Indicator report

Data on the Environment 2017

German Environment Agency

Umwelt Bundesamt

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DATA ON THE ENVIRONMENT 2017

Indicator report

CONTENT

PREFACE

Dear reader,

At the beginning of 2017, about 7.5 billion people lived on the Earth, and by 2050, it will probably be more than 9 billion. But even today, we are reaching the environmental boundaries of our planet. Progressing climate change, loss of biodiversity, nitrogen surplus and the increased use of resources are all endangering our natural foundations of life. To ensure that we can live decently in the future, we must change our habits and the way we run the economy to accommodate the environmental load. Facts and figures from Data on the Environment can help us to achieve this.

Overall, the 2017 Data on the Environment present a mixed picture. Climate change is one of the major challenges, and it keeps progressing: 2016 has been again the warmest year since weather records began. In the long-term, we must emit fewer greenhouse gases in Germany. We are on target regarding the development of renewable energies. The share of renewable energies in electricity consumption and final energy consumption has significantly increased since 2000. However, compared to the previous year, 2016 saw a rise in greenhouse gas emissions. There is a need for action,

especially in the transport sector, as this is the only sector in which emissions have not decreased since 1990.

More action is also needed in air quality management. Although the emission of air pollutants is overall decreasing, the measured values for nitrogen oxides, especially in cities, are still too high and compromise human health. The main cause are diesel cars.

Nitrogen is also at the bottom of many other unresolved environmental problems. More fertiliser is spread on the fields than can be absorbed by crops. Excess nitrogen seeps into the ground and is then leached as nitrate into lakes, rivers and seas. Example groundwater: since 2008, the threshold for nitrate has been exceeded in 18 % of the sampling sites in Germany. Nitrogen can pollute the air as ammonia and nitrous oxide, thus damaging sensitive ecosystems. The new Fertiliser Application Ordinance is a step in the right direction. However, we are still a long way from a truly ecologically compatible agriculture.

Successful environmental policy requires reliable information on the status and the development of the environment. The Data on the Environment play their part in flagging up trends, successes as well as need for action.

Maria Krautzberger
President of the German Environment Agency

SUMMARY

In its indicator report Data on the Environment 2017, the German Environment Agency gives a comprehensive overview of the state of the environment, the causes of environmental pollution and leverage points for improvement. A total of 50 indicators have been selected from all environmental domains and, wherever possible, underpinned by policy targets, as defined in documents such as the German Sustainable Development Strategy or EU directives. Thus, the environmental indicator system is also a record of environmental policy.

The overall assessment of all environmental domains highlights what challenges lie ahead of us. These challenges are, on the one hand, global environmental problems and our planet's boundaries – climate change, excess nitrogen, dwindling biodiversity, the over-use of resources or the bad ecological status of our water bodies and plastic in the oceans.

On the other hand challenges are local hotspots that mainly affect people's living conditions and health, such as air pollution in dense traffic, noise exposure or, to give a positive example, good bathing water quality.

Climate

Climate change can no longer be ignored. Globally, 2016 was the warmest year since records began. The 20 globally hottest years since 1850 were all in the period after 1990. The Federal Government has set itself the target of lowering greenhouse gas emissions by 40 % compared to 1990 levels by 2020. However, according to the most recent calculations, emissions have even slightly increased. This was caused by a cold winter and increased traffic emissions. The current development will not suffice for reaching the target. Measures and targets of the Federal Government's Climate Action Programme 2020 must be rigorously implemented.

Energy

Burning fossil energy carriers is one of the main sources for greenhouse gas emissions. Saving energy, using energy more efficiently and the further development of renewable energies are the cornerstones of climate protection. Primary energy consumption has so far not been sufficiently reduced, and energy efficiency enhancement is currently not on target either, whereas the development of renewables is successful.

Transport

An ecological turnaround in the transport sector is overdue. The transport sector is the only sector in which greenhouse gas emissions have not decreased compared to 1990. In addition, there are health-damaging emissions at traffic hotspots, mainly particulate matter and nitrogen oxides. So far, shifting freight transport from the road to more environmentally alternatives such as railways and waterways has not been successful.

Air quality and health

Since 2000, there has been a slight downward trend in particulate matter and nitrogen dioxide pollution. Ozone pollution is subject to significant fluctuation, depending on weather conditions. In agglomerations such as Hamburg, Stuttgart or Munich, nitrogen oxide emissions from traffic remain a problem. Diesel vehicles in particular produce significantly more nitrogen oxide compared to petrol-fuelled cars. Concentrations in the air in German agglomerations regularly exceed values recommended by the World Health Organization WHO. They may be even significantly higher in inner cities with dense traffic. According to extrapolations, 57 % of measuring stations close to traffic in cities will have exceeded mean annual nitrogen dioxide concentrations in 2016.

Nitrogen pollution and agriculture

The most worrying nitrogen emissions into the air are ammonia emissions in agriculture (2005 to 2015: + 15 %). In certain regions, nitrogen surplus from agriculture lead to a nutrient overload in the groundwater, eutrophication of waterbodies and the acidification of terrestrial ecosystems. This applies mainly to regions with a high livestock density. Mitigation measures such as low-emission spreading of liquid manure, direct application of manure to the soil, air purification for buildings housing livestock and covering liquid manure storage containers could significantly reduce ammonia emissions.

Water

Nutrients such as nitrogen and phosphorus that are released into the environment from agriculture and sewage works, will end up in bodies of water sooner or later. The same applies to plastic. The European Water Framework Directive stipulates that rivers, lakes and transitional and coastal waters of the North Sea and Baltic Sea should achieve at least a good ecological status. The target should be achieved for all rivers, lakes and coastal waters by 2027. The share for rivers was 6.7 %, while lakes achieved 26.4 %. Not a single area in the North Sea and Baltic Sea achieved a good or very good ecological status. Measures such as the regulations of the Fertiliser Application Ordinance have not yet had the desired effect.

Bathing waters in Germany are at least of sufficient quality, 91 % even of excellent quality. This rather pleasant state of affairs has been fairly stable (with only slight fluctuations) since 2001.

Raw materials and waste

Increasing total raw material productivity has been an important objective of the Federal Government's policy. This includes raw materials used abroad for our imports. In 2011, the German economy produced 20 % more value added from one tonne of raw materials than in 2000. In its Resource Efficiency Programme II (ProgRess II) the Federal Government set itself the target in 2015 to continue the upward trend undiminished by 2030. It is necessary to separate use of resources further from economic development. This can be achieved in three ways – using less raw materials, obtaining the raw materials we need in an environmentally friendly manner and using it efficiently and finally recycling waste several times over where possible or using it for energy generation. Germany has a good record in municipal waste recycling – two thirds of all municipal waste is recycled. The objective of recycling 65 % of municipal waste sustainably is now within reach. However, this does not apply equally to all material streams in municipal waste.

Land use

Every day, an additional 66 hectares of land are taken for settlement and transport infrastructure. Transforming arable land, woodland or grassland is associated with negative effects on the environment. In its Sustainable Development Strategy, the Federal Government set itself the target of lowering its land use to less than 30 hectares by 2030. From 2050, no extra land shall be claimed for settlement and transport infrastructure. More qualified inner development, the use of derelict land and the preservation of existing infrastructure rather than erecting new buildings are important in this context.

Consumption

Purchase decisions by private households have a high impact on the consumption of environmental resources. Purchasing highly energy-efficient products, thermal insulation in private housing and choosing environmentally friendly transport are just a few cases in point. Encouraging sustainable consumption remains a great challenge. The Federal Government set itself the target of increasing the market share of products with high-standard national eco-labels to 34 % by 2030. The current market share is only 6.1 %, but with a strong upward trend over the past two years.

Economy

Exploiting fewer resources and increasing efficiency is not only good for the environment, but also offers economic opportunities. An increase in jobs in environment protection or an increase in the market volume of environmental protection goods, for instance, are indicators for economic success. Traditionally, Germany has held a strong market position in environmental protection goods. In 2013, potential environmental protection goods worth nearly 82 billion euros were produced in Germany. However, their share in overall industrial production has been decreasing since 2011. This is mainly due to a decrease in the production of climate protection goods such as solar energy installations, which, in turn, is caused by strong competition from abroad, particularly China.

Development of selected indicators

How to read the table

Trend
The direction of the arrow shows whether the indicator is trending upwards or downwards. The colour of the arrow indicates whether it is a positive or negative development.

green: positive **red: negative**

Achievement of targets
A smiley indicates to what extent a policy target is likely to be achieved.

The target has been achieved or is likely to be achieved by the measures so far put in place.

If the trend remains unchanged, the target will probably be missed. Extra efforts are therefore necessary to achieve the target.

The indicator is heading in the wrong direction or the target will probably be missed clearly.

No explicit quantitative target has been set for this indicator.

Indicators and explanation	trend	achievement of targets
CLIMATE		
Greenhouse gas emissions		
Greenhouse gas emissions have fallen by 27.6 % between 1990 and 2016. The highest reductions were achieved in the energy sector, whereas transport related emissions even rose slightly compared to 1990. The current development will not suffice to reach the climate target (- 40 % by 2020). Measures and targets of the Climate Protection Action Programme 2020 must be rigorously implemented. → *See page 22*		
Global surface temperature		
Global surface temperature rose, and 2016 was the hottest year since records began, while 2015 was the second-hottest. The 20 hottest years since 1850 were all in the period after 1990. According to the Paris Climate Agreement, temperature increase should be limited to below 2 °C, if possible even to 1.5 °C, compared to the pre-industrial era. → *See page 24*		
Hot days		
The number of hot days above 30 °C is on an upward trend, but with strong annual fluctuations. In 2016, there was an average of 9 hot days, while 2003 and 2015 were record years with 19 and 18 hot days respectively. The elderly and other susceptible people may suffer increasingly from cardiovascular problems and allergic reactions when exposed to heat. → *See page 26*		

Indicators and explanation	trend	achievement of targets
ENERGY		
Energy consumption		
Primary energy consumption has fallen by 6.9 % since 2008, the base year of the Federal Government's Energy Concept. The government envisages further reductions – by 20 % by 2020 and by 2050 by 80 %. These targets have been enshrined in the Energy Concept and the Sustainable Development Strategy. The current trend will not be enough to reach the targets. → *See page 32*		
Energy consumption for heat		
Final energy consumption for the heating in buildings dropped by 11.1 % between 2008 and 2015. According to the Energy Concept, it must be reduced by 20 % by 2020. Planned measures, for example in the German National Action Plan on Energy Efficiency, must be consistently implemented in order to achieve this target. → *See page 34*		
Energy efficiency		
The use of energy resources has become more efficient. Efficiency increased by approximately 50 % between 1990 and 2015. However, the target of an annual increase in efficiency of 2.1 % (Energy Concept of the Federal Government and Sustainable Development Strategy) is not reached (currently 1.3 %). → *See page 36*		
Renewable energy		
The share of renewable energies in electricity consumption and final energy consumption has increased significantly since 2000. The targets set by the government for 2020 can be reached. In the long-term, a greenhouse gas-neutral economy should be aimed for, but further efforts are required. → *See page 38*		
Combined heat and power (CHP)		
Electricity generation from combined heat and power has been almost continuously increasing since 2003, from 77.5 to 102.2 terawatt hours (TWh). CHP Act stipulates that by 2020, 110 TWh should be generated by CHP and 120 TWh by 2025. It is currently unclear whether these targets can be reached. → *See page 40*		
AIR		
Emission of air pollutants		
Germany must reduce emissions of five air pollutants: sulphur dioxide (SO_2), nitrogen oxides (NO_x), methane (NH_3), non-methane volatile organic compounds (NMVOCs) and particulates (PM2.5) by 45 % on average between 2005 and 2030. This is the target set by the European National Emission Reduction Commitments (NERC) Directive and the German Sustainable Development Strategy. To achieve this, in particular ammonia emissions from agriculture must be reduced. → *See page 44*		

The topic **'air'** will be continued on the next page

Indicators and explanation	trend	achievement of targets
Air quality in agglomerations – particulates, ozone and nitrogen dioxide		
Since 2000, the concentration of air pollutants – particulates and nitrogen dioxide – has been decreasing, while ozone levels fluctuate, depending on the weather situation. The background levels of three main air pollutants in German agglomerations continue to exceed World Health Organisation (WHO) recommendations. → *See page 46*		
LAND USE AND TERRESTRIAL ECOSYSTEMS		
Land-take for settlements and transport infrastructure		
The four-year average land take for settlements and transport infrastructure between 2012 and 2015 was 66 hectares per day. According to the Sustainable Development Strategy, area should be limited to less than 30 hectares per day by 2030. More qualified inner city development, the use of derelict land and preservation of existing infrastructure rather than new construction are essential measures. However, from 2050 at the latest, net settlement and transport infrastructure area should not increase at all. → *See page 50*		
Nitrogen eutrophication		
In Germany, 54 % of vulnerable ecosystems are threatened by excess nitrogen deposition. Although there seems to be a positive trend, further efforts will be necessary, especially in agriculture, to achieve a decrease of 35 % compared to 2005. Above all, ammonia emissions from livestock farming and fertiliser application must be reduced. → *See page 54*		
Species diversity and landscape quality		
The diversity of species has been declining for years. This is measured using an index that shows changes to populations of selected bird species which are representative of Germany's most important landscape and habitat types. The index has been showing a negative trend for many years. → *See page 56*		
WATER		
River eutrophication by phosphorus		
Although phosphorus concentration in rivers has been declining over a long period of time, excessive phosphorus concentrations have been measured at 65.2 % of measuring points. They are therefore a long way away from being in an overall good ecological status. The result is an excess of nutrients (eutrophication). → *See page 60*		
Eutrophication of the North Sea and Baltic Sea by nitrogen		
Nitrogen load in the North Sea and Baltic Sea is too high, although input from many German tributaries has been significantly reduced. Nevertheless, target parameters for both seas are still exceeded (North Sea: 2.8 milligrammes of overall nitrogen per litre, Baltic Sea: 2.6 milligrammes per litre). → *See page 62*		

The topic **'water'** will be continued on the next page

Indicators and explanation	trend	achievement of targets
Plastic waste in the North Sea		
Plastic waste is mistaken for food by animals and results in injuries or even death. Around 60 % of the beached fulmars around the coasts of the North Sea have over 0.1 grammes of plastic in their stomachs. This proportion has remained constant over the years, but according to the OSPAR convention, this should only happen in a maximum of 10 % of birds. → *See page 64*		
Nitrate in groundwater		
In Germany, around 18 % of groundwater sampling sites exceed the European threshold of 50 milligrammes of nitrate per litre. The European Commission has initiated infringement proceedings against Germany because at many sampling sites nitrate values continue to rise. → *See page 66*		
Ecological status of rivers, lakes and coastal waters		
According to the Water Framework Directive, rivers, lakes and coastal waters should be in good ecological status by 2027. However, this is the case only for 7 % of rivers, 26 % of lakes and for none of the coastal waters. No improvement is currently in sight. → *See page 68, 70 and 72*		
Using water resources		
There is currently no water shortage in Germany. At 13.3 %, the water usage index lies well below the critical level of 20 %. However, regional problems may arise. → *See page 74*		
ENVIRONMENT AND HEALTH		
Bathing water quality		
Bathing waters in Germany are at least of sufficient quality, 91 % even of excellent quality. This rather pleasant state of affairs has been fairly stable (with only slight fluctuations) since 2001. → *See page 80*		
Population exposure to particulate matter pollution		
Exposure of the population to particulate matter away from traffic hotspots has significantly decreased since 2007. In 2014, 12.4 million people were exposed to particulate matter levels above the threshold considered health-damaging by the WHO. → *See page 82*		
Health risks due to particulate matter		
High particulate matter exposure can result in the increase of the amount of disability-adjusted life years. It was estimated that in 2014, there were approximately 41,000 premature deaths in Germany (related to particulates). Although the situation has significantly improved since 2007, health risks must be reduced further. → *See page 84*		

Indicators and explanation	trend	achievement of targets
RAW MATERIALS AND WASTE		
Raw material productivity		
In 2011, the German economy produced 20 % more value added from one tonne of raw materials than in 2000. In its Resource Efficiency Programme II (ProgRess II) the Federal Government set itself the target in 2015 to continue the upward trend undiminished by 2030. Further measures must be developed beyond ProgRess II to achieve this. → *See page 88*		
Amount of waste – municipal waste		
Since 2011, the amount of municipal waste has stabilised at around 50 million tonnes. In its waste prevention programme of 2013, the German Federal Government set itself the objective of decoupling economic growth from waste production. This has been achieved. → *See page 92*		
Recycling municipal waste		
Two thirds of municipal waste are recycled in Germany. The target of recycling 65 % of municipal waste in the long term has thus come within reach. In some waste flows, the recycling targets have not yet been achieved. These include recycling of used electrical appliances (2014: 42.9 %, target 2019: 65 %), plastic recycling from commercial waste and packaging (target significant increase, existing potential over 1 million tonnes). → *See page 94*		
TRANSPORT		
Energy consumption in transport		
The Federal Government's target is to lower final energy consumption in the transport sector by 10 % by 2020 and by 40 % by 2050 compared to 2005. However, by 2014, there was hardly any reduction, and in the freight sector, it even rose. Further measures must therefore be taken to lower energy demand. → *See page 98*		
Environmentally friendly passenger transport		
Walking, utility cycling, public transport and railways are environmentally friendly means of transport that put a comparatively low burden on the environment and climate. Their share in passenger transport remained stable at about 19.5 % between 2002 and 2014. → *See page 100*		
Environmentally friendly freight transport		
More than three quarters of total freight transport services were delivered by road. Attempts to shift freight transport to more environmentally friendly alternatives such as trains and ships have not been successful up to now. There is a slight positive trend in rail transport, whereas the share of shipping decreased more substantially. → *See page 102*		

Indicators and explanation	trend	achievement of targets
AGRICULTURE AND FORESTRY		
Agricultural nitrogen surplus		
Twice as much nitrogen is introduced into Germany's agriculture than is withdrawn through agricultural products. The surplus nitrogen has declined by 20 % since 1993, but no major progress has been made yet. Not only must long overdue changes to the amended Fertiliser Application Ordinance be implemented, but further action is needed to achieve the target of the Sustainable Development Strategy. → *See page 106*		
Grassland		
Grassland is very valuable for the environment and nature conservation. The recent reform of European Common Agricultural Policy (CAP) and its national implementation seem to support the objective that from 2012, grasslands should not decline any further. After years of shrinking grasslands, this tendency has recently been reversed. Compared to the baseline year 2012, the grassland area has slightly increased. The objective has thus so far been achieved. → *See page 108*		
Organic farming		
The percentage of organically managed agricultural land has increased for decades. However, growth has been slow, and currently, the proportion is no higher than 6.5 %. If the trend continues, it will take decades to reach the target of 20 % the Federal Government set itself. → *See page 110*		
Sustainable forestry		
A large proportion of Germany's forests is managed sustainably. Approximately 67 % of woodland area is ecologically certified according to the PEFC standard. In 2000, this was just 28.6 %. The more ambitious FSC label developed very positively over the past years, with a proportion of 10.5 %. However, the target of 80 % has not yet been achieved, especially since certifications according to both standards are counted twice. → *See page 112*		
Mixed forest		
The proportion of mixed forests in the total woodland area has been increasing slightly between 2002 and 2012. The proportion of forest with four or more tree species has also slightly increased. In its Forest Strategy 2020, the Federal Government set itself the target of increasing the diversity of tree species in forests. → *See page 114*		

Indicators and explanation	trend	achievement of targets
PRIVATE HOUSEHOLDS AND CONSUMPTION		
Energy consumption in private households		
Energy consumption by private households is a key indicator of environmental stress. In the Sustainable Development Strategy, the Federal Government set the target of continuous reduction. However, since 2000, there has only been a slight reduction by 3 %. No significant trend has been observed. → *See page 120*		
Environmentally friendly consumption		
The indicator looks at the turnover share of products with high-standard ecolabels. The turnover share has grown over the past year and is currently 6 %. According to the target set in the Sustainable Development Strategy, it should increase to 34 % by 2030. → *See page 122*		
ENVIRONMENT AND ECONOMY		
Environmental protection goods		
Germany has traditionally held a strong market position in environmental protection goods. In 2013, potential environmental protection goods worth nearly 82 billion euros were produced in Germany. However, their share in overall industrial production has been falling since 2011. One reason is growing competition from China, especially in the production of solar cells. → *See page 132*		
Employment in environmental protection		
More than 2 million people work in environmental protection in Germany. Their share of the total workforce rose between 2002 and 2012 from 3.7 % to 5.2 %. Exports, renewable energies and services were the main growth sectors. → *See page 134*		
Environmental management		
There are currently 2,111 sites in Germany registered under the European eco management and audit system EMAS. Since 2012, numbers have been rising slowly, but steadily. EMAS helps to improve environmental protection in companies and other organisations and can also help to cut costs. According to the Federal Government's target in the Sustainable Development Strategy, 5,000 sites should be registered by 2030. → *See page 138*		

01

CLIMATE

Greenhouse gas emissions

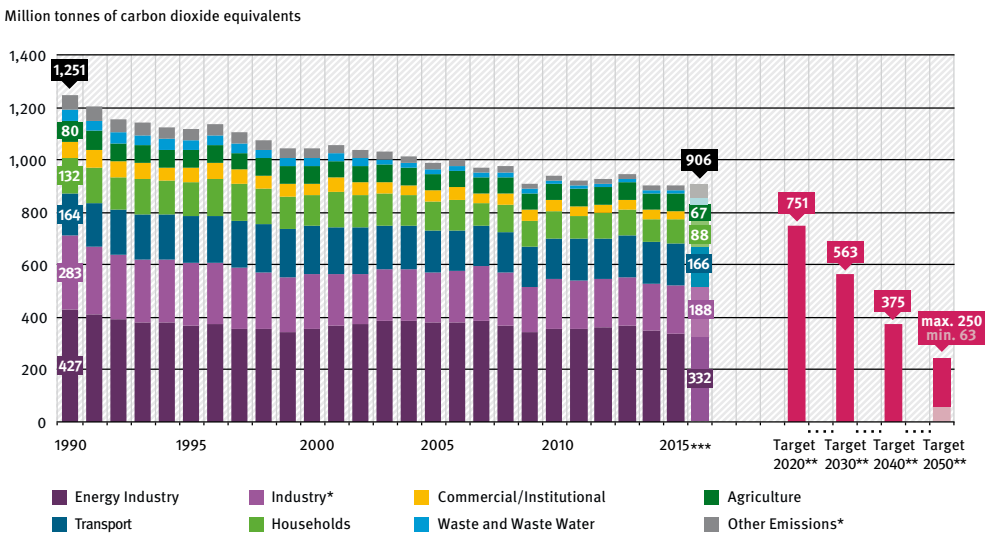
Global surface temperature

Hot days

Greenhouse gas emissions avoided through the use of renewables

Greenhouse gas emissions

Emission of greenhouse gases covered by the UN Framework Convention on Climate



Emissions by UN reporting category, without land use, land use change and forestry

* Industry: Energy and process-related emissions from industry (1.A.2 & 2);
Other Emissions: Other combustion (rest of CRF 1.A.4, 1.A.5 military) & fugitive emissions from fuels (1.B)

** Targets 2020 to 2050: Energy Concept of the German Federal Government (2010)

*** Short-term forecast for 2016, emissions from commerce, trade & services contained in Other Emissions

Source: German Environment Agency, National Inventory Reports for the German Greenhouse Gas Inventory 1990 to 2015 (as of 02/2017) and short-term forecast for 2016 (as of 03/2017)

At a glance

- Greenhouse gas emissions in Germany fell by around 28 % between 1990 and 2016.
- Germany aims to reduce greenhouse gas emissions by 40 % by 2020 and by 80 % to 95 % by 2050 compared with 1990 levels.
- Without massive and rapid efforts the set targets will not be achieved.
- The Federal Government intends to reach the climate protection targets with the help of the ‘Climate Action Programme 2020‘ and the ‘Climate Action Plan 2050‘.

Environmental importance

Greenhouse gases are released mainly through the use of fossil fuels such as coal and petroleum. Industrial processes and livestock farming are also relevant emission sources. Rising levels of greenhouse gases warm the earth's atmosphere, leading to climate change. Global warming has diverse negative impacts such as rising sea levels, increased risks of flooding, drought and other extreme weather events.

Thus at the 2015 Climate Summit in Paris the international community agreed to limit the temperature increase to 1.5 °C where possible and to keep it below 2 °C. This can only be achieved if global greenhouse gas emissions are rapidly reduced.

Assessing the development

Greenhouse gas emissions in Germany have been falling since 1990: from 1,251 million tonnes of CO_2 equivalents in 1990 to 906 million tonnes in 2016 – one of the lowest values since 1990. This amounts to a decline of 28 %. Despite the low value of the crisis year 2009, the indicator follows a long-term downtrend. In recent years, however, the trend has stagnated and rose slightly again. In this period the trend is roughly following the weather and the economic activity.

The Paris Agreement was adopted at the end of 2015 as a follow-up to the Kyoto Protocol. Germany is committed to the targets of the Energy Concept 2010 (Federal Government 2010), which calls for emissions to be reduced to 40 % below 1990 levels by 2020 and by 80 to 95 % by 2050. The previous development shows clearly that intensive efforts in climate protection are necessary to reach the targets. Therefore, the Federal Government has introduced measures with the 'Climate Action Programme 2020' and the 'Climate Action Plan 2050' (BMUB 2014 and 2016c).

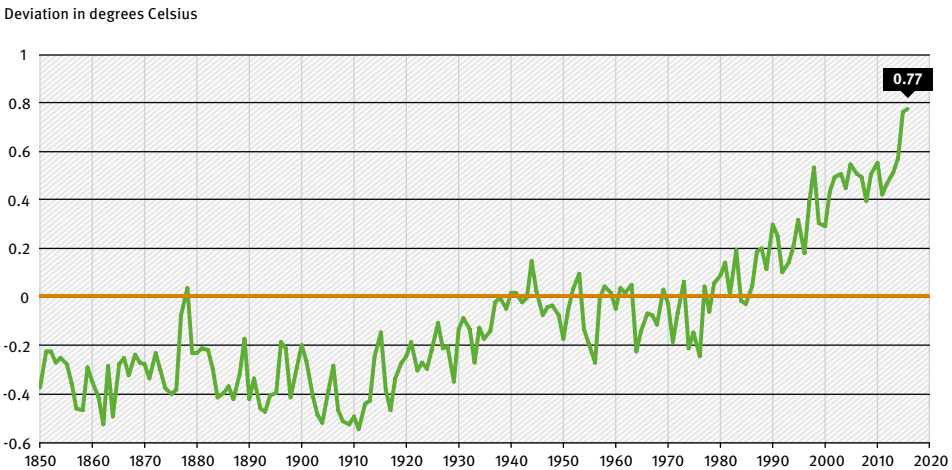
Methodology

The indicator is based on the National Greenhouse Gas Inventory 1990 – 2015. The calculation method is described in the latest inventory report (UBA 2017d). Emissions of all greenhouse gases governed by the Kyoto Protocol (e.g. carbon dioxide, methane) are compiled in a standardised format. Since the different gases have different impacts on the climate, their effect is expressed in terms of the effect of carbon dioxide (CO_2 equivalents). The indicator value for 2016 is based on a preliminary calculation of the German Environment Agency (UBA 2017b).

- Indicator online (latest data, data download): www.uba.de/en/49509
- Detailed information: www.uba.de/15214 (in German only)
- Last update: 03/2017

Global surface temperature

Deviation from global average surface temperature 1961-1990 (reference period)*



* The zero line corresponds to the global average surface temperature from 1961 to 1990. This is 14.0 °C. The global average surface temperature in 2015 was therefore around 14.8 °C.

Source: Met Office Hadley Centre, Climate Research Unit; HadCRUT.4.4.0.0 model; median of 100 calculated time series

At a glance

- 2016 was the warmest year since records began.
- The 20 warmest years worldwide since 1850 occurred after 1990.
- The Paris Climate Agreement stipulates that the increase in global temperature should be limited to well below 2 °C above pre-industrial levels, and even to 1.5 °C.

- Indicator online (latest data, data download): www.uba.de/en/57080
- Detailed information: www.uba.de/10991 (in German only)
- Last update: 01/2017

Environmental importance

Climate change manifests itself as an increase in the global average surface temperature. But we are also seeing increases in climate variability and risks of extreme weather events such as heavy precipitation, heat waves and droughts.

Germany as well has become warmer over the years. Consequently, the number of hot days are increasing (cf. 'Hot days' indicator). The increase in average temperatures is also changing the duration of individual seasons. As of yet we have only a rudimentary understanding of the complex effects of these seasonal shifts on plants and animals.

The global average temperature for one year alone is not very significant. We obtain more information from a given year's global mean deviation from the average for a longer period in the past. This shows whether one year was warmer or cooler than the climatological average. The internationally accepted 'climate normal period' 1961 to 1990 is normally used as the reference period.

The German Strategy of Adaptation to Climate Change envisages climate impact monitoring. Climate change impacts and adaptation in different areas are published in a monitoring report which is updated every four years (UBA 2015b).

Assessing the development

To prevent dangerous interference to the climate system, the aim is to limit the temperature increase to well below 2 degrees Celsius (°C) above pre-industrial levels, and even to 1.5 °C. This is the agreement adopted by the global community at the 2015 Climate Conference in Paris (UNFCCC 2015). To achieve this target, global greenhouse gas emissions must be reduced rapidly and substantially (cf. 'Greenhouse gas emissions' indicator).

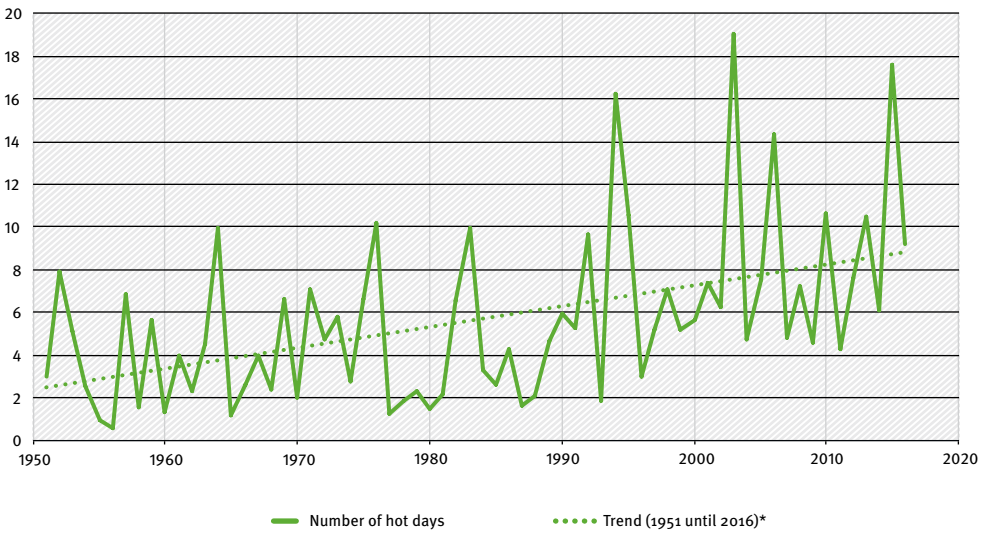
According to calculations by the Hadley Centre, in 2016 the global average near-surface temperature was approximately 0.77 °C above the average for the 1961 to 1990 period. This makes 2016 the hottest year on record. The 20 warmest years since records began have all occurred since 1990. According to the Hadley Centre, the average temperature in the last 30 years (1987 to 2016) was around 0.70 °C above the average for the first 30-year period on record (1850 to 1879).

