



**German Partnership  
for Sustainable Mobility**

*Sustainable Mobility – Made in Germany*

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# *Clean Air – Made in Germany*





# Table of Contents

## 1.0 POLICIES FOR HEALTHY ENVIRONMENTS:

### CLEAN AIR REQUIRES SOUND LEGAL FRAMEWORK CONDITIONS

- 1.1 *The German Government's Policy* → page 08
- 1.2 *Important Policy Instruments for Clean Air* → page 08
- 1.3 *Vehicle Emission Standards in Germany and EU* → page 10
- 1.4 *The Right for Clean Air* → page 13
- INTERVIEW with Axel Friedrich: Improving Air Quality – the German Experience* → page 14

## 2.0 CLEAN AIR MANAGEMENT: CLEAN AIR CAN BE PLANNED

- 2.1 *Measurement of Air Pollution* → page 18
- 2.2 *Data Base: Current Concentrations of Air Pollutants in Germany* → page 20
- 2.3 *Linking Emissions Calculation with Transport Demand Data at Street Level* → page 21
- 2.4 *Modelling Air Pollutant and Greenhouse Gas Emissions* → page 21
- 2.5 *Modelling Air Pollutant Concentration Levels* → page 23
- 2.6 *Air Quality Plans: Planning for Clean Air in Cities* → page 24

## 3.0 TAKING ACTION: EFFECTIVE MEASURES FOR BETTER AIR QUALITY

- 3.1 *Low Emission Zones in Germany – the Example of Berlin* → page 28
- 3.2 *Campaign: No Diesel without Filter / Soot-free for the Climate* → page 30
- 3.3 *Joint Forces for Clean Air in the City of Bonn* → page 32
- 3.4 *Shore-to-Ship Electricity Supply* → page 33
- 3.5 *Assessing the Effectiveness of Air Quality & Transport Measures* → page 33

## 4.0 TECHNOLOGY AND INNOVATION FOR CLEAN AIR:

### MANY ROADS LEAD TO BETTER AIR QUALITY → page 35–42

## 5.0 JOINT FORCES: EXPERTISE AND INTERNATIONAL COOPERATION

- 5.1 *Year of Air 2013 / Expertise on Clean Air* → page 44
- 5.2 *Clean Air for Smaller Cities in the ASEAN Region* → page 44
- 5.3 *Project on Electro-Mobility and Climate Protection in PR China* → page 46

## „SUSTAINABLE MOBILITY – MADE IN GERMANY“

*Friends of the German Partnership for Sustainable Mobility* → page 48

*Disclaimer* → page 49

*Imprint* → page 50

## SCOPE OF THIS PUBLICATION

*This publication informs about stakeholders, legal initiatives and measures which contribute to the high level of air quality in Germany. As traffic is a main contributor to air pollution, special emphasis is given to what can be done to reduce pollutant emissions from the transport sector.*

*Chapter 1 informs about legal framework conditions for clean air in Germany, which to a large extent derive from European Union legislation. Chapter 2 describes how air pollution in Germany is tackled from a planning perspective. Chapter 3 shows exemplary measures and initiatives taken by municipalities, companies and environmental associations to reduce pollutant emissions from the transport sector. Chapter 4 outlines technologic options for reducing emissions. Chapter 5 covers selected examples of international cooperation for clean air.*

### Facts and Figures on Transport in Germany

- In 2011 more than 42 million cars were registered in Germany, which means 517 cars per 1,000 inhabitants.
- About 70 per cent of freight traffic volumes are carried on the road, followed by rail with a share of 17 per cent.
- Lorry toll rates in Germany vary between €0.14 and € 0.29 per km depending on environmental performance.
- Greenhouse gas emissions in Germany declined from 1200 million tonnes CO<sub>2</sub> equivalent in 1991 to 937 million tonnes CO<sub>2</sub> equivalent in 2012; greenhouse gas emissions from transport accounts for about 20 per cent.
- In Münster about 38 per cent of the trips are done by bike; the average in German urban areas is over 10 per cent.
- A single trip by public transport costs € 2.60 in Berlin, Frankfurt and Munich and 3.00 € in Hamburg.
- Pollutant emissions from transport were reduced significantly in the last 20 years: carbon monoxide (CO) by 90 per cent, polycyclic aromatic hydrocarbons (PAH) by 90 per cent, benzene by more than 95 per cent, nitrogen oxides by 90 per cent and particulate matter by 70 per cent.





## CLEAN AIR – MADE IN GERMANY

According to an actual estimate, released in March 2014 by the World Health Organization (WHO), about 3.7 million premature deaths were caused by outdoor air pollution worldwide in 2012. If also health effects of indoor air pollution are taken into account, the pollution of air is the largest single environmental health risk on a global scale. Even though air pollution has its largest impact on human health in low- and middle income countries, particularly in South-East Asia, it is also a major health risk in industrialized regions. Calculations of the Federal Environment Agency of Germany show that exposure to fine particles causes about 47,000 premature deaths per year in Germany.

A considerable reduction of air pollution was achieved during the last decades in Germany. Today, we can see clear skies even over heavily industrialized regions and 'Waldsterben', a German expression for forest decline mainly due to acidic air pollution which has also become a loan word in other languages, seems to be removed from everyday vocabulary. However, it brings back to mind that mitigation of air pollution does not only protect human health, but also ecosystems.

In Germany, the emissions of most air pollutants decreased during the last years. First of all, these successes were achieved by technologies like flue-gas desulfurization or the use of electrostatic precipitators and catalytic converters. The application of these technologies was enforced by emission standards, which are now mainly implemented at European Union level and which are subsequently transferred to national laws and ordinances. These emission standards are mostly aiming at specific plants or motorized vehicles, like large combustion plants or diesel passenger cars. However, a successful air quality policy can not only be based on emission standards.

Once released to the atmosphere, emitted pollutants are dispersed in the air and may react with other air constituents to form secondary air pollutants. Hence, emission levels can only serve as proxies for ambient concentrations of air pollutants, which are directly linked to health outcomes. Therefore, it is also important to directly regulate ambient concentrations of air pollutants. In Germany, the responsibility to meet air quality levels enables local or regional authorities to set up air quality plans containing various measures to improve air quality. Well-known examples for local measures are Low Emission Zones, which exclude vehicles with low emission standards from areas within the zone.

Last but not least it is necessary to cooperate on an international level, since air pollutants can be transported over long distances. The Convention on Long-range Transboundary Air Pollution is an example how states can cooperate to reduce air pollution. Commitments not to emit more than a given total amount of a pollutant are instruments which can be used within these international conventions.

Although there has been done a lot to improve air quality in Germany, we still have a long way to go to meet the NO<sub>2</sub> (nitrogen dioxide) limit value and the WHO recommendation for PM<sub>10</sub> (particulate matter). Beside the reduction of emissions from classical sectors like traffic and industrial plants, several other fields of action have been identified. These include the reduction of particle emissions from non-road mobile machinery and domestic wood combustion as well as the reduction of ammonia emissions from agriculture. Hence, improvement of air quality is not only an important task for developing countries, but still remains a huge challenge for the industrialized world.

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### Text by the Federal Environmental Agency (Umweltbundesamt).

**Contact:** Marcel Langner, [Marcel.Langner@uba.de](mailto:Marcel.Langner@uba.de)

**Recommended further reading:**

➔ [www.umweltbundesamt.de/en](http://www.umweltbundesamt.de/en)



Umwelt  
Bundesamt



# 01.

## *Policies for Healthy Environments*

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### CLEAN AIR REQUIRES SOUND LEGAL FRAMEWORK CONDITIONS

*Air pollution is caused by human activities. Energy consumption, road transport, agriculture and the production of goods are the main sources. Of all air pollutants, particulate matter and nitrogen dioxide affect human health the most. Stringent limit values and measures to prevent emissions from industry, transport and private households have helped to significantly decrease air pollution in Germany compared to previous decades. However, concentrations of particulate matter and nitrogen oxides still exceed current limit values. Some particulate matter in the air is caused by the conversion of gaseous air pollutants such as sulphur dioxide, nitrogen oxides, volatile organic compounds and ammonia. These air pollutants also damage ecosystems and their biological diversity and lead to higher ozone concentrations which are detrimental to human health.*

## 1.1 THE GERMAN GOVERNMENT'S POLICY

Germany is well on the way to meeting the standards for air pollution control set by the European Union. For sulphur dioxide and volatile organic compounds, for example from solvents, it is sufficient to apply the measures already adopted and implemented in the past. Additional reductions are required, however, for nitrogen oxides and ammonia. The necessary reductions in nitrogen oxide emissions will be achieved in the transport sector and in stationary installations. The reduction in ammonia emissions will be achieved by the continued stringent implementation of the German government's programme for the reduction of ammonia emissions from agriculture.

**The German government bases air pollution control on four strategies:**

- laying down environmental quality standard
- emission reduction requirements according to the best available technology
- product regulations
- laying down emission ceilings

The limit values are more and more often stipulated in European air pollution control directives and then transposed into German law. Important European directives include, for example, Directive 2008/50/EC on ambient air quality and cleaner air for Europe, the future directive on industrial emissions and Directive 2001/81/EC on national emission ceilings for certain atmospheric pollutants.

## 1.2 IMPORTANT POLICY INSTRUMENTS FOR CLEAN AIR

### **Federal Immission Control Act and Implementing Ordinances**

Air quality control in Germany is mainly governed by the Act on the Prevention of Harmful Effects on the Environment Caused by Air Pollution, Noise, Vibration and Similar Phenomena, short Federal Immission Control Act (BImSchG) and its implementing ordinances and administrative regulations. In addition, there are also provisions on air quality control at Federal State level.

### **Technical Instructions on Air Quality Control (TA Luft)**

The Technical Instructions on Air Quality Control (TA Luft) are a modern instrument for German authorities to control air pollution. They contain provisions to protect citizens from unacceptably high pollutant emissions from installations as well as requirements to prevent adverse effects on the environment. In addition, it lays down emissions limit values for relevant air pollutants from installations. Existing installations must also be upgraded to the best available technology.

