LEBENSADERN

THE AMPRION MAGAZINE | VOL. 02

amprion

We’re building the energy world of tomorrow

AMPRION – A BRIEF PROFILE

With its 11,000-kilometre-long extra-high-voltage grid, Amprion GmbH is an important transmission grid operator not only within Germany but in Europe, too. As an innovative service provider, Amprion offers industrial customers and grid partners alike maximum security of supply. Around 1,400 employees put their all into achieving this.

~63 GW

the total installed generation capacity in the Amprion grid area

79,200 KM²

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

11,000 KM

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

~29 M

the number of people supplied with electricity via the Amprion grid

160

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

Amprion – working to construct the energy world of tomorrow. With every new power line and every new transformer substation built, our transmission grid becomes stronger.

The energy world of tomorrow is increasingly dependent on wind and sun. While the share of electricity generated from renewable energy sources in Germany today is just under 40 per cent, it is expected to rise to 65 per cent by 2030 and as much as 80 per cent by 2050. This can only be achieved if we have a strong, stable and resilient transmission grid. It transmits wind and solar power to consumption centres in western and southern Germany. We are strengthening our transmission grid to enable it to handle these duties – and in doing so are helping to restructure our energy system in such a way that Germany will achieve its climate targets.

To make progress in grid expansion, we are upgrading power lines, erecting new pylons, installing underground cables and retrofitting transformer substations. Expansion of the grid is picking up speed. With every new power line and every new substation built, our transmission grid becomes stronger. For only a reliable transmission grid can guarantee the quality of life of the people in our country and economic stability.

At the same time, we're also thinking "European". After all, we're using our grid to transmit the electricity that is traded on the European electricity exchanges. In many areas, we are promoting the integration of Europe's internal energy market. If we want to make our own power system more sustainable, the European market also has to play its part.

In this journal, we report on where and how we are building the energy world of tomorrow. Join us on a journey through Germany and Europe!

We hope you enjoy reading it.

THOMAS WIEDE

Head of Corporate Communications and Digital Media at Amprion

Our power lines are the **lifelines** of our national economy. We're strengthening them so that the …

Without electricity, the "chemparks" of Leverkusen, Dormagen and Krefeld-Uerdingen would come to a complete halt. Around 70 companies with more than 48,000 employees generate one-third of North Rhine-Westphalia's chemicals output in these chemical parks. They are totally reliant on a secure and uninterrupted supply of power at a reasonable price. Chempark operator Currenta distributes electricity to the companies located on these sites. We at Amprion are proud that our transmission grid plays a big part in ensuring industrial locations in western Germany and beyond generate value added and secure jobs.


CURRENTA
CURRENTA

restructuring of the power system to make electricity generation low on emissions and to be sustainable succeeds. We see this restructuring …

In order to achieve its climate targets, Germany is relying on renewable energy sources. To enable wind and solar power to also find its way to the consumption centres in western and southern Germany, we are upgrading and expanding our transmission grid by order of the government. Power line construction projects comprising an overall length of 2,000 kilometres and the expansion and construction of many new substations are on our agenda. These include the corridor along the Rhine, sometimes called the “Rheinschiene”, one of the most important north-south links in Germany. Between Osterath, near Düsseldorf, and Weißenthurm, near Koblenz, we are building new 380-kilovolt lines that will in part replace older ones.

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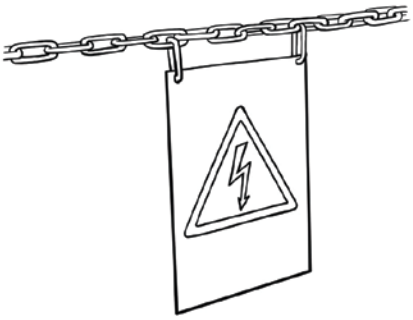
as a **joint effort:** only by working together will we …

Together, the energy transition and the necessary expansion of the power transmission grid amount to one of the biggest infrastructure projects ever undertaken in the history of the Federal Republic of Germany. But they are reliant on the acceptance of the general public. That is why it's important for us to strike up a dialogue with citizens, social groups and organisations, to pick up on their comments and to involve them in the planning process. In 2018, we held or participated in more than 560 separate events for precisely this purpose. In addition, we have further intensified collaboration with our customers and partners among the distribution network operators. That's because the energy world can only be transformed if we all work together to shape it.

make progress on the road to the **energy world of the future**.

Germany in 2030. Wind and solar energy will deliver 65 per cent of our electricity. At Amprion, we are preparing for this by making our transmission grid that stretches from Lower Saxony to the Alps fit for purpose. By connecting wind farms in the North Sea to our grid. By trialling technologies that make it possible to convert electricity from renewables into hydrogen on a large scale and make it storable. In this way, we are combining climate change mitigation with security of supply.



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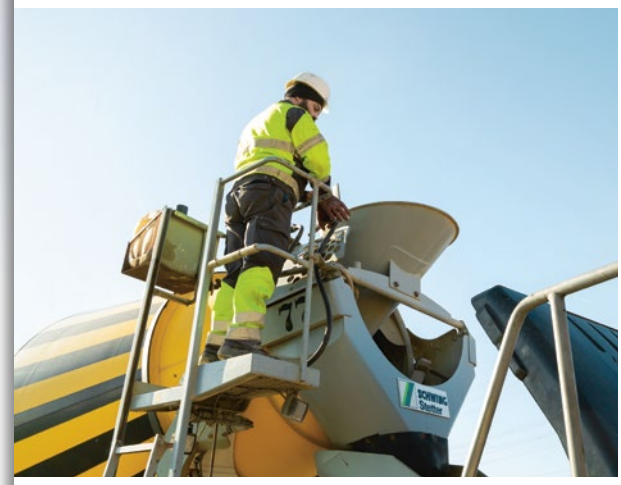

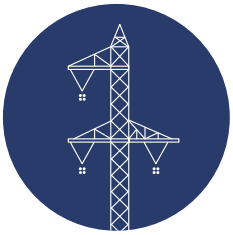

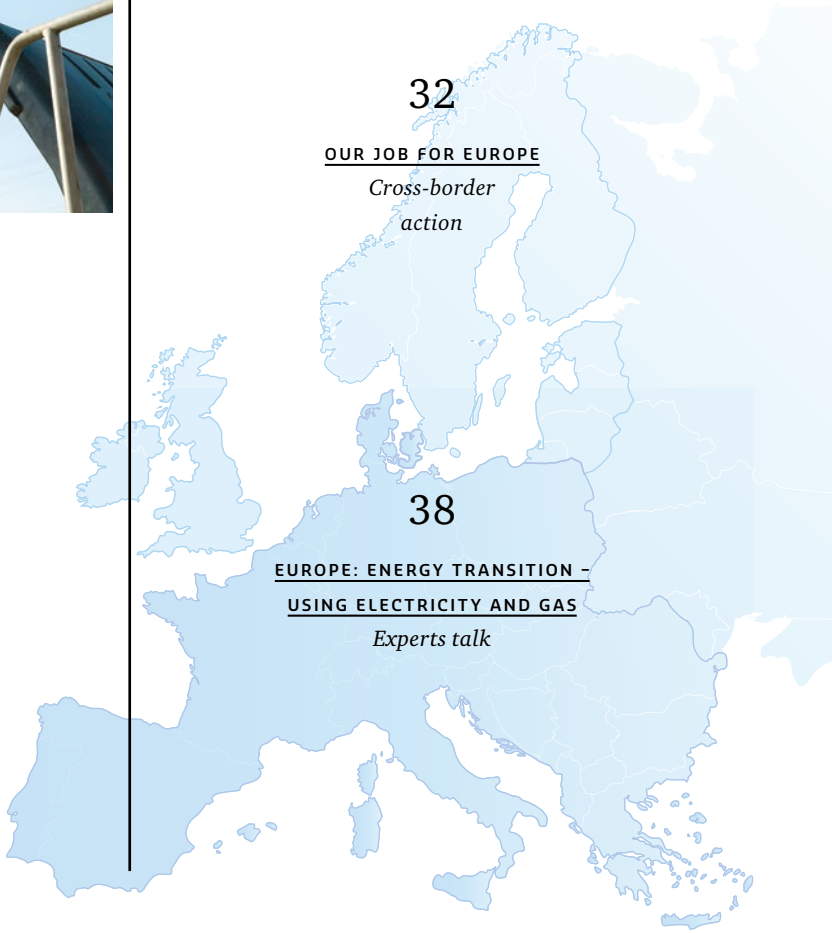

WWW

All articles in this journal and other exciting insights can be found online at amprion.net/gb2018

UNDER CONSTRUCTION

Grid expansion at Amprion is making progress. Right across our grid area, construction projects are moving along, power line sections are being completed and plants are going online. All this so that the transmission grid can transport more and more electricity from renewables to the consumption centres.

Text: Volker Göttsche Photos: Marcus Pietrek, Günther Bayerl

Amprion's grid expansion work is going through the gears. After lots of intensive planning, the entire grid area is now a hive of activity, with construction workers excavating, pouring concrete and bolting parts together everywhere you look. Lines and substations are being upgraded, cable trenches dug, new pylons erected. Along the "Rheinschiene" west of Cologne or in Aachen, in the Mannheim, Augsburg and Osnabrück regions and elsewhere – some 380 subprojects are underway. And Amprion has already completed more than 350 kilometres of lines.

"Our power lines are the lifelines of the national economy," explains Dr Hans-Jürgen Brick, Commercial Manager at Amprion.

According to the will of the legislators, they are to carry an ever-increasing volume of electricity, primarily from wind farms and photovoltaic (PV) installations, and transmit it to consumption centres in western and southern Germany. While the share of electricity generated from renewables in Germany today is just under 40 per cent, it is expected to rise to 65 per cent by 2030 and as much as 80 per cent by 2050. "To achieve this, we have to restructure the energy system," says Dr Klaus Kleinekorte, Managing Director and Chief Technical Officer at Amprion. "Grid expansion plays a key role in this – and we're making visible progress with it. With all of the challenges that still lie ahead." This is illustrated by the portraits of important projects depicted on the following pages.


North
Rhine-Westphalia
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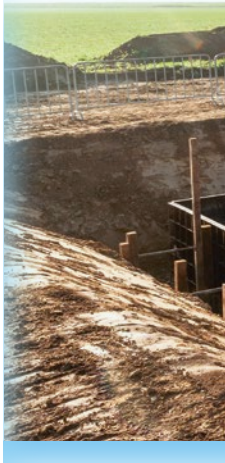
STRUCTION

"RHEINSCHIENE":
CONSTRUCTING A NEW AC LINK



1. »THE FIRST PYLON IS UP«

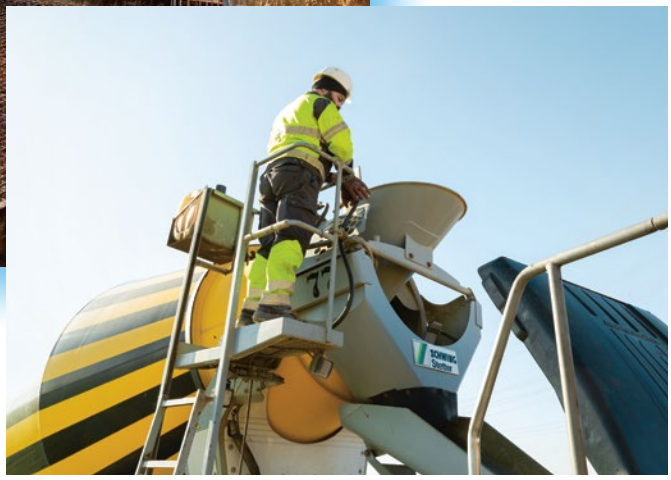
BY EXPANDING THE "RHEINSCHIENE", AMPRION IS UPGRADING ONE OF THE MAIN ARTERIES OF WESTERN GERMANY'S ELECTRICITY GRID.

The autumn sun is smiling this November day in 2018. In a field located east of Rommerskirchen, near Cologne, a truck-mounted crane is lifting the lower section of an electricity pylon onto the concrete slab in the ground. Thomas Hofmann, project manager at Amprion, has been working towards this moment since 2013. He's negotiated with landowners along the then still-planned power line route, consulted with experts about locations where the route crosses motorways, and commissioned construction companies. And now the time has come: "The first pylon is almost up," says Hofmann, visibly pleased.

It is the first of 29 new pylons that Hofmann will be erecting between Rommerskirchen and Gohrpunkt, ten kilometres to the north. This section belongs to the "Rheinschiene", one of the main arteries of western Germany's electricity grid. The Energy Grid Expansion Act (EnLAG) of 2009 stipulates that the lines between Osterath, near Düsseldorf, and Weißenthurm, near Koblenz, be upgraded. These new lines will be operated at a voltage level of 380 kilovolts (kV) and their main purpose is to transmit more wind power from the north to the consumption centres in the south.

South of Rommerskirchen, Hofmann's colleague Hermann Schneider is in charge of the construction work. His people are erecting 115 new pylons over a stretch of 38 kilometres, replacing mopre than 200 old pylons. In total, Amprion is responsible for expanding and constructing some 2,000 kilometres of power line, of which 350 kilometres have already been completed. Over the next decade, Amprion will be investing € 9.3 billion in implementation of the outstanding projects. "The wave is now picking up – and we're starting to ride it," says line construction engineer Schneider.

Milestone in the "Rheinschiene" grid expansion project: the first pylon foundation under construction.



Amprion is building a 380-kV AC line largely along the existing route between Osterath, near Düsseldorf, and Weißenthurm, near Koblenz (EnLAG Project No. 15). This measure will boost the capacity of one of the main arteries of western Germany's electricity grid.

