www.dena.de

transition

THE ENERGY TRANSITION MAGAZINE BY DENA | #2023

21 22 23 24 25

‘Climate policy can only work so long as we don’t forget about war, hunger and poverty.’

A profound change to the global energy markets is imminent: an interview with dena Chief Executive Andreas Kuhlmann and the Executive Director of the International Energy Agency, Fatih Birol.

INDUSTRY

How fossil fuels can be replaced

BUILDINGS

How heat pumps are making inroads with older buildings

UKRAINE

How green rebuilding efforts can be achieved

EDITORIAL

transition

Last year was one marked by crisis: the Russian war of aggression against Ukraine, the global energy crisis, rampant inflation, not to mention the extreme heat, droughts and floods around the world caused by climate change. All of this is having dramatic consequences. What we mean by a secure energy supply now is somewhat different from what we used to mean. A new dimension and connotation to how we approach cooperation and collaboration on the international stage has emerged. Having to deal with multiple crises at once has given us greater clarity in terms of how we view the future – we are focusing more on having a diverse range of solutions and partners. We are constantly making progress here, treading paths that we outlined years ago. We need this new dynamic along with the courage to fuel it.

This is something, along with many other aspects, we discussed with the Executive Director of the International Energy Agency, Dr Fatih Birol (page 8). Greater innovation is a key factor for a successful transformation. Another is improving the financial conditions for the global south.

The energy crisis and climate change are having an impact on everyone and every sector of society. That's why we asked a range of different people from society, business and politics for their assessments (page 14).

We take a look at which solutions are already being implemented with a glimpse into our daily work on energy transition and climate protection (from page 22). For example, manufacturing companies are doing everything they can to save energy in the short term and replace fossil fuels in the long term (page 24). Hydrogen is a vital energy source for the near future – produced locally with electrolysers at the point of use (page 28) or tested on a larger scale in living labs (page 32). In the building sector, heat pumps are proving to be a massive success – including in older buildings (page 36) – and customised heat supply concepts are emerging thanks to integrated planning in municipalities (page 44).

We have been particularly impressed by the courage shown by many Ukrainians in recent months. There is no better example of this than the two energy experts who are calling on people to start tackling the issue of sustainably rebuilding their country now (page 50).

Their efforts have inspired us to make promoting confidence and determination the focus of this sixth issue of our corporate magazine. We hope you enjoy reading it!

Andreas Kuhlmann
Chief Executive

Kristina Haverkamp
Managing Director

CONTENTS

PUBLISHER:
DEUTSCHE ENERGIE-AGENTUR GMBH (DENA)
CHAUSSEESTRASSE 128 A,
10115 BERLIN, TEL.: +49 (0)30 66 777-0, FAX: +49 (0)30 66 777-699
WWW.DENA.DE | @DENA_NEWS
EDITORS: GERMAN ENERGY AGENCY (DENA)
HANNE MAY, PHILIPP RUPP, PHIL ZETTEL, MARLEN BARTSCH, DOMINIK DRUTSCHMANN
PICTURE EDITOR: SILKE REENTS
PUBLICATION FREQUENCY: ANNUALLY
DESIGN AND PRODUCTION: DIE WEGMEISTER GMBH
CONTRIBUTING AUTHORS:
RALPH DIERMANN, HANS-CHRISTOPH NEIDLEIN, TILMAN EICKE, MARCUS FRANKEN, JAN OLIVER LÖFKEN, TANJA ELLINGHAUS, ANNE-KATRIN WEHRMANN, CHRISTIANE SCHULZKI-HADDOUTI, KATHARINA WOLF, MARTIN KALUZA
PRINTING AND PROCESSING:
DRUCKEREI HANSTEIN GMBH
RÖNTGENSTR. 12, 70736 FELLBACH
PRINTED ON CIRCLE OFFSET PREMIUM WHITE, AWARDED THE GERMAN BLUE ANGEL ENVIRONMENTAL LABEL FOR PAPER AND CARDBOARD. ITS PRODUCTION PROCESS USES LESS WATER AND ENERGY THAN OTHER PAPERS, AND IT IS MADE OF 100% RECYCLED FIBRES.

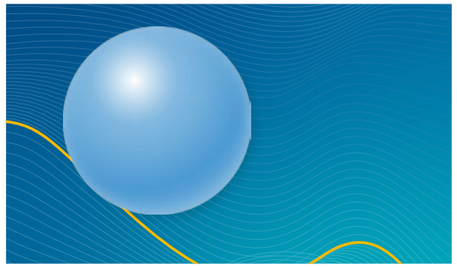
print production
www.natureOffice.com/2A5-BSC-474195
carbon neutral
through CO2 offsetting

THE BIG PICTURE

A look at the fundamental challenges

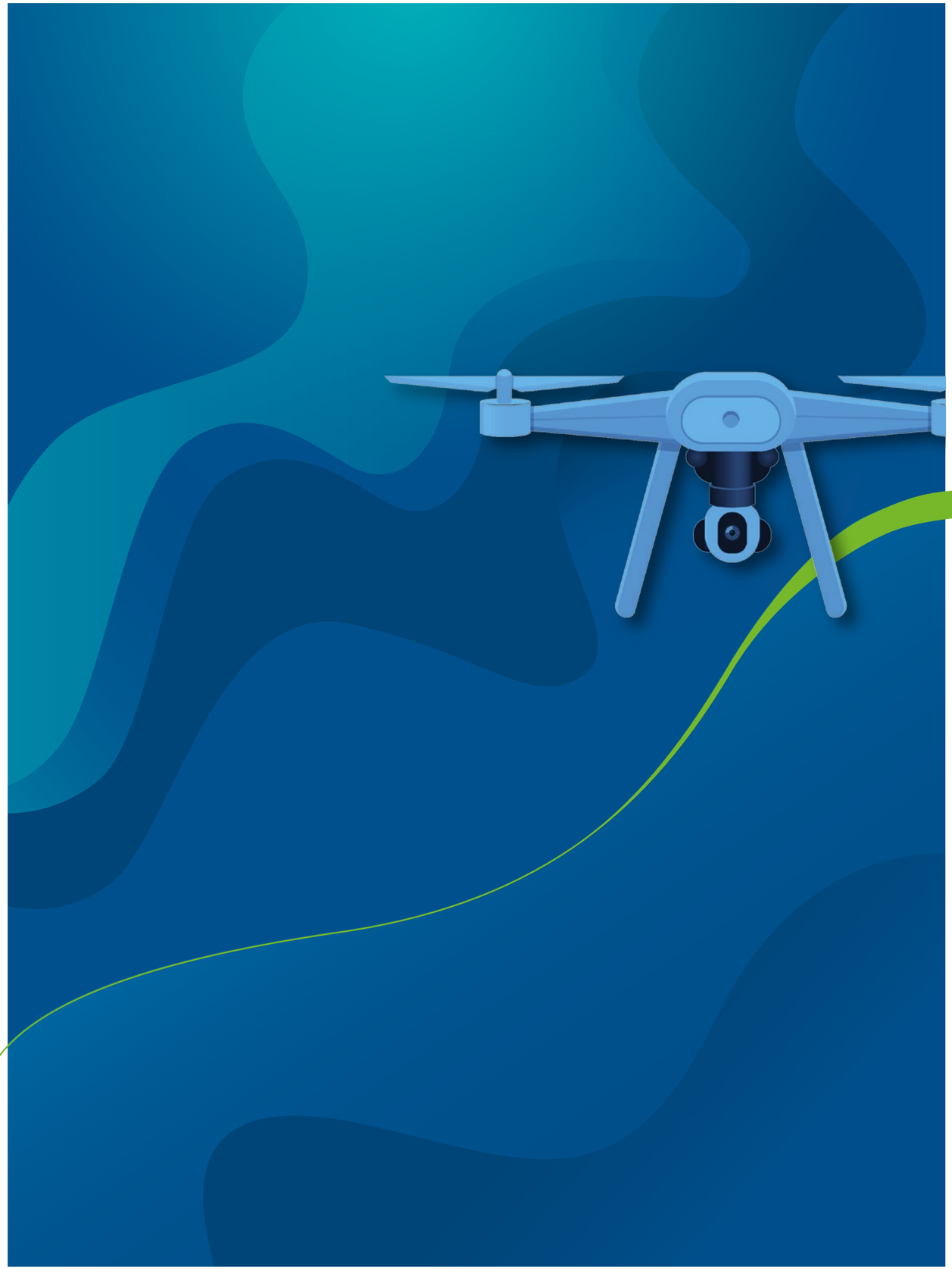
INSIGHTS

A look at selected projects



NEXT

A glance into the future



THE BIG PICTURE

A look at the fundamental challenges

‘Without innovation, we have no chance of reaching our net zero target’

INTERVIEW Hanne May

Daring to look ahead in turbulent times – IEA Executive Director Dr Fatih Birol and dena Chief Executive Andreas Kuhlmann discuss how to draw the right conclusions for the future despite the challenges of the present.

Photo: Janine Schmitz/photothek

transition: The world was rocked by a number of profound crises in 2022. Will this year see more of the same? Will our economic and energy systems face similar turbulence, or will we finally be able to return to normal?

FATIH BIROL: I think Russia’s invasion of Ukraine has changed the European and global energy system, not only for last year or this year, but for decades to come. One of the most important trade links between Russia, the world’s top energy exporter, and Europe, the leading energy market, is broken. And it is broken forever. To replace the energy volumes from Russia, Europe has to make a huge effort in terms of finding new energy exporters and increasing the share of their domestic energy production in many ways, ranging from using energy more efficiently, to renewables, hydrogen and, in some countries, to nuclear power. That’s why I believe this change was not only a change for last year or this year. We will see a major transformation in the energy markets in Europe and beyond in the next years.

One final word about Russia: as of 24 February 2022, Russia was the world’s top energy exporter. But the response from governments to Russia’s aggression combined with the response coming from the energy markets and the energy industry mean that Russia’s role in energy affairs will be greatly diminished in the future compared to what it was.

‘We will see a major transformation in the energy markets in Europe and beyond in the next years.’

FATIH BIROL

ANDREAS KUHLMANN: I see it in a very similar way, everything has indeed changed. We live in a time of profound uncertainty. There was no choice other than to respond to these crises. But looking beyond that, we can see that tremendous dynamics are emerging, which fortunately can build on the groundwork laid over the past few years. The International Energy Agency, the International Renewable Energy Agency (IRENA) and organisations such as dena have all drawn up plans to do this, which outline what might possibly happen and the options we have available to us in terms of how we approach everything. But there is a lot more pressure now, and it is no longer coming exclusively from governments – the vast majority of it is coming from individual stakeholders. Everyone now wants to be independent of fossil energies and fossil infrastructures. The challenge will be harnessing these dynamics through markets and market participants so that they develop and evolve as quickly and efficiently as possible.

I would also like to say that while ‘all in for climate’ sounds good, it is not enough. We need to look at the frameworks. Climate policy can only work so long as we don’t forget about war, hunger, poverty and redistribution. To put it another way, we need to use the Sustainable Development Goals (SDGs) to guide us.

transition: Mr Birol, during your presentation of the IEA’s World Energy Outlook in Berlin, you said that the whole world faces a profound energy crisis. What does that mean, and what are the consequences for our economy and our society?

FATIH BIROL: Yes, we are in the middle of the first global energy crisis. Our world had gone through several such crises before, but we have never witnessed one of this magnitude and complexity. For example, we had

‘Climate policy can only work so long as we don't forget about war, hunger, poverty and redistribution. To put it another way, we need to use the Sustainable Development Goals (SDGs) to guide us.’

ANDREAS KUHLMANN

ANDREAS KUHLMANN

has been dena’s Chief Executive since 2015. The graduate physicist campaigns for frameworks that facilitate innovation and for investments in climate-friendly technologies.

an oil crisis in the 1970s. At that time, it was focused on just one fuel, namely oil. But today, we are seeing the oil markets, the natural gas markets, the electricity markets and coal markets all being affected by the global energy crisis. We are going to see some fundamental shifts as a result of this. Firstly, Russia has lost its credibility as a reliable energy partner. That is on everybody’s minds, even beyond Europe. Yes, some countries still import Russian oil. But these are buyers who want to make the most out of the current situation.

Secondly, relying on energy importers who have the tendency to use energy as a political or economic weapon is not simply a challenge that the IEA calls attention to – it is a real thing. It can happen, as it has happened now. Governments have understood this.

Thirdly, more and more countries have understood that energy security is a critical issue and lasting solutions to our energy security problems require clean energy technologies. Examples of these include efficiency, renewables, electric cars, nuclear power, hydrogen and many others.

Finally, our data indicates that clean energy technologies are seeing explosive growth. This applies to solar, wind, heat pumps and electric cars. In the past, this growth was driven by our climate protection concerns, now it is driven by energy security concerns, especially in Europe and Germany. Given that, I think it is a very good move by the German government to shorten licensing and permit procedures for renewable energy projects.

One final issue for Europe: Europe’s economy relies on a strong industrial sector. European industry faces a major problem in the wake of the energy crisis, both in terms of high energy costs and as a result of the way that other national economies have responded to the crisis. Many of them promote and subsidise the production of clean energy technologies, such as batteries, electrolysers, solar panels and so on. In my view, Europe needs to have a master plan for how its industrial sector will tackle this challenge if it doesn’t want to be left behind countries such as the United States and China.

ANDREAS KUHLMANN: I think we’re on the precipice of something of a ‘turning of the tide’ moment. Many developments are now reaching the point where going back to how things were simply isn’t going to happen – in fact, we will be able to pivot in a new direction even faster than we could before. At first, it may seem that cooperation has become more difficult. But I think that we now have to make much more of an effort to cooperate. We see that there are talks being held between countries that have not done so for quite some time. I can only encourage them to keep doing that, as it will be impossible for us to get a handle on this global energy crisis if we don’t cooperate. What’s more, the better some cooperate, the greater the pressure will be on others to cooperate, too.

I’m also convinced that innovations will get an enormous boost. Crises always create bottlenecks, and these bottlenecks act as the spark for creativity and innovation. That’s what we have to rely on happening. I would like to see greater efforts in this regard worldwide, including from Germany and the EU. We should be faster with scaling the technologies that we already have, be it through financial instruments, through venture capital or through well-thought-out market regulations.

FATIH BIROL: Currently, our global annual spending on fossil fuels is about USD 1 trillion and about USD 1.3 trillion on clean energy. Under the current political conditions, clean energy investments will rise to USD 2 trillion by 2030. This is a good increase. And it is mainly driven by policies such as the Inflation Reduction Act in the US, RePower EU in Europe and transformation packages in Japan, China and India. But, if we want to reach the 1.5-degree climate goal, we need to reach an annual investment level of USD 4 trillion in 2030 for clean technologies. That means we have to double our efforts for clean energy investments.

transition: That sounds like an enormous challenge. What are the most critical issues to triggering this investment growth?

FATIH BIROL: There are many. But if I had to pick one out of the thousands of problems, I would say accelerating clean energy investments in developing countries is the main problem. I don’t think that developing clean energy projects and raising the necessary capital will be a big problem in Europe, North America or Japan. But in developing countries, the cost of capital for solar, for example, is five to six times higher owing to the number of risks in these countries.

So, increasing our current investment level by a factor of two is a challenge. But the biggest challenge will be to mobilise investments in the developing world.

ANDREAS KUHLMANN: The key challenge is obviously the financial costs, in other words the cost of capital, as Fatih mentioned. We also need to develop a better understand-

transition: To make this all happen, we will also need an explosive growth in investment levels. Taking a closer look at the IEA’s data for global investments in energy transition, we actually see a flat curve for several years and then an upward trend starting only in 2020. So what need for change do you see here to make the race to net zero happen?