### **Amendment to Ordinance on Small Firing Installations (1. BImSchV)**

The amendment to the Ordinance on Small Firing Installations (1. BImSchV), which entered into force in March 2010, was an important step towards reducing particulate matter emissions from small firing installations such as stoves and tiled stoves. Especially the amended requirements for new installations and the modernisation of existing installation will achieve a noticeable average reduction in particulate matter emissions of 5 to 10 % in the residential areas concerned.

### **Implementation of the directive on industrial emissions**

A large share of the emissions reduction necessary to meet the targets above will be achieved by the implementation of the directive on industrial emissions.



**Transboundary air pollution control policy**

A significant share of the pollution load is transported through the air over long distances from neighbouring countries. For this reason, shaping a transboundary air pollution control policy is of strategic importance for air quality in Germany. The German government is therefore actively involved in the constructive dialogue on air pollution control measures both at European and international level. One example for this is the cooperation with the Geneva Convention on Long-range Transboundary Air Pollution.



Pollutant Measuring Point Waldhof

**Recommended further reading:**

➔ [www.bmub.bund.de/en/topics/air-mobility-noise/air-pollution-control/general-information](http://www.bmub.bund.de/en/topics/air-mobility-noise/air-pollution-control/general-information)

### 1.3. VEHICLE EMISSION STANDARDS IN GERMANY AND THE EU

Transport accounts for one quarter of carbon dioxide (CO<sub>2</sub>) emissions in the EU. In 2009, the EU introduced a regulation to bring down emission levels of new passenger cars to an average of 130 grams of CO<sub>2</sub> per kilometre (g CO<sub>2</sub>/km) by 2015. Each manufacturer has an individual target, which takes into account the characteristics of its fleet. This regulation is an unequivocal success story. Before its introduction, annual CO<sub>2</sub> reduction rates were around one per cent. Since 2009, that rate has increased to about four per cent, and the 2015 target has already been met (Figure 1). The EU has followed with a similar regulation for light-commercial vehicles (2011) and a second regulation for new passenger cars (2013) that sets an efficiency target of 95 g CO<sub>2</sub>/km by 2020. And other countries have followed suit with similar regulations (Figure 2). For the future, it is expected that the EU will build on this successful pattern by extending the time horizon of CO<sub>2</sub> regulation to 2025/2030, extending the scope to heavy-duty vehicles, and improving the correspondence between vehicle lab test results and on-road, real-world performance.

Air pollutants from vehicles have been regulated in the EU since the 1970s, but the current form of regulation—the well-known “Euro” standards — dates to 1992. The latest standard, Euro VI (2013, for heavy-duty vehicle engines) / Euro 6 (2014, for light-duty vehicles) sets emission limits for carbon monoxide (CO), hydrocarbons (HC), nitrogen oxides (NO<sub>x</sub>), and particulates. The limits have tightened considerably over the years. For example, NO<sub>x</sub> emission limits for diesel passenger cars were reduced by about 70 per cent from Euro 4 to Euro 6. But recent on-road data indicates that real-world NO<sub>x</sub> emissions from diesel vehicles did not decline as much as emissions produced in vehicle tests under laboratory conditions (Figure 3). Therefore, the EU is working on a supplemental regulation that will bring into play on-road vehicle testing to complement the test-cycle-based Euro 6 standard. European regulation has a profound impact on emission standards globally, and most of the key vehicle markets follow the Euro-regulation pathway for air pollutants.

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#### Text by International Council on Clean Transportation.

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**Recommended further reading:**

- ➔ [www.theicct.org/europe](http://www.theicct.org/europe)
- ➔ [transportpolicy.net/index.php?title=Category:European Union](http://transportpolicy.net/index.php?title=Category:European_Union)



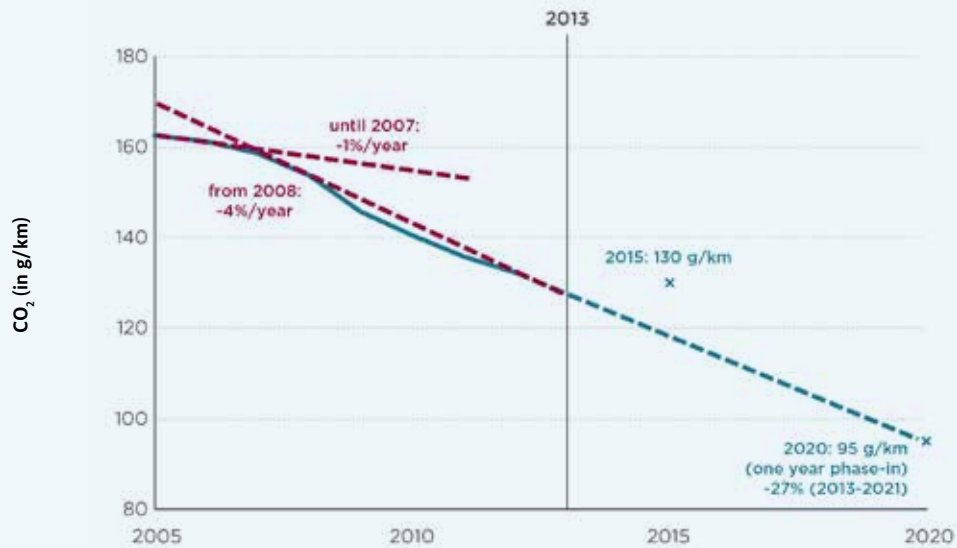


Figure 1. Comparison of EU CO<sub>2</sub> regulations for new passenger cars.

Source: ➔ [www.theicct.org/co2-emissions-new-passenger-cars-eu-car-manufacturers%E2%80%99-performance-2013](http://www.theicct.org/co2-emissions-new-passenger-cars-eu-car-manufacturers%E2%80%99-performance-2013)

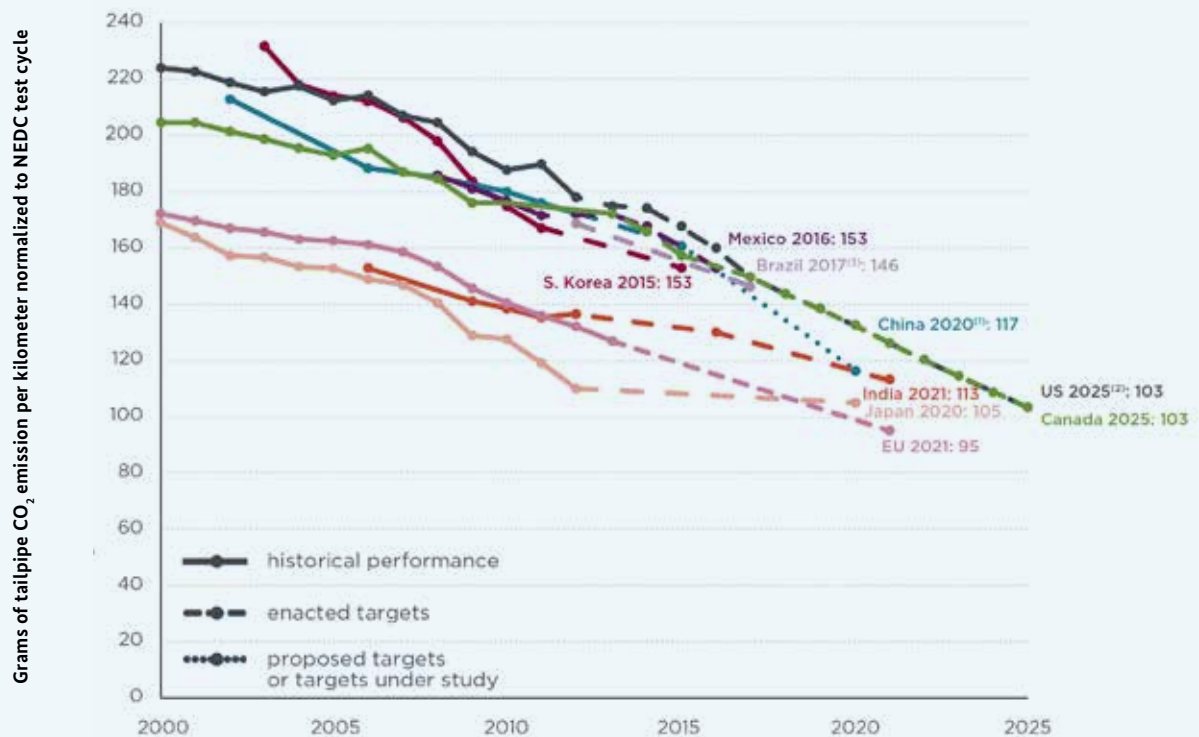
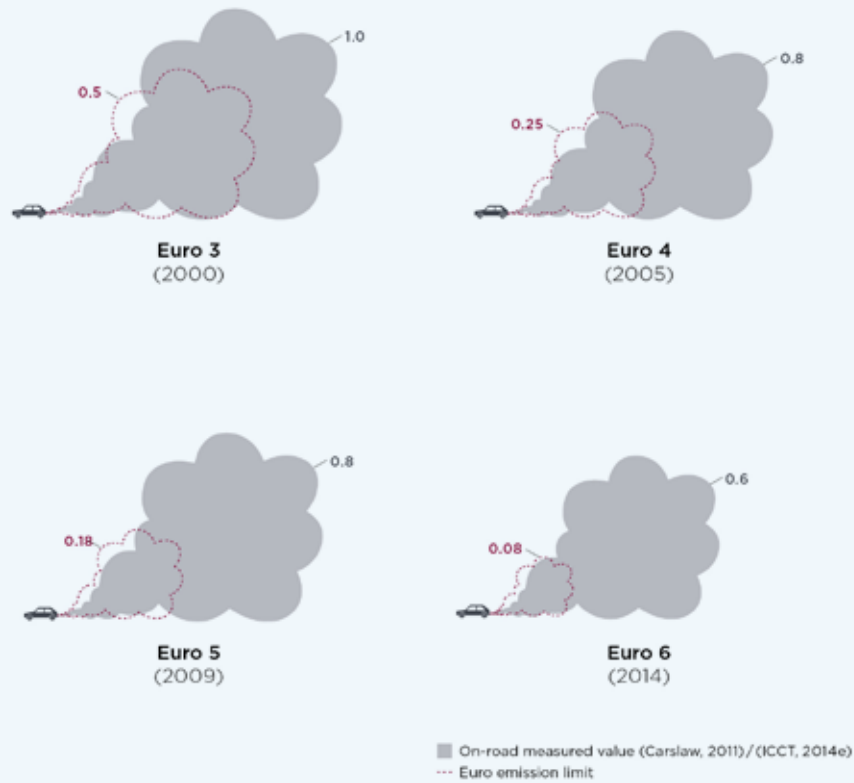


Figure 2. Comparison of global CO<sub>2</sub> regulations for new passenger cars.

