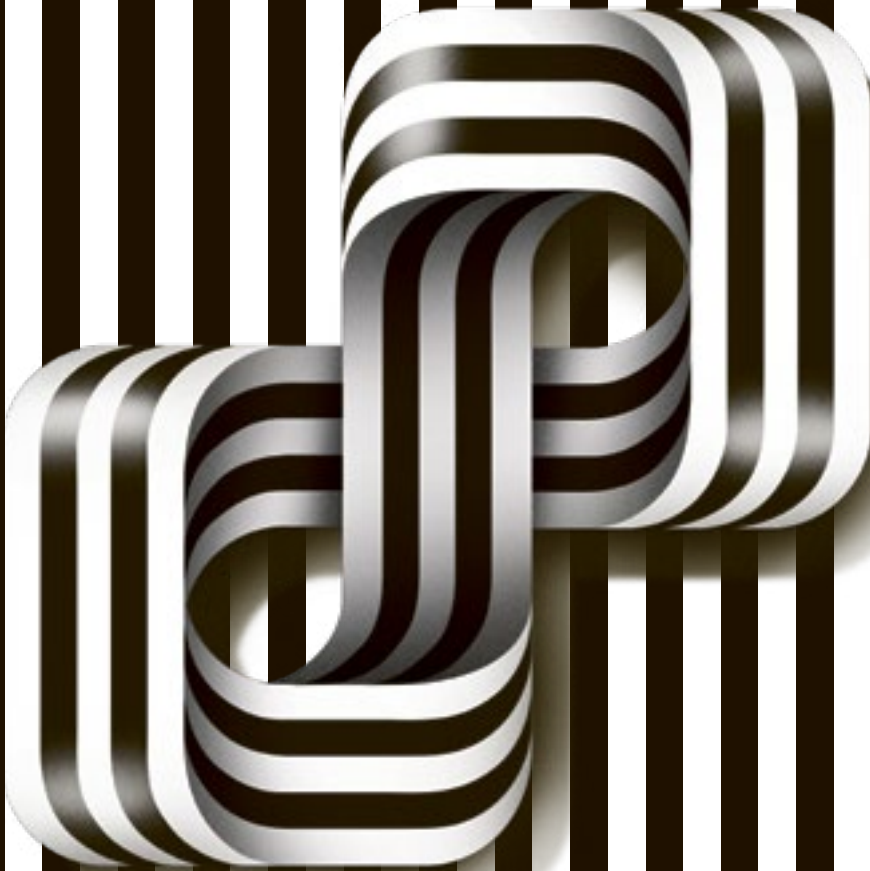




ESSENTIAL

FREUDENBERG SEALING TECHNOLOGIES



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ALL OPTIONS EXHAUSTED?

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(IN)FINITE
 ALL OPTIONS EXHAUSTED?

NEW ENERGY MAP

Political scientist Dr. Kirsten Westphal on hydrogen's growing role.

THIRD DIMENSION

Aerial trams from LEITNER AG improve public transport in cities.

THE SKILLS SHORTAGE

Skilled workers are in demand – and increasingly in short supply.

the magazine **1_21**

IN FIFTY WORDS

Resources are finite. Really? The ideas for dealing with scarcity are infinite – alternative processes, recycling, discarding a material. It simply means taking a fresh look at the resource question. Have we considered everything? Has everything been exhausted? There are usually ways out. Searching for them becomes all the more important.



(In)finite – All Options Exhausted?

An Essay by Claus Möhlenkamp, Chief Executive Officer,
Freudenberg Sealing Technologies

A person standing on the edge of a large forest or the shore of an enormous lake may find it hard to grasp that they contain finite amounts of wood and water. When we see vistas that stretch beyond what the eye can see, perhaps views of a mountain or a desert, we call them “endless landscapes.” The size of our planet is hard for us to comprehend, though we have an expression, “like sand in the sea,” that refers to seemingly endless quantities. It comes from the Bible, making it nearly 2,000 years old. In this day and age, we use 50 million tons of sand annually. The seemingly infinite supply of sand is running short. Coasts and rivers are eroding. Water is in a simi-

Nearly two-thirds of the world’s population endure water shortages at least one month a year.

lar situation. Nearly two-thirds of the world’s population suffer from a water shortage at least one month a year. And a full one-fifth of the world’s forests have been cleared since 1950.

This in turn has much to do with the sheer number of people, currently around 7 billion, populating our planet. By 2050, the United Nations expects the world’s population to increase to nearly 10 billion. Since resources are finite, it seems as though the planet is unable to support all of them.

Or are they finite?

In the 21st century, we doubtless find ourselves in a situation of historic magnitude. Still, shortages of resources are actually not that new. Over the course of history, many societies have faced them again and again.

For example, archaeologists have considered the island of Pantelleria an exciting field of research, wondering why people have been living there, of all places, for thousands of years even though it hardly has any water. The researchers found that the inhabitants collected rainwater in cisterns. In the end, shortages of resources spur invention. That was the experience of the Sumerians who built an advanced civilization on the idea of irrigating an arid landscape and conveying water from the Euphrates onto their fields. The idea was not sustainable, however, even if the difficulties only became apparent over the course of centuries. Evaporation salinized the soil, making it unusable. In the 15th century in central Europe, cities came up with the idea of replanting forests. It turned out

that the demand for wood in preindustrial metalworking required massive amounts of charcoal. At about the same period in Central America, mercury was used to mine silver to reduce the use of water and wood. But this proved not to be sustainable, mainly due to the impact on the workers’ health.

The examples show that scarcity had always led humankind to chart a different course and use a resource more efficiently as its supply dwindles. That means “finite” is a relative term. Sometimes reserves last longer than originally assumed. Or it helps to change perspectives: How crucial is the raw material actually? Do alternatives exist? The examples of water and wood show how diverse the possibilities may be. Raw materials can be replaced. Processes can be changed or tools can be reinvented. It might even be possible to reuse a material. And there is always another question: How much of our consumption is really necessary? Might we be able to set limits on what we consume?

All of this applies to the present as well. People have been projecting the scarcity of oil for a long time, and the world has responded with alternative sources of energy, battery-electric propulsion and fuel cells, not to mention new conveyor technologies and the more economical use of fossil fuels. Sometimes we find that parameters can be changed. For example, forecasts of the world’s population extend beyond the aforementioned year 2050 and suggest that growing prosperity could lead to significant declines in birth rates and thus to a shrinking population long-term. That alone won’t solve all the problems. But it will open up new possibilities.

Resource scarcity can often be managed and compensated for.

Incidentally, human labor can be a resource as well, and it is already in short supply in some areas. Similarly, scarcities of nonmaterial resources like time or attention may exist. The year 2020 did an excellent job of surprising us with what we might lack: from medical equipment to toilet paper – or even close human contact.

We are sure about one thing, however: It is often possible to manage and offset resource shortages, although not always immediately. And rarely without effort or sacrifice. But scarcity often leads to innovation and economic progress in the first place. Scarcity is a challenge that unleashes creative potential. Have we really exhausted all the options? All the possibilities? Some raw materials may be finite, but the sources of ideas and innovations that solve problems are clearly infinite, as is the range of ongoing social, technical and economic developments. We at Freudenberg Sealing Technologies want to make contributions in these areas. To this end, the latest edition of ESSENTIAL should serve as both an inspiration and an incentive. ©

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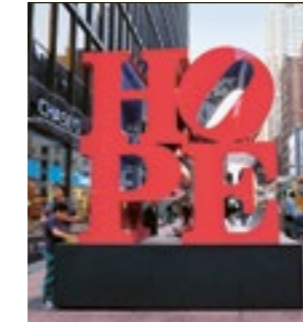
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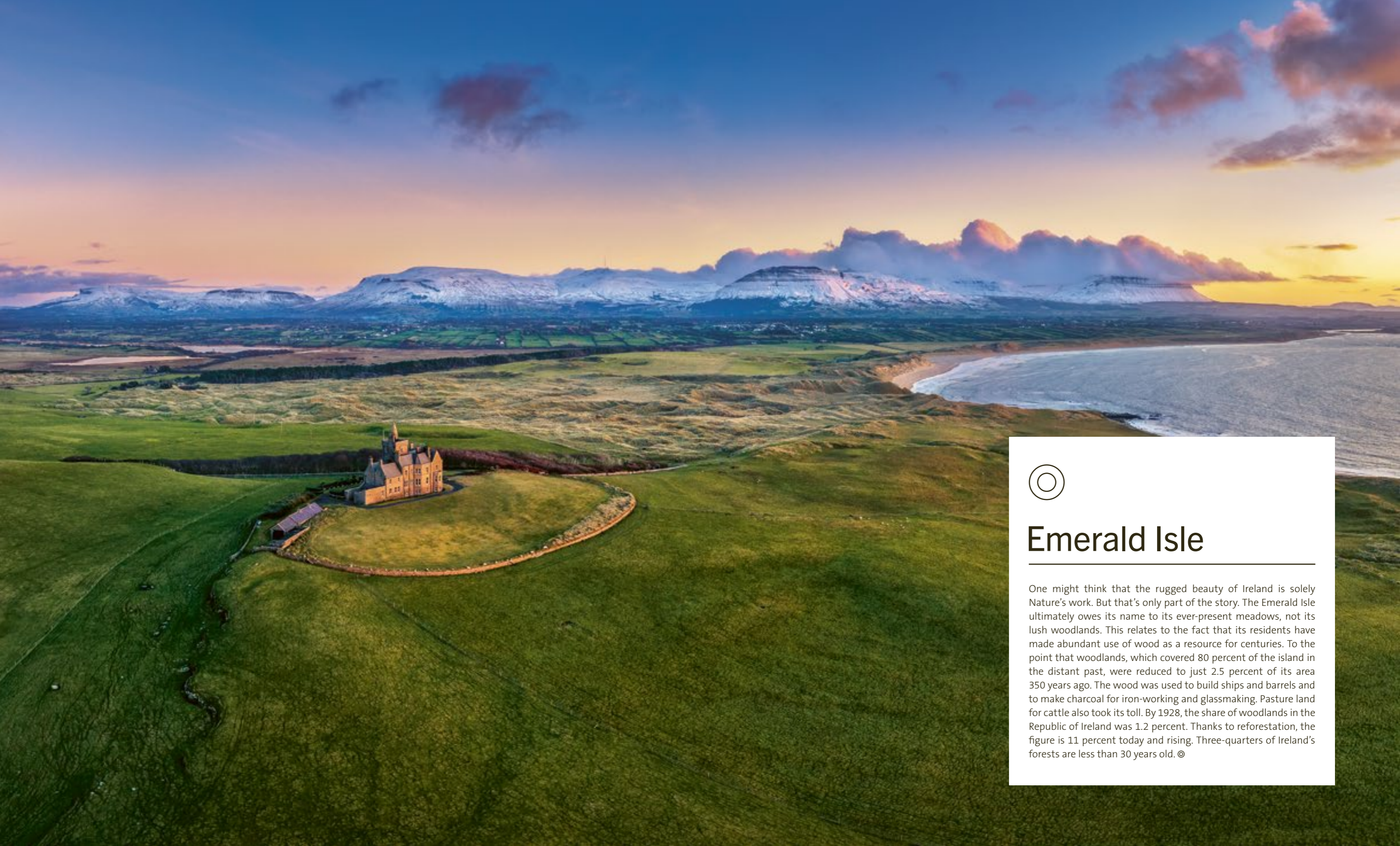
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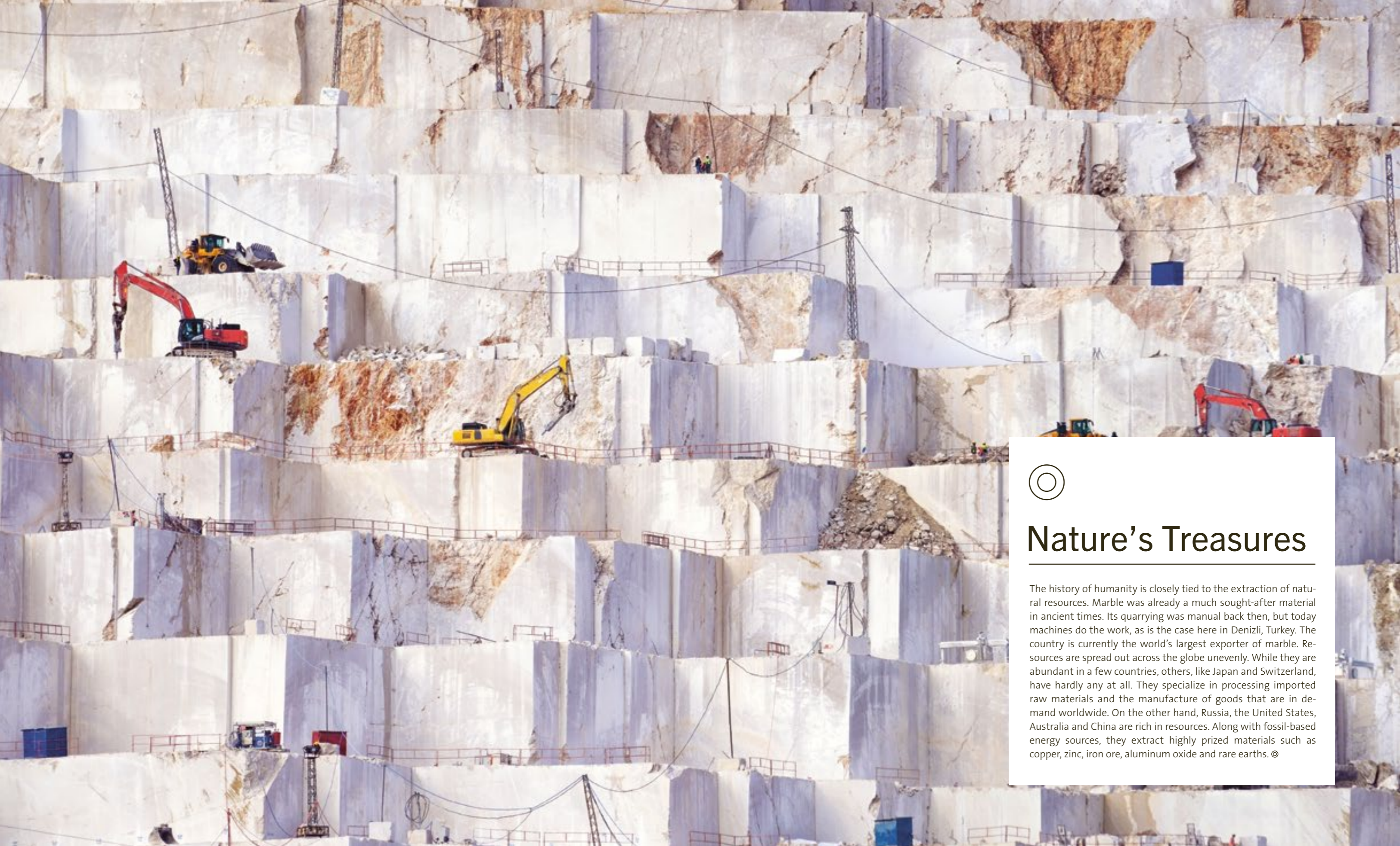
The Optimist

A Swedish author believes in progress.



