Magazine of the German
Environment Agency
2/2019

WHAT MATTERS

Aviation

Umwelt Bundesamt

For our Environment

FOREWORD

Maria Krautzberger, President,
German Environment Agency

Dear Readers,

Flying is a dream of mankind. To glide weightlessly through the air and leave the burden of everyday life behind. To be free. There have always been attempts to take off from the ground. Even Leonardo da Vinci tried to construct flying machines. Mythology is full of figures that soar into the air – but all too often fail, like Icarus, who comes too close to the sun and falls into the sea.

Today man flies and the sky is full. Millions of planes cross the airspace every year. But instead of leaving the burden of the world behind, flying is increasingly becoming a burden for the world.

Air traffic already contributes to overheating the earth. Not only through CO_2 emissions, but also through many other effects that make flying particularly harmful to the climate. All forecasts assume that more and more people will be flying in the future, which means that the share of air traffic in global warming will increase.

All analyses suggest that we have to fly less to protect the climate. But is that possible at all, is it acceptable to our society – and the world? Is that even fair?

Flying today is anything but fair. A very small proportion of people, even in Germany, fly at the expense of society. Cheap tickets are only available because flying in Germany is subsidised with billions – leaving less money for better, cheaper and more climate-friendly rail connections, for example.

In November 2019, UBA presented a comprehensive concept for more environmentally friendly air travel, which you will find in this issue in compact form. We also recommend how you can at least compensate for emissions if you really have to fly. And we looked at whether “Flygskam” – flight shame, is a good concept.

Dear readers, I am retiring at the end of the year and bid farewell to UBA. That is why you will also find an interview about my impressions of five years at UBA in this issue.

I wish you an inspiring read and please keep UBA in good memory.

Yours

Maria Krautzberger

CONTENTS

TOPIC

STUDY

Electric scooters do not help make traffic cleaner

The environment does not benefit from electric scooters currently available for hire in city centres. Initial figures show that they often replace walking and cycling which are more environmentally friendly. In addition, service life of rental scooters and batteries is apparently short. However, scooters certainly have the potential to make mobility more sustainable if they replace car journeys.

More info at www.uba.de/e-scooter.

POSITION

Lack of recycling capacity for wind turbines

More than 27,000 onshore wind turbines are currently working in Germany. At the end of 2020, turbines will for the first time fall out of the 20-year sponsorship period under the Renewable Energy Sources Act (EEG). Depending on local conditions, older turbines can be replaced by more powerful and efficient new turbines that allow higher yields on the site (also called repowering). Extended operation of turbines can also be considered if it is technically and economically feasible. It is expected that more extensive decommissioning will take place from 2021 onwards.

The German Environment Agency has investigated the recycling possibilities of these installations. Steel and concrete elements are expected to cause problems. However, there is a risk of bottlenecks in recycling capacity of the fibre-reinforced plastics used in the rotor blades and risks to people and the environment if the plants are not dismantled properly. UBA therefore recommends that clear guidelines be developed for the extent and methods of dismantling in order to protect people and the environment and to recycle materials practically.

More information at www.uba.de/weacycle.

STUDY

Climate neutral and resource efficient by 2050

In its RESCUE study, UBA has investigated how Germany can achieve greenhouse gas neutrality by 2050 and use 70 percent less raw materials and resources at the same time. The RESCUE study uses six scenarios to outline possible paths that still need to be developed in detail. The scenarios are intended to help the Federal Government to bring the agreed goal of greenhouse gas neutrality to life by 2050.

www.uba.de/rescue

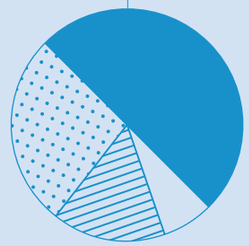
PUBLICATION

Fouling atlas

Algae, barnacles or mussels on boats are often fought with biocide-containing antifouling coatings that damage the environment. UBA has published an information portal for boat owners, the 'Fouling atlas', in which the fouling conditions in German waters can be displayed and researched. The portal also provides information and experience with biocide-free anti-fouling methods.

www.uba.de/bewuchsatlas

Litter on European beaches – what does it consist of?



OVERVIEW PUBLICATION

Plastics in the environment

Plastics are important materials and their demand and consumption have been rising sharply for years. If plastics enter the environment, they can have a massive impact on ecosystems and living organisms. In the meantime they can be found in seas, rivers, lakes and soils. A major cause worldwide is inadequate waste and wastewater management, but there are many other sources such as tyre scuff, foils used in agriculture or plastic particles in cosmetics and cleaning products. Littering also causes more and more plastics to end up in the environment. The brochure 'Plastics in the Environment' shows where Germany stands, what it must do, what research is needed and what measures can be implemented now to get the problem under control.

More information at www.uba.de/publikationen/plastics-in-the-environment

Editorial information

Publisher:
German Environment Agency
PO Box 14 06
D-06844 Dessau-Roßlau
Tel: +49 340-2103-0
info@umweltbundesamt.de
www.umweltbundesamt.de

/umweltbundesamt.de
/umweltbundesamt

Responsible editor:
Felix Poetschke
Design:
Studio GOOD, Berlin
www.studio-good.de
English by:
Nigel Pye
npservices4u@gmail.com
Print:
Bonitasprint GmbH, Würzburg
Printed according to the
Blue Angel criteria

Order from:
German Environment Agency
Hotline: +49 340 2103-6688
Fax hotline: +49 340 2104-6688
uba@broschuerenversand.de
www.umweltbundesamt.de

As of December 2019

Bildnachweis/Copyright:
Cover page, p.10/11, 12/13, 14, 20/21: Mike Kelley, p. 6: Riccardo Cirillo/iStock, p. 22: Eden Breitz / Alamy Stock Foto, p. 25: Robert Brook/gettyimages.de, p. 29: Patrik Müller, p. 30: AdrianHancu/iStock, p. 33: Michael Johne, p. 34, 37: Susanne Kambor, p. 38/39: Martin Stallmann, p. 42, 43 (bottom): atmosfair gGmbH, p. 43 (top): Climate Bridge GmbH, p. 45: German Environment Agency

Environmental awareness in Germany

Every two years, the Federal Ministry for the Environment's (BMU) and the German Environment Agency's environmental awareness study examines the development of Germans' environmental awareness and environmental behaviour.[1] Current studies show that societal awareness of the need for increased environment and climate protection has grown strongly in recent years. Climate change, in particular, is on people's minds in Germany.

In 2018, 64 percent of respondents considered environment and climate protection as a very important challenge, while 68 percent did so in 2019. This represents an increase of 15 percentage points compared to the 2016 survey. Thus environmental and climate protection is currently the most important challenge according to public opinion.

The state of the environment in Germany in 2018 and 2019 was rated significantly worse than in all previous studies. Only 60 percent of respondents rated it as 'very good' or 'fairly good', compared to 75 percent in the 2016 survey. The commitment of key stakeholders to environmental and climate protection was also rated significantly worse in 2018 and 2019 than in all previous surveys. In 2019, only 18 percent of respondents thought that the German government was doing enough for environmental and climate protection. Eleven percent believed that industry is doing enough, and 27 percent of respondents thought that citizens are doing enough to protect the environment.

1 The poll was based on about 2,000 respondents, who formed a representative sample of the German resident population. An interim survey was conducted in 2019.

Figure 1

These challenges are 'very important' in the respondents' view:

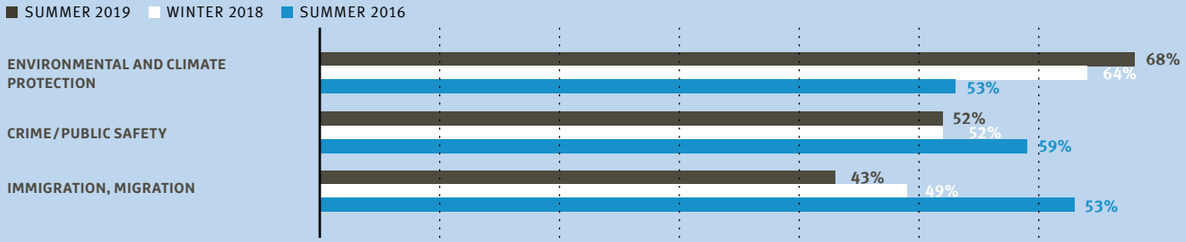


Figure 2

Requirements for environmental and climate protection should 'have an overriding importance' in:

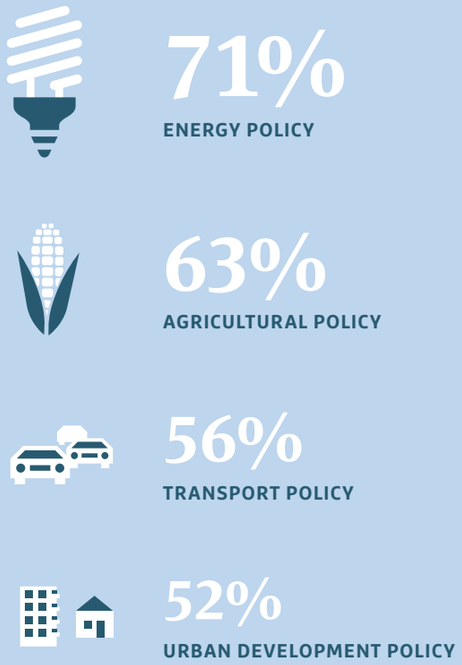
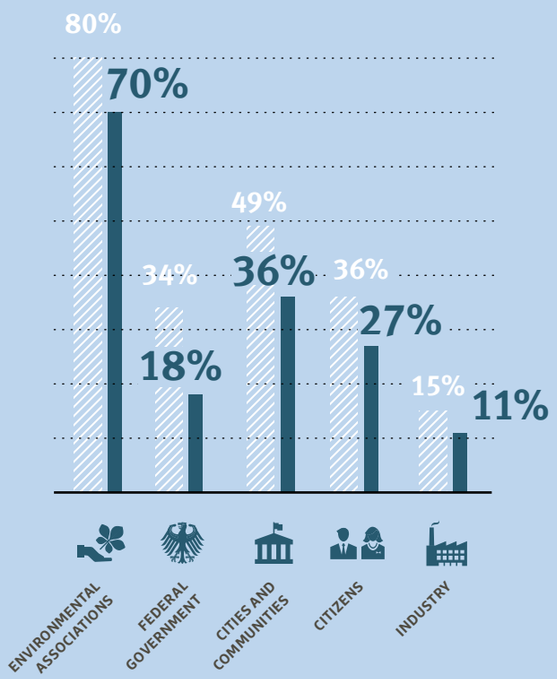


Figure 3

Are the following players doing enough for environmental and climate protection?

