WHAT MATTERS 2014

↗ Beyond Environmental Standards ↗ Soil: Our earth's „thin skin" needs protection ↗ Green IT: Sustainable information and communication

Annual Report of the Federal Environment Agency

Umwelt Bundesamt

For our Environment

WHAT MATTERS

2014

↗ Air: Beyond Environmental Standards ↗ Soil: Our earth's „thin skin" needs protection ↗ Green IT: Sustainable information and communication

Annual Report of the Federal Environment Agency

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President of the Federal Environment Agency

Change through environmental protection

You will often come across of the word „environment“ in this text. This now all too common notion is not old. The German term „Umwelt“ closely follows the English word „environment“, which embodies all natural life foundations of the human population. The terms „environment“ and implicitly „environmental protection“ thus made themselves a home in the German language in the early 1970s. The establishment of the Federal Environment Agency (UBA) also falls into this time. In 1974, 40 years ago, our office was established. Environment and environmental protection are now firmly embedded into social consciousness. The staff of UBA has contributed a lot to this in the past decades. “What Matters” is an occasion to look back: to celebrate the most important milestones of German environmental policy, which are closely related to UBA.

Back to the present and the future. One topic that was less important forty years ago than it is today is the urbanisation of our habitats. In 1975 37.2 percent of the world’s population – which equals to 1.5 billion people – lived in urban areas. Today, numbers rose to 3.9 billion – about 54 percent of the world population. In 2050, experts predict a global urbanisation rate of over 66 percent.

Urbanisation is one of the “mega trends” that determines the quality of our natural living conditions. The cleanliness of our air and drinking water and the availability of soil depend not least on living and economic patterns in the cities. The cities themselves are only worth living in if they have a good air quality, clean drinking water, sufficient water supplies and have enough green and recreational areas.

All major cities of the world, such as London, Beijing and Cairo are facing these challenges. Therefore, it is important to understand the interactions between urban life, the economy and the environment. The point is to show how life can be environmentally friendly in cities as well, so that cities become more livable. A further aim is to protect natural resources and to improve and sustainably secure environmental conditions in rural areas.

Environmental and resource protection should be an integral part of urban and construction planning. Conversely, urban planning and construction policy should be integrated into ambitious and revolutionary environmental policy. The merger of the building ministry with the environmental ministry by the new Federal Government is therefore a positive step. UBA has once again conducted scientific research on the interaction

between the built environment and the use of air, water and soil.

Without fertile soils, clean air and water, humans cannot sustain themselves permanently. This realisation was a reason for the establishment of the Federal Environment Agency 40 years ago. The then Minister of the Interior Hans-Dietrich Genscher's aim was to create a central federal authority for environmental matters and, as such, to contribute to the growing environmental awareness. This awareness was nurtured and embedded as a result of the proportions of environmental problems, for example in the domains of air and water. The Federal Pollution Control Act passed in the same year led to the systematic decrease of emissions and consequently the significant improvement of life quality in urban areas. This law has since been one of the pillars of environmental protection in Germany.

Even after 40 years, the air quality in German metropolitan areas remains an important issue for environmental protection. There are still many pollutants in the air, but focus is placed on different ones than those of 20 or 40 years ago. Instead of sulphur dioxide and lead, problems today are created mainly by particulate matter and nitrogen oxides. The reasons behind this are multilateral: traffic, construction machinery, the industry, private wood-burning installations or even the agriculture. In the interest of the protection of human health, emissions must be reduced in the future in the cities, as well as in the surrounding agricultural and industrial sites.

In terms of the protection of our air, our water and our soil, UBA has achieved a lot in Germany. You can read about the details in the individual chapters. An important milestone was the Federal Soil Protection Act of 1998. However, so far there is nothing adequate at a European level – the EU Commission's efforts to adopt an EU Soil Framework Directive were materialised in the spring of 2014. The UN International Year of soil in 2015 will hopefully mark a new momentum in international soil protection. A separate chapter of this book has been dedicated to this issue. It also demonstrates that soil protection is closely linked to urban and construction policy. In Germany we lose 74 hectares of soil on a daily basis, which constitutes the area of more than 100 football fields – due to the growth of settlement areas or new infrastructure. Soil that previously filtered water and could be used for the production of food is sealed off every day on a global scale.

Cities consume a large part of the available energy and resources. An important issue, therefore, is the efficient use of energy and resources in urban areas. It is not just about environmental sustainability in the cities alone, but also about the grounds far away from urban areas where the resources originate from. Approaches provide, for example, „Smart Grids" in support of the development of renewable energies. Or even an intelligent traffic control, which dissolves traffic jams. Such integration of data networks into everyday life will shape our future. This also makes it possible to detect environmental impacts in the planning process and to identify alternative, environmentally friendly ways. Sustainable information and communication technology finds its application in intelligent constructions or in the control of power networks. However, their use also consumes resources and energy. And they make a truly sustainable contribution to our society, but the so-called rebound effects cannot be ignored. Particularly striking are these effects in increasing energy needs of data centres, which are a pivotal point for all IT applications, as well as the consumption of resources in relation to the useful durability of IT products. This is a topic "What Matters" also tackles.

Environmental challenges are abundant. The overriding question is: how do we proceed in the future to significantly reduce the emission of greenhouse gases and to slow down climate change? A question that was not posed at the time of the creation of the UBA. Today it is one of the most crucial issues in national and international environmental policy. The preservation of our natural resources depends on political action. In 2013 UBA presented the study „greenhouse gas neutral Germany" – a comprehensive sketch for a low-carbon economy and life. It showed how it is technically possible to reduce the annual per capita emissions of today's 10 tonnes of CO_2 equivalents to less than one tonne per capita by 2050. Compared to 1990, the international year of reference, this represents a reduction of 95 percent. The development of worldwide greenhouse gas emissions will be decided in 2015. That is when the climate conference takes place in Paris. After the many disappointing results of recent international climate conferences this one must succeed in establishing binding agreements, thereby giving the development of the world hope for the future!

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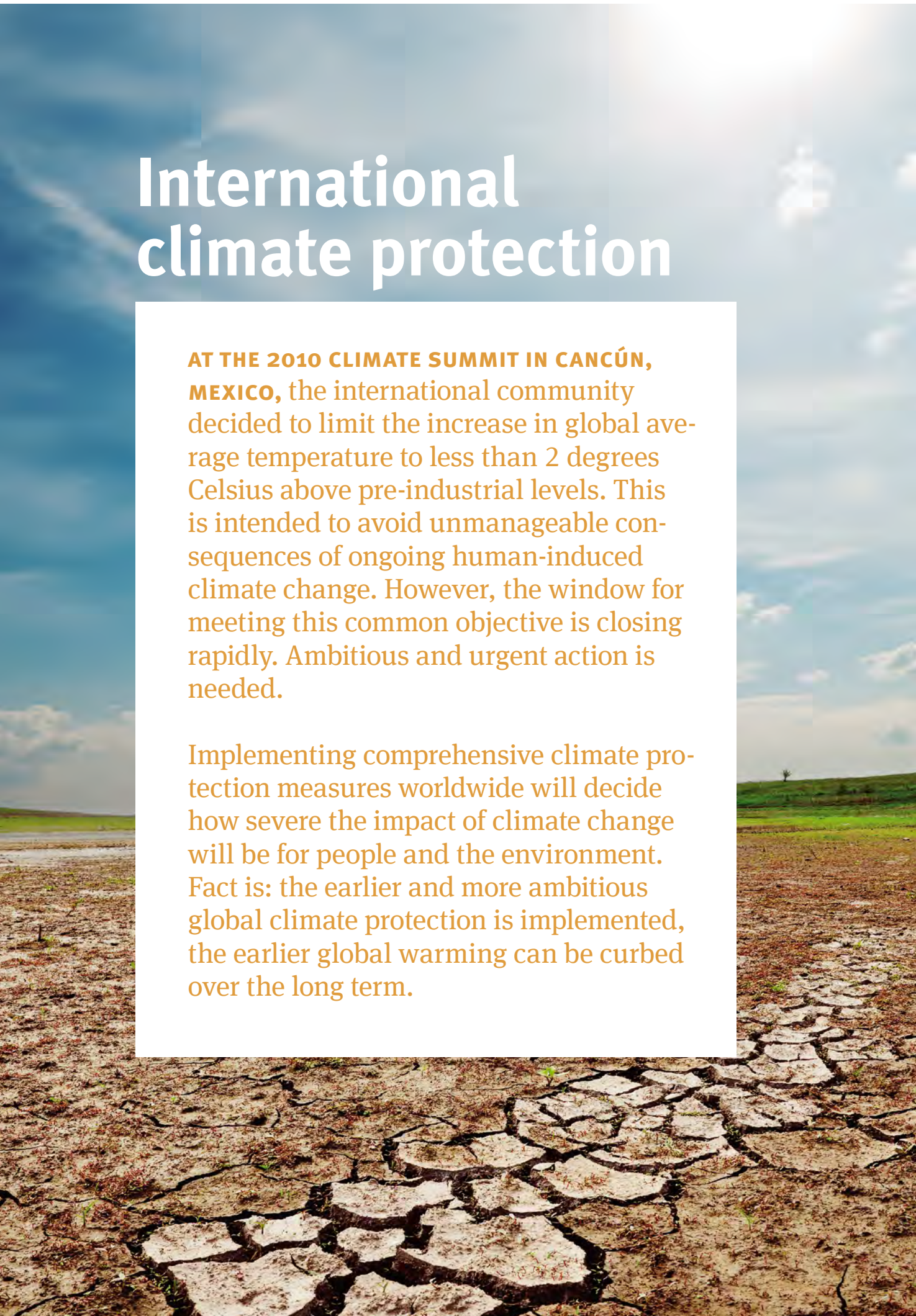


International climate protection

AT THE 2010 CLIMATE SUMMIT IN CANCÚN, MEXICO, the international community decided to limit the increase in global average temperature to less than 2 degrees Celsius above pre-industrial levels. This is intended to avoid unmanageable consequences of ongoing human-induced climate change. However, the window for meeting this common objective is closing rapidly. Ambitious and urgent action is needed.

Implementing comprehensive climate protection measures worldwide will decide how severe the impact of climate change will be for people and the environment. Fact is: the earlier and more ambitious global climate protection is implemented, the earlier global warming can be curbed over the long term.

Compliance with the 2-degree limit

To limit the increase in global average temperature to a maximum of 2 degrees Celsius above pre-industrial levels is the internationally agreed policy goal of the 2010 Climate Summit in Cancún. Compliance with this 2-degree limit will decide what the impact of climate change on us and future generations will be. The limit describes a temperature threshold beyond which climate scientists expect changes that will have serious consequences for people and the environment. To prevent this, we need comprehensive mitigation efforts: by 2050 global emissions of greenhouse gases must be at least halved compared to 1990, and should approach zero in the second half of the century.

But currently, greenhouse gas emissions worldwide are still rising. This shows that we're not yet on the right track.

Observed trends

Emissions and concentration

Since the beginning of industrialisation, the global emissions of greenhouse gases - especially carbon dioxide (CO_2) – has increased significantly. In 2012, global CO_2 emissions amounted to an estimated 34.5 billion tonnes[1] Taking into account other greenhouse gases such as methane and nitrous oxide, emissions are higher. In 2010, they were estimated at 50.1 billion tonnes of CO_2 equivalents (see box). This is 30 percent above 1990 levels.

According to the European Environment Agency, the concentration of CO_2 and other greenhouse gases in the atmosphere reached a new high in 2010. Since pre-industrial times, the proportion of CO_2 equivalents in the air increased from 280 ppm (parts per million) to 403 ppm[2]. To comply with the 2-degree limit, 450 ppm should not be exceeded. So far, greenhouse gas concentrations are still trending upwards - without ambitious climate protection that will not change.

Global temperature

The main reason for current climate change is the release of greenhouse gases from human activities. More and more of these gases are present in the lower atmosphere and contribute to global warming. Since 1880-2012, the mean surface air temperature worldwide has already increased by 0.85 degrees Celsius (see Figure1, upper part). Each of the last three decades has been successively warmer at the surface than all previous decades since 1850. In the northern hemisphere, the 30-year period from 1983 to 2012 has been the warmest for 1400 years[3] (see Figure 1, lower part).

INFOBOX

Carbon dioxide equivalents

Several greenhouse gases such as carbon dioxide, methane and nitrous oxide contribute to global warming. They differ in their warming influence. Experts call this „radiative forcing", which takes into account the different radiative properties and lifetimes of the gases in the atmosphere. The respective radiative forcing of greenhouse gases is expressed as a global warming potential (GWP). Carbon dioxide has a GWP value of 1. Based on a 100-year period, the global warming potential of methane is 34 times, and that of nitrous oxide 298 times greater than carbon dioxide - methane therefore has a GWP of 34, nitrous oxide one of 298. To represent the overall radiative forcing of greenhouse gases, the emission levels of the various gases are multiplied with their greenhouse gas potential and added up. The sum is expressed in CO_2 equivalents. If the emissions of all greenhouse gases amounts to 50 billion tonnes of CO_2 equivalents, this corresponds to the greenhouse gas effect of 50 billion tonnes of carbon dioxide.

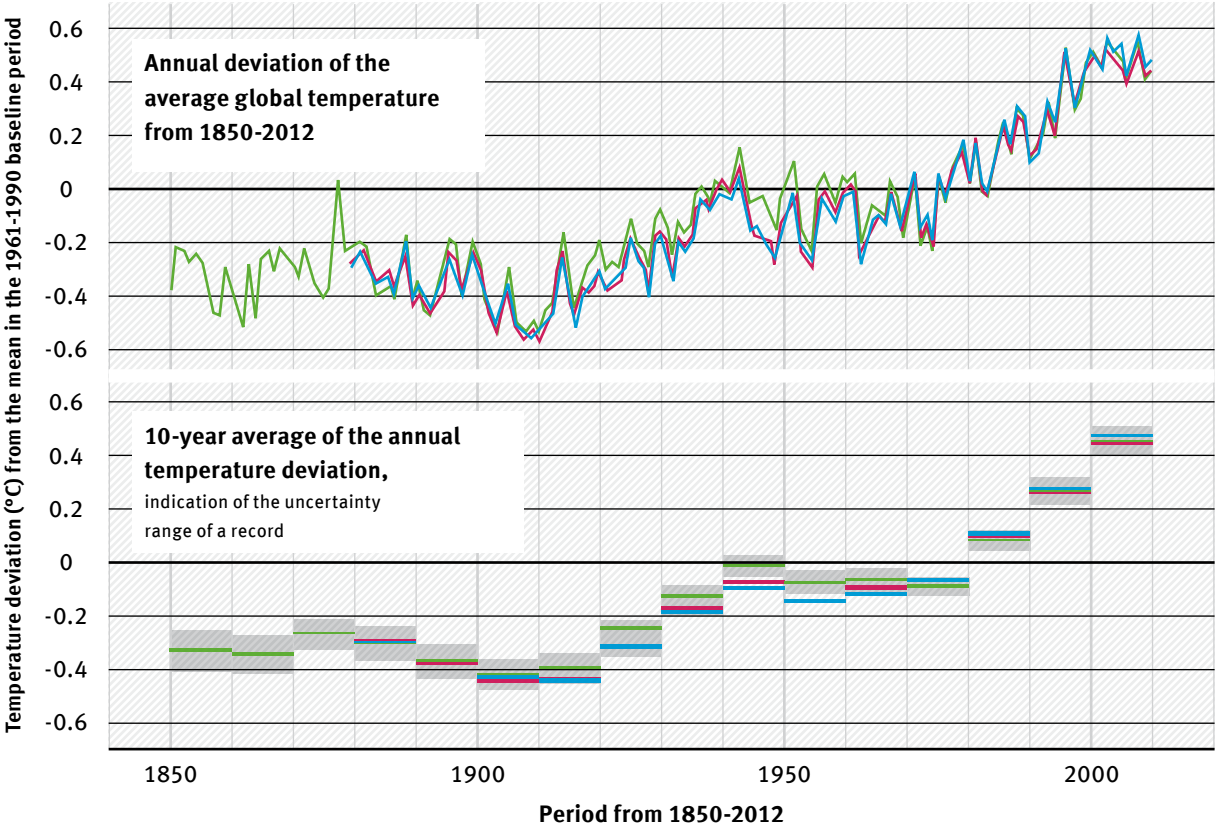
Vulnerability to climate change

Climate change is already a reality in many regions of the world: average temperatures rise, rainfall shifts from region to region and over the course of the year and glaciers are melting. Extremes of weather such as heat waves or heavy rain with occasionally disastrous effects on humans and the environment are also increasing[4]. But the effects of such climate changes and extreme events depend on the environmental and socio-economic situation of each region. The 2010 flood in Pakistan cost about 2,000 lives and the economic damage was estimated at around ten billion dollars[5].

In 2011, large areas were again flooded in Pakistan, the damage amounted to about four billion dollars. The Elbe and Danube floods of 2013 in Germany caused the deaths of seven people[6],

Figure 01

Deviation of the average global surface air temperature from the mean in the baseline period from 1961-1990 (for the 1850-2012 period)



Source: IPCC 5th Assessment Report, Report of Working Group 1, Figure SPM.1
http://www.climatechange2013.org/images/report/WG1AR5_SPM_FINAL.pdf

the damage was estimated at eight billion euros. As part of the German Strategy for Adaptation to Climate Change (DAS), adopted in 2008 by the Cabinet of Germany and prepared under the auspices of the Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety (BMUB) in cooperation with the ministries and the federal states, the Competence Centre on Climate Impacts and Adaptation (KomPass) was established in the Federal Environment Agency (UBA). KomPass examines the impacts of climate change in Germany and develops proposals for adaptation measures to future events under the framework of the German Strategy for Adaptation to Climate Change (DAS).

Future developments

Emissions and concentration

One objective of climate scientists is to estimate expected greenhouse gas emissions for 2020, 2050 and 2100 and their impact on climate change. They do this based on computer simulations with a large variety of equations, data and assumptions - such as information about how the economy will grow and how climate policy is going to develop. These simulations allow them to identify expected developments and trends.

This involves very specific issues: in its report on the 2020 emission gap (“Gap Report”), published

annually since 2010, the United Nations Environment Programme (UNEP) examines how many billions of tonnes of CO_2 equivalents must be reduced worldwide by 2020 so that the international community is able to comply with the 2 degree limit with a high degree of probability – i.e. a probability of more than 66 percent. The answer is that initially, global greenhouse gas emissions must fall to around 44 billion tonnes of CO_2 equivalents by 2020. That would already be over six billion tons less greenhouse gases than emitted in 2010. But after that global emissions have to continue to fall: to 22 billion tonnes of CO_2 equivalents by 2050, effectively halved once again.

Global temperature

Climate scientists predict different temperature increases by 2100: When they base their scenarios on ambitious climate policy, the average temperature increase by the end of the century is between 0.9 and 2.3 degrees Celsius above pre-industrial levels. However, when computing scenarios without basic mitigation efforts, they expect an increase from 2.2 to 5.4 degrees Celsius.

Even though global warming is a global phenomenon, it has different effects in different regions. It's effects are also stronger over land than over the oceans. The strongest warming is expected in the Arctic. Overall, more hot and fewer cold temperature extremes are expected.

Vulnerability to climate change

Climate change will continue to cause rising sea levels, spatially and temporally shift precipitation and increase the frequency of extreme events, such as heavy rain, heat and drought. At the same time, their intensity will increase. These changes would have consequences: coastal areas could be flooded and deserts expand further. In some areas, people would need to grow different crops to ensure food supplies. Climate change will affect ecosystems on land and in the water - and human health. For example, on extremely hot days and during heat waves, health researchers expect more cardiovascular disease incidents, sometimes with fatal consequences.

How regions or sectors such as agriculture and water management are able to react to climate change depends on their capacity to adapt - factors such as what financial resources and planning tools exist, how climate resilient infrastructures such as water supply are, or the quality of access to education and information.

For Germany modelling studies show that from mid-century on, heat waves as well as heavy rainfall and flood events could increase significantly. UBA therefore believes it is necessary to develop adaptive measures for Germany early on, and to assist other countries in preparing their own protective measures.

Flooding in Dresden, June 2013

Initial successes are not enough ...

On route to stabilising the concentration of greenhouse gases

Where do we stand? No longer at the beginning! At the 2009 climate summit in Copenhagen, the leaders committed to disclosing what they want to do about climate change by 2020. A large number of states have done so. They have voluntarily agreed to national reduction targets and measures. These commitments range from national action plans and climate protection laws, to the introduction of national or regional emissions trading systems, concrete measures in forest protection or public transport and energy efficiency requirements for the building sector. The Maldives have even declared that they will be carbon neutral by 2020.

According to calculations by the United Nations Environment Programme (UNEP), all these promises are not enough to achieve the overall goal of limiting global warming to a maximum of 2 degrees Celsius. Taken all together, they would, at best, limit global greenhouse gas emissions to 52 billion tonnes of CO_2 equivalents. This would still mean a gap of eight billion tonnes of equivalents to the GHG reduction level in 2020 necessary to keep the 2-degree limit . This emission gap, however, should be closed or at least significantly reduced in size. For time is short, as shown in the current UNEP report on the emissions gap in 2020: the more greenhouse gases continue to be emitted in 2020, the more drastic the necessary emission reductions will have to be in the following decades - and the more expensive the then necessary measures to adapt to climate change will be.

What‘s next? In international climate change negotiations two aspects are currently at the forefront:

- increasing the voluntary reduction commitments and the binding emission reduction targets under the Kyoto Protocol, as well as the reduction contributions up to 2020 promised since the climate summit in Copenhagen, and
- the design of a new effective climate protection agreement for the period thereafter.

The new global climate protection agreement is to be decided at the end of 2015 and go into effect from 2020 on.

INFOBOX

The Kyoto Protocol

To date, the Kyoto Protocol is the only international agreement in which states have committed to internationally binding specific emission reduction targets. In its current form the Kyoto Protocol is valid until 2020. However, this Protocol is binding to only a small group of industrialised countries. The United States never ratified the Protocol. Japan, Canada, New Zealand and Russia refused to participate in the ongoing second commitment period, which began in 2013. The share of global emissions currently covered by reduction commitments under the Kyoto Protocol, namely 14 percent, is therefore rather low. This is also due to the fact that, in contrast to the early 1990s, when the Kyoto Protocol was negotiated, the greenhouse gas emissions of emerging and developing countries have increased significantly. Overall, in recent years the emissions of industrialised countries have been relatively stable, some even declining.

What is important? The new climate change agreement can only come about if it adequately reflects the changing political and economic realities in the international power structure. Acceptable arrangements must be found for all states. Due to the different political and economic interests around the world, it is becoming apparent in the negotiations that the Agreement will treat individual countries or groups of countries differently. The expected wide range of schemes has its advantages and disadvantages: on the one hand, it takes into account specific national needs, but it also holds the risk that the implementation of the agreement will be difficult to manage and monitor. However, transparency and comparability of the different national activities are important prerequisites for building confidence and trust between the parties.

Steadfast and determined action will be necessary to create an ambitious and coherent agreement. From UBA's perspective it is essential that all countries participate fully. Particularly the biggest polluters among the industrialised and developing nations must lead with ambitious climate change goals.

Pioneering EU must get down to business

The European Union (EU) should especially take their climate policy leadership role seriously and do more than ever: it has already promised to emit at least 20 percent less greenhouse gases in 2020 than in 1990. This goal has almost been met. By 2020, the EU can therefore achieve even more: the EU should therefore increase its 2020 target unconditionally to 30 percent, and for the 2030 target a greenhouse gas reduction of at least 50 percent - in conjunction with the necessary targets for renewable energy and energy efficiency.

But currently only 40 percent is being discussed as the reduction of greenhouse gases by 2030[7]. This 40 percent target comes from the „A policy framework for climate and energy in the period from 2020 to 2030" white paper presented by the European Commission in January 2014, in which the Commission provides proposals for the energy and climate policy in the EU until 2030. The target level is still controversial – the Commission's proposals need to be discussed and ratified by the Member States of the EU in the coming months. An ambitious commitment to climate protection by the EU becomes particularly influential in that it could spark a new dynamic for the completion of the new climate change agreement at the international level, and encourage other states to take bigger steps.
The jointly set climate protection target of limiting global warming to below 2 degrees Celsius can only be achieved if all countries reduce their greenhouse gas emissions as far as possible, within their own means. According to calculations by the Intergovernmental Panel on Climate Change (IPCC), for today's industrialised countries this means that they must reduce their emissions by about 80 to 95 percent by 2050, compared to 1990. But Germany and other developed countries not only have to initiate mitigation measures at home, but also lend a hand to developing countries. At the climate summit in Copenhagen in 2009, the developed countries pledged that in the long term, starting from 2020, they would jointly mobilise $100 billion per year for the necessary reform and transformation processes in developing countries. One of the key instruments for applying these funds will be the „Green Climate Fund" which is designed to assist developing countries in their climate protection efforts.

In a first step in Copenhagen, the developed countries promised additional public funds to the amount of US$30 billion for 2010 to 2012, called Fast-start Finance. The industrialised countries kept their word; the EU contributed 7.34 billion euros, the German government was involved to the tune of 1.3 billion euros.

What else is there? Much is already being done to combat climate change. A continuously growing number of different initiatives are driving the greenhouse gas reduction process so complementing the international negotiation process. Although some initiatives do not focus on it directly but achieve it as a positive side effect – for example by building technical capacity and know-how in developing countries.

Well-known examples are:
- the „International Partnership on Mitigation and MRV" I, created by Germany, South Africa and South Korea in May 2010. Its goal is to promote the effective implementation of national mitigation activities through the exchange of knowledge between experts from developed and developing countries.
- the international Climate and Clean Air Coalition (CCAC), which aims to reduce emissions of short-lived climate pollutants. This includes, methane, which is released during oil and gas production or arises from landfills, but also the so-called „black carbon". The CCAC is now supported by more than 30 countries, including Germany.
- the International Renewable Energy Agency (IRENA), which was co-founded by Germany in 2009, and is a strong voice for renewable energy, strengthening the political and techni-

1 The abbreviation **"MRV"** stands for the international climate policy approach of providing greater transparency in global greenhouse gas reduction by measurement, reporting and verification of emissions.

cal cooperation between nations in the field of renewable energy.

There are also the global sustainability goals that are currently being negotiated by the international community in the wake of the „Rio + 20" UN Conference on Sustainable Development. It is being discussed whether they should include a global goal to reduce greenhouse gases.

The extent of the contributions these initiatives and political goal discussions goal for reducing greenhouse gases will make still remains to be seen. Their potential is to address specific issues in a focused manner and to encourage the pioneers to go ahead with ambitious steps. They can boost the efforts to create ambitious targets for 2020 and have a positive effect on creating consensus for a comprehensive climate change agreement from 2020 onward. The increasing number of initiatives also shows that the threat of climate change is being taken more seriously worldwide.

Can large-scale technical interventions help? Because greenhouse gas emissions must decrease drastically in future, so-called „geo-engineering" is also being discussed. These are large scale technical measures which are supposed to remove CO_2 from the atmosphere and then store it.

Another idea is to reduce the earth's solar radiation in order to cool the air layers near the surface. This effect can for example be achieved by artificially introducing sulphur compounds into the higher layers of the atmosphere. However, UBA is very sceptical towards these proposals for several reasons: until now, the suitability of such measures has not been established. Little is known about the risks and side effects. There is also the risk of turning away from the current, in principle, preventive and sustainable climate policy of elimination and adaptation.

UBA therefore regards the promotion of geo-engineering with some concern and is committed to the prohibition of commercial activities and to monitoring research projects internationally.

UBA considers that it is much more important to begin to reduce greenhouse gas emissions significantly now, while simultaneously preparing for inevitable climate change. That is where our focus should be. We want a liveable world to pass on to future generations. It is still doable – if we transform our economies and lives such that we can almost do without fossil energy sources. That is our vision of a low carbon era.

Low-carbon era

In the current Greenhouse Gas Neutral Germany in 2050 study[8], UBA shows that it is technically possible to reduce German emissions in 2050 by 95 percent compared to 1990 – without nuclear power or storing carbon dioxide underground, as is increasingly being discussed in the context of the debate on geo-engineering measures. However, it means that climate protection measures must be taken in all sectors. The energy sector must provide carbon neutral heat and electricity. People and freight must mainly be transported without the use of fossil fuels on roads, railways, waterways and in the air. Instead of using crude oil, industry must produce significantly more products from renewable resources.

Now is the time to motivate decision-makers in politics and business as well as citizens towards the transition to a low carbon era. But this also requires incentives for overcoming the currently predominant fossil fuel based economy. The argument that the competitiveness of domestic industry is at risk inhibits progress in national and international climate protection. But the German Energy Transition is a good example of having the courage to move ahead. Even today, the Energy Transition is internationally significant: a successful implementation can provide additional motivational thrust for potential imitators.

How much time remains? Not much! In the long term, only comprehensive changes in the economy and society can stop the dangers of more than 2 degrees Celsius of global warming. But the window of opportunity for initiating this transformation in Germany and worldwide in a fair, safe and environmentally sound manner

is closing rapidly. This is confirmed by a report prepared for UBA by the Potsdam Institute for Climate Impact Research (PIK) in 2013. The climate scientist at PIK analysed several scenarios for meeting the 2 degree limit. The study showed that the economic and technological challenge to sufficiently reduce greenhouse gas emissions increases the later the international community decides to radically change their economies. In order to devise long-term sustainable climate change protection that is consistent with the 2 degree limitwhile remaining affordable, quick and ambitious action is essential.

This also means that Germany has to consistently implement its short- and medium-term climate targets for 2020 and beyond. Much remains to be done in order to achieve Germany's 2020 goal to reduce greenhouse gas emissions by at least 40 percent compared to 1990. UBA contributes to closing this "climate protection gap" by providing studies and concrete proposals for measures.

INFOBOX

The Federal Environment Agency helps

The Federal Environment Agency (UBA) passes the experience and know-how gained in national work on climate change on to emerging and developing countries. These countries are particularly interested in two things: to build functional and efficient reporting of greenhouse gas emissions, and the Energy Transition in Germany. UBA specialists are also sometimes involved locally, training employees of local authorities, for example. Experts from UBA support a project in four countries in Latin America, Southeast Asia and Africa in the context of the International Climate Initiative (ICI) launched in 2008 by the Federal Ministry for the Environment. The idea is to enable them to measure greenhouse gas emissions in accordance with international standards and to report the measurement results to the United Nations Climate Change Secretariat. The specific needs and priorities of the countries are taken into account and national reporting, including relevant training events will be improved.

Our energy system must be fundamentally transformed.

Especially the poorest countries are affected by climate change

Adaptation to unavoidable climate change

In addition to the reduction of greenhouse gas emissions to avoid dangerous climate change, the second pillar of climate policy is to adapt to unavoidable climate change. Climate change can get really expensive – in its Communication of April 2013, the European Commission says as much[9]: in Europe alone, in the 2020s climate change damage of approximately 100 billion EUR will be incurred annually. In the 2050s these costs will rise to 250 billion EUR per year and increase to 600 to 2 500 billion EUR in the 2080s. Even though there are many uncertainties associated with these estimates, they do demonstrate that timely measures to adapt to climate change can significantly reduce the amount of damage. If they are well chosen, their benefits are much greater than the predicted costs. At various political levels much is already being done to prepare for climate change:

- In April 2013, the European Commission adopted the Communication „An EU Strategy on Adaptation to Climate Change“. Since climate change, climate impacts and adaptation measures need to be considered at a regional level, the European Commission wants to provide an appropriate framework for political and financial support to Member States for that purpose.
- The Group of Eight leading industrialised nations (G8) - including Germany - are looking at what climate resilient governance really means. They want to also support Small Island States and other countries particularly affected by climate change in dealing with the consequences of climate change. At a G8 conference in July 2013 in the UK, it once again became clear that prevention is better than cure. Measures for climate change adaptation can help preserve or again improve livelihoods and thus prevent conflicts or wars within and between nations. Adaptation measures must be

designed so that they reduce the risk of violent conflict, especially in fragile nations without strong political structures and administrations. This was recently demonstrated by the „Adaptation to Climate Change for Peace and Stability“ study commissioned by UBA.[10]

- In December of 2008, the German Federal Government adopted the German Strategy for Adaptation to Climate Change (DAS) and supplemented it in August 2011 with a concrete Adaptation Action Plan (APA). The federal government is implementing the measures of the Action Plan. Climate change is taken into account for the use of federally owned land, buildings or infrastructure, for example in the form of climate-proofed new construction of buildings. Also part of the APA is to comprehensively provide information on future climate change and ways to adapt to it. It is anticipated that by the mid-term of the legislative period, the federal government will describe the recent activities in a progress report and evaluate future adaptation needs for Germany.
- Many federal states have ratified adaptation strategies or are preparing them. These take into account the environmental and socio-economic conditions of the regions and focus in part on specific sectors such as flood control or agriculture.

One thing is clear: there is no single solution. Each region and each country must find its own way to adapt to changing climate conditions.

How high will the dikes on the North and Baltic Sea, and on the Elbe, Oder, Rhine and Weser have to be? How effective is prudent land management in reducing or preventing flood damage on rivers and coasts? What can farmers do in order to guard against drought or heavy rains? Can green roofs mitigate heat waves in cities? And: what does a climate resilient Germany look like? How can our country, with its diverse regions and economic sectors, best prepare for that?

In UBA‘s view it is essential that each strategy and climate adaptation measure happens in the context of sustainable development. That is possible! Using the example of green roofs, UBA has shown that environmental and social aspects can be taken into account and that this also contributes to better cost-effectiveness of measures to adapt to climate change.[11]

An important principle in the implementation of adaptation strategies is anticipatory action. The water sector is already taking future climate change into account in the design of protection systems. And the health care system should emphasise the protection of human health in the face of already increasingly hotter days and heat waves. In addition to such challenges in specific areas, there is also a need for action in disaster preparedness, protection of the public against extreme events, the protection of ecosystems or ecosystem-based adaptation and biodiversity.

UBA‘s „House 2019“ - the first climate-resilient zero-energy building of the Federal Government

There are guides!

In 2006, UBA established the Competence Centre for Climate Impacts and Adaptation (KomPass, www.anpassung.net). The competence centre has a number of tasks: KomPass experts support the implementation and development of the German Adaptation Strategy (DAS). Together with experts from other federal agencies, they will ascertain how vulnerable Germany is to climate change. The results of this project will be one of the essential foundations of the progress report on the DAS. KomPass also supports municipalities, businesses and other stakeholders in better preparing for climate change:

- The „Climate Navigator“ helps communities and businesses understand how they will be affected by climate change and what they can do to adapt to the consequences.
- The „Tatenbank“ (project database) contains many good examples of adaptation to climate change which can encourage imitation. In this context KomPass conducted a competition to highlight the pioneers of climate adaptation.
- A project catalogue provides an overview of research projects on climate change adaptation in Germany and Europe.

Everyone‘s joining in!

Just as important as scientific facts and first attempts to adapt to climate change are, it is equally important to raise the awareness of people and businesses and to let them participate in the implementation of climate adaptation measures. Only then will citizens and entrepreneurs take the consequences of climate change seriously and will be willing to get involved. There are many ways to make this happen. Dialogues with people, with decision-makers and representatives of business and environmental organisations, and scientific conferences are all part of this. Cooperation exchanges provide the opportunity to start joint activities of business, government and civil society.

Compass at home and abroad

UBA also supports other regions around the world with its experience. Two examples:

China: in 2012, UBA specialists created a training module for climate change adaptation together with Chinese experts. Using interactive learning formats, the training materials now show some 2,000 employees of Chinese authorities in provinces and cities how to prepare for climate change. This is a project under the framework of an externally funded project of the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) (Corporation for International Cooperation).

Baltic Sea: UBA experts participated in the EU „Baltadapt“ project. In this programme for adapting the Baltic Sea region to climate change, concluded in 2013, UBA coordinated embedding the project results into the European web platform for climate adaptation „Climate-ADAPT“. The new Baltic Sea Region section provides information about the main points of the first drafts of a macro-regional strategy and action plan for climate change adaptation in the Baltic sea region.[12] In future, the strategy, Action Plan and web site drafts will be further developed under the auspices of the Council of the Baltic Sea States (CBSS), and its eleven Member Nations.

UBA specialists support the federal states of Hamburg and Schleswig-Holstein in the development of adaptation strategies and indicator systems.

CONCLUSION

Much has already been achieved in climate policy at the national and international level. Nevertheless, much remains to be done - the road is still long and time is short. Only with ambitious climate protection can we prevent global warming above two degrees Celsius.

The earlier politics, business and citizens are willing to abandon their usual patterns of behaviour and break new ground, the better.

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Contributing sections:
I 1.2, I 2.6, I 2.2, II 2.1

FOOTNOTES

1 http://www.pbl.nl/en/publications/trends-in-global-co$_2$-emissions-2013-report

2 http://www.eea.europa.eu/data-and-maps/indicators/atmospheric-greenhouse-gas-concentrations-2/assessment-1

3 UBA: Chronik weltweiter Temperaturen, Niederschläge, und Extremereignisse (Chronicle of global temperatures, precipitation, and extreme events) http://www.umweltbundesamt.de/sites/default/files/medien/378/publikationen/hgp_chronik_weltweiter_temperaturen_niederschlaege_und_extremereignisse_seit_2010.pdf

4 IPCC (2012) Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation. A Special Report of Working Groups I and II of the Intergovernmental Panel on Climate Change (C. B. Field et al. (eds.)). Cambridge University Press: Cambridge, UK, and New York, NY, USA, 582 pp.

5 Bhattacharyya, A. Werz, M. (2012): Climate Change, Migration and Conflict in South Asia. Rising Tensions and Policy Options across the Subcontinent. Center for American Progress, Heinrich-Böll Foundation.

6 CEDIM Report June floods 2013 Mitteleuropa: Juni-Hochwasser 2013 in Mitteleuropa – Fokus Deutschland. Bericht 2: Auswirkungen und Bewältigung (Stand: 11.06.2013, 16.00 Uhr) (Central Europe: June 2013 floods in Central Europe - Focus Germany. Report 2: Impact and management (as of 11/06/2013 16.00)); http://www.cedim.de/download/FDA_ Juni_Hochwasser_Bericht2.pdf

7 Whit paper „A policy framework for climate and energy in the period from 2020 to 2030“

8 http://www.umweltbundesamt.de/publikationen/treibhausgasneutrales-deutschland-im-jahr-2050

9 European Commission: An EU Strategy on adaptation to climate change. Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions. Brussels, 16.4.2013, COM(2013) 216 final

10 http://www.umweltbundesamt.de/publikationen/adaptation-to-climate-change-for-peace-stability

11 www.uba.de/presse/presseinformationen/gruene-daecher-gegen-hitze

12 http://climate-adapt.eea.europa.eu/transnational-regions/baltic-sea

Beyond Environmental Standards

Air Quality Control – Success now and in the future

Many people in Europe are concerned about the quality of the air they breathe. According to the latest Eurobarometer surveys[1], air pollution is among the top five most worrying environmental problems for about one third of the respondents. 87 percent consider the frequent occurrence of respiratory diseases a serious problem; and 78 % are worried about the over-fertilisation of ecosystems.

However, air has become fairly clean: emissions of the three classical pollutants i.e. sulphur dioxide, nitrogen oxides and dust have decreased significantly in Germany since 1990. As a result, health stress both by these substances as well as particulate matter and ozone has also greatly decreased.

The focus has therefore shifted: today the attention is focused more and more on the remaining exceedances of EU-wide emission limits. However, at the same time the World Health Organization warns that large parts of the population in Germany are still exposed to pollutant concentrations that can cause damage to health.

Thus we cannot rest on the past successes of air quality control. Stricter emission limits are needed for cars, lorries and industrial plants. Some others – e.g. intensive farms or ship owners – also need to do more. All of us can make a decisive contribution to improved air: less motorised transport, low-meat diet and the proper operation of household wood burning equipment are just a few aspects. The Federal Environment Agency (UBA) therefore welcomes the European Commission's presentation of a programme at the end of last year to improve air quality in Europe.

Just how good is our air?

In Germany, air quality has significantly improved over the last decades. The days of winter smog episodes during which both morbidity and mortality greatly increased are fortunately over. Nevertheless, judging by the recommendations of the World Health Organisation, airborne pollutants are still causing damage to human health. This in particular concerns the three key pollutants, particulate matter, nitrogen dioxide and ozone. Every year they exceed the limit and target values for ambient air stipulated by the EU in 2008 (see Table).