Source: ➔ [www.theicct.org/info-tools/global-passenger-vehicle-standards](http://www.theicct.org/info-tools/global-passenger-vehicle-standards)

### Diesel cars: Nitrogen oxide (NO<sub>x</sub>) emissions (in g/km)



**Figure 3.** Nitrogen oxide (NO<sub>x</sub>) emissions (limits vs. on-road measured values) for diesel cars in the EU.

Source: ➔ [eupocketbook.theicct.org](http://eupocketbook.theicct.org)

## 1.4 THE RIGHT FOR CLEAN AIR

Clean air is essential to good health and a basic human need. EU law has recognized this need and given legal protection to it through directives and court judgments. The Ambient Air Quality Directive sets legally binding limits on levels of ambient air pollution. Failure to comply with the Directive is widespread throughout the EU: limits are frequently breached in many towns and cities, yet air quality plans are often late, inadequate, not properly implemented, or entirely non-existent.

Based on several EU law, every citizen has a “right for clean air” and can force competent authorities to initiate measures to lower air pollution. The authority responsible for the air quality must then prepare or improve an air quality management plan and an action plan. The Deutsche Umwelthilfe (DUH, German Environmental Aid) has initiated several court cases in the last years in order to lower air pollution in the cities. Up to now, every single case has been successful. Together with our partner Client Earth, DUH published a clean air handbook, summarizing basic legal information and background material. The handbook will soon be available in German, too. It will inform private people and NGOs to get capable of acting to realize their right on clean air.

DUH together with other European NGOs will also advocate for a stringent revision of EU legislation in order to improve the situation. We collaborate within the frame of our European campaigns Clean Air (➔ [www.cleanair-europe.org](http://www.cleanair-europe.org)), funded by EU Life program, and Sootfree for the Climate, a campaign not only addressing health but also climate impacts of air pollution.

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### Text by the Deutsche Umwelthilfe (German Environmental Aid).

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#### Recommended further reading:

- ➔ [www.russfrei-fuers-klima.de/international](http://www.russfrei-fuers-klima.de/international)
- ➔ [www.duh.de/verkehr\\_luftreinhaltung0.html](http://www.duh.de/verkehr_luftreinhaltung0.html)  
(German language)



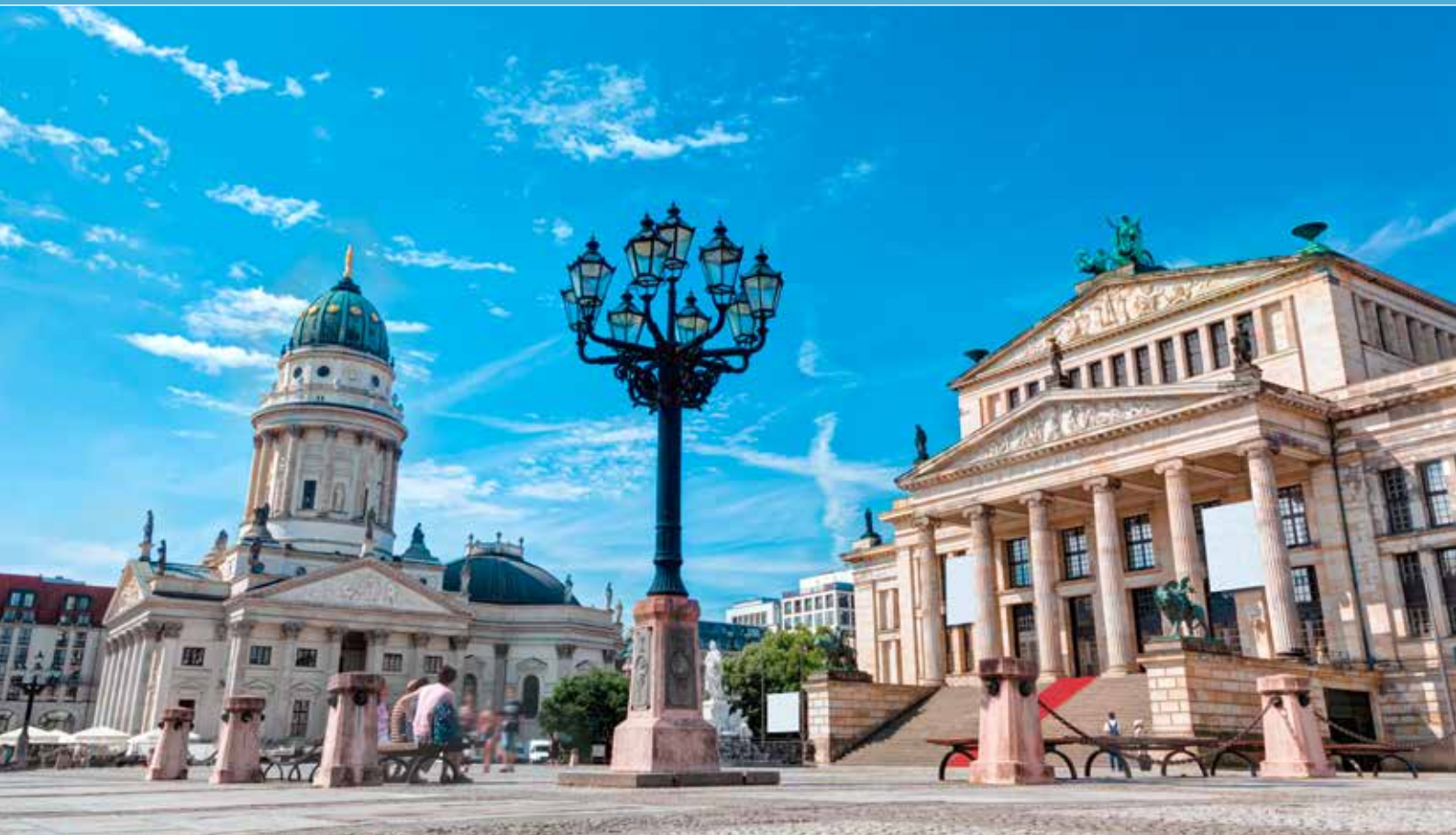
### The Clean Air Handbook – A practical guide to EU air quality law

Clean air is essential to good health and a basic human need. EU law has recognised this need and given legal protection to it through directives and court judgments. This practical guide to EU air quality is designed to help people exercise their right to clean air.

↓ **Download:** [www.clientearth.org/reports/20140515-clientearth-air-pollution-clean-air-handbook.pdf](http://www.clientearth.org/reports/20140515-clientearth-air-pollution-clean-air-handbook.pdf)







## Interview with Axel Friedrich: Improving Air Quality – the German Experience

### **Q: What has been achieved in Germany?**

**A:** Air quality in German cities is as high as the air quality in rural areas 20 years ago. We reduced carbon monoxide (CO) by 90 per cent, polycyclic aromatic hydrocarbons (PAH) by 90 per cent, benzene by more than 95 per cent, nitrogen oxides by 90 per cent and particulate matter by 70 per cent. This means we achieved a massive reduction of air pollution in Germany.

### **Q: How the problem of air pollution was approached?**

**A:** We started in different ways. First of all, exhaust regulations in the transport sector lead to decreasing concentrations of benzene and ozone, which accounted for the highest share of emissions in the 1970s and 80s. Second, legal initiatives by the European Union were driven by the persistent air quality problems and enforced strict regulations for industrial facilities. Also vapour recovery and hydrocarbon norms were introduced. We had reduction plans for hydrocarbons, for dioxins and ozone. There were a number of initiatives to implement these plans, meaning that we approached the problem from the planning side as well as from the legislation for achieving quick and significant improvements. Laws were useful, but so were economic incentives to spread the application of appropriate measures.

### **Q: What were success factors and what didn't work out so well?**

**A:** Crucial success factors were the engagement of the Federal Environmental Agency (UBA) and a number of environmental associations. Both kept up high political pressure and also informed the population about the problem. In the same time possible solutions were outlined and communicated. Many of these initiatives had their origin in the UBA, highlighting the fact that an effective environmental administration needs to be in place which is also able to enforce the right measures.