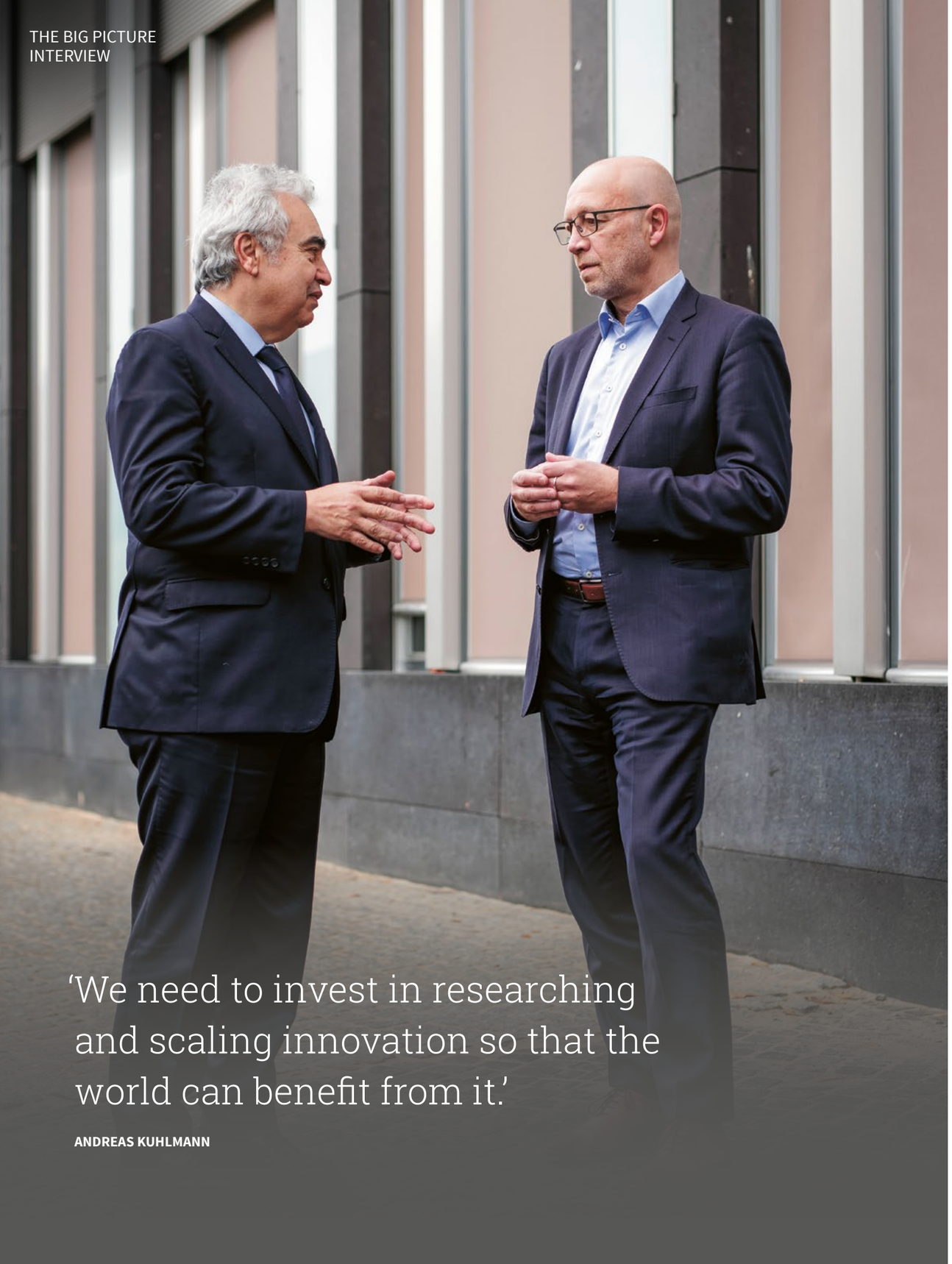
DR FATIH BIROL

has served as the Executive Director of the International Energy Agency (IEA) since 2015. He also chairs the World Economic Forum’s Energy Advisory Board in Davos. With its annual World Energy Outlook, the IEA publishes one of the most important reports on the state of global energy systems.

‘More and more countries have understood that energy security is a critical issue and lasting solutions to our energy security problems require clean energy technologies.’

FATIH BIROL

Photos: Janine Schmitz/photothek



‘We need to invest in researching and scaling innovation so that the world can benefit from it.’

ANDREAS KUHLMANN

Photo: Janine Schmitz/photothek

ing of the financial markets to find out how we can provide the right kind of impetus. Unfortunately, policymakers often create regulations for the things they understand. The level of understanding when it comes to financial markets is not as high as it could be. Developing a better understanding of the role that equity, debt and global investments play is one of the most important tasks we need to accomplish in the immediate future.

And to add to the point about the challenge in the developing world: developing a global hydrogen economy can also be a driver for the expansion of renewable energies in these countries. However, producing countries must also have the opportunity to create jobs, prosperity and renewable energies in their own countries.

For all the challenges that programmes such as the Inflation Reduction Act in the US present us with, I still find one thing encouraging: there is competition. It’s no longer about who has the most attractive climate protection goals, but about who will be most successful in clean energy technology in the future. And this competition will trigger an incredible amount of private investment. That is what we have to focus on and that is what we have to build the framework for.

transition: You mentioned innovation as a key element of the transition. Do we already see enough innovation? Is development comparable in the various regions around the world or do we face the same challenges as in the investment field?

FATIH BIROL: Reaching net zero in 2050 is a tremendous task for the energy world. I see two main jobs that need to be done between now and 2050. One job is to make the most of the existing clean energy options, such as increasing renewables, increasing electric mobility and using energy more efficiently. These are all solutions we already have; we just need to optimise and expand them massively. But this alone is not enough. We have a second job: we need a faster innovation cycle for those technologies that are still under development, such as hydrogen, battery technologies, the electrification of heavy goods transport and carbon capture and storage. They have to be innovated faster and have to complement the efforts to expand the existing clean energy technologies.

Without innovation, we have no chance of reaching our 2050 net zero target. Innovation will bring technologies from the laboratories and from the demonstrations phases to the markets at affordable prices. Therefore, innovation is a critical part of the solution.

ANDREAS KUHLMANN: The role of innovations cannot be overestimated. In a unique sort of way, it’s also something that Germany, the European Union and the countries that are in a better position than others need to do. We need to invest in researching and scaling innovation so that the world can benefit from it. There are plenty of examples of this from the past – We now just need to make sure there are plenty more to come. ■

‘It’s no longer about who has the most attractive climate protection goals, but about who will be most successful in clean energy technology in the future.’

ANDREAS KUHLMANN

Three questions for …

An energy crisis combined with rising prices is having an impact on everyone and every sector of society. So are the challenges on the road to climate neutrality. We asked a cross-section of different people from society, business and politics about how these can be solved.

1 **What are the key levers for overcoming the energy crisis?**

2 **Which policies promote a fair transformation?**

3 **Where do we need to be faster if we are to achieve the goal of climate neutrality?**

Katherina Reiche

Chair of the German federal government's National Hydrogen Council (Nationaler Wasserstoffrat)

1 Until now, Germany has been known primarily for thoroughness and diligence. That can be an advantage. But when the world is changing rapidly, it becomes a disadvantage. Suddenly, speed and pragmatism are what matter. So do having the right attitude, having confidence. A society that lacks confidence is a society without a future. It's during times of change in particular that people need to believe that things can change for the better. We then need a healthy dose of determination to make this happen. People who want to do something will find a way to do it. People who want to stop something from happening will find excuses. That's why we need to do one thing above all; we must want to make this happen together.

2 Entire economies have to become independent of fossil fuels and establish new partnerships for importing climate-neutral energy sources. Germany can play a leading role in this. It will require investments in efficient energy grids, including a hydrogen infrastructure. In addition, the regulatory framework needs urgent improvement, and planning and approval processes must be streamlined – at every level. Using climate-neutral technologies requires all the solutions that are available now. And we must remain open to disruptive innovations. Finally, we should not lose the hydrogen value chain to other regions of the world in addition to digitalisation.

3 Major crises can only be solved if we work together, which means everyone needs to step up – politics, companies and civil society. You can see a crisis as a threat or as an opportunity for a new beginning. I would advise the latter.

Ingbert Liebing

Managing Director of the German Association of Local Public Utilities (Verband kommunaler Unternehmen, VKU)

1 One key building block to overcoming the energy crisis is launching an investment drive to fund the expansion of renewable energies, combined with significantly increasing energy efficiency and increasing the number of H_2-ready CHP plants. This will enable us to increase the electricity supply in the short term and to eliminate our reliance on fossil fuels in the long term. This requires an investment package worth billions of euros that finances production and implementation capacities for climate-neutral technologies, reduces bureaucratic red tape and facilitates the promotion and safeguarding of investments. Another building block is producing and using hydrogen, including the gas infrastructure that can be used for it, without being influenced by an ideology. Although there will be usage priorities initially, the ramp-up of the hydrogen economy thrives on demand from as wide a spectrum of users as possible. We will also need decentralised electrolysers to serve as storage aids and instruments for sector coupling.

2 From a purely socio-political point of view, high energy prices could be compensated by social transfers. But that's not enough. What is needed is a nationwide funding programme that is implemented locally in municipalities and enables, for example, energy consulting, building refurbishment and the purchase of new, energy-efficient appliances to be financed. At the same time, energy policy is also industrial policy, especially for energy-intensive industry. Putting a solid, reliable legal framework in place will enable industry to contribute to success through innovation.

3 It is a massive undertaking and one we can only overcome if we, as in politics, business and society, all work together. Faster planning and approval procedures are a central lever in all of this. This will enable us to expand renewable energies and the electricity grids required for transport at the transmission and distribution grid level more quickly than before. It is vital that the electricity from renewable energy plants can also be used or stored in other forms as part of a highly effective system integration.

Photos: Copy Westenergie AG, VKU/Chaperon

Frank Werneke

Chair of the United Services Trade Union (Vereinte Dienstleistungsgewerkschaft (ver.di))

1 In the short term, we need to absorb the impact of extreme energy price increases further and establish security of supply by diversifying our import options and efficiency measures. We are making good progress in this. We must also keep our focus trained on making investments in a renewable and climate-friendly infrastructure – and doing so quickly – to reduce dependence on individual energy sources. To put it another way, we need to invest in renewable energies, electricity, gas and heating grids, public transport and modern transport concepts.

2 The phase-out of coal and the new changes to plans brought about by the energy crisis have led to deep uncertainty among workers in coal and gas-fired power plants. The pandemic in particular has left its mark on employees in the public transport and aviation sectors. With regard to the transformation to climate neutrality, workers must be given security and prospects, such as with the adjustment allowance for workers in coal-fired power generation.

3 Generally, it can be said that not a single sector involved in climate protection can sit back and relax. The Paris targets require every sector to make efforts in terms of climate protection and transformation. However, with the expansion of renewable energies and the German Act on the Phase-out of Coal-fired Power Plants (Kohleausstiegsgesetz), the energy industry has already achieved a great deal and set a path towards achieving its sector targets. The building sector and especially the transport sector, on the other hand, are still treading water. The plans set out by the ministries responsible for these sectors are still not sufficient. In particular, we need a comprehensive transport transition with an investment drive for public transport.

Thomas Heim

CEO Viessmann Climate Solutions

1 It has now become essential that we take responsibility and prepare Europe for the future. The building sector is the biggest lever in making the energy transition a successful one. This is because heating and cooling together account for over 40 per cent (%) of global CO_2 emissions. Converting all fossil and nuclear energy sources to renewable, environmentally friendly alternatives requires a long-term, comprehensive transformation based on two pillars: firstly, climate solutions based on green and renewable energy, and secondly, increasing energy efficiency, including through using digital solutions.

2 Germany has the potential to become a role model for energy independence in Europe. We already have all the solutions we need to decarbonise the building sector: heat pumps, self-generated and self-stored green electricity and digital services. What our country needs now are bold, pragmatic decisions and a determined industrial policy. The energy transition can only be managed if there is a close cooperation between politics, solution providers, skilled trades and consumers. Finally, the transformation also needs to be a socially responsible one. Individual living situations can be taken into account with hybrid heating solutions, such as using heat pumps to supplement existing condensing boilers.

3 Every company must now take responsibility and act. At Viessmann, we will invest €1 billion in heat pumps and green climate solutions over the next three years. Thus we are making a measurable contribution to Europe's energy independence and to shaping the living spaces of future generations. What is still missing are concrete political programmes that support the industry in this process – for example, through special depreciation allowances and funding for training or support in the transformation. I would personally like to see actual progress be tracked in monthly or quarterly cycles, finally bringing an end to the age of people merely paying the issue lip service.

Sabine Nallinger

Managing Director of the German CEO Alliance for Climate and Economy (Stiftung KlimaWirtschaft)

1 The expansion of renewable energy is the linchpin for both increasing security of supply and reducing energy prices in the long term. Renewables have long been the cheapest source of energy. For companies, access to cheap renewable energies has long been an issue of location. And the terrible Russian war of aggression against Ukraine has shown that expanding 'freedom energies' in Europe also means greater resilience for Europe as a business location.

2 A fair transformation depends on maintaining value creation and jobs in Germany. Companies want to invest in Germany and preserve jobs, but from their point of view, many things are still not progressing quickly enough. Without faster planning and approval procedures and an infrastructure to facilitate a modern, renewable energy supply, especially for hydrogen as well, it will be more difficult for companies to commit to Germany as a business location. This is where the politicians need to step in!

3 In every sector! The climate crisis doesn't provide any respite. At the same time, we have long been in an international competition to lead the way on key technologies in climate neutrality. The European Green Deal is a strong foundation. The task now is to pave the way for future markets with smart investments and a dynamic framework. And this needs to happen at every level of politics. For example, companies have been waiting for months for specifications on the certification of green hydrogen from Brussels. We can no longer afford these types of delays.

Photos: verdi/Kay Herschelmann, Viessmann, Niko Schmidt-Burgk

1 What are the key levers for overcoming the energy crisis?

2 Which policies promote a fair transformation?

3 Where do we need to be faster if we are to achieve the goal of climate neutrality?

Holger Schwannecke

General Secretary of the German Association of Skilled Crafts (Zentralverband des Deutschen Handwerks (ZDH))

1 Skilled crafts enterprises must remain efficient because their employees install and implement everything needed to become more self-sufficient and efficient with regard to energy. This requires qualified skilled workers. Policymakers therefore need to promote vocational education on an equal footing with academic education and equip training centres for the skilled trades and vocational schools with state-of-the-art technology. Moreover, firms must not be subjected to additional strain in these difficult times, be it through higher taxes or social security contributions or through more bureaucratic red tape. The same also goes for the current discussion surrounding an amended German Energy Efficiency Act (Energieeffizienzgesetz). Here, the skilled crafts sector needs practical solutions that do not overwhelm businesses. For example, in addition to ISO 50005, the 'alternative system' of the German Tax Cap Efficiency System Ordinance (Spitzenausgleich-Effizienzsystemverordnung, SpaEfV) should be taken into account.

2 Our skilled craft firms must always be taken into consideration in all the measures to support the transformation process. In the case of green hydrogen, for example, the focus should not only be on promoting large-scale solutions. There is a lot of potential in small-scale and decentralised offers, which is why they must be given much more attention – including in the new revision of the hydrogen strategy.

3 One thing is certain – climate protection and the energy transition can only happen with the skilled crafts and their qualified workers. Millions of skilled craftspeople are actively contributing to climate protection every day when they install solar panels on rooftops, build charging stations for e-mobility and wind farms, replace heating systems and renovate and build houses in an energy-efficient way. To make the energy transition a successful one, however, we urgently need significantly more qualified skilled workers in the skilled crafts. Otherwise, we might fail to achieve the climate targets because we lack the people we need to do the work. We need to train more young people in Germany to become qualified skilled workers, that is the decisive lever. Vocational education and training must therefore be a priority focus in policy decisions.

1 What are the key levers for overcoming the energy crisis?

2 Which policies promote a fair transformation?

3 Where do we need to be faster if we are to achieve the goal of climate neutrality?

Mario Kohle

Founder and CEO of Enpal

1 We need one thing above all – speed. We all have solutions to tackle the energy and climate crisis. Solar and wind energy have long reached market maturity and they are cheaper than fossil or nuclear power plants. And people want to become independent of fossil fuel. There is colossal demand for solar panels and electric cars. We just need to make it happen!

