FROM A RELIABLE SOURCE

DREES & SOMMER

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Solar or wind power? Thermal or hydrogen? Discover the many faces of renewable energy.

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FOREWORD

ABUNDANT ENERGY FOR OUR FUTURE

By Dierk Mutschler,
Member of the Executive Board at
Drees & Sommer SE

Dear readers,

There's no doubt that transforming our energy system is the biggest challenge facing humanity in the 21st century. To achieve net-zero carbon emissions by 2050, we need to be ambitious. It's no longer a question of simply protecting the environment. Instead, we will have to modernize our entire economy. And part of the challenge will be to generate enough green energy so that our energy supply is totally reliable whilst undergoing significant structural change and becoming an energy-intensive digital economy. And while progress has been made in embracing renewable energy, our energy supply is still overwhelmingly dependent on fossil fuels.

Bold innovation is needed to make a successful full-scale transition to renewable energy. But Drees & Sommer is taking up the challenge – our experts are providing support on multiple projects for greener, more energy-efficient buildings, districts, infrastructure and even cities. Working in interdisciplinary teams, we have been able to find overarching solutions for both public sector and commercial clients and help them reduce their carbon footprint.

You'll get an insight into some of the kind of challenges that our colleagues have been tackling in the articles and interviews in this dossier. We will be looking at themes such as expanding our power grid (and how it will soon be talking to intelligent buildings), smart waste heat recovery in data centres, dismantling and converting large power stations and using green hydrogen to power entire districts or fuel our transport sector. In fact, that's only the tip of the iceberg when it comes to what we do at Drees & Sommer. On behalf of the whole Executive Board, I'd like to thank all our own and external contributors for their thought-provoking ideas and articles.

We have put together this comprehensive energy dossier to give you food for thought and a bit more context around the energy transition. At Drees & Sommer, we remain firmly committed to sustainability and I assure you that we will continue to promote it, in line with our unique *'the blue way'* philosophy, which has been our guiding principle for decades. According to this, sustainability has to be tackled holistically: balancing ecological, economic and sociological considerations.

At Drees & Sommer, we are very proud to say that we actually became climate-positive last year through offsetting and reducing our carbon emissions across our global operations. We have also embarked on the process of becoming a 'Beneficial Company' – by giving back more than we take from the environment and society at large and setting a good example for others.

We can't afford to hold back. We need to work together and tackle this head on. So, without further ado, I hope you enjoy reading this dossier.

Yours, Dierk Mutschler
Member of the Executive Board at Drees & Sommer SE

WHAT'S THE FUTURE FOR RE-NEWABLE ENERGY?

Renewables have become a household term and have undeniable mass appeal – both as an energy source and an attractive career path. They are seen as heralding a new era of energy and there is now little doubt about it – renewable energy is our future.

By Ludger Eltrop, Head of Renewable Energy at the Institute of Industrial Energy and Rational Energy Allocation (IER) at Stuttgart University

Renewable energy has enormous potential. There are lots of ways to generate it and there are lots of locations in the world where we can tap into large quantities of it – even if, admittedly, some destinations are more promising than others. However, it's worth noting that renewables are only one side of the sustainable energy equation. They cannot be truly effective unless we can increase energy efficiency and energy-saving as well. In other words, just because the energy is "renewable" doesn't entitle us to use it wastefully or carelessly. After all, with its relatively small energy density, there are certain limitations as to when and where renewable power can be used. We also need to bear in mind that renewable energy installations take up a relatively large surface area and that demand for space can create conflicts with residents and citizens.

Harnessing its enormous potential

There is no doubt that renewable energy has huge potential. There is a huge amount of evidence to support this assertion (some of which you can find in this dossier) so we won't discuss it in any more detail here. There is no doubt that it is possible – both in theory and in practical terms – to create a 100 % renewable energy supply. However, it's less clear how to go about it. When we look at the issue, we typically divide it into categories: electricity, heating and fuel or sectors: transport, (private) households, industry, trade and services. Over the past few years, most progress has been made in the field of electricity generation – particularly with 'volatile' or 'fluctuating' energy such as

wind and solar power. These technologies have enabled us to generate up to 50 per cent of our annual electricity supply from renewables, which increases to up to 100 per cent at peak times (generally around noon).

However, there has been far less progress in the area of heat generation. Here, renewable energy only produces around 170 tera-watt hours, or approx. 6.5 per cent of total consumption, and this figure has remained static since 2010. The fuel sector is even less promising where, if we take transport for example, we see that renewable energy sources have only generated approx. 35 tera-watt hours out of a total of 750. Again, this has remained static since 2008.

Renewables only supply approx. 17 per cent of our total power requirements. So now we can see just how far we have to go to achieve our goal of 100 per cent. And unless we can find a way of achieving economic growth without consuming more energy whilst radically increasing energy efficiency, it remains a distant dream. However, the challenges of achieving 100 per cent renewable energy differ widely from sector to sector.


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Bioenergy – the controversial, versatile super-fuel
Bioenergy can be a vital energy source for both sustainable heat generation and fuels. The use of biomass for power is more controversial. Environmentalists believe that monocultures – particularly those with a high proportion of corn – are a threat to biodiversity and that they draw too much water during a climate crisis. Using biomass for fuel is equally contentious and has given rise to the "food vs. fuel" debate. These so-called agrofuels have been at the centre of global discussions about justice, environmental protection and species conservation. Meanwhile, the modern industrial energy sector regards the use of expensive and energy-rich biomass for heating and fuel as little more than a waste of resources, which could be better put to use for energy-intensive applications such as heavy-duty freight or industry. According to the latest thinking in bioeconomics, using biomass as a material commodity should be prioritized – with a cascading ladder of usage scenarios – before any consideration should be given to using it as a fuel.

All of these points of view have merit. Ultimately, the point of bioenergy should be to use resources intelligently and to devise a system where technological, economic and social factors are balanced with the need to feed our population and protect nature. For example, we could prioritize biological waste from industry, commerce and households as a potential biofuel.

Quo vadis, wind and solar?
Of all the renewable energies, wind and solar give us the greatest cause for optimism. But are we making any real progress? Well, onshore wind is meeting a certain amount of resistance and despite political goodwill, the expansion of wind farms in Baden-Württemberg has slowed down. Meanwhile, in 2019 only 15 wind energy plants were built in Germany. Conversely, offshore wind is picking up momentum. From 2018 to 2019, the power generated by offshore plants increased from 1.1 to 7.5 gigawatts. The current trend for huge wind energy farms with an output of just under 10 megawatts is projected to increase to 15–20 megawatt plants. The huge size of these plants means that highly innovative materials are needed for their construction and operation, and the entire process has to be skilfully managed.

Of all the renewable energies, wind and solar give us the greatest cause for optimism.

In the case of solar energy, there is a growing trend towards photovoltaic technology. In 2019, over 105 gigawatts of photovoltaic power were added to our global capacity. Meanwhile, the outlook is equally bright for shares in solar power. From a purely engineering standpoint, solar thermal installations – parabolic troughs or power towers – are the holy grail of renewable energy projects. However, because of their ease of handling and operation, the smart money is on photovoltaics becoming the solar technology of the future. They also have a wide range of applications, from classic rooftop solar panels (and installations on other types of buildings or structures) through to countryside agrophotovoltaic installations or installations in quarries. What's more, there are virtually no technical and economic limitations that dictate where photovoltaic technology can be used.

The world's largest solar power plants are two-gigawatt photovoltaic behemoths that take up an area of more than 50 km². Critics of massive plants object that they have an impact on the albedo – or reflection of solar radiation – on the earth's surface.

The biggest hurdle: integrating renewables into the power system.

It's easy to get carried away about the technology when the biggest hurdle is integrating renewables into the power system. All 100-per-cent renewable energy sources have to meet the specific power needs of each region or country they supply. The fact that electricity consumption varies significantly over time and from place to place presents a major obstacle to increased adoption. Flexibility is the name of the game here. For example, wind and solar energy require additional technology and systems to compensate for volatility in supply. There are many ways to do this: from evening it out using power storage, to importing and exporting power, to using control systems for renewable energy installations. Biomass, which is of course itself a storage system for solar energy, has an important role to play here. If we are to meet our goal of creating a sustainable, climate-friendly electricity supply, a diverse blend of technology and control systems needs to be put in place. But that's not all – there is also a social challenge that needs to be resolved through open discussion.

The biggest hurdle is integrating renewables into the power system .

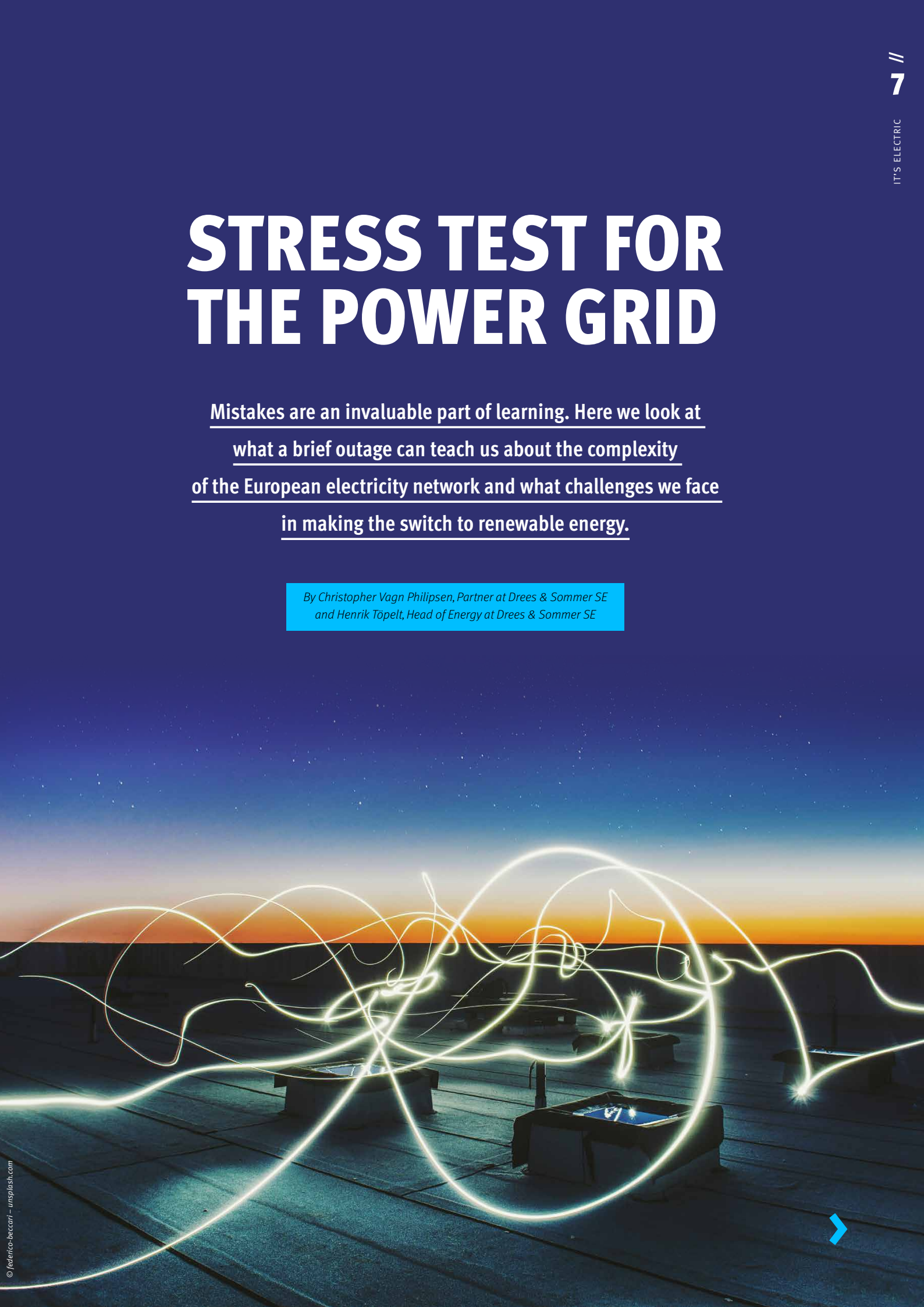
Ludger Eltrop
Head of Renewable Energy at the Institute of Industrial Energy and Rational Energy Allocation (IER) at Stuttgart University

Ludger Eltrop (born in 1959) comes from the lower Rhine region of Duisburg and Münster in Westphalia, Germany. He studied biology at Bonn University and completed semesters abroad at Toronto and Montpellier before doing a doctorate at the University of Hohenheim. He gained practical experience working as a project manager for composting and fermentation in construction, before returning to Stuttgart University where he now heads up the Department of System Analysis and Renewable Energy at the Institute of Industrial Energy and Rational Energy Allocation. In his current role, he researches renewable energy projects in Germany and abroad whilst working as a visiting professor at the University of Stuttgart. Ludger attributes part of his fondness for bioenergy and solar power to his love of red wine. Whether he's teaching students or consulting technology partners, he is passionate about showing people that climate protection and sustainable energy are an exciting opportunity rather than a problem.

STRESS TEST FOR THE POWER GRID

Mistakes are an invaluable part of learning. Here we look at what a brief outage can teach us about the complexity of the European electricity network and what challenges we face in making the switch to renewable energy.

By Christopher Vagn Philipsen, Partner at Drees & Sommer SE and Henrik Töpelt, Head of Energy at Drees & Sommer SE



In January, we had an extremely close shave. The breakdown of a small substation in Croatia came very close to shutting down the entire European power grid, creating newspaper headlines in the process. To help you grasp how this happened, it is important to understand how stability is maintained in electricity grids: there are several key parameters, such as the frequency, the baseload and the balance between supply and demand. Currently, we rely on huge power stations to keep the system in equilibrium. But as we shift to renewable energy and decentralized power generators, that is all set to change.

Frequency: keeping everything in phase

The first commandment of operating an electricity network is, "Thou shalt not deviate from 50 hertz". If the frequency falls below this number, there is too little power. If it goes up too much, the network overloads. And if either of these things happen, our closely interlinked European network can quickly get out of kilter.

On the day that the near blackout occurred, power oversupply in southern Europe caused an overload protection mechanism in a Croatian substation to shut the installation down. Suddenly, in less than a minute, the European grid divided into two sections: the north-west, which had a power shortfall, and the south-east, which had an overload.

As a result, in France and Italy, large energy consumers had to reduce their power usage. Meanwhile, Austria's energy suppliers engaged large quantities of hydropower to balance out the unexpected shortfall. The speed with which European grid operators reacted and the way they coordinated ensured that the grid returned to normal within the hour.

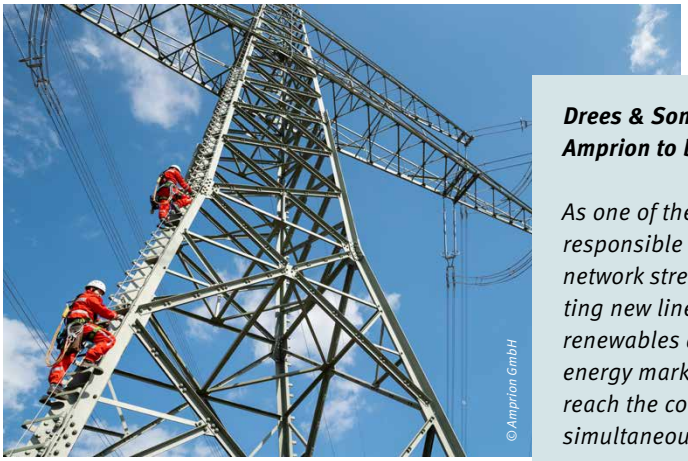
System back-up mechanism – control energy

Operating around the clock, a sophisticated mechanism balances power supply and demand to ensure that the network frequency remains stable at 50 hertz. A handful of electricity producers, consumers and storage facilities are on constant alert in case they need to generate or obtain what is called "control energy".

In Germany, four power grid operators are responsible for maintaining the network frequency and managing control energy: 50 Hertz, Amprion, TenneT and Transnet BW. Operating in their designated areas, or control zones, they tender out the control power requirements for the next day in fixed 15-minute periods.

Despite the fact that this incident at the start of January was easily handled by European network operators, it has triggered intense debate about the security of the electricity supply. Currently, minor frequency deviations can be balanced out relatively easily by coal and nuclear power stations. In a nutshell: if too much power is fed into the grid, then the generators will turn more slowly, producing less power and reducing the frequency. And vice versa for energy shortfalls.

In Germany, 750 megawatts of power are needed for primary control – the highest standard of frequency regulation. Control energy can be switched on in seconds and is equivalent to half the output of a large power plant. If we continue phasing out nuclear and coal power stations, then gas engines and turbines can fill the gap in the short-term, while vast battery installations may be a medium to long-term solution.



Drees & Sommer is helping Amprion to build and connect power grids

As one of the four German network operators, Amprion GmbH is responsible for safely running the high-voltage transmission network stretching from Lower Saxony to the Alps and constructing new lines as and when required. Because of the shift to renewables and the fact that we operate in a Europe-wide energy market, electricity has to travel greater distances to reach the consumer. With a vast array of projects going on simultaneously to upgrade and extend the network, project management is becoming highly challenging.

Since December 2017, infrastructure experts from Drees & Sommer have been helping Amprion by providing a range of project management services for network expansion and connection – including creating and updating roadmaps, project risk assessment and remedial measures, quarterly progress or focus meetings and record-keeping.

What is a green baseload?
The baseload plays an important role in helping keep the network frequency at 50 hertz. It refers to the minimum amount of power that should be constantly available in the network (whether it's during the day when more electricity is consumed or at night when demand tends to be low). Or put another way, the power should never fall below a specific threshold over the course of an entire day. Germany currently has a baseload of around 40 gigawatts per day.

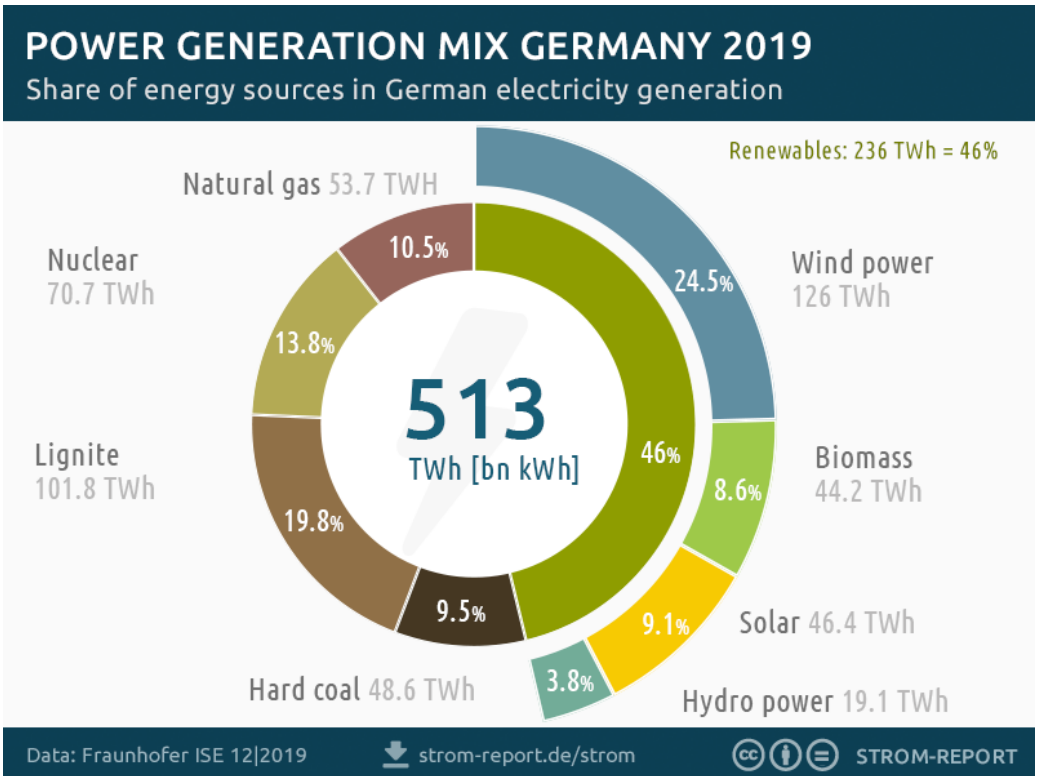
If, as planned, more power stations are taken off the national grid, increasing reliance on renewable energy heightens the risk of blackouts – particularly during seasonal periods of downtime, when wind and solar energy output can drop for several days in succession. It doesn't happen often, but there are certain times where the risk is greater.