Answer: some are doing enough, others doing something, the rest just about enough



Representative survey with about 2,000 respondents per survey

When asked about the most important players who could ensure that energy, agriculture and transport sectors become more environmentally friendly, respondents cited federal and state governments in the first place, followed by each and every individual and economic players. This is fairly understandable because citizens need suitable framework conditions that make it easier for them to convert their existing abstract willingness to act into implementable actions.

This also requires environment and climate protection to be more closely integrated into other policy areas – in particular energy and agricultural policy, urban and regional development and transport policy. The public demonstrate strong support for this requirement.

In the transport sector, for example, this can mean making rail travel cheaper and air travel more expensive (see the topic also in this issue) and expanding public transport in rural areas. Here, politicians are called upon to ensure that the necessary changes are made. This includes abolishing environmentally harmful subsidies, charging environmental costs more heavily to those who cause them and increasing government investment in sustainable infrastructure.

The fact that environment and climate should be better protected was more strongly present in society's awareness in 2019 than any other topic. There is therefore a good window of opportunity to finally act on climate protection in accordance with the objectives of the Paris Climate Agreement. This requires rethinking, new courage, a stronger pursuance of integrated policy approaches and strengthening cooperation across policy fields.

Angelika Gellrich
Expert in the Section 'Economic and Social Environmental Issues, Sustainable Consumption'

More information:
Study 'Environmental awareness in Germany in 2018'
www.umweltbundesamt.de/publikationen/umweltbewusstsein-in-deutschland-2018

TOPIC

Climate Protection in Aviation

Photos by **Mike Kelley**

The volume of air travel keeps increasing worldwide. At 4.3 billion passengers in 2018, more people boarded flights than ever before. Since the beginning of the 1990s the number of passengers more than doubled globally.

In Germany the number of passengers has even tripled from 38 million to 122 million per year. Of all the ways to get around, flying is the most damaging to the climate. It is about six times more harmful than taking the train.

Climate impact of aviation

Burning kerosene produces carbon dioxide (CO_2), which as a greenhouse gas contributes directly to warming the earth's atmosphere. The CO_2 emissions of all air travel amount to about 2.5 percent of CO_2 emissions worldwide (2015). As air traffic is growing rapidly, this share is expected to increase significantly in the next few years. However, the amount of CO_2 emissions is not the only relevant quantity. Aircraft leave behind other emissions in the atmosphere that impact climate: These are mostly particles, water vapour, sulphur and nitrogen oxides. They are responsible, among other things, for forming contrails at cruising altitude. However, they also influence the concentrations of some atmospheric gases such as ozone and thereby contribute to global warming. While CO_2 emissions are proportional to the amount of kerosene being burned, this relationship does not hold for non-CO_2 effects. These effects depend rather on diverse processes in atmospheric chemistry and can vary widely from flight to flight. Because of the non-CO_2 effects, according to the current state of science, the total climate impact of air traffic is double to triple that of CO_2 emissions alone - the total share of air traffic in global greenhouse gas emissions corresponds therefore to around five to eight percent. Bad news for the dream of climate-neutral flying: these non-CO_2 effects also occur when conventional kerosene is replaced by CO_2-neutral synthetic fuels.

In order to limit global warming to well below 2 °C compared to pre-industrial periods and to stop the temperature rise already at 1.5 °C, global CO_2 emissions must be reduced completely by 2050. This goal alone is very ambitious for aviation because a complete replacement of fossil kerosene with alternative fuels or means of propulsion is expensive and will take a long time. The non-CO_2 effects are not even taken into account. 185 out of the 196 state parties to the United Nations Framework Convention on Climate Change that signed the Paris Agreement must therefore not only reduce CO_2 emissions from aviation, but also drastically reduce the non-CO_2 effects if the above objectives are to be achieved.

How can this be achieved?

With today's propulsion technology, aviation cannot become climate neutral. However, with a set of effective measures, it can cause significantly less harm to the climate. This includes technical instruments that are operationally effective in aviation, and economic instruments that must be applied in Germany, Europe and internationally.

One of the most important parameters to adjust is the ticket price. Flying is often too inexpensive today – often more so than the train. The reason is that air traffic benefits from substantial subsidies. Cross-border air traffic in Europe is exempt from value-added taxes, unlike the climate-friendly railway. This subsidy costs German taxpayers around 4.2 billion euros per year. Aviation fuels also subsidized. The energy tax is not levied on kerosene. If kerosene were taxed in Germany at the same rate as petrol, the state would receive around 8.1 billion euros more. These subsidies have given air traffic clear competitive advantages over other modes of transport.

In their current form, the German ticket tax and the European emissions trading (EU ETS) do not sufficiently counterbalance this unjust subsidisation. So, for example, according to the air traffic tax law in Germany the air traffic tax rates are regularly reduced in the ratio of auction revenues from EU ETS European emissions trading. These framework conditions must be changed quickly and in a sustainable manner, because they are a major cause of the steady growth of air traffic.

The climate impact of flying

5 – 8 %

of the global climate impact is caused by aviation

Warming effects:

Radiative forcing in mW/m² (2005)

CO_2	Soot	O_3	Contrails / Contrail cirrus	Water vapour
28 mW/m²	3 mW/m²	41 mW/m²	50 mW/m²	3 mW/m²

Cooling effects:

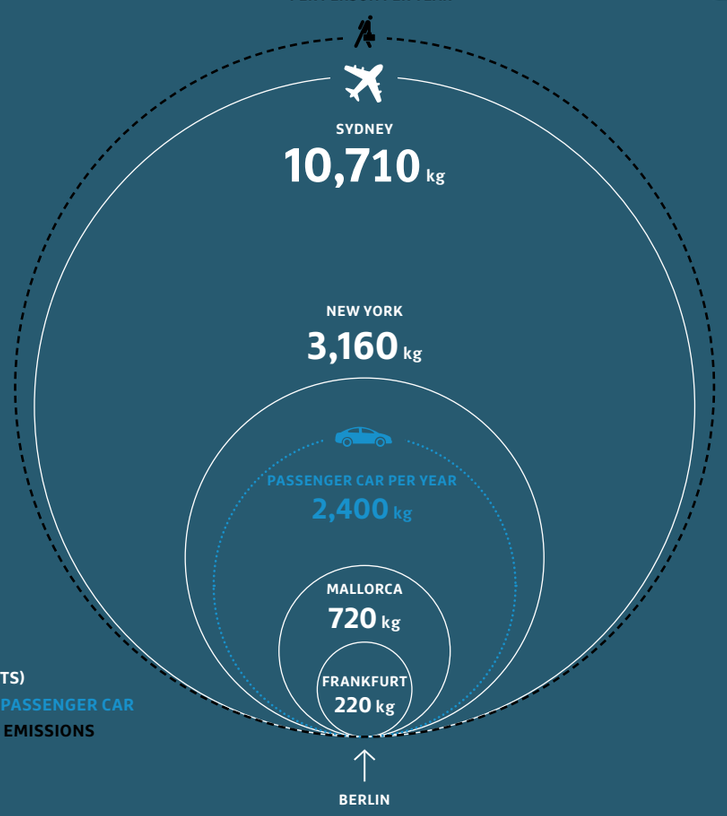
Indirect aerosol cloud effect	Methane degradation	Sulphate
unclear	-14 mW/m²	-5 mW/m²

"Non-CO_2 effects"

Source: DLR

Climate impact of return flights

per person per year, comparison in kg of CO_2 equivalents



— FLIGHT (INCLUDING NON-CO_2 EFFECTS)

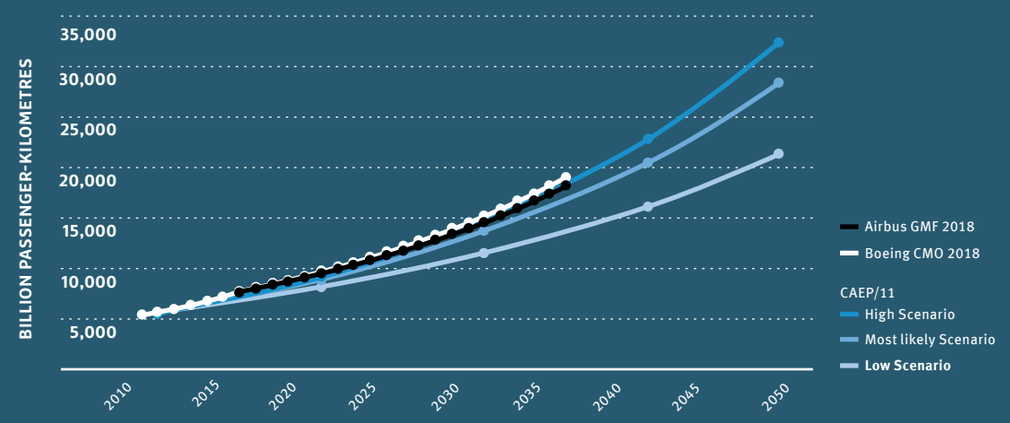
···· AVERAGE ANNUAL EMISSIONS FOR PASSENGER CAR

– – AVERAGE TOTAL GREENHOUSE GAS EMISSIONS PER PERSON

Source: German Environment Agency

Comparison of air traffic forecasts

Forecasts of the future traffic performance of Boeing and Airbus until 2037 or of the ICAO (International Civil Aviation Organisation) until 2050 under different framework conditions.