2 Everyone must be able to participate in the energy transition – locally and democratically. We have to make it as easy as possible for people to go through their own private energy transition. This includes cutting the bureaucratic red tape for small prosumers. More freedom for 'freedom energies'!

3 We need vast quantities of clean electricity very quickly for the nuclear and coal-fired power plants that are being decommissioned, for millions of electric cars and for the millions of heat pumps that are replacing old oil and gas heating systems. For that reason, we need to expand solar energy four times faster than before. The good thing is that anyone who has a roof can take part.

Eva Kreienkamp

Chair of the Management Board of the Berlin Public Transport Company (Berliner Verkehrsbetriebe (BVG))

1 The mobility transition plays a vital role, by which I mean two things: the comprehensive guarantee of independence from private cars and the realisation that the mobility transition means more than just an evolution in drive technology. At BVG, we are converting our entire bus fleet to electric mobility by 2030. Not only are procuring the buses and developing the charging infrastructure important, but so is the question of where the electricity comes from. At BVG, the answer is from renewables – which we've been doing since 2014!

2 The €9 ticket made a significant contribution to relieving the financial pressure on people and made local transport affordable. The €49 ticket will do the same. However, expanding the offer of shared mobility and heavily investing in public infrastructure will continue to be key to encouraging people to participate and ensuring the transformation is a fair one. We need fast, smart, digital offers. Having a cheap travel ticket is irrelevant in places with poor local transport connections.

3 We all have to make a major contribution if we are to avert the looming climate catastrophe. And we don't have a problem with knowledge, we have a problem with implementation. Last year, swift action was taken to avert the impending energy shortage. This sense of urgency, this quickness to take decisive action is what we need from all the stakeholders involved to achieve climate neutrality. It is excruciating how new problems keep being identified with regard to this issue instead of implementing existing solutions.

Photos: Agentur Bildschön/Boris Trenkel, Enpal, BVG/Phil Dera

INSIGHTS

A glance at selected projects

GETTING CLIMATE PROTECTION ON THE ROAD

Using electric motors and renewable fuels can greatly reduce the CO_2 emissions caused by heavy goods vehicles However, the transport industry believes that more support from politicians – and an approach that is open to all technologies – is needed if green HGVs are to become established.

TEXT Ralph Diermann

Photo: Volvo Truck Corporation

HGVs offer little in the way of climate protection. They bring in oranges from Spain, transport packages from online retailers and deliver car parts from suppliers. At the same time, delivery vans and HGVs generate almost 50 million tonnes (t) of greenhouse gases per year, which equates to almost one third of all transport in Germany.

From a technical perspective, the climate-neutral HGV of the future can either run on green electricity or renewable fuels. Looking at the green electricity option, HGVs with a large battery (BEVs), overhead lines (OH) and 'fuel cell electric vehicles' (FCEV), which convert hydrogen into electricity via a fuel cell, are all worth considering. Electricity-based fuels, known as e-fuels, and biogas (BioCNG) are the main options available for combustion engines. The benefit of e-fuels is that conventional engines, filling stations and HGVs can still be used to a certain extent.

A positive experience with Bio-LNG

dena is supporting the energy and drive technology transition in road freight transport with the 'Plattform Nachhaltiger Schwerlastverkehr' (the sustainable transport of heavy goods platform) (see info box).

It turns out that logistics provider Paneuropa from Bakum in Lower Saxony, for example, has had a positive experience with bio-LNG – using this fuel is no different from fossil liquefied gas. Readily available biogenic waste is used in the production of bio-LNG, says Henrik Bramlage, Managing Director of the parent company Avanca. The subsidiary Alternoil is currently building a nationwide filling station network for bio-LNG, with around 60 locations throughout Germany. E-fuels, on the other hand, are only available in homoeopathic quantities and at very high costs.

PLATTFORM NACHHALTIGER SCHWERLASTVERKEHR [THE SUSTAINABLE TRANSPORT OF HEAVY GOODS PLATFORM]

The aims of the sustainable transport of heavy goods platform are to bring alternative drive systems and fuels to the market and accelerate the expansion of the infrastructure need for this. It is coordinated by dena together with the German Technical and Scientific Association for Gas and Water (Deutsche Verein des Gas- und Wasserfaches, DVGW). Numerous players from the technology, infrastructure, fuel, energy and vehicle industries, as well as from the transport and logistics sector, are participating in this open-technology initiative.

For more information, visit www.plattform-nachhaltiger-schwerlastverkehr.de

Volvo Trucks starts e-series production

The development of e-HGVs is also progressing. Volvo Trucks was one of the first manufacturers to start series production of battery-electric 40-tonne HGVs. Starting in 2025, the company wants to begin testing e-HGVs that generate the necessary electricity from a fuel cell.

Speed is of the essence when it comes to converting vehicle fleets: the German federal government's Climate Protection Programme 2030 envisages that about one third of the mileage of HGVs should be electric or based on e-fuels. The state pays 80 per cent of the additional costs compared to a diesel for vehicles with an electric motor.

Relief for e-HGVs?

But that alone is not enough, says Volvo manager Gregor Frieb: 'The federal government should now be quick to adopt the CO_2 differentiation of the HGV toll agreed in the coalition agreement, including a toll exemption for electric HGVs. It will establish planning and investment security for shipping companies and manufacturers.' We also need to establish a public charging and refuelling infrastructure for electric HGVs and to upgrade the power grids so that they can handle this. 'The night-time bans that cities have imposed on HGVs for noise protection reasons could be lifted for vehicles with electric motors. After all, they are very quiet,' says Frieb.

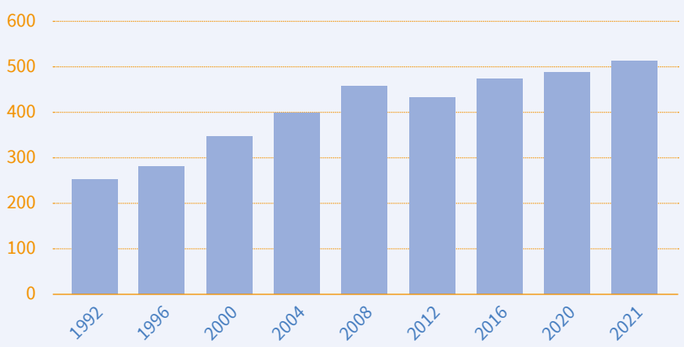
Henrik Bramlage, Avanca's Managing Director, also wants to see more support from policymakers. He is concerned that funding for e-HGVs will be a one-way street when it comes to restructuring the transport sector. 'Policymakers also need to create better conditions for bio-LNG, for example, by allowing it to be counted as part of the EU fleet regulation or as part of an emission-free toll,' he says. Paul Leon Wagner, senior expert for sustainable mobility and coordinator of the sustainable transport of heavy goods platform at dena, takes a similar view: the future design of the HGV toll should also be a factor in the potential that bio-LNG has to protect the climate.

An openness to technology to help protect the climate

'If we are to protect the climate, we need to have different drive technology and fuel options available to us, each of which can play to their different strengths depending on the area of application and requirements,' advises Wagner. An openness to technology is crucial for getting climate protection on the road. ■

HGV transport is growing

Delivery vans and HGVs generate almost 50 million tonnes of greenhouse gases per year, which equates to almost one third of transport in Germany



HGV transport capacity since 1992 in billions of ton kilometres

Source: German Federal Ministry of Transport and Digital Infrastructure (Ed.), 'Verkehr in Zahlen 2022/2023' [Traffic in Figures 2022/2023], p. 244f., and previous years/Uba 2022, PwC Truck Study 2020

THE PATH TO ELIMINATING THE USE OF NATURAL GAS

Climate change, rising prices, supply crisis – companies from the dena project group are demonstrating how energy can be saved and fossil fuels can be replaced faster than planned.

TEXT Hans-Christoph Neidlein

At BASF, half of the natural gas is used to generate steam and electricity, and the other half is used as a raw material to produce ammonia, acetylene and hydrogen, for example. ‘Natural gas cannot be replaced in chemical production in the short term, either as a raw material or as an energy source,’ says BASF spokesperson Florian Faber.

Photos: BASF, Deutsche Milchkontor DMK

BASF is feeling the full force of the gas price shock. The chemical giant covers most of its energy consumption with natural gas, and requires about four per cent of the total amount of gas consumed in Germany at its Ludwigshafen site alone. Half of this is used to generate steam and electricity, the other half is used as a raw material to produce ammonia, acetylene and hydrogen, for example. ‘Natural gas cannot be replaced in chemical production in the short term, either as a raw material or as an energy source,’ explains BASF spokesperson Florian Faber. The fact that gas consumption still fell slightly between March and October 2022 is due to specific technical optimisations and lower plant utilisation.

Milk in DMK Deutsches Milchkontor’s dairy factories is often heated to preserve it.

MAN is planning to use electrolysis

In order to further reduce consumption, the company is working with MAN Energy Solutions on a feasibility study for a high-temperature heat pump with 120 megawatts (MW) of thermal power that generates 150 t of steam per hour. Building an electrolyser with a capacity of 54 MW for green hydrogen is also planned. This hydrogen is expected to flow directly into production as a raw material.

The company secures the green electricity it needs by investing in its own renewable energy plants and through electricity supply contracts. BASF has a stake in the 1.4-gigawatt Hollandse Kust Zuid offshore wind farm in the North Sea. Energy supplier Engie will supply BASF with up to 20.7 terawatt hours (TWh) of renewable electricity over the contract term of 25 years. ‘We are sticking to our ambitious climate protection goals and pushing ahead with a low-carbon chemical industry, despite the challenging political and economic situation,’ emphasises Faber.

Warm milk with heat pumps?

It’s time for a change of scenery. Let’s head north. The vast expanses of the North German Lowlands are also struggling with the consequences of the global energy crisis. The small town of Zeven, situated halfway between Hamburg and Bremen, is home to the headquarters of DMK Deutsches Milchkontor, one of dena’s ‘Flagships for Carbon Reduction in Industry’. Germany’s largest dairy cooperative processes 6.3 billion litres (l) of milk annually at its 20 locations between Erfurt in Germany and Kaatsheuvel in the Netherlands. Some of the process steps require the milk to be heated, making heat a key issue at DMK. Until now, it was generated almost exclusively using natural gas, mostly in CHP plants.

Gas consumptions decreases by ten per cent

In the Edewecht plant alone, around one billion litres of raw milk are processed annually into cheese, whey powder and concentrate and butter. Here, gas consumption is expected to decrease by 24,800 megawatt hours (MWh) annually from 2023 – which equates to about ten per cent. To do this, DMK is linking heat sinks and sources by installing a plate heat exchanger. Thanks to its energy management system and the energy efficiency measures it has introduced, the Production teams saved around 1,700 MWh of energy in 2022, reports Lars Dammann, Head of Occupational Safety and Environment.

At another production site in Schleswig-Holstein, the company wants to test the use of a high-temperature heat pump to reduce gas consumption starting in 2023. Using solar process heat has been put on hold for the time being owing to the costs and the fact that the heat supply is not avail-

FLAGSHIPS FOR CARBON REDUCTION IN INDUSTRY

In the ‘Flagships for Carbon Reduction in Industry’ project, dena has helped ten industrial companies to reduce energy consumption and CO_2 emissions in their production. The focus was on energy-intensive sectors such as the chemical industry, plastics processing, the glass industry and foundries. The project was implemented on behalf of the Federal Ministry for Economic Affairs and Climate Action (Bundesministerium für Wirtschaft und Klimaschutz, BMWK).

For more information, visit www.dena.de/co2-leuchttuerme

able all year round, says Dammann. But Dammann doesn't want to rule out using piped hydrogen as a source of heat instead of natural gas – at least not in the long term.

Steel: 95 per cent less CO_2

Salzgitter AG, which is also based in northern Germany, is a pioneer in green steel production. The company wants to covert the crude steel production of the integrated steelworks in Salzgitter into a low-carbon operation by 2033 as part of a three-phase plan.

To this end, Salzgitter is converting its coking coal-fired blast furnaces to direct reduction, first by using natural gas and then green hydrogen later, in its Salcos project (Salzgitter Low CO_2 Steelmaking). The company aims to reduce its CO_2 emissions, which currently stand at eight million tonnes per year, by more than 95 per cent. In August 2022, Salzgitter signed the contract for the delivery of the first electric arc furnace and the construction of the technical infrastructure.

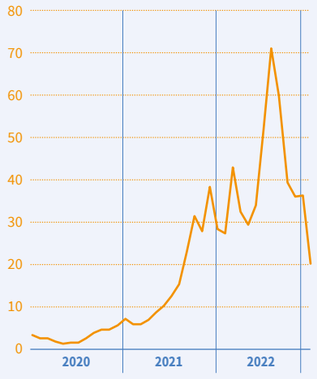
The steel group has been operating a high-temperature electrolyser in Salzgitter since 2019 in a preliminary stage. The green electricity needed to produce hydrogen is supplied (on balance) by seven wind turbines on the factory premises with a total output of 30 MW. However, Stefan Mecke from the Salcos project admits that converting the production process in the first phase from 2025/2026 will initially consume more natural gas before green hydrogen is successively added. Nevertheless, Salzgitter is sticking to its schedule and counting on the natural gas supply stabilising again by then, albeit at higher prices. The additional green electricity required has been secured through multi-year supply contracts (PPAs). 'We see a growing market for green steel and expect great economic opportunities,' says Mecke. Several German car and household appliance manufacturers have already secured the first deliveries of the steel produced with green hydrogen.

Taking a pig iron sample at the blast furnace in Salzgitter

Aurubis: a pioneer benefits

As dena's 'flagship for energy-efficient waste heat utilisation', copper manufacturer Aurubis in Hamburg turned its attention to saving energy several years ago. 'In our Hamburg plant, 80 to 85 per cent of the process heat we need is provided by waste heat,' says Christian Hein, Head of Sustainability. Most of the waste heat comes from the flash smelter's waste heat boiler. 'Heat energy is generated in the melting process by the sulphur bound in the copper concentrate and is therefore carbon-free,' Hein explains. That's why there have been almost no restrictions in production and in extracting process heat. Some of the waste heat has been flowing into Hamburg's 'Hafencity Ost' as district heating since 2018. The company is working on electrification and using hydrogen and ammonia to eliminate natural gas from production to an even greater extent. At the end of October 2022, a test series was started at the Hamburg plant for the use of blue, low-carbon (natural gas-based) ammonia from the United Arab Emirates as fuel in copper wire production. If the pilot project is successful, Aurubis will be able to reduce its natural gas demand in this production area by a further 20 per cent to provide better security against the effects of high gas prices. ■

The price of gas has increased tenfold



Average price of natural gas in Europe from January 2020 to January 2023 (in USD per million British thermal units (Btu))

Source: World Bank, Bloomberg, Energy Intelligence

Photo: Salzgitter AG/Carsten Brand

'Using the gas crisis as an opportunity'

What are the key levers, opportunities and hurdles for saving and eliminating the use of natural gas in industry? Three questions for Martin Albicker, Team Leader of the Industry Business Area at dena.

INTERVIEW Hans-Christoph Neidlein

Decarbonising Germany's economy is a massive undertaking. Are the current energy crisis and the rapid shift away from Russian natural gas acting more as an accelerator or a hindrance?

The higher costs are having a significant impact on the profitability of companies. Many companies have to reduce their production efforts or are questioning whether having production sites in Germany is still a feasible option. If companies are unable to replace their gas consumption with sustainable alternatives in the short term, the consumption of climate-damaging energy sources such as oil or coal will increase at first. But the gas crisis can also be an opportunity. We should use it to set the course for a real transition towards climate neutrality. The understanding in society that a faster phase-out of natural gas is an economic and climate policy necessity should be translated into concrete measures in all sectors. Previous resistance, for example, to the expansion of renewables or infrastructure, could fade away. And the higher price level expected for fossil fuels in the long term is making energy efficiency and renewable alternatives more attractive propositions. Accelerating the already necessary transformation to climate neutrality can also improve the long-term competitive situation of the industrial sector.

How can we save natural gas?

