amprion
connects

LEBENS-ADERN

THE
AMPRION
MAGAZINE
VOL. 03

What connects us.

Connecting out of connectedness

Our transmission network is more than just a network. Our power lines are lifelines of society. They transport electricity for millions of people and thousands of companies in our grid area. They secure people's jobs and their quality of life. We maintain the grid in a stable and secure condition so that life can thrive.

Our assignment is more than just a statutory mandate. We are proud of what we do. We confront the challenges of a rapidly developing energy landscape with passion and competence. In this time of transition, we are building true, tangible confidence: we do what we say. This dependability is the foundation on which we build connections with our partners. Together we are shaping the energy system of tomorrow.

Our mission is more than just a promise. We feel an obligation to, and a connection with, humanity, the environment and the economy. With this connectedness, this feeling of solidarity, foremost in our thoughts, we are working to make our power grid more sustainable, step by step. We communicate openly and honestly and work together with our partners and with stakeholders in order to find and install the best solution.

We bring the interests of people, the environment and technology into alignment. So that the lights never go out.

Amprion connects!

Our corporate mission quite simply entails taking responsibility for "the big picture" – the electricity system and its stability.

The energy world is changing – dramatically and rapidly. Who would have predicted five years ago that Germany would not only abandon nuclear energy but also phase out coal-fired power generation? That Europe would commit itself to a "Green Deal" and green hydrogen would become a beacon of hope for many branches of industry?

Transformation everywhere – and the big question everyone is asking: How do we keep track of it all? How can the differing interests of politics, business and civil society be brought together? And how do we stay focused on the real goal of building and maintaining a safe, secure and reliable energy supply? As a transmission system operator, Amprion has a vital role to play here. Our corporate mission quite simply entails taking responsibility for "the big picture" – the electricity system and its stability. Twenty-nine million people and many thousands of businesses in the area covered by our grid rely on us fulfilling this responsibility. And we feel a genuine obligation to them.

These feelings of solidarity and responsibility have led to us not only taking the initiative, but also to work on solutions for the energy world of tomorrow. This sense of purpose is what motivates all 1,800 of Amprion's employees, irrespective of whether they are trudging across the East Frisian mudflats, repairing conductor cables or helping to coordinate the work of Europe's transmission system operators. Get to know these people in this latest, all-new issue of "Lebensadern" – and find out more about what Amprion does for society.

We hope you enjoy reading it.

THOMAS WIEDE
Head of Corporate Communications and Digital Media

Amprion connects

CLIMATE PROTECTION WITH GRID STABILITY.

We're preparing the way for the energy transition: electricity from renewable energy sources must be delivered safely and dependably to where it's needed. Our power lines are the lifelines of society, safeguarding the quality of life and the jobs of millions of people.

Amprion connects

EXPERIENCE WITH INNOVATION.

We stand in the tradition of those engineers who invented the transmission grid in Germany 100 years ago. For the sake of a stable grid, we are working on new ideas for building a sustainable, decarbonised energy system.

Amprion connects

PASSION WITH A COOL HEAD.

We are committed to serving our clients' needs – and are proud that the lights in our grid area never go out. With a steady hand and in the service of the cause, we provide stability in what is a rapidly changing energy world.

Amprion connects

GERMANY WITH EUROPE.

We are expanding our transmission grid to neighbouring countries. We, like no other grid operator, are 100 % behind a functional, integrated power grid in Germany and Europe.

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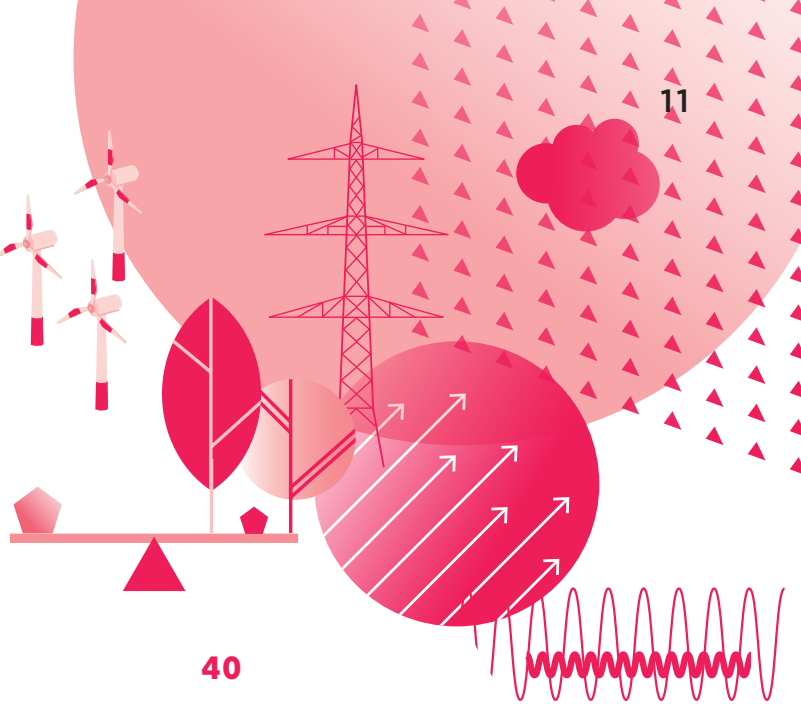

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www.amprion.net/gb2019

Trans-formation everywhere

DR HANS-JÜRGEN BRICK
Chairman of the Management Board
at Amprion GmbH

Germany wants to become largely carbon-neutral by 2050. Amprion supports this transition, is restructuring the grid and growing with every new task. How can the company pull all of this off? Dr Hans-Jürgen Brick, Chairman of the Management Board, talks about staying grounded in turbulent times.

Interview VOLKER GÖTTSCHE
Photos HARTMUT NÄGELE

Dr Brick, what does *Heimat*, homeland, mean to you?

Heimat is where I feel at home. Besides my family, this is the Ruhr region. I'm a typical child of the Ruhr: born in 1960 in Essen, to a working-class family, my grandfather worked in the mining industry. I like the people in this region. They stand by what they say, they are down-to-earth and quite direct. Knowing where I come from keeps me grounded – even though the Ruhr has changed like hardly any other region in Germany in recent decades.

In what way?

In the context of the structural transformation, away from coal and steel, the region has reoriented itself economically, and to some extent reinvented itself. Amprion has its headquarters in Dortmund – and the city's economy now employs as many people as it did in the days of coal and steel. By definition, a structural transformation requires change. And change requires that we learn, that we develop. This is something the Ruhr has directly experienced, that the companies there have experienced at first hand. And these changes are ongoing. We can see this in our industrial clients from the region. Like many other companies, they find themselves at the beginning of the next transformation: the transition to a climate-friendly, decarbonised economy.

"Decarbonisation" means …

… saying goodbye to fossil fuels, which are responsible for the emissions of carbon dioxide which is so detrimental to our climate. One structural transformation is invariably followed by another. The climate targets for Germany have been formulated. I am convinced that we're on the right track. We still have to find out what a carbon-neutral economy looks like.

“We are working to ensure that our industrial clients will in future be able to reliably and efficiently source green electricity from our grid.”

It’s becoming apparent, for example, that the chemical and steel industries, which require a huge amount of energy for their production, will make increasing use of renewables. The key enterprises in Germany’s primary industry are connected directly to our grid.

What is Amprion doing for these businesses?

We are working to ensure that they will in future be able to reliably and efficiently source green electricity from our grid. By doing so, we are making an important contribution towards achieving the country’s climate targets. To this end, we are upgrading our transmission grid and, together with our customers, are planning more capable and efficient connections. But it will also be essential to develop storage technologies for renewable energy sources. For instance, Amprion, together with the gas TSO Open Grid Europe (OGE), intends to trial power-to-gas technology for the first time on an industrial scale, that is 100 megawatts. These are all decisive parameters for industrial companies so that they can continue to invest in Germany and jobs in the country can be protected. This is also important to me in my role as Chairman of the Management Board at Amprion. By providing a stable electricity grid, we want to give businesses and households security in a world of dynamic change – while keeping an eye on costs.

What challenges will Amprion have to face?

By using more and more renewable energy, our life and our economy will become more sustainable. However, this makes the tasks of a transmission system operator all the more complex. Until a few years ago, we transmitted electricity generated in conventional power plants to customers located in our vicinity – business that is usually easy to predict. Today, wind and solar farms generate electricity far away from where the

consumers are located – and our lines have to transport it over hundreds of kilometres in some cases. Nuclear and coal-fired power plants are being disconnected from the grid as the feed-in of electricity generated by wind farms and photovoltaic installations fluctuates massively depending on the weather conditions. Sometimes there is so much electricity being generated in the north that the grid simply cannot carry it away. Sometimes the weather is different than forecast – and we can only keep the grid stable by cutting in backup power plants or flexibly controlling large-scale consumers. This is sometimes hard work and involves high costs. There is still much to be done before we have a power system that really integrates renewables. That said, I am confident that, by developing and installing innovative solutions, we will succeed in bringing about this transformation without having to sacrifice economic power and prosperity in Germany.

Do you think that in Germany we truly appreciate the value of a secure electricity supply?

Let's put it this way: I would like everyone to recognise the role a secure and reliable power supply network plays in their life. Ok, so electricity comes out of the power sockets, but for it to stay that way, there have to be people at Amprion who ensure the power grid runs stably, day in, day out, every second of the day. That's something we're proud of. And it is not only Amprion, but also the other TSOs in Germany who are investing

billions in grid expansion, so that Germany can and will master the energy transition. We at Amprion see this as a service to society – well aware of the fact that grid expansion sometimes clashes with the interests of local residents. Our aim is to reconcile their personal concerns with the common good. And we do this by informing residents from a very early stage, involving them in the planning process, taking their objections into account – and ultimately winning them over to amicable solutions. But it's also quite clear that we cannot always make all sides happy in this way.

New challenges, complex tasks – obviously Amprion itself is also in the middle of a transformation.