Emerald Isle

One might think that the rugged beauty of Ireland is solely Nature's work. But that's only part of the story. The Emerald Isle ultimately owes its name to its ever-present meadows, not its lush woodlands. This relates to the fact that its residents have made abundant use of wood as a resource for centuries. To the point that woodlands, which covered 80 percent of the island in the distant past, were reduced to just 2.5 percent of its area 350 years ago. The wood was used to build ships and barrels and to make charcoal for iron-working and glassmaking. Pasture land for cattle also took its toll. By 1928, the share of woodlands in the Republic of Ireland was 1.2 percent. Thanks to reforestation, the figure is 11 percent today and rising. Three-quarters of Ireland's forests are less than 30 years old. ©



Nature's Treasures

The history of humanity is closely tied to the extraction of natural resources. Marble was already a much sought-after material in ancient times. Its quarrying was manual back then, but today machines do the work, as is the case here in Denizli, Turkey. The country is currently the world's largest exporter of marble. Resources are spread out across the globe unevenly. While they are abundant in a few countries, others, like Japan and Switzerland, have hardly any at all. They specialize in processing imported raw materials and the manufacture of goods that are in demand worldwide. On the other hand, Russia, the United States, Australia and China are rich in resources. Along with fossil-based energy sources, they extract highly prized materials such as copper, zinc, iron ore, aluminum oxide and rare earths. ©



Artfully Small

Living space is in demand in times of growing urbanization. Shortages of residential space and higher rents in cities like Detroit have spurred the rise of “tiny houses” as alternatives to standard homes. Twenty-five compact houses are being built in that city to provide low income residents with new residences. A project in Mexico is following a similar path. It is a settlement of tiny houses that is being established in the country’s southeast region. The plan is to make 50-square-meter (538-square-foot) houses available to families who previously could only find makeshift housing. The project is backed by an American building technology company and a nonprofit based in the United States. The highlight: Thanks to a special concrete compound, the structures can be built quickly using a 3D printing process. ©



“The Energy Map Is Being Redrawn”

Political scientist Dr. Kirsten Westphal advises political decision-makers on issues relating to security and foreign policy. Her focus is currently on the energy transition. A conversation about inexhaustible resources and the growing importance of hydrogen.

DR. WESTPHAL, YOU HAVE BEEN DEALING WITH THE “GEOPOLITICS OF THE ENERGY TRANSITION” SINCE 2018. WHAT IS YOUR AREA OF INTEREST?

My team and I investigate how the energy transition in Germany and the EU affects their external relations. It can generally be said that the energy transformation will have geopolitical effects. It is going to be a different world.

IN WHAT RESPECT?

The countries that now import fossil resources are gaining greater power. The producers of fossil raw materials are relinquishing it. There is the prospect that Europe will get more room for maneuver, but it needs to answer a question: With whom does it intend to network on energy policy? In any case, the energy map is being redrawn.

IS THE ENERGY TRANSITION A REGIONAL OR GLOBAL ISSUE?

Germany and the EU are playing a pioneering role here. But the Paris Climate Agreement has shown that dealing with climate change is a global issue. More and more countries want to be climate-neutral by 2050 or at least CO₂-neutral by 2060. The declarations are coming in quick succession. Everything sounds positive for now.



The absolute supremacy of climate politics poses problems.”



THERE IS A “BUT” SOMEWHERE IN YOUR STATEMENT.

Climate politics is not energy politics. While declarations are important, measures must follow. The absolute supremacy of climate politics poses problems, especially when real progress on the energy transition lags and ambitions are spiraling faster and faster. This poses the risk of losing credibility at some point.

STILL, THE EARLY INDICATIONS SEEM TO BE POSITIVE FOR AN ENERGY TRANSITION.

Absolutely. We are seeing global momentum, not least of all because the costs of renewable energy have fallen sharply. This makes it an attractive option. It makes economic sense practically everywhere. From a global standpoint, the energy transformation is moving ahead very differently across the globe – the goals and the routes to the conversion are frequently different than those in Europe.

WHAT ARE THE ENERGY TRANSITION’S DRIVERS?

Besides reducing costs, it is public opinion. The public sees climate change as a threat. It is tangible in many places. For example, the air pollution that causes major problems locally.

SO THE RESOURCES ISSUE IS LESS IMPORTANT?

This is an exciting aspect. The focus was once on the finite character of oil and gas. We believed that extraction would soon reach its high point. The assumption became almost baseless with fracking, the revolution in the extraction of shale oil and gas. We now know there is more there than we thought. The actual scarcity is in the atmosphere. How much CO₂ may we load into the air if we want to stay with the two-degree goal?



With an energy transition, economic value is no longer created with resources but with the use of technology.”

SO RAW MATERIALS IN THE GROUND WON’T RUN OUT, BUT THERE HAVE BEEN AND STILL ARE COUNTRIES THAT HAVE LESS OF THEM. HAS THIS CIRCUMSTANCE LED THEM TO FIND INNOVATIVE SOLUTIONS?

That’s clear. The high level of energy efficiency in countries such as Japan and Germany shows this. Any country spending a large portion of its gross domestic product importing raw materials behaves differently than that who have substantial deposits of these resources. Countries poor in raw materials are also forced to diversify in terms of countries of origin and supply routes. The concentration of energy riches will change as the energy transition continues. Renewable energy along with generated hydrogen will be more evenly spread around the world than oil and gas are.

THE COUNTRIES EXPORTING FOSSIL RAW MATERIALS SHOULD BE INVOLVED IN THIS. HAVE THEY TENDED TO STICK WITH THEIR RESOURCES AND INNOVATE LESS?

They can’t all be lumped together. Consider the United States, Canada or Norway, for example. They are all resource-rich and innovative at the same time. Much would depend on how liberal the political system is. On the other hand, state-owned enterprises carry considerable weight in an economy. They are not under nearly the same pressure to innovate as multinational corporations.

YOU MENTIONED HYDROGEN. THE CAPACITY TO INNOVATE IS IN HIGH DEMAND FOR ITS PRODUCTION.

That’s right. With an energy transition, economic value is no longer created with resources, but rather through the use of technology. As a result, an economic system’s capacity to innovate is a crucial factor. Here, Asia and especially China are



Dr. Kirsten Westphal

Dr. Kirsten Westphal is a political scientist who works for SWP, the German Institute for International and Security Affairs, in Berlin. SWP analyzes foreign policy issues for federal political leaders, economic entities and the public. At SWP, Dr. Westphal is responsible for international energy relationships and global energy security. She is also a member of the National Hydrogen Council. In addition, she was on the panel of experts of the Global Commission on the Geopolitics of Energy Transformation 2018-19 and collaborated on the commission report “A New World.”



China clearly wants to advance key technologies such as hydrogen and set the standards for them. The EU must continue to be vigilant in this area.”

worth noting, all the more since the size of a market plays a major role when new technologies are introduced. It was significant for the battery revolution and e-mobility. China’s economies of scale are enormous.

WHAT DOES THAT MEAN FOR EUROPE?

China has caught up with us in batteries, solar panels and high-voltage, direct-current transmission lines. Will the EU succeed in avoiding this situation when it comes to hydrogen and will we manage to export these technologies as well? China is pursuing the strategies “Made in China 2025” and “Standards 2035.” China clearly wants to advance key technologies such as hydrogen and set the standards for them. And then there are the structural asymmetries. We have highly innovative small and medium-sized companies supported by foreign trade chambers and embassies. But in Africa, for example, they have to compete with China’s state-owned companies offering low-cost system solutions and loans as a package. The EU must continue to be vigilant in this area. Competition from China has to be taken seriously, especially when it is exporting its economic model as well.

THE EU IS STRIVING FOR GREEN HYDROGEN PRODUCED FROM RENEWABLE ENERGY. WHAT ARE THE PREMISES FOR IT?

I believe it is essential for us to develop the technology and create facilities for it to give Europe the ability to export and to keep it competitive and innovative. But it is important to remain realistic. The EU is limited when it comes to good locations for solar and wind energy and generally available space. In this sense, it is plausible or even essential to rely on imports and carry out hydrogen projects abroad with partners. Here I am initially thinking of Europe’s periphery and the countries connected by pipelines. Norway and Britain are close to us by any measure. Geographically and politically, they are part of a

European rule and market area and are pressing ahead with climate protection. Of course, hydrogen should also be sourced from other regions.

WHAT IS YOUR CONVICTION BASED ON?

Germany and the EU have to provide mutual economic interconnections to achieve stability and prosperity in neighboring regions. Imports of hydrogen and its derivatives offer countries like Russia, the Persian Gulf states or even Algeria and Egypt the opportunity to keep earning money. As Europeans, we are unable to create an exclusive island of happiness when our neighborhood is not benefiting as well. Such geopolitical considerations must be taken into account.

HOW WILL THE UNITED STATES POSITION ITSELF IN TERMS OF ENERGY POLICY?

It has heavily focused on fracking and fossil fuels recently. That will change under the new U.S. President, Joe Biden. He is stressing climate protection, and the new Vice President, Kamala Harris, is one of the signers of the Green New Deal. That’s why I expect the new administration to move ahead with the expansion of renewable energy and key technologies such as hydrogen. But its energy and technology policies will focus heavily on the country’s own industries and employment. The country will collaborate more multilaterally on climate, but “America First” will still guide its actions in economy. Not least of all due to its rivalry with China.



HOW IMPORTANT IS THE INTERPLAY OF THE GOVERNMENT AND BUSINESS FOR A NATIONAL HYDROGEN AGENDA?

Very important. Three approaches have to work in parallel: The technology has to be ready for market, you have to be able to foresee the business case, and the political conditions have to be right. It won't come together without this parallel interplay. Otherwise, the old chicken-or-egg problem will continue. Supply and demand must be triggered. We need new, clear framework conditions and, most likely in the initial phase, non-market-based tools, even if the goal must be to create a hydrogen market. Since it is essential to introduce new sources of energy and technologies, this touches on the issues related to EU subsidies. The policies are crucial. They determine whether projects will pay off.

WHAT IS INDUSTRY'S READINESS TO TURN TO HYDROGEN AS AN ENERGY SOURCE?

We are now experiencing a real hype about hydrogen. This is not the first time, but now it's different since it has seized the imagination of numerous countries and industries. An energy system that doesn't include the use of hydrogen would be inconceivable in 2050. In addition, financial institutions are

starting to get out of fossil resources. They tend to see hydrogen-related projects and the associated infrastructure programs as attractive measures.

WHAT INDUSTRIES ARE SHOWING A SPECIAL INTEREST IN HYDROGEN?

I think it is being discussed in every industry. It already plays a role in refineries. There are pilot projects in the steel industry. Plus cement, aluminum, glass. If you think further ahead, there is heavy-duty transport and aviation.

HOW COULD A BREAKTHROUGH FOR HYDROGEN TAKE PLACE?

"Hydrogen valleys," places where industries and logistics centers come together and network, seem promising to me. Take port cities, for instance. Antwerp produces about 15 percent of Belgium's CO₂ emissions, Rotterdam about 20 percent in the Netherlands. If these types of centers are de-carbonized with the help of hydrogen, much will have been gained.

HAVE THE OIL EXPORTING COUNTRIES SUCH AS THOSE IN THE PERSIAN GULF BEGUN TO RETHINK THEIR STRATEGIES AND SET THEIR SIGHTS ON HYDROGEN PRODUCTION?

Oh yes. They are further along than we have thought. Saudi Arabia is pursuing its Vision 2030 program to diversify its economy. This includes Project Neom, a new city the size of Belgium with desalinization facilities and green hydrogen production, encompassing the entire value creation chain that is due to take shape. When Saudi Arabia held the G20 presidency in 2020, it actively advocated a circular CO₂ economy.



'Hydrogen valleys,' places where industries and logistics centers come together and network, seem promising to me. Take port cities, for instance.'



An energy system that doesn't include the use of hydrogen would be inconceivable in 2050."

