER undertakes:
- to organise conferences and workshops for the exchange of experience and progress reports;
- to enable producers to present information on the availability of cleaner vehicles and fuels;
- to organise joint procurement of low emission vehicles through the ALTER Procurement Consortium, building on the experience of ZEUS.

Both voluntary and mandatory public procurement initiatives have the extra benefit of demonstrating government confidence in cleaner vehicles, and "leading by example". This can send a strong signal to private sector buyers, when accompanied by suitable publicity.

Apart from greening their own fleets, local authorities can also influence privately-run public transport fleets in their cities. This can be done through the use of Quality Contracts or Quality Partnerships.

Quality Partnerships are voluntary agreements between local authorities and public transport operators. Operators agree to invest in higher quality services including new, cleaner vehicles and staff training, and in return local authorities agree to invest in traffic management schemes such as bus lanes and improved facilities.

This approach has been used widely in the UK recently, although generally it has been used to encourage the adoption of cleaner diesel buses and easier disabled access (low floor buses) rather than alternative fuelled vehicles. It has been shown to improve patronage by 10-20% and to attract new passengers who previously used cars and taxis.

Quality Contracts allow the inclusion of environmental criteria when issuing contracts for purchasing public service vehicles such as refuse trucks, or franchises granting operating rights to bus companies. For example the authorities in Westminster (London) now include vehicle environmental criteria when asking for tenders for waste disposal services. One aim is that service providers will begin to realise they should include cleaner vehicles as an option or contract variation when they submit tenders to provide vehicles to the local authority.

Local authorities can also encourage companies in their area to adopt Green Fleet or Green Commuter plans.

Green Fleet schemes aim to encourage companies to improve the overall environmental performance of their fleets by offering special accreditation and other incentives. Green Fleet schemes generally focus on issues such as driver behaviour, energy efficiency and reduction of vehicle use, but they could also be used as a tool to promote the use of cleaner vehicles.

Green Commuter plans are run by companies who wish to encourage their employees to commute to work by a more environmentally friendly method, such as walking, cycling, public transport or car-pooling. Companies can achieve benefits by reducing parking provision at workplaces.

Although these schemes are usually run and promoted mainly by national governments, local authorities can offer significant support for companies wishing to participate. For example, bus services could be modified or enhanced to allow easier access to the workplace, self-service electric rental vehicles could be provided at nearby rail stations and cycle or pedestrian routes to the workplace could be provided.

Lobbying for national level support

We have described a number of important initiatives which local authorities can take to introduce cleaner transport alternatives into their cities. However, the success of these measures depends on having a supporting policy framework at national and EU level. It is therefore important to lobby the national government to provide such measures. Examples of possible government action include:

- fuel tax reductions for cleaner fuels (essential for the success of clean vehicle introduction);
- subsidies on cleaner vehicle purchase costs, or vehicle tax reductions;
- direct investment in refuelling infrastructure, and encouragement of fuel suppliers to provide this infrastructure;
- giving powers to local authorities to enforce low emission zones and other measures to favour cleaner vehicles (see box);
- agreeing EU-wide admission criteria for low emission zones, co-ordinated with policy on vehicle emission standards and eco-labelling/rating. (Local authorities may still need the power to select the requirement appropriate to local concerns, from a national or EU-wide set of options.)
- setting standards for a common protocol to allow interoperability between different telematics systems for vehicle identification, for use in road pricing and low emission zone schemes[7];
- removing any requirements on local authorities to buy the cheapest vehicles, and giving more power to them to make purchase decisions based on environmental criteria (see box);
- eco-labelling and information/awareness campaigns.

These are discussed further in Section 4.

Example: Empowering local authorities to buy greener vehicles

The use of Quality Contracts may require reforms to existing legislation on public procurement, which often requires local authorities to accept the cheapest tender regardless of environmental quality.

In the past there have been cases where the inclusion of environmental criteria has been challenged on the grounds that it conflicts with national or EU legislation on public procurement. Although the latest draft legislation indicates that environmental criteria will now be considered acceptable, it is important to clarify that this will indeed be the case and to ensure that any barriers and loopholes are removed.

National governments should remove any national legislative constraints on Quality Contracts. For example, in the UK the Government has changed legislation so that local authorities now seek “best value” rather than “least cost” when procuring external services.

Example: Empowering local authorities to set up low emission zones

Often changes in national legislation will be required to enable local authorities to implement and enforce low emission zones. For example, in Sweden a change in the law will be required to enable the extension of traffic bans from heavy goods vehicles to cars.

Many countries will have to pass new laws to allow local traffic wardens to collect fines for unauthorised vehicles entering low emission zones. For example, recent changes in the UK allow local authorities to charge for the use of roads and provision of workplace parking, and use the revenue for local infrastructure projects. However, further changes are needed to allow local traffic officers to enforce low emission zones without police involvement.

The case of Italy

Many recent bus innovations have taken place in Italian cities (e.g. electric minibuses in Florence, hybrid midi-buses in Bologna). A contributing factor to this achievement is the role of the government in empowering city authorities to restrict vehicle access to central city areas when air quality is expected to be poor. Following this legislation, both Florence and Bologna introduced restricted access zones, and other Italian cities are following suit (e.g. Rome and Napoli). National legislation has also been introduced regarding standards for enforcement equipment (i.e. the way that number plates are captured and handled as digital images).

These measures are complementary to national initiatives to reduce vehicle emissions through labelling, emissions and fuels standards, and a green procurement mandate for public fleets. National legislation also allows local authorities to adopt criteria relating to exemptions, such as those for local residents. The exemptions have not so far been made according to vehicle emissions, but on-line tail-pipe emission measurement technology could be used to restrict the access of residents' vehicles that cause high levels of pollution.

Section 3. Guidelines for demonstration projects

3.1 What do the Guidelines cover?

What is the purpose of the Guidelines?

In the Guidelines, a "project" is a pilot or demonstration project with cleaner road vehicles.

The Guidelines ("Demonstrating Cleaner Vehicles: Guidelines for Success", available from http://utopia.jrc.it/) provide advice on how to set up and run pilot and demonstration projects with cleaner vehicles in cities. The goal is to help decision-makers and project teams design and run projects in the most efficient and effective way possible, avoiding likely problems and managing potential risks.

The Guidelines were prepared following in-depth discussions at a number of demonstration project sites across Europe, and also draw on the experiences of consortium members.

When should the Guidelines be used?

The Guidelines support the various stages of decision making over the lifecycle of a project, from proposing an initiative through to evaluating the results and the options for follow-up work.

Consult the Guidelines when each new stage of the project lifecycle is to be tackled.

They are designed to be used as a reference manual or "recipe book", for consultation when each new stage of the lifecycle is to be tackled. As such, they provide a *coherent* but stylised set of good practice steps. Inevitably though, for hands-on application, the steps have to be tailored to every situation – the Guidelines are not a prescriptive model to be followed precisely. Therefore each user must select the relevant elements in the most appropriate order.

Who should use the Guidelines?

The Guidelines are aimed primarily at people who develop local pilot and demonstration projects. These include:

- project champions who initiate and facilitate such schemes;
- the project managers and experts who design, run and monitor the project implementation;
- host organisations, partners and sponsors, such as fleet operators and transport authorities.

The project in question can be a pilot project for a larger-scale demonstration or commercial application of an innovative transport technology or service. Alternatively it may be a demonstration project aimed at market testing or learning about user responses.

Why are the Guidelines needed?

The Guidelines are needed to get a better take-up of good practice in demonstration projects with cleaner vehicles. This will improve cost-effectiveness in the use of public funds, and increase the prospects for successful market introduction of such vehicles. It will also help future projects to avoid common problems encountered previously, such as:

- a failure to measure key indicators that would show whether or not the project's objectives have been reached;
- a lack of consistency between evaluation strategies in different cities, limiting the scope for cross-city learning within a national or European programme;
- resistance from local stakeholders who have not been involved at the planning stage.

Comprehensive guidance has not previously been compiled on the practical issues facing vehicle projects throughout the lifecycle stages. In addition, over the last few years, significant new experiences have been gained through large-scale multi-city demonstration projects at national and European levels. The focus has moved away from pilot testing of vehicle technologies, towards demonstration projects aimed at opening up the market for clean vehicles and embedding new technologies within the urban transport system.

Therefore the Guidelines pulls together good practice recommendations and examples of learning from recent projects across Europe. Also, since many projects draw on funding from national and European programmes, the Guidelines highlight ways of meeting the expectations and objectives of the different funding levels.

The Guidelines are based on a wide variety of European project experiences.

How do these Guidelines relate to existing standards and codes of practice?

A number of standards exist for quality assurance, project management and environmental management that may affect a pilot or demonstration project. The most commonly observed is ISO9000, used by many organisations to define basic procedures to ensure that work is done according to plan or design. The Guidelines are designed to be consistent with existing standards, and draw attention to key aspects of risk management where appropriate.

The Guidelines are complementary to *generic* standards and good practice for project management.

The external standards provide the *generic* context and process for conducting a project, while the Guidelines provide particular detail of topics to consider and possible actions. For example, the Guidelines highlight the need to design the evaluation process in such a way that the potential for scaling up the project, or transferring its results to another context, can be assessed at the end. ISO9000 specifies how such calculations should be recorded and checked.

Does good practice for the management of pilot and demonstration projects differ from that for other projects?

From industry experience and those involved in project management, the consensus is 'No'. Most guidance on project management splits a project's lifecycle into stages, one of which is the pilot or demonstration phase. The same principles of project management apply throughout the project lifecycle.

3.2 How should the Guidelines be used?

Four main life-cycle stages:
- decide on a project;
- set it up;
- conduct and evaluate the work;
- decide on exploitation.

How are the Guidelines structured?

The Guidelines are split into main Sections according to broad lifecycle stages: deciding on a project, setting it up, conducting and evaluating the work, and making decisions on the exploitation of the results. Each stage includes an element of evaluation.

Within each Section, the important topics are identified and guidance provided on how to tackle them. Examples are given of how certain issues have been handled in the past and how they can be critical to the success of the project. These examples draw on recent projects across the European Union.

How adaptable are the Guidelines?

The Guidelines present the lifecycle stages in a linear form for ease of finding information.

We do not expect *real-life* projects to follow this linear model of the process. Rather, there will be overlap and iteration between the various stages, and some of the steps may need to be merged or taken in a different order. It is essential to treat these Guidelines as advisory and not prescriptive.

For example, project learning and planning for exploitation will generally start during the technical implementation, and not just at the end when the final results are available.

We also recognise that projects arise in a variety of ways. Some are driven top-down by policy needs. However, many arise in a bottom-up way, where an entrepreneur spots an opportunity to use a new technology in a particular place. The Guidelines aim to accommodate this variety, but cannot hope to provide a step-by-step action list for every situation.

Even for projects that are not driven by policy, a mapping onto policy objectives can help public relations.

For completeness, we have chosen to base the Guidelines on the full sequence of steps for identifying projects from transport problems and policy objectives. Some of these initial steps may appear superfluous to a bottom-up project, which usually starts with the definition of project objectives. Nevertheless, it is often advisable for such projects to map back onto local transport issues in order to justify the innovations to users, sponsors and regulatory authorities.

So the user is invited to use the summary of good practice at the start of the Guidelines (and reproduced in Section 3.3) to identify those elements of the Guidelines that seem relevant to their situation. Subsequently, the user can consult the main Sections of the Guidelines for further detail at each lifecycle stage, as listed in Table 3.1. As a guide, Table 3.2 summarises key actions through the project life cycle.

Table 3.1 Lifecycle stages of a demonstration project

Table 3.1 identifies where to find further information in the Guidelines.

Lifecycle stage	Steps involved	Relevant Sections of the Guidelines
Decide on a project	Involve stakeholders	2.1
	Define the problems to be addressed	2.2 Step 1
	Assess alternative transport solutions	2.2 Step 2
	Identify whether a pilot or demonstration project is needed	2.2 Step 3
	Define the project objectives	2.2 Step 4
	Assess the project options	2.2 Step 5
	Define the preliminary design and assess user needs	2.2 Step 6
	Make an initial evaluation of the proposed project	2.2 Step 7
	Refine the proposal	2.2 Step 8
	Make a go/no-go decision	2.2 Step 9
Set up the project	Define and assess the detailed design	3.1
	Select/confirm the site	3.2
	Design the data collection and evaluation	3.3
Conduct and evaluate the project	Manage the project	4.1
	Measure and evaluate the results	4.2
Exploit the project results	Learn from the project	5.1
	Identify implications for other cities	5.2

Table 3.2 summarises key actions through the project life cycle.

Table 3.2 Lifecycle stages of a demonstration project

Lifecycle stage	Management actions	Technical operations	Project evaluation	Exploitation actions
Define problems	Involve stakeholders			
Assess transport solutions	Involve stakeholders			Assess full-scale solutions
Choose to pilot	Assess value of pilot-scale application			Select a promising solution
Define project objectives	Secure stakeholder commitment		Identify critical results to be proven	Define exploitation strategy
Assess project options	Initial risk assessment		Select appropriate technologies	
Define preliminary design	Relate to user needs		Define evaluation strategy	
Initial evaluation	Detailed risk assessment		Review design, evaluation plan and likely outcome	Review exploitation strategy
Refine proposal	Review objectives			
Go/no-go decision	*Funding adequate?*	*Viable project?*	*Credible expectations?*	*Credible exploitation?*
Define/assess project design	Involve stakeholders and project team, assess risks	Make contingency plans, collect baseline data	Evaluate detailed design and baseline results	Develop exploitation plans and marketing strategy
Select/confirm site	Relate to aims of sponsors			
Design data collection and evaluation	Identify critical indicators		Design data collection and evaluation plan	Confirm critical indicators
Manage the project	Monitor and communicate	Implement and fine-tune		Control dissemination
Measure and evaluate	Assess uncertainties	Collect results' data	Evaluate continuously	Continuously feed into exploitation
Draw lessons	Involve stakeholders	Conduct post-project review	Identify key results *and* broader learning	Assess risks of full-scale exploitation
Transfer results	Disseminate findings		Identify site-independent aspects	Control dissemination

3.3 Summary of good practice

What are the key actions at each stage of the project lifecycle?

This Summary brings together the good practice recommendations highlighted in the Guidelines, as a checklist.

Deciding on a project

Involve stakeholders

- Involve stakeholders in the project from the very beginning.
- Invite a range of stakeholders to take part, whether as project partners or in a more advisory role.
- Approach stakeholders individually, starting with the one that would impact the most on getting others to join.
- Establish a formal collaboration agreement, defining stakeholder responsibilities.
- Set up a forum where stakeholders can discuss their ambitions and roles.
- Have a continuing dialogue to review objectives, progress, results and exploitation strategy.
- Aim to secure financial and other resource inputs from stakeholders that will encourage them into an active participation.
- Where national or European funding is requested, identify how the local project must reflect higher-level policy objectives and evaluation requirements.
- Involve stakeholders in project publicity, but avoid premature and over-optimistic launch publicity.
- Disseminate project news to politicians and the public.

