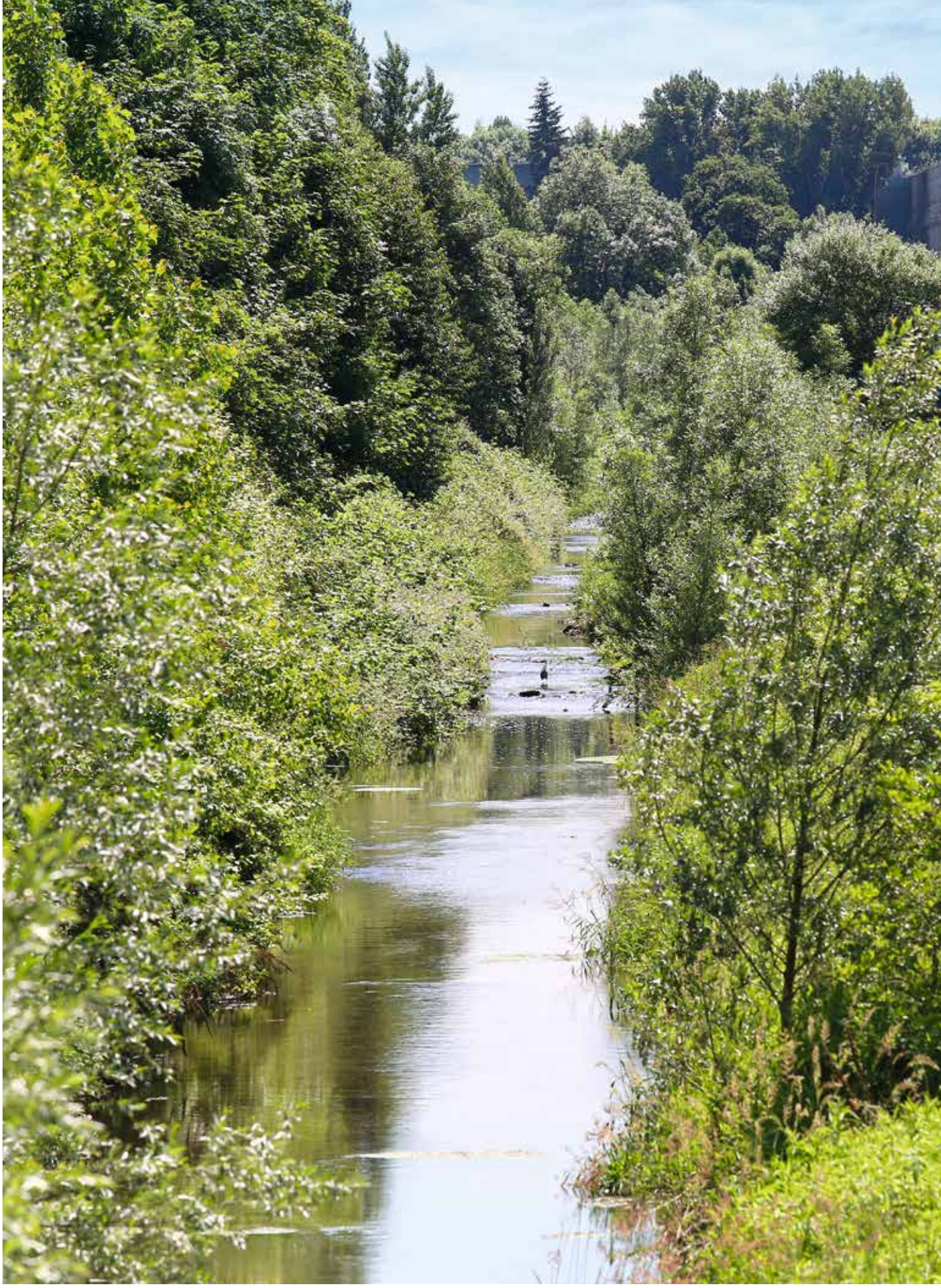
www.rvr.ruhr

Report on the State of the **Environment in the Ruhr Metropolitan Area** 2017

REGIONALVERBAND RUHR

Contents

Cover photograph: Measuring device on Gladbecker Strasse in Essen



River Emscher in Dortmund Dorstfeld

Foreword

Cooperation is the starting point of this first regional environment report for the Ruhr metropolitan area.

For many years, urban planners, promoters of economic development, the tourism industry, water management, the scientific community, several sectors of the economy and many cultural institutions have experienced successful cooperation at municipal and regional level. Now, municipal authorities with responsibilities for sustainable environmental development have decided to work more closely together on a more regular basis.

The state of the environment is a particularly important indicator when it comes to evaluating the state of development across the whole of the Ruhr region.

We know that a healthy environment is a prerequisite for good living and trading conditions and for the competitiveness of the region. We know that the environment has undergone notable changes as our region has transformed. We know that the demands for a healthy and clean environment are steadily rising. We have learned to develop specific solutions for specific environmental problems, taking advantage of the opportunities offered by changing land use to develop new urban landscapes, and we are today presented with a vibrant and internationally competitive environmental economy in the Ruhr metropolitan area.

For this reason, the Ruhr Regional Association (Regionalverband Ruhr or RVR) has supported the environmental policy initiative for joint environmental reporting from the very beginning. We believe it is important that this is seen as part of an integrated development strategy and that steps in the direction of sustainable environmental development are linked to the sustainable development of the region as a whole. With that in mind, we are making our regional and expert information available and will continue to provide the digital infrastructure for ongoing reporting in the future. To that end, contributors from different areas of our organisation are participating in the project.

In many respects, the findings of this environment report will serve as motivation for joint action: there is an eagerness to repeat innovative collaborative projects, but at the same time persistent breaching of benchmark values makes new ways of thinking and a new approach to environmental policy imperative. This can be successful if the parties involved jointly assume responsibility and develop solutions together. Developing a joint perspective on the state of the environment and the courses of action available to us is a good place to start.

Cooperation and the exchange of information and ideas will therefore form the next steps of the regional environmental reporting process. It is with this in mind that the Ruhr Regional Association presents another building block for the “Green Decade” in the Ruhr with its Report on the State of the Environment in the Ruhr Metropolitan Area 2017.

Yours,

Karola Geiß-Netthöfel
Regional Director of the Ruhr Regional Association (RVR)

I. Introduction

For the Ruhr metropolitan area to be fit for the future, it needs a sustainable approach to its use of resources, knowledge of their condition and the skills to use them. The association of cities and districts needs a shared vision of what ought to be accomplished now and in the coming years in order to achieve sustainability in the Ruhr metropolitan area.

The cities, districts, municipalities and region are in agreement about the importance of the environment for the development of the Ruhr metropolitan area.

That is why the heads of environmental protection from the eleven independent towns and cities, the four administrative districts and the Ruhr Regional Association (RVR) agreed in 2015 to work together to compile a regional "Report on the State of the Environment in the Ruhr Metropolitan Area" to be published for the first time on the occasion of the European Green Capital – Essen 2017.

A regional environment report of this kind can draw upon the diverse methodological experiences of the Ruhr's cities and districts in addition to those of other cities and regions as well as the findings of the various reports compiled by government, be that at the level of the federal state of North Rhine-Westphalia (NRW), the Federal Republic of Germany or the European Union.

The discussions between the local and regional governmental heads of environmental protection resulted in five technical requirements in terms of scope and environmental policy:

1. The new Ruhr environment report should comprise an empirical section – based on indicators – that is uniformly applicable to the entire Ruhr region and can be updated for the purposes of regular reporting.

2. Regional environmental reporting should properly reflect differences in natural environments and residential areas as well as material differences in the state of the environment in the region. To this effect, distinct sub-regional reports should also be carried out.

Phoenix See Lake, Dortmund

3. The 2017 Ruhr environment report should be factually up to date and at the same time informative about major current developments in environmental policy.

4. The new environmental reporting process should be open and compatible with current regional strategies and plans in the Ruhr region and, with this in mind, it should contribute to the integrated development of the Ruhr metropolitan area.

5. In terms of methodology, the Report on the State of the Environment in the Ruhr Metropolitan Area should be compatible with ongoing local and governmental reporting and look into the option of a more thematically comprehensive sustainability report for the Ruhr.

1.1 Classification

Many issues and many current developments are associated with the subject of the environment and the Ruhr region:

↦ The persisting conditions in the natural environment and changes as a result of human activity,

↦ The specific use and appropriation of natural resources throughout the region, in its associated sub-regions, in the individual town or city, in the community, in the neighbourhood, in the business, on the plot of land,

↦ Climate protection: the development and implementation of climate protection measures, funded by the federal government's National Climate Initiative, help municipalities to reduce their energy costs, stimulate regional value creation and cut greenhouse gas emissions,

↦ Adaptation to climate change,

↦ Soil, water and air quality and levels of quiet or noise,

↦ The type, prevalence, intensity, distribution, concentration and effect of emissions and pollutants, and the danger they pose

↦ The type of emission sources, and the ability to replace them,

↦ The diversity of plants and animals and the state of their habitats,

↦ The state of the urban landscape, the network of connected landscapes and viable biotopes, the condition of river basin systems,

↦ The proximity and accessibility of urban landscapes for the inhabitants of towns and cities,

↦ The islandisation and fragmentation or the permeability and resilience of the urban environment,

↦ The importance of the environment for health and quality of life in the metropolitan area,

↦ Previous and current environmental stresses, the clean-up of contaminated sites and former industrial locations,

↦ The development of environmental technology, measuring equipment and filters, the reduction of emissions,

↦ The realisation of the principles and the benefits of the

circular economy,

↦ The costs of remedial and preventive environmental protection,

↦ The development of European, national and regional environmental standards and legal norms ...

In short: an overall picture of the way the economic, public, social, cultural and private spheres interact with the environment and the associated prospects. The list is not complete and reflects the wealth of possible topics for regional environmental reporting. Within the group of heads of environmental protection, it was agreed that a particular range of topics would be covered in more detail in each of the upcoming environment reports.

The story of the Ruhr's environmental policy is one of learning and innovation.

On the one hand, the region has had to learn and test out everything in order to clean up the legacy of past industries and create new, attractive living conditions. At the same time, it has also been possible to exploit the opportunities arising from the economic structural change and the accompanying shift in attitudes towards the environment and the natural world:

↦ From the need to restore brownfield sites emerged expertise in the field of soil conservation,

↦ The necessity of ecological restructuring work on the River Emscher developed into competence in the restructuring of whole river systems,

↦With large steel industry sites and mining areas falling into disuse and hundreds of kilometres of industrial railway lines being taken out of service, there was an opportunity to create the Emscher Landscape Park – a regional network of parks in the heart of the metropolitan area, featuring new parkland and a new park infrastructure,

↦ New approaches and projects for integrated development are resulting from a growing understanding of the interdependencies between urban development, environmental development, trade and industry, climate change, education and social participation,

↦ On the basis of different development strategies, all linked by the common objective of creating a sustainable, resilient Ruhr metropolitan area, a new demand for a green economy is emerging. The key data and opportunities presented by green infrastructure in the Ruhr are unfolding, and the potentials of a Green Decade in the Ruhr are being revealed: from the European Green Capital year in 2017 through to the IGA Ruhr international garden exhibition in 2027.

Despite these achievements, the Report on the State of the Environment in the Ruhr Metropolitan Area highlights a number of areas that must be addressed in the future. These relate most significantly to the reduction of pollution levels – which are, in part, still too high – especially when it comes to NO_2. There is also a need to act on noise, reduce

Westpark, Bochum

greenhouse gas emissions and develop renewable energies.

And last but not least, the transport sector presents a major challenge to sustainable development.

Today, almost all major cities and metropolitan areas in Europe are facing very similar challenges. What is special about the Ruhr is its geographically and politically polycentric structure. This plays an important role and has great potential for common regional environmental policy extending beyond individual cities and municipalities.

In this sense, the 2017 Ruhr environment report – commissioned and overseen by the team of local government heads of environmental protection – marks a significant joint step towards a sustainable Ruhr metropolitan area.

The conditions, standards and requirements of forward-looking and integrated environmental policy can no longer (only) be developed and shaped in one city, one region or one federal state. With this in mind, it is also essential for the individual cities and districts, as well as the Ruhr region as a whole, to be adaptable and competitive in the face of national, international and global developments.

In the context of future local and regional environmental reporting in the Ruhr region, reference may thus be made, for example, to the United Nations' Sustainable Development Goals (the 2030 Agenda for Sustainable Development) and the sustainable development strategies of the European Union, the German Federal Government and the state of North Rhine-Westphalia.

1.2 The run-up to the 2017 Ruhr environment report

The present 2017 regional environment report for the Ruhr region depicts the results of discussions and investigations from 2014 to 2016, thus building upon the first observations from 2010 to 2014 as regards content and methodology.

It was in the context of the preparation of a regional bid for the title of European Green Capital by the whole Ruhr metropolitan area that the collaboration of the various local heads of environmental protection and the RVR came into being. This process led to a systematic compilation of local and regional environmental data and an active exchange between the local environment agencies and the RVR on the various topics and EU requirements relating to Green Capitals. This new collaboration on matters of administration and environmental policy was managed by the RVR with expert guidance from the Wuppertal Institute. (1)

Following the decision of the European Commission's Directorate-General for the Environment in 2012 to refuse, as a matter of principal and on formal grounds, the participation of a region or a group of cities in the contest to become European Green Capital, the cities, districts and the RVR agreed to continue the regional cooperation that had been initiated. The introduction of meetings between local government representatives under the auspices of the Ruhr Regional Association made it possible for the regional cooperation to be established on a formal and long-term basis through the conference of "environment" representatives.

When, on its second attempt, the city of Essen was awarded the coveted European title on 18 June 2015, local government colleagues in the other Ruhr cities and districts as well as in the RVR were quick to agree: the first regional environment report for the Ruhr, already in preparation, should be completed by 2017 and published as a regional contribution by the Ruhr metropolitan area towards the European Green Capital – Essen 2017.

1.3 Structure

The Report on the State of the Environment in the Ruhr Metropolitan Area 2017 is divided into three parts.

The first part puts forward current examples of integrated

environmental strategies and approaches from the Ruhr area that are particularly representative of the state of the debate in the region and at the same time will have a stimulating effect both within and outside the region.

The following will be presented:

↦ European Green Capital – Essen 2017 (Essen)

↦ The "Grüne Infrastruktur Ruhr" (green infrastructure in the Ruhr) initiative (RVR)

↦ InnovationCity Ruhr (Bottrop)

The second part consists of an up-to-date inventory of the environmental situation in the Ruhr metropolitan area, based on 15 selected environmental indicators. The RVR commissioned the Wuppertal Institute with the expert analysis of the second part, and it in turn engaged the planning office Richter-Richard from Aachen. The experts were charged with documenting the present situation on the basis of 15 environmental indicators, evaluating this situation in each case with regard to applicable and foreseeable environmental standards and norms and giving recommendations and suggested targets for the future development of environmental policy in the Ruhr region. The

ZollvereinPark, Essen

recommendations of the Wuppertal Institute with regard to environmental policy are then given with reference to each individual indicator and summarised at the end of the second part in a chapter on future prospects.

A systematic overview and discussion of a larger number of indicators currently used in environment reports, sustainable development strategies and sustainability reports preceded the selection of the 15 indicators. The working group comprised of the local and regional governmental heads of environmental protection and the RVR chose the 15 indicators on the basis of environmental relevance and the local and regional availability of corresponding data (i.e. no new data collection and no process of harmonisation with third parties). It was agreed that, in the light of the experience acquired with the first regional environment report, the selection of topics and indicators may be deliberated on a local and regional level and widened for the second regional report.

Chapter 5 presents the findings of the Wuppertal Institute and planning consultants Richter-Richard on the following environmental matters and the 15 selected environmental indicators:

Climate protection

1. Level of energy-related greenhouse gas emissions

Energy consumption

2. Primary energy consumption

Renewable energies

3. Share of renewables in final energy consumption (net)
4. Share of renewables in net electricity consumption

Transport

5. Modal split

Air

6. Nitrogen dioxide (NO_2)
7. Particulate matter (PM_{10})
8. Particulate matter ($PM_{2.5}$)

Noise

9. Number of people exposed to noise from road traffic per 1,000 residents full day (24 hours)
10. Number of people exposed to noise from road traffic per 1,000 residents during the night (22.00–06.00)

Land use

11. Increase in the amount of land used for human settlements and transport infrastructure

Organic farming

12. Proportion of organic farmland in the total agricultural land area

Biodiversity

13. Connected biotope area as a proportion of the total area

Water

14. Water quality of watercourses

Environmental economy

15. Number of people employed in the environmental economy

The third part of the 2017 Ruhr environment report presents a classification of the results from the perspective of environmental policy and a look ahead to the intended update of the report by the working group of Ruhr metropolitan area heads of environmental protection in two to three years.

II. European Green Capital – **Essen 2017**

2.1 How it all began

The origins for the motivation to bid for the title of "European Green Capital" lay in the collective experience of the region's cooperative project for European Capital of Culture 2010. With its mix of enthusiasm and creative energy, not only did it win over and inspire millions of visitors from all over the world through its ingenuity and originality, but the experience also generated a fresh sense of self-confidence among the people of the Ruhr region themselves.

On the strength of this, the mayors and district administrators decided in October 2010 to set out on the path towards a regional bid for European Green Capital. This regional bid, prepared with the help of all the cities and districts and the support of the Wuppertal Institute, was submitted to the European Commission in October 2012.

The formal decision by the European Commission that it would continue to only allow applications from individual cities meant that a rethink was required. Intensive discussions in the cities of the Ruhr metropolis led to the 2013 decision by Essen's city council to launch a bid on behalf of the city to become European Green Capital.

The knowledge and experience accumulated by the different local authorities in the meantime formed a key cornerstone of Essen's bid and were among the decisive factors in it being successfully selected as "European Green Capital 2017" in June 2015.

European Green Capital logo | image: EU

The title of "European Green Capital" is awarded to European cities that can demonstrate having achieved high environmental standards and continue to pursue ambitious targets to further improve environmental protection and sustainable development. Since more than two thirds of all Europeans live in urban areas, this is where many environmental initiatives originate. The contest is intended to motivate cities to undertake additional measures and provide a platform on which to present examples of best practice as well as promoting dialogue between European cities.

Cities participating in the contest must answer specific questions about the following 12 topics:

Stadtgarten park

↦ Climate change: mitigation and adaptation

↦ Urban transport

↦ Green urban areas incorporating sustainable land use

↦ Nature and biodiversity

↦ Air quality

↦ Quality of the acoustic environment

↦ Waste generation and management

↦ Water management

↦ Wastewater management

↦ Eco-innovation and sustainable employment

↦ Energy efficiency

↦ Integrated environmental management system

The winning city takes on a pioneering role in environmentally friendly urban living and thus serves as a role model for other cities. So far, the title has been awarded to Stockholm (2010), Hamburg (2011), Vitoria-Gasteiz (2012), Nantes (2013), Copenhagen (2014), Bristol (2015), Ljubljana (2016) and Essen (2017). The European Commission jury consists of representatives from the European Commission, the European Parliament, the Committee of the Regions, the European Environment Agency, the International Council for Local Environmental Initiatives (ICLEI), the Covenant of Mayors Office and the European Environmental Bureau.

2.2 Why Essen?

The European Commission awarded the title of "European Green Capital 2017" to the city of Essen on 18 June 2015. In explaining its decision, the Commission highlighted the exemplary role played by Essen for many cities in Europe as well as the city's position within the Ruhr metropolitan area. The bid's holistic approach impressed the jury. In particular, its vision for the future of a "liveable city", taking into account the effects of the structural change from a coal and steel city to a green city, scored points.

Winning the title of "European Green Capital 2017" is having a significant positive impact, both locally and at a European level. It presents an opportunity to communicate the future issues of climate change and environmental concerns at all levels and to establish these topics firmly in the city's long-term outlook. It will also play a special role in supporting the city of Essen's existing efforts to steer its structural change in the direction of a "green future" and further improve the quality of life in the city in the long term.

ESSEN 2017 GRÜNE HAUPTSTADT EUROPAS

European Green Capital – Essen 2017 logo | image: city of Essen

2.3 A green history

Even the logo for "European Green Capital – Essen 2017" tells this green story of the city of Essen, which is characterised by a special combination of city and nature. It is based on the urban-planning concepts that were developed under Robert Schmidt in his time as city councillor for Essen with a responsibility for engineering issues from 1907 to 1920.

From this point on, the city reformed its approach to planning in the rapidly growing municipality and worked with particular intensity until the outbreak of the Second World War. Many districts of Essen are interwoven with urban green space thanks to Robert Schmidt's green plans. Skilful use was made of the highly diverse topographical situation of the city, and the available hills and valleys served as the foundation for the greening of residential areas. The main elements of the logo are therefore the bold green bands, which symbolise Essen's valleys, gardens, avenues and meadows. These are framed by the two rivers, the Ruhr and the Emscher. The flow of the green bands from north to south highlights the growing connection of the landscapes in the Ruhr Valley with the Emscher Valley. This has resulted in a symbol that presents Essen's complex history of urban green spaces in a much-simplified form.

2.4 Flagship projects in the city and region

Even when bidding for the title, important regional and local projects were put forward, which now also represent the city of Essen and the region in 2017, thus demonstrating how environmental protection and green infrastructure are a winning formula when it comes to liveable metropolitan regions.

Borbecker Mühlenbach stream

With the restructuring of the Emscher river system, an open sewage system in the northern part of the Ruhr region, the Emschergenossenschaft (Emscher Association) triggered one of the largest infrastructure projects in Europe with numerous technological innovations. The reconstruction of the Emscher from an open sewage system to a restored body of water, expected to take until 2020, has already garnered numerous accolades.

Through the local action programme "Essen. Neue Wege zum Wasser", 150 kilometres of foot- and cycle paths have been created between the Emscher Valley in the north and the Ruhr Valley in the south over the last ten years, breaking down the separation of the northern and southern parts of Essen's urban area. In the past ten years, green urban development has been a driving force in Essen's city planning. The creation of green spaces, water bodies and foot- and cycle paths, which form a network that extends into the city's districts and wider region, were the basis for the successful urban development of larger areas with a view to creating an integrated strategy for climate change adaptation. The attention of European visitors is drawn to the "Kruppgürtel" (Krupp Belt) urban development project, with the new Krupp Park and Krupp-See lake, the man-made Niederfeldsee lake and park in Altendorf as well as the university quarter, which borders on the northern part of the city centre and includes the University Park and integrated bodies of water.

These three areas are connected by the "Rheinische Bahn" – the first section (RS1) of the "Radschnellweg Ruhr" (Ruhr Bike Highway) to be completed by the Ruhr Regional Association (RVR) and which runs for 5.5 kilometres in Essen. The Radschnellweg Ruhr has since been completed through to Mülheim an der Ruhr, thus connecting the centres of two Ruhr cities with a cycle path for the first time. The plan is to continue the track to Duisburg on the Rhine and to the east towards Gelsenkirchen and on to Bochum, Dortmund and Hamm.

With the Rhein-Ruhr-Express (RRX) project, North Rhine-Westphalia will have a new rail link, which will provide increased mobility and is expected to have a marked impact on the development of the state. A train will run on the core route between Cologne and Dortmund via Essen every 15 minutes, connecting the main stations at speeds of up to

Niederfeldsee and the "Radschnellweg"

160 km/h, and will therefore be an attractive alternative to the car for many commuters. There are plans to use a prototype at Essen's main station to introduce the RRX project to the public in 2017 in conjunction with the transport association Verkehrsverbund Rhein-Ruhr (VRR) and the Siemens company.

The development of existing neighbourhoods is another subject presented through several examples. A scheme in the city's "Südostviertel" (south-eastern district) being undertaken by the urban housing company Allbau AG and one in "Eltingviertel" – an InnovationCity project in Essen with the investor Vonovia – will be on show to visitors in 2017.

In 2017, the "Bathing in the Ruhr" project (www.sichere-ruhr.de) will enable the people of Essen to bathe once again in the Baldeneysee lake or the Ruhr in its first bathing area. This is also a trailblazing project for the implementation of the Water Framework Directive (WFD) in a watercourse and is a successful result of regional cooperation.

Focus will be placed on the experiences of the 2014 Pentecost week storm event (known as "Ela" in Germany) in 2017, particularly in terms of the city of Essen's areas of woodland. The suspension of the forest enterprise plan and the active participation of local people through several workshops on the future of their forest represent an exemplary process of mediation and participation. The subject will be presented to the public with the construction of an "Ela" trail in Schellenberg forest.

Further improvements to environmental quality are key features of the Green Capital programme, including the large Natura 2000 nature reserve Heisinger Ruhraue and other biodiversity hotspots, such as the Zollverein Park. One example of practical implementation is the updated

Bathing in the Ruhr

Tree-planting in the Heisinger Ruhraue, 2017

Heisinger Ruhraue maintenance and development plan and the presentation of biodiversity in the grounds of the former Zollverein Coal Mine Industrial Complex, now the Zollverein Park.

The 9,000 allotments within the Essen city area are an important part of the region's garden culture – as too are the rising number of community gardens – and will appear in the programme for the "Green Capital" year in a variety of ways. New garden projects are also being developed in collaboration with active gardeners and various partners from the housing industry, clubs and associations on both municipal and private land.

The city's natural and green areas are the main venues for "Green Capital Essen 2017". This includes important historic as well as new parks, the two river valleys of the Ruhr and the Emscher, current urban development projects and the inner city. Hands-on activities will extend to the city's districts and neighbourhoods. For this, Essen can make use of its pre-existing networks and draw on well-established local structures, for example the involvement of more than 900 tree sponsors and 200 playground supporters, the active allotment association as well as new community garden initiatives.

2.5 Exchange of ideas/citizen projects:

The involvement of local people in the European Green Capital year is vitally important. Particularly worthy of mention here is also the spontaneous community assistance provided after storm Ela through the network "Essen packt an" (Essen lends a hand), which is still active today. Established citizen participation formats, such as "PiccoBello-SauberZauber", "Urban Gardening", the "Runde Umwelttisch" and "klima|werk|stadt|essen", which has actively promoted "life in a new

Green Capital volunteers

Opening ceremony

climate culture" in the city of Essen for the past five years, are also exemplary. In many areas, environmental protection is unimaginable without the dedication of volunteers. Such examples include playground supporters and tree sponsors, the volunteers' office and many more besides.

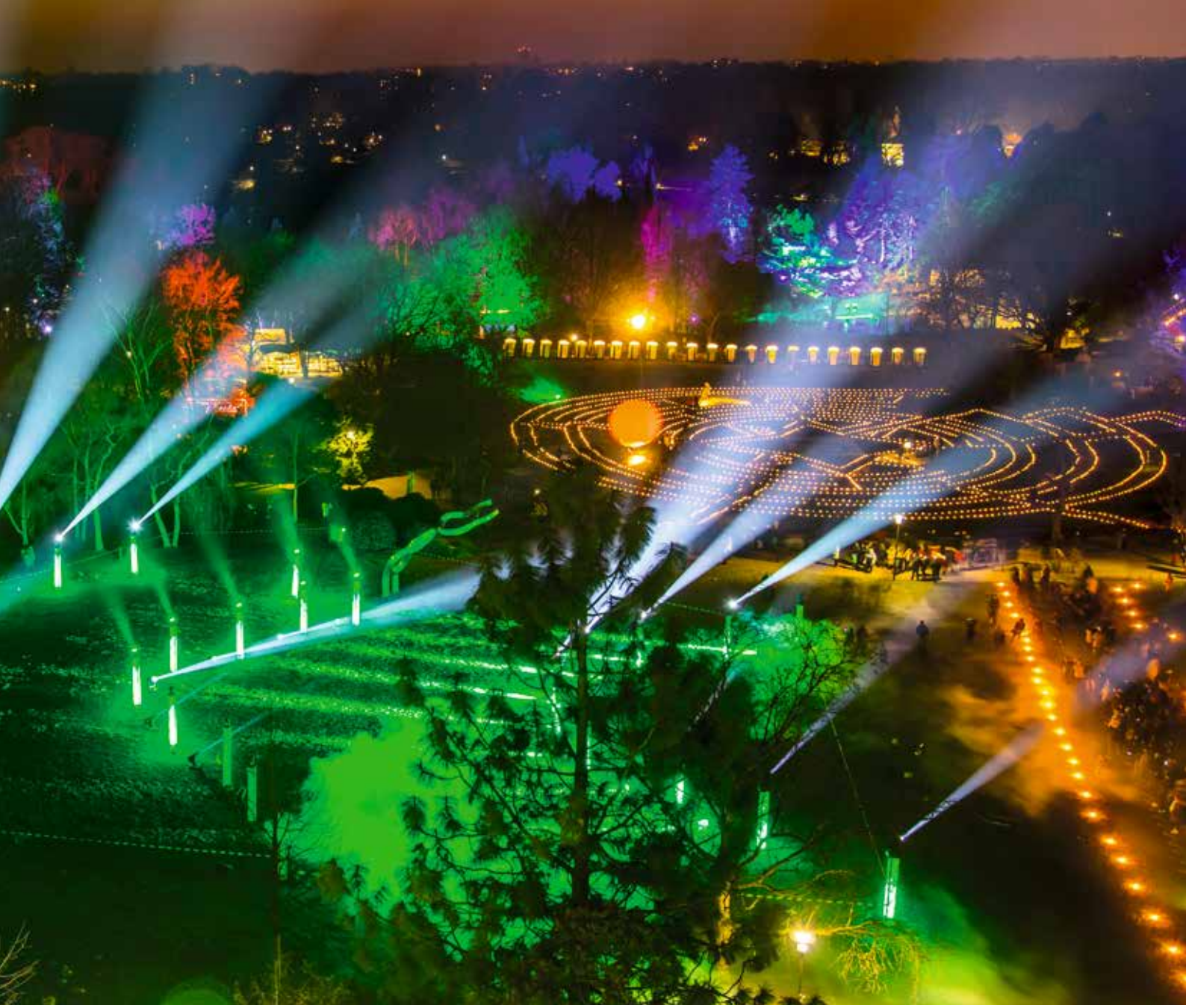
"My ideas, my projects, my Green Capital" – this was the slogan of the Green Capital idea exchange. Many Essen residents found out about opportunities to get involved in organising the programme for European Green Capital – Essen 2017 on site. Whether it be the creation of a community garden, hands-on activities in children's nurseries or exhibitions – all projects were welcome that shared the European Green Capital objectives and would be open to the public. Joint projects in the Ruhr metropolitan area were also encouraged.

To ensure that real projects resulted from the ideas, the project office offered financial support: small citizen projects are fully funded up to €1,000. Clubs and institutions requiring a total investment of up to €2,500 contribute a maximum of €625 (25 per cent) and receive funding to make up the additional 75 per cent. Large projects with a budget of up to €7,500 would receive up to €5,000 in funding.

Interested local people had two months to submit their specific "Green Capital" projects. "We received more than 260 citizen projects. We are overjoyed with the huge level of interest and the many exciting ideas. I am particularly pleased that project submissions have been sent in to us from every district of Essen", says Simone Raskob, Head of the Department for the Environment and Project Manager for the European Green Capital.

Many landscaping projects were submitted as well as ideas for exhibitions and workshops: from cookery courses for children to planting flower bulbs in the Volksgarten park in Kray through to building an insect hotel – there was something for everyone.

Some 200 citizen projects found their way into the "Green Capital" programme and are now being implemented thanks to the involvement of the people of Essen.



2.6 Events

International and European events are being implemented in cooperation with partners. Examples include the International Plant Fair (IPM) in spring 2017, the E-World energy & water show and an international conference in February 2017 on the subject of "Green Infrastructure", in collaboration with the Ruhr Regional Association. The interim presentation of North Rhine-Westphalia's KlimaExpo.NRW will also take place in 2017. The programme will likewise feature cooperation formats with partner cities and those in the European Green Capital Network. One example of the city of Essen's collaboration with klimametropoleRuhr 2022, KlimaExpo.NRW, the RVR and the Emschergenossenschaft (Emscher Association) will be an event on the theme of "Cities in Climate Change", held in November 2017.

National and regional events will also be realised in cooperation. Around 40 conferences and conventions will take place within the Green Capital programme. Themes range from sustainability, architecture and urban development through to energy, transport and environmental issues. The Ruhr metropolitan area as an agglomeration comprising more than 5 million inhabitants plays an equally important role as the key topic of the restructuring of the Emscher.

Many local events are aimed at the people who live and work in Essen. In addition to the important impact of our

active urban society as a role model for Europe, a focus is also being placed on hands-on activities and emotional "experiences".

As such, Green Capital Days, when certain locations, such as city squares, will be rearranged and planted up, initiatives in allotments and community gardens, urban interventions or even events run by environmental organisations or the volunteers' office will be among the activities being carried out to motivate local people to get involved and help to shape their green Essen. Essen's European Schools are also playing an important role, working together with their European partner schools to present the themes of the European Green Capital.

The aim at the heart of all these activities and efforts is to improve living conditions in Essen in the long term and above all on a sustainable basis with the help of the "European Green Capital", while also serving as an example for other cities in Europe.

The "Green Capital" year was launched on 21 January 2017 in Essen's Grugapark. In addition to the official "hand-over of the baton" from the 2016 title-holder, the city of Ljubljana, to the city of Essen in the presence of international representatives from the worlds of politics and business, members of the public had the opportunity to discover the European Green Capital – Essen 2017 through a varied programme at Grugapark. "Experience your green miracle" is the motto for the year – and the two-day cultural and family festival featuring illuminations, dance, theatre, sound installations, a light labyrinth, exhibitions and more besides brought this theme to life. "The impressive launch event showed people what to expect during our year as Green Capital: our city is bursting with green surprises", stressed the Lord Mayor of Essen, Thomas Kufen.

Schöngelegen – this street in Essen is literally "beautifully situated".

Over 200 events are planned in 2017 to inspire both visitors and the people of Essen, with surprising insights into their city, emotional experiences in the context of unexpected events and new impressions of their city. In this way, "Green Capital Year 2017" is expected to make a substantial contribution to the entire region's image transformation.

2.7 Conclusion and outlook

The "Internationale Bauausstellung Emscher Park" (International Architecture Exhibition Emscher Park), which ran for ten years from 1989 to 1999 as a "workshop for the future of industrial regions", laid the foundation for a very special transformation. With the subsequent bid of Essen for the Ruhr and the European Capital of Culture 2010, a major, unifying regional effort was undertaken. The collective experience of this "unlikely cultural capital", which represented an impressive collaborative effort by all those involved, was the basis for the application process to bring the European Green Capital 2017 to Essen.

No other region in Europe has gone through the transformation process from a former coal and steel region to a green region with a high quality of life via these different formats. These experiences will also be the subject of an international symposium in December 2017, with the objective of bringing together the networks associated with these different formats, to evaluate these experiences and tackle the key issues for the future together.

In 2017, the city of Essen, which is the only European city to hold the titles of "Capital of Culture" (2010) and "European Green Capital" (2017), is embarking on a green decade in cooperation with the entire region. The restoration of the Emscher will be completed in 2020, KlimaExpo.NRW will present its results in 2022 and, in December 2016, the region was awarded the bid for the "International Garden Exhibition – Ruhr Metropolis 2027" (IGA 2027).

Essen is not just "European Green Capital" in 2017, it always will be. It is our duty over the coming decades to face up to these issues on a sustainable and long-term basis.

III. Green infrastructure in the **Ruhr**

Hoheward slag heap, Herten

3.1 European format

In 2013, the European Commission launched a new policy area: Green Infrastructure – a strategically planned network of natural and semi-natural areas, to provide ecosystem services and enhance Europe's natural capital, in both rural and urban areas.[1]

The German Federal Government has been working on this issue since 2014 and has done so via two separate approaches: the Green Paper (2015)[2] and the White Paper (2017)[3] "Grün in der Stadt" (Urban Green Spaces) and the Federal Green Infrastructure Concept, "Bundeskonzept Grüne Infrastruktur" (2017).[4] Thanks to these efforts, the Federal Government is meeting the EU's expectations for the development of national strategies for green infrastructure.

The federal states are addressing the issue of green infrastructure at regional level. For instance, with "Grüne Infrastruktur NRW"[5], the state of North Rhine-Westphalia published its own call for support in August 2016 as part of the regional European structural support provided by the European Regional Development Fund (ERDF OP NRW 2014–2020).

The Ruhr region has been taking an active role since 2015 and has focused intensively on this issue. On behalf of the region's cities and districts, the Ruhr Regional Association (RVR) has investigated the issues relating to "green infrastructure" on a European, national, regional and local level. Many projects have sprung up in the urban landscape of the Ruhr since the early 1990s, starting with the "Internationale Bauausstellung Emscher Park" (International Architec-

ture Exhibition Emscher Park, IBA) from 1989 to 1999, the 457-square-kilometre Emscher Landscape Park in the heart of the metropolitan area and through to the current reconstruction of the entire Emscher river system and the conversion of hundreds of kilometres of decommissioned freight rail lines into new cycling and walking trails. It was therefore important to review the relevance and compatibility of all these strategies and projects against the definition of green infrastructure.

Analysis of the European documents also showed a high degree of compatibility with the objectives of sustainable development in the Ruhr metropolitan area. Through the concept of green infrastructure, the central goals of the EU's Europe 2020 strategy – with its requirement for smart, sustainable and inclusive growth – are being more clearly defined in terms of scope, which is of particular importance for the Ruhr Metropolis.

3.2 Regional strategy

The RVR published the results of this investigation and the key elements of its concept for a future strategy in October 2016 as "Grüne Infrastruktur Ruhr" (Green infrastructure in the Ruhr).[6] In this document, the term "green infrastructure" is applied in a manner that is both thematically open and geographically broad. "Grüne Infrastruktur Ruhr" is considered to represent the current status of the whole Ruhr region and a starting point for integrated action, underpinned by five specific action areas.

The Ruhr is already regarded as a best-practice example for the integration of urban, economic, social and ecological development in Europe.

The strength of the Ruhr metropolitan area lies in the strategies for sustainable and integrated development drawn up in the previous 25 years and, in particular, in the multitude of projects that have already been realised. From the Duisburg-Nord Landscape Park to Phoenix See lake in Dortmund, from the Tetrahedron in Bottrop to the Tiger & Turtle landmark in Duisburg, from the Slinky Springs to Fame footbridge in Oberhausen to the Erzbahnschwinge bridge in Bochum, from the new Niederfeldsee lake in Essen to Lünen's Seepark, from the Emscher Park cycle path to the Radschnellweg Ruhr (the German national cycle highway RS1), from the already completed ecological restructuring of the upper course of the Emscher to the Route der Industrie-Natur (Industrial Nature Trail), from the Garden of Remembrance to wilderness in the city and the Industriewald Ruhr (industrial forests of the Ruhr) project – the landscape of the Ruhr has been transformed and the results are impressive.

3.3 New challenges

The operational connection between the terms "green" and "infrastructure" holds significant potential for innovation in terms of new strategies, new forms of cooperation, new alliances and a new appreciation of the value of green space. Green infrastructure can become the hardware and connecting software for new kinds of sustainable urban and landscape development. This involves very deliberately

examining the qualities of the green space and its interconnection from the very beginning as well as the ongoing development concerns and the operating costs of green infrastructure.

Today, the high degree of public acceptance for complete infrastructure systems (individual elements, network, services, qualities, products, product development, users, responsible bodies, prices, operating costs, (re-)investment requirements) usually only applies to grey and cultural infrastructure (transport, energy, water management, recycling, digital communication, education, culture). This kind of acceptance and comparable operational responsibility is lacking when it comes to urban green spaces, open landscapes, cycle trails or the biotope network.

The EU refers to the benefits of natural capital for our society. For this to be taken seriously, green infrastructure must be adaptable, installed in an integrated manner and open to new management. In the Ruhr region, a management tool for digital green infrastructure in the Ruhr will therefore act as a linking information and management system and is therefore one of the current development tasks.

3.4 Integrated regional strategy

"Grüne Infrastruktur Ruhr" is an integrated approach to regional development, which is being jointly developed by the region's cities and districts, the Ruhr Regional Association, the Emschergenossenschaft (Emscher Association) and the Lippeverband water management association, as well as many other stakeholders. "Grüne Infrastruktur Ruhr" sees itself as a platform for joint action and is transferring the general debate on this issue into an operational dimension.

On the basis of the successes achieved to date, the region's stakeholders are working together to define priority areas, agree organisational models and realise projects. This undertaking is based on five action areas for the development of green infrastructure in the Ruhr metropolitan area:

1. The urban cultural landscape – with the Emscher Landscape Park as a centrepiece,

2. Water in the city – with the reconstruction of the Emscher system as the backbone,

3. Green urban development – with nature-based solutions in cities and neighbourhoods,

4. Emission-neutral transport – featuring regional and local cycle track networks and

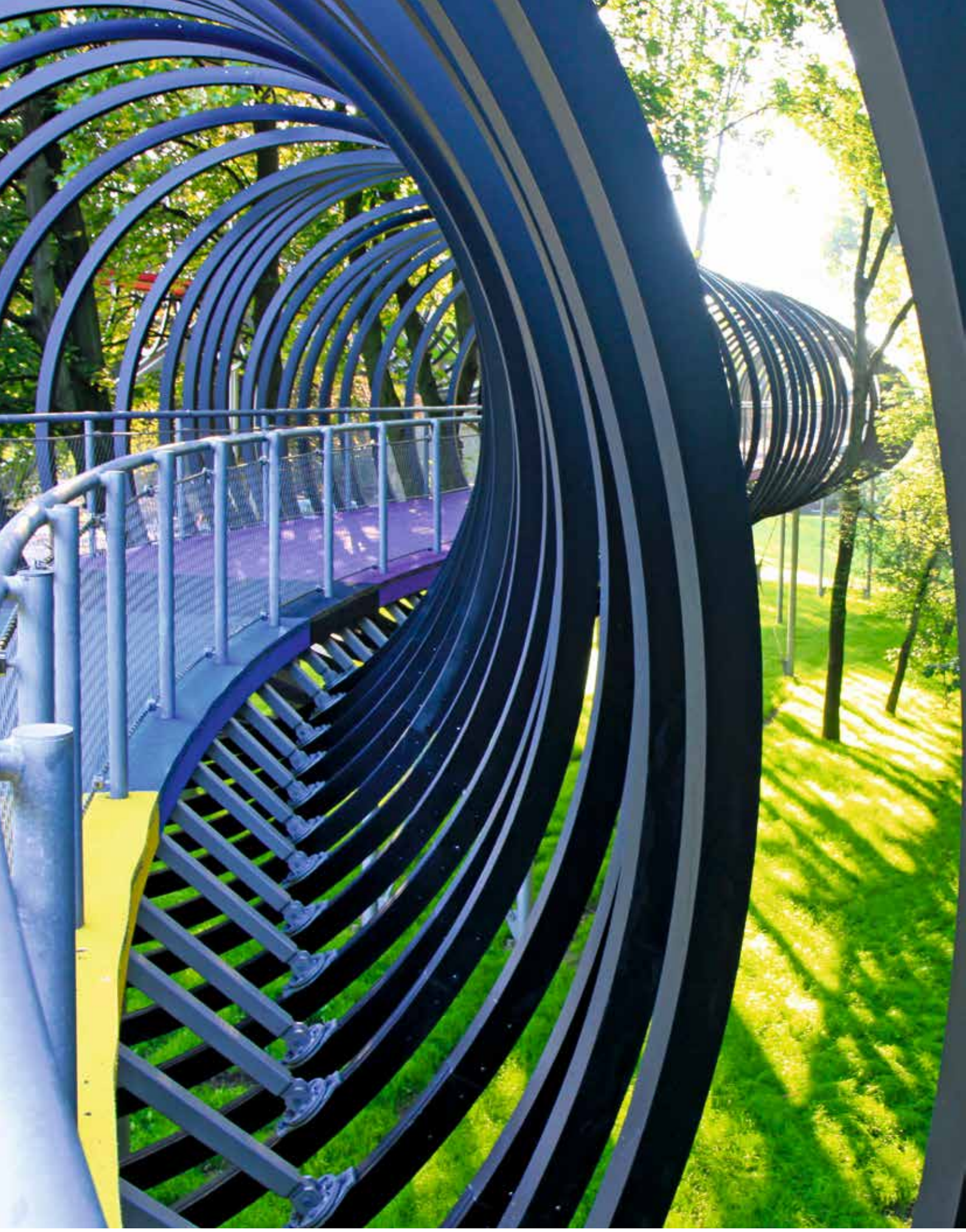
5. Sustainable climate protection in conjunction with increasing energy efficiency – with InnovationCity Ruhr and KlimaExpo.NRW/klimametropole RUHR 2022

Rheinpark Duisburg

In terms of content, these five action areas are interrelated and mutually complementary. For instance, the Emscher Landscape Park and the reconstructed Emscher are physically connected in many places and extend into the area's cities and neighbourhoods where they link up with green urban development measures. The networks of cycle tracks connect urban spaces, landscapes and water bodies. Projects in support of climate protection and energy efficiency contribute towards the improvement of environmental and living conditions in city districts and the region as a whole.

It is intended that this network of green infrastructure will continue to converge and thus evolve into an important component of the capital stock in the Ruhr metropolitan area's economy. Precisely because the measures are so diverse, they result in multidimensional ecological, economic and social impacts.

The fact that this is already economic reality is shown by the studies into the regional economy carried out by the Rhine-Westphalia Institute for Economic Research (RWI)



Slinky Springs, Oberhausen

into the reconstruction of the Emscher system: the comprehensive ecological restructuring of the river is paying off. The considerable investments made to improve the quality of the water system are generating direct and indirect tax revenue in the local area and in the region, securing jobs and increasing the attractiveness of the location.[7]

Connectivity to local as well as regional technical and social infrastructure is established by means of the system performance of all five layers of the "Grüne Infrastruktur Ruhr" programme. As a result, it is also becoming clear that the same value is attached to the operation and maintenance of green infrastructure as to those same aspects of grey infrastructure. Effective green infrastructure can form the basis for a sustainable and resilient Ruhr metropolitan area in conjunction with blue and grey infrastructure.

The Ruhr Regional Association, in partnership with the cities, districts and regional organisations, is now exploring the "operational dimensions of green infrastructure in the Ruhr". The investment and operational activity in all five action areas required for the next ten years will be investigated and the results published in summer 2017. There is a logic behind the time span for the collection of this data: the Ruhr is making preparations as a whole region for a "Green Decade": from the European Green Capital – Essen 2017 to the Ruhr Metropolis International Garden Exhibition – IGA 2027.

References

[1] EU "Green Infrastructure (GI) – Enhancing Europe's Natural Capital" Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions – (GI) (COM(2013) 249 final) Publisher: European Commission, Directorate-General for Environment, Brussels, 06/05/2013

[2] Green paper on the benefits of urban green space, Grünbuch Stadtgrün "Grün in der Stadt – Für eine lebenswerte Stadt" Publisher: German Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety (BMUB), Berlin, May 2015, 100 pages

[3] White paper on urban green spaces, Weißbuch Stadtgrün "Grün in der Stadt" Publisher: German Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety (BMUB), Berlin, May 2017

[4] "Bundeskonzept Grüne Infrastruktur – Grundlagen des Naturschutzes zu Planungen des Bundes" [Federal Green Infrastructure Concept – Nature Conservation Foundations for Plans Adopted by the German Federation] Publisher: German Federal Agency for Nature Conservation (BfN), Bonn, March 2017, 70 pages

[5] "Grüne Infrastruktur NRW – Aufruf des EFRE Programms zur nachhaltigen Verbesserung der natürlichen Umwelt und der Klima- und Umweltbedingungen zugunsten der Biodiversität und der Menschen in Quartieren, Städten und Stadtumlandgebieten in Nordrhein-Westfalen" Publisher: State Government of North Rhine-Westphalia, ERDF Managing Authority for NRW – MWEIMH (Ministry for Economy, Energy, Industry, SMEs and Trades in North Rhine-Westphalia) and MKULNV (Ministry for Climate Protection, Environment, Agriculture, Conservation and Consumer Protection of the State of North Rhine-Westphalia), Düsseldorf, August 2016, 14 pages

[6] "Grüne Infrastruktur Ruhr" [Green Infrastructure in the Ruhr] Publisher: Regionalverband Ruhr, Referat Europäische und regionale Netzwerke Ruhr (Ruhr Regional Association, Department for European and Regional Networks in the Ruhr) ISBN: 978-3-939234-22-7, Essen, October 2016, 84 pages

[7] "Regionalwirtschaftliche Effekte des Emscherumbaus" [The impacts of the Emscher reconstruction on the regional economy] Publisher: Rheinisch-Westfälisches Institut für Wirtschaftsforschung (RWI), Essen, 2013 – RWI project report, 154 pages (final report)

IV. InnovationCity Ruhr | **Model City Bottrop**

InnovationCity Bottrop

4.1 Background

In the spring of 2010, the Initiativkreis Ruhr network launched a region-wide competition for the climate-friendly city of the future. All 53 municipalities in the Ruhr, Germany's largest metropolitan area, were invited to participate in the project.

In November 2010, after a multistage selection process, an independent jury selected the city of Bottrop, home to around 117,000 people. InnovationCity is initially focused on a pilot region in the south of the city of Bottrop, which has approximately 70,000 inhabitants.

The aim of the overall project is to take an established urban neighbourhood with a strong industrial heritage and redevelop it with a focus on energy efficiency so that its CO_2 emissions are reduced by half within ten years – while also improving quality of life and maintaining its position as a location for industry.

This core objective is illustrated by the slogan "Blauer Himmel. Grüne Stadt." (blue sky, green city). "Blue sky" symbolises climate protection and, as a precondition for this, the measurable reduction of CO_2 emissions. "Green city" stands for a tangible increase in the quality of life in the working and living environment as well as in the city as a whole.

Specifically, the following strategies are being pursued:

↦ To reduce the energy requirement (heat and electricity) and improve the efficient use of energy in homes and businesses,

↦ To increase decentralised energy generation and the use of renewable energy sources,

↦ To use intelligent energy management systems in buildings and at district level as connecting elements,

↦ To reduce the number and length of the journeys taken by people and commercial goods and to increase the use of low-emission means of transport,

↦ To support the development of a pleasant urban environment and eco-friendly land use and

↦ To adapt to the potential impacts of climate change through urban greening and by optimising the management of water resources.

InnovationCity Ruhr aims to be a driver of the development and application of new technology or products in the field of climate protection and energy efficiency.

Furthermore, InnovationCity Ruhr strives to play a pioneering role in the implementation of the planned measures and projects. In particular, these include new strategies intended to galvanise and involve local people and businesses, form new partnerships between the participating stakeholders at local, regional and national level as well as developing new funding channels. The intensive collaboration between the municipality and the federal state and between industry and the scientific community facilitates new forms of cooperation and knowledge exchange.

4.2 Implementation process

The city of Bottrop, InnovationCity Management GmbH and their partners in industry and the scientific community are currently working on around 200 projects, each with their own objectives and project structure. The individual projects are able to draw upon the different human and financial resources of various partners for support with organisation and financing, as required.

This takes place within the framework of intensive and trusting cooperation in which the respective competencies of the stakeholders create synergies. The partners from the worlds of industry and science provide the technical expertise and current research findings. This makes a significant contribution to the financing of projects. The city of Bottrop and InnovationCity Management GmbH oversee project management, involve local partners and obtain the necessary funding. In this way, it is possible to realise projects together that would not be feasible alone.

Within InnovationCity Management GmbH, a company founded by the Initiativkreis Ruhr network, around 25 specialists are now working to execute the project. They are focused on informing and advising the public and mobilising local people, because many measures are founded on the participation of volunteers and the willingness of Bottrop's residents to invest and to take more action than is legally required of them.

Vivawest “Zukunftshaus” (future house)

4.3 The master plan

Climate-friendly urban redevelopment can only succeed when the interaction of various technical, social and economic factors is also taken into consideration. In order to coordinate content and exploit synergy effects, the individual projects therefore need to be incorporated in a common framework. With this in mind, InnovationCity GmbH commissioned a working group from four engineering, planning and consultancy firms to develop an overarching master plan by April 2014, led by the company AS+P Albert Speer + Partner GmbH (Frankfurt, Germany) and in cooperation with the city of Bottrop.

The “Klimagerechter Stadtumbau” (climate-friendly urban redevelopment) master plan for InnovationCity Ruhr | Model City Bottrop shows how the initiative’s objective can be achieved – not just on paper but with many specific projects that will be carried out in the coming years. So, this document is also a “road map” for implementation and shows where in the city of Bottrop and with which measures and projects in the areas of housing, work, energy, transport and city the most CO_2 emissions can be reduced and quality of life most improved.

Climate-friendly urban redevelopment is a joint effort that depends on the energy and determination of each individual. The master plan therefore makes concrete proposals for how the local residents and businesses should be supported. These include measures for providing advice on the subjects of energy and renovation, information on how to use funding channels as well as everyday tips on consumption behaviour or transport choices. Finally, the master plan shows how anyone – whatever their abilities and opportunities – can protect the climate, consume less energy and make life in Bottrop better.

Because InnovationCity needs a strong civic foundation in Bottrop, the master plan was developed not only by experts, but by everyone in the city who had ideas and wanted to take action. This process took place through events such as public workshops in the districts, a planning workshop with business representatives and an online “ideas box”. On 8 April 2014, Bottrop’s city council unanimously approved the “Klimagerechter Stadtumbau” master plan and its more than 300 projects as the basis for future urban development.

InnovationCity rollout map | image: Innovation City Management GmbH

4.4 Interim assessment

In view of the city's difficult financial situation, the InnovationCity project is opening up new prospects for Bottrop that wouldn't otherwise exist. The InnovationCity zone in the city of Bottrop was adopted as the state's largest development area in the joint federal and state government programme "Stadtumbau West" to support urban redevelopment in western Germany. For the period from 2012 to about 2020, around €23 million will be available to the city of Bottrop for urban renewal measures that will significantly improve the quality of life in the city.

To reach the target of a significant reduction in CO_2 emissions, it will be necessary to carry out systematic energy-efficiency upgrades to the building stock. In the pilot area, there is a total of around 14,500 buildings. Of these, approximately 10,200 are residential buildings in private ownership. Since September 2011, around 2,000 households have had a free energy consultation in InnovationCity Ruhr's newly established Centre for Information and Advice (ZIB). This offer is supplemented by a large number of additional motivational measures, such as information evenings and thermal imaging, which have been very well received.

Moreover, local residents are especially benefiting from direct grants for energy-efficiency building modernisation. Since the middle of 2014, around 280 grant applications have been submitted with resulting funding payments totalling around €738,000. As a consequence, investments of more than €5.8 million have been triggered. The average funding rate amounts to about 13 per cent of the eligible costs. Findings to date show that approximately 90 per cent of the contracts are being awarded within the city, meaning that local businesses are benefiting as well as local residents. Additionally, there is also further support directed at tenants, including a contribution towards the purchase of new, efficient electrical appliances.

These advisory services and direct grants are having a distinct impact. At approximately three per cent per year, the rate of modernisation of private residential buildings in Bottrop is many times higher than the national average. With regard to the pilot area, 56 per cent of those who were advised carried out measures within their own four walls. This corresponds to an energy-efficiency modernisation rate of 15.8 per cent of all residential buildings in the pilot area.

Measures that have already been completed or initiated and projects for which implementation is currently guaranteed are expected to result in a 38-per-cent reduction in CO_2 emissions between 2010 and 2020, i.e. approximately 100,000 tonnes. For comparison: this saving corresponds to the amount of CO_2 absorbed by a mature woodland the size of the entire Bottrop city area (100 km²) within a year.

Through the completed and hitherto initiated projects and the energy-efficiency modernisation measures, over €290 million are guaranteed to be invested within the framework of the project by 2020, of which €183 million have been allocated to initiatives that have already been realised. Local businesses in particular are benefiting from these investments, with Bottrop-based firms receiving an estimated €110 million from contracts. There is also an additional approximate €26 million in the production of intermediate and consumer goods (growth in regional

production as a result of increased regional income and thus consumer spending).

The employment rate is also affected by these investments. In terms of the direct impact on employment, an increase of 924 working years has been calculated in Bottrop over the entire period. A further 276 working years result from the indirect impacts. A total of 1,200 working years have thus been newly created.

Numerous media reports on the TV and the radio, in journals and in regional and national newspapers regularly paint a picture of the progress and latest developments in Bottrop. Visits from inside Germany and abroad (including from outside Europe) as well as guest lectures in the United States, China, Japan, etc. document the uniqueness of the project – after all, nowhere in the world has the housing stock of an urban district of this size been redeveloped to create a climate-friendly city of the future.

In 2010, 2013 and 2016, the city of Bottrop was honoured with a gold European Energy Award. In 2013, InnovationCity Ruhr | Model City Bottrop also received the special award at the German Sustainability Awards (DNP). Awards followed in 2014 from the state of North Rhine-Westphalia's Ministry of Culture and Science (MKW) as an "Ort des Fortschritts" (place of progress) and in the "Germany – Land of Ideas" competition as an "Ausgezeichneter Ort" (landmark) as well as the German CSR award for sustainable urban development. In 2015, the city of Bottrop was also selected by the German Federal Ministry of Education and Research (BMBF) as a "Zukunftsstadt" (City of the Future).

4.5 Outlook

If climate-friendly urban redevelopment is to be implemented on a widespread basis, however, the municipality cannot simply wait for property owners to "voluntarily" visit an advice centre. In future, the city of Bottrop will therefore appoint several neighbourhood managers who will approach these owners and mobilise them in support of the issue of energy efficiency.

By creating intelligent links between numerous projects in different subject areas, InnovationCity in Bottrop wants to point the way towards an "energy transition from the bottom up". This is intended to result in the demand, generation, storage and distribution of energy being networked and managed at a local level in such a way as to form an intelligent alternative to the planned "top-down energy transition". In doing so, the questions of large-scale energy transportation and central generation and storage, which are yet to be resolved, are taking a back seat.

Even before its master plan was drafted, the city of Bottrop had developed basic concepts that provided important inspiration in terms of content for the organisation of the InnovationCity process. Of particular note here are the "Zukunftsstandort" (location of the future) master plan (March 2010), the city of Bottrop's integrated climate protection concept (March 2011) and the integrated development concept for the InnovationCity programme area (April 2012, update 2016). Building on the master plan, a climate

RWE "Zukunftshaus" (future house) after renovation

protection sub-concept for transport was put forward in 2015, which defines numerous measures to be implemented in this action area. Many more ideas, including heating concepts, a heavy rainfall study, a vulnerability analysis and a "green infrastructure" integrated development concept, provide more detailed results to supplement the overarching plans.

An innovation manual, which builds on the master plan and can be transferred to other cities, shows what concrete steps, procedures, methods, tools and organisational structures are needed to implement the sustainable urban redevelopment of existing building stock. The InnovationCity Ruhr in Bottrop is thereby doing increasing energy efficiency in buildings and reducing CO_2 emissions. This way, every city and region in the world can benefit from this unique project.

Even after 2020, the city of Bottrop will continue along its path towards a sustainable future. With the "Zukunftsstadt 2030+" (City of the Future 2030+) process, funded by the German Federal Ministry of Education and Research (BMBF), the steady pursuit of climate-friendly urban redevelopment is set to continue, with the addition of the issues work and education, intergenerational equity and new types of housing.

4.6 InnovationCity rollout

Based on the experiences and findings from the Model City Bottrop initiative, with the InnovationCity rollout another project has been gathering momentum since March 2016. A total of 20 neighbourhoods in 17 cities in the Ruhr are being analysed in the course of the project and will obtain holistic neighbourhood plans.

In a six-month planning phase, the selected neighbourhoods are being studied at staggered intervals. In addition to preliminary evaluations, the energy-saving renovation plan and the energy supply concept are the focus of the work of the expert planners. At the same time, a plan for the mobilisation of stakeholders and a communications concept are being developed to create ideal conditions for the successful implementation of the intended energy-efficiency improvements. After all, these alone will ultimately contribute towards the stated goal of increasing energy efficiency in buildings and reducing CO_2 emissions.

The InnovationCity rollout is a joint project by Innovation City Management GmbH, the economic development agency metropoleruhr GmbH, the development association WiN Emscher-Lippe Gesellschaft zur Strukturverbesserung mbH and the Wuppertal Institut für Klima, Umwelt, Energie gGmbH. Its objective is to promote and establish climate-friendly urban redevelopment in the Ruhr metropolitan area. The scheme is supported by the Ministry for Climate Protection, Environment, Agriculture, Conservation and Consumer Protection (MKULNV) for the state of North Rhine-Westphalia with financial support from the European Regional Development Fund (ERDF).

V. The state of the environment in the Ruhr Metropolitan Area – presented using **15 environmental indicators**

Introduction

Background and definition of targets

Indicators and targets are important tools to assess the state of the environment in a region and to shape future development. In the second part of this report, the state of the environment in the Ruhr metropolitan area is presented and evaluated using 15 selected environmental indicators. The environmental indicators were compiled on behalf of the Ruhr Regional Association (Regionalverband Ruhr (RVR)) by the Wuppertal Institute in collaboration with the planning office Richter-Richard for the area of noise.

The 15 environmental indicators represent key environmental issues for the Ruhr metropolitan area and describe the current situation and the development of these issues in the Ruhr region. Furthermore, the Wuppertal Institute and the planning office Richter-Richard propose targets for future development in the Ruhr metropolitan area for each environmental indicator.

The indicators selected for presentation are as compatible as possible with existing indicators and targets at EU, German government, federal state (North Rhine-Westphalia) and municipal levels. The indicators have been selected in such a way that they can be updated in the future, e.g. with updates taking place every two years.

Choice of the environmental indicators presented

The choice of the indicators presented was made in mutual agreement with the client, the Ruhr Regional Association, and the steering committee of heads of environmental protection for the Ruhr region based on a proposal from the Wuppertal Institute. The criteria for the proposed indicators from the Wuppertal Institute were as follows:

↦ Relevance of the indicator in particular in terms of environmental sustainability, as well as in terms of social and economic sustainability,

↦ Applicability and relevance of the data for regional and/or municipal reporting (e.g. based on existing target proposals for the Ruhr metropolitan area),

↦ Compatibility with existing indicators and targets at EU, German government, federal state and municipal levels,

↦ Availability of data (no new collection of data necessary),

↦ Quality of the data available (e.g. possibility of presenting their chronological development).

The Wuppertal Institute's proposed indicators included proposals for portrayable environmental indicators as well as suggestions for presenting indicators of social and economic sustainability. Furthermore, in the course of editing the 15 environmental indicators that are presented, further proposals were developed for other thematically-linked environmental indicators, which the Institute recommends should be presented more extensively in a follow-up report in the future.

Table 1, below, shows the 15 environmental indicators which were selected and prepared to be presented in the environmental report on the Ruhr metropolitan area 2017.

