

# transition

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**“The goals  
are radical enough.  
But the efforts to achieve them lack  
consistency.”**

Energy transition and climate action are challenging society. dena's Chief Executive Andreas Kuhlmann talks to sociologist Jutta Allmendinger.

## INFRASTRUCTURE

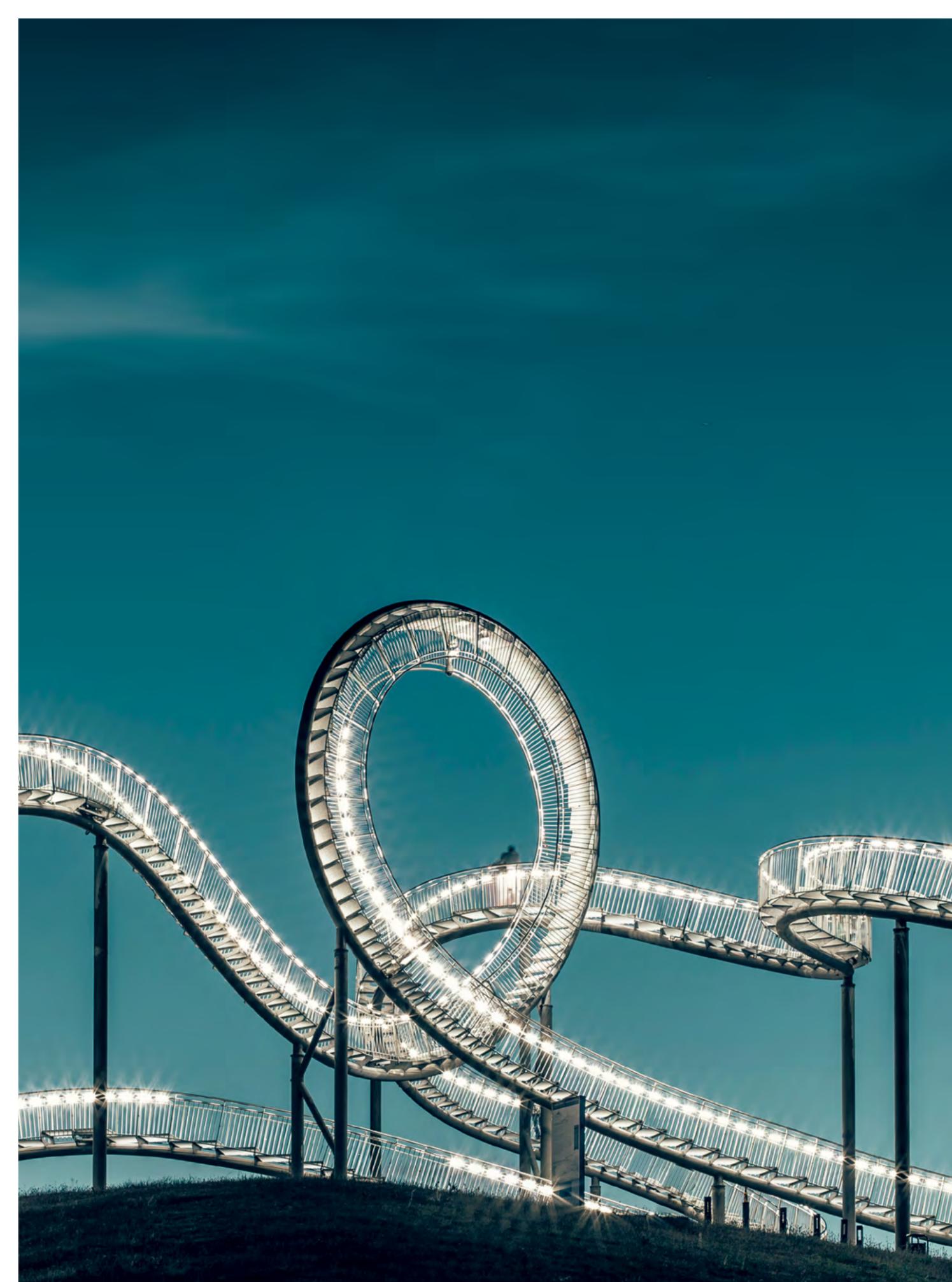
Backbone of the integrated energy transition

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Purchasing green electricity directly from the producer

## FACTS & FIGURES

Key data about dena and an anniversary



Sculpture: Tiger and Turtle, Heike Mutter and Ulrich Genth; photos: MiBo Fotografie/Shutterstock, Silke Reents

EDITORIAL

# transition

From the German Bundestag to the European Parliament, from small companies to large, in laboratories and think tanks, among friends or in public – the energy transition and climate action have become part of the conversation everywhere. Never before have the discourse, the debate, the economic impetus and the social momentum been so intense and so widespread. This opens up immense opportunities for everyone who works in this area and far beyond. We are now tackling the fundamental questions, such as how we as a society can master this crucial transformation while also maintaining our quality of life. What role should politicians play in this? What can the individual do? How willing are we to change overall? This discussion has received too little attention so far, and it is good that we are now addressing it honestly and with broad participation (page 16).

As the title of this issue says, the goals we're setting are radical enough. But the efforts to achieve them lack consistency. Our experience in Germany and in our many international projects has shown us that setting ambitious targets for the energy transition and climate action is not enough. Without the right instruments, appropriate incentives and the willingness to use them, these goals are unachievable. For the tasks that lie ahead – creating an ultimately climate-neutral society and economy by the middle of this century – we must adopt a different approach. We need more consistency and more openness to different technologies and solutions. And above all, we need a new economic framework that can guarantee this.

The good news is that we can build on knowledge and expertise that we have gathered over decades. This is especially true of the German Energy Agency: we'll be celebrating our 20th anniversary in 2020 (page 52). Naturally, we are planning a fitting way to mark two decades of developing practical solutions for realising the energy transition. We'll be in touch to tell you more about that soon.

In the meantime, we hope you enjoy reading this third issue of *transition*.



**Kristina Haverkamp**  
Managing Director



**Andreas Kuhlmann**  
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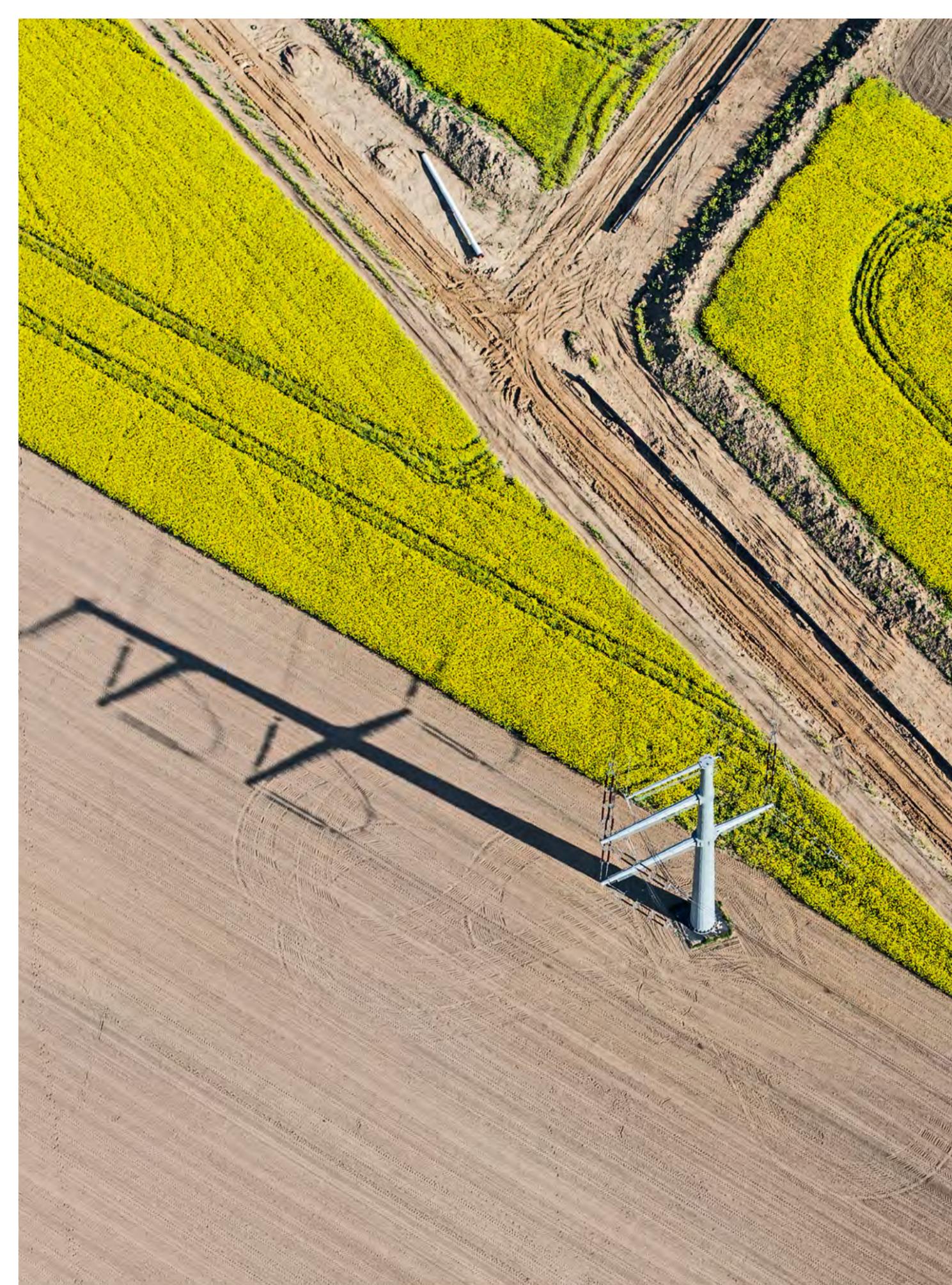


Photo: Spainter vfx/Getty Images/iStockphoto

# THE BIG PICTURE

The energy transition and climate action are two of the major transformation processes of our time. In **The Big Picture**, we look at the key challenges and opportunities they present, and at how we can either overcome or seize them. Is **society** ready for the **changes** that are on the horizon? What can each individual do? What roles and **responsibilities** do politicians have? How can we continue using existing infrastructures and systems?

# Backbone of the energy transition

The integrated energy transition is based on a key foundation: an integrated infrastructure. The existing cable and pipeline systems for electricity, gas, heat and liquid energy carriers must be better interlinked, and further development must be coordinated across all systems. This will be a long road. Initial efforts indicate where the journey might lead.

TEXT Marcus Franken, Hanne May, Hans-Christoph Neidlein

Grid operation is becoming more complex: the Transmission Control Centre run by system operator 50 Hertz just outside Berlin

Photovoltaic panels on almost every roof, large wind farms at sea and on land, millions of heat pumps and battery storage systems, electric and fuel cell vehicles on every road, powerfuels produced by offshore wind farms in the North Sea or by solar farms in North Africa – the energy landscape of a climate-neutral Germany in 2050 is extremely diverse. Renewable electricity is the main source of energy, either consumed directly or used indirectly to produce liquid and gaseous energy carriers or to supply district heating networks.

Making this vision a reality will require an efficient infrastructure that includes and coordinates all levels – the electricity grids, gas grids, heating networks, pipelines, storage systems, filling stations and charging stations. Today's existing infrastructure needs to be used to optimal capacity, linked up, improved, and strategically expanded where necessary. As well as helping to achieve climate targets and guarantee security of supply, this will also optimise costs on the road to a climate-neutral future. "An integrated energy transition, in which a wide variety of energy

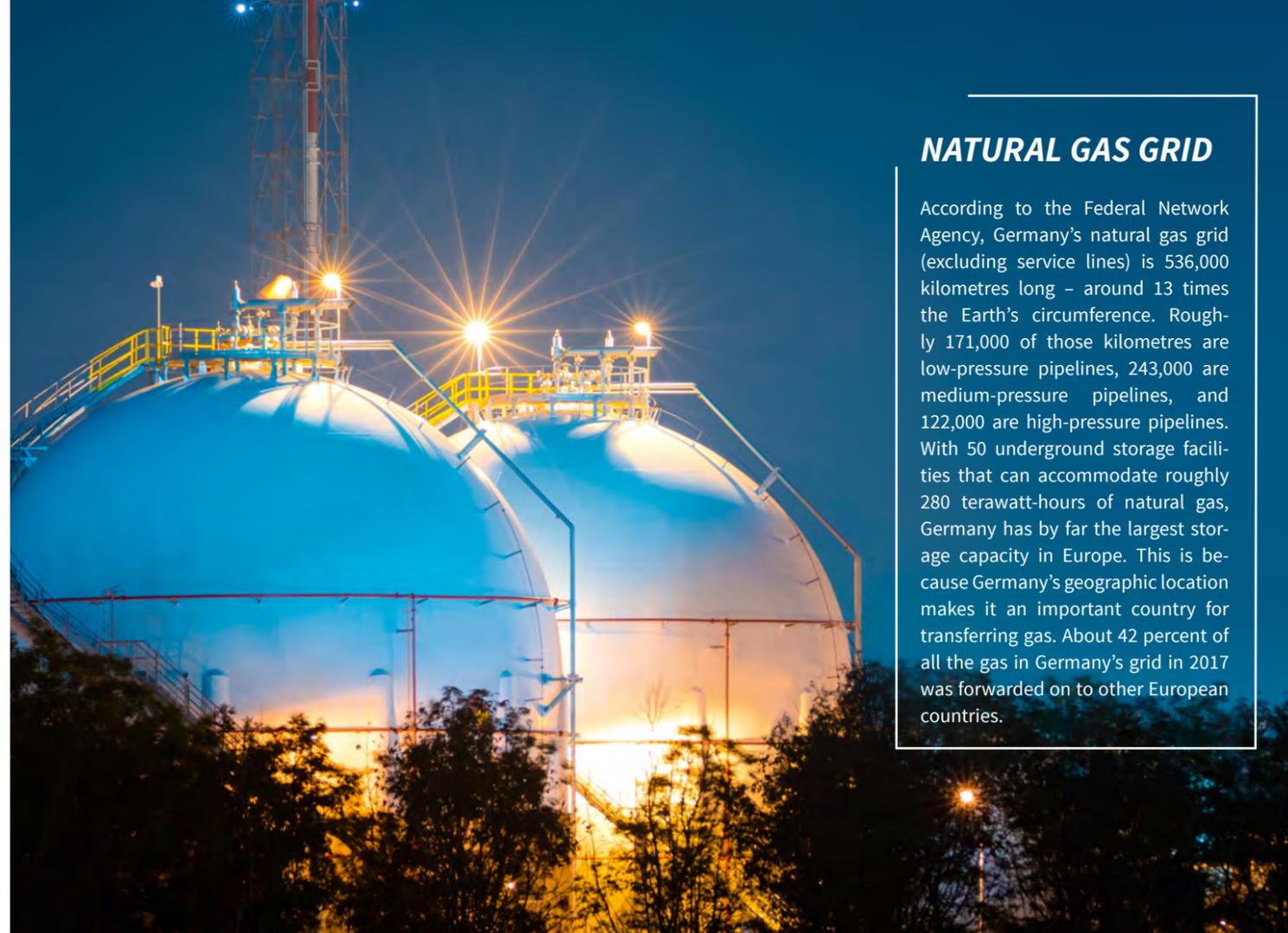
carriers are used, also requires an integrated infrastructure and a comprehensive view of that infrastructure," says Hannes Seidl, Head of Division for Energy Systems and Energy Services at dena.

This type of holistic approach could, for instance, help to reduce the need for curtailing coastal wind turbines in response to bottlenecks in the transmission system that carries the electricity to southern Germany. Using electrolysis to convert wind electricity into hydrogen or green gas that is then stored in the existing gas network or used in industry or transporta-

tion would have multiple benefits. It would allow more renewable electricity to be used, which would be good for the climate. Converting electricity into gaseous energy carriers would also make it possible to store renewable energies and better manage the seasonal fluctuations in the amount of electricity they produce. Not least, it would ease the burden on electricity transmission lines and reduce the costs associated with intervening in the grid; in the first quarter of 2019 alone, wind electricity curtailment reached a record level of more than three billion kilowatt-hours.

## Integrated infrastructure increases flexibility

To avoid this situation, the electricity grids must be expanded across all voltage levels and interlinked with other energy infrastructures. This will increase flexibility and make the entire system significantly more efficient. Germany is still quite far from achieving this kind of holistic approach to its energy infrastructure, and a look back at its history explains why. For many decades, the various infrastructures were planned, built and operated in isolation from each other. As well as focusing on high safety requirements,



## NATURAL GAS GRID

According to the Federal Network Agency, Germany's natural gas grid (excluding service lines) is 536,000 kilometres long – around 13 times the Earth's circumference. Roughly 171,000 of those kilometres are low-pressure pipelines, 243,000 are medium-pressure pipelines, and 122,000 are high-pressure pipelines. With 50 underground storage facilities that can accommodate roughly 280 terawatt-hours of natural gas, Germany has by far the largest storage capacity in Europe. This is because Germany's geographic location makes it an important country for transferring gas. About 42 percent of all the gas in Germany's grid in 2017 was forwarded on to other European countries.

new compressor relieves the pressure on the regional electricity grids, particularly when a lot of wind electricity is being produced that can't be transported to southern Germany," explains Thomas Hühener, Technical Director at Open Grid Europe. The station has been undergoing testing since October 2019. It is part of the "enera" project that is being funded by the Federal Ministry for Economic Affairs and Energy (BMWi) as part of its SINTEG programme.

## ELECTRICITY GRID

Figures from the Federal Network Agency show that Germany's electricity grids are 1.85 million kilometres long, meaning they could circle the Earth 46 times. The extensive low-voltage grids make up most of that – around 1.2 million kilometres. The medium-voltage grids stretch for 520,000 kilometres, and the high- and extra-high-voltage grids total 131,000 kilometres.

each infrastructure system concentrated on its own optimisation and expansion. The same applied when the European energy markets began opening in the late 1990s – a process that was about expanding beyond former territories and national borders.

Requirements only shifted with the expansion of renewable energies and the remodelling and increasing decentralisation of the generation structure. This has created the need for a new approach. A few years ago, Germany introduced a new procedure for establishing the level of expansion required in the medium term: since 2012, the country's electricity transmission system operators have been engaged in a multi-stage process for developing the Grid Development Plan Power; the gas transmission system operators are doing the same for the Grid Development Plan Gas. The plans separately show the need for expansion in the national transmission grids over the next 10 to 15 years. They are updated every two years. Similar processes are happening at the European level, and this is where the first threads are coming together:

the EU has been using jointly agreed scenario frameworks for electricity and gas transmission system planning since 2018.

This is a start, but it is not yet a unified approach. "Energy infrastructure planning still mostly happens separately," says Martin Altröck of BBH, a Berlin law firm specialising in energy legislation. "If we are going to take an integrated energy transition that covers all the energy sectors seriously," adds Seidl, "we have to make sure that the infrastructures are much better coordinated and connected than they are right now."

