



Environment

Less pollutants. More quality of life.
The Air Quality Plan 2011–2017 of Berlin.

Less pollutants. More quality of life.

The Air Quality Plan 2011–2017 of Berlin.

Contents

This is the air in Berlin	6
How and with what is Berlin's air polluted?	6
How is air pollution actually caused?	8
Monitoring stations in Berlin: Where do we measure what and how?	10
Why is nitrogen dioxide and particulate matter so hazardous?	12
The Air Quality Plan	14
What is the Air Quality Plan about?	14
What has the present Air Quality Plan achieved?	16
How would things continue without a new Air Quality Plan?	18
Measures and fields of action	20
What measures are planned from 2011 to 2017?	20
1. Field of action – spatial structure and urban planning	21
2. Field of action – road traffic and traffic engineering	22
3. Field of action – mobility and traffic management	26
4. Field of action – road areas and road surfaces	28
5. Field of action – heat supply of buildings	30
6. Field of action – industry and commerce	32
7. Field of action – construction sites and construction machinery	33
Results and perspectives	34
What does the Air Quality Plan 2011–2017 achieve?	34
What else is important in the Air Quality Plan?	38
What will be next for air quality in Berlin?	40
Imprint	42



The Air Quality Plan 2011–2017

Dear Citizens of Berlin,

Clean air is quality of life! Yet, in all metropolitan areas, keeping the air clean is a major challenge – also in our city. Especially because we know how important clean air is for all of us, we must take all feasible measures to keep the air clean. With the Air Quality Plan

2005–2010, we have succeeded to substantially improve the quality of Berlin's air in recent years. For example, foremost the low-emission zone and the promotion of environmentally friendly means of transportation have led to a considerable reduction of the air pollution. Despite of these successful steps, however, there continue to be exceedances of the regulatory limit values for nitrogen dioxide and particulate matter along Berlin's main roads. This means that we may not ease our efforts here.

Therefore, we have developed a new Air Quality Plan for the years until 2017, in order to comply with the regulatory limit values everywhere in Berlin. In the medium term, we will accordingly minimise the number, duration and intensity of the exceedances of the regulatory limit values to the furthest possible extent. In the struggle for clean city air, just one microgram less air pollution helps protect the health of all Berliners.

Our focus is on reducing pollutant emissions. Thus, we start specifically at the sources of pollution in the various areas. Even if the focus continues to be on road traffic as the biggest cause of air pollution, increasing measures are planned at construction sites, in the supply of heat, industry, and in the business sector.

However, to improve the quality of the air, we need your help, dear citizens. Please avoid unnecessary drives with your cars and why not ride your bike more frequently or go on foot. This often saves time and money, and it is healthy. And when buying a new vehicle or a new heating system, we should choose the model with the lowest emissions. Sometimes it is even sufficient to simply retrofit systems, vehicles or machinery to achieve a reduction of emissions.

We will do everything in our power to improve Berlin's city air for you. And if you support us in this effort, the sooner we will get to enjoy healthy air for an attractive city with even better quality of life.

Andreas Geisel
Senator for Urban Development and the Environment



How and with what is Berlin's air polluted?

Every human being produces pollutants

Nearly 3.5 million people live in Berlin. And nearly each of them contributes to pollutant emissions in Berlin's air – for example, because we take the car to ride to work or are on the road by bus and rail in our spare time. Because we produce foodstuff and other goods and transport these by truck, railway and ships. Because we work in air-conditioned offices and at modern construction sites, and live in well-heated flats. In following our regular daily routine, we produce a substantial quantity of emissions that pollute our air and also damage our health.

Road traffic as the main cause

A number of main sources cause “thick air” in Berlin. The major share in emissions such as hazardous nitrogen oxides is contributed by cars or road traffic. This is no surprise – almost 1.3 million vehicles are registered in Berlin. Countless further vehicles drive each day into

the city from surrounding regions. In addition, there is also plane and railway traffic as well as inland waterway transport.

Between 2005 and 2012, the annual average limit value for nitrogen dioxide was exceeded at all air monitoring stations in locations nearby traffic.

Numerous further sources

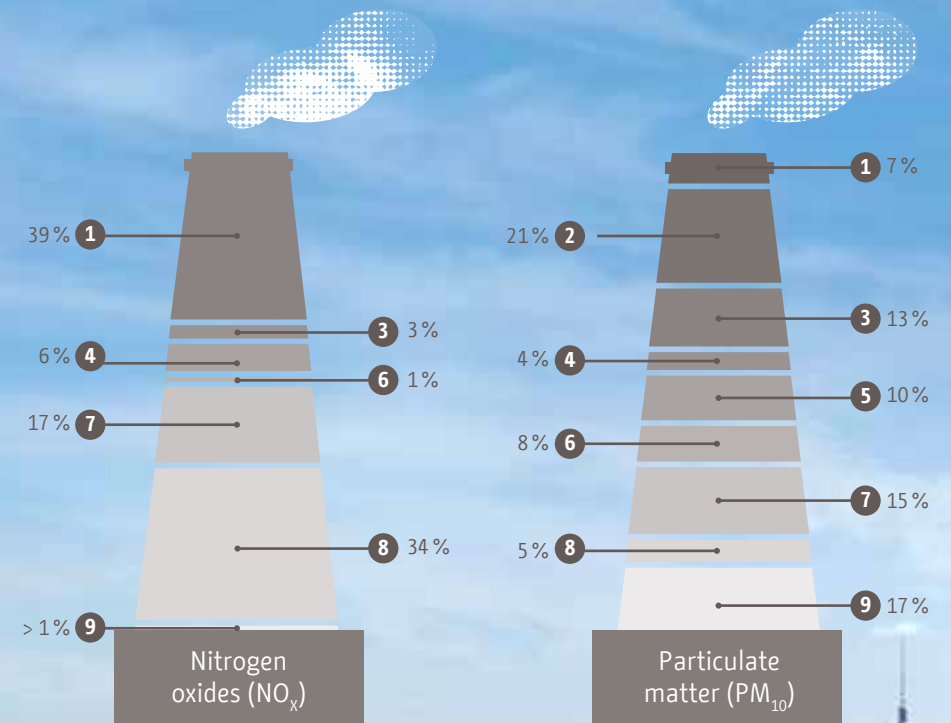
Further major sources are industrial plants, combustion systems of larger size for the heat and electricity supply industrial plants in the building materials industry (e.g. the production of concrete), waste treatment, the chemicals industry, foodstuff production, and metals processing. And last but not least: also heating systems of private households and those of smaller commercial enterprises, such as those used in the wood and metals industry and the foodstuff industry make for “thick air”. With regard to particulate matter, diffuse sources like construction machinery, chimneys, fireworks, charcoal barbecues and dust resuspensions cannot be discounted, either. They likewise figure into the sum as major sources – with increasing significance.

Annual average values exceeded

All of these sources produce considerable quantities of harmful nitrogen dioxide and particulate matter (PM₁₀). In order to protect the people from this pollution, the European Union has

Did you know that about three-quarters of the nitrogen dioxide pollution come from the exhaust gases of Berlin's vehicles?

Between 2005 and 2010, the highest nitrogen dioxide values occurred, by the way, at Hardenbergplatz Square in the west of the city. This is due to the large portion of bus traffic, besides automotive traffic, occurring near the railway station at Zoologischer Garten.