Companies need to realise their energy and resource efficiency potential, even if doing so has not been attractive enough thus far. In dena projects, we also deal with a number of innovative companies that have managed to leverage greater potential and are actively tackling the transformation. At the same time, long-term measures should be accelerated, first and foremost by integrating renewables through the electrification of process heat – especially in places where this is linked to final energy savings, for example, through industrial heat pumps or greater use of flexibilities (DSM). The ramp-up of the hydrogen economy is also crucial.

What hurdles do you see?

The parallel energy and supply chain crises, as well as the shortage of skilled workers, are weighing heavily on companies and can hinder long-term investments. The slow implementation of long-announced legislative processes, such as the reform of emissions trading and the associated introduction of a carbon border adjustment mechanism (CBAM), is creating planning uncertainty. The fact that the expansion of renewable energy sources in the EU has been too slow has meant that highly energy-intensive industry has been limited in how fast it can be converted.

The electrolyser next door

Decentralising hydrogen production doesn't just create precious storage capacity. As hydrogen pioneers in Husum and Adlershof are proving, it can also increase public support for the transition to green energy.

TEXT Tilman Eicke

Photos: HPS Home Power Solutions, GP JOULE

Mike Sommer thought the cars were so good that he immediately bought two of them. For a year now, his driving school in North Friesland, on Germany's North Sea coast, has been giving his pupils the choice of learning to drive in cars with conventional combustion engines or hydrogen fuel cells. It would be an understatement to say he is pleased with the hydrogen machines – and as he points out, 'The tank is full of 100 per cent green hydrogen, produced locally from wind energy.' Sommer's purchases were triggered by the opening of a new hydrogen filling station in Niebüll, the town near the Danish border where his driving school is based. However, even before the arrival of the filling station, he was already convinced that, 'We need to get away from fossil fuels.'

In fact, hydrogen fuel cells tend to be more suited to large vehicles like trucks and buses than to cars. Producing hydrogen requires large quantities of electricity, and the process is not efficient enough to supply energy for millions of private cars. However, Niebüll's example proves that the 'electrolyser next door' model can generate considerable enthusiasm. So, what is decentralised hydrogen production all about?

Mr Sommer's driving school has been able to complete its very own energy transition thanks Project eFarm, an initiative run by major renewables specialist GP JOULE. GP JOULE operates electrolysers at five sites in North Friesland, generating a combined output of 1.125 MW. What's more, they run entirely on locally-produced wind and solar energy. The hydrogen they generate is then sold at the company's own filling stations in Niebüll and nearby Husum – where Mike Sommer is a regular customer. eFarm Chief Executive André Steinau is clearly proud of his company's pioneering work. 'We have also acquired two buses, which we lease to the local public transport operator', he says.

Hydrogen fuel cells tend to work better in trucks and buses than in cars.

Don't stop it: store it!

The hydrogen produced by eFarm currently costs €9.99 per kilo. At the Shell petrol station in Handewitt, 40km north of Niebüll, it costs €13.85 per kilo. Why is it so cheap in Niebüll? The reason is that eFarm sources its electricity from wind farm operators outside the framework of Germany's Renewable Energy Act, which would otherwise force them to switch off their wind turbines at peak times. In addition, the residual heat generated by the electrolysers is transferred back into the electricity grid; the company claims this makes their electrolysis process 95 per cent efficient. By way of comparison, the German Environment Agency assumes that a quarter of the energy used to generate hydrogen is generally wasted in the form of heat alone. eFarm also sells emissions certificates to oil companies to help them stay within the German government's mandatory quotas for greenhouse gas emissions. Finally, the fact the hydrogen is all generated locally means there are none of the high transport costs faced by other producers – a major benefit of a decentralised generation model. As Steinau explains, 'It all helps to bring the price down.'

Boosting support for the energy transition

Best of all, he says, 'We're proving that green hydrogen can create wealth in the local economy. In my view, that also boosts support for the energy transition, which is not all that strong in some other parts of Germany,' he adds, in a reference to protests against the expansion of wind farms. The difference is that, in this region of northern Germany, wind power generated in the local area stays in the region in the form of hydrogen. Steinau feels the locals appreciate that. 'If you take a bus in this part of the

THE DECENTRALISED HYDROGEN PROJECT: H_2 DEZENTRAL

dena's stakeholder project H_2 dezentral (Decentralised Hydrogen) is investigating the risks and opportunities associated with plans for decentralised hydrogen production. We are working with stakeholders to identify future business models and assess how they can contribute to the overall energy system.

For more information, visit www.dena.de/h2-dezentral

Four benefits of decentralised hydrogen production

1

Stabilise the grid when and where its needed. Use a wide network of electrolysers to produce H_2 on demand.

2

Store wind power as H_2 instead of shutting down turbines.

3

Avoid high transport costs by using hydrogen locally.

4

Producing hydrogen generates heat. That heat is best used by consumers in the immediate area.

world, you experience the positive difference it's making in this area first hand.' Of the 1,200 hydrogen-powered cars registered in Germany, 60 of them are in sparsely-populated North Friesland. Steinau feels the locals appreciate that. 'If you take a bus in this part of the world, you experience the positive difference it's making in this area first hand.' Of the 1,200 hydrogen-powered cars registered in Germany, 60 of them are in sparsely-populated North Friesland.

A complete package for self-sufficiency

Home Power Solutions (HPS) is another company with a project dedicated to delivering the energy transition directly to consumers. The firm is based on the outskirts of Berlin, and markets the very first energy storage unit designed to power buildings all year round. 'Our system combines an electrolyser with a hydrogen fuel cell and a conventional battery,' says HPS spokesman Nils Boenigk.

He explains that the storage unit is just slightly bigger than a large fridge. The idea is that solar panels in the home often produce more energy in the middle of the day than can be used immediately, creating a surplus. This surplus of electricity can be used to charge the battery and produce hydrogen. In the evening, when the sun goes down, people carry on using their washing machines and fridges – and the power stored in the battery can be used to power their homes. Meanwhile, the hydrogen is kept in reserve to cover prolonged periods of limited sunshine, especially in the long northern winter. The system comes with an appealing promise: complete immunity from volatile energy prices and year-round solar power from your own rooftop.

The cost of hydrogen

HPS and GP JOULE are two pioneers of decentralised hydrogen production. There is a lot of talk of hydrogen nowadays, but the number of companies actually delivering it to customers is still very modest. The reason for that, as Katharina Sailer explains, is the cost of production. Sailer has been working on behalf of dena to determine the ideal conditions for profitable, decentralised electrolysis. Her findings are striking: 'Of the eight applications for hydrogen, with the exception of the quota for hydrogen in the transport sector and the EU emissions trading scheme (ETS), the business models considered were not realising their full potential under current conditions,' she says. She also points out that whether it will be profitable for oil companies to generate their own electricity-based fuels will depend on the costs associated with preventing CO_2emissions, and particularly whether those costs are lower than the current price of complying with emissions quotas. 'If the assumptions made in the study turn out to be correct', Sailer says, 'that will be the case from 2028 onwards.'

Storage for the energy transition

For Eva Schmid, dena's Head of H_2 & Synthetic Energy Resources, there are two more big issues to take into account. Firstly, we need to store surplus energy and take the pressure off the grid; secondly, we also need to increase support for the energy transition by giving the public a stake in it. As Germany continues to expand its renewable generating capacity, the surpluses produced on sunny and windy days will keep on getting bigger. This is already a problem in northern Germany. For years now, wind farms have had to switch off their turbines at certain times, because the grid lacks the capacity to transport surplus electricity to the south of the country. The Federal Network Agency, Germany's national grid authority, estimates that in 2021 alone, around 5.8 billion kilowatt hours (kWh) of power were wasted, costing fully €800 million in compensation payments. 'If we could build up a network of electrolysers at the worst-affected points on the grid instead, we could store the surplus electricity as hydrogen and use it later on,' Schmid explains.

If we accept this premise, decentralised hydrogen production provides an answer to one of the key issues surrounding the energy transition: what to do in the so-called 'dark doldrums' – those periods when electricity production drops because of changes in the weather. This is a powerful argument against those who argue that expanding renewables threatens the security of supply – a concern that, according to one 2021 survey, was shared by one in two of those questioned. Keeping the energy in the local area is another way of increasing support for the energy transition, says Schmid: 'People who live in and around solar and wind farms can use the electricity they generate in a number of different ways. The wind power doesn't just go to waste or disappear into the ether.'

A tall order: producing 5,000 H_2 HGVs

André Steinau's hydrogen filling stations have created quite a buzz in North Friesland, and he is very optimistic about the future of the hydrogen business. For his company GP JOULE, the filling stations in Niebüll and Husum are just a pilot project. Their next goal is to build a network of filling stations for heavy goods vehicles covering the whole of Germany. They plan to stick with the same basic concept that has proved so successful in North Friesland: taking green, locally produced electricity and using it to produce hydrogen. That hydrogen will then be used to power trucks. To make the switch to hydrogen fuel cells as easy as possible for logistics companies, GP JOULE is looking to buy the trucks itself and then lease them. The company is already working together with a range of manufacturers to turn this idea into a reality. In 2022, GP JOULE 2022 signed a framework agreement with Hamburg-based Clean Logistics to supply a total of 5,000 hydrogen-powered trucks.

The idea of a hydrogen-powered HGV appeals to Mike Sommer, too. So much so, in fact, that he already has one on order, even if converting it for use as a driver training vehicle will take a little while yet. He has no doubts about his decision: 'The technology has proved its worth as far as I'm concerned. I am excited to see how it develops, and ready to invest in it.' ■

The Berlin-based firm HPS provides energy storage for households. Their system combines a battery with an electrolyser, and is the size of a large fridge.

Photo: HPS Home Power Solutions

The dawn of **the hydrogen age**

The largest electrolyser (25 MW) in the Norddeutsches Reallabor (North German Living Lab) will soon be producing green hydrogen amidst the oil storage tanks of the Holborn refinery in Hamburg.

Photo: Holborn/Olaf Malzahn

Is the petroleum age coming to an end at the refineries in the Port of Hamburg? The North German Living Lab and the Bad Lauchstädt Energy Park are showing how the industry can switch to green hydrogen, and which hurdles still have to be overcome. By 2026, the labs are expected to deliver results that can be transferred to the entire economy.

TEXT Marcus Franken

The sweet smell of crude oil still lingers in the air on hot summer days amidst the large storage tanks in the south of the Port of Hamburg, where steamboats have given way to oil tankers. For over a hundred years, the North German oil industry has been very vibrant here. And ironically, it is where the future will begin.

'We are taking the first step in moving away from being a traditional oil refinery and turning into a green refinery,' Inga Tölke says proudly. She is the prokurist (a holder of a general commercial power of attorney) for the Holborn refinery, which processes five million metric tons of crude oil annually into diesel, petrol and heating oil. With a capacity of 25 MW, the largest and most important electrolyser in the North German Living Labs will be built amidst the ship yards and refinery storage facilities with over a hundred oil tanks. The feasibility study has been completed, and Holborn has opted for HAzwei, a partner from the energy industry, as the developer. Inga Tölke is already counting on green hydrogen. It will replace 3,400 cubic meters (m^3), or ten per cent of hydrogen produced from fossil fuels, annually in the desulphurisation of diesel – and that is just the beginning.

Plans for electrolysers with a total capacity of 125 MW

Green hydrogen is expected to forge ahead at the Holborn refinery even more. Holborn also plans to operate a 50-MW electrolyser for desulphurisation and a third 50-MW electrolyser to produce synthetic petrol. 'We plan to have electrolysers with a total capacity of 125 MW on our site by 2029, moving us further toward climate neutrality,' says Tölke. Naturally, the expansion is also driven by regulations regarding further CO_2 reductions.

The 25-MW electrolyser of the Holborn/HanseWerk partnership is just one of the projects in the North German Living Lab (NRL). Five living labs investigating the linking of sectors and hydrogen got under way in 2021. The H2Stahl, H2-Wyhlen and Westküste100 projects are focusing more on individual topics, while the North German and Bad Lauchstädt living labs have set their sights on a broader range.

'Given their complexity and size, the North German Living Lab and the Bad Lauchstädt project play an important pioneering role,' says Simon Pichlmaier, who heads the accompanying research involved with the living labs at Trans4ReaL. For him, the living labs are providing important insights, especially in the current development phase. He added that feasibility studies, permit applications and financing decisions are being made for projects on scales that did not exist before the living labs. 'The companies are injecting a lot of their own capital, so they also have a vested interest in telling policymakers directly where things aren't working out yet from a regulatory and financial standpoint,' Pichlmaier continues. 'This decisively accelerates the ramp-up of the hydrogen economy.'

The first transition congress in 2023

dena supports the Trans4ReaL living labs and accompanying research. 'It is crucial that the German hydrogen economy forms networks early on in order to establish a functioning ecosystem and exploit synergies,' says Jeannette Uhlig, Team Leader H_2 & Synthetic Energy Sources at dena. The energy agency already launched a series of workshops in 2022, is organizing the first transition congress in April 2023 and will provide continued support for the living labs on behalf of the Ministry of Economic Affairs and Climate Action.

One focus in the NRL is hydrogen and waste heat in industry. There are plans to build an electrolyser at copper manufacturer Aurubis AG in the Port of Hamburg in 2024, and H&R Ölwerke Schindler commissioned a power-to-liquid plant in 2022. In addition, electrolysers will be built at Stadtreinigung Hamburg, the municipal waste management facility for Hamburg, in 2024 and at Fraunhofer IWES in Bremerhaven in 2023, as well as in Mecklenburg-Western Pomerania in 2025. There are nearly 50 partners involved in 25 different projects. 'A strong network of projects and infrastructures is emerging here to take the decisive steps toward climate neutrality,' explains the NRL board. The total investment adds up to €405 million, including around €55 million in funding from the Ministry for Economic Affairs and Climate Action. The new plants are expected to save up to half a million metric tons of CO_2 annually from 2025.

THE LIVING LABS FOR THE ENERGY TRANSITION AS A TRANSFER PROJECT

The living labs for the energy transition bridge the gap between research and the development of marketable hydrogen technologies. dena supports transfer research through the Trans4ReaL project. The aim is to make the specialised knowledge gained in the living labs – each with their very different focuses – accessible to all areas.

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

HAzwei wants an electrolysis capacity of up to 500 MW

'We will show how northern Germany can cut its CO_2 emissions by 75 per cent by 2035,' says the NRL, indicating the direction in which everything is moving. Even for HAzwei, the hydrogen subsidiary of the two northern German energy suppliers Hansewerk and Avacon, the 25-MW electrolyser at Holborn is just a first step. 'The demand for green hydrogen will increase enormously and we want to serve this demand,' says Marleen Marks, senior project developer at HAzwei.

'Northern Germany needs 1,500 MW of electrolysis and wind power with an installed capacity of 4,000 MW just to meet the hydrogen demand for chemical processes in industry,' Marks adds. HAzwei has plans to contribute a capacity of 400 to 500 MW from its own electrolysers by 2030.

A 25-MW machine, like the one that will be built at Holborn, costs €50 to €60 million today. There are around ten companies worldwide that are able to offer electrolysers of this magnitude, with a gas purity of up to 99.999 per cent and delivery and commissioning by 2025. The electricity requirement of 160 gigawatt hours (GWh) per year is to be covered by new and old wind farms in northern Germany, which will be integrated via direct supply contracts. The preliminary work is complete, and the aim is take the final investment decision in 2023. That would send a meaningful signal.

Habeck: We're struggling with the design of the electricity market

There are two buzzwords currently echoing in the halls of the living labs: regulatory frameworks and prices. 'We cannot punish the industry with rising grid fees if we want them to switch to green power,' disputes a senior NRL expert in response to Robert Habeck, Minister for Economic Affairs, as he sits across from him at an NRL meeting. One thing is clear for the minister: 'We're struggling with the rules of an electricity market design that originated in a fossil-fuel mindset.' And it's not just Germany that needs to 'do its homework' (in the words of Mr Habeck). The industry is waiting for clear criteria from Brussels for green hydrogen generated by electrolysers using solar or wind power. This will allow industry to market the use of green hydrogen as a means of greenhouse gas reduction. 'We need a protected space for these technologies in the ramp-up phase,' the NRL expert argues. Only then can companies like HAzwei and Holborn plan for the future.