Digital and decentralized power equilibrium
A range of approaches are currently being discussed about how to maintain the baseload if renewable energy sources falter for several days in a row. One possible option could be to convert a few coal plants to run on gas, which can be climate-friendly providing that green hydrogen is used instead of the natural gas fossil fuel in future.

Another potential solution is building more smart grids (or intelligent networks). It is hoped that the new systems will automate the inflow and outflow of electricity and help keep the system in equilibrium. The technology behind it is digital and decentralized, with connected power generators, storage centres and consumers communicating using intelligent metering. Increasingly, artificial intelligence will manage the electricity system and keep it in equilibrium. In addition, smart systems could theoretically also reduce the baseload of the entire grid.

Electricity without borders
As we've seen, it's important to make our power system more digitized and decentralized. In the future, power networks will have to be upgraded and rolled out at a massive scale both in Germany and throughout Europe. As electricity travels from power plants to wall sockets, it passes through multiple regions with downstream distribution networks and localized low voltage networks.

The overload protection mechanism in the Croatian substation shut the installation down, causing a power overload in the southern European power network and an electricity surge in the power lines and various outages in Croatia and beyond. 14 transmission lines in Croatia, Serbia and Romania were overloaded in just 43 seconds, clearly demonstrating how tightly interwoven our European electricity grids are. Unchecked power surges can cause breakdowns in transmission lines, which can have an impact on distant lands.



In Germany, more power is now generated from green sources than fossil fuels, with the lion's share coming from wind power.

Source: https://strom-report.de/germany-power-generation-mix/#germany-power-generation-mix-2019

High-voltage lines running north to south

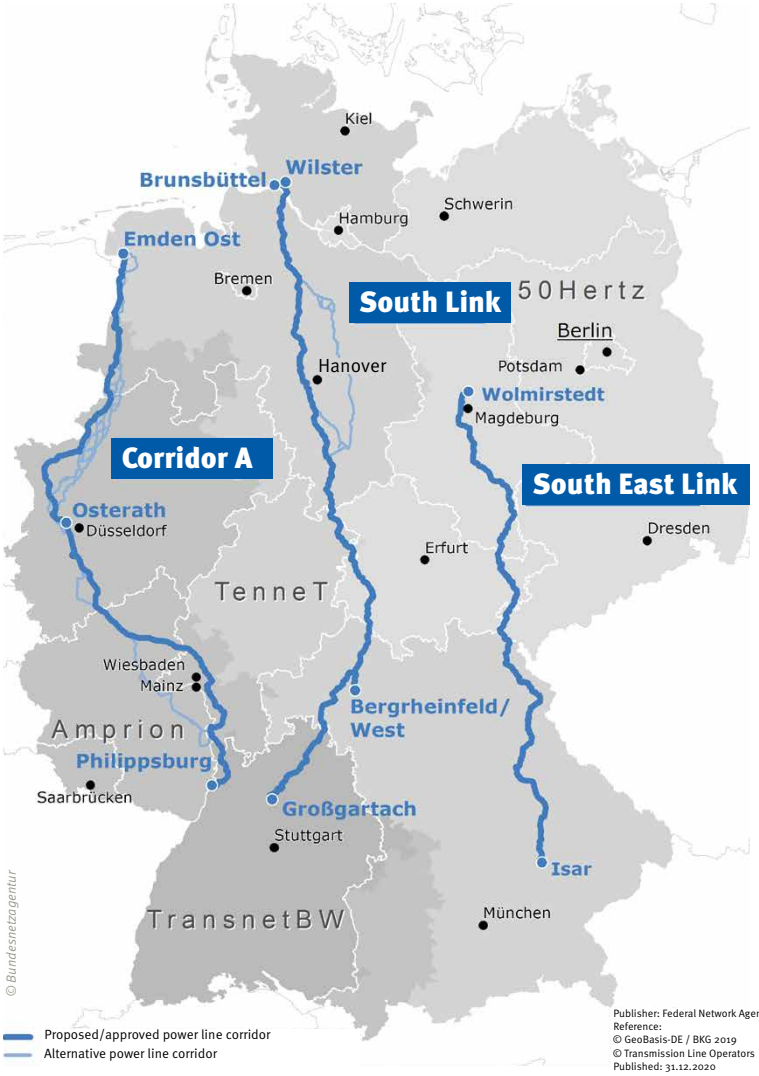
Another thing to note is that the centres of power are – literally – shifting. In the future, power stations in southern Germany will be phased out gradually while more and more wind energy farms in the north are established, particularly on the coast. Renewable energy currently accounts for more than 50 per cent of all power generated in Germany, with wind power responsible for 27 per cent. Given the new pattern of electricity generation, we need to build high-voltage transmission lines to connect the windy north of the country to the industrial south. The new network will be comprised mostly of high-voltage direct current transmission lines (HVDC lines) – otherwise known as power superhighways – such as South Link or South East Link.

Last but not least, we should expect a huge increase in demand for electricity across Germany as more and more cars and heating systems switch over from oil and gas.

Expertise on tap: your part-time construction team

Successfully rolling out this network expansion at scale will require close cooperation between all stakeholders, including network operators of all sizes, planners, power producers and the Federal Network Agency. Transparent lines of communications will have to be set up to keep citizens informed. with feasibility studies, communications for network expansion projects, upgrading or expanding land-based power grids and offshore wind farms, or help setting up approval plans for network expansion projects, our company has the relevant experience. We have supported a large number of network operators transition to renewable power from the earliest stages of project planning. If need be, we can also take over and run the construction too.

With tools like Lean Construction Management, we can ensure a high degree of quality throughout the building process and significantly reduce costs while saving time. For upstream planning, our tried-and-tested digital Building Information Modeling (BIM) system generates an identical digital replica of the future building site. This enables us to simulate processes and anticipate potential problems and planning errors, therefore preventing any unnecessary construction and operating costs.



Three "power superhighways" are in the works which will carry renewable power from north to south Germany.

Passing the stress test exam

When the moment came, network operators were up to the task and Europe narrowly avoided a blanket power outage. Despite coming completely out of the blue, the outage has had a positive impact in raising public awareness about what the shift to renewable energy will entail, as well as launching a wider debate about energy security. A comprehensive overhaul of our electricity system will certainly make it harder to manage this piece of critical infrastructure. But we need to grasp the nettle to hit our target of net-zero carbon by 2050.

Drees & Sommer has also been helping with the planning of offshore wind farms. The wind out to sea can reach higher speeds and is more consistent.

Henrik Töpelt
Head of Energy at
Drees & Sommer SE

Engineering graduate Henrik Töpelt is the Head of Energy at Drees & Sommer, coordinating all activities for our energy industry customers. He mainly focuses on building power networks, converting power plants, dismantling power plants and providing consultancy services to energy suppliers. After studying industrial engineering at Berlin Technical University, he got his first job at a Stuttgart-based engineering firm before joining an international planning and consultancy company. In summer 2020, he moved to Drees & Sommer, where he is our go-to for all things energy-related.

Christopher Vagn Philipsen
Partner at Drees & Sommer SE

In his role as a Drees & Sommer SE Partner, Christopher Vagn Philipsen oversees projects in the fields of power generation, distribution and storage, with a particular emphasis on renewable energy, offshore wind energy and power grid construction. In one past project, he and his team helped connect offshore wind farms in the North Sea to the grid. After completing his studies in procedural industrial engineering at the University of Stuttgart, he worked as a project manager at an engineering firm in the city, eventually joining Drees & Sommer in 1997, where he has been developing and expanding our portfolio of services for the energy industry.

"YOUR ELECTRICITY ORDER, PLEASE"

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Smart buildings that regulate energy usage and adapt to users could drastically increase energy efficiency across the property industry. Klaus Dederich, Partner and Head of ICT at Drees & Sommer SE and Project Manager Bita Sotoudeh sat down with freelance business journalist Harald Czycholl to explain the benefits of Customized Smart Buildings.

How can the property sector help us to reach our climate goal?

Klaus Dederichs: *it can do quite a lot. We are often told that if something isn't broken, don't try to fix it, but most buildings don't run efficiently. Meanwhile, intelligent building management can achieve energy savings of up to 20 per cent.*

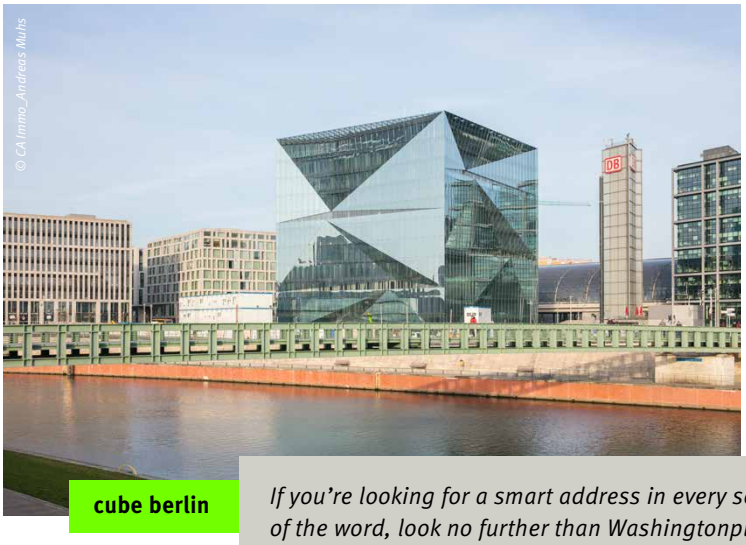
Bita Sotoudeh: *for the entire economy to transition to renewable energy, each sector has to chart their own way forward. It's high time we developed a bespoke strategy to increase efficiency within the construction industry.*

That said, there are reasons to be optimistic. For example, there are now a wide range of renovation subsidies from a wide range of sources and these have been available for a while now.

Klaus: *true, but that's more geared towards passive measures like insulating buildings or upgrading heating units. Aside from that, we can significantly reduce energy consumption through digitization and artificial intelligence. Customized Smart Buildings are beginning to be built with networked technical equipment that can generate a range of data. In these "buildings with brains", artificial intelligence combines information from technical units and sensors with planning, building and user data to optimize all processes within a building. AI can already optimize energy usage within today's buildings. But soon it will also be able to predict energy usage in advance and send this information to power grid operators. Metaphorically speaking, when the network asks your building for its electricity order, smart buildings will be able to respond.*

Of course, that's oversimplifying things a bit.

Bita: *typically, we have to estimate the heating, air-conditioning and ventilation for rooms like offices. We need time to assess a range of factors like the air temperature outside, humidity and wind conditions and in most cases, usage needs are estimated based on standardized minimum time periods. However, with an intelligent building you can optimize heating, air-conditioning and ventilation in real time based on the actual conditions and the amount of people in a space. This has the potential to save a lot of energy. Regulating rooms based on actual usage helps increase energy efficiency at a granular level as well as being eventually able to help us achieve our climate goals at the global level.*



cube berlin

If you're looking for a smart address in every sense of the word, look no further than Washingtonplatz 3 in Berlin. This is the home of cube berlin, a cutting-edge office building with stunning architecture. However, its behind the double glass facade that things get really interesting: it's jam packed full of the latest artificial intelligence technology that helps it run semi-autonomously.

How does a building recognize when rooms are used and what the conditions are like in the rooms?

Klaus: *it's mainly done through using sensors that measure and control changes in the building environment. The sensors collect data about factors like water, electricity and gas usage, and light intensity, and react to movement or sound. Most people will already be familiar with movement sensors that automatically turn on lights when they sense movement outside people's front doors. The information detected by sensors is then converted into electrical signals before being stored as data.*

Merely collecting data isn't hugely valuable. You would need to analyse it for insights first, surely?

Bita: *yes exactly. The data collected has to be turned into actionable information, which in turn can be used to create detailed usage profiles of buildings and installations in real time. Occupancy or IoT sensors can recognize which rooms are heavily used. And depending on this, heating, air conditioning and ventilation can be adjusted in real time or partially turned off. If the building uses only as much energy as it needs for the people currently inside it, then we can gain huge efficiencies. In the future, data analytics and AI will ideally help us identify trends across entire property portfolios, predicting long-term consumption. The important thing will be to identify exactly what data we need so that we're not just amassing big data for the sake of it. Developing KPIs upfront should help us identify which data has genuine value.*

Can generating our own energy with rooftop solar panels help us reach our climate goals?

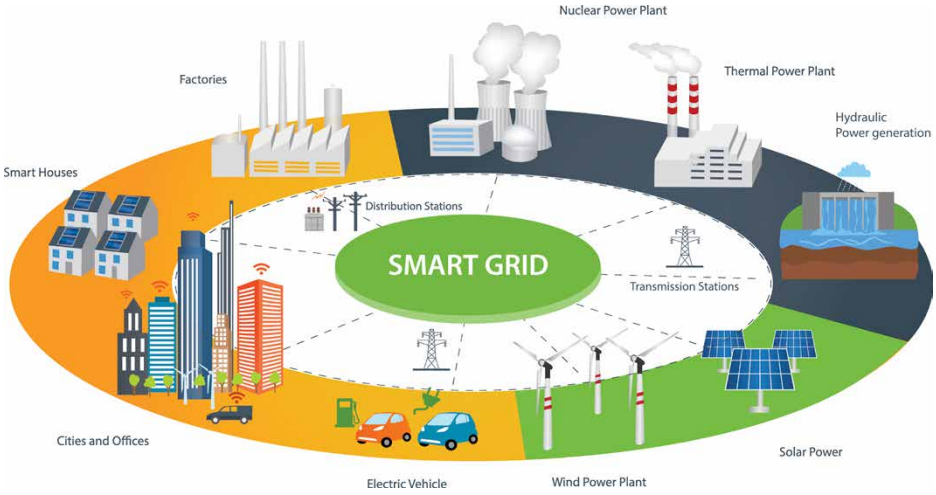
Klaus: *generating electricity from renewable sources helps us achieve our climate goals in conjunction with energy efficiency. However, we have to be mindful about energy stability within the electricity network, because solar and wind energy are highly variable according to environmental conditions. But Customized Smart Buildings might actually help to provide stability while smart grids act as a central controller, using real-time data about electricity generation, consumption and storage to optimize energy distribution and load management within the electricity network. The buildings of the future will 'talk' to the electricity grid, in other words, eventually becoming part of a smart district and finally, a smart city.*

Can you explain that more fully?

Klaus: *here's an example. The electricity grid sends a message out that too much photovoltaic or wind energy is being fed into the network. The smart building then reacts by sending power to its battery storage units, where it can be distributed to users as and when it is required. In the future, we will also be able to use electric cars as passive energy stores. We're actually currently working on a joint research project with the Center Smart Commercial Building at RWTH Aachen, where we are looking into this with a range of different partners. The key to intelligent power networks is to prioritize the energy needs of all connected devices in the building and allocate the available power accordingly.*

Do highly intelligent buildings already exist or are we still some way off?

Bita: *they do already exist, though most are one-off pilot projects. One good example is cube berlin, which opened last year. It's an office building developed by CA Immo that features both cutting-edge*



SMART GRID: ENERGY STABILITY THROUGH INTELLIGENT POWER GRIDS

Renewable energies like wind and solar are highly volatile by nature. That's why we need an intelligent, digital energy system to increase the proportion of renewables in our energy mix. Setting up a digital network, or smart grid, to run in parallel to the electrical grid will enable us to coordinate electricity generation, distribution and storage. It relies on information and communications technology to intelligently allocate the power supply within the network. If the smart grid registers that more power is being produced than is needed, it can shut down generators such as wind turbines until the system is in balance again.

As of January 2020, all households with an annual energy usage of more than 6,000 kilowatt hours (kWh) are legally obliged to have smart meters installed. Intelligent, digital devices such as these plug into the smart grid, sending energy consumption data to the network operator in real time and give the consumer an overview of how much energy they are using. The Department of Commerce has brought in a new Energy Industry Law, whereby smart meters can be used to offer dynamic electricity pricing across the whole market. Prices will vary according to the levels of supply and demand in the network, which should save consumers money and help protect the climate.

architecture and an interior packed full of smart technology. Other buildings in a similar vein are THE SHIP in Cologne, or Art Invest, which opened in Hamburg's Hammerbrooklyn development in summer 2021. Many other buildings are currently in development or close to completion. From our point of view, the tipping point for Customized Smart Buildings has already been reached.

Klaus: *or there's always our very own new Drees & Sommer headquarters in Stuttgart, a sustainable and – of course – smart building accommodating 200 of our colleagues, which was designed in partnership with OWP 12. The new building also doubles up as a live demo to show off the benefits of intelligent buildings to our clients.*

Digital technology was a key part of developing Fond Of's vision for THE SHIP building in Cologne. Which is why they brought Drees & Sommer in to help.

Bita Sotoudeh
Project Manager at
Drees & Sommer SE

Bita Sotoudeh studied industrial engineering at the Rhein-Westphalia Technical University in Aachen and the University of Technology in Sydney, with a major in construction. She joined Drees & Sommer as a trainee whilst still studying at Aachen, supporting the team on consultancy projects in the areas of ICT, industry 4.0 and the Internet of Things. In collaboration with Drees & Sommer, she wrote her master's dissertation on the subject of "Intelligent data usage in property portfolio management" and started working as a project manager at our Hamburg office in November 2020. Her project management work so far has mainly focused on high-rise and requirement management for digitization projects.