## DR.-ING. AXEL FRIEDRICH



*Dr.-Ing. Axel Friedrich is Technical Chemist from the Technical University of Berlin and worked for more than 28 years with the Federal Environment Agency of Germany (Umweltbundesamt, UBA).*

*From 1994 to 2008 he headed the division “Environment and Transport, Noise“, dealing with all transport related environmental issues, including air pollution, noise and planning.*

*Since 2008, Mr. Friedrich works as a consultant for the World Bank, GIZ, ADB and other international organisations in a number of middle income and developing countries, including China, India, Indonesia, Thailand, Malaysia, Chile, Mexico and Brazil.*

*In Europe, he was involved in the rulemaking process for the emissions standards for cars, trucks and fuels.*

*He was the former Chairman of the OECD working group on transport, as well as a former member of the Committee of the German Transport Ministry for the implementation of the National Bicycle Plan.*

*He is a member of the Advisory Committee of the German Bicycle Academy and member of the scientific advisory committee of the VCD (Verkehrsclub Deutschland) as well as a founding member of ICCT (International Council for Clean Transport).*

*Mr Friedrich was granted with the Haagen Smits Clean Air Award in 2006.*

*In the same time private businesses were not always eager to cooperate. They tried to block stricter regulations with the argument of higher costs. A negative aspect is that better air quality is not for free. But the damages are way more expensive than the costs for reducing emissions. Just, these costs are carried by the entire society and the mitigation costs at first hand by the entrepreneur. But also he doesn't pay these costs, but the consumer in form of higher prices. These are points which have to become clear. On the other hand, they are useful for an economy. It has proven that stricter regulations are an important driver for innovation.*

**Q: What are the remaining challenges and priorities for Germany?**

**A:** *The core topics are still climate change, in this area we still have a lot to do with regard to the further reduction of CO<sub>2</sub> as well as of short-term climate factors like black carbon, soot, fluorocarbon or methane. In the same time we still have problems with the amount of particulate matter. And especially in urban canyons we have problems with nitrogen dioxide (NO<sub>2</sub>) emitted by diesel-powered vehicles because of wrong incentives and misleading regulations are still in place.*

**Q: What can developing countries and emerging economies learn from the German experience?**

**A:** *The most important point before introducing rules is to create clarity about the problem. This means an emission inventory should be established to assess where the problems actually come from. This should be combined with an effective air quality monitoring system to generate the necessary information for being able to assess the most cost-efficient measures to reduce human health and climate impacts. There is no sense in just implementing a certain measure, but instead the measures with the lowest costs and the highest reduction potential in the particular area should be implemented first.*

**THANK YOUR VERY MUCH!**



# 02.

## *Clean Air Management*

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### CLEAN AIR CAN BE PLANNED

*Sustainable transport measures can positively affect the concentration of air pollutants, even if not specifically designed to reduce emissions. These include especially measures in urban areas, like public transport improvements and vehicle upgrades, the implementation of pedestrian areas, bike and car sharing systems, 30-km/h zones or even street cleaning. Many of these measures are taken up in so called Clean Air Plans, which are coordinated with overarching mobility planning processes.*

*This chapter outlines how air pollution is monitored and targeted by planning procedures in Germany. The measurement and modelling of air pollution as well as air quality planning at municipal levels are explored from administrative, technical-professional and municipal perspectives.*



*Measuring station at the Federal Environmental Agency.*

## 2.1 MEASUREMENT OF AIR POLLUTION

*Air-borne pollutants are often imperceptible to the human senses. They are invisible yet always present in moving air masses. Some air pollutants occur in such low concentrations that they do not have any effect on humans or the environment. With others it takes a long time until their effects are manifest.*

*In order to guarantee clean air for human beings and the environment or, where necessary, to improve air quality, experts regularly carry out measurements countrywide. The air monitoring networks operated by the German Federal Environment Agency and Germany's Länder (federal states) fulfil different tasks.*

*The air monitoring network of the Federal Environment Agency (Umweltbundesamt – UBA) operates measuring stations far away from densely populated areas and cities. Local sources of pollutants, such as industrial sites or power stations, should not affect the measurements.*

*Situated in rural areas, the stations of the Federal Environment Agency measure the quality of air masses transported over long distances and across national frontiers.*

### **Measurement of Local Air Pollution**

*Unlike the UBA, Germany's Länder operate measuring stations in cities, in conurbations, in areas with high traffic density as well as in rural regions, in order to monitor and determine local and regional air quality.*

### **Current Pollution Situation**

*The Federal Environment Agency brings together the air quality data from its own network and those of the Länder's networks. These data are used to provide, for each measured pollutant, maps showing the current air quality situation in all of Germany. This information is updated continuously.*

*Measuring values from individual stations with high air pollution levels are made available by the environment agencies of the Länder.*

### **Information on Measuring Sites**

*Each air monitoring station in Germany (Federal or Länder) has a specific measuring programme and works with specific measuring instruments. Information both on stations currently in operation and on stations that are no longer operational is available at the Federal Environment Agency's stations database.*

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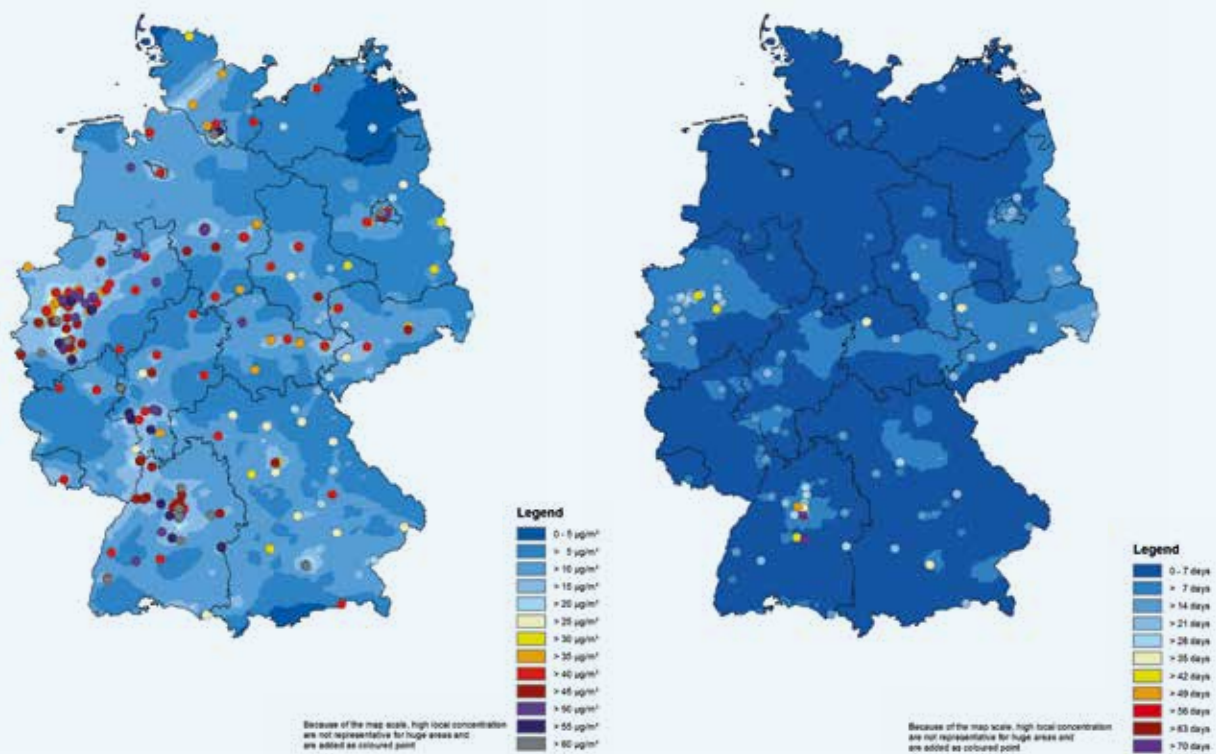
**Text by the Umweltbundesamt (Federal Environmental Agency).**

#### **Recommended further reading:**

➔ [www.umweltbundesamt.de/en/topics/air/measuringobservingmonitoring](http://www.umweltbundesamt.de/en/topics/air/measuringobservingmonitoring)



The logo of the Umwelt Bundesamt (Federal Environment Agency) is displayed. It consists of a green square containing the text 'Umwelt Bundesamt' in white, with a small green circular icon to the right of the word 'Umwelt'.

**NO<sub>2</sub> – ANNUAL MEAN YEAR 2013****NUMBER OF DAYS WITH PM<sub>10</sub> DAILY MEAN  
VALUES IN EXCESS OF 50 µG/M<sup>3</sup> YEAR 2013****Figure 4.** Source: Federal Environmental Agency

## 2.2 DATA BASE: CURRENT CONCENTRATIONS OF AIR POLLUTANTS IN GERMANY

The Federal Environment Agency and the environmental agencies of the Länder are responsible for monitoring air quality in Germany. Several times a day measuring stations of the Federal Environment Agency (UBA) and the German States measure data on ambient air quality in Germany.

**On this website you can get up-to-date information about air pollutant concentrations:**

➔ [www.umweltbundesamt.de/en/data/current-concentrations-of-air-pollutants-in-germany](http://www.umweltbundesamt.de/en/data/current-concentrations-of-air-pollutants-in-germany)



## 2.3 LINKING EMISSIONS CALCULATION WITH TRANSPORT DEMAND DATA AT STREET LEVEL (HBEFA)

The Handbook of Emission Factors for Road Transport (HBEFA) is a PC-supported database originally developed on behalf of the environmental protection agencies of Germany, Switzerland and Austria, but it is now used and supported by many other European countries. It presents emission factors per kilometre or driving situation depending on a vast number of parameters to choose from. The HBEFA offers different levels of differentiated output, e.g. (i) by type of emission (“hot”, cold, evaporative) and matching specific parameters; (ii) by vehicle category: passenger cars, heavy duty vehicles etc.; (iii) by year and implicitly by varying fleet compositions for certain countries; (iv) by pollutants (regulated and unregulated); and it also gives the option of weighted emission factors (per vehicle category, per concept, per fuel type or per sub-segment i.e. engine size). Because it is impossible to cover that many options by measurements within reasonable time and financial constraints, a simulation tool named PHEM (Passenger car and Heavy duty vehicle Emission Model) was developed by TU Graz which calculates the emission factors. Random measurements ensure the validity of the tool and its results. Ongoing projects are necessary to improve and extend PHEM e.g. to include findings from new technologies like Euro 6 exhaust gas after treatments (DOC, DPF, SCR). The HBEFA is used by many different institutions, e.g. federal agencies and state governments, research institutions and environmental consultancies, to estimate future air quality or to compare the impact of different measures regarding traffic and transport.