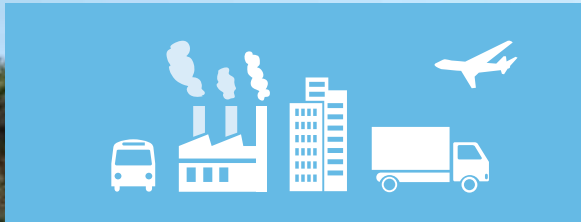
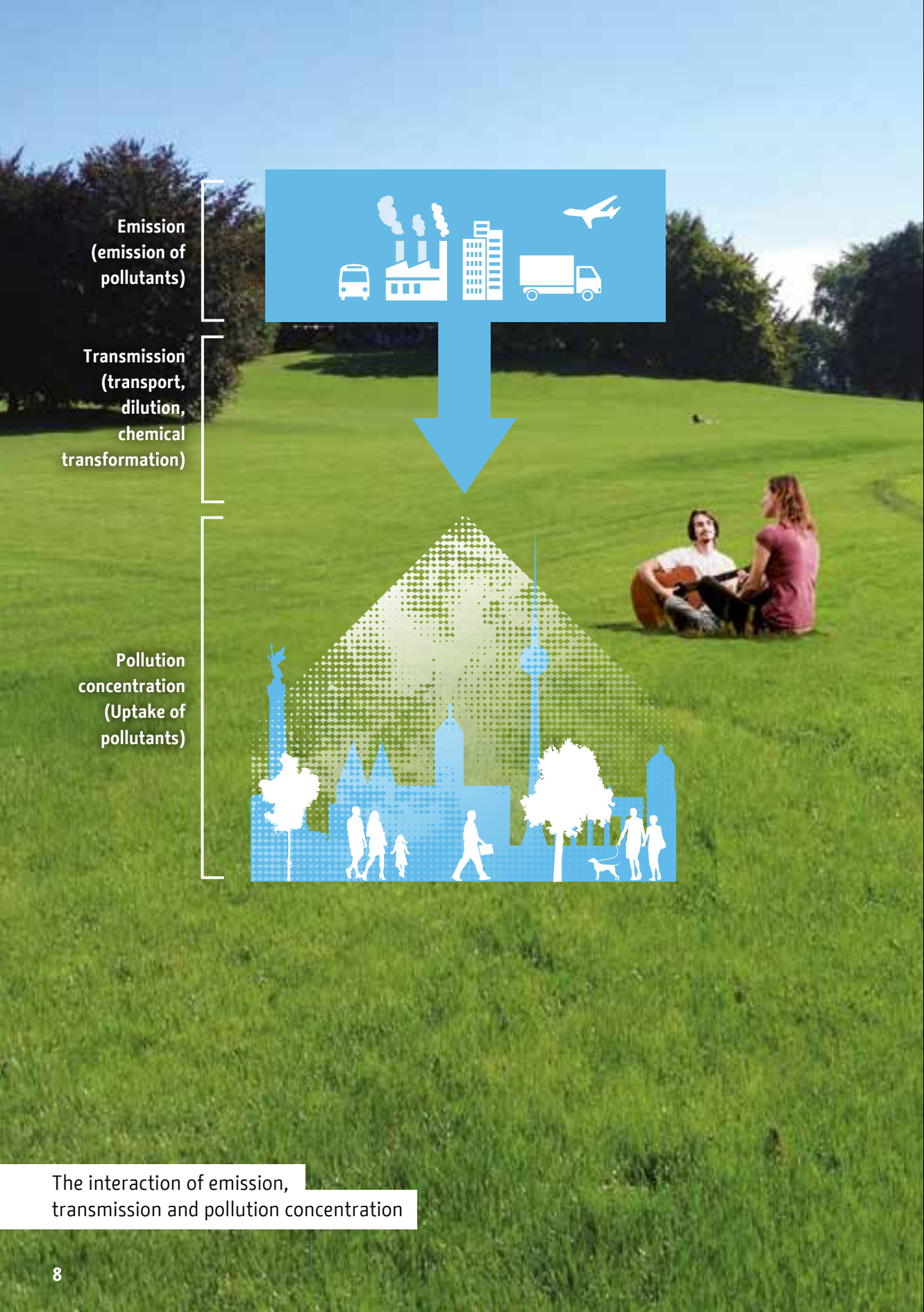


- 1 Exhaust emissions from vehicles
- 2 Friction and resuspension caused by vehicles
- 3 Other traffic
- 4 Exhaust emissions from mobile machines
- 5 Construction site activity
- 6 Small enterprises
- 7 Residential heating
- 8 Industry and power plants
- 9 Other sources

Share of different sources in Berlin's pollutant emissions in the year 2009

determined air quality limit values for these and other substances. Even if the air quality in Berlin has continuously improved in recent years due to numerous measures having been taken by the Senate and the Federal Government, the so-called annual average limit value for nitrogen dioxide (40 micrograms per cubic metre of air) has been exceeded at all air monitoring stations nearby traffic (values between

42 and 69 micrograms per cubic metre of air) in the years between 2005 and 2012. The same limit value also applies for particulate matter (PM₁₀). Even though it was not exceeded at any of the monitoring stations in the period from 2005 to 2012, the daily limit value of 50 micrograms per cubic metres of air was exceeded in some instances, however. It may be exceeded at most on 35 days.



Emission
(emission of
pollutants)

Transmission
(transport,
dilution,
chemical
transformation)

Pollution
concentration
(Uptake of
pollutants)

The interaction of emission, transmission and pollution concentration

How is air pollution actually caused?

Emission, pollution concentration, transmission

When trying to understand the issue of air pollution and when effective measures are to be taken against pollutants in the air, a few technical terms have to be distinguished: The term pollution concentration refers to the air contamination from pollutants such as nitrogen dioxide and particulate matter in the outdoor air that we breathe. This contamination results from the pollutant emissions of a multitude of sources and their transport and transformation (transmission) in the atmosphere.

Distance, weather, topography

On their way from the emission source to the point of impact, air pollutants are subject to different influences:

Distance: The greater the distance between the source of emissions and the pollution point, the more likely it is that the pollutants will disperse and dilute en route in the air or that they are even removed from the atmosphere. Exhaust gases from cars that are emitted directly near us therefore contribute particularly much to the city's air pollution.

Weather: In high winds, air pollutants can spread and dilute over vast areas. In lulls, they stay near the source of emission and collect there. The same applies when temperature layers prevent that air pollutants rise to greater

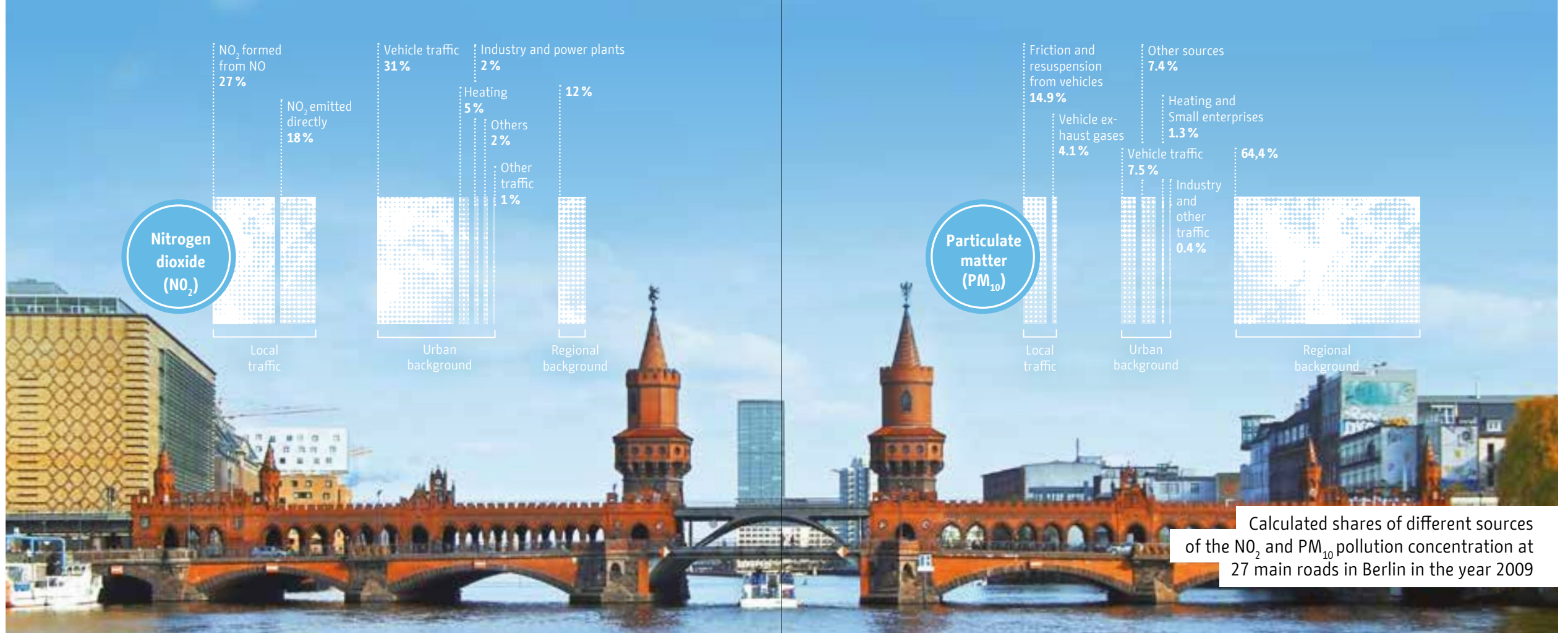
heights. The wind direction also effects the intensity of the pollutant concentration.

Topography: Mountains, hills and buildings can obstruct the transport of pollutants. For example, exhaust gases barely dissipate from low-altitude, narrow or closed urban canyons of roads. Where, in contrast, low-rise buildings and empty lots line the street, the pollutants can disperse better. The concentration drops. Leaves from trees and bushes additionally filter the pollutants out of the air.

Distribution of emission sources

What is important is how many sources of emission there are in any given area. In Central Europe they are found in high density. Therefore, a basic pollution load dispersed over a large area is present even in rural regions, far off from cities and industrial zones. The air flowing into Berlin thus transports more or less high loads of pollutants into the city as the background concentration. This is especially the case for particulate matter, which is why the limit value has been exceeded more frequently in Berlin.

