Wuppertal Institute
for Climate, Environment
and Energy

Progress Toward Low-Carbon Transport:

Experiences from Germany

Project report

Developed by:
Wuppertal Institute for Climate, Environment and Energy GmbH

For:
The Swedish Commission on fossil-free road transport

Wuppertal/Berlin, February 2013

Progress toward low-carbon transport: Experiences from Germany

Oliver Lah, Thorsten Koska, Miriam Müller and Hanna Hüging

Contact

Oliver Lah
Wuppertal Institute for Climate, Environment and Energy
Research Group Energy, Transport and Climate Policy

Berlin Office
Mercator Centre Berlin / Neue Promenade 6 10178 Berlin, Germany
+49 (0)30 2887458-16
oliver.lah@wupperinst.org

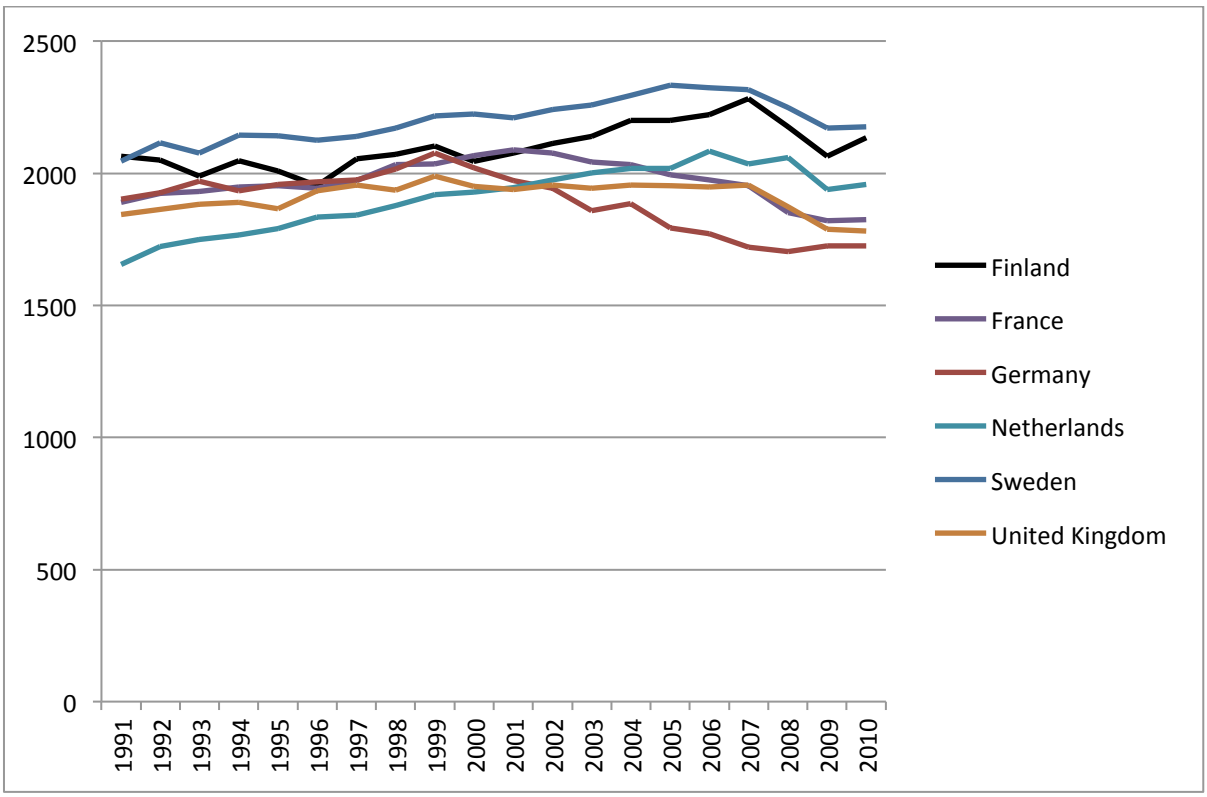
Content

1. Introduction

It is often claimed that transport is the hardest sector to decarbonise (ECMT 2007; IEA 2011). However, Germany managed to curb emissions in this sector at least to some extent, with per capita transport CO2 emission decreasing from just over 2 tonnes at their peak in 1999 to 1.7 in 2010 (IEA 2012).

While it is acknowledged that current measures in Germany and other OECD countries will not be sufficient to bring transport on a 2 Degrees pathway, some countries have shown reasonable progress. Germany, along with France and Japan, is one of the few developed countries that have seen a policy-led decline in transport GHG emissions in recent years. These countries stand out as they have seen their road greenhouse gas emissions stabilise or even decrease despite economic and road freight growth over the same period (ITF 2010).

Figure 1: Per capita transport CO2 emissions 1991-2010 of selected European countries



Source: IEA World Energy Database 2013

Among those industrialised countries, which already achieved a relatively low level of transport sector per capita CO2 emissions (at least compared to countries such as the United States and Australia) France, the United Kingdom and Germany have made noticeable progress in recent years in improving the overall efficiency of the sector. These three countries have reached levels of well below 2 tons of CO2 from the transport sector per capita (Figure 1), which is still far away from stabilisation levels consistent with a 2 Degrees scenario, but lower than rates of many other OECD countries.

2. National policies for reducing GHG-emissions from road transport in Germany

Low-carbon mobility strategies in Germany

Germany has committed to a reduction of greenhouse gas emissions of 40%, if the other EU member states agree to the EU's 30% reduction target for 2020. Framework of this economy-wide target is Germany's Integrated Climate and Energy Program, which sets out policy measures for the energy sector. The measures implemented for transport aim to reduce the GHG by 30 Mt per year by 2020 compared to 2005 (ITF 2010). As reductions in other sectors might be smaller as initially estimated, CO_2 emissions from transport need to be reduced by 40 Mt per year by 2020 to ensure that the climate protection objective of the German Federal Government is achieved (UBA 2010b).