Methodology

The Hadley Centre's temperature data form part of an internationally recognised body of temperature datasets. As with other available datasets, the global average surface temperature is based on measurement data from meteorological stations. The global average surface temperature is calculated from worldwide measurements using a combination of calculation rules and interpolations. More detailed information about the Hadley Centre calculations can be found in a paper which describes the HadCRUT4 model (Morice et al. 2012).

Hot days

Number of days when maximum air temperature exceeds 30 degrees Celsius (areal mean)

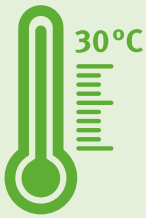


* Linear regression line above all indicator values presented

Source: Deutscher Wetterdienst (DWD), report dated 20 February 2017

At a glance

- The highest number of hot days averaged across Germany were recorded in 2003 and 2015.
- 2016 also had above-average numbers of hot days.
- Despite considerable fluctuations between individual years, the overall trend is rising significantly.
- More hot days are expected during summer months in the coming decades due to climate change.



Environmental importance

Rising temperatures can adversely affect human health. The Deutscher Wetterdienst defines the 'hot day' as any day on which the maximum temperature exceeds 30 degrees Celsius (°C).

High air temperatures have a direct impact on the human body, as the heat can cause circulatory problems. Indirectly, hot weather can raise pollutant levels in the air we breathe, leading to an increase in respiratory and circulatory diseases. High air temperatures combined with intense sunlight encourage the formation of ground-level ozone. Ozone irritates the eyes and airways and can exacerbate existing respiratory diseases. It can also trigger allergic reactions.

Assessing the development

In 2016 Germany recorded 9 'hot days', when temperatures exceeded 30 °C. Thus 2016 was a year with an above-average number of 'hot days'.

The strain on heat in 2003 and 2015 was particularly high: in these years there were 19 respectively 18 'hot days'. Seven of the ten hottest years based on the number of hot days were recorded between 1994 and 2016. Although the annual figures for this indicator vary greatly, the overall trend has increased significantly since records began.

Climate models show that in future Germany can expect an increase in the number of hot days in summer and more prolonged heat waves.

Methodology

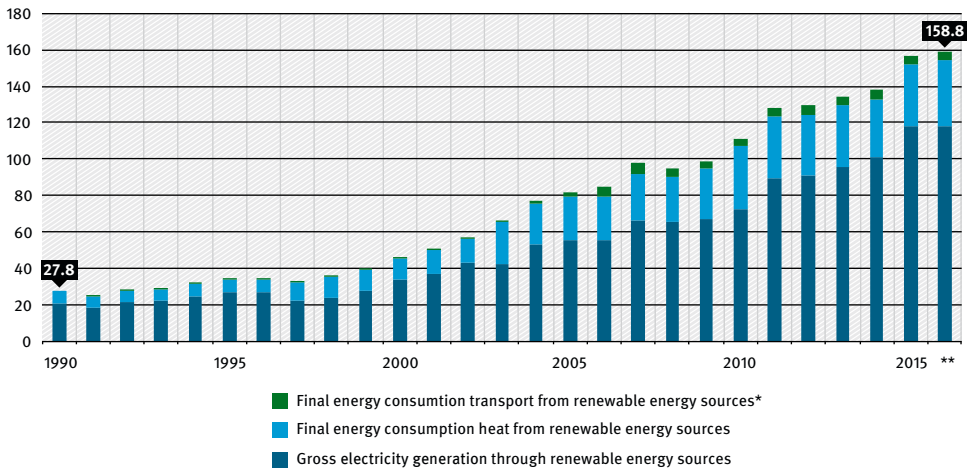
The indicator is based on temperature measurements taken at Deutscher Wetterdienst (DWD) monitoring stations. Temperature readings and indicator values must be calculated for those areas not covered by monitoring stations. The results can be presented in a grid (1×1 km) which shows the distribution. An annual total of hot days is calculated for each grid point. The indicator is the mean of the annual values for all grid points (areal mean). More information about the calculation method can be found at Müller-Westermeier (1995).

- Indicator online (latest data, data download): www.uba.de/en/57109
- Detailed information: www.uba.de/10991 (in German only)
- Last update: 02/2017

Greenhouse gas emissions avoided through the use of renewables

Greenhouse gas emissions avoided through the use of renewable energy sources

Million tonnes of carbon dioxide equivalents



* Discounting electricity consumption in the transport sector; using the emission factors for biofuels as per Directive 2009/28/EC
** Preliminary figures

Source: German Envionment Agency, Emissionsbilanz erneuerbarer Energieträger using data from AGEE-Stat, as of 02/2017

At a glance

- Renewables are increasingly replacing fossil fuels in the fields of electricity generation, heat production and transport.
- As a result, avoided GHG emissions are today more than five times higher than in 1990.
- The Federal Government intends to considerably expand the share of renewables to further reduce greenhouse gas emissions.

- Indicator online (latest data, data download): www.uba.de/en/57110
- Detailed information: www.uba.de/42668 (in German only)
- Last update: 02/2017

Environmental importance

All economic processes involve the use of energy. At present, fossil fuels such as coal, petroleum and natural gas are the primary energy sources in Germany and throughout the world. Burning fossil fuels releases greenhouse gases, which are the driving force behind global climate change.

One important way of protecting the climate is therefore to switch to cleaner forms of energy, particularly renewables. The indicator shows the contribution made by renewable energy sources to reducing greenhouse gas emissions and achieving climate protection targets.

Using energy more efficiently also plays an important role in achieving climate targets. However, measuring overall energy efficiency is a complex matter. Nevertheless the indicator 'energy productivity' provides a general measure for the energy efficiency of a national economy in terms of economic output for a given amount of energy (cf. 'Energy efficiency').

Assessing the development

The use of renewables has expanded significantly in Germany in recent decades. In 2016 around 159 million tonnes of carbon dioxide equivalents were avoided through the use of renewables. These emissions would otherwise have been generated through the use of fossil fuels. The respective amount increased more than fivefold since 1990.

Electricity generation from renewables accounted for 73 % of the avoided emissions. 24 % can be attributed to the heating sector and the remaining 3 % are coming from renewable energies (e.g. biofuels) used for transport.

Through its Energy Concept 2010, the Federal Government aims to reduce greenhouse gas emissions to 40 % below 1990 levels by 2020 and even 80 to 95 % by 2050 (Federal Government 2010). Renewables are expected to make a particularly important contribution to achieving this goal. It is targeted that they should have a 30 % share of final energy consumption by 2030 and 60 % by 2050.

Further substantial efforts are required to achieve these targets (cf. 'Greenhouse gas emissions' and 'Renewable energy' indicators).

Methodology

The calculation of the indicator is based on the assumption that energy generated from renewable energy sources today would otherwise have been provided by a fossil energy mix. The indicator shows the difference between assumed fossil emissions and the actual emissions. It also includes emissions from renewable energy sources occurring for example during production, installation or maintenance of renewable energy facilities. A detailed description of the calculation method can be found in the Emission Balance 2013 (UBA 2014a).

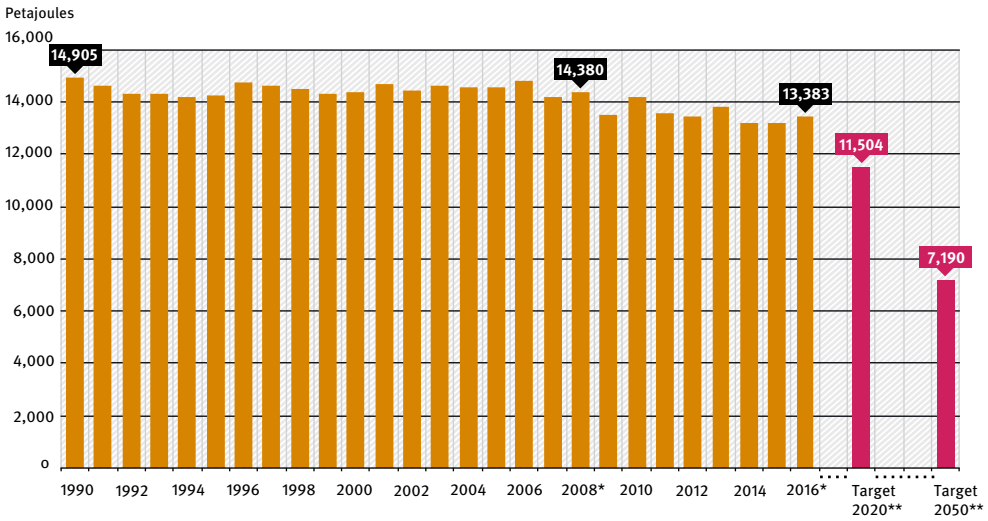
02

ENERGY

Energy consumption
Energy consumption for heat
Energy efficiency
Renewable energy
Combined heat and power (CHP)

Energy consumption

Primary energy consumptiom



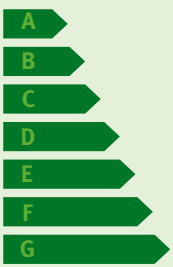
* Preliminary figures

** Targets of the Energy Concept and the German Sustainable Development Strategy: Reduction of the primary energy consumption by 20 % until 2020 and by 50 % until 2050 (base year 2008)

Source until 2014: Working Group on Energy Balances (AGEB), Evaluation Tables on the Energy Balance for Germany 1990 to 2015, as of 07/2016;
Source from 2015: AGEB, 'Primärenergieverbrauch in der Bundesrepublik Deutschland 2015/2016', as of 03/2017 (in German only)

At a glance

- Overall, primary energy consumption in Germany has been decreasing. Between 1990 and 2016, it fell by nearly 10 %.
- By 2020, energy consumption should fall by 20 % compared to 2008 and by 50 % by 2050. Since 2008 the energy consumption has fallen by an average of 0.9 % per year.
- To achieve the target of 2020 the primary energy consumption needs to decrease by an average of 3.7 % per year.
- More efforts must be made in the coming years to achieve these targets.



Environmental importance

The use of energy plays an eminent role in the production of goods. We also require energy in various ways in our day-to-day life, including mobility, heating and electric appliances in our households.

However, using and generating energy is also associated with many forms of environmental pollution: Mining of raw materials such as coal or crude oil destroys the Earth's surface. In addition, water is polluted, compromising local ecosystems. The transport of raw materials consumes additional energy, generating greenhouse gas emissions and other air pollutants that damage human health. Transforming and providing energy puts further pressure on the environment.

Therefore, lowering the primary energy consumption is an important part of an energy transition, alongside the switch to alternative and renewable energy sources.

Assessing the development

In Germany, 10.2 % less primary energy was used in 2016 than in 1990. As recently as 2006, energy consumption was still nearly as high as 1990. Since then, it has decreased significantly. In 2014, energy consumption was 13.180 petajoule (PJ), the lowest since 1990. This was mainly due to a mild winter and correspondingly reduced demand for heating. From 2014 to 2016 energy consumption rose again by 1.5 %.

However, the current trend is not enough to achieve the targets set by the Federal Government. In its 2010 Energy Concept (Federal Government 2010), it decided to aim for a reduction in primary energy consumption by 20 % by 2020 and by 50 % by 2050, compared to 2008 levels. The Energy Concept targets also became part of the Sustainable Development Strategy published by the Federal Government (Federal Government 2016).

However, in 2016 the decrease compared to the base year 2008 was only 6.9 %. This corresponds to an annual decline of 0.9 % but 1.8 % per year would have been required. In order to reach the 2020 target, energy consumption needs to be reduced by an average of 3.7 % per year. This requires the consistent implementation of measures laid out in the National Action Plan of Energy Efficiency (BMWi 2014).

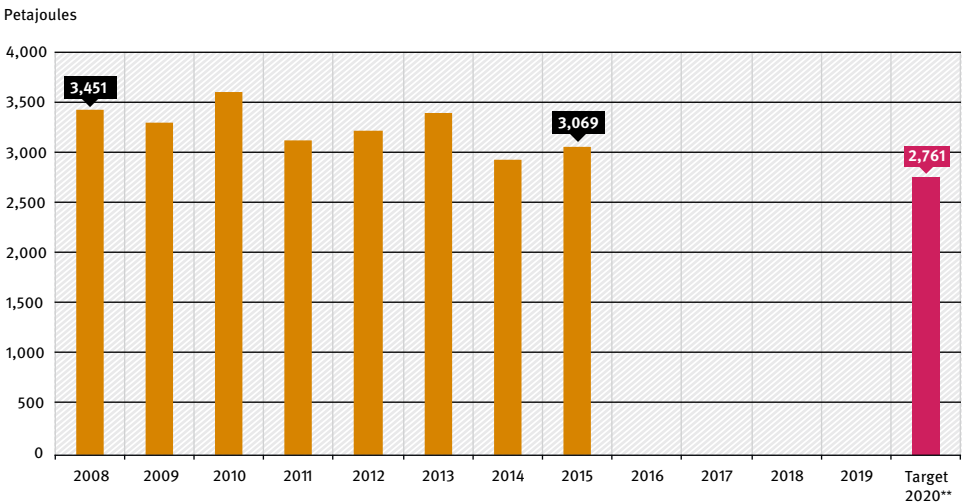
Methodology

The total primary energy consumption is determined by the Working Group on Energy Balances (AGEB) on the basis of efficiency ratios. The energy carriers burnt in power stations and other combustion plants are multiplied by their calorific value. The efficiency ratio of electricity generated from wind, hydropower or photovoltaic is defined as 100 %, while in geothermal energy, it is 10 % and in nuclear energy 33 %. The method is further explained in a documentation produced by AGEB (AGEB 2015).

- Indicator online (latest data, data download): www.uba.de/en/57111
- Detailed information: www.uba.de/12371 (in German only)
- Last update: 03/2017

Energy consumption for heat

Building-related final energy consumption for room heating, room cooling, hott water and lighting*



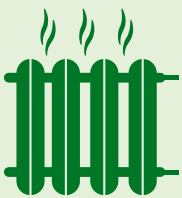
* Lighting in non-residential buildings only

** Target according to the 2010 Energy Concept: reduction of the energy requirement by 20 % in 2020 compared to 2008

Source: Fifth Monitoring Report – The Energy of the Future, by Working Group on Energy Balances, as of 10/2016

At a glance

- Final energy consumption associated with buildings decreased by 11.1 % between 2008 and 2015.
- However, according to the 2010 Energy Concept, the indicator should be decreasing by 20 % between 2008 and 2020.
- This target is to be achieved with the help of the National Energy Efficiency Action Plan and the Energy Efficiency Strategy for Buildings.



Environmental importance

In 2015, 27 % of the total final energy consumption in Germany went into heating in buildings. In addition, nearly 7 % were used to heat water and cool rooms. By comparison: electricity use makes up 21 % of total final energy consumption. Referring to this significant share, the Federal Minister for the Environment claimed in 2014 the need of a heat transition with a radically new approach to heating ('Wärmewende') in order to achieve a successful energy transition ('Energiewende') (Federal Government 2014).

The 'building-related final energy consumption' indicator shown here is based on one of the quantitative targets of the energy transition programme. It includes consumption for heating and cooling rooms as well as for hot water. For non-residential buildings, permanent lighting is, in line with energy-saving legislation, recorded as well.

Assessing the development

The building-related final energy consumption fell by 11 % to 3,069 petajoules between 2008 and 2015. This is equivalent to 35 % of the final energy consumption in Germany. Although over the years in question, residential and effective space have increased, energy consumption for room heating decreased. This is mainly the result of higher energy efficiency standards for new buildings and refurbished old buildings. Variation throughout the years is mainly due to differences in weather conditions over the years.

In its 2010 Energy Concept, the Federal Government set the target of reducing heat requirements in buildings, defined as final energy consumption for heat, by 20 % by 2020 (Federal Government 2010). Reaching this target remains a challenge. Measures laid down in the National Action Plan of Energy Efficiency (NAPE) and the Energy Efficiency Strategy for Buildings (ESG) are intended to help with the implementation (BMWi 2014 and 2015).

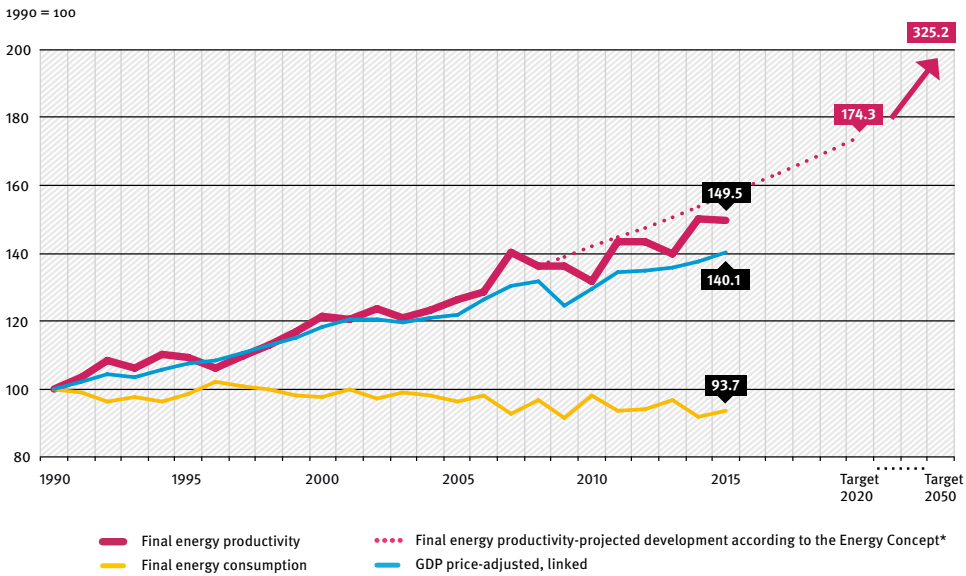
Methodology

The data required for the calculation of the indicator were provided by Working Group on Energy Balances (AGEB). Within the context of research projects, consumption balances are calculated that reproduce the consumption of final energy in various uses (e.g. heating, mechanical energy etc.). The methodology used has been described in various documents (AGEB 2014). Figures are taken from the fifth monitoring report of the energy transition 'The Energy of the Future' (BMWi 2016a).

- Indicator online (latest data, data download): www.uba.de/en/57112
- Detailed information: www.uba.de/42350 (in German only)
- Last update: 12/2016

Energy efficiency

Final energy productivity
Final energy consumption in relation to gross domestic product (GDP)



* The projected development is based on the climate protection targets pointed out in the Energy Concept 2010 published by the Federal Government. According to that final energy productivity should rise by 2.0 % annually between 2008 and 2011 and by 2.1 % from 2012 onward. Therefore, the target value is 325.2 in 2050.

Source gross domestic product: Federal Statistical Office of Germany, Fachserie 18 Reihe 1.4, as of 11/2016;
Source final energy consumption: Working Group on Energy Balances: Energy balance for Germany 1990-2015, as of 07/2016

At a glance

- Energy efficiency can be measured using the indicator 'final energy productivity'.
- Between 1990 and 2015, final energy productivity increased by approximately 50 %.
- The Federal Government plans to increase final energy productivity by 2.1 % every year.
- Between 2008 and 2015, the annual growth has been 1.3 %, which is significantly below the target.

- Indicator online (latest data, data download): www.uba.de/en/57113
- Detailed information: www.uba.de/22247 (in German only)
- Last update: 07/2016

Environmental importance

Energy efficiency must be increased throughout the world in order to stop unrestricted growth of global energy consumption and to avoid severe consequences for the environment. The energy productivity indicator specifies how much economic output (gross domestic product) is produced per unit of energy used. Energy productivity thus measures energy efficiency.

Increasing energy efficiency also makes sense in an economic context: Using up fewer resources to achieve the same economic output reduces the environmental impact and saves money. Private households can save money as well by using appliances with high energy efficiency ratings.

Energy productivity is assessed on the basis of final energy consumption rather than primary energy consumption. This enhances the validity of the indicator because losses in the energy supply system through energy conversion and transport do not appear in the balance. Final energy consumption includes electricity as well as heat, therefore, weather conditions and fuel provisions will cause fluctuations over the years.

Assessing the development

Between 1990 and 2015, final energy productivity rose by approximately 50 %. This increase in productivity was mainly driven by the gross domestic product growth, which has been around 40 % since 1990, whereas final energy consumption fell by 6 % in the same period. This decoupling of economic growth and energy consumption can be the result of improved energy efficiency, but also of structural change, which favours less energy-intensive economic activities.

The Federal Government has set a target of increasing final energy productivity by 2.1 % annually from 2008 onwards (Federal Government 2010). This target, which was first outlined in the Energy Concept of 2010, also became part of the German Sustainable Development Strategy (Federal Government 2016). Productivity should increase by 28 % by 2020 compared to 2008 and by around 138 % in 2050.

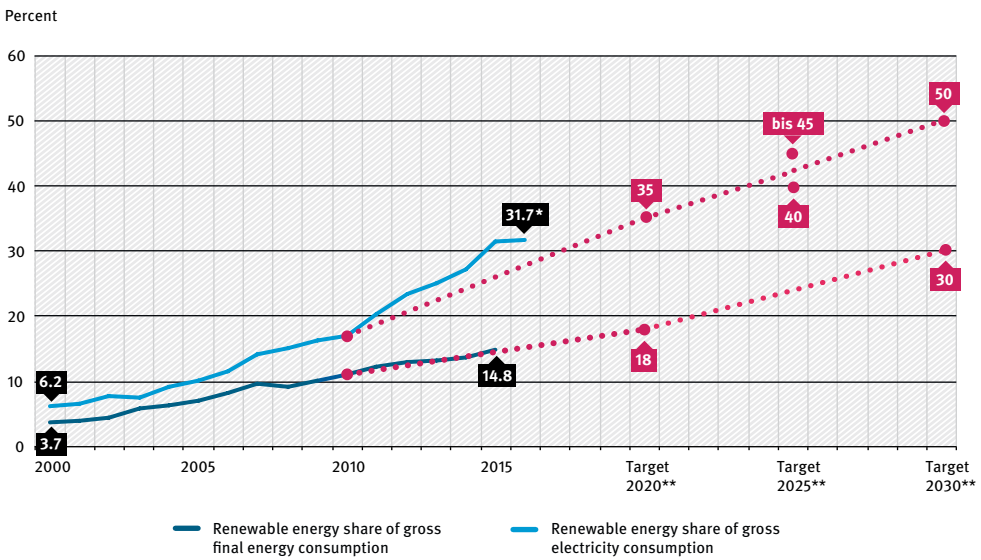
Final energy productivity actually grew 1.3 % per annum between 2008 and 2015. The target was thus missed. In 2014, the Federal Government enacted the National Action Plan of Energy Efficiency to reach the targets it has set (BMWi 2014).

Methodology

The energy productivity indicator is calculated as the ratio between gross domestic product and final energy consumption in Germany. The gross domestic product is calculated and published by the Federal Statistical Office of Germany as part of the macroeconomic accounts (StBA n.d. b). Final energy consumption is determined by Working Group on Energy Balances (AGEB) on a regular basis. Explanations of the calculation methods are published in the Preface to the Energy Balances (AGEB 2015).

Renewable energy

Renewable energy share in gross final energy consumption and gross electricity consumption*



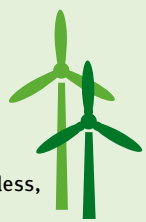
* Gross final energy consumption calculated according to Energy Concept; Values for 2016 preliminary

** Source target: Energy Concept 2010 and EEG 2014; additional targets: share of gross electricity consumption 2035: 55-60 %, 2040: 65 %, 2050: 80 %; share of gross final energy consumption 2040: 45 %, 2050: 60 %

Source: Federal Ministry for Economic Affairs and Energy on the basis of Working Group on Renewable Energy Statistics (AGEE-Stat), Time series for renewables in Germany, as of 02/2017

At a glance

- The share of renewable energies in electricity consumption increased from 6.2 % to 31.7 % between 2000 and 2016.
- The share of renewables in final energy consumption increased from 3.7 % (2000) to 14.8 % (2015).
- The Federal Government has set ambitious targets for the decades ahead.
- So far, the energy industry seems to be on track to reach the targets. Nevertheless, additional efforts, especially in the non-electricity sectors, are needed.



- Indicator online (latest data, data download): www.uba.de/en/57114
- Detailed information: www.uba.de/12338 and .../12427, ... /42350, .../44246 (in German only)
- Last update: 02/2017

Environmental importance

Energy-related emissions are responsible for more than 80 % of all greenhouse gas emissions. Increasing the share of renewables in electricity and energy consumption will help to reduce the use of fossil fuels such as coal and thus the emission of greenhouse gases. Increasing the share of renewable energy is therefore an important contribution to climate protection and also helps to save resources (cf. 'Greenhouse gas emissions avoided through the use of renewables' indicator).

Germany currently imports the majority of its energy carriers, whereas it is largely self-sufficient in renewables. Increasing the share of renewable energy therefore reduces dependency on the import of raw material and increases security of supply.

Losses through transformation and transmission are not included when calculating final energy consumption. Final energy consumption is therefore a useful indicator when looking at the specific use of energy in different sectors. Besides energy demand for heating and cooling purposes and transport, electricity consumption makes up an important share of final energy consumption.

Assessing the development

Renewable energies have seen a rapid development since the year 2000: Their share in electricity consumption increased fivefold by 2015, while their share in final energy consumption went up almost fourfold by 2014. This development is the result of a successful energy and environmental policy in Germany. The Renewable Energy Sources Act in particular was crucial for this development. Between 2015 and 2016 the increase of renewable energy share on energy consumption was rather small. The reason for that was the weather situation in 2015 and 2016. While in 2015 photovoltaic systems and wind power systems were very productive, 2016 had less sun and wind.

In 2010, the Federal Government enacted its Energy Concept (Federal Government 2010). It sets targets for the development of renewable energy, which are also part of the Sustainable Development Strategy of the Federal Government (Federal Government 2016). By 2020, the share of renewables in electricity consumption should rise to 35 %. Final energy consumption from renewables should reach 18 %. According to the 'Novelle des EEG' (EEG amendment) of 2014, the share of renewables in electricity consumption should be between 40 and 45 % by 2025.

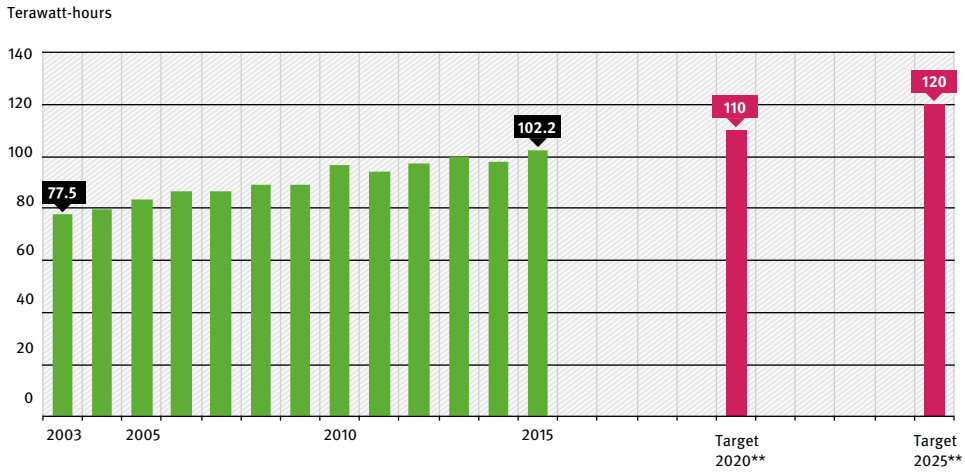
Judging from the development of the past years, these targets seem realistic. However, achieving the long-term objectives of the 'Energiewende' (energy transition) still presents a major challenge: by 2050, 80 % of electricity consumed and 60 % of all final energy consumption should be based on renewable energy.

Methodology

The indicator shows the ratio of renewable energy use to the total final energy consumption in Germany. The data used were provided by the Working Group on Renewable Energy Statistics (AGEE-Stat) and Working Group on Energy Balances (AGEB). AGEB explains its calculation methods for the total final energy consumption in the 'Preface to the Energy Balances' (AGEB 2015). Explanations on how the share of gross final energy and electricity consumption were calculated can be found in the publication 'Renewable Energy Sources in Figures 2015' (BMWi 2016b).

Combined heat and power (CHP)

Net electricity generation using combined heat and power (CHP)*



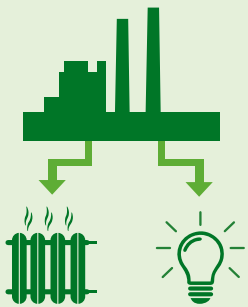
* Without electricity generation that corresponds to the heat used in fermenters

** Targets for 2020 and 2025 according to the 2016 CHP Act

Source: Federal Statistical Office of Germany; Öko-Institut; Zentrum für Sonnenenergie- und Wasserstoff-Forschung Baden-Württemberg (ZSW); Energy Environment Forecast Analysis Institute (EEFA), as of 04/2017

At a glance

- The volume of electricity generated by combined heat and power (CHP) has been increasing slowly, but steadily until 2015.
- The CHP Act stipulates that by 2020, 110 terawatt-hours (TWh) should be generated by CHP. By 2025 the target is 120 TWh.
- Efforts must be maintained in order to achieve the targets.



Environmental importance

Electricity generation usually also produces heat, which normally remains unused in conventional power plants. Combined heat and power makes use of this heat. CHP systems thus have a far higher fuel utilisation factor when operating as CHP. They then use a significantly higher share of the energy than conventional systems. Compared with installations that generate electricity and heat separately, savings of up to 20 % primary energy are possible.

With decreasing energy demand, pressures on the environment associated with energy provision and transformation will also decrease. For instance, greenhouse gas emissions can be reduced by increasing the share of CHP. Demand for fuel will also decrease. The use of CHP can thus contribute to an economy that is light on resources.

Assessing the development

Electricity generation by combined heat and power plants has seen an upward trend since 2003. The electricity generated rose almost continuously from 77.5 TWh to 102.2 TWh in 2015. This increase was mainly due to the development and use of biomass for energy generation as well as the capacity expansion of natural-gas CHP.

With the revision of the Act on Combined Heat and Power generation (KWKG) in 2016 future targets of annual energy generation by CHP systems were stipulated. In 2020 the target is 110 TWh, in 2025 120 TWh shall be generated by CHP systems per year. The regulations of the new act are meant to improve the conditions for CHP. Further it was stipulated that a call for bids will be obligatory for new CHP systems with an electrical power between 1 and 50 megawatts. This results in uncertainties regarding the expected development of additional CHP capacity. Thus it is difficult to predict target achievement at the moment.

Methodology

The indicator uses data on public and industrial power plants published by the Federal Statistical Office of Germany (StBA) ('Monatsbericht über die Elektrizitätsversorung' and 'Fachserie 4, Reihe 6.4', in German only). As the data collection by StBA does not cover all power plants new models were developed which consider electricity generation by additional power plants. The methodology and models are described in detail by Gores et al. (2014) and Baten et al. (2014).