UBA has noted that the annual averages for particulate matter with a diameter of up to 10 microns – the so-called PM_{10} fraction of particu-

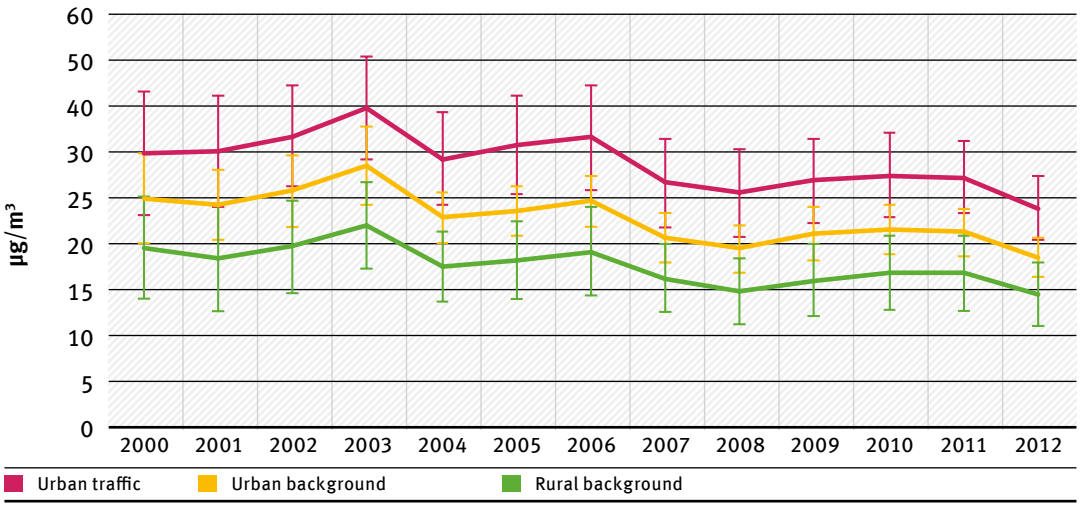
Table

Limit/target values for the protection of human health:
Particulate matter (PM_{10}), nitrogen dioxide (NO_2), ozone (O_3)

Reporting period	Particulate matter limiting value (PM_{10})
24 hours	50 µg/m³ must not be exceeded on more than 35 days a year
Calendar year	40 µg/m³
Reporting period	**Nitrogen dioxide limiting value (NO_2)**
1 hour	200 µg/m³ must not be exceeded more than 18 times in a calendar year
Calendar year	40 µg/m³
Parameter	**Ozone target value (O_3)**
Highest 8-hour average of a day	120 µg/m³; may be exceeded on no more than 25 days per calendar year, averaged over 3 years
Parameter	**Ozone long-term goal (O_3)**
Highest 8-hour average of a day	120 µg/m³

Figure 01

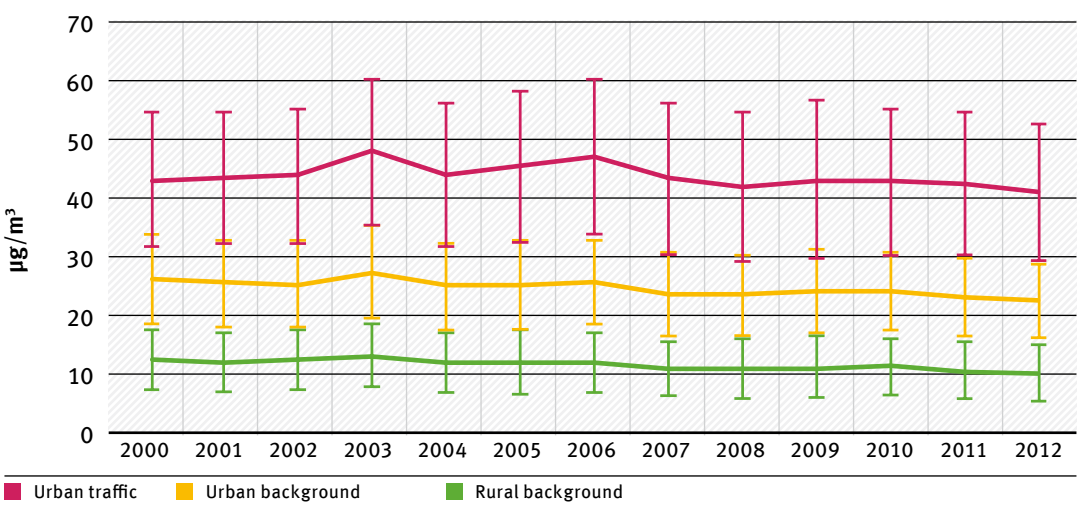
2000-2012 PM_{10} annual averages



Source: UBA

Figure 02

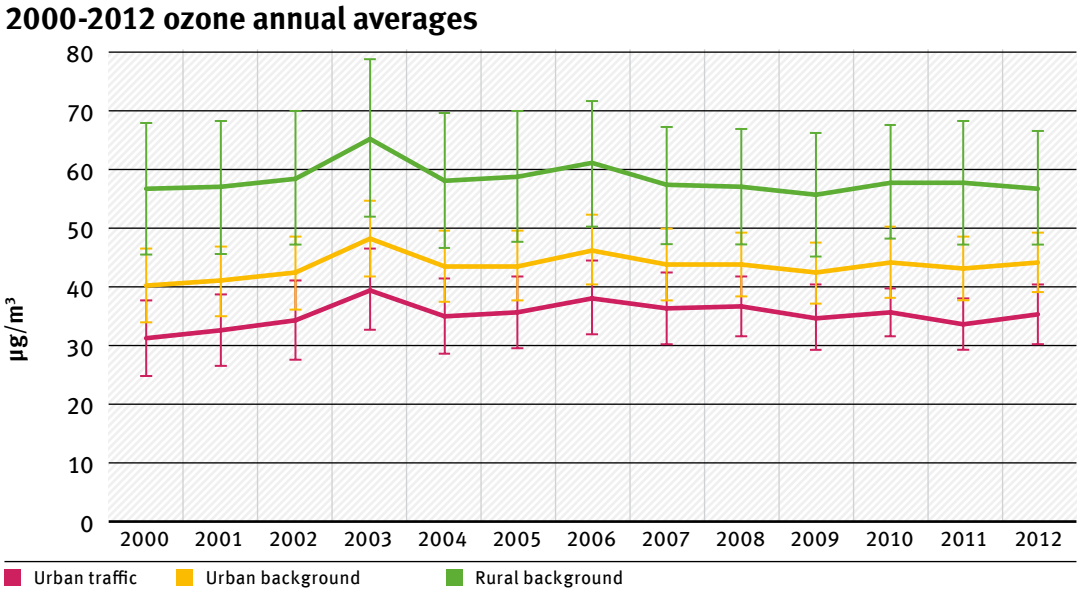
2000-2012 NO_2 annual averages



Source: UBA

Figure 03

2000-2012 ozone annual averages



Source: UBA

late matter – have only decreased slightly since 2000 (Figure 1). The averages of the PM_{10} fraction also vary greatly due to different weather conditions in different years. UBA did not detect any decrease for nitrogen dioxide and ozone in the same period (Figures 2 and 3).

About 35 percent of all citizens in Germany are affected by air pollution – i.e. the nearly 30 million people who live in conurbations. UBA's Germany-wide maps of annual averages of nitrogen dioxide and PM_{10} particles (Maps 1 and 2) prove conurbations – i.e. industrial and commercial sites, but also transportation hubs – are exposed to the highest air pollution stress. For example, the average annual nitrogen dioxide contamination exceeds the 40 micrograms per cubic metre (µg/m³) EU limit at about two-thirds of all urban traffic measurement stations, in some cases quite considerably.

The daily updated contamination maps can be downloaded from UBA's website[2] to get information about air quality.

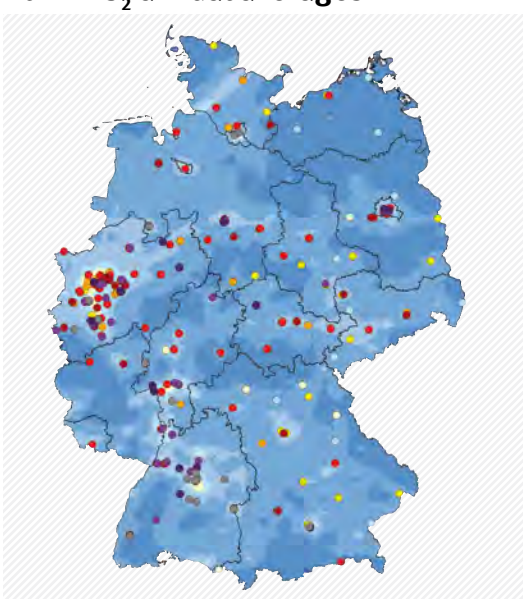
INFOBOX

Health risks from air pollutants

- Particulate matter consists of a mixture of solid and liquid particles of different sizes from different sources. Its health effects range from inflammation of the respiratory system to increased plaque formation in blood vessels and thus increased risk of heart attack. The variety of effects is due to the fact that the particles can penetrate to different depths in the human organism. Particles with a diameter between 2.5 and 10 micrometres (µm) (PM_{10}) penetrate into the nasal cavity and reach the large bronchi. Smaller particles with a diameter of up to 2.5 microns ($PM_{2.5}$) penetrate into the small bronchi and alveoli, and ultrafine particles with a diameter of less than 0.1 micrometres penetrate as far as the lung tissue and the blood circulation.
- High concentrations of the pollutant nitrogen dioxide (NO_2) measured specifically on busy streets primarily represent a health risk for asthmatics and allergy sufferers because this chemical substance also irritates the bronchial tubes.
- Ozone (O_3) is formed photochemically in the air from precursors under the effect of sunlight. Ground-level ozone concentrations are increased in summer by air pollution, especially nitrogen oxides and hydrocarbons. High ozone concentrations do not occur directly near pollutant sources, but mainly in the suburbs and rural areas. Ozone reduces lung function, leading to inflammatory reactions in the respiratory system and to respiratory problems, which can be exacerbated by physical exertion.

Map 01

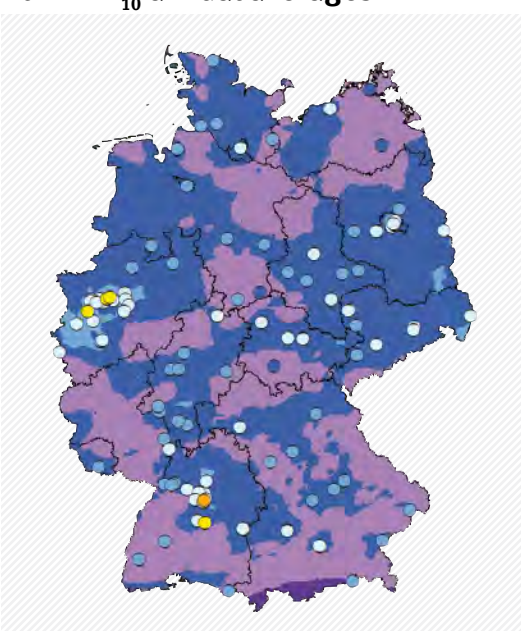
2012 NO_2 annual averages



Source: UBA

Map 02

2012 PM_{10} annual averages



Source: UBA

25,000

tonnes of particulate matter was emitted from small wood and coal burning in 2011.

3

months is the statistical reduction in life expectancy due to diesel exhaust.

94

percent of ammonia emissions in Germany came from agriculture in 2011.

Limiting values are compromises

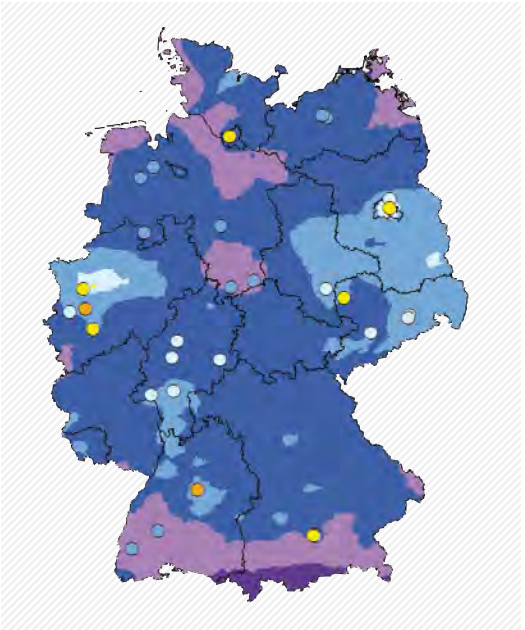
Current limit and target values represent compromises between the objective of protecting human health and the cost of possible mitigation measures. However, the World Health Organization (WHO) suggests much more stringent air quality standards that are solely based on the protection of human health. It recommends that the concentration of PM_{10} fraction of particulate matter in annual average should not exceed 20 micrograms per cubic metre (µg/m³) – but the annual value is often above this threshold even outside cities. The World Health Organization also advocated that the concentration of the fraction of the even smaller $PM_{2.5}$ particles should not exceed 10 µg/m³ in annual average. An UBA evaluation reveals that this value is currently adhered to in only a few of Germany's remote areas (see Map 3). People living in conurbations are exposed to the highest $PM_{2.5}$ particle contamination.

The ozone level is higher than recommended by the World Health Organization: the threshold 100 µg/m³ proposed by the WHO, which should be adhered to on average over eight hours, is exceeded across large areas of Germany. As UBA has observed, even the 8-hour target value of 120 g/m³ stipulated by the EU in 2013 was exceeded in many places on 88 days.

Not only do air pollutants pose a threat to human health, ecosystems too are affected by ozone, sulphur oxides and, above all, by large amounts of nitrogen. Thus about one third of all ecosystems in Germany such as poor grassland or peatlands are sensitive to nutrients and are insufficiently protected against over-fertilisation with nitrogen inputs.

Map 03

2012 $PM_{2.5}$ annual averages



Source: UBA

Not only is the level of 10 µg/m³ $PM_{2.5}$ recommended by WHO exceeded in conurbations, but also in most rural areas of Germany.

INFOBOX

Recent scientific findings confirm the need to further reduce the current limits: the WHO published the detailed report of the REVIHAAP project (Review of EVIdence on Health Aspects of Air Pollution) in the summer of 2013. Experts came to the conclusion that long-term exposure to particulate matter ($PM_{2.5}$) can lead to atherosclerosis, trigger premature births, lower birth weight and trigger asthma in children.

Air quality control is still in its infancy in many emerging countries

Air quality internationally

Every other industrialised nation has also established limits for air pollutants. There are interesting differences. For example particulate matter: in the EU, the PM_{10} daily limit of 50 micrograms per cubic metre (µg/m³) may be exceeded on up to 35 days per year; in Australia, however, only five exceeded days are permissible and just one in Switzerland. The United States, however, has a PM_{10} daily limit of 150 µg/m³ that may be exceeded once a year. There is a more ambitious limit for the smaller $PM_{2.5}$ particles in the US: the annual limit of 15 µg/m³ is well below the EU limit of 25 µg/m³, with the latter in effect since 2015. These examples show that limits are negotiable. The existing EU regulations need to be seen and discussed in this international context.

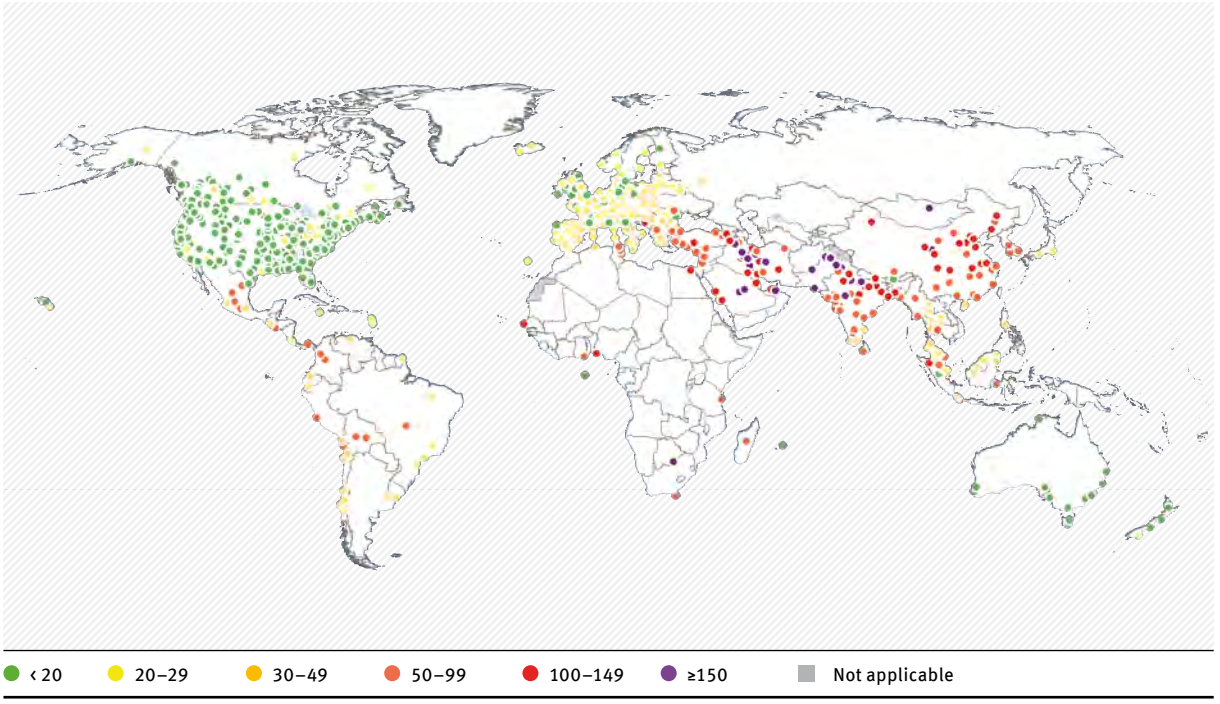
In developing and emerging countries the situation is different to Western Europe. In these countries, air quality control policy is still in its infancy and many people are exposed to contamination by particulate matter far beyond the level acceptable for health. Press reports about the serious smog events in Beijing have made air quality concerns the focus of public awareness. Emissions from both industrialised areas in Beijing's south and southwest and from transport impair air quality considerably.

Similar problems affect increasing parts of the population worldwide. Meanwhile, more people now live in cities than in rural areas. The number of cities with more than one million inhabitants has exploded to over 450. More than 20 of them are "megacities", i.e. cities with a population of over ten million.

A World Health Organization study3 shows that the recommended PM_{10} annual average of 20 µg/m³, but also the EU PM_{10} annual average of 40 µg/m³, is exceeded several times in many of the world's cities (see Figure 4). People in the Asian countries Iran, Mongolia, India, Pakistan and China are particularly affected. According

Figure 04

PM_{10} concentrations in 110 conurbations (2003–2010 average in µg/m³)



Source: WHO

Polluted air is often associated with economic hardship for local populations. The issue of air quality is therefore a matter of environmental justice.

to WHO data, the people of the Iranian city of Ahvaz are exposed to the world's highest PM_{10} annual average of 372 µg/m³ (2009).

There are diverse causes of the high particulate matter content in these cities' air. The main source is usually heavy traffic that has multiplied abruptly due to rapid urbanisation in the past two decades. In this context, not only is the number of vehicles crucial, but also their age and the fuel quality. Other sources include coal and wood burning for energy and heat production and for cooking as well as waste incinerators with inadequate waste gas purification, and the open burning of household waste. It should be noted that dust particles form only one part of air pollution. The concentrations of harmful gases such as sulphur dioxide or nitrogen dioxide have also increased in many places.

An improvement in air quality often fails in these countries because economic development usually has a higher priority than health. Polluted air is often associated with the population's economic hardship. The issue of air quality is therefore a matter of environmental justice.

Achievements in Air Quality Control in Germany: A review

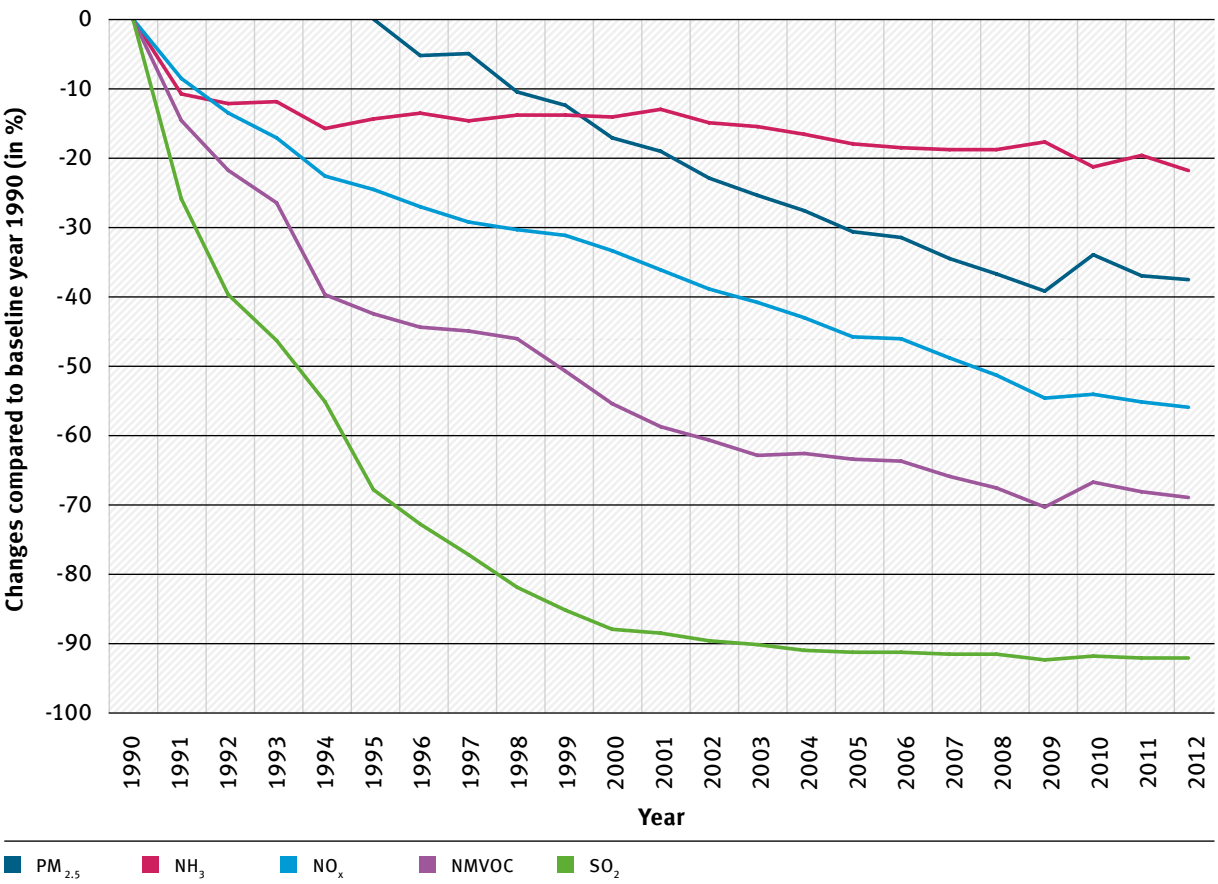
In the past 20 years emissions of conventional air pollutants in Germany have been reduced significantly (Figure 5). The reduction of sulphur dioxide emissions has been particularly successful, declining by more than 90 percent between 1990 and 2011. The introduction of flue gas desulphurisation in coal-fired power stations and other combustion installations as well as the use of low-sulphur fuels have been the key factors behind this result. The acidification of forests – a major cause of forest dieback – was thereby halted.

Forests as well as cereals and other plants also suffer damage by ozone. Ozone impairs human health, too. It is formed from oxygen and nitrogen oxides and volatile organic substances. Nitrogen oxides emissions have also decreased by about 55 percent since 1990 – thanks to a gradual tightening of emission standards for motor vehicles and the limits for coal-fired power stations and other firing and industrial installations. Volatile organic compound emissions have declined by about two thirds since 1990. These compounds are often used as solvents and enter the ambient air

Dying forests gave rise to the introduction of waste gas purification

Figure 05

Emissions of air pollutants in Germany in 1990-2012



Source: UBA

when solvent-containing products such as paints and varnishes are used. A variety of regulations helped reduce these emissions: some limit the use of solvents in industrial installations, others limit the solvent content in paints, varnishes and coatings and others mitigate evaporation losses from fuel tanks and during refuelling. Due to all these regulations, peak ozone loads decreased significantly – yet all too often the EU target value for ozone in Germany is still exceeded.

Reliable emissions data for dust particles have only been available since 1995. Emission of the PM_{10} fraction of dust has decreased by approximately 30, and that of the $PM_{2.5}$ fraction by about 38 percent between 1995 and 2011. This reduced exposure of people and ecosystems as well as that caused by nitrogen oxides has been achieved by stricter emission standards in traffic and stricter emission limits for firing and industrial installations.

Air quality control policy for ammonia, however, has been less successful. Emissions of this gas have decreased by only about 20 percent since 1990. The vast majority of ammonia emissions stems from agriculture – specifically from fertilised fields and from intensive livestock farming. These emissions pose a danger to the biodiversity of low-nutrient ecosystems: nitrogen compounds formed from ammonia may contribute to over-fertilisation of sensitive ecosystems.

National Emission Ceilings

Airborne pollutants know no boundaries. Reduction successes in Germany therefore also have positive effects in our neighbouring countries. This is also true the other way around: if air pollution is reduced in our neighbouring countries, less is transported to us.

The presence of fewer airborne pollutants is therefore in everybody's best interest. The EU Member States therefore agreed National Emission Ceilings (NEC) in 2001 and which must not be exceeded since 2010. There are such NECs for four airborne pollutants: sulphur dioxide, nitrogen oxides, ammonia and volatile organic compounds. These NECs – besides serving as limits for pollutants in the ambient air and emission controls for industrial installations, motor vehicles and products – are a third important control instrument of air quality control.

By introducing the four NECs the EU intended to ensure a halving of the surface exposed to acidification risk, to reduce by two thirds the ozone exposure of the population, and to gradually reduce over-fertilisation. And some of these objectives have actually been achieved since 2001: acidification has really been halved. Short-term, very high ozone episodes dropped significantly, but the long-term exposure to ozone in the intermediate concentration region is still too high. 20 % less area is now over-fertilised, but too much nitrogen still poses a risk to biodiversity.

Although far fewer people and less of the environment are exposed to conventional airborne pollutants today than 15 or 20 years ago, the targets stipulated have not been achieved. In particular, emissions of nitrogen oxides and volatile organic solvents still exceed the emission ceilings agreed for Germany (see Table). While the targets for volatile organic solvents missed the mark only slightly and UBA expects them to be reached soon, nitrogen oxide emissions are considerably above the allowed ceiling. The main reason for this is that the reduction results of introducing new emission standards for cars and lorries were overestimated in the agreement about reduction targets.

Table

Adherence to National Emission Ceilings
(Emission loads in kilotonnes/year)

	SO_2	NO_x	NH_3	NMVOC
National Emission Ceilings of the EU Directive for 2010	520	1,051	550	995
Emissions in Germany in 2010	430	1,221	548	1,023
Shortfall/exceedance	-90	+170	-2	+28
	-17.3%	+16.2%	-0.4%	+2.8%

The EU is currently debating the 2030 national emission ceilings. UBA supports the further improvement of the protection of humans and ecosystems in that the EU establishes new ambitious mitigation commitments and also introduces an ambitious national emission reduction commitment for the $PM_{2.5}$ fraction of particulate matter.

Not only has the EU set national emission ceilings, but so too does the UNECE Convention on Long-range Transboundary Air Pollution. Overall, 51 Member States – including Germany and all other EU countries – will observe this convention. These Member States agreed on the national emission ceilings for the same four airborne pollutants in 1999 – and a reduction commitment for another substance was added in 2012: $PM_{2.5}$ emissions are to be reduced by 26 percent by 2020 compared to 2005. Despite these reduction commitments however, they are not sufficient to comply with the concentration values recommended by the WHO. The EU should therefore set a more ambitious target.

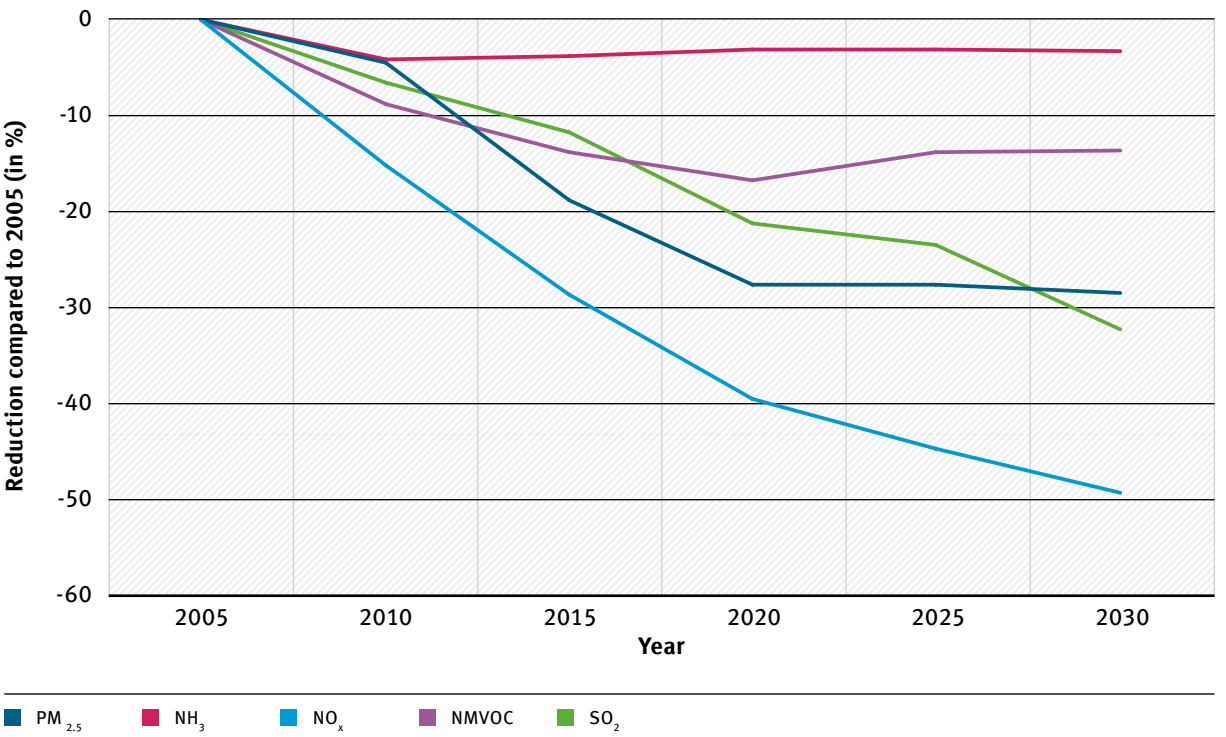
Even better protection of people and the environment

In order to further reduce the exposure of people and ecosystems to airborne pollutants, UBA considers it advisable to tighten the limits for ambient air. This must be accompanied by tightening emission limits for industrial installations, farms and road transport in accordance with technical advances. In addition, ambitious national emission reduction commitments should limit the transboundary transport of airborne pollutants in the future according to the existing reduction potentials. They must also provide a strong incentive not only to initiate technical improvements, but also to develop public transport or to limit the number of wood-burning stoves.

UBA expects the emissions of major pollutants to continue to decline by 2020 (see Figure 6). After that, however, the outlook is not so clear-cut: while nitrogen oxides and sulphur dioxide emissions will continue to decrease mainly due to climate protection and energy efficiency measures

Figure 06

Emissions of airborne pollutants in Germany in 2005-2030



Source: UBA

in industrial installations and large power plants, both PM_{10} and $PM_{2.5}$ fractions of particulate matter remain at the level reached in 2020 as mitigation options are lacking for the time thereafter. The forecasts predict only a small decrease in ammonia emissions, and emissions of volatile organic compounds are even expected to increase again from 2020. This is due to increasing economic growth in the absence of reduction targets beyond 2020.

It is clear that more must be done to achieve the desired level of protection of humans and the environment. The EU countries decided in 2005 that air quality has to be improved by 2020 to such an extent that there are no major negative impacts on human health and ecosystems and the ecosystems are better protected against acidification, ozone damage and eutrophication.

In order to achieve all this, it is essential that regulations and measures are coordinated at international, EU, national and local levels. An example: previously adopted stricter European emission limits for new cars, lorries and mobile machinery as well as more stringent requirements on wood-burning stoves and fireplaces in Germany will help ensure the improvement of air quality. However, current air quality limiting values for nitrogen dioxide cannot be met in some heavily congested inner cities and, in a few cases, those for particulate matter cannot be met either in a few years without further actions. Therefore, the cities affected are developing air quality plans to reduce pollutant emissions. An overview of the Federal Environment Agency shows that cities most often specify six measures in these plans: making public transport more attractive and expanding it, reducing pollutant emissions from construction sites, establishing low emission zones, improving lorry route planning and 'greening' cities (Figure 7).

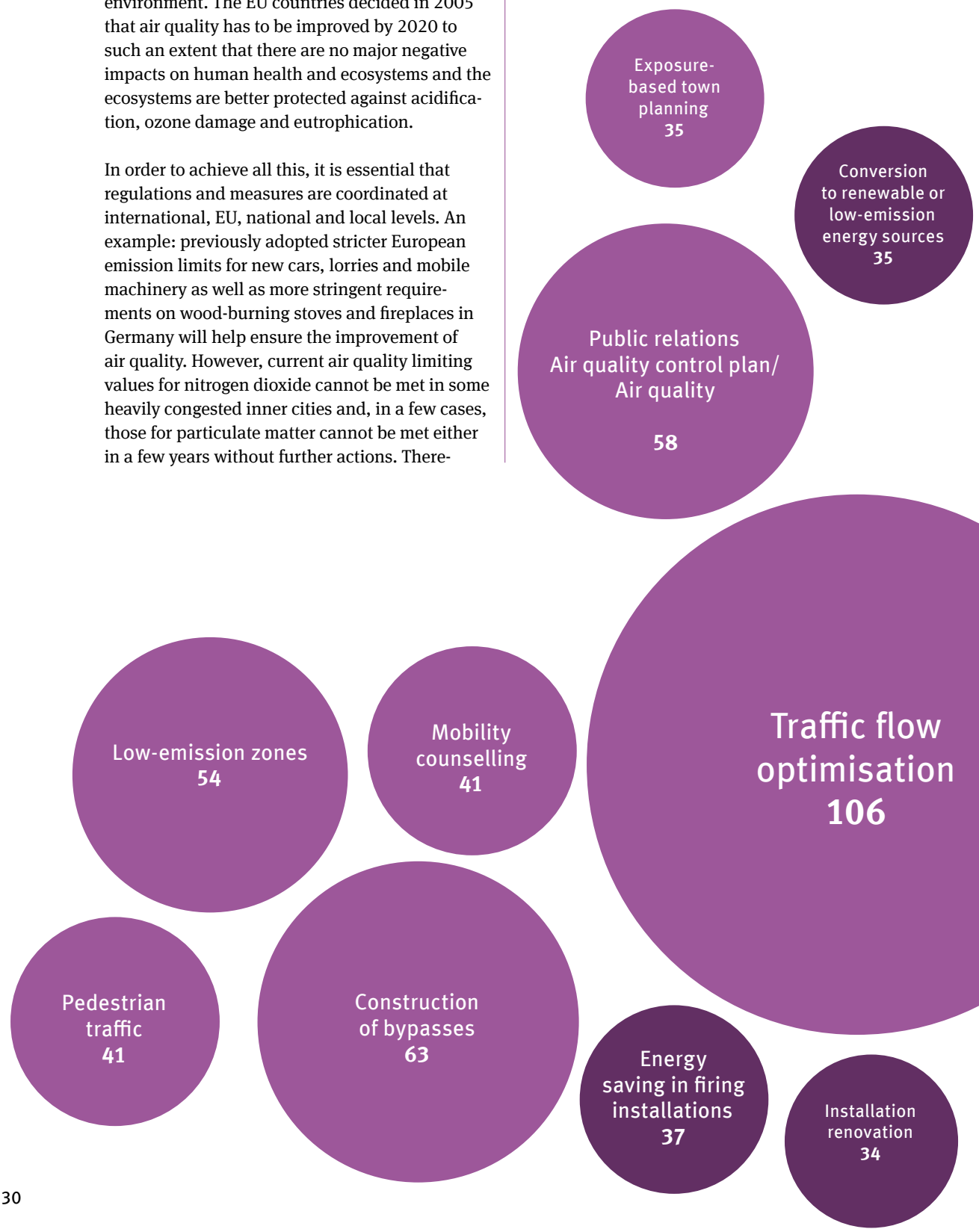
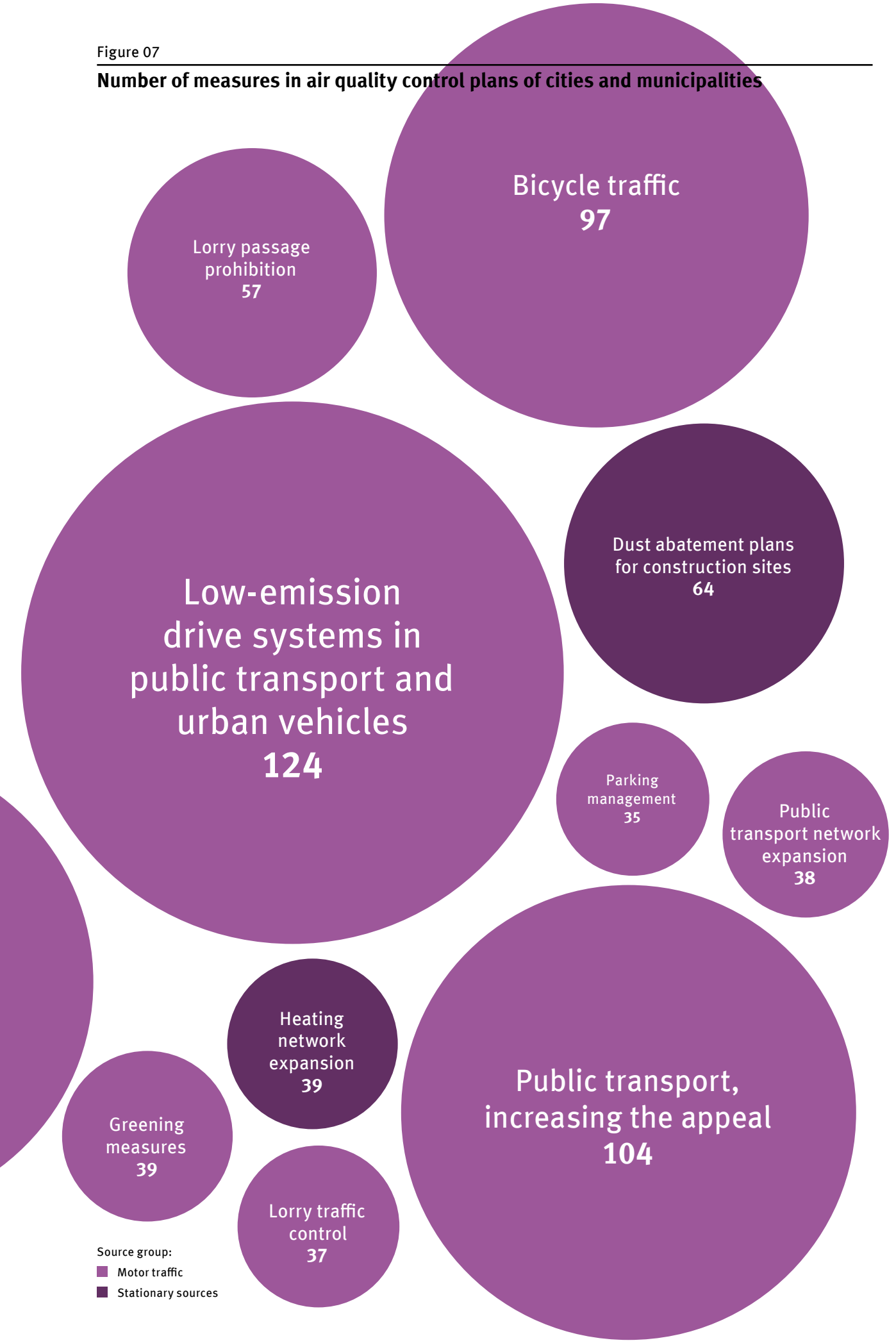


Figure 07

Number of measures in air quality control plans of cities and municipalities



Quelle: Diegmann Bestandsaufnahme und Wirksamkeit von Maßnahmen der Luftreinhaltung/IVU-UFOPLAN – Tab. 35: Rangordnung der standardisierten Maßnahmen nach Häufigkeit – Maßnahmen mit mindestens 10 Benennungen

Transport

Road transport contributes significantly to exposure to air pollution. Cars, lorries and buses in this country were responsible for 37 percent of nitrogen oxides and 16 percent of PM_{10} emissions in 2011. This led to a high exposure to these pollutants, especially in conurbations. Both technical and non-technical measures are required to reduce this exposure. Low-emission zones at the local level and EU emission standards have proved successful[4]. Partly due to stricter emission standards, the total emissions of PM_{10} particles from car exhausts have decreased by more than 50 percent since 2000.

But there are other sources of particulate matter: the abrasion of tyres, brakes and the road produces mainly larger particles than those attributable to the PM_{10} fraction. Such particles are stirred up again after they have been deposited on the roadway. This is where measures to reduce motor vehicle traffic and promote public transport and non-motorised mobility are effective. Speed limits can also reduce abrasion and re-suspension if they contribute to a uniform velocity pattern.

UBA still does not give the all-clear signal for nitrogen oxides. Although the EU tightened their emission limits, nitrogen oxide emission by vehicles has barely decreased in the cities. Exhaust aftertreatment systems in diesel vehicles play a special role: though the particle filters used retain a great deal of fine dust, the reduction of nitrogen oxide emissions as a function of exhaust gas temperature is still insufficient. Some of the new catalytic converters have even lead to higher nitrogen dioxide emissions. This in part explains the annual nitrogen dioxide limiting value cannot be met in the ambient air of many cities.

However, traffic-related urban air pollution will also decrease in a few years. UBA has high hopes that the Euro 6 emission category will enable an important step towards compliance with the nitrogen dioxide limits at measurement stations close to traffic. Euro 6 must significantly reduce emissions under real road conditions. To ensure this, a complementary test method is currently being developed at EU level (real driving emissions, RDE). RDE must be applied soon in order to achieve the necessary improvements as quickly as possible.

Also, great improvements in nitrogen oxide emissions are expected from the Euro VI standard for heavy-duty vehicles, which has applied to all newly registered vehicles since the beginning of 2014.

Mobile machinery and equipment

The air would also be cleaner if emissions from other internal combustion engines e.g. construction machinery were lower. UBA therefore supports an initiative of the States (Länder) that suggests aiming at harmonised nationwide and ambitious emission levels for particulate matter and nitrogen oxides from construction machinery within the framework of public tenders. In addition, the use of mobile machinery in contaminated areas should generally only be possible if ambitious emission standards are met e.g. by machines equipped with exhaust aftertreatment systems. UBA explicitly welcomes the planned UNECE regulation regarding the demand for and the testing of aftertreatment systems.

Stricter limits for construction machinery will enter into force this year. As particulate matter emissions have been significantly lowered since 2011, this step will significantly reduce NO_x emissions. The Commission is planning to further tighten the EU legislation in 2014, thereby increasing the emission requirements for diesel locomotives, multiple units and riverboats.