Define the problems to be addressed

- Put down on paper a first statement of the obvious local concerns to be addressed.
- Think more widely about the policy context and the objectives of potential funding programmes.
- Consider the perspectives of the range of potential stakeholders and transport users.
- Draft a problem definition and obtain stakeholder feedback.
- Develop an agreed statement of the problems and their relative importance (before starting to define solutions).

Identify alternative transport solutions

- Identify viable alternative strategies that address the problems of concern.
- Collect information on the various alternatives from a variety of sources (experts, Internet, experiences elsewhere).
- Estimate the relative cost-effectiveness of alternative strategies in tackling the specific problems within the local city context. This may include modelling the effects on emissions and air quality.
- Relate the strategies to the needs of the transport users.
- Assess ways of funding the various alternatives.

- Make an inventory of the barriers to realisation of the various strategies, including social, technical and economic barriers.
- Identify influencing factors such as acceptance by the various stakeholder groups (fleet operators, other road users, general public, shopkeepers, policy-makers etc.).
- Assess whether a transport solution involving cleaner or alternative-fuelled vehicles has the potential to make a significant contribution in overcoming the stated problems.
- Record the main uncertainties concerning the performance of the cleaner vehicle option(s) and any associated policy measures.
- For the cleaner vehicle option(s), identify the route to achieve a sustainable outcome (e.g. as part of a commercially viable transport service) within an acceptable time frame.
- Discuss the various options and major dilemmas with relevant stakeholders.
- Choose the option(s) to pursue, for example using a multi-criteria analysis.

From this stage onwards, the Guidelines assume that a solution involving cleaner vehicles has been selected.

Identify whether a pilot or demonstration project is needed

- Assess whether the chosen solution could be sustainable in the longer-term (e.g. in the absence of temporary Government grants and tax subsidies).
- Assess whether the chosen solution is likely to be the most cost-effective option in delivering the targeted benefits such as emissions reductions.
- Assess whether uncertainty over the implications of full-scale implementation necessitates carrying out a small-scale trial.
- Determine how a pilot project would lead to further implementation opportunities.

A project that results from someone spotting an opportunity to use a new technology in a particular place may start at the next step. However, identifying the problem definition and policy drivers retrospectively can help to justify the project and any public funding.

Define the project objectives

- Define and disseminate a statement of objectives that (a) is short and easy for everyone to understand, and (b) specifically addresses the problems to be tackled.
- Involve stakeholders (including end users) in setting objectives.
- Relate the objectives to the exploitation strategy for implementation opportunities after the pilot phase.
- Ensure that the objectives are suitable for direct investigation and evaluation, if necessary by modifying or dropping objectives.
- Review and be prepared to modify objectives during the course of the project.

Assess the project options

- Review the alternative vehicle technologies and related transport concepts, and see which provide the best match with the project objectives.
- Assess the local conditions that may require specific actions to be taken, such as the introduction of new policy measures.
- Talk to the funding agencies.
- Make a first assessment of risks inherent in the project.
- Check that the scale and scope of the project should be sufficient to allow key outcomes such as modal shift to be measured.

Define the preliminary design and assess user needs

- Systematically cover all the design aspects needed for the functional specification of the project.
- Discuss this preliminary design with the stakeholders and funding agencies.
- Assess user needs for the transport solution and user acceptance of changes in behaviour. Distinguish various types of user, including leading edge versus average users where appropriate. Determine whether leading edge users should be targeted.
- Be clear to what extent user needs should shape the project or to what extent the objective is to change and measure user behaviour. Set up channels for ongoing user feedback to the project.

Make an initial evaluation of the proposed project

- Estimate whether the design and the planned measurements will allow the project to demonstrate unambiguously whether or not the objectives have been reached.
- Check whether the strategy for exploiting the project results looks realistic.
- Systematically assess the project feasibility and all the risk factors, including its environmental acceptability.

Refine the proposal

- Assess potential discrepancies between the project design, the project objectives and the user needs.
- If needed, adjust the objectives and/or design and repeat the evaluation.

Make a go/no-go decision

- Check the proposal against the main decision criteria at the local level.
- Assess the proposal against the decision criteria that will be applied by funding agencies, such as national and European programmes.

Setting up the project

Define and assess the detailed design

- Define the financial, legal, political and time constraints at the start of the design process.
- Ensure that the design covers *all* the technical and non-technical aspects of the project that need planning.
- Check that the design (including the data collection plan) is able to achieve the project objectives.
- Check that the design satisfies the requirements of stakeholders and end-users.
- Allow at least one year for testing vehicle technologies, and allow at least two years to demonstrate new mobility solutions that require a change in user behaviour.
- Allow plenty of time for training and adapting to new vehicles.
- Allow adequate time and budget for post-project review and final reporting.
- Where inter-site comparison is intended, avoid too many differences between sites.
- Consider co-ordinated procurement of vehicles, combining orders across several projects/cities, particularly for less-developed technologies.
- Develop a marketing strategy, aimed at all stakeholder groups including end-users and vehicle operators.
- Analyse risks and develop a risk management plan, particularly for common problems such as late delivery of vehicles.
- Assess the detailed design, estimate the expected impacts of the project and take an explicit go/no-go decision.

Select/confirm the site

- Define criteria that will test the ability of the site to meet project objectives and the interests of stakeholders.
- Include feasibility criteria based on the project risk analysis.
- Check the site proposal against criteria defined by national and European funding agencies, where appropriate.
- Minimise bias in the site selection procedure by making the procedure open and objective.

Design the data collection and evaluation

- Develop the evaluation strategy as an integral part of the project design from the start.
- Check that the evaluation will deliver the *essential* measurements and indicators to prove whether or not the project objectives have been achieved, particularly where budget constraints on the evaluation effort are tight.
- Check what data collection will be needed at the start of the project *before* the new transport solution is piloted.
- Check what is needed to facilitate cross-city comparison (especially where this is a requirement of funding agencies).
- Define an adequate range of impacts and indicators to address the range of stakeholder interests.
- Within cost limits, collect experiences from those involved in the project, as well as measuring quantitative indicators. Review the data while the project is running.
- Note the collected good practice for vehicle energy and emissions measurements given earlier in these Guidelines.
- Use multi-criteria analysis for the overall project evaluation with stakeholder participation. Supplement this with cost-benefit analysis for economic evaluation and cost-effectiveness analysis for screening options for the project design.

Conducting and evaluating a project

Manage the project

- Define specific milestones for progress monitoring.
- Keep the management structure simple and light, with well-defined responsibilities, so that the managers can adapt quickly to unforeseen situations.
- Evaluate the results progressively as the project develops, so that decisions on follow-on actions can be taken during the course of the project.
- Monitor and solve technical problems efficiently, especially in the early stages of project implementation.
- Create a strategy for managing the information gathered in the project, to allow easy exchange within the project team but controlled release of overall project findings to a wider audience.
- Communicate and disseminate information according to a defined marketing strategy.

Measure and evaluate the results

- Be prepared to change the data collection procedures during the project.
- Always focus on matching the evaluation outputs to the project objectives, and identify the benefits per stakeholder group where possible.
- Ensure that the same impacts are determined using consistent methods at different test sites.
- Record the factors specific to the city and the operating context that have an influence on the results.
- Compare ex-post results with equivalent ex-ante estimates, and investigate the reasons for significant differences.
- Identify the differences in outcomes “with” and “without” the project.
- Identify and assess the uncertainty present in the measured results from the project.
- Develop interim/preliminary results that are useful for decision-making on exploitation and follow-on.
- Identify and assess the risk and uncertainty associated with the transfer of conclusions into recommendations regarding the wider application of the transport solution following the project.

Exploiting project results

Learn from the project

- The project team and stakeholders should conduct a post-project review.
- The outcome of the review should include a clear statement of the risk and uncertainty present in the results and conclusions from the project.
- The review should aim to cover broader areas of learning as well as evaluating the success of the project in attaining specific objectives. For example, changes in stakeholder expectations of the demonstrated technology/solution should be explored.

Identify implications for other cities

- Produce transferable information by documenting the details of the project implementation and the city context as well as the actual results.
- Prepare a report that is explicitly targeted on wider dissemination, in consultation with stakeholders.
- Highlight the learning on issues of wider interest, such as barriers to new transport solutions, policy actions, user acceptance and stakeholder expectations.
- Disseminate the project findings widely using a variety of media.

Critical success factors from previous projects

Post-project reviews of city initiatives around Europe have highlighted a number of aspects within the overall project life cycle as having been highly influential on success:

Define clear objectives.

- *Clear objectives*, which are agreed by the project stakeholders and kept under review.
- *Thorough assessment of the most suitable technology* for the transport application in question, according to the local city context and objectives.
- *Identification of user needs* and their willingness to change behaviour with respect to any new transport service.
- *The use of proven technologies*, except in projects targeted on technology development and testing (where commitment from a local manufacturer seems highly desirable).

Test the technical operations first.

- *Allowing a period for resolving technical problems* and fine-tuning vehicle operations before starting the measurement and evaluation of user responses to a new transport service.
- *Adequate financing and project design*, so that the scale and duration of the project provides a clear demonstration of the advantages and viability of the new technology and transport concept to all concerned.
- *Talking with those who provide the funds*, both early on in the inception stage and throughout the project.
- *Setting up a simple yet effective management structure* for the project, with a clear and skilful leader.

Match the data collection to the needs implied by the objectives.

- *Matching the measurement and evaluation strategy* to the needs of the project, so that unambiguous evidence can be provided concerning the achievement of each of the project objectives.
- *Communicating the vision, plans, results and successes* to users, politicians and the public at a local level. This includes providing milestones that attract political and public interest.
- *Contingency planning* for changes in external conditions and technical risks (particularly problems with vehicles). This is based on active risk management.
- *Defining the exploitation strategy or business plan*, during the project inception, for the transition from the demonstration phase to the follow-on "market" phase. This includes actions to encourage any necessary policy changes.
- *Building strong political support*, and linking the project with the transport strategy for the city.

Involve the right people.

- *Good project partner networking*. A stable and committed network is needed which is complete in terms of the resources necessary for the project (vehicle supply, vehicle operation, fuel supply, policy support, technology expertise, project management and funding agencies). Close co-operation assists the smooth running of the project. Win-win benefits aid motivation of stakeholders.

Section 4.
National and EU policies

National and European perspective

Market potential

Good practice in programme design

Important supporting policies

4.1 National and European perspective

Go to http://utopia.jrc.it/ to download the publication on “Promoting Cleaner Vehicles”.

Cleaner vehicles and alternative fuels can help to achieve Europe's goals for air quality, carbon savings and security of energy supply. However, there are many barriers to the introduction of these new technologies, such as high capital and lifetime costs and a lack of refuelling infrastructure.

Certain niche applications such as public sector fleets can provide a way of lowering some of the barriers, and demonstration projects are important in developing market acceptance. National governments and the European Community have a vital role to play, both in funding projects and in establishing a strong framework of supporting policies.

In *Section 4.2*, we look at the potential market penetration and environmental benefits of cleaner vehicles from a European perspective.

Section 4.3 then considers good practice in designing *programmes* of pilot and demonstration projects.

Finally, *Section 4.4* looks at key supporting policies, again from a national/European perspective, complementing the city perspective presented in Section 2.

4.2 Market potential

Within the UTOPIA project we have estimated the possible future market shares of the five promising applications for cleaner vehicles identified in Section 2:

- buses;
- heavy goods vehicles and vans;
- fleet cars;
- rental cars (including new concepts such as car sharing and self-hire);
- innovative two wheelers.

Two scenarios were examined: *"business as usual",* with medium economic growth but little promotion of sustainable technologies, and a *"best case"* with high economic growth coupled with strong support for sustainable technologies. Changes in demand and market share up to 2010 were assessed. The main conclusions are:

- *Overall transport demand:* Under the best case scenario, demand for passenger transport decreases due to the uptake of new concepts such as teleworking and teleshopping. However, demand for freight transport increases due to economic growth and provision of services such as teleshopping.
- *Buses:* Demand for bus transport will decrease slightly under a business as usual scenario, but could almost double by 2010 under a best case scenario, to supply 10% of urban transport demand.
- *Heavy goods vehicles and vans:* Demand for freight transport increases under both scenarios, but more under the best case scenario due mainly to higher economic growth.
- *Fleet cars:* The demand for fleet cars is unlikely to increase significantly over the next 10 years. The availability of new communications technologies will decrease the need for business travel.
- *Rental cars:* Demand for rental cars could increase under a best case scenario, although the overall market share is expected to remain relatively low at less than 2% of total urban transport.
- *Innovative two wheelers:* Market share will decrease under a business as usual scenario but could double under a best case scenario, to supply 5% of urban transport demand.

Modelling the take-up of cleaner vehicles

Possible developments in the European transport system and the take-up of cleaner vehicles have also been studied in the UTOPIA project using the *transport-environment model* STEEDS.

Here we summarise a 'base case' projection to the year 2020, the effects of policy variations, and the consequences for energy use and environmental impacts across the EU.

It is important to note that the results are not *forecasts* of future developments – rather they are simulations of the effects of "what-if" scenarios. Thus the absolute values of e.g. the market shares of new vehicle technologies are uncertain (and rather optimistic in the scenarios illustrated here). However, the value of the analysis lies in the comparison of the *relative effects of different policy actions*.

The 'base case' scenario reflects EU transport policy applied to date and committed, and also adopts similar socio-economic assumptions to those that underlie the various national road traffic forecasts.

Key results of the 'base case' scenario

- The demand for passenger travel continues to rise, in particular for air transport and car use. There are also sharp increases for road and air freight.
- Road transport demand in terms of vehicle-km increases by about 33% in 2010 and 53% in 2020 (when compared to 1995).
- The modelled market shares of alternative fuelled road vehicles by fuel type for the EU15 are illustrated in *Figure 4.1*. *Figure 4.2* shows the results for cars by engine class.
- Alternative fuelled vehicles achieve a market share of about 14% of all road vehicles in 2010 and 23% in 2020, with higher percentages of new vehicle sales. (These figures depend strongly on assumed changes in the *relative prices* of vehicle technologies and in *consumer acceptance*. Recent market trends suggest that the modelling scenario used here is overly optimistic towards new fuels.)

Note: Certain technologies such as petrol hybrids and bio-gas were not modelled. Their absence from the charts does not indicate zero market share.

