

transition

THE ENERGY TRANSITION MAGAZINE BY DENA | #2019

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“The biggest challenges are also the most powerful accelerators.”

dena’s Chief Executive Andreas Kuhlmann talks to GRAFT architects Lars Krückeberg and Thomas Willemeit about how the urban energy transition is transforming cities.

POWER FUELS

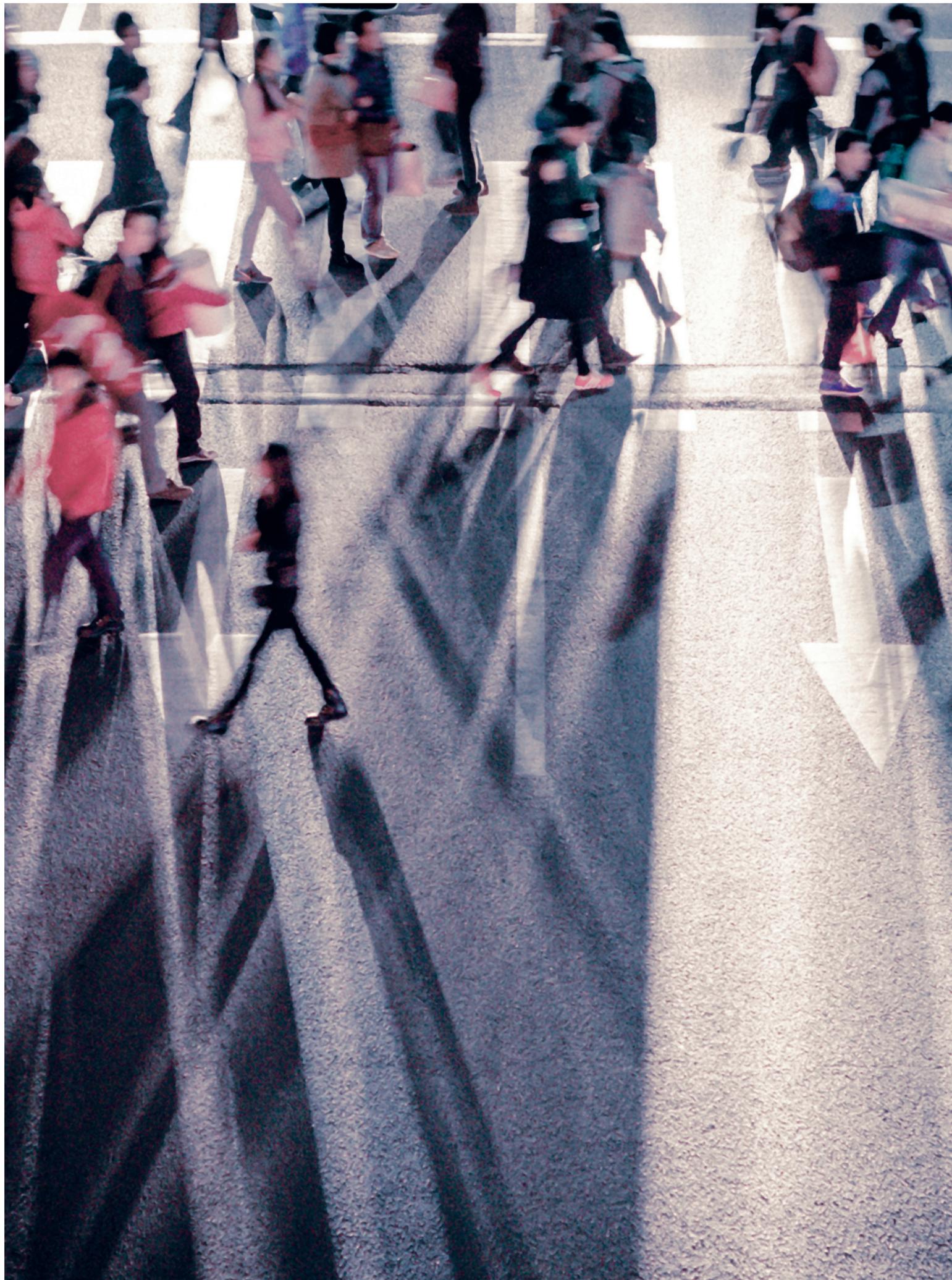
Missing link in the energy transition

SERIAL REFURBISHMENT

An industrial revolution in the construction sector

FACTS & FIGURES

Details about dena's activities



EDITORIAL

transition

The title of this issue tells us that the biggest challenges are also the most powerful accelerators. We chose this quote because it is such a good fit for the energy transition and climate protection – provided, of course, that we accept the challenges. 2019 could become a decisive year in this regard. In Germany, commissions dealing with key issues of the energy transition will present their findings, and a climate protection law is also in the pipeline. This is all with good reason, as just over ten years remain until 2030, the next important milestone. By then, Germany aims to have cut its CO₂ emissions by 55 per cent compared to 1990 levels.

It is hardly surprising that this ambitious target has prompted intense debate. Momentum is building, though. More and more stakeholders are getting involved. Across Germany, cities, municipalities and regions are departing the beaten tracks and planning a sustainable and liveable future (► Page 8).

Today, we know that the only way to achieve the climate targets is by adopting integrated approaches, focusing on innovation, and creating the right economic framework (► Page 22). All of these issues lie at the heart of our work and therefore take centre stage in this annual magazine. The articles present good approaches, for instance in the industrial sector (► Page 38), and new technologies such as power fuels. Germany has driven the development of these synthetic fuels, and they must now play a more prominent role on the global stage (► Page 28).

As you might expect, energy efficiency also features as a topic in this issue. Without it, we have no hope of achieving the targets. How wonderful that so many other stakeholders are now committed to this cause (► Page 42).

The energy transition and climate protection are projects that drive progress. They have long since spread beyond national borders. Many other countries are involved and are enquiring about the trends in Germany and about which technologies our companies have to offer. Collaborating with partners around the world is another key area of our work (► Page 46). And it should remain so.

We wish you a pleasant read and look forward to receiving your feedback!



Andreas Kuhlmann
Chief Executive



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THE BIG PICTURE

THE ENERGY TRANSITION IS ONE OF THE MOST FASCINATING AND SIGNIFICANT PROCESSES OF CHANGE OF OUR TIME. IN THE SECTION **THE BIG PICTURE**, WE EXAMINE THE MAJOR ISSUES AND CONTROVERSIES. WHAT WILL SUCCESSFUL **BUSINESS MODELS** OF THE FUTURE LOOK LIKE? WHICH **TRENDS** DEFINE THE ENERGY MARKET? AND WHICH NEW **IDEAS** ARE CHALLENGING OLD CERTAINTIES?

Cities as future labs

Cities show no sign of losing their appeal any time soon. As their share in global energy consumption soars, many are now seeking solutions for a sustainable future. A site visit to the urban energy transition.

TEXT Marcus Franken PHOTOS Niko Havranek



One of the world's tallest wooden buildings is under construction in Aspern Seestadt. It is designed to save 2,800 tonnes of CO₂ compared to a similar building in reinforced concrete.

Construction cranes pierce the sky above Aspern Seestadt in Vienna. New apartment blocks are taking shape on the banks of a pond carved into the park. Some 6,000 people already live here, and the first companies have moved into their offices. The space is very green, the architecture muted. From the outside, the energy revolution doesn't look very revolutionary.

Nevertheless, many of the buildings are brimming with sensors and digital metering points. In the admiring words of the Austrian newspaper *Kurier*, Seestadt is a “large-scale lab for the energy supply of the future.” “Aspern Smart City Research” describes itself as the biggest research project for the urban energy transition in Europe. People live here, businesses operate here, and the researchers do research here - on a “live object”, so to speak.

Neighbourhood electricity trading

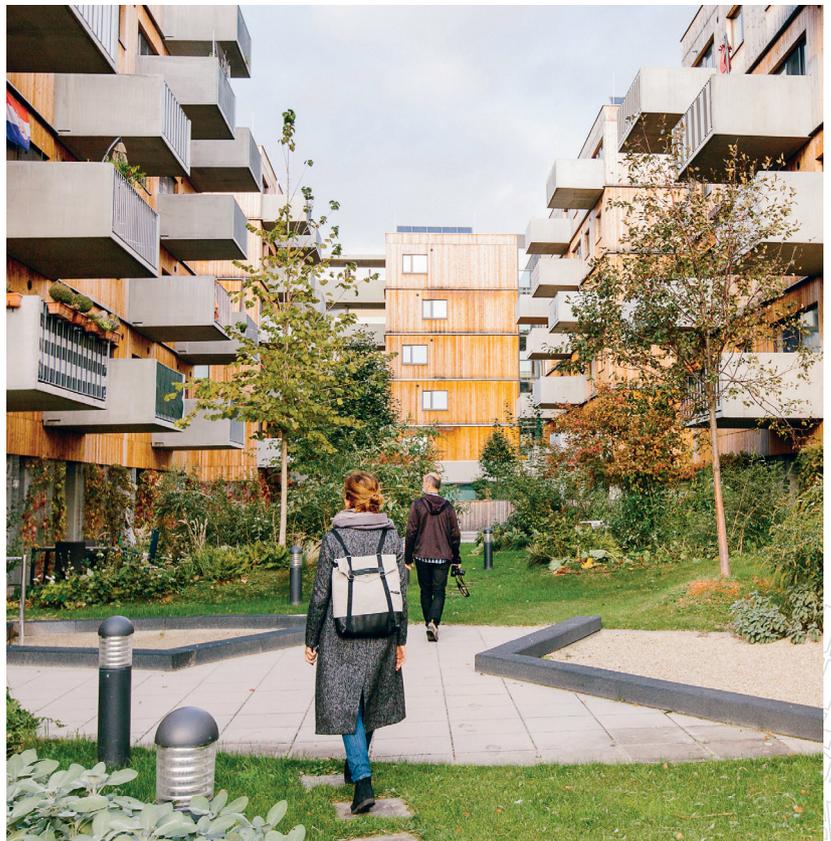
So how exactly does Seestadt's energy transition work? With a whole series of innovative approaches, such as filling thermal storage systems in summer for cold spells in winter, using heat recovery technology and deploying batteries. “We've shown that groundwater heat pumps, solar power systems and suitable storage systems can heat a modern apartment block with 213 units,” says project manager Oliver Juli with evident pride. “Even if it's minus 13 degrees for three weeks in January.” A new-build on Maria-Tusch-Straße has a solar power system mounted on the roof. Heat pumps in the basement connect it to a huge underground storage system that can hold 40,000 kilowatt hours (kWh) of thermal energy. Juli explains that the houses, which are connected to

low-temperature district heating, can even participate on the balancing energy market as controllable loads. The future apartment blocks will also be able to trade energy with each other, says Juli: “When the school isn't using the electricity from its solar panels in the summer holidays, the neighbouring offices can buy it for their air conditioning systems.”

A holistic approach

The new district in the east of Vienna is a lighthouse project for the urban energy transition - and this is in a city that already ranks among the most climate-friendly in Europe. Vienna's per capita CO₂ emissions are just 2.6 tonnes per year - which was originally the target for 2030. The use of coal and oil to generate heat has plummeted by 94 and 71 per cent, respectively, since 1995. Heat

In 2010, for the first time in human history, every second person lived in a city. This could rise to two-thirds by 2050.



Designed holistically, from the transport concept to the construction materials: residential buildings in Aspern.



“Clearly communicating the opportunities and challenges”

dena expert Susanne Schmelcher talks about the Urban Energy Transition project

Why has dena chosen to launch its Urban Energy Transition project now?

SCHMELCHER: Current approaches to the energy transition are overly focused on the sectors as separate entities. Now we've reached a point at which the construction and mobility sectors need to be brought into the equation. Cities play a vital role here, but so far this doesn't get enough recognition in the political agenda.

What is dena doing specifically?

SCHMELCHER: We bring together the various stakeholders with their differing perspectives of the urban space. The number

of stakeholders was previously considered a problem. We intend to use practical examples to show what is possible when the different sectors are connected. The expertise of our partners from public utilities to the industrial sector will help us. We also want to indicate clearly where conflicting targets still exist. The aim is to accelerate decisions in municipalities, companies and politics.

What do you expect the outcome of dena's Urban Energy Transition project to be?

SCHMELCHER: We need sustainable concepts for realising the urban energy transition that encompass both the use of tech-

nology and the processes involved. The key question is: how can we achieve urban development with less resource use and a higher quality of life? We plan to publish a report at the end of 2019 that will show companies and politicians where the opportunities and challenges lie. In doing so, we will provide strategic and political guidance for the urban energy transition. We hope it will create a similar implementation framework to the one that was initiated by dena's Integrated Energy Transition study. This issue will continue to dominate dena's work in the long term.

For more information, visit www.dena.de/urban-energy-transition

now comes from highly efficient combined heat and power plants and from the famous waste incineration plant designed by the artist Friedensreich Hundertwasser.

Seestadt will one day provide 20,000 people with a place to live or work. Designed holistically, their homes and businesses will be as green as possible, from the transport concept to the construction materials. An extensive network of cycle paths connects the individual buildings. Two tram lines, busses and the underground serve the district. In addition, one of the world's tallest wooden buildings is being built at the heart of the development: a high-rise with 24 storeys. It is designed to save 2,800 tonnes of CO₂ compared to a standard building of reinforced concrete. “That's equivalent to commuting 40 kilometres to work for 1,300 years,” the developer says.

Aspern wants to demonstrate how cities can – and must – contribute to the energy transition and climate protection.

After all, cities from Vienna to Vladivostok and Washington play a vital role: the majority of the world's population live in urban centres, where the lion's share of electricity, heat and fuels are consumed. “We have to show that modern lifestyles and climate protection are not mutually exclusive in cities,” says Christoph Jugel, Director of Energy Systems at dena and responsible for its Urban Energy Transition project (► Short interview “Clearly communicating the opportunities and challenges”). Jugel explains that today's discussions on how to convert energy supply systems in line with climate protection are too often restricted to the electricity supply. “Our dena pilot study on the integrated energy transition demonstrated that it's best to address the electricity, heat and mobility sectors as connected issues,” says Jugel. Nowhere else are these three sectors so closely intertwined as in cities, making them fertile ground for the energy transition.

Connecting electricity, heat and mobility

However auspicious the outlook may be, many things still separate electricity, heat and mobility: energy and fiscal laws that obstruct integration; a raft of stakeholders with conflicting interests, from the housing industry to traffic planners; and finally the fact that many cities have yet to recognise the opportunities and potential of the urban energy transition and have failed to place the issues on their agendas. Around the world, too many cities are still subscribing to obsolete models, such as the concept of car-friendly cities from the mid-20th century, or the strict separation of business and residential districts.

A volte-face is needed. Cities are expanding at a breathtaking speed, especially outside Europe. In 2010, for the first time in human history, every second person lived in a city. This number could grow to



A pioneer in more than just bicycles: Copenhagen is determined to become the world's first climate-neutral capital by 2025.

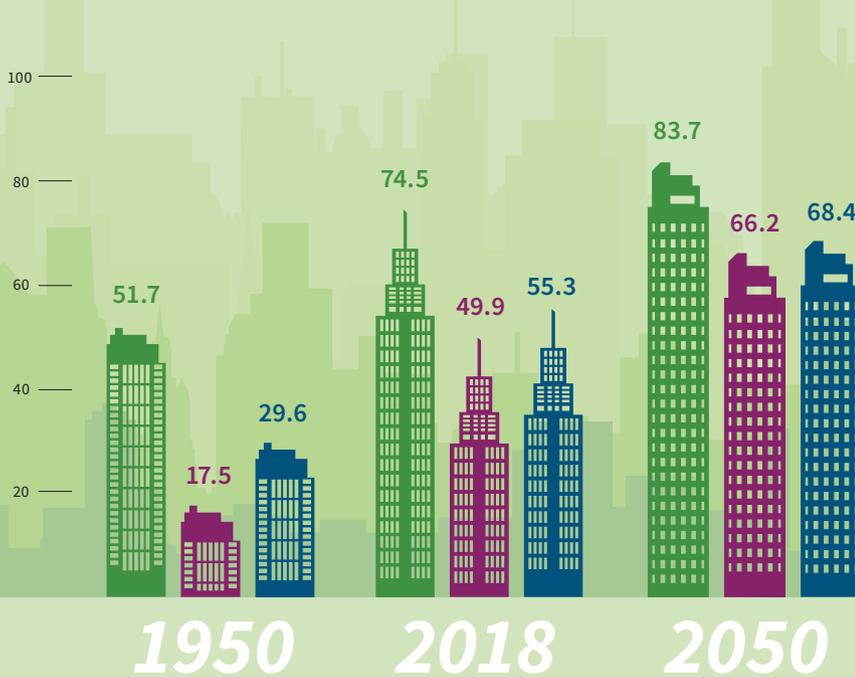
“We have to show that modern lifestyles and climate protection are not mutually exclusive in cities.”

Christoph Jugel, Director of Energy Systems at dena

THE URBAN POPULATION EXPLOSION

POPULATION IN URBAN SPACES (IN PER CENT)

■ Europe ■ Asia ■ World



While less than one third of the global population lived in cities in the 1930s, figures from the United Nations (UN) show that 55 per cent of the world's 7.6 billion people now live in cities. The urban populations are especially high in the United States (82 per cent) and Europe (74 per cent).

The trend gathered particular pace in the decades after 1950, with the number of city dwellers rising from just 751 million to 4.2 billion today. That is an almost six-fold increase!

UN estimates indicate that two-thirds of people will live in urban spaces by 2050, whereas the rural population will drop from 3.4 billion today to 3.1 billion in the same period. An additional 2.5 billion people will inhabit the cities, bringing the total to 6.7 billion.

URBAN LIFE

More climate-friendly than rural life

What springs to mind when you think about living in harmony with nature and the climate? Usually, it's a house in the country with a vegetable garden. Yet living in the city can be a lot kinder to the climate. The carbon footprints of many city dwellers are already smaller than those of their rural compatriots.

