Routes to Sustainable Transport

An overview of status and policy strategies for sustainable transport in Europe

EPTA

European Parliamentary Technology Assessment

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Introduction

Transportation is a large energy consumer in modern societies. In a future with considerably less fossil fuels and restrictive policies towards global warming it seems improbable that transportation can still increase its share of the available energy. The term Sustainable Transport is used as a signal of a new development in transportation, which involves strategy shifts with regards to for example energy-efficient transport, the use of renewable energy sources, motor and vehicle technologies, taxation systems, private/public transportation, and physical planning. Countries and regions aim to reduce emissions of CO2, to ensure security of energy supply, to maintain mobility and to protect their economy and growth – and Sustainable Transportation seems to be a key concept.

No country or region can claim to have a sustainable transportation system in place yet. Many of the needed technologies are not commercially available. The transitions needed involve enormous investments, from society, industry and for the citizens. And not least, we demand effective and cheap transportation, which provides us with the mobility we need at any time – and therefore, the claim for a large transition is often met with scepticism. Accordingly, new policy options are discussed, experimented with and evaluated.

The purpose of this report is to help to exchange knowledge to policy-makers by providing an overview of current developments, major challenges, policies and strategies in the EPTA member countries and regions. The presentations from the various countries share a common structure, while at the same time allowing for a focus on country-specific issues. Each country is reporting on issues concerning:

- The State of Policy
- Energy Use for Transport
- Regulation and Technology Options for Sustainable Transport
- Land Use and Physical Planning
- Border-crossing Transport in Europe

Presentations have been kept short to ensure readability, accessibility and oversight. We hope that this will be valuable to parliamentarians and other decision-makers.

This report is the result of a joint project of some of the members of the European Parliamentary Technology Assessment network (EPTA):

Member Organisations:

- CAPCIT - The Advisory Board of the Parliament of Catalonia for Science and Technology. Catalonia, Spain.

- Committee for the Future, Parliament of Finland. Finland.
- DBT - The Danish Board of Technology. Denmark.
- GPTCA - Greek Permanent Committee of Technology Assessment. Greece.
- IST - Institute Society and Technology. Flandern, Belgium.
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- BAS - Bureau of Research. Poland.
- The Committee on Culture, Science and Education of the Parliamentary Assembly of the Council of Europe.
- ITA - Institute of Technology Assessment. Austria.
- OSTC - Belgian Federal Office for Scientific, Technological and Cultural Affaires. Belgium.

The different institutions are responsible for the description of the country or region where they belong. The project has been coordinated and managed by the Danish Board of Technology (Teknologirådet), which holds the EPTA precidency for 2010. We would like to thank all participating institutions for their contributions to this extremely important topic.

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Copenhagen, October 26, 2010

Austria

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State of Policy

Currently, there is no "overall sustainable transport strategy" in Austria as such, but sustainable transport goals are integral parts of the

- *Austrian National Climate Strategy* ("Österreichische Klimastrategie 2007"; including "soft measures" in transport such as mobility management, bundled in the national transport climate protection programme "*klima:aktiv mobil*"), which attempts to achieve the "Kyoto goals" (for AT: minus 13% green house gas (GHG) emissions 2008-2012 compared to 1990.
- Furthermore GHG emissions are to be reduced by 16% by 2020 compared to 2005 levels (excluding emission trading), according to the EU's "20-20-20 targets", and the
- *Austrian National Energy Strategy* ("Energiestrategie Österreich"), paving the way for the EU "20-20-20" targets at national level. For transport in AT this means that by 2020 10% of the whole energy input will have to come from renewable energy sources, contributing to the target of a 19% reduction of final energy consumption in transport. As of 2008, the transport sector in AT was 95% dependent on fossil fuels[1] (almost entirely oil).

These goals for transport are quite ambitious, since it is the sector with the fastest growing GHG emissions (+60.8% from 1990 to 2008) and the one which deviates most from the sectoral target of the climate strategy.

To help meet the ambitious targets, varying instruments have been implemented to boost a cut in GHG emissions, energy consumption and to encourage energy efficiency in transport:

- Climate and Energy Fund, a national fund endowed with €150 million per year for climate protection and energy efficiency measures in all sectors
- "*klima:aktiv mobil*" programme, Austria's national climate protection programme in transport, offering consulting and financial support for CO_2-prevention measures (€25 million per year)
- an e-mobility master plan "under construction" (bringing together the action plans of varyious ministries)

For the "white hope"– e-mobility – alone, approximately €30 million per year is spent via "klima:aktiv mobil", "e- mobility model regions", "beacons of light for e-mobilty" and the technology research programmes "A3plus" and "energy systems of the future".

[1] Erneuerbare Energie in Zahlen, S.8, BMLFUW Dez. 2009

Governance and Responsibilities for Implementation

The latest version of the Austrian National Climate Strategy (2007) has only been endorsed by the federal government but not by the regional governments of Austria's nine provinces ("Bundeslaender"). That means that the federal level is responsible for reaching (or not) the targets set in the strategy. Nevertheless, a "climate protection law" is under construction, which is to determine the sharing of the burden regarding GHG emission reductions between the federal and regional levels for the "post-Kyoto" period (2013-2020).

Accordingly to the targets and visions described above, 200,000 e-cars should be on Austrian roads by 2020, which is a very ambitious plan, considering that 185 e-cars registered as of the end of 2009.

Energy Use for Transport

34% of Austria's final energy consumption (and 26.1% of GHG emissions, 2008) are within the transport sector (2009). Between 1990 and 2005, final energy consumption in transport rose by 80%[2].

In 2008 renewable energy sources contributed 5.3%[3] to the final energy consumption of the transport sector in Austria. Biofuels in particular helped to increase this share (and save GHG emissions: e.g. 1.375 million tons between 2007 and 2008). In the future, e-mobility (with electricity from renewable energy sources such as water, wind, biomass, solar energy) is expected to make a major contribution to increasing the share of renewables in transport to 10% by 2020 and to reducing energy consumption, especially from fossil energy sources.

- **Plans, policies and discussions on increasing the use of renewable energy sources for transport.** See point 1) and 2) above

Regulation and Technology Options for Sustainable Transport

As of today, a clear focus is laid on e-mobility/BEV (battery electric vehicles) but also on hybrids (combination of internal combustion engine plus electric motor):

On the one hand e-mobility is an important part of all strategies regarding GHG emission reductions and energy efficiency gains (see above). The Austrian Energy Strategy for instance is reckoning on some ten thousands of e-cars (powered with electricity from renewable energy sources) in 2020.

[2] Klimaschutzbericht 2010, S. 43, Umweltbundesamt, Wien 2010
[3] Erneuerbare Energie in Zahlen, S.8, BMLFUW Dez. 2009

On the other hand both federal and regional level have come up with several funding and support opportunities for different purposes ("model regions" and "beacons of light" for e-mobility, RT&D funds for technological developments, financial support for companies and private persons for the purchase of e-vehicles[4] and for electricity charging stations, exemption from vehicle purchasing tax, exemptions from local driving prohibitions due to high air pollution figures …).

Beyond alternative propulsion technologies such as BEV and hybrids, the blending of biofuels into fossil petrol (bio ethanol) and diesel (biodiesel) contributed to a significant drop of GHG emissions from transport and the share of fossil energy sources in transport. Since 2005, 5.75% (in terms of energy content) of regular fuels for road vehicles come from biogenic sources.

There is an Austrian road-pricing scheme for both cars (including two-wheelers such as motorcycles etc) and lorries, but only on motorways ("Autobahnen und Schnellstrassen"). For cars, every vehicle using the motorways has to pay a "flat rate" in the form of a sticker independently of the mileage. For heavy-duty vehicles the charge is dependent on the mileage and on the EURO class of the respective vehicle (the cleaner, the cheaper). In some places this road pricing scheme leads to "detouring traffic" on non-motorways, for which no charge is made.

Freight transport on Austrian roads has seen a decrease in the last two years due to the general economic crisis (e.g. minus 20% between January 2008 and January 2009[5]). This of course leads to less energy consumption and GHG emissions in/from transport, but is not "sustainable" as such, since the mileage will increase again once the economy prospers and since freight transport on more sustainable modes (rail and inland shipping) has also fallen to roughly the same extent.

Congestion charging schemes are often discussed, especially for cities and urban agglomerations, but as yet there is no such scheme in place anywhere in Austria.

The "purchase tax" on the purchase of a motorized vehicle ("Normverbrauchsabgabe - NoVA") can be considered a green tax, since vehicles with lower standardized CO_2 emissions (in terms of the NEDC/MVEG[6] driving cycle) pay less.

The NoVA has to be paid when a vehicle is registered for the first time in Austria (registration tax). As the tax burden is linked progressively to the vehicle's fuel consumption, NoVA is an incentive to buy more efficient cars regardless of the expected mileage. On 1 July 2008 the NoVA system was improved by a bonus-penalty system. This means that vehicles with CO_2 emissions of more than 180 g/km have to pay an additional NoVA of 25 Euros per gram in excess. If the car emits less than 120 g/km, a bonus of 300 Euros will be paid out. Furthermore, a bonus of 500 Euros is due if the vehicle has an alternative propulsion system (hybrid, gas, electric etc.). In 2010 the new system was tightened. Vehicles with an emission of more than 160 g CO_2/km have to pay the additional NoVA of 25 Euros per gram excess. Electric vehicles are exempt from this tax (so far).

[4] not at federal level, but most of the provinces provide funding for private persons when buying e-vehicles
[5] Klimaschutzbericht 2010, S. 43, Umweltbundesamt, Wien 2010
[6] NEDC…New European Driving Cycle; MVEG…Motor Vehicles Emission Group)

The “engine-related insurance tax” (“Motorbezogene Versicherungssteuer”) on motor vehicles is still bound to the vehicle's power in kW and not yet “greened” by binding it to the vehicle's CO_2 emissions.

Methods for Monitoring Environmental Impacts from the Transport Sector

- Yearly “Climate protection reports” of the Umweltbundesamt (Federal Environmental Agency): According to EU reporting requirements, these reports provide recent figures regarding GHG emissions from all sectors (compared to the year before and to 1990, the Kyoto baseline year). Transport is included and emission developments are split into sub-sectors like cars, heavy-duty vehicles, biofuels etc. Since CO_2 emissions are calculated indirectly from the amounts of fuel sold, energy values (PJ) are also available in this way.
- All air pollutants are also monitored by the Umweltbundesamt.
- There is a yearly report specifically on road transport/passenger cars, again by Umweltbundesamt, on "CO_2 emissions of newly registered passenger cars”, describing the development in GHG emissions from new cars.

Regulation on Specific Use of Technologies

- In Austria the usual EU EURO classification (setting limits to emitted air pollutants per vehicle) is in place.
- Particle filters are not mandatory for diesel vehicles. Nevertheless a consumer pays € 300.- more when purchasing a diesel car without filter. In 2009 90% of all newly purchased diesel cars were equipped with a filter.

Available and/or Necessary Technologies Beyond 2020

Beyond 2020 wide parts of the drive train of road vehicles will be electrified. At present BEV lead, followed by all types of hybrids and alternatives (plug-in hybrids, range extenders, hybrids etc.) However, technological solutions targeting vehicles only will never be able to solve the transport problem as a whole. It needs a balanced mix of awareness raising, intermodality, ICT, technology measures etc.

R & D Plan for Developing New Transport Technologies or Infrastructure

There is no plan specifically on this matter. However, transport technology is mainly tackled in R&D programmes of the transport ministry (known as IV2S+) and at present a comprehensive “Master plan on e-mobility” is being prepared by the government.

Land Use and Physical Planning

Generally speaking land use planning tools are quite weak at federal level in Austria (except perhaps infrastructure measures "of general public interest"). Land use planning mainly takes place at local and provincial level, which brings huge problems regarding climate change caused by more traffic resulting from scattered structures.

Transport and Mobility: Rural Areas Versus Densely Populated Areas

Motorization rates (cars per household) especially in rural areas are growing rapidly in Austria (overall from 460 cars per 1000 inhabitants in 1995 to 510 in 2008[7]), as in the rest of Europe, whereas the rate is decreasing in the Viennese urban area (the modal split of cars decreased from 40% to 32% during recent years).

In most land use plans, intermodality and "soft transport modes" such as walking and cycling are not dealt with in the same intensity as motorized transport.

Influence of Physical or Urban Planning to Reduce of Transport Growth

The car ownership rate in Vienna (403 cars/1000 inhabitants, 2005) and other urban agglomerations is significantly lower than in rural areas such as Lower Austria (570 cars/1000 inhabitants, 2005) or Burgenland (575 cars/1000 inhabitants, 2005[8]). The need to own a car in urban environments is not as great as in rural areas with insufficient or even no public transport. In urban agglomerations distances are shorter, roads more congested, public transport infrastructure is much better, and cycling and walking facilities are mostly also available.

E-mobility offers a chance for a paradigm change away from "you have to own a car" to "use cars in intermodal context", e.g. for the "last mile", especially in rural areas.

Strategies for Sustainable Urban Mobility and the Shift from Private to Public Transport

Strategies have been determined e.g. in the "Master Plan Transport Vienna 2003", where targets like reducing the modal split of motorized individual transport are set. Many initiatives such as testing electric vehicles, "model regions for e-mobility" ("VLOTTE" in Vorarlberg and "ElectroDrive" in Salzburg) plus cycling and walking incentives try to help to achieve the general modal shift towards more sustainable modes of transport.

[7] Statistik Austria; http://www.statistik.at/web_de/services/wirtschaftsatlas_oesterreich/verkehr/024196.html
[8] Verkehr in Zahlen, S. 80; Herry Consult für bmvit; Wien November 2007

Border-crossing Transport in Europe

Regulation/Policies of Transit Traffic

Transit (border-crossing heavy-duty goods vehicles) is a serious problem for Austria. Nevertheless, a former transit scheme for Austria ("eco points") was dropped by the EU and replaced with the possibility for “extra road-pricing“ in sensitive areas like the “Brenner” in Tyrol. Furthermore, the “road on rails“ (heavy-duty road vehicles on trains) is hugely subsidised in Austria in order to avoid excessive heavy-duty vehicle traffic on transit routes.

The “alpine convention“ would also offer appropriate tools but is not legally binding yet.
A desirable development would be to increase the EU share of goods transported via rail to Austrian levels (about 31% compared to 18% on EU25 level (2004[9]).
Hauliers from abroad in particular (mainly from the EU member countries in the east) use older rather than the newest EURO generations of lorries. These pay more for road pricing than newer ones (EURO IV, EURO V), and cause greater air pollution.

A specific issue here is also the VAT on fossil fuels. Since this tax is lower in Austria than in neighbouring countries the overall price for diesel and petrol is lower in Austria with the effect that fuel (causing about 5.6 million tons of GHG emissions) is purchased in Austria but used in other countries (“price induced fuel export”). These 5.6 million tons count towards the Austrian climate balance, causing a major part of the 6.9 million tons GHG emissions that Austria is in excess of its Kyoto targets[10].

Emission Standards and Speed Limits

Emission standards are determined by EU regulations. Speed limits have been unchanged since years. Lowering the latter would help to save GHG emissions, but generally is not to be expected. Rigorous controls of existing limits would, while regionally implemented lower speed limits due to NEC (National Emission Ceiling) Directive do help to lower GHG and pollutant emissions.

Environmental Impact Assessment of Large Infrastructure Investments and Green Transport Corridors

The EIA of large infrastructure investments up to now has not helped too much to reduce the negative environmental consequences of transport.
“Green transport corridors” at present is not much more than a nice catchword. Nevertheless, member states are working on plans to introduce such corridors.

[9] Verkehr in Zahlen, S. 114; Herry Consult für bmvit; Wien November 2007
[10] Klimaschutzbericht 2010, S. 43, Umweltbundesamt, Wien 2010

Harmonisation

Regarding the harmonisation of border-crossing railways, problems with e.g. signalling etc. are still evident. The biggest problem, at least for Austria and e.g. Italy, seems to be the different frequencies of the electricity used to power the trains. Only “dual-frequency locomotives” can handle these differences. In addition, different gauges (especially between Austria and the “Russian system”) starting with the Ukraine, but also – for instance – between France and Spain have not been solved yet.

European Strategies for Long Distance Transport – Concerns and Experiences in General

From an environmental point of view road TENs (Trans European Networks) are a reason of concern. “TENs” for a more sustainable transport system, for local and regional transport, for public transport and for cycling would be desirable.

Denmark

DBT – The Danish Board of Technology
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Pkm rose from 69.879 in 2000 to 75.326 in 2008. 83% pkm were driven in cars, 13% in public transport – the rest other modes, with inland aviation having increased.
I Denmark the road network is approximately 71.600 km and the cycle path network is more than 12.000 km.

State of Policy

Sustainable transport entered the Danish government's agenda with the transport initiative "Sustainable transport – better infrastructure" from December 2008. In January 2009 the government and oppositional parties agreed a Green Transport Policy. Until 2014 8,1 billion kr. (1,2 billion euros –figures to be checked) will be spent to improve the conditions for the environment, the security and the mobility in the transport system. Investments include the Fehmarn Belt connection - highway and electrified high speed rail. Other investments are directed at improving the railway network, in particular updating signal systems to EU standard (ERTMS).

Transport Policy Aims

- Reducing of the transport's CO2 emissions.
- Public transport should lift most of future growth in traffic. The railroad should be reliable, safe and modern.
- Road capacity must be developed, in places with congestion problems, but also where future traffic growth resulting from economic and social development will require an expansion of infrastructure.
- Transport by bike must be encouraged - the choice of the bicycle is preferable, where it is a realistic option.
- Denmark shall be a laboratory for green transport.
- Bridges, roads and railways must not destroy irreplaceable nature
- Noise and air pollution have to be reduced in cities.

Climate Targets and Transport

GHG – reduction 2050 (1990 level)	80-95%
GHG – reduction 2020 Transport should contribute	> 20%
Renewables share of energy consumption 2020	30%
Renewables share of transports energi consumption 2020	10%
Share of biofuels (surface transport) 2020	10%

R&D

A strategic research programme aimed at transport has set aside 8 billion euros in 2010 for research in sustainable transport and infrastructure.
A fund (approx 40 billion euros) has been set aside for projects that will develop technical solutions to green traffic.

The Climate Commission

The government's Climate Commission has worked out suggestions for a coherent energy system, which can ensure improved energy efficiency, increased share of renewable energy and promote the competition on the energy market. The vision is to make Denmark independent of fossil fuels before 2050. The energy system includes the transport sectors energy consumption as well.
The Danish Board of Technology's project on sustainable transport has taken up the idea and will investigate what it takes to switch over the transport system to 100% renewable energy before 2050.

Governance and Responsibility for Sustainable Development in the Transport Sector

Due to globalisation and rising competition (liberalisation) in the transport sector, the organisation of the sector has changed. Big international operators in both rail and bus service has entered the market, causing a fragmentation of public transport. Increase in transit freight transport and a shift from rail to road has created a pressure on road network capacity. Accordingly, needs for coordination, planning and regulation have increased. The national Danish Transport Authority together with regional transport authorities and local governments carries out these tasks. The Ministry of Transport has the overall responsibility for implementing strategies for a sustainable transport sector. Regulation and procurement is delegated to several authorities.

Energy Use for Transport

Energy Consumption in the Transport Sector and Renewable Energy Sources

The energy consumption in the transport sector was in 2007 225 PJ. This corresponds to approximately one third of the whole energy consumption of 685 PJ. The energy consumption in the transport sector is higher than the energy consumption in the households.
Today the share of renewable energy in the transport sector accounts for 1 % of the total share. Wind power and bio fuels are the two primary sources of renewable energy in the transport sector.

Plans, Policies and Discussions on Increasing the use of Renewable Energy Sources for Transport

Wind power and biofuels are the most important renewable energy sources in Denmark.
Ongoing discussions are about the balance (we allready import biofuels which can be not sustainable) and order of introducing biofuels and wind power electricity for transport. This is connected to technologies: biofuels can be used directly without shifting the carpark to BEV's. Much research and development is aimed at second-generation biofuels. On the other hand, BEV's are clean tech regarding CO2 and other polluters, and they can be integrated into the energy system as both capacity and consumer. Expectations are that even with the current policy BEV's will not reach sufficient numbers in 2020 (original target was ½ million, now the figure is reduced to 80.000). Some argue that in the short term biofuels might be the better option for transport, to achieve CO2 reduction targets before 2020.

Regulation and Technology Options for Sustainable Transport

BEVs

BEVs were boosted when Better Place (an american BEV company) agreed with the Danish energy consortium, DONG Energy, to invest 770 mio.dkr. in building a network for BEVs in Denmark.
DONG Energy sees BEVs as having the potential to increase flexibility in the energy system and turn surplus wind energy into business.
BEVs are exempted from the otherwise high taxes on cars in Denmark until 2012. Currently it is discussed whether the exemption should be prolonged.

Green Taxes

The green tax has long been an important tool to reducing the use and covering the expenses related to the environment. Depending on how far the vehicle can run on the litre the owner has to pay a green tax. If the car runs at least 20 km it costs approximately 35 Euros every 6 months and if the car runs les than 4,5 km on the litre it costs 1.240 Euros every 6 months.
A reduced tax on cars with low fuel consumption has increased the share of small, energy efficient cars. The green taxes and better information about the car's energy efficiency have increased the average GHG emissions from the new and more efficient cars more than 20 % since 2000.

Road Pricing

It was a governmental decision to introduce roadpricing by 2012, using the same model and technology as the Netherlands. However, as the Netherlands stopped their plans, the Danish Government took the consequence to postpone the Danish plans.

Methods for Monitoring Environmental Impact from the Transport Sector

The Environmental Protection Agency keeps an eye on the quality of air through measurements. To protect the citizens from adverse health effects of air pollution there has been set limits on how much pollution in the air we can accept and for each of the substances there are threshold limits. Denmark complies with the threshold limits for most of the substances but for particulates and NO2, we still need to do an extra effort. The Environment Protection Agency also measures the levels of noise from traffic and railways in Denmark.
In general, large infrastructure projects should undergo an environmental impact assessment before carried out**.**

Particle Filters

Since 1st. of April 2010 diesel cars should use a particle filter or otherwise pay a fee/tax of 1000 kr a year. To install a particle filter on old cars will however cost 5.000 – 10.000 kr, which from a cost-benefit analysis can be more expensive than paying the fee/ tax. A recent evaluation showed that by 1. September 2010 only 1000 out of 354.000 diesel cars had installed the particle filter. Further, critique says that the standard for the particle filter is not good enough to remove dangerous particles.

Land Use and Physical Planning

Physical planning and transport infrastructure building is in Denmark focused on three main transport corridors connecting Denmark to Scandinavia and the rest of Europe. Around Copenhagen the so-called ”finger plan” has prevailed for more than half a century, building space are the fingers and green zones are in between. This strategy is about to be developed for all of Zealand, so that urban development will take place in cities with railway connections. This is meant to avoid continued urban sprawl.

Transport and Mobility in Rural Areas Versus Densely Populated Areas

As part of a plan to avoiding further marginalisation of rural areas, the Government has initiated a plan to build new infrastructure (roads and highways) to connect rural areas with the more densely populated areas with dynamic economies. It also includes particular rules of physical planning, making it more attractive for production and retail companies to settle in these areas.

Urban Planning Aiming at Reducing Transport Growth

It is a general aim in Denmark to encourage bicycling, but some cities have chosen to take it further and have become cities of cyclists. Copenhagen and Odense are cities of cyclists and they have both made a massive effort in developing a comprehensive cycle infrastructure.

Cyclists in Copenhagen travel a total of 1.2 million km by bike every day. This is the equivalent of cycling to the moon and back – twice! There is a total of 350 km of cycle tracks and 40 km of green cycle routes in Copenhagen, equivalent to the length of Jutland. 37% of those working or studying in Copenhagen bike every day. A big city with so many cyclists offers many benefits. In terms of the environment alone, cyclists help keep the city's CO2 traffic emissions at a low level compared to other big cities. When we reach the stage that over 50% of commuters choose to cycle to their place of work or education, then Copenhagen traffic will be able to save an additional 80,000 tons of CO2 per year.

Border-crossing Transport in Europe

The biggest Danish border crossing infrastructure project, the Fehmarn Belt connection, prolonged towards Sweden via a new Helsingør-Helsingborg connection. The case shows the focus on connecting Scandinavia to Europe, paving the way for transit freight transport and high-speed rail connections between larger cities. Unfortunately the environmental aspects are not that much in focus. High-speed rail is discussed as an option, mainly to connect the large Danish cities with large cities outside Denmark. The plan for the Fehmarn Belt connection is to have electrified rail. However, in the short term there are no plans for electrification.

European Parliament

STOA – Science and Technology Options Assessment
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State of Policy

Globally, transport contributes with 13-14% to Green House Gases (GHC).[i] For Europe, this figure mounts to 21%[ii]; a half of this amount is attributed to long distance transport[iii] - a sector totally dependent on oil.

