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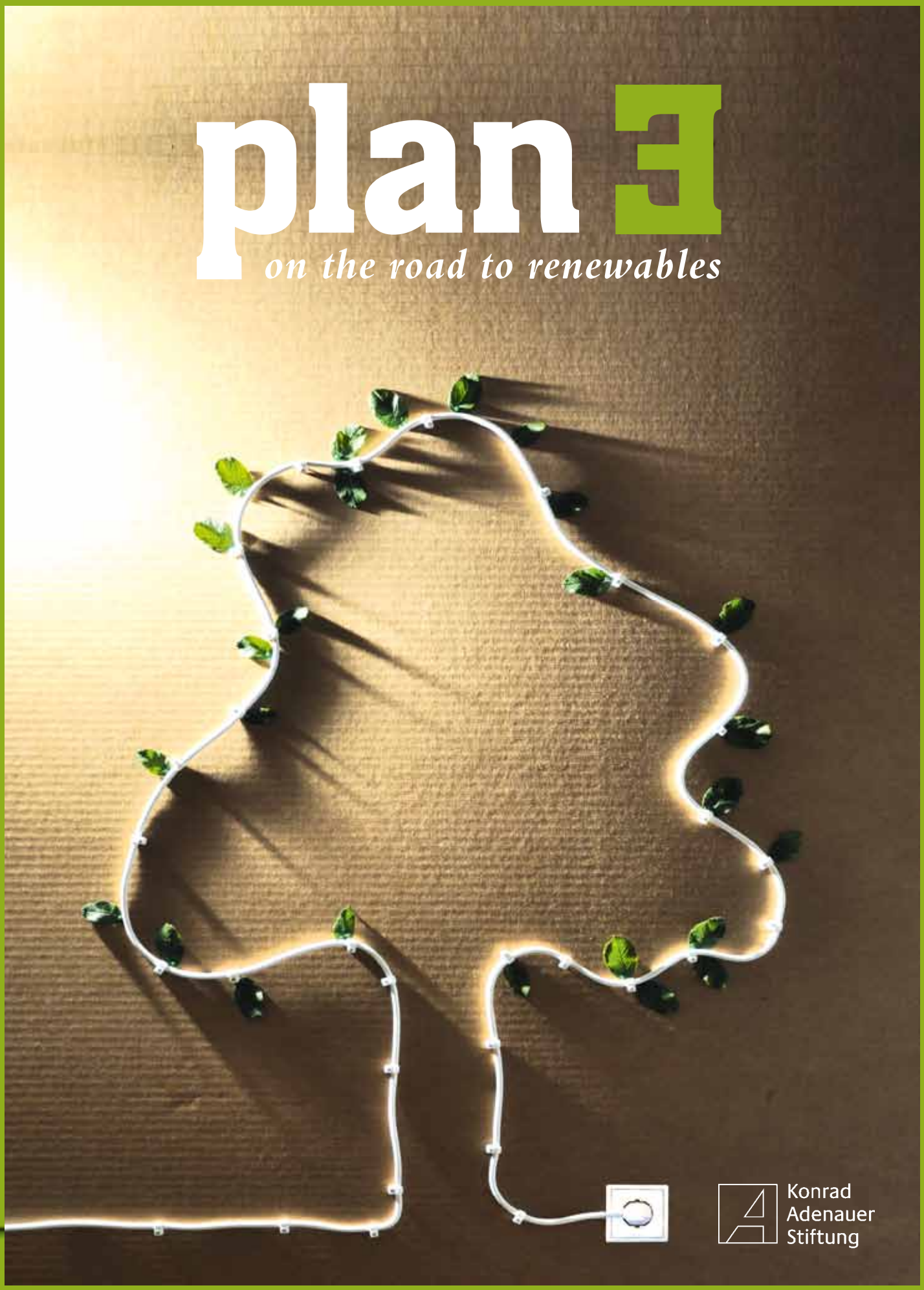
on the road to renewables



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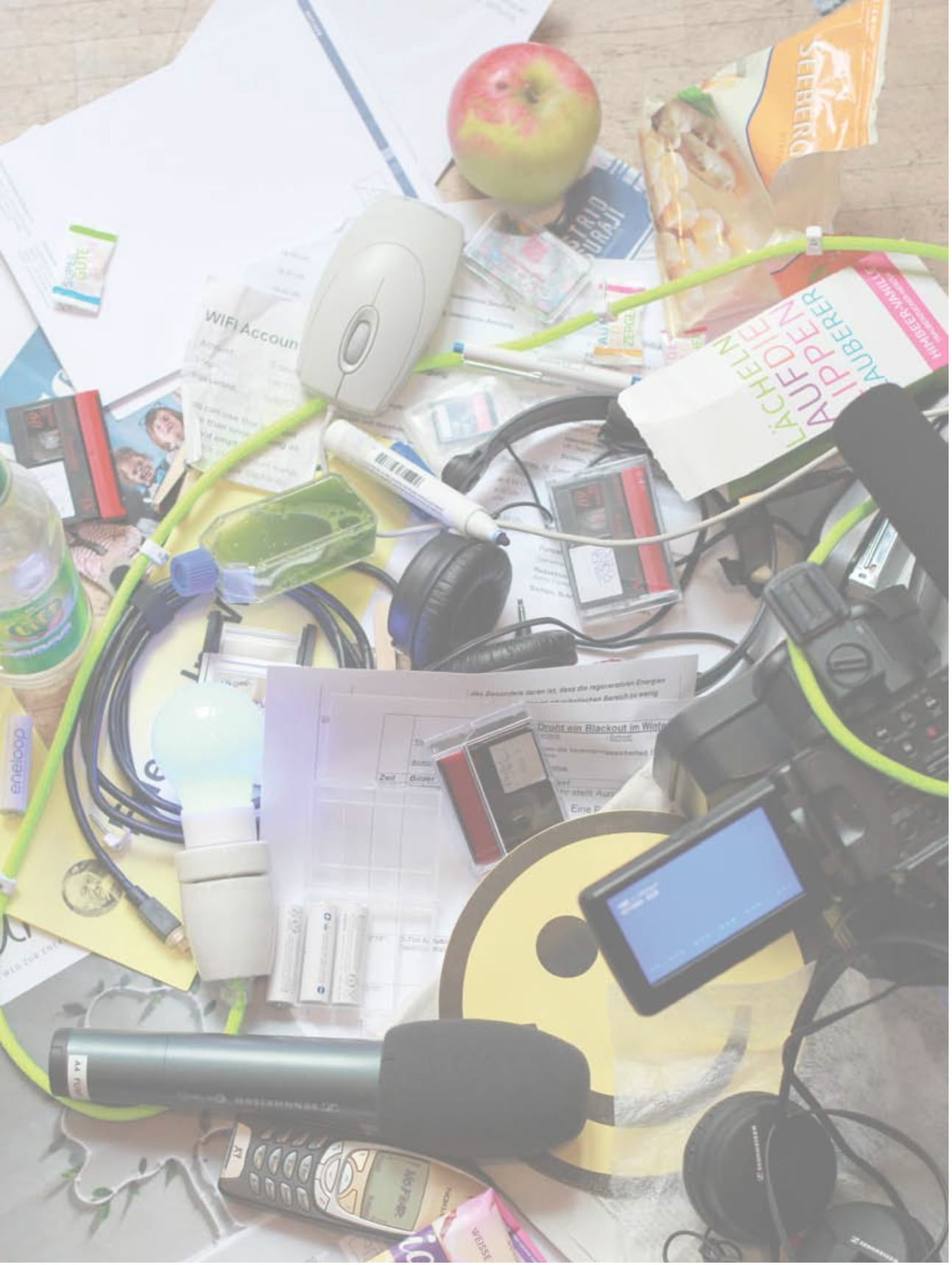

DEAR READER,

There's something about the switch to renewables that reminds me of "The Emperor's New Clothes". Amidst the debate over electricity prices, permanent repositories and bridging technologies, it took a child to get to the heart of what it all means: on one of our radio surveys a young girl from Hamburg said, "The switch to renewables is about turning bad electricity into good electricity."

That's one way of putting it. The main objective is clear, but the road to "good electricity" is a long and bumpy one. There are dead ends, fast lanes, dirt tracks, and forks in the road – and it is anything but clear where exactly the journey will take us. Only one thing is certain: the route to "good electricity" is exciting and challenging. We took a stroll along this road in Hamburg and met people who helped us to make sense of the tangle of technical terms and to give the journey meaning.

We spoke with men like Burkhard Jäckel, for whom the switch to renewables means a great deal of trouble: company Tennet plans to build an extra-high-voltage transmission route next to the town where Jäckel lives – but he is fighting back (p. 4). Jens Wiechmann, on the other hand, sees the electricity that Jäckel does not want in his backyard as a great opportunity: he helps to produce this electricity in huge North Sea wind farms – putting himself in peril in the process (p. 18). For Hana Tefrati, "good electricity" is not enough. She has installed a solar cell on her campervan and is working towards achieving a self-sufficient lifestyle (p. 38).

On our journey, we came to realise that the switch to renewables means more than just "good electricity". We looked into why Germany's biggest power guzzlers are being subsidised (p. 11), how woodpeckers are profiting from energy-efficient building renovations (p. 24), and how we can expect public transport to change in the future (p. 36).

We wish you an enjoyable read,
The editorial team

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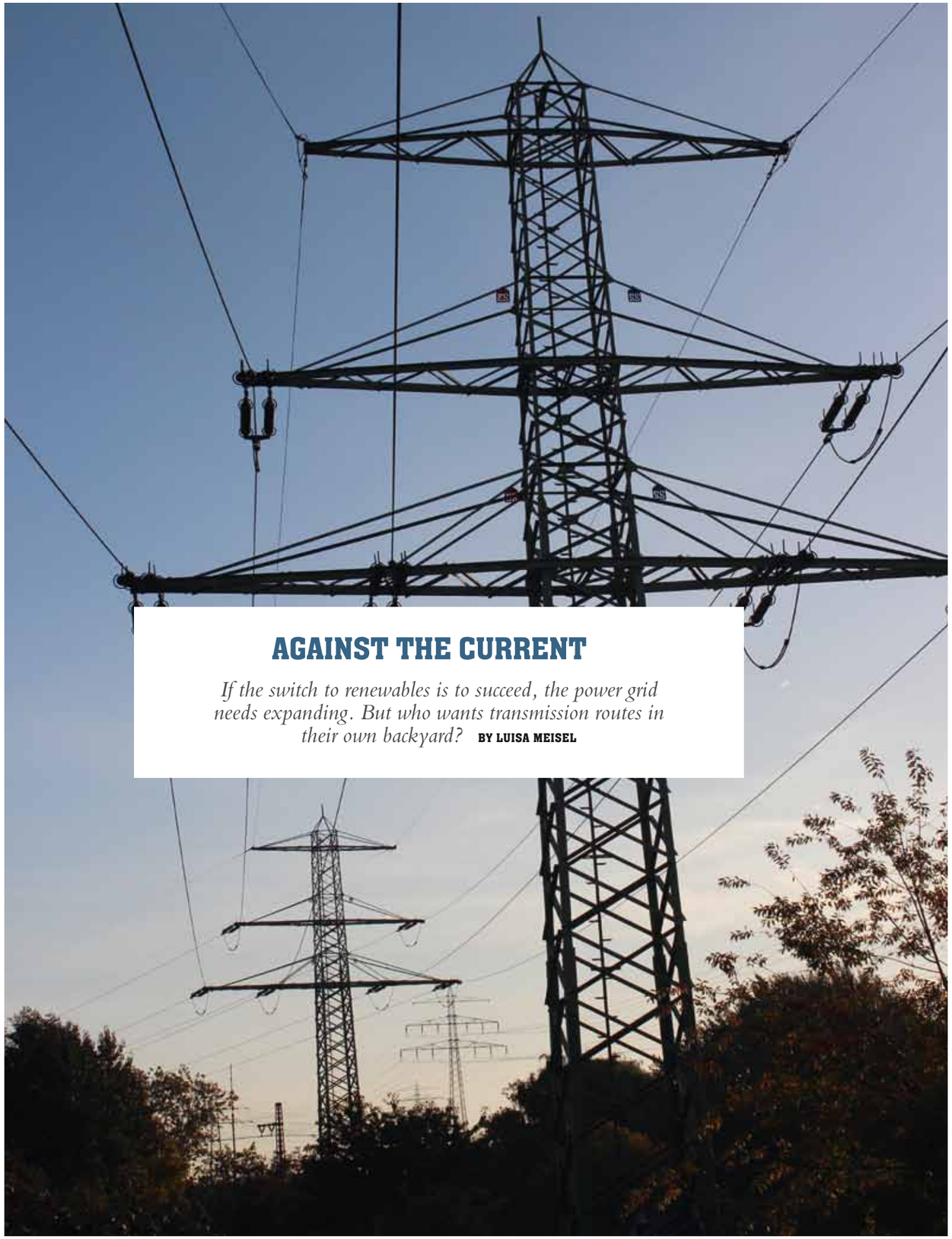

AGAINST THE CURRENT

If the switch to renewables is to succeed, the power grid needs expanding. But who wants transmission routes in their own backyard? **BY LUISA MEISEL**

"If we can get people to change the way they think, that will be a huge achievement." Burkhard Jäckel, chairman of citizens' action group Quickborn against giant pylons

Burkhard Jäckel has a goal: €20,000. "Twenty thousand would be enough to hire a lawyer and take the case to court," he says. Jäckel, 60, sports a grey crew cut that shags slightly over his collar at the back and speaks with a north German dialect. By day he works for a port company, and in the evening he plays bass in his rock band Punch and Judy – except for Monday evenings, that is, when he hosts a meeting of the core members of the citizens' action group Quickborn gegen Riesenmasten. Fuelled by cigarettes and red wine, Jäckel and his two fellow campaigners pore over land use plans and meeting minutes into the early hours of the morning.

