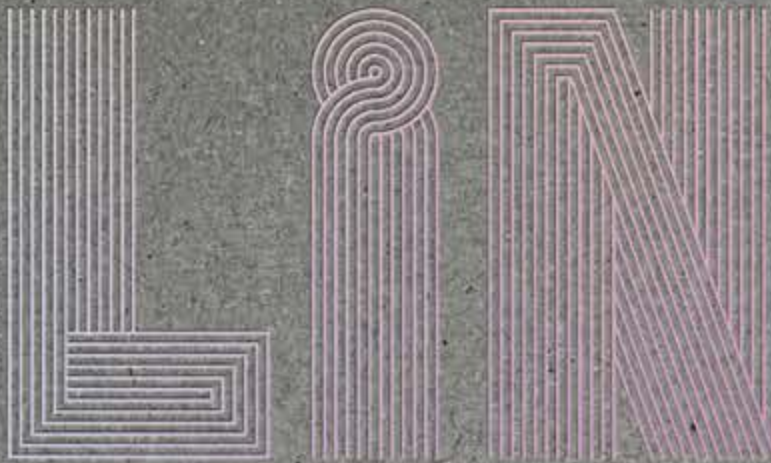
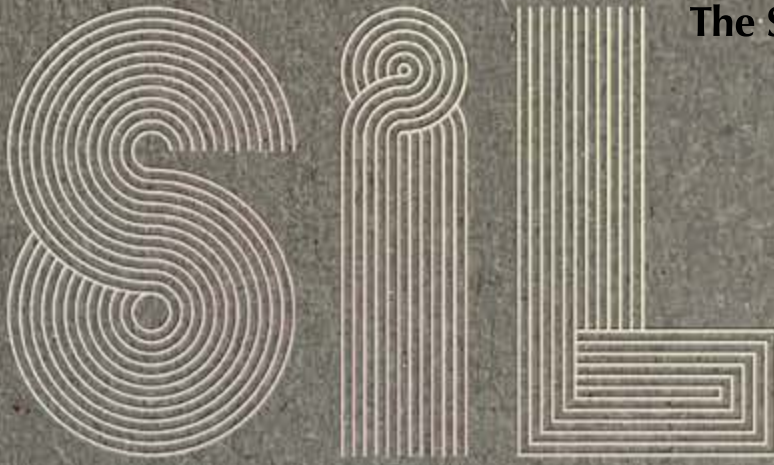


PERIODICAL #27



Belén Garijo

Merck

Pat Gelsing

Intel

Gunnar Groebler

Salzgitter AG

Christian Hartel

Wacker Chemie

Joe Kaeser

Siemens Energy and

Daimler Truck

Torsten Leue

Talanx Group

Klaus Rosenfeld

Schaeffler

Michael Schöllhorn

Airbus Defence and Space

Hung Tran

Atlantic Council

Lars Wagner

MTU Aero Engines

Hell or High Water

Remember this? "If a foreign country can supply us with a commodity cheaper than we ourselves can make it, better buy it of them with some part of the produce of our own industry, employed in a way in which we have some advantage."

No doubt, more than 200 years ago Adam Smith and David Ricardo could not have envisioned what kind of severe impact this equation has had for our economy today. Cheap and sufficient energy is definitely not our comparative advantage for the time being. Unfortunately, this hits all our energy-intensive industries.

Sure, economic shocks have always led to stagnation or contraction of the legacy. And cost disadvantages have ended up in closures or in offshoring of certain value chains. But for all the downsides, Adam's and David's equation does also have an upside: Focus on your comparative strengths. Time to reflect!

The last structural reform was two decades ago. Workforce transformation has failed so far. And while bureaucracy is at an all-time high, politicians outdo each other with ideas for subsidization. What we really need is another *Zeitenwende*, one that turns the focus on the supply-side fundamentals. Parameters that incentivize what we were once world-leading in: Engineering prowess! Innovation! Talent! And infrastructure.

So, let's pray that the current shock is just a wake-up call to reflect on our key sources of strength: Let's try turning this misery into an opportunity! The state has an enormous duty in terms of our ecosystem, education, workforce, and infrastructure. Start making good on this, and prepare the ground for our corporations to transform with tech and innovation.

Our authors have incorporated this spirit. They prove that their ideas and creativity can spark light in these gloomy times. Let's empower them to flip the switch on their ingenious plan.



Enjoy your read

Gerhard Nennung

3 **Hell or High Water**
 Editorial Comment
Gerhard Nanning
 Executive Director of
 The Stern Stewart Institute

20 **Hydrogen: A Panacea
 for All our Ills?**
Klaus Rosenfeld
 CEO, Schaeffler

50 **Mission Possible:
 Climate-Neutral Flying
 is Feasible**
Lars Wagner
 CEO, MTU Aero Engines

74 **Pioneering for Transformation:
 A Journey Towards Low-carbon
 Steel Production**
Gunnar Groebler
 Chairman of the Board, Salzgitter AG

6 **Sink or Swim?
 Europe in a New World Order**
Joe Kaeser
 Chairman of the Supervisory Board,
 Siemens Energy and
 Daimler Truck Holding

28 **Germany's First National
 Security Strategy:
 Intention Versus Reality**
Hung Tran
 Nonresident Senior Fellow,
 Atlantic Council

58 **The Power of
 Weak Signals**
Torsten Leue
 CEO, Talanx Group

82 **Photovoltaics from Europe
 for Europe: What it Takes to
 Establish a Competitive
 Solar Value Chain in Europe**
Christian Hartel
 President & CEO, Wacker Chemie

14 **Welcome to
 the Siliconomy**
Pat Gelsinger
 CEO, Intel

38 **Navigating the Zeitenwende:
 An Action-Driven Roadmap
 for a Resilient Defence Sector
 in Germany and Europe**
Michael Schöllhorn
 CEO, Airbus Defence and Space

66 **From Ashby's Law to
 High-Impact Innovation**
Belén Garijo
 Chair of the Executive Board & CEO,
 Merck

90 **Imprint**

Sink or Swim?

Europe in a New World Order




Joe Kaeser

Chairman of the Supervisory Board
Siemens Energy AG and Daimler Truck Holding AG

*"And you better start swimmin'
Or you'll sink like a stone
For the times they are a-changin'"*

Bob Dylan, 1963



“There is no single European country, not even Germany, that can meet the United States and China – and likely soon also India – on eye’s level.”

Bob Dylan’s lyrics have been running through my head quite frequently these days. They describe very aptly that we need to move if we want to help shape the new world order that is emerging, rather than just being caught up in it. Very few German words have made it into American vocabulary. They include Kindergarten, Weltschmerz, Zeitgeist and Schadenfreude. A new one was added last year: Zeitenwende, which means a historical turning point.

To describe the current geopolitical mood, Constanze Stelzenmueller from the Brookings Institution borrows from the title of the recent Oscar-winning film “Everything Everywhere All At Once.” We’ve only recently had to recalibrate our stance with Russia; now we’re facing debates about how to deal with China. And what about the perceived “rising star” India? We are witnessing the emergence of AI, but what are the ultimate consequences? Climate change is progressing, partly because we are not consistently applying our available technology to decarbonize the economy. Are we able to switch from announcing to implementing at COP28? New forms of activism are attacking established business and societal models. Mostly peacefully, but for how long?

Strong together

So, the question is, Quo vadis world? I believe we are living in a time of tremendous opportunity. As someone growing up in Europe but also observing the dynamics elsewhere, I do wonder how Europe can play a role in this new world order of “Everything Everywhere All at Once.” The thing we as Germans really need to understand is: There is no single European country, not even Germany, that can meet the United States and China – and likely soon also India – on eye’s level. Yet, that is where the major negotiations are happening. We as Europeans must finally realize that the only way we can be heard internationally and contribute to decision-making in the new world order is by acting together. Although the war in Ukraine has strengthened the transatlantic camp, it will not remain that unified forever. And who knows what the 2024 presidential elections in the United States will bring? America will look to Europe, but it will not wait for it forever. It is evident that European politicians should take the Inflation Reduction Act (IRA), a smartly designed piece of legislation, as a wake-up call for Europe. It incorporates key elements of geostrategic and geoeconomic priorities. It addresses an important future sector of the European economy: sustainability. It’s pragmatic and designed for economically feasible sustainability. So, the clock is ticking, and the world be looking while it moves on for its own priorities.

That doesn't mean we should talk ourselves down: We are a global player that is home to 500 million people, has great legal certainty, is innovative and represents around one-seventh of global economic power. Europe has a lot to offer and is also a priority for the United States, China, and India – as a partner and competitor in geoeconomic and geopolitical matters. That is why Europe needs to gain traction. A unified foreign trade policy based on a coordinated European industry and energy policy could be the way forward.

Here is my take on this. In order to implement a European foreign trade policy that safeguards prosperity in the long term, Europe needs:

1 ...an industrial policy that enables **key industries and future technologies** to become established here and then push into the global markets. Industrial digitalization, biotechnology, sustainable mobility, medical technology, sustainable energy and the circular economy are such industries. We need to win here by leveraging our business opportunities. Giving two examples from the energy industry: We have every chance of being the world leader in hydrogen and wind technology. Five of the ten leading wind turbine manufacturers are European companies that, together, hold 42 percent of the global market. We must succeed in developing this industry, which is so critical to the energy transition and energy sovereignty in Europe. In the hydrogen industry, too, we should use our good starting position of first-class technologies to scale the hydrogen market. We need targeted government subsidies for this industry, which is currently in the early stages.

...a **diversified and resilient procurement policy** for raw materials (and energy resources), which also includes raw material alliances and partnerships. We should have learned from our dependence on Russian gas that it is not a good idea to put all our eggs in one basket. Core criteria for a future-proof procurement policy are the close monitoring of strategic raw materials, diversification across the entire supply chain and the establishment of a circular economy. Some of these aspects have already been addressed by the EU's Critical Raw Materials Act. Let's hope that this legislation helps to safeguard Europe's access to raw materials.

“We are a global player that is home to 500 million people, has great legal certainty, is innovative and represents around one-seventh of global economic power.”

2 ...a **phobia-free approach to energy supply**, including an openness to technology. Here, too, diversification is critical when it comes to the supplying countries, supply routes, energy sources and technologies. We have made good progress with constructing LNG terminals in Northern Germany. There is a clear plan for developing the North Sea as a global wind energy powerhouse. These are enormously important initiatives. However, there is still no big picture, no energy master plan that maps out Europe's energy supply in 20 years. A plan providing answers to questions of supply security in the future: How can we accelerate the expansion of electricity and hydrogen infrastructure? How can we master the heating transition? And how can we ensure that access to clean energy preserves Europe's competitive edge? It is the only way we can retain and develop modern industries in Europe.

3 ...**faster decision-making**. To put it bluntly, what we need in Europe, and not just for the EU institutions, is a **Bureaucracy Reduction Act**. Ten years to plan a wind park? Thousands of files for a new power line? We can't be serious. Europe – or rather the next Commission – urgently needs a **Complexity Reduction Act** (keywords: taxonomy, delegated acts, etc.). Without it, we'll be making ourselves obsolete. We must greatly accelerate the current “speed” of approval processes and, as a result, the construction and expansion of infrastructure and future technologies.

4 ...a **courageous and visionary industrial policy** that facilitates creating global champions. Airbus is a good example of a globally successful industrial architecture. We have failed in other areas, though. Just look at the merger of Alstom and Siemens Mobility that was meant to create a European rail champion. Many of today's competitors are global rivals that are state-owned or quasi-state-owned enterprises, such as those in China. Our antitrust authorities need to take far greater account of this new normality when assessing mergers.



I was born in 1957, just a few kilometers away from the Iron Curtain. That was the year in which the Treaties of Rome were signed, making Europe the guarantor of peace and prosperity. But the world is changing more radically than ever before. We cannot just carry on “as usual.” The Europe of today and tomorrow must become more adaptable. And it must develop a longer-term vision underpinned by timely execution. The vision of a continent that is willing to change, so it can keep up with the best. And that is exactly what many global enterprises born and raised in Europe have been doing every day for many years. To quote Dylan: We as Europeans better start swimming now. ■

“We cannot just carry on ‘as usual.’ The Europe of today and tomorrow must become more adaptable.”



Welcome to the Siliconomy

Siliconomy:

noun [sil·i·con·o·my]

- 1) The structure or conditions of life in a new era of global expansion where computing is foundational to a bigger opportunity and better future for every person on the planet.
- 2) An evolving economy enabled by the magic of silicon where semiconductors are essential to maintaining and enabling modern economies.



Pat Gelsinger
CEO
Intel



Humans have an insatiable desire to continuously push forward with discovery and disruption. Our ability to learn from one another, integrating and building upon ideas that came before, makes our present world what it is – a place once considered impossible to imagine.

The more we advance, the more technology we need.

Humanity and technology are now interconnected, reflecting the impact of compute in modern life. Computing has thus far served as a source of information, a venue for productivity and a home for entertainment. Yet, the role of computing is undergoing a fundamental shift foundational to all aspects of the economy and our human existence. It is expanding into a new era where systems powered by artificial intelligence (AI) will be imbued with autonomy and agency, assisting us across both knowledge- and physical-based tasks, and will become part of our ambient environment. Investment is required to advance novel and more energy-efficient, domain-specific architectures, such as in-memory, neuromorphic and quantum computing.

Everything digital is based on silicon. Today, the digital economy alone contributes to more than 15% of global gross domestic product (GDP), and in the past decade it has been growing two and a half times faster than physical world GDP.

“Everything digital is based on silicon. Today, the digital economy alone contributes to more than 15% of global gross domestic product (GDP), and in the past decade it has been growing two and a half times faster than physical world GDP.”

Welcome to what I’ve dubbed, “the siliconomy!”

I used to broadly proclaim that every company is a tech company. But in this new era, technology is a standard baseline for success. As we look ahead to the decades yet to come, we will continue to see a move toward digital for everything – the way we work, learn, connect, worship, care for and evolve.

As advanced semiconductors enable new levels of human achievement, the world’s need for compute exponentially increases at an inverse ratio of size, cost and power. That’s Moore’s Law in a nutshell. (Moore’s Law is the observation that the transistor count of semiconductors doubles every two years.)

Technology is a tool, typically developed in service to our present challenges or desires – be that productivity, efficiency or ease. At the dawn of the information age, enterprise, academia and government worked together, building upon one another’s discoveries of personal computing, internet and networks that enabled us to become a global society, to launch our world into today. We must again work together to shape our technological future while advancements are in early development by coming together to create new possibilities that bring out the best in our human selves.

We must embrace the democratization of design, allowing rapid innovation built from heterogeneous building blocks over standardized interfaces. The diversity of an open ecosystem lends itself to resilience during challenging times – not perfect, but far better at finding balance among disruption. As adoption increases, additional ideas begin to appear alongside to drive further adoption and innovation. Yet we must also ensure technology advances responsibly. And that comes from both development and application. For example, AI is already performing human tasks that used to be difficult to achieve with traditional computing. Machines will soon make more decisions than humans. We need to make sure human oversight and alignment is incorporated by design.