The country is pursuing "direct air capture," that is, extracting CO₂ from ambient air, storing it and creating synthetic fuels from it.

EUROPE IS THINKING IN TERMS OF GREEN HYDROGEN. JAPAN IS INITIALLY BETTING ON THE IMPORT OF HYDROGEN EXTRACTED FROM COAL. WHERE IS THE WORLD HEADED?

The world is very multicolored in this respect. It will be exciting to see how open the EU will be to hydrogen being produced in different ways, how it will certify the fuel and build up commerce in it. This isn't just important with regard to the Gulf States – the issue involves Russia as well. That country is tackling a wide variety of production methods. So is the United States.

LET'S LOOK INTO THE FUTURE: WHAT ROLE WILL HYDROGEN PLAY AT THE END OF THIS DECADE?

I already hope that we in the EU will have achieved major progress in offshore wind parks and water electrolysis, which are key technologies. We have geographic advantages in these areas. In the western portion of the continent, the "backbone infrastructure" will have made a great deal of progress. Energy-intensive sectors will use hydrogen. At the same time, I think that we will discuss a number of issues more intensively and openly: the colors of hydrogen, its role in the heating sector, and above all its system function that hydrogen can provide as a storage medium for energy systems. Japan, the United States and China will all be using every form of hydrogen very pragmatically and will be geared to rapid industrial progress. ©



City — Sand — River

Except for water, no resource on the planet is in greater demand than sand, some experts say. Sand is not only found in many everyday objects — it is particularly in demand for building construction. As a result, it is increasingly in short supply.

Poyang Lake in southeast China is the largest freshwater lake in the country. At its longest point, it spreads out over a surface of up to 4,500 square kilometers (about 1,740 square miles). In the 14th century, the inland lake is said to have been the scene of one of the greatest sea battles in history. Depending on the time of year, its water level fluctuates a great deal, recently to the point that it could hardly be seen in satellite images. The powerful Three Gorges Dam, which disrupts its flow, is one reason for the fluctuation. In addition, the extraction of massive amounts of sand has broadened and deepened the lake's drainage channel, allowing its water to escape more quickly.

In 2014, the United Nations Environmental Program estimated that 235 million cubic meters (307 million cubic yards) of sand are mined from Poyang Lake annually. That would make it the site of the world's largest sand mining operation. The gritty material is proving to be a hot seller as the country's economy booms. Its many infrastructure products and its

rapidly growing cities are dependent on sand as an ingredient in cement. Every two or three years, China uses as much sand as the United States did in the entire 20th century. Of the up to 50 billion tons of sand consumed globally each year, China accounts for about 60 percent.

All Sand Is Not the Same

Some might say this isn't a problem. After all, sand can be found in abundance across the planet. The expression "like the sand in the sea" is already found in the Bible and suggests something available in great quantity. And that is certainly true: Deserts cover about one-fifth of the earth's land surface. But the





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tons of sand are needed to build an average single-family home.

math doesn't quite add up because all sand is not the same. Only about 5 percent of the world's sand deposits are suited for cement production.

Desert sand is out of the question because wind and weathering have polished it to make it smooth. The sand used in construction must have an angular structure. The sought-after variant only occurs in gravel and sand pits or in lakes and rivers, which carry it along to the ocean. So construction sand is primarily mined in pits, on riverbanks and shores, or at the bottom of bodies of water. That is what was going on at Poyang Lake. It had been targeted to the point that Chinese officials banned sand mining from the Yangtze River in 2001. This was required after sand mining washed away bridges, endangered levees and prevented navigation.

Illegal Mining On a Grand Scale

The global demand for sand continues to rise. Nine times more sand is mined than oil is extracted, statistics show. The United Nations highlights the magnitude of sand mining in its report, "Sand, rarer than one thinks." Enough construction sand is used in the production of concrete to build a wall 27 meters (32 yards) high and just as wide around the equator. It goes without saying that the large grained sand is being extracted much

more quickly than rivers can produce a fresh supply. The world is heading toward a severe bottleneck. This can be seen in the prices of the commodity. The price for sand extracted in Germany rose about 30 percent between 2000 and 2017. In the United States, the price rose by the same proportion between 2010 and 2019. And when a commodity becomes lucrative, criminal energies are unleashed. In India, there is already talk about Mafia-like structures in the sand business. It is being illegally mined there on a grand scale. In the south Indian state of Kerala alone, the value of the illegal trade is put at about \$2.3 billion U.S. Illegal mining has also been observed in other parts of the world.

Singapore is seen as a consumer of illegally mined sand. For a long time, the city-state obtained its sand from Indonesia, Malaysia and Cambodia from time to time. A few years ago, these countries imposed an official ban on exports. Nonetheless, Singaporean statistics continue to show sand imports from them. Singapore is heavily dependent on the commodity. Surrounded by water, the city-state has expanded its land area by 20 percent since its independence in 1965. A United Nations report from 2014 says Singapore has imported more than 500 million tons of sand over the past twenty years. The imports from neighboring nations have led to the disappearance of entire beaches and some sand islands off their coasts. The cause is the suctioning of sand from the ocean floor. Singapore turned to Australia, among other places, to obtain sand that is needed to build its huge container terminal. Dubai was another of Australia's customers, in part to build the Burj



Actually a lake, not a river: After massive sand mining, the waters of Poyang Lake are draining away even faster.



The breakthrough? Polymer resin turns ostensibly useless desert sand into polymer concrete.

Khalifa, the world's highest building, in the desert emirate. An abundance of sand was also needed for another prestige project: the artificial islands off the emirate's coast, designed in the form of palms.

A Glimmer of Hope?

The demand for sand persists in the West as well. It is substantial and unabated. After water, it is the world's most sought-after resource, experts say. The United Nations assumes that Africa will

follow suit when it comes to sand, which brings up the issue of alternatives. In this respect, the German company Polycare has attracted some attention; it is supporting a construction project in Namibia after years of research. Ostensibly unsuitable desert sand was used as a construction material after polyester resin was added to it as a crucial binding agent. The polyester resin was in part obtained from recycled PET bottles. The polymer-cement made of desert

sand and artificial resin hardens after just twenty minutes. In their finished form, individual polymer-cement parts can be inserted and screwed inside one another like Lego pieces. At some point, a building could be dismantled and rebuilt somewhere else. Time will tell whether the method will prove to be a breakthrough. If it works out, the construction sector could turn to smoothly polished desert sand. And this is indeed as abundant as sand in the sea. ©



Sand

Grains of sand are 0.063 to 2 millimeters in diameter. They consist of rock that is gradually weathered from the effect of wind, rain, the sun and frost. As rock is carried along by rivers to the sea, the grains are ground smaller and smaller. It is a process that can take place over several hundred years.



Methanol on the Open Seas

International commercial shipping is intended to be climate-neutral by 2050. This represents a major challenge for the transportation sector – and opens up an opportunity for alternative sources of energy. Freudenberg Sealing Technologies is developing maritime fuel cell systems that can produce electricity from green methanol.



These giant container ships consume 10 tons of heavy oil per hour. Methanol could change that.

The distance between the ports of Rotterdam and Shanghai is 10,557 nautical miles. Today's container ships travel the most important trade route between China and Europe in less than thirty days – some in regular service with intermediate stops and others without extra layovers. On these trips, a single ship can carry more than 20,000 standard containers while burning nearly 10 tons of heavy fuel oil per hour. These figures make it clear that operating the roughly 100,000 commercial ships CO₂-neutrally on the world's oceans is a huge challenge. Yet it still would be advisable

since goods transport by ship accounts for around 2.5 percent of global greenhouse gas emissions, according to the International Maritime Organization (IMO). The goal of the organization, which represents 174 member-states, is to make all shipping climate-neutral by 2050.

2050 seems far off, but Nils Martens, who is responsible for the batteries and fuel cell systems business at Freudenberg Sealing Technologies, points to the long life cycles in the industry. "In some cases, commercial ships are in service for more than thirty years. That's why

every shipbuilder and every operator is considering how to reach that goal." A pure battery solution is only viable when the traveling distance is short and the layover time is long enough to recharge the battery – in ferry services, for example. Batteries can also support diesel propulsion as part of a hybrid drive system, making it possible to maneuver emission-free in a harbor. It is a tried-and-tested technology. For example, in a partnership with ABB, Freudenberg supplied batteries for new ferries on the Dover-Calais run. They are scheduled to begin service in 2023.

Three Times the Energy In the Tank

"But we need different powertrains and different sources of energy for international shipping," Martens explains. This is where fuel cells come into play to generate the electricity for the propulsion system and the "hotel" on board. For shipping on the open seas, hydrogen is suited for use in fuel cells to only a limited extent. Even when it is liquefied and kept at -253°C (-423°F), the volumetric energy density of hydrogen is seven times less than the ship diesel commonly in use today. As a result, massive fuel tanks that take up valuable transport



3x

higher – methanol outstrips hydrogen's energy density by far.

space would be required. Freudenberg Sealing Technologies has therefore developed a fuel cell system that operates with an upstream methanol reformer. Methanol can be made with "green" hydrogen produced with the help of water and green electricity. But, unlike hydrogen, methanol is a liquid under normal conditions and has about three times its energy density. Moreover, if the carbon for the methanol production doesn't come from fossil sources, but is separated out of the air, or if methanol derived from biomass is used, the result is a completely climate-neutral fuel.



Destined for battery operation: short-run ferries in Scandinavia.



With operating lives of 30,000 hours or more, fuel cells are competitive with combustion engines.”

Freudenberg is developing fuel cells in a container design for use on the high seas. The fuel cell stack, reformer, control electronics and all other components are placed in a prefabricated container, permitting easy installation on board.

A single container can provide a rated output of up to 500 kW. When combined with other units, the total output is scalable to the high double-digit megawatt range or even higher.

Compared to a combustion engine system, a fuel cell also offers shipbuilders a huge advantage: The mechanical drive shaft to the propeller is eliminated. This permits entirely new designs that could make large central engine rooms unnecessary.

But are these fuel cell stacks – where hundreds of wafer-thin membranes containing precious metals work with one another – as robust as a massively heavy cylinder in a two-stroke diesel engine? “We achieve operating lifespans of more than 30,000 hours with our systems and can see possibilities to increase them to even higher in the future,” Martens says.



Shipping is expected to become more climate-friendly. Freudenberg Sealing Technologies has the answers.

<https://on.fst.com/3mvJRIR>



“This puts us in a range where we are competitive and are overtaking internal combustion engines.”

Taking the Ocean Plunge

Before year’s end, Freudenberg’s first fuel cell system will have to prove itself out on the high seas. It is scheduled to be tested under real-life conditions aboard a new Helios-class cruise ship built by Meyer Werft in Papenburg. At first, the system will only produce on-board electricity, however the first ships equipped with a hybrid system based on fuel cells and batteries could be launched well before the year 2030. “We are already in the middle of industrialization,” Martens says. In 2021, Freudenberg Sealing Technologies is opening a second development center in Munich. The focus will be on the ongoing optimization of production technologies as well as products. ©



BY THE NUMBERS

08/22/2020



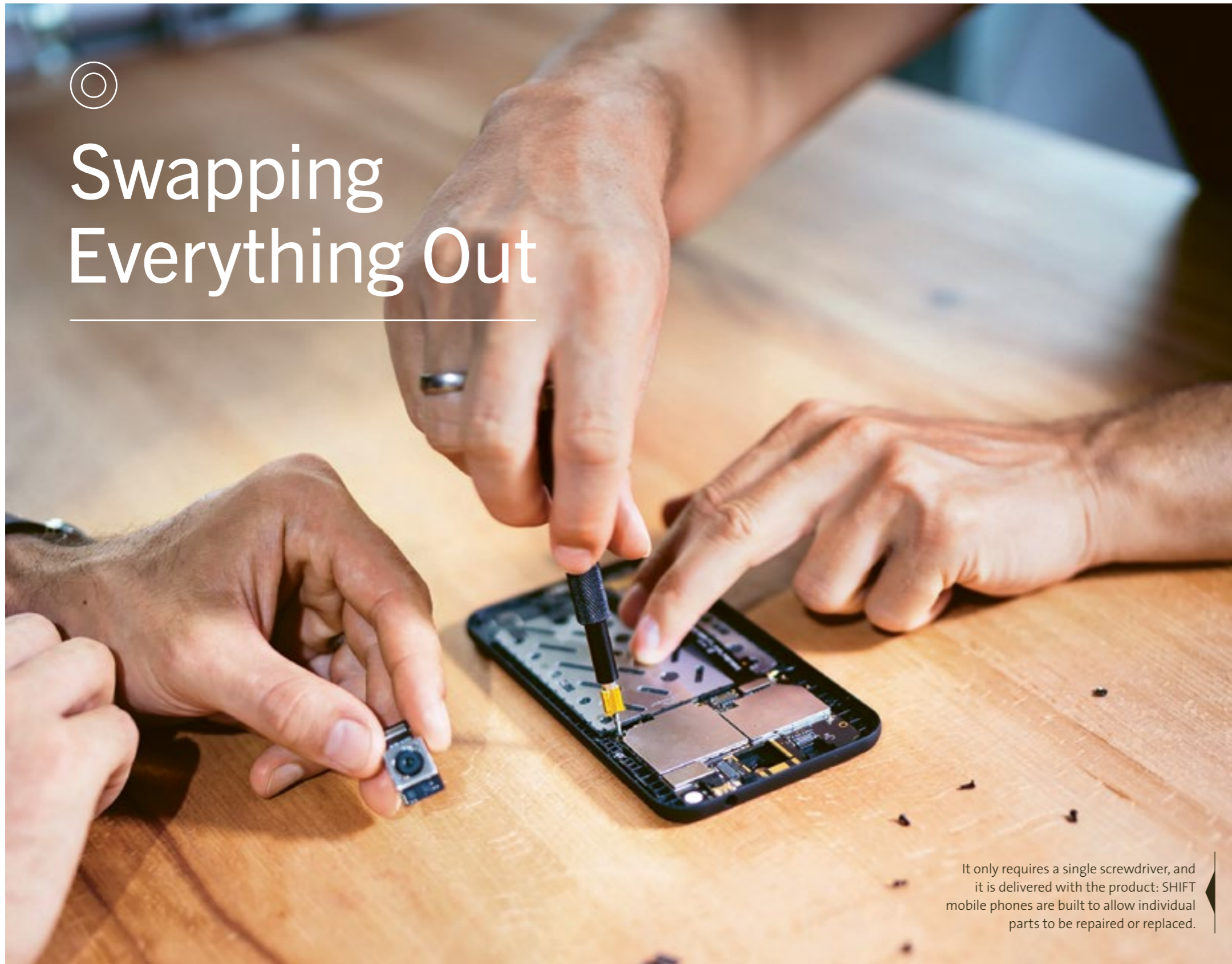
People aren’t very considerate of the planet they live on. The international research organization Global Footprint Network has tied humankind’s largely unsustainable activities to a particular date each year: Earth Overshoot Day. As of this day, the world’s population has consumed more ecological resources in a calendar year than Nature can renew. From then on, it can’t replace the forests harvested or the fish caught or absorb CO₂ emissions in equivalent quantities.