Electricity generation and power lines

Lorry in city traffic

Table 1: **Environmental indicators presented for the Ruhr region environmental report 2017**

Topic	Indicator (unit of measurement)
Climate protection	1. Level of energy-related greenhouse gas emissions (CO_2 equivalent absolute value and per capita)
Energy use	2. Primary energy consumption (in petajoules (PJ))
Renewable energies	3. Proportion of energy from renewable sources in final energy consumption (net) (in %) 4. Proportion of energy from renewable sources in net electricity consumption (in %)
Transport	5. Modal split (proportions of the various modes of transport – private car, public transport, cycling, walking – in the volume of traffic (in %)
Air quality	6. Nitrogen dioxide (NO_2): yearly average (in µg/m³) 7. Particulate matter (PM_{10}): daily average (number of days on which the level exceeded 50µg/m³) and yearly average (in µg/m³) 8. Particulate matter ($PM_{2.5}$): yearly average (in µg/m³) and Average Exposure Indicator – (AEI) (in µg/m³)
Noise	9. People exposed to noise pollution due to traffic per 1,000 residents all day (0-24 hrs): L_{den} >65 dB(A) = high noise exposure, L_{den} >70 dB(A) = very high noise exposure 10. People exposed to noise pollution due to traffic per 1,000 residents at night (22-6 hrs): L_{night} >55 dB(A) = high noise exposure, L_{night} >60 dB(A) = very high noise exposure
Land use	11. Increase in land use for housing and transport (in hectares per day)
Organic farming	12. Proportion of organic farming in relation to the total agricultural area (in %))
Biodiversity	13. Proportion of connected biotope areas (in %) in relation to the total area
Water quality	14. Quality of running water – proportion of running water classified as class I ("very good") and class II ("good") (Saprobic Module) in relation to the total area of running water of the assessed bodies of water
Environmental economy	15. Number of the workforce in the environmental economy

Data research

In terms of data research, the focus was on data available in the Ruhr region. No new data were collected. Municipal data, which were researched by the Wuppertal Institute to compile the maps at the start of each section (modal split data, climate protection concepts), were fed in via a survey carried out by the RVR with the districts and municipalities of the Ruhr region. The data presented in the report come from institutions and stakeholders at the state, regional and municipal levels, such as the Ministry for Climate Protection, Environment, Agriculture, Conservation and Consumer Protection of the State of North Rhine-Westphalia (MKULNV NRW), the North Rhine-Westphalia Chamber of Agriculture, the State Agency for Nature, Environment and Consumer Protection in North Rhine-Westphalia (LANUV NRW), North Rhine-Westphalia Information and Technology (IT. NRW), the Emscher Genossenschaft/Lippe Verband (EGLV) (Emscher/Lippe waste water management partnership), the Ruhrverband, the economic development agency metropoleruhr, the Ruhr Regional Association (RVR) and the districts and municipalities of the Ruhr region. In addition, individual stakeholders from the Ruhr region provided photographs to be included in the environmental report. We would like to thank these institutions and stakeholders for their close collaboration in the areas of data research and preparation and for providing the photos.

In addition, further data sources were researched and presented in order to compare the state of the environment in the Ruhr region with the situation at state and national levels (e.g. the German Federal Statistics Office). The data research was done by means of document- and internet-based research and by making enquiries directly with the relevant institutions and stakeholders (email, telephone calls, on-site visits).

Presentation of the environmental indicators

The 15 environmental indicators are described concisely in each case and explained more fully in endnotes. Each environmental indicator is presented visually using a diagram. The development of the environmental indicator is assessed using a weather icon. In addition, a map of the Ruhr region was produced for each environmental indicator to present a more detailed portrayal of the topic represented

by the environmental indicator from a regional perspective for the Ruhr metropolitan area. These regional maps were developed by the Wuppertal Institute in close collaboration with the planning office Richter-Richard and the Ruhr Regional Association and, in the case of some of the maps, with stakeholders from the Ruhr region.

The environmental indicators are presented using the following format:

↦ Map of the Ruhr region for the environmental indicator to provide more detail on the subject involved

↦ Description of the environmental indicator including

- a summary box giving a description of the environmental indicator and existing targets (e.g. at EU, German government, federal state, regional and municipal levels and targets proposed by associations and institutions), as well as the target proposed by the Wuppertal Institute or the planning office Richter-Richard (for noise) for the Ruhr metropolitan area;
- a description of the environmental indicator organised under the following sections: significance of the environmental indicator, existing targets and legislative context, if appropriate, current situation and development in the Ruhr region, (overall and in terms of selected cities/districts), assessment of the environmental indicator;
- weather icon giving a summarised assessment of the development trend for the environmental indicator;
- a suitable photo for the topic;
- a short description of one or more examples of good practice from the Ruhr metropolitan area.

↦ Endnotes providing references and clarifications.

Weather icons giving an evaluation of the development trend

The development trend for each indicator has been assessed in a simplified way using weather icons, except in cases where the only data available for an environmental indicator are those regarding the current situation, making it impossible to make any comments on its development in the past.

The weather icons are intended to give a simple illustrative summary of the progress the environmental indicators are making towards the proposed targets developed by the Wuppertal Institute and the planning office Richter-Richard for the Ruhr metropolitan area. To assess the trend of an environmental indicator, its previous development over the past few years is considered and based on this, an evaluation is made of whether the indicator is developing in a positive or less positive way in relation to the proposed target.

The weather icons come from the German Federal Statistics Office. They were developed for monitoring Germany's National Sustainable Development Strategy and were used, for example, for assessing indicators in the Federal Statistics Office's indicator reports in 2014 and 2016. (German Federal Statistics Office 2014 and 2017).

Based on the way the weather icons are used by the Federal Statistics Office, (cf. German Federal Statistics Office 2014, p. 66), they are used as follows in this report:

Table 2: Use of weather icons in this indicator report for the Ruhr region and in the 2014 and 2016 indicator reports assessing Germany's National Sustainable Development Strategy prepared by the Federal Statistics Office

Icon	Use of the weather icons in this indicator report for the Ruhr region	Use of the weather icons in the 2014 indicator report assessing Germany's National Sustainable Development Strategy prepared by the Federal Statistics Office
	The indicator is moving in the right direction and is expected to meet the proposed target if the rate of development remains constant in the future.	"The target for the indicator has been met or the remaining "gap" between the initial value and the target is expected to be covered by the target year (shortfall of less than 5%) or a limit has been complied with."
	The indicator is moving in the right direction, but the proposed target is expected to be missed by a small margin if the rate of development remains constant in the future.	"The indicator is moving in the right direction, but a gap of 5% to 20% between the initial value and the target value remains / is expected to remain in the target year, if the average annual rate of development continues unchanged."
	The indicator is moving in the right direction, but the proposed target is expected to be missed by a large margin if the rate of development remains constant in the future.	"The indicator is moving in the right direction, but a shortfall of more than 20% remains / is expected to remain in the target year, if the average annual rate of development continues unchanged."
	The indicator is moving in the wrong direction; if the rate of development remains constant in the future, the gap to the proposed target is expected to increase further.	"The indicator is moving in the wrong direction; the gap to the target is expected to increase further, or a limit will not be complied with, if the average annual rate of development continues unchanged."
	If no data for previous years are available for an indicator, making it impossible to observe a trend in this case, the following note is added: "No trend analysis is possible due to a lack of data from previous years".	This issue does not occur in the indicator report prepared by the Federal Statistics Office; all the indicators can be assessed using the weather icons.

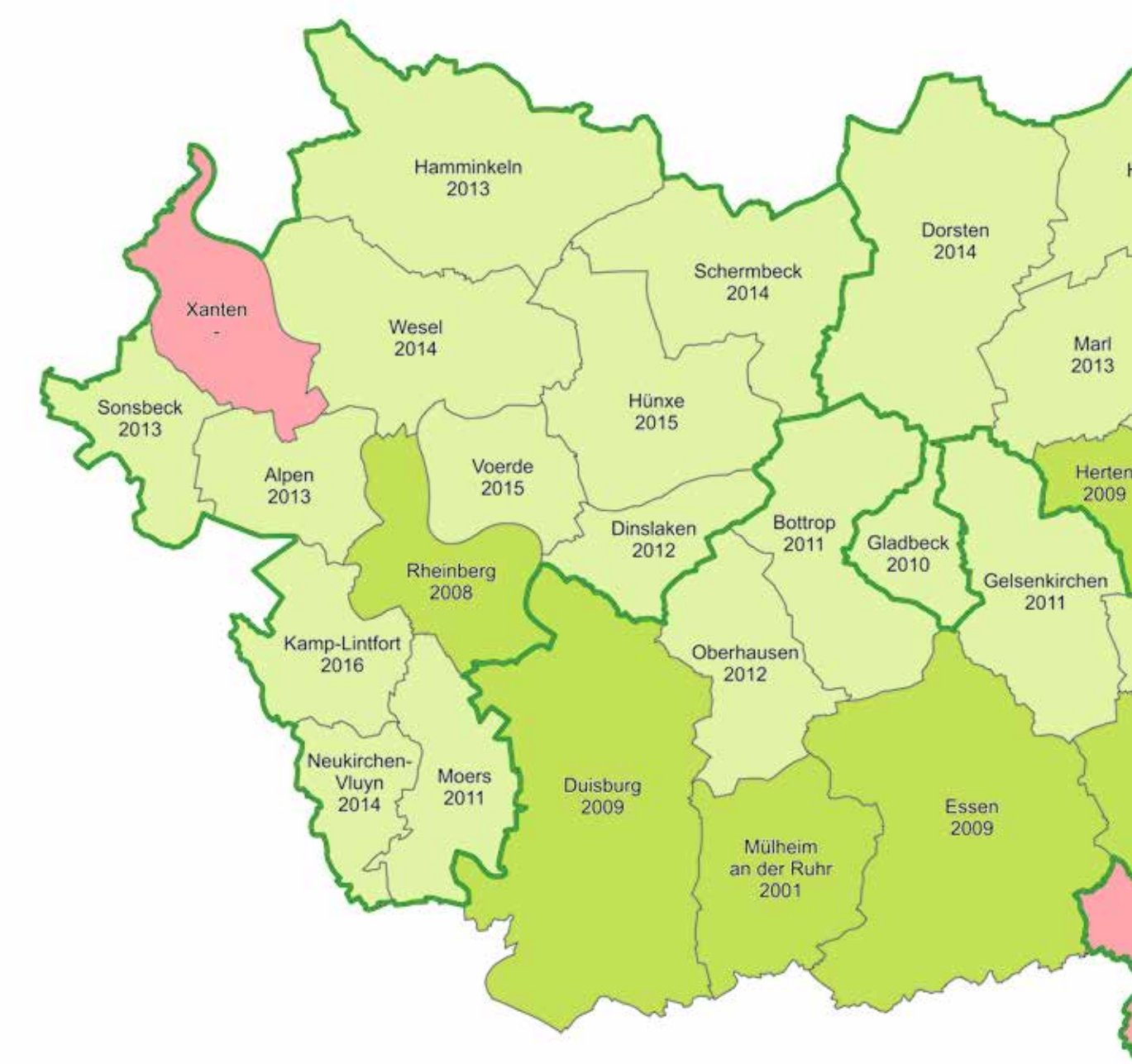
Source of the description of the use of the weather icons by the Federal Statistics Office: German Federal Statistics Office 2014, p. 66

References

The German Federal Statistics Office (2014): Nachhaltige Entwicklung in Deutschland – Indikatorenbericht 2014. [Sustainable Development in Germany – Indicator Report 2014.] Wiesbaden. https://www.nachhaltigkeitsrat.de/fileadmin/_migrated/media/Indikatorenbericht2014.pdf, accessed 18.11.2016.

5.1 Climate protection: Level of energy-related greenhouse gas emissions

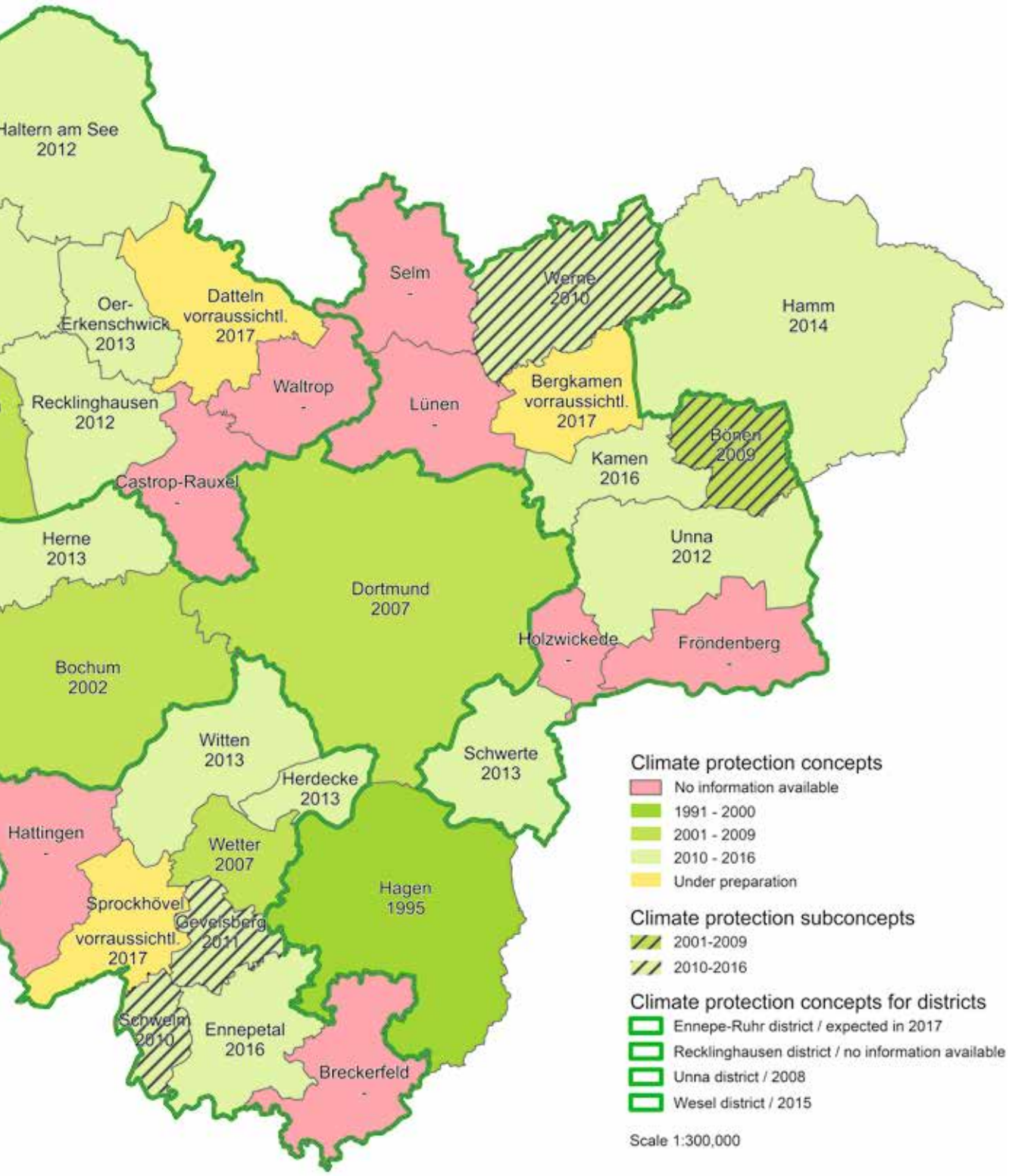
Earliest municipal and regional climate protection concepts or climate protection subconcepts in the Ruhr metropolitan area



Concept development: Wuppertal Institute, Ruhr Regional Association

Source: Wuppertal Institute research including surveys carried out by the Ruhr Regional Association in the districts and municipalities of the Ruhr metropolitan area in August 2016

Map source: © Ruhr Regional Association


Haltern am See
2012
Oer-
Erkenschwick
2013
Datteln
vorraussichtl.
2017
Selm
-
Werne
2010
Hamm
2014
Recklinghausen
2012
Waltrop
-
Lünen
-
Bergkamen
vorraussichtl.
2017
Kamen
2016
Bönen
2009
Castrop-Rauxel
-
Herne
2013
Unna
2012
Dortmund
2007
Holzwickede
-
Fröndenberg
-
Bochum
2002
Witten
2013
Herdecke
2013
Schwerte
2013
Hattingen
-
Wetter
2007
Hagen
1995
Sprockhövel
vorraussichtl.
2017
Gevelsberg
2011
Schwelm
2010
Ennepetal
2016
Breckerfeld
-
Climate protection concepts
No information available
1991 - 2000
2001 - 2009
2010 - 2016
Under preparation
Climate protection subconcepts
2001-2009
2010-2016
Climate protection concepts for districts
Ennepe-Ruhr district / expected in 2017
Recklinghausen district / no information available
Unna district / 2008
Wesel district / 2015
Scale 1:300,000

Indicator 1 – Climate protection: Level of energy-related greenhouse gas emissions

Overall objective: climate protection – to prevent dangerous man-made interference with the climate system
Indicator: level of greenhouse gas emissions (CO_2 equivalent (CO_{2e}) absolute value and per capita)

Existing operational targets:*

UN level: Paris Climate Agreement (2015)[1]		EU-level [2,3,4]	German government [5]	NRW state government [6]	Climate Alliance at city level [7]	City of Essen [8]	Target proposed by the Wuppertal Institute for the Ruhr metropolitan area[9]	
		Absolute (CO_{2e})	Absolute (CO_{2e})	Absolute (CO_{2e})	Per capita (tonnes CO_{2e}/ per capita)	Absolute (CO_{2e})	Absolut (CO_{2e})	Per capita** (tonnes CO_{2e}/ per capita)
Restricting the increase in the global average temperature to well below 2°C above the pre-industrial level	**2020**	-20%	-40%	min. -25%		-40%	min. -25%	
	2030	-40%	-55%	ca. -44%	"Long-term" 2.5 tonnes CO_{2e} per resident	-55%	ca. -44%	5 t
	2040		-70%			-70%		2,5 t
	2050	-80% to 95%	-80% to 95%	min. -80%		-95%	-80% – 95%	<1,0 t

*Targets on the reduction of greenhouse gases as compared to 1990 in each case
**Including major emitters

Significance of the environmental indicator

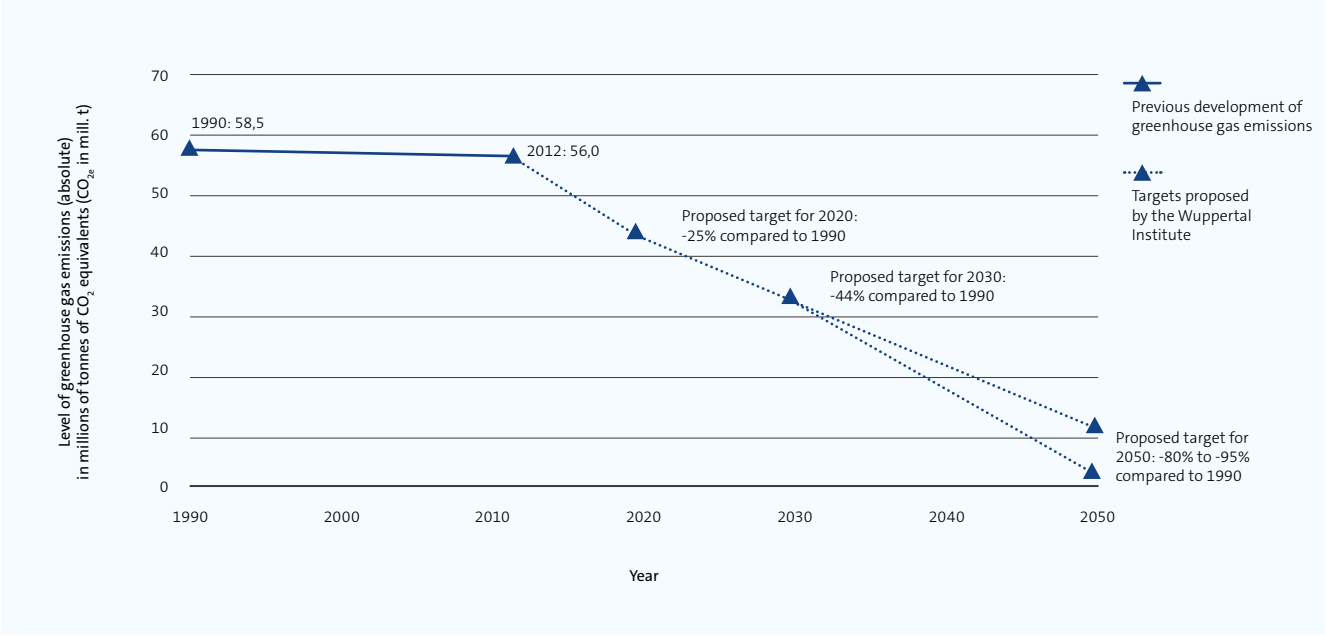
Greenhouse gases are the main cause of global warming attributable to mankind. They are gases in the atmosphere that absorb the long-wave reflection of the Earth's surface and warm the Earth's surface as atmospheric counterradiation in addition to short-wave radiation.[10] As a result of this warming, extreme weather events increase, such as hot spells, storms and heavy rainfall.[11] These lead to crop failures due to drought and flooding and to health problems caused by heatwaves. Costs also arise for adapting the infrastructure to the changed environmental conditions (e.g. dykes, drainage systems). There are two sources of greenhouse gas emissions: energy-related emissions (e.g. from the energy industry and from traffic) and non-energy-related emissions (e.g. from farming and certain industrial processes , for example, involving chemicals and plastics). The best-known greenhouse gas is carbon dioxide (CO_2), which accounted for 88% of greenhouse gases in 2014. Other greenhouse gases are methane (CH_4, accounting for 6% of the total), nitrous oxide (N_2O, laughing gas, 4%) and four other greenhouse gases covered by the Kyoto Protocol.[12] Since methane and nitrous oxide, for example, have a much more serious impact on the climate, per tonne, than CO_2, the various greenhouse gases are converted into CO_2 equivalents (CO_{2e}) in order to make them comparable in terms of the damage they cause to the climate.

Existing targets

In December 2015, 195 countries negotiated an agreement for the first time on a global, legally-binding climate treaty. The Paris Climate Agreement set the goal of restricting the increase in the global average temperature to well below 2 degrees Celsius above the pre-industrial level. At the European level, the aim is to reduce greenhouse gas emissions by 20% by the year 2020, and by 40% by 2030, compared to 1990 levels. The German government aims to reduce greenhouse gas emissions even further in Germany: by 40%, compared to 1990 levels, by the year 2020, by 55% by 2030 and by between 80% and 95% by 2050. In view of its structural features as an energy state and industrialised region, the federal state of North Rhine-Westphalia adopted a climate protection law (2013), setting itself the goal of reducing greenhouse gas emissions by at least 25% by the year 2020 and by at least 80% by 2050, compared to 1990 levels respectively. The Climate Alliance set itself the long-term goal that its members should not produce emissions

Energy-plus house in Bottrop [14]

Development of energy-related greenhouse gas emissions (absolute) in the Ruhr metropolitan area from 1990 to 2012 with targets proposed by the Wuppertal Institute for 2020, 2030 and 2050



Source: Wuppertal Institute presentation based on data from GERTEC 2016 [13]; targets proposed by the Wuppertal Institute

of more than 2.5 tonnes of CO_{2e} per capita of population. The Wuppertal Institute has recommended a proposed target to the Ruhr metropolitan area, in keeping with the North Rhine-Westphalia target, of reducing its greenhouse gas emissions by at least 25% by 2020, by around 44% by 2030 and by 80 to 95% by 2050, compared to 1990 levels. Following the Climate Alliance's targets, the Ruhr Metropolis Region is expected to set itself the target of reducing it emissions per capita (including major emitters) to 5 tonnes by the year 2030, to 2.5 tonnes by 2040 and to a maximum of one tonne of CO_{2e} by 2050.

Development trend

Current situation and development in the Ruhr region

In 2012, 56.0 million tonnes of greenhouse gases wereemitted in the Ruhr region. Since 1990, the level of greenhouse gas emissions has hardly changed: they have only gone down by 4.3% (1990: 58.5 million tonnes) – compared to a reduction in greenhouse gases of 17.4% at NRW state level[15] and a reduction of 24.7% at the national level[16] in the same period. In the Ruhr region, industrial and energy companies are traditionally of particular importance. This is demonstrated by the fact that about a quarter of the greenhouse gas emissions are caused by major emitters (26.6% in 2012). The major emitters include large energy facilities and energy-intensive industrial plants which are covered by the emissions trading scheme. Since the commencement of the European emissions trading scheme in 2005, the major emitters are often not considered in municipal observations. Without the major emitters, the value per capita for the Ruhr metropolitan area is 8.1 t of CO_{2e}; including the major emitters it is 11.1 t of CO_{2e}. Given the different sizes of the cities and municipalities, the value per capita is a suitable measure for drawing comparisons between them and also for comparing the situation with national and international developments. In addition, in the long term, it is possible to take account of the effects of any change in the population level. The cities and districts in the Ruhr region with the lowest local level of emissions per capita (without major emitters) are Herne (6.9 t of CO_{2e} per person), the district of Recklinghausen (7.4 t) and Duisburg (7.4 t).

Assessment

At 11.1 t of CO_{2e} per capita[17], the Ruhr Region is a little above the average in North Rhine-Westphalia (approx. 10.8 t of CO_{2e}) in 2012 and clearly above the German national average of 7.5 t of CO_{2e} per capita[18] (in terms of energy-related and polluter-based emissions, without non-energy-related emissions, such as those from farming, and without direct emissions from energy conversion) and it is still a long way from the proposed 5 tonnes per capita target for 2030. In the period of 22 years between 1990 and 2012, it was only possible to reduce greenhouse gas emissions by 4.3%. In order to achieve the recommended target, according to NRW state legislation, of at least 25% by the year 2020, emissions must be reduced by 20.7% in just eight years (2012-2020). This shows that huge efforts must be made in all sectors in the short term in order to achieve this target. [19] In the long term, a fundamental transformation of lifestyle and economic activity, resulting in substantially fewer greenhouse gas emissions than the current level, is necessary to achieve the target indicator. The city of Bottrop is a good example of commitment to climate protection: as "InnovationCity Ruhr" it has set itself the goal of halving its greenhouse gas emissions within just ten years (2010-2020). With the measures implemented or agreed up until 2015 (a total of more than 300), a reduction of approx. 37% is expected to be achieved by 2020. [20] [21]

Sources and notes

[1] At the UN Climate Change Summit in Paris in 2015, 195 countries negotiated a new agreement to combat global warming. The countries set themselves the goal of restricting the increase in the global average temperature to well below 2 degrees Celsius above pre-industrial levels. Efforts are to be made to limit the temperature increase to 1.5°C above pre-industrial levels. (The German Government (2015): UN-Gipfel in Paris – Neuer Klimavertrag beschlossen. [UN Summit in Paris – New climate agreement adopted.] Press release dated 12.12.2015. https://www.bundesregierung.de/Content/DE/Artikel/2015/12/2015-12-12-klimaabkommen.html, accessed 23.5.2016).

[2] European Parliament (2008): The EU Climate Change Package. http://www.europarl.europa.eu/sides/getDoc.do?pubRef=-//EP//TEXT+IM-PRESS+20081208BKG44004+0+DOC+XML+V0//EN, accessed: 4.4.2016

[3] European Council (2014): Conclusions on the 2030 Climate and Energy Policy Framework http://www.con- silium.europa.eu/uedocs/cms_data/docs/pressdata/de/ec/145377.pdf, Page 2, accessed: 4.4.2016

[4] European Commission (2011): Energy Roadmap 2050. Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions. Brussels, 15.12.2011. http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52011DC0885&from=DE, accessed 4.4.2016.

[5] The German Federal Government (2010): Energiekonzept für eine umweltschonende, zuverlässige und bezahlbare Energieversorgung. [Energy Concept for an Environmentally Sound, Reliable and Affordable Energy Supply.] http://www.bundesregierung.de/ContentArchiv/DE/Archiv17/_Anlagen/2012/02/energiekonzept-final.pdf?__blob=publicationFile&v=5, page 4, accessed: 4.4.2016

[6] MKULNV NRW – The Ministry for Climate Protection, Environment, Agriculture, Conservation and Consumer Protection of the State of North Rhine-Westphalia (2016): Nachhaltigkeitsindikatoren Nordrhein-Westfalen. [North Rhine-Westphalia Sustainability Indicators.] http://www.nachhaltigkeit.nrw.de/fileadmin/dowload/nachhaltigkeits-indikatorenbericht_2016.pdf, page 8, accessed: 6.7.2016

[7] Climate Alliance (2016): Unsere Ziele; Klimaschutz. [Our goals; climate protection.] http://www.climatealliance.org/climate-protection0.0.html?&L=1#c1856, accessed: 4.4.2016

[8] City of Essen (2014): Bewerbung zur Grünen Hauptstadt Europas 2017 – 1. Klimawandel: Schadensminderung und Anpassung, [Application for European Green Capital 2017 – 1. Climate Change: Mitigation and Adaptation], p. 10. Essen. https://media.essen.de/media/wwwessende/aemter/59/gruene_hauptstadt_europas_1/01_GHE_Themenfeld_Klimawandel_web.pdf, accessed 29.4.2016.

[9] Proposed targets for the reduction of absolute greenhouse gas emissions in the Ruhr region in compliance with the NRW's legally enshrined targets set out in the NRW climate protection law. In its application for the European Green Capital in 2012, i.e. before the adoption of the NRW climate protection law on 23 January 2013, the Ruhr region set itself the goal, in compliance with the German national target, of reducing CO_2 emissions by 40% by the year 2020, by 65% by 2035 and by 80-95% by 2050, compared to 1990 levels (cf. Wuppertal Institute (2013): Metropole Ruhr – Grüne Hauptstadt Europas. [Ruhr Metropolitan Area – European Green Capital.] Wuppertal, p. 19. http://wupperinst.org/uploads/tx_wupperinst/Metropole_Ruhr_Endbericht.pdf, accessed 14.09.2016). Proposed target from the Wuppertal Institute for per capita CO_{2e} emissions in the Ruhr region, based on the targets of the Climate Alliance, to reduce the greenhouse gas emissions to 2.5 tonnes of CO_{2e} per resident (no stated target date). The year 2040 is proposed as the target year for the 2.5-tonne target. An interim target of 5 tonnes of CO_{2e} per capita by 2030 has been proposed. This equates to approximately halving the per capita emission levels recorded in the Ruhr region in 2012 (11.1 t of CO_{2e}). The target year 2030 was derived from two different targets. On the one hand, from the reduction targets (-55% by 2030) for absolute CO_{2e} emissions set by the German federal government and the city of Essen. On the other, from the Climate Alliance's target of reducing per capita CO_{2e} emissions by 50% by the year 2030 compared to 1990 levels (cf. Climate Alliance (2016): Klima-Bündnis – Konkrete Ziele. [Climate Alliance – Concrete Targets]. Online at: http:// www.klimabuendnis.org/home.html, accessed 4.6.2016). For 2050, it is proposed that greenhouse gas emissions should be under one tonne of CO_{2e} per capita. This is derived from the budget approach of the German Advisory Council on Global Change (WBGU), which states the levels of overall per capita emissions that can still be produced in the various countries, if the 2-degree target is to be met by 2050. Emissions should be at around 1 tonne of CO_2 per capita by 2050. (WBGU (2009): Kassensturz für den Weltklimavertrag – Der Budgetansatz. [Solving the climate dilemma: The budget approach]. Berlin, p. 3, http://www.wbgu.de/fileadmin/templates/dateien/veroeffentlichungen/sondergutachten/sn2009/wbgu_sn2009.pdf, accessed 23.5.2016). In "Germany's model for climate protection until 2050," the target for 2050 is also stated as one tonne of greenhouse gas per capita. (Forecast, Öko-Institut e.V. 2009, p. 1, http://www.oeko.de/uploads/oeko/oekodoc/971/2009-003-de.pdf, accessed 23.5.2016); the same is stated by the German Federal Environmental Agency in its study "Treibhausgasneutrales Deutschland im Jahr 2050" ["Germany in 2050 – a greenhouse gas-neutral country"] (the German Federal Environmental Agency 2013, p. 27, https://www.umweltbundesamt.de/sites/default/files/medien/376/publikationen/treibhausgasneutrales_deutschland_im_ jahr_2050_langfassung.pdf, accessed 23.5.2016).

[10] Bauer, J., Englert, W., Meier, U., Morgeneyer, F. and W. Waldeck (2002): Physische Geographie [Physical Geography]. Heidelberg. Berlin.

[11] IPCC (2014): Summary for Policymakers. In: Climate Change 2014: Mitigation of Climate Change. Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Edenhofer, O., R. Pichs-Madruga, Y. Sokona, E. Farahani, S. Kadner, K. Seyboth, A. Adler, I. Baum, S. Brunner, P. Eickemeier, B. Kriemann, J. Savolainen, S. Schlömer, C. von Stechow, T. Zwickel and J.C. Minx (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

[12] UBA – the German Federal Environmental Agency (2016): Treibhausgas-Emissionen in Deutschland. [Greenhouse Gas Emissions in Germany.] http://www.umweltbundesamt.de/daten/klimawandel/treibhausgas-emissionen-in-deutschland, accessed: 5.4.2016

[13] GERTEC (2016): Metropole Ruhr – THG Emissionen 1990 und 2012 (unveröffentlichte Daten). [The Ruhr Metropolitan Area – GHG Emissions in 1990 and 2012 (unpublished data)]. Major emitters are included in the values shown in the chart, since their emissions were included in the calculations in 1990.

[14] EnergieAgentur.NRW (2015): Premiere in NRW: Energieplushaus in Bottrop. [Premiere in NRW: Energy-plus house in Bottrop.] http://www.energieagentur.nrw/eanrw/ea/premiere_fuer_nrw_ energieplushaus_in_bottrop, accessed: 5.4.2016

[15] In 1990, CO_{2e} emissions stood at 367 million tonnes at state level for North Rhine-Westphalia, in 2012 the figure was 303 million tonnes (cf. The State Agency for Nature, Environment and Consumer Protection (LANUV NRW) 2016 in compliance with the Ministry for Climate Protection, Environment, Agriculture, Conservation and Consumer Protection of the State of North Rhine-Westphalia (MKULNV NRW) (2016): Nachhaltigkeitsindikatoren Nordrhein-Westfalen – Bericht 2016. [North Rhine-Westphalia Sustainability Indicators – Report 2016], p. 8. Düsseldorf. http://www.nachhaltigkeit.nrw.de/fileadmin/download/nachhaltigkeits-indikatorenbericht_2016.pdf, accessed 14.9.2016).
At the German national level in 1990, CO_{2e} emissions stood at 1,248 million tonnes, in 2012 the figure was 940 million tonnes (cf. The German Federal Environmental Agency (2014): Treibhausgasausstoß im Jahr 2013 erneut um 1,2 Prozent leicht gestiegen. [Greenhouse gas emissions rise again slightly in 2013], by 1.2 per cent. http://www.umweltbundesamt.de/presse/presseinformationen/treibhausgasausstoss-im-jahr-2013-erneut-um-12, accessed 4.7.2016).

[16] Cf. The German Federal Environmental Agency (2014): Greenhouse gas emissions rise again slightly in 2013, by 1.2 per cent. http://www.umweltbundesamt.de/presse/ presseinformationen/treibhausgasausstoss-im-jahr-2013-erneut-um-12, accessed 26.10.2016.

[17] GERTEC (2015): Regionales Klimaschutzkonzept zur „Erschließung der Erneuerbaren Energien-Potenziale in der Metropole Ruhr" – Endenergie- und Treibhausgasbilanzierung. [Regional climate protection concept on "Tapping the potential of renewable energy sources in the Ruhr Metropolitan Area – Balancing end energy and greenhouse gases"]. Essen. Page 33 ff.

[18] GERTEC (2015): Regionales Klimaschutzkonzept zur „Erschließung der Erneuerbaren Energien-Potenziale in der Metropole Ruhr" – Endenergie- und Treibhausgasbilanzierung. [Regional climate protection concept on "Tapping the potential of renewable energy sources in the Ruhr Metropolitan Area – Balancing end energy and greenhouse gases"]. Essen. Page 33 ff.

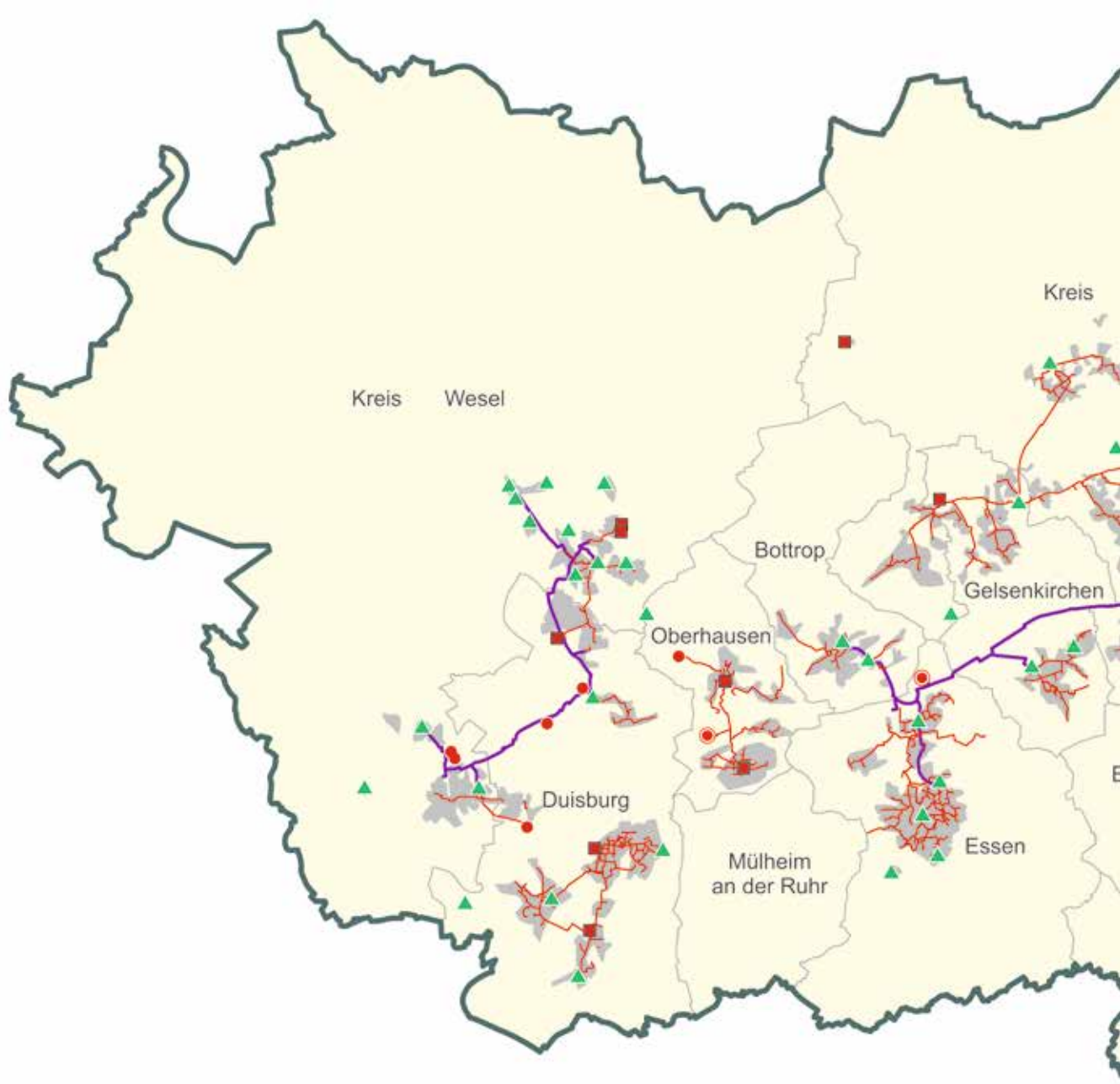
[19] Energy-related emissions also include the industrial sector, private households, transport and the commercial, trade and service sectors.

[20] Innovation City Ruhr (2015): InnovationCity roll out. http://www.icruhr.de/index.php?id=521, accessed: 5.4.2016

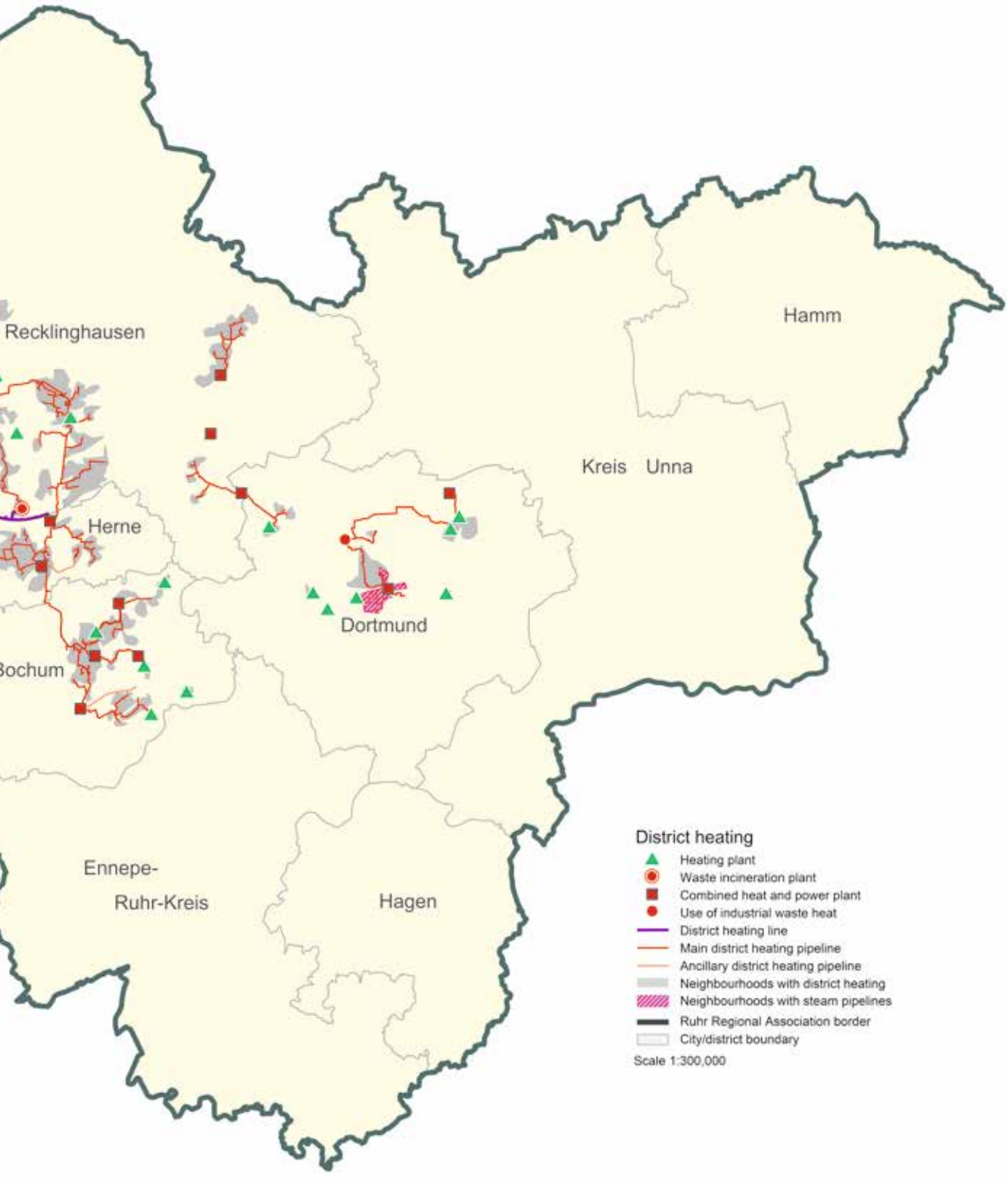
[21] Innovation City Ruhr (undated): Modellstadt Bottrop. [Model city of Bottrop]. http://www.icruhr.de/index.php?id=29, accessed: 5.4.2016

5.2 Energy: Primary energy consumption

The district heating network in the Ruhr metropolitan area



Source: © Dietrich & Hufen, Ingenieurbüro für Kartographie
(Engineering office for cartography) (last updated 2011)
Map source: © Ruhr Regional Association


Recklinghausen
Hamm
Kreis Unna
Herne
Dortmund
Bochum
Ennepe-
Ruhr-Kreis
Hagen
District heating
Heating plant
Waste incineration plant
Combined heat and power plant
Use of industrial waste heat
District heating line
Main district heating pipeline
Ancillary district heating pipeline
Neighbourhoods with district heating
Neighbourhoods with steam pipelines
Ruhr Regional Association border
City/district boundary
Scale 1:300,000

Indicator 2 – Energy: Primary energy consumption

Objective: to reduce the consumption of resources and to reduce greenhouse gas emissions that are harmful to the climate in the energy sector
Indicator: primary energy consumption (in petajoules (PJ))

Existing operational targets:

	EU-level: [1]	German government: [2]	NRW state government: [3]	City of Essen: [4]	Target proposed by the Wuppertal Institute for the Ruhr metropolitan area: [5]
Reference year	2020*	2008	2010	1990	2012
2020	-20%	-20%	-12% to -18%	-20%	-12%
2030	/	/	/	-30%	-25%
2050	/	-50%	-45% to -59%	-50%	-45% to -59%

*Primary energy consumption for 2020 as predicted in 2007 (reference year 2020 at EU level)

Significance of the environmental indicator

"Primary energy" is the energy that is harvested directly from natural resources. This includes fossil fuels such as coal and lignite, crude oil and natural gas, as well as renewable energy resources (e.g. solar power and wind energy, hydropower, biomass, geothermal energy) and nuclear energy. Primary energy consumption refers to the energy content of all the primary energy resources used in a region (state, district, city), which has not been subjected to energy loss through conversion (into what is known as "secondary energy", e.g. district heating, petrol) or through distribution to the consumer (known as "final energy" or "end use energy"). [6, 7, 8] The economic situation, raw material prices and technical developments influence a region's primary energy consumption.

Primary energy consumption is a key indicator for resource consumption and climate protection (cf. Indicator 1 "Climate protection"). To ensure greater sustainability, it is necessary, on the one hand, to reduce the absolute level of primary energy consumption in order to reduce resource consumption and greenhouse gas emissions and to decrease the reliance on fossil or nuclear fuels. On the other hand, in the context of the energy transition, it is essential to restrict the percentage of fossil fuels and nuclear fuels in the energy mix and increase the percentage of renewable energy resources (cf. Indicators 3 and 4 "Renewable energies"). In Germany, the percentage of fossil fuels and nuclear energy in primary energy consumption amounts to 87.4% (2015). [9]. Lower energy consumption can result in savings on energy bills for industry and private households (e.g. reduced utility costs by deliberately using heating more sparingly) and can thus combat the problem of energy poverty in low income households.[10] What is more, a lower demand for energy can reduce dependence on energy imports from other countries/regions.

Existing targets

The European Union has set itself the goal of reducing primary energy consumption by 20% by the year 2020 (compared to 2007). The target set by the German government is to save 20% of primary energy consumption by the year 2020 and 50% by 2050 (compared to 2008 levels in both cases). The federal state of North Rhine-Westphalia has set itself a target of reducing between 12% and 18% by 2020 and between 45% and 59% by 2050 (compared to 2010 in both cases). On the basis of the federal state target, the Wuppertal Institute has proposed a target for the Ruhr metropolitan area that requires a reduction of 12% by 2020, compared with reference year 2012.

By 2030, it is envisaged that primary energy consumption be cut by 25% and by 2050, it should be reduced by between 45% and 59% compared to 2012 levels.

Current situation and development in the Ruhr region

In 2012, primary energy consumption in the Ruhr region stood at a total of 0.68 PJ, or 187,993 gigawatt-hours (GWh) for the industrial sector, private households, transport and the commercial, trade and service sectors. This equates to 0.037 GWh per capita. The city of Bottrop had the lowest level of primary energy consumption in the administrative districts and cities of the Ruhr region, amounting to 4,224 GWh (0.015 PJ). The absolute consumption has little significance, however, due to the different population figures. Bottrop is also the independent city with the lowest population in the Ruhr region. Next in the ranking came the second and third smallest independent cities in the Ruhr region: Herne with 5,145 GWh and Hamm with 6,943 GWh. Per capita, the primary energy consumption was lowest in Herne with 0.031 GWh. The city of Duisburg was in second place with 0.033 GWh. The administrative district of Unna came third with 0.035 GWh per person.

Development trend

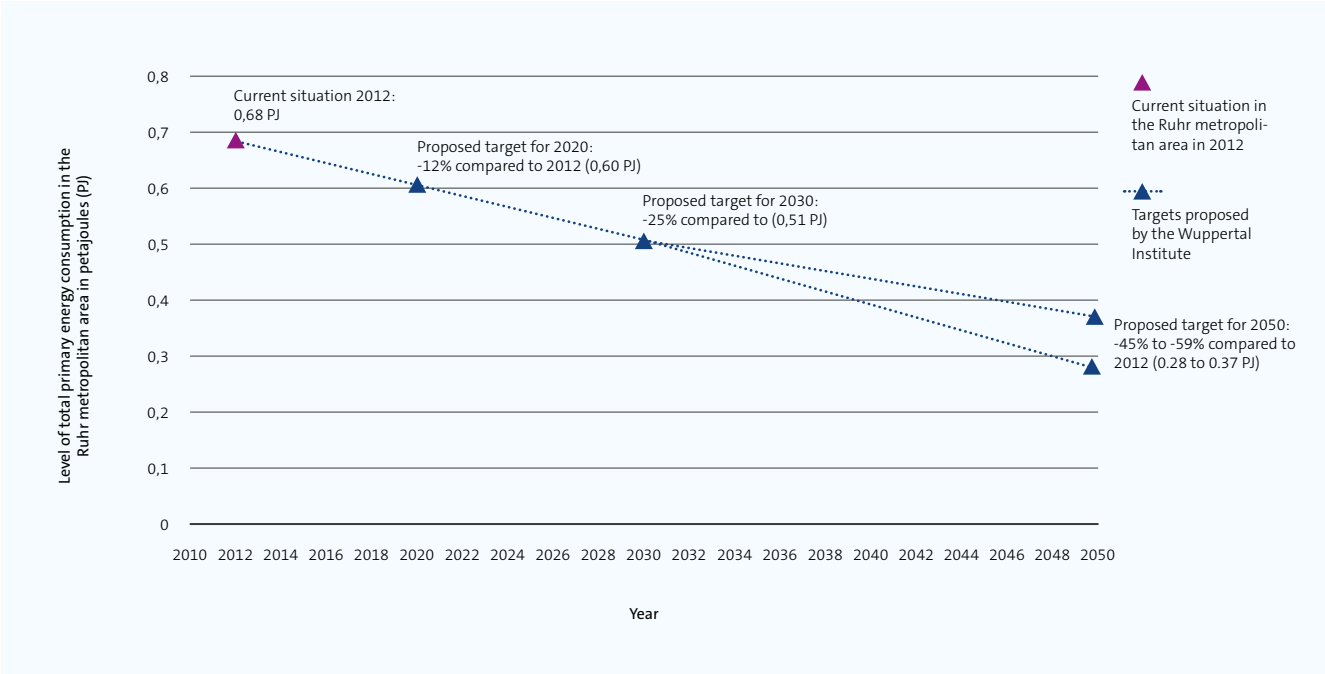
No trend analysis is possible due to a lack of data from previous years

There are no data available from previous years to allow analysis of the development of primary energy consumption in the Ruhr region. At a national level in Germany, total primary energy consumption fell by 10.7% between 1990 and 2015.[12]

Assessment

Current primary energy consumption in the Ruhr region stands at 0.037 GWh per capita, which is slightly lower than the national average in Germany (0.047 GWh, 2012)[13,14]. Nevertheless, huge efforts still need to be made to achieve the medium and long-term targets at the various political levels. This does not just mean that citizens have to reduce their energy consumption, for example in terms of transport or in their homes.

Total primary energy consumption in the Ruhr metropolitan area in 2012 and targets proposed by the Wuppertal Institute for 2020, 2030 and 2050



Source: Wuppertal Institute according to data from GERTEC 2016 and targets proposed by the Wuppertal Institute [11]

The industrial sector traditionally plays a particularly significant role in the Ruhr region when it comes to the development of energy consumption. By means of an increase in energy intensity (i.e. the ratio of final energy to gross value added), which is an indicator of energy efficiency, it is possible to reduce primary energy consumption while maintaining approximately the same level of production.

An example of good practice in the Ruhr region is the ESPADU project – Saving Energy at Schools in Duisburg, which was set up in 2002. In this project, school pupils and teachers take a look at possible ways of saving resources by reducing the use of electricity, heating and water. 134 of the 160 schools in Duisburg are now taking part in the project (a participation rate of 80%). Between 2002 and 2014, this led to savings of €2 million in energy and water costs and a reduction of 5,430 tonnes in CO_2 emissions.[15]

The Ruhr region district heating network, which is one of the largest interconnected district heating networks in Europe, is another good example of how primary energy consumption can be reduced.[16] District heating is heating which is generated outside of the buildings to which the heat is being supplied and is therefore more efficient than individual heating installations. In the Ruhr region, district heating comes predominantly from industrial waste heat, from the use of biomass in power plants and from combined heat and power plants.[17] The planned Rhine-Ruhr district heating network (Fernwärmeschiene Rhein-Ruhr), which is to be implemented from 2017 onwards, is expected to save the equivalent of more than 800,000 tonnes of heating oil between 2017 and 2050.[18]

Sources and notes

1 European Commission (2012): Directive on Energy Efficiency. http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32012L0027&from=DE, accessed 25.4.2015

2 The German Federal Government (2010): Energiekonzept für eine umweltschonende, zuverlässige und bezahlbare Energieversorgung. [Energy Concept for an Environmentally Sound, Reliable and Affordable Energy Supply.] http://www.bundesregierung.de/ContentArchiv/DE/Archiv17/_Anlagen/2012/02/energiekonzept-final.pdf?__blob=publicationFile&v=5, page 5, accessed: 25.4.2016

3 State Government of North Rhine-Westphalia (2016): Nachhaltigkeitsindikatoren Nordrhein-Westfalen. [Sustainability indicators for North Rhine-Westphalia.] http://www.nachhaltigkeit.nrw.de/fileadmin/ download/nachhaltigkeits-indikatorenbericht_2016.pdf, page 10, accessed: 6.7.2016

4 City of Essen (2014): Bewerbung zur Grünen Hauptstadt Europas 2017. [Application for European Green Capital 2017], 11. Energy Efficiency, p. 11. https://media.essen.de/media/ wwwessende/aemter/59/gruene_hauptstadt_europas_1/11_GHE_Themenfeld_Energieeffizienz_web.pdf, accessed 28.4.2016

5 Targets proposed by the Wuppertal Institute for reducing primary energy consumption in the Ruhr metropolitan area: Derivation: Since data on the primary energy consumption of the Ruhr metropolitan area were first collected in 2012, this year is taken as the reference year to which future targets are compared. In line with the targets of the state government, it is suggested that, in view of the different reference years (2010 at the NRW level, 2012 at the level of the Ruhr region) the lower target (-12%) for 2020 be transferred to the Ruhr metropolitan area. For 2030, an interim target in the range of -25% is considered reasonable in order to make it possible to orientate the development between 2020 and 2050. The Ruhr region should set itself the same target as the state government of North Rhine-Westphalia for 2050 (-45% to -59%). It should be noted that the targets proposed by the Wuppertal Institute are directional targets. Deeper and more detailed analysis with regionally specific scenarios is needed in future in order to calculate a more precise target.

6 Energy losses occur in the processing of primary energy, on the one hand through conversion into what is known as "secondary energy", (e.g. the conversion of crude oil to petrol and heating oil or the conversion of solar energy to electricity), or on the other hand when they are distributed to the consumer (known as "final energy").

7 UBA – The German Federal Environmental Agency (undated): Primärenergieverbrauch. [Primary Energy Consumption.] http://www.umweltbundesamt.de/daten/energie-als-ressource/primaerenergieverbrauch, accessed 25.4.2016

8 LANUV – The State Agency for Nature, Environment and Consumer Protection in North Rhine-Westphalia (2015): Primär- und Endenergieverbrauch. [Primary energy and final energy consumption.] http://www.lanuv.nrw.de/umweltindikatoren-nrw/index.php?indikator=4&aufzu=1&mode=indi, accessed 25.4.2016.

9 UBA – The German Federal Environmental Agency (undated): Primärenergieverbrauch. [Primary Energy Consumption.] http://www.umweltbundesamt.de/daten/energie-als-ressource/primaerenergieverbrauch, accessed 25.10.2016.

ESPADU: Saving electricity, heat and water at schools in Duisburg

[10] Cf. Kopatz, Michael (2013): Energiewende. Aber fair! [Energy transition. But a fair one!] Oekom Verlag, Munich, and Kopatz, Michael; Spitzer, Markus; Christanell, Anja (2010): Energiearmut [Energy Poverty]. Wuppertal. https://epub.wupperinst.org/files/3606/WP184.pdf, accessed 23.5.2016.

[11] Calculation of primary energy consumption based on data from GERTEC 2016 on final energy consumption and primary energy factors for the conversion of the data on final energy consumption in primary energy consumption based on BBSR (2012) (Federal Institute for Research on Building, Urban Affairs and Spatial Development) Fischknecht et al. (2012), Schüwer et al. (2015). Sources: GERTEC (2016): Metropole Ruhr – Endenergieverbrauch gesamt nach Energieträgern in 2012 [The Ruhr Metropolitan Area – Final energy consumption by energy source in 2012] (unpublished data); BBSR (2012): Primärenergiefaktoren von biogenen Energieträgern, Abwärmquellen und Müllverbrennungsanlagen. [Primary energy factors of biogenic energy sources, waste heat sources and waste incineration plants]. http://www.bbsr.bund.de/BBSR/DE/Veroeffentlichungen/BMVBS/Online/2012/ON122012.html, accessed: 22.4.2016; Frischknecht et al. (2012): Primärenergiefaktoren von Energiesystemen. [Primary energy factors of energy systems]. http://treeze.ch/fileadmin/user_upload/downloads/Publications/Case_Studies/Energy/itten-2014-PEF-Energiesysteme-v2.2plus.pdf, accessed: 22.4.2016; Schüwer, D. et al. (2015): Konsistenz und Aussagefähigkeit der Primärenergie-Faktoren für Endenergieträger im Rahmen der EnEV. [Consistency and significance of primary energy factors for final energy sources in the context of the EnEV (German regulations on energy saving)]. http://www.dvgw-innovation.de/fileadmin/innovation/pdf/g5_01_15.pdf, accessed: 22.4.2016.

[12] UBA – the German Federal Environmental Agency (2016): Primärenergieverbrauch nach Energieträgern. [Primary energy consumption by energy source]. http://www.umweltbundesamt.de/daten/energie-als-ressource/primaerenergieverbrauch, accessed: 25.4.2016

[13] AG Energiebilanzen e.V. (2013): Energieverbrauch in Deutschland im Jahr 2012 [Energy consumption in Germany in 2012]. http://www.ag-energiebilanzen.de/index.php?article_id=29&fileName=ageb_jahresbericht 2012_20130321_1.pdf , accessed: 25.4.2016

[14] The German Federal Statistics Office (2013): 80,5 Millionen Einwohner am Jahresende 2012 – Bevölkerungszunahme durch hohe Zuwanderung. [80.5 million inhabitants at the end of 2012. Population growth due to high immigration levels]. https://www.destatis.de/DE/PresseService/Presse/Pressemitteilungen/2013/08/PD13_283_12411.html, accessed: 25.4.2016

[15] City of Duisburg (2016): Projekt-Kurzbeschreibung: ESPADU – Energiesparen an Duisburger Schulen. [Project summary: ESPADU – Saving Energy at Schools in Duisburg]. Duisburg.

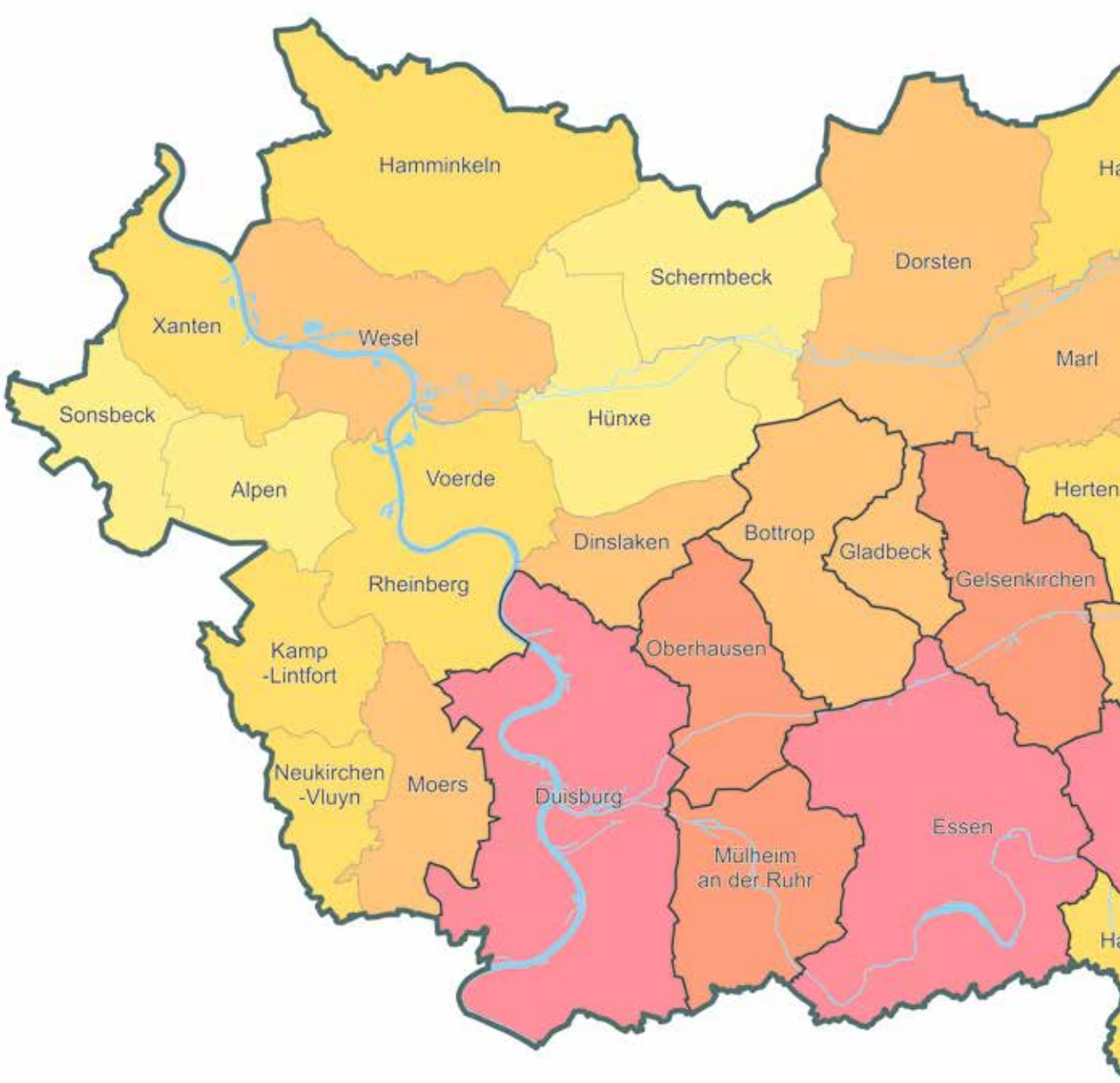
[16] Wuppertal Institute (2013): Metropole Ruhr – Grüne Hauptstadt Europas. [The Ruhr Metropolitan Area – European Green Capital]. http://wupperinst.org/uploads/tx_wupperinst/Metropole_Ruhr_Endbericht.pdf (22.04.2016).