Their goal is to prevent the expansion of a transmission route passing next to Quickborn, a town around 20 kilometres north of Hamburg.

"There have been times when I just wanted to throw in the towel."

On the evenings of their meetings, the shellac-coated wooden table in the dining room with its rose-patterned place mats almost disappears under an avalanche of paper. "My wife is in charge of the decoration," explains Jäckel. Next to the living room, however, Jäckel has a den of his own, with a Bob Dylan poster on the wall and shelves laden with ships in bottles.

From their patio, the couple enjoy a front-row view of the Hamburg Nord – Dollern transmission route. The pylons tower 35 metres above the ground, supporting 220 kilovolt power lines that appear rather like a giant set of musical notes cutting across the sky. That is the voltage of a domestic socket multiplied by a thousand. Plans are in place to increase the pylons' height to 60 metres and equip them with power lines carrying a maximum voltage of 380 kV. This expansion of the transmission route passing through Quickborn is one more step in Germany's switch to renewable energy sources.

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What looks like a line of musical notes across the sky over Quickborn belies the discord wrought by high-voltage power lines.

The theory of land-use plans vs. the reality on the edge of town: grid expansion is unavoidable.

By 2020, at least 35 percent of Germany's electricity is supposed to come from renewable sources such as wind and solar power. Yet the electricity generated by wind turbines in the north needs to be transported south in order to avoid power shortages. If every nuclear power plant in Germany is to be permanently shut down by 2020, grid expansion is an urgent priority. However, the greater the distance to be covered by the electricity, the higher the voltage required. Lines of 220 kV are no longer enough. That is why the Quickborn route is to be equipped with 380 kV extra-high-voltage lines.

"I have to do something before it's too late."

One of the pylons is located around 90 metres from a school sports ground. This pylon is the reason why Jäckel founded the action group and the reason why his Monday evenings are getting longer every week. "There have been times when I just wanted to throw in the towel," says Jäckel. "The huge amount of time I spend on the project means the less time I spend with my family." In the beginning, Jäckel was simply worried that large pylons on his doorstep might one day affect the value of his property. "Then at some point I found out that the electromagnetic radiation can cause cancer in children and decided I had to do something before it was too late," says Jäckel, exhaling cigarette smoke. In spite of the huge effort demanded by the project, Jäckel is committed to it. He is quite certain that "extra-high-voltage power lines make our children ill."

Whether or not electromagnetic radiation does in fact cause leukaemia in children remains an open question. Some studies suggest an increased risk, but this has yet to be confirmed. The debate has long become a matter of personal opinion, with each camp trotting out those figures and studies that support its specific view.

Jäckel's group has been active for over three years, providing information about the dangers of electromagnetic fields. He prints flyers, paints posters, and conducts talks with property owners about an alternative route for the transmission line. He has worked out how many hours he and his fellow campaigners have invested in the project over the last few years and came to a grand total of 3,300. Certain of those hours are still fresh in Jäckel's memory, such as one evening in the winter of 2010. The town was covered in snow, and all the paths were frozen over. It was dark outside, and neighbours and friends had made lanterns from used jam jars and tea lights and placed them along the transmission route – a chain of lights in the snow. Jäckel handed out mulled wine and grilled sausages. Only 35 people turned up. "It is difficult to get people mobilised," says Jäckel, mechanically clicking on the photos of the evening on his website. "I often have to tell myself that it's not how many people come that matters, but the fact that anyone comes at all." The unused boxes of mulled wine are still stacked in his hallway.

The power highway leading past Quickborn is sheer nonsense in planning terms, says Jäckel. There is no legally prescribed minimum distance between the power lines and residential areas, simply a directive establishing maximum values for electrical and magnetic field strength. But those who, like the action group, are convinced of the detrimental effect of the power lines are not content with threshold values – they regard any increase as harmful. That is why Jäckel's group is campaigning to have the route changed. However, this would mean getting the agreement of the owners of the properties that are affected by the new route. "We're unlikely to have much joy there," says Jäckel tersely. The frustration of prolonged negotiations for an alternative route has left furrows in his brow.

A round table was created in an attempt to find possible compromises. Municipal representatives, grid operator Tennet (responsible for erecting the pylons), and the citizens of Quickborn are all fighting for their own interests. "A lot of new bonds are formed, and a lot of old ones are broken," says Jäckel. Objectively speaking, there has been no real debate for a long time, as oft-repeated arguments fall on deaf ears while people become increasingly fixated on their own point of view. On the surface, Quickborn looks like a peaceful enough town: front gardens with carefully tended lawns, lace curtains, geraniums, and one or two nice mid-range cars parked in front of every garden fence. However, behind the fences and curtains, the Quickborn transmission route has long become a subject of dispute, and disparaging comments are rife among the neighbours here.

Yet everyone is in favour of the switch to renewables and everyone agrees that the grid expansion is necessary. "This power line is hugely important," says Martin Groll, of grid operator Tennet. "It is an intensification of the only line across the Elbe currently in existence. We need to act quickly, otherwise it is going to be impossible to transport wind energy from Schleswig-Holstein to the south for a very long time.

The process has been dragging on for over three years. The final stage is the forthcoming planning resolution, when the Schleswig-Holstein Ministry of Energy Transition will approve the path and type of the extra-high-voltage transmission lines. This resolution is expected in mid-January. After that, time will start running out for Jäckel's action group: they will have just four weeks to file an appeal with the Federal Administrative Court before the diggers and bulldozers arrive.

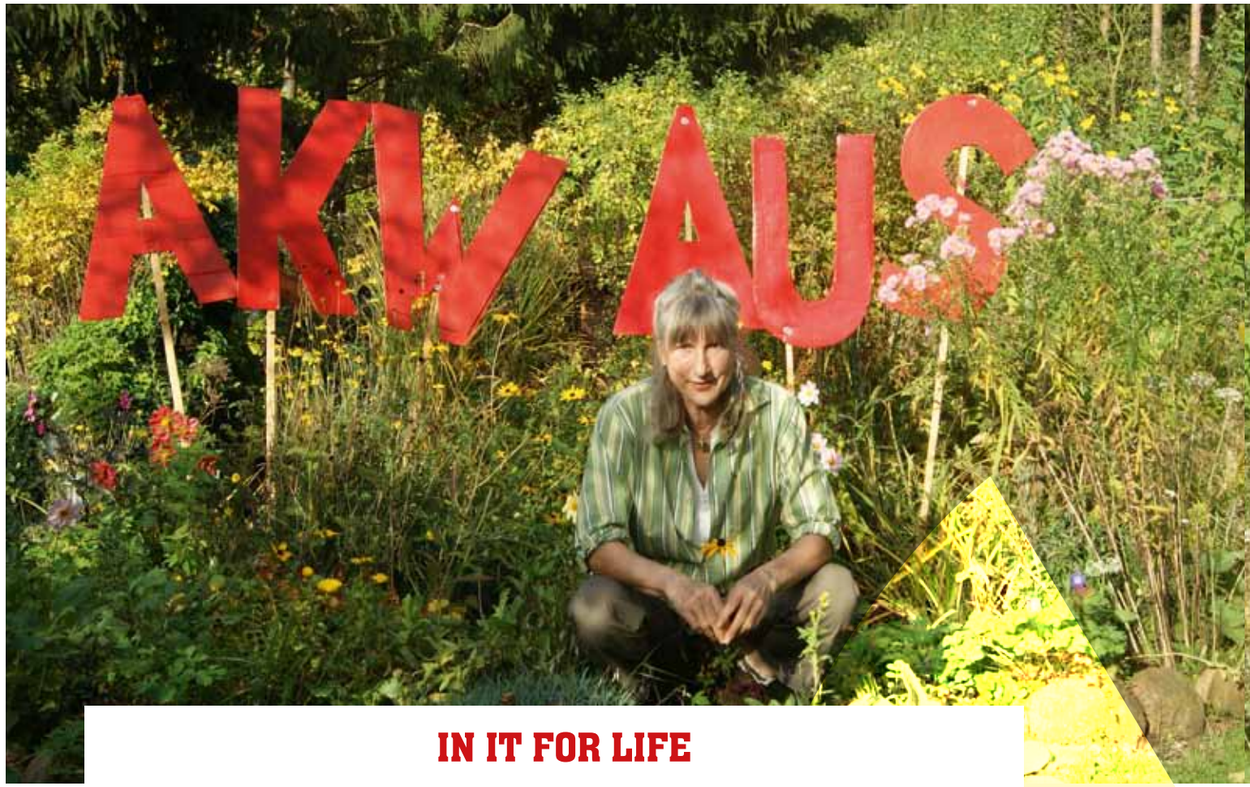
The procedure for a case like this is complicated, and a lawyer is essential. Hiring a lawyer will cost around €20,000, according to Jäckel's estimates. And the chances of success are slim. The Ministry has discretionary power over the plans: if the resolution determines that the transmission line can be upgraded as planned, the court cannot overrule this decision, which means that the route to be followed by the power line in Quickborn will remain unchanged.

When Jäckel considers the possibility that his group might not be able to raise the money, the furrows on his brow grow deeper. If that happens, Jäckel admits he will be all out of ideas. Even so, he says, the action group will have succeeded in blocking the expansion for a few years. "So it won't have been entirely in vain."

At least he will be able to look people in the eye in the bakery every morning, in the knowledge that he put up a fight. His son once asked him why he puts himself to all this trouble. "Because no one else will," was his reply.

Assuming the resolution is taken in mid-January, Jäckel has just under three months to raise the €20,000 needed for the lawyer. When he walks through Quickborn with his collection box, people always toss in a coin or two. For Jäckel, that feels like recognition for all the work he has put in. People reach for their wallets before he can even open his mouth to ask for a donation, he says. "The euro coins drop steadily into the tin. That's a real boost." As he speaks, he appears to forget the January deadline for a moment. On the action group's website, a red counter keeps track of the donations. Jäckel has already succeeded in raising €552.91 – just €19,447.09 to go.

His son once asked him why he puts himself to all the trouble.



IN IT FOR LIFE

Bettina and Gerhard Boll have been part of the anti-nuclear protest movement for over 30 years and have been particularly active in campaigning against the Krümmel nuclear power plant, which is situated just six kilometres from their home in Geesthacht, northern Germany. This is the story of two resistance fighters. **BY PHILIPP OFFENBERG**

28 February 1981: Over 100,000 people meet on the Wilster Marshes to protest against the nuclear power plant in Brokdorf. The demonstration goes down in history as one of the biggest ever in the Federal Republic of Germany. Gerhard Boll is there. He walks across the marshes with tens of thousands of others towards Brokdorf. When he arrives at the target, he climbs up a dyke and sees a group of police helicopters flying towards him from Hamburg. "They looked like a fighter squadron about to attack," says Gerhard, recalling those events today. The demonstration escalates into a riot, leaving 128 police officers and 70 demonstrators injured. Despite the protests, the nuclear power plant is completed in 1986. "I remember asking myself back then what kind of state I was living in," Gerhard says. Now 66 years old and retired, Gerhard lives with his wife Bettina in the town of Geesthacht in northern Germany. Bettina Boll, now 58, has been involved the nuclear protest movement since 1982. "Over time we have played a greater and greater role in the protests," she says. The Bolls lead a modest life. They buy little, recycle everything they can get from their neighbours, have only flown twice in the past 30 years, and live in a semi-detached house, built in 1918, which they have still not finished renovating. "Germany's decision to switch to renewable energy sources does not mean that we humans can carry on consuming energy the way we always have," says Gerhard. "People should consider the switch as a turning point in their own lives too." For the Bolls, this turning point came in the early 1980s. Back then, there were only a few people who supported their cause in Geesthacht as many of the families made their living either directly or indirectly from working at the nuclear power plant. People would often ask them if they were trying to go back to living in the Stone Age. Bettina started to seriously consider leaving the area.

26 April 1986: A runaway chain reaction causes a reactor to explode at Chernobyl power plant. When the reactor explodes, Gerhard and Bettina are on holiday with a group of children in the Wendland area of central Germany. The authorities tell them to stay inside. Unsure what to do, the Bolls eventually dare to go out, but make sure the children all take a shower in the evening. "It was a very eerie feeling to know that there was a danger that we could neither see nor smell," says Gerhard. Unlike the Wendland farmers on the left-hand side of the Elbe who heed warnings from the West German authorities and keep their livestock inside, the East German agricultural production cooperative (LPG) on the right-hand side of the Elbe continues to let its cows graze as if nothing has happened.

The Bolls' hopes that the disaster would sway German public opinion on nuclear power are not realised, however. "The whole story was quickly branded a disaster at a 'Russian reactor' that could never happen here in the West," says Bettina. Professor Jürgen Scheffran of the KlimaCampus at the University of Hamburg disagrees. He believes that the Chernobyl disaster made people in Germany aware of the risks of nuclear power. "Since then the majority of the population has had a negative view of nuclear energy," he says. "The disaster also meant that the industry was not able to build as many power plants as planned."