INFOBOX

Emission standards and low-emission zones

The Euro emission standards form the basis on which vehicles receive a plaque which entitles them to enter low-emission zones. Thus municipalities have an instrument on hand to exclude vehicles with particularly high emissions from polluted areas such as the inner cities. The extent to which low-emission zones improve urban air quality depends on many factors. Those low-emission zones which have been found successful are large and consistently allow only vehicles with a green plaque. Data from Berlin show that the Berlin low-emission zone has reduced the particularly hazardous diesel exhaust particulate fraction in particulate matter. The effectiveness of low-emission zones has decreased in the meantime, however, as the number of vehicles without a green plaque has fortunately also decreased.

Stoves, fireplaces and other wood-burning units

Using wood as a fuel has become attractive for many households in times of rising natural gas and oil prices, and government subsidies for the use of renewable energy. Burning wood however, emits hazardous pollutants such as particulate matter into the ambient air. Two examples show that this is a serious issue: in 2008, particulate emissions from wood-burning households exceeded the exhaust emissions from road transport (see Figure 8) for the first time. In the winter months, wood burning can produce up to a quarter of the total particulate matter concentration in air, especially in valleys, while its proportion often exceeds ten percent in winter even in a few large conurbations.

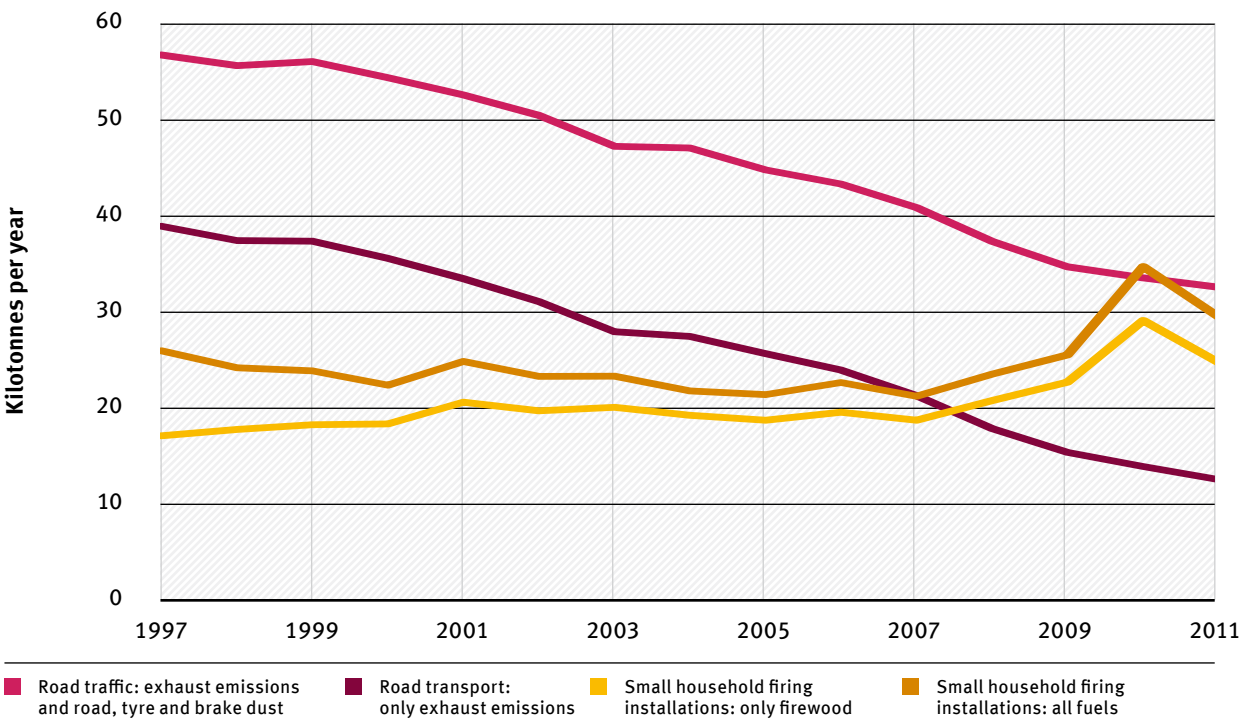
Two types of household wood-burning units can be distinguished: single-room installations, including fireplaces, stoves or tile stoves, serve as additional heating for a room. Central heating boilers on the other hand are used to provide houses and flats with heat and hot water. About 14 million single-room installations and about 0.7 million central heating boilers that can be fired with solid fuel are currently installed in Germany. In 2008, 17,000 tonnes of particulate matter was emitted from wood-burning in single-room installations and 3,200 tonnes from central heating boilers. The latter emits a higher proportion of particulate matter compared to their relative small number, as they provide a much higher heat output.

In addition to particulate matter, wood-burning installations emit pollutants such as carbon monoxide, polycyclic aromatic hydrocarbons and nitrogen oxides. It is therefore assumed that nitrogen oxides emitted by wood-burning installations contribute significantly to the background contamination, especially in rural areas.

However, by using a suitable fuel material, professional maintenance and operation as well as the use of low-emission installations, can reduce emissions from wood-burning installations. Since many people do not know how to suitably operate wood-burning installations in a low-emission mode, UBA has compiled the necessary information[5]. Our most important tips are:

Figure 08

PM_{10} emissions from road transport and small firing installations in Germany



Source: UBA

- Burn only untreated wood with a moisture content of less than 25 percent. Such wood is dry on the outside and only contains moisture in the wood cells. Waste and treated wood must not be burned in small heating installations.
- Have an expert do a thorough inspection and maintain your wood-burning installation regularly before the start of the cold weather.

The Federal Government has tightened the legal regulations for small and medium-sized firing installations in the Ordinance on Small and Medium-Sized Firing Installations (1. BImSchV) in 2010 in order to reduce emissions from small firing installations. Ambitious particulate matter and carbon monoxide emission limits apply to both new and existing central heating boilers. In addition, chimney sweeps check whether the emission limits are met every other year. Emission limits apply to fireplaces, stoves and other single-room heating installations – these are type-approval tested under specified conditions. The 1. BImSchV does not specify emission measurements for the actual operation of these stoves and fireplaces, but the installations are periodically checked for correct operation by the chimney sweeps. The 1.BImSchV also includes a rehabilitation scheme under which existing installations that do not meet the requirements must be either retrofitted with a dust filter or decommissioned by a specified date.

In the areas where the particulate matter limits in the air are exceeded, local authorities can take further action. Thus greater demands can be made on the firing installations, or the use of certain fuels can be restricted or even prohibited.

Industrial installations in particular contribute to SO_2 and NO_x emissions

Industrial installations

Despite the progress being made in waste gas purification and the manufacture of products or energy production, industrial installations are still major contributors to today‘s air pollution. Large firing installations currently produce about half the total sulphur dioxide, a quarter of total nitrogen oxide and about 10 percent of the total particulate matter emissions.

The European Industrial Emissions Directive (IED) is an important tool in limiting industrial pollution. The IED entered into force as the successor to the Integrated Pollution Prevention and Control Directive (IPPC) in 2011 and controls approval, operation and decommissioning of large industrial installations relevant to the environment EU-wide. The main objective of the IED is to provide uniform high-level environmental protection by the mandatory application of best available techniques (BAT) EU-wide. This should also avoid distorting competition, which has occurred repeatedly between companies due to different environmental standards in individual EU states.

The current state of the art is defined in the so-called “Sevilla Process”. Representatives of the European Commission, Member States and the

INFOBOX

Best Available Techniques

The Federal Environment Agency (UBA) coordinates information exchange between the Sevilla EU office and stakeholders and involved authorities in Germany. Thanks to an agreement between federal and state governments, up to two German experts are concurrently working full-time on the process in the Seville EU office.

A total of 33 Best Available Techniques Reference Documents, or BREFs, have been compiled so far. Binding BAT conclusions have already been published for the following industries:
- Glass production
- Iron and steel production
- Tanning of hides and skins
- Cement, lime and magnesia production
- Chlorine-alkali production

The following leaflets will be published in 2014:
- Pulp and paper production
- Refineries

German versions of the BREFs and BAT conclusions are available at the UBA website: http://www.umweltbundesamt.de/themen/wirtschaftkonsum/beste-verfuegbare-techniken/sevilla-prozess/bvt-download-bereich

associations involved from industry and environmental protection are working together to produce BREFs that describe the state of the art for individual industries and emission values that can be achieved using these techniques. BAT conclusions are derived from the BREFs and adopted as implementation decisions by the EU Commission. The BAT conclusions are published in the Official Journal of the European Union (OJ) and they are legally binding for the EU Member States. According to the statutory provisions, installations covered by the BAT conclusions shall comply with the requirements within four years.

Since environmental quality objectives for airborne particulate matter, nitrogen dioxide and ozone have not been reached in Germany and in many other EU Member States, UBA advocates a constant ambitious development of the EU-wide environmental standards at a high level.

The continuous adaptation of the current state of the art to a branch of industry in the BREFs (updates are provided every 10 years) is promising. It ultimately means that the industries involved regularly update their environmental technology, and therefore keep modernising. Sufficient high-quality data from good and very good installations presenting the current state of the art are crucial for the development of the BREFs. The support of industry and organisations is essential and must be improved where information is not available, in sufficient quantity and/or quality.

With the mandatory application of BAT conclusions, the importance of the Sevilla process has grown for all stakeholders such as industry and lawmakers. In UBA's opinion, the preliminary conclusions published by the EU Commission are not sufficiently ambitious. Thus an ambitious improvement of the state of the art at EU level will take place either too late or not at all. Some companies currently delay or avoid investing in environmental protection; therefore German

companies exporting environmental technologies are competing in a difficult market.
If the German sub-law regulations are different to the BAT conclusions, they must be adapted in consultation with federal and state authorities, the trade associations involved and environmental organisations. For this purpose the Federal Immission Control Ordinances (Bundesimmissionsschutzverordnungen), the Technical Instructions on Air Quality Control (TA Luft) or annexes of the Waste Water Regulation (Abwasserverordnung) must be amended, and given the general prohibition of deterioration, the existing environmental standards of TA Luft must not be relaxed.

The Industrial Emissions Directive (Industrieemissionsrichtlinie) brings even more news:

- Companies must now test soil and groundwater for pollutants if they want to expand an installation where hazardous substances are used, produced or released. This also applies when companies want to build a new installation. The test results must be summarised in a report on the soil's initial state. As a minimum, the original state must be restored after closure of an installation.
- Member States must report to the Commission about the implementation every three years, and make documents on relevant changes in installation approvals available on the internet.
- Installations must be monitored regularly and this must be recorded.

UBA expects that all Member States and industrial companies will implement the Industrial Emissions Directive consistently and ambitiously.

Agriculture

While everyone has been aware since the 1960s that transport and industry play an important role for clean air, agriculture only came to the fore in the late 1990s. This in particular involves the chemical element nitrogen denoted by the letter "N" in chemical formulae. Although nitrogen is one of nature's essential building blocks, its use as a nutrient in crop production and its release in large quantities from livestock, contaminates the environment. Agriculture – unlike other industries – works largely in an "open system". This poses a risk to the environment because only part of the nitrogen applied is used, degraded and retained in the soil and plants. A significant part reaches water as nitrate (NO_3-) and ammonium (NH_4^+) or the air as ammonia

Low-emission manure application using a manure cultivator with the 'absetziger' method

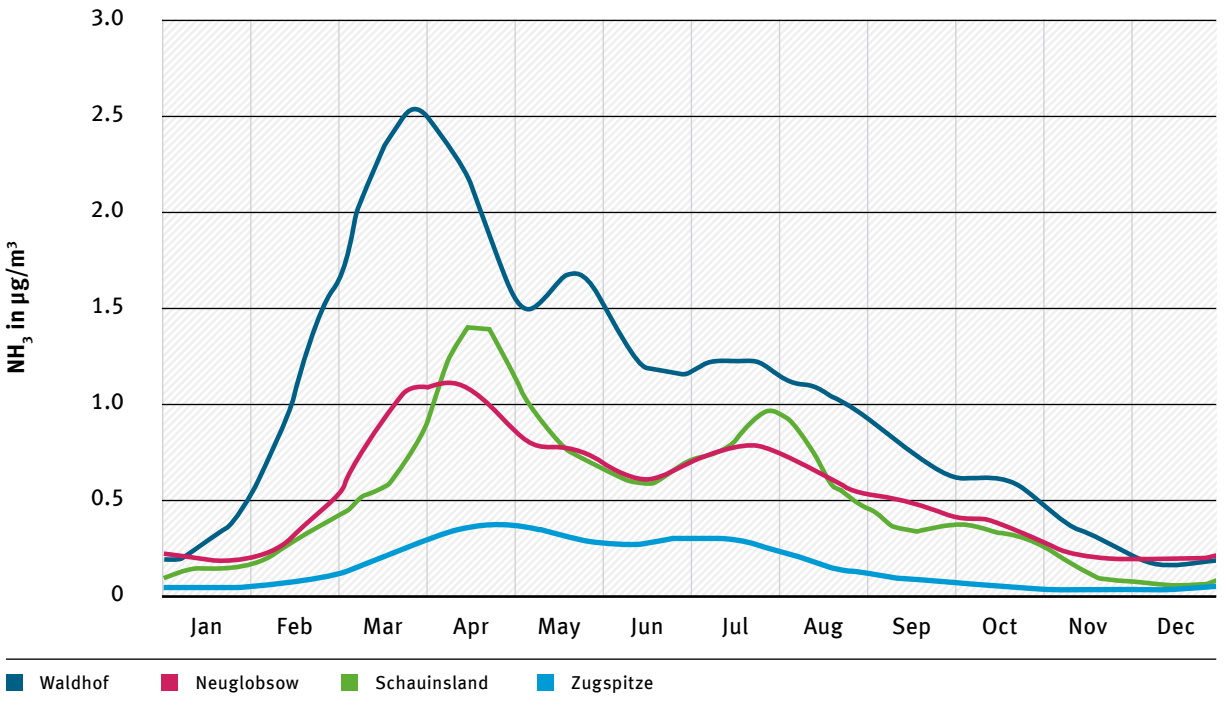
(NH_3) and nitrous oxide (N_2O). These compounds then may act as pollutants: if sensitive ecosystems on land and in water are over-fertilised, biodiversity will be endangered. In particular, low-nutrient ecosystems such as poor grasslands are affected. Nitrates in groundwater impair water quality and nitrous oxide emissions exacerbate climate change[6]. Ammonia escaping from manure and stables also contributes to the formation of particulate matter. 95 percent of total ammonia emissions stem from agriculture in Germany. The measured ammonia concentrations in the air show a characteristic seasonal cycle (see Figure 9). There is usually ammonia in the air at the beginning of the vegetation period in the spring and after harvest in the autumn. These are the times when farmers fertilise their fields with the manure collected over the winter – and manure releases ammonia. Increasing nitrogen efficiency is fundamental, so using low-emission application techniques such as drag hose, drag shoe, channel process and manure cultivator are the most important tools in reducing ammonia emissions. Also, farmers should spread manure immediately on bare soil, but this does not always happen.

Farmers can also avoid ammonia emissions in the barn and from manure storage. Cleaning exhaust air by forced ventilation is very effective: it can reduce emissions by 70 to 90 percent. In Germany, farmers have already installed such exhaust air purification systems in more than 1000 installations. The importance of exhaust air purification in poultry farming will also increase.

Many of these measures are well known. If farmers used low-emission manure application and removed ammonia from the exhaust air of pig and poultry farms, the total ammonia emissions in Germany could be reduced by 20 percent over the next ten years – without lowering meat consumption. Fertiliser regulations must be tightened and the nitrogen problem must be given

Figure 09

Annual NH_3 concentration values



Source: UBA

If farmers used low-emission manure application and removed ammonia from the exhaust air of pig and poultry farms in the future, the total ammonia emissions in Germany could be reduced by 20 percent over the next ten years.

greater importance in agricultural funding in order to implement ammonia emission reduction measures in agriculture. Also, the immission protection legislation should specify emission reduction requirements so as to cover the majority of livestock. In addition, as high Europe-wide environmental standards as possible must be established. In its "Best Available Techniques for Intensive Rearing of Poultry and Pigs" the EU specified similar requirements for poultry and pig farms in 2003. These standards are currently being updated in a BREF within the Sevilla process with involvement of the UBA, and they then will be valid for very large companies across the EU.

Airborne pollutants: classics, exotics and newcomers

Six airborne pollutants are considered "classic": sulphur dioxide, dust, nitrogen dioxide, carbon monoxide, ozone and the heavy metal lead. They occur in relatively high concentrations in the lower atmosphere and have been monitored for many decades. Also, their effect on humans and the environment is well known. In contrast, ammonia is a "newcomer" in air quality control, although reliable measurement methods for this gas are now available.

Finer dust particles are currently regarded as "exotics": their sizes range from a few nanometres (nm) to above 100 micrometres (µm). They differ in their shapes and chemical compositions. Health experts are particularly assiduously investigating ultrafine dust particles. They are particles with a diameter less than 100 nm. In conjunction with other dust particles, ultrafine dust particles contribute little to the mass, but essentially dominate the numbers. The following sample calculation clearly shows this: having the same density, a 10 µm particle weighs as much as a million particles with a diameter of 100 nm. There exists neither target nor limiting values for the number of particles in the ambient air so far.

INFOBOX

Particles: mass or numbers?

The mass of all particles that have an aerodynamic diameter smaller than a specified value is easy to measure. Thus all particles that can penetrate into certain areas of the human lung can be detected. In recent years, however, researchers have found evidence indicating that, in addition to particle mass, the number of particles can also affect health negatively. Since no automated measurement methods are available for the particle number, not enough reliable data are currently available.

Material components of the particles have recently moved into the spotlight. These newcomers give a new dimension to the debate about future limits for particulate matter. These include light-absorbing carbon black particles. They pose a danger to human health and also contribute to the warming of the atmosphere. Thus carbon black contributes to the human-induced climate change. Carbon black is produced when wood or coal undergoes an incomplete burning process. The International Coalition for Clean Air and Climate (CCAC[7]) is therefore committed to reducing carbon black emissions. The CCAC is now an initiative of more than 70 countries, supported by UBA since Germany has also joined it. CCAC intends to reduce emissions of carbon black and other substances that cause damage to the environment and pollute the air by providing financial support and knowledge transfer, especially in threshold countries.

Combustion processes also produce other "exotic" carbon-containing compounds, which can pose a risk to people. They include polycyclic aromatic hydrocarbons and there are several hundred different such hydrocarbons. Since their measurement and health assessment is relatively expensive, benzo[a]pyrene has been chosen as a key chemical species. The EU has set a target value of 1 ng/m³ for these polycyclic aromatic hydrocarbons in ambient air as an annual average, which was first applied in 2013. This value is currently not adhered to everywhere in Germany.

Target values do exist for the three metals arsenic, cadmium and nickel. Like many other metals, they are of concern not only to human health, since they also enter ecosystems, can bioaccumulate there and, unlike organic compounds, they are not biodegradable. Cadmium is, for example, damaging to human renal function. Chronic exposure to arsenic can lead to a changed blood count.

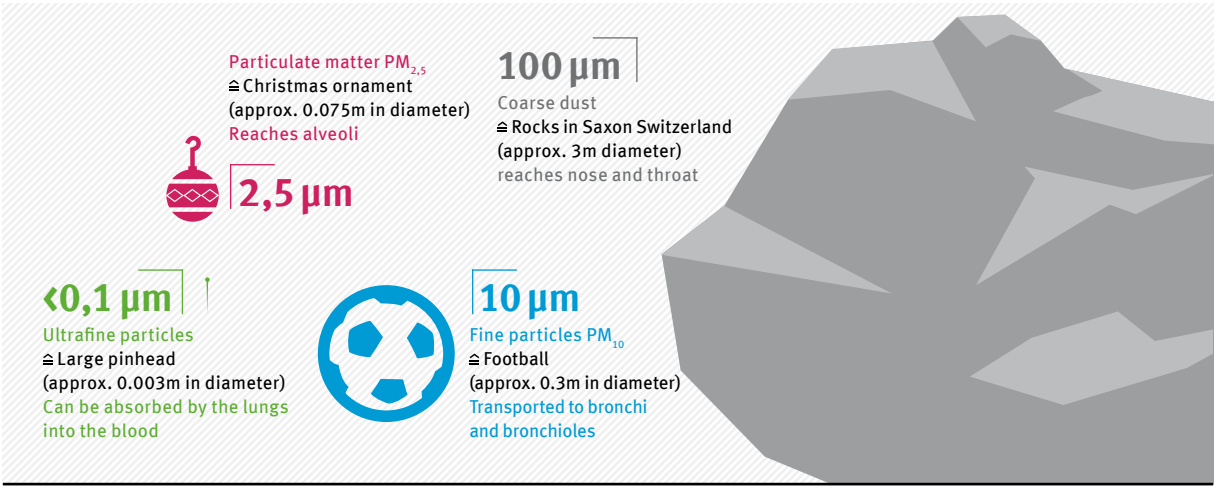
INFOBOX

Measurement of "exotics" and "newcomers"

In addition to the "classics", in their air monitoring network, the Federal Environment Agency (UBA) is observing even those pollutants and their emissions to the environment that have not yet been regulated by limits – in contrast to the monitoring measurement networks of the states (Länder). The measurement of these pollutants is usually accompanied by high cost as they often only occur in low concentration, and automated detection methods are not available. UBA can detect various volatile organic substances and also the components and size distribution of particulate matter, thereby largely contributing to a better understanding of air pollution.

Figure 10

Size of particulate matter in comparison



Source: UBA

Volatile organic compounds form another group of substances, which includes many constituents that are chemically reactive and participate in the formation of ozone and particles. An EU-wide limit for air quality exists for only one of these substances: benzene. The National Emission Ceilings Directive for certain atmospheric pollutants and the Regulation on Air Quality Standards and Emission Ceilings limit the total amount of volatile organic compounds, minus methane, released in Germany. Due to their high reactivity, however, many of these "exotics" are difficult to measure and quantify.

Fazit

Air quality control is a dynamic process. While great success has been achieved for conventional pollutants, the above "exotic" materials have lately been moved to the foreground due to new scientific discoveries. However, their risk assessment is not yet complete and how their emissions can be further reduced in a cost-effective way must be investigated. The objective of clean air has not yet been reached. The task can only be successfully accomplished if authorities, businesses and farms as well as all individuals are willing to take the necessary steps. Although this involves a cost, everyone will ultimately benefit from clean air both economically and in terms of a higher quality of life.

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Contributing sections:
I 2.6 "Emissions Situation"
I 3.1 "Environment and Transport"
I 3.2 "Pollution Abatement and Energy Saving in Transport"
II 1.5 "Environmental Medicine and Health Effects Assessment"
II 4.1 "General Aspects of Air Quality Control"
II 4.2 "Air Quality Assessment"
II 4.3 "Air Pollution and Terrestrial Ecosystems"
III 2.1 "General Aspects, Chemical Industry, Combustion Plants"

ENDNOTES

1 http://ec.europa.eu/environment/pdf/EB_summary_EB752.pdf und http://ec.europa.eu/public_opinion/flash/fl_360_sum_en.pdf
2 http://www.umweltbundesamt.de/daten/luftbelastung/aktuelle-luftdaten
3 http://www.who.int/phe/health_topics/outdoorair/databases/en/
4 Also see http://www.umweltbundesamt.de/verkehr/rechtliche-rahmenbedingungen/index.htm
5 Literatur: Heizen mit Holz. Ein Ratgeber des Umweltbundesamtes zum richtigen Heizen. (Heating with wood. A Federal Environment Agency guide about correct heating) 2011 Edition.
6 Erisman, J. W., et al. (2013). "Consequences of human modification of the global nitrogen cycle." Philosophical Transactions of the Royal Society B: Biological Sciences 368(1621).
7 CCAC: Climate and Clean Air Coalition

Soil

Our earth's „thin skin" needs protection

1. Based on facts – why we need soil

Soil is our planet's "thin skin" which we use in various ways. It is the basis for our agriculture and forestry, it serves as a space for human settlements, infrastructure and recreation. We exploit the resources of raw materials in surface or deep mines, dispose of waste on and below the earth. In addition, soil provides many ecological services that are essential for us but rarely perceived. That farmers produce food thanks to soils is obvious, but only very few people are aware of the important functions of soils such as a carbon store and as regulator of water supplies and recycler of raw materials or habitat for soil organisms.

However, soil is non-renewable within human time dimensions, which makes its careful treatment essential. Uses can be changed: forests can be cleared and converted in arable or pasture land, arable land can be built upon and converted into area for human settlements and transport infrastructure. The soil surface does not increase by the end of a cascade of use; only changes of use have taken place. So we must decide which soil function we prefer on which location because different uses often compete with each other: a wheat field offers high yields, but little habitat to species. An extensively used nutrient-poor grassland, however, has a high degree of biological diversity: many rare and protected species live in it, but only small amounts of agricultural products can be produced there.

When considering how soil should be used, ecological, economic and social considerations must all be taken into account. And: Soil is not the same everywhere. The soil's productivity is determined by site and soil properties. Not every soil has the same capacity to store carbon, to produce agricultural products or to provide a habitat to certain species. A soil's particular properties emerge in the course of its long history.

Soil formation

The soil forming process is extremely slow. In mid-latitudes such as in Germany, it takes about 100 to 300 years for a topsoil layer of 1 cm thickness to be formed. In the course of soil forming process, regionally different soil types develop depending on the parent rock material, climate and latitude, the activity of soil organisms and human use. These types differ in respect of their typical horizon sequence, their depth, permeability and the size of the soil particles and their chemical composition.

Reddish coloured, deeply weathered soils such as ferralic soils that occur mainly in the tropics are the result of soil-forming processes which occur for millions of years. The typical brown and black soils of Central Europe, by contrast, are much younger. The soil on which we live today started to develop at the end of the last ice age some 10 000 years ago when the climate warmed and ice melted away. Marsh, alluvial soil and soil formed by human influence such as the Plaggic Anthrosols rich in humus developed sometimes in only a few hundred years.

Soil: the basis of food production

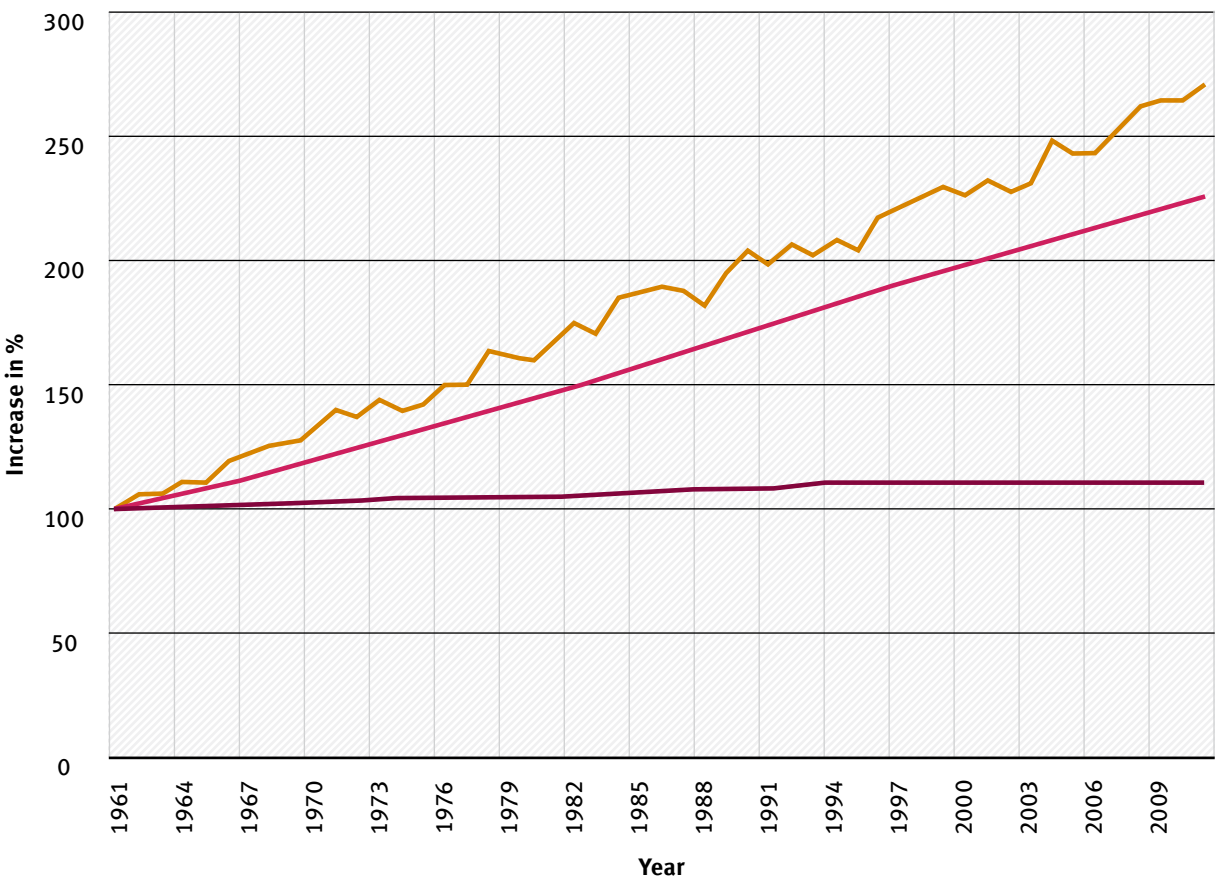
Globally, around five billion hectares (billion ha) of agricultural land are available to farmers, of which approximately 70 percent (3.55 billion ha) is used as pasture and 30 percent (1.45 billion ha) for arable farming. In addition there is a forest area of 3.9 billion hectares, which is also a source of raw materials. Agricultural and forest soils make up a total of about two-thirds of global land surface.

Agricultural land is a valuable asset. With a steadily increasing population, more and more people must be fed from this area which only grows slightly. Whereas agricultural area has increased by ten percent since 1961, world population has more than doubled in the same period, from about three billion to seven billion people today. At the same time, cereal yields per hectare have been increased considerably: while one hectare of arable land yielded just 1.4 tonnes of cereals in the global average in 1961 that figure rose to 3.7 tonnes in 2011. That is an increase of 160 percent! Even more dramatic is the growth in German wheat yield. That figure was 1.9 tonnes per hectare around 1900, growing to 7.3 tonnes in 2012. In 100 years, wheat yields have almost quadrupled in this country[1].

The bases for the productivity increase were advances in crop cultivation, increased use of fertilisers and pesticides and increasing mechanisation of agriculture. This, however, was accompanied by many adverse environmental effects such as loss of biodiversity, the contamination of soil and waters with high nutrient and pesticide loads, and high greenhouse gas emissions. This past increase in yield based on a massive consumption of resources that has its natural limits. The limited availability of fertile soil is only one of them.

Figure 01

Increase of agricultural land, the world‘s population and cereals yields in the past 50 years (1961 = 100).



UBA‘s figure, Data source: FAO

Soil is alive

In a handful of soil there are more microorganisms than there are people on the planet. The pores filled with air or water harbour bacteria, fungi and many other microorganisms. In addition, soil consists of mineral and dead organic matter. Dead organic matter in the soil also includes humus produced by soil organisms which crush, decompose and convert organic matter such as plant parts. In this case, nutrients are released and made available to plants. Carbon, nitrogen and phosphorus are stored in soil organic matter. Thus, soil plays a crucial role as a regulator and recycler in the global ecosystem.

Soil carbon

Following the oceans soil is the second largest active carbon sink of the earth. Worldwide it sequesters about 1 500 billion tonnes of carbon as organic matter – which is about twice the amount of carbon that is present in the atmosphere in the form of the greenhouse gas CO_2[2]. In case of land use changes, for example the conversion of marsh, forest and grassland to arable land or non-site-suitable land management, the sequestered carbon can be partially released as CO_2 into the atmosphere. This is especially true for peat bogs that store large amounts of carbon. Drainage and agricultural use of these areas gradually release the sequestered carbon in the form of carbon dioxide. Although drained peat bogs account for only two percent of the arable land in Europe, they are responsible for more than half of the carbon dioxide emissions from arable land.

Soil as a water filter

Not only does soil store carbon, it also stores significant amounts of water. With its versatile filtering, buffering and transforming properties, it protects our groundwater from pollutants at the same time. Rain seeps into the ground, is temporarily stored in soil pores and slowly enters the groundwater. Due to its fine particle structure and physicochemical properties, soil can filter out, neutralise and bind chemical elements and compounds. Pollutants such as pesticides, toxic heavy metals and pharmaceutical residues which are dissolved in the soil water are partly bound to humus and clay particles of the soil. Soil organisms also break down some of the pesticide and pharmaceutical residues. Thus fewer pollutants are transported into the groundwater – a crucial drinking water resource.

In a handful of soil there are more microorganisms than there are people on the planet.

Figure 02

Soil's age as shown by selected examples

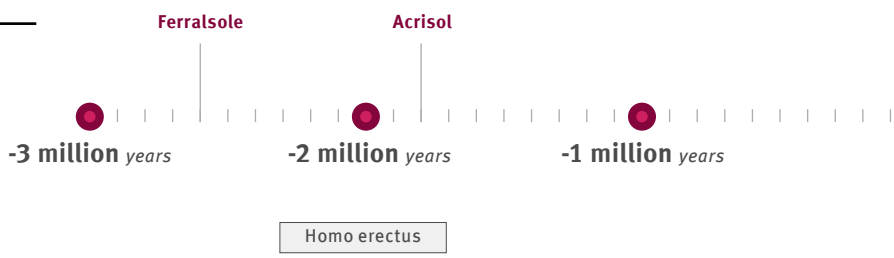
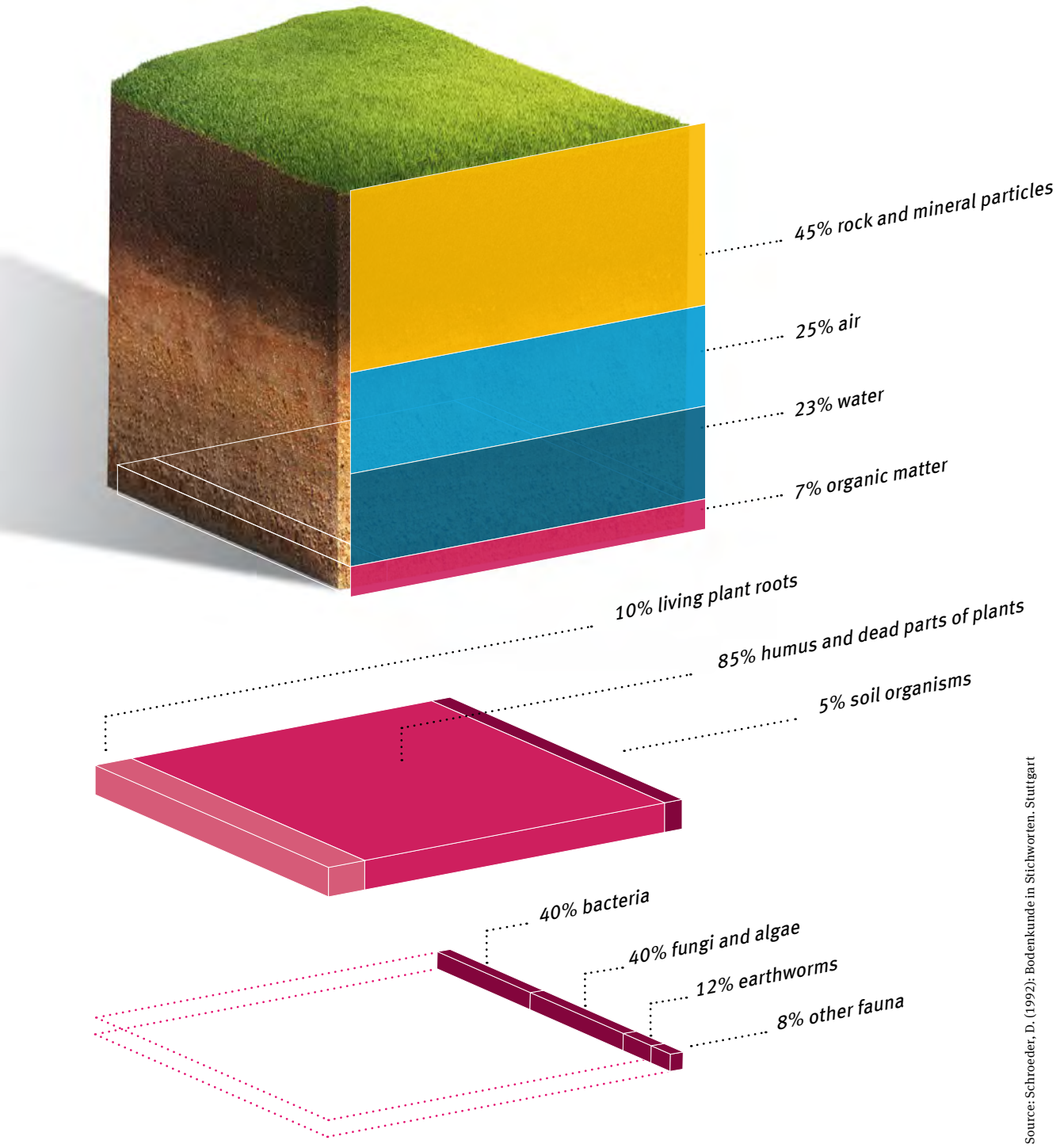
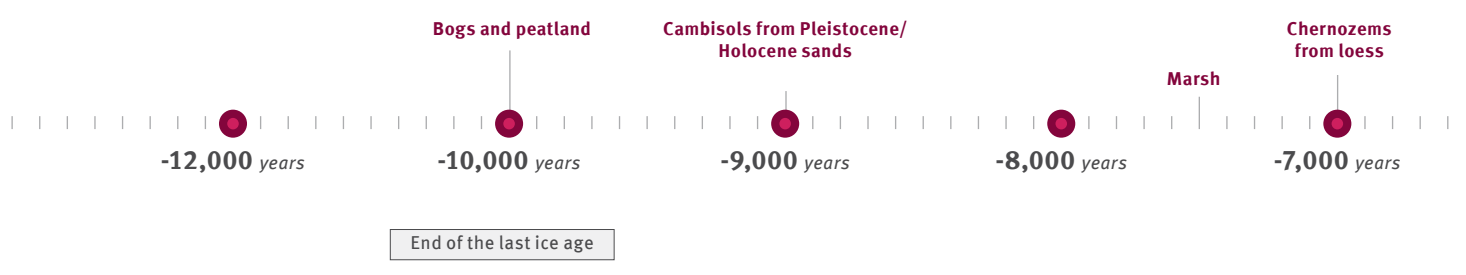


Figure 03

Soil consists of



Source: Schroeder, D. (1992): Bodenkunde in Stichworten. Stuttgart



Soils in transition
a. Pressures on soils

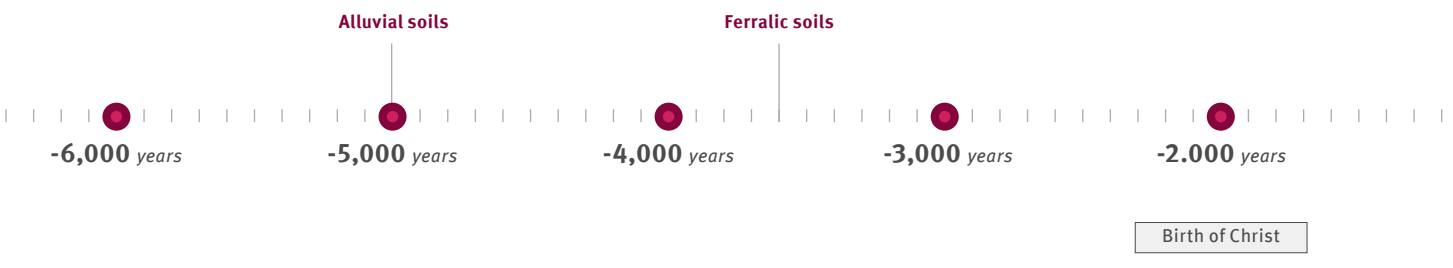
While the supply of fertile soil on the earth is limited, global pressure of use is increasing unabated. According to United Nations (UN) estimates, world population will increase from seven billion to about nine billion people over the next 40 years based on a moderate forecast. Thus, about one third more people will be living on Earth in 2050 than today. Strong population growth is expected for South Asia and Africa, where significant parts of the population even now are under- or malnourished.

The demand for agricultural products will also increase for reasons other than the increasing world population. A global shift of dietary habits is occurring towards a diet in which food of animal origin such as meat, egg and milk take an increasing share especially in the emerging countries. People in threshold and developing countries adopt, if they can, the resource-intensive dietary habits of the western industralized nations. However, the high demand for animal products triggers competition in the use of fertile soils: livestock and humans become direct competitors for food. Even today, a third of the world's arable land is used for feed production. In purely arithmetic terms, the amounts of cereals and soybeans that end up in the feeding trough contain enough food energy to feed three billion people. Whereas feed indirectly serves food production, in animal husbandry the bulk of feed energy supplied is consumed by the animal itself. Thus, in pig rearing, about 80 percent of the feed energy and about 90 percent of feed protein is lost as far as human consumption is concerned[3]. Assuming an intensive animal farming, a diet rich in meat clearly requires more fertile soil than one lean on meat. The annual global per capita meat consumption almost doubled between 1961 and 2009, from 23 to about 42 kilograms. Western industrialised countries in particular are leaders in meat consumption: at almost 90 kilograms per capita a year, Germany consumes more than twice the average of the world's population.

In addition, demand for renewable raw materials (RRM) is on the rise globally. In the last ten years, this was the case in the demand for renewable resources for energy production. More than 40 percent of maize production is converted into bioethanol in the US today. In Germany, renewable raw materials such as rapeseed for biodiesel production and maize for biogas production are grown on 20 percent of the arable land.

If we do not change resource-intensive consumption patterns such as heavy meat consumption and extensive food waste, we will have to produce up to 70 percent more agricultural products in the future than today. Therefore, we cannot afford a continuous loss of fertile soils. Yet this is exactly what is happening due to progressive soil degradation.