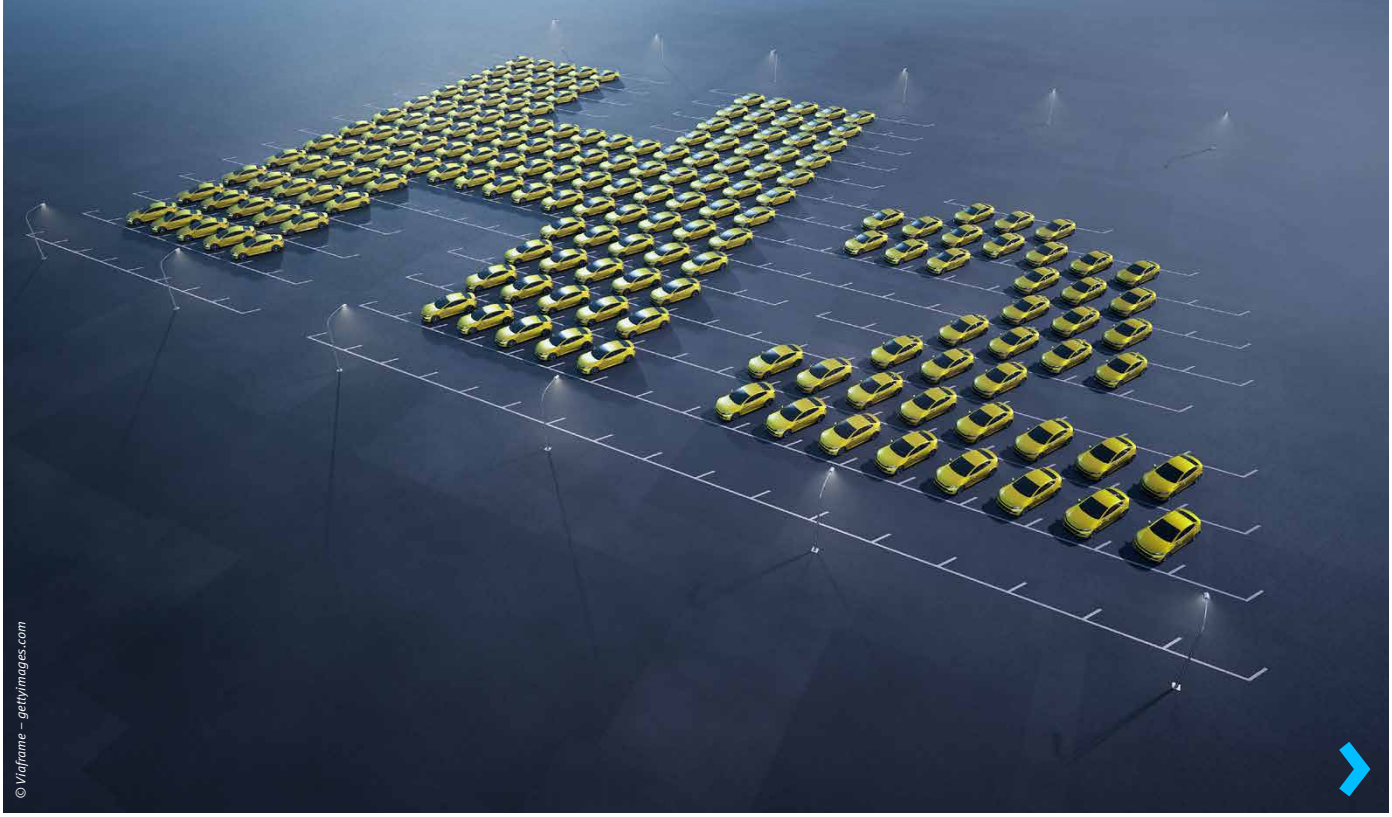
Klaus Dederichs
Partner and Head of ICT at
Drees & Sommer SE

Klaus Dederichs started as Head of ICT at the building, property and planning consultancy Drees & Sommer in 2015, becoming a partner in 2019. He is the managing director of the company's location in Aachen and his remit covers ICT, digitization, business transformation, IoT, big data, industry 4.0 and data centres, preparation and planning. After studying physical engineering at FH Aachen, he spent several years working for various engineering firms. Klaus set up the Smart Building Solution Congress in partnership with the Center Smart Commercial Building at RWTH Aachen and acts as its organizer and moderator. In 2019, he became Chair of the ULI Product Council Future Cities – Smart Cities.

THE HYDROGEN ECONOMY: GREEN AND GLOBAL

Those of us who used to pay attention in chemistry class might recall that hydrogen is the first element in the periodic table. Large parts of our universe consist of hydrogen. Now, it constitutes a great hope for the future in helping Germany hit net-zero carbon emissions by 2050. Having set out its National Hydrogen Strategy in June 2020, the federal government is putting billions of euros into the programme to see whether hydrogen – and particularly green hydrogen – can be the climate-friendly energy source of the future. However, there are enormous challenges to be overcome first for it to become viable in the longer term.

By Thomas Bittner, Senior Team Leader at Drees & Sommer SE



Hydrogen in its pure state is found practically nowhere on earth. However, it is relatively easy to manufacture through the process of electrolysis, which uses electricity to separate water into its constituent elements of hydrogen and oxygen. The latter is an environmentally friendly waste product that can be safely released into the environment, whilst hydrogen gas or liquid can be used as fuel. It is easy to transport in liquid form and can be used as an energy source to generate electricity or heat, as a fuel to power vehicles or as a raw industrial material that is practically carbon dioxide free. However, it's not totally climate friendly unless it has been produced using renewable energy – in which case it's called green hydrogen. However, green hydrogen costs 10 euros per kilogram, which is prohibitively expensive. Meanwhile, "grey" hydrogen produced through steam reforming uses up to 99 per cent natural gas and costs approx. two to three euros per kilo.

"We have to accelerate the development of hydrogen technology in order to reduce the cost of hydrogen and make it more commercially viable. To do that, we need to increase production and consumption of hydrogen at a global scale in order to speed up technological progress and leverage economies of scale. Only then will we have a critical mass of hydrogen for use in primary industrial sectors," writes the federal government in their "National Hydrogen Strategy".

Reliance on imports

Large amounts of renewable energy are needed to produce green hydrogen. As things currently stand, we don't have enough wind and solar power to do so in Germany and will therefore have to either import solar power through electrical lines or import hydrogen through pipelines or using ships.

The federal government's 2020 National Hydrogen Strategy allocates around two billion euros for importing green hydrogen, preferably from north Africa where solar energy is far cheaper. It plans to establish a foundation affiliated with the German Hydrogen and Fuel-Cell Association (DWV) with state support from the German International Development Agency (GIZ) to conclude long-term supply agreements with countries in the region. The supply agreements will follow an auction market model, where the cheapest offers and highest bids are taken forward.

The auction process should provide a framework to counteract price inflation for producing green hydrogen. Initial financing could be done through KfW loans – the development bank has already invested in a 100-megawatt electrolysis project in Morocco – and then it's up to both parties to make sure that the agreement works for them. With Europe securing a stable energy supply and African countries generating more wealth, it should be beneficial for all sides.

The potential hydrogen consumers: industry, heavy goods, air and sea freight

In the medium to long term, we should not only be thinking about how green hydrogen can meet the needs of industry but

Siemens Energy is planning a hydrogen R&D centre in Görlitz

An Innovation Campus is currently being set up at Siemens Energy's factory site in Görlitz, Saxony. The new development will provide a space for Siemens Energy to work with other high-tech businesses, start-ups and research institutes on the digitization, automation and energy technology projects of the future. One of the research topics will be hydrogen. Siemens Energy is creating a laboratory for hydrogen research in partnership with the Fraunhofer Society in order to carry out research into the production, storage and usage of this innovative new fuel. Experts will examine each point in the hydrogen value creation chain and focus on how to get it ready for industrial application. The Görlitz site is intended to be a long-term centre of excellence for hydrogen technology. Planning and consultancy firm Drees & Sommer is helping Siemens Energy with the design, planning and installation of the innovative research centre. The company is also carrying out project management for the new centre, ensuring that it is built on time and within budget. The centre of excellence for hydrogen is scheduled to be completed in 2023.

For more information, please visit:
https://new.siemens.com/global/de/produkte/energie/themen/innovationscampus-goerlitz.html

also about how to establish which sectors to prioritize for the new fuel. At the moment, German industry consumes half of the country's power supply per year – or about 234 tera-watt hours (TWh). If energy-intensive industries like steel, refineries and chemicals shifted to using hydrogen, enormous quantities of the fuel would be needed. And if we could switch to hydrogen at an energy efficiency of 70 per cent, the amount of energy needed would rise to 334 TWh. And since Germany only produces about 180 TWh of renewable energy in total, it once again highlights the need for imports.

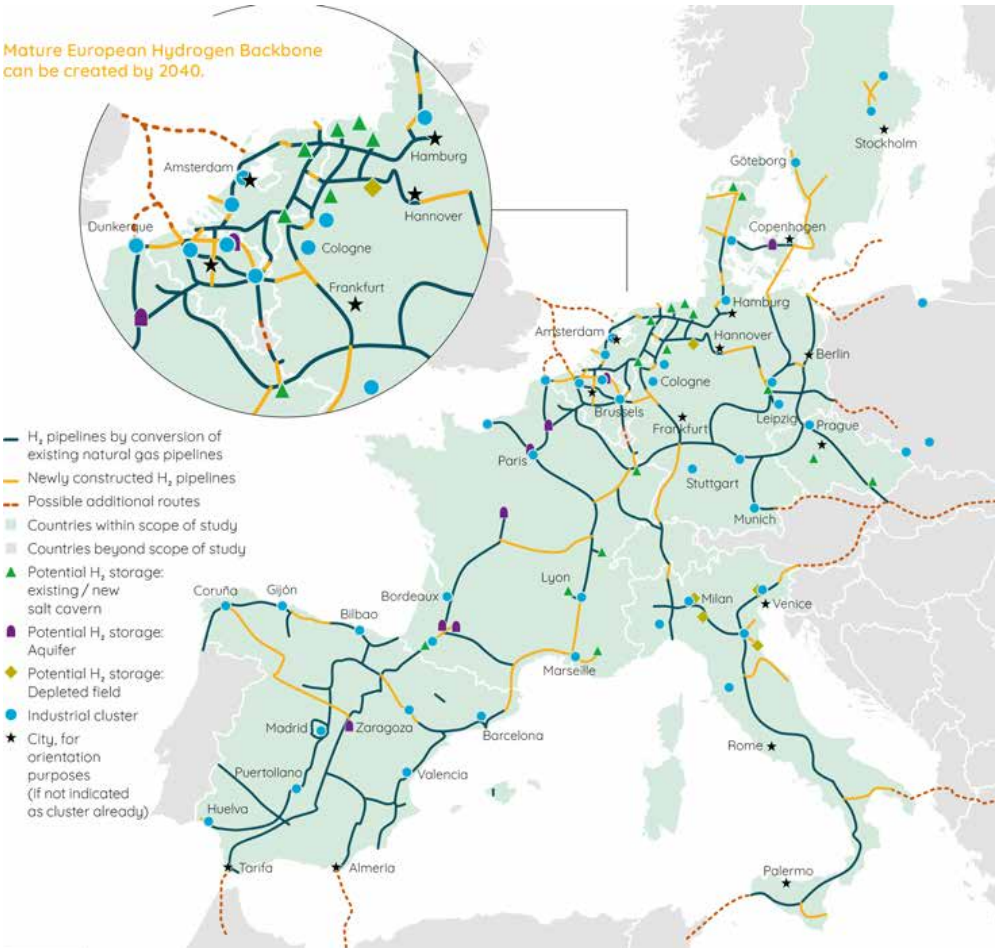
But there are other industries that could benefit from hydrogen too. For example, the transport sector is largely dependent on liquid fuels and greenhydrogen may be ideal for fuelling the majority of heavy goods vehicles (vehicles that carry more than 7.5 tons of cargo) and air and sea freight. If we wanted to go in this direction, a Greenpeace study suggests that we would need 363 TWh of energy.

The heating market is a different story. Heat pumps are more efficient when they run on electricity directly, making hydrogen less attractive. However, it could still be used at a more macro level. Rostock-based company Exytron has developed technology that uses photovoltaic energy generated on housing estate rooftops to power a small electrolyser in the basement. Surpluses of solar energy in the summer months could therefore be stored in fuel cells and used on an ad-hoc basis for heating and electricity in the winter.

The energy infrastructure of the future

Moving beyond the question of supply and demand, infrastructure also has to be created so that hydrogen can get from producer to consumer as cheaply and efficiently as possible. A group of energy providers, network operators such as EnBW, Uniper and TenneT, and a number of public utilities such as Mainova have already been working on this for a while. And some important groundwork has been done to build the new energy infrastructure that the industry desperately needs, and in which hydrogen plays an important role. Meanwhile, Drees & Sommer has also been helping the energy industry to convert its distribution network and create the electricity, gas and heating infrastructure that will be needed to support the new hydrogen economy.

A Europe-wide pipeline network known as the Hydrogen Backbone is also being planned. Operated by an organization of the same name, it consists of a 6,800 km network of pipes, up to 75 per cent of which will be made from converted natural gas pipes. The pipeline is due to be completed in 2030. The final part of the puzzle will be to build a dedicated hydrogen network and a bio-methane network.



Replacing natural gas with hydrogen – the European Hydrogen Backbone Initiative is planning to lay 6,800 kilometres of pipes by 2030. Three quarters of the network will consist of converted natural gas pipes which will be connected using new pipe sections.

Becoming a global leader in hydrogen exports
Germany is already a global leader in terms of technology exports, so it's a matter of leveraging a strong position to become the leader in green hydrogen too. But before exports can begin in earnest, the infrastructure has to be installed and tested on home soil.

To get the ball rolling, we need a clever package of incentives and regulatory measures. Getting rid of the renewable energy surcharge (EEG) would be one step in the right direction and a change in the Energy Industry Law is also needed to facilitate the new pipe network. There also needs to be a rapid acceleration in renewable energy production, which is currently stagnating. For Germany, building more land-based wind energy plants will be the key to unlocking green hydrogen.

Another important issue for the current legislative period is carbon dioxide pricing. Because green hydrogen is far more expensive – initially, at least – it cannot compete with fossil fuel power unless it is taxed appropriately. We therefore need regulatory action at the European level, with measures such as blending quotas.

In summary: the journey to the promised land of green hydrogen will be a long one. The type of paradigm shift required will only be possible through a combination of smart regulation, strong action from industry, a thriving research landscape and international partners.

Thomas Bittner
Senior Team Leader at Drees & Sommer SE

Thomas Bittner completed his studies in civil engineering at TU Dortmund, with a major in construction economics and management. After graduating, he joined Drees & Sommer as a project manager in 2002. In 2003, whilst working at the company, he completed a part-time master's degree in real estate at the EBS Business School. In 2006, he moved to a global construction company, where he worked in project management, contract management and claim management for the oil and gas industry in Africa. In this role, he was able to ensure high-quality delivery and budgetary control in challenging environments such as the Nigerian Delta. With years of experience in construction projects in Germany and abroad under his belt, he is a seasoned expert in large-scale building projects. In 2016, he returned to Drees & Sommer as a Senior Team Leader and has since been managing projects for the international accelerator facility FAIR.

“ONE AND ONE EQUALS THREE – OR MORE”

In an interview with the journalist and blogger for enwipo.de Frank Urbansky, Drees & Sommer experts Christoph Gawlik and Leonardo Estrada discuss the topic of polygeneration. Discover what it is, how it can be used for co-generating electricity, heat and hydrogen and why it might be particularly useful at a local level.

Leonardo, what exactly does polygeneration mean?

Leonardo: *combined heat and power (CHP) systems simultaneously produce electricity and heat from a single source. Polygeneration happens when we manage to generate an additional product on top of the other two. So, if we had to come up with a slogan, we’d say: “One plus one equals three – or more”. In practical terms, energy facilities operating at a regional level use different kinds of raw and waste materials to generate heat, electricity and then another gas or liquid fuel within an efficient energy system. If a plant isn’t running efficiently, polygeneration lets us generate an extra energy product like hydrogen – or raw materials for making it – and thereby generate additional income.*

How does that work in practice?

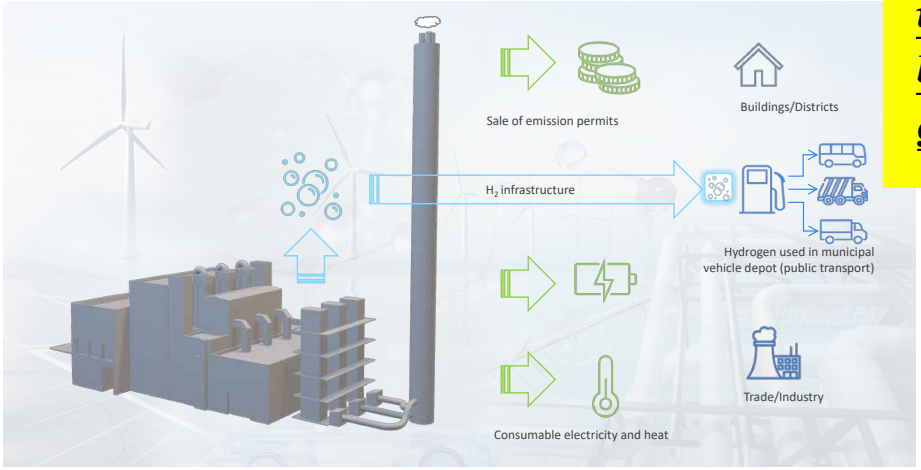
Leonardo: *first, we analyse performance reports to see how the plant is operating and if there are any reserves. After that initial work, we can determine what energy products could be produced from the reserves. For example, a plant could be adapted to produce hydrogen as well as heat and electricity. However, since it’s costly to transport hydrogen, it’s desirable for the main customers to be located relatively close by.*

Is that because the hydrogen of the future should be green?

Christoph: *yes, green hydrogen is produced using energy from renewable sources. It is also viable for incineration plants because, according to the Energy Industry Law, 50 per cent of the electricity they generate is designated as green energy. Part of our role as consultants is to act as facilitators, and so we help connect the operators of plants with the right stakeholders at a regional level; which could involve global gas companies, leading electrolyser manufacturers, industrial companies and of course the public sector.*

How exactly do operators of incineration plants benefit from this?

Christoph: *by opening up new markets. Instead of selling the electricity you generate into the power grid at unprofitable tariffs – where you might even be making a loss – you can develop an extra income stream by producing green hydrogen.*



Instead of selling the electricity you generate into the power grid at unprofitable tariffs – where you might even be making a loss – you can develop an extra income stream by producing green hydrogen.

If a power plant isn't profitable, we can create an extra energy product like hydrogen – or upstream materials for its production – and generate more income.

The benefit that you have over wind and solar power is that you have a continuous supply of electricity. That in turn offers operators guaranteed future production so they can chart a quick path to profitability.

What purposes does the green hydrogen best lend itself to?

Christoph: *because most incineration plants are run by local authorities, they already have links to public transport networks. The hydrogen generated could be used to power buses with fuel cells directly or converted into methanol, which many people think has a lot of potential as a liquid fuel of the future.*

That could certainly help the transport sector transition. But isn't there an opportunity in the heating market too?

Leonardo: *true. Polygeneration could potentially be used in heating systems, especially as a way of supplying large buildings. For example, electrolysers – which are machines that separate water into oxygen and hydrogen – could be installed in buildings and connected to photovoltaic installations. The electrolysis process generates heat, which could potentially be re-used to heat buildings, making the whole process more economical. We are actually building an installation like this in a building in Hanau, only in this case the hydrogen is being subsequently converted to methanol for use in transport. There is already funding available for these kind of installations. However, it's also worth considering whether to install heat pumps. These use geothermal energy, which is gained from the earth, to heat buildings (a direct power-to-heat conversion). With heat pumps, you can generate three times as much heat for the power that you put in, whereas an electrolyser produces a third as much heat for the electricity it consumes. Hydrogen isn't efficient as a heat source.*

Is there a way of making polygeneration more profitable?

Christoph: *yes, we can use the waste heat from electrolysis in the same way that they do in data centres. In fact, we're planning to do this in a large building in Esslingen, by installing a fourth-generation heat network, which is also known as low-temperature district heating.*

Leonardo: *at Drees & Sommer we've got a lot of experience in planning heat networks. In 2012, we designed one for Berlin's Tegel airport and it will soon be commissioned now that the airport has closed. The system uses much lower inflow temperatures at around 30 or 40°C. Meanwhile, buildings with very good insulation can be fitted with cold heat networks that use the earth's ground temperature at 15 to 17°C to produce heat. Networks that operate at low temperatures can be combined with waste heat units, which means that they don't need to run at 90°C.*

If polygeneration is rolled out at scale, there would be a host of decentralized electricity and heat networks operating at a local level. Doesn't that go contrary to the government's objective of guaranteeing a stable supply nationwide?