LENGTH: 136 kilometres

TOTAL COST OF INVESTMENT: 340 million euros

STATUS: three sections under construction, three sections online

COMMISSIONING: of the line as a whole scheduled for 2020

LAW ON GRID EXPANSION

–

Energy Grid Expansion Act (EnLAG) 2009

22 projects
in total

13
projects
Amprion

1,800 km
in total

723 km
by Amprion

800 km
completed

289 km
by Amprion

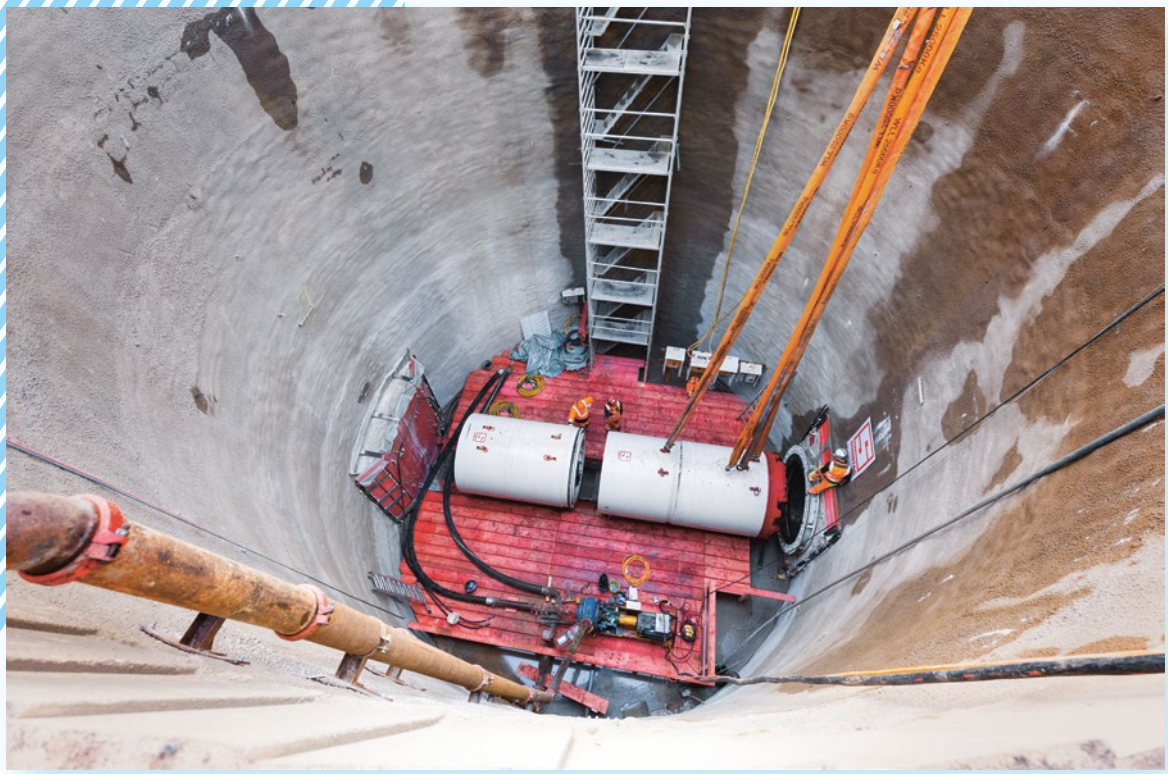
In cooperation with the Belgian grid operator Elia, Amprion is building a DC link known as the "Aachen Lüttich Electricity Grid Overlay" (ALEGrO). This link is being laid underground. It is listed as Project No. 30 in the Federal Requirements Plan Act (BBPIG). ALEGrO is the first direct power link to be built between Germany and Belgium, and is classified by the European Union as a "project of common interest" (PCI) urgently in need of implementation.

LENGTH: 90 kilometres in total,
40 kilometres on the German side

TOTAL COST OF INVESTMENT: 450 million euros in total, of which 321 million euros for Amprion

STATUS: under construction since October 2018

DATE OF COMMISSIONING: scheduled for 2020



The cables for the German-Belgian interconnector called "ALEGrO" run underground.

ALEGRO:
CONSTRUCTING A NEW DC LINK

2. SPEED DIGGING

AMPRION IS UTILISING MODERN TUNNELLING TECHNOLOGY IN THE CONSTRUCTION OF THE GERMAN-BELGIAN POWER BRIDGE "ALEGRO".

Car after car flash past on Germany's A44 motorway. Rainer Millinghaus has to shout to explain to the visitors to Amprion's construction site how the first tunnel for the cable of the "ALEGrO" underground DC link is being dug there. "We're using a special drill here in Aachen," says the subproject manager, pointing to a cigar-shaped machine stored next door that measures five metres long and has a drill head with a diameter of more than two metres. "It works on the same principle as a coffee grinder," he explains. "First of all it crushes the rock, then it mixes it with water to create a slurry, which is transported away by pipes."

The construction site is located on an industrial estate in the south of Aachen. On this day in October 2018, Amprion has invited guests from the worlds of politics and business to witness the ground-breaking ceremony for this grid expansion project. From 2020, this underground cable is to be the first link to directly connect the power grids of Germany and Belgium – a milestone for Europe's internal electricity market. In his welcoming address, North Rhine-Westphalia's Prime Minister Armin Laschet emphasises the importance of ALEGrO as a German-Belgian power bridge – and praises the "rapid pace of the planning and approval procedures".

And Rainer Millinghaus has played his part in this, too. Amprion hired the civil engineer in 2014 to break the ground for yet more underground cable projects. "In the meantime, our department has grown considerably", he says. "Amprion is capable of handling not only overhead lines, but underground cables, too."

LAMBSHEIM:
CONSTRUCTING A NEW SUBSTATION

3. DAY TRIP TO AMPRION

AMPRION BUILDS A NEW SUBSTATION IN LAMBSHEIM – AND THE LOCALS ARE EXTREMELY INTERESTED.

Why not visit a transformer substation? That's the question more than 400 people asked themselves one Saturday in May 2018 before turning up to an "Open Day" held by Amprion at its new substation in Lambsheim in Germany's Palatinate region. Not just because there was a bouncy castle for the kids, but also because employees like Christian Nöldemann were offering guided tours. "400 visitors – you don't often see that," says the project manager for switchgear construction looking back. What interested them most was how the new substation actually works.

This is an area in which Nöldemann is truly in his element. He was a member of the team that planned the 380-kV substation, obtained the necessary permits and managed the 18-month construction phase. This substation is now an additional important hub in the power grid, enhancing the security of supply in the region. "And it enables us to transmit wind power over the transmission grid." Background information: the state government of Rhineland-Palatinate aims to satisfy its entire electricity needs from renewables by 2030.

Nöldemann had already taken notice of the high level of interest in Amprion's activities by the locals in the spring of 2018 when a heavy-duty articulated truck with low-bed trailer transported a new transformer from Lambsheim railway station to the substation in the middle of the night. Residents lined the route and the local mayor served sandwiches. At this time, construction and repair work on the rail network had already delayed delivery of the transformer by nine months. "But we rearranged our plans accordingly," says Christian Nöldemann. In late summer 2018, the substation went online on schedule.

Lambsheim substation in the Palatinate: hub securing the region's power supply

Amprion has built a 380-kV transformer substation in Lambsheim. The new plant has become an important "assembly point" for wind energy and a hub securing the region's power supply.

TOTAL COST OF INVESTMENT: 48 million euros

STATUS: online since late summer 2018

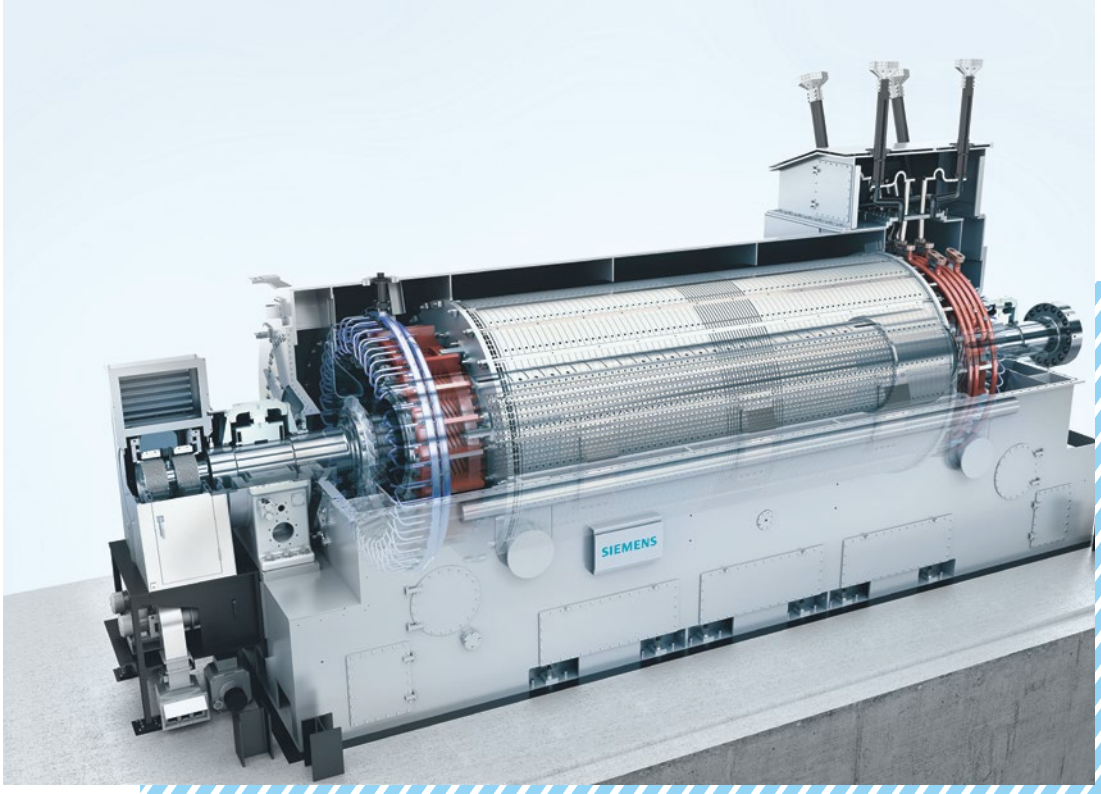
OBEROTTMARSHAUSEN:
UPGRADING A SUBSTATION

4. MAINTAINING THE TENSION!

AMPRION CONNECTS THE FIRST SYNCHRONOUS COMPENSATOR IN THE NEW TRANSFORMER SUBSTATION IN OBEROTTMARSHAUSEN TO ENABLE IT TO OPERATE THE POWER GRID STABLY AND SAFELY.

It is 13 metres long, 4.60 metres wide and 5.69 metres high, weighs 268 tonnes and is what experts call a "synchronous compensator" (aka "rotary phase shifter"). This piece of electrical wizardry has been in service at the 380-kV transformer substation in Oberottmarshausen, near Augsburg, since September 2018. "It ensures that we can keep our transmission grid operating stably and safely even as more and more conventional power plants are taken offline in the wake of the energy transition," says Stephan Wittner, subproject manager at Amprion. The generators of these power plants have until now helped keep the voltage level in the transmission grid constant. Now, innovative systems such as the synchronous compensator need to step in to stabilise the grid in the region of Bavarian Swabia.

They are being installed at important nodes of the electricity grid, such as the substation in Oberottmarshausen. This substation connects Amprion's transmission grid to the 110-kV distribution network of the regional grid operator LEW Verteilnetz GmbH (LVN). Built in 1962, it is the largest of its kind in the region. Since 2015, it has been undergoing modernisation work, because the EHV grid in Bavarian Swabia is to be converted to a 380-kV system over the next few years. "Converting a plant while it is up and running is in itself a great challenge," says overall project manager Jürgen Schuder. "But we did it – thanks to a great team effort." Amprion's employees and those of the companies who conducted the work identified with the project one hundred per cent.



A synchronous compensator provides greater grid stability in Bavarian Swabia.

Amprion converted the transformer substation in Oberottmarshausen to 380 kV and upgraded it by installing a synchronous compensator. This is intended to provide greater stability in the Bavarian Swabian electricity grid.

TOTAL COST OF INVESTMENT: 53 million euros

STATUS: online since September 2018

More than 11,000 tonnes of steel will be used to construct the new pylons on the Swabian Jura and in the Danube valley.

Amprion is building a 380-kV AC link along the existing route between Reutlingen and Herbertingen (BBPlG Project No. 24). This is designed to strengthen the regional power supply and increase transmission capacities on the 90-year-old north-south route.

LENGTH: 61 kilometres

TOTAL COST OF INVESTMENT: 112 million euros

STATUS: under construction since November 2018

DATE OF COMMISSIONING: scheduled for 2020

LAW ON GRID EXPANSION

Federal Requirements Plan (BBPlG) 2009

43 projects *in total*

10 projects *Amprion*

5,900 km *in total*

1,074 km *by Amprion*

150 km *completed*

79 km *by Amprion*

SWABIA:
CONSTRUCTING A NEW AC LINK

5. MORE ENERGY FOR BADEN-WÜRTTEMBERG

ON WHAT IS CURRENTLY THE LARGEST CONSTRUCTION SITE BETWEEN REUTLINGEN AND HERBERTINGEN, AMPRION IS USING MORE STEEL THAN WAS NEEDED TO BUILD THE EIFFEL TOWER IN PARIS.

The scale of the project is enormous: by 2020, Amprion will have used more than 11,000 tonnes of steel on its power line construction site between Reutlingen and Herbertingen in Baden-Württemberg. By way of comparison: the Eiffel Tower in Paris features 7,300 tonnes of steel. “We are also using thousands of tonnes of concrete on foundations and around 1,500 kilometres of aluminium conductor cable,” calculates project manager Klaus Ludwig. These quantities are needed to erect 181 new electricity pylons along the 61-kilometre route and to install more capable and efficient lines.

On this particular day in January 2019, fitters are busy assembling the first pylon sections in a field near Zwiefalten, ready to position one on top of the other later. Elsewhere, more fitters are dismantling 216 older pylons. Many belong to the very first supra-regional high-voltage line that was built between 1924 and 1928 to connect the power stations in the Rhenish coal-mining area with the pumped storage power plants in the Alps. “Today, it’s all about exchanging wind and solar power between north and south via the grid,” says Ludwig.

Four pylons dating from 1928 are to be preserved as industrial monuments at the request of the State Office for the Preservation of Monuments, Historic Buildings and Cultural Heritage to commemorate the historical significance of this section of power line and a pioneering achievement in Germany’s transmission grid, which Amprion still sees as an incentive for its own activities today. “We, too,” says project manager Ludwig, “are pushing ahead with the restructuring of the power system to ensure that the energy transition is a great success.”

