Journal 2014

RESPONSIBILITY

DIALOGUE

NEW START

amprion

SHORT PROFILE OF AMPRION

Amprion GmbH is one of the four German transmission system operators. The company, which is based in Dortmund, has more than 90 years' experience in planning, constructing and operating the high-voltage grid. Amprion employs about 1,100 people.

~59 GW

is the total output of all power stations in the Amprion grid supply area.

73,100 KM²

is the size of Amprion's grid supply area – from Lower Saxony to the Alps.

11,000 KM²

is the size of Amprion's transmission grid. It is the longest high-voltage grid in Germany.

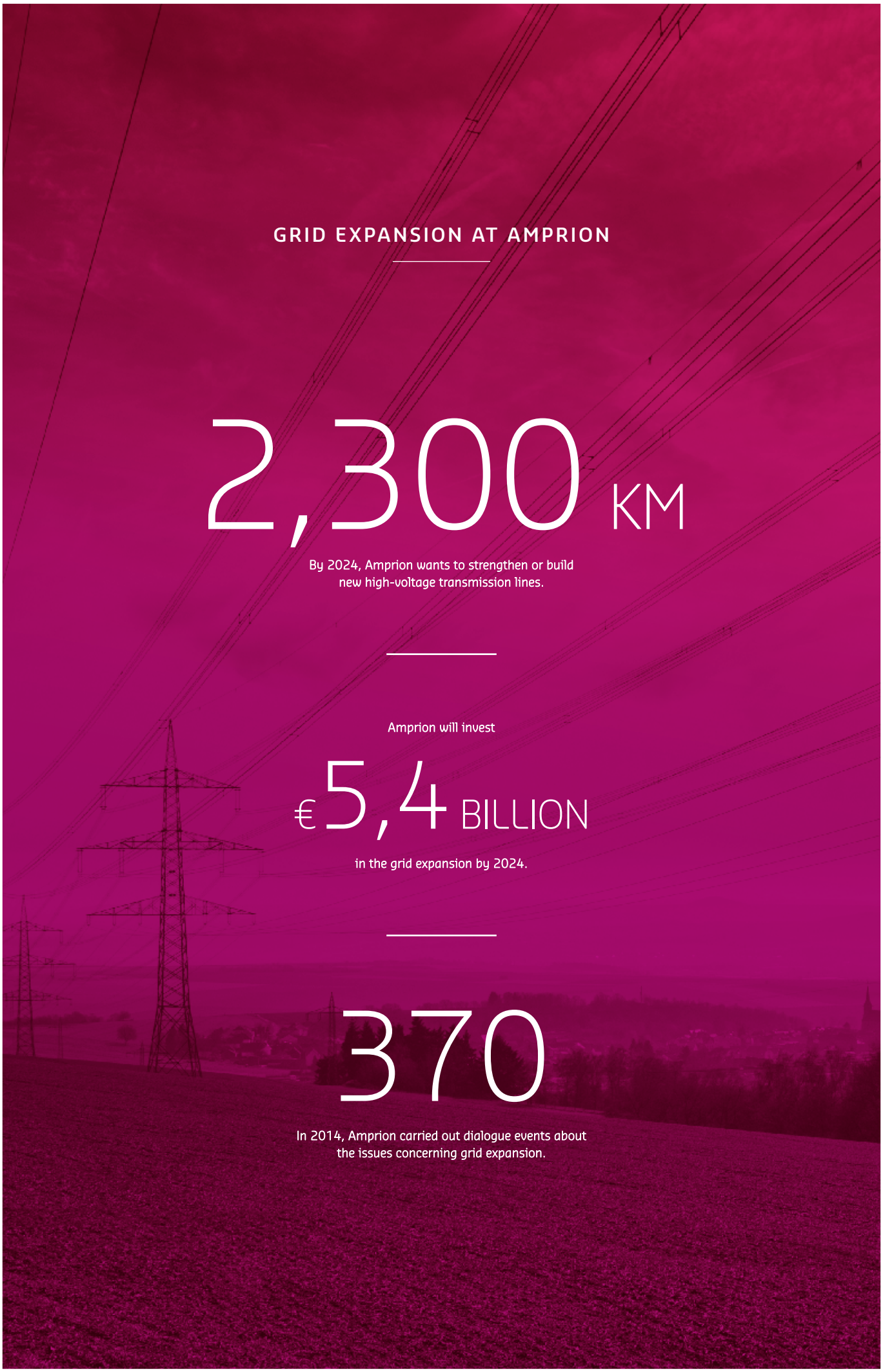
~27 M

people are supplied with electricity through the Amprion grid.

168

Transformer stations connect the Amprion grid to the downstream distribution grids.


THE AMPRION GRID
Netherlands
Lower Saxony
North Rhine-
Westphalia
DORTMUND
COLOGNE
Hesse
Thuringia
Belgium
FRANKFURT AM MAIN
Bavaria
Luxembourg
Rhineland-
Palatinate
Saarland
SAARBRÜCKEN
Baden-
Württemberg
France
STUTTGART
AUGSBURG
Switzerland
Austria
Overhead line
Transformer station


GRID EXPANSION AT AMPRION
2,300 KM
By 2024, Amprion wants to strengthen or build new high-voltage transmission lines.
Amprion will invest
€5,4 BILLION
in the grid expansion by 2024.
370
In 2014, Amprion carried out dialogue events about the issues concerning grid expansion.

Amprion is a significant transmission system operator in Germany and Europe. Our power lines are the lifelines for the national economy. We are seeking **DIALOGUE** *[page 8]* with citizens, society, politics and commerce in order to be able to face the challenges of the energy transition. We are meeting our part of the RESPONSIBILITY *[page 26]* for the operation and expansion of our grid in order to supply electricity into the future. We are developing innovative technical solutions for this NEW START *[page 40]* into the energy world of tomorrow.

CONTENTS

RESPONSIBILITY

NEW START

ENERGY EXCHANGE

Amprion Managing Directors Dr Hans-Jürgen Brick and Dr Klaus Kleinekorte discuss the energy transition in Germany and why a dialogue on the electricity grid expansion is required.

PHOTOS · **MARCUS PIETREK**

THE ENERGY TRANSITION IS ONE OF THE MOST IMPORTANT PROJECTS FOR THE FUTURE IN GERMANY. WHAT IS AMPRION CONTRIBUTING TO THE ENERGY TRANSITION?

DR HANS-JÜRGEN BRICK The energy transition is bringing about a fundamental restructuring of the German energy system. By 2050, 80 per cent of our electricity needs must be covered by renewable energy sources. We have a statutory duty to provide a transportation grid that meets that need, which is only possible by expanding the grid. We have to expand the grid so that green energy can be delivered to the people.

DR KLAUS KLEINEKORTE The challenge is that wind farms and solar facilities are weather-dependent, which means that they do not feed into the grid at a constant rate. At the same time, however, consumers want to extract electricity continuously all over Germany. The more renewable energies we want to integrate, the more we need an infrastructure that can balance out the fluctuations over a wide area. Think of the electricity grid as a group of trout ponds. They are connected to each other through narrow pipes. When it rains heavily in the north, only the ponds in the north fill up with water. If you want the water level in the south to rise, you have to lay new pipes to carry some of the rainwater to those ponds. That is the only way to make use of the rainwater from the north in the other regions.

BRICK If we stay with this analogy, Amprion is one of the companies that is to build those wide pipes. In reality, they are high-voltage transmission lines used to transport large volumes of wind power from the north to the regions of southern Germany with high consumption.

» The challenge is that wind farms and solar facilities are weather-dependent and do not feed into the grid at a constant rate. At the same time, consumers want to extract electricity continuously.«

DR KLAUS KLEINEKORTE

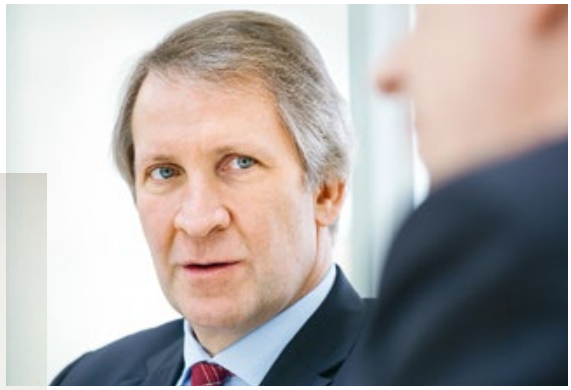
KLEINEKORTE Then there is another challenge: imagine that all the trout ponds have many different streams flowing out of them – these are the small and large electricity consumers. In addition, all the ponds have been connected to large, variable water taps for a long time. These were the power stations that produced the electricity required in each region close to where it was consumed. These power stations are now being removed from the grid, mainly because of the phaseout of nuclear energy. In the future, the trout ponds will therefore need to get water from further away to prevent them from drying out.

BRICK That is Amprion's job. Our transmission grid has to be secure so that the lights don't go out anywhere. That is our statutory duty and our social responsibility. That's also the reason why we are currently planning high-voltage transmission lines.

THREE OUT OF FOUR GERMANS SUPPORT THE ENERGY TRANSITION. NEVERTHELESS, MANY PEOPLE ARE PROTESTING AGAINST HIGH-VOLTAGE TRANSMISSION LINES NEAR WHERE THEY LIVE. HOW CAN YOU EXPLAIN THAT?

KLEINEKORTE That is a combination of many things. Let's take Bavaria as an example. This federal state is particularly affected by the energy transition because that is where the majority of the nuclear power stations are to be decommissioned. And new power lines are usually associated with a change in the landscape, in the personal environment.

BRICK But the local protests also express a new demand for participation: citizens want to be involved in decision-making. We have to meet this demand. Dialogue involves information and discussion, but also participation: we talk to local people about the design options in an open and unbiased fashion. We can picture ourselves laying power lines differently than we originally planned. Just think: the energy transition is one of the biggest infrastructure



» Citizens understand that we want to communicate as equals.«

DR HANS-JÜRGEN BRICK

projects since the Berlin Wall came down. For our society it is an enormous challenge to deal with that. Everyone has learned something new recently – including us. We have developed new formats for citizen participation. The citizens understand that we want to communicate with them as equals and that we are doing it now far more than we used to.

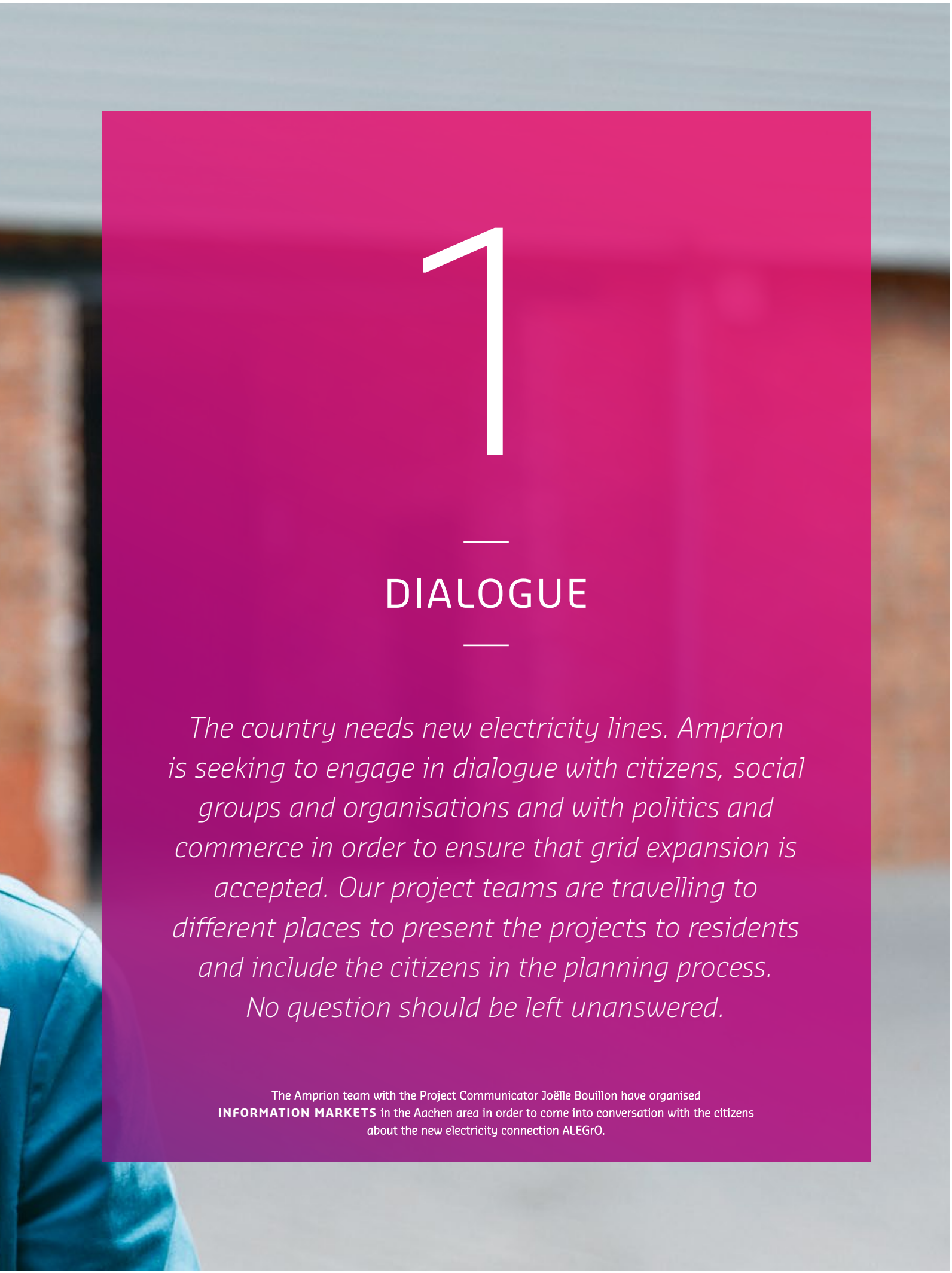
KLEINEKORTE A good example of this is the dialogue concerning the transformer station in Garenfeld, near Hagen. The transformer station has to be expanded in order to guarantee regional power supply. Local citizens got together and announced their opposition. We, together with the mayor, invited everyone to a mediation process and examined more than 15 alternative locations with all parties involved. Finally, we reached an agreement with which the action group was also satisfied.

