

transition

THE ENERGY TRANSITION MAGAZINE BY DENA | #2018

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Some
energy transition
obstacles need
**creative
destruction**

dena's Chief Executive Andreas Kuhlmann in a conversation
with blockchain pioneer Ed Hesse

UP AND RUNNING

Four energy transition
start-ups profiled

DRIVEN BY THE CITIES

The urban energy transition
in China and Germany

FACTS & FIGURES

Information on what
dena does



EDITORIAL

transition

The energy transition is one of the biggest challenges of our time – dynamic, complex, and highly exciting. It is characterised by numerous multilayered transformation processes: from the heating and transport transitions to digitalisation and the creation of an integrated energy system. At dena (German Energy Agency), we are currently working on around 90 projects, actively shaping these transformation processes, and advancing the energy transition, while also promoting climate protection.

With our new annual magazine **transition**, we would like to give you insight into what we do at the intersection of old and new energy. We would like to show you how we are driving the restructuring of the global energy system through our projects in collaboration with numerous partners. Furthermore, we will be taking a look at what the major topics of the energy transition are today, as well as what the challenges of tomorrow will be.

But **transition** is also an invitation to get involved. The energy transition is an undertaking that involves society as a whole, and requires a great deal of commitment from many along with broad dialogue in order to be successful. Hence, our projects aim to involve as many stakeholders as possible from various sectors and to develop solutions through collaboration.

If you are already a part of this endeavour, thank you for your commitment! Or if this has aroused your curiosity and you would like to work with us, do not hesitate to contact us!

Andreas Kuhlmann
Chief Executive

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Contents

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THE BIG PICTURE

- 8** Up and running
Four energy transition start-ups profiled
- 12** Quotes
- 14** Some energy transition obstacles
need creative destruction
dena's Chief Executive Andreas Kuhlmann
in a conversation with blockchain pioneer Ed Hesse
- 18** How will the integrated
energy transition work?
- 20** Driven by the cities
The urban energy transition in China and Germany
- 22** We need to talk ...
Three questions on the future of the energy transition

INSIGHTS

- 26** Retailers slash
energy costs
Three commercial enterprises perform
energy-efficient building refurbishment
- 30** 'What we are doing now
is just the first step'
CO₂-neutral heating for the Hafen-City in Hamburg
- 32** From big data to
smart contracting
A glossary of the digital energy transition
- 34** Stepping on the gas
Biomethane as a building block of the energy
transition
- 35** Cleaner driving
Alternative fuels for cutting CO₂ emissions
- 36** dena on tour
Travel anecdotes from dena staff
- 38** A journey of a thousand miles
begins with a single step
Individual refurbishment roadmap in practice
- 40** News
- 42** Accomplishing a revolution
with volts and amperes
Five challenges for the
electricity grid of the future
- 43** Storage facility researcher
with a passion
A profile of the entrepreneur Dr Doris Schmack
- 44** 'There is no catch'
Cooperatives assist municipalities
with the modernisation of street lighting
- 46** News

FACTS & FIGURES

- 50** What we do
- 52** How we work
- 54** Who we are

NEXT

- 58** Solutions know
no boundaries
The energy transition benefits
from the international exchange
of ideas
- 60** Watt really matters
An interview with the behavioural
economist Lorenz Götte on
incentives for saving energy
- 62** 'One day, we will be
charging cars
without a cable'
The vision of the Freiburg-based
start-up Blue Inductive

A white hot air balloon with vertical ribbing is shown floating against a background of diagonal green stripes in two shades of green. The balloon is positioned on the left side of the page, with its basket hanging below. The stripes create a sense of movement and depth.

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?

UP AND RUNNING

THERE WILL NOT BE JUST ONE ENERGY TRANSITION – THE FUTURE OF ELECTRICITY, HEATING, AND MOBILITY REQUIRES A GREAT DEAL OF NEW IDEAS. AROUND THE WORLD, START-UPS ARE WORKING ON NEW BUSINESS MODELS WHICH WILL PERMANENTLY CHANGE THE WAY WE TRAVEL, GENERATE ENERGY, AND LIVE. FOUR EXAMPLES OF HOW THE FUTURE MIGHT LOOK LIKE.

TEXT Daniel Erk and Alexander Langer

Sci-fi taxis

LILIUM

If Daniel Wiegand has his way, science fiction will soon become reality: the founder of the company Lilium in Munich celebrated the successful maiden voyage of his electrically operated Lilium Jet at the beginning of the year. Although it was only a two-seater prototype, it could carry out all essential manoeuvres – launching vertically and switching to forward flight. The Lilium Jet is the first electrically operated aircraft which has succeeded in doing so.

Wiegand's plans involve nothing less than making the Lilium Jet the basis for an entirely new transportation system, in which an aircraft can be booked via an app. In the not too distant future, a Lilium Jet will be able to accommodate up to five persons – enough for a small family that wants to get to the beach from home in the blink of an eye, or a delegation that needs to get to the airport quickly – the air taxi everyone has seen in sci-fi series and films will finally become reality.

Lilium is certainly not the only company dedicated to such a project. But it is certainly the one with the most impressive performance data to date. The Jet is reported to achieve speeds of up to 300 kilometres per hour and have a range of up to 300 kilometres. According to Lilium, this means that the 19-kilometre journey from Manhattan to JFK airport in New York would take

around 5 minutes. Wiegand says: 'The Jets are extremely quiet, which means it is no problem for them to travel in densely populated areas.'

These details have also impressed prominent financial backers. Frank Thelen, an investor known for his appearance on the TV show *Höhle der Löwen* (the German version of *Dragons' Den*), said that Lilium would establish a new industry. Thelen believes that thanks to Lilium, the cost for a flight will soon be less than that of a car ride. Others appear to share this opinion as well: the second round of financing was a success, with the company's coffers in Munich receiving 90 million US dollars. Above all, this funding will be used to recruit first-rate personnel. In early September, Lilium hired senior-level engineers from Airbus, Tesla and Gett in order to keep the company ahead. And above.



IMAGE: Lilium GmbH

Money and sun

SOLSHARE

Private solar power systems are a great invention, but have one disadvantage: As a rule, around 30 per cent of the electricity generated is simply lost. Showing that this one third can be put to much better use is ME SolShare, which entered the Bangladesh market at the end of 2015. With a SolBox, owners of solar power systems can sell surplus electricity to neighbours. The money thus earned is immediately credited through a payment app on a smartphone. The credit can then be used for mobile payments, a system that is widespread in Bangladesh. On the other end, people can also purchase electricity from private providers by topping up their prepaid credit in the same app. In both cases, users are able to view their credit at all times via the app.

Founder Sebastian Groh wrote his doctoral thesis on the role of energy in development processes with a focus on rural areas, and examined various models as part of his research. He quickly found Bangladesh to be an interesting market: 'Back then, there were already three million solar home installations in Bangladesh, while there are six million worldwide – a true exception.' However, when he pitched his idea to financial backers of an entrepreneur programme at Stanford University, they said: 'Nice idea, but you are just not authentic – none of you live in Bangladesh!' Which is why Groh did something about that. While

he was still writing his doctoral thesis, he rented office space in the capital city of Dhaka. He only returned to Germany to defend his doctoral thesis, and his life quickly centred around Bangladesh.

In late 2014, two colleagues joined him to work together on refining the model and the payment platform, which needed to be created from scratch. At the moment, they are working on scaling the endeavour: an investor from neighbouring India has accepted SolShare for an accelerator programme, an arrangement in which start-ups receive development support for a certain period of time. If everything goes well, says Groh, the start-up coaching programme will begin as early as 2018. The vast Indian market will not only be a demanding test, but also bring unprecedented opportunities. Groh has also observed that others have now got so involved with his system that what they have done can only be described as imitation: 'There's one company in Cambodia and another in Tanzania; they're both very similar.' He laughs: 'But this also shows that the idea can't be all that bad.'



Start Up Energy Transition Award

dena invites start-ups and young companies from all over the world to apply for the Start Up Energy Transition Award with their business models and vision. A top-notch jury chose the winner for the year 2017 from over 500 applications from 66 countries. The application phase for the 2018 award was launched at the UN Climate Change Conference COP 23, which took place in Bonn in November 2017. For more information, please visit: www.startup-energy-transition.com

'There is enough energy for everyone in the oceans'

IMAGE: Kiseleva Vladislava/Shutterstock.com

Turning up the heat

TADO

It sounds a little like a dream: falling asleep in a comfortably ventilated room at night, and waking up in a well-heated room in the morning that automatically turns down the heat during the day – thereby also reducing costs and saving the environment.

What Christian Deilmann and his co-founder Johannes Schwarz have been offering for six years now via their Munich start-up Tado sounds like sorcery for many, but not for long. 'It is true that customers first need to understand the advantages of intelligent thermostats: greater comfort, savings of up to a third, and significantly higher transparency when it comes to costs,' says Deilmann, describing his company's smart heating control system. On the technical side, this works by having

customers install digital thermostats outfitted with heat sensors on their radiators and underfloor heating systems. These regulate the heating via an app while also taking into account the weather forecast, allowing them to keep an eye on the costs.

Even though the advantages are clear, the trend in Germany has been slow to catch on, or at least not as fast as it could. Despite this, Tado is growing rapidly, and more than 100 per cent annual growth is possible. 'Our greatest challenge over the past years has been developing a completely new product category and hence establishing an entirely new market,' says Deilmann. However, since Google purchased the American Tado competitor Nest in 2014 for 3.2 billion dollars, the market has begun to shift. And Deilmann is optimistic: while up to 15 per

cent of households are already utilising smart regulation for their heating systems in the Netherlands, the figure is less than one per cent in Germany. With almost 150 staff members, Tado is currently focusing on the market in Western Europe: Germany, the United Kingdom, as well as Benelux, France, Italy, and Spain. But Eastern Europe has also been part of the Munich-based company's expansion plan since the Czech energy group Čez invested 20 million euros in Tado via a venture capital fund in spring 2016. Deilmann's company is already the European market leader. Nevertheless, there is still lots of space for growth. Space that will have exactly the right temperature thanks to Tado.

Wave power

WAVECO

One could easily mistake the retired geologist and teacher Inge Bakke from the small Norwegian town of Selje for a crazy person. He is a friendly old man who at 74 years of age still wishes to contribute to the energy transition and has invented his own method of energy production. That alone is surprising in its own right. But above all, it is surprising that nobody came up with the idea before him. Bakke, who is a passionate sailor, noticed one day while passing through a fjord how much energy the ocean generated through the strong swell alone. And Bakke thought: What if we could use the energy of the ocean to generate power using a large turbine like those on wind turbines, but driven by the up-and-down movement of the water? Bakke googled. And found nothing. 'I was also surprised that nobody had thought of the idea with the turbines,' says Bakke. But he found out that he was not entirely alone with this idea: the start-up Sebased from

the Swedish town of Lysekil intends to anchor generators on the ocean floor. Waves4Power, also from Sweden, is currently developing pump systems in which the swell of the ocean pushes oil upwards in a pump, generating energy when the pressure drops. In the Finnish town of Espoo, the start-up Wello Oy has built 'The Penguin' – a device that floats on the water's surface and converts the swell into energy. And just a few kilometres away from Bakke's hometown, the team of the start-up Havkraft in Raudeberg is working on floating wind farms. But nobody had thought of Bakke's specific idea with the turbine under the swell itself. However, Bakke did not want to found a start-up of his own.

'I am an inventor, not a founder!' he says. 'Besides, I'm too old for that.' But he did not want to simply give up, either. He spoke with specialists, researched, presented his idea at conferences, and finally ended up founding a company called Waveco and submitted his invention as a patent applica-

tion in Norway. He then contacted a manufacturer of plastic pipes, with whom he developed an initial prototype, as well as major Norwegian energy groups and a few universities to whom he would like to hand over the development of his project. 'The energy companies,' says Bakke, 'are still sceptical.' In spring 2018, the University of Bergen will be teaching a course covering his idea and test Bakke's prototype in water tanks. The steps are small and oft arduous, but the direction is right. But why is Bakke still doing this at his age? The simple answer: out of conviction. 'There is enough energy for everyone in the oceans,' says Inge Bakke.

'What Germany is doing serves as a blueprint for the entire world. I hope that we can achieve the same in the USA. We just need to bring the government-driven and customer-driven energy transitions closer together.'

Tony Fadell,
Computer Engineer and former
CEO of Nest Lab, Inc., 2015

**'DON'T BLOW IT –
GOOD PLANETS ARE
HARD TO FIND.'**

Author Unknown,
quoted in TIME Magazine 1996

'We have changed our environment so radically such that we now have to change ourselves to be able to exist in this new environment.'

Norbert Wiener,
Mathematician, 1950

**'I'D PUT MY MONEY ON
THE SUN AND SOLAR ENERGY.
WHAT A SOURCE OF POWER!
I HOPE WE DON'T HAVE TO WAIT
UNTIL OIL AND COAL RUN OUT
BEFORE WE TACKLE THAT.'**

Thomas Alva Edison,
Inventor and Entrepreneur, 1931

'Business as usual is not an option. Climate protection is the greatest challenge of the 21st century.'

Angela Merkel,
German Chancellor, 2007

AT A PLACE FORMERLY USED TO CONVERT DIRECT CURRENT INTO ALTERNATING CURRENT, DENA'S CHIEF EXECUTIVE ANDREAS KUHLMANN AND BLOCKCHAIN PIONEER ED HESSE EXPLORE HOW THE ENERGY TRANSITION CAN BE LED TOWARDS SUCCESS. OLD AND NEW ENERGY, START-UPS AND DISRUPTION, ENERGY POLICY AND THE FUTURE OF THE ENERGY SYSTEM – A DISCUSSION IN THE SWITCH ROOM OF THE FORMER BERLIN SUBSTATION AMPERE.

Some energy transition obstacles need creative destruction

INTERVIEW Titus Kroder
IMAGES Daniel Hofer

Mr Kuhlmann, dena is a driving force and adviser behind the energy transition. What stage are we at in this project of the century, and what is in your opinion the largest obstacle to be overcome?

ANDREAS KUHLMANN: My initial assessment would be: the energy transition is still young. Where technologies for renewable energy are concerned, the transition is fully underway. In this respect, breakneck progress is being made. However, if we look at the next phase of the energy transition, we will see that entirely new challenges await us.

What are they?

KUHLMANN: In the future, we will be faced with the task of intelligently coordinating the decentralised components of the energy system, which are growing daily, and above all also with thinking across all sectors with respect to the energy transition. This is exactly what we are doing in the dena Pilot Study Integrated Energy Transition. This study focuses on various kinds of infrastructure, regulations, markets, and a wide range of customer groups. Developing all these aspects so that climate protection can be designed efficiently and effectively is an exciting endeavour. But it is also a complicated one. It can only be successful if we remain open to new things which could suddenly change all assumptions.

Mr Hesse, you are working on basic technology, which could indeed change everything. How do you see the future of the energy transition?

ED HESSE: The technological dimension of the blockchain is certainly comparable to a quantum leap, like the discovery of the wheel. Something entirely new will replace the old world and fundamentally reorganise it. In the future, the restructuring of the energy system will be driven by a larger number of individual players. This is because

due to digitalisation, the initiatives of small start-ups are suddenly able to keep up with the ideas of large corporations.

What platform approach do you adopt at the Energy Web Foundation?

HESSE: At the Energy Web Foundation, we are working on linking blockchain and smart contract technology. Specifically, by doing so we create a decentralised non-profit platform, which will revolutionize energy trading. At the same time, we will create the prerequisites for an electricity grid that will need to be flexible and adaptable in the future, because it will need to accommodate an increasing amount of energy from renewable sources due to the energy transition. This technology will be offered as an open source platform. This means that with this basic technology, large numbers of established companies and start-ups will be able to develop their own business models. You can picture this as a decentralised PlayStation, which we develop and make available to game developers out there. Only in this case, it is not games being developed, but business models which will shape the energy of tomorrow. This could trigger a new founding boom.

Mr Kuhlmann, on the one hand there is your pilot study, and on the other a global blockchain platform. Can intersections really exist here? Are these the fundamentals you are calling for so that the energy transition does not just develop technologically, but also economically?