Wind-power generated hydrogen in Bad Lauchstädt

Things are also moving forward in Germany, just 250 km south-east of Hamburg between Halle and Leipzig, where Terrawatt Planungsgesellschaft mbH has received approval for a 50-MW wind farm with eight turbines. The tendering process for the 30-MW electrolyser has also been completed, with the winning bid going to Dresden-based company Sunfire. 'We want to be the first in Germany to demonstrate the entire supply chain from the production of green hydrogen to storage and delivery to the end customer in the chemical park,' says Hartmut Krause, spokesperson for the Bad Lauchstädt living lab and managing director of DBI – Gastechnologisches Institut gGmbH in Freiberg.

None of the individual elements in this value chain involve anything like rocket science, as the challenges lie in scope and interconnection. And that all starts with the necessary permits. 'Nobody is prepared for whether you have to approve an electrolyser together with the wind turbines or not and if so, how,' Krause says from experience.

How is the wind farm connected 'directly' to the electrolyser? Can the substation between the wind farm and the electrolyser have a connection to the power grid? How does all this affect the permitting process? Is the hydrogen produced truly 'green'? 'These questions are uncharted territory for companies and authorities alike,' says Krause.

Federal Minister Habeck pays a visit to the Bad Lauchstädt Energy Park to find out more about the proven value chain there for wind energy, hydrogen conversion, storage, transport and utilisation.

Photos: Energiepark Bad Lauchstädt, H&R Group

H&R Ölwerke Schindler commissioned a power-to-liquid plant in 2022 as part of the North German Living Lab, which produces alternative fuels.

The whole is more than the sum of its parts

Energy engineers are also asking themselves the question: what is the right size for the electrolyser? 'The design of the wind turbines and electrolysers is now aligned in such a way that we get about 4,000 full-load hours a year,' says Krause, explaining the solution in the living lab. For example, the electrolyser can deliver up to 6,500 m^3 of hydrogen per hour to a nearby cavern, which will be made ready to handle it. The pipeline technology at the head of the cavern, known as the wellhead, is specially designed for hydrogen instead of natural gas; a 25-km long natural gas pipeline to the Leuna Chemical Park can be upgraded for this purpose. But as mentioned earlier, the devil is in the details, and it will be the first time that these challenges have been encountered in this constellation.

Krause has a long list of questions that the living lab has to answer. Is the 99.96-per cent hydrogen purity that the industry is calling for readily achievable? Or do impurities spread out in the green hydrogen throughout the grid, making an additional purification stage necessary? 'We've done many of the calculations, but we also need to test it.' If the theory is found to align with the real-world conditions in the end, the living lab can also provide a reliable template for other projects.

Rolling out the hydrogen network from 2030

Krause is counting on rising CO_2 prices and scaling to ensure that green hydrogen can also compete with fossil gases in economic terms. 'The quantities that industry is demanding are very different to what we produce today,' says the gas engineer. The Leuna Chemical Park needs around 100,000 m^3 per hour, compared to the 6,500 m^3 of hydrogen per hour produced in the Bad Lauchstädt Living Lab. Hydrogen production will in future have to offer one hundred times the living lab's output today. Krause is convinced that 'we will be able to produce green hydrogen at competitive prices from 2030 if we establish the right framework conditions.'

His vision is that, in a region like central Germany, there will be three to four major electrolysers in future, powered by thousands of solar panels and hundreds of wind turbines, supplying hydrogen as an energy source that can be stored and as a primary product for industry. ■

HEAT PUMPS ARE MAKING INROADS WITH OLDER BUILDINGS

It's not just new buildings that can be heated with heat pumps. They can act as a reliable heat source for old buildings, too. Six million systems are expected to be in operation in Germany by 2030. The heating industry is ready to rise to this challenge. But who will install them?

TEXT Jan Oliver Löfken

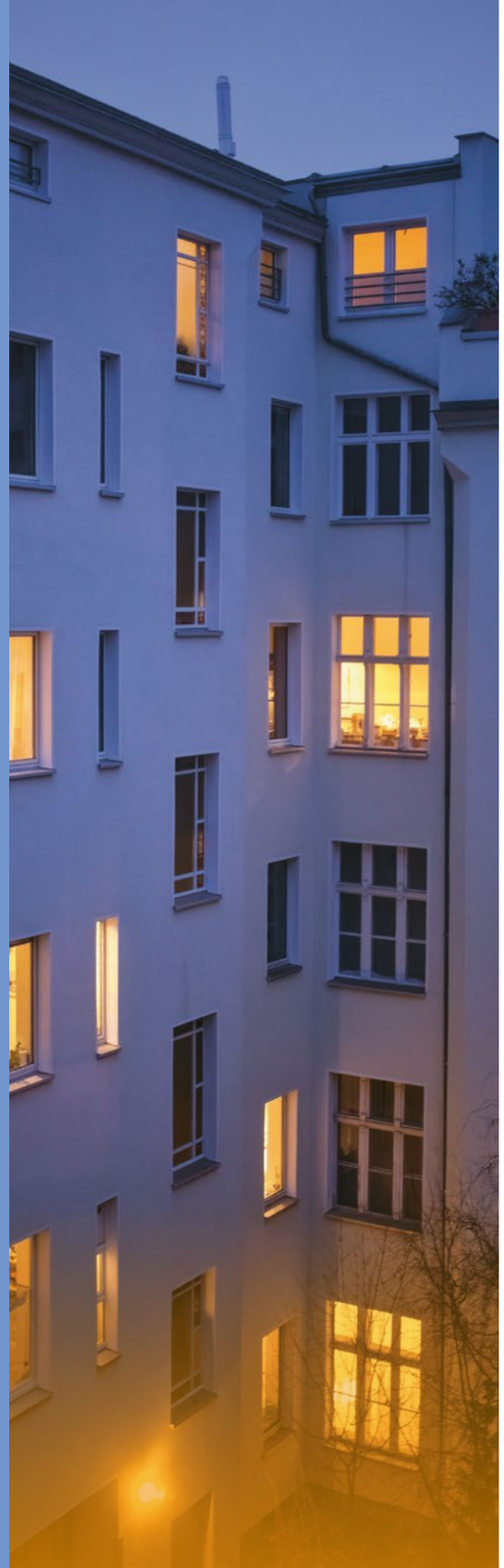


Photo: zettberlin/Photocase

Even adult education centres have put it on the timetable. There is an expert lecture called 'How does a heat pump work?' offered at the VHS Höxter-Marienmünster adult education centre. A reader called the hotline of Germany's daily tabloid BILD asking: 'Can I install a heat pump in my old house?'. Across the nation – from Flensburger Tageblatt to Passauer Neue Presse – the editors of German newspapers are delving into what heat pumps can do and how much they cost.

There is good reason for the great interest. 'Heat pumps will make a key contribution to climate protection in buildings,' explains Martina Schmitt, senior expert in Analyses and Building Concepts and Climate-neutral Buildings at dena.

Residential and commercial buildings in Germany will improve their climate neutrality thanks to heating with electricity as opposed to coal, oil or gas. Heat pumps extract heat from the outdoor air, surrounding ground or a water source. A temperature difference of just a few degrees Celsius may seem insignificant, but it is sufficient to heat homes and buildings. The underlying technology uses a refrigerant and compressor, much like in a refrigerator. The only difference is that the heat pump extracts the heat from the outside world instead of the interior of the refrigerator.

Great momentum – even before the outbreak of war

Heat pumps usually bring the hot water system up to 45°C to 55°C, but in some cases up to 70°C, which is hot enough to provide heat to homes and warm up service water in newly built homes. What's more, it even works for older buildings. The crucial question is: how efficiently does the refrigerant compressor in the heat pump work? With an input of 1 kWh of electricity, it can provide 3 to 5 kWh of heat on average.

It will be a great feat for the heat pump to make Germany's total existing building stock climate-neutral by 2045. Natural gas, oil and coal supplied more than 80 per cent of the heat in Germany before Russia invaded Ukraine. According to dena's recently released Building Report, nearly one in two households heat with gas, which used to be relatively inexpensive; however, things are changing rapidly. 'We've already seen a spike in growth for heat pump systems for heating since 2020,' states Schmitt. Around 1.5 million of these systems are being used in new buildings, as well as more and more in older buildings. One-third rely on ground-source and two-thirds on air-source heating systems. Heat pumps that use groundwater or nearby bodies of water play a minor role (60,000 systems).

Six million new heat pumps by 2030

In mid-2022, the German government set a target of six million heat pumps installed by 2030. To meet this goal, 500,000 new systems need to be added annually starting in 2024. This would mean meeting the government's planned target: that every newly installed heating system is powered by 65 per cent renewables where possible. To support this, dena is participating in the project group for a heat pump summit hosted by the Ministry of Economy Affairs and Climate Action. 'It's important that we get manufacturers and the real estate industry on board,' says Christian Stolte, head of dena's Energy-efficient Buildings division. Adding that, the manufacturers of heat pumps already have these expansion rates in mind and are greatly expanding their capacities. The industry is not unaccustomed to the incredible momentum. The heating sector grew by 28 per cent in the heat pump segment between 2020 and 2021 already, and has also been able to meet the increased demand from 140,000 to nearly 178,000 systems.

Urgent need for skilled labour

Proven technology, rising production figures and high subsidy quotas – there is still another hurdle for heat pumps, even if the conditions for switching are quite good now. 'The need for skilled workers – that's the biggest challenge at the moment,' says Martina Schmitt. Only one in three heating companies even offers heat pump installations, and wait times up to a year are quite common.

'But we can observe changes when it comes to the training of heating installers and in retraining courses,' notes Schmitt, referring to the increasing importance in

the curricula. In order to further this trend, it makes sense to offer training opportunities specifically for heat pumps, such as the German government's Heat Pump Development Programme, which kicks off in 2023. If the image is improved, it should become more attractive for trainees and newcomers alike. Likewise, there should be new job profiles.

'For this reason, dena is launching an information campaign on heat pumps in 2023,' states dena Chief Executive Andreas Kuhlmann. It will show examples of them and manufacturer-independent guides will be developed in an effort to communicate the advantages of heat pumps. This information is intended to give direction for people, because there are still few standardised solutions.

Making inroads with older buildings

But the transition from fossil fuels to something different will take more than just installing heat pumps in new buildings. Existing building stock will also need to significantly increase the share of renewables (biomass, solar thermal and sources used by heat pumps). After all, only 26 per cent of the nearly one million retrofits in this type of building used heat generators with renewable energy sources in 2021. 'It is technologically feasible and makes sense,' says dena expert Martina Schmitt with regard to people's reservations that heat pumps are primarily suitable for new buildings with underfloor heating. 'In existing buildings, heat pumps are as efficient today as in new buildings from 2007 to 2010,' proclaims Marek Miara, who coordinates heat pump activities at the Fraunhofer Institute for Solar Energy Systems ISE in Freiburg.

Fraunhofer studies show that the technology has improved significantly. In particular, the efficiency was increased by optimisations to components such as the compressor. Miara and his team spent many years analysing more than 300 heat pump systems, most recently in older existing buildings from as far back as 1973, 1950 or even 1937. They came to the following conclusion: the efficiency values of heat pumps are adequate, even with traditional radiator systems, antiquated windows and moderate insulation. 3 to 4 kWh of heat could be produced from 1 kWh of electricity at water temperatures of up to 55°C over the course of a year – without any problems. That corresponds to annual coefficients of performance (CoP) of 3 to 4.

'The efficiency still averaged 2.3, even in the coldest two weeks of the last 20 years – February 2021,' Miara proffers. Operating costs for the electricity are also still very modest. In a side-by-side comparison with gas heating systems, heat pumps are less expensive – and not just during periods of high natural gas prices.

'Gas boiler heating systems have been consistently more expensive than heat pumps, even when the gas price is at a moderate 12 cents per kWh,' Miara says. Subsidies covering much of the costs are also contributing to the increasing profitability of heat pumps.

How will the power grid cope with the boom in the heat pump business?

The higher demand for electricity also needs to be taken into account when planning to install 500,000 heat pumps each year as of 2024. After all, an older single-family home with 150 square meters of living space accounts for an estimated additional demand for 5,000 kWh of energy per year. According to a study published by the Institute of Energy Economics (EWI) at the University of Cologne, there could be a future gap of 3.2 TWh of electricity in 2030. Electric heat pumps pose a major challenge to the power supply system, especially during very cold spells. Grid operators are required to adapt their lines to the increasing demand according to the EWI. But heat pumps can also have a stabilising effect on the power grid. 'They can be used in load shifting,' says Schmitt. Doing so would require smart meters to act as an interface. If heat pumps can be flexibly adapted to periods when there is a shortage or surplus of electricity, more wind and solar power could be fed into the grids than before. A consortium led by Lechwerke AG in Augsburg is working on this flexibility, which should not affect heating comfort, as part of the Flair research project.

Heat pumps that use less propane gas as a refrigerant are also being developed. Most heat pumps still use partially fluorinated hydrocarbons (HFC), which can contribute to global warming if they escape. 'Propane, the climate-friendly refrigerant, is a major topic,' says Constanze Bongs, a researcher at ISE. For example, a working group from her institute managed to operate a heat pump using small quantities of propane as a refrigerant as part of the European research project LC 150. It took only 124 grams of propane to attain a heating capacity of 12.8 kilowatts. Consequently, only 9.7 grams of propane were sufficient per kilowatt of heating capacity. 'That's approximately equivalent to the amount of propane in five lighters,' says project manager Clemens Dankwerth. Heat pumps on the market now that use propane as a refrigerant require many times that amount (approx. 60 g per kilowatt). In particular, the fire risk is thereby reduced because significantly less of the highly flammable gas is required.

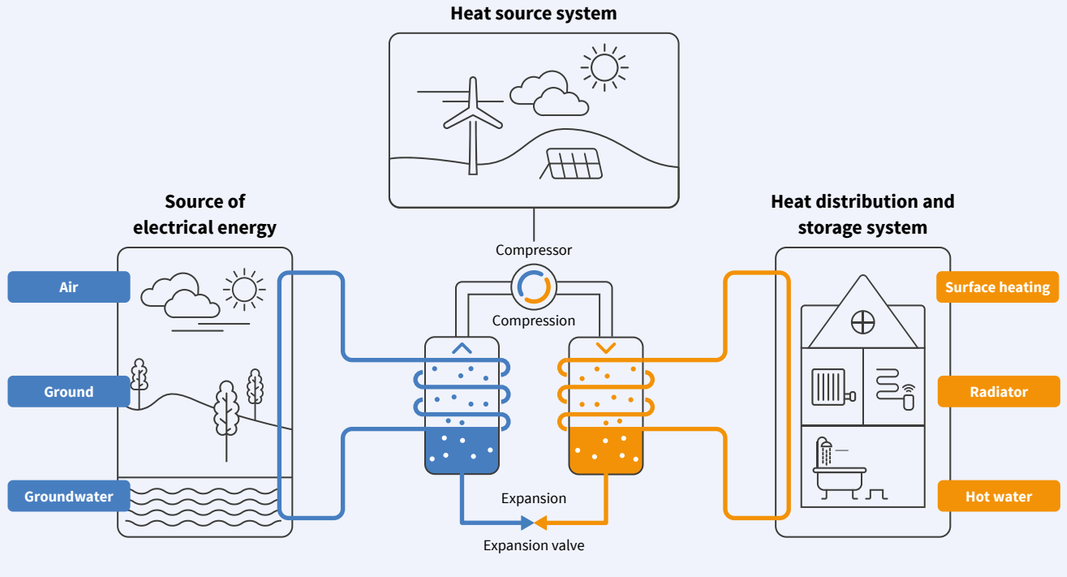
And last but not least, a lot of effort is being invested in heat pumps that can achieve much higher temperatures than the average 45°C to 55°C for space heating and up to 70°C for heating existing buildings and domestic hot water. For example, the food industry or paper manufacturers could benefit from process heat between 100°C and 250°C, which would minimise the use of gas or other fuels. In the meantime, the first systems featuring temperatures of up to 150°C are available on the market. Solar thermal collectors or deeper geothermal boreholes would also be suitable as heat sinks, in addition to waste heat sources in industry.