Emission refers to the discharge of pollutants. Pollution concentration is understood to mean the air pollution that impacts humans and the environment.



Monitoring stations in Berlin: Where do we measure what and how?

16 monitoring stations in the city area

In the Berlin city area, there are 16 stationary monitoring stations, which record the pollutant concentrations in the outdoor air in terms of time and location to the most complete extent possible. This monitoring network is supplemented by 25 micro-collectors at the main traffic roads. At the same time, the air pollution is always the result from the interaction of the pollutant emission and the transport, and transformation in the atmosphere. In the pro-

cess, air pollutants can sometimes be transported over long distances.

Sources also outside of Berlin

To know the causes of high air pollution in Berlin, it is always also necessary to consider the contribution of pollutant sources outside of the city area. The large-area distribution of air pollutants results in the basic regional background concentration. The additional contributions from Berlin's sources lead to higher pollutant

The Berlin Air Quality Monitoring Network (BLUME) consists of 16 stationary monitoring stations, some of which are located at roads with heavy traffic.

concentrations in the city, both dispersed over the city region (urban background) as well as peak concentrations along roads where much more pollution is generated by traffic.

Low-emission zone is effective

The shares of the regional background and Berlin's sources as part of the air pollution along roads were calculated by means of special models. The result for nitrogen dioxide: About three-quarters of the high pollutant concentra-

tion along roads come from Berlin's road traffic. For particulate matter, slightly more than one-third comes from sources in Berlin, of which three-quarters stem from road traffic. Compared to 2002, Berlin's own contribution could already be lowered substantially with the clean air measures to date, like the low-emission zone, as at that time, still about one-half of the particulate matter was home-grown in Berlin. Especially the reduction of exhaust gas particles contributed to this development.

Why is nitrogen dioxide and particulate matter so hazardous?

Poison breath-by-breath

Nitrogen dioxide (NO₂) is a gas. It reaches the body by inhalation and can damage the respiratory and cardiovascular system, foremost of children, seniors and people with prior conditions. Nitrogen dioxide is also transformed into particle-shaped nitrates in the atmosphere and thereby contributes to the formation of particulate matter. Ozone is formed from nitrogen dioxide under intense irradiation of the sun in interaction with volatile organic compounds such as hydrocarbons, so that increased ozone values can occur especially in the summer.

Small particles, big hazard

Particulate matter, too, can damage our health. They are particularly problematic if the diameter of the dust particles is smaller than 10 micrometres = 10 thousandth millimetre (PM₁₀) or even less than 2.5 micrometres (PM_{2.5}). Particulate matter enters the body through nose and mouth. Here, the rule applies: the smaller the particles, the more hazardous they are. If they are smaller than 10 micrometres (PM₁₀), they can even enter the respiratory system and in some cases reach the bronchia and lungs. Ultrafine particles with diameters of less than 0.1 micrometres can reach the pulmonary alveoli and transfer into the bloodstream from there.

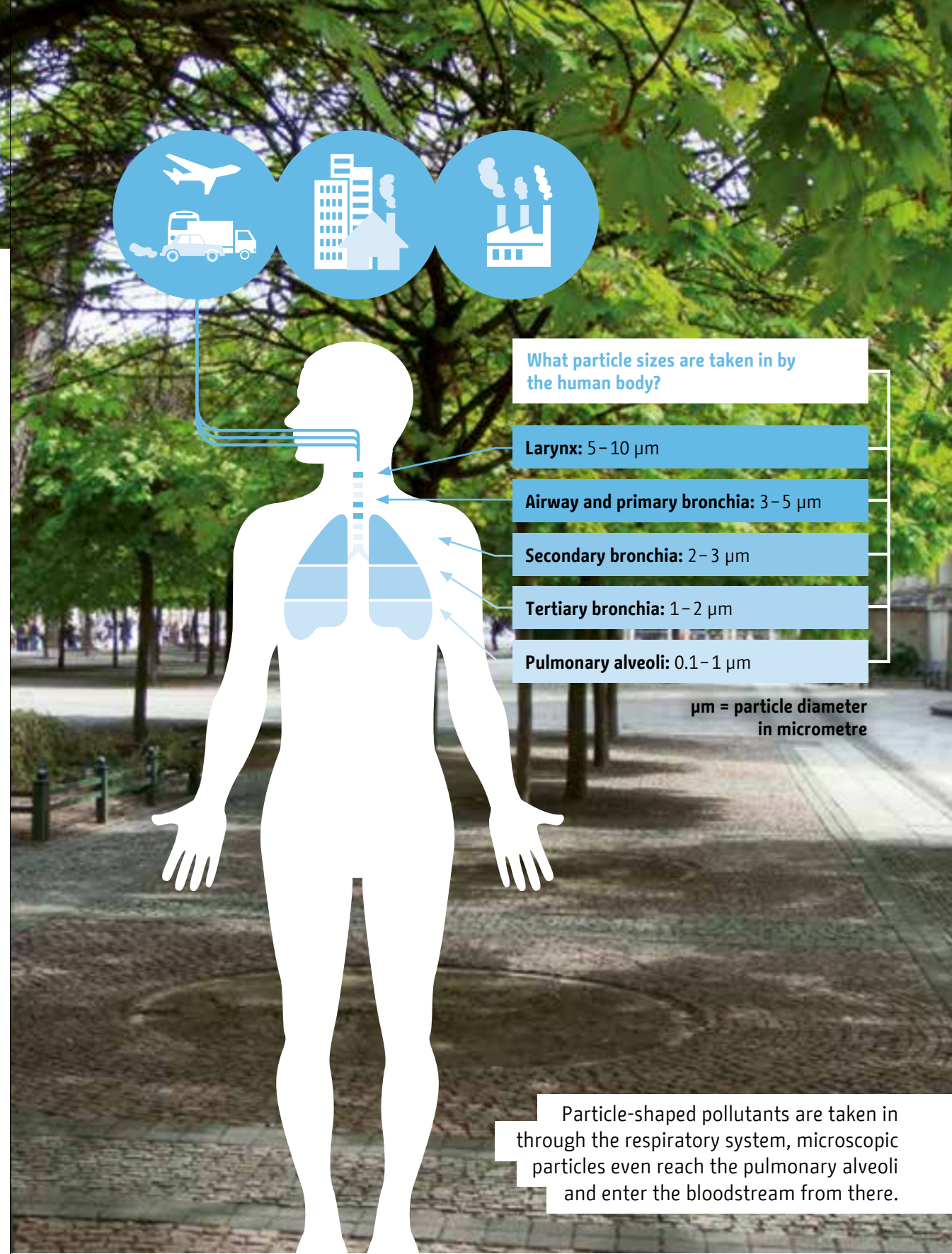
All in all, particulate matter increases the risk to contract coughs, bronchitis, asthma and cardiovascular problems. In children, they can furthermore impair the growth of the lungs. Particulate matter is hazardous to health in any

PM stands for Particulate Matter, the term used for fine dust, which refers to particle-shaped substances.

concentration, which means that there is no threshold below which, no damaging effect can be detected anymore. The damaging effect rises proportionally with the concentration. This means: every reduction of particulate matter is a benefit to health.

Did you know that diesel soot can cause cancer?

Diesel soot is created from incomplete combustion. It consists of carbon and various carbon compounds forming ultrafine particles. The World Health Organisation (WHO) classifies diesel soot as one of the substances with the highest potential for causing cancer. A reduction of diesel soot is also beneficial for climate protection, since the black particles contribute significantly to the warming of the atmosphere.



What particle sizes are taken in by the human body?
Larynx: 5 – 10 µm
Airway and primary bronchia: 3 – 5 µm
Secondary bronchia: 2 – 3 µm
Tertiary bronchia: 1 – 2 µm
Pulmonary alveoli: 0.1 – 1 µm

µm = particle diameter in micrometre

Particle-shaped pollutants are taken in through the respiratory system, microscopic particles even reach the pulmonary alveoli and enter the bloodstream from there.

What is the Air Quality Plan about?

Compliance with the limit values

Berlin complies with the regulatory limit values for many air pollutants. This is especially the case for sulphur dioxide, benzene, carbon monoxide and PM_{2.5} fine dusts. Also, heavy metals in the particulate matter are significantly below the limit values. However, there continue to be problems with the annual limit value for nitrogen dioxide (NO₂) and the daily limit value for PM₁₀ fine dusts.

Air Quality Plan 2005–2010

In the year 2002, it became apparent that without taking additional measures, Berlin cannot comply with the limit values for nitrogen dioxide and particulate matter (PM₁₀) within the prescribed deadlines. For this reason, the City was obligated to draw up an Air Quality Plan for the period from 2005 to 2010. The centre piece of this ambitious actions plan was the gradual introduction of the low-emission zone. Even if noteworthy success could be reported, it was still not accomplished everywhere to observe the limit values for nitrogen dioxide and particulate matter (PM₁₀).