### Converting wind into gas and heat

Where and how is this already happening? Which solutions are being tested? And what requirements need to be met? One example involves using electrolyzers to connect the electricity and gas grids. Electrolyzers produce hydrogen and synthetic gas from renewable electricity. Several dozen pilot projects are underway in Germany. One of the first is located at a wind farm in Prenzlau in the state of Brandenburg. The company Enertrag has been running a 0.5-megawatt

(MW) electrolyser there for several years now. When the three 2.3-MW wind turbines are turning at full speed, some of the electricity produces hydrogen that can be stored to cover the next slump in output, or fed via a short stub pipeline into the gas grid run by the transmission system operator Ontras. This mixture of natural gas and hydrogen is marketed as "windgas" via a surcharge model through Greenpeace Energy. Enertrag also invested in a filling unit in 2016, partly to supply backup power systems. The hydrogen is sold throughout Germany and can be used to fuel busses and recreational craft, for industrial processes or for electricity production. "Our first customer for the green hydrogen was Total, which wanted it for its filling stations," says Simon Müller, Head of Energy Systems at Enertrag. Now Enertrag is planning another hydrogen hub close to a wind farm in Bahnsdorf, Lusatia. This one will be much bigger, though: the idea is to install an electrolyser with a capacity of up to 100 MW at the new site.

Connecting electricity and heating systems at a municipal level is essentially

nothing new. Combined heat and power systems, which generate electricity and heat simultaneously, have already produced many clever solutions. However, with more electricity being generated from renewable energies, and with electricity becoming more important overall, new approaches are now needed. Public utilities and other energy suppliers are involved in countless projects where, at times when feed-in levels are high, green electricity is used to generate district heating and thereby relieve the electricity grid. This process is known as power-to-heat.

Another approach is on show in Krummhörn, East Frisia. The town is home to a compressor station that is part of the transmission system that brings Norwegian natural gas into Germany's pipelines. To keep the pressure in the transmission system balanced, the gas has to be compressed every 150 to 200 kilometres. In Krummhörn, this is achieved with an electric compressor. The station operator, Open Grid Europe, says that it primarily runs on electricity from renewable sources. "Our

### Driving with battery power and overhead lines

Connecting energy infrastructure with mobility offers particularly great potential. This is true whether the energy is used directly via batteries, or indirectly via synthetic fuels produced using electricity (see page 24). At every level, existing or new infrastructure must be connected with intelligent data management.

If renewable electricity is to be used directly, the most efficient solution is battery-electric technology. Around 5.6 million electric vehicles were on the roads worldwide at the start of 2019, with 142,000 of them in Germany. The number of charging points, a new infrastructure that links electricity and mobility, passed the 21,000-mark in Germany in autumn 2019.

Electromobility is particularly attractive when the vehicles are used to cover relatively short distances and regularly return to the same place. Things become more difficult with long-distance travel and with usage that requires a lot of energy, such as heavy-duty road transport; the batteries needed for these vehicles would be simply too big and too heavy. A variety of alterna-

Photos: left: Amprion/Thomas Bauer; right: Tontom/Shutterstock

## DISTRICT HEATING NETWORK

Germany has 1,400 district heating networks that, combined, are over 19,000 kilometres long and involve 453 operators. Figures from the German Association of Energy and Water Industries (BDEW) show that, in 2018, heating suppliers fed 134,900 billion kilowatt-hours into the heating networks, most of which came from combined heat and power plants.



tive approaches are currently being developed and tested. In addition to replacing fossil fuels with biofuels or powerfuels (see page 24), tests are also being carried out on something that has long been the norm for trains and trams: individual overhead lines. Trials on the first eHighway, located in the Greater Frankfurt area, began in May 2019. Hybrid trucks travelling on the A5 Autobahn can dock onto newly installed overhead cables that stretch for five kilometres in both directions. The trucks are powered by the electricity, which also charges a small battery. If the battery runs out of power after the truck has left the eHighway, the diesel engine will take over. "The dena Study Integrated Energy Transition showed that this kind of system could be a cost-efficient solution for very busy routes in future," says Stefan Siegemund, Director of Mobility at dena. However, he also notes that a few other conditions will need to be in place, such as a Europe-wide solution: "We can only achieve a positive overall effect if foreign trucks can also use the overhead lines in Germany."

Linking electricity and mobility can be especially efficient if drivers of electric vehicles mostly charge their batteries with solar electricity from panels on the roof of their garage or home, thereby reducing their use of the public electricity grid. An intelli-

gent energy management system can help here – as shown by the Fellbach Zero Plus field trial led by the Fraunhofer Institute for Solar Energy Systems ISE. Residents of five passive houses were able to enter their charging needs for their electric cars at home or using their smartphone. In conjunction with forecasts of how much electricity the photovoltaic system would produce and the household would use, charging timetables were then developed and monitored. "The energy management system can significantly increase self-sufficiency," says Christof Wittwer, Head of Department for Intersectoral Energy Systems and Grid Integration at Fraunhofer ISE. "On a sunny day the intelligent, forward-looking management system meant that the photovoltaic panels supplied 86 percent of the charging current. Without the charging algorithm, it would have been just 46 percent."

### Accelerating integration with digital solutions

This brings us to another important type of infrastructure: digital solutions, including the use of artificial intelligence (see page 58), are crucial for connecting existing physical cable and pipeline systems. They can act as a bridge between different networks or help to optimise a physical connection. TransnetBW and Netze BW, both electricity-

grid operators in the state of Baden-Württemberg, launched the DA/RE (Data exchange / REDispatch) initiative in June 2018. Its aim is to coordinate grid-stabilisation measures across all voltage levels using a digital platform. This would make it possible to use more plants for redispatching (which involves adjusting feed-in when the grid is overloaded) and would increase grid security. The digital approach provides a quicker overview of the redispatch capacity available at a given moment, for instance at generation plants, in storage systems or with bulk buyers who can adjust their consumption. Ultimately, this results in more redispatch capacity being available in total and means that plant deployment can be coordinated across the entire system. The platform is due to start operating in 2021.

Artificial intelligence could also help achieve an integrated energy system with an integrated infrastructure. Examples here include using optimised consumption and load forecasts with neuronal networks, self-learning sensors in distribution grids, and smart electricity meters. In order to manage the increasing complexity of grid operations, software developer PSI collaborated closely with transmission system operator TenneT to develop an autopilot for grid management. The PSIsaso system ("saso" stands for security assessment and

system optimization) independently assesses the status of the electricity grid using real-time data and algorithms. It is designed to simplify grid management for employees by assessing and visualising the current stability status, which will make it possible to identify critical situations at an early stage. The system also independently analyses which measures could return the grid to a stable condition.

### Obstacles to integration

Yet these highly promising approaches frequently face problems: a lack of price signals often prevents them from being economically viable, or regulatory requirements create obstacles for new business models. This is because technologies such as electrolyzers are only in their infancy and still very expensive, and because the current system of duties and fees makes electricity extremely expensive and therefore prevents it from being used flexibly for new areas of application. Then there are the technical challenges. These include retrofitting compressors in natural gas grids in order to accommodate blends containing more hydrogen, and producing durable electrolyzers and batteries. Another major issue is the need to improve the efficiency of the various steps involved in converting electricity to hydrogen and synthetic fuels.

Currently, less than 15 percent of the initial energy remains after electricity has been turned into liquid fuel.

However, solutions are beginning to emerge. One of them is the German government's decision to adopt carbon pricing and reduce duties on electricity. Another is the discussion, happening at the EU level, to allow grid operators to run electrolyzers and battery storage systems if the market fails. A further sign of new, integrated approaches are the plans drawn up by large consortia, in which electricity and gas grid operators often work together, for building electrolyzers in the three-digit megawatt range. Finally, transmission system operators TenneT, Amprion and TransnetBW are working on deploying powerful battery storage systems (known as grid boosters) to support higher grid loads.

### From grid planning to system development planning

These are all measures that work with existing infrastructures, seeking to link them, supplement them and optimise them. But are there also any signs of efforts to establish integrated planning for new energy infrastructures? And what might this look like?

Brussels has led the way with a good example. Since 2018, electricity and gas transmission system operators have been



## HYDROGEN GRID

Data from the German Hydrogen and Fuel Cell Association (DWV) show that the country's hydrogen pipeline system is just 340 kilometres long. By early 2020, Germany will have more than 100 hydrogen filling stations. By comparison, around 14,500 filling stations supply petrol and diesel across the country.



## “Public utilities are the pioneers of integrated planning”

Dresden’s public utility (DREWAG – Stadtwerke Dresden) is taking its first steps towards integrated planning for its energy infrastructure. Frank Brinkmann, Managing Director of DREWAG, talks about current experiences and the challenges of tomorrow.

### Are efforts already underway to establish integrated planning for the electricity, gas, district heating and liquid fuel systems?

**FRANK BRINKMANN:** Public utilities have always been pioneers of integrated planning for energy infrastructure. Our majority shareholder, the City of Dresden, also expects us to take this approach. So far, we have performed a detailed analysis of where and to what degree we can expect demand for electricity and heating, and which infrastructure can best meet this demand. We are always refining our methods, and our planning includes aspects such as efficiency improvements and mobility. We are open to all technologies and produce scenarios that describe different development pathways.

### Do nationwide planning structures and grid regulation benefit this kind of holistic approach?

**BRINKMANN:** When innovation and regulation come together, two different worlds collide – at least, this is true for the way I understand innovation. Politicians also know this and have launched funding schemes, such as Regulatory Sandboxes for the Energy Transition, that create opportunities for innovation in the energy sector. With our CityImpuls DD project, we’re aiming to pave the way for a climate-neutral heating supply in Dresden.

### Is integrated infrastructure planning important for making progress on an integrated energy transition?

**BRINKMANN:** As a public utility, we believe this is the case and are even thinking further ahead. We are working with the Dresden transport authorities to analyse mobility requirements and have already developed specific implementation plans for secure and flexible charging for the bus fleet as it gradually becomes electric. We’ve got experts for every sector either in house or close by.

### What must the energy infrastructure of tomorrow be able to deliver?

**BRINKMANN:** I’d like to broaden that question and talk about infrastructure as a whole. So that would also include transportation and, much more importantly, information and communications technology. The connected nature of many areas of our lives means that the electricity supply, for instance, must become increasingly secure. People’s need to communicate is growing, but so are the connections between devices. This means we have to react even faster to disruptions in the grid.

## CHARGING STATIONS

The number of public charging stations for electric vehicles is steadily growing. Figures from the Federal Network Agency show that there were around 21,100 public charging points in Germany in August 2019.



using a shared scenario framework for European grid development planning (the Ten-Year Network Development Plan). Yet electricity and gas grid operators in Germany are also seeking new approaches. For instance, the gas transmission system operators are now including hydrogen, synthetic methane and biomethane in their planning for updating the Grid Development Plan Gas up to 2030. In addition, North Rhine-Westphalia wants to be the first state in Germany to introduce a joint grid development plan for both electricity and gas.

Within the scope of its third Grid Study, which began in 2019, dena is developing a new approach for integrated planning at the national level. The aim is to design a process for a system development plan. It is unlikely that integrated planning will mean that electricity and gas networks are planned from a single source. “We will continue to have separate processes for electricity and gas infrastructures. For us, it’s primarily about optimising interfaces in both systems, such as gas-fired power plants or power-to-X systems, and ensuring that the plans are based on the same initial premises and are better coordinated,” says Stefan Mischinger, a team leader at dena. The system development plan is therefore intended to be a process that exists upstream of the grid development plan

and provides a holistic view of the system as a whole. This new integrated approach could also be expanded to include hydrogen infrastructure: “The trend is pointing to a paradigm shift – away from pure grid planning and towards a holistic system approach,” says dena’s Hannes Seidl.

Through broad public participation, which will include translating the specific issues into plain language, the system development plan should also provide politicians with a better basis for making decisions and should simplify basic future decisions about the energy transition. “There’s also a need to focus more closely on the future market design. Market structures are fundamental to the way in which a future energy system can and should function,” says Carolin Schenuit, also a team leader at dena. The first results of Grid Study III are expected in late 2021.

### Bringing energy planning into urban planning

Cities are a major starting point for integrated solutions. Nowhere else are the infrastructures for generating, transporting and consuming energy situated so closely together. This provides numerous opportunities to link the systems – particularly the electricity grids and heating networks. Cities often have a larger scope for using

waste heat or incorporating power-to-heat solutions that can offset fluctuating electricity feed-in from renewable energies. “System-wide planning for the heating supply in urban energy systems will become increasingly important in the future,” says Susanne Schmelcher, a dena expert for the urban energy transition. She believes that energy infrastructure planning overall must be better established as an integral component of urban planning. Future supply concepts should, for instance, aim to optimise infrastructures for energy, mobility and information technologies in an integrated way (see interview, left).

Achieving this will also require better coordination between the various actors. Structures in cities are more complex. The way in which planners, city and district authorities, energy suppliers, housing companies, transport operators, water utilities and other participants interact needs to be optimised. “We need new processes in which local actors can contribute their expertise and jointly develop infrastructures suited to their area,” says Schmelcher. The starting point at the local level is more or less the same as at the national level: more consistent efforts are needed to develop integrated solutions for the energy transition. Many things are already technologically possible. ■

Photo: Anja Schneider; Tank und Rast



# “Climate action is about creating a new normality”

dena's Chief Executive Andreas Kuhlmann talks to Professor Jutta Allmendinger, PhD, President of the WZB Berlin Social Science Center. To what extent is society willing to deal with the transformation required by the energy transition and climate action? And who plays which role in this change process?

INTERVIEW Hanne May PHOTOS Thomas Köhler/photothek

**The location for our discussion about climate change and society is both historically relevant and highly topical: Berlin's natural history museum (Museum für Naturkunde) regularly plays host to the Fridays for Future activists, who come here to talk with scientists and other experts. The movement's demands contrast starkly with what German policy – such as the climate action package that the government presented in September 2019 – claims to be able to actually implement. What is the best way to deal with this situation? One side has very high expectations, which are followed by immense disillusionment when politicians decide “what is possible”.**

**JUTTA ALLMENDINGER:** Firstly, I'd like to challenge that basic premise, since it was politicians who committed themselves to the climate targets for 2020 and 2050. We won't achieve the 2020 climate target because policy has failed. Fridays for Future are therefore merely demanding what politicians themselves decided.

**ANDREAS KUHLMANN:** But it's still an odd situation. One side is urgently and persis-

tently calling for things to be done that politicians have already promised and signed up to. On the other side, we have politicians who, given the size of the problem, can appear quite helpless at times. The result is deep sociopolitical polarization over a very fundamental issue. How can we resolve this?

**ALLMENDINGER:** Everyone agrees that something needs to be done. Even the goals are largely similar. This is what makes climate action different to many other social movements. The decisive issue is the speed of the implementation, and opinions are deeply divided about what politicians must do and what can be asked of the public.

**Politicians argue that they are responsible for social balance and must convince all segments of society. Do you share this view?**

**KUHLMANN:** I think that society's willingness to change is greater than political decision makers think. Fridays for Future and other movements have significantly improved the foundations for acceptance of political decisions. We need to harness this momentum and boldly move things forward.

**ALLMENDINGER:** Of course politicians must ensure social balance and make the case for this important project. In this sense, Fridays for Future is the best thing that could have happened to them. The movement calls for widespread participation and explains what it's about in plain language. It excites people and makes it absolutely clear that we must finally do something. I'm therefore extremely thankful for this unexpected movement.

**Professor Allmendinger, one of the questions that you and your institute examine concerns the changes that society or particular segments of society are willing to make. In your latest Legacy Study, the respondents assume that their social circumstances won't change much in the next ten years. How does this fit with the willingness to change that is needed if society is to become climate neutral?**

**ALLMENDINGER:** Our studies show that people no longer aspire to climb the social ladder. This makes them different to their parents and grandparents. One could see this as an expression of dissatisfaction, as a perceived lack of opportunities. But when asked about their personal circumstances,



**“If we are to confront climate change and empower people to change, we have to give them more security.”**

**Jutta Allmendinger**

**JUTTA ALLMENDINGER** has been President of the WZB Berlin Social Science Center since 2007 and is Professor of Educational Sociology and Labor Market Research at Humboldt-Universität zu Berlin. She has received numerous awards for her work on social policy.

most respondents say they are satisfied. Politicians can start from here. They must set goals and lead the way to achieving them. It has to be about enabling people to organise their lives differently. This isn't happening at the moment. Too many people are living in educational poverty, and many don't earn enough to live on. If we are to confront climate change and empower people to change, we have to give them more security.

**KUHLMANN:** These people are also unhappy with the state of society itself. To me, this seems entirely unrelated to the transformation that would occur through processes such as achieving the climate targets.

**ALLMENDINGER:** What we are seeing is that the people who get a very small slice of the pie rarely complain. They blame their precarious situation on themselves; they think it's because they haven't worked hard enough. We're not seeing an uprising among the socially vulnerable. There's more political activity among those who feel left behind. Many rural towns and villages have shrunk. Most people have moved to the cities. Those who stayed feel robbed of their familiar sur-

roundings, their social connections and the variety in their lives. It's true that this is only indirectly linked to climate issues.

**KUHLMANN:** But you're still describing a society that is very stable within its social framework. That makes me wonder if everyone is sufficiently aware of what achieving the Paris climate goals really means, and of the changes that this will involve.

**ALLMENDINGER:** Our surveys have told us that people are aware of climate change and that they are participating in the debate. People also know that it is not just about the planet and the biodiversity that is so beautifully displayed on this wall behind us. They know that it is much more radically about themselves, their children and their children's children. That's why they want their legacy – which is how we refer to people's instructions to future generations – to bring significant behavioural changes. One could well ask why they aren't living according to their own ideals. I just touched on one answer to this. For people on low incomes, the gap between their own actions and their wishes for coming generations is particularly big. They say that they can't

worry about how their food is produced as organic products are too expensive. They say they have to drive long distances by car because they can't afford to live close to where they work. Those might all seem like pretexts, but it doesn't change the fact that people feel helpless. And if you think about the many working poor who rely on extra benefits, and if you look at the increase in commuting distances, it's clear that there is some substance to this.

**And how do we reach a point where behaviours can change as quickly as possible and in all segments of society?**

**ALLMENDINGER:** Firstly, even if we all change our behaviour, that still won't be enough. The entire infrastructure has to be rearranged, manufacturing as a whole, and all trade relations. That's an enormous task for politicians. To come back to your question, of course politicians must also set standards that change behaviours. Let's look at a controversial but necessary political measure: the smoking ban in bars and restaurants. The scientific findings were conclusive, there was a political debate and then a decisive implementation. There was an

outcry at first, but now people barely mention the ban. Scientists must present their findings to the public, and civil society can support politicians in making these types of reform. The media must also report transparently and make their sources very clear.

**KUHLMANN:** More and more people are starting to see that there is clearly a fundamental problem. There is a growing certainty that we have reached a limit in the way we run our economies, use nature and consume resources. In our daily lives, though, we find it hard to make the right decisions because we don't know, for instance, if a given product's environmental performance is good or not. That's also why it's so important to have an economic framework that promotes climate-friendly technology and products, and makes others more expensive.

**ALLMENDINGER:** Behavioural economics shows that rewards and incentives are more effective than bans. We call this

“nudging”. The environmental footprint should be clearly visible on all products, and pricing must be proportional to the size of the footprint.

**How can we get to grips with topics that are harder to manage, such as refraining from flying or avoiding transportation per se? This is a source of conflict for many people who want to minimise their impact on the climate.**

**KUHLMANN:** I don't think it's right to leave people on their own to deal with these extremely complicated issues. The role of each individual is certainly very important. But it is the politicians elected by the people who must establish the right framework, using analyses, facts and good judgement.