Not only is this a pressure on natural resources and environment, in addition, the increase in congestions and bottlenecks in the European transport network restricts the free flow of goods and people, especially in the centrally located and densely populated regions of the European Union. Such trends run counter the Lisbon strategy, which aims at making Europe the most competitive and the most dynamic knowledge-based economy in the world. The increased traffic led to a reduction of the quality of life - emissions of air pollutants, noise and reduced spaces for living.

The future European transport has to overcome a range of challenges and will be on the agenda of the European Parliament's in the years to come. STOA projects were undertaken with the aim of reducing oil dependency by 80% and CO2 emission by 60% in the year 2047.

This report is primarily based on a number of completed STOA projects, carried out by Ida Leisner, Jens Schippl, Christian Dieckhoff, Torsten Fleischer, and Anders Kofoed-Wiuff et al. Given the importance of transport related issues, STOA is currently running a project "Technology Options for Urban Transport" and will soon start a new one around the theme of "User perceptions on eco-efficient transport futures for Europe".

Energy Use for Transport

Trucks (freight) consume the largest amount of energy used for transport, followed by aviation (passengers), mainly oil, emitting most of transport related CO2 emissions. The breakdown for well-to-wheel energy consumption is: Trucks (54%), Aviation (27%), Private cars and motorcycles (14%) - status quo of 2005.

Regulation and Technology Options for Sustainable Transport

The European Commission has established a proposal that requires a reduction of the average emissions of CO" from new passenger cars in the EU from around 160 g/km to 130 g/km in 2012 - the average sold

car produced between 160-190 g/km during 1995 - 2006 period. In scenarios, a reduction down to 100 g/km is assumed to be obtained by 2030.

With an aim to improve energy efficiency and reducing emissions, a wide range of technological pathways are being discussed. Hydrogen production from renewable sources (wind, photovoltaic, solarthermal, water) via electrolyses enables close to zero emissions of GHG. A 'clean' production of hydrogen from nuclear power is also feasible. Hybrid technology offers a possibility to save energy and emissions by using established technologies and infrastructures. The commercialization of electric cars (Battery Electric Vehicles) depends on the development of sustainable batteries. Electric vehicles and plug-in hybrid electric vehicles offer multiple benefits by improving fuel efficiency as well as the utilisation of wind energy by using electricity in a more flexible way - e.g. by charging at certain times or serving as "batteries" for the electricity systems.

Biofuels can be derived from a wide range of biomass and might serve as a relatively clean 'bridging' and 'additional' technology. First generation of biofuels, mainly biodiesel and bioethanol, are the only renewable transport fuel option that is commercially deployed. Second generation biofuels are produced by synthesis, in most cases from synthesis gas which is then treated in a so-called 'biomass-to-liquid' process (BTL) - offering an option to define specific fuel properties. It is estimated that 20-30% of EU 27 road transport fuels in 2030 could be covered by biofuels. Natural gas technology (CNG) is feasible in the transport sector and has the potential to bring at least mid-term GHG emissions improvements. Autogas (LPG), an uncomplicated technology, is becoming popular in several European countries. It is likely that innovative technological developments will be implemented and established faster in the road sector.

For air transport, there are less options and kerosene fuelled gas turbines will probably remain the relevant technology for the near future.

Land Use and Physical Planning

The task is to influence spatial planning with the aim to prevent transport growth that would jeopardize citizens' mobility. Sustainable (urban) infrastructure ought to serve mobility needs of the population - examples walking, cycling or public transport. Transport technologies and transport flows need to be orchestrated efficiently without wasting resources. ICT applications allow 'load matching' - improving capacity use and reducing empty running of trucks. An optimized distribution of warehouses should reduce transport volume. Industrial areas and railway station could be located closer together. Intelligent Transport Systems could improve traffic flow and thus accessibility. Route guidance has a potential to improve efficiency by avoiding detours or by circumnavigating congested areas. Rail transport would be the best way to introduce electricity in freight transport.

Land use planning is a relevant measure for the long run and will be more effective if coordinated at European level. Distribution of airports in a country, such as development of a few huge airports could

strengthen high-speed railways, given there is a corresponding infrastructure. Transport volumes in the air sector could be tackled by the implementation of high-speed railway lines.

Border-crossing Transport in Europe

The Trans-European transport network is a European Union current strategy, among others aiming at aiding with free movement of goods, people and services. It is also an element for economic growth and the creation of employment. It includes upgrading and building new airports, new high-speed railway lines, motorways of the sea, etc. Examples include the railway corridor Lyon-Trieste-Divaca/Koper-Divaca-Ljubljana-Budapest-the Ukrainian border and the Fehrman Belt railway corridor between Denmark and Germany.

Conclusion

It was concluded that no single policy can solve these problems. In conclusion, options for reducing oil dependency, including lowering CO2 emissions include: Investment in rail infrastructure to encourage modal shift, including cross-border high-speed rail; Reorganisation of airports distribution with the aim of travel reduction – only few mega airports and integration of rail and air; Introduction of hybrid trucks, especially if combined with renewable energies, including hydrogen and biomass. Further measures would utilise the ICT potential within the transport sector, and a link-up of transport modes – intermodality. Reassessing of pricing measures – fuel prices, carbon based taxation, road pricing – could be wise.

Finland

Committee for the Future

State of Policy

Ministry of transport and Communications published A Climate Policy Programme 2009-2020 for transport sector on March 17th 2009.

The aim the Programme is to substantially reduce emissions from business, industry, administration and people's everyday lives by means of transport and communications policies.

Besides the use of biofuels, emissions from transport will be cut by 2.8 million tonnes compared to the estimated emissions level of 2020.

The administrative sector of the Ministry of Transport and Communications will adapt to the climate change in construction, maintenance and management of the transport and communications infrastructure so as to maintain the level of transport and communications services. Advantage will be taken of the possible benefits of the climate.

The following measures will be taken to achieve the climate policy aims of the administrative sector:

1. The vehicle fleet will be renewed. 2. Energy efficiency in transport will be improved. 3. The growth of passenger traffic volumes in urban areas will be directed to more environmentally friendly transport modes. 4. The attainment of Finland's climate policy objectives will be supported by information society and communications policy. 5. A decision will be made in 2012 on the financial steering methods used in the transport sector. 6. Action will be taken to adapt to the climate change.

Climate Programme in Transport Sector Aims

1. That in 2020 specific emissions of new cars sold in Finland would be near the EU objective (95 g/km; the current level is at around 163.5 g/km) and the rate of vehicle fleet renewal would be around 7 per cent a year. The goal with regard to the entire vehicle fleet is that by 2020 the average carbon dioxide emissions would be 137.9 g/km at the most (currently around 180.1 g/km).

2. That goods transport and public transport operators party to energy efficiency agreements will save nine per cent in energy consumption and that the overall energy efficiency in the transport sector will improve. The emissions reduction potential from improved energy efficiency is 0.3 million tonnes.

3. That by 2020 a total of 100 million more public transport journeys and 300 million more walking and cycling journeys will be made, which means an around 20 per cent increase to the current figures.

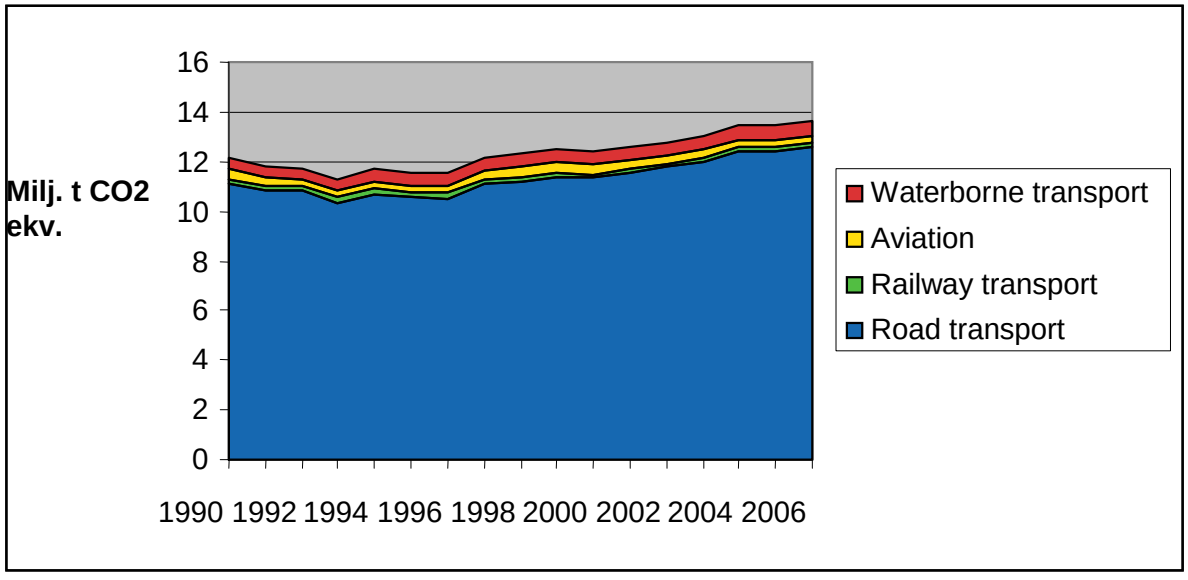
4. That the administrative sector will systematically promote the use of information society services, which decrease emissions in business, industry, administration and people's everyday lives.

5. That the climate change will not lower the current service level in transport and communications. In order to attain the goal the Ministry's administrative sector will update its instructions about transport infrastructure construction, maintenance and management, outline an action plan for exceptional circumstances and invest in research.

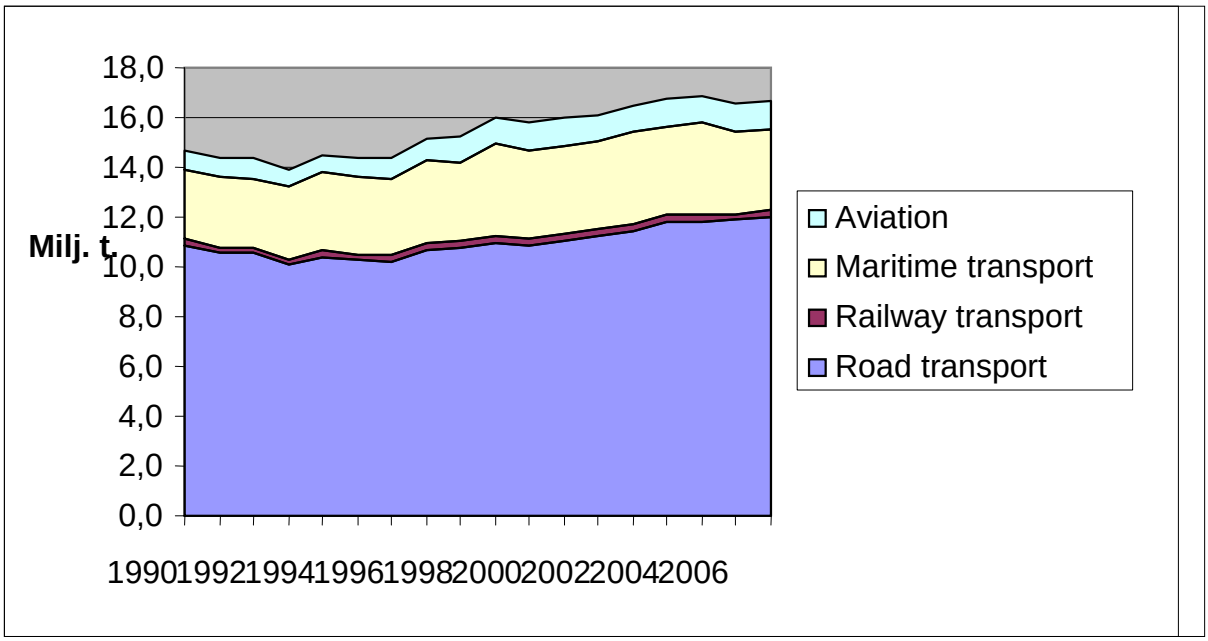
Climate Targets and Transport

The emissions reduction potential:

- from the vehicle fleet renewal (1) amounts to 2.1–2.4 million tonnes,
- from improved energy efficiency (2) is 0.3 million tonnes and
- from the change in the modal split (3) amounts to 0.3 million tonnes.



Total CO2 emissions in domestic transport



Total CO2 emissions transport sector of Finland, domestic plus international

Emissions of Transport and the Energy Use for Transport

Emission sand energy use of transport of Finland [t]

YEARI	CO	HC	NOx	Particles	CH4	N2O	SO_2	CO_2 [milj. t]	Energy use [PJ]
1980	501 781	70 445	192 735	8 934	4 286	442	31 640	11	146
1981	506 689	71 091	191 297	9 133	4 286	442	30 012	11	147
1982	509 193	71 839	189 852	9 311	4 324	453	28 436	11	149
1983	514 718	72 676	188 786	9 493	4 355	466	28 006	11	152
1984	516 608	73 668	189 072	9 705	4 405	483	27 583	11	155
1985	511 579	73 899	191 398	9 935	4 428	506	27 723	12	161
1986	506 334	74 286	192 304	10 137	4 447	521	26 289	12	169
1987	507 670	75 565	196 475	10 151	4 540	549	26 912	13	178
1988	509 628	77 459	199 811	10 143	4 666	579	26 172	14	185
1989	511 639	79 199	203 102	9 980	4 775	607	25 819	14	195
1990	497 372	77 700	201 392	9 881	4 652	632	25 399	15	200
1991	474 699	74 095	190 585	9 315	4 395	627	24 496	14	195
1992	461 090	72 042	185 666	9 022	4 256	626	23 944	14	194
1993	442 769	69 532	185 518	9 007	4 094	631	23 924	14	189
1994	428 560	67 223	186 596	8 871	3 953	639	24 250	14	197

1995	420 646	65 703	181 058	8 548	3 832	648	22 737	14	195
1996	408 697	63 188	174 826	8 167	3 672	650	21 399	14	194
1997	400 840	61 391	174 328	7 889	3 540	666	22 148	15	205
1998	391 855	59 282	164 549	7 316	3 393	673	20 720	15	206
1999	382 271	57 429	169 004	7 108	3 292	695	20 667	16	215
2000	365 539	54 171	160 088	6 587	3 098	686	19 962	16	213
2001	352 986	51 778	155 073	6 254	2 956	698	19 586	16	215
2002	337 581	49 244	148 278	5 980	2 823	696	19 846	16	216
2003	319 685	46 595	144 553	5 813	2 688	702	20 160	16	220
2004	299 336	43 424	134 512	5 391	2 467	689	18 790	16	225
2005	277 013	40 450	133 845	5 286	2 302	692	19 741	17	227
2006	252 923	37 371	121 373	4 855	2 064	675	18 159	16	223
2007	243 252	35 502	118 356	4 802	1 935	675	18 318	17	230
2008	**221 125**	**29 062**	**112 157**	**4 494**	**1 706**	**647**	**18 177**	**16**	**227**
2009	187 922	24 815	95 142	3 872	1 396	605	14 071	15	212
2010	181 939	24 027	94 381	3 863	1 323	619	13 795	15	218
2011	179 721	23 909	93 527	3 827	1 304	632	13 598	16	224
2012	177 956	23 762	93 023	3 810	1 287	647	13 456	16	229
2013	174 307	23 496	92 027	3 742	1 261	661	13 216	16	234
2014	170 153	23 105	89 605	3 667	1 227	674	12 502	17	238
2015	165 903	22 683	87 405	3 603	1 193	687	11 838	17	241
2016	160 760	22 112	84 930	3 482	1 160	698	11 218	17	243
2017	155 790	21 740	82 660	3 386	1 127	709	10 637	17	244
2018	150 744	21 491	80 636	3 310	1 098	721	10 091	17	246
2019	145 844	20 929	78 793	3 236	1 069	733	9 578	17	247
2020	141 860	20 634	77 132	3 155	1 047	750	9 092	17	248
2021	138 058	20 211	75 631	3 097	1 027	764	8 633	17	248
2022	134 399	19 997	74 351	3 046	1 008	778	8 196	17	248
2023	130 976	19 652	73 246	3 005	989	793	7 782	17	248
2024	127 969	19 333	72 264	2 969	973	807	7 389	17	248
2025	126 086	19 072	71 374	2 928	962	820	7 014	17	248
2026	124 346	18 907	70 772	2 904	952	833	6 660	17	248
2027	122 951	18 751	70 216	2 870	943	844	6 322	17	248
2028	122 014	18 661	69 748	2 837	937	853	5 998	17	248

The figures covers the domestic and international transport from and to Finladn but not the international overlights. In case of electric railways and trams the emissions are based on the total power supply in Finland and is calculated from share of the electricity use of trains and trams.

Lähde: LIPASTO 2008 laskentajärjestelmä

Last Updated 22.10.2009

By Kari Mäkelä, VTT

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The Current Share of Energy Consumption Used for Transport

The energy consumption in the transport sector was in 2007 227 PJ. This corresponds to one fifth of the whole energy consumption of 1 132 PJ. The energy consumption in the transport sector is higher than the energy consumption in the households.

The share of gross energy production coming from renewable energy sources such as bio fuels, hydrogen, electricity and other alternative fuels

The use of renewable energy sources at present in transport (excluding railways) is insignificant.

Plans, Policies and Discussions on Increasing the Use of Renewable Energy Sources for Transport

Government has introduced an Energy Package to enhance the use of renewable energy sources. The package includes different instruments (subsidies, R & D funding, and regulations) to develop and increase the use bio fuels and other renewable sources of energy. The Package does not have any dedicated means for transport. At the same time the Government has introduced a proposal for a reform of energy taxation, based on CO2 emissions – including some exceptions. New taxation is aimed to come into force at the beginning of year 2011.

Land Use and Physical Planning

Transport and Mobility in Rural Areas Versus Densely Populated Areas

The main challenge in reducing the use of energy in transport in Finland is that the country is sparsely populated and distances are long. The population is rapidly concentrating to urban areas but at the same time there is some signs of disintegration of urban areas in the regions of our biggest cities.

Strategies for Sustainable Urban Mobility and the Shift from Private to Public Transport or Cycling/Walking and Regulative Measures Like Road Pricing

Reference to the Climate Policy Programme 2009-2020.

Border-crossing Transport in Europe

In terms of vehicle volumes and total value of cargo Finland is the biggest import border-crossing country of Russia in road transport. Finland applies same rules for transit transport as to domestic. The only

exception is the maximum total weights and dimensions the vehicles. The maximum size of Russian vehicles is the same as in most of EU countries.

There are no user charges or road tolls in use and also all technical regulations are equal to EU regulations.

Flanders

IST – Institute Society & Technology
Authors: Donaat Cosaert and Marian Deblonde

State of Policy : PACT 2020

Flanders hardly has space to spare for new transport infrastructures. For that reason, more intelligent use must be made of what already exists. This is possible by dividing transport among the various transportation modes – both for the conveyance of passengers and goods. The relentless volume of road traffic has additional disadvantages: the number of traffic victims is unacceptable; there is the problem of too much traffic noise, plus the excess of greenhouse gas emissions and concentrated fine dust particles into the atmosphere. Flanders needs to promote environmentally responsible transport modes, especially within the urban centres.

Pact 2020 consists of twenty ambitious objectives with a clear delineation of the target figures. With this Future Pact, the signatories want to book progress within five principal domains:

A Competitive and Sustainable Economy

Flanders is **easily accessible** by road and rail, via the waterways and by air, using both private and public transit and transport modes. The region manages to attract a sufficient number of logistics players that are in a position to contribute **added value** and benefits and **generate more employment**.
Flanders will have stabilized its access to **energy sources**. This guarantees increased certainty of energy supply and results in sharper pricing. The **CO_2 emissions** have been **lowered**, in keeping with the European commitments already concluded.

Flanders makes **more efficient use of energy and** materials. Energy consumption inside buildings has been lowered considerably and new housing development meets **optimal performance norms**.

In its water and air quality standards, soil protection and purification, and the elimination of nuisance noise, Flanders scores on a par with the top European economic regions. The emission of **greenhouse gasses** has been lowered conform to the European objectives. The average annual concentration of **fine dust particles** has been **lowered** by 25% vis-à-vis 2007.

Flanders will have developed a **traffic and transportation system** to rank among the **finest and most efficient in Europe**. The year 2020 will register a substantially lowered count of traffic fatalities and seriously injured victims. Flanders has managed to combine the various transportation modes in an intelligent manner.

Logistics and Infrastructure

The economic gateways are readily accessible via the various transportation modes (road, rail, water, or air) and via the array of available carriers (both private and public). As a result, we will register less than 5% in hours lost (calculated on the total number of hours travelled by vehicle) on the trunk roads while, at the same time, we will limit the environmental impact of goods and passenger transport.

To this effect, missing links within the transportation network (on the road, on water, and by rail) in the Spatial Structural Plan Flanders will be eliminated. The transportation flows will be dynamically managed in order to be able to make optimal use of the available infrastructure. In order to derive maximum value from logistic operations, we will be attracting logistics players with the ability to generate full added value and employment.

High Quality of Life: Mobility

In 2020, Flanders will have developed a traffic and transportation system to rank among the most efficient in Europe. To this end, co-modality, supported by a purposeful location policy and by the STOP principle (first pedestrians, then cyclists, then public transport, and finally private vehicles), will figure as the cornerstone of the Flemish mobility policy, to the extent that from an economic, social, ecological, and
logistic point of view the optimal mode is being implemented. We will ensure that we satisfy the environmental objectives that are, likewise, being imposed on other European countries by 2020. Investments
in traffic and transportation systems will be supported within the policy by means of a socio-economic evaluation and a Flemish accessibility monitor.

By 2020, Flanders will figure as one of the best European regions in terms of traffic safety, expressed both in terms of the number of killed or seriously injured road casualties per million kilometres travelled and per million inhabitants. Vis-à-vis the objectives outlined in the Flemish traffic safety plan, to be in place by 2015, a drop of 20% in fatalities and of 25% in seriously injured road casualties will be realized in 2020.

Transport Policy Aims

Flanders is looking forward to 2020. In that year, it wants to assume a leading position among the best performing European regions, an ambitious goal, indeed, yet one that has every chance of succeeding if the Flemish community can fully bring to bear all of its considerable assets on the endeavour. For that reason, Flanders in Action anno 2008 is focussed on break-through actions.
Break-throughs demand drastic interventions that really will make the difference so as to strengthen and breathe new life into the Flemish economy and its society in a number of crucial aspects. Authorities, industry, the civil society, and the citizens, all must roll up their sleeves and get to work in order to enable crucial break-through.

Environmentally Friendly and Responsible Transport

The quality of life within urban centres is being raised through the construction of park and nature zones and by the realisation of improved traffic flows. Flanders maximizes passenger traffic that is conscious of environmental health. It stimulates research into alternative and less polluting fuels and energy-responsible vehicles. It offers financial incentives for the purchase of vehicles with reduced exhaust emission and encourages new forms of pooled and collective transport. Likewise, it devotes great attention to the strengthening of the Flemish automotive industry and its supply network. All parties must be in a position to satisfy the demand for lighter and renewable materials and for hybrid power trains for vehicles.

Standing Out in Traffic Management

Flanders can boast of outstanding achievements in intelligent mobility technology. The authorities, industry, and research institutions are collaborating in that respect to devise ICT applications to traffic management. ICT is the key to such novel technological mobility applications. The new systems inform the road traveler about the fastest, least expensive, and environmentally friendly traffic solutions. This information can be received via different media: via the Internet, electronic information panels, and information kiosks at railway stations and along the highways; it is likewise accessible via the traveller's GPS, GSM, or PDA. Businesses will be collaborating on logistical themes via electronic communication platforms. For instance, the transport of goods will be conducted as much as possible by using multi-modalities, outside of peak times, and by using improved grouping.

Flanders has the ambition to become a genuine intelligent pivot for transport and logistics in Europe. For that purpose, it is integrating traffic management for citizens and businesses into a wide-ranging action plan that has a variety of approach angles:

- concern for infrastructure;
- multimodal transferia;
- broad policy plan as compass;
- intelligent kilometrage levy;
- multimodal brokering;
- logistics with added value.

Concern for Infrastructure

Flanders needs to invest in accordance with an appropriately conceived plan, not only to make maximum use of existing traffic infrastructures but also to improve and expand them where necessary. Freight transport combines a variety of transportation modes (ship, train, truck). Individuals also purposefully select the most efficient transport mechanism for every travel route: on foot, by bicycle, train,

automobile, or plane. That kind of multimodal system demands a radical change in one's mentality and way of thinking.

Multimodal Transferia

Transferia render the traffic and transportation systems more effective. A transferium is a transit point where travellers can make a transfer from one conveyance to another (for instance, from automobile to streetcar), or a transit point for the transfer of containers (for instance, from an inland transport barge to a truck). More transferia enable a better distribution of passenger and freight movement across the various transport modes.

Broad Policy Plan as Compass

Transportation activities exert their impact on a number of different domains, for instance, in the areas of spatial development, industrial terrains, logistics, and mobility. This calls for a well-considered planning policy in the process of which the various administrations, partners, and initiatives join in a concerted effort to harmonize and attune their individual plans to one another. That kind of approach likewise needs to offer investors and businesses adequate reliability and legal certainty about its composition, thus to increase Flanders' attractiveness as
a desirable place to establish a business.