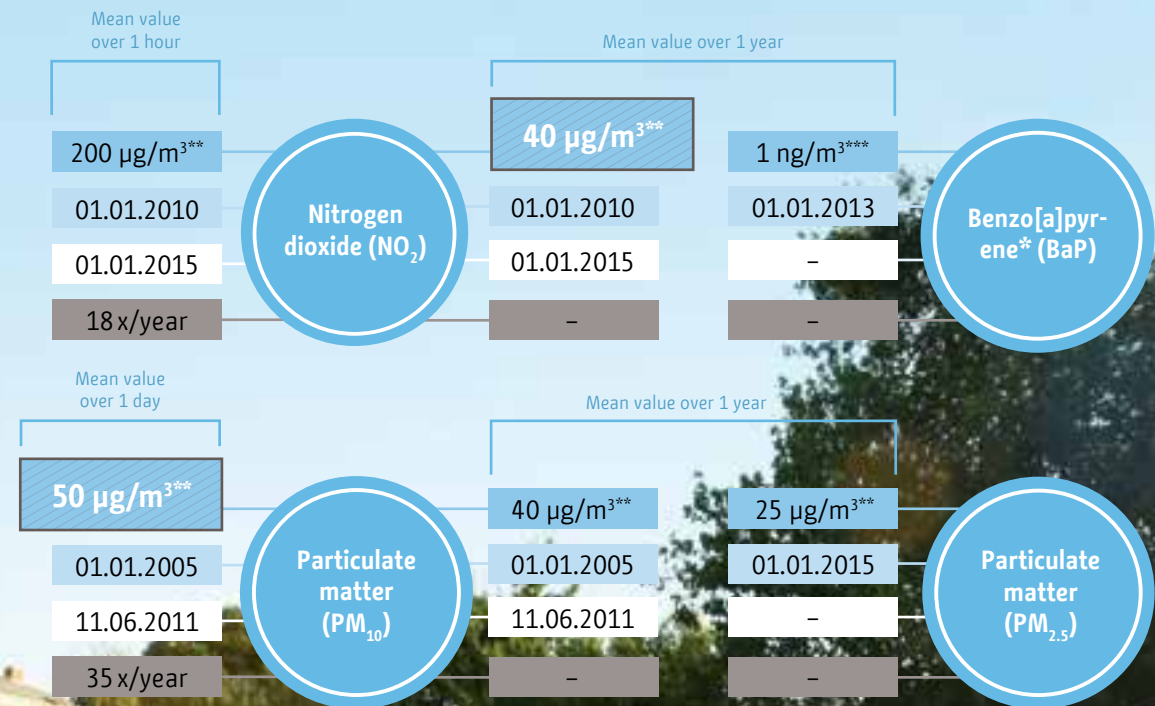
Benzo[a]pyrene causes cancer. It is created for example, by wood burning in fireplaces and wood burners.

ulate matter (PM₁₀). Likewise, the pollution with the cancer-causing benzo[a]pyrene is only slightly below the target value that has been applicable since 2013. The situation is similar in nearly all other large cities in Europe.

Air Quality Plan 2011–2017

Since there continues to be the risk that limit values are also exceeded in the future, thus after the deadlines expire, Berlin has requested a deadline extension from the European Commission. In Germany alone, another 56 regions and congested urban areas have been forced to do the same. However, a deadline extension is granted only if the applicant documents that it has already implemented all reasonable measures on scale and is taking further steps to observe the limit values in the future. To provide this proof, the City has drafted the new Air Quality Plan 2011–2017. It foremost serves the purpose of further lowering the concentration of nitrogen dioxide and particulate matter (PM₁₀). Upon its taking force in June 2013, it has replaced the previous Air Quality Plan.

Limit values and deadlines for selected air pollutants



* less binding target value, ** µg/m³ means 1 millionth of a gram per cubic metre, *** ng/m³ means 1 billionth of a gram per cubic metre

- Limit value
- to be observed by
- Possible deadline extension until
- Limit values are exceeded
- Permissible number of exceedances

What has the present Air Quality Plan achieved?

Low emission ZONE

Emission reduction by modernisation of trucks and cars:
nitrogen oxide emission -20 %
diesel soot emission -58 %



Emission reduction by modernisation of public transport buses:
nitrogen oxide emission -46 %
diesel soot emission -90 %



Increase of bicycle traffic **+33 %**



Increase of passenger numbers **+12 %**



Reduction of car traffic **-10 %**
 Reduction of pollutants:
Nitrogen oxide emission -7 %
Particulate matter -6 %

Success achieved through air quality and traffic policy

New low-emission zone, clean vehicles

Only low-emission vehicles have access to the low-emission zone. Compared to the development without the low-emission zone, it accounts for substantial relief on the main roads. For example, the daily limit value for particulate matter (PM₁₀) was exceeded about 10 days less frequently. The soot pollution generated by road traffic fell by more than half, nitrogen dioxide pollution dropped by about 5%. Modernisation of the municipal public transport buses also took a positive effect. Compared to 2004, the bus fleet now emits 90% less diesel soot and 46% less nitrogen oxides.

Less car traffic, more bicycle paths

The measures under the Urban Development Plan "Traffic" led to an increase in the use of environmentally friendly means of transport and a reduction of car traffic. Between 2003 and 2009, the passenger numbers in the ÖPNV public transport network rose by approx. 12%. Bicycle traffic has increased since 2004 by more than one-third and continues to grow. The length of bicycle paths and the number of bike parking stations has increased by about 60% since 2002. Pedestrians have received more than 200 new crossings since 2001 and also 100 additional crossing assistance systems. Car traffic has reduced by more than 10% between 2002 and 2012. There is no other city in Germany where citizens are more frequently on the road using environmentally friendly means of

transport: cars are used for only 32% of all roads travelled in Berlin. In other large cities in contrast, this share is at around 43%.

The Urban Development Plan "Traffic" has generated risen passenger numbers in the ÖPNV (Public Short-distance Transport Network), 60% more bicycle paths and 200 new pedestrian crossings since 2002.

Further successful measures

Between 2002 and 2010, the number of managed parking spaces has nearly doubled. The traffic caused by people looking for parking spaces on side streets has thereby reduced by 20% to 40%. In addition, speed limits have contributed to the reduction of air pollution. For example, the City has enforced full-day speed limits of 30 km/h on overall 130 km of main roads by 2009. On an additional 100 km, it has ordered a speed limit of 30 km/h for certain hours in the day. The measures under the Air Quality Plan 2005–2010 have contributed to the reduction of the total emissions of nitrogen oxides in Berlin by more than 15% and particulate matter reduced by 25% from 2002 to 2009.

Did you know that the low-emission zone cut the concentration of traffic related soot particles in half?

Owing to the low-emission zone, the nitrogen dioxide pollution was reduced by about 5%; the pollution from traffic related soot particles along roads reduced by more than half. The reason: In respect of diesel soot, the emissions in the year 2010 fell by 58% compared to the trend development without low-emission zone, and in respect of nitrogen oxides the reduction was about 20%.

How would things continue without a new Air Quality Plan?

Continued need for action

The measures thus far have improved the air quality in Berlin or at least prevented a deterioration of the situation. However, limit values continue to be exceeded. Thus, there continues to be a need for action. In this regard, it must be differentiated between what Berlin can achieve through its additional actions and what will improve already through the existing European and national laws.

Additional measures required

As of 2014, the EU prescribes a gradually lower pollutant emission for new vehicles by way of the

Euro 6 emission standard. For fireplaces and other small combustion systems, stricter values will apply as of 2015, which also require that old furnaces be overhauled. This and other regulations will lead to the further reduction of the air pollutant emissions in the coming years. But is this trend enough to improve the air quality in Berlin? One study makes it clear: without additional measures, the limit values will also not be observed in the coming years – despite a generally good trend.