How can aviation become more climate-friendly?

As a first step, the German Environment Agency recommends abolishing the regular reduction of the ticket tax and significantly increasing taxation. In the short term, the ticket tax should be at least doubled. At the same time the kerosene tax exemption in Germany should be abolished and the EU minimum tax rate of 33 cents per litre for domestic flights should be introduced. However, flying would still not contribute as much to tax revenue as other modes of transport. By 2030 at the latest, taxes should be fully aligned with other means of transport. The increased ticket tax compensates for the exemption from VAT which will continue to exist for the foreseeable future.

As a second step, a tax on kerosene should be introduced at the European level. To achieve this, we recommend that the Federal Government take action at European level by first introducing bilateral agreements with other pioneer states to introduce a kerosene tax on cross-border flights.

In the forthcoming process to reform the European Emissions Trading System (EU ETS) for aviation, Germany should also work to ensure that this key European climate protection instrument is further developed effectively. Key elements are: a faster reduction of the total quantity of emission certificates, gradual restriction of the purchase of emission allowances from other sectors and an obligation to surrender emission allowances for non-CO_2 effects.

At an international level, the "Carbon Offsetting and Reduction Scheme for International Aviation" (CORSIA) must be legally implemented in Europe before the start of the pilot phase (2021) and then developed further in a robust manner so that, in the longer term, it is in line with the Paris climate protection goals. The greatest challenges at present still lie in avoiding double counting of certificates and the exclusion of old certificates that are no longer associated with a positive climate effect. Here too, there is a fundamental requirement that non-CO_2 effects should also be taken into account.

With the ticket and kerosene tax, money can be generated in the short term to support the sustainable restructuring of the air transport sector. To this end, the German Environment Agency proposes to set up an "Aviation Innovation and Demonstration Fund". The fund should be designed in particular to promote investment in environmentally and climate friendly aircraft and flight procedures and also the market launch of sustainable, post-fossil fuels. Such fuels are the only realistic way to significantly reduce CO_2 emissions in aviation, as they can replace fossil kerosene within the framework of current propulsion technologies and infrastructure and can be used immediately.

By 2030 at the latest, taxes should be fully aligned with other modes of transport.

But there are numerous challenges: Biofuels from specially cultivated biomass are often highly problematic with regard to the sustainability of their raw materials, plus the vast areas of land required for cultivation are not available. Even biofuels made from waste or residual materials are nowhere near sufficient for the required quantities. From today's perspective, the best option is therefore to produce kerosene synthetically from renewable electricity and CO_2 from the air, called PtL (Power to Liquid). This synthetic kerosene has clear advantages in terms of land and water requirements and CO_2 emissions. In the view of the German Environment Agency, from 2030 onwards PtL should account for up to 10 percent of kerosene consumption. As a central strategy for the introduction of PtL, the German Environment Agency therefore recommends a mandatory blending quota for PtL. In addition, criteria must be agreed to ensure the sustainability and the greenhouse gas reduction of PtL. For example, no electricity from fossil fuels or cultivated biomass should be used, but only that from additional renewable energies. It must also be ensured that only non-fossil carbon – e.g. CO_2 from the air – is used for the production of PtL.

THE GERMAN ENVIRONMENT AGENCY VISION FOR ENVIRONMENTALLY FRIENDLY AVIATION 2030 / 2050

1 Making infrastructure sustainable

The Federal Government steers the development of air transport infrastructure with overarching ecologically orientated demand planning. User financing has been introduced.

2 Short haul flights shift to the railways

On routes where the train is as fast as the plane (including arrival / departure, check-in / check-out), there will be no more scheduled flights in 2030

3 Minimising climate relevant emissions

The climate relevant emissions from aviation, including non-CO_2 effects, will be integrated into international climate protection mechanisms based on a CO_2 pricing system. Regenerative PtL will be introduced worldwide as a greenhouse gas neutral fuel by 2050. Greenhouse gas neutral flying will be a reality by 2050.

4 Noise reduction – population protection

Noise quotas will be introduced at major German airports by 2050, limiting the daily aircraft noise exposure in residential areas to a time-average sound level of 58 dB(A). By 2050 at the latest, regular air traffic will cease between 10pm and 6am at airports close to cities.

5 External environmental costs – the polluter pays

The environmental and health costs of aviation will be charged according to the polluter pays principle (internalisation of external costs). Environmentally harmful tax concessions will be reduced.

6 Ensure clean air on site

Specific emissions of nitrogen oxide (NOx), particles and precursors during take-off and landing operations will be reduced by 90 % by 2050 compared with 2000, as a result of new propulsion technologies. Electrification will make apron traffic emission-free.

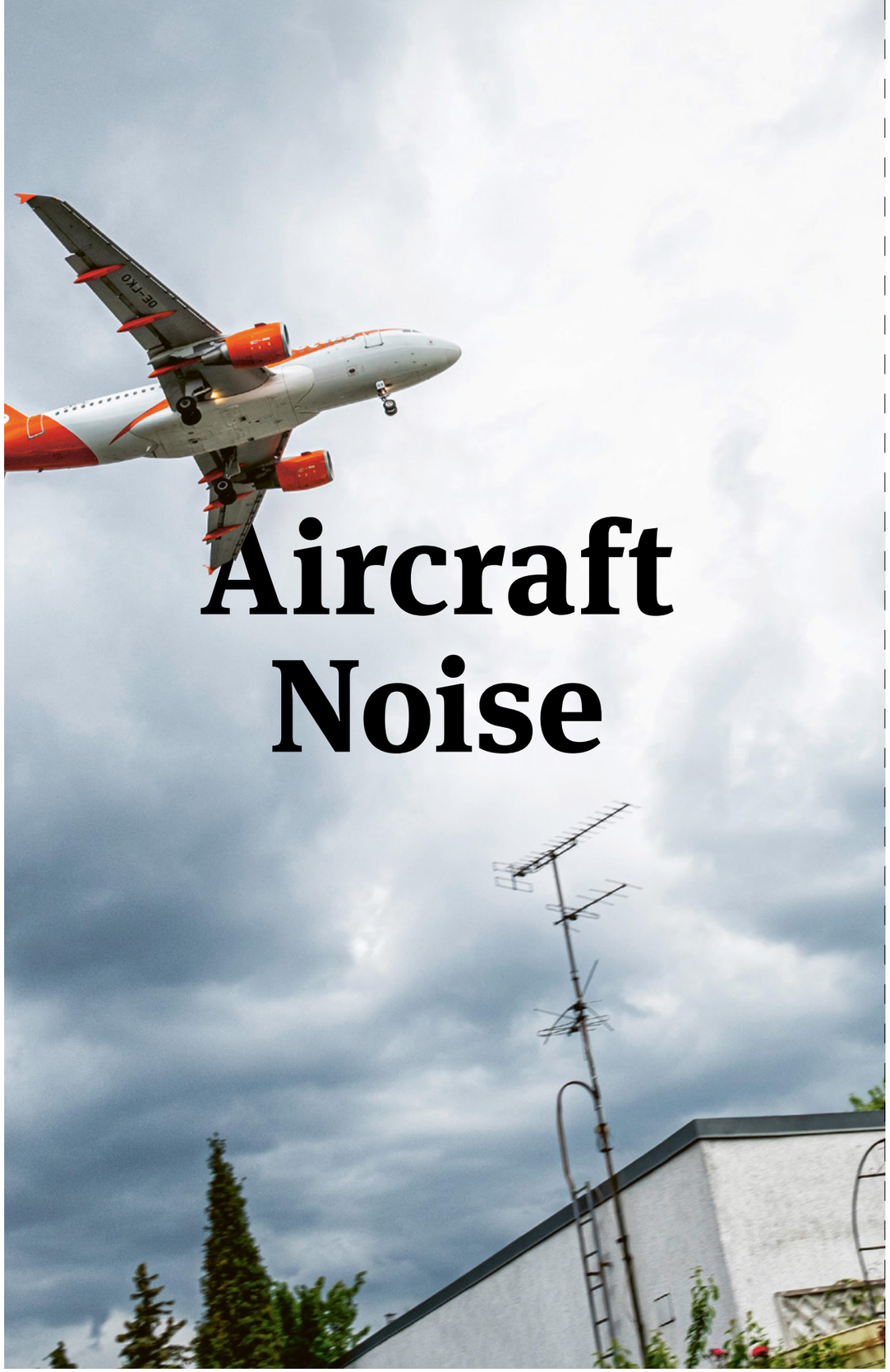
7 Conserve resources using raw materials efficiently

By 2050, aircraft production will be fully recyclable and based on renewable energies. Land use will be minimised by sparing and careful use of the land and ground areas in the development of airport infrastructure and by the subsequent use or renaturation of abandoned airport areas.