Technology superpowers drive the creation of the siliconomy

Our drive to innovate and improve created the siliconomy and every one of us is a part of it – all participating in an evolving economy enabled by the magic of silicon.

I have often talked about the five technology superpowers shaping the world and thereby driving the creation of the siliconomy:

Compute:

Every thing is a computer and computing now defines how we experience the world.

Connectivity:

Everyone and everything is connected.

Infrastructure:

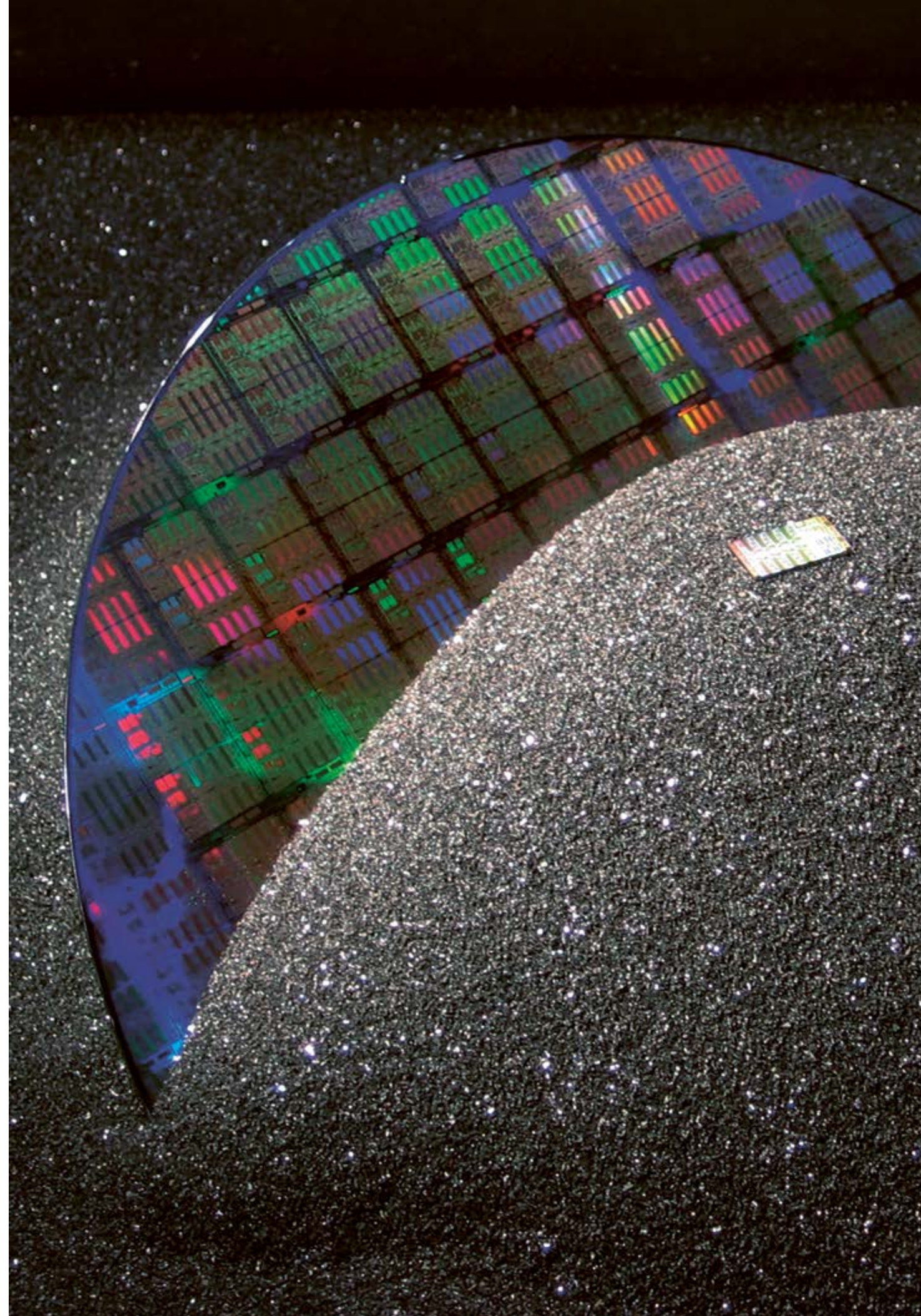
We are creating a dynamic reliable path for data storage and connected compute – combining unlimited scale with unlimited reach, while simultaneously addressing the need for lower latency and higher bandwidth.

Sensing:

Breakthroughs in low-cost, high-resolution sensors creating massive amounts of data from smart devices at the edge – converging with advances in automation, processing, inference and software – give machines human-centric abilities. Our weaknesses become digital enhanced strengths.

AI:

With intelligence everywhere, artificial intelligence turns infinite data into actionable insights. Data and compute enable greater refinement of AI algorithms to predict and create.



“For the past half-century, the location of oil reserves defined geopolitics. The location of technology supply chains and where semiconductors are built will be more important across the next five decades.”

These foundational technologies profoundly shape how we experience the world by creating the bridge from the analog age to the digital age.

And now an economic system is emerging via highly distributed edge-to-cloud compute platforms where semiconductors power essential technologies in a world that is becoming increasingly digital. Even as the current economic headwinds present challenges globally, the siliconomy clearly demonstrates that these tiny chips are essential to maintaining and enabling our modern economies.

For the past half-century, the location of oil reserves defined geopolitics. The location of technology supply chains and where semiconductors are built will be more important across the next five decades.

We must work together to meet the next surge of demand. It will take continued private-public partnership as well as new funding models with financial flexibility to maintain a thriving siliconomy – one supported by a sustainable and highly secure supply of exceptionally engineered processing power, delivered by globally balanced, resilient supply chains. ■

Hydrogen: A Panacea for All our Ills?

Why is the CEO of a group known mainly as a manufacturer of roller bearings writing about hydrogen? What does hydrogen have to do with bearings?

Klaus Rosenfeld
CEO
Schaeffler



Hydrogen is the most abundant element in the universe and key to a carbon-neutral economy. But there are still many and varied hurdles to overcome before we can say: Hydrogen is the solution! I would like to share some thoughts on this topic from the perspective of an automotive and industrial supplier. As a technology group primarily concerned with “motion,” Schaeffler has various points of contact with the hydrogen economy. On the customer side, in the form of components and products for hydrogen-powered mobility, or products and systems for the production of hydrogen through electrolysis technology. But also on the procurement side, where, for example, the issue of “green steel” from hydrogen is becoming increasingly important. In addition, there are various international partnerships and investments in research, development, and implementation projects in the field of green hydrogen production. Schaeffler is also an active member of several high-profile international bodies, such as the global Hydrogen Council and the German National Hydrogen Council, as well as being an investor in leading hydrogen funds.

“Hydrogen is the most abundant element in the universe and key to a carbon-neutral economy.”

Where are we?

The world is thirsty for clean energy, clean electricity, clean products, and clean production. A crucial thirst quencher on the way to the “net-zero” climate goal is hydrogen. Or to be more precise: green hydrogen – i.e., hydrogen that is produced in a climate-neutral way using electricity from renewable sources.

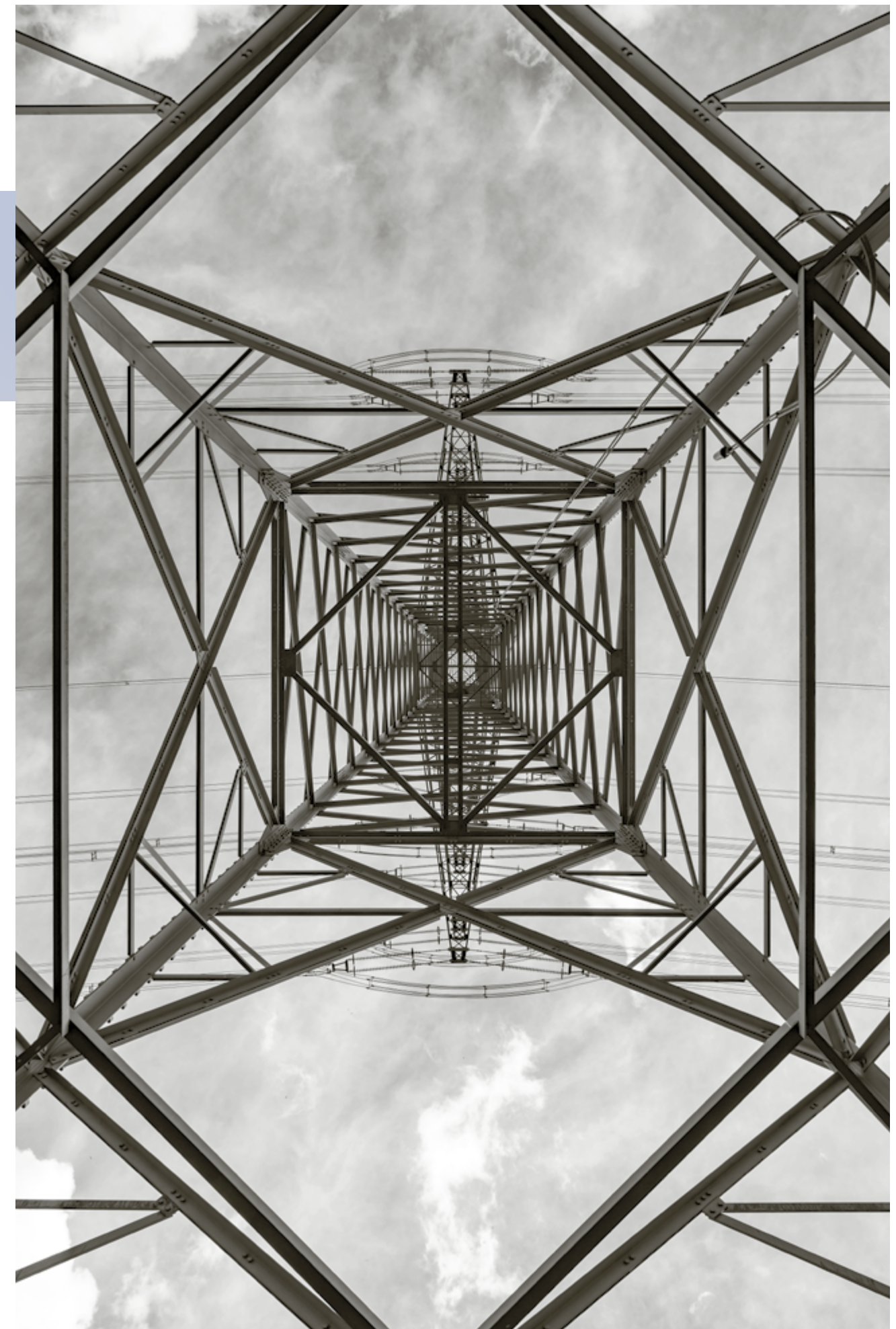
Already today, around 90 million metric tons of hydrogen are produced and used worldwide each year, in certain modes of transportation, but mainly in the petrochemical and fertilizer industries. But this hydrogen is almost exclusively derived from gas or coal (“gray hydrogen”).¹ And it comes with one heck of a carbon footprint: if you emit up to ten tons of CO₂ to produce one ton of hydrogen, it can’t really be called clean energy any more.²

So hydrogen needs to get greener. Currently, green hydrogen accounts for only a tiny fraction of global production. To illustrate it figuratively: we have a glass full of green hydrogen and we need to fill a whole lake. Researchers at the Fraunhofer-Gesellschaft, for example, predict that the potential demand for clean hydrogen will rise to 660 million metric tons³ per year by 2050. However, it looks likely that the green hydrogen capacity built up by then will not be enough to meet this enormous demand. Therefore, blue hydrogen will also have to be used as an interim solution. Blue hydrogen is also based on fossil gas, but the CO₂ released during the splitting process is captured and stored. Its use is therefore considered – not entirely uncontroversially – as sustainable.

¹ <https://www.woodmac.com/market-insights/topics/hydrogen-guide/>

² Section 2) in <https://newatlas.com/energy/japan-hydrogen-policy-failure/>

³ Page 2 of <https://www2.deloitte.com/dam/Deloitte/global/Documents/gx-green-hydrogen-executive-summary.pdf>



Where does the thirst for clean hydrogen come from?

Without the large-scale use of this energy-rich and climate-friendly gas, we will not be able to achieve the “net-zero” climate goal. In many sectors, clean hydrogen is the “missing link” when it comes to decarbonization. This is the case, for example, in cement production and in the chemical industry (e.g., the manufacture of fertilizers, plastics, or adhesives), where it can be used as a means of production; and in mobility, where hydrogen offers a potential energy source when battery-electric drives reach their limits, for example in long-distance travel by road, air, and sea. Hydrogen and its derivatives such as e-ammonia and e-methane can also replace fossil gas as a heat source.

Green hydrogen is therefore one of the keys to replacing fossil-based raw materials and fuels, as well as opening the door to sustainable mobility, production, and energy supply. In power grids, green hydrogen is also an ideal complement to naturally fluctuating hydro, wind, and solar generation. Modern electrolyzers are able to convert electricity into hydrogen within seconds. This can then be stored for several weeks or months or transported from one continent to another by ship or pipeline. Consequently, hydrogen can help to harness the substantial renewable energy potential in regions where energy conditions are favorable, such as southern Africa, Australia, or South America, which would otherwise remain off limits to us here in Europe.

One application of green hydrogen that is relevant to Schaeffler is steel production. The clean gas could replace the injection of pulverized coal as a reducing agent in the production process of the world’s leading construction material. Instead of CO₂, only water vapor would be emitted. Around 2 billion metric tons of steel are produced worldwide each year.⁴ This is a vast amount, and output is growing fast. For every ton of conventionally produced steel, an average of 1.7 tons of CO₂ is unleashed on the global climate.⁵ These figures alone explain why the steel industry is particularly hungry for green hydrogen. But as there is hardly any of this around, only a small quantity of green steel is produced in this way.

⁴ https://en.wikipedia.org/wiki/List_of_countries_by_steel_production

⁵ <https://www.faz.net/asv/zukunft-stahl-2018/saubere-stahlerzeugung-15636036.html> (in German)

“Green hydrogen is therefore one of the keys to replacing fossil-based raw materials and fuels, as well as opening the door to sustainable mobility, production, and energy supply.”

So much demand, so little hydrogen

Like all market players, Schaeffler is affected by the massive excess demand for green steel. At the moment, we are nowhere near being able to secure the quantities that we would be able to process, and it is not yet possible to foresee when we will achieve a sustainable balance between supply and demand. This is a dilemma for us. Precisely because securing and sustainably designing supply chains is a top priority for Schaeffler, and decarbonizing our main production material is of the utmost importance, we are aiming to achieve our CO₂ targets in the medium term.