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**Text by Federal Environmental Agency (Umweltbundesamt).**

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**Recommended further reading:**

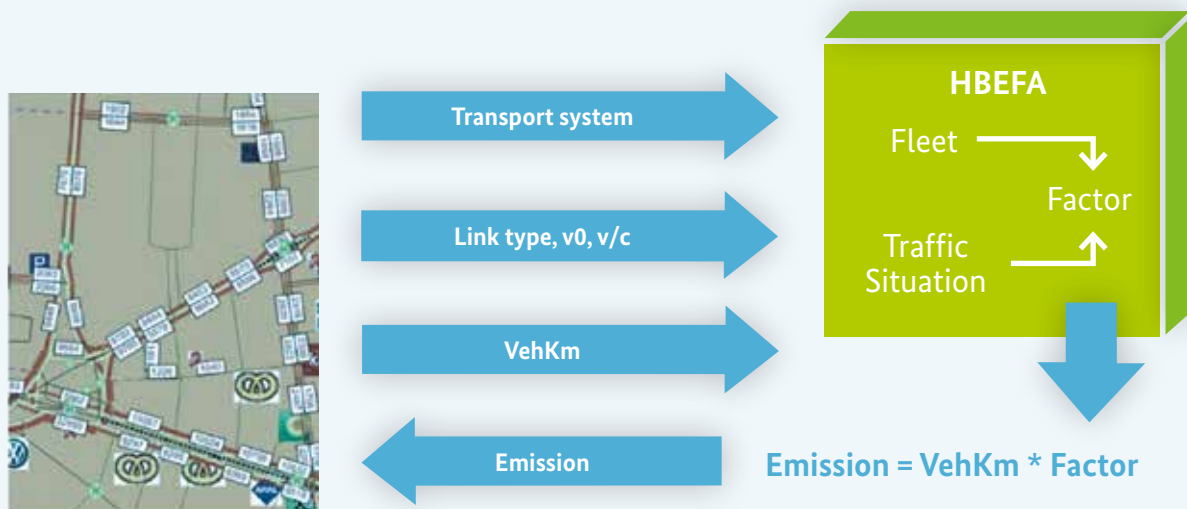
➔ [www.hbefa.net/e/index.html](http://www.hbefa.net/e/index.html)



## 2.4 MODELLING AIR POLLUTANT AND GREENHOUSE GAS EMISSIONS

The transport of persons and goods is one of the major sources of air pollution and carbon-dioxide emissions. Strategies in transport – and of course single measures – have to be assessed in terms of their mitigation potential to reduce both dangerous local emissions of toxic pollutants like NO<sub>x</sub> and particles and global emission of CO<sub>2</sub>. Measuring of emissions of transport (except the measuring of particular vehicle emissions) has been seen for a long time as an almost impossible exercise and therefore quite rough estimations have been used to evaluate the impact of certain measures on the emissions.

Transport planning offers solutions for this dilemma, as transport modelling can be used as an adequate basis to model emissions and evaluate the impact of mitigation measures. Based on the output of traffic modelling software such as VISUM and VISSIM (PTV Planung Transport Verkehr AG), internal or external emissions models can calculate emissions of the most important air pollutants and greenhouse gases both on a local (road section, intersection) and a system level (whole networks, e.g. an urban transport system).



**Figure 5.** Air pollutant and greenhouse gas emissions modelling (simplified). Source: PTV AG

On a macroscopic level (software models such as VISUM or IMMISem) the emissions are simulated based on the handbook of emission factors (HBEFA, refer to section 2.3). The knowledge of the emissions of specific vehicle types under different operation and traffic situations is employed by coupling this information with traffic conditions, traffic flows and fleet information. Thus, the emissions can be calculated reliably and the impacts on local environments can be evaluated properly, by using the emissions as input for dispersion models (refer to section 3.6).

On a microscopic level (in microscopic simulation, e.g. using PTV VISSIM) the emissions are evaluated based on the simulation of single vehicles, using related measurements for vehicles under the different operation modes.

Thus modelling is a powerful tool to design transport measures and strategies in regard to reduce air-pollutant and GHG-emissions and provide valid balances for planning and safe decisions. One example for the application of these tools is the modelling of the impact of traffic control strategies. Such tools are developed to minimize pollutant concentrations by regulating traffic flows in the City of Munich (Program for environmental oriented traffic management). The model has been used to evaluate the impact of changed traffic control programs in the network – from the traffic side as well as the basis for detailed environmental assessment. This was done in close cooperation with IVU Umwelt GmbH, which also modelled and evaluated the concentrations (refer to section 3.6).

**Text by PTV Group.**

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**Author:** Dr. Rainer Schwarzmann, Dr. Volker Waßmuth

**Further Recommend reading:**

➔ [www.ptvgroup.com](http://www.ptvgroup.com)

## 2.5 MODELLING AIR POLLUTANT CONCENTRATION LEVELS

Quantification of emissions is essential for reporting and for first impact assessments of different air quality strategies. However, to protect human health and the environment, it is important to know the pollution concentrations people and the environment are exposed to. Not only the emissions affect these concentration levels, but also they strongly depend on meteorological conditions and the environment, which both determine the transmission, i. e. the transport and possibly transformation of substances from the emission sources to the receptors.

Measurements and modelling both are used to quantify these concentration levels (see chapters 2.1–2.4), which are regulated by limit values. Measurements of pollutant concentrations, however, are expensive and time-consuming and, thus, monitoring stations can be set up only for singular locations and not for entire areas or cities. In addition, as measuring is possible only for existing situations, it cannot be used to assess future scenarios.

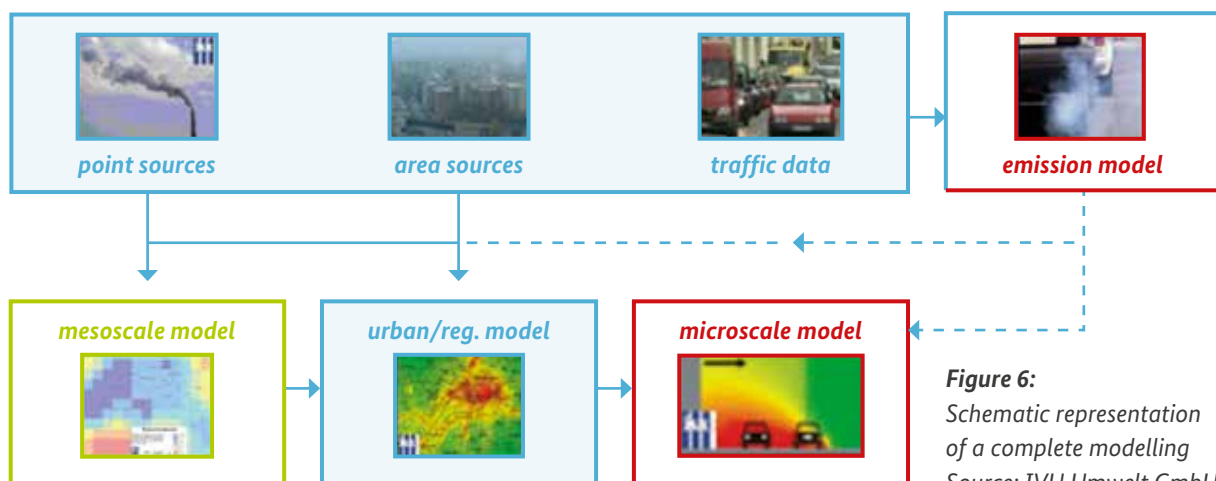
Dispersion modelling, on the other hand, does not have these limitations and can deliver assessments for entire areas in high spatial resolution as well as for future developments. Based on emission data (see section 3.5), dispersion modelling simulates the physical and chemical transport- and transformation-processes and calculates concentration levels for arbitrary locations and points in time. Depending on the aim of the modelling study and its spatial scope, different models or combinations thereof are employed. Operational modelling systems exist for all relevant spatial scales, ranging from continents or countries (e. g. RCG) down to specific street sections or crossroads (e. g. IMMIS), and are being routinely used by universities and private environmental consulting companies.

For example, so-called screening-models as IMMISluft allow to identify highly affected areas ('hot spots') and to assess the population's exposure for entire cities. A complete modelling chain with RCG and IMMIS has been applied, e. g., for Berlin. Such an exhaustive assessment is a valuable basis for air quality planning and prioritizing (see, in German, [www.stadtentwicklung.berlin.de/umwelt/luftqualitaet/de/luftreinhalteplan/download.shtml](http://www.stadtentwicklung.berlin.de/umwelt/luftqualitaet/de/luftreinhalteplan/download.shtml)).

**Text by IVU Umwelt GmbH.**

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**Further Recommend reading:** [www.ivu-umwelt.de](http://www.ivu-umwelt.de)



**Figure 6:**  
Schematic representation  
of a complete modelling  
Source: IVU Umwelt GmbH

## 2.6 AIR QUALITY PLANS: PLANNING FOR CLEAN AIR IN CITIES

*Clean air in German cities can be partly ascribed to a planning process on the municipal level reaching back several decades. Nowadays the focus is on municipal air quality plans which have to be compiled in all cities which exceed threshold values. In large cities, the air quality plan is prepared by the municipality and the process is supervised and controlled by the state environmental agency. The legal framework is defined by European and national legislation.*

*A municipal air quality plan comprises all emissions sources like transport, industry, power generation and households. Based on emission and exposure models of the two main pollutants PM and NO<sub>2</sub>, air quality measures are derived. The transport sector usually plays a big role and the measures go beyond the tightening of emission standards as part of the vehicle technology. Technological advancement reacts with a lag, is imponderable and is on its own not sufficient. Without additional measures the threshold values especially of NO<sub>2</sub> cannot be met at monitoring stations closes to high-capacity roads.*

*The additional measures interact with land-use planning and transportation planning. For a better air quality an improved spatial pattern, less urban sprawl, a multifunctional city with short travel distances and an alternative travel behavior of the inhabitants have the largest potential in the long term. In the short term, environmental zones, more attractive non-motorized modes, improved public transport service, less public transport emissions and a better traffic flow have positive effects. However, additional car traffic induced by a steadier and faster traffic flow generates new emissions. Therefore the most important component is to make car transport less attractive by means of e.g. speed limits, restrictive parking management and pricing schemes.*

*While preparing the air quality plan every five years, intensive public consultation has to take place. Before it comes into effect, the city council has to agree on it. Although this democratic participation is positive, the actual effect of the plan on air quality is limited in many municipalities. Measures stated in the plan may never be implemented and other city council decisions may even be contradicting. Currently the European Union as the highest controlling authority is starting to become more involved in enforcing measures of the air quality plan.*