- Indicator online (latest data, data download): www.uba.de/en/57115
- Detailed information: www.uba.de/12350 (in German only)
- Last update: 04/2017

03

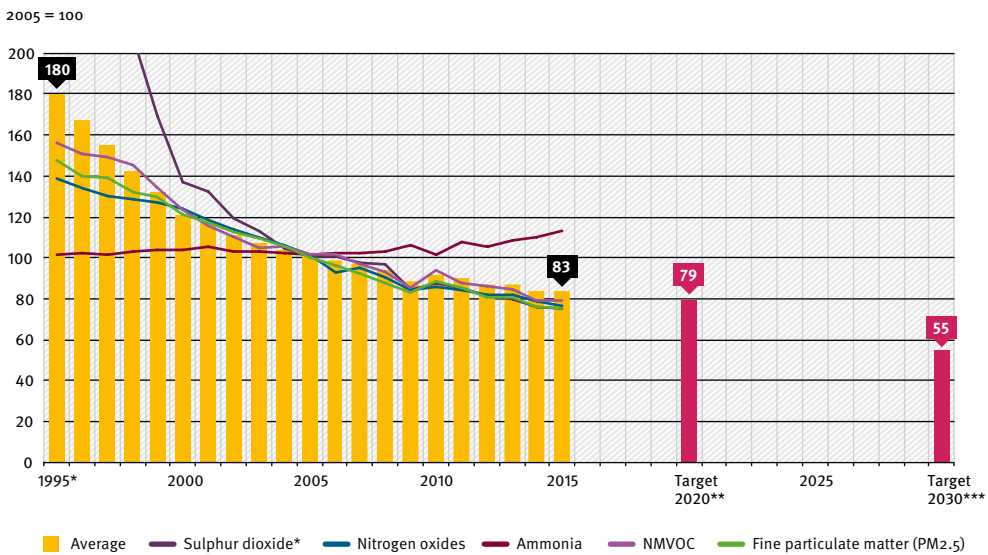
AIR

Emission of air pollutants

Air quality in agglomerations

Emission of air pollutants

Air pollutant index of emissions
Mean percentage trend of different air pollutant emissions compared with 2005



* Sulphur dioxide value in 1995: 360
** 2020 target based on the Gothenburg Protocol reduction commitments
*** 2030 target based on the future EU 'national emission reduction commitments' and the target of the Federal Governments' Strategy for Sustainable Development

Source: German Environment Agency, National trend tables for German reporting on atmospheric emissions since 1990, Emissions from 1990 to 2015 (as of 02/2017)

At a glance

- Annual emissions of five air pollutants decreased on average by almost 4 % between 1995 and 2015.
- The commitments of the Gothenburg Protocol for 2020 are expected to be reached.
- Reaching the commitments of the European NERC (national emission reduction commitments) Directive for 2030, is a major challenge for the German environmental policy. Ammonia emissions in particular, as well as – as agreed – coal-fired power generation must be reduced to achieve this.

Environmental importance

The indicator is based on the trend for five different pollutants (index) from different sources. Ammonia (NH_3) mainly comes from agriculture through livestock farming and fertilisation. Nitrogen oxides (NOx) and sulphur dioxide (SO_2) are mainly produced by combustion processes in power stations and engines. Non-methane volatile organic compounds (NMVOCs) mainly arise from the use of solvents in industrial processes. Fine particulate matter with a particle size of less than 2.5 micrometres (PM2.5) is derived from combustion processes in households, road transport and agriculture.

Their impacts on the environment are equally varied. Sulphur dioxide causes acidification of ecosystems by 'acid rain'. Ammonia and nitrogen oxides lead to excessive nutrient enrichment (eutrophication). NMVOCs contribute to the formation of harmful ozone pollution. PM2.5 causes respiratory diseases in humans.

Assessing the development

The value of the index has fallen sharply since 1995: From 180 in 1995 to 83 in 2015. However, the progress made with the different pollutants varies significantly. Emissions of sulphur dioxide have declined by almost 80 % since 1995. Emissions of ammonia, on the other hand, have risen by 12 % since then.

Germany has committed to reducing emissions of the five main air pollutants in accordance with the 2012 amendment to the Gothenburg Protocol of the Geneva Convention on Long-Range Transboundary Air (UNECE n.d.).

Germany must reduce emissions by an average of 21 % compared to 2005 by 2020. It is possible to achieve this target. Additional new targets were set for future 'national emission reduction commitments' for the five main air pollutants at the end of June 2016. Accordingly, Germany must reduce emissions of the five air pollutants by an average of 45 % between 2005 and 2030. The Federal Government has included this reduction target in the German Sustainable Development Strategy (Federal Government 2016).

Achieving these targets is a major challenge for German environmental policy. Additional measures are needed, especially to reduce ammonia emissions from agriculture. Coal-fired power generation must also be reduced. To do this, it will be necessary at least to implement the adapted climate policy scenarios ('With additional measures') on which the Federal Government's 'Projection Report 2015' is based (Federal Government 2015).

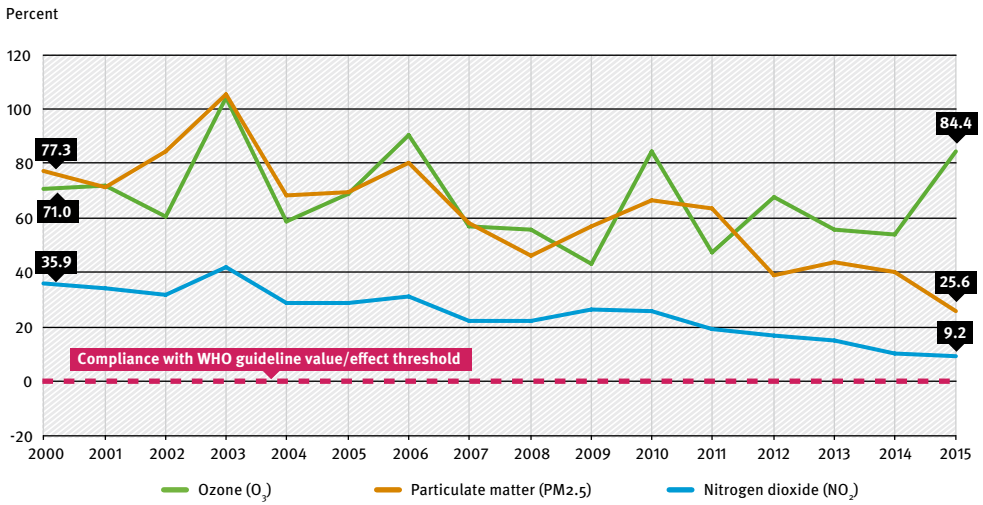
Methodology

The indicator is based on the relative trend in the emissions of five pollutants since 2005. Emissions of this year were set at 100 (indexed). The indicator is calculated from the annual average for the five pollutants. The calculation is based on data from the respective air pollutant inventories calculated by the German Environment Agency (UBA). These calculations are described in detail in the UBA's 'German Informative Inventory Report' (UBA 2017a).

- Indicator online (latest data, data download): www.uba.de/en/57122
- Detailed information: www.uba.de/15709 (in German only)
- Last update: 02/2017

Air quality in agglomerations

Discrepancy between average pollutant concentrations and WHO recommendations or prescribed effect thresholds in urban background locations in German agglomarations*



* WHO guideline values: O_3: 100 µg/m³ as max. daily 8-hour mean; PM2.5: 10 µg/m³ in annual mean (WHO Air quality guidelines - global update 2005); effect threshold for NO_2: 20 µg/m³ in annual mean (HRAPIE Project, WHO 2013)

Quelle: German Environment Agency 2016

At a glance

- The background levels of three main air pollutants in German agglomerations exceed World Health Organisation (WHO) guide line values and effect thresholds.
- Close to sources, pollutant levels can even be significantly higher.
- The situation regarding nitrogen dioxide and particulate matter has greatly improved since 2000.
- Ozone and particulate matter pollution is very dependent on the weather. Levels thus fluctuate significantly.

- Indicator online (latest data, data download): www.uba.de/en/57123
- Detailed information: www.uba.de/11137 (in German only)
- Last update: 07/2016

Environmental importance

Nitrogen dioxide (NO_2), particulate matter (PM2.5) and ozone (O_3) are of particular concern to human health. All three pollutants affect the respiratory organs. Many premature deaths are also attributed to particulates (cf. 'Health risks due to particulate matter' indicator). Ecosystems are also damaged by ozone.

The World Health Organisation WHO has defined air quality guideline values for particulates and ozone (WHO 2006). A new threshold for NO_2 has been proposed in a research paper (WHO 2013). Above these levels, health risks increase significantly. These values are stricter than the limits defined in the EU Air Quality Directive.

Air quality is particularly precarious in agglomerations, where one third of the German population lives. Here, industry, traffic and residential areas exist in close proximity. The indicator incorporates data from monitoring stations which measure background urban pollution levels. At busy locations in cities pollution levels may be significantly higher. The indicator represents the average discrepancy of all monitoring stations of urban background from WHO guideline values and an effect threshold, respectively. Even with negative indicator values, individual monitoring stations can still be above the target value.

Assessing the development

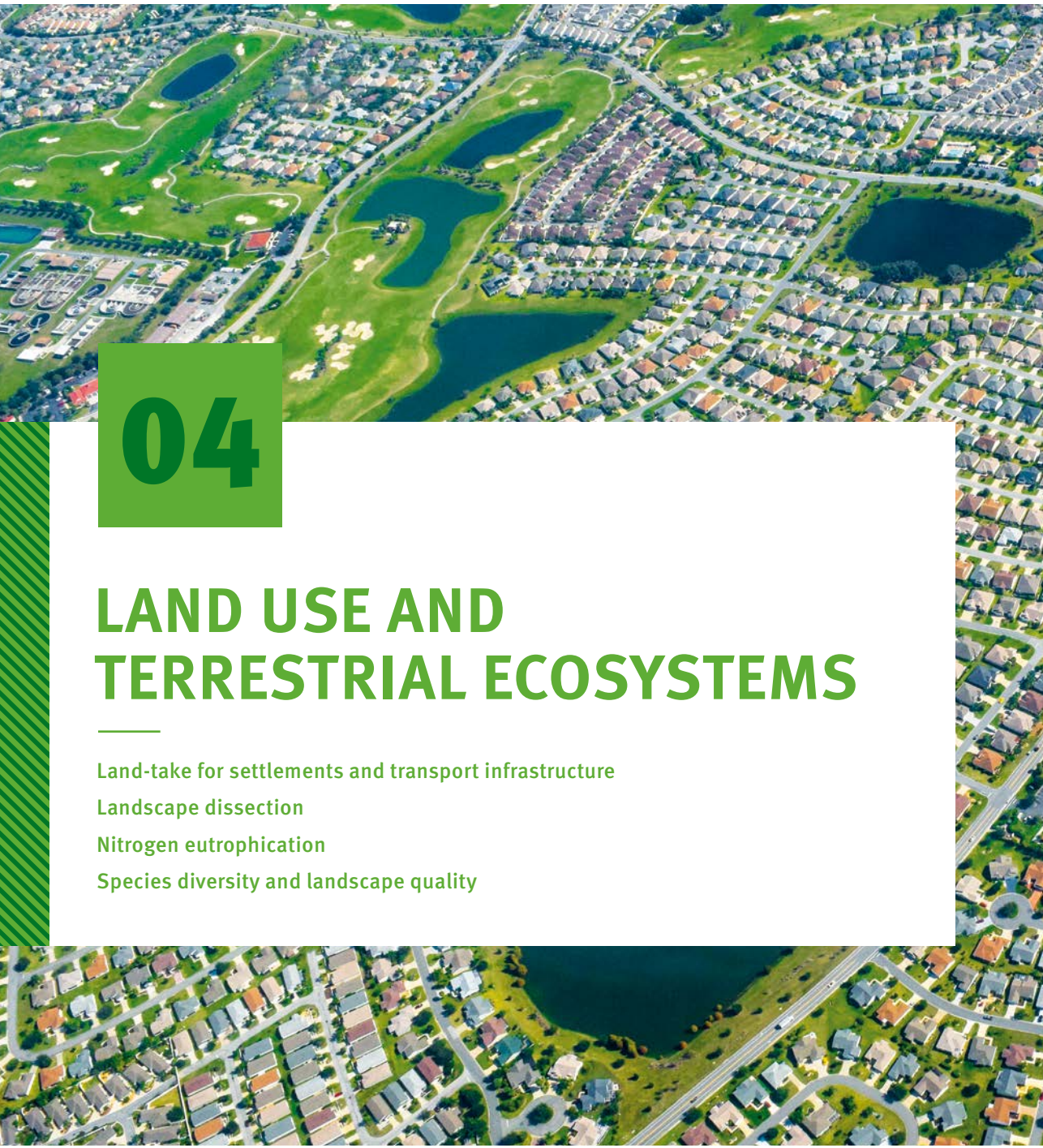
Levels of nitrogen dioxide and particulate matter have fallen considerably. If this trend continues, concentrations of both pollutants may fall below the WHO recommendations in the foreseeable future.

However, ozone concentrations fluctuate widely. This is largely due to the influence of the weather. In hot summers such as 2003 or 2015, ozone concentrations rise sharply. Thus it is impossible to make a meaningful statement about the trend in recent years.

In 2008 the EU set out its air quality objectives in the Air Quality Directive (EU Directive – 2008/50/EC). The German Environment Agency believes that, in the long term, the limit values defined in the directive should be reduced to the WHO recommendations. Even then, large parts of Germany would still fail to meet the less ambitious targets of the EU directive (UBA 2016c). There is still a long way to go until the air in agglomerations is sufficiently 'clean'.

Methodology

The indicator is based on measurement data from the network of German air quality monitoring stations. All monitoring sites within an agglomeration were included in the measurement of urban and suburban background pollution levels. Measurements of these monitoring sites are used to calculate the extent to which the three pollutants NO_2, PM2.5 and O_3 exceed or fall short of WHO recommendations. The average discrepancy between the values recorded at all monitoring stations and the WHO recommendation is calculated for each agglomeration. The average discrepancies are then averaged across all agglomerations and expressed in a standardised form with the WHO recommendation.



04

LAND USE AND TERRESTRIAL ECOSYSTEMS

Land-take for settlements and transport infrastructure

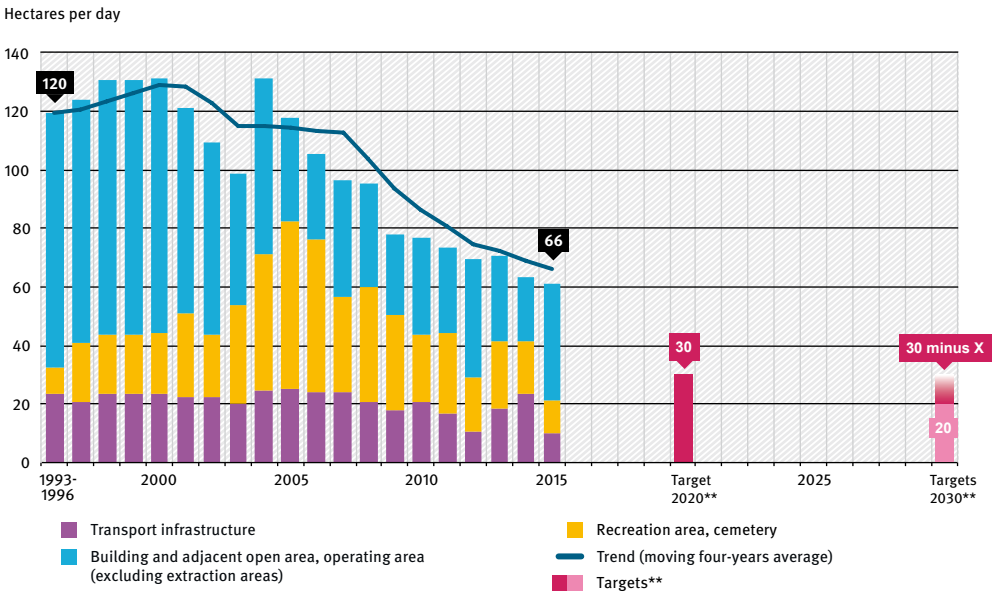
Landscape dissection

Nitrogen eutrophication

Species diversity and landscape quality

Land-take for settlements and transport infrastructure

Land-take for settlements and transport infrastructure*



* Land use survey is based on the evaluation of the states' (Länder) land registry. Data on increase in land use have been distorted from 2004 due to a change-over in land registries (recoding land use types in course of digitalisation).

** Target 2020: Climate Action Plan 2050; Targets 2030: '30 minus X' hectares per day: German Sustainable Development Strategy of the Federal Government, revised 2016; 20 hectares per day: Integrated Environmental Programme 2030

Source: Announcement of of the Federal Statistical Office 16.01.2017: values partially from Federal Statistical Office (2016): Fachserie 3 Reihe 5.1.2015. Bodenfläche nach Art der tatsächlichen Nutzung (in German only)

At a glance

- Between 2012 and 2015, 66 hectares (ha) of land per day were dedicated to settlements and transport infrastructure.
- The Federal Government aims to reduce this figure to 30 ha per day by 2020 and below 30 ha per day by 2030.
- Additional actions are necessary in order to achieve these targets.

- Indicator online (latest data, data download): www.uba.de/en/57125
- Detailed information: www.uba.de/11184 (in German only)
- Last update: 02/2017

Environmental importance

The conversion of agricultural land, forests or grassland to settlements and transport infrastructure has significant environmental impacts. Much of the land is covered with buildings and other facilities or sealed to expand transport networks. This destroys the natural fertility of soils, thereby impeding future (re-)use for agriculture and forestry. Sealed surfaces (i.e. asphalted or paved) lose their ability to regulate the microclimate and are unable to mitigate the overheating of towns and cities in summer. In addition, the loss of these areas has an adverse effect on species diversity as the new settlements and transport infrastructure increase fragmentation of landscapes and reduce the size of habitats.

Furthermore, newly developed settlements and transport infrastructure generate additional traffic which in turn creates noise and pollution. Material consumption also increases for the construction of buildings and transport routes. New buildings and infrastructures have to be operated, thereby energy consumption increases as well.

Assessing the development

Between 2012 and 2015, on average 66 hectares of land per day were designated for settlements and transport development. In the Climate Action Plan 2050, the Federal Government has confirmed the target of reducing the amount of new land for settlements and transport infrastructure to 30 ha per day by 2020 (BMUB 2016c). As part of the revised Sustainable Development Strategy, the German Federal Government has set itself the target of reducing land take for settlements and transport infrastructure to '30 minus X' ha per day or 'below 30' ha per day by 2030 (Federal Government 2016). The Integrated Environmental Programme 2030 by the Ministry for Environment, Nature Conservation, Building and Nuclear Safety sets a target of 20 ha per day for 2030 (BMUB 2016d).

Land-take for settlements and transport infrastructure almost halved since 2000. This was due to enforced legislation on planning and construction, increased efforts at federal state and local levels, slower economic growth and demographic change. If the trend of the last five years were to continue, the target '30 minus X' would be achieved even before 2030. Maintaining the trend, however, is an ambitious objective.

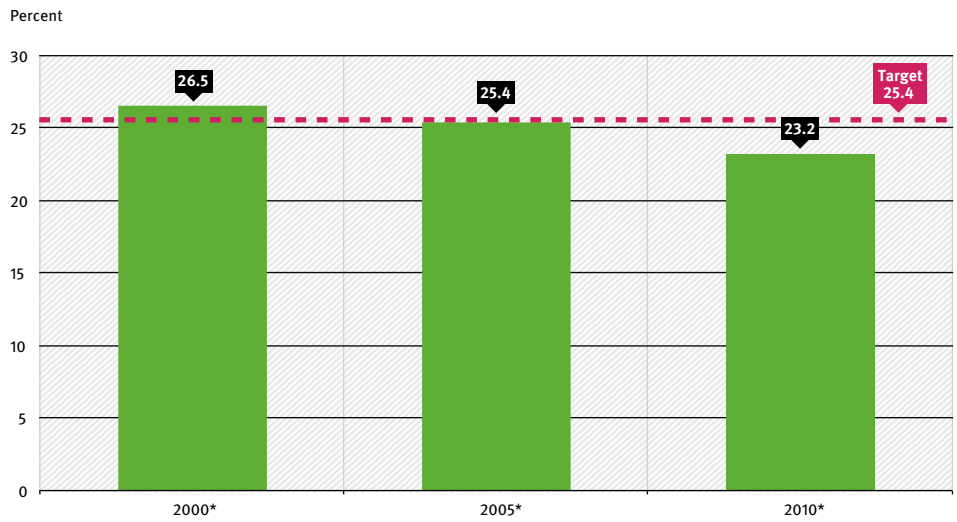
According to the Climate Action Plan 2050 the Federal Government strives at halting the net increase of land designated for settlements and transport infrastructure in Germany by 2050 at the latest. The German Environment Agency has compiled recommendations for policy measures in a publication (UBA 2009).

Methodology

The indicator represents the average increase in land used for settlements and transport infrastructure in hectares per day, based on each of the last four calendar years. Land for settlements and transport infrastructure includes buildings and open spaces, operational areas as stockyards, dumps and heaps (excluding extraction land), recreational facilities, cemeteries and transport routes and other transport facilities. The indicator is calculated annually by the Federal Statistical Office of Germany (StBA) on the basis of land use data reported by the Federal States. In many cases these are subject to one-off effects and have to be partially corrected by the StBA. Methodological hints thereto are given in the introduction to the annual publication 'Bodenfläche nach Art der tatsächlichen Nutzung' (in German only).

Landscape dissection

Undissected low-traffic areas with a minimum size of 100 km² as a percentage of Germany's total land area



* Due to very large differences in the underlying traffic volume data between the individual survey years, the comparability of the values in the time series is limited

Source: Federal Ministry of Transport, Building and Urban Development 2010; Federal Agency for Cartography and Geodesy 2013; Federal Highway Research Institute 2013; Federal States 2013

At a glance

- The data on undissected low-traffic areas are used to describe the fragmentation of the landscape by transport routes.
- In 2010 undissected low-traffic areas accounted for 23.2 % of Germany's total land area.
- The target of the Federal Government is to retain a proportion of 25.4 %.

- Indicator online (latest data, data download): www.uba.de/en/57126
- Last update: 02/2013

Environmental importance

Traffic adversely affects biodiversity by fragmenting habitats and creating noise and air pollution. Humans are affected by the loss of recreational areas. The indicator is based on a threshold area of 100 square kilometres (km^2), a size originally defined as a recreational space that allows walkers to go on day excursions largely undisturbed by intrusive sights or sounds.

Low-traffic areas are not necessarily near-natural. In Mecklenburg-Western Pomerania and Brandenburg, for instance, low-traffic areas make up more than 50 % of the total land area. This is largely because these Federal States are sparsely populated and have a lower density of transportation networks and less traffic, especially on regional and local roads. Furthermore, these regions are mainly characterised by intensive agriculture.

Assessing the development

In 2010 undissected low-traffic areas with a minimum size of 100 km^2 accounted for 23.2 % of the total German land area. In 2000 this figure was still 26.5 %. However, the basis for calculation (traffic density counts) was incomplete in 2000 and 2005. Models were therefore used to calculate traffic loads across the entire road network for the year 2010.

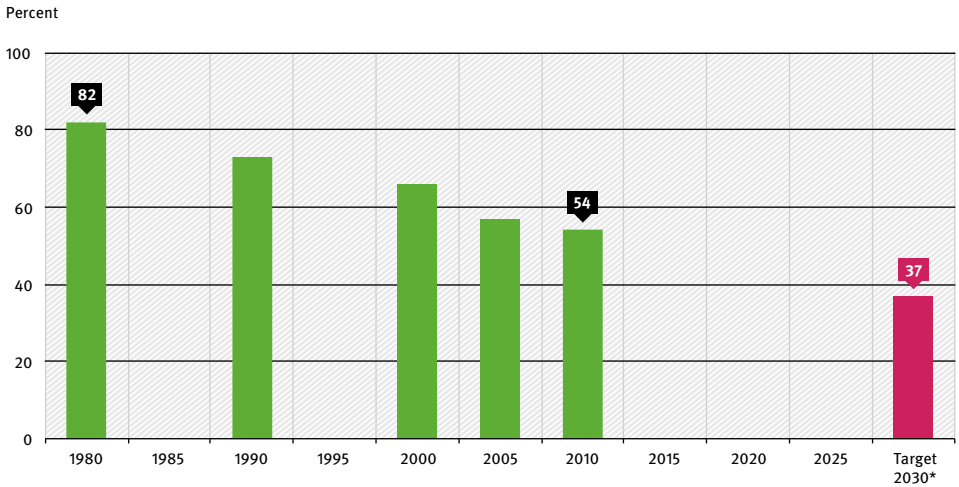
In the National Strategy on Biological Diversity, the Federal Government has set itself the target of keeping landscape fragmentation at least at a constant level (BMU 2007). The level of fragmentation in 2005 has been chosen as the target (25.4 %). However, the indicator value for 2010 is not comparable with those for 2000 and 2005 since in these years the data was incomplete. Closer analysis shows that the indicator value is significantly influenced by traffic loads on the subsidiary road network, i.e. the volume of traffic outside the main transport routes. Thus, the indicator is subject to certain fluctuations, depending on the chosen calculation method. This point must be considered when assessing the target attainment.

Methodology

The indicator is calculated by determining the proportion of Germany's total land area which is not dissected by transport routes. Dissecting transport routes are defined as roads (motorways, national, regional and local roads) with a traffic density of 1000 vehicles per day or above, at least double-track or electrified single-track railway lines and canals with the status of 'federal waterway' (Category IV or above). These areas can be identified using geo-information systems. Modelling and traffic counts (to calibrate the model) are needed to fully determine road traffic densities. The modelling approach for 2010 is described in Bosch & Partner et al. (2013).

Nitrogen eutrophication

Proportion of vulnerable ecosystems where critical loads for eutrophication are exceeded



* Federal Government's Strategy for Sustainable Development: The proportion of land affected by excess nitrogen deposition should fall by 35 % between 2005 and 2030. Based on a value of 57 % in 2005, this gives a target value of 37 % for 2030.

Source: European Environment Agency (EEA), Technical Report No.11, 2014

At a glance

- 54 % of vulnerable ecosystems in Germany are threatened by excess nitrogen deposition.
- As part of the revised German Sustainable Development Strategy 2016, the Federal Government aims to reduce this to 37 % by 2030.
- This target is feasible only if efforts to reduce air pollution are maintained.

- Indicator online (latest data, data download): www.uba.de/en/57128
- Detailed information: www.uba.de/11626 (in German only)
- Last update: 11/2014

Environmental importance

The maximum amount of pollutants that ecosystems can tolerate without being damaged is known as the 'critical load'. It is a measure of an ecosystem's sensitivity to pollution. Air pollution levels above these critical loads can permanently damage ecosystem structures and functions.

Excess deposition of airborne nitrogen compounds in terrestrial ecosystems can cause nutrient imbalances which may modify the species composition. Organisms that prefer low-nitrogen conditions will be displaced in favour of species that thrive in nitrogen-rich habitats.

Almost half of ferns and flowering plants on Germany's Red List are threatened by nutrient deposition. Moreover, many plants become more susceptible to frost, drought and pests due to changes in nutrient availability. The indicator focuses on natural ecosystems, especially forests, inland marshes, peat bogs, heathlands and nutrient-poor grasslands.

Assessing the development

Despite declining nitrogen deposition, in 2010 critical loads were still exceeded in 54 % of the area comprising vulnerable ecosystems. In 1980 this figure was as high as 82 %. High ammonia emissions associated with livestock farming and fertilisation are particularly problematic. These have fallen only marginally and are not expected to decline steeply in the near term.

The National Strategy on Biological Diversity includes the target of not exceeding the critical loads by 2020 (BMU 2007). This target is no longer feasible, but in the German Environment Agency's view it should remain a long-term goal. The Federal Government has set a new target in the German Sustainable Development Strategy 2016: The proportion of land affected by excess nitrogen deposition should fall by 35 % between 2005 and 2030 (Federal Government 2016). With the current basis for calculation, this gives a target value of 37 % in 2030.

The German Environment Agency proposes measures aimed at solving the problem of nitrogen eutrophication in its publication 'Reactive nitrogen in Germany' (UBA 2015a).

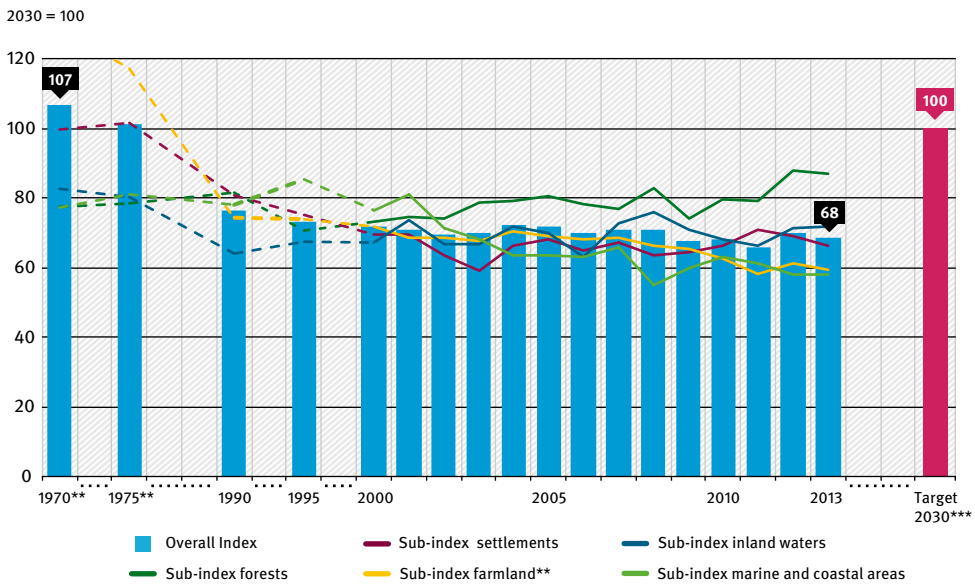
Methodology

The first stage is to calculate critical loads for vulnerable ecosystem types: How much nitrogen can be deposited without damaging the ecosystem in the long term? The critical loads are compared with substance depositions in the ecosystems, calculated in accordance with the Geneva Convention on Long-range Transboundary Air Pollution. More information is available in European Environment Agency (EEA) and German Environment Agency reports (EEA 2014, UBA 2014c). The German Environment Agency is currently working on a consistent national time series for the indicator as part of a research project.

Associated with the reporting of the National Strategy for Biodiversity a related indicator is published (BMUB 2015a). Due to deviating methods this indicator shows other values.

Species diversity and landscape quality

Population of representative bird species in different landscape and habitat types*

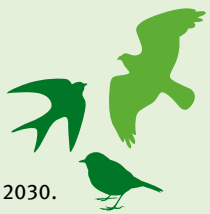


* The sub-index for the Alps has currently been abandoned across the entire data series.
** The values for 1970 and 1975 are based on a reconstruction; value of agricultural land 1970: 128.8
*** Target of the German Sustainable Development Strategy

Source: Federal Agency for Nature Conservation 2016; published in Federal Statistical Office of Germany (2017), Sustainable Development in Germany. Indicator Report 2016

At a glance

- The indicator has fallen from 70 % to 68 % during the last 10 years (2003 to 2013).
- The sub-indicators for farmland and marine and coastal areas have fared particularly badly.
- In the German Sustainable Development Strategy the Federal Government envisages that the indicator should rise to 100 % by 2030.



Environmental importance

A rich diversity of plant and animal species is essential to the balance of nature and provides an important natural resource for humans. Species diversity is closely linked to the diversity of habitats and landscapes. Sustainable forms of land use across the landscape and a responsible treatment of the natural environment are required to maintain biodiversity.

The indicator presented here was developed to assess the state of nature and landscape in Germany. It shows changes in the population of selected bird species which are representative of Germany's most important landscape and habitat types. Highly structured landscapes with intact, sustainably used habitats do not only provide habitats for birds. The indicator thus indirectly reflects trends in many other species living in the landscape and in the sustainability of land-use.

Assessing the development

In 1990, the indicator value was already significantly below the values that had been reconstructed for 1970 and 1975. The indicator continued to show a negative trend in the last 10 years of the data series (2003 to 2013). It was as low as 68 % of the target value in 2013. The main causes for this development are intensive agricultural use, landscape fragmentation and urban sprawl, sealing the ground and large-scale input of substances (e.g. nutrients, pesticides or acidifiers). The latest report 'Vögel in Deutschland 2014' (in German only) illustrates this trend in detail (Wahl et al. 2015).