But it isn’t just steel where green hydrogen is causing a bottleneck. Hydrogen is an essential building block for decarbonization in many other supply chains too. That’s why the journey to a green hydrogen economy is like a marathon, whereas meeting the 1.5°C climate target requires us to move at sprint speed.

All systems go!

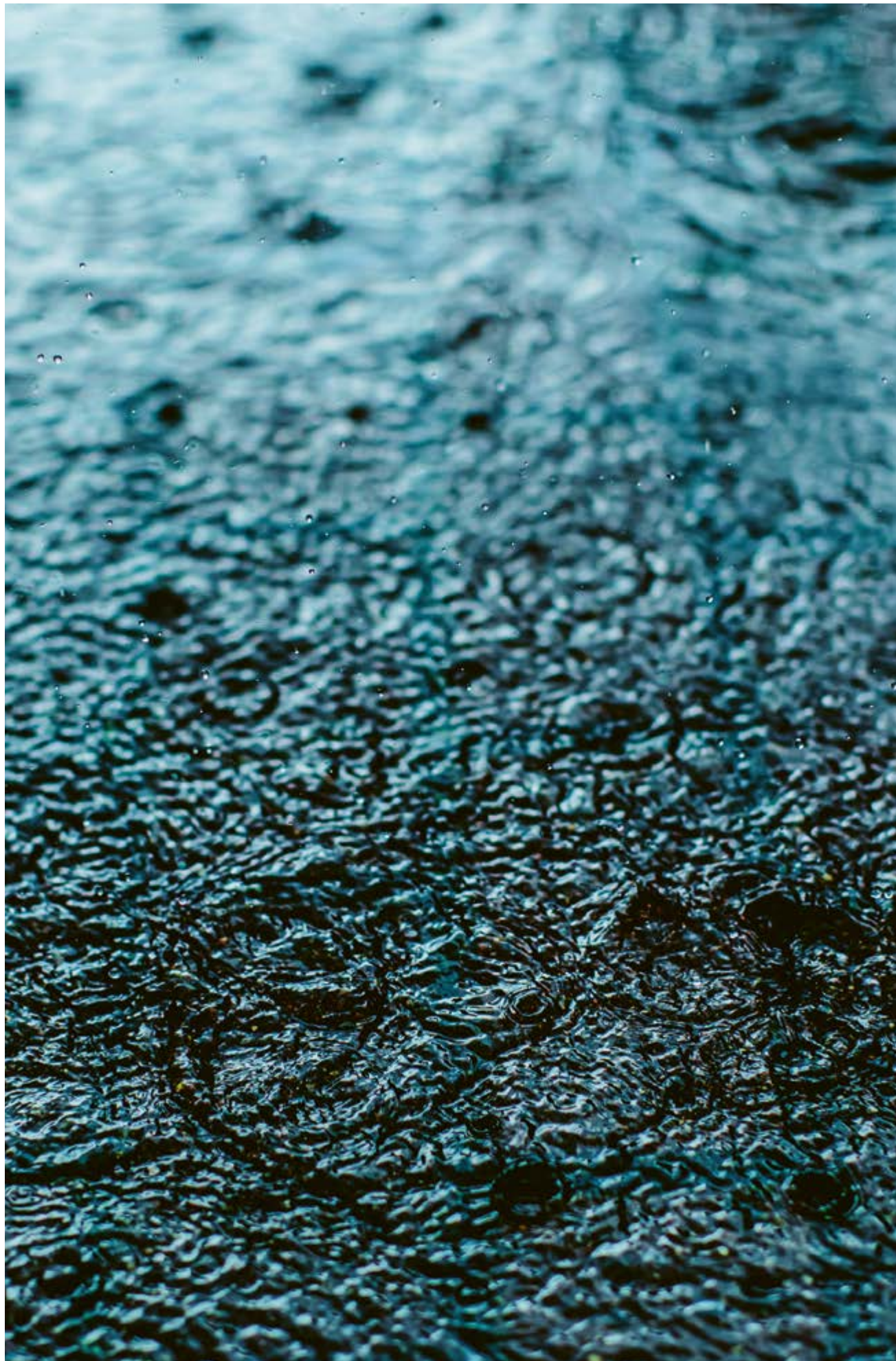
Satisfying the global thirst for green hydrogen is a challenge that can only be met holistically and with a systematic approach encompassing production, distribution, and storage, as well as use. It is clear that a lot of action is required at all levels of the value chain. But it is equally obvious that there are opportunities for innovative companies to move into new and lucrative business areas. Experts estimate that the global market volume of the hydrogen economy could already exceed USD 500 billion by 2030, rising to over USD 1 trillion by 2050.⁶ In a report on green hydrogen, consulting firm Deloitte also predicts that the sector could become a jobs engine, creating up to 1.5 million jobs per year worldwide.⁷ Hydrogen could therefore trigger a “rush” similar to that caused by the drilling of the first oil well in 1858.

At Schaeffler, green hydrogen has definitely awakened a pioneering spirit. As with the move from internal combustion engines to electric drives, we are using our technological know-how, in manufacturing, materials, and surfaces in particular, as well as our systems expertise to break new technological ground in the field of hydrogen with selected partners, and are gradually preparing for the expected market ramp-up.

On this basis, hydrogen is a strategic business area for Schaeffler’s Industrial division, with its own center of excellence and a focused market entry strategy geared toward the development and production of bipolar plates and stacks for electrolysis and fuel cells. Here, we are focusing on what we do best: quality, innovation, manufacturing excellence, and systems expertise. After all, we don’t just want to build a few electrolyzers: we want to build as many as possible, offering top-class performance and delivery. In doing this, we are prioritizing thoroughness over speed, because experience has shown that only those who do their homework thoroughly will be successful in subsequent industrialization.

⁶ <https://www.dnv.com/news/hydrogen-at-risk-of-being-the-great-missed-opportunity-of-the-energy-transition-226628> and page 2 of <https://www2.deloitte.com/content/dam/Deloitte/global/Documents/gx-green-hydrogen-executive-summary.pdf>

⁷ Page 2 of <https://www2.deloitte.com/content/dam/Deloitte/global/Documents/gx-green-hydrogen-executive-summary.pdf>



Hydrogen is volatile, funding must not be

Studies and outlooks cite staggering investments, amounting to trillions of dollars by 2050, to build the infrastructure needed for a burgeoning hydrogen economy – everything from electrolyzers and pipelines to marine infrastructure, electricity grids, user-side investments and, last but not least, wind, hydro, and solar power plants to supply the green electricity needed. In all of these areas, companies like Schaeffler as well as investors face the uncertainties that always accompany an emerging market. In this context, state support is undoubtedly important, especially in the development phase. Nevertheless, a sense of proportion is required in the design of such support programs.

The fact that more and more governments see hydrogen as a pillar of the energy sector and are implementing concrete policies and supporting commercial projects as part of a hydrogen strategy is a positive sign in itself. A crucial instrument in the ramp-up phase will be direct and indirect subsidies for green hydrogen, supplemented by well-secured off-take agreements in order to be able to offer the hydrogen at competitive prices. In addition, a globally recognized seal of quality for green hydrogen will need to be created. But such measures will only work to a limited extent as stand-alone solutions. A combination of different starting points and actors along a new hydrogen value chain is needed to help green hydrogen achieve a market breakthrough. Above all, this requires competition. Schaeffler sees itself as having a duty in this regard, especially in terms of cost optimization. We want to help drive down prices through innovations in stacks for electrolyzers and fuel cells and upscaling of volumes to a large industrial scale.

“The energy map of the world is set to change dramatically in the coming years as the hydrogen economy takes off.”

Will competition make or break business?

To return to the historical comparison with oil: over the years, there have been many disputes over access to coveted oil deposits. This is something we should bear in mind so as not to repeat the mistakes of the past, as there is undoubtedly potential for conflict here too. The energy map of the world is set to change dramatically in the coming years as the hydrogen economy takes off. Oil and gas deposits will become less important, while countries with abundant wind or sunshine and plenty of space for power plants to generate electricity for hydrogen production will have an advantage. Many industrialized nations such as Germany or Japan will be dependent on imports of green hydrogen – as is the case with oil and gas today – but may benefit from downstream processes. Multinational agreements in this area should be established early on to ensure a balance of interests. The distribution of the supply of green hydrogen, which will be limited, at least in the medium term, also harbors potential for friction. Temporary subsidies and government support may be warranted to provide initial support for the development of a global hydrogen economy. But essentially it is proven market-based mechanisms, supported by fair competition for the best technology developments, that must steer the course.

Conclusion: Is hydrogen the panacea?

Of course, hydrogen is no silver bullet for all of the world's energy and climate problems, but in the years to come it may be an important part of the complex solution to the challenges ahead. The key will be to promote new technologies and competition, to provide sufficient venture capital, to set global standards worldwide, and to develop solutions that make hydrogen competitive and therefore fit for the future in the long term. This requires companies and entrepreneurs who want to shape the future with innovation, courage, and a pioneering spirit. Not only for today and tomorrow, but for all the generations that come after us. ■

Germany's First National Security Strategy

Intention Versus Reality

On June 14, 2023 the German government issued the country's first ever National Security Strategy (GNSS) to address its "vulnerability to new military, economic and geopolitical threats" at a historic turning point (Zeitenwende) after Russia's invasion of Ukraine.



Hung Tran
Nonresident Senior Fellow
Atlantic Council

The GNSS was adopted after lengthy discussion to reach compromise within the coalition government – the Green Foreign Minister pushing for a robust, comprehensive values-based approach to security, the FDP Finance Minister trying to limit budget deficits and the SPD Chancellor wanting to “de-risk, not decouple” without harming Germany’s economic relationship with China.

Allied countries generally welcome the German GNSS as evidence of the country’s commitments to strengthen its defense posture. Many other observers however have criticized the GNSS as lacking in details and clear prioritization as well as financial commitments for its implementation. More important are incongruities between the GNSS and social and business reality in Germany as well as developments in Europe more generally.

As a consequence, the GNSS could end up being a declaration of intention by the current coalition government, rather than a realistic and implementable plan of actions to protect Germany’s “integrated security”.

“The GNSS could end up being a declaration of intention by the current coalition government, rather than a realistic and implementable plan of actions to protect Germany’s ‘integrated security’.”



Let's go into detail

The GNSS introduces the concept of “integrated security” combining foreign, economic and domestic priorities, based on Germany’s values and interests; going beyond the traditional focus on military security. The GNSS specifies three pillars of German security.

- ▶ **Robust defense:** fostering a new strategic culture with commitments to high military spending, aiming for deterrence not disarmament.
- ▶ **Resilience:** reducing economic dependencies on rivals; deterring and defeating cyber attacks.
- ▶ **Sustainability:** addressing climate change, food and energy crises.

The GNSS has tried to clarify Germany’s attitude towards Russia and China – a separate strategy paper on China has been delayed until later this month – but has raised some questions.

On Russia the statement seems straightforward: “Russia’s war of aggression against Ukraine is a violation of international law and the European security order. Today’s Russia is for now the most significant threat to peace and security in the Euro Atlantic area”. However, the qualifiers “Today’s Russia” and “for now” put the German view at odds with that of the Baltic and eastern NATO members which consider Russia to be a long-term threat.

On China, the GNSS tries to emphasize the partnership component of the existing EU formula “China is a partner, competitor and systemic rival” before concluding that “China is trying in various ways to remould the existing rules-based international order, is asserting a regionally dominant position with even more rigor, acting time and again counter to our interests and values...Regional stability and international security are being put under increasing pressure and human rights are being disregarded. China makes deliberate use of its economic clout to achieve political goals”. Against this assessment of China’s threats, the agreed responding strategy of “diversification” appears complacent.

A long way to go

The main criticism of the GNSS is that it fails to provide financing for the implementation of the strategy, instead insisting that the “GNSS is budget neutral” – implying that the GNSS can only be executed at the expense of something else, a very difficult proposition for the coalition government struggling to comply with the re-instated debt brake limiting the budget deficit to 0.35% of GDP (from 4.5% in 2023). In particular, the GNSS interpretation of the NATO’s target of 2% of GDP per year for defense spending seems to have been watered down to “an average of 2% over a multi-year period”. As such, the GNSS fails to match means with ends as a strategy should.

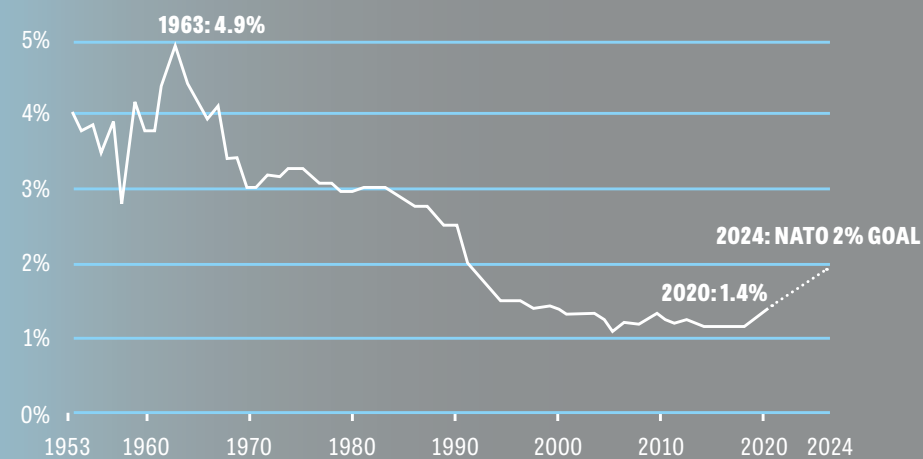
The government has also failed to set up a National Security Council – like in other major countries – to coordinate different aspects of security policy making and implementation; reportedly due to disagreement between the Chancellery and the Foreign Ministry in terms of where to house the Council and who would control it.

In terms of promoting resilience, the GNSS focusses on “reducing critical dependencies in strategically relevant sectors...by means of diversification” – without even mentioning the word “de-risking” which has become popular after the June 2023 G7 Summit in Hiroshima. The government relies on the business sector to implement the goal of diversification over a period of time. However, many German corporate leaders appear to be lukewarm if not skeptical about plans to restrict trade and investment with China – especially at present when the German economy is mired in a recession. For example, Mercedes-Benz CEO Ola Kaellenius said that “abandoning China is unthinkable for German industry” – perhaps an understandable statement as China accounts for 40% of the company’s total car sales.

In fact despite the GNSS, German trade with China has reached €298 billion (\$328 billion) in 2022, 21% higher than in 2021. German FDI to China has risen by 11% in 2022, same as in 2021, while US FDI to China fell by 40% during 2020-22. Consequently, German vulnerability to disruptions in the supply of several strategic and critical inputs to manufacturing, as well as to potential loss of market share in China, appears to have been increasing – not decreasing.