De-warning not before 2020

A de-warning cannot be expected for the nitrogen dioxide pollution before 2020. This is when

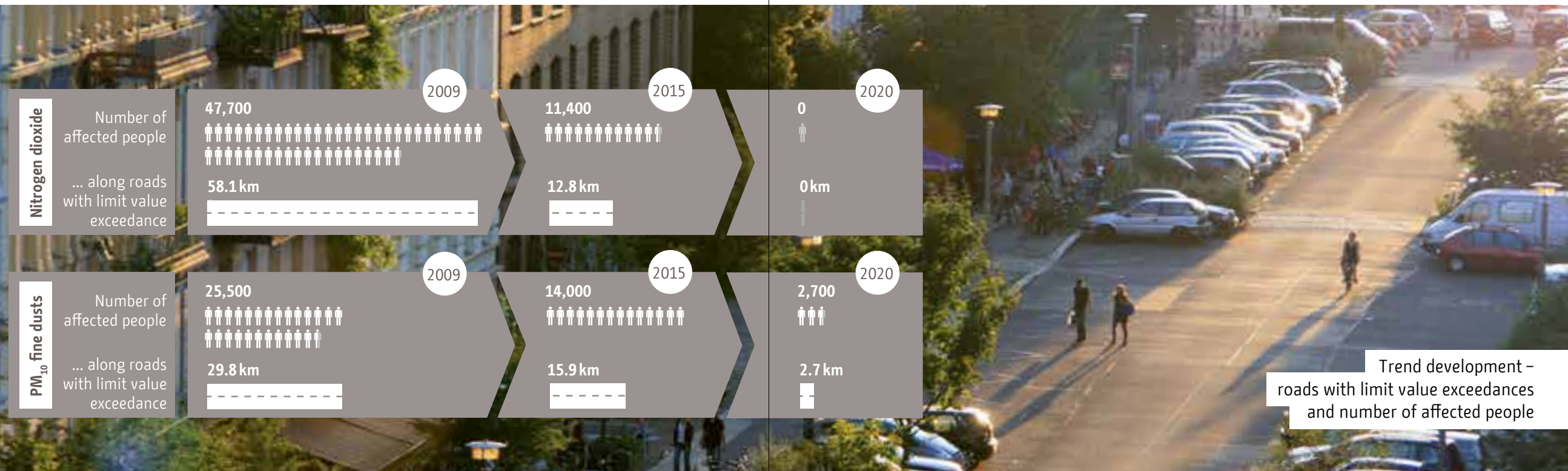
the high share of vehicles with the Euro 6 emission standard will lead to the limit value probably being observed on all roads, while in the year 2015, exceedances are still expected on about 12.8 km of roads along which approximately 11,400 people live. In the year 2009, this figure was still 58 km with about 47,700 people affected. Pollution is decreasing also as concerns particulate matter, even though this reduction is not as drastic than to achieve compliance with the limit values everywhere also in years with unfavourable weather conditions. The cause of this is foremost the contribution of the regional background concentration that continues to be at a high level. Of nearly 30 km roads with limit value exceedances, it is expected that still nearly 15.9 km will remain in exceedance in the year 2015 and about 2.7 km in 2020. The number of people affected will decrease from

about 25,500 to 14,000 in the year 2015 and 2,700 people in the year 2020.

Since 2014, a new emission standard applies for new vehicles. From 2015, new limit values apply for chimneys and combustion systems.

Did you know that stricter limit values apply for furnaces as of 2015?

In 2015, the second stage of the 1st Federal Pollution Control Ordinance will take force. From that time onward, it will be prohibited that fireplaces, furnaces, tile stoves and other small combustion systems exceed the limit value of 20 milligrams of dust per cubic metre of discharge air.





1 Spatial structure and urban planning

What measures are planned until 2017?



Cross-regional action also required

Further actions need to be taken by the City, so that Berlin can do better in observing the air quality limit values in 2015. This is particularly required to avoid exceedances of the limit value for nitrogen dioxide, given that local nitrogen oxide sources like car traffic are highly relevant in this regard. Local actions alone are not enough to prevent that the daily limit value for particulate matter (PM₁₀) is exceeded no more frequently than permitted. The reason for this is that the basic pollution load is largely created from particles outside of Berlin, which can be transported over hundreds of kilometres in unfavourable weather conditions. Yet it continues to be necessary to also

act locally against particulate matter. The aim: The likelihood is to be reduced that the daily limit value is exceeded more frequently than permitted. Likewise, the amount and duration of the exceedance of the limit value for NO₂ must be reduced. Essentially, the Air Quality Plan 2011–2017 provides for measures in the following fields of action:

1. Spatial structure and urban planning
2. Road traffic and traffic engineering
3. Mobility and traffic management
4. Road areas and road surfaces
5. Heat supply of buildings
6. Industry and commerce
7. Construction sites and construction machinery

In the scope of the campaign “City Trees for Berlin”, 10,000 new trees to line the streets are to be planted by the end of 2017.

Urban planning for “cool climate!”

Open areas can serve as air corridors and supply entire city districts with fresh air. Building fronts along streets are co-determinants of how strongly pollutants dilute in the street already. Green areas and trees lining the streets can filter out pollutants from the air and ensure a more pleasant city climate. In the campaign “City Trees for Berlin”, which is already underway, 10,000 new trees to line the streets are to be planted by 2017. Urban planning can furthermore contribute to keeping the distances of routes, for example going to schools or restaurants, short so to minimise traffic. On the other hand, the planning also has the aim to avoid conflicts between residential zones and industry and commerce, for example, by providing sufficient space between them.

Significant strategic role

Urban planning creates long-term framework conditions that can hardly be made up for by

individual measures. Questions of air quality are therefore to be appropriately considered at all levels – both in urban development plans and zone usage plans as well as in urban land use plans. Many plans of Berlin already contain aims and measures in support of air quality. Examples of this are the Urban Development Plan “Climate”, the Urban Development Plan “Centres”, the Urban Development Plan “Industry and Commerce”, and especially the Urban Development Plan “Traffic”.

Did you know that 440,000 trees lining the streets in Berlin ensure better air?

This makes Berlin one of the greenest metropolises of the world. Trees filter not only pollutants out of the air, they additionally generate oxygen, provide shading and a habitat for animals. By the way, the most frequently found tree lining streets in Berlin is the linden tree, followed by the acorn and oak tree.

2 Vehicle traffic and traffic engineering

New emission standards and the promotion of natural gas and electrical vehicles reduce the pollution with nitrogen oxides and PM₁₀.

Many roads lead to a reduction of pollutants

Car traffic causes the greatest part of the pollution with nitrogen dioxide and particulate matter along the main roads in Berlin – that is to say, 77% of nitrogen oxides and about 27% of the PM₁₀ fine dust pollution. The central aim of the Air Quality Plan therefore is to reduce these emissions, for example, by means of improved automotive engineering, steady traffic flows, better traffic management, shifting to environmentally friendly transport carriers and by avoiding traffic.

Repeal of rules for exceptions

It is still the case that not everyone in the low-emission zone meets the required emissions criteria. The cause of this are rules for exceptions. In the year 2010, more than one-third of the diesel soot emissions were generated by such vehicles that fall under rules for exceptions. To counteract this problem, most of the rules for exceptions will expire on 1 January 2015. It is planned that merely expensive special vehicles with low mileage and for people with walking disabilities, who have little income available, should continue to benefit from the

rules for exceptions. If the relevant vehicles are replaced by new vehicles or if they are retrofitted, the pollutant emissions will drop city-wide on all roads. Particular relief is expected for the main traffic road network. The emission of diesel soot will drop there by 4% and the emission of nitrogen oxides by 1%.

Increasing the percentage of Euro 6 vehicles

As of January 2014, the emission standard 6 applies for trucks and buses. From January 2015 onward, it applies for cars and from September 2016 for light-weight utility vehicles. The new trucks and buses emit up to 90% less nitrogen oxides and diesel soot. If new cars are purchased, the emission of nitrogen oxides is expected to fall by more than 60%. Only when a large percentage of the vehicles fulfil the euro 6 standard can the limit values for NO₂ be met everywhere in the city. This will probably not be the case before 2020. For this reason, Euro 6 vehicles should be introduced to traffic as quickly as possible. Besides the classification, also the introduction of user incentives is being considered. In addition, Berlin will only purchase diesel vehicles from now on, which meet the Euro 6 standard wherever possible.



Promoting natural gas vehicles

Vehicles driven with natural gas emit only small quantities of nitrogen oxide and practically no particulate matter. The Federal Government subsidises these vehicles until 2018 with an exemption from the mineral oil tax. The GASAG additionally promotes the purchase of natural gas vehicles with a one-off fuel voucher in amounts from 111 to 1,500 euro. Nonetheless, the percentage of natural gas vehicles in Berlin is stagnating at a low level. It accounts for merely 0.3% of the vehicles registered here. The City wants to maintain this percentage and if possible, increase it to more than 1%.

Did you know that nearly no air pollutants are created by the combustion of natural gas?

Natural gas has the lowest CO₂ emissions of wood and coal. The special relation of nitrogen and carbon achieves that considerably fewer carbon monoxides and carbon hydrates are emitted in the combustion process than is the case for example, in traditionally fuelled vehicles. According to a study by the German Energy Agency (dena), a natural gas vehicle causes around 25% less carbon dioxide than a comparable petrol car.