In 2020, Earth Overshoot Day fell on August 22. Thereafter, the resources of future generations were being consumed. The last time the day fell that late in the year was back in 2005. So, why so late last year? Because CO₂ emissions fell due to the corona pandemic, for example.

There has also been criticism of the Global Footprint Network’s calculations. The organization doesn’t hide the fact that it relies on assumptions and can only approximate reality. But it uses valid data when it can find the information, from the United Nations, the International Energy Agency and the Canadian Institute of Forestry. In the end, Earth Overshoot Day offers a sense of how wasteful humanity is. ©



Swapping Everything Out



It only requires a single screwdriver, and it is delivered with the product: SHIFT mobile phones are built to allow individual parts to be repaired or replaced.

So mobile phones have to be repaired by experts and end up as electronic scrap in two years? There are two entrepreneurs who aren't happy with that situation. The Waldeck brothers produce sustainable smartphones while keeping close track of the resources they use.

As children, Carsten and Samuel Waldeck confronted scarcities of resources at an early age. Their father had founded an organization to help drug-dependent young people. It was housed in an old manor out in the country. "There was a shortage of everything. It ran totally on donations," Samuel Waldeck recalled. Anyone who has ever started a charitable project likely knows how he feels. The experience left its mark on him. Waldeck says Mother Nature, with its ever-present cycles, became his model. "Everything that functions is actually a cycle. Only human beings conceive of cycles that don't work. Or there's no cycle to begin with." Take smartphones, for example. On average, less than 20 percent of people use their smartphones more than two years. In the United States alone, about 150 million smartphones are discarded every year – as special waste containing toxic components. Recycling is difficult because the individual parts are connected and fused to one another. "Shredded telephones are a huge mix of materials," Waldeck said.

The two brothers wanted to do things differently. They wanted to have mobile telephones that were easy to repair and to recycle. As much as possible, without glued and soldered



Shredded telephones contain a massive mix of materials.”

components. With as few multi-component plastics encased inside one another as possible. Both studied design. “A device that can’t be repaired is bad design,” Samuel Waldeck is convinced. So the two founded SHIFT in Falkenberg, Hessen, in 2014, and have produced about 50,000 devices since then. Waldeck reaches for a smartphone and removes its backside. There was a cracking sound and then the interior lay open. A user could replace what was inside without expert help – everything from the battery to the camera – and in some cases even repair the item. SHIFT offers advice and videos to explain all this. A screwdriver comes with the phone at purchase.

Coltan, Gold, Lithium and Cobalt

But then the Waldeck brothers turned their attention to the issue of resources. What about the raw materials that are built into telephones? The pair delved into the matter of where the over-exploitation of Nature or the abuse of workers has been taking place. One of their decisions involved coltan. “To the extent possible, we don’t want coltan in our devices,” Waldeck said. Coltan is a tantalum ore that is used to produce a heat-dissipating ceramic. Forced labor is used in a large part of Congo where it is mined. Due to smuggling, it’s not easy to see whether the trade in coltan is “fair.” Nor is it easy to determine the amount of coltan actually used in a phone. The brothers are now having their main circuit boards shot with neutrons to get the answer. They think the expense is worth it. At the same time, they are supporting local aid projects. The same issues apply to components such as gold, lithium or cobalt. But alternatives are clearly not available for every material.

“About 150 grams of gold have been incorporated in all the SHIFT phones that we have ever produced,” Waldeck said. “In any case, scouring our supply chains to preclude any problems is expensive. And this would basically be much too small a lever.” It would be better to spend money on support projects.

SHIFT buys electronic scrap from Ghana that is certified as child-labor-free and supports the Earth Beat Foundation, which finances small farmers in Uganda so they don’t need to work in gold mines. “Everything that we invest financially inevitably has something to do with sustainability and social justice,” Waldeck said.

Above all, the Waldecks have set the goal of seeing their smartphones recycled or reused as much as possible, and they have come up with the idea of a telephone deposit as part of the answer. Buyers pay a 22-euro deposit on their phone and get the money back later, even if they send an inoperable phone back to the company. “Electronic scrap that is discarded may not legally be resold or reused,” Waldeck said. “But we’re allowed to do it since we are officially taking the used devices back.” That not only lengthens the phone’s lifecycle – the manufacturers can also recycle individual parts if they are needed. This is especially true for precious metals and single-variety plastics. The designers have provided a modular design and an assortment of raw materials in advance that makes this recyclability possible and ensures that it runs smoothly. “For us, it is ultimately a matter of closing the material cycle,” Waldeck says.

Paying Attention to Time and Money

SHIFT is deliberately striking out in another direction when it comes to another resource: time. After placing the order, customers wait four to eight weeks to get their phone. That is part of the concept. “We start about a year before the production of a device, in part to pay for it,” Waldeck said. “If we have any buffer in terms of the timeframe, it helps us.” As some supply chains wobbled during the pandemic, SHIFT was still able to make on-time deliveries. “As consumers, we’re used to getting everything the next day,” Waldeck said. “I think that, as a producer, you can draw attention to why a long-term approach can be a good thing.”

Part of the reason for this approach is that the brothers have been running their company without investors since 2014. “To us, it was important for the company not to fall into a state of dependency,” Waldeck said. All too frequently, they have seen investors exert considerable pressure on companies during crises. This has not always been to the company’s benefit. SHIFT wants to grow, but not in response to pressure. “This brings us back to Mother Nature as our model,” Waldeck said. “In a forest, large trees and small trees grow at their own pace.” That makes them resilient. If companies grow independently, they don’t suddenly find themselves in dire straits. ©



Company founders: Samuel (l) and Carsten (r) Waldeck launched their company in Falkenberg, Hesse, in 2014.



22 €

(\$ 26) is the deposit for a phone, and customers get their money back.



The assembly and screwing operations take place in China, at fair terms. Social justice is important to the entrepreneurs.





A Material On the Move



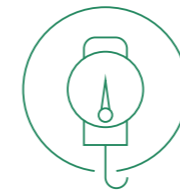
Bamboo – isn't it breakable? Not any more than steel, to cite one example. This underappreciated natural material has been inspiring bicycle designers for a while. A survey of visionaries in Vietnam, Malaysia and California – as well as a German world traveler.

It is indeed strange that a Vietnamese engineer would be inspired, in Germany of all places, to use bamboo to build things. In 2009, Minh Tri Pham, then a student at the Berlin Institute of Technology, attended a workshop on bamboo bicycles. The idea fascinated him, and he was unable to shake it. Today Pham runs a company called “Vietnam Bamboo Bike,” in Ho Chi Minh City. As an engineer, he is above all fascinated by bamboo’s material qualities. “Various forces are at work when you ride a bike,” he said. “For example, the position of the pressure points is crucial when someone presses down on the pedals full-strength.”

bamboo is reinforced, heated and glued with epoxy resin at its joints. Pham now manufactures his bikes for customers worldwide. That makes him part of a trend: Manufacturers are designing and selling bamboo bikes in other countries as well, and not just for stylish, leisurely excursions, but for racing and mountain biking, too. The first e-bikes are now available as well.

Basti Gutmann has subjected the material to a special stress test: In 2017, the German cyclist set out on a trip around the world on a bamboo bicycle he built himself. “On a whim,” he said. So far, it has developed into a 37,000-kilometer (23,000-mile) trek. Traveling under the nickname “Bamboo Basti,” Gutmann was on the road nearly three years before the corona pandemic and its accompanying border restrictions stopped him in his tracks. Aside from being an advocate of sustainability, he is tinkerer and carpentry hobbyist. The fact that he chose a bamboo frame for his trip has more than just symbolic significance.

“Compared to carbon or other materials, bamboo is the easiest to patch. You only need an epoxy resin and hemp, which



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Bamboo can achieve a tensile strength of 40 kilonewtons per cubic centimeter, plus a tensile strength at break of more than 200 pascals. That gives it an advantage over steel in some applications.

Bamboo isn't wood – it's a grass. It consists of fibers grouped around a hollow form, separated by nodes. “The strongest fibers are exactly where the largest stress point prevails mechanically,” Pham said. That gives bamboo extreme hardness combined with great tensile and compressive strength. It is an illustration of lightweight construction in Nature. The material can't compete with ultra-light carbon frames based on weight, but it does very well in comparisons with metal. For bicycle frames, the



Viet Bamboo Bike

Minh Tri Pham founded his company as a side project. In his regular job, he works as an engineer in the renewable energy field. He now sells city and mountain bikes worldwide through his online shop.

Find out more at
<https://vietbamboobike.com/>



can be easily obtained anywhere, especially if you are on a coast." By contrast, steel or aluminum would have to be welded. Bamboo doesn't break apart like wood either; the fibers tear lengthwise, which does not affect its stability provided that the tears are promptly closed. Gutmann rode his bamboo bicycle across the Balkans to India – and happened to meet a man in Malaysia who owned a large bamboo factory. Ahmad Mazlan Othman is an engineer, construction planner and visionary who also uses bamboo, in his case, for home construction. It was then that Gutmann realized there were more than a thousand species of bamboo with highly specific properties. "Ahmad told me with a grin that my bike was assembled extraordinarily well, but the bamboo wasn't really suited for it. There were better choices," he said. Still, the bike had indeed carried him all the way to Malaysia. Ahmad Mazlan Othman is a bamboo activist. In his lectures, he especially stresses the sustainability of the material. Due to its rapid growth, bamboo binds up large quantities of carbon dioxide and, in the bargain, produces

"I want to build attractive, robust bicycles." One of the models from Minh Tri Pham, an engineer.

more oxygen than most other plants. Architects worldwide are increasingly discovering the material's advantages.

Minh Tri Pham tackled the promise of bamboo with a similar scientific approach. After his return to Vietnam from Germany, he identified 360 species of bamboo, and he has worked intensively on mechanical simulations since then. He has now settled on the species that are best suited for bicycle frames. The pandemic has slowed him down as well, but Pham has used the time for more research and development. "The designs are my strength," he said. "I want to build attractive, robust bicycles" – with materials that do not have to be imported. Pham is planning a small factory where 300 frames a month can be built. Target audience: Customers abroad. In Vietnam, the hot weather coupled with torrential rain discourages the use of bicycles as a daily means of transportation. But Pham finds that the number of active recreational cyclists is growing.

Craig Calfee of California is considered one of the world's pioneers in bamboo

frame construction. He first experimented with the material in 1995. Since 2005, he has been manufacturing bamboo bicycles professionally and advertises his current model as "more rigid than many carbon frames." That is remarkable inasmuch as Calfee was one of the first in the industry to develop carbon frames in the 1980s, equipping Tour de France winner Greg LeMond with them, among others. Accordingly, his bamboo frames fetch a high price: between \$3,000 and \$5,000. Basti Gutmann also met Calfee during his travels, encountering him accidentally while he was looking for lodging. "Tomorrow I want to find that madman around here who builds bamboo bicycles," Basti told him. "That's me," Calfee replied. Gutmann stayed with him for two weeks.

Bamboo grows quickly. Some species shoot up as much as 90 centimeters (about 35 inches) per day. The niche market for bamboo bicycles may not be growing quite as quickly – but buyers' interest seems to have been awakened. "Bamboo can grow in a great many locations on the planet," Pham said. From all appearances, the same applies to the interest in Nature's lightweight material. ©

A special kind of stress test: "Bamboo Basti" underway on his world tour.



Bamboo Basti

Cyclist and activist Basti Gutmann, 29, launched his trip around the world from Munich in June 2017. As part of his plan, he resolved to plant 40,000 trees over the course of his trip. As soon as the pandemic permits, he wants to wrap up his circumnavigation with a European tour.



Find out more at
<http://bamboobasti.com>





For Lack of Evidence

Some resources can be replaced. But what happens when there is a lack of evidence, but you know who the offender is? Or you at least have a suspicion. In an interview, Chief Detective Jörg Schmitt-Kilian talks about evidence that comes to light decades after the crime and the moment that the felon is suddenly standing before you.

JÖRG SCHMITT-KILIAN, HOW LONG DO YOU KEEP LOOKING IF YOU HAVEN'T FOUND ENOUGH EVIDENCE IN YOUR CASE?