At any rate, Bettina no longer feels safe in Geesthacht and in 1989 she applies to emigrate to New Zealand. The Bolls' application is accepted, but in the end they decide not to go. "New Zealand may not have any nuclear power plants or mid-range nuclear missiles, but the next nuclear testing ground is not so far from there either," says Bettina. Instead, the couple choose to channel their fear of nuclear power into protesting against it.

27 October 1998: The first SPD-Green federal government coalition forms in Berlin
The Bolls have high expectations of this government, and it does indeed manage to pass several important laws, including the Renewable Energy Act. But the Bolls also have plenty to be dissatisfied about, and feel that Gerhard Schröder's Social Democratic Party (SPD) is

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not all that keen on phasing out nuclear power. At an event in Lüneburg, Bettina enters into a heated debate with Jürgen Trittin, the federal environment minister. "I told him that it was nonsense to set up an interim storage facility at each nuclear power plant and that I would take him to court over it," she said. In 2004 she is true to her word and goes to court over the interim storage facility at Krümmel. The €24,000 legal fees are covered by donations from sympathisers. However, her case is rejected by the court of first instance, and she does not have enough money left to mount an appeal.

28 June 2007: When a new turbine is started up at Krümmel nuclear power plant, a fire breaks out in the transformer. Vattenfall, which operates the plant, says that the security systems functioned as planned and that the plant was automatically shut down.
"Vattenfall was right. The power plant knew what it had to do and switched itself off of its own accord. It knew that its time was up," says Bettina. In 2009, she joins Geesthacht town council as a member of the Green Party, and her husband follows in 2010. That same year, a new threat looms when plans are introduced for extending the lifetime of Germany's nuclear power plants. The Bolls take to the streets once more.

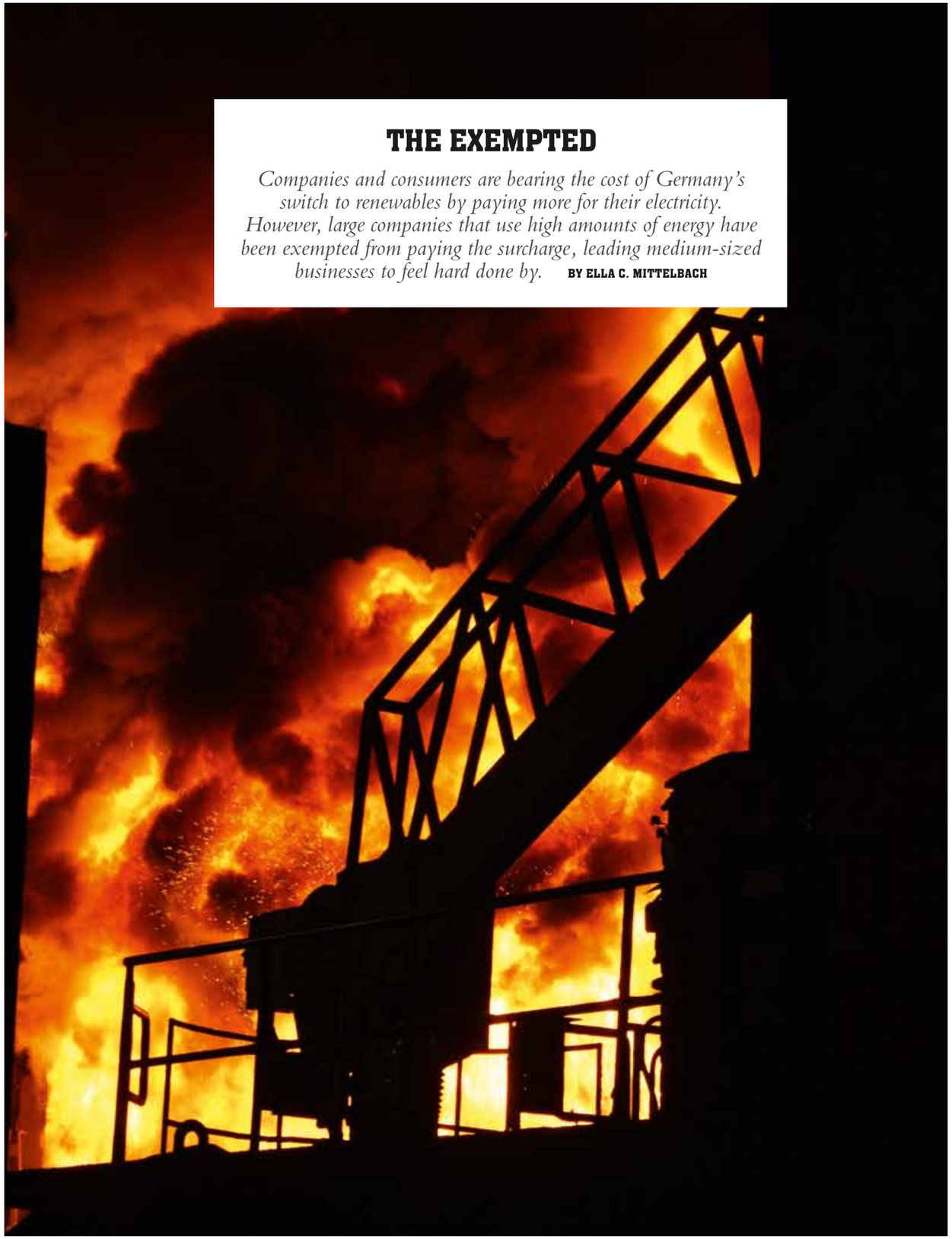
24 April 2010: Around 100,000 demonstrators form a human chain around the Krümmel and Brunsbüttel nuclear power plants.
The Bolls organise the three-kilometre stretch between Krümmel and the Bergedorf district of Hamburg. A succession of incidents at the Krümmel plant and years of campaigning by local activists has led to a change in the public mood in Geesthacht. The Bolls are suddenly heralded as pioneers. The chain is three people deep at some points and includes many people they would never have expected to see there.

28 October 2010: The German Bundestag decides to extend the lifetime of Germany's nuclear power plants. This includes Krümmel, but the plant remains shut down.

11 March 2011: A deadly accident takes place in the reactors at Fukushima power plant in Japan.
Gerhard vividly recalls that day. "I remember thinking straight away that this would not be easily solved and that a nuclear meltdown was taking place." The Bolls contact radiation victims in Fukushima. "Their descriptions were very similar to those given by people from Chernobyl," says Bettina. Since Fukushima, people have understood that nuclear disasters do not just take place in old Soviet reactors, but that nuclear energy can present a danger even in high-tech countries like Japan.

14 March 2011: German Chancellor Angela Merkel announces that the government is reversing its decision to extend the lifetime of Germany's nuclear power plants. The Krümmel plant therefore remains off the grid.
On Easter Monday the Bolls organise a demonstration of 15,000 people in front of the Krümmel nuclear plant. At precisely 2 p.m., the demonstrators turn away from the plant and walk in the opposite direction. "Until then, we had always protested by the fence around the plant, but we wanted to consciously draw a line under that era," says Bettina.

30 June 2011: The Bundestag passes a resolution to phase out nuclear energy in Germany by 2022. The motion passes with votes from the Christian Democratic Union (CDU), the Free Democratic Party (FDP), the Social Democratic Party (SPD), and the Green Party.
Despite the switch to renewables, known in Germany as the "Energiewende" or "energy transition", Gerhard and Bettina do not feel that the struggle is over. They have fought for over 30 years for something that has now become common consensus, but, as they say, challenges remain: "We don't know how we will get around the problem of nuclear waste. Future generations will be dealing with that for a long time to come," says Gerhard. The couple now plan to campaign for the dismantling of the Krümmel nuclear power plant.



THE EXEMPTED

Companies and consumers are bearing the cost of Germany's switch to renewables by paying more for their electricity. However, large companies that use high amounts of energy have been exempted from paying the surcharge, leading medium-sized businesses to feel hard done by. **BY ELLA C. MITTELBACH**

Hall One is an inferno. Every few seconds, sparks fly and boiling slag lights up the steelworks. Between the machines and the barriers glows a giant arc furnace, its electric arcs melting scrap steel. The molten metal will later be used to produce reinforcing steel and wire rods. Arcelor Mittal has been supplying the global market with these products for 40 years now. The steel manufacturer employs over 300 people in Hamburg alone, and has confirmed that it will remain in the city for the time being. "For the time being" being the operative phrase. The company channels over 800 gigawatts of electricity into its production every year – enough to power a city of 500,000. Marc Hölling, a process technician at Arcelor Mittal, is, in principle, in favour of Germany's switch to renewables. However, he is critical of rising electricity prices. "Even our more energy-efficient furnaces require a huge amount of electricity," shouts Hölling above the din of the steelworks.

The Renewable Energy Act (EEG) aims to expand renewable energy in Germany. Written into law in 2000, it stipulates payment of a surcharge on top of the normal electricity price to cover the higher costs of fostering renewable energies. Initially, the Renewable Energy Act surcharge was set at 0.41 cent per kilowatt hour, but it was raised to 3.6 cent in 2011. The following year, the surcharge was increased again to 5.3 cent per kilowatt hour. To ensure that energy-intensive industries would remain competitive at international level, all companies in the metal, cement and chemical industries were declared exempt from paying the surcharge. Companies initially qualified for exemption if they used over 100 gigawatt hours of electricity. This threshold was then reduced to ten GW/h and again in 2012 to just 1 GW/h. But only companies whose energy costs amount to at least 14 percent of their production value are eligible for the exemption.

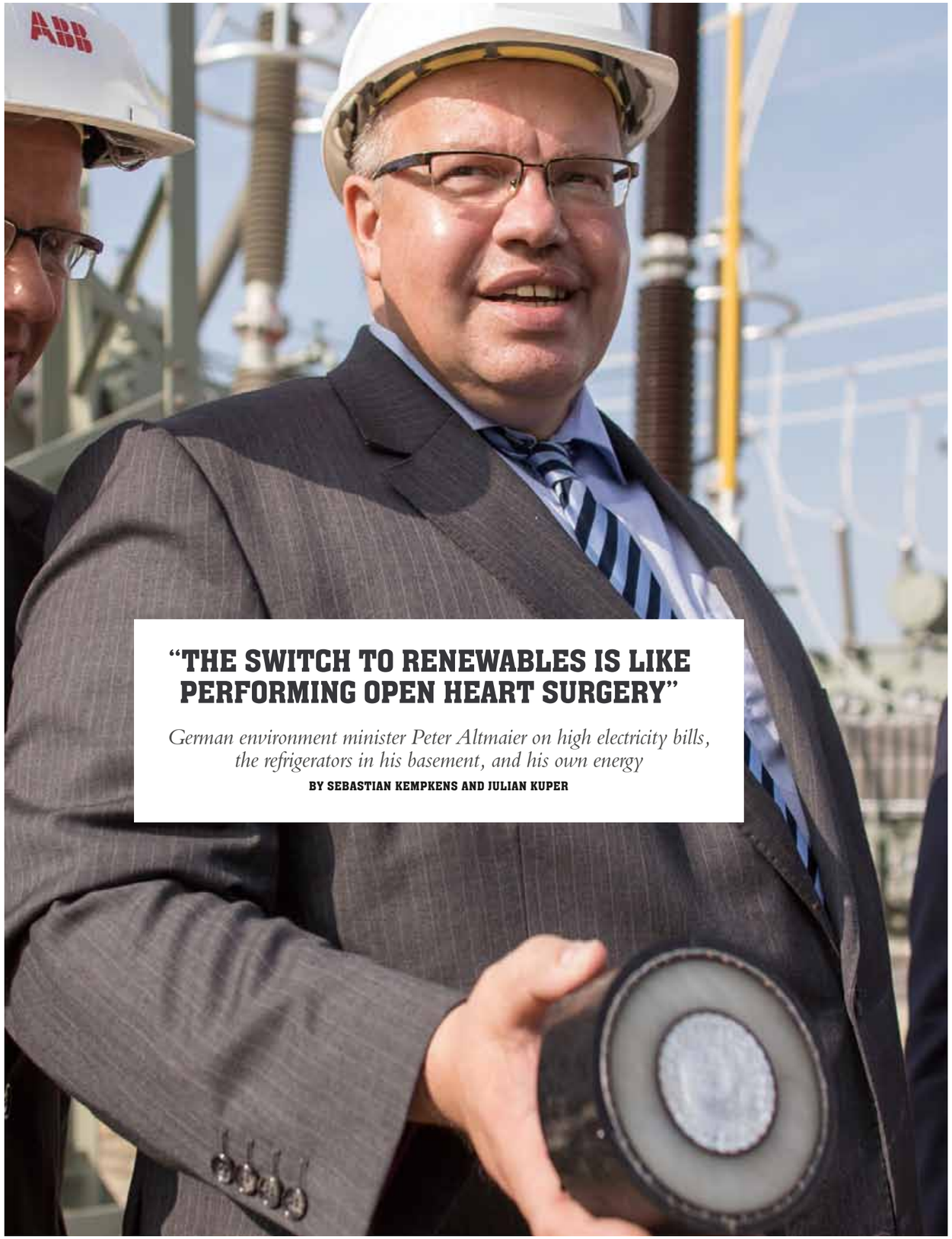
All consumers pay the Renewable Energy Act surcharge, it's just that energy-intensive companies pay significantly less. The German government took this step to protect German jobs by encouraging big companies like Arcelor Mittal not to move production to countries where electricity is cheaper. Arcelor Mittal has numerous production facilities around the world. In Germany alone, it has 25 plants employing over 8,000 people in total. "If we had to pay the surcharge, our costs would exceed our revenue. Either we are granted the exemption or we have to close the Hamburg plant," says Hölling.