Currently, the Federal Government is developing a Mobility and Fuel Strategy in a participative process, together with stakeholders from science, industry, politics and civil society. The strategy aims at defining fields of action and integrating measures for low carbon transport to reach the reduction targets (BMVBS 2012).

Table 2 provides an overview on some key measures that have been reported to the UNFCCC as part of Germany's National Communication on observed and projected changes in greenhouse gas emissions and policy initiatives. The measures have been implemented between 2000 and 2007. By expanding the use of biofuels, the federal government aims at reducing the CO_2 emission related to petrol and diesel consumption by 7 per cent. This translates to an aimed share of biofuel of 12% by 2020. It was projected that the expansion of biofuel use is one of the most important measure for CO_2 emission reduction in the transport sector. However, as the total effect of the measures will not be sufficient to achieve emission reduction target in transport, additional measures have been implemented or are under discussion. For instance, the tightened vehicle emissions standard (95 g CO_2 / km by 2020) will lead to additional reductions of 3 Mt. The combined measures outlined in Table 2 are estimated to account for greenhouse gas emission reductions of 28Mt or about 18% below 2005 levels.

Table 2. Estimated emission reductions from the Federal Government's Integrated Energy and Climate Programme and other transport measures (Mt)

Measure	Type of Instrument	Estimated CO_2 Reduction by 2020 compared to 2005
CO_2 Strategy for Automobiles	Regulatory, efficiency	-6 Mt
Expansion of Biofuels use	Regulatory, fuels	-10,5 Mt
Conversion of Motor-vehicle Vehicle Registration Tax to CO_2 basis	Fiscal, efficiency	-3 Mt
CO_2 Labelling for cars and light trucks	Information, efficiency	- 4 Mt

Additional CO_2 reduction from Heavy Vehicle Toll	Fiscal, efficiency, demand	-0,3 Mt
Air transport in EU ETS (EU directive)	Regulatory, efficiency, demand	not accounted
Promotion of Electric Vehicles (Electromobility plan)	Research, investment, efficiency	not accounted
Other measures		
Ecological Tax Reform (1999-2003)	Fiscal, efficiency, demand	-2Mt
Subtotal		**-26 Mt**
Additional effects due to synergies of several measures		**-2 Mt**
Total		**-28 Mt**

Federal Environmental Agency (UBA) 2009

The following sections will explore these and other initiatives in some more detail using the structure provided by the Swedish Commission on fossil-free road transport in its request to the Wuppertal Institute.

2.1. Fuel and vehicle taxation and standards

Germany has implemented a number of relevant measures in recent years that combine fuel and vehicle taxation to improve the efficiency of the vehicles fleet as well as vehicle use and influence modal choice. The following sections explore briefly the key policies that shape Germany's vehicle fleet and use.

Fuel taxation

As part of Germany's Ecological Tax Reform ('Ökosteuer' discussed in more detail later) petrol and diesel prices increased from 1999 to 2003 by 3.07 cents per litre and year (totalling an increase of 15.34 cents/l as of 2003). This aimed to internalise a part of the external costs and increase energy efficiency in the transport sector. By 2012 the energy tax on transport fuels was 65,45 cent/litre Petrol, 47,04 cent/litre Diesel and 18 cent/kg CNG or LNG (BMF 2012).

Vehicle taxation

The motor-vehicle tax (annual circulation tax) includes a CO_2 based calculation basis since January 2009. The new system only applies to automobiles that were newly registered since then. It takes account of typical CO_2 emissions for vehicles and has lower rates for automobiles that have especially low emissions, which supplanted the former mineral-oil-taxation advantage that favoured diesel engines. Additional to a taxation based on the engine size, the CO_2-taxation accounts for 2 Euros per g CO_2 above the margin of 110 g in 2012/13 and

above 95 g in 2014. It was estimated that the implementation of the CO_2 based motor-vehicle taxation will lead to GHG emission reduction of about 3 Million tons CO_2e per year by 2020. For vehicles in service as of 31 December 2008 motor-vehicle taxes are not directly related to CO_2 emission. For these vehicles, tax-rates only based on engine-size and European emission standards. Tax-rates were increased for the Euro 2, Euro 3 and Euro 4 emission categories in relation to emission-dependent taxation of other vehicles and for old vehicles in Euro 1 category and below higher tax rates were retained (ITF 2010).

Tax policies that negatively affect road transport energy efficiency

Some tax policies in place in Germany are suggested to have a potentially counterproductive effects on road transport energy efficiency. The option to deduct commuter travel from income tax has this potential. Until 2001 only travel by car was eligible for deduction from income tax, which was considered as boosting urban sprawl as it fiscally incentivises long distances between home and work (UBA 2010). There is a fixed rate be kilometer travelled that can be deducted. While this tax deduction option is now applicable to all modes of travel it is still considered to provide unjust benefits car based commuter travel. This is for instance because the maximum limit of deductible costs can be increased if the commuter uses a private car (UBA 2010). Tax incentives for home ownership and building is also considered to contribute to urban sprawl and incentivise commuting by car (Hirte and Tscharaktschiew 2012).