BRICK By inviting people to participate in the mediation process, we built trust. Based on this trust, we were able to work out a new solution together that was fully accepted. This approach will serve as a model.

CAN NEW TECHNOLOGIES ALSO CONTRIBUTE TO INCREASING ACCEPTANCE FOR THE GRID EXPANSION?

KLEINEKORTE Yes, without a doubt. Think about the underground cable technology that we are installing for the first time in Raesfeld in the Borken region. Think about the north-south “Ultranet” connection that will transport direct current from North Rhine-Westphalia to Baden-Württemberg. We spent a lot of time researching how to transmit direct current and alternating current using the same pylons without having to build new lines. It is a world first. We will increase the capacity of our grid without adding to the burden on people and the environment. This makes dialogue with local citizens easier and creates acceptance.


amprion
Joëlle Bouillon
Amprion GmbH



1

DIALOGUE

The country needs new electricity lines. Amprion is seeking to engage in dialogue with citizens, social groups and organisations and with politics and commerce in order to ensure that grid expansion is accepted. Our project teams are travelling to different places to present the projects to residents and include the citizens in the planning process. No question should be left unanswered.

The Amprion team with the Project Communicator Joëlle Bouillon have organised **INFORMATION MARKETS** in the Aachen area in order to come into conversation with the citizens about the new electricity connection ALEGrO.

GRID EXPANSION? ONLY THROUGH DIALOGUE!

For the energy transition, Germany needs high-performance electricity lines – a challenge for grid operators such as Amprion. In addition to the technological and planning expertise, there is another key element: informing the citizens and including them in the planning process.

TEXT · **JOHANNES WINTERHAGEN**

When Joachim Vanzetta switches on his computer in the morning in Brauweiler near Cologne, he first looks at the weather forecast, just like millions of other people. However, the reason this engineering graduate does it is not to help him decide whether or not to take his coat with him. He has a different view of the data. He has to ensure that the Amprion grid is working reliably, and that, as a result, 27 million people are supplied with electricity at all times: for lights and tools, for computers and all other devices we need for modern life. Nowadays, electricity is increasingly generated through wind and solar energy. "Good weather forecasts," he says, "are therefore particularly important for our work."

Vanzetta is responsible for system operation and control at Amprion – or, to put it in another way: in an area from Lower Saxony down to the Alps, he keeps the electricity generation and consumption in constant balance. Because that is the only way that Amprion's alternating current grid can work with the ideal frequency of 50 hertz. Fluctuations put the grid's stability at risk.

"A deviation of only one hertz would mean that 15 to 20 per cent of the consumers would be automatically switched off in order to stabilise the system," says Vanzetta. This could mean that industrial companies have to stop production.

Previously, it was a relatively simple task to ensure that it did not get to that stage: the power stations were mostly near the centres of consumption and were regulated according to the electricity demands. This situation has changed fundamentally with the massive expansion of renewables since the turn of the millennium: electricity generated by renewables has been given priority since that time, which fully reflects the views of most Germans who want Germany to be committed to protecting the environment (see graph on page 11).

However, there are large fluctuations in the productivity of wind and solar facilities depending on the weather. Thus, the proportion of renewables used for electricity generation in 2014 was already 26 per cent. However, if there is no wind and dull winter days, they account for less than one per cent. On those occasions, electricity from conventional power stations has to be used to fill the gaps.

On other days – when renewables are feeding in large amounts of electricity – Amprion has to carry this electricity away. The wind power comes mostly from the north of Germany and has to be taken to the areas of consumption in the centre and south of the country. This leads to bottlenecks: "We are already operating our grid at the limit of its capacity," says engineer Vanzetta.

SURVEY

93 per cent of Germans support the increased expansion of renewables.
The use and expansion of renewables are …

Source: TNS Emnid 2013

» We are already operating our grid at the limit of its capacity.«

JOACHIM VANZETTA, SYSTEM OPERATION AND CONTROL MANAGER AT AMPRION

That is why Germany needs new electricity lines. This is also essentially the view of environmental organisations, such as WWF and Deutsche Umwelthilfe (DUH, German Environmental Relief Organisation). The German transmission grid is to be extended by about 3,800 kilometres by 2024 – that corresponds to an expansion of almost 10 per cent. An additional 13 per cent of the existing grid – roughly 5,300 kilometres – is to be strengthened and therefore made more productive. This is the conclusion of the current Power Grid Development Plan (GDP), which the four German transmission system operators are putting together and the Federal Network Agency is reviewing. The essential elements of this are the new north-south electricity routes, which are intended to use direct current (DC) transmission technology with particularly low levels of losses to transport wind power from the north to the south, where it is then retransformed into alternating current (AC) electricity. There is also a plan to improve the connection to neighbouring European countries in order to be better able to balance out fluctuations in the national electricity networks. Amprion alone is intending to invest more than five billion euros in the new electricity connections in the next ten years.

In order to advance grid expansion, however, not just engineering expertise and investments are needed. Politicians and grid operators agree – public acceptance is equally critical so that the required projects can be implemented on time and successfully. And the key to acceptance is dialogue in terms of information, explanation and citizen participation.

Dialogue accompanies the entire grid expansion, which is taking place is several stages (see graph on page 13). It begins at the stage of the Scenario Framework and continues with the GDP, which every citizen has the opportunity to comment on. On this basis, the Bundestag and Bundesrat will subsequently determine where the power lines will begin and end in the "Federal Requirement Plan Act". At this stage, where it is a matter of finding a specific corridor for the connection from A to B, Gerald Kaendler comes to the fore. As Asset Manager at Amprion, he is responsible for the company's most important assets. 11,000 kilometres of power lines and more than 160 substations and transformer stations. And this grid is to be prepared for the future. The most important principle for Kaendler and his team is: the existing power lines and stations are to be improved as far as possible. It is only when all technical possibilities have been exhausted that the Amprion experts plan a new electrical connection – and if at all possible within an existing route. This form of sustainability can also be summed up in figures: the Amprion grid is to be expanded by a total of 2,300 kilometres in the next ten years. Amprion will build around 1,600 kilometres of new power lines – of these, about 800 kilometres will be in existing routes. Almost 700 kilometres of the existing grid can be strengthened.

In places where new trans-state routes are required, the Federal Sectoral Planning will identify potential corridors with widths of 1,000 metres. The highest goal of route planning: the new power lines are to impact people and the environment as little as possible. "That's why we are ▸

STEPS TOWARDS GRID EXPANSION

Grid expansion in Germany is taking place in several stages and in dialogue with the public.

1

SCENARIO FRAMEWORK

The four transmission system operators develop the Scenario Framework based on information on the energy act from the federal states. They describe at least three scenarios for how the electricity generation and demand will develop in the next ten years. For the most likely scenario, a 20-year forecast is created as well. The scenario parameters are approved by the Federal Network Agency.

PARTICIPATION

Public comments are taken into account by the Federal Network Agency in its review.

2

POWER GRID DEVELOPMENT PLAN

The transmission system operators prepare the Power Grid Development Plan (GDP) on the basis of the scenario parameters. The GDP describes where the German high-voltage network needs to be expanded or strengthened in the next ten years. The Federal Network Agency reviews the plan and then confirms it.

PARTICIPATION

Citizens, associations and institutions can comment on the plan. The transmission system operators revise the plan on this basis and present it to the Federal Network Agency.

3

FEDERAL REQUIREMENT PLAN

The power line construction projects necessary for the energy industry and for the overriding need flow from the GDP into the law. Only the starting and finishing points of the power lines are stipulated, but not the specific path of the route. The transmission system operators are obliged to implement these projects.

PARTICIPATION

This law is then passed after discussions with the public and in the media.

4

FEDERAL SECTORAL PLANNING/ REGIONAL PLANNING

In the case of trans-state and cross-border power line construction projects that arise from the Federal Requirement Plan, the Federal Network Agency's coordinated Federal Sectoral Planning applies. For all other projects, Regional Planning Proceedings are to be carried out by the state authorities if required. In both processes, the rough routing will be set out.

PARTICIPATION

The Federal Network Agency carries out a public application conference and a process of official and public participation. The comments from citizens, associations and institutions are discussed in a consultation meeting.

5

PLAN APPROVAL

Planning a new high-voltage transmission line ends with the Plan Approval Proceeding. In this procedure, the precise route, the construction points for the pylons and all other technical details are stated in binding form. Once the Plan Approval Proceeding is completed, construction can start.

PARTICIPATION

After the application conference, the revised application documents are made accessible to the public. The opinions and objections of the public-interest bodies and the public are discussed in the consultation meetings.

CHANGE IS POSSIBLE

KLAUS-PETER SCHÖPPNER
is one of the most renowned opinion pollsters in Germany. He is managing partner of "Mentefactum", an institute for surveys and consultation on opinion polls. From 1990 to 2013, he ran the Emnid Institute.

ILLUSTRATION · **TINA BERNING**

Germany is known as an "I-want-to-stay-as-I-am country." Whether it is a question of new runways or urgently needed power lines, large infrastructure projects create opposition. Project sponsors try to calm the protests. This often results in projects costing more and taking longer to implement.

However justified the concerns of the protesters might be in individual cases, they are usually a vocal minority. Nevertheless, this minority dominates the debate on infrastructure projects. Political decision makers also listen to these protesters, creating the risk that the representative democracy is turned into a "democracy of the loudest protesters." More and more often, emotions rather than factual arguments form the basis of decisions – which is a worrying development.

In most cases, the majority of the population is in favour of the infrastructure projects. But they don't speak out. Probably also because many people have the feeling that politics and economics are becoming more and more complex and it is almost impossible to understand the decisions. Whom can you trust nowadays? People expect decision makers to exude empathy and trustworthiness. These values determine the public image of the decision makers and therefore the way in which their decisions are judged – with regard to construction projects and structural improvements as well. So, the question is: how can the silent majority become a supporting majority?

Within a climate of trust, sponsors of large projects should provide transparent information and listen to reservations. This allows people who believe that decisions have always been made for them to be involved in the decision-making process. Specifically, it is important to make the individual and collective benefits of a project clear right from the start. It is also useful to call for public participation: we want your advice! Project sponsors and politicians should use opinion surveys to find out about the wants and fears of the majority – and report about them. This is also a way to make it clear that counterarguments are often the voices of the minority. Presentations and constant feedback to questions from citizens underline how seriously the dialogue is being taken.

Cooperation through knowledge, trust through taking people seriously, acceptance through transparency, planning security through inclusion of the knowledge of local citizens – these factors create consensus between project sponsors, politicians and the majority of the population.

Nowhere in Europe is the gap between what actually needs to be done and what is willingly accepted larger than in Germany. It does not have to stay like that. "Fair structural improvements" instead of "democracy of the loudest protesters" – this is what will make Germany fit for the future and is worth the effort involved.

not simply building any of the lines straight across the shortest route," explains Kaendler. Instead, he and his team are trying to find a way to take into account the needs of the residents and equally those of nature conservation and species protection. Specifically, the Amprion planners are looking into placing new connections along motorways and railway lines or bundling them together with other electricity lines, diverting around residential areas, restricting disruption of the natural environment and avoiding topographical hurdles, such as large bodies of water. However, the final route corridor is not determined by the Federal Network Agency until after the citizens, authorities and associations have had the opportunity to voice their objections. "That's why we inform the citizens in the affected regions in advance and during the approval process," says the grid planner, Kaendler.