Promoting electro-mobility

Electrical vehicles do not generate any engine related air pollutants when driving. These however can nonetheless be created in power generation, primarily in coal power plants. Electrical vehicles are ecologically sensible only if the required electricity comes from renewable, low-emission sources of energy. Furthermore, they create particulate matter like any other vehicle through tyre friction and dust resuspension. Berlin intends to achieve by 2015 that electrical vehicles contribute up to 1.2% to the mileage of motorised road traffic. This would also contribute to a reduction of the diesel soot emission by 1.2% while the reduction of nitrogen oxides would amount to 1.4%. To be able to reach this goal, the City will implement the actions programme “Electro-mobility Berlin 2020” for example, and expand the charging infrastructure, gradually introduce user incentives and consider electrical vehicles for its own procurement purposes.

Up to 200 double-decker buses of the bus transport association, BVG, are to be retrofitted with an additional nitrogen oxide catalyser. This will lower the nitrogen oxides emissions of these buses by up to 70%.

Retrofitting vehicles in the ÖPVN public short-distance transport network

Berlin's bus fleet could already lower its diesel soot emissions by 90 % by means of particle filters. But public transport buses continue unchanged to cause about 13 % of nitrogen oxide emissions in the overall road traffic of Berlin. Retrofitting systems to reduce nitrogen oxide have already been tested successfully. In 2013, a subsidy programme was started that supports the BVG in the retrofitting of 100 to 200 buses. In 2014, the entire fleet is to comply with the Euro 5 standard at a minimum. For new procurements, the City intends to invite tenders for the purchase of buses with Euro 6 standard in such a way that the vehicles will also reach the aimed for reduction in the inner-city traffic. Buses that cannot be retrofitted are furthermore planned to be replaced on an expedited schedule. These measures will reduce the additional local pollution by 5 % to 45 % in terms of nitrogen dioxide. The retrofitting of buses will cost between 1.5 and 2 million euro.

Modernising municipal vehicle fleets

The vehicle fleet of Berlin's administrations, the subordinated agencies and the municipal enterprises is being continuously modernised through retrofitting and new procurement. Strict environmental standards apply in this regard. For example, also diesel vehicles with the Euro 5 standard must have a closed particle filter wherever possible, even if the emission stand-

ard could be reached without filter. The entire vehicle fleet is to gradually comply with the Euro 6 standard through retrofitting and replacement of vehicles. Heavy-weight utility vehicles are to be retrofitted with systems for the reduction of nitrogen oxide if this is technically possible and permitted under registration rules.

Retrofitting Euro 4 vehicles

In the year 2015, it is expected that 75,000 diesel cars, 22,000 light-weight utility vehicles, and 8,000 trucks (with weights of more than 3.5 tons)



will be registered, which meet only the Euro 4 standard. It is not known how many of them have particle filters or denitrification system to reduce nitrogen oxides. Half of these heavy-weight utility vehicles and buses are to emit at least 50 % less particulate matter and nitrogen oxides by 2015. The same is to apply for cars and light-weight utility vehicles. This way, it would be possible to reduce diesel soot emissions by a good 12 %. The particle filters cost roughly between 1,000 to 2,000 euro per car and light-weight utility vehicle, denitrification

systems cost between 10,000 and 15,000 euro per truck and bus. To be able to implement these measures, the technical regulations for the registration of the denitrification systems are yet to be determined first by the Federal Government.

Modernising passenger ships

The emission limit values are less demanding for ships than for automobiles. But ship engines often have a very long lifetime. In consequence, they frequently cause high emissions. In the scope of a pilot project, it has been proven that passenger ships can be retrofitted with particle filters and that their particulate matter emissions are thereby substantially reduced. This kind of modernisation costs between 20,000 and 30,000 euro per ship. The aim is to retrofit about every third ship. This way, the fleet could lower its particulate matter emissions by one-fifth within the low-emission zone.



3 Mobility and traffic management



Speed limit of 30 km/h on main roads can lower the concentration of nitrogen dioxide caused by local traffic by up to 15%. The reduction even amounts up to one-third for particulate matter

Steadying the traffic flow

Studies are underway on up to 90 road sections to find out how traffic jams can be avoided. An important instrument for this purpose is traffic guidance. It contributes to a steadying of the traffic flow and reduces the risk of traffic jams. It is being explored in pilot tests how the inflow of traffic can be guided when traffic jams are impending and how traffic light synchronisation can be adjusted accordingly. Even though these measures show effects only locally on the affected road section, they can nonetheless also reduce emissions by around 10% on roads with large percentages of traffic jams. The maximum possible reduction can be up to 35%. If all the traffic jams could be avoided in the city, more than one-third of the people would be relieved, who are presently affected by limit value exceedances.

Introduction of a speed limit compatible with the city needs

Measurements have shown: the speed limit of 30 km/h can lower the additional nitrogen dioxide pollution due to traffic by up to 15% on main roads. The reduction even amounts to nearly one-third for particulate matter (PM₁₀), insofar as the traffic flow is steady. Although the speed limit of 30 km/h is not intended to be introduced for the entire main traffic road network, as speed limits can only be imposed whilst preserving the effectiveness of main roads, the speed limits that are compatible with the city needs, however, can be sensible in places where it is expected that the nitrogen dioxide limit value will be exceeded in 2015. This always requires a check of the particular case, since also aspects of the effectiveness of the traffic network and questions relat-

ing to the coordination of traffic lights must be considered. The maximum effect achievable: the number of people, who suffer from the limit value exceedances, would be reduced by up to 40%. At the same time, the speed limit of 30 km/h means less noise and more safety in traffic.

Traffic guidance for trucks and buses

Presently, concrete data are not available regarding the transit traffic of trucks rolling over the city's motorway. It is assumed that many trucks take the shorter route via the city's motorway during the hours with less traffic, instead of travelling on the beltway. The Urban Development Plan "Traffic 2025" provides for the closure of this gap in knowledge. The aim is to review to what extent the transit traffic of trucks can be sensibly guided to the beltway. Overland buses in turn can contribute to the additional pollution at attractive sites rising because of traffic: in terms of diesel soot the increase amounts up to 17% and in terms of nitrogen dioxide up to 15%. To lower this pollution, Berlin is planning an overland bus concept. Keeping engines running, especially those of overland buses, also leads to avoidable emissions and nuisance to passers-by and waiting passengers. Here, more information is to contribute to a reduction.

Making the ÖPNV more attractive

In Berlin, the share of motorised passenger traffic amounts to merely 32%. Berlin's short-distance traffic plan aims at even lowering this share to 25%. The aim is to guarantee the attractiveness of the ÖPNV short-distance public transport network in the future as well. For this purpose, numerous measures are to be implemented, such as the further development of the bus acceleration programme, ensuring a high density of stops and sufficient offers for rides even at night.

Promoting bicycle traffic

In the year 2008, half of the drives by car undertaken by city residents covered distances of less than 6 km. More than one fourth of these drives was even shorter than 3 km. Such distances can be covered in an optimal way by bicycle. The aim is therefore to increase the share of bicycle traffic. For this purpose, the Urban Development Plan "Traffic 2025" includes numerous measures like the preservation and expansion of bicycle paths, bike parking stations and bike rental systems. Since 2002, the bicycle path network has grown by 60% already. Studies show: city-wide, the concentration of air pollutants decreases if residents cover more distances by bike from now on. If they used the bike for at least some of the distances of less than 10 km, about 10% to 13% of the emissions from automobiles could be avoided.

Expanding car-sharing

Car-sharing makes it easier to decide against having a car of one's own. There are 219 car-sharing stations in Berlin to date. Most of them are located in the city centre. Meanwhile flexible offers without fixed stations are new in contrast. To support this trend, Berlin plans to make around 1,000 parking spaces available for this purpose.

Did you know that a single car-sharing car replaces between 5 to 7 private cars on average?

There are about 140 car-sharing providers in Germany at the present time. Two-thirds of all users are between 30 and 50 years of age. By the way, the first German car-sharing provider started its services as early as in the year 1988 – coincidentally in Berlin.



4

Road areas and road surfaces



Smooth asphalt surfaces reduce the resuspension of PM₁₀ fine dust. Redesigning road areas lowers the air pollution caused by traffic by 5% to 10%

Repairing road surfaces

The condition of the road surface has an influence on the quantity of particulate matter reaching the air through tyre friction and resuspension. On average, about 14% of the PM₁₀ pollution along roads comes from these sources. When the road surface is in bad shape, the pollutant emission can rise by two to five times as much in comparison to smooth asphalt surfaces. What is more: all roads where the PM₁₀ limit value is exceeded also have high noise emissions. Consequently, if heavily frequented roads are repaired, two problems can be mitigated at the same time.

Rearranging road areas

The strategy of rearranging road areas is derived from the noise actions plan. The aim is to enlarge the distance between the road traffic and residential units by up to 3 m. On the one hand, this will lower the noise emission impacting on building facades. On the other hand, this leads to the air pollutants being diluted already before they reach the windows. In addition, more room will be created for pedestrians and cyclists and where necessary, there will be space for a bus lane. Redesigning where it has already been implemented proves that the traffic related additional pollution is thereby reduced by 5% to 10%.