8 Fewer flights

Where technical innovations and measures do not lead to the necessary reductions in climate impact and noise and air pollutant emissions, the development of aviation volume is linked to its environmental compatibility through regulatory instruments and economic incentives.


Condor
Lufthansa Cargo
American
ANA
Lufthansa
QATAR
Emirates
UNITED
Condor
Lufthansa
Condor



Aircraft Noise

It was only with the development of the jet engine that civil aviation really took off. The jets were much faster than the old propeller planes, much more comfortable and suddenly offered space for two to three times as many passengers. Between 1962 and 1969, the number of air passengers in Germany grew 16-fold – mass tourism began in air travel.

A turbojet of the first generation was still a real noisemaker – it produced as big a "noise footprint" as 30 aircraft of the current generation, which are much quieter. But it is still noisy at German airports as the number of take-offs and landings has increased continuously.

How loud is it in reality?

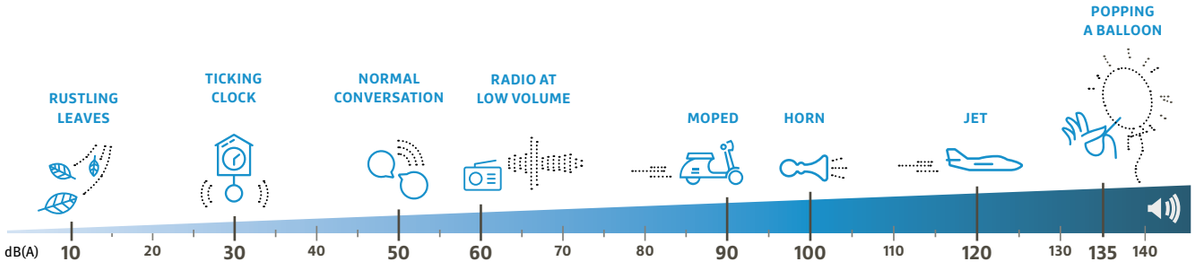
In Germany, aircraft noise monitoring systems are operated at all airports. Strictly speaking, the systems do not measure noise, but sound levels. The overflight of an aircraft or the passing of a freight train can show the same value on the sound level meter – most people would still perceive both sounds differently and evaluate them differently. But even the same sound level can be annoying to different degrees, depending on age, gender, culture or attitude to the sound. Subjectively perceived annoyance caused by noise cannot be measured using physical methods.

In order to quantify the noise pollution caused by aviation, the equivalent continuous sound level is measured, which reflects the time average of the sound pressure level, and the maximum sound level. The way these sounds are measured is regulated by a standard in Germany so that aircraft noise measurements are precise and thus comparable.

Most of the larger airfields publish their measurement results in the form of an aircraft noise report. Many major airports also offer the opportunity to track real flight operations and the noise levels currently recorded at the measuring points online.

The subjectively perceived annoyance caused by noise cannot be measured using physical methods.

These measurements are very complex and can only ever record levels for a defined location. In order to determine the level of noise pollution caused by aircraft in the area surrounding the airport and to estimate how many people are affected, continuous sound levels are calculated for a dense network of points. The advantage of this is that the exposure to aircraft noise for a particular airport can be determined over a larger area, in particular residential areas.



Noise impacts

Aircraft noise is plotted every five years at major German airports and airports in urban centres in accordance with the EU Environmental Noise Directive, i.e. based on air traffic in a particular year, the continuous LDEN noise level (DEN = Day, Evening, Night) and the number of people affected by a continuous noise level of over 55 dB(A). The current noise mapping from 2017 showed that a total of around 815,000 people are affected by aircraft noise above 55 dB (A) at the eleven airports examined in Germany. The situation at Berlin Tegel, Frankfurt/Main and Cologne/Bonn airports is particularly serious (see Figure 4).

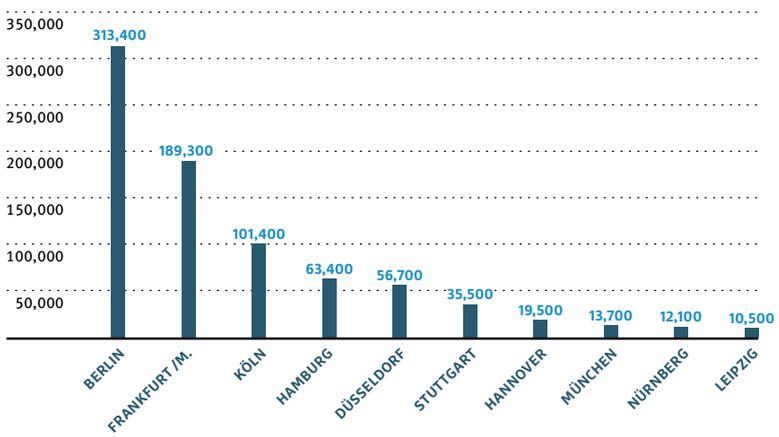
Aircraft noise is not only a nuisance. It can also cause illness. People who are permanently exposed to aircraft noise are at a higher risk of cardiovascular diseases. When exposed to noise, the human body releases stress hormones such as adrenaline, which increase the heart rate and blood pressure. In addition to the hormone balance, chronic noise pollution also changes the metabolism. In the long term, this can favour arterial calcification and lead to hypertension, coronary heart disease, heart attack or stroke.

Cognitive development is also affected by noise. For example, primary school children learn to read more slowly in regions with high aircraft noise levels than in quiet areas. If the continuous noise level increases by 10 dB(A), the acquisition of reading skills is delayed by an average of one month.

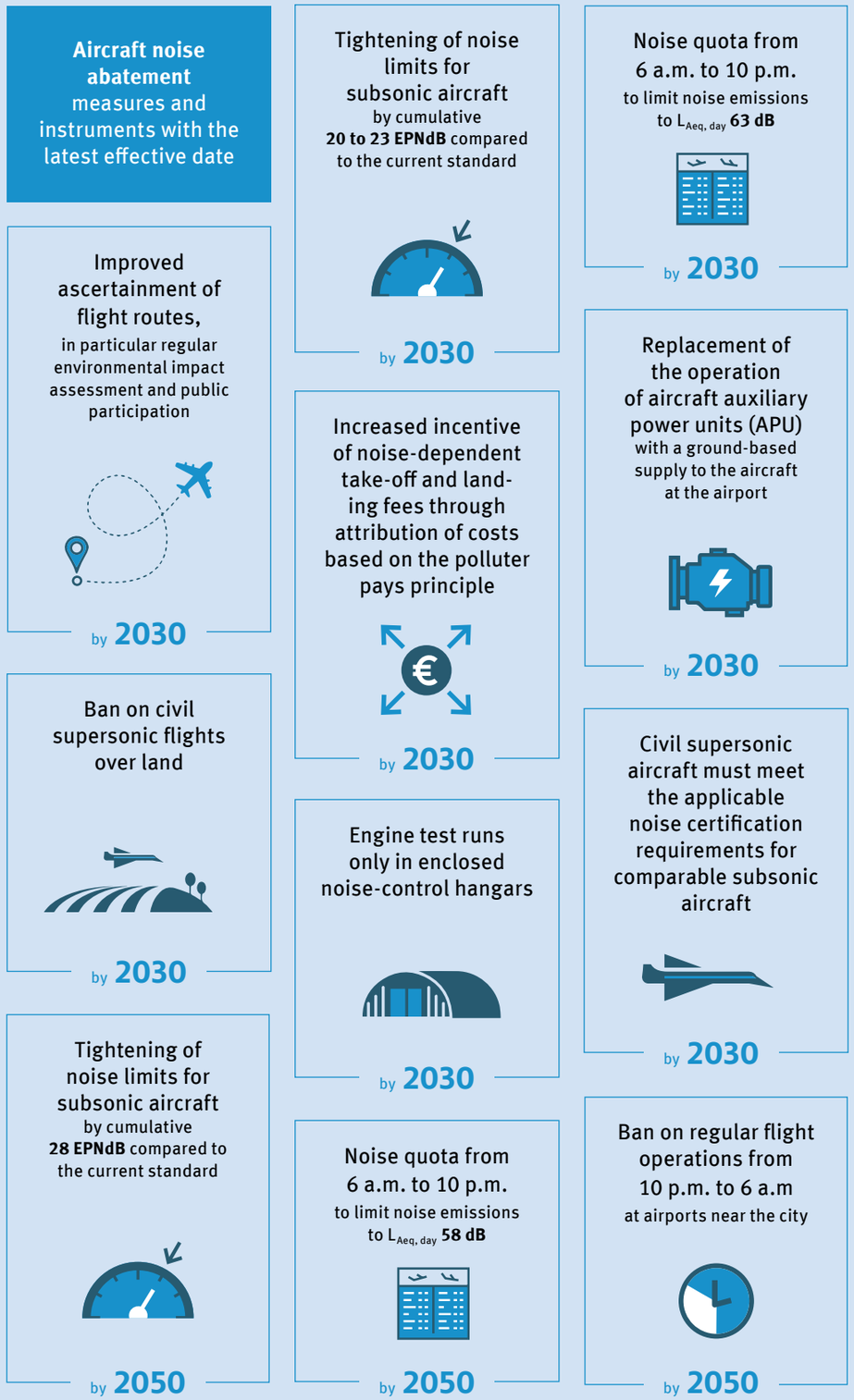
Protection against aircraft noise at night is particularly important. Undisturbed and adequate long sleep is essential for mental and physical recovery.