In 2002, the indicator was developed as a key indicator for sustainable land use as part of the Strategy for Sustainable Development and incorporated in the National Strategy on Biological Diversity (Federal Government 2002, BMU 2007). Initially, the target value of 100 % was to be achieved by 2015. According to the most recent progress report on Germany's Sustainable Development Strategy, this deadline has been extended to 2030 by the government (Federal Government 2016). The 'Naturschutz-Offensive 2020' sets out key measures to achieve a positive trend (BMUB 2015b, in German only).

Methodology

The indicator reflects the trend in populations of selected bird species for five landscape and habitat types. For each bird species, an expert committee has defined a population target for 2015 which can be achieved if nature conservation regulations and guidelines for sustainable development are implemented rapidly. The target values have been standardised to give a target of 100 % for the overall indicator. Initially set for 2015, this target has been carried forward to 2030. It is intended to check the level of the target values up to 2020. A detailed description of the method can be found in Achtziger et al. (2004).

- Indicator online (latest data, data download): www.uba.de/en/57129
- Last update: 03/2016

05

WATER

River eutrophication by phosphorus

Sampling sites which exceed the requirement for good status for total phosphorus
Percentage of sampling sites of quality class II-III and worse*

* The specific requirement for good status for different types of water bodies is exceeded if the water quality class for total phosphorus is ""II-III"" or worse. The indicator shows the percentage of sampling sites which exceed the target value compared to the total number of sampling sites.

** From 1991 including sampling sites in the new Federal States

*** Target of the German Sustainable Development Strategy

Source: Prepared by the German Environment Agency from data provided by the German Working Group on water issues of the Federal States and the Federal Government 2016

At a glance

- Elevated phosphorus concentrations are recorded at almost two thirds of all river measurement stations.
- This proportion has only declined slightly since the beginning of the 1980s. However, very high levels of pollution are very rare nowadays.
- The Federal Government's aim is to meet the requirements for good status for phosphorous in all water bodies by 2030 at the latest.
- This primarily requires a change in fertiliser practices in agriculture. Small sewage treatment plants also need to remove phosphorus in accordance with current technology.

Environmental importance

The term 'eutrophic' comes from Greek (eu trophos) and means 'well fed'. Eutrophication is caused by human activities which lead to an accumulation of nutrients in previously nutrient-poor water bodies. Algae and water plants can then become overabundant and deprive other species of plants, many microorganisms and animals of essential resources.

Germany's water bodies are not in a good status. One of the biggest problems is the eutrophication of water bodies (cf. indicators of the ecological status of rivers, lakes and seas). The key factor when determining the degree of eutrophication is pollution by phosphorus. According to the 'law of the minimum', the growth of organisms is restricted primarily by the resource in shortest supply. In the case of algae and water plants, in most water bodies this is phosphorous.

Assessing the development

At the beginning of the 1980s excessive phosphorus concentrations were measured at over 80 % of sampling sites. In 2014 this proportion was still almost two thirds. However, if the poorer quality classes are considered, then a noticeable improvement can be seen. The proportion of sampling sites where the requirement for phosphorus was exceeded by a maximum of twice the value (quality class II-III) rose from 12 % to almost 56 % between 1982 and 2014. The worse classes declined accordingly. This improvement is mainly the result of introducing phosphate-free washing powders and phosphate precipitation in the larger sewage treatment plants.

According to the European Water Framework Directive (EU Directive 2000/60/EC), all water bodies must achieve a good ecological status by 2027. In Germany almost two thirds of water bodies have concentrations of phosphorus which are too high to meet this requirement. In order to remedy this, fertilising practices in agriculture need to change. Small sewage treatment plants also need to remove phosphorus using state-of-the-art technology. This is already happening in the bigger plants. According to the German Sustainable Development Strategy the requirements for good status for phosphorus need to be met by 2030 at the latest (Federal Government 2016).

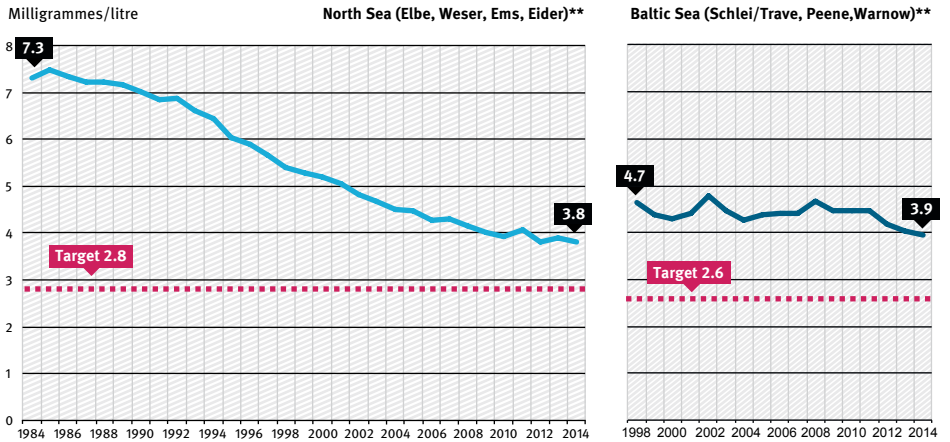
Methodology

The Federal States send measurements to the German Environment Agency from approximately 270 representative sampling sites. The 3-year mean phosphorous concentration is calculated for each sampling site for classification into a water quality class. This value is compared with the concentration which should not be exceeded for good ecological status in each of the types of water body. Details are regulated in the Surface Waters Ordinance (OGewV 2016). The indicator gives the proportion of sampling sites which have a water quality less than 'good' (Class II) in terms of total phosphorus.

- Indicator online (latest data, data download): www.uba.de/en/57154
- Last update: 2016

Eutrophication of the North Sea and Baltic Sea by nitrogen

Concentration of total nitrogen in main tributaries of the North Sea and Baltic Sea (Moving five-year-average)*



* The indicator includes only rivers flowing from German territory into the North Sea and Baltic Sea even though the target values of the Surface Waters Ordinance (Oberflächengewässerverordnung, OGewV) apply also to rivers with an estuary located outside of Germany, e. g. Rhine and Odra. Measurements are taken at the points where these tributaries finally leave the German territory.

** For the tributaries of the Baltic Sea measurements are only available from 1994 onwards. For the river Eider annual measurements are only available from 1990 onwards.

For the mean values the nitrogen concentrations of the individual rivers are weighted considering the total run-off of the rivers.

The coastal Federal States have not decided yet about the evaluation routine and the measuring stations to be used. The graph is therefore preliminary.

Source: German Environment Agency 2016 according to the Federal States and River Basin Communities

At a glance

- To achieve the objectives for the protection of the marine environment, Germany has committed to comply with maximum concentrations of nitrogen at river mouths.
- Averaged over all rivers, the target concentrations in the North Sea as well as in the Baltic Sea are exceeded.
- In order to achieve further reductions in nitrogen concentrations in the rivers, measures need to be taken, particularly in agriculture.

- Indicator online (latest data, data download): www.uba.de/en/57156
- Detailed information: www.uba.de/14508 und www.uba.de/14512 (in German only)
- Last update: 11/2015

Environmental importance

Coastal and transitional waters of the German North Sea and Baltic Sea fail to achieve good environmental status. The main cause of this are the excessive nutrient loads of nitrogen and phosphorous (eutrophication). The negative effects of eutrophication are described by the indicator 'Ecological status of transitional and coastal waters'.

Nutrients are carried into the sea mainly via rivers. This indicator looks at the concentration of nitrogen in rivers which flow into the North Sea and Baltic Sea in Germany (the Rhine and Odra are therefore excluded). These concentrations can fluctuate significantly depending on the weather, because in years with plentiful precipitation more nitrogen is leached out of the soils. In terms of the nutrient phosphorous, it can be assumed that the achievement of the guideline values that have been set for rivers is sufficient for the achievement of good status of the coastal and marine waters (cf. 'River eutrophication by phosphorus').

Assessing the development

Under the EU Water Framework Directive (WFD) and the EU Marine Strategy Framework Directive (MSFD), Germany is obliged to avoid excessive eutrophication of the German North Sea and Baltic Sea. In addition, under the Baltic Sea Action Plan (HELCOM 2007), Germany is obliged to reduce the input of nitrogen into this sensitive inland sea.

In order to achieve these objectives, the German Surface Waters Ordinance sets what are known as management target values for the rivers running into the North Sea and Baltic Sea (OGewV 2016): 2.6 milligrammes of total nitrogen per litre (mg/l) for rivers flowing into the Baltic Sea and 2.8 mg/l for those flowing into the North Sea. These target values were also used for the German Sustainable Development Strategy (Federal Government 2016).

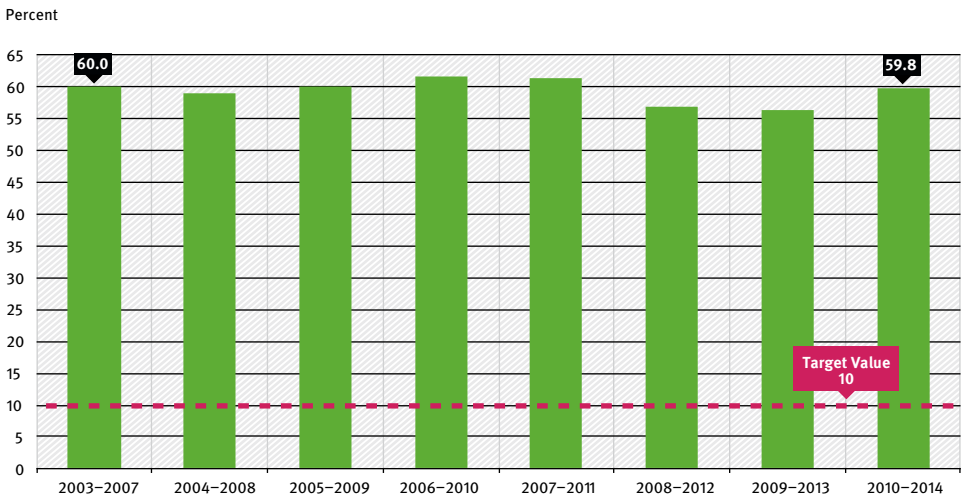
However, the average concentrations have dropped significantly since. This is mainly a result of the improvement in waste water purification in sewage treatment plants. The main responsibility for achieving these target values lies with the Federal States. Measures to reduce the input of nutrients are being taken as part of the implementation of the WFD. Currently most pollution comes from agriculture. The amendment to the German Fertiliser Application Ordinance will lead to a reduction in this pollution in the medium term (cf. 'Agricultural nitrogen surplus'). It is likely that additional measures will be needed in agriculture in order to achieve the target values.

Methodology

The Federal States where the rivers flow into the North and Baltic Seas maintain measuring stations at the estuaries. The nitrogen concentration of each of the flowing waters is measured at these stations at least once a month. These values, recorded over the period of a year, are used as the basis for the indicator. In order to compensate for annual weather-related fluctuations, the indicator is calculated as the moving average of the last 5 years.

Plastic waste in the North Sea

Percentage of beached fulmars on the North Sea coasts of Germany with over 0.1 g of plastic in their stomachs (5 year average)



Source data until 2013: Research and Technology Centre, West Coast (2012), 'OSPAR Fulmar Litter EcoQO - Masse von Plastikmüllteilen in Eissturmvogelmägen' (in German only);
Source data of 2014: Report by the Research and Technology Centre, West Coast (FTZ), 09.02.2016

At a glance

- Since studies began, the stomachs of 93 to 97 % beached fulmars have been found to contain plastics.
- Around 60 % of beached fulmars on the North Sea coasts have more than 0.1 gramme of plastic in their stomachs.
- The target set by the OSPAR convention is to reduce this to a maximum of 10 %. However, it may take a long time to reach this target.
- Large quantities of plastic waste still end up in the seas where plastics only break down very slowly to ever smaller particles.

Environmental importance

An average of 18,000 plastic particles are found on every square kilometre of the sea surface. Animals perceive the plastics as food. After ingestion plastic particles can damage and block the digestive organs which may cause internal injuries and death from starvation. Around 800 marine species are known to be negatively affected by contact with marine litter. The most obvious effects are ingestion of and entanglement in marine litter. The entanglement of marine life in litter items causes visible injuries which can be fatal, the effects of swallowing litter are often invisible.

For monitoring purposes, the fulmar has been established as an indicator species in the North Sea. This seabird has a wide distribution and feeds exclusively at the open sea. So far no species has been identified for the Baltic Sea which can be used for similar studies. Therefore no comparable information for the Baltic Sea is available for the time being.

Assessing the development

The majority of beached dead fulmars on Germany's North Sea coast has more than 0.1 g of plastic waste in their stomachs. This percentage has varied from 56 to 62 % since the beginning of the studies. Therefore, no clear trend can be statistically established for the entire period.

Germany has signed the Convention for the Protection of the Marine Environment of the North-East Atlantic (OSPAR). In 2008 the Contracting Parties to OSPAR decided as one of its so-called Ecological Quality Objective (EcoQO) that the percentage of beached fulmars having more than 0.1 g of plastic in their stomachs should be 10 % at the maximum. This value was derived from the relatively unpolluted Canadian Arctic.

Large quantities of plastic waste are still entering the seas and plastics take a very long time to break down. Therefore it can be expected, that the OSPAR target can only be achieved in the long term. An important instrument for reducing further inputs and existing quantities of marine litter in the Northeast Atlantic is the OSPAR Regional Action Plan on Marine Litter (OSPAR Commission 2014) adopted in 2014. It addresses a series of measures related to the relevant sea- and land-based sources and on opportunities for the removal of marine litter and awareness raising.

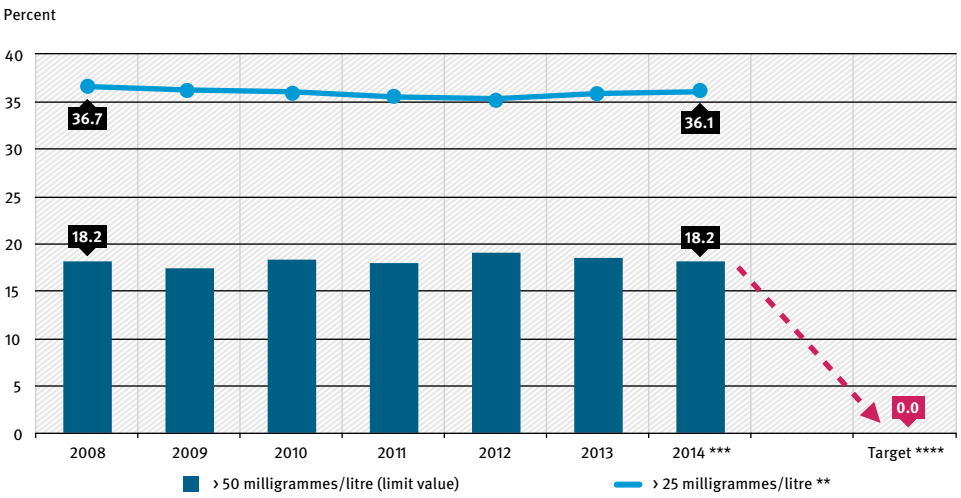
Methodology

The indicator is based on studies of beached (dead) fulmars on the North Sea coasts of Germany (south-east North Sea). In the laboratory, the stomach contents are studied and the plastic particles found are counted and weighed. As the values sometimes vary greatly between years, the indicator is calculated as the average of the last five years. A detailed description of the methods is given in Guse et al. (2012).

- Indicator online (latest data, data download): www.uba.de/en/57157
- Last update: 02/2016

Nitrate in groundwater

Proportion of sampling sites which exceed the target value*



* Basis: EEA monitoring network limit value: 50 milligrammes per litre annual mean value
** The value includes the percentage of sampling sites with › 50 mg/l.
*** In 2014 Berlin and Mecklenburg-Western Pomerania were not included in the calculation as there were no measurements available for this year.
**** Target set by the Nitrates Directive and the German Sustainable Development Strategy

Source: German Environment Agency and the Länder Initiative on Core Indicators (LIKI) based on data from the German Working Group on water issues of the Federal States and the Federal Government (LAWA, Report dated 3.6.2016)

At a glance

- The European Nitrates Directive places Germany under the obligation to prevent exceedances of the threshold of 50 milligrammes per litre.
- This threshold has been exceeded at around 18 % of sampling sites since 2008.
- The EU Commission has initiated infringement proceedings against Germany.
- Agriculture is the most important source of high nitrate concentrations in groundwater.

- Indicator online (latest data, data download): www.uba.de/en/57158
- Detailed information: www.uba.de/11224 (in German only)
- Last update: 06/2016

Environmental importance

In agriculture crops are given the necessary nitrogen via fertiliser. However, the fertiliser is often not applied correctly for the specific site and use. If the amount of fertiliser is too high the plants do not absorb it completely. Excessive nitrogen is leached out and ends up as nitrate in the groundwater and other water bodies. This leads to eutrophication in rivers and lakes (cf. 'Ecological status of rivers' and 'Ecological status of lakes' indicators).

Nitrate can be converted to nitrosamines in the body. This can result in disruption to the oxygen transport in infants (methemoglobinemia). The Drinking Water Ordinance (TrinkwV 2001) therefore stipulates a maximum value for nitrate of 50 milligrammes per litre (mg/l).

The threshold is very rarely exceeded in drinking water (UBA 2015c). It is complex and expensive to remove nitrate from groundwater in water treatment plants.

Assessing the development

The aim of the European Nitrates Directive (EU Directive 91/676/EWG) is to prevent the groundwater being polluted by nitrates.

Governments are obliged to develop action plans to prevent nitrate concentrations above 50 mg/l. The EU Commission has initiated infringement proceedings against Germany because the directive has not be adequately implemented there. Since 2008 the proportion of sampling sites which exceed the threshold value has fluctuated between 17.5 and 19 %. The proportion of sampling sites with a nitrate concentration above 25 mg/l has also stagnated since 2008. Since 2016 meeting the nitrate limit has also become part of the German Sustainable Development Strategy (Federal Government 2016).

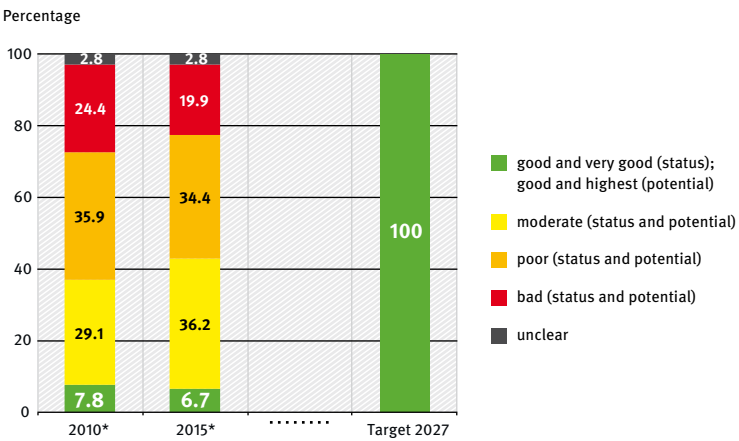
The most important instrument for achieving the Nitrates Directive targets is the German Fertiliser Application Ordinance. This was revised in a long-term process by the Federal Government and adopted in spring 2017. The effects of this new regulation will only become apparent in a few years. However, it is already foreseeable that they alone will not be sufficient to achieve the objectives of the Water Framework Directive and the Groundwater Directive. The effectiveness is essentially dependent on a reduction in the existing enforcement deficit. An improved control and sanctionability of violations of the regulatory law is urgently required.

Methodology

Germany has to send data on the condition of the groundwater to the European Environment Agency (EEA) on a regular basis. The Federal States therefore selected representative sampling sites to add to the EEA groundwater network. These are reported to the EEA through the German Environment Agency. The indicator compares the sampling sites where the limit value is exceeded with the total number of sampling sites.

Ecological status of rivers

Percentage of running waters in at least good status or with at least good potential



* The year refers to the year of reporting to the EU. For the 2010 reporting year, data were collected until 2008. The reporting year 2015 uses data collected between 2009 and 2014.

Source: German Environment Agency, report portal WasserBLIcK; German Federal Institute of Hydrology 2015, management plans for the period 2016 to 2021

At a glance

- In 2015 only around 7 % of German streams and rivers were in at least a good ecological status or had at least a good ecological potential.
- According to the European Water Framework Directive, by 2015 all rivers should have achieved at least a good ecological status or potential.
- This target has not been achieved. The time up to 2027 must be used to reach these demanding objectives.
- The measures taken to date require more time to take effect. Other measures are also required.

- Indicator online (latest data, data download): www.uba.de/en/57159
- Detailed information: www.uba.de/19639 (in German only)
- Last update: 02/2016

Environmental importance

Streams and rivers are an important part of the environment. The character of landscapes away from the coasts is provided primarily by rivers. Their status had deteriorated seriously in the past. Due to water engineering works over the last few centuries, around half of all streams and rivers are now considerably modified or artificial. Rivers are also polluted by contaminants and nutrients from industry, private households and agriculture.

Water pollution causes changes in the original species composition. The indicator primarily reflects the degree to which the current species composition in the rivers corresponds to the original composition. The closer the species diversity to the original status, the better the ecological status and therefore the more resilient the ecosystem. The ecological potential, on the other hand, is specified in significantly modified or artificial water bodies, because a comparison with the natural species composition is not possible in such cases.

Assessing the development

The proportion of streams and rivers in at least good ecological status or with at least good ecological potential remained almost constant between 2010 and 2015. This proportion was just under 7 % when last measured. The most important reason for this is that species communities which have been disturbed on the long term require time to recover. This was initially underestimated. However, the proportion of running waters in a bad or poor status declined between 2010 and 2015. At the same time the proportion of running waters in a moderate ecological status increased significantly.

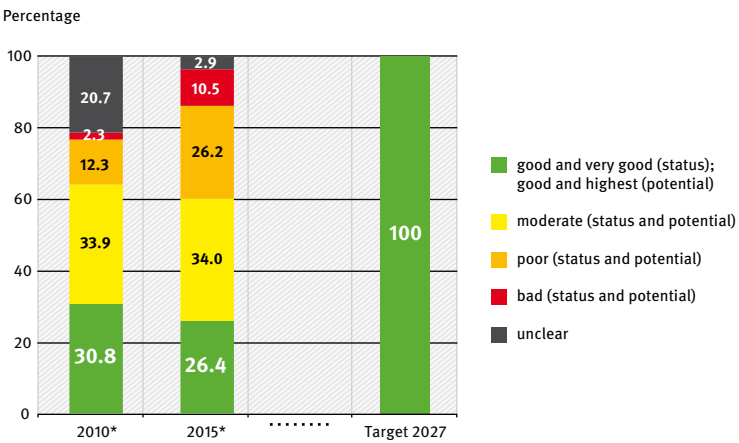
The European Water Framework Directive (WFD, EU Directive 2000/60/EC) was agreed in 2000. This set a target for all water bodies in Europe of a good or very good status by 2015. The Federal States drew up management plans defining measures for improving water quality. Germany was not the only country that missed the 2015 target for most streams and rivers by a large margin. The two subsequent management cycles under the WFD now need to be used to reach the ambitious targets by 2027 at the latest.

Methodology

The ecological status of a stream or a river is primarily defined on the basis of the presence of different species and their abundances. This is compared with the species composition which would naturally be present in this type of water body. Five status classes are defined, depending on the degree of divergence, from ‘very good’ to ‘bad’. An ecological potential is assessed for artificial and heavily modified water bodies. The highest potential is present when all measures to improve the environmental quality have been taken which do not have a significant negative effect on use. The classification is laid down in the Surface Waters Ordinance (OGewV 2016).

Ecological status of lakes

Percentage of lakes in at least good status or with at least good potential



* Due to changes in the methodology, the annual values for 2010 are only comparable to a limited degree with those for 2015. The relevant indicator value is the one for 2015. The year refers to the year of reporting to the EU. For the 2010 reporting year, data were collected until 2008. The reporting year 2015 uses data collected between 2009 and 2014.

Source: German Environment Agency, report portal WasserBLIcK/German Federal Institute of Hydrology, management plans for the period 2016 to 2021

At a glance

- In 2015 26 % of the lakes in Germany were in at least good ecological status or showed at least a good ecological potential.
- The Water Framework Directive states that this figure should reach 100 % by 2015.
- Germany is still far away achieving this target. The time up to 2027 must be used to reach these challenging objectives.

- Indicator online (latest data, data download): www.uba.de/en/57161
- Detailed information: www.uba.de/11351 (in German only)
- Last update: 02/2016

Environmental importance

Lakes not only provide us with recreation but also have important functions for protecting nature and the environment. For example, their shores provide habitats for a wide range of species of plants and animals. These (in places) sensitive ecosystems are threatened by nutrient inputs and, in particular, by increasing use.

There are numerous reasons why many lakes do not reach an optimal ecological status. Biological, chemical, physicochemical and structural (hydromorphological) aspects all contribute. Lakes only regenerate slowly, because the water in them is only exchanged very slowly. One major problem are inputs of nutrients from agriculture. If this inputs are reduced, a restoration effect can only be achieved with a delay. It usually takes many years until a lake recovers from excessive nutrient inputs.

Assessing the development

The proportion of lake water bodies in a good or very good ecological status is considerably higher in the case of lakes than in other types of water bodies. In 2015 24.0 % of lakes were in a good ecological status and 2.3 % in a very good status. The fact that the values have deteriorated in comparison to 2010 is mainly due to better measurement methods. The real status of the lakes has remained roughly constant overall.

Germany is still far away from achieving the targets laid down in the European Water Framework Directive (WFD, EU Directive 2000/60/EC). According to this all water bodies should be in at least a good status by 2015. As this target has been missed, the two subsequent management cycles under the WFD now need to be used to reach the ambitious targets by 2027 at the latest. The Federal States drew up management plans defining measures for improving water quality.

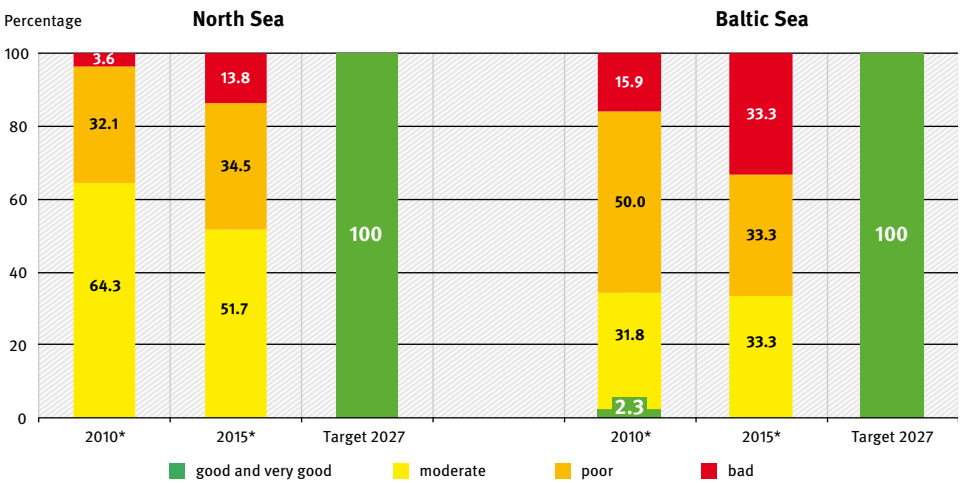
A major problem for the status of many lakes is the use of too large amounts of agricultural fertilisers (cf. 'Agricultural nitrogen surplus'). To reduce this surplus the Fertiliser Ordinance was comprehensively revised and adopted in spring 2017. It is already foreseeable now that additional measures are necessary to reduce the input of nutrients into surface waters to an acceptable level.

Methodology

Determining the 'ecological status' of a lake relies mainly on a comparison of the presence of a range of species with what would naturally be present in that type of water body. Five status classes are defined from 'very good' to 'poor', depending on the degree of divergence and other assessment factors. An ecological potential is assessed for artificial and significantly modified water bodies. The highest potential is present when all measures to improve the ecological quality have been taken. However, these must not have a significant negative impact on use. The classification is laid down in the Surface Waters Ordinance (OGewV 2016).

Ecological status of transitional and coastal waters

Percentage of water bodies in transitional and coastal waters in at least good status



* The year refers to the year of reporting to the EU. For the 2010 reporting year, data were collected until 2008. The reporting year 2015 uses data collected between 2009 and 2014. Due to improved available data and modified limit values for the evaluation, the annual values for 2010 are only comparable to a limited degree with those for 2015.

Source: Voß et al. (2010), Ökologische Zustandsbewertung der deutschen Übergangs- und Küstengewässer 2009 (in German only); Management plans for the period 2016 – 2021

At a glance

- In 2015 no water body of transitional or coastal waters in the North and Baltic Seas achieved good or very good status.
- According to the European Water Framework Directive, by 2015 all waters should have achieved at least a good ecological status.
- This target has not been achieved. The time must now be used to reach the ambitious targets by 2027 at the latest.
- This will require considerable additional efforts.

- Indicator online (latest data, data download): www.uba.de/en/57162
- Detailed information: www.uba.de/30414 und www.uba.de/30415 (in German only)
- Last update: 01/2016

Environmental importance

The high input of nutrients such as nitrogen and phosphorous into the North and Baltic Seas leads to a large growth of algae. A high density of algae causes a shortage of light at greater depths. Plants which require light are suppressed. If the algae and other plants die, they are decomposed by microorganisms. This process uses up oxygen and the oxygen concentration of the water declines. This can cause animals to suffocate. Large areas of the Baltic Sea now have low oxygen levels or contain no oxygen.

The Baltic Sea and North Sea are quite different in terms of their nutrient and oxygen concentrations. The North Sea constantly exchanges water with the Atlantic and Arctic Oceans and is generally more turbulent. The Baltic Sea, on the other hand, is only connected to the North Sea and the connections are very narrow. It therefore has the character of an inland sea and reacts more sensitively to excessive nutrient inputs.

Assessing the development

In 2015 no water body of the coastal and transitional waters of the German parts of North and Baltic Seas achieved good or very good ecological status. The target set by the European Water Framework Directive (WFD, EU Directive 2000/60/EC) i.e. that all waters should be in at least a good environmental status by 2015, was therefore missed by a wide margin. As this goal was clearly missed, the two subsequent management cycles under the WFD now need to be used to reach the ambitious targets by 2027 at the latest.

The reason for missing the targets is primarily the excessive input of nutrients into coastal and transitional waters (eutrophication). These mainly come from agriculture, sewage treatment plants and shipping. The nutrients enter the sea via rivers or the atmosphere (cf. 'Eutrophication of the North Sea and Baltic Sea' and 'River eutrophication by phosphorous' indicators). The measures taken so far are not (yet) taking effect to an adequate degree. Efforts must be significantly increased in order to reduce nutrient inputs to a level which allows a good status to be achieved.