The next important phase of the citizen dialogue begins for Amprion once the power lines plan is about to be approved. Because, at this stage, it is not only important to decide on the locations of the individual pylons but also the precise technical design within the route corridor determined in the Federal Sectoral Planning. "It is particularly important to us at this stage to get any constructive input from the public and those affected," says the Amprion Manager Kaendler. "Because, once we have this knowledge from the residents, we can make our plans even better."

This also helps to face the challenges of difficult situations, such as in December 2014 in Garenfeld, a district of Hagen in North Rhine-Westphalia. Amprion is planning to build a transformer station there in order to better connect the local distribution network to a 380 kilovolt high-voltage power line, which was initially rejected by the local action group. There was a mediation process, in which a new, minor change to the location was mutually agreed and common ideas were developed as to how the station could fit into the landscape better.

Dialogue is also important if there are no new routes of overhead lines to be built. Take the example of the north-south connection "Ultranet", which is expected to transport up to two gigawatts of electricity from North Rhine-Westphalia to Baden-Württemberg by the end of the decade. Here, for the first time, AC and DC current will be transported on the same pylons. Therefore, the existing routes can be used for the most part, which saves resources. By mid-2015, only for Ultranet, the Amprion project team will have had around 300 individual discussions with mayors and associations. In addition, it is organising 20 information markets for the citizens along the route.

It is often small steps like these which contribute to Germany's ability to face the challenge of the energy transition. "The energy transition is a common task," explain Amprion Managing Directors, Mr Brick and Mr Kleinekorte. "It would not be possible to realise the associated projects without any impact at all," they add. "But we look for compromises." And they promise: "We want to plan every new power line and every substation with the citizens and not against them."

3,800 KM

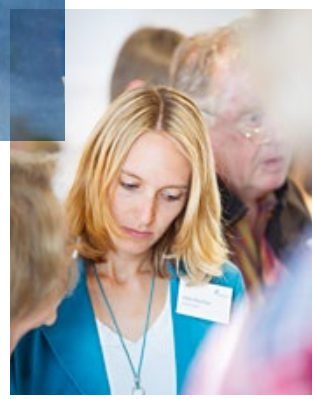
HIGH-VOLTAGE TRANSMISSION LINES
are to be built across Germany in the next ten years.

ON THE MOVE

Joëlle Bouillon travels through towns and villages in the Aachen district. At information markets, the Amprion project communicator explains the plans for the German-Belgian electricity bridge ALEGrO and takes questions from the citizens. “Sustainable dialogue creates acceptance,” she says.

PHOTOS · **MATTHIAS HASLAUER** TEXT · **MARC-STEFAN ANDRES**

ON THE WAY TO AACHEN
Joëlle Bouillon has already experienced many information markets: "Generally, most people think that grid expansion is a good idea."



DIALOGUE ON SITE
Joëlle Bouillon answers citizens' questions. Presentations on display boards also provide information.

DAY 1 // 15 SEPTEMBER

12 P.M. — AMPRION CAR PARK, DORTMUND

Joëlle Bouillon exits the lift quickly. The slender woman in jeans and a green blazer carries a box of brochures and puts it on the roof of a black compact car. She pushes her blond, shoulder-length hair behind her right ear with two fingers and pulls the car keys out of her trouser pocket. The 37-year-old opens the car, puts the brochures into the boot, sits down behind the steering wheel and takes a deep breath. "Let's go," she says and starts the car.

Her journey takes her to Aachen. At an information market, the Amprion project communicator will present plans to the affected citizens of a new electricity connection that is intended to transport DC current between Germany and Belgium from 2019. It is called "Aachen Lüttich Electricity Grid Overlay" or "ALEGrO" for short. It will strengthen the German and European electricity networks and will be built as an underground cable. Amprion is responsible for the German part of the route, about 45 kilometres in length. "We are already informing the citizens about the plans, although from a legal point of view, we have no obligation to do so," says Joëlle Bouillon. But in this way, Amprion finds out at an early stage what is important to the citizens. "Sustainable dialogue creates acceptance for the project in the region."

1.45 P.M. — MOTORWAY A 4, SHORTLY BEFORE AACHEN

Keeping a firm eye on the road ahead, Joëlle Bouillon talks about her experience at information events. "Generally, most people think that grid expansion is a good idea," says the project communicator. "But, when their own region is affected, many residents have concerns." That is why it is even more important to talk to them, to respond to their concerns and explain the purpose of the new electricity route. "Working on the energy transition is fun," says Joëlle, who was born in Munich and lives with her husband and four-year-old son in Münster. "We need the grid expansion because in the future, there will be more and more electricity from renewable energies. This is not generated in a regular basis. So the regions need to be more closely connected in order to have a better blend and as a result to be able to guarantee a secure supply of electricity. Many people understand that."

»I want to know about the plans at an early stage so there won't be any surprises later on.«

MICHAEL SIMON, RESIDENT OF AACHEN

Wind farms, the brown coal power station Weisweiler and dozens of electricity pylons rush past the car window. "Our route will run here, in parallel to the motorway. It isn't easy for the local residents because the region has been deeply affected by open-cast mining," says Joëlle Bouillon. It doesn't matter where you come from, people love their home. "That's why we need to work hard to bring them with us." We will see if that succeeds today.

2.15 P.M. — NADELFABRIK, AACHEN

Joëlle Bouillon is happy to wait and see what happens. "That's what makes my job exciting: there's always something different happening," says the project communicator, while she parks her car in the inner courtyard of the Nadelfabrik venue. In the event hall of the former factory building, two Amprion colleagues are already waiting for her. Gradually, more people join them: for example, the project manager, the technical manager for the route and a lawyer. Everything is in place, everyone gets down to work, helping to put up screens, attaching maps with pins, laying out brochures, pens, tins with peppermints and notepads on the tables.

5.30 P.M. — EVENT HALL IN THE NADELFABRIK

Joëlle Bouillon is in her element: in a friendly way, the 37-year-old approaches the people looking at the project presentations, alone or in small groups. "What brings you here?" she asks one man in black suit trousers and an orange fleece jacket who has spent ten minutes wandering through the room. "I want to know about the plans at an early stage so there won't be any surprises later on," answers Michael Simon, 55, an engineer from Aachen and father of three children. It turns out that he lives near the planned route and has even worked as an expert analyst on environmental impact tests. "Of course it makes sense to expand the electricity routes," he says. "But I don't know so much about electrical and magnetic fields, for example, and whether they might have a negative effect on health."

Joëlle Bouillon leads him to a presentation about emissions from power lines. The electrical field is undetectable in the area around the cable route. "The magnetic field is not so easy to screen off," says the Amprion employee. It is strongest directly above the cable at a height of 20 centimetres. "But there it is only slightly higher than the values of

COMMUNITY MEETING WITH LOCAL OFFICIALS
Joëlle Bouillon informs Hermann Heuser, mayor of Niederzier, about the current status of the converter plans.

the earth's natural magnetic field which is present everywhere." Michael Simon nods and takes a brochure with more detailed information. His opinion: "The topics are well presented. I will do some more research."

6.15 P.M. — EVENT HALL IN THE NADELFABRIK

Monika Winter-Aretz also lives near the planned electricity route. "I want to know about the progress of the project at an early stage so that I can still influence the plans if necessary," says the Aachen resident, who calls herself a critical citizen and is active in local politics. "Once the decision process has started, it could be too late." She concentrates closely on the Amprion presentations. In between, she puts her jacket on a table, takes a coffee and leafs through a brochure. Finally, she talks to Joëlle Bouillon: "I don't understand: why does the planned route make a detour through Aachen and does not continue to follow the existing supply route?" – "That's because we are avoiding a water protection zone," answers the project communicator. "In 2013, we talked to municipalities, rural districts and associations in order to discover these very things and include them in the plans."

DAY 2 // 18 SEPTEMBER

2.30 P.M. — TRANSFORMER STATION NIEDERZIER

Three days later, Joëlle Bouillon steers her car towards a turnip field near the small town of Niederzier. There, next to an existing transformer station, the new underground electricity connection to Belgium is to start. A so-called converter will be constructed for this in a 120-metre long hall. At some time in the future, it will transform DC current from Belgium into AC current and feed it into the grids which start at the transformer station and distribute electricity as far as the Ruhr district. In the other direction, the converter also takes the AC current from wind farms in Eifel, transforms it and sends it to Belgium as DC current as required. Hermann Heuser is waiting at the side of the field. The mayor of Niederzier has a meeting with Joëlle Bouillon

TEAMWORK FOR CITIZENS
Joëlle Bouillon and her colleagues explain what is happening. "Working on the energy transition is fun," she says.

to bring him up-to-date with progress. He has run the business of the community of 14,000 residents since 2008; he has a positive attitude towards the ALEGrO project: "It makes sense for the security of electricity supply." But: "It mustn't create any more noise," says the social democrat. The residents have already had to deal with the noise from the brown coal open-cast mining works in Hambach and Inden, as well as the A4 motorway. Joëlle Bouillon nods and points at the transformer station. "We will replace the existing transformers with modern, quieter ones and insulate the converter very well. This is more likely to reduce the noise." The works traffic will be diverted around the local districts using a specially built road.

7.30 P.M. — TOWN HALL HUCHEM-STAMMELN, NIEDERZIER

The noise emissions are also on the agenda at the Amprion information market in Huchem-Stammeln, a local district of Niederzier. As in Aachen, about 50 local residents and representatives come to get an overview of the plans. Two farmers ask about the precise route – and later write their opinion on a website which Joëlle Bouillon's colleagues have set up for the dialogue with the citizens (www.alegro-dialog.de): they say that the placing of the route is "acceptable for the local farmers of Echtz-Konzendorf," because it is the one that has the least impact on agriculture.

At about 8 p.m., the team starts to take down the exhibition. "We have had a lot of good discussions," says Joëlle Bouillon in summary, while she loads up her car. She sits down once again with her colleagues to talk about how it went. "We have made a good start with ALEGrO. We were able to explain our plans in an objective atmosphere. Of course, it doesn't go this well everywhere," she says on the way to the motorway towards Dortmund. "But that was only the first step. We have to keep the discussions going with the citizens, and we will."

Question Time

Many people have questions about the grid expansion. The need for new routes and health issues are at the top of the list of their concerns. Experts answer the six most common questions.

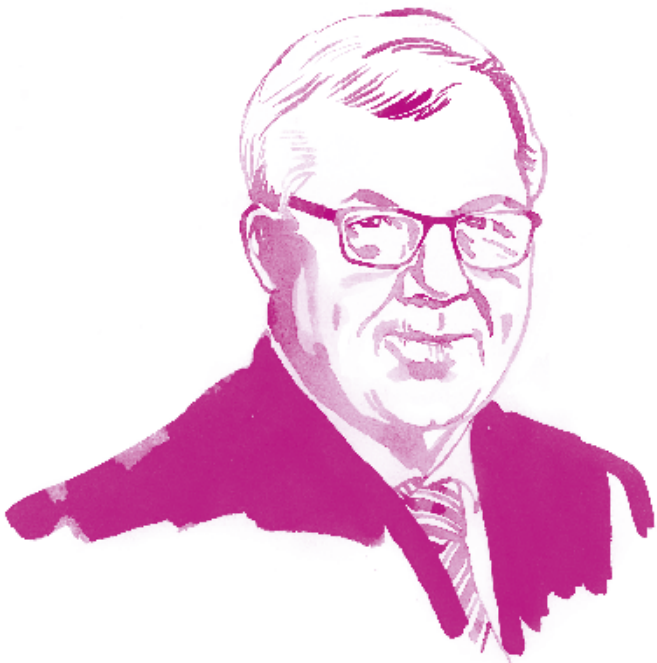
ILLUSTRATIONS · **TINA BERNING**

1

WHY IS GRID EXPANSION SO IMPORTANT FOR THE ECONOMIC LOCATION GERMANY?

From a commercial point of view, the energy transition will only be successful if it can ensure internationally competitive electricity prices and security of supply. Neither is possible without grid expansion. Firstly, sufficient transmission capacities are a prerequisite for ensuring that there is free trade in electricity, generation capacities are used efficiently and renewables are further expanded to productive locations. Grid expansion also helps to keep the costs of the energy transition under control. Secondly, it is necessary in order to balance out the generation capacities that will disappear from the network in the next few years in southern Germany. Without grid expansion, there is a danger that there will be supply shortfalls for companies in that region in times of high demand.

DR HERMANN HÜWELS, DIVISION MANAGER FOR ENVIRONMENT, ENERGY AND RAW MATERIALS IN THE GERMAN CHAMBERS OF COMMERCE AND INDUSTRY (DIHK)



2

WHAT ROLE DOES POLITICS PLAY IN THE IMPLEMENTATION OF GRID EXPANSION?