Until then, the lecture halls of the adult education centres, the BILD hotline and the consumer news pages of Germany's daily newspapers will be in high demand. ■

High level of demand: industry is ramping up the production of heat pumps.

Photo: Vaillant Group/Mike König

How a heat pump works



For every 1 kWh of electricity used to power the heat pump, it can extract on average 3 kWh of energy from the outdoor air, 4 kWh from the ground and 5 kWh from water sources (groundwater, rivers/streams, wastewater).

CON-STRUCTION CYCLE

INSTEAD OF A DISPOSABLE ECONOMY

Circular construction conserves resources and can help the construction industry emerge from the one-way street of extracting/using/discarding – with the right building materials, reversible planning and the help of digital platforms.

TEXT Tanja Ellinghaus

The monks at Plankstetten are now taking serious steps toward the integrity of creation. House St. Wunibald – named after an abbot who converted Germanic tribes long ago – is a three-storey multi-use building with 30 guest rooms, the rectory and a kindergarten. To the largest extent possible, it consists of materials yielded by the monastic forests and fields.

A building that is as close as possible to the biological cycle: The outside walls are made of prefabricated modules in a timber frame construction, featuring spruce cladding – and insulated with straw. The 400 m^3 of spruce come from Plankstetten Abbey's own forest. The 2,500 bales of straw were sourced from the Abbey's own organically cultivated fields 'as a building material from the farmland next door,' says Master Carpenter Benedikt Kaesberg. Within the scope of the EU project UP STRAW, in which the Abbey participated, he helped guide the building process and contributed his experience in straw-bale construction. For him, straw is a 'building product like any other.' Concrete was only used in areas where the slope of the site allowed for no other option.

It may seem strange to most builders, but it has a long history. Straw-bale houses already existed in the USA at the end of the 19th century – at that time, because of a timber shortage. As far as the building planning is concerned, Kaesberg doesn't see any major differences compared to timber construction. He is convinced that straw-bale construction is becoming increasingly attractive in Germany. Although these designs still lag far behind timber construction, 'the development of timber construction in the last 20 years could easily be taken by straw-bale construction as well,' Kaesberg predicts.

Less glue, more screws

This is because the pressure on the construction industry is growing worldwide. The overexploitation of raw materials is evident in material shortages and rising prices.

GEBÄUDEFORUM KLIMANEUTRAL (CLIMATE-NEUTRAL BUILDING FORUM)

As the central contact point for climate-neutral construction and renovation, this forum provides quality-assured expertise on climate-neutral buildings and neighbourhoods and presents outstanding projects that play exemplary roles.

For more information, visit www.gebaeudeforum.de

The extraction, production, transport and use of building materials as well as their dismantling and disposal account for 40 per cent of CO_2 emissions in Europe alone. This means that the construction sector surpasses the entire mobility sector. The amounts of waste are also breaking records: In Germany, 55 per cent of all waste comes from the construction sector. Much of this waste can't be recycled and ends up in landfills or is concealed in road construction. And at this point, only a small part of building materials comes from recycling.

The new building at the Bavarian Planstetten Abbey shows how to do things differently. It is the largest straw-bale building in southern Germany and uses the most renewable and resource-friendly construction materials possible. Moreover, it is built according to the passive house standard.

Material and construction

The idea behind circular construction is to manage resources for buildings and infrastructure in cycles and reuse them continuously instead of discarding them as waste. This is all about choosing the right materials and a construction that can be dismantled,

Close to the biological cycle: the straw-bale building of Plankstetten Abbey, House St. Wunibald

The interior of House St. Wunibald

Photos: hirner & riehl architekten und stadtplaner

The recyclable RoofKIT prototype for renovations and building additions in urban development

Interior view of the RoofKIT on the campus of the Karlsruhe Institute of Technology (KIT)

explains Heike Marcinek, Manager of Analysis and Building Concepts at dena. She sees renewable raw materials such as wood, clay and straw as the building materials of the future: 'Even if they can't be reused, they can at least be returned to the biological cycle.'

Or they can be reused in construction cycles, like the conventional building materials aluminium and glass. 'What matters is that the building materials are durable and non-toxic and that the material combinations can be separated,' says Marcinek. This also changes the construction method. It involves less gluing and more screwing or plugging together.

Living in a 100% recyclable module

On the campus of the Karlsruhe Institute of Technology (KIT), students working on the RoofKIT project have constructed an entire, life-size residential storey that is completely recyclable. The storey is intended to be a prototype for renovations and building additions in urban development.

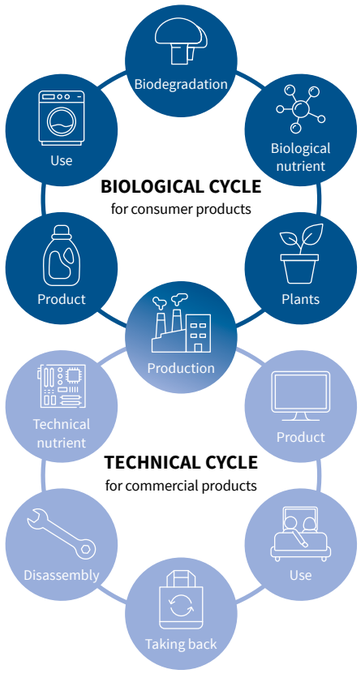
It is a unit consisting of prefabricated wooden modules that can be easily and quickly assembled and disassembled on site. Wood from old barns in the Black Forest as well as bathroom and kitchen fixtures from dismantled trade fair structures were used in its construction. Some of the recycled materials were procured in line with the concept of urban mining. This means that old buildings are used as 'mines' for raw materials. 'Since we're unable to dismantle most of our buildings 100 per cent at this time, this has created a large reservoir of building materials,' explains Project Manager Dirk Hebel, Professor of Design and Sustainable Construction at KIT.

The students received first place in the 'Solar Decathlon 2021/22' for this design, which also includes the renovation of a café in Wuppertal with the construction of new storeys. Two premises were observed in planning: 'Firstly, we use unmixed materials and no composite materials that contain glue. Secondly, it must be possible to disassemble the materials again,' Hebel says. This ensures that the building materials can be reused in their original quality.

Building materials from the urban mine

For their housing unit, the students also used recycled materials such as copper for the roof or highly polished steel for mirrors, as well as organic materials such as clay, felt and untreated wood. Some of this sounds exotic at first: The insulation, for example, is made of dried seaweed and there are lampshades made of mycelium from fungi. As far as the materials go, 'we have acquired a lot of knowledge over the years,' Hebel reports. The materials actually aren't all that exotic: All of the building materials can be bought at exchanges and markets for construction materials.

Whether it's Galeria Kaufhof in Osnabrück, the Old City Library in Augsburg or the dismantling of the Vodafone headquarters in Düsseldorf: By now there are companies such as Madaster or Concular that use online platforms to collect extensive data on materials and components from buildings. The installed materials receive a digital passport with information about their quality, origin and location, which makes it easier to reuse them in case of disassembly.



The industry will change

St. Wunibald and RoofKIT are distinguishing themselves as showcase projects and demonstrate what is possible when the people involved in construction share a vision. The reuse of old doors, windows or building components won't offer a quick solution for the climate problems caused by construction – given the 60 billion tonnes of building materials that are used worldwide each year, according to estimates by experts. So it is all the more important that the industry gets active as a whole: 'The real estate industry must change,' says Heike Marcinek. The climate neutrality goal that Europe has committed to is driving this change. According to Marcinek, the issue of sustainable construction will gain more weight in the future, when the carbon footprint and life cycle considerations of building materials and entire buildings will play a greater role.

She believes that sustainability labels such as the international Cradle to Cradle certificate can also boost this development. The cradle to cradle principle, developed in the 1990s, aims at the unlimited recycling of raw materials and products, and consequently at resource conservation and a true circular economy. Even if a comprehensive circular economy of raw materials is still a long way off, the dena expert is certain: 'Now there are things in motion that will activate and change the market.' ■

Photos: Zooey Braun

'Focus on material and construction methods'

Three questions for Heike Marcinek, Leader of Analyses and Building Concepts at dena

INTERVIEW Tanja Ellinghaus

What distinguishes circular construction from sustainable or energy-efficient construction?

Sustainable construction is the bracket around everything. It includes the entire life cycle, the ecology and social and economic aspects. Circular or recyclable construction is a part of sustainable construction that focuses on the choice of materials and construction methods. Energy-efficient construction is about lowering energy consumption for heat and electricity in building operation.

How important are online material registers?

These platforms are an important foundation for recyclable construction. You must be able to identify the installed material, otherwise it loses its value. With careful documentation, every building can become a material database. The best-known material registers include Madaster and Concular.

What does dena offer stakeholders that are interested in circular construction?

On our website gebäudeforum.de, we bundle information for planners and experts who are looking for neutral and reliable information on the topics of energy efficiency, sustainable building and recyclable building in areas related to new construction and renovations. Here we publish information on tools such as the registers, as well as background information on individual materials and standards. We also link to valuable specialist materials from our partners in the Gebäudeforum klimaneutral.

HEATING TRANSITION INSTEAD OF GLOBAL WARMING

Freiburg, Lörrach and Leipzig are leading the way in municipal heating planning in Germany. As pioneers, they are encountering hurdles that many German municipalities will soon face. dena's Municipal Heating Transition Excellence Centre is providing them with support.

TEXT Tilman Eicke

Municipal heating planning takes into account the local conditions in the specific region, which gives rise to customised local heat and energy supply concepts.

Freiburg looks like a big red spider. At least, that is how a map published in October 2021 portrays the city. The main body of the spider covers the city centre and its red pixelated limbs stretch out toward Sankt Georgen, Littenweiler and Gundelfingen. The closer you are to the city centre, the closer together the red squares lie.

The city map in question is a heat demand cadastre. It shows where the demand for heat in Freiburg is particularly high, such as the areas shown in orange and red. Based on this and other data, the city has designated areas that are considered suitable for various types of heat supply. It could be either district heating networks or heat pumps; however, the decisive factor is that the heat demand atlas provides a reliable decision-making tool for all stakeholders involved in the heat supply chain. 'Instead of working on a small scale with no coordination where everyone builds their own heating system, there is now a joint plan for the entire municipality. That's a first,' says Magdalena Magosch. She works at the environmental protection agency, where they are coordinating this process in Freiburg – a city to use as a reference if you want to know about the future of heat supply.

From 'each to their own' to mandatory

Many municipalities like Freiburg are fervently drawing up municipal heating plans – with good reason. 'The carbon footprint of the heat supply in Germany is devastating,' says Robert Brückmann, who heads dena's Municipal Heating Transition Competence Centre in Halle an der Saale (see interview). He adds that 80 per cent of Germany's heat is still generated using gas, oil or coal; more than half of its energy consumption is used for heating and cooling. Brückmann: 'If we want to be climate neutral by 2045, we need to transform the heat supply as quickly as possible.' dena founded the Municipal Heating Transition Competence Centre in 2021 to ensure that municipalities are not left to deal with heating planning on their own (see box). At the same time, the German government is planning a law that will make municipal heating planning mandatory. The municipalities are to draw up corresponding plans within three years of passing the law. Freiburg, Lörrach and Leipzig have started this process, but these cities are at different stages. What can be learned from their experiences?

From analysis to implementation

'Heating planning consists of four work steps,' explains Inga Nietz, who helped draw up the plans in her capacity as the director of the climate protection unit in the Lörrach district. She says that the first step is to determine how much heat is consumed and where it comes from. She adds that the picture in Lörrach was sobering. 'When you are holding the results in your hands – that's when you see how tricky the situation really is. Three-quarters of the district is supplied with natural gas.'

Then the municipalities prepared an analysis of potential to ensure that the transition will be successful. Two questions were posed in the process: which new heat sources can we add? And where can we save tremendous amounts of heat? 'Heat supply was quite simple up until now. We either used fossil fuels directly on site or in the local power plant. In comparison, heating planning for the future is a much more involved process, because the number of possible heat sources that we can consider is huge,' explains Inga Nietz. A practical guide from the Klimaschutz- und Energieagentur (KEA) Baden-Württemberg GmbH lists a whole range of possible technologies: biomass boilers, solar thermal systems, heat pumps, deep geothermal systems and waste heat from industrial processes or municipal wastewater. This is one of the reasons why municipalities will continue to work on heating planning in the future. After all, the potential for new heat sources differs from municipality to municipality (different types of industry, availability of geothermal sinks). For example, in the case of the Lörrach district where all 35 munici-

KOMPETENZZENTRUM KOMMUNALE WÄRMEWENDE (MUNICIPAL HEATING TRANSITION EXCELLENCE CENTRE)

The decarbonisation of heating is one of the keys to climate protection. Appropriate municipal heating planning is an absolute must in order to achieve a climate-neutral heating supply in municipalities, districts and neighbourhoods. In Halle an der Saale in Saxony-Anhalt, dena operates a nationwide Municipal Heating Transition Competence Centre on behalf of the German Federal Ministry for Economic Affairs and Climate Action to provide support to municipalities.

For more information, visit www.kww-halle.de

palities have joined forces to develop their heating planning, the answer is a district heating pipeline that could transport waste heat from the High Rhine industry to the Black Forest.

The third step involves analyses of the status quo and potential, which are then combined in a target scenario. 'Where do we need to build a district heating network, drill for geothermal energy or insulate a building's façade? We need to align supply with demand so we can clearly see what the climate-neutral heat supply would look like in 2040,' explains Inga Nietz. Planning is considered completed in step four: a specific set of measures, including implementation priorities and a timetable. There should be some flexibility with the definition of 'completed', because the heating plan needs to be regularly evaluated and adapted if necessary.

Yes to networking, no to mandates

Freiburg has made the most progress in transforming its heating sector. 'We had already awarded the contract to a planning office when Baden-Württemberg introduced mandatory heating planning in 2020,' says Magdalena Magosch, who is responsible for the heat transition as climate protection manager. She has a tip for other municipalities: 'It is very important to involve all stakeholders in the process at an early stage.' In Freiburg, this includes Badenova, which together with its subsidiaries operates both heating and gas networks, meaning it is faced with quite a challenge. After all, if the city of Freiburg expands its district heating networks, the gas supply business is directly affected, posing a threat to an important source of revenue.

This conflict of goals between gas and district heating is not only a concern for Badenova. As the second largest shareholder, Freiburg also benefits from the company's revenues. How will the city deal with that? 'The issue has not yet been resolved,' says Magosch. This situation highlights one of the fundamental challenges of heating planning: 'We can sit everyone down together and try to convince them of climate-friendly solutions,' explains the climate protection manager. 'But in the end, many different players have to work together for the success of municipal heating planning.'

It's a question of money

The city of Leipzig is at the very beginning of its journey. The city council decided in February 2022 to develop a heating plan by 2023. Its implementation has been tasked to the climate protection department headed by Simone Ariane Pflaum: 'Leipzig emits 1.2 million metric tons of CO_2 annually through its heat supply. That's one and a half times the amount emitted by traffic. This shows how great the need for action is.' Leipzig cannot fall back on its own monies for heating planning, unlike Freiburg or Lörrach, which receive funding from the state budget of Baden-Württemberg, so the administration there does not have any additional positions yet. Stimulus funding for municipal heating planning, which has been in effect since November 2022, has been helpful. Through it, the Ministry of Economic Affairs and Climate Action funds up to 100 per cent of expenditures related to municipal heating planning. The head of the environmental protection department needs to take care of a range of other tasks as well, ranging from implementing the UN's 2030 Agenda to supporting fair trade. Thus there are many questions that have been left unanswered, such as: what data do we actually need? How will we finance heating planning? And how do we motivate the municipal utilities to make the right decision, both in terms of economics and the environment?

The challenge posed by data protection laws

But the challenges posed by heating planning are great even where there is sufficient financial support. Inga Nietz in Lörrach: 'The municipality needs data on the heat consumption of individual buildings in order to know what should be done and where. You can't get anything off the ground without this data.'