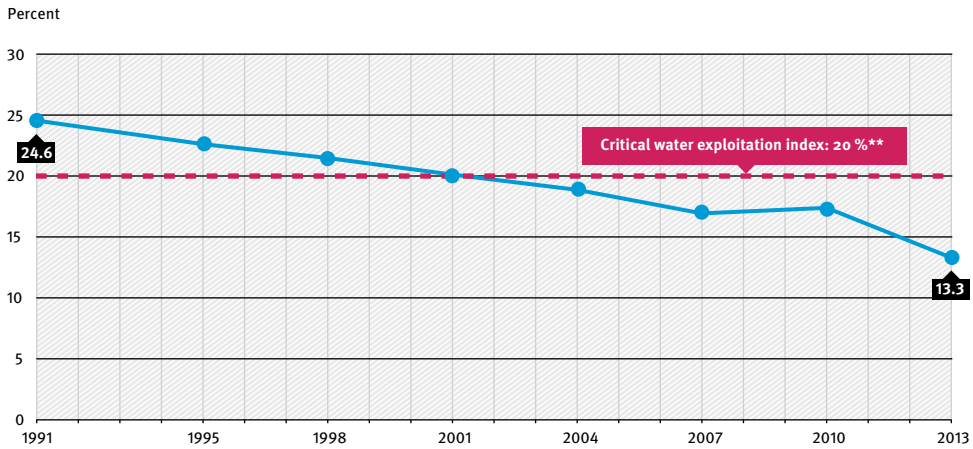
Compared to 2010 there has been an increase in the proportion of bad and poor areas. This can be explained mainly from the much improved availability of data and modified threshold values. In reality there has been almost no deterioration.

Methodology

Determining the ecological status of coastal and transitional waters basically requires analysis of the species composition of selected plant and animal communities which function as indicators: to what degree do they correspond to the typical composition of the particular habitat? Five status classes are defined, depending on the degree of divergence from the natural status, from 'very good' to 'bad'. A detailed description of the evaluation of water bodies has been published by Voß et al. (2010).

Using water resources

Water exploitation index
Proportion of water abstraction to water resources*



* The water exploitation index is derived from the ratio of total water abstraction of the given year (since 2007 including irrigation) to the long-term potential water resources in Germany (188 billion m³).

** A water exploitation index of 20 % is considered as threshold for water stress.

Source: Federal Statistical Office of Germany; Fachserie 19, R. 2.1 and 2.2, Wiesbaden, various years; German Federal Institute of Hydrology, Koblenz, release dated 09.12.2016

At a glance

- A water exploitation index of 20 % or above indicates the threshold of water stress.
- Water stress means an increasing risk of environmental problems and economic difficulties.
- Since 2004 the water exploitation index has been below the critical level of 20 %. Without cooling water the value is far below 20 %.
- Germany is causing water exploitation in other parts of the world by importing goods. In some regions this can contribute to water stress.

- Indicator online (latest data, data download): www.uba.de/en/57163
- Detailed information www.uba.de/20044 (in German only)
- Last update: 08/2016

Environmental importance

The water exploitation index shows the level of water abstraction in Germany, measured against the renewable water resources. A usage level of the water resources above 20 % is considered as water stress in international terms. Using too much water can lead to environmental problems and hinder economic development (Raskin et al. 1997). For instance, groundwater resources near the coast can become saline due to the penetration of seawater. Falling groundwater levels can lead to the drying out and loss of marshes and wetlands.

Although there is generally no water stress in Germany, there are regional and seasonal differences. Precipitation is very unevenly distributed in Germany. Regions such as Brandenburg and Saxony-Anhalt have particularly low precipitation. Other regions, e.g. the Alpine foothills, have particularly high levels of precipitation.

The indicator should have a regional reference added in future. This would enable the water exploitation index to be specifically identified on a regional basis and regions with potential water stress could be shown. Indicators of this kind are currently being developed.

Assessing the development

In its Roadmap to a Resource Efficient Europe the European Commission has set a target of not exceeding the 20 % threshold value for the water exploitation index (European Commission 2011a). In Germany the index fell from 24.6 % to 13.3 % between 1991 and 2013. The reason for this development is a continuous decline in water abstraction in Germany. In 1991 it was still 46.3 billion cubic metres (m^3) while in 2013 it was about 45 % less, at 25.1 billion m^3.

Large amounts of the water volume are used for cooling and are returned after use. If this is included in the calculation, then the water exploitation index would be considerably below 10 %. The sharp fall in water abstraction between 2010 and 2013 was largely due to the lower use of cooling water in conventional power plants.

There is therefore no water stress in Germany itself. However, the German economy contributes to water usage in other countries through the import of water-intensive goods. This can cause water stress in some places, depending on the local conditions.

Methodology

The indicator compares water abstraction with potential water resources. Calculating the water resources includes inflow from other countries and the difference between precipitation and evaporation from soils and plants. The mean of the period from 1961 to 1990 is used for calculating the index. Water abstraction is recorded by the Federal Statistical Office of Germany and published every three years in the 'Fachserie 19 Reihe 2.1.1 and 2.2' (StBA 2015b and 2016a, in German only). These technical series also include guidelines on collecting the data.

06

ENVIRONMENT AND HEALTH

Population exposure to traffic noise

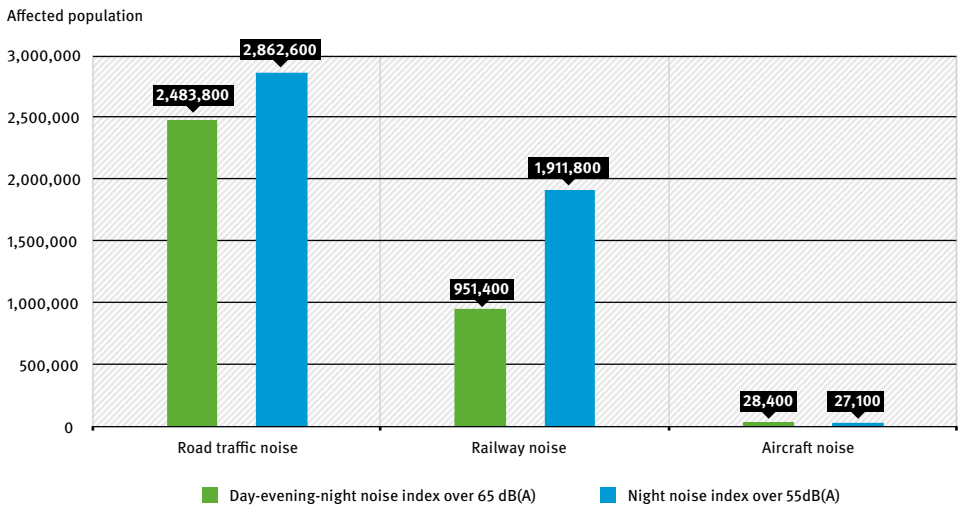
Bathing water quality

Population exposure to particulate matter pollution

Health risks due to particulate matter

Population exposure to traffic noise

Population exposure to traffic noise around major roads, major railways and major airports and in agglomerations (according to Environmental Noise Directive)*



* The figures are for data collection year 2011.

Source: German Environment Agency 2016, compilation of notifications from the Federal States and the Federal Railway Authority, in accordance with § 47c BImSchG; Last update: 29.02.2016

At a glance

- In 2012, the health of 4.8 million people was affected by night-time noise. Throughout the day, noise affected the health of 3.5 million people.
- The main source of noise is road traffic. Rail traffic is particularly relevant at night. Overall, aircraft noise plays only a minor role.
- Noise that exceeds exposure limits can lead to health problems.

Environmental importance

Traffic noise affects the lives of a large number of people in Germany. There are a number of ways in which noise caused by road and rail traffic or air traffic can have a negative impact on health and wellbeing. Noise affects quality of life, including sleep quality. It can alter sleep patterns. Those people affected wake up more often and produce more stress hormones. The risk factors for cardiovascular disease increase. The impacts are described in detail in a scientific article published by the German Environment Agency (Wothge 2016).

In order to avoid negative impacts on health, the World Health Organization (WHO) recommends that night-time noise exposure should not exceed a time-average level of 40 decibels (dB(A)) (WHO 2009). There is evidence that the risk of cardiovascular disease increases when the average night-time noise rises to more than 55 dB(A), or if the average noise level during the day is more than 65 dB(A). These two values were therefore used as threshold values for the indicator.

Assessing the development

In 2012, 4.8 million people were affected by excessive traffic noise (over 55 dB(A)) around major transport routes and major airports, and in agglomerations. Throughout the day, around 3.5 million people were exposed to traffic noise that exceeded 65 dB(A). This means that nearly 6 % of the German population was affected by night noise, and over 4 % by daytime noise.

The different types of transport produce different noise problems. The main noise source is road traffic. Rail traffic tends to be a problem at night, and few people are affected by aircraft noise.

In 2009, the Federal Government passed a second national traffic noise protection package ('Nationales Verkehrslärmschutzpaket II') (BMVBS 2009), which states that noise from road traffic and inland waterway transport is to be reduced by 30 %, air traffic noise by 20 % and rail traffic noise by as much as 50 % below 2008 levels by 2020. Some measures have already been taken (BMVI n.d.). More efforts are necessary to achieve a significant reduction in noise pollution.

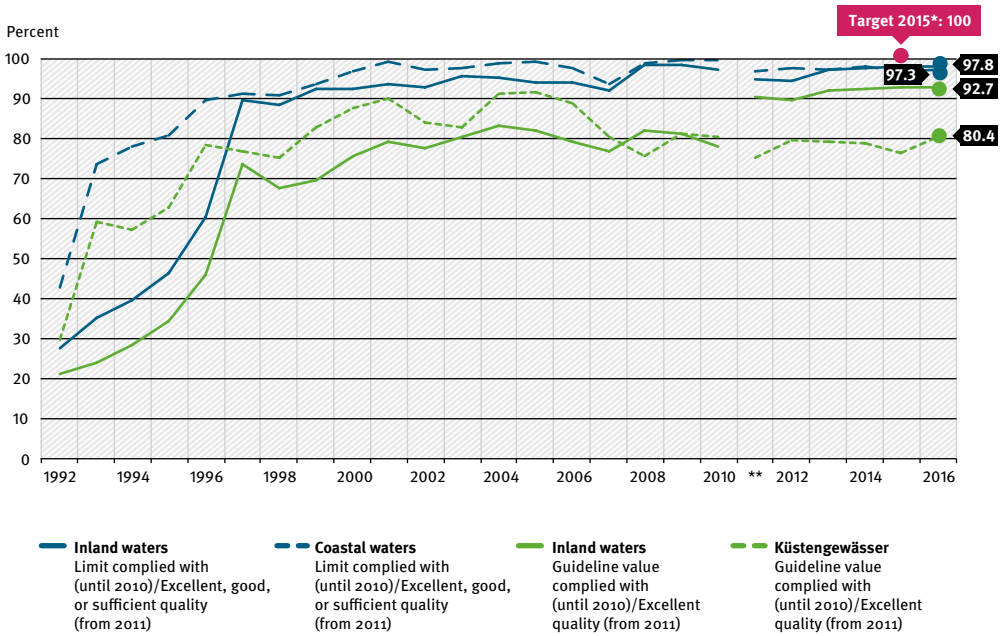
Methodology

The basis for calculating the indicator is noise mapping. Noise mapping has been enshrined in the Federal Immission Control Act (BImSchG) since June 2005 based on the standards of the European Environmental Noise Directive. Noise maps have to be drawn up for agglomerations, major roads, major railways and major airports. Detailed calculation instructions can be found in two method documents published by the Federal Government (BMU and BMVBS 2006 and 2007). The noise level is expressed as an A-weighted sound pressure level. The A-rating is used to recreate the frequency-dependent hearing sensitivity of people.

- Indicator online (latest data, data download): www.uba.de/en/57235
- Detailed information: www.uba.de/12399 (in German only)
- Last update: 02/2016

Bathing water quality

Percentage of German bathing waters that comply with the provisions of the Bathing Water Directive or have 'excellent' bathing water quality



* Excellent, good, or sufficient quality (EC Bathing Water Directive)

** Change in assessment: Since 2011 there has been a new quality scale for bathing waters in line with the new European Bathing Water Directive (2006/7/EC)

Source: European Commission 2017, Quality of Bathing Waters, Bathing season 2016

At a glance

- All bathing waters in the EU were supposed to be of at least sufficient quality by 2016.
- Germany missed the target by a narrow margin: nearly 98 % of all bathing waters met the requirements in 2015 and 2016.
- Taking into account only those bathing waters that were assessed, 99.8 % of the bathing waters met the requirements.
- Nearly 93 % of inland bathing waters and 80 % of coastal bathing waters had excellent water quality in 2016.

Environmental importance

Swimming in natural waters may be associated with health risks. Like all waters, bathing waters are used for a wide range of purposes and are therefore exposed to a number of pollution risks.

The indicator is based on the hygienic quality of the bathing water by measuring the level of faecal bacteria in the water. Bathing waters with high concentrations of these bacteria are at risk of also having pathogens present. These can cause diseases involving fever, sickness and diarrhoea. This risk is present after heavy rain, for instance, as a result of combined waste water overflow from sewage treatment plants or runoff from agricultural land. Another problem arises as a result of high nutrient discharges (especially phosphates). These can lead to a mass development of cyanobacteria. If these bacteria occur in large numbers, measures have to be taken. The presence of cyanobacteria is, however, not included in the quality assessment.

Assessing the development

Germany's bathing waters are of good quality. In 2016, nearly 98 % of all bathing water sites met the EU's minimum quality standards (inland waters 97.8 %, coastal waters 97.3 %). Taking into account the fact that not all bathing water sites can be assessed (e.g. because they are new), 99.8 % of the assessed bathing water sites meet the criteria. Nearly 93 % of inland bathing sites and 80 % of coastal bathing sites had excellent bathing water quality. Between 1992 and 2001, the proportion of bathing sites complying with the guideline and minimum values rose steadily. Since then, the quality of Germany's bathing waters has remained at a high level with slight fluctuations. The European Bathing Water Directive (EU DIR 2006/7/EC) sets out the values that bathing water has to comply with for the various levels of hygiene quality. All bathing water sites were supposed to at least meet the requirements of the sufficient quality level by 2015. The target was missed by a narrow margin, but Germany is still one of the leading countries in Europe.

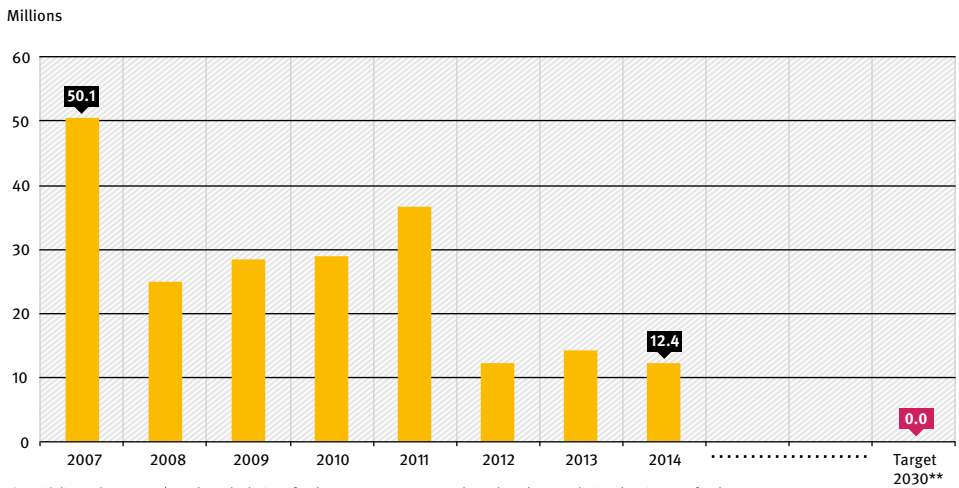
Methodology

Water samples have to be taken in all European bathing waters before and during the bathing season according to a monitoring calendar. The samples are analysed for the faecal bacteria *Escherichia coli* and for the clade group intestinal enterococci. Specified concentrations have to be met for the different quality levels, which are set out in Annex I of the Bathing Water Directive. A detailed description of the methodology can be found in the Bathing Water Directive and in the report on the state of bathing water quality published by the European Environment Agency (EEA 2016).

- Indicator online (latest data, data download): www.uba.de/en/57182
- Detailed information: www.uba.de/11348 (in German only)
- Last update: 05/2017

Population exposure to particulate matter pollution

Proportion of population exposed to PM10-concentrations exceeding the WHO annual average guideline value*
Rural and urban background



* Guideline value: 20 µg/m³; The calculations for the years 2007-2010 are based on the population density map for the year 2005. Since 2011 the population density map for the year 2011 is used. Both were retrieved from the Federal Institute for Research on Building, Urban Affairs and Spatial Development (BBSR).

** Target of the German Sustainable Development Strategy

Source: German Environment Agency 2016

At a glance

- Exposure to particulate matter pollution in areas not affected by intensive traffic has decreased substantially since the year 2007.
- Particulate matter concentrations in ambient air are considerably affected by weather conditions which may vary substantially throughout the year and from one year to another.
- The emissions of particulate matter and substances that can form secondary particulates have decreased only slightly.
- The Federal Government's aim is, that the WHO guideline value should not be exceeded by 2030.

- Indicator online (latest data, data download): www.uba.de/en/57183
- Detailed information: www.uba.de/28087 (in German only)
- Last update: 06/2016

Environmental importance

Particulate matter in ambient air is harmful to human health: the particles enter the human body through the respiratory system. Depending on the size of the particles, they can reach deep into the respiratory tract system and even enter the blood stream when penetrating the pulmonary tissue. There is clear evidence that particulate matter can trigger various diseases (cf. 'Health risks due to particulate matter' indicator).

Particulate matter is largely man made resulting from combustion processes. A considerable share of particulate matter are 'secondary' particulates, which are formed in the atmosphere from precursor substances, including nitrogen oxides from combustion processes and ammonia from agriculture.

The indicator takes into account the particulate matter exposure levels from rural and urban background areas, i.e. the pollution levels at a certain distance from emission sources, such as industrial plants or roads with high traffic volumes. The WHO guideline value for health protection is used as the standard of evaluation for the indicator. The German Environment Agency considers the limit set by the European Ambient Air Quality Directive (EU DIR 2008/50/EC) as too high to be protective for human health.

Assessing the development

The number of people exposed to particulate matter concentrations that exceed the WHO long-term exposure guideline value has decreased substantially since the year 2007. This is largely because measures to reduce emissions are showing initial successes, particularly in the transport sector. Other developments including the growing number of households using wood-fired heating are counteracting this progress.

In addition particulate matter concentrations in ambient air are considerable affected by weather conditions which might vary substantially throughout the year and from one year to another.

The EU Air Quality Directive defines an annual average limit value of 40 µg/m³ for PM10 to protect human health. This annual limit value has not been exceeded in Germany in recent years. However, the WHO recommends a more stringent guideline value of 20 µg/m³ (WHO 2006). The German Sustainable Development Strategy states that by 2030 the stricter WHO guideline value should not be exceeded in Germany (Federal Government 2016).

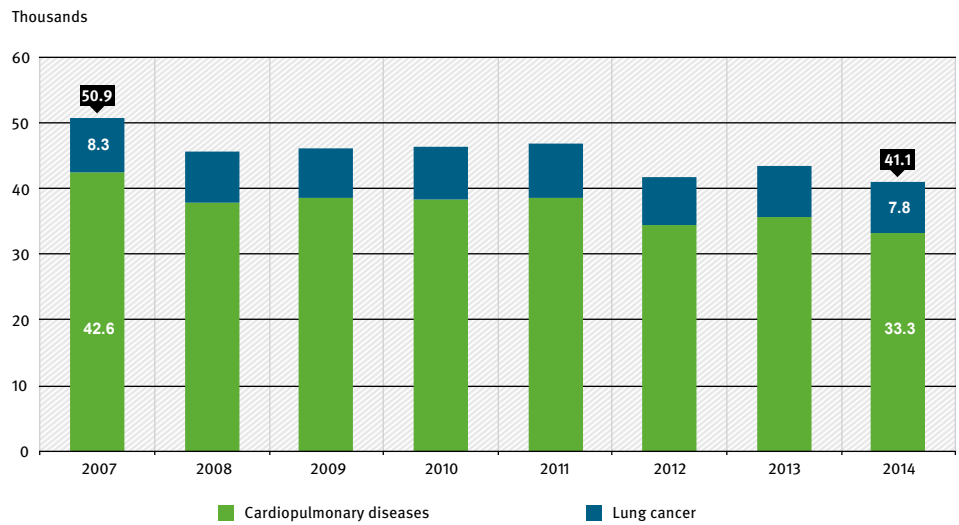
Further stimuli for reductions in particulate matter pollution are primarily expected from binding international air pollution treaties (cf. 'Emission of air pollutants' indicator) and from clean air plans introduced by cities and local authorities.

Methodology

The indicator is calculated by combining modelled data from the REM-CALGRID chemical transport model with PM10 measurement data and additional interpolation procedures resulting in national wide PM10 exposure maps for Germany. The areal PM10-concentrations are combined with population density maps to introduce a population weighting scheme. The data used in the calculation only represent the rural and urban PM10 background concentration levels in Germany not considering e. g. urban traffic related hot spot concentration levels. For more details on the method, see Kallweit et al. (2013).

Health risks due to particulate matter

Premature deaths from diseases caused by particulate matter



Source: German Environment Agency 2016, own compilation

At a glance

- In 2014, about 41,100 premature deaths in Germany can be attributed to ambient particulate matter pollution.
- The adverse health effects of particulate matter decreased in recent years however, the health threat associated with particulate matter pollution is still too high.
- The Federal Government has set a target to further reduce particulate matter emissions.

- Indicator online (latest data, data download): www.uba.de/en/57184
- Detailed information: www.uba.de/28087 (in German only)
- Last update: 06/2016

Environmental importance

Particulate matter includes both solid and liquid fine particles. The indicator is based on the fine fraction PM10, i.e. small particles with a diameter of less than 10 micrometres (µm, PM10). Particulate matter also has natural sources. However, particularly in urban agglomerations, particulate matter is primarily produced by incineration plants and vehicles. Agriculture also contributes to ambient particulate matter pollution. Secondary particulates also formed by precursor substances such as nitrogen oxides, ammonia and sulphur.

Ambient particulate matter is harmful to human health. The health impacts of particulate matter range from irritation of the mucous membranes to respiratory infections, increased risk for thrombosis and changes in the regulatory function of the autonomic nervous system. Very fine particles with a diameter of less than 2.5 µm (PM2.5) represent a particular health risk because they penetrate deep into the bronchi and even into the bloodstream. Cardiopulmonary diseases in general, and particularly lung cancer, are well-known health outcomes associated with particulate matter pollution.

Assessing the development

According to calculations by the German Environment Agency in 2007 around 51,000 premature deaths resulting from cardiovascular diseases and lung cancer could be attributed to particulate matter pollution in rural and urban areas. In 2014, the amount of premature deaths decreased but was still at an amount of around 41,100. This represents about 5.5 years lost per 1,000 inhabitants each year. The downwards trend is mostly a result of reductions in particulate matter pollution (cf. 'Population exposure to particulate matter pollution' indicator).

Air pollutant emissions are regulated by a number of international agreements, in particular the Gothenburg Protocol (UNECE n.d.) and the EU's air pollution policy. Under these treaties, Germany is committed to reduce emissions of fine particulate matter (PM2.5) by 26 % of 2005 levels by 2020 and by 43 % until 2030 (cf. 'Emission of air pollutants' indicator). A number of precursor substances are also covered by the legislation. Achieving these targets presents a major challenge for the German environmental policy.

Methodology

The estimated health risk is based on the average annual population-weighted particulate matter concentration (PM10, cf. 'Population exposure to particulate matter pollution' indicator). These data are used in calculations based on the Environmental Burden of Disease (EBD) method. Here, data on overall and disease specific mortality, life expectancy and population data (population composition by age and gender) from the Federal Health Monitoring System (GBE) are used as model input parameters. Methodological details can be found in Kallweit et al. (2013).

07

RAW MATERIALS AND WASTE

Raw material productivity

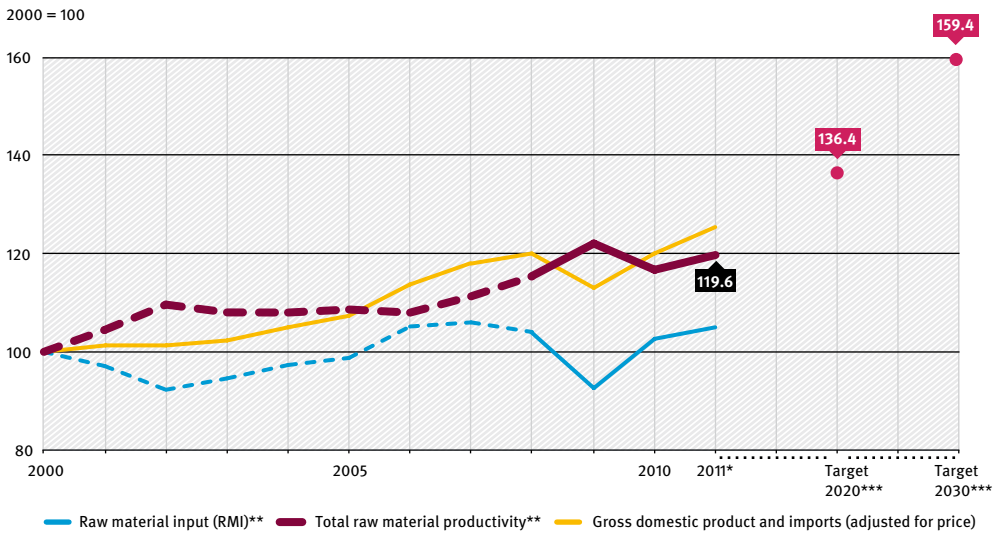
Raw material consumption

Amount of waste – municipal waste

Recycling municipal waste

Raw material productivity

Total raw material productivity
Primary raw material inputs (RMI) in relation to gross domestic product and imports



* 2011 preliminary value

** RMI = Raw Material Input; there are no values available for the indicator from 2001 to 2007; the graph shown is based on an estimate of the missing values

*** The targets reflect the aim of the German Resource Efficiency Programme II: continuing the trend from 2000 to 2010 on to 2030. Total raw material productivity rose from 2000 to 2010 by 1.57 % per year.

Source: Report by the Federal Statistical Office of Germany, 13.07.2016; Targets: German Environment Agency 2016, own calculations based on the German Resource Efficiency Programme II

At a glance

- Total raw material productivity rose by almost 20 % between 2000 and 2011.
- The indicator considers also the raw materials which were required for manufacturing imported goods.
- The aim is to increase productivity by almost 60 % by 2030 compared to 2000.

Environmental importance

Primary raw materials are obtained mainly from mining but also forestry and agriculture. Some of these economic activities have huge environmental impacts. The aim of environmental policy is therefore to ensure that the national economy uses raw materials as efficiently as possible. In order to measure this development, the 'Total raw material productivity' indicator relates economic activity to the utilisation of raw materials.

However, Germany imports and exports mainly manufactured and finished products. The indicator 'Primary raw material inputs' reflects the amount of primary raw materials actually used. It is based on raw material equivalents. It therefore includes the total weight of primary raw materials which were required to manufacture the goods produced by the German economy or imported into it. To calculate raw material productivity, the primary raw material input is compared to the total value added produced using these raw materials, in other words, to the sum of gross domestic product and the value of the imports.

Assessing the development

Between 2000 and 2011 total raw material productivity increased in Germany by 19.6 %. This was primarily due to a growth of over 25 % in the GDP and the value of imports. At the same time, only 5 % more primary raw materials were used in 2011 than in 2000. Even if this decoupling of the variables is to be viewed as positive, the absolute level of raw material inputs is still too high (cf. 'Raw material consumption' indicator). The crisis year of 2009 was an exception. The use of primary raw materials fell even more than GDP. In 2010 the variables were once more at the same values as 2008. Total raw material productivity increased by 1.57 % annually between 2000 and 2010. In the German Resource Efficiency Programme II (ProgRess II) approved in 2015, the Federal Government announced its target of continuing this growth rate up to 2030 (BMUB 2016a). This gives a target value of 159.4 for 2030. But this target is a long way off. ProgRess II lists a wide range of measures for the period from 2016 to 2019. ProgRess will need to be further developed for the period following this. The ProgRess II target was also incorporated in the German Sustainable Development Strategy (Federal Government 2016).

Methodology

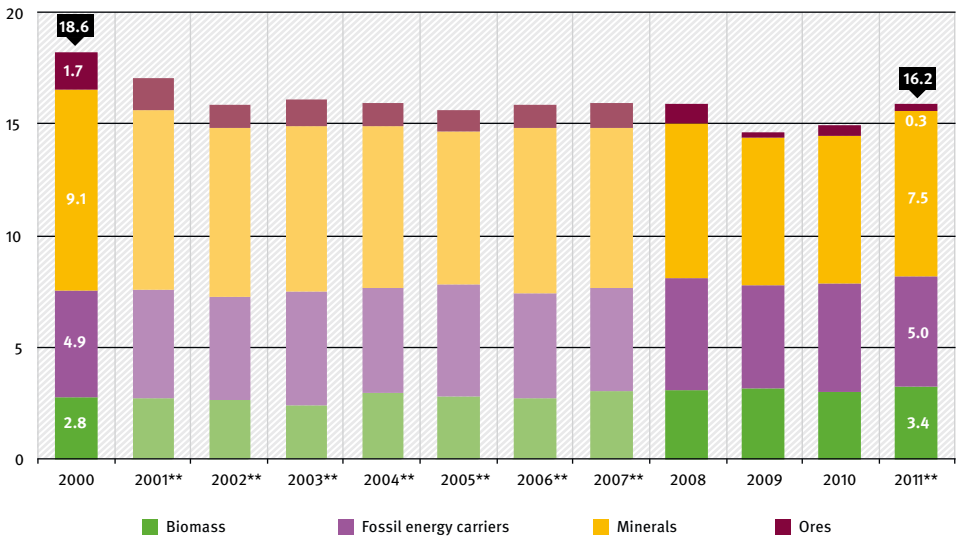
The total raw material productivity results from the ratio of two variables: the numerator is formed from the sum of gross domestic product and the value of German imports. This figure is prepared by the national accounts of the Federal Statistical Office of Germany (StBA). The denominator contains the information on the primary raw material input in Germany from production and imports in tonnes. The process for determining the indirect imports ('raw material equivalents') is described in a research report (UBA 2016d).

- Indicator online (latest data, data download): www.uba.de/en/57185
- Detailed information: www.uba.de/15102 (in German only)
- Last update: 06/2014

Raw material consumption

Raw material use for domestic consumption and investments (RMC) per capita*

Tonnes of raw material equivalents



* RMC = Raw Material Consumption; Population: annual mean based on population projections from earlier censuses and the 2011 census

** 2001 until 2007: shown values are based on estimations ; 2011: preliminary data

Source for RMC: German Environment Agency (2016), The Use of Natural Resources - Report for Germany 2016; Source for population data: Umweltökonomische Gesamtrechnung der Länder 2015, Band 1. Indikatoren und Kennzahlen. Tabellen. Ausgabe 2015, Tabelle 1.6 (in German only)

At a glance

- Per capita raw material consumption fell by 13 % between 2000 and 2011.
- This includes raw materials which were required for the manufacture of consumed goods both at home and abroad.
- German raw material consumption is too high and needs to be reduced further.

IN 2011, EACH GERMAN CITIZIEN USED

16.2 tonnes of raw materials

Environmental importance

The manufacture of goods and the provision of services requires raw materials. The German economy is strongly internationally integrated. Germany imports and exports large quantities of semi-finished and finished products. The weight of raw materials used for this manufacture is taken into account in the raw material equivalents. These include all raw materials used in the production of these goods both at home and abroad. The indicator shown here includes the total weight of all goods used in Germany for home consumption – including the 'raw material equivalents'. In order to make the issue understandable and comparable, 'raw material consumption' is referred to the number of inhabitants in Germany.

The mining or cultivation of these raw materials and their subsequent processing are accompanied by large environmental impacts. If the global per capita raw material consumption were as high as in Germany, this would put a heavy burden on global ecosystems. Germany is therefore responsible for reducing the use of primary raw materials.