That's for sure. The energy transition and new demands being made on us by our customers are changing our work. We are helping to shape the energy system of the future, and will for the first time be connecting wind farms located in the North Sea directly to our power grid in the coming years. We are constantly learning, adapting processes and structures. This applies to all departments, but also to our management team, which we have expanded in April 2020. In the past ten years, Amprion's workforce has doubled to 1,800. More than 300 new colleagues joined us in 2019 alone – and we continue to grow. In view of this dynamic, it is important that we remain constantly aware of what Amprion is all about and what our company does for society. We want to communicate this more in the future; we aim to raise our profile and make our name more widely known.

If Amprion were a person, what would make them tick?

They'd know where they came from and what they are capable of. Amprion stands in the tradition of those engineers who invented the transmission grid in Germany 100 years ago. And through our System Operation and Control Centre in Brauweiler, we ensure like no other transmission system operator that the interconnected power grid in Germany operates safely, reliably and efficiently. This is a great responsibility. Knowledge of this fact should make one humble. If Amprion were a person, they would be down-to-earth, clever and focused on facts. A person who is greatly valued and who is the first person one approaches when problems arise, in other words a likeable guy (laughs).

Despite all the changes underway, what is the key trait of Amprion that people in Germany can rely on?

They can rely on us doing everything conceivably possible to ensure that the lights in our grid area and across Germany never go out. We support the transformation to a climate-friendly, decarbonised economy. We say what we're doing – and we do what we say. And we will continue to work on innovations that upgrade and expand the power system.

“We support the transformation to a climate-friendly, decarbonised economy. We say what we’re doing – and we do what we say.”

OFF TO

Text HEIMO FISCHER
Photos KOLJA SCHOEPE

Amprion is preparing for the next chapter of the energy transition: the expansion of offshore wind energy. For the first time in its history, the company will connect wind farms erected in the North Sea to the German power grid. The planned routes also run through the East Frisian mudflats.

NEW SHORES

Out and about in East Frisia: Christoph Evers, spatial planner at Amprion, on the way to the car park in Hilgenriedersiel. From there, we walk out onto the mudflats off Norderney.

“So far, we have been planning, building and operating our transmission grid exclusively on land, that is, onshore. Now, Amprion is going offshore for the first time.”

CHRISTOPH EVERS
Spatial planner at Amprion

The 33-year-old is one of the many new specialists who the Dortmund-based transmission system operator has brought on board to help prepare for the expansion of wind energy in the North Sea.

Lower Saxony Wadden Sea National Park: anyone planning a power line here must comply with the most stringent environmental regulations.

The clouds hang over the Wadden Sea and the air smells of mussels and algae. In heavy rain, Christoph Evers trudges through the mudflats off the island of Norderney. The 33-year-old spatial planner negotiates tideways, which are now slowly draining as the tide recedes. There, in the sandy seabed off East Frisia, submarine cables will soon be laid to transport electricity from wind farms in the North Sea to the mainland.

Christoph Evers works for Amprion – and is one of the many new specialists the Dortmund-based transmission system operator has brought on board to help prepare for the next chapter of the energy transition: the expansion of offshore wind energy. In order for Germany to achieve its climate targets, the German government wants offshore wind farms to supply as much electricity as 20 large coal-fired power plants – and to do so by 2030. This requires not only the wind farms themselves, but also new cables connecting them to the onshore power grid. This is the only way the wind power generated offshore can reach the industrial centres in the west and south of Germany. Amprion will be investing billions of euros in this project. Christoph Evers is helping to plan these cables and to obtain the necessary permits. One of his areas of responsibility are the mudflats between the isle of Norderney and the mainland.

Until recently, everything that has been planned in this area and on the high seas was uncharted territory for Amprion. “Until now, we have planned, built and operated our transmission grid exclusively on land; that is, onshore,” says Evers, pointing towards the mainland. “Now, Amprion is going offshore for the first time.” The 33-year-old points towards Norderney. The offshore wind farms that Amprion is to connect to the grid will be erected up to 130 kilometres out to sea, behind the island. These links are expected to go online in 2028 and 2029. With a capacity of 900 megawatts each, they could cover the electricity needs of a major city such as Hamburg.

What animals and plants live on the mudflats?

The East Frisian Wadden Sea is part of the Lower Saxony Wadden Sea National Park – which in turn is part of the UNESCO World Natural Heritage Site that also covers the Schleswig-Holstein Wadden Sea and the Dutch Wadden Sea. Anyone planning

The mudflats are alive. When mapping the seabed, expert Jens Stecher pays attention to every mussel and every last lugworm cast.

to build a power line there must submit a comprehensive study depicting how the project will affect nature and the landscape. To this end, the flora and fauna along the planned corridor must be documented. These tasks are carried out on behalf of Amprion by experts such as marine biologist Dr Jens Stecher. Christoph Evers is accompanying him on this rainy October day. Stecher knows every tideway and sandbank in the mudflats off Norderney. And he knows the dangers: “When the tide comes in, the tideways can become torrents and cut off the way back to dry land,” says the 57-year-old scientist. To be on the safe side, the men wear life jackets and backpacks with provisions.

An hour after they have set off from the dyke near Hilgenriedersiel, they reach the first of a total of 18 waypoints. Stecher begins mapping biotope types on a large muddy area. For this purpose, he uses a light-alloy measuring frame, which he has carried in his hand the whole time and which is divided into open squares. He places it on the mudflat floor at previously determined points. He takes notes and photos of everything that can be seen inside the squares. The images will be evaluated later on the computer. Among other things, these observations can be used to deduce how heavily populated the tidal flats are at the respective location. “Every little lugworm cast counts,” says the marine biologist. Amprion can plan the course of the cable route accordingly.

Mudflats with an eventful history

While Christoph Evers is trudging around the mudflats, his colleague Michael Hahn is 300 kilometres to the south at Amprion’s head office in Dortmund, on the phone to companies that specialise in laying submarine cable in the tidal flats and coastal waters.

“When the tide comes in, the tideways can become torrents and cut off the way back to dry land.”

DR JENS STECHER
Marine biologist

The flora and fauna found inside the measuring frame are photographed and the images evaluated later on the computer.

"I want to leave nature the way I found it."

MICHAEL HAHN
Engineer in our offshore team

The 34-year-old experienced mechanical engineer is one of many offshore experts Amprion has hired in recent months. He will have a say in deciding through which cables the electricity generated by the offshore wind farms will flow. This task is challenging. For Hahn needs to know what the seabed is like. "Only then can I tell you how to lay the submarine cable." Geological studies using echo sounders show that sand, stones and gravel have been compressed into the seabed, and even peaty layers. They have evolved from former moors – and bear witness to the region's eventful history: "Where the North Sea is today was land 10,000 years ago," says Hahn.

To lay subsea cables, specialist companies use, among other things, underwater ploughs and special flushing methods. How do they impact the seabed? "With sandy seabeds, six months later it's impossible to see any difference compared with the original seabed. That's my experience from numerous projects I have been involved in," says Hahn. Treating nature with respect is important to him. He grew up in Neuharlingersiel, 30 kilometres from the point where the new power line is to reach land. "That's another reason why I want to leave nature there the way I found it."

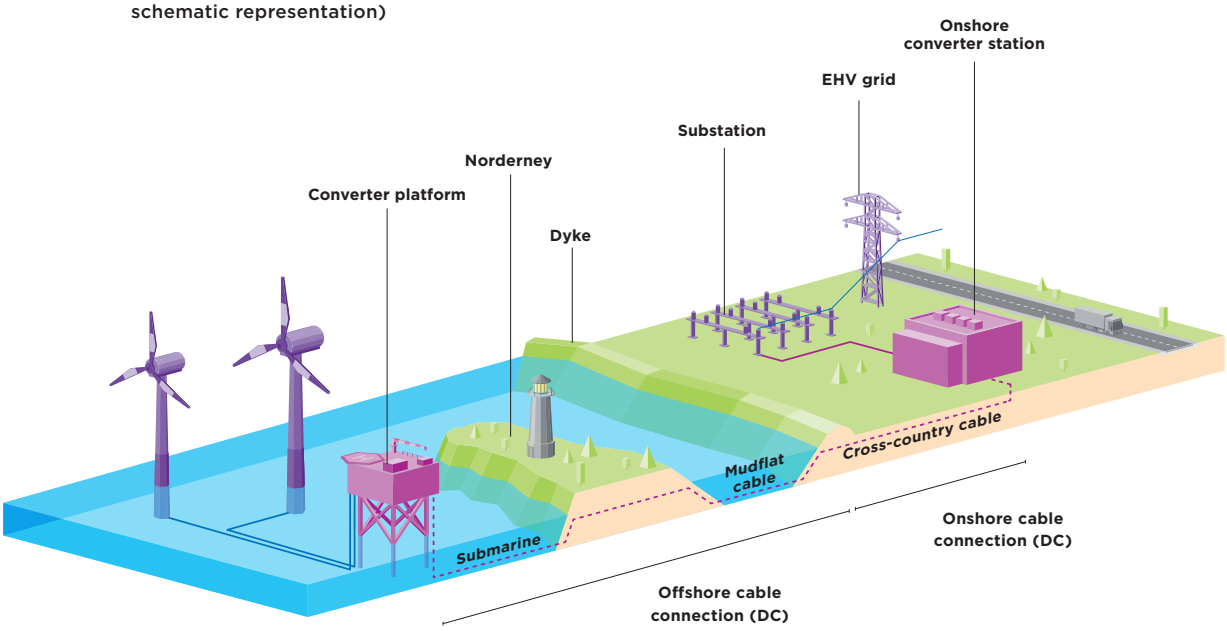
This is also important to Christoph Evers, who, after four hours on the mudflats, has reached the car park near the dyke again. He peels off his wet jacket and puts on dry clothes, then says goodbye to Jens Stecher. The mudflats through which they were tramping just a moment ago are being slowly submerged by the tide again. Soon, the water will have reached the salt marshes by the dyke – and will also have washed away the last traces of their hike.