Figure 4

People affected by aircraft noise above 55 dB(A) at major German airports in accordance with the EU Environmental Noise Directive



Source: German Environment Agency 2018



Protecting people from aircraft noise

With the aim of better protecting the population from the health effects of noise, the World Health Organisation (WHO) published guidelines on environmental noise in 2018. It recommends that a 24-hour continuous L_{DEN} noise level of 45 dB(A) and an L_{NIGHT} value of 40 dB(A) be maintained at night to protect against aircraft noise. The German Environment Agency supports these recommendations. These values mean that only a small number of flights could operate at the airports in the longer term. In order to come closer to the WHO recommendations in the long term, the German Environment Agency believes that noise quotas should be introduced at German airports, which limit the daily aircraft noise pollution in residential areas to a time-average sound level of 63 dB(A) by 2030 and 58 dB(A) by 2050.

By latest 2050 regular flights should no longer take place at airports near the city between 10 p.m. and 6 a.m.

Moreover, the EU Commission sees a need for action and has set itself an ambitious goal with “Flightpath 2050”: to reduce the noise limit values of new aircraft by a total of 45 EPNdB[2] – a unit used for noise certification, also considering annoying tones – compared to 2000. Experts believe that completely new aircraft would have to be designed for this. However, even if such aircraft are ready for series production, it will take a long time to replace older models. Against this backdrop, the German Environment Agency recommends that the measures shown in the overview be implemented by 2030 and 2050, respectively, in order to achieve an acceptable noise situation, especially in settlement areas in the vicinity of the airports.

2 EPNdB = Effective Perceived Noise Decibel

NOISE QUOTA

The aim of the noise protection policy is to protect people from noise. In order to reduce aircraft noise around the airport, many individual measures are often taken such as technical improvements to the aircraft or noise-reducing flight procedures. This can make a single flight audibly quieter, but the successes are hardly noticeable with ever more flights.

Noise quota is one way of controlling and limiting noise over large areas. For this purpose, a criterion (quota) for the noise pollution and a maximum value are specified, which must not be exceeded. For example, one could simply set a certain number of “noise points” as a limit. Airplanes get noise points depending on how loud they are. The quiet ones get few points, and the louder ones get more. The noise points of all flights are added up. Airports can then calculate in advance how many flights they can handle each year in order not to exceed the maximum number of noise points – the quota is then full.

Another type of quota is a noise index, which reflects the number of people affected per noise level class. To ensure that the noise index is only a measure of aircraft noise pollution, the number of people should be kept fix. This type of noise quota has the advantage that noise pollution must be reduced, especially in residential areas.

Noise quotas generally offer the advantage that the airport operator, together with the airlines, is free to organise flight operations within the specified target. If airports want to handle a lot of traffic, they have to carry out operations at a correspondingly low noise level in order to remain within the specified noise limits. It is important for goals to be ambitious and at the same time achievable – so that as few people as possible are exposed to harmful aircraft noise.

“Flying? Climate change is our imperative.”

Interview with Professor Stefan Gössling on the subject of air travel and its ecological sustainability

Mr. Gössling, “flight shame” spreads throughout Europe and the world, starting from Sweden, where the term “Flygskam” was coined in 2018. What does this mean exactly?
“Flight shame” means that you perceive yourself as contributing to climate change and that this feeling is uncomfortable. We all want to do the right thing, we don’t want to accelerate climate change. However, the desire to travel to other countries can stand in opposition. “Flight shame” means that you have these negative feelings because you know that you just now contributed to climate change.

Can we then still fly?
That depends on whether you personally want to live within the framework of the climate goals or not. If so, it’s a tight squeeze as soon as you get on the plane. Even a medium-haul trip eats up a significant portion of the climate budget that would be sustainable for one person per year.

Should you be ashamed of it when you fly?
Psychologically speaking, shame is not a good concept because it leads to cognitive dissonance. This means that you will deliberate about whether the environment or your own goals are more important to you. You will presumably end up more often in a corner and perhaps rationalise your own behaviour. If you want to see it positively, then “flight shame” is actually quite a good thing because it forces us all to examine what we actually do.

Who actually flies and why?
The climate problem we have is the result of the actions of approximately 7.7 billion individuals. If every single person behaved in line with the climate goals, the problem would be solved tomorrow. However, only a very small fraction of the world’s population flies at all. In Germany, it is not even half of the population who board a plane in a single year.

Moreover, among those who fly there is a very small group that flies a lot. This means that this group has a particularly large responsibility. It is interesting to note that the air travellers themselves do not consider every trip to be particularly important. In a sample of international students, we recently found that 42 % of all trips were rated as not very relevant or completely unimportant.

What could flying be like in the future? Who will still fly and why and is that still OK?
Climate issues are an imperative. Only if we stop climate change will people be able to fly to other parts of the world that we know in 40 years. Conflicts are increasing due to climate change and we can already see that climate change is depriving people of their livelihood. Conversely, I would ask: What is the price we would have to pay to make air traffic sustainable, to use synthetic fuels, to curb demand through higher costs?

Stefan Gössling is professor at the Institute for Service Management at Lund University and at the School of Business and Economics at Linné University in Kalmar (both in Sweden). He has worked on climate change and mobility against the backdrop of global emissions reductions since 1992.

Moreover, what is the price for accepting personal responsibility, which of course can also be taken at a national level? I then want to answer: We have to get used to the fact that air traffic will become more expensive, significantly more expensive. This does not mean that there will no longer be any air traffic, but that we must carefully consider when and how we fly and how long we stay.

“In Germany, it is not even half of the population who board a plane in a single year.”

Does “flight shame” help with this consideration?
A lot has happened in Sweden. For me, it starts with the fact that we have a debate about it that involves a large part of the population. We still have far too few people who actually see climate change as a serious problem and who themselves are also trying to find solutions. The debate seems to be taking effect: This year in Sweden around 9 percent fewer flew domestically than in the previous year. “Flight shame” is thus also reflected in numbers.

Trains instead of planes!

Trains are undoubtedly more environmentally friendly than aeroplanes – this has become a commonplace fact. Germany has the potential of making all domestic flights redundant by 2050, which is a necessary step if its contribution to climate protection is to be taken seriously.

Domestic short-haul flights are particularly easy to replace with railways. Currently one out of five air passengers in Germany boards a domestic flight which is more than seven times more environmentally damaging compared to rail travel. In 2018, domestic flights in Germany caused climate impacts of around 2.4 million tonnes of CO_2 equivalents[3].

Empirical evidence points to the fact that travellers choose the rail over air travel if it is an appealing and efficient alternative and if their travel time remains below four hours. This actually happened after the expansion of high-speed transport between Frankfurt/Main and Cologne or between Berlin and Hamburg. These routes are no longer served by scheduled flights. The reduction in travel time between Berlin and Munich to just under four hours has also led to the railways replacing aircraft as the number one mode of transport on this route. On the section between Berlin and Nuremberg, flights have even been completely discontinued due to the new ICE line.

The railway is almost completely electrically driven. Since Germany will rely more on renewable energy such as sun, wind and water in the future, the emission of greenhouse gases from trains will also decrease continuously. However, the direct use of electricity will not be available even in the medium term for aviation. The only way to power aircraft in a CO_2-neutral manner will therefore continue to be through fuels produced from renewable electricity, so-called Power-to-Liquid (PtL) fuels. However, on the comparatively short domestic routes within Germany, the specific kerosene consumption and correspondingly the demand for renewable electricity for the production of PtL fuels is very high.

But how does Germany manage to reduce the travel time between metropolitan areas to less than four hours? On the one hand, by consistently expanding high-speed routes. Rail services must be available throughout the country – even outside metropolitan areas. And trains must run frequently and in close succession. Furthermore, airports must also be well connected to the long-distance rail network. This is the only way to replace domestic feeder flights to international medium and long-haul flights with trains. End-to-end ticketing – i.e. the integration of rail travel and flight in one ticket – and the through-checking of baggage from the train to the plane (and vice versa) promote this development.

3 Including non-CO_2 effects and emissions from the provision and conversion of energy sources into kerosene.

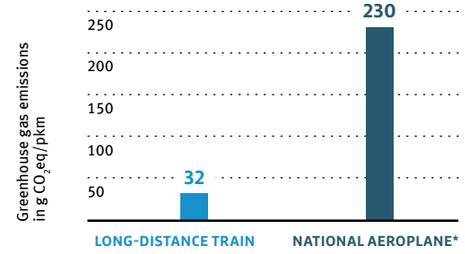
A recent study[4] commissioned by the German Environment Agency shows that shifting all domestic flights of less than 600 kilometres to the railways could make 200,000 domestic flights within Germany obsolete and shift 18.5 million travellers onto the railways – equivalent to 73 percent of the domestic aviation volume.