KUHLMANN: As different as our working methods are, both projects are united by a bottom-up approach. We will both look at what is possible and will not just be devising a rigid future scenario which may not even occur. As I mentioned: The energy transition is still young. With the pilot study, we are searching for options in the context of what is already possible today. But we

are promoting openness to new technology and innovation. And we are optimising what already exists. Ed Hesse is preparing what is to come. And when the time is right, we will include it in our plans if it is able to boost the success of the energy transition. We are all working towards bringing about a new energy era. What you are doing there, Ed, sounds like an enormous innovative accomplishment which could enable us to make a huge leap forward. The question will be: which regulatory framework will you require, and above all if the stakeholders driving the energy system today will agree to it.

HESSE: I agree that we will have and require a regulatory framework. However, I believe that the approach of our technology will be so fundamental that it will most certainly establish itself. The question of what the supervision will look like for the resulting markets and innovation initiatives is a different one altogether. The essential advantages of the blockchain for energy and the incentives for introducing it are simply too big to ignore.



Mr Hesse, you are certainly blessed with a wealth of technological vision. For example, you promised that you will be able to eliminate 95 per cent of transaction costs from energy trading in the future. Mr Kuhlmann, you are much more focused on here and now. What does that mean for the work dena does?

KUHLMANN: Our actions are bound by a current societal and political framework. That is correct. In the work we do, we continuously deal with several thousand stakeholders from the energy sector, who are all active in important thematic areas of the energy transition; in the fields of mobility, buildings, energy production, energy distribution, and of course industry. In practice, this ranges from power plant operators to industrial entrepreneurs, wind turbine manufacturers, biogas farmers, and of course all the energy consultants. Our strength lies in bringing together all these stakeholders, identifying problems, and coming up with solutions at the interface between commerce and politics. This is where you quickly see what is feasible and what is not. Ed, you guys at the Energy Web Foundation are more technology-focused proponents of the future, for whom the energy transition issue appears easy to solve thanks to the blockchain. Of course, that is extremely challenging technically, but probably less politically complex than what we do.

Mr Hesse, what is your opinion on that?

HESSE: As a foundation which aims to help a future technology achieve a break-

ANDREAS KUHLMANN, 50, HAS BEEN DENA'S CHIEF EXECUTIVE SINCE 2015. FOR THE SECOND PHASE OF THE ENERGY TRANSITION, THE PHYSICIST (DIPLOM-PHYSIKER) IS ADVOCATING ABOVE ALL A STRONGER INTEGRATION OF THE ENERGY, INDUSTRY, TRANSPORT, AND BUILDING SECTORS, AND REINFORCING ENTREPRENEURIAL SOLUTIONS.

through, we of course need to focus less on the political feasibility in the here and now. However, the contrast between 'old' and 'new' energy is in fact important for us in order to be able to maintain our vision. I myself worked in the 'old' world of energy for a period of time. And the fact is that it is driven by people who have a different perspective on the topic of technology and the energy transition from what is often required for our solutions. Ultimately, I must say: What you do at dena, Andreas, is the more difficult job. You need to find ways to link old and new, and require a consensus that the energy transition can be built on. We are currently building something that could facilitate your task.

KUHLMANN: Now I'm all ears.

HESSE: From our point of view, politics is nothing more than a non-automated consensus mechanism. And the blockchain can automate and accelerate so many things in the world of energy that we then no longer argue about it politically – such as when smart contracts radically simplify the interaction between manufacturers and consumers on the electricity market. Each day, we see a protruding nail which we could hammer in with this technology, thereby eliminating once and for all an entire range of problems of the energy transition.

Mr Kuhlmann, politics as a consensus mechanism, is that what your world is like?

KUHLMANN: Politics is created by people. There are interests and things that need to be taken into account, and that is a good thing. But saving on transaction costs and

EWALD 'ED' HESSE, 38, IS THE CEO OF GRID SINGULARITY AND VICE PRESIDENT OF THE ENERGY WEB FOUNDATION. TOGETHER WITH THE ROCKY MOUNTAIN INSTITUTE, THE MECHANICAL ENGINEER IS WORKING ON CREATING A FOUNDATION FOR THE WIDESPREAD IMPLEMENTATION OF BLOCKCHAIN AND SMART CONTRACT TECHNOLOGIES IN THE ENERGY SECTOR.



accelerating decision-making processes – that is certainly something we could all really use. We work within a framework that is set by politics, industry, and society. But the image within this framework can be designed much better than we are currently doing.

Mr Kuhlmann, Mr Hesse's technology is an assault on the existing world of energy. How does dena deal with the topic of disruption?

KUHLMANN: This makes me think of the principle of 'creative destruction' by the economist Joseph Schumpeter. In the energy transition, we often encounter obstacles that call for creative destruction. My background is in physics, and I am infinitely inquisitive when it comes to new developments. We will certainly see disruptive developments which will aid the energy transition. Just think about LED or fracking technology. Back then we were still calling them game-changers. Digitalisation, the blockchain, but also the conversion of significant industrial processes are exciting places to be in research. Wherever we can, we at dena will build bridges. It does not matter if that turns out to be unsuccessful. Incidentally, a little disruptive action can also be helpful now and then in politics. But we should also be aware of one thing: the existing energy system has created the most reliable supply structures in the world. In light of the changes over the past 15 years, this is indeed a magnificent engineering achievement.

The model of the 'creative destroyers' - Uber and Airbnb, for example – is certainly seen critically from a socio-political standpoint. Can disruption

end up destroying too much in the world of energy?

KUHLMANN: That which brings progress is good. But not every innovation brings about progress. In terms of the energy transition, innovations are needed which help solve the existential problem of climate change and shape the related structural transition such that it helps people and creates jobs. Simply building a digital super-platform which causes the loss of numerous jobs and maximises profits for a small group – that would not be enough for me.

HESSE: That is exactly how I see it. The internet is currently extremely centralised and dominated by around ten companies. Blockchain allows for democratisation, both on the Internet as well as the digitalisation of the electricity market. A decentralised communications platform which allows for the automated transfer of value is more or less the basic building block of a grassroots democracy. This will make it possible for many parties to get involved, make monopolisation difficult, and hence create more jobs. Our technology can be used for free by anyone who has an idea. It is only when the entry threshold for a tech-

nology is so low that projects can also fail and then be re-launched in an improved version. This significantly increases the innovative capability of the energy transition.

Mr Kuhlmann, if nobody is turning a big profit, who is going to invest in the infrastructure which the energy transition so urgently needs?

KUHLMANN: This is one of the most important questions which we at dena are discussing. Our pilot study shows that some technologies have a spectacularly good run ahead of them, and will probably find it easy to find investors. It is up to us to create the necessary economic framework for this purpose. But I am convinced that this is possible. This requires us to make this tremendous dynamism of the energy transition visible and work out the opportunities that lie in the future. This is a difficult task for policymakers alone. Anyone who can help is extremely welcome.

Mr Kuhlmann, Mr Hesse, thank you for the interview.

FOR MORE INFORMATION ON THE BLOCKCHAIN, SEE PAGES 32/33.

HOW WILL THE INTEGRATED ENERGY TRANSITION WORK?

In order to achieve the 2050 climate protection targets, we require a sustainable and intelligent energy system. The integrated energy transition shows how this can be successful. The focus here is on two challenges: the growing number of energy producers and consumers from all sectors needs to be coordinated better and the various infrastructures need to be connected to create an intelligent system.

In this infographic, you will find four specific examples of how this might look in the **INDUSTRIAL, ENERGY PRODUCTION, MOBILITY and BUILDING** sectors.

In order for the changes in the individual sectors to contribute together to a stable energy system, they need to be managed via a clear **REGULATORY FRAMEWORK** which also ensures that they are embedded in **INTERNATIONAL RELATIONS**. **INNOVATIVE SOLUTIONS** can then be developed and **INTEGRATED INFRASTRUCTURES AND MARKETS** established in these sectors.

DRIVERS OF THE INTEGRATED ENERGY TRANSITION

INNOVATION-FRIENDLY REGULATORY FRAMEWORK

A further developed regulatory framework ensures reliable conditions and strengthens highly optimised solutions across sector boundaries. It includes incentives for energy efficiency and CO₂ avoidance that can be planned over the long term, and focuses on regulatory policy that is open to a range of technologies and is market-oriented.

INTEGRATED INFRASTRUCTURES AND MARKETS

In a sustainable and intelligent energy system, the energy infrastructures (electricity, gas, and heating networks as well as infrastructures for liquid energy sources) work together with digital grids to ensure the optimised coordination of energy production and consumption. This means that, for example, higher consumption at one location could trigger the throttling of consumption at another location or the delivery of more energy by another stakeholder.

INNOVATIVE SOLUTIONS AND NEW BUSINESS MODELS

The integrated energy transition requires innovative production and application technologies as much as it promotes their development. New business models are equally drivers as the result of integrative solutions in the individual sectors and across sector boundaries. One key aspect is the development of digital business models, which allow even small-scale and heterogeneous processes to be coordinated and optimised comparatively easily, in order to improve energy efficiency for example.

EMBEDDING INTO INTERNATIONAL RELATIONS

A successful management of the energy transition in Germany must be closely coordinated with the climate and energy policy of the EU member states. In addition, international collaboration for the development of innovative energy transition technologies and global markets for renewable fuels is also essential.

INDUSTRY

Demand side management (DSM)

Industrial companies regulate their energy consumption depending on the generation of electricity from renewable energy sources, thereby helping to stabilise the grids. With this flexibilisation, they contribute to a better balance between electricity generation and consumption, and hence also to the integration of renewable energy. Intelligent management makes it possible to combine the optimisation of local consumption (energy efficiency) with the optimisation of the overall system (flexibility).

ENERGY PRODUCTION

Power to gas

The sun and wind do not provide a constant amount of energy. One major challenge of the energy transition is therefore storing large quantities of energy and then making it available when required. Power to gas can play an important role here. This technology allows surplus renewable energy to be stored in the form of synthetic gas. Power to gas allows favourable prerequisites for renewable energy in other regions of the world to be used to conduct global trade with renewable fuels. This energy can then be used when insufficient electricity from renewable energy sources is available.

MOBILITY

Electric cars for transportation and energy storage

Electric cars can not only contribute to sustainable mobility: in the context of the integrated energy transition, they also serve as mobile electricity storage. They can, for example, withdraw energy from the electricity grid or a local photovoltaic installation during the day and dispense it during the night. By doing so, they contribute to a decentralised energy supply as a small part of an integrated energy system.

BUILDINGS

Networked residential buildings

In the future, an increasing number of efficient buildings fitted with a photovoltaic installation and connected to a local district storage facility will not only be energy consumers, but also energy producers. Furthermore, storage facilities installed in buildings can store electricity when too much of it is available in the grid and allow it to be used again when needed. This will make networked buildings a key component of the integrated energy transition in the future.

2050
THE CLIMATE-FRIENDLY AND
INTEGRATED ENERGY SYSTEM
OF THE FUTURE

In **CHINESE CITIES**, all climate protection measures come from city officials. Working together with partners such as dena, Chinese institutes are attempting to change the thinking of today's planners, says Nicole Pillen, who is in charge of international cooperations in the dena division for energy-efficient buildings.

Take Jingzhou for example: with 6.4 million inhabitants and located around 900 kilometres from Shanghai, the city is a major industrial hub in China's interior region. In Jingzhou, we are working with the Chinese Society for Urban Studies (CSUS), who is our link to the Chinese government. The CSUS is part of the Ministry of Housing and Urban-Rural Development in Beijing and advises the Chinese State Council and cities all over the country, including on how to do more for the environment and climate protection.

Jingzhou lies directly on the Yangtze and is suffering acutely from the consequences of the environmental pollution in China. In particular, the people living there are directly affected by the smog from the coal power plants, cars, and factories. There are many fundamental problems that neither we nor the city administration can solve overnight. Hence, the main objective here is to change the way of thinking. And to do so, we support the launching and implementation of lighthouse projects and model municipalities.

More green spaces

Jingzhou intends to become the 'National Pilot City for Eco-Cities' with our help. In China, an 'eco-city' is a city which has set itself comparatively ambitious targets for energy savings, the supply of renewable energy, in waste disposal, and in transport. Specifically, this involves efficiency measures such as initial energy audits, better monitoring during the construction phase of new buildings, green building standards, and the exemplary integration of renewable energy into buildings. For this purpose, a district with 305 new energy-efficient buildings and a total of 1.9 million square

metres of usable floor space will be built in Jingzhou. The plans are ambitious by Chinese standards: by 2020, renewable energy is expected to account for eight per cent of total energy consumption, almost double the current value. And – this is an important issue in China today – the percentage of green spaces in the city will climb to 42 per cent. With assistance from dena, a museum building will also be built according to passive house standards, in which insulation know-how and ventilation technology from Germany will be used. Furthermore, we would also like to help build a highly efficient sewage treatment plant.

Booming bike rentals

There are currently areas in China where a lot is happening: rental bikes are becoming modern, renewable energy is being developed, and many cities want to position themselves as eco-pioneers. But it is not just local citizens' initiatives that are involved. Often, it is officials from the ruling party or mayors who wish to draw attention to themselves and their city. And for them, the question of where the funds for a street tram, a sewage treatment plant, or efficient buildings will come from quickly becomes highly relevant. That is where we can establish contact with the KfW (German government-owned development bank).

We see that the eco-cities in China mostly consist of new districts and neighbourhoods. However, one big question continues to be what will happen to buildings that already exist today. Will they be refurbished? Is that even technically possible? And will the many hundreds of private apartment owners agree to that? Do they have the money? Or will these buildings perhaps once again be torn down in a few years and be replaced by a new generation of residential buildings? The life cycles are short. That is why it is so important to change the mindsets of the planners today.

NICOLE PILLEN IS THE DEPUTY HEAD OF DIVISION FOR ENERGY-EFFICIENT BUILDINGS AND IS RESPONSIBLE FOR INTERNATIONAL COOPERATION IN THE BUILDING SECTOR AT DENA.



DRIVEN BY THE CITIES

Global growth is taking place above all in urban centres: already today, more than half the world population lives in cities, and seven out of ten are expected to do so by the year 2050. Hence, ecological urban renewal

is a pressing issue in many countries. However, the challenges on the different continents can vary considerably. A closer look at two cases of urban energy transition – Germany and China.

A REPORT Marcus Franken

Looking towards 2050, **GERMAN MUNICIPALITIES** above all need to refurbish their existing buildings and involve their residents in all measures to achieve CO₂ savings of 95 per cent, reports Rolf Warschun, Head of the Environment Agency in Magdeburg.

Climate change already impacted our lives in the first decade of this century: we had floods in 2002 and 2013, and three more in between. Meteorologists are hesitant to blame these floods directly on climate change. But everyone is aware of one thing: such weather conditions are becoming increasingly frequent. This certainly contributed to the unanimous decision in the city council when voting on the new climate protection programme for the city of Magdeburg – without opposing votes or abstentions – and the overwhelming approval for the 'Masterplan 100% Klimaschutz' (lit. 'Master Plan: 100% Climate Protection').

This commitment to climate protection is not new for Magdeburg: already back in 1992, in the euphoric post-unification atmosphere, the city committed itself to implementing a particularly large number of climate protection measures. Today, we also see climate protection as a signal of sustainability, particularly towards the politically inclined and younger residents in the city. But a glance at our CO₂ emissions shows a situation similar to that at the federal level: a lot is being done, and we have also converted a large percentage of the inner city illumination to LED in order to save electricity and costs. But overall, the emissions have not declined for over a decade. That is why we need a new vigour. We now intend to launch the second stage in climate protection.

A self-sustaining model

And to do so, we also need assistance from dena: with the pilot project 'Energy-Efficient Municipalities,' we were able to come up with a management system for climate protection which will bring continuity to the work even long after the term of the project, allowing us to compile reliable emission calculations and es-

tablish working groups. Thanks to this, a self-sustaining model has been created.

Examining the source of the emissions sets the priorities for our work: energy requirements in apartments, ministries, and offices are an important issue. Our main focus is existing buildings, and in this area it is important to involve the people of Magdeburg. That is why we are creating projects which send a message: such as the energy-efficient refurbishment of apartments in the neighbourhood of Buckau, which has 5,000 residents. Here, owners are receiving federal subsidies, and we have the financial funds to communicate these measures as well. Overall, Magdeburg is in good shape where the supply of heat is concerned: In the nineties, many apartments were upgraded to gas heating systems, and a large percentage of the city is supplied via a local heat network.