Another production facility at another company: At the Jastram plant in Hamburg, the machines work at full speed, even after the working day is over. The air is heavy with the smell of lubricant and diesel, and the hall is full of large, brass-coloured ship propellers. There are also a few rudder propellers wrapped in clear plastic leaning against the walls. It was the patent for these propellers that established the Jastram brand on the international shipping market. The medium-sized company has 30 employees and is based in Hamburg's Bergedorf district. It was founded 120 years ago when it began building diesel engines. Since the 1950s it has specialised in marine steering technology, and now exports 80 percent of its rudders and control systems around the world. Manager Gerhard Erb has invested heavily in energy-saving measures in recent years. "And now we have this huge surcharge to contend with, while large companies are exempt," says Erb. He is sympathetic to the situation of the exempted companies, but his concerns lie with his own company. He is therefore calling for "a rethink on the exemption regulations and limits for the EEG surcharge – to the benefit of exporters."

In a market economy, any interference distorts competition. "After all, Germany does not subsidise any orange plantations or the textile industry, for example, in order to compete with markets in Italy and Bangladesh," says Wolfgang Maennig, a professor of economics at Hamburg University. He says that the EEG surcharge may be a subsidy, but it is also an investment in the future. "I believe that it will not be long before we have developed renewable technologies to the point where they can succeed on the market without subsidies," he says.

Even environmental associations like Greenpeace support the subsidies for large industrial companies. "Of course, we have to support energy-intensive industries like steel, aluminium and paper manufacture as their business depends heavily on the global market price," said Niklas Schinerl, spokesman for Greenpeace in Hamburg. Despite this, he believes too many companies have been exempted from the surcharge. He says that not every larger medium-sized business should be exempt – otherwise the surcharge will need to be gradually increased for private individuals. "Companies already benefit enough from locating their production in Germany – we don't have to carefully nurture every single company," he says. He also believes it may be little more than bluster when companies claim they will relocate abroad if they are not exempted from the surcharge.

Maenning cannot say whether or not the exemption limits should be redefined. He sees that as the responsibility of policymakers, and suspects that, at any rate, few changes to the surcharge are likely until the German elections are over. "TV reports of plant closures never go down well before an election," he says.



"THE SWITCH TO RENEWABLES IS LIKE PERFORMING OPEN HEART SURGERY"

German environment minister Peter Altmaier on high electricity bills, the refrigerators in his basement, and his own energy

BY SEBASTIAN KEMPKENS AND JULIAN KUPER

Mr Altmaier, your father was a miner and your mother a nurse – how did they react when they suddenly had to spend €60 more a year on electricity?
The biggest item in household budgets was and still is the heating bill – by which I mean either heating oil or district heating. It's precisely because I come from a modest background that I'm very unhappy about the rising electricity prices. We all knew that the switch to renewables was going to cost something, but I'm sure that a price rise of this scale could have been avoided if policymakers had taken the appropriate measures in good time.

But it was not avoided. You recommend enlisting the help of an energy adviser to explain how we can save electricity – has one been to your house yet?
As a minister I am fortunate enough to regularly come into contact with people who know about this sort of thing. I have already learnt a lot – for example, I discovered that the heating pump in my house is a huge power guzzler and that if I replaced it with a new one, I could save 80 percent of the energy it uses. I now also know that my old fridge and freezer, which I bought 20 years ago, use vast amounts of electricity – and if I do not defrost them regularly, they waste even more. This is all common sense, but I didn't use to think about these things at all in my day-to-day life. That has changed now that I'm environment minister.

So are you getting rid of the power-guzzling appliances?
Well, the thing is, I bought a new kitchen four years ago with an energy-saving fridge-freezer and put the old appliances in the basement, where I've kept them running for the time being. Only now have I realised what effect this has on my electricity bill and my energy consumption. I'm going to get them taken away soon.

So you are learning new things all the time. That means your appointment as environment minister has already led to small electricity savings.
Everyone can make a difference by making little changes to their daily routine. For example, I often used to leave my computer on overnight so I didn't have to boot it up the next morning. These aren't the sort of things where people should be forced to act one way or the other, but they're worth talking about. They help you to knock your electricity bill down to size.

But can the general public really be expected to take the transition to greener energy into their own hands?
No, they can't be expected to do that. We also need to offer advice and concrete support, particularly for low-income families. I'm currently discussing this issue with welfare associations, utility companies and lots of other organisations. We must ensure that the transition to greener energy costs less on the whole. This includes sticking to the original plan for the expansion of renewables – which was to take place over a period of 20 to 30 years. This will mean that the costs don't all come at once and that electricity prices are kept at a tolerable level.

It looks as if the switch to renewables could soon cause problems for the Christian Democratic Union – particularly in the 2013 general election. Why can't you put an end to the electricity price debate?
Switching to renewables is not exactly child's play. It's rather like performing open heart surgery on the economy. But we have one year until the election to prove that we can do better than a SPD-Green coalition.

Although you have a reputation as a self-made man who has taught himself, it is still only relatively recently that you took office. Can you always understand the flood of information that comes your way from the energy sector?
Yes, I've learnt the ropes pretty well and I have an overview of the sector. Now my aim is to present this wealth of information to the public in a way that they can understand. For example, the faster we force the transition to renewable energy, the more costs we will incur in a shorter time period. This is a principle that can be understood by anyone.

The threat of an SPD-Green coalition is not your only problem. As environment minister you are often caught between politicians, lobbyists and the public – they all want something from you. How can you keep a clear head?
I really like cooking – I find it relaxing and it helps to break up the day-to-day life of political routine. I like inviting colleagues around. It's not about the food being particularly fancy or impressive, it's about the fact that politicians can sometimes see things with more clarity when they are in a relaxed, private setting rather than in some back room somewhere. By providing this kind of convivial setting, I hope to make a small contribution towards keeping politics straightforward and human.

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Have you ever considered inviting the various key players in Germany's switch to renewables one by one to the Altmaier house? Perhaps you can tempt them over to your way of thinking.
I'll let you in on a secret: since I've been environment minister, I haven't had the chance to cook for anyone; I've just had too much work. All the same, I'm hoping to find time over the next few months to have some people over. But it doesn't have to have anything to do with the switch to renewables.

You joined the Junge Union, the youth organisation of the Christian Democratic Union and Christian Social Union back in 1974. The energy situation looked quite different back then.
What did you think about nuclear energy as a young man?
Back then, just like now, I was neither a supporter nor an opponent of nuclear energy. It was just one of several types of energy, as far as I was concerned. I always felt that it would be difficult for Germany to go it alone in phasing out nuclear power.

And did the Fukushima disaster change your opinion?
Since the Fukushima disaster I have come to the realisation that nuclear energy no longer has a future because it has been the most controversial political and social issue. Therefore I am now quite certain that it was right to phase out nuclear power. I also believe that we're making the right type of transition with our energy sources – we're not simply replacing nuclear energy with coal and gas, but are making the switch to renewable energies. I believe that this has been the right decision, also from the perspective of sustaining and developing technological progress in Germany.

One thing is certain, stressful weeks lie ahead for you. Where do you get your energy from?
I derive the energy I need for my political work from being motivated by this very difficult but tremendously exciting project. There are many government departments that are much bigger than the environment ministry and that have a lot more money but, with the switch to renewables, we have a project that is simply crucial for Germany. That's what spurs me on.

KEYWORDS

A quick A-Z of the switch to renewable energy in Germany

BIOGAS
Biogas is obtained from energy crops like rapeseed and maize, manure and other organic waste. The substances are fermented by micro-organisms in a biogas plant without any light or oxygen. Methane gas is produced, which can then be burned in a gas engine. Many combined heat and power (CHP) units rely on this to generate electricity and heat.

COLD RESERVE
It is precisely in winter, when people turn up the heating and consume particularly large amounts of electricity, that the sun and wind tend to provide only low levels of energy. It was for this reason that the grid operators had to activate the cold reserve for ten days in February 2012. In Germany the cold reserve is composed of five coal-fired plants that have actually been closed down but can, when necessary, be started up again relatively quickly.

DISPATCHERS
Dispatchers are people who work for grid operators and ensure that every region in Germany receives enough electricity. As there needs to be a constant balance between the supply of and demand for electricity in the grid, the dispatchers measure how much electricity is being consumed every quarter of an hour. If demand is greater than supply, the dispatchers choose which power plants to bring online. They have to give preference to plants that generate electricity from renewable energy sources.

EFFICIENCY LEVEL
Every power plant has an efficiency level indicating the percentage of the energy obtained from coal, gas, sun or wind that it has actually converted into useable electricity by the end of the process. During the electricity generation process, a proportion of the energy is lost, for example through heat and friction. The higher the efficiency level, the more efficient the power plant's use of primary energy.

ELECTRIC CURRENT
Electric current is the movement of electrically charged particles that jump back and forth between the atoms of conducting materials, such as water. The atoms capture some particles and release others, producing a chain reaction. We use the kinetic energy of the charged particles as electricity.

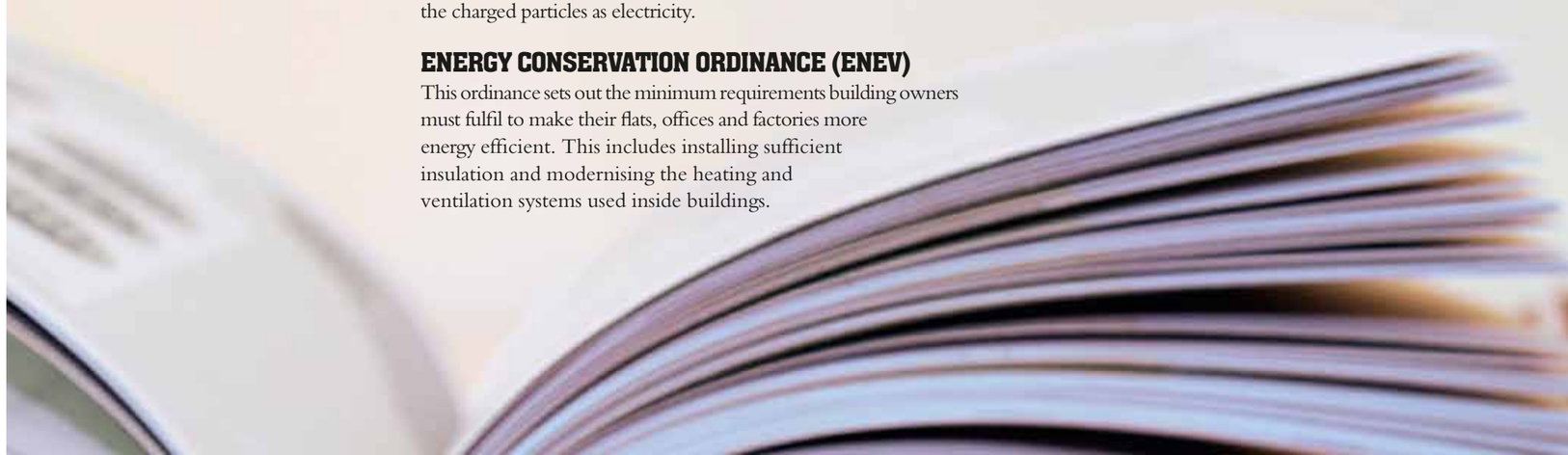
ENERGY CONSERVATION ORDINANCE (ENEV)
This ordinance sets out the minimum requirements building owners must fulfil to make their flats, offices and factories more energy efficient. This includes installing sufficient insulation and modernising the heating and ventilation systems used inside buildings.

ENERGY EXCHANGE
Unlike gold, coal or oil, electricity cannot be stored and must be used at once. If suppliers produce more electricity than they need, they offer the surplus to buyers at the European Energy Exchange in Leipzig. If they produce too little, they can purchase electricity there. The exchange is intended to regulate prices by matching supply with demand. Trading takes place online, where energy providers and traders from all across Europe can deal in the derivatives market (up to six years in advance) and the spot market for the following day. Only wholesale traders are permitted to take part.

FEED-IN TARIFFS
In comparison to conventional energy sources, it is still relatively expensive to generate electricity from renewables. Renewable energy plant operators would actually have to demand higher prices for their electricity – which would prevent them from being competitive – were it not for feed-in tariffs paid by the Federal Government to balance out the additional costs.

GRID OPERATORS
Grid operators or, more precisely, transmission grid operators, are responsible for ensuring that electricity flows across Germany from the energy provider into the big transmission routes. They also make sure that electricity is constantly available in the German grid and that the grid remains stable. In Germany there are four operators managing the 380-kilovolt grid: Amprion, TransnetBW, TenneT TSO and 50Hertz Transmission.

RENEWABLE ENERGY SOURCES ACT SURCHARGE
This surcharge, stipulated by the Renewable Energy Sources Act (EEG), is added as a premium to electricity prices. It shifts the cost of promoting renewable energy to private and commercial energy consumers. The surcharge's value is determined each year by the four grid operators in Germany. For 2013 they have decided to raise the surcharge from 3.6 to 5.3 cents.



On the high seas: Technicians working on a ship out at sea to lay the cables for Riffgat wind farm

Not too sure about that: Future offshore workers about to embark on their survival training

LEAPING INTO THE UNKNOWN

Dozens of wind farms are due to be installed near Germany's coastlines. Day-to-day life on these offshore facilities is so dangerous that the workers require rigorous survival training. **BY SEBASTIAN KEMPKENS**

Jens Wiechmann never thought it would be this bad. Of course he'd heard his team's stories, and of course he expected to swallow a good deal of water. One of his colleagues had even refused to come along because he was not a strong swimmer. Wiechmann, though, went anyway. He wanted to go offshore and be part of the adventure of capturing wind energy far out at sea. But he didn't expect the apocalyptic scenario he's looking at right now.

