

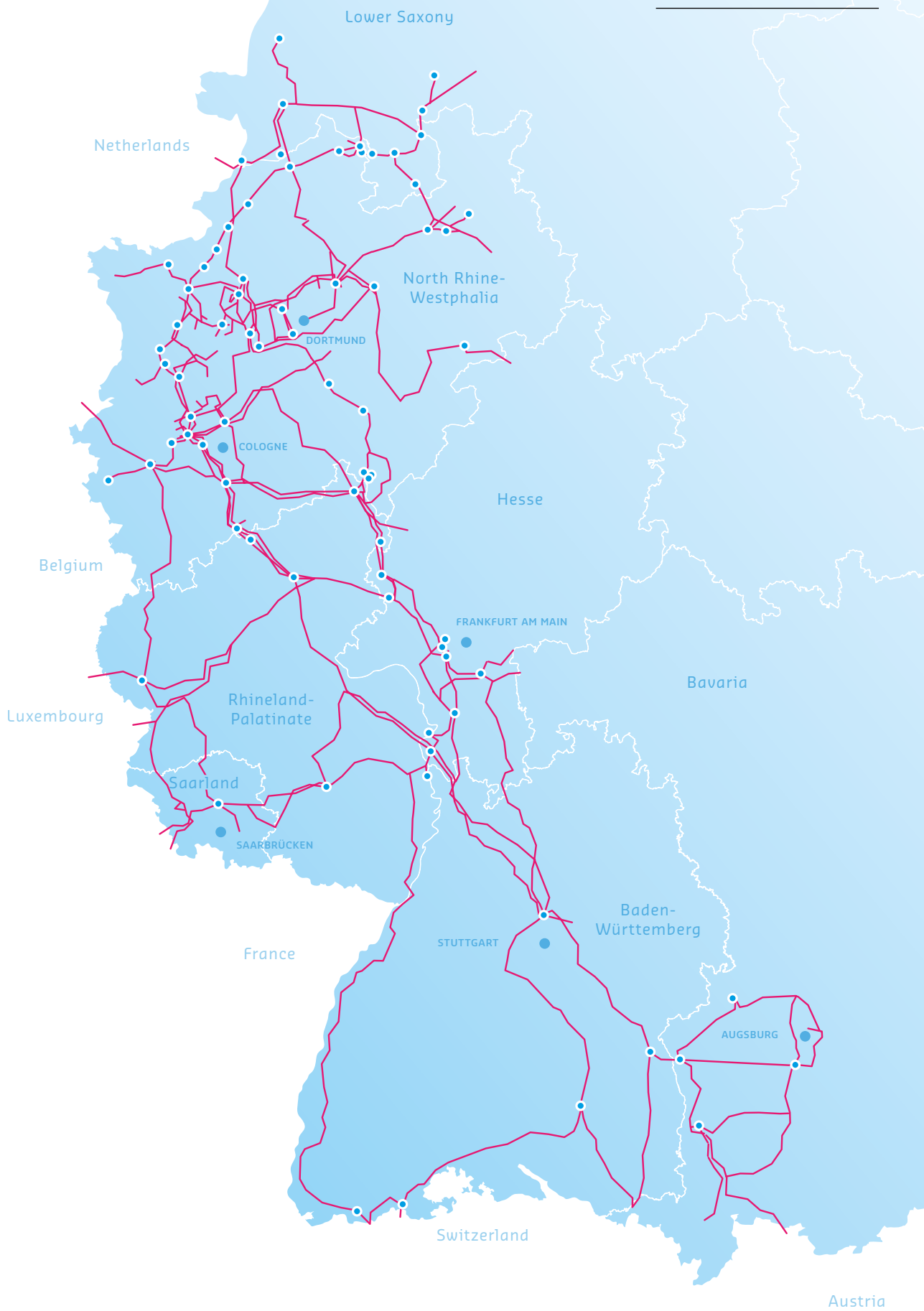
POWER LINES AS LIFELINES

BIOTOPE MANAGEMENT AT AMPRION

THE AMPRION GRID

Amprion's transmission grid has a length of about 11,000 kilometres. More than 29 million people from Lower Saxony to the Alps are supplied with reliable electricity via our grid – day in, day out.

- Overhead power line
- Substation



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Long stretches of our power lines pass through open landscapes, forests and meadows. They are the backbone of the power supply system but also a habitat for countless species of animals and plants. In order to ensure the reliable and safe transmission of electricity, we pay special attention to the vegetation to be found underneath our overhead lines – because trees and shrubs must not be allowed to grow too close to the lines.

Amprion's responsibilities

Amprion GmbH runs Germany's longest transmission network, which stretches over a distance of 11,000 kilometres. Covering an area from Lower Saxony in northern Germany to the Alps in the south, we transmit electricity to more than 29 million people. We operate our grid at two voltage levels: 380 kV and 220 kV. Our number one priority is to ensure safe, reliable and cost-efficient transmission at all times, and our 1,100 employees invest the full extent of their know-how to achieve this.

The energy world of tomorrow

The German government is following a clear goal with its energy transition policy: by 2040 wind turbines and photovoltaic panels are to supply 65 per cent of the country's average annual electricity requirements. However, this power is for the most part not generated where it is actually needed, with wind farms predominantly located in the north and solar parks in the south of Germany. As a result, more and more electricity is being transmitted over longer distances across the grid in order to reach the customer. To be able to feed even more renewable energy into, and transport it around, our grid, we are working hard to fulfil our statutory duty by expanding our grid at the points necessary during the course of the next ten years. By preparing our power lines for the new electricity flows, we are playing an active role in shaping the energy world of tomorrow.