WHY AMPRION IS CONNECTING OFFSHORE WIND FARMS

Until now, connecting offshore wind farms to the onshore grid has not numbered among Amprion's responsibilities. This was taken care of by the transmission system operators with lines and facilities located on the coast. However, owing to the massive expansion of wind power in the North Sea, the grid in the coastal region of Lower Saxony is now under considerable strain. The Federal Network Agency therefore decided to relocate the connection points for two new wind power connections 170 kilometres inland: to Lingen in Emsland (a district which borders North Rhine-Westphalia in the south and the Netherlands in the west). This is where Amprion's Hanekenfähr transformer station is located. To date, this substation connects the Emsland nuclear power plant to the transmission grid. Following the shutdown of this plant in 2022, transmission capacities will be freed up at this major grid hub, capacities that will in future be used to transport wind power. To this end, Amprion is building the two grid connection systems "DolWin4" and "BorWin4" from the North Sea to Lingen. From the wind farm to the coast, these connections will be run as submarine cables, passing under the island of Norderney. Once on land, Amprion will be executing the power lines as underground cable projects – from end to end.

HOW THE OFFSHORE CONNECTION WORKS

(Illustration not to scale, schematic representation)



Energy for 500 million people

The European Commission wants Europe to be carbon-neutral by 2050. Europe's transmission system operators want to help implement what's being called Europe's "Green Deal", says Joachim Vanzetta, System Operation and Control Manager at Amprion and Chair of the Board of the industry association ENTSO-E.

Interview HEIMO FISCHER
Photo RAPHAEL FOIDL

"The Green Deal will accelerate the transformation of Europe's energy system."

JOACHIM VANZETTA

Carbon-neutral by 2050 – Europe has set itself a mighty ambitious goal. Mr Vanzetta, what do Europe's TSOs have to say about this?

They support the project – and look forward to the opportunity to use their expertise to shape the future energy world in Europe. ENTSO-E is an affiliation of 42 transmission system operators from 35 countries. Together, we bear the responsibility for a secure and dependable power grid that supplies more than 500 million people.

To what extent does the EU Commission's Green Deal impact transmission system operators?

The Green Deal will accelerate the transformation of the European energy system, which will have a direct impact on the continent's electricity grids. On the one hand, the policy of decarbonisation will see progress, i.e. the phasing-out of fossil fuels such as lignite and hard coal. Renewable energy sources will increasingly take their place. Unfortunately, this also means that the system will be losing generating capacity that is available on a secure basis – and is being replaced by capacity that fluctuates greatly depending on the weather. As generation and consumption in the transmission system must always be in equilibrium in order to keep the network stable, the task of ensuring this is the case will become much more demanding for the transmission system operators. Nevertheless, all major industrial nations in Europe will be following this path, but most of them will not be renouncing nuclear power as a dependable energy source.

You are alluding to Germany, which will be phasing out both nuclear power and coal-fired power generation.

With what it calls its "dual phase-out", Germany has taken on a special position within Europe. As a result, the challenges faced with respect to Germany's energy system will be none the smaller. We must prepare ourselves for this and develop solutions that combine climate protection and system reliability.

We were talking about the Green Deal and its consequences for the energy system. What developments will it accelerate besides decarbonisation?

The Green Deal will also lead to increased electrification of the economy and society. For example, we will be consuming more electricity in sectors such as mobility and heat, because we can generate it in a carbon-neutral way. To achieve this, we need to expand the power grids, develop new storage technologies and expedite digitalisation in the sectors. But electrification has its limits. We will be able to cover only part of the total energy requirements across Europe with electricity.

Why isn't even more electrification possible?

Many energy-intensive processes simply do not function with electricity – take shipping or industry, for example. Moreover, it's virtually impossible to store electricity in the volumes required. This, however, would be absolutely essential as renewables do not generate electricity on demand, but only when the wind is blowing and the sun is shining. For this reason, we in Europe will additionally start to convert green electricity into hydrogen. And we'll be doing so whenever this green electricity is available in abundance thanks to favourable weather conditions. Hydrogen can also be used to generate heat and steam for use in industrial processes, for example. Experts refer to this as "sector coupling", because the electricity and heat sectors are connected in this way. Without sector coupling on a large scale, the Green Deal will not succeed. However, these power-to-X technologies still have to pass through a number of development stages before we can deploy them on an industrial scale. The sooner we begin with these developments, the sooner technical solutions will be available.

Smart stations

Transformer substations are the nodal points of the transmission grid. The energy transition will lead to a broadening of their functions. Amprion is preparing its substations for this. Here is a quick rundown of the key technologies.

Text ALEXANDRA BRANDT

STATCOM

A static synchronous compensator (STATCOM) is a power electronics device that can be used to raise or lower the voltage in the grid – steplessly and very quickly. This enables control engineers at Amprion to react immediately to changing conditions in the grid and stabilise the voltage.

Installation locations:
Kusenhorst and Dauersberg substations (commissioning planned for second half of 2020)

HYBRID SYSTEM

MSCDN and STATCOM devices can also be used in combination. In 2019, Amprion put its first hybrid power factor correction system into operation. It is the most powerful of its kind in the German grid.

Installation location:
Kriftel substation

For more than 80 years, transformer stations have connected the transmission grid with regional distribution grids, power plants and large industrial enterprises. If this power transfer is to function smoothly, the voltage has to be matched to the requirements of the customers. This "transforming" – from 380 to 110 kilovolts, for example – is performed by transformers.

As a result of the energy transition, wind and solar installations with heavily fluctuating generation patterns due to the natural whims of the weather feed electricity into the grid. This affects the voltage level in the grid. In future, the equipment installed in the transformer substations will play a key role in keeping the voltage level stable and, figuratively speaking, in regulating the traffic in the network. Amprion is preparing several transformer stations for these new tasks.

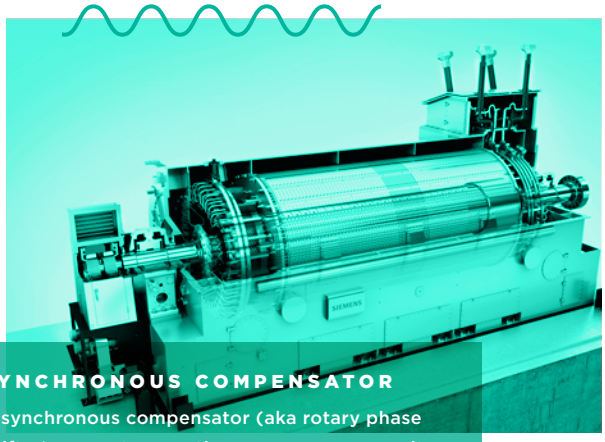
Stabilising the grid voltage

In order to build up the voltage in the AC grid, we need what's called "reactive power". This functions rather like a lubricant for the active or real power: the power that consumers can actually use. If the reactive power is too low, the voltage drops and the current flow is disturbed. If it is too high, less active power can be transported across the grid. Up to now, it was mainly the generators of large power stations that generated reactive power. However, with the phasing-out of coal and nuclear power, many of these generators are going offline. For this reason, Amprion is using more and more systems in transformer substations that absorb or generate reactive power as required.

MSCDN DEVICE

An MSCDN device uses mechanically switched capacitors to generate reactive power. MSCDN stands for mechanically switched capacitor with damping network.

Installation locations:
Essen-Eiberg and Bürstadt substations



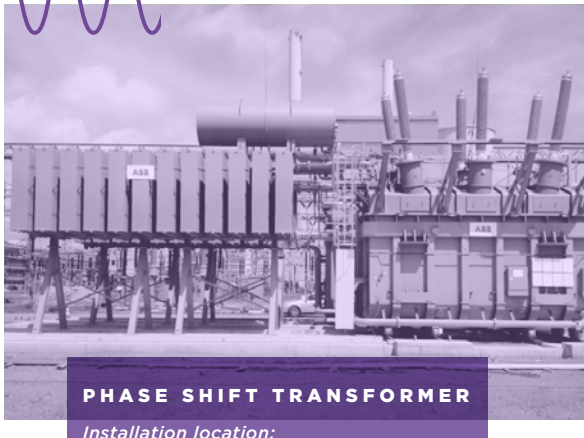
SYNCHRONOUS COMPENSATOR

A synchronous compensator (aka rotary phase shifter) generates reactive power as soon as its rotational speed is synchronised with the frequency of the transmission grid. In addition, it provides what is known as short-circuit or fault power that supports the power grid in the event of a fault, and its rotating mass dampens frequency fluctuations in the grid.

Installation locations:
Oberottmarshausen and Uchtelfangen substations

Controlling power flows

Amprion uses what are called “phase shift transformers” in substations to divert power away from bottlenecks to less congested sections of the grid. They function like controllable resistors. The principle behind them: If the control engineers reduce the resistance, the power flow on a line increases. If they increase the resistance, the power flow is slowed down and parallel lines are loaded more heavily.



PHASE SHIFT TRANSFORMER

Installation location:
Oberzier substation

Jonas-Daniel Glane doesn't mind climbing to great heights. While he climbs the pylon, his colleague on the ground prepares the cable trolley for the repair work.

High-wire act in the rain

Major disruptions in Amprion's network are rare. That's in part because fitters carry out regular maintenance work on the power lines. If damage does occur, these troubleshooters are the ones who carry out the repairs – at a truly dizzy height.

Text CHRISTINA SCHNEIDER
Photos JAN P. BALDUS

A Wednesday morning in autumn and it's raining cats and dogs. Thick fog clings to the hills of Germany's Sauerland region. But the 55-metre-high power line pylon is clearly visible. At its base, three company vehicles belonging to Amprion pull up. Hans Brinkers, Klaus Rothlübbers, Jonas-Daniel Glane and Frank Hölscher get out and look around. "Today's a good day for a swim," says Hölscher. His colleagues grin.