You keep looking until you have it. But if the search comes up empty, the team working on the crime is reduced in size, and at some point the prosecutor stops the process. But if new evidence comes up, some cases are reopened. There is no statute of limitations on murder. This is occurring a lot right now. You couldn't perform DNA analyses before, but samples for DNA matches are available today. I know of a cold case involving a woman who was murdered in 1994. In that case, the murderer was convicted because he committed another offense and his DNA ended up in a file.

SO A HIT ISN'T EVIDENCE IN ITSELF?

No. Sometimes it's not proof, but rather a reason to take up the case again. Actually, after such a long time, some offenders are so surprised that they break

down during interrogation and confess. Another reason for their behavior is that they can finally ease their consciences.

CAN THERE BE EVIDENCE THAT YOU HAVE BUT CAN'T USE?

Yes. For example, this is often the case with crime-related telephone surveillance subject to prohibitions on its use as evidence. In Germany, we offer greater protection for the offender than in most other countries. That can be frustrating, of course. You know someone is the offender, but you can't prove it.

WHY NOT? CAN YOU CITE AN EXAMPLE?

Let's take narcotics: You have a dealer under surveillance and you see him coming out of a location that is a proven drug house. But his lawyer says, "Maybe he was visiting the apartment next door." If we don't have other evidence, the accused person will get the benefit of the doubt here.



Cold Case

"Cold Cases" refers to unsolved crimes for which there is new evidence, either from new testimony from witnesses or DNA analyses. In many countries, there is no statute of limitations on serious crimes such as murder and rape. The first special cold case unit was established in the United States in the late 1990s.



Jörg Schmitt-Kilian

A chief detective and former narcotics investigator, he spent more than forty years on the job. Today, he holds readings, training sessions and events on the prevention of violence and illicit drug use. Schmitt-Kilian also writes crime novels based on real cases as well as advice books and travel guides. Find more information about the author at www.schmitt-kilian-aktuell.de

SO WHAT SEEMS TO BE EVIDENCE IS SUDDENLY NEGOTIABLE?

On one occasion, we arrested the son of a well-known municipal politician on whom 4 kilograms (8.8 pounds) of heroin were found. His attorney asked whether we might have convinced the suspect to make a delivery. The problem: As a narcotics investigator, I can only make specific statements on tactical anti-crime measures in court if I have been given an exemption. Wily attorneys often try to make officers seem as though they aren't credible. They stray into your private life, ask all kinds of questions, and as soon as you say, "I don't recall," they counter with: "Ah, but somehow you do remember that detail in this case. You may have worked on the case two years earlier."

DO INVESTIGATORS LEARN THE OUTCOME OF THE CASES THEY WERE INVESTIGATING?

The spectacular cases, yes. But in practice, you get totally caught up in your next case for quite a while. Some trials go on forever. I can't remember everyone that I put in jail. Once, after playing

tennis, I was taking a shower, and someone suddenly began speaking to me. It turned out that I was responsible for sending him to prison for seven years. I felt queasy for a moment, and then it was okay. "You did your job," he told me, "and you dealt with me fairly."

ON THE SUBJECT OF POLICE RESOURCES: WERE YOU WELL-EQUIPPED AT THE TIME?

Back then, our resources weren't as good as they are today. But staffing is always in short supply, especially in the area of organized crime. For the most part, we can only infiltrate these areas with covert measures, which are labor-intensive. And now the Internet is adding new issues, and the police have to continually handle more tasks. It's possible for an organized crime department to be reduced in size because other basic areas would otherwise be neglected.

DO YOU REMEMBER A CASE THAT WAS PARTICULARLY PUZZLING?

Yes, it was obvious that a heroin dealer was deeply involved in the drug scene. But based on her resume, she was com-



Wily attorneys often try to make officers seem as though they aren't credible."



Got a taste for crime fiction? You can find some short crime stories in our "Future Files." This is where we visualize the world of tomorrow. <https://on.fst.com/3fRJQHz>



pletely clean. There was nothing that we could find in her past. Nothing at all. It was only after we arrested her that we learned she had adopted the identity of her sister in Canada. The computer spit out a huge file once we entered her real name. In fact, she was a main witness in an unsolved murder case in the Netherlands. She used that as a bargaining chip after her arrest.

SHE WAS WILLING TO TESTIFY IN EXCHANGE FOR A MORE LENIENT PENALTY?

Due to her addiction, she was in therapy. The principle of "therapy, not punishment" was at work here. She was released from custody to meet with me. The murder wasn't my case, but my colleagues asked me to try to figure out what evidence she had. The end of the story was that she never showed up for the meeting. She seized the moment to vanish without a trace and is still at large. And the murder case is still unsolved.

DO YOUR CASES REMAIN STORED IN YOUR MEMORY FOR A LONG TIME?

In my crime novels, I come up with literary solutions to some of the crimes. The case I described with the dealer was even filmed. In the novels, I often describe situations that seem invented to the reader. But sometimes reality surpasses even my fantasies. ©



©

Catapulted to the World's Summit

A decade ago, Iceland wasn't even ranked among the top 100 in the world's soccer rankings. Since then, it has been the smallest nation to qualify for both a World Cup and a European Championship. The country has accomplished a great deal despite very few advantages. But how?

No Icelander will ever forget June 27, 2016. On that evening, a country with barely 350,000 inhabitants made headlines worldwide. Their origin was an event in Nice, southern France, where the Icelandic national soccer team saw to nothing less than a sensation. Gylfi Sigurdsson, Kolbeinn Sigthórsson and his comrades knocked England, the birthplace of the sport, out of contention for the European Championship in the round of 16. The England team, packed with international stars, seemed bereft of ideas and strategy against the well-organized Icelanders. They were a surprise even during the qualifiers for the final rounds. They defeated the team from the Netherlands twice and denied it eligibility to play for the Championship. The Dutch, who had come in third at the 2014 World Cup after all. Two years after that night in Nice, for the first time, the Icelandic team was on the grandest stage of all: the World Cup in Russia. Once again, the team was impressive in the qualifiers. The Icelanders again managed to defy the heavyweights. It is true they were knocked out

in the preliminaries, but the Vikings were still able to come away with a 1:1 tie against the Argentinian team led by international star Lionel Messi and only lost to Croatia, the eventual runner-up, due to a goal in the last minute of play.

How can a tiny country with just 1 percent of the population of California field such a strong team? How could such a small football association, which was 131st in the world rankings in 2012, surge to the 18th spot in just six years. How can a pool of negligible size, consisting of just 3,000 players organized into clubs and just 100 professionals, stand up to the world's elite? The answer is a good mental attitude, a strong concept and smart investments.

From a Summer to an All-Year Sport

The origin of the huge upswing in Icelandic soccer dates back to the turn of the millennium. Until then, Iceland's national team was regularly knocked out in the qualifying rounds for the European Championships and the World Cup, and only a few players had brought it to



900

Icelanders hold a UEFA “A” or “B” coaching license. That works out to one coach for every 390 inhabitants.

international attention. So it’s no surprise that soccer would have played a minor role in Icelandic life. It was mostly seen as a summer sport, and as soon as the weather deteriorated and the chilly winds picked up on this North Atlantic island, soccer balls would lay inert on the cinder pitch.

In the hopes of changing the situation, the national association began to invest in the basics – in part with television revenue, which the European Football Association (UEFA) distributes among its member clubs. The officials had a plan for investing these resources. They built artificial grass venues, some of which are heated, entered into joint projects with schools while investing in small fenced-in playing fields nearby and had large soccer halls built with artificial turf pitches. Seven indoor soccer fields, each standard-sized and complete with grandstands, were built by 2018. Six more had half of a standard pitch. The sports halls are open to anyone who wants to train, and they continue to build enthusiasm for the game. A foundation was laid to transform soccer from a summer activity to an all-year sport.

Qualified Coaches

Then it was a matter of improving the level of play. The association made huge investments in training coaches. Between 2004 and 2018, more than 900 Icelanders earned a trainer license from UEFA. If someone wants to coach 10-year-olds in Iceland, the person needs to be an A-license holder and will generally be remunerated for the work.

Compared to other European countries, proportionate to its population, Iceland has an unmatched supply of qualified coaches training its young players. This has been a key to the country’s success, says Dadi Rafnsson, who coordinated youth soccer at the first league club Breidablik Kópavogur for years. “I would say that we are world-class in the 6- to 14-year range. And in the older segments, we’re making a lot of good progress.”

The strange thing is that there are no professional soccer teams in Iceland. Even first league players have regular careers. If they are really good, they go abroad, often at a young age. That was the case for Gylfi Sigurdsson, the team’s current star. He left Breidablik for England as a teenager and made his

breakthrough there. The 31-year-old now plays for Everton FC. He is one of the players who benefited from Iceland’s measures early on and donned the jersey of the national team. This golden generation was also the first junior national team to qualify for a European Championship in 2011 and hand the German team, including a few subsequent world champions, a 4:1 loss. That was the first bombshell, and the above mentioned would soon follow.

Sociologist Vidar Halldórsson of the University of Iceland sees further factors at work that contribute to the success of Iceland’s national team. For all the professionalization around the team, he says soccer in Iceland held onto the valuable characteristics of amateur sports. In contrast to commercialized sports, intrinsic motivation, friendships and strong teamwork play a major role here. Since they are from a small nation, players know they have all 350,000 Icelanders cheering them on when they play in major events, which gives them a strong identity. That makes the national team more than the sum of its parts. It can punch beyond its weight. Icelandic soccer: a pint-sized sport with a growth spurt. ©



ESSENTIAL – VITAMIN D



A section on things that can be found everywhere, yet are so small they often go unnoticed. Still, they are extremely important. Like a seal...

Vitamins are important. That’s what parents say when they urge their children to eat their fruit and vegetables. Vitamin D is especially important for the health of our bones, muscles, blood pressure and vessels. It is found in fatty fish, and in eggs in small amounts – and that’s about it. It is mainly absorbed through the skin from sunlight. Since we get out of our homes less and less often today, vitamin

D levels in many countries are below what they should be. There is a debate over whether this is a “lack” or just an undersupply – and over how much supplements help. Sunshine would be the best option, but there is often too little of it in the winter. Norwegians eat a great deal of fish and take cod liver oil to get a vitamin D boost. No one contests the fact that fruit and vegetables aren’t much help. ©



The Third Dimension


LEITNER is one of the world's leading manufacturers of ropeways. The company's emergence paralleled the rise of winter sports-related tourism. Today, ropeways construction outside the winter sports regions accounts for one quarter of its revenue.

Heavily populated Ecatepec de Morelos lies to the northeast of Mexico City. Over the past five years, if you wanted to reach the upland area of this rambling city, you could take a special form of transportation: the "Mexicable" cable line. It starts at the Santa Clara Terminal, located on the heavily traveled Federal Highway 85, which connects Mexico City with United States. As you approach the station, a huge colorful mural showing the Mexican painter Frida Kahlo comes into view as multicolored trams continually depart the modern building at its rear.

Based in northern Italy's South Tiro region, LEITNER built the "Mexicable," which has two lines running a total length of 4.7 kilometers (2.9 miles). Its transformation into a global company began in the Alps. Initially a family-owned business producing farm machinery, LEITNER turned to ropeways manufacturing as tourism revolving around winter sports emerged 70 years ago. Together with its sister companies PRINOTH and DEMACLENKO under the umbrella of its corporate group HTI, LEITNER has become the world's only complete provider of ropeways, trail



The aerial tram "Mexicable" carries up to 3,000 passengers per hour over the rooftops of Ecatepec de Morelos.



Works of art line the route of the aerial tramway that LEITNER built in Mexico.

groomers and snowmaking systems. In short, everything that tourists require for the carefree enjoyment of winter sports in the mountains. “The fact that we offer everything from a single source gives us an edge in new ski areas like those being developed in China and Russia,” said Michael Tanzer, LEITNER’s Sales Manager for Austria and Germany.

Shortage of Transit Space Paves Way into Cities

Despite its initial strength, winter tourism today only accounts for about 75 percent of the company’s total revenue, about 1 billion euros. This can be traced to the fact that LEITNER began eyeing new markets in 1980. The company started by building systems in Japan and Malaysia that helped to develop new destinations for summer tourists. As in winter sports, the challenge was to bridge great differences in elevation. About twenty years ago, LEITNER added another pillar to its “non-snow” business: urban ropeways. Incidentally, the project mirrors one undertaken by LEITNER’s French sister company, POMA. It was responsible for the construction of the first aerial tram in Medellín, Colombia, to be followed by additional lines.

Today, several Latin American countries have urban ropeways. “Central Europeans still think ropeways systems belong in the mountains. But people see them as modes of transportation in South America,” Tanzer said.