Responsibility for nature and the environment

We plan, construct and operate our grid based on the premises of economic and ecological sustainability. We see it as an integral part of our remit and corporate responsibility. This also includes maintaining the routes or the rights of way (ROW) of our transmission lines – an area that totals 11,000 hectares. More than two decades ago, Amprion was the first transmission system operator to develop and implement a biotope management concept – a concept that ensures safe and reliable operation of our power lines and, at the same time, protects both flora and fauna. The maintenance measures are organised specifically in line with ecological principles. In dialogue with the relevant authorities and nature conservation organisations, we develop for each individual section of our routes a biotope management plan that helps preserve the biodiversity of existing habitats – and sometimes even gives rise to unique new biotopes.

Habitats underneath power lines

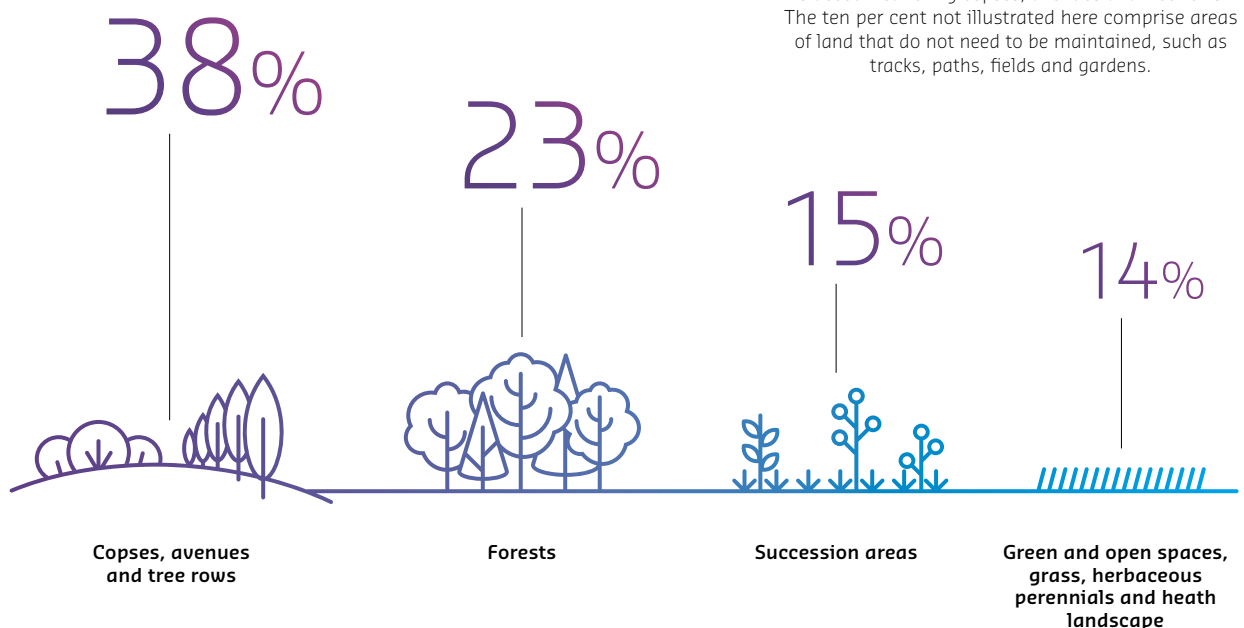
We at Amprion view environmental protection as an important part of our social responsibility. To be able to operate our power grid safely and trouble-free, we have to prevent vegetation from growing too close to the conductors. This is why it's essential to carry out maintenance measures along the routes. However, the manner in which this is done has changed fundamentally over the past 30 years.

Complete removal of the trees and shrubs along the routes is nowadays no longer the norm. Instead the focus is on conservation and sustainable development of valuable habitats.

As a pioneer of ecologically optimised power line route maintenance, we aim to minimise intervention in nature and landscape and furthermore to promote worthwhile biotope structures in the immediate vicinity of our power lines. Our biotope management plans help us to ensure that the maintenance measures we implement have as small an impact on nature and the environment as possible, preserve the habitats of the animals that live there and allow them to develop. We put this proven approach into practice throughout our entire grid.

MAINTAINED SPACES

Our overhead lines span countryside with a huge range of differing vegetation. By far the largest share is accounted for by copses, avenues and tree rows. The ten per cent not illustrated here comprise areas of land that do not need to be maintained, such as tracks, paths, fields and gardens.



Copses, avenues and tree rows

Forests

Succession areas

Green and open spaces, grass, herbaceous perennials and heath landscape

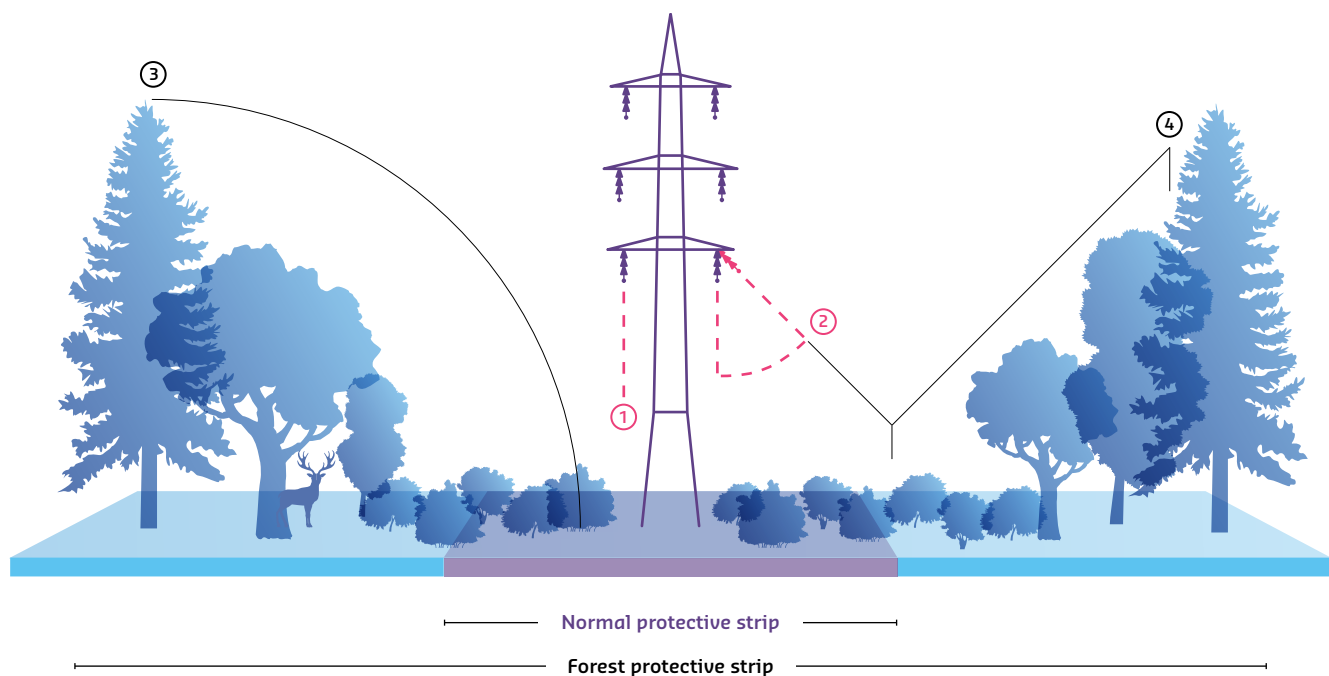
The basic principle of biotope management