The transmission system operators must construct the grids. Politics must ensure the correct general environment for this. In the past few years, we have created regulations which enable consistent planning for grid expansion focused on the requirements of the energy transition – and which at the same time ensure maximum citizen participation and transparency. Now it is important that politics continues to support these sensible framework conditions, even if there is occasional opposition to grid expansion. It will only be possible for the companies to successfully realise such demanding and long-term projects, such as the large DC current sections if politicians at all levels react reliably. In addition, we must repeatedly make it clear to politicians: without grid expansion, there will be no energy transition.

DR MICHAEL FUCHS, DEPUTY CHAIRMAN OF THE CDU / CSU PARLIAMENTARY GROUP

3

DO HIGH-VOLTAGE CORRIDORS DAMAGE HEALTH THROUGH ELECTRICAL OR MAGNETIC FIELDS?

Intensive research has been carried out since the early 1970s on whether electrical or magnetic fields from high-voltage plants can have detrimental effects on health. However, so far there has been no indication that there are any dangers to health. Based on research results, the international radiation protection commission has made a recommendation: from their perspective, the constant presence of people in fields of 50 hertz, values of 5 kilovolts per metre for the electrical field and 100 microtesla for the magnetic field are harmless. These internationally recognised values have been given binding effect in Germany in the Regulation on the Federal Immission Control Act (Bundesimmissionsschutzgesetz). Our power lines and facilities meet these threshold values.

OLIVER SANDERS, EXPERT AT AMPRION FOR ELECTROMAGNETIC FIELDS

4

WHO REGULATES AMPRION AND THE OTHERS? AND WHO MONITORS THE REGULATORS?

Amprion and the other companies are "regulated". That is: the Federal Network Agency monitors almost everything that the transmission system operators do. We check the costs that the companies are permitted to produce. And ask: do they provide the services to all grid users on fair terms? Do their organisational structures and resources ensure independence from the interests of the electricity generators and traders? Are the company's expanding the grids sufficiently, but not excessively? The controls are aimed at ensuring the most secure, reasonably priced and environmentally friendly electricity transportation. In particular, we analyse whether there is really a need for grid expansion which Amprion and the other companies determine every year. If the need exists, we check whether this is implemented in a way that protects people and the environment in the best possible way. No corners are cut but, of course, no money is wasted. Because we are also monitored closely by the public, the courts and other authorities.

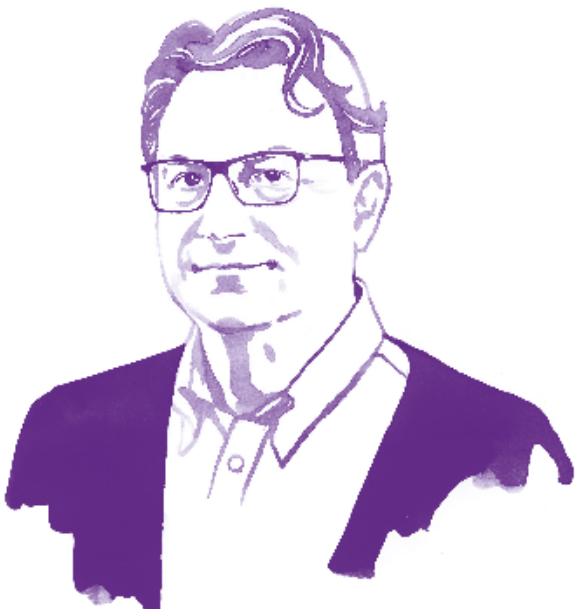
ACHIM ZERRES, DEPARTMENT MANAGER ENERGY REGULATION IN THE FEDERAL NETWORK AGENCY

5

WHY IS GRID EXPANSION NECESSARY AT ALL?

Well-developed grids are the key to secure and affordable electricity supply. Why? Only productive grids are able to balance out the fluctuations in electricity supply from wind and solar energy across the different regions. It is only possible with well-developed grids and markets connected in this way to efficiently use the different technologies available in different locations in Germany and Europe to generate electricity (e. g. wind and sun in Germany or hydroelectric dams in the Alps). And only productive grids can guarantee uniform wholesale electricity prices all over Germany. Constant shortfalls in the grid lead to high costs and reduced security of supply. In this respect, grid expansion and new electricity connections to our neighbouring countries are prerequisites for an energy system in Germany and Europe that is fit for the future.

MICHAEL SCHULTZ, FEDERAL MINISTRY OF ECONOMIC AFFAIRS AND ENERGY

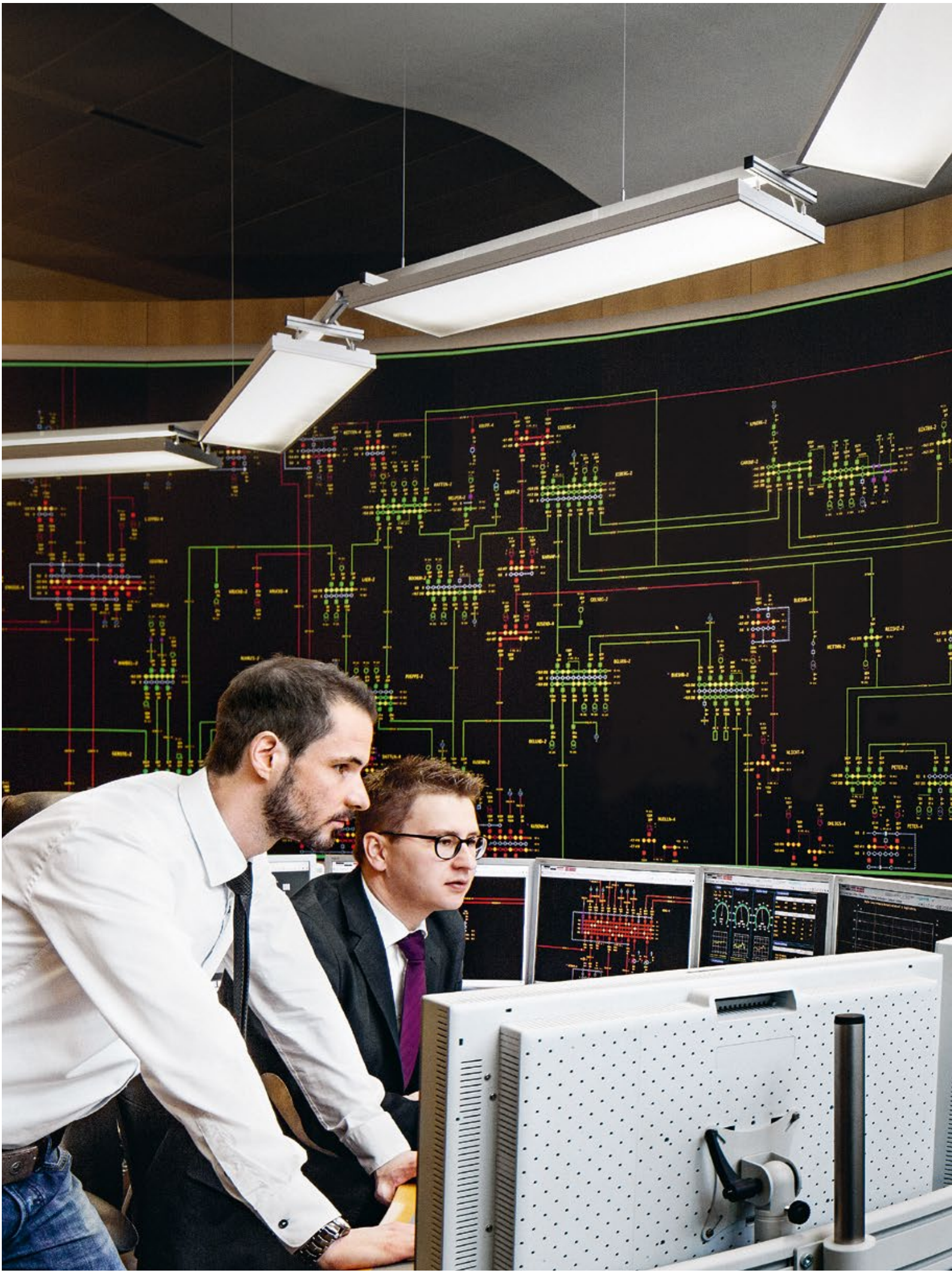


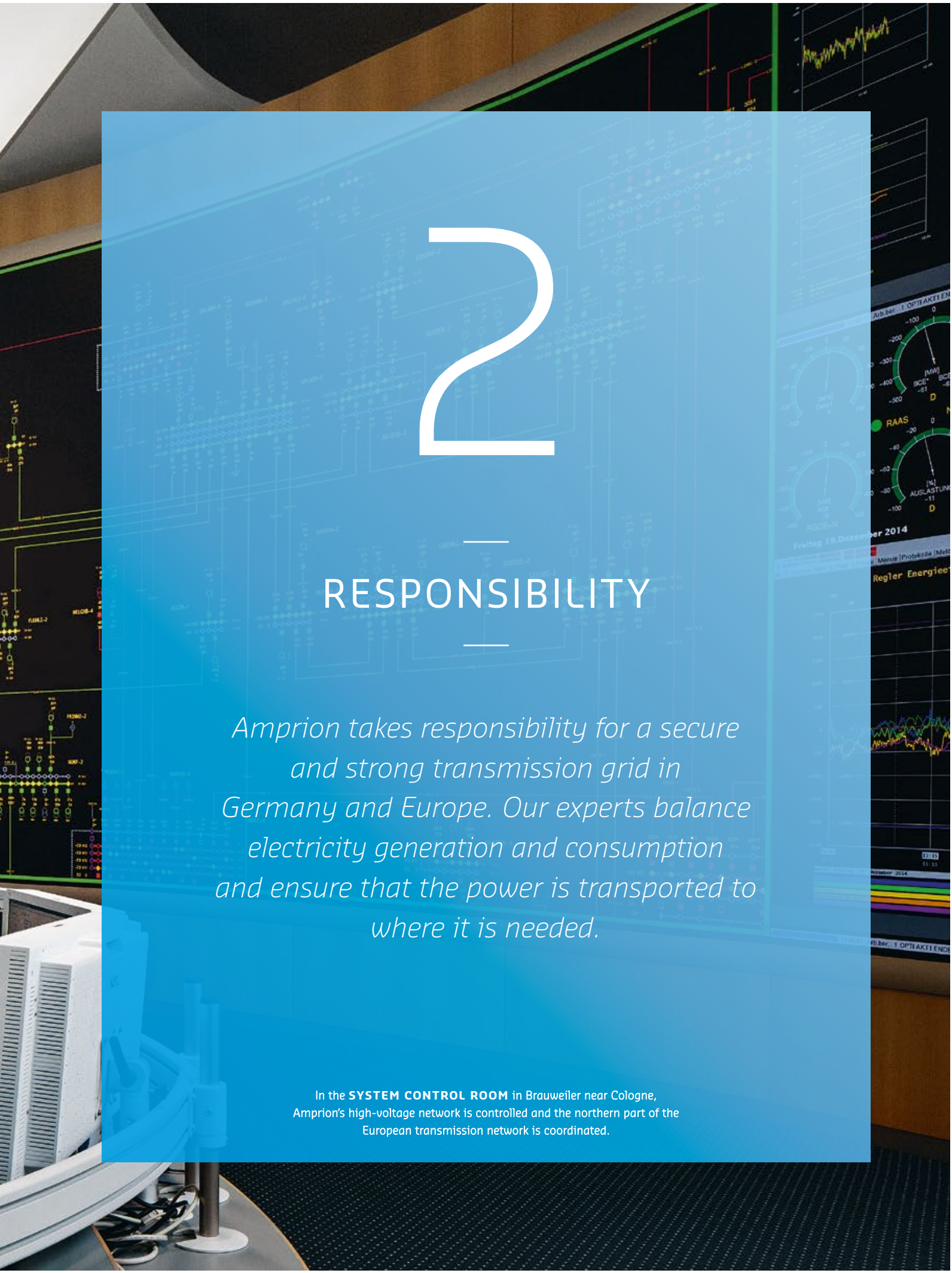
6

WHAT IS AMPRION DOING FOR ENVIRONMENTAL PROTECTION ALONG THE ROUTES?

The routes of overhead lines are biotopes for animals and plants. Amprion is aware of this responsibility. We were the first transmission system operator to introduce ecologically optimised route maintenance 20 years ago. We use biotope management plans, which we coordinate with the landowners, authorities and ecological organisations, to take extensive measures to maintain our routes over 11,000 hectares. As a result, many of these spaces have become valuable nature reserves. The German Association for Landcare (Deutscher Verband für Landschaftspflege, DVL) has honoured our dedication by awarding us the German Landcare Prize. Protection of birds is also important to us. We have therefore initiated research projects with ornithological centres, universities and associations and we have had our grid extensively examined by ornithologists. Based on the results, we have equipped all the critical sections of power lines with special bird protection marks. In this way, our aim is to operate the most bird-friendly grid.