[17] Uniper Wärme GmbH, Energieversorgung Oberhausen AG, Fernwärmeversorgung Niederrhein GmbH, Stadtwerke Bochum GmbH, STEAG Fernwärme GmbH (Ed.) (undated): Für Fernwärme spricht viel, z.B. Komfort plus Klimaschutz. [The many benefits of district heating, e.g. comfort plus climate protection]. http://www.fernwaerme-im-ruhrgebiet.de/fernwaerme-vorteile/index.php, accessed 10.11.2016.

[18] Fernwärmeschiene Rhein-Ruhr GmbH (2015): Die Vorteile für die Region: Umweltschutz und Effizienz. [The advantages for the region: environmental protection and efficiency]. http://www.fwsrr.de/auf-einen-blick/vorteile-fuer-die-region/, accessed: 9.11.206

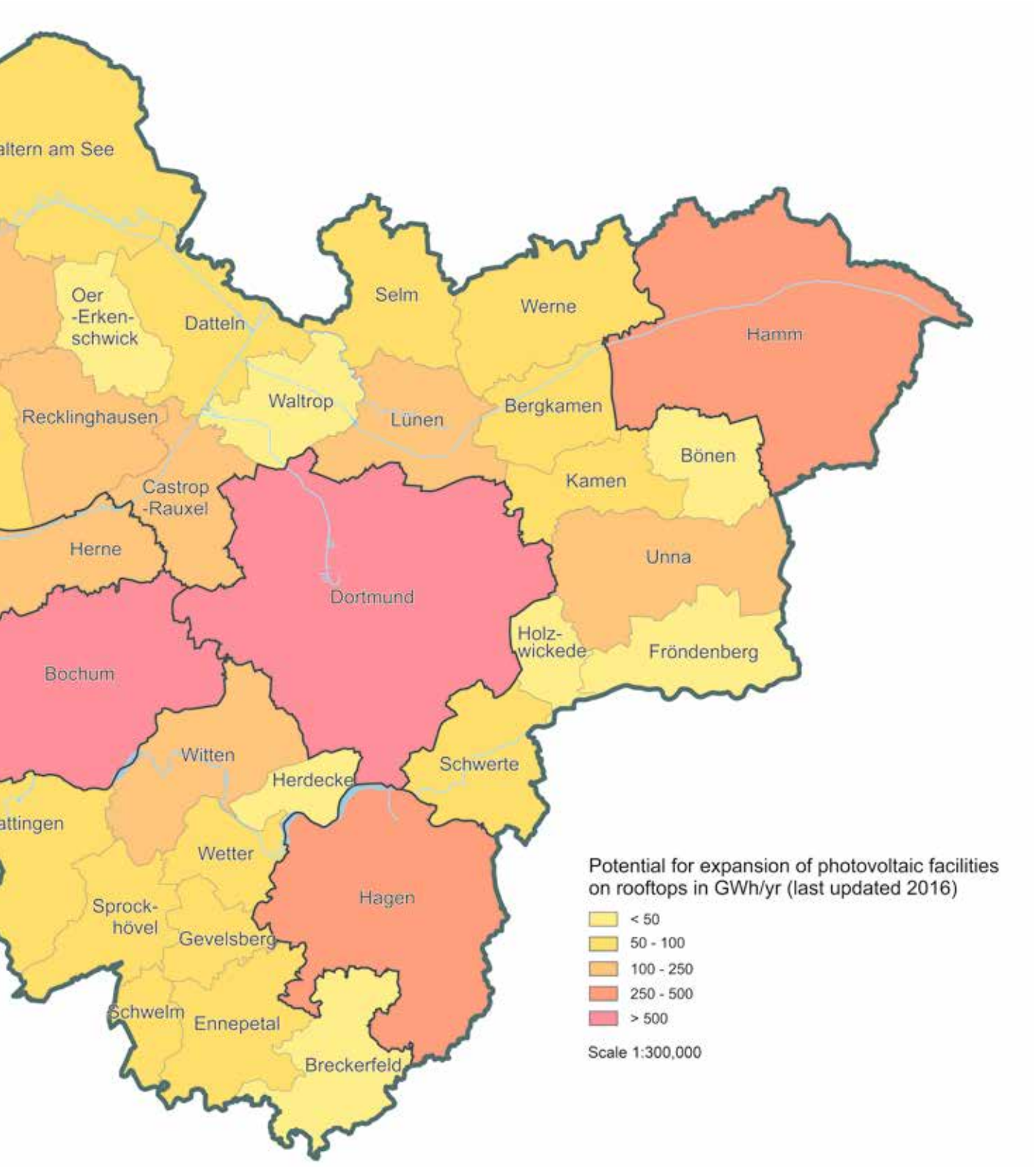
5.3 Energy: Proportion of energy from renewable sources in final energy consumption

Potential for expansion of photovoltaic facilities on rooftops in the municipalities of the Ruhr metropolitan area (in GWh/yr)



Source: Gertec GmbH (2016): Regionales Klimaschutzkonzept zur Erschließung der Erneuerbaren-Energien-Potenziale in der Metropole Ruhr. [Regional climate concept on tapping the potential of renewable energy sources in the Ruhr Metropolitan Area], p. 70. Essen.

Map source: © Gertec GmbH

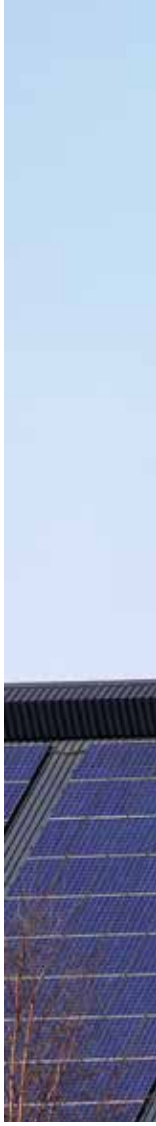

altern am See
Oer
-Erken-
schwick
Datteln
Selm
Werne
Hamm
Waltrop
Lünen
Bergkamen
Recklinghausen
Bönen
Kamen
Castrop
-Rauxel
Herne
Unna
Dortmund
Holz-
wickede
Fröndenberg
Bochum
Witten
Herdecke
Schwerte
attingen
Wetter
Hagen
Sprock-
hövel
Gevelsberg
Schwelm
Ennepetal
Breckerfeld
Potential for expansion of photovoltaic facilities
on rooftops in GWh/yr (last updated 2016)
< 50
50 - 100
100 - 250
250 - 500
> 500
Scale 1:300,000

Indicator 3 – Energy: Proportion of energy from renewable sources in final energy consumption

Objective: to provide a safe and sustainable energy supply
Indicator: proportion of energy from renewable sources in final energy consumption (net) (in %)

Existing operational targets:

	EU level:	German government:[1]	Target proposed by the Wuppertal Institute for the Ruhr metropolitan area:[2]
	Gross final energy consumption:	Gross final energy consumption:	Final energy consumption (net):[3]
2020	20%[4]	18%	10%
2030	27%[5]	30%	/
2040		45%	/
2050		60%	60%



Significance of the environmental indicator

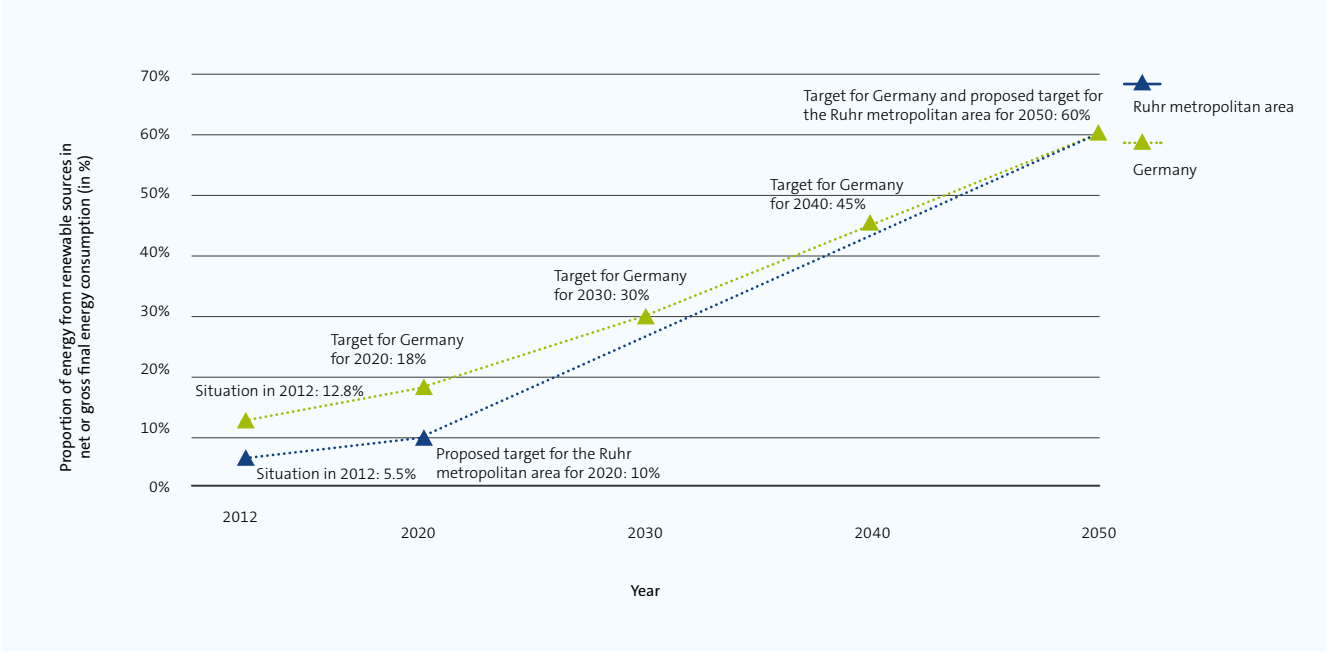
Energy from renewable sources plays a key role on the journey towards achieving a sustainable and carbon neutral energy supply. It generates almost no greenhouse gas emissions[6] in comparison to fossil fuels and can also be assessed favourably, on the whole, in terms of other emissions and environmental impacts (e.g. no large-scale extraction sites). Renewable energy is generally produced locally and therefore contributes to supply security. In addition, it increases the economic strength of the local area.[7] Solar power and wind power are the most important sources of renewable energy in the case of energy supply in Germany. Alongside these, biomass, hydropower and geothermal energy make a valuable contribution to the sustainable supply of energy. Final energy (end use energy) is the amount of energy that is used by consumers after primary energy has been converted into electricity, heat or fuel. Final energy is used in the three areas of electricity, heating and transport. Renewable energy is used in all these areas and is promoted at the political level. The competitiveness of renewable energy in comparison to fossil fuels has increased considerably in some cases over the past few years.[8] In 2012, more than 55,000 people were employed in the renewable energy sector in North Rhine-Westphalia alone.[9] Final energy consumption includes the industrial sector, transport, private households and the service sector, including the public service sector and the agriculture, forestry and fishing industries. In contrast to gross final energy consumption, distribution losses and the energy used by power plants are not included in the calculation in the case of net final energy consumption.

Existing targets

The European Union aims to increase the proportion of energy from renewable sources in gross final energy consumption to 20% by 2020. In 2030, it is planned to stand at 27%. The German government has set the target of increasing the share of renewable energy in gross final energy consumption to 18% by the year 2020. By 2050, this proportion is planned to rise to 60%. In the state of North Rhine-Westphalia, the state government has not yet set any specific targets for this indicator. The Wuppertal Institute recommends that the Ruhr metropolitan area should subscribe to the national target of achieving a 60% share for energy from

Dinslaken-Lohberg

Proportion of energy from renewable sources in final energy consumption in the Ruhr region (net) and in Germany (gross) in 2012, with German government targets and targets proposed by the Wuppertal Institute for the Ruhr region up until 2050



Source: Wuppertal Institute presentation based on data for 2012 from GERTEC 2016[10] and targets proposed by the Wuppertal Institute for the Ruhr region; see also the Working Group on Renewable Energies – Statistics 2016, p. 12 [11]

renewable sources by 2050. A short-term interim target of 10% is proposed for the year 2020.

Current situation and development in the Ruhr region

In 2012, the proportion of renewable energy in the final energy consumption for the whole of the Ruhr region stood at 5.5%. 94.5% of final energy consumption was still based on fossil fuels. The administrative districts of Wesel and Unna had the highest proportions of energy from renewable sources in their final energy consumption, with 9.9% and 9.4% respectively. The city of Bottrop came third with 7.6%, followed by Mülheim a. d. Ruhr with 7.1%. The figures for the proportion of renewable energy in final energy consumption for the administrative districts and cities of the Ruhr region ranged from 2.4% to 9.9%.

Assessment

It is not possible to make a direct comparison between Germany as a whole and the Ruhr metropolitan area in terms of the proportion of renewable energy in final energy consumption, since different reference values are used. At the German government and European levels, the calculations are made on the basis of gross final energy consumption, i.e. including distribution losses and the energy used by power plants. For the Ruhr metropolitan area, the data provided relate to net final energy consumption, i.e. not including distribution losses and the energy used by power plants. In 2012, the difference between gross final energy consumption and net final energy consumption in Germany was just under 3%. [13] The proportion of energy from renewable sources in gross final energy consumption in Germany in 2012 was 12.8%. [14] The proportion of energy from renewable sources in the Ruhr metropolitan area was 5.5% of net final energy consumption.

Development trend

No trend analysis is possible due to a lack of data from previous years

Geothermal energy for heating and cooling in the “Exzenterhaus” in Bochum

In order to achieve the medium- to long-term targets set by the German government in the Ruhr metropolitan area, the proportion of energy from renewable resources needs to be increased rapidly. This can be done, in particular, by extending the land and facilities used for generating energy from renewable sources. At the same time, demand for energy should be reduced as a result of improvements in efficiency, and a decline in the demand for energy-intensive goods and services should be triggered. A good example of promoting local projects in the field of renewable energy is found in the city of Gelsenkirchen, where the activities to implement the concept of the „Gelsenkirchen Solar City" are supported by the inter-municipal „Klimabündnis Gelsenkirchen-Herten e.V." (Gelsenkirchen and Herten Climate Alliance), which emerged from the solar city support association. The „Solarbunker", or rather the photovoltaic facility installed on the ore and coal bunker of the former Schalker Verein steel works, is a good example of the countless projects that have been implemented. However, the increase in projects has fallen significantly here in the meantime, following the amendment of the 2014 Renewable Energy Sources Act (EEG), as is the case in the entire Ruhr metropolitan area. Of the independent cities in the Ruhr Region, Gelsenkirchen is ranked third with a 6.1% share of energy from renewable sources in net final energy consumption (behind Bottrop (7.6%) and Mülheim a. d. Ruhr (7.1%)).

Sources and notes

[1] The German Federal Government (2010): Energiekonzept für eine umweltschonende, zuverlässige und bezahlbare Energieversorgung. [Energy Concept for an Environmentally Sound, Reliable and Affordable Energy Supply.] http://www.bundesregierung.de/ContentArchiv/DE/Archiv17/_Anlagen/2012/02/energiekonzept-final.pdf?__blob=publicationFile&v=5, page 4, accessed: 11.4.2016

[2] Targets proposed by the Wuppertal Institute: the targets for the proportion of energy from renewable sources in final energy consumption in the Ruhr metropolitan area are aligned with the German government's targets for 2050. Since the current proportion of energy from renewable energy sources in the net final energy consumption in the Ruhr metropolitan area (5.5%, reference year 2012) is considerably lower than the share at the German national level, a short-term target of 10% is proposed for the year 2020, which equates to approximately double the proportion in 2012. Since final energy consumption for the Ruhr metropolitan area is currently calculated without distribution losses and the energy used by power plants, the targets are not related to gross final energy consumption, as they are at other levels, but to net final energy consumption. The difference between gross final energy consumption and net final energy consumption is negligible due to the minor differences involved. It should be noted that the targets proposed by the Wuppertal Institute are directional targets. Deeper and more detailed analysis with regionally specific scenarios would be needed in order to calculate a more substantial target.

[3] In final energy consumption (net), distribution losses and the energy used by power plants in the electricity and heating sectors are factored in.

[4] European Parliament (2008): The EU Climate Change Package. http://www.europarl.europa.eu/sides/getDoc.do?pubRef=-//EP//TEXT+IM-PRESS+20081208BKG44004+0+DOC+XML+V0//EN, accessed: 11.4.2016

[5] European Council (2014): Conclusions on 2030 Climate and Energy Policy Framework. http://www.consilium.europa.eu/uedocs/cms_data/docs/pressdata/en/ec/145356.pdf, page 5, accessed: 11.4.2016

[6] Energy from renewable sources can indirectly cause greenhouse gas emissions, if trees are felled, transported and processed into firewood, for example.

[7] Lechtenböhmer, S., Gröne, M. and S. Samadi (2016): Kurseinheit Nationale und europäische Energiepolitik – Übergang zu einem nachhaltigen Energiesystem. Modul: Politische und Rechtliche Rahmenbedingungen der Energiewirtschaft. [Course unit on National and European energy policy – transition to a sustainable energy system]. Module: Political and legal framework of the energy industry). 4th edition. Koblenz-Landau.

[8] UBA – the German Federal Environmental Agency (2012): Nachhaltige Stromversorgung der Zukunft. Kosten und Nutzen einer Transformation hin zu 100% erneuerbaren Energien. [Sustainable energy supply for the future. Costs and benefits of a transformation to 100% renewable energy.] https://www.umweltbundesamt.de/sites/default/files/medien/publikation/long/4350.pdf (accessed: 12.4. 2016)

[9] Renewable Energy Agency (undated): Nordrhein-Westfalen. [North Rhine-Westphalia.] http://www.foederal-erneuerbar.de/landesinfo/ bundesland/NRW/kategorie/arbeitsplaetze/auswahl/563-bruttobeschaeftigung/#goto_563, accessed: 19.4.2016

[10] GERTEC (2016): Metropole Ruhr – Endenergieverbrauch gesamt nach Energieträgern und Stromverbrauch aus erneuerbare Energien in 2012 (unveröffentlichte Daten). [Total final energy consumption in the Ruhr Metropolitan Area by energy source and electricity consumption from renewable energy sources in 2012 (unpublished data).]

[11] Cf. The Working Group on Renewable Energies, Statistics (AGEE Stat) (2016): Zeitreihen zur Entwicklung der erneuerbaren Energien in Deutschland. [Time series for the development of renewable energy in Germany], p. 6. http://www.erneuerbare-energien.de/EE/Redaktion/DE/Downloads/zeitreihen-zur-entwicklung-der-erneuerbaren-energien-in-deutschland-1990-2015.pdf;jsessionid=0D51942013A2447A04FFE00F91CA62CB?__blob=publicationFile&v=6, accessed 14.09.2016.

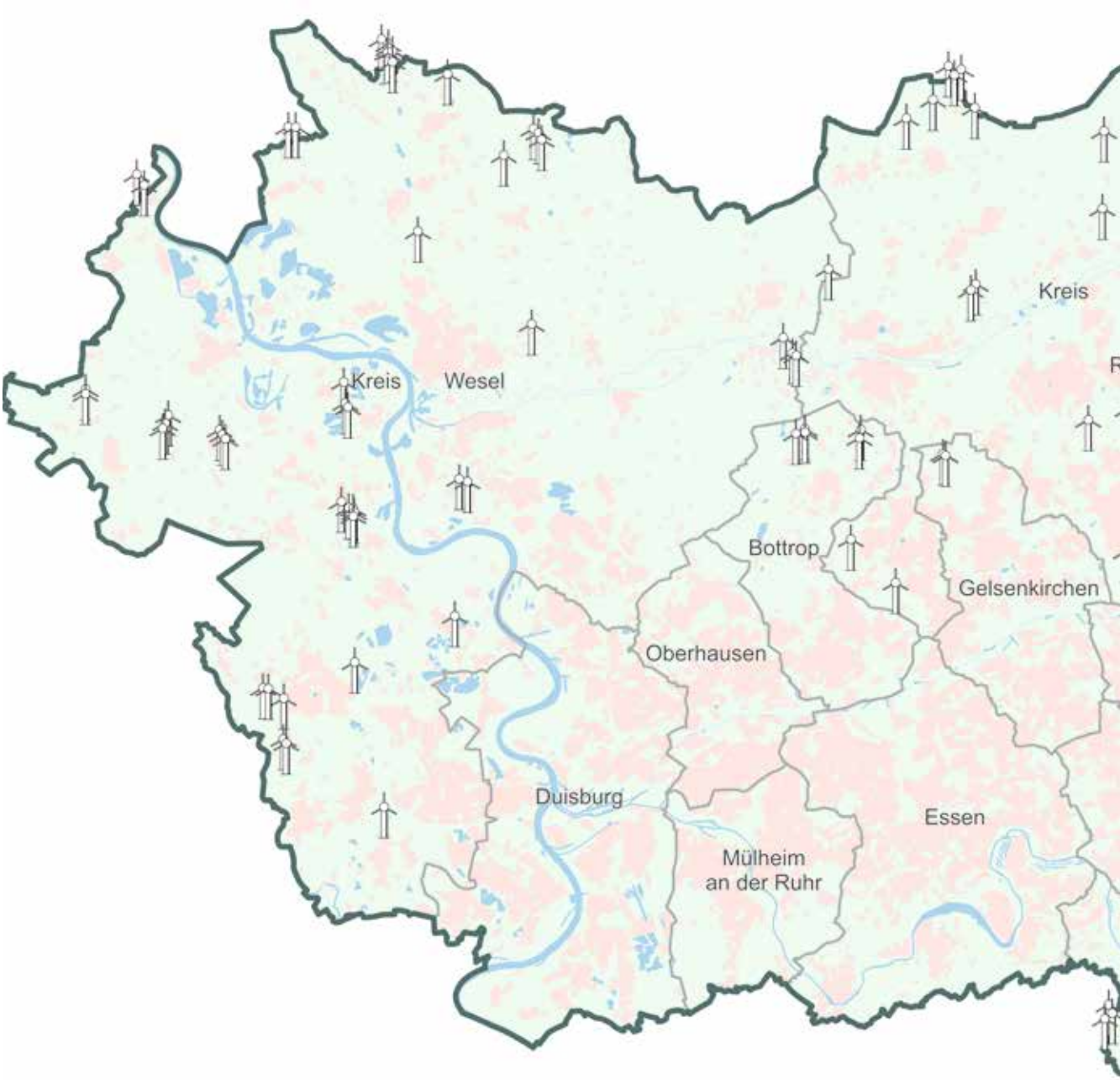
[12] City of Gelsenkirchen (undated): Sauberer Strom von der Kohlehalde in Scholven. [Clean power from the coal tip in Scholven]. Photo: EVE. http://www.solarstadt-gelsenkirchen.de/, accessed: 12.4.2016

[13] Buttermann, H.-G. and T. Baten (2013): Bestimmung des „Bruttoendenergieverbrauch" nach den Vorschriften der EU-RL/2009/28/EG auf Basis der Daten der AG-Energiebilanzen (AGEB). [Determining "gross final energy consumption" in accordance with the provisions of EU Directive 2009/28/EC on the basis of data from AG-Energiebilanzen (AGEB)]. Münster, Berlin.

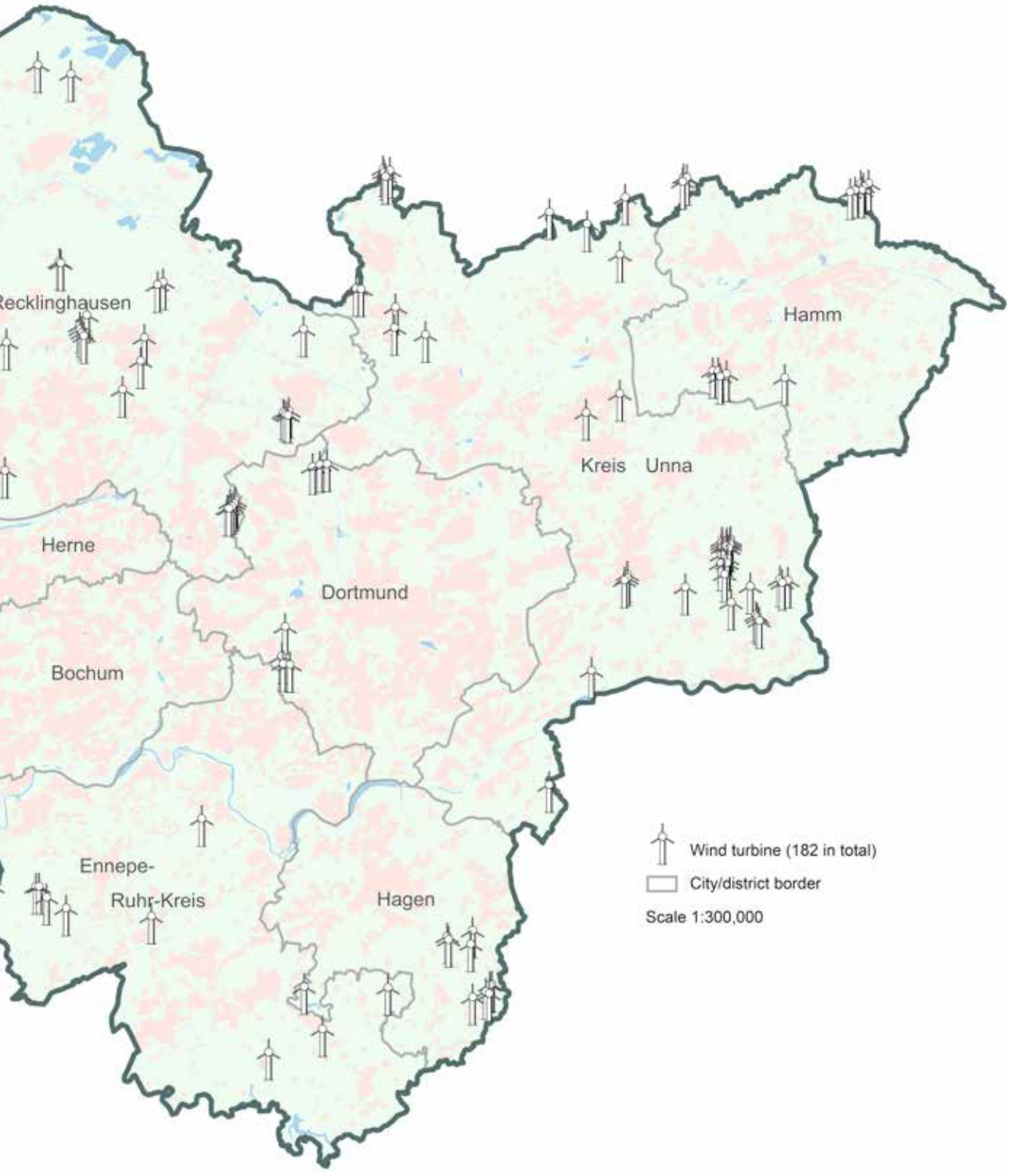
[14] Cf. The Working Group on Renewable Energies, Statistics (AGEE Stat) (2016): Zeitreihen zur Entwicklung der erneuerbaren Energien in Deutschland. [Time series for the development of renewable energy in Germany], p. 6. http://www.erneuerbare-energien.de/EE/Redaktion/DE/Downloads/zeitreihen-zur-entwicklung-der-erneuerbaren-energien-in-deutschland-1990-2015.pdf;jsessionid=0D51942013A2447A04FFE00F91CA62CB?__blob=publicationFile&v=6, accessed 14.09.2016.

5.4 Energy: Proportion of energy from renewable sources in net electricity consumption

Wind turbines in the Ruhr metropolitan area



Source: Ruhr Regional Association / LANUV (last updated 2014)
Map source: © Ruhr Regional Association


Recklinghausen
Hamm
Kreis Unna
Herne
Dortmund
Bochum
Ennepe-
Ruhr-Kreis
Hagen
Wind turbine (182 in total)
City/district border
Scale 1:300,000

Indicator 4 – Energy: Proportion of energy from renewable sources in net electricity consumption

Objective: to provide a safe and climate-friendly power supply
Indicator: proportion of energy from renewable sources in net electricity consumption (in %)

Existing operational targets:

	German government: [1]	NRW sustainability strategy: [2]	Target proposed by the Wuppertal Institute for the Ruhr Metropolitan Area: [3]
	Gross electricity consumption:	Gross electricity consumption:	Net electricity consumption:
2020	35%	/	/
2025	/	More than 30%	More than 30%
2030	50%	/	/
2040	65%	/	/
2050	80%	More than 80%	More than 80%

Significance of the environmental indicator

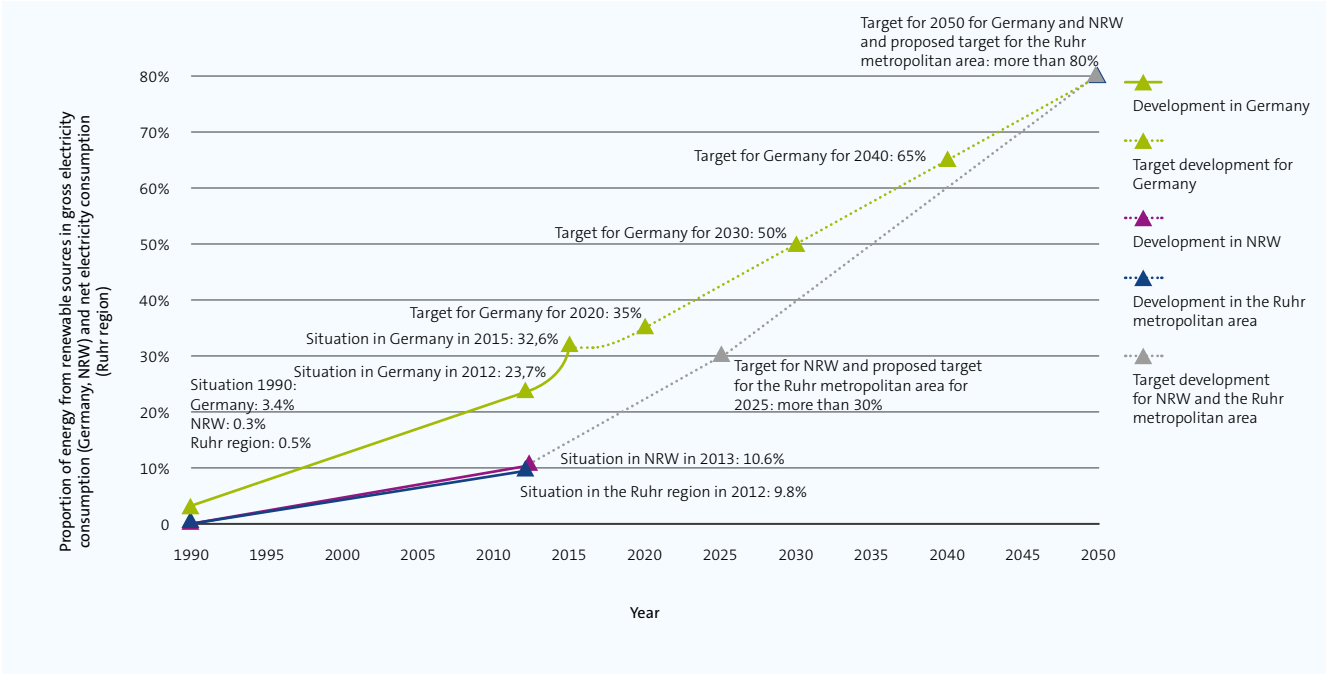
The electricity sector in Germany is playing a pioneering role in implementing the energy transition. As a result of longstanding political support (e.g. the Renewable Energy Sources Act (EEG) set up in 2000) and the wide variety of potential resources available (wind, biomass, sun), renewable energy is making a significant contribution to providing a sustainable energy supply in the electricity sector. In 2014, 73% of the reduction in greenhouse gas emissions achieved in Germany by using renewable energy can be attributed to the electricity sector.[4] Due to the composition of the electricity mix, which in the past depended to a large extent on lignite, coal and nuclear energy, the electricity sector plays a central role in terms of the energy transition, opting out of the nuclear programme and reducing greenhouse gas emissions. Generating power locally reduces the dependence on electricity imports from other countries and regions. The manufacture and maintenance of plants that produce electricity from renewable sources (wind turbines, solar facilities, etc.) create and guarantee jobs in the region.

Existing targets

The German government has set itself the target of increasing the proportion of energy from renewable resources in gross electricity consumption in Germany to 35% by the year 2020. In 2030, half of the gross electricity consumption in Germany is expected to come from renewable energy sources. For 2050, an 80% share is envisaged.[8] The state of North Rhine-Westphalia has set itself the target of generating more than 30% of its gross supply of electricity from renewable energy sources by 2025. By the year 2050, North Rhine-Westphalia aims to achieve the same target as the German government (80%)[9] The Wuppertal Institute recommends that the Ruhr metropolitan area adopt the state targets for the Ruhr region, aiming at a proportion of energy from renewable resources in net electricity consumption of more than 30% by the year 2025 and of more than 80% by 2050.

Power lines, Gladbeck

Share of energy from renewable sources in electricity consumption in the Ruhr metropolitan area (net electricity consumption), in Germany and in NRW (gross electricity consumption) and existing targets for Germany and NRW and targets proposed by the Wuppertal Institute for the Ruhr metropolitan area



It should be noted that different reference values are used (net/gross electricity consumption). If gross electricity consumption was also used as the reference value for the Ruhr region, the share of renewable energy might turn out to be slightly lower.

Source: Wuppertal Institute presentation based on data from GERTEC (2016 [5]; targets proposed by the Wuppertal Institute for the Ruhr metropolitan area; data for NRW cf. NRW state government 2016 [6]; data for Germany cf. AGEE 2016 [7]

Skating park and solar facility on the ore bunkers of the former Schalker Verein steel works in Gelsenkirchen

Current situation and development in the Ruhr region

In 2012, net electricity consumption from renewable energy sources stood at about 2,400 gigawatt-hours [10] (GWh) in the Ruhr region. This equates to a proportion of 9.8% of total net electricity consumption. In North Rhine-Westphalia, the proportion of renewable energy in gross electricity consumption stood at 10.6% in 2013; at the German national level it was 23.7% in 2012. It should be noted that different reference values are used (net/gross electricity consumption). If gross electricity consumption was also used as the reference value for the Ruhr region, the share of renewable energy might turn out to be slightly lower. In 1990, the proportion of renewable energy in net electricity consumption in the Ruhr region stood at only 0.5%. [11] Fossil fuels accounted for approximately 90% of net electricity consumption in 2012. The somewhat rural districts of Wesel and Unna had the highest proportion of renewable energy in net electricity consumption registering 34.3% and 32.8% respectively. The city of Hamm came

Development trend

in third place with 16.8%. The figures for the proportion of renewable energy in net electricity consumption for the administrative districts and independent cities of the Ruhr region ranged from 2.2% to 34.3%.

Assessment

It is not possible to make a direct comparison between Germany as a whole and the Ruhr region in terms of the proportion of renewable energy in electricity consumption since calculations at the national level are based on gross electricity consumption, whereas for the Ruhr region they are based on net electricity consumption. The difference between gross

and net consumption is that gross electricity consumption includes the energy lost in distribution and the energy used by power plants; in the case of net electricity consumption these two factors are not considered in the calculation. In 2012, the difference between gross and net electricity consumption in North Rhine-Westphalia was 16.5%. [12] If the energy used by power plants was included in the calculation of electricity consumption in the Ruhr metropolitan area, it can be assumed that the current proportion (2012) of renewable energy of 9.8% would be lower, since these plants use less energy than plants running on fossil fuels. It is therefore essential to substantially increase the share of electricity from renewable sources in the Ruhr metropolitan area in order to meet the targets set by the state and the German government. This can be achieved, on the one hand, by expanding the facilities that produce electricity from renewable energy sources (PV, wind turbines, etc.). On the other hand, general demand for electricity should fall as a result of improvements in efficiency and changes in people's behaviour aimed at achieving a more energy-sufficient lifestyle. This type of behavioural change can be shaped and supported through political measures. [13] Coal mining will come to an end in the Ruhr metropolitan area in 2018. Nowadays electricity is produced from renewable energy sources at some of the former sites. On the Gelsenkirchen-Scholven slag heap, for example, two 2.3-MW wind turbines have been installed [14] and solar panels generate electricity on the site of the former Pattberg mine in Moers. [15]

Sources and notes

[1] The German Federal Government (2010): Energiekonzept für eine umweltschonende, zuverlässige und bezahlbare Energieversorgung. [Energy Concept for an Environmentally Sound, Reliable and Affordable Energy Supply.] http://www.bundesregierung.de/ContentArchiv/DE/Archiv17/_Anlagen/2012/02/energiekonzept-final.pdf?__blob=publicationFile&v=5, page 4 f., accessed: 11.4.2016

[2] North Rhine-Westphalia State Government (2016): Nachhaltigkeitsstrategie für Nordrhein-Westfalen. [Sustainability strategy for North Rhine-Westphalia.] https://www.umwelt. nrw.de/fileadmin/redaktion/Broschueren/nrw-nachhaltigkeitsstrategie_broschuere.pdf, p. 60, accessed: 6.7.2016

[3] Targets proposed by the Wuppertal Institute for the development of the proportion of energy from renewable sources in electricity consumption: the targets for the proportion of energy from renewable resources in net electricity consumption in the Ruhr metropolitan area are based on the NRW state government's targets for the proportion of energy from renewable sources in gross electricity consumption. Since net electricity consumption is currently calculated for the Ruhr metropolitan area, the targets are not related to gross electricity consumption as they are at other levels (e.g. also at the national German level). It should be noted that the net values can only be compared to a limited extent with the targets on gross electricity consumption set by German national and NRW state policy, but they can certainly serve as indicative values at the regional level.

[4] UBA – the German Federal Environmental Agency (2015): Durch den Einsatz erneuerbarer Energieträger vermiedene Treibhausgasemissionen in Deutschland (2014). [Reductions in greenhouse gas emissions achieved by using renewable energy sources in Germany (2014)]: https://www.umwelt-bundesamt.de/sites/default/files/meden/376/publikationen/emissionsbilanz_erneuerbarer_energietraeger_2014_faltblatt.pdf, accessed: 18.4.2016

[5] GERTEC (2016): Metropole Ruhr – Stromverbrauch gesamt und Stromverbrauch aus erneuerbare Energien in 2012 (unveröffentlichte Daten). [The Ruhr Metropolitan Area – total electricity consumption and electricity consumption from renewable energy sources in 2012 (unpublished data).]

[6] North Rhine-Westphalia State Government (2016): Nachhaltigkeitsindikatoren Nordrhein-Westfalen – Bericht 2016. [Sustainability indicators in North Rhine-Westphalia – 2016 Report], p. 9. Düsseldorf. http://www.nachhaltigkeit.nrw.de/fileadmin/download/nachhaltigkeits-indikatorenbericht_2016.pdf, accessed 14.09.2016

[7] The Working Group on Renewable Energies, Statistics, (AGEE Stat) (2016): Zeitreihen zur Entwicklung der erneuerbaren Energien in Deutschland, S. 6. [Time series for the development of renewable energy in Germany, p. 6.] http://www.erneuerbare-energien.de/EE/Redaktion/DE/Downloads/zeitreihen-zur-entwicklung-der-erneuerbaren-energien-in-deutschland-1990-2015.pdf, accessed 14.09.2016..

[8] The German Federal Government (2010): Energiekonzept für eine umweltschonende, zuverlässige und bezahlbare Energieversorgung. [Energy Concept for an Environmentally Sound, Reliable and Affordable Energy Supply.] http://www.bundesregierung.de/ContentArchiv/DE/Archiv17/_Anlagen/2012/02/energiekonzept-final.pdf?__blob=publicationFile&v=5, page 4 f., accessed: 11.4.2016

[9] North Rhine-Westphalia State Government (2016): Nachhaltigkeitsindikatoren Nordrhein-Westfalen – Bericht 2016. [Sustainability indicators in North Rhine-Westphalia –2016 Report], p. 9. Düsseldorf. http://www.nachhaltigkeit.nrw.de/fileadmin/download/nachhaltigkeits-indikatorenbericht_2016.pdf, accessed 14.09.2016.

[10] Calculation made by the Wuppertal Institute based on data from the North Rhine-Westphalia Energy Atlas and GERTEC (2016): Electricity consumption from renewable energy sources and electricity consumption in the cities of the Ruhr metropolitan area (unpublished)

[11] Calculation made by the Wuppertal Institute based on data from the North Rhine-Westphalia Energy Atlas (2016): Monitoring. http://www.energieatlasnrw.de, accessed: 19.4.2016

[12] NRW Energy Statistics (undated): Stromverbrauch. [Electricity consumption.] http://www.energiestatistik-nrw.de/energie/strom/stromverbrauch, accessed: 19.4.2016

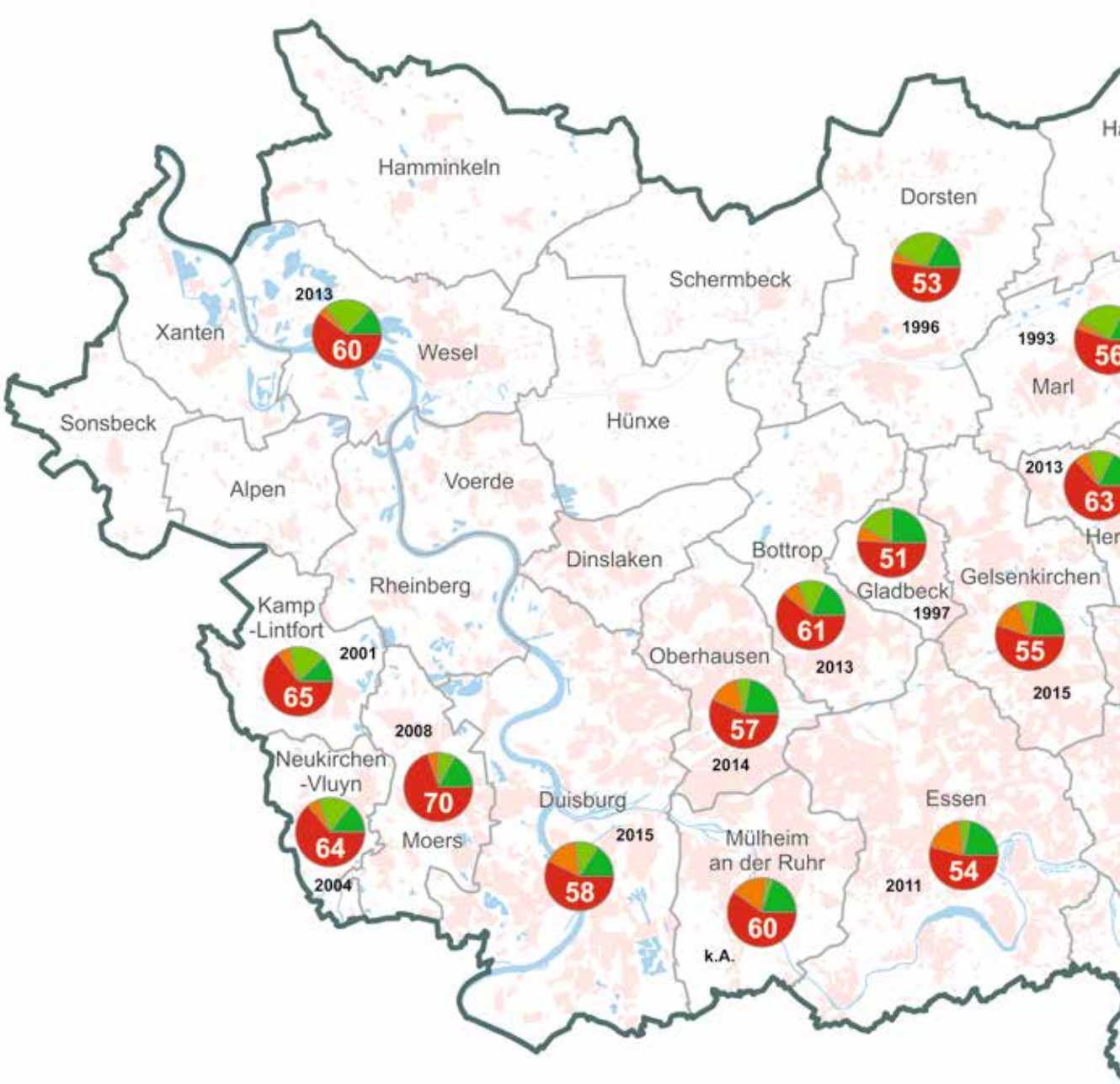
[13] Cf. e.g. Linz, Manfred (2015): Suffizienz als politische Praxis. [Sufficiency as political practice.] Wuppertal Spezial 49, Wuppertal. https://epub.wupperinst.org/files/5735/WS49.pdf, accessed 23.05.2016; and Schneidewind, Uwe; Zahmt, Angelika (2013): Damit gutes Leben einfacher wird – Perspektiven einer Suffizienzpolitik. [Prospects of the Politics of Sufficiency – Making It Easier to Live the Good life.] Oekom Verlag, Munich.

[14] Solar City Gelsenkirchen (2009): ELE beteiligt sich an der ELE-Scholven-Wind GmbH. [ELE becomes part of ELE-Scholven-Wind GmbH] http://www.solarstadt-gelsenkirchen.de/newsletter-einzelansicht/ele-beteiligt-sich-an-der-ele-scholven-wind-gmbh/, accessed: 19.4.2016

[15] EnergieAgentur.NRW (undated): Photovoltaik-Projekte.[Photovoltaic Projects.] http://www.energieagentur.nrw/solarenergie/photovoltaik-nrw/photovoltaik-projekte, accessed: 19.4.2016

5.5 Transport: Modal Split

Proportions of the various modes of transport in the volume of traffic (modal split) in the municipalities and districts of the Ruhr metropolitan area



Concept development: Wuppertal Institute, Ruhr Regional Association

Source: Wuppertal Institute research including surveys carried out by the Ruhr Regional Association in the districts and municipalities of the Ruhr metropolitan area

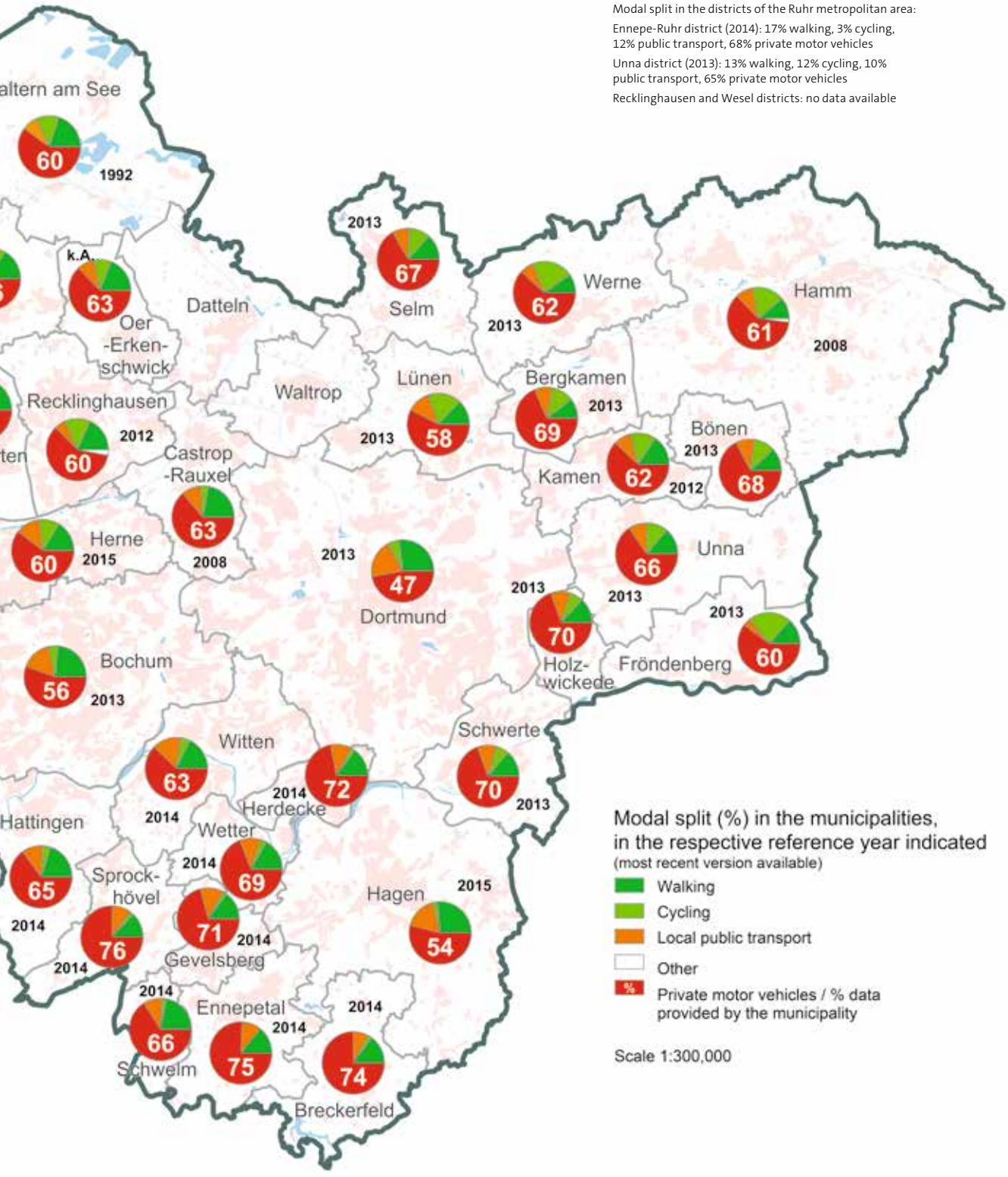
Map source: © Ruhr Regional Association

Modal split in the districts of the Ruhr metropolitan area:

Ennepe-Ruhr district (2014): 17% walking, 3% cycling, 12% public transport, 68% private motor vehicles

Unna district (2013): 13% walking, 12% cycling, 10% public transport, 65% private motor vehicles

Recklinghausen and Wesel districts: no data available



Indicator 5 – Transport: Modal Split

Objective: to increase the proportion of eco-friendly modes of transport (walking, cycling, public transport) in passenger traffic, to reduce transport by private car

Indicator: modal split (proportions of the various modes of transport – private motor vehicles, public transport, cycling, walking – in the volume of traffic, in per cent)

Existing operational targets:

NRW sustainability strategy: [1]	↦ Increase in local mobility (particularly walking and cycling, including pedelecs) to achieve a 60% share of the modal split for inner city passenger transport by 2030
NRW climate protection plan: [2]	↦ Long-term reduction in the percentage of private cars in urban areas to 25% (no target year stated); more moderate changes for rural areas
The Association for Pedestrian and Bicycle-friendly Cities, Districts and Municipalities in North Rhine-Westphalia (AGFS) in the NRW local mobility action plan: [3]	↦ 60% share for eco-friendly modes of transport in local mobility (35% walking, 20% cycling, 5% pedelecs), 14% bus and rail transport, 25% car, 1% long distance train/coach, 0.1% plane (no target year stated)
City of Essen: [4]	↦ 2020: 44% private motor vehicles, 21% public transport, 11% cycling, 23% walking ↦ 2035: 4x25% for private motor vehicles, public transport, cycling, walking
Unna district: [5]	↦ 2025: 45% private motor vehicles, 10% public transport, 25% cycling, 20% walking
Targets proposed by the Wuppertal Institute for the Ruhr metropolitan area: [6]	↦ 2020: 23% walking, 16% cycling, 20% public transport, 41% private motor vehicles ↦ 2035: 4x25% (walking, cycling, public transport, private motor vehicles) [7]

Significance of the environmental indicator

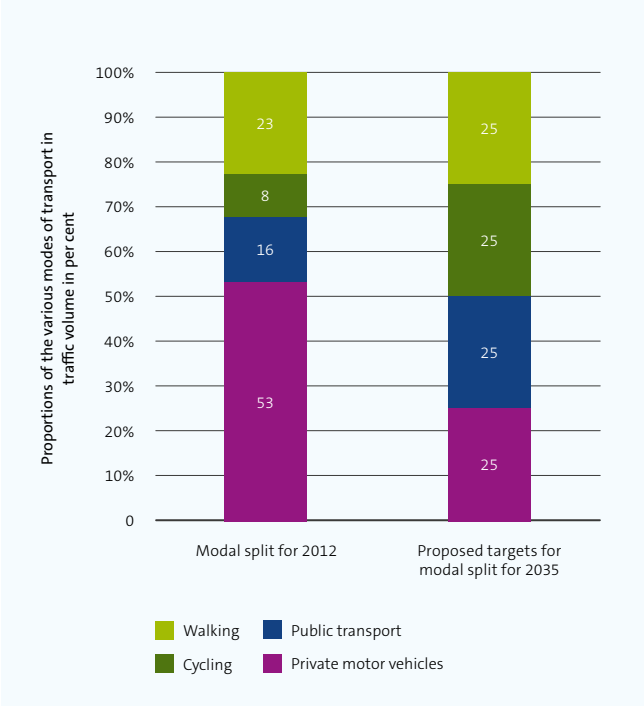
The modal split shows which modes of transport people use. A high proportion of what are known as private motor vehicles, consisting of cars and motorcycles, constitutes a burden for human beings and the environment as far as sustainability is concerned. In 2014, 93.7% of the total energy requirements of the transport sector was covered by petroleum products,[8] and burning these products causes CO_2 emissions which are harmful to the climate (cf. climate protection indicator) – 18% of the greenhouse gas emissions in Germany are caused by the transport sector.[9] The transport sector is also the „problem child" of climate policy,[10] since it is the only sector that has not been able to reduce its emissions compared to 1990 levels.[11] Journeys made by car cause air and noise pollution (see indicators for NO_2, PM_{10}, $PM_{2,5}$, noise), which damage people's health and impose high overall costs on society. Motor traffic is a threat to safety, especially for children, the elderly, cyclists and pedestrians, and takes up a great deal of space. Motor traffic therefore restricts people's living space and freedom of movement and has a negative impact on the quality of life in public areas. Compared to motor traffic, eco-modes of transport (walking, cycling, buses and rail transport) save resources and are more climate- and eco-friendly; they also make it possible for everyone to move around independently – irrespective of whether or not they have access to a car. Their proportion in terms of people's mobility therefore needs to be increased so that in 2035 three out of four journeys (75%) will be made on foot, by bicycle or by bus and rail and only one out of four journeys by private motor vehicle (target proposed by the Wuppertal Institute).

Existing targets

At federal-state level, the long-term target is to reduce the percentage of cars in urban areas to 25% (no target year is stated); for rural areas the aim is to effect a more moderate reduction.[14] The Wuppertal Institute recommends that the Ruhr metropolitan area should adopt the proposed target stated in its application for European Green Capital, i.e. that a quarter of all journeys should be made on foot, by bicycle, by public transport and by car respectively by the year 2035.[15]

Ministers cycle along the RS1 Ruhr cycle highway

Modal split for the Ruhr metropolitan area in 2012 and targets proposed by the Wuppertal Institute for 2035



Source: Wuppertal Institute presentation based on Grindau & Sagolla (2012), [12] Targets proposed by the Wuppertal Institute in 2013, p. 19. [13]

Current situation and development in the Ruhr region

In 2012, more than every second journey undertaken in the Ruhr region was made by private motor vehicle (53%), 23% of journeys were made on foot, 8% by bicycle and 16% by public transport. [16] The choice of mode of transport may vary slightly in the different cities and municipalities. [17] For example, the city of Dortmund recorded a lower proportion of private motor vehicles (46.9%, 2013) [18], the rural district of Unna showed a higher proportion of private motor vehicles (65.0%, 2013) [19]. In Hamm, people cycle more (17%, 2008) [20], in Essen, the proportion of public transport is higher than the average (19%, 2011). [21] Significant changes in the modal split have only been observed in isolated cases over recent years, such as in Dortmund, where the proportion of private motor vehicles dropped by 11 percentage points between 1998 and 2013 (from 58% to 47%). [22]

Assessment

The proportion of private motor vehicles in the Ruhr region is high; at 53% it stands at a similar level to the national average for Germany (59%, 2008) [23], even though the urban structures of the Ruhr region favour car-free mobility in principle. Especially on short journeys of up to 5 kilometres, there is a great potential to shift journeys using private

motor vehicles to eco-friendly modes of transport, since short distances can be covered easily by cycling or walking. Electrically-powered bicycles (pedelecs, e-bikes) can also be used to cover greater distances.

In order to achieve the targets for the modal split by 2035 and halve the percentage of travellers using private motor vehicles by that date, a major effort is needed. This will include measures to promote eco-friendly modes of transport (walking, cycling, bus and rail transport), thus providing an incentive for people to choose a different form of transport, for example by creating a high quality footpath and cycle path network and improving public transport services (so-called "pull measures"); but it will also entail restrictive measures against motor traffic, such as imposing extensive speed limits, decommissioning lanes for private vehicles on main roads, managing parking or introducing a private vehicle toll across the Ruhr region (so-called "push measures").

Development trend

No trend analysis is possible due to a lack of data from previous years

A good example of a scheme promoting cycling is the Ruhr cycle highway (RS1), which is currently under construction. It stretches a distance of 85 kilometres right across the Ruhr region, linking the cities of Duisburg, Mülheim an der Ruhr, Essen, Gelsenkirchen, Bochum, Dortmund and Hamm and the district of Unna; the new cycle path is intended to make it easier for commuters and other people travelling on a daily basis to switch from driving to cycling.[24] 2015 saw the completion of the second, five-kilometre-long section of the path between Mülheim a. d. Ruhr and Essen.[25]

Sources and notes

[1] North Rhine-Westphalia State Government (2016): Nachhaltigkeitsstrategie für Nordrhein-Westfalen. Düsseldorf. [Sustainability strategy for North Rhine-Westphalia. Düsseldorf.] www.umwelt.nrw.de/fileadmin/redaktion/Broschueren/nrw-nachhaltigkeitsstrategie_broschuere.pdf, accessed 30.6.2017.

[2] The Ministry for Climate Protection, Environment, Agriculture, Conservation and Consumer Protection of the State of North Rhine-Westphalia (MKULNV NRW) (2015): Klimaschutzplan Nordrhein-Westfalen – Klimaschutz und Klimafolgenanpassung. [Climate Protection Plan for North Rhine-Westphalia – Climate Protection and Adaptation to the Impacts of Climate Change.], p. 132. Düsseldorf. https://www.klimaschutz.nrw.de/fileadmin/Dateien/Download-Dokumente/Sonstiges/NRW_BR_Klimabericht_web_januar.pdf, accessed 22.3.2016.

[3] The Ministry for Building, Housing, Urban Development and Transport of the State of North Rhine-Westphalia (MBWSV NRW) (2012): Aktionsplan der Landesregierung zur Förderung der Nahmobilität. [State government action plan for promoting local mobility.], p. 16. Düsseldorf. http://www.agfs-nrw.de/uploads/tx_ttproducts/datasheet/Aktionsplan_NM_2012_2.auflage_WEB.pdf, accessed 22.3.2016.

[4] City of Essen (2014): Bewerbung als Grüne Hauptstadt Europas 2017, Themenfeld 02: Nahverkehr. [Application for European Green Capital 2017, Topic 02: Local transport.], p. 10. Essen. https://media.essen.de/media/wwwessende/aemter/59/gruene_hauptstadt_europas_1/02_GHE_Themenfeld_Nahverkehr_web.pdf, accessed 22.3.2016.

[5] District of Unna (2013): 1. Nachhaltigkeitsbericht Kreis Unna. [1st Sustainability Report for the district of Unna.], p. 67. http://www.kreis-unna.de/fileadmin/user_upload/Kreishaus/kfp/pdf/I_Nachhaltigkeitsbericht_Kreis_Unna.pdf, accessed 22.3.2016.

[6] Wuppertal Institute (2013): Metropole Ruhr – Grüne Hauptstadt Europas. Auswertung und Aufbereitung der Sachinformationen (Daten) für die Bewerbung der Metropole Ruhr um die EU-Auszeichnung „Grüne Hauptstadt Europas / European Green Capital": Antworten zum EUFragenkatalog 2012. [Ruhr Metropolitan Area – European Green Capital. Analysis and Preparation of the Factual Information (Data) for the Ruhr Metropolitan Area's application for the EU's European Green Capital Award: Responses to the EU questionnaire 2012.], p. 19. Wuppertal. http://wupperinst.org/uploads/tx_wupperinst/Metropole_Ruhr_Endbericht.pdf, accessed 29.3.2016.

[7] The Ruhr Regional Association (RVR) also formulates the vision of a 25% modal split for each mode of transport in the publication "Perspectives for the spatial development of the Ruhr Metropolitan Area" (2014) but gives no target year; cf. The Ruhr Regional Association (RVR) (2014): Perspektiven für die räumliche Entwicklung der Metropole Ruhr. [Perspectives for the spatial development of the Ruhr Metropolis, p. 13. Essen.] http://www.metropoleruhr.de/fileadmin/user_upload/metropoleruhr.de/01_PDFs/Regionalverband/Regionaler_Diskurs/RF_Zukunft_Perspekt/2014_05_14_Perspektiven.pdf, accessed 22.3.2016.