A modal split of 1:1:1:1

In the development of transport, we are striving for a modal split of 1:1:1:1 – i.e. an equal distribution of person-kilometres across bicycles, public transport, cars, and pedestrians. For a city like Magdeburg that has been shaped to a great extent by the automobile, this is practically a small revolution. And I am curious to know how the discussion between the city council and residents will go. We recently had a visiting delegation from China that informed us that they simply removed the car parking lots in order to promote travel by bicycle – we cannot and do not want to do something like that.

The advantage of the current master plan concept: if we simply set ourselves the goal of being more or less CO₂-free by the year 2050, it is easy to lose sight of this target in day-to-day politics. In the master plan, we set ourselves interim goals which are reviewed regularly. Hence, we see immediately if we are on the right path where climate protection is concerned.

ROLF WARSCHUN HEADS THE ENVIRONMENT AGENCY OF THE CITY OF MAGDEBURG, WHICH WAS CERTIFIED AS A DENA ENERGY-EFFICIENT MUNICIPALITY IN 2013.

IN THE NEW LEGISLATIVE TERM, GERMAN ENERGY POLICY IS FACED WITH MAJOR CHALLENGES. HENCE, WE ASKED FOUR EXPERTS FOR THEIR OPINION: WHAT SHOULD THE FEDERAL GOVERNMENT'S PRIORITIES BE? HOW WILL WE DEAL WITH THE COSTS OF THE ENERGY TRANSITION IN THE FUTURE? AND WHERE DOES THE GREATEST DYNAMISM EXIST?

What is the greatest energy policy challenge for the new federal government?

How should the costs of the energy transition be distributed in the future?

Which trends and ideas from the energy sector are you excited about?



'We must finally stop putting off costs and obligations to the future.'

Dr Alexander von Frankenberg has been the CEO of the High-Tech Gründerfonds since October 2005, and has been active in the venture capital/start-up sector since 2000. He previously worked at an IT start-up and in various positions at Siemens.

The greatest challenge is certainly the transition to electromobility: enormous investments in charging and grid infrastructure are necessary, while incentives for buyers of electric cars should not get out of hand. At the same time, the automobile industry should be challenged, but not overwhelmed. Electromobility, above all in combination with autonomous driving, entails the risk that the most important German industry could suffer significant losses. In this regard, the federal government requires not only a great deal of expertise, but also a highly sensitive approach in an international context.

We must finally stop putting off costs and obligations for the future – 'kicking the can down the road', as the Americans say. The costs need to be borne today. When doing so, initiators, beneficiaries, and performance need to be taken into account. Under no circumstances should this be financed by debt.

Above all two aspects: for one, the marginal cost of energy will fall to zero; i.e. energy will, at least temporarily, be available at extremely low prices or entirely free, thereby opening up new areas of application. Furthermore, energy will become increasingly clean and therefore less a burden for the planet, or even none at all.



'In a digital world, it will definitely no longer be possible for us to do everything alone.'

Hildegard Müller has been Chief Operating Officer Grid & Infrastructure at innogy SE since 2016. Between 2008 and 2016, she was the Chairwoman of the General Executive Management of the German Association of Energy and Water Industries (BDEW).

Our vision is an energy system which consists primarily of renewable energy, flexibility, demand side management, and intelligent grids. Apart from the electricity sector, the heating and transport sectors also need to be taken into account. It is only through the linking of sectors – i.e. an integrated energy transition – that Germany will be able to achieve its climate targets and lead the generational project that is the energy transition towards success.

The energy transition will not be without its costs. But it is important to focus more strongly on its affordability. We contribute to this with smarter distribution grids and intelligent networks which lead to more efficiency and less strain on the overall system. However, it is also crucial that policymakers ensure electricity does not cost more than other energy sources, which is currently the case.

I am fascinated by the interaction of various industries and disciplines. In a digital world, it will definitely no longer be possible for us to do everything alone. Collaboration will increase on all levels. One particularly good example is Designetz. In this undertaking, we are working together with 45 partners from research, industry, and council services in 30 individual projects and three federal states to develop a blueprint for the energy transition.



'Consumers want to be involved in the energy transition.'

Klaus Müller has been the Executive Director of the Federation of German Consumer Organisations (vzbv) since May 1, 2014. Before that he also served as the Minister of Environment, Nature Protection, and Agriculture of the State of Schleswig-Holstein.

The vast majority of consumers support the energy transition targets. However, one major challenge is also winning over and involving consumers in the energy transition in the future. One prerequisite to achieve this is fairer cost allocations in financing and tax write-off options for the energy-efficient refurbishment of buildings.

Since 2000, the price of electricity has more than doubled. The number of exceptions to the Renewable Energy Sources Act (EEG) reallocation charge for industry has grown, and consumers are bearing the costs. Hence, it is also essential that consumers see cost reductions, such as in the electricity tax. Industry privileges must be limited, or at least financed from tax revenue.

Consumers want to be involved in the energy transition. Solar panels and electricity storage could soon become so affordable that households producing, storing, and selling a percentage of their electricity – as well as networking with each other – becomes a widespread phenomenon. However, tenants' electricity will need to be accorded equal status with the electricity produced by homeowners.



'The greatest challenge certainly lies in achieving the climate protection targets.'

Dr Christina Elberg has been the co-managing director of ewi Energy Research & Scenarios since June 2015. Before that, she held an executive position in the project management division of ewi.

The greatest challenge certainly lies in achieving the climate protection targets, i.e. in developing a suitable framework in which these targets can be achieved effectively and efficiently. One central question is also how a sufficiently high (cross-sectoral) CO₂ price signal can be designed and established.

In this regard, it is necessary that efficiency and distribution goals be addressed and/or weighed. For efficiency, the effect of incentives and governance are decisive. A CO₂ price can improve allocation, because a price tag is placed on the negative (external) effect of CO₂ emissions, thereby creating an incentive for avoiding CO₂.

Via digitalisation and smart metering, the end customer will be incorporated more strongly into the market. Space will be created for new business models and individualised services which more closely correspond to the needs of consumers. This trend is gaining attention in science and will also require economic know-how in the real world.

PHOTOS: Klaus Müller: vzbv - Gert Baumbach, Av. Frankenberg: High-Tech Gründerfonds, Hildegard Müller: innogy



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.

RETAILERS SLASH ENERGY COSTS

SHOPS AND SUPERMARKETS HAVE A HIGH ENERGY CONSUMPTION. WHAT DO RETAILERS NEED TO DO TO REDUCE IT? BEHIND THE SCENES WITH THREE RETAILERS FROM THE DENA PILOT PROJECT FOR THE ENERGY-EFFICIENT REFURBISHMENT OF RETAIL BUILDINGS.

TEXT Titus Kroder IMAGE dena/Ingo Heine

Otersen is an idyllic town in Lower Saxony. It is one of those places where, on a beautiful day, you could easily shoot an advertisement for fruit yoghurt, margarine, or pumpernickel. These products are found on the refrigerated shelves of the village shop in the 500-inhabitant settlement located between paddocks and picturesque alleys lined with lime trees. Keeping them at six degrees Celsius contributes to the just under 11,000 euros in annual electricity bills paid by the village shop, which is not profit-oriented.

'When we renovated the shop in 2011, we bought refrigeration units that were already eight years old. We have done everything possible to reduce the electricity consumption of the units, such as replacing the interior lighting with LEDs,' says Günter Lühning. He launched the 180-square-metre shop through a residents' association when the last grocery shop closed down in his home town.

Lühning, in his mid-fifties, a rugged Lower Saxon, family man, and corporate consultant at a bank, not only has to be good with figures at his day job. The village shop he operates in his free time also needs to be managed prudently in terms of energy so that the revenue covers the costs. Savings are hard to put aside for the business. On a Friday afternoon, a car pulls into the parking lot about every ten minutes, and a crate of Herforder beer and a frozen pizza

are loaded onto it. Then all is quiet again.

The residents' association purchased the 200-year-old half-timbered property seven years ago and modernised it to the latest building standards. Walls were insulated and photovoltaics were installed on the roof. 'The refrigeration equipment is currently our most pressing challenge,' says Lühning, summarising the results of the energy advice process, in which the village shop received assistance from the experienced energy consultant Marcel Riethmüller from Ecogreen Energie and Andreas Kaupp from the building technology specialist Hörburger.

Orange measurement cubes were installed for the refrigeration units in the metre cabinet. A 60-page diagnosis report now details what the sensors recorded. For example, covering the freezers at night saves 123 euros per year. Defrosting them saves another 24 euros. Replacing the last twenty halogen spot lights in the shop with LEDs will save another 450 euros.

However, compared to the old refrigeration devices, these potential savings are tiny. That is because 'a new, centralised refrigeration system would achieve savings of approximately 33 per cent,' states the report. 2,000 euros less in electricity costs per year – but for an investment of 51,000 euros which would only pay off in 26 years. Would something like that be worth it in a shop that simply wishes to stay in the black?

'It would be worth it – and I didn't

know this at first either – if we were to switch to CO₂ refrigerant,' says Lühning. In two years, retail establishments will need to switch to climate-friendly refrigerants in any case due to statutory regulations. And for such small businesses, advised the energy consultant, subsidies of up to 85 per cent would be given for doing so. Hence, the modernisation with an amortisation period of two years is a prudent investment that fits the village shop's budget. This means that the yoghurt in Otersen will soon be cooled with a third less energy consumption.

Fashionable jumpers, jeans, and blouses in the right light

Entirely different are the energy requirements of medium-sized textile chains. In this case, the most important thing is that the products look good.

That is why the branches of Mode Hell – all located in mid-sized Bavarian towns – need lots of light. Customers want to select and try on high-end off-the-rack products in the right light. 'Our main branch already requires 60,000 watts over a floor space of 1,000 square metres,' explains Michael Hell.

The entrepreneur, who is about fifty, sees himself as an 'advocate of the energy transition'. His personal car is electric, and before taking part in the dena pilot project 'Energy-Efficient Trading', he had already implemented a number of measures at the five store properties with a combined annu-



Since early 2017, dena has been running the pilot project '**Energy-Efficient Trading**'. Based on comprehensive energy advice, around 25 retailers of different sizes have been receiving assistance with reducing their energy consumption by up to 40 per cent. The pilot project is funded by the Federal Ministry for Economic Affairs and Energy and supported by numerous industry partners (Hottgenroth, Hörburger, Krumedia, Multicross, Vattenfall Wärme Europe), institutions, and associations (EHI Retail Institute, Confederation of German Retail, German Property Federation (ZIA)). More information is available at www.dena.de/non-residential-buildings

al revenue of 4.5 million euros from high-end fashion brands. He now wishes to find out what savings can be achieved through an energy advice process. He too would like to reduce energy consumption by another 40 per cent.

All that light in the store generates so much heat that Hell would probably have had to switch to selling swimwear, had he not installed a climate-friendly geothermal cooling system several years ago. From a depth of 20 metres, groundwater is pumped via pipes through the ceiling of the branch in Ampfing in order to keep the rooms at comfortable temperatures.

Hell is now considering switching the 400 halogen spot lights in each shop to energy-saving LEDs. However, he is sceptical so far. 'Savings are achieved in this technology by removing the red spectrum. That is something that we cannot have in the textile industry. A red jumper would then simply look too lifeless,' says Hell.

The refurbishment measures in Ampfing are also limited by the rural location. For example, the town has no district heating grid to which the heat could be supplied. That would also be the problem with installing a cogeneration plant, which Hell





is considering. 'What would we do with the heat in summer?' he asks.

And choosing the right option is proving difficult for the shop windows as well. Replacing the glass windows which go round the entire building with new ones would save significantly more energy. 'But that would require installing entirely new frames – resulting in a major construction project,' says Hell, and summarises the total costs: 'Lighting: 40,000 euros; a 9-kilowatt cogeneration plant: 30,000 euros; and new shop windows: 150,000 euros.'

He will know if that is really worth the effort when he receives the energy advice report.

Major grocery store client values climate protection

Oliver Veigl is light years away from idyllic village shops or a clothing chain. As the Head of Division for sustainable construction at the construction and energy consulting firm CEV, he works with the retail chain Netto to 'revitalise' the branches of one of the largest retail shop networks in Germany.

With a total of around 4,200 shops, the energy efficiency analysis takes place with military precision. On average, each branch is examined by experts from Netto and CEV every seven years. '60 per cent of the energy consumption of a grocery store comes from refrigeration equipment, and lighting and ventilation account for 20 per cent each. By replacing everything with state-of-the-art equipment, you have often achieved the energy-saving target,' says Veigl.

Taking part in the dena pilot project 'Energy-Efficient Trading' is a Netto branch in Schönefeld, south of Berlin. Energy consumption is earmarked to fall by 40 per cent at this branch. The findings of a specific energy audit are being used for the modernisation. Furthermore, tried-and-tested optimisation concepts from Netto will be implemented. In the newly designed entry area, a highly modern air curtain will be installed at the door after refurbishment, such that the interior temperature remains stable. Between-rafter insulation will reduce heating losses via the roof in winter, and prevent excessively high temperatures

in the shop in summer. Also planned are an LED lighting concept, the use of the process heat from refrigeration for building heating, and a ventilation system with heat recovery. Furthermore, the refrigeration units and freezers will be modernised and operated with natural refrigerants in future.

Modern control technology will also be used to coordinate all equipment components with each other at the branch in Schönefeld, as is the standard for all new buildings or modernisation projects by Netto. The constant monitoring will allow all systems to be adjusted as needed at a later date, allowing malfunctions and anomalies to be discovered early on. 'This will enable the supermarket to be managed extremely efficiently,' explains the energy expert.

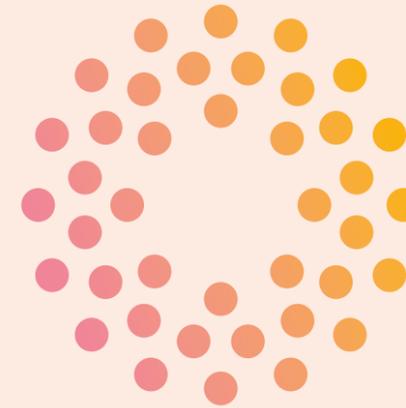
On average, a typical retail supermarket consumes 210 kilowatt hours less energy per square metre per year than most small shops. Despite this, certain problems at Netto resemble those at 'Mode Hell' in Ampfing: often, there is too much heat in the shops, for example due to the body temperature of the customers or the sun shining through the large glass panels.

A grocery store of the future will then no longer require a gas supply, explains Veigl: 'The waste heat from the refrigeration system can be used for underfloor heating, such that fossil fuel is no longer required.' Already since 2010, most Netto supermarkets have been using waste heat from refrigeration to produce heating and hot water via a heat exchanger.

But Veigl always takes one fixed rule to heart: when investments are made, the supermarkets must have lease periods of more than ten years. Anything less, and an energy-efficient refurbishment will not pay off. After all, the Netto chain is a tenant at most locations.

Ultimately, even one of the largest grocery retail chains in Germany does not calculate its figures any differently than the village shop in Otersen. 'When you purchase a yoghurt for 50 cents, you have a profit margin of perhaps three per cent. These are 'mini-cent' amounts. By saving one euro on energy costs in this context, you can then sell ten yoghurts more profitably,' says Veigl. ■

A successful energy transition becomes reality



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'WHAT WE ARE DOING NOW IS JUST THE FIRST STEP'

THE METAL PRODUCER AURUBIS AND ENERCITY INTEND TO SUPPLY THE NEW EASTERN HAFEN-CITY IN HAMBURG WITH CO₂-NEUTRAL HEATING. A COOPERATIVE AGREEMENT FROM WHICH COMPANIES, THE CITY, AND THE ENVIRONMENT BENEFIT. AND WHICH IS SLATED TO BE EXPANDED SIGNIFICANTLY.

TEXT Marcus Franken

For over 150 years, Hamburg's residents and Aurubis have been neighbours. The main factory of Europe's largest copper producer is located on Peute, an inland island in a bend on the Norderelbe river. When you climb the iron steps on the smokestacks of the copper furnace, you will see the glittering exterior of the Elbphilharmonie in the northwest. Directly adjacent to the south is the district of Wilhelmsburg, where the port workers used to live. The city and the factory now wish to become even more closely networked: 'Copper producer to heat HafenCity', wrote the Hamburger Abendblatt newspaper. 'For the very first time, an entire city district will be supplied almost exclusively with waste heat from the industry,' praised Jens Kerstan, Hamburg's Senator for the Environment and Energy.

