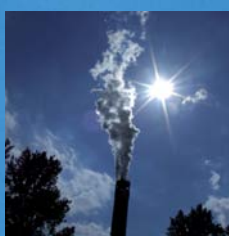
| UMWELTDATEN |

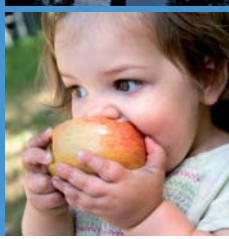
DATA ON THE ENVIRONMENT

Edition 2009

Accompanying brochure to CD ROM







Umwelt Bundes Amt
For our Environment

SELECTED ENVIRONMENTAL TRENDS

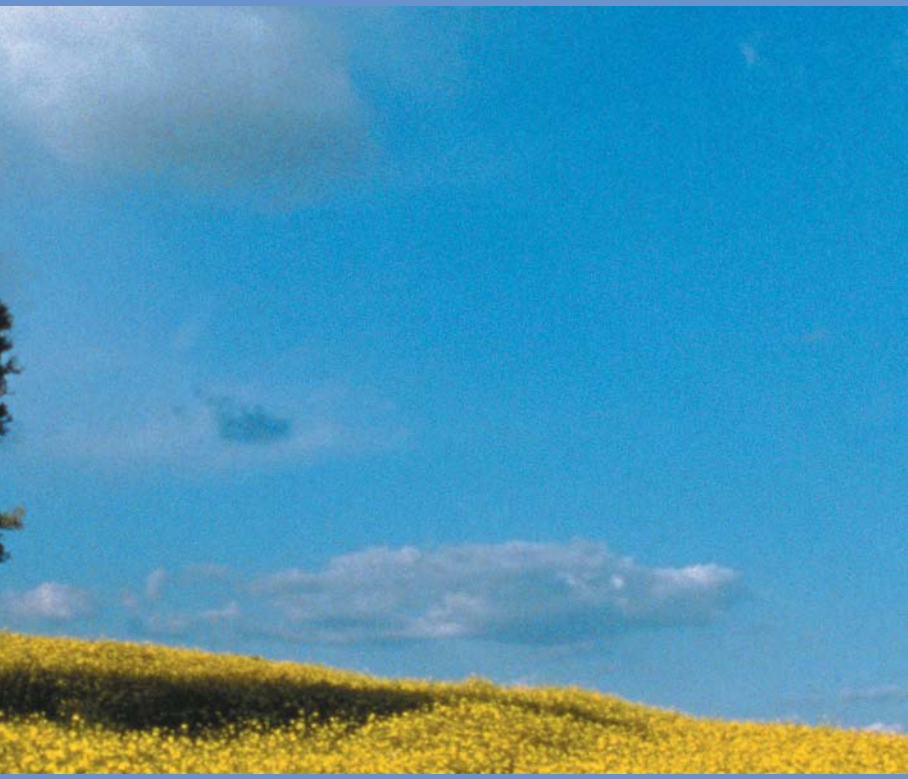
Indicator	Period	Status/Trend	Target	
CLIMATE PROTECTION				
Greenhouse gas emission in CO_2 equivalents	1990/1995 –2008	–23.3 %	Reduction by 21 % from 1990/1995 to 2008/2012	☺
ENERGY				
Energy productivity	1990–2008	+40.6 %	Doubles from 1990 to 2020	😐
Share of renewable energy in primary energy consumption	2008	7.1 %	Increase to 4.2 % by 2010 and 10 % by 2020	☺
Share of renewable energy in gross electricity consumption	2008	14.8 %	Increase to 12.5 % by 2010 and at least 30 % by 2020	☺
SUSTAINABLE MOBILITY				
Passenger transport performance	1991–2007	+26.1 %	–	☹
Freight transport performance	1991–2007	+65.7 %	–	☹
Share of rail in freight transport performance	2007	18.1 %	Increase to 25 % by 2015	😐
Share of inland waterways in freight transport performance	2007	10.2 %	Increase to 14 % by 2015	☹
ECOSYSTEM				
Development of representative bird species populations according to type of main habitat	2006	70 %	Increase to an index value of 100 by 2015	☹
Share of organic farming in total utilized agricultural area	2007	5.1 %	Increase of the share of organic farming to 20 % of agricultural land areas in the coming years	😐
AIR				
Airborne pollutant index of emissions	1990–2007	–56 %	Reduction to 30 % by 2010 compared to 1990	😐
Share of areas with a significant or very significant excess of critical load limits for eutrophying nitrogen in areas of sensitive ecosystems	1995–2004	+1.7 percentage points	–	☹
Share of areas with a significant or very significant excess of critical load limits for acid in areas of sensitive ecosystems	1995–2004	–16 percentage points	–	😐

Indicator	Period	Status/Trend	Target	
INLAND WATERS				
Discharges/leakages into surface waters in Germany				
Nitrogen	1983/1987–2003/2005	–45.2 %	Nutrient discharges to the seas halved between 1985–2000	☹
Phosphorus	1983/1987–2003/2005	–71.3 %	Phosphorus discharges to the seas halved between 1985–2000	☺
Share of monitoring stations in rivers classified as water quality class II or better				
Adsorbable organic halogen compounds (AOX)	2007	59 %	Attaining water quality class II or better at all monitoring stations by 2015	😐
Total nitrogen	2007	14 %	Attaining water quality class II or better at all monitoring stations by 2015	☹
SOIL				
Nitrogen surplus	2004/2006	104 kilograms per hectare	Decrease to 80 kg/ha in agricultural area by 2010, further decrease by 2020	☹
HUMAN EXPOSURE TO POLLUTANTS				
Lead in the bloodstream	1984–2006	–79 %	–	☺
RESOURCE MANAGEMENT				
Raw material productivity	1994–2007	+36.1 %	Doubles from 1994 to 2020	😐
WASTE				
Total amount of waste generated	1999–2006	–16 %	–	☺
Waste recovery rate	1999–2006	+7.9 percentage points	–	☺
Waste disposal rate	1999–2006	–8.9 percentage points	Disposal of untreated municipal waste terminated after June 1st 2005	☺
LAND USE				
Daily increase in settlement and transport area	2004/2007	113 hectare/day	Reduction of daily increase to 30 hectare/day by 2020	😐

☺ = indicates significant environmental progress, respectively trend towards reaching the goal

😐 = indicates weak environmental progress, respectively more effort is required in order to reach the goal in time

☹ = indicates no environmental progress, respectively reaching the goal is unlikely



This brochure is designed to tell you about selected significant trends within five important areas of environmental protection. On the CD-ROM you will find the complete contents of the internet application 'Data on the Environment' (in German). 'Data on the Environment – State of the Environment in Germany' contains comprehensive, detailed information about environmental conditions, policy and law as well as suggested further reading and hyperlinks. The 'Environmental Key Indicator System' provides activities and actions for environmental policy. On the Internet, under www.umweltbundesamt.de/daten-zur-umwelt you will find regularly updated web pages of 'Data on the Environment'.

CONTENTS

PREFACE

With this edition of 'Data on the environment', the Federal Environment Agency (UBA) continues what has become an established tradition. For a quarter of a century, the agency has reported regularly on the state of the environment in Germany. There have been many positive developments during this time. Germany and the European Union (EU) play a leading role in climate protection worldwide. Renewable energy is booming and drives growth and employment. Air quality and water quality in rivers has clearly improved – particularly in the eastern Federal States (Länder), while the waste management industry is developing into a resource and climate friendly closed substance cycle economy. Nevertheless, this is no time to rest on one's laurels. High levels of pollutants and nutrients still contaminate rivers, lakes and ecosystems, and further efforts must be made to achieve the environmental quality goals set out by Germany. Urban expansion and increasing traffic volume continue to be big problems. The demographic development requires new environmental policies to provide solutions for land use and environmental planning. Concerns around the opportunities and prospects of future generations force us to rethink many of our production and consumption patterns. UBA data also suggests that populations of low social status are subject to increased health risks arising directly from environmental factors.

You will find the facts and data on all of these topics on the CD-ROM. Entitled 'Data on the environment – State of the environment in Germany' it contains comprehensive, detailed

information about environmental conditions, law, strategies and goals, as well as suggesting further reading and providing useful hyperlinks. Also on the CD-ROM you will find the 'Environmental Core Indicator System', which sets out past achievements and new action items for environmental policy. Via the embedded hyperlink, you have access to constantly updated articles on the Internet (www.umweltbundesamt.de/daten-zur-umwelt).

This brochure also tells you about important trends in five key areas of environmental policy. It was made possible only through the concerted efforts of many state and federal institutions and organisations – they all contributed greatly in creating a comprehensive whole from the many and varied aspects of environmental information available. My particular thanks go to the Federal Office for Radiation Protection, the Federal Agency for Nature Conservation, the Federal Statistical Office, the Federal Office of Consumer Protection and Food Safety, the Federal Institute for Risk Assessment, the Deutscher Wetterdienst (National Meteorological Service), the Federal Office for Building and Regional Planning, the Federal Institute of Hydrology, the Federal Maritime and Hydrographic Agency, the Länderarbeitsgemeinschaften (Working Groups of the Federal States) and the associations, which contributed articles, supplied data, consulted on the project, and thus contributed to the success of 'Data on the environment'.

Dr. Thomas Holzmann
Vice-president

CLIMATE PROTECTION

CLIMATE CHANGE – A GREENHOUSE EFFECT

Even the most persistent sceptics cannot deny it any longer: the climate is changing, and it does it as a consequence of the greenhouse effect caused by mankind! Observations over the past 100 years clearly show that the global climate has become warmer. Since the beginning of the 20th century, the global annual average temperature has increased by 0.74 degrees Celsius (°C). Over the last 50 years, the global average temperature rose by an average of 0.13°C per decade. Monitored since 1950, the predominant portion of warming is due to human activities where greenhouse gases are emitted into the atmosphere. From 1961 to 2003 the world-wide sea level rose by approximately 1.8 millimetres (mm) annually. This rate increased to 3.1 mm between 1993 and 2003. In the Arctic the average temperatures rose twice as fast as has the world-wide average over the past ten years. The annual expansion of the arctic ice reduces by an average of 2.7 per cent (%) per decade, and during summer it is even 7.4 % per decade. In higher latitudes precipitation will probably continue to increase, while it will likely decrease in the subtropical regions. According to the Intergovernmental Panel on Climate Change (IPCC), there is a 66 % probability that tropical hurricanes will increase in their intensity, with higher wind velocities and stronger precipitation over seas, coasts and the mainland.