**ALLMENDINGER:** I agree. At the moment, individuals are being asked to do many things that are actually the responsibility of politicians. People's behaviour alone won't

sort out climate change. And their behaviour in itself depends heavily on the political and social context.

**KUHLMANN:** That's true, but I'd also say that the problem lies in the implementation. Personally, I believe that extreme measures are needed to achieve the Paris climate goals. The transport sector needs to change immensely.

**ALLMENDINGER:** Yes, of course. And failure to achieve the goals definitely won't be caused by people being stubborn and saying, “There's no way I'm doing that!” I don't think we are making full use of the potential that lies in what we can ask of the public.

**KUHLMANN:** I agree. It bothers me that people keep saying we need to be more radical. The goals we're setting are radical enough. But the efforts to achieve them lack consistency – and boldness and creativity in designing the best possible ways of getting there.

Physicist **ANDREAS KUHLMANN** has been dena's Chief Executive since 2015. He believes that frameworks which promote an openness to all types of technology and create an innovation-friendly market environment are the key to an integrated energy transition and effective climate action.

**“I think that society's willingness to change is greater than political decision makers think.”**

**Andreas Kuhlmann**





“It bothers me that people keep saying we need to be more radical. The goals we're setting are radical enough.”

Andreas Kuhlmann

“The economy and the environment shouldn't be played off against each other. We have a goal and not much time to achieve it.”

Jutta Allmendinger

**Consistency in climate policy and climate action has to last for a very long time. How can we make this long journey, and what will be our shared vision?**

**ALLMENDINGER:** It's basically about creating a new normality. I think that people are willing to leave the destructive path that we are currently on.

**KUHMANN:** The desire to live in harmony with the planet's limits, nature's limits and the limits of the resources that we have available is growing. We failed to do this in the past because we were using measures and objectives that could not show how our normality is exceeding limits and, far from being normal or rational, is therefore causing immense damage. Above all, many people today see the economy and the environment as being incompatible. This has to be our starting point for finding a new normality that is reconcilable with the limits I just mentioned.

**ALLMENDINGER:** I also agree on this point. The economy and the environment shouldn't be played off against each other. We have a goal and not much time to achieve it.

**KUHMANN:** I do find some arguments against growth peculiar, though. Instead of helping with the search we've outlined, they wrongly pin every problem on a single factor. Nevertheless, it's clear that we've spent far too long living in a way that sees nature as just an economic variable. What we should be doing is designing our economies so that, overall, they benefit nature, to which humans also belong.

**ALLMENDINGER:** Behavioural economics is a major research focus at the WZB. Our experiments show that morals often tri-

umph over the market. In one, participants were asked to throw chickpeas into a bowl. A lot of the chickpeas landed on the floor. The question was: who's going to clean up the mess? Interestingly, most of the participants wanted to clean it up themselves – even though they had been told that a special team would perform the task. Morals were more important to the participants than the market arrangement.

**KUHMANN:** People very obviously act according to a broader set of motivations than those that are generally covered by the primarily utility-maximising homo economicus. As well as pursuing their own utility, people are also guided by questions of fairness and consider a variety of social relationships. Our everyday lives are dominated – sometimes also at a subconscious level – by social needs. If we try to describe the economy with mathematical models, it is often difficult to include these complex motivations and orientations, which results in them being ignored.

**ALLMENDINGER:** Perhaps that's actually the problem – that they're just mathematical models.

**KUHMANN:** Yes, something's taken on a life of its own there. Ultimately, the economic models almost always assume that nature...

**ALLMENDINGER:** ... is our slave.

**KUHMANN:** That's mainly because this dimension of social needs is not so easy to grasp; you can't easily quantify and communicate it.

**ALLMENDINGER:** But wouldn't you say that people today have a much clearer view than they did ten years ago of how much the frameworks of their lives have changed?

**KUHMANN:** That's the hope. Now we have to make something of it.

**One last question: How are these new frameworks changing the role that scientists and experts play in the public discourse?**

**ALLMENDINGER:** At the WZB, we systematically share our research findings with the public and get involved in the discussion going on in society. We don't want to do research in a *l'art pour l'art* kind of way – after all, our work is financed by public money. I'd like to see science as a whole stand up and go forward a lot more when it comes to important social topics.

**KUHMANN:** When the issue is this important, everyone has a personal role to play. But I think that, to enable a targeted discourse, we need to clarify the various roles and tasks. For the politicians: panicking won't help! They need to confront the challenge consistently and work through each task with a holistic view. For the scientists, it is about working out the facts and communicating them to society and politicians with clearly defined, understandable concepts and categories. I don't think it's good when science and politics become too mixed up with each other.

**ALLMENDINGER:** Science obviously doesn't make policy. Research findings are always subject to the principle of possible falsification. However, that doesn't mean that we can't draw any conclusions from our results. A challenge like climate change will bring immense transformation to every aspect of our lives, and in this situation it is important that everyone pulls together. So I'm delighted that the various social stakeholders are slowly joining forces. ■



## INSIGHTS

In **Insights**, we show you where and how we are making progress on the **energy transition** and **climate action**, both in Germany and worldwide. From networks between companies to policy advice in Ukraine, this section reveals more about the spectrum of our work and its impact.

# THE POWER OF THE DESERT

Industrialised countries will need to embrace synthetic fuels, also known as powerfuels, if they are to achieve their climate targets. Several dozen pilot projects are underway in various countries, and large-scale production is the next step. Ideal locations will be places where renewable energies are available very cheaply. Morocco could be one of the first suppliers.

**TEXT** Roman Zurhold

Workers install a mirror at the CSP plant in Ouarzazate, Morocco.

Things have fallen silent at Desertec, the desert electricity initiative. Ten years have passed since a broad alliance of economists, politicians and scientists announced plans to build huge solar power stations in North Africa that would cover 15 percent of Europe's electricity needs. Technical, political and economic challenges meant that the vision was never realised. Individual concentrated solar power (CSP) plants were, however, built in Morocco, the United Arab Emirates and Israel to contribute to the domestic energy supply in those countries.

Now, though, the region's solar energy is gaining momentum in a different form. Rapidly declining technology costs and outstanding local conditions mean that it is possible to generate renewable electricity from the sun and the wind for less than two eurocents per kilowatt-hour. This is reviving the vision of electricity from the desert. It could, however, reach Europe in a different guise to the one originally planned – namely, as powerfuels. The cheap electricity generated from renewables could be used to produce green hydrogen in the region. This could then be consumed directly or, using carbon-containing gases such as CO<sub>2</sub>, converted into methane or other fuels and raw materials. Existing undersea gas pipelines could be used to transport them. Alternatively, the powerfuels could be shipped around the world in tankers.

## Morocco in focus

Germany wants to provide an important boost to the energy transition by increasing its support for demonstration projects that convert electricity into gaseous or liquid energy carriers. The country hopes it will eventually be able to replace imports of crude oil and natural gas with powerfuels. This will help protect the climate, create scope for using German technology and improve the economic prospects of the exporting countries. The focus is primarily on northern Africa and the Middle East.

According to a study by Germany's Federal Ministry for Economic Affairs and Energy (BMWi), suitable supplier countries will initially be those that fulfil certain pre-conditions. In terms of importing green hydrogen, they should not be too far away,

they should have installed or be building a sufficient number of cheap green power plants, and the necessary transport infrastructure such as ports and gas pipelines should be available. It is especially important that they have a stable political system and maintain good bilateral relations with Germany. This reduces risks for investors, which in turn makes capital cheaper.

Morocco performs well in each of these areas. A free trade agreement with the EU is in place, and a Moroccan-German energy partnership (Parema) has existed since 2012. Germany's state-owned development bank KfW has invested over a billion euros in transforming Morocco's energy sector. Of that, a little over €800 million was spent on the CSP plants Nour I to IV, which have an installed capacity of 580 megawatts (MW). At the Green Energy Park in Ben Guerir, a pilot system for producing hydrogen is being built with help from Germany's Fraunhofer Institute for Microstructure of Materials and Systems IMWS. The project is modelled on a system at the Leuna Chemical Complex in Saxony-Anhalt.

According to a study commissioned by Parema, Morocco could become one of the first export countries for powerfuels and eventually cover between two and four percent of global demand. As a concrete example, Morocco currently imports between one and two million tonnes of ammonia produced using fossil fuels each year. By 2030, it could produce the same amount in a climate-neutral way itself, and also export one to two million tonnes. The Parema study says that producing a million tonnes each year would require about 3,000 MW of green electricity.

## The key to airborne climate action

Ammonia is one of many products that could be made using renewable energies in the future. Besides this and other raw materials for industry, heavy-duty modes of transport are a second, key area of application for powerfuels. Heavy-duty transport on water, on land or by air will continue to rely on carbon-containing fuels with a high energy density in the future. If, for instance, an aircraft such as the Airbus A380 were powered by battery-electric technology, its weight would roughly double and phys-



It takes about 3,000 MW of green electricity to produce a million tonnes of ammonia in a year.



“Powerfuels are the key to climate action in air transport.”

Stefan Siegemund,  
Head of Division at dena

ics would prevent it from flying. Sustainable biofuels are of little help here, as their availability is very limited. “Powerfuels are the key to climate action in air transport,” says Stefan Siegemund, a divisional head at dena. “International policy should be focusing on them.”

This is a call echoed by the Global Alliance Powerfuels, an industry-wide alliance of companies and associations that was launched in 2018 and is coordinated by dena (see box). “Even at the high cost – compared to conventional kerosene – of €2.40 per litre, the powerfuel product could significantly reduce carbon emissions caused by air transport. According to our estimates, this could be achieved in the near future, and moderate blending rates wouldn’t substantially increase ticket prices,” says Kilian Crone, a senior expert at dena. The first projects for establishing a powerfuels manufacturing sector are getting underway. They include Kerosyn100, a German research project for air transport that is situated at the Heide refinery in Schleswig-Holstein. The German company Sunfire is also running a project, this one in Herøya in Norway. Sunfire’s aim is to produce liquid powerfuels on a large scale for use in a variety of modes of transport. Globally, some 70 pilot projects are now working on producing fuels from electricity. Most of them are happening in Europe, and over 30 are located in Germany. However, projects are also underway in Canada, the United States (in California and Texas) and Argentina.

#### Supplies from anywhere in the world

For most of the projects – such as the BMWi’s Regulatory Sandboxes project – it is about moving the technologies from the pilot scale to an industrial scale, and testing how the various components interact. They are currently helping German system manufacturers and operators to gather important experience and learn more about the processes and technology. “Scaling up production capacities is important for bringing the first volumes of electricity-based renewable energy carriers and raw materials to the market, reducing manufacturing costs, and expanding our industrial advantage,” says Jeannette Uhlig, a project manager at



A panel discussion about powerfuels in June 2019 in Brussels



#### GLOBAL ALLIANCE POWERFUELS

The Global Alliance Powerfuels aims to develop a global market for fuels produced using renewable electricity. It provides information about the fuels’ potential, recommends how to develop suitable frameworks, and initiates pilot projects. The alliance was founded in late 2018 by international companies and associations working in the energy, renewable energy, automotive, aviation, chemicals, petroleum and engineering industries. Its current members are Audi, Bosch, the German Aviation Association (BDL), Daimler, Deutsche Post DHL, Deutscher Verband Flüssiggas, Enertrag, ExxonMobil, Institut für Wärme und Öltechnik (IWO), Lufthansa, MEW Mittelständische Energiewirtschaft Deutschland, Mitsubishi, Mineralölwirtschaftsverband (M WV), Schaeffler, Shell, Sunfire, Paul Wurth, Uniper Kraftwerke, and UNITI Bundesverband mittelständischer Mineralölunternehmen. dena initiated the Global Alliance and now coordinates its activities.

Learn more at  
[www.powerfuels.org](http://www.powerfuels.org)

dena. “A robust domestic market is essential for competing on a global level.”

However, it is also clear that densely populated industrialised countries will be unable to meet the long-term demand for powerfuels on their own. As the dena Study Integrated Energy Transition also found, Germany will probably have to cover more than 80 percent of the expected demand for powerfuels via imports in 2050. This would mean importing up to 900 terawatt-hours of fuel. A large share of today’s imported fossil fuels would therefore be replaced by imports of renewable energy carriers, as the production systems can be operated most efficiently in places where generating green electricity is cheapest.

As a result, potential trade partners could be anywhere in the world, from Norway to North Africa and from the Middle East to Australia, Chile and Canada. This would create – similar to the situation with fossil fuels today – a global trade between countries with excellent local conditions and those with ambitious climate policies. The transport costs for powerfuels are negligible because existing infrastructures can generally be used for transporting and storing them. However, water must be available, as it is needed for producing hydrogen and for running the CSP plants. Seawater desalination systems can help ensure that this does not compete with domestic water demand, and they increase production costs only very slightly.

#### Swiftly building a global network

The German government has recognised the need for powerfuels. The responsible ministries, such as those for economic affairs, the environment, and development, are already pursuing a variety of concepts for importing the fuels, and various projects for accelerating market development. The main criterion when selecting partners is that the country must have enough green electricity potential to cover both its own needs and its hydrogen production activities. The powerfuels exports must not jeopardise domestic supply or increase the use of fossil-fuelled or nuclear power plants. The carbon-reduction potential of powerfuels depends heavily on the electricity mix and the carbon sources involved in the production process.

#### Global Alliance calls for global blending ratio

“For the technology to make a commercial breakthrough, it needs political as well as technical assistance. The first step is to fund pilot projects, but this should be followed as soon as possible by a structured market ramp-up that creates a stable demand for powerfuels,” says Christoph Jugel, Director of the Global Alliance Powerfuels. The authors of the Parema study on Morocco also recommend building demonstration plants at the megawatt scale and then following this with a government programme for the market launch.

To kick-start production worldwide and stimulate global trade, the Global Alliance Powerfuels believes that an important next step will be to introduce a global blending rate for air transport. The guideline should be a minimum of two percent. This rate could be quickly agreed by, for instance, the member states of the UN’s International Civil Aviation Organization (ICAO). This would help the market to grow faster, and economies of scale would quickly bring down the price per litre. By 2050, a litre of the new green kerosene could cost as little as one euro. The cost of air travel would rise in accordance with the blending ratio. An initial €2.40 per litre and a blending ratio of 10 percent would increase ticket prices by about 10 percent. Essentially, the more green kerosene that is used and produced worldwide, the lower the costs per litre will be.

In addition to the joint action taken through the ICAO, individual countries and regions should set up their own incentive programmes for the aviation industry and fuel producers. The German government, for instance, could use income from its increased tax on air transport to support not just trains but also powerfuels for aviation.

After entering the market, powerfuels would become increasingly able to compete with other technologies for avoiding carbon emissions. However, if a tonne of carbon dioxide costs less than €30 in the EU Emissions Trading Scheme, which also covers air transport, there would be no incentive to invest in powerfuels. The global revolution in liquid energy carriers has begun. The fascinating question now, is: will powerfuels become the third pillar of the energy transition? ■



“For the technology to make a commercial breakthrough, it needs political as well as technical assistance.”

Christoph Jugel, Director  
of the Global Alliance  
Powerfuels



# Purchasing green electricity

**Long-term direct supply agreements for renewable electricity are gaining ground worldwide. For system operators, they pave the way for new business models after fixed tariffs. They also attract new investments in the energy transition and will help achieve the 2030 climate targets. In Germany, though, there are still a few hurdles to clear.**

TEXT Hans-Christoph Neidlein

The wind turbines in Ellhöft, North Frisia, will still be producing electricity after 2020. That might sound self-evident, but it actually isn't at all, and this is why: the six wind turbines at the community wind farm went online in June 2000, just a few months after Germany's Renewable Energy Sources Act (EEG) came into force. Since then, the local operating collective has been receiving a legally guaranteed feed-in tariff for every kilowatt-hour produced. The arrangement is limited to 20 years, though, meaning it will cease at the end of 2020. Yet the turbines are still in good working order and can continue to reliably produce electricity.

Part of the solution to this problem came in the form of a long-term electricity supply agreement that the Ellhöft operators reached with Greenpeace Energy. It's known as a Power Purchase Agreement, or PPA for short. Starting in January 2021, the community wind farm will supply the majority of its

electricity to Greenpeace Energy for an initial period of five years. The owners – 51 village residents – also want to build an electrolyser that will use their electricity to produce hydrogen. They plan to supply the hydrogen directly to a local filling station. “We're taking a two-pronged approach. But given the new situation, the PPA is crucial to us being able to continue to run the wind farm profitably,” says Reinhard Christiansen, Managing Director of the wind farm.

So how exactly does a PPA work? The wind farm has negotiated a fixed price per kilowatt-hour with Greenpeace Energy. The price will apply for the duration of the agreement, which also covers possible adjustments if electricity trading prices rise above or fall below a certain threshold. This limits the risk for both parties, and brings other benefits: the Ellhöft community receives reliable remuneration, and Greenpeace Energy can work with long-term, stable purchase prices and offer its

customers green electricity with a guarantee of regional origin.

## New solutions for the energy transition

These types of long-term supply agreements could be a solution for many wind farms, photovoltaic systems and biogas plants in Germany. Between now and 2030, the EEG tariffs will cease to apply for thousands of these facilities. The total figure is in excess of 51 gigawatts (GW). The situation will arise as early as 2021 for over 8 GW of wind turbine capacity.

Another solution for wind turbines is “repowering”, an example of which can be found in Waldow in Brandenburg. Waldow's 14-turbine wind farm went into operation in 2003, and its state-guaranteed feed-in tariffs will end in 2023. Re-Wind, a Berlin-based company, took over most of the turbines in early 2019. When the tariffs cease to apply, Re-Wind will replace the old turbines

with new, more powerful models that will produce five times as much electricity as their predecessors. The higher yields should make the wind farm profitable over the long term, even without the tariffs. It is, however, unclear how many of Germany's wind turbines can be repowered like this. Local regulations often block approvals for more powerful turbines with higher hub heights.

What is clear, though, is that without repowering or guaranteed purchase agreements, these old turbines will no longer be competitive. “If we want to achieve the goals of the energy transition, as many turbines as possible must remain operational in areas where repowering is not an option,” says Tibor Fischer, Director of Renewable Energies and Innovation at dena. “We also obviously need investments in new systems so that we can achieve the goals even as electricity demand grows.” By 2030, Germany hopes to increase the share of renewables in its energy consumption from currently just under 38 percent to 65 percent. And since efforts to expand renewable energies in Germany have recently stalled, it is all the more important that existing systems find new business models.

## Fast growth at the global level

PPAs are already playing an important role in the new-system segment worldwide. According to Bloomberg New Energy Finance, long-term supply agreements for green electricity from wind and photovoltaics totalled 13.6 GW in 2018 – more than twice the volume of 2017.

Purchasers of the green electricity do not just include energy suppliers, as dena's market survey on Corporate Green PPAs up to 2030 showed (see box). Bulk buyers from trade and industry are also interested in long-term supply agreements for wind and solar electricity. After all, a climate-friendly energy supply is part of many company strategies, and the demand for green products is constantly growing. “In particular, the model allows companies working in energy-intensive sectors to achieve their sustainability goals while also hedging against rising electricity prices,” explains Fischer. Mercedes-Benz Cars, for instance, will begin purchasing electricity from six existing community wind farms in Lower Saxony in 2021, partially to power the production of its EQC electric car in Bremen. The carmaker negotiated the corresponding PPA with the Norwegian energy firm Statkraft.