From blast furnace to radiator

In the Aurubis factory, the furnaces glow, and liquid copper gushes out of the opening on the flash smelting furnace. As Christian Hein begins to explain, it is almost impossible to understand. 'This is where pure copper is obtained from highly enriched copper ore,' shouts the Project Director and Coordinator for Energy Efficiency and Energy Management at Aurubis, when the noise abates somewhat.

The processes taking place in the Aurubis furnaces are quickly explained: ore concentrate is made up of approximately one third copper, one third iron, and one third sulphur. This mixture is heated to over 1,200 degrees Celsius, yielding liquid 99.5 per cent pure raw copper and iron silicate after multiple process steps; the sulphur is contained in the fumes as gaseous sulphur dioxide. Aurubis sells the

products made from it worldwide. 'When we look at the emissions, such a factory in the middle of the city is of course a great challenge,' says Hein. Aurubis has invested millions in operational optimisations and filter installations over the past years. 'But for district heating, this spatial proximity is a real stroke of luck.'

After all, what can you do with all that heat? The hot exhaust gases from the flash smelting furnace have a temperature of 1,400 degrees Celsius. 70 to 80 per cent of the process steam required by the factory is now already being obtained from waste heat in a CO₂-neutral manner. However, the reaction heat from the sulphuric acid process could not be used completely to date. 'We have much less use for heat that is lower than 100 degrees in the factory,' explains Hein. But it is exactly this heat which is ideal for e.g. heating apartments.

Waste heat in the instrument mix of the energy transition

'The use of waste heat, such as at Aurubis, is a top issue in the instrument mix of the German energy transition,' explains Armin Kühn, Project Director for Energy Systems and Energy Services at dena. Companies in Germany could save around five billion euros annually through the intelligent use of waste heat, and tap into heating potential of 125 terawatt hours. Hence, the federal government is funding such projects via the KfW, and dena has chosen ten lighthouse projects from almost 100 proposals. These include the public utility Stadtwerke Gießen with Bosch Thermotechnik and Bosch KWK Systeme GmbH (heating technology and CHP), Brau-

erei C. & A. Veltins (brewing), Evers-Druck GmbH (printing), Evonik Industries (chemicals), Fahrzeugwerk Bernard Krone (truck trailers), Georgsmarienhütte GmbH (steelworks), GETEC heat & power AG, GILGEN'S Bäckerei & Konditorei (bakery and confectionary), and Nestlé Deutschland AG. 'We want to set a precedent,' explains dena project director Armin Kühn.

Aurubis is playing to the high number of new building projects in Hamburg. The new Hafen-City is currently being built on the shores of the Norderelbe, opposite the Aurubis factory, which will provide floor space of 1.4 million square metres – that corresponds to almost 20,000 average-sized apartments. Between the factory and apartments, a district heating pipeline is being built which will supply the apartments with climate-friendly heating energy and hot water.

'That,' says Christian Hein and points to the eastern section of the factory grounds, 'is where the heat is delivered.' The first of the three lines in the 'contact plant' converting the sulphur dioxide from the furnace into liquid sulphuric acid is already being put into place. The heat from the sulphur reaction can then be transferred to the water of the planned district heating pipeline in a heat exchanger. From there, it will then flow through underground, thickly insulated pipes along the Aurubis factory towards the northeast, then further on through the industrial park and along Veddeler Brückenstrasse over the Norderelbe. The pipeline is 2.7 kilometres long in total.

Using energy economically

'After the wages and salaries, the energy costs are the second-largest source of expenditure at Aurubis. We searched for a suitable client for the CO₂-neutral heat for a long time,' explains Hein. The renovations in the process and for the internal heat pipeline will cost 17 million euros; a third of this amount is being funded by the Federal Ministry for Economic Affairs and Energy via the 'Energy Efficiency

Programme for Waste Heat' of the KfW. By using the waste heat from this line of the contact plant, Aurubis will save on natural gas, the combustion of which to generate steam has resulted in 11,000 tonnes of CO₂ annually to date.

The district heating pipeline outside the factory is being built by enercity Contracting Nord GmbH, a subsidiary of the council services Stadtwerke Hannover. 'In order to compensate for the production-related fluctuations in waste heat from Aurubis, we are building a new power station on Peute. Furthermore, peak load boilers and a cogeneration plant powered by biomethane at the power station in Oberhafen have been available to balance out the difference between the waste heat generated and heating requirements of HafenCity Ost since 2014,' explains Carlo Kallen, enercity spokesperson. Hence, the waste heat from Aurubis will cover the base load heating requirements in future. Heat storage facilities with a current capacity of 300 cubic metres in the Oberhafen power station at the moment assist with fulfilling all energy needs year-round. The entire project is on the home stretch: the construction of the district heating pipeline has begun, and the hot water is expected to start flowing by the start of the 2018 heating season. The total costs of the decoupling for enercity in the context of this project amount to around 16 million euros.

But the representatives at Aurubis are planning even further ahead. So far, only one of three production lines has been utilised. 'What we are doing now is just the first step,' says Hein. The idea of converting the two remaining facilities is 'truly exciting,' he says. However, the challenges for building another connecting pipeline would be immense: the pipeline towards the city centre would need to pass through one of Hamburg's main transportation routes behind the bridges over the Elbe. The federal government would also need to provide funds for this. However, 'doing so would save up to 140,000 tonnes of CO₂ annually,' enthuses Hein. He hopes that the necessary decisions will be made by the end of 2018. ■

From big data to smart contracting

THE DIGITAL REVOLUTION IS FULLY UNDERWAY. SENSOR TECHNOLOGY, CLOUD COMPUTING, APPS, ROBOTICS, DATA ANALYSIS, ARTIFICIAL INTELLIGENCE, HIGH STORAGE CAPACITIES AND PROCESSOR PERFORMANCE HAVE BECOME AFFORDABLE FOR COMPANIES. THIS MEANS THAT DATA-DRIVEN BUSINESS MODELS WILL BECOME INCREASINGLY WIDESPREAD. DIGITALISATION IS ALSO SHAPING THE ENERGY TRANSITION. AFTER ALL, MARKET-READY DIGITAL TECHNOLOGIES SIMPLIFY, FOR EXAMPLE, THE CONTROL AND CONVERSION PROCESSES IN AN INTEGRATED ENERGY GRID WHICH NEEDS TO ACCOMMODATE AN INCREASING AMOUNT OF RENEWABLE ENERGY SOURCES. WE PRESENT A NUMBER OF TRENDS IN DIGITALISATION.

Smart meter

An energy counter that records energy consumption and displays the resulting costs in real time, e.g. on a monitor or in an application on a mobile device. Smart meters help private households and companies to shift electricity consumption to times of the day when energy is cheaper. In turn, producers and grid operators can use the real-time data to develop price models and manage the load on the grid. Hence, smart meters are a crucial component of intelligent electricity grids.

BIM

BIM stands for Building Information Modelling, a digital planning and coordination tool for construction projects. Corresponding software solutions also allow for the centralised monitoring of data across the entire life cycle of a building. Particularly during the building phase, BIM can contribute to increasing adherence to deadlines and budgets, as well as planning quality. For example, energy flows in a building or various efficiency standards can already be simulated early on. At the same time, the energy-saving effects of structural changes can easily be represented and observed holistically. At the heart of such applications is a high-resolution, digital 3-D model of the building, in which all details can be managed and all relevant data and dimensions are stored, such as the dimensions of the ventilation system.

Big data

Large quantities of digital data provide additional findings and insights by the use of analysis software. Big data analyses can for example help in optimising the business workflows of energy companies and studying the behaviour of energy consumers in detail. This information can result under certain circumstances in the creation of new business models. In the electricity grid of the future, feed-ins from decentralised producers such as wind farms will produce an increasing amount of data. Evaluating this information through big data analyses will provide the basis for controlling complex workflows and for the stabilisation of the electricity grid when the percentage of volatile energy sources grows.

Internet of things

An increasing number of daily objects are being outfitted with processing capacity and software that allows them to communicate with each other. For example, in the energy sector, gas and electricity grids can be controlled in a 'smart' manner with the help of digital sensor technology. Practically every single component used in an integrated energy system – from cogeneration plants to heat pumps, electric cars, wind turbines, and even biomethane fermenters – needs to be able to coordinate its actions with the other components. Hence, the Internet of Things is one of the most important building blocks of integrated energy systems.

Artificial intelligence

Software technology that makes it possible for machines to 'think' and 'act' autonomously. The base technologies are machine learning, speech recognition, and text and sentiment analysis. Complex AI solutions exhibit characteristics of human behaviour, such as the weighing of risks based on acquired real-world knowledge, and reacting accordingly. In the energy sector, artificial intelligence can be used in the self-management of electricity grids. Weather information can be utilised by 'thinking' algorithms for example to determine the feed-in quantities from solar power systems for the subsequent 48 hours.

Smart homes

Office buildings, residential buildings, or apartments which are able to 'think' in a context-sensitive manner thanks to a combination of innovative building technology and software. For this purpose, optical sensors and temperature probes measure, such as energy consumption, exterior and interior temperatures, current lighting conditions, and the current usage density of workspaces at various locations on a piece of property. This data is linked to each other in such a way that the installation equipment works optimally with the necessary energy consumption. Smart home technology enables the building users to interact with the technology via digital interfaces at the same time, thereby allowing individualised management. One practical and unique feature of smart homes is the intelligent linking of production and consumption. This allows for instance the electricity generated by photovoltaics to be used directly for electric vehicles.

Blockchain

An enabling technology which documents the digital exchange of information in a decentralised and forgery-proof manner. This eliminates the need for centralised data records. In the energy industry, the blockchain is perfectly suited for billing systems, such as between electricity producers and consumers in a microgrid. But maintenance procedures, feeding-in documentation, and information on origin can also be documented using this technology.

Smart contracting

In combination with the blockchain, an automatic billing for energy quantities for example will become possible. Smart contracts are self-triggering software programmes which could be used e.g. in energy grids, where they autonomously launch billing, payment, and documentation procedures. Local energy producers, such as a private wind turbine, could then sell their electricity directly to a local consumer – such as a customer at a charging station for electric cars – and immediately be credited the corresponding value via a smart contract.

When a farmer in Leinfelden-Echterdingen or the Uckermark shovels maize chaff into the fermenter and then pours in liquid manure, microbes immediately cause valuable gas to start bubbling out. After removing the water, carbon dioxide, and hydrogen sulphide, the resulting biomethane is directly fed into the natural gas grid.

Wind and sun have their 'darkness and lull periods'. Biomethane, on the other hand, is the consistent driving force behind the energy transition which can jump in when the rotors in the fields in Brandenburg stand still or the skies above the Saarland are grey and gloomy.

Its widespread use can result in significantly lower nitrogen oxides and particulate emissions in Germany, for more climate-friendly passenger cars, lorries, and ships – and it is also an ideal fuel for local and district heating grids.

'Currently 207 installations in Germany supply more than nine terawatt hours of biomethane each year. This is approximately two per cent of the electricity, heating, and fuel output obtained from renewable energy sources. That is respectable, but there is a lot of room for expansion,' says Matthias Edel, dena's resident biomethane expert.

Great potential – but market development is difficult

For rapid development, this multi-talent among renewables requires additional funding and a solid international framework.

'But the trend is currently moving in the opposite direction. The feed-in remuneration for renewable electricity was recently reduced even further. What Germany lacks so far is a special quota – which is also subsidised by the EU – for particularly eco-friendly fuels as part of the quota for the reduction of greenhouse gases. It would give the market much more momentum,' says Edel.

At the European level, the gas is often produced on a large scale at places where it cannot be used. Of the current 490 production facilities in the EU, around 330 are located in three countries: Germany, Sweden, and the United Kingdom. 'But we are still far away from a unified EU biomethane market, which could use the well-developed European gas grid as a gigantic storage system and marketplace,' says the dena expert.

Harmonised registers and standardisations are needed

So what needs to happen? Information on biomethane production in Europe to date is not comprehensive, and where information is available, it is often not comparable to data from other countries. 'Hence, each EU country requires a register that makes

the local producer landscape transparent, standardises both the quality and quantity of biomethane feed-ins, and keeps documentary records of them. Only by doing so will it be possible to trade this raw material internationally,' says Edel.

To date, dena has maintained the German Biogas Register, and at the same time cooperates with similar registers in Denmark and Austria – a possible model for a future EU-wide system that links the national registers.

Furthermore, the European natural gas network needs to become a mass storage system for the feed-ins of all 27 EU countries. It will only be able to fulfil the role of a unified marketplace when the subsidy models and calculation methods of individual EU member states are coordinated with each other, which has not been the case so far.

'Biomethane will always be a supporting actor in the energy mix, but it will have a significant supporting role,' says Edel. After all, the domestic supply of this raw material is sufficient to replace around a tenth of German natural gas consumption with biomethane by 2030. This is equivalent to filling the tanks of more than twelve million cars annually, or electricity for 12.5 million four-person households.

But in order to achieve this, policymakers will need to create a suitable framework at both the national and EU levels. ■

Further information is available at www.biogaspartner.de/en and www.biogasregister.de/en

Biomethane – stepping on the gas

Biomethane is an important component of the energy transition. But why does this versatile gas obtained from organic matter and liquid manure exist in the shadows? A better market framework – both nationally and internationally – could solve the problem.

TEXT Titus Kroder

CLEANER DRIVING

For years, greenhouse gas emissions from road freight transport have been growing disproportionately. Hence, it is high time for alternative forms of propulsion and fuels which reduce CO₂, particulate emissions, and noise.

TEXT Sarah Buch

A number of lorry drivers from Meyer Logistik wear goggles and gloves when refuelling, both in summer and in winter. This is because 20 articulated lorries from this family-run company from Friedrichsdorf in the Taunus region run on liquefied natural gas, or LNG for short. The liquefied natural gas is cooled down to minus 161 degrees Celsius. It is one of the alternative fuels which could replace diesel in the future – and requires protective equipment to be worn when refuelling.

For Matthias Strehl, Managing Director of Meyer Logistik, the sub-zero temperatures are not a problem. In 2016, the company invested in the technology with support from the Federal Ministry of Transport and Digital Infrastructure (BMVI). 'Our articulated lorries consume up to 18 per cent less fuel with LNG than conventional diesel lorries which fulfil the Euro VI standard. Because the fuel is also significantly cheaper, I expect an amortisation period of less than two years,' says Strehl, explaining the economic advantages. 'Furthermore, we also plan to save 50 tonnes of CO₂ per vehicle with the current LNG fleet by 2022.'

Overwhelming advantages, insufficient information

Compared to diesel, LNG is a much better fuel. Lorries with a liquefied gas engine emit up to 37 per cent less nitrogen oxides (NO_x) and generate up to 43 per cent less noise. LNG also reduces up to 90 per cent of particulate emissions during transport. Composed mainly of methane, LNG contains a quarter less carbon than diesel. This means it burns cleaner and generates less emissions.



But few companies are familiar with the advantages of LNG. Marcus Trommler, Team Leader for Renewable Energy and Mobility at dena, recognises the necessity for increasing awareness. 'In order to convince more fleet operators to use LNG, policy-makers need to advertise it more and build confidence in the technology – similar to electromobility.'

Chicken-and-egg dilemma on the market

Apart from insufficient awareness, there also exist additional reasons why this alternative fuel has not established itself on the market so far, explains Trommler: 'This is a classic chicken-and-egg dilemma. So far, there are almost no forwarding companies with LNG lorries. This is because the companies go by the offerings at petrol stations. But the operators of the petrol stations require a minimum daily LNG turnover so that the location can cover its costs. So far, this is rarely the case – precisely because there are so few forwarding companies which utilise LNG lorries.'

Due to the stiff competition, forwarders are also under enormous cost pressure. 'When switching to LNG, entrepreneurs first need to invest in the vehicles,' explains the dena team leader. The costs could pay off through the low fuel price – but, with low diesel prices, there is hardly a company willing to take the risk.