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**Further Recommend reading:**

➔ [www.tu-dresden.de](http://www.tu-dresden.de)







### **Consultation of Stakeholders and the Public when Developing Berlin's Air Quality Plan**

*Following European and international legal obligations Berlin's draft air quality plan was published on the web and the public was invited for comments over a two months period. In 2004, more than 130 interventions were received, most of them dealing with the core measure, a low emission zone, which should prevent polluting vehicles driving into Berlin's central area. After having assessed the incoming comments a public hearing was held and the draft was amended before adopted by Berlin's government.*

*Beyond that obligation, there is a long tradition in Berlin to involve already at an early drafting stage other relevant institutions, bodies and associations in order to avoid troubles during the final adoption process. Involvement of affected groups of the civil society, especially environmental NGOs and businesses associations during or even after the adoption of the strategy often facilitated the implementation of the measures later on, enhancing mutual understanding for the planned action to reduce pollutant emissions. Stakeholders, in particular industry federations can also be a useful source of information on feasibility, costs and socio-economic impacts of potential measures. This was particularly important for framing details, like the timing and stringency of the low emission zone.*

**Text:**

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**Further Recommend reading:**

➔ [www.stadtentwicklung.berlin.de/umwelt/umweltatlas/eic311.htm](http://www.stadtentwicklung.berlin.de/umwelt/umweltatlas/eic311.htm)





# 03.

## Taking Action

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### EFFECTIVE MEASURES FOR BETTER AIR QUALITY IN CITIES

*Limit values on particulate matter have been in effect in EU law since 1 January 2005. A yearly average of 40 micrograms per cubic metre ( $\mu\text{g}/\text{m}^3$ ) and a daily average of 50  $\mu\text{g}/\text{m}^3$  have been set for particulate matter smaller than 10 micrometres (PM 10). The daily average may not be exceeded on more than 35 days per calendar year. Many German cities have recorded a significantly higher rate of exceedances above the tolerated limit.*

*Since vehicle traffic is a major factor contributing to air pollution by particulate matter in urban areas, a number of Germany's cities have designated low emission zones (LEZ) whose purpose is to improve the air quality within these zones and thus protect public health. But they are only one measure which is implemented by municipalities, private business and civil society to improve air quality in urban regions. The following section presents numerous effective measures for improving air quality.*

**Further Recommended Reading:** ➔ [www.cleanair-europe.org/en/home](http://www.cleanair-europe.org/en/home)

**Figure 7:** Low emission zone inside the S-Bahn ring in Berlin

**Source:** Senate Department for Urban Development and the Environment (2013):

→ [www.stadtentwicklung.berlin.de/umwelt/luftqualitaet/umweltzone/de/gebiet.shtml](http://www.stadtentwicklung.berlin.de/umwelt/luftqualitaet/umweltzone/de/gebiet.shtml)



### 3.1 LOW EMISSION ZONES IN GERMANY – THE EXAMPLE OF BERLIN

Driving a car produces emissions: air pollutants, climate-damaging gases and noise. Of course, modern cars produce fewer emissions than older ones, so thankfully the days of Berlin smog alarms are long gone – the last alarm in West Berlin was in 1985. The modernisation of Berlin's industry and household heating systems has also made a major contribution to reducing atmospheric pollution.

The EU has set stringent limit values for these pollutants and threatens countries with and financial fines for breaching them. However, these are still being exceeded in Berlin, which is why the city has introduced a 'low emission zone'. A low emission zone is a defined urban area in which limit values are often exceeded and where only low-emission vehicles can be driven. In Berlin this is the area within the city rail ring, home to just over a million people. Contraventions incur a fine, currently set at €80. Federal law defines four categories ranging from slightly lower emission to ultra-low emission vehicle. Vehicles receive a windscreen sticker in different colours to show which category they belong to. It is at the discretion of the local authorities to decide, on the basis of local pollution conditions, which category of vehicle should be prohibited from entering the low emission zone and which exemptions may be granted.

Berlin's low emission zone was introduced on 1 January 2008, as there was no other obvious way of quickly achieving a sufficient reduction in air pollution levels. Motor vehicles in Berlin are still major contributors to particulate pollution and are almost solely responsible for nitrogen oxide pollution. The low emission zone was introduced in two phases to give owners time to retrofit their vehicles or buy new ones. Initially vehicles with the highest emissions were prohibited, and the other three categories – red, yellow and green – were still allowed to enter the low emission zone. The second phase began on 1 January 2010. Since then, only vehicles that have a green sticker, i.e. the cleanest category of vehicles at present, are allowed within the zone. Continual monitoring of air quality has shown that the introduction of the low emission zone has been effective: it has significantly speeded up the replacement of old vehicles by low-emission ones. This has meant that particulate emissions are 50 % lower than the predicted trend and nitrogen dioxide emissions are 20 % lower. Despite this success, low emission zones, which have now also been introduced in over 300 other European cities and agglomerations, are the subject of heated public debate. Nevertheless, the fact that limit values are still being exceeded means that low emission zones remain a necessity. Other transport policies designed to further lower the percentage of motor traffic in the city's overall traffic volume promise to reduce pollution further.

**Text:** Sustainable Urban Transport Project (SUTP): The Sustainable Urban Transport Guide Germany – Discover Berlin by Sustainable Transport: ➔ [www.sutp.org/documents/PublicFiles/sut%20travel\\_guide\\_berlin.pdf](http://www.sutp.org/documents/PublicFiles/sut%20travel_guide_berlin.pdf)

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## European City Ranking – Berlin's efforts get noticed

What measures have been designed and implemented in some of Europe's most polluted cities? The European City Ranking of the initiative SOOT FREE FOR THE CLIMATE aims to answer this question and demonstrate that local solutions to reduce air pollution exist. It identifies which cities are best at it, and what others can learn from them.

### Ranking overview

Below is our ranking of 17 European cities based on nine categories of measures which can reduce soot emissions and help improve air quality. Berlin finishes first, followed very closely by Stockholm, Copenhagen, Vienna and Zurich. All five cities reached grade B.

OVERALL MARK	CITY	EMISSION REDUCTION SUCCESS	LOW EMISSION ZONES & BANS OF HIGH EMITTERS	PUBLIC PROCUREMENT	NON-ROAD MOBILE MACHINERY	ECONOMICS INCENTIVES	MOBILITY MANAGEMENT & MODAL SPLIT	PROMOTION OF PUBLIC TRANSPORT	PROMOTION OF WALKING & CYCLING	PARTICIPATION & TRANSPARENCY
B 84 %	Berlin Capital of Germany	++	++	++	+	0	++	0	+	+
B- 82 %	Copenhagen Capital of Denmark	+	-	+	+	++	+	+	++	++
B- 82 %	Stockholm Capital of Sweden	0	0	+	0	++	++	++	++	+
B- 80 %	Vienna Capital of Austria	+	0	0	++	+	+	++	+	+
B- 80 %	Zurich Switzerland	++	-	++	++	+	+	+	+	0
C- 80 %	Amsterdam Capital of Netherlands	0	0	+	0	+	0	+	+	+
D+ 80 %	Lyon France	0	-	-	0	-	+	+	++	++

**Figure 8:** European City Ranking. Source: ➔ [www.sootfreecities.eu/](http://www.sootfreecities.eu/)



### 3.2 CAMPAIGN: NO DIESEL WITHOUT FILTER / SOOT-FREE FOR THE CLIMATE

*In the campaign “Soot-free for the Climate” and the EU LIFE-Project Clean Air German environmental NGOs Deutsche Umwelthilfe, Verkehrsclub Deutschland, BUND and NABU cooperate with European partner NGOs. Their goal is to equip all diesel vehicles and machines with diesel particle filters. Avoiding emissions of diesel soot helps human health and protects the climate.*

*The alliance of environmental NGOs always has encouraged for tightening of the limits for the emissions of new vehicles. This has contributed to adopting legislation on particle filters for new diesel-cars. Since January 1st 2014 every sold lorry or bus has to have the standard euro VI, that means all new diesel vehicles have a diesel particle filter and technical measures to reduce the emissions of nitrogen oxides.*

*Low emission zones (LEZ) are very effective for reducing diesel soot in the air. There are 48 LEZs in Germany. In the capital of Berlin the share of diesel soot in the air was cut by more than half. Cities can do a lot more to clean up the air. For example they can oblige transport companies to use only busses with particle filters and SCR-systems. Selective Catalytic Reduction (SCR) reduces nitrogen oxides. Environmental NGOs achieved that in Budapest 200 modern buses were purchased. Berlin will retrofit more than 100 buses with SCR systems.*

*Not only technical measures are possible. If you enhance the share of bicycle traffic, fewer emissions will result. In the network “biking cities” champion cities of bicycle traffic cooperate with NGOs in showing what measures are especially powerful.*

*On European level the NGOs cooperate to achieve standards for air quality that follow the recommendations of the World Health Organisation (WHO). Therefore higher standards for new construction machines, inland waterway ship and diesel locomotives are necessary.*



Figure 9: Joint action for clean air. Source: → [www.cleanair-europe.org](http://www.cleanair-europe.org)

Text by Verkehrsclub Deutschland (German Transport Association, VCD).