## Prospects for old and new systems

As well as being a solution for keeping renewable energy systems in operation after they have depreciated, PPAs could also be an attractive way of financing new and larger systems. Energy supplier EnBW and developer Energiekontor, for instance, signed a PPA in February 2019 for the con-



## DENA MARKET SURVEY CORPORATE GREEN PPAS

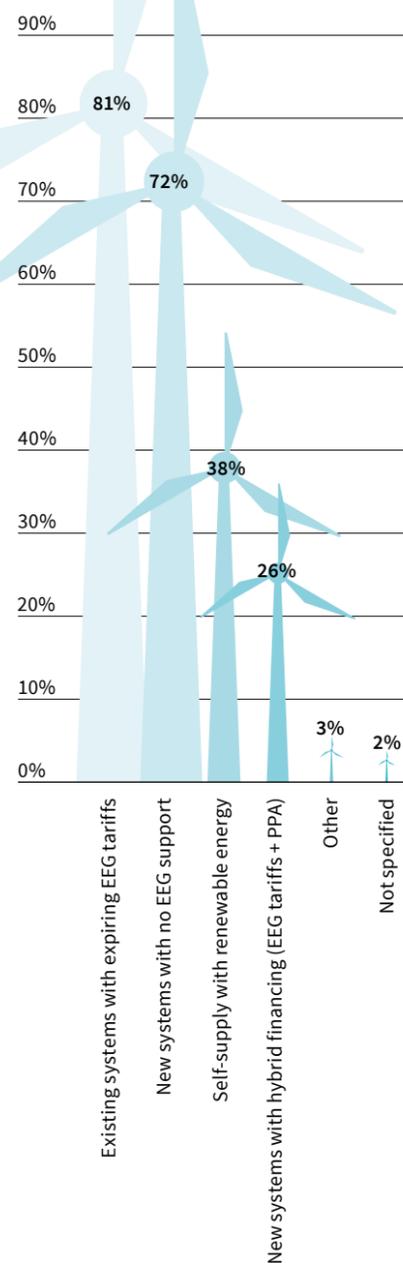
Corporate Green Power Purchase Agreements (PPAs) are a relatively new phenomenon in Germany. dena's market survey on Corporate Green PPAs up to 2030 contains comprehensive data on the outlook for demand-driven electricity supply agreements. The survey collected input from 128 experts from the industry, such as investors, project developers, energy suppliers, direct marketers and energy customers. They assessed the market potential of PPAs from the perspective of both supply and demand. The survey provides the first complete picture of all relevant market actors.

[Learn more \(in German\) at www.dena.de/ppa](http://www.dena.de/ppa)

struction of a solar farm. The project, which totals 85 MW and is located in Marlow in Mecklenburg-Vorpommern, is scheduled to go online at the end of 2020. The new model is attractive because of the sharp decline in costs for solar and wind electricity, which in some cases are already below electricity trading prices.

However, if PPA models are to become widespread in Germany, frameworks will have to change. The industry experts who participated in dena's survey on Corporate Green PPAs said that problems included complex contracts, uncertainties regarding government regulations, and a lack of pricing transparency. Fischer adds to the list, explaining how energy-intensive companies that enter into a green-electricity PPA risk becoming ineligible for the compensation they receive in connection with emissions trading. In addition, Germany's antitrust law does not currently allow long-term supply contracts for new systems. “The obstacles have to be removed before PPAs can play a larger part in making the energy transition a success. We will be addressing these issues in the future,” says Fischer. ■

For which systems do you think PPAs are most attractive?



Source: dena-Marktmonitor Corporate Green PPAs

Photo: Alphabet/Google

# Saving together

**Sharing experiences, learning from each other, discussing mistakes: energy-efficiency networks provide crucial impetus for businesses. It's not uncommon for participants to exceed their own energy-saving goals.**

TEXT Ralph Diermann

It takes a lot of energy to produce heat exchanger tubes. MPG, a company in Minden, North Rhine-Westphalia, casts them seamlessly using a variety of copper alloys. The energy costs that European market leader MPG has to cover account for over 20 percent of the gross value added. It is therefore not surprising that the company has long been doing everything it can to reduce its energy consumption. One way it is achieving this is through its membership of the Energy and Resource Efficiency Network run by the South Westphalian Chamber of Industry and Commerce. At the facilitator-guided meetings, ten regional businesses from various industries share ideas, discuss solutions and present their efficiency projects.

"At first I was sceptical about whether our energy efficiency would actually benefit from this kind of network," says Andreas Gahl, Managing Director of MPG. His doubts evaporated quickly, though: "We've never left a single meeting without at least one valuable idea." One outcome is that Gahl and his team have significantly reduced the energy consumption of their compressed air supply. "Another company in the network had faced a similar challenge. We couldn't copy their concept exactly, but we used the idea as a guide to develop our own solution," says Gahl.

## Communicating with peers

The Energy Efficiency Networks Campaign (IEEN), which launched in December 2014, says that more than 250 of these clusters now exist. A network usually involves eight to twelve companies that meet roughly once per quarter over several years. Many networks are regional in scope, while others are devoted to specific industries. "The groups bring together established energy experts who have a great deal of knowledge and experience. So the level of the discussions is very high," says Carsten Ernst, a facilitator and energy advisor for networks supported by the consultancy firm Ökotec. Lutz Lohmann of energy supplier EnBW is also a network facilitator and confirms what Ernst says: "The way the experts share experiences is extremely fruitful – not least because they also talk about measures that didn't have the desired effect. They hear enough success stories from salespeople as it is."

For participating companies, the process usually starts with advice from a trained energy consultant. This provides the basis for setting individual savings targets. The companies then use these to set a shared goal for their network. It is not uncommon for the companies to exceed their own expectations, as they can often achieve more in practice than was initially thought.



Visiting the CHP plant at the Mercedes-Benz factory in Hamburg with network facilitator Mario Spitzmüller (right)

According to monitoring by IEEN, actual savings exceed the targets by an average of eight percent. A dena survey of the networks found that most of the companies focus on heat generation, waste heat usage, pumps and lighting to improve their energy efficiency.

## More climate action, more power to compete

Energy efficiency networks are a crucial part of the German government's energy transition strategy. "Few other newer instruments have such an important role to play in achieving the energy-efficiency goals. The networks are expected to save a total of 75 petajoules of energy each year starting in 2020. That's according to the National Action Plan on Energy Efficiency (NAPE), and it equates to the energy consumption



A network meeting at Mitteldeutsche Hartstein-Industrie in Hanau with facilitator Carsten Ernst (left)

Photos: Industrieverband Hamburg IVH; Carsten Ernst



## OFFICE OF THE ENERGY EFFICIENCY NETWORKS CAMPAIGN

Inform, coordinate, support – these are the tasks of the Energy Efficiency Networks Campaign office, which dena has been running since late 2015. The dena specialists support the German government and the 22 partner associations by providing expert advice and organisational help. They arrange conferences and workshops, produce information materials and act as a point of contact for all the networks and for companies interested in joining one.

Learn more at [www.dena.de/energy-efficiency-networks](http://www.dena.de/energy-efficiency-networks)

of 1.35 million households in Germany," says dena's Steffen Joest, who manages the IEEN office with financial support from the Federal Ministry for Economic Affairs and Energy (see box). It is already clear that the savings targets will be achieved – and with fewer networks saving much more energy. At the start of the project, it was expected that around 500 networks would be needed to achieve the savings targets. Now it turns out that the targets can be achieved with around half that number. One reason for this is that the IEEN expanded the circle of its supporting institutions to cover the entire economy, which has evidently led to the inclusion of many energy-intensive businesses with a high potential for reducing their consumption.

Meanwhile, the networks don't just promote energy efficiency and climate action; they also, as a kind of welcome side effect, improve the companies' ability to compete internationally. "Compared to other countries, the energy costs in Germany are very high. So if you want to succeed on the global market, your business has to be extremely energy efficient," says Mario Spitzmüller of IVH Industrieverband Hamburg, who currently facilitates three networks. By collaborating, therefore, the companies strengthen both their own position on the market and that of Germany as a manufacturing location overall.

## Looking behind the scenes

One reason for the networks' success is that they are extremely practical. The meetings generally take place at one of the participating companies. Carsten Pöttker values this ability to look behind the scenes very highly. Pöttker is head of a factory in Hamburg run by Ingredion, a manufacturer of starches for the food industry. He participates in two networks run by IVH. "Our processes need a lot of heat for drying. Visiting other companies let us see the solutions that they were using," he says. The result is that Ingredion now also uses the waste heat from the drying system: "It's helped us reduce our heating consumption by a quarter."

Joest explains that another reason for the networks' success is that participants discuss internal problems and solutions very openly. "The consistently positive experiences show that this openness absolutely pays off for the companies," he says. ■

START UP ENERGY TRANSITION

**IN THE LIMELIGHT:  
START-UPS AT THE WORLD  
ENERGY CONGRESS**



The World Energy Congress is the biggest congress of its kind. Eighty start-ups from around the world presented their sustainable business models at the event in Abu Dhabi in September 2019. The young businesses are in the top 100 (#SET100) of the Start Up Energy Transition Award, which is organised by dena. Their ideas are helping to make a global, integrated energy transition a reality. The start-ups were able to participate in the event thanks to dena's collaboration with the World Energy Council and the Dubai Electricity and Water Authority (DEWA).

Speaking to an audience of experts, the founders demonstrated innovations ranging from hydrogen electrolysis to cloud-based energy systems and sustainable bamboo briquettes. Under the banner of "Start Up Energy Transition: The Power of the Bold", the SET Award winners also spoke with Andreas Kuhlmann, Chief Executive of dena, and Marwan Bin Haidar, Executive Vice President of DEWA.

The Start Up Energy Transition Global Innovation Platform identifies leading start-ups working on the energy transition and climate action anywhere in the world, and connects them with relevant companies and investors. The platform includes the SET Award, the SET Tech Festival and the #SET100 list. The deadline for applications for the 2020 SET Award is 15 January 2020.

Learn more at [www.startup-energy-transition.com](http://www.startup-energy-transition.com)

GAS 2030 DIALOGUE

**IN FOCUS: THE ROLE OF GAS IN  
THE ENERGY TRANSITION**

Gas will continue to be an essential component of Germany's energy supply for many years to come. Gaseous energy carriers must, however, become increasingly carbon neutral and eventually reach a stage where they produce no harmful emissions at all. This is one of the many findings to emerge from discussions between stakeholders within the Gas 2030 dialogue process initiated by the Federal Ministry for Economic Affairs and Energy (BMWi). From dena's perspective, this will be possible if powerfuels (synthetic gaseous and liquid fuels produced using renewable energies) are expanded to become the third pillar of the energy transition.

dena handled both the content and organisation of the dialogue process on behalf of the BMWi. This involved collaborating with Prognos AG, Navigant Consulting and PwC. The BMWi launched the process in late 2018 as a way of discussing the future of gaseous fossil and renewable energy carriers with politicians and businesses. Participants included stakeholders from the fields of energy generation and infrastructure, and from the consumption sectors of industry, buildings, electricity and transport. Key questions asked how high the demand for gaseous energy carriers in the individual sectors will be, and which infrastructures will be needed to cover that demand. An initial review of the dialogue process was published in October 2019.

Learn more (in German) at [www.dena.de/gas2030](http://www.dena.de/gas2030)

GERMAN-TURKISH ENERGY FORUM

**ALL ABOARD: STUDY TOUR  
TO OFFSHORE WIND FARM**



The boat ride from the port of Sassnitz on the German island of Rügen to the 80 large wind turbines that make up the offshore wind farm EnBW Baltic 2 took about four hours. The study tour (pictured above) was held in September 2019 and was designed to enable the German and Turkish participants to share their experiences of offshore wind energy. On board were representatives of Turkey's energy ministry and experts from dena and the energy supplier EnBW. In order to reduce its dependency on energy imports, Turkey is seeking to expand renewable energies. Wind is set to play a major role.

Turkey and Germany are working closely together within an energy partnership. It is led by the Federal Ministry for Economic Affairs and Energy, and dena provides support by organising the German-Turkish Energy Forum. It arranges regular expert workshops, study trips and discussions about renewable energies, energy efficiency, infrastructure and the integrated energy transition. The events involve companies and institutions from both countries.

Learn more at [www.dena.de/turkey](http://www.dena.de/turkey)

ENERGY-EFFICIENT CONSTRUCTION IN CHINA

**PRIZEWINNING:  
AN EXEMPLARY BUILDING IN JINAN**

dena oversaw the construction of a new laboratory building in the Chinese city of Jinan. In June 2019, the German Chambers of Commerce Abroad (AHK) selected the project for an award, describing it as a shining example of innovative German energy-efficiency solutions in Chinese buildings.

The six-storey laboratory building, which is located on the campus of Jinan Vocational College (pictured right), was built in compliance with Germany's Passive House Standard. The building envelope is insulated, the windows are triple glazed, and solar thermal panels and several heat pumps are installed on the flat roof. Ventilation systems ensure optimal air quality on all floors.

During the two-and-a-half-year construction process, dena supported the project with its own quality assurance concept. Its experts trained the planners, checked and optimised the planning documents, evaluated energy data and monitored implementation throughout the construction phase.

The new laboratory complex means that the college, whose students include future engineers, now has a showpiece for energy-efficient construction. The aim is that the students will spread the idea beyond the borders of the province.

dena has been committed to improving the energy efficiency of Chinese buildings for more than a decade. So far, this has involved 34 pilot projects that have implemented, monitored and certified Efficient House standards in 12 provinces. Over 5,000 specialists have participated.

Learn more at [www.dena.de/en/china](http://www.dena.de/en/china)



THERMOS SOFTWARE

**EFFICIENT:  
DIGITAL PLANNING  
FOR HEATING GRIDS**

For cities and municipalities, planning a heating grid is a complex task. The open source software THERMOS (Thermal Energy Resource Modelling and Optimisation System) allows local decision makers to work faster and more efficiently. The free tool helps them find sound answers to a variety of questions, such as which type of heating grid is the most suitable, whether modernising the heating supply is economically feasible, and whether the desired reduction in carbon emissions is actually achievable. THERMOS is suitable for both setting up new grids and modernising existing infrastructure.

THERMOS is funded by the European Union, and dena is responsible for disseminating it in Germany. Its experts, for instance, are helping Berlin energy suppliers and local planners to use the program. With feedback from users, the development team is continually improving the software. dena is also involved in providing THERMOS training sessions for specialists involved in planning local heating grids.

Learn more at [www.thermos-project.eu](http://www.thermos-project.eu)

BERLIN ENERGY TRANSITION DIALOGUE

**EXCHANGE: CLEAN ENERGY IN MOROCCO AND CHILE**



Geopolitics, structural change, digitalisation and the integrated energy transition were the key topics at the international Berlin Energy Transition Dialogue (BETD) in April 2019. During the conference, dena held Business-to-Government Dialogues, a format that facilitated exchange between German energy companies and government representatives from Morocco and Chile. Kristina Haverkamp, Managing Director of dena (pictured left), welcomed the high-ranking guests to Berlin.

Entrepreneurs from Germany used both events as an opportunity to learn about the situation in Chile and Morocco. Renewable energies and energy efficiency were the main areas of focus. The BETD is held annually at the invitation of the German government and is organised by the German Energy Agency (dena), the German Renewable Energy Federation (BEE), the German Solar Association (BSW-Solar) and eclareon.

Learn more at [www.energydialogue.berlin](http://www.energydialogue.berlin)

Photos: Start Up Energy Transition/24th World Energy Congress; German-Turkish Energy Forum/Rafael Noster; Energy-efficient construction in China/Feng Puchun; Berlin Energy Transition Dialogue/photothek/Axel Schmidt



# The power of density

In Germany, 77 percent of the population live in cities or urban areas, and just 15 percent live in villages with fewer than 5,000 inhabitants. dena's Urban Energy Transition project has evaluated hundreds of examples of best practices from European cities, and recommends specific measures for making the energy transition a reality in urban environments.

TEXT [Marcus Franken](#)

## “Many innovations in the areas of electricity and mobility can be transferred from one city to another.”

Susanne Schmelcher, Project Manager, dena

Rather than more inventions, what we need is a great deal more speed and the desire to work together to put existing insights into practice. This is the conclusion of an in-depth project that dena conducted with experts on achieving the energy transition in Germany's densely populated regions. Susanne Schmelcher, a project manager at dena, explains what this actually means: “For the urban energy transition, many innovations in the areas of electricity and mobility in particular can be transferred from one city to another. Yet the cities are often pursuing separate paths for their heating supply.”

Thirty-five partners including public utilities, IT service providers, housing companies and logistics firms participated in the project. Working with the partners, dena has created a pool of knowledge about the energy transition in cities. This is primarily intended to support local politicians and businesses, though it also provides recommendations for the national level. The project also identified which political frameworks need to be improved so that municipalities and local businesses in Germany can move forward with the energy transition, even outside of pilot projects.

In Germany's large and medium-sized cities, most of the residents are concentrated on just a fifth of the urban area. One outcome of this is that the cities don't have enough space to supply themselves with renewable energy. Berlin, for instance, generated around 36 percent of its electricity in the city in 2016. However, this was not from wind and solar; 94 percent

of it came from combined heat and power (CHP) in small and large power plants using gas and coal. The dena study found that Hamburg gets 80 percent of its electricity from the region surrounding the city. This exchange is often economically advantageous for cities and their surrounding regions, but it also shows the immense imbalance of energy in conurbations.

### Computer heat for swimming pools

When it comes to remodelling the energy system, cities have the major advantage of energy generators and consumers existing in close proximity. Industrial high-temperature processes in industrial zones and ports – such as in Hamburg – take place in the vicinity of homes that are heated with low-temperature heat. This creates scope for cascading the heat from one level to the next. Processes can also be integrated over short distances. Waste heat from the servers in a data centre, for instance, could help to heat the water in a nearby swimming pool. Another option is to set up heating networks that allow energy to move back and forth between different users. Projects underway in Cologne and Halle show that we already have the technology to do this.

The big task now is to take the successful examples from research and funding projects, and make them fit for widespread use. The intensive discussions held during the dena project shone a clear light on the obstacles blocking this path. For a start, the many different actors from the energy industry, transport authorities and residential construction companies must work together

instead of (as they do today) just working in parallel. One way of helping them do so would be to allow municipalities to produce master plans for energy infrastructure. At the national level, the rules governing the energy market should be designed to make this kind of collaboration legally possible and economically attractive.

Intelligent CHP technology has a central role to play. For instance, when wind turbines produce more electricity than is currently required, the surplus can be used to heat the water in existing heating networks with electric heating. This technique, known as power-to-heat, can help keep wind turbines operating in these situations in future, instead of having their output curtailed. Large concentrated solar power systems (as used in Denmark), geothermal energy systems (with the right subsurface conditions, as in Munich), and hybrid systems that connect electricity and gas grids can be linked up to the heating infrastructure and thereby “networked”. This can help create an intelligent, integrated energy system in cities.

The heating transition will initially change very little about the way cities look. The process of swapping fuels derived from coal, gas and nuclear for energy from the wind, the sun, biomass and waste heat will be largely invisible to the public – especially in cases where conventional power plants are located outside the city. The same can't be said for mobility: as public transport expands, as electric vehicles bring mobile electricity storage to cities, and as rental schemes for cars, bikes and mopeds are launched, so the face of our cities will change. ■

# Ten recommendations for the urban energy transition

If the energy transition in Germany's cities is to actually succeed, a few fundamental changes will have to be made. We have distilled them down into ten basic approaches:

## Electricity I

Cities are consuming more, partially because of heat pumps and electric vehicles. The low-voltage electricity grid is not capable of handling this. The **grids need to be equipped with intelligent technology** that enables better use of existing infrastructure and makes it easier to connect the electricity grid to the heat and mobility sectors.