In Germany the average air temperature increased from 1901 to 2008 by nearly 1 °C. The period between 1990 and 1999 was the warmest decade of the entire 20th century. Changes in rainfall are also seen. According to regional climate models an increase in the annual average temperature of 1.5 to 3.5 °C is expected by the end of this century compared to the period from 1961 to 1990. Alongside this, a blanket de-

crease in summer precipitation can be expected in the order of 20–40 %. Without adequate adaptation, high summer temperatures in combination with unusually low rainfall could lead to severe problems in regions which already experience increased drought conditions today.

GREENHOUSE GAS EMISSIONS DECREASING – THE FIRST ACHIEVEMENTS IN CLIMATE PROTECTION

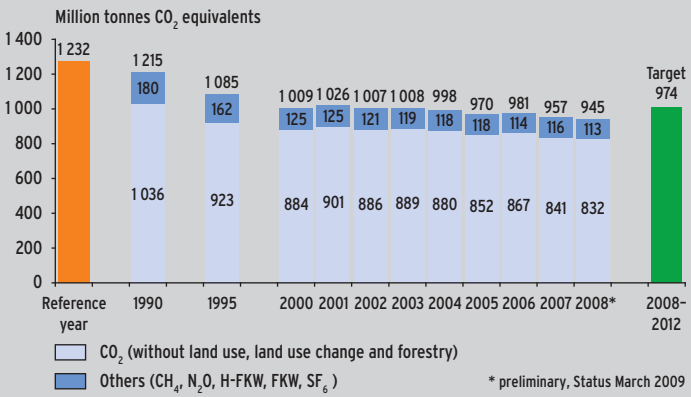
Within the burden sharing of the European Union, and in the framework of the Kyoto protocol, Germany committed itself to reducing greenhouse gas emissions by an average of 21 % for the years 2008 to 2012 compared to 1990. In 2008 a reduction of over 23 % was estimated to have been achieved. Thus Germany has already fulfilled its obligations by the first year of the target period.

The proportions of the six individual greenhouse gas source categories in Germany are consistent: at 80 %, the biggest source of greenhouse gas emissions is the consumption of fossil energy in power stations and the transport sector, followed by industrial processes which account for over 12 %, agriculture with scarcely 5 %, and waste management industries at only 1.2 %. The waste management industry has achieved the most significant reduction in greenhouse gas emissions at –71.5 % in 2007 compared to the current reference year – mainly due to decreased methane emissions as a result of increased waste recovery, and more efficient methane gas capture.

In 2008, carbon dioxide (CO_2) accounted for approximately 88 % of greenhouse gas emissions in Germany. The decrease of CO_2 emissions which has been observed since 1990 is due to economic restructuring in the eastern Federal States with

decreased lignite consumption and to the climate protection policies of the Federal Government. As before, the largest portion of CO_2 emissions comes from the energy industry with 45.8 %, followed by households/small business (15.2 %), road traffic/transport (18.1 %) and business/industrial processes 20.5 %.

Emissions of six greenhouse gases in Germany referenced in the Kyoto Protocol



Source: Federal Environment Agency

HOW MUCH ENERGY DOES GERMANY USE AND HOW EFFICIENTLY IS IT USED?

Despite economic growth, primary energy consumption in Germany has followed a moderately declining trend since the beginning of the 1990s. In 2007 it was approximately 6.1 % lower than in 1990. In 2007, 13,993 petajoule (PJ) of primary energy were used. 33.6 % came from petroleum products, 22.3 % from natural gas, 14.2 % from hard coal and 11.5 % from lignite. Nuclear energy use declined to 11 % of primary energy consumption.

Energy consumption and economic growth are decoupled to a degree, a phenomenon which is unusual in the rest of the world. A measure for the efficient use of energy is 'energy intensity' which indicates how many units of primary energy are necessary in order to create a monetary unit of GDP (Gross Domestic Product). While in 1990 8.7 megajoules (MJ) were necessary for the production of one Euro of GDP, in 2007 only 6.2 MJ were needed. However, primary energy consumption has for many years been decreasing to some extent, while GDP has increased by about 30 % over the same period. Contributing factors in lowering 'energy intensity' were, above all, improvements in power stations and the implementation of energy saving measures across all economic sectors and private households. Energy productivity is the reciprocal value of 'energy intensity'

and increased by 40.7 % from 1990 to 2008. In accordance with national sustainability strategies, 'energy productivity' is supposed to be doubled by 2020 – a goal which can only be reached if further measures for more efficient and intelligent use of energy are developed and implemented.

GERMANY FACES NEW CLIMATE POLICY CHALLENGES

Although Germany has already fulfilled its obligations in the first year of the target period, the Kyoto goal can only be seen as an intermediate step if the world-wide temperature increase is to be limited to a maximum of 2 degrees. In order to fight climate change effectively, further emission reductions are urgently required. Going beyond the European Union goals, the Federal Government has established a goal for lowering greenhouse gas emissions in Germany by 40 % by 2020, compared to 1990 levels.

In the Meseberger resolutions of 2007, the Federal Government firmly laid out how the goal of a 40 % reduction in greenhouse gas emissions by 2020 (compared to 1990 levels) is to be accomplished. For this purpose, the Federal Ministries for the environment, economics and transport have created the Integrated Energy and Climate Programme (IEKP), which consists of 29 measures. They are designed to promote more efficient consumption and supply of energy, as well as further development of renewable energy sources.

A further reason for the re-orientation of climate policy is that Germany must initiate the development of a permanently secure supply of energy, since nearly 70 % of the fossil energy resource used in Germany is imported. The significant dependence on imported energy resources represents a serious risk, especially in view of rising energy prices.

POWER STATION MODERNIZATION

Fossil fuel power stations produce the majority of Germany's energy today. Even given the ambitious expansion of renewable energy and further efficiency gains, this will likely remain so for a while. With many power stations reaching the end of their service life, the energy system needs to be modernized with a new energy mix. To reduce greenhouse gas emissions and replace the capacity of nuclear power stations being phased out, modernization must consist of new power stations with higher efficiency, energy savings and the increased addition of renewable energy. For the most advantageous and efficient use of fossil fuel, additional combined heat and power stations will be necessary.

A central policy instrument for influencing the investment decisions of energy companies is emissions trading. It sends a clear price signal, promoting the replacement of aging power stations with higher emission levels by new and more efficient power stations. Since emission rights are becoming scarce, a strong incentive is created to increase the efficiency of the entire power generation system. Emissions Trading System was introduced in 2005, and sets a ceiling for CO_2 emissions from power generation and industry. From 2013 on, CO_2 emission rights from the power sector will be fully auctioned off.

From 2013, the emission cap will decline annually by 1.74 %. By 2020 this leads to a CO_2 emission reduction of 21 % compared to 2005 levels.

DOUBLING COMBINED HEAT AND POWER CAPACITY (CHP)

In order to use energy more efficiently, it makes sense to capture and use the waste heat generated by the process of power generation (combined heat and power, CHP). At present, cogeneration accounts for approximately 15 % of total power generated – by 2020 this will be increased to 25 %. Legislation has been amended to create economic incentives for modernization and for building new CHP plants. Additionally, the more efficient development of district heating and short-distance heat transport is promoted.

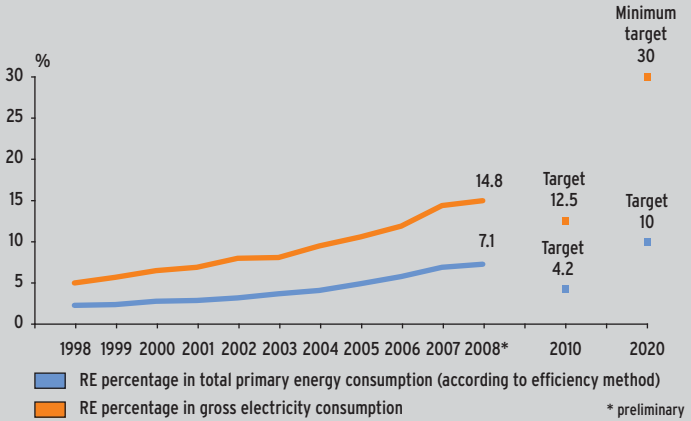
RENEWABLE ENERGY TO REPLACE FOSSIL FUEL ENERGY AND GENERATE MORE POWER

The share of renewable energy (hydropower, wind energy, geothermal, biomass and solar energy) in primary energy consumption (PEC) – increased to 7.1 % from 1990 to 2008. The Federal Government's sustainability strategy aspires to reach a PEC share of 4.2 % by 2010. This goal has, however, already been achieved. By 2020, at least 10 % of PEC is to be derived from renewable energy. The Council of the European Union decided in 2007 to raise the portion of all renewable energy in EU energy consumption to 20 % by 2020. According to the draft European Union Guideline for the Promotion of the Use of Energy from Renewable Sources, the percentage of renewable energy in consumer energy consumption in Germany is to amount to 18 % by 2020. Electrical power will account for the largest portion.

Since the Stromeinspeisungsgesetz[1)] of 1990 and the Erneuerbare-Energien-Gesetz (Renewable Energy Act, EEG)

[1)] German law governing the handling of power generated from renewable energy sources by utilities

Share of renewable energy (RE) in primary energy consumption and gross electricity consumption



Sources: Federal Ministry for the Environment, Nature Conservation and Nuclear Safety

of 2000, each year, larger amounts of Germany's electric power requirements have been provided by renewable energy. By 2008 this portion amounted to about 15 %. Since the EEG was enacted in 2000, the total installed capacity of electric power generation from renewable energy has almost tripled.

Over the past few years, wind energy has contributed significantly to the growth of power generation from renewable energy. Depending on location and rotor height, a modern wind turbine with a generator capacity of 2 megawatts (MW) can produce about 4 to 5 million kilowatt-hours (kWh) of electricity per year. That corresponds to the average annual consumption of 1,400 households without the emissions generated from conventional energy sources. With each kilowatt-hour of electricity from wind-power, 860 g of carbon dioxide emission is avoided compared to the same amount of energy generated by burning coal.

In 2008, the German Bundestag (Parliament) enacted an amendment to the EEG, deciding that the share of renewable energy in electricity generation is to be increased to at least 30 % by the year 2020 and to 50 % by 2050. The EEG promotes extending the development of the following renewable sources of energy: hydropower, wind power, solar, geothermal and biomass for generating electricity, and offers incentives for investment particularly in the development of wind power and biomass. It emphasizes the effective use of waste and residual substances, as well as the more efficient use of biomass in combined heat and power stations. Special provisions in the legislation governing the natural gas grid support feeding biogas into the grid. The EEG promotes innovation and produces added value: 278,000 new jobs have been created in Germany as a result.