Assessing the development

Raw material consumption per capita fell between 2000 and 2011 from 18.6 tonnes (t) to almost 16.2 t and thus by 13 %. This fall is due mainly to developments in overall investment in the economy. Investments in buildings and equipment in particular and other capital goods declined by 30 % between 2000 and 2010. The recovery in construction sector resulted in rising consumption of raw materials. Statistically, the overall indicator has not developed in any clear direction so far.

German and European policies have so far not set themselves any target for raw material consumption. However, experts and the German Environment Agency believe that consumption of raw materials needs to be considerably reduced. Political strategies such as the European Roadmap to a Resource Efficient Europe (European Commission 2011a) or the German Resource Efficiency Programme II (BMUB 2016a) head in the right direction, but require further ambitious development in the long term.

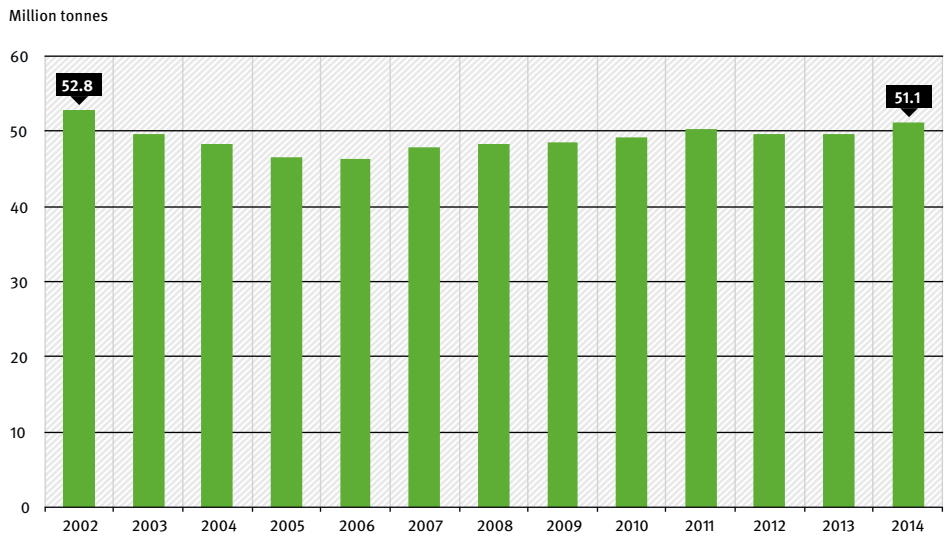
Methodology

The indicator 'Raw material consumption' is composed of domestic raw material extraction and imports. In order to calculate indirect imports (raw material equivalents) use is made of input-output and linkage tables plus data on imports and exports in the German economy. The method was developed in research projects for the German Environment Agency and is described in a research report (UBA 2016d). The data used for the indicator presented here were prepared for the report 'The Use of Natural Resources 2016' on the basis of the data of the Federal Statistical Office of Germany (UBA 2016a). They differ slightly from the data of the Federal Statistical Office of Germany.

- Indicator online (latest data, data download): www.uba.de/en/57186
- Last update: 09/2016

Amount of waste – municipal waste

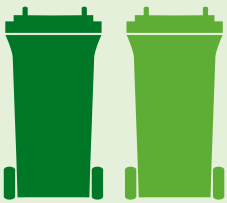
Waste generation in municipal waste category



Source: Federal Statistical Office of Germany, Waste balance 2014

At a glance

- Since 2011 the amount of municipal waste has stabilised at around 50 million tonnes.
- The target of environmental policy is to decouple the amount of waste from economic growth.
- This target has been achieved. However, to reduce resource consumption, municipal waste has to decline further.



- Indicator online (latest data, data download): www.uba.de/en/57187
- Detailed information: www.uba.de/12535 (in German only)
- Last update: 10/2016

Environmental importance

Government is pursuing a variety of strategies to reduce the economy's demand for raw materials. One approach is the prevention of waste. Paragraph 6 of the German Circular Economy Law (KRWG 2012) defines a waste hierarchy. It assigns the highest priority to the prevention of waste. Where possible, waste should not arise at all.

The total amount of waste generated in Germany is dominated by building waste which makes up around 60 %. The total amount of waste therefore primarily reflects the economic situation in the building industry.

The indicator used here is the development of municipal waste which, in 2014, formed almost 15 % of the total waste generated. Municipal wastes mainly cover the types of waste collected by municipal waste management companies. The main 'waste producers' are households, administration and commercial companies. The amount of municipal waste therefore reflects the behaviour of a wide spectrum of waste producers.

Assessing the development

The amount of municipal waste has fallen slightly since 2002. While in 2002 it was still 52.8 million tonnes (million t), the lowest level occurred in 2006 with 46.4 million t. Since 2011 the value has stabilised around 50 million tonnes.

In 2013 the German Federal Government agreed a Waste Prevention Programme (BMU 2013). Economic growth and the amount of waste should be decoupled and the amount of waste should grow at most as fast as the economy. This target has been achieved in terms of municipal waste. While the German economy grew by 15 % and the number of households by 4 % between 2002 and 2014, the amount of municipal waste fell in this period.

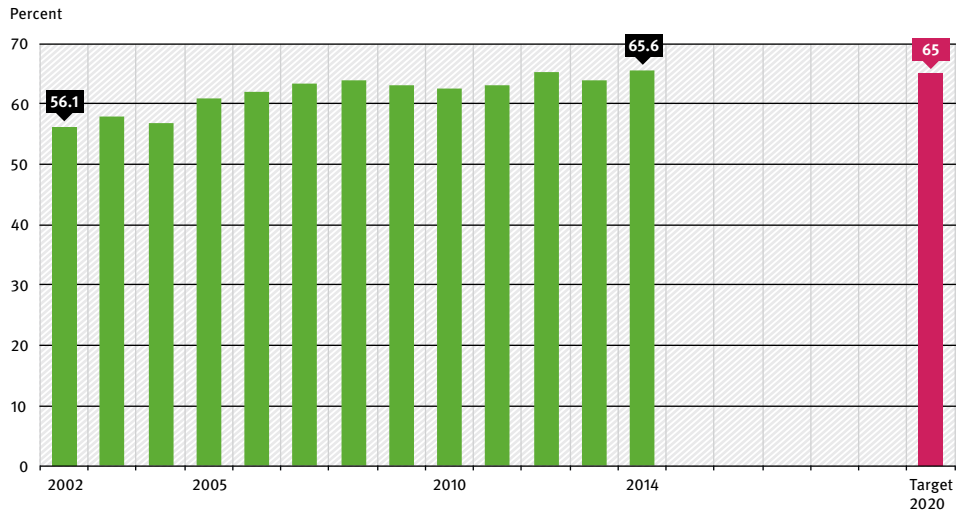
This is a success of environmental policy. However, even if the declining trend in municipal waste continues, further efforts are necessary. The waste prevention programme is an initial step in this direction.

Methodology

The amount of waste is published annually in the waste balance (StBA 2016c). The waste statistics are based on a series of different surveys which are collated into a waste balance. Further information on the waste statistics can be found in the relevant quality reports issued by the Federal Statistical Office of Germany (StBA n.d. a). Following the changeover to the European waste register in 2002, large changes occurred between categories. This is why the indicator is only shown from 2002 onwards.

Recycling municipal waste

Share of processed and recycled municipal waste in the total amount of municipal waste*



* The Federal Statistical Office of Germany uses a simplified definition for calculation of the recycling rate for the waste category of waste electrical equipment, which leads to a 100 % rate. A survey according to the electronics law yields different results.

Source: Federal Statistical Office of Germany, Waste balance, various years

At a glance

- The recycling rate for municipal waste rose from 56 % in 2002 to almost 66 % in 2014.
- The target set by the Federal Government of increasing the recycling percentage for municipal waste to 65 % by 2020 has therefore been achieved.
- However, there is still a need for action for individual subgroups of municipal waste.

- Indicator online (latest data, data download): www.uba.de/en/57188
- Detailed information: www.uba.de/13772 (in German only)
- Last update: 08/2016

Environmental importance

Municipal wastes cover a broad range of different types of waste, such as domestic waste, collection of segregated paper, glass and organic waste and electrical appliances. Although these only account for around 15 % (net) of the total waste generated annually, they are very heterogeneous and resources relevant compared to other types of waste. They are therefore representative of the challenges faced by waste management overall.

Substances worth recovering are increasingly collected separately and usually recycled. This applies particularly to waste paper, glass, packaging and organic wastes. This saves raw materials, decreases the use of primary energy and therefore reduces carbon dioxide emissions. In the past it was customary to deposit municipal wastes without further processing. This has been forbidden since 2005. Methane emissions from landfill sites have therefore declined significantly.

Assessing the development

Recycling of municipal waste has been at a relatively high level in Germany for a long time. In 2002 it was 56 %. Over 60 % of municipal waste has been recycled in Germany since as long ago as 2005.

The EU Waste Framework Directive sets a recycling target. Every country must achieve a recycling percentage of 50 % for specific materials by 2020 (EU Directive 2008/98/EC). The German Federal Government has increased this requirement in the Circular Economy Law passed in 2012. 65 % of all municipal waste must be recycled (KrWG 2012).

A clear rise in recycling rates has been observed since 2002. The recycling rate for municipal waste reached 65 % for the first time in 2012 and, after falling in 2013, exceeded this value again in 2014. The efforts to expand material recycling of municipal waste will be continued in order to raise this level further.

In addition to the recycling rate for municipal waste, the Federal Government has set further recycling targets in its resource efficiency programme ProgRess II (BMUB 2016a). A number of these objectives still require action. In order to achieve the objective of a substantial increase in the plastics recycling cycle by 2020, considerable efforts are still required, for example, in the areas of commercial waste and packaging (UBA 2016b). The increase in the collection rate for waste electrical and electronic equipment from 43 % in 2014 to at least 65 % by 2019 is also a major challenge.

Methodology

The recycling rate is published annually in the waste balance of the Federal Statistical Office of Germany (StBA 2016c). The waste statistics are based on a series of different surveys which are collated into a waste balance. Further information on the waste statistics can be found in the relevant quality reports (StBA n.d. a). Due to the changeover in 2002 to the European waste register, there were large changes between categories. This is why the indicator is only shown from 2002 onwards.

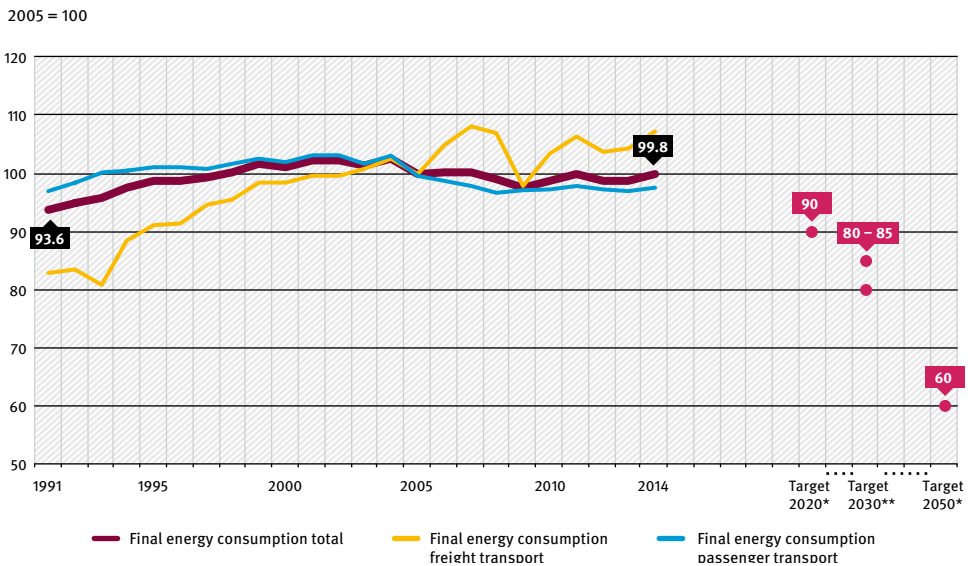
08

TRANSPORT

Energy consumption in transport
Environmentally friendly passenger transport
Environmentally friendly freight transport

Energy consumption in transport

Final energy consumption in transport



* Targets for final energy consumption total: based on the Energy Concept of the Federal Government (2010)
** Target for final energy consumption freight transport and passenger transport: based on the German Sustainable Development Strategy (2016)

Source: German Environment Agency, TREMOD Version 5.63 (11/2016)

At a glance

- The Federal Government wants to lower final energy consumption in the transport sector by 10 % by 2020 and by 40 % by 2050 compared to 2005.
- However, final energy consumption in transport seems to stagnate at a high level. It will be difficult to reach the target.
- Since 1991, freights and passenger transport have become significantly more efficient.

- Indicator online (latest data, data download): www.uba.de/en/57189
- Detailed information: www.uba.de/12085 (in German only)
- Last update: 11/2016

Environmental importance
Transport requires energy. Making energy available, distributing and using it are causing multiple problems in a global context.

The predominant source of energy in the transport sector is oil, which is often extracted in or transported through ecologically sensitive areas. Further energy input is needed in refining the crude oil into petrol, diesel or aviation fuel, and finally, the combustion of fuels releases pollutants such as nitrogen oxides and particulate matter. The main focus, however, is on the greenhouse gases that arise from combustion and that are responsible for the global climate change.

For all these reasons, the Federal Government decided to reduce overall energy consumption – including the energy consumption of the transport sector.

Assessing the development
No long-term trend has been observed in the development of final energy consumption in the transport sector. Until 2004, there was an increase in consumption. Since then, there have been fluctuations in energy consumption, but no clear trend emerged. Overall energy consumption in 2014 was approximately 7 % above 1991 levels. However, during the same period, transport volume increased more than energy consumption. In other words, both freights and passenger transport have become significantly more energy-efficient.

In its Energy Concept the German Federal Government set an energy-saving target for the transport sector in 2010. By 2020, final energy consumption should be 10 % below 2005 levels, and 40 % below by 2050. (Federal Government 2010). In the revised German Sustainable Development Strategy of 2016, the Federal Government has defined an intermediate target for 2030. By then, energy consumption in the passenger as well as in the freight transport sector should fall by 15 to 20 % (Federal Government 2016). However, since 2005, transport energy consumption has only decreased by 0.2 %. This makes it hard to reach the 2020 reduction target.

If energy consumption in the transport sector is to fall, more energy-efficient alternatives must receive more support (cf. 'Environmentally friendly passenger transport' and 'Environmentally friendly freight transport').

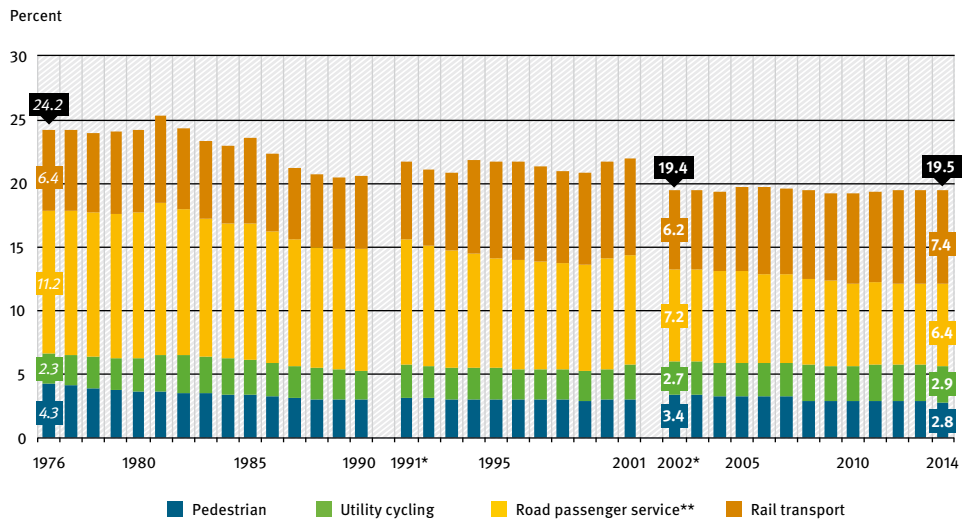
Methodology

Energy consumption in the transport sector is calculated using the tool TREMOD (Transport Emission Model), based on transport volume and specific energy consumption. TREMOD was developed by the ifeu - Institute for Energy and Environmental Research in Heidelberg, commissioned by the German Environment Agency. A research report explains the methodological background (ifeu 2012).

The Federal Government determines energy consumption of the transport sector as part of its energy transition monitoring, using data provided by the Working Group on Energy Balances (AGEB) as a baseline. These, in turn, are based on fuel consumption. The data used for our indicator on the basis of TREMOD are different from those used by AGEB.

Environmentally friendly passenger transport

Share of pedestrian, utility cycling, railway and passenger transport services in the total passenger transport volume*



* Due to changes in methodology, results from 1991 and/or 2002 are not entirely comparable to those of previous years.
** Contains among others public busses, tram and subway services

Source: Federal Ministry for Transport and Digital Infrastructure (ed.): Verkehr in Zahlen (various years; in German only); Information by the DIW from 25.04.2016 (for in-between years for which no figures have been published)

At a glance

- Since 1976, the share of environmentally friendly passenger transport fell significantly from 24 % to 20 %.
- However, over the past few years, it has hardly changed at all.
- The Federal Government is now launching the National Cycling Plan 2020 to support cycling as a means of transport.

Environmental importance

Passenger transport has long been dominated by the car, what is known as individual motorised transport (IMT). In 2014 the IMT share was around 76 %. Car traffic, however, is a heavy burden on the environment. Overall, apart from aviation, public transport modes have a better environmental balance than cars with average occupancy. The use of bus, train, walking and cycling have been summed up under the term 'Umweltverbund' or ecomobility. The indicator shows the share of ecomobility in overall passenger transport. This share should be increased as much as possible to keep the burden on the environment from passenger transport low.

Assessing the development

Our mobility has been increasing. Between 1976 and 2014, passenger transport approximately doubled in Germany, to recently 1,200 billion passenger-kilometres. While in 1976, the share of environmentally friendly transport modes was around 24 %, it fell to 19.5 % by 2014. In passenger-kilometres, all transport modes increased their volume in 2013 compared to 1976, but car transport increased disproportionately.

By the same token, the share of public road and rail transport in particular decreased significantly. From 17.6 % in 1976, it fell to 13.8 %. The pedestrian mode share also declined. By contrast, the proportion of bicycle passenger-kilometres has increased.

In its 2010 Energy Concept, the Federal Government set the target of reducing transport energy consumption by 10 % by 2020 and by 40 % by 2050 (Federal Government 2010). This can only succeed if environmentally friendly passenger transport is further encouraged. The National Cycling Plan 2020 (BMVBS 2012) was developed in order to encourage utility cycling.

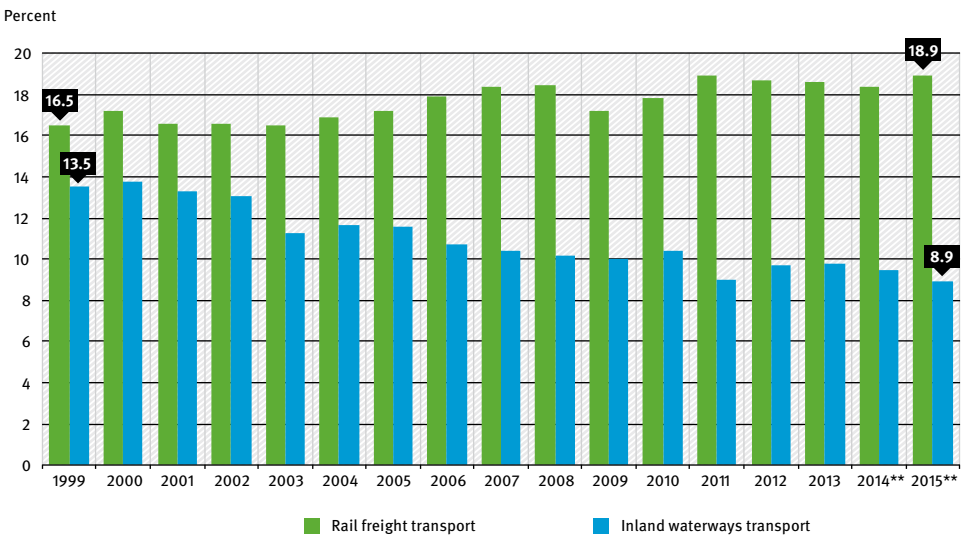
Methodology

Official statistics by the Federal Statistical Office of Germany do not actually monitor motorised individual transport, walking or cycling. Instead, the figures are approximated by the German Institute for Economic Research (DIW) using a passenger transport model. This model is based on results of the 'Mobilität in Deutschland' (in German only) survey and the 2011 microcensus. A more detailed description of the method used can be found in the methodology report published by the DIW (Kuhfeld et al. 2014). The results are published annually in 'Verkehr in Zahlen' (in German only) (BMVI 2016).

- Indicator online (latest data, data download): www.uba.de/en/57190
- Detailed information: www.uba.de/11166 (in German only)
- Last update: 11/2016

Environmentally friendly freight transport

Share of rail freight and inland waterways transport to overall freight transport volume*



* Not including local heavy goods vehicle transport (up to 50 km)
** Including preliminary data

Source: Federal Ministry for Transport and Digital Infrastructure, Verkehr in Zahlen 2016/2017 (in German only)

At a glance

- The rail share in freight transport fluctuated between 18 and 19 % over the past years.
- The share of inland waterways transport fell continuously from 13.5 % to 8.9 % since 1999.
- According to the Federal Government, the rail freight transport share should have been rising to 25 % by 2015, while final energy consumption from renewables should have reached 14 %.
- Both targets were clearly missed.

Environmental importance

More than three quarters of the total freight transport is managed by road. However, shifting transport to more environmentally friendly modes such as ships and trains is a prerequisite for sustainable mobility.

It has to be said that trains and ships pose their own environmental challenges. Rail freight transport causes noise pollution, while inland waterways transport require well maintained waterways. Extending waterways is often associated with a decline in water quality and a burden on the natural environment, but energy consumption per tonne-kilometre is significantly lower in rail and ship transport than in heavy goods vehicle transport. The same applies to greenhouse gas emissions.

For short distances under 50 kilometres, motorised freight transport is almost unrivalled. Trains and ships are unsuitable for extensive distribution of goods. This is why for this indicator, only goods transport over distances above 50 kilometres was taken into account.

Assessing the development

The long-term development of rail freight transport was positive. Between 1999 and 2008, it first increased considerably. Since then, no clear trend could be observed. In inland waterways transport, the trend has been clearly negative. Between 1999 and 2015, its freight transport market share fell almost continuously.

In the Strategy for Sustainable Development of 2002, the Federal Government set the target of increasing the rail share in freight transport volume to 25 % and the inland waterways shipping share to 14 % by 2015 (Federal Government 2002). These targets were clearly missed. Both targets are no longer included in the revised German Sustainable Development Strategy (Federal Government 2016).

Measures taken by the Federal Government could not prevent the ever-increasing dominance of road based freight transport. Clearly, more efforts must be made. It must be also taken into consideration that from an environmental perspective, goods traffic as such should be reduced. However, we currently expect a continuous rise in freight transport.

Methodology

The figures on which the indicator is based are published annually by the Federal Ministry for Transport and Infrastructure (BMVI) in its series 'Verkehr in Zahlen' (BMVI 2016; in German only). They are largely based on data that have been published by the Federal Statistical Office of Germany in its paper 'Verkehr im Überblick' (StBA 2015d; in German only). Descriptions on the methods used are found in the quality reports of the Federal Statistical Office of Germany (StBA n.d. a). Figures on road freight transport are based on data collected by the Federal Motor Transport Authority.

- Indicator online (latest data, data download): www.uba.de/en/57191
- Detailed information: www.uba.de/11166 (in German only)
- Last update: 11/2016

09

AGRICULTURE AND FORESTRY

Agricultural nitrogen surplus

Grasslands

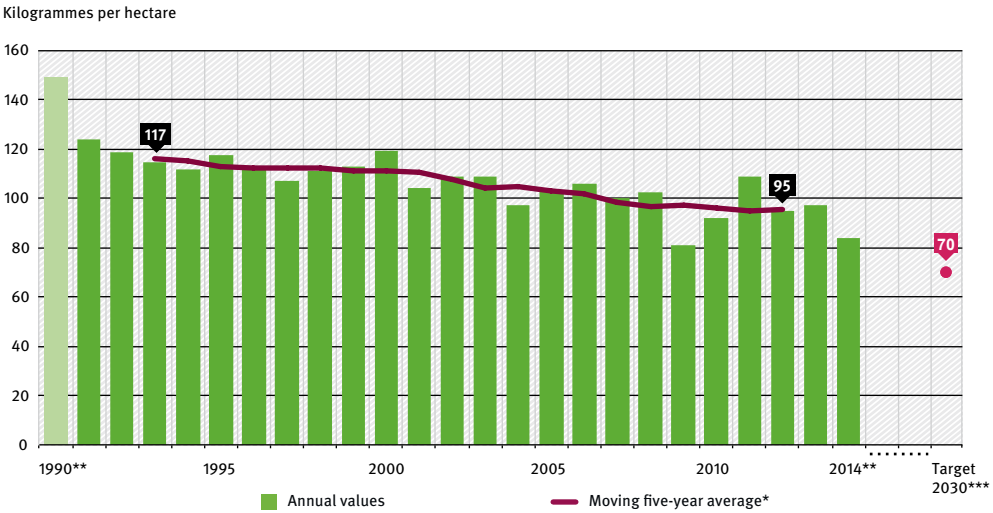
Organic farming

Sustainable forestry

Mixed forest

Agricultural nitrogen surplus

Nitrogen surplus of the national farm-gate balance*



* Annual surplus referred to the middle year of the five-year-period
** 1990: data partially uncertain and of only limited comparability with the following years, 2014: preliminary data
*** Target of the Federal Government's Sustainable Development Strategy, referred to the average of the five-years-period 2028 - 2032

Source: Federal Ministry of Food and Agriculture (BMEL) 2016, Statistischer Monatsbericht Kap. A Nährstoffbilanzen und Düngemittel, Nährstoffbilanz insgesamt von 1990 bis 2014 (MBT-0111260-0000) (in German only)

At a glance

- The five-year average of nitrogen surplus per hectare of utilised agricultural land has decreased by around 19 % since 1993.
- The Federal Government aims to reduce the average nitrogen surplus of the years 2028 to 2032 below 70 kilogrammes per year.
- Efforts must be considerably intensified to reach this target.

- Indicator online (latest data, data download): www.uba.de/en/57192
- Detailed information: www.uba.de/11218 (in German only)
- Last update: 05/2016

Environmental importance

Nitrogen is an essential nutrient for all living organisms. However, excessive input of reactive nitrogen compounds to the environment have serious effects on the climate, biodiversity and landscape quality. For example, nitrogen which is not utilized by plants may leads to pollution of the groundwater, nutrient enrichment (eutrophication) of waterbodies, acidification of terrestrial ecosystems and the formation of greenhouse gases. An introduction to the issue of nitrogen surplus is given in the publication 'Reactive nitrogen in Germany' (UBA 2015a).

In Germany problems occur especially in regions with high livestock density. Due to the high amount of farm manure in the form of animal excreta, often more nitrogen is applied to the fields as the crops can convert into biomass. The nitrogen surplus is an indicator of the potential nitrogen losses from agriculture to the environment.

Assessing the development

Between 1993 and 2012, the average nitrogen surplus decreased by around 19 %. Farmers are therefore using nitrogen more efficiently, the area of cultivation of high-output crops has increased and feed conversion by domestic animals has improved. However, the nitrogen balance indicates that only half of the total nitrogen input is removed by agricultural products (BMEL 2016a).

In the Strategy for Sustainable Development of 2002 the Federal Government set itself the aim to reduce the three-year average nitrogen surplus to 80 kilogrammes (kg) per hectare per year by 2010 (Federal Government 2002). This target has been missed considerably. A new target has been set in the revised version of the Strategy in 2016: a maximum nitrogen surplus of 70 kg per hectare in average for the years 2028 to 2032 (Federal Government 2016). The German Fertilizer Application Ordinance, extensively revised in spring 2017, aims to achieve that target.

According to current estimates, the German Environment Agency assumes that neither the revised Fertilizer Application Ordinance, nor the new targets of the German Sustainable Development Strategy are sufficient enough to preserve soil, water, air and biodiversity extensively (cf. 'Eutrophication of the North Sea and Baltic Sea by nitrogen'). Further suggestions have been made in 2015 by the German Advisory Council on the Environment (SRU) in an expert report (SRU 2015).

Methodology

The nitrogen surplus is the difference between the input (e.g. fertiliser, feed, seed and seedlings, atmospheric inputs) and the output (animal and plant products) of the national farm-gate balance. A detailed description is given in Bach et al. (2011). The data are published annually by the Federal Ministry of Food and Agriculture (BMEL). In order to adjust for annual fluctuations a five-year moving average is calculated from the values of the individual years with the two previous and two following years.

Grasslands

Total area of permanent grassland and proportion of the utilised agricultural land

Source: Federal Ministry of Food and Agriculture (BMEL), Statististisches Jahrbuch (various years; in German only); Source for 2016: Federal Statistical Office of Germany, Bodennutzung der Betriebe - Landwirtschaftlich genutzte Flächen 2016, Fachserie 3 Reihe 3.1.2 (in German only)

At a glance

- Between 1991 and 2016 the area of grassland in Germany shrank by 12 %.
- The area of permanent grassland has risen slightly in the recent years.
- The national implementation of the European Common Agricultural Policy (CAP) aims, among others, at maintaining the 2012 level of (total) grassland area.
- Effective steps are required to achieve this target.

- Indicator online (latest data, data download): www.uba.de/en/57193
- Detailed information: www.uba.de/13793 (in German only)
- Last update: 05/2017

Environmental importance

Extensively managed grassland is important for species-rich plant communities which require nutrient-poor soils and are rare in farmland. Approximately 40 % of endangered ferns and flowering plants in Germany occur on grassland (BfN 2014). But grasslands are also important for protecting soils and water and in addition help towards climate protection by storing carbon. Permanent grassland is of particular value. It is defined as meadows and pastures that have not been used as field for at least five continuous years.

The loss of grasslands is due to more intensive agriculture and the associated changes in land use. Using grasslands for pasture and hay is becoming less attractive to farmers while there is a growing demand to cultivate the land for feed and energy plants. Many farmers therefore increasingly use former pastures and meadows as arable land. Particularly valuable sites from an environmental viewpoint such as semi-arid grasslands and humid grasslands are ploughed and converted to arable. If these areas are then used for intensive arable agriculture, the above-mentioned positive effects of the grassland are lost. Furthermore low yielding and remote grasslands are at risk of being abandoned due to not being economically viable (land abandonment). Such grasslands may convert to shrub lands and lose their function as habitat for rare plants and animals.

Assessing the development

Permanent grassland in Germany has been under pressure in recent decades. In 1991 there were still over 5.3 million hectares (m ha) of utilised agricultural land managed as permanent grassland. By 2016 the total area of permanent grassland had declined by 12 % to around 4.7 m ha.

Since the decision of the EU agricultural reform in 2013, the 'Greening' obligations regulate the protection of permanent grassland. Farmers must comply in order to qualify for the direct payments system. Various regulations aim at prevention of loss of permanent grassland like a general prior authorisation requirement for ploughing up of grassland and the complete prohibition of ploughing up and change of grassland with elevated environmental value.