For instance, the average German emits 11 tonnes of CO₂ per year. However, a person living in Hamburg emits just six tonnes, and a person in Berlin emits less

than five. People in Paris, London, Singapore, Moscow and Hong Kong also consume comparatively little energy. It's all about scale: in cities, energy production and consumption are close together.

What's more, people in cities have shorter distances to travel, are less dependant on cars and find it easier to switch to bikes, buses and trains. Take Berlin, for instance, where statistics show that three people share a car on average – the nationwide average is just two.

CO₂ EMISSIONS IN GERMANY
11 TONNES
PER CAPITA/YEAR



Source: Federal Environment Agency; Berlin Senate Department for Economics, Energy and Public Enterprises

two-thirds by 2050, with 6.7 billion people in a global population of 9.8 billion living in metropolitan regions (► Information box “The urban population explosion”). Population growth is therefore expected to take place exclusively in cities. A study by Siemens has shown that urban centres are already responsible for two-thirds of total energy consumption. Cities are therefore responsible for the majority of harmful CO₂ emissions. At the same time, as the global population grows, so does the demand for energy. While European

experts expect a worldwide increase of ‘just’ seven per cent, US authorities are predicting that global demand will grow by almost 30 per cent compared to 2015. One thing is certain, though: the pressure to accelerate the energy transition in cities is rising.

“Cities are under the most pressure to change”

Sometimes we fail to notice that cities offer immense opportunities and potential

solutions: shared heating concepts for commercial and residential areas, compact neighbourhoods, short distances (► Information box “Urban life: More climate-friendly than rural life”).

“Cities are under the most pressure to change,” says Weert Canzler, a mobility expert at WZB Berlin Social Science Center. “For cities, the decision to use their limited space as car parks or to improve quality of life is increasingly becoming a factor that affects inward investment,” he says, describing one of the trends. These days, cities sometimes build cafe terraces, jogging paths and skateboard parks instead of parking spaces. Car traffic is no longer the main concern – the focus has shifted to residents' other needs.

Canzler finds examples for this shift all over the world: Seoul tore up a city-centre expressway to make space for a park. Cars are only permitted to enter Singapore if they are carrying at least two people. And since the start of 2018, the 5.6 million inhabitants of this Asian city have only been allowed to register a car if they can prove that they have scrapped an old one. The US state of California is investing heavily in electric cars and zero-emissions delivery vehicles, especially in its urban centres.

Vehicle-sharing schemes are also on the rise in German cities such as Munich, Hamburg and Berlin. The streets are dotted with scooters, cars and bikes for hire. And the transport companies



Heating with renewables, even at minus 13°C: Project manager Oliver Juli is proud of the heating supply in Aspern.



The city as storage system

Herten's public utility, Hertener Stadtwerke, has brought the existing storage systems and energy producers together within a virtual energy storage unit designed to improve the use of fluctuating electricity production from renewable energy sources. Detlef Großjohann, Head of Technical Services at Herten's public utility, describes the experience and discusses the role his city is playing in the energy transition.

Mr Großjohann, have you already achieved the urban energy transition in Herten?

GROSSJOHANN: Definitely not. But we know what to do now, and are ready to tackle it.

From your operational perspective at Herten's public utility, what do you associate with an abstract concept like "decentralised energy supply"?

GROSSJOHANN: Five years ago I would have said that it's a miniature combined heat and power plant, a CHP plant, in the basement. Now I interpret it in terms of the potential for a city like Herten to generate and control all of its own energy.

And how will that work?

GROSSJOHANN: Mainly with digitalisation. We need smart metres, because the first step is to find out what our loads actually are. Then we will see what the demand is. Based on my experience in Herten, I believe that the current generating plants are too big by around 30 to 40 per cent.

Herten is a city of 60,000 inhabitants. What did you do?

GROSSJOHANN: Here in the city we established a load shifting management system and connected all conceivable types of potential loads and heat storage systems, from the public swimming pools to a photovoltaic system, a hydrogen electrolysis unit and even small storage heaters. The main problem from an engineering perspective was to switch these highly heterogeneous facilities to a system of central, automated operation. However, the system worked smoothly during the one-year project. We were able to switch the loads on and off, depending on the supply of electricity.

Where are the stumbling blocks?

GROSSJOHANN: At present, it costs a lot of time and money to connect the systems to the IT, especially the smaller ones. It's not economical; the systems should be fitted with suitable communications interfaces as standard. The legal frameworks also need to change and be adapted so that business models can be established here as well.

What lessons has this taught you for the energy transition?

GROSSJOHANN: Several million heating systems will need to be replaced in the next few years in Germany. This is an immense opportunity to make them compatible with the energy transition. If we extrapolate the experience garnered from the field test in Herten and assume that all relevant consumers and producers will be digitally connected in future, it is also reasonable to assume that we will need less peak load. If so, the energy transition should be significantly easier.

What will you do next?

GROSSJOHANN: We will continue to refine the CHP plants from the field test and develop new pricing systems for the electricity storage heaters that better reflect the needs of the urban energy transition. Then we will link the energy sectors within the districts. We'll look at electricity, heat and mobility as a whole and bring them into alignment. We actually neglected to include heat in the original energy transition, even though it is a significant element. We need to change that now, and we will.

“Urban spaces offer the flexibility that will allow the energy transition to function.”

Ramona Pop, Berlin Senator for Economics

are experimenting with new, digital solutions to allow passengers travelling in similar directions to share a group taxi. In addition, the vehicle-sharing schemes are increasingly using electric vehicles. The entire fleet of the Deutsche Bahn subsidiary CleverShuttle, for instance, runs on electricity and hydrogen. “With digitalisation, things that used to be impossible are now a reality. If things go according to plan and users can access everything via a single app, the future of urban mobility will have become at least partially a reality,” says Weert Canzler.

“Hundreds of thousands of small battery units”

Electrifying transport works particularly well in cities. Whether it’s buses, trucks or private vehicles, the journeys tend to be short, and the next charging station is never far away. What’s more, these batteries-on-wheels will be an excellent way to compensate for the fluctuations in electricity production from weather-dependent wind and solar energy – one of the key challenges of the electricity transition. Experts like Jörg Jasper, an EnBW specialist for the energy sector, are convinced: once

people have acquired batteries (and have paid for them with the vehicles), they will use them for the energy transition as well. Jasper believes there will be “hundreds of thousands of small battery units spread across the country” in future – in cars and in former boiler rooms that already house solar batteries. Yet cities need to do more to develop this potential.

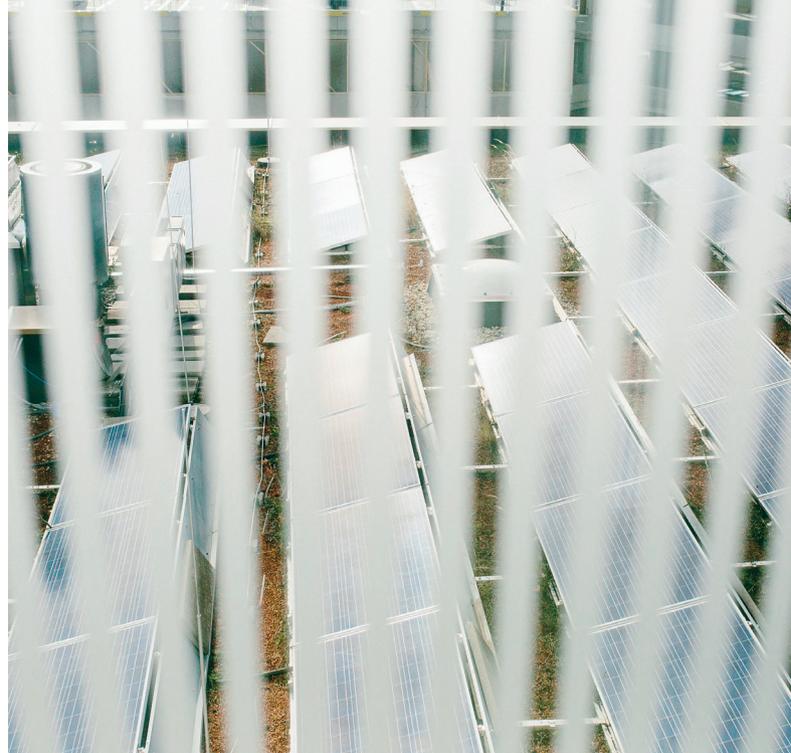
“Urban spaces – with their infrastructure and the consumption and transport patterns of their businesses and residents – offer the scope for flexibility that will allow the energy transition to function,” says Ramona Pop, Berlin’s Senator for Economics,



Cars are no longer the focus: Seoul transformed an expressway into a park.



Space for leisure, right on the doorstep: playgrounds, parks and traffic calming are all part of the concept in Aspern Seestadt.



Electricity trading: During the summer holidays, the school could sell its solar electricity to neighbouring offices.

Energy and Public Enterprises. She wants Berlin “to become a modern electropolis” – with electric cars on the roads and solar panels on the rooftops. However, many large cities are struggling with electricity production. Sparsely populated rural districts can easily generate enough electricity with wind turbines and solar panels. In Friedrich-Wilhelm-Lübke-Koog in the German state of Schleswig-Holstein, for instance, a pilot project is using some of the wind electricity to heat people's homes. This reduces the amount of heating oil used by homeowners, and minimises the need to limit wind turbine output.

Cities are using more renewables

Given the lack of space available, cities have limited scope for renewables. Berlin is home to millions of people and yet it has just five large-scale turbines, all of them out on the fringes. And despite having many solar power systems, the city can barely generate four per cent of its own electricity. For heating and vehicle fuels, the figure is more or less zero. The situation is even worse in vast conurbations such as Tokyo, Delhi, New York and Shanghai.

One exception is Copenhagen – a pioneer of urban self-sufficiency. Blessed by

a favourable location, the Danish capital has been investing in onshore and offshore wind farms for decades. In fact, the city has taken things even further: Høfør, Denmark's biggest energy provider, is building an entirely wood-fired power plant at the port of Copenhagen that will go into operation in 2019. This new power plant will supply a third of the city's homes with green heat and bring it closer to achieving its goal of becoming the world's first climate-neutral capital by 2025.

The Danes have chosen an ambitious strategy. However, it cannot be transferred entirely to other urban centres, due to differences in resources and population structure. Most municipalities in Germany are focusing on the immense potential for savings in the supply of heat to existing buildings.

Augsburg is one example: “Refurbishing an apartment block built in the 70s has halved the energy consumption,” explains Karl-Heinz Viets, Head of Energy Services at Stadtwerke Augsburg, the local public utility. Solar panels have now been installed on the roof, supplying the tenants with electricity and powering an electrolysis unit that produces hydrogen and, in a second step, synthetic natural gas. “The aim is to use the electricity from the solar panels to also supply heat,” ex-

plains Viets. Is that just a pipe dream? “Not in the slightest,” says Viets. “With this system, we are already meeting the German government's climate protection requirements for 2050.” He is convinced that many properties could use this combination of solar power and electrolysis technology as a kind of building block in efforts to drive energy transition forward. “The technology works. We still need to improve the economics of it, but that won't take magic.”

Herten, a city in the Ruhr region of Germany, is another example: Here, city leaders use a virtual power plant to intelligently manage consumers and multiple small and medium-sized power plants. (► Interview “The city as a storage system”). Is this an urban energy transition? “We know how to do it now, and we're ready to tackle it,” says a confident Detlef Großjohann, Head of Division at Herten's public utility.

Many cities are also working on initial approaches to the integrated energy transition, which brings together electricity, heat and mobility. Often they are still at the experimental stage. “There are no blueprints for the urban energy transition,” says dena expert Jugel. “But it's now time to promote integrated approaches. A holistic perspective is becoming increasingly important.” ■



“The integrated energy transition is also about new forms of collaboration”: Andreas Kuhlmann visits the Berlin offices of GRAFT

The changing face of cities

The urban energy transition will create a paradigm shift in urban planning. GRAFT architects Lars Krückeberg and Thomas Willemeit join dena's Chief Executive Andreas Kuhlmann to talk about rising complexity, new collaborations and fascinating opportunities.

INTERVIEW Hanne May **PHOTOS** Patrick Desbrosses

Let's discuss the urban energy transition. What do you associate with these words? What does 'urban' mean to you?

THOMAS WILLEMEIT: Urbanity primarily means settledness – so houses, buildings, a man-made environment. Put differently, it means the displacement of nature. These days, though, cities tend to be associated more with mobility and connectivity. They are nodal points that we use increasingly for temporary accommodation. The most successful cities today are the ones that can connect with other urban centres. They are trading centres for physical and intellectual mobility, are self-learning and constantly evolving.

LARS KRÜCKEBERG: For decades now, urban spaces have been gradually merging with suburban areas. It is becoming increasingly difficult to draw the line between the city and the country. Urbanity is easier to define in reverse: true rurality is remote and unconnected. These places have no train stations, and the Hyperloop won't stop there in future, either. When these forms of urban connectivity – mobility, education and much more – are no longer available out in the country, the people living there

will inevitably feel left behind or even shut out. We've observed these processes on multiple occasions. So if we want a functioning society, we need to achieve a good balance between urban and rural areas. We need to think about them both at the same time.

ANDREAS KUHLMANN: The words I spontaneously associate with urbanity are diversity, vitality, mobility, culture, meeting places and dialogue. But I can also see that cities might accidentally become swamped, that there's a risk of them being overloaded. Our simultaneous hope and challenge is that urban spaces, which are currently home to 50 per cent of the global population and produce around 70 per cent of CO₂ emissions, will become climate-friendly living spaces in the future. How can we fit all of that together? Currently there is a painful lack of creative concepts – in the political world, but also among the stakeholders who need to work on these issues. Some initial good examples and solutions already exist, but we're still very much at the beginning. And it's true: you cannot address urban issues without considering the rural spaces as well. It's always been this way, but as the energy transition makes our energy systems less centralised and more

connected, a significant issue has been added into the mix.

Cities are responsible for the lion's share of global CO₂ emissions. So cities are the linchpin in any successful climate protection strategy. What do you believe are the most pressing tasks?

LARS KRÜCKEBERG: We spend a lot of time thinking about how to transport energy to where it is needed. Architects, urban planners and infrastructure planners are intrigued by renewable energies. Simply put, fire is no longer our source of energy. Now our energy comes from sources that, for most people, are far more abstract. The challenge is to connect it all with our current infrastructure. After all, we can't just toss everything overboard. The next question is how we can connect it with new forms of mobility, with digitalisation. Ultimately these are all energy issues, and the biggest challenges are also the most powerful accelerators.

ANDREAS KUHLMANN: For me, the crux of the matter is how we will connect the various infrastructures in the future. This applies to the old infrastructures and to the

new ones, which are frequently digital. Systems that have existed so far as parallel entities need to be linked up, or even merged. Cities have immense, far-reaching potential to shape this development. The issue of our future mobility is particularly fascinating. Many current mobility strategies are too insular and neglect the overall infrastructure, the housing infrastructure and other needs in the city. By joining forces, architects and pioneers of the integrated energy transition could make a substantial contribution to this area.

THOMAS WILLEMEIT: I agree. For centuries, urban planning had a tradition of designing the entire city in a single process that included both buildings and transport infrastructure such as roads and bridges. Then in the modern age, everything became extremely specialised: one person plans the building, the next one does the

heating, somebody else builds the bus stop, and then comes the fire protection. These days, planning in urban spaces takes place in sequential stages. The master planner – who builds urban spaces or plans a market square – no longer comes first. Rather, it is the transport planners. They decide where the residential roads and thoroughfares will be. We expect this process to change radically in the near future. After all, many of the rules we currently apply to city planning concern emissions: noise or exhaust gases, for example. When we lose these emissions – through electric vehicles, for instance – we'll see a paradigm shift in urban planning. Mobility and immobility are converging. We can take an integrated view of transport and housing

LARS KRÜCKEBERG: Once noise pollution declines, we can build different, more cost-efficient façades, for instance. Cars will

no longer produce exhaust gases, so people can park them in their living rooms or allow them to park autonomously.

ANDREAS KUHLMANN: That's right. Plans for all of that already exist. And these are precisely the far-reaching changes and possibilities that an integrated energy transition can tap into. But I do ask myself sometimes: is it still a pipe dream, or are we already in the thick of things?

THOMAS WILLEMEIT: Yes, these developments are already happening at both the small and the large scale. For instance, we have an urban development project in China that is designed exclusively as a stopover district and actively combines transport and housing structures. Another thing is that many buildings already produce enough energy to power an electric vehicle – and this could definitely become standard. Ulti-

ANDREAS KUHLMANN has been the chief executive of dena since 2015. For the second phase of the energy transition, the physicist primarily advocates stronger integration of the energy, industry, transport and building sectors, and an increase in entrepreneurial solutions.

“We want to show which technologies are already available and how they can be used to the greatest possible benefit in cities and municipalities.”

Andreas Kuhlmann



mately, though, it depends heavily on each individual and especially on how much they are willing to invest.

ANDREAS KUHLMANN: What concerns me is that there is so much that still needs to be planned. What kind of supernova do we need to ignite in order to change things? How can we ensure that all the people who are currently rethinking our urban spaces end up in the right positions and are able to actually implement things?

THOMAS WILLEMEIT: That is correct. We have a lot of catching up to do. The growing complexity is one of the challenges for architects. Increasingly, we are becoming generalists who need to be skilled in more and more parts of the planning process. If, for instance, we need to integrate an e-mobility platform into one of our buildings, we have to know the business cases long before they have proven themselves. We have to understand whether it still makes sense to build underground car parks or parking spaces, because the cars might be able to park themselves in ten years' time. On the other hand, in 50 years' time, we'll still be living in 90 per cent of the buildings that are standing today. The concepts for these different types of building vary significantly. With a new-build, we'll try to plan in as much energy-efficiency as possible. With an old building, it might make more sense to install a heat pump rather than insulation.

LARS KRÜCKEBERG: This is actually a very exciting time. In a way, planners like us are playing urban development chess, and we must be able to think through a whole variety of options. Online phenomena like Airbnb and trends such as the WeWork culture are changing our cities overnight. We can see how much these things affect urban functions. The main thing we will need to move the energy transition in the right direction is a flexible system that can adapt quickly to current challenges.