Vehicle energy efficiency standards

CO_2 emission targets have been introduced to implement the European CO_2-oriented strategy for automobiles. The EU regulation requires vehicle manufacturers that their passenger cars achieve on average an emission level of 130 g CO_2/ km by 2015. A tightened level of 95 g CO_2/km is set for 2020. The average carbon of the manufacture's fleet is required to meet the target, which allows a number of higher emitting vehicles in the fleet provided vehicles that emit less than stipulated by the regulation balance out the average. Since, the relatively high shares of heavier cars in Germany, the European limits are expected to lead to an average CO_2-emission level, for all new automobiles registered in Germany, of 143 g CO_2/km in 2015 and 105 g CO_2/km in 2020. In addition to these reductions, which are to be achieved via improvements of engines/ power plants, cuts in emissions of 10 g CO_2/km are expected from implementation of non-engine related measures.

Vehicle fuel efficiency labelling

Emission labelling based on fuel consumption and CO_2 emissions for new automobiles were introduced in January 2008. Energy efficiency is given as the relation of CO_2 emissions and vehicle weight. The efficiency classification, ranging from A+ (best) to G (worst), is dependent on the deviation of a particular vehicle model from a reference value for the respective vehicle class. The efficiency classification allows less than 111.5 g CO_2/km for automobiles with 1,000 kg of empty weight in efficiency class A and the limit raises with weight to 171.5 g CO_2/km with 2,000 kg empty weight. UBA (2012) suggests, however, that this measure by itself has only a limited effect on CO_2 mitigation.

Table 3. CO_2 efficiency classes (Pkw-Energieverbrauchskennzeichnung)

CO_2 efficiency class	Deviation from the reference value
A +	≤ -37 %
A	-36,99 % bis -28 %
B	-27,99 % bis -19 %
C	-18,99 % bis -10 %
D	-9,99 % bis -1 %
E	-0,99 % bis +8 %
F	+8,01 % bis +17 %
G	> +17,01 %

2.2. Alternative energy carriers (biofuels and electromobility)

As part of its second Economic Stimulus Package the Federal Government invested heavily in the development and commercialisation of electric mobility. Part of this programme was the establishment of pilot regions for **electric mobility**, which included the establishment of test sites and basic infrastructure. Research programmes to evaluate the effectiveness of the individual projects accompanied the scheme. A study carried out by the Wuppertal Institute on the electromobility model regions suggests that a substantial net climate benefits may not be achieved before 2030 considering the dependence on the electricity mix (Schallaböck et al. 2012).

Natural gas was supported as transport fuel by application of a reduced tax rate on natural gas for passenger cars or duty vehicles. A reduced tax rate is also applied to Liquefied Petroleum Gas (LPG). The reduced tax level is valid until end of 2018, but an extension up to 2030 is under discussion. However, the Federal Environmental Agency stated that natural gas has very limited potential to contribute to GHG mitigation in the transport sector as extraction and transport of natural gas is associated with leakage of methane. As supply distances for natural gas are very long (mainly from Russia) leakage rates are high.

Biofuels have long been considered to play a vital part in the German low-carbon transport policy. This view has changed somewhat during recent years. The federal government has subsidised biodiesel by imposing lower taxes on biodiesel than on other fuels. The reduced tax level made Germany the biggest producer of biodiesel in the European Union with more than 3 billion litres produced in 2007, mainly from rapeseed. In recent years, the biodiesel production in Germany slightly declined to 2.7 billion litres in 2011 (Flach et al. 2012). One factor that triggered this decline is the phase out of the tax exemptions for biodiesel, which led to an increase in tax on biodiesel to 45,03 cent per litre from just 18,6 cent before 2011.

There are several blending regulations in place for petrol (10%) and diesel (7%). Biofuels, however, are increasingly treated with more caution with regard to their emission benefits over their life cycle and are also perceived less positively by the general public (Anderson-

Teixeira, Snyder, and Delucia 2011). In 2009, the government released a regulation to ensure the sustainability of biofuels under consideration of life-cycle emissions (Biokraftstoff-Nachhaltigkeitsverordnung). The regulation states that biofuels are only allowed to be declared as sustainable if they result in emission reductions of at least 35% over the production and supply chain compared to fossil fuels. Biofuels that do not achieve these standards are exempted from tax reductions and are not eligible for the biofuel quota.

A key vehicle for future activities of the federal government on alternative energy carriers and mobility options is the **Mobility and Fuel Strategy**. The strategy is currently being developed by the federal government, building on a broad-based dialogue process with around 400 businesses, associations and experts from society, industry, politics and the scientific community (BMVBS 2012). In 18 workshops and expert discussions in 2012, the stakeholders could insert their points of view on current challenges and future needs of political action in the different fields of the transport sector, with a focus on fuels. The first stage of the process stakeholders could adress relevant challenges and identify unresolved issues. The second stage introduced expert knowledge on these issues into the process. In the final stage, the stakeholders proposed political measures for the development of a sustainable transport system. The results of the participative process are currently being implemented into a Mobility and Fuel Strategy by the federal government. The Wuppertal Institute provides scientific support to the process.

2.3. Freight transport and urban logistics

One of the measures to improve the efficiency of long haul road freight transport in Germany that received international recognition is the In January 2009, the road-use toll rates for trucks were assessed based on the vehicle's emission class and its number of axles. For a three-axle heavy vehicle the charge per kilometre rages from 10 to 23 cent, depending on the emission standard of the vehicle. In 2010 the heavy vehicle road user charge (LKW-Maut) generated €4.48 billion of which €600 million are earmarked for the reduction of light duty vehicle taxes (€100m) and the promotion of low-emission vehicles, driver trainings and environmental programmes (€450m). It was estimated that the heavy vehicle toll will lead to reductions of 0,3 Million tons of CO_2e by 2020 compared to 2005 (UBA 2009). So far no detailed ex-post evaluation with a focus on its climate change mitigation aspects has been carried out.