Leonardo: *our centralized electricity grid consisting of four transmission networks and about 900 distribution networks has served Germany well up until now. However, if we want to transition to renewable energy, smaller energy producers and network operators operating at the municipal level will need to be part of the picture. They will also help develop new energy-efficient technology. Likewise, digital solutions such as intelligent networks and metering systems will be needed to control these decentralized energy networks. However, it certainly won't be easy for the government to create the required regulatory framework.*

Christoph: *this year, there have been new amendments made to the Renewable Energy Law and Building Energy Law that make it easier to implement solutions for individual buildings – such as using regenerative electricity for producing heat – or for clusters of neighbouring buildings. That puts polygeneration very much in the frame.*

Leonardo Estrada
Leading Consultant at Drees & Sommer SE

In 2019, Leonardo joined Drees & Sommer as a Leading Consultant and the Team Leader of the Berlin-based Blue City Development Team. Prior to that, he spent 10 years working for the engineering firm MegaWATT as a project lead and was part of the senior management team. Leonardo studied energy and process technology at TU Berlin, graduating in 2009. As a member of Drees & Sommer's H2 Core Team, he works alongside colleagues from different departments to help companies with their hydrogen strategy. He and other Drees & Sommer colleagues also regularly participate in conferences and workshops on the subject of hydrogen. Leonardo is extremely well-connected in the energy industry and advises construction firms and developers on all aspects of planning and designing for an innovative, sustainable energy supply.

Christoph Gawlik
Associate Partner at Drees & Sommer SE

Christoph began his career in 2014 working as a senior project manager with the automotive team where he tackled large-scale, complex projects. In 2019, he joined the management team for the project management division in Stuttgart and has been Head of Automotive since 2020. Christoph is responsible for automotive strategy across the entire Drees & Sommer Group and for growing the business. He studied civil engineering at the University of Dortmund before taking up roles in research, engineering firms and the steel industry. During that period, he also spent several years in the US, where he oversaw the construction of a new stainless-steel factory. He also represents Drees & Sommer at a range of innovation events put on by the Arbeitsgemeinschaft Industriebau e. V. (AGI).

GREEN HYDROGEN AS A BASIS FOR E-FUELS

Five questions for Prof. Dr. Hans Sommer,
Chairperson of the Supervisory Board at Drees & Sommer SE

Combustion engines have a reputation for being really bad for the environment. Electric motors, in contrast, are very much on trend. Below we ask Prof. Dr. Hans Sommer, Chairperson of the Supervisory Board of Drees & Sommer SE in Stuttgart, why electric motors aren't the only solution in our transition to a greener, more eco-friendly way of life. Plus, he tells us why we should produce and use hydrogen-based e-fuels as well.

Many people see electric as the ultimate climate-friendly drive technology. Do you agree?
It's clear that, in the future, all drive technologies will be based on green energy in some shape or form. On the one hand, electric engines that run directly on green fuel can't be beaten for efficiency and they are really beneficial in large cities, particularly those in Asia, because of their impact on air quality. On the other hand, we need to ensure that electric vehicles are fully powered with renewable energy and there needs to be a massive expansion in charging infrastructure. In addition, a lot of work has to be done in terms of making battery production more sustainable.

What about making the transport sector more environmentally friendly? Are electric motors the only solution?
It's still early days for electric motors and a lot depends on future development. Therefore our existing stock of vehicles will play a decisive role in reaching our climate objectives. Worldwide, there are 1.3 billion vehicles running with combustion engines, with 47 million of them in Germany alone. Many of these cars have a long working life ahead of them. And that's just road vehicles. In normal times, there would be around 200,000 kerosene-powered planes flying daily, plus countless vast cargo and cruise ships which are fuelled by heavy crude oil. Meanwhile, military aviation is another sector where we are unlikely to be seeing electric motors in the foreseeable future.

In other words, there's a transitional period in which we need an alternative solution – and synthetic fuels based on green hydrogen could be the way forward.

What are the benefits of using synthetic fuels?
There are lots. It's actually relatively easy to modify combustion engines so that they produce practically zero carbon emissions. And e-fuels contain very few harmful compounds so their emissions are much cleaner, and more cleanable. E-fuels also tend to be more environmentally friendly than bio-fuels, which might be made from palm oil – for which tropical rainforest may be cleared – or corn, which could be cultivated for food production. What's more, e-fuels are as easy to store and transport as the fossil fuels we currently use, so we can simply piggy back off the existing petrol station and supply infrastructure.

It comes down to whether we can produce hydrogen economically for the global market by taking advantage of cheap electricity in areas with an abundance of solar or wind energy. If we can do this soon, the transition to future fuels would be more sustainable. At the same time, this has the twin benefit of preventing huge economic and social upheaval at existing production sites as well as bringing opportunities for poorer countries.

What would a production facility for zero carbon synthetic fuels look like?
There are three different types of site:

1. ***Green electricity plant:*** *at locations such as the North African desert or South Europe, where there is an abundance of wind or solar energy. Photovoltaic plants: take up the most land surface area but produce the cheapest energy. However, because they only produce power from dawn to dusk, they often need to be paired with wind farms.*
2. ***Hydrogen plant:*** *using electrolysis and in the vicinity of a body of water that isn't being used for any other purpose – so a sea location is ideal. The ideal site would also be located close to an electricity generation plant so that we can avoid large costs in terms of building transmission lines and the loss of energy during transmission. The hydrogen produced would be stored initially in stationary storage tanks.*
3. ***Methanol production:*** *as the basis for various e-fuels. Ideally, production would be combined with an electrolyser unit to avoid the need for transporting hydrogen to the plant (which is still relatively expensive), so that the e-fuels can be transported using the existing infrastructure used for fossil fuels. This production method requires carbon dioxide as a raw ingredient. This would either need to be transported in or extracted from the air.*

One option would be to build plants that incorporate all three production types next to one another, with North Africa or the south of Spain as possible locations. The other option would be to have hydrogen production in North Africa and methanol production in Europe, in which case you'd need to transport the hydrogen by building new pipelines or using specialized ships.

How realistic will it be to implement your suggestions?
That, I think, is largely dependent on international cooperation and whether the political will exists. In any case, Germany and Europe as a whole will need to import green hydrogen since we won't have the capacity to produce enough renewable energy and it will also be too expensive.

We already have all the necessary technological expertise in Europe – particularly so in Germany. Moreover, in locations where solar plants at the gigawatt scale are being planned or already under construction, projected electricity costs are between 1.5 to 2.5 cents per KWh. That fulfils another important criterion as it would enable us to produce green hydrogen at a price of 1.2 to 1.5 euros per kilo, which is 70 per cent less than its current cost in Germany. However, the cost-efficiency gained would be compromised if the hydrogen had to be transported from Europe to North Africa to make benzene. Instead, it would be most economical to hydrogenate it and make benzene at the same location as the hydrogen plant.

If the political will exists and all the conditions could be satisfied at the proposed site locations, then we would need to create a consortium of German, or even better, European companies to look into building and operating extremely large industrial plants in sunny partner countries. The current economic stimulus package already includes funding for building and operating projects like this.

The political class should not pass up on this massive opportunity to boost electric mobility and decarbonize the existing stock of vehicles with combustion engines. The initial focus would be on cargo and air transport, but once we've got up and running, we can pick up the pace quickly.

Prof. Dr. Hans Sommer
Chairperson of the Supervisory Board at Drees & Sommer SE

Hans was born in 1941 and studied civil engineering and architecture at the University of Stuttgart. After working as a statistician and design engineer at Baresel AG in Stuttgart, he joined the engineering firm Drees + Kuhne as a project leader before becoming a partner at Drees & Sommer GbR in Stuttgart. In 1991, Drees & Sommer changed its structure from a partnership to a public company, with Hans acting as the main shareholder and Chairperson of the Board. The focus of his work was hands-on project management, digitization, integrating cutting-edge planning services and managing large-scale, high-rise and infrastructure projects. In addition, he has published numerous essays and books, including a 1983 dissertation on cost management using the cost element method. Since 2008, Hans has been the Chairperson of both the supervisory board and the Drees & Sommer AG consortium, which has been operating as Drees & Sommer SE since 2017. In 1986, Hans became an honorary professor at the University of Stuttgart and is on the board of trustees of the Fraunhofer Institute for Industrial Engineering and Organization (IAO). He has been a contributor of ideas for the transition to renewable energy and the hydrogen economy for the institute since 2011.

EXYTRON GMBH – GOODBYE TO THE FOSSIL FUEL DINOSAURS

Wind and solar energy are capable of generating enormous quantities of power but are subject to significant fluctuations. For many years, it was thought that storing unlimited amounts of green energy would be impossible. Now, that might be about to change: EXYTRON GmbH, a company founded in Rostock in 2013, has developed a market-ready solution that solves one of the key problems facing the transition to renewable energy sources – storing enough green energy to guarantee a stable supply. Meanwhile, planning has already started on projects to distribute decentralized, zero-emissions electricity to regions, industrial areas and city districts. Drees & Sommer energy expert Martin Pietzonka interviewed Klaus Schirmer, a sales manager at EXYTRON, to find out more about the technology behind it.

Your company was only founded in 2013 so it's still pretty young. How did you come up with this idea in the first place?
The idea was actually several years old by the time our firm was started. It dates back to 2008 when our founder Karl-Hermann Busse was grappling with the problem of how to power a sailing boat with wind and solar energy, which are sustainable and so abundant at sea, instead of with 1,000 litres of diesel. Even though it proved difficult in practice, this was the initial spark behind the idea.

Yet it took five years to translate the spark into action …
Yes. Then he came up against the perennial problem of how to store large amounts of renewable energy in an efficient and economically viable way. The logical solution is to use a battery, but once you look into it in more detail, it soon becomes clear that it's totally impractical. To understand why, let's take the example of the sailing boat. To generate power equivalent to 1,000 litres of diesel fuel, we would need a battery

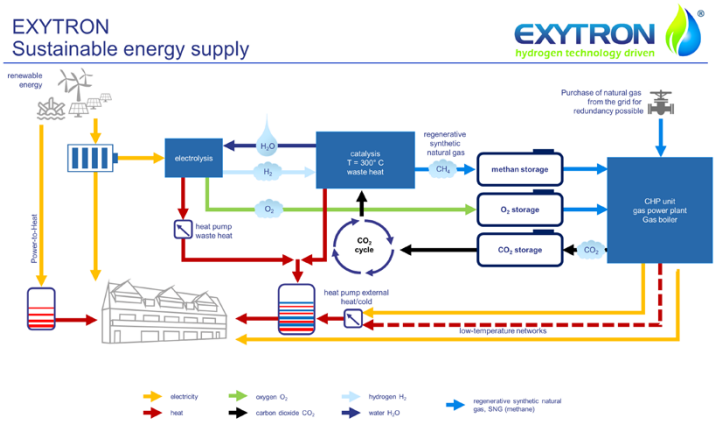
> ***"Until very recently, the idea of storing unlimited amounts of green energy would have been the stuff of pure fantasy. However, we now have a technology on the market that can do exactly that."***
>
> **Klaus Schirmer**

capable of supplying 10 megawatt hours of energy. Which would be about as big as a sports hall. There's no way you could install it on a sailing boat and even if you could, it would cost you several million euros. So, rather than going down the battery route, a different technology with the same energy storage capacity as fossil fuels would have to be developed.

What was the solution?
The solution was to develop our SmartEnergy-Technology and Zero-Emission-Technology, which uses units like power-to-gas and power-to-X plants to store energy. Powered by renewable energy, these installations generate hydrogen before converting it directly into methane. The methane can be stored in tanks and used by a CHP unit or boiler to generate electricity, heat or energy for cooling. There are several reasons why it's better to use green natural gas than hydrogen: higher energy density, less safety requirements and the fact that it relies on infrastructure and technology that have been around for decades.

However, the key thing about the technology is that the carbon dioxide generated by burning the renewable natural gases is not emitted into the environment. Instead, it stays within a closed loop system and is used and reused to produce green natural gas and fuel. Likewise, all the heat generated during electrolysis and methanation is also reused rather than dissipating into the atmosphere. Because of this, our installations are over 90 per cent energy efficient, which makes them very appealing to our clients.

Do you still remember your first big commission?
Our first one was in January 2016. We'd just set up a test facility with funding from the Mecklenburg-Vorpommern state when we received a commission to design a plant to supply 37 terraced houses. Two years ago, we started project number two: building the world's first decentralized power-to-gas installation in a housing estate in Augsburg dating from 1974. The plant generates green energy for tenants with any surplus energy being converted to methane and stored in giant tanks for later use. The technology is so energy efficient that the carbon dioxide footprint of the building is as low as a Passive House Plus – a feat that has never been achieved in old housing stock before. As well as having a climate-friendly system, tenants are also guaranteed a stable renewable energy supply. And despite the installation of a new system, property rents and energy bills aren't pushed any higher. In 2017, planning got under way to construct the very first EXYTRON energy factory in the Lübesse region of Mecklenburg-Vorpommern. The construction is scheduled to begin in the first half of 2021.



The Lübesse project

In the Lübesse region of Mecklenburg-Vorpommern, plans are being drawn up to build wind and photovoltaic power plants near Schwerin to supply 100 % decentralized green energy to the region, including a nearby industrial area. The 35-to-40 million euro initiative, which is being led by Lübesse Energy GmbH in partnership with naturwind GmbH and which is partly funded by the state of Mecklenburg-Vorpommern and the EU, will use EXYTRON's patented SmartEnergy Technology to provide a stable source of energy and heat. Using electrolyser units with 20 MWh of input power, it converts any surplus energy into hydrogen as well as renewable fuels like methanol, kerosene and ammonia and renewable chemical substances that could be used by the plastics industry. Plans for the 57,000-square-metre site started being drawn up at the end of 2019, with construction due to start halfway through the current year. The first stage of the project is due to be completed by the end of 2022.

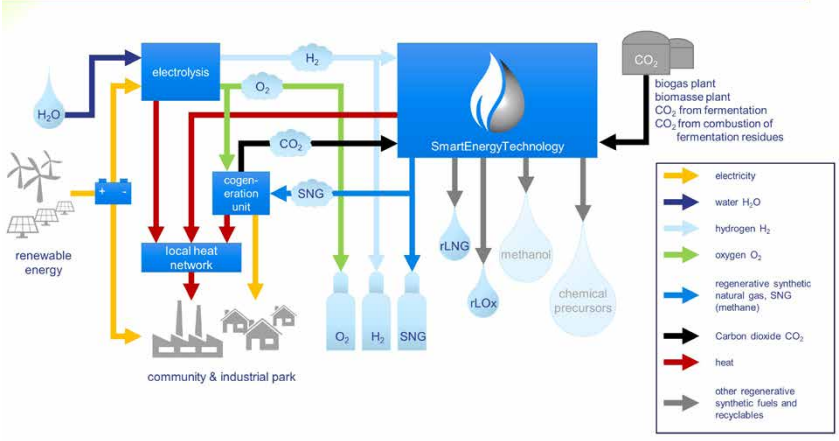
How much demand is there for a decentralized, zero-carbon energy supply?
There has been a significant amount of hype around our technology, which has been reflected in the number of new enquiries we have received. We also have a number of other projects in the pipeline that are similar in scope to the Lübesse project. EXTYTRON energy plants can supply entire districts and industrial areas with electricity and produce renewable fuels. In terms of appetite for renewable energy, the potential opportunity is almost limitless. However, tapping into that full potential is another thing. For a bit of fun, we worked out that EXYTRON would have to install around 1,500 units per month to help all apartment buildings in Germany become carbon-neutral by 2050 – which is totally unfeasible. So instead, this year we're going to focus on selling licences abroad so that our technologies can be adopted in other countries. That way, we can go the extra mile to tackle climate change. That would definitely give our efforts a boost.

What do you think about hydrogen?
All things hydrogen tend to be really expensive and because it has low energy density compared to methane or natural gas, you need to store more of it – or compress it using a much higher pressure. Safety regulations for hydrogen are also much stricter. So at EXYTRON, we only use hydrogen at the first stage before it gets converted into methane. This makes life easier for us as it's a common gas that is compatible with work products that have been on the market for decades.

About EXYTRON

EXYTRON is a medium-sized company with 20 employees. It was founded in 2014 and has brought to market a patented, closed-loop system that converts surplus wind and solar energy into the natural gas, methane. Its aim is to make clean energy available at all times of day and night. When there is insufficient wind and solar power in the network, the gas is used as an energy source.
In 2018, EXYTRON received the German gas industry's innovation prize as well as the WEKA Verlag's Smarter World Award. The system works as follows: an electrolyser unit that is powered using renewable energy sources generates hydrogen. A catalyser converts the hydrogen into the natural gas methane. If need be, the synthetically produced gas and the oxygen – which is a byproduct of the electrolysis process – can then be used for heating in a CHP installation or boiler. This chemical reaction generates very pure carbon dioxide that can be constantly recycled to produce methane from hydrogen. The EXYTRON installation is completely emission-free as all the carbon dioxide produced is kept within the system. The really smart thing about it is that the heat produced through electrolysis and methane production can be also used for on-site/ neighbourhood heating and hot water. That means that there is hardly any wastage and the system boasts an energy efficiency of over 90 per cent.

EXYTRON Energy Plant



Klaus Schirmer
Head of Sales at EXYTRON GmbH

Klaus started a law degree at the Justus Liebig University in Gießen in 1989 after completing his college education in Siegen. His career began at a large German insurance company. He then changed roles and became a contract and project manager at an engineering firm before setting up as a self-employed project manager specializing in renewable energy. In October 2014, the 51-year-old joined the Rostock-based company EXYTRON GmbH as Head of Sales.

UNDER THE MICROSCOPE: 2050 – COMPACT POWER STATIONS

Their numbers may still be few but we're going to be seeing a lot more of them. In this article, we look at buildings that function as miniature power stations. Also known as energy-positive buildings, they generate their own energy and use surplus energy to supply their immediate environment – whether that's neighbouring buildings or feeding into the power grid. Soon, they will be supplying power for transport locally too. And the buildings also make economic sense. Real-world examples exist that show that the upfront investment can be paid off within eight to nine years. What's more, they can help reduce carbon dioxide emissions, protect the environment and contribute to our transition to renewable energy.

By Prof. Dr. Michael Bauer, Partner at Drees & Sommer SE and Johannes Hopf, Building Performance Manager at Drees & Sommer SE

Featuring photovoltaic panels on both its façade and roof, a high-insulation envelope and integrated geothermal and solar energy, Freiburg's new town hall in the Stühlinger district is the world's first public net-energy-positive office building. While other property managers try to find the most suitable and best-value energy provider, the new town hall building doesn't need to; it has been generating its own energy since being built in 2017. And since it generates more energy than it uses, the town hall building has also been feeding power back into the city's electricity network. To all intents and purposes, Freiburg town hall is just like a power station – only on a much smaller scale.

Built in 2019 by Powerhouse, a consortium of entrepreneurs that specializes in turning buildings into power plants, the Brattørkaia office building in Trondheim in Norway can generate twice as much energy as it consumes, on average. Powerhouse was also involved in the renovation of a property from the 80s in Kjørbo in the suburbs of Oslo. It proved that it's possible to make an old building not just energy-efficient but, with the property's energy consumption dropping by over 86 per cent after the refurbishment, even energy-positive.

What's more, a study published by ETH Zürich last year found that any building could be transformed and become like Freiburg town hall or the Brattørkaia office block. This piece of news offers some relief as we contemplate a looming climate crisis, shortages of raw materials and rising greenhouse gas emissions. It's also worth doing, especially when you consider that 40 per cent of Europe's energy is used up by the property sector. So yes it's desirable but is it actually realistic? Will we be able to turn most buildings into power plants within 30 years or less?