Fertile soils are the basis of our food and bioenergy production



INFOBOX

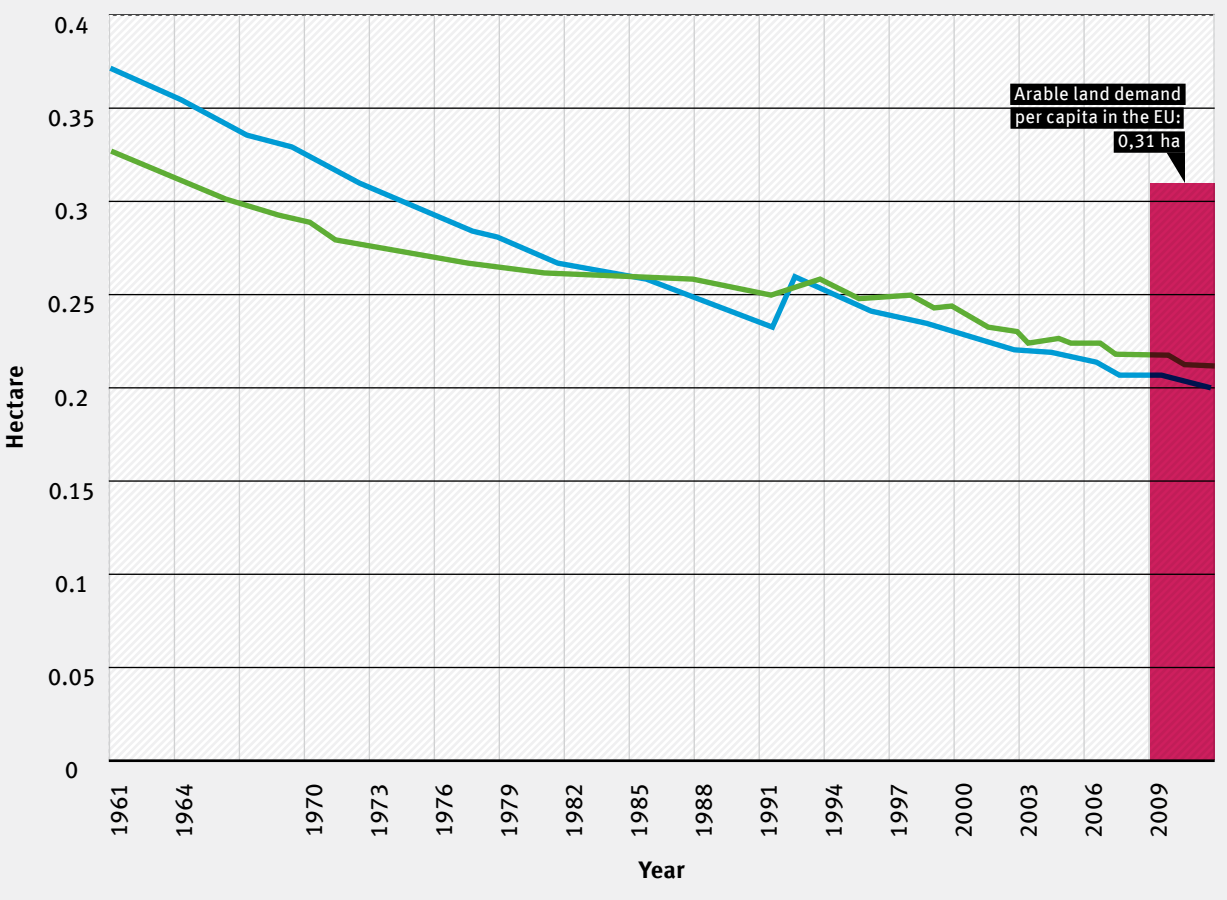
How much arable land do we need?

The world population is growing faster than arable land area. This steadily reduces the per capita arable land available to the world's population – even though arable land, primarily in the tropics, has been expanded in recent years, associated in part with massive negative environmental impacts. However, how much fertile soil we need altogether does not only depend on the number of people to be supplied with food, but to a large extent on our dietary habits. Western industrialised nations require significantly more per capita fertile arable land due to their high meat consumption compared to the rest of the world. An average EU citizen requires about 0.31 hectares of arable land, which is about a third more than the global average available, i.e. a quarter more than available in the EU. In order to meet consumer demands in the EU, fertile soils must be claimed in other regions, especially for feed imports.

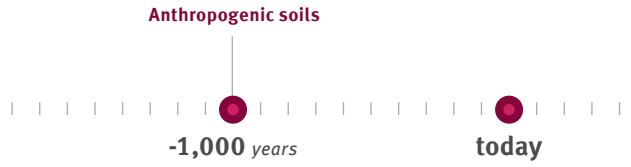
According to United Nations Environmental Program (UNEP) recommendations, an arable land demand not exceeding 0.2 hectares per capita of the world's population should be achieved by 2030.

Figure 04

Per capita arable land



Data source: World Bank, Bringezu et al. 2012



b. Soils in jeopardy

Almost any human intervention into the complex multi-layered soil system exerts environmental impacts. If the intervention in the soil ecosystem goes to an extent such that the soil loses its functions partially or fully, this is called soil degradation. This deterioration of soil quality is often a subtle yet steady process whose effects are only visible when it is rather late. Such deterioration or destruction can ex post only be dealt with– if at all –if massive effort is expended.

Farmers are by far the most important land users on the planet. They pose particularly high demands on soil fertility with their agronomic use, which also interferes massively with the soil system. Agricultural practices which are not adapted to local (soil) conditions therefore represent the dominant cause of land degradation across large areas worldwide. Typical consequences include increased wind and water erosion.

Erosion

The risk of soil erosion is always particularly large when soil is not covered by sufficiently dense, protective plant cover. This is the case on arable lands or overgrazed pasture grasslands. Heavy rains and gale-force winds can then erode soil particles. Thus climatic conditions and soil cover play a major role in erosion risk. Fine sandy soils are more likely to be wind-erodible, whereas loamy-silty soils are rather prone to water erosion. Mostly the valuable humus and nutrient-rich top soil layer is removed by wind and water. Once it has been lost, soil fertility and thus the soil's agricultural potential, decreases. In Africa alone – the most famine-struck continent – scientists assume that soil erosion could possibly lower the yield potential of arable land by 16.5 percent by 2020 compared to the initial state if no action is taken[4]. In addition to the damage on the surface itself, soil erosion has implications beyond the area actually affected: the removed soil will eventually be re-deposited elsewhere. These "off-site effects" of water erosion include silted rivers and reservoirs as well as impaired biological equilibrium in water due to nutrient runoff with soil particles. Dust storms formed by wind erosion now regularly disrupt urban life in world metropolises such as Beijing. Such displacement processes can lead in part to positive effects elsewhere. For example, large river delta regions such as the Mekong and the Nile Delta are among the most fertile areas of the world, which is ultimately due to the deposition of topsoil from upstream.

The Sahel, the transition between the Sahara in the north and the savanna areas in the south, is one of the regions most affected by wind erosion.

INFOBOX

The Grapes of Wrath

Disastrous dust storms devastated parts of the Midwest of the United States in the 1930s. The soil in this region later called the "Dust Bowl" had been used in an unsustainable manner: farmers had removed the prairie grass covering the soil and ploughed up the areas, especially for growing wheat. Thus the plough horizon – i.e. the ploughed soil – dried up and was prone to wind erosion. The result of the dust storms was crop failure, which robbed many farmers of their livelihoods. Many families had to leave their homes and moved to California in search of work and better living conditions.

The 1962 novel "The Grapes of Wrath" by Nobel laureate John Steinbeck tells of the hardships, disappointments and hostilities of a family affected by the Dust Bowl.

In response to the disaster, the United States established the Soil Conservation Service (now the Natural Resources Conservation Service). Ploughless and conservative methods of tillage to reduce erosion have gained importance in the US and worldwide. However, two new "Dust Bowls" are currently threatening at global level: one in the African Sahel and another in north-western China and western Mongolia.

1,500

billion tonnes of carbon are stored in the soil in the form of organic matter. Proper management can prevent the release of large amounts of the greenhouse gas CO_2.

21

According to FAO data, 21 percent of the world's population – 1.5 billion people – is currently directly affected by land degradation.

0.31

hectares of arable land is required on average by every EU citizen – one third more than available per capita to the world population. The reason: our resource-intensive, high consumption life style.

Wind erosion rates of around 50 tonnes/hectare per year are not uncommon there. They are one of the reasons that the land formerly used for agriculture is losing its fertility and is turning into a desert. The task of the "United Nations Convention to Combat Desertification in Those Countries Experiencing Serious Drought and/or Desertification, Particularly in Africa" (UNCCD) is to combat this desertification. So far, these efforts have unfortunately not been successful enough: the desert regions of the world are growing by 23 hectares per minute due to human impact today, according to estimates by the UNCCD.

Nutrients

If plants are harvested from the same area over long periods of time, nutrients are extracted from the soil, which is why the soil must be fertilised. The chemical elements nitrogen, phosphorus and potassium are the nutrients that most often need to be re-fertilised for any type of agricultural use. Natural fertilisers of animal origin – liquid manure, slurry and solid dung – or mineral fertilisers can be used for fertilisation. A special form of fertilisation is green manure which includes, for example, growing legumes such as beans, peas, and lupins, which are able to fix nitrogen from the air due to a symbiosis with bacteria and supply nitrogen compounds to the soil. If no or insufficient re-fertilisation takes place to balance the nutrient uptake by the crop, soil quality gets worse and yields decrease. However, too much fertiliser – for example, liquid manure application in areas with excessive cattle density – is also detrimental. Excess nitrogen does not simply remain in the soil: it is leached as nitrate into rivers, lakes and groundwater, or it escapes into the atmosphere after being transformed by the so-called nitrogen cascade in which microbiological activities in soil convert nitrogen compounds to ammonia and laughing gas. These compounds have undesirable environmental effects: ammonia and nitrate lead to nutrient enrichment and may threaten biodiversity. Ammonia causes acidifying conversion processes, and nitrogen oxides emissions accelerate climate change[5].

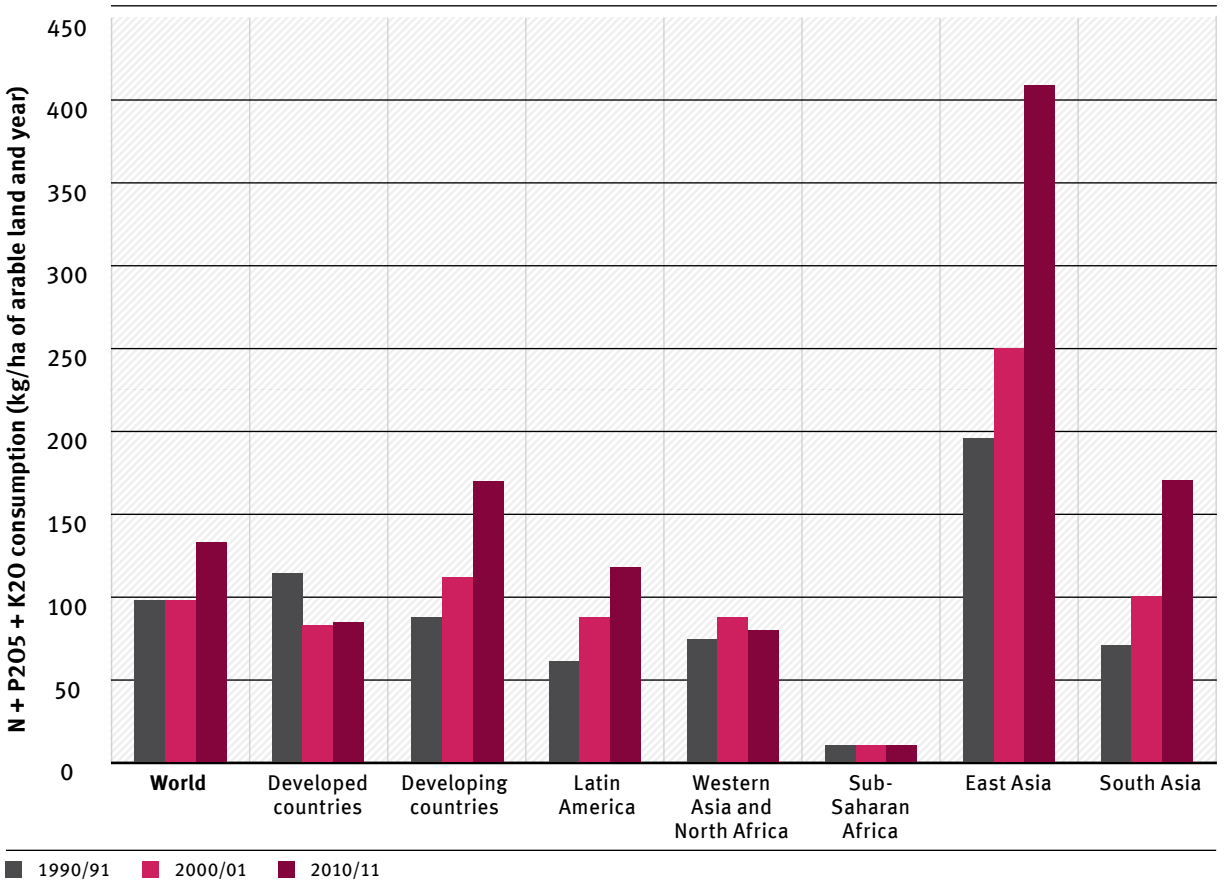
A global comparison shows that fertilisers are used in different quantities in the world's regions. In sub-Saharan Africa, farmers have on average 10 kg nutrients per hectare per year; East Asian soils, however, are fertilised with an average 400 kilograms per hectare per year[6].

Overfertilisation mainly has a negative impact on water, air and biodiversity. A nutrient-depleted soil, however, lowers its quality. In theory, this form of soil degradation could quite easily be reversed. However, the needed adequate financial resources, infrastructure and know-how are often lacking in those regions where farmers depend on a low-income and use most of the produced food for their own consumption. Nutrient depletion in soils poses a major problem and is one of the main reasons why agricultural yields in tropical Africa remain far below the potential level.

Other land degradation types triggered by non-site-specific agriculture are salinisation and compaction of soil. While soil salinisation is often a result of improper irrigation and inadequate drainage of irrigated land, soil compaction is mostly due to the use of heavy machinery and equipment on soils, particularly in wet and humid condition.

Figure 05

Mineral fertiliser consumption for different regions of the world per hectare of arable land (Sum of nitrogen, phosphate and potassium in kg N, P2O5 and K2O)



Source: Sutton et al. 2013; Data source: FAO

Pollutants

Harmful substances which include both naturally occurring substances such as metals and synthetic chemicals may also cause soil degradation.

Naturally occurring trace substances in small quantities often have significant biological effect – thus the metals zinc and selenium are essential in small quantities for human health. However, the chemicals used specifically by man for certain applications in large quantities often have damaging effects. This is especially true if they are persistent and accumulate in the environment.

For as varied the contaminants are, so too are the human activities by which these substances enter into the soil. They are introduced into the soil by contaminated waste, accidents, spills, wastewater, sewage sludge, fertilisers or pesticides. However, these materials do not remain in the soil. They can be absorbed by plants and get into feed and food or may contaminate groundwater through seepage. Some pollutants are metabolized in the soil, but some of the metabolize products are hazardous to humans or the environment. Other substances that are metabolized only very slowly or not at all will accumulate over the years in the soil (e.g. heavy metals such as lead and cadmium).

Since the beginning of industrialisation, large amounts of harmful substances have been introduced worldwide into the soil by both disposal and careless handling of hazardous wastes. Poorly degradable substances can be found still today. Many of the contaminated sites are still waiting to be rehabilitated. But soil is threatened by new dangers too: pollutants in products will eventually be released and can stress the soil – this applies for example to the use of zinc in building materials and phosphorus fertilisers containing cadmium and uranium. The worldwide rise in the mining of raw materials and their processing at unsound environmental standards causes the release of heavy metal-containing dusts, acid mine water and radioactive substances – a pollution hazard to the soil which should not be underestimated.

Land use in Germany is currently 74 hectares per day (2012). About half of that area is sealed.

Land take

Land take especially the sealing of land, destroy fertile soil. Conversion of agricultural and forest land into housing and transport areas is known as land take. About half of the housing and transport area is sealed in Germany. These soils can then neither store carbon dioxide nor filter water. All processes of soil formation and microbiological activities come to a standstill. The consequence is the loss of the soil's ecological functions. In addition, sealing prevents groundwater formation and increases the risk of flooding.

Land take in Germany, with a current slightly downward development (2012), is at 74 hectares (ha) per day. This corresponds to the area of more than 100 football pitches. In its National Sustainable Development Strategy of 2002, the Federal Government set a goal to reduce land take to a maximum of 30 hectares per day by 2020. The issue is gaining importance elsewhere in Europe, too. From 1990 to 2000, increasing urbanisation led to an increase of the area built upon and sealed by about 270 ha per day. The annual average of this value adds up to an area that is larger than the city of Berlin, which is 1 000 km².

This value is likely only a conservative estimate based on remote sensing data, which can only detect large-area changes. The United Nations assume that the proportion of the world's urban population will increase from its current level by 50 percent to 60 percent by 2030. New residential and industrial areas are being developed on the outskirts and surrounding areas, resulting in land take and soil sealing. This applies particularly to emerging countries where the population and economic activities are growing very quickly. However, developing countries are also affected by so-called informal settlements, which are mushrooming across the landscape.

Interim conclusion

The entire global extent of land degradation could hardly be estimated due to a lack of data. As early as in 1991, experts commissioned by the United Nations Environment Programme (UNEP) concluded that as much as 15 percent of Earth's total land area and 38 percent of arable land were affected by soil degradation at the time. 296 million hectares – an area the size of Argentina – were so severely degraded that their

agricultural productive capacity was near-zero. Massive efforts such as flushing salinised areas to dissolve the salts or other engineering measures would have been necessary to restore the soil's well functioning. About 9 million hectares – an area larger than Austria – was so severely degraded that it could not be considered for agricultural use and a restoration of soil fertility appeared impossible to the experts. Although recent figures for land degradation at the global level are lacking, there are studies that provide evidence that the situation has worsened and soil degradation has advanced into new regions[7].

This extent of land degradation is of course not without economic and social consequences. According to the Food and Agriculture Organisation of the United Nations (FAO), soil degradation incurs annual costs of a roughly estimated €30 billion – and 1.5 billion people in the world are directly affected since they live on and from the degraded land. They keep losing the fertile soil under their feet.

INFOBOX

Rocks against extinction: dramatic cultural and natural environment changes on Easter Island

The Moai – monumental tufa stone colossi on Easter Island – are still visible signs of a lost civilisation in the Pacific Ocean about 3700 km off the Chilean coast. The collapse of the civilisation is partly due to the systematic clearing of 16 million palm trees between 1200-1600 A.D. When the soil was no longer protected by the palm trees, fertile soil has been eroded in many places and increasing parts of the island became barren. The people of Easter Island tried to prevent complete collapse by placing more than a billion rocks in order to protect the remaining fertile soils. But they were unable to prevent the downfall of their civilisation. Easter Island is thus a unique testimony of how land use by humans can affect the landscape and cultural behaviour.

Rocks against extinction: dramatic changes of culture and natureon Easter Island

Desertification is a special consequence of soil degradation in dry lands. According to UNCCD estimates, deserts worldwide expand by 23 acres per minute

c. Soil and climate change

Soils have generally a strong influence on the local climate and vice versa. Global climate change will therefore have an impact on all soils worldwide.

For Europe, climate change experts predict a further increase of temperatures, and for Central Europe drier summers, wetter winters and more frequent extreme weather events such as heavy rain and storms. This can have many different consequences. The lack of water in summer may lead to crop failure.

It is also possible that the humus content of soil decreases as higher temperatures accelerate the decomposition of organic soil matter. More carbon dioxide would be released, the capacity of soils to hold nutrients and water would be reduced, and the susceptibility of soils to compaction and erosion would increase. But currently, scientists cannot confidently predict how organic soil matter will change in the context of climate change: the relationships are very complex.

Frequent heavy rainfall events have other consequences: if more rain falls than soils can absorb, increased surface runoff and erosion would be the consequence. Soil life also does not remain unaffected by climate change because soil temperature and humidity strongly influence the type and composition of soil organisms.

Climate change and the impact of climate change on natural soil functions will vary in the different regions of the world. Therefore, a regional perspective is essential.

d. Land grabbing

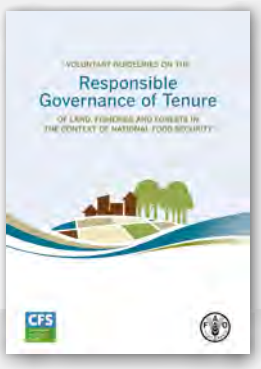
The sharp rise in world food prices in 2007 and 2008 increased the demand for land and fertile soil. Since then, public and private entities increasingly lease and buy large areas of land, especially in countries of the global South. At the same time soil itself became lucrative as an object of investment and speculation. According to estimates by the Federal Ministry for Economic Cooperation and Development, the scope of large-scale land acquisitions and leases, so-called "land grabbing" in developing countries, in the last decade stands at about 230 million hectares of which about 130 million are in Africa alone.

The local population often suffers under these "acquisitions". They complicate their access to land and water and thus deprive them of some of their supply base. Local food security in the countries concerned may therefore be further endangered by "land grabbing". In addition, according to studies by the World Bank, the new owners use it productively[8] in only about 22 percent of all purchases. Land acquisition is in itself no investment in agriculture because initially only ownership or use rights are acquired.

The "land grabbing" phenomenon demonstrates that many economic stakeholders have recognised the high value of fertile soils. But it also indicates the need to better coordinate the global and equitable access to soils. Real agricultural investment in developing countries could only regard as positive if fundamental human rights, social, environmental and economic guidelines are adhered to.

INFOBOX

Stopping the illegitimate sale of soils – a first step



In order to halt the clearance sale of fertile soil, the UN Committee on World Food Security, CFS, has worked out the "Voluntary Guidelines on Responsible Governance Tenure of Land, Fisheries and Forests in the Context of National Food Security" (FAO guidelines). These guidelines are the first international legal instrument which deals with issues of access to land resources, and provide guidance to states for a suitable design of their legislation and administration. They provide suggestions on how the legitimate interests of local populations can be protected, how transfers of use rights can be designed responsibly and transparently, and how conflicts over fertile soil can be resolved. Each state is responsible for the implementation of the guidelines. Therefore, the FAO-guidelines are an important first step, however, others have to follow.

3. Gaining ground!

Fertile soils are a prerequisite of humanity. Without them, no sustainable development is possible. Soils are used locally, but have a global function. Therefore, next to local impact, the degradation of fertile soils always has a global impact. The driving forces behind increased demand are also global in nature. Accordingly, in order to resolve the conflict of a rising global dependence on the quality of soil on one side, and the progressive degradation of soil on the other hand, global approaches to soil protection and its sustainable management are needed.

a. Soil protection at the international level – a gap analysis

The Ramsar Convention protects peatlands

A part of international soil protection – or more precisely, only the protection of peatlands – started in the mid-seventies with the Ramsar Convention for the protection of wetlands. Although peatlands make up only about three percent of the earth's surface, this small part is very important for storing the greenhouse gas carbon dioxide: worldwide, this three percent binds about 550 billion tonnes of carbon – the equivalent of 30 percent of all carbon stored in soils in the form of organic substances[9]. However, the Ramsar Convention protects only intact natural peatlands. In Germany, for example, only about five percent of the original peatlands are intact.

Climate Change Convention promotes soil carbon - partially.

In the 1992 Climate Change Convention (UNFCCC) all states agreed to contribute to storing greenhouse gases. They should therefore also seek to preserve or restore the carbon sink function of soils. The international agreements on climate change are very explicit about soils in two instances: reforestation activities and re-wetting former peatlands. Both types of carbon accumulation in the soil are now recognised in the Kyoto Protocol as carbon sinks.

The Convention on Biological Diversity and soils

With the Convention on Biological Diversity (UNCBD) concluded in 1992, the international community wants to preserve biodiversity and ensure its sustainable use. This includes the protection of ecosystems, which of course include soils. It however lacks specific operational requirements for the protection of soil. In some programs of the Convention such as those on biological diversity in agriculture, in arid or semi-arid areas and in forests, soil-related issues are addressed indirectly. In addition, in 2010 in the Japanese prefecture of Aichi, the Parties to the Convention adopted the "Strategic Plan for Biodiversity" with goals for 2020. Three of the 20 so-called Aichi targets include soil-related aspects. These include the seventh target for the sustainable use of agricultural and forest land, the eighth target to reduce pollution and the 14th target to restore and conserve ecosystems and their services.

The fight against desertification is also soil protection

The Convention to Combat Desertification (UNCCD) of 1994 regulates another important aspect of soil protection. It aims to combat deser-

For centuries, terraced fields have made the intensive agricultural use of slopes possible, which, without this technique would be at severe risk of erosion.

tification and mitigate the effects of droughts. According to the understanding of the Convention, desertification is a form of land degradation, which is caused by factors such as climate fluctuations and unsustainable agricultural use. In the Convention, developed countries such as Germany committed to support the affected countries financially and through technology transfers. The geographical scope of the UNCCD is expressly limited to dry areas. This affects at least 40 percent of the earth's surface – the remaining 60 percent are not covered.

Interim conclusion

Each of the four international conventions addresses individual aspects of soil protection. However, none has the mandate to conduct comprehensive soil protection. In each case, their scope is limited, and even taken together they cannot sufficiently contribute to the preservation and restoration of soils.

The Millennium Development Goals could contribute to soil protection, but so far they don't

Eight Millennium Development Goals (MDGs) were developed in 2000 and 2001. They specify the global development policy agenda up to 2015. Although they are not legally binding, they have come to be very influential in financing cooperation in development policy. Of the eight targets, the seventh is dedicated to environmental sustainability. One of its sub goals is to reverse the loss of natural resources – including soil. However, none of the indicators that are used to evaluate the development steps applies directly to soil.

What is missing is an international regime which addresses the causes and consequences of land degradation in all its dimensions and includes possible countermeasures. Therefore other international instruments are necessary. The fact that urgent action is required is now increasingly recognised. Many initiatives commit to act, such as the "Global Soil Partnership" of the Food and Agriculture Organization (FAO) and the "Global Soil Week" of the Institute for Advanced Sustainability Studies (IASS) in Potsdam in partnership with the Federal Environment Agency (UBA). The United Nations also increasingly recognise the importance of soil: they recently announced December 5th as the official annual World Soil Day and 2015 as the International Year of Soil.

b. A first step: the concept of a "land degradation neutral world"

Progress is being made: there is a first global vision for soil conservation. In the outcome document of the United Nations Conference on Sustainable Development in June 2012 in Rio de Janeiro (Rio+20 Conference), the Heads of State committed themselves to strive for a "land degradation neutral world". This includes a world without net soil loss.

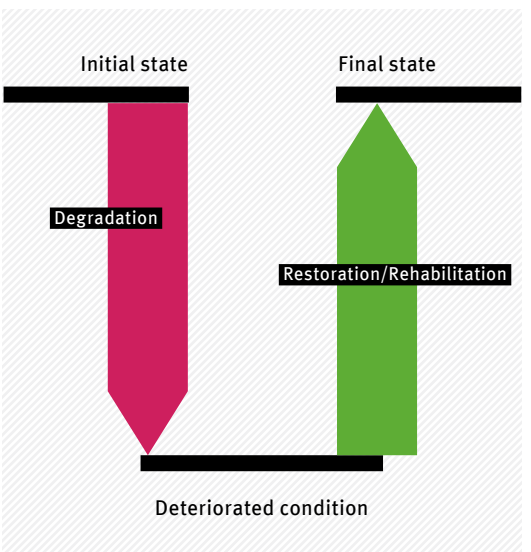
Therefore, going forward, soil losses from erosion, sealing and other forms of soil degradation are meant to be offset by soil restoration and rehabilitation. Since soil degradation cannot be completely prevented, it must at least be minimised, and non preventable soil degradation must be compensated by restoration and rehabilitation measures.

Although the concept of a land degradation neutral world sounds simple, many questions are still open. Still missing are indicators and methods by which to monitor and assess the developments. So far, the concept also remains somewhat vague. To really come into fruition, it needs an organisational and institutional anchoring at the global level.

Figure 06

The concept of a land degradation neutral world

The loss of soil from soil degradation must be minimised and unavoidable soil degradation must be compensated by restoration and rehabilitation measures.



Source: Ehlers 2013

c. How can soil protection be anchored at the international level?

If the global community could agree on integrating the notion of a "land degradation neutral world" into a straightforward and manageable set of common goals, it would mean a big step for anchoring soil protection at the global level. This is quite possible: new targets are currently being discussed on the international agenda.

Global Sustainable Development Goals Like the concept of a "land degradation neutral world", the global Sustainable Development Goals (SDGs) are a result of the Rio+20 Conference in 2012. There it was decided to develop these Sustainable Development Goals in an intergovernmental negotiation process by 2015. Current discussions show that many states want to see the concept of a "land degradation neutral world" included in the Sustainable Development Goals.

Succession to the Millennium Development Goals

The Millennium Development Goals expire in 2015. In the recent discussion about further development, a positive development for soil protection emerged: a panel of experts (the High Level Panel of Eminent Persons – HLP) convened by the Secretary General of the United Nations has explicitly declared the improvement of soil quality, reducing soil erosion and desertification as a sub-target of the proposed ninth target for the sustainable use of natural resources.

In September 2013 at the United Nations in New York, the Heads of State and Government supported combining these two sets of goals in a target catalogue.

Sustainable development can only take place within the planet's ecological boundaries. Therefore, going forward, we cannot consume more soil than we can restore at the same time. The UBA therefore supports making the concept of a land degradation neutral world part of such a target catalogue.

The negotiation of such an objective requires sound, concrete and globally coordinated suggestions as to how exactly the land degradation neutral world target can be achieved and what aspects must be taken into account. The UBA is involved in the development of such proposals. It is important to show that, in addition to the world's prevailing hazards such as wind and water erosion, salinisation and contamination with pollutants, soil protection is essential for water management, climate change and food security and must therefore be regarded as a cross-cutting issue.

What are the potential outcomes of global goals and agreements?

Behind the idea of global goals is the experience that international cooperation is facilitated if mutually agreed and easily communicable goals lead the way. The Millennium Development Goals, for example, exhibited good control effects for the financing of development policy cooperation. Like Millennium Development Goals, the new list of Sustainable Development Goals will only be politically, but not legally binding .

The implementation of the policy objectives could be ensured by legally binding agreements at the international level. The Convention to Combat Desertification (UNCCD) would be suitable for that, with certain limitations. UBA believes that a protocol as a separate international treaty under the auspices of this Convention, which applies to all soils worldwide and includes concrete measures for the implementation of the goals would make sense. Amongst the Parties to the Convention, however, such a protocol is strongly debated.

Conclusion

A more mindful approach to soils, meaning the sustainable management, is indispensible. Otherwise, that which took hundreds and thousands of years to emerge, could be lost within a few decades. The importance of soil for man's supply of food, renewable resources and ecosystem services will continue to increase. National approaches to soil protection are essential, but alone are not sufficient to ensure the protection of soil resources in a globalised world. The UBA therefore supports the European Union and the international community in their efforts to identify effective actions for soil protection and to develop and agree upon globally coordinated approaches to the protection of soils.

Burgeoning hopes: If the international community can agree on integrating the goal of a world without net soil loss into sustainability goals, we would at least have a common vision for global soil protection.

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Contributing sections:
I 1.1, I 1.2, I 1.3, I 1.6, I 1.7, I 2.1, I 3.6, II 2.1, II 2.6, II 2.7, II 4.3, III 1.4, III 2.4, III 2.5, IV 1.2, IV 1.3, E 1.6

FOOTNOTES

1 DBV (2012): Situation report 2012/13 at http://www.bauernverband. de/12-jahrhundertvergleich
2 European Commission (2011): Boden: Der verborgene Teil des Klimazyklus. Luxemburg: Amt für Veröffentlichungen der Europäischen Union 2011 (Soil: The hidden part of the climate cycle. Luxembourg: Publications Office of the European Union 2011) – 20 S. ISBN 978-92-79-19268-5
3 Smil, Vaclav (2002): Feeding the World: A Challenge for the twenty-first century. The MIT Press.
4 Lal, Rattan (1995): Erosion-Crop Productivity Relationships for Soils of Africa. Soil Sci. Soc. Am. J. 59: 661–667
5 Erisman et al., 2013, Consequences of human modification of the global nitrogen cycle
6 Sutton et al. 2013, Our Nutrient World
7 Bai ZG, Dent DL, Olsson L and Schaepman ME 2008. Global assessment of land degradation and improvement. 1. Identification by remote sensing. Report 2008/01, ISRIC – World Soil Information, Wageningen
8 Deininger, Klaus; Byerlee, Derek; Lindsay, Jonathan; Norton, Andrew; Selod, Harris; Stickler, Mercedes. 2011. Rising Global Interest in Farmland: Can it Yield Sustainable and Equitable Benefits? World Bank.
9 Parish, Sirin, Charman, Joosten, Minayeva, Silvius, Stringer (2008): Assessment on Peatlands, Biodiversity and Climate Change: Main Report. Global Environment Centre and Wetlands International.

Green IT

sustainable information
and communication

Hopes are high that information and communication technology (ICT) will promote environmental and climate protection: Intelligent power grids, so-called „smart grids“, are said to accelerate the development of renewable energies, intelligent traffic management is said to put an end to traffic jams, and „Big Data“ are said to help improve citizen participation in planning. Whether those hopes can be fulfilled is uncertain. But it is already certain today that the production, use and disposal of ICT products require natural resources. It is also certain that the optimisation of the energy consumption during the use of ICT products will not be sufficient to reduce resource requirements. Short product development cycles, new products such as networked refrigerators or data eyeglasses and also the ever increasing integration of data networks in people‘s everyday lives are trends that increase the utilisation of resources by ICT.

Therefore, environmental policy wants to highlight ways in which ICT can be used sustainably. We at UBA have already made a start: we consistently procure environmentally friendly and very energy-efficient ICT equipment and continuously improve the energy efficiency of our data centre in Dessau. What is more, our employees know how to use their computers and monitors in an energy saving fashion.

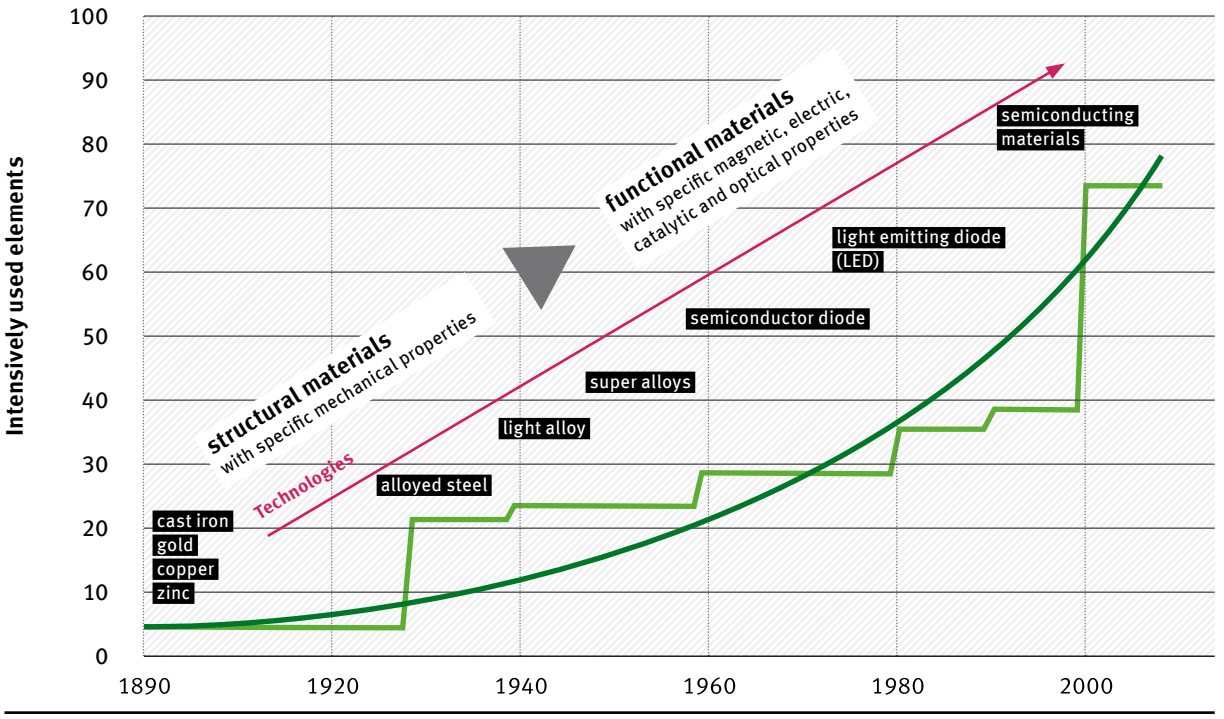
Raw material use in ICT is high

The production of ICT devices is raw material-intensive. The reason for this lies both in the amount and the number of the metals used. In addition to the quantitatively significant metals such as iron, copper, aluminium, nickel and zinc, many special and precious metals are used in small quantities in ICT equipment. Only part of the metal is recovered when the equipment is recycled: the yield of iron, aluminium and copper is usually very high, as it sometimes is for precious metals such as gold, silver and palladium. However, special metals such as indium, gallium or tantalum are hardly ever recovered. Yet precisely these metals are not unlimitedly available for ICT manufacturers and other high-technology sectors. While ICT equipment manufacturers use aluminium, iron, nickel and zinc mainly for their mechanical, and copper for its conductive and heat transfer characteristics, they use precious and special metals because of their electrical, optical or catalytic properties. These metals are essential for modern ICT equipment. Driven by advances in semiconductor technology, increasing functionality, increasing performance and progressive miniaturisation, the number of chemical elements used – particularly metals – has increased dramatically since the 1960s. Today almost all the elements of the periodic table are used commercially[1] (see Figure 1).

Some precious and special metals are used to such an extent in ICT devices that this use accounts for a major proportion of the worldwide production. For example, more than 40 percent of the annual global production of antimony, beryllium, gallium, indium and tantalum are used in ICT equipment. 10 to 40 percent of the world’s production of cobalt, germanium, gold, palladium, silver and tin are used in ICT devices[2]. But many of these metals are only available in limited quantities, and for gallium and indium, typical for use in ICT, more than 90 percent of the amount mined from natural deposits since 1900 were produced after 1978[3].

Figure 01

increase in the number of technically relevant metals in the last century[4]



Quelle: Eigene Darstellung, Material Selection in Mechanical Design, Michael F. Asby, 1992

In contrast, only the copper used in ICT devices represents a significant share of world production of metals like aluminium, iron, nickel or zinc.

Availability of ICT raw materials – their "criticality"

The worldwide demand for precious and special metals has grown over the last two decades and will continue to do so. Given this increasing demand, the question arises how the medium to long-term demand will be covered. There are two opposing views: "Resource pessimists" fear a physical shortage because the deposits of rare metals such as the special metal indium or the precious metal palladium are going to be exhausted. "Resource optimists", however, assume that the geological reservoir is almost inexhaustible because in principle the entire earth's crust can be exploited. In their view, raw material shortages are therefore only a sign of an imbalance between supply and demand. Supply shortages would therefore always be overcome by technological advances and market forces. Reality is likely somewhere in between[5]. However, given the unabated rise in demand for raw materials and the limited known deposits, it can hardly be assumed that in particular special and precious metals will soon be fully available again. Furthermore, mining metal ores also consumes a lot of energy, water and land, which are additional factors that can complicate tapping new deposits.

It is however certain that the availability of raw materials is determined by many factors: geological, geo-political, economic, social and environmental. Depending on the raw material, time horizon and stakeholder group, availability evolves differently. In order to address this complexity adequately, the concept of "raw materials criticality" was established. It describes the relationships of the different supply risks to the economic and technical importance of raw materials: the more risky a supply situation and the more important a commodity, the more critical its availability is rated. What level of importance is attached to a commodity also depends on perspective: an ICT equipment manufacturer may assess the availability of a resource differently from an industrial sector or a national economy. In that sense, the results of criticality analyses are also always subjective[6].

Raw materials loading dock in the Port of Hamburg

Ecological and social aspects of the production of ICT raw materials

To what extent metal deposits in the earth's crust can be accessed also depends on the extent to which society accepts the negative impact of extraction on people and the environment. UBA assumes that in the medium term, socio-ecological factors will be more important than the depletion of deposits. However, in most criticality analyses, these factors are usually neglected. Two current UBA research projects therefore deal with the negative social and ecological impacts of metal mining and reassess the availability of raw materials[7].

INFOBOX[8]

What aspects determine the availability of ICT-related raw materials?

Priority ICT raw materials (› 40 percent of the world's annual production goes to the electronics sector):

Antimony: market concentration (producing countries), geopolitical risks, limited recyclability, limited substitutability
Beryllium: market concentration (producing countries and corporations), limited recyclability, low substitutability, high demand by future technologies
Gallium: market concentration (producing countries), exclusively a by-product of other metals, low recyclability, low substitutability, high demand by future technologies
Indium: exclusively a by-product of other metals, low recyclability, lack of substitutability, high demand by future technologies
Tantalum: market concentration (producing countries and corporations), limited recyclability, partially small-scale mining and a conflict resource

Other ICT raw materials (10-40 percent of the world's annual production goes to the electronics sector):

Cobalt: market concentration, mainly a by-product of other metals, lack of substitutability, partially small-scale mining and a conflict resource
Germanium: market concentration (corporations), geopolitical risks, exclusively a by-product of other metals, limited recyclability, low substitutability, high demand by future technologies
Gold: geopolitical risks, low substitutability, high environmental relevance, partially social aspects (small-scale mining)
Palladium: extreme market concentration (producing countries and corporations), mostly a by-product of other metals, low substitutability
Silver: mainly a by-product of other metals, low substitutability
Tin: limited recyclability, low substitutability, partially small-scale mining and a conflict resource

Environmental damage caused by a gold mine in Australia

INFOBOX

Metal is not always metal in e-waste recycling

High-quality recycling of electrical and electronic equipment has two advantages: it protects the environment from adverse effects of improper disposal and it recovers valuable materials from the devices. Recycling rates of about 80 percent for Waste Electrical and Electronic Equipment (WEEE) are very good for iron, copper and aluminium, but the recovery of precious and special metals from ICT devices must be increased significantly in order to close the material cycles for these metals. One tonne of mobile phones (without batteries) contains about 300 grams of gold – whereas a tonne of gold ore contains only about five grams.[9]

In order to consistently keep these metals in a materials cycle, more waste products have be collected and selectively supplied to appropriate treatment and recovery. In addition, the collection must be handled such that the devices arrive as intact as possible in the treatment plant. An UBA research project[10] is currently developing specific recommendations for a better collection, treatment and recycling of WEEE. Thus, the environmentally sound and material-specific management of some device classes can still be optimised. For example, the collection and treatment methods of screens and monitors are not yet optimal. By participating in working groups and standards bodies, UBA experts help to continuously improve these methods in order to recover more raw materials for subsequent re-use and to safely retain pollutants.