“The government relies on the business sector to implement the goal of diversification over a period of time. However, many German corporate leaders appear to be lukewarm if not skeptical about plans to restrict trade and investment with China.”

How Germany’s military expenditure has developed
Share of military expenditure of gross domestic product (GDP) of Germany



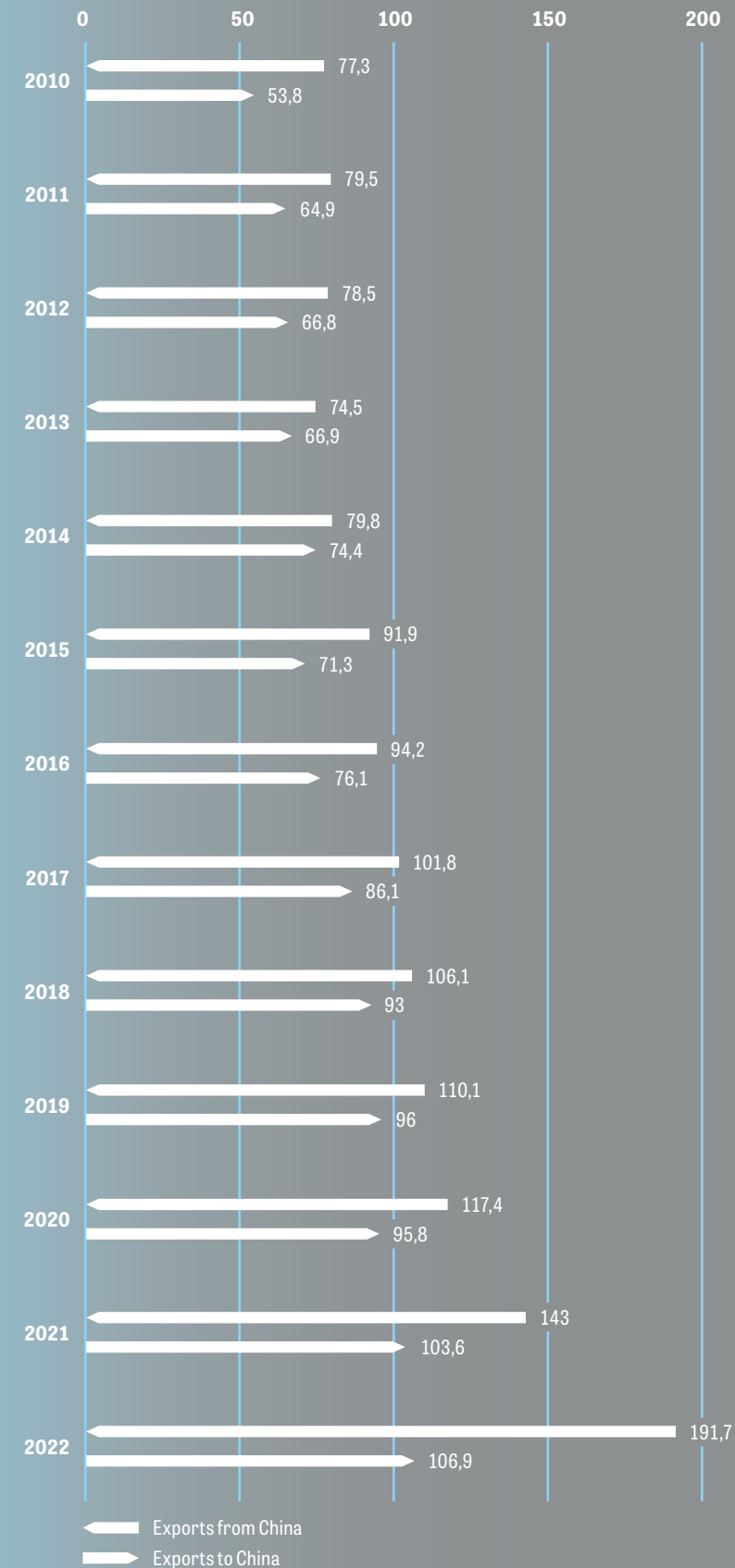
Source: SIPRI

Back-and-forth...

More generally, these differences between Germany's government and business have found echoes in the dilution of the European Commission's proposed Approach to Enhance Economic Security released on June 20, 2023 into the Conclusions of the European Council Summit on June 29–30, 2023. Basically, the back-and-forth has been between European Commission President Ursula von den Leyen, arguing for a robust and all-embracing de-risking approach closer to the US position; and several major countries like France, Germany, the Netherlands and Italy trying to water it down, keeping security matters especially with China in national capitals. In the end, the European Council conclusions do not refer to the economic security proposal; only highlighting the need to reduce critical dependencies in strategic areas – without naming China but mentioning the US Inflation Reduction Act (probably reflecting the immediate concern in Brussel!)

Last but not least, while mentioning domestic security, the GNSS has nothing to say about it – a striking omission in light of the worsening of the social and political situation in Germany. Capitalizing on popular discontent with rising immigration (largely due to the influx of Ukrainian refugees), high energy prices and the high costs and pervasive prescriptions of the green energy transition, and the sending of weapons to Ukraine involving Germany too closely with the war there, the far-right populist Alternative for Deutschland (AfD) has risen strongly in the polls. Specifically the YouGov poll puts the AfD (20%) ahead of the SPD (19%) as the second most popular party behind the CDU (at 28%). Notably, for the first time, an AfD politician has won a district council election in Sonneberg in the eastern state of Thuringia. It is important to keep in mind that the AfD youth wing has been designated an extremist organization and put under investigation by the Constitution Protection Office. It would be a serious problem if (still a big if) the AfD evolves to become Germany's main opposition party after the next federal election in 2025. The rise of far-right populist parties has also been seen in other countries including Italy, France, Austria and Spain. All together, these developments could eventually pose a threat to the current political and security alignment in many European countries.

Value of German Imports from and Exports to China from 2010 to 2022 (in billions of euros)



Source: Statistisches Bundesamt



“While mentioning domestic security, the GNSS has nothing to say about it – a striking omission in light of the worsening of the social and political situation in Germany.”

Conclusions

The GNSS represents a step forward for Germany to articulate its overall security interests and its approaches in protecting them. However, this is a work in progress as the GNSS does not include a detailed plan of action with budgetary commitments to render the strategy implementable. More importantly, much more needs to be done to overcome the lack of strong domestic support for the GNSS – among the political parties, the business community and society at large. Basically, Germans appear more concerned about rising immigration and the high costs of the green transition than the still vague concept of threats to resilience. Accordingly, domestic security issues should receive more attention in the GNSS. After all, without social cohesion and consensus, it is difficult to execute a strategy to deal with foreign threats to national security. ▀

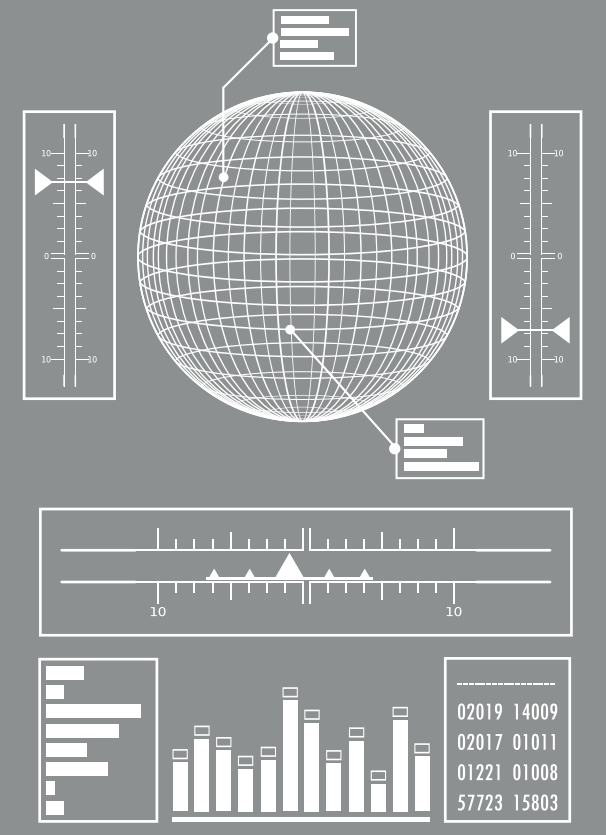


Navigating the Zeitenwende



Dr. Michael Schöllhorn
CEO
Airbus Defence and Space

An Action-Driven Roadmap for a Resilient Defence Sector in Germany and Europe



In the face of geo-political shifts and technological advancements, the German, and by extension, the European defence industry, finds itself at a critical juncture.



Living off a 'peace dividend' has obscured our geo-political perception and strategic focus for several decades. We willingly ignored the rise of autocratic powers and unhealthy dependencies, making us dependent on them: We used cheap Russian gas despite Putin devastating Grozny and Syria and invading Georgia. And with the United States ensuring European security over decades, we significantly reduced defence budgets, effectively kneecapping capabilities to defend ourselves.

With the U.S. shifting its focus to the Indo-Pacific region and considering China as the 'pacing threat', Russia's war against Ukraine has exposed Europe's and Germany's strategic errors in judgement and a tragic disproportion: We still might be economic giants, but we are military dwarfs.

We painfully realised that if Germany and Europe want to become less dependent on the U.S. and more resilient and at the same time contribute to the burden sharing within NATO we must move forward and strengthen our national and European defence. And indeed, proclaiming a 'Zeitenwende' (turn of the times), the German government allocated an impressive one-time €100 billion special fund to plug the biggest holes in a partially dysfunctional Bundeswehr. However, more than a year later, the 'Zeitenwende' is largely still awaiting execution, and the much needed reforms of defence policy, industry, and procurement on a European level are not in sight. Instead, political lip service is paid when European defence is on the agenda while pushing national agendas.

“Russia’s war against Ukraine has exposed Europe’s and Germany’s strategic errors in judgement and a tragic disproportion: We might be economic giants, but we are military dwarfs.”





Reassessing the industrial and technology policy: creating a new defence roadmap

A comprehensive industrial strategy and policy is the bedrock of a nation's economic strength. However, the alignment and synergy between industry and national security have been largely neglected in Germany. For example, unlike the U.S., France or the United Kingdom, Germany has never integrated defence into its industrial policy. With Germany clinging to its 'Sonderweg' (special way) and governed by a unique belief in 'German foreign policy is peace policy', the continent's economic powerhouse has been noticeably absent as a leader from Europe's military and defence framework. This is reflected by, e.g. the so-called civil clause banning research work for the military or even dual use at German universities.

To ensure a resilient and future-proof defence industry, viewing it as an integral part of the nation's technological and industrial strategy is imperative. At the roots of the economic success of the Silicon Valley or the Israeli start-up ecosystem stood the conviction that military research not only demands cutting-edge technologies but also allows for early scaling and growth, which Germany regularly fails to accomplish.

However, this requires an inclusive technology and industrial policy that actively involves the industry. And it requires sustainable, long-term investment. The historic decision to finally meet the NATO defence target of 2 percent is an important first step. We are facing urgent military needs that necessitate a rapid equipping of the Bundeswehr. In this regard, the new Minister of Defence – cognizant of the seriousness – deserves praise for driving forward quick procurement decisions.

Nevertheless, strategic mistakes and omissions made over decades will not stand corrected in a few months. For example, Germany and Europe have failed to keep up with advancements in ground based air defence and are lacking a 5th-generation fighter jet.

“If we don't take these steps now, the 'Zeitenwende' will remain nothing but a nicely worded promise.”

“The alignment and synergy between industry and national security have been largely neglected in Germany.”

Embracing change in turbulent times

So what needs to be done? If the 'Zeitenwende' is to succeed, Germany must take four decisive steps: **First**, a fundamental and honest reassessment of our industrial and (defence) technology policy. **Second**, a focused approach to and rethinking of procurement processes. **Third**, a new way of working for the defence sector based on a process, digital and technological transformation; and **fourth**, a realistically balanced approach to export and foreign relations.

A full-blown, bold roadmap for all stakeholders in Europe's and Germany's defence sector is needed.

This has prompted many governments, including Germany, to procure defence goods outside of Europe: A significant portion of the German Air Force's expenditures go to foreign suppliers, such as the U.S. for F-35 fighter jets or the Israeli missile defence system 'Arrow3'. Interestingly, Germany, contrary to Switzerland and Finland, has not requested any industrial participation (so-called 'offsets') in their contracts with the U.S. and Israel. Not only does it prevent parts of German taxpayers' money from flowing back, but it also misses out on the opportunity to develop technological prowess where it got lost or was thrown out the window before.

Consequently, procuring these foreign off-the-shelf products will accelerate the further eroding of German and European defence capabilities. While it may be tempting to purchase products from American or Israeli suppliers, it's essential to understand the long-term impact on our national defence industry: Once it's been dismantled, rebuilding its capabilities is – mildly put – difficult. Now, some demand that the rules of the market prevail if other nations' products are more competitive. But the defence market is not a market: the U.S. and Israel invest large amounts of money in their defence players while Germany prevents theirs from thriving with their 'Sonderweg'; this includes preventing exports from German companies. This will be touched upon later.

To break this vicious cycle, we must reduce our dependence on foreign suppliers by accelerating and intensifying the development of European leading-edge technologies such as FCAS¹ (Future Combat Air System). FCAS is not only Europe's biggest defence

programme ever – it's one of the last opportunities for Europe to close the technological and industrial gap between the U.S. and emerging defence industries worldwide. This applies particularly to new technologies such as 'Artificial Intelligence' (A.I.), which will play a crucial role in FCAS and all other relevant defence projects of the 21st century. Therefore, it is essential for the German and European industry to gain leading competencies in this field quickly. In the recently launched project 'KITU 2' (Künstliche Intelligenz für taktische UAS; Artificial Intelligence for tactical UAS), Airbus Defence and Space is teaming with German start-ups Quantum-Systems and Spleenlab to demonstrate and analyse A.I. building blocks for swarms of tactical UAS. This technology will be of key importance for FCAS but should also be seen as one of the few opportunities in Europe to make leaps in the fields of A.I., uncrewed systems and swarms, as well as edge computing. Such research efforts need to be increased significantly both on a national and European level, as only those players, states and industries who manage to shape A.I. will also be able to have a word in defining its technological and ethical standards.

Such programmes and technologies require Europe's united political, financial and sustainable commitment, hardwired into its industrial and technological policy, including future-proof ESG² principles.

Let's not be mistaken: If we don't take these steps now, the 'Zeitenwende' will remain nothing but a 'flash in the pan', a one-time satisfaction of the most urgent needs and a nicely worded promise, undermining Germany's and Europe's global credibility and reliability.