[8] In 2014, final energy consumption in the transport sector was 730 terawatt-hours (TWh) in total. This was made up of the following energy sources: petroleum products (684 TWh), gas (2 TWh), electricity incl. renewable energy sources (12 TWh) and renewable heat (32 TWh), cf. The German Federal Environmental Agency (UBA) (2015): Endenergieverbrauch 2014 nach Sektoren und Energieträgern (vorläufige Angaben) nach Arbeitsgemeinschaft Energiebilanzen: Auswertungstabellen zur Energiebilanz 1990 bis 2014, Stand 08/2015. [Final energy consumption in 2014 by sector and energy source (provisional data) according to the Working Group on Energy Balances: Evaluation Tables on the Energy Balance 1990 to 2014, status as of 08/2015.] http://www.umweltbundesamt.de/sites/default/files/medien/384/bilder/dateien/3_abb_eev-sektoren-et_2016-04-15.pdf, accessed 19.5.2016.

[9] UBA – The German Federal Environmental Agency (UBA) (2015): Daten zur Umwelt 2015. [Environmental Data 2015.], p. 12. http://www.umweltbundesamt.de/sites/default/files/medien/376/publikationen/daten_zur_umwelt_2015.pdf, accessed 19.5.2016.

[10] UBA – The German Federal Environmental Agency (UBA) (2015): Daten zur Umwelt zeigen: Verkehr beim Klimaschutz noch nicht auf Kurs. [Environmental data shows that the transport sector is not on course in environmental protection.] Press release dated 4.8.2015, http://www.umweltbundesamt.de/presse/presseinformationen/daten-zur-umwelt-zeigen-verkehr-beim-klimaschutz, accessed 23.3.2016.

[11] In 1990, greenhouse gas emissions for the transport sector in Germany stood at 163 million tonnes of CO_2 equivalent; by the year 2000, greenhouse gas emissions had risen to 181 million tonnes of CO2 equivalent, then by 2009 they had dropped to 152 million tonnes of CO_2 equivalent; by 2013, they had risen

again to 158 million tonnes of CO_2 equivalent (cf. Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety (BMUB) (undated): Entwicklung der Treibhausgasemissionen in Deutschland nach Sektoren. [Development of greenhouse gas emissions by sector in Germany.] http://www.bmub.bund.de/fileadmin/Daten_BMU/Download_PDF/Klimaschutz/entwickl_treibhausgasemissionen_sektoren_bf.pdf; accessed 19.05.2016).

[12] Grindau, Georg; Sagolla, Winfried (2012): Nahverkehr – Lokales Verkehrswesen. [Urban transport – local means of transport.] In: Kratzsch, Ernst (City of Bochum); Raskob, Simone (City of Essen); Lürwer, Martin (City of Dortmund), Carow, Ulrich (Ruhr Regional Association) (Ed.) (2012): Memorandum zur Bewerbung der Metropole Ruhr als „Grüne Hauptstadt Europas 2015". [Memorandum on Ruhr Metropolitan Area's application for the European Green Capital Award 2015], p. 64. Bochum/Essen/Dortmund. http://www.bochum.de/C12571A3001D56CE/vwContentByKey/W28RZDQG323BOLDDE/$FILE/Anlage1_Memorandum_Gruene_Hauptstadt_Europas.pdf, accessed 22.3.2016.[13] Wuppertal Institut (2013): Metropole Ruhr – Grüne Hauptstadt Europas. Auswertung und Aufbereitung der Sachinformationen (Daten) für die Bewerbung der Metropole Ruhr um die EU-Auszeichnung „Grüne Hauptstadt Europas / European Green Capital": Antworten zum EU-Fragenkatalog 2012, S. 19. Wuppertal. http://wupperinst.org/uploads/tx_wupperinst/Metropole_Ruhr_Endbericht.pdf, Zugriff 29.3.2016.

[13] Wuppertal Institute (2013): Metropole Ruhr – Grüne Hauptstadt Europas. Auswertung und Aufbereitung der Sachinformationen (Daten) für die Bewerbung der Metropole Ruhr um die EU-Auszeichnung „Grüne Hauptstadt Europas / European Green Capital": Antworten zum EU-Fragenkatalog 2012. [Ruhr Metropolitan Area – European Green Capital. Analysis and Preparation of the Factual Information (Data) for the Ruhr Metropolitan Area's application for the EU's European Green Capital Award: Responses to the EU questionnaire 2012.], p. 19. Wuppertal. http://wupperinst.org/uploads/tx_wupperinst/Metropole_Ruhr_Endbericht.pdf, accessed 29.3.2016.

[14] NRW) (2015): Klimaschutzplan Nordrhein-Westfalen – Klimaschutz und Klimafolgenanpassung. [Climate Protection Plan for North Rhine-Westphalia – Climate Protection and Adaptation to the Impacts of Climate Change.], p. 132. Düsseldorf. https://www.klimaschutz.nrw.de/fileadmin/Dateien/Download-Dokumente/Sonstiges/NRW_BR_Klimabericht_web_januar.pdf, accessed 22.3.2016.

[15] Wuppertal Institute (2013): Metropole Ruhr – Grüne Hauptstadt Europas. Auswertung und Aufbereitung der Sachinformationen (Daten) für die Bewerbung der Metropole Ruhr um die EU-Auszeichnung „Grüne Hauptstadt Europas / European Green Capital": Antworten zum EU-Fragenkatalog 2012. [Ruhr Metropolitan Area – European Green Capital. Analysis and Preparation of the Factual Information (Data) for the Ruhr Metropolitan Area's application for the EU's European Green Capital Award: Responses to the EU questionnaire 2012.], p. 19. Wuppertal. http://wupperinst.org/uploads/tx_wupperinst/Metropole_Ruhr_Endbericht.pdf, accessed 29.3.2016. Cf. also Ruhr Regional Association (RVR) (2014): Perspektiven für die räumliche Entwicklung der Metropole Ruhr. [Perspectives for the spatial development of the Ruhr Metropolitan Area.], p. 13. Essen. http://www.metropoleruhr.de/fileadmin/user_upload/metropoleruhr.de/01_PDFs/Regionalverband/Regionaler_Diskurs/RF_Zukunft_Perspekt/2014_05_14_Perspektiven.pdf, accessed 22.3.2016.

[16] Grindau, Georg; Sagolla, Winfried (2012): Nahverkehr – Lokales Verkehrswesen. [Urban transport – local means of transport]. In: Kratzsch, Ernst (City of Bochum); Raskob, Simone (City of Essen); Lürwer, Martin (City of Dortmund), Carow, Ulrich (Ruhr Regional Association) (Ed.) (2012): Memorandum zur Bewerbung der Metropole Ruhr als „Grüne Hauptstadt Europas 2015". [Memorandum on Ruhr Metropolitan Area's application for the European Green Capital Award 2015], p. 64. Bochum/Essen/Dortmund. http://www.bochum.de/C12571A3001D56CE/vwContentByKey/W28RZDQG323BOLDDE/$FILE/Anlage1_Memorandum_Gruene_Hauptstadt_Europas.pdf, accessed 22.3.2016.

[17] For an overview of various modal split values for selected cities in the Ruhr Metropolitan Area, see Grindau, Georg; Sagolla, Winfried (2012): Nahverkehr – Lokales Verkehrswesen. [Urban transport – local means of transport.] In: Kratzsch, Ernst (City of Bochum); Raskob, Simone (City of Essen); Lürwer, Martin (City of Dortmund), Carow, Ulrich (Ruhr Regional Association) (Ed.) (2012): Memorandum zur Bewerbung der Metropole Ruhr als „Grüne Hauptstadt Europas 2015". [Memorandum on Ruhr Metropolitan Area's application for the European Green Capital Award 2015 p. 62. Bochum/Essen/Dortmund.] http://www.bochum.de/C12571A3001D56CE/vwContentBy- Key/W28RZDQG323BOLDDE/$FILE/Anlage1_Memorandum_Gruene_Hauptstadt_Europas.pdf, accessed 22.3.2016.

[18] City of Dortmund (2014): Haushaltsbefragung zum Mobilitätsverhalten der Dortmunder Bevölkerung 2013. Drucksache Nr. 13036-14. [Household survey on the mobility patterns of citizens in Dortmund 2013. Printed Paper No. 13036-14.], p. 4. Dortmund. http://www.dortmund.de/media/p/stadtplanungs_und_bauordnungsamt/stadtplanung_bauordnung_downloads/verkehrsplanung/ Vorlage_Mobilitaetsverhalten.pdf, accessed 29.3.2016.

[19] Helmert Engineering Office (2014): Mobilitätsbefragung – Modal Split Untersuchung zum werktäglichen Verkehrsverhalten der Bevölkerung im Kreis Unna S. 36. Schlussbericht. Im Auftrag des Kreis Unna. [Mobility survey – Modal Split investigation of citizens' mobility patterns on workdays in the district of Unna p. 36. Final report.] Commissioned by the district of Unna. http://www.kreis-unna.de/fileadmin/user_upload/Kreishaus/kfp/pdf/Verkehr/Bericht_KreisUnna_Mobilittsbefr_2013.pdf, accessed 29.3.2016.

[20] City of Hamm (undated): Verkehrsmittelwahl 2008. [Choice of transport 2008.], p. 14. https://www.hamm.de/fileadmin/user_upload/Medienarchiv/Planen_Bauen_Verkehr/Dokumente/Verkehr/Zahlen_und_Fakten.pdf, accessed 29.3.2016.

[21] City of Essen (2014): Bewerbung als Grüne Hauptstadt Europas 2017, Themenfeld 02: Nahverkehr. [Application for European Green Capital 2017, Topic 02: Local transport.], p. 4. Essen. https://media.essen.de/media/wwwessende/aemter/59/gruene_hauptstadt_europas_1/02_GHE_Themenfeld_Nahverkehr_web.pdf, accessed 22.3.2016.

[22] In 1998, the percentage of private motor vehicles in Dortmund stood at 58%, in 2013 it was 46.9%, cf. City of Dortmund (2014): Haushaltsbefragung zum Mobilitätsverhalten der Dortmunder Bevölkerung 2013. Drucksache Nr. 13036-14. [Household survey on the mobility patterns of citizens in Dortmund 2013. Printed Paper No. 13036-14.], p. 4. Dortmund. http://www.dortmund.de/media/p/stadtplanungs_und_bauordnungsamt/stadtplanung_bauordnung_downloads/verkehrsplanung/Vorlage_Mobilitaetsverhalten.pdf, accessed 29.3.2016 and the Wuppertal Institute (2013): Metropole Ruhr – Grüne Hauptstadt Europas. Auswertung und Aufbereitung der Sachinformationen (Daten) für die Bewerbung der Metropole Ruhr um die EU-Auszeichnung „Grüne Hauptstadt Europas / European Green Capital": Antworten zum EU-Fragenkatalog 2012. [Ruhr Metropolitan Area – European Green Capital. Analysis and Preparation of the Factual Information (Data) for the Ruhr Metropolitan Area's application for the EU's European Green Capital Award: Responses to the EU questionnaire 2012.], p. 53. Wuppertal. http://wupperinst.org/uploads/tx_wupperinst/Metropole_Ruhr_Endbericht.pdf, accessed 29.3.2016.

On the other hand, the modal split in Essen largely remained constant between 1989 and 2011 (the percentage of private motor vehicles stood at 55% in 1989, 54% in 2001 and 2011); cf. City of Essen (2014): Bewerbung als Grüne Hauptstadt Europas 2017, Themenfeld 02: Nahverkehr. [Application for European Green Capital 2017, Topic 02: Local transport.], p. 4. Essen. https://media. essen.de/media/wwwessende/aemter/59/gruene_hauptstadt_europas_1/02_GHE_Themenfeld_Nahverkehr_web.pdf, accessed 22.3.2016.

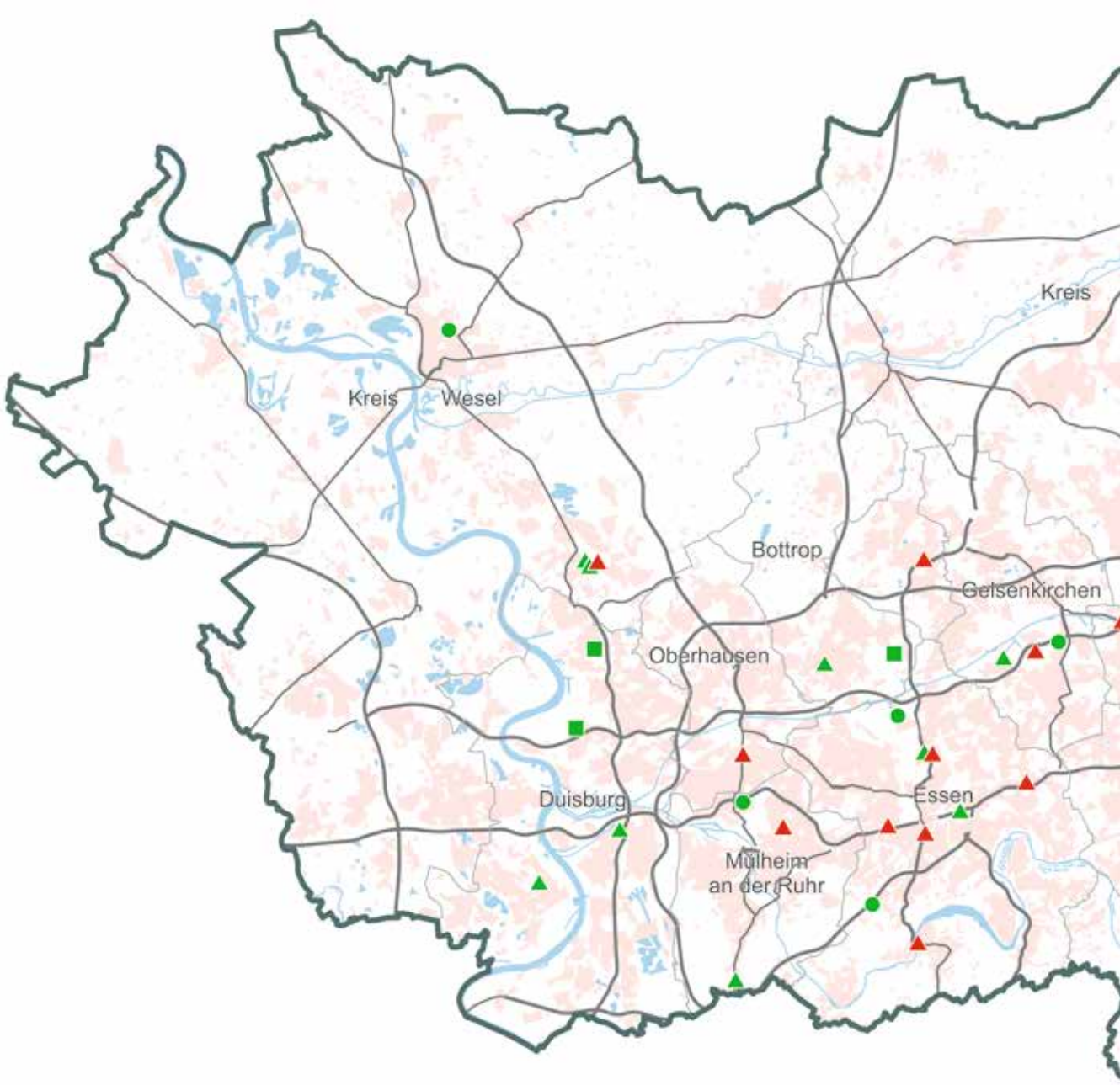
[23] Figure according to Mobilität in Deutschland 2008. [Mobility in Germany 2008.] (MiD 2008), cf. infas – Institut für angewandte Sozialwissenschaft GmbH (infas Institute for Applied Social Sciences) and DLR – Deutsches Zentrum für Luft- und Raumfahrt e.V. (German Aerospace Centre), Institute for Transport Research (2010): Mobility in Germany 2008, Report of findings, p. 21. http://www.mobilitaet-in-deutschland.de/pdf/MiD2008_Abschlussbericht_I.pdf, accessed 29.3.2016.

[24] Ruhr Regional Association (undated.): Radschnellweg Ruhr RS1 – der schnellste Weg am Stau vorbei. [The RS1 Ruhr cycle highway – the quickest way to bypass traffic jams.] http://www.rs1.ruhr, accessed 29.3.2016.

[25] Ruhr Regional Association (Ed.) (2015): Bau der Strecke: Aktueller Stand – Herzstück Radweg „Rheinische Bahn". [Construction of the cycle path: current status – the core section along the "Rheinische Bahn" path.], http://www.rs1.ruhr/radschnellweg/bau.html, accessed 8.11.2016 and Ruhr Regional Association (Ed.) (2015): Radschnellweg Ruhr (RS1) – Eröffnung von Mülheim bis Essen. [The Ruhr cycle highway (RS1) – Opening the section from Mülheim to Essen.] http://tour.tipp.ruhr/2015/12/11/radschnellweg-ruhr-rs1-eroeffnung-von-muelheim-bis-essen/, accessed 8.11.2016.

5.6 Air: Nitrogen dioxide (NO_2)

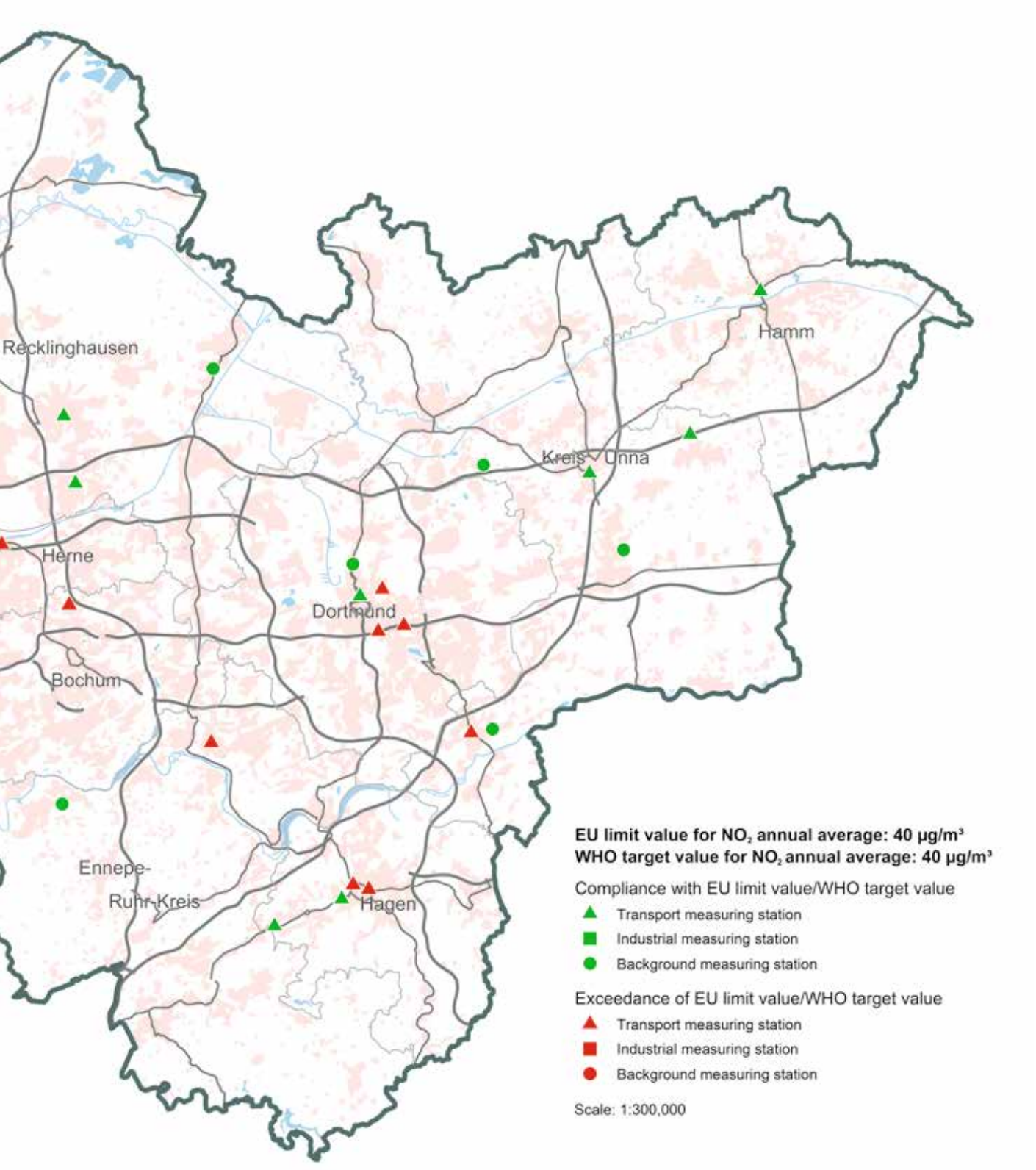
Nitrogen dioxide (NO_2) measuring stations in the Ruhr metropolitan area: compliance with or violation of the EU limits and the target values 2 of the World Health Organization (WHO) for the annual average value



Concept development: Wuppertal Institute, Ruhr Regional Association

Source: North Rhine-Westphalia State Agency for Nature, Environment and Consumer Protection (LANUV NRW, 2016): EU-Jahreskennzahlgrößen 2015. [EU annual parameters 2015], last updated 29.03.2016

Map source: © Ruhr Regional Association


Recklinghausen
Hamm
Kreis Unna
Herne
Dortmund
Bochum
Ennepe-
Ruhr-Kreis
Hagen
EU limit value for NO2 annual average: 40 µg/m³
WHO target value for NO2 annual average: 40 µg/m³
Compliance with EU limit value/WHO target value
Transport measuring station
Industrial measuring station
Background measuring station
Exceedance of EU limit value/WHO target value
Transport measuring station
Industrial measuring station
Background measuring station
Scale: 1:300,000

Indicator 6 – Air: Nitrogen dioxide (NO_2)

Ziel: to reduce and prevent health hazards and harmful environmental effects caused by nitrogen dioxide (NO_2)
Indicator: annual average amount of nitrogen dioxide in micrograms per cubic metre (NO_2 in µg/m³)

Existing limits and operational objectives:

World Health Organization (WHO): [1]	↦ Annual average target value 40 µg/m³ ↦ Hourly average target value 200 µg/m³ (without exceedance days)
European Commission: [2]	EU directive on ambient air quality and cleaner air for Europe (EU Directive 2008/50/EC), since 1 January 2010: ↦ Annual average limit value 40 µg/m³; ↦ Hourly average limit value 200 µg/m³, 18 authorised exceedance days per year
Germany: [3]	↦ Implementation of the EU limit values in German national law in the 39th Ordinance for the implementation of the Federal Immissions Control Act (39. BImSchV)
NRW: [4]	↦ Reduction of average annual values of the air concentration levels of NO_2 in metropolitan areas to 40 µg/m³ by 2030
City of Essen: [5]	↦ By 2020: "Widespread compliance with the NO_2 limit value" ↦ By 2035: "Compliance with the EU limit values and WHO reference values for NO_2"
Proposed objective from the Wuppertal Institute for the Ruhr metropolitan area: [6]	↦ By 2020: Compliance with the EU limit values (annual average 40 µg/m³, hourly medium 200 µg/m³ with 18 authorised exceedances per year) ↦ By 2035: Compliance with the WHO target values (annual average limit value 40 µg/m³, hourly medium 200 µg/m³ with no exceedances)

Significance of the environmental indicator

The air pollutant nitrogen dioxide (NO_2) is a nitrogen oxide (NO_x). It is a toxic gas [7] with a pungent odour that can be perceived even in small concentrations. [8] Nitrogen dioxide comes predominantly from the exhaust gases generated by industrial, heating and transport combustion processes. Diesel vehicles cause the most nitrogen dioxide pollution. [9] Metropolitan areas and cities have more nitrogen dioxide pollution than rural areas, [10] especially on cramped, busy roads. [11]

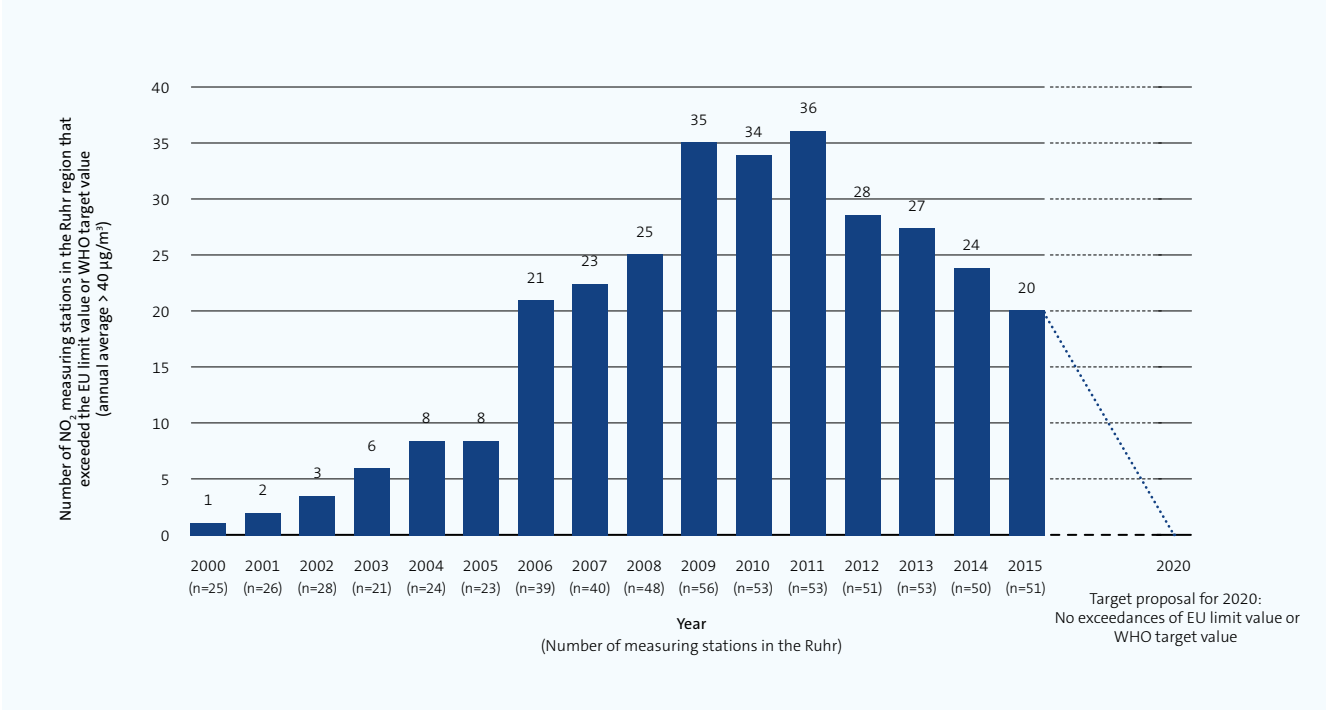
Nitrogen dioxide is characterised by low water solubility, which is why it is hardly washed away by rain [12] and can penetrate into the deeper areas of the respiratory tract where it has adverse health effects (including changes in lung function, impaired defence against infection). [13] This results in healthcare costs that are borne by the society as a whole. Based on current information, no threshold value can be specified for nitrogen dioxide, "below which long-term effects of NO_2 on humans could be excluded". [14] Through increased air pollution along main traffic roads, the problem of social injustice also arises since predominately people with lower incomes live here due to cheaper rent and are thus subjected to higher health risks. Nitrogen dioxide also contributes to ozone formation and the acidification of soil and water.

Existing targets

Through the implementation of the EU Air Quality Directive 2008/50/EC [16] into German national law by the 39th Ordinance for the Implementation of the Federal Immissions Control Act (39. BImSchV) [17] immissions limit values for nitrogen dioxide have been in place since 2010 to protect human health in Germany (annual average limit value 40 µg/m³; hourly average limit value 200 µg/m³, with 18 authorised exceedances per calendar year). [18] In 29 regions of Germany, the EU limit values could not be adhered to during the time period 2010-2013 despite clean air plans, this also includes the Ruhr region cities of Dortmund, Duisburg, Essen, Hagen, Mülheim a. d. Ruhr and Oberhausen. [19] The European Commission therefore introduced the precursor to an infringement procedure against the Federal Republic of Germany in 2015, which can be associated with high penalties. The European Commission criticises the fact that no sufficient measures have yet been taken in Germany to effectively adhere to the NO_2 limit values. [20]

Low-emission zone in the Ruhr region – in Dortmund Dorstfeld [15]

NO_2 measuring stations in the Ruhr region that exceed the EU limit value or WHO target value for the annual average value (40 µg/m³) and the target proposal from the Wuppertal Institute for 2020



Source: Wuppertal Institute diagram according to data from LANUV and target proposal from the Wuppertal Institute

The Federal Government considers traffic to be the main cause of exceedance of the NO_2 limit values and assumes that the limits in many polluted areas will not be adhered to before 2020 – this also includes cities in the Ruhr region. [21,22] The Wuppertal Institute suggests adopting the target from the application by the Ruhr metropolitan area for European Green Capital and to adhere to the EU annual average limit value for NO_2 of 40 µg/m³, also presented as the World Health Organization's (WHO) target value, until 2020. [23]

Current situation and development in the Ruhr region

In 2015, nitrogen dioxide pollution was measured in the Ruhr region by a total of 51 measuring stations (see map). While the hourly average limit value of 200 µg/m³ (with 18 permitted exceedances) was satisfied at every station, the annual average limit value of 40 µg/m³ was exceeded at 20 out of 51 measuring stations. Exceedances occurred exclusively in places affected by heavy traffic – in the Ruhr metropolitan area as well as in the whole of NRW. [24] The highest annual average values occurred in 2015 at measuring stations in Oberhausen (53 µg/m³), Essen and Gelsenkirchen (je 50 µg/m³), Dortmund and Hagen (je 49 µg/m³ each). The annual average values were well above the EU limit value at these locations. On average across all measuring stations, the annual average value in the Ruhr region was situated at 36,7 µg/m³ in 2015. Overall, the Ruhr region demonstrates a slight decline in nitrogen dioxide pollution since 2009, however, it remains at a high level.

Development trend

Assessment

The air pollutant nitrogen dioxide is currently recognised as the most critical air pollutant in the Ruhr region, as well as in its federal state and nationwide, due to the frequency and scale of exceeding the limit value. [25] Particularly in the transport sector, sustained efforts are required from the EU, countries, federal states and municipalities to adhere to the NO_2 limit values and to reduce the amount of NO_2 pollution to a level that is safe for human health. This includes promoting low-emission drives, restrictive measures to reduce vehicle traffic like restricted access or car-free city centres and specifications concerning compliance with Euro 6 emission standards for diesel vehicles in real-life operation – especially in light of some car manufacturers manipulating their nitrogen dioxide reduction systems. [26] A good example of reducing air pollution in the Ruhr region is the Ruhr region's low-emission zone (Umweltzone) established in 2012 [27] – the largest continuous LEZ in Germany and the second largest in Europe behind London's Low Emission Zone. Emission standards for motor vehicles should be further increased to effectively reduce NO_2 limit values.

Sources and notes

[1] World Health Organization (WHO) (2014): Ambient (outdoor) air quality and health. Fact sheet No. 313, updated March 2014. http://www.who.int/mediacentre/factsheets/fs313/en/, accessed 30.3.3016.

[2] European Parliament, Council of the European Union (2008): Directive 2008/50/EC of the European Parliament and of the Council of 21 May 2008 on ambient air quality and cleaner air for Europe, Annex XI. http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2008:152:0001:0044:de:PDF, accessed 30.3.2016.

[3] Thirty-ninth regulation for the implementation of the Federal Immissions Control Act on air quality standards and emission ceilings (39. BImSchV), http://www.gesetze-im-internet.de/bundesrecht/bimschv_39/gesamt.pdf, accessed 30.3.2016.

[4] Ministry for Climate Protection, Environment, Agriculture, Conservation and Consumer Protection of the State of North Rhine-Westphalia (MKULNV NRW) (2015): Entwurf einer Nachhaltigkeitsstrategie für Nordrhein-Westfalen. [Draft on a sustainability strategy for North Rhine-Westphalia.], pg. 5. http://www.nachhaltigkeit.nrw.de/extUpload/nachhaltigkeitsstrategie_nrw_entwurf.pdf, accessed 30.3.2016.

[5] The target description for NO_2 in the City of Essen's application for European Green Capital is not clear: The target for the year 2020 indicates "Comprehensive compliance with the NO_2 limit values", though it is not clear whether this applies to both of the European Commission's NO_2 limit values (annual average and hourly average) or just one of them. Compliance with the EU limit values and the WHO guideline values for NO_2 were listed as the objective for 2035. The target for the annual average was listed as 40 µg/m³ and as 200 µg/m³ for the hourly average with 18 exceedances per year. In order to comply with the WHO hourly average, no exceedance days may be permitted for 200 µg/m³. See City of Essen (2014): Themenfeld 05: Luftqualität. Bewerbung zur Grünen Hauptstadt Europas, S. 11. [Topic 05: Air quality. Application for European Green Capital, pg. 11.] https://media.essen.de/media/wwwessende/aemter/59/gruene_hauptstadt_europas_1/05_GHE_Themenfeld_Luftqualitaet_web.pdf, accessed 09.11.2016.

[6] See Wuppertal Institute (2013): Metropole Ruhr – Grüne Hauptstadt Europas. [Ruhr Metropolis – European Green Capital], pg.129. Wuppertal. http://wupperinst.org/uploads/tx_wupperinst/Metropole_Ruhr_Endbericht.pdf, accessed 31.3.2016.

[7] „Irritant gases are gases that produce a reaction in the body when they come into contact, especially in the respiratory system." (see Chemie.de (undated.): Reizgas. [Irritant gas.] http://www.chemie.de/lexikon/Reizgas.html, accessed 31.3.2016.

[8] State Agency for Nature, Environment and Consumer Protection of North Rhine-Westphalia (LANUV NRW) (undated): Wirkungen von Stickstoffdioxid (NO_2). [Effects of nitrogen dioxide (NO_2)]. http://www.lanuv.nrw.de/umwelt/umweltmedizin/wirkungen-von-luftschadstoffen/schadstoffe/stickstoffdioxid-no2/, accessed 31.3.2016.

[9] In 2013, 40.7% of NOx emissions in Germany came from transport (36.4% of which from road traffic), 24.0% from the energy industry, 7.5% from the manufacturing industry, 8.6% from agriculture, 7.0% from industrial processes and 12.2% from other sources of emissions (calculated by the Wuppertal Institute in accordance with the table "Emission trends for Germany since 1990, NOx in kt", see download "Emissionsentwicklung 1990-2013 für klassische Luftschadstoffe" from the Federal Environment Agency (UBA) (2015): Emissionen von Luftschadstoffen. [Emissions of air pollutants.] http://www.umweltbundesamt.de/themen/luft/emissionen-von-luftschadstoffen, accessed 19.5.2016.

[10] Federal Environment Agency (UBA) (2015): Stickstoffdioxid-Belastung. [Nitrogen dioxide pollution]. Article from 1.10.2015. http://www.umweltbundesamt.de/daten/luftbelastung/stickstoffdioxid-belastung, accessed 31.3.2016.

[11] State Agency for Nature, Environment and Consumer Protection of North Rhine-Westphalia (LANUV NRW) (2010): Gesundheitliche Wirkungen von Feinstaub und Stickstoffdioxid im Zusammenhang mit der Luftreinhalteplanung. [Health effects of fine particles and nitrogen dioxide in connection with the clean air planning.] As of: October 2010. http://www.lanuv.nrw.de/fileadmin/lanuv/gesundheit/schadstoffe/gesundheitliche_wirkungen.pdf, accessed 31.3.2016.

[12] Hesse State Agency for Nature Conservation, the Environment and Geology (undated): Stickstoffdioxide (NO/NO_2). [Nitrogen oxides (NO/NO_2)]. http://www.hlnug.de/themen/luft/luftschadstoffe/stickstoffoxide.html, accessed 31.3.2016.

[13] State Agency for Nature, Environment and Consumer Protection of North Rhine-Westphalia (LANUV) (undated): Wirkungen von Stickstoffdioxid (NO_2). [Effects of nitrogen dioxide (NO_2)]. https://www.lanuv.nrw.de/umwelt/umweltmedizin/wirkungen-von-luftschadstoffen/schadstoffe/stickstoffdioxid-no2/, accessed 09.11.2016. Long-term studies on the effects of NO_2 have produced varying results on whether multi-year exposure to NO_2 pollution leads to increased overall mortality (all causes of death, cardiac and respiratory diseases, lung cancer). It is therefore difficult to determine its long-term effect with certainty (ibid.).

[14] Ibid. (LANUV undated)

[15] RuhrNachrichten.de (2014): Nur noch Autos mit grüner Plakette dürfen in Dortmunds Umweltzone. Article from 30 June 2014. http://www.ruhrnachrichten.de/staedte/dortmund/44137-Dortmund~/Ab-1-Juli-Nur-noch-Autos-mit-gruener-Plakette-duerfen-in-Dortmunds-Umweltzone; art930,2409647, accessed 9.5.2016.

[16] European Parliament, Council of the European Union (2008): Directive 2008/50/EC of the European Parliament and of the Council of 21 Mai 2008 on ambient air quality and cleaner air for Europe, Annex XI. http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2008:152:0001:0044:de:PDF, accessed 30.3.2016.

[17] Thirty-ninth regulation for the implementation of the Federal Immissions Control Act on air quality standards and emission ceilings (39. BImSchV), http://www.gesetze-im-internet.de/bundesrecht/bimschv_39/gesamt.pdf, accessed 30.3.2016.

[18] Ibid. (39. BImSchV), pg. 6f.

[19] European Commission, General Secretariat (2015): Letter of formal notice – contract infringement No. 2015/2073, pg. 23. Brussels. https://www.greenpeace.de/sites/www.greenpeace.de/files/publications/2015_06_18_mahnschreiben_eu_kommission.pdf, accessed 30.3.2016.

[20] Ibid. (European Commission 2015), pg. 17

[21] Ibid. (European Commission 2015), pg. 15

[22] Additional information: The Federal Government cites traffic as the main culprit for exceedances of the NO_2 limit values. The main reason for NO_2 limit value exceedances from traffic emissions is that NO_x emissions from vehicles in real-life driving conditions are significantly higher than could have been expected given the ever-tightening emissions limits from the European Union. This primarily applies to diesel vehicles and especially to diesel passenger cars, whose share has increased significantly in the last 15 years (the share of diesel vehicles totalled 13.2% in 1999, compared to 30.1% in 2014, and the share of new diesel car registrations totalled 22.4% in January 1999, compared to the current 47%). "Dies ist auf ihre Vorzüge beim Ressourcenschutz zurückzuführen, weswegen sie durch das nationale System der Energiebesteuerung besser gestellt werden" [This is due to the advantages of resource protection, which is why they are better off in the national energy taxation system"] (European Commission, General Secretariat (2015): Formal notice – contract infringement No. 2015/2073, pg. 13. Brussels. https://www.greenpeace.de/sites/www.greenpeace.de/files/publications/2015_06_18_mahnschrei- ben_eu_kommission.pdf, accessed 30.3.2016). The European Commission proposes measures that can make a significant contribution to problem solving by prohibiting diesel vehicles from entering certain urban areas and promoting hybrid or electric cars or other vehicles that can be operated without emitting pollutants. This can have a positive effect on the reduction of CO_2 and NO_2 emissions. "For starters, Germany should have changed its tax policy that offers incentives for diesel vehicles." (ibid., pg. 14).

[23] See Wuppertal Institute (2013): Metropole Ruhr – Grüne Hauptstadt Europas. [Ruhr Metropolitan Area – European Green Capital], pg. 129. Wuppertal. http://wupperinst.org/uploads/tx_wupperinst/Metropole_Ruhr_Endbericht.pdf, accessed 31.3.2016.

[24] Ministry for Climate Protection, Environment, Nature and Consumer Protection (MKULNV NRW) (2016): Minister Remmel: Nitrogen dioxide pollution in cities is still the number one air pollution control problem. Press release on 10 May 2016. https://www.land.nrw/de/pressemitteilung/minister-remmel-die-belastung-der-staedte-mit-stickstoffdioxid-ist-weiterhin-das, accessed 17.10.2016.

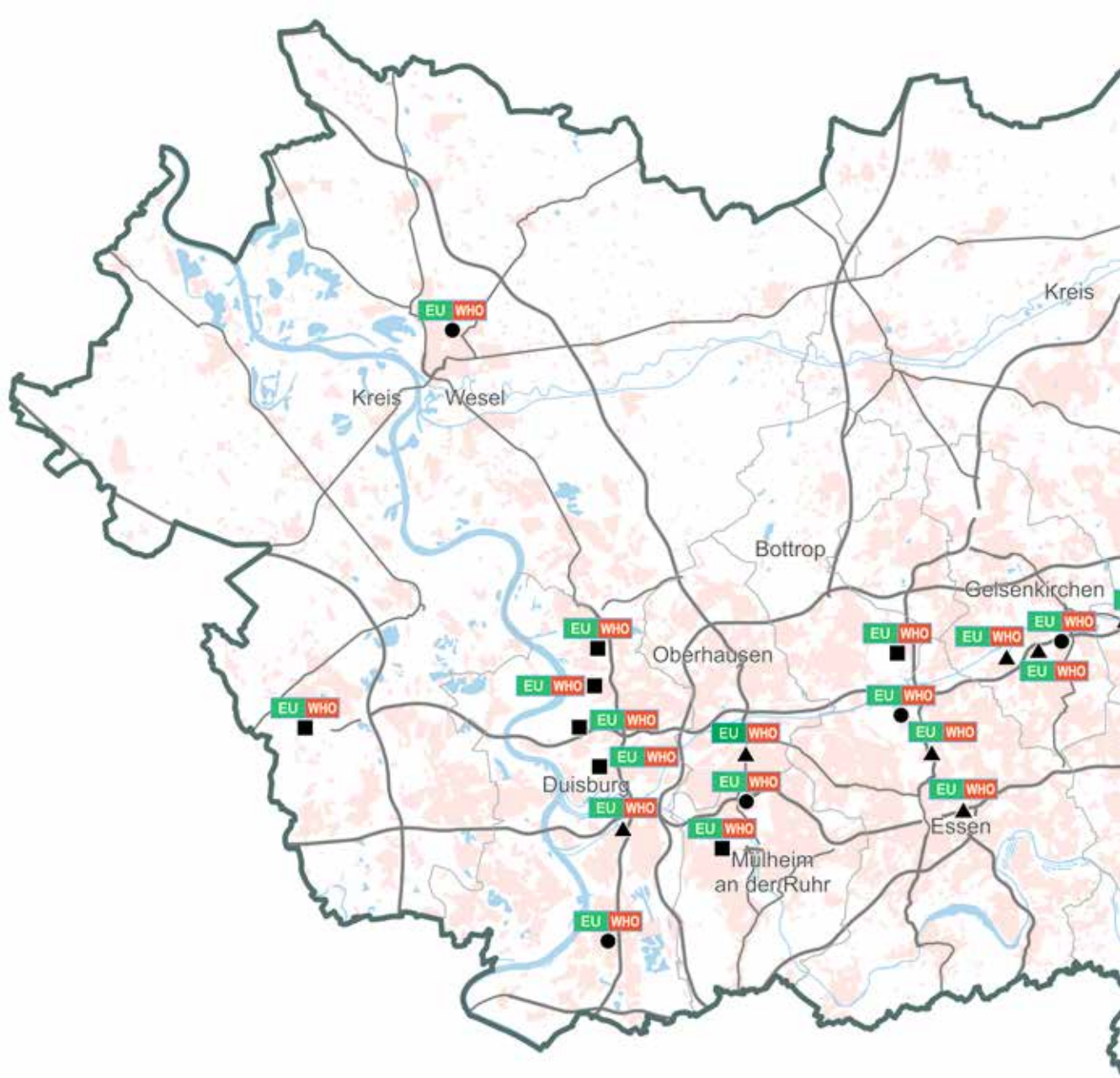
[25] Ibid. (MKULNV NRW 2016)

[26] Ibid. (MKULNV NRW 2016)

[27] Ministry for Climate Protection, Environment, Agriculture, Nature Conservation and Consumer Protection of the State of North Rhine-Westphalia (MKULNV NRW) (undated): Umweltzonen. [Low-emission zones]. http://www.umwelt.nrw.de/umweltschutz-umweltwirtschaft/umwelt-und-gesundheit/luft/umweltzonen/, accessed 16.09.2016.

5.7 Air: Particulate matter (PM_{10})

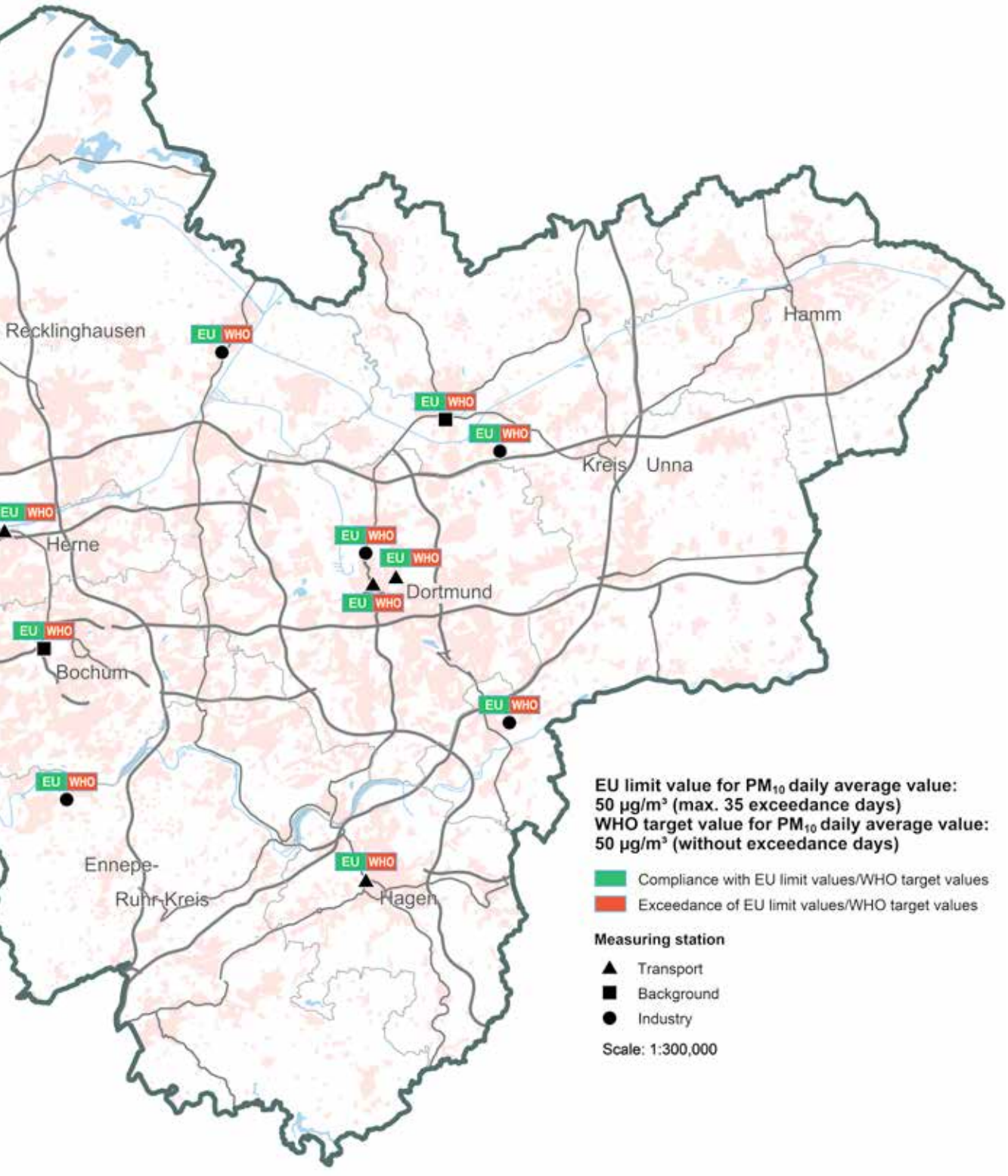
Measuring stations for particulate matter (PM_{10})in the Ruhr metropolitan area: compliance with or exceedance of the EU limit values and the target values of the World Health Organization (WHO) for the a daily average value



Concept development: Wuppertal Institute, Ruhr Regional Association

Source: State Agency for Nature, Environment and Consumer Protection of the State of North Rhine-Westphalia (LANUV NRW, 2016): EU-Jahreskennzahlgrößen 2015. [EU annual parameters 2015], last updated 29.03.2016

Map source: © Regional Association Ruhr


Recklinghausen
Hamm
Kreis Unna
Herne
Dortmund
Bochum
Ennepe-
Ruhr-Kreis
Hagen
EU WHO
EU limit value for PM10 daily average value:
50 µg/m³ (max. 35 exceedance days)
WHO target value for PM10 daily average value:
50 µg/m³ (without exceedance days)
Compliance with EU limit values/WHO target values
Exceedance of EU limit values/WHO target values
Measuring station
Transport
Background
Industry
Scale: 1:300,000

Indikator 7 – Air: Particulate matter (PM_{10})

Objective: to prevent and reduce the health-threatening exposure to particulate matter (PM_{10})
Indicator: daily limit of particulate matter (PM_{10}) (number of exceedance days of 50 µg/m³) and annual average value of particulate matter (PM_{10}) (in µg/m³)

Existing limits and operational objectives:

World Health Organization (WHO): [1]	↦ Daily average target value 50 µg/m³ without exceedance days ↦ Annual average target value 20 µg/m³
European Commission: [2]	EU directive on ambient air quality and cleaner air for Europe (EU Directive 2008/50/EC); since 01 January 2005: ↦ Daily average limit value 50 µg/m³ (maximum of 35 exceedance days) ↦ Annual average limit value 40 µg/m³
Germany: [3]	↦ Implementation of the EU limit values in German national law in the 39th Ordinance for the Implementation of the Federal Immissions Control Act (39. BImSchV)
City of Essen: [4]	↦ By 2020: "Reduction of PM_{10} annual average values to <29 µg/m³. This would ensure compliance with the annual maximum of 35 allowable exceedances of the daily average value of 50 µg/m³ even in years with frequent weather conditions with reduced vertical exchange. ↦ By 2035: Widespread compliance with the WHO target value (20 µg/m³) and zero PM_{10} exceedance days of the EU daily limit value (50 µg/m³)
Proposed objective from the Wuppertal Institute for the Ruhr metropolitan area: [5]	↦ By 2020: Compliance with the EU limit values ↦ By 2035: Compliance with the WHO target values

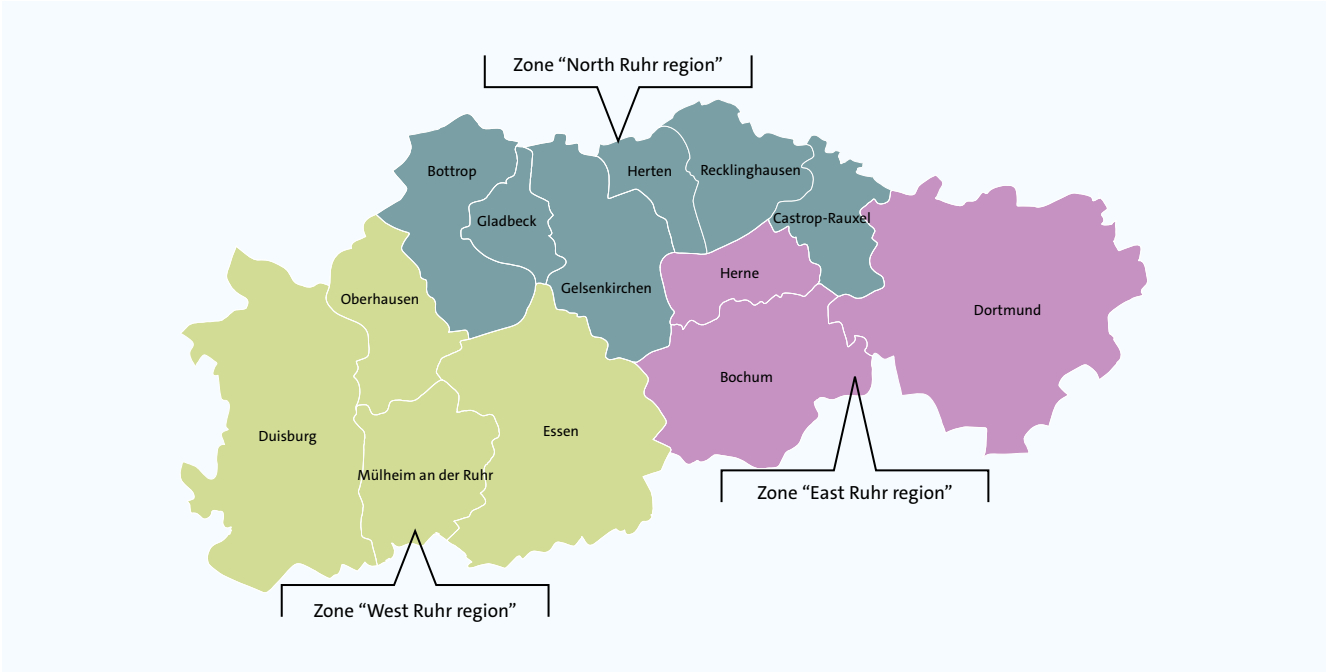
Current situation and development in the Ruhr region

The term particulate matter (PM) refers to airborne dust particles with various chemical compositions. In the case of PM_{10}, particulate matter has a diameter smaller than 10 micrometres (µm), or one-hundredth of a millimetre (10 µm = 10/1,000 mm). The main sources of particulate matter are industrial processes, heating, agriculture and transport. [6] Transport is the dominant source of particulate matter in urban areas. [7] Air streams can transport particulate matter over vast distances. This is why particulate matter must be stopped at the source. [8] The problem of particulate matter is especially relevant to an industrial region like the Ruhr region with its high traffic volume.

Particulate matter can be detrimental to human health. Particulate matter can cause cardiovascular and respiratory diseases and there is evidence of increased lung cancer mortality. [9] The size of the inhaled particles directly corresponds to their potential for causing health problems. While larger particles only reach the upper airways, smaller particles penetrate deep into the respiratory tract and into the pulmonary alveoli and the bloodstream. [10] Even more detrimental to health than PM_{10} is the adverse effect of $PM_{2.5}$ (see the following environmental indicator).

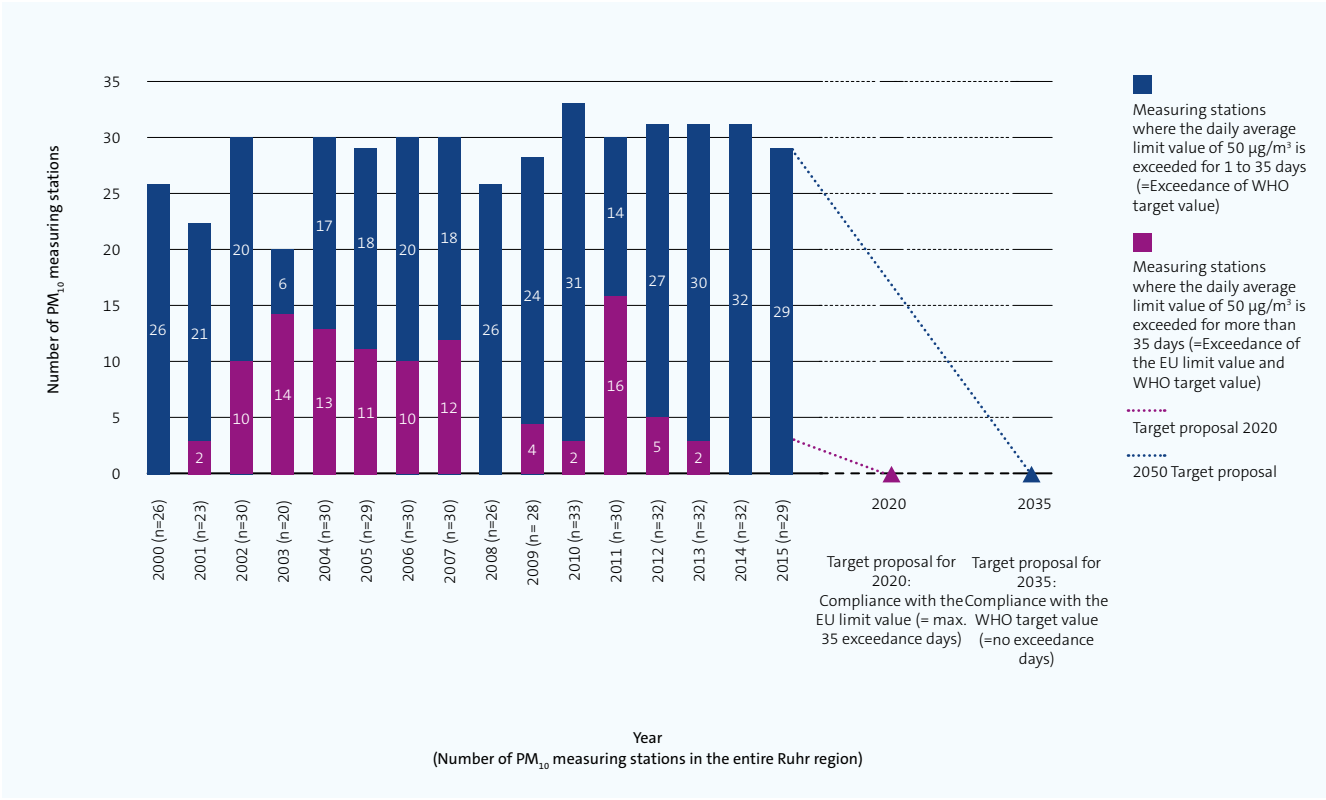
Legal background and existing targets

The following limit values for particulate matter (PM_{10}) have applied in Germany since implementing the EU Air Quality Directive 2008/50/EC [11] in German law by adopting the 39th Ordinance for the Implementation of the Federal Immissions Control Act [12] (39. BImSchV) on 1 January 2005: a daily average limit value of 50 µg/m³ (with a maximum of 35 exceedance days) and an annual average limit value of 40 µg/m³. The World Health Organization (WHO) suggests stricter target values for health protection: no exceedance days for the daily average limit value of 50 µg/m³ and an annual average target value of 20 µg/m³. The Wuppertal Institute proposes adopting the objective from the application by the Ruhr metropolitan area to become European Green Capital, to comply with the EU limit values by 2020 and the World Health Organization (WHO) target values by 2035. [13]



The Ruhr region Clean Air Plan with the subdivisions of the administrative districts of Arnsberg, Düsseldorf and Münster | Photo: Arnsberg District government, public display regarding the Clean Air Plan East, 2011

Development of the exceedance days for 50 µg/m³ for the daily average limit value of particulate matter (PM_{10}) at the measuring stations in the Ruhr region and target proposals of the Wuppertal Institute.



Note: The WHO target value (no exceedance of daily average value of 50 µg/m³) could not be observed over a one-year period at any of the measuring stations in the Ruhr region. Source: Wuppertal Institute diagram according to data from LANUV and target proposal from the Wuppertal Institute

Traffic on the A40

Current situation and development in the Ruhr region

In 2014 and 2015, neither the annual average limit value of 40 µg/m³ nor the maximum amount of 35 permitted exceedances of the daily average limit value of 50 µg/m³ were exceeded for the first time both in the Ruhr region as well as throughout NRW (measured at 29 measuring stations). All in all, the daily average limit value of 50 µg/m³ was exceeded on a total of 425 days at the 29 measuring stations in the Ruhr region – significantly too frequently to comply with the proposed objective of no longer exceeding the daily average limit value by 2035. The most frequent exceedances of the daily average limit value of 50 µg/m³ occurred during 2015 at the traffic measuring stations in Gelsenkirchen (32), Hagen (23), Herne (22) and Essen (20) as well as at two industrial measuring stations in Duisburg (31/ 24). The WHO annual average target value of 20 µg/m³ that the Wuppertal Institute recommended as the Ruhr metropolitan area target for 2035 was exceeded at 19 of the 29 measuring stations in 2015.

Trend in development

Assessment

Pollution from particulate matter in the Ruhr region is still way too high. Although the EU limit values were met in 2015 (as well as in 2014) and there is a long-term decreasing tendency of PM_{10} pollution, the Ruhr region is still far from adhering to the WHO target values for the protection of human health. Furthermore, favourable meteorological conditions also contributed to meeting the EU limit values in 2014 and 2015.[14] For this reason, the State Ministry of the Environment indicates that "an all-clear cannot be given for the particulate matter air pollution" in NRW.[15] In March

2015, the particulate matter pollution levels were so high in NRW that the State Ministry of the Environment recommended foregoing unnecessary driving.[16] Additionally, no threshold value can be given for the health problems caused by PM_{10} underneath which health hazards for people could be excluded[17] ("virtually safe dose"). It is therefore necessary to adopt more comprehensive and extensive measures to reduce PM_{10}, especially in the polluting transport, industrial and residential heating sectors. This includes both the Europe-wide legislation for particulate matter reduction (e.g. emission limits) as well as local and regional measures for clean air planning in NRW. A good approach to reducing air pollutants has been in force since 2008 in the Ruhr Clear Air Plan because of its regional approach to clean air planning.[18]

Sources and notes

[1] World Health Organization (WHO) (2014): Ambient (outdoor) air quality and health. Fact sheet No. 313, updated March 2014. http://www.who.int/mediacentre/factsheets/fs313/en/, accessed 30.3.3016.

[2] European Parliament, Council of the European Union (2008): Directive 2008/50/EC of the European Parliament and of the Council of 21 May 2008 on ambient air quality and cleaner air for Europe, Annex XI. http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2008:152:0001:0044:de:PDF, accessed 30.3.2016.

[3] Thirty-ninth ordinance for the implementation of the Federal Immissions Control Act on air quality standards and emission ceilings (39. BImSchV), http://www.gesetze-im-internet.de/bundesrecht/bimschv_39/gesamt.pdf, accessed 30.3.2016.

[4] City of Essen (2014): Topic 05: Luftqualität. Bewerbung zur Grünen Hauptstadt Europas. [Air quality. Application for European Green Capital.], pg. 11. https://media.essen.de/media/wwwessende/aemter/59/gruene_hauptstadt_europas_1/05_GHE_Themenfeld_Luftqualitaet_web.pdf, accessed 09.11.2016.

[5] See Wuppertal Institute (2013): Metropole Ruhr – Grüne Hauptstadt Europas. [Ruhr metropolitan area – European Green Capital]., pg. 129. Wuppertal. http://wupperinst.org/uploads/tx_wupperinst/Metropole_Ruhr_Endbericht.pdf, accessed 31.3.2016.