Intelligent Kilometrage Levy

The introduction of an intelligent kilometrage levy pursues traffic-technical, economic, and ecological goals. From a traffic-technical point of view, such a levy improves the accessibility, and optimizes the use, of the traffic infrastructure. From an economic standpoint, it asks the road user to pay his or her share of the infrastructure investment and maintenance costs. The levy furthermore serves an ecological purpose: the polluter pays for the pollution caused to the environment. As a result, road users will give greater thought to the impact of their road conduct and modify their behaviour accordingly.

Multimodal Brokering

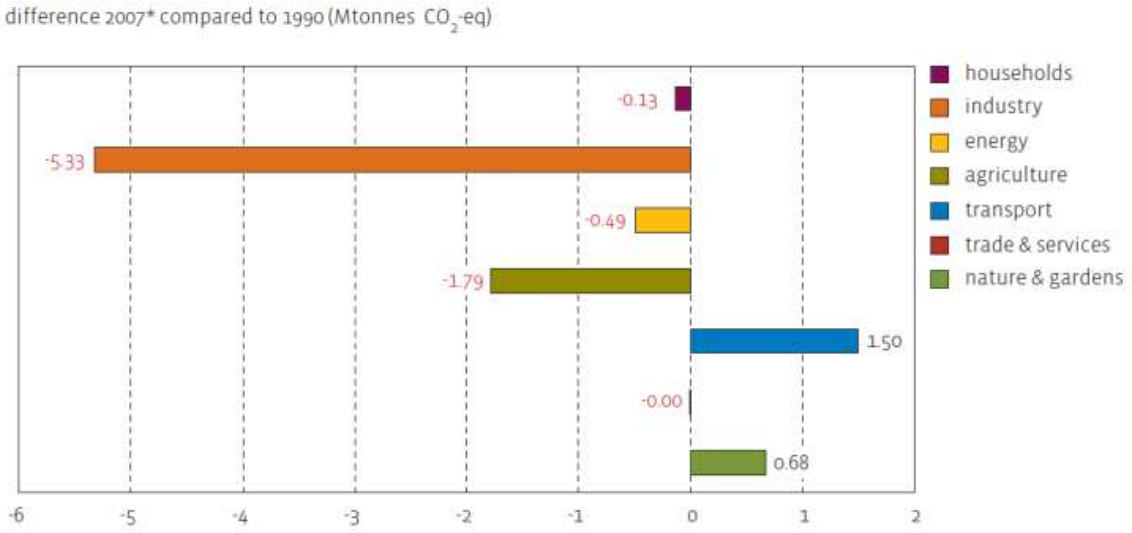
The authorities and business organisations safeguard the presence of sufficient independent multimodal transport brokers. The latter's tasks are to stimulate businesses, assist them with counsel and advice, and support them in the realisation of a proper and appropriate transport mix.

Logistics with Added Value

Investments in novel ICT solutions and innovative mobility applications are highly necessary. By better attuning the logistics and the education sectors to one another, one also improves the influx of talent into the region. Flanders maintains its position as a logistics top player and is the most readily accessible region.

Emission of Greenhouse Gases: Transport Is the Only Sector in Which Emissions Continue to Increase

Transport (including private transport; 17 %) and households (15 %) are important sources. The emissions of greenhouse gases by transport continue to increase further after a strong increase at the start of the 1990s. In contrast to passenger transport, the increased energy efficiency of most modes of transport was not enough for freight transport to compensate for the growth of the transport flows.



* provisional figures

Source: MIRA based on EIL (VMM)

greenhouse gas emissions (ktonnes CO_2-eq)	1990	1995	2000	2005	2006	2007*	*difference 2007/1990*
households	12 362	13 612	12 895	13 500	12 906	12 227	-1 %
industry	23 951	25 398	22 545	21 746	20 315	18 624	-22 %
energy	23 805	22 957	23 584	24 321	23 337	23 311	-2 %
agriculture	10 634	10 782	10 112	9 221	9 091	8 843	-17 %
transport	12 206	13 619	13 441	13 586	13 601	13 707	12 %
trade & services	4 175	4 893	5 019	4 719	4 270	4 174	-0 %
nature & gardens	-1 255	-1 098	-991	-936	-470	-579	-54 %

The CO2 emissions followed this trend up to 2006. In 2007 there was a slight deviation due to the use of biodiesel by road traffic. Biofuels are considered to be CO2 neutral. The changes in the energy consumption and the CO2 emissions were largely determined by road traffic, which represents the bulk of transport flows. The gradual increase of diesel cars in the vehicle fleet and an increased availability and purchase of more energy efficient vehicles explain the slight fall for passenger transport. The stronger growth in freight transport, on the other hand, resulted in rising greenhouse gas emissions.

R&D

Flanders' DRIVE was set up in 1996 as an **industry initiative** by: Agoria Flanders, LMS International, Bekaert, Bosal, Tenneco and Sirris. Activities started in 2001 with the support of the Flemish Government. In 2004, the building and infrastructure of Flanders' DRIVE in Lommel came into operation.

At first, Flanders' DRIVE focused solely on product innovation. Since 2005, we expanded our focus to include process innovation for production and assembly companies as well. The Flemish government gave Flanders' DRIVE new impetus for the 2007-11 period so that Flanders' Drive could develop into an **international competency pool.**

C aim at:

- a coordinated approach to innovation, driven by the industry
- a targeted build up of competencies and research with the aim of international recognition
- the development of a wide network in Flanders and the ELAT triangle (Eindhoven, Leuven, Aachen) with the objective of exchanging experience, cross-pollination and cooperation
- a cross-border and international profile.

Energy Storage: Battery and Battery Management in Electric Vehicles

The availability of sustainable, reliable and cost-effective energy storage, in batteries for example, is crucial to the development and acceptance of vehicle electrification. This project is studying the latest generation of lithium-ion batteries for electric and hybrid vehicles. There is a special focus on the battery managementsystem.

The first step in this project is to define the demands a vehicle places on the battery system. Market research into the available technology is already in its final stage. Based on the data gathered, the first set of battery cells have already been bought. Tests with these cells will begin shortly. The basic structure of the battery pack has already been defined as well. Details will be provided in the coming months.

This project will develop a modular battery pack, which can be used for hybrid as well as fully electric cars and buses. The pack consists of lithium cells connected in parallel or series that are controlled by an intelligent battery management system. Knowledge about lithium batteries is being built up and used to develop an intelligent management system that controls batteries safely and efficiently.

Research Vehicle for Active Safety: Active Suspension

Active safety systems for avoiding accidents are extremely complex electro-mechanical systems. The product developer has a strong interest in managing this complexity in a short development time. This project uses a specific methodology called V-methodology. In this project it is used specifically in the development of a new active suspension system. If this system is coupled to a vision system, the vehicle can see potholes in the road and anticipate them. The active suspension is fitted to and tested on a real vehicle, which can later be used to test other active safety applications. The basic functions of the system have already been fitted and tested. Safety functions and energy management have been integrated and an initial parameter optimisation was carried out on the vehicle.

The goal of this project is to make V-development methodology proprietary, specifically through the development of active suspension. The approach of judging the forces acting on the wheels and the intelligent management of the suspension lead to improvements in comfort and vehicle dynamics. A vehicle equipped with active suspension will display stable ride characteristics under all conditions. The research has been backed by an innovative rapid prototype, a powerful computer which can calculate complex algorithms. The project includes research into future vehicles' architecture and the use of sensors.

Internal Logistics Improvements Through RFID Technology: Monitoring Goods Flows with Radio Frequency Identification

Radio Frequency Identification (RFID) is a technology used in many domains, such as in clothing tags to prevent shoplifting for example. In this project, this technology is being used for the first time to chart and

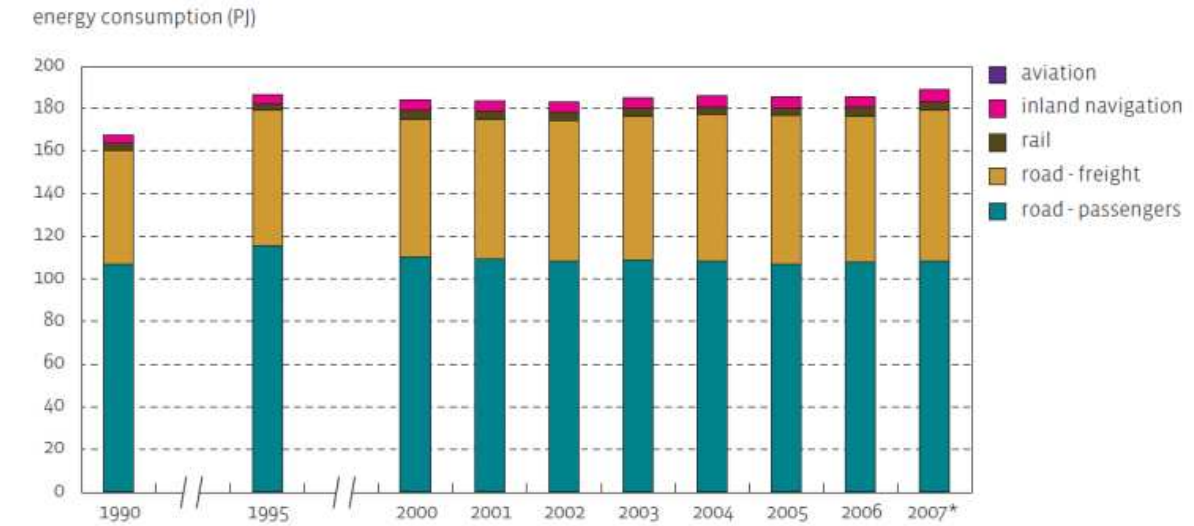
follow the flow of goods actively. RFID can contribute to a more efficient and streamlined delivery of components to production lines, and thus also to a reduction of logistics costs. This project is researching the possibilities of using RFID technology to analyse and redesign internal goods flows.
The participants in this project have defined their scope and explored the technology. Currently, research case studies are under preparation.

The aim of this project is cost savings through the improvement of internal logistics flows with the help of RFID technology.

By applying RFID technology, goods flows can be examined and analysed. Using dynamic models, goods flows can then be visualised and improved.

Energy Consumption for Transport

Energy consumption of transport is not decreasing in spite of efficiency improvement.
In 2007, the transport sector was responsible for 11.7 % (188.8 PJ) of the gross domestic energy consumption in Flanders. Road transport accounted for 95 % of the transport sector. Compared to 1990, the total energy consumption of the sector increased by 12.6 %. The energy consumption of passenger transport by road experienced a certain stabilisation from 2000 onwards. This is the result of a smaller increase in activity combined with an increase in the energy efficiency of vehicles. For freight transport by road, which also uses more energy efficient technologies, there was a general increase in the energy consumption (+33.4 % compared to 1990) due to the still strongly increasing activity.



* provisional figures; for aviation only the fuel consumption of small aircrafts and not of international flights; inland navigation including shipping between North Sea ports

Source: Flanders Energy Balance VITO

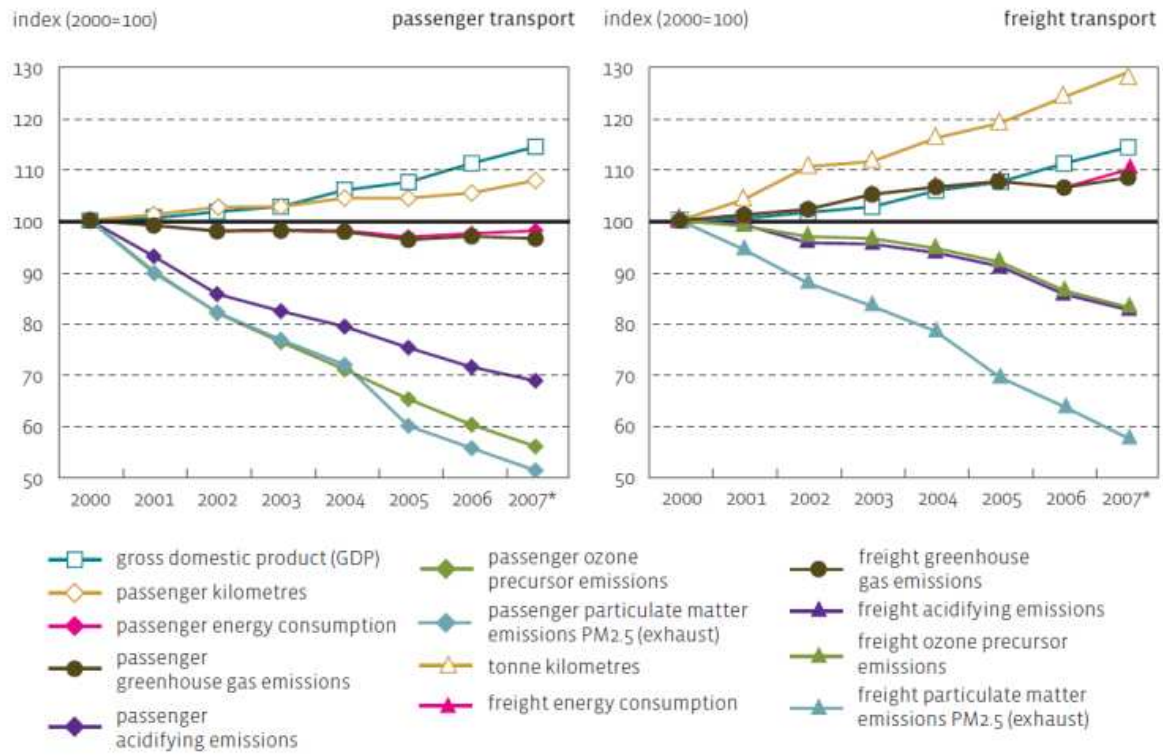
The energy consumption by rail has increased by 6.4 % compared to 1990, this is less than the increase in activity. The further electrification of the railway is responsible for that as electric motors are much more efficient than diesel engines.

In 2007, 74 % of the energy consumption for rail was provided by electricity, in 1990 that was still only 53 %. Inland navigation saw an increase in energy consumption of 40.3 % in the period 1990-2007. Economic concerns ensured that the energy efficiency of the ships was also forced upwards.

energy consumption (PJ)	1990	2000	2006	2007*
aviation	0.1	0.1	0.0	0.0
inland navigation	4.0	4.9	5.2	5.6
rail	3.5	4.0	3.8	3.8
road - freight	53.3	64.5	68.8	71.1
road - passengers	106.8	110.5	107.7	108.3
total transport	*167.7*	*184.0*	*185.5*	*188.8*

The Climate Commission: Eco-efficiency of Passenger Transport Better than that of Freight Transport

This indicator compares the environmental pressure caused by the transport sector (emissions, resource use) with a relevant activity indicator. For that reason the sector was divided into passenger traffic (first figure) and freight traffic (second figure). Decoupling occurs when the growth rate of a pressure indicator is lower than the growth rate of the activity indicator. Decoupling is absolute if the growth of the pressure indicator is zero or negative and is relative if the growth of the pressure indicator is positive but not as large as that of the activity indicator.



* provisional figures
The calculation of the energy use and the emissions was adjusted for all modes compared to MIRA-T 2007. The results for most pollutants are lower than in the previous calculations.
For rail, only the activities, energy use and emissions of diesel trains are included.

Source: MIRA based on De Lijn, Flanders Energy Balance VITO, HERMREG, FODMV, NIS, NMBS, NV De Scheepvaart, PBV, VMM, W&Z

The energy consumption of passenger transport (road and rail traffic) decreased by 2.1 % in the period 2000-2007. There was an absolute decoupling with the passenger kilometres. The energy consumption of goods transport (road and rail traffic and inland navigation) increased by 9.9 % in this period; although a relative decoupling occurred with the tonne kilometres.

	GDP (10^9 euro)	passenger km or tonne km (10^9)	energy consumption (PJ)	greenhouse gases (ktonnes CO_2-eq)	ozone precursors (tonnes TOFP)	acidifying pollutants (10^6 Aeq)	PM2.5 (tonnes)
passengers 2000	144.3	62.03	110.9	8 165	87 208	1 031	2 630
passengers 2007*	164.9	66.83	108.6	7 867	48 786	708	1 348
freight 2000	144.3	34.89	68.3	5 035	72 344	1 245	2 227
freight 2007*	164.9	44.96	75.0	5 455	60 055	1 027	1 279

Plans, Policies and Discussions on Increasing the Use of Renewable Energy Sources for Transport.

Biofuels

Potential for local production of biodiesel (1st generation)

- In Flanders: 1.3 ktoe/yr
- In Belgium: 13 ktoe/yr

Potential for local production of bio-ethanol (1st generation)

- In Flanders: 440 ktoe/yr
- In Belgium: 930 ktoe/yr

Seven producers of biofuels received a quotum from Belgian authorities

- 4 biodiesel producers; 300 ktoe/yr
- 3 bio-ethanol producers; 127 ktoe/yr

These quota are valid till september 2013. Still no obligation to partly mix biofuels in the regular fuel circuit.

Hydrogen

Hydrogen technology at most a complement to, not a competitor of, other energy sources for transport use.

Flanders has the largest underground pipeline grid for hydrogen (900 km) worldwide.

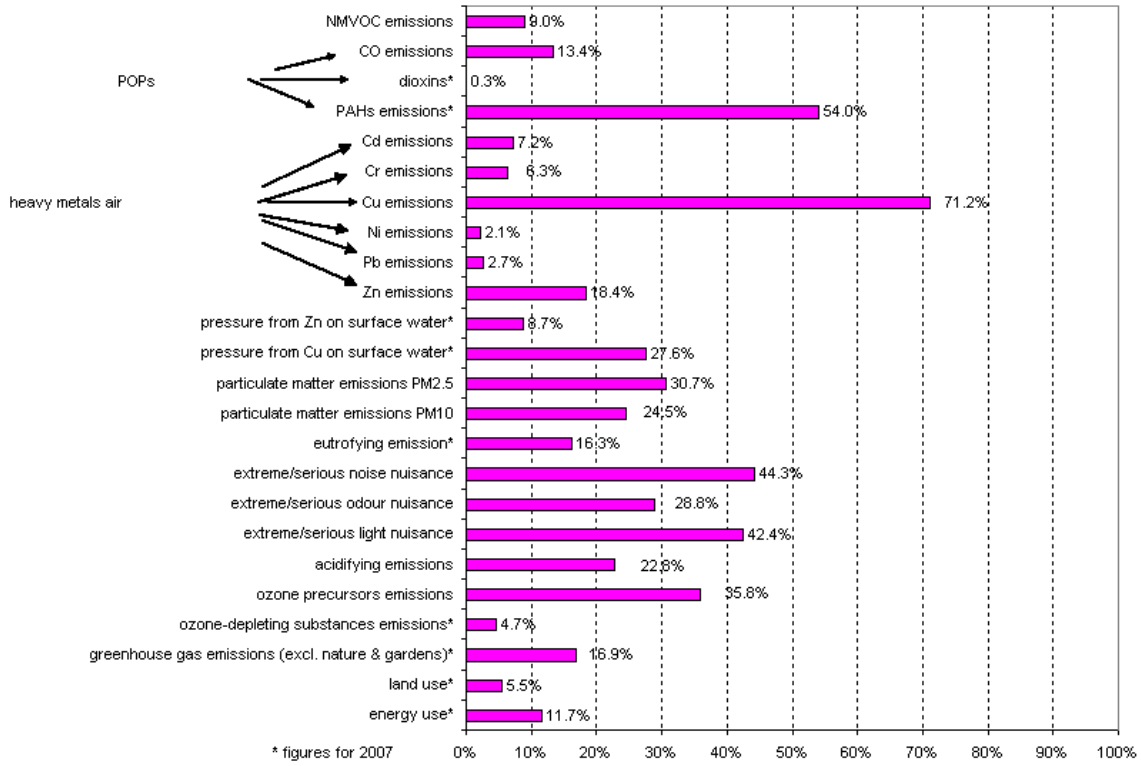
Consortium of 35 Flemish organisations active in the domain of hydrogen and fuel cell technology.

Lacking infrastructure of filling stations

Methods for Monitoring Environmental Impact from the Transport Sector

The transport sector causes air pollution that is harmful to humans and nature. The traffic makes a major contribution to the emissions of CO, NO_x, NMVOC and CO_2. These emissions make a significant contribution to climate change, photochemical air pollution and acidification. Particles and heavy metals are also emitted by the traffic and are harmful to health.

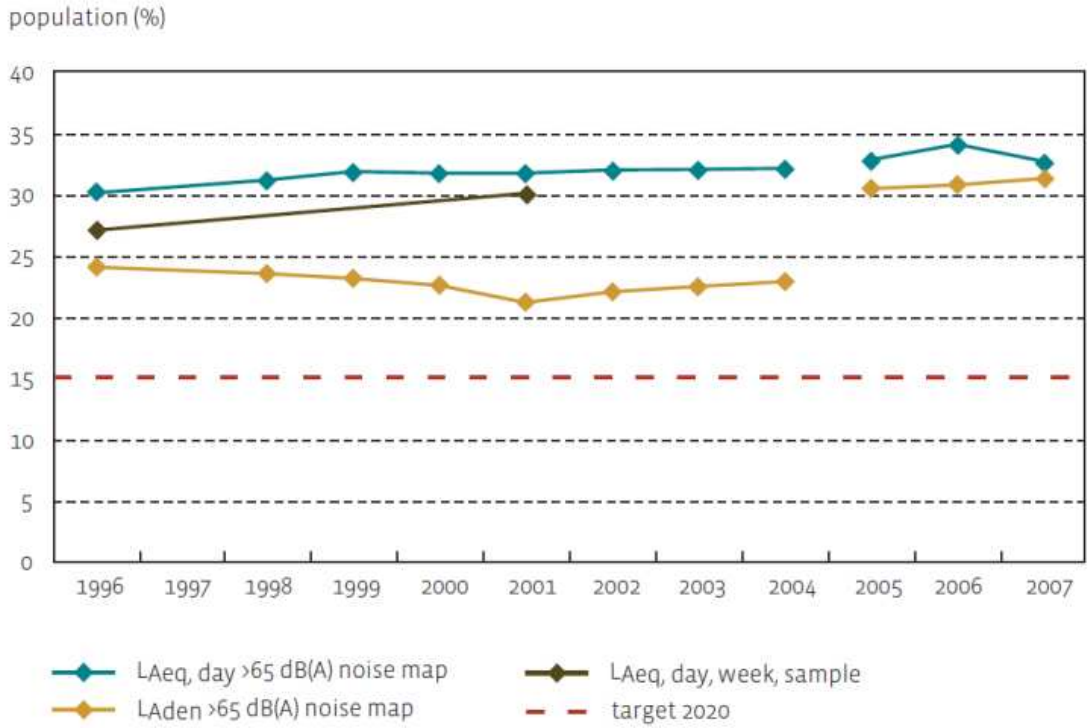
Figure: Share of transport in the environmental pressure of various themes (Flanders, 2008) **(**



The sector also causes major pressure on other environmental themes. Rail, air and road traffic cause noise nuisance. Rail, water and road infrastructure result in fragmentation and barrier function resulting in a decrease in biodiversity. The lighting of the roads also causes nuisance. The increasing amount of means of transport also causes an increase in the waste problem once the vehicles are taken out of use. The marginal environmental damage costs caused by the transport sector are important but the marginal external costs for transport are mainly controlled by the costs caused by congestion.

Road Traffic is a Major Source of Noise Nuisance.

The exposure of the population to sound pressure levels above 65 dB is described by means of three indicators which show the sound pressure level at the building facade, i.e. a measured indicator (LAeq, day, week, sample), a calculated indicator that shows the exposure during the day (LAeq, day >65 dB(A) noise map) and a calculated indicator that includes the need for quiet at night (LAden >65 dB(A) noise map).



There is a jump in the data in 2005 because of an improvement in the traffic model.