A tonne of mobile phones (without batteries) contains about 300 grams of gold – a tonne of gold ore contains only about five grams

300 g gold
= 77.1 coins*

5 g gold
= 1.3 coins*

* Twenty-euro commemorative coin of the Federal Republic of Germany

ICT devices and their environmental impact

The EU Ecodesign Directive specifies requirements for environmentally friendly ICT devices. The EU wants refrigerators, engines, boilers, ventilation systems, windows and other products that use energy or affect energy consumption be designed more environmentally friendly. It adopted the Ecodesign Directive in 2005 for this purpose.

Exactly how environmentally and climate friendly individual products must be designed is specified by the EU in so-called implementing regulations. The EU has already adopted such regulations for 22 product groups and is preparing around another 20 more such regulations (as of March 2014). Three of these regulations relate specifically to ICT devices:

- The implementing regulation for desktop computers, notebooks and small servers has been in place since June 2013[11]. It defines energy efficiency standards for these devices in two stages, the first of which goes into effect on 1 July 2014[12]. The second one, with more stringent requirements, goes into effect in January 2016. These requirements could lead to annual electricity savings of 12.5 to 16.3 terawatt-hours (TWh) across the EU in 2020 – which corresponds to the annual amount of electricity provided by three to four medium-sized power plants. In addition, the EU requires that from July 2014 on, manufacturers specify the maximum number of battery charge cycles for notebooks. If the battery cannot be replaced by the user, this must be indicated on the packaging, technical documentation and on the Internet.
- Ecodesign requirements for displays will be drafted soon. They will be included in the current revision of the implementation regulation for televisions.
- Ecodesign requirements for server systems are scheduled. The preliminary scientific study which analyses the regulatory options and their environmental benefits is currently being conducted.

For now, there will be no implementing regulation for printers and other devices with printing function. In 2011, the manufacturers of these devices committed to their own eco-friendly standards under the Ecodesign Directive. In 2012, 90 percent of these devices complied with the Energy Star Standard (Version 1.1.) adopted by the manufacturers. The devices are designed to support recycling and allow for the use of non-OEM cartridges.

More than

40

percent of the annual global production of antimony, beryllium, gallium, indium and tantalum are attributable to the ICT sector.

A 10% more energy-efficient notebook would have to be used for

87

years in order to make a new purchase worthwhile in terms of climate protection.

20 to 50

percent is the average server utilisation rate in data centres in Germany.


3 Li Lithium
4 Be Berylium
66 Dy Dysprosium
26 Fe Iron
27 Co Cobalt
79 Au Gold
29 Cu Copper
30 Zn Zinc
31 Ga Gallium
47 Ag Silver
33 As Arsenic
44 Ru Ruthenium
46 Pd Palladium
32 Ge Germanium
48 Cd Cadmium
49 In Indium
50 Sn Tin
51 Sb Antimony
59 Pr Praseodymium
60 Nd Neodymium
13 Al Aluminium
73 Ta Tantalum
78 Pt Platinum
28 Ni Nickel
80 Hg Mercury
82 Pb Lead

INFOBOX

A study has shown that extended use is crucial to reducing the environmental impact of a notebook

The Federal Environment Agency (UBA) commissioned an analysis of the global warming potential for all four product life cycle phases – i.e. production, distribution, use and disposal/recycling – for an average notebook[13]. The result showed that over 5 years, a notebook contributes about 380 kilograms of carbon dioxide equivalents to climate change (see page 7). More than half of these greenhouse gases are generated during the manufacture, and only 36.5 percent occur during the use phase.

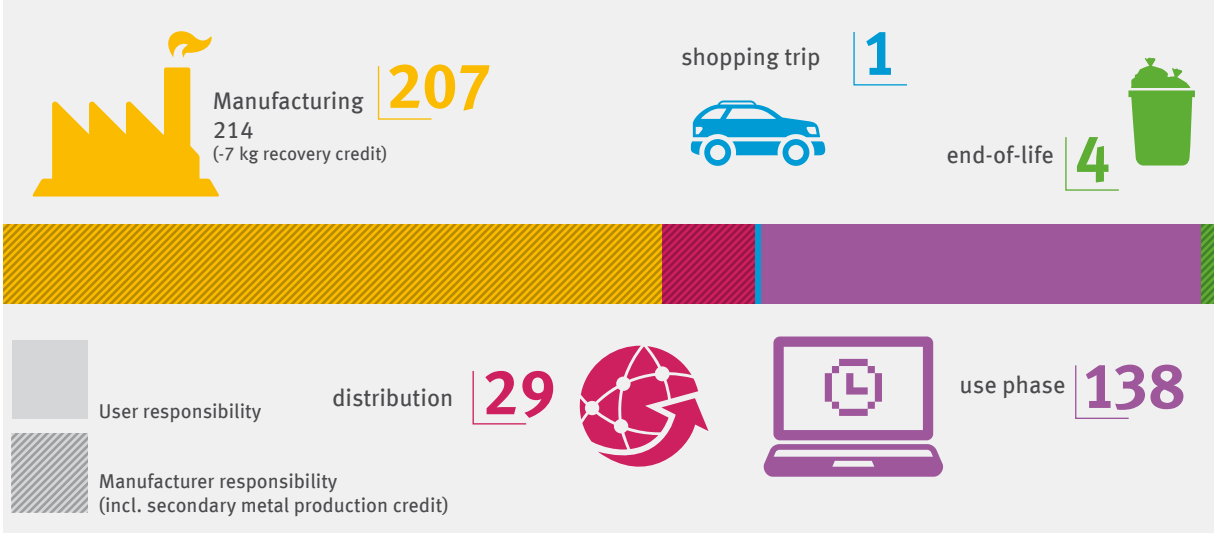
A new, energy-efficient notebook may save energy during use, but the greenhouse gas emissions from the production of new notebooks are so high that the new notebook would have to be used for several decades – an unrealistic period of time – before a new purchase were worthwhile from a climate protection perspective. So service life is crucial: in order for notebook computers and other ICT devices to contribute to climate protection and resource conservation, their design must take into account the requirements of a long service life. And of course: the manufacturing process needs to be more environmentally friendly.

The goal must therefore be to extend the service life of notebooks (see Figure 3) and to make their manufacturing process more environmentally friendly. The extraction of the metals is only a small part of the high global warming potential of production. Processing steps like semiconductor manufacturing in clean rooms and the provision of high-purity chemicals are much more harmful to the climate. Manufacturers must make these processes more environmentally friendly.

However, high quality recycling of notebooks has only a small impact on the energy balance. Raw material recovery and the protection of natural resources are the focus of environmental protection. The recycling rates for many precious and special metals from ICT equipment are well below ten percent, for some even below one percent. Higher recycling rates would reduce demand for raw materials and therefore relieve the burden on the environment. At the same time, considering the amount of units produced worldwide, energy savings would be significant.

Figure 02

Life-cycle assessment of a notebook, in terms of global warming potential
in kg CO_2e



Source: UBA

The longer the service life of a notebook, the better its environmental performance

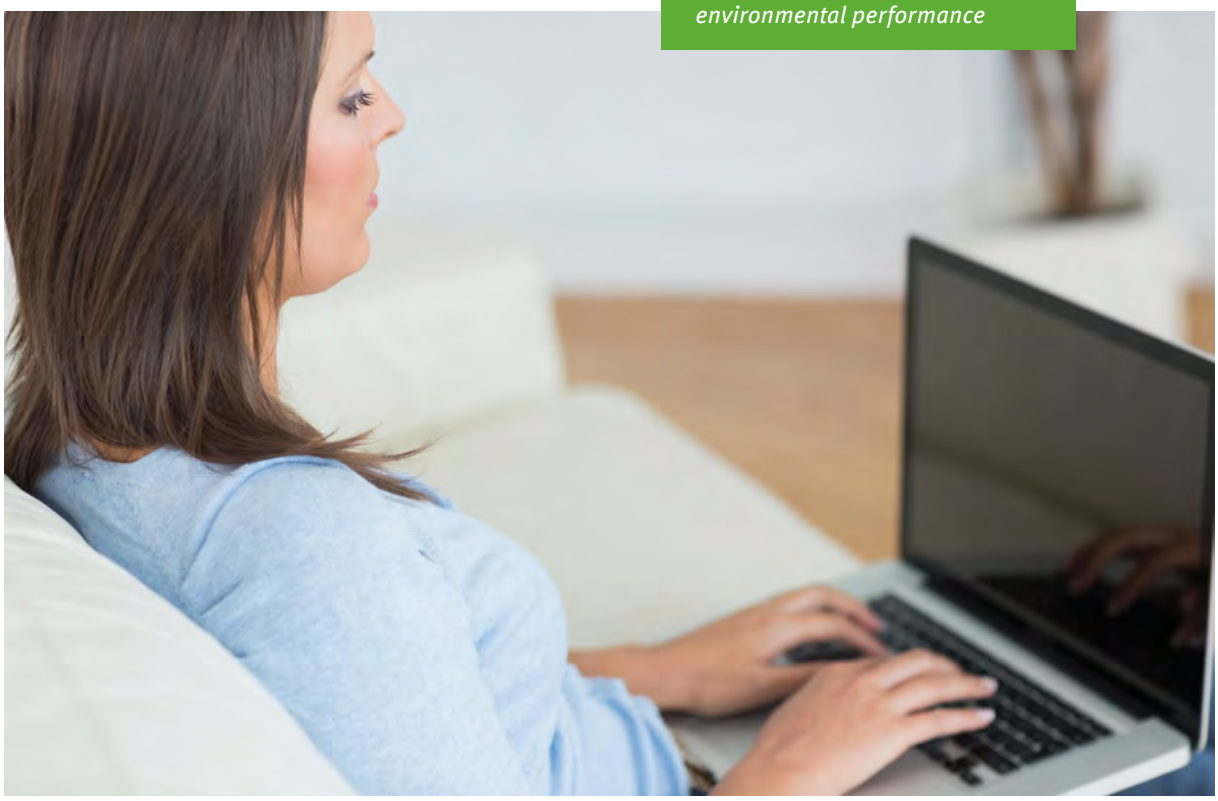
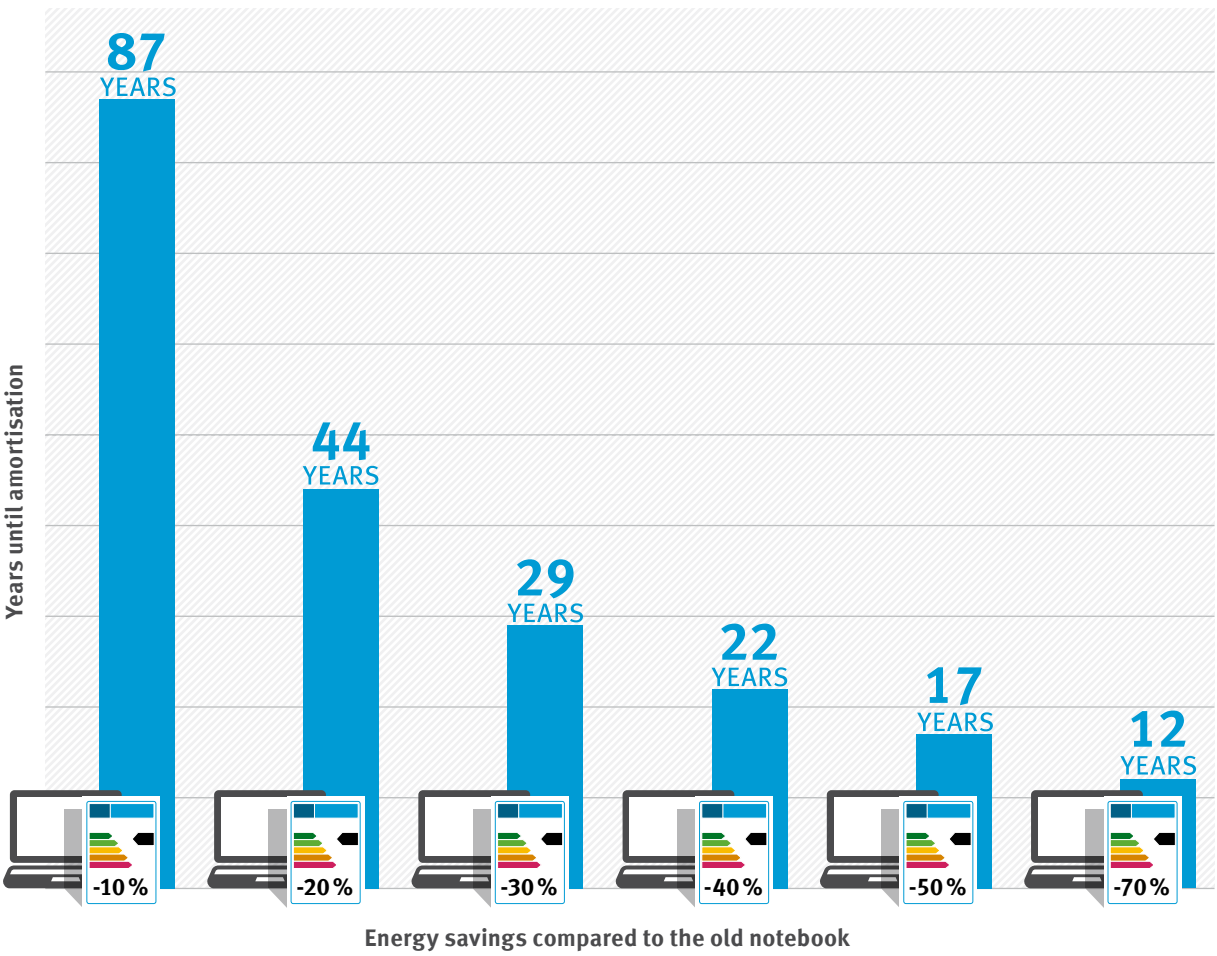


Figure 03

When is the production & use of a new, energy-efficient notebook worthwhile from a climate protection perspective?



Source: UBA

The Blue Angel stands for environmentally friendly ICT products

In Germany, the „Blue Angel“ environmental label increasingly helps consumers buy more environmentally friendly and energy-efficient ICT devices. In 2008, in the context of the „National Climate Initiative“, the Federal Ministry for the Environment (BMUB) initiated a project to promote eco labelling of climate relevant products. Since 2012, products from around 100 climate relevant product categories can be eco-labelled, among which are ICT devices from 16 product groups (see Infobox). Nine ICT product groups were newly added in the BMUB initiative and the specifications for seven existing ICT product groups were fundamentally revised[14].

It makes sense to buy devices with the ecolabel. An example: in an office workstation consisting of seven Blue Angel devices, the annual greenhouse gas emissions can be reduced by 31 percent compared to typical devices in this product group. At the same time, annual energy costs are reduced by about 69 euros if only Blue Angel products are utilised[15].

In addition to energy consumption, the ecolabel takes into account other environmental aspects: for the award of the label, strict criteria apply to pollutant concentrations, suitability for recycling and longevity. In addition, office equipment with print functions may emit only very little pollution, and mobile phones and digital cordless phones may expose people to only very low electromagnetic radiation.

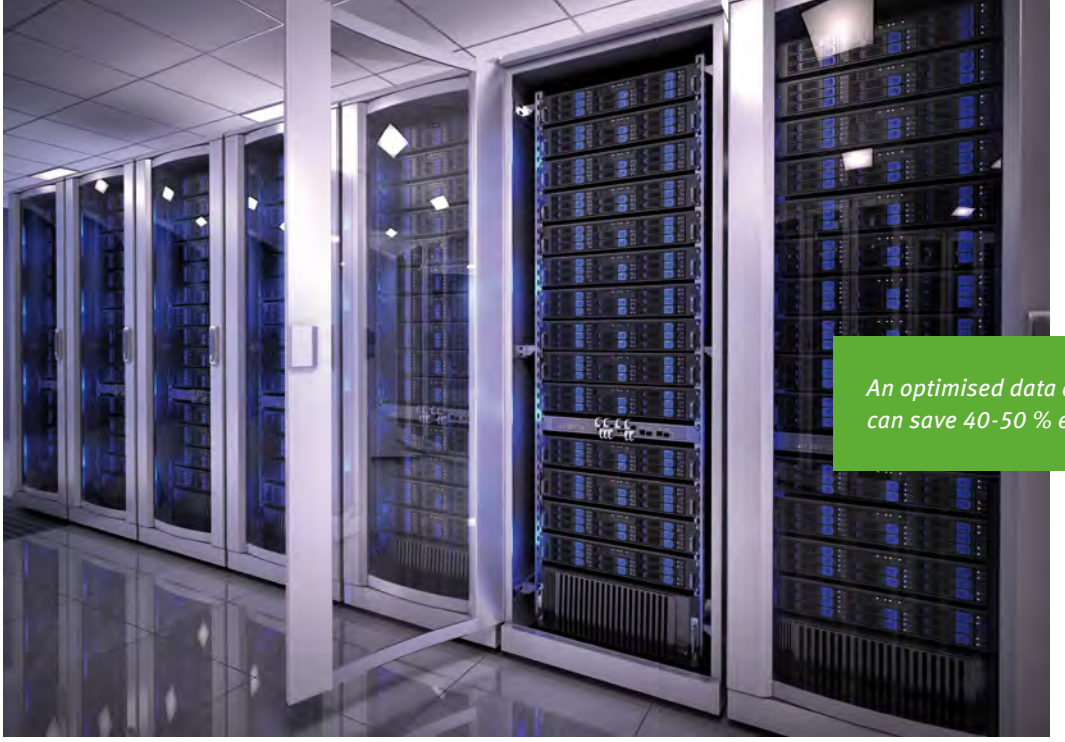
INFOBOX

ICT product groups with the Blue Angel

- office desktop computers (integrated desktop computers, thin clients, workstations)
- keyboards
- monitors
- portable computers (tablet computers, notebooks) *
- office equipment with printing function (printers, copiers, multifunction devices)
- digital projectors *
- digital cordless phones
- mobile phones *
- external hard drives *
- voice over IP phones
- routers *
- small network storage *
- telephone systems
- video conferencing systems *
- uninterruptible power supplies (UPS) *
- data centres

*) currently no suppliers for this product group

In an office workstation consisting of seven Blue Angel devices, annual greenhouse gas emissions can be reduced by 31 percent compared to typical devices of this product group.Annual energy costs are reduced by about 69 euros if only Blue Angel products are utilised.



An optimised data centre can save 40-50 % energy.

Procurement guidelines facilitate the use of sustainable ICT products

For public administration it is now easier to procure energy-efficient and more environmentally sound desktop computers and notebooks. Since 2009, UBA, the Procurement Office of the Federal Ministry of the Interior and the Federal Association for Information Technology, Telecommunications and New Media (BITKOM) have provided several environmental guidelines to authorities. They can be downloaded from the Internet at http://www.itk-beschaffung.de/. Additional guidance documents are to follow.

In 2010, UBA put the first two guidelines to test, procuring new computers and notebooks. The result: the new workstation equipment used 40 percent less energy compared to the old equipment.

In absolute terms, this means savings of approximately 120,000 kilowatt-hours of energy, almost 70 tonnes of climate-damaging carbon dioxide and about 12,000 euros of savings in energy costs each year. The inclusion of additional criteria such as the reduction of noise emissions also has a positive effect on the health of employees.

UBA hopes that other institutions will also use these guidelines and points out that the German ordinance governing public procurement expressly permits environmental aspects as part of the technical requirements and award criteria.

Data centres and their environmental impact

Data centres must always be available and guarantee a high level of data security. In order to reduce the consumption of energy and valuable raw materials, it makes sense that information technology (IT) should be used efficiently. This also reduces operating costs.

In recent years, rising energy costs led to the increasingly energy efficient operation of more and more data centres. However, average server utilisation in German data centres is currently still only 20 to 50 percent[16]. And around one-third of the businesses with their own data centre do not use its full capacity. Even today, high operating costs do not automatically trigger investment in energy efficient IT hardware, because energy costs are often booked under building expenses, while the cost of new IT hardware and software comes out of data centre budgets.

Data centre operators who want to save energy, currently focus mainly on buying new equipment, and less on improving energy and resource efficiency of existing technology. But, according to business associations and research institutions, the optimisation of existing equipment can save 40 to 50 percent energy costs. Data centre air conditioning systems often have a high potential for energy savings: they account for 25-50 % of the energy requirements. Data

Blue Angel data centres conserve resources, protect the environment and save money

centres are usually air conditioned with cold water, which is provided through compression refrigeration systems. This water then cools air which flows into the data centre through a raised floor from where server racks draw it in and then blow it out as warm air on the other side.

The energy requirements for air conditioning a data centre can be reduced by the following measures:

- by increasing the room temperature from an average of 20 to at least 26 degrees Celsius, which is uncritical for the hardware, but reduces the energy demand for air conditioning by one-fifth[17],
- by separating hot and cold airstreams with e.g. hot/cold aisle containment
- by using outside air for cooling when it is colder than 16 degrees Celsius. Outside air can then replace refrigeration.

But it is not just about direct energy consumption: the refrigerants used in air conditioning are usually hydrofluorocarbons. These gases, called HFCs for short, have a high global warming potential and can pass into the atmosphere through leaks in the refrigerant circuit. For example, the commonly used HFC refrigerant "R410A" has a global warming potential of 2,088 times that of carbon dioxide. However, such refrigerants can be replaced by natural refrigerants such as propane, ammonia or carbon dioxide with either very low global warming potential or without greenhouse effects. Heat-driven chillers (absorption and adsorption), which use water as the refrigerant are an appropriate alternative. And it works: the data centre of the UBA building in Dessau has been cooled using an absorption chiller since 2012. It is powered by solar and district heating.

In addition to data centre cooling, servers also provide potential for energy savings. One way would be to use energy-efficient machines. Another is to reduce the number of servers when they can be utilised more efficiently by virtualisation and consolidation of applications. A lower number of machines while maintaining computing power leads to cost savings; in addition, an important contribution is made to conserving natural resources.

A new "Blue Angel": "Energy-conscious data centres " (RAL-UZ 161) ecolabel

Since July 2012 energy and resource-conscious data centres can get the "Blue Angel". The goal of this new ecolabel for energy and resource-conscious data centres is to provide high computing power with as little server hardware as possible. It is one of the ecolabels which characterise not just a single product, but a service because it ultimately comes down to providing computing power at the lowest possible level of natural resource consumption.

Only data centres run by operators who employ a long-term strategy to increase the energy and resource efficiency of IT services[18] can be labelled with the Blue Angel. They have to meet a number of requirements:

- they must comply with efficiency criteria for hardware components such as server and communication technology, power supply and air conditioning.
- need for IT performance and energy consumption monitoring as well as an energy management system. Part of the management system is to report annually on the development of energy efficiency of the data centre.

The requirements for the label include more suggestions for saving energy. Thus a continuous improvement process is started, and a balance between user requirements, technical development and the demands of resource protection is made possible.

Trends and options for sustainable ICT

The boundaries between information devices and communications technology (ICT) have become increasingly blurred. You can surf the Internet with the TV, make phone calls on the computer (PC) and watch TV with your Smartphone. Whether this results in overall fewer devices and thus saves energy and resources, or whether users acquire newer devices such as tablets and smartphones additionally, and operate them in parallel with TV and PCs, is still questionable and is the subject of an ongoing UBA research project[19].

Based on current trends, it is however most likely that the demand for storage and bandwidth will steadily increase: significantly more data is transmitted for movies in high resolution HD quality or 3D than for simple video. Online computer games are also increasingly common in high resolution or 3D. And not to forget: photos and videos on sites like Flickr or YouTube or on social networks like Facebook are also increasingly high resolution. In addition, the trend towards mobile Internet continues to grow and more and more users are online all the time.

The thus growing demand for storage space and bandwidth increases the energy and material consumption in data centres and the network infrastructure. However, it also acts as an incentive to create higher performance network and computing resources. The additional services in turn inspire consumers to buy new and more powerful hardware.

It is often said that computing "in the cloud" will in summation reduce the energy and resource requirements of information and communication technologies. It is hoped that local hardware would then have to meet lower performance requirements, and that in the data centre only those servers would be used which are really needed. In addition, the idea is that computing power can thus be moved to places where large quantities of renewable energy are readily available, or where, because of the climatic conditions, little additional energy is required for cooling. But it is by no means certain that the "cloud" will actually lead to the much-vaunted savings. That is because the amount of additional data which needs to be transmitted on the Internet will entail additional power and hardware use. Currently there is a lack of data that would allow for a reliable quantitative assessment of energy and resource needs. The available studies have very different scoping and accordingly produce very different results. It should also be noted that in the current debate, the term "cloud computing" is used to describe very different scenarios.

More and more users are constantly mobile and online

Energy-saving objectives of the Federal Government in the IT sector

Modern administration is unthinkable without information technology (IT). This applies to the individual workplaces as well as to data centres. Data centres are the backbone of the ICT of an institution. Electronic data processing and the growth of electronic services are increasing the number of servers as well as the storage and network components in data centres which, in turn, is leading to steadily increasing energy demand. Integrated measures are needed to reduce this energy consumption.

Green IT initiative of the Federal Government

The Council of the IT Representatives of the Federal Government adopted the Federal Government's Green IT Initiative in November 2008[20]. The Federal Administration was commissioned to make the use of information technology energy-efficient and sustainable. Thus all authorities of the Federal Administration are supposed to reduce the damage associated with the energy consumption of IT operations by at least 40 percent by 2013 – as compared to the highest level of consumption before 2009. In addition, all federal ministries and authorities must include the energy consumption of all IT equipment during their service life in the procurement criteria and consider it in all major new investments.

The IT Council established the "Green IT Project Group" in 2009 in order to support the ministries and authorities. It has published manuals and handouts on the Green-IT-Initiative[21] website. They help to measure energy consumption, obtain energy-efficient information technology and reduce energy consumption during operation. UBA has been a permanent member of the project group since 2012, has advised its members on environmentally friendly procurement and has presented recent research findings.

Sustainable use of ICT in the Federal Administration

The determination of energy consumption is often the crucial first step to introducing green IT measures. Only measurements can create awareness of where electricity is consumed and where potential savings exist and should be used. The IT Council therefore has introduced an annual reporting obligation for the collection of energy consumption data in the federal administration. It was found that the annual total power consumption by information technology in the federal administration was approximately 650 gigawatt-hours (GWh) at the beginning of the Green IT Initiative.

The efforts have been worthwhile: in 2012 the IT sector of the entire federal administration only consumed about 445 GWh. This is 31.4 percent less than in 2009 – although the performance of many data centres increased during this period. Electricity consumption decreased mainly due to two measures in 2012: consolidation, i.e. merging servers and data centres as well as energy-efficient air conditioning of data centres (see Figure 5).

In 2013, data centre operators achieved further energy savings by increasingly using energy management systems and improving energy supply and air conditioning in data centres. More efficient servers and an increased level of virtualisation also contributed to energy saving.

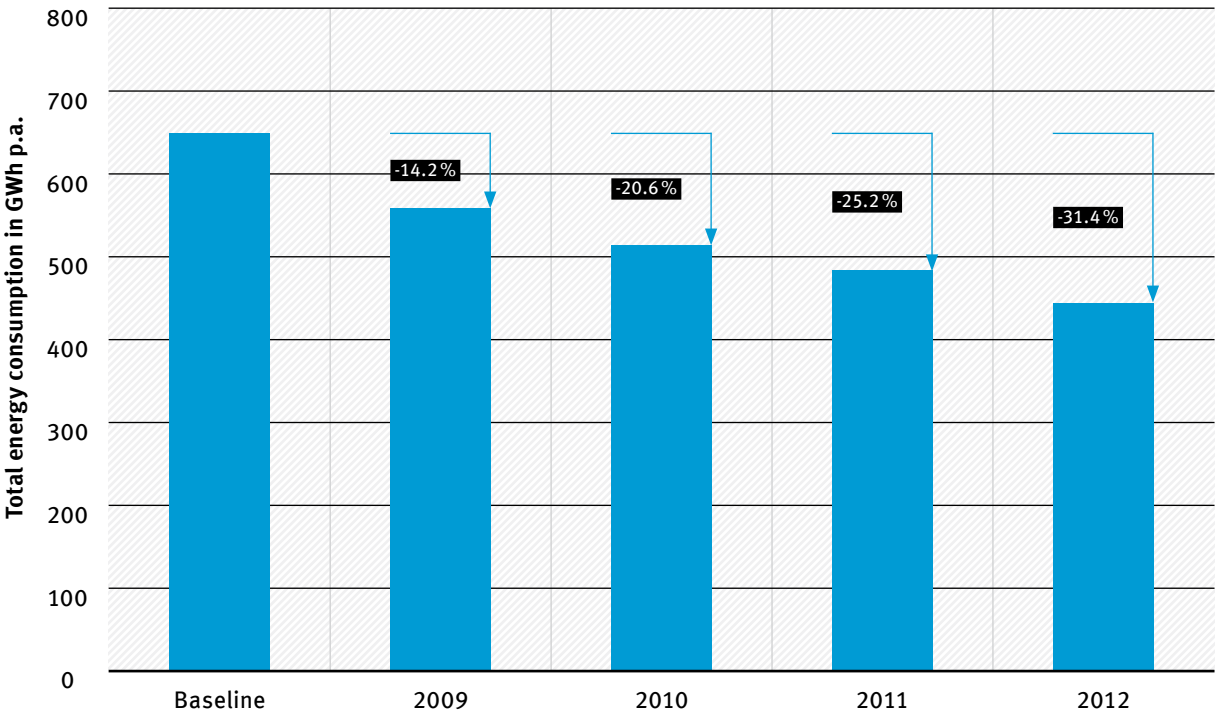
UBA recommends that all data centre operators make efforts to save energy. These are no small amounts at stake here: servers and other data centre infrastructures in Germany used about 1.4 percent of the total electricity consumption in 2007. If consumption were cut by 30%, not only could expenses be reduced, but a medium-sized coal-fired power station could also be shut down.

UBA, together with other authorities and the Federal Association for Information Technology, Telecommunication and New Media (BITKOM), provides information about large energy saving potentials in information technology within and outside the federal administration. Popular venues and tools are the CeBIT computer fair, publications and the "Green-IT-Tage" events.

Measurements and reporting are continuously needed to ensure that energy saving remains the focus of interest in the federal administration's IT sector. With the help of software-based measurements, energy consumption in the workplace can be continuously and more accurately measured than by using qualified extrapolations. Furthermore, merging servers and data centres and using greater standardisation of information technology within the government can open up large synergies and efficiency potential. It is an important objective to implement the Blue Angel ecolabel requirements for "energy-conscious data centre operation" in the government's data centres.

Figure 04

Federal Government IT energy saving compared to the baseline

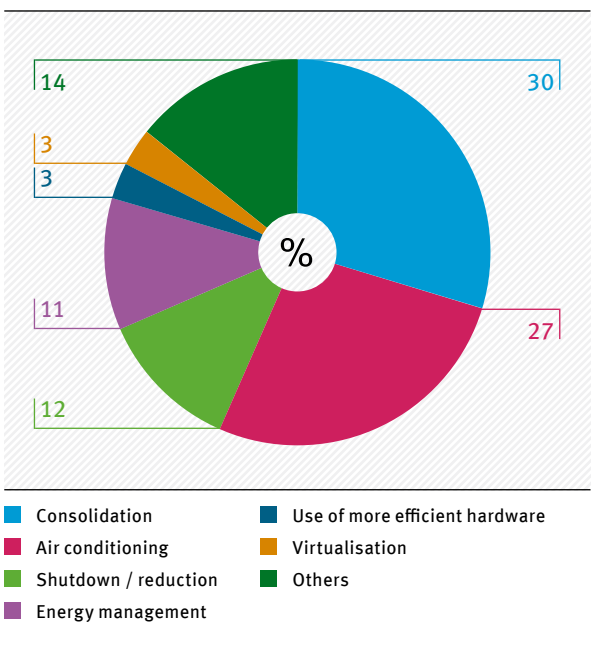


The information is based on data measured and partly extrapolated. About 40 percent of the energy consumption caused by the government's data centres has been continuously recorded. Energy consumption is distributed approximately equally between the federal administration's data centres (53 percent) and individual workplaces, i.e. decentralised information technology (47 percent).

Source: own data[22]

Figure 05

Breakdown of kWh saved in 2012 per category of measures



Source: own data

Environmentally friendly procurement in the Federal Government's IT sector

Through the Green IT initiative started in 2009, the federal government also hopes to achieve that, in addition to reducing energy consumption over the planned service life, further ecological criteria will be considered in procurement. The aim is to only employ IT devices that can be used for longer periods and can be reused or recycled at the end of life. IT equipment must be reliable, durable and easy to repair.

The federal administration, i.e. the federal ministries and federal authorities, need to undertake more action. A better integration of ecological criteria into the government's framework agreements would pave the way to sustainable procurement. The procurement guidelines developed by the Procurement Office of the Federal Ministry of the Interior, the Federal Association for Information Technology, Telecommunication and New Media (BITKOM) and UBA provide a good basis for this (see page 71).

Due to the success of the initiative and the fields of action identified, the Council of the IT Representatives decided in December 2013 to continue the Green IT initiative up to the end of 2017. The initiative has three main goals: first, the consolidation of the target value of the energy consumption caused by the IT operation (390 GWh/year) from 2013 to 2017. In particular, the aim is to avoid an increase in energy consumption in spite of the expected performance increase in the same period of time. Second, the implementation of green procurement of IT products by introducing a distinctive labelling of standardised environmentally friendly products in the framework contracts in order to be able to choose "green products" as an alternative in all product areas. Third, the consistent application of the "Blue Angel" criteria for energy-efficient data centre operation in the assessment of energy and resource efficiency of data centres.

As a longstanding member of the project team, UBA will continue to advise the members of the project group on environmentally friendly procurement and the Blue Angel and present the latest research findings.

The Federal Government's Green IT initiative

Sustainable use of ICT in the Federal Environment Agency

UBA's data centres

As most organisations, UBA also depends more than ever on ICT in its daily business. The main task of the data centre is to provide this service to the employees permanently, reliably and in high quality. Phone calls and emails should work trouble-free at all times. The personal data storage must always keep the data available even if a data centre hard drive is defective. Large computing power and storage are also needed for software and databases required to execute the UBA's daily tasks. All this presupposes properly managed multiple ICT environments.

Power consumption and server utilisation are measured in the data centre. This monitoring allows to identify energy-intensive equipment and inactive services. If the applications permit, seldom-used servers can be virtualised. The higher the degree of virtualisation – i.e. the more virtual servers are running on a real server – the more efficiently the data centre can use hardware resources and energy. As of August 2013, UBA had 71 physical and 155 virtual servers. This corresponds to a degree of virtualisation of 2.18. In 2014, UBA reorganised its data centre to meet the "Blue Angel" requirements for energy-conscious data centres. The degree of virtualisation of 2.0 required by the Ecolabel has been exceeded. In

addition, energy efficiency of air conditioning will be further improved by installing cold and hot aisles. The future data centre at the Bismarckplatz site in Berlin has been planned from the beginning to meet the Blue Angel criteria for "energy and resource-conscious data centre operation".

Energy consumption of UBA desktop computers

In 2012, UBA measured the energy consumption of a representative sample of 80 desktop computers. This identified what actions can reduce computer energy consumption. At the same time, empirical results of patterns of use were compared to the current methods for determining the energy consumption of the computers.

The results of the energy measurements show that the real energy consumption of UBA's computers is significantly lower than would be expected from the manufacturer's data sheet. Figure 6 shows a comparison of measured energy consumption data with corresponding calculations. The first column shows the real outcome of the UBA measurement. The other columns represent the theoretical energy consumption resulting from the different calculation methods, based on the manufacturer's data sheet.

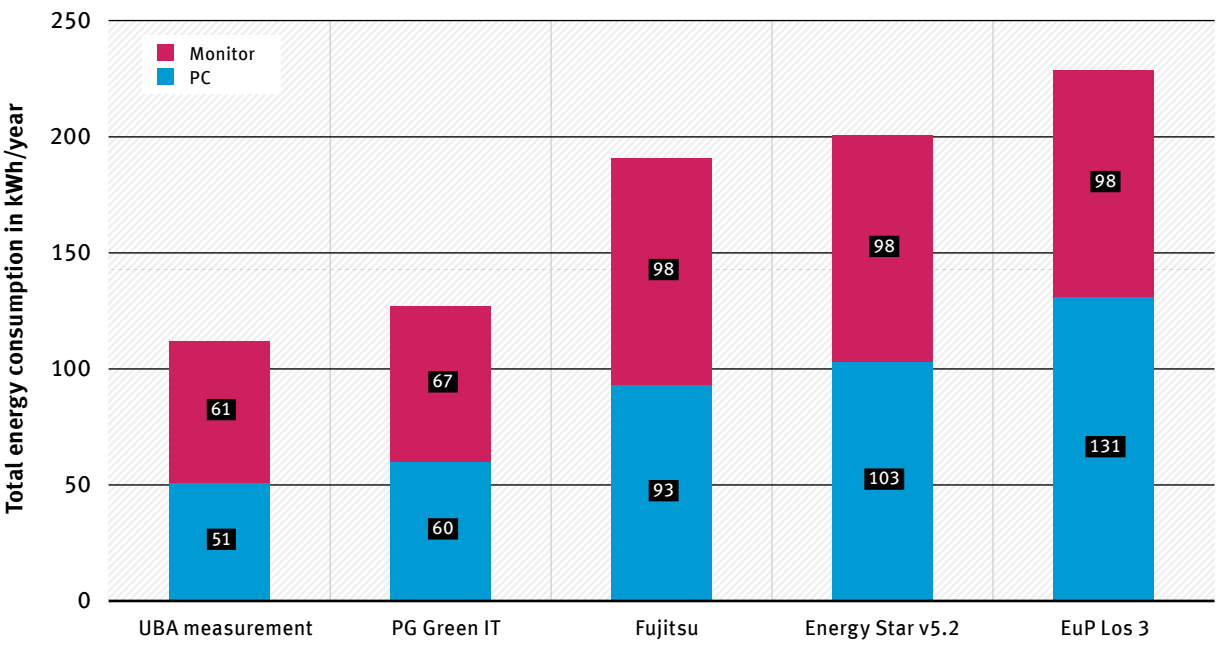
The comparison shows that the energy consumption calculated by the Energy Star computer model is higher by up to 90 percent than the results of the UBA measurement. The second column shows the theoretical consumption, obtained by the method applied by the federal administration for the annual reporting of energy figures. Only this calculation method of the energy figures provided results roughly in agreement with the measured values.

The results from the UBA measurement are used in an ongoing UBA research project which investigates ecological and economic aspects of computer systems, as typically used in public authorities and taking into account patterns of use.

In addition, the findings will be incorporated in the international discussion with the aim to develop a more appropriate calculation method for the use of computer systems which provides a more realistic basis for determining their environmental impact in the use phase.

Figure 06

Comparison of calculation methods used for annual energy consumption



Source: own data[23]

INFOBOX

The eco mode of the monitor helps to save energy

The Federal Environment Agency (UBA)'s monitors consume more energy than the computers. Although the monitors used in UBA have an automatic power saving setting („eco mode") which provides highly efficient brightness setting, the evaluation of the measurement showed that this option was not enabled on many monitors, i.e. thus they consumed energy unnecessarily.

A monitor in UBA consumes about 30 watts when eco mode is activated and about 66 watts, i.e. more than twice as much, in deactivated eco mode. Targeted information now notifies users and encourages them to adjust the monitor to save energy. In addition, UBA's IT services enable the eco mode when attending to the computer. The report on energy measurements on UBA's computers and monitors (in German) is available on request from the Green IT Advisory Office of UBA.

The energy saving potential of monitors is higher than assumed

Energy consumption of UBA's desktop computers is mainly caused by the base load. It means that the computer is in operating condition between phases of active use. To ensure energy-efficient operation, the idle time until the monitor and the computer enter energy-save mode must be reduced.

Energy measurements showed that the differences between the three modes of operation ‚standby', ‚sleep' and ‚off' mode are minimal for the equipment used by UBA: power consumption is about 1.8 watts in ‚standby' and ‚sleep' mode, and 1.5 watts in ‚off' mode. However, these modes differ considerably in their usability: the waking of a computer from ‚sleep' and' off' mode may take three to five minutes, while ‚standby' takes less than five seconds. It therefore makes sense for UBA to increasingly use ‚standby' to increase the energy efficiency of computers. An internal memorandum from UBA's Environment Commissioner informed employees about the use of standby mode and ways to save electricity.

Conclusion

The demand for sustainable information and communication technology poses major challenges to businesses, consumers and environmental policy. The environment and the climate can be relieved by more efficient equipment and structures, but mandatory instruments and voluntary initiatives must be coordinated to achieve this.

UBA will continue to face this challenge. Further research will identify ways in which ICT material cycles can be closed and how ICT equipment and software can be designed more environmentally and climate friendly – and how everyone can contribute to resource-friendly ICT. In addition to scientific work, UBA as a pioneer will advocate sustainable ICT among the German federal authorities.