Table 4. German Heavy Vehicle road user charges (€/km)

Year	Axle configuration	Exhaust emission standard		
		EURO IV and cleaner	EURO II and EURO III	Pre-EURO and EURO I
2003	Up to 3 axles		€ 0.10	€ 0.13	€ 0.15
	4 and more axles	€ 0.12	€ 0.15	€ 0.17	
2005	Up to 3 axles		€ 0.11	€ 0.14	€ 0.16
	4 and more axles	€ 0.12	€ 0.16	€ 0.18	
2010	Up to 3 axles		€ 0.10	€ 0.23	€ 0.15
	4 and more axles	€ 0.12	€ 0.15	€ 0.18	

(Doll and Schaffer 2007)

City logistics concepts have been applied in Germany with varying degrees of success. In general they aim at improved efficiencies in the delivery and collection of goods, consolidating trips, increasing load factors and reduce handling and transaction costs. Among the solutions that have been implemented in Germany are: regulations (traffic restriction, low emissions zones), transport pricing and taxes, transport planning and the development of infrastructure dedicated to urban freight (lorry lanes, delivery and loading spaces, urban consolidation centres). Many cities in Germany have implemented dedicated loading zones, either as zones where private parking is restricted or as separated space with dedicated infrastructure. Often delivery or loading in these zones is restricted to time periods. Some public authorities provided research and development funds and regulative support for urban consolidation centres. Urban consolidation centres provide facilities where deliveries can be consolidated for the last kilometres of the trip into the target area. It is intended that the consolidation of deliveries leads to a high level of vehicle utilisation and to alleviation of local environmental and traffic concerns. The effectiveness of city logistics concepts has very often been negatively affected by competition between shippers and conflicting objectives, which limit's the cooperation between them and is the vital aspect of consolidation centres. Consequently many urban consolidation centres were closed or operate below capacity.

3. Programs and policy measures of international importance

Eco-tax – 'Ökosteuer'

The ecological tax reform in Germany resulted in a substantial increase of petrol prices at the pump, while at the same time reducing social security costs. This was an important instrument for country's progress in reducing transport greenhouse gas emissions along with other policies. While having been developed in Switzerland, the Eco-tax is a success story for Germany's move toward sustainability. The concept is very closely linked to the social contract that dominates the German policy process and is very similar to the policy environment in Sweden (Scruggs 2001). The Eco-tax follows the rationale that the polluter pays an increased price (e.g. at the pump) and this revenue is used mainly to reduce social security costs (through a reduction of the superannuation cost) and to a smaller extent to support renewables energies. Beginning in 1999 the taxes on fuels were increased in a stepwise approach till 2003. The tax for petrol and diesel was increased by 3,07 cent/l each year. Compared to the prior tax levels (petrol 50,1 cent/l and diesel 31,7 cent/l) taxed were increased by 15,34 cent/l in total till 2003. This concept has proven to be highly effective in reducing demand for fossil fuel based energy and it has also been relatively well accepted considering the substantial increase in energy and fuel prices it generated (Holland 2012).

Policy integration

Apart from single policy measures, such as the Eco-tax that may be relevant for international dissemination, the policy integration approach could be considered as a success factor for Germany's success in improving the sustainability of the transport sector. The approach to policy integration has two elements, the integration across policy areas and the integration across levels of governance, which includes not only policy cohesion across governmental

structures at EU, national, regional and local level, but also involves key societal players such as unions, business and NGOs. The Integrated Energy and Climate Program (2007/8) was an important step towards cross-spectral policy integration that targets climate mitigation in transport and energy supply and energy efficiency (Rietig 2012).

4. Local government and private sector initiatives of particular significance

At the local level there are a number of innovative low-carbon transport measures that can be further disseminated and transferred from one city to another. While some German cities, such as Freiburg and Bremen (see contacts below) are at the forefront of sustainable transport innovation others have yet to take up some of these measures to improve the efficiency of urban transport throughout Germany. This includes in particular substantial investments in walking and cycling infrastructure and high quality public transport.

A number of cities in Germany have developed and implemented innovative policy and infrastructure measures.

Walking and cycling and modal integration

The city of Munich implemented a variety of measures to foster modal integration and boost cycling throughout the city. In 2006 the city developed a Transport Development Plan under the slogan “Gscheid mobil” (clever mobile). Gscheid mobil is a long-term strategy with an annual budget of about 1,5 Mio. Euro. The concept covers a number of coordinated, target group focused measures, including mobility management for schools or businesses, parking policies, mobility information packages for new citizens, mobility consultation for senior citizens, and the promotion of cycling. Special attention has been paid to the mobility information packages for new citizens. Each year, 85.000 new citizens can be addressed by this measure. According to evaluations by the City of Munich, information packages including a ticket for testing public transportation can increase the use of public transportation by 7,6 percentage points and decrease the use of cars by 3,3 percentage points, leading to emission reductions of approximately 12.000 tons CO_2/a (Nallinger 2007). Mobility management for businesses exists since 2001 and includes workshops and consulting services on site. Until 2011, 32 businesses have been addressed, leading to CO_2-reductions of 72.000 tons (2001-2011) or 3.600 tons CO_2/a per business (difu 2012). The mobility management for schools include information programmes for different age groups: driving license for rollers, “walking busses” to school, games and information on public transportation, information on transport and environment. In the years 2008/09, 146 schools and 254 classes with more than 6.200 pupils could be addressed with a budget of 160.000 Euro (Kaczor 2011).