Source: measurements and INTEC-UGent noise map; traffic counts, Antwerp Traffic Centre

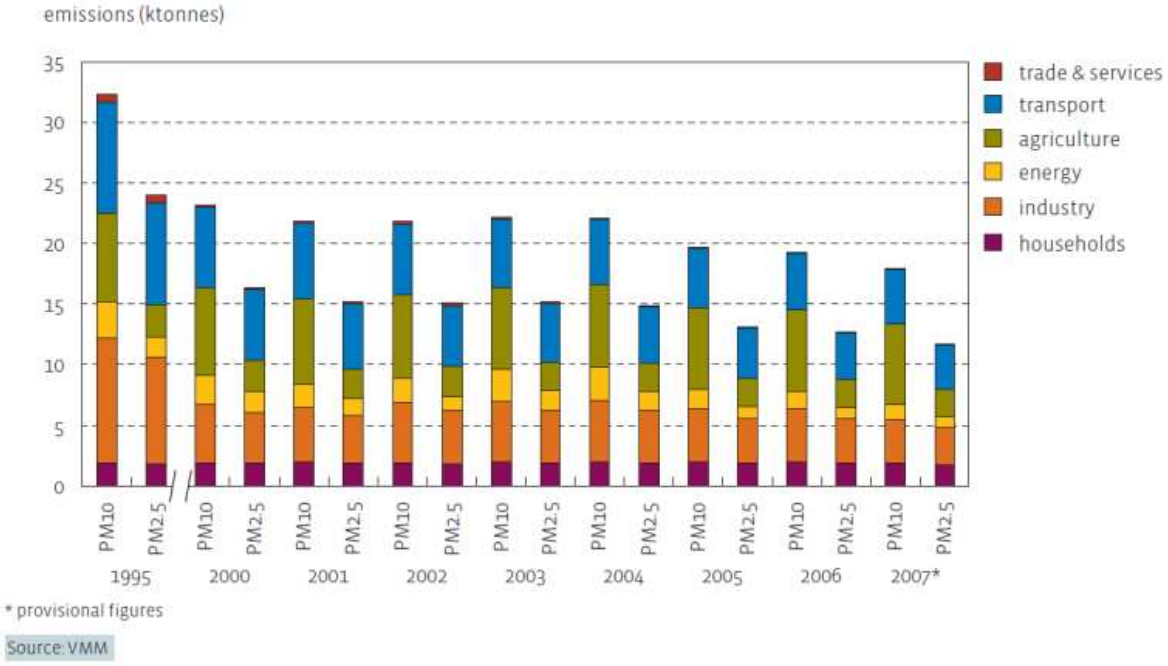
Sound Pressure Levels in Flanders Keep Increasing

The long-term target in the MINA plan 3+ (2008-2010) stipulates that in 2020 only 15 % of the population will be exposed to outside traffic noise during the day in front of the house (LAeq >65 dB(A)). At present this is still twice as much.

Between 1996 and 2001 the sound pressure level at the measured indicator has increased significantly. We see the same change in the indicator that shows the sound pressure level during the day. The sound pressure level for a good night's rest has also increased since 2001. In 2007, the exposure to high sound pressure levels during the day has decreased while the indicator that includes the need for a night's rest increased slightly. This seems to indicate that traffic is shifting to the night hours and/or that the average driving speed during the day is increasing. A detailed analysis of the data is needed to confirm this.

Emission of PM10 and PM2.5

Attention is increasingly shifting to finer fractions of particulate matter such as the PM2.5-fraction. These finer fractions could be even more harmful to health than the larger PM10-fraction. PM2.5 may enter the atmosphere via direct emission (primary particles). This indicator shows the emissions of primary PM2.5 divided according to the different sectors.



* provisional figures

Source: VMM

Transport remains a major source of PM10 and PM2.5 emissions. The method of calculation for transport was changed, as a result of which these figures can differ strongly from figures reported earlier. After agriculture, transport (25 %) and industry (20 %) the most important emission sources of PM10. For PM2.5, transport, with a share of 31 % is the most important emission source. Industry comes second (26 %). The introduction of Euro 4 engines in 2005 caused a stronger decrease in the emissions of fine particles (PM2.5) in both passenger and freight transport.

emissions	1995		2000		2005		2006		2007*	
(ktonnes)	PM10	PM2.5	PM10	PM2.5	PM10	PM2.5	PM10	PM2.5	PM10	PM2.5
households	1.91	1.81	1.95	1.88	2.00	1.92	1.97	1.88	1.86	1.77
industry	10.31	8.80	4.77	4.15	4.35	3.64	4.46	3.72	3.63	3.06
energy	3.02	1.70	2.43	1.79	1.60	1.02	1.37	0.88	1.20	0.86
agriculture	7.22	2.66	7.23	2.57	6.78	2.34	6.73	2.31	6.74	2.30
transport	9.13	8.40	6.60	5.82	4.86	4.09	4.64	3.86	4.41	3.63
trade & services	0.76	0.60	0.16	0.15	0.11	0.10	0.09	0.08	0.08	0.07
total	*32.4*	*24.0*	*23.1*	*16.4*	*19.7*	*13.1*	*19.3*	*12.7*	*17.9*	*11.7*

Technologies Beyond 2020

Biofuels

Estimated demand (by 2020) for biodiesel in Belgium

- Scenario 1: 800 ktoe/yr
- Scenario 2: 708 ktoe/yr

Estimated demand (by 2020) for bio-ethanol in Belgium

- Scenario 1: 90 ktoe/yr
- Scenario 2: 107 ktoe/yr

R&D of a diversity of energy sources—both different generations of biofuels and alternatives for biofuels—should be supported. Where the step is made from experiment to societal introduction, the precautionary principle should be applied

Flemish authorities should stimulate research with respect to a diversity of energy sources and the sustainability impacts of various circumstances of mobilisation, production and use of various generations of biofuels and of alternatives to biofuels.

Hydrogen

Flemish authorities should

- develop a clear **long term vision** on energy policy and strategy, constituted by a **variety of energy resources and technologies** and prioritising renewable energy resources
- support **R&D** to keep pace with international developments w.r.t. **hydrogen and fuel cell technology**
- attune regional and federal initiatives w.r.t. **(safety) regulations, permits, training** in order to simplify introductions of new technologies or infrastructure

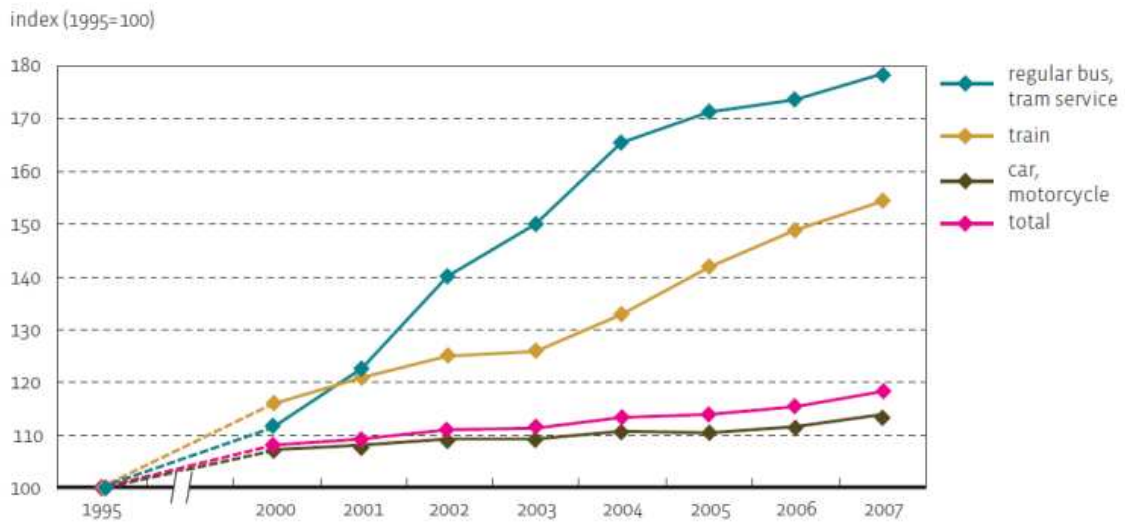
Electric vehicle (EV)

- Volvo: EV-production (planned 2012/13, market development plan: leasing companies, local authorities, ..)
- Unicore: metal production for LI – batteries
- Vito: energy management

Strategies for Sustainable Urban Mobility and the Shift from Private to Public Transport or Cycling/Walking and Regulative Measures like Road Pricing

Passenger Transport : Limited Modal Shift in Passenger Transport

In 2007 the total number of passenger kilometres amounted to 72.47 billion, 2.4 % higher than in 2006 and 18.2 % higher than in 1995. In 2007 private motorised transport still accounted for 88 % of transport flows, regular bus/tram services represented 4 % and rail transport 8 %. In 1995 the shares were 91 % (car, motorcycle), 3 % (regular service bus/tram) and 6 % (rail). Despite the significant growth in public transport, only a limited modal shift has been observed.



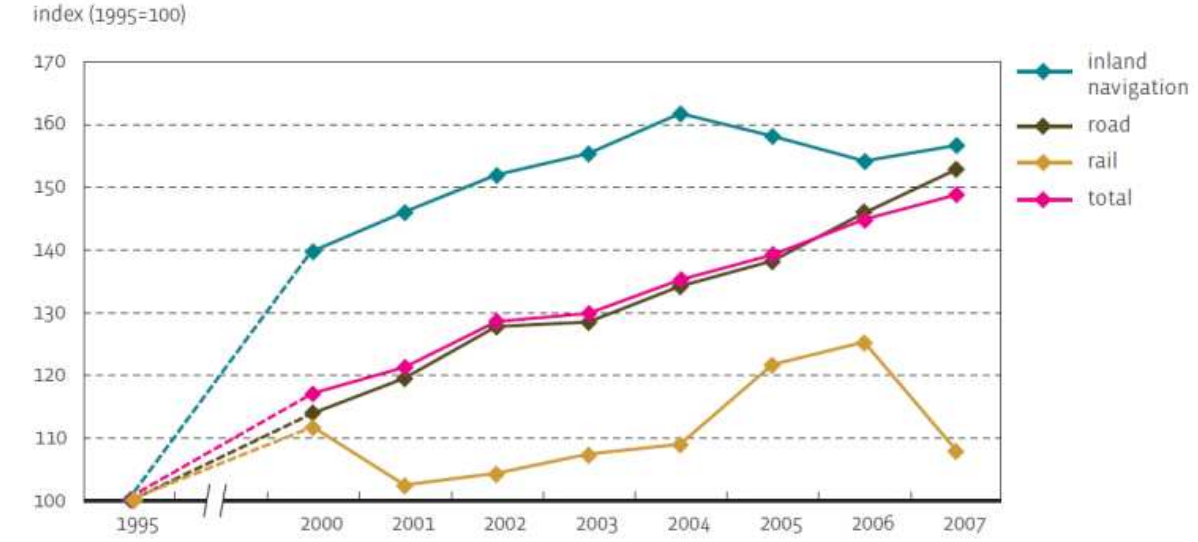
The number of passenger kilometres travelled with public transport has increased strongly since 1995. Between 1995 and 2000 there was a larger growth for train transport than for the regular bus/tram services. In the period 2000-2004 mainly passenger transport with bus/tram services grew explosively(+48 %). Passenger transport by train has experienced again a larger growth in the last four years (+23 %). A focused pricing strategy and an expanded service stimulated the use of bus/tram services. For rail travel there are also reduced prices for certain groups. The capacity was also increased further by a 5 % increase in the number of train kilometres and the introduction of more double deck carriages. Last year the train continued its growth by 3.8 %, regular bus/tram services reinforced their growth in return and increased by 2.9 %.

Passenger transport by car and motorcycle continued to increase. In 2007 the increase was 2.3 %, the largest growth since 1999.

passenger transport (billion passenger km)	1995	2000	2005	2007
regular bus, tram service	1.64	1.83	2.80	2.92
train	3.79	4.39	5.38	5.85
car, motorcycle	55.87	59.98	61.69	63.70
total	*61.29*	*66.20*	*69.87*	*72.47*

Freight Transport Flows

The transport flows are a measure of the activity of the transport sector. The freight transport flows are evaluated on the basis of the tonne-kilometres covered by truck, train and inland shipping. The tonne-kilometres show the number of kilometres covered per tonne transported by a specific category of modes of transport, multiplied by the number of tonnes of freight transported.



Source: FODMV, NIS, NMBS, NV De Scheepvaart, PBV, VMM, W&Z

Since 1995, the transport of freight by road has continued to grow. In 2007 it amounted to 37.47 billion tonne kilometres, a growth of 53 % compared to 1995. Freight transport by rail decreased in 2007 to 3.50 billion tonne kilometres, a decrease of 14 % compared to 2006. This can be partially attributed to a decrease in the transportation of iron ore, coke and coal. In 2007, the number of tonne kilometres by inland navigation amounted to 6.56 billion. Compared to 1995, freight transport by water increased by 57 %. Since 1998, inland navigation has been stimulated by the Flemish government's embankment programme, a financial incentive for the construction of loading and unloading facilities. That has resulted in a continuous increase in activity. In the last three years there has however been a stabilization.

No modal shift in freight transport. In 2007 the total number of tonne kilometres was 47.53 billion, which means a 49 % increase compared to 1995. Road transport made up 79 % of the total, railway transport 7 % and inland navigation 14 %. In 1995, this was 77 %, 10 % and 13 %. The target values for 2010 (Flanders Mobility Plan Policy Resolutions, sustainable scenario) are 69 %, 14 % and 17 % respectively. To reach those objectives and to realise a modal shift must be stimulated further.

freight transport (billion tonne km)	1995	2000	2005	2007
rail	3.24	3.62	3.94	3.50
inland navigation	4.19	5.85	6.62	6.56
road	24.54	27.95	33.90	37.47
total	*31.97*	*37.42*	*44.46*	*47.53*

Germany

TAB – Office of Technology Assessment at the German Bundestag
Authors: Reinhard Grünwald, Juliane Jörissen, Maike Puhe and Jens Schippl

State of Policy

Germany is a rather densely populated country and is located at the heart of the European Union. As for many other EU countries, the transport infrastructure is a basic pillar for economic growth and a high quality of life. On the other hand, induced by heavy growth rates in particular in road transport, Germany suffers from congestions and bottlenecks which restrict the free flow of goods and people especially in the densely populated regions. European enlargement and the heavy increase in east-west freight volumes strongly contributed to this development.

At the same time, the increased traffic volume has led to serious environmental consequences including emissions of greenhouse gases, air pollutants and noise as well as reduced spaces for living and the segregation effects caused by the expanding transport infrastructure. So, paradoxically one of the basic pillars of today's quality of life at the same time threatens and reduces that quality.

This introductory statement is underpinned by the following figures, which illustrate that especially in the freight sector strong growth rates are expected for the next decades. Currently the German transport performance totals 1.100 Mrd passenger-kilometers. Individual motor car traffic accounts for 80 % of this number. In the area of freight traffic the gross number is ca. 650 Mrd tonne-kilometers of which road transport has a share of ca. 70 %, rail transport about 18 % and inland waterway transportation ca. 10 %. In a scenario[11] with ambitious CO_2-reduction goals (1990-levels minus 40 % until 2020, minus 85 % in 2050) this transport performance is projected to decrease only modestly (by less than 10 %) in the passenger domain but to rise by more than 60 % in the freight sector till 2050. The modal split will change only slightly except a moderate increase of the share of freight transport by rail (from 18 % to 27 %) (Prognos, EWI, GWS (2010)).

This means that the assumed greenhouse gas reduction in the transport sector derives mainly from an increased efficiency of propulsion systems and transport carriers and from a switch to biofuels. Their share is expected to rise from 6 % today (2008) to 33 % in 2030 and 85 % in 2050.

Against this background, it is of utmost importance to find ways for tackling the expected growth in the freight sector. An important document is the so-called "Masterplan on Freight Transport and Logistics" (Masterplan Güterverlehr und Logisitk), that was published by the Federal Ministry of Transport in the year 2008. The plan encompasses the following aims:

- Improving efficiency of the system and optimizing the capacity utilization of existing infrastructure

[11] The quoted scenario exercise was commissioned by the German government and forms the analytical basis for the recently adopted "energy strategy" (Bundesregierung (2010)).

- Improved usage of Intelligent Transport Systems (telematics) for the management and better integration of all modes of transport
- Avoiding the transport of goods wherever this is feasible
- Modal Shift to rail and water
- A sustainable, socially acceptable and environmental friendly extension of transport infrastructures

Also in 2008, the federal government adopted the so-called "Integrated Energy and Climate Program" (Integriertes Energie- und Klimaprogramm, IEKP), that lists measure to be implemented for the development of a climate friendly energy and transport system. Key elements of the program are:

- CO_2 limits for cars
- Taxation of motor vehicles based on the CO_2 emissions of the vehicle
- Transparent labeling of energy consumption and CO_2 emissions of vehicles
- A toll system for lorries that is strongly based on emission of the vehicles
- Increasing the shares of biofuels and, at the same time, introducing regulation that should ensure a sustainable production of the biomass

In Germany the responsibilities for the transport system are dispersed to different institutions, on federal level, the level of the 16 states ("Länder") and the local level. It surely can be stated that the principle of sustainability is an immanent part of transport policy making on all levels, but it is conceptualised in varying ways. The most important actor on the federal level, the Ministry for Transport, highlights the need for a transport system that is both efficient and environmentally friendly. The economic relevance of transport and its infrastructure is emphasised. Intelligent transport systems or Telematics are seen as a key technologies to make a more efficient usage of the infrastructure, to enable optimised logistics and thus, to strengthen the economic competitiveness of the German industry. Currently, a main focus of German transport policy is on the promotion of electric vehicles. The Federal Government, together with industry, jointly created the „National Platform for Electric Mobility, NPE" with the aim to turn Germany into a leading market for electric vehicles. To this end, the Federal Ministry of Transport has launched pilot projects in eight cities and regions. In context of electric mobility, in the meantime many actors consider not only technologies but also business models (such as car-sharing) as being crucial for sustainable mobility mainly in urban areas.

On local level, many urban authorities are promoting sustainable urban transport in their transport development plans or city development plans. In particular, a variety of successful approaches to make public transport, walking and cycling more attractive can be observed. However, many experts argue that the potentials for modal shift are not fully tapped yet and further initiatives are needed.

Energy Use for Transport

Currently the transport sector is responsible for 28 % of final energy consumption in Germany in absolute terms 2575 PJ (year 2008) (Tab. 1). In a long term perspective the aim is to reduce this consumption to ca.

1500 PJ in 2050. At the same time the share of renewable energies is expected to rise from presently 5,5 % to 64 % in 2050. Another marked trend is the large scale introduction of electricity as an energy source for transport from just over 2 % today to more than 15 % in 2050 (Tab. 2).

The associated greenhouse gas emissions amount to 153 Mio t/a (2008) which is 20 % of the total emissions (Tab. 3). In terms of the contribution to CO_2 reduction goals compared to 1990 levels, the transport sector emissions today have already decreased only by ca. 7 %, which is significantly less than the other sectors. In the longer term it is expected that the transport sector will catch up and deliver -20 % in 2020, -45 % in 2030 and -90 % in 2050 (Tab. 4).

Tab. 1: Final Energy Consumption in Germany (2008)

Sector	Final Energy Consumption (PJ)	Share (%)
Private Households	2502	27,4
Trade, Commerce, Services	1404	15,4
Industry	2645	29,0
Transport	2575	28,2
TOTAL	9126	100

Source: Prognos, ewi, gws (2010)

Tab. 2: Final energy use in the transport sector (Szen. IA)

	2008	2020	2030	2050
Gasoline (fossil)	854,8	466,8	269,3	34,5
Diesel (fossil)	1139,2	1154,3	747,8	102,2
Aviation fuel (fossil)	378,3	381,6	361,4	313,2
Natural Gas (fossil)	21,2	95,8	154,6	41,6
Electricity	59,6	79,0	115,7	233,5
Hydrogen	0	0	0,1	14,8
Biofuels	132,1	232,5	499,8	772,0
TOTAL	2575,2	2410,1	2148,6	1511,7
Bio-share gasoline/diesel (%)	6,1	12,8	33,6	87,9
RES incl. Electricity (%)	5,5	10,9	26,2	63,6

Source: Prognos, ewi, gws (2010)

Tab. 3: Greenhouse Gas Emissions in Germany

Sector	Share (%) (2008)	Mio t (2008)	Mio t (2020)	Mio t (2030)	Mio t (2050)
Private Households	13,9	105	79	51	18
Trade, Commerce, Services	6,3	48	31	18	8
Industry	12,6	96	71	61	48
Transport	20,2	153	132	91	18
Energy Industry	47,0	357	259	175	49
TOTAL	100	773	581	403	145

Source: Prognos, ewi, gws (2010)

Tab. 4: Change (%) relative to 1990-levels

Sector	2008	2020	2030	2050
Private Households	-19,8	-39,7	-61,1	-86,3
Trade, Commerce, Services	-46,1	-65,2	-79,8	-91,0
Industry	-38,5	-54,5	-60,9	-69,2
Transport	-7,3	-20,0	-44,8	-89,1
Energy Industry	-15,0	-38,3	-58,3	-88,3
TOTAL	-19,6	-39,5	-58,1	-84,9

Source: Prognos, ewi, gws (2010)

Regulation and Technology Options for Sustainable Transport

There is a wide range of instruments and technical approaches to support the development of a more sustainable transport system in Germany. In the following, some of the most important regulations and technology options for sustainable transport in Germany are described:

Promoting the Usage Alternative Fuels and Propulsion Technologies

In the past, the German automotive industry was primarily focussed on the development of hydrogen (or methanol) powered fuel cell technology. In the mid-1990s a big company (Daimler Benz) communicated the goal to achieve full commercialisation of fuel cell vehicles before 2005. The worldwide trend towards hybrid and full-electric propulsion was taken up in Germany just recently. In order to (re-)establish a leading role in technology development for alternative propulsion technologies, German government has announced the goal to have one million BEVs (battery electric vehicles) on the road by 2020 and six million by 2030. This would translate to a share of about 10 % relating to the total fleet. In addition ca.

20 % of the fleet would be hybrid electric vehicles. There exists a general awareness that these goals will not be achieved without political support. However, concrete policies and measures to this avail still await realisation. Apart from financial support schemes (e.g. tax rebates, “cash for clunkers”) also other measures e.g. privileged parking exempt from charges are being discussed.

Intelligent Transport Systems (ITS) / Telematics

In order to optimise the usage of the capacities of the transport system, the development and implementation of applications based on information and communications technologies (ICT) are considered as being crucial. The relevant ICT applications are usually subsumed under the terms “Telematics” or “Intelligent Transport Systems” (ITS). ITS can contribute to a better organisation and management of the transport system and lead to improved traffic flows, less congestion, more efficiency through better load factors and the use of less energy consuming modes of transport. These concepts are related to control and guidance, road pricing, parking, assistance, freight and fleet control and management.

ICT applications collect, create and supply real time data to the users, individual travellers as well as freight distributors. Due to user friendly interfaces, better information on travel options, possible delays or congested networks help to better plan and execute a trip in an effective and comfortable way. In the car sector, the idea is that the cars start communicating between each other, exchanging information on congestions or accidents, and, thus improving travel flows. Also for public transport (road and rail) and for freight logistics the technology offer huge potentials. Furthermore, it can be considered as an enabling technology for innovative concepts such a car sharing or bike sharing.

There are many promoters in Germany, in particular in the Ministry for Transport, in the Ministry of Economics and Technology as well as in the car industry ITS are high on the agenda. However some experts and environmental associations do question the sustainability effects of ITS in the road sector. The argument is, that the technology might well help to make improved use of existing capacities, but this could make road transport more attractive and, thus, attract additional transport and hamper a modal shift to “cleaner” modes of transport.

Road Pricing

In 2005 Germany introduced a distance-based toll for heavy trucks (12 t gross vehicle weight and above). A service provider (Toll Collect), acting on behalf of the state, has set up an automatic toll system to calculate and collect road use charges. The price level of the toll is based on the emissions class and number of axles on the truck and on the distance travelled. The system is based on a combination of mobile telecommunications technology (GSM) and GPS. Main element of the system is an on-board Unit (OBU) that stores all relevant information to automatically determine how many kilometres have been driven and transmits the information to the Toll Collect computer centre for further processing. OBUs will be installed, initialized and personalized in all registered trucks. For truck drivers and transport companies using only infrequently German motorways, a manual log-on to the system is provided.

Environmental Zones

To ensure that the limits currently specified for fine particulate matter are complied with, Germany introduced so called “environmental green zones” (Umweltzonen) in areas especially burdened by particulates, eg. city centres. All vehicles have to be labelled with an environmental badge based on their emission levels. Only appropriately labelled cars are allowed to enter environmental zones.

Methods for Monitoring Environmental Impact from the Transport Sector

The Federal Environmental Agency (UBA) publishes periodically a handbook of Emission Factors for Road Transport (HBEFA) in cooperation with agencies in Switzerland, Austria, Sweden, Norway and France as well as the JRC (Joint Research Centre of the European Commission). HBEFA provides emission factors, i.e. the specific emission in g/km for all current vehicle categories (PC, LDV, HDV, buses and motor cycles), each divided into different categories, for a wide variety of traffic situations. The newest version dates from January 2010. Additionally the monitoring tool TREMOD (Transport Emission Estimation Model) is used to identify air pollutant emissions of motorized transport. These serve as a basis for environmental impact assessment and the development of emission standards.

Available and/ or Necessary Technologies Beyond 2020

What is particularly missing in technology development today are methods and options to interlink different modes of transport in order to encourage intermodal transportation. Effort needs to be put into the integration of different infrastructures and technologies. Innovative and service oriented concepts for existing and upcoming technologies, which meet users’ preferences, are needed.

Germany’s R&D Plan

To relief the tension between traffic growth and environmental compatibility, the Federal Government presented the "Federal Government Fuel Strategy" for the time horizon to 2020 to support the launch of alternative fuels and innovative propulsion technologies. A declared goal is it to have one million electric vehicles and a further 500,000 fuel cell powered vehicles operating on Germany's roads by 2020. Between 2009 and 2011, the Federal Government is providing a total of 500 million Euros to fund the development and commercialization of electric mobility.