Freight transport also benefits from an efficient rail system: better rail connections to airports and improved cooperation between air and rail freight will make it possible to provide high-performance freight train connections at night. These could make domestic freight flights within Germany obsolete in the medium to long term. Overall, however, domestic air freight plays only a minor role – 96 percent of all greenhouse gases emitted by national flights are caused by passenger transport.

If the railways are to be made more appealing, the unfair competitive advantages of flying must also be eliminated. Chapter “Climate protection in aviation” of this magazine shows that the prerequisites are not the same. The competitive disadvantage of rail must be urgently compensated.

Figure 5

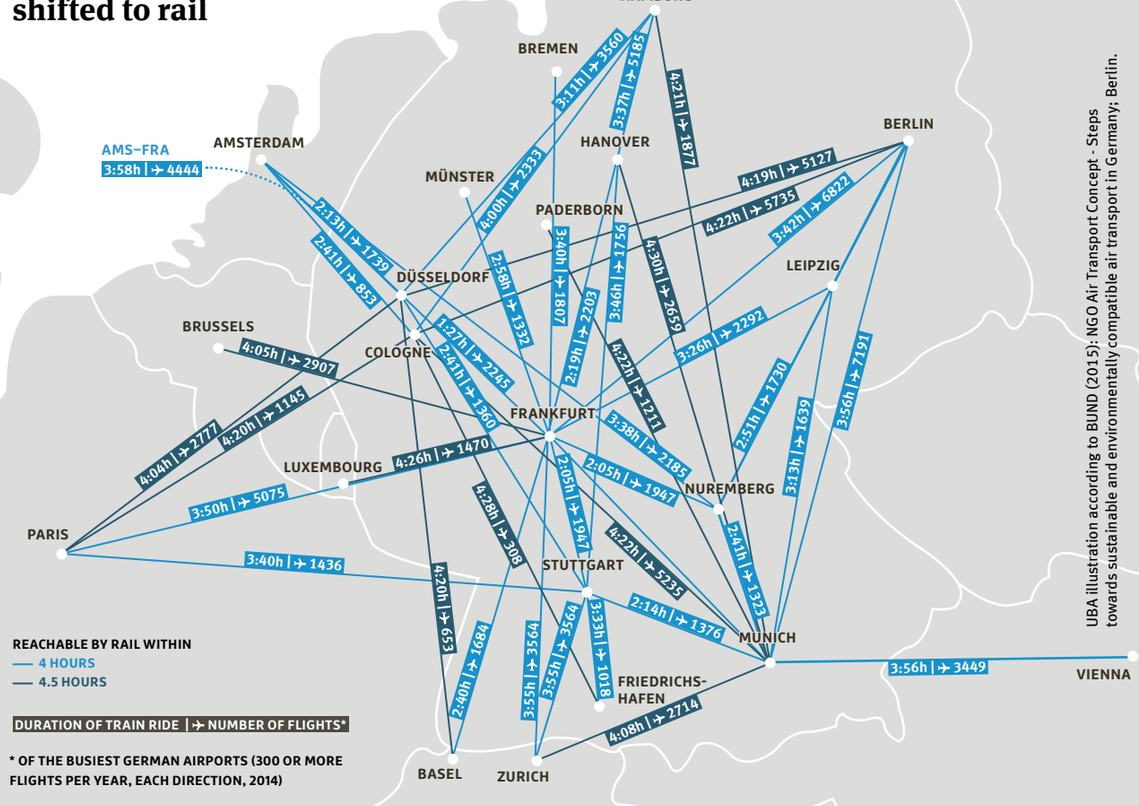
Comparison of greenhouse gas emissions from rail travel and aviation in Germany in 2018



Source: TREMOD 6.02

4 Aviation scenario in Germany including environmental aspects
www.umweltbundesamt.de/publikationen/szenario-luftverkehr-deutschland-unter-einbezug-von (German)
* Including non-CO_2 effects and emissions from the provision and conversion of energy sources into kerosene.

Domestic and international short-haul flights that can be shifted to rail



UBA illustration according to BUND (2015): NGO Air Transport Concept - Steps towards sustainable and environmentally compatible air transport in Germany; Berlin.

Environmentally compatible tourism

Environmental relevance of travel

Travel is part of everyday life today. With increasing prosperity and the reduction of travel barriers such as visa requirements and the right to paid holidays, there are steady annual growth rates of around four percent worldwide. In 2018, a total of 1.4 billion people worldwide made a trip abroad. This means that the number of people travelling abroad has increased more than fifty times since 1950. Germans particularly love to travel. Only a small percentage of the German population never travels.

Unfortunately, air travel is quite damaging to the environment. Arrivals and departures cause noise and take up space (the airport was built for this purpose); the air is polluted. Also, the destination is rarely environmentally friendly: food and products, fresh water and energy are consumed; waste and wastewater must be disposed of afterwards.

2018 share of flights in travel:

In 2019, Germans undertook

70 M

HOLIDAY JOURNEYS

Of which

41%

BY AEROPLANE

DOMESTIC FLIGHTS

For the

18.9 M

DOMESTIC HOLIDAY JOURNEYS

1%

chose

THE AEROPLANE

INTERNATIONAL FLIGHTS

Of the

51.1 M

INTERNATIONAL HOLIDAY JOURNEYS

56%

took place

BY AEROPLANE

Source: Research Association for Vacation and Travel (FUR) 2019: First selected results of the 49th travel analysis for ITB 2019. https://reiseanalyse.de/wp-content/uploads/2019/03/RA2019_Erste-Ergebnisse_DE.pdf as of 12/12/2019

Sustainable travel behaviour and trends

How can we travel in a more environmentally friendly way? We should voluntarily take a step back from the principle of “further – faster – more exotic – more individual” and aim for a qualitative and above all sustainable mode of travel. This would be the first step. Anyone wanting to travel in an environmentally friendly way should primarily choose a domestic holiday destination or a nearby foreign country that can be reached without a flight. Travelling by plane is, as was made clear in the previous chapters, very harmful to the environment. Travelling by train or even by car is more environmentally friendly. If a flight cannot be avoided, one should prolong the time on site as much as possible and thus avoid further flights. It is also a good choice to offset the greenhouse gas emissions through voluntary compensation payments for climate protection projects with a reputable provider. Further information on this topic can be found in the chapter ‘CO_2 compensation of air travel’.

In the meantime, there is a diverse range of sustainable travel offers that covers all customer wishes and at the same time does not have to be more expensive. Holidaymakers can find information and booking portals as well as other tips on the website of the German Environment Agency: www.umweltbundesamt.de/umwelttippsfuerdenalltag/gartenfreizeit/urlaubsreisen.

Further information on the climate and environmental impacts of aviation can be found in the following German Environment Agency publications

- Environmentally friendly aviation, local – national – international
- Where are you headed? Aviation in the future: environmentally and climate-friendly, greenhouse gas neutral, low noise: www.umweltbundesamt.de/publikationen/wohin-geht-die-reise

“I think very highly of Greta Thunberg.”

After five years, UBA president Maria Krautzberger is leaving the German Environment Agency. A conversation about idealism, successes, crises and environmental protection in times of climate packages and Fridays for Future.

“State-certified environmental protector” – that was how the Berliner Zeitung addressed you when you took office in spring 2014 – do you like this title?
No, I’m not a certified environmentalist – environmental protection is beyond the scope of state certificates. I brought to UBA extensive experience with civil dialogues, citizens’ events, also in political committees. I had already had to prove myself in dialogue with society, citizens and politicians. Environmental protection needs to be implemented after all.

You turned your professional career towards environmental protection early on. That requires a good portion of idealism. Is there anything left of it?
My idealism has rather increased at UBA where I am no longer on the side of pragmatic policymakers, but on the side of those who passionately seek solutions. This also extends to the private sphere: how one feeds, moves, lives. Moreover, the problems have not decreased. They have been described many times, science has made important contributions. And solutions have also been presented. All in all, what happened is far too little. Climate crisis, species loss, land consumption – all these developments have come to a head in recent years. It is therefore all the more important not to give up.

What are some of your favourite memories from your five years at UBA?
Chiefly the personal encounters that have enriched me. I was impressed by the particularly strong collegiality at UBA right from the start.

My goal has always been that UBA should be an independent scientific authority accepted by the entire German government.

I also consider the introduction of mobile working to be a success. Perhaps it is also a component that contributes to the job satisfaction of the employees – which has increased further over the years. Of course, I’m very pleased about that.

What I also remember fondly is the further development in the agency’s management board, which has come together more strongly over the years. In my view, everyone has developed a greater understanding of the needs of others and the relevance of issues that are not within their own division.

And what successes do you foresee in the political field?
We don’t do politics. We offer political consulting. That is why it is very difficult to measure success by concrete political solutions. I think we have made very good advisory offers, even though they were not always taken up. These successes often come to fruition only years later. For example, the realisation that bisphenol A is a problematic substance.
Or the debate on environmentally harmful subsidies, which is now experiencing a renaissance. I am sure that this approach will also be implemented more systematically

Limiting values and taxes alone are hardly visions for a society.

than it is today at some point in the future. But it is unrealistic to expect this to happen solely after the presentation of a report. UBA has been pointing out incorrect issues in the diesel debate for many years. We have made important contributions to the diesel debate, but then also had to "take it on the chin" when our epidemiological study was criticised in a very unobjective manner.