“It was clear to us early on that ropeways systems can solve urban transportation problems,” Tanzer said. “Cities ultimately continued to grow and increase in density. Surface area for transportation became scarce.” But people first had to become more aware of the solution. Medellín eventually commissioned a line for local transit about twenty

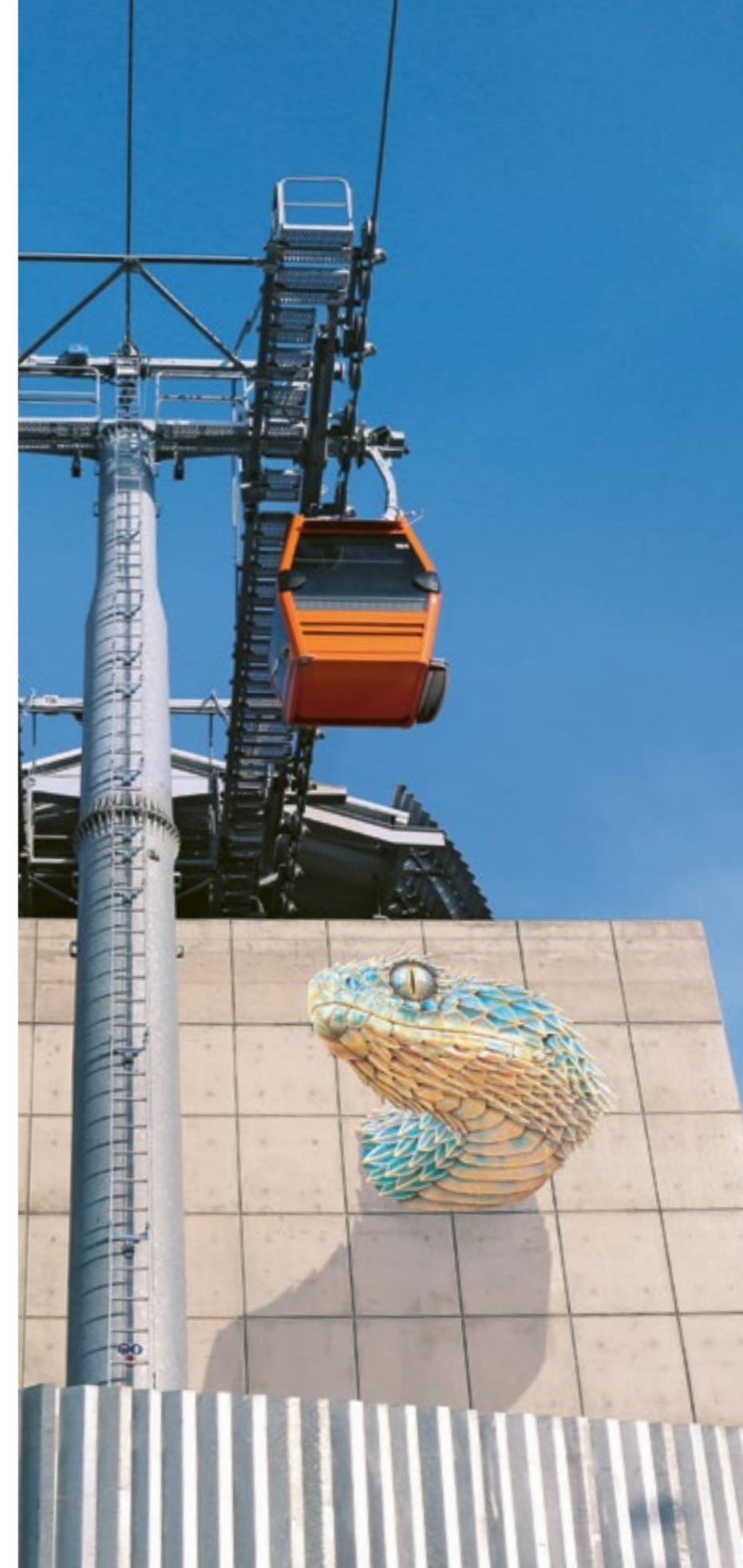


It was clear to us early on that aerial tram systems can solve urban transportation problems.”

ty years ago. The transfer of ropeways technology from the mountains into this urban environment required some adjustments. First of all, due to the different periods of operation, ropeways are used seasonally in ski areas, and, even then, only for about eight hours a day. In cities, they are part of the local transportation system and are in continual use, except for breaks overnight. “We need to shift the inspection time when maintenance takes place to nighttime, and have it completed in just a few hours,” Tanzer said. At 6 a.m., at the latest, the cabins must be loading the first commuters. After all, the availability of the lines is the top priority for operators. But this naturally cannot come at the expense of safety. Ropeways have done extraordinarily well in this regard. A survey by the Federal Statistical Office of Germany found that air travel is the only mode of transportation involved in fewer accidents than ropeways. An accident only occurs once every 17.1 million kilometers (10.5 million miles) traveled in ropeways. For streetcars, the figure is 225,000 kilometers (139,000 miles) and 616,000 kilometers (383,000 miles) for buses.

A Range of Advantages for Ropeways

To make the maintenance and operation of urban ropeways as efficient as possible, LEITNER has to continually develop products. One development is





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cable cars carry up to 3,000 passengers per hour on the “Mexicable” tram.

the gearless direct drive. Besides eliminating gear maintenance, its advantages include the reduced use of resources, greater efficiency, and up to 7 percent less energy consumption. As Tanzer points out, energy use for ropeways is already lower than for buses. “For our ropeways, we only need one drive unit generating 780 kW at most. We can use it to transport up to 5,000 people in one direction. With its approximately 250 kW, a bus transports only a fraction of that number.”

Officials in Medellín and Ecatepec found two other arguments that were compelling. One is the high physical profile of the cities in relation to their existing built-up areas. Streetcars and subways are reaching their limits in the battle to overcome differences in elevation. Many cities are also densely built-out. “When the space on the ground becomes scarce, I have to enter the third dimension. That means into the air,” Tanzer said. The approach pays off financially as well as practically. “A subway certainly carries more passengers, but it is twenty times as costly as a ropeways system, and it takes significantly longer to complete.”

Aside from these tangible arguments, there are other rationales for urban ropeways. In Medellín, the stated goal

was to connect the favelas on the city’s slopes with its downtown. Schoolchildren and workers are supposed to get to the city-center more quickly without being afraid of being assaulted. “Mexicable” connects poor neighborhoods at higher elevations directly with a transportation hub. “Crime is a major issue in cities like Medellín. Streets and buses are more susceptible to it than cabins are,” Tanzer said. “Medellín’s ropeways is considered to be one of several reasons crime is on the decline. There is also an opportunity to develop the neighborhood around the ropeways stations by establishing shops and libraries, for example. The lines are thus becoming pieces of infrastructure as well as socio-political projects.

Tourists also like to climb aboard to gain a special view of the city they are visiting. The mural of Frido Kahlo described at the start is just one of several on the walls of houses and roofs along the route taken by the “Mexicable.” It is small wonder that the addition of a third line to the route is being discussed. One advantage should not be underestimated as well: Passengers don’t have to keep track of a schedule because ropeways doesn’t have one. The system runs without interruption and leaves traffic jams far below.

The Difficult Step Toward Europe

While ropeways are finding more and more imitators in Latin American cities, they have only enjoyed exotic status in Europe so far. But the HTI corporate Group has come up with its first projects. Starting in the summer of 2021, a ropeways system from its French affiliate POMA will be connecting three transportation hubs in Toulouse, France,



An urban aerial tram has been operating in Medellín for about twenty years.



LEITNER AG

Based in Sterzing in South Tirol, Italy, LEITNER was founded in 1888 and is part of High Technology Industries (HTI) today. Besides Leitner, there are several other brands under the HTI umbrella: POMA (Rope-hauled transportation systems), PRINOTH (snow groomers and tracked utility vehicles), DEMACLENKO (snowmaking systems), LEIT-WIND (wind turbines) and AGUDIO (material ropeways). They are all part of the world’s leading manufacturer of ropeways, which is the Group’s core business, snow groomers and snowmaking systems. In 2019, the Group, which has 70 subsidiaries and 131 sales and service offices, generated revenues of just over 1 billion euros (\$1.18 billion), surpassing the one-billion mark for the second year in a row. HTI has more than 3,800 employees worldwide.

climbing to a plateau at a higher elevation. In Ankara, Turkey, a line has supplemented local public transit for years. In Germany, Berlin is working on the integration of an existing ropeways with its public transit system. The system, erected for the International Garden Exhibition in 2017, could close the gap between the subway and commuter train stations in two of the city’s districts.

There are also legal reasons why ropeways are still awaiting a breakthrough as a local transit option in Europe. The laws and regulations covering the systems must first be negotiated. The process starts with residents who create an uproar when they see cabins floating past their living room window. A clarification is also needed on the shading of

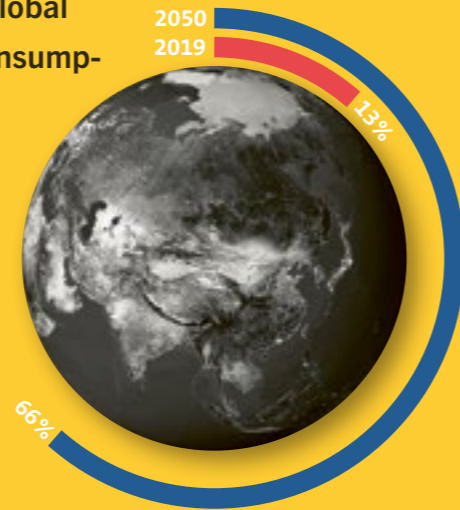
private lots and the right to travel above them. In Turkey, Ankara made special changes to its municipal laws to allow the construction of ropeways up to 45 meters (148 feet) high that floated across skyscrapers. By comparison, the legal hurdles are low in Latin America. Thus, ropeways projects are – and will continue to be – dependent on society’s acceptance and political will. But something else is happening: The EU is making a commitment to CO₂-free transportation, and ropeways help it achieve that goal. German states have approved the systems for funding. That’s not the least important reason that twenty German cities are currently dealing with the construction of ropeways. “These things take time,” Tanzer said. “We just have to keep the ball rolling.” ©



Full Speed Ahead – With Renewable Energy

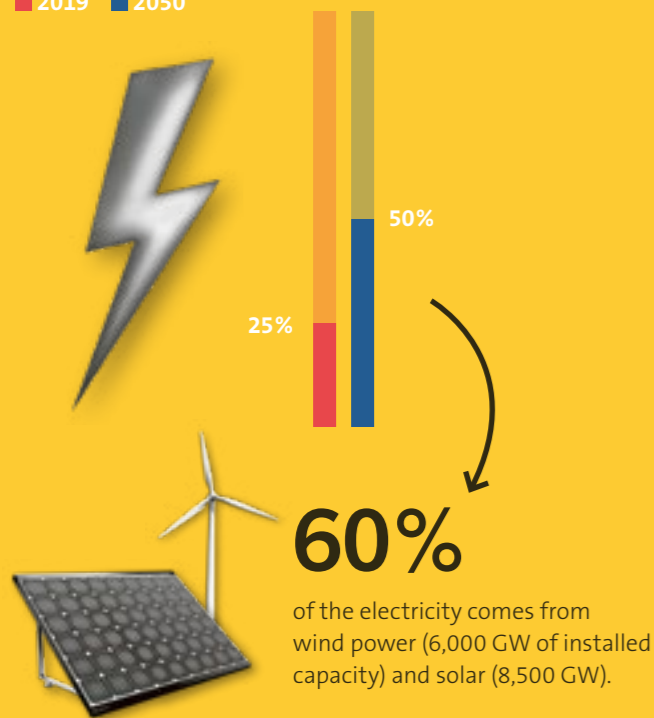
An infinite amount of energy is available from the sun, wind and water to meet global energy needs – theoretically, since we have to transform our energy infrastructure. The outlook for 2050 shows that the space requirements are actually not that great.

Renewable Energy's Share of Global Energy Consumption



The Future Is Electric

2019 2050



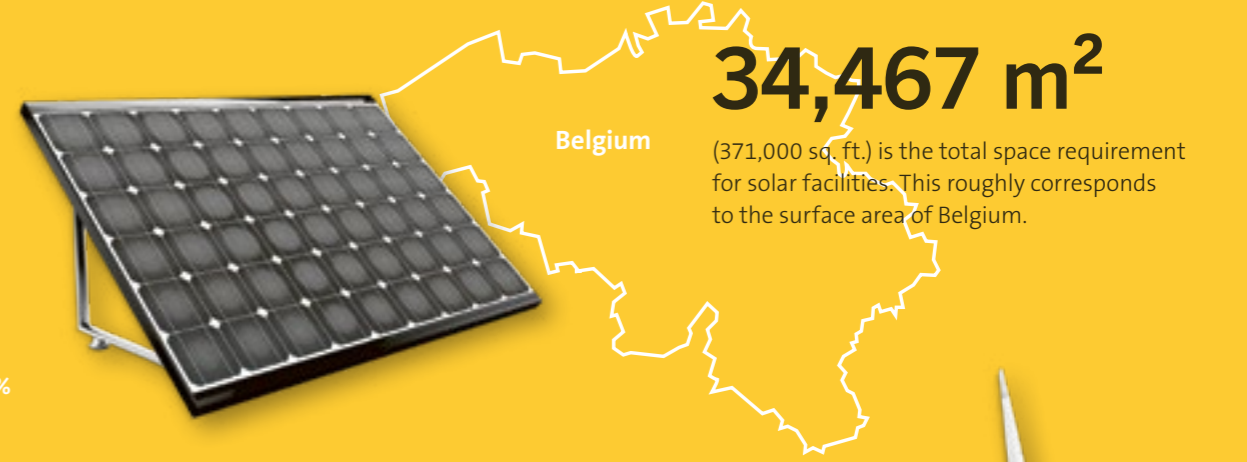
Data on the Transition*

The "Transforming Energy Scenario" from the International Renewable Energy Agency (IRENA) offers a look ahead at 2050:

- Global energy declines due to technological advances in energy efficiency.
- Electricity becomes the most important energy carrier. Its share of primary energy consumption rises to 50%.
- 86% of the electricity comes from renewable energy sources.
- 8% comes from "green" hydrogen from renewable sources.
- 70 percent of trucks, passenger cars, buses and two- and three-wheeled vehicles operate on battery-electric power.