CONSUMING ELECTRICITY MORE EFFICIENTLY

Although electricity consumption constitutes 'only' a fifth of consumer energy consumption, it causes nearly half of the energy-related greenhouse gas emissions, because the generation of electricity requires about three times the amount of primary energy resource. Therefore, reducing electricity consumption is of special importance for reaching the German climate protection objectives.

But for now, electricity consumption is still rising in all sectors. This trend must be reversed. All studies prove that there is a huge potential for decreasing electricity consumption in industry, refrigeration and air conditioning systems, household appliances, information and communications technology and electric water heating. UBA calculated that by 2015, 110 billion kWh of electricity per year could be saved overall by making full use of all presently known methods of energy saving. This figure corresponds to 20 % of today's total electric power generation. The climate would be spared a lot of pollution, and the electricity bill cut by around 10 billion euros. In the context of the Integrated Energy and Climate Program, important measures such as changing the Energiewirtschaftsgesetz (EnWG – Energy Management Act) and the creation of a resolu-

tion for metering standards were implemented which should contribute to an 11 % reduction in electricity consumption by 2020 compared to 2005 levels. Within the EU, and as part of the implementation of the Eco Design Directive, Germany promotes the creation of ambitious efficiency standards for electric appliances based on the top-runner approach.

REDUCING FOSSIL FUEL HEATING DEMAND

Renewable energy and combined heat and power play an increasingly important role in heat generation. At the same time heat demand can be generally lowered by efficiency measures. The heating market makes up more than half of Germany's energy requirement. Currently for heat generation, natural gas and oil are primarily used. Utilizing combined heat and power increases energy efficiency from 40 % up to 90 %. At present, renewable energy accounts for approx. 7 % of heat generation, mostly from biomass and solar energy. This portion is to be increased to 14 % by 2020.

There is also much to be done on the demand side as 50 % of generated heat is used for space heating purposes and 35 % for process heating in industry. The Erneuerbare-Energien-Wärme-Gesetz 2009 (Renewable Energy Heating Act 2009) creates mandatory guidelines for the use of renewable

energy in new buildings. Important measures include doubling the rate at which existing buildings are brought up to current energy efficiency standards, the installation of more efficient heating systems, and increasing energy efficiency requirements for new buildings. Under the Energieeinsparverordnung (Energy Conservation Ordinance), which specifies energy efficiency standards for buildings, the energy consumption levels of new buildings are to be lowered by 30 % beginning in 2009, and by the same amount again in a second stage beginning in 2013. As part of the economic stimulus package, the Federal Government is contributing additional funds in excess of 3 billion euros for CO_2-related building modernization measures for the years 2009 to 2011.

MITIGATING TRAFFIC-RELATED EMISSIONS

The transport sector alone is responsible for 20 % of the greenhouse gas emissions in Germany and must therefore contribute significantly to carbon reduction. Due to several technical innovations and the promotion of biofuels, emissions in the transport sector have been dropping since 1999. Still, this area features the most inefficient use of energy, full stop. Only about 30 % of the energy used is converted into engine performance. Additionally, private vehicle and commercial traffic on German roads are still the dominant form of travel, while air traffic still increases steadily. Essentially, emission reduction can only succeed by offering incentives for the use of climate friendly modes of transport and with further technological changes, such as more economical engines, smaller engines and lightweight structures. Planned instruments and measures include: CO_2 emission limits for cars, CO_2 emission-based vehicle taxes, increased use of biofuels and the inclusion of air traffic in emission trade schemes.

RESOURCE MANAGEMENT

USING RESOURCES MORE EFFICIENTLY – PROTECTING THE ENVIRONMENT

Natural resources are raw materials such as minerals, biomass and fossil fuels, environmental media such as water, air and soil, physical space (land) and flow resources such as wind and solar power. They form an important basis for our economic system and our prosperity. They serve as habitat, production sites for goods and absorb emissions. Sustainable resource management includes quantitative approaches for the efficient use of materials, and qualitative approaches for the reduction of associated environmental impacts – like land use, contribution to the climate change by energy use, mass transfer and the release of pollutants.

REDUCING RESOURCE EXTRACTION AND IMPORT

The sustainable use of resources primarily means using them more efficiently. But efficiency is not everything – as production and consumption levels continue to rise, gains in efficiency are quickly negated by the absolute increase of resource consumption. The goal must be not only to decrease resource consumption per unit of production, but to lower it in absolute terms. It is part of this strategy to increase product lifetime and create products that can be easily repaired and recycled. Non-renewable resources must gradually be replaced by sustainably gained renewable resources.

In 2006, the material input for the German economy was 3,824 million tonnes. That corresponds to 46.4 tonnes of material per capita. This includes domestic extraction of biotic and abiotic materials and imported raw materials, semi-finished and finished products. About 45 % of materials were used commercially. The remaining materials are often environmentally significant, but not of commercial value, such as

overburden from the mining industry. In 1994 the material input was 4,139 million tonnes, or 50.7 tonnes per capita, of which 44 % was used commercially.

The share of imported materials used in the German economy is increasing. Of prime significance are increased imports of semi-finished and finished metallic products, as well as the replacement of domestic coal by imported energy sources. Thus, the domestic environment is less burdened, while the environmental impact connected with the extraction of raw materials and their processing into semi-finished and finished products is shifted abroad.

USING RESOURCES MORE EFFICIENTLY

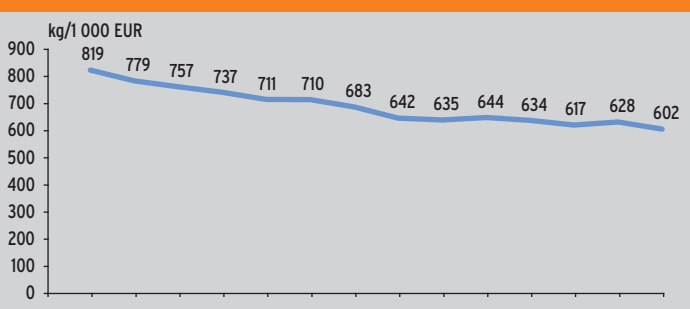
Resource consumption levels are determined by a variety of factors – such as economic growth, the change in economic structure to the less material-intensive service sector, and the resource intensity of individual industries. The fewer resources are used, the less the environment is impacted. If good economic results are thus obtained, the resources were used efficiently.

By the year 2020, the Federal Government aims to double raw material productivity compared to 1994. That means cut-

ting raw material intensity in half – the ratio between commercially used abiotic materials and gross domestic product (GDP) over the same period of time. Between 1994 and 2007 raw material intensity was lowered by around 26.2 %. With declining materials use (– 9.7 %), gross domestic product rose by 22.3 %.

In 1994 about 819 kg of materials were used to produce one thousand euros worth of goods, in the coming years this figure is to be halved to 409 kg per one thousand euros by 2020. In 2007 the raw material intensity of the German economy was 602 kg per one thousand euros. In general the indicator is developing in the desired direction, mainly due to structural economic changes towards less resource-intensive industries: The less materials-intensive service sector grew while industries which consume higher levels of materials, such as the construction industry, shrank by comparison. At the same time the import of semi-finished and finished products rose. The raw material input necessary for the produc-

Raw material intensity



Source: Federal Statistical Office

tion of these products came from abroad and therefore was not included in the calculation of Germany's raw material intensity. Shifting raw material-intensive processes abroad thus increases resource efficiency of the German economy, but does not reflect the total material input.

However, the decrease in raw material intensity clearly slowed over the last few years. In the last six years, the average annual reduction amounted to only 6.2 kg per one thousand euros. In order to achieve the objective, raw material intensity would have to decline by an average of 15 kg per one thousand euros annually. German industries must therefore undertake further efforts toward the reduction of their raw material intensity. The Federal Ministry of the Environment supports them with the 'Umweltinnovationsprogramm' (a programme which promotes investments that demonstrably reduce environmental damage). The Netzwerk Ressourceneffizienz (Resource Efficiency Network) created by the Federal Ministry for the Environment aims to facilitate the exchange of information between politics, industry and research organizations, as well as consumers and also serves as an ideas platform for small and medium-sized enterprises. The Federal Ministry of Economics and Technology initiated the formation of the Deutsche Materialeffizienzagentur (German Materials Efficiency Agency – demea). This Agency advises companies in realizing their efficiency potential.

LAND AREA IN GERMANY – A LIMITED RESOURCE

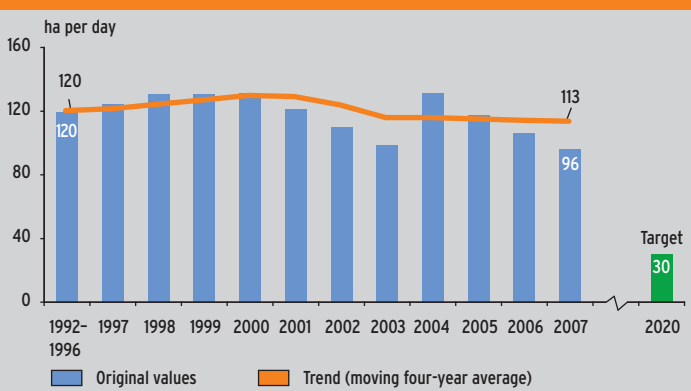
In Germany, an increasing proportion of land is being cultivated, fragmented and affected by urban sprawl. Environmentally, this results in the loss of natural soil functions by sealing, loss of access to nature, and decreased biodiversity, for example by fragmentation. In 2007, the land area used

for settlement and transport purposes amounted to 46,789 square kilometres (km^2) compared to 40,305 km^2 in 1992. The sector affected most by this increase was primarily agricultural land. 46 % of Germany's settlement and transport area is sealed. This adds up to approximately 2.14 million hectare (ha) or 6.0 % of Germany's total area.

Compared with the end of the last century, the daily land consumption of 129 ha (from 1997 to 2000) has decreased to 113 ha (from 2004 to 2007). By 2020, the rate of land consumption is to be further reduced to 30 ha per day. Germany is far from reaching this goal of the national sustainability strategy, despite encouraging trends in the areas occupied by buildings and open areas.