A PYLON FOR ALL SEASONS

When Amprion erects new pylons, it's not absolutely essential to take the line in question out of service. Thanks to what are known as "temporary loading arrangements", expansion of the grid progresses without putting the grid under any additional load.

Text: Meike Pedack

Just suppose an important motorway is closed completely for a period of weeks for construction work – a horrible thought for commuters and traffic planners alike. How do you divert the traffic? Can nearby motorways take up the extra load? Or is there a real threat of massive traffic jams that bring the entire region to a standstill?

Grid planners at Amprion have similar worries when they think about the extent of grid expansion essential in the wake of the energy revolution. Hundreds of pylons along vital transmission routes have to and will be renewed in the coming years. Shutting down these lines during the construction work would lead to real bottlenecks in the already heavily loaded power grid. Amprion therefore intends to use "temporary loading arrangements" at sensitive construction sites within the grid: mobile pylons that make it possible to run the power lines around the construction sites, like a temporary bypass.

Like between Kruckel, near Dortmund, and Dauersberg in the Rhineland-Palatinate. This power line is part of an important north-south link that will in future increasingly transport wind power from the north to the consumption centres in the south. Starting in 2021, a 126-kilometre stretch of the existing overhead line is to be upgraded in order to transmit electricity in the future at a voltage of 380 instead of 220 kilovolts. This will significantly increase the transmission capacity of the line. During the planning phase, it quickly became clear that the power line will have to remain in operation during this upgrade work.

Temporary load arrangements are a flexible and practical solution to this problem. This is because the mobile pylons are erected right next to the existing pylons and take over their conductor cables for a limited period. They follow a modular principle and can be adapted to any application. This was a crucial design feature Amprion paid special attention to when its technicians collaborated with external engineering consultants to develop this new type of pylon. The new temporary load arrangements have been undergoing trials since 2018, and 2021 will see the commencement of large-scale deployment between Kruckel and Dauersberg – with more than 100 mobile pylons being installed.

AMPRION'S TEMPORARY LOAD ARRANGEMENT

for greater flexibility in power line construction

Thanks to its modular design, the pylon can be configured for any application. The number, width and arrangement of the "pylon arms" – two beams on either side make up a "cross-arm" – can be configured individually.

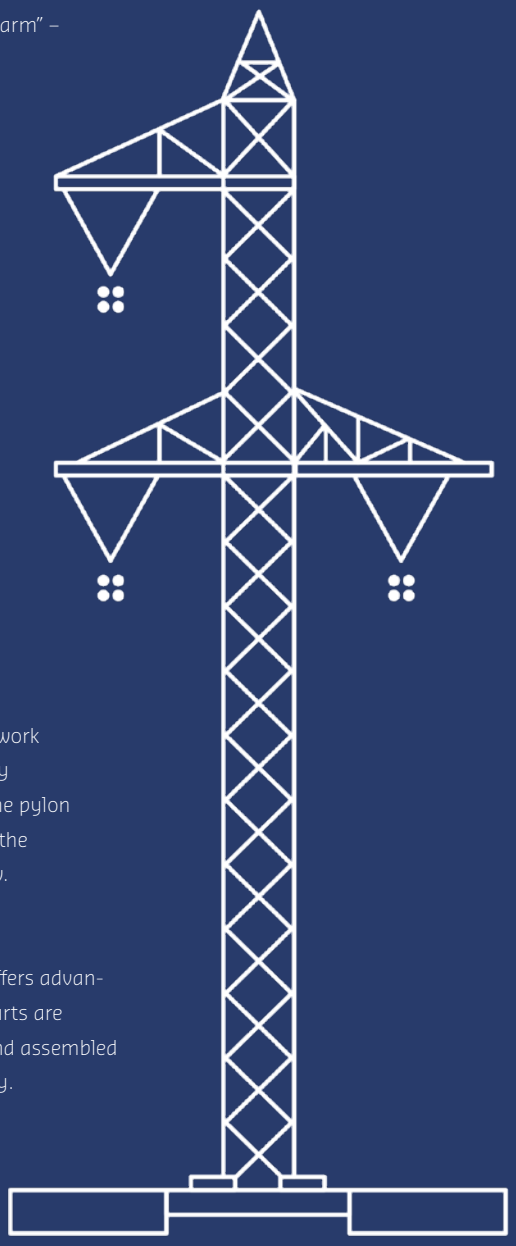
The number of conductors carried by the pylon can also vary. Depending on requirements, the pylon can carry up to two circuits. Each circuit consists of three phases with up to four individual cables each.

The modular system shortens assembly and disassembly times: pre-assembled elements are kept in store ready to be called up. This enables the mast to be erected within two days.

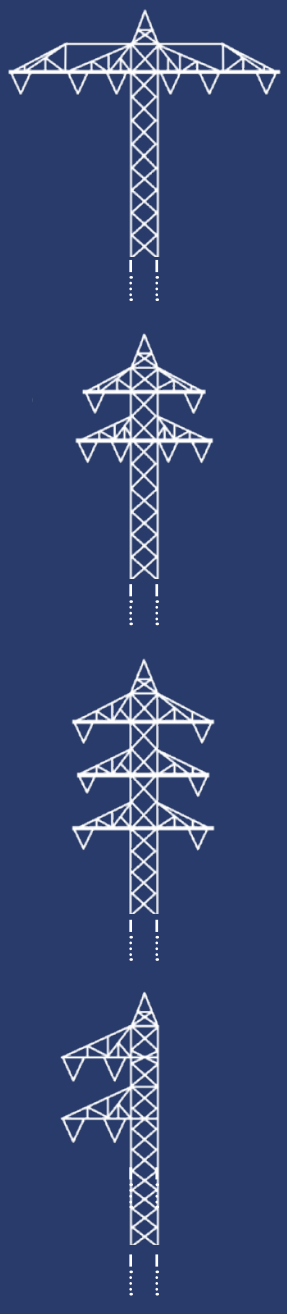
As a rule, only minor civil engineering work is required when erecting the temporary pylon. Due to the fact that the foot of the pylon is weighted down with concrete blocks, the impact on the ground is particularly low.

The modular design of the pylon also offers advantages during transport: the separate parts are delivered to the installation locations and assembled using commercially available machinery.

At the end of the project, the pylon is dismantled just as quickly as it was erected and leaves no lasting traces where it stood.



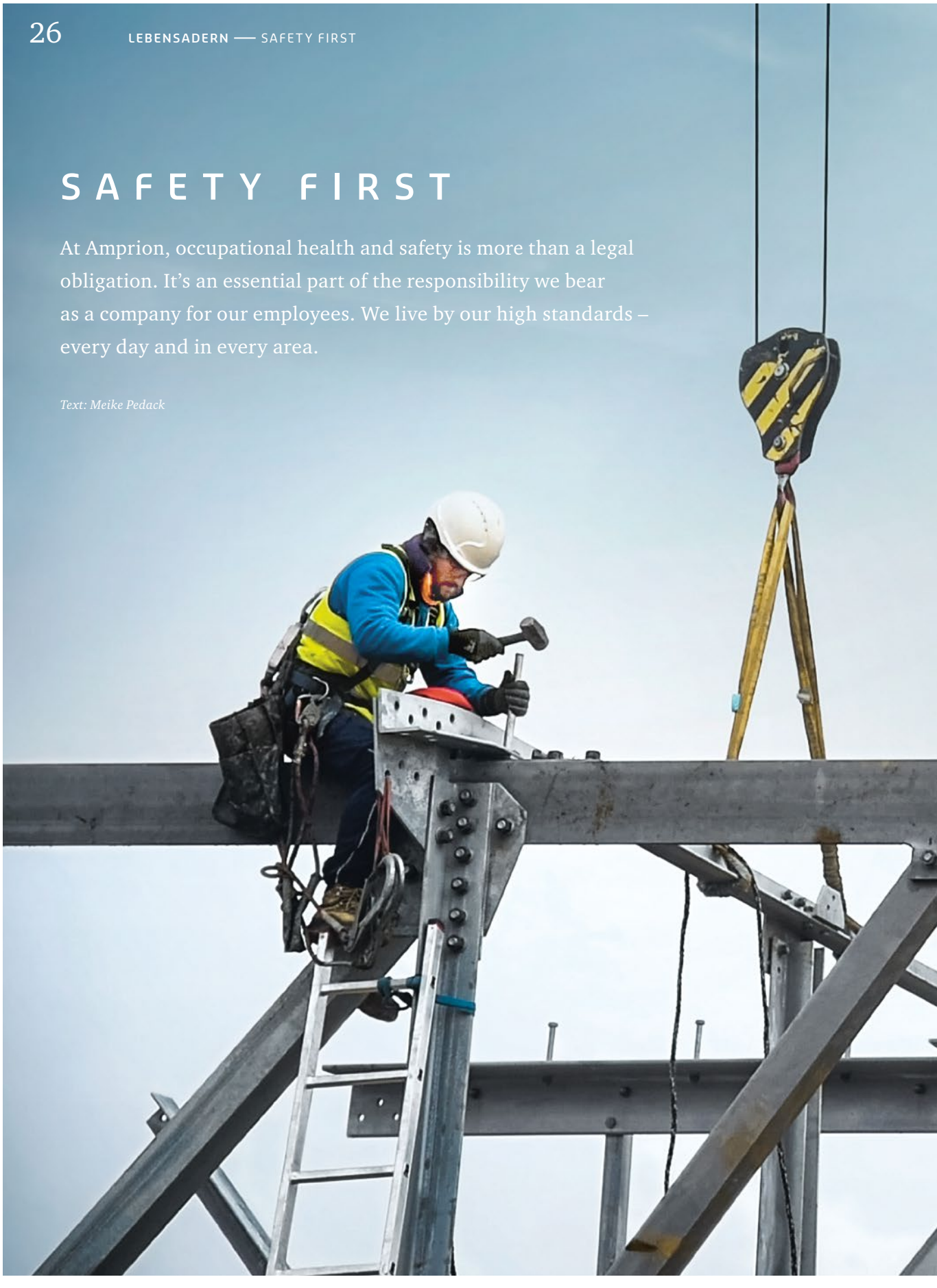
Possible configurations:



SAFETY FIRST

At Amprion, occupational health and safety is more than a legal obligation. It's an essential part of the responsibility we bear as a company for our employees. We live by our high standards – every day and in every area.

Text: Meike Pedack



HEALTH AND SAFETY
AT AMPRION

SAFETY

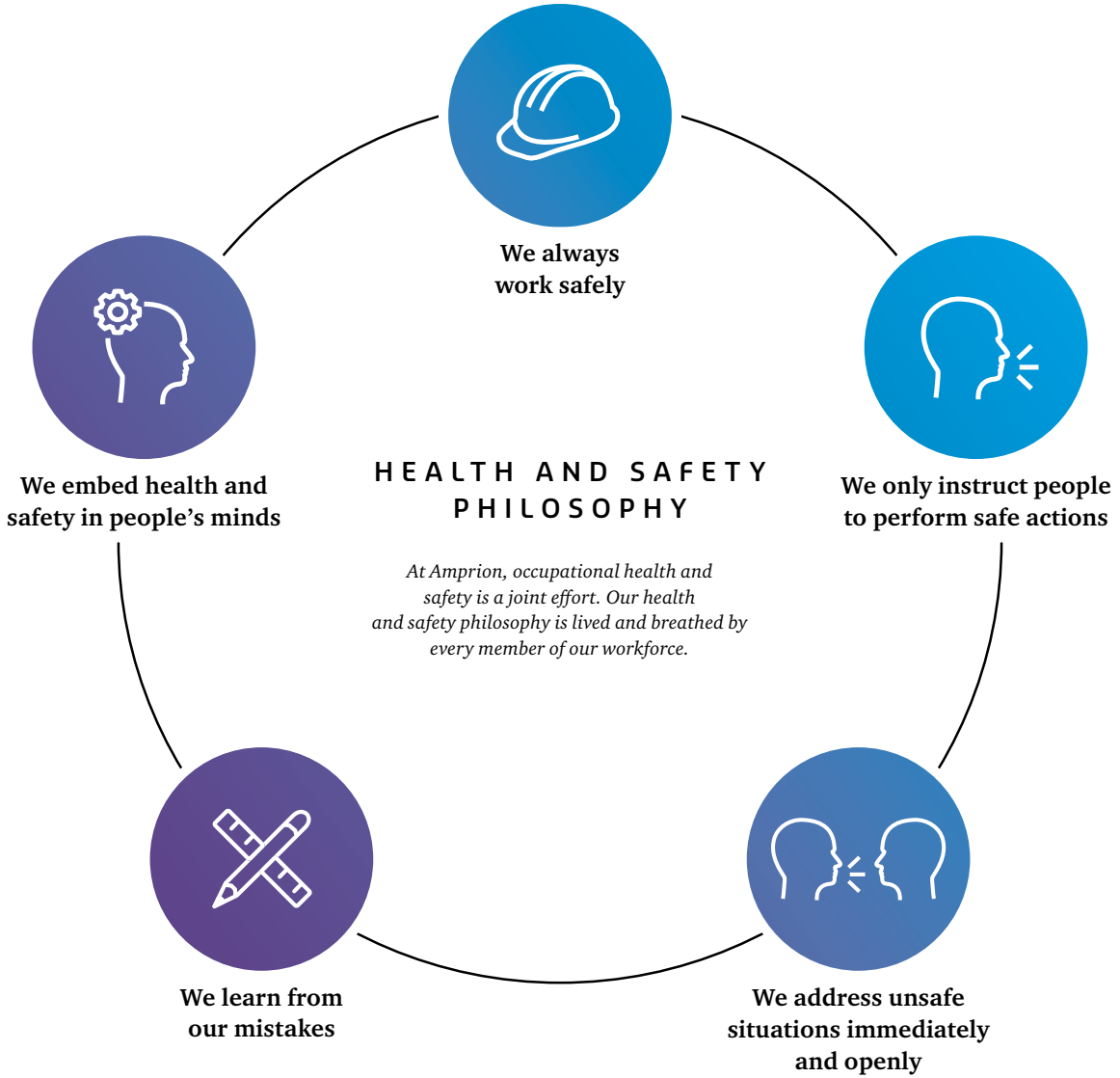
amprion

HEALTH AND SAFETY
AT AMPRION

SAFETY

amprion

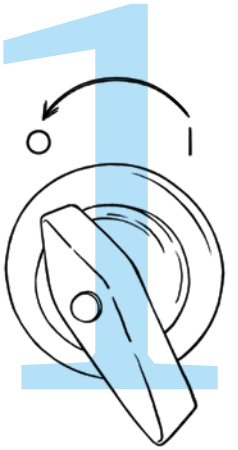
Handling extra-high voltages and current ratings is part and parcel of our working life. That's why we at Amprion have a common goal: everyone who works for us is to go home as healthy as they came. The basis on which we aim to fulfil this goal are our occupational health and safety philosophy and the five golden safety rules.