[6] Traffic-related particulate matter comes primarily from engines (predominantly from diesel engines), secondly from the wear of brake linings and tyres and thirdly from particles suspended from the street surfaces (UBA – Federal Environment Agency (2009): Feinstaubbelastung in Deutschland [Particulate matter pollution in Germany.], pg. 4 Dessau Roßlau. https://www.umweltbundesamt.de/sites/default/files/medien/publikation/long/3565.pdf, accessed 31.3.2016.

[7] Federal Environment Agency (UBA) (2016): Feinstaub. [Particulate matter] http://www.umweltbundesamt.de/themen/luft/luftschadstoffe/feinstaub, accessed 31.3.2016.

[8] See Federal Environment Agency (UBA) (2009): Feinstaubbelastung in Deutschland. [Particulate matter pollution in Germany], pg. 3 Dessau Roßlau. https://www.umweltbundesamt.de/sites/default/files/medien/publikation/long/3565.pdf, accessed 31.3.2016.

[9] LANUV NRW – State Agency for Nature, Environment and Consumer Protection of North Rhine-Westphalia (undated): Wirkungen von Feinstaub (PM_{10}). [Effects of particulate matter (PM_{10})]. http://www.lanuv. nrw.de/umwelt/umweltmedizin/wirkungen-von-luftschadstoffen/schadstoffe/feinstaub-pm10/, accessed 31.3.2016. See also World Health Organization (WHO) (2016): Ambient (outdoor) air quality and health – Fact sheet, updated September 2016. http://www.who.int/mediacentre/factsheets/fs313/en/, accessed 09.11.2016.

[10] See Federal Environment Agency (UBA) (2009): Feinstaubbelastung in Deutschland. [Particulate matter pollution in Germany.], pg. 4 Dessau Roßlau. https://www.umweltbundesamt.de/sites/default/files/medien/publikation/long/3565.pdf, accessed 31.3.2016.

[11] European Parliament, Council of the European Union (2008): Directive 2008/50/EC of the European Parliament and of the Council of 21 May 2008 on ambient air quality and cleaner air for Europe, Annex XI. http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2008:152:0001:0044:de:PDF, accessed 30.3.2016.

[12] Thirty-ninth ordinance for the implementation of the Federal Emissions Control Act on air quality standards and emission ceilings (39. BImSchV), http://www.gesetze-im-internet.de/bundesrecht/bimschv_39/gesamt.pdf, accessed 30.3.2016.

[13] See Wuppertal Institute (2013): Metropole Ruhr – Grüne Hauptstadt Europas. [Ruhr metropolitan area – European Green Capital.], pg. 129. Wuppertal. http://wupperinst.org/uploads/tx_wupperinst/Metropole_Ruhr_Endbericht.pdf, accessed 31.3.2016.

[14] LANUV NRW – State Agency for Nature, Environment and Consumer Protection of North Rhine-Westphalia (2015): Bericht über die Luftqualität im Jahre 2014 – LANUV Fachbericht 60. [Report on air quality in 2014 - LANUV technical report 60.], pg. 6. http://www.lanuv.nrw.de/uploads/tx_commercedownloads/30060.pdf, accessed 31.3.2016.

[15] MKULNV NRW - Ministry for Climate Protection, Environment, Nature and Consumer Protection (2016): Minister Remmel: Nitrogen dioxide pollution in cities is still the number one air pollution control problem. Press release on 10 May 2016. https://www.land.nrw/de/pressemitteilung/minister-remmel-die-belastung-der-staedte-mit-stickstoffdioxid-ist-weiterhin-das, accessed 17.10.2016.

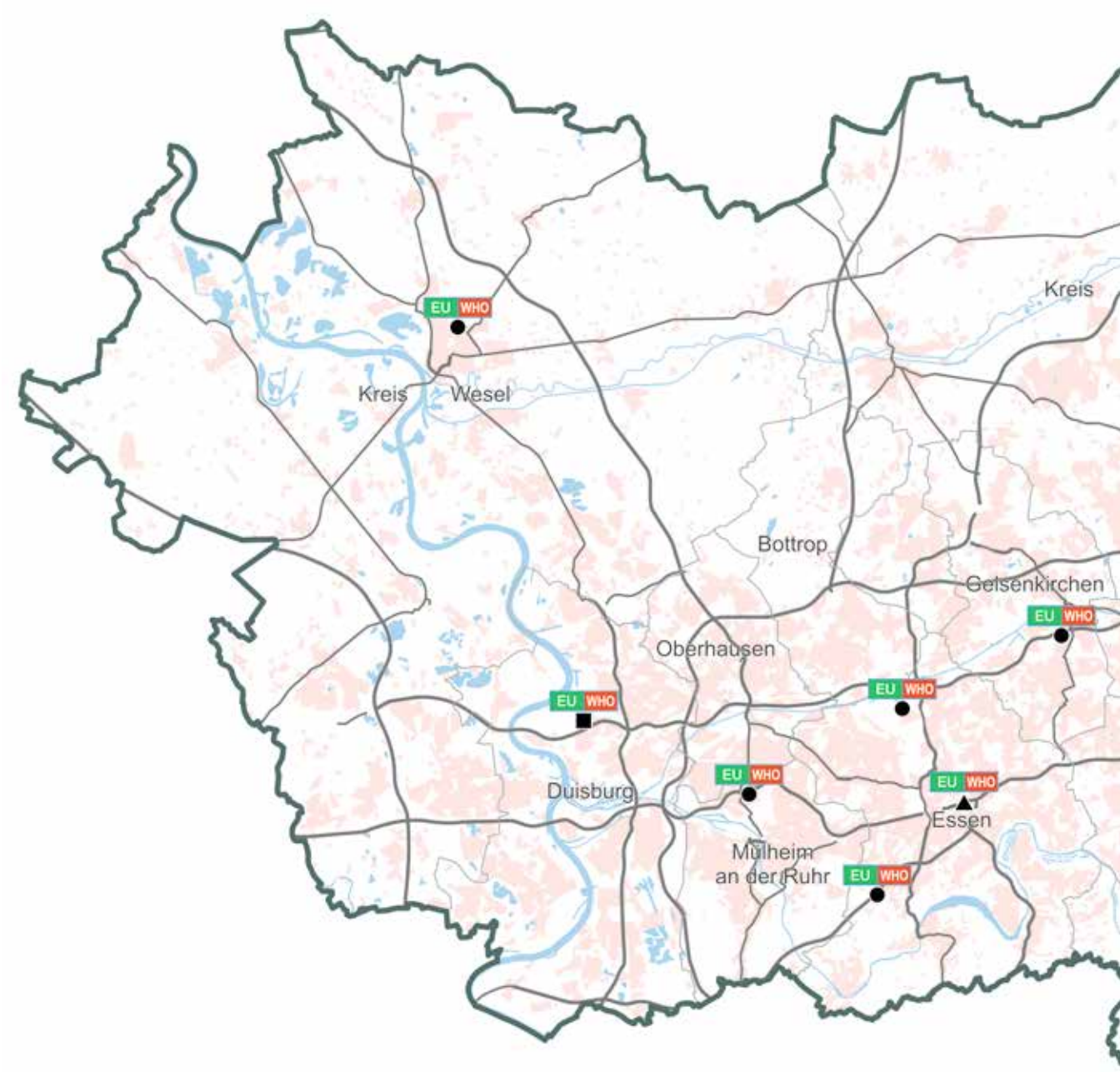
[16] See RP Online (2015): Feinstaub-Warnung: NRW-Bürger sollen das Auto stehen lassen. Article from 19/03/2015. http://www.rp-online.de/nrw/panorama/nrw-feinstaubbelastung-buerger-sollen-auto-stehen-lassen-aid-1.4955731, accessed 31.3.2016.

[17] District Government of Düsseldorf (2011): Luftreinhalteplan Ruhrgebiet 2011. Teilplan Nord. [Ruhr Clean Air Plan 2011, Segment Plan North], pg. 8 http://www.bezreg-muenster.nrw.de/zentralablage/ dokumente/umwelt_und_natur/umweltzonen-und-luftreinhalteplaene/LRP_Ruhrgebiet_Teilplan_Nord.pdf, accessed 2.5.2016.

[18] See District Government of Düsseldorf (2011): Luftreinhalteplan Ruhrgebiet 2011. Teilplan Nord.[Ruhr Clean Air Plan 2011, Segment Plan North.], pg. 2 http://www.bezreg-muenster.nrw.de/zentralablage/ dokumente/umwelt_und_natur/umweltzonen-und-luftreinhalteplaene/LRP_Ruhrgebiet_Teilplan_Nord.pdf, accessed 2.5.2016.

5.8 Air: Particulate matter ($PM_{2.5}$)

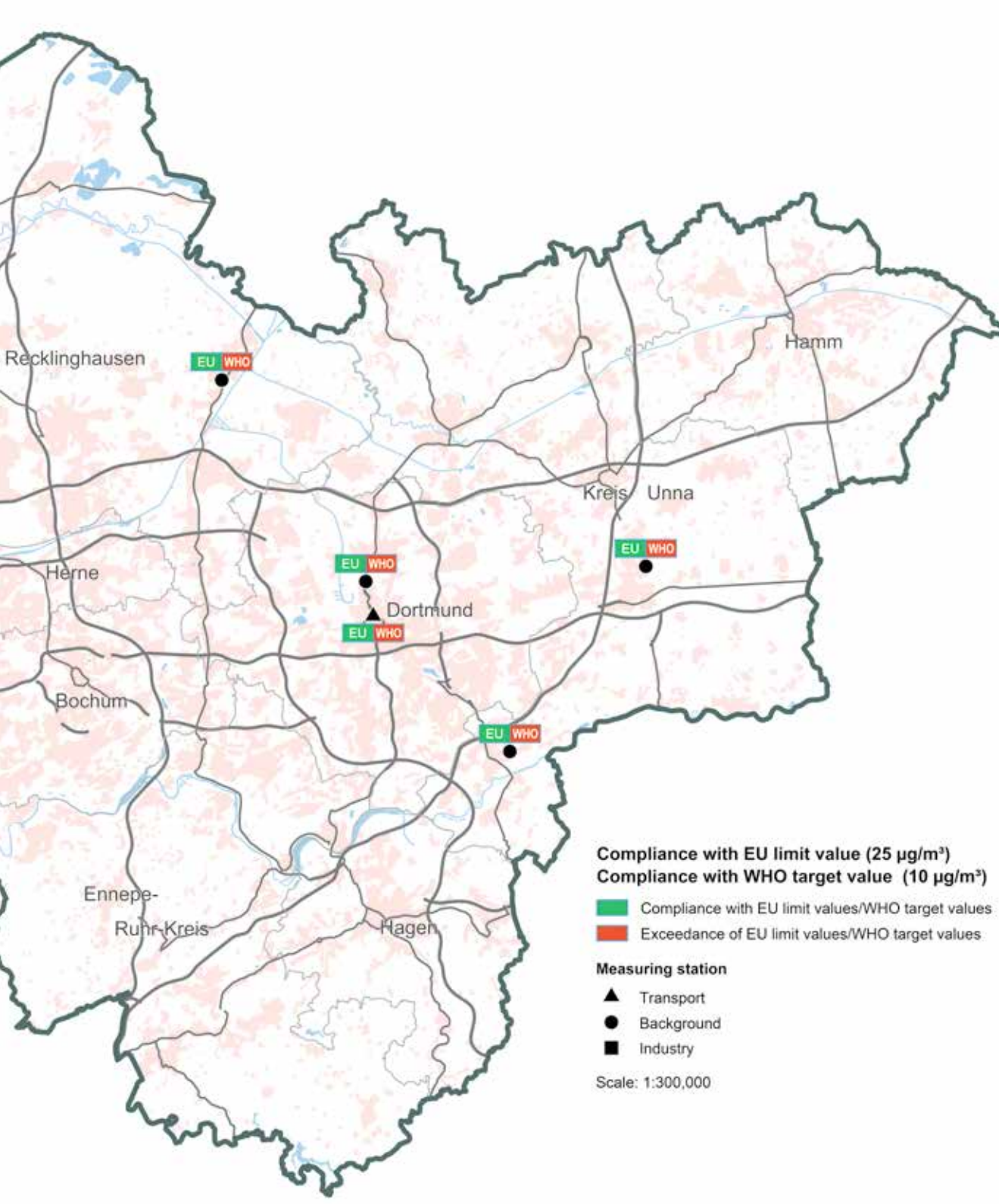
Measuring stations for particulate matter ($PM_{2.5}$) in the Ruhr metropolitan area: compliance with or exceedance of the EU limit values and the target values of the World Health Organization (WHO) for the annual average value



Concept development: Wuppertal Institute, Ruhr Regional Association

Source: State Agency for Nature, Environment and Consumer Protection of the State of North Rhine-Westphalia (LANUV NRW, 2016): EU-Jahreskennzahlgrößen 2015. [EU annual parameters 2015], last updated 29.03.2016

Map source: © Ruhr Regional Association


Recklinghausen
EU WHO
Hamm
Kreis Unna
EU WHO
Herne
EU WHO
Dortmund
EU WHO
Bochum
EU WHO
Ennepe-
Ruhr-Kreis
Hagen
Compliance with EU limit value (25 µg/m³)
Compliance with WHO target value (10 µg/m³)
Compliance with EU limit values/WHO target values
Exceedance of EU limit values/WHO target values
Measuring station
Transport
Background
Industry
Scale: 1:300,000

Indicator 8 – Air: Particulate matter ($PM_{2.5}$)

Objective: to prevent and reduce the health-threatening exposure to particulate matter ($PM_{2.5}$)
Indicator: annual average value of particulate matter ($PM_{2.5}$) (in µg/m³) and the average exposure to $PM_{2.5}$ (Average Exposure Indicator (AEI) – moving average over three years) (in µg/m³)

Bestehende operationalisierte Zielsetzungen:

World Health Organization (WHO): [1]	↦ Annual average limit value 10 µg/m³
European Commission: [2]	EU Air Quality Directive 2008/50/EC: ↦ Since 2015: Annual average limit value of 25 µg/m³; as of 2020: 20 µg/m³ ↦ Average Exposure Indicator (AEI): 20 µg/m³ (since 2015) ↦ Average Exposure Indicator (AEI): EU Member States set national reduction targets for 2020 compared to 2010
Germany: [3]	↦ Implementation of the EU limit values in German national law in the 39th Ordinance for the Implementation of the Federal Immissions Control Act (39. BImSchV) ↦ National AEI target: -15% AEI by 2020 compared to 2010 (reference value) [4]
Proposed objective from the Wuppertal Institute for the Ruhr metropolitan area: [5]	↦ By 2020: Compliance with the EU limit values ↦ By 2035: Compliance with the WHO annual average target value of 10 µg/m³

Significance of the environmental indicator

The term particulate matter $PM_{2.5}$ refers to airborne dust particles with a diameter smaller than 2.5 micrometres (µm) (2.5 µm = 2.5/1.000 mm). $PM_{2.5}$ comes primarily from three sources of emissions: households and small consumers, industrial processes and transport. [6] Particulate matter is harmful to human health and is associated with cardiovascular and respiratory diseases and lung cancer. [7] Particulate matter $PM_{2.5}$ is significantly smaller than PM_{10}. As a result, $PM_{2.5}$ can penetrate the respiratory tract much deeper and reach the bronchi and pulmonary alveoli. $PM_{2.5}$ is therefore also called “alveolar” or “respirable” dust. [8] Ultra-fine particles smaller than 0.1 µm can even enter the bloodstream. [9] $PM_{2.5}$ is classified as much more harmful to human health than PM_{10}. [10]

The health problems caused by $PM_{2.5}$ are evaluated by the $PM_{2.5}$ Average Exposure Indicator (AEI), in addition to the annual average concentration. The AEI is measured at measuring stations in urban locations and provides an average value indicating the population’s exposure to $PM_{2.5}$. In Germany, there are 36 AEI measuring points nationwide, 9 stations of which are to be found in NRW and 3 stations in the Ruhr metropolitan area (in Dortmund, Essen and Mülheim) [11].

Legal background and existing targets

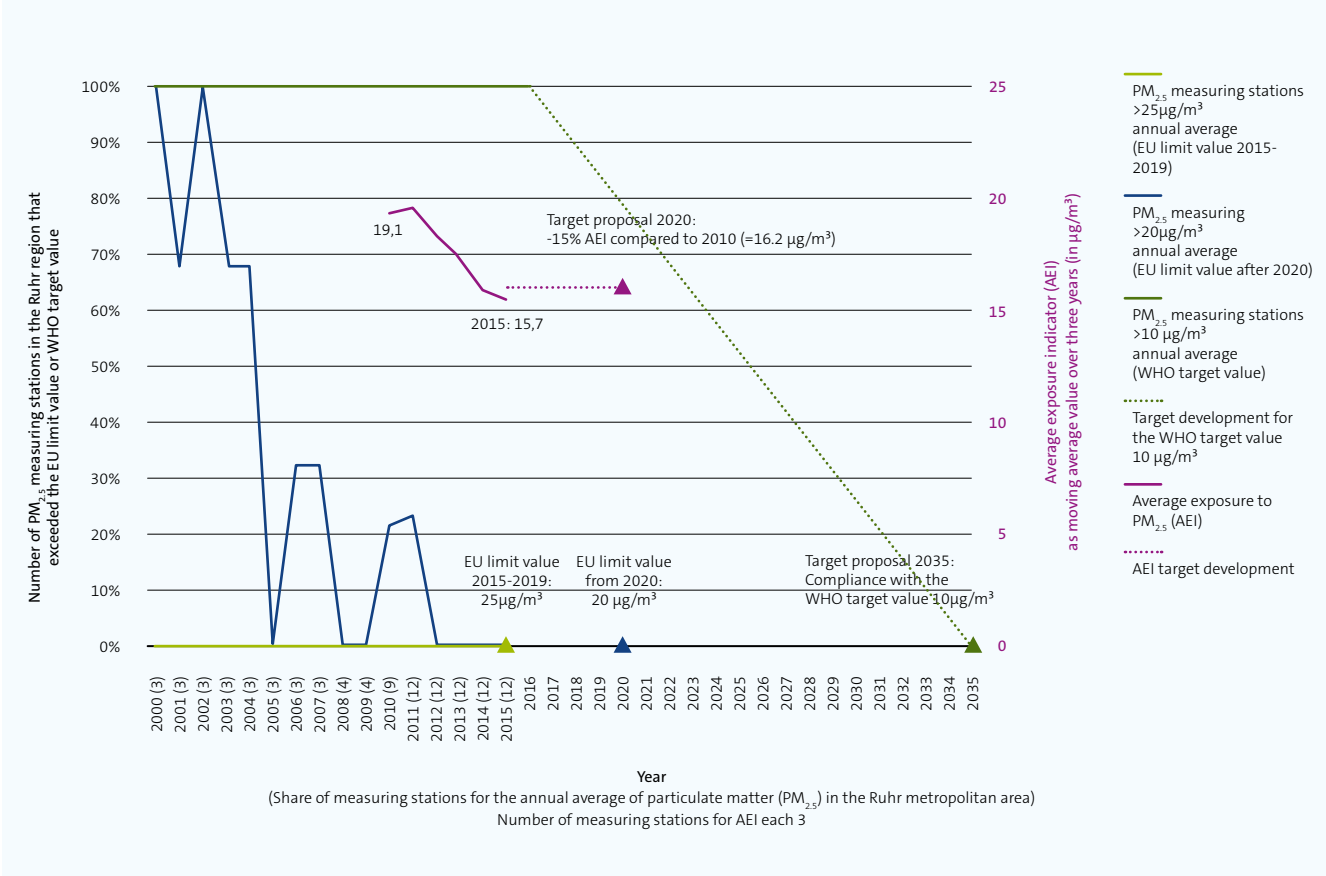
The EU annual average limit value of 25 µg/m³, has been in effect since 2015, in accordance with the EU Air Quality Directive 2008/50/EC, and will be lowered to 20 µg/m³ in 2020. The World Health Organization (WHO) defines 10 µg/m³ as the target value. Since 2015, there is also an EU limit value of 20 µg/m³ for the average $PM_{2.5}$exposure over a moving average of three years. The EU Member States must also set national targets to reduce the average exposure to $PM_{2.5}$ (AEI) by 2020 compared to the reference value for 2010 (the average from 2008, 2009, 2010). The EU limit values were implemented in German national law by adopting the 39th Ordinance for the Implementation of the Federal Immissions Control Act [12] (39. BImSchV). A national AEI objective was determined for a 15% reduction by 2020 compared to 2010. The Wuppertal Institute proposes adopting the objective from the Ruhr metropolitan area’s application for European Green Capital, to comply with the EU limit values by 2020 and the World Health Organization (WHO) target values by 2035. [13]

Current situation and development in the Ruhr region

$PM_{2.5}$ was measured at 12 measuring stations in the Ruhr metropolitan area in 2015. Both the annual average limit value of 20 µg/m³ applicable after 2020 were observed at

Mobility without locally produced air pollutants from engines: electric mobility via the tram and the electric bus in Oberhausen

Share of measuring stations for the air pollutant particulate matter ($PM_{2.5}$) that exceed the EU limit value and the WHO target value and the Wuppertal Institute target proposals for 2020 and 2035 (annual average and average exposure indicator, AEI)



Source: Wuppertal Institute diagram according to data from LANUV and target proposal from the Wuppertal Institute

Pollution from particulate matter

all stations in 2015 – both in the Ruhr metropolitan area as well as in the federal state of NRW. The annual average value in the Ruhr metropolitan area registered 14.1 µg/m³ on average in 2015.[14] There has been an overall decreasing trend in $PM_{2.5}$ pollution since 2000. This is also demonstrated by the average exposure to $PM_{2.5}$ in 2015, which was below the AEI reduction target of -15% compared to 2010. This development trend was supported by favourable meteorological conditions in the past few years. Less favourable meteorological conditions could counteract this trend. Thus, we can neither give the all-clear for particulate matter air pollution, nor can we say with certainty that the AEI reduction target will be met by 2020.[15] Additionally, the WHO annual average target value of 10 µg/m³ has not been exceeded at a single $PM_{2.5}$ measuring station so far. Aiming to reach this target value by 2035 should be the goal of the Ruhr region.

Trend in development

Assessment

Air pollution by $PM_{2.5,}$ the particulate matter especially harmful to health, remains high in the Ruhr region. This is particularly apparent by the exceedance of the WHO annual average target value of 10 µg/m³ at all $PM_{2.5}$ measuring stations in the Ruhr region. Even though particulate matter pollution has declined in recent years, we must keep in mind that favourable meteorological conditions supported this development and that pollution may increase under varied

conditions. Since there is no air concentration for particulate matter under which PM has a negligible health effect on humans ("virtually safe dose"), [16] we must secure the greatest possible reduction of particulate matter pollution to protect human health. To this end, considerable efforts are required at the EU, national, regional and local levels, especially stricter emissions standards by the EU for motor vehicles and industrial furnaces, as well as measures aimed to reduce and shift traffic and to technically improve transport (see indicator traffic). A good example of emission-free mobility are the trams and electric buses in Oberhausen – two bus lines (lines 962 and 966) have been fully electrically operated since October 2015.

Sources and notes

[1] World Health Organization (WHO) (2014): Ambient (outdoor) air quality and health. Fact sheet No. 313, updated March 2014. http://www.who.int/mediacentre/factsheets/fs313/en/, accessed 30.3.3016.

[2] European Parliament, Council of the European Union (2008): Directive 2008/50/EC of the European Parliament and of the Council of 21 May 2008 on ambient air quality and cleaner air for Europe, Annex XI. http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2008:152:0001:0044:de:PDF, accessed 30.3.2016.

[3] Thirty-ninth ordinance for the implementation of the Federal Immissions Control Act on air quality standards and emission ceilings (39. BImSchV), http://www.gesetze-im-internet.de/bundesrecht/bimschv_39/gesamt.pdf, accessed 30.3.2016.

[4] National target for the reduction of the average exposure to $PM_{2.5}$ (AEI): -15% AEI by 2020 compared to the reference value for 2010. The reference value for 2010 is calculated based on the average value from 2008, 2009 and 2010 and amounts to 16.4 µg/m³ for the Federal Republic of Germany. Based on the 15% target, a national reduction of 2.5 µg/m³ to 13.9 µg/m³ is necessary by 2020. The average exposure to $PM_{2.5}$ (AEI) is measured nationwide at 39 measuring stations located in urban settings (see LANUV – State Agency for Nature, Environment and Consumer Protection of North Rhine-Westphalia (2015): Bericht über die Luftqualität im Jahre 2014 – LANUV Fachbericht 60. [Report on air quality in 2014. LANUV Technical Report 60], pg. 13. http://www.lanuv.nrw.de/uploads/tx_commercedownloads/30060.pdf, accessed 9.5.2016.)

[5] See Wuppertal Institute (2013): Metropole Ruhr – Grüne Hauptstadt Europas. [Ruhr Metropolitan Area – European Green Capital], pg. 129. Wuppertal. http://wupperinst.org/uploads/tx_wupperinst/ Metropole_Ruhr_Endbericht.pdf, accessed 31.3.2016. Note: The City of Essen did not set any targets for particulate matter $PM_{2.5}$ in its application for European Green Capital (see City of Essen (2014): Topic 05: Luftqualität. Bewerbung zur Grünen Hauptstadt Europas [Air quality. Application for European Green Capital], pg. 11. https://media.essen.de/media/wwwessende/aemter/59/gruene_hauptstadt_europas_1/05_GHE_Themenfeld_Luftqualitaet_web.pdf, accessed 09.11.2016. accessed 09.11.2016.

[6] See Federal Environment Agency (UBA) (2015): Emissionen von Feinstaub der Partikelgröße $PM_{2.5}$. [Emissions from particulate matte size $PM_{2.5}$] Article from 01.06.2015. http://www.umweltbundesamt.de/ daten/luftbelastung/luftschadstoff-emissionen-in-deutschland/emission-von-feinstaub-der-partikelgroesse-pm25, accessed 18.5.2016.

[7] Federal Environment Agency (UBA) (2009): Feinstaubbelastung in Deutschland (Particulate matter pollution in Germany). Dessau-Roßlau, pg. 3. https://www.umweltbundesamt.de/sites/default/files/medien/publikation/long/3565.pdf, accessed 09.11.2016.

[8] LANUV – State Agency for Nature, Environment and Consumer Protection of North Rhine-Westphalia (undated): Aktuelle Luftqualität – Feinstaub $PM_{2.5}$. [Current air quality – particulate matter $PM_{2.5}$]. http://www.lanuv.nrw.de/luft/immissionen/aktluftqual/eu_pm25/, accessed 9.5.2016.

[9] Federal Environment Agency (UBA) (2016): Feinstaub. [Particulate matter]. Article from 17.10.2016. http://www.umweltbundesamt.de/themen/luft/luftschadstoffe/feinstaub, accessed 09.11.2016.

[10] See VCÖ – Verkehrsclub Österreich (2013): Ultra-Feinstaub macht krank. [Ultra-fine particulate matter makes us sick.] http://www.cleanair-europe.org/fileadmin/user_upload/redaktion/aktivitaeten/2013-02_VCOe-Factsheet_Ultra-Feinstaub.pdf, accessed 9.5.2016.

[11] Measuring stations Dortmund (DMD2), Essen (EVOG), Mülheim (STYR) are located in suburban areas of the cities.

[12] Thirty-ninth ordinance for the implementation of the Federal Immissions Control Act on air quality standards and emission ceilings (39. BImSchV), http://www.gesetze-im-internet.de/bundesrecht/bimschv_39/gesamt.pdf, accessed 30.3.2016.

[13] See Wuppertal Institute (2013): Metropole Ruhr – Grüne Hauptstadt Europas. [Ruhr Metropolitan Area – European Green Capital.], pg. 129. Wuppertal. http://wupperinst.org/uploads/tx_wupperinst/Metropole_Ruhr_Endbericht.pdf, accessed 31.3.2016.

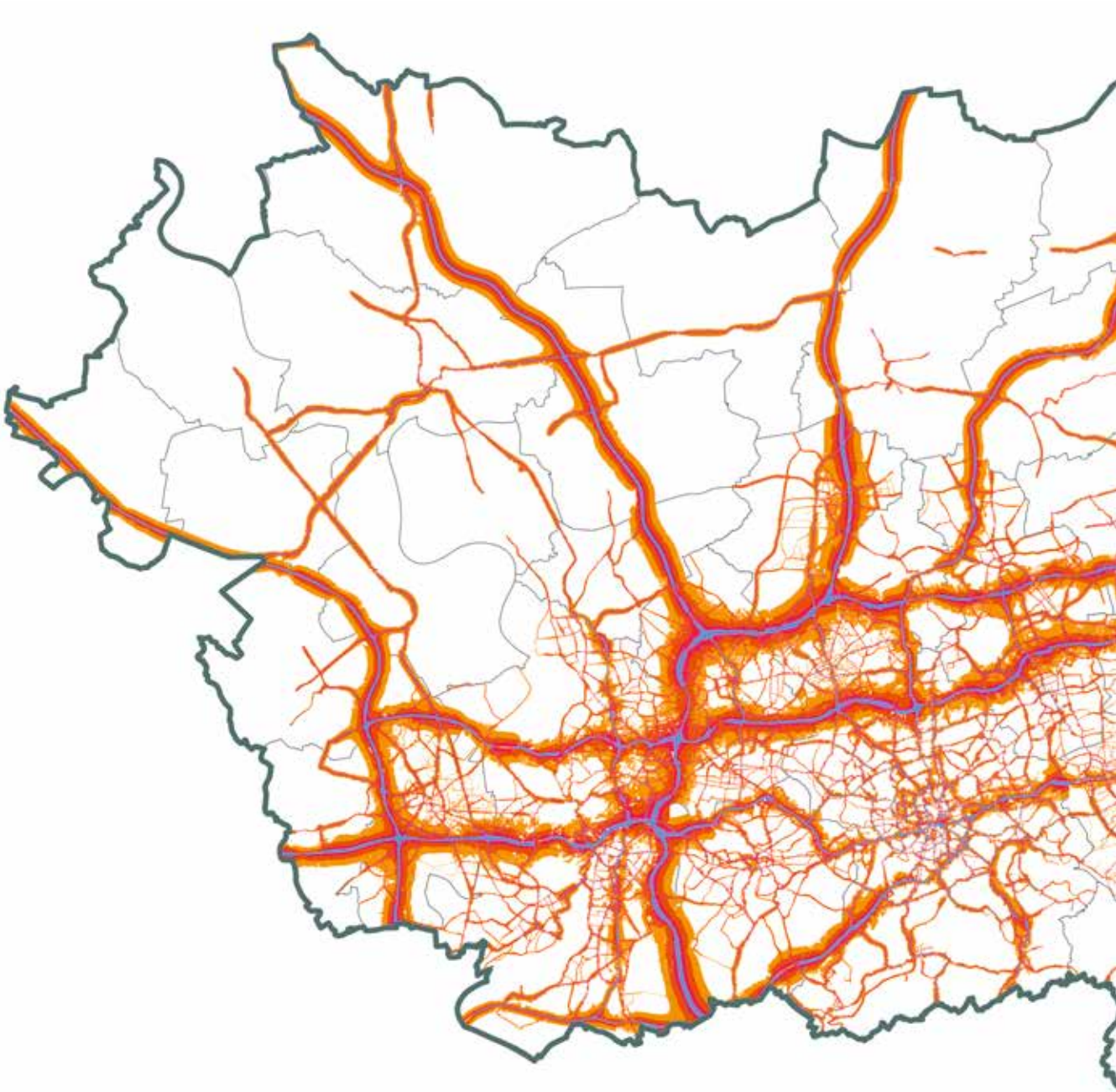
[14] LANUV – State Agency for Nature, Environment and Consumer Protection of North Rhine-Westphalia (2015): Bericht über die Luftqualität im Jahre 2014 – LANUV Fachbericht 60. [Report on air quality in 2014. LANUV Technical Report 60.], pg. 13. http://www.lanuv.nrw.de/uploads/tx_commercedownloads/30060.pdf, accessed 9.5.2016.

[15] LANUV NRW – State Agency for Nature, Environment and Consumer Protection of North Rhine-Westphalia (2015): Bericht über die Luftqualität im Jahre 2014 – LANUV Fachbericht 60. [Report on air quality in 2014 - LANUV Technical Report 60.], pg. 13f. http://www.lanuv.nrw.de/uploads/tx_commercedownloads/30060.pdf, accessed 31.3.2016.

[16] The "virtually safe dose" in toxicology is a dose with a mortality risk classified at 1/1 million (10^{-6}) and is therefore classified as having negligible health effects (Runge, Karsten (1998): Die Umweltverträglichkeitsuntersuchung. [The environmental impact assessment study.] Heidelberg, pg. 77).

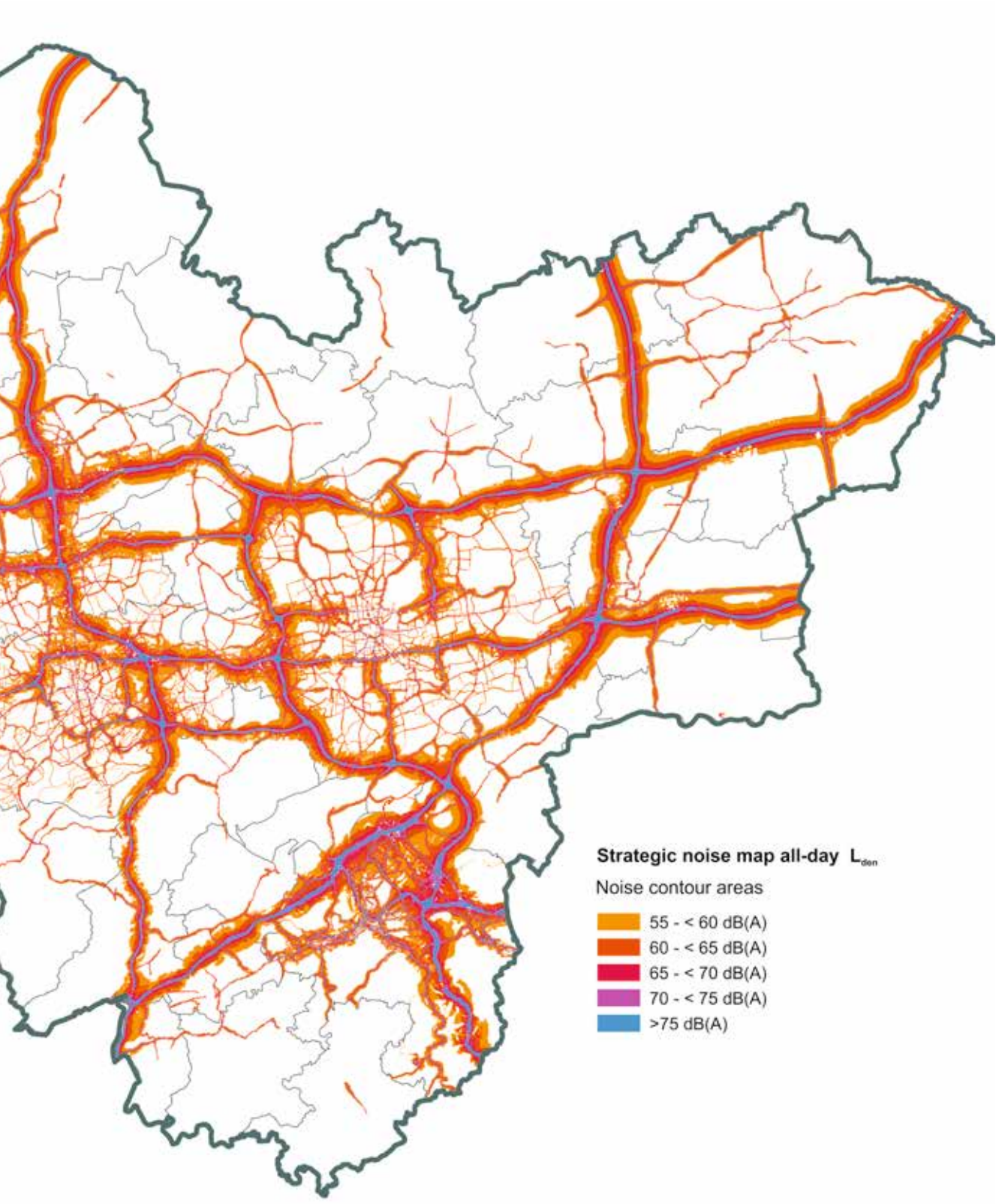
5.9 Noise: Number of people exposed to noise from road traffic per 1,000 residents full-day (0:00-24:00)

Strategic noise map of road traffic for the Ruhr metropolitan area all-day (L_{den})



Source: Data from the State Agency for Nature, Environment and Consumer Protection of North Rhine-Westphalia (LANUV NRW), last updated 2012

Map source: © Planungsbüro Richter-Richard


Strategic noise map all-day L_{den}
Noise contour areas
55 - < 60 dB(A)
60 - < 65 dB(A)
65 - < 70 dB(A)
70 - < 75 dB(A)
>75 dB(A)

Indicator 9 – Noise: Number of people exposed to noise from road traffic per 1,000 residents full-day (0:00-24:00)

Objective: to reduce health concerns caused by road traffic noise
Indicator: people affected by road traffic noise per 1,000 inhabitants full-day (0:00-24:00):
L_{den} >65 dB(A) = high noise disturbance, L_{den} >70 dB(A) = very high noise disturbance

Existing operationalised target values:

World Health Organization (WHO): [1,2]	↦ <55 dB(A) to avoid significant noise pollution ↦ <50 dB(A) to avoid moderate noise pollution
Council of Experts for Environmental Issues: [3]	↦ <65 dB(A) short-term, 62 dB(A) medium-term, 55 dB(A) as a precautionary value (without concrete target years)
Federal Environment Agency (UBA): [4]	↦ 65 dB(A) as short-term trigger criterion, 60 dB(A) medium-term, 55 dB(A) long-term (without concrete target years)
NRW: [5]	↦ By 2030, significant reduction of the total noise pollution in residential areas, taking into account the WHO recommendations and the findings from research on the effect of noise on adverse health effects in the event of all-day noise pollution >65 dB(A)
City of Essen: [6]	↦ ≤65 dB(A) observe as comprehensively as possible by 2018, trigger value noise action plan L_{den} 55 dB(A) ↦ 55 dB(A) by 2035
Target proposal from the application for European Green Capital: [7]	↦ 65 dB(A) by 2018 ↦ 55 dB(A) by 2033
Target proposal from the planning office Richter-Richard for the Ruhr metropolitan area: [8]	↦ ≤65 dB(A) by 2028 (5th round of noise abatement planning), ↦ ≤55 dB(A) as long-term objective

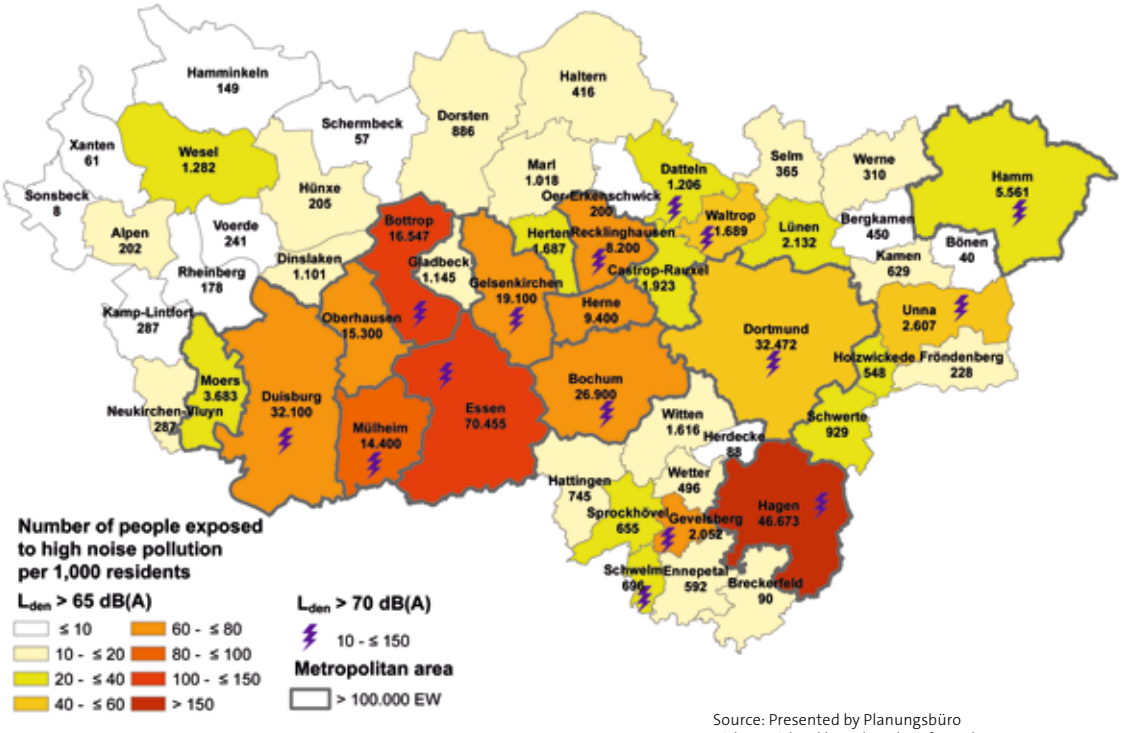
Significance of the environmental indicator

Noise is "one of the biggest environmental and health problems", particularly in cities and agglomerations.[9] Research findings on the impact of noise clearly demonstrate the connection between noise and cardiovascular disease, including heart attacks, as well as changes in medical risk factors (e.g. blood lipids, blood sugar, blood clotting factors). The question is therefore not whether noise makes us sick, but to what extent.[10] Additionally, noise affects outdoor communication and thus social cohabitation. Noise does not only produce additional health costs for society as a whole, but also leads to lower rent and property prices, which, among other things, lower contributions made to the public budget through the land transfer tax and income tax. This in turn poses the question of environmental justice – people who must live on noisy main roads due to the low rent are overwhelmingly economically disadvantaged. One of the main sources of noise in the Ruhr metropolitan area is road traffic (in addition to rail transport). [11] This environmental indicator examines the number of people per 1,000 inhabitants affected by noise pollution from road traffic over an entire day (24 hours, day/evening/night = L_{den}).

Legal background and existing objectives

In 2002, the EU Environmental Noise Directive (2002/49/EC) [12] came into force and was then implemented into German national law with the amendment to the Federal Immissions Control Act (BImSchG) in June 2005. Since the second round of the Noise Action Plan in 2012, noise reduction planning is updated every five years for all agglomerations with over 100,000 residents, for all federal highways and federal and state roads with more than 3 million vehicles per year in non-metropolitan areas since the second round of the noise action plans in 2012. [13] 65 dB(A) during the entire day is considered a health threshold value for establishing noise action plans. 65 dB(A) during the entire day is considered a health threshold value for establishing noise action plans. [14] In NRW, as in most federal states, the municipalities are responsible for establishing the trigger values (also referred to as threshold values). If these are exceeded, a noise action plan must be established with measures aimed at reducing noise pollution as per § 47d BImSchG. The Federal Environment Agency proposes an immission level of L_{den} = 65 dB(A) as a short-term operation target to reduce health concerns, >60 dB(A) as a medium-term environmen-

High noise pollution from road traffic in the Ruhr metropolitan area – affected people per 1,000 inhabitants and in absolute numbers (L_{den} >65 dB(A)) in 2012



Source: Presented by Planungsbüro Richter-Richard based on data from the LANUV

tal target and 55 dB(A) as a long-term operation target.[15] The World Health Organization (WHO) offers a target value of 50 dB(A) to prevent disruptive noise pollution. NRW has committed itself to significantly reducing total noise pollution in residential areas (without a target year) and factoring in the World Health Organization (WHO) recommendations as well as findings from research on the impact of noise, according to which adverse health effects increasingly occur starting at noise pollution levels of >65 dB(A) full-day. [16] An immission level of L_{den}=70 dB(A) could be established as a priority in particularly polluted cities in order to reduce especially high noise pollution for those affected. Planungsbüro Richter-Richard recommends that the densely populated Ruhr metropolitan area with its high levels of road traffic set the goal of comprehensively restricting daytime road traffic noise levels to below 65 dB(A) until the Noise Action Plan is updated in 2028 and to stay below 55 dB(A) over the long term.

Current situation and development in the Ruhr region

In 2012, 300,000 people in the Ruhr metropolitan area were affected by high noise levels caused by road traffic over 65 dB(A) during the entire day (6.5% of the population), [17] one-third of these people were even subjected to very high levels of noise over 70 dB(A) (109,000, 2.2% of the total population). The cities most affected by road traffic noise through high noise pollution >65 dB(A) as well as very high noise pollution >70 dB(A) were the cities of Hagen (>150 or 100-<150 person/1,000), Essen (100-<150 or 60-<80 person/1,000) and Bottrop (100-<150 or 40-<60 person/1,000). Noise disturbance significantly decreased towards the outskirts of the Ruhr region, especially near the Lower Rhine and western Münsterland. By comparison: in NRW, approximately 792,000 people were exposed to all-day road traffic noise >65 dB(A) in 2011, [18] (4.5% of the population). [19]

Assessment

The data show that a particularly high level of noise disturbance is present in the Ruhr metropolitan area. This is true especially in the central municipalities, not only because they are located in what can be defined as a congested urban area (conurbation), but because this is where a dense network of highly congested traffic routes exists and where many people live. There is a particularly high need for noise

control in this area. The rural areas on the outskirts of the Ruhr metropolitan area are less severely affected by noise. However, noise must be reduced in all municipalities to allow for widespread healthy living. There is no model city for noise control in the Ruhr metropolitan area. However, there are good measures and interesting strategic approaches in individual cities – for example Bottrop with an integrated approach to urban renewal and noise control [20] or Essen with its „Quiet Areas“ [21] and the use of noise-reducing asphalt surfaces. We can learn from these examples and develop joint approaches to utilise currently untapped regional potentials.

Trend in development

Table: Noise disturbance in the Ruhr metropolitan area

		Affected inhabitants full-day (0:00 - 24:00)		Affected inhabitants at night (22:00 - 6:00)	
Municipality	**Inhabitants**	**Full day >65 dB(A)**	**Full day >70 dB(A)**	**Night >55 dB(A)**	**Night >60 dB(A)**
Alps	12,629	202	79	236	111
Bergkamen	48,534	450	45	650	92
Bochum	362,213	26,900	6,500	27,300	6,200
Bönen	18,023	40	8	96	14
Bottrop	116,498	16,547	4,947	16,410	3,510
Breckerfeld	8,942	90	9	115	17
Castrop-Rauxel	74,123	1,923	231	2,474	399
Datteln	34,507	1,206	417	1,403	589
Dinslaken	67,379	1,101	117	1,368	209
Dorsten	76,030	886	161	1,097	407
Dortmund	572,087	32,472	7,897	38,574	10,307
Duisburg	486,816	32,100	7,500	34,800	7,200
Ennepetal	29,931	592	204	697	292
Essen	566,862	70,455	37,079	69,202	33,817
Fröndenberg	20,698	228	84	273	126
Gelsenkirchen	257,607	19,100	5,200	23,900	7,000
Gevelsberg	31,080	2,052	611	2,463	862
Gladbeck	74,002	1,145	173	1,812	288
Hagen	186,243	46,673	24,096	58,749	30,050
Haltern	37,246	416	54	541	117
Hamm	176,440	5,561	1,885	6,448	2,322
Hamminkeln	26,284	149	10	315	28
Hattingen	54,286	745	146	871	253
Herdecke	22,754	88	16	193	26
Herne	154,563	9,400	800	10,500	1,000
Herten	61,001	1,687	233	1,635	105
Holzwickede	16,725	548	110	905	186

Noise protection on Gladbecker Straße in Essen

		Affected inhabitants full-day (0:00 - 24:00)		Affected inhabitants at night (22:00 - 6:00)	
Municipality	**Inhabitants**	**Full day >65 dB(A)**	**Full day >70 dB(A)**	**Night >55 dB(A)**	**Night >60 dB(A)**
Hünxe	13,526	205	31	310	55
Kamen	43,496	629	134	1,045	243
Kamp-Lintfort	37,093	287	21	353	31
Lünen	84,798	2,132	540	2,443	629
Marl	84,055	1,018	53	1,424	127
Moers	103,504	3,683	394	4,516	512
Mülheim	166,654	14,400	2,600	19,200	4,600
Neukirchen-Vluyn	26,924	287	46	376	63
Oberhausen	210,005	15,300	1,700	20,900	2,300
Oer-Erkenschwick	30,503	200	87	226	97
Recklinghausen	115,385	8,200	2,300	11,400	2,400
Rheinberg	30,684	178	81	197	108
Schermbeck	13,408	57	6	84	22
Schwelm	28,139	696	298	822	410
Schwerte	46,376	929	209	1,305	285
Selm	25,697	365	29	448	87
Sonsbeck	8,655	8	0	33	0
Sprockhövel	25,230	655	81	876	186
Unna	59,015	2,607	709	3,639	763
Voerde	36,729	241	17	304	31
Waltrop	28,926	1,689	307	2,035	535
Werne	29,578	310	21	513	69
Wesel	60,241	1,282	370	1,585	558
Wetter	27,725	496	85	699	161
Witten	96,136	1,616	358	1,912	452
Xanten	21,273	61	17	78	22
Total	**5,047,258**	**330,287**	**109,106**	**379,750**	**120,273**

(Source: Data provided by the LANUV, as of 2012)

Noise protection walls on the A40 in Essen

Sources and notes

[1] WHO – World Health Organization (1999): Guidelines for Community Noise. Geneva. http://www.google.pt/url?sa=t&rct=j&q=&esrc=s&source=web&cd=2&ved=0ahUKEwi_5fCf467MAhVGXB4KHXISAjsQFggrMAE&url=http%3A%2 F%2Fwhqlibdoc.who.int%2Fhq%2F1999%2Fa68672.pdf&usg=AFQjCNHq0SR jmXAXPKGPvQC88NtlGaJJBQ.

[2] See also Babisch, Wolfgang (2011): Quantifizierung des Einflusses von Lärm auf Lebensqualität und Gesundheit. [Quantification of the Influence of Noise on Quality of Life and Health.] Special print from: UMID: Umwelt und Mensch - Informationsdienst, 01/2011. [UMID: Environment and Human Health - Information Service, 01/2011.] http://www.umweltbundesamt.de/sites/default/files/medien/pdfs/umid_11_04_01_sonderdruck_laerm.pdf, pg. 28-36.

[3] German Advisory Council on the Environment (1999): Sondergutachten des Rates von Sachverständigen für Umweltfragen: Umwelt und Gesundheit – Risiken richtig einschätzen. [Special Report from the Advisory Council on the Environment: Environment and Health – Properly Assessing Risks.] The German Bundestag, 14th legislative period, printed matter 14/2300 on 15.12.1999, pg. 32. http://www.umweltrat.de/SharedDocs/Downloads/DE/02_Sondergutachten/1999_SG_UmweltundGesundheit.pdf?__blob=publicationFile.

[4] UBA– Federal Environment Agency (UBA) (2008): Silent City – Umgebungslärm, Aktionsplanung und Öffentlichkeitsbeteiligung. [Silent City – Environmental Noise, Action Planning and Public Participation.], manual, pg. 8. Berlin. https://www.umweltbundesamt.de/sites/default/files/medien/publikation/long/3685.pdf.

[5] State Government of North Rhine-Westphalia (2016): Nachhaltigkeitsstrategie für Nordrhein-Westfalen. [Sustainability Strategy for North Rhine-Westphalia]. https://www.umwelt.nrw.de/fileadmin/redaktion/Broschueren/nrw-nachhaltigkeitsstrategie_broschuere.pdf, pg. 61.

[6] City of Essen (2014): Bewerbungsunterlagen zur Grünen Hauptstadt Europas 2017 – Themenfeld 06: Qualität der akustischen Umgebung. [Application documents for European Green Capital 2017 – Topic 06: Quality of the acoustic environment.] https://media.essen.de/media/wwwessende/aemter/59/gruene_hauptstadt_europas_1/06_GHE_Themenfeld_akustische_Umgebung_web.pdf, pg. 14.

[7] Wuppertal Institute with Planungsbüro Richter-Richard and with Regionalverband Ruhr (2013): Metropole Ruhr – Grüne Hauptstadt Europas. [Ruhr Metropolitan Area – European Green Capital.], pg. 19. Wuppertal. http://wupperinst.org/uploads/tx_wupperinst/Metropole_Ruhr_Endbericht.pdf, accessed 8.11.2016.

[8] Target proposal from Planungsbüro Richter-Richard: L_{den} = 65 dB(A) by 2028, L_{den} = 55 dB(A) as long-term objective by 2050. More ambitious still is the target formulated in the application by the Ruhr Metropolitan Area for the European Green Capital to reach L_{den} = 65 dB(A) by 2018 and L_{den} = 55 dB(A) by 2033 (see Wuppertal Institute (2013): Metropole Ruhr – Grüne Hauptstadt Europas. [Ruhr Metropolitan Area – European Green Capital]. Wuppertal. http://wupperinst.org/uploads/tx_wupperinst/Metropole_Ruhr_Endbericht.pdf, pg. 147).

[9] Federal Environment Agency (UBA) (2015): "Forum Lärm und Stadt". Article from 29.7.2015. http://www.umweltbundesamt.de/themen/verkehr-laerm/forum-laerm-stadt.

[10] See Ministry for Climate Protection, Environment, Agriculture, Nature Conservation and Consumer Protection of the State of North Rhine-Westphalia (MKULNV NRW) (undated): Lärm. [Noise.)] https://www.umwelt.nrw.de/umweltschutz-umweltwirtschaft/umwelt-und-gesundheit/laerm/. accessed 29.11.2016.

[11] See Ministry for Climate Protection, Environment, Agriculture, Nature Conservation and Consumer Protection of the State of North Rhine-Westphalia (MKULNV NRW) (undated): Lärm. [Noise.] https://www.umwelt.nrw.de/umweltschutz-umweltwirtschaft/umwelt-und-gesundheit/laerm/.

[12] Directive 2002/49/EC of the European Parliament and of the Council of 5 June 2002 relating to the assessment and management of environmental noise. http://www.bmub.bund.de/fileadmin/bmu-import/files/pdfs/allgemein/application/pdf/rl_umgebungslaerm.pdf.

[13] The BImSchG distinguishes metropolitan areas from non-metropolitan areas. According to the national definition, cities with more than 100,000 inhabitants are considered metropolitan areas. All smaller municipalities are assigned to the non-metropolitan areas. A more or less comprehensive noise mapping must be carried out to combat traffic noise in the metropolitan areas (mostly roads over an ADT of 4,000 to 5,000 vehicles), while only roads with an annual amount of 30 million motor vehicles (ADT = 8,200 vehicles) are considered in non-metropolitan areas and only for regional, national or cross-border roads (= state and federal roads as well as federal highways). The higher mapping density of metropolitan areas explains to a (smaller) extent why the central Ruhr region, with its chain of agglomerations, significantly deviates especially towards the municipalities near the Lower Rhine and Münsterland.

[14] Ministry for the Environment and Nature Conservation, Agriculture and Consumer Protection (2008): Lärmaktionsplanung. [Noise action planning]. RdErl. d.- V-5 - 8820.4.1, Düsseldorf.

[15] UBA– Federal Environment Agency (UBA) (2008): Silent City – Umgebungslärm, Aktionsplanung und Öffentlichkeitsbeteiligung. [Silent City – Environmental Noise, Action Planning and Public Participation.], manual, pg. 8. Berlin. https://www.umweltbundesamt.de/sites/default/files/medien/publikation/long/3685.pdf.

[16] Landesregierung Nordrhein-Westfalen [Regional Government of North Rhine-Westphalia] (2016): Nachhaltigkeitsindikatoren Nordrhein-Westfalen. [North Rhine-Westphalia sustainability indicators]. http://www.nachhaltigkeit.nrw.de/fileadmin/download/nachhaltigkeits-indikatorenbericht_2016.pdf, pg. 26.

[17] 330,000 / 5,054,634 = 6.5% (2014, see RVR database statistics on population development since 1961, http://www.metropoleruhr.de/fileadmin//user_upload/metropoleruhr.de/Bilder/Daten___Fakten/Regionalstatistik_PDF/Bevoelkerung/ BevEnt_14_Tab.pdf, accessed 8.11.2016) .

[18] Landesregierung Nordrhein-Westfalen [State Government of North Rhine-Westphalia] (2016): Nachhaltigkeitsindikatoren Nordrhein-Westfalen. [Sustainability indicators North Rhine-Westphalia], pg. 26. http://www.nachhaltigkeit.nrw.de/fileadmin/download/nachhaltigkeits-indikatorenbericht_2016.pdf, accessed 8.11.2016.

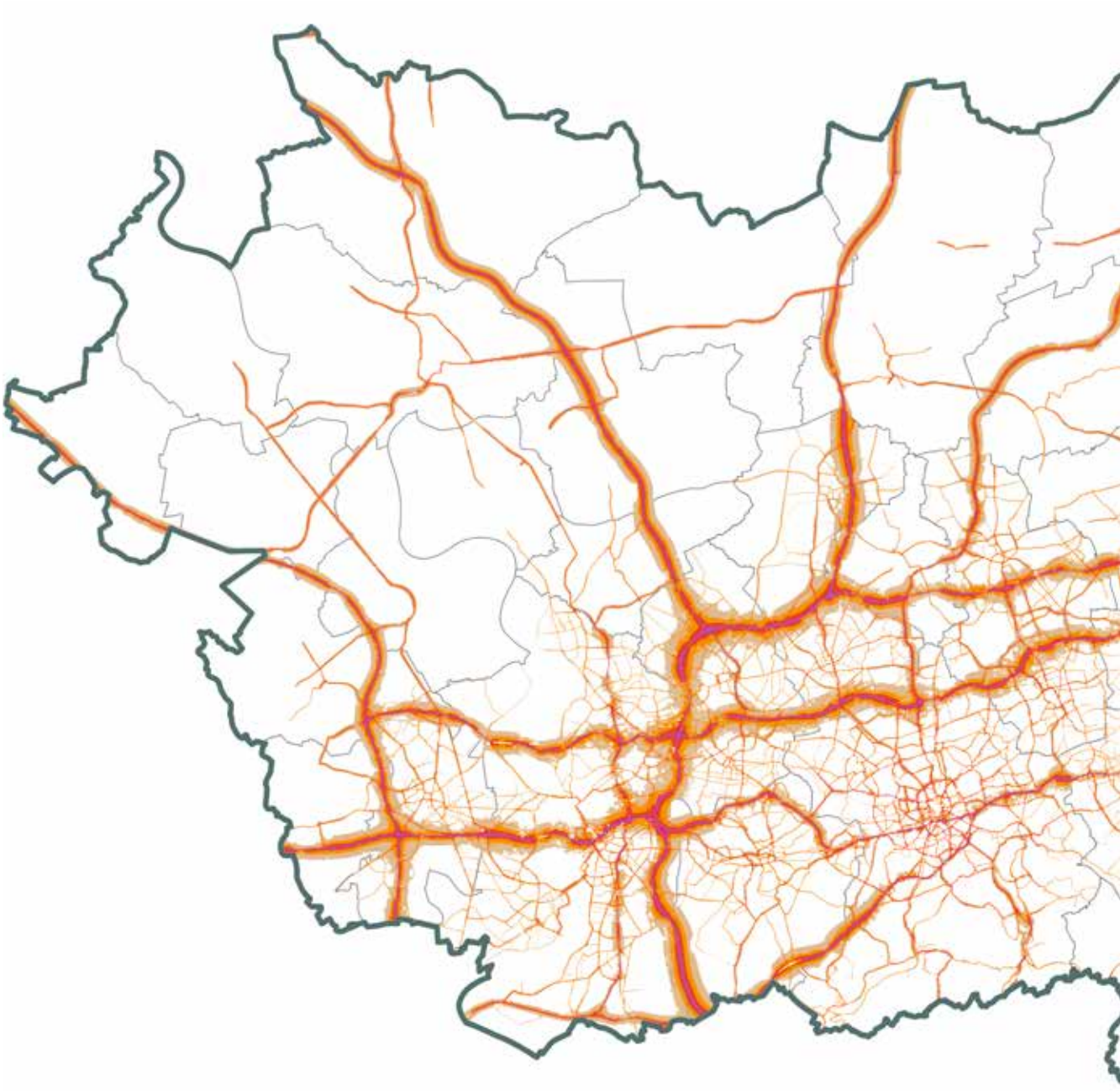
[19] NRW had 17,538,251 residents in 2011 (2011 census, see IT.NRW 2013: 2011 Census: North Rhine-Westphalia has 17,538,251 inhabitants, https://www.it.nrw.de/presse/pressemitteilungen/2013/pres_122_13.html). 792,100 / 17,538,251 = 0.045.

[20] See Federal Ministry of Transport, Building and Urban Development (BMVBS) (2011): Gute Beispiele der städtebaulichen Lärmminderung.[Good examples of noise abatement in urban development.] BMVBS online publication, No. 12/2011, pg. 7-12. http://www.bbsr.bund.de/BBSR/DE/Veroeffentlichungen/BMVBS/Online/2011/ DL_ON122011.pdf;jsessionid=2D0678FEDA585EE7DC96EC432DEC39B8.live11292?__blob=publicationFile&v=2, accessed 8.11.2016.