The four men are overhead linesmen and are used to working outside in wind and weather. Their assignment today: to repair a damaged conductor close to the pylon. Each power line consists of several conductors. One of the strands of a conductor has broken. It's sticking out and has to be repaired with what's known as a "line guard".

We need to be prepared at all times

Maintaining the power grid network has top priority at Amprion. After all, the power supply of many millions of people stands or falls with the reliability of grid operation. "Our network is robust. Overall, it suffers from very few faults, but despite this, we need to be prepared at all times," says Hans Brinkers, who is assignment manager. The native Emslander knows his way around. He has been working as an overhead linesman for 32 years. On this autumn morning, however, he and his colleague Klaus Rothlübbers remain on the ground. It's Jonas-Daniel Glane and Frank Hölscher who will climb the pylon. That's what they have agreed.

“No matter how experienced we are, we can’t afford to be sloppy in this job.”

HANS BRINKERS
Overhead linesman and assignment manager

The men put on rain gear, helmets and gloves, then go off to set things up. They move the van and trailer, on which a motorised cable winch is mounted, into the right position. They remove around 100 metres of lifting rope and lay it down in front of the pylon along with other materials. Later, they’ll hoist most of these materials up with the winch. This includes the 200-kilogram cable trolley, a type of cradle they affectionately call “the little chair”. This specialist piece of equipment lets you travel along the overhead cables way above ground level.

Is the conductor live?

Jonas-Daniel Glane and Frank Hölscher get into their climbing harnesses. A harness weighs more than ten kilograms. Secured as on a via ferrata (for the uninitiated, a fixed-rope route for adventurous hikers), they climb 55 metres up the pylon. They also carry a non-contact voltage tester in their kitbag, a rod-shaped device they use to test whether or not current is still flowing through the conductor. However, this shouldn’t be the case now, because Hans Brinkers had a few days earlier submitted a request to Amprion’s grid management for this line to be isolated (i.e. disconnected) today – and he has telephoned them early in the morning to confirm that it has been. “We still need to have the testers with us, though. They’re our life insurance,” says Glane. He’s been doing the job for seven years. After several safety checks, his colleagues below hoist up the remaining equipment. Everyone is fully focused on the job. “No matter how experienced we are, we can’t afford to be sloppy in this job,” says Brinkers.

Glane now has to get from the pylon to the conductors. He climbs carefully onto the insulator string. Below him a 50-metre-deep abyss. It’s still raining, and the porcelain insulators are slippery. From below he looks like a tightrope walker. He slowly works his way forward. To slip or stumble here would be dangerous, despite all the safety precautions. But he gets to the spot he wants to be without any problems. He mounts an attachment for the cable trolley between the conductors. The trolley itself now has to be hoisted up – working as a team, with the aid of the winch, using hand signals.

“Our job: hiking, climbing and flying”

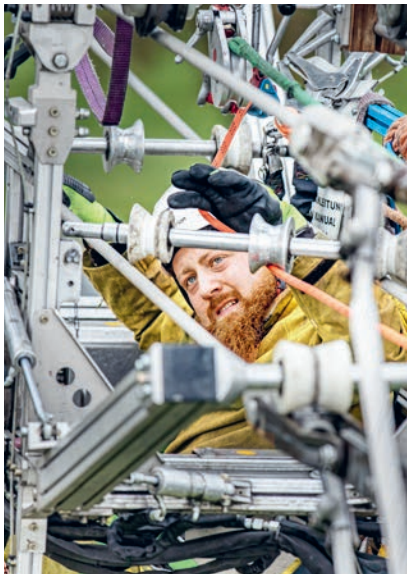
After Glane has hooked in the cable trolley, he climbs in and starts the motor. It’s about 300 metres from the pylon to the damaged area. It was discovered in summer, during a helicopter inspection flight. Once a year, Amprion flies along the entire length of its grid and inspects the conductors for damage. In addition, a walkdown inspection of every pylon and conductor is carried out once a year. Every five years every single pylon is climbed up and closely inspected. “We hike, climb and fly – all the things other people do in their free time,” says Glane. There are almost 4,500 pylons in their district – a lot of work for these overhead linesmen. Brinkers alone drives around 35,000 kilometres (22,000 miles) a year. Every five weeks he’s on emergency standby duty for seven days. If a major fault occurs at night, he has to go to the location immediately. “But that’s rare,” he admits.

Not for the faint-hearted – Jonas-Daniel Glane climbs from the pylon, via the insulators, to the conductors. This demands maximum concentration.

What looks spectacular to the layperson is just part of the job for overhead linesmen. They hoist the cable trolley up to conductor level with the aid of a winch. Hans Brinkers (left) has everything under control. The assignment manager has more than 30 years under his belt as an overhead linesman.

“We hike, climb and fly – all the things other people do in their free time.”

JONAS-DANIEL GLANE
Overhead linesman



Every step must be perfectly executed. Jonas-Daniel Glane assembles the cable trolley, which he calls “the little chair”. He uses it to get to the damaged area 300 metres away.

Glane starts to repair the damaged conductor. While he wraps the damaged section of the conductor in patch rods (repair sleeves) made of aluminium, the other men take a break. Shortly before Glane is finished, he discovers a second damaged section of conductor a few metres further on. He deals with it after completing the initial repair. “There’s no way you could’ve seen the second strand breakage from the helicopter,” he says later. “It was too small and too close to the spacer between the conductors.” What caused these two breakages? “Good question,” says Brinkers. “We can’t say for sure.” Conductor damage can be caused by lightning strikes or defective bundle spacers – sometimes also by hunters accidentally hitting the cables with their bullets.

Repair work completed: line “free of work”

Meanwhile, Glane is on his way back to the pylon in the cable trolley. Dismantling can begin – and it’s still raining. In the afternoon, everything is stowed away again and the men make their way home. Only Hans Brinkers still has one final duty to fulfil. He phones the colleagues in grid management to tell them that the line is “free of work” and can be switched back on. A short time later, electricity flows once again through the repaired conductor.

CLIMATE PRO- TECTION PIONEER

North Rhine-Westphalia (NRW) is setting the course for a climate-friendly, reliable and affordable power supply system. In collaboration with the energy industry, the state government has drawn up the Energy Supply Strategy for NRW.

A GUEST ARTICLE BY PROF. DR ANDREAS PINKWART

Minister of Economic Affairs, Innovation, Digitalisation and Energy of the state of North Rhine-Westphalia.

For the energy and industry powerhouse that is North Rhine-Westphalia, the energy transition represents a radical transformation. Questions regarding the security of supply, expansion of the power grids and economic viability present huge challenges. In order to successfully meet these challenges and strengthen North Rhine-Westphalia as a business and energy hub, the state government, in collaboration with the energy sector and industry, has drawn up the Energy Supply Strategy for NRW and published it in July 2019. This sets the course for a reliable, affordable and climate-friendly power supply system in NRW.

If the recommendations of the "Growth, Structural Change and Employment Commission" are implemented, electricity generation from local coal-fired power plants will be cut by up to 70 per cent by 2030 and CO_2 emissions from coal-fired power generation will fall by up to 80 million tonnes per annum. This makes North Rhine-Westphalia a climate protection pioneer.

Exploiting the potential of wind and sun

The path chosen in the battle to achieve carbon neutrality requires a sustainable energy supply for the electricity, heat and mobility sectors. Expanding renewables in a market-driven and generally accepted manner is therefore of crucial importance. In view of the potential here, the state government considers a doubling of onshore wind and photovoltaic generation capacities by 2030 to be possible.

“We support the move on the part of the grid operators to take a closer look at integrating the power grids and gas networks in order to optimise the energy system as a whole.”

ANDREAS PINKWART

However, this restructuring of the energy system must not be carried out at the expense of the security and reliability of the energy supply and the competitiveness of our industries. The issue of affordability must be taken into account with regard to both energy-intensive industries and consumers, with appropriate forms of financial relief, including reduction of the electricity tax.

We as the state government are working at the federal level to promote development of the methodology for assessing the security of supply. Furthermore, we need an investment mechanism for flexible backup power plants to ensure that sufficient capacities are available in the medium term and that gas-fired power stations incorporated into the scenarios of the Grid Development Plan Electricity also become a reality. The Energy Supply Strategy for NRW is based on local locational advantages: gas-fired power stations can be built at existing power plant sites as replacements for coal-fired power stations, meaning existing network nodes in the transmission grid can continue to be used. In the long term, these power stations can be converted to synthetic gas produced from renewable sources.

Approval procedures will be simplified

In addition to sufficient generation capacities, it is essential that capable networks are available to transmit and distribute the electricity generated. By establishing technical standards, the state government is simplifying approval procedures in order to accelerate the demand-oriented expansion of the electricity grids. The cross-sectoral planning of infrastructure is also gaining in importance as a result of sector coupling. We support the move on the part of the grid operators to take a closer look at integrating the power grids and gas networks in order to optimise the energy system as a whole.

Setting the course for green hydrogen

The course must also be set today for the next development steps, for example for the use of power-to-X (PtX or P2X) technologies such as green hydrogen. Since PtX applications will also have a massive influence on future transport requirements in the transmission grid, these must be taken into account from an early stage when updating requirements planning. At the same time, the political framework conditions must be set in such a way that market penetration by PtX is efficient and synchronised with the development of the grid infrastructure.

In our efforts to restructure the energy system, we are focusing on securing the power supply for a modern, green and prosperous North Rhine-Westphalia and we will build on the successful dialogue and collaboration around work on our Energy Supply Strategy.

ENERGY AND INDUSTRY POWERHOUSE NRW

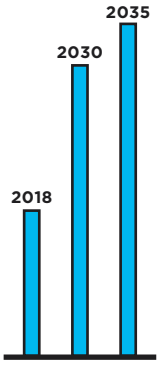
North Rhine-Westphalia was once the heart of Germany's coal and steel industries. In future, the country's most populous state will be focusing more on renewable energy sources. At the same time, the domestic economy is to remain competitive.