## Electricity II

**Taxes should be changed so that consumers are rewarded for behaviour that is both kind to the climate and benefits the grid and the overall system.** The different taxation of energy carriers is an obstacle to climate-friendly innovations. The EEG and combined-heat-and-power surcharges alone make electricity so expensive that it cannot compete with heating oil in the heating system. Ideally, taxation would be based on actual carbon emissions. Green electricity would then increasingly become an option for replacing heating oil.

## Electricity III

The principle of **"usage, not curtailment"** should go from being the exception to being the rule. Yet the Energy Industry Act (EnWG) currently only allows CHP plants to be linked with power-to-heat systems. Particularly for cities in windy regions, the law should be opened up and allow electric boilers in district heating networks.

## Electricity IV

Experts welcome the German government's decision to support small solar power systems with fixed feed-in tariffs even when the installed capacity exceeds 52 gigawatts. It is also high time to **remove obstacles preventing property owners from supplying their tenants with locally generated electricity** (*Mieterstrom*). This could be done

via exemptions regarding trade-tax privileges for generating electricity. The complex billing process for *Mieterstrom* should also be simplified.

## Heat I

The Combined Heat and Power Act should be amended to include **support for district heating that uses renewable energy sources.** Crucially, this will require expansion of the heating networks, heat storage systems, solar energy, geothermal energy, large-scale heat pumps and power-to-heat systems such as electric and electrode boilers. This could also pave the way for operating large seasonal heat storage systems.

## Heat II

GHG emissions should be used as an indicator in the energy performance evaluations carried out as standard on buildings today – primarily because, compared to parameters such as primary energy consumption, they would make it easier for building owners and laypeople to assess the efficacy of measures.

## Heat III

Municipalities should be able to set out **their own heating plan** within the framework of land-use planning and city-planning contracts so that all investors are involved in achieving the long-term goals. Some states, such as Baden-Württemberg, have begun work on this.

## Heat IV

**An appreciable increase in incentives for property owners can achieve a higher refurbishment rate.** Public buildings in particular can serve as examples. They should be swiftly refurbished and made climate neutral.

## Mobility I

More public transport, fewer cars! To achieve this, public options need to be improved, such as by adding more bus lanes and trams and by designing a form of carsharing that sensibly complements busses, trains, etc. By switching to quiet electric vehicles, some delivery traffic can take place at night so as to relieve congestion on the roads.

## Mobility II

Financial support for **adding more charging points for electric vehicles** must continue – it is the only way to make electric vehicles attractive in the city. Requiring buildings to provide charging points, in a similar way to existing rules that require them to provide parking spaces, can help.

**All the examples and areas of activity in the urban energy transition share a common factor: many business models emerged in the "old energy world" and must now be transformed. Almost no standardised processes exist for connecting the different infrastructures for heat, electricity, transport, waste and water. The aim of reducing carbon emissions is also poorly anchored. And since technical concepts are frequently available much sooner than the rest of the context in which they must be deployed, the regulatory framework often no longer fits. This mixture creates the pressure to act that urban areas are now experiencing – and that will continue for many years to come.**

Photos: Vattenfall/Pedro Becerra; Jörn Sackermann/Alamy Stock Photo; Stadtwerke Stuttgart/Leif-Hendrik Piechowski; Stadtwerke Halle; ubitricity

## THE DIVERSE URBAN ENERGY TRANSITION

In its Urban Energy Transition project, dena examined and evaluated hundreds of best practices. Here are five projects from the categories Overall System, Heat, and Mobility.



### Heat: Green heating at a coal power plant

In 2017, Vattenfall began building Europe's largest power-to-heat system at the Reuter coal-fired power plant in Berlin. The 120-megawatt electrode boiler, which relies on the immersion-heater principle, makes it possible to use more renewable energies in the building stock. In line with the idea of "usage, not curtailment", the system uses surplus wind and solar electricity to produce hot water for the district heating pipelines in the district of Spandau.

### System: Europe, GrowSmarter!

Cities such as Cologne, Stockholm and Barcelona are developing transferable smart-city solutions. On the Stegerwald estate in Cologne's Mülheim district, 1,400 flats totalling 80,000 square metres of living space are being refurbished. Heat will be generated using air-source heat pumps that will run on electricity from the new rooftop solar panels. A mobility station will provide residents with rental bikes and various classes of vehicles (electric options will be available).



### Mobility: Electric mopeds in Stuttgart

Stuttgart wants electromobility to play a key role in its urban energy transition. That's why its public utility launched the Stella Sharing scheme for mopeds powered by green electricity. It is a flexible and cheap alternative to cars in the city centre. Stella Sharing's system partner Emmy proves that the concept is transferable: Emmy has over 2,000 Vespa-style mopeds on the roads in Hamburg, Munich, Düsseldorf and Berlin.

### Heat: Energie-Initiative Halle

Energie-Initiative Halle is aiming to substantially decarbonise the district heating system that supplies Halle, a city on the Saale river in eastern Germany. Plans include building a power-to-heat system with an electrode boiler (25 MW), a river heat pump (Saale-to-heat, 7 MWel and 20 MWth), a solar power system (11 MW) and a power-to-gas pilot system with investment costs of roughly €800 million. The seasonal heat storage system with a capacity of 50,000 cubic metres and a heat output of 70 MW began operating in September 2018.

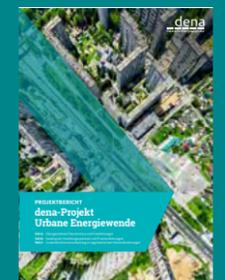


### Mobility: New air for Berlin

In order to increase the number of charging stations on Berlin's streets, the Neue Berliner Luft (New Berlin Air) project is using SmartCables to allow 1,000 street lights to also function as charging stations. Retrofitting street lights is substantially cheaper and takes up much less space than installing separate charging stations. The potential is huge: Berlin alone has around 220,000 street lights. Retrofitting is straightforward in any city where the lights are connected individually to the electricity grid (as is the case in Berlin and London).



Learn more (in German) about the urban energy transition at [www.dena.de/urbane-energiewende](http://www.dena.de/urbane-energiewende)



# Home refurbishments, one step at a time

An individual refurbishment roadmap can help convince homeowners to undertake energy-efficiency renovations. Initial experiences with this new tool for energy consulting have been positive.

TEXT Ralph Diermann



An individual refurbishment roadmap offers a step-by-step approach to energy-efficient modernisation.

**D**raughty windows, a façade and roof without insulation, an old oil-fired heating system in the cellar: for Lutz Badelt, an energy consultant from Altlandsberg near Berlin, there was no question that this old detached house needed a complete energy-efficient refurbishment. For the owner, a pensioner, this was out of the question. He didn't want to have to cope with the hassle, the stress and the expense at his age. Badelt responded by recommending a special instrument: an individual refurbishment roadmap. "It lists the suggested improvements and groups them into packages with a coordinated schedule. The plan also contains initial estimates of possible energy savings and costs. The homeowners can then decide if they want to do everything in one go, or step by step over time," says Badelt.

As with every energy consultation, the experts preparing the roadmap consid-

er the entire house, from cellar to roof and from the building envelope to the systems technology. The main difference is that the roadmap enables a step-by-step approach; it also presents the results very clearly. "This allays the fears that homeowners have about refurbishment," says Badelt.

The consultation always starts with a detailed discussion with the property owners. This enables the consultant to address

some basic questions: what is the goal of the renovation – is saving energy the main focus or are other renovations planned, such as a new bathroom? Who uses the property and what are the inhabitants' daily rhythms? What kind of budget is available? The consultant also looks at the building in detail. This all provides the basis for the refurbishment roadmap, which is tailored precisely to the needs and situation of the property and its owners.

#### Guidance for homeowners

Individual refurbishment roadmaps have been available throughout Germany as a new tool for energy consultations since 2017. The Federal Office for Economic Affairs and Export Control (BAFA) funds the production of the roadmaps (see box). On behalf of the Federal Ministry for Economic Affairs and Energy, dena developed the method and the templates for the consulting report in collaboration with the "ifeu" research institute and the Passive House Institute. "The roadmap gives homeowners a refurbishment plan that will guide them over the long term," explains Katharina Bensmann, an expert at dena. She says that the consultations always focus on an overall concept for the building: "This holistic approach results in higher-quality energy advice."

Lutz Badelt has been successfully using individual approaches in his energy consulting for a long

time. His expertise helped to develop the roadmaps. The tool had to be understandable for building owners and offer a high degree of user-friendliness for the energy consultants.

Badelt highlights the wide range of materials and aids that energy consultants can access online when they are compiling a roadmap. "The diagrams give the homeowners an overview of the costs and benefits of each measure. If people want more details, they can find comprehensive information in the detailed descriptions contained in the Implementation Guide," explains Badelt. He says that homeowners really appreciate having the information in such a clear and concise form.

#### A motivational approach

The roadmaps have been in use for about two years now, and the results so far are positive. "Our goal was to develop a tool that would motivate homeowners," says Bensmann. "The feedback from the consultants shows that we have achieved this." She says that about a third of the BAFA-funded energy consultations currently concern individual refurbishment roadmaps – and the figure is rising. Badelt reports that the roadmap's modular approach was exactly the right thing for the pensioner with the detached home in need of refurbishment. "Every year, he sends me a handwritten letter proudly telling me about which part of the plan he completed over the past months," says Badelt, smiling. "In his most recent letter he told me that, as well as saving energy, his back pain has also disappeared – because it's no longer draughty when he's sitting in his leather armchair." ■



#### INDIVIDUAL REFRUBISHMENT ROADMAP

An individual refurbishment roadmap illustrates and clearly explains the results of an energy consultation. The new energy consulting instrument has been available throughout Germany since July 2017. An online tool gives energy consultants access to standardised templates that simplify their work: the My Refurbishment Roadmap document gives customers a concise summary of all the key information from the consultation, and the Implementation Guide goes into more detail about each measure. A specialist portal for energy-efficient building and refurbishment (FEBS) provides energy consultants with a series of checklists, a quick reference guide and a handbook for the roadmaps. The Federal Office for Economic Affairs and Export Control subsidises the production of roadmaps as part of its funding programme for residential energy consultations. For detached and semi-detached houses, the state will cover up to 60 percent of the eligible consultation costs, up to a maximum of €1,300. For apartment buildings, the state will fund up to €1,700.

Learn more at  
[www.dena.de/en/febs](http://www.dena.de/en/febs)



# Farewell to dependency

To see how important a sustainable energy supply is for a country's development, one must only look to Ukraine. Under its new president Volodymyr Zelensky, the country hopes to make up lost ground – with the help of German expertise.

TEXT Philipp Rupp



Buildings in need of refurbishment were examined in Kiev, Odessa and Lviv.

Volodymyr Zelensky, once an actor and TV star, now the president of Ukraine, owes much of his election success to three promises he made to the electorate: to fight widespread corruption, reform the country and move it closer to the West. Within this process of economic and political transformation, the energy sector has a special role to play.

“Ukraine is unfortunately a country with a high energy dependency and is also one of the most inefficient economies in Europe at the moment,” says Dr Anja Sivakova-Kolb, an expert on Eastern Europe at dena. Ukraine does indeed import over 60 percent of its energy. The oil and gas mostly come from a single supplier – neighbouring Russia – and Ukraine is keen to free itself from this dependency.

A second challenge is that Ukraine is a very energy-intensive country. Energy intensity is the ratio of a country's energy consumption to its gross domestic product (GDP). Ukraine's ratio is three to four times higher than the European average. This high level of inefficiency and the heavy reliance on energy imports are not just a

political problem and bad for the global climate; above all, they are expensive. Ukraine spends over €10 billion on energy imports annually, which is about nine percent of the country's GDP. By comparison, Germany imports energy worth less than two percent of its GDP. Any reduction of its huge bill would therefore give Ukraine more scope to invest in its own future.

## New momentum for energy market reform

Plans for modernising the energy sector have existed for years, but efforts to actually make the reforms have been sluggish. An energy strategy agreed in 2012 states that Ukraine should significantly reduce its need for imports, primarily by expanding domestic renewable energies. By 2035, they should be producing 25 percent of the country's electricity. This doesn't seem like much if one considers that Germany already generates over 40 percent of its electricity from renewables. But for Ukraine, it's an ambitious goal: renewables currently account for 8.6 percent of its electricity.

President Zelensky is now planning to push ahead with the urgently needed reforms. They include – as set out in the energy strategy – establishing a competitively organised electricity market. Under the EU Association Agreement and the European regulations, Ukraine's electricity market was formally liberalised on 1 July 2019 in order to break up the oligopoly of a handful of companies that dominated the market.

To help competition develop, other participants should be able to access the market. At the time the market opened up, there was just a single trader who bulk-bought the electricity and supplied it to consumers via the distribution grids. “In 2019 and in line with the third EU energy package, the reform of the Ukrainian electricity market made a great deal of progress. The lack of competition, however, remains a problem,” says Sivakova-Kolb.

## Local expansion for more participation

Hans-Josef Fell, a former member of the German Bundestag for the Green party, ad

Photos: Oleh Slobodeniuk/Getty Images/istockphoto, dena

## FUTURE GERMAN-UKRAINIAN COLLABORATION

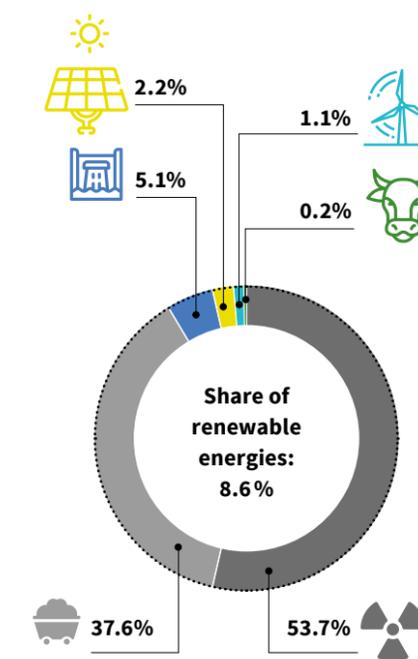
Germany and Ukraine want to turn their existing energy collaboration into an official partnership that will accelerate Ukraine's energy transition. The priorities will be to modernise the electricity grid, expand renewables and improve energy efficiency. dena will be closely involved in the process.

Learn more at [www.dena.de/en/ukraine](http://www.dena.de/en/ukraine)

is urging Ukraine to take a decentralised approach to expanding its renewable energies: “Otherwise, the oligarchs will just divide up this new business area between themselves.” Fell advises the government in Kiev, and recommends introducing a modern scheme for promoting green electricity – one that will allow everyone in the country to participate.

German expertise and technologies should now help to make the energy sector more efficient and gradually transition to renewable energies. In a joint project, dena and Ukraine's state-owned transmission system operator Ukrenergo, are investigating ways of improving the integration of green generation technology into the overall electricity system. They are primarily concerned with technical issues, but are also working on recommendations for politicians and regulatory authorities. Much of Ukraine's grid equipment is outdated and in poor condition. The decentralised, volatile feed-in of electricity from renewable energies is therefore a major challenge.

## Electricity generation in Ukraine



Source: National Energy and Utilities Regulatory Commission (NEURC)

## Energy-efficient buildings and a modern heating supply

About 35 percent of Ukraine's energy is consumed in the buildings sector. The savings potential here is huge. Four Ukrainian cities – Zhytomyr, Kamianets-Podilskyi, Chortkiv and Lviv – have set themselves the goal of transitioning to a 100% renewable energy supply by 2050.

Since 2016, as part of the German-Ukrainian Efficient House project, dena has been assisting 20 pilot schemes that aim to set standards for comprehensive energy-efficient refurbishments of apartment blocks. dena is also providing support through the Municipal Heating Transition project, which aims to modernise the heating supply. The solutions include implementing efficiency measures and developing new business models. Sharing experiences with German cities that are aiming for a high percentage of renewables in their supply is also an important part of the process. ■



Study tour in Lille, northern France: municipal housing company Vilogia modernised ten terraced houses in the suburb of Hem using the Energiesprong concept.

# Bespoke serial retrofits

The Lille region is home to the first houses in France to be refurbished in line with the Energiesprong concept. The process promises short construction times, low costs and high-quality results – and all without increasing the overall rent. A study tour to northern France visited the first completed prototypes.

TEXT Martin Kaluza PHOTOS Sebastien Jarry

Madame Bertin has dressed up for the occasion. Wearing sunglasses and a red suit made of kimono silk, she stands at the door of her two-storey terraced house on Rue Védrières in Hem, a suburb of Lille in northern France. A house viewing wasn't actually scheduled, but Bertin waves the visitors, who are crowded together on the pavement in the midsummer heat, into her home. The guests gladly accept the invitation. It is over 30°C outside, but the house is pleasantly cool – as if an air conditioning unit is running somewhere. There is no air conditioner, though. The house is just very well insulated.

The visitors, about 20 of them, are on a study tour. They hail from France, Belgium and Germany, where they work as energy consultants, in building departments or as climate action officers in municipalities.

Their visit is part of a two-day tour focusing on building and neighbourhood refurbishment. It has been organised by the Franco-German Energy Platform (a collaboration between dena and the French energy agency ADEME) and the Tandem project, which coordinates Franco-German climate partnerships.

The guests have travelled a long way in order to get a close-up view of an innovative approach to energy-efficient refurbishment in this northern French community. Bertin's house is one of the first buildings in France to be refurbished using the Energiesprong principle. The municipal housing company Vilogia has modernised ten terraced houses in Hem with this concept, which originated in the Netherlands.

## The Dutch show how it's done

Energiesprong is about carrying out serial refurbishments to create net-zero-energy homes – in a process that is faster, cheaper and higher quality than previous approaches. To achieve this, the Dutch non-profit organisation developed a special process using standardised elements. Insulated facades and roof elements with new windows are prefabricated in one piece and then just have to be installed on the building. Heating technology and renewable energies are also part of the package. Serial refurbishments have been carried out on 5,000 homes in the Netherlands so far, and a further 10,000 are currently planned.

On the estate in Hem, it is immediately clear which houses have been fully modernised. They are the ones with the gleaming new facades – which conceal a layer of glass-wool insulation. A timber construction company in the region produced the thermally insulated facades and roof elements. The windows are now triple glazed, and Bertin's roof is equipped with solar panels that produce electricity.

"See?" says Bertin, who has lived here for roughly 20 years, "they lowered the ceiling in the hallway a bit. And you know what? I'm not connected to the gas grid anymore." That's because her gas heating has been replaced by an air-to-air heat pump. A brown door that has been installed next to the front door provides access to the heating system. Technicians can service it without having to enter the house. Asked how the new heating performed last winter, Bertin answers with a delighted *impeccable!*

Instead of cooking with gas, she now uses electricity. The refurbishment also included new kitchen equipment. It's part of the overall concept. "We wanted to involve the residents at an early stage," says Agnieszka Bogucka, a project manager at Vilogia. She explains that this increases acceptance of the refurbishment work. Vilogia involved the tenants in the planning and gave them a say on the choice of kitchen equipment. "It makes the residents almost feel like owners," says Bogucka.