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Contributing sections:

Advisory Office on Sustainable Information and Communication Technology - Green IT
III 1.1
III 1.3
III 1.4
III 1.6
III 2.2
Z 7

Contributing sections/details:

Introduction: III 1.1 - Maike Janßen
Raw material use in ICT is high: III 2.2 Jan Kosmol
INFOBOX Metal is not always metal in e-waste recycling: III 1.6 - Dmitri Hörig
ICT devices and their environmental impact: III 1.3 – Ines Oehme
INFOBOX A study has shown that extended use is crucial to reducing the environmental impact of a notebook and Figures 02 and 03: Green IT Advisory Office – Marina Köhn and Maike Janßen – III 1.1
The Blue Angel stands for environmentally friendly ICT products: III 1.3 Jörn-Uwe Thurner
Procurement guidelines facilitate the use of sustainable ICT products: Green IT Advisory Office – Marina Köhn
Data centres and their environmental impact: Green IT Advisory Office – Marina Köhn and III 1.4 - Daniel de Graaf
A new „Blue Angel": „Energy-conscious data centres „: Green IT Advisory Office – Marina Köhn
Trends and options for sustainable ICT: III 1.1 – Maike Janßen
Energy-saving objectives of the Federal Government in the IT sector: Green IT Advisory Office – Hans-Jürgen Baumeister
UBA's data centres: Z 7 – John Erdelt
Energy consumption of UBA desktop computers and INFOBOX, The eco mode of the monitor helps to save energy: Green IT Advisory Office – Marina Köhn

FOOTNOTES

1 Reller 2011: Criticality of metal resources for functional materials used in electronics and microelectronics. Phys. Status Solidi RRL, 1–3 (2011) / DOI 10.1002/pssr.201105126.

2 Sander et al. 2012: Abfallwirtschaftliche Produktverantwortung unter Ressourcenschutzaspekten. Meilensteinbericht. Im Auftrag des Umweltbundeamtes (FKZ 3711 95 318) (Advancement of product responsibility in waste management with regard to the protection of natural raw materials using the example of electrical and electronic equipment. Milestone report. Commissioned by the Federal Environment Agency (Project No. 3711 95 318)). European Commission 2010: Annex V to the Report of the Ad-hoc Working Group on defining critical raw materials.

3 Hagelüken und Meskers 2010: Complex Life Cycles of Precious and Special Metals, in: Graedel und van der Voet (eds.) Linkages of sustainability. Strüngmann Forum Report 4. Cambridge, MA: The MIT Press.

4 amended, M. F. Ashby, Materials Selection in Mechanical Design (Elsevier, 1992).

5 Tilton 2003: On borrowed time? Assessing the threat of mineral depletion. Resources for the Future, Washington DC.

6 Westerkamp et al. 2010: Sustainable Prevention of Resource Conflicts - Case Study and Scenarios on Copper and Cobalt in the Democratic Republic of Congo (ROHKON Report 3.2) Study commissioned by the Federal Environment Agency (Project No. 3708 19 102). Download: http://www.umweltbundesamt.de/publikationen/sustainable-prevention-of-resource-conflicts Federal Environment Agency (ed.): Rare metals - Measures and concepts for the solution of the problem of conflict-aggravating raw material extraction – the example of coltan. UBA-Texte 23/2007. Download: http://www.umweltbundesamt.de/publikationen/rare-metals

7 Erörterung ökologischer Grenzen der Primärrohstoffgewinnung und Entwicklung einer Methode zur Bewertung der ökologischen Rohstoffverfügbarkeit zur Weiterentwicklung des Kritikalitätskonzeptes („Öko-Ress", FKZ 3713 93 302). (Environmental Limits, Environmental Availability and Environmental Criticality of Primary Raw Materials („Öko-Ress"), Project No. 3713 93 302).) „Ansätze zur Reduzierung von Umweltbelastung und negativen sozialen Auswirkungen bei der Gewinnung von Metallrohstoffen" (FKZ 3712 94 315) („Approaches to reducing environmental and negative social impacts in the production of raw metals" (Project No. 3712 94 315)), http://www.adelphi.de/de/projekte/projektdatenbank/dok/43524.php?pid=624

8 Sander et al. 2012, European Commission 2010 (see Footnote 2), UBA 2007, Westerkamp et al. 2010 (see Footnote 6)

9 Hagelüken, Christian and Christopher W Corti: Recycling of gold from electronics: Cost-effective use through 'Design for Recycling'. Gold Bulletin, Vol. 43 No 3, 2010. To be downloaded from http://link.springer.com/article/10.1007%2FBF03214988#page-1

10 vgl. Forschungsvorhaben des Umweltbundesamtes „Weiterentwicklung der abfallwirtschaftlichen Produktverantwortung unter Ressourcenschutzaspekten am Beispiel von Elektro- und Elektronikgeräten (RePro)" (Project No. 3711 95 318). Koordination Ökopol GmbH. Dokumente und weitere Informationen downloadbar unter (see UBA research project „Development of waste management product stewardship resource conservation issues on the example of electrical and electronic equipment (RePro)" (Project No. 3711 95 318). Coordination Ökopol GmbH. Documents and further information can be downloaded in German from: http://www.oekopol.de/themen/ressourcen-und-kreislaufwirtschaft/repro/publikationen-repro /

11 COMMISSION REGULATION (EU) No 617/2013 of 26 June 2013 implementing Directive 2009/125/EC of the European Parliament and of the Council with regard to ecodesign requirements for computers and computer servers

12 The requirements are more ambitious than the level of voluntary Energy Star 5.0 energy efficiency label, where additional surcharges for certain functionality such as graphics cards are used in the regulation.

13 Prakash, Siddharth; Liu, Ran; Schischke, Karsten; Stobbe, Dr. Lutz: Timely replacement of a notebook under consideration of environmental aspects, , published by the Federal Environment Agency, 2012 (Project No. 363 01 322, UBA-FB 001666, Texte 44/2102); to be downloaded from http://www.umweltbundesamt.de/publikationen/timely-replacement-of-a-notebook-under

14 More information is available on the Blue Angel website: https://www.blauer-engel.de/en/get/producttypes/all

15 Gröger et al. 2013: TOP 100-Ecolabel for Climate-Relevant products, Final Report: http://www.oeko.de/oekodoc/1739/2013-433-de.pdf (Report in German; information in English: http://www.oeko.de/en/research-consultancy/issues/sustainable-consumption/climate-angel-label/)

16 Oracle: „Next Generation Data Center Index", 2011

17 Bundesverwaltungsamt, Bundesstelle für Kommunikationstechnik: Gestaltung von energieeffizienten Serverräumen (Federal Office of Administration, Federal Bureau of communication technology: Design of energy-efficient server rooms, February 2011); http://www.bva.bund.de/SharedDocs/Downloads/DE/BVA/GreenIT/gestaltung_serverr%C3%A4ume.html (in German)

18 Any data centre operator can apply for RAL-UZ 161. Tender documents and other important information can be obtained from the following website: https://www.blauer-engel.de/en/products/office/energy-conscious-data-centers/data-centers

19 Ermittlung und Erschließung des Energie- und Ressourceneffizienzpotenzials von Geräten der Unterhaltungselektronik(Estimating the potential of consumer electronics devices in terms of energy and resource efficiency), UFOPLAN 2011, FKZ 3711 95 313. (abstract available in english)

20 Beschluss Nr. 8/2008 des Rates der IT-Beauftragten (Decision No. 8/2008 of the Council of IT Representatives.)

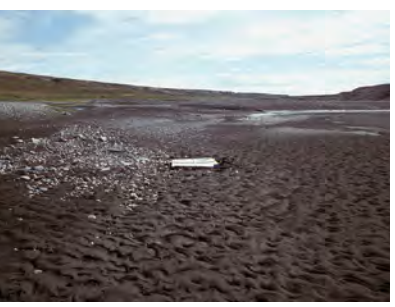
21 http://www.cio.bund.de/DE/Innovative-Vorhaben/Green-IT/green_it_node.html

22 26th Meeting of the Green-IT Working Group, Rudolf Herlitze (BMUB), April 2013

23 Datenerhebung im Vorhaben „Energiemessung von Arbeitsplatzcomputern (APCs) und Erarbeitung von Maßnahmen für deren energieeffizientere Nutzung", 2013, deZem GmbH; Auswertung im Rahmen des Forschungsvorhabens „Ökologische und ökonomische Aspekte beim Vergleich von Arbeitsplatzcomputern für den Einsatz in Behörden unter Einbeziehung des Nutzerverhaltens"(TU Berlin); Forschungskennzahl (UFOPLAN) 3712 95 301 (Data acquisition in the Project „Energy measurement of desktop computers (APCs) and development of measures for their energy-efficient use," 2013 deZem GmbH; Evaluation as part of the research project „Ecological and economic aspects of the comparison between desktop computers for the use in government agencies including user behaviour „(TU Berlin); Project No. (UFOPLAN) 3712 95 301.)

Forensics of vanishing landscapes

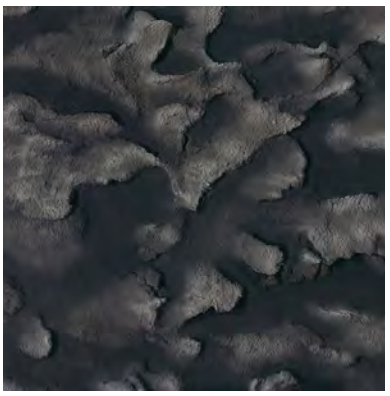
The Earth Print Archive. An art project by Betty Beier.



First the soil print is made on site, then the time-consuming creation of the relief in the studio.

Climate change, urbanisation processes in developing countries and elsewhere, demand for raw materials and energy and the consumption of natural resources have a significant impact on the landscape. Betty Beier, visual artist and sculptor, creates signs of remembrance for disappearing landscapes. For her study "The EARTH PRINT ARCHIVE" she has monitored landscape-changing processes since the mid-1990s – in Germany, Iceland, China, and most recently, in Alaska.

Soil is at the centre of her search for clues in times of change. Betty Beier's earth prints are prints of soil surfaces on site, which she then permanently fixes in acrylic or resin in her studio. Her image sculptures bear exotic names such as Kivalina, Kárahnjúkar or Xiaolangdi. They document projects such as a dam on the Yellow River in China, a dam in the middle of the largest nature reserve in Iceland, or an island in north-western Alaska which is increasingly threatened by water as a result of global warming. The Federal Environment Agency (UBA) showed a selection of Betty Beier's works within its exhibition series "Art and Environment" in Dessau from 14 November to 18 December 2013.



“Kárahnjúkar 6**”**. Loess, acrylic on fiberglass. Site of the print/date: Kárahnjúkar/Island, 09.08.2006.

“Kárahnjúkar 1**”**. This conserved soil with plants in it comes from a region of Iceland which is now flooded.

On Kivalina, Beier documented the futile struggle of the Inuit against rising sea levels.


Umwelt-
bundesamt

Forty years ago, Germany was given a central national environmental authority in the form of the Federal Environment Agency. ”UBA” was established prior to the Federal Ministry for the Environment created in 1986 as a result of the implementation of comprehensive environmental legislation by the social-liberal coalition under Chancellor Willy Brandt.

The anniversary is an opportunity for critical retrospection into its own history, an occasion to objectively examine past successes and future challenges alike. Environmental protection must not be taken for granted, for it remains a task for society as a whole.

An individual publication about UBA‘s history was printed to commemorate its 40th anniversary. Likewise, ”What Matters” will also provide the reader with an overview of how the institution was established in 1974 as well as its achievements in the domains of ”soil” and ”air”.

1974–2014
40 Years Federal Environment Agency

page 86–Seite 119

In 1969 man stepped on the moon for the first time in history – a media event that became ubiquitous through live footage and images. The view from space of the home planet was described by environmental historian Joachim Radkau as a "Copernican revolution backwards". People became aware of the vulnerability and uniqueness of the blue planet in the frighteningly endless and lifeless universe. This shift increased consciousness about the consumption of our environment.

“A hybrid of power and impotence”?[1]

The foundation of the Federal Environment Agency (UBA) in Berlin and the introduction of modern environmental policy in the Brandt-Genscher era.

By Thomas Forstner

Environmental Protection *(Umweltschutz)* – a concept that crafts its own career

Hans-Dietrich Genscher (born in 1927, 1969-1974 Federal Minister of the Interior) found the issue to be too complicated: “Water and air quality control and noise reduction” – it sounded cumbersome. The Minister wanted a more concise name for the former Division III of the Ministry of Health which, as a result of a reshuffle, subsequently became part of the Ministry of the Interior. When Joachim Berg, the head of the relocated department made his first visit to Genscher on 7 November 1969, the Minister asked him to suggest a name. Berg[2] explained to Genscher that the entire complex of natural resources had recently been named “environment” (German: *Umwelt)* and proposed to simply translate the already widespread American term “environmental protection” into German. Genscher agreed and the department was renamed “Environmental Protection” *(Umweltschutz)*, thus giving birth to a new political notion which at the time was taking its first steps on a swiftly ascending career path.[3]

Environmental protection? – Environmental protection!

In the autumn of 1970 the majority of Germans still could not associate the concept of environmental protection with anything specific. Polls showed that 59 % of Germans admitted to having never heard of or read this term. It was only a year later, in November 1971, that the situation changed completely. Surveys revealed that only 8 % were unfamiliar with the term – the issue had obviously enjoyed a tremendous resonance among the public in an astonishingly short time.[4]

Historical research now describes the phenomenon of 1970 as the “ecological revolution”.[5] The founding president of the Federal Environment Agency, attorney Heinrich von Lersner (born in 1930), dared an even greater comparison and affiliated the ecological revolution to the French Revolution of 1789: the three principles of liberty, equality and fraternity had been fulfilled: “Following the liberal reforms of the late 18th and 19th centuries, as well as the social transitions of the 19th and 20th centuries, the rights of the environment can finally be claimed [...], the demand for liberté and égalité can be concluded with the call for fraternité with the surrounding natural world”[6], wrote Lersner retrospectively in 1991.

1970

59 %

of German citizens confessed to having never heard or read of the term “environmental protection”.

1971

8 %

One year after the first survey, only 8% of the German population was unfamiliar with the concept of environmental protection.

In her book "Silent Spring" which first appeared in 1962, American biologist Rachel Carson wrote about the consequences of using DDT and its effects on the environment. The book is considered to be one of the triggers of the global environmental movement.

Following the example of the USA?

What was unexpected about this revolution or "the third reform" (Lersner), was that it simultaneously, and yet independently, took place in many different countries. Its pioneers were the United States and Japan, and within Europe, Sweden and West Germany. Environmental protection was a topic that gained popularity in rich industrialised countries in particular. In her book "Silent Spring", first published in the USA in 1962, marine biologist Rachel Carson wrote about the consequences of uncontrolled pesticide use and succeeded in raising ecological awareness and consciousness.[7] The condemnation of the thoughtless use of environmental toxins was more pronounced in the United States than in any other industrialised country. In this respect, the Vietnam War played an important role: aversions to the war among the American population had been pronounced from the very beginning. Reports in the American media about the military use of the herbicide Orange Agent in the large-scale defoliation of forests in Vietnam only increased antipathy and raised critical awareness about the exploitation of natural resources.

Nixon and the EPA

Nevertheless, the mobilisation of civil society in support of environmental issues, as was characteristic of the early 1980s, remained stagnant for the time being. The anti-war movement as well as the events of 1968 achieved very little in terms of direct environmental progress. In the United States it was the conservative government of President Richard Nixon (1913-1994, in office 1969-1974) that first broached environmental issues. This in and of itself reveals how far the beginnings of environmental policy diverged from the usual left-right scheme of politics. What's more, environmental protection was a unifying, positive force. "Conservatives were in favour. Liberals were in favour. Democrats, republicans and independents were in favour" – as summarised by the encyclopaedia of world environment history.[8] This consensus was precisely what Nixon needed: the country was divided, the Vietnam War had exhausted the nation, youth was in rebellion. Environmental protection was the ideal large-scale project that could bridge domestic fronts. It was a positive enterprise that had the power to unite the nation. The USA remained the international leader for environmental protection up until the inauguration of Ronald Reagan (1911-2004, in office 1981-1989) in 1981. The 1969 National Environmental Policy Act (NEPA) was the first milestone in the successive establishment of the United States *Environmen*tal Protection Agency (EPA) in 1970.

Environmental agencies around the world

However, the EPA was hardly a direct model for the Federal Environment Agency which was founded three years later. The EPA not only set standards, it was also responsible for their implementation, whereas the UBA was at first completely dedicated to research and the education of the population. Nevertheless, the EPA was not the first environmental authority at a national level. Sweden had already set up an environmental agency by 1967 and initiated the first UN Conference for environmental issues in 1968, which ultimately took place four years later in Stockholm. Japan followed in 1971 together with France, which formed its own Ministère de l'Environnement. Environmental protection received cabinet rank.[9] The GDR followed in 1972 and was the first country in the eastern bloc to have a Ministry for Environmental Protection and Water Management.

NATO and "the third dimension"

In the first year of his presidency Nixon proposed the expansion of NATO assignments to incorporate a "third dimension" of environmental protection as well as the establishment of a committee dedicated to the improvement of environmental conditions.[10] The newly elected Chancellor Willy Brandt (1913-1992, in office 1969-1974) promised in his inaugural speech at the end of October 1969 that Germany would actively participate in the

work of the new NATO committee. However, the Chancellor did not seem to make much fuss about it and rather succinctly announced: “For adequate protection against air, water and noise pollution corresponding legislation will be implemented”.[11]

Genscher and Brandt

Germany’s situation was similar to that in the United States, although the public environmental awareness was less pronounced in the German population. It was Hans-Dietrich Genscher in particular who, as a result of the social-liberal coalition of 1969, sought out a positive issue that would help to define himself and the FDP politically. The traditional responsibilities of a Minister of the Interior (administration, homeland security, police) did not carry much weight with what were by then very popular student movements – in the aftermath of 1968, his status as Minister of the Interior would only get him into trouble. The change in Division III of the Ministry for Health in Genscher’s department was no by-product of the new government formation – it was something Genscher had fought for. The topic was out in the open and Genscher had a flair for promising issues. It was time to build on such ideas, and he did – nowhere in Europe had environmental policy been so quickly and consistently implemented as in the first years of the social-liberal coalition.

1973 – detergent residues in a river

Children playing next to the Welheim coke factory in the Ruhr District

“Blue sky over the Ruhr District”?

However, politics was not the driving force, a fact which became obvious in one of Brandt’s policy statements. Environmental protection had not played a major role in the 1969 federal election campaign. Brandt’s call for a “blue sky above the Ruhr” remained nothing more than a political slogan and was even less so a sign of a fundamentally changed environmental awareness.[12] A further example for this was the 1962 Exposure Protection Act of the CDU Government in North-Rhine Westphalia, which was credited to the special situation in the Ruhr District. After his accession, Brandt’s interests revolved mainly around socio-political reforms and Ostpolitik. Even civic engagement in environmental issues had not yet taken on critical dimensions. While there were a number of committed environmentalists, there was meagre enthusiasm from the general public. This would only later change in the context of an educated environmental awareness, and especially as a result of the dispute surrounding nuclear energy and nuclear weapons in the late 1970s. Such initiatives ultimately culminated in the establishment of the Green Party as a political representative of environmental protection.

Ministerial bureaucracy as the driving force of environmental protection

So what was the driving force? The answer might be surprising: the issue was propelled forward predominantly by ministerial bureaucracy – by the Ministry for Health in the 1960 and the Ministry of the Interior[13] since 1969. An intense exchange with the United States had been ongoing for nearly a decade.[14] In addition to the recently elected Joachim Berg as the new leader of the U Department in the Ministry of the Interior, there were four other men who promoted matters of environmental protection in politics and society: Günter Hartkopf (1923–1989) Permanent State Secretary since 1969,[15] Martin Uppenbrink (1934–2008); head of the Environmental Protection and Environmental Policy unit of the BMI (Federal Ministry of the Interior) since 1971, Heinrich von Lersner (born in 1930) head of the department of *Water* and Waste Management since 1970, and Peter Menke-Glückert (born in 1929), head of the Environmental Coordination unit of the BMI since 1970.

Flakhelfers* at the front of the environment

Each of these men were lawyers and belonged, just like “Bonn’s Chief Environment Protector”[16] Genscher, to the same generation. To the generation born between the mid-1920s and the mid-1930s, the end and loss of

* German WW II adolescent anti-aircraft gun assistants

the Second World War was a common, identity-shaping experience which called for an intellectual reorientation. A pragmatic, anti-totalitarian approach and an inclination towards an Anglo-Saxon consensus-based liberalism are considered to be characteristic of the so-called *Flakhelfer-generation*[17] (German adolescents born between 1926 and 1929 deployed as anti-aircraft gun assistants in WWII). In addition to Lersner, it was mainly Uppenbrink who played a key role in the establishment of the Federal Environment Agency.

Peter Menke-Glückert – an unconventional civil servant

Genscher supported the initiatives of his ministry staff. As a result, his university friend Menke-Glückert became one of the main promoters of environmentalism in the Ministry.[18] Before Genscher brought him into the Ministry for the Interior (BMI) in 1970, Menkel-Glückert was head of the Science Resource Division of the OECD and had participated, in this function, in the UNESCO Biosphere Conference in Paris in 1968.[19] This conference was the most important predecessor and path-setter of the first UN Environmental Conference in Stockholm in 1972. The cosmopolitan Menke-Glückert, who had many contacts in the United States, brought a completely new style into the BMI – he was perpetually accusing colleagues of being "office fascists" and made sure that usual routines got muddled. [20]

Scientific foundations for environmental protection

Naturally, the lawyers didn't work without preconditions: The scientific supports were elaborated by either governmental research institutions, such as the Berlin Institute for Water- Soil- and Air Hygiene (German: WaBoLu), or by academic institutions. Projects like the Collaborative Research Centre of the German Research Foundation for Atmospheric Research, which later was absorbed by the Federal Environment Agency, provided indispensable groundwork for political and administrative activity. Nevertheless, a governmental research organisation dedicated to environmental issues as a whole was still missing.

Political coordination

Since thirteen different divisions were involved in environmental topics, the Federal Government created a Cabinet Committee on Environment as well as a Committee of the Heads of Department to coordinate matters – both of which were headed by State Secretary Günter Hartkopf.[21] Consequently, everything came together in the BMI. In September 1970 Genscher already presented a programme for immediate environmental protection which outlined a series of legislative measures ready to be implemented. However, environmental initiatives soon bumped into constitutional boundaries, as such responsibilities were still subordinated to state, not federal government authority. Not coincidentally, Bavaria was the first German state to form its own Ministry for the Environment in 1970. Such actions were not so much motivated by a desire to lead the way in environmental protection, but rather constituted a defensive strategy against feared expansion of federal authority in this area. Nevertheless, in 1972 the federal government successfully enforced constitutional amendments to state legislation which, as a result, were extended to matters of air quality control, waste management and noise abatement.[22]

Bernhard Grzimek (1909-1987) – Nature Protection Officer of the Federal Government in the 1970s.

Lobbying in a different way

The popular rise of environmental protection in politics must also be credited to a change in public opinion. A significant individual at the heart of the publicity was the popular director of the Frankfurt Zoo, Bernhard Grzimek (1909-1987), whom Brandt appointed as *Nature Protection Officer of the Federal Government*.[23] The significance of citizens' initiatives also grew. Today, it is common opinion among researchers that officials promoted citizens' initiatives in order to secure their own lobbying platform

for environmental issues.[24] While that may be an overstatement, the undeniable fact was that citizens' initiatives of environmental nature received financial aid and incentive from government funds. The inaugural meeting of the Federal Association of Citizens' Initiatives for Environmental Protection saw many government officials present. Moreover, the Ministry of Finance provided financial compensation to cover private individuals' travel expenses.[25]

"Bonn wants to clean up"

There are two typical characteristics of German environmental policy in the 1970s: The actors were all lawyers. Accordingly the instruments of environmental protection were, also of legal nature. Environmental policy efforts were clearly based on the euphoria of concrete planning and execution that was typical of the time. To a man like State Secretary Hartkopf, all environmental problems were solvable through technical means, provided these were based on appropriate planning and control. He therefore sharply criticised the "dismal visions"[26] of sceptics who rejected a purely technical approach to environmental issues and called for an overall concept that addressed the underlying causes of environmental degradation, not just their consequences.

The number of laws, regulations, provisions and decrees advanced by the BMI is impressive. Between 1970 and 1976, 54 legal standards were created from scratch, while the already existing ones were amended significantly.[27] Only two of these are particularly memorable: the Lead Petrol Act of August 1971 decreased air pollution through the limitation of lead compounds in petrol and marked the first step in the ban on leaded petrol throughout Europe. The Waste Disposal Act of June 1972 provided the legal basis for orderly and systematic waste disposal, which had previously existed on an ad-hoc footing. The number of waste disposal sites was reduced from approximately 50,000 landfills in 1970 to around 450 by 1990.[28] Both pieces of legislation are milestones in the shaping of a modern environmental policy. It seemed evident: "Bonn wanted to clean up" – the title of an article in the weekly newspaper Die Zeit regarding Genscher's environmental protection programme.[29]

Counterforces

Opponents gradually emerged. Despite the initial positive reception of environmental policies by the major economic powers, support decreased significantly in the lead up to the 1973/74 winter oil crisis and the subsequent recession. The change of Chancellors of the social-liberal coalition in May 1974 marked the transition from reform phase to crisis management. Genscher joined the Foreign Office. The economic division dominated in the FDP through the efforts of Otto Graf Lambsdorff (1926-2009, Minister for Economics 1977-1984).[30] Environmental politics was forced to go on the defensive. The start-up of the Federal Environment Act legalised in 1974 stumbled into the first environmental policy ice age. The office started under adverse conditions. But how did the establishment of a new Federal Office for Environmental Protection come about?

ARGUS

A committee of four professors commissioned by the BMI at the end of 1970 proposed the reorganisation of the scientific counselling of the government on environmental matters. They recommended the establishment of an association of roughly thirty people from different interdisciplinary backgrounds to form a team to execute realistic overall analysis of environmental protection (German: *Arbeitsgruppe zur Realistischen Gesamtanalyse des Umweltschutzes*, ARGUS). ARGUS was meant to focus on causes rather than symptoms. However, the political majority found the idea of an independent and non-taxable "think tank of visionary experts"[31] that had the potential to question the entire economic system of the Federal republic too radical.

Günter Hartkopf (1923-1989) – State Secretary at the Federal Ministry of the Interior and responsible for environmental protection. He was one of the leading personalities in the implementation of national environment protection policies in the first half of the 1970s.

1970

50,000

household waste landfills

1984

385

household waste landfills

Hans Dietrich Genscher (born in 1934, Federal Minister of the Interior 1969-1974), pictured in 1971 at the reception of British Minister for the Environment, Peter Walker, in the inner courtyard of the Ministry of the Interior.

Brandt's Environment Programme of 1971

In a letter dated 23 August 1971, Genscher proposed Brandt the establishment of a Federal Environment Protection Agency for the first time – in a sense, this constitutes the "spiritual birth" of the future UBA.[32] The Environment Programme of the federal government, approved in 1971 by 450 experts of the Bundestag after extensive preparatory work and which supported the set-up of a "council of experts of the environment" remained uncertain in the face of a new authority: "The Federal Government is considering the establishment of a Federal Office for the Environment to function as an umbrella organisation for the more efficient organisation of existing environmental agencies and institutions, as well as to take over all non-ministry related environmental tasks which are under the jurisdiction of the government".[33]

The demand for an "early warning and forecasting information system" was also raised for the first time in the 1971 Environment Programme, an idea which later led to the concept of the environmental database of the UBA, UMPLIS.[34] However, due to the federal structure of Germany, the foundation of an independent Federal Environment Ministry in the early 1970s appeared to make little sense. It was only to be in 1986, five weeks after the Chernobyl disaster.

On the way to the UBA

Due to the initially vague statements of intent, the tasks and obligations of the yet to be established Office were conceptually outlined in the course of 1972. There was a conspicuous lack of a central, non-governmental authority that was capable of delivering reliable and scientific information concerning environmental planning. The research institutions subordinated to individual ministries were no longer sufficient, especially in that there was no interdisciplinary coordination. Such deficiencies were to be corrected by the formation of a new department. On 29 May 1972 the call for a Federal Agency dedicated to environmental issues was agreed upon and its immediate implementation approved.[35]

The duties of such an agency were to be in accordance with the proposal of the Federal Court: the assumption of all non-governmental tasks regarding environmental protection (initially the adoption of Division U, later other departments as well), the finalisation of the UMPLIS project, the planning of further documentation in environmental matters, the coordination of environmental research institutions, as well as serving as a point of contact for all German states. Furthermore, the office was to act as the central agency for environmental discourse while fulfilling all affairs of public relations.[36]

However, planning and development within the Ministry soon encountered significant resistance in the federal administration. "It became an obvious tendency to restrict the duties of all departments and the Federal Agency to the requirements of the BMI and to limit the centralising function of the Agency as outlined in the Environmental Programme as much as possible".[37]

Federal Agency for Environmental Protection or Federal Environment Agency?

Martin Uppenbrink, head of the Environmental Planning and Policy unit of the BMI and later head of the Department of General Environmental Affairs of the UBA, was the one who prohibited the fragmentation of future federal agencies for environmental protection. In January 1973 he proposed to Genscher to abandon the previous plan which foresaw the foundation of three government-level agencies to tackle environmental protection tasks: a Federal Environmental Protection Agency, a Federal Agency for Pollution Control and a Federal Institute for Waste Management. Instead, Uppenbrink argued in favour of an integrative solution, although plans had already advanced at this point – the government had already acquired a property in Essen, where the planned Federal Institution for Waste Management was to be built.

Uppenbrink proposed to unite all three institutions into one authority. He also knew how to make the idea appealing to Genscher: "This solution would be realised by our department's claim to be a political and technically important authority within the government in matters of environmental protection".[38] He also prepared a name: "It is proposed to call this federal authority the Federal Environment Agency".[39] Genscher accepted this proposal, not least because the Federal Minister of Finance, Helmut Schmidt (born in 1918, in office 1972-1974) saw the solution as pragmatic, whereas in the past the Ministry for Finance had always expressed reservations regarding the notion.

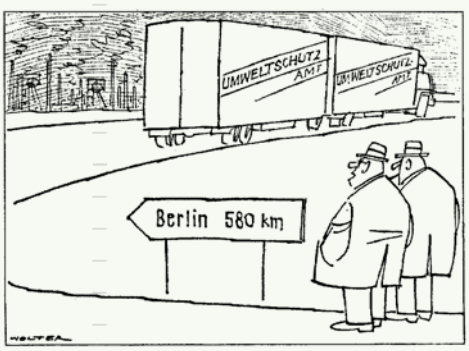
"This solution would be realised by our department's claim to be a political and technically important authority within the government in matters of environmental protection. [...] It is proposed to call this federal authority the 'Federal Environment Agency' "

Martin Uppenbrink
to Hans Dietrich Genscher

Whereto with the new Agency?

At this point it was not yet clear where the headquarters of the new UBA would be. The Organisational Department of the BMI recommended to Genscher at the beginning of May 1973 an area in Bonn as the most suited location of the UBA, given its proximity to the Ministries.[40] Genscher seemed dissatisfied and gave his Secretary of State Jürgen Hartkopf instructions to assemble a committee for the selection of an appropriate location.[41] Greater bureaucratic thoroughness was hardly conceivable.

The Federal Research Centre for Regional Studies issued a report about suitable locations in February 1973 commissioned by Federal Building Minister Hans-Jochen Vogel (born in 1926, in office 1972-1974). The report was the result of a complex evaluation process which took into consideration spatial division as well as the functionality of the new agency and led to different conclusions.[42] Depending on which criteria they placed more weight on, the decision was split between the cities of Kaiserslautern, Karlsruhe and Kassel on the one hand, and Mannheim and Bonn on the other. The report was clear in one respect: no matter what angle the criteria were approached from, there was always something unsuitable about each location. Ultimately, headquarters were set up in the location ranking last on the list: Berlin.



"Certainly, one should not capitulate to the GDR, but why not consequently move the Coastal Protection Agency to Obersdorf?"

"Der Spiegel" mocked in its 32/1974 edition the seemingly idiosyncratic choice of location for the (West) German Federal Environment Agency.

"Political Pollution"

Hartkopf's committee, which first convened in July 1973, had no time to come to a clear conclusion. Hartkopf himself, along with other BMI officials, considered the new agency's efficient functioning of the highest priority, favoured the location in Bonn.[43] But world politics got in the way.

Minister of the Interior Genscher met with Governing Mayor of Berlin Klaus Schütz (1926-2012, in office 1967-1977) on the 27 August in Berlin.[44] Four days later, the GDR national newspaper Neues Deutschland published

Neues Deutschland / 31. August 1973 / Seite 2

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ganze Aufmerksamkeit
erung eines neuen Ju-
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setzt. Die jungen Ar
Rohre

Kommentare und Meinungen

Politische Umweltverschmutzung

Der Innenminister der BRD, Genscher, begab sich kürzlich an einen Ort außerhalb des Hoheitsgebiets seiner Regierung, nämlich nach Westberlin, und teilte dort dem Regierenden Bürgermeister mit, das Bundesamt für Umweltschutz solle in Westberlin errichtet werden. Das sei, so hob Genscher rühmend hervor, eine „sehr große und leistungsfähige" seinem Ministerium nachgeordnete Dienststelle. Dieses BRD-Amt soll zuständig sein für Umweltschutzfragen der BRD.

Ein erstaunlicher Vorgang! Daß das Innenministerium der BRD eine Dienststelle außerhalb des Hoheitsgebiets der BRD errichtet, erscheint im Falle eines Amtes für Umweltschutz ganz besonders absurd. Ein Blick auf die Landkarte zeigt doch, daß dieses Amt von der Umwelt, die es schützen soll – nämlich der BRD – durch weite Gebiete eines anderen Staates, nämlich der DDR, getrennt ist. Zweifelos waren die Mitglieder der Sachverständigenkommission der BRD, die nach übereinstimmenden Meldungen in der BRD-Presse das Amt in der Nähe Bonns oder im Ruhrgebiet ansiedeln wollten, besser beraten.

Aber Herr Genscher denkt ja gar nicht an den Umweltschutz. Laut „Tagesspiegel" erklärte er in Westberlin, es gebe für seine Entscheidung „sowohl sachliche als auch politische Gründe". Von den sachlichen ist allerdings nicht weiter die Rede, aber seine politische Absicht verdeutlicht er weiter: „Angesichts der aktuellen Ereignisse und der Schwierigkeiten bei den Vertragsverhandlungen mit osteuropäischen Ländern erhalte die Entscheidung für Berlin eine besondere politische Dimension."

Herr Genscher kann sich offenbar nicht von einer gescheiterten Politik trennen, die sich über die gegebenen Dimensionen und die Grenzen der BRD hinaus Rechte anzumaßen versuchte. Das Vierseitige Abkommen, von dem bekanntlich für Berlin (West) wichtige praktische Regelungen abhängen, legt eindeutig fest, daß Westberlin kein Bestandteil der BRD ist und nicht von ihr regiert werden darf. Das heißt also, daß auch das Bonner Innenministerium in Westberlin nichts zu regieren hat, keine Zuständigkeiten besitzt und keine Dienststelle zu errichten hat. Im Sinne des Vierseitigen Abkommens haben die Besatzungsbehörden der Westmächte gerade erst den Antrag des Senats abgelehnt, ein Westberliner Verfassungsgericht zu schaffen, und erneut bekräftigt, daß Westberlin kein Land der BRD ist.

Sicher sind die Fragen des Umweltschutzes und die Wege ihrer Lösung auch für Westberlin wichtig. Sie könnten vom Senat von Berlin (West) selbst bzw. mit seiner Umwelt – nämlich der DDR –, aber nur direkt, geregelt werden. Die DDR hat hierzu wiederholt Vorschläge unterbreitet.

Das Vorhaben des Herrn Genscher verletzt grob das Vierseitige Abkommen über Berlin (West), dem für den Prozeß der Normalisierung große Bedeutung zukommt. Die Errichtung dieser BRD-Dienststelle in Westberlin, die dazu noch von der Sache her vollkommen sinnwidrig ist, kann nur darauf abzielen, die Normalisierung der Verhältnisse zu stören und Schwierigkeiten zu schaffen. Ein Bundesamt für Umweltschutz der BRD in Westberlin ist angelegt auf politische Umweltverschmutzung.

Dr. K.

Merkwürdige Position

Eine Korrespondenz von A. Gubanow in der „Prawda"

Der sich in Westberlin zu einem Kurzbesuch aufhaltende BRD-Innenminister H. O. Genscher traf sich mit dem Regierenden Bürgermeister Westberlins, K. Schütz. Anschließend teilte er Journalisten mit, daß der Sitz des westdeutschen Amtes für Umweltschutz Westberlin sein wird. Das Amt soll in unmittelbarer Nähe zur DDR-Grenze untergebracht werden.

Genscher mußte zugeben, daß vor einiger Zeit eine hierfür zuständige Expertengruppe der BRD alle Aspekte aufmerksam studiert hatte, die mit der Tätigkeit des neu entstehenden Organs im Zusammenhang stehen und zu der einmütigen Schlußfolgerung kam, daß eine Einrichtung in der Nähe von Bonn zweckmäßig sei. Der Minister bezeichnete die Entscheidung der Spezialisten als „fehlerhaft" und erklärte, daß die Kommission dabei lediglich die sachliche und nicht die politische Seite des Problems berücksichtigt habe.

Die demokratische Öffentlichkeit Westberlins weist in diesem Zusammenhang darauf hin, daß eine solche Haltung das Problem der Normalisierung der Lage in Westberlin und die Gewährleistung seiner Lebensfähigkeit auf der Grundlage des Vierseitigen Abkommens vom 3. September 1971 lediglich erschwert.

Abkommen zwischen DDR und Österreich unterzeichnet

Vereinbarungen über Handel und Zahlungsverkehr beider Länder

Berlin (ADN). Der Minister für Außenwirtschaft der DDR, Horst Sölle, und der Bundesminister für Handel, Ge- und Industrie Österreichs, ...ibacher, unterzeichneten ... der sich die Handelsbeziehungen auf der Gr... ...tigung

31 August 1973 – The central organ of the Socialist Unity Party of Germany (German: SED), "Neues Deutschland" described the planned establishment of the Federal Environment Agency in Berlin as "Political Pollution". The establishment of a West German federal authority in the city under the power of four Allies, which was not even constitutionally part of the Federal Republic, was seen as a provocation.

an article entitled "Political Pollution" – which is what Bonn had done in the eyes of the East German government:[45] Genscher and Schütz agreed on Berlin as the new location for the new Federal Environment Agency.

Objective reasons?

It is difficult to determine the exact course of the decision-making process. It was among others the commitment of Federal Minister for Special Affairs Egon Bahr (born in 1922, in office 1972-1974) who, since 1972, was also Federal Representative of Berlin in Brandt's cabinet and who, in June 1973, strongly supported the idea of Berlin as the new location for the UBA.[46] The lack of objective arguments in favour of the new location became apparent when in October 1973 the BMI asked its Head of Office Heinrich von Lersner, who was overpowered in opinion by a majority of Ministers, to nevertheless "support the argument of the Federal Government" in a report about "environmental activities in Berlin": "The goal is to publicise the objective reasons behind the choice for the Berlin location".[47] A diligent official underlined "objective reasons" and placed a question mark next to it.

Environmental policy as Germany's policy

The reasons for choosing Berlin weren't in the least objective: they served as a support for German politics at best, as admitted by Genscher himself: "The aim is to develop ties between West Berlin and the rest of the Federal Republic as envisaged by the Four Power Agreement. This is an opportunity that should be made the most of and not be left to disappear into oblivion through lack of action", responded Genscher at the end of September to the surprised reaction of the Council of Environmental Advisors regarding the new location.[48]

The Four Power Agreement of September 1971 (a first concrete result of Brandt's Ostpolitik), which particularly facilitated transit traffic, clearly stated that (West)Berlin was not part of the Federal Republic nor was it under its jurisdiction which, nevertheless, did not imply the complete separation of ties. Moscow viewed the choice of location for the UBA as a provocation and sent letters of protest.

The Western Allies were also sceptical: Lersner, now President of the Federal Office of Environmental Affairs (established through a Ministerial Decree on the 30 July 1973) was forced to report at the embassies of the United States, Great Britain and France: The Allies were primarily interested in whether the new agency would pursue any executive powers.[49] Lersner rejected these assumptions. As a result, Genscher secured the support of the Western powers. Any other action would have meant losing face to the East anyway – something that was not desirable because in spite of the détente the Cold War was not over.

Trouble with East Berlin and Moscow

The East German government presented its complaints to the Federal Government only after the definite establishment of the UBA through the Federal Law of 22 July 1974[50] and claimed that the Four Power Agreement had been violated as a result of it. The GDR even prohibited the entry of a UBA employee onto its territory five days after the law had been passed.[51] As such, UBA staff had to be transported to and from Berlin via aircraft.

The conflict was only settled when the new Chancellor Schmidt, the Minister for Foreign Affairs Genscher and the Soviet State and Party Leader Leonid Brezhnev (1906-1982, in office 1964-1982) met in Moscow in October 1974.[52] However, difficulties still prevailed, especially on occasions of UBA's presence at international conferences.

Rumours that the name Federal Environment Agency had been chosen instead of Federal Agency for Environmental Protection with regard to Moscow and (East)Berlin are inaccurate.[53] What's more, starting in January 1973, the Ministry itself began to use the name UBA coined by Martin Uppenbrink to define solutions for emissions control and waste management.

> ***"The aim is to develop ties between West Berlin and the rest of the Federal Republic as envisaged by the Four Power Agreement. This is an opportunity that should be made the most of and not be left to disappear into oblivion through lack of action"***
>
> *Hans Dietrich Genscher regarding the choice of location for the UBA*

see:
"The Federal Environment Agency and the History of Air Pollution"
page 102

Heinrich von Lersner – a skilled tactician

The choice of location motivated by domestic policy had its consequences. Heinrich von Lersner feared that not only would the distance between Bonn and Berlin present the BMI with practical difficulties, it would also make the recruitment of adequate staff troublesome. In turn, Lersner cleverly used the situation and claimed that "difficulties had to be overcome by flexible and generous personnel policy". He further urged the Ministry of Finance to "accept the controversial job assessments as we see it appropriate".[54] Finally, Baron von Lersner asked for the transfer of the Institute for Water, Soil and Air Hygiene (WaBoLu) – which was under the authority of the Ministry for Health – to the UBA by no later than 1976, as it was "pointless" to have two independent institutes with overlapping goals in the same place.[55] However, this was only achieved after the dissolution of the Federal Health Office in 1994.