ANDREAS KUHLMANN: Some people are quicker on their feet than others. But in the end we will need them all, the full fleet.



“Mobility and immobility are converging. We can take an integrated view of transport and housing.”
Thomas Willemeit



“If we want a functioning society, we need to achieve a good balance between urban and rural areas.”
Lars Krückeberg

Building the future: Lars Krückeberg, Thomas Willemeit and Andreas Kuhlmann (from left to right) discuss the urban spaces of tomorrow.



After all, we have set ourselves global climate protection targets, especially in the Paris Agreement. These targets are highly ambitious in Europe and in Germany. The pressure is immense. But not everyone in the cities seems to have realised that yet. So poor city councillors are now asking: what are we meant to do? Our Urban Energy Transition project addresses this. We want to show which technologies are already available and how they can be used to the greatest possible benefit in cities and municipalities. Learning curves have allowed us to very quickly achieve efficiency and create large markets for a variety of energy transition technologies. I get the feeling with cities that everyone is starting to search for their own solutions. Very few approaches can be used as templates that

can be built on quickly. So we need shared platforms and a much faster pace ...

THOMAS WILLEMEIT: ... to make sure it's all worth it in the end. That's it! We also need mass solutions, such as apps that – in the same way as they help us improve many other aspects of our lives – allow us to optimise our energy consumption. However, I also believe that a government which sets these kinds of goals should guarantee that it will adhere to them, with everything that this implies.

You spoke about the growing complexity that architects face. How do you rise to the challenge? Do you hire more specialists or build more networks with other experts? What form

does the integrated, urban energy transition take in your work?

THOMAS WILLEMEIT: First of all, we communicate externally and take a proactive approach. We don't wait for a building contractor or client. Instead, we initiate our own future and research projects and thereby demonstrate to outsiders that we are open and willing to broaden our horizons.

LARS KRÜCKEBERG: Good architects will automatically be sustainability experts, because they operate at the interface of the environment, the economy, society and culture. They can join the dots in many different areas, create a network and use this to propose a solution. Not because they invented it, but because they assemble

the right people. It's a bit like a director, who cannot make a film without actors, editors, musicians and post production. We are no different. Sometimes we have an idea for a film and put a crew together. The project is much too complex for us to do it alone. That's why the whole concept of a star architect as a one-man show is so absurd. We've always been a team of three, from the very beginning. We've struggled with and argued about the right way to go. I believe that architects can acquire a new significance within society if they accept these challenges.

That also means taking more risks.

THOMAS WILLEMEIT: Architects leave familiar territory the instant they embark on a technical experiment – with a new facade,

new equipment. So they need to be working with a contractor who is equally ambitious. If both sides keep this challenge in mind, it can become an opportunity for learning. For instance, it took us an incredibly long time to get the hardware working with the software controls in energy-plus houses. These solutions are not available off the peg. As architects, we have to be aware that we still need to develop many things in collaboration with industry and various experts. Our learning curve is only just beginning.

LARS KRÜCKEBERG: Architects are creative people and capable of thinking freely. We can sketch out the future, whether it's a house or an entire city. Moving forward is something we enjoy. This means that politicians tend to put us in the front line – because they can't stand there themselves. But sending us out ahead like this will only

be worthwhile if politicians and society as a whole get involved and help to shape the process.

ANDREAS KUHLMANN: If you want to create the future, you need a clear direction. In terms of the energy transition and climate protection in Germany, we are currently stuck between the devil and the deep blue sea. On the one hand, we're concerned about jobs, prices and complexity. On the other we've got these ambitious goals and many stakeholders who have new technologies and want to change things. We are not focusing enough on the fascinating opportunities that are inherent to the energy transition and climate protection. Changing that is one of the many tasks ahead. An integrated energy transition also means initiating new collaborations between the various stakeholders. ■

GRAFT was founded in Los Angeles in 1998 by Lars Krückeberg, Wolfram Putz and Thomas Willemeit (from right to left). It operates worldwide in the areas of architecture, urban development, design and communication. The 'hybrid office', which has additional branches in Berlin and Beijing, takes a highly experimental and interdisciplinary approach to its design work, and uses an innovative stylistic language. Besides traditional planning for residential buildings, hotels, health centres, commercial premises and cultural venues, the GRAFT founders also initiate socially sustainable projects such as Make it Right, Solarkiosk and Heimat2.



Pathways to our climate's future

dena's Integrated Energy Transition study identifies a variety of transformation pathways that will allow Germany to achieve its climate targets. Making a fundamental decision about the goal will provide clarity on the best choice of route.

The path ahead for the energy transition and climate protection has been defined in broad brushstrokes: Germany should be largely carbon neutral by 2050.

Power plants, vehicles, the industrial sector and buildings should all emit between 80 and 95 per cent less CO₂ than they did in 1990. That's a big task for a highly industrialised nation. The emissions in Germany should be 55 per cent lower by 2030, so in little more than a decade. The message from dena's Integrated Energy Transition study is that, although they are ambitious, the climate targets are achievable.

An integrated energy transition needs integrated policies

Compiled by dena and ewi Energy Research & Scenarios, the study uses four practical scenarios to chart a possible course from now until 2050. The study incorporates the viewpoints and experience of more than 60 partners from industry. They include companies from every sector, energy providers and grid operators. "We wanted to consider the market knowledge and competencies of all those who must, in the end, shape these transformation processes. The cross-sectoral, bottom-up perspective is necessary in order to develop new, integrated policies for the integrated energy transition," explains dena's Chief Executive Andreas Kuhlmann. The study analysed three consumption sectors – industry, building and mobility – as

well as the infrastructure for energy production and distribution. "Not every solution that seems obvious at first glance leads to the desired target when interactions with other sectors are taken into account," says dena team leader Christoph Jugel when describing one of the effects of the new approach. The crucial thing is to stay focused on the big picture: an integrated, smart energy system that largely eliminates the rigid boundaries between sectors.

Power fuels – the third pillar of the energy transition

The four scenarios in the dena study are based on different premises. Two of them assume that a large proportion of energy consumption will be electrified. This means, for instance, that a significant number of buildings would have to be refurbished to improve energy efficiency and equipped with electric heat pumps. Many industrial facilities would be switched to electric power, and electric vehicles would dominate road traffic.

The other two scenarios are based on a technology mix. Gaseous and liquid fuels in particular play a bigger role. In the long term, though, they would not be obtained from fossil sources. Instead, they would be manufactured synthetically using solar power or wind energy. These carbon-neutral power fuels close a gap that cannot be filled by the direct use of electricity from renewable energies or by savings achieved with improvements in energy efficiency.

The fuels would be particularly important in industrial settings and in heavy goods transport (► Page 28).

Overall, the hybrid technology scenarios offer several advantages. They would make it easier to use existing technologies and infrastructures. The energy system would be more flexible in general, so innovative technologies could be integrated without so much disruption. In total, these methods would cost up to €600 billion less than the scenarios with widespread electrification. This means that the population might be more willing to embrace them. "If we want the energy transition to be as cost-effective as possible and to have broad social support, we should start creating market-oriented frameworks for a broad mix of technologies today. That is the only way to make sufficient use of the massive potential of different technologies," concludes Kuhlmann.

Change is imperative

Aside from the individual scenarios, the study also contains some overarching insights. It identifies three central trends. Firstly, expansion in the use of renewable energies must proceed at a faster pace than it has so far. For solar power and wind energy alone, an additional net annual capacity of 6 to 7.6 gigawatts is required. Secondly, carbon-neutral power fuels must replace fossil fuels across the board. Depending on the scenario, they will cover a demand of 150 to 908 terawatt-hours in 2050. Thirdly, energy efficiency must continue to rise sharply in all areas – from industrial facilities to the housing sector.

The study also makes it clear that things cannot continue as they are if the targets are to be reached. A fifth scenario was also analysed and used as a reference. It assumes that the energy transition performs slightly more ambitiously than in previous years. This would, however, only lead to a 62 per cent reduction in greenhouse gases in 2050. “We have to decide soon which path we want to take,” says Kuhlmann, emphasising the urgency. He explains that the long-term climate goals need clarification and the political framework needs to be re-modeled during the German government's current electoral term. Resolute actions, says Kuhlmann, will bring many advan-

tages: “By tackling it together, we will be able to find workable and widely accepted solutions, and make the energy transition a successful project for society as a whole.”

The integrated energy transition as a guiding principle

The partners and initiators involved in dena's study therefore perceive it as an invitation encouraging stakeholders in politics, society, industry and science to accelerate the necessary debate and make decisions. dena itself intends to lead by example and introduce a number of follow-on initiatives to the integrated energy transition as a means of enlivening the debate. For instance, it is cooperating with partners from a variety of sectors to investigate the conditions for an urban energy transition (► Page 8), establishing a global network for power fuels (► Page 28) and building on the central

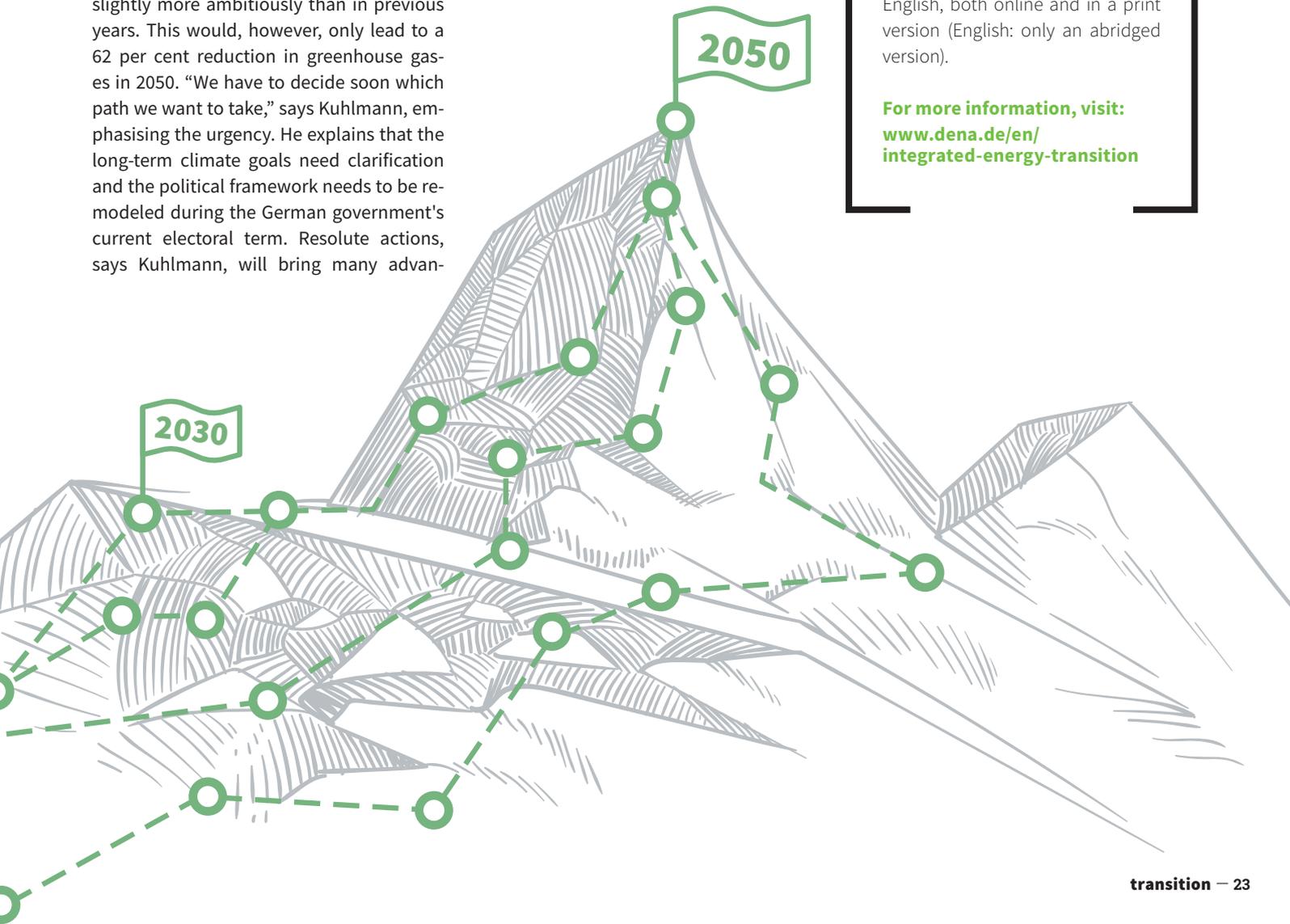
insight of the study. dena is also working with the Federation of German Industries (BDI) and the National Academy of Science and Engineering (acatech), to prepare a comparison of the baseline studies published by these three organisations on the issues of climate protection and the energy transition in Germany. The purpose is to visualise the commonalities and differences between the three studies in regard to central issues of energy policy and to use this as a basis for recommending joint courses of action. ■



THE DENA STUDY

dena's Integrated Energy Transition study is available in German and English, both online and in a print version (English: only an abridged version).

For more information, visit:
www.dena.de/en/integrated-energy-transition



We need to talk ...

... about the integrated energy transition

In future, technical facilities, infrastructures and markets in the energy, industry, building and transport sectors need to be brought together to form an intelligent energy system. We spoke to major German companies about how they can contribute to this endeavour.

What is the main thing that policymakers must do to achieve the 2030 climate targets?

How can we achieve a more integrated energy transition?

How can your company contribute?



Dr Frank Appel,
CEO, Deutsche Post DHL Group

**»Nationwide electro-
mobility is possible in
Germany.«**

“Civil society, the business sector and policymakers need to work hand in hand if we are to achieve the national climate targets by 2030. Among other things, this includes political frameworks that permit or facilitate the implementation of climate-friendly technologies. Targeted funding or incentives for using electric vehicles, alternative fuels and efficient technologies are important political mechanisms that can help achieve these targets.”

“Linking the energy and transport sectors is of particular importance to the energy transition. The energy transition can only succeed if the energy sector also takes steps towards using renewables to cover the increased demand for energy within the transport sector.”

“With our Mission 2050 programme, we became the first global logistics company to set itself the target of reducing all logistics-related emissions to zero by 2050. We are convinced that our industry can contribute significantly to the 2°C target, providing we work together and give it our all. With our 8,000 StreetScooters, for instance, we're showing that nationwide electromobility is already possible in Germany.”



Reiner Mangold, Head of Sustainable Product Development, AUDI AG

»E-fuels are necessary for a **comprehensive energy transition**.«

“If we remain open to multiple technologies and, in addition to electric vehicles, focus on other types of drive systems and fuels, this will reduce the economic costs of a sustainable energy transition that actually achieves the climate targets. It will also be far less risky for market participants and hence more socially acceptable, robust and probable.”

“In terms of mobility, manufacturers must be able to deduct from their fleet emissions the carbon savings that they achieve with sustainable e-fuels. These innovative energy sources are necessary for a comprehensive energy transition. Faced with the high costs of reducing CO₂, carmakers are currently alone in their willingness to pay the premium for e-fuels compared to fossil fuels. Once the technology has been scaled up, it could also benefit aviation, shipping, the chemicals industry and energy providers.”

“As buyers, carmakers could offer investment certainty to potential providers of these innovative energy sources. We are preparing for sustainable fuel scenarios with our CNG vehicles and investments in hydrogen technology. Audi operates the world’s first industrial power-to-gas plant and is working with innovative partners on other pilot projects for producing e-fuels.”



Nikolaus Graf von Matuschka, CEO, HOCHTIEF Solutions AG

»The energy and transport transition would be inconceivable without the **construction industry**.«

“Germany has wasted time in recent years. This is evident in the slow expansion of the power grid, and in storage technologies. To this day, we do not have a viable business model for pumped-storage plants. The business sector will not provide the necessary capacities in this kind of market environment. We need market-ready projects and reliability.”

“Focusing on electricity production alone isn't getting us anywhere. We need to invest much more in all areas, for instance in expanding local and long-distance public transport. Germany will only achieve its ambitious targets if we use all of the means at our disposal.”

“HOCHTIEF is a pioneer and visionary in many areas, among them sustainable buildings. Our industry now operates at a very high level in this field. Now it's time for other areas of infrastructure to catch up. The energy and transport transition would be inconceivable without the construction industry. We are willing to increase our capacities in Germany considerably – but only if the public sector reliably increases its own investments.”