At this moment he is standing in his red safety suit three and half metres high. His breathing is restricted by his buoyancy aid and all around him the storm rages, pelting his face with rain. It is dark and he can hardly see. There is a siren blaring, a loud thunder clap, and every now and then he can hear the sound of helicopter blades beating through the darkness. But help is not yet in sight. Wiechmann has no other option; he has to go it alone. Lightning strikes again, and during the brief flash of light, he leaps into the murky depths.

Jens Wiechmann, a 41-year-old father of two and a construction manager with an installation company, lands in a swimming pool in Bremerhaven. This emergency situation is just an exercise, part of a survival skills course at a training centre for offshore workers. Anyone wanting to work on a wind farm out in the North or Baltic Sea has to complete a course like this. That is why Wiechmann is here with nine other men, being shouted at by safety trainer Andreas Carstens: "Quick – everyone get into a huddle," yells Carstens, a broad-shouldered man with powerful hands, from the side of the pool. He shines his torch over the heads bobbing in the water, bathing them in light, and shouts: "The only way you'll survive out there is by sticking together!" Wiechmann battles his way through the waves to the other side of the pool. The other men gather there too, linking their arms in a tight circle to form a huddle that stabilises them while they are being buffeted by the waves. A short time later, Carstens flicks a few switches. He turns the lights on and the waves, wind and rain off – and the nightmare is over. His next command is much more welcome: "Coffee break!" Ten sopping wet figures emerge from the pool, which is now revealed to be no larger than a tennis court.

This is the Sea Survival training hall where Carstens teaches future offshore workers the basics of surviving at sea. Here they learn the best way to jump into the water if there's a fire, how they can attract the attention of helicopter pilots, and how they should prepare to be pulled out of the water by a helicopter.

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The men struggle through the storm to a rescue pod during a training exercise.

The men here are divers, technicians and engineers, and most of them work in the wind industry like Wiechmann. Business is booming in the offshore wind sector, and as he stares at the floor in a state of exhaustion, unable to drink any coffee or eat any cake, Wiechmann is still very much aware of that. His company, too, is benefiting from Germany's switch to renewables. The company has moved beyond installing conventional substations and is now focusing on wind energy. Wiechmann and his team built the transition pieces for Riffgat wind farm, which is 15 km from Borkum. These 60-metre-high yellow tubes will support the towers and their rotor blades.

Wiechmann, who is now breathing more easily after unfastening his buoyancy aid and safety suit, was born in Bremerhaven. Germany's switch to renewables has come at a good time for him. Now he can combine his job with what he calls the "maritime thing". He has more responsibility than before and has more influence over decisions. He sees battling the waves in the pool and leaping into the void as a kind of test of courage to prepare him for what lies ahead. After all, the transition pieces in the wind farm near Borkum are only the beginning. Wiechmann hopes that his team will also be placed in charge of maintaining the station. Staff at the wind farm are already stretched to their limits and Wiechmann's team know the components that come between the wind turbine and the seabed inside out.

And there could be many future contracts, too. The German government plans for 15 percent of the country's energy mix to be produced on the North and Baltic seas by 2020, and energy companies are busy building a world of steel and electronics out at sea to meet this target. As well as Riffgat, another 30 or so wind farms are being built and each one has the surface area of a small town. In coming years, up to 10,000 jobs could be created in the sector, and 1,000 of these will involve working on the turbines themselves. In short, the expectations are huge, even of rather reserved gentlemen like Wiechmann.

But producing offshore wind power can also be a dangerous business. Most of the turbines are built at least 30 kilometres out to sea so that they do not impede maritime traffic or spoil the view for tourists and coastal dwellers. If a worker has an accident on a turbine or falls into the water, he or she may have to wait up to 90 minutes before help arrives. These men and women must therefore depend on their own resources for a significantly longer period of time than in comparable cases on land. Anyone you ask will confirm that even getting onto the platform is extremely risky. Wiechmann is a little in awe of this moment. If the sea is rough, the boat may rise and fall several metres with each wave. His team once travelled there in a storm so fierce that the captain tried four times to approach the landing platform. In the end they abandoned the attempt, but that is only possible in exceptional cases; the costs of such missions in the offshore sector are very high, and there are always waves to contend with. "It's quite a challenge to overcome your fear," admits Wiechmann. "You have to keep telling yourself: Do it! Do it now!""

Anyone wanting to find out just how dangerous these offshore jobs can be should visit Hamburg's Unfallkrankenhaus hospital. Nils Weinrich, a 43-year-old physicist, works there in the biomechanics laboratory. He is an exuberant, friendly man who brews coffee for his guests and then subjects them to detailed PowerPoint presentations about his work. He is in charge of the Rettungskette Offshore Wind (ROW) research project, and there is good reason for his enthusiasm as he is working with biologists and doctors in a completely new field. In contrast to shipping, where there are tried-and-tested regulations for responding to emergencies, the offshore wind industry is uncharted territory. The main problem is that there is no central command centre for rescue services at present. "If you're on land in Germany, you call 112 to reach the emergency services. But who do you call if you're offshore?" he asks, raising his eyebrows. "There's no one".

In Bremerhaven it becomes clear what this means. It is dark again and a storm rages through the training hall. The men know the scenario by now, and Wiechmann has a more confident air about him this time. The men are swimming towards a rescue pod as instructed when they suddenly hear a sharp whistle from across the waves. A trainer pretending to be an injured worker desperately tries to draw attention to himself before being carried off by the waves. For seamen, dealing with these situations is all part of the job, but the offshore workers take longer to respond to the situation, and had this been a real situation, the injured man would have been lost.

When Wiechmann and his team head to the North and Baltic Sea, they will find themselves in situations that they have only ever seen in movies. Wiechmann admits that even flying out in the helicopter has something "rather James Bond" about it. What happens if the helicopter crashes? He admits he finds the thought terrifying. During a helicopter escape exercise, the men were thrown into the pool inside a helicopter mock-up. Even though all the participants each had a trainer next to them, oxygen tanks to hand, and a detailed briefing behind them, Wiechmann says he started to panic: " I mean, really panic. You can't help feeling that you are completely on your own."

As he stands outside the hall after the training day, Wiechmann is flushed and the hair on his neck is still damp. At least now he feels prepared, though. He has his first meeting at the wind farm by Borkum next week. That's when it all begins for real.

IF I SWITCH TO GREEN ELECTRICITY...

Today, one in five German households gets its electricity from a green energy provider. But few people know what "green energy" actually entails. Here are three common misconceptions. **BY MAREIKE ZECK**

... THE ELECTRICITY THAT COMES OUT OF MY SOCKET WILL BE EXCLUSIVELY FROM RENEWABLE ENERGY SOURCES.

No. The same electricity comes out of your power socket as before. This is electricity that has to cover the shortest-possible distance – so it could even be electricity from the nearby nuclear power plant. Imagine our electricity grid as a big lake. Every power plant feeds into this lake, regardless of whether its energy is generated by nuclear power, coal, or hydropower. So even if nobody opts for a green electricity provider or tariff, a portion of that electrical lake will still be made up of electricity from renewable sources. This is laid down in the Renewable Energy Sources Act (EEG). However, those who buy green electricity are at least helping the proportion of renewable energies in that electrical lake to grow faster. This is because they are telling their electricity provider to purchase green electricity on their behalf. Up to now, however, customers have had no way of checking whether or not the electricity company actually does this. But a Europe-wide green electricity register is currently being set up, which will list every kilowatt hour of green electricity produced in Europe. This register should allow people to see where this electricity was produced and who bought it, ensuring that nobody ends up paying for something that they do not get.

... I WILL BE PROMOTING THE EXPANSION OF RENEWABLES.

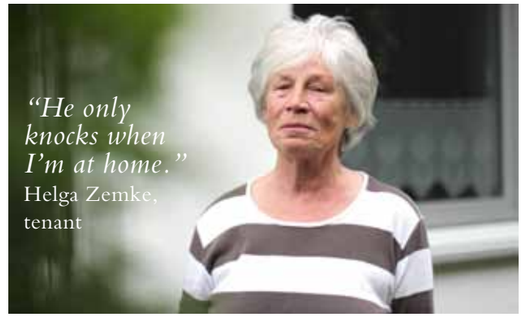
Not necessarily. It is true that some providers purchase exclusively green electricity and plug their profits back into the expansion of renewables, but most providers in Germany also purchase coal and nuclear-generated electricity produced in their own plants alongside ecologically generated power. Customers purchasing green electricity from these providers are therefore also funding coal and nuclear plants. Those householders who want to err on the side of caution should choose a tariff where one cent per kilowatt hour goes into a separate fund that then finances the construction of new green power plants. Tariffs with the "supplier model" also promote the expansion of renewables. With this model, the electricity provider promises that it will purchase a third of its green electricity from plants that are less than six years old, which encourages plant owners to regularly build new green power plants.

... MY GREEN ELECTRICITY WILL BE PRODUCED IN GERMANY.

Not for the time being. Green electricity providers in Germany buy the majority of their electricity from abroad – particularly from hydropower plants in Norway. Renewable energy is currently much more expensive on the German market than it is abroad. This is because the federal government is promoting Germany's green electricity through the Renewable Energy Sources Act, meaning that we are all paying a surcharge. Now, 25 percent of every electricity tariff, whether green or not, comes from renewable sources funded by the Renewable Energy Sources Act. If electricity providers wish to provide a tariff with 100 percent green electricity, they must purchase the remaining 75 percent from green energy producers at a non-subsidised price. That is so expensive, however, that hardly any customers accept such tariffs, so electricity providers prefer to buy cheaper green energy from Norway.

PECKING UP THE WRONG TREE

In order to achieve its climate targets, the German government has advised homeowners to reduce the energy consumption of their properties. Most are responding by insulating their building façades with polystyrene panels, but woodpeckers are posing an unexpected problem. **BY JULIAN KUPER**



Benjamin Seider is making sure that Helga Zemke can once again sleep in peace. The steeplejack leans his ladder against the wall of the house, grabs a green haul bag full of wool insulation, and climbs up towards the gutter. Just below the roof he finds a gaping hole, 20 centimetres in diameter and so perfectly round that it looks like it must have been made with a pair of compasses. This is the second time that the woodpecker has pecked a hole in the façade of this building, and it regularly returns to continue with its work. The noisy bird has been the cause of many a sleepless night for tenant Helga Zemke. "I kept hearing knocking, but when I went to the door there was nobody to be seen," says Helga. She explains how it was only after days of this annoying tapping that she spotted the woodpecker sitting outside.

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Steeplejack Benjamin Seider cuts the insulating block to size, fills in the gaps with grout, and the woodpecker's hole is sealed. But these repairs are not covered by insurance.

The block of flats in Erpmannstieg, Hamburg, is an easy target for the woodpecker, as the outer wall is covered in a polystyrene-composite thermal insulation system. This is the cheapest and therefore most widely used insulation method in Germany. These panels, made of insulating material, mortar, fastening elements and plaster, ensure that less heat is lost through the walls of the house, saving energy for the homeowners who invest in it. But the panels also attract woodpeckers, as they sound very similar to the dead, hollow wood where the birds are used to making nests and looking for insects. The fact that woodpeckers are now hunting for food in these insulation panels also shows that their natural habitat is disappearing. "The city is prettying up all of its green areas, so rotting or dead wood is immediately removed," says Torsten Nitzsche, head of company Ropeworx. Sometimes he and his employees come across holes where their arms could vanish up to the elbow.

These holes are a serious problem for the insulation systems. Either animals like squirrels or blackbirds will move in, or the hole will remain empty and fill up with rain water. As a result, the building façade and the plaster will get wet inside, and then, when it freezes, the wall will no longer be able to expel the moisture and could crack.

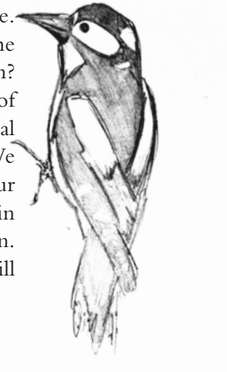
Currently, Nitzsche's company repairs somewhere between 150 to 200 woodpecker holes a year. This number is growing, as there is high demand for thermal insulation in Hamburg. One reason for the demand is the city's large number of old houses. "The numerous old buildings from the post-war era are in an especially poor condition from an energy point of view," says Edgar Badenius, an expert on heat insulation with Hamburg's city government. Around 900,000 flats in Hamburg are in older buildings, and only a third of these have medium to good insulation systems; the rest are either poorly insulated or have no insulation system whatsoever.

Saga, Hamburg's biggest housing association, has already equipped almost 60 percent of its 130,000 properties with a thermal insulation system, either of polystyrene or mineral wool. Between 1990 and 2009 these measures lowered the properties' energy consumption for heating by 39 percent. Heat insulation expert Badenius agrees that insulation is an easy way to make existing buildings more energy efficient. Efficient thermal insulation is also one of the key points in the federal government's energy concept, drawn up in 2010. Germany's Reconstruction Loan Corporation (KfW) is supporting investments in improving energy efficiency by providing grants and low-interest loans. This financial support also goes towards the thermal insulation of exterior walls.