## Germany could refurbish 500,000 apartment blocks

In the Netherlands, Energiesprong has primarily refurbished terraced houses because the standardised process is especially well suited to buildings with simple, flat facades. However, the concept has also been used to refurbish apartment blocks with up to seven storeys. The process is almost always the same. Specialists start by measuring the building using digital technology. The data are then sent to a company that prefabricates the components accordingly. The roof and facade elements are then wrapped around the building like a shell. The benefit here is that the construction work is finished much sooner than with traditional refurbishments. For tenants, an Energiesprong refurbishment has another advantage: the initiative aims to refurbish

homes without raising the overall rent – in other words, the sum of the basic rent plus service charges such as energy costs should remain unchanged.

Unlike the Netherlands, France and Germany are just starting to introduce serial refurbishments. In both countries, expectations for the new approach are high. Many of the buildings are not up to date in terms of energy efficiency. On average, heating and hot water use three to five times more energy than would be necessary with modern technology. And if buildings are refurbished, it often involves long construction times and the energy savings frequently fall below what was expected.

This needs to change. Estimates by dena indicate that Energiesprong refurbishments in Germany would initially make sense for roughly 500,000 apartment blocks from the 1950s, 60s and 70s that are in need of modernisation. A team at dena is working with external specialists to adapt the process to the German market, and is connecting the building and housing sectors in the process. The Federal Ministry for Economic Affairs and Energy (BMWi) is funding the project. The first pilot projects are scheduled for completion in early 2020 (see box). The study tour to France organised by the Franco-German Energy Platform is about gathering insights into practical experiences and boosting motivation for the new approach. “We need examples of successful refurbishments like the ones in Hem to help us convince more representatives of municipalities in Germany,” says Sonja Leidner, an expert at dena.



Serial refurbishment in Longueau, France: insulated facades and roof elements are prefabricated and then simply attached to the building.

#### France could refurbish 60% of its homes

The Dutch idea is also thought to have a great deal of potential in France. “Energiesprong isn’t suitable for all homes, but 60 percent of France’s existing homes could be refurbished in this way,” says Deborah Knight of strategy consultancy Greenflex, which is running the project in Hem with Vilogia. The serial refurbishments offer substantial opportunities for Vilogia. It owns 71,399 subsidised homes throughout France – in Lille, Paris, Nantes and Bordeaux, and in the Grand Est and Grand Sud regions. So far, just 1,947 (less than three percent) have been refurbished.

The main hope among those involved is that higher refurbishment rates will bring costs down. The refurbishments in Hem cost around €157,000 per home. “If we refurbish 500 homes, the costs go down to €75,000 per unit,” says Knight. She explains that the figure, which comes from experience in the Netherlands, would mean that the long-term financing would pay off for Vilogia. Fabien Lasserre, Head of Development at Vilogia, says: “We want to follow the Dutch example. The energy costs should be included in the rent.” He explains that Vilogia also wants to be an energy supplier. Since the company guarantees that rents will remain the same after refurbishment,



#### ENERGIESPRONG IN GERMANY

In Germany, dena is helping housing companies and the building sector to develop refurbishment concepts based on the Energiesprong principle. At the moment, the German market has no scalable serial solution for refurbishing residential buildings. Pilot projects totalling roughly 50 homes in three German cities are either being planned or are already underway. They are primarily unmodernised rental apartment blocks built in the 1950s, 60s and 70s with up to three storeys.

Germany’s first Energiesprong prototype will be in Hamelin and is scheduled for completion in early 2020. The Arsago Group is refurbishing a row of terraced houses there, with a total living space of 720 square metres in the Kuckuck neighbourhood. Two housing cooperatives – Wohnungsgenossenschaft am Vorgebirgspark in Cologne and Baugenossenschaft Oberricklingen in Hannover – are also planning to complete serial refurbishments in 2020. “Other housing companies have combined several thousand homes in a volume deal and are expecting to carry out the work in the next four years,” says Uwe Bigalke, a team leader at dena.

In order to accelerate the development of scalable solutions in the construction sector, dena and Energiesprong Deutschland launched an accelerator programme in September 2019. The idea is to support construction companies and industrial component manufacturers in developing serial refurbishment solutions. Energiesprong Deutschland is coordinated by dena and financed by the Federal Ministry for Economic Affairs and Energy (BMWi). It is supported by the Federal German Housing and Real Estate Organisation (GdW). Work on the first pilot projects is also receiving funding from the EU programme INTERREG NEW, as part of the MUSTBEO project.

Learn more at [www.dena.de/en/energiesprong](http://www.dena.de/en/energiesprong)

Photo: ICF Habitat/Fabrice Singevin

it is in its interests to help its tenants consume as little energy as possible. The less they use, the sooner the refurbishment will become profitable for Vilogia.

For landlords in Germany, though, these models still present legal problems. If, for instance, a housing company installs a photovoltaic system and sells the electricity to its tenants, it risks losing the trade-tax privilege on its total income. The result is an increase in complexity and additional costs.

#### Climate action with a social element

Vilogia’s decision to guarantee its tenants the same rent after refurbishment also has compelling economic grounds. Lasserre explains: “Petrol prices are rising, energy costs are rising. Soon people will have to decide between heating their homes for themselves and their children, buying petrol so they can get to work, or paying their rent.” This trend means landlords will have to expect rising rental arrears. By investing in lower energy costs, Vilogia is therefore safeguarding its rental income for the long term.

Christiane Bouchart, Vice President of Lille European Metropolis, also sees the problem: “We’re struggling with energy poverty on a massive scale throughout the metropolitan region. A quarter of tenants cannot afford the rising electricity costs.” At the same time, she adds, Lille has a strong political will to tackle the issues of refurbishment and climate action. “Our building stock is very mixed – a third of our buildings were built before 1949,” says Bouchart. “We’re aiming to refurbish 1,800 homes annually. That’s three times as many as today. To achieve this, we’re going to need new methods.”

Plans are also in place to carry out serial refurbishments on Lille’s 222 public buildings. “They should be consuming 50 percent less energy by 2050,” says Stéphane Baly, a member of the city council. The first school should be refurbished using the new approach in 2021. “It will be a pilot project,” says Baly. “We have two months to do the renovations in the summer holidays, then the pupils come back. So we’ll have to work fast.” Insights gathered during this project should then help with refurbishing other public buildings. All of this means that it will be very interesting to see how things develop in and around Lille. And it seems likely that a few more groups will be making the trip to northern France. ■

## HOW SERIAL REFURBISHMENT WORKS



**1 Digital MEASUREMENT** using photos and laser measurements of the building



**2 PLANNING:** Performed in line with energy and architectural standards  
**TECHNOLOGY:** Energy self-sufficiency (calculated across the year) using solar panels, accumulators, heat pumps, etc. (net-zero emissions)  
**ARCHITECTURE:** Design of balconies, loggias, windows and facades



**3 Computer SIMULATION** of the interaction between all elements



**4 PREFABRICATION** of all elements (including electricity and water lines) in factories, regardless of weather conditions



**5 PREPARATION** of the building site



**6 INSTALLATION** of the new facades and prefabricated energy module, and connection of ventilation, electricity and water lines

# GUARANTEED SAVINGS

Reduce energy costs and protect the climate, all without having to make a large investment: energy savings contracting is an attractive option for public institutions. Yet very few institutions actually make use of it. dena wants to change this.

TEXT Ralph Diermann

Actors aren't the only ones who do creative work at theatres. Technical and administrative staff also often have to be resourceful – such as when money is tight but urgently needed refurbishments have to be carried out. This was the situation facing the public theatres in the German city of Chemnitz. High costs for electricity and heat tore holes in the budget, reducing the money available for the artistic side of things. The building technology in the opera house (built in 1909) and the neighbouring playhouse (1980) was completely outdated. Yet there was not enough money for an energy-efficient refurbishment.

The operators decided to bring a partner on board. They entrusted an energy-efficiency service provider with modernising and subsequently operating and maintaining the systems. A highlight of the arrangement is that the service provider also handles the financing for the work. In return, the company will receive an annual fee for the duration of the eleven-year contract, which the theatre will cover via energy savings. "We have absolutely no risk because our partner

has contractually guaranteed that our energy costs will drop by at least one third," says Raj Ullrich, Technical Director of Theater Chemnitz, clearly delighted. Among other things, the service provider has replaced the ventilation systems, air conditioning systems and water heating, and has installed heat-recovery systems and modern circulator pumps. The buildings were also fitted with new windows to minimise heat losses through the building envelope.

### Seize every opportunity for efficiency

This model is known as energy savings contracting, or ESC. Target groups are generally large private or public owners of buildings and properties that enter into a partnership with a specialised contracting service provider. "The provider handles the investments required to increase the energy efficiency, and gives the client a contractual guarantee that the agreed energy-saving goals will actually be achieved," explains Ronny Bischof, a team leader at dena. It's a classic win-win situation, he says: contracting providers know significantly more than many public institutions about heating



### MULDENTAL HOSPITALS IN GRIMMA AND WURZEN

#### MEASURES

Combined heat and power plant

#### GUARANTEED SAVINGS

€515,000 per year

#### CARBON REDUCTION

970 tonnes per year



### ESSEN TOWN HALL

#### MEASURES

Replacement of the central air conditioning system and of 3,106 room air conditioners, LED lights, optimisation of building technology, etc.

#### GUARANTEED SAVINGS

€1,000,000 per year

#### CARBON REDUCTION

2,700 tonnes per year

supplies, building and systems technology, and energy-efficient refurbishments. "They find it easier to fully exploit the property's potential for energy savings," says Bischof.

So the model has many advantages – yet comparatively few building owners have embraced these contracting partnerships so far. Why is that? Although their buildings are in great need of refurbishment, authorities and other public institutions are particularly reluctant to use ESC. "In many cases, it's simply a lack of experience," explains Bischof. He says that only very few examples from Germany's states and municipalities are publicly known as model projects.

What is more, finding a contracting partner requires specialised calls for tenders. The procedure and management demand suitable resources and a certain prior knowledge that is by no means present in all institutions. This concerns aspects such as recording energy consumption in all relevant properties, and drawing up the contracts. This is where dena's Centre of Expertise for Contracting comes in. By providing free online guidelines, contract templates, calculation tools and other services, it aims

to make it as easy as possible for public building owners to embark on ESC. As a main point of contact, the centre also connects experts and interested parties at the national, state and municipal levels with contracting providers.

### Regulatory hurdles

Sometimes the problems go deeper, though. "The regulatory framework in some of Germany's states makes it very difficult for public authorities to use contracting solutions," says Bischof. Some states, he explains, classify ESC as being similar to a loan, which can scare municipalities off. This restrictive approach is often caused by uncertainty about how the state's guidelines should be applied.

The states' approvals procedures are therefore an important topic at the annual ESC dialogue that dena organises between representatives of Germany's federal and state levels. "We want to promote knowledge sharing and are hopeful that a liberal approach to approvals will eventually become the norm," says Bischof. The different frameworks also mean that the offers available on the market and the level of expertise



### TOWN OF SEHNDE

#### MEASURES

Over 60 measures in 11 municipal buildings, including boiler replacement, energy-efficient lighting, intermediate-floor insulation and a combined heat and power plant

#### GUARANTEED SAVINGS

€130,000 per year

#### CARBON REDUCTION

586 tonnes per year



### PILOT SCHEME CO2NTRACTING: BUILD THE FUTURE!

Up to 2021, dena will be working with Germany's Federal Ministry for Economic Affairs and Energy (BMWi) and numerous regional and local supporters to implement ten high-quality ESC projects in states that have little contracting experience. During the three-year pilot scheme, dena will provide participants with a project developer free of charge, who will support them throughout the process – from inviting tenders and awarding the contract, to implementing the efficiency measures and evaluating the project. A total of 20 municipalities and owners of state property are receiving comprehensive guidance and advice for specific refurbishment measures as part of Co2ntracting: Build the Future. Ten of them will then be selected for the pilot scheme. dena will announce the winners in early 2020.

Learn more at  
[www.dena.de/en/contracting](http://www.dena.de/en/contracting)

vary widely between the states. To help address this problem, dena sets up mentoring partnerships between established experts from state energy agencies and colleagues from other states.

The next goal is to increase awareness of examples of good ESC practice. "Many state and municipal representatives are interested in successful, practical solutions that they can learn from," says Cornelia Schuch, a team leader at dena. With this in mind, dena has set up a pilot scheme in which ten states and municipalities will receive guidance for implementing a project (see box). "We want to create flagship projects that inspire people to copy them," says Schuch. Contracting, she explains, enables effective climate action, particularly for municipalities with limited financial and human resources. ■

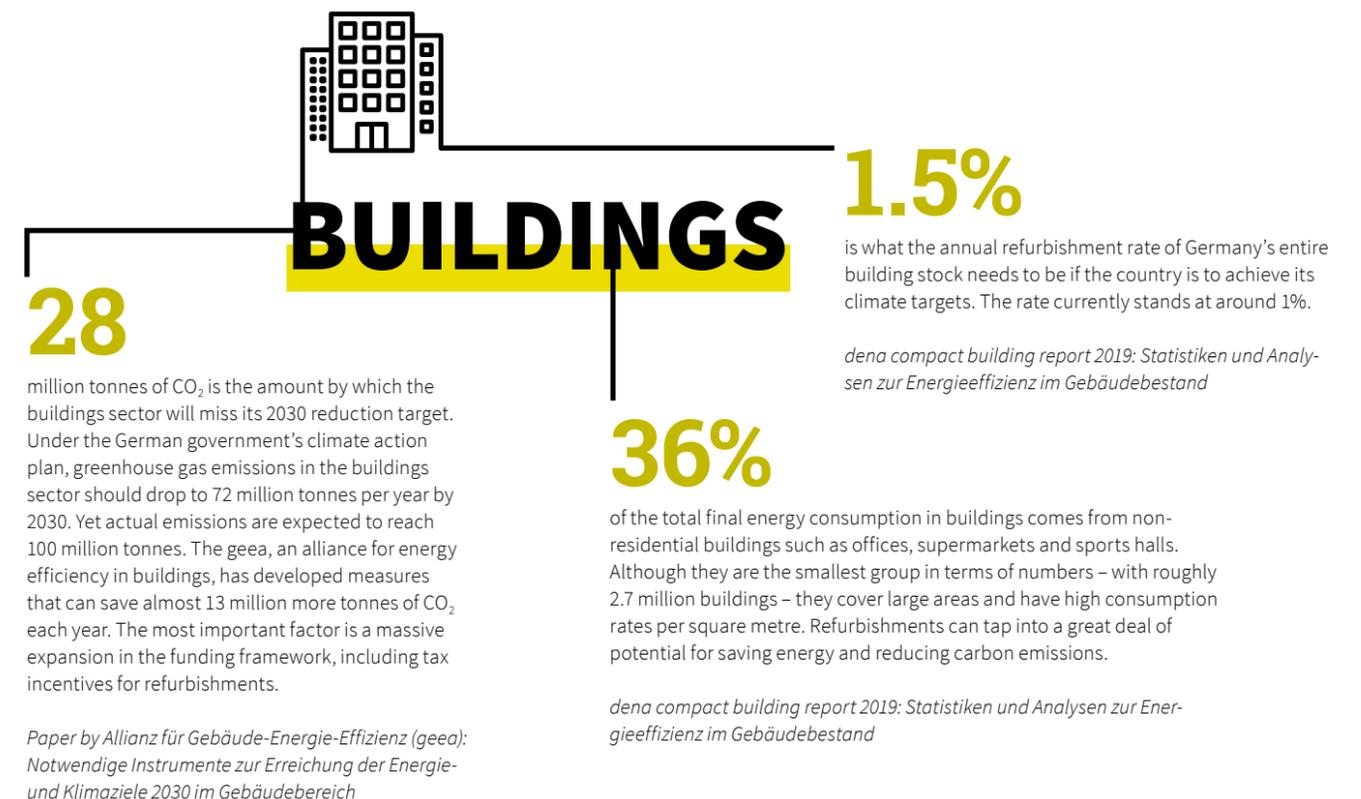
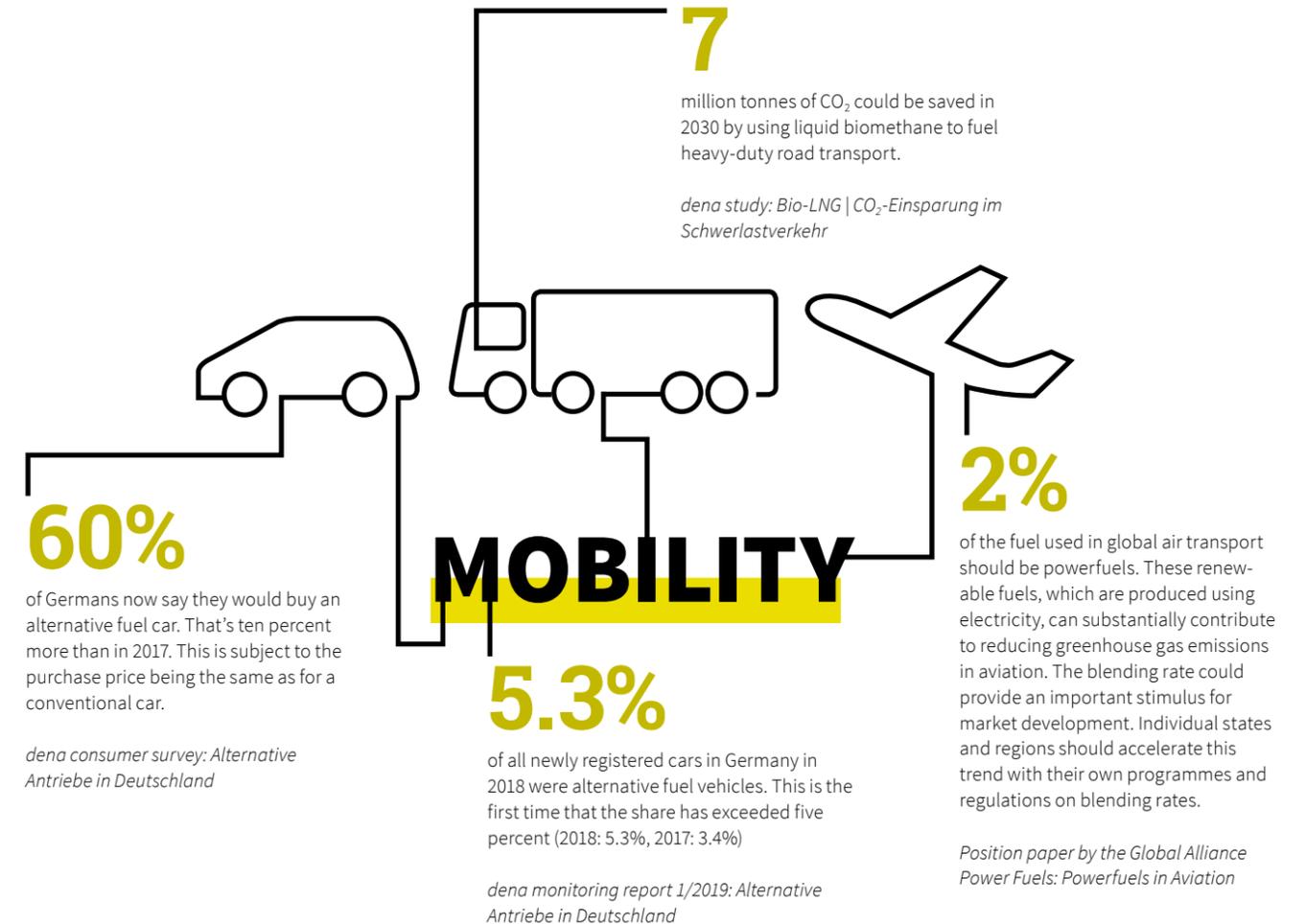
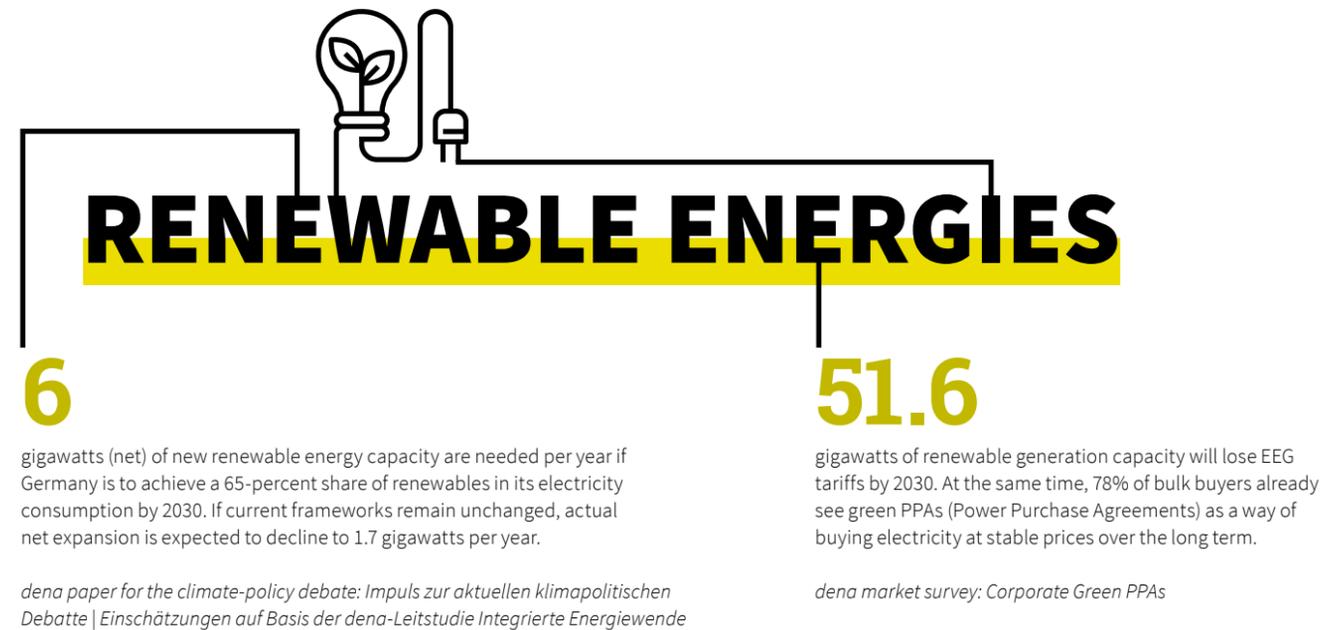
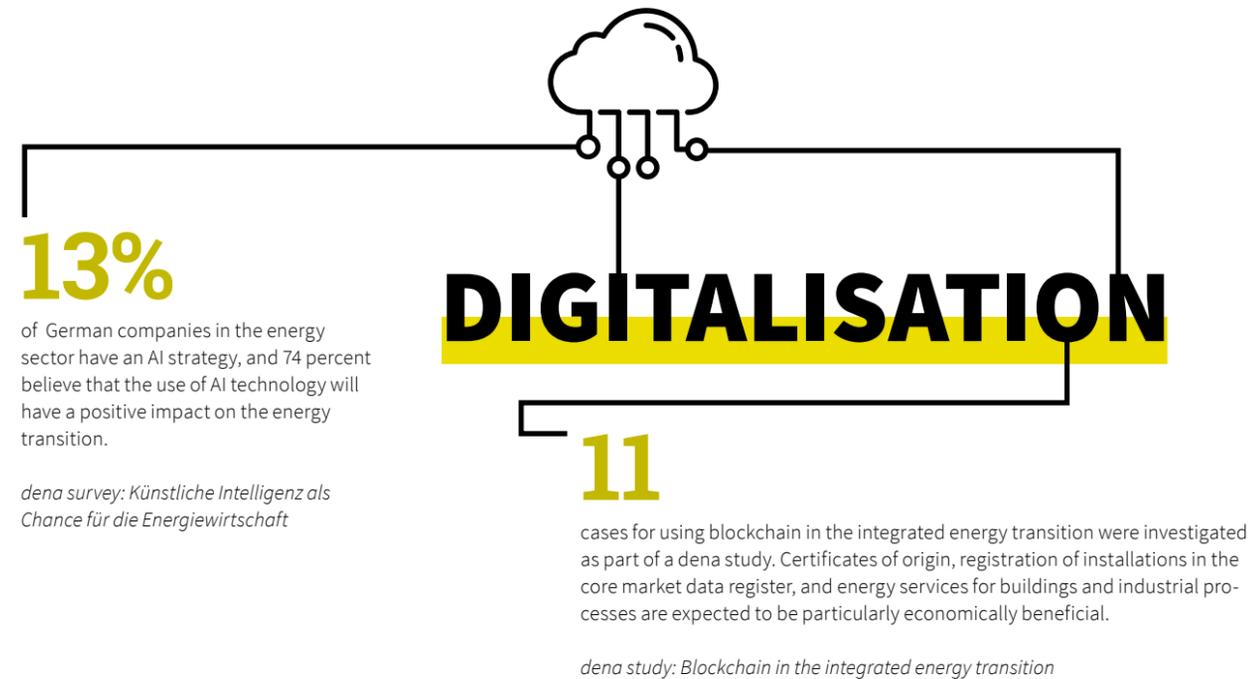