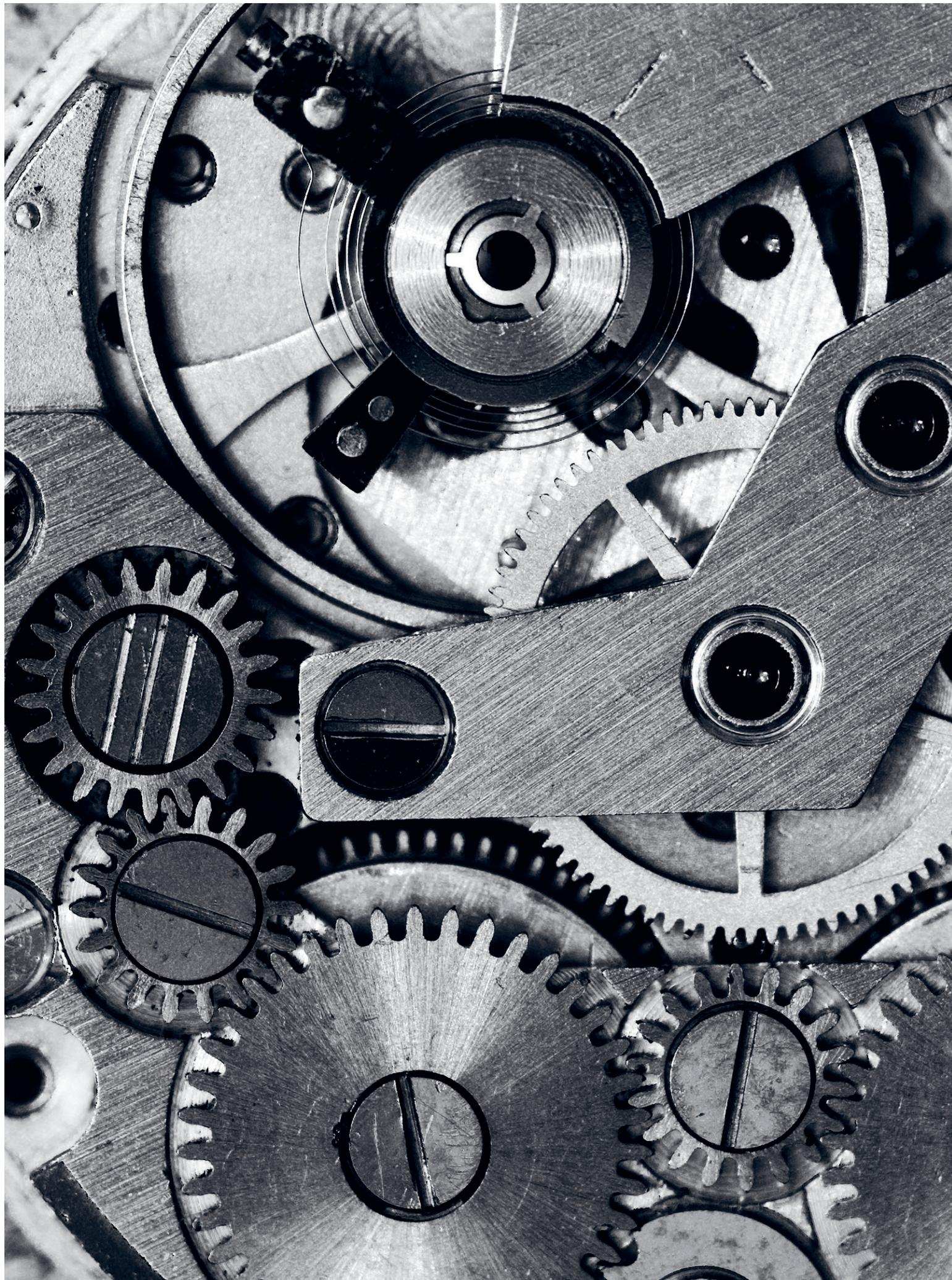
Dr Johannes Teysse, CEO, E.ON SE

»The aim must be to achieve an effective **CO₂ price signal** both inside and outside the ETS.«

“We need to use solar power and wind energy for transport and heating as well. We can't keep building wind turbines and solar farms, just to leave the electricity they produce unused or to send it abroad. To achieve the climate targets for 2030 and 2050, we must now roll out climate-friendly energy in conjunction with efficient applications and smart connectivity throughout the economy.”

“Electricity has become greener and more local. But it is also so expensive that oil and gas usually remain the more economical choices for transport and heating. We need to change that and reform energy taxes, duties and surcharges. The aim must be to achieve an effective CO₂ price signal both inside and outside the Emissions Trading System (ETS). No other instrument can mobilise so much innovation in the interests of climate protection across all energy markets.”

“We believe that the foundation of future commercial success in the energy industry will be smart networking of diverse energy flows and outstanding innovation in the interests of customers. This was our strategic motive for restructuring E.ON, a move that included the planned takeover of the energy company innogy. The new E.ON is therefore increasing its focus on smart networks and innovative customer solutions.”



INSIGHTS

DENA IS DRIVING THE ENERGY TRANSITION AND ADVANCING CLIMATE PROTECTION. IN **INSIGHTS**, YOU WILL DISCOVER HOW WE ARE WORKING TO RESTRUCTURE THE ENERGY SYSTEM THROUGH OUR **PROJECTS** – BOTH IN GERMANY AND INTERNATIONALLY.

Missing link in the energy transition

Fuels do not have to harm the environment. Liquid and gaseous fuels can be obtained from green electricity. These power fuels could become the third pillar of the energy transition. But how can they play a bigger role?

TEXT Titus Kroder

A sunny day in May 2051. A transport ship with a bulky pot belly chugs lazily into the Elbe estuary. Ropes creak, and the gas tanker berths at the huge nozzles of Terminal H in Brunsbüttel. It is one of many ships that regularly dock here, carrying hydrogen and synthetic liquefied gas from the Arab region. Many countries there have built solar and wind farms covering several hundred square metres to produce electricity for state-of-the-art electrolysis plants that split water into oxygen and hydrogen. In subsequent steps, the plants produce renewable methane and liquid fuels. Once oil-producing nations, the Arab countries now export green fuels – aka power fuels or e-fuels – to Germany and other countries.

The scenario is fictional, but it could become reality just a few years from now. The dena Integrated Energy Transition study estimates Germany will need up to 900 terawatt hours of the green fuels each year by 2050. Power fuels just might be the

urgently needed missing link in the energy transition. Besides methane, green hydrogen can be used to obtain synthetic petrol, diesel or kerosene. This could close gaps in the energy transition in areas where greater energy efficiency is not possible or green electricity cannot be used directly – for instance, in certain industrial applications or in heavy-duty haulage, aviation or shipping.

Power fuels as a buffer and storage medium

Power fuels could also increase security of supply by offsetting the fluctuating production of electricity from renewable sources. “Where a surplus of renewable electricity is available, it could be stored as hydrogen or methane as a secondary product. Then, during calmer periods, it would be converted back into electricity and heat in gas-fired power stations or fuel cells,” explains Patrick Schmidt from the consultancy firm Ludwig-Bölkow-Systemtechnik, which co-authored a study on the potential of e-fuels with dena. Germany’s wind turbines and solar power farms will soon produce increasing amounts of electricity that cannot all be fed into the grid immediately. Electrolysis plants could convert it into gas and make it storable.

If power fuels are to become a connecting link in the energy mix, Germany must also build more production plants. “We will need electrolysis plants with a capacity of more than 100 gigawatts by 2050,” says Christopher Hebling, Head of Hydrogen Technologies at the Fraunhofer Institute for Solar Energy Systems in Freiburg. At present, Germany only has demonstration



and pilot facilities with a total capacity of around 25 megawatts. The world's largest facility is currently under construction just south of Cologne. However, its capacity is a mere ten megawatts.

Hardly any new infrastructure needed

Discovered by chemists back in the 19th century, electrolysis has significant advantages for the energy transition. The necessary infrastructures are largely available and only require conversion. The chemical structure of synthetic methane is identical to that of natural gas, which means methane can be fed directly into the public gas grid for use as a fuel. "The opportunity to continue using current infrastructures and facilities is one of the key aspects in favour of power fuels," says Hannes Seidl, Head of Energy Systems and Energy Services at dena. This way, many of the energy transition targets would be within reach and would be largely accepted. Power fuels are also compatible with combustion engines. The e-fuels study by dena predicts that around 70 per cent of the energy needed to power all transport resources in the EU would have to be met by power fuels if we are to achieve the climate targets.

Many experts agree that an energy transition involving complete electrification of all modes of transport would not be economical.

The target: one euro per litre

German engineers and universities lead the world in power-to-X processes. The crucial next step will be to start cultivating future markets today. "We need to create demand to force down the costs of production in the coming years," says Stefan Siegemund, Deputy Head of Renewable Energies and Mobility at dena. Only if this happens will power fuels play a central role in the energy transition. They are not competitive at present: for instance, it costs up to €4.50 to produce just one litre of synthetic diesel. "The market for electricity-based fuels needs a robust, sustainable boost, like the one we gave solar power and wind energy around the year 2000. This is the only way to create reliable regulatory frameworks that foster industrialisation," says Patrick Schmidt from Ludwig-Bölkow-Systemtechnik. He notes that costs of around one euro per litre of power fuel are certainly conceivable in the long term. ■



GLOBAL ALLIANCE POWER FUELS

dena launched its Global Alliance Power Fuels in September 2018. This international alliance aims to open up global markets for synthetic fuels based on renewable energies. It is supported by a cross-sectoral network of companies from commerce, and intends to establish a broad network of partners from the areas of research and science and politics and society. dena launched its Power to Gas Strategy Platform in 2011. The platform brings together 26 partners from the industrial, business and scientific communities to work on resolving important issues concerning power-to-X and power fuels.

For more information, visit
www.powertogas.info/english

Alternative fuel vehicles in the fast lane

Vehicles with diesel or petrol engines continue to dominate the car market. However, alternative fuel vehicles are starting to catch up. Their numbers have more than doubled in Germany since 2013. We assess their relative strengths and weaknesses.

TEXT Alexander Hirsch

Of the roughly 2.5 million new cars registered in Germany up to until August 2018, approximately 123,000 were alternative fuel vehicles. That is a 74 per cent rise compared to the same period last year. Within this market, hybrid vehicles lead the field, accounting for 71.2 per cent. They are followed by electric-only vehicles with 18.1 per cent, natural gas vehicles with 8.1 per cent and liquefied gas vehicles with 2.6 per cent.

Alternative fuel vehicles are becoming more attractive to consumers. This is because the technologies are more efficient, the financial and political frameworks have improved, and a wider range of vehicles is available.

So what aspects should you consider when buying an alternative fuel vehicle? As well as the price and running costs, practical considerations are also important. There's a difference between needing a car for short journeys in the city and using one

for long commutes. Reviewing one's personal driving habits and the pros and cons of the individual technologies is therefore worthwhile.

The city slickers: Electric cars (1a)

Electric cars are exclusively battery-powered. They are especially suited to the stop-and-go nature of city driving, as they make very good use of the energy stored from braking. Their energy utilisation is also better than combustion engines. The downside is their range, which is only good for short or moderate distances. Depending on the model, they can travel between 100 and 400 kilometres on one battery charge. Another disadvantage is the scarcity of charging stations in public spaces. Homeowners are in a better position, as they can install a wall-mounted charging station in their garage. Charging times of around 30 to 60 minutes need to be added to the duration of longer trips. Germany has now installed more than 300 fast-charging stations along its motorways.

The team players: Plug-in hybrids (1b)

Plug-in hybrids can be a good choice for people who travel both inside and outside of cities. Drivers can charge the battery

1a



Electric car

New vehicle registrations 2018*	22,217
Available models in 2018:	20
Costs per 100 km:	€5.15
Total CO ₂ emissions** (g/km):	approx. 87
Additional investment (compared to petrol vehicle):	+7 to +55%
Charging stations:	11,000

1b



Plug-in hybrid

New vehicle registrations 2018*	23,205
Available models in 2018:	18
Costs per 100 km:	€6.50
Total CO ₂ emissions** (g/km):	approx. 116
Additional investment (compared to petrol vehicle):	-8 to +55%
Charging stations:	11,000



* Period: January to August 2018
 ** Production, recycling, provision of electricity or fuel, and direct emissions for lower mid-range vehicles, grams per kilometre with a total mileage of 150,000 kilometres in the German electricity mix
 Reference value for petrol/diesel engine: approx. 190



during the journey or by plugging it into the electricity grid as normal. Although the battery usually only lasts for around 40 km of electric-only driving, plug-in hybrids can intelligently switch drive systems. This means you can fully benefit from the electric drive, particularly in the city. The car only switches to the combustion engine for cross-country journeys or when the battery is empty.

The all-rounders: Mild and full hybrids (1c)

The main difference between plug-in hybrids and mild and full hybrids is that the latter have no external charging system and either no electrical range (mild hybrid) or only very little (full hybrid). The electric motor is only used when the combustion engine is inefficient – for instance, when starting the car or accelerating. The system saves fuel and cuts emissions. This makes it suitable for a variety of scenarios. The cars save most fuel when travelling around town. Mild and full hybrids use regular filling stations, and a generator supplies the electric motor with energy.

The retrofitter for frequent travellers: LPG (1d)

Liquefied petroleum gas (LPG) is a by-product of crude oil and natural gas production. It is stored as liquid fuel in a pressurised tank at 8 bar and used in a normal combustion engine, which means that all petrol cars can theoretically be retrofitted to run on LPG. This is also why only a few automakers offer new cars with LPG technology. The vehicles are equipped with an LPG tank and a petrol tank. Drivers can therefore choose between them, although gas power is cheaper and produces fewer emissions.

LPG vehicles are especially good for frequent travellers with relatively high running expenses, as the costs of the retrofit must be included in the equation. A significant advantage is that you can find around 6,600 LPG filling stations in Germany.

The eco-friendly endurance runner: Natural gas (CNG) (1e)

Compressed natural gas (CNG) consists mainly of methane. Cars require a retrofit to run on this fuel. Most manufacturers offer the option when buying a new hatchback. The cars then have a pressurised tank that stores gaseous fuel at 200 bar, as well as a small petrol tank for emergencies. The range is again high. Natural gas reduces costs and emissions, especially on long journeys. One advantage compared to LPG is that CNG drivers can include biogas in their fuel. This reduces nitrogen oxide and particulate emissions compared to petrol engines. At present, there are only around 870 natural gas filling stations in Germany.

Visionary technologies with a bright future

In addition to these more established technologies, researchers are also exploring other types of alternative fuel vehicles. These include catenary-hybrid trucks that have both a combustion engine and the ability to run on electricity from overhead lines. The first fuel cell vehicles running on hydrogen have also been released, although they are still in a relatively high price bracket. ■



THE CAR ECOLABEL: MAKING EFFICIENCY TRANSPARENT

dena has launched the Pkw-Label.de platform to raise awareness of the car ecolabel and to make it more accessible for responsible stakeholders. It uses a colour scale to show the CO₂ efficiency of a new car. The website also lists the alternative fuel vehicles and allows users to compare their consumption, emissions, range and other performance indicators.

For more information, visit
www.dena.de/car-ecolabel





In the engine room of the energy transition

Start-ups enrich the energy transition with fresh ideas and business models. But many regulatory and legal obstacles make it hard for young entrepreneurs to enter the market. The SET Lab allows them to share their thoughts with decision-makers in Germany's federal ministries.

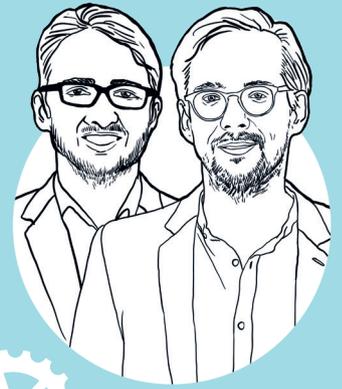


A dull Thursday in late August. Room G. 3.021 in Hall 4 at the Federal Ministry for Economic Affairs and Energy (BMWi) in Berlin is full. Outside, the first rain for weeks is breaking the monotony of the hot summer, falling gently on Hohenzollern Canal and Central Station. Inside, coffee cups are rattling, the last emails are being punched into smartphones and chairs are being edged towards the table in a brightly lit, wood-panelled conference room. The atmosphere is relaxed, as is the dress code. Hardly anyone is sporting a tie, and many have rolled up their sleeves.

This is one of dena's SET Lab workshops. The name stands for Start Up Energy Transition Laboratory, a discussion and networking forum for start-ups and government representatives. One might also say that it's where two distant poles of the energy transition are finally brought together. One end of the spectrum is occupied by the young, innovative and highly specialised companies that are chomping at the bit. The other end is occupied by the policymakers, who are in charge of the entire system, civil society, the economy, the big picture. SET Lab's idea: to build bridges and get these two groups talking. It's also a kind of engine room for the energy transition, in which the big gears of the political world drive the delicate cogwheels of progress. And vice versa.

Bottom-up movement in the energy transition

The SET Lab helps entrepreneurs to navigate a highly complex market. With multiple legal and regulatory requirements, the energy industry does not make life easy for newcomers. That's why there are fewer start-ups in this field than in booming sectors like online retail. This needs to change – after all, these young companies can drive a bottom-up movement in the energy transition, and their innovative ideas are important building blocks in the fight against climate change. To get this trend moving though, the rules and regulations of the energy market need to become more transparent. This is where the SET Lab, a BMWi-funded project, comes in. An important target is to eliminate the structural obstacles for start-ups. The SET Lab plays an important role within the global network Start Up Energy Transition (SET), explains Leo Hille, team leader at dena: "Alongside the SET Award and the SET Tech Festival, which are all about networking and recognising best cases, the SET Lab allows us to work specifically on regulatory improvements." The plan is to bring as many new business ideas for the energy sector to market maturity as possible – and to avoid them failing early due to complex regulations or a lack of capital.



Auxolar

Personal solar power systems are usually mounted on the roofs of homes. So how can tenants in high-rises, prefabricated blocks and other apartment buildings benefit from solar power? This was the question that **Florian Herrmann** asked before founding Auxolar with **Uwe Lebelt**. Located in Berlin-Adlershof, the start-up specialises in innovative solar solutions for the housing industry. The solar modules are installed on the facades or balcony parapets of apartment buildings. With this idea, Lebelt and Herrmann are on the cusp of sparking a minor revolution in the photovoltaics market. And far from being naive, they are very aware of how important building regulations and laws are for their business idea. "We are operating in a highly regulated market, so the political dimension is crucial for Auxolar," says Lebelt.

www.auxolar.de

The plan is to bring as many new business ideas to market maturity as possible.



Lumenion

It is absurd that, despite renewables producing ample electricity on many days of the year, Germany still has to limit the output of many plants. The lack of storage capacity is one of the reasons. The Berlin start-up Lumenion has developed the high-temperature storage system Menion as a cross-sectoral solution to this problem. It converts surplus electricity from wind and solar farms into heat. The storage medium is steel, which is heated to 650°C. The metal comes with a number of benefits, explains **Dr Constanze Adolf**, Head of Regulatory Affairs at Lumenion. The charging capacity is three to five times greater than the discharge capacity, and the hot steel exclusively delivers thermal energy that can be fed back in when necessary. The only problem is that no regulatory framework for this kind of system exists. Constanze is used to tackling tough problems and complex regulations, though: she spent 18 years working for the EU in Brussels before joining Lumenion. “The industrial sector is starting to realise that gas prices will rise, so companies are looking for sustainable and innovative decarbonisation solutions,” she says.

www.lumenion.com

“How much electricity are the occupants of an apartment building allowed to feed into the grid? And how is the income taxed?”