DIRK UTHER, AMPRION BIOTOPE MANAGER





2

RESPONSIBILITY

Amprion takes responsibility for a secure and strong transmission grid in Germany and Europe. Our experts balance electricity generation and consumption and ensure that the power is transported to where it is needed.

In the **SYSTEM CONTROL ROOM** in Brauweiler near Cologne, Amprion's high-voltage network is controlled and the northern part of the European transmission network is coordinated.

GERMANY, YOUR ENERGY!

Wind and solar energy is booming, nuclear energy is being decommissioned – the energy transition is changing the energy landscape in Germany in a significant way. This is particularly evident in places such as Wilhelmshaven and Puchheim, or by people such as Harald Schwager and Franz Untersteller.

PHOTOS · **MATTHIAS HASLAUER** TEXT · **HEIMO FISCHER**

When Uwe Herzig talks about his career, he tells the story of wind power at the same time. As a student of electrical engineering, he was involved with renewable energies in the wake of Chernobyl. His route took him via research institutes and community participation organisations to his own wind farm. “Electricity companies and grid operators were sceptical about these forms of generation in the 1990s”, says the 54-year old, who is now the spokesperson for the network working group at the German Wind Energy Association. But, later, they recognised the potential.

One of the wind farms that he was involved in building is near Wilhelmshaven. The place where the motorway and a multilane federal highway cross. This is the ideal area to use. It is only a few kilometres from the sea, the wind is strong. There are many locations like this in Lower Saxony. That is why wind power is booming: today, 5,500 devices could, in theory, generate 7.6 gigawatts of electricity – the same amount as five nuclear power stations.

However, wind power is volatile: if there is no wind, the wind farms only generate little electricity. When the wind is blowing strongly, more energy could be generated than the amounts that grids can transport away. “Therefore, devices often have to be switched off when they are at medium performance level,” says Herzig. Although at the same time, there is not enough electricity in other parts of Germany. “This is why the grid expansion that has been long-delayed has to be accelerated,” he insists. Only then can a new chapter in the story of wind power begin.

Uwe Herzig

SPOKESPERSON FOR THE NETWORK WORKING GROUP AT THE GERMAN WIND ENERGY ASSOCIATION, WILHELMSHAVEN

Dr Harald Schwager

MEMBER OF THE BOARD OF BASF SE, LUDWIGSHAFEN

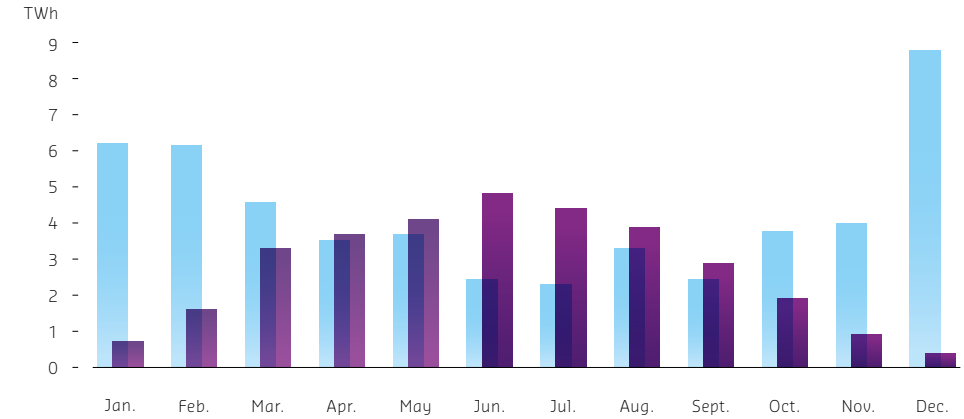
BASF, as the largest chemical company in the world, needs electricity, heat and natural gas – as energy sources and raw materials. They form the basis for thousands of chemical products. “Raw materials are further refined partly by using energy-intensive process steps,” says BASF Chairman Harald Schwager. “So for us, the availability of energy is a basic prerequisite for our production to function.”

The manager, born in 1960, describes the chemical industry as an association with many branches where one cog drives the next. If there are waste products in one production process, they are often used in a different place as input materials. These processes must run smoothly. So security of supply is critical for BASF. Schwager places high demands on transmission system operators such as Amprion: “We expect an uninterrupted supply of electricity with only minor voltage fluctuations.” Even if power were out for only a thousandth of a second, highly sensitive security systems could interrupt the production and cause high costs.

This is why Schwager has reflected seriously on the state of the German electricity grid. The existing power lines are not strong enough, in his view, to transport the wind energy generated in the north to the consumption centres in the west and south of Germany. “The grid bottlenecks in Germany have to be removed urgently,” he says. Otherwise, the security of supply could deteriorate – to the disadvantage of private consumers and companies, such as BASF, which want to remain internationally competitive.

WEATHER-DEPENDENT

Solar and wind power 2014, a seasonal comparison (Germany)



Monthly power generation from wind farms (TWh)
Monthly power generation from solar facilities (TWh)

Source: Fraunhofer Institute for Solar Energy Systems

PRIORITY FOR RENEWABLES

Future generation capacities in Germany (in GW)

	nuclear energy	solar energy	wind energy
2012	12	33	31
2024	0	56	68
2034	0	60	97

Source: GDP 2014 (Draft), Scenario B

SECURITY OF SUPPLY

International comparison of power outages (in minutes)

Denmark	Germany	France	Poland	Romania	Sweden
14.8	15.9	60.1	254	630	84

Source: CEER Benchmarking Report Update 2013

Franz Untersteller

MINISTER OF THE ENVIRONMENT, CLIMATE PROTECTION AND THE ENERGY SECTOR OF THE BADEN-WÜRTTEMBERG PARLIAMENT, PHILIPPSBURG

Rheinschanzinsel near Karlsruhe is an important place for Baden-Württemberg's energy supply. Nestling between the Rhine and one of the old branches of the river, the nuclear power station Philippsburg is located there. Since 1979, it has supplied large parts of the federal state with electricity. That will end in 2019. Philippsburg will be decommissioned in that year.

However, the island in the Rhine will remain just as important for energy supply in the state. Because in the future, new power lines will end in Philippsburg and Neckarwestheim, where Baden-Württemberg's last two operational nuclear power stations are located now, and they will bring power from north Germany to the south-west. Their targets are the connection points near the power stations which will allow the transition into the power lines that branch out into the region. "The existing grid infrastructure can be best used in this way," says Baden-Württemberg's environment minister Franz Untersteller (Alliance 90/The Greens).

His state will need imported electricity in the future. "In the facilities in Baden-Württemberg, we generate about 60 terawatt hours of electricity per year, but we have a gross requirement of about 80 terawatt hours," Untersteller works out. The missing volume will be brought in via modern DC current power lines from north Germany in the future.

By the time Philippsburg (in 2019) and Neckarwestheim (in 2022) leave the grid, the power lines must be ready. "Time is moving quickly," says the minister and father of two adult children. "However, grid expansion will also have a major impact on the landscape, environment and biotopes. That is why it is important to close ranks with the local population. Politicians and transmission system operators must always be aware of that."

Dr Thomas Maier-Eschenlohr

FARMER, PUCHHEIM

Raising pigs, cattle and poultry is a difficult business – particularly for small farms. That is why Thomas Maier-Eschenlohr was looking for new business areas for the family farm in Puchheim in Bavaria. A few years ago, he ventured into unknown territory: the 35-year-old became an electricity generator.

A solar facility of 600 square metres on the roof of the barn transforms sunshine into electricity and feeds enough power into the grid for about 20 average households. Maier-Eschenlohr receives just under 24 cents per kilowatt hour for this – based on the Renewable Energy Sources Act (EEG). “The sustainability and profitability of energy generation were the most important criteria for me,” says the farmer. Hundreds of thousands of Germans had the same idea and installed solar facilities. Solar energy has become a main pillar of the decentralised energy supply – as opposed to central generation using conventional power stations. When comparing the federal states, Bavaria is far ahead in terms of solar panels on buildings and open areas.

The increasing number of solar facilities places high demands on the power line grid: it has to transport power and simultaneously absorb energy fed in locally. The operators ensure that the grids do not break down. They have just installed remote controls on the Puchheim farmer’s roof. This means that the solar facility can be switched off remotely if necessary. Meanwhile, Thomas Maier-Eschenlohr is taking care of a new business idea: his company is producing insulated packaging from straw. He sources this, naturally, from his own farm.