Chimney sweeps can act as a source of data. They have a record on their books listing which types of heating systems are used where. But initially the district had a problem because the chimney sweeps are not allowed to pass on personal data. The state of Baden-Württemberg then had software developed that automatically evaluates the records and transfers them in compliance with data protection laws. It was an additional task that took several months, but one that will help other municipalities with their data collection efforts.

Problems with data collection, the lack of regulations for heating planning and the open question of financing – the experiences from Lörrach, Freiburg and Leipzig exemplify how great the challenges in municipal heating planning are. This is also felt by dena's employees in the Municipal Heating Transition Excellence Centre. 'Our inboxes are overflowing with emails right now. Heating planning is in full swing,' reports one employee on the current situation. ■

The four stages of municipal heating planning

1

Organisational phase
- Sit down together with all stakeholders
- Assign roles, establish caretakers
- Develop communications strategy

2

Analyses of the status quo and potential
- Existing heat sources and heating consumption levels
- Savings potentials
- Potential new heat sources

3

Target scenario
- Setting of specific, individualised targets
- Milestones
- Integration of existing plans

4

Set of measures
- Measures with timetable
- Responsibilities
- Available subsidies

Photo: Götz Schleser

'The planned federal law can significantly accelerate the heat transition.'

Robert Brückmann,
head of the Kompetenzzentrum Kommunale Wärmewende (Municipal Heating Transition Excellence Centre) in Halle an der Saale

INTERVIEW Tilman Eicke

Where are the municipalities right now in terms of implementing their municipal heating planning?

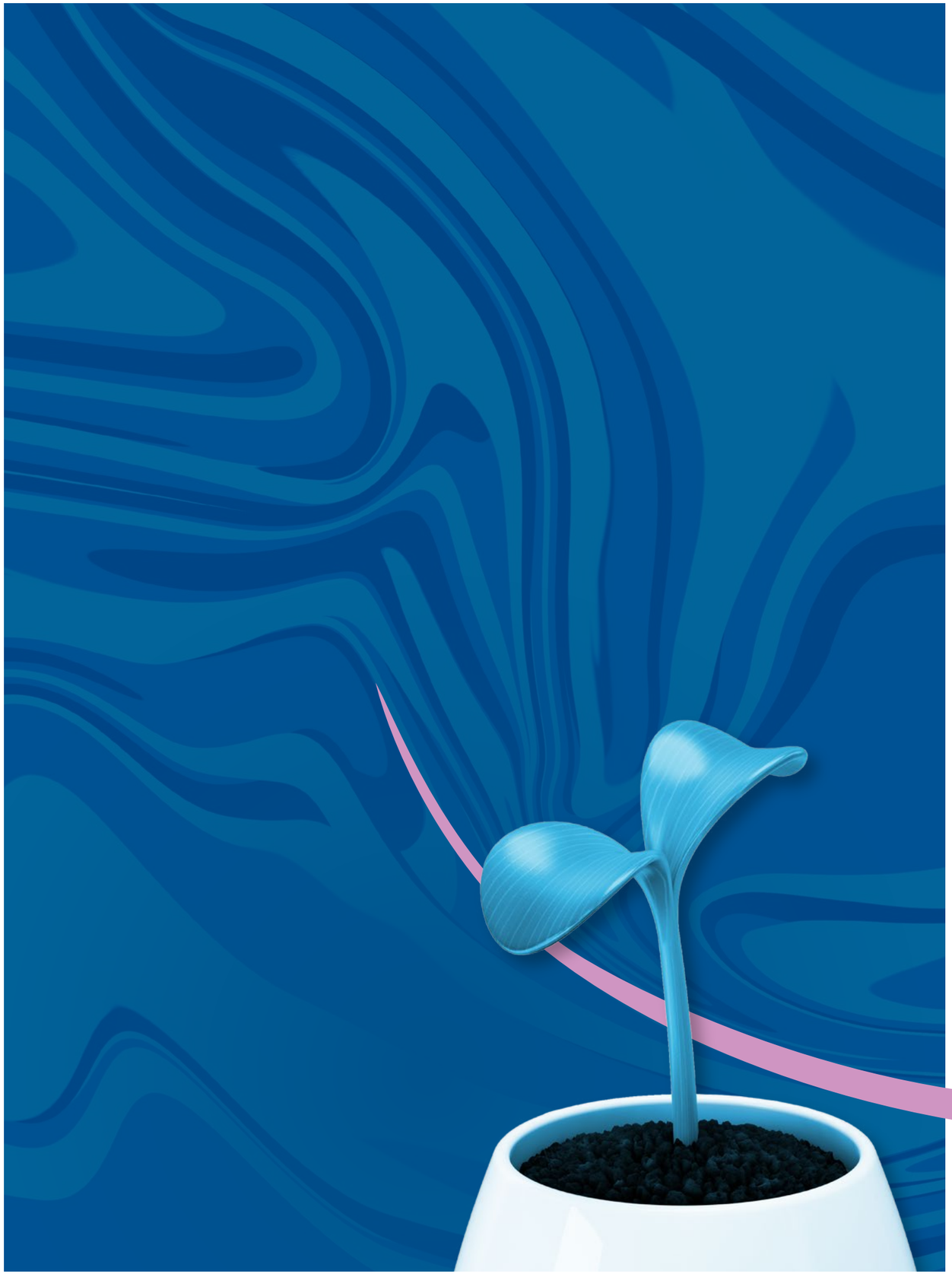
We see major differences between the more than 10,000 municipalities. Some of them are not even addressing the issue yet, whereas others are already implementing it. Likewise, municipalities in the states of Schleswig-Holstein and Baden-Württemberg are often much further ahead because those states made heating planning mandatory early on. Then again, there are cities like Rostock on the Baltic Sea that already adopted heating plans in 2022.

What are the biggest challenges in municipal heating planning?

Obtaining the data for the heat cadastres in the first place is one difficulty. How much heat is consumed and where? As usual, funding is also an issue. And finally, how binding can the heating plans be? The planned federal law can set clear guidelines on all of these points.

What advice do you have for municipalities?

I think three things are particularly important. Municipalities should seek the support of all stakeholders involved before planning begins. This means local residents, the administration and local energy suppliers. Municipalities should also provide financial resources and create the appropriate staff positions. There need to be 'caretakers' – people with functioning networks and who know the municipality very well. Finally, it is important that municipalities see municipal heating planning not as a duty but as an opportunity to get free of fossil fuels, to create further value at the local level and to achieve their climate targets.



NEXT

A glance into the future

The hope
for a green post-war Ukraine

Rebuilding Ukraine will require a lot of time, energy and money. Despite the ongoing destruction, Ukrainian energy experts are looking to the future with cautious optimism. With the help of international partners, the possibility of a more sustainable energy supply, economy and society once the war ends is within reach.

TEXT Anne-Katrin Wehrmann

A transformer in Kherson that has been destroyed by Russian troops. Russia's attacks are aimed at Ukraine's critical infrastructure.

Photo: Ziv Koren/Polaris/laif

Ukraine has already embarked on its journey. The country pursued major reforms in the energy sector using a strategy aimed at 2035. The expansion of renewable energies and the reduction of CO_2 emissions played an important role in these reforms. Between Eastern Europe und Central Asia, Ukraine led the growth as regards renewables: According to the Status Report 2022 from the United Nations Economic Commission for Europe (UNECE), a total of 8.3 gigawatts (GW) of solar and wind energy capacity was added between 2017 and 2021 – more than in any of the other countries in the region. Then began the Russian war of aggression, and with it, the targeted destruction of critical infrastructure. According to the report, in June of 2022, 90 per cent of the installed wind capacities and more than 30 per cent of the solar capacity were inoperative. Ukrainian President Volodymyr Zelenskyy reported in November 2022 that 50 per cent of the country's energy infrastructure was heavily damaged by rockets and drone attacks.

What does this mean for the country's future? And how can European partners assist the country with the tasks to come? 'A functioning energy system is the driver for rebuilding the country, for the economy and for our lives as a whole', stresses Ukrainian renewable energies expert Khrystyna Kasyanova. This is why, in addition to the repair work being done at present, it is so incredibly vital to develop a more long-term strategy at an early stage: 'We need a plan that includes the different needs and potential consumption figures of consumers and production plants, as well as the locations of the future energy producers, and we need it right from the start. This helps our partners to understand what we require so that the support efforts are carried out in a targeted manner.' Ukraine could use a basis such as this to determine to what extent things such as transformers, cables and the like would be needed. The partners could produce and deliver this equipment accordingly. 'Without such a strategy, the whole endeavour would devolve into nothing more than chaotically replacing destroyed infrastructure. And that would make it almost impossible to achieve a harmonised energy system', she says.

WOMEN IN ENERGY – UNITED FOR UKRAINE

dena, together with the Women's Energy Club of Ukraine (WECU), created the 'Women in Energy – United for Ukraine' initiative as part of the energy partnership between Germany and Ukraine. The initiative provides support for Ukrainian female energy expert refugees via training programmes, mentoring and networking when integrating into the Ukrainian and German labour market.

For more information, visit www.energypartnership-ukraine.org/tr/home/we-united-for-ukraine/

Don't wait till the war is over

Just as it was for many of her compatriots, life for Kasyanova was radically changed by the Russian invasion. The fact she no longer has a stable job is the least of her problems: mobile working had already become the 'new normal' before that due to the pandemic, reports the business segment developer who works in the photovoltaic industry. Being far from home and experiencing the collapse of the Ukrainian market significantly adds to her discomfort – on top of the fact that her five-member team was disbanded. 'Letting these people go was a huge emotional blow for me', she reports. Due to a lack of investments, she herself is practically unable to continue developing photovoltaic projects. Instead, she focuses on the Balkans and Central Asia. As Kasyanova

'Since the war started, our main priority has been to provide the Ukrainian energy sector with emergency assistance.'

Olha Zhuk, dena expert on international cooperation.

sees it, ‘It would be important to assist small energy companies with financing.’ ‘For example, companies that are willing to invest in biomass power plants or small pellet-fired power plants. That would be incredibly beneficial, as regions in which economic activity is possible do still exist.’

Maryna Ilchuk, a lawyer specialising in energy projects, stresses this as well. ‘Life in the country continues despite the war: people go about their daily activities and lots of companies continue to do business, even if the conditions under which they do so are difficult’, reports the 34-year-old ‘We can’t wait until the war is over. Now is already the time that we have to figure out how we can create a sustainable energy sector and ensure a smooth energy transition in Ukraine.’ Collaboration with international experts is already under way to gauge which possibilities exist for renewables and green hydrogen, and to sound out the options for exporting green energies to Europe once these possibilities are determined. dena is also actively working in a consulting capacity as part of the German-Ukrainian energy partnership – for example, providing consultation on introducing a biomethane registry and on completely integrating Ukraine into the European electricity market.

‘A functioning energy system is the driver for rebuilding the country, for the economy and for our lives as a whole.’

Khrystyna Kasyanova,
renewable energies expert

Ukraine’s ties to Europe

Regarding the closer ties to Europe that Ukraine is striving for, the decoupling of the Ukrainian electricity grid from the Russian-Belarussian System and its swift connection to the EU’s grid, as Ilchuck puts it, was an ‘enormous success’. The Ukrainian transmission system operator Ukrenergo and the European Network of Transmission System Operators, ENTSO-E, had already prepared this step over a period of several years. At the end of February 2022, the partners wanted to do a test run over several days, but this has become a permanent endeavour due to the outbreak of war. An emergency synchronisation was successfully performed within just three weeks, and the first electricity exports to Romania began at the end of June. ‘This means that Ukraine has the ability to help Europe save natural gas that would otherwise be needed for producing electricity’, explains Maryna Ilchuk. Conversely, the electricity sales are expected to become a stable source of income for Ukrainian households in the future. Despite the massive Russian bombardment that began on 11 October 2022, the export of electricity initially continued. The government only halted the export once energy became scarce for the people in Ukraine itself.

MARYNA ILCHUK

is a lawyer at the international corporate law firm CMS, where she is in charge of projects in the energy sector. She is a co-founder of the Women’s Energy Club of Ukraine (WECU), a professional association for women working in the energy industry in Ukraine. She was also a Board Member of the European-Ukrainian Energy Agency (EUEA) as well as a member of various Ukrainian bioenergy and wind energy associations. When the war began, Ilchuk initially fled from Kyiv to a village in Western Ukraine and made her way from there to Croatia six months later.

KHRYSTYNA KASYANOVA

has been working in business development for a Ukrainian solar company for five years. She is the Head of the Energy and Energy Transition working group in the German-Ukrainian Chamber of Industry and Commerce, and in her role in the WECU, she focuses on the European Green Deal and gender issues. Kasyanova fled form Kyiv to Vienna after the Russian attacks on Ukraine began.

Energy partnership since 2020

The German and Ukrainian governments had already agreed to an energy partnership in August 2020, and dena was commissioned for its implementation by the German Federal Ministry for Economic Affairs and Climate Action (Bundesministerium für Wirtschaft und Klimaschutz). At that time, increasing energy efficiency, modernising the electricity sector, expanding and integrating renewables, hydrogen and reducing CO_2 emissions were established as the key focal points collaboration. Other objectives gained precedence when the war broke out. ‘Our main priority is to provide the Ukrainian energy sector with emergency assistance’, reports Olha Zhuk, one of dena’s experts on international cooperation.

dena prepared an analysis of technical options for the short-term repair of destroyed heat supply systems and intensified support for the grid operator Ukrenergo regarding permanent synchronisation with the EU’s grid. Collaborative efforts with the Women’s Energy Club of Ukraine (WECU) resulted in the creation of the new network ‘Women in Energy United for Ukraine’, which seeks to make it easier for female refugees from the energy industry to transition into their new environment and help them find jobs.

Another topic has gained relevance as well: ‘Ukraine is planning to export biomethane in the future and is currently developing a legal framework to do so’, explains Olha Zhuk. ‘We are advising the Ukrainian Ministry of Energy in the process.’ Collaboration in the course of the energy partnership plays an important role in being able to rebuild the energy infrastructure and economy in a way that’s both green and sustainable. ‘Every European country hopes that Ukraine will be able to become an exporter of green energy in the future’, says Zhuk. ‘The geographical location is good, and the resources are there.’

Green exports and decentralised systems

Maryna Ilchuk agrees: Ukrainian and European experts are now examining the extent to which exporting green hydrogen and biomethane using existing pipelines is economically and technically feasible. Meanwhile, the people in Ukraine have learned how to act in an energy-conscious manner and how to value energy. ‘Our main tasks now are to attain energy self-sufficiency by developing more green projects,’ says Ilchuk. ‘And to gauge our hydrogen potential, so that we can be a reliable energy partner for other European countries.’

As Khrystyna Kasyanova sees it, small decentralised systems will play an important role in the future when it comes to restoring the energy supply – both for private households and production facilities. ‘To do this, we need an industry that consumes less and consumers that use energy more intelligently and more sparingly’, explains Kasyanova. That being said, rebuilding the country will take decades. Though this outlook is not very promising, a hopeful perspective does exist: ‘We can rebuild our country and improve it in the process, making it greener and more sustainable using modern technologies and innovations.’ ■

Photo: dena, private

‘Now is already the time that we have to figure out how we can design a sustainable energy sector.’