Uwe Lebelt, founder of Auxolar

The programme opens up bright new opportunities for the participants in the SET Lab, who were selected from a large number of applicants. The entrepreneurs usually aren't able to contribute to the legislative process. This largely because most lack access and experience, and very few have employees who could take on this role.

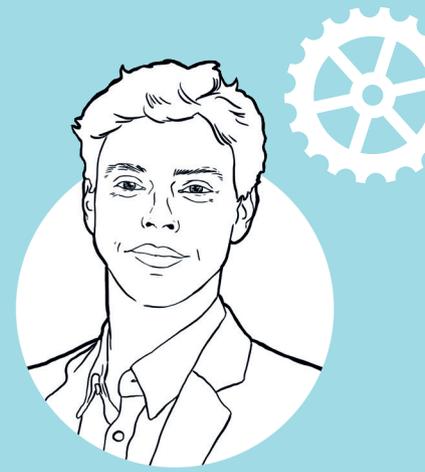
The representatives of the start-ups assembled at the workshop share a common hope: they want to eliminate, in the medium term at least, the regulatory obstacles preventing small companies from entering an electricity market that remains firmly in the hands of major corporations. For over five hours, they discuss (and, if necessary, argue about) grids, assets and infrastructure. Four ministerial heads of department have kept their entire day free.

Concrete questions for politicians

Twelve start-ups are represented at the workshop. The companies are all young and

ambitious, however different their business models might be. Among them is Auxolar from Berlin-Adlershof. It's looking to sell solar panels to housing cooperatives and owners of large apartment buildings, but is still struggling with the regulatory obstacles (► Information box, page 33). Co-founder Uwe Lebelt asks concrete questions: How much electricity are the occupants of an apartment building allowed to feed into the electricity grid? And how is the income taxed?

Lumenion, another Berlin-based company, develops high-temperature storage systems that take surplus electricity from wind and solar farms and convert it into storable heat (► Box on the left). However, Germany currently has no legal framework for this kind of technology, so the company has been restricted to running pilot projects so far. Can that be changed? Ready-2plugin has developed software for inverters and energy management systems that can help connect small, domestic solar power systems to the mains using the sim-



Ready2plugin

The technology works, but the regulations are complex: engineer **Marcus Vietzke** is very familiar with this kind of starting point. Since 2014, he has been working on solar power systems that can simply be attached to a tenant's balcony. Besides a variety of bureaucratic obstacles, Vietzke has run up against another problem: how can a small photovoltaic system be installed easily and connected just as easily? If the process became simple enough, calling a technician would no longer be necessary. Vietzke developed software for inverters and energy management systems to connect solar cells using the plug-and-play principle. An algorithm ensures that the circuitry in the house doesn't overheat. He took this idea and founded a start-up called Ready2plugin in 2018. The aim is to make it easy for tenants to participate in the energy transition.

www.ready2plugin.com

ple plug-and-play technique (► Box on the right). This would remove the need to call a technician to set up the system. It's a promising solution – but how can it be made consistent with current regulations?

Experimentation and the big picture

Both sides use the discussions as a learning experience. Dr Hartmut Versen, Head of Division at BMWi, asks the entrepreneurs very detailed questions about their concepts and what they felt was getting in the way: "How can your ideas be made viable simply by tweaking the current regulations?" Different viewpoints emerge at various points of the discussions. While the start-ups are only concerned with free access to the market and a greater willingness to experiment, the civil servants from the ministries must consider overarching issues: who will be responsible for keeping production capacities available for emergencies and peak load times? What are the consequences of a

contracting consumer market if on one not-so-far-off day in the future, many consumers are producing their own electricity? And what will that mean for the grid infrastructure and the levies with which it is financed? It takes time and patience to reconcile these very different viewpoints. But the day at the SET Lab is certainly a productive first step. It will not remain just talk, either, and the ideas will be put into practice. "That's the great thing about this workshop," says Versen: "We talk about it – and then things happen." ■

Blockchain – beyond the hype

From transparent, real-time electricity trading to electric cars that automatically charge themselves and pay while at traffic lights – blockchain could usher in all-new business models. But some questions remain unanswered.

TEXT Matthias Bastian

Solar power systems, wind turbines, combined heat and power plants – the energy transition is increasing the number of electricity producers. This poses a number of questions: how much electricity is available at a given time if production relies on wind or the sun? How much simultaneous demand is there in the grid? And how do supply and demand set the price at which electricity is traded? One thing is certain: the energy system is becoming more complex. The only way to handle huge quantities of data is with digitalisation.

One solution might be blockchain, a baseline technology used for digital transactions and currently the talk of the town. With smart grids, energy and data need to flow at the same time to balance electricity generation and consumption. “A vast amount of information is exchanged in smart grids, ideally in real time. Stakeholders working with the system, such as transmission or distribution system operators, must be able to fully rely on this content, as they are using it to build the energy system of tomorrow,” explains dena expert Philipp Richard.

Factors such as current utilisation of the electricity grid or the question of where and how the electricity is produced – conventionally or with renewable energies –

need to be included in the equation. Blockchain could make it easier to handle this deluge of data and improve the management of the energy system.

Blockchain simplifies trading

Blockchain is particularly suitable for transactions between multiple partners. The technology removes the need for intermediaries like banks or brokers, as the transactions are largely automatic. This is what makes blockchain so revolutionary. All transaction data is kept in decentralised storage on the computers of all participants, where it is synchronised continuously. The individual blocks of data connect to each other like links in a chain, ensuring forgery-proof documentation of data transmission. Permanent synchronisation and sophisticated encryption immunise the blockchain from attacks or manipulation. Anyone seeking to alter the data would have to access each individual computer in the network. That would be an enormous task.

It is precisely this self-regulation that makes the technology so exciting, explains Professor Jens Strüker of the Institute for Energy Management (INEWI) at Fresenius University of Applied Sciences: “Blockchain enables secure and direct

digital transactions – including performance and payment fulfilment – between entities that do not know each other. Commodities like electricity can – with some adjustments – be traded directly between producers and consumers.”

Potential for electromobility

Besides electricity trading, electromobility might be another area in which blockchain could be used - for instance if the battery in the car runs out in an area with no public charging stations. That wouldn't be an issue if you could use any private charging station in the vicinity. Owners could use blockchain as an easy way of selling access to their systems to third parties. This kind of system is already available by smartphone in some cases, but it still needs an intermediary. Blockchain transactions could conceivably be quicker, cheaper and more direct.

A more spectacular idea would also be possible: induction panels recessed in the tarmac could automatically charge electric vehicles while they are waiting at traffic lights. Once connected via blockchain, the vehicle would communicate with the charging station and then make payment automatically. Suddenly we wouldn't be all that bothered about waiting at the lights: it

would be a welcome opportunity to charge the battery, after all.

Energy consumption is a problem

Despite the hype surrounding blockchain, there are a few points of criticism. One of them is that the energy consumption is comparatively high. For instance, simply processing transactions in the cryptocurrency bitcoin, which is also based on blockchain technology, requires huge data centres. dena expert Richard believes that the high energy consumption is currently one of the central issues that could decide the future of blockchain. “There is no doubt that widespread digitalisation will require more energy,” he says. However, he also notes that it is important to place the energy consumption and the benefits of blockchain in relation to alternative IT solutions. It would then be necessary to assess the overall energy requirements of a certain application in a particular situation.

Strüker also takes a levelheaded view of the hype surrounding blockchain: “The energy industry is excited about blockchain. But we’ll have to see whether the enthusiasm survives once we put it into daily practice.” His guess: the term blockchain



THE DENA BLOCKCHAIN STUDY

dena is conducting a study entitled “Blockchain in the Integrated Energy Transition” in collaboration with partners from the business community. The study investigates practical uses, technical requirements and business models for integrating the technology in to the energy system.

For more information, visit www.dena.de/en/blockchain

will slip into obscurity, but the underlying technology will be “quietly integrated more or less everywhere.” Richard is also not yet convinced that blockchain is the ideal solution for digitalisation within the energy system. It is still very much early days, he says. Richard also notes that the digital transaction technology is vying with other IT solutions, for instance centralised database systems. “Companies should decide prag-

matically whether blockchain offers them added value,” he advises. The blockchain scene, which is especially strong in Berlin, is certainly doing a very good job of marketing the technology and is gradually gaining the upper hand over alternative solutions. Of course, it’s about market shares as well. Despite the unanswered questions, Richard expects the importance of blockchain to rise sharply in the next few years – including in the energy industry. “Digitalisation will cause the volume of available data to continue rapidly increasing. And automatic, transparent documentation is essential to manage these vast quantities of information. This is precisely what blockchain does.”

Algorithms vs bankers: is trust shifting to technology?

Richard mentions another relevant aspect: “In a globally connected world, the number of transactions in which people are no longer in direct contact with each other is rising.” Establishing trust, he says, is becoming more difficult. Blockchain is resistant to manipulation and highly transparent, so it could easily be part of the solution: “The question is whether blockchain might be more reliable than direct human contact for certain applications.” ■

WERLTE

PAINTING VEHICLES WITH WASTE HEAT: FIRST PILOT PROJECT GETS UNDER WAY

Small and medium-sized enterprises have the potential to be trailblazers for the industrial energy transition in Germany. This is demonstrated by a new surface finishing centre opened by vehicle manufacturer Krone in Werlte, a town in Lower Saxony, Germany. Since August 2018, the company has been using industrial waste heat to apply corrosion protection and paint to commercial vehicles. It is among the lighthouse projects supported by dena for the energy-efficient use of waste heat. The new facility saves almost 40 per cent in fuel and reduces CO₂ emissions by 30 per cent. The investment of around €35 million was supported by the KfW Waste Heat Energy Efficiency Programme with funds provided by the Federal Ministry for Economic Affairs

and Energy (BMWi), and will help to protect jobs at the site in Werlte.

With its project, dena is helping more than ten companies to find ways of preventing and using industrial waste heat. They include a copper manufacturer, a pastry bakery, two steelworks and a brewery. All of them are using particularly innovative or efficient approaches to exploiting the potential of their waste heat and are therefore acting as role models for other companies. Among other things, dena advises the companies on how to put the ideas into practice and to apply for funding. The selected lighthouse projects have the aggregate potential to save more than 170,000 tonnes of CO₂ each year. Calculations prepared by dena indicate that companies across Ger-

many could reduce their carbon emissions by more than 35 million tonnes each year and save roughly €5 billion in energy costs simply by making consistent use of their waste heat.

For more information, visit www.dena.de/waste-heat



The opening of the new surface finishing centre

COMPANIES ACROSS GERMANY COULD REDUCE THEIR CARBON EMISSIONS BY 35 MILLION TONNES PER YEAR SIMPLY BY MAKING CONSISTENT USE OF THEIR WASTE HEAT.

FRANCE

FRANCO-GERMAN FRIENDSHIP ON DIFFERENT LEVELS

Whether it is the “Energiewende” in Germany or the “transition énergétique” in France, both countries face similar strategic decisions in reforming their energy systems. This is why dena cooperates with the French energy agency ADEME and other partners on a number of bilateral energy projects. The Franco-German Energy Platform is the basis for this collaboration.

Agency chief executives Andreas Kuhlmann (dena) and Arnaud Leroy (ADEME) used a meeting in September 2018 to emphasise the two countries’ particular responsibility for implementing the energy transition. Germany and France are widely considered the engines of European

integration. Some cities and municipalities have already taken up the challenge. Among them are twinned cities such as Nice and Nuremberg, which the platform is assisting during the rollout of energy-efficiency programmes in schools. Others, such as Herten and Aras, are receiving support for refurbishing public buildings. dena and ADEME are also cooperating closely with regional stakeholders to introduce transnational smart grids and energy-efficiency networks, and to launch a lighthouse project for the cross-border use of waste heat. The planned renewal of the Élysée Treaty will provide a binding framework for these projects in future. The energy agencies are

calling for the Franco-German friendship accord to place the issues of energy and climate protection at the heart of the cooperation between the two countries. For their part, dena and ADEME intend to strengthen the links between their two organisations. dena’s Managing Director Kristina Haverkamp has already been appointed to the scientific advisory board at ADEME. “ADEME is driving the energy transition in France, like dena in Germany. Together we can contribute to a successful energy transition throughout Europe.”

For more information, visit www.dena.de/energy-platform

BERLIN

GETTING MORE GAS ON THE ROADS

Liquefied natural gas (LNG) and renewable methane can already significantly reduce road-traffic emissions. The dena-coordinated LNG Taskforce has therefore prepared clear recommendations on how their use could be accelerated in road freight transport: by basing the energy tax on the climate-relevant emissions of the individual fuels; by reducing the toll charges for LNG trucks; and by expanding the filling station infrastructure through public-sector investment. Also important are political targets for LNG vehicles and infrastructure, as these would increase confidence among potential investors. In order to achieve initial positive visibility on the marketplace, the LNG Taskforce recommends that Germany should set a target of 2,500 registered LNG trucks and 50 filling stations by 2020, and 25,000 trucks and 200 filling stations by 2025. Countries like Italy and Spain clearly demonstrate that the market for LNG trucks can

evolve very quickly with the right regulatory framework and political support. Germany is trailing some way behind by comparison, prompting dena's Managing Director Kristina Haverkamp to call upon the German government to consistently strengthen the public-sector commitment

to biogenic and synthetic fuels in future. dena has established the action group Bio-LNG and the Global Alliance Power Fuels as its own contribution.

For more information, visit www.dena.de/en/lng-taskforce



Presentation of the catalogue of recommendations for LNG: Professor Linke, Chairman of the German Technical and Scientific Association for Gas and Water (DVGW) (5th from the left), Dr Schulz, State Secretary in the Federal Ministry of Transport and Digital Infrastructure (BMVI) (6th from the left) and Kristina Haverkamp, Managing Director of dena

GERMANY HAS MORE THAN



ENERGY EFFICIENCY NETWORKS WITH OVER 1,800 PARTICIPATING COMPANIES.

(as of December 2018)

BERLIN

CREATIVE IDEAS FOR CLIMATE-FRIENDLY BUILDINGS

The idea competition RE:frame Energy Efficiency aimed to make climate-friendly construction and refurbishment more attractive. It invited proposals for innovative communication methods, business models or apps that cast a fresh light on energy efficiency in buildings. Members of the creative professions, students and interested citizens submitted a wide variety of ideas. An interdisciplinary jury selected the most original ideas, and the winners were announced in early 2019. The competition

had a total prize money of €45,000. The Federal Environment Ministry commissioned and financed the contest, while the Federal Building Ministry organised it. As the implementation partner, dena received support from the agency mc-quadrat and the energy and environmental management consultancy Pöschk.

For more information, visit www.dena.de/reframe

BAVARIA

LAUNCH OF THE 200TH ENERGY EFFICIENCY NETWORK

Five car dealerships from Bavaria came together in September to devise ways of optimising their compressed air, lighting and heating processes. The aim was simple: to save energy by working as a team. In doing so, they have become the 200th company alliance within the Energy Efficiency Networks Campaign. dena manages the campaign office. Germany-wide, over 1,800 businesses are already involved in the campaign launched by the German government, asso-

ciations and business organisations. Participants share ideas about energy efficiency and leverage savings potential together. On average, companies can reduce their annual CO₂ emissions by 5,000 tonnes by participating - and thereby make an effective contribution to climate protection. Word of the initiative's success has since spread around the world, and networks are now active in many European countries, as well as in China and Japan. Mexico is also keen to get on board and launch similar initiatives with dena's advice.

For more information, visit www.dena.de/energy-efficiency-networks

ABU DHABI

DENA SENDS START-UPS TO ABU DHABI

Innovation will be a top priority at the 24th World Energy Congress in September 2019 in Abu Dhabi. This is the world's largest and most influential event for energy issues – so the 100 best cleantech start-ups that apply for dena's Start Up Energy Transition Award 2019 simply have to be there. The international award honours innovative young companies whose business models advance the cause of climate protection. dena received over 1,000 applications from 88 nations in the first

two years. The best applicants for 2019 will appear on the list of the Top 100 (#SET100) international start-ups in the energy transition. Attending the World Energy Congress will give them the unique opportunity to pitch their ideas to an international audience comprising heads of state, CEOs, pioneers and NGOs. They will also be able to share ideas and make valuable contacts.

For more information, visit www.startup-energy-transition.com

Over
1,000

DENA PILOT PROJECT: ENERGY-EFFICIENT RETAIL

25

**RETAILERS
TOOK PART**

**ENERGY SAVINGS:
HIGHEST SAVINGS SO FAR
AFTER REFURBISHMENT**

45%

€4.4m

**PLANNED INVESTMENTS
BY THE PARTICIPANTS IN
ENERGY EFFICIENCY**

Installing a photovoltaic system on the branch of Stanbic Bank in Dansoman (Ghana)



Refurbished branch of ALDI SÜD in Frankfurt-Schwanheim



APPLICATIONS ARRIVED FROM 88 NATIONS IN THE FIRST TWO YEARS OF THE START UP ENERGY TRANSITION (SET) TECH FESTIVAL.



GHANA

CROWDFUNDING ENABLES SOLAR PROJECTS

One of Ghana's biggest banks is benefitting from German solar technology. Stanbic Bank now uses renewable energy to produce over 30 per cent of the electricity consumed at three branches in and around Accra. The project is special because it was made possible by crowdfunding organised by the German project development firm ecoligo investments as part of dena's Renewable Energy Solutions Programme. The implementation of solar power projects often fails at the funding stage, especially in developing and emerging countries. Local companies tend to focus financial resources on their core business. It is rare for much to be left for investment in renewable energy. Crowdfunding is an effective way of overcoming this obstacle. Within this campaign, more than 40 private investors covered a share of the technology budget for the Stanbic Bank systems. ecoligo recruited the German company SMA Sunbelt Energy as a consortium partner, and two local companies were involved in the technical planning and installation of the facilities. All in all, this is a concept that allows companies in emerging countries to focus on their core business and, with support from German technologies, to benefit from savings achieved by using solar energy.

For more information, visit www.dena.de/res-programme

RUSSIA

CLIMATE PROTECTION IN RUSSIAN MUNICIPALITIES

Cities and municipalities play a vital role in climate protection. However, they are facing stiff challenges. The Energy and Climate Protection Management System (EKM) by dena helps municipalities to save energy systematically. To do this, it develops efficiency strategies for all important activity areas and creates organisational structures that include a broad range of stakeholders.