Figure 4.1 Modelled road vehicle stock in the EU15, by fuel type

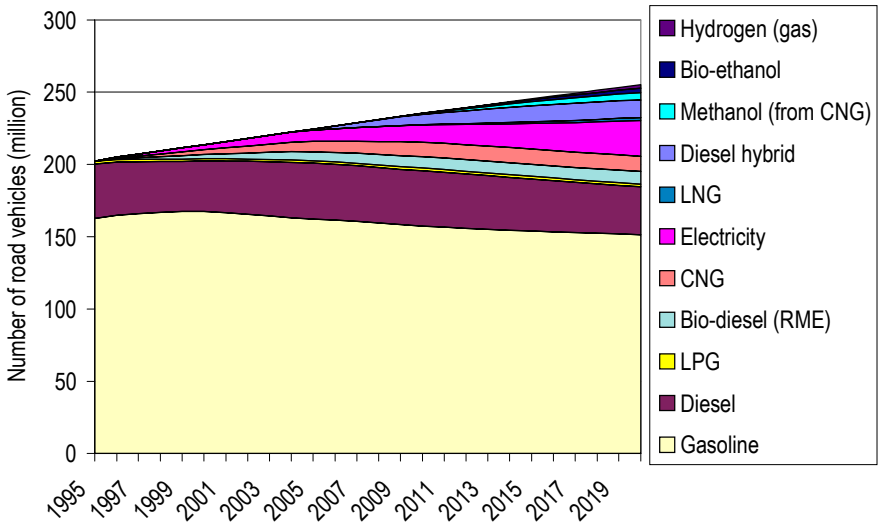
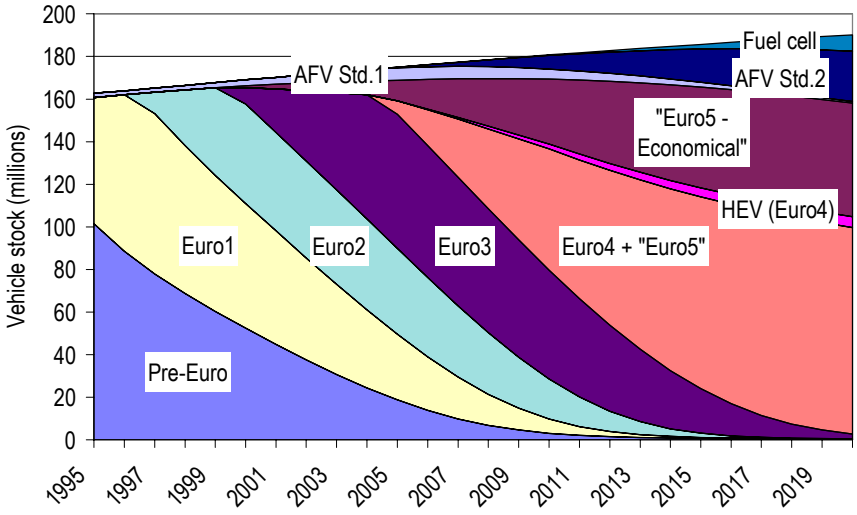


Figure 4.2 Modelled car stock of the EU15, by engine class



1) Alternative Fuelled Vehicle (AFV) Standard (Std.) 1 and AFV Std.2 are two consecutive, fictitious emissions standards for alternative fuelled vehicles.

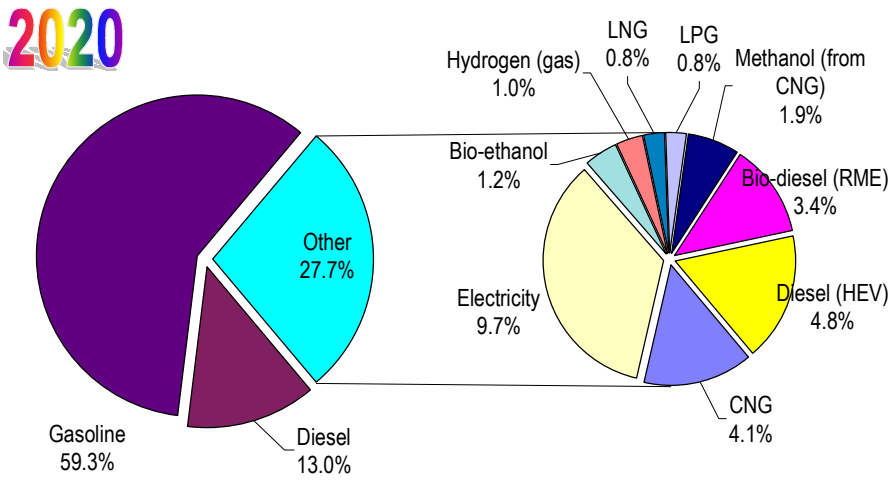
2) "Euro5 - Economical" represents economical and clean improvements to Euro4 vehicles.

3) HEV (Euro4) are hybrid electric vehicles based on Euro4 diesel engines.

4) Fuel cell vehicles are gasoline and methanol reformer as well as gaseous hydrogen vehicles.

- The modelling suggests that electricity, bio-diesel and CNG are the most likely short to medium-term alternatives to gasoline and diesel for road vehicles.
- In the longer term, the simulation shows that hybrid electric vehicles with Euro4 diesel engines and fuel cell vehicles running on gasoline, methanol and gaseous hydrogen claim a significant market share (see *Figure 4.3*).

Figure 4.3 Modelled market share of road vehicles in 2020



Policy options

The policy options chosen for this analysis include technology incentive schemes and area restrictions. These are summarised in *Table 4.1*. These are *hypothetical* policies, chosen to illustrate the scale of the effects of different options.

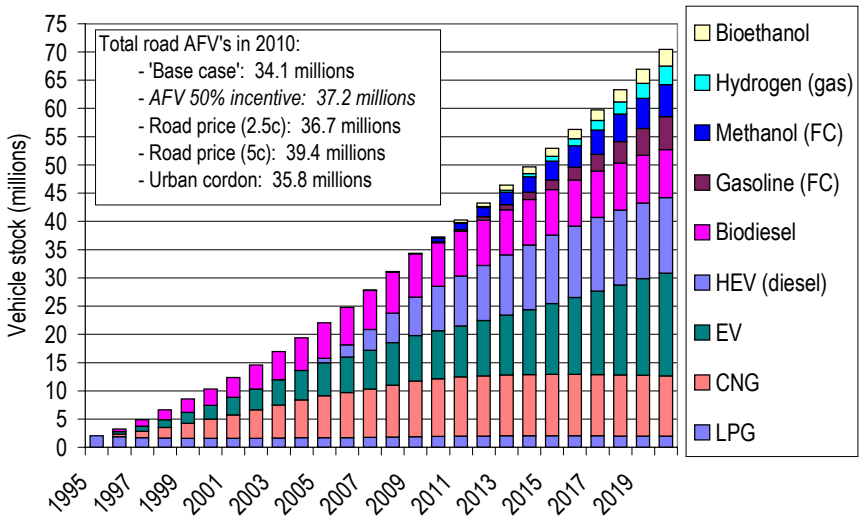
Table 4.1 The policy options chosen for analysis

Policy name	Policy variables: assumptions different from the 'base case'	Ref.
Alternative fuelled vehicle (AFV) incentives	Subsidies of 50% of the marginal cost premium over the conventional vehicle from 1998 onwards, for buses, trucks and cars.	AFV incentive (50%)
Low emission zones (urban area restrictions)	All urban driving affected, banning pre-EURO cars, buses and trucks from 2002, EURO1 vehicles from 2005, and EURO2 vehicles from 2010.	Low E. Zones
Road pricing (two options)	Road-user charges from 2002 for cars only, broadly differentiated according to environmental performance. For gasoline and diesel, either 5 or 2.5 Euro-cents (c) per vkm. For LPG, CNG, bio-diesel, bio-ethanol and methanol, 2.5 or 1.25 c per vkm; No charge for EVs and FCVs.	Road price (2.5c) Road price (5.0c)
Urban cordon charge	Flat rate increase in costs for motorists wanting to drive their vehicle in a city, charged annually from 2002. Set to 600 Euro per year for urban car driving, and 1,000 Euro for urban bus/truck driving, *except* for EVs, HEVs and FCVs.	Urban cordon
Retrofit exhaust treatment to pre-Euro vehicles	Retrofit scheme in 2002 for *all* pre-Euro gasoline cars (fitted with a catalyst), and pre-Euro diesel buses and trucks (to be fitted with a particulate trap).	Retrofit

The following paragraphs and Figures show the key results of the comparison between the 'base case' and these policy options.

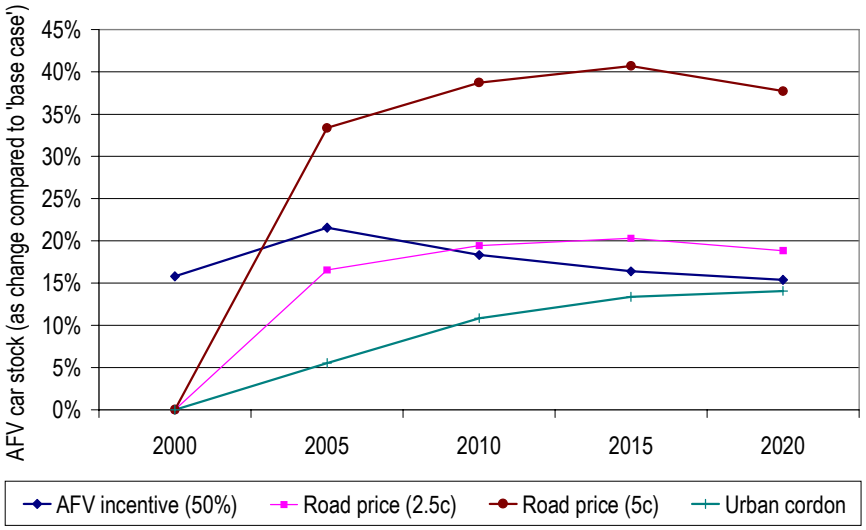
- *Transport demand*. The AFV incentive option slightly increases road transport demand (0.1% in 2010) whereas the road pricing measures have the most significant effect on demand, reducing it by 1.5% to 2.5%.
- *Total stock of alternative fuelled road vehicles*. The uptake of alternative fuelled road vehicles changes moderately between policy options. *Figure 4.4* illustrates the outcome for the AFV incentive scheme, with an indication of AFV uptake across the policy options in the boxed text. The retrofit and low-emission zone schemes have no impact on the uptake of AFVs because the LEZ scheme modelled here only excludes the older EURO standard vehicles from urban areas.

Figure 4.4 Modelled road AFV stock for the AFV incentive scheme, by alternative fuel type



- *Alternative fuelled cars*. The biggest effect on the uptake of AFVs is seen for cars. The *relative* effects of selected policy options are shown in *Figure 4.5*, giving the % change in AFV uptake in a given year when compared to the 'base case' simulation. The road-pricing scheme with the higher charge per vkm appears to be the most powerful option to increase the number of AFV cars bought in the EU15. Compared to the 'base case', this option predicts a 41% higher AFV uptake in 2015. In particular EV, HEV and FCV fare well, in line with the design of the road pricing schemes to charge motorists according to the local air pollution they cause.

Figure 4.5 ***Relative change*** **in total number of alternative fuelled cars when comparing selected policy options to the 'base case'**



- *Alternative fuelled buses and trucks*. The effect is smaller for buses and trucks – an increase in uptake of 1-5% for the AFV incentive and urban cordon charge schemes after 2010. The uptake of EV, HEV and FCV buses and trucks is modelled to be higher (10-20%) for both road pricing schemes, in line with their goal of advancing the take-up of clean urban vehicle technologies.

Environmental benefits

Emissions – base case

The base case results show that, even without applying any policy measures, direct (tailpipe) emissions of key pollutants associated with local and regional air quality (CO, NO_X, PM_{10}, benzene) are expected to decrease considerably over the next 20 years (see *Figure 4.6*). At the same time, total road vehicle-km are expected to increase by about 50% by 2020. However, carbon dioxide emissions are set to increase. *Total* life-cycle emissions increase faster than *direct* (tailpipe) emissions due to increased use of alternative and cleaner conventional fuels, which produce a greater proportion of their total CO_2 emissions during fuel production. *Figure 4.7* emphasises that trucks are responsible for most of the PM10 emissions in urban areas, yet these decrease significantly after 2005.

Figure 4.6 Emissions from road transport in the EU15, for the 'base case'

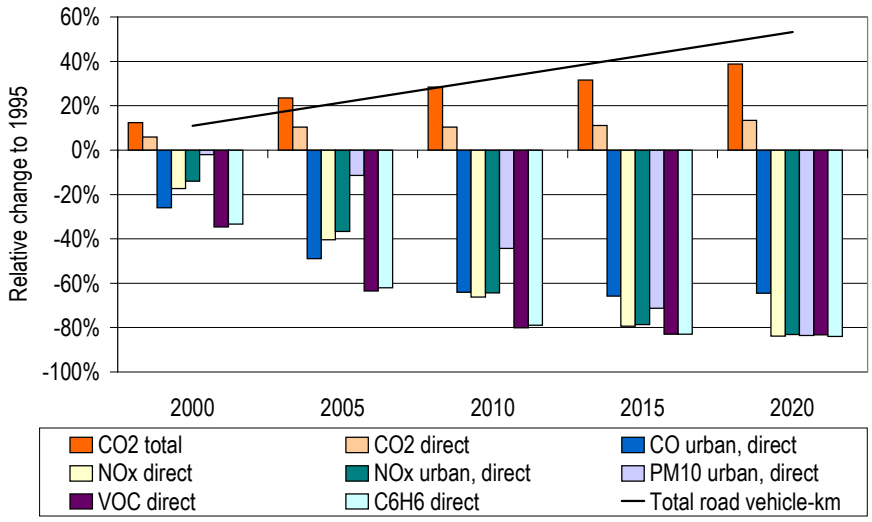
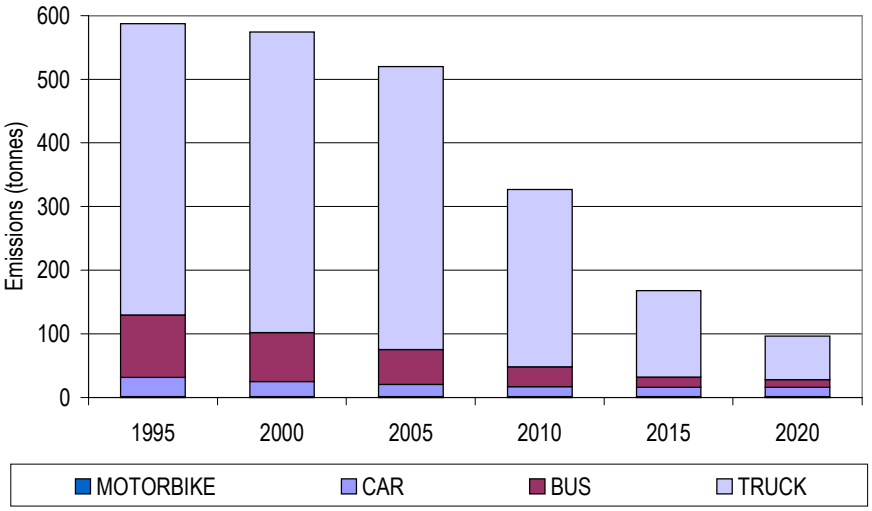