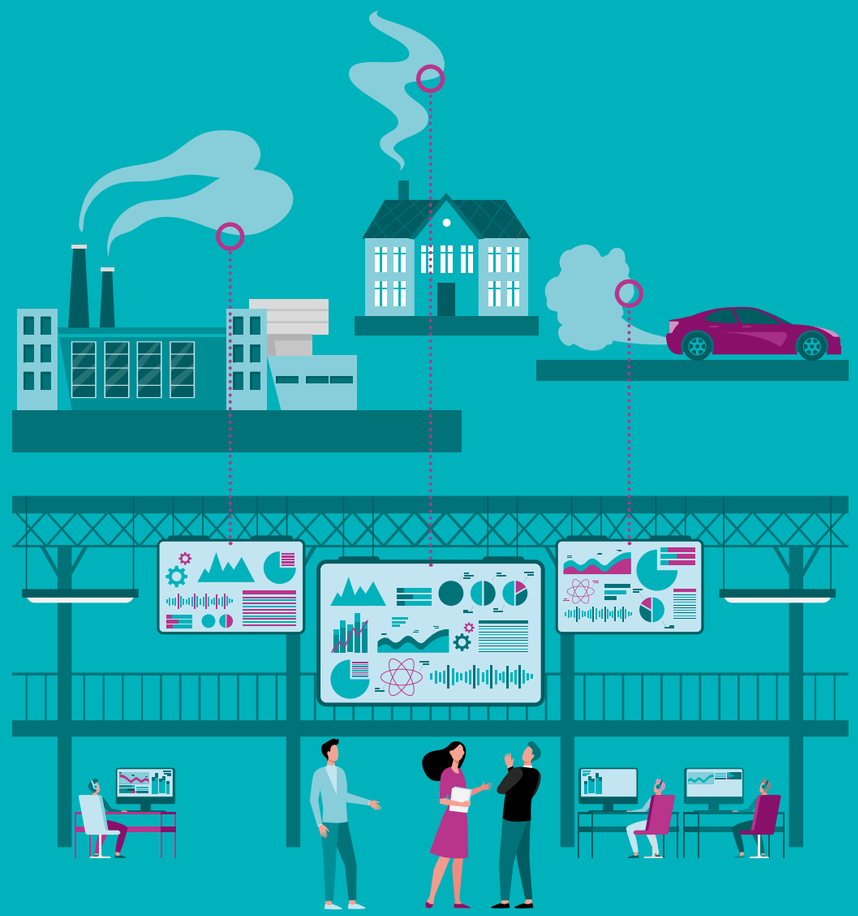
Maryna Ilchuk,
lawyer in the energy sector

Partner donations: transformers for Ukrainian substations

CLIMATE PROTECTION IN REAL TIME

What can digitalisation contribute to climate protection in communities? As part of dena's klimakommune.digital (climatecommunity.digital) project, the German city of Hagen analysed how digital measurement technologies and IT systems improve climate protection in transport, buildings and industry.

TEXT Christiane Schulzki-Haddouti



What would it be like if instead of working with outdated emissions data, the climate advisers in the communities saw how their measures effect CO_2 emissions in real time? The klimakommune.digital project from dena's Future Energy Lab, which started the project in 2022, seeks to answer this question using the city of Hagen as its model. The intention here is for the emissions data from the transport, buildings and industry segments to be collected digitally and ideally in real time by 2024. In doing so, Hagen wants to devise its climate protection measures more precisely and evaluate their effectiveness.

Transport: The city is installing traffic sensors at 17 intersections that deliver precise data on the volume of traffic. At the same time, the CO2 concentration is measured using affordable CO_2 sensors. 'We want to use these traffic measurements to gauge how much CO_2 is currently being emitted by traffic and assess the effects it has on the concentration of CO_2in the air', explains dena Project Director Benedikt Pulvermüller. The vision is to collect real-time data in the most efficient way possible in order to better control traffic.

Buildings: The focus in the initial step is on the energy consumption in municipal facilities, such as administrative buildings, nurseries, schools and museums. For measurement, Hagen uses cadastre data and building plans as well as the previous consumption data for electricity, water and heat. 'We are digitalising all our meters and setting them up so they can take readings remotely, supplying energy data that is specific at least to the day', says Pulvermüller. Taking this data as its basis, the city soon wants to decide where efficiency measures concerning heating or insulating are particularly worthwhile. Other buildings that are representative of Hagen's building stock are also expected to be equipped with digital meters in the further course of the project.

Industry: To date, the EU Commission Regulation on the monitoring and reporting of greenhouse gas emissions only requires large industrial companies to use CO_2 sensors and carry out an energy audit. Both small and medium-sized companies are involved in Hagen. The goal, especially for energy-intensive companies, is to help bring about an energy management system equipped with sensor technology for recording energy consumption and thus CO_2 emissions. This is intended to help optimise energy consumption or manage it in such a way that peak loads can be avoided.

Reducing time delays

klimakommune.digital seeks to utilise real-time data – or at least data that is specific to a given day – to tackle the problem of experiencing time delays when dealing with centralised environmental data. To date, many cities base there CO_2 balances on up to two years' worth of old figures. The procurement of hardware and software is supported in the project in order to collect consumption and emissions data, transfer it to a platform and analyse it there.

'The data should be passed along via an internal municipal process to database-supported administrative computer programs and should also be passed along to companies and citizens – taking the relevant data protection and data security aspects into account of course', explains Dominik Noroschat, Project Director and the city of Hagen's Smart City Division Head. Database-supported administrative computer programs are IT systems that are used in municipal management processes. This also includes systems for property information or road management.

Collecting data via an encrypted network

The data from the transport, buildings and industry segments is to be transferred to a data platform in an encrypted state via a narrowband wireless network or via mobile communications technology. The data is visually prepared in the platform and can be analysed in real time. A key building block for the communication process is what is known as a LoRaWAN (long range wide area network). It has the ability to transmit small data packets in the entire municipal area in a way that is affordable and saves energy. This network is supplied by the German regional energy supplier Enervie Group.

Data protection versus information interests

Data protection is an important topic: 'When it comes to consumption data, the end customer is the data owner', explains Pulvermüller. That is why a data protection agreement is needed that allows data to be monitored at differentiated levels for clearly defined purposes. This means that users with different usage rights can access the data: while a company's boss receives information on the company's own energy consumption in the form of a precise breakdown into kilowatt hours, the competition's consumption is either not presented at all or is only presented in aggregated form. This is how data protection and public information interests should be balanced.

Real-time CO_2 data can provide a reliable basis and a legitimate reason for making climate protection-related political decisions that have to be made on site. A solid database is crucial for communicating with municipal stakeholders and the population. This is the only way that both sides can determine whether the implemented climate protection measures are also effective. ■

KLIMAKOMMUNE.DIGITAL

The klimakommune.digital project is being carried out in dena's Future Energy Lab. In December 2021, the city of Hagen was chosen as part of a nationwide application process amongst German communities. Hagen is now expected to be transformed into a model smart city with a focus on climate protection and energy transition. Gathered experiences and developed software will be made available to other communities thereafter.

For more information, visit www.dena.de/klimakommune.digital

THE DIGITAL MACHINE ID

TEXT Katharina Wolf

Our energy system should also be stable and reliable in the future. A dena project in the Future Energy Lab shows why digital machine identities constitute a key building block for this – and presents a well-functioning concept.

The German electricity grid is among the most reliable in the world: In 2021, electricity customers had to go without electrical energy for an average of merely 12.7 minutes. Maintaining this level of stability is no small task, as the number of electricity producers and electricity consumers continues to increase as a result of the energy transition. Instead of only a few large producers bearing the brunt of the work as it was in the past, these days, millions of small units feed electricity into the grid.

Digitalisation and automation are indispensable when it comes to coordinating these units and guaranteeing system stability. Machines such as electricity generation systems, storage facilities, consumers and the computers for managing the grid have to be able to communicate with one another autonomously. Stable operation requires the exchange of data – for example, weather forecasts or data on electricity production and consumption. This is because the grid management system has to be able to request additional energy from a large number of small decentralised storage facilities should a sudden drop in voltage occur within the electricity grid, for instance, due to clouds unexpectedly forming and less solar electricity being fed in. This is what is known as balancing energy. ‘The grid operator has to be able control the storage facility automatically and also be able to identify it’, says Moritz Schlösser, Digital Technologies Expert at dena. ‘What has been missing up to now is a uniform digital identity for generation plants and consumers.’ Such a ‘personal digital ID’ for a machine is the starting point for reliable chains of trust and transparent data exchange.

Unique IDs in the blockchain

But what can such a ‘personal ID’ look like? It should make important data, such as a machine’s location or capacity, available and also be so secure that the data can be trusted. The ‘Blockchain Machine Identity Ledger’ (BMIL) project in dena’s Future Energy Lab provides the answer to this question. 22 To address this matter, project partners brought their ideas to the table and tested a concept in the field.

Here’s how it works: When installing a new machine, what’s called a decentralised identifier (DID) is created in the smart meter gateway using specific additional hardware. This DID makes the machine uniquely identifiable – just the same as a person’s photo on their personal ID card. The machine is then registered in the blockchain along with its DID. ‘DIDs are markers used for identification purposes that are verifiable, decentralised and digital and are not linked to central identity providers’, says Matthias Möller, Director Operations at BOTLabs GmbH, which introduced the blockchain-based KILT Protocol to the project. ‘There is no central system that assigns the identifier and in which the identities can be managed.’

Year of construction and eye colour

A machine’s digital identity is composed of its identifier as well as its attributes that describe its properties, such as its type, capacity or date of commissioning – exactly the same way a personal ID card contains various details on height, date of birth or eye colour. A systems’ attributes are verified using digital certificates, which are known as verifiable credentials (VCs). These are issued by reliable third parties. ‘Thus VCs are becoming the digital equivalent of physical certificates’, says Möller. They are put into a secure digital wallet by the machine itself and are anchored in the blockchain.

One of the advantages of this decentralised system is that only the data that is needed for the respective use case is delivered. Similar to how it works with a personal ID card when buying alcohol at the supermarket, the only relevant information on the document is the photo for identifying the owner of the ID card and their date of birth – their name and address are not important in this case. Because a central data storage facility can malfunction or be more easily attacked than the decentralised blockchain, this system is altogether more secure and more readily available.

Decentralised and secure

That being said, a decentralised identity that is not linked to a central identity provider, which is known as the self-sovereign identity, is created for every machine that is part of an energy system. The smart meter gateway provides the secure Internet connection. ‘We were able to prove that our concept technically works in principle, and does so within the current legal framework at that’, says Moritz Schlösser. ‘IT security regulation requirements and data protection requirements are complied with.’

Advantages in practice

Back into the field to create a secure electricity grid: Currently, plants that seek to provide the balancing energy for stabilising the grid have to be of a certain minimum size and have to undergo complex prequalification procedures. This is because the grid operator has to have reliable knowledge as to how fast, for how long, and how much energy can be reliably delivered or also taken in when required. ‘A procedure such as this could be simplified to a considerable degree by using a digital machine identity that automatically makes this information available to the grid operator. Even small storage devices, such as the batteries of electric vehicles, could efficiently participate in the balancing energy market’, says Robert Sprunk, Director E-Mobility, Energy Web Foundation.

Socially acceptable standard

‘Digital identities for the energy system must now be made socially acceptable’, says dena expert Schlösser. ‘Among other things, this means that an industry-wide machine identity standard needs to be developed.’ Specific use cases should be examined and additional technical, economic and regulatory questions should be answered in a follow-up project: Which bandwidths does the smart meter have to have in order to be used as hardware? How can process costs be reduced? ‘Questions concerning data protection play a role, too’, emphasises Robert Sprunk. ‘When it comes to e-mobility, it’s always about people and their movement data.’ This is because in the energy system of the future, not only should the supply be secure, but the data should be as well. ■

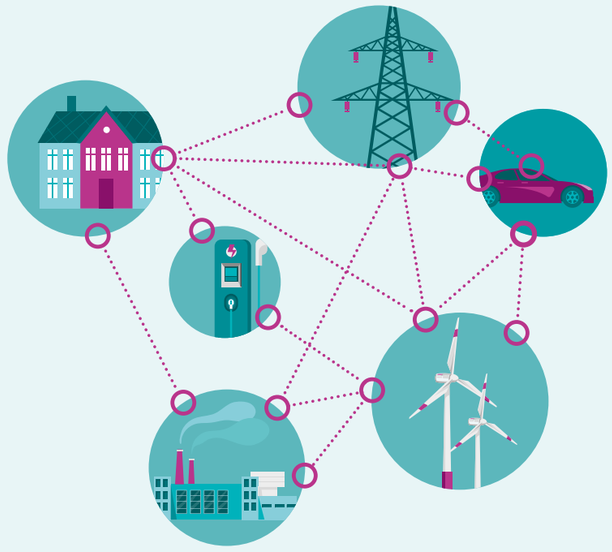
THE FUTURE ENERGY LAB

With the Future Energy Lab, dena on behalf of the German Federal Ministry for Economic Affairs and Climate Action (Bundesministerium für Wirtschaft und Klimaschutz (BMWK)) has created a space in which the digital and energy industries convene. The goal is to test new technologies and regulatory approaches for the electricity, heating and mobility sectors in a think tank and pilot testing laboratory capacity in order to drive the energy transition forward. The Future Energy Lab serves as a platform for bundling the cooperative efforts of all major industry players and provides a creative space for start-ups to develop innovative solutions.

For more information, visit www.future-energy-lab.de

Communication in the automated energy system

In an automated energy system, machines such as electricity generation systems, storage facilities, consumers and the computers for managing the grid have to communicate with one another autonomously. Reliable machine identities form the basis for secure communication.



A true circular economy for batteries

Ninety-five per cent of all used lithium-ion batteries end up in the rubbish bin. With his start-up Green Li-ion, Leon Farrant has found a way to make battery recycling a highly profitable venture.

‘When I graduated, I upset my sustainability-oriented family by going to work in the oil and gas sectors – out of convenience and because the jobs paid well. After a few years, I shifted my focus in the energy sector to offshore wind energy. I learned in the process that batteries are needed as buffers to store renewable electricity and to feed electricity into the grid when needed.

I met chemist and environmental engineer Reza Katal at a workshop in Singapore. We asked ourselves how the energy transition could be supported using sustainable batteries – because the necessary raw materials for batteries are limited. It’s a sad reality that to date, 95 per cent of all used lithium-ion batteries end up in the dump. This is because it hasn’t been worth it to recycle them until now. Back then, Reza had already been doing research on recycling batteries for ten years. I decided to help him create his business plan. We finally founded Green Li-ion together in 2019.

Today, we develop and build recycling modules. We use these modules to recover the lithium carbonate and cathode material from lithium-ion batteries – more specifically, PCAM ‘precursor cathode active material’. We license the modules and set them up in recycling and battery manufacturing plants. We don’t produce any new batteries ourselves; we leave that to the established manufacturers. But we can supply them with recycled PCAM.

Processing mixed batches without toxic waste

We found a way to make recycling highly profitable. To date, cobalt, nickel and manganese are individually recovered and then have to be processed back into cathode material – this separation process generates high costs. We, however, recover complete cathode material without the interim separation step. It sounds simple, but it’s actually an incredibly complex method and took a long time to develop. We can process iPhone batteries, Tesla batteries, the batteries from toys and power tools – and we can do it all in a mixed production batch. We use all the residual materials and run them back through the process. No toxic waste is produced with our method.

My ultimate goal is to achieve a true circular economy for batteries in which we send our recycled material out into the world and then get it back when the next battery containing those materials loses its charge – in order to use it again. We predict that in the future, recycling 95 or even 100 per cent of all batteries will be a worthwhile endeavour.’ ■

LEON FARRANT

grew up in Western Australia and graduated from Curtin University with an MBA. He has worked in the energy sector for 15 years – for the oil industry and later for the wind industry, among others. In 2019, he founded Green Li-ion in Singapore together with chemist Reza Katal. Their company develops and produces systems that quickly process used lithium-ion batteries in a way that is environmentally friendly. Green Li-ion won the 2022 Start Up Energy Transition Award in the category Energy Distribution & Storage. The SET Award is presented by dena every year in collaboration with the World Energy Council.

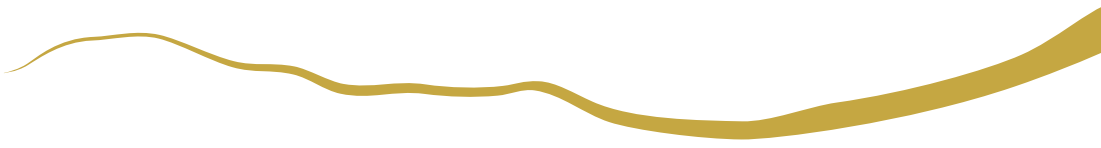
Photo: Gowrishankar Uniqueye Photography

For more information and background on dena, as well as for all important contact details, visit

www.dena.de

Follow us on Twitter:

@dena_news



dena
Deutsche Energie-Agentur