Maintaining our power line routes and protecting nature go hand in hand for us. The principle we follow is to cut back trees and shrubs as selectively, carefully and with as much foresight as possible. The main aim of our maintenance measures is to create an adequate safety clearance between the conductors and the vegetation. To this end, we remove fast-growing species of tree and shrub and promote slow-growing varieties. At the same time, we take regional differences into account. At the periphery of the **protective strip** and close to the pylons, trees and shrubs may grow considerably higher than in the middle of the **span**; this allows a smooth transition between the route vegetation and the adjacent **industrial forest**. The stepped, stable and highly structured peripheries of the forests offer varied habitats for a multitude of species worthy of being protected. In this way, we make sure that our overhead lines operate reliably and preserve and foster existing **biotopes**.

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MANAGED GROWTH

The vegetation along the route must not be allowed to grow too close to the conductors. Consideration must also be paid to the extent to which the conductor cables elongate when hot – and how much they can then swing, too. Close to the pylons and at the periphery of the protective strip, shrubs and trees may grow higher than in the middle of the span.



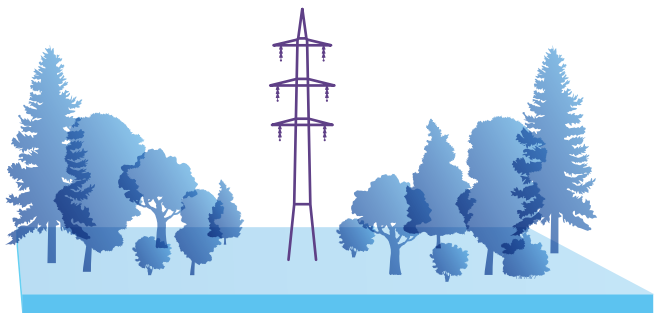
- ① Sag of the stationary conductor cable (cable temperature 80 °C + stretching value in acc. with DIN VDE 0210)
- ② Sag of the swinging conductor cable (cable temperature 40 °C + stretching value in acc. with DIN VDE 0210)
- ③ Falling curve of tree at periphery of forest protective strip on reaching its fully grown height
- ④ Limitation of fully grown height by promoting highly structured forest peripheries

TODAY'S MAINTENANCE PRINCIPLE: MORE FREQUENT AND EXTENSIVE INTERVENTION

In order to create an adequate safety clearance between the conductor cables and the vegetation, we now intervene more frequently, cutting back trees and shrubs as carefully and with as much foresight as possible.



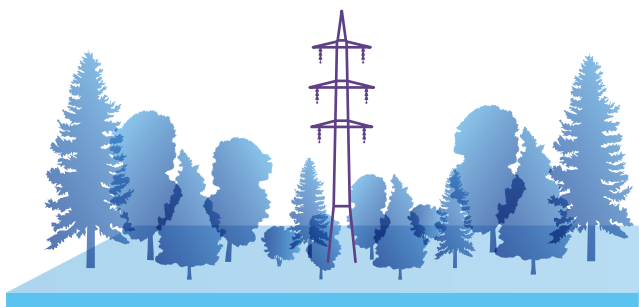
Before maintenance measures



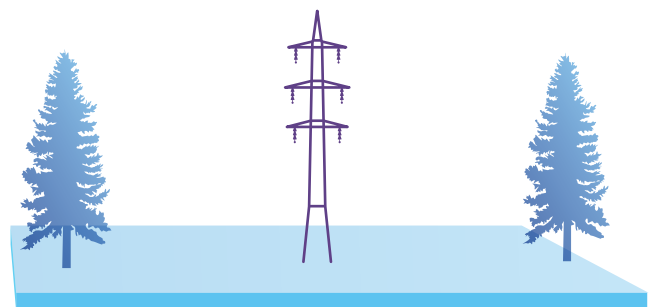
After maintenance measures

FORMER MAINTENANCE PRINCIPLE: INFREQUENT AND INTENSIVE INTERVENTION

In the past, maintenance measures were carried out infrequently but intensively. All of the trees and shrubs along the rights of way were removed completely and an aisle was cut through the forest.



Uniform growth along route



Maintenance measure: complete removal of the trees and shrubs close to the conductor cables



Planning, objectives & guiding principles

Our biotope management planning is an innovative concept for power line route maintenance that unites both ecological and economic benefits.