5 Heat supply for buildings

In the future, there might be 100,000 mini-block power plants in Berlin generating heat and electricity in an environmentally sustainable way.

Choice of energy source is decisive

About 15% of the nitrogen oxide and particulate matter emissions in Berlin is generated by household heating systems. These emissions occur during the winter months when there is a high background pollution load, especially of particulate matter. To reduce these emissions, the heat requirement must be lowered for one thing. At the same time, the choice of the energy source plays a central role. For example, the combustion of natural gas causes nearly no air pollutants, while the combustion of wood and

coal causes particulate matter, nitrogen oxides and even benzo[a]pyrene with its high risk of causing cancer. Furthermore, the technical equipment and maintenance status of combustion systems accounts for substantial effect.

Reducing the heat requirement

In the scope of its climate protection policy, Berlin is presently developing quantitative targets for the reduction of the heat requirement of buildings. Accordingly, there are numerous measures in place at the present time already.

an area of 100km². Urban planning is to contribute to the improvement of the air quality in that area. This means for example, that development plans can determine the emission requirements for heating systems. Accordingly, in new buildings in the priority zone, only heating systems may be installed, which do not exceed pollutant emissions of a modern oil heater. A contrary development is presented in the city periphery. There, biomass fuel heating systems such as fireplaces have been on the rise for many years. These cause up to ten times more dust emissions than heating oil. It is under review against this background, how much wood burning actually contributes to the particulate matter pollution. Should there be a significant reduction potential in this area, additional measures will be taken. Initial model calculations have shown that the emission of PM₁₀ fine dust could drop annually by around 407 tons if the City was to prohibit wood and coal burning in general.

Using block heating power plants

Through the simultaneous generation of heat and electricity, block heating power plants reach a high energetic efficiency. They can save up to 30% of primary energy. By now, mini-block heating plants are also used to heat larger buildings. For reasons of climate protection, they are subsidised with public funds. Whether they can contribute to a reduction of particulate matter and nitrogen oxides emissions depends on the energy source they use as well as the system's maintenance and technical condition. Currently, there are about 300 mini-block heating plants in Berlin. This figure could grow to 100,000 in the future. This is about equal the capacity of two larger power plants, which however are subject to stricter emission limit values and monitoring regulations. To this end, strict emissions standards must also apply from now on for mini-block heating plants in the interest of the principle of precaution.

Among them, in particular, are energy savings contracting, energy savings partnerships, energy and climate advising for private households and small- and mid-sized businesses, as well as the energy modernisations of the buildings owned by the City's own enterprises and the City's housing societies.

Using clean energy

As early as in 1984, the land use plan of Berlin defined a priority zone for clean air. Today it covers primarily the inner city districts covering

6 Industry and commerce

Additional equipment with a closed particle filter, the soot emissions of a diesel engine can be lowered by more than 90%.

Retrofitting of mobile machinery

Industry, power plants and commerce cause about 36% of the nitrogen oxide emissions in Berlin and 13% of particulate matter emissions. The exhaust gases of these plants however are considerably below the regulatory limit values so that no additional measures are reasonable.

Meanwhile, this group of sources also uses machines and devices within their plants, which are driven by diesel motors. Permits for the plants by now include the requirement to retrofit the machines with closed particle filters. This way, the diesel soot emissions reduce by 21 tons per year.



7 Construction sites and construction machinery

Retrofitting with diesel soot filters would lower the particulate matter emissions of construction machines by 75%.

Particulate matter pollution from construction sites

Construction sites can substantially increase the particulate matter pollution within their vicinity. Particulate matter is created for example, during mechanical crushing, resuspension and drift. These particles are comparably large. Their diameter is usually larger than 2.5 micrometres; in some cases, it even exceeds 10 micrometres. These particles are not transported very far in the atmosphere, their effect is rather limited in terms of place and time. More problematic are diesel soot particles from construction machines. They are smaller than 1 micrometre and are dispersed city-wide in the air. Because of the large number of construction sites, this leads to an increase of the basic pollution load of particulate matter in the city.

Retrofitting construction machinery

Emissions regulations applicable for construction machinery are more relaxed than those applicable for automobiles. Concentrations can increase locally, especially because some of the machines run in continuous operation. Overall, the machines cause nearly just as much diesel soot emission in Berlin as road traffic does. 140 tons per year. The aim is to retrofit almost all

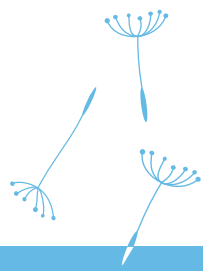
construction machines with diesel soot filters. This would lower the particulate matter emissions of the machines by rounded 75% in total. That this is possible is demonstrated by the experiences gained in Switzerland. In the first step, low-emission construction machines are to be used gradually at city construction sites starting from 2014.

Lowering diffuse dust emissions

The aim is to reduce dust emissions. For this purpose, architects, construction businesses, and builders are to receive more information. At the same time, the City will review if it is possible to include accordant requirements in building permits. In this regard, a guideline is already available that informs about the measures for dust reduction.

Reducing transport emissions

Supplies to and disposals from construction sites also cause emissions. Important factors are cleanliness of the vehicles and the number as well as distances covered by the transports. In this context, truck traffic plays a special role. Not all trucks travelling to construction sites fulfil the requirements of the low-emission zone. They are partly granted exceptions under the Federal Emissions Protection Act. In October 2012, Berlin changed the administrative ordinance for its public procurement. For construction projects, also such located outside of the low-emission zone, bidders now have to prove that they exclusively use vehicles that have a green environmental sticker.



What does the Air Quality Plan 2011–2017 achieve?

Five bundles of measures checked in advance

To evaluate the success, it was checked in advance what the effects of the chosen measures will be. To be able to calculate the effects on emissions and pollutions, these were summarised in five bundles of measures (MB).

Good forecasts for emissions

A city-wide lowering of pollutant emissions can be reached through the use of modern technologies such as those in the bundles of measures 1, 4 and 5. More modern and clean vehicles and further particle filter retrofitting would help avoid 18% of diesel soot and 4% of nitrogen

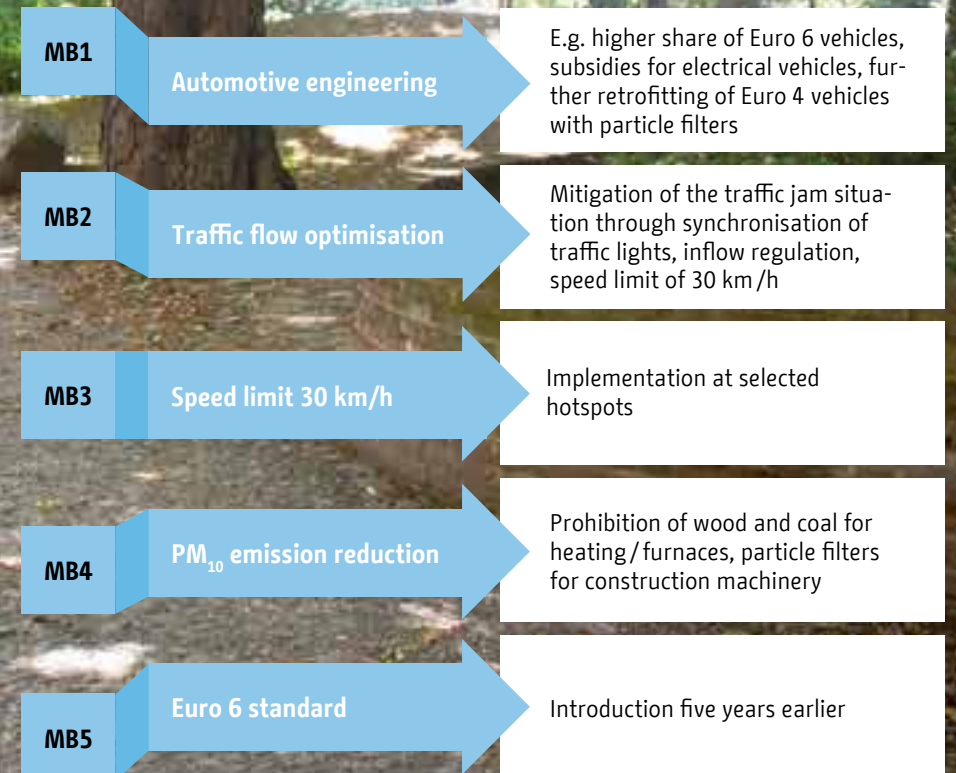
oxides. More demanding European emissions legislation, as it was assumed with regard to the bundle of measures 5, would have rendered significantly better results. If the stricter emissions values of the Euro 6 standard had been introduced five years earlier, the emissions in the year 2015 would have been reduced most strongly: diesel soot by 48% and nitrogen oxides by 36%. A lot of particulate matter – up to 400 tons of about 3,000 tons of total emissions per year – could also be avoided if no wood and no coal was burnt in furnaces anymore. The two bundles of measures 2 (dust prevention) and 3 (speed reduction) only develop local effects and with reductions of 0.2 to 1%, they contribute only little to the lowering of pollutant emissions in all of Berlin. The impact along the affected road sections however is substan-

tially higher. At the speed of 30 km/h, the emission of PM₁₀ fine dust can be reduced there by about one-third. Diesel particles and nitrogen oxides caused by traffic respectively reduce by approximately 15%. Optimising the traffic flow (MB2) would lower the nitrogen oxides and PM₁₀ emission by respectively 10% on average. Diesel soot reduces by 7% according to the study. The prerequisite would be, however, that not a single traffic jam occurred anymore, which is hardly realistic.