Until now, that is, as a result of the debate on banning diesel vehicles in German city centres, logistics companies are now searching for other solutions. LNG presents itself as a viable alternative on the market – despite the protective clothing and goggles. ■



A task force for LNG

Together with the German Association of Energy and Water Industries (BDEW) and the Zukunft ERDGAS initiative, dena founded the LNG Taskforce in 2015. Its goal is to convince industry and political stakeholders of the advantages of this alternative fuel and to further develop the German LNG market. Their first success: the energy tax relief for natural gas and biomethane as fuels was extended up to the end of 2026. Furthermore, the LNG Taskforce is releasing a catalogue of recommendations for future market development, so that the new federal government will be able to accelerate the expansion of LNG.

MANY STAFF MEMBERS AT DENA NOT ONLY WORK IN BERLIN, BUT JOURNEY ALL OVER GERMANY AND THE WORLD IN THEIR MISSION TO DRIVE FORWARD THE ENERGY TRANSITION. FIVE OF THEM TELL OF THE EXPERIENCES THEY HAVE HAD.



MINIGRID DRAWS A CROWD
Felix Schmid

We recently put a minigrid into operation in a very remote region of India, in the small village of Sarvantara, which was previously not connected to the electricity supply. Shortly before activating the grid, we performed a test by turning on a light and a fan in a small house. The outdoor temperature was 50 degrees. This attracted a lot of interest: the house quickly filled up with people who wanted to watch and be refreshed by the cool air from the fan.



HEATING WITH THE WINDOW OPEN
Lina Uzsilaityte-Schulte

Our training course for energy specialists in Kazakhstan brought us into contact with extreme weather experiences: minus 30 degrees and a lot of snow. The frigid climate offers great potential for a more efficient use of energy. That is because the people in Kazakhstan usually heat intensively due to the cold and the poorly insulated houses. And because energy is extremely cheap, people also like to leave a window open for ventilation. That is why it is all the more important to groom an initial generation of energy managers with an awareness for an efficient way to use energy.



NO CASH
Ang Ye

When I am in China on business for dena, we usually exchange cash currency in advance. For some time now, this has resulted in some amusement among our business partners on location, because almost all monetary transactions are now carried out in a cashless fashion in China – whether at a kiosk, the supermarket, or an airport ticket counter. The Chinese find our obsession with cash a little old-fashioned.



**REFURBISHMENT EXPERTS
PROVOKE POLICE INTERVENTION**
Bastian Stenzel

Convincing building and apartment owners of the advantages of an energy-efficient building refurbishment is always a challenging affair. However, the target groups of our pilot project in Ukraine need particular convincing. At the first on-site meeting, the residents were so unsettled by the refurbishment experts who examined the buildings that they initially called the police. It was only with detailed information about the project that these residents could be convinced of the advantages – the fabled 'aha' effect after a police intervention.



ENERGY MADE VISIBLE
Julian Elizalde-König

As part of our project on the topic of demand side management, we were searching for flexibilisation potential in the electricity usage of industrial companies. Energy-intensive companies such as aluminium mills or cement factories generally have high, flexible loads, which is why we initially analysed large-scale consumers of electricity and/or energy. It is often hard to imagine how large the energy quantities are, because energy is after all invisible. But I experienced an exception in the dead of winter at a factory tour in Baden-Württemberg. In the middle of the snowdrifts there was a location completely free of snow and dry on the factory grounds: around the rotary furnace, the enormous energy consumption and the resulting heat generated created an almost Mediterranean microclimate.



DENA ON TOUR

PHOTOS (from left): Anatoli Styf, Vasily Gureev, Jiangdi, FCG, OlegDoroshin; All: /Shutterstock.com

PORTRAITS: dena

A journey of a thousand miles begins with a single step

A YOUNG COUPLE PURCHASES A HOUSE FROM AN OLD LADY. THE ROOF IS LEAKY. IT IS HEATED WITH ELECTRICITY. FUNDS FOR REFURBISHMENT ARE LIMITED. THE ENERGY CONSULTANT MAKES THE BEST OF IT.

TEXT Marcus Franken PHOTO Fabian Schubert

Jan Krebs takes the exit 'Dortmund Stadion,' drives into the Bittermark district, and parks his VW Up! in an estate that could not be more typical of the Ruhr region. Single-family terraced houses are all neatly arranged in rows, and the estate in the south of Dortmund stretches across the hills. 'The city forest is just a few hundred metres away,' says Krebs. The consultant from Energieeffizienz Hochbau in Dortmund is on his way to meet Christian Wockenfuss and Annkathrin Spelz to hand over his final energy consultation report. Bittermark is one of the most popular residential areas in the city. Even a few professional players from German football club Borussia Dortmund (BVB) are said to live here.

Wockenfuss, 28, is a fan. He has had the letters 'BVB' in a cloud of ornaments tattooed on his left calf. 'I am a Dortmund boy,' he says, laughing. Wockenfuss has had the BVB season ticket for 'die Süd', the largest standing grandstand in European football, for eleven years. The house he is currently renovating, on the other hand, has only been in his possession for less than eleven months. He and his girlfriend Annkathrin, 27, intend to move in by Christmas.

Energy-efficient refurbishment not the only challenge

Even though the atmosphere is positive, the young couple has a lot to worry about: moving out of a shared studio apartment,

new furniture and fittings, a huge loan from the local savings bank. And they also have their jobs. Just thinking about all this would cause most couples to break out in a cold sweat. How important can energy savings and climate protection be for such a couple along with everything else?

'Well,' admits Wockenfuss, 'it has to be a good fit. Technically and financially.' In order to ensure that good fit, energy consultant Jan Krebs has tailored an individual refurbishment roadmap for the couple. 'It would not make sense for us to describe the ideal energy-efficient dream house, and then the client does not follow the plan because it does not correspond to what he wants or to his means,' says Krebs, and places his work on the temporary meeting table: a modest stack of paper – the result of detailed consultations, summarised concisely in text and images.

The photo of the property is on the front page: mid-terrace house, built in 1976. 'It was clear that a number of things needed to be done,' says Krebs, who is listed as an energy consultant in the Database of Energy Efficiency Experts for Government Subsidy Programmes. The false ceiling on the upper floor was slightly mouldy due to damp damage from the flat roof. And the electricity bill of the previous owner was 400 euros per month in winter. 'The house was heated with night storage heaters, and the 89-year-old liked it warm,' explains Krebs. A common case. For the expert, this meant that the agenda was more or less clear:

insulating the roof and exterior walls, new windows and a new heating system, perhaps even pellet heating or a heat pump. And in addition a ventilation system, ideally with heat recovery. But the client wanted something else entirely.

Setting priorities and incorporating requests

'A solar power system and a battery storage system for our own supply of electricity,' says Wockenfuss. In addition, he wanted a gas heating system, because the pipeline from the Dortmund council services was located directly at their door and was offering a limited-time preferential rate for new connections: 600 euros instead of 2,200. Furthermore, he wanted new light domes in the hallway and the bathroom of the upper floor, and 'a wood-burning fireplace in the living room'.

However, the refurbishment measures ultimately also needed to suit and build on each other, which is why Christian Wockenfuss and Annkathrin Spelz consulted an expert. And energy consultant Jan Krebs knows that a journey of a thousand miles begins with a single step. Thus he adapted the ideal blueprints to their wishes and adjusted them to take into account KfW funding options: 'Over the long term, we will reduce the CO₂ emissions of the old house by more than 90 per cent. But let us begin with 50 per cent.'

Energy consultant Krebs: 'Over the long term, we will reduce CO₂ emissions by more than 90 per cent.'



iSFP – More time for the important things

The findings of an energy advice process presented in an understandable and easy-to-compile report – the individualised refurbishment roadmap ("individueller Sanierungsfahrplan", iSFP) makes this possible. 'This new instrument makes day-to-day work easier for energy consultants,' explains dena team leader Katharina Bensmann. With this tool, two reports are created for the homeowner, practically with just a single click. Over eight pages, the refurbishment roadmap summarises the planned measures step by step. The implementation aid then explains them in greater detail without getting lost in the technical details. Furthermore, a clear structure using a familiar colour scale from red to green makes it easier for the energy consultant's client to maintain an overview of the entire process. Furthermore, dena also provides a range of checklists for implementation, a brief guide, and a manual for energy consultants which serve to assist the experts with their work. More information is available at www.dena.de/service-for-experts

In the cellar, the connections for gas have already been installed, the gas condensing boiler has been chosen, and a new roof commissioned. And the overhang for the insulated flat roof will be built from the very beginning such that a future insulation of the exterior walls can easily be performed. 'Because it is a mid-terrace house, the insulation of the exterior walls does not have the highest priority,' says Krebs understandingly. The ventilation system with heat recovery and damp control will also need to wait. On the other hand, the client Wockenfuss has allowed himself to be convinced that a photovoltaic installation on the small flat roof would be a nice thing to have, but not cost-optimal at the moment. The energy consultant and the young couple appear satisfied with the results, which now exist in the form of two compact booklets: the refurbishment roadmap and the more detailed implementation aid. The energy consultant can easily generate and print out the two clearly laid out documents as pdf files with a single click in his accounting software. 'As a consultant,

the software tool and compact report print-out allow me to save hours of work that I can put to better use working for the homeowners,' says a pleased Krebs (see info box).

A brief, understandable report

The format is important: 'It is well structured. It is so clear that even I understood it,' says Wockenfuss with self-deprecation while standing in the future living room with his consultation report and the implementation aid. On a single page, his refurbishment roadmap indicates all steps that are to be performed in the future: after the current refurbishment, it is anticipated that the cellar ceiling can be renovated in five years. Following that, the exterior walls. At some point in the future, the fireplace will be built into the living room. And the heat recovery and photovoltaic systems also appear in the refurbishment roadmap. Wockenfuss now only has two more wishes: that he will be able to celebrate Christmas in his new home. And that BVB win the championships. ■

NETHERLANDS

**SERIAL REFRUBISHMENT:
IS IT TIME TO 'GO DUTCH'?**

Initiated by dena, a delegation of 20 experts travelled to the Netherlands in September 2017 to inform themselves about the possibilities of serial refurbishment. Participants included representatives from the housing industry, construction industry, Federal Ministry for Economic Affairs and Energy, housing associations, and dena's Chief Executive Andreas Kuhlmann.

The delegation visited an apartment building and an estate of terraced houses which had been refurbished as part of the Dutch initiative Energiesprong. During serial refurbishment, buildings are completely modernised by a single provider. Industrially manufactured prefabricated components are used for this purpose. Buildings refurbished using serial manufacturing methods differ from other offers due to the lower costs and a very short refurbishment duration of approximately three to ten days, among other things.

In the Netherlands, this process has been used successfully for some time now. The participants of the delegation discussed the extent to which serial refurbishment could also be implemented in Germany. dena is exploring the options of this approach in the project 'Serial refurbishment of apartment buildings,' which is being implemented in collaboration with the construction and real estate industries with support from the Federal Ministry for Economic Affairs and Energy.

More information is available at www.dena.de/energiesprong and www.energiesprong.eu

CHILE

**RENEWABLE ENERGY
FOR A HOTEL IN CHILE**

Chile possesses great potential for the use of solar energy. Located far away from the public electricity grid, the Tierra Atacama Hotel & Spa in the Chilean Atacama desert is taking advantage of solar energy. In October 2017, the operators inaugurated a new photovoltaic installation including a battery storage facility.

The heart of the project is the intelligent energy management solution which manages the combination of a photovoltaic system, storage facility, and existing diesel generators such that the hotel will be able to turn off its diesel units entirely for eight to nine hours during the day and several more hours during the night. The project by the German companies Kraftwerk Renewable Power Solutions and Qinous is supported by dena's Renewable Energy Solutions Programme (dena RES Programme). Funded by the Federal Ministry for Economic Affairs and Energy, the programme offers German companies from the renewable energy industry the opportunity to realise reference projects at representative locations overseas.

More information on the RES Programme is available at www.dena.de/res-programme



KAZAKHSTAN

**PRESIDENT OF GERMANY AT THE
DENA GERMAN ENERGY DIALOGUE**

In July 2017, German President Frank-Walter Steinmeier attended the German Energy Dialogue organised by dena as part of EXPO 2017 in the Kazakh capital of Astana. He welcomed the fact that Kazakhstan had set itself ambitious targets for the transition to renewable energy sources.

German know-how could contribute to their implementation, as Germany already possessed experience in the modernisation of energy production and supply. 'Germany would like to be a long-term, committed, and reliable partner to Kazakhstan,' said Steinmeier. At the two-day event, around 200 guests and 80 speakers from the energy, industry and commerce, construction, plant construction, mobility and renewable energy sectors had the opportunity to discuss energy-relevant topics and form networks.

For more on the topic, please visit: www.dena.de/en/newsroom/energy-efficiency-in-kazakhstan

GERMANY

**TOWARDS A
GLOBAL ENERGIEWENDE**

At the Berlin Energy Transition Dialogue (BETD) in March 2017, decision-makers and experts from 80 countries discussed ways of securing the world's future energy supplies. The common goal is fulfilling the Paris Agreement. But each country is confronted with different challenges.

BETD 2017 provided the over 2,000 political, economic, scientific, and civil representatives with the opportunity to learn from each other, tap into synergies, and shape a secure and sustainable global energy supply. dena was responsible for organising the BETD in collaboration with the German Renewable Energy Federation (BEE), the German Solar Association (BSW-Solar), and eclareon.

Before and after the individual conference events, dena offered the participants from all over the world an interesting supporting programme. For example, business-to-government dialogues allowed German companies to discuss investment terms in the areas of renewable energy and energy efficiency directly with high-ranking minister delegations from Iran and Colombia. Furthermore, numerous guided tours offered the international experts and participants of the BETD the chance to find out about innovative energy companies and energy projects in Berlin and the surrounding area.

For more information, please visit: www.energie2017.com and www.dena.de/betd2017

DENA INTERNATIONAL

UKRAINE

**ENERGY-EFFICIENT REFRUBISHMENT:
PILOT PROJECT IN UKRAINE**

How can residents of apartment buildings in Ukraine be motivated to perform energy-efficient refurbishments? And how can doubts related to the financing or the implementation of the construction measures be assuaged? These questions were the focus of a seminar organised by dena in collaboration with its project partners in Kiev in March 2017.

The attendees were building owners participating in the dena pilot project 'German-Ukrainian energy-efficient houses'. As part of the pilot project, 20 apartment buildings were slated to be comprehensively modernised. The status-quo assessment of the buildings is complete, and most of the refurbishment concepts have been compiled. Now, the focus of the seminar was on communicating with the residents of the buildings, who in Ukraine are also their joint owners.

For more information on the pilot project, see www.dena.de/german-ukrainian-pilot-project

PHOTOS: F.-W. Steinmeier: dena/Amir Saparov, K. Haverkamp: Roscongress/Alexey Danilkin



RUSSIA

**DENA'S MANAGING DIRECTOR AT
THE RUSSIAN ENERGY WEEK**

dena's Managing Director Kristina Haverkamp advocated the further development of the Russian funding system for energy-efficient refurbishment during a visit to Moscow in October 2017.

In her speech, Haverkamp spoke of the experiences in Germany and presented recommendations for the existing funding programme, which had been drafted by dena in collaboration with the Russian Ministry of Energy. In addition, the Managing Director of dena also spoke about the challenges of sustainable, energy-efficient urban development in Moscow at a meeting of mayors from all over the world, and presented dena's energy and climate protection management system.