We always work safely
We only instruct people to perform safe actions
We address unsafe situations immediately and openly
We learn from our mistakes
We embed health and safety in people's minds
HEALTH AND SAFETY PHILOSOPHY
At Amprion, occupational health and safety is a joint effort. Our health and safety philosophy is lived and breathed by every member of our workforce.

5 GOLDEN SAFETY RULES

Our grid transmits electricity with a voltage of up to 380,000 volts. Working in this potentially dangerous environment requires great care and specialist knowledge. And the five golden safety rules of electrical engineering always form the basis of all actions. We give our employees intensive training in how to implement these rules in the best possible way every day of their working life. This is the only way we can guarantee the health of our employees and the functionality of our grid in equal measure.

1. DISCONNECT FROM THE MAINS

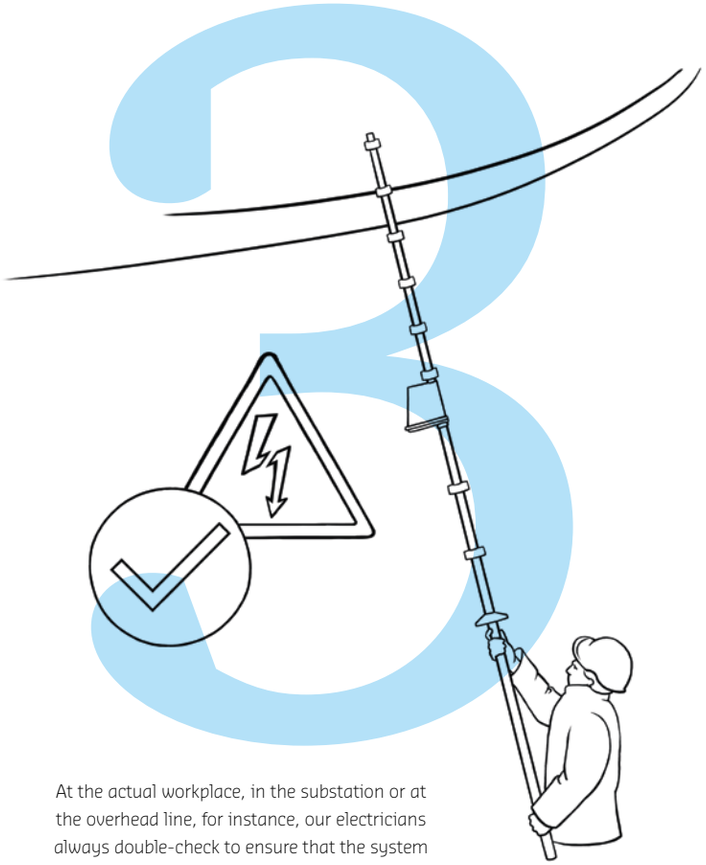


Whenever we work on our grid, no electricity must be allowed to flow through the equipment we are working on. To this end, the respective line or system must be dead, i.e. de-energised. Our experts call this "disconnecting". The starting point is our System Operation and Control Centre in Brauweiler, which "diverts" the electricity flow via remote control and disconnects the line. In addition, specially trained staff in our stations can perform this switching procedure on-site, too.

2. SECURE AGAINST RECONNECTION

We play it safe and prevent the system from being switched on again by mistake. This is documented by our system operation and control staff who make an entry to this effect in the control system. In addition, the colleagues on-site carry out interlocking measures and affix prohibition signs on all possible switching devices in order to prevent them from being switched on again.

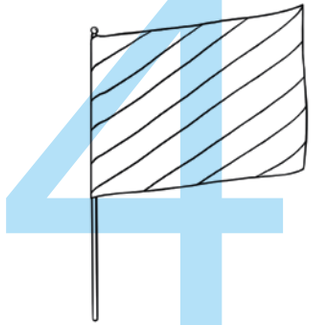
3. VERIFY THE SYSTEM IS DEAD



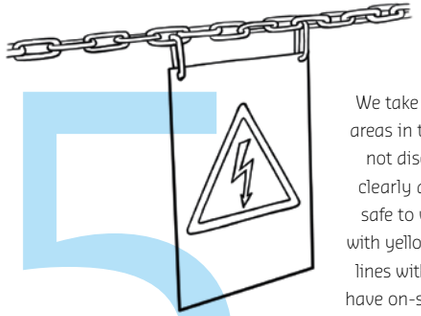
At the actual workplace, in the substation or at the overhead line, for instance, our electricians always double-check to ensure that the system is dead. They do this using a high-voltage tester, which is itself tested immediately before and after carrying out this check.

4. CARRY OUT EARTHING AND SHORT-CIRCUITING

Our equipment is not considered completely dead, or de-energised, until we have earthed and short-circuited it. This is done by staff immediately at the workplace, who also make sure that the earthing and short-circuiting device is clearly visible.



5. PROVIDE PROTECTION FROM ADJACENT LIVE PARTS

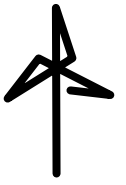


We take special precautionary measures for areas in the vicinity of the workplace that are not disconnected. Our employees always clearly and visibly mark the areas that are safe to work in: in transformer substations with yellow-and-black chains and on overhead lines with green flags. In addition, we always have on-site a person in charge, who keeps an eye on the work. Because it's better to be safe than sorry.

THREE GOOD REASONS FOR POWER-TO-GAS

Amprion and Open Grid Europe (OGE) are forging ahead with power-to-gas technology. hybridge – the first large-scale power-to-gas (PtG) plant in Germany – can be fit for service by 2023. An electrolyser with a capacity of 100 megawatts is to convert green electricity into green hydrogen, which will then be transported directly to users via its own pipeline. Why is this so important for the energy revolution?

Text: Alexandra Brandt



The energy system is becoming more flexible

Energy generation in Germany is becoming greener and greener and therefore more climate-friendly. The German government has set itself and above all the electricity industry an ambitious target: the share of renewables in Germany's electricity production is to reach 65 per cent by 2030. As a result, power generation will be increasingly weather-dependent and volatile. The downside of this is that green electricity is not necessarily available when it is needed. On 11 January 2018, for example, wind and sun delivered just one per cent – yes, 1 per cent – of the electricity required across Germany. However, when the weather gods smile down on us, it's a completely different ballpark: take 1 May 2018, when during a one-hour period renewables provided 100 % of the nation's electricity demand. Situations like these will be more frequent in the future. That's because by 2030, wind energy and photovoltaic plants will provide up to 133 gigawatts of power throughout the land. However, the actual load – the level of consumption – is probably no more than "just" 92 gigawatts, and often considerably lower than that. How can such large volumes of wind and solar power be put to use in future if they are at times unable to find direct customers? This is where power-to-gas plants, which convert green electricity into hydrogen and make it available to other sectors, could step in.

Spreading climate action to other sectors

The European Union has an ambitious climate goal: by 2030, it wants its member states to reduce their greenhouse gas emissions by 40 per cent compared to 1990 levels. How can this goal be achieved? This target can only be achieved if all value chains that make up the national economy – from raw material extraction to industrial production and mobility – are included. As a versatile raw material in the chemical industry and the mobility sector, hydrogen will play an important role in this. It can be obtained from water by electrolysis. If green electricity is used for this conversion process, the process is carbon-neutral. As a result, power-to-gas plants contribute to reducing the carbon footprint of the entire economy. If this technology is to be available on an industrial scale for the second stage of the energy revolution, we need to develop and field-test a sufficient number of high-capacity plants right now. The hybridge pilot project aims to make a decisive contribution to precisely this. From 2023, Amprion and OGE want to test this system under real-world conditions, as part of the grid infrastructure. This is an important step for the energy transition and for European and global action against climate change.

Gas and electricity systems converging

In principle, electricity from renewable energy sources can be transmitted via the transmission grid. However, the grid operators often have to carry it over long distances from the sunny and windy regions to where its consumers are located: on average a distance of 240 kilometres. Since Germany's transmission grid was not originally designed for this purpose, it needs to be strengthened and expanded at a whole host of points. Amprion alone will implement projects totalling an overall length of some 2,000 kilometres between now and 2030. How does the transmission grid need to be expanded and upgraded if the share of renewables is to rise above 65 per cent? The key lies in the optimally coordinated utilisation of existing transport routes for both electricity and gas. In this way, the storage capacity inherent to the gas infrastructure can be utilised and, over time, help to uncouple production and consumption. The "sector transformer" known as "hybridge" can transform electrical energy into storable energy in the form of hydrogen and in doing so can help other sectors cut carbon emissions. This is made possible by intelligently controlled and suitably dimensioned power-to-gas systems that supplement the electricity transmission grid at appropriate locations. Such a hydrogen infrastructure can be created by reallocating some of today's natural gas pipelines in a targeted manner.

THREE QUESTIONS FOR

Dr Klaus Kleinekorte (Amprion) and Dr Thomas Hüwener (Open Grid Europe)

Why are your two companies driving the hybridge project forward?

Dr Klaus Kleinekorte: On the one hand, because – and this should go without saying – we are true believers in the efficacy and utility of power-to-gas technology and its pertinence to the success of the energy revolution. And on the other hand, because we need this technology to counter the volatility of renewables and make them systemcompatible. It won't be long before we are at certain times generating more electricity from renewables than we can actually deploy directly to power electrical machinery, equipment and appliances. But we want to utilise every single kilo-watt-hour generated from renewable sources in a way that makes total economic sense.

Dr Thomas Hüwener: And this is what power-to-gas systems can give us as long as they offer the right level of capacity, are located in the right places and are used intelligently. Amprion and OGE are already responsible for controlling the energy flows via their respective routes and for maintaining stable operation of their electricity and gas systems. Deploying power-to-gas plants as interconnectors between the worlds of electricity and gas is therefore the logical route to go down as we upgrade our present infrastructures.

How far along is hybridge?

T. H.: We have the technology, we have a suitable location and we know many different and useful applications for hydrogen. The investment proposals have been submitted to the Federal Network Agency. So as soon as we get the necessary construction permit for our plant, we can start building it. If the course is set now, the plant can be put into operation as early as 2023.

You want to build the plant in the Lingen area. Why there?

K. K. : In southern Emsland (a district which borders North Rhine-Westphalia in the south and the Netherlands in the west), Amprion's EHV lines intersect with a suitable gas transport line owned by OGE, which can be converted to carry hydrogen. In addition, all potential applications of the hydrogen we convert can also be tested there.

T. H.: We can reallocate a 50-kilometre-long gas pipeline for exclusive transport of hydrogen and use this to supply hydrogen applications in the region. In addition, we want to trial admixing small volumes of hydrogen to the conventional natural gas network and gather experience with methanisation. Going forwards, we could utilise existing gas storage facilities and extend the hydrogen pipeline to the Ruhr region to develop and exploit yet more applications.

DR KLAUS KLEINEKORTE

Chief Technical Officer at Amprion GmbH

DR THOMAS HÜWENER

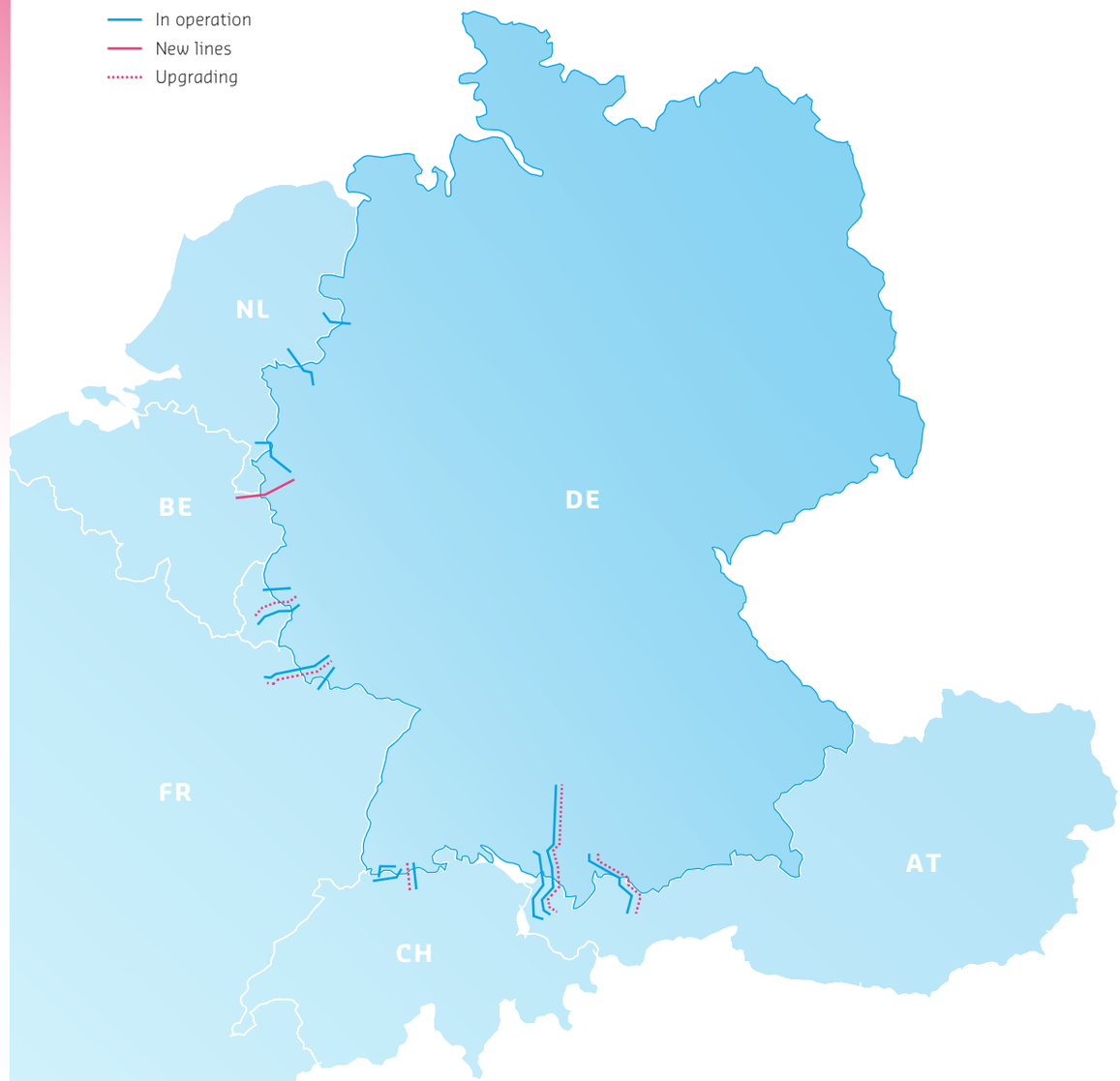
Chief Technical Officer at Open Grid Europe GmbH

Amprion makes the
interconnected
European network safer
and more efficient

Our responsibility extends beyond Germany's borders: we connect Europe by expanding our transmission grid to neighbouring countries. We help to operate Europe's interconnected grid safely and efficiently. And we are working with partners to further develop Europe's internal electricity market.