Land Use and Physical Planning

Settlement dispersion is linked with a higher specific land use rate per capita and a drop in population density. The consequences are an increase of traffic flows, a loss of fertile arable land and a dividing up of previously connected open areas. That’s why the fight against land consumption and urban sprawl is an important topic in spatial planning for several decades and is considered to be a key factor for sustainable development. The German National Sustainability Strategy of 2002 postulates a limit for the additional land use rate of 30 ha/day by 2020. The strategy to reach this ambitious target will be primarily a

promotion of inner urban development by mobilisation of land reserves, reutilisation of brownfields, filling of vacant lots and improving inner-city living conditions by upgrading existing structures. In growth regions, where expansion of settlement might be inevitable, this should be realized in line with the guiding principles of spatial planning like “decentralized concentration”, well adapted to the public transport network and giving preference to land-saving constructions (e.g. multi-storey commercial buildings). In recent years there have been considerable efforts on federal, regional and local level to develop and improve innovative concepts for sustainable land use management. The German planning law offers a wide range of instruments for the control of land use, which has been considerably extended and improved through fundamental amendments to the German regional planning act (ROG) and the German federal building code (BauGB). Although the current rate of land consumption indicates a downward trend in recent years, it is with approximately 100 ha/day far away to meet the 30- ha/day-goal. This unsatisfactory implementation of the reduction target is not due to a lack of efficient planning instruments but due to a lack of enforcement. Therefore a support of planning law by economic incentives is considered to be necessary, which should make land consumption more expansive and thereby economically less attractive. Several proposals are under discussion, including the introduction of “tradable land use certificates”, which have been already tested in different simulation games, the introduction of a “new site development charge”, to be paid by property developers and investors and a radical reform of the land tax system. Various parties call furthermore for the complete abolishment of subsidies promoting urban sprawl like the commuter’s tax allowance (Entfernungspauschale).

Border-crossing Transport in Europe

Border crossing transport is a crucial issue for Germany, which is situated in the centre of the European Union. Many rather general statements can be found in official documents, supporting the need for an efficient and environmental friendly long distance transport in Europe. However, several specific instruments and measures can be identified as well:

- Regulation/policies of transit traffic: In contrast to many other countries Germany has no road charge for cars. But cross border freight traffic (on trucks over 12 t) passing though Germany is charged a toll.
- Harmonisation of the technical standards and regulations are a major issue. This holds true particularly in the rail sector. The different systems in different countries impede the flexibility in cross-border rail transport. One illustrative example: recently German Railways introduced a new high-speed train called the Velaro D, to be launched at the end of 2011. The train will be used in Germany but also is designed for cross-border traffic to France and Belgium. A rather sophisticated technology is needed to cope with the requirements of the systems in the different countries. The train is able to run on four different electricity systems (direct and alternate current). Connections to the UK and the Netherlands would necessitate still further retrofitting. In terms of harmonised regulation, the German government wants to accelerate the introduction of the European Train Control System (ETCS) which is a signalling, controlling and train protection system designed to replace the many incompatible safety systems currently used in different European countries, especially on high-speed lines. The aim is to make cross-border train traffic more efficient and to

avoid an exchange of the locomotive at the border. Transit traffic (on roads and rails) is expected to increase by a factor of 2.5 until 2025, this means that transit traffic grows more than twice as much as freight transport in Germany. Germany wants to optimize this traffic by a reduction of the transit trips and by shorter and more energy efficient routes (rail, short-sea-shipping or inland water transportation).

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Greece

GPTCA – Greek Permanent Committee of Technology Assessment

State of Policy

The use of environmentally friendly and energy efficient vehicles and other transportation means is strongly promoted by the EU for the growth and development of sustainable transport. To this end, Greece promotes and implements several instruments, policies and programs, such as:

The design and construction of environmentally friendly and energy efficient transport infrastructure, which include:

- The extension of subway lines.
- The construction of new metro lines in Piraeus (country's biggest port) and Thessaloniki.
- The expansion of the suburban railway.
- The Modernization of specific parts of the national railway infrastructure.
- The electrification of the national railway network between Athens and Thessaloniki.

The adoption of regulatory and administrative programs and actions, such as:

- Promoting public transport.
- Training transport personnel.
- Informing and training passengers.
- Implementing new traffic management measures for the decongestion of the city center.
- Replacing fleet with new cleaner* and energy efficient vehicles (cars clean technology, CNG, hybrid, electric, etc.).
- Linking vehicle taxation to CO2 emissions.
- Inspecting vehicles (including emissions control and the obligatory issue of Exhaust Control Card).
- Promoting incentives for the replacement of old vehicles not using environmental friendly technologies.

Energy Use for Transport

In Greece, on the basis of the 2005 energy consumption energy balance, the transport sector represents almost 39% (8,07 Mtoe) of the total final energy consumption in the country.

With respect to greenhouse gas emissions, the transport sector emits 23% (Odyssee 2004) of the total CO2 in Greece.

Under Law 3851/2010 the national target for participation of RES in final energy consumption in transport has been increased to 10%. To meet this target, we will have to implement all institutional changes that

have been initiated in order to achieve less energy consumption through the use of more efficient systems and adoption of policies for the rational use of energy in all sectors. Regarding biofuels, the effort lies in the use of domestic resources to produce bio-diesel from crops and to develop and manage a network of biomass for energy use.

Regulation and Technology Options for Sustainable Transport

The regulation and the technological options for sustainable transport are not solely a responsibility of the Ministry of Transport, but a responsibility of the Ministry of the Environment and Energy, of the Ministry of Finance and of the General Secretariat of Public Works.

In collaboration with the Ministry of Finance, measures taken for the promotion of the use of cleaner engines are:

- The prohibition of the import of used cars from other EU countries if their emissions do not meet the requirements of the EU Exhaust Gas Directive in force (exceptions apply to special groups).
- The progressive taxation of imports for private passenger vehicles from the EU, depending on engine capacity and levels of emissions (according to vehicle's age and gas emissions), with discounts or reductions for cleaner technologies (e.g. hybrid vehicles).

Also, the Ministry of Transport, the Ministry of the Environment and Energy and the Ministry of Finance have prepared a proposal regarding the levy of a tax on vehicles bought after January 1st 2011, calculated either on the engine capacity or CO2 emissions.

Cleaner and more energy efficient vehicles that promote sustainable transport is the goal of both the EU law (which is incorporated into national law through the relevant instruments) and national provisions.

This category includes transactions and activities relating to:

- The regulatory framework for the approval of vehicles that meet the new demands.
- EU Guidelines associated with the emission limits of gaseous pollutants from internal combustion engines in vehicles.
- Relevant technical regulations which have been accepted by our country both from the UN and the European Parliament and Council concerning all vehicles with internal combustion engines, hybrid vehicles, electric, hydrogen, etc.

It is pointed out that the perspective of widespread use of cleaner and more energy efficient vehicles using hybrid technology, natural gas, hydrogen and electric vehicles, is a key priority for the Ministry of Transport.

Land Use and Physical Planning

Land use and planning is basically a responsibility of the Ministry of the Environment and Energy and the Ministry of Rural Development and Food.
Efforts are made to persuade the public to use public transportation rather than private vehicles. These efforts - initiatives focus on:

- Supporting - expanding of the bus lane network.
- Redesigning the transport network in order to promote the use of combined transport, that is to say the use of multiple transport means (bus, metro, suburban railway) with particular emphasis given on means of stable orbit (as a cleaner and more energy efficient means of travel).
- As part of the promotion of combined transport, the use of the same ticket for one and a half hour has been applied. Also, the pricing policy (low ticket costs) aims to increase the use of public transport.

In an effort to integrate cycling on the roads of the country and highlight its use as an alternative mode of travel, it was decided in the summer of 2008 to provide funds of fifteen million Euros for the "Construction of bicycle related infrastructure". Today, the program includes several projects that operate in seventeen municipalities of the country.

At the same time, the following research programs have been completed (under the supervision of the Ministry of Transport):

- "Research methods of implementation to promote conditions for sustainable mobility in Greece". This project includes the integration of cycling in the municipality of Halandri (nearby Athens) and in the Strategic Plan for the Sustainable Development of Transport in Rethymno (Crete).
- "Planning cycling infrastructure in the Constabulary Park (Metro Station Katehaki-Athens) and the connection between them through the Goudi Metropolitan Park, National Technical University Campus and National Capodistrian University Campus".

Border-crossing Transport in Europe

A long-term program providing as a key policy both the upgrading and expansion of existing infrastructure and the promotion of intermodal freight transport, with emphasis on optimal use of road, rail, port and airport infrastructure, is applied. It is estimated that the successful implementation of this program will help in upgrading the Greek role in European transport, providing a significant boost to freight services, but also giving impetus to environmental friendly means of transport. In particular, the Ministry of Transport has already promoted legislative or other means with significant national and international importance, such as:

- The Pan-European Way.
- The Adriatic Intermodal Way.

- The Maritime Way of South - East Europe
- The rail network, which will connect Greece with South - East Europe.
- The proposal of the European Parliament and Council for the European Rail Network for competitive freight.
- The Law 3333/05 (A 91/12-4-05): “Establishment and Operation of Freight Centers and other provisions”.
- Significant investment in rail infrastructure.
- Integration of rail EU law into national law.

In order to achieve the promotion of intermodal transport, major projects to upgrade networks are adopted. However, the creation of Logistics Centers constitutes a key infrastructure and an important precondition for the rationalization and consolidation of functions in the transport chain and for the promotion of sustainable and energy-efficient transport.

In addition to the above, regarding road freight, incentives are granted for the replacement of the fleet of old truck carriers, with new ones of clean vehicle technology.

Finally, regarding emission standards and speed limits for road freight, the following measures are in use:

- In line with EU legislation, our country uses the emission standards set out in EU legislation and reviews them from time to time.
- Regarding the speed limits for trucks, our country has adopted, in line with EU legislation, a speed limit of 90 km / h for common vehicles, and of 80 km / h. for vehicles transporting dangerous loads.

Italy

VAST – Comitato per la Valutazione delle Scelte Scientifiche e Tecnologiche

State of Policy

According to the 3rd Euromobility Report[12], in Italy, the number of motor vehicles per number of inhabitants is the highest in Europe (about 61 motor vehicles per 100 inhabitants compared with a European average of 46). Furthermore the use of low impact fuels is not very widespread, with vehicles running on GPL and methane accounting for less than 4% of total vehicles.

The **difficult traffic conditions** prevailing in Italian cities are also described in the Legambiente report "Ecosistema urbano"[13], which reports that about one third of CO_2 emissions are produced by the transport system (of which 80% accounted for by road transport).

The latest National Plan allocating CO_2 shares for 2008-2012 specifies the following **CO_2 reduction measures** to be applied over this period in the sectors not included in the Directive 2003/87/EC (*emission trading*). The measures applying **to the transport sector** are as follows:

Measures	Reductions over the period 2008-2012 [MtCO_2eq/year]
Over the period 2007-2011 the scrapping of circulating vehicles registered prior to 1996 and producing emissions exceeding 145 gCO_2/km and their replacement with vehicles having emissions of less than 145 gCO_2/km	9.0
Infrastructural measures in the transport sector	4.5
Use of biofuels	6.0

As far as **infrastructural measures** are concerned the **Strategic infrastructure programme** (PIS) **provided for in** law no. 443/2001 (**socalled 'target' law**) involving the implementation of 348 projects (mainly railway and road works) for an estimated total value of 358 billion euro. Against the total works included in the PIS as at the end of April 2010, the value of the works or parts thereof approved by the CIPE, that is after the preliminary design or detailed plan and the financial framework have been decided, amount to 131 billion, or 37% of the cost of the entire programme[14].

In the case of **biofuels,** the 2007 budget law states that by 31 December 2010 the percentage of biofuels and other renewable fuels versus the total diesel and petrol fuels **offered on the consumer market** must be at least 5.75%.

[12] www.euromobility.org/documenti/atti_di_convegni/2009_50_citt%C3%A0/index.html.
[13] www.legambiente.eu/documenti/2009/ecosistemaUrbano/EcosistemaUrbanoXVIedizione-1.pdf.
[14] For a summary see www.camera.it/465?area=23&tema=71&Le+infrastrutture+strategiche.

Furthermore, subjects placing on the consumer market petrol or diesel fuels for motor transport deriving from non renewable primary sources are obliged the following year to make available a minimum quota of the following biofuels; bioethanol and derivatives, ETBE and biohydrogen, as well as of synthetic fuels obtained from biomasses. This quota is set at 3.5% for 2010, 4% for 2011 and 4.5% for the year 2012. The development of the biofuel supply chain is to be supported also by means of tax breaks (**reduction of excise duty**).

Uncertainty over the chances of attaining the targets of greenhouse gas emissions set by the Kyoto Protocol necessitated the launching, as approved in CIPE resolution no. 135 of 11 December 2007, of a process of revision of the guidelines referring to national policies and measures aimed at reducing greenhouse gas emissions which culminated in the establishment of a **Greenhouse Gas Emission Technical Committee (CTE)** mandated to adopt **new reduction measures,** with priority accorded to the transport sector (in particular, urban and extraurban mobility management).

Several days ago, Parliament began the examination of **a bill** (C. 2844) designed to **refinance the Sustainable Mobility Fund** for which, in the three years 2007-2009, some **240 million euro** were earmarked for projects designed to improve air quality in urban areas as well as to boost public transport. Also of significance is the recent establishment of the **Fund for the promotion and support of local public transport development** to the tune of 463 million euro for the period 2008-2011.

An active role in the sustainable mobility **initiatives** aimed at sustainable mobility was also played by the **Ministry of the Environment,** which, over the past decade, has fostered a total of approximately 500 interventions to the tune of a total of approximately 500 million euro in favour of local authorities and regions (municipal level car sharing, low environmental impact fuels, methane project initiative, ecological Sundays, structural interventions to rationalize mobility in an urban environment, etc.)[15].

Lastly, with the promulgation of **legislative decree no. 155/2010,** the Government proceeded beyond the simple transposition of Directive 2008/50/EC and also provided for the substitution of Directive 2004/107/EC, setting up a **unified legislative framework covering the evaluation and management of environmental air quality**.

Energy Use for Transport

The Energy Quota Currently Utilized in Transport

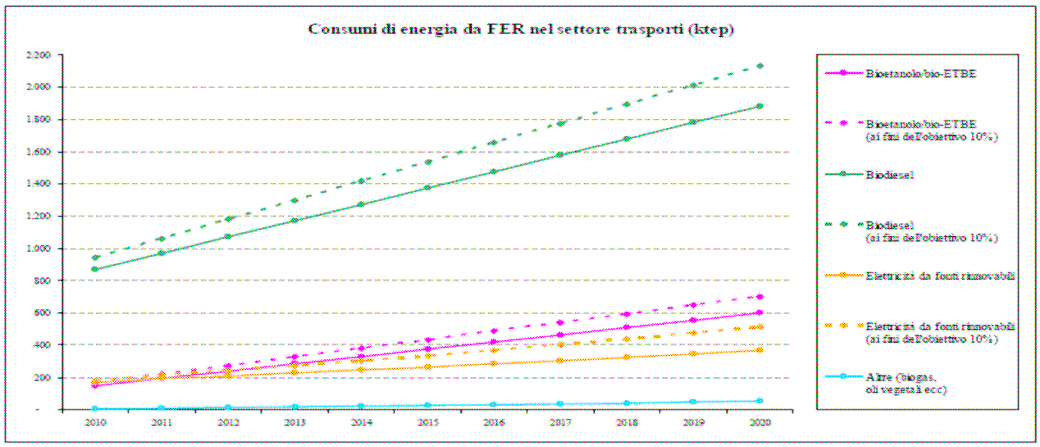
The share of final energy consumption that may be assigned to the transport sector in 2009 is **32.2 per cent**. It should be noted that the highest share among the final energy user sectors (35.2%) in 2009 was accounted for by use in civil sectors (which includes the domestic sector, commerce, services and the public administration); this is followed by the transport sector (32.2%) and the industrial sector (22.6%)[16].

[15] www.minambiente.it/opencms/opencms/home_it/menu.html?mp=/menu/menu_attivita/&m=Mobilita.html.
[16] http://www.istat.it/salastampa/comunicati/non_calendario/20100706_00/testointegrale20100706.pdf

The Share of Energy Produced from Renewable Sources

According to the national energy budget[17], energy from renewable sources utilized in the transport sector in 2008 amounted to 0.662 million tons of oil equivalent (MTOE), compared with 0.148 MTOE the previous year.

In the **National renewable energy action plan**[18] (June 2010), the renewable energy quota in the transport sector[19] for 2010 is estimated at 3.5% versus 0.87% in 2005. The same Plan also contains an estimate of the renewable energy sources actually used in the transport sector and their forecast development in future years for the purpose of ensuring the European target of 10% of renewable sources in this sector is achieved.



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compulsory quota of biofuels versus total fossil fuels placed on the market and in the excise duty reduction applied to biodiesel fuels.

In future, according to the recent national renewable energy action plan, it is intended to rely principally on the **compulsory minimum quota approach** while respecting the conditions of sustainability, as well as focusing attention on the development of second and third generation biofuels and on the social sustainability of biofuels.

Regulation and Technology Options For Sustainable Transport

In the period 2006-2009 **incentives** were granted **for the purchase** of motor vehicles with a low environmental impact, in particular vehicles with exclusive or dual fuel supply based on methane, hydrogen, GPL or equipped with an electric motor. Incentives were made available also for the purchase of **bicycles**. Low environmental impact vehicles also benefit from **reduction of or exemption from** the payment of the **annual road tax** (the regions are competent in this matter and each region has a different system).

[17] http://dgerm.sviluppoeconomico.gov.it/dgerm/ben/ben_2008.pdf
[18] http://www.governo.it/GovernoInforma/Dossier/energie_rinnovabili/PAN_Energie_rinnovabili.pdf
[19] Aggregate of national production and imported biofuels.

In order to encourage the spread of **electric vehicles** it is proposed to favour the development of a grassroots network of **recharging and assistance points** throughout the national territory, adopting a single standard for all electric power points.

In the case of vehicles with **petrol or diesel** engines, over the past few years a number of **incentives** to encourage the **substitution** (scrapping) of vehicles at least 10 years old with brand new vehicles. Similar measures have been taken also regarding the replacement of **commercial vehicles** for the transport of commodities, while the introduction of incentive measures regarding the renewal of motor buses circulating in Italy, the age of which exceeds the European average, is still under discussion.

Tolls, Congestion Tax, Green Taxes

In legislative decree no. 7/2010 Italy transposed the socalled 'eurovignette' Directive 2006/38/EC regulating the taxation of heavy vehicles used for freight transport. In an urban environment, mention must be made of the system of paid access to the city centre, introduced in Milan (socalled ecopass) following the example of London, which has resulted in a decrease in traffic in the city centre and a consequent reduction in atmospheric pollution. Under the ecopass system drivers of the more polluting vehicles have to pay to gain access to uptown Milan. Euro 3, 4 and 5 motor vehicles, motor bikes, mopeds and bicycles are exempt from this payment.

Methods for Monitoring Environmental Impact in the Transport Sector

Legislative decree no. 155/2010 established a unitary regulatory framework covering the assessment and management of environmental air quality. It entails in particular the zoning of the entire national territory by the Regions for the purpose of assessing air quality with respect to each of the pollutants mentioned in the decree. As far as the activity of assessing air quality performed by the Regions is concerned, detailed regulations govern the way measures are made at fixed sites, the reference measures used, and the modelling techniques or techniques for ensuring an objective estimation is made in each zone or built-up area, also by means of reference to the technical annexes accompanying the decree itself. Each Region or Autonomous Province must draw up an assessment programme compliant with the new provisions and present to the Ministry of the Environment a project covering the updating of the measuring network. The network stations must be managed or monitored by qualified public entities and must be maintained and run in conditions such as to ensure that all the requirements of the decree are met.

Regulation of Specific Uses of Technology

Antiparticle filters: in 2009 some **11 million euro** were allocated to equipping public transport vehicles with **antiparticle filters**.
Intelligent traffic systems: In March 2009, the Transport Committee of the Chamber of Deputies approved the final document regarding the Commission communication "Action Plan for the Deployment of Intelligent Transport Systems in Europe" (COM(2008)886 definitive).

Use of the Territory and Territorial Planning

In July 2010, the Transport Committee of the Chamber of Deputies approved a document containing government guidelines to the **Action plan on urban mobility presented by the European Commission COM(2009)490 def**. which sets out the principal requirements to be taken into consideration by the Government in legislating on the matter.

Mobility of Persons

The mobility of persons in the larger Italian cities is still largely based on private motor car vehicles. Conversely, the development of public transport, especially railway and tramway transport, is inadequate and has led to traffic congestion and increased journey time. The strategies proposed for the replacement of private vehicles with public transport are proceeding in both these directions.

To reduce the use of private vehicles the following measures are envisaged:

- **the expansion of limited traffic areas,** with remote monitoring of access thereto;
- **measures in favour of non motor transport**, such as bicycle and pedestrian traffic by instituting dedicated and protected itineraries, avoiding mixed usage thanks to a rational functional subdivision of the road network;
- **the raising of citizens' awareness** by means of publicity/progress campaigns, focusing in particular on younger people, also at school level.

Bike Sharing

Recent years have seen a much more widespread use of this means of sustainable transport also in Italy, and by sharing may now be found in almost all the cities.
According to the 2009 Euromobility Report, the users of this service have increased by 206.5% compared with the previous year. Milan in particular is the city in which bike sharing is most widespread, with 12,346 users, followed by Rome with 8,700. The service consists in users sharing bicycles made available by the Municipality. Subscribers can pick up a bicycle at any one of the parking spots located in their own city and drop it off again at a different parking area. The aim of the service is to cater for short journeys inside the city.

Transport of Goods

In Italy, one of the problems most keenly felt in the urban environment consists of goods delivery to shop in the historic centres. This critical aspect of this problem is that the vehicles transporting the goods travel half empty, are often obsolete (and so are more polluting) and the deliveries take place during the shops' opening hours and therefore at times in which there is more traffic, thus contributing to increase congestion. To overcome this problem, outside many cities trucking terminals have been constructed, or it is planned to do so, where the goods are unloaded and subsequently delivered to the shops using smaller vehicles with a lower environmental impact.

Border-crossing Transport in Europe

Italy is a participant in numerous trans-European transport projects within the framework of the TEN-T Networks. One of the more significant and complex of these is the projected new high-speed Turin-Lyon line which will link this coutnry to the great Lisbon-Kiev railway axis **(Corridor 5).**

The sustainability targets of long-distance transport, with special reference to freight transport, has now been at the focus of transport policies in this country for a number of years. The principal approach identified for the purpose of achieving these targets is the development of intermodal transport, which will allow an increasing share of traffic to be transferred from road transport to rail and sea transport. The **Motorways of the Sea** project have been included by the European Commission in the list of the thirty top priority projects. In this country several different steps have been taken to implement the Motorways of the Sea project. These include in particular funds earmarked for the rehabilitation and modernization of sea port infrastructures provided for in laws nos. 413/1998 and 166/2002, incentives granted to the motor transport sector to enable the transfer of all-road traffic to combined road-sea traffic by means of the introduction of the socalled "ecobonus" and the boosting of the sea port installations and logistic platforms provided for in the 'target law'. Regarding this issue, mention must also be made of the agreement signed on 10 September 2009 by the Italian and Spanish Ministers for Transport aimed at the promotion and development of one or more motorways of the sea between the two countries.

The growth in terms of quality and efficiency of the rail links between Italy and the other European countries stands out as an essential prerequisite for the reduction of road congestion. The estimates regarding traffic across the Alpine passes, which represent a compulsory access path for incoming and outgoing freight, reveal that the number of heavy lorries using these passes will increase by about 30% by 2020; it is expected that by 2030 the road capacity of the entire Alps area will be saturated. One of the projects under way to solve this emergency is the **new San Gotthard tunnel** which should come into service by 2017. This will be the world's longest tunnel and will not only reduce journey time between Switzerland and Italy but above all considerably increase rail freight volume.

The Netherlands

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State of Policy

The Dutch sustainable transport policy is formulated in the policy document “Nota Mobiliteit” (Memorandum Mobility) from September 2004. This document describes the general transport and traffic policy until 2020 and includes a chapter about sustainable transport. The aim of this chapter is to limit the negative effects of traffic while giving space to transport and traffic in a growing economy.
The short term policy is to meet the international agreements about the environment. In order to prevent climate change, air pollution and noise pollution, the international rules for technical demands to vehicles and fuels for vessels and vehicles have to be sharpened according to the Dutch government. The long term policy aims at a transition to sustainable transport and a complete new concept for transportation.