EKM, an open-source tool, has been in use in Germany for some time. Sixteen cities in China installed it after it was modified to suit their specific needs. And now Russia is interested. EKM was presented to delegates from Russian municipalities during a workshop in Moscow at the end of 2018. The participants will analyse which particular factors the tool needs to accommodate in order to be used in Russia.

For more information, visit www.dena.de/efficient-municipalities

FRANKFURT-SCHWANHEIM

CLIMATE PROTECTION IN THE RETAIL SECTOR: PILOT PROJECT SUPPORTS ALDI SÜD

Profitable and climate-friendly refurbishment solutions for retail buildings: around 25 retailers have been collaborating with dena since early 2017 to develop practical solutions for more energy efficiency in the retail sector. The participants in dena's pilot project Energy-Efficient Retail include major German retail chains such as Edeka, ALDI SÜD, Netto Marken-Discount, Globus and toom, as well as small specialised businesses and a community shop in a village.

The most successful projects include the energy-efficient refurbishment of a branch run by the food retailer

ALDI-SÜD in Frankfurt-Schwanheim. Reopened in August 2018, the supermarket now saves more than 45 per cent of its energy costs as a result of the efficiency measures. Its CO₂ emissions have declined by over 40 per cent. At the branch, the retailer optimised its insulation, replaced double glazing with triple glazing and installed efficient heat pumps and a ventilation system with heat recovery.

It also installed LED lighting, equipped the system with motion detectors to activate and deactivate the lights, and installed new refrigeration units. A photovoltaic system on the roof produces

electricity, around 80 per cent of which is used directly in the supermarket. The dena pilot project Energy-Efficient Retail – Energy-Efficient Modernisation of Retail Buildings – is funded by the Federal Ministry for Economic Affairs and Energy (BMWi). Supporters include the German Retail Federation (HDE), the EHI Retail Institute, the Central Real Estate Committee (ZIA), as well as the corporate partners Hottgenroth Software, Hörburger Control Systems, kru-media, MultiCross and Vattenfall Wärme.

For more information, visit www.dena.de/retail



Astrid Andre in her home, which was refurbished in 2014. The building is among the first in the Netherlands to be refurbished under the Energiesprong initiative.

Simply revolutionary

Energiesprong is a Dutch concept for using prefab facades and roofs for energy-efficient refurbishments. The idea has created a buzz in Europe. Now dena has launched the first projects in Germany.

TEXT Marcus Franken **PHOTOS** Jurrian Photography

Everything was done and dusted after just three weeks: a new facade, new windows, solar panels on the roof, and the garden transformed into a miniature power plant to supply Astrid Andre's terraced home with heat and hot water all year round. What it cost her: nothing. How she feels: happy.

Andre lives in the Dutch town of Heerhugowaard, 25 kilometres north of Amsterdam. In 2014, her home became one of the first of the now 4,500 buildings to have been refurbished in the Netherlands under the

Energiesprong initiative. The idea is taking Europe by storm and recently received the prestigious David Gottfried Global Green Building Entrepreneurship Award.

It is indeed a revolutionary approach. Construction costs are rising everywhere in Europe, companies are struggling to recruit specialists, and schedules are binned by the minute. In among all of this, Energiesprong promises to do everything better, cheaper and quicker.

"Four million apartments in Europe have to be refurbished each year due to nec-

essary maintenance or modernisation. Our concept is a good solution for many of these apartments," says Jasper van den Munchhof, founding director of Energiesprong. He and his team use standardisation, digital building surveys and entire prefabricated facades. In other words, it's the opposite of traditional building-site work, which often involves multiple small manual tasks.

The Dutch government helped to fund Energiesprong – as an autonomous market development team dedicated to uniting the housing and construction industries,

“Prefabrication will enable a quantum leap in quality, refurbishment times, and costs.”

Uwe Bigalke, dena team leader for energy-efficient buildings

but without the intention to return profits. Offshoots have since sprung up throughout Europe. In Germany, dena coordinates the initiative on behalf of the Federal Ministry for Economic Affairs and Energy (BMWi). After all, what van den Munckhof is promising would be a huge leap forward for the entire building sector: “Quick, affordable and high-quality zero-energy refurbishment.”

The concept works

The engineers from the construction division of the housing company BAM use aerial photographs to produce 360° images of the ground level and 3D maps based on data from a laser scanner. This produces a precise cartography of the housing blocks to within just a few millimetres. BAM uses this information to factory-produce facades, roofs and energy units. “Facades and roofs are installed over the old building shell like an external skin and then fastened in place using special anchors,” explains Tom Jongen, who

oversees innovative refurbishment concepts at BAM in Nieuwegein near Utrecht. The individual elements are put together and tested in the factory; attaching them to the house can take as little as two hours. Afterwards, the ventilation, water and electricity lines are connected to the facades, roof and energy centre in the garden – and that’s all it takes to create a zero-energy house (► Diagram on page 44/45). Architects can design the new shells according to their own aesthetic preferences.

Eighty Dutch companies have now come together in the working group Stroomversnelling. BAM alone has mounted more than 4,000 facade and roof elements so far.

“I couldn’t be happier with my ‘new’ home,” says Andre. That’s no coincidence, as satisfying tenants is an integral part of the refurbishment concept. BAM spent a lot of time reassuring its tenants, providing information and offering a legally binding price guarantee for the future rent, with util-

ities. Andre was even able to remain in her home during the refurbishment work. Now, as a tenant, she is delighted that the wind no longer whistles through the cracks in her almost 60-year-old house, that the rooms stay warm in winter and that her home is climate-neutral. What’s more, the rent with utilities is still €770 per month – just like before the refurbishment.

Most experts in Germany would dismiss the idea that you could achieve an energy-efficient, zero-emissions home without raising the rent: “Can’t be done.” It’s no secret where the problems lie: energy-efficient refurbishments often take longer than six months, are noisy and dirty affairs and will often be associated with a rise in the rental price. At the same time, homeowners are finding it increasingly difficult to hire skilled tradespeople. The financial rewards of the refurbishment tend to be meagre for landlords as well. So it’s a lose-lose situation for the tenants, landlords and for climate protection.



Astrid Andre from Heerhugowaard in the Netherlands is very happy with her “new” home.

Energiesprong does things differently

From an engineering perspective, none of the elements that were added to Andre’s rented home were particularly innovative at first glance: “To reduce costs, we optimised the insulation and energy supply as a single system,” says Jongen. A refurbished family home with 100 square metres of floor space uses 5,500 kWh each year, of which 2,500 kWh goes on electricity for domestic appliances and 3,000 kWh is needed to power the heat pump that delivers hot water for the radiators, shower, bathroom and kitchen. The solar panels up on the roof produce around 6,000 to 7,000 kWh each year and therefore cover the energy requirements. “The costs sink even more due to the simplicity of in-



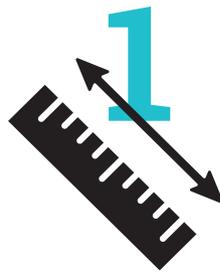
**SERIAL REFURBISHMENT
“MADE IN GERMANY”**

dena is helping to launch the serial refurbishment of the first buildings in Germany. Unlike the terraced family homes in the Netherlands, the project will focus on the country's many large apartment blocks.

In **Hannover**, the building cooperative Oberricklingen eG. has selected four rental apartment blocks with 25 units and 1,503 square metres of effective floor space as possible prototypes. The plan is to attach new facade elements on the current masonry of the unrenovated buildings. The old tiles will be removed from the roof and replaced with a sandwich construction that serves as a base for a photovoltaic system. A heat pump will supply hot water that will continue to be distributed via the current radiators in the gas heating system. The house will need to be well insulated so that the capacity of the heat pump is sufficient; it will therefore be fitted with triple glazing, and the basement ceiling will be insulated. The controlled ventilation required for buildings after high-quality, energy-efficient refurbishment can be installed in the facade elements.

In **Bochum**, the housing company VBW Bauen und Wohnen is planning a second project that will involve the serial refurbishment of six buildings comprising 48 apartments in total. The aim is compliance with the net-zero standard for 3,226 square metres of floor space in total. As in Hannover, a long-term performance guarantee will be provided for the work, which is scheduled for completion in 2020.

HOW SERIAL REFURBISHMENT WORKS



Digital MEASUREMENT
using photos and laser surveys of the property



PLANNING: based on energy-efficiency and architectural specifications.
Engineering: year-round energy self-sufficiency using solar cells, accumulators, heat pumps, etc (net-zero emissions)
Architecture: Design of balconies, loggias, windows and facades



COMPUTER SIMULATION
of how all the elements fit together

dustrial prefabrication, standardisation and ongoing improvements,” says Jongen. “Industrial prefabrication is profitable as long as we refurbish 500 to 600 houses per year. And we’ll have reached that level in two years at most.” The company says that the facades produced today are already 30 to 40 per cent cheaper than the first batch, because the factory now uses a robot instead of a mason to fit the klinker tiles.

The potential for Germany is obvious

“Prefabrication will enable a quantum leap in quality, refurbishment times, and costs,” says Uwe Bigalke, Head of the Energiesprong team at dena. In particular, around 500,000 buildings from the 50s, 60s and 70s would be prime candidates for serial refurbishment. Construction firms

working on these properties would mostly encounter simple, smooth facades and basic roof constructions, meaning the refurbishment would also make the buildings look much better. And because the energy consumption here is typically more than 130 kilowatt-hours per year and square metre (kWh/a·m²), the savings in energy costs would be considerable. The refurbishment should reduce consumption to just 30 to 40 kWh.

However, “a certain volume of refurbishments would be necessary” for this approach to be cheaper than traditional methods, says Bigalke as a cautionary aside. He also doesn’t hide the fact that some legal aspects still require clarification: the electricity metres in the Netherlands run clockwise when the tenants take energy from the grid, and anticlockwise when the solar power system is feeding in

ARTWORK: Jane Kelly/Shutterstock.com; Rauf Aliyev/Shutterstock.com; Vector4/Shutterstock.com; brown dog studios/Shutterstock.com; Cube29/Shutterstock.com; VooodooDot/Shutterstock.com



PREFABRICATION of all elements, including electricity and water lines, in factories (and therefore protected from the weather).



PREPARATION of the building site



ATTACHMENT of the new facades, installation of the prefabricated energy module, and connection of the ventilation, electricity and water lines

current. At the end of the year the readings tend to be zero. It's a simple solution, but unfortunately unlawful in Germany. Another problem is the involvement of the homeowner as electricity producer. Housing companies could easily become ineligible for their 'privileged trade tax status'. Legal constructions using service providers as intermediaries would be conceivable, but would also add to the costs.

Nevertheless, the potential is clear: an Energiesprong-style initiative could increase Germany's refurbishment rate, which is currently below one per cent. In addition, the heating transition would move significantly faster if refurbishments with prefab elements took weeks instead of months or even years. This kind of refurbishment also brings fresh innovation to the construction trade and the supplier industry, creating attractive employment

opportunities. Last but not least, the fixed rental price with utilities, which is firmly enshrined in Energiesprong's concept, could create a win-win situation for everyone involved.

That's why dena is cooperating with the construction and property sectors to launch initial projects in Germany (► Box on the left). The success in the Netherlands is certainly impressive: while the costs of refurbishing the first family homes were around €100,000 per unit, the experience acquired since then has pushed them down to just €65,000. The benchmark for construction work on the building itself is now only two weeks.

Word about the initiative has also spread to France. Bigalke says that French housing companies keep telling him: "It doesn't get better than this. You'd have to be mad not to do it!" ■



THE ENERGIESPRONG INNOVATION ROUTE

The market for new refurbishment concepts based on the Energiesprong concept has started to evolve in Germany: guided by dena, housing companies looking to refurbish model properties are coming together with general contractors and individual service providers that make the individual components for the facade, roof, photovoltaics, technical systems and monitors. dena supports the partners in developing their concepts.

Experts attended an Innovation Day event in november to share their thoughts on building envelopes, technical modules and other challenges. The connections with construction and housing companies in France is a key element in the concept. An excursion to Energiesprong building sites and solution providers in the Netherlands is also planned for January 2019.

The Energiesprong concepts will then be presented to around 150 guests from the housing and construction industry, as well as political decision-makers, in February 2019. Housing companies that are planning prototype refurbishments can then select the solutions that best suit their needs. All other participants will receive a glimpse into how Energiesprong implements its concept and which highly innovative organisations are currently operating on the market.

For more information, visit www.dena.de/en-energiesprong Twitter: @EnergiesprongDE

Spotlight on the global energy transition

For one week each spring, Berlin takes centre stage in the global energy transition. In April 2018, government representatives, entrepreneurs, experts, members of civil society and the start-up community came together at Berlin Energy Week (BEW) to discuss the future of global energy supply. Main events at BEW include the Berlin Energy Transition Dialogue, a high-level conference with participants from 90 countries, as well as the Start Up Energy Transition Tech Festival. BEW 18 was a huge success – and here a selection of photographs to prove it!

For more information, visit: www.energydialogue.berlin

Project Drawdown ▶

A European offshoot of the climate-protection initiative was founded in April 2018: “Drawdown Europe” unites dedicated people from the scientific and business communities, as well as from civil society. The non-profit initiative maps, calculates and communicates the most important solutions for curbing global warming. Attending the opening event were Federal Environment Minister Svenja Schulze, founder of the Potsdam Institute for Climate Impact Research Hans Joachim Schellnhuber (pictured right) and Vice President of Project Drawdown Chad Frischmann (▶ Photo).



▲ SET Tech Festival ▶

Innovative start-ups aiming to shape the future of the energy transition came together once again at the Tech Festival. Eighteen young companies from Europe, North America, China, India, Israel and Kenya presented their ideas to an audience of 800.



Berlin Energy Transition

With around 2,100 attendees, 30 ▶ ministers and state secretaries, 100 high-level speakers and 20 sessions, the BETD is one of the most important forums in the international energy transition. The two-day conference is organised by the German government in collaboration with dena, the German Renewable Energy Federation (BEE), the German Solar Association (BSW-Solar) and the consultancy firm eclareon. Foreign Minister Heiko Maas and Minister for Economic Affairs Peter Altmaier welcomed the international guests at the start of the event (▶ Photo on the right). ▼



Business-to-government (B2G) dialogues ▼

Green business for the energy transition: the B2G dialogues allow high-ranking representatives of foreign governments to engage in discussion with the German business community. The focus in 2018 was on Jordan and the United Arab Emirates.



Dialogue (BETD)



▼ Women's Lunch ►

Leading women from the international energy transition community met at the Federal Foreign Office to share their thoughts at an event organised under the motto of “empowering women in the energy transition”.



◀ BETD evening gala and the SET Awards ceremony ▼

Guests at the BETD, the SET Tech Festival and the EventHorizon conference gathered at Kraftwerk Mitte for an evening reception, during which the six winners of the Tech Festival received the SET Awards.



◀ Guided tours ►

From sustainable office architecture and driverless electric cars to energy-efficient ice cream production: the guided tours offer the international guests at the BETD an opportunity to see what the German energy transition looks like in practice.

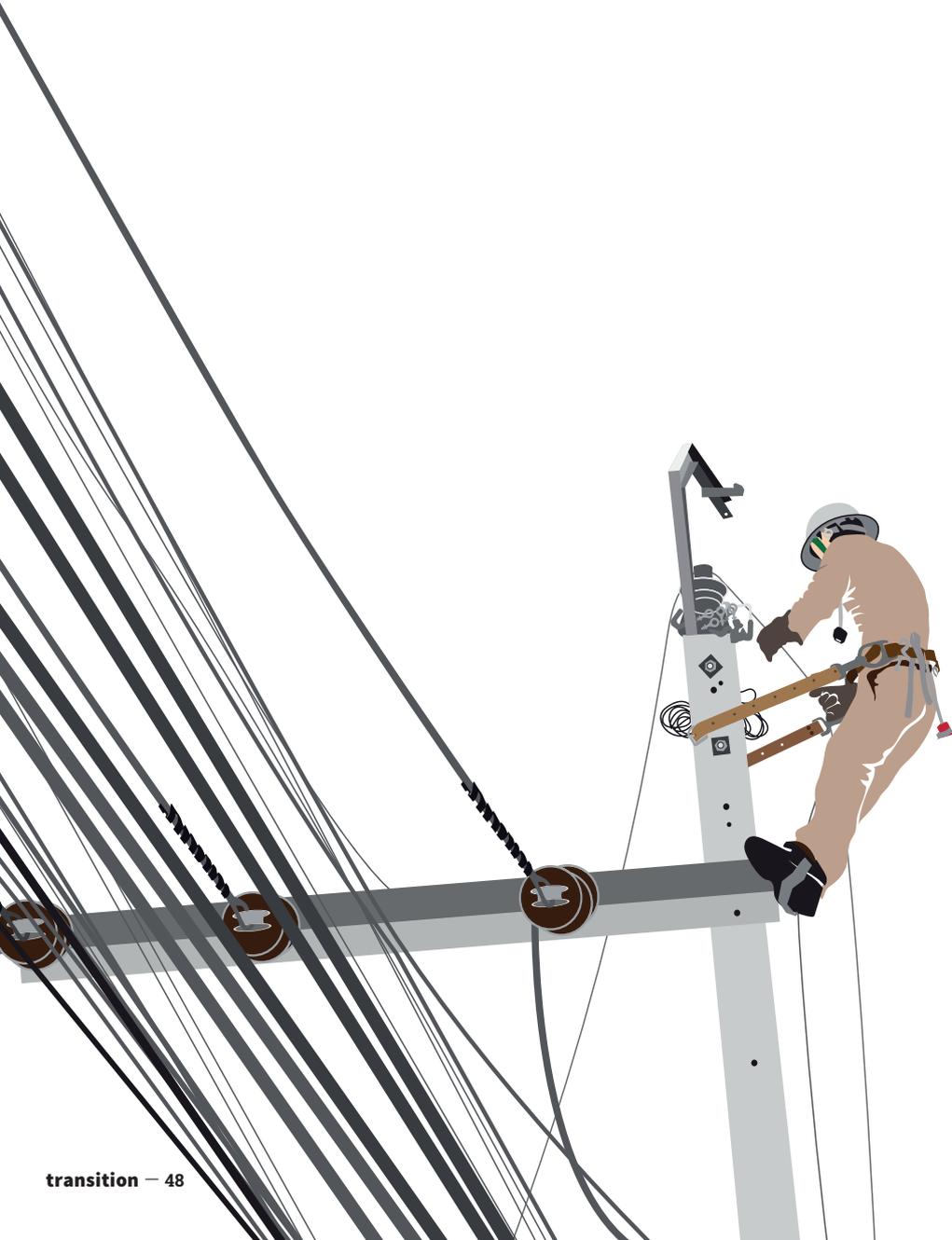


Bringing voltage 4.0 to the grid

Germany has an extremely reliable electricity supply. Each consumer will only experience roughly 12 minutes of power outage per year – even though the energy transition is bringing radical change. Innovations in grid operation are crucial to overcoming the challenges.