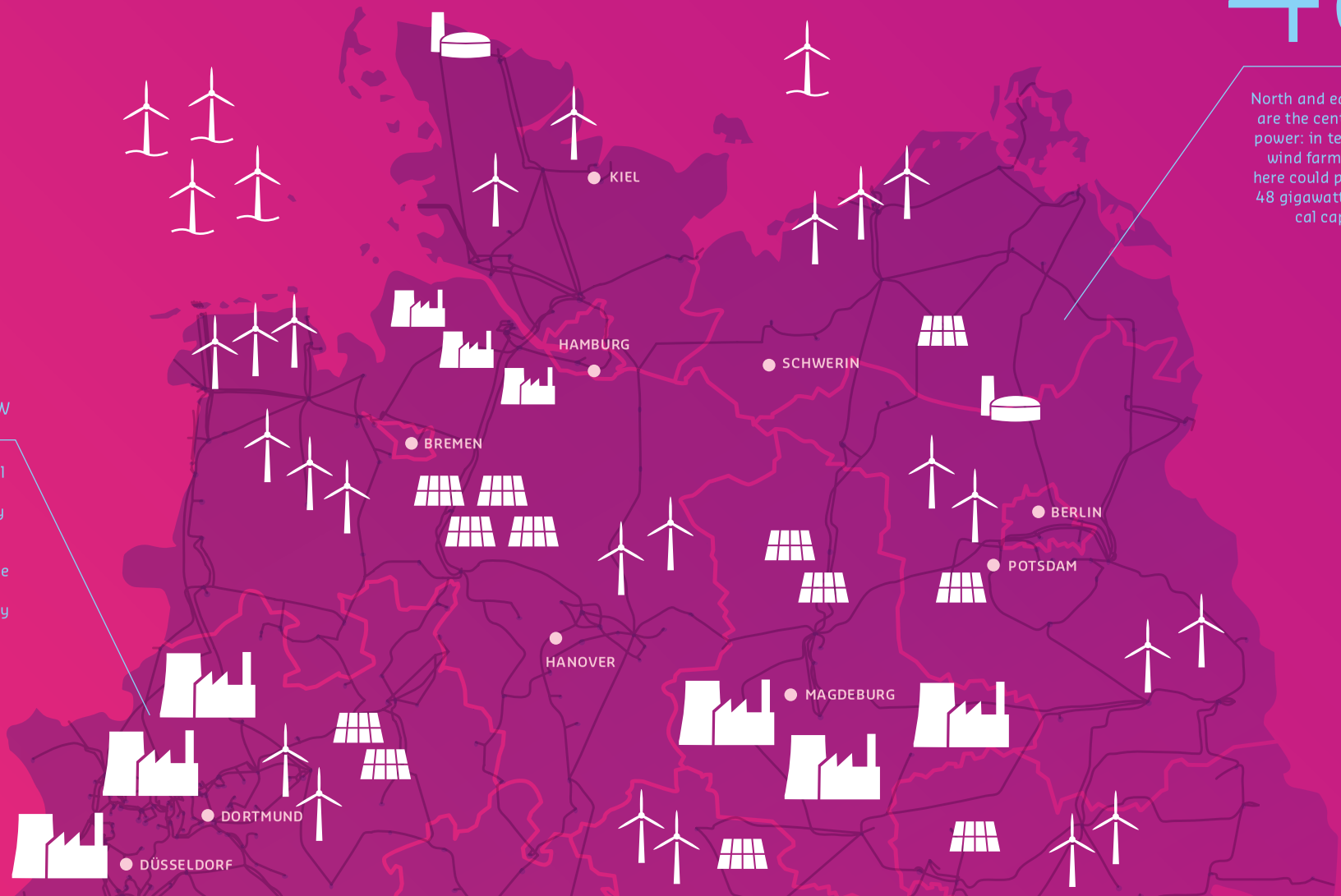
TOMORROW'S ENERGY WORLD

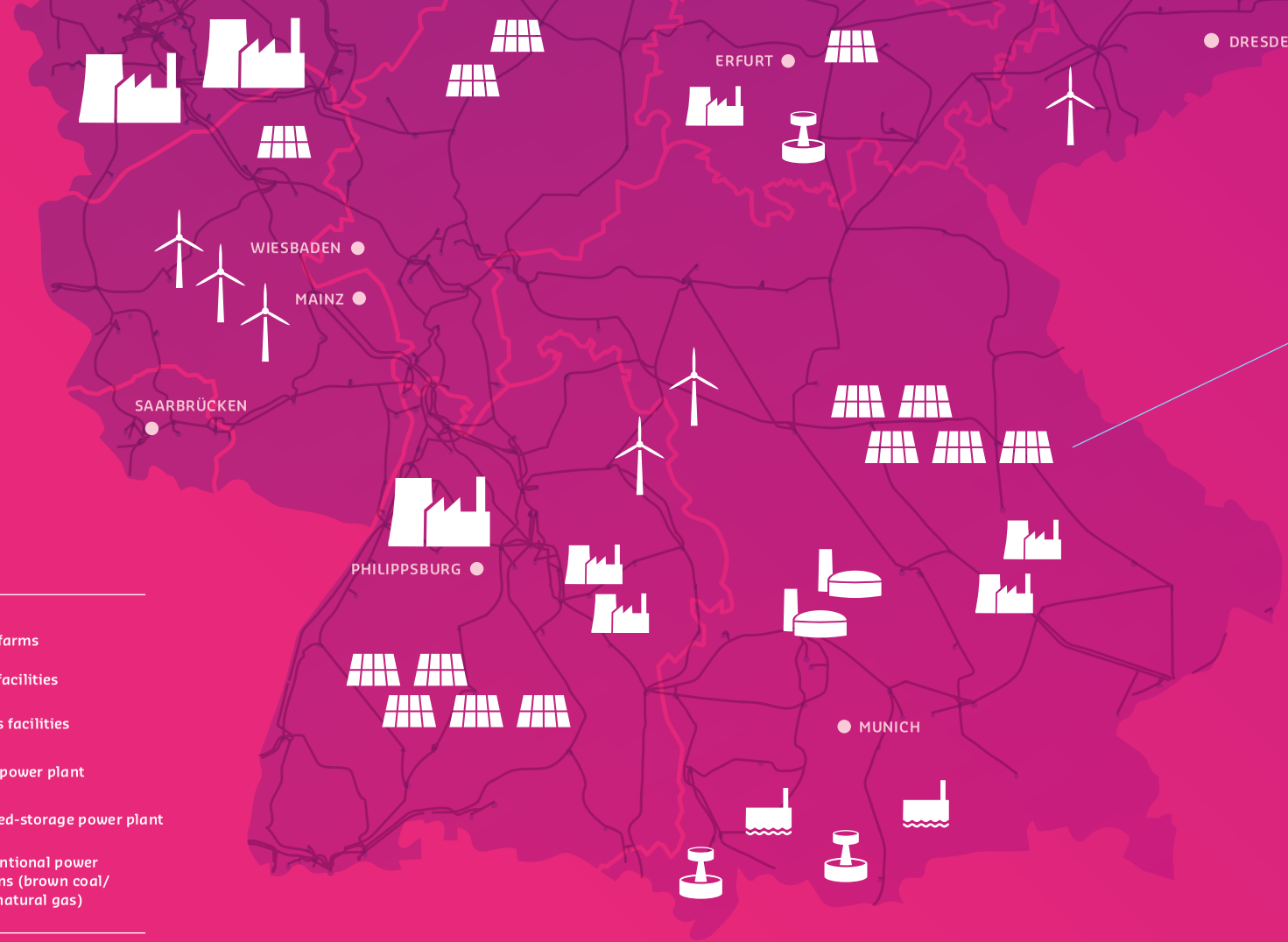
48 GW

North and east Germany are the centres of wind power: in ten years, the wind farms installed here could provide up to 48 gigawatts of electrical capacity.

33 GW

In 2024 the conventional power stations in the western part of Germany with a generation capacity of about 33 gigawatts are still a guarantee of a secure and non-weather-dependent supply of power.





21 GW

In southern Germany, the sun will become the main energy supplier. In ten years, the capacity of the solar panels there could add up to about 21 gigawatts.

- Wind farms
- Solar facilities
- Biogas facilities
- Hydropower plant
- Pumped-storage power plant
- Conventional power stations (brown coal/ coal/natural gas)

The German energy landscape

is changing: by 2022, all nuclear power stations will have been removed from the grid. At the same time, renewables continue to increase: the capacity of wind farms, which mainly generate power in the north of Germany, is expected to double to 68 gigawatts in the next ten years. The capacity of solar facilities is also increasing by almost 40 per cent to 55 gigawatts – mainly in the south. Because wind and sun cannot always supply power reliably, conventional power stations will also be needed in the future. The power generated, however, must be delivered to the consumers. We, as transmission system operators, are responsible for that, and that is why we are expanding our grid.

ELECTRICITY WITHOUT BORDERS

Europe is growing closer together – even in the energy sector. Klaus-Dieter Borchardt, the European Commission's director of the internal energy market, on the network expansion in Europe and the role of Amprion.

ILLUSTRATION · **TINA BERNING**

GERMANY IS WORKING TOWARDS THE ENERGY TRANSITION. IS THERE A SIMILAR DEVELOPMENT ON A EUROPEAN LEVEL?

Yes. The EU member states agreed on ambitious climate targets in 2014: by 2030, there should be a fall of 40 per cent in greenhouse gas emissions compared to 1990 and at least 27 per cent of the energy needs should be met by renewable sources. That is why we need a European internal energy market. It is the most cost-efficient way of ensuring a safe, environmentally friendly and affordable energy supply.

WHAT WILL BE THE BENEFITS FOR EUROPEAN CITIZENS?

Electricity generation will become more sustainable. In addition, more intense competition among generators will also bring about lower prices in the medium term. There is another important issue: once the national grids are more closely connected with each other, the security of energy supply will increase. This is because we will be able to distribute the fluctuating green electricity in a better way and reduce supply bottlenecks, such as the ones in Belgium at the moment. You could summarise it in this way: without the EU internal market, it will not be possible to implement the energy transition.

HOW IS IT POSSIBLE TO CREATE A PAN-EUROPEAN ELECTRICITY NETWORK FROM THE MANY NATIONAL GRIDS?

There is already a European electricity network, we now have to ensure that it is fit for the future. We are working intensively on this in the European Commission. The current focus is on developing harmonised rules for network operation throughout Europe and, of course, on expanding the network. And there is an urgent need for this because bottlenecks within a market are critical. Germany is a good example. Here, the increasing energy supply from renewable sources in northern Germany at the same time as decommissioning power stations in southern Germany makes it necessary to construct new power lines.

KLAUS-DIETER BORCHARDT

manages the Internal Energy Market Directorate
of the European Commission

WHAT OBSTACLES ARE THERE, FROM YOUR POINT OF VIEW, FOR EXPANSION OF THE NETWORK AND HOW CAN THEY BE REMOVED?

The network expansion must not be delayed any further. If it is, the security of supply would decrease, which is damaging to the economy, especially for a highly developed country such as Germany. In order to avoid this, any existing administrative and coordination obstacles must be removed. Just as important is the dialogue with the affected citizens in order to find satisfactory solutions.

WHAT IS THE EUROPEAN COMMISSION DOING TO ACCELERATE THE NETWORK EXPANSION?

Together with the member states, the Commission determines the most important network expansion projects, the projects that represent common interests. The member states must ensure that the planning and authorisation procedures for these projects are pushed ahead especially quickly. These projects could also be eligible for EU subsidies under certain circumstances.

WHAT IS AMPRION'S ROLE IN THE EUROPEAN NETWORK DEVELOPMENT?

Amprion is involved in several strategic EU infrastructure projects of common interest. These include, for example, the direct current connections ALEGrO, Ultranet and the Corridor D. Two other important issues are the creation of European rules for network operation, as mentioned before – the so-called Network Code – and the "e-Highway 2050" project which is supported by the Commission. In this regard, Amprion, together with other European network operators, is developing a long-term plan for the electricity infrastructure. The results will make it easier to expand large renewable electricity generation beyond the EU borders.

~50,000

KILOMETRES

of extra high-voltage transmission lines, based on the estimate of the European transmission system operators, must be built or modernised by 2030.

~150

BILLION EUROS

could be the cost of this expansion of the European transmission network by 2030.

80

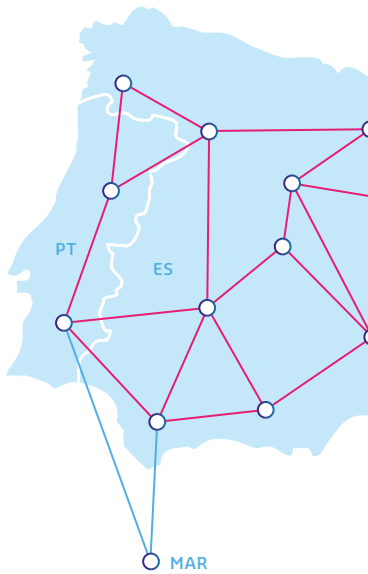
PER CENT

of the CO_2 emissions in the EU are to be reduced by 2050.

27

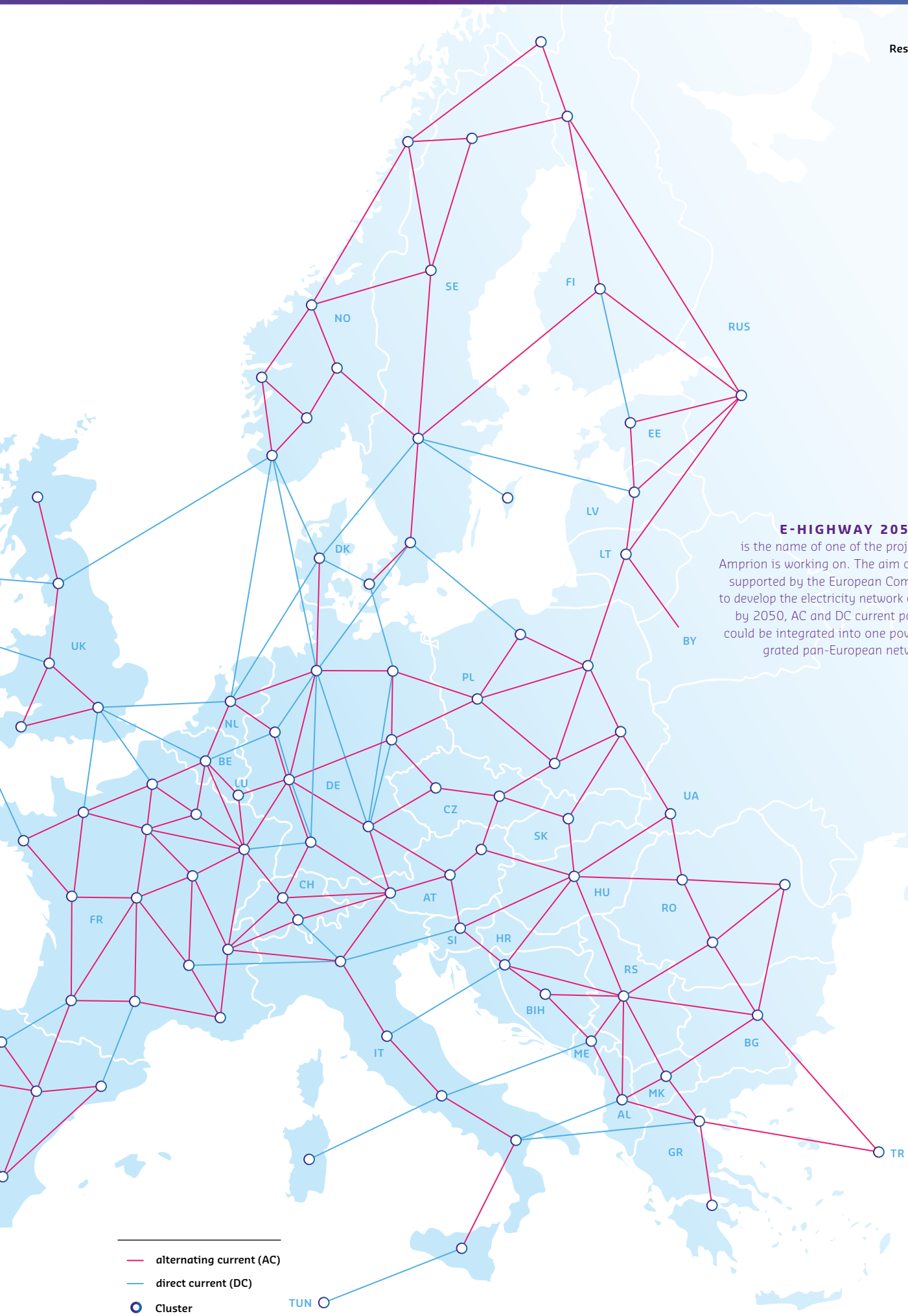
PER CENT

is to be the share of renewables of the overall energy consumption in the EU by 2030.