The campaign “Radlhauptstadt” (cycling capital) received international attention for its innovative approach and measurable success (budget: 1 Mio. Euro per year). The programme combined investments in cycling infrastructure with a campaign that actively promoted cycling. Interconnected cycling corridors, bicycle parking facilities and bike+ride facilities for seamless modal interchange were vital for the success of this programme. For the entire

transport strategy, the City of Munich estimates a reduction potential of 60.000 t CO_2/a (Schreiner 2010).

In Cologne, for example, the Traffic Calendar - an online information platform - provides information to people about current traffic conditions, route disruptions and construction projects, as well as advice on possibilities to use alternative modes to avoid delays, making travelling within Cologne easier for all people. Frankfurt developed parking ticket machines into parking and charging stations to recharge electric vehicles and thus provides basic infrastructure for e-mobility. Bremen is working very actively on modal integration concepts that link walking and cycling with public transport and car sharing systems. Part of this strategy is reclaiming public space for walking and cycling infrastructure, reducing parking space within the city centre and increasing parking fees.

Integrated Planning and support for public transport

Integrated planning has been common practice (in some form) in many German cities. This approach has been rejuvenated by the Sustainable Urban Mobility (SUMP) concept, which is heavily promoted by the European Commission. The city of Dresden for example is working on an SUMP for the city called 2025plus Transport Development Plan. This plan aims for an integrated approach that considers practices and policies of different policy sectors, authority levels, and neighbouring authorities, which is a key characteristic of a SUMP. It aims to integrate policy areas by creating an open and participatory process through round table discussions that involve all relevant stakeholders.

In many of the urban mobility plans, public transport is considered as a priority. After several decades of decline, the modal share of urban public transport has been rising in the last 10 years. Cities like Hamburg, Munich, or Hannover have implemented a high-quality public transport system, resulting in rising modal shares. Relevant success factors are safety and security, comfortable and accessible vehicles like low-floor buses and trams, reliable and dense timetables and a cost-efficient implementation. The local public transport systems obtain financial support from the federal government, the state government (‘Länder’) and the municipalities, depending on the service provided. It is estimated that users pay about one third of the total budget of local public transport in Germany. However, this differs significantly between cities or regions. For instance, in Berlin 49% of local public transport services were financed by ticket revenues (Bormann et al. 2010).

Mobility Management in cites and companies

Mobility management focuses on the demand side of transport, and it is implemented with a broad range of measures from the fields of information and communication. Different actors can implement mobility management – e.g. municipalities, schools or universities, and businesses. Compared to other measures it is very cost effective, since it builds on existing infrastructures or mobility systems and tries to optimize their usage. The national action programme “effizient mobil”, started by the Deutsche Energie Agentur (dena) in 2008, implemented mobility management in 85 businesses throughout Germany, reaching more than 50.000 car-users. The average reduction potential for car trips was estimated at 10 percent. Thus, it was concluded that the programme successfully contributed to a reduction of 133

million kilometres travelled in the participating businesses, resulting in a CO_2-reduction of 23.000 t / year (dena 2010).

Regional measures

The Länder (states) have developed climate change strategies and action plans, which include transport sector initiatives, such as expansion of rail transport and investments in public transport, promotion of walking and cycling, and car-sharing. Their role, however, is focused primarily on setting strategic frameworks for the cities, supporting research and provide matching funding for local initiatives.

5. Research programs on policy instruments and measures for low-carbon transport

There are a number of research programmes on the national level focusing on policy instruments and measures to foster low-carbon transport, modal integration, electric mobility and fuels. Results of these programmes, for example the research programme accompanying the electromobility model regions are available at the **Federal Ministry of Transport, Building and Urban Development-**http://www.bmvbs.de/EN/TransportAndMobility/transport-and-mobility_node.html

The **Federal Ministry of Education and Research** also funds a number of relevant research and development programmes, such as Klimazwei - Research for Climate Protection and Protection from Climate Impacts, which focuses on technologies and strategies to mitigate and adapt to climate change . The Framework Programme Research for Sustainable Development (FONA) brings together a number of initiatives on low-carbon development pathways for Germany, but also for international cooperation: http://www.fona.de/en/10011.

The **Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU)** and the **Federal Environment Agency (UBA)** also fund a number of research programmes focusing on policy frameworks and single policy measures such as road pricing and low-emission zones
http://www.bmu.de/english/mobility/general_information/doc/4315.php
http://www.umweltbundesamt.de/verkehr-e/index.htm.

6. Policy innovation yet to be considered

City toll

In October 2012 the Transport Ministers of the 'Länder' discussed the introduction of the possibility to introduce a city toll in German cities. For instance, the mayor of Tübingen was interested to introduce a city toll. However, today municipalities are not allowed to impose city tolls. Regulations on state level ('Länder') need to be altered to allow cities to introduce city tolls.

Expansion of the heavy vehicle road toll

Currently, the heavy vehicle road toll is only applied to highways (Autobahn). It is suggested to expand the road toll to other highways such as federal highways (Bundesstraßen). Furthermore, it was suggested to apply the road toll also to smaller vehicles (3.5 t). For instance, this measure was suggested by the Ökoinstitut.

Abolition of tax-exemption for company cars

Another important aspect of CO_2-related car taxation is the treatment of company cars. Purchasing and operational cost of company cars are tax deductible. The employee has only to pay a very low tax on the vehicle. Since more than half of the German new car registrations are company cars, this tax-exempt is a major gap for the regulative effectiveness of CO_2-related car taxation. A solution would be a CO_2-related tax exemption which would be effective beyond a margin that refers to the shifting fleet emission limits (e.g. 100 g when the emission limit is 130 g, 90 g when the limit is 120 g, etc.) as suggested by a joint expert report from Green Budget Germany (’Forum Ökologisch-Soziale Marktwirtschafft) (Görres and Meyer 2008).