Urgent action needed to renovate old building stock

To answer the questions we've just posed, let's take stock of where we are. While the idea of a zero-energy, or energy-positive house is gaining traction, only comparatively few examples have actually been built and most buildings are very much still energy guzzlers. This is due to the fact that, on the one hand, thermal insulation in existing building stock is inadequate and the majority of heating and cooling systems are outdated. On the other, it's still standard for buildings to have fossil fuel power supplies and be fitted with power-hungry infrastructure. In the EU, about a third of the building stock is more than 50 years old, while it's a similar picture in Germany, where roughly half of all residential buildings were constructed between 1949 and 1990. These older buildings account for more than 50 per cent of energy consumption – compared to, say, residential builds constructed after 2009 where the figure is just three per cent. The fact is: it's easier and quicker to make new buildings energy-positive.

Upgrading old buildings' energy systems is both urgently needed and an enormous opportunity. At present, the annual renovation rate in Germany is approx. one per cent, which is way behind where we need it to be. And why? Well, legislators have always struggled with setting concrete renovation objectives for property owners and upgrading buildings' energy systems is a big investment, so it needs to be financially rewarding. In reality, there is little appetite to do more than what is legally required, perhaps because many constructors and property managers simply aren't aware that a sustainable, energy-efficient building can also be a good investment. For example, a new photovoltaic installation would typically pay for itself within 10 years, while the payback period for a geo-thermal installation – where heat pumps provide heat in the

The world's first public net energy-positive office building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Town hall in Stühlinger, Freiburg
Completed in 2017, the town hall in the Stühlinger district of Freiburg is the world's first net energy-positive public office building. With around 800 solar panels mounted on its façade and roof, it produces sufficient energy from renewable sources such as photovoltaic or geothermal power for its own needs, with any surplus being fed back into the grid. Drees & Sommer was responsible for designing the energy system from start to finish and for making the relevant carbon calculations. Freiburg town hall was certified as climate-positive by the DGNB in 2019.

winter and cooling in the summer – is typically 10 to 12 years. It is clear that sustainable solutions can be profitable for property owners; because they do things like reduce operating costs, for example. That said, it's necessary to conduct a thorough cost benefit analysis before making any decision.

Thinking outside of the building

It's not as if we don't have the technology to start making changes. We could already be building far better buildings with our existing technology if we can think out of the box – or perhaps more accurately, out of the building. For example, it's a good idea to install solar panels on the façade as well as on the roof. This provides more renewable energy instantly and is a much more efficient use of available space. We could also consider combining different types of technology: like using low-temperature heating and high-temperature cooling systems (heat-pump operated) alongside geothermal energy.

There is also no shortage of political support. Plenty of subsidies and funding programmes are available to constructors. For example, the KfW banking group is financing the construction or purchase of energy-efficient houses with low interest rates and a repayment grant. Other financial incentives are available for upgrading the energy system in older buildings, solar power upgrades, or other upgrades with renewable energy plants to supply heat or electricity. With the construction sector playing an important role in the European Green Deal and EU Taxonomy, there will be new requirements to adapt to and the trend towards energy efficiency and sustainable technology will pick up pace. A potential sticking point is the classic landlord vs. tenant dilemma, where the argument arises about who benefits most from new energy systems in buildings and who pays for it. New legislation needs to be brought in to manage the financial aspect of the renewable energy generated by photovoltaic installations in apartment blocks. Although they are not on most people's radar yet, one potential solution is landlord-to-tenant electricity contracts. In any case, it's time for property owners, managers, developers and investors to act. They can't guarantee that their properties will remain profitable unless they start implementing the solutions that are available today.

OWP 12 office building, Stuttgart

OWP 12 – Drees & Sommer's new building in Stuttgart – amply demonstrates how new thinking and technology can be intelligently combined. The innovative office block is energy-positive, which means it produces more energy than it needs to operate. It achieves enormous energy efficiency through its highly insulating façade, PV units on the roof and south face, geothermal technology (drawing heat from the earth) and a north façade planted over with greenery. Constructed according to the cradle-to-cradle principle, this showcase project is due to be completed in autumn 2021.

With a thermal envelope just 90 mm thick and innovative materials, the OWP 12 building has a unitized façade that offers excellent heat and noise insulation. (By way of comparison, a conventional envelope would be at least 400 mm thick.)

Power-generating buildings need stable electricity grids
Our objective is to fit out buildings so they can act as decentralized power plants and protect the environment. The energy they generate therefore needs to come from renewable sources like wind and solar power. However, these are subject to a high degree of fluctuation by their very nature and it has proven difficult to optimize the production, storage and consumption of electricity without the risk of power grids being compromised or overloading. The grids have to be regulated and smart grids may be the solution. These are intelligent electricity networks that enable suppliers, renewable energy providers, consumers and the buildings themselves to communicate with each other. The smart grid regulates the energy supply by letting energy management systems in buildings know exactly when to draw energy and when to feed energy back into the network, intelligently keeping the whole system in equilibrium. To become part of a smart, self-regulating network, buildings need to be equipped with digital technology and software in order to communicate with the power grid and manage their own energy consumption.

Measures of intelligence: smart meters will be an integral part of the smart grid

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Digitization also has an important role to play in terms of energy accounting. Increasingly, we're going to see more and more smart meters and other smart measuring systems. These will function within the smart grid, keeping track of energy consumption and communicating energy requirements to the network operators in real time. Users benefit too, with real-time reports about how much electricity they are actually using and therefore more transparency. And while it's not yet standard practice to put smart metering systems into buildings, the trend is only going in one direction. The technology is still relatively costly for small-scale property managers or private households, but prices should fall in the long term. To see smart networking in action – including extremely energy-efficient buildings, heat pumps, solar installations on the façade and roof, and electricity charging infrastructure in the basement – check out the impressive SQUARE project in Mannheim. Consisting of two 12-apartment housing blocks connected to a smart grid, it's a great example of an old building that's been given a modern energy upgrade.

Decentralized, yet connected
If we want to get the most out of buildings that double up as power plants, connectivity is crucial. Rather than imagining them as islands, we should see them as part of a campus or localized network of buildings, streets and green energy sources. Thinking in a joined-up way is essential if we want to move towards a climate-positive future. For example, take logistics buildings. These have a huge surface area that could accommodate plenty of solar panels. At the same time, they don't use much energy themselves so they would have an energy surplus that could be used to supply nearby office buildings with insufficient auto-generated power or storage capacity. If there aren't enough energy consumers nearby, the current thinking is that the surplus energy could be converted into hydrogen, a next-generation fuel that could be used to power transport. This kind of approach – where different sectors such as residential developments, commercial spaces and industrial sites, logistics sites, individual buildings and transport solutions are connected to use renewable energy – is known as sector coupling. With the potential to generate healthy returns whether it is applied to residential, office or industrial districts, it's certain that more projects like this will be carried out in the near future.

There is no doubt that, in the coming decades, we will see more and more buildings and quarters operating as small-scale power plants. And if we want to decarbonize heating, wean ourselves off fossil fuels and embrace renewable energy, sector coupling and connected energy-generating buildings with built-in charging infrastructure will be necessary too. It is the only way to achieve our climate goals and make the transition to renewable energy. Meanwhile, trailblazing projects like Freiburg town hall and the Brattørkaia office development prove that it's possible to transform any building into a power plant. However, we need to get serious about it, pick up the pace, knuckle down and start making it happen. The EU has already put the right political framework in place. Now it's up to us.

Sector coupling encourages the use of renewable energy

Johannes Hopf
Manager Building Performance at Drees & Sommer SE

Johannes leads the energy design team and sustainability consultancy practice at Drees & Sommer. He studied building technology and climate control at Biberach College and has been working in the Energy and Sustainability department at Drees & Sommer since 2009. Alongside developing sustainable room climate control and energy systems, he is also an expert for the Green Building labels: DGNB, BNB und LEED. Over the past few years, he has focused increasingly on energy optimization in existing housing stock to improve efficiency and reduce carbon dioxide emissions. One of his most notable recent achievements was developing a climate-neutral energy system for the Federal Ministry for Economic Cooperation and Development – proving that it's possible to achieve huge energy savings even in a listed building.

Prof. Dr. Michael Bauer
Partner at Drees & Sommer SE

Michael has been a partner at Drees & Sommer since 2005. He is responsible for the engineering consultancy practice, specializing in energy design, energy management, building technology, green building, sustainability, carbon dioxide, ESG, climate-positive buildings and infrastructure, and networked buildings. In addition, he has expertise in developing innovative energy systems, new implementation methods and technical project management. He has worked on a range of cutting-edge projects such as Freiburg town hall, the experimenta Science Center in Heilbronn, the Neue Messe in Stuttgart and the A-plus terminal at Frankfurt airport. Michael graduated in energy-efficient building technology from the University of Stuttgart, where he also completed a PHD in simulating energy-efficient heating installations. Today, he keeps one foot in academia as an honorary professor and lecturer at the Institute for Building Energy Infrastructure, Thermotechnology and Energy Storage and at the Institute for Construction Management. He has shared his expertise in multiple publications, including co-authoring the book 'Green Buildings'. Michael also volunteers on the Expert and Guidance Committees at the VDI and DGNB.

THE BIG PICTURE: WHAT DOES THE FUTURE HOLD FOR LARGE POWER STATIONS?

Germany plans to stop using coal power by 2038 at the latest. In 2020, the first brown coal power stations were shut down and black coal power stations will surely be next. But it's not simply a question of shutting down or demolishing these huge concrete constructions – an expensive, time-consuming process. Some of them will be reincarnated into another form. For example, the energy drink producer Red Bull has transformed an old electricity substation in the Kreuzberg area of Berlin into a music studio for budding creators. Meanwhile in Munich, a power station in Obersendling has been turned into a retail outlet for designer furniture. However, the planning for transformation projects like this is far from straightforward and the type of use is heavily dependent on local variables. For example, a power station situated in a designated industrial zone with good transport and commercial infrastructure is higher in value. When they are in a prime location like this, it's often better to opt for conversion rather than demolition.

That was certainly the case with the old Philippsburg nuclear power station in Baden-Württemberg – a project where Drees & Sommer was called in to carry out a feasibility study to assess the best use scenario for the site. Given the site's prime location, the study looked at whether it could be converted into a leisure area or commercial space.

Philippsburg nuclear power station

One option would have been to convert it into an amusement park following the 'Wunderland Kalkar' model. Located on the border with the Netherlands, the Wunderland Kalkar theme park has replaced a nuclear reactor that was never connected to the grid. There are eight roller-coasters, a merry-go-round, some log flumes and a conference and convention centre where the reactor once stood. Its location on the River Rhine would have made the Phillipsburg nuclear power station site well-suited as an amusement park. The cooling towers could have been used as viewing platforms, climbing walls and a bungee jumping launch pad. But there was a hitch: that would have required the land utilization plan, which stipulated that any new building works carried out needed to be for energy generation, to change. So, back to square one. Instead of becoming a theme park, a converter for electricity produced from wind power would be installed in the cooling towers, operating a bit like a giant multi-socket. The converter would turn huge quantities of direct current travelling down the Ultranet transmission lines from north to south Germany into alternating current before being routed onwards to the regions. The new plant is due to become operational in 2024.

The Staudinger coal-fired power station in Großkrotzenburg is the biggest power station in the Hessen region. Due to the federal government's planned moratorium on coal, the plant's operator, Uniper, is planning to shut it down in 2025. A feasibility study conducted by Drees & Sommer and bulwiengesa in 2018 assessed which parts of the site were suitable for conversion based on criteria such as location, the regional economic set-up and the landscape plan. The study recommended the following applications:

- **Data centres:** because increasing digitization means there is rising demand for data centres. Many are already located in Frankfurt, Hessen's financial centre.
- **Industrial park:** as the site is particularly well-suited to energy intensive applications
- **Office buildings:** with a booming office market in the area around the Rhine and Main rivers, the site had potential as an office hub.

In the meantime, the local authorities reached the conclusion that the site should be earmarked as a commercial and industrial area. A data centre operator and several companies have expressed an interest, while Hanau municipal utilities are looking into whether they might build a large CHP plant there.

Wunderland Kalkar

Staudinger coal power station

HOW TO TRANSFORM COAL POWER STATIONS TO THERMAL ENERGY-STORAGE PLANTS

Interview with Prof. Dr. André Thess, Director of the Institute for Engineering Thermodynamics at the German Centre for Air and Space Travel (DLR) in Stuttgart

What's the point of converting coal power stations in the first place?
Looking at it from a free market standpoint, the price of carbon dioxide is currently rising and when it reaches a certain price point, coal will no longer be profitable. At which point it becomes a straight business decision about what to do with the plant; to shut down or convert it. It's a decision that needs to be made on a plant-by-plant basis, however, in my view, it's important to ground it in free market thinking.

What are the benefits of conversion?
You can use the steam turbine, generator and cooling tower from the original plant. Then you just have to replace the steam generators and burners and install new thermal converters and thermal stores (using either molten salt or solid materials as a heat transfer fluid). The stores are ideally powered using locally generated renewable energy, though you can use a combination of renewable energy and gas by adding a gas turbine. We already have solar thermal power plants with integrated high-temperature thermal stores that supply 50 MW of power.

How much outlay would be needed?
You would certainly need both renewable energy sources and gas pipes, so that the gas turbine can be fuelled with natural and renewable gas. Then all you'd need is some kind of storage tanks and there you have it – a power station that runs on 100 per cent renewable energy. In fact, we are currently planning to do a live lab with RWE where we will be installing thermal stores into part of a coal (lignite) power station to test if we can convert part it into a thermal energy storage plant. The project is called Store2Power.

André D. Thess
Director of the DLR Institute for Engineering Thermodynamics

André was born in Leningrad in 1964. After completing a physics degree at TU Dresden, a PHD at (what is now) the Helmholtz Centre at Dresden-Rossendorf and various research sabbaticals at Lyon, Grenoble and at Princeton University, he was made professor for engineering thermodynamics at TU Ilmenau at the age of 34. Since 2014, he has been the director of the DLR Institute for Engineering Thermodynamics and is a professor and lecturer in energy storage at Stuttgart University. He has been a visiting professor at Stanford University, Nagoya University, Northeastern University Shenyang and Dalian University of Technology. A keen amateur chef, André also shares insights into cooking, baking, frying and schnaps distillation with students in a lecture entitled: "Culinary Thermodynamics".

WHEN GREEN MEADOWS GIVE WAY TO REACTOR DOMES

By Peter Liebsch, Associate Partner at Drees & Sommer SE and Hans-Peter Semmler, Senior Project Leader at Drees & Sommer SE

Next year, the final German nuclear power stations are being taken off the grid. Dismantling them can be an extremely complex process. However, Building Information Modeling can be used to create an exact digital replica of the site to encourage better planning decisions and simplify the management of practical tasks.

In the aftermath of the Fukushima nuclear disaster in March 2011, the German government took a decision that would have far-reaching consequences for the energy sector; namely that all nuclear power stations would be forced to close down by 2022. This year, the practical implications of that decision are being felt. The Grohnde (Lower Saxony), Grundremmingen C (Bavaria) and Brokdorf (Schleswig Holstein) nuclear power stations are closing down over the course of this year, while the three remaining reactors, Isar II (Bavaria), Emsland (Lower Saxony) and Neckarwestheim II (Baden-Württemberg), will follow over the course of next year. Soon an industry that supplied almost a quarter (22.5 per cent) of Germany's electricity in 2010, pre-Fukushima, will be no more.

But these iconic dome-shaped structures don't just disappear off the map once they have come to the end of their working lives.

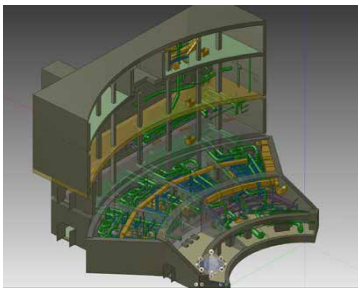
The fact is that even standard buildings are subject to myriad laws, regulations and guidelines – which often vary significantly from one region to another – and so you can imagine the challenge facing nuclear power stations. Firstly, there are recyclable materials, highly radioactive building parts and hazardous waste that need to be carefully disposed of. Secondly, nuclear fuels need to be cooled down in spent fuel ponds for at least five years before they be put in castor containers and transferred to interim storage facilities. The post-operational and decommissioning period usually lasts for several years and involves comprehensive cataloguing of parts in all areas that were exposed to radioactive radiation. Using this information, a dismantling plan is then created and submitted to the relevant authorities to approve the shutdown and disassembly. The dismantling process can only begin once this has been given.

The shutdown and disassembly planning process is highly complex

Several decades can elapse between a nuclear power station being shut down to being fully dismantled. For example, Germany's first nuclear power station at Kahl am Main near Aschaffenburg was shut down in 1985. Incredibly, the dismantling process took even longer than the 25 years the plant ran for and cost 150 million euros, which was more than the construction costs. In fact, it wasn't until 2008 that the reactor block and any remaining buildings were fully removed. In their place, green grass has grown, covering the area where the plant stood and supplanting what was once cutting-edge technology. Stade nuclear power plant, which was the first reactor to be disconnected from the grid by the SPD-Green Party coalition, was dismantled more quickly, yet the process still lasted 13 years.

The reason why there is such a long period between these reactors being shut down and fully dismantled is that many parts have been exposed to radiation, which means they have to be taken apart and cleaned very carefully before they can be disposed of. Moreover, nuclear power stations are vast. To give you some context, dismantling AKW Greifswald involved the disposal of some 1.8 million tons of building materials.

However, help is at hand. The laborious decommissioning and dismantling process can be made a little easier thanks to new technology called Building Information Modeling, or BIM for short. BIM is a cutting-edge piece of software and collaboration tool that aggregates all project data and provides an organizational interface for tasks, products and project stakeholders. In essence, Building Information Modeling is to the real-estate sector what Industry 4.0 was for engineering.



A part of the digital twin of a nuclear power station

How Building Information Modeling facilitates the dismantling process

Before a single stone is touched in real life, BIM generates an accurate digital model of the power station and all its equipment. As well as all the geometrical data, the model gathers an incredible variety and depth of information, from material specifications to fire safety equipment. In fact, BIM is so detailed that it's almost like the plant has a digital twin that can also be used to schedule all the meetings, building tasks, material processing tasks and logistics tasks. Ideally, all stakeholders will be able to access the tool in real time and from any location.

Dismantled materials are cleaned and recycled for the circular economy

A major milestone in the disassembly of Baden-Württemberg's nuclear power stations was reached when the region's environment ministry gave the go-ahead for a new waste recovery centre on the site of the Neckarwestheim power plant. The centre is designed to keep the amount of radioactive waste to a minimum and has already successfully undergone a test run in summer 2020. "It was a big step in ensuring that the whole disassembly process is as efficient and sustainable as possible. While we're still only recovering a small amount of waste material in the overall context of the power station, it still comes to a few tens of thousands of tons. We are spreading the recycling work across our new centres and that frees up space in the disassembly areas," explains Jörg Michels, Head of the Nuclear Power Division at EnBW. After treatment, the radioactive material falls into the categories of low and intermediate-level waste. The process also enables a greater proportion of material to be recovered and recycled for reuse. Drees & Sommer helped EnBW Kernkraft GmbH (EnKK) navigate the highly complex planning, construction and approval process, which lasted six years.

The Philippsburg waste material processing plant received approval to begin operating in 2020.