250,000
PEOPLE

in NRW work in energy-intensive sectors, such as the primary industry. Their jobs depend on a secure and affordable energy supply. The competitiveness of energy-intensive industries must be ensured.

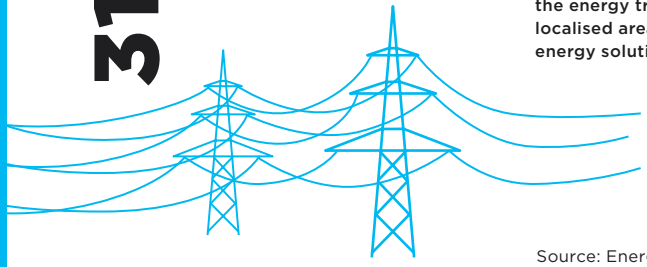
22
GIGAWATTS

of power are to be provided by wind and solar installations in NRW by 2030. This corresponds to a doubling compared to 2018. An installed capacity of 25 GW is planned for 2035.



315,000
KILOMETRES

– that's the total length of the power grids in NRW. This includes a 10,000-kilometre-long transmission grid. The gas networks measure some 86,000 kilometres in length. This energy infrastructure has to be restructured and expanded. This expansion needs to span both energy systems.



10 million
PEOPLE

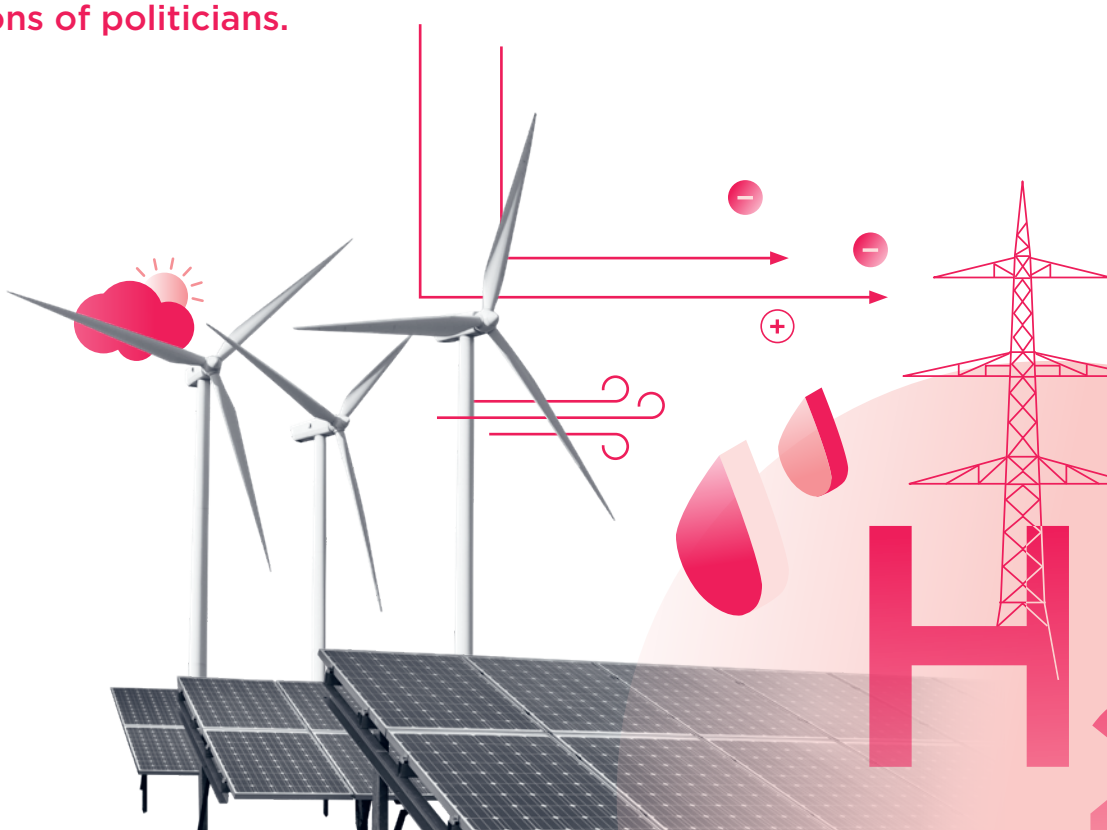
live in the Rhine-Ruhr region, one of the most densely populated metropolitan regions in Europe. In cities, the challenges associated with the energy transition are focused on a very localised area. NRW is searching for new urban energy solutions.

Source: Energy Supply Strategy of NRW

Let's think ahead

Interview VOLKER GÖTTSCHE

To limit the extent of climate change, Germany has decided to phase out coal-fired power generation by 2038 at the latest. So what will our energy system look like then? Christoph Bals, Political Director of the environmental organisation Germanwatch, and Gerald Kaendler, Head of Asset Management at Amprion, discuss the dynamics of the climate debate, the change in awareness and attitudes in the chemical industry and people's expectations of politicians.



Mr Bals, Mr Kaendler, our energy system is changing dramatically and rapidly. Would you have predicted just five years ago that Germany would abandon not only nuclear energy but also coal-fired power generation?

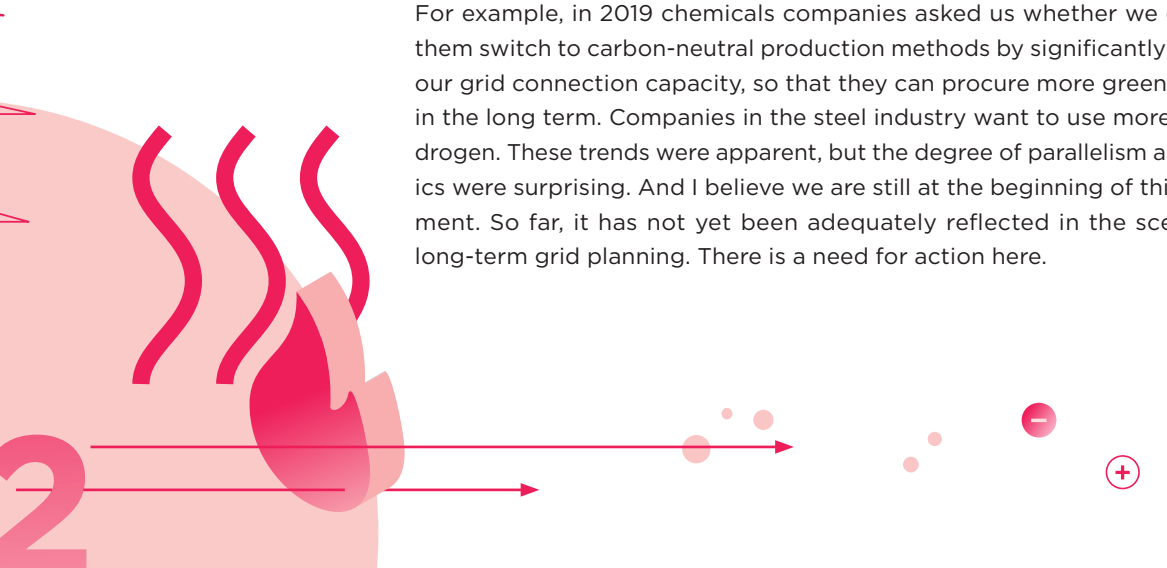
GERALD KAENDLER I did not expect this. The climate debate in Germany has always had its ups and downs: picking up speed, only to recede into the background again. The direction in which we were heading was foreseeable, but the dynamics of today were impossible to predict; just like no-one could have predicted that in 2019 the EU Commission would initiate a "Green Deal" for Europe, setting it on course to become carbon-neutral by 2050.

CHRISTOPH BALS The end of coal was already in the offing at that time. At the G7 summit in Elmau in 2015, the seven most influential industrialised nations announced for the first time that they would be phasing out coal, oil and gas in the long run. This kicked off a serious political debate in Germany, which was also driven by the Paris Agreement reached in the same year. The goal of limiting global warming resulting from human activities to well below two degrees Celsius, if possible even below 1.5 degrees Celsius, compared to the pre-industrial era, means we have to phase out coal by around 2030.

Why is this goal so important?

BALS The more fossil fuels that are burned, the more greenhouse gases accumulate in the atmosphere – and the more global temperatures rise. We have now exited the temperature range of the last 11,000 years since the last ice age. All advanced human civilisations and our ecological environment were adapted to it. Whatever follows with every additional tenth of a degree rise in global temperature is a dangerous worldwide experiment with mankind and nature. The dramatically accelerated melting processes in Greenland and West Antarctica are just one example.

KAENDLER I share this assessment. Climate awareness is now growing everywhere – and this is also clearly evident in industry. For example, in 2019 chemicals companies asked us whether we could help them switch to carbon-neutral production methods by significantly increasing our grid connection capacity, so that they can procure more green electricity in the long term. Companies in the steel industry want to use more green hydrogen. These trends were apparent, but the degree of parallelism and dynamics were surprising. And I believe we are still at the beginning of this development. So far, it has not yet been adequately reflected in the scenarios for long-term grid planning. There is a need for action here.



Let's think ahead – to the time after coal has finally been phased out. What will our energy system look like then? After all, coal still currently plays an important role in power generation.

KAENDLER Germany will bank on a new generation mix comprised primarily of wind power, solar energy and decarbonised gas. I expect offshore wind energy to take off, and we will also have more photovoltaics – embedded in decentralised concepts with local battery storage facilities.

BALS I totally agree. I think the gathering momentum in photovoltaics will surprise us all. Solar power is becoming more and more affordable all around the world and in many cases is already cheaper than coal.

How do you see electricity consumption levels developing?