Introduction of speed limits on highways (Autobahn)

One of the lowest cost measures with considerable and immediate emission reduction effects would be the introduction of speed limits on the highways (Autobahn). Fuel consumption for a light-duty vehicle reduces by 23% when travelling at 90 km/h constant instead of 110 km/h (ECMT, 2006), Heavy vehicles can reduce their fuel consumption by about 20% when reducing speed from 90 km/h to 80 km/h (VTT, 2006). The Federal Environment Agency advocates strongly for an introduction of a speed limit of 120 km/h on highways. This proposal, however, has not been adopted by any of the major parties yet.

7. Government agencies currently working on low-carbon transport

There are a number of agencies at the national, regional and local level active in developing and implementing low-carbon transport measures. The agencies and contacts below provide some examples. Additional contacts, in particular at the city level can be provided on request depending on the specific policy context.

Level	Contact
National	
	Federal Ministry of Transport, Building and Urban Development (BMVBS), Directorate-General: Environmental Policy, Infrastructure and Policy Issues, Invalidenstraße 44, 10115 Berlin **Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU),** Directorate-General IG Environmental Health, Immission Control, Safety of Installations and Transport, Chemical Safety, Division IG I 5 Environment, Traffic and Transport, Electric Mobility (Matthias Samson), Stresemannstraße 128 – 130, 10117 Berlin **Federal Environment Agency (UBA)** Division I: Environmental Planning and Sustainability Strategy (Dr. Harry Lehmann), Wörlitzer Platz 1, 06844 Dessau-Roßlau **Federal Highway Research Institute (BASt)** Department V: Traffic Engineering (Michael Rohloff), Brüderstraße 53, 51427 Bergisch Gladbach Federal Institute for Research on Building, Urban Affairs and Spatial Development (BBSR) Department I 5 – Enviroment and Transport (Dr. Peter Jakubowski) Deichmanns Aue 31-37, 53179 Bonn
Regional	
	Ministry of Building, Urban Development and Transport North-Rhine Westphalia, Directorate III: Infrastructure and Traffic, Jürgensplatz 1, 40219 Düsseldorf **Ministry for Transport and Infrastructure Baden-Württemberg**, Directorate 5: Sustainable Mobility, Hauptstätter Str. 67, 70178 Stuttgart
Local	
	City of Bremen Senator for Environment, Building and Transport, Ansgaritorstraße 2, 28195 Bremen, Michael Glotz-Richter

	City of Dresden Department for transport development planning, Dr.-Külz-Ring 19 01067 Dresden, M. Mohnhaupt
Academia and think tanks	
	IFEU Institut für Energie- und Umweltforschung Heidelberg GmbH Wilckensstraße 3, D-69120 Heidelberg Transport and Environment, Udo Lambrecht **Technical University Dresden** Transport Infrastructure and Planning, Gerd Axel Ahrens **DLR German Aerospace Center Institute of Transport Research** Rutherfordstraße 2, 12489 Berlin, Barbara Lenz

References

Anderson-Teixeira, Kristina J., P.K. Snyder, and Evan H. Delucia. 2011. “Do Biofuels Life Cycle Analyses Accurately Quantify the Climate Impacts of Biofuels-related Land Use Change?” *University of Illinois Law Review* 2011 (2): 589–622.

BMF. 2012. Federal Ministry of Finance, Grundlagenwissen zum Benzinpreis und seiner Entwicklung, Berlin.

BMVBS. 2012. Federal Ministry of Transport, Building and Urban Development, Mobility and Fuel Strategy, Berlin.

Bormann, R., T. Bracher, O. Dümmler, L. Dünbier, M. Haag, H. Holzapfel, F. Kunst, O. Mietzsch, J. Mirbach, and H. Mossakowski. 2010. “Neuordnung Der Finanzierung Des Öffentlichen Personennahverkehrs.” *Bündelung, Subsidiarität Und Anreize Für Ein Zukunftsfähiges Angebot. Bonn*.

Doll, Claus, and Axel Schaffer. 2007. “Economic Impact of the Introduction of the German HGV Toll System.” *Transport Policy* 14 (1) (January): 49–58. doi:10.1016/j.tranpol.2006.09.001.

ECMT. 2007. *Cutting Transport CO2 Emissions: What Progress?* Paris: OECD. http://www.internationaltransportforum.org/Pub/pdf/07CuttingCO2.pdf.

Flach, B., Bendz, K. and Lieberz, S. 2012. EU Biofuel Annual 2012, USDA Foreign Agricultural Service, GAIN Report No. NL2020. http://gain.fas.usda.gov/Recent GAIN Publications/Biofuels Annual_The Hague_EU-27_6-25-2012.pdf.

Hirte, Georg, and Stefan Tscharaktschiew. “Income Tax Deduction of Commuting Expenses in an Urban CGE Study: The Case of German Cities.” *Transport Policy* (0). doi:10.1016/j.tranpol.2012.05.003. http://www.sciencedirect.com/science/article/pii/S0967070X1200073X.

Holland, Stephen P. 2012. “Emissions Taxes Versus Intensity Standards: Second-best Environmental Policies with Incomplete Regulation.” *Journal of Environmental Economics and Management* 63 (3) (May): 375–387. doi:10.1016/j.jeem.2011.12.002.

IEA. 2011. *World Energy Outlook 2011*. Paris: International Energy Agency, OECD/IEA.

———. 2012. *World Energy Outlook 2012*. International Energy Agency, OECD/IEA. www.iea.org.