The European network of the future

Power generation in Europe is changing – towards more sustainability and lower greenhouse gas emissions. In order for this "energy transition" to succeed, the European electricity grid must be made even more efficient and closely integrated in the future. The European network operators are working on this in many projects.



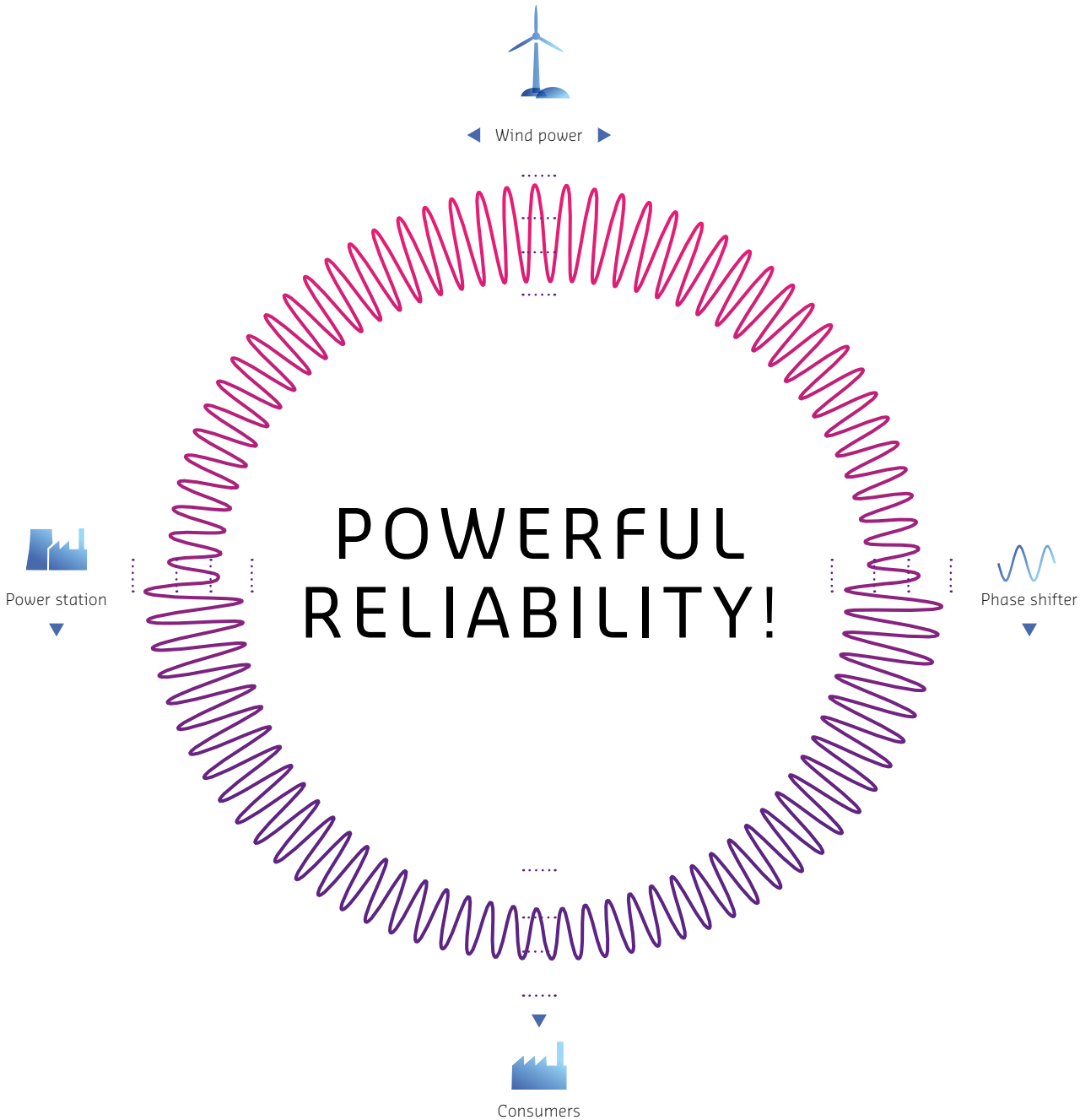
E-HIGHWAY 2050
is the name of one of the projects that Amprion is working on. The aim of the project supported by the European Commission is to develop the electricity network of the future: by 2050, AC and DC current power lines could be integrated into one powerful, integrated pan-European network.

3

NEW START

Amprion is developing new solutions so that the transmission network functions securely now and in the future. From phase shifters to stabilising the voltage to underground cable pilot routes in the high-voltage network – we use innovative technologies. And our employees deliver the highest performance every day in order to achieve this.

11,000 KILOMETRES is the current length of Amprion's transmission network. It can only transport power securely and reliably if it is regularly maintained and repaired.



PHASE SHIFTERS STABILISE THE GRID

In order to move the electricity generated by wind power in the north to the consumers in the south, the voltage must be supported on the way – either by power stations, or, where these are being decommissioned, by new facilities, such as rotating phase shifters.

Minimum and maximum voltage corridor. The voltage must not go above or below these limits.

Electricity must flow as evenly as possible. However, during the energy transition period, this brings technical challenges. Amprion is making plans to take care of this – using innovative technologies which balance out the voltage in the grid.

TEXT · **SÖNKE GÄTHKE**

How does an electricity grid work? Why does it need voltage? And what do power stations actually do? Questions like these have always fascinated Martin Lösing. He is responsible for grid analyses at Amprion. This particular morning, he is trying to explain the world of physical phenomena to a layperson, and why new technology is needed to guarantee the security of the electricity grids in the future as well.

"Electricity does not just flow on its own," says the 57-year-old. "It does not have any mass, so it can't just flow down a gradient and turn a wheel or a turbine like water." "So power stations create an artificial gradient – the voltage – which allows the electricity to flow to the customers through the electricity grids." However, in contrast to a natural gradient, the voltage does not remain constant. It changes according to the laws of physics. So transmission system operators like Amprion monitor and regulate it around the clock, so that the flow of electricity remains steady.

What bothers Lösing: maintaining voltage in the electricity grid, particularly in southern Germany, will be the most challenging task. Because, as part of the phaseout of nuclear power and the energy transition, more and more conventional power stations are being decommissioned. At the same time, the flows of electricity in the grid are changing far more quickly and powerfully than before. This is, on the one hand, because the feed-in from wind and solar facilities can change very quickly, and on the other hand, because the Europe-wide electricity trade influences generation and consumption of electricity, sometimes in unexpected ways.

In order to maintain a steady voltage in the electricity network, even with fewer conventional power stations, Amprion engineers are looking to new, innovative technologies. They have been working more intensively on this since the German government removed eight nuclear power stations from the grid after the nuclear catastrophe in Fukushima in 2011.

The most important technologies are called "Static Synchronous Compensator" – "statcom" for short – and "phase shifters". When Martin Lösing explains how they work exactly, he has to dig deeper. He then talks about a phenomenon that non-engineers hardly ever hear about: "reactive power". Admittedly: it is even more difficult to understand than the phenomenon of electricity. While it is at least possible to show the effect of electricity, for example, by switching on the lights, it is not even possible to do that with reactive power. It does not produce anything. Almost nothing, because it does have one effect: just like invisible oil, it

380–420

KILOVOLTS
is the corridor within which the network voltage has to move.

enables AC current to flow through the power lines from the generator to the consumer. Unfortunately, the reactive power gets used up and needs to be "refilled" so that the electricity can flow constantly.

It is possible to see that the reactive power is at the "full level" by looking at the voltage in the grid: if the use of reactive power increases in a power line, the grid voltage decreases. In this case, more reactive power needs to be fed into the grid. But, now the electricity lines only have a limited capacity. The more reactive power there is in them, the less space there is for the so-called effective power – that is the important part of the electricity whose effect you can see, for example, when you switch on a light. So the transmission system operators keep the "full level" as high as necessary but also as low as possible. It is a balancing act that until now has been carried out locally by power stations.

One of the technologies that can also generate reactive power without power stations is "statcoms". Using clever switching of many electronic components, these facilities generate reactive power from the electricity that is flowing through the power lines. Statcoms work quickly, precisely and economically. But the components are sensitive. For example, if lightning strikes a power line, it needs to be switched off quickly.

The "phase shifter" technology is more robust. In principle, it is based on an electric motor which is powered by the grid. This technology also creates the "lubricating oil" reactive power from the electricity flowing in the power line. However, this time it is a motor that creates it and not electronic components as with the statcoms technology. This makes the phase shifter less vulnerable to short circuits. In addition, the electric motor with its rotor of several hundred tonnes rotating at 3,000 revolutions per minute also acts as an accumulator, which can automatically balance out small frequency fluctuations in the electricity grid with its rotating mass.

The Amprion engineers tested how well these technologies work in cooperation with Siemens and RWE Power in Biblis. When the nuclear power station there was the first

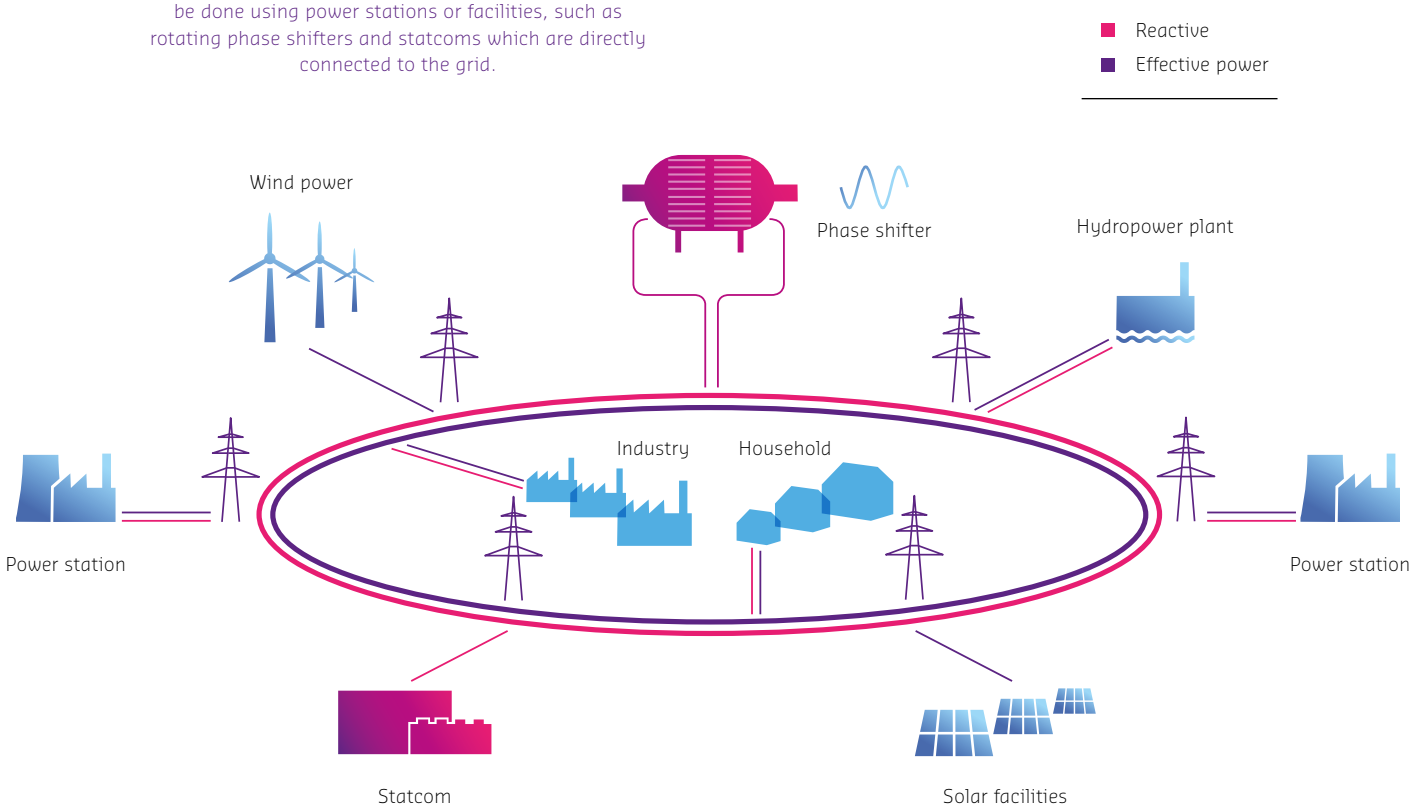
one in Germany to go offline in 2011 after Fukushima, there was an immediate gap in the reactive power in the grid. This gap needed to be filled before the electricity demand grew in the winter, and with it the demand for reactive power.

In Biblis, the engineers worked out that the quickest solution was to convert one of the power station generators in the non-nuclear part of the nuclear power station into a phase shifter. They separated the generator from the power station turbines, provided it with new mounts and a starting device, among other things. This project was unique in the world. In February 2012, this phase shifter came into operation. It will feed reactive power into the grid until at least 2018 before it is replaced by alternative technologies.