At the heart of this concept is the basic principle of maintaining existing biotopes in such a way that the operation of the line is not disrupted and the natural habitats along our routes can develop sustainably. To this end, the concept comprises maintenance measures designed to foster and develop vegetation that is typical of the respective region. Implementation of these measures is based on the biotope management plans we have drawn up in which all areas of our overhead line routes are mapped and divided into “maintenance units”.

The plans for biotope management are put together in close collaboration with external experts, such as biologists and nature conservation and forestry authorities. We consult with local associations and landowners on a case-by-case basis. The respective maintenance measures are planned for a period of ten years and documented accordingly. Since it's important to us that the development of the local biotope structure and the relevant interests of nature are taken properly into account, we monitor and re-examine these biotope management plans at regular intervals.

We employ biotope management to care for the specific local conditions beneath our power lines – with our focus always on developing and maintaining a harmonious natural landscape and stable biotope structures. At the same time, we prove through this approach that nature conservation and cost awareness are not mutually exclusive: route maintenance in accordance with Amprion's biotope management concept is no more expensive than conventional measures.

Our key guiding principle, therefore, is to carry out maintenance measures more frequently, in smaller areas and more gently instead of infrequently and intensively.

THE BIOTOPE MANAGEMENT PLAN

- Contains principles and objectives for developing vegetation
- Forms the basis on which the annual maintenance requirements are determined
- Outlines maintenance units, that is, the composition of the vegetation in individual areas of the route and the recommended maintenance measures
- Specifies expedient intervals for implementing the maintenance measures

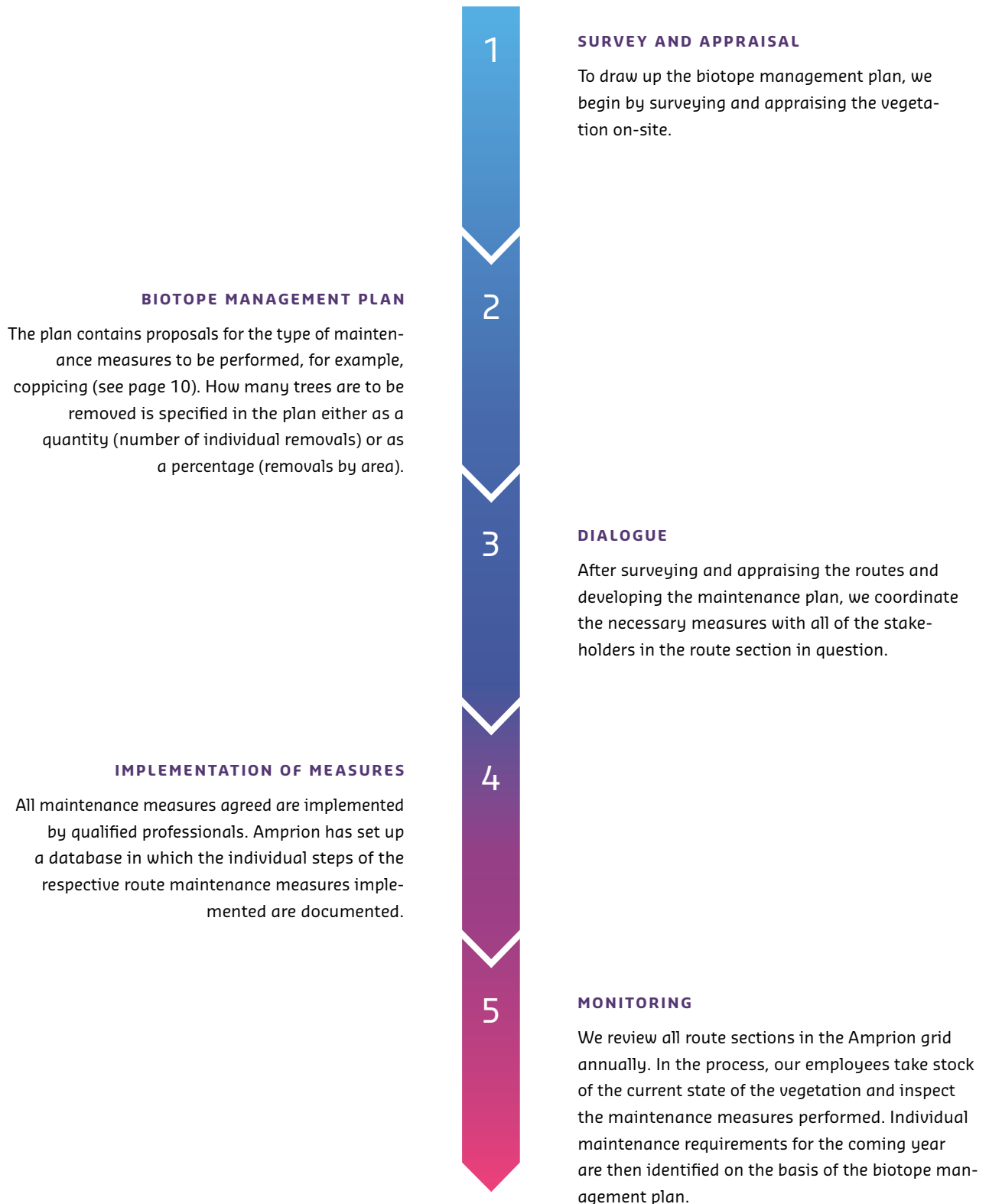
From mapping to maintenance measures

Biotope management planning process

In the first step of the planning process, experts (biologists, landscape conservationists, foresters) survey and assess the existing vegetation in the respective route section. We then select and coordinate maintenance measures that are appropriate for the actual situation on-site, taking ecological, technical and economic aspects into account. These measures form the basis for our biotope management planning. The ten-year plan is also presented to the local authorities and nature conservation associations, because we believe transparency builds understanding regarding the necessity for route maintenance. This can only be developed in dialogue with all relevant stakeholders.