Kaczor, Bianca. 2011. Mobilitätsbildung: Weniger Verkehr im Umfeld von Schulen und Kitas durch Mobilitätsbildung und PRM. Workshop-presentation. Köln. Online available at www.vrsinfo.de

Nallinger, Sabine. 2007. Neu in München – gleich gewusst wo’s langgeht. Die Mobilitätsberatung für Neubürger in München. Presentation at SRL-ÖPNV- Tagung 2007 „Stadtmobilität – Mobilität in der Stadt! Beispiele des modernen Mobilitätsmanagements“, 15./16. March 2007, Munich.

Rietig, K. 2012. Climate policy integration beyond principled priority: a framework for analysis. Centre for Climate Change Economicx and Policy, Working Paper No. 99

Schallaböck, Karl Otto, Rike Carpantier, Manfred Fischedick, Michael Ritthoff, Georg Wilke (2012) Modellregionen Elektromobilität : Umweltbegleitforschung Elektromobilität, Wuppertal Paper 6, Wuppertal: WI.

Scruggs, L. 2001. Is There Really a Link between Neo-Corporatism and Environmental Performance? Updated Evidence and New Data for the 1980s and 1990s, British Journal of Political Science 31 (4):686-692.

UBA 1999. Umweltauswirkungen von Geschwindigkeitsbeschränkungen, Dessau: UBA.

UBA 2009. Politikszenarien für den Klimaschutz V – auf dem Weg zum Strukturwandel. Treibhausgas-Emissionsszenarien bis zum Jahr 2030, Dessau: UBA

———.2010a. Umweltschädliche Subventionen in Deutschland - Aktualisierung für das Jahr 2008, Dessau: UBA.

_____ 2010b. CO_2-Emissionsminderung im Verkehr in Deutschland. Mögliche Maßnahmen und ihre Minderungspotentiale. Ein Sachstandsbericht des Umweltbundesamtes. Dessau: UBA

———. 2010. Road Pricing for Cars in Germany, An evaluation from an environmental and transport policy perspective, Dessau: UBA.

Appendix 1 Overview of low-carbon transport measures in Germany

Title	Year	Status	Type	Scope
Greenhouse gas emission reduction measures for the transport sector	2001		Policy Support, Strategic planning, Fiscal/financial incentives	In 2001, the federal government drew up measures to reduce greenhouse gas emissions and energy consumption in the transport sector. These measures included: - investment in the rail infrastructure to the amount of Eur 3.7 billion and in road construction to the amount of Eur 5 billion for the years (2008). - Introduction of a mileage-based highway toll for heavy trucks as of 2003. - Reduced motor vehicle tax (support for "three litre cars" and "five litre cars") to assist low fuel consumption cars and fuels. - Agreement with the automotive industry on possibilities to reduce consumption (e.g. greater use of low friction oil). - Information campaigns on fuel-conserving driving habits. - Introduction of integrated transport and housing-settlement planning attuned to climate factors. - Employment of telematics and fleet management systems.
Urban and Regional Planning	2004	In Force	Regulatory Instruments	Road user behaviour and as a consequence the resulting emissions are affected by, among other things, urban and regional planning. The amendment of the Federal Building Code in 2004 strengthened the significance of development planning for sustainable urban development. For this purpose, it was underlined in particular that the mobility of the population including public short-distance passenger transport and non-motorised transport belongs to the transport aspects that must be taken into consideration in the planning process, taking special account of urban development that aims to avoid or reduce transport.
Research Programmes	On-going		Research, Development and Deployment (RD&D), Research programme , Technology deployment and diffusion, Research, Development and Deployment (RD&D)	The Federal Ministry of Education and Research also funds a number of relevant re-search and development programmes, such as Klimazwei - Research for Climate Protection and Protection from Climate Impacts, which focuses on technologies and strategies to miti-gate and adapt to climate change . The Framework Programme Research for Sustainable Development (FONA) brings together a number of initiatives on low-carbon development pathways for Germany. Federal Ministry of Transport, Building and Urban Development, The Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU) and the Federal Environment Agency (UBA) also fund a number of research pro-grammes focusing on policy frameworks and single policy measures such as road pricing and low-emission zones

Old vehicle scrappage scheme	2009	In Force	Economic Instruments, Fiscal/financial incentives, Grants and subsidies	In order to stimulate demand for new and less polluting vehicles, the German government introduced an old vehicle scrappage scheme as part of its economic recovery package in February 2009. The scheme operated during 2009, offering a EUR 2500 bonus to those who traded in their old vehicles for a new one. The scrapped vehicle had to be at least nine years old and have been registered with the current owner for one year or more. The new vehicle purchased had to meet or exceeded Euro 4 emissions standards, the European Unions current emission standards for light-duty vehicles. Used vehicles that are a maximum 1 year old could also be purchased. The initial budgeted amount of EUR 1.5 billion to support the purchase of approximately 600 000 cars, was rapidly spent; over a million consumers had applied for the bonus in April 2009.
New vehicle car tax system	2009	In Force	Economic Instruments, Fiscal/financial incentives, Taxes, Information and Education, Performance Label	Since 2009, newly registered cars are subject to a motor vehicle tax system based both on engine cubic capacity as well as vehicle CO_2 emissions. New vehicles registered between 5 November 2008 and 30 June 2009 are exempt from paying vehicle tax for one year, extending to two years if the vehicle meets Euro 5 or Euro 6 emission standards. The base tax amount is dependent on engine capacity: EUR 2 per 100cc for petrol and EUR 9.5 per 100cc for diesel engines. On top of this, vehicles that emit more than 120 g CO_2/km are taxed EUR 2 per g CO_2/km. This threshold emission level applied until 2011, after which it was tightened to 110 g CO_2/km in 2012 and 2013, and will be tightend to 95 g CO_2/km in 2014 and beyond. An online calculator available on the Federal Ministry of Finance website allows vehicle owners to rapidly calculate their vehicle tax. Starting in 2013, the vehicle tax paid on older cars was adjusted to be in line with the new system.
Mandatory Fuel Efficiency Labelling for Passenger Cars	2004	In Force	Regulatory Instruments, Information and Education, Information provision, Information and Education, Performance Label, Comparison label	The labelling of fuel economy and CO_2 emissions information for new passenger cars has been mandatory in Germany since November 2004, but is considered having only a minor influence on car buyers' purchasing decisions so far (UBA 2009).
Energy Taxes: Coal, Biodiesel, Natural Gas	2006	In Force	Economic Instruments, Fiscal/financial incentives, Tax relief, Regulatory Instruments, Economic Instruments, Fiscal/financial incentives, Taxes	In August 2006, Germany implemented a tax on coal, coke and lignite and rescinded tax breaks for biofuels. The taxation law implemented the European energy taxation directive as national law. Under the law, biodiesel was taxed at euro 0.09 per litre, slightly lower than the government first planned. Taxation of biofuels was extended and raised, reaching euro 0.45 per litre for rapeseed biodiesel and ethanol by 2012. To replace biofuel tax exemptions, the German government introduced an obligation on suppliers to ensure a 5.75% of motor fuels by 2010.