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For more information please refer to:

→ [www.vcd.org](http://www.vcd.org)







### 3.3 JOINT FORCES FOR CLEAN AIR IN THE CITY OF BONN

*In the city of Bonn at some high frequented streets the limit values for nitrogen dioxide are exceeded. Consequently the district government in Cologne disposed the elaboration of an air quality plan. The air quality plan includes extensive measures to reduce the high nitrogen dioxide and equally the particulate matter pollution in the city of Bonn. An environmental zone has been established, the number of job-ticket users increased and the traffic flow improved. Furthermore, climate protection, renewable energy and sustainable traffic related measures have been outlined und will be implemented gradually. It is noteworthy that the whole contributions for “Clean Air in Bonn” are provided by numerous partners, even though there has not been consensus about all measures.*

*Among others, a “Partnership of Air Quality and Low-Emission Mobility” has been founded to improve air quality. The city of Bonn, public utility companies as well as industry, craft, retail, hotel and restaurant associations and the House-owner and property association signed a self-imposed obligation, in order to promote environmental friendly mobility. To encourage commuters in using public transport, business organisations provided successfully further information events. Furthermore, company bicycles have been provided and car sharing encouraged. In order to tackle the challenges of climate protection broadly the initiative promotes also the reduction of energy consumption and the use of renewable energies. The measures developed by the partnership have been largely included into the air quality plan of the city of Bonn.*

**Text:** City of Bonn, Department for Environment, Consumer Protection and Local Agenda.

**Contact:** Dr. Dieter Misterek, [dieter.misterek@bonn.de](mailto:dieter.misterek@bonn.de)



### 3.4 SHORE-TO-SHIP ELECTRICITY SUPPLY

*Despite the positive benefits of the intensive Baltic Sea shipping industry both economic and in terms of tourism the burden on the environment remains a pressing, unsolved problem. High levels of pollution were the motivation for the Lübeck-led EU project, “New Hansa“. In Lübeck-Travemünde, 95 % of SO<sub>2</sub>, 75 % of NO<sub>x</sub> and 50 % of CO<sub>2</sub> emissions were found to originate from ships.*

*The solution: the supply of the vessel with power from a shore-based source via a plug-in connection, thus allowing it to shut down its auxiliary engines. The system is conceived to allow onboard personnel to take the necessary actions independently and without interruption of the power supply. Moreover, electricity can be provided at various voltages, frequencies and power levels via the single on-shore connection according to the ship's specific requirements. In Lübeck, the local energy utilities provide eco-power, which further reduces the impacts on the environment.*

*Having initially faced some legal and technical problems, the pilot project in Lübeck has been implemented very successfully and is now ready to be transferred to 23 other Baltic ports. An important step towards more climate protection and better air quality in harbours has been taken.*

**Text:** Climate Alliance, see ➔ [www.klimabuendnis.org/luebeck.0.html?&L=2](http://www.klimabuendnis.org/luebeck.0.html?&L=2)

**Contact:** Ralf Giercke, [ralf@giercke.de](mailto:ralf@giercke.de)



### 3.5 ASSESSING THE EFFECTIVENESS OF AIR QUALITY & TRANSPORT MEASURES

*In Germany, many measures to improve air quality have been implemented during the last years. Assessing their effectiveness, however, is not an easy task. Effects of almost all measures are small with respect to the total concentration, which itself shows a strong variability independent of the measures (e.g. due to varying meteorological conditions). Nevertheless, there are assessments available which are based on monitoring data, scenario modelling, or a combination of both approaches.*

**Focusing on three sample measures, the following reduction potentials can be expected:**

#### **Low Emission Zone (LEZ):**

Reduction potentials to reduce concentration levels for LEZs highly depend on the level of access restriction. Evaluation studies of actual LEZ implemented in the years 2008–2011 result in reduction potentials of up to 10 % for  $\text{NO}_2$ , 7 % for  $\text{PM}_{10}$  and 10 % for  $\text{PM}_{2.5}$ . A high reduction potential of up to 19 % for soot (black carbon) is particularly mentioned. It has to be noted, that a LEZ's reduction potential decreases the later it is being implemented as the fraction of the vehicle fleet that is banned decreases due to the general modernization of the vehicle fleet. Theoretical assessments of future scenarios, e. g. an intensified penetration of 50 % of Euro-6/VI vehicles in the fleet in 2015 would lower annual mean values of the total  $\text{NO}_2$ -concentration by up to 20 %.

#### **Environmental Traffic Management (ETM)**

ETM denotes traffic management that also focuses on environmental aspects (please refer to section 3.5. for an example of from the city of Munich). This is achieved with temporary dynamic measures which are tailored to the local pollution levels with respect to both spatial and temporal aspects and are activated only if the current air quality situation requires action. The reduction potentials of ETM strongly depend on the activation rate of the respective measure. For the total concentration, they range from a few percentage points at the low end up to 15 % or up to 10 exceedance days ( $\text{PM}_{10}$ ) in specific designs. Thus, reduction potentials of ETM are in the same range as reduction potentials of LEZs.

#### **Truck transit bans**

The reduction potential of truck transit bans strongly depends on local conditions, notably on the share of trucks in overall road traffic and the expected compliance rate. As trucks have a higher reduction potential for non-exhaust emissions of particulate matter due to resuspension and abrasion, reductions of the  $\text{PM}_{10}$  annual mean value by several percentage points can be expected even with lower truck shares. The theoretical potential to reduce total concentrations is always higher for  $\text{NO}_2$  than for  $\text{PM}_{10}$  and can reach more than 10 % if truck share and compliance rate are suitably high (e. g. 6 % truck share, 80 % compliance rate in 2015).

#### **Speed limits of 30 or 40 km/h on major roads**

Reducing speed limits on major roads from 50 to 30 or 40 km/h is a measure that is especially difficult to quantify. For the additional concentration caused by road traffic, reduction potentials for road traffic of 18 % for  $\text{NO}_x$ , 15 % for  $\text{NO}_2$  and 30 % for  $\text{PM}_{10}$  are given.

More details on air quality planning, measures and the assessment of their effectiveness in Germany can be found in IVU Umwelt (2013): IVU Umwelt (2013): Inventory and effectiveness of measures to improve air quality. Published in German as UBA-Texte 26/2014 'Bestandsaufnahme und Wirksamkeit von Maßnahmen der Luftreinhaltung'. Contracting authority: German Federal Environment Agency (UBA). 2013.

⬇ **Download:** [www.umweltbundesamt.de/publikationen/bestandsaufnahme-wirksamkeit-von-massnahmen-der](http://www.umweltbundesamt.de/publikationen/bestandsaufnahme-wirksamkeit-von-massnahmen-der)

A condensed English version of the report is in preparation (to be published winter 2014/2015).

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# 04.

## *Technology and Innovation for Clean Air*

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### MANY ROADS LEAD TO BETTER AIR QUALITY

*The following pages provide examples of technological solutions which reduce vehicle emissions as well as innovative technologies which aim at replacing car and lorry trips by more sustainable modes. This includes innovative logistics concepts as well as vehicle technologies used in public service vehicle fleets.*

## ADVANCED VEHICLE ELECTRIFICATION PRODUCTS HELP IMPROVE THE MARKETABILITY OF ELECTRIFIED VEHICLES

With more than 20 years of experience in the field, Delphi Automotive PLC offers vehicle manufacturers scalable solutions for all levels of electrification and is focused on aggressively lowering the cost of vehicle electrification. Delphi provides full system integration, from power electronics to electrical/electronic architecture to electric propulsion systems and thermal management, including high-voltage cables and wiring, connection systems, electrical centers, plug-in and wireless electric vehicle charging, AC/DC inverters, DC/DC converters, battery packs, controls and the safety disconnect for the packs.

### Latest technologies for hybrid and electric vehicles include:

- Vehicle sound generator to protect pedestrians
- Scalable and Compact 12 Volt DC/DC converters for Start/Stop Vehicles
- High-Voltage Inverter with the Dual-Side, Liquid-Cooled Delphi Power Switch
- High Voltage Connection Systems for Auxiliary Modules and Devices
- High Voltage Power Connection Systems
- Battery Pack Components
- Chargers and Charging Cables

### Text by the Delphi.

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**For more information please refer to:**

- [delphi.com/manufacturers/auto/hevevproducts/evap-emiss-sys](http://delphi.com/manufacturers/auto/hevevproducts/evap-emiss-sys)

**DELPHI**  
Innovation for the Real World





## EMISSION MEASUREMENT DEVICES

MAHA ( → [www.maha.de](http://www.maha.de) ) has the leading technology for Periodical Technical Inspection (PTI) on safety and emission relevant components for motor vehicles. MAHA develops and manufactures high-precision exhaust gas analyzers and test lanes for all kind of motor vehicle. With a worldwide expertise on PTI Projects, 20 own subsidiaries and 100 sales/service stations in over 150 countries around the world, we support municipalities, countries and stakeholder with our experience to set up, establish and reorganize the PTI system in every country around the world. These measuring devices help make sure that vehicles are in a technically perfect and environmental friendly condition. As a member of many initiatives we support also NGO in their activities to set up sustainable urban transport. In addition, MAHA's ISO 14001 and ISO 50001 certifications provide the highest environmental and energy efficiency standards over the entire lifecycle of its products.

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**For more information please refer to:**

→ [www.maha.de/emission-tester.htm](http://www.maha.de/emission-tester.htm)





## EXHAUST-GAS AFTER TREATMENT

According to the World Health Organization (WHO), diesel fumes are more dangerous than was previously thought and have recently been reassigned to the same class of hazardous materials such as asbestos, arsenic and mustard gas. This means that diesel exhaust emissions are no longer merely suspected of causing cancer, but have now been labelled by the WHO as being a definite cause of lung cancer. Despite this, the use of diesel engines is still being promoted in all areas. Not only is the amount of diesel engines continuously growing in the passenger car segment, they are also playing a big part in the debate about mobility in modern societies and in solving the transport problem. The diesel engine is the lynchpin in road-based logistics, shipping and rail-bound goods distribution. What's more, diesel power in mobile machinery is a key component of an efficient industrialised society.

HJS Emission Technology GmbH & Co KG, one of the leading suppliers of exhaust- gas aftertreatment systems, has led the way in the development and manufacture since 1976.

As a winner of the German Environmental Award, the company is making an important contribution to protecting mankind and the environment through its innovative technologies and products. HJS technologies can be used either as original equipment or for retrofitting passenger cars, commercial vehicles, coaches, public transport buses as well as a wide range of non-road mobile machinery and stationary applications. In addition to systems for gasoline engines, HJS specializes in diesel engines systems, predominantly for reducing the emissions of soot particles (PM) and nitrogen oxides (NO<sub>x</sub>). All systems meet the statutory requirements and are certified in accordance with the valid licensing regulations.