The Federal Agency of Environmental Affairs as antecedent

Since matters were fairly urgent and the establishment of a new Federal Agency required complex preparations, the BMI founded the so-called Federal Office of Environmental Affairs and appointed the Head of the Department of Water and Waste Management, Heinrich von Lersner, as its President. The actual creation of the UBA only occurred one year later through the passing of federal legislation.

The Office was to provisionally assume some of the duties of the future UBA[56], procure the necessary facilities and equipment for the functioning of the Agency, prepare the acquisition of existing facilities and select the additionally required staff for the UBA.[57]

The integration of existing facilities into the Federal Office

On 1 January 1974, the Federal Office took over the Air Sampling Network founded by the support of the German Research Foundation as well as the Frankfurt pilot station, which focused on the measuring of air pollution in urban areas and was particularly dedicated to the exposure to lead and other heavy metals.

The Centre for Waste Disposal followed on the 1 July 1974, which had previously been attached to the Water, Soil and Air Hygiene (WaBoLu) of the Federal Health Office. It was founded through a joint effort of the government and the German states and devoted itself to the scientific study, research, coordination and statistical documentation of waste management-related issues.[58]

The Laboratory Group for Soil Protection of the WaBoLu also transferred to the Division of Waste Management of the UBA. Its purpose was the analysis of water-related problems as well as the development and testing of solutions for hazardous wastes.[59]

Location – the long-term makeshift office at Bismarckplatz

Once Berlin had been selected as new host location, it was time to choose a space. The choice was made in late 1973 and presented a federally owned property on Bismarckplatz in Berlin-Grunewald. The building was constructed in two phases by the architect Heinrich Kurt Tischer and had previously housed the national leadership of the Reich Labour Service of the National Socialist Party.[60] The badly war-damaged building was presently used by the Berlin Graphic Society. The society had converted the building to suit their needs – most notably it arranged a printing room where daily editions of the Telegraf were printed and published. The Federal Office took over ten rooms on 1 December 1973, and went on to occupy an additional 74 on 1 January 1974.[61]

The building located in the Bismarck Square was meant to be a temporary solution. Permanent offices were to be set up in the former National Debt Office in Kreuzberg, Berlin (corner of Oranienstraße/Alte Jakobstraße), which served, at the time, as a warehouse for Senate Reserves. The open spaces would have been ideal for the construction of new laboratories and

The first location of UBA on Berlin's Bismarckplatz

research facilities.[62] The plans were not finalised – most likely because of financial impediments.

The temporary Bismarckplatz location thus remained a permanent institution until the official seat was transferred to Dessau in 2005. UBA staff and employees worked in an ongoing construction site for many years – renovation and restoration works on the ailing Nazi-era building weren't completed until 1986.

The offices of the UBA had initially been built to house the national leadership of the Reich Labour Service of the National Socialist Party.

An agency without power and dignity?

The UBA was "a new type of authority" from the outset. Firstly, it was an agency "without power and dignity"[63] – Der Spiegel wrote critically of a "pulp authority [...] devoid of any form of control"[64] and further chastised the UBA, claiming that it lacked the ability to competently tackle both water pollution and nuclear safety issues. The former was still under the individual jurisdiction of the German states, while matters of nuclear safety fell under federal government authority – and the establishment of an institution with executive powers in Berlin was, in the context of current domestic politics, not possible.

Secondly, the UBA subsequently succeeded in developing a very specific and independent profile. This was credited not least to its intake and expansion of jobs and responsibilities. Initially, UBA was not bestowed with enforcement tasks; this remained an assignment for the states. It was designed to be an authority that would facilitate analysis and study of all matters regarding environmental protection. This presupposed the recruitment of young professionals with expertise in this novel field of research. As a result, a new type of agency was created, where the idea of teamwork was more important than hierarchy,[65] a concept which was entirely novel for the 1970s! Furthermore, the UBA provided a space for the formation of a new social type – that of the critical scientist, inseparable from the modern environmental movement.[66]

The first employees are hired

The first employees of the UBA, or the Federal Office respectively, came from the organising team of the BMI and its integrated facilities. 138 vacancies were available in the financial year of 1973, 48 of which came from the German Research Foundation's project for the monitoring of measurement stations, while 22 were offered by the Frankfurt pilot station. The remaining 68 vacancies were filled in the second half of 1973 with external staff. Over 1,000 applications were reviewed. Messengers, typists and drivers were hired from the bankrupt Graphic Society.[67] In 1974 the UBA applied for an addition of 15 authorised, but locked jobs.[68]

Heinrich Freiherr von Lersner – the Founding President of the Federal Environment Agency

The first president of the Federal Environment Agency was a Swabian, born on 14 July 1930 in Stuttgart. After gaining his secondary school-leaving qualifications, he studied law in Tübingen and Kiel, graduated from the University for Administrative Studies in Speyer and passed his State Examinations in law in 1955 and 1959, respectively.[79] Also in 1959, he completed his Ph.D. about the issues of liability in legislative injustice under the supervision of the acclaimed professor of governmental law, Günter Dürig. He subsequently began his career as an assessor in various district administration offices in South Baden.

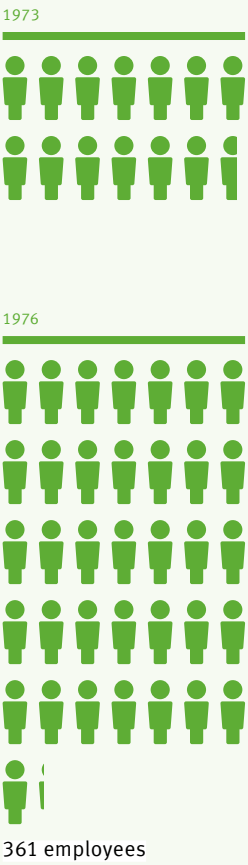
After only two years Lersner transferred into the Federal Service, with excellent credentials and assessments. As of 1961 he worked in the Department of Social Issues of the Federal Ministry of the Interior, followed by his reassignment to the Department of Public Security. It was not until 1970 that he became head of the Department of Water and Waste Management in the Environmental Protection Agency. Hans-Dietrich Genscher appointed him in 1973 as head of the Federal Office of Environmental Issues, which later became the Federal Environment Agency. Lersner was president of the UBA from the institute's establishment in 1974 until his retirement in 1995.

Aside from being a lawyer, Lersner was also a generalist and came to environmental protection much like "a virgin to a child"[80] – his own words from an interview in 1983. However, Lersner learned to love the child, showing incredible productivity in matters of environmental law: Between 1970 and 1990, he published over 50 scientific articles regarding the legal aspects of water and waste management as well as various other environment-related topics.[81]

His leadership style was rather unusual for a head of office of the 1970s and 1980s. As a representative of the left-wing Free Democratic Party, he was a determined advocate of the right to freedom. The "new style" of the UBA was more than just a cliché for him. He sought to demolish hierarchical structures within the office, treating all his employees as equals – an entirely novel mind set for his time. He always defended his staff when, for example, the BMI complained about the UBA's "insubordinate dress code".[82] In his spare time he showed an interest in history and art and organised numerous fine art exhibitions in the UBA. He considered artists to be the "seismographs of environmental protection". However, his greatest passion perhaps was the collection of heraldic wine labels.[83] Heinrich von Lersner lived in Berlin until his death in August 2014.

Following the official establishment of the Agency in July 1974, there was a further increase of job vacancies. In May 1976, the UBA was already employing 361 workers.[69] This rapid expansion was succeeded by a brief stagnation – the number of employees only reaching 400 by the end of 1977. There were plans to create a further 25 vacancies for 1978.[70] This resulted in the consolidation of staff positions. The 1980 budget provided for 424 full-time employees, while the UBA boasted 458 staff members including part-time and temporary workers.[71]

The recruitment of adequate work forces for the public sector was a problem already back then. A further issue was the frequent staff turnover due to the growing mobility of young employees. However, Berlin as office location didn't seem to create any difficulties.[72]



Leading figures in the early years

Besides Lersner, key figures of the start-up years were the engineers Dietrich Hartmann and Werner Schenkel, as well as the lawyers Martin Uppenbrink and Norbert von Nieding. Together they formed the Heads of Office.[73]

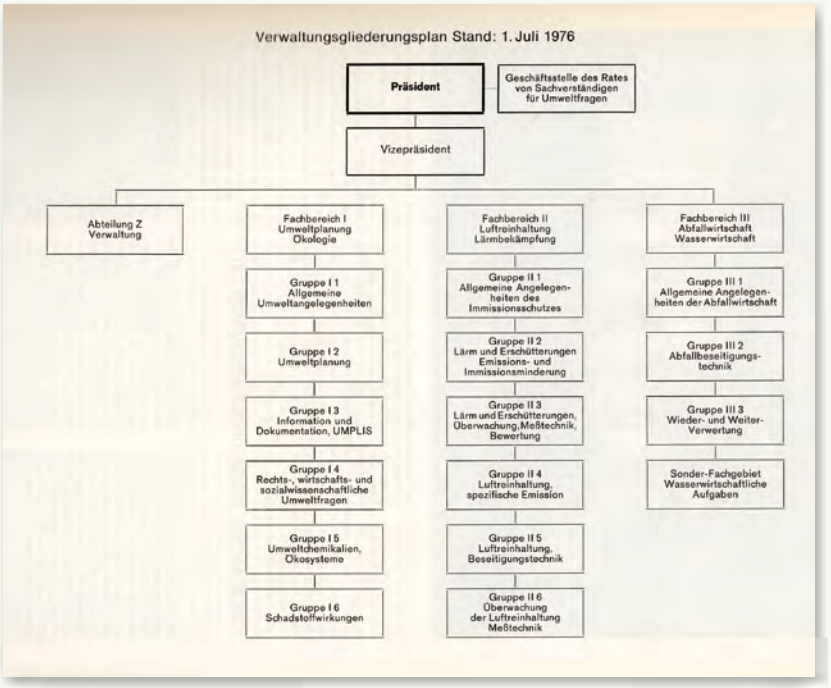
Dietrich Hartmann (1935-1982) had already researched issues concerning air quality control for the BMI in 1971, and consequently headed the Division of Air and Noise Pollution of the UBA. He also served as Vice-President of the institution and was, as such, Lersner's deputy. He died in 1982 while he was still employed by UBA.

Werner Schenkel (1938-2013) was head of the Division of Waste Management, which also incorporated certain aspects of water pollution. As former head of the Information and Counselling Centre for Waste Management of the Regional Association of the Ruhr Area, he was considered an expert in waste management issues. The Association played an important role in the planning and organising of intercity waste management projects in the 1960s.

The Policy department of the UBA (Division I Ecological Planning) was led since 1974 by Martin Uppenbrink (1934-2008). He also transferred from the BMI where he had been head of the Environmental Protection and Policy Unit since 1971. In this new function, he was not only in charge of the Federal Environmental Programme, but also responsible for UBA's concept, a task which was later assigned to Lersner in 1973 as part of his leadership of the Federal Agency. Uppenbrink left the UBA in 1989 and became European Director of the United Nations Environment Programme (UNEP) in Geneva as well as founding president of the Federal Agency of Nature of Nature Conservation.

A purely administrative officer with no specific environmental protection experience was Norbert von Nieding (born in 1934), head of the Central Division. He had previously been in charge of the Administrative Department of the German Archaeological Institute for five years. Nieding left the UBA in 1982 and became the Director of the Federal Authority for the Recognition of Foreign Refugees in Zirndorf.

The Management Board of the UBA in 1976 (from left to right): Martin Uppenbrink, President Heinrich, Baron von Lersner, Vice-President Dietrich Hartmann and Norbert von Nieding. Not pictured: Werner Schenkel.



The organisation chart of the Federal Environment Agency in 1976

Composition and structure of the "new type of Agency"

Based on its tasks and the research facilities of the integrated institutions, the BMI division responsible for the organisation of the UBA elaborated three so-called specialised divisions (departments): Division I for Environmental Planning and Ecology, Division II for Air Quality Control and Noise Reduction and Division III for Waste and Water Management. (July 1976)

Environmental Planning and Ecology – Division

Division I consisted of six groups and devoted itself to basic tasks that weren't of environmental or scientific nature.[75] The first group was responsible for the coordination and planning of environmental research and development as well as the education of the public at a national and international level. The second group processed tasks related to environmental planning in association with regional and urban planning, nature conservation and landscape management and their performance at environmental impact assessments.

The third group was in charge of the Construction and Operation of the Information and Documentation System for Environmental Planning (UMPLIS). A fourth group tackled all issues of legal, economic and social nature. Two further groups were dedicated to concerns regarding environmental chemicals, ecosystems and the consequences of pollutants on humans, animals and plants.

An aerobiological assessment unit examined the content of plant seeds and pollen in the samples collected by measuring units and provided valuable research material for the medical analysis of allergies. The first-ever attempt at a pollen forecasting system was set up in Germany through the collaboration of the German Weather Service and the Bavarian radio broadcasting.[76]

Air Quality Control and Noise Reduction – Division II

Division II also consisted of six groups. The first group dealt with matters of planning and statistics as well as issues regarding emission control law. Groups two and three were concerned with noise and vibrations in terms of both emission and exposure, as well as in relation to fundamental tasks of monitoring, measurement and evaluation. The other three groups (four to six) handled the problem of air quality control, especially with regard to specific measurement and disposal technology. Supervised by the division, the Exhaust Heat Commission studied the proportions heat caused by

energy production. The first years of activity focused largely on the reduction of motor vehicle emissions, the desulphurisation of fuel and waste gases, and the research and reduction of traffic noise.

Waste and Water Management – Division III

Division III consisted of three groups that dealt with waste management issues, as well as a special section which tackled all water management-related tasks. Group one was dedicated to the legal and economic aspects of waste management; Group Two to the technology required for waste disposal; and Group Three to the reuse and recycling of waste. The idea of recycling was still novel in the 1970s – exact methods and proceedings had yet to be developed and tested. The UBA launched a comprehensive study of the organisational, technical and economic requirements to devise an experimental system for recycling, which was planned to be built in south-west Germany.

Initially, the water management and protection sector was slow to action. In this field, the Berliner WaBoLu and the Federal Institute of Hydrology in Koblenz (which was responsible for all federal waterways) supervised all scientific issues which had not already been settled by individual German states. Although the UBA sought a change in this situation, potentially by the integration of these establishments, it only succeeded partially and after many delays (integration of WaBoLu in 1994).

Comprehensive education of the population

The idea of a federal agency educating the people was novel and unusual. The notion was specifically outlined by the UBA Planning Committee of the BMI: "The UBA will, in timely and technical collaboration with the Federal Press Department (BPA), be responsible for all matters of public relations for environmental protection".[77] This statement outlined the central tasks pursued by the UBA as of 1974: the publishing of relevant periodicals, the elaboration and distribution of environmental protection materials and the answering of all environmental protection-related questions from the public. The proposals of the officials were very specific and attentive to details: the UBA was to raise environmental awareness in the German population through any means possible – through ecolabels, even student competitions and matchbox adverts. Submitted manuscripts and screenplays were also subjected to a preliminary examination.[78]

The countless endeavours of the newly established Agency, which is now celebrating its 40th anniversary, will be reported in detail in a chronicle compiled by historians to commemorate its activities.

1978 – an advertisement for a vacuum cleaner with the ecolabel "Blue Angel"

1979 – The first volume of the successful UBA paperback entitled "What You've Always Wanted to Know about Environmental Protection"

UBA promoted environmental protection messages on matchboxes in the 1970s

The Federal Environment Agency and the milestones in the history of air quality control

By Stefanie Knebelspieß

1961

150

Air poisoned by sulphur dioxide in the Ruhr District claimed 150 victims

London, December 1952. The city is enveloped in thick fog. 4,000 people died, followed shortly afterwards by further 8,000 who lost the battle against sulphur dioxide, dust and soot. The world is startled and scared. Panic arises in areas of high industrial and population density such as the Ruhr District. Rightly so: Ten years later in December 1961, 150 people were killed by high levels of sulphur dioxide in the air. By now it was clear to everyone: something had to be done! Factories built higher chimneys the following year in an attempt to reduce air pollution. This aim was to be achieved through the Technical Guidance on Air Quality (German: TA Luft) issued in 1964. It implemented a maximal limit on exposure and emissions for industrial and corporate installations based on economic viability. The less the emission control installation was able to comply with the approved limit, the higher the chimney had to be built in order to better diffuse the harmful substances.

"Air superiority" for the Federal Government

The first federal law for air quality control – the Federal Immission Control Act – was adopted on 18 January 1974 as part of the Environmental Protection programme of the Brandt government. This fell within the area of concurrent federal legislation which ranked above the legislative competences of individual German states. What was new about this in particular were the principles of prevention and causation: the duty of system operators to

establish a precautionary security installation, paired with the obligation to assume responsibility for environmental degradation. The regulations, general and administrative legal provisos implemented in the following years are especially important, for example the Ordinance on Large Combustion Plants and the updated Technical Instructions on Air Quality Control (TA Luft). UBA played a key part in both tasks and as such, helped ensure that winter smog is now an issue of the past. UBA also provided the necessary technical and scientific materials to support exposure reports, which were presented, in accordance with the Federal Immission Control Act, by the Federal Government to the Bundestag.

The DFG monitoring network and the Frankfurt pilot station

How is it that poisoned air can spread across thousands of kilometres? How do the pollutants in the atmosphere react? And how can the consequences be measured? In the aftermath of the smog catastrophes of the 1960s both politics and science strived to understand and answer these questions and encouraged projects dedicated to the study and research of the issues. The Institute of Meteorology and Geophysics of the University of Frankfurt built a pilot station in 1965 using governmental funds along with nationwide air quality monitors. These installations measured outside of the direct influence of pollutant sources, and thus, facilitated the study of how toxins were transported through the air.

Both the pilot station in the Rhine-Main district as well as the six air quality monitors were integrated into the UBA in 1974.[1] The government assumed the matter of air quality control as a national responsibility. The Frankfurt pilot station became the centre of cross-border air transport of the UBA air monitoring network. This was soon followed by a reorganisation of the network. The air monitoring vans that were brought into service at the pilot station soon after made the nationwide measuring tasks much more flexible.

The large-scale measuring of air pollution was one of the central roles of the UBA from the beginning.[2]

There were also specialist groups that worked on the reduction and elimination technology of exposure and emissions.

Air measuring van of the Frankfurt pilot station in the pedestrian zone on 1 Dec 1973. The results of the 'car-free Sunday' were established before and after measurements

International cooperation

Because the transboundary movement of polluted air knows no national borders, it is obvious that pollutants must be combated through international efforts. UBA had always been active in global-scale research. For example, it managed two research groups dedicated to the systematic assessment of pollutant emissions as part of a pilot study of the Committee of the Challenges of Modern Society, established by NATO in 1969.[3] In addition, UBA worked in cooperation with the Warsaw Pact countries in the United Nations Economic Commission for Europe (UNECE) in the framework of the Geneva Air Quality Control Convention and was involved in the design of EU directives.

Beyond borders: long-distance atmospheric transport

Scandinavia, late 1960s: for reasons at first unknown, lakes were acidifying and fish dying. Central Europe was also experiencing changes: a growing number of trees were showing damage. It seemed like the entire European ecosystem was on the razor's edge. What had happened? Scientists suspected, among others, that pollutants were being transported over long distances. Researchers traced back the levels of acidity in the northern European lakes and seas to emissions in Western, Central and Eastern Europe.

Germany was also viewed as a culprit. The previous politics of "high chimneys" provided only a local solution for the problem. The issue had only been postponed. But West Germany was not just an "exporter" of pollutants. As it was later discovered, large amounts of winter smog in North Rhine-Westphalia were imported from the GDR.

The 1979 Geneva Convention

In order to examine the cross-border transport of polluted air and the consequences of individual air pollutants, the UNECE approved the Geneva Convention on Long-Range Transboundary Air Pollution in 1979.[4] The Geneva Convention is the first international, legally binding instrument to reduce air pollutants and came into effect in 1983. The Convention was signed by most European countries, as well as the Soviet Union, the United States and Canada, and the European Community.

The Convention was special because international cooperation had occurred in spite of the "Iron Curtain". East and West came together to discuss options and plans to reduce air pollution – not an easy task during the Cold War. This applied especially to the employees of the UBA who represented West Germany at the Convention. After all, the Soviet Union did not officially recognise the West German delegation. From the Soviet Union's perspective, the establishment of the UBA headquarters in West Berlin was not entirely lawful. (*see article on the history of its foundation).

see:
"A hybrid of power and impotence?"
page 87

Diplomatic complications

This resulted in diplomatic rituals which bestowed all kinds of attention on the UBA: The diplomats of the Soviet Union asked that representatives of the UBA be excluded from the gatherings. Such protest forced the Western Allies – the United States, Great Britain and France – to rally on common ground. Representatives of the GDR protested in response – completely in rhythm with the diplomatic dance until, finally, the Ambassador of the Federal Republic made a statement. Fifteen minutes passed before the actual meeting could begin and the order of the day could be discussed. In order to save on translation expenditures, the wording of each sequence was kept the same in all meetings. Over the years, this bizarre tradition became less important and was carried out only in writing.

Even workshops presented the UBA delegation with curious situations: they could not introduce themselves as members of the Federal Environment Agency, but instead had to state their name and the postal address of the UBA headquarters. The same pattern was followed in bilateral environmental agreements: members of UBA staff were listed only under their name and the UBA mailbox address – naturally, it was known what the address was supposed to hide.

Constructive cooperation beyond the Protocol

Apart from such diplomatic skirmishes, the cooperation went surprisingly well. The result was a more accurate picture of where the pollutants actually came from and the negative impact they had on humans and ecosystems. A final assessment brought the most endangered ecosystems to light and pointed to where trees had been most affected by acidification.

The collaboration resulted in national laws which ensured the significant decline of air pollutants transported over long distances and across borders in Europe.

1980–2000

70 %

emissions of sulphur dioxide decreased by 70% in Europe

The obligations of the Member States were formulated in the respective protocols. The aim was to reduce emissions of sulphur dioxide and nitrogen oxides: as a result, emissions of sulphur dioxide decreased by 70% in Europe between 1980 and 2000. Some agreements were substance- and product-related such as the 1998 Aarhus Protocol on Heavy Metals (HM) and Persistent Organic Compounds (POP) – long-lived in the environment and highly toxic substances.

The Geneva Convention also facilitated the implementation of measures which were already successful in Germany throughout Western and Eastern Europe. Most notably, the need for the desulphurisation of power plants was internationally recognised. No country in Western Europe could avoid equipping new facilities with desulphurisation systems and upgrading old plants. As a result, acid deposition decreased by 90% and is no longer a topic of concern today.

The Federal Environment Agency actively supported these developments from the start, for example through the definition of critical loads for eco-

Dead trees on display. Visiting a dying forest as part of a school lesson. Harz, Goslar County, August 1983

systems in Europe and North America, as well as the cartographic representation of the endangerment of soil, water and forests by air pollution. To name a further example, UBA elaborated proposals for the POP protocol and incorporated it into the draft protocol.[5] In addition, it participated in the organisation of multinational environmental monitoring programmes, as well as in the calculation of the cost-effective use of air quality control systems.

Within the framework of the Geneva Convention, the air monitoring network gained a new purpose: The UBA took over the measuring duties of other involved parties as a result of the cooperative programme for the monitoring and evaluation of long-range transmission of air pollutants in Europe (EMEP) of 1986.

"If the forest dies, man dies"

However, acid rain was not just an issue of international environmental diplomacy. It also dominated the headlines of the German media. In November 1981, Professor Bernhard Ulrich caused an uproar among the entire German nation: "The great forests," said the soil expert from Göttingen, "will die within the next five years. They are beyond salvation".[6] The prognosis appeared in the opening article of the three-part series of Der Spiegel magazine about the "dying forests". The title: "Acid Rain over Germany. The Forest is Dying". The main cause of the predicted forest decline was identified in the politics of "tall chimneys". Namely, it caused "continued emissions of pollutants to threaten to turn the entire Federal Republic into a giant Ruhr District and forest dying through SO2 progressed. The polluted rain descends far away from its source, and the Federal Government recently advises that this trend is continuing: 'Results from the UBA measurement network confirmed previous findings according to which rain is often more acidic in the area further removed the emission source than in agglomerations.'"[7]

November 1981: "Der Spiegel" sounded the alarm. Soon after, the issue of dying forests dominated the headlines of the German media

An "ecological Hiroshima"

UBA aimed to achieve double goals via the widely discussed Spiegel series: On one hand, it was the Agency that commissioned the study from professor Ulrich in 1980. On the other, employees of the UBA used their contacts

in the press to build pressure in politics – in this case to reduce pollutant emissions at their source that is directly at the power plants. A corresponding analysis by UBA in 1981 showed that emissions control was both technically feasible and economically viable.

As of summer 1982, the death of the forests became "environmental problem number one". The issue climaxed with the "debate on forest decline" in 1983. Der Spiegel evoked an "ecological Hiroshima"[8] adding more fuel to the fire. (Supposed) experts voiced their opinions everywhere. The UBA tried to objectify the discussion by publishing reports, organising lectures and hosting open house days.

The UBA shows complex causal relationships

In its special report on forest decline published in March 1983, the Advisory Council on the Environment (founded as part of the first Environmental Programme of 1972) relied heavily on the groundwork and research of the UBA air measuring network and thanked them explicitly for the support. The network had been expanded in the late 1970s to 38 automatic measuring stations in order to carry out in-depth analysis of the ionic balance in rainwater.

As a result of the research strongly financed by the government, UBA was able to show that acid rain was not solely caused by the polluted air. The mechanism, however, was decidedly more complex: ground level ozone, monoculture, wildlife feeding, an overload in silviculture and forestry – a combination of all these factors played a major part.

Within a few years, the government introduced countermeasures – which, for a bureaucratic endeavour, went astonishingly quickly. The Ordinance on Large Combustion Plants was implemented in 1983 followed by an amendment to the Clean Air Act, the Technical Instructions on Air Quality Control (TA Luft) in 1986. The UBA participated in all these developments.

1983

Ordinance on Large Combustion Plants

1986

Amendment of Technical Instructions on Air Quality Control (TA Luft)

For a switch to clean energy: the Ordinance on Large Combustion Plants

"The German forest is in danger [...] According to experts, air pollution by SO2 poses the greatest threats. Large combustion plants are the main cause of air pollution through SO_2 [...]. The new Ordinance on Large Combustion Plants will reduce pollution of this nature significantly".[9] The forecast of Chancellor Helmut Kohl, who had only been in office for a few months at that point, was accurate: the Ordinance on Large Combustion Plants, implemented on the 1July, was a huge success.[10] Through the reduction of the emissions of dust, SO_2 and nitrogen oxides from power stations and large combustion power plants, emission levels in West Germany decreased by 89% for SO_2, 72% for nitrogen oxides, and 80% for dust.

The Federal Environment Agency was the leading force behind the drafting of these regulations. It had already developed comprehensive reports about the state of the art for emission control of such installations in the 1970s and had subsequently advised the Federal Government in hearings and the preparation of cabinet discussion papers.[11] However, it was the pressure of the public in light of the "dying forests debate" which forced the government to go head on against industry.

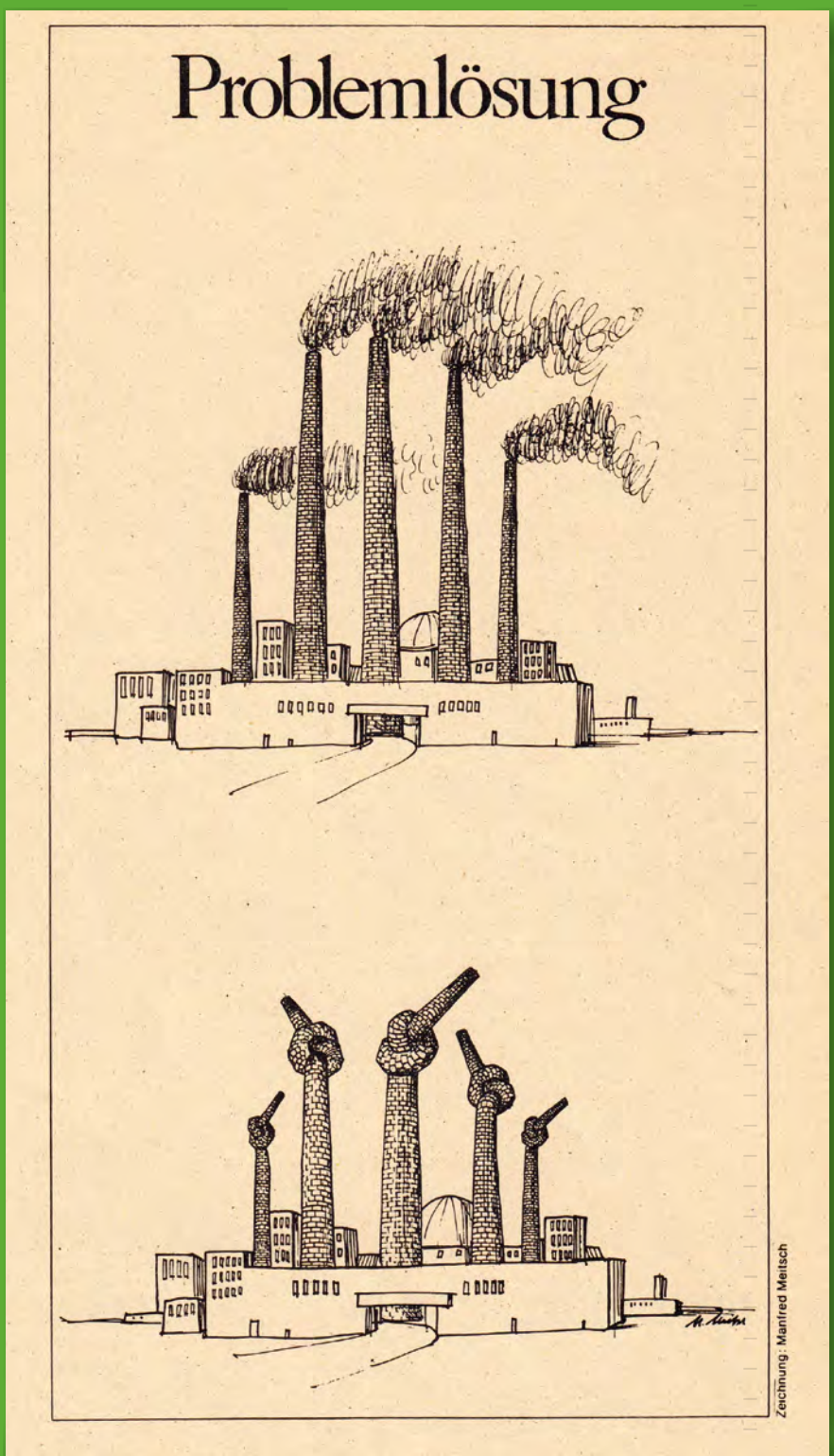
The Ordinance put Germany in the lead in terms of European air quality control policy. On 24 November 1988, the European Community adopted a directive on large combustion plants which was based on the German model and was supported significantly by the UBA.

"The German forest is in danger [...] According to experts, air pollution by SO_2 poses the greatest threat. Large combustion plants are the main cause of air pollution through SO_2 [...]. The new regulation for large combustion plants will reduce this air pollution significantly".

Helmut Kohl

The new version of TA Luft

In addition to the Ordinance on Large Combustion Plants, the amended Technical Instructions on Air Quality Control (TA Luft) in 1986[12] also played a significant part in the reduction of emissions from installations subject to authorisation. The UBA had worked out the technical background for the new organisation and got involved in the classification of danger-



“End-of-pipe” in a different way – sketch from the annual report of the Federal Environment Agency in 1978

ous substances and the determination of their ceilings. Several projects had been initiated and evaluated for this purpose by the UBA. It established strict limits for carcinogenic substances like cadmium or arsenic in particular. Moreover, an additional reduction requirement for emissions was elaborated which also applied to highly toxic and persistent substances like dioxins and furans.

The Technical Instructions on Air Quality (TA Luft) is an administrative regulation which applies to licensing authorities. It refers to the approval of both new and old systems. For new installations, the prevailing state-of-the-art technology was crucial. Existing installations had to come into compliance with the limits within certain transition periods. The adoption of the new TA Luft was preceded by heated arguments at the hearings. There was a clash of different interests: representatives of environmental and consumer associations met with the environment protection supervisors and lobby groups on the industry and business side. Industry representatives wanted limitations which were as weak as possible and tried to assert their position through the force of their sheer numbers and abundant data. However, they were not very convincing, and thus from the UBA's perspective, the meeting had been a success.

Coal power plant in Hamm/Lippe in 1985. The waste gas was released without processing through a desulphurisation system. The times when smoking chimneys were a sign of wealth are long gone.

New technology for old installations: the Old Installations Programme

A major breakthrough and enormous progress in the developments of air quality control technologies was the Old Installations Programme. Old installations were the object of focus for the first time. The programme was commissioned by the Federal Ministry of the Interior and designed in detail and implemented by UBA. The government had already provided funding of 600 million Deutschmarks for the upgrading of existing installations in 1979. Industrial companies that wanted to renovate their installations in

order to contribute to the reduction of air pollution obtained, up to 50% of investments in subsidies through this programme. The construction of technical demonstration plants was particularly encouraged. Between 1979 and 1981 the UBA received 425 individual project proposals with a total investment sum of more than 1.6 billion Deutschmarks.[13]

Funding was tied to UBA's obtaining relevant data and being able to subsequently determine which technology led to which results. This meant that UBA gained an advantage over industry in terms of reliable data on technical feasibility and cost.

The works of the Federal Environment Agency were later incorporated into European legislation such as the IPPC Directive (see below).

Hard fibres boiled soft: The slow death of the "magic bullet" asbestos

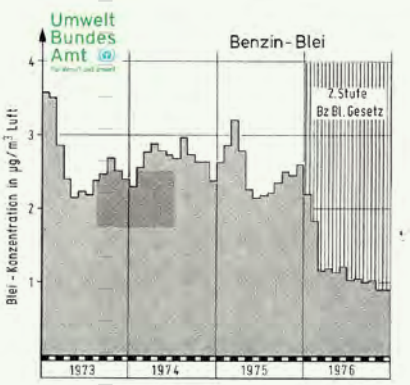
In addition to the technical aspects of environmental protection, UBA was also active in areas of product-related emissions control. It published a study in 1980 which caused, even before its release, a general uproar in the industry while also drawing the attention of the media – all of which proved to be useful to the UBA. In its 400-page report the UBA exposed the mineral asbestos as highly carcinogenic and called for a ban of the material in order to prevent further deaths. But the study did not settle with simply pointing out the danger. UBA simultaneously published proposals for substitution substances composed of man-made fibres which, to some extent, were more cost effective as shown by special calculations. UBA also presented a series of remediation methods. In this context, UBA had proven its vast expertise and professionalism.

As a result, the the use of asbestos was slowly phased out – a material that was used, due to its strength and heat resistance predominantly in the manufacturing of construction materials. It was a time-consuming struggle which, nevertheless, proved worthwhile: the use of asbestos was finally banned in 1993, which can be credited to one of the UBA's most prised attributes: tenacity.

Cause for joy for Heinrich von Lersner (born in 1930, President of the UBA 1974-1996): asbestos-free brake pads with an ecolabel in 1981.

Tackling the polluters: the Petrol Lead Law

Since the 1960s, the car had become a status symbol for the German population. The problem: the use of leaded fuels in vehicle engines emits leaded fumes into the air – a toxic heavy metal that attacks the human respiratory system and damages the nervous system alike. Although the Petrol Lead Law of 1971 limited the use of lead, UBA did not find it to be sufficient. Unfortunately, whoever dared to criticise "Germany's favourite child" made few friends. In spite of widespread resistance, UBA fought in the mid-1970s for a tighter limit. The implementation of the second stage of the Petrol Lead Law in 1976 provided important momentum in the history air quality control. Concentrations of lead in the air in 1975 were roughly 2.5 micrograms per cubic metre and had already dropped to less than one microgram per cubic meter of air by the end of 1976.



The 1971 Petrol Lead Law was updated in 1976, and now, a maximum quantity of 0.15 grams of lead was allowed in petrol. The percentage of lead in the air decreased significantly as a result.

From the regular statutory exhaust test (ASU) to the three-way catalytic converter

On 1April 1985, a new milestone was achieved: the statutory exhaust test for vehicles with petrol-based engines was introduced. However, it was soon clear to the UBA team that such an aftertreatment would not technically work on leaded petrol and thus it promoted the development of a catalytic converter for unleaded petrol. The next step was a ban on leaded petrol was introduced on 1February 1988. The use of a regulated catalytic converter became compulsory in the EC in 1993. This was an important step in the battle against summer smog which preoccupied Germany in the 1970s and was mainly caused by chemical pollutants emitted by cars and industry.

The Federal Government decided on the introduction of catalytic converters in 1984. Their installation in new cars became compulsory in 1989.

European environmental policy: Germany must rethink

European environmental law became increasingly significant from the 1990s onward. The aim of European legislators was to establish uniform levels for certain substances in the air, which would protect all European Union citizens. The main instruments of action of European environmental policy are the environmental programmes which form the guideline for future European directives. In the field of air pollution the Fifth Action Programme of the European Community entitled "For a sustainable and environmentally just development" played a relevant role. This formed the programmatic basis for the years between 1992 and 2000 – and forced Germany to rethink its previous policies on air quality control.[14] Germany had been very successful in this area due to systematic approaches on the matter, but now it was time to focus more closely on issues of exposure.

Integrated environmental protection

Since European environmental law perceives the environment as a system, cross-sectored regulations were deemed necessary for its protection. These were regulations that not only applied to the individual media of the environment – water, soil and air – but also considered the knock-on effects, for the protection of one environmental medium may result in the pollution of another. A definite air quality level had to be immediately introduced, regardless of the sources that might jeopardise such an action. This integrative, cross-media mindset was a challenge to German air quality control policy as it was characterised by a media- and source-oriented approach.[15] In the area of environmental protection technology, the European concept complemented the German establishments where the tradition of the end-of-pipe technology prevailed. Measures to reduce environmental pollution, through desulphurisation for example, had been integrated into the production process (additive environmental protection). The European concept of integrated environmental protection presupposes minimal environmental intrusion from production onwards.

Common strategy of the EU countries: the Air Quality Framework Directive of 1996

The directive for the assessment and inspection of air quality, implemented on the 27 September 1996, was the foundation of future European air policy.[16] The EU Member States were obligated to achieve certain air quality objectives in order to reduce or avoid the negative effects of harmful substances on the health of EU citizens.[17] The maximum values for individual pollutants, as well as the deadlines for compliance were determined in the daughter directives. These were drawn up by experts of the European Commission – including employees of the Federal Environment Agency who elaborated scientific papers about pollutants such as sulphur dioxide, nitrogen oxides, particulate matter and lead.[18] Since there were no long-term measurement systems for some air pollutants, studies performed by the pilot station and WaBoLu of the UBA played a crucial role in the improvement of data quality.[19] The Federal Environment Agency participated in the preparation and implementation of the Directives into German law.[20]

1996

Guideline for the evaluation and inspection of air quality

1999

The Particulate Matter Directive was passed

2000

Directive for the stipulation of limiting values for benzene and carbon monoxide concentration in the air

The first two daughter directives

The so-called "Particulate Matter Directive"[21], adopted on 22 April 1999 and implemented on 1 January 2005, set limits on sulphur dioxide, nitrogen dioxide, nitrogen oxides and lead particles in the air. Its primary objective is to avoid health hazards caused by air contaminated with particulate matter. Compliance with these terms is still a problem for Germany today.[22]

The aim of the second daughter directive of 16 November 2000[23] was the establishment of limits for benzene and carbon monoxide to avoid, prevent and reduce their harmful effect on human health and the environment as a whole.

The UBA as "National Focus Point" in the Seville Process

The Directive of 24 September 1996 concerning "Integrated Pollution Prevention and Control"[24] was an instrument for the EU-wide introduction of environmentally relevant industrial equipment. The aim was to reduce or eliminate emissions to water, soil and air. For this purpose, requirements for the authorisation conditions and monitoring processes of polluting systems were determined.[25] The limits of the approved installations in industry and agriculture were ranked by "best available techniques" (BAT). European workshops created the so-called BREF documents which informed the Member States of the state of the art. The exchange of information was led by the European IPPC Bureau in Seville, which is why IPPC-related discussions are also known as part of the Seville Process.

In Germany, the Federal Environment Agency was the national coordinator for and played a key role in the implementation of the directive. Expert groups headed by UBA developed the German contributions to the BREF documents.[26] As of 1997, the UBA nurtured close contacts with experts from various German states, industry, research and environmental organisations in order to further develop IPPC directives and make further proposals for the BREF documents.

Conclusion

In the 1970s and 1980s, UBA delivered decisive data relevant for decision making and hard measurement technology facts to support the former "Air Quality Control Policy". It has helped create an understanding of the relationship between air pollutants and pursued the implementation of key measures which made it possible for issues such as "smog alert" and "dying forests" to have become things of the past. The expertise of its team in matters of installation-related air quality control and the state of the art enabled UBA to contribute to the development of European directives in the 1990s.

Great successes are credited, aside from the expertise of UBA staff, to one of its greatest strengths: tenacity and determination. It also lies in its ability to understand and accept the fact that success goes hand in hand with failures and can take years, sometimes decades, to materialise. A good deal of staying power is still called for because despite all the successes, there is still much to be done to resolve current problems such as harmful particulate matter pollution

From the remediation of contaminated sites through the Federal Soil Protection Act to international soil protection

40 years of soil protection in the Federal Environment Agency

By Romy Schindler

Children at Niagara Falls protest their poor living conditions on the former chemical waste landfill and demand immediate resettlement.