[21] According to §47d para. 2 BImSchG, a goal of the noise action plans should be "to protect quiet areas from increased noise" (http://www.gesetze-im-internet.de/bimschg/__47d.html, accessed 8.11.2016)

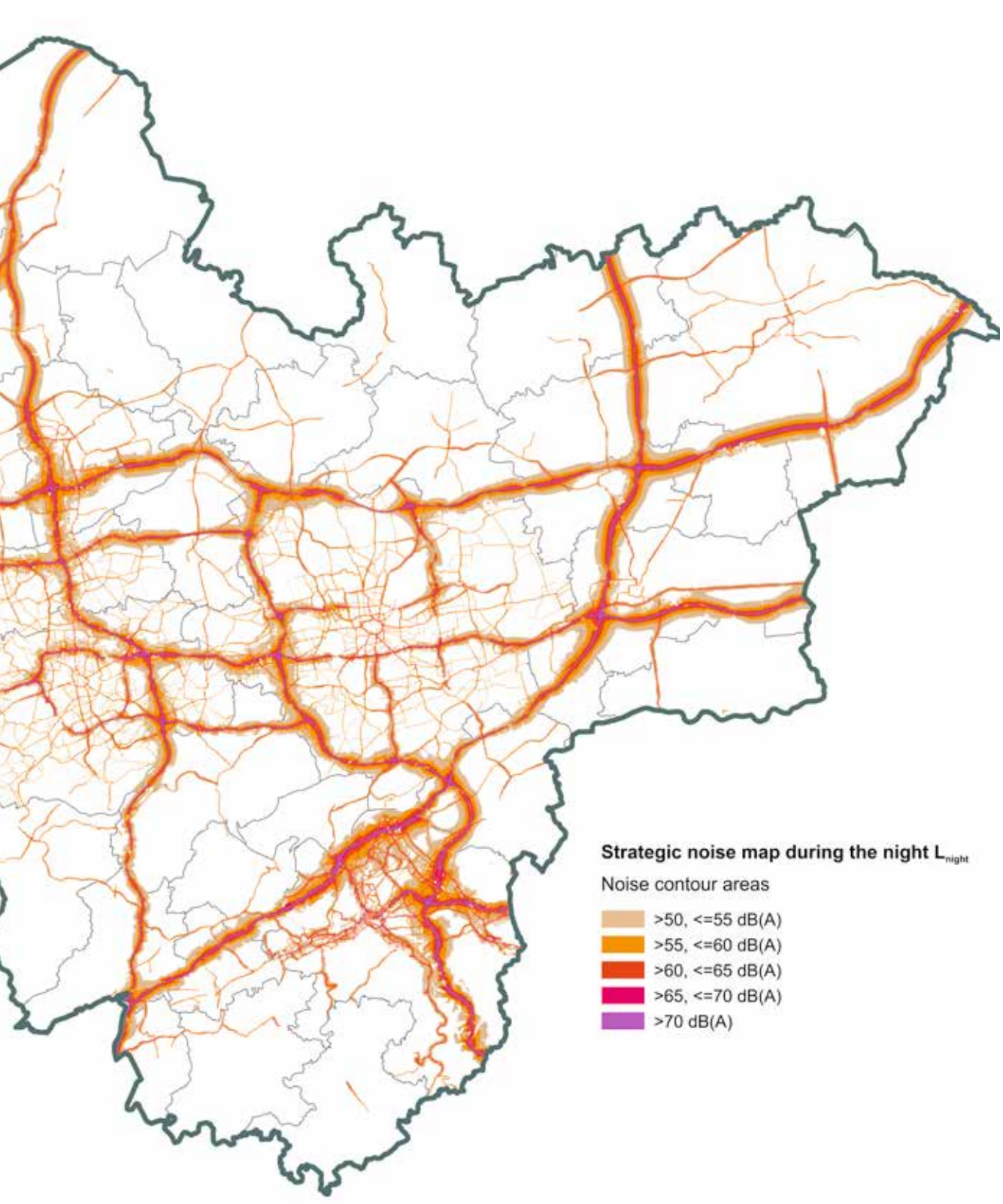
5.10 Noise: Number of people exposed to noise from road traffic per 1,000 residents during the night (22:00-6:00)

Strategic noise map of road traffic for the Ruhr metropolitan area during the night (L_{night})



Source: Data from the State Agency for Nature, Environment and Consumer Protection of North Rhine-Westphalia (LANUV NRW), last updated 2012

Map source: © Planungsbüro Richter-Richard


Strategic noise map during the night L_{night}
Noise contour areas
>50, <=55 dB(A)
>55, <=60 dB(A)
>60, <=65 dB(A)
>65, <=70 dB(A)
>70 dB(A)

Indicator 10 – Noise: Number of people exposed to noise from road traffic per 1,000 residents during the night (22:00-6:00)

Objective: to reduce health concerns caused by road traffic noise at night
Indicator: people affected by road traffic noise per 1,000 inhabitants during the night (22:00-6:00):
L_{night} >55 dB(A) = high noise disturbance, L_{night} >60 dB(A) = very high noise disturbance

Existing operationalised objectives:

World Health Organization (WHO): [1]	↦ <55 dB(A) as interim objective ↦ <40 dB(A) in order to ensure undisturbed sleep
Council of Experts for Environmental Issues: [2]	↦ 55 dB(A) short-term, 52 dB(A) medium-term, 45 dB(A) as a precaution (without concrete target years)
Federal Environment Agency: [3]	↦ 55 dB(A) as short-term trigger criterion for noise action plans, 50 dB(A) medium-term, 45 dB(A) long-term (without concrete target years)
NRW: [4]	↦ By 2030, significant reduction of the total noise pollution in residential areas, taking into account the WHO recommendations and the findings from research on the effect of noise on adverse health effects in the event of noise pollution during the night >55 dB(A)
City of Essen: [5]	↦ ≤55 dB(A) compliance as comprehensively as possible by 2018, trigger values for noise action planning of 45 dB(A) ↦ 45 dB(A) by 2035
Target proposal from the application for European Green Capital: [6]	↦ 55 dB(A) by 2018 ↦ 45 dB(A) by 2033
Target proposal from the planning office Richter-Richard for the Ruhr metropolitan area [7]	↦ ≤55 dB(A) by 2028 (5th round of noise abatement planning), ↦ ≤45 dB(A) as long-term objective

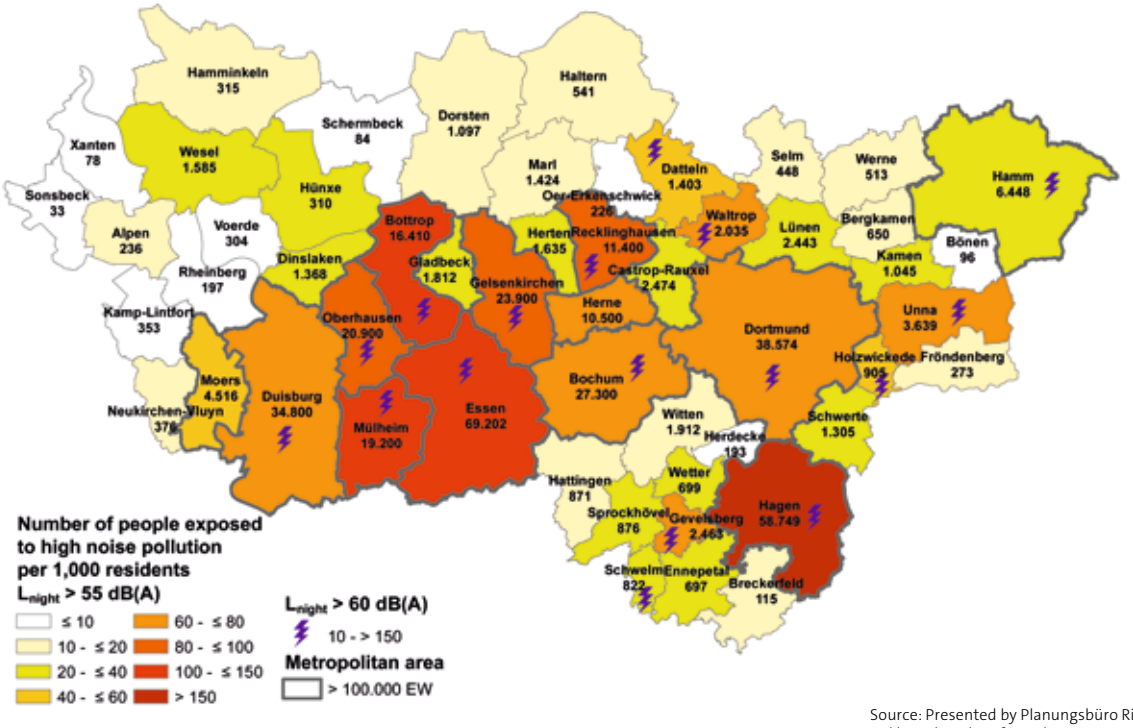
Significance of the environmental indicator

Disturbances to night-time sleep have a much greater adverse effect on people than does high noise pollution during the day (shortening of rest time). Noise during the night can not only result in sleep disturbances and insomnia, but it can also weaken the immune system and cause cardiovascular disease. [8] The target values for noise prevention during the night are therefore significantly lower than those used for full-day assessment (see indicator 9). The indicator L_{night} is used to delineate noise pollution in the Ruhr region during the night based on the number of people affected by road traffic noise during the hours of 22:00 to 6:00. 55 decibels (dB(A)) correspond to a high level of noise pollution during the night, 60 dB(A) to a very high level of noise pollution.

Legal background and existing targets

The legal background is constituted by the EU Environmental Noise Directive (2002/49/EC) [9] and the Federal Immissions Control Act (BImSchG) (see indicator 9). A health-related threshold value of 55 dB(A) applies during the night. [10] The German Advisory Council on the Environment indicates a threshold of 45 dB(A). Undisturbed sleep can be ensured under this value and waking reactions can be observed above the value. [11/12] The World Health Organization lowered this value to 40 dB(A) in 2009. The Federal Environment Agency (UBA) recommends immission levels of L_{night} = 55 dB(A) as a short-term operation target to reduce health concerns, 50(A) as a medium-term environmental target and 45 dB(A) as a long-term operation target. [14] NRW has committed itself to significantly reduce the total noise pollution in residential areas (without target year) and observe the recommendations made by the World Health Organization (WHO) along with the findings from research on the impacts of noise that indicate adverse health effects due to noise exposure starting at >55 dB(A) during the night. [15] Special urgency should be given to reduce very high noise pollution during the night with immision levels >60 dB(A). Planungsbüro Richter-Richard proposes that the densely populated Ruhr metropolitan area with its high traffic volume set the goal of comprehensively keeping night-time

High noise pollution from road traffic during the night in the Ruhr metropolitan area – affected people per 1,000 inhabitants and in absolute numbers (L_{night} >55 dB(A)) in 2012



Source: Presented by Planungsbüro Richter-Richard based on data from the LANUV

road traffic noise levels below 55 dB(A) by the time the Noise Action Plan is updated in 2028. Levels below 45 dB(A) should be maintained comprehensively over the long term.

Current situation and development in the Ruhr region

In 2012, around 380,000 people were affected by noise levels >55 dB(A) during the night in the Ruhr metropolitan area, i.e. 7.5% of the population. 50,000 more residents were affected by noise during the night with levels >65 dB(A) than during the day (see indicator 9). 120,000 residents were affected by levels over 60 dB(A) during the night (3.4% of the population). This equates to nearly one-third of the people affected by levels over 55 dB(A) also exposed to levels over 60 dB(A). The people most affected by noise during the night were those living in the central parts of the Ruhr metropolitan area, especially in the cities of Hagen (with 150 inhabitants/1,000 inhabitants), Essen, Mülheim a. d. Ruhr and Bottrop (each with 100-<150 and 40-<60 inhabitants/1,000 inhabitants respectively). Noise pollution significantly decreased near Lower Rhine and western Münsterland. By comparison: in 2011, nearly 914,000 people in NRW were affected by road traffic noise >55 dB(A), i.e. 5.2% of the population of around 17.5 million inhabitants. [17]

Assessment

Noise disturbance during the night is significantly more pronounced than noise disturbance during the day due to higher noise protection requirements for night-time sleep. The data provide a similar picture of noise pollution as during the full-day day periods: noise pollution is particularly high in the agglomerations in the central part of the Ruhr metropolitan area. In addition to the generally high importance of measures intended to afford noise protection in the Ruhr metropolitan area, measures must be chosen especially to protect night-time sleep and must be implemented as a priority. These measures must also take effect during the night, such as the night-time “Tempo 30” provision that reduces traffic speeds to 30 km/hr or bans on driving trucks during the night. There is no model city in the Ruhr metropolitan area for noise protection (during the night). However, there

are good individual measures and interesting strategic approaches in many cities. We can learn from these examples and develop joint approaches to utilise currently untapped regional potentials.

Trend in development

A40 Road Church Bochum

Sources and notes

[1] WHO – World Health Organization (2009): Night Noise Guidelines for Europe. http://www.euro.who.int/__data/assets/pdf_file/0017/43316/E92845.pdf.

[2] German Advisory Council on the Environment (1999): Sondergutachten des Rates von Sachverständigen für Umweltfragen: Umwelt und Gesundheit – Risiken richtig einschätzen. [Special Report from the Advisory Council on the Environment: Environment and Health – Properly Assessing Risks.] The German Bundestag, 14th legislative period, printed matter 14/2300 on 15.12.1999, pg. 32. http://www.umweltrat.de/SharedDocs/Downloads/DE/02_Sondergutachten/1999_SG_UmweltundGesundheit.pdf?__blob=publicationFile.

[3] Federal Environment Agency (UBA) (2006): Richtlinie über die Bewertung und Bekämpfung von Umgebungslärm – Auslösekriterien für die Lärmaktionsplanung. [Directive on the assessment and management of ambient noise – trigger criteria for noise action planning]. March 2006. https://www.umweltbundesamt.de/sites/default/files/medien/pdfs/UBA_Kriterien_ULR.pdf.

[4] State Government of North Rhine-Westphalia (2016): Nachhaltigkeitsstrategie für Nordrhein-Westfalen. [Sustainability strategy for North Rhine-Westphalia]. https://www.umwelt.nrw.de/fileadmin/redaktion/Broschueren/nrw-nachhaltigkeitsstrategie_broschuere.pdf, pg. 61.

[5] City of Essen (2014): Bewerbungsunterlagen zur Grünen Hauptstadt Europas 2017 – Themenfeld 06: Qualität der akustischen Umgebung. [Application documents for European Green Capital 2017 – Topic 06: Quality of the acoustic environment.] https://media.essen.de/media/wwwessende/aemter/59/gruene_hauptstadt_europas_1/06_GHE_Themenfeld_akustische_Umgebung_web.pdf, pg.14.

[6] Wuppertal Institute with Planungsbüro Richter-Richard and with Regionalverband Ruhr (2013): Metropole Ruhr – Grüne Hauptstadt Europas. [Ruhr Metropolitan Area – European Green Capital], pg. 19. Wuppertal. http://wupperinst.org/uploads/tx_wupperinst/Metropole_Ruhr_Endbericht.pdf, accessed 8.11.2016.

[7] Target proposal from Planungsbüros Richter-Richard: L_{night} = 55 dB(A) by 2028, L_{night} = 45 dB(A) as long-term objective by 2050. More ambitious still is the target formulated in the application by the Ruhr metropolitan area for the European Green Capital to reach L_{night} = 55 dB(A) by 2018 and L_{night} = 45 dB(A) by 2033 (see Wuppertal Institute (2013): Metropole Ruhr – Grüne Hauptstadt Europas. [Ruhr Metropolitan Area – European Green Capital]. Wuppertal. http://wupperinst.org/uploads/tx_wupperinst/Metropole_Ruhr_Endbericht.pdf, pg. 147).

[8] In addition to the displayed correlations, statistical relationships are seen between the exposure to traffic noises in residential areas during the night and impairments to the immune system and metabolism. In comparison with traffic noise during the night, noise pollution during the day exhibits less significant correlation with medical treatments of said diseases. However, the frequency of medical treatments for mental disorders shows a strong correlation with the subjectively perceived noise disturbance during the day. People in noisy residential areas receive more medical attention due to high blood pressure than people in areas with less noise pollution. Thus, people who are exposed to a medium sound level of 55 dB(A) or more through their bedroom window during

the night are almost twice as likely to receive medical treatment for high blood pressure than people with levels below 50 dB(A). The Federal Environment Agency (UBA) concludes through the evaluation of different epidemiological noise effect studies that around three per cent of all cases of heart attacks in Germany are caused by road traffic noise (see Federal Environment Agency (UBA) (2015): Stressreaktionen und Herz-Kreislauf-Erkrankungen. [Stress reactions and cardiovascular diseases]. Article from 22.12.2015. http://www.umweltbundesamt.de/themen/verkehr-laerm/laermwirkung/stressreaktionen-herz-kreislauf-erkrankungen).

[9] Directive 2002/49/EC of the European Parliament and of the Council of 5 June 2002 relating to the assessment and management of environmental noise. http://www.bmub.bund.de/fileadmin/bmu-import/files/pdfs/allgemein/application/pdf/rl_umgebungslaerm.pdf.

[10] Ministry for the Environment and Nature Conservation, Agriculture and Consumer Protection (2008): Lärmaktionsplanung. [Noise action planning]. RdErl. d.- V-5 - 8820.4.1, Düsseldorf.

[11] German Advisory Council on the Environment (2004): Umweltgutachten 2004 – Umweltpolitische Handlungsfähigkeit sichern. [Environmental Report 2004 - Securing Environmental Legal Capacity].

[12] German Advisory Council on the Environment (2005): Sondergutachten Umwelt und Straßenverkehr – Hohe Mobilität – Umweltverträglicher Verkehr. [Special report environmental and road traffic – high mobility – environmentally friendly transport]. Berlin.

[13] WHO – World Health Organization (1999): Guidelines for Community Noise. Geneva. http://www.google.pt/url?sa=t&rct=j&q=&esrc=s&source=web&cd=2&ved=0ahUKEwi_5fCf467MAhVGXB4KHXISAjsQFggrMAE&url= http%3A%2F%2Fwhqlibdoc.who.int%2Fhq%2F1999%2Fa68672.pdf&usg=AFQjCNHq0SRjmXAXPKGPvQC88NtlGaJJBQ.

[14] Federal Environment Agency (UBA) (2006): Richtlinie über die Bewertung und Bekämpfung von Umgebungslärm – Auslösekriterien für die Lärmaktionsplanung. [Directive on the assessment and management of ambient noise – trigger criteria for noise action planning]. March 2006. https://www.umweltbundesamt.de/sites/default/files/medien/pdfs/UBA_Kriterien_ULR.pdf.

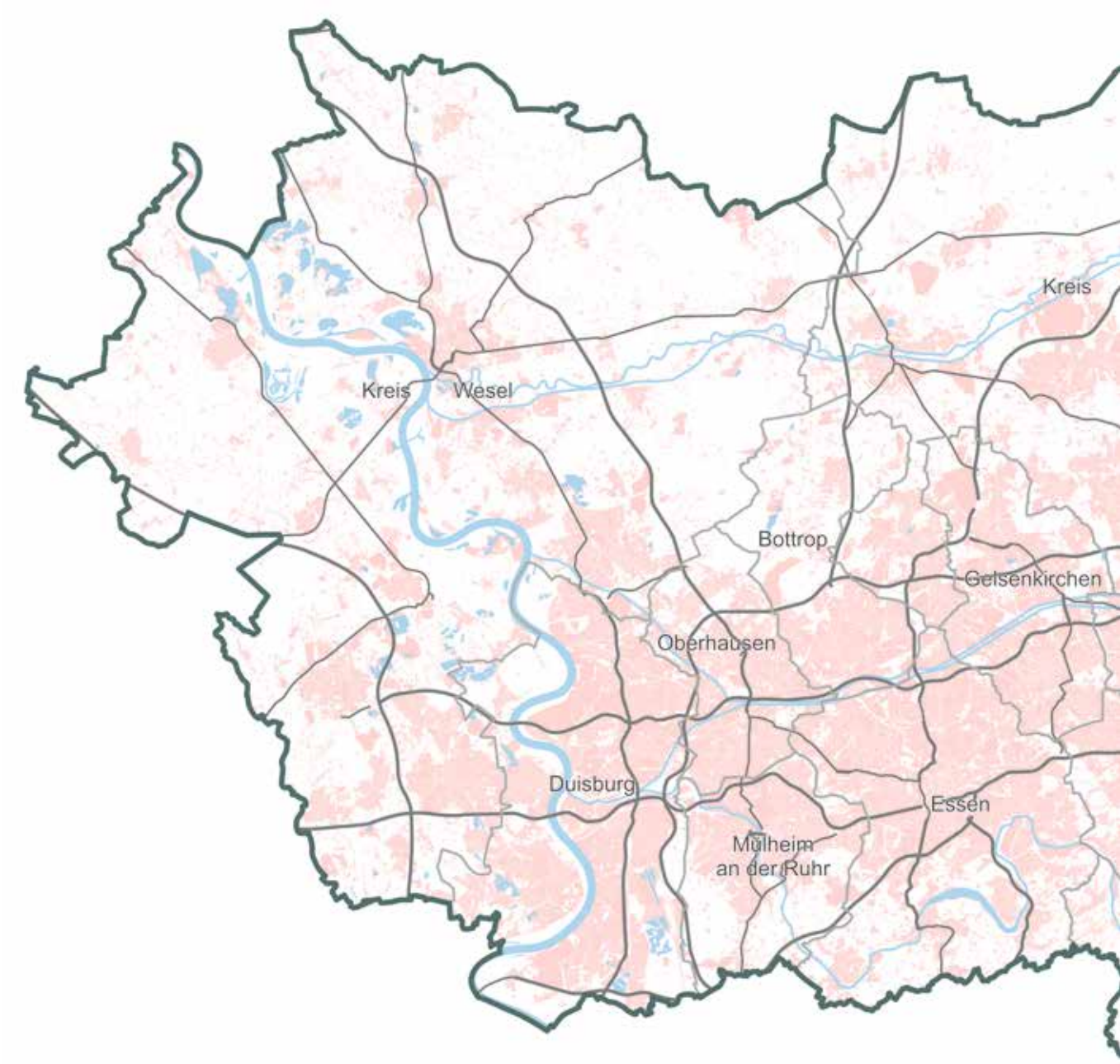
[15] State Government of North Rhine-Westphalia (2016): Nachhaltigkeitsindikatoren Nordrhein-Westfalen. [North Rhine-Westphalia sustainability indicators]. http://www.nachhaltigkeit.nrw.de/fileadmin/download/nachhaltigkeits-indikatorenbericht_2016.pdf, pg. 26.

[16] State Government of North Rhine-Westphalia (2016): Nachhaltigkeitsindikatoren Nordrhein-Westfalen. [North Rhine-Westphalia sustainability indicators]. http://www.nachhaltigkeit.nrw.de/fileadmin/download/nachhaltigkeits-indikatorenbericht_2016.pdf, pg. 27.

[17] 913,700 inhabitants who were affected by noise during the night in 2011 correspond to 5.2% of the total number of inhabitants in NRW in 2011 (IT.NRW (2013): 2011 Census: North Rhine-Westphalia has 17,538,251 inhabitants. Düsseldorf. https://www.it.nrw.de/presse/pressemitteilungen/2013/pres_122_13.html, accessed 8.11.2016).

5.11 Land Use: Increase in the amount of land used for human settlements and transport infrastructure

Land use by residential and transport areas in the Ruhr metropolitan area

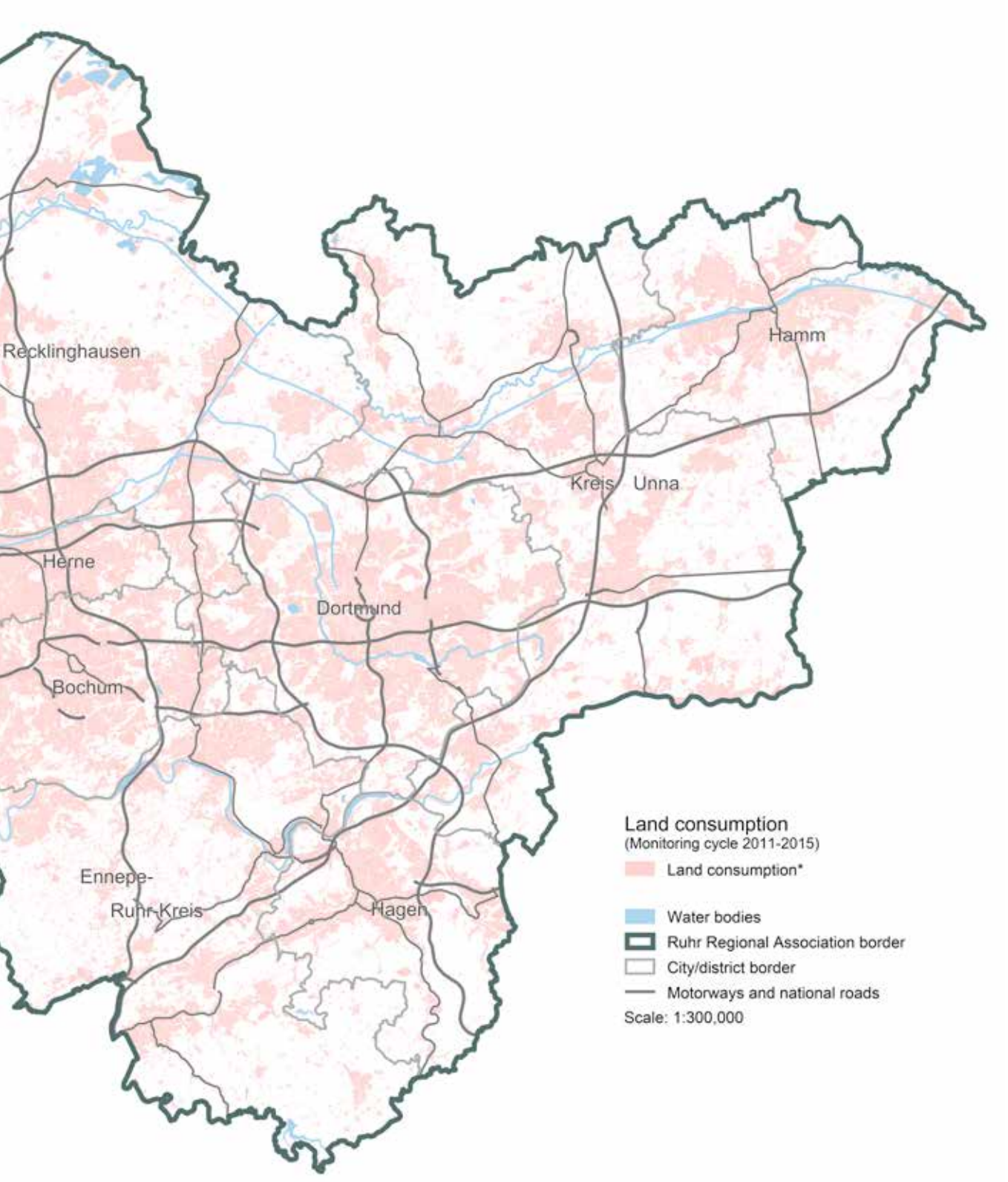


* Based on the catalogue of land use according to the land use survey: residential areas, commercial areas, industrial areas, sports and recreation building areas, public purpose land, agricultural farm and building spaces, other construction areas (military installations), road space, rail-bound traffic areas and auxiliary installations, air fields and landing strips, other public areas, energy supply, water supply, wastewater treatment, waste disposal, landfills, excavation areas, public and private parks and green spaces, cemeteries, allotments, playgrounds and sports facilities, campsites, roadside vegetation, horticulture, stockpiles/spoil tips, other land

Concept development: Wuppertal Institute, Ruhr Regional Association

Source: Ruhr Regional Association

Map source: © Ruhr Regional Association


Recklinghausen
Hamm
Kreis Unna
Herne
Dortmund
Bochum
Ennepe-
Ruhr-Kreis
Hagen
Land consumption
(Monitoring cycle 2011-2015)
Land consumption*
Water bodies
Ruhr Regional Association border
City/district border
Motorways and national roads
Scale: 1:300,000

Indicator 11 – Land Use: Increase in the amount of land used for human settlements and transport infrastructure

Objective: to reduce and prevent land use
Indicator: increased residential and transport areas (in hectares per day)

Existing operationalised objectives::

European Commission: [1]	↦ Reduction to 0 ha/day by 2050
Germany: [2]	↦ Limiting daily land use for residential and transport to 30 ha/day by 2020 ↦ Proposal of the German Council for Sustainable Development: 0 ha/day by 2050
NRW: [3]	↦ 5 ha/day by 2020 ↦ 0 ha/day long-term
Demand from the NRW Nature Conservation Association for NRW: [4]	↦ 0 ha/day by 2025
Targets proposed by the Wuppertal Institute for the Ruhr metropolitan area: [5]	↦ 1 ha/day by 2020 ↦ 0 ha/day by 2050

Significance of the environmental indicator

Land use indicates the increase of residential and transport area, or the conversion of farmland, meadows and forests into space for settlement and transport purposes. Residential and transport areas do not only contain developed, sealed surfaces like areas for building, commercial and traffic use, but also contain green and open spaces like parks, gardens and cemeteries. In the statistical records, residential and transport areas consist of the following land registry categories: buildings and open spaces, industrial areas (without mining sites), recreational areas, cemeteries and traffic areas. [6]

The change in land use for residential and transport purposes (in hectares per day) is a key indicator for the sustainability of land consumption. Areas have various functions and are subject to a multitude of competing uses: for residential and transport, habitat, landscape and nature conservation and agricultural use. Important soil functions are permanently destroyed by covering the ground surface. [7] Vital soils are the foundation for our agriculture and forestry industries, are an important habitat for animals, plants and microorganisms and are essential for water cycles and replenishing groundwater. [8] Land use and fragmented landscapes have a negative impact on biodiversity.

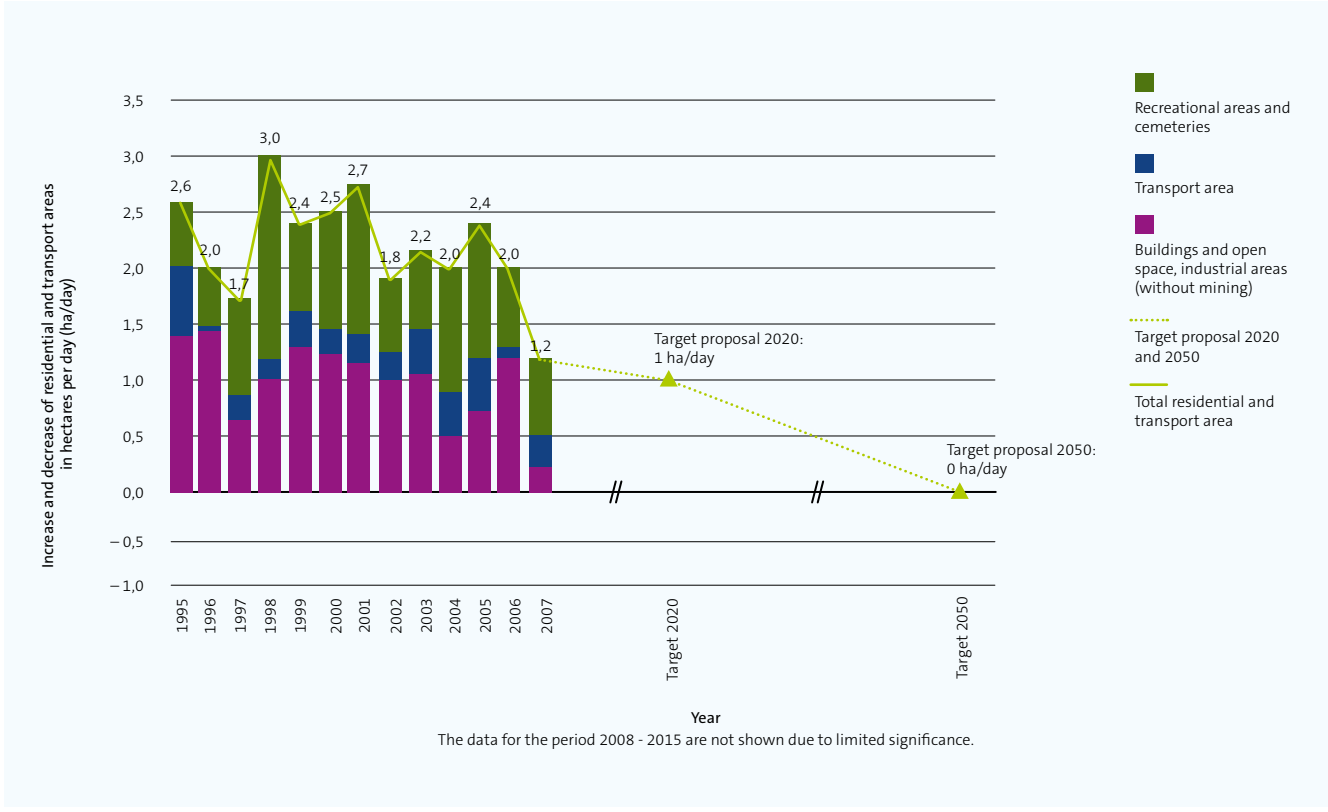
Land use and urban sprawl contradict the model of a compact settlement structure. This reduces infrastructure utilisation and increases infrastructure costs. If offers such as kindergartens, schools or public transport are less profitable and spread out, dependence on passenger cars increases. [9]

Existing targets

The federal government formulated the objective in its National Sustainability Strategy (2002 and 2016) [12] to reduce the increase of residential and transport areas nationwide to 30 hectares per day by 2020 and to zero hectares over the long term (without target year; actual value 2014: 69 ha/day). [13] In accordance with the federal objective, the federal state government of NRW strives to reduce land consumption to an average of 5 hectares per day by 2020 and to zero hectares over the long term through the "Allianz für die Fläche" [14] and the Sustainability Strategy NRW [15] from 2016 (2014 actual value: 9.13 ha/day). [16] Nature conservation associations call for a reduction in land consumption to zero hectares by 2025. [17] The Wuppertal Institute recommends that the Ruhr region reduce the increase in residential and transport areas to one hectare per day by 2020 and to zero hectares per day by 2050, in accordance with the national and federal state objectives.

Land recycling on the site of a former steel factory – Phoenix Lake in Dortmund

Increase and decrease of residential and transport areas in the Ruhr region (in hectares per day) and target recommended by the Wuppertal Institute for the Ruhr region for 2020 and 2050



The data for the period 2008 - 2015 are not shown due to limited significance.

Source: Representation by the Wuppertal Institute using data from IT.NRW [10], target recommended by the Wuppertal Institute; presentation and selection of the portrayed land types in accordance with the Sustainability Strategy NRW [11]

Current situation and development in the Ruhr region

Land use in the Ruhr region illustrates the region's character as a densely populated agglomeration: 39.3% of the land in the Ruhr region was used for residential and transport purposes in 2015 [18] – a significantly higher share than the federal state or national average (23% and 14%). [19] An average of 2.2 hectares of new residential and transport areas were added in the Ruhr region each day from 1997 to 2007 – this corresponds to around 87 square kilometres (8,699 hectares) or the size of around 12,000 football fields [20] or almost the area of Mülheim an der Ruhr (91 square kilometres) over the decade from 1997 to 2007. [21]

It is important to note that a nationwide conversion of the official statistics for land use was performed in recent years. In NRW, the land statistics were gradually converted from 2008 to 2015, temporarily limiting the significance of the data in this period. [22] The data for the period 2008 to 2015 are therefore not taken into account for the evaluation of the indicator. Starting in 2016, data validity once again improved and was stabilised.

The data until 2007 show a decreasing tendency in land use in the Ruhr region. From 1998 to 2002, an average of 2.5 additional hectares of open space were converted into residential and transport areas every day, corresponding to about 3.5 football fields per day. This fell to 1.9 hectares (or about 2.7 football fields) per day from 2003 to 2007. In 2007, land use increase reached 1.2 hectares per day – already close to the Wuppertal Institute's 1 hectare objective for 2020. Area analysis made by the Ruhr Regional Association from aerial photographs revealed that land use from 2009 to 2016 reached a similar magnitude as in 2007 (approx. 1.1 ha/day). [23] The cities and districts of the Ruhr region differ considerably from one another. From 1997 to 2007, residential and transport areas increased most profoundly in the districts of Wesel (0.5 ha/day), Unna and Recklinghausen (each 0.3 ha/day). The cities with the lowest land use increase during this period were the cities of Gelsenkirchen, Hagen and Herne (each 0.0 ha/day).

Development trend

No trend analysis is possible due to a lack of data from previous years

Assessment

Data until 2007 show a favourable decreasing tendency in land use. However, the data also show that efforts to reduce land consumption must be further intensified in order to reach the desired target value of one hectare per day by 2020 and to continue to reduce land consumption towards zero hectares by 2050. In the Ruhr region, there are already good concepts to stop urban sprawl, like in the regional land use plan for Bochum, Essen, Gelsenkirchen, Herne, Mülheim an der Ruhr and Oberhausen (RFNP, since 2010), which advocates the economical use of the ground. [24] The Phoenix See in Dortmund is a good example of recycling [25] (industrial) wastelands in the Ruhr region. On the formerly polluted, industrial area of a steel mill now lies a lake with adjacent recreational, residential and commercial areas as well as a new habitat for plants and wildlife. [26]

Sources and notes

[1] European Commission (2011): Roadmap to a resource efficient Europe. KOM(2011)571, Brussels, p. 17f. http://eur-lex.europa.eu/legal-content/DE/TXT/PDF/?uri=CELEX:52011DC0571&from=EN, accessed 7.11.2016.

[2] The Federal Government (2002): Perspektiven für Deutschland – Unsere Strategie für eine nachhaltige Entwicklung. [Perspectives for Germany – Our Strategy for Sustainable Development], p. 68. https://www.bundesregie- rung.de/Content/DE/_Anlagen/Nachhaltigkeit-wiederhergestellt/perspektiven-fuer-deutschland-langfassung.pdf?__blob=publicationFile&v=3.

[3] State Government of North Rhine-Westphalia (2016): Nachhaltigkeitsstrategie für Nordrhein-Westfalen. [Sustainability Strategy for North Rhine-Westphalia], p. 61. Düsseldorf. http://www.nachhaltigkeit.nrw.de/fileadmin/download/nrw-nachhaltigkeitsstrategie_broschuere.pdf, accessed 03.08.2016. See also "Allianz für die Fläche in Nordrhein-Westfalen" at http://www.allianz-fuer-die-flaeche.nrw.de.

[4] NABU NRW (2016): Flächenverbrauch Einhalt gebieten. [Curbing land use]. https://nrw.nabu.de/news/2016/20039.html, accessed 22.3.2016.

[5] Targets proposed by the Wuppertal Institute: 1 hectare by 2020, 0 hectares by 2050. Derivation: The proportion of area in the Ruhr region to the total NRW amounts to 13% (445,945 hectares (own calculation) compared to 3,410,265 hectares (https://www.it.nrw.de/presse/pressemitteilungen/2014/pdf/188_14.pdf)). The population of the Ruhr region amounts to approximately 29% of the total NRW (5.05 million residents compared to 17.5 million residents). A share of 13% of the 5-hectare target of the federal state of NRW for the corresponds to a value of 0,65 hectares for the Ruhr region, a share of 29% corresponds to a value of 1.45. Thus, a target value for 2020 should fall between 0.65 and 1.45 hectares. The Wuppertal Institute recommends the target value of 1 hectare per day by 2020 as a pragmatic, easily expressed target value.

[6] State Government of North Rhine-Westphalia (2016): Nachhaltigkeitsindikatoren Nordrhein-Westfalen. Bericht 2016. [North Rhine-Westphalia sustainability indicators. Report 2016], p. 24. https:// www.nachhaltigkeit.nrw.de/fileadmin/download/nachhaltigkeits-indikatorenbericht_2016.pdf, accessed 26.10.2016.

[7] Note: The "residential and transport areas" do not fully equate to "sealed areas", since residential and transport areas also "[include] a significant proportion of undeveloped and not sealed surfaces" in the official statistics (Federal Statistical Office, 2014): Siedlungs- und Verkehrsfläche wächst täglich um 73 Hektar [Residential and Transport Areas Increase 73 Hectares per Day]. Press release No. 461 from 18.12.2014. https://www.destatis.de/DE/PresseService/Presse/Pressemitteilungen/2014/12/PD14_461_331.html). In NRW, the proportion of sealed surfaces amounts to approximately half of the residential and transport areas (LANUV NRW – State Agency for Nature, Environment and Consumer Protection of North Rhine-Westphalia (2015): Umweltindikatoren NRW – 32 Flächenverbrauch. [Environmental indicators NRW - 32 land use]. Last updated: 12.06.2015. http://www2.lanuv.nrw.de/umweltindikatoren-nrw/index.php?indikator=2&aufzu=3&mode=indi), each accessed 22.3.2016.

[8] European Commission (2012): Guidelines on best practice to limit, mitigate or compensate soil sealing, starting on p. 55, Brussels. http://ec.europa.eu/environment/soil/pdf/guidelines/DE%20-%20Sealing%20Guidelines.pdf, accessed 22.3.2016.

[9] BMUB – Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety (2015): Flächenverbrauch – Worum geht es? [Land use – what is it all about?] http://www.bmub.bund.de/themen/strategien-bilanzen-gesetze/nachhaltige-entwicklung/strategie-und-umsetzung/reduzierung-des-flaechenverbrauchs/, accessed 22.3.2016.

[10] Calculation by the Wuppertal Institute based on "Kommunalprofil: Fläche nach Nutzungsarten – Zeitreihe (12 Jahre)" [Municipal profile: area according to use type – 12-year time series]; Landesdatenbank NRW from the State Office for Information and Technology North Rhine-Westphalia (IT.NRW), https://www.landesdatenbank.nrw.de/ldbnrw/online/data;jsessionid=FB8F8939D- 1857C536F7B487DB6C85381?operation=statistikAbruftabellen&levelindex=0&levelid=1477524762891&index=3, accessed 26.10.2016.

[11] See footnote 6 (Sustainability indicators NRW, p. 24).

[12] See footnote 2, p. 68 as well as the Federal Government (2016): Deutsche Nachhaltigkeitsstrategie – Neuauflage 2016, [German Sustainability Strategy – new edition 2016], p. 162. https://www.bundesregierung.de/Content/DE/StatischeSeiten/Breg/Nachhaltigkeit/0-Buehne/2016-05-31-down-load-nachhaltigkeitsstrategie-entwurf.pdf?__blob=publicationFile&, accessed 26.10.2016.

[13] See footnote 3 (Sustainability strategy NRW, p. 61).

[14] See footnote 3 (Allianz für die Fläche).

[15] See footnote 3 (Sustainability strategy NRW, p. 61).

[16] IT.NRW as per footnote 6 (Sustainability indicators NRW, p. 24).

[17] NABU NRW (2016): Flächenverbrauch Einhalt gebieten. [Curbing land use]. https://nrw.nabu.de/news/2016/20039.html, accessed 22.3.2016.

[18] Website of the Ruhr Regional Association, Statistics Portal Ruhr (undated): Siedlungs- und Verkehrsfläche 2015 in %. [Residential and transport areas in 2015 in %]. http://www.metropoleruhr.de/regionalverband-ruhr/statistik-analysen/statistik-portal.html, accessed 27.7.2017.

[19] State Office for Information and Technology of North Rhine-Westphalia (IT.NRW) (2013): Siedlungs- und Verkehrsfläche beansprucht ein Viertel der NRW-Landesfläche. [Settlement and Transport Areas Claim One-Fourth of NRW's Territory]. Press release from 5.7.2013. https://www.it.nrw.de/presse/pressemitteilungen/2013/pres_156_13.html; Federal Environment Agency (2015): Siedlungs- und Verkehrsfläche [Residential and Transport Area], http://www.umweltbundesamt.de/daten/flaechennutzung/siedlungs-verkehrsflaeche; Federal Statistical Office (destatis) (2015): Germany, https://www.destatis.de/DE/ZahlenFakten/LaenderRegionen/Internationales/Land/Europa/Deutschland.html; each accessed 18.3.2016.

[20] FIFA standard for a football field: Length 105m, Width 68m = 7,140 m^2 = 0.714 ha, see FIFA - Fédération Internationale de Football Association (2010): Reglement. 2010 FIFA World Cup South Africa, p. 40. Zurich. http://de.fifa.com/mm/document/tournament/competition/56/42/69/fifawcsouthafrica2010inhalt_d.pdf, accessed 18.3.2016. 8,699 hectares / 0.714 hectares = 12,183

[21] The City of Mülheim an der Ruhr has an area of 91.28 km^2, (IT.NRW, Landesdatenbank NRW (LDB) (2016): Structural data for Mülheim an der Ruhr, last updated: 31.05.2017, https://www.it.nrw.de/kommunalprofil/k05117.pdf, accessed 27.07.2017).

[22] Nationwide conversion from the Automated Property Register (ALB) to the Official Land Registry Information System (ALKIS) (Federal Statistical Office (2013): Flächenerhebung nach Art der tatsächlichen Nutzung, p. 4. Wiesbaden. https://www.destatis.de/DE/Publikationen/Qualitaetsberichte/LandForstwirtschaft/Flaechenerhebung.pdf?__blob=publicationFile; Meinel, Gotthard; Schumacher, Ulrich (2008): Flächennutzungsmonitoring – Grundlagen, Statistik, Indikatoren, Konzepte. [Land use monitoring – essentials, statistics, indicators, concepts], p. 3. https://www.destatis.de/DE/Publikationen/Thematisch/LandForstwirtschaft/Flaechennutzung/FlaechenstatistikDL.pdf?__blob=publicationFile). Additionally, rates of change are based partly on purely mathematical corrections to the cadastre (Information and Technology of North Rhine-Westphalia (IT.NRW) (2013): Residential and transport areas account for a quarter of the total area in NRW. https://www.it.nrw.de/presse/pressemitteilungen/2013/pres_156_13.html), e.g. due to new surveying techniques (German Federal Statistical Office (undated): Warum nimmt die Bodenfläche Deutschlands zu? [Why is Germany's soil surface increasing?] https://www.destatis.de/DE/ZahlenFakten/Wirtschaftsbereiche/LandForstwirtschaftFischerei/FAQ/Methodik/Bodenflaeche.html;jsessionid=EFEDB0A6F939494C1D1AE4E272B0374A.cae1), each accessed 22.3.2016.

[23] The Ruhr Regional Association evaluates the land use survey for the Ruhr metropolitan area by means of aerial photographs that do not exhibit the same temporal density as the data from IT.NRW. Land use data from 2009 and 2012-2016 is available. If the median annual value from 2014 is chosen as a reference value from the period of 2012-2016 and the registered increase in land use is distributed over a time period of five years or 1,825 days (2012-2014), then land use in the Ruhr region during this period is approximately 1.14 hectares per day (data evaluation from the Ruhr Regional Association, made available in July 2017).

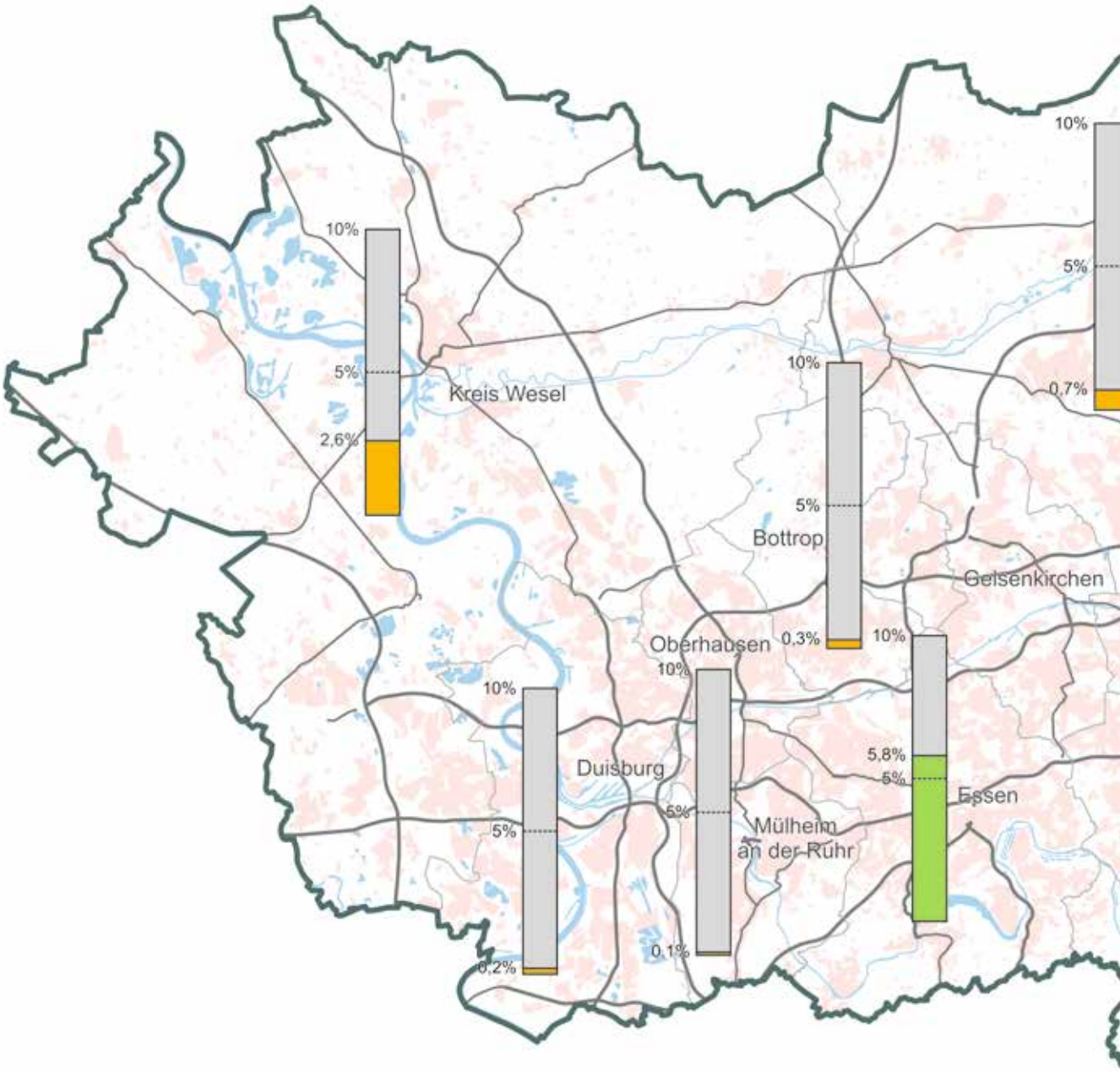
[24] The cities of Bochum, Essen, Gelsenkirchen, Herne, Mülheim an der Ruhr, Oberhausen (2009): Textteil und Begründung zum Regionalen Flächennutzungsplan der Planungsgemeinschaft Städteregion Ruhr. [Text and explanatory statements regarding the Regional Land-Use Plan by Planungsgemeinschaft Städteregion Ruhr]. http://www.staedteregion-ruhr-2030.de/cms/shared/datei_download.php?uid=7b45b7e6d7adcba62d39cc9c969ff7cc, accessed 27.10.2016..

[25] Land recycling is the rehabilitation of locations previously used for commercial/industrial, traffic, military, residential purposes or as public buildings or facilities that were generally dilapidated or under-used before rehabilitation (Heyer, Rolf (2012): Flächenrecycling bei gewerblichen Brachflächen. [Land recycling of industrial derelict land], In: KommP spezial 3/2012, p. 142-147, p. 142. http://www.nrw-urban.de/fileadmin/user_upload/pdf_flyer___journale/downloads/Flaechenrecycling_bei_gewerblichen_Brachflaechen.pdf, accessed 22.3.2016.

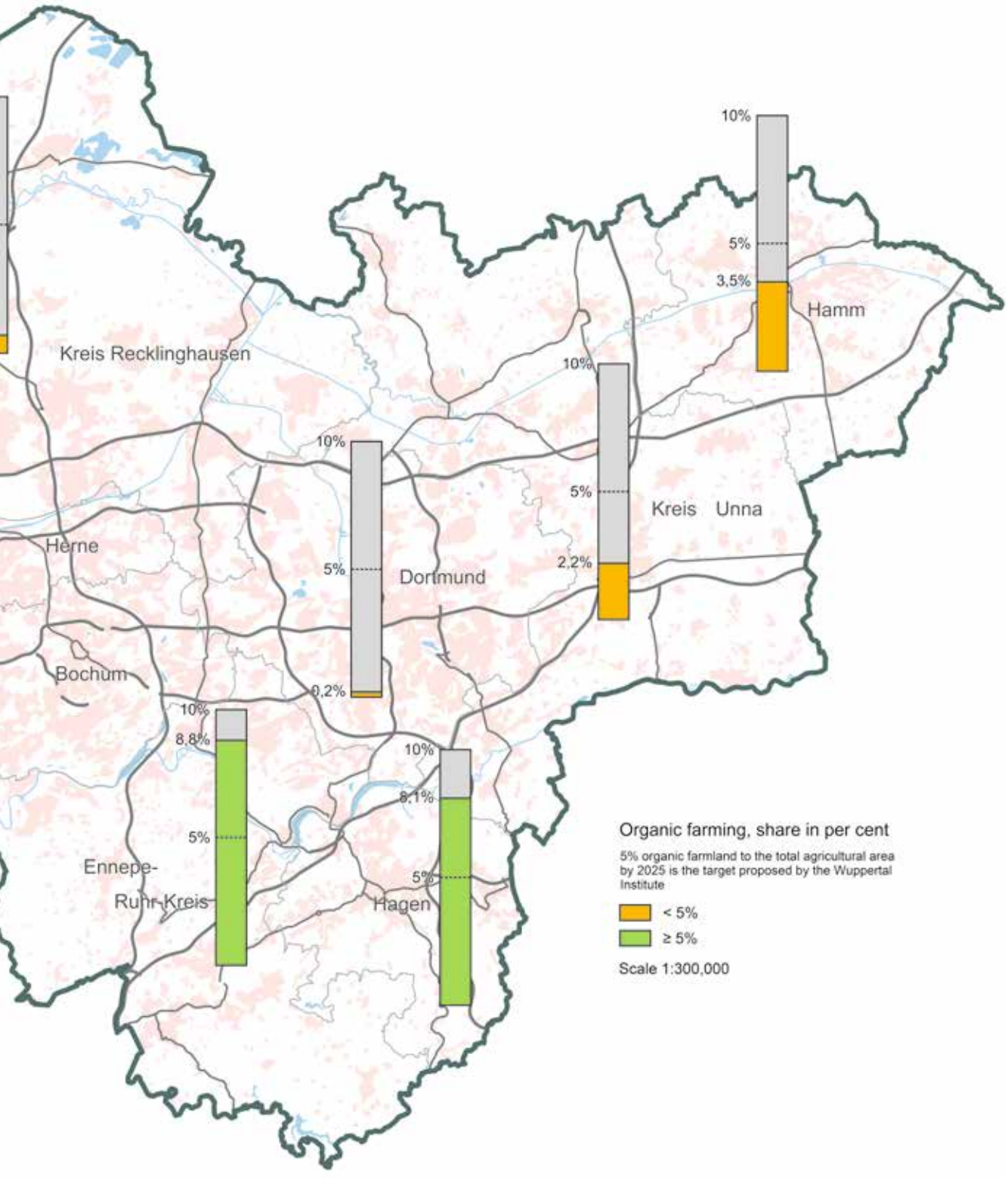
[26] Emschergenossenschaft, Lippeverband (2014): Artenvielfalt im Phoenix See. [Biodiversity in Lake Phönix-See]. Press release from 1.8.2014. http://blog.eglv.de/artenvielfalt-im- phoenix-see/, accessed 22.3.2016.

5.12 Organic farming: Proportion of organic farmland in the total agricultural land area

Proportion of organic farmland in the total agricultural area (in %) in the cities and districts of the Ruhr metropolitan area



Concept development: Wuppertal Institute, Regional Association Ruhr
Source: Agricultural Chamber NRW (last updated 2015)
Map source: © Regional Association Ruhr


10%
5%
3,5%
Hamm
Kreis Recklinghausen
10%
5%
Kreis Unna
2,2%
10%
5%
Dortmund
Herne
0,2%
Bochum
10%
8,8%
5%
Ennepe-
Ruhr-Kreis
10%
8,1%
5%
Hagen
Organic farming, share in per cent
5% organic farmland to the total agricultural area by 2025 is the target proposed by the Wuppertal Institute
< 5%
≥ 5%
Scale 1:300,000

Indicator 12 – Organic farming: Proportion of organic farmland in the total agricultural land area

Objective: to ensure a sustainable and eco-friendly management of farmland and to expand the production of organic, high-quality food
Indicator: proportion of organic farmland* in the total agricultural area (in %)

Existing operationalised objectives:

Germany: [1]	↦ Increase amount of organic farmland to 20% (without target year)
NRW: [2]	↦ Consistent expansion of organic agriculture to meet continuously increasing demand by 2020
Target proposed by the Wuppertal Institute for the Ruhr metropolitan Area: [3]	↦ Increase percentage of organic farmland in the total agricultural area to 5% by 2025 (average area in the Ruhr region)

*Fields, permanent crops and grassland

Significance of the environmental indicator

Organic farming is particularly environmentally and climate-friendly, conserves the natural resources water and soil and contributes to the conservation of biological diversity. Organic farming strives for, among other things, a largely closed nutrient cycle, meaning that fodder and fertiliser should come from within the farm as often as possible. No easily soluble mineral fertiliser or chemical, synthetic pesticides are used and soil fertility is maintained through distinct humus management and crop rotation with catch crops and green manure. Animals are kept in species-appropriate conditions and are predominantly given feed produced on the farm. Antibiotics are largely avoided, the amount of livestock is limited and is strictly tied to the available area. [4]

By restricting chemical, synthetic pesticides and herbicides and utilising small amounts of fertiliser, organic farming encourages diversity of animal and plant life, protects bodies of groundwater from eutrophication and also serves to link biotope networks (see indicator biotope network). Simultaneously, this can strengthen the added value locally, create new market structures and secure jobs in rural areas [5] (see indicator environmental economics). The rural areas of the Ruhr metropolitan area can particularly benefit from this design. Additionally, organic food fulfils the increasing demand from consumers for environmentally and animal-friendly, locally-sourced food production. [6] From a sustainability perspective, it is helpful to increase the number and share of organically cultivated farmland.

Existing targets

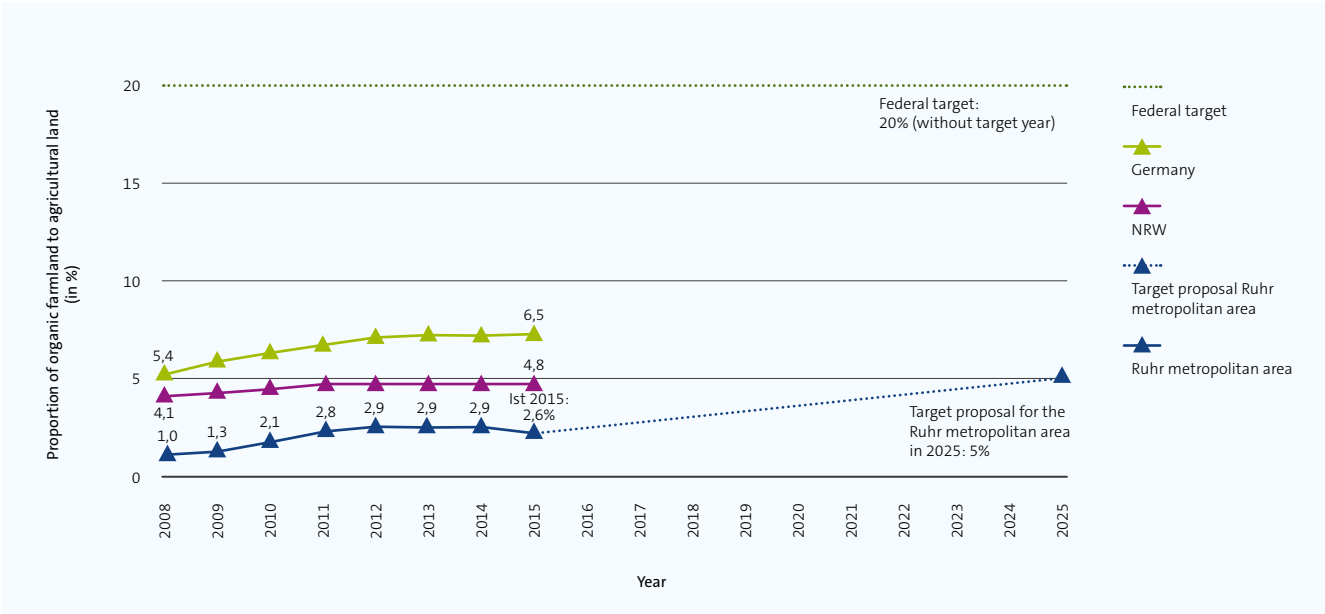
The federal government defined a goal to increase the share of organic farmland in agricultural area to 20% "over the next few years" in its progress report on the national sustainability strategy in 2012. [8] Ongoing expansion of organic agriculture should be carried out to satisfy the continuously increasing demand by 2020 as part of the Organic Farming Strategy for North Rhine-Westphalia 2020 and the Sustainability Strategy NRW (without operational target value). [9] In this context, the Wuppertal Institute proposes that the Ruhr metropolitan area set the goal of increasing the share of organic farmland in agricultural areas to 5% by 2025 and preserve all arable land. A share of 5% organic farmland in 2025 is equivalent to an area of 6,040 hectares.

Current situation and development in the Ruhr region

In 2015, 34% of the entire Ruhr metropolitan area was used for agriculture [10] (443.554 hectares). [11] Organic farming occupies 2.6% of this agricultural land (3,991 hectares, as of 2015). Between 2008 and 2012, the share of organic farmlands rose from 1.0% to 2.9% and slightly decreased to 2.6% from 2014 to 2015. [12] The amount of the proportion of organic farmland to the total agricultural land is influenced largely by the loss of agricultural land to other land uses. The Ruhr region loses an average of 10.41 km^2 of agricultural land to other land uses per year, illuminating the competition on the use of the limited resources soil and area (see indicator land use). [13]

Feldfreunde Schuir / European Green Capital – Essen 2017

Development of the proportion of organic farmland to agricultural land in the Ruhr metropolitan area from 2008 to 2015 as well as targets proposed by the Wuppertal Institute for 2025



Source: Depiction from the Wuppertal Institute using data from the Chamber of Agriculture (LWK) NRW (applications received by the LWK NRW to promote organically farmed areas in accordance with the EU-Eco-Regulation 834/2007) and LiKi Federal States Initiative Core Indicators [7], target proposed by the Wuppertal Institute

Haus Holte Witten

Assessment

The current proportion of area used for organic farming in the Ruhr region of 2.6% is significantly lower than NRW's federal state average of 4.8% [14] and the national average of 6.3%. The growth of the proportion of area used for organic farming from 1.0% to 2.6% over the last 5 years (2008-2015) is going in the right direction. It should, however, be increased further during the next few years in order to reach the level of the federal state average. The target should be to double the proportion of organic farmland to 5% by 2025.

Good starting points for increasing the proportion of organic farmland are targeted marketing strategies for organic products, networking and expanding the regional sales structures in organic farming.

The increase in the proportion of organically cultivated farms in the Ruhr metropolitan area can only happen if the current high use of arable land is reduced, since organic farming is dependent on available and suitable land.[15] For further residential and commercial areas (see indicator land use), initiatives such as wasteland recycling should be pursued.