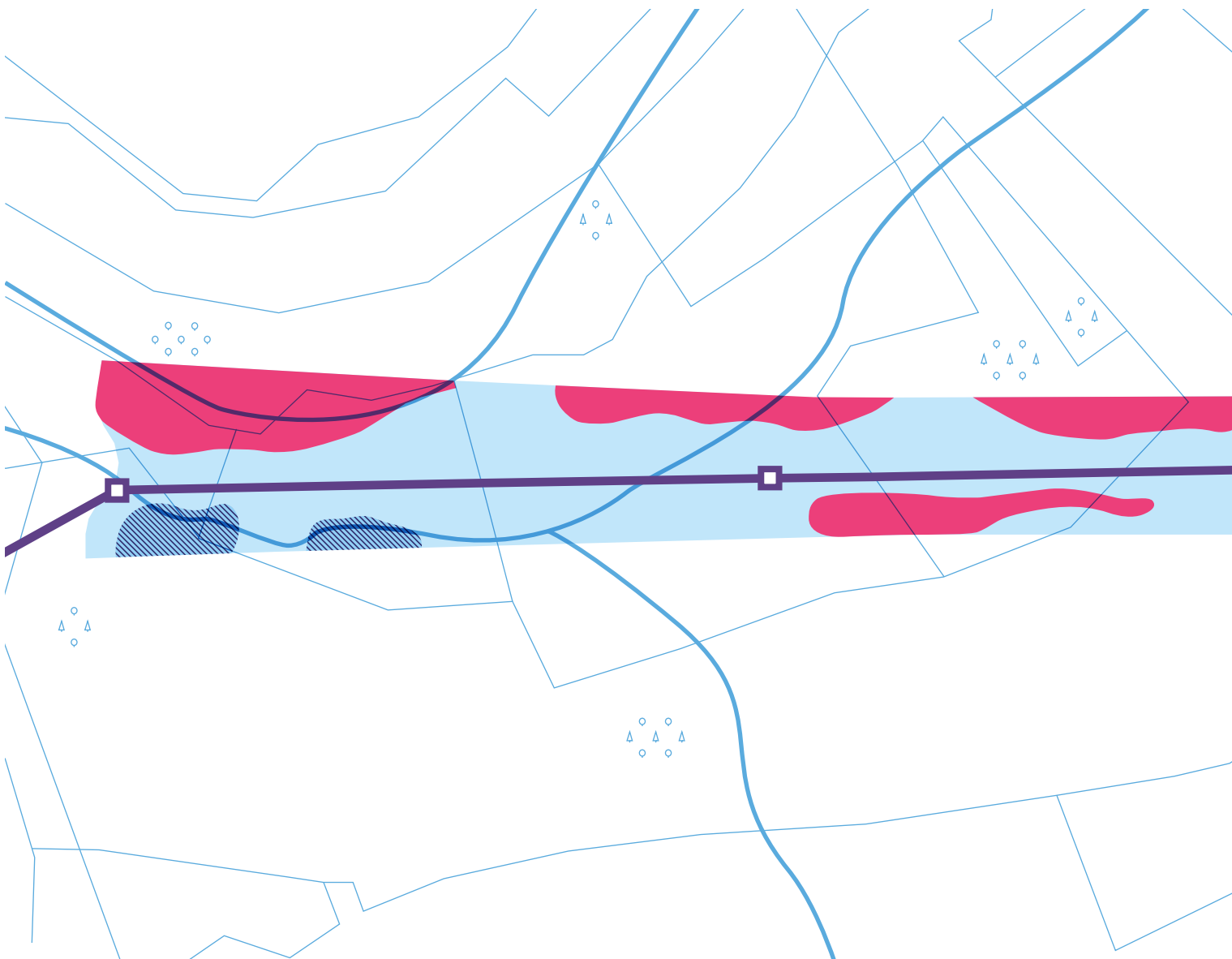


THE PROCESS IN DETAIL



A look at the biotope management plan

A biotope management plan comprises two parts: a map section and a text section for each maintenance unit. The latter contains fundamental information about the biotope type and flora. Furthermore, the types, objectives and specifics of the maintenance measures are documented. The respective sections can be matched to the relevant districts, towns and authorities with administrative responsibility based on the detailed location information.