INTERCONNECTORS

Amprion connects electricity markets across borders



Europe is seeing convergence in the energy sector, too. Amprion is building cross-border lines, known as "interconnectors", to connect our power grid more closely with those of our European neighbours. A new power bridge linking Wesel and Doetinchem in the Netherlands went into operation in 2018. Interconnectors such as this one are intended to make the grids safer and electricity cheaper across Europe as a whole. If, for instance, a power plant in Germany has to be disconnected from the grid unscheduled, others power utilities in Europe can supply the necessary electricity via interconnectors. What's more, this internationally available power can be transported right across Europe via the cross-border connections.

Amprion is particularly committed to making the transmission of electricity around Europe efficient. The staff at the System Operation and Control Centre in Brauweiler coordinate the electricity flows between the national grids in the northern section of Europe's extra-high-voltage grid.

Text: Volker Göttsche

The power supply industry in Europe has changed massively over the past 25 years. Step by step, the national electricity grids are developing into a close-meshed interconnected grid that transports electricity generated in power plants and traded on exchanges across Europe. To this end, Amprion makes its own transmission grid available as a physical platform. In order to be in a position to coordinate this exchange of energy effectively, Amprion has an indirect stake in the European Power Exchange EPEX SPOT **(1)** in Paris and also in the "Joint Allocation Office" **(2)** in Luxembourg, an auction platform that offers long-term transmission capacities for trading. In addition, the company ensures that this combined system of electricity trading and interconnected grids functions efficiently. The staff members at Amprion's System Operation and Control Centre in Brauweiler handle this and coordinate the electricity flows between national grids in the northern section of Europe's extra-high-voltage grid. This "northern block" stretches from the Netherlands in the north-west to Romania in the south-east of Europe.

Europe's power supply industry is facing major challenges: more and more electricity is coming from renewable energy sources whose feed-in varies greatly depending on the time of day and the weather. In addition, the volumes of electricity being traded on the exchanges and exchanged across national borders are rising. This makes system operation and control an increasingly demanding task. "As staunch Europeans, we want to make the interconnected grid even more capable and efficient and further develop Europe's internal electricity market," says Joachim Vanzetta, System Operation and Control Manager at Amprion. This is being done, for example, under the umbrella of the European Network of Transmission System Operators for Electricity (ENTSO-E; see text opposite) or the international symposium on the development of extra-high-voltage grids in Paris.

Amprion's task is and remains to operate its own grid safely and stably. To achieve this, we have to keep a close eye on the grids of our European neighbours, too. The corresponding "monitoring area" includes, among others, the Benelux countries, parts of the French grid, Switzerland and northern Italy. Amprion's system operation and control staff identify critical grid situations early on and can react to impending bottlenecks by coordinating with colleagues across borders. This is facilitated by international partnerships. The Munich-based "TSO Security Cooperation" **(3)**, founded and operated by 12 European grid operators, provides cross-border analysis of grid situations and calculates transmission capacities available for trading – to make sure electricity is always delivered to where it's needed, right across Europe.

Brauweiler

1 2 3

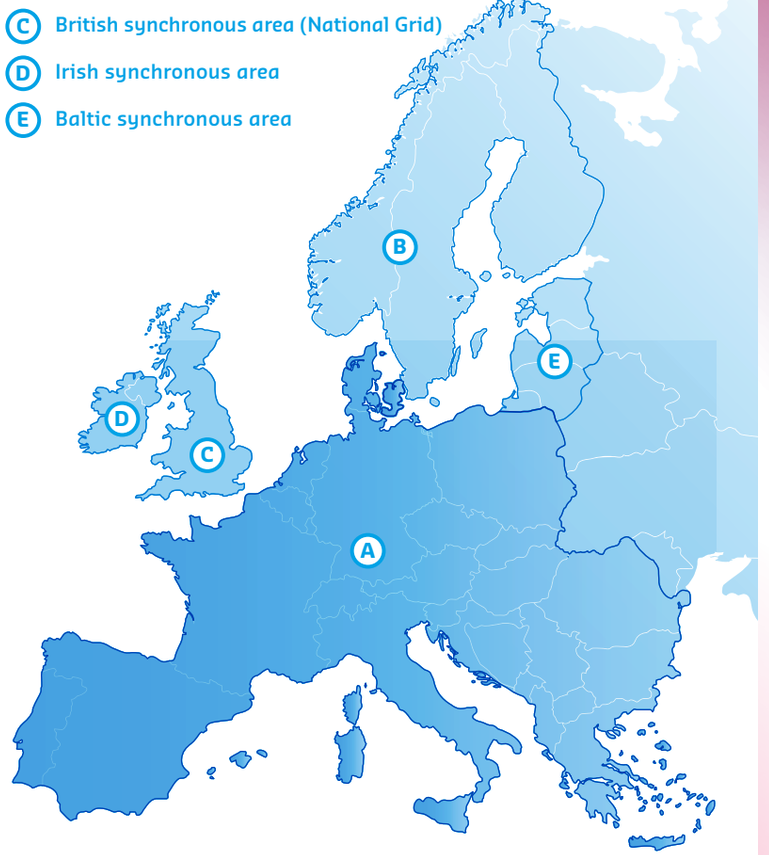
Area of Amprion's grid
ENTSO-E NORTH
ENTSO-E SOUTH
Amprion's monitoring area
Border between northern and southern blocks

ENTSO-E

Amprion continues to develop Europe's power grid

As a member of the European Network of Transmission System Operators for Electricity (ENTSO-E), Amprion is working to make Europe's interconnected grid more capable and efficient. ENTSO-E represents 42 transmission system operators (TSOs) from 34 countries. These embrace five synchronous areas that are interconnected by a direct current (DC) grid. The largest of these is the synchronous grid of continental Europe, also known as the Continental Synchronous Area (formerly the UCTE grid), which includes Amprion's grid. Its members define rules that regulate grid operation and the electricity market, set safety standards and regularly publish ten-year plans for grid development. The latter reveal which new power links will be needed across Europe in the future.

- **A Continental synchronous area**
- **B Northern European synchronous area**
- **C British synchronous area (National Grid)**
- **D Irish synchronous area**
- **E Baltic synchronous area**



EUROPE: ENERGY TRANSITION – USING ELECTRICITY AND GAS

Interview: Volker Göttsche

Photos: Hartmut Nägele

Prof. Dr Klaus-Dieter Borchardt, Deputy Director General of the EU Commission's Directorate-General for Energy, and Amprion's Managing Director, Dr Klaus Kleinekorte, discuss progress towards a low-carbon economy and the opportunities of sector coupling.

Prof. Dr Klaus-Dieter Borchardt, Deputy Director General of the Directorate-General for Energy of the EU Commission

As part of its efforts to check climate change, Europe is investing in renewables to generate the power we all desperately need. Will the energy transition succeed?

PROF. DR KLAUS-DIETER BORCHARDT: In December 2018, the European Commission, Council and Parliament agreed on new rules for the EU electricity market. This package of measures entitled "Clean Energy for All Europeans" will see us take a huge step towards a European energy revolution.

Dr Klaus Kleinekorte,
Managing Director and CTO at Amprion

»The world is looking to Europe to see how we can achieve a low-carbon economy by 2050.«

PROF. DR KLAUS-DIETER BORCHARDT

It may sound a bit melodramatic, but the world is looking to Europe to see how, step by step, we can achieve a low-carbon economy by 2050. And we can actually do it!

DR KLAUS KLEINEKORTE: It is all about increasingly integrating wind and solar energy – which, since they are dependent on the weather, fluctuate greatly – into the energy system, but also into the electricity market. By going down this route, Europe is opening the next chapter in the energy transition process. We all want to decarbonise our economies, that is, change the way we generate energy so that we release less carbon dioxide into the atmosphere. To this end, Europe's politicians must set up incentives. No single nation can do this alone – it requires the wider community. For instance, if we want to make electricity consumption across Europe more flexible in order to adapt it to the fluctuating feed-in of renewables.

K.-D. B.: I agree. We can no longer manage the essential restructuring of the energy system at the national level. I'm convinced of that. We need an integrated electricity market in Europe. It can only work if we have an integrated power grid whose lines transmit more electricity across national borders than is currently the case. Such cross-border lines – industry experts refer to them as "interconnectors" – must be prioritised as we work to expand the grid, because they facilitate electricity trading within Europe. It will help us to better balance out fluctuations in electricity generation that result from the massive expansion of renewables.

In the discussions on reform of the EU's electricity market, there was a certain degree of disagreement between the EU Commission and Germany's transmission system operators with respect to interconnectors.

K.-D. B.: The question in dispute was with regard to how much interconnector capacity the transmission system operators should make available for cross-border trading. The more trade we make possible, the better. I still see a lot of room for improvement there – as do the EU Commission, Parliament and the Council: they have decided to lay down clear legal requirements on this account as of 2025.

K. K.: The problem is this: interconnector capacities are kept open for electricity trading even when the transmission grid is not actually in a position to provide the relevant capacities owing to reasons of physics. We're talking here about a virtual capacity that can only be guaranteed by means of massive redispatch. The level of outlay for this would cost us, and therefore German electricity consumers, a great deal of money.

K.-D. B.: In future, the following principle will apply in Europe: anyone who creates problems for cross-border trading must also bear the cost of eliminating them. Granted, as things stand today, it would cost the transmission system operators in Germany a lot of money to assume the obligations as currently laid down. But this will give us incentives to speed up grid expansion over the next few years and to eliminate bottlenecks in the grid. That's badly needed. If I look at Germany today, my head spins. The sluggish rate at which Germany's grid is being expanded is a huge problem for Europe, because Germany is a major conduit for electricity flows. Something has to happen – and something is happening now. If you expand the transmission network in Germany by 2025 as planned, you will have the major cost items under control. I therefore believe that both politicians and transmission system operators can live quite well with the new rules.

Germany is phasing out nuclear power, and possibly coal, too. What impact will this have on the power grid?

K. K.: In Germany, our source of reliable, stable power feed-in will gradually diminish and then disappear. I expect a similar development in the neighbouring countries to the west of us. Belgium will be shutting down its nuclear power plants in 2025, while France and Switzerland also face similar decisions. All of us will suffer gaping black holes in our capacity to generate electricity. I'm deeply worried about this scenario: without a sufficiently reliable supply of energy to the system, we cannot operate the grid stably. The risk of disruptions is growing right across Europe.

K.-D. B.: I share these worries. These are challenges that we also see.

What form of solution would be necessary to ensure the security of supply?

K.-D. B.: Above all, such a solution must give the European energy system a second leg to stand on: we need to exploit the potential of gas! In my opinion, gas is of crucial importance as a stabilising factor in Europe's future energy system.

»Power-to-gas will enable us to extend the reach of renewables to other sectors, too.«

DR KLAUS KLEINEKORTE

K. K.: There's not a lot of daylight between us here. Take the "hybridge" project, for example, in which Amprion is working intensively on the question of how the electricity and gas systems can best be coupled together. Power-to-gas plants act as a bridge between these two sectors. They enable electricity to be converted to hydrogen. And this should also be seen against the background that industry, households and the transport sector consume far more gas than electricity. The heating sector alone is 56 per cent gas-based. Power-to-gas technology will enable us to extend the reach of renewables to these sectors, too. Together with the gas TSO Open Grid Europe (OGE), Amprion intends to trial this technology on an industrial scale.

K.-D. B.: I would very much like to pay Amprion and OGE a huge compliment, not only for thinking along these lines, but also for pressing ahead with it. You have my full support! Without expansion of the gas sector as a second string to our bow, Europe's energy transition will not succeed. For this reason, the EU Commission is now preparing to reform the gas market, as a follow-up to its reform of the electricity market. Sector coupling as you have just described it will be a key element of this reform.

What type of gas do you think of when you talk about "power-to-gas"?

K. K.: By "gas", we're not just talking about synthetic methane gas, but first and foremost about hydrogen. And we can then also envisage making this available for use in fuel cells in cars, buses and trains.

K.-D. B.: Hydrogen still divides opinion. To what extent can it be admixed with conventional natural gas in existing gas lines? Or do we have to build new pipelines? That's what we're researching right now.

K. K.: I don't believe we need to build a completely new infrastructure specifically for hydrogen. We should try to use the existing gas network. The odds are good: the thermal insulation measures introduced in Germany are ensuring the need for gas for heating buildings is continuously decreasing. This is freeing up gas lines. As part of our pilot project, a section of OGE's existing gas network will be converted to exclusively transport hydrogen. The hydrogen, which is gained by means of electrolysis, will be fed into this hydrogen grid. Small volumes of the hydrogen will also be fed into the natural gas grid.