ACCOMPLISHING A REVOLUTION WITH VOLTS AND AMPERES

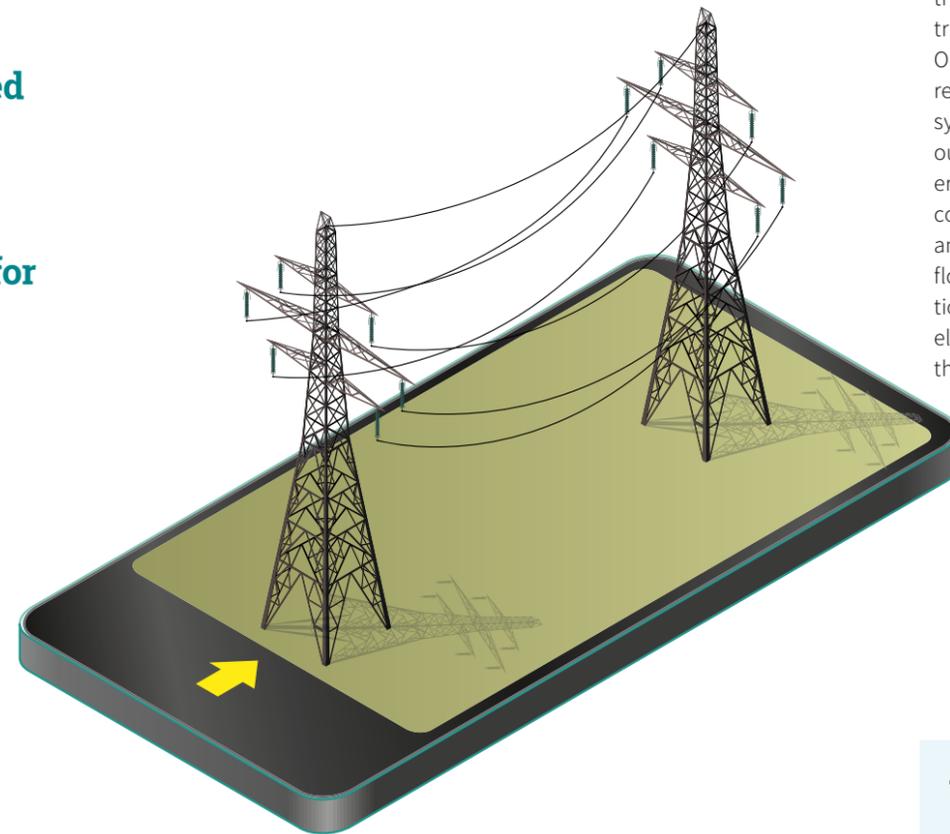
If the energy transition is to succeed by 2050, innovative electricity grid concepts are needed. However, development has stalled at important junctures. Five central challenges for the electricity grid of the future.

1 Acceptance by citizens is crucial

The expansion of the electricity grid is lagging behind the renewable energy revolution. In order to transport wind-generated electricity from northern Germany to Bavaria and solar power from the south in the opposite direction, we require enormous investments in the transportation grid – e.g. in north-south power lines. A national grid development plan has existed since 2012. This means that everyone knows what needs to be done – grid operators, regulatory authorities, and producers. However, policymakers are making slower on-site progress than expected. Campaigning for more support for the electricity transition is a task that involves society as a whole, from the federal government to local politics.

3 The regulatory framework needs to strengthen grid flexibility

In Germany, the grid operators are regulated as individual regional monopolies. The Federal Network Agency determines what returns are allowed to be obtained on which of the company's investments. For investments in intelligent grid management, such as for the lower grid levels, no strong incentives exist. The reason: regulatory authorities have only permitted significantly smaller returns for such smart solutions than for conventional grid technologies. But without these solutions, the grid will not be ready for the future.



2 The grid needs to become intelligent 'in depth'

The uppermost layers of our electricity grid – the 36,000 km long transmission grid and the 97,000 kilometre long high-voltage grid – are already highly controllable. However, in this respect, more partially automated management and coordination with other grid levels are necessary. In the medium- and low-voltage distribution grids, which lead up to sockets in homes, there exist additional challenges. Measuring 1.6 million kilometres, these distribution networks require better load and consumption management, and hence more measurement sensors and intelligent control technology. This is because the complexity will increase even further when private heat pumps, local cogeneration plants, and car charging stations are connected to the lower grid levels as new participants.

4 Grid stakeholders need to expand their collaboration

Transmission system operators, distribution system operators, and electricity producers need to decide how they wish to cooperate in the future. What used to be 1,000 megawatts flowing out of a large-scale power plant and directly into the transmission grid is now 200 to 500 wind turbines that feed into the lower grid level in a decentralised fashion. In light of this, how should the flow of information in the overall grid be regulated so that the electricity always flows to where it is needed? One possibility: the transmission grid level reports its requirements to the distribution system operator, which then assembles this output from its network of providers. Another option: the transmission system operator communicates directly with the producers and only informs on the distribution level flowing through their grids. A crucial question that needs to be answered soon if the electricity grid is to function seamlessly in the future as well.

5 The electricity grids need to collaborate internationally

The EU recently passed regulations which will govern load and consumption management in electricity grids as well as their operation in the member states in the future. One thing is certain: a centralised, EU-wide management of the electricity grids is not sensible. That would be too complex. It is all the more important that the EU implements and further develops the recently introduced regulations.

PORTRAIT

Storage facility researcher with a passion

POWER TO GAS IS A KEY TECHNOLOGY OF THE ENERGY TRANSITION – AND THE SCIENTIST DR DORIS SCHMACK IS ONE OF THE MOST PROMINENT RESEARCHERS IN THIS FIELD. WITH HER PRACTICAL EXPERIENCE AND KNOWLEDGE SHE SUPPORTS DENA'S POWER TO GAS STRATEGY PLATFORM.



In the mid-eighties, Doris Schmack witnessed the failure of the reprocessing facility in Wackersdorf, and along with it the nuclear closed loop recycling management. 'That greatly shaped my thinking on the energy supply,' says the woman from Upper Palatinate, who at the time was about to take her school leaving examinations, and had a voracious appetite for physics, biology, and chemistry.

Today, she holds a PhD in chemistry and is one of the most high-profile researchers and entrepreneurs in the fields of biogas technology and storage facility concepts in Germany. As the Managing Director of the Viessmann subsidiary MicrobEnergy GmbH, she develops power to gas technologies. They are meant as a solution to the reducing of greenhouse gases in all sectors and for a key problem of the energy transition: finding suitable storage technology for the increasingly volatile supply of electricity of the future from solar modules and wind installations.

'We are taking advantage of what microbes have already known for thousands of years,' says Schmack, who is working on the development of the key technology with a team of twelve. The principle: surplus electricity is converted into hydrogen via electrolysis. Process flows optimised by MicrobEnergy and a special selection of microorganisms convert the gas into methane at approximately 60 degrees Celsius via the addition of carbon dioxide. The flammable gas can be immediately injected into the gas grid or stored. From there, it is then transported to facilities which convert it back into electricity when it is needed – or to biomethane filling stations in order to enable 'green' mobility.

Doris Schmack's Audi A3 already runs on biomethane – which her company produces itself. ■

More information about the Power to Gas Strategy Platform is available at: www.powertogas.info/english

The streets of Bacharach meander under the towering sandstone towers of the old Werner Chapel. In the evening, yellow light flickers over the cobblestones and the Rhine flows so picturesquely below the half-timbered houses that even romanticists 200 years ago were captivated by it. 'World Heritage Site,' says Gunter Pilger, who works as a volunteer deputy mayor for his town.

Pilger is proud of his picturesque town of Bacharach. A travel magazine chose the small town with its characteristic walls and vineyards in the Rhine valley as the top pick among the 'most beautiful small towns in Germany'. And that is a good thing: 'We live from tourism to the Rhine region here,' explains Pilger.

But it is also a bad thing: The season is only seven months long, and the coffers of the local community are empty. And as part of the 'UNESCO World Heritage Site Upper Middle Rhine Valley,' the maintenance of the town is a costly affair. Pilger needs to save wherever he can. Even on energy costs.

Master plan for the Rhine valley

115,000 kilowatts of electricity are consumed by the 374 old mercury vapour lamps alone each year. The town pays almost 25,000 euros in electricity bills for this. Pilger knows that he could drastically reduce the running costs of the municipality if he were to replace the old lamps with LED lighting. He would need to do so anyway, as the EU has forbidden the sale of mercury vapour lamps due to their low energy efficiency. LED lighting would be the best alternative.

But the 'Master Plan: Light for the Upper Rhine Valley' also requires that the town, as a World Heritage Site, keeps the light as it would have been in the Middle Ages: warm and yellow. This is not available off the shelf for LED technology. In this case, it is not just a few bulbs that need to be changed, but in addition to the lamps themselves, entirely new inserts will need to be procured which direct and concentrate the light. The total costs amount to over 150,000 euros. And a town such as Bacharach has neither the

'There is no catch'

18 MONTHS FROM THE IDEA TO IMPLEMENTATION: A TOWN ON THE RHINE REPLACES ITS OLD STREET LIGHTING WITH LEDS THAT FULFIL MONUMENT PROTECTION REGULATIONS WITH DENA'S HELP AND SAVES SEVERAL THOUSAND EUROS IN RUNNING COSTS EACH YEAR. A REGIONAL COOPERATIVE MANAGES THE WORK AND INVESTMENTS. THE MODEL IS EXPECTED TO SET A PRECEDENT.

TEXT [Marcus Franken](#)

IMAGE: Babich Alexander/Shutterstock.com

funds to purchase these new lamps, nor the experts to independently implement such a project. Pilger requires a partner. Hence, it was a stroke of luck when he received an email with the cryptic subject line 'Municipal Funding Guidelines: Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety (BMUB) in LED Lighting Projects' in mid-2016. It came from a colleague who wanted to point out an information event to him. Consulting and funding – the offer was perfect. Pilger not only took along colleagues from the town, but also staff members from his local authority association, who would ultimately be the ones making decisions regarding projects in the town.

At the same time, the dena pilot project 'Energy efficiency cooperatives – street lighting' was launched, and contact was established with the Rhineland energy collective, where Andreas Pfaff had been racking his brain for a solution to the investment dilemma since 2015. 'We advised more than 250 municipalities. It was clear to everyone that the investments would quickly pay off via savings on energy costs. But the investments still had to be paid from local community budgets first, or directly by the residents. And no mayor would be inclined to do so,' says Pfaff, explaining the problem. That was why meaningful projects in the region were put on ice – until Pfaff found a solution to how his coopera-

tive Bürgergenossenschaft Rheinessen eG could not only be successful when it came to solar power systems and investments in electricity grids, but also in energy efficiency projects.

The principle is simple: it is not the town that invests, but the members of the cooperative. And they are paid by the town with approximately 80 per cent of the energy savings. The rest – around 3,000 euros annually in Bacharach – is saved by the local community starting from the first day of the conversion. In addition, the funds from the National Climate Initiative also flow directly into the municipality. And are immediately available in its budget. This makes contributing to climate protection doubly attractive for municipalities. And not just in Bacharach.

dena pilot project

In addition to the small town on the Rhine (2,000 inhabitants), dena also brought together two other municipalities in the pilot project 'Energy efficiency cooperatives – street lighting': the local community of Glandorf at the edge of the Teutoburg Forest with 7,000 residents, and the city of Kehl in Baden-Württemberg with 35,000 inhabitants. 'From the experiences of these municipalities and the local cooperatives, we are developing a guide which will enable many other municipalities to launch such residents' and climate protection projects in Germany as well,' explains dena Team Leader Dr Karsten Lindloff.

In fact, the prevailing conditions of the local communities in the pilot project could not be more different: Bacharach is small, has a limited budget, and the collaboration with the cooperative is something that is entirely new for the town. The cooperative in the local community of Glandorf, on the other hand, has existed for 100 years – since the beginning of electrification; here, the residents themselves wish to be involved in climate protection and a financially healthy municipality. And in the city of Kehl, the representatives have set themselves the goal of getting their residents more involved: We even had the idea

of putting up a small sign at each of the up to 6,000 new lights: 'Funded by the dedication of residents.'

Legal requirements

The challenges in such projects do not lie in the selection of the lamps, but instead the budgetary regulations of the local communities and the Banking Act (Kreditwesengesetz). According to these regulations – as formulated by the legal advisers commissioned by dena – the financing of the LED lamps via a contracting solution is deemed to be a 'credit-like legal transaction'. And unless it is classified as a 'transaction for ongoing administration' due to a small scope, it is subject to authorisation. 'Under this regulation, the municipal supervisory body aims to prevent municipalities from incurring significant hidden debts. Hence, approval is necessary in most cases,' explains Alfred Bauer, a lawyer from the legal firm W2K, which advises the municipalities on behalf of dena. In principle, this applies equally in all federal states, but the detailed requirements vary. 'But a lucrative contracting arrangement that results in savings is seen favourably by the state administrations,' says Bauer. After all, the state governments have also committed themselves to climate protection. In order to make it even easier for municipalities and energy efficiency cooperatives, dena will release a guide and a sample contract. 'Based on the work we have done and the materials we provide, other municipalities all over the country can also implement their own energy savings contracting arrangements in collaboration with their residents,' says a convinced Karsten Lindloff. 'We describe the challenges and methods for resolution in detail.'

That is because ultimately all the towns had win-win situations to show for their work. The town leaves the financing and implementation of the projects to involved residents; the members of the cooperative contribute to climate protection, and conquer a new business field.

Gunter Pilger, the deputy town mayor of Bacharach, is glad: 'There is no catch, there are no disadvantages.' All that is left is to wait for the new lamps. They are expected to shine their light on the ancient walls and paths for the first time in spring 2018. ■



INTEGRATED ENERGY TRANSITION

KUHLMANN ADVOCATES AN APPROACH THAT IS OPEN TO A RANGE OF TECHNOLOGIES



required for an optimised and sustainable energy system by 2050. The unique aspect here is that the options are developed 'bottom-up' in an intensive dialogue process among stakeholders, and subsequently assessed through modelling. Doing so allows the stakeholders who ultimately implement the energy transition to use their expertise. 'dena's pilot study invites policymakers to identify and enable the best transformational pathways possible, also from the perspective of businesses. To do this, we will bring all industries and sectors together to one table and jointly work out real-world, targeted pathways for achieving our climate protection targets,' said Kuhlmann.

Final results of the pilot study by mid-2018

Germany can reduce its CO₂ emissions by up to 90 per cent by 2050 if technologies available today are used optimally in an ambitious transformational pathway. 'The energy transition is achievable if we approach it with determination, an openness to a range of technologies, and broad dialogue,' emphasised dena's Chief Executive Andreas Kuhlmann when presenting the interim summary of the pilot study 'Integrated Energy Transition' in Berlin in October 2017. The regulatory frameworks in the energy industry will need to be geared consistently – right from the start of the new legislative term – towards allowing climate protection technologies to prove themselves in a competitive market, said Kuhlmann.

Since spring 2017, dena has worked with academic experts and more than 50 companies and industry associations from all sectors relevant for the energy transition on the pilot study 'Integrated Energy Transition'. The aim of the study is to identify the frameworks, solutions and planning options

In the first phase of the study, which was completed with the interim summary, dena worked with its partners to define three scenarios and analysed in a comprehensive modelling procedure how the climate policy targets in the sectors of energy production and distribution, buildings, industry and mobility can be achieved. The second phase of the pilot study will focus on specific issues of plausibility and feasibility for the better integration of the individual sectors. 'The pilot study helps us to better understand the dimensions of the energy transition. What is particularly helpful here is having a model for an integrated energy transition. An integrated energy transition involves the coordination of a growing number of components from all sectors, while combining different kinds of infrastructure and various markets in an intelligent and sustainable system,' emphasised Kuhlmann. The final results of the pilot study will be available mid-2018.

More information about the pilot study at www.dena.de/integrated-energy-transition



Regional network in South Westphalia: On a tour of the premises at Werner Turck GmbH & Co. KG

ENERGY EFFICIENCY NETWORKS

HIGH LEVEL OF SATISFACTION AMONG PARTICIPANTS

Three out of four companies which participate in an energy efficiency network are very to extremely satisfied with the results of the networking. This was the result of the survey by the market research institute mindline energy on behalf of the Energy Efficiency Networks Campaign. Sponsoring the initiative were the Federal Government along with 22 associations and organisations from the industry. The campaign office is administered by dena.

An energy efficiency network is an alliance of several companies within a region or industry which works together in a structured manner over an extended period of time in order to reduce their energy consumption by increasing energy efficiency. Networks within companies spread over several production sites or branches are also possible. The networks' main elements are a moderated exchange of ideas and information between participants, and also the setting and monitoring of a common savings target. In this way, companies acquire the necessary know-how to enable them to increase their energy efficiency.

The concept originates from Switzerland, and has also been implemented in Germany since 2002. At the moment, around 1,300 companies in more than 130 networks are actively involved in the Energy Efficiency Networks Campaign – and this figure is constantly growing. The aim is to launch around 500 new energy efficiency networks by 2020, thereby contributing to climate protection and the increase of energy efficiency in industry, skilled trades, business, commerce, and the energy industry.