¹ FCAS (Future Combat Air System) is a collaborative project between Germany, France and Spain, and Belgian as an observer, to develop a next-generation combat aircraft with advanced capabilities, including uncrewed systems and networked connectivity, to enhance air defence and combat capabilities. It aims to create a future air combat system- of-systems that is technologically advanced, adaptable, and capable of addressing evolving security challenges. Airbus Defence and Space is in charge of the FCAS pillars Remote Carriers (RC) and System-of-System/Air Combat Cloud (SoS/ACC).

² ESG: Environmental, Social, and Governance: set of criteria used to evaluate the sustainability and ethical impact of an investment or business.

On life support? Taking stock of the German defence procurement process

This is especially important for the German procurement process. It is here that defence industry players such as Airbus Defence and Space are consistently presented with stern challenges. The well-intentioned perfectionism and overemphasis on legal aspects by the German procurement office prevent a rapid and result-oriented procurement process, especially for European development programmes.

Whenever Germany and Europe have invested in large programmes, they often resulted in advanced products such as the Eurofighter, A400M, and Tiger helicopter.

True, these platforms suffered from delays, cost overruns, and lengthy development times until they ultimately met most of the extremely ambitious and heterogeneous requirements. The industry must and is about to transform itself and take responsibility for mistakes made by overpromising, demanding too much, and delivering too little.

But let's be honest: Demanding a turboprop aircraft to reach Mach 0.75 (825km/h) leads to a highly complex and costly propulsion solution. A contractual requirement for 100% reliability of electronic components is something not even the automotive industry, with its millions of products, would practically demand.

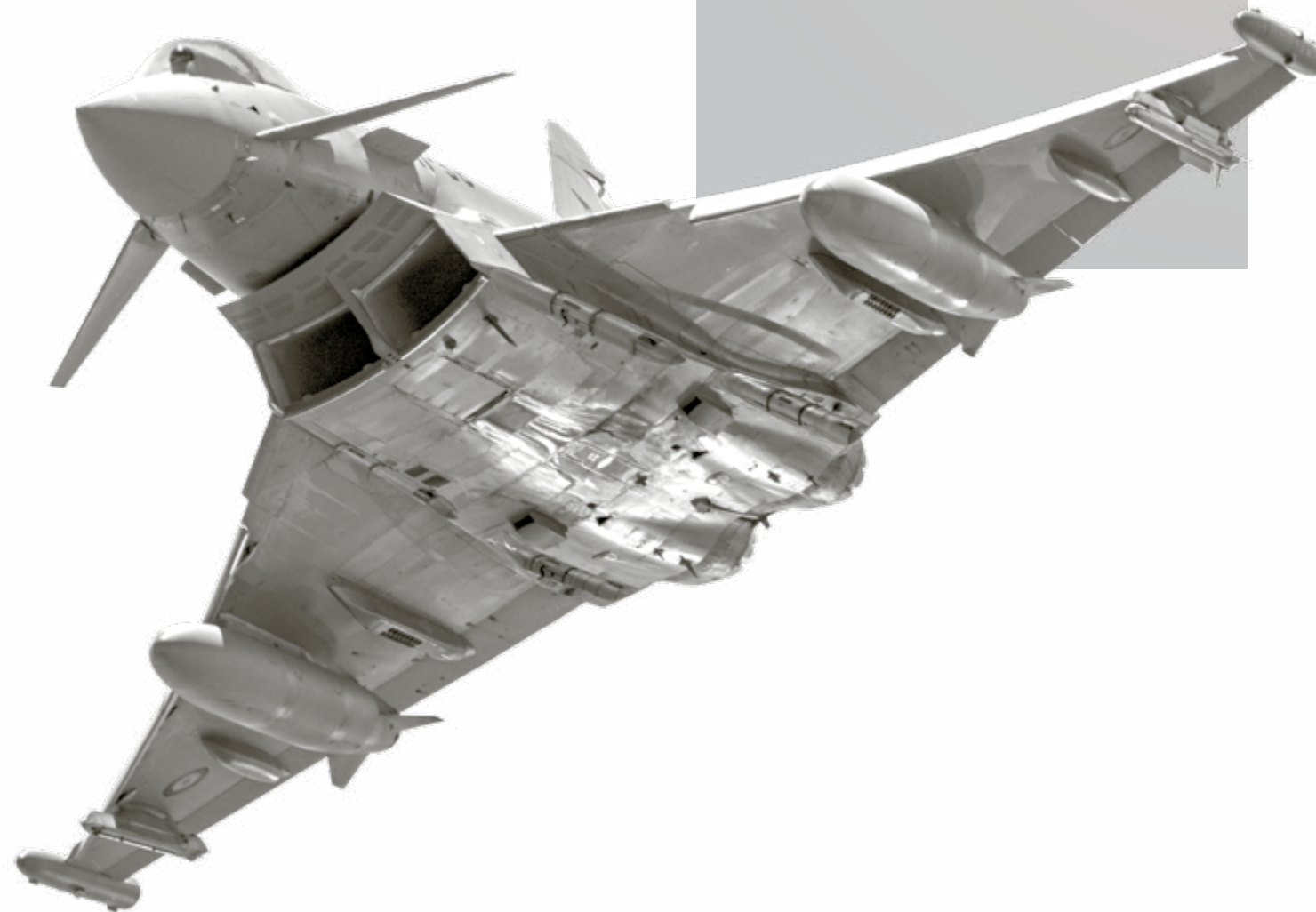
These are just two examples of the excessive requirements the German procurement process is notorious for. This predicament primarily results from overblown national requirements, mainly German 'Goldrandlösungen' (gold-plating solutions), kneecapping European scalability.

The problem is not the ill intentions of the stakeholders involved in the process but the objective of zero risk. Or as one politician said recently: "As long as the 'BAAINBw'³ (Bundesamt für Ausrüstung, Informationstechnik und Nutzung der Bundeswehr) is more afraid of the 'Bundesrechnungshof' (Court of Audit) than of the Russian forces, nothing will change."

³ The BAAINBw is the Federal Office responsible for managing equipment, information technology, and in-service support for the German Armed Forces (Bundeswehr), ensuring their operational readiness and effectiveness.

Germany, in particular, needs to reform its procurement system. This can be achieved by empowering cross-functional, agile co-creation and a culture of innovation, allowing for swift adaptation to rising security challenges. This requires a serious change of industry as well.

So, mutual finger-pointing between industry and politics is unproductive. I want to emphasise that the will to become more efficient and effective is greater than ever on both ends – and the industry has its part to fix.



"The ever-evolving security needs of modern armed forces also require adaptable systems that are easy to operate, combat-ready and compatible with other fleet systems."

Defending the future: the need for process, digital and technological transformation

In the rapidly evolving defence and security landscape, embracing new approaches and technologies has become essential for staying ahead. On the one hand, key areas that demand attention are agile working methods. And on the other hand, interoperability⁴ and MOSA⁵ (Modular Open System Architecture) within the necessary digital transformation of the defence industry.

Agile methodologies, such as the Minimal Viable Product⁶ (MVP) approach, offers faster and improved results, while interoperability enables seamless communication and collaboration between diverse military systems. Continuous iteration instead of a fixed development process leads to faster and improved results. This would also address the biggest challenge in procurement: the largely disconnected (meaning that the procurement agency is required to not speak to the supplying industry) specification and creation of requirements by the contracting side for a product that has – on average – a 10–15 years time-to-market cycle. Nobody else works like this anymore in any industry – and I make this statement as someone who has worked in three different, highly competitive commercial industries. Collaborating within the sector in developing product specifications and characteristics is crucial for timely, capable, and cost-effective results. Those who don't cooperate should expect delays, limitations, and high costs. The key is transparent industrial cooperation while, of course, observing strict compliance.

The ever-evolving security needs of modern armed forces also require adaptable systems that are easy to operate, combat-ready and compatible with other fleet systems. The importance of interoperability and open architecture is becoming increasingly vital for our armed forces to act efficiently together to achieve tactical, operational, and strategic objectives.

⁴ Interoperability refers to the ability of different systems or devices to work together and communicate effectively.

⁵ MOSA (Modular Open System Architecture) is a design approach that promotes modularity, interoperability, and openness, enabling easier integration and upgrades of systems and components. It provides flexibility and adaptability to evolving technologies in various industries, including defence.

⁶ A Minimal Viable Product (MVP) is the simplest version of a product with just enough features to satisfy early customers and provide valuable feedback for further development. It aims to validate assumptions and reduce risks before investing more resources into the full product.

And it is precisely here that the pitfalls caused by the extensive introduction and procurement of foreign platforms such as the F-35 across European Air Forces become apparent: Europe and the U.S. will increasingly operate mixed fleets of crewed and uncrewed 6th-, 5th-, and 4th-generation aircraft, demanding digital solutions to solve recurring interoperability issues caused by different technological standards. As is, achieving interoperability between the F-35 as a black box and other platforms will require creative and expensive workarounds – undisclosed yet significant costs typically not addressed in the debate on introducing the F-35. And create a financial incentive to add more U.S. systems to the F-35.

Modern armed forces need systems that adapt to diverse needs, products with low operational complexity, fit for combat and always mission ready. This can only be achieved if we introduce true interoperability and MOSA, establishing them as global, industry-wide standards. Both interoperability and MOSA enable different military systems from various suppliers to communicate, share data, and operate cohesively, regardless of their origin, generation or specific functionalities. In digital warfare, interoperability and MOSA will be and already are key to meeting the demands of a constantly evolving geo-political and defence landscape.

Driven by the lessons learned from the war in Ukraine, we must accelerate the lead time by adopting MVP-based, iterative approaches. Additionally, we must prioritise MOSA and interoperability by making them global-wide industry standards.

Global reach, local impact: the importance of export and foreign relations policy

All our technological and industrial efforts to become more collaborative, agile, effective and efficient are in vain if we do not have the opportunity to profitably scale our business. This implies exports are not limited to only those nations partnering in the various programmes, typically Germany, France, Italy, Spain and the United Kingdom. The volumes and scale coming from these countries are insufficient for a resilient business with a reasonable payback, let alone for competitive prices and a fast learning curve. And among these partner nations, Germany, in particular, has an infamous reputation for constantly delaying or blocking exports of defence goods, thus avoiding revenues and GDP for all.

In the face of war in Ukraine, European collaboration and alignment on defence has never been more important. Unfortunately, despite some movement, Germany has not yet given up their ‘Sonderweg’, adding to a general tendency to return to national champions and nationalistic views of procurement and armament. Or, differently put: To design defence systems as ‘German-free’ and, thus, successfully marketable. Aside from the undermining effect on European defence cohesion, this attitude also devastates its defence industrial base. As opposed to France who has a clear strategy and active export policy in this regard, Germany’s already vulnerable defence industrial system is put in question. It ultimately makes industrial capabilities and competencies obsolete, putting thousands of highly skilled jobs at risk. It is close to cynical that, in parallel, Germany invites the U.S. to import the F-35 without any contractual obligations for domestic industrial participation (offsets) which would compensate at least some of the missing business.



Indeed, it makes great sense that Germany considers carefully to whom it supplies modern weapon systems such as fighter jets – we at Airbus are doing this assessment in a substantial human rights due diligence process before we even apply for an export licence – but assuming that human rights and lives will be more protected if Eurofighters are not sold to a country like Saudi Arabia is considered close to naive by many experts of the region. Germany not only overestimates its influence on world affairs, it alienates the ‘Global South’ it claims not wanting to lose.

“In the face of war in Ukraine, European collaboration and alignment on defence has never been more important.”

There is an intense discussion and some movement in the current administration's stance, not least by the new German defence minister. However, the bitter truth remains: The administrations in the Gulf or any other country will not change their policy based on Germany dividing the world into 'good' and 'bad' and taking the moral high ground. More realistically, these countries will purchase from the U.S., France or, as we painfully witness, China or Russia. Notably, procuring a complex system like a military aircraft inevitably implies respective pilot training through the selling nation and, implicitly, the influence of its military doctrine. In the case of Russia and China, this might very well lead to an even more harmful effect on human rights and lives. Thus, it is fair to say that all good intentions of the German administration might very well achieve exactly the opposite.

Furthermore, this preventive attitude toward defence exports must also be seen in a broader commercial context. Germany's decoupling of defence and commercial export policy is, simply put, only virtual. National policies are always holistic, driven by both economic and security considerations. This also holds for countries like Saudi Arabia, Indonesia or India. It should, therefore, be of interest to any corporate and political leader to reflect on this interdependence.

We need a transparent debate on the European harmonisation of defence exports. This requires willingness and transparency to share all ethical, political and economic arguments and find a socially acceptable and viable way for us and our partner nations. If Germany maintains its 'Sonderweg', it misses its opportunity to really influence and protect German and European interests and stop the continued fragmentation in Europe.



Conclusion: a roadmap paving the way for a resilient defence sector

As the 'Zeitenwende' unfolds, the German defence industry has the historic opportunity to redefine itself if it follows a new roadmap for a more resilient defence sector at home and in Europe. To ensure the success of this transformation, three key actions must be taken:

Adopting New Working Methods: Policymakers must adopt a holistic approach recognising the interdependence between industrial, technological, and defence policies. By integrating defence into industry and technology strategies, Germany can create an environment that fosters innovation, drives economic growth, and enhances national security. Long-term, it will also strengthen Europe's strategic autonomy.

Investment in new technologies and digitalisation: To deliver innovation-driven defence technology, increased R&D investment and systems interoperability are a must – especially regarding third party suppliers and mixed fleet operations. Its government support, collaboration with academic institutions and start-ups, and leveraging public-private partnerships enable leading-edge technologies and digital transformation. The U.S. example of DARPA⁷ is a good showcase.

International collaboration and export: Cooperation with international partners is crucial in an interconnected world. Germany should actively engage in multinational defence projects and their export. Both offer an opportunity to participate in joint research initiatives and share knowledge and expertise with existing and future allies. And exports are crucial to sustain our business.

By embracing these actions, the German defence industry can become a European, even global, leader. However, challenges lie ahead, and the transformation will require honesty, adaptability, perseverance, and a willingness to challenge the status quo.

Together, policymakers and industry can shape a resilient German defence sector by adopting a comprehensive approach. A roadmap that integrates industrial and technological policies embraces agile and innovative thinking and strikes a sensible balance in export and foreign relations policy.

The time for change is now. A true Zeitenwende demands bold and joint action to build a future-proof defence industry. Let us seize the momentum and shape a resilient Germany and Europe, contributing to a safer world and serving our armed forces. ■

⁷ DARPA (Defense Advanced Research Projects Agency) is a US government agency responsible for developing cutting-edge technologies for national security purposes.



Lars Wagner
CEO
MTU Aero Engines

Mission Possible: Climate-Neutral Flying is Feasible

The growth of air travel is both an economic opportunity and a social challenge – and it requires a climate-neutral perspective.