# FACTS & FIGURES

dena has existed for almost exactly **20 years!** What have been the milestones on this road so far? What have we achieved in the past year? How has the German Energy Agency developed as a company? In **Facts & Figures**, we share **the data that answers those questions.**

# Working it all out

With its studies, analyses, surveys and reports, dena creates a solid foundation for fact-based communication. We provide reliable information that enables effective action.



# DENA TURNS 20

In 2020, dena will be celebrating its 20th birthday. The Agency for the Applied Energy Transition started out in October 2000 with a staff of four, and now employs around 250 experts. It has initiated roughly 650 projects since it was founded. Here are 20 highlights from 20 years.

## 2000

### DENA IS FOUNDED

The founding shareholders are the Federal Republic of Germany (74%) and KfW Group (26%). Stephan Kohler is appointed as the first managing director. In July 2001, Kristina Steenbock completes the management team as the second managing director. At first, dena's offices are located on the top floor of Germany's economics ministry.



## 2002

### FIRST PROJECT: ENERGY INFO

dena launches its first project – *Informationsangebot Energie* – in 2001. By 2002, the campaign already has a website, a hotline and a traveling exhibition displaying easy-to-understand information about energy.



## 2004

### LAUNCH OF INTERNATIONAL SOLAR ROOFS PROGRAMME

dena develops the international Solar Roofs Programme as part of the German Energy Solutions Initiative, which is run by the Federal Ministry for Economic Affairs and Energy. It later becomes the Renewable Energy Solutions Programme and is expanded to cover all renewable energies.



## 2006

### ENERGY-EFFICIENT CONSTRUCTION IN CHINA

dena has been developing and running projects for energy-efficient construction in China since 2006. The aim is to improve market conditions for efficiency technologies, share expertise and establish energy-efficiency concepts that are suitable for the mass market.



## 2008

### GERMANY HYDROGEN STUDY

The Federal Ministry for Transport, Construction and Urban Development commissions dena with researching how Germany can cover its hydrogen demand in 2050. The results are soon used as a strategic basis for action by the newly founded National Organisation Hydrogen and Fuel Cell Technology (NOW).



## 2010

### FIRST DENA ENERGY EFFICIENCY CONGRESS

dena holds its first cross-sector Energy Efficiency Congress in October 2010 at the Estrel hotel in Berlin. The title of the congress is "Energy – Systems – Future: Strategies for Markets and Policy".



## 2012

### DENA DISTRIBUTION GRID STUDY

Following its two baseline studies on the transmission grid (the Grid Studies), dena produces one for the distribution grid. In it, dena examines the need for expanding and converting Germany's electricity distribution grids using two alternative scenarios for the expansion of renewable energies.



## 2014

### PILOT PROJECT: DEMAND-SIDE MANAGEMENT BADEN-WÜRTTEMBERG

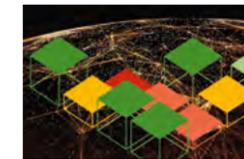
One of dena's guiding themes is identifying potential for making the electricity system more flexible. This pilot project provides key impetus for creating concrete opportunities for demand-side management in businesses. dena collaborates with companies to identify the economic potential and test out marketing methods.



## 2016

### DIGITAL ENERGY WORLD PLATFORM LAUNCHES

dena launches the cross-sector Digital Energy World Platform. The topics range from intelligent grids and smart-home solutions to Industry 4.0 and e-mobility. dena also produces the "digital dynamics" map, a tool for evaluating new business fields.



## 2018

### DENA STUDY INTEGRATED ENERGY TRANSITION

dena publishes the results of its Integrated Energy Transition study in June. Over 60 companies and industry associations from all sectors involved in the energy transition participated in the work. The study shows a variety of transformation paths that would allow Germany to achieve its climate goals for 2030 and 2050.



## 2000

### DENA IS FOUNDED

The German Energy Agency (dena) is founded on 24 October.



## 2001

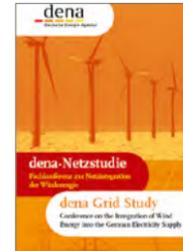
### FOUNDING CEREMONY

Celebrations marking the founding of dena are held in September 2001. Guests include Werner Müller (then economics minister) and Jürgen Trittin (then environment minister).

## 2003

### UMBRELLA CAMPAIGN ZUKUNFT HAUS STARTS

The umbrella campaign Zukunft Haus (Future House) launches in 2003. Its website is targeted at building owners, companies, refurbishment experts and politicians; the *Bild* newspaper ranks it as one of the 100 most important online addresses. The annual Zukunft Haus congress is a precursor to dena's later Energy Efficiency Congress.



## 2005

### GRID STUDY I

dena publishes its highly regarded Grid Study in April 2005. It is the first study to analyse which infrastructure is needed to achieve a 20-percent share of renewable energies in electricity generation. The Grid Study II follows in 2010, and work began on the third study in 2019.

## 2007

### FIRST ENERGY EFFICIENCY AWARD

Since 2007, dena has been honouring public and private companies that find innovative ways of boosting their energy efficiency. The international award includes prize money totaling €30,000.



## 2009

### ENERGY EFFICIENCY CAMPAIGN (IEE)

This information campaign is launched in 2002 and becomes dena's largest and furthest-reaching project with an annual budget of €6 million. The initiative runs until 2015 and reaches a huge audience every year with millions of press contacts and brochures. The Forsa research institute finds that 20 percent of Germans have heard of IEE.



## 2011

### DATABASE OF ENERGY EFFICIENCY EXPERTS

The EEE online database allows users to find qualified consultants for all buildings-related efficiency measures. Over 600,000 users access the database today. The geea, an alliance for energy efficiency in buildings, is also founded in 2011. Its aim is to recommend political measures for making buildings more efficient.



## 2013

### EFFICIENT HOUSE PILOT PROJECT

dena launches a long-term project that will lay valuable foundations by supervising refurbishments of several hundred existing buildings over the coming years. The data provide the basis for key studies such as dena's renovation study.



## 2015

### NEW MANAGEMENT: ANDREAS KUHLMANN AND KRISTINA HAVERKAMP

dena's first managing director, Stephan Kohler, leaves the agency at the end of 2014. Ulrich Benterbusch takes over temporarily on 1 January 2015. Andreas Kuhlmann is appointed Chief Executive. Kristina Haverkamp joins him as Managing Director in October 2015.



## 2017

### FIRST SET AWARD AND FIRST SET TECH FESTIVAL

With the SET Award, dena begins honouring innovative start-ups around the world. In 2017, over 500 applicants from 66 countries take part in the competition. An international jury selects 18 finalists, who present their business models at the first SET Tech Festival in Berlin on 20 March.



## 2019

### BLOCKCHAIN STUDY RESULTS

With its comprehensive study "Blockchain in the integrated energy transition", dena publishes its first analysis of how and where blockchain technology can contribute to the energy transition.



# Healthy growth, new momentum

In 2018, dena increased its revenue for the third year in a row. Through new collaborations and pioneering studies, it created new momentum for the energy transition.

The positive trajectory of dena's business development, which has prevailed for several years, continued in 2018. Once again, dena moderately increased its revenues, which rose by 2.3 percent over the previous year to €22.3 million. Figures for 2019 are also likely to show further revenue growth.

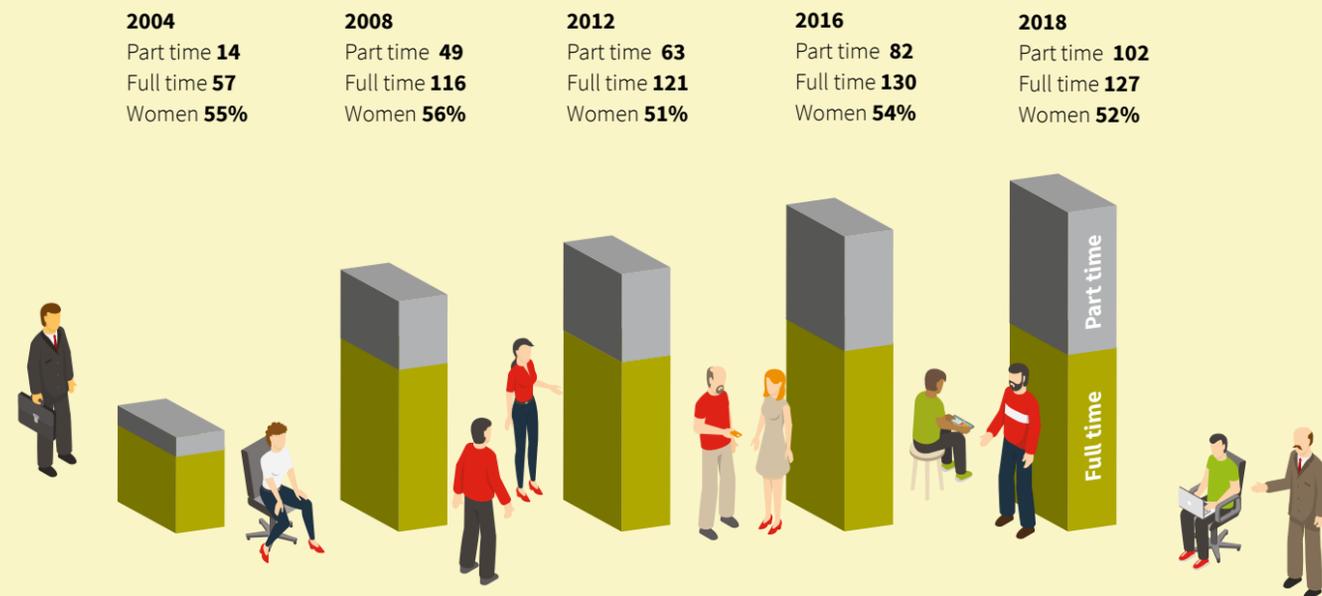
Kristina Haverkamp, Managing Director of dena, is delighted: "We're also seeing an upward trend in our profits. We generated €411,000 in 2017, and increased that operating result to €605,000 in 2018."

Annual net income, however, was just €38,000. This was due to one-off circumstances. Financial processing of tax audits on

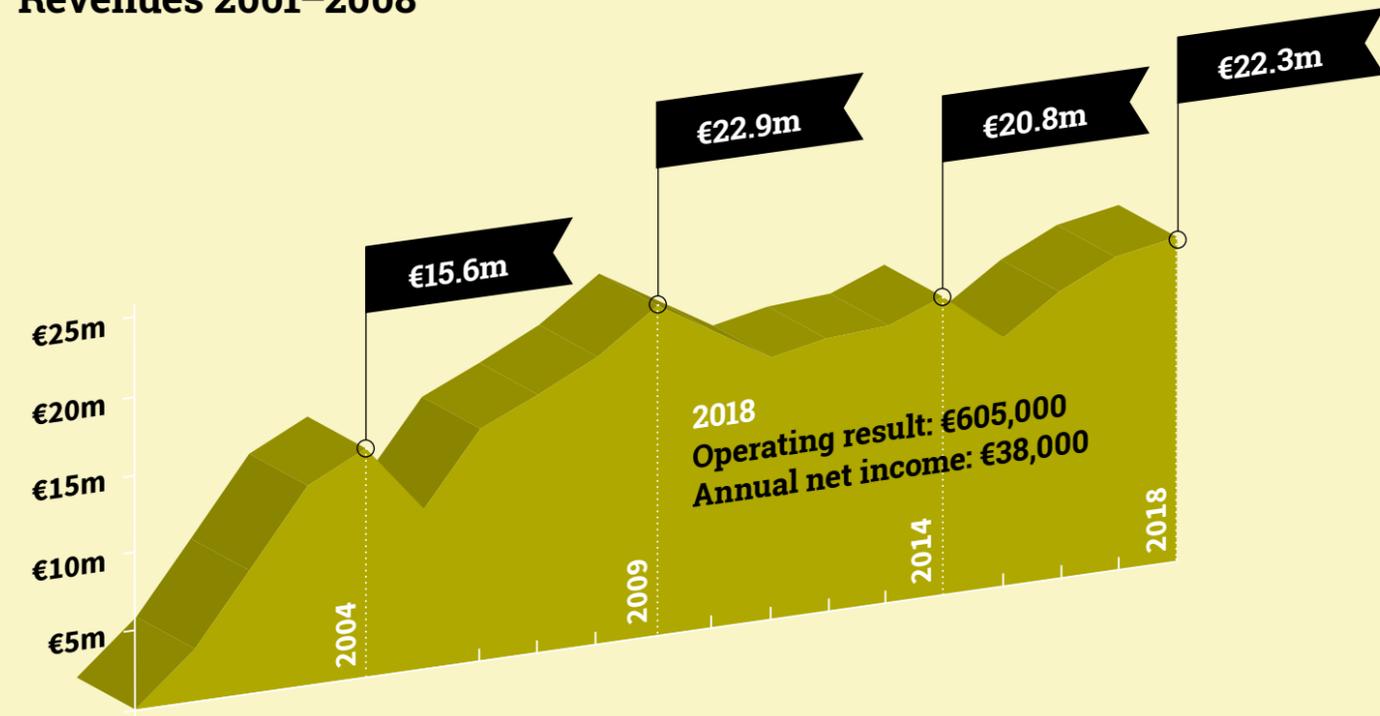
previous years (2005–2008 and 2009–2012) led to an extraordinary tax burden of €431,000. This significantly contributed to the decline in net income compared to previous years.

The positive economic trend also led to a further increase in employee numbers: dena employed 229 people at the end of 2018, up from 218 the previous year.