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

ENERGY TRANSITION AT LOCAL LEVEL

Kristina Haverkamp names three new dena Energy-Efficient Municipalities

The local authority associations of Bad Ems, Birkenfeld and Jockgrim have been certified by dena as Energy-Efficient Municipalities. Through this certification, dena recognised the three municipalities in Rhineland-Palatinate for having introduced dena's energy and climate protection management (ECM) system.

dena's Managing Director Kristina Haverkamp, the Rhineland-Palatinate Minister for the Environment, Energy, Nutrition, and Forestry Ulrike Höfken, and the Managing Director of the Rhineland-Palatinate Energy Agency Thomas Pensel (see image) presented the awards to the mayors of the local authority associations in Mainz in September 2017. This means that there are now twelve dena Energy-Efficient Municipalities throughout Germany which have completed all the steps of the ECM and successfully implemented



Presentation of the certificate to the local authority associations of Bad Ems with dena's Managing Director Kristina Haverkamp (centre), Environment Minister Ulrike Höfken (2nd from right) and Thomas Pensel, Managing Director of the Rhineland Palatinate Energy Agency (2nd from left)

the corresponding savings measures. 'The dena Energy-Efficient Municipalities have shown their commitment to approach the topic of energy savings strategically and at all levels,' said Kristina Haverkamp. 'It is not only the climate which benefits from this, but also the municipal budget.' The systematic approach of the ECM ensures that the municipalities not only discover weak spots related to energy efficiency, but

are also able to exhaust the potential identified for buildings, electricity use, transport sector and energy system. As a rule, municipalities can expect energy savings of 10 to 15 per cent with dena's energy and climate protection management system.

Further information is available at www.dena.de/efficient-municipalities

ENERGY TRANSITION IN THE BUILDING SECTOR

STUDY EXAMINES VARIOUS SCENARIOS AND TRANSFORMATION PATHS

dena has published a study on various development options for the energy transition in the building sector in conjunction with the Allianz für Gebäude-Energie-Effizienz (geea) – Alliance for Building Energy Efficiency in October 2017. 'The climate protection targets in the building sector can be achieved, but for that to happen we'll have to make considerably more effort and come up with more ideas than we have up to now. However, we do have the technological potential to do so,' said Andreas Kuhlmann, geea spokesman and dena's Chief Executive, when presenting the study in Berlin. In the study, various transformation paths for achieving the energy and climate policy targets set by the federal government for the building sector by the year 2050 are compared to each other and assessed based on aspects such as cost, energy imports, and infrastructure requirements.

As with the dena Pilot Study – Integrated Energy Transition, various scenarios were investigated in the building study. The projected scenario has been extrapolated from current trends. It serves as a benchmark for two alternatives: the mixed technology scenario, which relies on a wide range of technologies; and the electrification scenario, which aims for a very high level of use of renewable electricity in the heating sector. The study came to the conclusion that the energy transition in the building sector will best be achieved by 2050 if all available technologies are employed economically, and the infrastructures for electricity, gas and oil are used efficiently with renewable energy sources. By contrast, a rapidly accelerated electrification of the supply of heat would lead to higher costs and necessitate higher refurbishment rates. 'The precepts of economy and competition are in danger of being lost if we try to manage individual technologies politically, instead of developing frameworks that are open to a range of technologies and maintaining a clear focus on cutting CO₂. This makes it all the more important that politics, business, science and society agree on solutions. We want to promote this dialogue through our building study. Hence, we have made a point of working on this jointly with numerous companies and associations involved in the industry,' said Kuhlmann.

More at www.dena.de/en-geea



FACTS & FIGURES

HOW FAR ARE WE WITH THE ENERGY TRANSITION? IN WHICH **BUSINESS AREAS** IS DENA ACTIVE? AND HOW MANY LANGUAGES DO THE DENA STAFF MEMBERS SPEAK EXACTLY? IN **FACTS & FIGURES**, YOU WILL FIND **FIGURES, DATA, AND FACTS** RELATED TO DENA AND THE WORK IT DOES.

WHAT WE DO

In 2016, renewable energies in Germany already generated **31.7%** of gross energy consumption,

The number of newly registered passenger cars with a hybrid propulsion system increased by **52%** in 2016,

Over **500** international start-ups submitted an application for the dena Start-Up Energy Transition Award 2017,

Despite increasing comfort, efficiency measures were able to reduce the heating needs of residential buildings by around **11%** between 2008 and 2015,

THE ENERGY TRANSITION IS MAKING GOOD PROGRESS ...

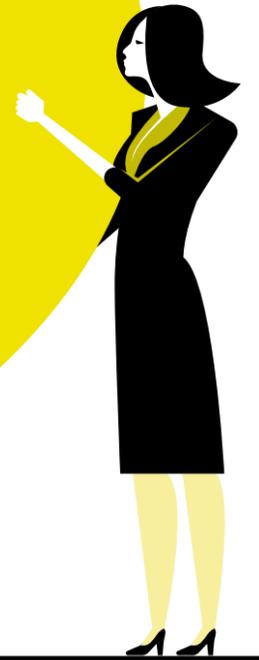
but it only accounted for **12.6%** of primary energy consumption in the same year.

but alternative drive systems only accounted for **2%** of the total number of new registrations.

but only **3.9%** of German start-ups were active in the green technology sector in the same year.

but more than **60%** of facades and over **30%** of the roofs of detached and semi-detached houses in Germany are still uninsulated.

... BUT THERE IS STILL A LOT LEFT TO DO.



Sources: Federal Environment Agency, AG Energiebilanzen, Federal Motor Transport Authority (Kraftfahrtbundesamt), dena, KPMG AG, Federal Ministry for Economic Affairs and Energy (BMWi), Federation of German Industries (BDI)/German Association of Energy and Water Industries (BDEW)/ dena/Alliance for Building Energy Efficiency (geea)/German Trade Union Confederation (DGB)/German Confederation of Skilled Crafts (ZDH)

dena is currently working with around 90 projects on finding solutions for the energy of tomorrow. Our range of services includes:

Studies & Analyses

Strategy & Consulting

Project Development

Market Development

Networks

Public Relations

More information on our range of services and contact partners is available at www.dena.de/en/services

HOW WE WORK

Financial figures, partners, projects, and structure of dena

MANAGEMENT



Chief Executive
Andreas Kuhlmann



Managing Director
Kristina Haverkamp

DIVISIONS

Energy Systems and Energy Services
Hannes Seidl
(Head of Division)

Energy-Efficient Buildings
Christian Stolte
(Head of Division)

Renewable Energies and Mobility
Oliver Frank
(Head of Division)

Communications
Hanne May
(Head of Division)

Administration
Hans-Jürgen von Herwarth
(Head of Division)

DENA SHAREHOLDERS

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, Building and Nuclear Safety**, and the **Federal Ministry of Transport and Digital Infrastructure**, along with the **KfW Group**.

220 COLLABORATIVE PARTNERS

dena is currently involved in around **90** PROJECTS with over

Here are some of the **COUNTRIES** where it is active:

INDIA CHILE JAPAN KENYA COLOMBIA NAMIBIA PHILIPPINES POLAND IRAN
RWANDA SOUTH AFRICA UZBEKISTAN MOROCCO ITALY ECUADOR ZIMBABWE
GHANA VIETNAM SENEGAL MADAGASCAR CANADA CUBA DENMARK IRELAND
RUSSIA BELARUS UKRAINE KAZAKHSTAN CHINA CROATIA FRANCE

2016 FINANCIAL FIGURES

Revenue in 2016	20.1 mil. euros
... of which from private sector contracts	11.0 mil. euros
... of which from government grants	7.4 mil. euros
... of which from federal contracts (bids for tender)	1.7 mil. euros
Net income for 2016	1.1 mil. euros

3 QUESTIONS FOR DENA'S MANAGING DIRECTOR KRISTINA HAVERKAMP

What is your economic assessment of the year 2016?

KRISTINA HAVERKAMP: 2016 was a very successful year for dena. We were able to increase revenue by over 15 per cent to 20.1 million euros, and once again obtain a significantly positive operating result after a difficult preceding year. All dena business divisions contributed to this wonderful success with innovative, thematically relevant and economically significant projects. I am particularly pleased about that.

Due to the favourable development, the number of staff members also increased. Currently, we have over 220 colleagues working in our organisation – of which around 32 per cent are part-time staff. This demonstrates that dena not only delivers top performance, but is also family-friendly. A really good combination!

In 2017, there was a change in the share ownership structure: what does this mean for dena?

HAVERKAMP: On 1 January 2017, dena acquired the company shares of its private shareholders Deutsche Bank AG, DZ BANK AG,

and Allianz SE. The remaining shareholders with voting rights are the federal government and the KfW Group. This change was a request by the federal government, which wishes to make greater and more immediate use of dena's expertise to promote the energy transition.

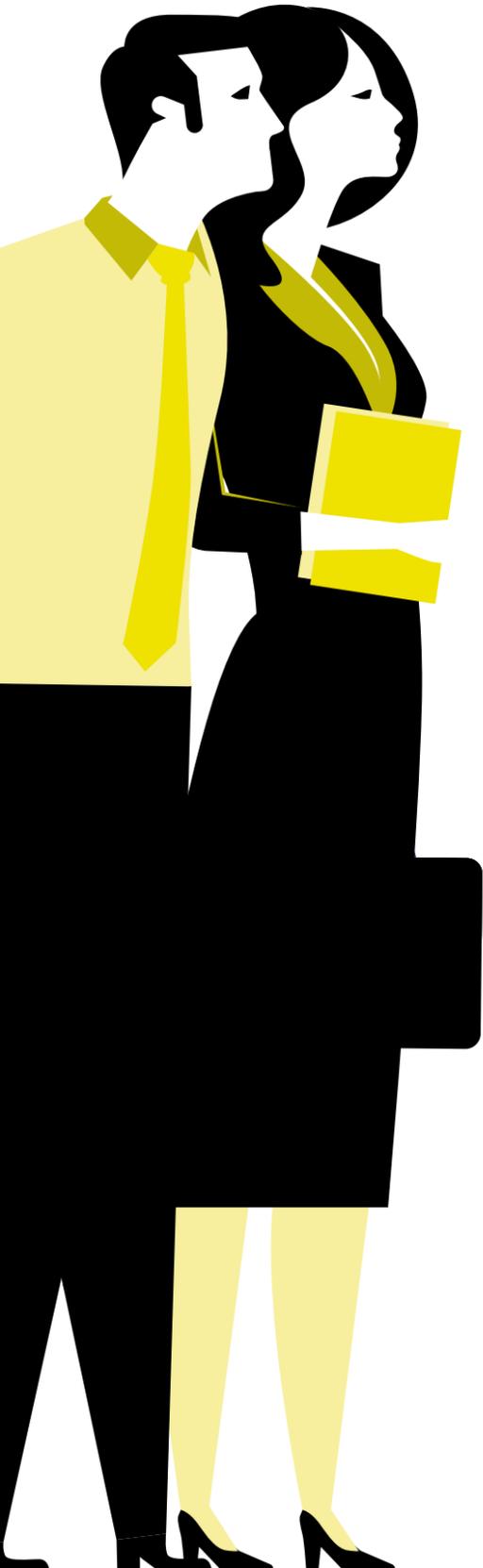
At the same time, our articles of association were also modernised and now explicitly recognise climate protection as one of our corporate goals. Naturally, we as an effective national energy agency will also continue to work closely with industry and other stakeholders, because it is only by working together that we can achieve the energy and climate targets.

What are dena's targets over the coming years?

HAVERKAMP: We want to continue with the positive trend of the past year and further strengthen dena as a think tank and driving force behind the energy transition – both in Germany and internationally. We have a lot more planned, as the energy transition remains a massive undertaking, and we wish to contribute decisively to its success. ■

IN NUMBERS

FACTS AND FIGURES ABOUT DENA'S STAFF



226

staff members

66%

40 years or younger

54%

women

13

nations are represented at dena.

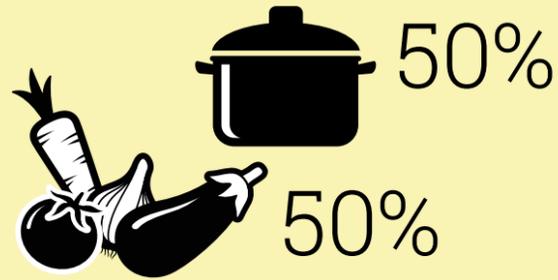
104

staff members have been at dena for 5 years or more.

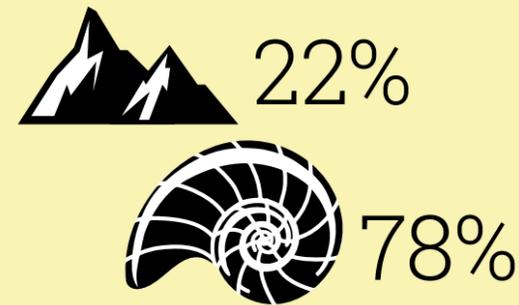
WE ASKED

OUR STAFF...

LUNCH:
GOULASH OR
STIR-FRIED VEGETABLES?

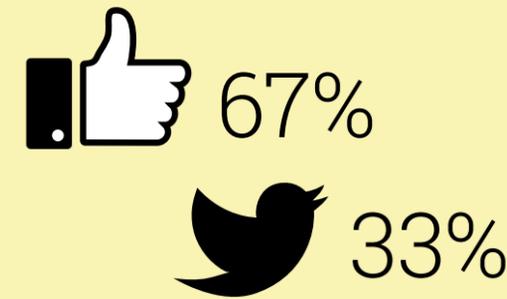


HOLIDAYS:
IN THE MOUNTAINS
OR BY THE BEACH?

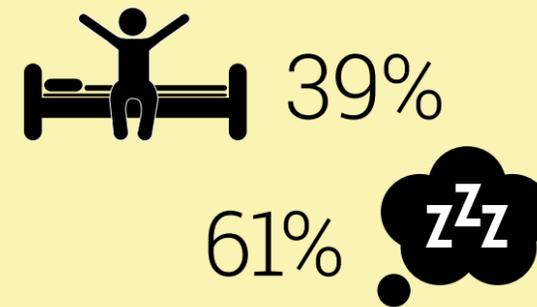


WHICH LANGUAGES
DOES DENA SPEAK?

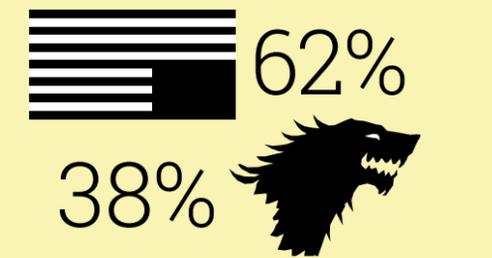
SOCIAL MEDIA:
FACEBOOK OR TWITTER?



ALARM CLOCKS:
GET UP IMMEDIATELY OR
HIT THE SNOOZE BUTTON?



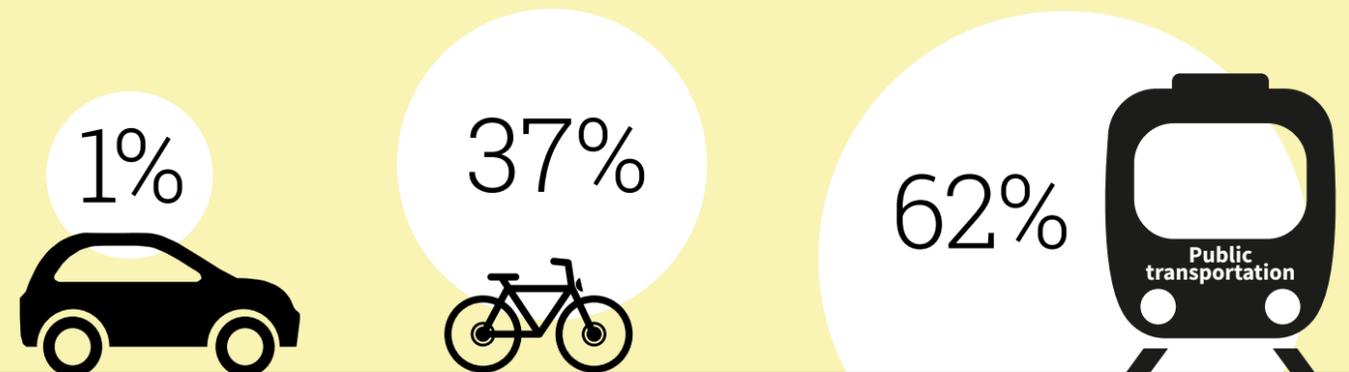
TV CHOICE:
HOUSE OF CARDS OR
GAME OF THRONES?