Aviation is booming again, and the desire for mobility continues unabated. The International Civil Aviation Organization (ICAO) sees a “full and sustained recovery”: last year, passenger numbers reached 74 percent of pre-Corona levels. By 2023, ICAO expects passenger numbers to be 3 percent higher than in 2019, and 4 percent higher in 2024. At the same time, airlines are intensifying their long-term fleet planning with a clear focus on modernization and growth. Demand for new aircraft is growing accordingly, with more aircraft ordered last year than in 2019.

While growth before the pandemic was strongly driven by China, India is now increasingly coming into focus. Earlier this year, Air India secured one of the largest orders in aviation history, ultimately ordering a total of 470 aircraft from Airbus and Boeing to expand its domestic and international network. At the Paris Air Show in June, this trend was reinforced when Air India’s competitor Indigo ordered 500 short-haul A320neo aircraft from Airbus. India has caught up with China in terms of population. Both countries have more than 1.4 billion inhabitants and are at the top of the International Monetary Fund’s economic forecasts. As prosperity increases, more people will want to fly. A growing middle class will spend more money on air travel. After all, more than 80 percent of the world’s population have never flown.

The potential is obvious – and at the same time it is clear: There is no way around drastically reducing the climate impact of air traffic. And I am convinced that this can be achieved with future-oriented solutions. Growth and rising demand are both a challenge and an opportunity to bring innovative and sustainable technologies into use as quickly as possible.

“We need to stop thinking in evolutionary terms and start thinking in revolutionary terms. We have to rethink flying.”

Climate-neutral flying is possible

At aircraft engine manufacturer MTU Aero Engines, we are working hard to achieve this goal in close interdisciplinary cooperation with our partners in industry and research. Our core competencies are low-pressure turbines, high-pressure compressors, turbine center frames, and manufacturing and repair techniques. In new commercial business, the company plays a key role in the development, production and sale of high-tech components within the framework of international partnerships. MTU components are used in one-third of the world’s commercial aircraft. Based on decades of technological expertise, we are convinced that climate-neutral flying is possible.

The fact that engines are becoming more and more powerful and efficient is nothing new. Airlines have always demanded more fuel-efficient and economical engines. We will continue on this path. But we need to stop thinking in evolutionary terms and start thinking in revolutionary terms, in the best sense of the word. Climate-neutral flying means alternative fuels, new engine architectures and completely new concepts beyond today’s gas turbines. We have to rethink flying.



“Today, every commercial airliner flies on kerosene. The future will be much more diverse. By the middle of the next decade, we will have a mix of technologies. And these technologies will be implemented in the most efficient way.”



The future is diverse

Today, every commercial airliner flies on kerosene. The future will be much more diverse. By the middle of the next decade, we will have a mix of technologies. And these technologies will be implemented in the most efficient way. In the field of urban air mobility, battery-powered aircraft could also be used in the future. MTU is not yet active in this area. However, the high-performance electric motors produced by the company's subsidiary eMoSys offer potential in this area. Their use is also an important building block in the ecosystem surrounding the Flying Fuel Cell™. We intend to develop these hydrogen fuel cells as a propulsion system for aircraft carrying up to 100 passengers. This propulsion system is CO₂, NO_x and particulate free.

For aircraft with 150 to 200 seats, we are focusing on the advanced gas turbine. MTU's preferred concept is the water-enhanced turbofan (WET), which can run on sustainable aviation fuels or liquid hydrogen. As the only gas turbine engine concept currently being discussed on the market, the WET concept massively reduces nitrogen oxide emissions in addition to CO₂ emissions. It also significantly reduces condensation trails. In the future, intercontinental wide-body aircraft with 250 seats or more will take off with highly efficient gas turbines and sustainable fuels.

This transformation will not happen overnight. Aviation development and production times are measured in decades. Sustainable fuels will therefore play a key role on shorter routes in the short term – and on long-haul routes in the long term. Produced from green hydrogen and renewable electricity, Sustainable Aviation Fuels (SAF) can make a direct contribution to making aviation sustainable.

Sustainable fuels for greener flying

SAFs result in a largely closed carbon cycle. In the best case, the CO₂ released during combustion is completely removed from the atmosphere and can be used to produce fuel. Although MTU is not a fuel producer, the company is committed to the use of SAFs. For example, it is supporting several projects to set up power-to-liquid production facilities. MTU Maintenance is also the world's first MRO provider to offer SAF acceptance runs on its test cells.

Today, SAFs can already be used as a “drop-in”, i.e. without adaptation to the aircraft and engine, in blends of up to 50 percent in the existing fleet. The trend is toward 100 percent. The U.S. is very ambitious in this regard: As part of the Inflation Reduction Act (IRA), they want to produce about 3 billion gallons of SAF per year by 2030, which is equivalent to 12 percent of U.S. kerosene consumption, i.e. a notional blend of 12 percent – at a time when the EU is considering a blend of only 6 percent.

In any case, we need more production capacity and a clear timeline for aviation to use sustainable fuels. E-fuels for aviation and shipping are a priority. Electric solutions are not a viable option here on the road to climate neutrality. The high energy densities required cannot be electrified.

By comparison, electromobility already offers a more efficient alternative to e-fuels for large parts of the automotive sector. The efficiency of combustion vehicles using e-fuels is around 15 percent, while that of electric vehicles – which use electricity without complex conversion processes – is between 70 and 80 percent. So e-fuels belong in airplanes, not cars.

Competition for the use of these fuels could lead to excessive prices, e.g. for sustainable hydrogen, and, in turn, slow down the the rapid transition to sustainable fuels envisaged by the aviation industry. Despite its technological openness, aviation must be given priority in promoting the production and use of e-fuels – at least until sufficient quantities are produced for all applications. And this is the crux of the matter.

E-fuels are not commercially available today. The manufacturing processes have been developed and approved, but there is no industrial-scale production. There are very few demonstration plants in operation around the world. According to a recent analysis by the Potsdam Institute for Climate Impact Research (PIK), about 60 new e-fuel projects have been announced through 2035, of which only about 1 percent have been backed by a final investment decision.

Even if the market were to ramp up as quickly as the growth champion, solar photovoltaics, has done in comparison, the global supply in 2035 would not even be enough to meet the indispensable German demand for aviation, shipping and chemicals. I agree with the study's conclusion: Binding quotas for e-fuels in aviation and shipping would give policymakers the tools they need to accelerate the market launch of e-fuels.

The production of synthetic fuels also requires electricity, and a lot of it has to come from renewable energy sources such as wind or solar, otherwise it is not sustainable. The question of where the future volumes of sustainable fuels and green electricity will be produced is key. We could potentially even see a shift in economic power towards regions with high solar and wind availability. This will be as critical to technology leadership as the question of when they will be available on an industrial scale.

Currently, the U.S. is leading the way. With the above-mentioned \$370 billion Inflation Reduction Act (IRA), it wants to make American industry climate and future-proof. In the EU, the law has triggered discussions about the future of Europe as a business location. The U.S. was already an attractive destination for foreign investors because of its low energy prices.

In response to the massive subsidy plans of the U.S., but also to the investment push in China, India and Canada, the EU has presented its 350 billion Euro Green Deal Industrial Plan – and must now act in order not to jeopardize its goal of being a pioneer in green technologies.

It's about climate change, but it's also about competitiveness. Europe can only remain a global technology leader if European companies can secure their technological leadership, especially in transformational and future technologies.

SAF made in Germany

That is why my clear wish for Germany and Europe is to quickly set up three or four pilot factories to ensure the ramp-up of SAF production for European consumption and – even more importantly – to create references for our mechanical engineering. After all, Europe will not supply the world with SAF, but the foundations must be laid now so that SAF can be manufactured worldwide in “made in Germany” or “made in Europe” production facilities.

However, the financing of basic research into new technologies, the development of a dedicated SAF and hydrogen industry and the expansion of the infrastructure cannot be borne by companies alone. This is where Europe can score with targeted funding, as the IRA provides only \$46.5 million for technology research and development, hardly any additional funding.

Sustainable public funding – at both national and European level – is also indispensable for a technology leader like MTU to work with its partners to bring future-oriented technologies such as the Flying Fuel Cell™ and the WET concept to market maturity on the road to climate-neutral aviation.

Because global without air transport is not an option. In addition to technical, economic and ecological aspects, the desire and need to fly should not be underestimated. Flying generates emotions and connects people across continents. At MTU Aero Engines, we are already working to ensure that this will continue to be possible in the future in a climate-neutral manner. ▀

“It's about climate change, but it's also about competitiveness. Europe can only remain a global technology leader if European companies can secure their technological leadership, especially in transformational and future technologies.”





Torsten Leue
CEO
Talanx Group

The Power of Weak Signals

Niels Bohr once wisely said:
"Prediction is very difficult, especially if it's about the future!"
This quote is particularly relevant in today's VUCA world. As companies strive to stay ahead of the curve, predicting future trends and events has become increasingly challenging.



However, it's essential to note that all disruptive events and innovations were predicted by someone, somewhere. They don't appear out of nowhere but are usually preceded by subtle and often overlooked signs – known as weak signals. Weak signals are early signs of change that, if identified and acted upon, can provide valuable insights into emerging trends and opportunities. By embracing complexity through decentralization, trust, and relative performance, organizations can position themselves to identify and act on weak signals, allowing them to thrive amidst uncertainty and disruption.

When I started working in the insurance industry about 30 years ago, many experts predicted that the traditional agent distribution model would soon become irrelevant. However, today, captive and affiliated agents remain the dominant distribution channel. This highlights the difficulty of accurately anticipating future trends and distinguishing the signal from the noise.

Despite the exponential growth of data and the emergence of new technologies such as AI in recent years, the quote by mathematical statistician and best-selling author Nassim Taleb still applies today: *“Sometimes a lot of data can be meaningless, at other times one single piece of information can be very meaningful.”*

Early signs of change or disruption are often elusive and challenging to detect, as they manifest in unexpected or unconventional ways instead of through widely publicized channels. Often, these signs present themselves as weak signals – ambiguous, qualitative, and fragmented indicators of change – that can go unnoticed if not recognized and acted upon. But for leaders who understand their significance, they hold the key to staying ahead of the curve and maintaining a competitive edge.

As business leaders, we must, therefore, ask ourselves: How can we correctly detect weak signals before they impact our business? How can we ensure that our organization is nimble enough to respond to weak signals in a timely and effective manner?

At Talanx the answer is simple: **Embrace complexity.**

“For leaders who understand their significance, they hold the key to staying ahead of the curve and maintaining a competitive edge.”

Embracing Complexity

The key to embracing complexity is to acknowledge that running a business today is fundamentally different from 30 years ago. The rapid pace of technological advancements and globalization have transformed organizations from complicated into complex systems.

Although these terms are often used interchangeably, managing a complex system means not just playing by different rules but playing a completely different game.

Complicated systems like a watch are characterized by many interrelated components. Problems within these systems can be understood, addressed piece by piece, and solved.

Complex systems such as corporations, on the other hand, are characterized by dynamic, non-linear relationships. They exhibit emergent behavior that cannot be fully understood or predicted. Within complex systems, the **“butterfly effect”** comes into play – the idea from chaos theory that a butterfly's wings flapping in one part of the world can trigger a hurricane in another.

Why is this distinction important? If we believe we are dealing with complicated systems, we will attempt to control outcomes and try to find simple, straightforward solutions. However, within complex systems this approach is destined to fail.

For this reason, we at Talanx embrace complexity and don't try to control it. This doesn't mean that we track every butterfly's wing flap, but we also don't wait for a Category 3 hurricane to hit us either. We aim to identify weak signals by following three basic principles:

1. **Reinforcing decentralization**
2. **Establishing a culture of trust**
3. **Focusing on relative performance**

“Separating a complex organization into multiple, more easily observable parts makes it easier to understand each part’s dynamics.”

1 Reinforcing decentralization

Weak signals may be buried deep within the organization, obscured by noise or distractions, or masked by more obvious signals. The further removed leaders are from the day-to-day business, the harder the detection of weak signals becomes.

One way to address this is by reinforcing decentralization.

Separating a complex organization into multiple, more easily observable parts makes it easier to understand each part’s dynamics. Moreover, by allowing different parts of the organization to operate independently and respond quickly to changes, decentralization creates a more agile and adaptable system. This is particularly important as weak signals often require quick and decisive action.

However, it’s essential to keep in mind that decentralization is not a panacea but requires a clear set of guiding principles. At Talanx, these guiding principles include **accountability** and **responsibility** on all levels, as well as a “**pull instead of push**” approach.

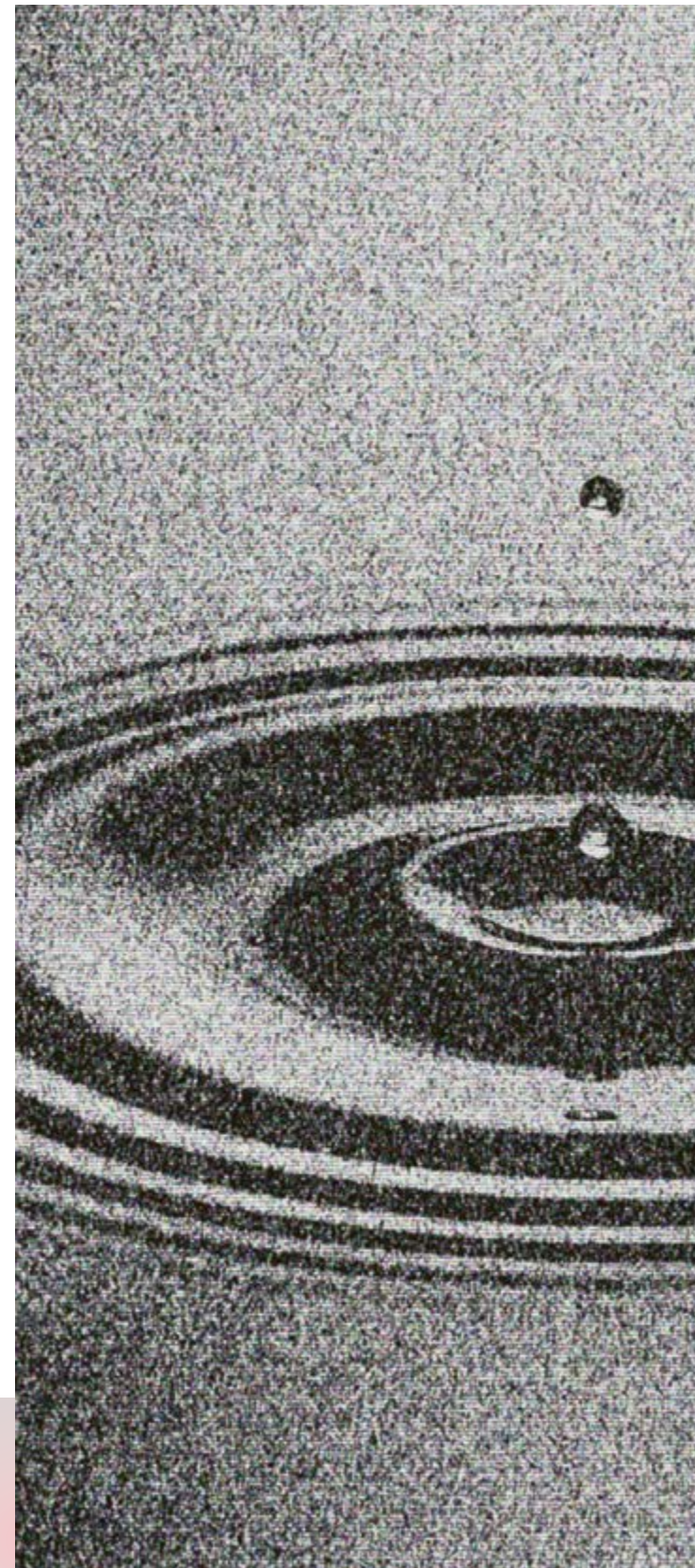
2 Establishing a culture of trust

Given that the detection and interpretation of weak signals is the result of an emergent and dynamic process, all employees should act as both receptors and amplifiers of weak signals. Thus, one answer to complexity is trust. Employees need to feel empowered to express their opinions and put forward arguments based on the weak signals they perceive. Active listening helps employees to feel safe to speak up. When they have a sense of ownership for their work, they are more likely to share information that can help detect weak signals, even if it goes against the status quo.