The Rat für Nachhaltige Entwicklung (Council for Sustainable Development – RNE) additionally demands a total cutback of

Increase in settlement and transport area



Sources: Federal Statistical Office, Federal Office for Building and Regional Planning

new land consumption to zero by 2050 – by better utilization of building gaps and the redevelopment and reuse of previously used land (brownfield).

The decrease in daily land consumption over the last few years is however, essentially the result of general economic conditions, i. e. the recent economic decline. Future developments are hard to gauge in the context of the current economic crisis. During times of economic uncertainty it is advisable to first improve and adjust existing buildings and infrastructure in the inner city areas and villages in order to cope with the challenges of energy saving, adaptation to climate change and the loss of population by demographic development. The time spent waiting until the economy has recovered would be better spent advancing the planning, legal and economic instruments and their practical implementation. A promising approach is the use of brownfield land.

The country-wide increase in land consumption for settlements and transport was about 74 ha per day in the old Federal States and about 39 ha per day in the new Federal States for the period from 2004 to 2007.

On a per capita basis, the increases in land consumption for settlements and transport are lower in the old Federal States

than in the new Federal States. This is due to the fact that development increased in these states while population levels stagnated, or even decreased. However, the strongest development growth in absolute terms takes place in the southern German regions of economic prosperity, around Munich and Stuttgart.

In the old Federal States the growth of land consumption for settlements and transport decreased by 17 % for the period 2004 to 2007 relative to the period 1997 to 2000. This also reflects a slowdown in economic and population growth, as well as the fact that, apart from private residential buildings, wholesale demand for dwellings is for the most part covered in most regions, with the exception of the economic growth centres.

Although the increase in areas developed for transport is lower than that for settlements, the growth rate has remained constant at approximately 23 ha per day since 1993. This carries with it some unwanted environmental impacts such as fragmentation of open space and noise pollution.

WASTE MANAGEMENT

FROM WASTE DISPOSAL TO MATERIAL MANAGEMENT

An effective policy of natural resource conservation and environmental protection always seeks to create closed material management cycles – from the extraction of raw materials, to production, use and consumption, collection, and ending in high grade recovery.

Modern methods of waste management are therefore an integral component of sustainable material management which has the objective of comprehensively reducing harmful environmental impacts through efficient resource

management and the reduction in waste quantity. The priority has to be to achieve the highest possible degree of utilization of all resources extracted from nature in order to conserve those resources and avoid creating waste. The principle must be: avoidance before reuse before recycling before other recovery before disposal.

It is the goal of the Federal Government's environmental policy to virtually avoid disposal of waste to landfill by 2020. By consistently separating waste, pre-treating it, recycling it, or otherwise utilizing its inherent energy content, the energy and materials contained in waste are to be utilized as completely as possible.

This environmental and efficiency strategy also represents a huge opportunity for the German economy. On the one hand, companies can realize significant resource and energy savings. On the other hand, the strategy creates incentives for process and product innovation. In regards to materials management this means developing products and materials with the longest possible life spans. It also requires the introduction of production methods which create the least possible amount of waste. Thus, Germany has the opportunity to strategically position itself as a market leader in the industries of the future.

At the same time, this creates substantial gains in climate protection: A study of the Öko-Institut (Institute for Applied Ecology) on behalf of UBA in 2005 determined the achievements of waste management in terms of greenhouse gas emissions reduction at 46 million tonnes of CO_2 equivalents over the period of 1990 to 2005.

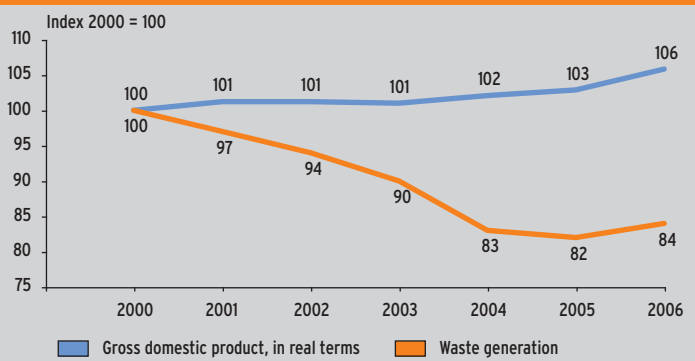
A GOOD START FOR THE CLOSED SUBSTANCE CYCLE ECONOMY

The waste statistics for the last reporting period of 2006 are not directly comparable to earlier years due to methodological changes in creating the waste balance sheet. However, the net waste figures (excluding waste from waste treatment plants) starting from 2006 are indeed comparable with past years.

The result is clear: in 2006 the net waste quantity in Germany amounted to approximately 340 million tonnes and therefore decreased by 16 % compared with 2000. The overall decrease is due mainly to decreases in construction and demolition waste. In the same period the German gross domestic product rose by 6 % thus resulting in decoupling waste generation from economic performance.

However the consumption of short-lived products by private households in Germany clearly needs to be lowered. Per capita municipal waste generation was still 560 kg in 2006.

Decoupling waste generation from economic performance

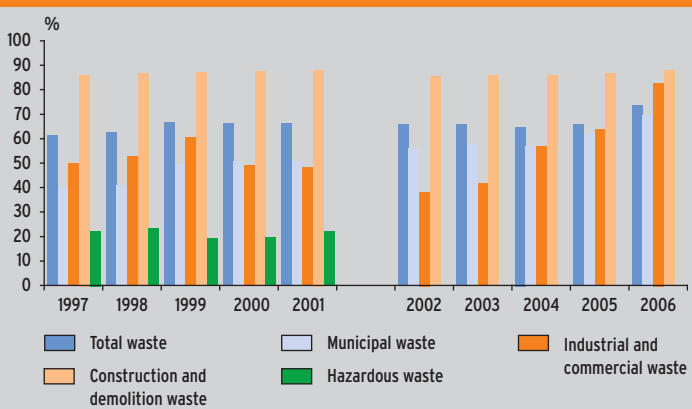


Source: Federal Statistical Office

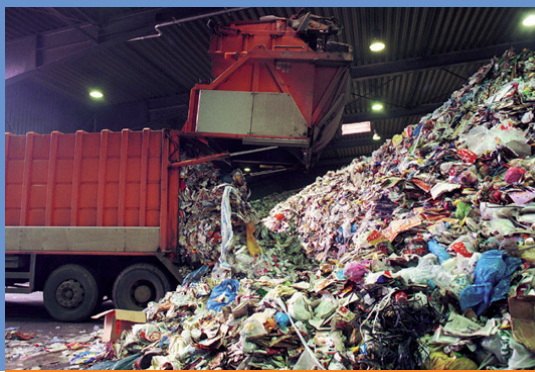
WASTE BECOMES A SOURCE OF RAW MATERIALS

In 2006, about 74 % of total waste generated was recovered – this amounted to 253 million tonnes. Therefore, waste recovery has clearly outpaced waste disposal. In particular, significant recovery rates were achieved in construction and demolition (174 million tonnes or 88 %) which constitute about half of the entire waste generated in Germany. Manufacturing also features high recovery rates (47 million tonnes or 83 %). 70 % of municipal waste was recovered in 2006, household waste even achieved a rate of 29 million tonnes or 72 %. This high rate was mostly achieved by separation of waste at source.

Recovery rates of main waste types



Sources: Federal Statistical Office; Federal Environment Agency



WASTE DISPOSAL RATES DECREASING

Altogether the disposal of waste – not including stockpiling of overburden from the mining industry – decreased between 1997 and 2006 from approximately 23 % to approximately 10 % of total waste.

Since June 1st 2005 the disposal of non-pre-treated municipal waste is forbidden which has led to a radical decrease in the amount of municipal waste disposed. As a result, the disposal rate of municipal waste between 1997 and 2006 decreased from 39 % to as low as 0.7 %. By 2020 the disposal of recyclable municipal waste is supposed to stop – waste should either be avoided altogether, or recovered.

ENVIRONMENT, HEALTH AND QUALITY OF LIFE

The 'environment' is everything that surrounds people in their lifetime – at home, while shopping, at work or in their spare time. The health and well-being of people depends to a large extent on the quality of their environment. Protecting the population against health risks from air pollutants, noise, and other harmful influences is therefore a component of environmental and public health policy as well as an element of shaping society's future: environmental protection is also sustainable health protection!

NOISE – AN UNDERESTIMATED RISK

For people in Germany noise is one of the most strongly felt environmental pollutants. This is one of the findings of a population survey entitled 'Environmental awareness in Germany 2008', in which about 2,000 adults participated. 59 % of those questioned indicated that they feel disturbed or annoyed by road traffic in their residential environment, 12 % felt even 'extremely' or 'strongly' annoyed. Road traffic is the most significant traffic-related source of noise pollution in Germany, followed by air traffic and then by rail traffic.

As well as traffic noise, industry and commercial noise and neighbourhood noise affect the quality of life.

Amongst the total population, people with lower education, blue collar jobs and low income are most strongly affected by traffic noise. According to the analysis of the Federal Health Survey by the Robert Koch Institute (RKI), 28.3 % of those questioned from the lowest income bracket feel moderately to strongly annoyed, compared to only 18.4 % of those from the highest income bracket. According to parents addressed in the UBA study 'Kinder Umwelt Survey' (German Environmental Survey for Children – GerES IV) 11 % of children with low social status felt annoyed by road traffic noise, compared to only 3 % of children with higher social status.

In order to reduce the noise burden on the population, permanent noise levels of less than 65 decibels (dB(A)) during the day and 55 dB(A) during the night outside dwellings should be achieved as a quality goal in preventive health protection.

Elevated sound levels and chronic noise stress are not only annoying, but also pose health risks such as cardiovascular complications and high blood pressure. Young people in particular frequently suffer from irreversible hearing damage from listening to portable audio devices (MP3-Players). Since the devices are mostly used outside where ambient noise is not kept out by the small earphones, volume levels can quickly rise beyond the bearable – reaching the damage

threshold of the ear. Lifelong irreversible hearing damage can be the result.

CLEAN OUTSIDE AIR – A PREREQUISITE FOR HUMAN HEALTH

Conurbations and cities are amongst the regions in Germany most significantly affected by air pollution. Cities are sites for industry and trade, traffic junctions and living space for most people. Adherence to air quality level limits becomes a serious challenge because of the vicinity to pollution sources.

While sulphur dioxide from power stations and industrial facilities nowadays hardly represent a threat, air pollution from traffic like particulate matter (PM_{10}) and nitrogen dioxide (NO_2) have become a matter of concern for the public because of their high concentrations in densely populated areas and the resulting health risks.