The diesel debate is also known as the "diesel crisis"...
The crisis I identified was first and foremost, manipulation. As a result, the Republic was immersed in heated debate without a clear strategy for resolving it. In principle, nothing happened, to be honest. Except for software updates that didn't do much, statutory driving bans that were only occasionally enforced. In the end, the problem was sat out. I find this to be an extremely disappointing result for both politicians and political consultants. I also felt that the Leopoldina's mandate to assess the situation was a crisis. All the more as UBA is the institution best and most qualified to assess this issue. My goal has always been that UBA should be an independent scientific authority that is accepted by the entire German government. And not just by selected departments. I also consider the ruling of the Braunschweig Administrative Court on the possibility of not imposing conditions on the approval of plant protection products that take biodiversity into account as a crisis – a real defeat for species protection.

UBA has a reputation for making critical statements on environmental and climate issues. What do you think is UBA's role?
Exactly so! That is one of UBA's core tasks – that we advise policy for the good of the environment. This is not always welcomed. But it must be done, and it is also a strong motivation for the staff here. I have repeatedly found that these debates are also conducted in moderation at UBA. We do not always demand 100 percent environmental protection. We also have social concerns in mind. There is always a reflection on the social impact of the proposals, and I regard that as a high quality in this institution. That is what makes UBA credible. Political muzzles are registered very sensitively, and rightly so.

What could be going even better for UBA – or what would you wish for the future?
That the already high level of scientific expertise is being expanded, new topics can be taken up more quickly, more freedom in research and greater leeway. In this context, it is also important that we consolidate and improve the good approaches of our own research. I am well aware that more capacity is needed. I also think it is important that more PhD programmes are carried out at UBA; we have not yet exhausted this innovative potential.

Back to business: What challenges do you see in the environmental sector in the coming period? Where has not enough happened yet?
Climate protection is well and truly on fire. That will certainly be the biggest challenge. What I miss in politics, including in the climate package, is that visions are not being presented to society. What does the big picture look like? Where do we want to be by 2030? Limiting values and taxes alone are hardly visions for a society. If we want to tackle the climate crisis, much will have to change in society. And this must not lead to a discussion of renunciation, but it must become clear that at the end of renunciation there will be a better life for everyone. This also applies, of course, to the other major issues: agriculture, extinction of species, consumption, to name but a few. We need a social transformation, and this requires visions.

What is your opinion of Greta Thunberg and the FFF movement?
I think very highly of her. She is the lifeline in climate protection and her movement has already achieved a lot. I hope that this will continue and that it will change young people and society in the long term. The fact that someone is so courageously committed to a topic can also be inspiring. Our work has great relevance for future generations as well. This must always guide us.

Will you miss UBA?
I will certainly miss many colleagues who have grown dear to my heart, and the ever-new experiences and insights. UBA is an ongoing educational institution, and one learns something new every day.

A brief glance into the future: What do you wish for UBA and the people who work here?
That they remain self-confident and combative, while maintaining a collegial, friendly dialogue. Openness for new topics and approaches. To look beyond the horizon of one's own consciousness, not forgetting the social environment. Getting involved in debates and not give up fighting for the better way.

Ms Krautzberger, many thanks for the interview!

The German Environment Agency

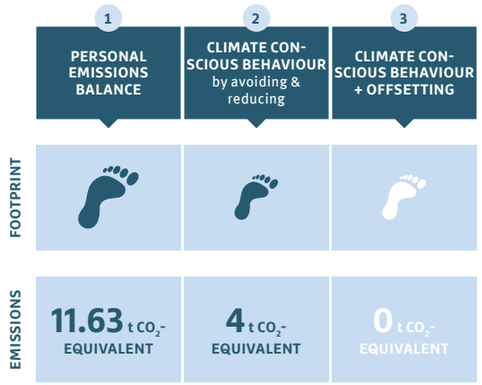
CO_2 offsetting of flights

Anyone living in Germany causes an average of rather more than eleven tonnes of greenhouse gas emissions every year. Whether living, eating or mobility – whatever we do, it causes emissions. More and more people are trying to make a contribution to global climate protection by changing their lifestyle. This is particularly useful when planning holidays because a flight always involves a very large CO_2 package. However, anyone who cannot or does not want to do without a flight should at least make a voluntary contribution to offsetting the resulting emissions by using carbon credits generated by projects that are reducing green house gas (GHG) emissions elsewhere.[5] Many of these projects are carried out in emerging and developing countries. In this way they also promote the social or economic development of the country (co-benefits). For example, jobs are created, energy is provided in rural areas or health protection is improved. This costs much less than one might think, increasing the price of a trip by only a few percent.

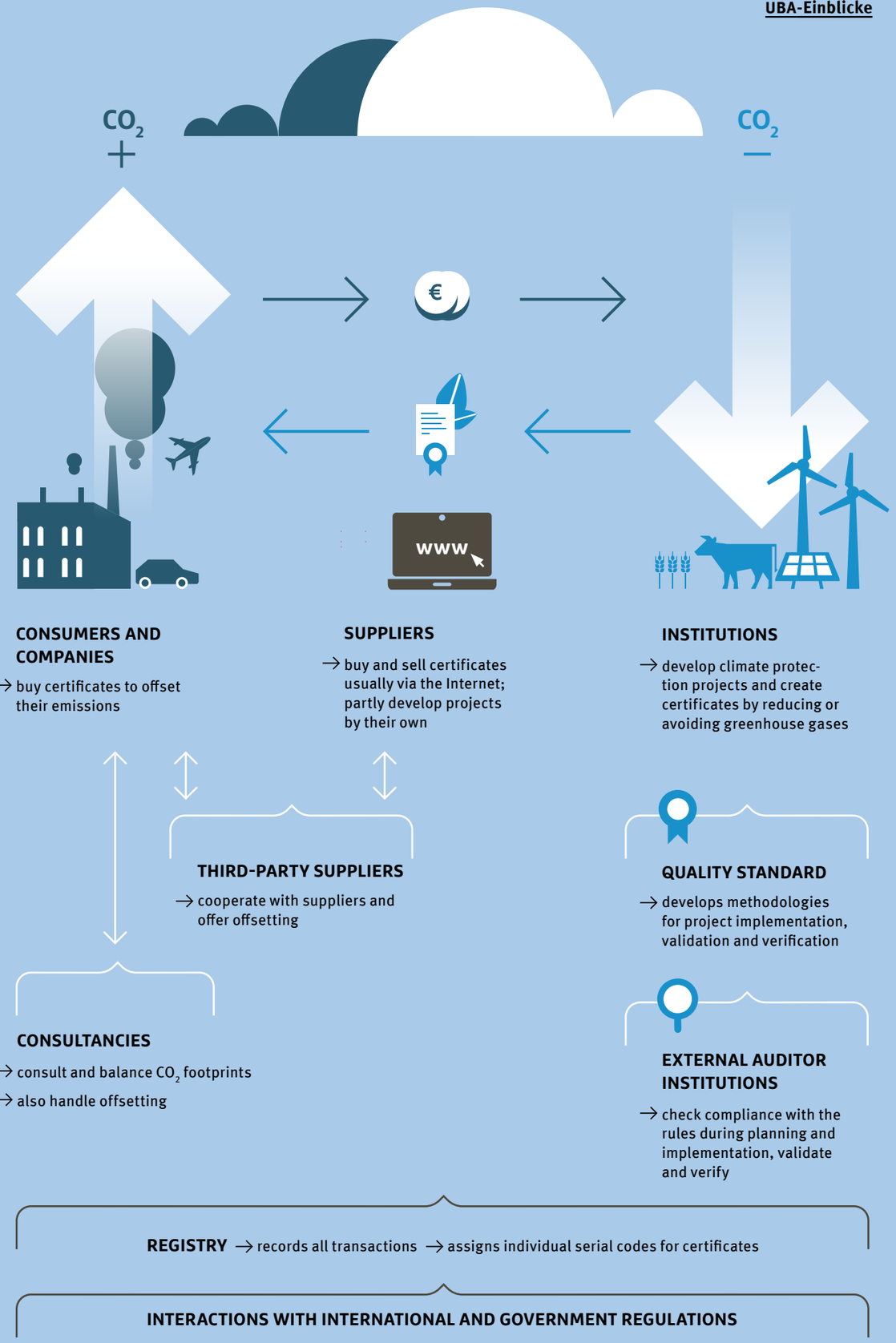
How can one do offsetting?

Climate impact is not dependant on where on the Earth greenhouse gases are emitted or offset. Nevertheless, offsetting should not be regarded as a licence for continued actions of an environmentally harmful manner – avoidance and reduction always come first. But offsetting is very welcome as the final step of an individual's commitment to climate protection in order to at least offset one's own emissions that cannot be currently further reduced (see figure on the right).