What is the potential of power-to-gas?

K. K.: Let's take Germany as an example. The planned expansion of wind farms, especially in the North Sea, would require around ten gigawatts of sector coupling capacity by the period between 2030 and 2050 in order to cope with the volatility involved with renewables. At the same time, this would greatly reduce the need for further expansion of the transmission grid. I can imagine that in addition to large-scale power-to-gas facilities installed in the transmission grids, smaller PtG gas units in the distribution grids – to which wind farms are also connected – will also help. These decentralised units could be used, for example, to produce hydrogen for fuel cell cars in use in the local region. We'd have to think about this systemically and holistically.

K.-D. B.: This form of dual-track system employing electricity and gas would also be more robust than one that relies solely on power and digital control. It would be less vulnerable to cyberattacks. And let's face it: 100 per cent electrification based on renewables could only be achieved if we had invented some kind of super battery. But we haven't. We don't have an electrical storage system that is capable of helping us cope with the volatile supply of wind and solar power. Only the gas system is capable of doing that. Here's my prognosis: by 2050 we will have an economy that is more electrified than it is today, but that also exploits the enormous potential of power-to-gas.

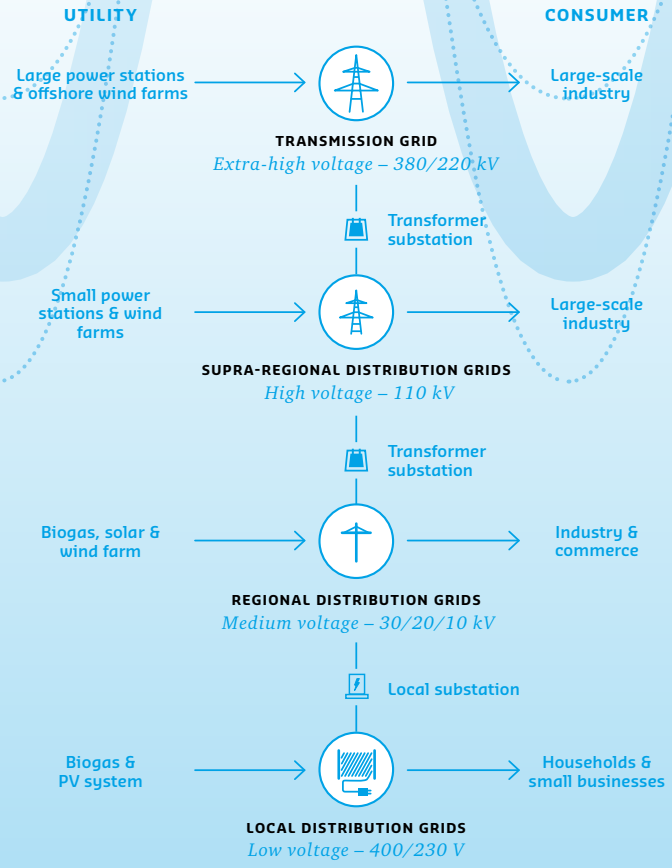
EXTRA-HIGH VOLTAGE – GUARANTEED

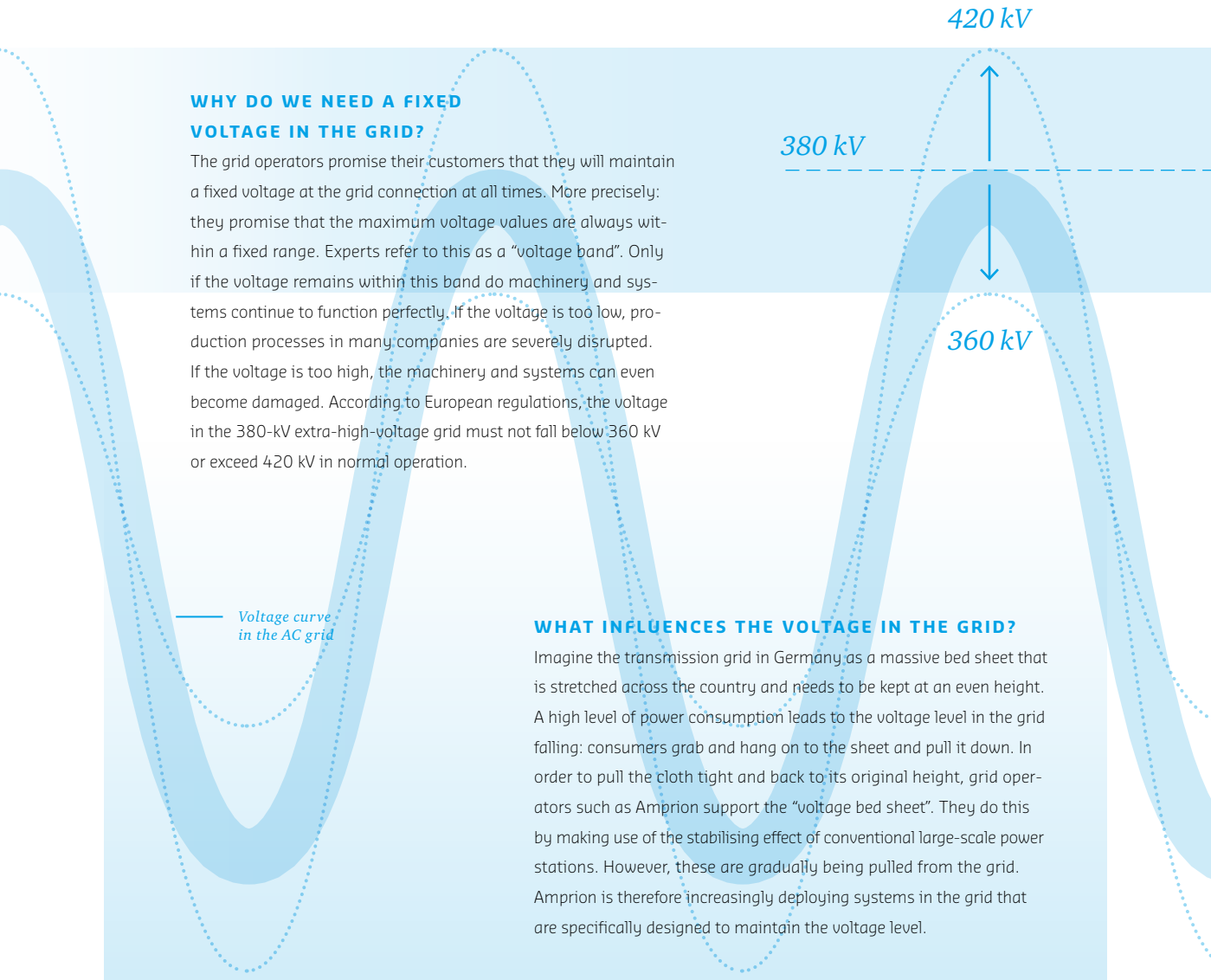
The power grid must function safely and reliably. That goes without saying. But what does this actually mean? Absolutely crucial to guaranteeing this is a constant voltage at each of the various levels in the grid. This is something grid operators like Amprion guarantee.

Text: Volker Göttsche

WHAT IS THE VOLTAGE IN THE AC NETWORK?

Do you remember your physics lessons? Electric current flows when electrons move in a conductor. A voltage is required to move the electrons. It is measured in volts. In Europe, the voltage at a power socket is usually 230 volts, whereas in the extra-high-voltage grid, it can be up to 380,000 volts, or 380 kilovolts (kV). Germany's AC grid operates at four different voltage levels, which are connected to each other via transformers and for which different grid operators are responsible. Alternating current gets its name from the fact that the current and voltage change their direction in fixed time intervals, i. e. periodically. The voltage curve has the shape of a sine wave.





WHY DO WE NEED A FIXED VOLTAGE IN THE GRID?

The grid operators promise their customers that they will maintain a fixed voltage at the grid connection at all times. More precisely: they promise that the maximum voltage values are always within a fixed range. Experts refer to this as a "voltage band". Only if the voltage remains within this band do machinery and systems continue to function perfectly. If the voltage is too low, production processes in many companies are severely disrupted. If the voltage is too high, the machinery and systems can even become damaged. According to European regulations, the voltage in the 380-kV extra-high-voltage grid must not fall below 360 kV or exceed 420 kV in normal operation.

WHAT INFLUENCES THE VOLTAGE IN THE GRID?

Imagine the transmission grid in Germany as a massive bed sheet that is stretched across the country and needs to be kept at an even height. A high level of power consumption leads to the voltage level in the grid falling: consumers grab and hang on to the sheet and pull it down. In order to pull the cloth tight and back to its original height, grid operators such as Amprion support the "voltage bed sheet". They do this by making use of the stabilising effect of conventional large-scale power stations. However, these are gradually being pulled from the grid. Amprion is therefore increasingly deploying systems in the grid that are specifically designed to maintain the voltage level.

WHAT IS THE IMPACT OF THE EXPANSION IN RENEWABLES?

On the other hand, it can also happen that the "voltage bed sheet" threatens to fly up and take off. This can be the case, for example, when wind and solar farms generate so much power due to the weather and feed it into the distribution grids that the distribution grids are forced to transfer the renewable energy to the transmission grid. This is happening more and more frequently owing to the expansion of renewables. Amprion then has to stabilise the voltage at all grid nodes in order to cope with the strong fluctuations in generation levels. But – and this is the good news – every single wind turbine and solar system can also play its part towards maintaining the voltage. That said, the task of coordinating the feed-ins of millions of small generating plants is a complex undertaking and represents a major challenge for grid operators in the wake of the energy transition.

THE €103 MILLION STORY

For some years now, electricity generation using renewable energy sources has been growing faster than the transmission grid. This is increasingly pushing the grid to its limits. The consequence of this are costly interventions in grid operation, the costs of which are passed on to private households and businesses via grid fees. Amprion is working to reduce these interventions. Technological solutions such as the phase shift transformer installed in the transformer substation in Oberzier will help these efforts in future.

Text: Alexandra Brandt Illustration: Xenia Fink

REMEDIAL ACTION THROUGH AD HOC MEASURES

Amprion has developed a technical concept to counter these cost increases. In the Network Development Plan 2030, the Federal Network Agency then confirmed a number of urgent measures aimed at reducing the grid load – including phase shift transformers for controlling the power flows.

COST-BENEFIT ANALYSIS

Approval of these ad hoc measures is subject to one precondition: the benefits gained must outweigh what they cost because, after all, they are intended to reduce the financial burden on private households and businesses. The Federal Network Agency only gave the go-ahead to projects that will pay for themselves within three years and can go into operation by 2023.

THE BENEFITS IN FIGURES

The cost-benefit analysis carried out for a phase shift transformer in Oberzier revealed the following: with an overall benefit of €143 million and investment costs of €40 million, the financial benefit over three years amounts to €103 million.

NO MAGIC BULLET

Grid optimisation measures such as those in Oberzier are in no way a substitute for grid expansion. If the long-term climate objectives of the Federal Government are to be achieved, new power links are imperative. However, until the vital north-south links have been completed, the temporary measures can relieve the load on the grid and lower the costs for the economy.

LONG-TERM BENEFITS

Even after grid expansion has been implemented, the phase shift transformer in Oberzier will still be useful. For example, in the medium to long term, it will help to manage the transmission capacity at the border with the Netherlands.

»A phase shift transformer is like a pilot in the grid. It helps to control the power flows better and to redirect them, for example, away from bottlenecks to less loaded sections of the grid. For this purpose, the phase shift transformer is connected in series with a transmission line like a controllable resistor. If the resistance is reduced, the power flow on the line increases. If the resistance is increased, this slows down the power flow, which in turn reduces the current on the line and places a greater load on parallel lines.«

DR HENDRIK NATEMEYER
AMPRION GRID PLANNER, EXPLAINING THE PRINCIPLE OF THE PHASE SHIFT TRANSFORMER

EVERYONE AROUND THE SAME TABLE

Breaking down reservations and building trust – that's often easier said than done. And it sometimes also requires new formats to enable us to come up with and develop new ideas. Formats such as the "planning dialogue", in which citizens and experts work hand in hand to plan a route.

It was supposed to be a fresh start on the public relations front for what had so far been a project fraught with conflict. It was against this background that the German Institute of Urban Affairs (Deutsches Institut für Urbanistik, Difu) came to Borgholzhausen – a small town of just under 9,000 inhabitants in North Rhine-Westphalia's Teutoburg Forest – for the first time in 2017 on behalf of Amprion. A power link, which leads from Wehrendorf in Lower Saxony to the city of Gütersloh, cuts across the parish. Amprion plans to upgrade this extra-high-voltage line from 220 to 380 kilovolts in order to create a high-capacity link between the Osnabrück region and Eastern Westphalia.

The first application for a permit made by the transmission system operator back in 2013 for this eight-kilometre section leading to the state boundary with Lower Saxony had been for an overhead line. But the people of Borgholzhausen had been far from happy about this, and around 700 objections were submitted during the course of the planning approval proceedings. However, initially the legal basis for constructing this link as an underground line – as desired by many – was not given. It was not until the Energy Grid Expansion Act (EnLAG) was amended at the end of 2015 that the federal government classified the route as a pilot project for partial underground cabling.

Amprion decided to re-open the planning process for this section – and also took this as an opportunity to try a new PR approach. Dialogue with citizens was to be initiated in advance of the approval procedure, well before the stage at which they must officially be invited to

participate. For the first time, Amprion involved a scientific institution in such a procedure: Difu was to accompany and evaluate the participation process right from the very start.

The first phase of the "Borgholzhausen Planning Dialogue" began in 2018. The aim was to incorporate the local knowledge of the citizens into the planning activities and to build confidence in the project. Particular attention was paid to the selection of participants. In addition to representatives from as diverse a spectrum of interests as possible (citizens' action groups, "public interest bodies", the local authority and business), six citizens were allocated a seat on the committee by lottery.