Trend in development

A good example for organic farming is the Kornkammer Haus Holte in Witten, where potatoes and grains have been grown according to the guidelines of the Bioland Association since 1987. [16] Around 200 hectares of organic farmland are distributed throughout the Ruhr region in Essen, Witten, Dortmund and Bochum. [17] Another good example is the Schultenhof in Dortmund, where ecological, economic and social aspects are combined: people with and without disabilities live and work here on the organic farm, where they cultivate, process and market the products made here in their own farm shop. [18]

Sources and notes

[1] The Federal Government (2012): Nationale Nachhaltigkeitsstrategie Fortschrittsbericht 2012. [National Sustainability Strategy Progress Report 2012]. Berlin, p. 32. http://www.bundesregierung.de/Content/DE/_Anlagen/Nachhaltigkeit-wiederhergestellt/2012-05-21-fortschrittsbericht-2012-barrierefrei.pdf?__blob=publicationFile&v=1, accessed on 15.02.2016.

[2] MKULNV – NRW Ministry for Environment, Agriculture, Conservation and Consumer Protection of the State of North Rhine-Westphalia (2016): Öko-Landwirtschaftsstrategie für Nordrhein-Westfalen 2020, [Organic Farming Strategy for North Rhine-Westphalia], p. 8. Düsseldorf. https://www.umwelt.nrw.de/fileadmin/redaktion/PDFs/landwirtschaft/oeko_landwirtschafts_strategie_nrw_2020.pdf. Accessed on 15.04.2016.

[3] Target proposed by the Wuppertal Institute for the organic farmland: to increase the proportion of the organically farmed area in the Ruhr metropolitan area to 5% by 2025 in accordance with the concept "double the share of organic farmland within a decade".

[4] Federal Ministry for Food and Agriculture (BMEL) (2016): Ökologischer Landbau, [Organic farming], https://www.bmel.de/DE/Landwirtschaft/Nachhaltige-Landnutzung/Oekolandbau/_Texte/OekologischerLandbauDeutschland.html, as of February 2016, accessed 28.04.2016.

[5] BMEL Federal Ministry for Food and Agriculture (2015): Ökologischer Landbau in Deutschland, [Organic farming in Germany], p. 13, 07/2015, https://www.nap-pflanzenschutz.de//fileadmin/user_upload/_imported/fileadmin/SITE_MASTER/content/Dokumente/Indikatoren/Oekolandbau Deutschland.pdf, accessed on 19.04.2016.

[6] MKULNV – NRW Ministry for Environment, Agriculture, Conservation and Consumer Protection of the State of North Rhine-Westphalia (2016): Ökologischer Landbau. [Organic farming]. Düsseldorf. https://www.umwelt.nrw.de/laendliche-raeume-landwirtschaft-tierhaltung/landwirtschaft-und-umwelt/oekologischer-landbau/, accessed 15.04.2016.

[7] LiKi Federal States Initiative Core Indicators (2015): D2 – Ökologische Landwirtschaft. [D2 – organic farming.] https://www.lanuv.nrw.de/anwendungen/liki/index.php?liki=D2, accessed 23.05.2016.

[8] The Federal Government (2012): Nationale Nachhaltigkeitsstrategie Fortschrittsbericht 2012. [National Sustainability Strategy Progress Report 2012]. Berlin, p. 32. http://www.bundesregierung.de/Content/DE/_Anlagen/Nachhaltigkeit-wiederhergestellt/2012-05-21-fortschrittsbericht-2012-barrierefrei.pdf?__blob=publicationFile&v=1, accessed on 15.02.2016.

[9] MKULNV – NRW Ministry for Environment, Agriculture, Conservation and Consumer Protection of the State of North Rhine-Westphalia (2016): Öko-Landwirtschaftsstrategie für Nordrhein-Westfalen 2020, [Organic Farming Strategy for North Rhine-Westphalia], p. 8. Düsseldorf. https://www.umwelt.nrw.de/fileadmin/redaktion/PDFs/landwirtschaft/oeko_landwirtschafts_strategie_nrw_2020.pdf, accessed on 15.04.2016 Regional Government of North Rhine-Westphalia (2016): Sustainability Strategy for North Rhine-Westphalia, p. 65. Düsseldorf. http://www.nachhaltigkeit.nrw.de/fileadmin/download/nrw-nachhaltigkeitsstrategie_broschuere.pdf, accessed 03.08.2016.

[10] Without horticultural enterprises

[11] LWK Agricultural Chamber NRW (2012): Landwirtschaftlicher Fachbeitrag zum Regionalplan „Metropole Ruhr", [Agricultural contribution to the regional plan "Ruhr Metropolitan Area"], p. 5, http://www.metropoleruhr.de/fileadmin/user_upload/metropoleruhr.de/01_PDFs/Regionalverband/Regionaler_Diskurs/FD_Land_Forst/FD_Land_ Forst_Lenzen.pdf, extended version: https://www.landwirtschaftskammer.de/landwirtschaft/landentwicklung/regionalentwicklung/pdf/fachbeitrag-ruhr.pdf, accessed on 15.04.2016.

[12] Data submitted by the Chamber of Agriculture NRW on 20.04.2016.

[13] An average of 10.41 km² of agricultural land is lost per year in the Ruhr metropolitan area. 156.3 km² of farmland was lost from 1995 to 2010. During the same period of time, recreational areas, building areas and open spaces increased by around 50 km² each and forested areas increased by 38.2 km² and transport areas by 14.2 km². The decrease in agricultural land is particularly due to use as residential and commercial areas and the compensation measures as a result of this, which in turn are allocated to agricultural land. The loss of agricultural area in cities and districts from 2000 to 2010 reached 112 ha in Dortmund, 56 ha in Bochum and 52 ha in Bottrop, closely followed by 49 ha in Hamm. Duisburg lost 38 ha and the cities of Wesel and Moers lost 52 ha and 46 ha, respectively, in the Wesel district. The City of Duisburg lost 38 ha and in the Recklinghausen district Dorsten lost 31 ha, closely followed by the City of Oberhausen with 29 ha and Essen with 23 ha. All other districts in the Ruhr metropolitan area lost between 20 and 1 ha of agricultural area during this period (LWK Chamber of Agriculture NRW (2013): Zahlen und Fakten zu Landwirtschaft und Gartenbau in der Metropole Ruhr. [Facts and Figures on Agriculture and Horticulture in the Ruhr Metropolitan Area], p. 13, https://www. landwirtschaftskammer.de/landwirtschaft/landentwicklung/regionalentwicklung/pdf/fachbeitrag-ruhr-kurz.pdf, accessed on 15.04.2016).

[14] Liki Federal States Core Indicators (2015): Ökologische Landwirtschaft. [Organic farming.] http://www.lanuv.nrw.de/anwendungen/liki/index.php?liki=D2, accessed on 28.4.2016.

[15] Federal Ministry for Food and Agriculture (2016): Ökologischer Landbau in Deutschland. [Organic farming in Germany.] https://www.bmel.de/DE/Landwirtschaft/Nachhaltige-Landnutzung/Oekolandbau/_Texte/OekologischerLandbauDeutschland.html, accessed on 28.4.2016.

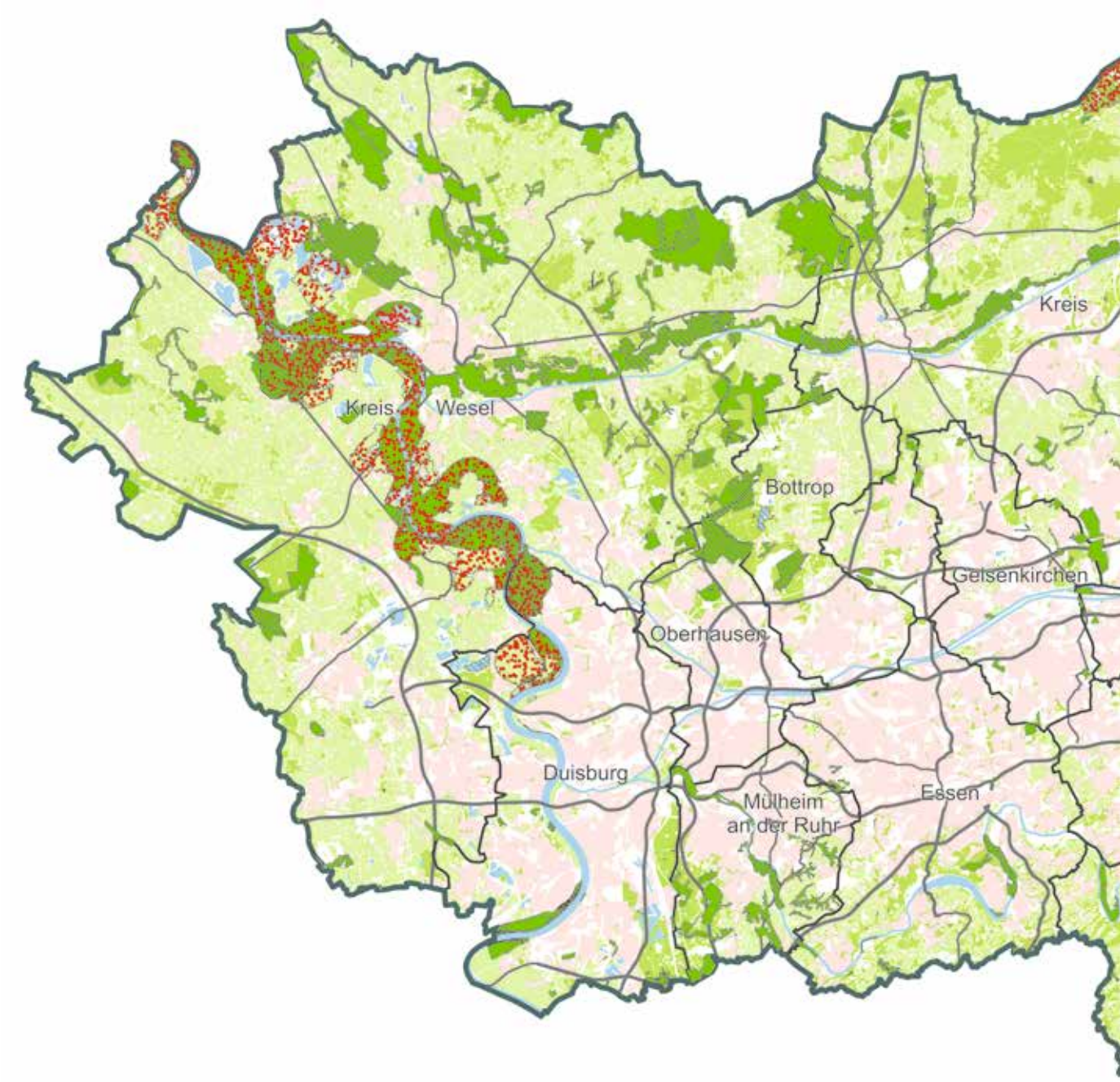
[16] Kornkammer Haus Holte (undated): Betriebsgeschichte. [Company history]. http://www.team-kornkammer.de/geschichte.htm, accessed on 11.11.2016.

[17] Chamber of Agriculture North Rhine-Westphalia (2013): Ökolandbau in NRW – Erfolgreiche Betriebskonzepte für die Zukunft. [Organic Farming in NRW – Successful Business Models for the Future], p. 8f. Münster. http://www.landwirtschaftskammer.de/landwirtschaft/oekolandbau/pdf/oekolandbau-nrw.pdf, accessed on 11.11.2016.

[18] http://www.schultenhof-dortmund.de, accessed on 19.04.2016.

5.13 Biodiversity: Connected biotope area as a proportion of the total area

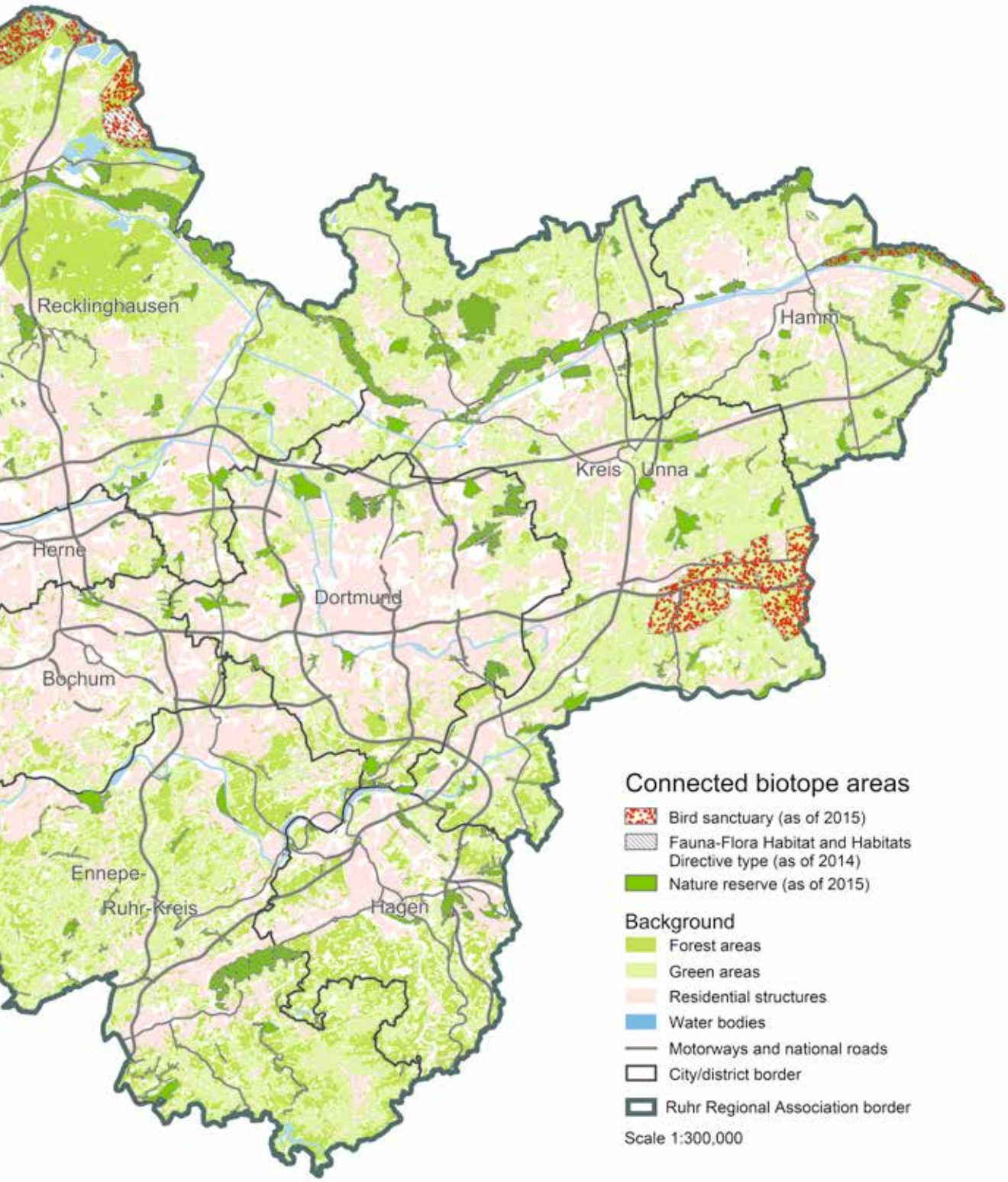
Connected biotope areas in the Ruhr metropolitan area, consisting of bird sanctuaries, wild fauna and flora habitats conservation and nature reserves



Concept development: Wuppertal Institute, Ruhr Regional Association

Source: Ruhr Regional Association, State Agency for Nature, Environment and Consumer Protection North Rhine-Westphalia (LANUV NRW, last updated 2015)

Map source: © Ruhr Regional Association


Recklinghausen
Hamm
Kreis Unna
Herne
Dortmund
Bochum
Ennepe-
Ruhr-Kreis
Hagen
Connected biotope areas
Bird sanctuary (as of 2015)
Fauna-Flora Habitat and Habitats Directive type (as of 2014)
Nature reserve (as of 2015)
Background
Forest areas
Green areas
Residential structures
Water bodies
Motorways and national roads
City/district border
Ruhr Regional Association border
Scale 1:300,000

Indicator 13 – Biodiversity: Connected biotope area as a proportion of the total area

Objective: to protect biological diversity and improve habitat quality
Indicator: proportion of connected biotope areas (in % to total area)

Existing operationalised objectives:

Germany: [1]	↦ Create a network of connected biotopes (biotope network) that should contain at least 10% of the area in each federal state (Federal Nature Conservation Act: without target year[2]; National Strategy on Biological Diversity of 2007: target year 2010)
NRW: [3]	↦ Reach a share of connected biotope areas in NRW (nature reserves, national parks, wild fauna and flora habitats conservation and bird sanctuaries) of 15% of the total area by 2030
Demand from the NRW Nature Conservation Associations for NRW: [4]	↦ The state-wide biotope network should extend over at least 20% of the area of NRW (without target year)
Objective proposed by the Wuppertal Institute for the Ruhr metropolitan area [5]	↦ Increase the share in area of the biotope network to 15% by 2030 and 20% by 2050 (of the total area in the Ruhr region)

Significance of the environmental indicator

Protecting and conserving biological diversity is one of the most important tasks of our time to secure the basis for life on Earth – for both current and future generations. Biodiversity and functioning ecosystems are the foundations for human life and render important services – among which are air and water purification, pollination, the development of fertile soils for food production as well as climate and flooding regulation. At the same time, they are a driving force for technical innovations and provide people with a high quality of life and leisure activities.

In order to stop and reverse the continuous decline of biodiversity, it is important to designate sufficiently large nature reserves and to connect these reserves into a biotope network. [6] Biotope networks are areas that serve as lasting protection for wild animals and plants and their habitats (biotopes). [7] In NRW, this includes Flora-Fauna Habitats (FFH), bird sanctuaries, nature reserves and national parks. [8] Connecting biotopes in network systems enables exchanges between populations, animal migrations and natural dispersion processes. [9] Developing biotope networks is of particular relevance in light of climate change, since sanctuaries for climate-sensitive species, such as those that prefer cold and moist environments, are being created. [10]

Existing targets

In 2002, the implementation of an interstate biotope network totalling at least 10% of the area of each federal state was amended into the Federal Nature Conservation Act (without target year, §20). [12] In 2007, this objective was set in the National Strategy for Biodiversity (NBS) with the target year of 2010. [13] The Biodiversity Strategy of the state of North Rhine-Westphalia [14] aims to increase the biotope network area to 15% by 2030, taking into account the Climate Adaption Strategy. [15] The Wuppertal Institute recommends that the Ruhr metropolitan area assume the federal state objective of 15% by 2030 as its regional objective. The nature conservation organisations in NRW demand that the biotope network cover at least 20% of the total area in NRW. [16] The Wuppertal Institute therefore proposes that the Ruhr region set the objective of increasing its biotope network to at least 20% of the total area by 2050.

Current situation and development in the Ruhr region

The proportion of the biotope network to total area in the Ruhr region [17] reached 10.2% (454.3 km²) in 2015 [18] and lies slightly below the state average of 11.6% (in 2016) [19]. From 2011 to 2015, the share of biotope networks in

the Ruhr region increased by 0.9 percentage points from 9.3% (414.5 km²) to 10.2% – higher than the federal state average (+0.4 per cent from 2010 to 2016).

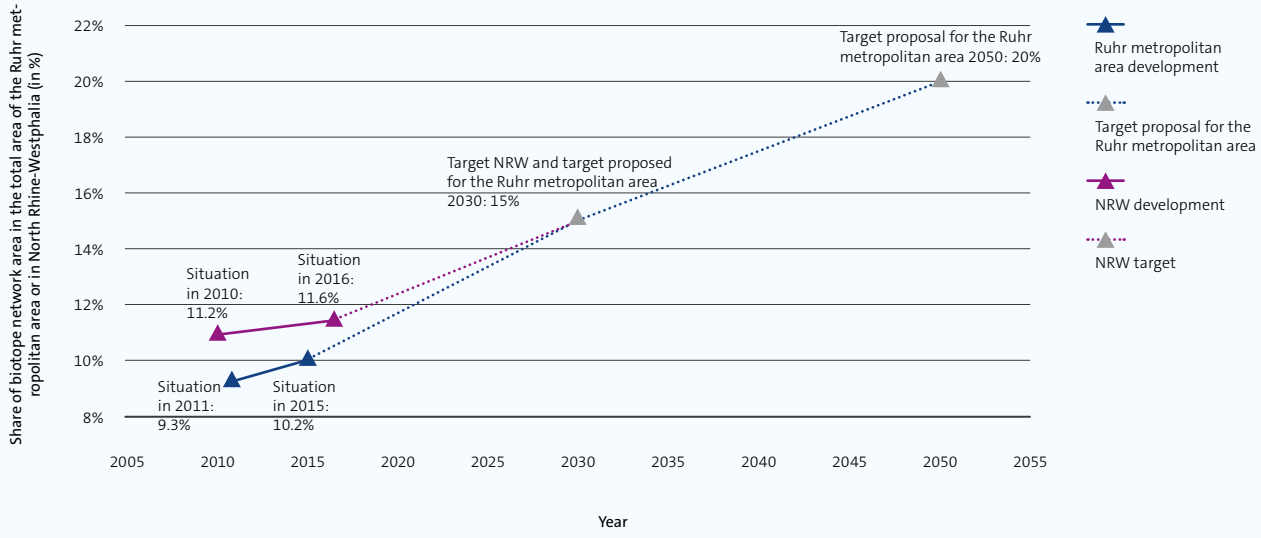
The Ruhr region is a special area for "urban biodiversity" in Germany. Since mining and industrial areas have been re-naturalised, a multitude of secondary biotopes have arisen in the urban area of the Ruhr region. A great variety of different habitats have developed in this confined space, many of which are home to highly endangered animal and plant species, such as the peregrine falcon, the natterjack toad and the blue-winged grasshopper. [20] The green corridors that run north-south and the waterways that run east-west in the Ruhr metropolitan area serve as migration corridors for the dispersal of the species.

Trend in development

Assessment

The share of biotope networks in the Ruhr region lies slightly below that of the NRW average, although it did increase more rapidly than the federal state average from 2011 to 2015. This represents good development for the Ruhr region as an agglomeration. Additional potential areas should be made accessible for further development and expansion of the biotope network areas. The area surrounding the "Biotope Network Level 1" from the LANUV thus provides an appropriate basis for nature conservation planning in the Ruhr region.[21] The "Biotope Network Level 1" includes protected areas (nature reserves, flora-fauna habitats, bird sanctuaries) and areas with high ecological potential (floodplains in meadows) that are not yet under protection and demonstrates suitable areas to secure and produce an interconnected biotope network in the Ruhr region over the long term. In 2016, the share of area in the "Biotope Network Level 1" in the total area in the Ruhr region was situated at 16.3%.[22] Particular challenges lie in connecting the biotope areas in the highly dense Emscher area in the centre of the Ruhr region with the outskirts of the Ruhr region, as well as in conserving open space that has not yet been divided by residential and transport areas.[23] The current high land consumption should be significantly

Development of the share of biotope network areas in the Ruhr region and in North Rhine-Westphalia (in % of total area), national target for 2030 and target proposed by the Wuppertal Institute for the Ruhr region for 2030 and 2050



Source: Depiction from the Wuppertal Institute using data from the LANUV NRW 2016 (see federal state government NRW 2016)[11], target proposed by the Wuppertal Institute for the Ruhr region 2030 and 2050

reduced (see indicator land use). Particular potential for area in the Ruhr region can arise through the renaturalisation of the Emscher River and its tributaries (see indicator "water quality") and through bodies of water in soil settlement as well as by recycling former industrial and commercial areas.[24] A good example for the further development of an urban biotope network is the development concept of the approximately 35-hectare mining wasteland General Blumenthal XI in Herne.[25] In addition to commercial/industrial use, a green corridor will be constructed here between Herne and Wanne-Eickel, which will contribute to expanding the biotope network and further networking.

Hansa bridge, Dortmund

Sources and notes

[1] In 2002, the Federal Nature Conservation Act was amended to include the implementation of an interstate biotope network to span at least 10% of the total area of each federal state (without target year, see §20 in the Federal Nature Conservation Act and the Federal Agency for Nature Conservation (BfN) (undated): Biotopverbund: Grundlagen und Fachkonzept. [Biotope network. Principals and Specialist Concept]. https://www.bfn.de/10298.html, accessed 05.08.2016. The national strategy on biodiversity from 2007 strove for the "implementation of an interstate, function-oriented network of biotopes over at least 10 per cent of the total land area at each level (by 2010)" (Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety (BMUB) (2007): Nationale Strategie zur biologischen Vielfalt (NBS), [National Strategy for Biodiversity (NBS)], p. 29, http://www.biologischevielfalt.de/fileadmin/NBS/ documents/broschuere_biolog_vielfalt_strategie_bf.pdf, accessed on 08.04.2016. The concept of the biotope network is also supported by the EU Water Framework Directive, which will contribute to improving the condition of the bodies of water including dependent terrestrial ecosystems and connecting these biotopes (see Federal Agency for Nature Conservation: Biotopverbund, https://www.bfn.de/0311_biotopverbund.html, accessed 7.11.2016).

[2] Since the Federal Nature Conservation Act has not set any requirement as to when the biotope network system should be implemented in the federal states, "the Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety will take the initiative to amend the Federal Nature Conservation Act" (Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety (2015); Naturschutz-Offensive 2020 – Für biologische Vielfalt! Berlin, [Nature Conservation Offensive 2020 – for biological diversity], p. 23, http://www.bmub.bund.de/fileadmin/Daten_BMU/Pools/Broschueren/naturschutz-offensive_2020_broschuere_bf.pdf, accessed 5.8.2016).

[3] MKULNV – NRW Ministry for Environment, Agriculture, Conservation and Consumer Protection of the State of North Rhine-Westphalia (2015): Vielfalt der Natur, Die Biodiversitätsstrategie des Landes Nordrhein-Westfalen, [For natural diversity, The Biodiversity Strategy of the State of North Rhine-Westphalia], p. 42. Düsseldorf. https://www.umwelt.nrw.de/fileadmin/redaktion/Broschueren/biodiversitaetsstrategie_nrw_broschuere.pdf, accessed on 11.04.2016 and the Federal State Government of North Rhine-Westphalia (2016): Nachhaltigkeitsstrategie für Nordrhein-Westfalen, [Sustainability Strategy for North Rhine-Westphalia], Düsseldorf, p. 33, http://www.nachhaltigkeit.nrw.de/fileadmin/download/nrw-nachhaltigkeitsstrategie_broschuere.pdf accessed on 04.08.2016.

[4] Landesbüro der Naturschutzverbände NRW [State office for the nature protection associations NRW] (2016): Gemeinsame Stellungnahme der anerkannten Naturschutzverbände zur Landtagsanhörung zum Gesetz zum Schutz der Natur in Nordrhein-Westfalen und zur Änderung anderer Vorschriften. Stellungnahme vom 23.05.2015, [Joint statement from the recognised nature conservation associations to the parliamentary hearing on the nature conservation act in North Rhine-Westphalia and on amending other provisions. Statement from 23.05.2015], p. 38. Oberhausen. www.lb-naturschutz-nrw.de/fileadmin/redaktion/fachgebiete/Naturschutzrecht/STN_LNatschG-E_BUND_LNU_NABU_23052016.pdf, accessed on 16.09.2016.

[5] Target proposal from the Wuppertal Institute for the future development of the biotope network areas in the Ruhr metropolitan area: increase the area of biotope networks (nature reserves, national parks, flora-fauna habitats and bird sanctuaries) to 15% by 2030 in accordance with the existing objective of the federal state government of NRW. Additionally, the Wuppertal Institute proposes reaching a target value of 20% biotope network areas in the Ruhr metropolitan area by 2050. This roughly corresponds to a linear extrapolation of the development from 2015 to 2030 for the period 2030 to 2050. In addition to this, the 2050 target proposal is inspired by the claim from the state office of the nature conservation associations NRW which includes the North Rhine-Westphalian Nature Conservation Associations for Environment and Nature Conservation Germany NRW (BUND), the Regional Association for Nature Conservation and the Environment NRW (LNU) and the Naturschutzbund Deutschland NRW (NABU): "The nature conservation associations believe the interstate biotope network within the meaning of § 21 para. 1 Federal Nature Conservation Act (BNatSchG) – notwithstanding § 20 para. 1 BNatSchG – must extend across at least 20% of the federal state territory" (see state office of the nature conservation associations NRW (2016): Gemeinsame Stellungnahme der anerkannten Naturschutzverbände zur Landtagsanhörung zum Gesetz zum Schutz der Natur in Nordrhein-Westfalen und zur Änderung anderer Vorschriften. Stellungnahme vom 23.05.2015, [Joint statement from the recognised nature conservation associations to the parliamentary hearing on the nature conservation act in North Rhine-Westphalia and on amending other provisions. Opinion from 23.05.2015], p. 38. Oberhausen. http://www.bund-nrw.de/fileadmin/bundgruppen/bcmslvnrw/PDF_Dateien/Themen_und_Projekte/Naturschutz/2016_05_23_STN_NSV__LT_STN_16-3901.pdf, accessed on 16.09.2016).

In accordance with the technical contribution of nature conservation and landscape maintenance for the Regional Plan Ruhr (LANUV - State Agency for Nature, Environment and Consumer Protection of North Rhine-Westphalia (2012): Fachbeitrag des Naturschutzes und der Landschaftspflege für den Regionalplan Ruhr, Kurzfassung, [Technical contribution of nature conservation and landscape maintenance for the Ruhr Regional Plan, summary], http://www.metropoleruhr.de/fileadmin/user_upload/metropoleruhr.de/01_PDFs/Regionalverband/Regionaler_Diskurs/FD_Freiraum/Kurzfassung_Fach-

beitrag_des_Naturschutzes_und_der_Landschaftspflege.pdf, accessed on 13.04.2016.) the following should be taken into account with regard to the objectives: since the expansion of the biotope network is considered to be closely linked to land use, the objective of reducing land consumption is also emphasised for this indicator, especially against the backdrop of the high value of unsegmented open spaces, which are essential for the conservation of biodiversity in the landscape. Furthermore, the development objective and the ecological improvement to complete the biotope network will be extended to also stretch across surface waters including riparian strips, shore areas, wetlands as well as the creation of further linear and punctiform networking elements such as strips of hedges, field boundaries and stepping stone biotopes, especially on agricultural land, in accordance with the requirements of the Federal Nature Conservation Act BNatSchG §21 and the National Strategy on Biodiversity (NBS) 2007, p. 63 see note 1. An additional goal should be to secure suitable post-mining landscapes (stockpiles and water resulting from settling soil) for nature conservation purposes in the Ruhr region.

[6] See Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety (2015); Naturschutz Offensive 2020 – Für biologische Vielfalt! [Nature Conservation on the Offensive 2020 – For Biodiversity!] Berlin, p. 62, http://www.bmub.bund.de/fileadmin/Daten_BMU/Pools/Broschueren/naturschutz-offensive_2020_broschuere_bf.pdf, accessed 5.8.2016.

[7] Law updating the legislation on nature conservation and landscape management from 29 July 2009 (Federal Nature Conservation Act), §21. https://www.bfn.de/fileadmin/MDB/documents/themen/monitoring/BNatSchG.PDF, accessed 23.5.2016.

[8] State Government of North Rhine-Westphalia (2016): Nachhaltigkeitsindikatoren Nordrhein-Westfalen, [Sustainability indicators North Rhine-Westphalia], Düsseldorf, p. 19, http://www.nachhaltigkeit.nrw.de/fileadmin/download/nachhaltigkeits-indikatorenbericht_2016.pdf, accessed on 04.08.2016.

[9] See Federal Agency for Nature Conservation (undated): Biotopverbund. [Biotope network]. https://www.bfn.de/0311_biotopverbund.html, accessed 23.5.2016.

[10] In addition to reduced land, the composition and the distribution of the species in NRW is also negatively affected by climate change. Heat-loving species are increasing and foreign species from southern countries will most likely establish themselves while cold and moisture-loving species decline (MKULNV – Ministry for Climate Protection, Environment, Agriculture, Nature and Consumer Protection of the State of North Rhine-Westphalia (2016): Klimawandel-Folgen in den Regionen, [Climate change consequences in the regions], https://www.umwelt.nrw.de/klima-energie/klimawandel-und-anpassung/klimawandel-folgen-in-den-regionen/, accessed on 20.05.2016). Through the development and preservation of an interstate biotope network (network of (individual) habitats of wild plants and animals), it is possible to make way for climate sensitive species in spaces that are ecologically suitable for them (MKULNV NRW – Ministry for Climate Protection, Environment, Agriculture, Nature and Consumer Protection of the State of North Rhine-Westphalia (2015): Für die Vielfalt der Natur, Die Biodiversitätsstrategie des Landes Nordrhein-Westfalen. [For natural diversity, The Biodiversity Strategy of the State of North Rhine-Westphalia], p. 41f. Düsseldorf. https://www.umwelt.nrw.de/fileadmin/redaktion/Broschueren/biodiversitaetsstrategie_nrw_broschuere.pdf, accessed on 11.04.2016).

[11] Federal State Government of North Rhine-Westphalia (2016): Nachhaltigkeitsindikatoren Nordrhein-Westfalen, [Sustainability indicators North Rhine-Westphalia], Düsseldorf, p. 19, http://www.nachhaltigkeit.nrw.de/fileadmin/download/nachhaltigkeits-indikatorenbericht_2016.pdf, accessed on 04.08.2016.

[12] Law updating the legislation on nature conservation and landscape management from 29 July 2009 (Federal Nature Conservation Act), §20. https://www.bfn.de/fileadmin/MDB/documents/themen/monitoring/BNatSchG.PDF, accessed 23.5.2016.

[13] BMUB Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety (2007): Nationale Strategie zur biologischen Vielfalt (NBS), [National Strategy for Biodiversity (NBS)], p. 29, http://www.biologischevielfalt.de/fileadmin/NBS/documents/broschuere_biolog_vielfalt_strategie_bf.pdf, accessed on 08.04.2016.

[14] MKULNV NRW – Ministry for Environment, Agriculture, Conservation and Consumer Protection of the State of North Rhine-Westphalia (2015): Für die Vielfalt der Natur, Die Biodiversitätsstrategie des Landes Nordrhein-Westfalen, [For natural diversity, The Biodiversity Strategy of the State of North Rhine-Westphalia], p. 42. Düsseldorf. https://www.umwelt.nrw.de/fileadmin/redaktion/Broschueren/biodiversitaetsstrategie_nrw_broschuere.pdf, accessed 11.04.2016.

[15] Thus climate change will "have clearly noticeable effects on biological diversity in North Rhine-Westphalia". The Climate Protection Plan North Rhine-Westphalia includes measures for climate change adaptation in the field of biodiversity and nature conservation (MKULNV NRW - Ministry for Climate Protection, Environment, Agriculture, Nature and Consumer Protection of the State of North Rhine-Westphalia (2015): Klimaschutzplan Nordrhein-Westfalen, Klimaschutz und Klimafolgenanpassung. [Climate Protection Plan North Rhine-Westphalia, climate protection and adaptation to the impacts of climate change], p. 204f, https://www.umwelt.nrw.de/fileadmin/redaktion/Broschueren/klimaschutzbericht_nrw_151201.pdf, accessed on 13.04.2016).

[16] State office for the nature protection associations NRW (2016): Gemeinsame Stellungnahme der anerkannten Naturschutzverbände zur Landtagsanhörung zum Gesetz zum Schutz der Natur in Nordrhein-Westfalen und zur Änderung anderer Vorschriften. Stellungnahme vom 23.05.2015, [Joint statement from the recognised nature conservation associations to the parliamentary hearing on the nature conservation act in North Rhine-Westphalia and on amending other provisions. Opinion from 23.05.2015], p. 38. Oberhausen. www.lb-naturschutz-nrw.de/fileadmin/redaktion/fachgebiete/Naturschutzrecht/STN_LNatschG-E_BUND_LNU_NABU_23052016.pdf, accessed on 30.06.2017.

[17] Non-overlapping protected areas including flora-fauna habitats, bird sanctuaries and nature reserves (there are no national parks in the Ruhr region), as per the definition of the biotope network at the NRW federal state level.

[18] Data source: Ministry for Environment, Agriculture, Conservation and Consumer Protection of the State of North Rhine-Westphalia (LANUV NRW) 2015, data provided to the Wuppertal Institute in 2016.

[19] Data source: State Government of North Rhine-Westphalia (2016): Nachhaltigkeitsindikatoren Nordrhein-Westfalen, [Sustainability indicators North Rhine-Westphalia], Düsseldorf, p. 19, http://www.nachhaltigkeit.nrw.de/fileadmin/download/nachhaltigkeits-indikatorenbericht_2016.pdf, accessed on 04.08.2016.

[20] See City of Essen (2014): Bewerbung als Grüne Hauptstadt Europas – Themenfeld 04: Natur und Biodiversität, [Application for European Green Capital – Topic 04: Nature and Biodiversity], Essen, p. 2. https://media.essen.de/media/wwwessende/aemter/59/gruene_hauptstadt_europas_1/04_GHE_Themenfeld_NaturBiodiversitaet_web.pdf, accessed 05.08.2016.

[21] State Agency for Nature, Environment and Consumer Protection North Rhine-Westphalia (LANUV) (2012): Fachbeitrag des Naturschutzes und der Landschaftspflege für den Regionalplan Ruhr, Kurzfassung, [Technical contribution from nature conservation and landscape management for the Ruhr Regional Plan, summary], http://www.lanuv.nrw.de/natur/landschaftsplanung/fachbeitrag/ accessed on 22.04.2016.

[22] Data from LANUV NRW (as of 2016).

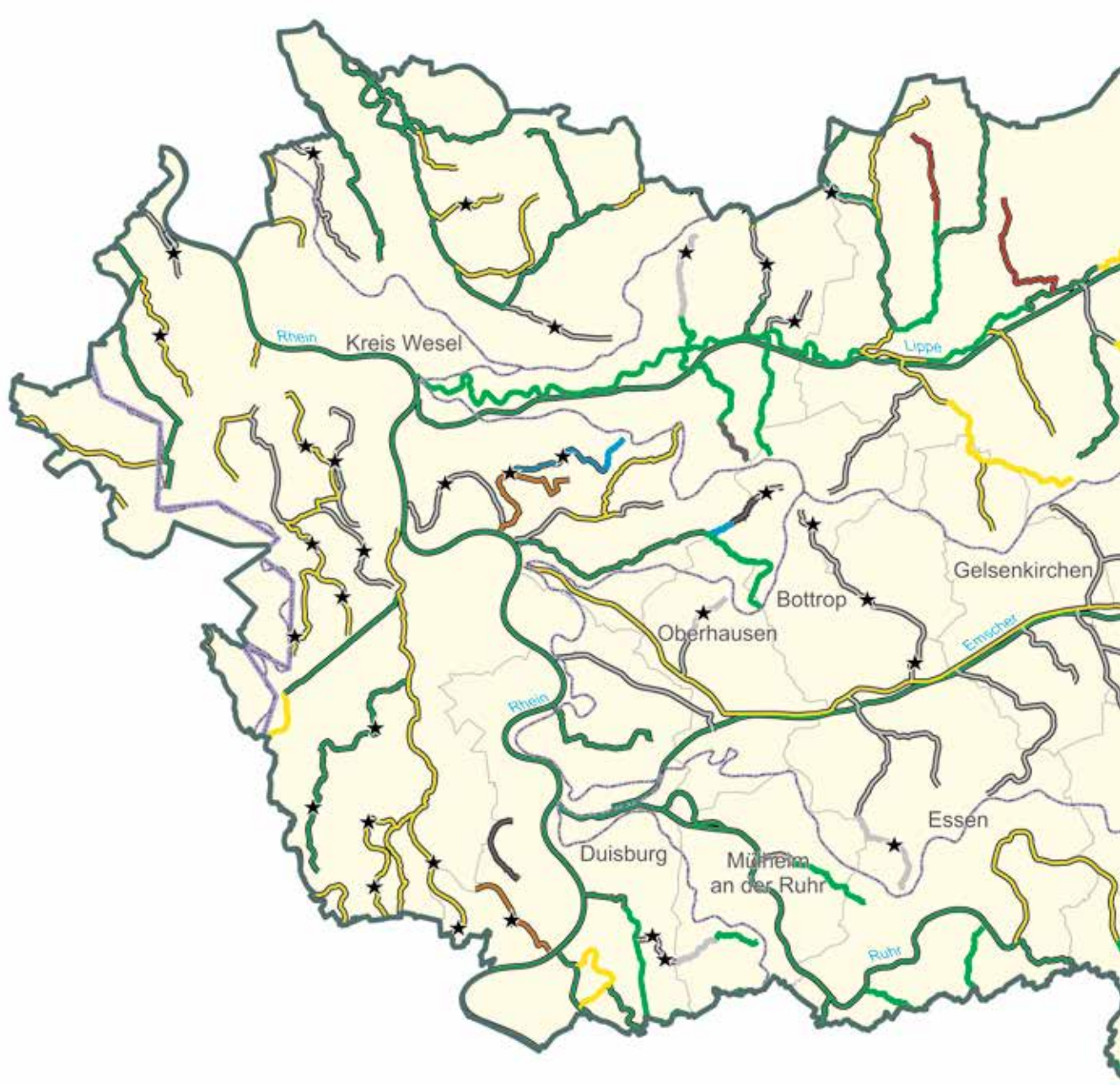
[23] LANUV– State Agency for Nature, Environment and Consumer Protection of North Rhine-Westphalia (2012): Fachbeitrag des Naturschutzes und der Landschaftspflege für den Regionalplan Ruhr, Kurzfassung, [Technical contribution from nature conservation and landscape management for the Ruhr Regional Plan, summary], p. 6f, http://www.metropoleruhr.de/fileadmin/user_upload/metropoleruhr.de/01_PDFs/Regionalverband/Regionaler_Diskurs/FD_Freiraum/Kurzfassung_Fachbeitrag_des_Naturschutzes_und_der_Landschaftspflege.pdf, accessed on 08.08.2016.

[24] Ibid. (LANUV 2012, p. 6f).

[25] Agreement on mining areas, Wandel als Chance – Vereinbarung zur vorausschauenden Revitalisierung bedeutsamer Bergbauflächen, [Embracing Change – agreement on the prospective regeneration of relevant mining areas], 25.02.2014, p. 25, http://www.konzept-ruhr.de/fileadmin/user_upload/metropoleruhr.de/Konzept_Ruhr/Veroeffentlichungen/Vereinbarung_FINAL.pdf, accessed on 22.04.2016.

5.14 Water: Water quality of watercourses

Condition assessment of the quality of running water in the Ruhr metropolitan area in terms of organic pollution in accordance with the quality grades of the "saprobity" module



Concept development: Wuppertal Institute, Ruhr Regional Association LANUV NRW

Source: Ruhr Regional Association and federal state of NRW (condition assessment of bodies of surface water in accordance with the Management Plan 2016 -2021 of the federal state of NRW)

Map source: © Ruhr Regional Association


Kreis Recklinghausen
Hamm
Lippe
Kreis Unna
Herne
Dortmund
Emscher
Bochum
Ruhr
Hagen
Ennepe-
Ruhr-Kreis
Assessment of running water conditions including ship canals
Saprobity module (PERLODES or DIN 38410) Second monitoring cycle (2009-2011)
Surface water bodies (periodically) dry
Surface water bodies dam
Surface water bodies heavily modified or artificial
Evaluation of the surface water bodies
very good
good
mediocre
unsatisfactory
poor
Evaluation is not possible (e.g. due to the ongoing renaturalisation activities during the Emscher River conversion)
no evaluation
NRW river basin district borders
NRW sub basin borders
Ruhr Regional Association border
City/district border
Scale 1:300,000

Indicator 14 – Water: Water quality of watercourses

Environmental quality objective: to improve the qualitative condition of running waters (watercourses)
Indicator[1]: share of running waters with quality grade I (very good) and II (good) (saprobity module) in the total flow length of assessed water bodies[2]

Existing operationalised objectives:

European Commission:[3]	European Water Framework Directive (EC-WFD) ↦ Good ecological and chemical condition for all natural running water or good ecological potential[4] and good chemical condition for all heavily modified or artificial running water by 2015 or 2021/2027[5] (extended deadline) ↦ Saprobity module: quality grade I and II (very good and good)
Germany:	↦ According to the European Water Framework Directive (EC-WFD)
NRW: [6]	↦ According to the EC-WFD by 2015 or 2021/2027
Target proposed by the Wuppertal Institute for the Ruhr metropolitan area [7]	↦ According to the EC-WFD by 2015 or 2021/2027

Significance of the environmental indicator

Living waters and intact aquatic ecosystems are of especially high importance in the densely populated and industrialised region of the Ruhr metropolitan area because they are particularly stressed through a wide range of uses.[8] In the Ruhr region in particular, the bodies of water have always come second to the needs of the industrial and mining sectors: 150 years of industrialisation and growth of residential areas have seemingly irreversibly changed the appearance of many watercourses.[9] The old Emscher River, now considered a "Köttelbecke" (a Ruhr colloquial expression for a heavily channelised, once natural watercourse), is an inglorious symbol of such a development.[10]

Living watercourses contribute to enhanced biodiversity, recreational function and living environments, as well as increased attractiveness of the region for its residents.[11] Additionally, further positive effects are improved flood control and – as green and blue infrastructures – a positive contribution to climate adaptation. Water is increasingly used and appreciated as a design element in urban and open space planning.

Legal background and existing targets

The ecological functions of bodies of water were placed at the centre of management with the European Water Framework Directive (EC-WFD) of 2000.[12] The basis for this is an integrated river basin management across administrative boundaries like what has already been practised for decades by the large water boards in the Ruhr metropolitan area.[13] Ecological water development aims at preserving and strengthening the quality of aquatic ecosystems and diversity of native species. The central objective of the European Water Framework Directive (EC-WFD) of 2000 is to reach "good condition" for all rivers, lakes and groundwater. For natural watercourses, this objective is achieved if both the ecological and the chemical state of the water are rated at least "good". For considerably modified and artificial bodies of water, at least "good ecological potential" and "good chemical status" must be reached. The objectives should be met by 2015 or, in the case of a granted deadline extension, no later than 2027.[14]

The quality of the waters is assessed based on their function as habitats for aquatic animals and plants. The ecological

Hallbach in Essen

condition is thus evaluated based on various animal and plant groups identified as biological quality components: macrozoobenthos (microorganisms), fish and aquatic flora. The worst rated biological quality components are used for the overall assessment in accordance with the worst-case principle.[15] The saprobity module is part of the microorganism quality components and illustrates the organic water pollution. Organic pollution arises predominantly from communal wastewater discharge into watercourses and is reduced by proper wastewater treatment. The water quality in all watercourses should reach at least a good quality grade (II "good" or I "very good") regarding organic pollution, in accordance with the EG-WFD.

Current situation and development in the Ruhr region

The water quality of the watercourses in NRW has been systematically investigated and documented in water quality reports since the end of the 1960s[16] and in accordance with the more extensive EC-WFD monitoring system since 2006.[17] The improved and intensified wastewater treatment has led to a significantly improved water quality in terms of organic pollution.[18] The Ruhr now demonstrates

Trend in development

a nearly continuous "good" saprobic state, meaning low organic pollution[19] (see map of indicator).

The map shows a different picture for the catchment area of the rivers Emscher and Lippe. Saprobity here reaches just "mediocre" quality in many river sections.

Gecksbach[20] and the upper course of the Wienbach stream in the catchment area of the river Lippe are classified as "poor" (marked in red on the map). The river Emscher and its tributaries are still technically expanded and transport wastewater in the middle and lower course. The upper reaches of the Emscher and many of its tributaries are largely free of channelling and have been renaturalised up until the Dortmund area. As a result, the assessment for this area was increased to "mediocre" just one year after

the transformation. The water quality can be improved once the large division projects are successfully carried out, removing the wastewater from the Emscher and placing it in a (new) sewage channel.

Most of the bodies of water in the Ruhr metropolitan area are so severely damaged by human settlement and mining that they can only be improved to a limited extent. Many watercourses will also remain significantly altered bodies of water in the future. [21] The morphology and the water cycle of the river Emscher have been irreversibly impaired and its old appearance can no longer be reconstructed. This is a great challenge for the ecological development of the bodies of water. [22] Over the course of the ecological development of the water body, [23] great efforts will be undertaken to convert back to a near-natural water system. During the Emscher conversion, €4.5 billion have been invested in 350 projects over 30 years in order to sustainably transform the entire Emscher system (with all of its tributaries) by 2020: the wastewater will be led through new channels totalling 400 km, while the 350 km of surface water will be renaturalised. [24] The commenced restoration of the watercourses is a first and indispensable step for sustainable water development. The development of the water will take time: at least 10 years are needed to develop a mature biocoenosis.

Assessment

The problem of organic pollution in streams from wastewater discharges has been significantly improved thanks to enormous efforts in rehabilitating wastewater conditions. However, more action is needed. In the area of restored watercourses, so far only a small part of the flowing stretches exhibit good water quality. It is important to take into account that the restoration of the watercourses definitely has positive effects on the species communities and the floodplain (see indicator biotope network) – but this is not (yet) relevant to the valuation in accordance with the EC-WFD. Thus, additional procedures and indicators will be developed for success monitoring of the restored watercourses. [25,26,27] For the medium-term future, positive developments can be expected from the continued division of the wastewater and the near-natural conversion. [28]

A good example of ecological water development from the Emscher renovation is the floodplain to be built in Holtener Bruch in Oberhausen. The river Emscher will receive an area of around 30 hectares that will serve for both flood protection and the ecological development of the new river. [29]

Sources and notes

[1] The selected indicator constitutes a quality component (saprobity module) of the ecological condition or potential according to the EU Water Framework Directive (EC-WFD). It depicts only one potential water pollution – the contamination from organic pollutants that are biologically degradable by consuming oxygen. In accordance with the EC-WFD, additional quality components are to be taken into account to assess the ecological status or potential. For methodology, see MKULNV NRW – Ministry for Climate Protection, Environment, Agriculture, Nature and Consumer Protection of the State of North Rhine-Westphalia (2015): Bewirtschaftungsplan 2016-2021 für die nordrheinwestfälischen Anteile von Rhein, Weser, Ems und Maas, [Management Plan 2016-2021 for the North Rhine-Westphalian areas of the Rhine, Weser, Ems and Maas], http://www.flussgebiete.nrw.de/img_auth.php/1/14/BWP-NRW_2016-2021_final.pdf, accessed 18.5.2016.

[2] Bodies of water are sections of rivers and streams determined by the authorities. It corresponds to a specific water body type with a specific natural population and features a specific ecological condition. A body of water is the smallest EU reportable management unit of the EC-WFD.

[3] EU Water Framework Directive of 22 October 2000. http://eur-lex.europa.eu/legal-content/DE/TXT/?qid=1430893844470&uri=URISERV%3Al28002b, accessed 18.5.2016.

[4] The central objective of the European Water Framework Directive (EG-WFD) of 2000 is to reach "good condition" for all rivers, lakes and groundwater. For natural watercourses, this objective is achieved if both the ecological and the chemical state of the water are rated as "good". For considerably modified and artificial bodies of water, "good ecological potential" and "good chemical status" must be reached.

[5] The objectives should be achieved where possible by 2015. A maximum of two six-year deadline extensions (2021 or 2027) may be granted if natural or technical reasons prevent reaching the target in a timely manner or if disproportionate effort is required to comply with the schedule (§ 29 Water Resources Act (WHG)). Reasons for delayed target achievement for all water bodies are presented in the planning unit profiles, available at http://www.flussgebiete.nrw.de/index.php/WRRL/Bewirtschaftungsplan/2015#Planungseinheitensteckbriefe, accessed 18.5.2016. The methodology for verifying target achievement as well as a tabular summary of all objectives related to the individual water bodies in NRW can be found at MKULNV NRW – Ministry

for Climate Protection, Environment, Agriculture, Nature and Consumer Protection of the State of North Rhine-Westphalia (2015): Bewirtschaftungsplan 2016-2021 für die nordrheinwestfälischen Anteile von Rhein, Weser, Ems und Maas, [Management Plan 2016-2021 for the North Rhine-Westphalian areas of the rivers Rhine, Weser, Ems and Maas], http://www.flussgebiete.nrw.de/img_auth.php/1/14/BWP-NRW_2016-2021_final.pdf, accessed 18.5.2016.

[6] See Ministry for Environment, Agriculture, Conservation and Consumer Protection of the State of North Rhine-Westphalia (MKULNV NRW) (2015): Bewirtschaftungsplan 2016-2021 für die nordrheinwestfälischen Anteile von Rhein, Weser, Ems und Maas, [Management Plan 2016-2021 for the North Rhine-Westphalian portions of the rivers Rhine, Weser, Ems and Maas,] http://www.flussgebiete.nrw.de/img_auth.php/1/14/BWP-NRW_2016-2021_final.pdf, accessed 18.5.2016.

[7] With regard to assuming the objectives of the EC-WFD, it must be considered that special development objectives must be applied for heavily modified water bodies. Relevant for this is good ecological potential (see above). However, it must be discussed whether or not additional valuation methods and indicators that take account of the specific conditions for the renaturalised waters should be considered – see also notes on further reporting.

[8] See Ministry for Climate Protection, Environment, Agriculture, Nature Conservation and Consumer Protection of the State of North Rhine-Westphalia (MKULNV NRW) (undated): Ruhr – Gebietsbeschreibung. [Ruhr – Area description]. http://www.ruhr.nrw.de/index.php/Ruhr/Gebietsbeschreibung, accessed 26.10.2016.

[9] In the Emscher area, all watercourses are classified as heavily modified with the exception of the upper reaches of the Hörder Bach, Schondelle, Deininghauser Bach, Ostbach, Dorneburger Mühlenbach and Handbach streams.

[10] Frank, Susanne (2010): Rückkehr der Natur. Die Neuerfindung von Natur und Landschaft in der Emscherzone. [The return of nature. Reinventing nature and landscape in the Emsche river zone]. EMSCHERplayer. www.emscherplayer.de/main.yum?mainAction=magazin&id=49786, accessed 18.5.2016.

[11] The "Programm Lebendige Gewässer" summarises the activities for ecological water development in NRW.

[12] The Water Framework Directive was implemented in 2002 by amendments to the Water Management Act (WHG) in German federal law, which is effective uniformly in all federal states.

[13] www.eglv.de, www.ruhrverband.de, accessed 18.5.2016.

[14] See also Ministry for Climate Protection, Environment, Agriculture, Nature and Consumer Protection of the State of North Rhine-Westphalia (MKULNV NRW) (2015): Unser Wasser, unsere Gewässer in NRW. Schon alles gut? [Our water, our water bodies in NRW. Everything's fine already?] p. 20f. http://www.flussgebiete.nrw.de/img_auth.php/a/ac/Broschuere_unser_wasser_web.pdf, accessed 18.5.2016.

[15] The biological quality component with the worst evaluation determines the class affiliation. If a pollutant relevant to the river basin exceeds a certain limit (environmental quality standard), the ecological condition can be rated as moderate at best.

[16] See State Agency for Nature, Environment and Consumer Protection of North Rhine-Westphalia (LANUV) (undated): http://www.lanuv.nrw.de/umwelt/wasser/wasserrahmenrichtlinie/gewaesserzustand/gewaesserguete/, accessed 18.5.2016.

[17] From 2006 to 2008, the State Agency for Nature, Environment and Consumer Protection (LANUV) in cooperation with the district governments and the water industry associations with special legal status first conducted chemical and biological investigations of the water in accordance with the requirements of the EC-WFD with nationwide coordinated methods and evaluation rules. Due to changes in the evaluation methodology compared to the previous customary procedures in accordance with the Regional Water Working Group (LAWA), no continuous time series representation on water quality in the past is possible. For monitoring, see State Agency for Nature, Environment and Consumer Protection of North Rhine-Westphalia (LANUV) (2013): Begleittext zur Veröffentlichung der Daten des 2. Monitoringzyklus (2009-2011), [Text accompanying the publication of the data from the 2nd monitoring cycle (2009-2011)].

[18] Federal Environmental Agency North Rhine-Westphalia (2001): Gewässergütebericht 2001 Nordrhein-Westfalen. Berichtszeitraum 1995-2000. [Water Quality Report 2001 North Rhine-Westphalia. Report period 1995-2000.] http://www.lanuv.nrw.de/uploads/tx_commercedownloads/gewgue01.pdf, accessed 18.5.2016.

[19] Source: Ruhr Association (2015): Ruhrgütebericht 2014, [Ruhr Quality Report 2014], pg. 56. http://www.ruhrverband.de/fileadmin/pdf/presse/wissen/Ruhrguetebericht_2014.pdf, accessed 18.5.2016.

[20] The data in the map refer to the 2nd monitoring cycle (2009-2011). The Gecksbach stream was upgraded to "mediocre" during the third monitoring cycle (2012-2014).

[21] Hurck, Rudolf; Bechtel, Antje; Korte, Thomas (2013): Lebendige Gewässer in NRW – wo stehen wir bei der Umsetzung der Maßnahmenprogramme? Contribution to the Essen Tagung 2013. [Living water bodies in NRW. How far have we got in implementing the programmes of measures?] http://www.eglv.de/fileadmin/Medien/Dokumente/PDF/WP/BeitragEssenerTagung2013LebendigeGewaesserinNRW.PDF, accessed 18.5.2016.

[22] Fekkak, Miriam; Wilts, Henning (2013): Technik und Natur gemeinsam denken. [Jointly considering techology and nature] In: Emscher 3.0 – Auf dem Weg zu „blauen Infrastrukturen". [On the road to „blue infrastructures"]. Verlag Kettler, p. 31-65.

[23] Emscher Conversion, Seseke Programme, Lippe Floodplain Programme

[24] The water body conversion will take place in three consecutive phases, which have already been partially completed: 1. The decentralisation of wastewater treatment through four large biological wastewater treatment plants in the region (completed in 2001), 2. The construction of a total of 400 km of underground sewers, including associated storm water treatment on the river Emscher and its tributaries, 3. The near-natural transformation of a total of 350 km of bodies of water after being relieved of wastewater, including the transformation of the cycling and foot paths. See also Emscher Water Management Association (undated): Generationenprojekt für eine Region mit Zukunft. [Generation project for a region with a future.] http://www.eglv.de/emschergenossenschaft/emscher-umbau/, accessed 07.11.2016.

[25] Federal Environment Agency (ed.) (2014): Strategien zur Optimierung von Fließgewässer-Renaturierungsmaßnahmen und ihrer Erfolgskontrolle. [Strategies to optimise the renaturalisation measures for watercourses and their success monitoring]. Texts 43/2014. Dessau-Roßlau.

[26] Emscher and Lippe Water Management Associations investigate the "amount and incidence of naturally occurring aquatic animals" as an indicator for biological diversity in order to depict the increasing ecological improvements in the watercourses of the Emscher and Lippe areas in addition to the operative monitoring as per the EC-WFD. Indicator species, umbrella species, keystone species appear naturally in the watercourses and are part of the mission, they reflect the natural function capability and the level of renaturalisation of the aquatic ecosystem. A target value for 2023 will be defined for the Emscher and Lippe catchment areas separately – three years after completing the Emscher conversion. Source: Emscher, Lippe Water Management Associations (2013): Balanced Score Card (BSC) – Ökosystemdienstleistungen. Biologische Vielfalt. [Balanced Score Card (BSC) – ecosystem services. Biological diversity]. Unpublished.

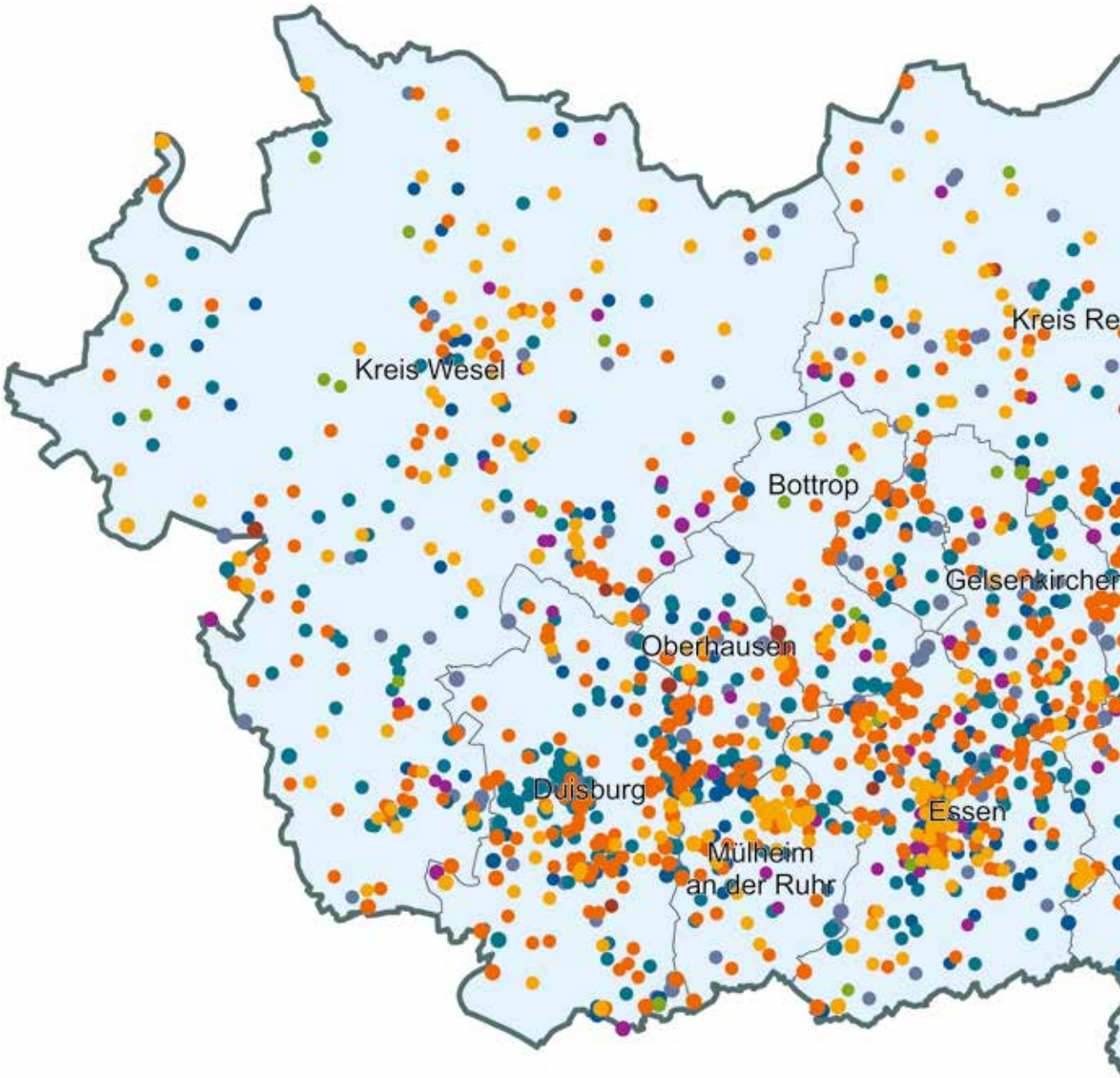
[27] www.dessin-project.eu, accessed 18.5.2016.