Especially high particulate matter levels are registered at monitoring stations near busy streets, where traffic-related emissions like (diesel-)soot, particles from tire abrasion as well as blown dust occur. Since January 1st 2005 stricter PM_{10} limits apply. The number of days on which the 24-hour limit

levels for particulate matter may exceed 50 microgram per cubic metre ($\mu g/m^3$) must not exceed 35 per year. But in metropolitan areas this limit is still clearly exceeded. 23 % of the urban monitoring stations near busy streets registered more than 35 days of exceeding the limiting values in 2007.

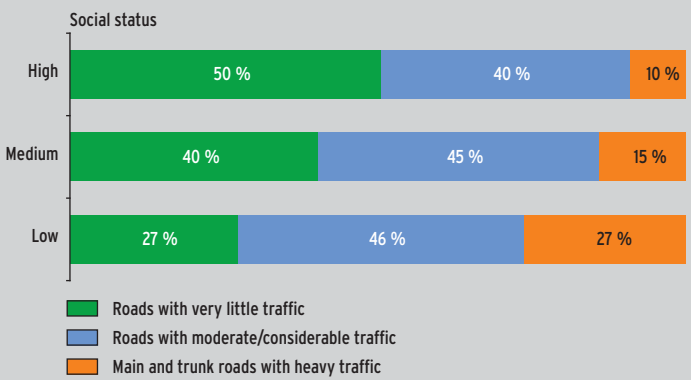
The annual NO_2 limit for the protection of the human health of 40 $\mu g/m^3$ which comes into effect in 2010, cannot be met at present at many of the urban air quality monitoring stations in Germany. More than half of the urban air quality monitoring stations near traffic routes register excessive levels. If this pollution burden were to remain constant for the coming years, it might result in exceeding the mandatory annual average NO_2 level limits which will be introduced from 2010. NO_2 is formed in combustion processes in industry, households or in traffic. The substance is harmful to the respiratory system.

In contrast to the limits for particulate matter and nitrogen dioxide, the 5 $\mu g/m^3$ limit (annual average) specified for benzene, which becomes mandatory from January 1st of 2010, is already being met in metropolitan areas and cities today.

The UBA study 'Kinder-Umwelt-Survey' (German Environmental Survey for Children – GerES IV) also shows that social status is a crucial factor for those affected by air pollution. People of low social status are more heavily exposed to traffic and traffic-related air pollutants than people of a higher social status. 3 to 14 year old children from families of low social status (27 %) more frequently live next to heavy-traffic main roads or streets than children from families of medium (15 %) and high social status (10 %).

Moreover, analysis of the Bundesgesundheitssurvey (Federal Health Survey) shows that the lower education, income and job levels are, the more likely people's residences are on main and trunk roads with heavy traffic. Thus, 30.6 % of those questioned from the lowest income bracket live on heavily trafficked streets compared to 14.7 % of those in the highest income bracket.

Housing situation of 3–14-year olds according to social status

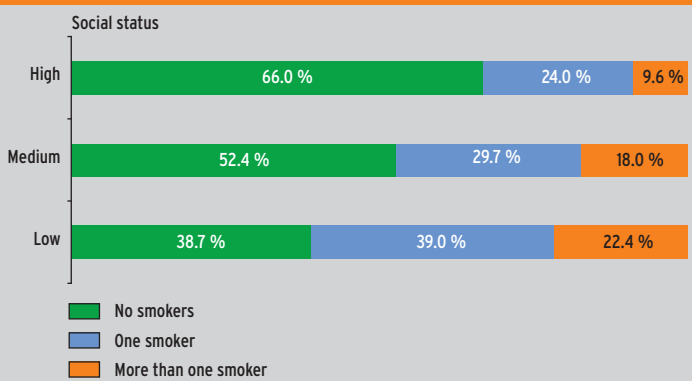


Source: Federal Environment Agency

TOBACCO SMOKE – AN INDOOR AIR POLLUTANT

While completely avoidable, tobacco smoke is the most significant and dangerous indoor air pollutant. Children who are forced to inhale tobacco smoke absorb a multitude of carcinogens and mutagens. Second-hand smoke exposure in Germany is higher for people of low social status than for people of high social status. Children from families of low social status are more frequently exposed to tobacco smoke. 39 % of these children live with one smoker, and 22 % with two or more smokers. Only 39 % of them live in non-smoking households. 66 % of the children from families of higher social status live in non-smoking families, and only every tenth child lives with more than one smoker.

No. of smokers in homes of 3 to 14-year-old non-smoking children according to social status



Source: Federal Environment Agency

WHAT DOES CLIMATE CHANGE HAVE TO DO WITH HUMAN HEALTH?

Climate change affects human health adversely, for instance, continuing periods of hot weather can cause cardiovascular disease.

OZONE

High air temperature in combination with intense sunlight promotes ground-level atmospheric ozone formation. Ozone causes mucous membrane irritation, respiratory problems, and impairs overall physical performance. Global warming activates the sources of substances which combine to form ozone, such as hydrocarbons from vegetation, which together with nitrogen oxide emissions, increase the potential for ozone production.

Despite the significant reductions of nitrogen oxide emissions (approx. 50 %), and volatile organic compounds (approx. 60 %) in Germany since 1990, the emissions of human-related ozone precursor substances must be reduced considerably to achieve and stay below the target ozone value and the long-term objective for the protection of human health. Potentials

for reduction exist in the transport sector, solvent use in industry, in trade and in private households.

ALLERGIES

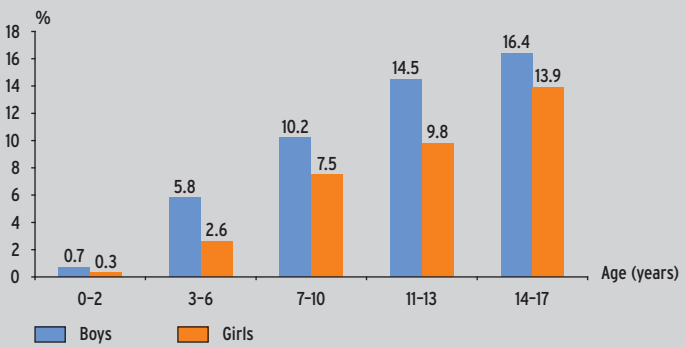
The extent of environmental impact on allergy occurrence levels cannot be predicted in detail. However, it is certain that climate change promotes environmental factors that cause allergies and increases the frequency of allergic diseases. Allergies are unwanted and sometimes violent defence reactions of the immune system against substances in the environment (allergens) which lead to respiratory and skin diseases. Climate change causes the 'pollen season' of some plants to begin earlier and sometimes last longer, making pollen allergy (hay fever) affected people suffer longer than usual.

In addition, climate change causes the proliferation of allergenic neophytes – plants which do not usually occur in Germany. Such plants can lead to an increased occurrence of new allergies and, because of their special flowering seasons, may contribute to extended allergy seasons for hay fever sufferers. Additionally, rising CO_2 concentrations in the air can increase

pollen production. Overall, the pollen season has been extended by ten to twelve days over the last 30 years.

According to data from the Robert Koch Institute (RKI) 10 to 11 % of the child population and around 20 % of the adult population in Germany are affected with hay fever. Boys are more frequently affected than girls in all age groups.

Allergic diseases – 'prevailing' hay fever according to age and gender



Source: Schlaud, M., Atzpodien, K., Thierfelder, W.

REDUCING AIR POLLUTANTS – A CHALLENGE FOR GERMANY

Emissions come from traffic, agriculture, power generation, industrial processes, and many other activities. They contaminate the air with pollutants and thus lower its quality. Germany has achieved the most success in reducing emissions of individual air pollutants during the first half of the 1990s. The best results in emission reduction were obtained with sulphur dioxide (SO_2), the least success with nitrogen compounds (NH_3 and NO_x) which continue to seriously contaminate the environment and its ecosystems.

SO_2 emissions decreased by 90.7 % from 1990 to 2007. The principal reasons for this are the economic and industrial restructuring in the new Federal States, the implementation of the Großfeuerungsanlagenverordnung (Ordinance on Large Combustion Plants and Gas Turbine Plants) with their technical requirements for emission control, decommissioning, big reduction in power requirements, and the use of fuels with a lower sulphur content. Germany thereby meets the international obligations in accordance with the Geneva Convention on Long-Range Transboundary Air Pollution and the Gothenburg Protocol (Protocol to Abate Acidification, Eutrophication and Ground-level Ozone). According to the Directive on National Emission Ceilings (NEC Directive) Germany has to adhere to emissions restrictions that set maximum SO_2 emissions at 520 thousand tonnes, starting in 2010. This goal had already been met by 2006, and the emissions for 2007 fell well below the maximum quantity allowable by 26 thousand tonnes or 5 %.

From 1990 to 2007 **NO_x emissions** decreased by approximately 55 % – most significantly in the transport sector (minus 58 %). Despite this decrease, the transport sector is still the main source of NO_x with 49 % of emissions predominantly originating from large goods vehicles (LGV). In accordance with the Gothenburg Protocol, Germany committed itself to lowering emissions further. In 2010 NO_x emissions must not exceed 1,081 thousand tonnes. At the European Union level the NEC Directive specifies still stricter regulations of national emissions. After 2010, Germany must keep maximum NO_x emission levels under 1,051 thousand tonnes, which corresponds to a reduction of 243 thousand tonnes or 19 % compared to 2007. The implementation of the 2007 'Nationales Programm zur Verminderung der Ozonkonzentration und zur Einhaltung der Emissionshöchstmengen' (National Programme for Ozone Concentration Reduction and for the Adherence to Maximum Emission Quantities), seeks to achieve adherence to the national emission ceilings of the four air pollutants SO_2, NO_x, ammonia (NH_3) and non-methane volatile organic compounds (NMVOC). The programme also prescribes appropriate measures for the road traffic sector.