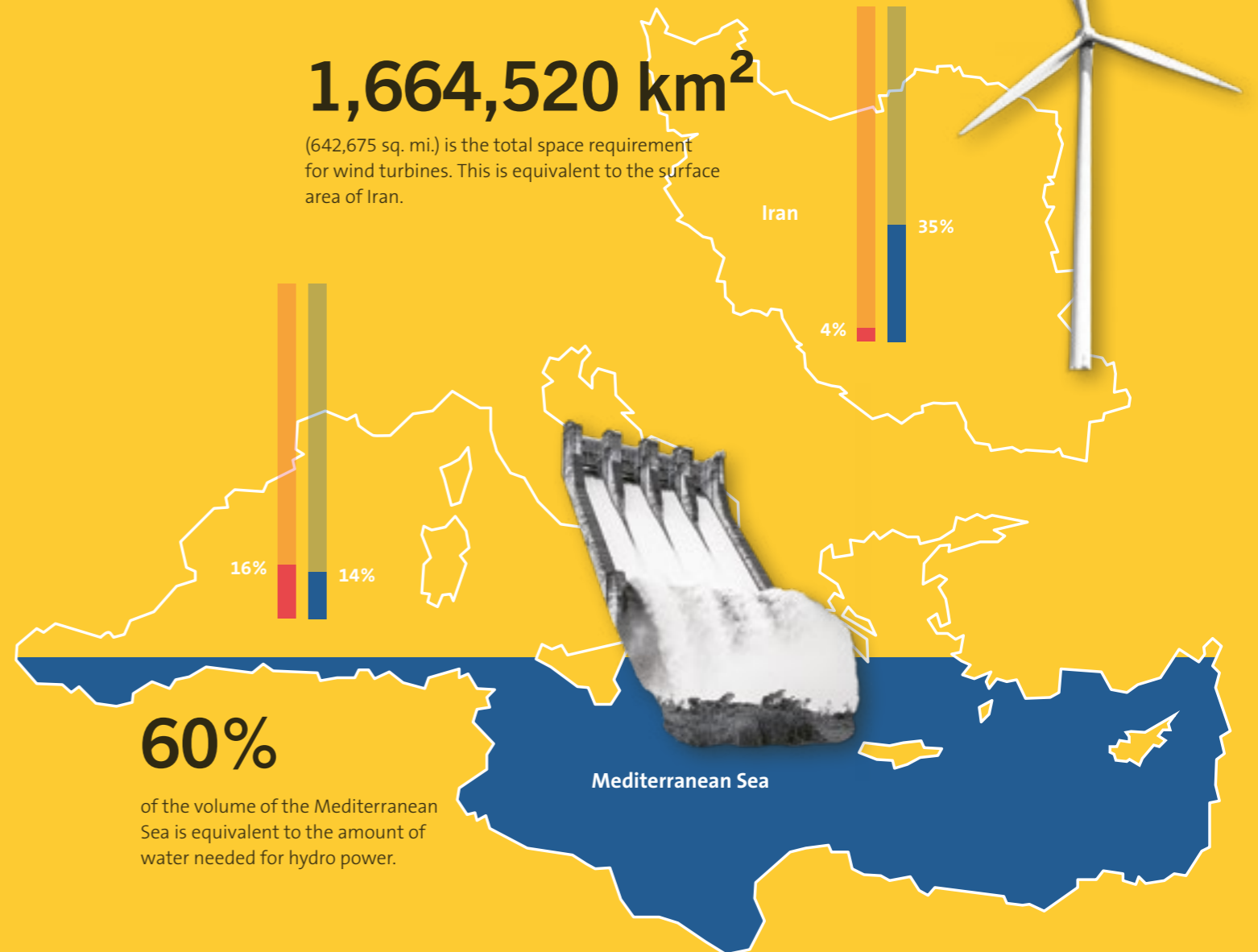
Share of Electricity Production

2019 2050



1,664,520 km²

(642,675 sq. mi.) is the total space requirement for wind turbines. This is equivalent to the surface area of Iran.



* Source: IRENA Global Energy Transformation 2019:



Who is Missing – and Where?

What good is state-of-the-art technology if there is no one to operate it? Well-trained skilled workers are still an economy's most important resource despite the increased automation of work processes. And those workers are in short supply.

Bleak prospects are looming for 2030: Analysts have been warning about the global skills gap for years. A shortage of highly trained workers is going to slow technological progress, reduce prosperity and usher in a global crisis – if companies and political leaders fail to introduce countermeasures in the form of training programs and changes in the work culture. Those who are sounding the alarm present charts that show lines radiating in scissor-like patterns and age pyramids in the shape of bulging urns. There is broad agreement that a critical imbalance between supply and demand will be reached in 2030. That's when the baby-boomer generation of Western industrial nations will have retired.

The consulting firm Korn Ferry has predicted that there will be a shortage of 85 million workers in 2030, quantifying it as \$8.5 trillion in unrealized revenue. To put the problem more precisely, there is a shortage of people with the skills that match the jobs of the near future. In this light, the notion of a “scarcity of skilled workers” is imprecise – the problem is that there is a talent imbalance or mismatch. The change in perspective reveals that many people have not had the opportunity to build up the skills that prepare them for the highly specialized tasks that are increasingly in demand. Moreover, the structures of the old world of work do not meet the needs of the younger generation.



85 million

skilled workers will be the global shortfall in 2030.



A shortage of skilled workers can be found in a wide range of sectors.

There is worldwide demand for engineers and IT specialists in professions that have just emerged.

There are also too few doctors, nurses and support staff in many countries.

A Skills Shortage at One in Two Companies

In 2019, one company out of every two did not have enough skilled workers. The ManpowerGroup analyzed the trend in its report entitled “Closing the Skills Gap: What Workers Want.” A world map in this report shows the most affected countries in deep red. They were the United States, Japan, along with European countries like Poland, Finland, Hungary, Romania, Croatia and Greece. Shown in lighter red, Germany, Sweden, Portugal and Slovakia were only a bit better off. Israel and New Zealand fell into the same category.

“Compared to all the other countries in our study, the United States is facing an especially alarming scarcity of skilled labor,” Korn Ferry summed up in “Future of Work. The Global Talent Crunch.” This could entail a 6 percent decline in economic volume, the analysts say.

In 2030, only India will have a worker surplus ranging from technical experts to factory staff. There is huge potential in Africa since a quarter of its people will be younger than 25 in 2030. Everything now depends on the educational opportunities for that generation. At present, many companies in Africa still cannot find enough qualified workers, which is why two-thirds of its CEOs are investing less than they would like.

What Expertise Is Really Lacking

The demand for skilled employees is often associated with the so-called MINT fields – mathematics, information science, natural sciences and technology, which are the foundations of the engineering professions. From the standpoint of the entire economy, this impression is deceiving. While many

major studies concentrate on the technology and financial sectors, bottlenecks in the nonacademic professions that support public life go unnoticed.

A study from the ManpowerGroup offers a balanced picture. Here the skilled trades top the list of the most sought-after competencies, ahead of sales, marketing and technology. Engineers land in fourth place, and drivers and logisticians follow. IT specialists only appear in sixth place, followed by occupations such as machine operators and the building trades. For the first time, physicians and nurses have risen into the top 10 of the annual ratings.

Clinic Beds – But No Caregivers

The damage to Germany’s medical sector has been especially severe during the corona pandemic. Many intensive care beds and respirators were indeed available, but there weren’t enough intensive care nurses in these situations. Germany’s health system is considered to be one of the best in the world, but its Achilles’ heel is a shortage of nursing staff. The country, which has the second-oldest population in the world, will need about 150,000 nurses, including geriatric caregivers, by 2025. That is why they are recruited from other countries, including Mexico, Vietnam, Tunisia, Serbia, Bosnia-Herzegovina and the Philippines. Bilateral agreements are designed to prevent a brain drain since a disproportionate migration of well-trained experts weakens the home economy. But countries with demographic trends like Germany’s are dependent on the migration of workers.

The World Needs These Skills

One strong indication of the global technological change is the rising demand



150,000

additional nurses, including geriatrics specialists, will be needed in Germany by 2025.

for certain specialists. For example, Germany is looking for engineers in mechanics and automation. In the United States, renewable energy is increasingly important, and the demand for technicians with experience in wind turbines and solar is soaring.

For its part, Saudi Arabia cannot rely on its oil reserves forever. The country has to build up its IT expertise to keep up with technological change. That means its young, mobile, networked population is its most important resource for the future. They are due to be trained in cloud computing, cybersecurity and network technology. It is also essential for the country to open up its male-dominated world of work to large numbers of well-educated women.

In Japan, by contrast, a natural decline in the number of workers is accompanying the fall in its birth rate. In response, the country is automating production processes – which merely shifts the demand. Then it is app developers and experts in artificial intelligence and the Internet of Things who are sought-after. Meanwhile, China is pressing ahead with the massive digitalization of its huge industrial sector. It has its eye on the still rare specialists in artificial intelligence and blockchain along with full stack developers, the super talent among programmers.

In many countries, jobs are emerging that are totally new to state employment exchanges. One thing is sure: We need a skills offensive. In the interests of business and humanity. ©

Pioneering work in a new profession:
Cara Mia Pesta was trained to
become a production metrologist.



FST Creates Customized High-Skill Occupation

Cara Mia Pesta is training for a profession that didn't even exist a year ago. The new employee at Freudenberg Sealing Technologies (FST) has set her sights on work as a manufacturing metrology technician.

At the company's Kufstein facility, Pesta is specializing in precisely the skills that will move it forward. As sealing technology has progressed, the demands on measurement and testing have been rising. So have the skill levels that are needed. But it is increasingly difficult to venture out into the labor market and find staff with the expert knowledge that FST requires. To solve the problem, the company has gone on the offensive and established a new skilled profession in Austria. It is an extraordinary solution to a problem – a shortage of skilled staff – that FST shares with many companies worldwide.

Daniel Stocker, Team Leader at Measurement and Testing Technology at Freudenberg in Kufstein, explains the initiative this way: "At our site, the average seniority is thirteen years. Our long-time employees have continued to build up their skills over the years to meet growing requirements. But if they resign or retire, it's hard for us to fill in the gap. The few applicants with the right training and practical experience are also being pursued by other companies."

Stocker therefore came up with the idea of inventing a new skilled occupation: manufacturing metrology technician. The goal was to align the training closely to real-life practices at FST. And it was also supposed to provide skills for future technologies such as automation and Industry 4.0.

Tanja Hofer, the trainee coach in Kufstein, brought Stocker's proposal to the

Vienna Chamber of Commerce. It surveyed various industrial companies, and they unanimously welcomed the notion of a new skilled occupation. Then everything went very quickly: Hofer and Stocker worked jointly with representatives of other companies and measurement labs to define the training content. The Chamber of Commerce fed it into guidelines and presented it to the ministry for approval.

The result: Since July 2020, Austria has had a new skilled occupation: manufacturing metrology technician. And in October, Freudenberg Sealing Technologies in Kufstein hired Cara Mia Pesta as the first trainee in the specialty – just one year after the idea first emerged. Stocker puts it this way. "Our hope was that the trainees would quickly build up their knowledge and add to our productivity – and the plan is working out with Cara Pesta." ©



NOW I'M TELLING YOU



Rare Earths

Our name could hardly be more misleading. After all, we aren't rare at all. Nor are we earths. We are seventeen metals – rare earth metals, to be precise. We are neatly arranged on the periodic table, from scandium to lutetium. The name scandium points to where you began to figure us out. It was in Sweden, at the end of the eighteenth century, where one of us was isolated from an ore for the first time.

Since you have done without us for so long, you might think that you could continue on your merry way. Not at all. You must be joking. You have finally identified our beneficial traits. Neodymium has such a high energy density that makes it ideal for magnets in electric motors and generators in wind turbines. The element is also found in

high-performance lasers, as is yttrium. Cerium makes special glass and paint more robust. It is put to use in smartphones, notebooks, catalytic converters, ceramics and LED lighting and is therefore very important.

Our deposits are what worries you. To be sure, we are at home anywhere in the world, but are hidden in other minerals, mostly in small concentrations. That makes mining difficult and unprofitable, so you don't bother with us in many locations. But we can be extracted somewhat more effectively in China. Total production came to 132,000 tons in 2019, or 63 percent of the world's production. A problem persists: Our mining is not exactly environmentally friendly. But you apparently can no longer live without us. ©



With a Cold Runner

It especially pays off at high volumes: valve gate cold runner technology for injection molding.

Though only used in the United States initially, a new injection molding technology has now spread to many other Freudenberg Sealing Technologies plants worldwide. The example shows that, when every cent counts, technologies that conserve resources pay off.

The phrase “Live free or die.” has only been the official motto of the state of New Hampshire since 1945, but it dates back to the time when the United States was founded. Robert Scavuzzo is responsible for developing new production technologies at Freudenberg Sealing Technologies. In his office, there are always a few signs bearing the motto on his bookshelf. He presses them into the hands of his visitors as they leave. Scavuzzo, who descended from German and Italian immigrants, has personally seen how the combination of freedom and hard work can lead to social advancement. For him, the American dream is still alive, as it is for many people throughout the world. In 2019, according to a survey by the Pew Research Center, more than 44 million people born in another country were residing legally in the U.S.

But the gleam of the star-spangled banner has paled in some parts of the world. No particular president is to blame ei-

ther, but rather the enormous consumption of resources by the West’s leading power. The typical American generates about four times the global average for carbon dioxide emissions per capita. When it comes to water consumption per capita, the U.S. is the record-holder among OECD countries, a tribute to farming on formerly arid landscapes. To many Europeans, life in America is an example of how not to live a sustainable lifestyle. One suspicion is that a lack of regulation is the main reason for the country’s profligate use of resources.