In the climate program “Schoon en Zuinig, nieuwe energie voor het klimaat” (Clean and Economical, New Energy for the Climate) from September 2007, CO2- reduction targets are sharpened. According to Clean and Economical, The Netherlands wants to profile itself as one of the most innovative countries in traffic and transport and wishes to have one of the most efficient transport systems in Europe with a large role for climate neutral, sustainable fuels. New forms of cooperation between government, business and social partners are necessary according to the climate program.
In order to achieve this, the government pushes for a preferably European emission policy. Second, the government wishes to stimulate the demand for clean and economical cars by putting environmental costs in the price of mobility and informing citizens and business in their choice for more sustainable transport.
Policy has to be developed to reduce emissions from the international air traffic and maritime shipping. The amount of hybrid, plug-in hybrid, electrical, flexifuel and natural gas/biogas vehicles will have to increase.

Because of a growing traffic jam problem and a greater use of the public transport system than expected in the Memorandum Mobility, in October 2008 policy as formulated in this memorandum is sharpened in the MobilityProcedure (MobiliteitsAanpak).

The question is whether these ambitious policy goals work out as planned with an ever growing transport system and a growing need for mobility. Although vehicles with renewable energy sources are stimulated, their share in the total amount of vehicles and transport movements is still very small. Since the government keeps on stimulating mobility and limitations are no option, the question is whether cleaner and more efficient engines and renewable fuels make up for a total increase in transport movements.

The policy as mentioned above was formulated by former governments. The Netherlands is forming a new government at the moment with less environmental ambitions. It is not sure how this will work out

for the formulated plans and for the successions of these policy plans. The speed limitation will be raised from 120 to 130 km/hr, where this is possible without a conflict with air quality and noise regulation. The ambitions for climate policy will be downscaled to European ambitions. It seems that the Netherlands doesn't want to be a European leader concerning environmental and climate policy.
However, there will be a kind of feed-in regulation for renewable electricity.

Transport Policy Aims

- Improve air quality and more efficient use of energy.
- Building projects have to meet the European norms for air quality. In the National Cooperation Program Air Quality (2008) measurements are taken to improve the air quality.
- Control and force back CO2-emissions. International regulation of emissions is necessary, therefore the Netherlands pushes internationally for:

    - further optimization of the combustion engine
    - high usage of sustainable biofuels
    - strong growth of electric or "plug in" hybrid vehicles
    - growth of fuel cells/ hydrogen vehicles
    - further development of vehicle efficiency

- Force back high noise exposure by traffic by implement noise policy, develop and implement innovative noise reducing measurements along roads and railway. No houses next to state highways with a noise exposure of more than 65 dB. Reduction of bottlenecks over 70 dB along railroads until 2020. Growth of railway transport within the valid noise exposure legislation.
- There should be no negative effects for special nature values by the construction of infrastructure. The quality of the soil should be maintained and possibly improved. Nature should be conserved or compensated for. The government wants ambitious international agreements for improving water quality.

Climate Targets and Transport

The ambition of the Dutch government in 2007 was to realise a 30% CO2-reduction in 2020 compared to 1990 and to make 20% of the energy use sustainable. In the climate program "Clean and Economical" the ambitions for traffic and transport are formulated. According to the program the sector is responsible for almost 20% of the Dutch emission of CO2 and has to reduce 13 till 17 Mton CO2/year in 2020 compared to an unaltered situation (47 Mton CO2 emission in 2020). The total CO2 emission for transport and traffic in 2020 compared tot 1990 may be 30-34 Mton. This means the CO2 emission is allowed to grow with 0-13% compares to the emission in 1990 (30Mton). Overall there will be no CO2 reduction from transport in 2020 compared to 1990.

1990	2020 unchanged policy	With CO2 policy Clean and Economical	reduction
30	47	30-34	13-17

CO2-emissions from transport and traffic in the Netherlands and planned effects of policy in Mtons/year (table 1 chapter 7 Schoon en Zuinig).

In the governmental agreement 2010-2014 of the coming new government, is formulated that the Netherlands will follow European agreements about CO2 emission reduction. This means that also the Dutch reduction targets will be equal to the European targets and change to 20% CO2 emission reduction in 2020. The share of renewables in 2020 should be 14% compared to 1990.

R&D

For improving the quality of the environment, € 1 billion is reserved for the period 2011-2020.
30 million euro is available for measures for the introduction of clean fuels and the implementation of ICT to support a better flow through.
€ 5 million is available for pilot projects for driving on hydrogen and € 65 million is available for pilot projects to promote electric driving.

Energy Use for Transport

The current share of energy consumption used for transport

The energy use of traffic and transport in the Netherlands in 2009 was 561 PJ . In 1990 it was 451 PJ. The cause of growth is mainly due to a growth in passenger cars. The road traffic used 426 PJ, navigation 86,4 PJ, air traffic 9,0 PJ and rail traffic 0,9 PJ. The transport sector contribution 17% to the total amount of energy used in 2009. This total use of energy in the Netherlands in 2009 was 3262 PJ. Households contributed 425 PJ in 2009. The amount of energy used by transport and households is nearly equal. http://www.compendiumvoordeleefomgeving.nl/indicatoren/nl0030-Energieverbruik-door-verkeer-en-vervoer.html?i=6-40.

The Share of Gross Energy Production from Renewable Energy Sources

In 2009 3.4% of the petrol and car diesel sold in the Netherlands consisted of biofuels. The government target for biofuels was 3,75% for 2009. No figures for other renewable energy sources are found.

Plans, Policies and Discussions on Increasing the Use of Renewable Energy Sources for Transport

At this moment, the transport sector almost solely depends on fossil fuels. To keep fuels affordable and reduce CO2 emissions, according to Dutch politics vehicles have to become more economical and renewable energy sources have to become more important.
For 2040 the Dutch government wishes to stimulate the use of sustainable biofuels to reduce CO2 without the disadvantuous consequences for food production, biodiversity etc. Furthermore, the government wants to stimulate the growth of electrical vehicles and vehicles with a fuel cell or on hydrogen.
To stimulate and to profit from these possibilities for innovation, until 2020 the Dutch government pleads for norm reduction in a European context. Instead of choosing a technology from the renewable possibilities, the market will be stimulated to innovate and compete in order to meet the strict norms.
The Taskforce Energy Transition, a initiative of the government, is established to create an energy transition towards a sustainable energy household. Different platforms are established, amongst which the Platform Sustainable Transport. This Platform consists of representatives of government, industry and ngo's. Their goals are to reduce emissions of GHG from new vehicles by a factor 2 in 2015 and by a factor 3 of the entire fleet of cars in 2035. For this, four transition paths are formulated: 1. Hybridization and electric driving; 2. Sustainable biofuels; 3. Driving on hydrogen; 4. Intelligent transport systems.
The Platform wants to stimulate the creation of an international infrastructure for the dissemination of alternative fuels and stimulate the demand for new fuels and clean vehicles. The working groups that support these transition paths stimulate local initiatives and try to detect bottlenecks.

Regulation and Technology Options for Sustainable Transport

Biofuel

Part of the total amount of fuels have to consist of biofuels. Target for the use of biofuels in 2010 was 5,74 %, but this percentage has been adjusted to 4%. The most important reason is concern over the effectiveness and sustainability of the biofuels, for instance in the competition with food.
In 2006-2007 there was a tender biofuels which stimulates the introduction of innovative, second generation sustainable biofuels, for the period until 2013 with a total amount of € 12 million.

Electric Driving

The former government had the intention to support electric driving by supporting market initiatives. It has taken the initiative for a Formula-E team, a joint project of governments, market parties and social organisations. Its mission is to encourage market developments and take away obstructions. At the same time the government will stimulate pilot projects including the necessary loading infrastructure. In total € 65 million is available. From 2012-2015 the amount of cars is expected to increase and from 2015-2020 there will be a further rolling out of the amount of electric vehicles. From 2020 on there should be a mature market.

Road Pricing

The former government planned to introduce a different system for paying for mobility by the introduction of road pricing. However, there was discussion about the technological possibilities of a differentiated road pricing system and the political desirability. In their governmental agreement, the new Dutch government mentions road pricing is no longer a policy option.

Green Taxes

The tax on new cars is differentiated and partly depends on the CO2 emission of the vehicle. From 2013 the tax will solely depend on the CO2 emission. Economic and clean cars will be cheaper in purchase than heavier and less economic cars. Electric cars don't have to pay tax. Hybrid cars and cars that run on lpg or natural gas pay a reduced tax rate. The road taxes are also CO2 dependent. Since 2010 clean cars don't have to pay road taxes.

Green Driving

The program "The green driving" tries to influence the driving behaviour of car drivers. To program promotes a more economic driving style by showing that driving at a constant speed and switching gear at a low number of revolutions saves fuel.

Euro 4-5

To prevent PM10 and NOx the government wishes to stimulate an early introduction of Euro 4 and Euro 5 engines in trucks and busses.

Particle Filters

There is a subsidy program for particle filters in light vehicles for existing cars and light vans with a total budget of € 50 million. Up till week 39 80.515 filters are installed.

Scrapping Arrangement

In 2009 a national scrapping arrangement started. With buying new cars, old cars could be traded in. The arrangement ended in 2010 with the exchange of over 81.000 old vehicles.

Reduction of Maximum Speed

At five locations in the highwaysystem the maximum speed was reduced to 80 km/hr to reduce the emission of PM10. In the new governmental agreement the general speed limit will be raised to 130 km/hr.

Noise Reducing Source Measurements

New, innovative noise reducing (source) technologies like silent road surfaces and silent train braking systems are being developed and tested to promote implementation. Implementation of silent road surface on highways near residential development.

Quality of Nature

Policy is to reducing 208 bottlenecks in the highway structure in realising the ecological mainstructure. It is not sure whether this policy will be maintained, since the new government will limit the ecological mainstructure.

Land Use and Physical Planning

The Netherlands are densely populated and we have a great need for transportation, which conflicts from time to time. The last twenty years so-called VINEX-locations are planned at the outside of cities. These VINEX-locations are large urban residential areas for living but without many possibilities for employment. This has created quite some commuter traffic. Therefore, the need for transportation has grown, without many possibilities for public transport. This has contributed to a rise in car traffic. There is a public discussion about the necessity of more and broader highways. Because procedures for the expansion of existing highways and the planning of new ones took long procedures and quite some time, the former government has implemented emergency legislation to speed up the construction of highways.

To reduce the increasing traffic jam problem, two strategies are formulated that come down to : 1. realise a growth in transport by train by amongst others creating high frequency railway transport, six trains per hour in the densely populated area’s and stimulate regional public transport. In September 2010 a test started with high frequent railway transport between Eindhoven and Schiphol. Unfortunately, this leads to more delays in other regions. The question is whether the railroad system an actually process more train travellers.

And 2. development and more efficient use of highways by untwining regional and trough traffic and creating at least 2x4 carriageways on the most important highways in between cities in the most populated western part of the Netherlands. One highway already received an extra carriageway. The question is whether extra highways solve traffic jam problems or create extra mobility.

Almere is a growing city near Amsterdam. There are plans for the construction of an extra highway as well as a railway between Amsterdam and Almere. Since they will go through a nature area this raises a lot of public discussion.

According to the former government, the negative effects of infrastructure on nature should be minimalised. There should be no negative effects on special nature values, the quality of the soil system should be maintained and negative impacts on nature should be compensated. However, the realisation of the ecological mainstructure, a natural structure that ties nature reserves together to enlarge the living areas of many species and improve biodiversity, is not running on time and the new government will invest less in the purchase of land.

The Netherlands have a strong tradition of biking. Most citizens use a bike for short distances, especially in cities. The expansion of good bike facilities near train stations is stimulated. Many towns have a policy for stimulating bikes by improving bike paths, often part of the climate policy of the town.

Road pricing is no longer desired by the new government

Since a few years most towns have some form of climate policy. This climate policy includes a program on sustainable traffic. The Platform Sustainable Transport supports many local and regional initiatives to promote and facilitate sustainable traffic, e.g. hydrogen busses, electric transport in Amsterdam, hybrid public transport in Gouda.

Border-crossing Transport in Europe

The Netherlands wants to sharpen the EU-regulation concerning the norms for emission by road traffic and dieseltrains. Further regulation of emission norms for air traffic and the sea navigation sector is strongly promoted by the Netherlands.

The position of the national airport Schiphol is point of discussion for many years now. The airport wishes to grow while it creates noise pollution and not always meet the noise reduction norms. The recent outcome of a new study is that Schiphol should have the possibility to grow within limits, made possible by new noise reducing technologies.

There is no specific international component in the sustainable transport policy plans of the Netherlands.

Norway

The Norwegian Board of Technology
Author: Jon Magnar Haugen

State of Policy

Major **policy documents** are

- The National Transport Strategy for 2010-2019, which mainly concerns infrastructure.
- The White paper on climate, supplemented by the Climate Settlement between the government and major opposition parties of 2008. The settlement takes up car taxation and incentives for public transportation and alternative fuels.

The overall **objective** outlined in the National Transport Strategy is to provide an efficient, accessible, safe and environmentally friendly transport system. It shall satisfy society's needs for transport and promote regional development.

The strategy states that different forms of transport have **different advantages** in the transport market. Policies must differentiate between, inter alia, geographical conditions ranging from the more densely populated Oslo-area to the rugged western and northern coasts. This means that funding for public transport and railways is targeted at and around major towns, while roads have priority in the rest of the country. Overall, the aim is to spend an average of 32.2 billion NOK (>4 billion EUR) annually on investments and maintenance of infrastructure during the 10-year period, compared to 24.6 b NOK for 2009. This involves 22 b on roads, 9 b on rail, 1 b on coastal infrastructure. Focal areas for investments involve

- stronger capacities for rails in the Oslo area
- improving roads along major axes to reduce travel times
- facilities that protect roads from landslides and avalanches.

Taken combined, the Transport Strategy and the Climate Settlement emphasize the following **initiatives towards sustainability**:

- Investments in rail for freight and passenger transport
- Investments in harbours for freight transport
- Subsidies for public transportation (bus/rail)
- Strong CO_2-components in taxation for cars and fuels
- Incentives for alternative fuel use. Strongest incentives for electric vehicles, more modest for hybrids and biofueled vehicles.
- Investment in facilities for walking/cycling

Climate targets and transport:

GHG – reduction 2050 1990 level	100%, based on a combination of policies domestically and abroad	
GHG-reduction 2020, domestically	12-14 Mt compared to BAU (approx. 20%) 2.7-4.7 Mt compared to 1990 level	The climate settlement
GHG-reduction in transport 2020	1-2 Mt (< 10% of overall emissions from transport)	The climate settlement
Renewables share of energy consumption 2020	No set target, currently>50%	
Renewables share of transports' energi consumption 2020	10%	The renewables directive
Share of biofuels (surface transport) 2020	No set target	

R&D

R&D towards efficient vehicles include efforts towards renewable electricity supply in general, including hydro, solar, offshore wind and waves, and CCS. Hydrogen technology is also prominent, including supply, storage and fuel cells. Even infrastructure and transport system management are continuous issues of research.

Transnova is a public enterprise funded by the state to support

- establishment of infrastructure for alternative fuel/propulsion technologies
- other efforts towards sustainable transport or reduced transport volumes.

Climate Cure 2020

Norwegian authorities are undertaking their most comprehensive assessments of opportunities and costs for emissions reductions across sectors – called the "Climate Cure 2020". The assessment establishes a BAU-scenario where emissions from mobile sources are expected to increase from 16.8 Mt CO_2 currently to 19 and 21 Mt in 2020 and 2030. The Climate Settlement aims to reduce emissions by 2.5-4 Mt compared to BAU by 2020. Climate Cure 2020 sees this as an ambitious target given that certain policies have already been implemented and form basis for the BAU, including green taxes and new propulsion tech.

The strongest potential contribution within 2020 is identified for biofuels, measuring 1.8-1.9 Mt CO_2. This figure does not reflect eventual emissions abroad relating to supplies of biofuels. The theoretical contribution of propulsion technology (BEV, hybrids and a more efficient fleet) is estimated at 0.8 Mt CO_2. Other targets like doubling the proportion of cycling, improved public transport, ecoefficient driving, gas ferries and efficient ship technology are estimated to contribute 0.8 Mt. Heavily restrictive measures

against air and car travels are estimated to contribute 1.2 Mt. This would involve doubling of fuel prices, heavy toll and parking prices, combined with stuimulating alternative public transport. The assessment states that such policies may have unwanted implications for demography, welfare distribution etc.

For 2030, alternative fuel and propulsion, combined with improved rail capacity for freight transport, could kick in and contribute 8-12 Mt in reduced emissions compared to the BAU.

Governance and responsibility for sustainable development in the transport sector
The Ministry of Transport has the overall responsibility for implementing strategies for a sustainable transport sector. Regulation and supplies of transport services involves a multitude of actors. Local authorities play important roles in spatial planning, which may determine transport needs and which modes of transport that are feasible. County authorities are responsible for public transport services by bus, tram and boat. They would either own services, or procure services from others. They also own national and regional road infrastructure, although new investments are the domain of the state. The state also runs the national infrastructure for rail, and holds stocks in SAS.

While most passenger transport providers have **public ownership**, this is not so much the case for freight. As investment and wage costs are high, one sees a tendency that foreign trucks eat into the domestic market for freight.

Energy Use for Transport

The energy consumption in the transport sector in 2008 was 200 PJ, compared to a total domestic consumption of 778 PJ. Renewables contribute the following shares:

- Electricity (mainly hydroelectric): 46.5%
- Biomass and waste: 5.3%
- Thermal/surplus heat: 1.5%

In 2008, the energy supply to transportation consisted of
195.7 PJ petroleum
2.0 PJ natural gas (gas ferries and buses)
2.5 PJ electricity (rail)

Plans, Policies and Discussions on Increasing the Use of Renewable Energy Sources for Transport

As Norway is broadly self-sufficient with renewable electricity (hydro), a shift in transportation towards electricity is an obvious way forward. Options for this include:
1: Substitution to modes of transport where electricity is established (e.g. **rail**)
2: Introduction of **electric cars**, bikes etc.

Policies towards such options include investments in rail infrastructure and green taxes/subsidies which are discussed below.

An expert group established by the minister of Transport in 2009 found 2400 **BEV** in Norway. The group suggested to aim that BEV, including plug-in hybrids, should contribute 10% of the total fleet within 2020, corresponding to >200,000 units. An expert group in the Norwegian Board of Technology the same year was less optimistic about the pace of substitution, and estimated that all alternative propulsion combined could at best be found in **5-10% of new cars** purchased within 2020. With annual rates of purchase for new cars at >100,000, this could amount to 50,000-100,000 units. The Climate Cure assessments calculate with 120,000 units in 2020, with equal shares for BEV and plug-in hybrids. This effort is calculated to cost society 1100 NOK (140 EUR) per tCO_2 saved. With increasing maturity, BEVs are estimated to be profitable by 2030.

To consider sustainability of BEVs raises questions about the source of electricity. Even if one could guarantee that the load is based exclusively on hydropower, this implies that less hydropower is available for other purposes (opportunity costs). However, the efficiency of BEV is so high that even the impacts of a large scale introduction on the energy system are considered rather marginal. If the proportion of BEV rises to 10 %, they are estimated to demand 0.7 TWh per year (0.6 % of domestic electricity production).

Another option of interest is **hydrogen**. However, as hydrogen must either be derived from fossil methane, leaving a CO_2-residue, or through energy-intensive hydrolysis, this option also has its sceptics. Some propose that if CO_2-residues could be stored, methane-based hydrogen could be counted as climate neutral.

Support for 1st gen **biofuels** is modest, while more or less mature alternatives based on waste and wood attract support. Some hope that such options may contribute to self-sufficiency for biofuels in Norway. Current policies include compulsory mixing of biofuels into petroleum, currently set at 3.5%. The intent is to increase the level to 5% as soon as schemes to ensure sustainability in supplies are introduced.

Biofuels could be expected to play the strongest role where electricity is less competitive, like in ships, air, and trucks. In the **maritime sector** there are also ambitions towards fuel cells and increased use of wind and sea currents. Already, ships that supply and support rigs in the North Sea harvest some of their energy from currents.

Regulation and Technology Options for Sustainable Transport

Green Taxes

- Taxation for **combustion engine cars and fossil fuels**. The CO_2-component in car purchase taxes has stimulated demand for low-emission cars including 1st generation hybrids. Fuel taxation is combined of a road use tax (amounting to 4.54 NOK/l (0.57 EUR) for gasoline and 3.56 NOK/l (0.45 EUR) for

diesel), a CO_2-component (amounting to 0.88 NOK/l (0.12 EUR/l or 50 EUR/tCO2) for petrol and 0.59 NOK/l (0.075 EUR) for diesel), and VAT. Taken together, these amount to >60% of consumer prices. Such taxation must have left its marks; even though studies show that car and fuel use have low price elasticity.

- **Biofuels** meet a complex taxation structure. Flexifuel-cars meet a tax-reduction of 10.000 NOK (1250 EUR) on the specific car purchase tax. Bioethanol and biodiesel is excempt for the CO_2-component of the fuel tax. Biodiesel is charged with 1.78 NOK/l as a road use tax (50% of the level for fossil diesel). Petrol/ethanol mixtures are charged with the same road use tax as petrol whenever petrol is the main ingredient, and excempt in the opposite situation.

BEV

BEV are supported through tax exemption (VAT and specific car purchase tax, as well as a reduction on the annual car tax), and free admission to public ferries, public parking and toll roads. Further, they are admitted to road lanes that are otherwise restricted to public transport. The state also supports establishment of loading stations with approx 50 mill NOK/year. There are discussions how to prepare the grid for ultrarapid loading.

Hybrids

Currently, only pure BEV meet all kinds of stimuli, while 1st generation hybrids are handled like any other efficient combustion engine car. Plug-in EV may challenge current schemes for car taxation.

Hydrogen Vehicles

HV meet may of the same stimulants as BEV, but are not excempt for VAT. Hydrogen can only be introduced through large scale coordinated investments in fueling stations. The state has supported establishment of loading stations along a pilot route Oslo-Stavanger.

Public Procurement

The Climate Settlement concludes that public procurement should be used as a tool to kick-start the market for new propulsion technologies. A few Norwegian towns have invested in fleets of BEV.

Road Tolls, Road Pricing and Parking Restrictions

The Oslo road toll scheme was a pioneer in road pricing, installed to fund investments in infrastructure and public transportation. It is based on a settlement (called the Oslo-package) between the municipality, county and state. The state government has urged towards modifying the scheme more in line with

Stockholm or London congestion charge models, with differentiated taxes across time and space. However, such decision claim local support, and was excluded from the last Oslo-package. The state remains committed, and say that regions that establish congestion charge schemes will be prioritized for state subsidies to public transport.

In the National Budget for 2011, the government signals intent to shift taxation from purchase to use. As heavy fuel taxation may be unacceptable as it would put a disproportionate burden on rural areas where no alternative modes of transportation exist, the government signals intent to look into road pricing. There are also discussions to use parking prices as a restrictive tool for urban transport.

Methods for Monitoring Environmental Impact from the Transport Sector

The Environmental Protection Agency monitors air quality. Last winter, air quality in Bergen, Norway's second largest city, was so poor that the local authorities introduced unprecedented traffic restrictions, including prohibitions for half the car fleet within a certain zone, and limiting space available for parking. In many urban centers, threshold levels for particulates and NOx are surpassed a number of days each winter.

Particle Filters

Diesel cars without particle filter are charged 455 NOK extra on their annual car tax. An added car-wrecking subsidy of 5000 NOK (630 EUR, compared to the standard level of 1300 NOK), targeted at older vehicles with high emissions of NO_x and particulates, was in force in 2008.

Spatial Planning

Spatial planning could play a role both at reducing transport needs and substituting from high-emissive to low-emissive modes of transport. When assessing the potentials of this tool, one must keep in mind that there is a political priority to maintain population all over the country. This materializes through heavy investments in road infrastructure, as well as subsidies to boat and air transport in the west and north. Admitting that transport use in these regions could hardly be reduced or substituted, efforts towards sustainability in these regions would rather focus on efficiency and alternative propulsion.

Opportunities to reduce transport needs or shift transport modes can be learned from studies of **travel patterns**. For the population in central Oslo daily travel distances amount to 23 km, and pkm made by public transport equals those made by car. The similar distances as one moves to the suburbs and further surroundings are 30 km and 35-40 km, respectively, while the proportion covered by public transport is reduced to 1:2 and 1:4. However, people in Oslo spend more time travelling than people in surroundings, indicating that transport in Oslo is hampered by congestion.

For the population in Oslo overall, a study from 2005 demonstrated that public transport covers 21% of all daily travels, compared to 35% by car and 35% for walking/cycling combined. In areas outside the ten larger cities/towns with surroundings, public transport's share of daily travels diminishes to 4% while the car's share grows to 60%. Turning to long-range travels (>100 km), 64% of such travels go by car, compared to 20% by air, and 5% by bus, rail and boat, respectively. For travels >300 km, the portion served by air increases to 45%, compared with 9% by rail.