Figure 4.7 Modelled urban PM_{10} (tailpipe) emissions for the EU15, for the 'base case'



Emissions – policy comparison

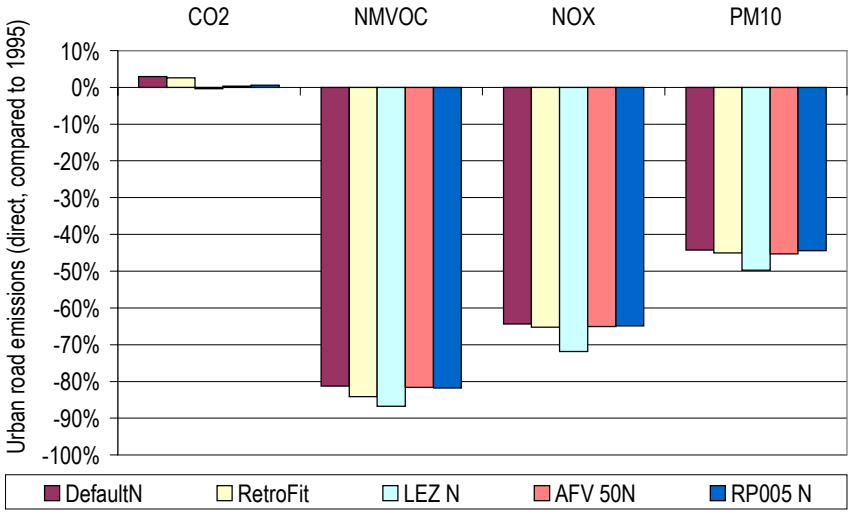
The effects of alternative policies on urban road emissions are shown in *Figure 4.8*. The CO_2 emissions are affected by differences in transport demand. The Figure shows relatively little difference between the different policy options and the base case. In other words, limited changes in the AFV population yield only limited environmental benefits compared to the large improvements gained through emissions standards for conventional vehicles/fuels.

In the short term (2005), the best options to reduce local, regional and global emissions are the introduction of Low Emission Zones in Europe's cities and the retrofit of pre-Euro vehicles with clean exhaust technologies. In the long term (2010-2020), however, the policy simulations show no big changes of emissions when compared

to the 'base case'. This is because the low emission zone option (as modelled) does not introduce any new entry criteria after 2010, so that incoming EURO standards gradually "catch up" with the LEZ entry criteria. Similarly the retrofit option only affects vehicles that will soon be scrapped.

The most notable long-term improvements to urban road emissions result from introducing urban cordon charges and granting subsidies for alternative fuelled vehicles. The emission reductions are, however, less than 3% for most pollutants when compared to the 'base case' simulation.

Figure 4.8 Policy comparison of direct urban road emissions in 2010 when compared to 1995



So why bother with alternative fuels?

This analysis may appear at first glance to show that policies to promote alternative fuels have little impact on the environment. However, caution should be taken when interpreting the modelling results, for the following reasons:

- The policy options modelled here are not radical. For example, a stricter low-emission zone policy (e.g. excluding all but electric and fuel cell vehicles from city centres, or with entry criteria that get more stringent over time) would show a greater impact.
- Urban transport policies cannot be easily modelled on an aggregated European scale. For example, STEEDS calculates the environmental benefits averaged over all urban driving and does not highlight the greater benefits that could be achieved in air quality "hotspots" in city centres. (This requires complementary fine-scale modelling in individual cities.)
- Despite the dramatic improvement in gasoline and diesel vehicle emissions in recent years, urban air quality continues to be a severe problem in many cities. Alternative fuel vehicles and geographically localised policy measures have a valuable role to play in reducing local "hot spot" pollution.
- Alternative fuel vehicles have other benefits, including reduced noise for urban deliveries and municipal services.

- Alternative fuel vehicles can act as a stepping stone to long term sustainable transport based on renewable energy. Renewable fuels reduce the environmental impacts of oil and gas extraction and refining, reduce greenhouse gas emissions and improve security of supply.

Environmental impacts of total emissions

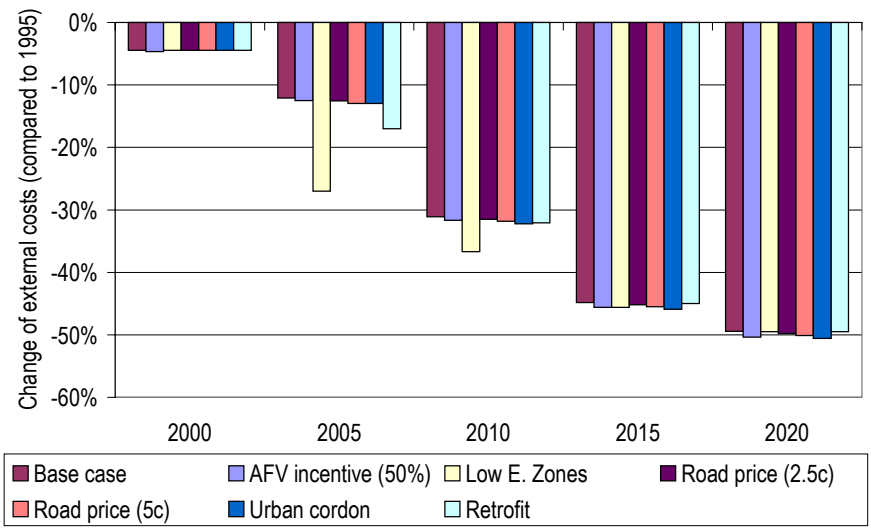
Taking into account direct (tailpipe) and indirect (fuel and vehicle life cycle) emissions, various impact indicators can be calculated.

The biggest environmental benefits in the short term occur for the Low Emission Zone and the Retrofit schemes, in line with the modelled decreases of key road transport emissions (see above). In 2005, for example, air quality impacts on humans (measured by the indicator *Human Toxicological Classification (Air)*) by road transport emissions are down by 63% and 53% for the Low Emission Zone and Retrofit schemes respectively, compared with only 43% in the 'base case'. However, these gaps *decrease* gradually over time and in 2020, there are no significant differences between the modelled policy options and the 'base case'. (As previously indicated, a more progressive low emission zone policy might continue to deliver real benefits in 2020, with relatively greater impacts on city centre hotspots.)

Air quality, global warming and external costs

Air quality and global warming objectives do not always call for the same policy measures. One way to tackle the challenge of optimising the benefits under *combined* policy objectives is to compare the policy options in terms of external costs associated with emissions, accidents and noise. Our modelling shows that external costs are set to decrease considerably over the next 20 years. In the short term, the Low Emission Zone and Retrofit schemes are the best options in reducing *total* external costs. In the long run, however, the alternative fuelled vehicle incentive and urban cordon charge schemes are the (close) winners (see *Figure 4.9*).

Figure 4.9 Policy comparison of total external costs for the EU15 when compared to 1995 - upper limit



4.3 Good practice in programme design

Here we present recommendations on how to design an effective national or European programme of pilot and demonstration projects. Key supporting policies are described in Section 4.4.

Critical success factors

The following factors are essential for success:

- *Hitting the target* – aiming the programme at the right technologies, projects, suppliers and users;
- *Working together* – involving stakeholders, building confidence;
- *Infrastructure support* – providing refuelling and maintenance infrastructure;
- *Exiting gracefully* – phasing out support to avoid market collapse.

Hitting the target

- *Prioritise*. Is the main priority CO_2 reductions, air quality improvements, fuel diversity or industrial benefits? Maintain flexibility of objectives to take account of changing policy priorities.
- *Be consistent*. Ensure that the priorities are taken into account consistently across the different measures that contribute to the programme (including the linkage with national tax policies). Conflicting policies may create barriers. For example, the reduced duty on gaseous fuels in the UK has only a limited impact in promoting gas-fuelled buses because public transport operators also obtain a duty rebate on diesel (aimed at reducing their costs and promoting public transport).
- *Set clear criteria* for the actions to be supported. Clarity will avoid attracting applications from projects unlikely to qualify, as these will lead to disappointment and can give a programme a bad name.

- *Target the right applications*. Target the most promising markets and applications first (see Section 2). For example, urban bus fleets are particularly suitable for introducing new fuels. It is important not to target the private car market too early, before adequate refuelling and maintenance infrastructure is in place, as this can lead to disappointment and adverse publicity.

  Target the right fuels for each application. This depends on e.g. the required range, vehicle size and availability of refuelling infrastructure (see Section 2).
- *Pick the right product*. Premature use of immature technologies and products can lead to public rejection. For example, in France the rapid uptake of LPG cars led to problems (see box). Elsewhere, it has repeatedly been found that *dedicated new fuel vehicles are much cleaner than conversions*, which often offer

little emission reduction compared to conventional vehicles. The involvement of manufacturers to solve problems "on the ground" is also important. It is important to remain flexible so that new technologies can be included in the programme as appropriate.

LPG cars in France

When the tax on LPG was reduced in France in 1996, rapid uptake occurred, leading to a rapid increase of cars on the road to 100,000 compared to only 10,000 ten years previously. Initially safety release valves on the fuel tanks were prohibited because it was thought that this could lead to leakages of LPG which could cause explosions. However, it was soon realised that safety release valves were necessary in the case of fire and most LPG cars were recalled to have valves fitted. Unfortunately not all cars were recalled and there were two explosions involving LPG cars which created much adverse publicity and led to the suspension of LPG car manufacture for 6 months by one manufacturer. Even today, joy-riders are fond of taking LPG cars and blowing them up! These problems were mainly caused by too fast an uptake of a relatively untested technology, and lack of control of the quality of retrofit systems. This shows the value of properly monitored demonstration programmes before general uptake of a technology in the private car market is promoted.

- *Take account of changing standards* e.g. update selection criteria as Euro III and Euro IV emissions standards become compulsory.
- *Target the right users*. "Leading-edge" users who particularly value the benefits of innovations should be targeted first. This allows critical learning and economies of scale to be developed before acceptance by more conservative "average" users is sought.
- *Support the relevant types of action* to suit the programme objectives – either technical learning for novel technologies, or market stimulation for well established technologies (see boxes).

Technology testing: The French Natural Gas Buses Programme

The French programme on natural gas buses aimed to set up well monitored demonstration projects and carefully evaluate the costs, benefits and barriers of the new technology. The focus was on selecting projects which could be easily monitored and would provide credible results. For example, only fleets above a certain size were included, to avoid excessive uncertainty in the results. Criteria for support included the existence of centralised maintenance and the possibility of borrowing the vehicles for tests. Significant effort was devoted to setting up a common evaluation procedure which could be applied across all test sites and technologies to allow cross-comparison of results, and to disseminating the results widely to local authorities and other potential users.

Market stimulation: The UK Powershift programme

The Powershift programme is aimed at stimulating market take-up of alternative fuels which are close to commercial viability – mainly LPG and CNG, with limited support for electric vehicles. The main tools are subsidies for vehicle purchase – up to 75% of the extra cost of purchasing a clean-fuelled vehicle instead of a conventional vehicle. In addition the programme provides grants towards the installation of refuelling stations. A recent survey forecasts that sales of LPG vehicles will increase from 6,000 in 1999 to over 16,000 in 2000 and nearly 25,000 in 2001. UK sales of clean fuel vehicles running on natural gas or electricity are expected to rise to around 500 in 2001. Fuel suppliers have been sufficiently impressed to start investing heavily in LPG refuelling outlets.

- *Support the right size of action*. A critical scale and duration of project may be needed to attract replication by other cities.
- *Package measures together*. Encourage the use of integrated measures, including both "carrots" and "sticks", such as subsidies for cleaner fuelled cars, establishment of park and ride schemes using cleaner buses, low-emission zones in city centres and free parking for cleaner vehicles.
- *Get the image right*. Public transport offers a good niche for introducing cleaner vehicles, but it often suffers from an image of old, dirty, inefficient vehicles. It is important for cleaner fuelled buses to be accompanied by service improvements such as increased bus frequency, better connections, bus lanes, bus priority at junctions, improved timetable and information services and smart card ticketing. Innovative services such as door to door service using taxis or on-demand buses can also help to reduce barriers to bus use. For private transport, it is also important to promote an innovative image and emphasise the state-of-the art nature of the technologies in order to attract more users.
- *Support a portfolio of options*. This allows novel solutions to be tested and also allows each city to pick the most appropriate option for their own situation.
- *Target the key barriers* – focus on overcoming the *most important* hurdles to market take-up (in the national situation). These hurdles may have to be faced *in succession*, rather than simultaneously. Important hurdles include:
  - high capital costs;
  - shortage of refuelling infrastructure;
  - misperceptions and lack of information on vehicle comparisons, costs and supply options;
  - the need to persuade manufacturers to co-operate with Government programmes;
  - lack of understanding of insurance companies on appropriate risk premiums for alternative fuelled vehicles;
  - uncertainties over vehicle resale values.
- *Evaluate* the benefits of the programme, and communicate early results. A common evaluation method which can be applied to all

sites and technologies permits wide cross-comparison (see example of French NG bus programme above). Provision of monitoring information can be made a condition of support, as in the French and Swedish programmes.

- *Choose technology-neutral support measures*. This avoids lock-in to a particular technology when an improved way of meeting the same goal comes along. A more effective and cheaper option is likely to emerge if the measure is sufficiently flexible. For example, the Powershift programme offers different levels of support based on tailpipe emissions. This allows the options of meeting support criteria based on a variety of alternative fuels or even very clean examples of conventional fuelled vehicles using improved engine design or tail-pipe treatment technologies. At the same time it excludes support for vehicles which use alternative fuels but fail to achieve good emission reductions, e.g. poor quality retrofit conversions.

Working together

- *Strong leadership* is crucial, both at local level and by national government.
- *Involve all appropriate stakeholders from the start of the programme*. This is a condition of funding in the Swedish programme.

  For example, in the UK, recent experience shows that round-table discussion with all stakeholders prior to the development of policy on clean vehicles is important in building consensus and a shared vision of what will happen.
- *Manufacturers are crucial*. The UTOPIA research showed that involvement by vehicle manufacturers significantly increases the success rates of projects (see Figure 2.1).