Now it's true that these nuclear power stations are several decades old and were designed and built at a time when Building Information Modeling didn't exist. But with modern technology, this isn't necessarily a problem. Cutting-edge laser scanners can be used to measure existing buildings and automatically generate a digital model. It's a worthwhile investment of time because as BIM isn't just a great planning tool for new building projects, it can also make the dismantling process much more efficient.

So, how does it work if you want to dismantle a power station using BIM? Well, first the entire site has to be measured with scanning devices, with robots being drafted in to help for any areas that are inaccessible due to high radiation levels. BIM can create a highly realistic virtual model of the power station and because levels of radioactivity, asbestos and other harmful materials can also be measured, it also holds a cadastre of harmful substances. The model therefore creates a representation of the site that is accurate to the nearest couple of centimetres. The team uses the model to plot all the important information and plan the disassembly process.

Like cogs in a finely oiled machine

Creating a digital twin may sound like hard work – especially considering that it relies on a wealth of different data sets – but it justifies the upfront investment. Through collision detection, BIM can identify errors before dismantling begins, preventing expensive delays once the building work has got underway and ensure that the entire dismantling process runs smoothly. What's more, the BIM software also enables simulation and comparison between different planning models, including different process timings and costs.

In fact, it's not just an effective planning tool. BIM also helps manage the day-to-day aspects of running the dismantling process as well. Workers enjoy increased safety as you can do virtual walk-throughs of the in-depth model and avoid unpleasant surprises on the actual site. It also speeds up the rigorous entry and exit procedures at the security control area (which can be slow given the radiation and the nature of the work). In just a few clicks, the BIM software can generate a plan with exact timings for all the tendering, preparation and logistics work, as well as managing certification processes with experts and authorities in a seamless way.

As such, the software accelerates the dismantling process because it gets everything working together like cogs in a well-oiled machine. With BIM's help, it won't be long until Germany's nuclear power industry is history – and all that's left are green meadows.

Peter Liebsch
Associate Partner at Drees & Sommer SE

Peter has been the Head of Digital Processes and Tools at Drees & Sommer since March 2015 and manages the firm's Building Information division. After studying architecture at Darmstadt Technical University, he gained hands-on experience in the field from 1999 to 2015, which included stints in the UK and Australia. There, he took up the post of Head of Design Technology at the architecture practice Grimshaw where he developed digital tools to support the entire design process. At Drees & Sommer, he focuses on the development of digital tools, implementing Building Information Modeling in live projects and advising many of our clients on how to plan and implement their BIM strategy.

Hans-Peter Semmler
Senior Project Leader at Drees & Sommer SE

Hans-Peter is an expert in Digital Twin technology for conventional and nuclear power stations, and industrial sites. After completing his studies in civil engineering, he built up decades of experience working in project management, where he managed large-scale infrastructure projects – including the dismantling of nuclear power stations in Baden-Württemberg, Hessen and Lower Saxony. Having worked extensively on these types of project – where dismantling is approached in a very traditional way – he saw an opportunity for developing digital modeling software using a digital twin. With a number of successful digitization projects and growing industry interest in the software, it is becoming clear that digital is the way forward.

“THE TRANSITION TO RENEWABLE ENERGY DEPENDS ON CITIES”

One of the most important tasks in town planning is ensuring that districts are sustainable and environmentally friendly. With that in mind, energy efficiency and connecting the various stakeholders in an intelligent way are an important part of the planning process. In an interview with freelance business journalist Harald Czycholl-Hoch, Gregor Grassl, Associate Partner at Drees & Sommer SE, and Iris Belle, Leading Consultant at Drees & Sommer SE, explain how the city of tomorrow looks and how it will be powered.

What role will cities play in the great transition to renewable energy?

Gregor: *cities are key since they account for 80 per cent of greenhouse gas emissions worldwide – which is hardly surprising given the concentration of infrastructure and economic stakeholders in cities. With a lot of people, a lot of buildings and a lot of vehicles, they tend to be extremely energy and resource-hungry. But because of their size, there is a great opportunity for meaningful change.*

Iris: *to achieve Germany and the EU’s much-vaunted target of net-zero carbon, the transition to renewable energy depends on cities. That’s why it’s important for politicians to place them higher up their list of priorities. We therefore need to set up a strategic roadmap that binds cities into national targets, defines the optimal baseload for local infrastructure and promotes a joined-up approach between different stakeholders.*

A strategic roadmap sounds great. But what is it exactly?

Iris: *let's take our energy supply for example. The status quo is that energy production and consumption are completely separate, with energy consumers based in towns while producers operate huge installations outside them – regardless of whether it's a conventional power station or a more modern wind power installation. But we need to shift to a model where energy is produced in a decentralized way; much, much closer to where it is consumed. The easiest way to do this would be to create a system of incentives and regulation to encourage the installation of photovoltaic units. These would be fitted on the full surface area of roofs, and the power they generated would be used to charge electric cars, which are perfect for city transport. Funding would promote landlord-tenant electricity models and distributed networks. For heating, the best way forward is to use heat pumps, which draw heat from the earth, and efficient local heating networks that can reuse the heat generated by factories or data centres by channelling it to other buildings.*

That sounds like a pretty complicated network.

Iris: *it is. There's a complex relationship between stakeholders and the design of an energy system is always highly district specific, which means that it's important to do the groundwork and carry out a detailed assessment of the district first. We have to consider factors like: How will on-street charging stations be powered? What are a building's structural requirements to have solar panels on its roof? And how should feed-in tariffs and tax incentives be structured? These things lie outside the normal scope of town planning projects, but they do need to be addressed in the master plan. There might be a need for local politicians to jump in and ensure that, when communal planning offices are working on a land development proposal, they get specialist expertise in for technical areas. We call this carrying out a technical masterplan.*

AMST, Amsterdam

Sitting within a district regeneration project and due for completion by 2023, the AMST development will be located just opposite Amsterdam Amstel train station. Initiated by MRP Development, the project consists of two mixed-use buildings that will provide space for 252 residential units and a variety of businesses and community organizations. The buildings will be equipped with a custom-developed water storage system. With storage reservoirs on the rooftops and communal gardens and integrated water recycling systems, the water supply has been designed to withstand water shortages and extreme rain, as well as minimizing heat stress.

The system has been designed to supply hot water at 40 degrees instead of the usual 60 degrees – although households will still be able to get water at 60 degrees by pressing a booster button. The heating system will be powered by photovoltaic panels installed on the roof. Drees & Sommer is helping MRP Development select a main contractor, develop the technical plan and oversee the building work.

Politicians, urban planners and developers often make plans at a district level. Why is that exactly?

Gregor: *a city district is the perfect size. On the one hand, it's big enough to have a wider impact and leverage synergies. On the other hand, it's small enough so that you don't risk losing sight of the big picture. It's no coincidence that most of the funding packages are aimed at district-scale developments, including incentives offered by the KfW or BAFA. Some of these, such as the KfW programme 432 for upgrading a district's energy supply or the BAFA programme for "Heating networks 4.0", focus on specific improvements to the energy system. The biggest developers are beginning to wake up to these opportunities, launching projects like the Deutzer Hafen District in Cologne, the Schumacher District on the site of Berlin's old city airport (Tegel) and the Beiersdorf Campus in Hamburg. As the names suggest, these are all district developments. When all these districts are added together, a new form of town emerges.*

It sounds like we're back to the idea of networks. How networked will tomorrow's cities be?

Gregor: *the city of the future will be connected both in terms of the interaction between various stakeholders and digital connectivity. These networks will be essential in cities' transition to renewable energy. We can illustrate this by using the electricity supply as an example: to make the switch to green energy in the medium term, we need to tackle the issue of a fluctuating energy supply. In essence,*

there will be a lot of power when the wind is strong and the sun is shining, but there will also be times when the opposite is true. At peak energy generation times, we need to find a suitable way to store the energy like the batteries in electric cars or in the hot water tanks of buildings. But how can we power electric car charging stations when no energy is being generated? To answer these types of questions, we need to use digital tools to process different types of energy data. The data will provide the key to integrating the electricity, heating and transport sectors to optimize overall energy allocation.

Have any smart projects with networks been built yet or are we some way off?

Iris: *some are already in the pipeline. One project that is currently in the works is the Quartier Heidestrasse in Berlin Europa City. The district will have its own dedicated mobile app, enabling users and tenants to connect, discuss local issues and take advantage of offers. It will also enable workers to manage the rooms in office buildings while tenants will be able to automatically control the heating, air-conditioning, ventilation and blinds in apartments. Lastly, the app will enable users to monitor their energy usage.*

Gregor: *there is a whole series of connected urban planning projects being developed. One of these, the Urban Tech Republic in Berlin, is a good example of how old network infrastructure can be converted into state-of-the-art low energy networks, and how existing buildings can be made just as eco-friendly as new builds. This kind of approach can be profitable in the long term as well as efficient. We can also create a new kind of operating model that attracts developers – as shown by the number of companies that applied to take part in our tendering process to build and operate this innovative infrastructure project. Meanwhile, healthy competition will result in the best-possible service for future residents and users. The project's*

Urban Tech Republic, Berlin

On the site of the former Berlin Tegel airport, an innovative, sustainable research and industrial park for urban technology is under construction. "Berlin TXL – The Urban Tech Republic" will house a range of industrial, commercial and scientific units, as well as a residential district comprising over 5,000 apartments and fitted with smart technology.

Thanks mainly to its next-generation energy system, it became the world's first commercial district to be awarded the DGNB platinum sustainability pre-certificate at the start of 2016. The innovative design features a low energy network with a cogeneration plant, geothermal energy, an intelligent system to monitor and control energy usage (a smart grid), and an integrated transport system that consists of various connected mobility solutions. Drees & Sommer's experts provided support in various areas during the project, including helping to design the innovative infrastructure and energy concepts and managing the DGNB certification process. The regeneration project is due to be largely completed by 2027.

Quartier Heidestraße, Berlin

Quartier Heidestrasse is very much the urban district of the future. Featuring energy-efficient construction methods, future-focused transport solutions and extensive connectivity, the development is located on a plot of 85,000 square metres at the heart of the Europacity in Berlin. The new development will consist of seven buildings with 944 flats and a mixture of office, retail, restaurant and hotel spaces. Digital technology will be used to promote healthy and sustainable lifestyles. There will also be a dedicated app that enables residents in the district to connect and take advantage of service offers. Beyond that, it will enable rooms in offices to be managed and residents to control the heating, light, blinds, etc. in their flats at any time – even remotely – and stay on top of their energy consumption. Drees & Sommer is providing expertise in a range of areas, including project management, digital consultancy, general specialized planning and energy consultancy.

energy consumption will be ultra-sustainable and has received the DGNB's highest district-level certificate for efficiency. Our technical masterplan also identified new synergies between the low energy network heat exchange system for the water supply and electric mobility solutions, with a combination of possible options for the project. And that's just a glimpse into how important connectivity between sectors can be to reduce energy consumption.

What is your vision for the city of the future?

Gregor: *the city of the future will generate its own energy and all the buildings will be connected to one another. It will be entirely fuelled by renewable energy sources, which improves air quality and will contribute to a better all-round quality of life. The cars will be powered by electricity or hydrogen and smart public transport services will take people where they need to go. All the roofs will be planted with rooftop gardens or be covered with photovoltaic panels for electricity generation.*

Iris: *at the same time, it's also important that we conserve our heritage. There are wonderful historic buildings in this country, and it's important not to lose that character in our haste to renovate. Instead, we should equip these old buildings with intelligent energy systems while any additional energy needed can be supplied by modern active houses in the neighbourhood. The new Building Energy Law will also make this simpler from a legal standpoint and support this symbiotic relationship between young and old. So, it still makes sense to continue upgrading our housing stock even if we design completely new infrastructure networks for urban spaces. As a result, the city will retain its unique character and residents will feel more at home in it. The old buildings are a slice of living culture that cannot be recreated through construction and infrastructure planning alone. And culture is important, not least because the transition to renewable energy won't succeed without people being on side.*

Gregor Grassl
Associate Partner at
Drees & Sommer SE

Gregor Grassl studied architecture in Munich and joined Drees & Sommer in 2007, where he has managed numerous projects in Germany and abroad. Specializing in sustainable town and district development, Gregor handles everything from strategic consultancy and developing climate-friendly concepts to infrastructure systems planning for large global projects with City BIM. In 2009, he founded the Urban Districts working group at the DGNB. Later, he created and led the Commercial and Industrial Sites working group. In 2013, the Federal Government appointed him to the team for the "National Platform for Future Cities" initiative. He also teaches as a lecturer on the International Project Management course (IPM) at the Technical College (HfT) in Stuttgart and has written a book called "Sustainable Town Planning".

Iris Belle
Leading Consultant at
Drees & Sommer SE

Iris studied architecture at TU Karlsruhe before taking a PHD in Geography at the University of Heidelberg in 2013. After work stints in China, Singapore and Switzerland, she started as a project partner at Drees & Sommer in 2019. As part of the Smart City Development team, she is responsible for developing sustainability and digitization concepts for city districts in Germany and abroad. As a Leading Consultant at Drees & Sommer, she advises public and private sector clients and develops concepts to create more liveable cities. Her research work and practical experience in how socio-technological systems impact the urban environment enables her to bring a unique level of insight to projects. She is currently working on a number of projects, including the York and Oxford district development in Münster. Iris is also a visiting professor for the Master's programme in Smart City Solutions at Stuttgart Technical College.

LET'S POWER UP FOR CLIMATE-POSITIVE BUILDINGS

Christine Lemaitre, Managing Director and Chair,
German Sustainable Building Council – DGNB e. V.

In recent years, climate change has become a hot topic and, as a result, our cherished western lifestyles are being called into question. Increasingly, we are having to question how we use buildings and consume energy. Here, the focus has shifted from reducing the consumption of primary fuels and one-dimensional insulation grants, to the giant elephant in the room, which is the need to reduce carbon dioxide emissions.

To achieve this goal, two things have to happen across every industry in the economy. Firstly, we need to reduce our energy consumption and cut carbon emissions across the board. Secondly, we need effective greenhouse gas sinks.

The real-estate sector has a tremendously important role to play here. Unlike other sectors, property can generate its own energy. This enables a building to offset carbon dioxide directly and achieve net-zero carbon status without the need for carbon dioxide certificates. Therefore plenty can be done with our existing building stock.

It's buildings' carbon dioxide footprint that counts

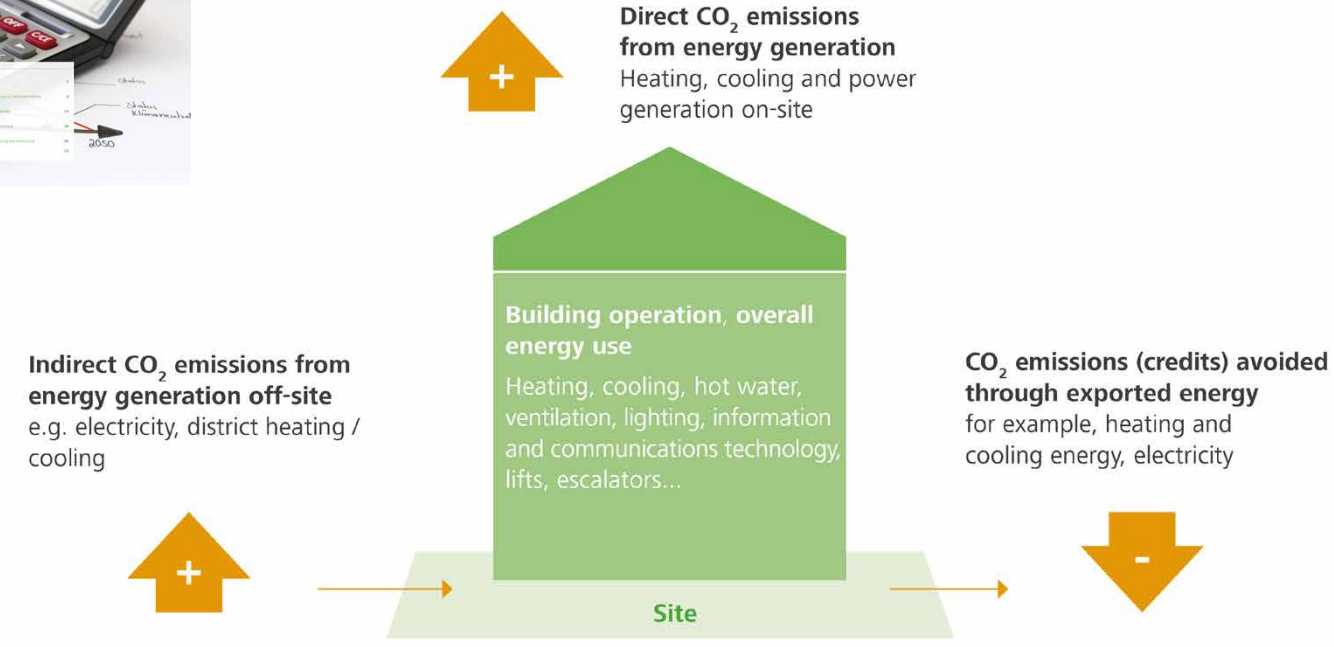
Before we can decide on the most efficient and effective measures to reduce carbon emissions, we need to have a common understanding what we actually mean by climate-friendly buildings. The non-profit organization, the German Sustainable Building Council (DGNB e.V.), has been building up a suitable knowledge base and decision-making framework for many years. One of the resources provided by the DGNB is a roadmap for climate-neutral buildings and sites. Since the term "climate neutrality" is rather vague, the roadmap seeks to give it a more concrete definition, namely: "over the period of a year, the carbon dioxide balance of a building should amount to zero or less."

There are two sides to the equation when calculating a building's carbon dioxide footprint. On the minus side, we calculate the amount of carbon dioxide emissions generated by energy consumption – or in other words, users' electricity usage. This depends on how carbon dioxide intensive the fuel sources used to generate it are. Due to their lower energy intensity, electricity and heat generated by renewable energy do better than fossil fuels. On the plus side of the equation, we add up the amount of carbon dioxide saved. Once you've calculated this, you realize that there's only one way to achieve climate neutrality; buildings and sites need to generate energy for their own needs and feed any surpluses back into the grid.

A joined-up action plan is needed

Of course, we won't achieve net-carbon zero just by equipping buildings and sites to generate their own energy. There needs to be a joined-up action plan with all sectors working in close collaboration. The DGNB framework sets out what the key areas are to minimize energy consumption: this includes assessing the stock of existing buildings, optimizing building envelopes, optimizing energy usage and improving the systems that supply energy – as this can make a big difference to how efficient the installations are. And finally, as just mentioned, we need to start generating renewable energy on site.

Focus area 1	Focus area 2	Focus area 3	Focus area 4	Focus area 5
Local context	Building energy	User energy	Supply systems	Renewable energy
Optimisation of local context for daylighting potential and solar exposure	Optimisation of building services and envelope, for low energy use	Optimisation of plug loads and process loads for low energy use	Optimisation of supply systems for high efficiency	Optimisation of energy generation at the site (balanced imported vs. exported energy)



If that is too much to get one's head around initially, you can also apply a general rule of thumb, which stipulates that any decisions or measures taken should be planned and assessed using three criteria:

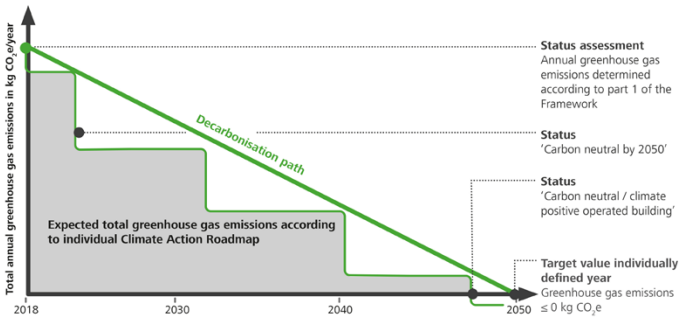
› Reduction of overall energy consumption
› Efficient energy generation
› Choose energy sources with low carbon dioxide intensity

One thing is for sure: the only way to square climate protection with economic growth is to define clear objectives for your buildings, stick rigorously to these objectives and adopt long-term decision-making. With its climate protection roadmap for buildings, the DGNB offers clear guidance for stakeholders in the detailed roadmap mentioned above.