Options to change travel patterns are illustrated in the textbox above. This indicates that opportunities to **substitute** to low-emissive modes of transport are most feasible for the following tasks:

- urban personal transport
- intercity personal transport
- intercity freight transport

Infrastructure for **intercity transport** is in the governments domain. Air and car transport dominates passenger travels between the major cities across southern Norway, and 3 domestic Norwegian air-routes are listed among the 10 busiest in Europe. Nationwide, air transport contribute equal amounts of passenger kilometres (pkm) as those by bus or rail, despite that the latter are also present in urban personal transport. This indicates that rails are not really competitive. There are now undertakings to study the feasibility of high-speed rail between urban centers in southern Norway.

Intercity freight transport is served by ships, rail and trucks. Strengthening the role of ships and rails in these markets is a priority in the National Transport Strategy.

Strategies for Sustainable Urban Mobility

There is a growing awareness to develop urban areas so that family life, work and social needs can be sustained without much transport. Most specifically, establishment of new residential or business is channelled towards hubs for public transportation. The state operates a reward scheme for towns that mobilize towards public transport, cycling and walking. The reward scheme allocates 431.1 mill NOK (55 mill EUR) in 2011.

The National Transport Strategy aims that cycling will contribute 8% of all travels in 2020. This compares to 5% of all travels in 2005, and to 12 % in Sweden, 17 % in Denmark and 27 % in the Netherlands. Dedicated facilities for cycling are more modest than in other Scandinavian countries. In Oslo, dedicated

bicycle lanes amount to approx. 70 km, aiming at 100 km in 2012. In addition there are secondary lanes that are not physically separated from other traffic. The Transport Strategy outlines to construct 500 km new cycling/walking lanes the coming ten years. For 2011, 330 mill NOK (42 mill EUR) are allocated to the purpose.

Border-crossing Transport in Europe

Apart from transport through Sweden, and by car-ferries through Denmark, much of Norwegians' **travels abroad go by air**. This will hardly change in the near future. In the ongoing assessments of high-speed rail, however, connections to the Swedish high-speed rail grid are part of the consideration.

Another issue of large-scale dimensions concerns the opening of the North-east passage for **freight transport** from Asia to Europe and eastern America, as well as for petroleum and mineral shipments from the Barents regions of Norway and Russia. A number of North Norwegian towns try to position themselves to become the preferred supply harbour and entry point for such traffic. There are concerns that such transport may affect the vulnerable Arctic ecosystems through chronic or accidental spills and leaks; whether of oil, chemicals, or alien species.

As a country in the European periphery, Norway is no transit country whether for passenger transport or for freight – apart from shipping. There are certain concerns that our position in the periphery hampers competitiveness. For foreign traffic to Norway, we operate certain unique restrictions. Firstly, we operate low speed limits, with 100 km/t as the top level. Secondly, the upper limit for the length of container trucks is lower than in most countries.

Poland

BAS – Bureau of Research

State of Policy

'Transport quality improvement and development of transport system in accordance with principles of sustainable development' is the main goal of the ***National Transport Policy 2006-2025***. The document, adopted by the government in June 2005, describes prevailing trends and weaknesses in the transport sector (among others it points out: the growing role of road passenger transport and freight, diminishing share of railway transport and of public transport in cities, high number of road fatalities, growing negative impact of transport on the environment). Consequently, as the main challenges the Policy has identified: reduction of the demand for transport, greater share of railway and intermodal transport, development of public transport in cities, improvement of road traffic safety and reduction of harmful pressure on the environment (noise, air and water pollution, GHG emissions). However, there are no clear and precise description of targets the Policy aims to achieve.

The Policy is accompanied by other strategic documents of a more sectoral nature (e.g *Railway Master Plan 2030*, *Program of building national roads 2008-2012*), often mutually unintegrated. Despite high priority they all give to the idea of sustainable transport any practical implementation of the idea often proves unsatisfactory. The reasons for that are complex. On the one hand, it is a poor technical condition of the public transport infrastructure, today badly in need of modernization. On the other hand, it is the prevailing consumption modes that promote the use of private cars (though in some peripheral regions, where public transport has ceased to operate, private cars are necessity, since they serve as a sole means of transport). The state policy mostly tends to fulfill the society and economy rising demands for transport, and to a lesser extent attempts to reduce their needs for transport.

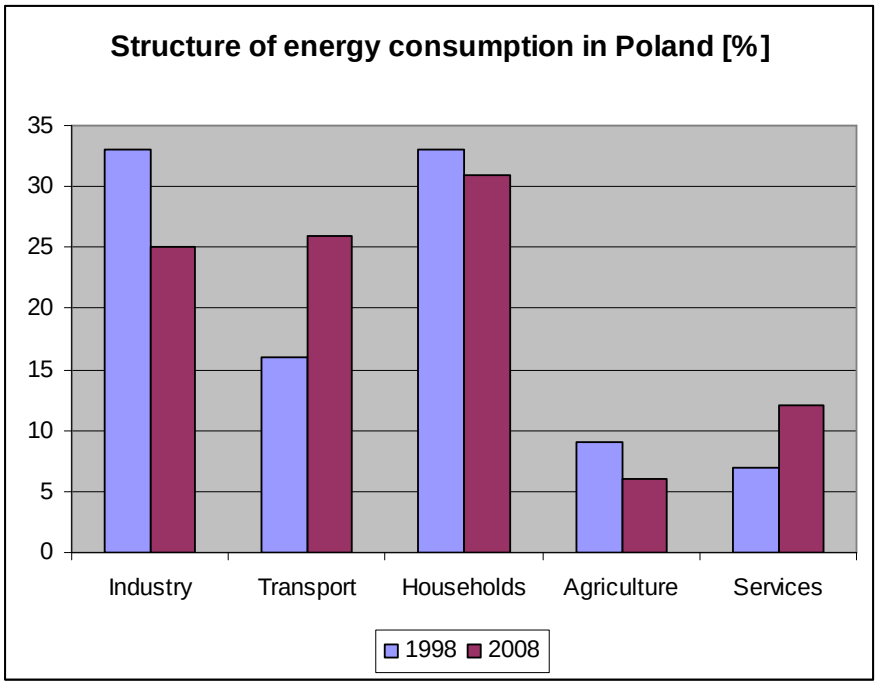
Over the last years the total length of railway network has been reduced by a quarter (from 26200 km in 1990 to 19400 km in 2007), which deprived many urban areas of access to railway. At the same time the road network has expanded by 20%. The number of private cars increased from 10 million in 2000 to 16 million in 2008 (but still the number of cars per thousand inhabitants is below EU-27 average). Thanks to the EU cohesion and structural funds the transport infrastructure in Poland is significantly being developed or modernized. However, the great majority of funds are allocated to road infrastructure. At the end of September this year representatives of railwaymen organized a protest in front of the Ministry of Infrastructure to alert public opinion to the deteriorating condition of their sector. One of their demands was an increase in funds allocated to railway infrastructure, to a proportion: 40% railway - 60% roads.

Recently, the government initiated a process of horizontal integration of all state strategies and development programs. The expected result should be 9 new long-term strategies covering areas crucial for the development of the society and economy. One of them is an integrated strategy for development of transport.

Many local governments develop their own sustainable transport strategies. Such strategies and programs include a variety of measures promoting public transport, cycling paths or pedestrian zones, and restricting the use of private cars.

Energy Use for Transport

Over the last years transport has been the economy sector with the fastest increase in **energy consumption** (see: graph below). Road transport account for 94% of energy consumption of the sector (railway approx. 3%, air and water transport 3%). In the years 1990-2008 the share (volume) of road transport increased three times, while the share of railway passenger transport decreased by 60% and railway transport of goods by 38%.



The main source of **renewable energy in transport** are biofuel components: ethanol blended into petrol and methyl-ester blended into diesel (at present the additives do not exceed 5% content) or biodiesel (100% biofuel). Their use in transport results mostly from an EU requirement imposed on Member States to achieve 10% minimum share of biofuels consumption in transport sector by 2020 (Directive 2009/28/EC). The Polish government has adopted a schedule with national minimum targets to be achieved each year by 2013. Up to now all the targets have been achieved (the 4,60% target set for 2009 was slightly exceeded). According to the schedule in 2010 the share of energy from renewable sources should reach 5,75%, however there are fears this year target and the future targets may not be achieved, unless higher levels of biofuel components are allowed. To make it possible the government is currently working on a standard allowing the blending of higher levels of biofuel components (e.g. diesel B7).

The consumption of biofuel has so far been encouraged by **fiscal incentives** (i.e. reduced excise duty). However, the incentive will be withdrawn in April next year. It is likely the price of biofuels will then rise, which might hinder accomplishment of the required share of biofuels in transport energy consumption.

Quite significant and growing share of the energy consumption in transport is represented by **automotive LPG** (autogas). At present it is the leading alternative fuel in Poland. Although it is an environmentally friendly fuel (as it is characterized by low particle and NOx emissions, low sulphur content), the main reason for its widespread use is not ecological, but rather economical (i.e. much lower price than that of traditional fuels). Autogas currently powers approx. 13% of Poland's passenger car fleet (more than 2100 thousand vehicles), which is serviced by an extensive infrastructure network (more than 6000 filling stations and a network of services specialized in gas system installation and maintenance).

Today electric cars represent only a tiny fraction of the transport sector. However, some initiatives have been launched to stimulate the use of hybrid vehicles and to develop plug-in infrastructure. Several cities are testing hybrid buses with a view to supplement their public transport fleet.

Regulation and Technology Options for Sustainable Transport

From the 1st July 2011 the existing vignette system will be replaced by ETC system. It is planned that the ETC will gradually expand, from 1600 km of national roads in the first year, to 4000 km in 2014. The toll will vary depending on vehicle's weight and emissions. The system is expected to contribute to a greater rationalization of costs and improvement of freight structure (i.e. shifting to alternative modes of transport, especially from road to rail).

There is a growing interest in ITS solutions and services. However, initiatives launched by some cities lack coordination, which in time may lead to an emergence of a fragmented system. There is an urgent need for a national ITS development strategy. Recently, a financial support scheme for ITS has been adopted, being an opportunity to significant development of ITS services. The scheme aims at subsidizing initiatives in such areas as traffic management, road safety, road pricing, information for passengers, urban mobility. Its overall budget amounts approx. to 164 million euro (financed mostly by the European Regional Development Fund).

Land Use and Physical Planning

Land use planning falls within the scope of competence of local authorities, which can use it for implementation of their local transport strategy. Practical implementation varies depending on citizens' transport needs, the authorities' determination, available budget etc. For example, the *Strategy for Sustainable Development of Warsaw Transport System by 2015* includes a variety of physical planning measures to restrict traffic and to promote public transport (e.g. zones with restricted traffic, limited

parking capacity in the city centre, protection of green areas, separate bus lanes, park and ride system, cycling paths). The Strategy also points out a necessity to coordinate local land use plans in order to control developments generating transport needs. But, in practice, it is highly difficult to implement as land use plans are often dispersed, not integrated and generally in scarcity. Lack of land use plans is a more general problem in Poland (only 25% of the country is covered with land use plans). Today, it is the main reason for chaotic spatial development in suburban areas (urban sprawl) and along main road corridors. Also the regional planning system needs to be strengthened. Lack of regional spatial plans or poor integration between them and local plans often hinders line infrastructure projects (building new roads, power lines etc.). The main role of planning at regional scale - so far often neglected - is to balance transport needs and provide access to public transport in peripheral areas.

Border-crossing Transport in Europe

Poland is a transit country with a heavy transport moving along the West-East direction (from Russia, Belarus and Ukraine). As the railway is still less competitive most of the freight is put on roads that often lack sufficient capacity (frequently the traffic crosses city centers). An extensive and long-term program of building new roads (motorways, express roads, ring roads around urban agglomerations) is currently being realized. One can expect that with time the transit situation will improve.

One of the major projects in transport sector will soon be a **high speed rail** (according to a recent declaration of the minister of infrastructure). A high speed line of 450 km will connect Warsaw with Poznan and Wroclaw. This should be a part of the European network of high speed rail. The project feasibility study should be ready by the end of 2012.

Sweden

PER – The Parliamentary Evaluation and Research Unit, Research Service
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State of Policy

Objectives and Targets

The overall objective of the Swedish transport policy is to ensure the economically efficient and sustainable provision of transport services for people and businesses throughout the country. The objective has been divided into a functional and an impact objective.

The functional objective on one hand implies that the design, function and use of the transport system will contribute to provide everyone with basic accessibility of good quality and functionality and to development capacity throughout the country. The transport system will be gender equal, meeting the transport needs of both women and men equally. The impact objective on the other hand, implies that the design function and use of the transport system will be adapted to eliminate fatal and serious accidents. It will also contribute to the achievement of the environmental quality objectives and better health conditions. More specifically, the transport sector will contribute to the achievement of reduced climate impact, by aiming at following CO_2 reduction targets:

- The transport sector will reduce the climate impact by gradually increasing energy efficiency in the transport system and decoupling from dependence on fossil fuels.
- The year 2020 10 per cent renewable energy in the transport sector
- By 2030, Sweden should have a vehicle fleet that is independent of fossil fuels.

Governance

The Swedish Transport Administration began operations on 1 April 2010. It is a public authority that takes on responsibility for long-term planning of the transport system for road, rail, maritime and air traffic. The authority is also responsible for the construction, operation and maintenance of public roads and railways. The Swedish Transport Administration includes activities and operations that before 1 April 2010 were undertaken by the Swedish Rail Administration and the Swedish Road Administration, as well as certain activities that were undertaken by the Swedish Maritime Administration and the Swedish Institute for Transport and Communications Analysis. By organizing these activities under one umbrella the administration of the transport system as a whole can be achieved more efficiently.

Example of responsibilities:

- Mobility management - more efficient use of transport modes, roads and other infrastructure
- greater use of more environmentally-sound modes of transport

- better accessibility
- more efficient transports and use of land
- less demand for travel in motorised vehicles

The Swedish Transport Administration has a large responsibility to advance the development of public transport. However, the real responsibility for local and regional public transport lies with the public transport authorities i.e. the local authorities together with the County Council in each county. Financing is arranged by local authorities and the county council in the respective county.

Energy Use for Transport

Transport Energy Consumption

The transport sector accounts for about a quarter of Sweden's total energy use. The energy use in the transport sector in 2009 was 93 TWh. The transport sector is divided into four subsectors: road transport, aviation, rail traffic and shipping. Of the transport sector's total energy use in 2009, including bunkers for foreign air and shipping, the road transport sector accounted for 69%, air traffic for 8%, rail traffic for 2% and shipping for 21 %.

The road subsector mainly consists of private vehicles, public transport and freight transport by truck where gasoline and diesel are the main fuels. In the road sector are also a number of alternative fuels used, mainly ethanol, FAME (fatty acid methyl esters, of which the RME, rapeseed methyl ester is the most common in Sweden today), biogas and natural gas. Ethanol is used both in low-level blends in petrol and as a major component of fuels such as E85 and ED95. FAME is used as pure FAME and low-level blends in diesel. Vehicles gas usage has increased strongly in recent years and this trend is expected to continue. The renewable fuel consumption share was 7.2 % in 2009 and is expected to increase to 10% in year 2012.

Table 1. Energy use in the Swedish transport sector 2009 and forecast 2010-2012, TWh

	2009	**%**	**2010**	**%**	**2011**	**%**	**2012**	**%**
Petrol	42	45%	41	45%	40	42%	41	41%
Low-admixture of ethanol	1	1%	1	1%	3	3%	3	3%
Diesel	40	43%	40	43%	42	44%	44	44%
Low-admixture of FAME	2	2%	2	2%	2	2%	2	2%
Heating oil	0	0%	0	0%	0	0%	0	0%
Heavy fuel oil	1	1%	1	1%	1	1%	1	1%
Aviation fuel, domestic	2	2%	2	2%	2	2%	2	2%

Pure Ethanol	1	1%	1	1%	1	1%	1	1%
Pure FAME	0	0%	0	0%	0	0%	0	0%
Electricity	3	3%	3	3%	3	3%	3	3%
Biogas	0	0%	1	1%	1	1%	1	1%
Natural gas	0	0%	0	0%	0	0%	0	0%
Total	92,8	100%	92,5	100%	95,4	100%	98,5	100%
Renewable fuel consumption percentage1)		7,2 %		7,7%		9,8%		10,0%

1) Under EU directive reckoning: Biogas are doubled, renewable electricity is about 50%.
The calculation excludes fuel oil, heavy fuel oil and natural gas. Source: Swedish Energy Agency

Regulation and Technology Options for Sustainable Transport

The Swedish transport sector accounted in 2007 for approximately 30% of carbon dioxide emissions in Sweden, 52% of nitrogen oxides emissions and about 6% of sulphur dioxide emissions.

The Swedish Tax System on Fuels

A general energy tax is paid for fossil fuels and is partly based on the energy content. The carbon dioxide tax is paid per kg emitted carbon dioxide for all fuels other than biofuels and peat. The sulphur tax on fuel amounts to 30 per kg sulphur emissions in coal and peat, and 27 per cubic meter for every tenth weight percent sulphur content in oil. Oils with less than 0.05 weight percent sulphur content is exempt from sulphur tax. Biofuels are exempted from the energy and carbon dioxide taxes. The system allows a promotion of renewable fuels. The current tax exemption for biofuels has been approved by the EU Commission, and Sweden has received an approval in force until 2013.

The Pump Act

In 2005 a new Act on the obligation to supply renewable fuels, also known as the Pump Act was adopted in Sweden. The Act states that from 1 April 2006 the major filling stations are obliged to supply renewable fuel, such as ethanol or biogas. The objective of the decision was to reduce carbon dioxide emissions by improving the availability of renewable fuels, mainly in the light of the fact that accessibility has been regarded as one of the major obstacles to increased use of renewable fuels. The obligation to supply renewable fuels is to be realised in several stages in which all points of sale in Sweden with sales volumes of over 1,000 cubic metres of motor gasoline or diesel fuel from 1 March 2009 onwards are, by means of one or more fuel pumps or in an equivalent manner, to supply at least one type of renewable fuel.

The Committee on Transport and Communications performed in 2009 a follow-up of the implementation and consequences of the introduction of the Pump Act[20]. The results show that the possibility to use renewable fuels has increased dramatically since the Pump Act was introduced. The are however large geographical differences regarding accessibility to renewable fuels, both between different parts of the country and between urban and rural areas. The Pump Act was intended to be technologically neutral, that is not promoting the use of any specific type of renewable fuel at the expense of others. In practice, however, to a great extent the Act has resulted in the installation of pumps providing E85 at filling stations covered by the Act. The follow-up concludes that the Act has helped to increase the use of renewable fuels and that there is a considerable scope for increasing domestic production and use of biogas as a fuel.

The Congestion Tax in Stockholm

A congestion tax is charged for Swedish-registered vehicles that are driven into and out of central Stockholm, Mondays to Fridays between 06.30 and 18.29. The tax is not charged on weekends or public holidays, on a day preceding a public holiday or during the month of July. Some vehicles are excluded from the congestion tax. Vehicles are automatically registered at 'control points' during the periods when congestion tax is charged. Each passage into or out of central Stockholm costs SEK 10, 15 or 20, depending on the time of day. The maximum amount per day and vehicle is SEK 60.[21]
The primary aim with a congestion tax is to reduce congestion and thereby improve the environmental conditions in Stockholm. The city of Gothenburg will, in a similar way, use a congestion tax system starting in January 2013.

The Motor Vehicle Carbon Dioxide Tax in Sweden and Weight-based Vehicle Tax

The vehicle tax is determined on the basis of the vehicle's fuel use and its carbon dioxide emissions. The CO_2-based vehicle tax includes only newer cars from "vehicle year" 2006 or later, and older cars that meet the requirements for Environmental Class 2005, Environmental Class Electricity or Environmental Class Hybrid. All other cars are taxed according to their weight and fuel use.

Research

The Swedish state funded jointly and by agreement with the Swedish auto-motive industry, research, innovation and development activities. The authorities involved are The Swedish Governmental Agency for Innovation Systems (VINNOVA), the Swedish Transport Agency and the Swedish Energy Agency.

Research and development effort involves collaboration between the parties to achieve the societal and industrial targets within the two thematic areas: Climate & Environment and Security. The background to

[20] Parliamentary Report 2009/10: RFR7 (In Swedish)
[21] http://www.transportstyrelsen.se/en/road/Congestion-tax/Congestion-tax-in-stockholm/.

this initiative is the development of the road transport system and the importance of the Swedish automotive industry for the economic growth.

There is already good experience a successful cooperation between the parties. The experience has been harnessed in the new joint-venture-one formulated under the "Strategic Vehicle Research and innovation".

The collaboration programs are currently: Sustainable Manufacturing, Vehicle Development, Transport efficiency, Vehicle and Traffic Safety, Energy and Environment. The entire investment will lead to R&D activities of approximately 1 billion SEK per year of which public resources are 450 million SEK per year.

Land Use and Physical Planning

The Infrastructure – An Important Asset

The Government points out that the transport infrastructure is one of the country's most important assets. Roads and railways need to be maintained to keep them in working order. The infrastructure also needs to be expanded as new housing and businesses emerge and when globalisation and technological advances create new opportunities. According to the Government the transport sector, like all other activities, need to be constantly developed and made more efficient. Maintenance and new investments must be performed efficiently so that the taxpayers' money is spent where it is most needed and will suffice for the discussed actions. Greater efficiency can be achieved through improved coordination between the responsible actors, efficient agencies, a smoothly functioning regulatory system and proper competition in the transport sector.

Transport Planning

Transport of persons or goods often involve several different modes of transport. Goods transport may start with a truck that goes to a terminal, where the goods are reloaded onto a train that then goes to a port where the goods are shipped to another country. A commuter trip may start with a bike ride to the bus stop, then a bus trip to the station, a train ride to another town and finally a walk to the place of work. According to the government the transport system must be planned with the aim of ensuring that the entire journey, or mode of transport, functions smoothly for everyone and that all travel and transport modes have been token into consideration. Greater interaction is needed between the users and those who are responsible for infrastructure at local, regional and national level. The transport sector accounts for about one-third of Sweden's greenhouse gas emissions and a shift to transports with less emission is needed for the future. Further development of the transport system requires, according to the Government, a combination of measures. These may include instruments that put a price tag on emissions, a climate-efficient vehicle park and climate-efficient construction and operation of the infrastructure. Developing the transport system requires both measures to reduce climate impact and increasing energy efficiency, but also to maintain economic profitability. Both the user focus and the

climate efficiency point to the need for solutions that involve several traffic modes. This approach is the key, according to the Government.[22]

A near-term package (2009-2010) will, according to the Government, ensure that crucial railway projects such as the Haparanda Railway and investments in the Emmaboda-Karlskrona line can be implemented and that concerted efforts are directed at improving punctuality in the Stockholm region, western Sweden and Skåne. Access in major goods corridors is to be enhanced and priority road projects can get underway early and be efficient implemented. This applies to projects throughout the country, including the E18 approach road into Stockholm, the E22 in Skåne and the road connections to the port of Göteborg.

Border-crossing Transport in Europe

Cross-border Traffic and Green Corridors

The Swedish Government[23] is working for open competition in the field of passenger traffic, improved transport corridors in an east-west direction and support to an intermodal system, all of which call for climate adapted solutions.

The Green Corridors project[24] origins from a European Commission initiative aiming at reducing environmental and climate impact while increasing safety and efficiency. Characteristics of a green corridor include:

- sustainable logistics solutions with documented reductions of environmental and climate impact, high safety, high quality and strong efficiency,
- integrated logistics concepts with optimal utilization of all transport modes, so called co-modality,
- harmonised regulations with openness for all actors,
- a concentration of national and international freight traffic on relatively long transport routes,
- efficient and strategically placed trans-shipment points, as well as an adapted, supportive infrastructure, and
- a platform for development and demonstration of innovative logistics solutions, including information systems, collaborative models and technology.

Responsibility for managing the Green Corridors project has been placed within the Swedish Logistics Forum, the advisory body serving the Minister for Communications.

The Logistics Forum has developed Green Corridors as a project and co-operative structure linking business, society and research, and has set up working groups for issues, policy and communication, intermodality, innovation and technology. From now on focus will be on making reality of the concept. The idea behind the Swedish work is:

[22] http://www.sweden.gov.se/sb/d/11941/a/125740.
[23] http://www.sweden.gov.se/sb/d/11941
[24] Green Corridores, fact sheet, 15 June, Ministry of Enterprise, Energy and Communications

- to demonstrate efficient transport solutions,
- to promote the development of Green Corridors in EU transport policy, and
- to establish international partnerships that can lead to Green Corridors to and from the Nordic region.

In Sweden alone around 30 local projects have been identified and of these ten have short-term priority. In order to implement the transnational efforts better, Sweden is currently carrying out its work in close collaboration with the new Super Green research consortium, yet another EU initiative. This consortium evaluates the conditions for the geographic transport corridors and maps out the bottlenecks. A number of pilot corridors will be chosen and, after Super Green's mapping, concrete implementation proposals will be presented.

Through international collaboration corridors will be established that stretch through Finland, Norway, Sweden and Denmark, as well as Germany, Holland and Belgium. East-west corridors are also possible.