  The UK Powershift programme achieved a good participation rate through the following strategy:

  - The programme began with well-funded demonstration projects which attracted participation from manufacturers.
  - A large purchasing consortium was set up, involving several key customers such as local authority fleets as well as important private sector customers. This demonstrated the potential size of the market for cleaner fuelled vehicles.
  - Good publicity was organised – the programme was launched at a motor trade fair, with a speech from the transport minister.

  A long-term national strategy is also necessary to give confidence that support measures and tax differentials will be maintained long enough for manufacturers to recoup their investment costs.
- *Build networks*. It is important to encourage co-operation and build partnerships between players, e.g. local authorities and transport operators. This may involve breaking down institutional and cultural barriers. Good networks for sharing information are vital, including sharing experience with other countries and other cities.
- *Build purchasing consortia*. Grouping together users to increase purchasing power can be successful in stimulating manufacturers

to produce cleaner vehicles, and bringing down purchase costs. However, problems can arise (e.g. consortia can be slow to agree common criteria, and manufacturers may not always rise to the challenge of providing suitable vehicles). It is important to learn lessons from past efforts.

- *Maintain a financial stake*. It is preferable not to fund the entire additional costs of cleaner vehicles as better commitment is obtained if participants have a financial stake.
- *Disseminate* critical data to potential users and suppliers (e.g. on technology costs). Also disseminate successful project results, to ensure that stakeholders obtain prestige for their participation.

Building confidence among users

- *Lead by example* by greening Government fleets.
- *Keep talking.* Keep major users of cleaner vehicles in a constant dialogue, and inform them of impending problems (such as funding for vehicle subsidies being close to depletion). (In Belgium, a users club has proved successful in clarifying expectations and barriers.)
- *Long term strategy*. Confirm that support mechanisms (such as subsidies and fuel tax differentials) will be in place for several years.
- *Good publicity*. Promote cleaner vehicles through press coverage and on-vehicle advertising.

Provision of refuelling infrastructure

- *Ensure infrastructure is in place* before promoting a new fuel extensively, otherwise the initiative can fail. (This was the case with the attempted introduction of natural gas vehicles in Egypt.)
- *Consider public support* for infrastructure as a short-term measure to overcome market barriers. For example, the Powershift programme in the UK is subsidising the installation of public filling stations for CNG vehicles.
- *Encourage private sector investment*. It is often possible to persuade fuel suppliers to fund fleet refuelling facilities. They can recoup their investment costs through a long-term supply contract.
- *Encourage third-party use* of fleet refuelling infrastructure, to spread the investment cost over a higher throughput and to attract a wider market.
- *Streamline regulations and planning permission*. Local authorities can be unsure how to assess applications to build refuelling infrastructure for alternative fuels such as LPG and CNG, and recharging systems for electric vehicles, due to lack of information on safety and environmental aspects. In order to streamline and harmonise the provision of infrastructure, national governments could provide guidelines for granting planning consent for refuelling and recharging stations.
- *Consider concentrating infrastructure into "clean cities" and "clean corridors".* The impact of infrastructure investment can be enhanced by concentrating effort into certain areas (see box).

Concentrating infrastructure: Clean Cities and Clean Corridors

The US Clean Cities programme targets infrastructure investment along "corridors" linking participating cities. The UK Powershift programme has recently adopted a strategy of focusing investment on areas with existing infrastructure. The idea of concentrating investment in certain areas is also strongly recommended by a recent IEA report. This will require a co-ordinated approach by national, regional and local governments together with fuel and vehicle suppliers and retailers. Actions could include:

- *Select areas* on which to focus effort.
- *Decide which fuels* to focus on, depending on fuel and vehicle availability, local and national policy priorities, existing infrastructure, geography, etc.
- Set up mandatory or voluntary *Green Fleet* programmes for local business and public sector fleets. Require central fleet refuelling facilities to offer public access.
- *Provide vehicle or fuel tax incentives* or subsidies, guaranteed over 5-10 years to enable confident investment.
- Set up strong local *awareness and publicity* schemes and advice on purchasing cleaner vehicles. Broker *collective purchasing agreements* with fuel and vehicle suppliers and maintenance providers.
- Set a *target for the number of refuelling stations* offering alternative fuels and encourage fuel retailers and suppliers to participate. Offer government support to cover any extra costs, e.g. for facilities which are under-utilised in the short term.

Exiting gracefully

At some point it will be necessary to make the transition from demonstration to wider commercial use. This should be done with care:

- *Phase out* subsidies and incentives gradually as the need for support falls, e.g. when vehicle prices drop as economies of scale are realised. There are examples where markets have collapsed when subsidies were removed too abruptly (see box).
- *Move the goalposts*, i.e. progressively change the rules to favour newer cleaner technologies. For example, the criteria for support under the UK's Powershift programme are constantly revised. Make this strategy clear to market actors.

Sweden: Collapse of LPG market

For some years in the 1970s and 1980s, there was a tax rebate on LPG as a vehicle fuel. An infrastructure was developed and many taxis had dual fuel systems installed. The fuel increased in popularity until the government decided to level the tax for propane fuel with that of other fuels. This immediately removed the economic incentive and development came to a halt. Subsequently, the refuelling infrastructure was removed and today it is virtually impossible to find this fuel for sale.

4.4 Important supporting policies

Demonstration programmes are crucial for the successful introduction of clean vehicles, but they are much more likely to succeed within a strong framework of supporting policies at the national and EU-level.

Novel policy approaches are needed to introduce clean vehicles in new applications, because radical changes in the behaviour of users and suppliers are often necessary. For example, car sharing requires users to drastically change their transport habits, but the admission of car-share vehicles to low-emission zones within a city can compensate for this. Here we summarise the most important supporting policies.

Fiscal measures

In the last few years, fiscal policy has been revolutionised by the concept of including environmental and social costs as well as direct costs in the price of goods. In transport policy, this has led to measures such as:

- Fuel taxes based on carbon content, fuel type, or life-cycle emissions.
- Tax exemptions for greener fuels – it is legally possible to reduce taxes on green fuels to the EU minimum of 8p/kg.
- Differentiated vehicle taxes, based on engine size, fuel consumption, fuel/vehicle type or emissions.

Fiscal measures are vitally important for promoting cleaner fuels. They have been the main means of achieving wide use of LPG and CNG vehicles in many countries worldwide. However, there are several key issues and problems which must be addressed. These include:

- how to determine fuel prices which include environmental and social costs;
- obtaining public acceptance for higher (environmental) taxes on conventional fuels;
- providing subsidies for cleaner vehicles and fuels without infringing EU rules on State Aid;
- harmonising fuel taxes to avoid unfair competition.

Levelling the playing field

In theory it would be preferable to tax fuels so that their environmental and social costs were reflected in their prices. Several countries have already introduced taxation systems which attempt to partially achieve this. A rigorous treatment would involve the calculation of external costs of each environmental impact, so that global damage such as CO_2 emissions could be weighted with respect to local air pollution and other damage. However, external cost data are inevitably subjective and uncertain and it is difficult to achieve consensus on, for example, the value of a lost life. Nevertheless, it would be useful if the EU could at least agree a *common ranking* of fuels from the most damaging to the least damaging which could be

incorporated as *guidance for Member States* when formulating their tax policies. Out of respect for differences in Member State policy objectives, the guidance would need to provide some flexibility to focus e.g. on carbon content or on other impacts such as air quality.

Public acceptance

A key problem with tax increases on conventional fuels (for environmental purposes) is in gaining acceptance from the public and from the transport industry. The recent protests across Europe emphasise this problem – despite commitments from ministers, several countries reduced their fuel taxes to satisfy protesters.

However there are several methods of increasing public acceptance.

- Making measures *revenue-neutral*. For example, in the UK recent changes have increased vehicle tax for larger cars whilst reducing it for smaller cars. Alternatively taxes on cars or fuels can be compensated for by reductions in other taxes such as income tax or national insurance contributions.
- *Hypothecation* of revenue for transport or environmental projects.
- *Awareness campaigns* and consistent presentation of the measure as an environmental policy tool rather than a revenue-raising tool.
- *Provision of adequate alternatives* to private car use, i.e. a good public transport system, especially in rural areas. This can be partially funded by revenues from taxes but some initial investment will be required as this is a chicken and egg situation.
- *Harmonising taxation*. Protests are frequently sparked by what is seen as unfair competition in the freight industry from neighbouring countries with lower fuel taxes. One way of addressing this is to continue attempts to harmonise fuel taxes in the EU (see below).

Urban vs rural impacts

It should be noted that reducing fuel tax for alternative fuels does not specifically target urban areas – indeed, any increase in the uptake of alternative fuelled vehicles may be greater in rural areas where mileages are higher and therefore paybacks quicker. However, taxation is still one of the most powerful instruments available to a government for influencing transport patterns.

Clashes with EU competition and State Aid law

Some countries have had problems with using fiscal instruments to promote specific fuels or technologies as they can be interpreted by the EC as trade barriers or unfair State Aid. This is part of an alarming trend across the EU in which many subsidies are being challenged, despite their environmental benefits. It is critical to establish the role of environmental taxation and subsidies and to ensure that current legislation does not undermine EU environmental policy.

All exemptions to energy taxes, "which favour certain undertakings or in the production of certain goods" are subject to EU approval and are normally only allowed to last for 3-4 years. In general, tax incentives which encourage the adoption of EC standards before the required time limit are permitted, so long as they do not overcompensate the costs involved in compliance with the standard.

However, problems with support for cleaner technologies still arise. For example, French aid for bio-ethanol was recently ruled to be illegal as it was being applied to mature technologies rather than pilot

projects. It appears that one cause of this conflict lies in the original aim of the State Aid rules, which allowed support for immature technologies but required this support to be removed once the technologies were mature. However, this ignores the wider problem of the lack of inclusion of external costs in the price of conventional fuels. It can be argued that until the price of fuels reflects all external costs, the provision of State Aid for more environmentally friendly fuels can be justified. This Aid should be enabled regardless of the commercial maturity of the product. Concerns over unfair competition could be mitigated by the adoption of a harmonised tax policy across the EU.

Harmonising taxes

Efforts to harmonise EU fuel tax policy have been ongoing for some time. The issue will become both more urgent and more problematic once the process of EU enlargement accelerates. A harmonised tax regime would have several key benefits for cleaner vehicles:

- It would avoid complaints of unfair competition from the transport industry in countries with currently high conventional fuel taxes.
- It could in principle permit the agreement of a tax system reflecting the environmental and social costs of fuels.
- It would facilitate long-term stability in fuel price differentials which would reduce uncertainty for potential investors in cleaner fuelled vehicles.

However, resistance from countries which currently have lower fuel taxes, particularly new EU applicants, is likely to be strong. It is notable that the recent fuel price protests provoked tax cuts even in countries which currently have low tax rates by EU standards, such as Spain. One line of argument suggests that countries with lower fuel taxes also have lower employment costs and capital costs of goods, and that this can compensate them for higher fuel prices. Also the revenue from fuel price increases could be recycled into other tax reductions such as income tax.

Long term signals

Both taxes and subsidies should be implemented as part of a consistent long-term framework, in order to build confidence in cleaner fuelled vehicles among both manufacturers and users. Users need to know that fuel and vehicle prices will be sufficiently low to justify their investment in vehicles and (for fleets) infrastructure, and manufacturers need to be confident in a continued demand from users.

Standards and regulations

Standards and regulations can be used to promote cleaner vehicles in several ways:

- *Standards for quality and safety* of cleaner vehicles will help to reassure users.
- *Standards for technical design* will promote compatibility of refuelling systems and technologies for vehicle identification and enforcement of access restrictions, and allow free movement of vehicles between Member States.
- *Legislation* will enable local authorities to enact measures such as low emission zones and quality contracts.

Quality standards reassure users

One of the biggest market barriers faced by new technologies is lack of confidence among users. The introduction of quality or safety standards for new vehicles or fuels, and particularly for converted vehicles, can help to reassure users that the clean vehicle they are about to buy will not explode, break down constantly or create particular hazards in a crash.

Technical standards for a single market

Technical standards can be used to ensure that technologies are compatible with each other. For example, standards for refuelling systems are needed to ensure an alternative fuelled vehicle can refuel in any country of the EU. Likewise, manufacturers would be helped if alternative fuelled vehicles no longer needed separate approval in each country of the EU. Technical standards also reduce uncertainty for suppliers by reassuring them that they will not be stuck with the "wrong" type of technology, and that their product will be suitable for the whole EU market. This encourages competition and can reduce development costs, as the effort to design certain vehicle components is not duplicated. Standards also help the vehicle maintenance sector to focus their training and adaptation.

However, there are two caveats in setting technical standards. Firstly, standards need to take into account variations between countries e.g. standards for alternative fuels need to ensure that the fuels are suitable for the very cold winters in Sweden and Finland.

Secondly, standards can restrict innovation if implemented too early or made too restrictive. During the development of a novel technology, better ways of doing things will emerge over time and it is important that standards do not accidentally exclude new technical developments. Standards should therefore be set after extensive testing and demonstration of the new technology, and should be as flexible as possible.

Emissions standards

There is considerable evidence that regulations such as the Euro standards are the only certain means of guaranteeing improvements in vehicle emissions. However, emissions standards must be set with care to be effective. For example:

- Regulations need constant updating to remain challenging.
- It is necessary to avoid problems of cycle beating, where manufacturers could tailor their engines to produce unrepresentative low emissions over the regulatory test cycle.

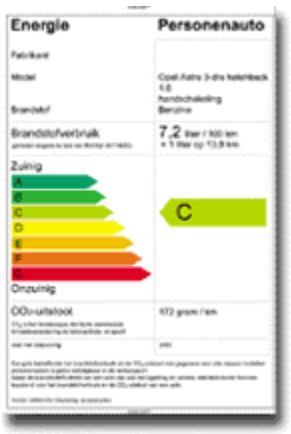
- Test cycles should be representative of real-life driving conditions, including cold starts and congested traffic.
- Standards should take account of extra emissions due to the increasing use of ancillary equipment such as air conditioning, as well as the basic engine exhaust emissions.
- It can be useful to have standards to differentiate vehicles that significantly improve on current minimum emissions standards (such as Environmentally Enhanced Vehicles). This helps in simplifying and harmonising the design of incentive schemes.

Specific needs

The following specific needs have been identified:

- revise vehicle test cycles to take into account cold starts and resistance to cycle beating;
- start looking beyond EURO IV to the next set of standards;
- agree fuel composition standards for CNG, LPG and bio-fuels;
- develop EU-wide homologation approval for alternative fuelled vehicles;
- agree standards for compatibility of refuelling / recharging systems;
- simplify and harmonise CNG refuelling safety standards (minimum distances to be respected, gas detection systems etc);
- harmonise restrictions on the use of gaseous fuels in enclosed spaces such as tunnels and underground car-parks;
- develop a consolidated framework for safety standards for bio-fuels;
- agree safety standards for converted vehicles;
- provide guidelines for streamlining planning consent for infrastructure;
- review curfew limits for vehicles with demonstrable noise benefits (e.g. for goods delivery);
- empower local authorities to set up Low Emission Zones and Quality Contracts.