Ammonia (NH_3) is released predominantly from livestock, and, on a smaller scale, in the production and use of fertilizers. Emissions decreased between 1990 and 2007 by 13 % – as a consequence of the reduction of the animal population to

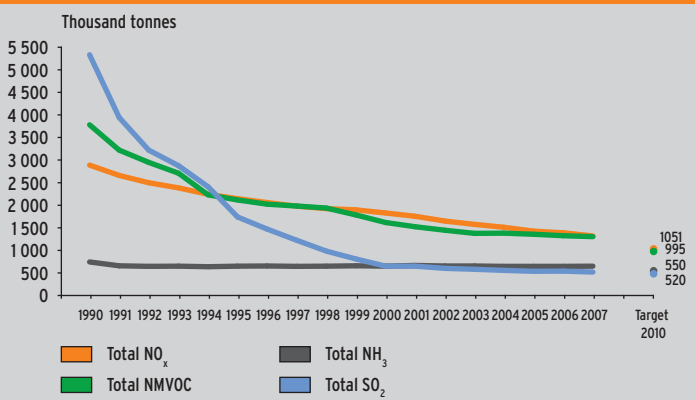
a large extent in the new Federal States immediately after reunification. Since the mid-1990s, ammonia emissions from agriculture dominate the cumulative emissions of the acidifiers SO_2, NO_x and NH_3, calculated as acid equivalents: when calculating the acidification potential of these three pollutants, a rising significance of NH_3 (and therefore agriculture) emerges because of the considerable emission reductions of SO_2 and NO_x. Acidic emissions from agriculture rose from 16 % in 1990 to nearly 46 % in 2007, even though emissions declined in absolute terms.

In the Gothenburg Protocol, Germany committed to reduce its NH_3 emissions further. No more than 550 thousand tonnes of NH_3 may be released by 2010. At the European Union level, this is also the ceiling agreed for nationwide emission by the 'Directive on National Emission Ceilings'. Through the 'Ozon- und Emissionshöchstmengenverordnung' (33rd Ordinance to the Federal Emission Control Act, Ordinance on the reduction of summer smog, acidification, and input of nutrients), Germany has converted this guideline into national law. To reach this goal, the emission levels of 2007 must be reduced by another 74 thousand tonnes or 12 %. Germany tries to accomplish this by promoting organic farming, the advancement of good agricultural practice

(amended Fertilizer Ordinance of 2007), low-emission techniques, and by further supporting environmentally beneficial agricultural techniques.

NMVOC, non-methane volatile organic compounds, are precursors of secondary air pollutants and, together with nitrogen oxides, form ground-level ozone, for example the so-called summer smog. In 1990, more than half of all NMVOC emissions came from incomplete combustions processes, three quarters of these from motor vehicles. Today the dominant source is the use of solvents and solvent containing products. From 1990 to 2007 NMVOC emissions decreased by approximately two thirds because of the introduction and advancement of catalytic converters in passenger cars and the reduction in the number of two-stroke engine vehicles in the new Federal States.

Emissions of selected air pollutants



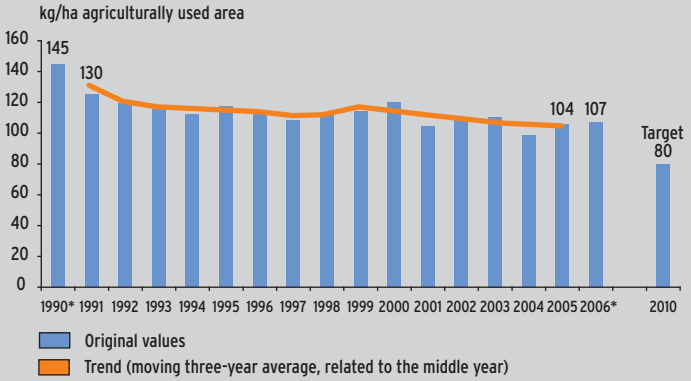
Source: Federal Environment Agency

In accordance with the Gothenburg Protocol and the 'Directive on National Emission Ceilings' Germany committed to reducing NMVOC emissions to 995 thousand tonnes by 2010, which means that the 2007 emission levels must still be reduced by a further 285 thousand tonnes, or 22 %. In the 2007 'Nationales Programm zur Verminderung der Ozonkonzentration und zur Einhaltung der Emissionshöchstmengen' (National Programme for Ozone Concentration Reduction and for the Adherence to Maximum Emission Levels) appropriate reduction measures are prescribed for SO_2, NO_x, NH_3 and NMVOC for the solvent sector and road transport.

NITROGEN SURPLUS – AN EXTENSIVE ENVIRONMENTAL PROBLEM

Nitrogen compounds are important plant nutrients. But the release of excess nitrogen in the soil, water and in the atmosphere has far-reaching effects on the ecosystems acidification, eutrophication, nitrate pollution of groundwater, contamination of surface water bodies and oceans, damage to biodiversity and aggravation of climate change. From 1991 to 2005 the nitrogen surplus decreased on a three-year average from 130 kg/ha to 104 kg/ha. That represents an annual decrease of 20 %. Altogether, the reduction achieved in the period from 1991 to 2005 amounts to slightly more than half of the desired reduction for 2010. In 2005 and 2006 there was even an increase in nitrogen surplus. Between 1991 and 2006, annual nitrogen input rose somewhat (a 7 kg/ha decrease in forage, but 13 kg/ha increase in fertilizers), while the removal in harvest products grew by 10 kg/ha (20 %). This is mostly due to yield increases in crop husbandry and to higher nutrient efficiency with decreasing animal populations. However, it is necessary to make a substantial effort to

Nitrogen surplus in total balance in Germany



Sources: Federal Environment Agency/Gießen University, Julius Kühn Institute Braunschweig

increase the efficiency of nitrogen uptake in order to reach the Federal Government's goal of reducing the excess to 80 kg/ha by 2010.

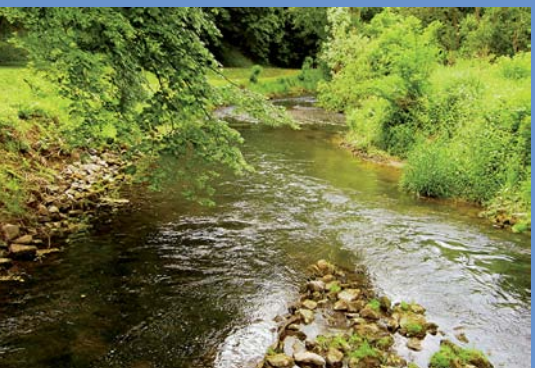
WATER BODIES – ESSENTIAL FOR MAN AND THE ENVIRONMENT

Only 21 % of German rivers and brooks – predominantly in less populated regions – are still in their natural state, i.e., moderately modified, or unmodified by man. Altogether 33,000 kilometres (km) of watercourses were surveyed and evaluated according to a seven-level classification system (from class 1 = unmodified, to class 7 = completely modified) of the LAWA (Joint Working Group of the Federal Government and the Federal States). Large rivers have mostly been modified with weirs and locks for watercraft transport and the use of hydroelectric power. Furthermore their flood plains have been separated from the river and restricted by dykes. This explains their considerable deficit in biodiversity and their predominant allocation to the classes of 'strongly' to 'completely modified'. The rivers Ems, Danube, Weser and

Oder are all classified 6 and 7 (strongly modified to completely modified) for 50 % of their length. The extensive commercial use of the Rhine and its adjoining countryside from the Lake Constance (Bodensee) to the Netherlands has resulted in a classification of 6 to 7 for 80 % of its length.

In contrast, the river Elbe is classified between grades 3 and 4 (moderately modified to significantly modified), with richer habitats from where it leaves the Mittelgebirge (Central German Uplands) to the Geesthacht weir at Hamburg. Only the Tideelbe and the more densely populated areas along the upper Elbe show a deficit in biodiversity and are therefore classified 6 and 7. This emphasizes the special significance of undisturbed natural water sections of large rivers, such as the free-flowing Danube below the Isar estuary.

Most of the smaller rivers and brooks in the low mountain ranges, the hilly areas and the lowlands have in the past also been modified for hydropower, for flood protection, roads or for agricultural use – for example farm land improvements. They are regularly maintained thus the morphodynamic processes, i.e. natural developments, are prevented. These watercourses are mostly classified as grade 4 to grade 7.



FURTHER REDUCING NUTRIENT AND POLLUTANT INPUT

High concentrations of biologically degradable compounds adversely affect the oxygen balance of the water. Nutrient excess causes algal blooms. Pollutants, like pesticides and heavy metals, are poisonous to organisms. The European Union (EU) Water Framework Directive (WFD) was enacted in 2000 and is meant to achieve good ecological and chemical conditions of waters by 2015. Based on the Marine Strategy Framework Directive 2008/56/EC, good marine water quality should be achieved by 2020.

The main sources of pollution and nutrient contamination of waters are agriculture, municipal waste water treatment plants, power stations, traffic and industrial facilities. Water contamination due to waste water discharge from towns and cities and industry has substantially decreased in recent years, predominantly as a consequence of the demolition or replacement of the chemical industry facilities in the eastern Federal States that could not be brought up to acceptable technical standards. Beyond that the amended Water Resources Act brought in measures for the municipal and industrial sectors that reduce emissions of pollutants from single point sources; these are predominantly heavy metals. Such measures include

improved waste water treatment techniques, consistent application of best practices, and waste water reduction. Improvements in the industrial sector are particularly noticeable since the beginning of the 1990s – due to the enactment of the Waste Water Ordinance and former Abwasserverwaltungsvorschriften (Waste Water Administrative Regulations) for municipal waste water and nearly 50 industrial branches. The above average reduction of pollutant and nutrient contamination in surface waters from point sources led to the fact that contamination from non-point sources, mostly agriculture, now dominates. This means that the target limits (grade II) prescribed by the LAWA for the protection of inland waters are exceeded, and will likely result in the inability to reach the WFD goal of achieving good ecological and chemical water conditions by 2015.

The most important measure for decreasing water contamination by nutrients is the adherence to the best practices prescribed by the agricultural legislation. Of particular significance in this area are the 'Düngeverordnung' (Fertilizer Ordinance) and the best practices of plant and soil protection. Nitrogen contamination levels in surface waters in Germany were at 565 kilotonnes per year (kt/a) in 2005, having decreased by 465 kt/a (45 %) from 1985 levels. Therefore, the internationally agreed goal of halving nitrogen contamination in the oceans between 1985 and 2000 was not even achieved by 2005. The observed reduction of 76 % was achieved mainly by a strong decrease of nitrogen contamination from point sources – namely municipal waste water treatment plants and direct industrial discharge. The percentage of point sources in overall contamination sank to 18 % in 2005. This is clear proof of the improved performance of waste water treatment plants. In contrast, nitrogen contamination from non-point sources reduced by only 24 %.