However, these polystyrene panels are facing increasing criticism. Although they are certainly cheap and offer good insulation, if tenants do not air their flats well, they can lead to mould or a build-up of lichen on the exterior wall. To avoid this, tenants must either radically change their ventilation behaviour or install a heat exchanger, which consumes a lot of electricity.

And mould is not the only problem. Polystyrene does not catch fire easily, but when it does, it burns ferociously. "I imagine this will lead to some fatalities in the future," says Heinrich Stüven, chairman of the Hamburg landowners' association. The integrated fire barrier should restrict the flames, but Stüven claims it is insufficient. He is also sceptical about whether the material really lasts between 20 and 30 years, as the manufacturers promise. And when the thermal insulation reaches the end of its lifespan, what do we do with it then? Polystyrene is hazardous waste, so disposing of it is a problem, not least because the individual components have to be separated first. "We clearly need good insulation systems for our homes, but the systems we currently have in place are not properly developed," says Stüven. He hopes that these insulation systems will evolve considerably in the next few years.

Steeplejack Benjamin Seider prefers to trust his own judgement. He picks up a small saw and cuts a rectangular shape around the woodpecker's hole. Flakes of white polystyrene flutter to the ground. He then fills the resulting hole with mineral wool from his sack to restore the insulating properties, and closes it up with a ready-made insulating block. Ten minutes later, the wall is fully sealed. Whether or not it stays that way remains to be seen; woodpeckers are keen-sighted and intelligent birds. Ropeworx manager Nitzsche says woodpeckers tend to be very territorial – once they have found an appropriate habitat, they stay put. And it would seem this particular woodpecker has decided that insulated houses are its ideal pecking ground.



WHEN THE WIND TURNS

Most people view Germany's switch to renewable energy sources positively, but they also fear possible burdens and shortcomings. Here are four accounts of the positive impact the switch is having on individual lives. **BY SINA ZIMMERMANN**

Christina Wulf, 28, PhD student

As part of my doctorate, I have spent two and a half years researching how we can use hydrogen in the energy system. A hydrogen station was opened in Hamburg's HafenCity in February, for example. In these stations, hydrogen is produced through electrolysis and can then be used to fuel specially adapted buses and cars. I am researching how much energy is used in this process, what the alternatives are, and where there is potential to save on costs.
For me, the switch to renewables is important as it enables my research into renewable energies and opens up good career opportunities.

Ralf Borchardt, 48, project manager for reactor dismantling

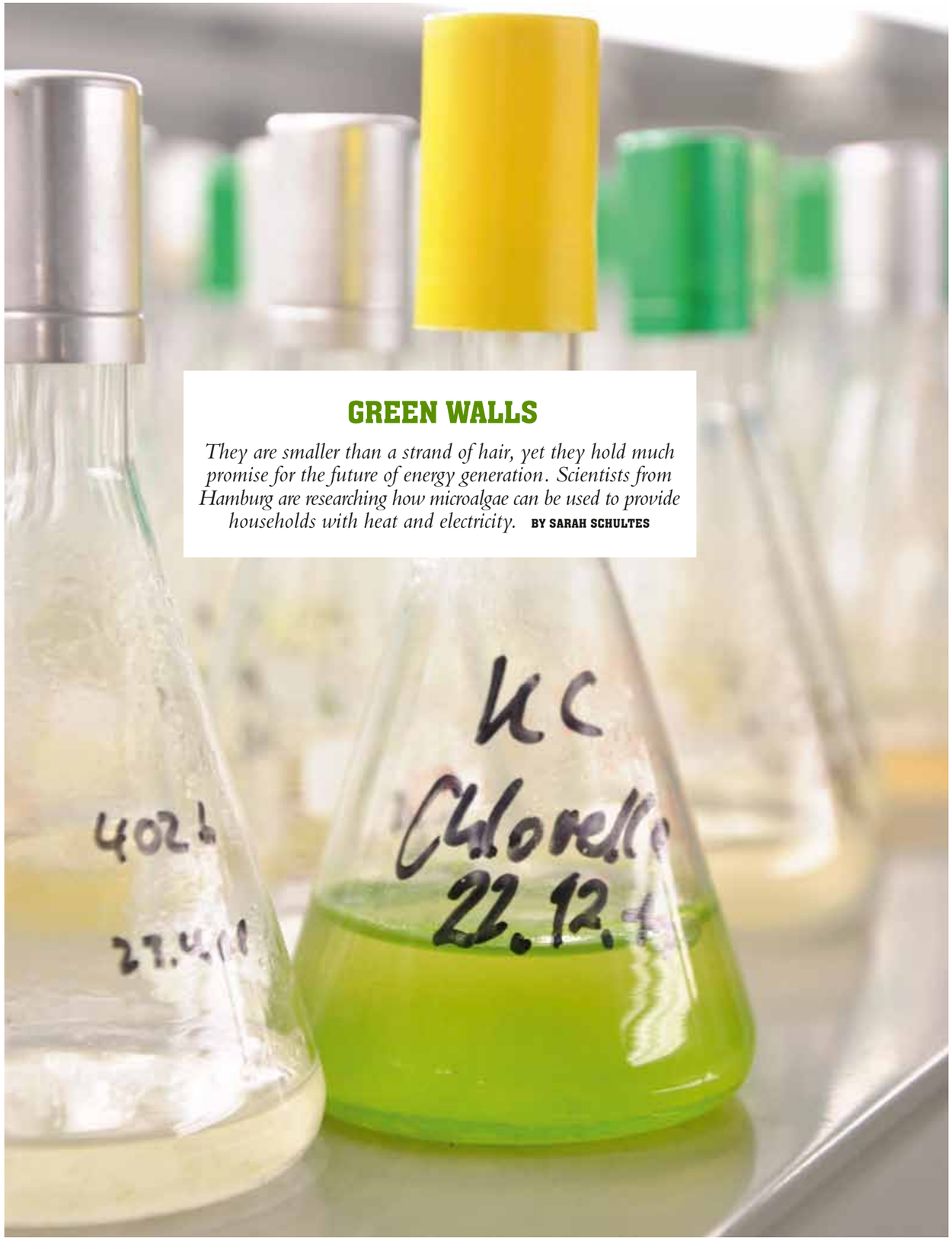
I have been working on nuclear power plants for 30 years. Initially I was an engineer for assembling reactors, and now I am in charge of their dismantling. Qualified personnel will clearly continue to be needed in the dismantling of nuclear plants in Germany, so my professional future is secure. Also, working in nuclear plants is no more dangerous than any other job. It's not like bomb disposal; as long as you follow all the radiation protection measures, nothing can happen. Metre-thick walls and water shields protect us from radiation.
I am currently working on the Obrigheim nuclear power plant in the Neckar district of northern Germany, where we are in the process of planning the reactor's demolition. This sort of job takes between five and six years. At the moment we are installing manipulators, band saws, plasma torches and other cutting tools in the rooms to enable the reactor units to be dismantled and packed up remotely. In spring we will be able to get started with the actual dismantling. After they are taken apart, the reactor units will be packed up and finally taken to a permanent repository.
To be honest, in the past I thought I would end up generating electricity from these plants; it was a big readjustment for me when they shut down. But dismantling is now another aspect of the job and I find this task exciting too.

Anja Koops, 40, mother

We have lived in Geesthacht, northern Germany, for almost ten years. I actually didn't want to live in a small town again – and certainly not close to the Krümmel nuclear power plant. We used to live in Hamburg, but when our son Lucas was seven months old we wanted to have a garden for him to play in. When the study was published about the link between childhood cancer and proximity to nuclear power plants we were really worried: the closer children live to a plant, the greater the likelihood that they will get ill. Then you start wondering: What if this affects our child? Should we stay here? Where should we move to? It was a really oppressive feeling.
In May 2011 we found out the plant was to be permanently closed. Now, when we are cycling along the Elbe and see the plant, we feel much more at ease.

Wärme-Hamster, 4, hot water storage tank

I sit in the cellar all day long, next to the central heating. It's nice and dark down here. To look at me, you would think that my mother was a thermos flask and my father was an advertising column, but actually my dad is Rolf Förster from Energie Depot, and he looks nothing like me. Some 2,500 litres of water gurgles away in my belly. I spend the whole day heating this water up, using the warmth of the sun. Then, when it reaches almost 60 °C, it sits in my belly until my owner comes home from work. Thanks to me, he can enjoy a nice hot shower and a cosy warm living room. Boilers like me have become really popular since the nuclear disaster in Fukushima.



GREEN WALLS

They are smaller than a strand of hair, yet they hold much promise for the future of energy generation. Scientists from Hamburg are researching how microalgae can be used to provide households with heat and electricity. **BY SARAH SCHULTES**

They may look like indistinct green goo, but to Dieter Hanelt they are endlessly fascinating: algae.

A windowless room with glossy white walls and bright clinical lights houses a collection of 500 glass flasks. Densely packed together across four levels of metal shelving, they are arranged chronologically. The contents' dates of origin are written clearly on the sides. Order is of paramount importance here, and no one is allowed to rearrange these flasks. The three centimetres of liquid they contain may well constitute the energy supply of the future.

This precious algae collection is housed at Biozentrum Klein Flottbek, part of the University of Hamburg. This is where Dieter Hanelt, Professor of Cell Biology and Phycology, is investigating the aquatic plants. The biologist is fascinated by algae. When he peers into the microscope, he looks past the disgusting pond slime that most of us would see – his vision is one of crystalline flakes and feathery shapes. Hanelt's aim is to cultivate algae in order to turn them into biomass. One of the uses for this biomass will be power generation. This would make algae a viable "green" energy source, joining the ranks of wind and solar power.

Hanelt has identified the tiny organisms' unique talent: With the help of sunlight, they can generate much more energy than other plants. Trees, for example, have trunks and branches, and photosynthesis is restricted to the leaves they carry. Algae, on the other hand, are single-cell organisms, and each and every one of those cells uses photosynthesis to convert sunlight into energy. What the algae do with this energy, among other things, is multiply. Algal cells divide up to twice per day. This is exactly what Hanelt wants – his aim is to grow as many algae as possible. Once harvested, the algal biomass can be used as a raw material in biogas plants. This makes it interesting for researchers and energy providers alike.

As a result, the City of Hamburg and E.ON Hanse AG are currently funding research into open-air algae cultivation. A field in Reitbrook, just outside Hamburg, has been home to a pilot plant for algal bioreactors since 2008. Here, green panels line up, facing the sun. The flat plastic containers may look a lot like solar panels, but instead of silicon, they contain microalgae, sourced directly from Hanelt's lab. The algal solution is suspended in ordinary tap water, enriched with CO_2 and other nutrients. A jet of

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Business-savvy biologist: Martin Kerner at his pilot plant for algal bioreactors

air bubbles is injected at regular intervals to whirl the mixture around. The pilot plant is owned by Martin Kerner, a biologist and business consultant. Kerner is aiming to grow algae on a large scale and turn them into a profitable venture. To speed up the process, he has enlisted the help of researchers at universities across northern Germany, including Professor Hanelt, and launched the TERM project (Technologien zur Erschließung der Ressource Mikroalgen/Technologies for Exploring Microalgae as a Natural Resource). Kerner tries out the results of this collected expertise at his pilot plant in Reitbrook. "We strive to harvest the greatest amount of algae using as little energy as possible," says Kerner, watching as the viscous liquid drips from a pipe labelled "Harvested Biomass".

There are inherent problems to growing algae in direct sunlight. In the sun, the thick green fluid reacts much like a black car – it gets too hot. This is very dangerous for the microorganisms, as they perish in temperatures above 60 °C. To prevent this, Kerner needs to cool the algal biomass. As he explains, however, this consumes energy: "And, at the same time, we are wasting heat that could be redirected for human use." Kerner's idea is to deploy the heated-up microalgae in a meaningful way, by supplying an entire building with heat.

Kerner will present his innovations on a grand scale as part of the IBA building exhibition in Hamburg. In March 2013, Kerner's algae will be used here to provide heating for a pilot apartment block. The structural work has already been completed, and now Kerner is working on the site, overseeing the installation of the bioreactor. Glass panels a storey high, housing 200 m² of circulating algae, are to be attached to the façade, forming a kind of living skin for the building. Much like a solar thermal system, the warm algal mass is used to heat up the cold water inside the building. This is done using a heat exchanger – the water gets warmer while the algae are cooled down. "It's a symbiotic relationship between the algae and the house," enthuses Kerner. The green mass warms the water up to 40 °C so it can be used for central heating or hot water. In winter, the heat is thermally stored underground, and any excess heat can be diverted into the district heating grid.