DGNB Climate Positive Award recognizes exemplary buildings

You might be thinking that climate-positive buildings are all lighthouse projects. But in fact, many buildings with a variety of uses have already received the climate-positive award and proven that it's possible. In fact, some of these were built on a low budget but achieved climate-positive status through design and pure commitment. A few good examples are the Eisbärhaus in Kirchheim/Teck, the Zedler Institute in Ludwigsburg, the Schmuttertal Gymnasium in Diedorf, Freiburg town hall and the Aktiv-Stadthaus in Frankfurt.

We need more pioneering buildings like these, and fast. We are running out of time in the fight against climate change and, even if a single building is just a drop in the ocean, there is huge potential in the real-estate sector to become more climate-friendly and embrace renewable energy. In the words of the Berlin Energy Transition Dialogue, the building sector is a "sleeping giant". Now it's time to finally wake it up.



Decarbonisation path =
actual CO_2 budget available to a building over time

Now's the time to go climate-positive!

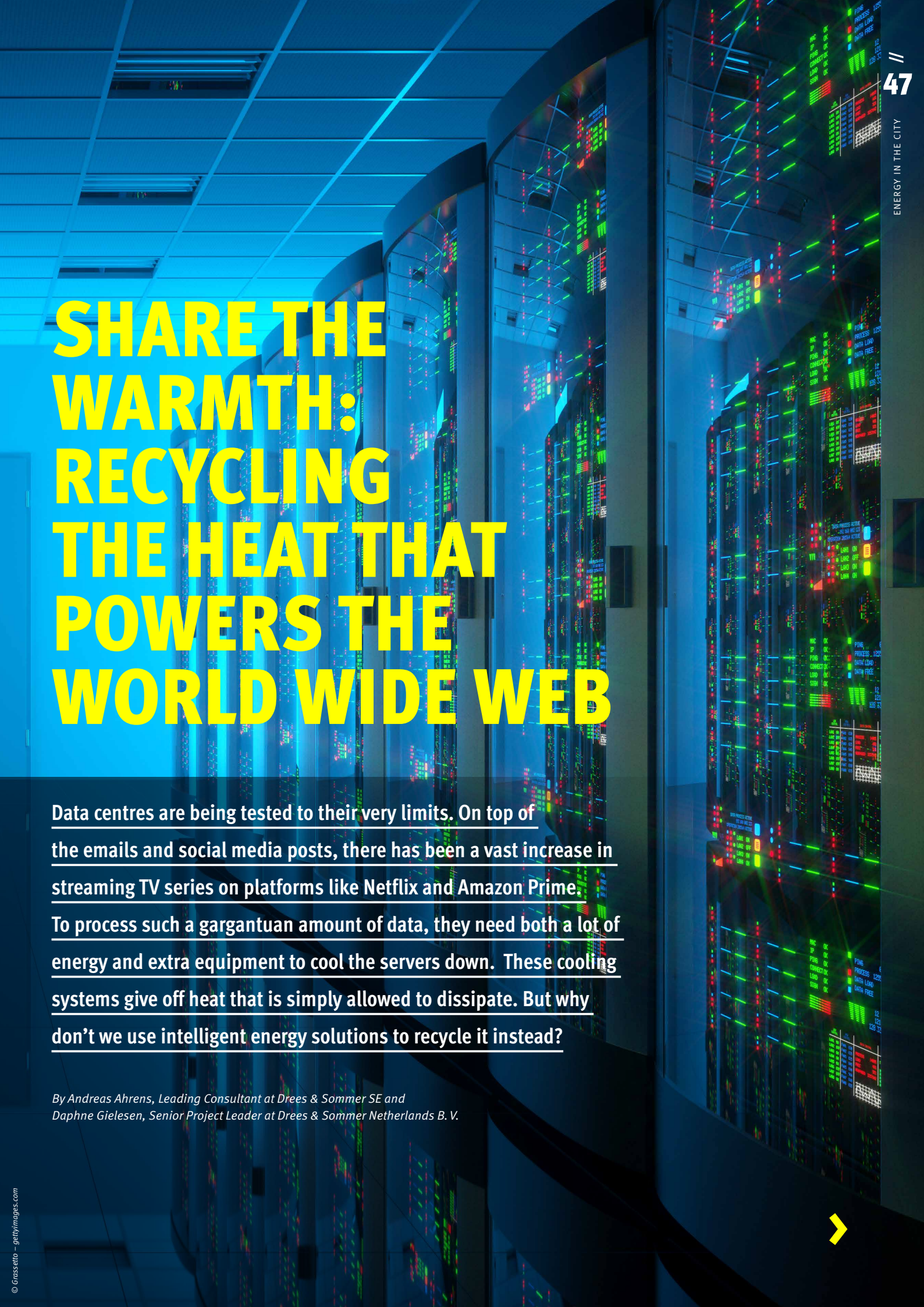
The most important message to take away is that you can go climate-positive today. It's certainly not rocket science and there's plenty of information out there to get you started. The DGNB offers a wide range of publications, free introductory seminars and courses to deepen your knowledge in the DGNB Academy. You can also use tools like the free carbon dioxide footprint calculator.

These resources are all available at: www.dgnb.de/klimaschutz. You can also find more useful information at the Wissenss-tiftung knowledge base and its sister platform: www.norocket-science.earth.

We already have the knowledge. Now it's just a matter of applying it and ourselves. The most important thing? To get started.

Christine Lemaitre,
Managing Director and Chair
at the DGNB

Christine Lemaitre was born in Gießen and studied civil engineering at the University of Stuttgart before beginning her career in the US. She started a new role at the University of Stuttgart's Institute for Lightweight Construction in 2003, joining Bilfinger Berger AG in 2007. Christine became head of the Systems division at the DGNB in 2009. Christine has been the Managing Director and chair of the organization since February 2010. Alongside her work at the DGNB, she sat on the Board of Directors of the World Green Building Council from 2016 to 2020 and was the chair of the European Regional Network. She is a co-founder of the Building Sense Now global initiative, chair of the Wissensstiftung, and has received multiple awards for her work in sustainable real estate, including the Eco Innovator Award from the Global Green Economic Forum in 2019.

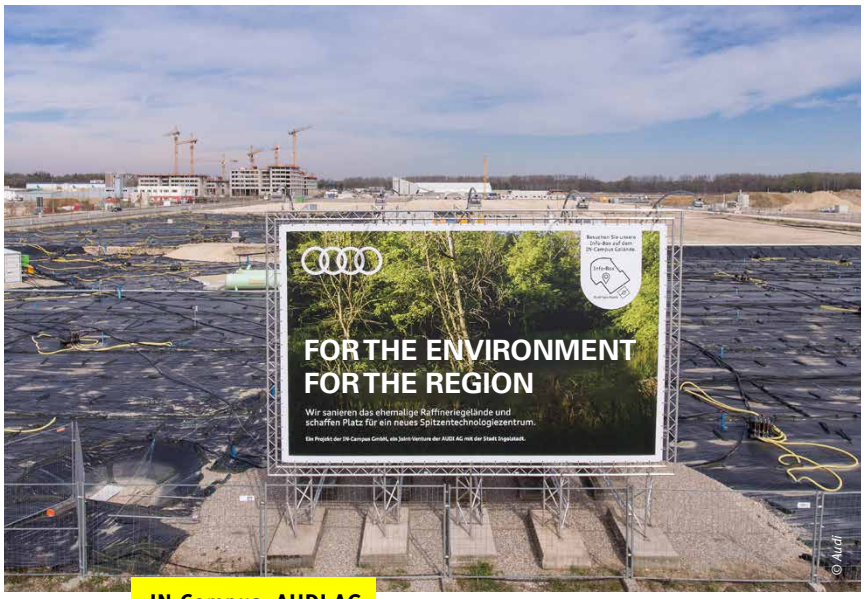


SHARE THE WARMTH: RECYCLING THE HEAT THAT POWERS THE WORLD WIDE WEB

Data centres are being tested to their very limits. On top of the emails and social media posts, there has been a vast increase in streaming TV series on platforms like Netflix and Amazon Prime. To process such a gargantuan amount of data, they need both a lot of energy and extra equipment to cool the servers down. These cooling systems give off heat that is simply allowed to dissipate. But why don't we use intelligent energy solutions to recycle it instead?

By Andreas Ahrens, Leading Consultant at Drees & Sommer SE and Daphne Gielesen, Senior Project Leader at Drees & Sommer Netherlands B. V.

The contrast could hardly be more stark: a research site with cutting-edge sustainability credentials is being built on the site of a former oil refinery in east Ingolstadt. AUDI's IN-Campus, which is set open at some time during this year, is a complex within which the mobility concepts of the future will be developed. As a pioneering zero-energy project, it will set new standards in terms of energy efficiency, by extracting heat from the data centre and distributing it around the campus from a central hub. Waste heat emanating from specific buildings will be recycled and used for heating. Drees & Sommer has been supporting the project with expertise in project management, Green Building consultancy, technical project management, start-up management and integration tests. The top priority for the project is combining energy efficiency and stability.



IN-Campus, AUDI AG

AUDI AG is working with the town of Ingolstadt to renovate a former crude oil refinery and turn it into a campus for a new industry. The campus also features a cutting-edge sustainable energy system for its data centre.

"An hour of streaming on Netflix uses about the same amount of energy as driving a car for around seven kilometres in the city."

Data centres have grown in importance in the era of social distancing and home working; to the point that they are now critical infrastructure. They are also under more stress than ever before, processing vast flows of data from video conferencing and emails, and coping with the rising popularity of streaming TV series on platforms like Netflix and Amazon Prime.
These factories of the future are becoming the backbone of our increasingly connected and digital world, and they will help the German and wider European economy remain competitive. It's therefore important that data centres are economically viable, as this will decide whether global data flows go via Europe, bringing jobs and earning revenue, or whether it bypasses us completely.

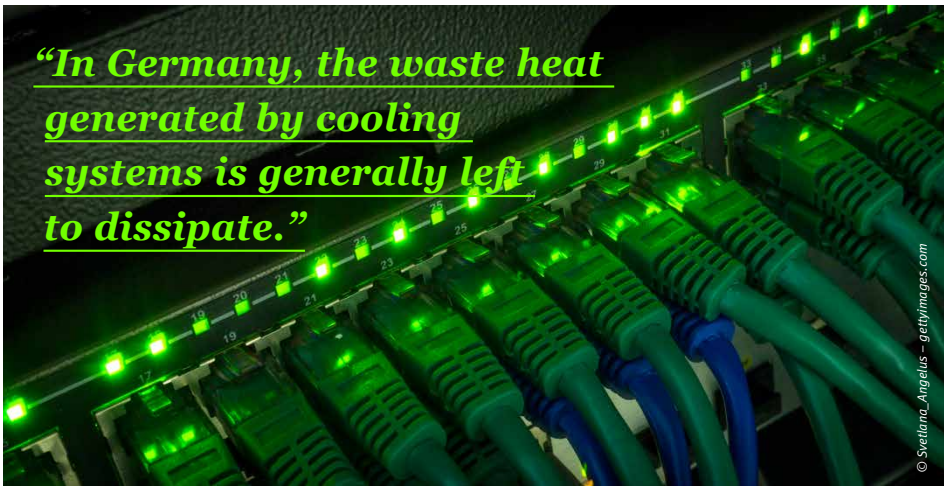
Because of the mixture of benefits they offer, data centres have long been a sought-after real-estate asset. However, they are far less beneficial for the environment as they consume a vast amount of energy. For example: an hour of streaming on Netflix uses about the same amount of energy as driving a car for around seven kilometres in the city. And because everybody is at it, those hours begin to stack up pretty quickly. According to a recent Bitkom study, data centres and communications networks emit the equivalent of approx. 200 to 250 megatons of carbon dioxide globally. Some people predict that data centres will account for up to a fifth of worldwide electricity consumption by 2025. Currently, it's hard to get an accurate picture because many operators aren't publishing figures. However, data centres could be using between 200 and 500 billion kilowatt hours of electricity per year. The Borderstep Institute analysed the data from 55,000 data centres in Germany, many of which are owner-operated by companies and banks, and estimated that they consume 13 billion kilowatt hours per year. That's roughly equivalent to the entire annual energy needs of a big city like Berlin.

To be viable in the long term, data centres need to become much greener and new data centres need to be designed with sustainability in mind. Utilizing renewable energy will be key, obviously, but there could also be a lot of potential in recycled heat. Data centres' servers become very hot while operating

and require continuous cooling. In Germany, the waste heat generated by cooling systems is generally left to dissipate. Wouldn't it be better to use it to heat nearby office buildings, flats or even greenhouses?

A recent PwC study has shown that recycling waste heat is relatively rare at present. The study revealed that most data centre operators (82 per cent) in the country do not recycle heat from their data centres, and only one in 10 data centre operators plans to do so in the future.

It would perhaps be a good idea to follow Sweden's lead and start connecting data centres to local and district heating networks. The Swedish capital, Stockholm, is one of the only cities in the world that recycles heat from data centres on an industrial scale. There are 30 data centres in the Stockholm region that feed heat into the city's heat distribution network. The waste heat is expected to provide 10 per cent of Stockholm's heating requirements by 2035. Meanwhile, the European Commission also sees potential in using data centres for climate protection. Its strategy paper, "Shaping Europe's Digital Future", lays out a roadmap for making data centres carbon-neutral by 2030.



The reason Germany is lagging behind is due to both planning and infrastructure issues. Because data centres produce heat all year round, there needs to be consumers close by who need heat permanently, not just during winter. So, the challenge for towns and local authorities is to factor in the right kinds of heat consumer into their planning at an early stage. Some examples that spring to mind are swimming pools, laundries or certain agricultural sectors. It's important to note that if the recycled heat is below 30 degrees Celsius, it cannot be used for heating unless you use heat pumps to raise the temperature. Otherwise, it can only be used for low-temperature heating in adjoining residential or office buildings. The installation of heat pumps would be another significant building and running cost for operators to bear, so financial incentives would be needed to sweeten the pill. For example, we could exempt data centre operators from the renewable energy surcharge if they start recycling their waste heat (as they would be actively contributing towards the EEG objective of moving towards sustainable energy). Or tax breaks and funding incentives could be used to encourage investment.

Until that happens, it's up to the pioneering companies to design new concepts like the sophisticated smart energy system at the IN-Campus in Ingolstadt. The IN-Campus system is based on what's known as a LowEx network; a network of pipes that transports water around all the buildings and functions as a heat source and sink simultaneously. Buildings with a high cooling load like the data centre supply waste heat into the LowEx network, while buildings with a high heating load consume it as required. As such, energy consumers become producers too. The network temperature will automatically adjust to match seasonal variations between five and 30 degrees Celsius, enabling it to benefit from any available heat in the environment too. The buildings are equipped with reversible heat pumps that ensure that the temperature within the system is always stable. Meanwhile, the load management and energy efficiency of the system is secured by thermal heat storage tanks, with an approx. 3,000 cubic metre capacity, that can store both heat and cold. The IN-Campus system shows that, through smart design, data centres can help us navigate the transition to renewable energy and set new standards in terms of sustainability.

"There needs to be consumers close by who need heat permanently, not just during winter."

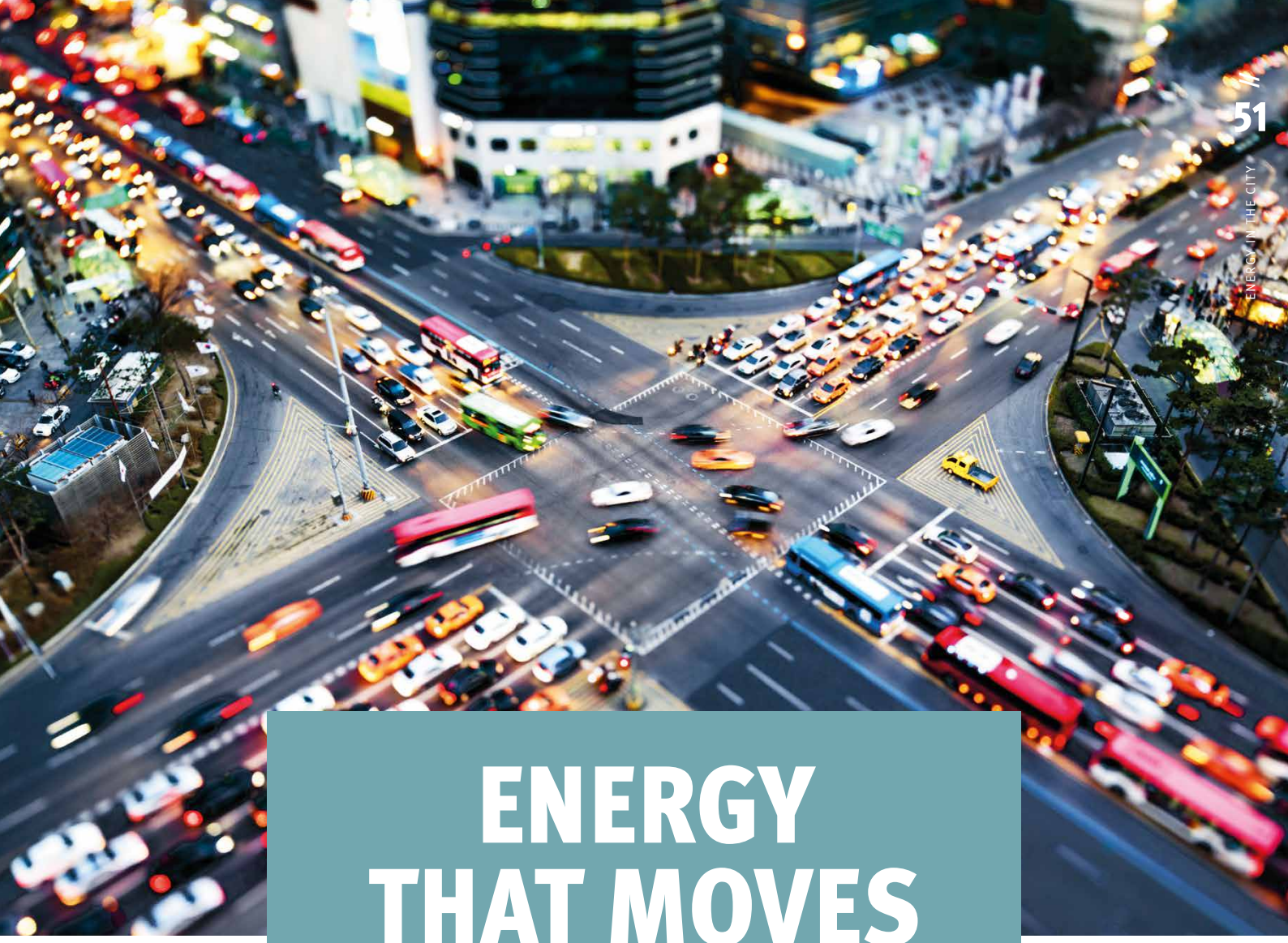
“Through smart design, data centres can help us navigate the transition to renewable energy and set new standards in terms of sustainability.”