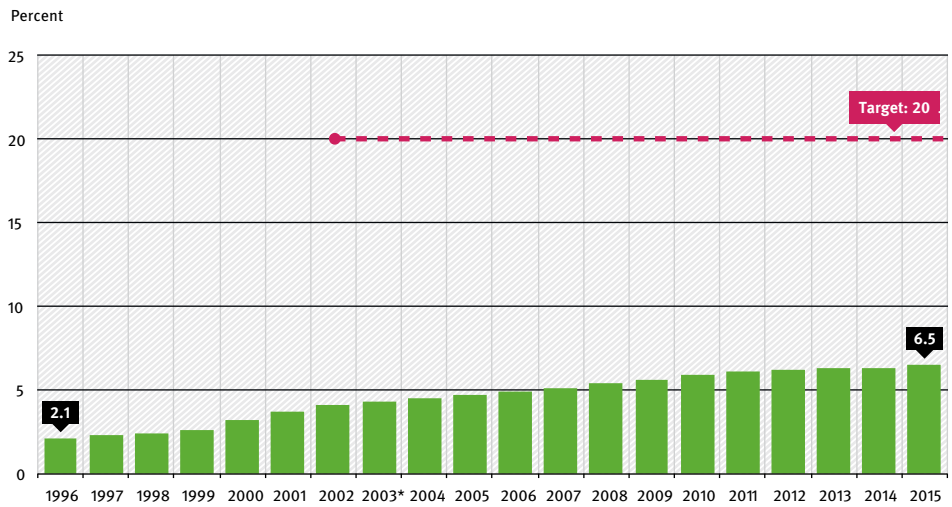
Although the percentage of grassland has recently risen again slightly, the overall drivers of the loss of grassland remain largely unchanged. Major pressures continue to be exerted on grassland in particular by subsidies for the cultivation of energy plants and intensification of milk production as well as land abandonment. It can therefore be assumed that the long-term pressure on grassland has not changed. The effective protection of grassland therefore remains task of outstanding importance.

Methodology

The indicator is based on information from the land-use survey by the statistical offices of the Federal States. The results are published in the Statistical Year Book and, prior to this, in the monthly reports by the Federal Ministry of Food and Agriculture (BMEL). A detailed description of the method is given in the quality report on the land-use survey (StBA 2016b).

Organic farming

Share of organic farming in total utilised agricultural area



* Only limited comparison possible with previous years due to a change to the survey boundaries

Source: Federal Ministry of Food and Agriculture (BMEL), http://www.bmel.de/DE/Landwirtschaft/Nachhaltige-Landnutzung/Oekolandbau/_Texte/OekologischerLandbauDeutschland.html (accessed on 05.12.2016) (in German only)

At a glance

- The percentage of agricultural land farmed organically rose by more than a factor of three since 1996.
- More recently, this proportion has only grown slowly.
- The Federal Government aims to increase the proportion of organically cultivated areas to 20 %.
- At the growth rate of recent years, this aim will take decades to achieve.

- Indicator online (latest data, data download): www.uba.de/en/57196
- Detailed information: www.uba.de/10952 (in German only)
- Last update: 02/2017

Environmental importance

Conventional intensive agriculture causes a range of environmental impacts and is partly responsible for a loss of biodiversity. Organic agriculture, on the other hand, is a more environmentally sustainable and ecologically beneficial type of management. The aim is to create nutrient cycles which are as closed as possible and a type of management in harmony with nature.

Organic farming does not use any mineral fertilisers. A range of crop rotations with intercropping maintain and support soil organisms and soil fertility. Avoiding the use of synthetic chemical pesticides enhances biological diversity on agricultural land. Animal husbandry aimed at the species' welfare benefits the animals and improves acceptability amongst the public. Organic agriculture therefore has a pioneering role in sustainable land management.

Assessing the development

The proportion of organically managed areas has risen continuously over the last 30 years. The percentage has more than tripled from 2.1 % to 6.3 % between 1996 and 2015. But even though the area of organic farming has shown a steady increase in recent years, the annual increase has slowed, however. German farmers often find that organic farming does not give high enough yields to finance the large increase in rents.

As part of both the German Sustainable Development Strategy and the Biodiversity Strategy, the Federal Government aims to increase the proportion of organically cultivated areas to 20 % (Federal Government 2016 and BMU 2007). Germany is still a long way from achieving this aim. If the percentage area continues to develop as slowly as it has over the last six years, the target will only be reached after several decades.

Additional effective steps are required if the aim is to be reached within the foreseeable future. Adequate guaranteed funding is a key requirement for encouraging farmers to convert to and continue with organic farming.

Methodology

To qualify as an area of organic farming requires certification under the EU Regulation on organic production (EC No. 834/2007). The Federal States collect the data and the Federal Office for Agriculture and Food (BLE) publishes the complete figures annually. Along with data on the total agricultural area, the percentage area of organic farming is published annually in the ‘Statistisches Jahrbuch über Ernährung, Landwirtschaft und Forsten’ (BMEL 2016b; in German only). A slightly different data set is used by the Federal Statistical Office of Germany for the German Sustainable Development Strategy indicator. Due to methodological differences, this discloses a slightly lower share of organic farming areas within the total utilised agricultural area in Germany.

Sustainable forestry

Proportion of forest area certified under PEFC or FSC*

* This refers to the forested area, i.e. the area under permanent use for timber production

** The target cannot be related directly to the two components of the indicator, because it refers to the areas certified according to high-quality environmental standards: areas can be certified under both PEFC and FSC. The extent of double certification is not known. In the case of this indicator it cannot therefore be judged whether the target has been reached.

Source: PEFC and FSC certified areas: Federal Agency for Nature Conservation (BfN), Programme for the Endorsement of Forest Certification Schemes (PEFC) and Forest Stewardship Council (FSC); Source total forested area: Forested areas, from BWI 2 up to 2002, from BWI 3 after 2012, linear interpolation between values from BWI 2 and 3 between 2002 and 2012

At a glance

- After a sharp rise between 2000 and 2003, the proportion of PEFC certified areas has stagnated over the last few years.
- The proportion of areas certified under FSC has developed very well since 2000 overall.
- The Federal Government wanted the forested area in Germany certified under high-quality environmental standards to be expanded to 80 % by 2010.
- This target has not been achieved. In 2016, 66.8 % of forests were managed under PEFC and 10.5 % under FSC.

Environmental importance

Around a third of the surface of Germany is covered with forests. The majority of these forests are used for forestry. In the past, forest management mainly concentrated on high timber production. This resulted in planting of monocultures of fast-growing species which are more susceptible to being damaged by storms, drought and attack by pathogens. Soils are degraded by monocultures and the use of heavy machines. Biodiversity in these forests is generally lower than in semi-natural forests.

The most important sustainability standards under which forestry companies can be certified are PEFC (Programme for the Endorsement of Forest Certification Schemes) and FSC (Forest Stewardship Council). The enterprises have to meet environmental, economic and social criteria, some of which are above the legal requirements specified in the forest and nature conservation laws. FSC often involves stricter guidelines than PEFC.

Assessing the development

Over the last few years the development of PEFC forests has stagnated at a high level. Since 2006 the value has fluctuated around 67 % with gradually declining values more recently. The proportion of FSC certified areas has developed very positively over the last few years at a low level. Responsible for this is the certification of extensive areas by the regional State Forestry departments in the recent years, particularly in Rhineland-Palatinate and Hesse.

In 2007 in the National Biodiversity Strategy, the Federal Government set itself the target of increasing the proportion of areas certified according to 'high-quality environmental standards' to 80 % by 2010 (BMU 2007). This is mainly based on the PEFC and FSC standards. However, it cannot currently be ascertained how far away the forestry is from this target, as some woodland areas are certified under both systems. However, what is clear is that it may take time to reach this target. The Federal Government therefore needs to promote sustainable forestry more vigorously.

Methodology

PEFC and FSC establish the extent of certified areas in the course of certification by forestry enterprises and publish these figures. The woodland area is used as a comparative figure. This is the area permanently designated for timber production. This area was determined during the 2nd and 3rd National Forest Inventories (BWI). To avoid jumps in the indicator value, the two values of the second and third BWI were interpolated linearly. General notes on the method for the BWI are given under the indicator 'Mixed forest'.

- Indicator online (latest data, data download): www.uba.de/en/57226
- Detailed information: www.uba.de/18345 (in German only)
- Last update: 02/2017

Mixed forest

Proportion of mixed forest area in total forest area*

* Varies from the definition of the National Forest Inventories: mixed stands = at least one additional tree species with at least 20 % share of area; the amount of forest without stocking data is not shown (2002: 4.8 %; 2012: 4.9 %).

Source: German Environment Agency 2015, Monitoringbericht 2015 zur Deutschen Anpassungsstrategie an den Klimawandel, Indicator FW-R-1 (in German only)

At a glance

- Between 2002 and 2012 the proportion of mixed stands in the total forest area increased from 55 to 58 %.
- The Federal Government has set itself the aim of increasing the proportion of mixed forest.
- It will require many decades until the forest conversion is completed.

- Indicator online (latest data, data download): www.uba.de/en/57227
- Detailed information: www.uba.de/41313 (in German only)
- Last update: 02/2015

Environmental importance

Woodlands cover around a third of the surface of Germany. Besides providing timber, they fulfill various functions, such as purifying the air, providing a habitat for many species of plants and animals, protecting the soil, etc. The forest therefore needs to be as vigorous and robust as possible.

However, in recent years, it has become increasingly obvious that monocultures are particularly susceptible. This relates in particular to changing site conditions, such as those caused by climate change. These woodlands are therefore at increased risk of losing their protective and compensatory functions. Mixed cultures with a larger number of tree species with differing characteristics and requirements increase structural and genetic diversity. Semi-natural mixed stands also provide a habitat for typical species of woodland plants and animals.

However, mixtures are not automatically valuable in terms of nature and environmental conservation. Mixed stands can also be made up of tree species which do not correspond to the natural forest community or are not adapted to the site.

Assessing the development

The proportion of mixed forest in the total forested area has grown between 2002 and 2012. It rose from 54.9 % to 57.8 %. It is particularly encouraging that the percentage of stands with four or more tree species has increased from 24.4 % to 26.1 %.

This development shows that forestry is increasingly moving away from monocultures (pure stands). The percentage of the latter has fallen from 40.3 % to 37.3 % since 2002. The percentage of semi-natural pure stands has remained constant.

In the German Strategy for Adaptation to Climate Change' and the Forest Strategy 2020 the Federal Government has set itself the target of increasing the tree species diversity of the forests (Federal Government 2008 and BMELV 2011). No specific target has been set. The percentage of mixed forests with many tree species should therefore increase further. However, this forest conversion will last for many more decades.

Methodology

The indicator values are based on the results of the second and third National Forest Inventories. Here 'forest' is essentially defined as '[...] every piece of ground stocked with forest plants irrespective of the information in the land register or similar registers.' This definition and detailed descriptions of the methods are given in a working report by the Thünen Institute (Schmitz et al. 2008) and the 'Aufnahmeanweisung für die dritte Bundeswaldinventur' (BMELV and vTI 2011; in German only).

10

PRIVATE HOUSEHOLDS AND CONSUMPTION

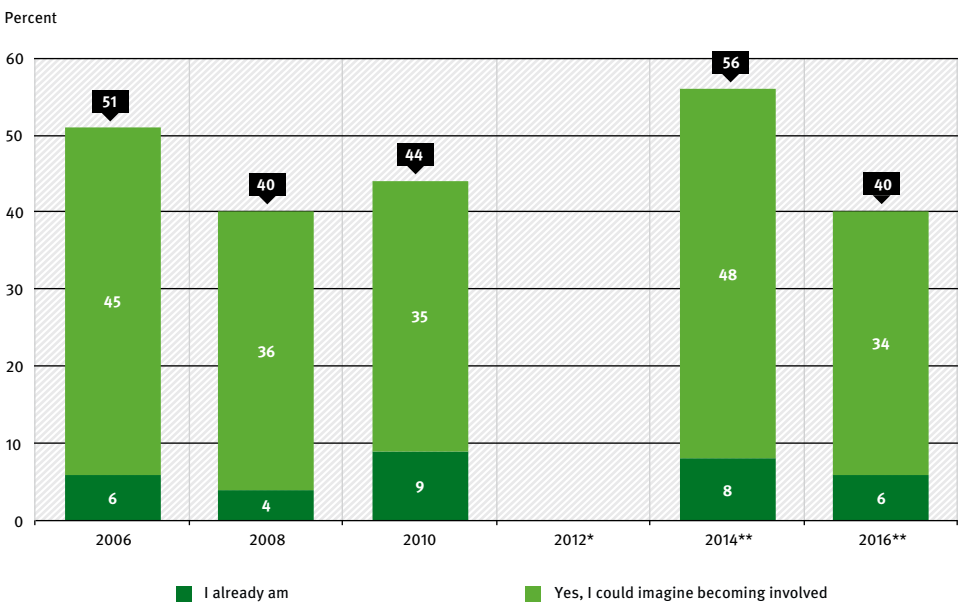
Commitment to environmental protection

Energy consumption and carbon dioxide emissions in private households

Environmentally friendly consumption

Commitment to environmental protection

Percentage of the population actively involved in environmental protection and nature conservation or who could imagine becoming involved*



* The question was not included in the 2012 survey

** Online survey, only to some extent comparable with previous years

Source: Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety (BMUB); German Environment Agency, Umweltbewusstsein in Deutschland (various years; in German only)

At a glance

- In 2014 almost one in two Germans could imagine participating actively in environmental protection and nature conservation. In 2016 this was only about a third.
- 6 % are already actively involved with an environmental organisation or similar.
- The proportion of people who could imagine becoming involved with environmental issues in the future varied greatly since 2006. The indicator does not show a clear trend.

Environmental importance

Our behaviour has an impact on nature and the environment – whether through our work, our leisure activities or the journeys that we make. An ongoing environmental awareness study published every two years by the German Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety (BMUB) and the German Environment Agency (UBA) indicates that environmental protection is of great importance to German society (UBA and BMUB 2017). The study takes the form of a survey designed to chart attitudes to environmental policy and environmental protection.

Environmental protection is driven not just by policy, but to a large extent by the work of volunteers. The indicator illustrates the potential for voluntary work in the environmental sector and the number of people already actively involved in environmental associations or similar. Temporary, local environmental projects and activities are particularly relevant for future involvement.

Assessing the development

The indicator does not show a clear trend. The number of people who could imagine becoming actively involved in the future fluctuated between 35 % in 2010 and 48 % in 2014. Furthermore, 9 % indicated being actively involved already. According to the latest results, however, this trend has reversed in the meantime. The number of active environmentalists, for instance volunteers in an environmental association, decreased to 6 %. Lack of time or other voluntary work are the most frequently named reasons why voluntary work for environment protection fails.

A high level of environmental awareness is not only essential for a sustainable way of living. It is also an important driver for robust environmental policy which can adequately protect natural resources. Thus, voluntary involvement and participation should be further supported by environmental policy. In addition, it is necessary to demonstrate different ways how to strengthen voluntary work for an ecologically as well as socially sustainable transition in other areas of civil society engagement.

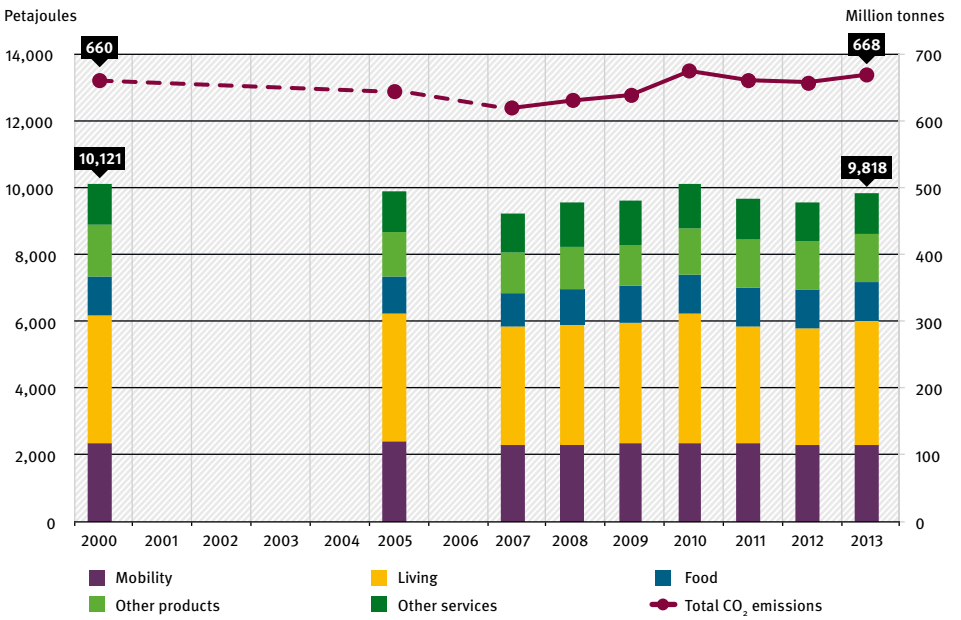
Methodology

The environmental awareness study has been conducted every two years since 1996. The purpose of this representative survey is to chart the environmental attitudes and behaviour of the German population. In 2014 the survey was conducted online for the first time and young people in the 14 to 17 age bracket were included. More information on the survey methodology can be found in the publication 'Umweltbewusstsein in Deutschland 2016' (UBA and BMUB 2017, in German only).

- Indicator online (latest data, data download): www.uba.de/en/57251
- Detailed information: www.uba.de/11271 (in German only)
- Last update: 02/2017

Energy consumption and carbon dioxide emissions in private households

Energy consumption and carbon dioxide (CO_2) emissions – direct and indirect*



* Values indicated are not temperature-adjusted; Indirect: energy consumption and CO_2 emissions from the manufacture of products used and the provision of services; No calculation results available for 2001 to 2004 and 2016.

Source: Federal Statistical Office of Germany report, 22.11.2016

At a glance

- Energy consumption in private households has fallen only slightly by 3 % since 2000.
- The sharpest drop in energy consumption for production was in 'other products', down by 8 %.
- Carbon dioxide emissions in private households have risen slightly since 2000. This is mainly due to the higher carbon dioxide content of imported goods.

Environmental importance

Private households are responsible for a significant share of energy consumption in the German economy, as well as the carbon dioxide (CO_2) emissions are closely associated with energy consumption. Energy is used directly in private households to provide heating or fuel for vehicles, for instance. Indirect energy consumption in private households involves the use of energy to manufacture consumer goods. We talk about the 'energy content' or 'carbon dioxide content' of consumer goods. The use of energy to manufacture consumer goods abroad is another example of indirect use. Breaking down consumption into different areas of demand – living, food, mobility, products and services – provides information about the success of environmental measures and the need for further action.

By reducing energy consumption, we can conserve resources at home and abroad and reduce harmful CO_2 emissions. Through the German Sustainable Development Strategy, the Federal Government thus aims to achieve a sustained reduction in energy consumption and CO_2 emissions in private households (Federal Government 2016).

Assessing the development

Energy consumption in private households has fallen only slightly by 3 % since 2000. The indicator has not followed a stable trend to date. Consumption was in decline until 2007, then rose, only to fall slightly again between 2010 and 2012. Energy consumption in private households rose slightly from 2012 to 2013. The largest increase occurred in the 'living' sector, which rose by 7 %. This can be attributed to the unusually cold winter that year. Energy consumption for the manufacture of products recorded the most significant decline since 2000 (- 8.2 %). The 'living' sector fell by around 3 % and 'mobility' by 2.3 %. In the 'food' and 'services' sectors there were only marginal changes (less than 1 %).

Achieving a sustained reduction in the energy consumption of private households is a prime objective. During the coming years, additional measures must be taken to further reduce energy consumption, particularly in the 'living' and 'mobility' sectors. Furthermore, we should continue to advance the use of renewable energies to reduce CO_2 emissions.

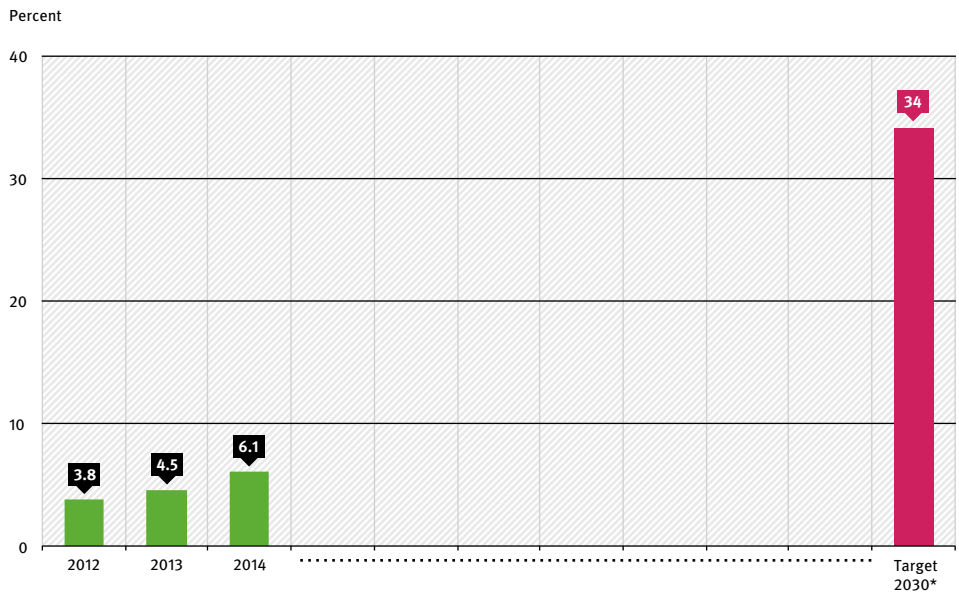
Methodology

Direct energy consumption is based on data from the Working Group on Energy Balances (AGEB). The System for Integrated Environmental and Economic Accounting was used to allocate consumption to specific areas of demand and calculate the energy content of consumer goods. The methodology is described in a research paper (UBA 2014b). Calculating the indirect environmental footprint is particularly challenging. It is done by consulting input-output tables showing the intersectoral connectedness of the German economy. The methodology is described in a paper published by the Federal Statistical Office of Germany (StBA 2015c).

- Indicator online (latest data, data download): www.uba.de/en/57252
- Detailed information: www.uba.de/44253 (in German only)
- Last update: 11/2016

Environmentally friendly consumption

Weighted market shares by sales of products with official eco-labels



* Target of the German Sustainable Development Strategy 2016

Source: German Environment Agency calculations based on consumer surveys conducted by GfK and data from the Federal Motor Transport Authority

At a glance

- In the sector of products with official eco-labels, 6 % of turnover was generated with particularly environmentally friendly products.
- The Federal Government has set the target of increasing the market share of environmentally friendly products to 34 % by 2030.
- Further efforts are needed to achieve this target, especially in the food sector.

- Indicator online (latest data, data download): www.uba.de/en/57253
- Detailed information: www.uba.de/11321 (in German only)
- Last update: 02/2016

Environmental importance

Private households can encourage sustainable consumption both directly and indirectly. Their purchasing decisions influences their own environmental footprint. For instance, energy-efficient vehicles or well-insulated homes need less energy and produce fewer greenhouse gas emissions. At the same time, consumers can reward manufacturers who have particularly sustainable production methods by favouring their products.

The indicator records the market shares of products with eco-labelling that sets stringent environmental standards. Up to now, only state-regulated eco-labelling has been considered: Energy labelling (cars, household appliances, lighting and televisions), organic labelling (food) and the Blue Angel label (sanitary tissues, washing and cleaning products). With this indicator it is possible to ascertain whether conventional products are being replaced by environmentally friendly versions. Sustainable consumption is all about replacing non-sustainable consumer habits with sustainable ones.

Assessing the development

In 2014, environmentally friendly products had a 6.1 % market share in the product groups investigated. Thus the indicator shows dynamic growth beginning at a low starting point. Market shares vary considerably within the various product groups. In household appliances for example, washing machines in the highest efficiency class most recently had a market share of 75 %. In contrast, electric cookers and ovens in the highest efficiency class had a market share of just 1 %.

In the updated German Sustainable Development Strategy 2016, the Federal Government has set targets for the market share of environmentally friendly products. These are to increase to 34 % by 2030 (Federal Government 2016). First and foremost, this target requires the existing dynamic growth of energy-efficient products to be maintained. Sales of organic foods must also increase substantially. In light of the above, the Federal Government adopted a National Programme for Sustainable Consumption in early 2016 (BMUB 2016b). This sets out a range of measures aimed at further promoting sustainable consumption.

Methodology

To calculate the indicator, particularly environmentally-relevant product groups for which market data are available were identified in each consumer area. Since the market volumes for individual product groups vary greatly, the market shares were weighted by the volume of sales for the respective market as a whole. This guarantees that the indicator is not distorted by high market shares in small niche markets. A description of the methodology can be found in a study commissioned by the German Environment Agency (UBA 2015d), although not all the product groups described there are covered by this indicator.

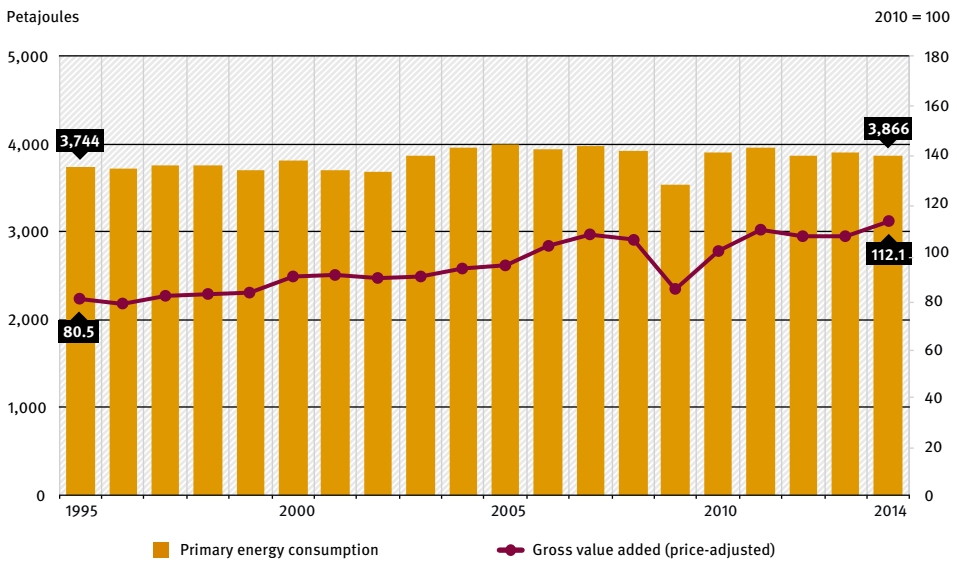
11

ENVIRONMENT AND ECONOMY

Energy consumption in manufacturing
Greenhouse gas emissions in industry
Environmental costs of energy and road transport
Environmental protection goods
Employment in environmental protection
Environmental taxes
Environmental management
National Welfare Index

Energy consumption in manufacturing

Primary energy consumption in manufacturing industry*



* The manufacturing industry sector is equivalent to Category "C - Verarbeitendes Gewerbe" in the industry classification in the Environmental Economic Accounting

Source energy consumption: Federal Statistical Office of Germany (StBA) report, 20.01.2017; Source gross value added: StBA 2016, Inlandsproduktberechnung - Lange Reihen ab 1970 Fachserie 18 Reihe 1.5 - Tabelle 2 (in German only)

At a glance

- Energy consumption in manufacturing hardly changed at all between 1995 and 2014.
- The energy consumption has been declining in the sector since 2005.
- Germany's primary energy consumption should fall by 50 % by 2050. The manufacturing sector will have to contribute to it.

Environmental importance

Energy consumption is a major contributor to various environmental problems. Mining raw material and building transport infrastructure involves massive interference with ecosystems. Furthermore, the use of fossil energy sources is the main driver of climate change. To mitigate these problems, energy consumption must fall.

Manufacturing is the main consumer of energy in Germany, alongside private households. Since 1995, its share of primary energy consumption has been a quarter of overall consumption. In addition, there is proportional energy consumption in power stations because the industry receives and uses a large proportion of the electricity and heat produced in power stations. This so called indirect energy consumption is included in the indicator.

The indicator does not tell us whether energy-intensive production processes have been outsourced abroad. If that were the case, domestic consumption would fall, whereas the environmental impact of high energy consumption would be felt abroad. New indicators that take such exports of the environmental impact into account are being developed.

Assessing the development

Energy consumption of the German manufacturing sector has been rising slightly since 1995. It was 3,744 Petajoule (PJ) in 1995 and 3,866 PJ in 2014 – a rise of 3 % in 19 years. Energy consumption peaked in 2005 at almost 4,000 PJ (+ 7 % since 1995). Since 2005, final energy consumption in German manufacturing has been declining.

During the same period 1995 to 2014, the sector's gross value added, which measures economic performance, has increased by nearly 39 %. In other words, the manufacturing sector uses energy much more efficiently.

In its Energy Concept of 2010, the Federal Government set targets for primary energy consumption. By 2020, it should fall by 20 % compared to 2008 and by 50 % by 2050 (Federal Government 2010). These targets are barely achievable if the manufacturing sector does not lower its energy consumption. There is still a lot of unused potential, in particular in energy efficiency.

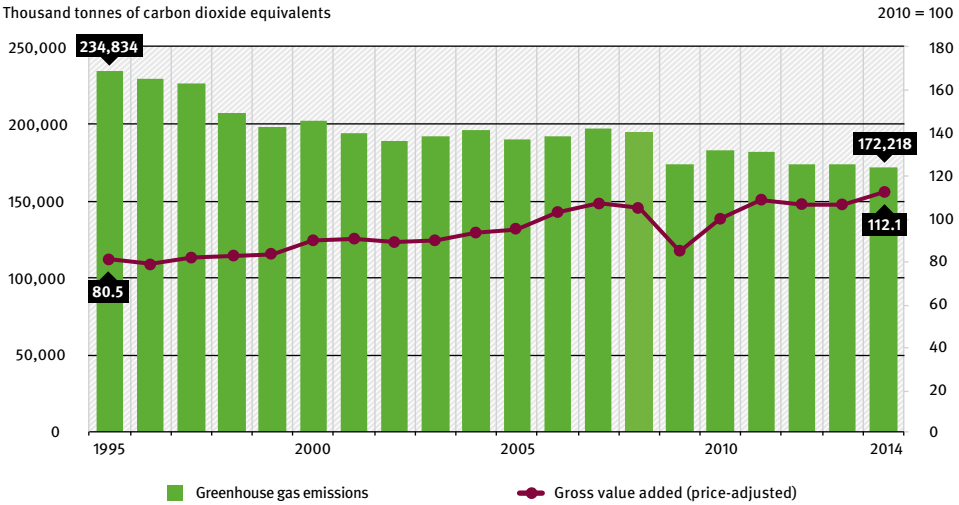
Methodology

The indicator is based on figures from the Environmental Economic Accounting (UGR). The UGR tables are based on figures from the Energy Balances Working Group (AGEB), but must be adapted to the UGR system. The proportional energy consumption in power stations is included following the UGR methodology. The methodology has been described by Mayer (2015).

- Indicator online (latest data, data download): www.uba.de/en/57197
- Last update: 01/2017

Greenhouse gas emissions in industry

Greenhouse gas emissions in manufacturing industry*



* The manufacturing industry sector is equivalent to Category "C - Verarbeitendes Gewerbe" in theindustry classification in the Environmental Economic Accounting (UGR)

Source greenhouse gas emissions: Federal Statistical Office of Germany (StBA) report, 20.01.2017;
Source gross value added: StBA 2016, Inlandsproduktberechnung - Lange Reihen ab 1970 Fachserie 18 Reihe 1.5 - Tabelle 2 (in German only)

At a glance

- Greenhouse gas emissions by manufacturing industry fell by nearly 27 % between 1995 and 2014.
- Over the same period, productivity grew by 33 %.
- Overall greenhouse gas emissions in Germany should fall by 95 % by 2050.