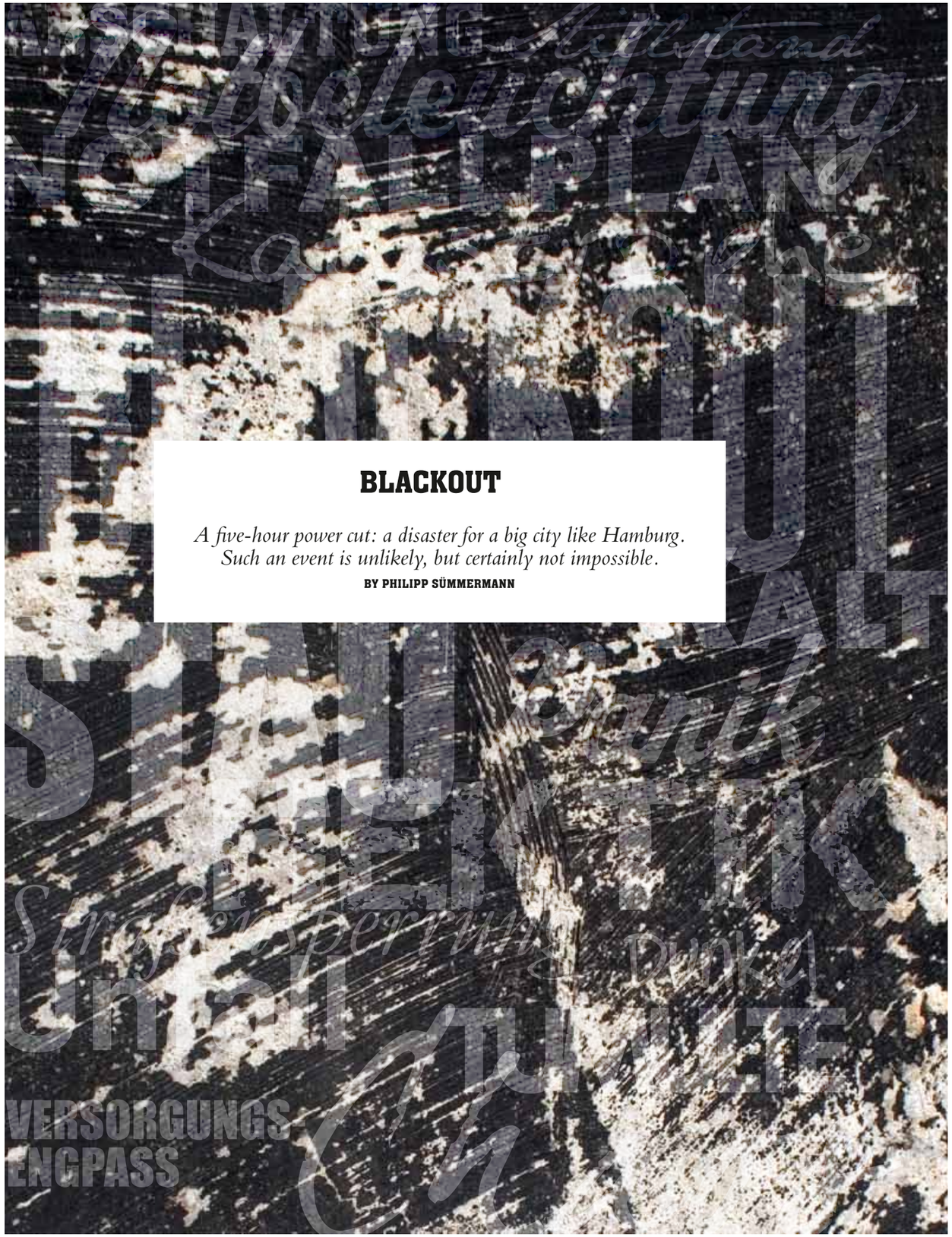
The building, which is valued at around €5 million, is one of the most spectacular construction projects at the IBA. The bubbling façade serves to protect against light, cold weather and

A highly sought-after building site: There are already 35 parties interested in moving into the algae-clad house.

noise – and it looks pretty impressive, too! The algae come in a range of luminous green hues, and the bubbles travel at different speeds, creating shifting patterns across the façade. The 15 apartments contained within are already highly sought-after. According to building contractor Otto Wulf, 35 parties have registered an interest in moving in once the exhibition has finished.

For Kerner, the heat generated by the algae may be useful, but it is still just a side effect. His overriding goal is to generate biomass. Kerner wants to harvest the micro-organisms from the panels on the building exterior and then process the resulting biomass in the basement. The algae can accumulate enough energy to fuel a biogas digester. This creates methane gas with an energy efficiency of 70 to 80 percent. Mineral coal, by comparison, only has around half that energy efficiency. What Kerner foresees for the future is independently operated bio-power plants in residential basements. The machine he envisions will convert algal biomass, household waste and faecal matter into hydrogen and methane. An accompanying fuel cell in the basement would then generate electricity directly in-house.

Not only are algae a very clean energy resource, in the future they could also contribute to cleansing the air. After all, the main substance that microalgae feed on is climate-damaging CO^2, large volumes of which are being emitted into the air by coal-fired power stations, among many other things. Kerner is already feeding the algae in his Reitbrook pilot plant with waste gas from a gas-fired combined heat and power station. But if this makes you think that the best idea might be to connect algal bioreactors to coal-fired power plants to absorb all their CO^2 emissions, think again. Researcher Dieter Hanelt knows better: "Taking on all the CO^2 coming from a medium-size 500-megawatt power plant would require algal reactors with a surface area of around 350 km²," he warns – that's roughly half the size of Hamburg.



BLACKOUT

A five-hour power cut: a disaster for a big city like Hamburg. Such an event is unlikely, but certainly not impossible.

BY PHILIPP SÜMMERMANN

The supermarket is suddenly plunged into darkness. The only light comes from the emergency lighting by the exits. The conveyor belt at the check-out halts, the radio dies – everything stops. Marie, 40, sits at the till where she has worked for ten years. She is not easily ruffled. The familiar whirr of the air conditioning and beep of the scanners are no longer to be heard, and only now that it is so quiet does Marie realise how noisy it usually is. She has only experienced a power cut at the supermarket once before, and that was the result of a blown fuse. She reassures customers waiting in the queue: "I'm sure it will come back on in a minute."

At the cargo port a few kilometres south, cars and forklift trucks are still driving around. Peter's crane, however, has stopped mid-manoeuvre. "Shit," he mutters – a twelve-metre-long container hovers on his crane's hook inches above a truck. Just half an hour after his shift started, the power has cut out. He will have to make up for the lost time, and he has a lot to do today. "It will only be a brief pause," thinks Peter, and picks up the radio to contact head office.

At Veddel, two stops away from the central station, the S-Bahn has ground to a halt in the middle of a bridge. Johannes, 25, is returning home from university. He is on the phone to a friend. He is not concerned that the train has stopped. "Another technical problem," he thinks. It doesn't even occur to him that there might be a power cut.

Two hours later, and the supermarket manager has decided to close the shop. Without functioning barcode scanners and tills, Marie can't work anyway, so she gets the evening off. She has to tell the customers to come back tomorrow, although most of them have already gone, leaving their half-filled shopping trolleys in the aisles. She locks up the shop in semi-darkness, six hours earlier than usual, feeling a sense of relief at not having to deal with the frustrated customers anymore.

At the same time, Peter is also packing up his things. Continuing to work would be pointless as port operations have ceased, and with the cranes out of action Peter can't move the heavy shipping containers. He gets into his car and drives to the gate, where a long queue of trucks has built up. Frustrated drivers stand on the road, speaking loudly into their phones. They are on a tight schedule and should have set off a long time ago. On the way home, Peter advances slowly and cautiously over the junctions as all traffic lights are out. Several passers-by congregate on the side of the road to tend to an injured motorcyclist – just one of many accidents.

Meanwhile, on the S-Bahn, a 20-year-old woman who has been listening to the radio tells Johannes that the power is still down. He recognises her from uni but doesn't know her name. They have never spoken before as Johannes has never dared to approach her. "I'm Lea by the way," she says. By now all passengers have left the train and climbed down the embankment beside the bridge. Lea also has to get to the city centre, so they set off on the long walk together.

The shopping centre car park is dark, illuminated only by weak emergency lighting. Marie's footsteps echo through the empty space. She is happy to have the evening off, but at the same time it is rather spooky to be alone in the dark car park. When she reaches the exit, she finds that the barrier has been broken off.

Outside, Peter sits in a traffic jam. Many of the drivers are on their way home from work or are picking someone up. Horns honk and sirens blare. In his rear mirror, Peter sees the blue flashing lights of two approaching fire engines, weaving their way through the traffic. The radio presenter asks everybody to remain calm.

The petrol indicator in Marie's car is flashing, telling her it's almost empty. The next petrol station is 100 metres away, but it will be shut as the petrol pumps can't work without electricity. "Hopefully I have enough to get home," thinks Marie.

Johannes and Lea have almost reached the city centre. The road has been long, but during their walk they have got to know one another. Street lamps flicker – the power is back on.

According to Germany's Federal Network Agency, the electricity grid is strained but manageable. Hamburg lies in a particularly vulnerable region for power failures – a complete blackout such as the one described above is unlikely, but it could happen. To be on the safe side, grid operators have developed emergency action response plans to be implemented in the event of a stalled electricity supply.

CHIPS WITH EVERYTHING

New transportation concepts should lead to fewer people using cars. Jürgen Pietsch, professor of urban development and intelligent technologies, explains how we will get from A to B in the future. **BY NORA MARIE ZAREMBA**

How easy is it today to get from one place to another without your own car?
If I live in a city and if all public transport is well coordinated, then I can get around very easily and without long periods of waiting. If I want to travel to Berlin as quickly and as cheaply as possible, for example, I start by entering the destination into my mobile phone. I can use services such as Carsharing or Car2go to get to Hamburg central station, where I catch the Inter City Express to Berlin. Then I either get on the S-Bahn or jump on a hire bike, depending on where I need to go. Things already run smoothly in terms of transferring from one means of transport to another. However, in order to save on energy as well we need to improve communication between the individual transport elements.

Like traffic lights turning green when a bus is approaching?
Right. That is achieved with an integrated traffic signal pre-emption system. This sort of interconnectedness between traffic lights and vehicles prevents unnecessary stopping, saving on petrol – or electricity in the case of electric vehicles.

Are new mobility concepts crucial to the success of Germany's switch to renewables?
Actually, these are two different things. The switch to renewables is all about saving energy, but electric cars consume electricity. So at first glance these two concepts seem contradictory. What binds them together, however, is that they are both about moving away from the use of fossil fuels.

It is clear that the switch to renewables is becoming more expensive than anticipated. Will that slow down the development of more environmentally friendly transport?
That remains to be seen. The federal government wanted to see one million electric cars on German roads by 2020. That target has now been lowered, but even without the current criticism of the switch to renewables, enthusiasm over electromobility has definitely died down. Electric cars were unable to live up to the expectations of their users. They are more expensive than conventional cars and charging their batteries is still problematic.

Why are we not seeing the introduction of innovative transport ideas such as maglev trains in Germany?
Germany is the market leader in embedded systems, i.e. devices with integrated chips. This is how traffic lights can operate automatically and how trains can work without drivers. The only question is whether this technology will actually be introduced here in Germany. I think it certainly will be in the long term. People care about their cities becoming more attractive, and new transportation concepts certainly improve the appearance of a city as they lead to fewer private vehicles on the roads. With a good transport network in place, more reduced-traffic areas can be introduced.

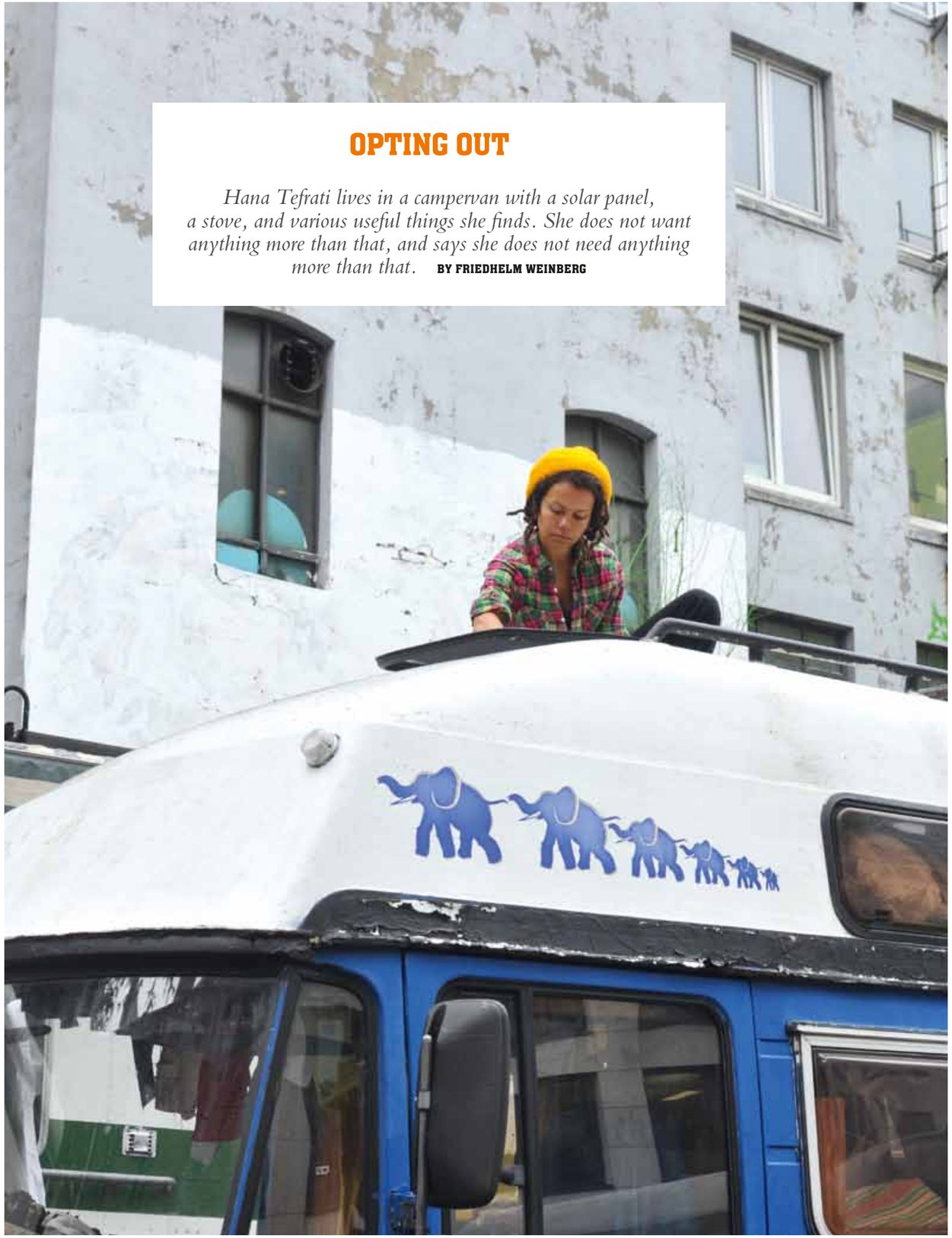
Are there any cities that can serve as a role model?
Copenhagen aims to be carbon neutral by 2025, and the coordination of buses and trains there is already very good. In addition, a lot of people travel by bicycle, so "bicycle highways" have been built. Zurich is also interesting, because there all sectors of the population travel by bus and train – from bankers to nurses.