KAENDLER We expect a significant increase in electricity demand in the long term. Electromobility will have its share in this, while heat pumps for heating need electricity, and industry will electrify production processes. The sectors of the energy industry will converge. In addition, power-to-gas technology will become established on an industrial scale in the long term. With this technology, plants convert green electricity that cannot be integrated into the system into hydrogen, which can be stored in the gas network. Industrial enterprises will use it as a fuel and raw material to decarbonise their production process. As a transmission system operator, we are adapting to these developments and planning our system accordingly. After all, we are committed to supporting decarbonisation and to ensuring that the electricity grid continues to operate stably and reliably.

BALS I'm not so sure if the demand for electricity will grow so fast. One question I have not yet heard asked relates to what measures we are taking in the transport sector to, for example, reduce the number and size of cars. Trains, trams and bicycles are eco-friendlier than any electric car. It would be wrong to simply extrapolate needs without working to bring about a mobility revolution.

GERALD KAENDLER
Head of Asset Management
at Amprion

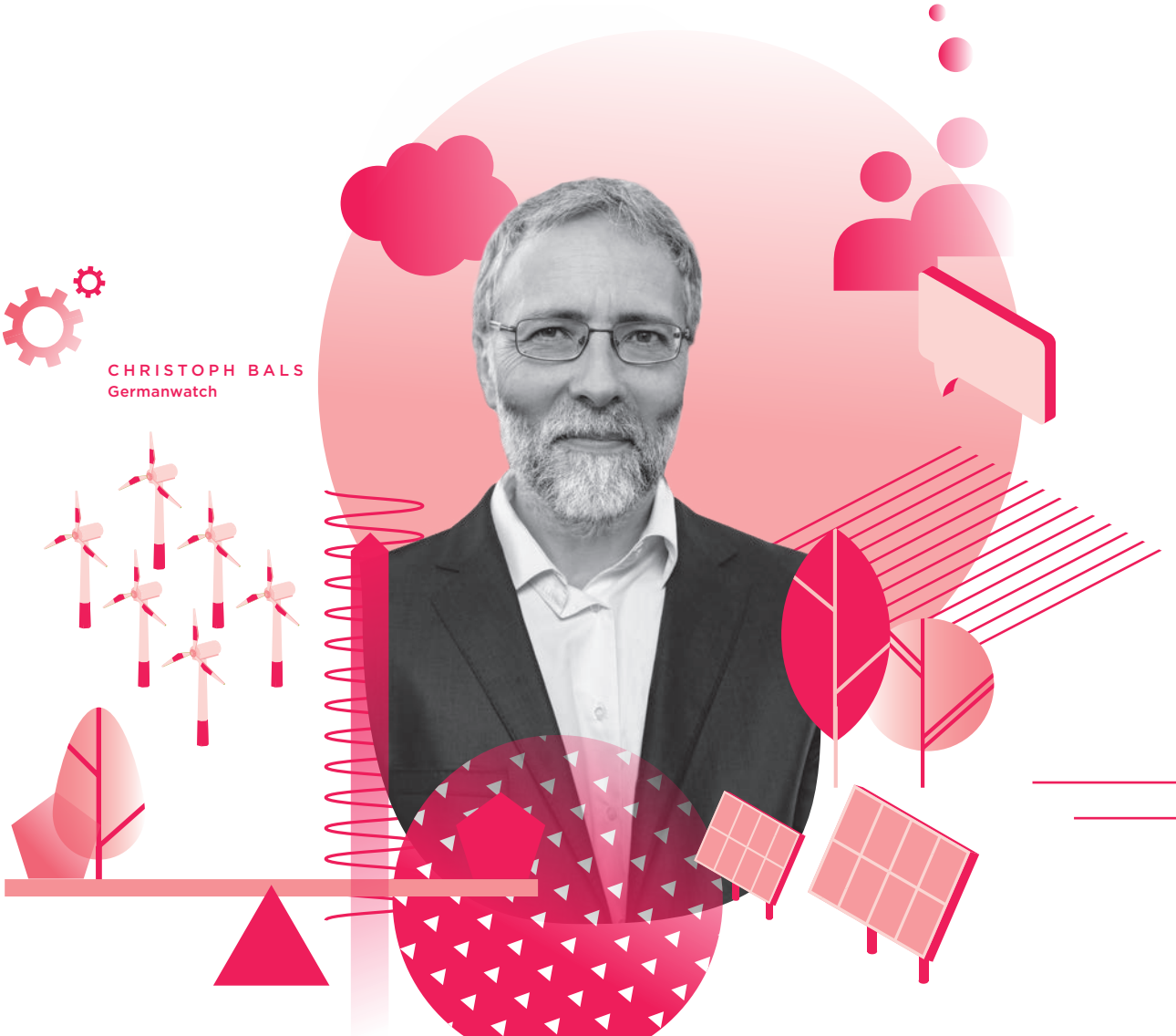
Will Germany still be importing electricity in 2038?

KAENDLER Even if, in the long term, we are able to store and use large amounts of energy in the form of green hydrogen thanks to power-to-gas, we will still be dependent on imports of decarbonised primary energy to cover our electricity needs. Because more renewable energy will be generated and energy will be used more efficiently overall, the level of imports should, however, be lower than today.

BALS Here, too, it begs the question as to how can these imports be reduced and organised on fair terms? Since the dawn of industrialisation, our economy, and later our democracy, has thrived off exploiting other regions and the environment. Before we decide to import hydrogen, we first need to know how the exporting countries are actually going to generate renewable energies. If we are thinking about importing large volumes of hydrogen from Africa in future, this can only be possible with new business models based on partnership and a level playing field. There's still a huge amount of work to be done before we get that far.

As a TSO, Amprion will hardly be in a position to influence things …

KAENDLER Decisions regarding energy imports will impact the power system in Germany, for which we feel jointly responsible. That is why it is important that we follow these debates and social trends. In addition, I think it is important to talk to many people from different industries in order to learn from each another. Just like Amprion is talking to the gas industry in order to make progress on power-to-gas. By 2038, we will see new technological solutions in all areas. We are in no position right now to foresee what technological possibilities will be found to facilitate decarbonisation. But one thing is clear: electricity will play an important role and we must all learn from each other in order to recognise the potentials. Perhaps solutions will emerge that we cannot envisage today.



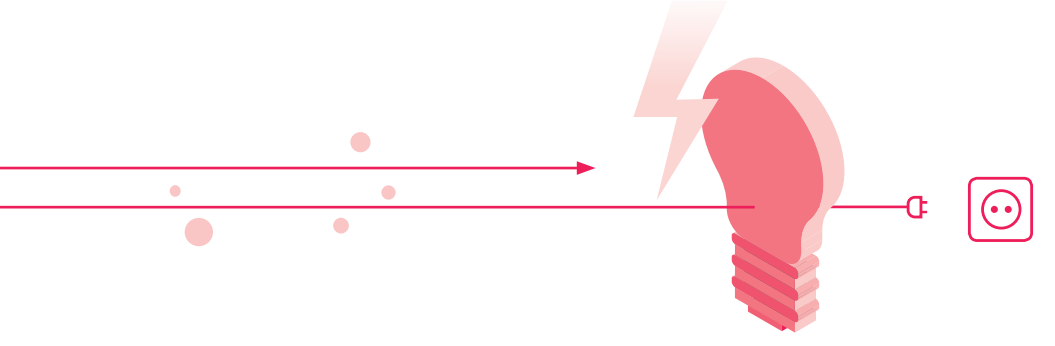
CHRISTOPH BALS
Germanwatch

BALS Such innovation processes could lead to a new spirit of optimism. We currently find ourselves in a phase of the energy transformation filled with uncertainties. To respond with fear would be wrong.

The energy industry plans for the long term. 2030 feels like tomorrow, 2050 the day after. What measures should politics introduce today for the time after the coal phase-out?

BALS The government must do everything it can to ensure that we in Germany have sufficient renewable sources of energy available to us. What's more, in this current "systemic" phase of the energy transformation, it will be important to combine the expansion of renewables with grid expansion, sector coupling and new opportunities for controlling consumption, and to optimise all of this. So, my dear Federal Government, what does a sustainable road map for energy efficiency and for power-to-gas look like in concrete terms – and for hydrogen? What can we achieve of this here at home and what do we need to import, under fair terms?

KAENDLER For Amprion, it is first of all important that grid expansion makes progress and that we have more instruments at our disposal to ensure system security in 2038 and beyond. There is currently a lack of opportunities to conduct large-scale trials with new technologies – even if this is a risk that they may fall short of expectations. But I'm confident that one or two of these innovations will be a winner and help us all. After all, we all need to finally start thinking and planning across the sectors. I believe that Amprion, as a transmission system operator, could develop into a kind of platform that brings together the various currents.



Real men

Text HEIMO FISCHER
Photos JAN P. BALDUS

Putting their backs into it: Frank Bierwagen, Jörg Kramer and Olaf Häberle (left to right) push the wagon into position. Then it's no longer brawn but fine motor skills that are required – handling bolts and wrenches.

A kitchen-living room, two bedrooms with bunk beds – this is where Jörg Kramer and his colleagues live when they are "on the road". These men transport transformers for their employer, Amprion, by train, and with a feeling they do one of the most unusual jobs Amprion has to offer.

Knocking-off time. Jörg Kramer takes off his oily work clothes, under which he's wearing a fleece sweater and jeans. He fishes a pack of pre-cooked fried potatoes out of the fridge and cuts a sausage into slices. A splash of oil in the pan and shortly afterwards dinner is sizzling on the stove. The smell of food wafts through the kitchen. A table, three chairs, next door in the two side rooms two bunk beds – this is the domain of Jörg Kramer and his two colleagues Olaf Häberle and Frank Bierwagen. "And a bit like our second home," says Kramer.

But this home has neither a garden nor a hobby room. It's a railway carriage, of sorts. The three men cook, sleep and spend their work breaks and evenings there when they're "on the road". And that's often for weeks on end. That's because their job is to transport transformers to new, often remote locations. These machines, that weigh more than just a few tonnes, are usually located in transformer stations and are indispensable for the power supply system. "At Amprion, as well as installing new transformers, we also replace older ones with younger models," says Kramer. "It's a bit like car tyres that are swapped from the front axle to the back and vice versa, so they wear evenly."