- Indicator online (latest data, data download): www.uba.de/en/57199
- Last update: 01/2017

Environmental importance

Since the beginnings of industrialisation in particular, humans have caused the emission of large amounts of greenhouse gases into the atmosphere, where temperatures rose as a consequence. This has a number of repercussions, such as an increase in precipitation, destabilisation of infrastructure, the spread of tropical diseases etc.

The most important source of greenhouse gas emissions has been and still is the combustion of fossil energy sources. Energy is largely used in the production of goods. This explains the important role the manufacturing sector plays in resolving climate issue.

The industry is also an indirect cause of greenhouse gas emissions, as it purchases electricity and heat from external power station operators. This share of emissions should also be attributed to the industry, but the effect is not taken into account in the indicator because no suitable data are currently available.

Assessing the development

Since 1995, greenhouse gas emissions by manufacturing industry have fallen by nearly 27 %. According to Environmental Economic Accounting (UGR) figures, total emissions in Germany fell by just around 19 % (cf. 'Greenhouse gas emissions') in the same period. The trend is thus better in this sector than in the overall economy. At the same time, the sector grew by 39 %. The main reason for this development is the switch to cleaner energy sources within the sector.

What has to be taken into account is that when installations are not used to full capacity, their efficiency will decrease. This explains the development of the indicator in the crisis year 2009, when gross value added fell by 20 %, whereas emissions of greenhouse gases decreased by approximately 11 % only.

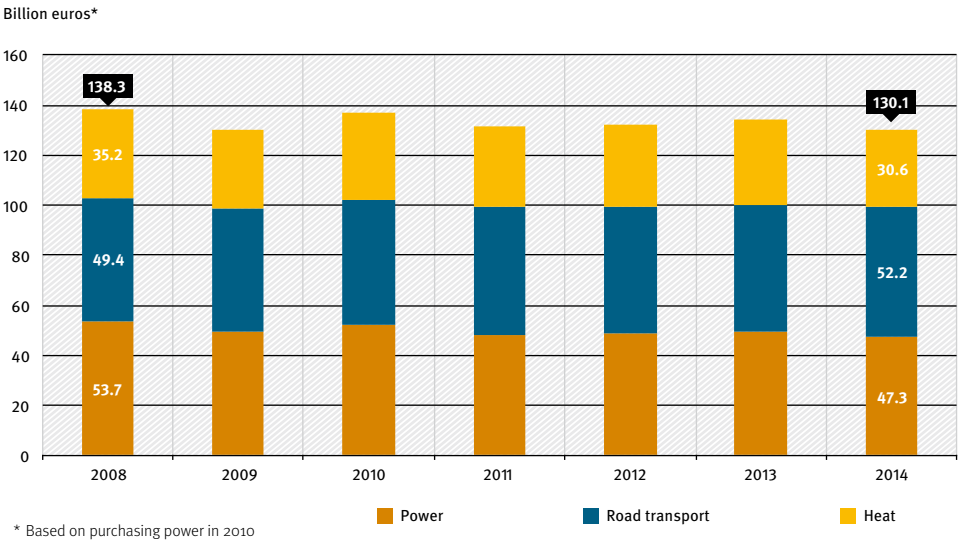
In its Energy Concept of 2010, the Federal Government set ambitious targets for reducing greenhouse gas emissions. By 2050, emissions should be 80 % to 95 % below 1990 levels (Federal Government 2010). In order to achieve these targets, the manufacturing industry – one of the major emitters – must also continue to reduce its emissions.

Methodology

The indicator uses figures of the Environmental Economic Accounting (UGR) provided by the Federal Statistical Office of Germany. The greenhouse gas tables of UGR are essentially based on data of the Emissions Inventory of the German Environment Agency (UBA 2017c), but must be adapted to the UGR system. The method is explained in detail by Thomas (2012).

Environmental costs of energy and road transport

Environmental costs (greenhouse gases and air pollutants) of power and heat generation as well as road transport



* Based on purchasing power in 2010

Source: German Environment Agency 2016, own calculations based on data from Working Group on Energy Balances (AGEB); Working Group on Renewable Energy Statistics (AGEE-Stat); TREMOD - Transport Emission Model, Federal Ministry for Economic Affairs and Energy (BMWi), Renewables in Figures

At a glance

- Environmental costs of energy generation and road transport decreased by only 6 % between 2008 and 2014.
- Transport-related environmental costs rose by nearly 6 % between 2008 and 2014.
- Environmental costs of power and heat have decreased over the past years by 12 % and 13 % respectively.

- Indicator online (latest data, data download): www.uba.de/en/57228
- Detailed information: www.uba.de/21998 (in German only)
- Last update: 02/2017

Environmental importance

Environmental costs are economically highly relevant, as was demonstrated by the economist Sir Nicholas Stern in his Review on the Economics of Climate Change in 2006 (Stern 2006). The Stern Report, as it became known, estimates that the costs caused by climate change will amount to 20 % of the global annual gross domestic product.

The use and transformation of energy resources for electricity and heat generation and road transport pollutes environment through the emission of greenhouse gases and air pollutants, e.g. particulate matter and nitrogen oxides. The air pollutants released cause an increase in morbidity, damage to buildings and monuments (facade pollution) and are a burden on ecosystems (cf. 'Health risks due to particulate matter' and 'Agricultural nitrogen surplus'). The emitted greenhouse gases contribute to climate change. This is linked to costs to the economy, for instance for repairing damage caused by storm or treatment of environment-associated diseases.

Energy generation and road transport cause environmental damage through greenhouse gases and air pollutants, but also infringe further on the environment by land consumption, noise pollution and water pollution. These are not included in the indicator.

Assessing the development

Total environmental costs decreased from 138.3 billion euros in 2008 to 130.1 billion euros in 2014. This is equivalent to a decrease of 6 %. However, environment costs for transport increased over the same period (+ 6 %). This could not even be changed by the development of more efficient drive systems. An increase in road traffic and a trend towards more powerful motor vehicles are responsible for this development.

By contrast, environmental costs for heat and electricity fell by 12 % and 13 % respectively. This is due to an increased use of renewables. Using renewable energy sources causes significantly less environmental damage through air pollutants and greenhouse gases than using fossil energy sources such as coal, mineral oil or natural gas.

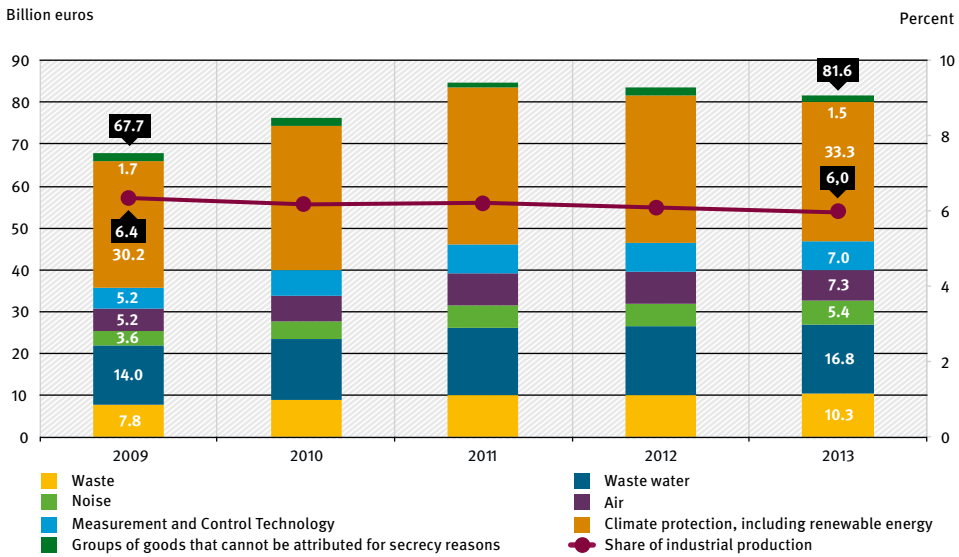
Methodology

Calculations of environmental damage are based on the 'Methodological convention for the estimation of environmental costs' of the German Environment Agency (UBA 2013). The convention helps to determine costs for the use of the environment according to uniform and transparent criteria. It takes current research into account.

The methodological convention includes cost rates for the environmental costs of greenhouse gases, air pollutants and noise as well as cost rates per kilowatt-hour of electricity and heat generated and per kilometre travelled. The environmental costs incurred by electricity and heat generation as well as transport can be estimated on the basis of these cost rates.

Environmental protection goods

Production of potential environmental protection goods



Source: Gehrke, B; Schasse, U (2015): Umweltschutzwirtschaft in Deutschland. Produktion, Umsatz und Außenhandel, in: UBA, BMUB (ed.): Reihe Umwelt, Innovation, Beschäftigung, 04/2015. Dessau-Roßlau, Berlin (in German, Summary in English)

At a glance

- Approximately 6 % of goods produced in Germany can be used to protect the environment, e.g. for noise protection or climate mitigation.
- In 2013, potential environmental protection goods worth nearly 82 billion euros were produced in Germany.
- The production of environmental protection goods has been declining since 2012. Its share in overall industrial production has also been falling.

- Indicator online (latest data, data download): www.uba.de/en/57331
- Detailed information: www.uba.de/22129 (in German only)
- Last update: 10/2015

Environmental importance

Environmental protection has been established in Germany as an important economic factor. The environmental economy includes waste management and recycling, water conservation and wastewater treatment, air quality control, noise abatement, renewable energy sources, environmentally friendly products, efficient use of energy, climate protection and measurement and control technology.

Global demand is growing for environmental protection and climate change mitigation technologies as well as products that are environmentally friendly and help to save resources. This will enhance the economic importance of environmental protection in the future. German companies have long been established in producing environmental protection goods on the global market, but competitive pressure is growing. The production of potential environmental protection goods is one of the indicators for assessing competitiveness of the German environmental protection sector and the general importance of environmental protection for the economy.

Assessing the development

In 2013, companies produced goods worth nearly 82 billion euros, which can be used for environmental protection purposes. This is 6 % of the overall German industrial production. Climate protection goods make up the major share or 40 % of the entire environmental protection goods production. These also include installations for the generation of renewable energy. Next in line are the areas water conservation and wastewater treatment, waste management, air quality control, measurement and control technology and noise abatement.

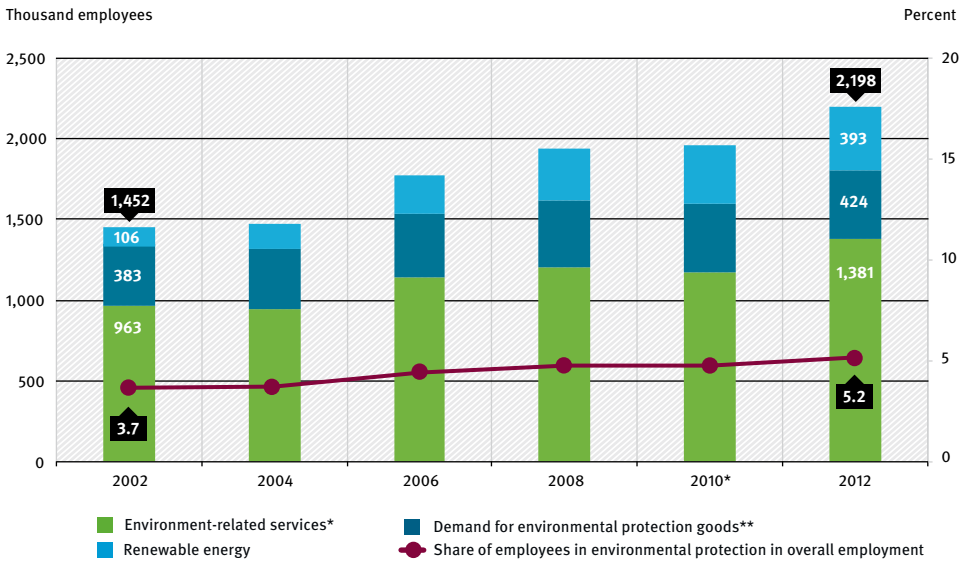
After production soared by 25 % between 2009 and 2011, the trend has reversed since then. Production volume fell by 3.9 % between 2011 and 2013. The decline is mainly due to lower production rates in climate protection goods, in particular solar energy installations. Further details can be found in a publication by Gehrke at al. (2015). Strong competition, especially from China, is responsible. Production of air quality control goods also fell according to the latest findings, while other sectors continue to see a slight increase.

Methodology

The concept of potential environmental protection goods was developed in the 1990s and has been further refined through conventions drawn up by various research institutions in cooperation with Germany's Federal Statistical Office. The concept is based on a list of goods that (can) help to protect the environment. Because it uses standard international goods classifications, this concept lends itself to international competitiveness comparisons. For further information, see Gehrke et al. (2013).

Employment in environmental protection

Employment in environmental protection



* Due to methodological changes, data from 2010 are not fully comparable to preceeding years.

** Net: adjusted for double counting. Includes employment due to energy efficiency renovation of buildings.

Source: Edler, D; Blazejczak, J (2016), Beschäftigungswirkungen des Umweltschutzes in Deutschland im Jahr 2012. Reihe Umwelt, Innovation, Beschäftigung 01/2016. Released by UBA and BMUB. Dessau-Roßlau, Berlin (in German only)

At a glance

- In 2012, 2.2 million people worked in environmental protection, which is 5 % of the total employment.
- Of this, over half are environment-related services.
- Employment in environmental protection has risen by more than 50 % since 2002.

Environmental importance

Employment in environmental protection is an important indicator for the relevance of environmental protection for the economy. The main objective of environmental protection is not the creation of jobs. Still, environmental policy should be designed as much as possible in a way that also allows for positive effects on the economy and job creation.

The indicator shows how many people in Germany work for environmental protection, either by doing environmental protection activities as part of their job description or because they work in upstream production areas. In addition to absolute numbers of people employed, the indicator also gives the proportion of people employed in environmental protection compared to overall employment figures. The figure gives an indication whether the overall significance of environmental protection for the labour market is increasing or declining.

Assessing the development

With a share of 5.2 %, environmental protection is an important factor in Germany's labour market. In 2012, approximately 2.2 million people owed their job to environmental protection. About 60 % of these jobs are environment-related services, such as planning offices, environmental authorities, environmental education or car-sharing businesses.

In recent years, employment in environmental protection has been rising constantly, by more than 50 % between 2002 and 2012. Between 2010 and 2012 alone, employment rose by 12.5 %, increasing more steeply than overall employment. An increase in the export of environmental protection goods, the further development of renewable energy during this period and the increasing importance of environmental services all had a positive effect.

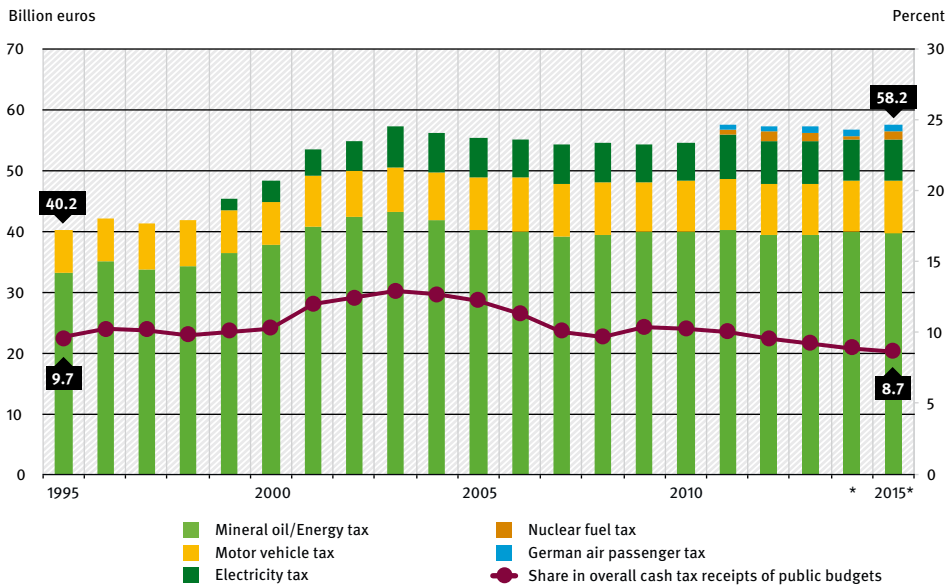
Methodology

The number of employees working in the field of environmental protection cannot just be read from a statistics table, due to the huge amount of occupational fields, activities and sectors involved. The German Environment Agency commissions research projects on a regular basis to estimate employment in environmental protection, using an internationally recognised method. An extensive documentation of the method and its results can be found at Edler and Blazejczak (2016).

- Indicator online (latest data, data download): www.uba.de/en/57330
- Detailed information: www.uba.de/17774 (in German only)
- Last update: 04/2016

Environmental taxes

Environmental tax revenue



* Preliminary result

Source: Federal Statistical Office of Germany 2016, Gesamtaufkommen aus umweltbezogenen Steuern (www.destatis.de, accessed by 07.03.2017) (in German only)

At a glance

- The most important environmental taxes are energy, motor vehicle and electricity taxes.
- In 2015, environmental taxes amounted to a total of 58.2 billion euros.
- Environmental taxes have significantly increased since 1995. Since 2009, however, their share of overall taxes has been in constant decline.

Environmental importance

Environmental taxes are effective tools for tackling ecological challenges that arise, for instance, from the consumption of energy and resources. A higher price is an incentive for companies and private households to consider the environmental cost of products when deciding on production methods and purchases. In addition, companies are encouraged to develop more environmentally friendly technologies, which will give them the option of improving their international competitiveness.

The manufacturing industry and agriculture and forestry benefit from tax breaks for electricity, heating oil and gas, while the service sector and private households are more heavily taxed. Approximately 90 % of the revenue from the ecological tax reform fund the state pension scheme, thus lowering individual and company contributions.

Assessing the development

In 2015, revenue from environmental taxes amounted to 58.2 billion euros. The largest proportion came from the energy tax, 39.6 billion euros, followed by the motor vehicle tax (8.8 billion euros) and the electricity tax (6.6 billion euros).

Environmental taxes have risen by 20.9 % between 2000 and 2015, whereas overall taxes increased by 44.1 %. The share of environmental taxes in overall tax revenue is only 8.7 % - the lowest figure since 1995.

The introduction of the Ecological Tax Reform in 1999 led to a substantial rise in revenue from environmental taxes until 2005. Revenue from environmental taxes fell slightly by 2010 because the Ecological Tax Reform led to a more economical use of energy and electricity. Price hikes and inflation had no effect on revenue, as the taxes are quantity taxes (e.g. 2 cents per kilowatt hour of electricity). In 2011, the newly introduced nuclear fuel tax and aviation tax led to a slight increase in environmental taxes.

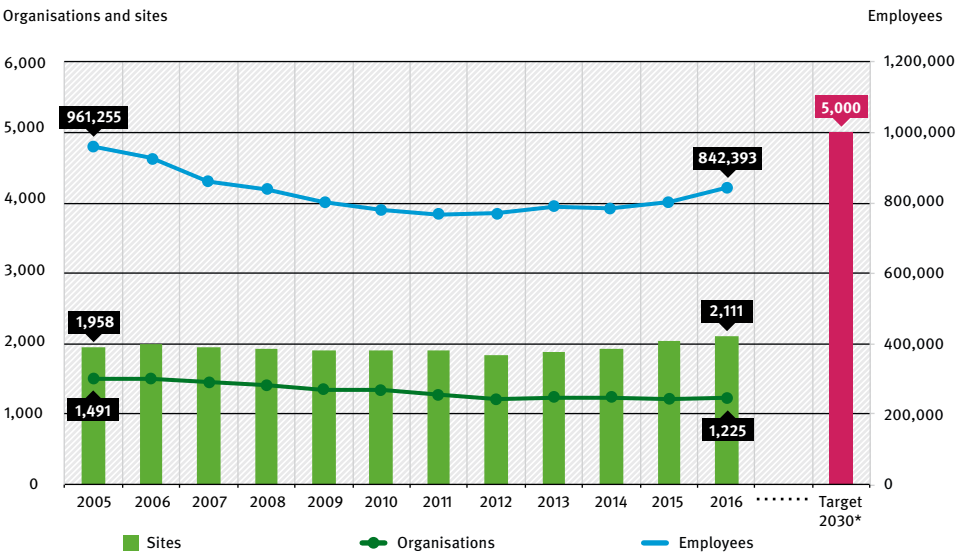
Methodology

The concept of statistics on environmental taxes was developed at an international level by the Organisation for Economic Co-operation and Development (OECD) and the Statistical Office of the European Communities (Eurostat 2013). Reports on the development of environmental taxes are part of the Environmental Economic Accounting of the Federal Statistical Office of Germany (StBA 2015a).

- Indicator online (latest data, data download): www.uba.de/en/57200
- Detailed information: www.uba.de/31531 (in German only)
- Last update: 06/2016

Environmental management

Number of EMAS-registered organisations, sites and employees



* Target of the German Sustainable Development Strategy (2016) for number of sites

Source: EMAS-Register of the Association of German Chambers of Commerce and Industry (DIHK) (http://www.emas-register.de/)

At a glance

- EMAS is an internationally applicable system for environmental management. It is the most ambitious publicly available environmental management standard.
- From 2005 to 2012, the number of EMAS-registered organisations declined by around 20 %. Since 2012, registrations remain on a stable level.
- The number of EMAS registered sites and the amount of employees in EMAS-registered organisations decreased until 2012 and 2011 respectively. Since then, numbers are rising again.
- The Federal Government aims for 5,000 EMAS sites by 2030.

- Indicator online (latest data, data download): www.uba.de/en/57201
- Detailed information: www.uba.de/22254 (in German only)
- Last update: constantly updated at www.emas-register.de

Environmental importance

The number of organisations and sites registered with the Eco-Management and Audit Scheme (EMAS) and the amount of employees in EMAS-registered organisations are a measure for the acceptance of sustainable production patterns in the economy. EMAS is applicable for companies and other organisations that want to improve their environmental performance in a systematic, transparent and credible manner. The scheme's requirements are defined in the European EMAS regulation (EU regulation 1221/2009).

EMAS focuses on the environmental aspects of activities, products and services over the entire life cycle. These must be taken into account when defining and implementing processes, responsibilities and decision structures so that adverse effects on the environment are continuously reduced. Progress is monitored by independent, accredited verifiers and reported in publicly accessible environment statements.

EMAS improves environmental protection and can help to save costs. An increased number of organisations joining the EMAS scheme will have an overall positive effect on environmental, climate and resource protection. EMAS builds on the internationally widely used environmental management standard ISO 14001, but is more ambitious.

Assessing the development

In late 2016, 1,225 organisations at 2,111 sites were EMAS-registered. After a decline between 2005 and 2012, numbers remain on a stable level. The number of EMAS registered sites and the amount of employees in EMAS-registered organisations decreased until 2012 and 2011 respectively. Since then, numbers are rising again (sites+ 15 %, employees + 10 %).

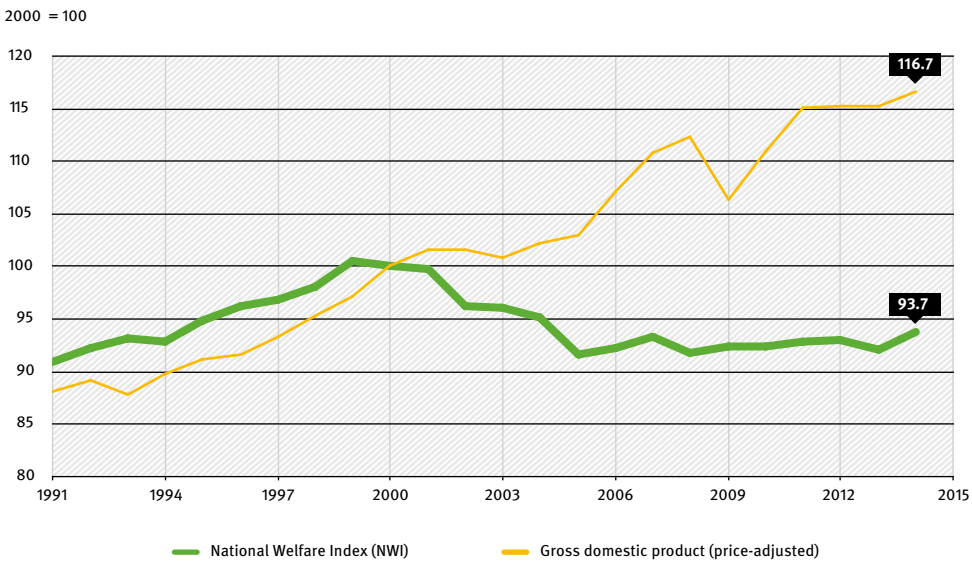
In the revised German Sustainable Development Strategy, the German Federal Government commits to further supporting EMAS (Federal Government 2016). In 2030, 5,000 sites should be EMAS-validated and registered. Since it will be easier in the future for certain industries to include multiple sites in an EMAS registration, this target does not seem unrealistic. However, EMAS still needs more support and further steps to be taken to achieve this goal. So far, companies that are EMAS-registered have had advantages in water, waste and immission control legislation and can benefit from various exemptions.

Methodology

EMAS organisations and sites are registered by the competent Chambers of Industry and Commerce and Chambers of Handicrafts and enter the publicly accessible database of the Association of German Chambers of Commerce and Industry (DIHK) database (DIHK n.d.). Data based on a unified collection method are available from 2005 onwards. The office of the German EMAS Advisory Board (UGA) publishes a monthly summary of developments, based on relevant DIHK statistics (UGA n.d.).

National Welfare Index

Economic development - National Welfare Index (NWI) and gross domestic product (GDP)



Source: Freie Universität Berlin; Forschungsstätte der Evangelischen Studiengemeinschaft (FEST); www.fest-nwi.de

At a glance

- Gross domestic product (GDP) measures the economic performance of an economy, but does not reflect social welfare.
- The National Welfare Index (NWI) includes overall 20 activities that raise and diminish welfare.
- The NWI reached its peak in 1999 and declined afterwards until 2005. Since then it fluctuates only slightly while GDP was mainly rising.

- Indicator online (latest data, data download): www.uba.de/en/57202
- Last update: 02/2017

Environmental importance

GDP indicates the economic performance of an economy and has been recognised as an internationally comparable statistical parameter. However, GDP does not measure social welfare. The main criticisms include the fact that GDP does not take into account distribution of income and does not incorporate voluntary work and housework. Furthermore, it does not include costs through damage to the environment. Thus it does not show decreases in natural capital. Crime, drug abuse and car accidents tend to have a positive effect on GDP.

The NWI has been developed as an indicator that takes account of such criticism. Based on consumption expenditure, it contains bonus and malus components, depending on whether they contribute to welfare or not. Greater income inequality lowers the value of the index. The NWI has been increasingly used by the German Federal States (Diefenbacher et al. 2016).

Assessing the development

Since 1991 GDP increased more than 30 % while the NWI only increased by 3.1 %. The GDP increase was continuous during that time, being only disrupted by the 2009 economic crisis. Between 1991 and 1998, the NWI developed in parallel with GDP with the NWI being slightly above the GDP. Since then, the two indicators have been diverging. While GDP rose by 16.7 % between 2010 and 2014, the NWI fell by 6.3 % and has been stagnating around the value it already reached in 1991 over the past few years.

The main component of the NWI consists of real consumption expenditure weighted by the distribution of income (Gini coefficient). While real consumption expenditure has been essentially stationary since 1991, income distribution has become more unequal. This is the main reason for the drop in the NWI. On the other hand, there has been a modest reduction in other welfare reducing components including environmental damage.

Differing reactions to the crash of 2009 can also be explained by the construction of the NWI. While value-added in the economy and hence GDP declined dramatically, none of the components of the NWI were significantly affected in 2009.

Methodology

The NWI is the sum of 20 monetarily assessed components, the most important of which is real consumption expenditure weighted by the distribution of income (Gini coefficient). There are more welfare-enhancing components such as housework, volunteer work and expenditure for health and education that have a positive impact on the NWI, whereas negative activities are subtracted, such as environmental damage or crime.

A more detailed description of the calculation method is found at Diefenbacher et al. (2016). Up-to-date information on the NWI are published on the website www.fest-nwi.de.

ANNEX

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Status of internet sources: August 2017

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Abbreviations

%	percent
AGEB	Working Group on Energy Balances
AGEE-Stat	Working Group on Renewable Energy Statistics
BfN	Federal Agency for Nature Conservation
BImSchG	Federal Immission Control Act
BLE	Federal Office for Agriculture and Food
BMEL	Federal Ministry of Food and Agriculture
BMELV	Federal Ministry of Food, Agriculture, and Consumer Protection
BMU	Federal Ministry for the Environment, Nature Conservation and Nuclear Safety
BMUB	Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety
BMVBS	Federal Ministry of Transport, Building and Urban Affairs
BMVI	Federal Ministry of Transport and Digital Infrastructure
BMWi	Federal Ministry for Economic Affairs and Energy
BWI	National Forest Inventory
°C	degree Celsius
CAP	European Common Agricultural Policy
CHP	combined heat and power
CO_2	carbon dioxide
db(A)	A-weighted sound power level
DIHK	German Chambers of Industry and Commerce
DIW	German Institute for Economic Research
DWD	Deutscher Wetterdienst
EEA	European Environment Agency
EEFA	Energy Environment Forecast Analysis
EEG	Renewable Energy Act
EC	European Community
e.g.	exempli gratia (for example)
EMAS	Eco-Management and Audit Scheme
ESG	Energy Efficiency Strategy for Buildings
et al.	et alii (and others)
etc.	et cetera (and so forth)
EU	European Union
FSC	Forest Stewardship Council

GDP	gross domestic product
ha	hectare
HELCOM	Baltic Marine Environment Protection Commission (a.k.a. Helsinki Commission)
IMT	individual motorised transport
ifeu	Institute for Energy and Environmental Research
ISO	International Organization for Standardization
KBA	Federal Motor Transport Authority
kg	kilogramme
km	kilometre
km²	square kilometre
KrWG	Circular Economy Act
KWKG	Act on Combined Heat and Power generation
LAWA	German Working Group on water issues of the Federal States and the Federal Government represented by the Federal Environment Ministry
m³	cubic metre
max.	maximum
mg/l	milligramme per litre
min.	minimal
m	Million
MSRL	Marine Strategy Framework Directive
µg	microgramme
µg/m³	microgramme per cubic metre
µm	micrometre
NAPE	National Action Plan of Energy Efficiency
NBS	National Strategy on Biological Diversity
n.d.	undated
NERC	National Emission Reduction Commitments
NH_3	ammonia
NMVOC	non methane volatile organic compounds
NOx	nitrogen oxides
NO_2	nitrogen dioxide
NWI	National Welfare Index
O_3	ozone
OECD	Organisation of Economic Co-operation and Development
OGewV	Surface Waters Ordinance
OSPAR	Oslo Paris Commission for the Protection of the Marine Environment of the North-East Atlantic
PEFC	Programme for the Endorsement of Forest Certification Schemes

PJ	petajoule
Ppm	parts per million
PM10	particulate matter 10 (particle size ‹ 10 micrometres)
PM2.5	particulate matter 2.5 (particle size ‹ 2.5 micrometres)
RL	directive
RMC	Raw Material Consumption
RMI	Raw Material Input
SO2	sulphur dioxide
SRU	German Advisory Council on the Environment
StBA	Federal Statistical Office of Germany
t	tonne (metric)
TREMOD	Transport Emission Model
TWh	terawatt-hour
UBA	German Environment Agency
UGA	German EMAS Advisory Board
UGR	Environmental-Economic Accounting
UN	United Nations
UNECE	United Nations Economic Commission for Europe
UNFCCC	United Nations Framework Convention on Climate Change
UZVR	undissected low-traffic areas
VO	regulation
WFD	Water Framework Directive
WHO	World Health Organization
WRRL	EU Water Framework Directive

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