The electricity grid is changing. At present, grid operators face supply bottlenecks on a virtually daily basis. Instead of controlling a few hundred large-scale facilities, they are now dealing with millions of small-scale systems. Wind turbines and solar power systems are frequently far away from the places where the electricity is needed. Production fluctuates according to the weather, no matter how high the demand might be in the grid. The systems feed power into the grid at levels that were originally only designed for distribution and whose transmission capacities are often inadequate. The costs of preventing this kind of bottleneck in the German electricity grid have risen sharply in recent years. In 2017 alone, they amounted to €1.4 billion.

Germany needs a powerful and flexible electricity grid if the energy transition is to succeed in this industrial nation. Grid expansion is vital to this process, and grid operations must continue to develop as well. A raft of ancillary services are available for controlling the frequency, voltage and load on the grid equipment, and for restoring normal operations in the event of disturbances. A great deal of potential exists in this area for reducing costs and helping the electricity system to retain its stability at all times during the immense changes ahead. Many things are already happen-



ing, although consumers won't have noticed much. After all, electricity continues to emerge from the socket whenever it is needed. Nevertheless, grid operators, manufacturers, associations and government agencies are cooperating closely to drive innovation, and the revolution is playing out in the background.

Power lines at high temperatures

Production and consumption will always be balanced in a stable electricity system. The amount fed into the system will be equivalent to the amount that is consumed, and vice versa. Sometimes, though, the available power lines will be insufficient. An example of this is when wind farms in northern Germany feed a lot of electricity into the grid that must then reach consumers in the south. In these cases, the grid operators will intervene in the power plants to keep the situation stable. Experts use the term 'redispatch' to describe changes in power plant deployment ('dispatch') at short notice. On the side of the bottleneck where there is too much electricity, operators will shut down the power plants. On the other side, operators will ramp up production if necessary.

Some bottlenecks could be avoided if the electricity lines were capable of carrying more power. As a rule, transmission capacity depends on the operating temperature. Higher amounts of electricity and warmer weather cause the power lines to heat up. Traditionally, Germany has calculated the maximum transport capacity very conservatively – for instance, by using an ambient temperature based on a standard climate that would rarely occur in reality. Continuous monitoring of line temperatures and weather data from the immediate vicinity would make the whole system more flexible. "There are times when you can send more electricity down the lines, for instance when the wind conditions mean they will be cooler than usual," says dena expert Stefan Mischinger, explaining the principle of monitoring overhead lines.

Methods like this are already in use in some regions, such as in those with strong

prevailing winds and long, straight power lines. They will be introduced throughout the transmission grid by 2022, so at the highest voltage level transporting electricity over longer distances. The pressure to innovate is high, but smart lines need reliable sensors and software. Grid operators are being asked to collect and process increasingly big datasets and measurement values in their control centres. What's more, the lower voltage levels that frequently run through more densely populated regions require decentralised management concepts, as the number of lines, nodes and connected consumers is significantly larger.

End of the one-way street

Bottlenecks and dispatching will become easier to manage when the distribution levels play a larger role in balancing supply and demand. Until now, electricity has flowed mainly in one direction: from the power stations, to the transmission grid, to the lower voltage levels, and finally to the various consumers in industry, commerce and private households. Today's grid is no longer a one-way street. The number of power-generating systems at distribution grid level has grown exponentially. Occasionally, grid operators are already redirecting surplus production into the higher grid levels in regions with many wind turbines and solar power systems. To do this, they need to adapt their operations and coordinate with the higher grid levels.

There are, however, other ways of redirecting the temporary surpluses. "At distribution level, the volumes of electricity could also be used to charge e-vehicles or for heating. Using electrolysis to store it as hydrogen is also conceivable. We'll have to do a lot of research and testing first, though," says Mischinger. Numerous components and stakeholders must be coordinated at all levels of the grid. Grid operators need digital tools to measure and

analyse the data, and to manage operations.

Complexity is rising within the electricity system. Aside from overhead line monitoring, redispatch and feed-in management, other ancillary services exist, such as instantaneous reserve, operating reserve and reactive power. These, too, will require innovative solutions. Three approaches are key to all these services: cooperation between the stakeholders across the various voltage levels; smart management using digitalised data; and a reformed regulatory framework. Grid operators, manufacturers and politicians must commit to this cause. If they do, the hidden revolution will succeed, and Germany's electricity supply will remain secure and reliable in the future. ■



INNOVATION REPORT ANCILLARY SERVICES

Ancillary services ensure a stable flow of electricity through the grid. They include providing an instantaneous reserve, and other services that keep the voltage and frequency steady. In its Innovation Report Ancillary Services, dena conducted a detailed analysis of the necessary innovation in these services and released the findings as a roadmap for the electricity grid up to 2030.

For more information, visit
www.dena.de/en-ancillaryservices



FACTS & FIGURES

WHAT ARE DENA'S **CORE RESPONSIBILITIES**? IN HOW MANY COUNTRIES IS IT ACTIVE? AND WHAT DO ITS EMPLOYEES DO? THE **FACTS & FIGURES** SECTION GIVES AN INSIGHT INTO DENA AND ITS WORK.

An industrious year

Here's a snapshot of dena's most important resource: its employees. Their skills, enthusiasm and dedication are helping to sustainably transform the energy system. An overview of one year's work in figures.

192

**national and international
cooperation partners**

4 million

page views

on www.dena.de and

more than **20** other
dena websites

3,757

media reports

about dena
and its work



Over **40**
studies, reports
and other publications

90
projects
in more than **20**
countries

2,385
tweets
and over **9,700**
Twitter followers

133
events with **5,638**
participants



Shaping and driving the transformation

dena's core tasks are to serve as a global ambassador for the energy transition, take concrete action to drive it forward, and gather knowledge and experiences.

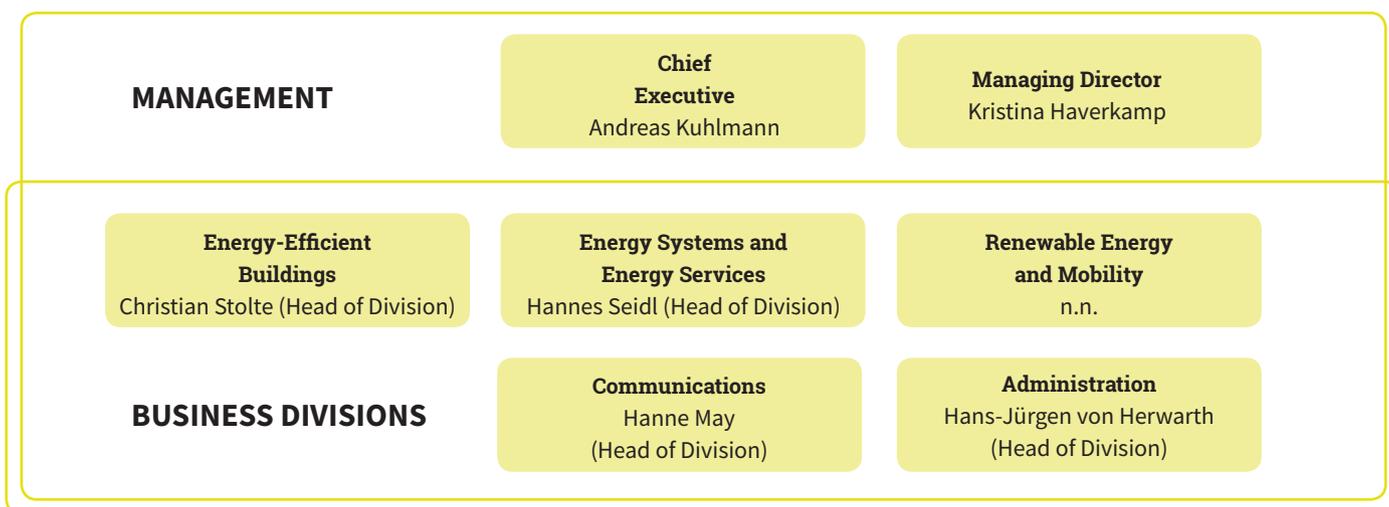
The German Energy Agency (dena) sees itself as an independent engine and pioneer of the energy transition – in Germany and in all the other countries in which it is active. With its work, it aims to actively contribute to the energy transition and climate protection. Its key focus areas are energy efficiency, renewable energy sources and the energy system as a whole. dena helps to implement the energy transition in a variety of ways: by developing strategies as a think tank; by outlining and testing innovative and market-oriented solutions in studies and pilot projects; by connecting key stakeholders in platforms and initiatives; and by pooling knowledge and experience

to advise politicians on developing suitable regulatory frameworks.

dena's shareholders are the Federal Republic of Germany represented by the Federal Ministry for Economic Affairs and Energy in consultation with the Federal Ministry of Food and Agriculture, the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety, and the Federal Ministry of Transport and Digital Infrastructure, as well as KfW Group. The shareholders appoint representatives to a Supervisory Board with nine members, which supports dena's business development and uses its skills and experience to help the organisation evolve. The new Supervisory Board was appointed on 1 September 2018. The current chair is

Thomas Bareiss, Parliamentary State Secretary at the Federal Ministry for Economic Affairs and Energy (► Interview on the right).

Chief Executive Andreas Kuhlmann and Managing Director Kristina Haverkamp have been responsible for running dena since 2015. They receive support from five heads of division, each of whom is responsible for between 20 and 70 staff members. dena is working on around 90 projects in Germany and more than 20 countries worldwide. Within these projects, it collaborates with hundreds of partners from business, politics, science and society. This broad-based structure ensures well-founded, diverse and highly innovative solutions for all aspects of the energy transition and cli-



SUPERVISORY BOARD

Thomas Bareiss

Parliamentary State Secretary at the Federal Ministry for Economic Affairs and Energy, **Chair of the Supervisory Board**



Jochen Flasbarth

State Secretary at the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMUB)



Dr Astrid Freudenstein

Head of Department Z at the Federal Ministry of Transport and Digital Infrastructure



Tanja Gönner

Chair of the Management Board at Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH



Dr Katrin Leonhardt

Director of KfW Group, Head of Customised Finance & Public Clients



Dr Velibor Marjanovic

Director of KfW Group, Head of Development & Economics



Dr Helmut Schönenberger

CEO of Unternehmertum Venture Capital Partners GmbH and UnternehmerTUM GmbH



Michael Stübgen

Parliamentary State Secretary at the Federal Ministry of Food and Agriculture



Ewald Woste

Management Consultant



“We need an overall strategy for the energy transition”

An interview with Thomas Bareiss, Parliamentary State Secretary at the Federal Ministry for Economic Affairs and Energy, and Chair of the Supervisory Board at dena

Which areas will you focus on as Chair of the Supervisory Board at dena?

BAREISS: I'm really looking forward to working with the Supervisory Board and with dena itself. It is a valuable think tank that considers overarching solutions, innovation and various contexts to drive the energy transition forward. dena has a wealth of expertise, and I would like to make better use of this potential to ensure that the energy transition is a success.

Where do you currently see the biggest challenges in implementing the energy transition?

BAREISS: We need an overall strategy to make the energy transition work. This sweeping process of transformation presents us with multiple challenges that relate to the energy sector, business, consumers and so ultimately to each one of us. But there are plenty of opportunities in the energy transition as well. Our energy policy is based on the three targets of climate and environmental protection, cost-effectiveness and security of supply. In particular, we need to

make progress on cost-effectiveness and affordability. To do so, we must primarily make better use of the potential offered by energy efficiency – particularly in terms of making existing buildings more energy-efficient. Besides that, renewables can only be rolled out at a higher level if there is a simultaneous expansion of the power grid. Security of supply must also remain a focus at the national and European level.

Where do you see dena's role in the future?

BAREISS: I see dena as a driving force for the debate about energy policies and the applied energy transition, as we still face many unanswered questions. How can we best organise an integrated energy transition that encompasses all energy sectors? How can we make sure that fresh ideas and new technologies establish themselves on the market and are able to make a difference? Building on its close collaboration with multiple economic actors, dena will continue serving as an important think tank for policymakers and businesses.

mate protection. It also allows dena to operate with a significant degree of autonomy. The individual teams – dena has around 50 team leaders in charge of up to 20 employees each – make sure that every project is

run efficiently. The growing complexity of the integrated energy transition means that the project teams increasingly incorporate expertise from various divisions within dena. Its employees, who now number roughly

230, possess a growing range of specialist knowledge and skills. Experts with a variety of professional backgrounds from different nations work together in interdisciplinary teams at dena. ■

Positive trend continues

2017 was another successful year at dena. Revenue and earnings rose significantly, and new projects sharpened its profile as a pioneer of the energy transition.

The upward trend in business development continued throughout 2017. dena increased its revenue by eight percent in a year-on-year comparison and, at €21.8 million, recorded the second-highest result since its foundation in 2000 (► Diagram). The only period with a higher revenue was in 2009. In that case, though, the figures were due to the various stimulus packages and corresponding programmes that the German government launched in response to the global financial and economic crisis.

Income from the private sector and other sources accounted for the lion's share (€14.4 million) of dena's 2017 revenue. This represented a significant increase compared to the previous year (+€1.7 million). In contrast, the second revenue area – government grants – remained constant at €7.4 million.

The 2017 operating result of €411,000 was very good, and the annual net profit of €880,000 was also pleasing. This was mainly due to a very positive non-operating result (€661,000), which in turn was largely the result of a revaluation of reserves for tax

audits (2005–2008 and 2009–2012) in this financial year.

The positive economic trend also led to an increase in employees. dena employed 218 people at the end of 2017, compared to 212 the year before.

The Integrated Energy Transition study was a considerable focus of work during 2017 (► Page 22). All of the divisions at dena were involved in this extensive project, which was conducted with around 60 partners from the business and scientific communities. Preliminary findings were available in October 2017, shortly after the German election. The final results were presented in early summer 2018. They were greeted with considerable interest by politicians, experts, the media and the public. dena will continue to focus on integrated solutions for the future energy system over the coming years. Findings from the study have already been used to initiate a number of follow-on projects and to expand existing projects (► Page 28).

Promoting innovative approaches and solutions for the energy transition and climate protection was another priority in

the 2017 financial year. For instance, dena organised the first Start Up Energy Transition (SET) Award and the Tech Festival in Berlin attended by several hundred participants.

Both events are part of the global SET initiative for pioneers in the fight against climate change. These new initiatives have helped to strengthen dena's international focus and have made a major contribution to connecting innovative entrepreneurs from all sectors relevant to the energy transition.

To ensure that it remains an efficient, future-proof organisation, dena has begun engaging more intensively with its employees. A whole-day Bar Camp was held once again in 2017. Many of the discussions and ideas addressed the issue of sustainability.