On the way from Koblenz to Duisburg

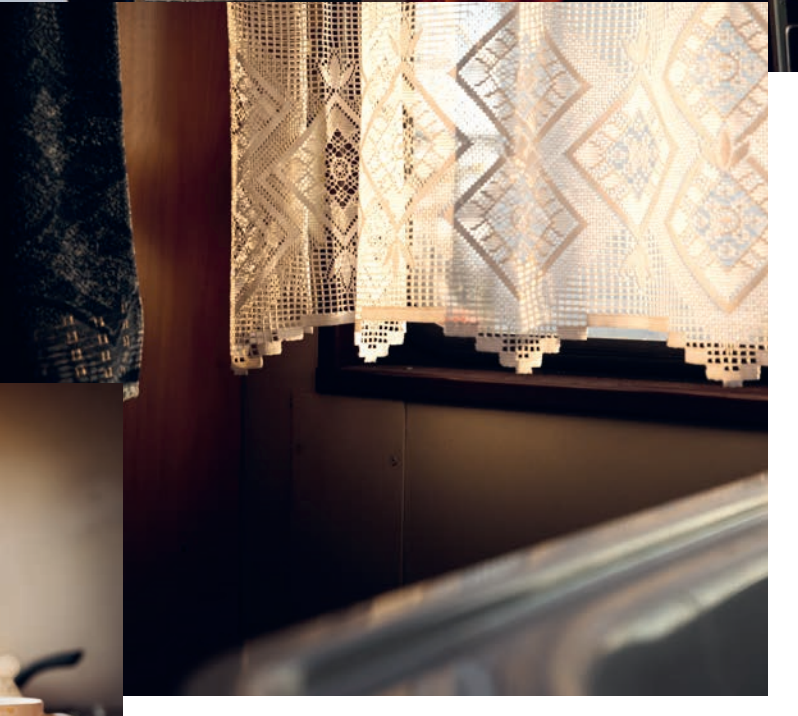
Around 15 times a year, Kramer and his colleagues go off on a big trip. Today, they are transporting a transformer that weighs a massive 240 tonnes. They have picked it up in Koblenz and are taking it to a transformer station in Duisburg. Kramer has been doing the job for almost 25 years and is seen as the "elder statesman" of transformer transportation at Amprion. "I probably have the most unusual position in the whole company," says the 56-year-old. He's powerfully built, has upper arms like most people's thighs, and alert eyes. A skilled fitter, he used to work underground as a miner.

"You have to want to live like this"

Railway fans with a penchant for nostalgia will get all teary-eyed at the sight of their accommodation. The carriage in which the three men live when working dates from the 1960s. The centrepiece of the train, however, is a heavy-duty wagon called a "Schnabel car" or "Schnabel wagon", designed to carry heavy and oversized loads and equipped with lifting arms. It was built in 1956, weighs 110 tonnes unladen and can carry a load of 240 tonnes.

When loaded to fully capacity, the train's maximum speed is no more than 40 km/h or 26 mph. As a result, the train often has to switch to secondary lines in order not to hold up traffic on the rail network. But it can also be the case that Kramer and his colleagues end up having to spend a weekend waiting in a freight depot. This means that before each assignment, the men say goodbye to their families without knowing exactly when they will return. "2019 was the first time in four years that I celebrated my birthday at home," says Kramer. Olaf Häberle nods his head. "You have to want to live like this."

On some days, time passes infinitely slowly, on others the men race from one exciting situation to the next. Because a transformer is wider than a normal train: is the curve too tight for the train? Does



Afternoon coffee break: Olaf Häberle (left) and Frank Bierwagen take a breather in the kitchen of the accommodation carriage. They have furnished their mobile home in line with their own taste – lace curtains and all. Next door are bedrooms with bunk beds.

“There’s no modern technology that can help us in such situations, just experience and a good eye.”

JÖRG KRAMER
works for Amprion in the railways and transformer transportation department.

Rolling at walking pace: progress is slow at critical locations. It's at such moments that the men need to trust in their own experience and good eye.

the transformer fit into this tunnel? Are those signals too close to the track? At critical locations, the train rolls at no more than walking pace. When it's dark, the men have to illuminate the embankment with a lamp. "There's no modern technology that can help us in such situations, just experience and a good eye," says Kramer.

It's a DIY job if the heating packs in

When out on assignment, the men are for the most part on their own. For instance, a few years ago during the winter, the heater unit of the accommodation carriage packed in. "I was lying under the carriage for hours," Kramer remembers. Early next morning, he had finally fixed it.

Sometimes, the Amprion transformer team receives some unexpected help. Like at the marshalling yard Cologne-Kalk North, where, after several turning manoeuvres, the train was standing the wrong way round. Kramer described the problem to a Deutsche Bahn foreman who he happened to meet. Without further ado, the foreman alerted a shunting engine driver and a few hours later, the three men were able to continue their journey as planned.

Three guys cooped up together for weeks on end – how well does that work out? Jörg Kramer ponders briefly over that one. "Sometimes we have to sit down over a beer and talk things over." They rarely leave the train. "There's always a risk of thieves coming," says Frank Bierwagen. This evening, too, while parked at Duisburg-Walsum train station, the men remain in their carriage after dinner, chatting, with the TV on in the background. A typical evening out on assignment. Anyhow, at least they won't have to live in their 1960s carriage for much longer. Since the number of transport

assignments is increasing and the transformers are getting heavier and heavier, Amprion has ordered a new heavy-duty Schnabel wagon and a new accommodation carriage as well. This new Schnabel wagon can carry transformers weighing up to 500 tonnes, and the living quarters will also offer significantly greater comfort.

The next morning, they set off on the final section of this latest transformer transport assignment. The diesel locomotive sounds its horn, while the engine roars into life. Slowly the locomotive pulls the train out of the station, through the neighbouring coal-fired power station and into Amprion's transformer station. At a railway crossing, Jörg Kramer, Olaf Häberle and Frank Bierwagen have to raise the transformer using hydraulic equipment, so that it does not touch the ground. They also temporarily remove a switch point lantern, because it is too close to the track. Routine procedures.

The 240-tonne transformer has reached its destination

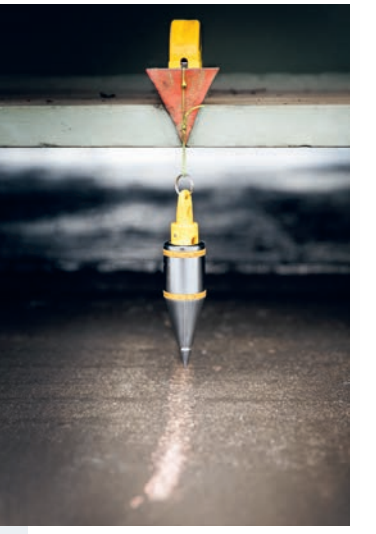
Once inside the compound of the transformer substation, and as if in slow motion, they lower the 240-tonne transformer onto two low-loader wagons that are positioned on transport rails at right angles to the track. Shortly afterwards the transformer is standing where it should be. In the coming weeks, it will be fitted with side walls and roofed over, before it is connected to the electricity grid.

But Jörg Kramer and his colleagues play no part in this. They're looking forward to the journey home – and to their real homes.

TRANSFORMERS ON TOUR

Each transformer delivery is carefully planned. In order to disrupt regular rail traffic as little as possible, Amprion's logistics teams go by the timetables and track closure times of Deutsche Bahn. To meticulously plan a transport assignment and to obtain all necessary permits takes at least eight to 12 months.

Amprion has around 100 kilometres of its own track and 60 private sidings to transformer substations. Add to this 70 trans-shipment yards. Transformers being transported to substations that do not have their own railway siding are unloaded here from the rail wagon onto a heavy-duty truck and cover the final few miles by road.



Once unloaded, the 240-tonne transformer must be positioned to the nearest millimetre. The precise position is determined with the aid of a plumb line. The colossus then slowly slides into its final position on transport rails positioned at right angles to the direction of travel.

Natural balance

Text ALEXANDRA BRANDT

Wherever new power links are built, nature and the landscape will change. Amprion compensates for these impacts elsewhere. For example, the transmission system operator acquires land on which it renaturalises watercourses or upgrades monocultures. One such “ecological compensation area” is located near Plettenberg in the Sauerland region. This 50-hectare site owned by Amprion covers large sections of the protected area known as the “Lenne-altarm Siesel” (meaning the “cut-off Lenne river meander at Siesel”) that hosts rare habitats. The number of species that live there is growing from year to year. Please take a look at the following pages and we’ll show you some of them.

Large skipper

To hibernate, the caterpillars construct a shelter from grasses or a curled-up leaf, which they spin together with their silk.

These diurnal butterflies can be identified by their reddish-brown wings and broad head. They favour natural locations with a wide variety of flowers, whose nectar they drink. Since large numbers of plants thrive and blossom in the Amprion biotope around the Lennealtarm, the butterflies find an adequate supply of food there. So do their caterpillars, which feed on various grasses.

The conspicuous macrofungus grows on older or damaged tree trunks. It decomposes the wood and turns it into humus. It is rarely encountered in spruce forests, which are often planted as monocultures in Germany. On Amprion's estate in the Sauerland, tinder fungus (also known as horse's hoof fungus) grows in a mixed forest of oak and beech trees.

Tinder fungus

The fungus owes its name to its earlier use: it was turned into tinder and used to start fires. With the invention of matches, its once significant economic value declined.

King-fisher

Kingfishers feed on small fish, insects, crabs and tadpoles. They hunt by pulling their wings tight against their body and diving head first into the water to grab their prey with their beak.

With its clear, unpolluted waters, which do not freeze over even in winter, the protected area at the “Lennealtarm Siesel” offers an ideal habitat for the common kingfisher. This strictly protected bird also finds natural sections of water with steep banks into which it can dig breeding burrows.