Phosphorus contamination of surface waters in Germany has been reduced by 71 % since 1985 and amounted to only about 23 kt/a in 2005. Thus the objective of reducing marine phosphorus contamination by 50 % was attained in all river basins. The reduction of phosphorus contamination is attributable mostly to a decrease of contamination from point sources (86 %). Contamination from non-point sources was only reduced by 29 %.

Between 1983 and 2005 a strong reduction of heavy metal contamination in surface waters could be observed in Germany. The highest heavy metal contamination exists in areas with high population density and urbanisation. However, in the Elbe and Oder river basins, heavy metal loads have actually decrease substantially since the demolition and replacement of outdated industries in the new Federal States that could not be brought up to current industrial standards.

ECOLOGICAL SYSTEMS HEAVILY OVERLOADED

Whether an ecosystem is overloaded or not can be determined on the basis of scientifically established effect thresholds, called critical loads. Below the critical loads, harmful effects on specified sensitive elements of the environment do not occur, according to present knowledge. When compared with current air pollution levels the degree to which regional measures are necessary in order to preserve stable and sustainable ecosystems can be determined. Being able to stay within limits of ecological stress thereby becomes an important principle and a goal for environmental protection measures.

While airborne nitrogen input from traffic and industry has decreased in the last few years, input of ammonia and am-

monium from livestock has remained at high levels. Compared to the progress made in decreasing acidification, the advances made in reducing eutrophication are relatively small in spite of the implementation of national and international air pollution control measures.

The critical loads for **eutrophying nitrogen** are still being exceeded in sensitive ecosystems all over Germany. In parts of northwest Germany, critical loads are being hugely exceeded in areas of intensive livestock farming on sensitive soil – here deposition of predominantly ammonium nitrogen is particularly high.

Between 1990 and 1995 the percentage of areas with excessively high levels of nitrogen input was reduced. However, after 1995 no further reduction in nitrogen concentrations has been seen. Most of the areas examined now still exhibit a significant excess.

Because of only a marginal decrease in ammonia emissions, continuing wide ranging eutrophication of natural ecosystems is to be expected in the coming years. Diffuse nitrogen emissions must therefore be reduced drastically.

Critical loads for **acidification** are quantitative estimates of an exposure to airborne nitrogen and sulphur, below which immediate or long-term harmful effects on sensitive ecosystems such as forests, heaths and moorlands and adjacent systems, such as groundwater do not occur. From the beginning of the 1990s, acidification was significantly reduced, however, after 1995, it only decreased slightly.

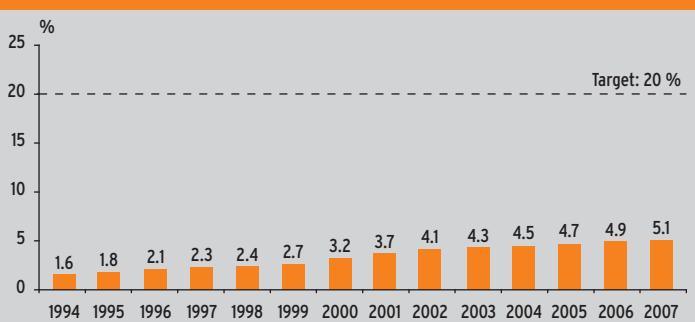
The pollutants mentioned are transported through the air over several hundreds or thousands of kilometres, before they do any damage. Therefore international negotiations

for a reduction in emissions are required in order to arrive at effective and fair solutions, consequently Germany signed the Gothenburg Protocol of the UNECE in December 1999. In this protocol, the European member states commit to reducing their emissions in order to decrease the regional variability in surpassing critical load limits for acidification, eutrophication and ozone thresholds to more comparable levels all over Europe by 2010. In this way the reduction in emissions relates directly to effects exhibited in the ecosystems most affected.

ORGANIC FARMING – ENVIRONMENTALLY CONSCIOUS LAND USE

Organic farming is a form of agriculture that is particularly protective of resources, animal friendly, and compatible with the environment. Enterprises that work according to the principles of organic farming do without mineral nitrogen fertilizers and synthetic chemical pesticides among others. The number of animals kept is matched to the amount of available land and the goal of this type of management is to avoid negative environmental impact by ensuring closed nutrient cycles. In addition, organic farming is characterized by animal welfare and diverse crop rotation. Organic farming is a core element of agricultural policy that is aligned with the principles of sustainability. It plays a pioneering role in sustainable agriculture. Therefore the percentage of area used for organic farming was adopted as a key indicator for the national sustainability strategy.

Share of organic farming in total utilized agricultural area



Source: Federal Ministry of Food, Agriculture and Consumer Protection

ENVIRONMENTAL PROTECTION AS AN ECONOMIC FACTOR – RECONCILING ECONOMICS AND ECOLOGY

ECOLOGY DRIVES THE ECONOMY OF THE 21ST CENTURY

The economic and financial crisis shows how vulnerable our economy is when the long-term effects of our activities are not properly considered. We need economic solutions that address the mid- to long-term ecological challenges such as climate change and resource shortages today, otherwise the next economic crisis is predetermined.

There is certainly no shortage of significant environmental policy challenges in the new millennium. Unlike in previous years, we are dealing primarily with long-term and covert environmental problems. Ever more obvious signs of climate change, continuing extinction of species and loss of fertile soil, air pollution, increasing water shortages in many regions, and increasingly scarce natural resources are explicit examples.

Following public debate, one gets the impression that environmental protection is simply and exclusively, a cost factor. This is a short-sighted approach: Environmental protection does pay off economically. Many environmental protection measures already pay a good return to individual enterprises due to cost savings for energy, water, materials or waste disposal.

Since environmental protection leads to reduced environmental damage, it results in lower overall costs to society – because the decrease in the so-called external costs caused by air pollution, water pollution or climate change can be expressed in fiscal terms. For example, the cost savings from reduced emissions linked to the encouragement of renewable energies already equal the additional costs they produce. By

2020 the external environmental annual costs avoided will presumably be twice the additional costs.

That shows that environmental protection and economic development are not mutually exclusive but support each other. Today environmental protection is an important economic factor.

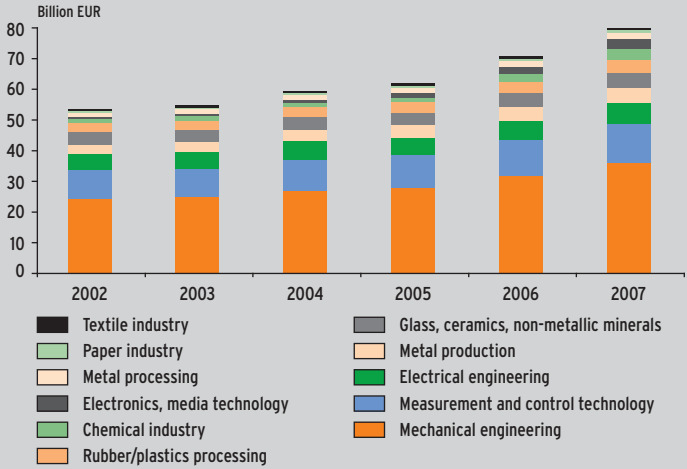
THE IMPORTANCE OF ENVIRONMENTAL TECHNOLOGY EXPANDS

In 2007 the production of commodities that are potentially instrumental in climate and environmental protection amounted to 69.5 billion euros. Thus more than 5 % of commodities produced by German industry are used for environmental protection and the tendency is rising. The leading industries were mechanical engineering, followed by measurement and control technology, and electrical engineering.

About 60 % of the revenue generated from the production of environmental protection goods are from businesses with less than 250 employees. Therefore environmental protection is also an important economic factor for small and medium-sized enterprises.

The 'green' markets of the future grow at an above average rate. Experts predict that environmental technologies will grow at an average of 8 % annually. According to a current study by Roland Berger Consulting on behalf of the Federal Ministry for the Environment, the current development exceeds all expectations. World-wide revenues of 1,000 billion euros from environmental technologies in 2005 will increase to 3,100 billion euros in 2020. Promoting 'green economic policy' therefore offers a great opportunity for sustainable growth and employment.

Production of commodities[1)] that are potentially instrumental in climate and environmental protection according to industries



[1)] Climate protection commodities include commodities for efficient use of energy, for efficient energy conversion and for using renewable energy sources

Sources: Federal Ministry for the Environment, Nature Conservation and Nuclear Safety; Federal Environment Agency

Efficient management of environmental resources is increasingly becoming a key factor for economic success. This is the case for overall economic development as well as for individual enterprises.

GERMAN ENTERPRISES ARE VERY SUCCESSFUL IN 'GREEN MARKETS'

German enterprises are world market leaders in environmental protection commodities. Their share of world trade amounted to 16.1 % in 2006.

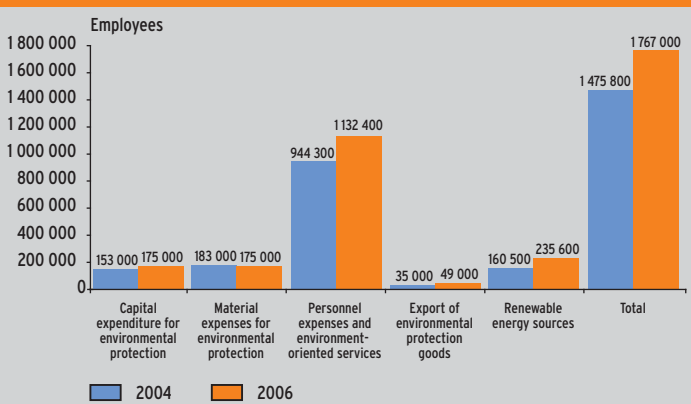
Particularly good opportunities for growth exist in the areas of energy and resource efficiency, renewable energies and water consumption reduction techniques.

'GREEN' JOBS ARE BOOMING

Employment in environmental protection has risen continuously in Germany over the past few years, most recently from 1.5 million jobs in 2004, to approximately 1.8 million in 2006. The biggest increases were registered in the area of renewable energies: From 2004 to 2006 employment rose by nearly 50 % and the trend continues. According to latest estimates, approximately 278,000 people worked in the renewable energy sector in 2008.

'Green' investment tends to generate employment for several reasons:

Employees in environmental protection



Source: Edler, D. et al.

- Increases in efficiency means lower costs – funds can be used more effectively in other areas
- Investment in energy efficiency and green energy use, for example in building renovation, tends to be more labour intensive
- Increasing the share of renewable energies means replacing imports with domestic value added.

ENVIRONMENTAL POLICY CREATES INVESTMENT INCENTIVES

Expenditure for research and development in environmental business is above average: an indication of high levels of innovation.