DINNER:
EAT IN
OR EAT OUT?



HOW DO DENA STAFF
MEMBERS USUALLY
COME TO WORK?



German, English, Russian, Arabic, Italian, Ukrainian, Polish, Chinese, Spanish, Portuguese, Greek, Lithuanian, French, Bulgarian, Dutch, Swedish, Farsi

EITHER OR



NEXT

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?

SOLUTIONS KNOW NO BOUNDARIES

GLOBAL CLIMATE PROTECTION BENEFITS WHEN STATES LEARN FROM EACH OTHER AND NETWORK THEIR ENERGY SYSTEMS AND INFRASTRUCTURES EVEN MORE CLOSELY. THIS INTERNATIONAL COLLABORATION WILL BECOME ALL THE MORE IMPORTANT AS THE ENERGY TRANSITION PROGRESSES.

TEXT Marcus Franken

For its own energy transition, Germany got a lot of ideas by observing other countries: wind power, which is so essential for electricity generation today, was first promoted in Denmark. Solar energy began with American satellites in space – in 1958! For the success of the global energy transition, it was and continues to be crucial that good ideas and experiences are shared across national borders and developed collaboratively. In the future, this will become even more important, as solutions must know no boundaries.

The French-German axis

For Germany, the exchange of information and ideas as well as its partnership with France are vital where the energy transition is concerned. 'The collaboration between these two countries at the heart of the EU can be a game changer for the whole of Europe,' says Franca Diechtl, who is responsible for the Franco-German Energy Platform at dena. 'A cross-border European strategy would reduce the costs of the energy transition and make it more efficient.'

In this case, it is not just about the exchange of ideas, but also trying out specific improvements. In Saarland and the Lorraine region, a cross-border pilot project is planned in the context of the Franco-German Energy Platform which aims to link

the energy systems of the two neighbouring regions more strongly. At the heart of the Smart Border Initiative (SBI) is the first cross-border smart grid with the involvement of the two energy companies innogy and Enedis. Its purpose is to create new options for the distribution system operators to coordinate the production and consumption of energy more flexibly, thereby facilitating the integration of renewable energy.

Networking electricity and heating

Other targets of the Smart Border Initiative include the integrated optimisation of the energy system via the coupling of the electricity and heating sectors, as well as the expansion of climate-friendly mobility. The use of hydrogen and electric vehicles for cross-border commutes between the two regions will be promoted, for example, via the establishment and expansion of joint charging infrastructure and corresponding services such as billing systems.

'If we are successful, the SBI can serve as a model for the restructuring of the energy system at the international level,' says Diechtl with conviction. 'Germany and France can start the ball rolling in this context.' By doing so, they would provide yet another building block for the 'global energy transition'. ■

For more information about the Franco-German Energy Platform, please visit www.dena.de/energy-platform

Watt really matters

INTERVIEW Titus Kroder

WE HUMANS DO NOT RESPOND TO ETHICAL PLEAS WHEN IT COMES TO SAVING ENERGY. IT IS ONLY WHEN WE ARE SHOWN EXACTLY WHEN, WHERE, AND HOW MUCH ENERGY WE CONSUME THAT WE START BECOMING THRIFTY. LORENZ GÖTTE CAN EVEN PROVIDE EXACT FIGURES TO PROVE THIS.

Mr Götte, as a professor for behavioural economics at the University of Bonn, you have confronted study participants in the shower with a meter on the shower head. It shows exactly how much energy and water is consumed. A refreshingly practical approach for an economist.

LORENZ GÖTTE: In a field experiment, we simply wanted to know under which exact conditions people felt the incentive to save energy. After all, those five minutes in the shower already account for seven per cent of the energy that we consume each day. Hence, we can certainly leverage this if we want to save energy.

And what was the result?

GÖTTE: In short, people reduce their water consumption by a good 20 per cent when they are shown in real time how much mon-

ey they are spending when in the shower. Because the water is warm, it results in 0.6 kilowatt hours per shower, or around 1.2 kilowatt hours per day in a two-person household. Over an entire year, this adds up to a handsome sum saved.

Would it not be enough for a household to simply check their gas and water meters once a week to achieve the same effect?

GÖTTE: In fact, that appears to be the crux of the matter. Either there is insufficient discipline or there is not enough pressure from their purse or conscience. If we are not confronted with our ongoing energy consumption in exact figures, there is no savings effect, or it is much weaker. This was shown by the control group in the experiment. Apparently, we need the costs literally 'shoved in our face' for us to make an economical decision and save energy and resources.

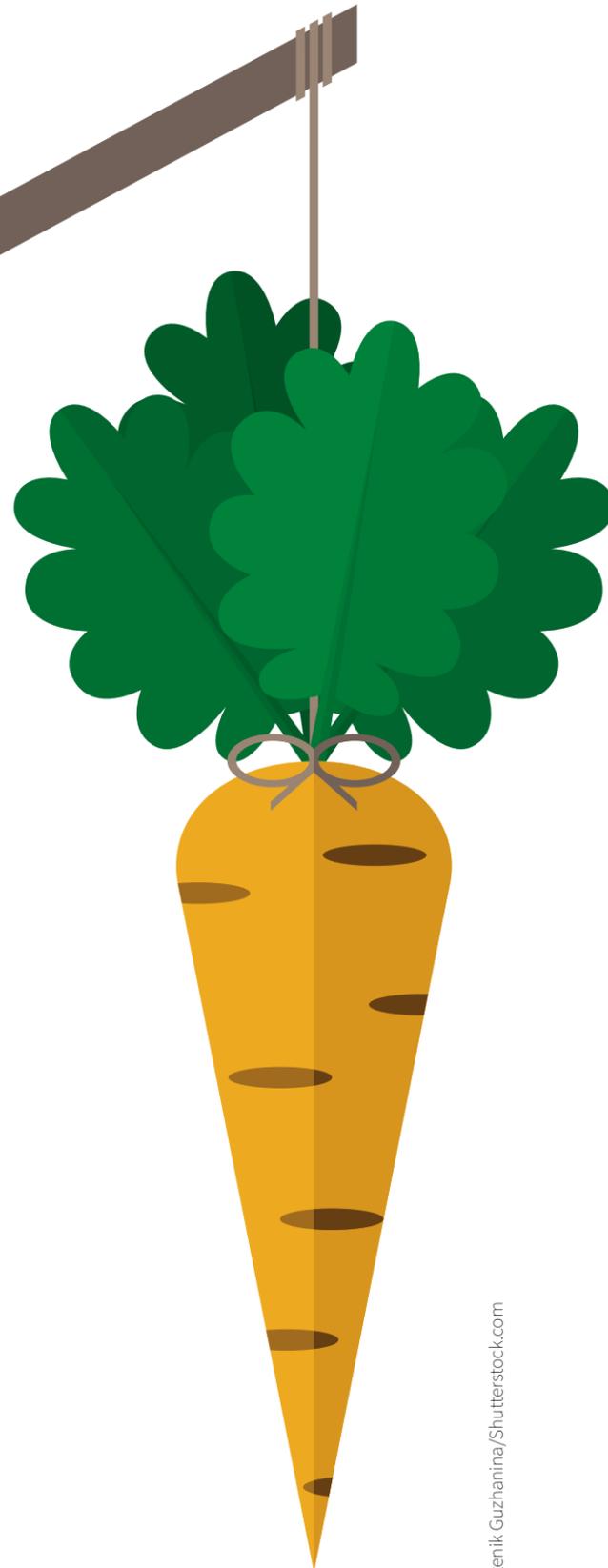


IMAGE: Satenik Guzhanina/Shutterstock.com

Studies in Switzerland and Singapore found very similar results.

A smart meter on the living room table which displays the daily consumption of a household in real time – in your opinion, that is not enough?

GÖTTE: Our experience is that doing so leads to daily savings of around 0.2 kilowatt hours, which is not really that much. However, if the individual consumptions of the washing machine, stove, and toaster in the household are listed individually on the smart meter, then we achieve savings of 0.7 kilowatt hours. We are currently conducting a field experiment on this in Germany. Here too, we see that only broken-down information about individual consumption values actually lead to savings.

Other than direct information on costs for showers, making pancakes, or doing the laundry, is there really no other way to get households to save energy?

GÖTTE: This does not appear to be that easy. For example, we told our participants in the aforementioned study if they were part of the group consisting of the highest energy consumers. We then gave them an incentive by offering them an Amazon shopping voucher for each percentage point that they saved and improved by. However, the additional savings achieved were zero. At least in Germany, where energy is already extremely expensive, this does not appear to achieve anything.

This also means that, from a political standpoint, the high energy prices alone have not resulted in an urge to save among the general population, is that right?

GÖTTE: Within a certain price range, we need to assume that for developed countries. For example, studies in the USA showed that the energy price would need to be increased by 25 per cent in order to achieve savings of just five per cent. Simply making energy more expensive is therefore not practical as leverage. This is because

economically speaking, we apparently have a conspicuously low price elasticity for energy. As long as we do not immediately and directly see the costs of our actions, we hardly limit our consumption.

Microeconomists like you study not only households, but also companies. How can incentive systems be created there in order to save energy effectively?

GÖTTE: Many companies are small and function like private households where their energy decisions are concerned. Presumably, they too could be encouraged to save energy by providing a detailed breakdown of consumption information. For companies, we could probably also play another card: the 'green image' in the eyes of their customers and society. Hence, the government could definitely also provide more transparency on how energy-efficient individual businesses are. The thinking would be: the restaurant around the corner where you have lunch consumes this much, and that is this much more or less com-

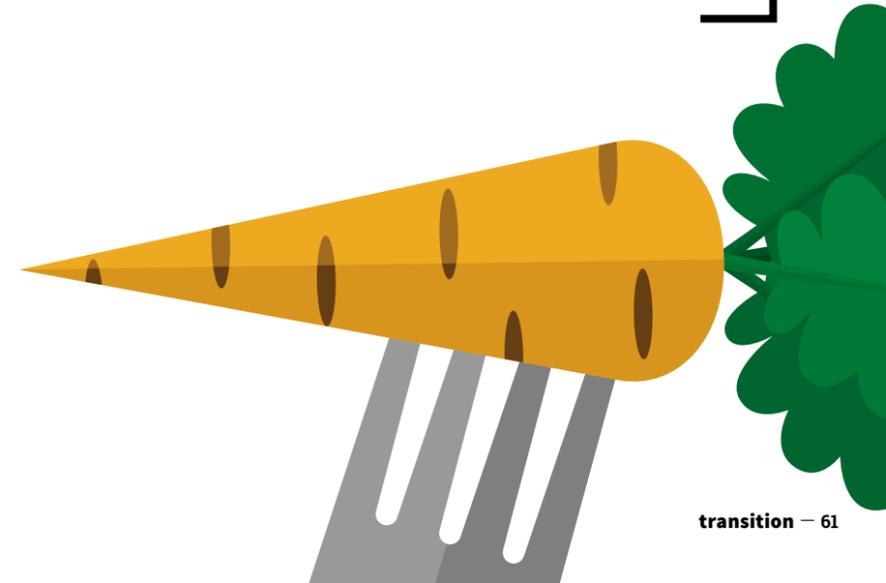
pared to others. For households, this is not possible due to data privacy laws. But for companies, this would result in significant savings, I would say.

One last question: to what extent are the findings from such practical research studies also taken into account in practical policy-making?

GÖTTE: In Europe, researchers in this field have it surprisingly difficult when attempting to win over industry or political partners. I personally feel that the problem has not really registered in the minds of the people yet. Look at Singapore, for example. There, the National Environment Agency is now scaling up our small field test with the showers into a large-scale real-world test that will involve tens of thousands of households. Of course, the pressure is higher over there. Resources are scarce and the population is growing rapidly. But nobody here is reacting to the problem as quickly as over there. In this case, the link between politics and applied research needs to be strengthened. ■



Lorenz Götte has been a Professor for Behavioural Economics at the Institute for Applied Microeconomics at the University of Bonn since 2015. Up till 2009, he held a professorship at the Institute for Applied Microeconomics at the University of Lausanne. A native of Switzerland, he has worked at renowned international research institutes between 2001 and 2008, including at MIT in Boston. He is a Research Fellow at the Centre for Economic Policy Research in London and at the Center for Economic Studies in Munich.



'One day, we will be charging cars without a cable'

THE FREIBURG-BASED START-UP BLUE INDUCTIVE HAS DEVELOPED TECHNOLOGY WHICH ALLOWS EVEN THE BATTERIES OF LARGE ELECTRIC MOTORS TO BE CHARGED WITHIN A SHORT TIME WITHOUT THE USE OF A CABLE. BLUE INDUCTIVE CO-FOUNDER FLORIAN REINERS EXPLAINS HOW THIS WORKS.

One day, of this I am certain, we will no longer need to use cables to charge electric cars, and electricity will be available just about everywhere, like Wi-Fi is today. Why am I so sure? Because together with my co-founders Johannes Meier, Johannes Tritschler and Benriah Goeldi, I have already developed the technology for this. We met at the Fraunhofer Institute for Solar Energy Systems, which for some time now has been working on much more than just solar cells. At the institute, we developed inductive charging technology for electric vehicles – our solution is especially suited for high outputs starting at around 500 watts.

At the time, we were already very much at the cutting edge of technology, and worked intensively on inductive energy transfer. We came across the topic of electric cars because we read in one study that there are generally two reasons why customers are sceptical of electric cars. Firstly, because they presume that the range achievable with a single charge is too low, but this turned out to be an unfounded concern in real-world use. Secondly, many said that the charging procedure with the charging cable is inconvenient, particularly in rainy and snowy weather. That was the greatest obstacle.

We have a very good solution to this problem. At the Fraunhofer Institute, we developed a demonstrator; i.e. a model which allowed us to demonstrate the technical feasibility of the idea: we modified a VW Caddy and charged it via induction at a distance of 15 centimetres from the ground. It is actually quite an obvious solution for the problems faced by electromobility. We were able to demonstrate that even with contactless



Florian Reiners, 37, started his own business in 2015 together with Johannes Meier, Johannes Tritschler and Benriah Goeldi. Their start-up Blue Inductive was founded in 2016. Prior to that, the four founders worked at the Fraunhofer Institute for Solar Energy Systems (ISE for short), where they developed a high-efficiency system for charging electric vehicles. This system allows vehicles to be charged without a cable and at a distance of 15 centimetres via a ground plate. Blue Inductive was a finalist for dena's Start Up Energy Transition Award in 2017.

energy transfer, extremely high efficiencies could be achieved. Where output and efficiency are concerned, there are almost no disadvantages compared to charging devices that used a cable. Because we were so confident in the technology, we started our own business in 2015 and founded Blue Inductive in 2016 – with the goal of outfitting electric cars with our charging technology.

But the automobile market is a difficult one. Manufacturers and customers are relatively conservative and the entry barriers are extremely high for a young start-up. Hence, Blue Inductive will initially focus on industrial applications, in particular mobile robots in the logistics and production sectors. Entering the market in this segment is significantly easier and the advantages of the applications are obvious. Robots can utilise short downtimes within a process to recharge their batteries. This constant charging in-between cycles eliminates the need for separate charging periods. Today, they often need to remain at special charging stations for long periods of time, during

which they are not available for the production process. In this manner, a great deal of money can be saved, because significantly fewer robots are needed. We have successfully completed our pilot tests, and will be putting the technology on the market in 2018. Naturally, mobile robotics is only one possible application out of many – one could of course use it to charge wheelchairs, electric scooters, golf carts, and all electrically driven vehicles.

And that is just the beginning. At some point in the future, such an inductive solution will also be available for electric cars. When that happens, we will be able to charge our cars simply by parking them. ■

What should we talk about at the 2018 dena Congress?

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what you would like to discuss
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dena-kongress@dena.de
and keep your schedule free on
26 and 27 November 2018.
We look forward to seeing you there!

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**Lose not yourself in a
far-off time,
seize the moment
that is thine.**

Friedrich Schiller