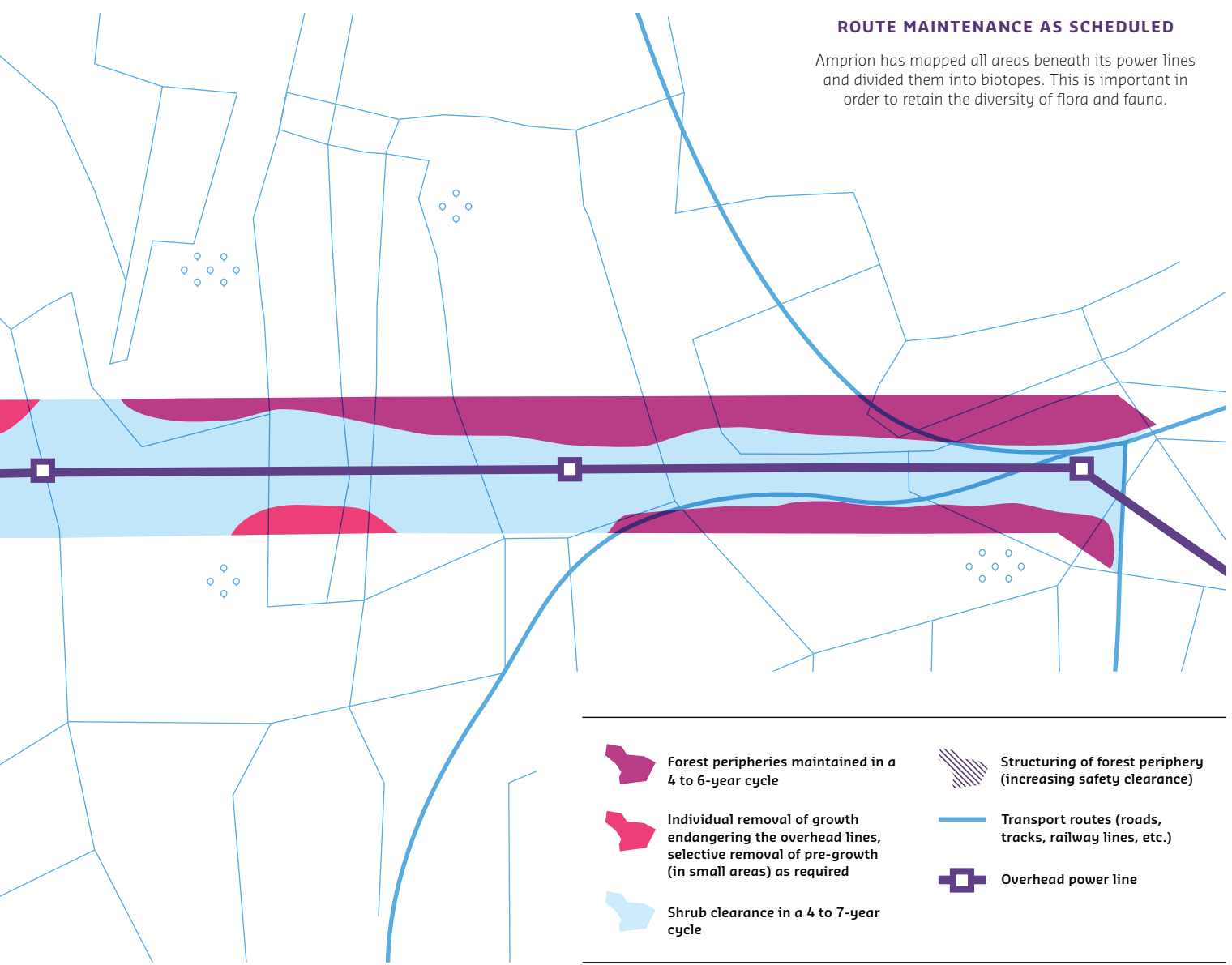
11,000

HECTARES

is the size of the area we manage within the scope of our biotope management plans.

ROUTE MAINTENANCE AS SCHEDULED

Amprion has mapped all areas beneath its power lines and divided them into biotopes. This is important in order to retain the diversity of flora and fauna.



Maintenance measures

In the interests of nature conservation, all maintenance measures are conducted exclusively between the beginning of October and the end of February. During this period, the contractors remove trees and shrubs in line with the following specifications:

Individual removal

Trees that have grown to within five metres of the conductor cables or will do so within the following two years are marked with coloured paint to identify them as ready for removal. The main emphasis here is placed on fast-growing species, such as poplar, alder, willow, spruce and birch.

Group removal

Selective thinning of wood growth also follows the aim of keeping fast-growing tree species a safe clearance from the conductors. Removal of the various types of flora is divided into four maintenance intensity levels, by which the trees and shrubs are removed completely, to 50 per cent, by a third or to 10 per cent. ☰ p.23

Area-based measures

■ Coppicing

Deciduous tree species such as oak, hornbeam, ash, hazel, elder or dogwood bushes are cut back to a height of 30 centimetres above the rootstock. The new growth (shoots) rejuvenates the forest and **coppice** structures develop. ☰ p.22

■ Mowing

Mowing serves to maintain existing low-growth plants species. Saplings are likewise removed by mowing.

■ Mulching

This involves covering the ground in selected areas with organic material that has not yet rotted. This maintenance measure prevents fast growth of new plants (“**succession** growth”). By minimising what’s known as “shrub encroachment”, we maintain and develop open areas. ☰ p.23





Power line route maintenance – an opportunity for nature conservation

FOR MORE THAN 20 YEARS, AMPRION HAS BEEN GOING FAR BEYOND THE SCOPE OF MEASURES LEGALLY PRESCRIBED FOR ROUTE MAINTENANCE. IN DOING SO, THE COMPANY HAS TAKEN ON A PIONEERING ROLE IN THE FIELD OF NATURE CONSERVATION AND LANDSCAPE PROTECTION. FOUR QUESTIONS FOR CLAUDIA JAEHRLING.

WHAT IS SO SPECIAL ABOUT AMPRION'S BIOTOPE MANAGEMENT PLANNING CONCEPT?

CLAUDIA JAEHRLING (CJ) Above all, the fact that we take the local circumstances into account to such a large degree. While Amprion operates in accordance with standardised maintenance principles across its entire grid, we also customise the individual measures specifically to the respective local biotope structure. In this way, we ensure the quality of our maintenance measures and unique new biotopes can develop.

WHY IS IT SO IMPORTANT TO AMPRION TO SUPPORT NATURE CONSERVATION TO SUCH A GREAT EXTENT?

CJ We like to see our power lines as the company's calling card – and as the lifelines of the national economy. At the same time, we do not forget that the routes along which they run also represent lifelines. After all, they are home to numerous plants and animals,

including rare species that are subject to special protection. We believe we have a responsibility to maintain and foster this diversity. To this end, we bring together know-how from a large number of different fields. Amprion employs numerous experts from the worlds of forestry and agriculture as well as others who specialise in biotope management and route maintenance. Our interdisciplinary teams act in concert, and whenever necessary, they also like to offer the benefit of their experience to research or nature conservation projects. This results in a valuable transfer of knowledge, another point that also reflects our perception of ourselves as a company.

AS GRID EXPANSION PROGRESSES, MORE UNDERGROUND CABLE IS BEING USED IN THE TRANSMISSION GRID – FIRST IN PILOT PROJECTS. ARE THESE ROUTES NOT AS HIGH-MAINTENANCE AS THOSE WITH OVERHEAD POWER LINES?