Grass snakes can increase their body surface area to quickly absorb or dissipate heat as needed. What's more, they can play dead when in danger: they lie on their back, go limp and open their mouth.

Grass snake

This snake, which can grow up to 1.2 metres in length, is at home in what are called "mosaic habitats", where bodies of water as well as forest and grassland can be found. Such habitats offers these reptiles a perfect food supply, with snails, amphibians, spawn and mice. The grass snake is protected throughout Europe under the EU Habitats Directive.

This reddish-brown and white-coloured species of marten is the smallest carnivore on earth. With a body length of just 15 to 20 centimetres, the least weasel or common weasel is scarcely bigger than its main prey, the field mouse (aka common vole). These nimble hunters eat up to five small rodents every day. However, since mice are often controlled through the use of poison in today's modern agriculture, their habitat has worsened in some places – with the result that the weasel is running out of food. This is not the case in the protected area near Plettenberg. Here, the weasels find a rich abundance of prey – and hiding places in burrows, rock crevices or under tree roots.

Least weasel

Least weasels are mainly diurnal. If you want to observe them, you need to keep still, because the animals have poor eyesight and mainly perceive movement.

Always in equilibrium

What do a tightrope walker and a grid operator have in common? They do everything to maintain their balance. In the electricity grid, generation and consumption must be kept in equilibrium at all times. This is where the flywheel of generators helps.

Text HEIMO FISCHER
Illustration LISA TEGTMEIER

An acrobat needs a great deal of practice to be able to walk a tightrope safely. A long balancing pole helps them to keep their balance. Our electricity grid also needs to be balanced to function properly: power generation and consumption must be in equilibrium at all times. When they are, the alternating current grid operates with a nominal frequency of 50 hertz. Plant and equipment installed in the network are set up to operate at this frequency, but are also able to function even if the frequency deviates slightly from this level. If deviations from the nominal frequency are more serious, disturbances can arise in the grid.

Transmission system operators have a range of measures at their disposal with which to balance out deviations. At Amprion, our System Operation and Control Centre in Brauweiler, near Cologne, carries out this important task by influencing the electricity feed-in and consumption levels. However, these measures take effect at different speeds. To balance out unforeseen deviations without delay, transmission system operators make use of a particular physical phenomenon: the inertia of heavy masses. This phenomenon can be observed when driving a car, when you take your foot off the accelerator: the vehicle initially continues to move at the same speed. In the generators of conventional power plants, rotors weighing several tonnes rotate at a speed that is synchronised with the grid frequency. If, for example, a power station somewhere in the grid fails, these flywheel masses continue to rotate and soften the drop in frequency. Experts speak of the “operating reserve”. In the case of the tightrope walker, it is the balancing pole whose mass initially counteracts unexpected fluctuations.

System without flywheel masses

By 2050, at least 80 per cent of electricity in Germany is to come from renewable energy sources. For many hours there will be no conventional power plants feeding into the grid. As a result, there will also be no flywheel masses in the system that stabilise the grid frequency. Staying with the analogy of the tightrope walker: the balancing rod gets shorter and shorter. Wind farms and photovoltaic installations, on which the power supply will in future be based, do not currently react immediately to deviations in frequency. The consequence of this: “In the event of major unexpected disturbances and fluctuations in the grid frequency, there is a real danger of the acrobat falling off the rope,” says Marvin Kaiser, Amprion expert on the behaviour of the power system.

This is why Amprion is working together with partners on new technical solutions. Such solutions could, for example, involve changing the behaviour of wind farms and photovoltaic installations so that they react immediately to frequency deviations. “We want to give the tightrope walker a long balancing pole again,” says Kaiser. “To keep the frequency in the power grid stable.”

transitioned

Text ALEXANDRA BRANDT
Portraits FRAUKE SCHUMANN

They have worked below ground, in the police force, in forestry – now they are driving the energy transition: employees with very different professional experience feel at home at Amprion and are helping the company move ahead.

“Until 2019, I was an electronics technician for industrial engineering, working underground. Following the demise of the hard-coal mining industry in Germany, I got a job at Amprion that offers good prospects for the future. The work in our substations fits my profile perfectly.”

ANDRE THIELBIER (32)
Electronics technician for industrial engineering, installs and maintains high-voltage switchgear.

“From the Criminal Investigation Department to a grid operator – for a business information systems specialist, this isn’t that big a move. As an IT investigator, success can only be found by being a team player. This experience is now helping me in my project work at Amprion.”

MARKUS MENZ (34)
Business information systems specialist, develops IT solutions for communications equipment at Amprion.

“As a former consultant for a nature and environmental protection organisation, I know from my own experience what interests environmental experts, public officials and conservationists. This appreciation of other people’s interests helps a great deal when communicating the arguments for and details of our grid expansion projects.”

CLAIRE TRANTER (45)
Landscape architect, manages grid expansion projects.

“Officers must act independently and take responsibility. That’s why my time with the Bundeswehr (German military) prepared me well for my new duties and responsibilities in corporate development. The fact that Amprion is currently growing extremely dynamically makes the work all the more exciting.”

CHRISTINA SCHUMACHER (32)
Industrial engineer and former IT officer,
is the contact at Amprion for ideas management.

“As a forestry scientist, I’m passionate about conservation. In my previous job with a government agency, the resources available for conservation measures were limited. At Amprion, I’m able to ecologically upgrade large areas of land – and give back to nature something of what we take from it elsewhere through our projects.”

CHRISTOPH TÖLLE (36)
Forestry scientist and landscape architect, plans and implements nature conservation compensatory measures.

Amprion connects …

millions of people and thousands of businesses in an area stretching from Lower Saxony down to the Alps. Our 1,800 employees make sure that the grid is operated safely and dependably at all times. And to ensure they can, we're expanding it in line with consumers' needs. And we're looking ahead, working today on solutions for the decarbonised energy world of the future.

So that the lights never go out.

11,000 KM

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

63 GW

the total installed generation capacity in the Amprion grid area.

29 M

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

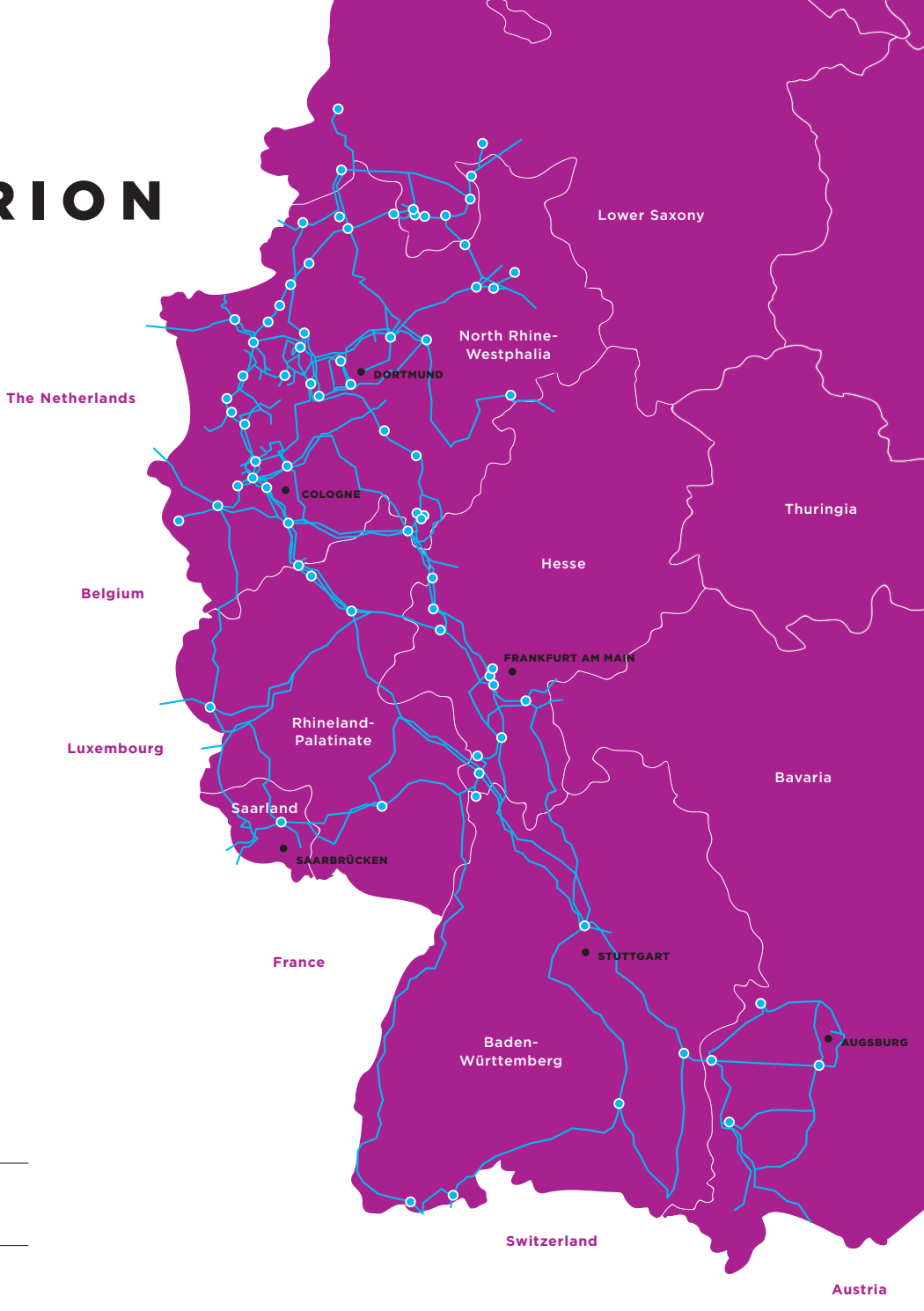
79,200 KM²

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

160

the number of substations that connect the Amprion grid to power utilities, regional distribution networks and our customers in industry.

THE AMPRION GRID



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