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➔ [www.hjs.com/aftermarket/products.html](http://www.hjs.com/aftermarket/products.html)

**HJS**  
Emission Technology



## INTRODUCING FUEL CELL-HYBRID BUSES IN THE RHINELAND

Sustainable urban mobility is one of the major challenges to a greener future. Aided by industry partners from North Rhine-Westphalia and the Netherlands the Cologne regional transport agency (RVK) started deploying two Fuel Cell-Hybrid buses in 2011 in regular route service. The implementation of the innovative technology was financed by the European regional development fund and the federal state North Rhine-Westphalia. The project is further supported by the cities of Hürth and Brühl as well as the Rhine-Erft-District. The project is academically accompanied by the universities RWTH Aachen and FH Köln. The aim is to provide energy efficient and environmentally friendly, as well as flexible, public transportation. Since May 2014 the RVK deploys two more Fuel Cell-Hybrid buses – a further step in a sustainable zero-emission future.

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**For more information please refer to:**

➔ [www.rvk.de](http://www.rvk.de)





## CARGOTRAM IN DRESDEN - HOW TRAMCARS DO AVOID TRUCK TRANSFERS

Since 2001 the city of Dresden is home of few tramway-based urban logistics system worldwide. Based on experiences with freight tramways in the middle of the 20th century the system was newly established to supply a Volkswagen production plant. An alternative logistics concept was the condition for the permission to build that “manufactory style” plant in the inner city area of Dresden. Two 60-meter CarGoTram trainsets connect the production plant with a peripheric logistics hub and replace three truck journeys on each ride.

**Text by VerkehrsConsult Dresden-Berlin GmbH.**

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**For more detailed information please refer to**

➔ [www.eltis.org/discover/case-studies/cargotram-dresden-germany-how-tramcars-do-avoid-truck-transfers](http://www.eltis.org/discover/case-studies/cargotram-dresden-germany-how-tramcars-do-avoid-truck-transfers)



## URBAN HUB „BENTOBBOX“ FOSTERS MORE SUSTAINABLE URBAN FREIGHT DELIVERY IN BERLIN

*Between 2011 and 2012, couriers and customers in Europe used an exceptionally flexible and independent modular consignment system: the BentoBox. It was tested in a field test in Berlin and supported by the EU as part of the City-Log project.*

*The BentoBox served as an urban place of transshipment and consolidation for couriers, as well as parcel pick-up station for customers. It was designed for parallel usage by various CEP services. The project results were positive: The BentoBox enabled the bundling of orders and about 85% of car deliveries could be replaced by cargo bikes.*

**Text by the LogisticNetwork Consultants GmbH.**

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**For more detailed information please refer to:**

- ➔ [www.bentobox-berlin.de](http://www.bentobox-berlin.de)
- ➔ [www.eltis.org/discover/case-studies/urban-hub-bentobox-fosters-more-sustainable-urban-freight-delivery-berlin](http://www.eltis.org/discover/case-studies/urban-hub-bentobox-fosters-more-sustainable-urban-freight-delivery-berlin)







## THE WORLD'S FIRST HYDROGEN FUEL CELL POWERED WASTE COLLECTION VEHICLE IS USED IN BERLIN

*The Berlin waste management company (BSR) is trialling a waste collection truck with an electrically driven waste collection body and lifter makeup. The power is provided by a hydrogen fuel cell, reducing fuel consumption during waste collection by up to 30 %. Air quality improvements emanate from the use of a hydrogen fuel cell powering the waste truck and emitting solely water. The vehicle was put in operation within the project “ElektroAES – Deployment of three electric waste disposal vehicles” by Berlin’s Agency for Electromobility (eMO).*

**For more detailed information please refer to**

➔ [www.eltis.org/discover/case-studies/worlds-first-hydrogen-fuel-cell-powered-waste-collection-vehicle-used-berlin](http://www.eltis.org/discover/case-studies/worlds-first-hydrogen-fuel-cell-powered-waste-collection-vehicle-used-berlin)

➔ [www.emo-berlin.de/en/showcase/projects/electric-freight-transport/elektro-aes](http://www.emo-berlin.de/en/showcase/projects/electric-freight-transport/elektro-aes)

# 05.

## *Taking Joint Action: Expertise and International Cooperation*

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## 5.1 EXPERTISE ON CLEAN AIR

*This Federal Environment Agency web page offers regularly updated information about air and other topics related to this most important elixir of life. Find out here how air quality has developed and which pollutants are harmful to health. The webpage identifies sources of pollution and points out measures to combat it.*

**Text by the Federal Environmental Agency (Umweltbundesamt).**

**Recommended further reading:**

➔ [www.umweltbundesamt.de/en/year-of-air-2013](http://www.umweltbundesamt.de/en/year-of-air-2013)

**Umwelt  
Bundesamt**





## 5.2 CLEAN AIR FOR SMALLER CITIES IN THE ASEAN REGION (ASEAN-GERMAN TECHNICAL COOPERATION)

Asia's urban population is rapidly growing. Expanding industrial development and increasing motorisation have adverse impacts on the environment by deteriorating air quality, increasing greenhouse gas emissions and contributing to climate change. In the fight against these challenges, ASEAN cities face particular challenges. If air pollution and climate change mitigation is addressed, it is usually in large metropolitan areas. Despite their vital role in the country's development, smaller cities are rarely considered and usually do not have access to reliable data on air quality.

The project 'Clean Air for Smaller Cities' supports one to two medium-sized cities in ASEAN member states in the development and implementation of clean air plans (CAPs). These plans aim to improve air quality and support sustainable urban development. Participating countries include Cambodia, Indonesia, Lao PDR, Myanmar, Malaysia, the Philippines, Thailand, and Vietnam. The project is implemented by Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH on behalf of the German Federal Ministry for Economic Cooperation and Development (BMZ).

The project also elaborated institutionalised a training system on air quality ('Train-for-Clean-Air'). The training is customised for different stakeholder groups, such as decision makers, technical staff, non-governmental organisations and the media. Further, Environmental Ministries are supported in the refinement and/or development of national legislation on air quality.

Political decision-makers have shown remarkable interest in the project's activities. In Indonesia, self-financed emission inventories are developed in 12 more cities, following the project's approach as well as emission inventory guidelines were developed by the Ministry of Environment. With a focus on public participation and ownership, the project also helped to initiate cooperation between civil society, universities, city administrations and other institutions to work together towards better air quality.

**Text by Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ).**

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**Further recommended reading:**

- ➔ [www.CitiesForCleanAir.org](http://www.CitiesForCleanAir.org)
- ➔ [www.citiesenvironmenttransport.org](http://www.citiesenvironmenttransport.org)



### 5.3 ELECTRO-MOBILITY AND CLIMATE PROTECTION IN PR CHINA (SINO-GERMAN TECHNICAL COOPERATION)



*On behalf of the Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety of the Federal Republic of Germany (BMUB) and the Ministry of Science and Technology of the People's Republic of China (MoST), the Sino-German Cooperation Project on Electro-Mobility and Climate Protection is jointly implemented by the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH and the China Automotive Technology and Research Center (CATARC). The overall objective of the project is to provide the relevant Chinese ministries as well as related institutes and think tanks access to conceptual and technical background to introduce Electro-Mobility in China in a climate-friendly and environmental sound way.*

*In order to implement this objective, the Sino-German Cooperation Project on Electro-Mobility and Climate Protection is structured into 4 components.*



*The first component aims to identify and analyse the environmental impacts of Electro-Mobility in China. To this end, participatory scenario analyses will be performed, which quantitatively describe the market penetration of electric vehicles and take into account the share of renewable energies in the grid mix. Based on these scenario analyses, policy recommendations will be forwarded to the Chinese government to assist in the design of the regulatory framework. Moreover, the results will be used to design pilot and demonstration projects for efficient charging systems and the integration of renewable energies to fuel electric vehicles in a climate and environmental sound way.*

*In the second component, joint studies and workshops will build the methodological and technical capacities to integrate electric vehicles into the environmental regulations governing the transport sector in China. The focus will lie on standards and solutions that lower greenhouse gas emissions, such as Chinese Fuel Economy Standards beyond 2015. In the course of the third component, studies will be performed to analyse the feasibility of an environmental sound and resource efficient pilot system for traction batteries of electric vehicles. On the basis of these feasibility studies, policy recommendations for the design of pilot recycling projects will be formulated.*

*The fourth component investigates possible applications of electric vehicles in sustainable inter- and multi-modal urban transport patterns. The work in this component establishes an active exchange of practical experience as well as scientific research on pilot projects and fleet tests in Germany and China. Moreover, guidelines on how to develop climate and environmental sound Electro-Mobility solutions and integrate them with sustainable urban transport patterns will be developed. Finally, the component will analyse the feasibility of different uses of electric vehicles that incorporate novel driving patterns, such as carsharing.*

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**Text by Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ).**

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**Further recommended reading:**

- ➔ [www.electro-mobility.cn](http://www.electro-mobility.cn)
- ➔ [www.sustainabletransport.org](http://www.sustainabletransport.org)



## FRIENDS OF THE GERMAN PARTNERSHIP FOR SUSTAINABLE MOBILITY



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## SUSTAINABLE MOBILITY – MADE IN GERMANY

“Sustainable Mobility – Made in Germany” stands for sustainable, proven, resource efficient, innovative, trustworthy and flexible solutions for all domains of mobility and logistics services.

### **Germany has a long history of successful changes and transformations in the transport sector – including**

- the establishment of comprehensive funding schemes
- the re-emergence of walking and cycling as safe and viable modes of transport
- the reorganization of the public transport sector
- the continuous development of progressive regulations
- the development of efficient propulsion systems
- the integration of different modes of transport, including multimodality in logistics and ecomobility

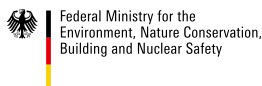
Academia, businesses, civil society and associations have gathered invaluable experience and skills in framing these transformations.

The German experience is worth of study. Due to the scarcity of energy resources, the high population density and number of enterprises, as well as the compactness of the country, Germany opted early on for energy-efficient, integrated and smart solutions in the transport sector.

More on → [www.german-sustainable-mobility.de](http://www.german-sustainable-mobility.de)

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