Collaboration takes place with the government offices in Denmark, Finland and Norway, as well as the European Union's research consortium Super Green.

Switzerland

TA-SWISS – Swiss Centre for Technology Assessment
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State of Policy

Switzerland has developed an integrated strategy for transport policy, focusing on better coordination between transport modes, and paying greater attention to environmental problems. This strategy has been strengthened in recent years with a broader integration of transport policy into spatial development and the general sustainability context. The main thrust of the resulting policies lies in promoting a shift towards more sustainable modes of transport, planning and providing infrastructure that supports such a shift, and by passing legislation that reduces emissions and promotes low-emission technologies.

Passenger Transport

Switzerland has an excellent road and rail infrastructure that is permanently maintained, modernized and improved.

The first phase of a major expansion of rail transport capacity RAIL 2000 was completed in 2004. It marked a milestone for Swiss public transport, as rail service levels increased by 12%. At the same time, work is progressing on the New Rail Link through the Alps. A first tunnel (Lötschberg) opened in 2007, the second is expected to open in 2017 (St. Gotthard). The tunnels are increasing the capacity and attractiveness for both transalpine freight and passenger transport from Switzerland and northern Europe to Italy.

Funding for development and maintenance of road infrastructure is provided through the infrastructure fund, which has been launched in 2008. Amongst others, Switzerland runs an agglomeration programme aimed at providing financial resources for infrastructure projects that promote public and non-motorized transport in suburban regions and agglomerations out of this fund. Switzerland has developed further programmes aimed at specific parts of the transport sector like leisure transport, non-motorized transport, traffic telematics and a service centre for innovative mobility. These programmes are complemented with regulations and recommendations at the technical level, such as emission standards, environmental labels for motor vehicles, promotion of biofuels and measures at the cantonal and communal level.

Freight/Heavy Goods Transport

Switzerland's freight transport policy rests on article 84 of the federal constitution, which requires that transalpine freight transport shifts from road to rail. The central policy element to reach this target is the

heavy vehicle fee (HVF) combined with measures to improve competitiveness of international rail transport. The HVF is applied to passenger and freight transport vehicles of more than 3.5 tonnes gross weight. The fee is calculated according to three criteria: the kilometres travelled on Swiss roads, the highest authorized gross weight, and the pollutants emitted by the vehicle, according to EURO classes. Additional measures to support modal shift of freight traffic from road to rail include for example the modernisation of rail infrastructure by 2030, the further increase of the productivity and competitiveness of rail transportation or bringing down slot prices and providing additional intermodal services.

Energy Use for Transport

Energy Use and Production

In Switzerland, the share of energy used for transport was 34.7% of total consumption in 2009 (i.e. 305 of 878 PJ). In 2009, 55.1% of total final energy consumption was oil, 23.6% electricity and 12.1% gas. The remaining 9.2% comprised wood (4.1%), district heating (1.8%), industry waste (1.2%), coal (0.7%) and several other renewable forms of energy (1.4%). Amongst the latter, the shares were 1% for ambient heat, 0.19% for solar heating, 0.17 % for biogas and 0.04% for biofuels.
In the year 2009, 55.8% of electricity generation in Switzerland was from hydropower plants, 39.3% from the five domestic nuclear power plants and the remaining share from thermal power plants or other renewable sources, i.e. solar, wind and biogas. The contribution to electricity generation from solar and wind is still small (< 1 per mill). However, supported by the Energy 2000 programme and since 2001 by SwissEnergy, it increased markedly between 1990 and 2009: Solar energy from 1.0 to 50 GWh and wind power from 0.0 to 23 GWh.

Biofuels Policy

Tax exemption for biofuels is limited to fuels that meet ecological and social criteria. The conditions are set out in such a way that biofuels do not compete with food production and are not causing degradation of rainforests or other valuable ecosystems. The Swiss Centre for Technology Assessment (TA-Swiss, www.ta-swiss.ch) conducted the study “Impact Assessment of 2nd Generation Biofuels”. The study was published in June 2010. Its aim was to analyse the potential and risks involved in using second generation biofuels, i.e. assess different sources of biomass, production technologies and forms of energetic use, their potential and impact of complete value-added chains, and their ecological, economic and social impacts. The short version (in German, French, English) of this study can be downloaded and the complete version (in English) is available as a book or as an e-book at www.vdf.ethz.ch .

Regulation and Technology Options for Sustainable Transport

Regulations

The Federal Act on the Protection of the Environment defines maximum immission values for air pollution (Art. 14): The maximum immission values for air pollution must be set so that, in the light of current scientific knowledge and experience, immissions below these levels (a) do not endanger people, animals or plants, their biological communities and habitats; (b) do not seriously disturb the well-being of the population; (c) do not damage buildings; (d) do not harm soil fertility, vegetation or waters.
The CO_2 Act entered into effect on 1 May 2000 and forms the central pillar of Swiss climate policy. Its objective is to reduce the emission of climate-relevant carbon dioxide (CO_2) arising from the combustion of fossil fuels by 10% versus the 1990 level by 2010. This means that the consumption of heating fuels must be reduced by a total of 15% and of motor fuels by 8%. The targeted reduction of CO_2 emissions is primarily to be achieved through voluntary measures on the part of companies and private individuals. The relevant legislation provides that the federal government may introduce a steering fee on fossil fuels (CO_2 fee), if the voluntary measures fail to produce the desired effect. A CO_2 fee on combustibles will be introduced from 2008.

Research and Support for Energy Efficiency

The SwissEnergy programme aims at promoting energy efficiency and the use of renewable energy. The main objectives of SwissEnergy in the area of mobility are as follows:

- Reduction of CO_2 emissions from new vehicles to 140 g/km by 2010 (same as EU targets), together with reduction of energy consumption and air pollutants (e.g. particulate matter from diesel engines).
- Increase of gas-powered fleet to 30,000 vehicles, hybrid/electric car fleet to 20,000 vehicles, and electric bikes to 30,000 by 2010.
- To familiarise all new drivers with the main principles of EcoDrive® by 2008.

To achieve these objectives, the focus has to be on two main areas:

- Technology: SwissEnergy supports innovative research and development projects, and co-ordinates public sector energy research in the area of mobility, especially concerning the development of light vehicles and new drive systems, e.g. for natural gas and biogas drives.
- Market: SwissEnergy promotes the distribution of energy-efficient vehicles, primarily through the use of an energy label for motor cars. It also promotes energy-efficient driving, and supports a variety of measures targeting energy-efficient mobility and accompanying publicity campaigns.

Road Pricing

From time to time, road pricing is discussed in Switzerland – at least 20 political motions have been formulated in this context so far. But as a “publifoucs”, a participative project oragnized by TA-SWISS in 2004 has shown, the acceptance for this measure is quite small. One question of dissent among the

participants of the publifoucs was the aim of road pricing. Should it reduce pollution? Should it provide money for the traffic infrastructure? Should it reduce the traffic in the cities? The participants claimed that road pricing measures should be simple, the use of the money earned by road pricing should be transparent and only the communities where road use is charged should be recompensed. Thus, at the local level, there is no road pricing system operating in Switzerland at the moment. But for the use of national highways (Autobahn), in 1985 Switzerland introduced a road tax for motor vehicles and trailers weighing up to 3.5 tonnes. It has to be paid annually by every car driver who uses the highways (flat rate, CHF 40 per year). The Directorate General of Customs levies this tax by selling motorway tax stickers (vignettes). Furthermore, there is the heavy vehicle fee (HVF), which is applied to passenger and freight transport vehicles of more than 3.5 tonnes gross weight (see also p. 1, Freight/heavy goods transport).

Monitoring of Environmental Impacts

The National Air Pollution Monitoring Network (NABEL) measures air pollution at 16 locations in Switzerland. The stations are distributed throughout the country and monitor pollution at typical locations (e.g. city-centre streets, residential areas, rural stations). NABEL measures indicator pollutants of national significance (e.g. nitrogen dioxide, ozone, fine particles (PM10), etc.). It serves to monitor the success of air-pollution control measures (Art. 44 of the Environmental Protection Law). Furthermore, the data collected through NABEL are made available for use in scientific investigations of air pollutants (effects on the environment and on human health), meteorological aspects, atmospheric chemistry studies, etc.). NABEL was expressly conceived as a monitoring network and not as an early-warning system.

Specific Use of Technologies e.g. Particle Filters

In 2006, the Federal Council approved an action plan to reduce particulate matter, which is also being supported by the cantons. The aim is to bring about a significant reduction in soot emissions, especially during periods of weather inversion in winter. The plan contains five new measures:

- The federal government will notify the World Trade Organisation (WTO), the European Free Trade Association (EFTA) and the European Union (EU) about its premature introduction of the future EURO 5 soot emission limit value for all light diesel vehicles. This means that, as of 2007, all new diesel cars, mini-buses and light duty goods vehicles (up to 3.5 tonnes) in Switzerland must be equipped with particle filters.
- In future, oil tax refunds to public transport operators are to be effected in a differentiated manner. For diesel buses which are not equipped with a particle filter, the operators will only receive a reduced refund of the oil tax.
- For new diesel tractors, too, the federal government will notify the WTO, EFTA and EU about the premature introduction of the future European diesel soot emission limit value, III B. In addition, the possibility of providing financial incentives for retrofitting vehicles is to be closely examined.

- From 2007, the Federal Council will only purchase diesel-driven cars, utility vehicles and heavy goods vehicles (HGVs) for use in the administration and armed forces if they are equipped with particle filters (subject to availability on the market).
- With respect to the next increase in the HGV fee, which is due in 2008, and within the framework of the joint committee on the land transport agreement, the Federal Council wanted to negotiate with the EU on the option of collecting a reduced fee for HGVs that are equipped with a particle filter.

Land Use and Physical Planning

Spatial Development / Urban Planning

The Swiss national policy in respect of spatial and transport planning, sustainable development and the alpine conservation convention is prepared and implemented by the Federal Office for Spatial Planning (Bundesamt für Raumentwicklung, ARE). The remit of ARE includes the following:

- Strategies for spatial and transport planning and for sustainable development
- Principles of spatial planning, general and leisure traffic, sustainable development and the alpine conservation convention
- Liaison between federal authorities on projects affecting land use and transport
- Collaboration with the cantons in all official tasks
- Assisting with coordination to solve problems connected with agglomeration policy and equalisation measures in rural areas
- Information
- Monitoring spatial planning from a legal viewpoint

ARE follows the aim to make a fundamental contribution to sustainable spatial development in Switzerland and its regions and to guide this development within the framework of the relevant principles and provisions, e.g. those of the Federal Constitution, the Regional Planning Act, transport policy, the sustainable development strategy and the Alpine conservation convention. Over the next ten years, ARE will help to achieve the following objectives:

- Improvement of quality of life for the population
- Sustainable development of urban and rural areas
- Preservation of undeveloped space, areas of outstanding natural beauty, and biodiversity
- Promotion of non-motorised and public transport in the context of an all-embracing transport policy
- Balanced development of all of Switzerland's regions
- Spatial integration of Switzerland into Europe

One major hurdle for the implementation of these objectives is the federal organization of Switzerland. In many areas, the national state has only little decision-making power but the cantons or even the communities have their own authority to decide. This is the case for many aspects spatial planning, so the

co-ordination on a national level is difficult. E.g. housing development is a matter of the communities and every community decides on its own, which land areas are provided as building sites. In this context, private interests (land owners) are also important. At least for national highways (Autobahn) and for railway lines, planning and financing of the infrastructure is on a national level, but of course the concerned cantons and communities are consulted during the planning process.

Sustainable Forestry

The first federal Forest Act of 1876 only covered the Alpine region. Its aim was to put a halt to the depletion of forests, to manage the remaining forest areas in a sustainable way, and to promote afforestation. The Forest Act of 1902 covered the whole country. The Forest Act and an enabling overall economic development resulted in an increase of the forested area in Switzerland by nearly 50% compared to the mid 19th century. The Forest Act that came into force in 1993 reaffirms the long-standing Swiss tradition of preserving forest area as a natural ecosystem. It prescribes sustainable forest management, prohibits clearing, and bans deforestation unless it is replaced by an equal area of afforested land or an equivalent measure to improve biodiversity. The forested area is still increasing. The growing stock is estimated to have increased from less than 150 in 1880 to 359 m3/ha in 2005. In 2004, the national forest programme was published, outlining an action plan for 2004–2015. It specifies five priority objectives:

- The forest's protective function is guaranteed
- The economic viability of the forestry sector is improved
- The value-added chain for wood is strengthened
- Biodiversity is conserved
- Forest soils, trees and drinking water are not threatened

These objectives encompass that CO_2 removals by sinks and emissions by sources in the forests shall be recognized in terms of compliance with the Kyoto Protocol while making better use of the potential of forests for timber production and fuel wood through economic incentives and implementing new technologies. Taking into account the high growing stock, Swiss forest policy's climate related goal is to reduce CO_2 emissions by substituting fossil fuels rather than enhancing sink capacity. The sink potential of Swiss forests is dwindling. Among other reasons, this results from largely old forests, which have decreasing productivity and wood quality, so that a large proportion of mature trees need to be harvested in the near or more distant future.

In 2006, the Swiss government intended that forest management will be accounted under Article 3.4 of the Kyoto Protocol. One goal was to give forest owners the option of trading carbon credits on the basis of the sink service provided by their forests. But the revision of the Forests Act necessary for this purpose was rejected by parliament in 2008. Moreover, because use of wood becoming economically more attractive over recent years, carbon trading based on sink services is commercially less interesting. However, few forest owners are preparing to offer carbon credits on the basis of sinks provided by their forests on the voluntary market.

To implement the objectives of the national forest programme, the wood resource policy is coordinated with the other relevant sectoral policies (e.g. energy policy, regional development policy). A wood action plan has been started in 2009. Its main focus lies in on the ecologically and economically effective use of wood. With a view to the efficient use of wood, cascade use is prioritised, i.e. wood is used as material prior to its use for energy. In the case of energy use, greater overall efficiency of the conversion technology should be targeted.

Border-crossing Transport in Europe

Rail Infrastructure

Switzerland provides a very important infrastructure for border-crossing transport in Europe, connecting Germany through the alps with Italy, part oft the “European corridor A Rotterdam-Genoa”. The Swiss infrastructure consists in one highway link (through the St. Gotthard tunnel) and in two railway links (St. Gotthard and Lötschberg tunnels). Switzerland’s transport policy requires that transalpine transport shifts from road to rail. For this purpose, a modernization of the rail links is essential. The New Rail Link through the Alps project was accepted 1998 by the Swiss voters in a referendum. The first new tunnel (Lötschberg, length 34.6 km, cost Euro 3 billion) opened in 2007. The second is expected to open in 2017 (St. Gotthard, length 57 km, cost estimated Euro 7 billion). On October 15, 2010, a milestone of this project – the longest railway tunnel in the world – has been celebrated: The cut-through of one of the two tubes oft the St. Gotthard tunnel was achieved. The new Lötschberg an St. Gottahrd tunnels are increasing / will be increasing the capacity and attractiveness for both transalpine freight and passenger transport from Switzerland and northern Europe to Italy. An open question is, if the Italian infrastructure will be ready to “digest” the additional traffic coming from the north in 2017, when the St. Gotthard tunnel is expected to open. What concerns harmonization, Switzerland plays an active role in the application of international standards, e.g. the European Train Control System (ETCS) is already in use on several Swiss railway lines.

Aviation

With respect to climate change, Swiss aviation policy is focused on international aviation, as the share of Switzerland’s domestic aviation emissions is very small. Switzerland joined the International Civil Aviation Organization (ICAO), the European Civil Aviation Conference (ECAC), and the European Aviation Safety Agency (EASA). Switzerland adopted European civil aviation legislation within the framework of the bilateral transport agreement between Switzerland and the EU. Within the ECAC, EASA and ICAO, Switzerland strives for internationally coordinated measures to limit GHG emissions from aviation. Switzerland applies and promotes airport emissions charges systems and works towards stricter internationally accepted emission standards for new aircraft engines. With respect to market based measures, Switzerland is studying how civil aviation could be integrated in an emissions trading system compatible with European aviation policy. The Federal Council evaluates to what extent revenues from

current taxes on kerosene in domestic aviation could be used to finance environmental protection measures relating to aviation.

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United Kingdom

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Background

The UK's recent general election of May 2010 resulted in a Coalition Government of the Conservative and Liberal Democrat parties succeeding the previous Labour Government. At the time of writing, the short time period since the change in government meant that transport policy was still under development. Further details will follow after 20 October 2010 and the publication of the Spending Review, which will set out the spending plans for the years 2011-15. Nevertheless, certain information regarding the Government's vision for sustainable transport, and of initial policies and short-term funding schemes, was available at the time of writing and is summarised in this report.

National governance for transport is led by the Department for Transport (DfT) which, together with the devolved administrations for Scotland, Wales and Northern Ireland, sets the strategy and policy context for transport in the UK[25]. These bodies liaise with the organisations that provide transport infrastructure and services.

The new Government's vision for a more sustainable transport system was indicated recently by the Secretary of State for Transport[iv]. For long distance, inter-city journeys within the UK, the long-term vision is for a national, high-speed rail network to make rail travel the mode of choice for citizens. Nearer-term goals have also been outlined, such as reform and improvement of the wider rail network. The DfT has an Intercity Express Programme, for example, that has been aiming to develop a new generation of inter-city trains, although this programme has recently been reviewed[v] and awaits a decision in October 2010. For short-distance urban travel the aim is to make public transport, cycling and walking the most attractive modes of transport. And for intermediate journeys across rural and suburban areas, the Government envisages private cars remaining dominant but decarbonisation being achieved through a technological shift towards low-carbon cars such as electric vehicles. In addition, the Government aims to devolve more responsibility for local transport initiatives to the local level and to encourage alternatives to travel (such as home working) where appropriate.

Energy Use for Transport

The UK's domestic transport sector used 2360 PJ_{HCV} of delivered energy[26] and emitted 150 Mt $CO2_{eq}$ in 2008, 37% and 24% respectively of the national (domestic) totals[vi,vii]. Delivered energy demand for

25. Where appropriate, transport policy is designed to support wider Government goals, for example to support the climate change mitigation and energy policies of the Department of Energy and Climate Change.
26. Commercial energy carriers (e.g. fuel or electricity) delivered to the end-user.

transport has doubled since 1970 largely because of increased energy use for freight and passenger road travel as well as air travel. These modes represented 24%, 48% and 23% of energy demand respectively in 2009. Petroleum products are the main form of energy used, meeting 97% of total delivered energy demand and currently providing for all air, water and road transport. In the rail sector, which accounts for 3% of transport-related energy use, approximately half of the delivered energy used is in the form of petroleum products while half is electricity (a small but negligible quantity of coal is also used).

Renewable sources of energy account for less than 2% of the energy currently used for transport. A proportion of the electricity used by the rail sector comes from renewable sources, implying that 0.1% of transport's delivered energy use is in the form of renewable electricity. Liquid biofuels, meanwhile, provided 1.8% of delivered energy for transport in 2009[viii] via 1044 million litres of biodiesel and 317 million litres of bioethanol[vi]. Almost all the bioethanol and 79% of biodiesel were imported rather than domestically produced, though capacity for biodiesel production has been estimated to double for 2010[viii]. The use of biofuels has been encouraged by the Renewable Transport Fuels Obligation, a certificate trading scheme that came into effect in 2008 and obligates fuel providers to source a growing proportion of their fuel from renewable sources. The (recently amended) targets are 3.5% for 2010/11, 4.0% for 2011/12, 4.5% for 2012/13 and 5.0% for each subsequent obligation period.

Policy and Technology Options for Sustainable Transport

Policy-making regarding sustainable transport is framed by the Climate Change Act (2008). This legislation commits the UK to reducing greenhouse gas emissions by at least 80% by 2050 compared to 1990 levels, and three five-year 'carbon budgets' have been set to give a trajectory towards the 2050 target. The budgets limit the allowable quantity of greenhouse gas emissions over each five-year period, reflecting the fact that the UK's overall contribution to global greenhouse gas emissions is determined by emissions over time, not through meeting specific targets in specific years. The requirement of the third budget period (2018–2022) is that average annual emissions are 34% below 1990 levels.

In addition to the implications of the carbon budgets, a significant increase in the use of renewable energy for transport is required to meet the targets set by the EU's Renewable Energy Directive (2009). This specifies that the UK must source 10% of the delivered energy used for transport from renewable sources by 2020[27], and also that any biofuels used comply with certain sustainability criteria. The Fuel Quality Directive (2009), meanwhile, requires fuel suppliers to reduce life-cycle greenhouse gas emissions by 6% by 2020.

In light of the carbon-reduction and renewable-energy targets the DfT produced a strategy for the transport sector in 2009[ix], but have not yet confirmed or updated the strategy since the formation of the new Government in May 2010. The House of Commons Transport Committee found that the emissions-related figures of the previous strategy were confusing and created an overly optimistic impression, and stated that the DfT needs to be clearer in the way such figures are presented in the future. Although

27. Calculated on a net calorific value basis and with a cap on fuel used for air transport.

longer-term details of strategy and funding are currently absent, the Coalition Government has made a variety of commitments that indicate policy direction, and have also announced some initial funding schemes related to transport.

It appears that a major area of focus will be in the area of low-emission vehicles, led by the recently created cross-government 'Office for Low Emission Vehicles'. The Coalition has committed, for example, to mandating a national recharging network for electric and plug-in hybrid vehicles, and in this context has continued the demonstration programme 'Plugged-in Places' that was initiated by the previous administration. The aim is to build evidence for the design of a national charging infrastructure, and so far £8.8m (€10m) has been awarded to three areas (London, Milton Keynes and the North East). A second round of funding is planned by will be determined by the conclusions of the Spending Review. To encourage consumer demand for electric, plug-in hybrid or hydrogen-fuelled vehicles, the recently confirmed 'Plug-in Car Grant' reduces upfront costs by 25%, capped at maximum grant of £5000 (€5900). £43m (€50m) is available for these grants until March 2012; the level of incentive thereafter will be subject to a review in January 2010. It is important to note that the potential for these vehicles to contribute to decarbonising the transport sector relies on the decarbonisation of electricity supplies.

The Government has also recently announced support for research-and-development (R&D) via the 'Low Carbon Vehicles Innovation Platform'. Six projects have been awarded £24m (€28m) of Government funding and a total of £52m (€61m) given contributions from the private sector. The projects include development of new engines for plug-in hybrids, a lightweight electric bin wagon, lightweight materials for vehicle weight reduction, and new technologies using thermal energy to improve vehicle performance. Projects involving improvements to conventional vehicle technologies are particularly important in light of the King Review of Low Carbon Cars[x], which asserted that such improvements are vital to the achievement of short-term (five to ten year) emissions-reductions for road transport. Widespread penetration of electric vehicles, for example, is not only uncertain but also unlikely until into the 2020s[xi], as is the case for the proposed high-speed rail network.

Research funded by the DfT during 2004 to 2009 has indicated that behaviour change can provide notable sustainability benefits within relatively short timescales, with three 'Sustainable Travel Towns' demonstrating reduced car use and increased walking, cycling and bus use[xii]. In this context, the DfT is investing £58m (€68m) in cycling initiatives for England in 2010, as well as providing £40000 (€47000) to the national transport charity Carplus for the accreditation of car clubs. In addition, £30m (€35m) of funding supported the purchase of 350 new low-carbon buses in December 2009, and a further £15m (€18m) is available for 2010. In line with the new Government's aims to devolve more responsibility to the local level, simplified funding streams have recently been announced together with a 'Local Sustainable Transport Fund' for local authorities, further details of which will follow the Spending Review.

Endnotes

European Parliament

[i] IPCC (2007)
[ii] EEA (2007)
[iii] STOA (2008

United Kingdom

iv. Department for Transport (10 September 2010), *Sustainable Transport – Speech by Philip Hammond MP, Secretary of State for Transport,* www.dft.gov.uk.
v. Foster, A (2010), *A Review of the Intercity Express Programme*, www.dft.gov.uk
vi. Department of Energy and Climate Change (2010), Digest of United Kingdom Energy Statistics, www.decc.gov.uk
vii. Department of Energy and Climate Change (2010), Estimated emissions of Greenhouse Gases by National Communication source and end-user category, 1990-2008, www.decc.gov.uk
viii. Department of Energy and Climate Change (2010), *Digest of United Kingdom Energy Statistics*, www.decc.gov.uk
ix. Department for Transport (2009), *Low Carbon Transport: A Greener Future (A Carbon Reduction Strategy for Transport)*. The Stationery Office Limited: London.
x. HM Treasury (2007), *The King Review of low-carbon cars. Part I:the potential for CO2 reduction*. The Stationery Office: London.
xi. Committee on Climate Change (2010), *Building a low-carbon economy – the UK's innovation challenge*. www.theccc.org.uk
xii. Sloman L, Cairns S, Newson C, Anable J, Pridmore A, and Goodwin P (2010), *The Effects of Smarter Choice Programmes in the Sustainable Travel Towns: Summary Report*. The Department for Transport: London.