"...more than 90% of waste materials are dumped into the soil without any hygienic precautionary measures, just like 100 years ago"

report published by the Environmental Programme of the Federal Government in 1971

During the 1970s shocking news rocked the globe. Disease epidemics were recurring due to increased soil contamination with environmental toxins and chemicals. To cut back on costs, landfills were only superficially covered and no information had been given to new buyers and builders about the previous uses of the land. An example for this is the Love Canal in Niagara Falls (US state of New York). Between 1920 and 1950 this area was filled with toxic chemicals, industrial wastes and chemical warfare agents. The truth only came out when residents founded a citizens' initiative and drew the attention of the media to several cases of chronic illnesses and high rates of cancer. The settlement was declared a disaster area in the same year.[1]

The beginnings of soil protection in Germany

In 1971 the Environmental Programme of the Federal Government stated that in spite of the rapid rise of packaging and industrial waste, "more than 90% of waste materials are dumped into the soil without any hygienic precautionary measures, just like 100 years ago".[2] This was to be combated by the Waste Disposal Act which was to organise effective management of waste and establish disposal regulations. It was implemented in 1972.[3]

However, this act alone was not sufficient: an environmentally friendly mechanism for waste disposal had to be developed first as well as an effective detection method for harmful substances being introduced into soil

through waste. This was, yet again, a task for the Federal Environment Agency. Starting in 1974, it not only tackled the question of "where to go with all the waste?", but also devised several concepts for the reuse and use of landfill gas as a source of energy.[4]

"Seveso is everywhere"

Despite new regulations, problems still remained: the illegal dumps that were formed long before the new laws had been passed and it was unclear where the wastes had originated and how toxic they were. An independent environmental assessment of the Advisory Council on the Environment (SRU) in 1978 spoke of more than 50,000 such illegal dumps on German territory.[5]

Things got even worse in the late 1970s when newspapers reported about the explosion of a pharmaceutical factory in the northern Italian Seveso, where highly toxic dioxins were released and led to chloracne and malformations in newborn babies in the area.[6] The alarmed public started to pay attention and unleashed the avalanche. In 1978 Fritz Vahrenholt (UBA) and Egmont Koch (Der Spiegel) published a book entitled "Seveso is everywhere" – and they were proven right.[7]

Even Germany's soil hosted several thousand barrels of dioxin-containing waste in unsecured landfills. These were "an arsenal of highly toxic industrial waste which, if released, would be sufficient to contaminate several regions".[8] In 1983 researchers found traces of dioxins in the former Georgswerder landfill in Hamburg, which had been filled with highly toxic industrial waste since 1967. On the factory site in Stoltzenberg, three children suffered accidents while playing with highly toxic chemicals. The housing estates Bielefeld-Brake and Dortmund-Dorstfeld also held Seveso dioxins. The danger was present in Germany as well – Seveso was indeed everywhere.

Remediation concepts of contaminated soil

The great task of counting illegal dumps began in the late 1970s, but merely sealing off the contaminated areas was not enough because – as the UBA proved through extensive research – toxic substances could easily seep into the groundwater and cause great harm outside of the landfills.

In order to protect the groundwater, which is consumed as drinking water in large parts of Germany, contaminated sites and landfills had to be remediated. UBA organised the conference series "Remediation of contaminated sites" in 1982 and presented remediation proposals to reduce groundwater and soil pollution in former landfills and abandoned industrial sites.

Towards a holistic approach to soil protection

In order to raise nationwide awareness of the soil as a vulnerable resource, UBA has been working together with the Federal Ministry of the Interior (BMI) and the Inter-Ministerial Working Group on Soil Protection (IMAB) since 1983 to develop a concept for soil protection. This was the first overview of all the potential sources of soil endangerment. In addition, already existing regulations on soil protection were analysed in detail in order to find out which aspects of the soil were already under protection and which needed immediate legal protection. It was found that due to its diverse functions, soil had various overlapping areas with waste, water and air. However, there were significant gaps as well, such as the struggle against soil erosion, a topic which, in the context of desertification, had already gained international importance.

UBA employee Fritz Vahrenholt and Egmont Koch (Der Spiegel) agree. Their research showed in 1978 that Germany was also threatened by dioxin pollution.

The landfill at Georgswerder in Hamburg exposed the careless disposal of industrial waste during years of clear regulation

The former landfill Georgswerder has been rehabilitated and regreened since 1986. Today there are four windmills and 10,000square metres of large solar panels. It was renamed "Georgswerder Energy Hill" in 2013.

The soil protection concept of the Federal Government (1985)

An important part of the 1985 soil protection concept therefore relied on the precautionary principle. Up to this point, soil protection had revolved mostly around responding to already existing damage by the industry or uncontrolled waste disposals. Now, the soil was the provider of the livelihoods of people and was considered a valuable resource. The first goal of the concept was to reduce soil contamination, to achieve a change of habits in land use and ensure changes in the soil structure by counteracting sealing, compaction, mudding and erosion.[9]

In order to achieve these goals, a working group of the Federal Government and the States (Länder) called "Soil Protection" was set up in 1988 and drafted appropriate soil conservation measures.[10] UBA was given the task of establishing uniform criteria for the recognition, assessment and monitoring of suspected sites. This was followed by the combination of data collected by state monitoring devices with other information about soil contaminants.

The sketch presented at the first TNO Congress in Utrecht in 1985 is: barrels of toxic waste are just as much of a time bomb as municipal waste. If the poison seeps into the groundwater, it endangers the provision of drinking water.

"Contaminated Land" – international cooperation and remediation concepts

The United States became a pioneer in dealing with the so-called "contaminated sites" of old abandoned industrial areas and former landfills at the beginning of the 1980s and influenced developments in Germany as well. The 1969 NATO Committee on the Improvement of the Environment initiated by President Richard Nixon (in office 1969-1974) dedicated itself from 1981 to the development of remediation plans for contaminated sites. This was triggered by the Love Canal waste scandal, which resulted in the implementation of the so-called Superfund Law which outlined comprehensive regulations for the remediation of polluted sites.[11] As part of the pilot study "Contaminated Land", Germany joined the debate alongside Denmark, France, the Netherlands and Canada between 1981 and 1984 – one of the reasons why the problem of contaminated sites became an issue in its own right at UBA in the early 1980s.

In 1982 UBA introduced a research project entitled "Rehabilitation of Contaminated Sites". New technologies for the investigation and remediation of contaminated sites were funded by the Federal Ministry of Research and the results were published both nationally and internationally.[12] In the follow-up study by the NATO Committee "On Contaminated Land" of 1986, the UBA was not only participant, but became headed the study alongside the United States and the Netherlands.

New technologies

In 1987 UBA created a special field to focus on the development of technologies for the remediation of contaminated sites. At the beginning, most important remediation processes included excavations, landfilling and capping. This changed with the pilot study launched in 1992 called "Evaluation of Demonstrated and Emerging Technologies for the Treatment and Clean-Up of Contaminated Land and Groundwater". It encouraged participating countries to develop and present new remediation technologies such as thermal treatment, soil washing and biological treatment at international level.

New landfills are lined with impermeable plastic sheets to prevent toxic substances from seeping into the groundwater

Assessment of the contaminated sites left by the Cold War

As an indirect result of Germany's unification, UBA had increased the number of professionals it employed, now recruiting from former GDR enterprises and institutions. However, unification also came with an increase of environmental problems. A special project was the contamination assessment of the property of the Western Group of Forces of the Soviet Union (WGT). The reason for this was that after the withdrawal of its troops from the former GDR, the Union of the Soviet Socialist Republics demanded financial compensation for the facilities they had constructed in the post-1945 era. It was agreed that, in return, the Federal Republic of Germany

would claim compensations covering the costs of environmental damage caused by the military use of these territories.[13] As a result, the Federal Ministry for the Environment initiated a special project for the study of environmental damage on 1,026 properties (243,000 ha) – a total area at least the size of Saarland.

The task of assessing the premises was carried out by Industrial Plant Operating Company (IABG). However, the technical coordination of the project was UBA's responsibility, which deployed several employees to support any necessary emergency measures.[14]

The goal was to create a separate report for each of the properties which established the cost for the remediation of the respective territory. Firstly, the site was investigated by an inspection company. "It was contractually determined when the companies were allowed to enter Soviet territory".[15] UBA suspected that the main damage was to be found in the soil and groundwater. Therefore, fuel storage tanks and tank garages from which oil and gas could have seeped into the ground were the main targets.

It quickly became apparent that the environmental damage was significantly greater than the value of the facilities built on the properties – likely one reason why some local commanders denied access to German environmental technicians into the most endangered areas.

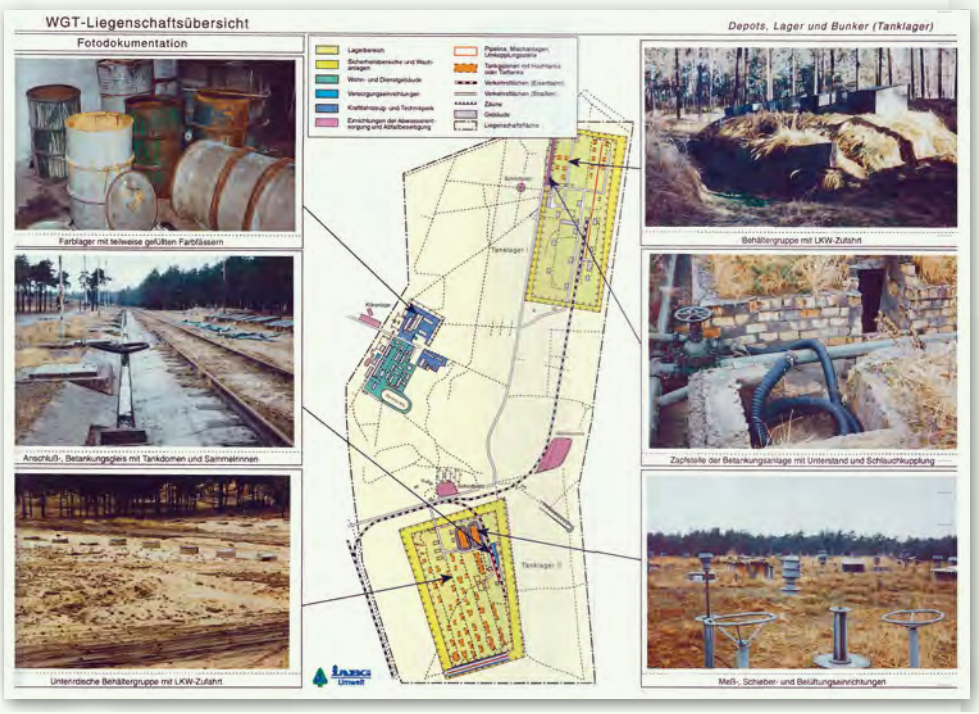
Leftover ammunition on a military property of Soviet troops

UBA employees examine the terrain of a WGT site. The water in the foreground is heavily contaminated by petrol and oil. A test at the water pump proves the liquid is flammable.

After 1990: dealing with the GDR's contaminated sites

In addition to the detection of contaminated military sites, the UBA was strongly involved in the "ecological development and remediation plan for the area of the former GDR" commissioned by the Federal Ministry for the Environment. This project focused mostly on the industrial areas in need of rehabilitation and the question of how to deal with them. In December

An exemplary report of the IAGB examines tanks and bunkers on the former WGT properties. Many of the installations were buried deep into the ground, enabling the uncontrolled seepage of toxic substances into the groundwater.[16]



The property of the Chemie Ltd. Bitterfeld-Wolfen prior to rehabilitation. Most of its individual factories had to shut down between 1990 and 1994. What was left was a derelict industrial site. The area was considered one of the most pressing environmental issues in the 'new' German states as early as 1990, and the contract on the exemplary environmental remediation was signed.

In 1993 only three towers remain of the former Publicly Owned Company, VEB Bitterfeld Chemical Combine. Soil rehabilitation can start after debris removal.

1992, the Federal Government and its new federal states (Länder) agreed in an administrative agreement on the remediation of ecological contaminated sites and their funding.

The "VA Contaminated Land Financing" contains criteria for the definition of so-called large-scale projects. On this basis, a Joint Working Group of the Government (Ministry for the Environment/Ministry for Finance), the Treuhandanstalt and the German states identified 21 major ecological projects, as well as the major project for the rehabilitation of lignite and split the costs between the government and the states. The basis of measurements and their financing was the obligation of the Treuhandanstalt, which had the responsibility of drawing up privatisation contracts with each investor in accordance with the Contaminated Sites provisions.

A designated UBA team have contributed their expertise on the assessment and clean-up of contaminated sites to each of these major projects to this very day. For the "lignite rehabilitation" project, the UBA set up an internal team "Contaminated sites in lignite areas" which developed many techniques based on the remediation of contaminated sites.[17]

On the way to the Federal Soil Protection Act

The Federal Soil Protection Act (BBodSchG) took a long time to prepare. A first draft appeared in 1993 under the supervision of Federal Minister for the Environment Klaus Töpfer (1987-1994). It stipulated that owners were responsible for the elimination of residual contamination on their land.[18]

The UBA was to devise inspection and measuring systems which determined if a specific area posed a danger to humans and the environment and whether the area needed rehabilitation or not. There were many different lists of pollutants until then, but because the number of chemicals and new research results was growing, there was no definite regulation for all German states. As such, a factory in Berlin could be found in need of rehabilitation, but would not be deemed so in another state. This was also a problem for investors as they often remained in doubt about whether a property was going to be in need of costly rehabilitation in future.[19] "Even the industry insists", said UBA president, Heinrich von Lersner and complained that the institution had been waiting for a soil protection act for three legislative cycles.[20]

In the context of the increasing public importance of the matter, UBA created a special department called "Soil" in 1994, which merged the Sections Precaution and Aftercare in Soil Protection with the already existing Contaminated Sites Section.

In addition to contaminated sites problems, the UBA had to deal with issues generated by agricultural practices. Through the intensification of industrial agriculture, the extensive use of pesticides and the introduction of heavy tractors, damage to the soil increased considerably.

Good fences make good farmers

To give these threats a legal framework, the next draft of the Federal Soil Protection Act of 1995 – this time under Minister for the Environment Angela Merkel (1994-1998) – included a section on agriculture. It referred to a "site-adapted use" and called for preventive measures to reduce erosion and soil compaction.

However, conflicts with farmers' associations could not be avoided. They viewed agriculture as an activity in harmony with the environment and found a legislative regulation to be superfluous – one reason why the implementation of the act was further delayed. After being criticised by farmers, the Ministry of Agriculture opposed all proposals such as the Parliamentary Group Alliance 90/The Greens' own draft of the Soil Protection Act, which called for stricter measures to protect the soil from damage caused by agriculture.[21]

Good things come to those who wait

Only two years later, in February 1998, the long awaited legislation for the protection of the soil from harmful intrusions and for the remediation of contaminated sites (Federal Soil Protection Act) was adopted. According to Article 1, the purpose of the law was "ensuring sustainable soil functions and their restoration". Article 17 "Good practices in agriculture" contains seven points to prevent erosion and soil compaction and the facilitation of soil fertility conservation22 – a small victory in the conflict with the farmers' organisations.

Values, procedures and methods for the investigation and assessment of potentially contaminated sites were incorporated into subordinate regulations, the Federal Soil Protection and Contaminated Sites Ordinance (BBodSchV) of 17 July 1999, which has been updated continuously.

Overall, the Federal Soil Protection Act is a landmark in the history of soil protection. It sets out the obligation of hazard prevention and the remediation of contaminated sites. Critics call it a 'contaminated land law'. However, provisions in the sections concerning agriculture are more of a compromise. Farmers only have an obligation of prevention if they violate the Fertiliser and Plant Protection law.[23] To promote precautionary soil protection further, the Ministry for the Environment appointed the Scientific Advisory Council on Soil Protection (WBB) in 1998.

1998

The Federal Soil Protection Act is adopted

Soil & Water

In 2006 the soil department of the UBA was reinforced with the Water Department, building a joint department called "Water & Soil". The priorities of the new department were newly emerging topics such as the consequences of biomass cultivation for soil and groundwater, underground carbon dioxide storage (CCS) and the unconventional extraction of gas (fracking). Furthermore, UBA was supporting preparatory work on a regulation which is aimed at harmonising the permitted levels of soil loads with the substantive requirements for the protection of soil and water. The National Biodiversity Strategy of 2007 changed the view on soil completely. It no longer focused on soil pollution alone but also on the potentials of soil and its ecological functions.

UBA has done substantial work on the topics of soil and climate. Therefore, it was one the early initiators of proceedings for the protection of soils rich in carbon – particularly peatlands.

Land recycling – UBA making progress

The Federal Commissions of the German Bundestag decided to move the Federal Environment Agency to Dessau as early as 1992. The plan was to build a unique ecological building on a former factory site – the Dessau gas district.

However, before even considering the construction of a new building, areas destroyed and polluted by the effects of the Second World War had to be rehabilitated. According to a report, there were tar oils, cutting oils, chlorinated hydrocarbons and heavy metals in the soil which had seeped into the water. However, modern technology enabled completion of rehabilitation of the contaminated soil. The UBA thus demonstrated that abandoned industrial areas can in fact be redesigned and used.

Of course it would have been easier to build on an uncontaminated area, in which case the soil would have lost its natural functions – for plants, animals and humans alike. The UBA was a leading example and not only designed a new type of environmental showcase, but at the same time reduced the surface area use by recycling.

The decision to move the UBA to Dessau was made in 1993. The photo shows the train station in Wörlitz and the former "gas district" prior to rehabilitation

The abandoned and mostly degraded factories of the former gas appliance industry had to be demolished in 1995 before the rehabilitation of soil and water. However, building No. 109 was kept as a memorial and was integrated into the UBA grounds.

Environment Minister Angela Merkel inspects the award winning design of architect Matthias Sauerbruch and Louisa Hutton at the planning contest of 1998.

Aerial view of the UBA building in Dessau-Roßlau. The roof houses a large photovoltaic system to harness solar power to create energy.

The advisory board for soil testing

When the BBodSchV was being discussed, a methodological guide for the ordinance was often demanded to implement soil-related scientific knowledge.

The Federal Ministry for the Environment, Nature Conservation and Nuclear Safety established an Advisory Board at UBA for the surveillance of soil in 2000.

The Soil Protection Commission

In order to strengthen interdisciplinary work, the UBA is being advised since 2004 by the Soil Protection Commission (KBU) of the Federal Environment Agency. This group of renowned scientists of different disciplines supports UBA in important matters in the national and European field. As such, the Commission has warned early on against the problems of the excessive exploitation of renewable sources and possible environmental hazards and also addressed issues of the economical use of land.[24]

Since 2012 the Global Soil Weeks bring together politicians, scientists and interested agents from all over the world to promote soil protection. Participants discussed issues of soil degradation under the slogan "Losing Ground?".

UBA promotes the initiative “Soil of the Year” as part of its public relations activities. Since 2007, a yearly event is organised on 5t December within the framework of “World Soil Day”. The event is held jointly by UBA and KBU and targets current global soil issues.

Soil conservation is picking up speed once again

Through the “European Soil Forum” of 2002, UBA laid the foundations for the work on the EU Soil Directive. However, the EU Commission’s draft of 2006 has so far been rejected by Germany.

Meanwhile, soil protection has been put on the global agenda. The reason for this is climate protection and food security problems due to the progressive degradation and competition for usage through the cultivation of energy crops. The final document of the Rio+20 Conference on Sustainable Development of 2012 requires a “land-degradation neutral world”. The Global Soil Partnership of FAO urges the implementation of uniform rights for the access to soil and land, as well as the sustainable use of soil.

The “Global Soil Week” (www.globalsoilweek.org) already took place twice in Berlin (2012, 2013) and in which UBA acted as a partner in preparation and execution of numerous events. It also played an active role in the discussion on the global sustainable development goals (SDG). The action was triggered in September 2011 – a “Call for Action” entitled “Protecting Soils for our Common Future”, which was written by renowned international scientists under the supervision of the UBA.

Conclusion

In the 1970s and 1980s, the Federal Environment Agency committed to the protection of soil for proper waste management and remediation of contaminated sites. It was through specific studies and factual solutions that the protection of soil entered the public consciousness and many of the formerly acute problems could be solved. Numerous contaminated sites were remediated and prepared for reuse through the technical support from the Federal Environment Agency. A particular success of the 1990s was the adoption of the Federal Soil Protection Act, which not only controls the remedies but also coordinates the preventive measures for soil protection in conjunction with the Federal Soil Protection and Contaminated Sites Ordinance based on prevention, testing and action values determined by UBA. Through this motion, UBA successfully demonstrated that soil should be recognised –in addition to water and air – as the third environmental medium, as a vital, limited and fragile resource in need of protection.

New challenges such as climate change, global environmental change, renewable energy and food security require the broadening of spectrums and the establishment of ecological standards in the use of soil. Land use and soil management must be sustained by adopting a long-term perspective. The recognition of the land as a resource is not enough – it must be paired with its environmentally conscious use.

2015 will be the International Year of Soils. Again, this is an important milestone and a chance to initiate and enforce further soil protection measures. A cautious and informed use of soils is essential. Otherwise, what took centuries and millennia to be created will be lost within a few decades. The importance of soil in the supply of mankind with food, renewable resources and other ecosystem services will only continue to increase. National approaches to soil protection are essential, but they are not sufficient on their own to ensure the protection of soil resources in a globalised world. The Federal Environment Agency therefore supports the European Union and the international community in their efforts to identify measures for the preservation of soil and to develop effective, globally coordinated approaches for its protection.

Fußnoten

"A hybrid of power and impotence"? The foundation of the Federal Environment Agency (UBA) in Berlin and the introduction of modern environmental policy in the Brandt-Genscher era.

1 So the article: Agency devoid of power and dignity (Amt ohne Macht und Würden), in: BMI (ed.), Umwelt Magazin (1976), 6 f., here 7.
2 To Berg: http://www.bundesarchiv.de/cocoon/barch/1000/x/x1956e/kap1_4/para2_3.html.
3 Cf. Hans-Peter Vierhaus, Environmental consciousness. For the constitutional requirement of democratic decision-making (Zum Verfassungsgebot demokratischer Willensbildung) (papers on Environmental Law 48), Berlin 1994, 104–107.
4 Cf. Public opinion research on "environmental problems", in: Environmental protection. Information of the Federal Ministry of the Interior on issues of water management, air pollution, noise pollution and sanitation (Öffentliche Meinungsforschung zum Thema „Probleme des Umweltschutzes", in: Umweltschutz. Information des Bundesministeriums des Innern zu Fragen der Wasserwirtschaft, Luftreinhaltung, Lärmbekämpfung und Abwasserbeseitigung) Booklet 13 (1972), 1–11.
5 Joachim Radkau, The Age of the Ecology. A world History (Die Ära der Ökologie. Eine Weltgeschichte), München 2011, 124.
6 Heinrich von Lersner, The Ecological Turn (Die ökologische Wende), Berlin 1991, 27.
7 On the effects of Carson etc. cf.: Kai F. Hünemörder, The early history of the global environmental crisis and the formation of German environmental policy (Die Frühgeschichte der globalen Umweltkrise und die Formierung der deutschen Umweltpolitik) (1950-1973), Wiesbaden 2004, 114-120.
8 Encyclopaedia of World Environmental History, Vol. 1, 355; quot. after Radkau, The Era of the Ecology, 153.
9 All data after Radkau, The Era of the Ecology, 123-133.
10 Cf. Hünemörder, Early History (Frühgeschichte), 141–146.
11 Cf. Brandt's Governing Statement: http://www.hdg.de/lemo/html/dokumente/KontinuitaetUnd Wandel_erklarungBrandtRegierungserklaerung1969/.
12 Cf. Vierhaus, Environmental Consciousness (Umweltbewußtsein), 85–90.
13 Cf. comprehensive: Vierhaus, Environmental Consciousness, 101–138.
14 Cf. Hünemörder, Early History, 121–126.15 Cf: Henning von Köller (ed.), Environmental policy with sound judgment (Umweltpolitik mit Augenmaß). Commemorative paper for State Secretary Dr. Günter Hartkopf on the occasion of his 10th anniversary of death on September 19, 1999 Berlin 2000.
16 Cf. Haug von Kuenheim, Bonn wants to Clean up (Bonn will säubern) in: Die Zeit of 27.08.1971.
17 Cf. lastly: Malte Herwig, The Flakhelfers. How Hitler's youngest soldiers became Germany's leading democrats (Die Flakhelfer. Wie aus Hitlers jüngsten Soldaten Deutschlands führende Demokraten wurden), München 2013. Historical research meanwhile speaks of the "1945 generation" rather than „Flakhelfergeneration".
18 Cf. e.g. Hünemörder, Early History, 156 f.
19 Radkau, Era of the Ecology, 141.
20 Cf. A rebellious civil servant. Environmental expert Peter Menke-Glückert is constantly at odds with his ministers (Ein aufmüpfiger Beamter. Umweltexperte Peter Menke-Glückert ist ständig im Clinch mit seinen Ministern), in: Die Zeit 29/1980 of 11.07.1980, 51.
21 Cf. Hünemörder, Early History, 155 and 159.
22 Cf. Hünemörder, Early History, 155.
23 Cf. Hünemörder, Early History, 160-162. For Grzimek's role as campaign engine cf. Jens Ivo Engels, Nature Politics in the Federal Republic. World of ideas and political behaviour styles in conservation and environmental movements. (Naturpolitik in der Bundesrepublik. Ideenwelt und politische Verhaltensstile in Naturschutz und Umweltbewegung), 1950–1980, Paderborn u. A. 2006, 246–251.
24 Cf. Vierhaus, Environmental Awareness, 166–182.
25 Cf. Edda Müller, Social-liberal environmental policy. From the career of a new policy area, in: From Politics and History (Sozial-liberale Umweltpolitik. Von der Karriere eines neuen Politikbereichs, in: Aus Politik und Zeitgeschichte), B 47-48 (1989), 3–15, here 7.
26 So in July 1970 at the BDI staff meeting; quot. after Hünemörder, Early History, 172.
27 Cf. Vierhaus, Environmental Consciousness, 110-114.
28 UBA, Brief information sheets on the history of environmental protection, No. 712: Disposal of waste (landfill)/History (Ablagerung von Abfällen (Deponie)/Geschichte).
29 So the Title of an article in the weekly "Die Zeit" of 27.08.1971 about Genscher's environmental programme.
30 Cf. Müller, Environmental Policy, 8-10.
31 Cf. Hünemörder, Early History, 180.
32 Cf. UBA, registry 90.042-2/0, History of the Federal Environment Agency, Generalities, Development of the Federal Environment Agency (Chronicle), (Geschichte des Umweltbundesamtes, Allgemeines, Entwicklung des Umweltbundesamtes)
33 Cf. Environmental Programme of the Federal Government, German Bundestag, 6th election period, printed matter VI/2170, here 15; Online: http://dip21.bundestag.de/dip21/btd/06/027/0602710.pdf.
34 Cf. Hünemörder, Early History, 158.
35 Cf. UBA, registry 90.042-2/0, History of the Federal Environment Agency, Generalities, Development of the Federal Environment Agency (Chronicle), (Geschichte des Umweltbundesamtes, Allgemeines, Entwicklung des Umweltbundesamtes) and 90.042-2/2, History of the Federal Environment Agency, Structure of the UBA to construction law, from Uppenbrink to Genscher (Geschichte des Umweltbundesamtes, Auf bau des UBA bis zum Errichtungsgesetz) on 17.01.1973.
36 UBA, registry, 90.042, Opinion of the Federal Court on the question of the establishment of a Federal Office for the Environment, March 1972.
37 Cf. UBA, registry 90.042-2/2, History of the Federal Environment Agency, Structure of the UBA to the Establishment Act (Geschichte des Umweltbundesamtes, Auf bau des UBA bis zum Errichtungsgesetz), Uppenbrink to Genscher, 17.01.1973.
38 Ibid.
39 Ibid.
40 UBA, registry 90.042-2/4, History of the UBA, Location problems of the UBA (Geschichte des UBA, Standortprobleme UBA), BMI organisational paper to Genscher 10.05.1973.
41 UBA, registry 90.042-2/4, History of the UBA, Location problems of the UBA (Geschichte des UBA, Standortprobleme UBA), Genscher to Hartkopf 15.05.1973.
42 UBA, registry 90.042-2/4, History of the UBA, Location problems UBA, site survey of the planned Federal Office for the Environment (Geschichte des UBA, Standortprobleme UBA, Gutachten zum Standort des geplantes Bundesamtes für Umweltschutz), February 1973.
43 UBA, registry 90.042-2/4, History of the UBA, Location problems UBA, statement from Hartkopf imposing the deliberations of the independent body for location decision (Geschichte des UBA, Standortprobleme UBA, Statement from Hartkopf zur Einführung in die Beratungen des unabhängigen Gremiums zur Standortentscheidung) 30.07.1973.
44 UBA, registry 90.042-2/3, History of the UBA, Berlin issues (Geschichte des UBA, Berlinproblematik UBA),BMI organisational paper to Genscher 24.08.1973.
45 UBA, registry 90.042-2/3, History of the UBA, Berlin issues (Geschichte des UBA, Berlinproblematik UBA), commentary „Political Pollution" („Politische Umweltverschmutzung") in „Neues Deutschland" of 31.08.1973.
46 UBA, registry 90.042-2/3, History of the UBA, Berlin issues, BMI organisational paper to Genscher 24.08.1973. About Bahr' engagement wrote DER SPIEGEL in No. 32/1974, 21.
47 UBA, registry 90.042-2/3, History of the UBA, Berlin issues, BMU- UA I to Lersner 04.10.1973.
48 UBA, registry 90.042-2/3, History of the UBA, Berlin issues, Genscher's speech title 27.09.1973.
49 Cf. UBA, registry 90.042-2/3, History of the UBA, Berlin issues, Note on the meeting with the Embassadors of the Allies 18.09.1973.
50 Act on the Establishment of a Federal Environment Agency on 22. July 1974, Federal Gasette (BGBl). I, 1505.
51 Cf. Berlin "Low-level harassment" (Berlin „Schikanen auf niedriger Ebene"), in: Der Spiegel No. 33/1974, 17 f.
52 Cf. the memoirs of Schmidt: Helmut Schmidt, people and powers (Helmut Schmidt, Menschen und Mächte), Berlin 1987, 55-62.
53 Cf. Rumours in the Department of Environmental Protection excite Berlin, in Frankfurter Allgemeine Zeitung (Gerüchte im Umweltamt erregen Berlin, in: Frankfurter Allgemeine Zeitung), 21.01.1974.
54 UBA, registry 90.042-2/3, History of the UBA, Berlin issues (Geschichte des UBA, Berlinproblematik UBA), Lersner to Genscher, 29.08.1973.
55 Ibid.
56 The decree in: UBA, registry 90.042-2/3, Decree on the Establishment of a Federal Bureau of Environmental Affairs 30.07.1973.
57 Cf. UBA, registry 90.042-2/2, History of the Federal Environment Agency, Structure of the UBA up to establishment act, situation explanation on the structure of the Federal Environmental Agency (Geschichte des Umweltbundesamtes, Auf bau des UBA bis zum Errichtungsgesetz, Sachdarstellung zum Auf bau des Umweltbundesamtes), 11.02.1974.
58 Cf. UBA (ed.), Annual Report 1975/76, 7.
59 Ibid, 8.
60 On the history of the building: Wolfgang Schäche, Architectural history report Bismarck Square Vols. 1, 2 (Bauhistorisches Gutachten Bismarckplatz), Berlin 2013 (available in the library of the Federal Government).
61 Cf. UBA, registry 90.042-2/0, History of the UBA, Generalities (Geschichte des

Umweltbundesamtes, Allgemeines), BMI to BMF of 18.12.1973.
62 Ibid. The building now houses various Berlin Senate administrations. The open spaces were redeveloped as part of the International Building Exhibition in 1984
63 Cf. An agency devoid of power and dignity (Ein Amt ohne Macht und Würden), in: BMI (ed.), Umwelt Magazin (1976), 6 f.
64 A little too hot (Bißchen zu heiß), in: Der Spiegel, 32/1974, 19-21, here 21.
65 Ein Amt ohne Macht und Würden, in: BMI (ed.), Umwelt Magazin (1976), 6.
66 Cf. Hünemörder, Early History, 120.
67 Cf. UBA, registry 90.042-2/0, History of the Federal Environment Agency, General, Memoranum for the establishment of the Federal Environmental Agency (Geschichte des Umweltbundesamtes, Allgemeines, Aktenvermerk zum Auf bau des Umweltbundesamtes), 06.12.1973.
68 Cf. UBA, registry 90.042-2/0, History of UBA, Generalities (Geschichte des Umweltbundesamtes, Allgemeines), BMI to BMF of 18.12.1973.
69 Cf. Federal Government (ed.), Annual Report 1975/76, 9.
70 Cf. Federal Government (ed.), Annual Report 1977, 6 f.
71 Cf. Federal Government (ed.), Annual Report 1980, 6.
72 Ibid, 6 f.
73 Cf: Federal Government (ed.), Annual Report 1975/76, 5.
74 Federal Government (ed.), Annual Report 1975/76, 11 (Organisational chart on 1. July 1976).
75 Following after: Federal Government (ed.), Annual Report 1975/76, 10.
76 Ibid, 18
77 UBA, registry 90.042-2/2, History of the UBA, construction of the Federal Environment Agency to establshment law, previous work product of the inter-ministrial working group on the construction of the UBA (Geschichte des UBA, Auf bau des Umweltbundesamtes bis zum Errichtungsgesetz, Bisheriges Arbeitsergebnis der innerministeriellen Arbeitsgruppe zum Auf bau des UBA), 02.01.1973.
78 Ibid.
79 All biographic data after: Werner Schenkel/Peter-Christoph Storm (ed.), Environmental policy, technology, law. Heinrich von Lersner on his 60th birthday (Umwelt: Politik, Technik, Recht. Heinrich von Lersner zum 60. Geburtstag), Berlin 1990, 7-9.
80 So Lersner himself in an interview in 1983: Michael O. R. Kröher, Sisyphus' civil servants (Die Beamten des Sisyphus). Or: How the German environment is protected (Wie die deutsche Umwelt geschützt wird), in: TransAtlantik, Booklet 4 (April) 1983, 34-38, here 34.
81 Cf. the selected bibliography of his environmental writings: Siegbert Lohse, Bibliography Heinrich Baron von Lersner (Bibliographie Heinrich Freiherr von Lersner), in: Schenkel/Storm (ed.), Umwelt, 387-390.
82 Interview with Dr. Christiane Markard on 25.11.2013.
83 Schenkel/Storm (ed.), Umwelt, 9.

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1 Cf. Federal Government (ed.), Federal Environment Agency (Umweltbundesamt) 1975/76, 6 f.
2 Cf. Act on the Establishment of a Federal Environmental Agency (Gesetz über die Errichtung eines Umweltbundesamtes) of 22. July 1974, § 2 Para. 2.
3 Cf. Federal Government (ed.), Federal Environment Agency 1975/76, 15.
4 Convention on Long-Range Transboundary Air Pollution (LRTAP).
5 Cf. Federal Environment Agency (ed.), Annual Report 1997, 157 f.
6 Acid rain: "There's something in the air" („Das liegt was in der Luft") (I), in: Der Spiegel No. 47/1981, 96–110, here 99.
7 "There's something in the air" („Da liegt was in der Luft") (II), in: Der Spiegel No. 48/1981, 188-200, here 188.
8 "We're facing an ecological Hiroshima" („Wir stehen vor einem ökologischen Hiroshima"), in: Der Spiegel 7/1983, 72–92.
9 Federal Government, 6.11.1982, quot. After Newig, Jens: Symbolical Legislation between the exercise of power and social self-deception (Symbolische Gesetzgebung zwischen Machtausübung und gesellschaftlicher Selbsttäuschung), in: Cottier, Michelle/Estermann, Josef/Wrase, Michael: How does the law work? Selected Contributions to the first joint congress of the German legal sociology associations (Wie wirkt Recht? Ausgewählte Beiträge zum ersten gemeinsamen Kongress der deutschsprachigen Rechtssoziologie-Vereinigungen), Luzern 4.–6. September 2008, Baden-Baden 2010, 301-322, here 313.
10 Regulation on large combustion and gas turbine systems (Thirteenth Order implementing the Federal Pollution), 13. BImSchV).
11 Cf. Federal Environment Agency (ed.), Annual Report 1978, 50 f.
12 First General Administrative Regulation for the Federal Pollution Control Act (Technische Anleitung zur Reinhaltung der Luft – TA Luft).
13 Federal Environment Agency (ed.), Annual Report 1981, 62.
14 Cf. Fonk, Christian Friedrich, European air quality objectives and national fulfillment of responsibility (= writings on international and public law, Vol. 78) (Europäische Luftqualitätsziele und nationale Erfüllungsverantwortung (= Schriften zum internationalen und zum öffentlichen Recht, Bd. 78), Frankfurt am Main 2009, 36.
15 Cf. ibid., 33, 61 ff.
16 Guideline 96/62/EC of the Coucil of 27. September 1996 on the inspection and control of air quality.
17 Cf. Fonk, Air quality aims, 40.
18 Cf. Federal Environment Agency (ed.), Annual Report 1997, 152 f.
19 Cf. Federal Environment Agency (ed.), Annual Report 1996, 125.
20 The implementation of the policies carried out by the 7th BimSchG amendment and the 22.BImSchV.
21 Guideline 1999/30/EC of the Council form 22. April 1999 about limits on sulphur dioxide, nitrogen dioxide and oxides of nitrogen, particulate matter and lead in the air (1. Subsidiary directive).
22 Cf. Fonk: Air quality objectives, 31 f.
23 Guideline 2000/69/EC of the European Parliament and the Council of 16. November 2000 about limits for benzene and carbon monoxide in the air (2. Subsidiary directive).
24 Guideline 96/61/EC of the Council of 24.September 1996 about the integrated prevention and reduction of environmental pollution.
25 Cf. Fonk: Air quality objectives, 37.
26 Cf. Federal Environment Agency (ed.), Annual Report 1999, 33 ff.

From the remediation of contaminated sites through the Federal Soil Protection Act to international protection of soil – 40 years of soil protection in the Federal Environment Agency

1 Volker Franzius, Lecture on contaminated sites – an international problem, Aachen 1984, 2–3.
2 Cf. German Bundestag: Environmental Programme. 1971, 29–33.
3 Cf. http://www.wirtschaftslexikon.co/d/abfallgesetz/abfallgesetz.htm
4 Cf. Federal Environment Agency, Press archive, Interview with Dr. Volker Franzius of 06.12.2013.
5 Cf. Environmental Guidelines of the SRU 1978.
6 Explosive Combination (Explosive Mischung), in: Der Spiegel 33/1978, 102–103.
7 Cf. Egmont Koch, Fritz Vahrenholt, Seveso is everywhere (Seveso ist überall), 1978.
8 Cf. Chemical waste: The poisoned flood that follows us (Chemie-Müll: Nach uns die Giftflut), in: Der Spiegel 22/1983, 31.
9 Cf. Federal Government (1985): Soil protection concept of the Federal Government, Bonn 1985.
10 Cf. The Federal Minister for Environment and Conservation and Nuclear Safety, Environmental Policy, Report of the Federal Government to the German Bundestag, measures for soil conservation, Bonn 1988.
11 Volker Franzius, Lecture on contaminated sites – an international problem, Aachen 1984, 4–6.
12 Cf. Federal Environment agency (ed.), Annual Report 1982.
13 Cf. IAGB (ed.) Identification of potentially contaminated sites on the property of the Western Group of Soviet troops (WGT), Final documentation, Ottobrunn 1995, 2–4.
14 Cf. Federal Environment Agency (ed.), Annual Report 1994, 196.
15 Cf. Federal Environment Agency, Press archive, Interview with Dr. Volker Franzius, 06.12.2013.
16 Once again, full speed (Noch einmal volle Pulle), in: Der Spiegel 3/1992, 69.
17 Cf. Federal Environment Agency (ed.), Annual Report 1995, 201-206.
18 Cf. Federal Environment Agency (ed.), Annual Report 1993, 78-82.
19 Cf. Volker Franzius; Günther Bachmann, Rehabilitation of contaminated sites and soil protection 1998, Berlin 1999, 11.
20 We wait and wait (Wir warten und warten), in: Der Spiegel 29/1995, 34.
21 We wait and wait (Wir warten und warten), in: Der Spiegel 29/1995, 34.
22 Cf. Hans-Peter Vierhaus, Soil protecting legislation (Das Bundes-Bodenschutzgesetz), in: Neue Juristische Wochenschrift 1998, 1262-1269.
23 http://www.kritischer-agrarbericht.de/fileadmin/Daten-KAB/KAB-2010/Valentin.pdf
24 http://www.umweltbundesamt.de/sites/default/files/medien/publikation/long/3472.pdf
25 The contribution is based on both literature and material from the source, on interviews that were conducted with Marion Wichmann-Fiebig, Wolfgang Grosch, Heinz-Detlef Gregor, Michael Long, Ruprecht Schleyer, Christiane Markard and Peter David. We would like to take this opportunity to cordially thank them for their commitment.

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Industrial park: Ullstein
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Page 91: Federal Archive
Page 92: Federal Archive
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Page 94: Neues Deutschland Archive
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Aerial photograph: Steffen Mainka,
Group photo: IASS

Editorial information

Publisher:
Umweltbundesamt (Federal Environment Agency)
Wörlitzer Platz 1
06844 Dessau-Roßlau
Telephone: 0340 21 03-0
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Concept and coordination:
Martin Ittershagen,
Christoph Zinsius (Chronik),
Christian Marc Lakotta

English by:
Nigel Pye
http://www.npservices4u.co.uk/

Design:
Studio GOOD, Berlin
www.studio-good.de

Print:
printed on 100 % recycled paper

This publication forms part of the Federal Environment Agency's public relations material. It can be obtained free
of charge from:
GVP | Postfach 30 03 61 | 53183 Bonn
Customer service line: 0340 21 03-66 88
Customer service fax: 0340 21 03-66 88
Email: uba@broschuerenversand.de
Internet: www.umweltbundesamt.de

Publicationen as a pdf:
http://www.umweltbundesamt.de/publikationen/what-matters-2014-offprint-of-the-chapter-soil-our

As at December 2014

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Jahre 1974–2014
Umweltbundesamt