Eco-labelling and environmental rating



Environmental rating schemes rank vehicles according to a number of environmental impacts, typically including CO_2 emissions, local pollutants and noise. Results are published as ranking lists to enable comparison between different makes and models.

Eco-labelling involves physically labelling vehicles that meet certain environmental criteria, based on emissions. Labelling in the showroom is the norm, while on-road identification could be implemented via the number plate, a vehicle sticker or the vehicle tax disc.

With other consumer goods the main purpose of eco-labelling is to attract environmentally concerned buyers. However, vehicle eco-labelling may be a pre-requisite for the effective implementation and enforcement of many other important measures, including:

- fiscal measures such as road pricing or reduced parking charges for cleaner vehicles;
- fleet procurement mandates (i.e. obligations imposed on public administrations to buy a certain percentage of cleaner vehicles);
- access restrictions, e.g. low emission zones, use of priority lanes or restricted parking spaces (i.e. only cleaner vehicles would be permitted access).

Eco-labelling also sends a signal to manufacturers concerning the viability of future markets for cleaner vehicles.

There are several implementation challenges for eco-labelling, listed here. Some are then discussed in more detail below:

- *Common EU labelling criteria.* The label may need to be valid across the whole of the EU so that drivers know whether they will be allowed into low emission zones in other countries
- *Calculation of the environmental rating* must balance scientific validity against cost and complexity.
- *Format.* The format of the label should be clear, simple and allow consumers to easily compare different makes and models.
- *Supplementary guidance.* The label should be backed up by other promotional material and web-based buying guides, aimed at influencing consumers before they get to the showroom.
- *The system must be resistant to abuse* i.e. theft or forgery of labels.
- *Opposition from stakeholders.* Negotiations to agree the criteria will involve many actors with differing points of view, e.g. vehicle manufacturers, local authorities, national governments. In particular, there is some opposition from the vehicle industry, which is already mandated to provide information on fuel consumption and emissions under the new EC Directive. The industry seems reluctant to agree to a more comprehensive voluntary eco-label (covering the overall, damage-weighted environmental impacts). However, some manufacturers are interested in promoting the environmental benefits of their products and others may follow if they fear they will lose market share.

Labelling criteria: which impacts?

One fundamental issue to be determined is which impacts to include: CO_2 emissions, local air pollutants, noise, and other impacts. The new EC Directive focuses on fuel consumption and CO_2 emissions, but many cities are more interested in controlling local air pollutants. Local air quality and noise are also the issues most relevant to determining which vehicles can enter low emission zones in city centres.

Ideally an eco-label would take account of both CO_2 and local pollutants. This could be done through weighting emissions according to the external costs of the damage they cause (health effects, global warming etc.). However, the determination of external costs is complex and faces some disagreement, while other weighting systems tend to be subjective. Also, impacts depend to some degree on the location of the emissions of individual species and the proximity to receptors such as urban populations. This means that a vehicle could, in theory, merit different rankings in different cities. Nevertheless there is a view that even an imperfect method of weighting is better than none at all.

An alternative approach is to have separate ranking of CO_2 and local air pollutants on the labels. The local air pollutant indicator could be simply the relevant Euro emissions standard or a higher standard (such as EEV or ZEV) if appropriate. Both criteria would be available to guide purchasing decisions, and the choice of which component to use for a given policy or measure could be left to individual Member States or cities. For example, the CO_2 component could be used to determine eligibility for vehicle purchase incentive schemes, and the local air pollutant component could be used as the basis for admission to low emission zones. Other information such as noise levels, recyclability or other toxic emissions could also be included separately.

Basis for calculating emissions

The next issue is to agree on a basis for calculating emissions for each vehicle. Here there is a trade-off between achieving a realistic rating of the environmental impact of the vehicle and achieving a workable approach. Possible approaches, in increasing order of complexity, are:

- *Euro standards* for local emissions and drive cycle emissions for CO_2. However, the Euro standards will not differentiate vehicles that are significantly better than the defined standards. New standards to distinguish much cleaner vehicles would be valuable in this context. For example, the Environmentally Enhanced Vehicle (EEV) standard for heavy-duty vehicles, which is 50% of the Euro IV emission levels, has been agreed by the EC Directorate General for Enterprise. A standard for light-duty vehicles is under consideration.
- *Tailpipe emissions for both CO_2 and regulated pollutants*, based on an urban drive cycle typical of real-life driving conditions.
- *Full fuel life-cycle emissions*, including emissions from the generation of electricity to charge electric vehicles, and emissions from oil extraction and refineries. One problem is that a different mix of electricity generating technologies is used in each EU country so the life-cycle emissions from electric vehicles depend on where the vehicle is charged. Similarly, energy use and emissions vary between refineries.

- *Whole life impacts.* As well as full fuel life cycle emissions this approach would include the environmental impact of constructing and disposing of the vehicle.

Format of label

Consumer research[5] suggests that buyers want to be able to compare different makes and models – figures giving absolute emissions are of little use. It has been suggested that a format based on the existing labels for electrical appliances, with seven coloured bands from A (green, best) to G (red, worst), would best allow this. The adoption of the same label format would enhance recognition and give the label more impact.

A SAVE[6] study suggested that the label should focus on fuel economy, as this is familiar to drivers, with CO_2 emissions shown as supplementary information. However, a recent UK study[5] recommended basing the label on CO_2 emissions in order to allow comparison between petrol, diesel and alternative fuelled vehicles without having separate scales for each. A consequence of either of these approaches is that consumers will automatically be influenced more by the coloured scale, and hence by fuel economy or CO_2, than by any supplementary information on local air pollutants. This will apply especially if the latter is limited to a statement of the Euro standard (which will be either 3 or 4 after 2001 anyway). If governments want to emphasise local air pollution more strongly, care must be taken over designing the label, with possibly the introduction of additional bands for local air pollutants (e.g. Euro 3a and 3b, Euro 4a and 4b, EEV, ZEV).

Should we compare a mini with a Ferrari?

There is still disagreement over whether vehicles should be compared only with others in the same size class. Denmark is adopting an approach where all vehicles are compared against each other, in an attempt to encourage buyers to select smaller vehicles. However, the SAVE study concluded that buyers decide what size car they need based on lifestyle factors and would prefer to compare only vehicles within a given category.

Categorise or normalise?

If this is to be done, the basis for the comparison must be agreed: it could be vehicle volume, engine size or vehicle footprint (length x width). One problem here is that there is no universally agreed basis for classifying vehicles as small, medium or large, and a small change in criteria could move a vehicle from the top of one category to the bottom of another. Alternatively, fuel consumption could be normalised by dividing by vehicle size to give a continuous measure of energy efficiency, e.g. in litres per km per square metre of floor space, as recommended by the UK study[5]. However this does not facilitate comparison of fuel consumption between cars of different sizes, and eliminates the opportunity to persuade consumers to favour slightly smaller cars within the same broad size range. The concept would also be unfamiliar to consumers, although the figures would be hidden within the A-G banding.

Where do we put the average?

If an A-G scale is adopted, the next decision is how to determine the width and position of the bands. The UK study recommended setting the scale such that the current average CO_2 emissions for the UK fleet were at the division between E and F on the scale, to allow the scale to remain useful without further revision until 2006.

Supplementary guidance

In order to prevent cluttering the label with too much information, supplementary information can be presented in a separate guide

which compares different makes and models of car. The EC Directive requires a guide to be produced which includes advice on the effects of driving style, air conditioning, power steering etc. on fuel consumption.

Research shows that many consumers have decided what car to buy before they go to the show room. Extra material should therefore be made widely available, such as web-based tools which allow searching, filtering, comparison and selection based on different criteria. More detailed information, including eco-rating schemes, can also be made available on the web.

"I went in, I said "I'll have one of those please" and that was it." Focus group response on being asked whether much time was spent in the showroom[5].

In summary, therefore, the main issues to be resolved are:

Issues for action

- the need for a dialogue with vehicle manufacturers (in particular) and other stakeholders;
- agreement on common or co-ordinated approaches across Europe that minimise problems for people travelling between Member States (e.g. where labels are used as the basis for Low Emission Zones and parking restrictions);
- the appropriate rating methodology (such as the weighting of emission species according to their external costs, the use of life-cycle analysis, and the trade-off between scientific validity and cost/complexity);
- the link between labels/ratings, national/local policy priorities (e.g. greenhouse gas emissions versus air quality) and their use in other measures such as Low Emission Zones;
- the design of labels that use simple indicators such as bands (analogous to energy labels on freezers) rather than scientific data, in order to assist consumer understanding;
- whether to compare all vehicles or just those within a size class, and the appropriate methodology for vehicle comparison (e.g. based on vehicle volume, footprint or engine class);
- the link between labels and vehicle emissions standards, and the desirability of additional emissions categories tougher than Euro IV to distinguish cleaner vehicles available now;
- the choice of appropriate drive cycles for emissions data (taking account of e.g. congested traffic conditions and the use of air conditioning);
- the procedures for making labels clear, visible and fraud-resistant;
- provision of back-up information and training for dealers;
- the lack of multi-make dealers which restricts showroom choice for purchasers.

Low Emission Zones

Low emission zones are widely seen as a key tool for encouraging cleaner vehicles in urban areas and dealing with local air quality problems in a cost-effective way. (See also Section 2.4.)

Care is needed in designing LEZs to avoid diverting business away from the centre, so it is vital to provide plenty of high-quality alternatives to private car use. Additional traffic management measures may be necessary to ensure that congestion and pollution problems are not diverted to the area just outside the zone. LEZs therefore work best as part of a package of measures including traffic management, provision of clean, accessible public transport and promotion of cycling and walking.

A wide variety of access restriction schemes are in place in EU cities, although few of these are designed specifically to encourage cleaner vehicles. Currently most schemes aim primarily to reduce overall traffic flow by diverting through traffic or restricting access to certain essential users. Some schemes focus on providing pedestrian priority, thus improving safety. Although several cities have complemented their restricted access zones by introducing a handful of cleaner vehicles (e.g. buses or waste disposal trucks), the goal of restricting access **only** to clean vehicles is not universal, or is a longer-term aim. However, hundreds of towns across Europe are now committed to introducing both low emission zones and cleaner vehicles as part of the ALTER programme.

Empowering local governments

Often changes in national legislation will be required to enable local authorities to implement and enforce low emission zones. For example, in Sweden a change in the law will be required to enable the extension of traffic bans from heavy goods vehicles to cars. Many countries will have to pass new laws to allow local traffic wardens to collect fines for unauthorised vehicles entering low emission zones. For example, recent changes in the UK allow local authorities to charge for the use of roads and provision of workplace parking, and use the revenue for local infrastructure projects. However, further changes are needed to allow local traffic officers to enforce low emission zones without police involvement.

Admission criteria

There is a critical role for national governments and the EC to co-ordinate vehicle emission criteria for admission to a LEZ. It is essential that drivers and manufacturers know that consistent criteria will apply across the EU, although the criteria do not need to be identical in every town. Smart card technology can allow different authorisation schemes to co-exist to some extent, although there is a need to harmonise protocols at the EU level.

Entry criteria – balancing local flexibility with EU-wide mobility

The entry criteria could be based around an EU-wide eco-label. However, several key issues with regards to agreeing the labelling criteria must be solved first (see above). Different countries and cities may have different requirements and preferences – for example, some may favour a true “zero-emission” zone which would only permit electric and fuel cell vehicles to enter, whereas others might favour admitting vehicles conforming to the latest Euro standard. Special exemptions, e.g. for local residents and traders, disabled drivers or public transport must also be resolved.

In the short term at least, it is desirable to allow cities to design schemes to match their individual needs, but a more harmonised approach will be preferable in the longer term to allow free movement of traffic within the EU. Some local flexibility could be built into the system, for example by allowing cities to choose from a limited set of emission standards of different levels, perhaps comparable to the US LEV, ULEV, SULEV and ZEV categories. For example, a banding system could comprise the four EURO standards, the new EEV standard and a ZEV standard. However very good driver information systems and signage would have to be in place to clarify which vehicles were allowed into which cities.

The use of a banding structure based on common standards would allow a high degree of flexibility to individual cities. For example, cities could design schemes with a core area restricted to pedestrians, cyclists and ZEVs, with lesser restrictions in the outer area. Also, tighter restrictions could be applied to buses or goods vehicles (which often cause the majority of the pollution and are also easier to target) than to private cars.

Access and enforcement infrastructure

A variety of enforcement methods are possible. These are discussed in Section 2.4.

While cities are still experimenting and learning about the best way to implement low emission zones, it is advisable to maintain this choice of methods so that individual cities can tailor a scheme to match their circumstances. However, in the long term it will facilitate the EU-wide implementation of low emission zones if there is a common protocol to allow interoperability between telematics systems. For example, automatic vehicle recognition systems should be compatible across the EU, with the facility to be used for entry to low emission zones, road pricing schemes and even integrated with traffic management measures such as priority traffic light systems. At present a variety of systems are being developed in isolation and there is a need for standardisation and harmonisation through the ISO and CEN transport telematics working groups[7].

Enforcement – the long term need for EU-wide telematics protocols.

Key actions

To summarise, the key issues and actions required are:

- *Legislation.* Introduce the legislative frameworks that will enable local authorities to implement and enforce LEZs, e.g. giving local authorities powers to restrict access and collect fines for non-compliance.
- *Entry criteria.* Provide a simple and common framework for the entry requirements for these zones, co-ordinated with policy on vehicle emission standards and eco-labelling/rating. (Local authorities may still need the power to select the requirement appropriate to local concerns, from a national or EU-wide set of options.)
- Identify whether any technologies should qualify for further *privileges/incentives*, e.g. free parking or charging facilities for electric vehicles.
- *Enforcement.* Identify options for automated entry to an LEZ, and for enforcement. There is a need to standardise and harmonise telematics-based vehicle recognition systems which can be used for access restrictions or road pricing schemes EU-wide.