An important step to **creating a culture of trust** is to establish open channels for communication and collaboration throughout the organization. These cultures require interactive guidelines that allow for flexibility in handling each situation uniquely. Above all, organizations require **more leaders and fewer managers**. Managing involves controlling and directing people toward specific goals while aiming for operational excellence. It comes from a position of power and authority. By contrast, leadership involves delegating authority, **listening actively**, building trust, and inspiring people to achieve a shared vision. Leaders must be able to “**sense and respond**,” rather than trying to “predict and control.”

To promote leadership behavior, we have defined leadership principles that apply throughout the company. These principles are **transparency**, **collaboration**, and **engagement**. By adhering to these principles, we aim to ensure that our leadership team provides **diversity of thought**. A diverse range of perspectives helps us to diverge from the beaten path.

“Above all, organizations require more leaders and fewer managers.”



“While having a plan is important, sticking to it rigidly can be dangerous.”

3 Focusing on relative performance

By prioritizing relative over absolute performance, we focus on outperforming our competitors rather than achieving a certain benchmark. This approach encourages us to continuously strive for improvement, staying ahead of the curve and anticipating emerging trends and weak signals.

While having a plan is important, sticking to it rigidly can be dangerous. In the face of new market conditions, customer needs, and technological innovations, businesses that are unable to pivot and adjust their strategies risk falling behind their competitors.

Comparing our performance against that of our peers provides us with a more contextualized view of performance, accounting for external factors such as market trends and industry developments that are beyond an organization’s control.

Example from the Field

In 2019, Hannover Re and HDI Global bundled their cross-business specialty insurance expertise in a new company, HDI Global Specialty. The new company's objective was to write agency and specialty insurance in lines like directors' and officers' (D&O) liability, sports and entertainment, aviation, and off-shore energy. The decision was made in response to various weak signals that were pieced together like a jigsaw puzzle: On the one hand, our scattered specialty business was not reaching its full potential. On the other hand, premiums were starting to rise, and we noticed that some competitors were achieving good results in this field. We decided to embrace complexity and fully leverage market potential by establishing a new joint venture with a mission to grow and focus on profitable market segments. We emphasized a culture of trust and a decentralized setup. Responsibility for results lies with the individual units. This way we ensure that weak signals can be recognized and acted upon. An exchange of best practices is provided by centers of competence. This is a good example of our "pull instead of push" approach. The results have been impressive: HDI Global Specialty's premium volume rose from around EUR 1 billion in 2019 to EUR 3.1 billion in 2022.

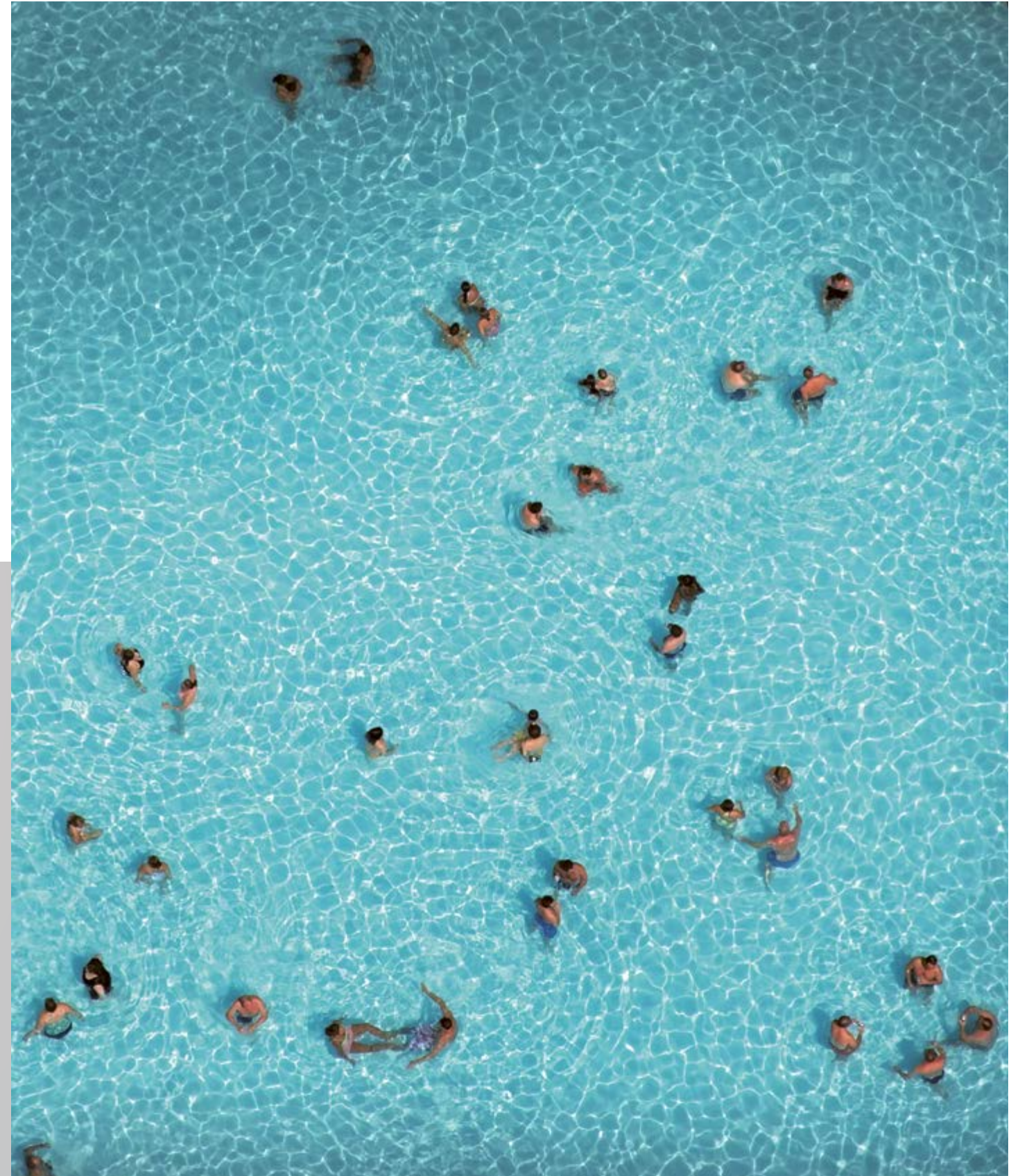
Final Remarks

By embracing complexity through decentralization, fostering a culture of trust, and prioritizing relative performance, we can create adaptable and resilient systems that are better equipped to detect and respond to weak signals.

As leaders, our role within these systems is not to control or dictate goals but to establish an environment where employees feel empowered to share information and ideas.

One thing is for sure: The world is going to continue getting exponentially more complex and will keep changing. Those who can recognize and act on weak signals will be the ones who come out on top.■

"The world is going to continue getting exponentially more complex and will keep changing. Those who can recognize and act on weak signals will be the ones who come out on top."



From Ashby's Law to High- Impact Innovation

Why we need a different mindset to
take science and technology from
incremental to groundbreaking change

Belén Garijo
Chair of the Executive Board & CEO
Merck





Making a revolutionary breakthrough after centuries of studying cancer. Initiating the necessary paradigm shift to address climate change. Finding viable new ways to supply food and energy sustainably. How will the world rise to these complex challenges? And how can leading players in science and technology truly make an impact?

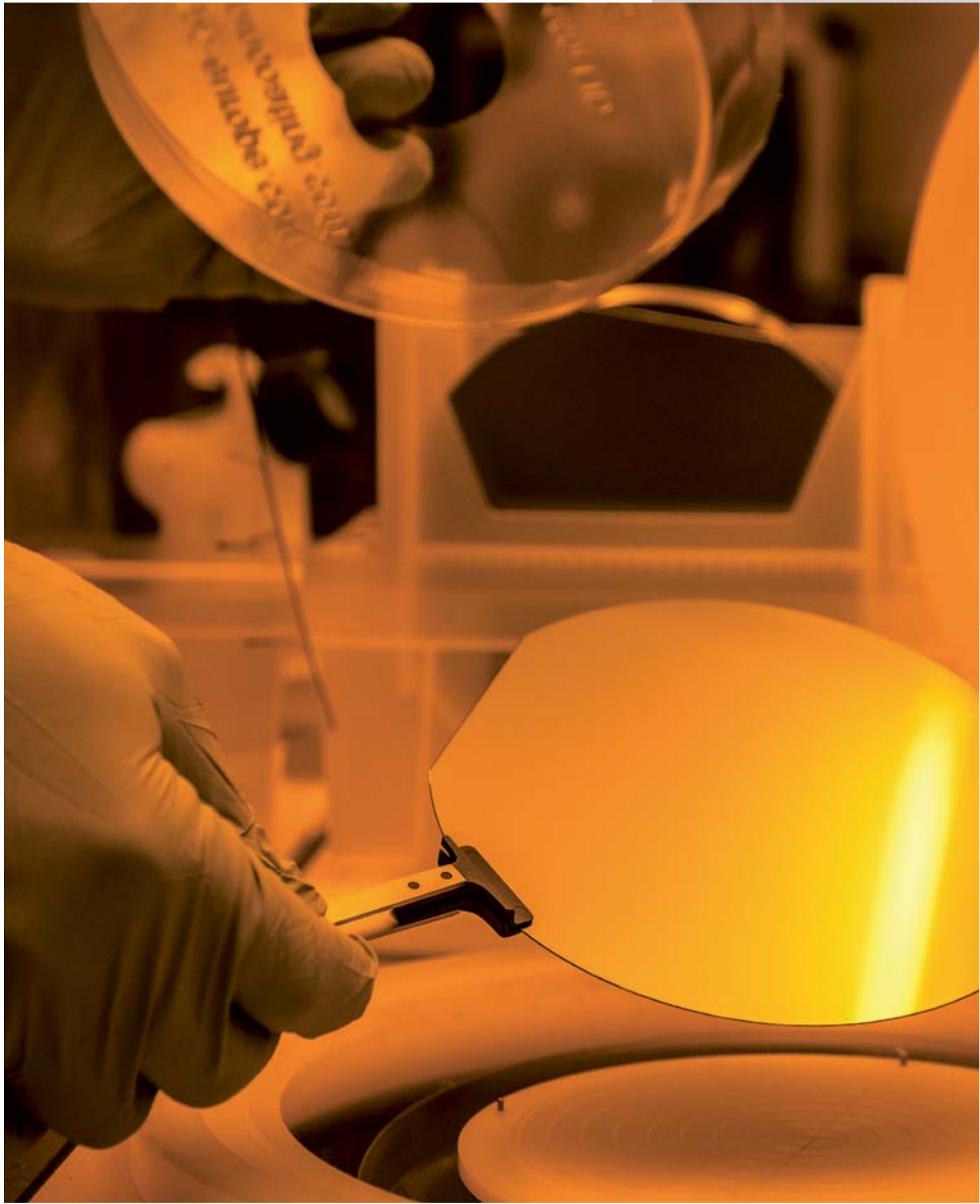
If you ask me, one answer stems from the 1950s. More precisely, from the British psychiatrist and systems theory pioneer W. Ross Ashby, and what is known today as ‘Ashby’s Law.’ Ashby studied self-regulating biological systems, such as temperature regulation in the human body. Based on his findings, he established that a complex challenge cannot be approached with a linear ‘right-versus-wrong’ or ‘cause-and-effect’ toolbox. “In order to deal properly with the diversity of problems the world throws at you,” he wrote in 1958, “you need to have a repertoire of responses which are (at least) as nuanced as the problems you face.”

“In order to deal properly with the diversity of problems the world throws at you, you need to have a repertoire of responses which are (at least) as nuanced as the problems you face.”

Repertoire of responses

What does this tell us today? From the global economy to supply chains and social media, contemporary society is increasingly steered by highly interconnected, multi-faceted systems. The “world is throwing problems at us” that even the elites can no longer fully grasp. At the same time, Artificial Intelligence (AI), biotech and other key technologies present historic opportunities to drive human progress. Ashby’s Law reminds us that managing – and innovating boldly in – such complexity requires us to drop our binary mindset of ‘either-or’ and ‘on the one hand – on the other hand.’ It teaches us instead to explore and experiment, think and interact in diverse networks – and continuously diversify our “repertoire of responses.”

Does tackling complex challenges require complex organizations? On the contrary: We need to *simplify* in-house structures and processes to focus on outcomes. We need to incessantly improve and integrate feedback, democratize knowledge access, and make room for outside-the-box thinking. And we should welcome a further ‘member’ to our diverse networks: generative AI. In Ashby’s terms, success is about getting all views and options on the table as fast and efficiently as possible – and having the right answers at hand when it counts. It’s about celebrating speed and agility!



“Unlike in previous scientific eras, where disciplines such as biology and chemistry operated mainly in isolation, it is likely that the most significant future breakthroughs in human health and well-being will harness a diverse mix of experts, processes, and technologies.”

Megatrend bioconvergence

A megatrend which exemplifies this idea of ‘agile diversity’ is that of bioconvergence. Unlike in previous scientific eras, where disciplines such as biology and chemistry operated mainly in isolation, it is likely that the most significant future breakthroughs in human health and well-being will harness a diverse mix of experts, processes, and technologies. These are spread across several disciplines which are increasingly converging, namely biology and medicine, computing and electronic engineering.