Through an optimisation of the traffic flow the nitrogen oxides and PM₁₀ emissions could be lowered respectively by 10% on average.



List of measures and bundles of measures (MB1–5) for scenario calculations





Forecast for nitrogen dioxide

The trend development without additional measures under the Air Quality Plan means in the year 2015 that the limit value for nitrogen dioxide would continue to be exceeded on 13 km of roads. About 11,400 people would be affected thereby. If the bundles of measures 1, 2 and 3 are implemented, this pollution can be reduced by 40% by 2015. This means: On "just" 7 km up to 8 km of roads, it is probable that limit value exceedances will continue to occur. This reduces the number of people affected from 6,700 to 7,100. The nitrogen dioxide limit value can only be met when the vehicle fleet fully complies with the Euro 6 standard.

The speed limit of 30 km/h results in a 60% reduction in the number of those, who suffer from limit value exceedances.

Forecast for particulate matter

By 2015, the number of limit value exceedances for particulate matter will reduce less than for nitrogen dioxide. Therefore, 14,000 people are affected in the year 2015 by the pollution with

particulate matter. The cause of this is the high share of cross-regional background pollution with PM₁₀ fine dust. Of the mentioned traffic measures, the speed limit of 30 km/h achieves the greatest relief. The number of those, who suffer from the limit value exceedances, will thereby reduce by more than 60% compared to the development without a new Air Quality Plan. This is owed to the speed limit of 30 km/h not only lowering the emissions from engines, but also to emissions from friction and resuspension being reduced. The bundle of measures 1 and 2 respectively entail that the number of people affected decreases by 25%. The bundle of measures 4 is also quite effective. It would substantially reduce the inner city pre-existing pollution with PM₁₀ fine dust, especially during the critical winter months. This would also lower the peak concentration on the main traffic roads. In consequence, the number of those, who suffer from the PM₁₀ limit value exceedances would drop by about 40%.



What else is important in the Air Quality Plan?



Low-emission zone for all of Berlin?

Although some measures have been discussed, yet they were not integrated in the new Air Quality Plan, because they are either ineffective, legally impracticable, out of proportion or not appropriate in light of the cause, such as the expansion of the low-emission zone to cover the entire Berlin urban area or stricter technical vehicle standards within the low-emission zones. The criteria for the low-emission zone were not raised to an even stricter standard, since the Ordinance regarding the Environmental Sticker does not permit such. In addition, the potential to reduce soot particles has already been fully utilised with the present regulation. The nitrogen oxides pollution in turn can be reduced further again, only once the Euro 6 standard is introduced in automotive engineering. A city road toll was likewise not included as a measure, since it is primarily a tool to reduce vehicle traffic. Yet, Berlin has been successful in achieving this anyway through other measures. In other respects, the legal prerequisites are missing in Germany to enforce a city road toll.

When will it be implemented?

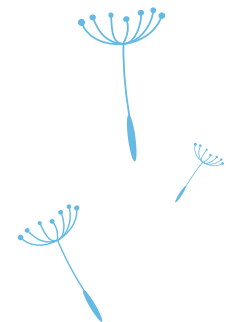
Many of the outlined measures can already be realised soon. Others rather take effect in the medium or long term. Some of the measures have already been launched. Among them is a pilot project for retrofitting construction machines with particle filters, a subsidy programme for retrofitting passenger ships, and retrofitting public transport buses with denitrification systems.

How was the public involved?

The draft of the Air Quality Plan was made publicly available for one month for examination as of 27/04/2012 in the offices of the Senate Department for Urban Planning and the Environment. Furthermore, it could also be down-

loaded via the websites of Berlin. Statements were received from private individuals, citizens' action committees, companies, associations, chambers, guilds and regional corporations. The Senate Department for Urban Planning and the Environment presented and discussed the objections in the course of a public town-hall meeting. It additionally reviewed all statements and responded in writing to all those who expressed objections. Based on the received comments and additional discussions with affected associations, the estimation of the impact of some of the measures and their wording in the Air Quality Plan was revised. This concerned for example, the requirements for the retrofitting of construction machinery and the pursued incentives for users of particularly low-emission vehicles.

The retrofitting of construction machines with particle filters and retrofitting public transport buses with denitrification systems has already started.



What will be next for air quality in Berlin?

The European level needs to take action

The Air Quality Plan 2011–2017 of Berlin has been in effect since June 2013. Although a lot has been accomplished since then, keeping the air clean is a process that will also continue in the years to come. Many further improvements can be achieved only at the national and European levels. This involves especially the reduction of cross-border emissions such as the long-distance transport of particulate matter from coal power plants and small combustion systems of our eastern neighbours. The same applies with regard to raising the emissions standards for diesel vehicles. At the same time, the real driving conditions within the city have to be considered more closely. This has been recognised by the European Commission by now and solutions are being worked on.

Many measures not only help keeping the air clean – they also contribute to noise or climate protection in the city area.

Looking beyond the horizon

Many measures not only serve for keeping the air clean, but also help noise or climate protection. Besides such synergies, also conflicts may arise, however. For example, the burning of wood spares the climate. Meanwhile it pollutes the air with particulate matter. Another example is gaps in the construction along roads. For reasons of noise protection it is sensible to close these gaps. Whereas, it is more beneficial when these gaps remain vacant in view of the air quality. These examples illustrate that there often are no simple and generally applicable answers in environmental policy. Especially urban planning has the mission to consider the pros and cons in each individual case. This is the only way to succeed in finding the best possible solutions for the long term.



Imprint

Publisher

Senate Department
for Urban Development and the Environment
Communication Unit
Württembergische Straße 6
10707 Berlin, Germany
www.stadtentwicklung.berlin.de

Content and editing

Senate Department for Urban Development and
the Environment, Directorate IX: Environmental Policy,
Waste Management and Pollution Control,
Unit IX C: Pollution Control,
Ute Holzmann-Sach

Photo credits

P. 4: GUD, Marco Urban (www.marco-urban.de); p. 7: ptnphoto (Can Stock Photo Inc.); p. 8: Votograf
(pixabay.de), martinan (Can Stock Photo Inc.); p. 10: totalpics (Can Stock Photo Inc.); p. 13: GUD;
p. 15/16: GUD; p. 18/19: n8schwimmer (fotolia.de); p. 20: electropower (Can Stock Photo Inc.), Tem-
pelhof Projekt GmbH (www.tempelhoferfreiheit.de); p. 23: GUD; p. 25: anyaivanova (istockphoto.com);
p. 26/28: Senate Department for Urban Planning and the Environment; p. 30: GUD; p. 32: Georg Slickers
(creativecommons.org); p. 34: GUD; p. 36/37: karin.schupp (creativecommons.org); p. 38: fotandy
(fotolia.de) p. 41: Tempelhof Projekt GmbH, Andreas Labes; p. 42: GUD

Idea, editorial board, layout, concept

GUD. GRÜNER UND DEUTSCHER GmbH
www.gruenerunddeutscher.de

Translator

Übersetzungsbüro SCHNELLÜBERSETZER GmbH

Print

Medialis Offsetdruck GmbH
www.medialis.org

Berlin, January 2015

ISBN 978-3-88961-343-1



According to a classic folk song, Berlin's air is something quite special. And especially in recent years, the air quality in the city has substantially improved, which is also owed to the measures of the Air Quality Plan 2005–2010. Yet, even if many efforts to reduce the air pollution in the city area are successful, the regulatory limit values for nitrogen dioxide and particulate matter are still exceeded many times. This is so because air pollution does not stop at the city limits. And especially particulate matter is transported over great distances. The Air Quality Plan 2011–2017 was developed so that the regulatory limit values can be observed in Berlin over the long term. For this purpose, the City has devised numerous effective measures that are compatible with the needs of the city. These measures target the areas of urban planning, traffic, heat supply of buildings, construction, industry and commerce. In this brochure, we provide you with an overview of the Air Quality Plan 2011–2017 of the City of Berlin. We present to you the fields of action and the objectives, meanwhile we also explain the challenges and difficulties. Interesting facts and information surrounding all aspects of the topic of air pollution round out the content.