- *Awareness and acceptance.* Promote public acceptance through active marketing of the concept and some pilot implementations.
- Determine how to accommodate local residents and traders and minimise social and economic impacts. Local *stakeholder involvement* at all planning stages is vital, and it would even be possible to run the zone through a board comprising representatives of all stakeholder groups[7].
- *Good practice.* Determine and disseminate good practice. Cities may need guidance in designing a scheme which matches their local needs, and examples of successful schemes should be disseminated at EU level. For example:
  - At what *times* should parking and access restrictions operate? During the working week and/or weekends? Should there be additional restrictions on delivery vehicles?
  - What *exemptions* should there be, e.g. for disabled users, emergency vehicles, public transport, taxis, delivery vehicles, utility vehicles? There is a trade-off between acceptability and effectiveness.
  - Offer guidance on how to avoid problems with increased *traffic flow* just outside the zone.
  - How can *innovative transport services* help LEZs to function effectively? Possibilities include a service to deliver goods purchased by shoppers to park and ride sites, a car-sharing scheme for local residents, green commuter plans for local businesses or an integrated freight delivery service to minimise goods vehicle movements within the zone. Real time information services and smart ticketing will also help public transport systems to function effectively.
- *Funding.* Consider how the costs involved in setting up and running a LEZ should be covered: e.g. from central or local government funds, from fining non-compliant vehicles, from charging vehicles for access, from charging local businesses or transport operators, or from voluntary sponsorship? This needs full consideration of socio-economic issues, and the risks of damaging public acceptance of the scheme by imposing further financial penalties on local residents or traders who may already be inconvenienced to some extent by the scheme. It is important to avoid businesses re-locating outside the zone. In the short term it may be necessary to provide subsidies, e.g. for public transport, to encourage use of the zone and help public acceptance.

Green procurement

There are a variety of approaches to green procurement, i.e. the deliberate purchase of cleaner vehicles. (See also Section 2.4.) The main approaches are:

- public procurement mandates: compulsory purchase of cleaner vehicles for Government and local authority fleets;
- voluntary public procurement agreements, e.g. ALTER;
- Quality Contracts and Quality Partnerships between local authorities and public transport operators;
- Green Fleet initiatives aimed at private fleets.

Public procurement mandates are operating successfully in several countries including France, the USA and Canada. Generally cleaner vehicles have to be phased in gradually as older vehicles are replaced. A *voluntary approach* to procurement of cleaner vehicles is also underway in the ALTER initiative, where hundreds of EU cities are forming a purchasing consortium to negotiate favourable prices for cleaner vehicles.

Both voluntary and mandatory public procurement initiatives have the extra benefit of demonstrating government confidence in cleaner vehicles, and "leading by example". This can send a strong signal to private sector buyers, when accompanied by suitable publicity.

Quality Contracts and Green Fleet initiatives are discussed in more detail below.

Quality Contracts

Traditionally tenders for public service vehicles have been constrained to opt for the cheapest offer. However, "Quality contracts" are a new development which permit the inclusion of environmental criteria when tendering for new vehicles. For example the authorities in Westminster (London) now include vehicle environmental criteria when asking for tenders for waste disposal services.

In the past there have been cases where the inclusion of environmental criteria has been challenged on the grounds that it conflicts with national or EU legislation on public procurement. Although the latest draft legislation indicates that environmental criteria will now be considered acceptable, it is important to clarify that this will indeed be the case and to ensure that any barriers and loopholes are removed.

National governments can:

- Encourage Government organisations and local authorities (and subsequently the private sector) to include vehicle environmental criteria when asking for tenders for transport services. Service providers will begin to realise they should include cleaner vehicles as an option when they submit tenders for e.g. waste disposal, public transport and goods distribution services.
- Remove any national legislative constraints on Quality Contracts. (For example, in the UK the Government has changed legislation

so that local authorities now seek "best value" rather than "least cost" when procuring external services.)

The European Commission and national governments can:

- Ensure that forthcoming EU legislation will not lead to further challenges to green procurement.

Green fleets

In general in the EU, fleet cars account for 10 to 15% of the market. However, fleet cars travel much further than private cars – around 30,000 km per year compared to 13,000 for private cars. There is therefore a tremendous opportunity to open up the market for cleaner vehicles into business fleets. The benefits will also "trickle-down" into the second hand market when fleet cars are sold on to private buyers.

Green Fleet schemes aim to encourage companies to voluntarily improve the overall environmental performance of their fleets. The benefits for companies are the opportunity to reduce fuel costs, and to gain a greener image and thus a competitive benefit. Several countries have launched Green Fleet schemes. For example, the UK government Greener Fleet Certification Scheme, Motorvate, sets a target for fleets to reduce CO_2 emissions by 12% over 3 years and reduce mileage by 3%. The programme is not targeted specifically at clean vehicles – the emphasis is on reducing fuel use – but the use of clean vehicles gains extra recognition.

If such programmes become established they could be used as tools to promote clean vehicle use. It is therefore important for green fleet schemes to be seen as prestigious, and good publicity is vital. Governments should lead by example by greening their own fleets first.

Key actions

National governments can develop schemes for green fleet certification. Issues to be addressed include:

- setting criteria for fleet certification;
- defining the form of label/accreditation;
- identifying how to provide the incentive for operators to seek certification (e.g. as part of ISO14000).

Good practice for Green Fleet schemes

Good practice includes:

- Green government fleets first and demonstrate government support (financial and other) for the scheme.
- Raise awareness of the scheme through a high-profile publicity and marketing campaign. The scheme should be promoted as a mark of excellence in fleet management, not just as a "Green" award. Marketing should be directed at senior managers in the company, not just fleet managers, as senior management support is vital for fleet managers to be given the necessary resources and authority to succeed.
- Involve major fleet leasing companies in developing and promoting the scheme.

- Provide support at senior management level and training for fleet managers.
- Provide advice and assistance to help companies meet their targets, e.g. seminars, literature, driver training and on-site consultancy.
- Publicise potential incentives such as vehicle or fuel taxation benefits or subsidies for purchase of cleaner vehicles.
- Set targets that are simple, challenging yet achievable.
- Set reduced targets for companies which have already made progress towards greening their fleets.
- Verify achievements through collection and auditing of data, but minimise the burden of data collection on companies.
- Provide immediate recognition for companies participating in the scheme, and successively greater recognition as progress towards full certification is achieved.
- Publicise real life success stories and disseminate best practice in fleet management to help the incentive to improve performance trickle down to non-participating fleets.

How to promote new propulsion systems in the long term

In the short term, the greatest reductions in pollution will come from the introduction of cleaner gasoline and diesel vehicles, together with measures to reduce vehicle use.

However, in the long term it will be necessary to move to a more sustainable transport system based on renewable energy. This will be necessary firstly in order to reduce greenhouse gas emissions, and secondly because fossil fuels will one day start to become more scarce. Also, ultra-low emission vehicles will be needed in local air pollution hotspots.

The problem lies in making the transition to a radically new transport system, involving new technologies (electric and fuel cell vehicles), new fuels (hydrogen) and a new infrastructure. Gasoline and diesel vehicles are becoming so clean in terms of local air quality that it is difficult to persuade manufacturers and users to invest in alternative fuelled vehicles, which are seen as more expensive, less convenient and risky. And even the most environmentally minded local authorities tend to opt for well-proven technologies, and can achieve greater benefits in the short term through other measures.

For example, the CENTAUR project showed that Quality Bus Corridors and access control restrictions were among the measures that generate the greatest energy savings and pollutant reductions in the short-term. However, CENTAUR pointed out that a short-term focus on achieving maximum energy savings may lead to an avoidance of more-costly, longer-term improvements based on emerging vehicle technologies. CENTAUR recommended that specific awards or grants should be available at national level to favour the introduction of next-generation technologies such as hybrid or bio-gas buses.

Governments cannot expect private investors to back novel long-term technologies without strong public support. There are two main avenues for providing such support:

- support for long term R&D;
- using market-ready cleaner vehicles and fuels as a stepping stone to novel technologies.

Funding long term R&D into alternative fuelled vehicles is a vital task for both national governments and the EU. The best approach for this is the use of collaborative partnerships for pre-competitive R&D between governments, manufacturers and universities, exemplified by the PNGV approach in the USA. Specific issues where R&D is urgently needed include:

- reduction of electric vehicle battery price, weight and charging times, and increase of battery lifetime and reliability;
- on-board reforming for fuel cells;
- adsorption storage for gaseous fuels.

The stepping stone approach

Many of the policies and support measure described in this report are aimed at market-ready cleaner vehicles. Indeed we have stressed the importance of ensuring that technologies are fully tested and reliable, and that infrastructure is in place, before promoting cleaner vehicles for general use. However, the introduction of cleaner vehicles running on fossil fuels can act as a stepping stone to the use of, for example, fuel cell vehicles running on renewable fuels. For example, hybrid diesel-electric vehicles can be used to test and develop electric motors and batteries whilst avoiding the problems of limited range and lack of recharging infrastructure which hinder the short term introduction of battery electric vehicles. Fuel cell vehicles running on reformed gasoline can pave the way for vehicles running on bio-ethanol and hydrogen. Natural gas vehicles can eventually be modified to run on bio-gas.

Renewable electricity – a vital long term need

Finally it is vital that measures to achieve long term sustainability in the transport sector are accompanied by moves to a renewable energy system for power generation. Ultimately, the majority of sustainable transport will depend on the availability of renewably generated electricity, either to charge battery electric vehicles or to produce hydrogen for fuel cell vehicles. There is a long way to go before renewable electricity technologies can be deployed on a wide scale in the EU.

Section 5. Conclusions

Is there a need for alternative and renewable transport fuels?

Which technologies are of interest?

How should the take-up of alternative fuels be stimulated?

What should be the priorities for EU action?

What local actions are needed?

Is there a need for alternative and renewable transport fuels?

Yes, for the following reasons:

- Fossil fuels are finite. Over the short term, expanding the range of road fuels will extend the availability of gasoline and diesel. For the long term, renewable fuels such as bio-fuels and hydrogen from renewable electricity are essential.
- Europe is facing a high dependence on oil imports (especially from less stable regions). Transport is such an important element of the economy that diversifying the range of fuels and reducing the dependence on other countries (price instability etc.) is highly desirable.
- We need to reduce CO_2 emissions, but improvements in vehicle efficiency will be inadequate to deliver all of the required savings, and changing consumer behaviour is difficult.
- Alternative fuels can provide a moderately cost-effective means of reducing CO_2 emissions and improving air quality (especially for urban "hotspots").
- It is worth stimulating market demand for a portfolio of energy sources, so that industry then has the incentive to make them commercially viable through economies of scale and improvements in productivity.
- Bio-fuels may meet less than 10% of needs, but this will still extend the availability of fossil fuels. Moreover, with the enlargement of the EU, it will be important to have a constructive use for the potential large increase in arable production, to avoid problems for the Common Agricultural Policy.
- Recycling of e.g. waste vegetable oil, municipal waste and woody residues to make transport fuels are ways of pursuing sustainable development.

Which technologies are of interest?

- *Natural gas* and *liquefied petroleum gas* can improve air quality.
- *Bio-fuels* (methanol, ethanol, fatty acid methyl esters, gas) are notable for low CO_2 emissions over the fuel life-cycle.
- *Battery electric* and *hybrid* propulsion can reduce both local and global pollutants.
- *Fuel cells* are seen as a key technology for a hydrogen economy based on renewably generated electricity.
- These technologies are not cost-competitive at present with gasoline and diesel vehicles (on a pre-tax basis). Also, most of them involve some loss of utility for the consumer.
- Some or all of these fuels might become commercially viable once a sufficient market is established. Fleet applications such as buses are usually the most promising initial market.
- Nevertheless, *improved gasoline and diesel technologies* can be expected to dominate the market for many years, with significant environmental gains.

How should the take-up of alternative fuels be stimulated?

- The most important measures are *fiscal incentives*. A distinction is needed between incentives to kick-start the market for individual fuels, and efficient and durable incentives in the longer term that are not technology-specific (e.g. differential rates of fuel taxation based on external costs). However, reducing fuel tax fails to differentiate between "pollution hotspots" and rural areas.
- *Demonstration projects* have an important role in testing technologies, stimulating the market and raising consumer awareness.
- *Eco-labelling* and *green fleet certification schemes* are important, especially where the label remains on the vehicle in everyday use. This allows the consumer or fleet operator to show they have green values, and develops family/peer pressure to switch to greener options.
- *Green procurement* by Governments, whether voluntary or mandatory, can be significant in creating an initial market for new fuels and providing a signal to private consumers that these fuels are serious.
- *Standards* for vehicles and fuels are important in creating a unified market and ensuring consumer confidence.
- *Low emission zones* that allow city centre access only for clean vehicles, and *Quality Contracts and Partnerships* between local authorities and fleet operators, are new powerful tools for encouraging cleaner vehicles at a local level. Governments may need to provide the regulatory framework for their implementation and enforcement.
- It is important for Governments to assess short-term actions in relation to a longer-term strategy. The aim must be to minimise the risk of non-acceptance by the consumer. This reduces the risk for investors and allows economies of scale and learning to be reaped.

What should be the priorities for EU action?

- Develop *common standards and regulations* (e.g. for vehicles, fuels and refuelling infrastructure).
- Develop a methodology for *vehicle environmental labelling and rating* schemes that show clearly the benefits of cleaner vehicles, and encourage a common or harmonised approach across Member States.
- *Communicate developments* with cleaner vehicles. For example, facilitate the exchange of information between cities, disseminate R&D results, provide technology forecasts, and stimulate the co-ordinated supply of information from the European supplier base to Member State markets.
- *Lead by example*, e.g. in making procurement decisions for transport services and own vehicle fleets.
- Develop and disseminate an *EU transport fuels policy/strategy/analysis*, aimed at influencing the expectations of consumers and suppliers and promoting consistency between national policies. In part, this will be informed by the results of pilot and demonstration projects, evaluated at a European level.

- Propose *guidelines for tax policies* that reflect the relative environmental damage of vehicle options and encourage harmonisation within a European market.
- Provide *funding for R&D, for pilot and demonstration projects*, and for evaluation tools (such as the assessment of external costs) to guide the market actors and national/local policy-makers.
- Provide *guidelines for Low Emission Zones, green procurement mandates, green fleet certification and Quality Contracts* – particularly concerning the avoidance of barriers to cross-border trade and mobility.
- Clarify the *rules on State Aid* concerning the use of short-term subsidies to stimulate the market for cleaner vehicles.

What local actions are needed?

- *Use demonstration projects* to promote the uptake of cleaner vehicles. Good practice includes:
  - *hitting the target* - target the project at the most suitable fuels, applications, technologies and users;
  - *working with stakeholders* – ensure that all relevant stakeholders are included from the start of the project;
  - *packaging measures together* – introduce cleaner vehicles in parallel with supporting measures such as low emission zones, bus priority measures, information systems etc.;
  - *getting the image right* - ensure that clean vehicles are also fast, frequent (for public transport), comfortable, stylish, easy to use and highly visible;
  - *exiting gracefully* – have a strategy for making the transition from a supported demonstration project to commercial use.
- *Infrastructure support* is vital. Ensure the provision of refuelling, recharging and maintenance infrastructure, either by direct funding at local, national or EU level or in partnership with fuel and vehicle suppliers.