[28] See Ministry for Climate Protection, Environment, Agriculture, Nature and Consumer Protection of the State of North Rhine-Westphalia (MKULNV NRW) (2015): Steckbriefe der Planungseinheiten in den nordrhein-westfälischen Anteilen von Rhein, Weser, Ems und Maas. Bewirtschaftungsplan 2016-2021. Oberflächengewässer und Grundwasser. Teileinzugsgebiet Rhein/Emscher. [Descriptions of the planning units in the North Rhine Westphalian areas of the rivers Rhine, Weser, Ems and Maas. Management Plan 2016-2021. Surface waters and groundwater. Sub basin Rhine/Emscher.]

[29] EGLV – Emschergenossenschaft and Lippeverband (undated): Umbau vereint drei Projekte. [Conversion combines three projects.] http://www.eglv.de/emschergenossenschaft/emscher-umbau/der-umbau/holtener-bruch/, accessed 07.11.2016.

5.15 Environmental economy: Number of people employed in the environmental economy

Companies in the environmental economy in the Ruhr metropolitan area by market segment

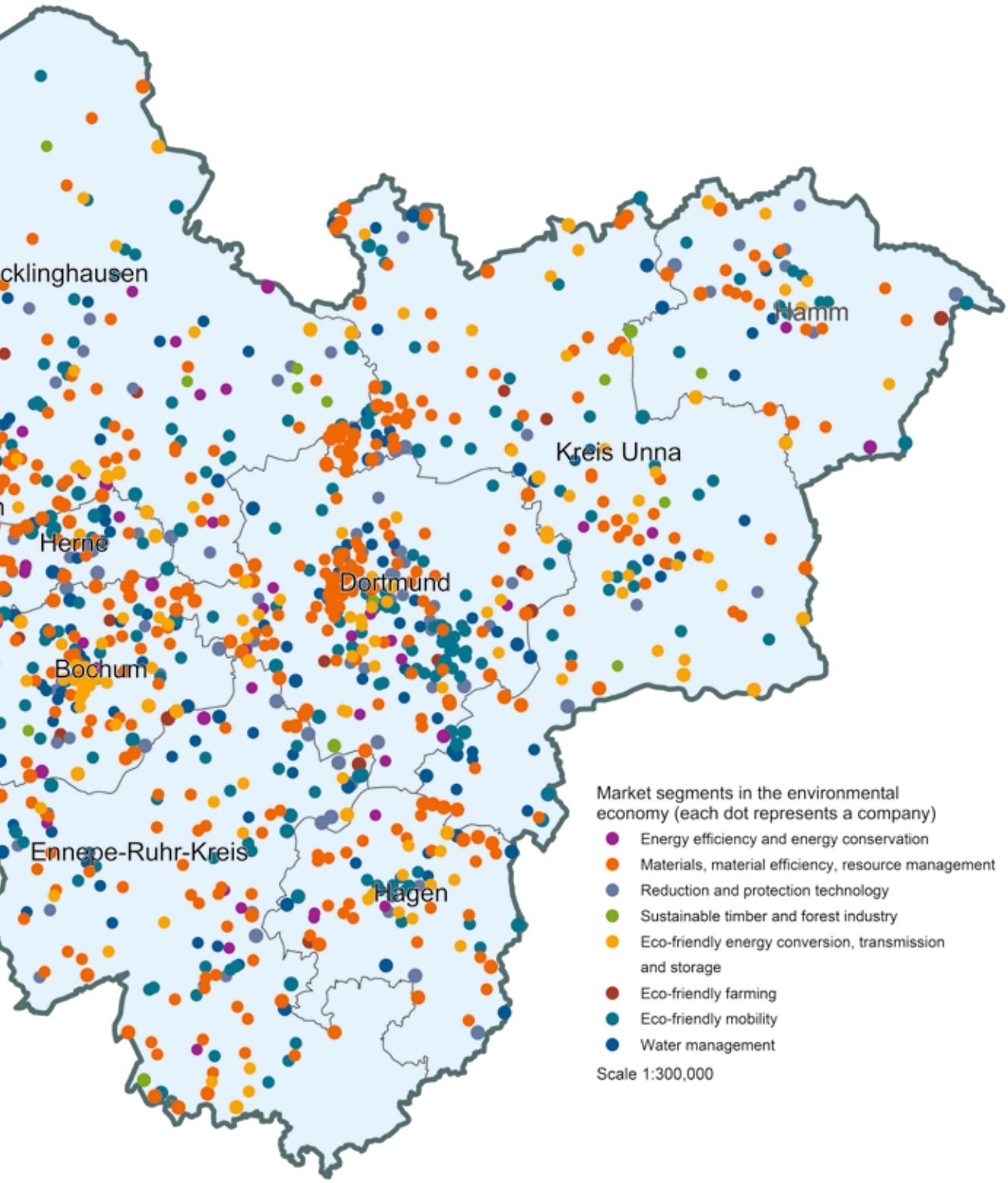


Source: Calculations from Prognos AG 2015 based on data from the German Federal Employment Agency and from IT.NRW (NRW statistical office) (for 2012)

Map source: © Ministry for Environment, Agriculture, Conservation and Consumer Protection of the State of North Rhine-Westphalia (MKULNV NRW);

Cf. MKULNV NRW (2015): Umweltwirtschaftsbericht Nordrhein-Westfalen 2015,

[Report on the Environmental Economy [1] North Rhine-Westphalia 2015], p. 120. Düsseldorf.


cklinghausen
Hamm
Kreis Unna
Herne
Dortmund
Bochum
Ennepe-Ruhr-Kreis
Hagen
Market segments in the environmental economy (each dot represents a company)
Energy efficiency and energy conservation
Materials, material efficiency, resource management
Reduction and protection technology
Sustainable timber and forest industry
Eco-friendly energy conversion, transmission and storage
Eco-friendly farming
Eco-friendly mobility
Water management
Scale 1:300,000

Indicator 15 – Environmental economy: Number of people employed in the environmental economy

Objective: to strengthen the environmental economy and the areas of the economy involved in climate protection
Indicator: number of the workforce (full-time equivalent employees in full-time entities) in the environmental economy

Existing operational targets:

NRW: [2]	↦ By 2025: 420,000 members of the workforce in the environmental economy (new posts or securing existing jobs)
Target proposed by the Wuppertal Institute for the Ruhr metropolitan area [3]	↦ By 2025: 130,000 members of the workforce in the environmental economy

Significance of the environmental indicator

Environmental protection is closely linked to economic activity and, as a cross-sectional goal, therefore makes demands on all sectors of the economy. The environmental economy includes all companies that "offer products or services which protect the environment and are eco-friendly and resource-efficient." [4] The term environmental economy is often used synonymously with the term environmental protection industry. The environmental economy is not (yet) identified as an independent economic sector in classical economic statistics, [5] but is incorporated to some extent in all relevant market sectors. [6] The environmental economy covers those companies which include eco-friendly goods and services that protect the environment, such as "[...] waste management and recycling, water pollution control and sewage treatment, air pollution control, noise reduction, renewable energy sources, eco-friendly products, efficient energy use, climate protection and measurement, control and regulatory equipment." [7]

Alongside its ecological significance, the environmental economy is also relevant from an economic and social perspective, since it represents an important ecologically sound factor of the economy, with a turnover of nearly €26 billion in North Rhine-Westphalia alone and a turnover of about €85 billion in total for the whole of Germany. [8] Since the (gross) employment figures for the environmental economy have risen in recent years, this sector contributes both to environmental sustainability and to economic and social sustainability.

Existing targets

The aim of the North Rhine-Westphalia state government is to increase the number of the workforce in the environmental economy from around 320,000 in 2012 (4.7% of the total workforce) [10] to 420,000 in 2025. Based on the state target, the Wuppertal Institute recommends that the Ruhr metropolitan area set a target of increasing the number of the workforce in the environmental economy from 97,000 in 2012 (5.6% of the total workforce) to 130,000 in 2025. [11] Accordingly, the Ruhr metropolitan area will thus set itself a more ambitious target, in view of its favourable initial conditions, in order to take an active part in the structural change of the Ruhr region.

Current situation and development in the Ruhr region

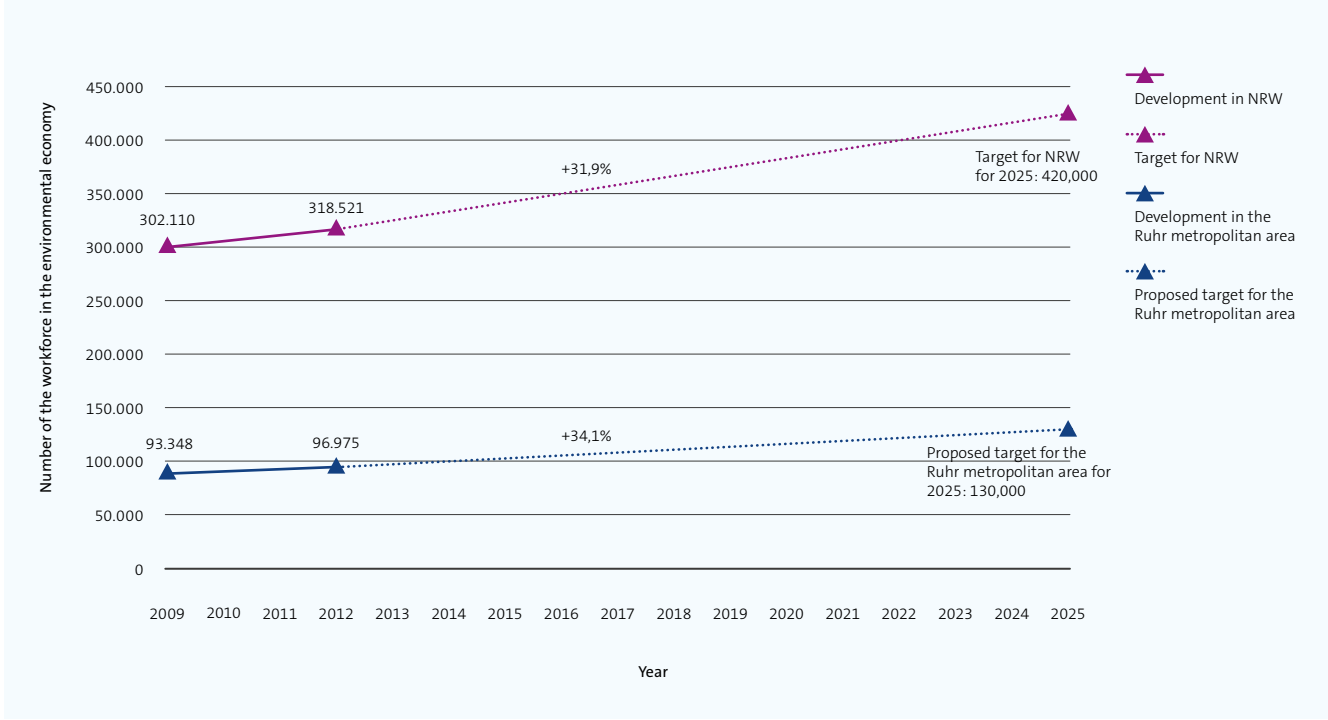
In 2012, 96,975 people were employed in the environmental economy in the Ruhr metropolitan area, which equates to 5.6% of the total workforce in the Ruhr metropolitan area and 30% of the entire environmental economy in North Rhine-Westphalia which had around 319,000 of the workforce. Compared to 2009, the number of people working in the environmental economy in the Ruhr metropolitan area had risen by 3.9%, or more than 3,500 additional people, in 2012. The turnover for the environmental economy rose from €20,760 million in 2009 to more than €26,168 million in 2012 – which equates to around 38% of the total turnover for NRW in the environmental economy in 2012 and nearly 8% of the turnover for Germany as a whole. [12]

Assessment

The Ruhr metropolitan area is the leading region in the area of the environmental economy in the whole of North Rhine-Westphalia – both in terms of employment figures and turnover: [13] 5.6% of the total workforce in the

Environmental technology

Number of the workforce in the environmental economy in North Rhine-Westphalia and in the Ruhr metropolitan area in 2009 and 2012, NRW target for 2025 and target proposed by the Wuppertal Institute for the Ruhr metropolitan area for 2025



Source: Wuppertal Institute presentation based on the NRW Environmental Report (2015) and the Wuppertal Institute's own calculations and proposed target for the Ruhr metropolitan area for 2025 [9]

Ruhr metropolitan area is employed in the environmental economy compared to the state average of 4.7% for North Rhine-Westphalia.[14] In terms of turnover for the environmental economy, the Ruhr metropolitan area stands above the state average of €0.22 million per member of the workforce, achieving an average of €0.27 million per individual.[15] Concerning patent applications, however, the Ruhr metropolitan area has a lower average of patents per 1,000 members of the workforce in the environmental economy (3.2 patents or 21% of the patents for the state as a whole) compared to the NRW state average of 4.6 patents per 1,000 members of the workforce.[16] The growth rate of the environmental economy in the Ruhr metropolitan area between 2009 and 2012, which stood at 3.9%, was also slightly below the state growth rate of 5.4%.[17]

The strengths of the Ruhr metropolitan area lie in its high degree of specialisation in many subsectors of the environmental economy[18] and in the "vast technological and innovative skills [...], which range from power engineering, to resource management and chemical processes, right up to sustainable urban development."[19] The Ruhr metropolitan area thus demonstrates that it is able to combine economic success and environmental protection. The data look promising, indicating that the environmental economy has further potential for growth and will continue to have a positive impact on employment. There are possible ways of

Development trend

strengthening the environmental economy, for example, by promoting innovation, supporting foreign trade, developing competencies in the individual regions, creating appropriate frameworks and standards, as well as ensuring systematic organisation and networking across different industrial sectors.[20]

The Gebrüder Eickhoff Maschinenfabrik und Eisengießerei GmbH (Eickhoff brothers engineering works and iron foundry) is a family business based in Bochum that has been globally active since it was founded in 1864. The company, which was originally set up as an iron foundry and supplier for the mining industry (in the Ruhr region and worldwide), developed its first wind turbine gearboxes in 1990. In 2009, they started mass production of wind turbine gearboxes in a new factory built specially for this purpose. Eickhoff has a workforce of around 1,800 employees (2014 figure) and is a good example of the structural changes taking place in the Ruhr region in the area of the environmental economy.[21,22]

Sources and notes

[1] The Ministry for Climate Protection, Environment, Agriculture, Conservation and Consumer Protection of the State of North Rhine-Westphalia (MKULNV NRW) (2015): Umweltwirtschaftsbericht Nordrhein-Westfalen 2015, [Environmental Economy Report North Rhine-Westphalia 2015], p. 120. https://www.umwelt.nrw.de/fi-leadmin/redaktion/Broschueren/umweltwirtschaftsbericht_nrw_2015.pdf, accessed 19.04.2016.

[2] The Ministry for Climate Protection, Environment, Agriculture, Conservation and Consumer Protection of the State of North Rhine-Westphalia (MKULNV NRW) (2015): Umweltwirtschaftsbericht Nordrhein-Westfalen 2015, [Environmental Economy Report North Rhine-Westphalia 2015], p. 3. https://www.umwelt.nrw.de/fileadmin/redaktion/Broschueren/umweltwirtschafts- bericht_nrw_2015.pdf, accessed 19.04.2016 and North Rhine-Westphalia State Government (2016): Nachhaltigkeitsstrategie für Nordrhein-Westfalen, [Sustainability strategy for North Rhine-Westphalia], p. 29. Düsseldorf. http://www.nachhaltigkeit.nrw.de/fileadmin/download/nrw-nachhaltigkeitsstrategie_broschuere.pdf, accessed 03.08.2016.

[3] Targets proposed by the Wuppertal Institute for the number of the workforce in the environmental economy in the Ruhr metropolitan area by 2025: the number of the workforce in the environmental economy for NRW in 2025 is taken from the report on the environmental economy. For the Ruhr metropolitan area, the number of the workforce was calculated as follows: NRW in 2025 / NRW in 2012: 420,000 / 318,521 = a factor of 1.3186; assuming the same target growth in the environmental economy for NRW and the Ruhr metropolitan area: Ruhr metropolitan area in 2025: 96.975 * factor 1.3186 = 127,871 members of the workforce in the environmental economy in 2025. The favourable initial conditions in the environmental economy in the Ruhr Region support the somewhat ambitious proposed target compared to the target at the NRW state level. The figure of 130,000, which can be communicated more easily, is proposed as the target number of the workforce in the environmental economy for 2025.

[4] The Ministry for Climate Protection, Environment, Agriculture, Conservation and Consumer Protection of the State of North Rhine-Westphalia (MKULNV NRW) (2015): Umweltwirtschaftsbericht Nordrhein-Westfalen 2015, [Environmental Economy Report North Rhine-Westphalia], p.8. https://www.umwelt.nrw.de/filead- min/redaktion/Broschueren/umweltwirtschaftsbericht_nrw_2015.pdf, accessed 18.04.2016.

[5] Such as agriculture and forestry, fishing; industry, manufacturing industries; energy; construction; service industries; domestic trade, the hospitality industry; tourism; transport and haulage.

[6] The environmental economy includes activities such as "measuring, monitoring, remediating, avoiding, remedying, minimizing, researching and raising awareness of environmental damage to the air, water and soil, as well as [areas such as] waste disposal, noise, biodiversity and landscape and resource depletion" (The Ministry for Climate Protection, Environment, Agriculture, Conservation and Consumer Protection of the State of North Rhine-Westphalia (2015): Umweltwirtschaftsbericht Nordrhein-Westfalen 2015, [Green Economy Report North Rhine-Westphalia 2015], p.8.

https://www.umwelt.nrw.de/fileadmin/redaktion/Broschueren/umweltwirtschaftsbericht_nrw_2015.pdf, accessed 18.04.2016.

[7] The German Federal Environmental Agency (2014): Umwelt, Innovation, Beschäftigung// Februar 2014. Die Umweltwirtschaft in Deutschland, [Environment, Innovation, Employment// February 2014. The environmental economy in Germany], p. 4. https://www.umweltbundesamt.de/sites/default/files/medien/378/publikationen/hgp_umweltwirtschaft_in_deutschland.pdf, accessed 14.04.2016.

[8] The German Federal Environmental Agency (2014): Umwelt, Innovation, Beschäftigung// Februar 2014. Die Umweltwirtschaft in Deutschland, [Environment, Innovation, Employment // February 2014. The environmental economy in Germany], p. 5. https://www.umweltbundesamt.de/sites/default/files/medien/378/publikationen/hgp_umweltwirtschaft_in_deutschland.pdf, accessed 14.04.2016.

[9] Illustration: Number of the workforce in the environmental economy in NRW and the Ruhr metropolitan area. The data for 2009 and 2012, and for NRW for the target year 2025 come from the report on the environmental economy in NRW (2015). The Wuppertal Institute used a proportional calculation to estimate the data for the Ruhr metropolitan area based on the NRW target assuming the same proportion of employment in the environmental economy until 2025. Note: the number of the workforce in the environmental economy for NRW was taken from the report on the environmental economy. For the Ruhr metropolitan area, the number of the workforce was calculated as follows: NRW in 2025 / NRW in 2012: 420,000 / 318,521 = 1.3186; Ruhr metropolitan area in 2025: 96.975 * 1.3186 = 127,871. The figure of 130,000, which can be communicated more easily, is proposed as the target number of the workforce in the environmental economy for 2025. This target value is subject to the risk of error and the further into the future it extends, the greater the level of uncertainty it entails. The development of the employment rate is affected by many factors. Possible influences that are not market driven and/or market driven influences such as net immigration over the coming years, increased life expectancy, the birth rate, or increasing digitisation and automation may substantially affect this target.

[10] Cf. The Ministry for Climate Protection, Environment, Agriculture, Conservation and Consumer Protection of the State of North Rhine-Westphalia (MKULNV NRW) (2015): Umweltwirtschaftsbericht Nordrhein-Westfalen 2015, [Environmental Economy Report North Rhine-Westphalia 2015], p. 34. https://www.umwelt.nrw. de/fileadmin/redaktion/Broschueren/umweltwirtschaftsbericht_nrw_2015.pdf, accessed 19.04.2016.

[11] Cf. Notes 2 and 3.

[12] The Ministry for Climate Protection, Environment, Agriculture, Conservation and Consumer Protection of the State of North Rhine-Westphalia (MKULNV NRW) (2015): Umweltwirtschaftsbericht Nordrhein-Westfalen 2015, [Environmental Economy Report North Rhine-Westphalia 2015], p. 42 and p. 119. https://www.umwelt. nrw.de/fileadmin/redaktion/Broschueren/umweltwirtschaftsbericht_nrw_2015.pdf, accessed 19.04.2016.

[13] The Ministry for Climate Protection, Environment, Agriculture, Conservation and Consumer Protection of the State of North Rhine-Westphalia (MKULNV NRW) (2015): Umweltwirtschaftsbericht Nordrhein-Westfalen 2015, [Environmental Economy Report North Rhine-Westphalia 2015], p. 119. https://www.umwelt.nrw.de/fileadmin/redaktion/Broschueren/umweltwirtschaftsbericht_nrw_2015.pdf, accessed 19.04.2016.

[14] Cf. The Ministry for Climate Protection, Environment, Agriculture, Conservation and Consumer Protection of the State of North Rhine-Westphalia (MKULNV NRW) (2015): Umweltwirtschaftsbericht Nordrhein-Westfalen 2015, [Environmental Economy Report North Rhine-Westphalia2015], p. 34 and 119. https://www.umwelt.nrw.de/fileadmin/redaktion/Broschueren/umweltwirtschaftsbericht_nrw_2015.pdf, accessed 19.04.2016.

[15] Wuppertal Institute calculation for NRW: number of the workforce in the environmental economy in NRW (2012): 318,521; turnover for the environmental economy in NRW (2012): €69,636 million (cf. MKULNV NRW (2015): Umweltwirtschaftsbericht Nordrhein-Westfalen 2015, [Environmental Economy Report North Rhine-Westphalia 2015], p. 34 https://www.umwelt.nrw.de/fileadmin/redaktion/Broschueren/umweltwirtschaftsbericht_nrw_2015.pdf, accessed 19.04.2016); €69,636 million / 318,521 members of the workforce in the environmental economy = €0.219 million per individual. Wuppertal Institute calculation for the Ruhr metropolitan area: 96,975 members of the workforce in the environmental economy (2015); turnover for the environmental economy in the Ruhr metropolitan area (2012): €26,168 million (cf. ibid. p. 120). €26,168 million / 96,975 members of the workforce = €0.270 million per individual.

[16] 4.6 patents per 1,000 members of the workforce in 2012 (cf. MKULNV NRW (2015): Umweltwirtschaftsbericht Nordrhein-Westfalen 2015, [Environmental Economy Report North Rhine-Westphalia 2015], p. 33, https://www.umwelt.nrw.de/fileadmin/redaktion/Broschueren/umwelt-wirtschaftsbericht_nrw_2015.pdf, accessed 19.04.2016); 3.2 patents per 1,000 members of the workforce in the environmental economy in the Ruhr metropolitan area according to the calculations of the Wuppertal Institute: 308 patents in 2012 (ibid., p. 116) / 96,975 members of the workforce in the environmental economy (ibid., p. 120) = 3.176 patents per 1,000 members of the workforce in the environmental economy.

[17] The Ministry for Climate Protection, Environment, Agriculture, Conservation and Consumer Protection of the State of North Rhine-Westphalia (MKULNV NRW) (2015): Umweltwirtschaftsbericht Nordrhein-Westfalen 2015, [Environmental Economy Report North Rhine-Westphalia 2015], p. 120, https://www.umwelt.nrw.de/fileadmin/redaktion/Broschueren/umweltwirtschaftsbericht_nrw_2015.pdf, accessed 19.04.2016.

[18] As part of its Smart Specialisation Strategy, the Ruhr metropolitan area aims to achieve an intelligent, sustainable and inclusive economy. This shows a portfolio of the sectors which are found, specific to the region, in the major market sectors of the Ruhr metropolitan area. Several strong areas of potential growth can be seen here (health, digital communication) and a focus on and orientation towards sustainability is seen in overlaps with the submarkets of the green economy (urban construction and housing, efficient use of resources) (Economic development in the Ruhr metropolitan area (2016): Wirtschaftsbericht Ruhr 2015/ Industrie 4.0 und Cyber-Physische Systeme, [Ruhr economic report 2015/ Industry 4.0 and Cyber-physical systems], p. 30 f. http://business.metropoleruhr.de/fileadmin/user_upload/Dokumente/Veranstaltungen/Wirtschaftsbericht/2016/wmr_wirtschaftsbericht2015_230216.pdf, accessed 10.05.2016). Smart specialisation, based on a balance between export orientation and regionalisation, offers the region long-term stability of primary care and also guarantees employment in the region.

[19] The Ministry for Climate Protection, Environment, Agriculture, Conservation and Consumer Protection of the State of North Rhine-Westphalia (MKULNV NRW) (2015): Umweltwirtschaftsbericht Nordrhein-Westfalen 2015, [Environmental Economy Report North Rhine-Westphalia], p. 119. https://www.umwelt.nrw.de/fileadmin/redaktion/Broschueren/umweltwirtschaftsbericht_nrw_2015.pdf, accessed 19.04.2016.

[20] The Ministry for Climate Protection, Environment, Agriculture, Conservation and Consumer Protection of the State of North Rhine-Westphalia (MKULNV NRW) (2015): Impulse für die Umweltwirtschaft. Handlungsansätze zur Stärkung der Umweltwirtschaft in Nordrhein-Westfalen, [Inspiration for the environmental economy. Approaches for strengthening the environmental economy in North Rhine-Westphalia], p. 9. https://www.umwelt.nrw.de/fileadmin/redaktion/Broschueren/impulse_umweltwirtschaft_nrw_broschuere.pdf, accessed 18.04.2016.

[21] The company Gebr. Eickhoff Maschinenfabrik und Eisengießerei GmbH currently produces machines and gear boxes, which have to prove themselves under extreme conditions worldwide. The company is the global market leader for high-performance machinery for mining engineering and also supplies gear systems for the renewable energy sector. With its Wind and Power business unit, Eickhoff is a key supplier for the wind energy sector in NRW and a main player in the environmental economy. The company's innovative approach, in particular, which gets customers and users actively involved in the work process, makes Eickhoff Wind and Power stand out. (Cf. Eickhoff (2016): Internet site for Gebr. Eickhoff Maschinenfabrik und Eisengießerei GmbH. http://www.eickhoff-bochum.de/de/node/69, accessed 03.05.2016 and WELTN24 GMBH (2014): How Bochum is defying the loss of coal mines, Opel and Nokia. http://www.welt.de/newsticker/bloomberg/article129911128/ Wie-Bochum-dem-Verlust-von-Zechen-Opel-und-Nokia-trotzt.html, accessed 04.05.2016 and EnergieAgentur.NRW (2015): Innovation & Energy 04/2015, the magazine of EnergieAgentur.NRW. http://www.energieagentur.nrw/content/anlagen/IE_2015-4_DEU.PDF, accessed 03.05.2016.)

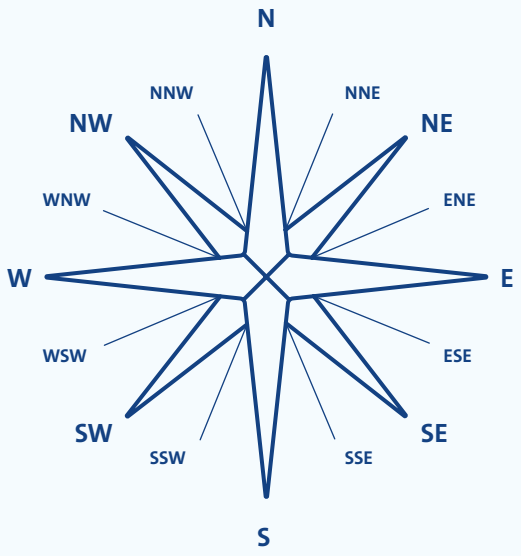
[22] Wirtschaftsförderung metropoleruhr GmbH (the economic development agency for the Ruhr metropolitan area (2015): WIRTSCHAFTSBERICHT RUHR 2014, [RUHR ECONOMIC REPORT 2014], P. 38. http://business.metropoleruhr.de/fileadmin/user_upload/Dokumente/Publikationen/Wirtschaftsberichte/Wirtschaftsbericht_Ruhr_2014.pdf, accessed 28.06.2016.

From environmental report to sustainability report: Starting point, signposts and target prospects for the Ruhr metropolitan area

From here on:
The first report based on environmental indicators for the Ruhr metropolitan area

The first report on the state of the environment in the Ruhr metropolitan area has arrived – that is a good sign! On the one hand, because the 15 environmental indicators show that the Ruhr metropolitan area is doing better in some areas than some people may have expected. There is, of course, still a lot to do and efforts need to be stepped up. But in many areas the Ruhr metropolitan area is certainly developing in the right direction. On the other hand, this kind of environmental report is an important basis in order to take a strategic approach to environmental protection and sustainable development and to make constant progress in these areas. And that is exactly what this report should be used for: as a starting point for ambitious, target-orientated and measurable future development leading to a "sustainable Ruhr metropolitan area".

Compass



Source: RVR

Signpost: the significance of the first regional report on the environment for the Ruhr metropolitan area

With this first regional report on the state of the environment, the Ruhr metropolitan area is providing, for the first time, a comprehensive database on the state of the environment in the region – using 15 measurable environmental indicators. They present the current situation and the development to date for 15 key environmental issues in a way that is transparent. They show whether the quality of the environment is moving in the right direction. And they illustrate the success achieved so far and the action that needs taking in the future.

Environmental protection and sustainable development are political tasks that need to be addressed constantly over the long term. Take the area of climate protection, for example: the targets for reducing greenhouse gas emissions cover a timespan from 1990 to 2050, i.e. a timespan of thirty years into the future. We could put this in a different way: within just one generation greenhouse gas emissions must be reduced drastically, by 80 to 95 per cent – in Germany as a whole as well as in the Ruhr region. Indicators take on an important role as a means of orientation within this kind of development process, because they provide information on how the situation is developing over time in a particular context. Similar to a compass when travelling, concrete operational targets show the direction to be taken. Good targets fulfil so-called "SMART" criteria; these are as follows:

- ↦"specific", i.e. a target indicates a precisely-defined situation,
- ↦"measurable", i.e. a target is observable, verifiable and comparable,
- ↦"agreed", i.e. targets need to be agreed by those involved at the social and political levels,
- ↦"realistic", i.e. a target must be achievable using the resources and skills that are available,
- ↦"time-based", i.e. a target must be clearly defined in terms of its time frame.

In this report, the Wuppertal Institute and the planning office Richter-Richard, together with the steering committee of the heads of environmental protection departments from the administrative districts and cities in the Ruhr metropolitan area, have compiled an initial set of 15 environmental indicators for the Ruhr metropolitan area. The environmental indicators were selected to ensure as close an alignment as possible with existing indicators and targets set at the higher levels of the EU, the German government and the state of NRW, and at the subordinate level of the municipalities: this includes, for example, alignment with the targets of the state of North Rhine-Westphalia that are legally enshrined in NRW's climate protection act for reducing greenhouse gas emissions (NRW state parliament 2013); and alignment with the national sustainability strategy (German government 2016) and with North Rhine-Westphalia's sustainability strategy (state government of North Rhine-Westphalia 2016) as well as with the targets set by the city of Essen in its application for European Green Capital 2017 (City of Essen 2014).

The Wuppertal Institute and the planning office Richter-Richard developed proposed targets for each of these indicators. These make it possible to evaluate the previous development in terms of the 15 environmental indicators: is anything happening as regards the various environmental issues and is the quality of the environment moving in the right direction? Where is it possible to support and strengthen a correctly adopted strategy? Where does more need to be done than has previously been the case in order to actually achieve the targets? Where is it a case of countering mistaken developments and correcting courses of action in order to successfully steer a course of sustainable development?

The current situation: what the environmental indicators reveal about sustainability in the Ruhr metropolitan area

The assessment of the state of the environment in the Ruhr metropolitan area based on 15 environmental indicators and the proposed targets clearly illustrates three main issues:

First of all, the report shows that, in terms of the environmental indicators, "the sun is not yet shining everywhere" by any means, i.e. the development of the state of the environment cannot yet be rated as good. A rating of good applies only to indicator 15: there is no other part of North Rhine-Westphalia where as many people are employed in

Assessment of the development trends in the quality of the environment in the Ruhr metropolitan area

Environmental indicator	Assessment	Environmental indicator	Assessment	Environmental indicator	Assessment
01. Climate protection		**06. Nitrogen dioxide (NO_2)**		**11. Land use**	No trend analysis possible*
02. Primary energy consumption	No trend analysis possible*	**07. Particulate matter (PM_{10})**		**12. Organic farming**	
03. Proportion of energy from renewable sources in final energy consumption	No trend analysis possible*	**08. Particulate matter ($PM_{2,5}$)**		**13. Connected biotope areas**	
04. Proportion of energy from renewable sources in net electricity consumption		**09. Noise all day**		**14. Water quality**	
05. Choice of mode of transport (modal split)	No trend analysis possible*	**09. Noise at night**		**15. Number of the workforce in the environmental economy**	

*due to lack of data from previous years

the environmental economy and where the turnover per member of the workforce is as high as in the Ruhr metropolitan area – and these figures are on the increase.

Secondly, the indicator chapter of the report also shows, however, that all the indicators (for which data is available making it possible to evaluate the development trends) are basically developing in the right direction – but at very different rates. For example, the percentage of connected biotope areas in the whole of the Ruhr region is below the average for North Rhine-Westphalia, but this figure increased more rapidly between 2011 and 2015 than the NRW average. And in terms of water quality, organic pollution of running water due to the discharge of wastewater was reduced significantly in the past.

Nevertheless, there is still a great deal of work to be done in many areas and previous efforts need to be significantly intensified in order to achieve the proposed targets for sustainable development. Take the example of climate protection (indicator 1): greenhouse gas emissions in the Ruhr region fell by 4.3% between 1990 and 2012. They are therefore moving in the right direction. However, the Ruhr region is still far from being on track to achieve the targets of -25% by 2020 and at least -80% by 2050, as imposed by legislation in North Rhine-Westphalia. To achieve these targets, the reduction rate for greenhouse gas emissions needs to be increased significantly.

Or take the example of particulate matter air pollution (indicators 7 and 8): the limits for PM_{10} were complied with in both 2014 and 2015, as were the applicable EU limits for $PM_{2.5}$ for 2015 to 2019 (25 µg/m³, from 2020 20 µg/m³). In order to comply with future EU limits, even in less favourable meteorological conditions, and to achieve the targets of the World Health Organization, much more extensive measures are needed, however, particularly in the light of the harmful effect particulate matter has on health.

Thirdly, the indicator report shows that the Ruhr region already has a lot of good examples of measures that are being taken to create a better quality environment – even in the area of climate protection. One example is the "Innovation City Ruhr" which has a very ambitious target for reduc-

Nordstern Park Gelsenkirchen

ing greenhouse gas emissions – "Halving emissions within a decade" (-50% between 2010 and 2020) – and shows promising interim results: by means of the measures implemented or agreed up until 2015, a reduction in greenhouse gases of approx. 37% should be achieved by 2020. Another example is the Phoenix project in Dortmund, where the industrial brownfield site of a former blast furnace plant and a steelworks was recycled and developed for new residential, leisure, technology and commercial purposes – including fresh habitats for plants and animals at the newly-created Phoenix Lake. Any additional use of the land is therefore prevented. A further example is the long-term project for rehabilitating the river Emscher where it has been possible to significantly improve the water quality of the former waste water canal by cleaning up the sewage and restoring the river's natural structure. Another successful major project is the construction of the Emscher Landscape Park where the cityscape has been developed sustainably at the heart of the conurbation on an area covering 457 km². Since the start of the 1990s, the former mines and steel works and their railway tracks and road infrastructure have been converted into a system of new parking facilities, cultural sites and cycle paths, which today represent a starting point for a new strategic dimension of integrated development: the Ruhr Green Infrastructure. And the new Ruhr region low emission zone – which is the largest interconnected low emission zone in Germany and, after London, the second-largest in Europe – is also part of this league.

Good examples like these are encouraging. They show that change is possible – and it is also possible in a very individual way here in the Ruhr metropolitan area. We need more of these good examples to support mutual learning processes in the region and to gain common perspectives.

More than just the environment: 15 environmental indicators and their significance in terms of social and economic sustainability

The 15 environmental indicators that are presented span a wide variety of environmental issues: climate protection and the energy transition, mobility, noise and air pollution, sustainable land use, biodiversity and water purification and last but not least the sustainable green economy. The

15 environmental indicators are not only significant in terms of ecological sustainability, but also in terms of the social and economic aspects of sustainability. This is reflected for example in:

↦ Climate change: climatically-driven extreme weather events, such as droughts and flooding, are a security risk, e.g. for agricultural harvests as well as for people's health. And the infrastructure modifications necessary to deal with the changed climate conditions (e.g. dykes and drainage systems) involve considerable costs.

↦ Traffic: dangerous and fatal traffic accidents occur on a daily basis, noise and air pollution are detrimental to human health and adversely affect the quality of life in public spaces. At the same time, motor traffic causes high external costs that have to be borne by the general public, e.g. health expenditure, climate-related costs or the costs for surfaces subjected to heavy wear from traffic.

↦ Biodiversity: biological diversity and well-functioning ecosystems are fundamentally essential for human life: they purify the air and water, ensure crop pollination, produce fertile soil and regulate the local climate and the water balance. At the same time they provide impetus for technical innovation and offer people a high-quality living environment and space for leisure activities.

The three examples show that environmental, economic and social aspects cannot be considered separately since they are very closely interlinked in many ways.

The principle of justice: The relationship between environment and health

The interdependencies between environmental, economic and social aspects are particularly clear in terms of the relationship between environment and health – for example in the areas of traffic, noise and air pollution. The environmental pressures to which people are exposed on a daily basis are unevenly distributed in social terms to a large extent. Gender-specific differences also play a key role in this area. In particular people on low incomes – as is often the case with single mothers for example –, with a low level of education and frequently also from a migrant background are exposed to environmental pressures. This may be, for example, because these people can only afford flats located on main roads, which are much cheaper due to the poor environmental conditions. People who are financially worse off are therefore much more affected by health-threatening noise and air pollution than people on higher incomes. This uneven distribution of environmental pressures also hits elderly people who suffer from poverty, women being most frequently affected. Children are also worse affected, since they are less likely to be seen by car drivers and are therefore more at risk. Moreover, children become ill more readily than adults as a result of air pollution due to the fact that their bodies are more sensitive. People with a low economic status often have less access to urban green areas and therefore fewer opportunities for exercise and recreational activities in the open air in natural surroundings. On the whole, the risks and opportunities as regards the quality of the environment are unevenly distributed in terms of social status and gender to a large extent. Social conditions therefore have a great influence on how healthy people are and how long they live.

The term "environmental justice" is used to describe the relationship between environment, health and unequal social conditions (cf. the German Federal Environmental Agency 2015). The North Rhine-Westphalia state health service (Landeszentrum Gesundheit) also takes up the subject of "environmental justice" in its "Guidelines for a healthy city" (LZG 2016: 27, 41, 165). In order to achieve better environmental justice, i.e. to create healthy environmental and living conditions for all people on an equal basis, an interdisciplinary and integrated approach is necessary, as well as joint action from various policy sectors and stakeholders. In terms of environmental issues, it is necessary to approach these in a way that incorporates social and economic considerations in order to develop comprehensive solutions – ensuring that the people affected are intensively involved in the process. In the case of monitoring sustainability, it is also important to consider environmental issues in combination with social and economic issues. In the indicator section of this environmental report, this was the approach taken in indicator 15 regarding the workforce in the environmental economy, which covers environmental and economic issues as well as social well-being and gives evidence of how the economic structural change in the Ruhr region is taking place in a way that is becoming more sustainable.

...and for the future! The next steps towards achieving a sustainable Ruhr metropolitan area

With its environmental report, the Ruhr metropolitan area is using the momentum brought about by the city of Essen's

year as European Green Capital in 2017 to take a further step towards sustainability. The report on environmental indicators presented here is an important milestone and a signpost on the way to achieving sustainability in the Ruhr metropolitan area. The Ruhr metropolitan area needs to use this signpost as a starting point for its ambitious, target-driven and measurable development in the future towards a "Sustainable Ruhr metropolitan area". The environmental indicator report offers the cities and administrative districts of the Ruhr region, and thus the region as a whole, the opportunity of shaping their environmental policy on a common basis and thereby improving the living conditions of people in the Ruhr region.

The Wuppertal Institute sees four key tasks that are paramount in this context:

1. **Hold regional discussions!** The Ruhr Regional Association (RVR) needs to enter into a comprehensive regional dialogue with stakeholders and decision makers in the Ruhr metropolitan area. The aim of this dialogue should be to agree and mutually shape the sustainable development of the Ruhr metropolitan area for the future and to devise integrated, cross-departmental strategies and measures, which cover all three dimensions of sustainability.

2. **Adopt the environmental targets as policy!** The Ruhr metropolitan area should make use of the targets developed in the environmental report and adopt them as policy, and, by making this commitment, establish a common basis for the development of the Ruhr metropolitan area towards greater sustainability in the future.

3. **Implement measures!** The Ruhr metropolitan area should build on the examples of good practice that already exist in the Ruhr region and add many other good examples. As vivid and clear role models they show how change works in practice and encourage others to follow their example. The Ruhr metropolitan area needs to engage in a lively exchange of ideas within the region and with partners from outside the Ruhr region in order to learn from each other and with each other how sustainable development can be successfully implemented.

4. **From environmental report in 2017 to sustainability report in 2019!** The Ruhr metropolitan area also needs to monitor the state of the environment in the Ruhr region in the future by means of regular indicator-based environmental reports – broadened to include additional indicators on social and economic issues and prepared in close collaboration with the relevant stakeholders. This would enable the Ruhr metropolitan area to connect with existing sustainability reporting in the multilevel political system, particularly with

   a) The United Nations 2030 Agenda for Sustainable Development with its 17 Sustainable Development Goals and 169 sub-targets (United Nations 2015),

   b) The EU Sustainable Development Strategy, adopted in 2001 and revised in 2006, which includes more than 100 social, economic and environmental indicators (Eurostat 2015; Council of the European Union 2006),

   c) Germany's National Sustainable Development Strategy, first adopted in 2002, the new 2016 edition of which, including 63 key social, economic and environmental indicators (German Federal Government 2016), was adopted in January 2017 and

   d) The Sustainability Strategy for North Rhine-Westphalia adopted in 2016 including nearly 70 social, economic and environmental indicators (State Government of North Rhine-Westphalia 2016).

   Possible social and economic indicators are, for example, the poverty rate, the premature mortality rate, the proportion of people without formal educational qualifications, the employment rate for people with a migrant background, or the number of road accident fatalities. A good example of comprehensive sustainability reporting can be found in the Ruhr region itself: there is currently already a system of comprehensive and regular reporting on sustainability in the district of Unna where sustainability reports were produced in 2013 and 2015 (District of Unna 2013 and 2015).

Sustainable cities and regions signify a high standard of living – as we can see from internationally prominent examples such as Copenhagen, Zürich or Vancouver. Many cities and regions have recognised this fact and are actively pursuing targets on a path towards greater sustainability and a higher standard of living. The Ruhr

The Hoheward slag heap in Herten

region needs to get dynamically involved in this process and take an active lead

↦ to provide transparency and orientation by using targets and indicators as signposts and milestones in the future,

↦ to actively promote sustainable structural change in the Ruhr region in a target-orientated way and

↦ to develop the Ruhr metropolitan area as a healthy, sustainable region in which everyone feels it is worth living.

2. Sustainability Report for the District of Unna

Source: District of Unna 2015

References

The German Federal Government (2016): Deutsche Nachhaltigkeitsstrategie – Neuauflage 2016. [Germany's National Sustainable Development Strategy – New edition 2016]. Berlin. https://www.bundesregierung.de/Content/DE/_Anlagen/2017/01/2017-01-11-nachhaltigkeitsstrategie.pdf?__blob=publicationFile&v=9 accessed 3.2.2017.

Eurostat (2015): Sustainable development in the European Union. 2015 monitoring report of the EU Sustainable Development Strategy. http://ec.europa.eu/eurostat/documents/3217494/6975281/KS-GT-15-001-EN-N.pdf, accessed 15.12.2016.

District of Unna (2013): 1. Nachhaltigkeitsbericht Kreis Unna. Unna. [1st Sustainability Report for the district of Unna. Unna.] http://www.kreis-unna.de/fileadmin/user_upload/Kreishaus/kfp/pdf/I_Nachhaltigkeitsbericht_Kreis_Unna.pdf, accessed 12.12.2016. District of Unna (2015): 2. Nachhaltigkeitsbericht Kreis Unna. Unna. [2nd Sustainability Report for the district of Unna. Unna.] http://www.kreis-unna.de/fileadmin/user_upload/Kreishaus/69/pdf/2_Nachhaltigkeitsbericht_Kreis_Unna.pdf, accessed 12.12.2016.

North Rhine-Westphalia State Parliament (2013): Gesetz zur Förderung des Klimaschutzes in Nordrhein-Westfalen.[Law to promote climate protection in North Rhine-Westphalia.] https://www.landtag.nrw.de/portal/WWW/dokumentenarchiv/Dokument/MMG16-29.pdf?von=1&bis=0, accessed 12.12.2016.

State Government of North Rhine-Westphalia (2016): Heute handeln. Gemeinsam für nachhaltige Entwicklung in NRW. [Take action today. Cooperating for sustainable development in NRW.] Düsseldorf. https://www.nachhaltigkeit.nrw.de/fileadmin/download/nrw-nachhaltigkeitsstrategie_broschuere.pdf, accessed 25.11.2016.

LZG – North Rhine-Westphalia State Health Service (2016): Leitfaden Gesunde Stadt – Hinweise für Stellungnahmen zur Stadtentwicklung aus dem Öffentlichen Gesundheitsdienst. [Guidelines for a healthy city – Notes for statements on urban development from the public health authorities]. Bochum. https://www.lzg.nrw.de/_media/pdf/service/Pub/2016_druckfrisch/lzg-nrw_leitfaden_gesunde_stadt_2016.pdf, accessed 3.2.2017.

The Council of the European Union (2006): The revised EU Sustainable Development Strategy. http://www.bmub.bund.de/fileadmin/Daten_BMU/Download_PDF/Nachhaltige_Entwicklung/eu_nachhaltigkeitsstrategie_neu.pdf, accessed 15.12.2016.

City of Essen (2014): Bewerbung zur Grünen Hauptstadt Europas 2017. [Application for European Green Capital 2017]. https://media.essen.de/media/egc2017media/egc2017_dokumente/BewerbungEssen.de.pdf, accessed 12.12.2016.

The German Federal Statistics Office (2014): Nachhaltige Entwicklung in Deutschland – Indikatorenbericht 2014. [Sustainable Development in Germany – Indicator Report 2014. Wiesbaden.] https://www.destatis.de/DE/Publikationen/Thematisch/UmweltoekonomischeGesamtrechnungen/Umweltindikatoren/IndikatorenPDF_0230001.pdf?__blob=publicationFile, accessed 18.11.2016.

The German Federal Environmental Agency (2015): Umweltgerechtigkeit – Umwelt, Gesundheit und soziale Lage. [Environmental justice – Environment, health and social conditions.] Article dated 20.10.2015. http://www.umweltbundesamt.de/ themen/gesundheit/umwelteinfluesse-auf-den-menschen/umweltgerechtigkeit-umwelt-gesundheit-soziale-lage#textpart-1, accessed 12.12.2016.

United Nations (2015): Transforming our world: the 2030 Agenda for Sustainable Development. 18 September 2015. http://www.un.org/depts/german/gv-70/a70-l1.pdf, accessed 25.11.2016.wikimedia.org (2005): Compass with English labels. https://de.wikipedia.org/wiki/Datei:Kompass.svg, accessed 15.12.2016.

VII. On route to a sustainable Ruhr metropolitan area – prospects for environmental reporting and regional cooperation

With this first regional Report on the State of the Environment in the Ruhr Metropolitan Area 2017, the conference of environment representatives from the eleven independent towns and cities, the four administrative districts and the Ruhr Regional Association (RVR) is taking a common stance.

The report's starting point was to illustrate the environmental diversity in the cities, districts and different landscapes, as well as the many environmental measures and initiatives. Lastly, it aimed to document the current state of the environment by means of 15 jointly selected environmental indicators.

To this effect, the first part of this report presents the projects, measures and challenges of European Green Capital – Essen 2017, the "Grüne Infrastruktur Ruhr" initiative and InnovationCity Ruhr.

All three examples are representative of the cooperation, integrated approach and high level of compatibility of each of the environmental initiatives with respect to the issues of overall urban and neighbourhood development, the economic angles, the development of transport and mobility and the cultural circumstances that contribute towards the quality of life and attractiveness of the Ruhr.

The city of Essen would not have been awarded the title of European Green Capital had it not been able to convince the jury that the "green" label applies to all levels and areas of the city and that Essen will realise ambitious environmental objectives in the coming years. The new strategy for green infrastructure in the Ruhr is characterised by the fact that it is a platform for the cooperation of five action areas throughout the Ruhr region, covering the urban cultural landscape, water in the city, green urban development, climate-neutral transport and climate protection as well as energy efficiency. From the start, the city of Bottrop set its approach for achieving InnovationCity Ruhr's reduction targets for climate-damaging emissions on citywide foundations. In doing so, it involved all of the public bodies and built up a strong cooperative relationship with the private sector.

Now, all three examples have achieved national, international and, in some cases, even worldwide prominence. They convey the expertise of the Ruhr metropolitan area in developing new, integrated, effective and sustainable strategies and projects.

All three examples have long histories and highly complex parameters. The ability of the Ruhr's cities and districts and the regional community to respond to these varied challenges strategically and operationally and implement compelling projects is one of the region's success stories.

All three initiatives are ongoing and will be continued in the years to come.

The presentation of further integrated and sustainable strategies, initiatives and connected projects will be the subject of subsequent environment reports.

In the second part of the regional environment report for the Ruhr metropolitan area, the selected 15 environmental indicators provide detailed information about the state of the environment and how this can be measured.

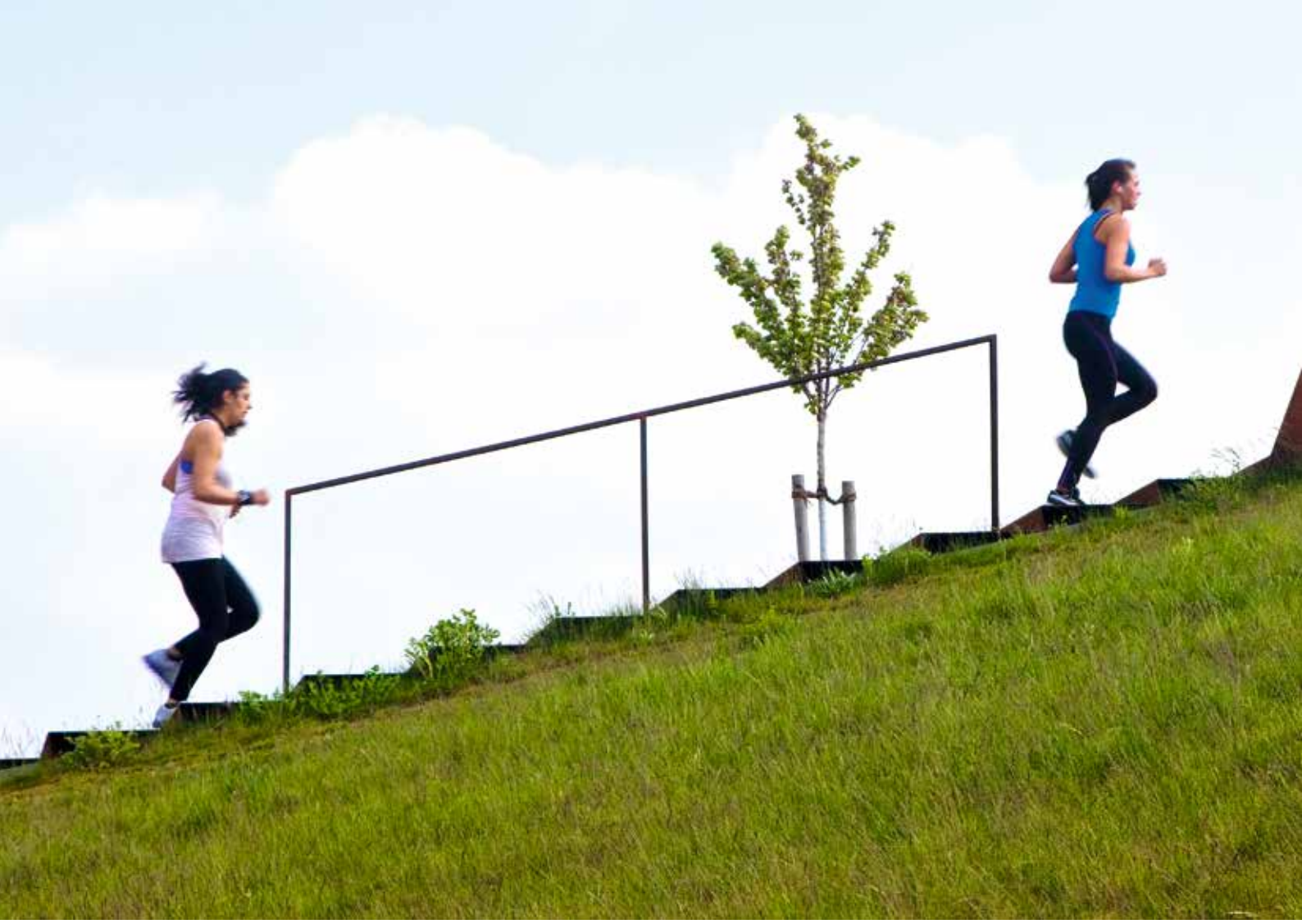
In terms of methodology, the starting point for this section of the report by the Wuppertal Institute and the planning consultants Richter-Richard was the availability of existing data and a selection of the environmental indicators for the first regional environment report, made jointly by the heads of environmental protection and the RVR.

From the outset, it was agreed that this should be the start of a reporting process that could be updated and that this regular review should be compatible with the environment and sustainability reports from the region's cities and districts, the state of North Rhine-Westphalia and with comparable reviews at the federal level.

The findings in relation to the individual indicators and as a whole do not paint a satisfactory picture of the Ruhr metropolitan area. For the majority of the critical situations and trends, it is evident that considerable changes are necessary, and that it will not be possible to make these changes at the level of individual issues or individual indicator values.

In the presentation of the individual environmental indicators, the naming and explanation of the respective currently applicable legal provisions and environmental standards, environmental quality goals and the binding medium and long-term development targets – at European, national or regional government level or on the basis of applicable, specialist legal requirements – show how urgently changes must be effected here.

Climate monitoring station by Lake Kemnade, Bochum



If one also takes into account the fact that these standards, policy objectives and rules are expected to change (intensify) quickly and substantially in the coming years, then the imminent need for joint action by every city, every district and by the whole region is very real. (This is evidenced in detail in the analysis and explanation of each indicator and in the chapter summarising the experts' assessments.)

This concerns, for example, the level of air pollution and thus the exposure to NO_2 and particulate matter, noise pollution and also climate protection with binding targets for the reduction of CO_2. To some extent, achieving the objectives in this group is an extreme challenge for the Ruhr metropolitan area in relation to NO_2 emissions, noise pollution and the reduction of greenhouse gas emissions.

The region's transport requirements give rise to a particular challenge. As far as both pollutants and noise are concerned, and not forgetting the requirements of climate protection, this sector is in need of drastic measures and, in some aspects, a rethink. The 25 per cent target stated in the indicators section for the proportion of travel by car, local public transport, bicycle and on foot is in reality far from being achieved – private transport is by far the most dominant. Mobility and sustainable transport systems will be key elements of successful metropolises of the future. With its deliberations and measures intended to improve cycling infrastructure, the Ruhr metropolis is making progress in this sector towards an improved transport infrastructure; bus and rail transport as well as a higher share of e-mobility should be quick to follow.

The local and the joint regional analysis and discussion of the findings relating to the individual environmental indicators will now be the subject of the work within the team of environmental protection representatives. The nature, details and publication date of the second environment report will also be decided on this basis.

The working group of environment representatives from local and regional government regards this environment report as a good basis on which to jointly discuss knowl-

Kaiserberg viewpoint above Phoenix Lake, Dortmund

edge sharing in the region and in particular the results of future cooperation and define these in conjunction with their cities, districts and the RVR.

Alongside the reporting process that has been initiated, it would also appear expedient to organise and strategically align cooperation on particular issues in local and regional environmental policy.

Debate over the results of the environment report has therefore resulted in the recommendation to select the following four overarching priority topics as the basis of future work .

1. **Transport and quality of life**
   (Reduction of pollutant levels/airborne pollutants/ noise/climate protection/local transport/modal split/ networking transport systems/regional transport plans/ low-emission transport/energy-efficient forms of transport)

2. **Green infrastructure in the Ruhr**
   (With the integrated approach of the five action areas)

3. **Environmental Economy**
   (Products/technology/know-how/R & D/materials/use of resources/logistics/reuse of materials)

4. **Environmental health and environmental justice**

Initial discussions have already given high priority to the focus area of transport and quality of life. So many developments are converging in this area that joint action is urgently needed. It is also the focus of media and public attention. From support for e-mobility through to potential driving bans in the inner cities, it is possible to foresee a whole series of points requiring action.

Nevertheless, it is essential to determine the possible working methods and their necessary resources for all four proposed subjects.

Imprint

Publisher:
Regionalverband Ruhr (RVR) Regional Director

Kronprinzenstraße 35
45128 Essen

www.metropoleruhr.de

In cooperation with

The **Beigeordnetenkonferenz Umwelt** (conference of environment representatives) with the heads of environmental protection in the cities of Bochum, Bottrop, Dortmund, Duisburg, Essen, Gelsenkirchen, Hagen, Hamm, Herne, Mülheim an der Ruhr, Oberhausen and in the districts of Ennepe-Ruhr, Recklinghausen, Wesel and Unna and the RVR

Project management/editing/oversight – RVR:
Ulrich Carow
Dr. Wolfgang Beckröge
Michael Schwarze-Rodrian

Contact details:
beckroege@rvr.ruhr
schwarze-rodrian@rvr.ruhr

Appointed expert assessors for the indicators-based part of the environment report:

Wuppertal Institut für Klima, Umwelt, Energie gGmbH
Döppersberg 19
42103 Wuppertal
Website: www.wupperinst.org

In cooperation with planning consultants
Planungsbüro Richter-Richard
Suedstr. 52
52064 Aachen
Website: www.prr.de

Editors – experts:
Prof. Dr.-Ing. Oscar Reutter (project leader, oscar.reutter@wupperinst.org)
Dipl.-Geogr. Miriam Müller, M.A. (co-project leader, miriam.mueller@wupperinst.org), Dipl.-Umweltwissenschaftlerin Andrea Esken
Dipl.-Geogr. Miriam Fekkak
Dipl.-Geogr. Marie-Christine Gröne, M.A.
Dipl.-Ök. Mona Treude
with the assistance of David Knor, Matti Strohschein and Julia Ziem

In cooperation with
Dipl.-Ing. Jochen Richard (prrac@t-online.de)

Responsible for/editors of the chapters:

1 Introduction – RVR
2 European Green Capital – City of Essen
3 Green infrastructure in the Ruhr – RVR
4 InnovationCity Ruhr – City of Bottrop
5 State of the environment – 15 indicators – Wuppertal Institute / Planungsbüro Richter-Richard
6 Outlook – Beigeordnetenkonferenz Umwelt (conference of environment representatives)

Authors	Indicators
Dipl. Umweltwissenschaftlerin Andrea Esken	12 – Proportion of organic farmland 13 – Biotope area
Dipl.-Geogr. Miriam Fekkak	14 – Water quality of watercourses
Dipl.-Geogr. Marie-Christine Gröne, M.A.	01 – Climate protection 02 – Primary energy consumption 03 – Share of renewables in final energy consumption 04 – Share of renewables in net electricity consumption
Dipl.-Geogr. Miriam Müller, M.A.	Introduction 05 – Modal split 06 – Nitrogen dioxide 07 – Particulate matter PM_{10} 08 – Particulate matter $PM_{2,5}$ 11 – Land use 13 – Biotope area
Dipl.-Ök. Mona Treude	15 – Number of people employed in the environmental economy
Prof. Dr.-Ing. Oscar Reutter Dipl.-Geogr. Miriam Müller, M.A.	Summary & expert assessment – indicators/state of the environment
Planungsbüro Richter-Richard Dipl.-Ing. Jochen Richard	09 – Noise throughout the day 10 – Noise in the night

Layout:
FREIWILD Kommunikation
www.freiwild-kommunikation.de

Translation:
Sprachwerkstatt Berlin
www.green-translation.eu

Printer:
Kettler GmbH, Bönen
Gedruckt auf Circle Silk Premium White

Bibliographic information held by the German National Library (Deutsche Nationalbibliothek)
The German National Library lists this publication in the German National Bibliography (Deutsche Nationalbibliografie); detailed bibliographic information is available online at http://dnb.dnb.de.

ISBN 978-3-939234-31-9

Essen (Germany), August 2017

List of illustrations

Photo	Page
123rf.com/goodluz	129
Adler	134 / 135
Berns	138
Bittrich	30
Deckert	61
Dreysse	10 / 11
Eckel	62
EnergieAgentur.NRW	43
Gabrian	140
Innovation City Management GmbH	31
©iStockphoto.com/Stefan_Redel	86
Kassenberg	13
Kornkammer Haus Holte	112
Kozlowski	6 / 7
Kreis Unna	139
Kreklau	18
Laaks	32 / 33
Lueger	36 / 37, 80
Oberhäuser	16 / 17, 34, 94
Schlautmann	14 / 15
Schumacher	8 / 9
Schwarze-Rodrian	Titel, 4, 22 / 23, 24 / 25, 26, 55, 56, 67, 73, 93, 105, 118, 123
Stadt Duisburg	51
STOAG GmbH	85
Tack	17, 18 / 19, 111
Thirty Seconds Filmproduction	28 / 29
Vollmer	20 / 21
Ziese	100 / 101, 142 / 143

Picture editing was carried out by Regionalverband Ruhr.