CJ On the contrary. Routes with underground cables generally need to be cut back even more than those with overhead lines. Since the routes in forest areas need to remain free of deep-rooting trees and shrubs and the cables have to be readily accessible in the event of a fault, the amount of maintenance work necessary is much higher.

LOOKING BACK AT THE PAST 20 OR MORE YEARS OF BIOTOPE MANAGEMENT PLANNING, WHAT ACHIEVEMENTS DO YOU THINK ARE PARTICULARLY WORTHY OF MENTION?

CJ Particularly pleasing is the success of our measures in endangered habitats such as arid biotopes and wetlands. Also pleasing is the fact that habitats that have developed as a result of biotope management can be networked. Among other things, we can observe this in the reintroduction of the smooth snake in North Rhine-Westphalia. But our concept is also bearing fruit along the 2,000 kilometres our routes cut through forests. As time has passed, coppice structures that have become home to a multitude of animals and plants have been systematically developed. Among the creatures that call these locations home are various species of bat as well as the now rare hazel grouse, which requires open and varied wooded areas. By implementing our maintenance measures, we are promoting cultural landscapes that are increasingly being pushed back by today's intensive land use. The fact that a number of our route sections have been designated as German or even European nature reserves (e.g. fauna flora habitats = FFH areas) confirms how effective our maintenance measures are. The construction and operation of power lines, therefore, by no means has to conflict with nature conservation, landscape protection and the protection of birds.

Marscheid Forest – a refuge for reptiles

Since the very beginning of our ecologically oriented route maintenance work, we have been initiating and supporting local wildlife and habitat conservation projects in the vicinity of our overhead power lines. One example of this is the Hattingen–Ronsdorf route that traverses the Marscheid Forest in the east of the city of Wuppertal, along which we do our utmost to preserve and enhance the quality of the habitat specifically with reptiles in mind.

The reason behind this is the fact that the smooth snake is on the red list of endangered species in North Rhine-Westphalia. For more than ten years from 1985, conservationists were unable to find any signs of this snake around the periphery of the Marscheid Forest, an area in which it used to be widespread. The smooth snake is a **keystone species** for highly structured, warm and dry biotopes characterised by **heathland** vegetation.

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In the end, an environmental consultancy found evidence of what was probably the last population of smooth snakes in the Marscheid Forest – in a very small area of our route. The companies operating the power line at that time, RWE and VEW, did some pioneering work and drew up a concept specially tailored to the needs of the snakes in what was one of the very first biotope management plans. The plan was to keep the 16-hectare area permanently open and to cultivate ground-level heathland vegetation.

Thanks to our efforts over the following 20 years to regularly remove the shady trees and shrubs, the biotope has remained permanently exposed to sunlight – this project has been highly successful. Furthermore, in cooperation with various partners from the working group, we have built a large natural-stone wall and put a pile of sawn timber in place, both of which offer ideal refuges for smooth snakes. This has also had positive effects on insects and birds.

Today, the open vegetation of this stretch of the overhead power line route between Hattingen and Wuppertal offers the perfect habitat for this rare species of snake. The population has recovered and is now stable – an outcome that can largely be put down to our maintenance measures. The latest findings reveal that the smooth snake has in the meantime even spread to neighbouring areas. Subpopulations have been found in adjacent areas and measures taken to link up these habitats. So over the years, through our collaboration with full-time and volunteer conservation partners, Untere Landschaftsbehörde (Lower Landscape Agency) of Wuppertal's city authority, Landesbetrieb Wald und Holz (State Forestry and Timber Agency) and Landesamt für Natur, Umwelt und Verbraucherschutz LANUV (State Agency for Nature, Environment and Consumer Protection) of North Rhine-Westphalia, a highly effective species protection concept has developed. In 2014, Deutscher Verband für Landschaftspflege DVL (German Association for Landscape Management) awarded it first prize in the "Exemplary Projects" category.





The meadows at Hirtenborn – a blossoming gem

Rare species of orchids in the Hunsrück mountain range also benefit from our biotope management planning. The “Wiesen am Hirtenborn” nature reserve close to the Rhine Gorge at Bacharach is an ecological gem that is located right underneath an overhead power line. In May, numerous plant species typical of the region blossom here, among them species of orchid that are rare in this region of Germany nowadays, such as the broad-leaved and the green-winged marsh orchid or the white helleborine. The dry grasslands on the hills west of the villages of Manubach, Oberdiebach and Oberheimbach are unique in the area and a popular destination for orchid-lovers from all over Germany.

However, the annual splendour of the blooms at Hirtenborn is only possible because the flowers have fully utilised the special local conditions; for thanks to our continuous maintenance of the overhead line route, the soil there is kept low in nutrients and therefore in the ideal state for these rare species to thrive. If we left the bushes, trees and grasses to their own devices, they would quickly place into shadow and crowd out the orchids in the reserve. To stop this from happening, we continuously monitor the growth of the vegetation along the route of the overhead line and maintain the area in accordance with the specifications of the biotope management plan, which have been tailored right down to the last detail to the needs of these flowers that are so worth protecting.

p. 22 ☰ Every three years, specialist contractors mow the **poor grassland** along the route. We deliberately refrain from mulching the area because some of the grass cuttings would automatically be left behind, rot and act as a kind of organic fertiliser, putting nutrients back into the soil. What at first sight seems to make ecological sense would in fact be distinctly harmful for the orchids at Hirtenborn. In order to retain the poor soil conditions preferred by the orchids, Amprion removes the grass cuttings, playing a crucial part towards maintaining a valuable habitat that hosts a total of more than 150 species of plant typical of the region in the process.