- Use *urban planning controls*. For example, low emission zones where all but the cleanest vehicles are banned from city centres can be a highly effective tool for promoting the use of cleaner vehicles.
- Encourage *green procurement*. Set a good example by buying green vehicles for local authority fleets, and encourage other fleet operators to green their fleets using tools such as Quality Contracts and Partnerships, or by supporting Green Fleet and Green Commuter programmes. Joining with other cities to form a procurement consortium can be effective in persuading manufacturers to reduce prices and extend the range of vehicles available.
- *Lobby for national support*. Supporting policies at national and EU level are vital. These may include a long-term fuel tax regime which recognises the environmental benefits of cleaner fuels, subsidies to offset the high cost of vehicle purchase in an immature market, and legislation to enable local governments to use tools such as low emission zones and green procurement.

Info-points

Where can I find further information?

The following list identifies selected Web sites that may be useful. The list cannot be comprehensive, and it does not imply any form of recommendation or approval.

Electric and hybrid vehicles

- European electric road vehicle association (AVERE)
  www.avere.org
  Contains links to national electric vehicle associations, links to demonstration project sites, general information on electric vehicles, details of forthcoming exhibitions and a summary of incentives currently available in each EU country. Also has the European Electric Vehicles Database - a catalogue of available models with photos, technical information and manufacturer contact details.
- CITELEC, European Association of cities interested in the use of electric vehicles
  www.citelec.org
- Skåne electric vehicle programme
  www.kfb.se/ehvproge/ (www.vinnova.se from late 2000)
- Le Touc EV service
  www.letouc.fr
- Mendrisio EV fleet test
  www.infovel.ch
- ELCIDIS, Electric vehicle city distribution systems
  www.elcidis.org

CNG, LPG and biogas

- European Natural Gas Vehicles Association
  www.engva.org.
  Contains general information on natural gas vehicles, a second-hand gas vehicle advertising board, and a guide to services and equipment.
- International Association for Natural Gas Vehicles
  www.iangv.org
- World LPG Association
  www.worldlpg.com
- French CNG bus programme
  www.ademe.fr
- Linköping biogas bus project
  www.kfb.se, www.linjebuss.com, www.sbgf.org, www.sgc.se

Buses

- SAGITTAIRE hybrid bus project
  www.sagittaire.org
- Leeds guided bus project
  www.eltis.org

Freight vehicles

- ELCIDIS, Electric vehicle city distribution systems
  www.elcidis.org

Car sharing

- The Car sharing Network http://www.carsharing.net/. Links to car sharing organisations in Europe, the USA, Canada and beyond, plus a library.

Self-service electric vehicles

- Praxitele short-term EV rental scheme
  www-rocq.inria.fr/praxitele/
- Martigny CityCar short-term EV rental scheme
  www.post.ch/d/postauto/main/neue_angebote_citycar.html

Two-wheelers

- Trondheim bicycle lift
  http://spiderman.novit.no/dahls/Trampe/
- E-TOUR (Electric two-wheelers on urban roads)
  www.etourproject.org
  Contains useful links to many other cycling and electric two-wheeler sites (under "E-TOUR links").

Low emission zones and urban planning

- ALTER programme
  www.alter-europe.org.uk
- Clear Zones programme, UK
  www.clearzones.org.uk
- National Society for Clean Air, Cleaner Transport Forum (UK)
  www.greenchannel.com/nsca
- Car Free Cities
  www.carfree.com

General demonstration projects

- ELTIS (European Local Transport Information Service)
  www.eltis.org
  Database of several hundred demonstration projects in Europe.
- THERMIE targeted transport projects
  www.thermie-transport.org
- ZEUS project on low emission vehicles
  www.zeus-europe.org
- CENTAUR project (including Bristol, Bologna and Dublin examples)
  btsa@btsa.es

EU Member State support programmes

- UK Powershift programme
  www.est-powershift.org.uk
  The UK support programme. Gives general information and news on alternative fuelled vehicles and details of how to apply for a grant to help cover purchase costs (currently for LPG, CNG and electric vehicles). Also has the Powershift Register – a catalogue of approved models available in the UK – and a map of LPG refuelling sites in the UK.
- French programme on clean vehicles
  www.ademe.fr
- Swedish vehicle and fuel programmes
  www.vinnova.se
- Dutch sustainable mobility programme
  www.novem.nl
- Italian cleaner transport initiatives
  www.minambiente.it

World-wide experiences and links

- US Department of Energy Alternative Fuels Data Center
  www.afdc.nrel.gov
- US Environmental Protection Agency
  www.epa.gov/otaq/consumer/fuels/altfuels/altfuels.htm
- US Alternative Fuel Directory
  www.vwc.edu/library_tech/wwwpages/gnoe/avd.htm
- EURO-EST
  www.euroest.environ.se/.
  Environmentally sustainable transport in Europe – a networking, discussion and information site run by the Swedish Environmental Protection Agency.

Assistance for project selection, management and evaluation

- "Navigate UTOPIA" support tool
  http://utopia.jrc.it/
- MAESTRO Guidelines
  www.europrojects.ie/maestro
- ExternE project on external costs
  http://ExternE.jrc.es/

Information on alternative fuels and cleaner vehicles

- International Energy Agency Automotive Fuels Information Service
  innas@wxs.nl
- Report of the Alternative Fuels Group of the UK Government's Cleaner Vehicles Task Force, available from
  www.autoindustry.co.uk/library/books_reports/books_7.html
- Reports to the Canadian Government Transportation Climate Change Table
  www.tc.gc.ca/envaffairs/english/climatechange/ttable/

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Summary of project outputs

Deliverables

Deliverable	Description	Lead partner
D1	Review of new propulsion systems	VW
D2	Review of new vehicle and transport concepts	TNO
D3	Survey of pilot and demonstration projects with clean vehicles	CERTU
D4	CD-ROM of final project outputs	CERTU
D5	Review of factors influencing the market acceptance of cleaner vehicles and new transport concepts	UTwente
D6	Analysis of case study findings	TNO
D7	Prototype of “Evaluation Tree Methodology” for studying the success factors for pilot and demonstration projects	CERTU
D8	“Evaluation Tree Methodology” for studying the success factors for pilot and demonstration projects	CERTU
D9	Review and modelling of market factors affecting the introduction of cleaner vehicles	INSEAD
D10	Survey and review of policy options affecting the introduction of cleaner vehicles	CERTU
D11	Methods and software tools for assessing the environmental impacts of cleaner vehicles	IER
D12	Survey of stakeholder requirements for decision support	EST
D13	Validation of methodology for on-site data collection	DITS
D14	Specification of NAVIGATE UTOPIA decision support system	JRC
D15	Review of on-site surveys	DITS
D16	“Demonstrating cleaner vehicles: Guidelines for success” (available from http://utopia.jrc.it/)	AEAT
D17	“Promoting cleaner vehicles: Policies and programmes in the EU” (available from http://utopia.jrc.it/)	AEAT
D18	NAVIGATE UTOPIA web-based decision support system for selecting clean vehicle solutions to city transport problems http://utopia.jrc.it/	JRC
D19	“Cleaner vehicles in cities: Guidelines for local governments” (available from http://utopia.jrc.it/)	AEAT
D20	Video of main project outputs	DM

Publications and presentations

Publications and presentations	Lead partner
UTOPIA project newsletters 1-6 (1998-2000).	CERTU/ CETE-L
“ENGVA is a Partner in new UTOPIA Project”, ENGVA News, September 1997.	ENGVA
B. Guellard, UTOPIA poster presentation, Electric Vehicle Symposium EVS 14, Orlando, USA, December 1997.	CERTU
“Project UTOPIA Gets Started”, ENGVA News, January 1998.	ENGVA
“UTOPIA: snellere marktintroductie van nieuwe aandrijf- en vervoersconcepten” (UTOPIA: rapid market-introduction of new propulsion systems and transport concepts), Inro Nieuws, Number 16, April 1998, Delft, The Netherlands, ISSN: 1380-1821, p5. (In Dutch.)	TNO
J. M. Seisler, incorporated into presentation at combined IANGV & ENGVA 4th Annual NGV Conference & Exhibition, “NGVs Becoming A Global Reality,” 26-28 May 1998, Cologne, Germany. Also presented to ENGVA Board of Directors meeting and Annual Meeting of the Members, May 1998.	ENGVA
B. Elzen, “Strategic Niche Management in Context - The wider-reaching objectives of the UTOPIA project”, Paper presented at Strategic Niche Management Conference, Seville, Spain, 8-10 June 1998.	UTwente
B. Guellard, UTOPIA poster presentation, Car Free Cities Conference, Edinburgh, UK, June 1998.	CERTU
UTOPIA article in Generation VE Flash no 27, AVERE, July 1998.	AVERE
B. Guellard, Conference paper presented at EVS-15 Symposium, Brussels, Belgium, 1-3 October 1998.	CERTU
B. Guellard, Conference paper presented at International local authorities forum, Monaco, 16 October 1998.	CERTU
B. Elzen, ‘Tuning Technological Change to the Needs of Society – Examples from the Domain of Traffic and Transport’, in *Memoria de las 3as Jornadas Latinoamericanas de Estudios de la Ciencia y Tecnología*, 23-25. Invited keynote lecture, Querétaro, Mexico, 19-21 October 1998.	UTwente
J. Murray. Presentation at International Conference on Innovation in Urban Transport, Graz, Austria, 25-26 November 1998.	EST
B. Guellard, “Potentials of alternative fuels in urban transport”, Conference on Innovation in Urban Transport, Graz, Austria, 25-27 November 1998.	CERTU
D. Bauner, “UTOPIA- ett EU-projekt om utvärdering av alternativ fordonsdrift”, (UTOPIA – an EU-project on the evaluation of alternative vehicle propulsion), Transportforum, Linköping, Sweden, 14 January 1999.	KFB (now Vinnova)

Publications and presentations	Lead partner
J. M. Seisler, incorporated into presentation at ENGVA 5th Annual NGV Conference & Exhibition, "NGVs On the European Agenda", 18-20 May 1999, Amsterdam, The Netherlands.	ENGVA
D. P. Moon, "Market introduction of urban transport solutions based on new propulsion systems", 1999 Windsor Workshop on Transportation Fuels, Toronto, Canada, 7 June 1999.	AEAT
B. Guellard, "How the policy context affects new transport propulsion systems' market introduction", Conference New Mobility '99, Workshop on New propulsion systems, Dortmund, Germany, 17 June 1999.	CERTU
UTOPIA poster, 3rd Rebuild Conference: Rebuilding the City of Tomorrow, Barcelona, Spain, 4-6 October, 1999.	EST/BTSA
B. Elzen and R. Hoogma, "EVs as a Stepping Stone towards a Sustainable Transport Regime - Stimulating Renewal by means of Strategic Niche Management", Proceedings of the 16th International Electric Vehicle Symposium, Beijing, China, 12-16 October 1999.	UTwente
B. Guellard, "Towards new urban transport systems: UTOPIA, an evaluation project", 16th International Electric Vehicle Symposium and Exhibition "Clean driving into the 21st Century", Beijing, China, 12-16 October 1999.	CERTU
P. Zwaneveld, A. Heyma and W. Korver, "The determination of success factors in European demonstration projects for new propulsion systems and transport concepts", presentation by Arjan Heyma, Colloquium Vervoerplanologisch Speurwerk, The Netherlands, November 1999.	TNO
J. Murray, UTOPIA project presentation, EC Transport Research Conference, Lille, France, November 1999.	EST
T. Fischer, "Development tendencies of electric vehicles", Fuel Cell Symposium, Graz, Austria, November 1999.	AMOR
B Guellard and K Guessoum, "Transporting people and goods. Le Touc, a new and clean alternative", European meeting "City of Tomorrow – Electricity for Sustainable Development", Strasbourg, France, December 1999.	CERTU
T. Fischer, Development tendencies of electric vehicles, VEO-Journal (Austrian Association of electricity producers), January 2000.	AMOR
D. Bauner, UTOPIA-ett EU-projekt, Transportforum, Linköping, Sweden, 11 January, 2000.	KFB (now Vinnova)
B. Elzen, "Learning from experiments with transport innovations - A crucial step towards sustainable mobility", Paper for the 2nd Colloquium "Verkeer, Milieu en Techniek" (Traffic, Environment and Technology), RIVM, Bilthoven, The Netherlands, 29 June 2000.	UTwente
G. Malavasi and S. Ricci, "New urban transport systems: ongoing experiments and application fields", Urban Transport and the Environment for the 21st Century 2000, Cambridge, UK, July 2000	DITS

Publications and presentations	Lead partner
C. Brand and D. P. Moon, “Integrated modelling and decision support for environmental transport policy and technology choices across Europe”, European Transport Conference 2000, 11-13 September 2000, Cambridge, UK. Published in Proceedings of Seminar K, Transport Modelling, Volume P445, ISBN 0-86050-341-0, 2000.	AEAT
D. Bauner, “Hybrids in Sweden”, presented at INTERTECH conference Hybrid Vehicles 2000, Windsor, Ontario, Canada, 13 September 2000.	KFB (now Vinnova)
A. Rader-Olsson (ed.), “Clean Vehicles with Electric Drive. Final report from the Swedish research, development and demonstration programme on electric and hybrid vehicles”, KFB-Report 2000:27, Sweden.	KFB (now Vinnova)
UTOPIA seminar, Paris France, 30 May 2001.	CERTU, CETE-L
W. Krewitt in “Towards Reduced Environmental Burden of Mobility: Improving the Automobile Life Cycle”, M. Kuhndt, B. Bilitewski (Eds.), with contributions from C. Abrassart, G. Carli, F. Convery, W. Krewitt, W. Niderle, K. Sauer. A CHAINET Case Study Report. To be published by the European Commission.	IER

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[2] National Society for Clean Air and Environmental Protection Cleaner Transport Forum, July 1999, “Low Emission Zones: Reducing the environmental impact of vehicles in urban areas”, report by TTR and University of the West of England, ISBN 0 903474 47 6.

[3] ZEUS project, 2000, Final Report to DG Energy and Transport: Reducing Barriers to Zero and Low Emission Mobility: A Guide for Cities, www.zeus-europe.org.

[4] www.alter-europe.org.uk

[5] “Choosing Cleaner Cars: The Role of Labels and Guides”, Transport Research Institute, Napier University, and Environmental Change Institute, Oxford University, October 2000, TRI Record 00/10/01, ISSN 1472-5789.

[6] “Fuel economy labelling of passenger cars”, EVA report, www.eva.ac.at/(en)/projekte/carlab.htm.

[7] “New funding and organisational mechanisms to create clear zones: a debate”, Clear Zones Working Cities Group, May 1999. Available on http://www.clearzones.org.uk