In order to develop a joint concept for the underground cable route through the actual built-up area of Borgholzhausen, experts from Amprion kicked off by informing the committee members about the starting point of the project, the technology and various boundary conditions, thus creating the basis for the intensive discussions that were to follow. In conclusion, all of the participants formulated recommendations for the course of the route and the locations of the cable transfer stations.

An external intermediary attended the closed-door meetings in order to make the process as transparent and fair as possible. Presentations and minutes were coordinated promptly and published on the project website at www.planungsdialog-borgholzhausen.net.

DR STEPHANIE BOCK
GERMAN INSTITUTE OF URBAN AFFAIRS (DIFU)

Dr Stephanie Bock works as a research assistant and team leader for the German Institute of Urban Affairs (Difu). Her main areas of interest include urban and regional development as well as citizen participation.

At the beginning of the dialogue, scepticism was rife on all sides, with the first sessions characterised by poorly formulated goals, an issue perceived by many as diffuse, and communications dominated by previous conflicts. But over the course of the meetings, we increasingly succeeded in breaking down people's reservations. The technical experts from Amprion had a special role to play here. Their expertise was in great demand and it was this that played a big part in gaining everyone's trust. Those citizens who had been selected by lottery introduced a healthy degree of openness and common sense, and succeeded in diffusing old conflicts and counteracting the polarisation that had held up progress for many years. Then, in the summer of 2018, a joint proposal was actually on the table.

It's not yet clear whether Amprion will be able to initiate the new approval procedure on this basis, because there are still residents of Burgholzhausen who oppose the laying of an underground cable. One thing's clear: it's impossible to dispel the concerns of some without new conflicts arising elsewhere. This makes transparent and comprehensible procedures that explain how decisions are reached all the more important.

From Difu's viewpoint, the planning dialogue was a difficult but rewarding challenge for all participants. It was important and right to initiate it at such an early stage and to plan and coordinate it as a longer-term process, because a successful dialogue doesn't come about just overnight. It's hard work and demands the right attitude from all players.

Five facts about the planning dialogue

1 Unique

Amprion is breaking new ground with its planning dialogue. A format that is tailored to grid expansion at the local level and is accompanied from the outset by a scientific institute has never before existed in Germany in this form. The planning dialogue accompanies the project from the development of an idea through the preparation of the planning approval procedure to construction. Amprion is therefore in a position to expand its scope in the area of early public participation, it is present on-site as a point of contact and it gathers valuable knowledge on the opportunities, but also the limits, of such a process.

2 Well versed

The construction of a new power link opens a wide range of issues that are of interest to the local population. Consequently, several expert meetings were held as part of the planning dialogue. In a technical discussion on technology, cable construction experts explained the possibilities and limits of partial underground cabling and various other construction methods. Independent speaker Dr Hannah Heinrich gave a lecture on electric and magnetic fields as part of a public meeting held for the residents of Borgholzhausen.

3 Diverse

The range of interests expressed in the first dialogue phase was broad. While some representatives advocated the laying of an underground cable, others preferred the overhead line variant. Forestry, environmental and water conservation issues were also discussed by the committee, as well as aspects relating to tourism. Grid security, security of supply and energy prices were also considered. Amprion aims to minimise the impact its projects have on mankind and nature. On the other hand, it is the statutory duty of a grid operator to pay due consideration to economic viability and system security. Ultimately, it's the regional government of Detmold that will decide how the power line will be built, after evaluating the various interests and weighing them against each other.

4 Goal-oriented

Right from the start, the participants in the planning dialogue had a clear milestone in mind: a common idea for a potential route and search areas for the two cable transfer stations that are necessary. In the next step, Amprion will carry out preliminary investigations on-site, prepare various expert opinions and conduct discussions with citizens who own land in the area of the planned power line. Amprion intends to submit the documentation for the new planning approval procedure to Detmold's regional government in mid-2020.

5 Citizen-centric

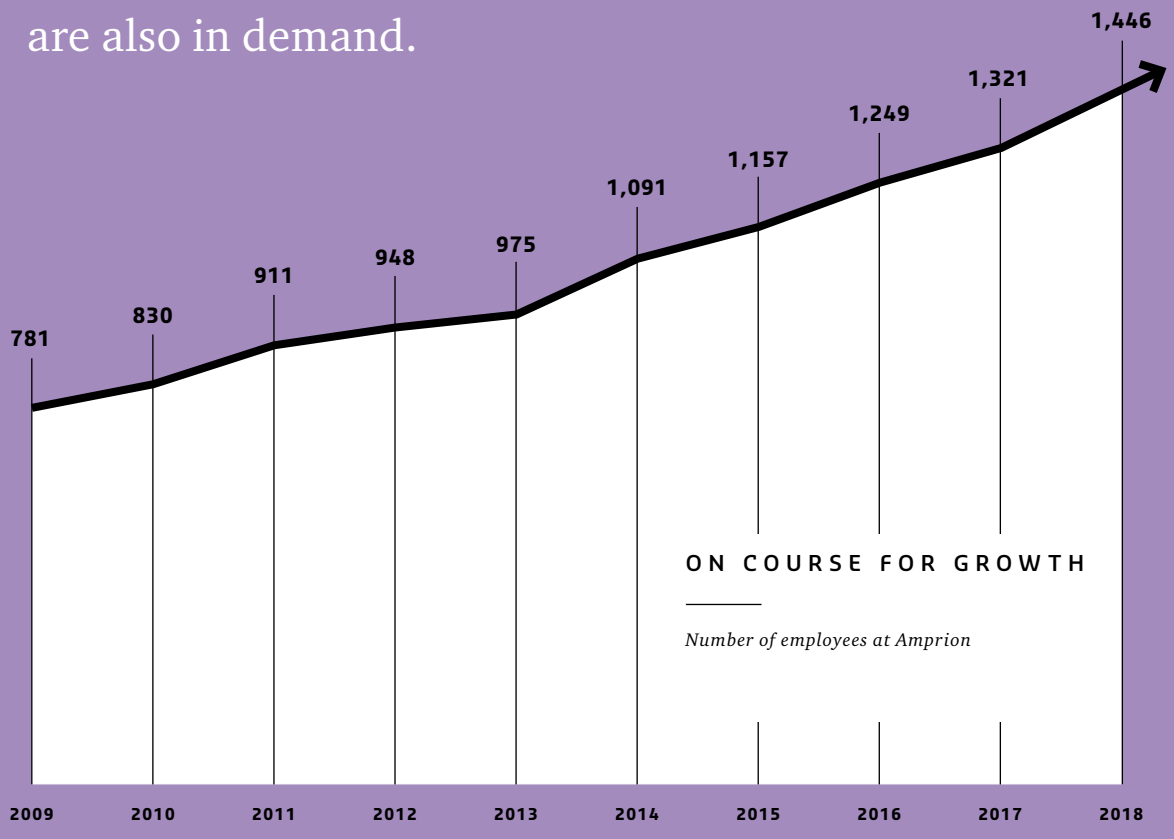
Two "citizens' info markets" in Borgholzhausen marked the beginning and end of the first planning phase. In January 2018, around 100 visitors attended the first of these markets to find out about the project and the concept of the planning dialogue. It was here that the six citizens who had applied to participate in the committee were also drawn by lots. In August 2018, at the end of the first phase, the members of the planning dialogue reported on their work and presented the concept they had jointly developed before an audience of around 170 interested parties.

THE GRID ENABLER

Amprion opens up new career opportunities to many people. Six of them tell us what they love about their new job.

Photos: Johannes Döppler, Matthias Haslauer, Henning Ross and Daniel Schumann

The number and complexity of duties and responsibilities at Amprion are growing – and so is the number of employees. In recent years, we have already welcomed many new colleagues on board. Currently, Amprion is looking not only for engineers, technicians and fitters – IT specialists, lawyers and communication experts are also in demand.



ON COURSE FOR GROWTH

Number of employees at Amprion

»Underground cables are still a relatively new technology in the transmission grid, with new processes and developments. At Amprion, I can work on projects that are being implemented in this form for the first time. That's extremely appealing to an engineer.«

MAIBRITT ENGELL

at Amprion since 2018 as a civil engineer working on underground cables

»I was originally a mathematician. As a student, I would never have dreamed that I would one day find myself trying to come up with ways to make better utilisation of the electricity grid. Today, I'm particularly impressed by the fact that innovative algorithms and functions of the control systems can significantly improve utilisation of the transmission grid.«

GEORG VAN DE BRAAK

since 2017 Head of Control Systems and Grid Analysis Functions at Amprion

»Working in a company with complex IT management and large-scale projects matches my profile exactly. I also see a lot of interesting opportunities opening up at Amprion in the medium to long term, because topics such as artificial intelligence and digital networks are becoming increasingly important.«

JAN PETER GETZLAFF

at Amprion since 2018 as Head of IT Governance & Architecture

»I took the opportunity to take on more responsibility within the company. After four years as a primary technology fitter and further training to become a state-certified technician, I switched to the Overhead Lines department, where I now work as deputy head of the supervisory area. My area of responsibility has diversified since then. It's a good feeling to have taken this step.«

JAN ALFES

at Amprion since 2017 in the Overhead Lines department

»As a geographer, I specialise in urban and regional development. My interdisciplinary training is highly beneficial to me at Amprion, because I work together with many specialist departments, authorities and citizens. There are no daily routines in this job – and that's precisely what makes it so exciting.«

LISA PETERS

at Amprion since 2016 as a subproject manager
in the Permits & Approvals department

»My specialisation during my studies was on public-sector commercial, environmental and infrastructure law – good preparation for my work at Amprion. Nevertheless, I still learn something new every day here and can gain valuable experience as a young professional.«

JONAS HILSMANN

at Amprion since July 2017 as a lawyer working in planning and approvals law

INTERVIEW

Amprion Managing Director, Dr Hans-Jürgen Brick, talks about the most exciting phase of his career

Interview: Alexandra Brandt Photo: Hartmut Nägele

»Our employees are the company's most important resource.«

Dr Brick, Amprion is currently experiencing a major surge in growth. Why does the company currently need so many new employees?

Our business is currently very dynamic. Expansion of the grid has got under way. Since the beginning of 2016, the responsible authorities have approved the construction of more than 300 kilometres of new power lines – an important prerequisite when it comes to making progress with the restructuring of our energy system.

That said, we still have around 2,000 project kilometres in the pipeline. The job of planning these projects, launching their approval process and implementing them is very demanding and labour-intensive. Moreover, expansion of the grid is not yet keeping pace with the growth of renewables. This is why we are developing short-term technical solutions to keep our grid stable during the restructuring phase as well. We need reinforcements to enable us to cope with all of these labour-intensive tasks.

Amprion will be planning and installing around 2,000 kilometres of power lines over the next few years.

Particularly since we foresee further challenges that will arise from the restructuring of the electricity system. How is Amprion preparing itself for future innovation surges?

By taking the initiative right now. Amprion must prepare for future challenges such as the connection of offshore wind farms, sector coupling and the deployment of new technologies. Only by doing so will we continue to fulfil our responsibility to absorb more and more energy from renewables and at the same time operate a reliable transmission grid for the 29 million people in our grid area. In order to prepare such long-term projects from a strategic point of view, we are now building up our in-house know-how. Our employees are the most important resource allowing Amprion to fulfil its economic mission.

What would you like to see most in view of this constant growth of the Amprion team?

That we succeed in maintaining the strong team spirit we have in our company. If everyone continues to pull in the same direction, if everyone works well together, from the technical colleagues to the lawyers, the communicators and IT experts, we will find solutions to keep our grid operating securely and cost-effectively in the future. For me, this is the most exciting phase in my career. We as a company can make an active contribution to the success of the energy transition. This is a unique opportunity that we want to, and must, seize.

NEW HOME

41

SPECIES OF FLOWER

The most striking are the red poppies and the blue cornflowers, which create a sea of colour in summer.

75

FRUIT TREES

Traditional species of wild plums, pears, apples and cherries attract bats, dormice and a wide variety of songbirds.

~ 5,000

SPECIES OF INSECT

Butterflies, spiders and grasshoppers, for example, find a good nutrition base here. Meanwhile, beekeepers are also making use of the flower meadow, since we do completely without any pesticides and insecticides.

15

DIFFERENT GRASSES

They give the area a varied structure and provide a suitable habitat for the grey partridge, which is now endangered in Europe.

20 ha

OF FLOWER MEADOW

In Dinslaken, Amprion has created a 20-hectare flower meadow with fruit trees that provides nutritional and hunting habitats for numerous species of insects and birds. And countless nature lovers also appreciate this brightly coloured, blossoming landscape in summer: “We have seen licence plates from all over North Rhine-Westphalia and the Netherlands here,” reports Christoph Tölle, forestry scientist at Amprion. Between 2016 and 2018, the company planted this species-rich meadow to compensate for future power line construction projects to be conducted in the lowlands of the Lower Rhine.

Amprion's goal is to keep the impact on nature and the landscape as low as possible in all power line construction projects. Despite this, it's not possible to completely rule out such impact. For this reason, the company is creating its own protected areas within its grid area and implementing nature conservation compensatory measures, such as ecologically upgrading areas elsewhere. Flora and fauna find new habitats here, some of which have become scarce.

Text: Meike Pedack Illustration: Xenia Fink

NARROW-HEADED ANT

On a section of the power line from Kelsterbach to Schönbrunn, Amprion discovered several nests of the narrow-headed or excised wood ant (Formica exsecta). These seven- to eight-millimetre-long insects form vast colony networks comprising several hundred thousand individuals and they prefer open or slightly shaded areas, such as forest clearings or the edge of a wood. But in many places here in Germany, the species lacks suitable nesting locations. This is why it is one of the animal species specially protected under the Federal Species Protection Regulations and is classified as endangered on Germany's Red List.

By conducting special maintenance measures, Amprion helps to systematically optimise the habitat of the narrow-headed ant along this line section. In particular, this includes mulching as part of route maintenance measures, in which a machine works its way through the undergrowth, shreds it and leaves behind a layer of mulch that is rich in nutrients. This has created open areas that the narrow-headed ant needs if it is to be able to make use of the warmth of the sun. In addition, Amprion is making sure that trees are only removed selectively, if they endanger the power line. Thanks to the aphids and bark lice that live on the various species of deciduous tree, this means that the ants retain an important source of nutrition. By these actions, Amprion not only ensures safe operation of the power line, but also tailors the necessary maintenance measures precisely to the needs of the flora and fauna living along the route.