The coppice – habitat to the hazel grouse

The hazel grouse is one of the smaller members of the grouse family of birds. Only very patient birdwatchers get to see this woodland hen because it is extremely shy and also perfectly camouflaged thanks to its grey-brown plumage. This makes it very difficult to find evidence of its presence in a habitat. However, what we can be certain of is the fact that its population in North Rhine-Westphalia continues to shrink and the species is now in danger of becoming extinct. Experts estimate there are around only 20 breeding pairs left in the state. The reason why this shy bird is now so rare has to do with the ongoing transformation of the forests. For centuries, Siegerland – a region in central Germany on the border triangle of the states of North Rhine-Westphalia, Rhineland-Palatinate and Hesse – was covered by extensive **coppices** at various stages of maturity and management – what are known as “Hauberge”. These cultural landscapes offered the hazel grouse a good habitat, but demanded a lot of hard and intensive work from the forest managers and workers, so that during the past decades large areas were turned over to high forests, which are easier to look after. Such forests provide neither shelter and protection nor food for the hazel grouse.

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The Special Protection Area (SPA, in accordance with the EU Birds Directive) “Vogelschutzgebiet Wälder und Wiesen bei Burbach und Neunkirchen” in the south of Siegerland has between 10 and 15 hazel grouse preserves that provide the species with an important habitat. This SPA, which covers a total area of 4,660 hectares and comprises expansive beech, ravine, and mixed hillside forests, coppices, mowed mountain meadows and pastures as well as numerous streams, is traversed by one of our overhead power lines. The line connects areas in which LANUV NRW (State Agency for Nature, Environment and Consumer Protection) has repeatedly found proof of the presence of hazel grouse.

Since the bird is highly sedentary and does not like relocating to other areas, it's extremely important that we maintain and support the few existing preserves in North Rhine-Westphalia. To this end, we do our utmost to implement the measures developed by LANUV to protect the species in our biotope management plan. As the hazel grouse prefers mixed woodland that offers sunny areas, a herbaceous layer with lots of ground-level hiding places and sufficient food, we focus on conducting localised maintenance measures designed to strengthen the structure in the former coppice stands. By cultivating slow-growing trees and bushes, we preserve potential habitats and valuable **biotope network structures** for this endangered species.

☰ p.22



Glossary

Biotope

A biotope is the habitat of a “biocoenosis”, that is, a biotic or ecological community of plants and animals. It has a certain minimum size and a homogeneous structure and character that can be distinguished from its environs.

Biotope network structures

The concept of nature conservation aims to connect, i.e. network, different biotopes. By employing targeted networking measures, species can be motivated to move beyond the boundary of their traditional habitat and to colonise other suitable biotopes. This can also result in a widening of the gene pool of a species.

Heath(land)

Heath or heathland is a type of landscape that is characterised by low-growing, evergreen bushes, grasses and infertile soils. Among the typical types of plant to be found in these habitats are different species of heather and juniper. As anthropogenic cultural landscapes, i.e. habitats that have been created by human clearance and cultivation, heathland areas can only be preserved by employing special land management techniques. If neglected, these barren areas would be re-colonised by bushes and trees, which would suppress and supplant the characteristic heathland vegetation.

Keystone species

A keystone species is a species of animal or plant that is closely linked to a certain habitat and plays a critical role in it. The presence of the keystone species at a location often enables conclusions to be drawn about the entire biotic community in this biotope.

Poor grassland

This umbrella term refers to grassland at dry, infertile locations, which has normally come about as a result of extensive farming. Since it's considered no longer profitable to cultivate such poor grassland and modern (intensive) farming makes use of nutrient-rich fertilisers, these sensitive ecosystems are increasingly under threat. If they are not managed by means of grazing or regular mowing, they are rapidly taken over by trees and shrubs. In the process, many of the animal and plant species that had adapted to this environment lose their habitat. In order to conserve endangered species that are at home on such poor grassland, numerous locations still in existence have been designated as conservation areas.

Coppicing

This traditional method of woodland management was established many centuries ago with the primary purpose of cultivating firewood. This involves cutting down tree species such

as oak, hornbeam, ash and maple to near ground level every 10 to 30 years. Since the rootstocks sprout new shoots, the trees regenerate themselves without any further human intervention. Coppices (also known as copses) are characterised by shrub-like trees and bushes in different stages of maturity and at different heights; sunlight is able to penetrate the woods right down to the herbaceous layer on the ground. Today, less than one per cent of Germany's forests and woodland is still coppiced.

Protective strip

To protect our power lines, we have to adhere to certain safety clearances between buildings and vegetation. These apply both to stationary and swinging conductor cables and are stipulated in DIN VDE 0150-100:2015-10, DIN VDE 0210/12.85 and European overhead electric lines standard EN 50341. The protective strip underneath and to the sides of the overhead line remains the property of the landowner. An entry made in the land register ensures that we are able to build, operate and maintain the overhead lines, and also to carry out the necessary route maintenance measures. The owner receives compensation. How often and intensively we can perform maintenance work along our route depends on how the landowner utilises the protective strip or, in the event of non-use, on how much the vegetation has grown.

Selective thinning

Selective thinning – i.e. thinning out in places – is a maintenance measure that regulates the growth and composition of trees and shrubs. It involves the targeted felling of a substantial number of trees in order to optimise the stand in order to ensure trouble-free operation of our power lines.

Span

The term “span” describes the area between two pylons. The middle of the span is therefore halfway between.

Succession

In the ecological context, succession refers to the process of change in the species structure of an ecological community over time. In a broader sense, it can also be used to describe previously used areas of land that have been abandoned to nature over a longer period of time and been taken over by trees and shrubs.

Industrial forest

Industrial forest refers to all wood areas that are regularly managed and used for timber production.



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AMPRION IN FIGURES

78,900 KM²

– the area covered by the Amprion grid,
stretching from Lower Saxony down to the Alps

~ 29 M

– the number of people supplied with
electricity via the Amprion grid

11,000 KM

– the total length of power lines that
make up the Amprion transmission grid

~ 59 GW

– the total installed capacity of the
Amprion grid



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