Prompted by this, an interdivisional working group was established in autumn 2017 to work on a sustainability strategy for dena and on proposals for how it should be put into practice. dena already aims for climate-neutral business travel and uses rail transport whenever possible. When air travel is unavoidable, it offsets the emissions. ■



2017 revenue

€21.8 million in total

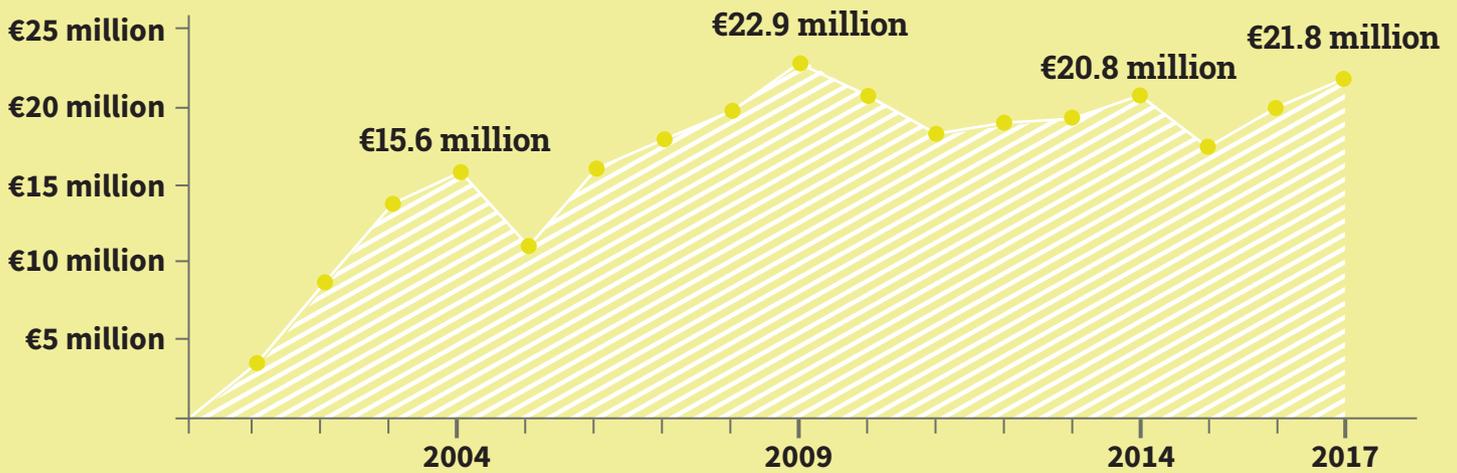
€14.4 million from private-sector contracts and other income

€7.4 million from government grants

€880,000 annual net profit



Revenue development 2001–2017



Employees

■ Full-time
■ Part-time

2003



54

Full-time: 53
Part-time: 1

2009



174

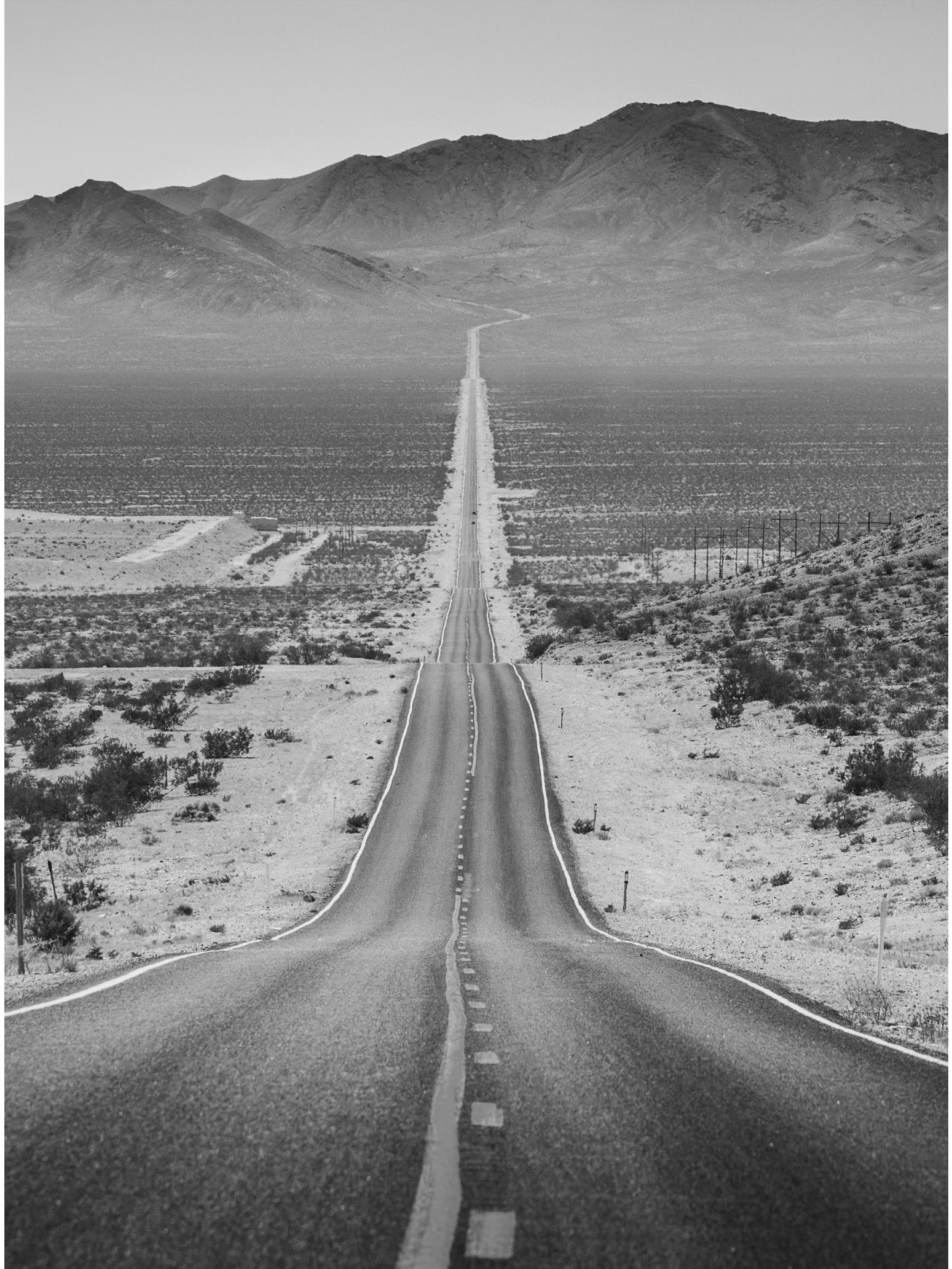
Full-time: 127
Part-time: 47

2017



218

Full-time: 132
Part-time: 86



N E X T

ENTERING A NEW ENERGY ERA – IN **NEXT**, WE ATTEMPT TO ENVISION WHAT TOMORROW HOLDS FOR US: WHAT WILL THE **FUTURE** BRING? AND WHICH VISIONS AND IDEAS COULD HELP US ADVANCE?

A photograph of Andrea Barber, founder and CEO of Rated Power, speaking at a microphone. She has long, wavy blonde hair and is wearing a blue and red patterned blazer. She is gesturing with her left hand while holding the microphone in her right hand.

Entrepreneurship as a life philosophy

Andrea Barber is founder and CEO of the tech start-up Rated Power in Madrid. She also produces a podcast that makes successful women more visible as role models.

TEXT Marcus Franken

We will cut the planning time that engineers need from between two and three weeks to five minutes,” promises Andrea Barber at the Start Up Energy Transition Tech Festival 2018 in Berlin. Along with 17 other finalists she is pitching her business idea to an audience of hundreds. Barber is CEO of the start-up Rated Power, which she founded in Madrid with Juan Romero and Miguel Ángel Torrero. She has a confident manner and

a strong promise: the ability to prepare all planning documents for large-scale photovoltaic systems within five minutes. The start-up's software aims to save several weeks of engineers' time. Drumming up interest is all part of a day's work for start-ups. The audience is professionally sceptical. The questions are probing. Andrea Barber enjoys this kind of pressure.

“Founding a company is a constant challenge,” she says. “People hold up a mirror to you all the time, and your strengths

and weaknesses don't stay hidden for long.” This might put others off, but she sees it as an opportunity: “If you can accept yourself and at the same time embrace the opportunity to improve, then this kind of criticism becomes a very positive experience.”

Entrepreneurship is a life philosophy for Barber. She more or less inherited her passion for seeking out new challenges. Both of her parents are research chemists, one in aviation, the other in pharmaceuticals. She studied business administration

at university and business school in Madrid, and then went to work for the chamber of commerce.

Computing power instead of engineering hours

The idea behind Rated Power came when she and her fellow founders were employed at an engineering firm that plans solar power systems around the world. "Simply checking the feasibility of a project often took weeks of arithmetic, drawing and preparing reports. We'd often have to more or less start over again as soon as the slightest changes came up," she says. So the trio sat down with a single thought in mind: there has to be a quicker way of doing this! "And there was. That's why we did it," says Barber.

The software, pvDesign, works through millions of strings until it has discovered the perfect design for the specific solar power system, Barber explains to the audience in Berlin. According to figures released by the company, engineers from more than 50 countries have already used the program.

Creating role models for women

Barber is very aware that she remains an exception in the male-dominated world of technology. After years navigating the engineering, technology and energy sectors, she has now teamed up with other women to launch the Vostok 6 podcast, named after the 1963 Russian cosmonaut mission that sent a woman into space for the first time. "Our mission is to create strong role models that empower and inspire other women," says Barber.

She is also intrigued by the idea of helping companies to benefit from the differences between the two sexes. Women, for instance, are said to be more empathetic and have a greater ability to sense how another person is feeling. "Accepting this perceptive skill helps you to connect better with your customers, understand their needs and thereby improve your own product."

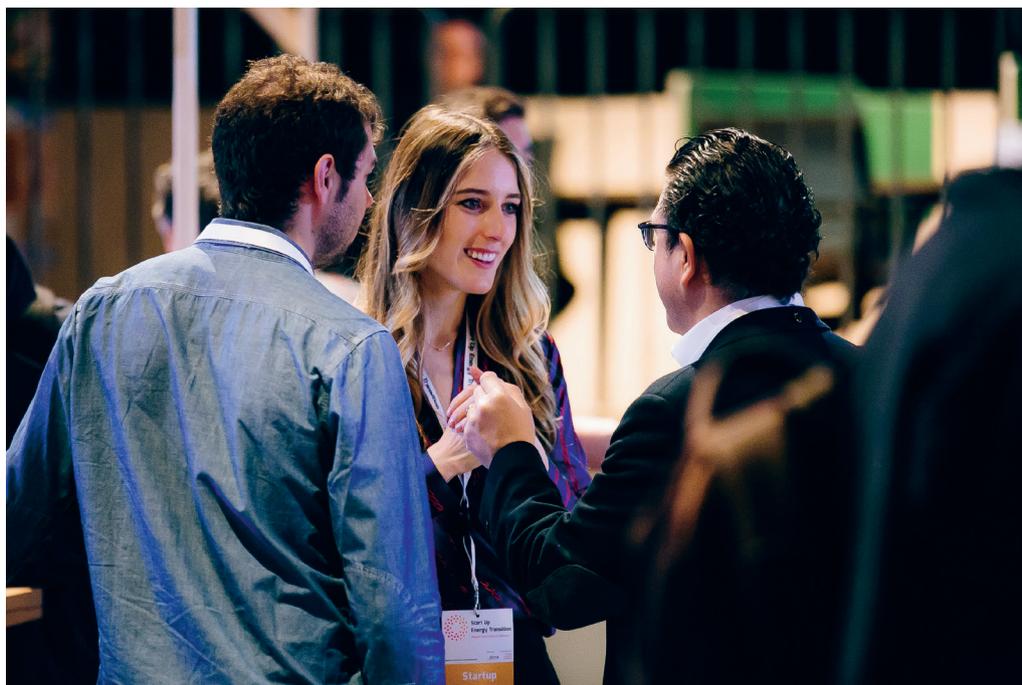
Worst-case scenario: learning a lot

For Barber, many of the women who feature on the podcast are also personal role models. She is also very impressed by Roya Mahboob, who – despite receiving death threats – founded several companies and became the first female boss of an IT company in Afghanistan. Mahboob also looks beyond the IT world. She has established a foundation that helps women and children in countries like Afghanistan to overcome their digital illiteracy.

Barber travels a lot on business. She prefers this life to a safe job in a big company. This is partly because, in addition to addressing specific technical problems, she can focus on developing a "business as a whole" by overseeing financing, growth and employees. It also allows her to manage her own time. Describing her life as an entrepreneur, she says: "It's an incredibly exciting experience." And if it doesn't work out? "The worst-case scenario is that I'll have learned a lot." ■

“Our mission is to create strong role models that empower and inspire other women.”

Andrea Barber



Sharing insights at the SET Tech Festival: Andrea Barber, CEO of the tech start-up Rated Power.

Heading for new shores

With 66 cities exceeding one million residents, and four billion square metres of new floor space each year, China's urban growth is staggering. Sustainability is becoming increasingly important. With support from dena, a pioneering urban development project is being planned on the outskirts of canal town Tongli.

TEXT Alexander Hirsch

A popular tourist destination:
the historical canal town of Tongli

Home to picturesque canals and around 50 historical bridges, Tongli in eastern China is primarily known to tourists. But the town, which is incorporated within the city of Suzhou, could soon become an attractive travel destination for city planners and other urban experts. Over the next few years, the Tongli Next Energy Town (TNET) is set to be erected on a 300 hectare plot on the outskirts of this ‘Venice of the East’ as an international lighthouse project within the integrated urban energy transition. The energy group State Grid, the world’s largest grid operator and responsible for most of the Chinese market, is the project developer. The concept for TNET comes from dena.

The project in Tongli is designed to yield answers to important questions of the urban energy transition. It comprises two residential neighbourhoods, one business district, a hotel and a congress centre. Around 20,000 people could live in the city one day. Conceived as an integrated urban energy system, TNET is built around an innovative energy supply, improved energy efficiency in buildings, and sustainable mobility. The aim: lower energy consumption, fewer CO₂ emissions and a better quality of life. TNET should also be a ‘living lab’, an illustrative and interactive experience that inspires ideas for further innovation.

Creating the sustainable city of the future

dena has already developed numerous Sino-German collaborative projects for smart energy systems, energy-efficient construction and sustainable urban development. But the project in Tongli is still a particular challenge. “TNET is not designed simply as a high-tech lab, but also to include the needs of the people in the community. It therefore needs to be as realistic as possible,” says Susanne Schmelcher, Senior Expert for Energy-Efficient Buildings at dena.

In essence, the aim is to integrate the various sectors of the energy system and their interdependencies as holistically as possible within the planning. This includes the necessary grids for electricity, heat and cooling, the use of renewable energy sources, energy-efficiency standards for residential and commercial buildings, and mobility. “We have also

developed criteria to enable benchmarking with similar projects elsewhere in the world,” adds Schmelcher.

Visualising interdependencies

In order to explore the complex interplay between the various technologies, dena called on experts from the E.ON Energy Research Center at RWTH Aachen, who produced a dynamic simulation. The aim: to reconcile the calculated need for heat, cooling and electricity in the new district with the local resources and infrastructures. The basic idea is that deploying new technologies must not be an end in itself.

For instance, a fully electric transport and energy system proved uneconomical when viewed from a holistic perspective. The Tongli plans therefore include investing in an energy mix in which hydrogen obtained from surplus solar power will be used for mobility. Wind turbines will also feature in the production of electricity, despite the difficult conditions: “Cities are simply too densely built-up to install large-scale wind turbines. But instead of rejecting the technology entirely, we looked around for alternatives and have now planned some smaller turbines that can be installed on buildings or in public spaces”, reports Mareike Wolke, Expert for System and Market Integration of

Renewable Energies at dena. However, plans do not envisage creating an energy-autarkic district. “TNET should not be an insular solution. The energy systems will also be connected flexibly with the surrounding areas,” explains Wolke. These measures will include the ability to absorb and store surplus electricity from nearby wind turbines and solar power systems.

Another aspect of the dena concept could set the project apart from other urban development initiatives in China: the future residents are being included in the planning. “State Grid initially approached dena with a list of largely technological projects. But we managed to convince the company to take a step back first,” says Wolke. The concept now includes public information events and digital forms of participation that are intended to draw the population into the project. Inspiration came from urban development projects like Quayside in Toronto and Smarter Together in Munich.

From a test site to a vibrant district

The TNET project is scheduled for completion in 2022. If it is a success, it should ideally serve as a template for other urban development projects. Some of the four billion square metres of new floor space added in China each year could then bear the hallmarks of TNET. ■

Eco-Cities in China

dena develops and implements Sino-German collaborative projects in the fields of energy-efficient construction, sustainable urban development, energy efficiency in industry, renewable energy sources, and smart energy systems. One of the key projects is Eco-Cities, which aims to identify ways of reducing CO₂ emissions in the urban energy system. The project mainly addresses buildings, energy, transport, water and waste, as well as overarching planning and organisation. Twelve cities in nine provinces have been taking part since 2014.

- | | |
|-----------------------|-------------------------|
| 1. Baiyin (Gansu) | 8. Urumqi (Xinjiang) |
| 2. Haimen (Jiangsu) | 9. Yantai (Shandong) |
| 3. Huai’an (Jiangsu) | 10. Yinchuan (Ningxia) |
| 4. Huailai (Hebei) | 11. Yixing (Jiangsu) |
| 5. Jiangyou (Sichuan) | 12. Zhangjiakou (Hebei) |
| 6. Jilin (Jilin) | |
| 7. Jingzhou (Hubei) | |



For more information, visit www.dena.de/en-eco-cities

“I dream of 80 per cent less CO₂”

Ole Møller-Jensen, CEO of Danfoss Germany, explains why we shouldn't wait for grand solutions to climate protection, how the building sector can help, and why energy-efficient technologies alone will not be enough.

I dream of a future in which we are more careful and ecologically minded in our use of heat and energy. I dream of Germany cutting its carbon emissions by 80 per cent. I'm certain that this is both



OLE MØLLER-JENSEN has been CEO at Danfoss Germany since 2015. The Danish manufacturer of heating and thermostat systems is active in over 100 countries, has 53 factories in 21 countries and employs a global workforce of around 26,000. The Germany headquarters are in Offenbach am Main. Ole Møller-Jensen has worked for Danfoss since 1978. Looking back on an extensive track record, his most recent position was as president of the electronics division, Danfoss VLT Drives.

possible and economically viable. Like many others in our industry, we have developed the technology to achieve this. But we need to actually deploy it!

So why isn't there more happening? Because in Germany, with its strong car-making tradition, people tend to discuss mobility when climate change comes up. Or they speak about electricity production. Yet although the building sector's carbon footprint is only negligibly smaller, it tends to be left out of the discussions. If we talk of more efficient heating systems at all, then it is exclusively in relation to new-builds. Yet the biggest potential is in the old systems, some of which have been chugging away unchanged for decades. Annual refurbishments currently stand at around one per cent. We urgently need better regulatory frameworks so that we can pick up the pace.

The heat sector is changing overall: district heating is becoming increasingly important in the cities. It is the most efficient type of heating supply in built-up areas and perfectly equipped to use waste heat from industry and retail. To exploit this potential, we need brave and powerful political decisions - and we need them soon.

Conventional heating systems are facing increasing competition from high-efficiency heat pumps. They already top the list for new-builds, as they effectively triple the output of the energy used. Establishing

these new technologies on the market is the principal challenge for legislators and the industry as a whole. Above all, we need to make the idea of refurbishment more attractive to homeowners.

However, the most important factors in heat optimisation are the people who actually use the new technologies. Much has changed in the last few years from a technical perspective, and it has happened very quickly. Everything has become more digital. Yet the installation trade has stayed virtually the same. Data collection using digital systems will also be an issue in the future, so data privacy will quickly become relevant. The installer's profession will be more complex.

That's why we as a heating manufacturer - and indeed the whole sector - are offering more training courses and sharing our knowledge. This may sound like an obvious thing to do, but it is extremely important. After all, we will only make full use of the climate-protection potential within our sector if the new technologies are actually installed in the buildings.

All of this is complex and a long-term affair. But given the very real threat of climate change, we cannot just sit here and wait for the grand solution to appear. We must use the technology we have. All the components are already available. We just have to be quicker at using them. ■

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