FLOWER OF THE YEAR

Common heather (Calluna vulgaris)

FAMILY: Ericaceae

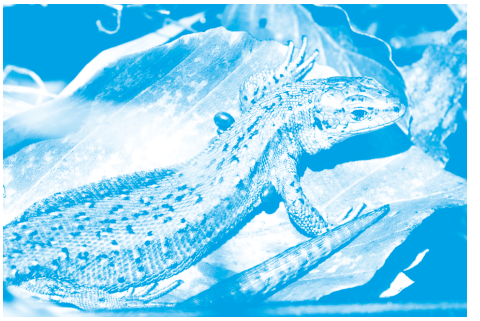
DISTRIBUTION: native to the whole of Europe, with a focus on Central and Northern Europe

HABITATS: heath, moor, dunes, lightly wooded areas

LIFESPAN: up to 40 years

FLOWERING SEASON: late summer to autumn

The Loki Schmidt Foundation has chosen common heather as "Flower of the Year 2019". Every year since 1980, the foundation has been using this initiative to draw attention to endangered plant species and their habitats. By selecting the common heather, the foundation would like to support both the preservation and the maintenance of heathland areas – because these have declined considerably. Amprion has specifically recultivated parts of its route areas as heathland, for example the "airport route" south-west of Frankfurt. Among other things, the Flower of the Year 2019, the common heather, has succeeded in establishing itself here.



MEADOWS, FOREST AND WATER

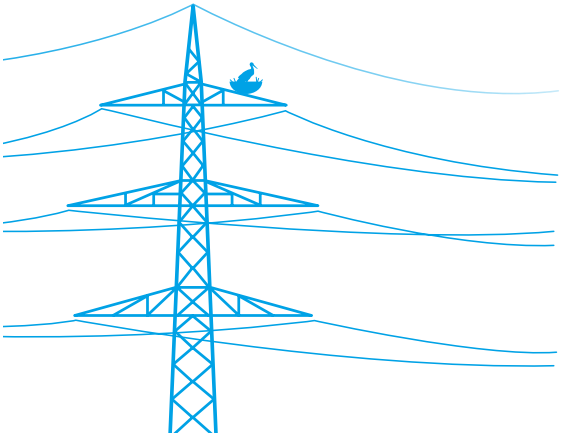
In the Sauerland region of central Germany, Amprion is transforming a property of 500,000 square metres on which, among other things, a floodplain forest had previously been used for forestry purposes. Due to its geographical location and the combination of grassland, forest and water in one contiguous area, this property offers opportunities for a wide variety of nature conservation measures. Among other things, refuge zones have already been created for kingfishers as well as for common and sand lizards on stands of common heather. Amprion's nature conservation team expects a large increase in other rare and protected species over the coming decades.

BIRDS' NESTS IN THE RHEINAUE WETLANDS

»Three stork pairs have built their nests on our electricity pylons in the Rheinaue wetlands near Bingen and quite obviously feel very comfortable there: in 2018 alone, seven young storks hatched.«

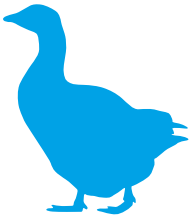
GÜNTER LIPS
manages Amprion's Kreuznach Overhead Line division.

A number of stork families have made their home on several of Amprion's power pylons in the Rheinaue wetlands between Bingen and Ingelheim, and they return every year to rear their offspring. Every summer, various Amprion employees help out with ringing the young storks. The birds have small rings fitted to their legs that carry certain pieces of information regarding, for instance, migration routes, wintering sites or breeding seasons. This is totally painless for the birds, but it nevertheless results in a grand palaver on the part of the stork parents, who keep a close eye on their offspring during the ringing and circle over the nests the whole time.



Lapwing

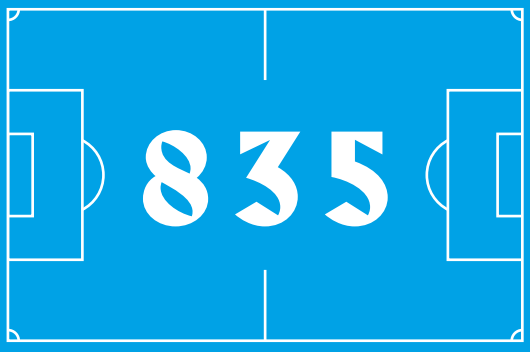
Curlew



Geese

Compensation measure at Dümmer See

A power line construction project in Lower Saxony has negatively impacted open habitats that Amprion had restored elsewhere. In cooperation with the nature conservation association "Naturschutzring Dümmer e.V.", 11 hectares of intensively cultivated arable land near Dümmer See, a lake in north-eastern Germany, was transformed into a species- and herb-rich meadow that is used by birds such as lapwing and curlew and a number of goose species. As the birds prefer wet grasslands, a pond was also created that was able to provide enoughwater even in the drought of the summer of 2018.



football pitches correspond roughly to the area on which Amprion implemented **nature conservation projects** between 2012 and 2017 – that's 650 hectares.

NATURE CONSERVATION AT AMPRION

Amprion sees nature conservation and environmental protection as a very important part of its social and corporate responsibilities and has been actively engaging in effective biotope management for two decades. The company systematically organises the route maintenance measures this requires in line with ecological principles, and also supports local wildlife and habitat conservation projects.

For some years now, Amprion has also been acquiring land on which rare and endangered animal and plant species are being encouraged through targeted nature conservation measures. In this way, the company generates added value for nature and the environment even before it implements grid expansion projects, and it goes over and beyond the actions it is legally bound to perform.

WWW.AMPRION.NET/MAN_AND_ENVIRONMENT/BIOTOPE_MANAGEMENT

POWER IN OUR TIME

1928 saw the birth of the German transmission grid in the Rhineland. For the past 15 years, Amprion has been planning, operating and developing what is a key piece of infrastructure for both our company and society – backed by 90 years of experience.

1928

The first power lines between Brauweiler and Bludenz in Austria and the System Operation and Control Centre in Brauweiler are built – the nucleus of the German transmission grid.

1957

The grid is growing and becoming more capable – thanks in part to Germany's first 380-kV line between Rommerskirchen and Ludwigsburg.

1975

In Brauweiler, the first computer-based control system is used to operate and control the grid.

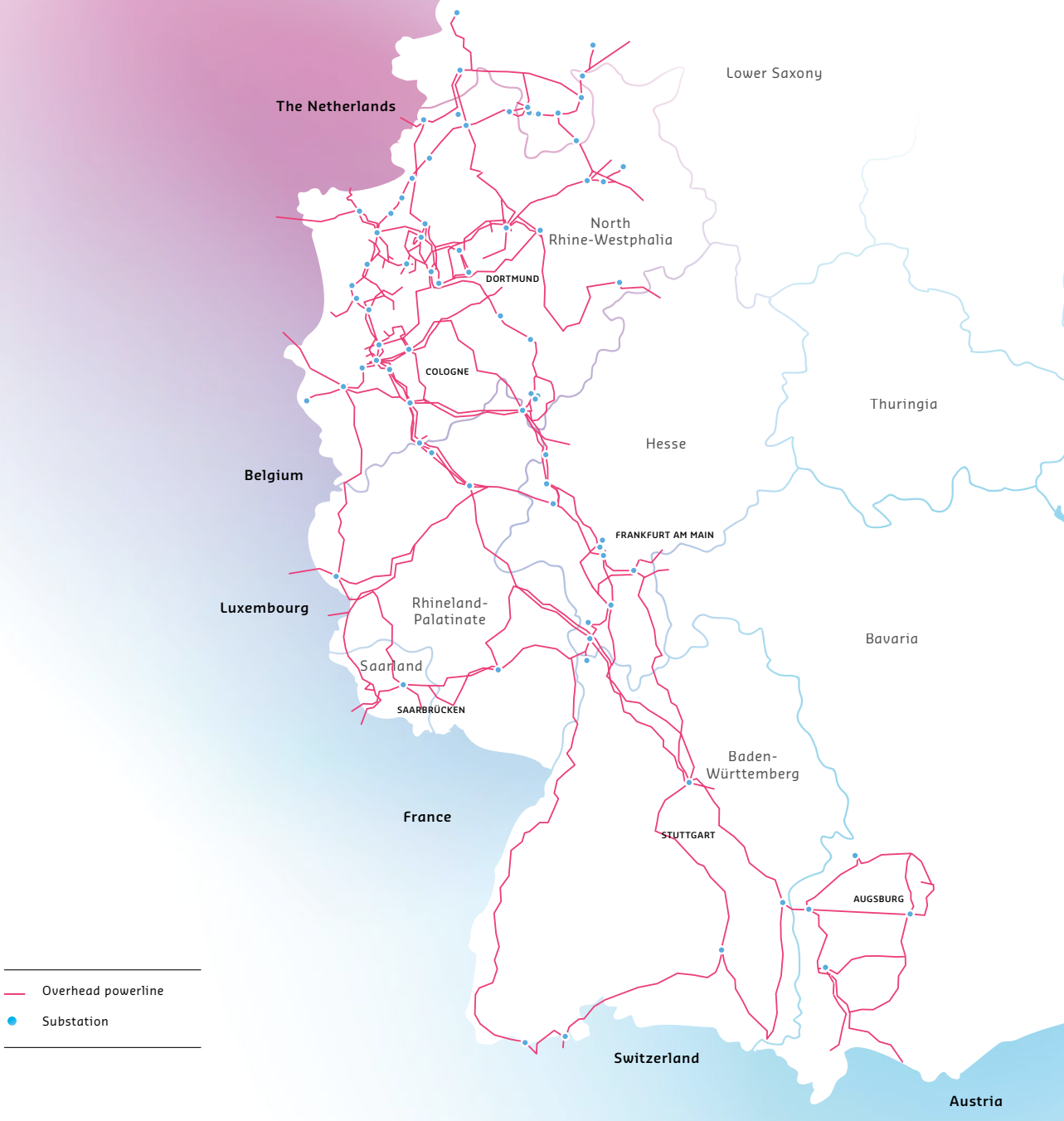
2016

Amprion trials Germany's first 380-kV AC underground cable in Raesfeld.

2020

ALEGrO is to be the first DC link in Germany's close-meshed transmission grid to go online.

THE AMPRION GRID



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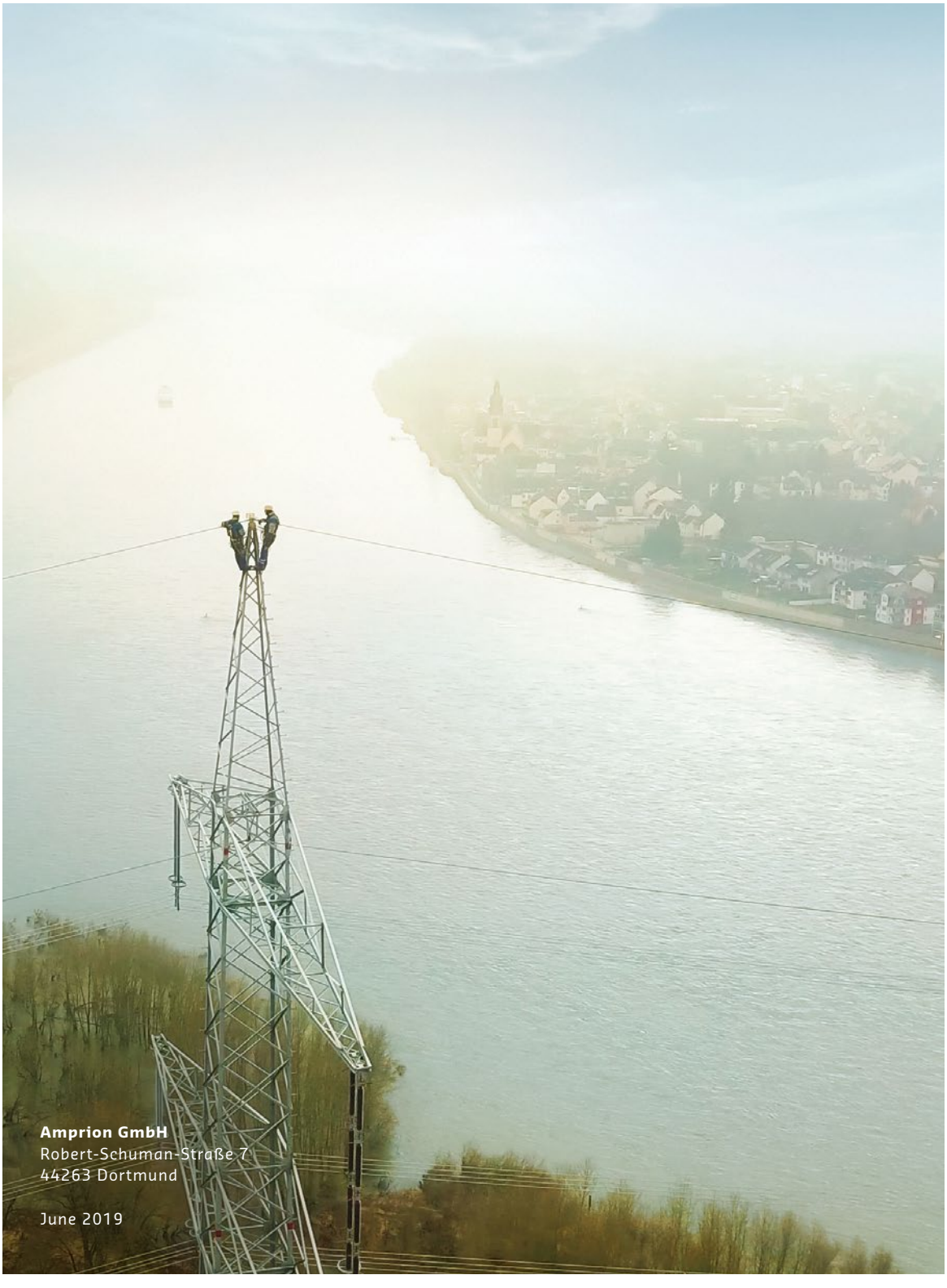

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