The amount of CO_2 or greenhouse gases produced must first be calculated in order be able to be offset. For this purpose, the German Environment Agency provides a CO_2 calculator.[6] If it is clear how high the emissions are, the users buy emission reduction credits, also called certificates, for example from offset providers[7]. A certificate denotes the reduction in the respective climate protection project. As a rule, one certificate corresponds to one tonne of emissions reduced. Whether these projects actually achieve the reductions they claim to achieve is ensured by quality standards. In the case of climate protection projects for voluntary offsetting, the prerequisite is always that the respective project could not have been carried out without the proceeds from the certificate purchase (additionality).[8]



5 **Further information:** www.dehst.de/EN/carrying-out-climate-projects/carbon-offsetting/carbon-offsetting-node.html
6 **The German Environment Agency provides such a CO_2 calculator (in German) at** https://uba.co2-rechner.de/ de_DE.
7 **A non-binding and non-exhaustive overview of offset providers can be found (in German) at** www.dehst.de/SharedDocs/downloads/DE/ projektmechanismen/Anbieter.html
8 **'Voluntary CO_2 offsetting using climate protection projects' (in German) at** www.umweltbundesamt.de/ publikationen/ freiwillige-co2-kompensation-durch



Offsetting the Federal Government's business trips

The Federal Government fully offsets the greenhouse gas emissions from its business trips, including the non-CO_2 effects of air travel. Only projects from the UN-based Clean Development Mechanism (CDM) are used for this purpose which strengthens the multilateral approach to climate protection. The standard also ensures that only proven actual emission reductions are certified. A total of almost 1.2 million tonnes of CO_2 were offset for the period from 2014 to 2018.[8]

Certificates from various climate protection projects are purchased for offsetting, primarily from the least developed countries. The German Environment Agency only uses projects with documented co-benefits that have no negative environmental impacts. The selected projects include household biogas projects, cooking stoves, projects for clean drinking water and electricity generation from crop residues, landfill gas, wind power or small run-of-river power plants. Three project types are described here in more detail as examples.

8 **See further information on offsetting the Federal Government's business trips at** www.dehst.de/EN/carrying-out-climate-projects/business-trips-of-the-german-government/business-trips-of-the-german-government-node.html

PROJECT EXAMPLE

Household biogas from biomass in Nepal

Biogas from anaerobic fermentation of cow dung, agricultural waste and faeces replaces the usual firewood for cooking. In addition to the reduction of CO_2 emissions, the large amount of smoke produced during cooking, which is associated with considerable health risks for women and children, is reduced. Biogas is an affordable, decentralised and smoke-free source of energy and therefore an alternative to the use of wood from unsustainable forestry.

PROJECT EXAMPLE

Efficient cooking stoves in Rwanda

Efficient stoves reduce the amount of wood needed for cooking. Households can thus save considerably because by using the efficient stoves they are independent of rising charcoal prices, allowing their savings to cover other financial expenses. At the same time, among other things, ancient mountain forests, which were previously cut down, are being preserved. It also helps the health of the women, who suffer less from respiratory diseases.

PROJECT EXAMPLE

Small run-of-river power plant in the Lao People's Democratic Republic

Hydroelectric power as a renewable source of energy is still important worldwide. It contributes considerably to the reduction of the CO_2 emissions and thus contributes to climate protection. At the same time, it reduces the need for conventional primary sources of energy and thus serves to improve security of supply and reduce dependence on fossil and nuclear fuels.

The energy generated is fed directly into the national power grid. In addition, a water supply programme was started in the project area to provide better drinking water for affected people. Water filters and pumps were installed to supply the villages in the surrounding areas.

The German Environment Agency's anechoic room

The German Environment Agency's anechoic room called "noise laboratory" is in the basement of the main building in Dessau-Roßlau. It is a large bare room that makes visitors rub their ears. Anyone entering the room suddenly has the feeling of hearing loss. The reason is that the walls are designed in such a way that no sound is reflected. The usual noises that surround one are almost completely absorbed.

In the noise laboratory, the noise protection regulations are checked by measurements and further developed. Precision microphones enable noise to be measured without interference. For example, the following issues are investigated:

- How are products measured to produce comparable and reasonable results?
- Are the known sound parameters and measuring methods suitable for assessing the noise of products?
- Are the current standards for noise abatement technology implemented?

One example of these investigations are drones. More and more people fly them or use them to film themselves as a replacement for remote-controlled cars. However, the noise emitted by drones is a nuisance for other people. There is currently no national or international established knowledge about the effects of this noise. To date, there are two European Commission regulations: Implementing Regulation (EU) 2019/947 governs the operating regulations for drones. Delegated Regulation (EU) 2019/945 describes the construction regulations and characteristics of drones in the various categories. The Annex to this Regulation contains a maximum permissible sound power level which depends on the drone's weight. In addition, a labelling of the guaranteed sound power level has been introduced. Manufacturers are obliged to indicate this noise level so that it can be taken into account when purchasing the drone.

The EU Regulation 2019/945 is a first step towards reducing noise pollution from drones. However, this is not yet sufficient because the operation of drones is not only associated with physical noise pollution, but also with subjective noise nuisance. The German Environment Agency conducts extensive investigations to determine the extent of noise nuisance. The sounds of different drone models during different flight manoeuvres are thereby analysed both in the noise laboratory and outdoors. The results are an important basis for discussions with politicians, industry and the public about strict criteria for noise assessment of drones.

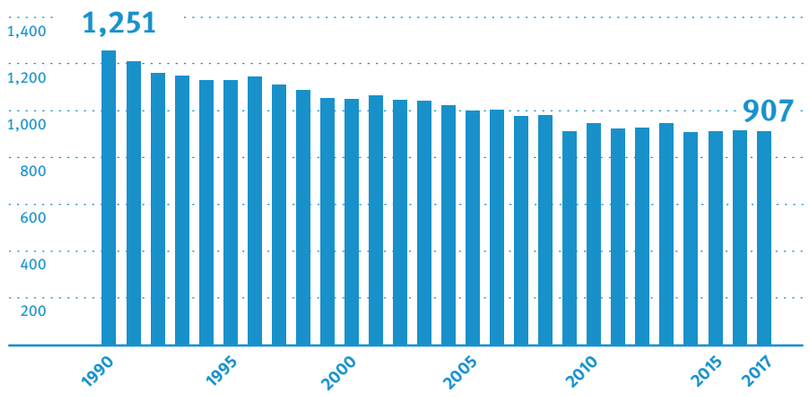
Noise measurement on a drone in the German Environment Agency's anechoic room

ENVIRONMENTAL DATA

GHG EMISSIONS SINCE 1990

(excluding land use, land use change and forestry)

in million tonnes of carbon dioxide equivalents



CO_2

(carbon dioxide)

1990 **1,052.5** Mt

↓

2017 **798** Mt

N_2O

(nitrous gas)

1990 **64.1** Mt

↓

2017 **37.7** Mt

CH_4

(methane)

1990 **120.9** Mt

↓

2017 **55.2** Mt

F gases

1995 **17.1** Mt

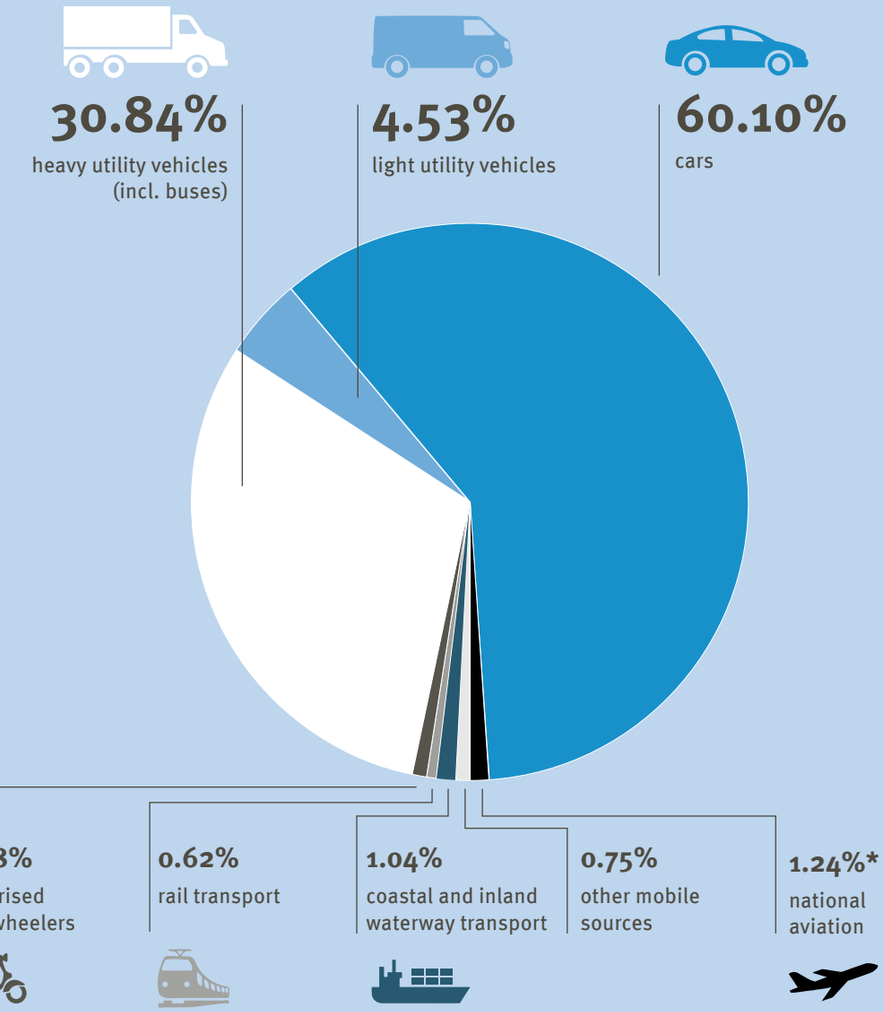
↓

2017 **16.2** Mt

2017 transport emissions

in percent of greenhouse gas emissions

18.53%



* Data excluding non-CO_2 effects

The reporting does not cover international aviation: 29 million tonnes, excluding non-CO_2 effects

Publications as pdf:
https://www.umweltbundesamt.de/publikationen/what-matters-2-2019-flying