But as with so many stereotypes, this one fails to grasp every facet of the situation. CO₂ emissions per capita may be high in the U.S., but the country has recently seen the greatest decline in this metric among all industrialized countries. This is not the result of billions in subsidies for renewable energy but solely due to the switch from coal to less expensive natural gas, which is extracted domestically. The world’s largest electric

car manufacturer is not based in Germany, where an official government platform is tackling the mobility of the future, but in California – which has championed air purity for decades.

Avoiding Scrap

That brings us back to the office of Robert Scavuzzo as he passionately explains a complex technical process used in the production of seals. The raw material, an elastomer, is heated inside a cylinder and transformed into a fluid. Then, it flows through a closable nozzle down

into a tool not unlike a baking mold. The technology is called valve-gated cold-runner injection. Without the precise operation of the valve gate, small sprue marks are formed in each operation that have to be removed from the cured product. Since individual elastomer molecules cross-link during the curing – the only way to achieve the desired elasticity – the scrap cannot be recycled directly. It is mostly incinerated, releasing its carbon content as CO₂. With Freudenberg Sealing Technologies now using the process in its plants worldwide, it is eliminating about 70 tons of scrap each year and emitting 600 tons less CO₂.

The Freudenberg plant in Manchester, New Hampshire, is the lead facility for the valve-gate cold-runner injection molding technology. Manchester is a livable city of 100,000 where the company manufactures engine seals and valve stem rings, among other products, producing volumes in the millions. The technology was developed and introduced about 20 years ago. “Our customers are extremely price-sensitive,” explains Robert Lidster, the division’s technical director. “But if we can avoid engineering waste, we are not only improving the environment but we can offer our products at lower prices.” But it is also true that the valve gate technology comes with a higher price tag compared to traditional cold-runner tools. So, in Manchester, a separate decision is made for each product as to whether or not the cold runner valve-gate technology comes into play. There is a simple rule of thumb: the higher the volume and the bigger the product, the greater the savings, and the sooner a more expensive tool is amortized. Lidster points to

another advantage as well: “Product quality rises because no excess material can flow back through the closed nozzle. That could otherwise potentially lead to unevenness in the structure of the material.”

Computer-Assisted Progress

The success of the cold runner technology is no reason for Scavuzzo, an engineer working on advanced developments, to rest on his laurels. In recent years, much of his work has involved optimizing the geometry of the channels. “Here we used the kind of computer-assisted processes for fluid calculations that are used to design turbochargers and aircraft turbines.” The result: It now takes up to 35% less pressure to move the raw material through the now-rounded channels. This in turn saves energy and promotes a more even flow. A new generation of the valve drive is still in development. To this point, the valve has only been able to open and close at predetermined intervals. But, as in vehicle engines, a variable valve control system could offer major advantages. “With a servo drive, we could control the opening of the drive almost at will,” Scavuzzo said. “This would make it possible for us to adjust the process to changes in conditions at any time.” It is an Industry 4.0 technology that is also sparking interest in Freudenberg Sealing Technologies factories in Germany. The example of the cold runner technology illustrates how quickly a technology that from an ecological standpoint can make headway, but its spread mainly depends on whether it offers economic advantages, too. In turn, freedom is a key condition for an innovation to emerge in the first place. ©



70 tons

That is the quantity of scrap that Freudenberg Sealing Technologies saves each year worldwide thanks to this process.



Every cent counts – and so does every gram of material: seal production at the Manchester plant in New Hampshire.



In turn, freedom is a key condition for an innovation to emerge in the first place.”



The Optimist

Will the world's resources be plentiful enough for 10 billion people, all aspiring to lead a prosperous life? Certainly, says Swedish historian and author Johan Norberg. With progress and openness to new ideas and developments, he feels opportunities are opening up.



Corona appeal: Humanity can only solve truly large problems by cooperating.

It is the late 1980s, and Johan Norberg is preparing for his selection as student body representative at his school in a Stockholm suburb. He dreams of a free life, living out in the country. To him, modern, industrial Sweden and its school system seem to be full of constraints. So the 15-year-old creates his own student party, the “Anarchistic Front.” In 2001 – he has completed his studies in history by this point – 250,000 critics of globalization demonstrate during the G8 summit in Genoa. At about this time, Norberg publishes a book defending globalization and capitalism. It is translated into 25 languages. That success enables him to make his living as an author. Today he talks about a gradual process of reflection that transformed him from anarchist to liberal. And he describes a key moment in his studies. While doing research in the records of his family, he learned that it only took a single year in the 17th century, a year with a bad winter and a failed harvest, to decimate a large proportion of his forebears. The last remnants of a romantic image of the “good old days” shattered into pieces.

He says the golden age of human history is in the here and now. With such assertions, Norberg simultaneously inspires some readers and stirs opposition in others. In “Progress,” pub-

lished in 2016, he calculates that 90 percent of humanity at the start of the 19th century still lived in extreme poverty as defined by the United Nations today. That figure has now dropped to 9 percent. Life expectancy has more than doubled in the same timeframe, not just in rich Western countries but as a global average. Enormous progress has been made everywhere in literacy, equal rights, measures to combat violence, and even environmental protection, he writes. The reviews have mainly been glowing, but Norberg has repeatedly stirred outrage. “You have your facts, but I have my own stories,” the accusation runs.

Traders and Tribe Members

In his latest work, “Open,” Norberg goes a step further: He points to progress as a function of openness. Drawing on numerous historical examples, he shows that the eras that we define as high culture are all marked by a lively exchange of ideas and goods. Trade is in the very nature of humanity, he says. But Norberg also shows that human development has suffered many reverses. One of the most striking examples: At the start of the 15th century, China had the world’s most powerful ocean fleet, with ships far exceeding 100 meters in



The most important raw material is the human brain, and it is potentially infinite.”

length. Compared to them, the “Santa Maria” commanded by Columbus would have seemed a mere nutshell. China could therefore have been the country that discovered and conquered the Americas. During the Ming Dynasty, however, the fleet was initially nationalized, and then sea trade was halted. Societies close themselves off again and again. Norberg says this is rooted in a second human characteristic, “tribalism,” or putting the welfare of one’s own tribe ahead of everyone else – and ending up achieving the opposite.

With its autocrats and trade conflicts, isn’t that exactly the track that the world is on? “This duality of human nature does not allow us to break loose from the cycle. Since the financial crisis, growing numbers of populists are seizing the opportunity that tribalism offers.” When the ESSENTIAL editorial team interviewed Norberg by video in January 2021, nearly the entire world was closed off due to the corona pandemic. Yet he radiated optimism. “There has naturally been much discussion about value creation chains. But the world has also learned that you can only understand major problems when there is global cooperation.” He says there is definitely an opportunity for a golden era to come our way after the pandemic.

Open Doors

Norberg does not see bottlenecks impeding access to resources. “The most important resource is the human brain, and that is potentially infinite. It’s not the reserves of copper or lithium that will determine whether prosperity for 10 billion people



Johan Norberg

Born in 1973, Johan Norberg studied history at Stockholm University and began working for the Swedish think tank Trimbro in 1999. His second book, “In Defense of Global Capitalism,” was published in the original Swedish in 2001 and has been translated into more than 30 languages. Its commercial success allowed Norberg to begin work as an independent author in 2006. One of his best-known works is “Progress.” The subtitle for the English edition is “10 Reasons to Look Forward to the Future.” As a senior fellow at the U.S.-based Cato Institute, he champions free trade, among other policies.

Poster campaign in Britain: Can humanity overcome its tribal nature?



can be achieved but rather open exchanges, open minds and open societies.” Norberg also makes the case for “open doors,” that is, more or less unhindered migration. The view has stirred up some unpleasantness, but he feels he has been proven right again and again.

Norberg says the climate crisis also can only be overcome with innovation – and a price levied on CO₂ emissions, which would promote this kind of innovation. He has not discussed this with fellow Swede Greta Thunberg, but certainly with many of her supporters. And with politicians who have little patience for openness to technology and want to regulate how a desirable state of affairs should be achieved. Norberg, who prefers not to classify himself along the left-right spectrum, makes the case for objectives instead of concrete plans. He is repeatedly asked why he is not involved in politics himself. His

answer: “I am comfortable in the role of someone who moves new ideas along to breakthroughs.” That means talking about things that the majority doesn’t agree with. In politics, you would have to do exactly the opposite.

The fact that Norberg distances himself from these kinds of responsibilities likely relates to the longing for freedom that has been driving him since his school days and that he can enjoy today as an author. He is always writing. He does it everywhere, in every room in his house, and he likes to do it in cafés or on trips, at any time of the day. If his smartphone happens to vibrate and show him a new tweet, that doesn’t bother him at all – after all, it could give him another idea. He doesn’t yet know what his next project will involve, only that “I will be dealing with great misconceptions and trying to refute them.” That’s exactly what he has done for 20 years. ©

November 2020

Hydrogen on the High Seas



Equipping the roughly 100,000 commercial ships traveling the world's oceans with CO₂-neutral powertrains is a Herculean task. All the more since a large share of these ships are part of the world's deep sea fleet. That means the new propulsion systems will have to help them cover very long distances.

In its search for a solution, Freudenberg Sealing Technologies has developed a methanol-powered fuel cell system that has been certified with an "approval in principle" from the classification society DNV GL. That clears the way for the government-backed system to be tested in the cruise ship AIDAnova this year.

For its solution, Freudenberg Sealing Technologies turned to renewably pro-

duced hydrogen in combination with methanol. The PEM fuel cell consumes methanol and operates with an upstream reformer. Using steam reforming, the system produces the hydrogen that reacts with ambient oxygen to produce energy for the ship's power plant and onboard network.

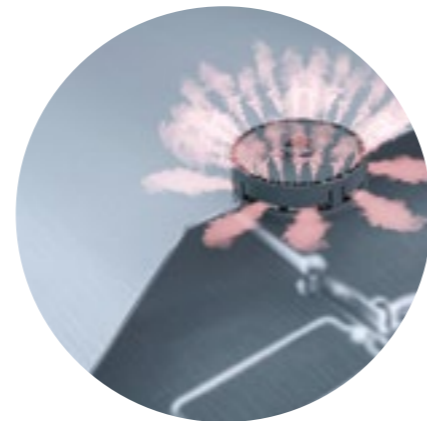
Its container-based design is ideal for shipping. All the components are housed in a prefabricated unit that is easy to install on board. The rated output for several units can be scaled up to the two-figure megawatt range. Other fuel cell applications are possible in addition to the methanol system. They include the use of pure hydrogen and liquefied natural gas. ©

January 2021

New Valve for Safe Batteries

The lithium ion batteries of today's electric cars are densely packed power packages. That means protective measures are indispensable. Reaction gases must be able to drain away quickly and in a controlled manner when there is a defect. But there also has to be a mechanism for pressure equalization during normal operation. Freudenberg Sealing Technologies combines both functions in a valve called "DIAvent."

The next generation of the valve offers emergency degassing that is four times as fast. The improved gas flow can be traced back to fairly small geometric changes, such as extra openings on the side of the umbrella valve. The "DIAvent High Flow" intrinsically combines the proven strengths of its predecessor: A water-repellent nonwoven promotes effective air exchanges during normal operation. The umbrella valve, which



encloses the nonwoven membrane like a ring, ensures degassing in an emergency. When the pressure is too high in the housing, it opens until there is equalization and then shuts with a watertight closure. ©



November 2020

Innovative Butterfly Seals

Valves for the process industry must meet high hygienic requirements. The French manufacturer Definox needed a customer-specific sealing solution for a series of new high-performance butterfly valves. The idea was to work with Freudenberg Sealing Technologies to find the ideal combination of uncompromising leak-tightness, easy assembly, a dead-space-free seal geometry, and resistant material. The effort was a success. With the help of comprehensive tests on a Freudenberg test rig, the partners created a novel, long-lasting and reliable butterfly valve seal out of wear-resistant materials, with an innovative design. ©

October 2020

Crossing the Divide

The American manufacturer Trek has come up with an innovative rear wheel suspension system in its Supercaliber cross-country mountain bike. As part of its IsoStrut system, the suspension strut is completely integrated into the frame, providing a balance between efficient "hard tail" design (without suspension) and the fully suspended, comfortable "fullies." Two custom-fit Freudenberg Sealing Technologies sealing rings made of nitrile rubber keep the high-tech system free of dirt, even under high off-road stresses, reducing the need for maintenance. The two companies are already working on the next generation of compact seals. ©



Find more news online at:
<https://on.fst.com/2PCI9mR>



October 2020

Batteries for Ferries

Freudenberg Sealing Technologies is pressing ahead with its environmentally friendly powertrains in the shipping sector. Two new ferries operated by P&O Ferries, equipped with around 1,200 high-performance batteries from XALT Energy, a Freudenberg Group company, will be linking Dover and Calais starting in 2023. With a

capacity of nearly 9kWh per ship, the project represents one of the world's largest battery systems in the maritime sector. The lithium ion batteries support the ferries' diesel engines and enable zero-emission maneuvering in port. They are housed in specially designed XRS-2 rack systems that withstand corrosive marine environments. ©



1,200

high-performance batteries will be installed in ferries traveling between Dover and Calais starting in 2023. ©

Feedback and Contact

Current and Fully Informed

Would you like to learn more about Freudenberg Sealing Technologies, our products, solutions and services? Then take a look at www.fst.com and discover our wide-ranging portfolio. On our Internet site, you can also download all the editions of our company magazine as PDFs or subscribe to the magazine at no charge.

We look forward to a dialogue with you!

Freudenberg FST GmbH

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