## Employees



## Revenues 2001–2008



The highlight of the year regarding the content of dena's work was the publication of the dena Study Integrated Energy Transition in June 2018. The scenario analysis, which was produced in collaboration with 60 partners from industry and science, indicates target paths that will allow Germany to achieve its energy and climate goals for 2050. The results received a great deal of attention from experts, the media and the public. They were presented at a variety of events, and discussed in great detail. The study subsequently led to new projects and collaborations that build on the results or delve deeper into individual topics. The study's integrated approach was transferred to other areas, including dena's Urban Energy Transition project, which looks at integrated strategies and solutions for the urban energy transition. The closing conference for the project took place at the dena Energy Transition Congress in 2019.

One collaboration that arose as a result of the study was with the initiators of two other baseline studies: the Federation of German Industries (BDI) and the German Academies of Sciences with their project ESYS (Energy Systems of the Future). The result was a joint paper with key recommendations for politicians and other stakeholders.

The study findings also gave rise to the Global Alliance Powerfuels. The alliance is supported by a cross-sectoral network of companies and associations. It aims to establish a broad network of partners from the areas of research, science, politics and business, and cultivate an international market for synthetic fuels produced using renewable energies.

In addition, autumn 2018 saw the start of dena's largest infrastructure project to date: the Grid Study III. In collaboration with the transmission grid operators,

large-scale distribution grid operators and other partners from science and industry, dena is investigating how grid expansion planning can be adapted for the next stage of the energy transition. The project will run for three years and is being funded by the Federal Ministry for Economic Affairs and Energy.

The continued growth in dena's employee numbers and the increasingly wide spectrum of its activities mean that it must also keep an eye on internal structures and organisation. In order to gauge its workplace culture and identify pathways for optimisation, dena participated in the Great Place to Work survey in 2018. The results, published in September 2018, were discussed in depth with employees. In addition, an ongoing process involving employees, managers and executive leaders has developed specific areas of action and solutions for dena. ■



# NEXT

The energy transition is a long-term project that needs a continuous supply of good ideas and dedicated innovators. What and who will help us make progress? What ballast can we offload? Which new technologies are about to make their **breakthrough**? In **Next**, we focus our attention on what's coming up.

# The key to a more intelligent system

**Artificial intelligence can help better master the complexities of an integrated, decentralised energy transition. Yet the technology is rarely used in the energy industry. This needs to change.**

TEXT Hans-Christoph Neidlein

Artificial intelligence (AI) will radically change the way we live and work. Norwegian business philosopher Anders Indset is convinced of this. In his bestseller *Quantenwirtschaft* (The Quantum Economy), he advocates using the technology to develop a consistent circular economy, protect the climate and establish a “share economy”. The astonishing thing is that – as Indset notes – the theoretical foundations of AI go back to the 1950s, when the term was first used to describe the interdisciplinary research field. Today, rapid technological advances in IT systems

and fast-growing volumes of data mean that AI applications are already a common feature in many areas of our lives. Self-learning algorithms and artificial neuronal networks make it easier for search engines to tackle the oceans of information available online. Machine translation programs like DeepL and Google Translate are very popular. Personal computer assistants such as Siri and Alexa, which users can speak to, use machine speech recognition.

And beyond the visible day-to-day applications, AI is already being successfully used on a wide scale in almost all areas of industry and in the energy sector. “AI has particular potential for the energy sector and an integrated energy transition,” says Philipp Richard, Team Leader for Energy Systems and Digitalisation at dena. The technology makes it possible to effectively use the data streams produced by digitalisation and thereby deal with the increasingly complex and decentralised nature of the energy system. “AI can play an important role in establishing a secure, climate-friendly and cost-efficient energy supply. It is also a key technology for improving energy efficiency in industry – although you also have to consider the rise in energy consumption caused by AI,” says Richard.

## Saving money and securing supplies

Improving forecasts is one of the many areas in which AI can be used in the energy sector. AI can help produce more accurate predictions of solar and wind electricity generation, which can fluctuate heavily at short notice as a result of local weather conditions. Trianel, a cooperation between public utilities that manages a direct marketing portfolio of 3,200 MW, uses AI for this purpose. Two years ago, the Aachen-based company switched its forecasting

tools to a cloud solution that uses self-learning algorithms. This means that the generation and weather data for each renewable system can be recorded, analysed and compared with historical weather data in real time. “Artificial intelligence is significantly improving the quality of our data analyses,” says Reinhard Klimeck, Head of Energy Trading and Portfolio Management at Trianel. Experience so far shows that short-term changes in generation can be predicted with up to 20 percent more accuracy than with the previous method. For Trianel, this has real monetary value: if the electricity volumes supplied to the exchange for direct marketing match forecasts more accurately, the utilities have to pay fewer fines for deviations. Another positive effect is that more accurate forecasts make it easier to integrate volatile wind and solar electricity into the energy system, which in turn increases security of supply.

AI can also help make the electricity grids more efficient. Researchers working on the PrognNetz project at the Karlsruhe Institute of Technology (KIT) are developing

self-learning weather sensors to improve capacity utilisation of the high-voltage lines. The sensors are being designed to model the cooling effect of the weather in real time. “So when we have favourable conditions – low ambient temperatures or strong winds – we can increase the volume of electricity being transported by 15 to 30 percent,” says Wilhelm Stork, Head of Microsystems Technology at KIT’s Institute for Information Processing Technologies.

## Building AI expertise

Other important uses for AI in the energy sector include optimising energy management systems, identifying cyberattacks on critical infrastructures such as grids or power stations at an early stage, and deploying algorithms for “predictive maintenance” (preventive servicing and maintenance using AI-generated predictions about the life span of individual components). It is also now possible – as demonstrated by the Austrian Power Grid – to monitor electricity grids using AI-based autonomous drones.

Many other areas of AI application are conceivable. An analysis carried out by dena found that around three quarters (74 percent) of 250 surveyed businesses assume that AI technologies will have a positive effect on the energy transition. In total, 82 percent believe that AI has a key role to play in the integrated energy transition (the merging of the electricity, heat and transport sectors) and in optimising the system as a whole. Nevertheless, decision makers in the energy sector are cautiously reserved about AI. “This is partly because businesses still know relatively little about it,” says Richard. Just 17 percent of the surveyed businesses felt that they were well informed about topics related to AI. dena is working to address this problem with its EnerKI project (see box). “Germany’s energy sector must strategically address the topic, develop expertise and personnel, and produce future-proof business models,” says Richard. With the right approach, Germany can benefit economically from AI, keep pace internationally and make progress with both the energy transition and climate action. ■



ENERKI

With EnerKI, a project funded by the Federal Ministry for Economic Affairs and Energy, dena is helping to increase knowledge about using artificial intelligence (AI) in the energy sector. The aim is to explore the potential of AI in the energy transition, initiate a broad discussion and provide insights into the widespread use of AI. EnerKI will involve a variety of dialogue events and expert workshops, and will produce a metastudy.

Learn more at [www.dena.de/en/artificial-intelligence](http://www.dena.de/en/artificial-intelligence)

# Money goes green

**Achieving the climate targets will require substantial investments from the public and private sectors. The result is a steady increase in the demand for sustainable or green investment options. What began as a small niche is becoming a global growth market. Europe and China want to lead the way.**

TEXT Hanne May

Investors virtually besieged real estate financier Berlin Hyp when it issued its third green bond in summer 2019. With a volume of €500 million, the bond will finance the construction of energy-efficient and environmentally sustainable buildings. Berlin Hyp says that it had received 76 orders totalling more than €950 million in just two and a half hours. The first green bond to be issued by Landesbank Baden-Württemberg (LBBW), with a volume of €750 million, was also heavily oversubscribed in 2017. The bank used the proceeds to finance energy-efficient commercial properties, and projects focusing on renewable energies.

“There’s a lot of demand for investment opportunities in green buildings,” says Nana von Rottenburg, an expert at dena. However, she also points out that the high demand from powerful investors is not matched by a large supply. One reason for this is that potential providers aren’t finding enough projects that satisfy their requirements. Von Rottenburg says that this is partially due to insufficiently standardised criteria for what exactly can be classified as a “green” building. “What’s needed are uniform assessment criteria that are also internationally recognised,” she says.

Uniform assessment criteria for properties could encourage more investment in green buildings.

Photo: Baona/Getty Images/istockphoto



## From niche to mainstream

Investments in green buildings are actually nothing new. In fact, capital has been flowing into investments that fulfil sustainability criteria for decades. This capital finances a broad portfolio of buildings, companies and energy generation systems. Two basic principles apply: the investments either rule out certain areas of industry for being unsustainable, or they specifically direct capital into selected sectors, companies and projects that meet defined sustainability standards and goals. Some banks have long had policies that mean their entire money-market business is run sustainably.

What was initially a niche market driven by a few private and institutional investors has grown enormously in recent years. Sustainable investments totalled €219.1 billion last year in Germany alone. And the momentum is showing no signs of slowing down. The market looks set to enter the mainstream in the coming years and decades, as redirecting financial flows is crucial for achieving the technology and infrastructure transition required by the Paris climate agreement. This trend is driving the high demand for investments such as green property bonds, stocks and insurance products.

## A green financial market for Europe

A key requirement for transforming the financial markets involves standardising what are currently very different investment criteria for sustainability. The European Commission laid the groundwork for this in March 2018, with its Action Plan on Financing Sustainable Growth. This is the first time that the EU has provided the financial markets with clear guidelines on climate action and sustainability. At the heart of the action plan is a classification system (or taxonomy) for green investments and economic activities in energy generation, transport, property and agriculture. The taxonomy is designed to make it easier to classify an investment as green. There are also plans to draw up EU standards for green bonds.

Alongside this, the EU’s revised Buildings Directive now obliges member states to include in their long-term renovation strategies an explanation of what instruments they plan to use to encourage private investment. However, the EU’s taxonomy might



dena has organised several workshops on green financing. They provided a forum for representatives from the financial sector, various business sectors, and politics and science to discuss the EU’s development of a uniform taxonomy for green and sustainable investments. Special attention was given to identifying obstacles that are currently hindering investments in green and energy-efficient buildings.

not come into force until late 2022. Von Rottenburg says that some aspects of its practical application and quality assurance still need to be clarified.

## China reorients its financial sector

Europe is not alone with its plans. In 2016, the Chinese government published guidelines for developing a green financial system, along with its own taxonomy, which was revised in 2019. The government also designated five pilot regions for developing and testing green financial structures.

China’s general environmental and sustainability goals are closely linked to a reorientation of its financial sector. During China’s G20 presidency, for instance, the G20 Green Finance Study Group (GFSG) was initiated under the leadership of the People’s Bank of China and the Bank of England. The aim is to create universal definitions and frameworks for a green international financial system.

European countries such as France, Luxembourg and Germany are therefore intensifying their dialogue with China about green financing. In August 2019, dena organised a workshop in Qingdao in collaboration with the National Energy Conservation Center of China and the German development agency GIZ. The event focused primarily on new approaches to financing and the political frameworks for promoting green financing in China. ■



A lot of smiles at the Start Up Energy Transition Award ceremony in April 2019 in Berlin

# A boost for green entrepreneurs

**How did things go for the prizewinning companies after the Start Up Energy Transition Award? Here, awardees and finalists report on how their businesses have been doing.**

**TEXT** Hans-Christoph Neidlein



dena Chief Executive Andreas Kuhlmann (left) presents an SET Award to the start-up Enapter.



Alexie Seller, founder of Pollinate Energy, speaks at Kraftwerk during the SET Tech Festival in Berlin in April 2018.

Photos: Stageview/Pedro Becerra; Fabian Starosta; Patricia Kalisch

**D**ena has been awarding its Start Up Energy Transition Award (SET Award) to young and innovative companies from around the world since 2017. From over 1,300 applicants, 51 companies have made it to the finals, and 17 start-ups have received the award. Four companies covering the three years of the award tell us about what impact it had on their business.

## **Enapter: Membranes for electrolysers**

Sebastian-Justus Schmidt's mission to provide "green hydrogen from renewable electricity for everyone, and at a lower cost than fossil fuels". Schmidt, Chairman of Enapter, thinks big. Serial production of the modular hydrogen generator EL 2.0 began in mid-September 2019 at a new factory in Pisa, Italy. "It's quintupling our production capacity and reducing manufacturing costs by 20 percent," says Schmidt proudly. Enapter's electrolysers use an anion exchange membrane (AEM). The patented technology requires no precious metals, which results in lower costs and higher durability.

The start-up's order books are full. It doubled its employee numbers between January and September 2019. The company, which was founded in Germany, now has sites in Berlin, Pisa and Chiang Mai, Thailand. Enapter's projects are also becoming increasingly international: residential heating in the Netherlands, an independent electricity and heating supply for the mountain village of Malate on the French island of Réunion, and a pilot system for producing methane in Queensland, Australia. Enapter won an SET Award in March 2019, in the category of Low-Carbon Energy Production. Did that give the company an added boost? "Yes," says Schmidt. "We became better known and were able to establish valuable contacts with companies in the energy sector and with the media. It makes it easier to reach reliable and visionary investors."

## **Hydrogenous Technologies: Liquid hydrogen**

"We had more attention from the media after the award," says Cornelius von der Heydt, Chief Commercial Officer at Hydrogenous Technologies. The start-up from Erlangen in Germany won an SET Award

**SET GLOBAL INNOVATION PLATFORM**

The SET Award is part of the SET Global Innovation Platform. Over 1,300 start-ups from 88 countries have taken part in the Start Up Energy Transition Award competition over the past three years. The award was initiated by dena in collaboration with the World Energy Council. The deadline for applications for the 2020 SET Award is 15 January 2020. The three best start-ups in each category will be invited to present their ideas at the SET Tech Festival, which will take place on 24 March 2020 in Berlin.

[Learn more at www.startup-energy-transition.com](http://www.startup-energy-transition.com)

in 2017, in the Clean Tech Against Climate Change category. It sells systems for liquid hydrogen storage which are safer and cheaper than conventional high-pressure gas tanks. The systems are based on Liquid Organic Hydrogen Carrier (LOHC) technology, which uses liquid materials as a transport medium for the hydrogen. Hydrogenous Technologies is also enjoying a steep upward trend in its business. "We've successfully completed two rounds of financing," says Heydt. The last round, in July 2019, totalled €17 million. "We've also been able to set up very important strategic partnerships," adds Heydt. He says the company has recently seen further strong growth in the demand for short-term projects and for very large longer-term projects.

## **BeeBryte: Software for saving**

BeeBryte (Building Energy Intelligence) has also been developing successfully. It won an SET Award in 2017, in the Urban Energy Transition category. The French start-up was chosen for its cloud-based software

that is designed to optimise energy consumption. The software controls batteries, heating systems and air conditioners in real time. It can reduce utility bills by up to 40 percent. "This is especially interesting for shopping centres, cold storage facilities and other large-scale consumers of energy," says BeeBryte founder Frédéric Crampé. BeeBryte's customers now include major logistics companies such as DHL and STEF, chemicals company Solvay, building firm Bouygues, and energy supplier Engie. The start-up has secured several million euros in venture capital over the last two years.

## **Pollinate Energy: Solar lights for better lives**

Pollinate Energy was one of the finalists in the 2018 SET Award, in the category entitled Special Prize: Quality Access & SDG-7. The prize recognises solutions that ensure an affordable, reliable, sustainable and modern energy supply for all. Pollinate Energy brings solar lights, improved cookstoves, and water filters to people living in difficult circumstances in slums.

As well as focusing on India, the start-up is now also active in Nepal. This is because Pollinate Energy merged with Empower Generation, a social enterprise working in Nepal, to form Pollinate Group in 2018. It has been a real success: 120,000 affordable solar lights have been sold so far. "By replacing their harmful kerosene lamps with our solar lights, poor families can save up to €62 per year," says Biheng Zhang, Director of Philanthropy at Pollinate Group. The lamps have also saved over 65,000 tonnes of carbon emissions. More than 500 women have been trained to be Leaders of Change. "As small-business owners, they can earn up to seven times their current wage by distributing the products," says Zhang.

Each year, the SET Initiative nominates the top 100 start-ups working on the energy transition and publishes these as the #SET100 list. Pollinate Energy was among them, so Zhang and her company attended the 24th World Energy Congress in Abu Dhabi in September 2019. "I was excited to meet so many inspiring start-up founders who share our vision. We'll definitely stay in touch so that we can continue working on solutions that will improve many people's lives." ■

# “I dream of tree nurseries throughout East Africa”

Divine Bamboo is a Ugandan start-up that produces sustainable fuels from bamboo. The company won dena's Start Up Energy Transition Award in 2019. Here, founder Divine Nabaweesi talks about what drives her.

“My earliest childhood memory is of a small cooking area – an open fire in a smoky room. It was really smoky because the wood that was being burned was dreadful.

Later, when I was a teenager in Uganda, I witnessed how the nature around us was disappearing. Centuries ago, all of our fertile land was covered in forest. Today, only fragments of the forest remain and



**DIVINE NABAWEEESI** studied social work and social administration in the Ugandan capital of Kampala. In 2015, she and Maria Nampijja founded the start-up Divine Bamboo. It received a Start Up Energy Transition Award from dena and the World Energy Council in 2019, winning the category “Special Prize SDG 7: affordable, reliable, sustainable and modern energy for all.”

the deforestation continues. Our trees are turning into the smoke rising from our fires. Almost everyone in Uganda has to use charcoal or firewood to cook their daily meals. And everyone who inhales the harmful smoke suffers as a result. According to the official statistics, the smoke kills 23,000 people every year in Uganda alone.

How do you deal with a situation like that? I'm an entrepreneur at heart. I set up my first company over ten years ago. Then, in 2015, I set up Divine Bamboo. The idea came to me after doing a simple Google search. I learned that you can use bamboo to make all kinds of different things, like furniture, structural timber, textiles and paper. I wondered if it could also be used to make fuel. Bamboo is native to Uganda; we have three local species.

My idea was to use fast-growing bamboo to reforest large areas of land and thereby stop the widespread deforestation. The bamboo would provide people with a clean fuel from local sources. It would also help us alleviate the situation in the refugee camps. Uganda has taken in around 1.4 million refugees who are fleeing the conflicts in Congo and South Sudan. Bamboo would be a way of quickly supplying large quantities of fuel to the camps. At the moment, most of the refugees cook using firewood.

New ideas often have it tough. For Divine Bamboo, a lack of knowledge was the biggest hurdle. So we offered training

sessions for smallholders, gave them bamboo saplings and guaranteed the purchase of their bamboo charcoal. Financing came from private donors or companies that use these investments to offset their own carbon emissions. Bamboo traps large quantities of greenhouse gas. We secured new investors in 2018 and this allowed us to develop the prototypes for our bamboo briquettes. They burn more cleanly than traditional firewood and are 30 percent cheaper than conventional charcoal. Women living in villages have to spend a lot of time gathering firewood from the forest. By using the bamboo briquettes, they can devote this time to something productive. This is a huge innovation for all of sub-Saharan Africa!

We now run the largest bamboo nursery in Uganda. Even the government is now focusing on replanting and maintaining bamboo forests. At the moment we're working on the next round of financing. We want to use the USD500,000 to train 5,000 smallholders and grow 300,000 bamboo saplings over the next two years. The Start Up Energy Transition Award and the attention we received as a result have been enormously helpful.

Our vision is to become East Africa's largest supplier of sustainable cooking fuels within ten years. At the same time, we're helping to protect our forests, create jobs and improve the situation for women in this part of the world. ”

Photo: Stageview/Pedro Becerra

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