Promotion of use of sulphur-free fuel	2001	Ended	Economic Instruments, Fiscal/financial incentives, Taxes	Increasing mineral oil tax on fuels that do not meet the sulphur standards of 50 ppm, between Nov 2001 and Jan 2003, and of 10 ppm subsequently. This measure fostered the entry of new vehicles into the fleet, which may have affected fuel efficiency as well.
Tax exemption for biofuels (in relation to Directive 2003/30/EC)	2006	Ended	Economic Instruments, Fiscal/financial incentives, Tax relief	The Mineral Oil Duty Act was amended on 1 January 2004 to grant full exemption from duty for biofuels until 2007. Both pure and the biofuel component of blended fuels were exempt from excise duty. Today, biofuel components of blended fuels are fully taxed. For pure biofuel a reduced energy tax is applied.
Distance-Based Road Pricing for Heavy Vehicles	2005	In Force	Economic Instruments, Fiscal/financial incentives, User charges, Economic Instruments, Fiscal/financial incentives, Taxes	Distance-based road freight fees will apply to heavy transport as of 2005. Drivers within Germany will pay between 0.09-0.14/km traversed, categorised by weight and emissions category. While the legislation allows for charges specific to time and place, both remain to be levied. In charging freight movements on the German motorways, the Government plans to collect €2.8 billion annually. In accordance with EU rules, this money may not flow into the German Federal Governments general budget, but must be used for specified purposes: mainly in upgrading transport infrastructure, on roads, rail and water routes. The automatic log-on system used by the German government uses a combination of mobile telecommunications (GSM) and satellite-based Global Positioning System (GPS). GPS satellite signals and other positioning sensors calculate how many kilometres have already been driven on the toll route, the toll based on the vehicle and toll rate information.
Integrated Energy and Climate Change Programme	2007	In Force	Policy Support, Strategic planning	Financial assistance from the federal government in the amount of more than 8 billion a year for investment to improve traffic and transport in local communities (community transport financing act, regionalisation act) with an eye to the greater use of short-range public transport. Additional measures in the transport sector are foreseen in the framework of the national Energy Efficiency Action Plan and the Integrated Energy and Climate Change Programme. These measures include: - CO_2 - strategy for passenger cars - Expansion of bio fuels - Reform of vehicle tax on CO_2 basis - Revised Energy labelling for passenger cars - Update HGV-toll

Source: IEA Policies and Measures Database, BMU, UBA and BMVBS

Appendix 2 Overview of fuel economy technology options

Petrol cars		Fuel efficiency improvement %	Costs (€, 2008)		
			<1.4 l	1.4l-2l	>2l
Engine	Downsizing with Turbo-charging	20%	180	200	220
	Direct fuel injection (Piezo injectors for diesel)	5%	0	0	0
	Exhaust gas recirculation (EGR)	5%	10	10	10
	Reduction of engine friction	4.5 %	30	40	50
	Latent heat accumulator	3%	420	400	450
	Optimised cooling circuit	3%	45	45	45
	Variable compression ratio (VCR)	6.5 %	120	150	180
	Variable valve timing (VVT)	11%	187.5	225	262.5
	Cylinder de-activation	1-4%	130	140	150
Transm.	Optimised gearing	4%	0	0	0
	Continuously variable transmission (CVT)	5%	200	250	300
	Dual clutch transmission (DCT)	5%	562.5	600	637.5
Hybrid	Stop-start system	3%	200	250	300
	Mild hybrid	12.5 %	600	750	900
	Full hybrid	30%	1875	2400	3000
Other	Low rolling resistance tyres	4.0 %	0	0	0
	Improved aerodynamic efficiency	1.0 %	0	0	0
	Low viscosity lubricants	1.0 %	6	6	6
	Weight reduction of 5%	3.5 %	50	80	110
Combined measures	Optimised cooling circuit + latent heat accumulator	4.0 %	465	485	495
	Optimised cooling circuit + Low viscosity lubricants	3.5 %	426	446	456
	Optimised cooling circuit + latent heat accumulator + Low viscosity lubricants	4.5 %	471	491	501
	Downsizing with Turbo-charging + stop-start system	22.0 %	380	450	520
	Downsizing with Turbo-charging + mild hybrid	27.0 %	780	950	1120
	Downsizing with Turbo-charging + full hybrid	35%	2055	2600	3220

Source: UBA, 2008