Amprion relies on statcom technology as well as phase shifter technology. “They can both be justified,” says Martin Lösing. Specifically, Amprion is planning in the southern part of the grid statcom containers – the first is expected to go onto the grid in 2017 in Kriftel in Hesse – and new phase shifters. They work like the one in Biblis, but they are smaller. However, their effect is big. Because together these technologies contribute to making the electricity grid more secure.

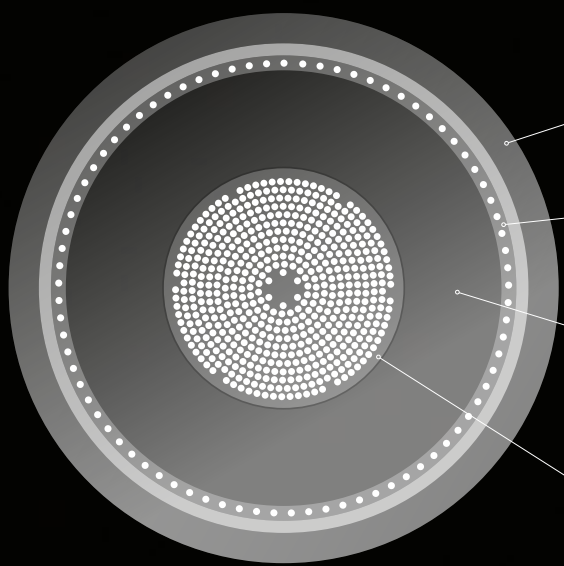
PHASE SHIFTERS

When high levels of power are being transmitted over the grid, the power lines need reactive power. This has to be delivered subsequently, so to speak. This can only be done using power stations or facilities, such as rotating phase shifters and statcoms which are directly connected to the grid.



DOWN INTO THE EARTH

CROSS SECTION OF AN UNDERGROUND CABLE
Diameter 15.5 cm



Cable housing
provides protection for the cable, particularly against moisture

Electrical shielding
consists of copper wires and helps to control the electrical field and conduct away residual currents

Insulation layer
2.7 cm, consists of cross-linked polyethylene (PEX), provides insulation for the voltage

Copper wire
Diameter 6.5 cm, conducts the electricity

In the Münsterland region, Amprion is laying electricity cables at a voltage level of 380 kilovolts underground for the first time. Many citizens have high hopes for this technology. What can it do in reality?

PHOTOS · **LUTZ KAMPERT · CHRISTIAN NIESSING · FRANK PETERSCHRÖDER**
TEXT · **SÖNKE GÄTHKE**

The heavy loads usually arrive in Raesfeld in Münsterland in the early morning hours. Two lorries, sometimes three, one behind the other turn before the village into a side road towards the Amprion construction site. Between October and December 2014, they make 15 journeys. They are loaded with enormous cable drums: 55 tonnes, more than four metres high. When it's light, the workers hook the drums into the chains of a special crane and let them swing carefully onto a frame. From there, the cable, which is as thick as an arm, is unrolled and disappears into one of twelve pipes in the ground.

The construction work has been going on since June 2014. Over a length of 3.4 kilometres, workers have removed earth in sections, they have laid pipes two metres deep and refilled the earth. There is only the topsoil left to replace. The construction site moves through the landscape as a brown strip in the winter of 2014/15 as far as the electricity pylons in the distance. In the future, 3.6 gigawatts of electrical capacity will be transmitted through the underground cable. This would be able to supply roughly 3.5 million people.

This is pioneering work by Amprion: for the first time in Germany, extra high-voltage electricity of 380 kilowatts will not be flowing through overhead lines on pylons but through cables directly in the earth. Amprion is testing the underground electricity route on a section of the planned connection between Wesel and Meppen.

Many people have high expectations for this new technology. All over the land, citizen action groups are demanding that electricity networks be expanded and at the same time that the environment is protected. But, the transmission system operators are forging new ground with the underground cables. This is demonstrated in Raesfeld, as can be seen already at the construction stage. "We are facing major technical and ecological challenges," says Christoph Gehlen, responsible for building the power lines at Amprion.

"So the insulation within a cable with this level of voltage is very demanding," adds the engineer. In overhead lines, the surrounding air takes care of this. In contrast, underground cables are technology carriers that are far more elaborate to construct: every cable comprises copper bundles which are enclosed in plastic and metal shields. In addition to this, there are the coupling sleeves and terminations. In order to transport the large amount of electricity power of 3.6 gigawatts, twelve cable harnesses are also needed. They are laid apart from each other for thermic reasons and therefore need space.

When Amprion announced in 2009 that they were going to lay underground cables in Münsterland, the local residents were initially impressed. "As time has gone by, the opinions have grown apart," reports Raesfeld's mayor Andreas Grotendorst. "We were certainly surprised by the size of the construction site." At 42 metres, it is almost as wide as a motorway.

The farmers in Raesfeld are also concerned about these dimensions. They are worried that the arable land surrounding the route could suffer damage. "The soil is our capital. We need it to earn our money," says Raesfeld farmer Bernd Nienhaus. He represents the roughly 20 farmers affected and participates in the weekly construction meetings at the invitation of Amprion.

The construction site for the underground cables was up to 42 metres wide. The most difficult part was tunnelling under the federal road 70.

» Our pilot project in Raesfeld shows how much work is involved in putting high-voltage cables underground.«

LUDGER MEIER, DEPARTMENT MANAGER FOR OPERATIONS AND PROJECT PLANNING

The cabling in the high-voltage network represents a significant disruption of the earth – it is important to keep this to a minimum. Amprion is committed to working in a way that protects the soil, and has developed a new process for this: the workers removed layers of earth one by one at the start of the construction work and stored them separately in order to replace them in the same order after the pipes had been laid. A geoscientist is supervising the work. "That is a good feeling," says farmer Bernd Nienhaus. Another thing that helps is that the temperature and moisture of the soil are measured along the route. Special liquid soil surrounding the power cables will later be used to remove the heat produced by operating the underground electricity connections. "This means, there will be no restrictions to the farmers cultivating their fields after the construction," says Amprion Project Manager Ludger Jungnitz.

He wants to have the work in Raesfeld finished by early summer 2015. The only thing remaining will be a protective strip of a good 20 metres, which the farmer will be able to plough as normal but, for example, will not be able to plant trees in. That is important in order to protect the underground cables. Apart from that, they must also remain accessible so that any incidents can be dealt with quickly in an emergency.

Similarly, repairs to underground cables require a large amount of work compared to overhead lines. Even more so when the sections to be repaired are located under streets or bodies of water. Ludger Meier, department manager for Operations and Project Planning at Amprion, explains: "We are facing the challenges of the new technology. However, we don't know yet whether they will satisfy the high requirements regarding the reliability of our transmission grid."

The people of Raesfeld will continue to monitor the pilot project closely. "Amprion has done everything possible in constructing the underground cable," says mayor Grotendorst. "We will see if that is enough." Farmer Nienhaus adds: "Of course, there were disagreements and arguments at times, but in the end we always found common ground."

"For a pilot project," says Amprion Manager Meier, "the construction in Raesfeld is going very well. But it shows how much work is involved in underground cables transmitting power of almost four gigawatts." The bottom line is that one kilometre of underground cable is six times more expensive than one kilometre of overhead line. That is also the reason that the cable will not become the ideal solution for the grid expansion. But it is an important option for suitable sections in order to increase the local acceptance and to be able to move forward with the grid expansion.

TOP PERFORMANCE

The energy transition brings unique challenges with it. Never have so many electrical power lines been strengthened or newly built. The Amprion employees are working hard to make the grid fit for the future.

PHOTOS · **ANDREAS FECHNER** · **NORBERT HÜTTERMANN** · **MARCUS PIETREK**

»For the energy transition, we want to expand our grid in a demand-oriented, resource-friendly and, as far as possible, mutual way. In order to do this, we need to be planners, technicians, diplomats and communicators at the same time. I am fascinated by finding the best solution for everyone involved.«

Dr Ingo Jürgens in Amprion's Asset Management division plans grid expansion projects

» In Human Resources Development, we are preparing our colleagues to be ready for the challenges of the energy transition. As service providers and advisers, we want to offer everyone the best qualifications possible. Individual advices and solutions – that's what we are commited to on a daily basis! «

Dr Christina Wiebusch is responsible at Amprion for Human Resources and Management Development

» When power lines are being constructed or serviced, they cannot be live. My colleagues and I are responsible for activating them. Even if our workload has increased, we work with caution and enthusiasm every day. «

Mareike Heming is responsible for operational technology in Amprion substations

»Every year, we inspect and maintain hundreds of electricity pylons, we replace insulators and we are responsible for servicing the lines. At the moment, the first 380,000 volt underground cables are being laid in our grid region: it is a completely new technology for us and we are excited about it.«

Jonas-Daniel Glane repairs electricity pylons and power lines in the northern operations of Amprion

» In order to determine the EEG allocation, we forecast how much electricity will be produced by wind and solar energy. It is a complicated job for which you need a lot of experience and know-how. We make every effort to improve our forecasts continuously. «

Rainer Bause deals with fundamental questions in the Amprion division Grid Management

AMPRION IN DIALOGUE 2014

Information, explanation, participation – these are important aspects for Amprion. There are many positive examples of them in 2014.

JANUARY

DIALOGUE ABOUT CORRIDOR D

In January 2014, Amprion starts the citizen dialogue about the planned corridor D from Saxony-Anhalt to Bavaria. The aim is to provide information about potential route corridors even before the Federal Sectoral Planning. Local residents in Donauwörth and Nuremberg are airing their grievances because they feel they have been presented with a fait accompli. "We were surprised by the intensity of the protests," says Amprion Managing Director Dr Hans-Jürgen Brick. "We have learnt our lesson since then."

APRIL

MEDIATION PROCESS FOR TRANSFORMER STATION

Amprion and the local action groups "Menschen unter Strom" (People under Electricity) start a mediation process in April 2014 in order to reach mutual agreement about the expansion of the transformer station in Garenfeld near Hagen. This process, which is unique in Germany, ends in December after 17 meetings with a consensus which is "a win for all involved," according to a spokesperson for the local action group.

SEPTEMBER

"CONSTRUCTION SITE OPEN DAY" AT THE UNDERGROUND CABLE PROJECT

On 14 September 2014, Amprion opens the underground cable construction site in Raesfeld in the Borken region to the public. More than 2,000 people come and visit the accompanying exhibition and see the excavation works (see page 46). As well as dialogue with the public, the weekly meetings with the affected farmers are also part of the everyday life of the pilot project's construction site.

OCTOBER

CITIZEN PARTICIPATION ONLINE FOR ALEGRO PLANS

In October 2014, Amprion releases the website www.alegrodialog.de in order to enable citizens to participate in the planning of the German-Belgian network expansion project ALEGrO (see page 16). Before that, there are information markets in the region. "We are treading new paths with this online platform," says Project Communicator Joëlle Bouillon. "The comments from local citizens are very valuable for us."

NOVEMBER

COOPERATION WITH THE MUNICIPALITY IN ROUTE IDENTIFICATION PROCESS

In November 2014, Amprion and the Bissendorf district near Osnabrück jointly invite citizens to discuss the power line construction project Osnabrück-Lüstringen. A group of experts has prepared potential routes in advance. The cooperation partners want to develop the most widely accepted route before the official approval process.

DECEMBER

DIALOGUE ABOUT ULTRANET CONVERTER LOCATION

In December 2014, Amprion presents the preferred location for the converter of the DC current connection Ultranet. The area in Kaarst near Düsseldorf is the one that best corresponds to the wishes of the citizens, with the furthest distance from the residential areas. Previously, Amprion, together with the affected municipalities, has developed location criteria for the converter and used these to react to the protests of citizens in the Rhine district of Neuss.

IMPRINT

ONLINE

Further information is available at www.amprion.net

PUBLISHER

Amprion GmbH
Tel. +49 0231 5849-14109
Fax +49 0231 5849-14188
Email info@amprion.net

CONCEPT AND DESIGN

3st kommunikation GmbH

PHOTOS

(if not identified in the article)

Thomas Bauer [pages 40 – 41]
Matthias Haslauer [pages 8 – 9]
Marcus Pietrek [cover, pages 26 – 27]
Plainpicture [pages 11, 46]
Shutterstock [pages 32]
Thinkstock [pages 28]

PRINTING

Eberl Print GmbH

MIX
Paper from responsible sources
FSC® C002727
www.fsc.org

carbon neutral
natureOffice.com | DE-141-079214
print production

NOTE REGARDING USE OF MALE / FEMALE

We would appreciate your understanding that for reasons of readability, we have not used the male and female forms of language throughout. Naturally, all texts refer equally to men and women.

Amprion GmbH
Rheinlanddamm 24
44139 Dortmund

May 2015