It appears that additive environmental protection measures (i.e. systems that are separate from the rest of the production process, such as incineration plants for waste, sewage works, noise barriers or exhaust air filters) are becoming less prevalent in favour of integrated solutions (which form part of a larger system and are not clearly identifiable – recirculation of substances and cooling water, for example, or use of heat exchangers to recover heat of reaction). As a result, old technology is increasingly being replaced by new technology and services with a high innovative potential. Above all, knowledge-intensive methods, high level research, planning and consulting services play a key role.

One of the most important indicators for innovation levels are patent applications. Germany holds 21 % of annual patents registered with the European patent office in renewable energies – the highest share in the EU. Germany's environmental protection industry has thus been playing a lead-

ing role for years. More than their competitors, German enterprises have been preparing for future markets by securing the patent rights for new products and processes. This is an important factor in ensuring future competitiveness.

Political requirements are often important triggers for innovation. In a 2003 survey by the Mannheim Innovation Panel approximately 9 % of enterprises cite environmental regulations as a decision driver. This shows that a green economic policy promotes innovation and supports businesses with investments in more efficient technology. A good environmental policy thus makes an important contribution to growth, employment and sustainable resource management.

AMBITIOUS ENVIRONMENTAL POLICY IS A PREREQUISITE FOR THE HIGH-LEVEL COMPETITIVENESS OF THE ENVIRONMENTAL PROTECTION INDUSTRY

In addition to established competitors such as the USA and Japan, newly industrialized countries such as China are also making a push to enter the environmental protection technology market. Further efforts in research and development as well as support for market penetration of innovative environmental and climate protection technology is urgently required in order to maintain the excellent competitive position. It is important to create a framework of political conditions that systematically create incentives for innovation in all relevant fields.

Environmental policy plays a central role in the development of future green markets. It must create regulations that make environmental investment and innovation attractive to individual enterprises. A good example is how the renewable energy law in Germany substantially contributed to the fact

that German industry is now a world leader in wind power plants. Guaranteed feed-in tariffs provide the industry with long-term support for their investment. Emission trading also creates long-term planning security for businesses so environmental protection pays off economically.

The instruments of environmental policy create incentives for technological advancement and a stable framework of operating conditions for business. This creates a competitive advantage against rivals who are subject to less stringent regulations in their domestic markets.

ECOLOGICAL FINANCIAL REFORM

The use of taxes and fees that favour environmental protection helps to effectively meet the ecological challenges that result from energy and resources consumption: by paying a higher price, businesses and households are forced to consider the environmental costs of products in their production and purchase decisions. Furthermore, businesses are motivated to develop new environmentally friendly technologies.

The best example to show the effectiveness of these mechanisms is the ecological tax reform, which encourages the economical handling of energy, increases overall employ-

ment and contributes to increased profitability of innovative energy technologies. Since its introduction in 1999, consumption of fuels decreased annually by up to 3 %, after having been on the rise for decades. Despite the fact that overall more driving is being done now, about 17 % less fuel is consumed compared to the time before the tax reform. The additional revenue generated from the ecotax amounts to approximately 18 billion euros annually, and by 2005 up to 250,000 people owed their job at least partially to the ecological tax reform.

The increase of energy taxation results in additional tax revenue, about 90 % of which flows back to businesses and households due to a reduction in and the stabilization of pension plan contributions. This increases the net income of employees and reduces ancillary wage costs for employers. Without the ecotax, pension plan contributions would have to be 1.7 % higher. Thus the ecological tax reform decreases labour costs and increases costs for energy consumption. In this way positive impacts on environment and employment are interconnected. The remaining additional tax income is used for promoting renewable energy, for energy-saving building refurbishment and for budget consolidation.

Taxes and fees that favour environmental protection exist in all OECD states. Beyond that a growing number of countries, particularly in the European Union, have introduced more comprehensive ecological financial reforms. With such reforms, new or increased environmental protection taxes, and/or a reduction of environmentally harmful subsidies are combined with reductions in other dues or taxes. In order not to limit incentives for environmental protection to energy taxation alone, the ecological tax reform must be developed into a more comprehensive ecological financial reform

in Germany. The aspiration should be to create environmentally conscious subsidy policies and the consideration of aspects of environmental protection in all national expenditure and projects. The Federal Government has already implemented the first steps for removing environmentally harmful subsidies, namely by abolishing the Eigenheimzulage (Private Home Subsidy) and with reductions in subsidy for the German coal mining industry.

WHAT DOES ENVIRONMENTAL PROTECTION COST?

The costs for environmental protection, that appear in environmental accounts, cover investments for environmental protection facilities as well as the costs of operating them. Over time, the share of the operating expenses has increased relative to new investments for environmental protection. This stems from the now considerable number of existing environmental protection facilities, built primarily over the past two decades.

In 2005, industry, the government, and privatized public enterprises have together spent approximately 34.1 billion euro (respective prices) on environmental protection.

This corresponds to approximately 1.5 % of gross domestic product. More than half of it is covered by the former public water and waste industries. The government is responsible for another 23 % of expenditure, only the remaining 19 % is borne by industry.

91 % of expenditure went towards water conservation and waste management, the remaining small portions were allotted to air pollution control and noise control.

ENVIRONMENTAL POLICY IS A GLOBAL TOPIC

In terms of competitiveness it is very important that environmental policy regulations are implemented EU-wide. In consideration of the Lisbon Agenda, the European Commission should maintain the goal of creating a framework of conditions that make it possible to reduce greenhouse gas emissions by 20 % by 2020, and that a 20 % share of renewable energies is achieved. In addition, industrial policies should be aligned with sustainable methods of production and sustainable forms of consumption.

TOPICS ON THE CD ROM ‘DATA ON THE ENVIRONMENT’

DATA ON THE ENVIRONMENT. STATE OF THE ENVIRONMENT IN GERMANY

POPULATION AND LAND USE

- **Demographic change and settlement structure**
- **Land use**
  - Structure of land use
  - Development of settlement and transport area

PRIVATE HOUSEHOLDS

- **Private households: number, size and structure, consumer spending**
- **Energy consumption of private households**
  - Direct energy consumption of private households according to energy sources
  - Final energy consumption of private households according to areas of application
- **Area used by private households**
- **Use of products in private households**
  - Equipping private households with long-lasting consumer goods
  - Sustainable products and consumption
  - Energy-efficient products
  - Consumption of washing and cleaning agents
  - Constituents of washing and cleaning agents
- **Environmental awareness and environmental behaviour**

AGRICULTURE

- **Structure of agricultural land use**
- **Structure of agricultural businesses**
- **Fertilizer sales in agriculture**
- **Pesticides sales in agriculture**
- **Environmentally conscious agriculture**

- Organic farming
- Environmental measures in the farming sector and their promotion

Renewable raw materials

Contribution of agriculture to greenhouse gas emissions

INDUSTRY

Recording, evaluating and authorizing chemicals

- Chemical production and assessment of materials
- REACH (recording, evaluating and authorizing chemicals)
- How does the REACH ordinance protect people and the environment?

Risks and incidents in industrial facilities

Accidents with substances hazardous to water

WATER MANAGEMENT

Water resources and their use

Public water supply

Water use in the mining and processing industries

Water use in public supply thermal power stations

Water use in agriculture

Connecting households to waste water treatment facilities

Quantity of water treated in public waste water treatment facilities

Waste water treatment in the mining and processing industries

Waste water treatment in public supply thermal power stations

WASTE MANAGEMENT

Waste generation

Generation of hazardous wastes

Handling of radioactive wastes and spent fuel elements

Recovery ratios of main waste types

Packaging materials and recovery of waste packaging

Paper consumption and recycling of waste paper

Recycling of waste glass

Generation and recovery of plastic wastes

Used electrical and electronic equipment

- **Return and recovery of batteries**
- **Scrap vehicle generation and recovery**
- **Recovery of demolition wastes**
- **Bio waste collection and treatment**
- **Disposal of wastes**
- **Disposal ratios of main waste types**
- **Transfrontier shipment of waste**
- **Waste treatment and disposal facilities**
  - Thermal waste treatment facilities
  - Mechanical-biological residual waste treatment facilities (MBT)
  - Disposal of wastes in landfills
- **Climate compatible waste management**

ENERGY

- **Structure of energy consumption according to sectors**
- **Energy consumption according to energy sources**
- **Energy consumption according to production areas**
  - Energy consumption according to production areas (total, absolute and proportionate)
  - Cumulated inland CO_2 emissions including production activities brought forward
- **Energy-linked emissions of air pollutants**
- **Energy intensity**
- **Energy efficiency in power generation**
- **Power stations and integrated grids in Germany**
- **Combined heat and power (CHP)**
- **Renewable energies**
- **Development of energy prices**
- **Sustainable energy use in existing buildings**

TRANSPORT

- **Traffic route types (transportation network)**
- **Motorized traffic**

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- Miles travelled, transport performance and purposes of travel
- Transport intensity and energy efficiency of transport performance
- Fuel consumption
- Specific road traffic pollutant emissions
- Emissions from traffic

Contribution made by rail and inland waterway transport to freight transport performance

Flight movements at German airfields

Emission-reducing requirements for traffic

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- Raw material consumption
- Water consumption
- Use of settlement area

Intensity of resource use

- Raw material intensity and productivity
- Water intensity according to production sectors
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ENVIRONMENTAL PROTECTION

Expenditure on environmental protection by manufacturing industry, the state and privatized public enterprises

Environmental protection industry

EU Eco Management and Audit Scheme

Environment and occupation

Environment-linked taxes and fees, ecological tax reform

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- **Objectives of the European Union (EU-15 and EU-27) to mitigate greenhouse gas emissions**
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- **Trends in height of precipitation**
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  - Riverine and direct discharges into the North Sea
  - Deposition of airborne pollutants to the North Sea
  - Pollutants in the water and sediments of the North Sea
  - Pollutant concentrations in organisms of the North Sea
  - Eutrophication of the North Sea
  - Nutrient concentrations and phytoplankton

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Oxygen shortage in the German Bight

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  - Riverine and direct discharges into the Baltic Sea
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- Pathogenic microorganisms in coastal and inland waters
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- Suspected contaminated sites in relation to the number of reclamation sites

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www.umweltbundesamt.de/daten-zur-umwelt

Data on the environment. State of the environment in Germany
(Comprehensive information, background, further tips)

Environmental core indicator system
(Selected parameters for fast overview)

Brochures and 'Facts on the environment' for download

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