Daphne Gielesen
Senior Project Leader at Drees & Sommer Netherlands

Daphne is an expert in implementing complex building projects using the principles of Lean Construction Management (LCM). She graduated in real-estate economics from the University of Rotterdam and gained a Master’s in business management from Nyenrode Business University Breukelen. She has handled a range of challenging projects for clients such as Booking.com, ABN AMRO and L’Oreal. Currently, she is coordinating the construction of a new data centre for NTT near Schiphol in Amsterdam, which has been in development since 2019.

Andreas Ahrens
Leading Consultant at Drees & Sommer SE

Andreas is a civil engineer who started his career as a project manager at Drees & Sommer SE in 2006. From 2011 onwards, he has focused mainly on consulting for data centre projects. In 2016, he started concentrating on feasibility studies as well and has since become a certified TSI.PROFESSIONAL for data centre design. Andreas has worked for a variety of clients such as Vodafone, Ericsson, InterXion, Generali, Nürnberger Insurance, Parker Hannifin and JCB, as well as public-sector clients such as Deutsche Bahn and the NRW Ministry of Finance.



ENERGY THAT MOVES PEOPLE

The coronavirus has given us a tantalizing glimpse of what transport could be like in the future. We've seen less crowded trains and buses, far less traffic and lots of people out and about, walking and cycling. Unfortunately, it's likely that things will revert to normal once the pandemic is over. The transport industry, a bête noire for the climate change movement, will once again be a cause for concern. More and more cars and lorries will be on the roads. At the same time, fossil fuel consumption will increase dramatically, along with harmful greenhouse gases. With this in mind, it's easy to see how important overhauling our transport system will be. We need to prioritize renewable mobility. Only then will we be able to hit our climate targets and keep people moving.

By Fabian Gierl, Senior Consultant at Drees & Sommer SE, and Jan Vorkötter, Senior Consultant at Drees & Sommer SE

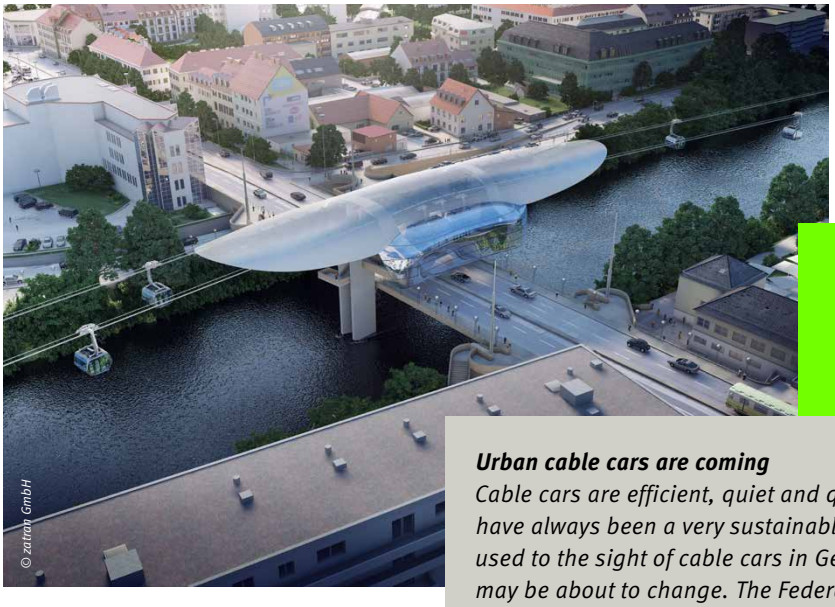
The situation we see in our towns and cities today is largely a relic of town planning in the 1960s and '70s. With multi-lane main roads, no cycle lanes, a shortage of parking places and narrow pavements, this car-centric approach is responsible for much of the chaos we see on city streets today – as well as a raft of other problems like traffic jams, air pollution and stressed commuters and residents. And although some cities are trying (see Berlin's cycling strategy or Stuttgart's strategic pavement plan), it is not easy to uproot structures that have become strongly engrained in our cities. Our bid to transition to renewable energy and make transport greener is currently stuck in first gear.

The goal: avoid, shift, improve

Theoretically, at least, the solutions for making transport more sustainable and efficient already exist. A popular model in industry circles is "Avoid, shift, improve", which is a three-step approach to reduce the transport sector's carbon footprint. Step one is trying to avoid the need to travel. Step two is to shift people into greener forms of transport. Step three is to improve drive technology so that vehicles are more efficient.

The simplest and most cost-efficient solution is to avoid traffic/journeys in the first place. Obviously, if we can reduce the number of cars out on the road then we can reduce our consumption of fossil fuels. So, the idea is to nip traffic in the bud by removing the need to travel. And the way to achieve this is through mixed-use districts, where residents have everything they need – living space, office space and leisure facilities – within a relatively short distance. Finally, employers need to step up too. As the pandemic has shown, it's possible for people to work from home providing that they have the communications and collaboration tools to do so. But there is also a limit to what can be achieved through avoidance: it's unrealistic and impractical to reduce cities to a standstill, even if most journeys are short distance.

So, we come to the second step, which involves getting people to use alternative means of transport. In an ideal world, SUV drivers will one day be persuaded to get on a tram. However, for those of us who can't, or don't want to, give up driving, car-sharing provides a much more eco-friendly way to travel. While driving a private motor vehicle is a comfortable and convenient way to get around, it's also highly inefficient. Cars take up five to 10 times more space than public transport in cities. This space could arguably be put to far better use and providing we put the right planning efforts in, we could make inner cities into a much more attractive environment for visitors and residents to be in.



Cable cars are efficient, quiet and quite low in emissions

Urban cable cars are coming

Cable cars are efficient, quiet and quite low in emissions. And they have always been a very sustainable means of transport. We are not used to the sight of cable cars in German towns and cities, but all that may be about to change. The Federal Ministry for Transport and Digital Infrastructure (BMVI) has asked Drees & Sommer, the planning and consultancy company, and the Stuttgart Institute for Transport Research (VWI) to explore the potential of cable cars in urban areas. Namely, research will be conducted into "using cable cars in town planning and transport planning" and the team will also examine how to "integrate cable cars into existing public transport networks".

We also need to harness green technologies to transform our transport and energy industries and ensure that all modes of transport are powered by renewable energy in the future. There have already been some signs of progress, with ever more electric cars and hydrogen-powered buses appearing on the roads. In fact, the signs are especially encouraging for electric vehicles, which have taken the market by storm and which benefit from a rapidly expanding charging infrastructure (in fact, many new buildings and district developments come with built-in charging stations). Currently, 15 per cent of all new vehicles registered in Germany have rechargeable batteries, hybrid engines or purely electric engines – and that figure is growing.

But unless the energy being consumed at charging points and during the manufacturing process is green as well, electric cars aren't necessarily a leap forward. At the moment, we do not generate enough renewable energy , which is partly due to a lack of storage capacity and partly because renewable power causes voltage peaks. This means that unlike fossil fuels, renewable power installations have to be disconnected from the grid from time to time. However, there's no doubt that green energy could make up a higher proportion of the energy mix. One solution we could start implementing soon would be to use parked vehicles as decentralized storage systems.

Could hydrogen be the future of mobility?

Our transition to new forms of energy depends on our ability to "couple" sectors, and how seamless and green the transition itself is will depend largely on our ability to innovate. Hydrogen is an environmentally friendly fuel that could be used alongside battery-powered vehicles in the future. Hydrogen also has momentum: ever since the federal government published its "National Hydrogen Strategy" in mid-2020, there is a lot of expectation around the new fuel. Both hydrogen and battery technology have a role to play in designing a new transport strategy for cities. So, while hydrogen is best used as a fuel for heavy industry and manufacturing from a carbon dioxide reduction point of view, it can still help in the transport sector where battery power is no longer viable.

Hydrogen fuel is produced by electrolysis, a carbon dioxide-free process that can be powered by renewable energy sources such as solar power, wind and bioenergy. The hydrogen can then be stored and transported to end consumers in liquid or gas form. And because it's a good fuel for powering cargo vehicles like lorries, petrol stations are one potential destination. In fact, several German cities such as Frankfurt am Main have already begun developing a regional hydrogen value chain. Meanwhile certain big technology companies are leading the way. Siemens has started building a research centre at its Görlitz site to explore ways of producing, storing and utilizing this innovative fuel. The real opportunity lies in creating a closed, localized energy ecosystem that allocates power in a flexible way – and where it is most needed.

Fürholzen motorway services

Fürholzen services isn't your typical motorway services and rest stop. Innovative, self-sufficient and sustainable, the Bavarian motorway stop offers alternative fuels like natural gas, hydrogen and rapid-charging units for electric cars, as well as the usual refuelling options. Fürholzen is also an energy-positive petrol station and services so it's as efficient as it is innovative. It was developed on behalf of the South Bavaria Motorway Authority and is located on the A9 between Allershausen junction and the Neufahrn interchange. Drees & Sommer provided support in terms of project management and helped design the site's innovative energy concept.

To overhaul our mobility sector, we need the right energy mix. Only focusing on one type of fuel is as counterproductive as only promoting one means of transport. A more sensible way forward would be to adopt a multi-faceted approach with electric cars for errands, hydrogen-powered buses for commuting and trams powered by 100 per cent renewable energy for wider travel. Petrol and diesel-driven cars will still be on the roads in the medium term – great news for car lovers – but will be powered by synthetic fuels instead of fossil fuels. In this way, we can save entire fleets of cars from being scrapped prematurely and cut down on carbon emissions.

The smart city – connected, sustainable transport

Thinking about the future of urban mobility, it has to be diverse, multi-modal, needs-based and user-friendly. It will also be powered by decentralized and sustainable green energy. A well-planned smart city will offer residents a wide range of ways to travel. From the moment you leave home in the morning, drop the kids off at nursery and go to work, to the time you return home in the evening, perhaps stopping off at the supermarket, gym or cinema, buses, trains and car-sharing schemes will be on hand to help you. However, this needn't be the case in a city designed around short-distance travel. Most journeys will actually be walkable or within cycling distance. And if not, you will be able to travel longer distances in zero-carbon cable cars while smart technology (and apps) helps you plan your journey – with multiple transport options if need be – while optimizing overall energy consumption. Meanwhile, the districts themselves will generate their own power for flats and electric cars. If this all sounds a bit utopian, it's worth having a look at cities like Copenhagen and Singapore, where some of these ideas are already being implemented. Meanwhile, new district-level developments such as Berlin's Quartier Heidestrasse are showing the way closer to home.

Fabian Gierl
Senior Consultant at
Drees & Sommer SE

Fabian earned a Master's degree in geography from the University of Bayreuth, followed by a second Master's in town planning from Stuttgart Technical College. Since 2016, he has been consulting Drees & Sommer's clients in the area of mobility. He has helped develop mobility concepts for companies, buildings and districts, as well as entire city regions. Fabian is also a member of Drees & Sommer's H2 Core Team, a working group focusing on the potential of hydrogen in mobility and district planning. As part of his work as a development consultant, he specializes in sustainable urban districts.

Jan Vorkötter
Senior Consultant at Drees & Sommer SE

Jan studied civil engineering at TU Darmstadt and TU Berlin. He has been working as an infrastructure consultant for both private and public sector clients at Drees & Sommer since 2016. Jan has advised clients across a variety of industries, from energy suppliers, to transport companies, through to municipalities like Stuttgart, Münster and Russelheim. Some of his recent projects have involved dismantling nuclear power stations, planning offshore windfarm developments and developing charging infrastructure projects. Jan is therefore highly knowledgeable about the challenges involved in the transition to renewable energy and new forms of mobility.

OUTLOOK

THE GREEN DEAL: EMBARKING ON A GREEN FUTURE FOR ALL

By Steffen Szeidl
Member and Spokesperson of the Executive Board at Drees & Sommer SE

"Form follows function" is a familiar phrase in English, but it has had a far-reaching influence in architecture and beyond. It is thought that this simple, yet meaningful, slogan was first coined by the American sculptor Horatio Greenough in 1852. It was then revived about 40 years later by Louis Sullivan, one of the early great American skyscraper architects. His basic philosophy was that the form of a building should always follow its function, i. e., it should meet the requirements of those who use it. However, the idea didn't gain worldwide popularity until it was espoused by the Bauhaus art school, which was founded more than 100 years ago in Weimar. It has since provided the inspiration for spectacular buildings, designer furniture and a host of ordinary, everyday objects. The idea was revolutionary at the time, with its proponents igniting a debate that transcended the world of architecture.

Form Follows Planet

You might be wondering what relevance this slice of Bauhaus history has for us today. Well, in the EU's New Green Deal – which aims to make Europe climate-neutral by 2050 – the president of the EU Commission, Ursula von der Leyen, clearly references the European Bauhaus movement with the slogan: "Form Follows Planet". And this new rallying cry for sustainable design has definitely got people talking. Form now no longer follows function; it has to serve the planet too.

While the analogy has been criticized by some, I believe that it is quite apt. As the world was going through the upheaval of industrialization, the Bauhaus school was not just concerned with design, but with asking the big questions: like imagining what life should be like in the future; or thinking about how we should be living; or how we should be learning; or what our homes should be like; or how we fit into society as a whole. And while we might well arrive at different answers, the same questions still apply.

Construction needs to be digital and sustainable

100 years after Bauhaus, we find ourselves in an era of dwindling resources with a changing climate, a growing population, a trend towards increased urbanization and a world going digital. Following the lead of the Bauhaus movement, we have to radically rethink the world around us and create a sustainable paradigm that ensures a good quality of life for us and our grandchildren. So, when Ursula von der Leyen says, "the European Green Deal needs to be a cultural project for Europe", I couldn't agree more. While the Bauhaus-inspired slogan may give the European Green Deal publicity, the real work has to begin now; and that means going green and harnessing the tremendous potential of digital technology. For those of us working in the construction

and real-estate sector, our responsibility under the New Green Deal will be to construct new buildings and renovate existing stock up to the highest environmental standards.

With financing, it's a matter of perspective

To achieve our climate goals, we will have to reduce our consumption of primary energy by about 80 per cent by 2050. And the real-estate sector is one of the worst offenders: in Germany, for example, 21 million buildings account for 35 per cent of the country's entire energy consumption. Across the EU as a whole, buildings account for around 40 per cent of the bloc's total energy consumption and greenhouse gas emissions, so there's a huge potential for change. At the moment, only one in every 100 buildings is being renovated to be more efficient. Meanwhile, 85 per cent of buildings across Europe fall into the "old" bracket. In other words, there is much to be done. The good news is: we have made progress with new buildings. The bad news is that there is a lot of existing stock that needs renovation. If we are serious about hitting our goal of being net-zero carbon in the EU by 2050, we really need to pick up the pace.

In recent years, we have seen that renovation, when done shrewdly, can cut operating costs quickly. Around the end of 2019, however, plenty of people voiced concern about hidden costs in the Green Deal. But to put that in perspective, one and a half years since the COVID pandemic began, billions of euros have been raised to fight the virus at the stroke of a pen. While it's only natural to treat today's problems with more urgency, it's time for our political class to stop treating the problems of tomorrow as problems for tomorrow. It is high time that we rethink how we calculate yields and aim for sustainable, rather than short-term profits.

A second life for buildings after demolition

Our ecological goals are only attainable if we construct a lot more buildings that combine innovative, sustainable construction practices with digital technology. If we accept that the most effective way of saving energy is not to use it in the first place, then we can come up with new ideas: like using artificial intelligence to reduce a building's energy usage by recognizing – or predicting – when spaces are not being used. Once smart grids are in place and controlling everything centrally, smart buildings will be able to adjust their energy consumption in real time based on energy production data. And once there are enough connected buildings within the same area, you can ladder up to an energy efficient district, or even an entire city.

Another area that requires a rethink is how we consume raw materials. The construction sector uses half of all Europe's primary resources and produces 60 per cent of the total waste (some of which is hazardous, too). To counteract this, we need to start applying the cradle-to-cradle principle – a circular system where building materials are recycled after a building is demolished and can then be put to use again. A second life, if you will. You can think of every building as a bank of materials for reuse in new projects, rather than to be thrown into landfill. When this principle is applied at scale, cities become giant depots for raw materials.

Looking forward to the EU Climate Law

The EU Climate Law is the heart of the Green Deal. The principle behind it is to help all member states, and the EU as a whole, to be net-zero carbon economies by 2050. Obviously, this means that we will have to fix more carbon dioxide than we release into the atmosphere but it would be more helpful if there were clear and measurable targets across our economy – including the construction sector – that could serve as a benchmark. Furthermore, instead of concentrating on net-zero carbon to the exclusion of all else, it could be beneficial to factor in other considerations such as biodiversity or working conditions within the framework of the ESG (Environment Social Governance).

21
MILLION BUILDINGS
exist in Germany

73
BILLION EUROS
WERE PAID BY USERS
of residential and non-residential buildings for heating, hot water, lighting and air conditioning in 2014

40 %
IS THE PERCENTAGE
OF EU'S TOTAL
energy consumption that buildings account for

APPROX 80%
IS THE PERCENTAGE BY WHICH
the primary energy consumption of buildings needs to fall by the end of 2050

Form and function become one

Critics of Bauhaus are fond of pointing out that the architecture, houses and furniture that it inspired were not particularly environmentally friendly. But they are missing the point, which is as relevant now as it was back then; it's more about breaking with the past, imagining a better future and trying to enthuse others about new ideas. After all, net-zero carbon isn't just about data and accounting; or about how much carbon dioxide a building can save; or about how much energy it can produce or feed into the grid; instead, sustainable construction will also need to address issues like how well a building fits into its environment and whether people feel at home there. Drawing from Bauhaus isn't about copying old ideas, but rather transposing its ethos into the here and now. And the main takeaway for us is: let's build a world where sustainability has a home.

Let's build a world where sustainability has a home.

Uniting opposites *"the blue way"* – for a brighter future

The film "THE BLUE WAY – Next Exit" was created to celebrate Drees & Sommer's 50-year anniversary. But rather than put out a retrospective piece of film that highlights the company's historical successes, here we shift our gaze to the future. Every day, our employees try to reconcile opposing forces in their work: tradition vs. modernity, nature vs. design and profit vs. art. The characters in the film have to grapple with the same issues. This is particularly so for the main character, a young woman who has dreamed and tried to create a better world since she was a girl. Her aim is for us to come together and design a world that is made for living, and which will be equally wonderful for our grandchildren and future generations to come.

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As the leading European Consulting, Planning and Project Management enterprise, Drees & Sommer has worked with private and public clients from construction bodies to investors on all types of real estate and infrastructure projects – both analog and digital – for over 50 years. With its pioneering and future-shaping consulting, the company offers solutions for successful buildings, high-return portfolios, powerful infrastructure and liveable cities. 3,820 employees in interdisciplinary teams based at 46 locations worldwide support clients across a wide spectrum of sectors. All the services provided by the partner-run company take into consideration both economic and ecological concerns. Drees & Sommer calls this holistic approach *'the blue way'*.

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PUBLICATION DETAILS

Drees & Sommer SE
Press Office
Untere Waldplätze 28
70569 Stuttgart

Telephone +49 (0)711 1317-2411

presse@dreso.com
www.dreso.com

EDITORS
Barbara Wiesneth (V.i.S.d.P.)
Hanna Müller
Madina Khidoyatova
Max Pradler

ART AND LAYOUT
Kathrin Schorn

FREELANCE CONTRIBUTORS:
Harald Czycholl-Hoch (freelance business journalist)
Frank Urbansky (freelance energy journalist)