So environmentally friendly transport is also a question of personal attitude?
The Swiss, for example, began discussing environmentally conscious transport very early on, when it was still something of a side issue in Germany. For the good of the environment, I should ride my bike or use public transport, but I also have to enjoy it. Only then will I feel encouraged to leave my car at home.

What is the next step in intelligent transport?
Introducing chips for all public services, or the option of holding smartphones up to reading devices.

And if I don't have a smartphone? Will I be left stranded in the future?
In my opinion it won't be a problem – soon everybody will have a smartphone. I think those people not living in cities will be at a greater disadvantage, because in small towns and in the countryside these new transport concepts will not be economical.

Jürgen Pietsch researches sustainable urban development at the University of Hamburg and his preferred means of transport is his bicycle.



OPTING OUT

Hana Tefrati lives in a campervan with a solar panel, a stove, and various useful things she finds. She does not want anything more than that, and says she does not need anything more than that. **BY FRIEDHELM WEINBERG**

Hana Tefrati breathes on the flame, again and again. The cardboard is already alight, but the remains of the wooden pallet still need a while to catch. She blows, takes a breath, blows again. At last, flames crackle in the stove and it slowly warms up inside the campervan where the 29-year-old artist has been living for four months.

Hana always wanted a campervan. It gives her the freedom to go anywhere at any time, she can design it however she wants, and it allows her to pursue a simple, frugal life. Hana bought her new mobile home, christened it "Ella", installed a stove, and screwed a solar panel to the roof.

Hana is a woman who has opted out, living in a country that wants to opt out.

Hana is a woman who is opting out of the mainstream – in Germany, a country that wants to opt out of conventional energy sources: a country where people fit solar panels to their roofs and install combined heat and power (CHP) units in their basements because they want to move away from nuclear power and coal electricity, away from big suppliers and, sometimes, away from excess as well; a country that is building huge new power lines so that electricity can flow from North to South, from East to West; a country that is not quite sure whether it should rely on central planning or on a myriad of independent supplies.

Hana wants less. She wants to provide for herself, make things herself, and, in the process, use things that other people do not want anymore. She no longer wants to stand around with a champagne glass at premieres, feeling out of place among intellectuals and artists. "I want to find a way to bring the way I express myself on the stage to real life," she says. Admitted to a ballet boarding school in France at the age of five, she later studied dance in Holland and performed at prestigious venues. But she does not want to do this anymore because it does not make her happy. She is seeking simplicity.

Hana's search has brought her to the Gängeviertel neighbourhood in Hamburg. Ella, her 1977 campervan, is parked next to a caravan that is currently being converted into a public sauna. On the other side is another campervan with eight solar panels on the roof, which still do not provide enough for its two inhabitants' electricity needs. So far, Hana has got along fine with her single panel. She does not use much energy: gas for the coffee, which she doesn't want to give up, and electricity for the lamps. And even if she wanted to, she would not be able to consume any more electricity as she cannot plug in most of her devices, since she does not have a transformer to convert the electricity from the solar-powered battery.

Hana charges her computer and her mobile phone when she is visiting friends or in pubs and cafés. She cannot give up absolutely everything. She uses the computer to write grant applications for her performance art and to programme the websites where she presents her projects. She also does not want to give everything up. But since moving out of her flat, she only reads her e-mails once a week. She now finds different ways of using her time.

One of Hana's new pastimes is working on Ella's interior. She rips the covering from the walls, peels off what remains with a knife, and wonders why sometimes wool insulation emerges and sometimes polystyrene. Then she saws planks from a wooden board full of holes that she found on the street. She mounts them as shelves and is pleased because they fit perfectly and because it was such a serendipitous find.

Hana is doing a lot of this sort of thing at the moment. She bought Ella four months ago for €3,000, and the campervan is still not exactly how she wants it. She aims to install two more solar panels on the roof for winter, replace her light bulbs with more energy-efficient LED lamps, and, as soon as she has time, weld together her own stove. Her current stove is only borrowed, from a friend living in another van. The trained dancer has thus become a handywoman, electrician and mechanic: "There have always been great changes in my life, but none as great as this one," she says.

Hana has been acquiring these skills because she wants to be able to do everything herself. Above all, she wants to understand how everything works – for example the wiring in her van, a complicated system that someone else installed years ago. She wants to understand technology the way she does people – partly to prevent herself being at the mercy of craft workers who may botch the job and who only care about money. That is why she also prefers to exchange apples and hand-sewn goods for repairs – and permission to watch over the worker's shoulder.

Hana charges her computer and mobile phone when she visits friends or goes to cafés. She cannot give up absolutely everything.

But even if one day she can do it all herself, going off to live alone in the countryside would not be an option for her. "If you have gifts, you have to put them to use," she says. She seeks out confrontation, friction and the challenge of getting to know other people – and, in the process, herself. This is why she has worked with problem schools in Hamburg to produce youth dance performances at big theatres, and why she enjoyed working on a piece of performance art at Documenta in Kassel, where she told strangers about what she perceives as one of her biggest weaknesses: she does not always have the courage to be free.

One example of this was when she tried to live in Morocco, her father's homeland. While she was there she always felt that she was doing something wrong. She made an effort, she dressed appropriately, she held her tongue. She had wanted to stay there forever, but after two months she came back to Europe. Since then she has realised that she can only "opt out" where opting out is allowed.

What Hana is doing on a small scale, Germany is trying to do on a much larger scale. German homeowners are tearing open their walls in order to install new insulation systems, and renewable energy is booming. Yet it does not seem likely that, any time soon, the country will be able to do without new coal and gas power plants that run when the sun is not shining and the wind is not blowing. The energy supply system may be changing more radically than ever before, but this change is fraught with dilemmas. And if the transition to greener energy is successful, then it will only be through a combination of courage, cunning and chance.

Perhaps Hana has it easier, even if the world doesn't always make it so easy for her. As there are hardly any public water pumps, she has to go to friends' places when she needs drinking water. When she needs to go to the toilet, she has to leave the campervan. But this does not really bother her: "Outside is where life is happening," she says.

Hana was also surprised at how simple it is to live on raw fruit and vegetables. She actually began to do this in order to do without gas for cooking and to make the electricity from the solar panel go further. But then she found that she liked the taste of the raw fruit and vegetables from the communal garden of the caravan park in Kassel. She enjoys it most when there's still soil on it: "It's good for your teeth."

Hana does not have her own garden. She is on the move too much for that – nowadays with the campervan but beforehand just with her rucksack. "I am a Berber, the nomadic lifestyle is in my blood," she says. In her life on the move, there's no place for plants, which need constant care.

Soon Hana will head for Spain, to wind down after her summer at Documenta, a project in Hamburg, and the renovation of her campervan. After that is a meeting of artists in Morocco, which she is organising herself. She hasn't yet decided whether or not she will visit her family while she is there.

Hana likes to go with the flow and take things as they come. All she is certain of for now is that she will return to Germany in April 2013 – as that's when Ella's safety certificate expires.

Hana, a dancer, has become a handywoman, electrician and mechanic: "There have always been great changes in my life, but none as great as this one."

I GET CHARGED UP WHEN ...

... I suddenly fall in love.
Friedhelm Weinberg, Berlin

... I'm left holding the cable.
Sarah Schultes, Marktredwitz

... I can't go travelling.
Nora Marie Zaremba, Bayreuth

... Never!
Philipp Offenberg, Wiesbaden

... the digital world overtakes the real world.
Judith Uhlemann, Düsseldorf

... the red light comes on straight away.
Mareike Zeck, München

... I have no signal and I have to wait.
Ella C. Mittelbach, Berlin

... I'm at an audition.
Winnie Heescher, Berlin

... interviewees drop out at the last minute.
Sina Zimmermann,

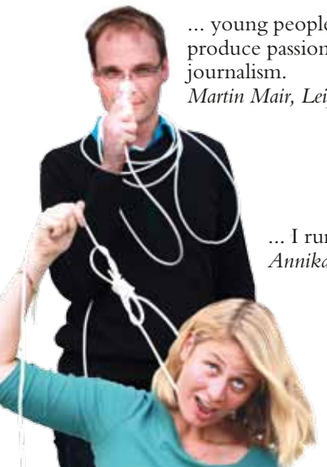
... I put my finger in a socket.
Sebastian Kempkens, Berlin

... my wires get crossed at work.
Luisa Meisel, Heidelberg

... anyone calls me "Stefffiie"!
Stéphanie Souron, Hamburg

... I'm expected to be creative at the touch of a button.
Julian Kuper, Köln

... young people produce passionate journalism.
Martin Mair, Leipzig

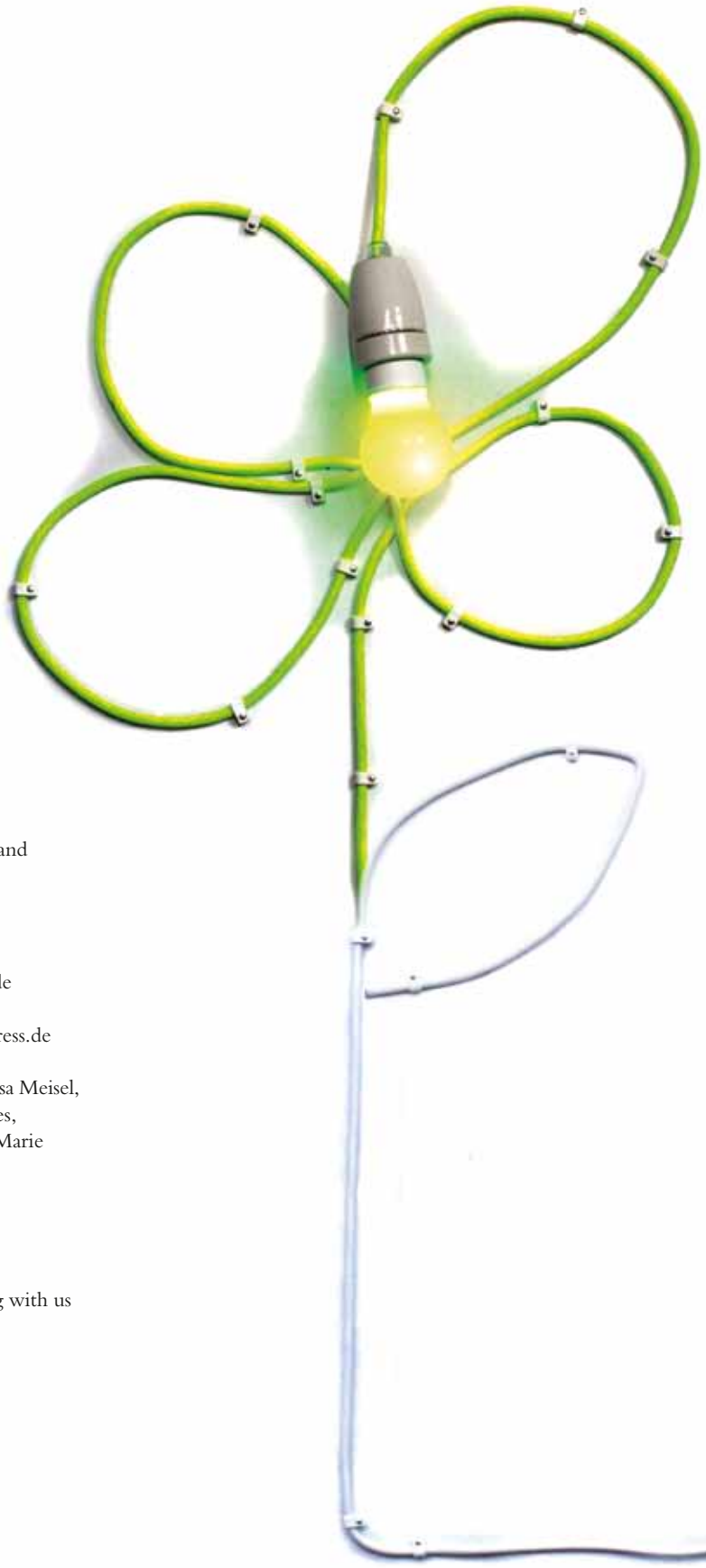


... I run out of breath.
Annika Witzel, Bonn

... I get the feeling I'm not grasping the situation.
Astrid Csuraji Lüneburg

... my memory card is suddenly full. *Philipp Sümmermann, Köln*

... I don't get enough sleep.
Thomsa Iskra, St. Augustin



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