Imagine picking up your personalized, 3D-printed medicine at the local pharmacy, for example – tailored to your unique biology. Wearing, or even implanting, a device that can prevent or treat severe chronic diseases, by using electronic impulses to stimulate the nervous system. Think of cutting the time needed for drug development from twelve years to less than four through AI and automation. Or testing the safety of a new drug on precise, lab-grown mini models of human organs. Such ‘organs-on-chips’ could not only lead to much better results for patients from clinical trials; they could also make animal testing in clinical trials history. Or what if we could take our testing 100 percent ‘in silico’ by creating an accurate virtual model of our human organ, a ‘digital twin’? Synergizing AI and smart manufacturing could bring a whole range of benefits to many industries, from identifying and producing new drug compounds faster to improving the design and production of electronics materials.

As a science and technology leader, we at Merck engage in projects in all these areas, and more. Our diversification across life science, healthcare and electronics, paired with our global footprint, allow us to bring together key bioconvergent technologies, knowledge, as well as a diverse spectrum of strong collaboration partners. Needless to say, we would not build on our unique position if we did not see a competitive edge. Still, I am convinced that companies like ours should think bigger – as their contribution to scientific progress is needed on a much greater scale.

More knowledge, but less disruption

To underscore my point, the scientific journal *Nature* recently published an alarming finding¹: Indeed, new knowledge in science and tech has grown exponentially in recent decades. But at the same time, scientific papers and patents are actually becoming less disruptive – or, as *Nature* puts it: “less likely to break with the past in ways that push science and technology in new directions.” The authors also found that, “in fields in which there is more use of diverse work, there is greater disruption.” Meanwhile, the ongoing U.S.-China tensions are a further serious challenge to promoting the diversity and fruitful exchange of scientific work. Two nations that not only happen to be political superpowers, but also scientific – and, until recently, scientific *collaboration* – heavyweights.

Against this backdrop, I believe even more that global science and technology companies can and must be a key driver of multi-disciplinary research and development. Unsurprisingly, diversity and inclusion are a fundamental priority. Diversity of thought needs diverse teams, and inclusion – making sure that everyone feels psychologically safe to bring their perspectives to the table – is key to unlocking the value of diversity. A dedicated team and strategy at Merck address this mission-critical topic on many levels, for example, via awareness training on unconscious bias or tools to prevent biased hiring.

Whether in- or outside Merck, we promote diversity in our collaborations. Merck has initiated, or is a part of, numerous communities and partnerships that further multi-disciplinary innovation and exchange across industry, start-ups, academia, as well as the public sector. We also host interdisciplinary scientific competitions and events, such as the Curious Future Insight Conference. Our strategic corporate venture capital arm, M Ventures, provides an additional opportunity to engage with external innovators, greatly broadening our horizon in the novel bioconvergence field. This team invests in world-leading entrepreneurs who are doing groundbreaking work – enabling us to both support and benefit from the highly diverse and innovative start-up community.

“Building a strong, shared data culture is one high-priority objective – a key enabler to truly innovating as one company.”

Breaking down silos

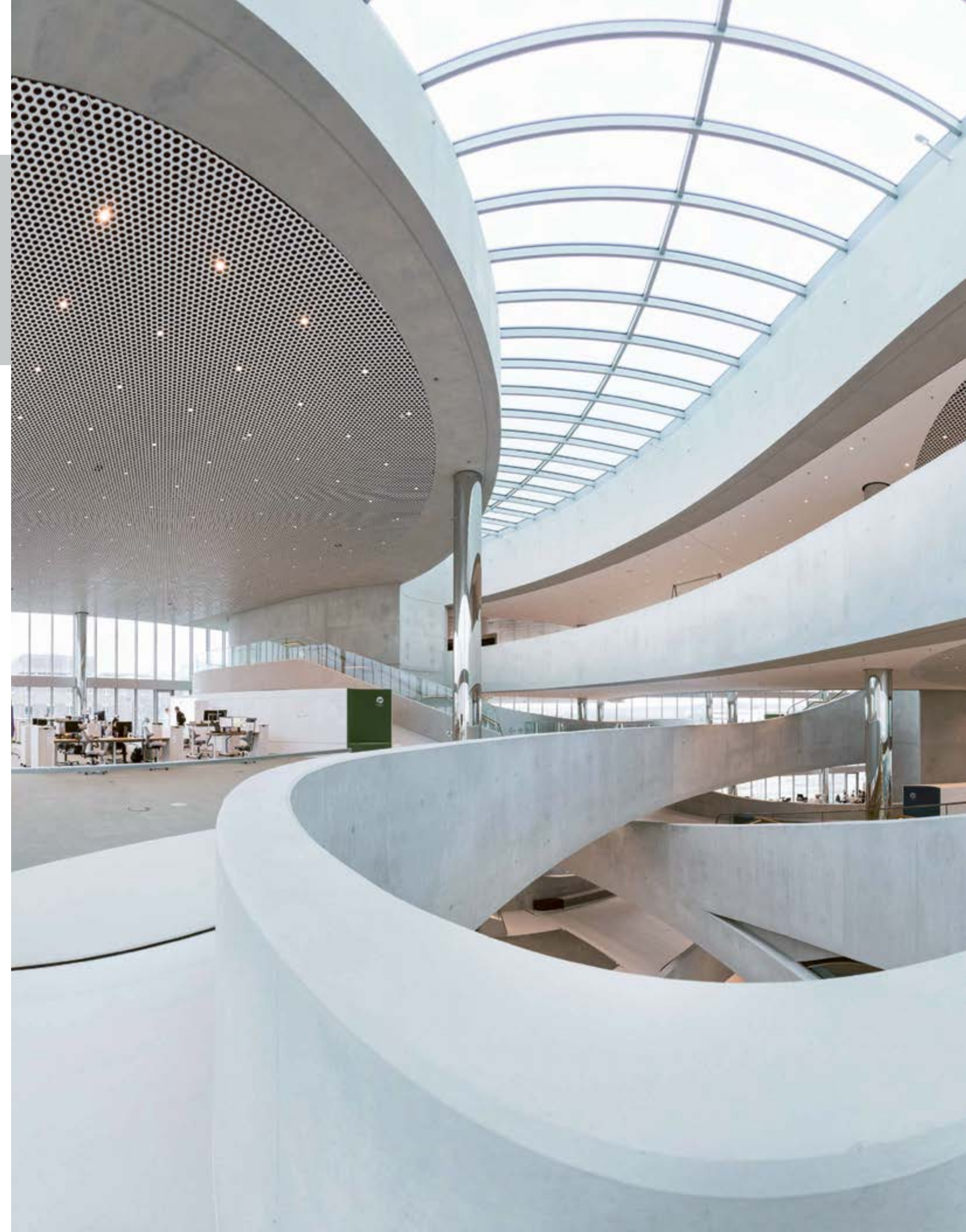
At the same time, we are breaking down silos that typically arise in a multi-sectoral company with a long-standing history. Building a strong, shared data culture is one high-priority objective – a key enabler to truly innovating as one company. We recently took an important step on this journey by giving an initial group of colleagues access to myGPT@Merck. This custom-built AI chatbot tool underscores our commitment to security and data privacy, while allowing our colleagues across the globe to learn and leverage the productivity potential of AI.

Of course, to be ethically sound, every road we take must have clear guardrails – especially in sensitive areas such as AI and biotech. We at Merck take our ethical responsibility very seriously and decided early on to lead by example. Over a decade ago, for instance, we initiated a Bioethics Advisory Panel, and now also have a Digital Ethics Advisory Panel in place. We regularly consult and receive clear guidance from both panels, which consist of multi-disciplinary external experts.

Ultimately, embracing collaboration and diversity in any form, whether in science, tech or people, boils down to a very elemental factor: the human brain. As leading neuroscientists tell us today, our brains prefer stable and known environments. Their natural urge is to reduce uncertainty – in stark contrast to what it takes to grow in a complex environment: openness to diverse perspectives. So, it’s really up to each and every one of us to leave our comfort zones, switch to ‘learning’ and ‘exploration’ mode, and most importantly: help shape an inclusive culture to enable and empower others.

In this spirit: What are your thoughts? What ideas have I perhaps missed? I look forward to more opportunities for discussion, best-practice sharing and possibly even collaboration. ▀

¹ <https://www.nature.com/articles/s41586-022-05543-x>



Pioneering for Transformation

A Journey Towards Low-carbon Steel Production

Steel has played a vital role in shaping the modern world and it certainly plays a big role in today's industrial decarbonization. But its production accounts for around 7% of global CO₂ emissions. As we embrace the urgent need for a greener future, Salzgitter AG faces an existential challenge: we must reduce our environmental impact while remaining globally competitive.



Gunnar Groebler
Chairman of the Board
Salzgitter AG

“By replacing coal with green hydrogen, we aim to reduce the carbon footprint of steel production by at least 95% in the next ten years, cutting Germany’s CO₂ emissions by around 1%.”

Salzgitter AG has embarked on a groundbreaking transformation journey: By replacing coal with green hydrogen, we aim to reduce the carbon footprint of steel production by at least 95% in the next ten years, cutting Germany’s CO₂ emissions by around 1%. With our ambitious transformation program SALCOS (Salzgitter Low CO₂ Steelmaking), we are spearheading Germany’s industrial decarbonization and setting a benchmark for the entire industry. This is also recognized by European policy makers: Salzgitter AG is the first German steel company to receive EU-approved funding of €1 billion for its transformation path.

Our commitment to green steel is imperative for securing the long-term viability of steel production in Germany under the EU’s emissions-trading system. However, as sufficient capacities of green electricity and green hydrogen are yet to emerge, we are relying on a successful energy transition.

Steel is the cornerstone of economic development, powering industries and driving growth. Its versatility, strength, durability and recyclability make it an indispensable material across various sectors. It is the starting point of many value chains, a raw material for most German export products and green technologies, like wind turbines and electric vehicles.



Green steel – made in Germany?

While the importance of steel is undeniable, above all, the future of German steel production resolves around one question: Will there also be a market for green steel that is globally competitive? The answer is yes.

We believe that climate neutrality as a product characteristic is becoming increasingly important. For the automotive industry or producers of household appliances, green steel as a raw material is indispensable for reducing Scope 3 emissions and offering carbon-neutral products to end consumers. A car made of green steel will cost around an additional €500, which is a far more affordable price tag than, for example, a car's paintwork. We are already witnessing demand and a higher willingness to pay: Three years in advance, we are now receiving orders for the first batches of green steel that we will produce from 2026.

“We believe that climate neutrality as a product characteristic is becoming increasingly important.”



“In total, our conversion to low-CO₂ steel production will cost a mid-single-digit billion-euro amount. This is the largest single investment in the history of Salzgitter AG, but looking at the big picture, it is one of the best overall packages for climate protection.”

Salzgitter AG's pioneering SALCOS Program

At our site in Salzgitter, the old and new worlds of steel production are already colliding. In our μ DRAL demonstration plant, we have successfully tested what will later be implemented on a much larger scale: a fundamentally new approach for steelmaking – a process which has remained untouched for hundreds of years.

Instead of smelting iron ore in blast furnaces, oxygen is removed from the iron ore without melting it in a process called direct reduction. The direct reduction plant converts iron ore into sponge iron, which is in turn then melted in an electric arc furnace to produce steel. Unlike conventional steel production, this process generates steam instead of CO₂ as a by-product.

To achieve full decarbonization, however, the plant must run on green hydrogen. Until we have enough available, the plant configuration allows us to use natural gas and hydrogen in different mixing ratios. In this way, we can steadily increase the proportion of green hydrogen until the plant only emits H₂O instead of CO₂. But even with natural gas, direct reduction already reduces CO₂ emissions by 60% compared to the blast furnace process.

Our early commitment to the potential of green steel means that we are already far beyond PowerPoint presentations: As the first steel manufacturer in Germany, Salzgitter AG has recently placed the order for the first direct reduction plant as well as the electric arc furnace, and its foundations are already being laid on-site. A particular challenge here is that the

construction of new technology and the ramping down of old technology will take place simultaneously whilst also continuing normal, day-to-day operations – a little like open-heart surgery. For this reason, our SALCOS transformation program is divided into three phases.

In the first phase, a hydrogen-capable direct reduction plant and an electric arc furnace for the production of almost 2 million tons of crude steel, as well as a 100-megawatt electrolyzer, will be built. This phase will be completed in 2026, when the first blast furnace can be shut down. We were the first German steel producer to receive around 1 billion euros from the German government and the state of Lower Saxony for this phase and in addition, we will also contribute around 1.3 billion euros ourselves.

By 2033, the current blast furnaces and converters will be fully replaced. We will then have the technical ability to reduce our carbon footprint by at least 95% and cut Germany's CO₂ emissions by around 1% – around 8 million tons per year.

In total, our conversion to low-CO₂ steel production will cost a mid-single-digit billion-euro amount. This is the largest single investment in the history of Salzgitter AG, but looking at the big picture, it is one of the best overall packages for climate protection. Achieving similarly large CO₂ reductions in other industries (e.g., the mobility sector) is significantly more complex and requires even more resources.

A new way of thinking for a new industry

SALCOS is the main pillar of our “Salzgitter AG 2030” strategy, but our overall transformation is built upon an even more holistic approach: Circularity. Steel is the best ambassador for this because it is infinitely recyclable.

With two of the world’s leading offshore wind developers, Ørsted and RWE, we have started a strategic partnership to explore the supply of green energy, which we in turn then use to produce green steel for new offshore wind turbines. At the end of their life span, the steel from the turbines is recycled back at our plant. By focusing on the entire life cycle of steel and creating closed loops with our customers, we can further minimize the use of finite resources.

These partnerships also demonstrate what we call “partnering for transformation”. A more collaborative way of doing business, where we tap into synergies and promote and create cooperation clusters. We have already established additional partnerships with Uniper, SAP, BMW Group, Volkswagen and Tenova, among many others, and our network is constantly growing – always with the intention of working towards a common goal: a greener future for us all.

Overcoming challenges – together

Collaboration will continue to be key in the future. Only by working together can we forge new methods and approaches and transform the whole industry. For example, by solving the biggest bottleneck of industrial transformation: the availability of green hydrogen. When our transition to direct reduction is complete, we will require up to 300,000 tons per year, much more than we intend to produce on site. Today, the hydrogen economy in Germany is still in its infancy. The big task for the next few years will be to ensure that both supply and demand, as well as the infrastructure in between, are developed simultaneously.

We at Salzgitter AG have made investment decisions without knowing when our steelworks will be connected to a hydrogen pipeline. But for the industrial turnaround to become a success story, we must return to the core values of entrepreneurship: A focus on opportunities rather than risks and the courage to act and take the first step. The faster more companies follow our lead, the stronger we will emerge from this transformation – and be a successful blueprint for the whole world. ■



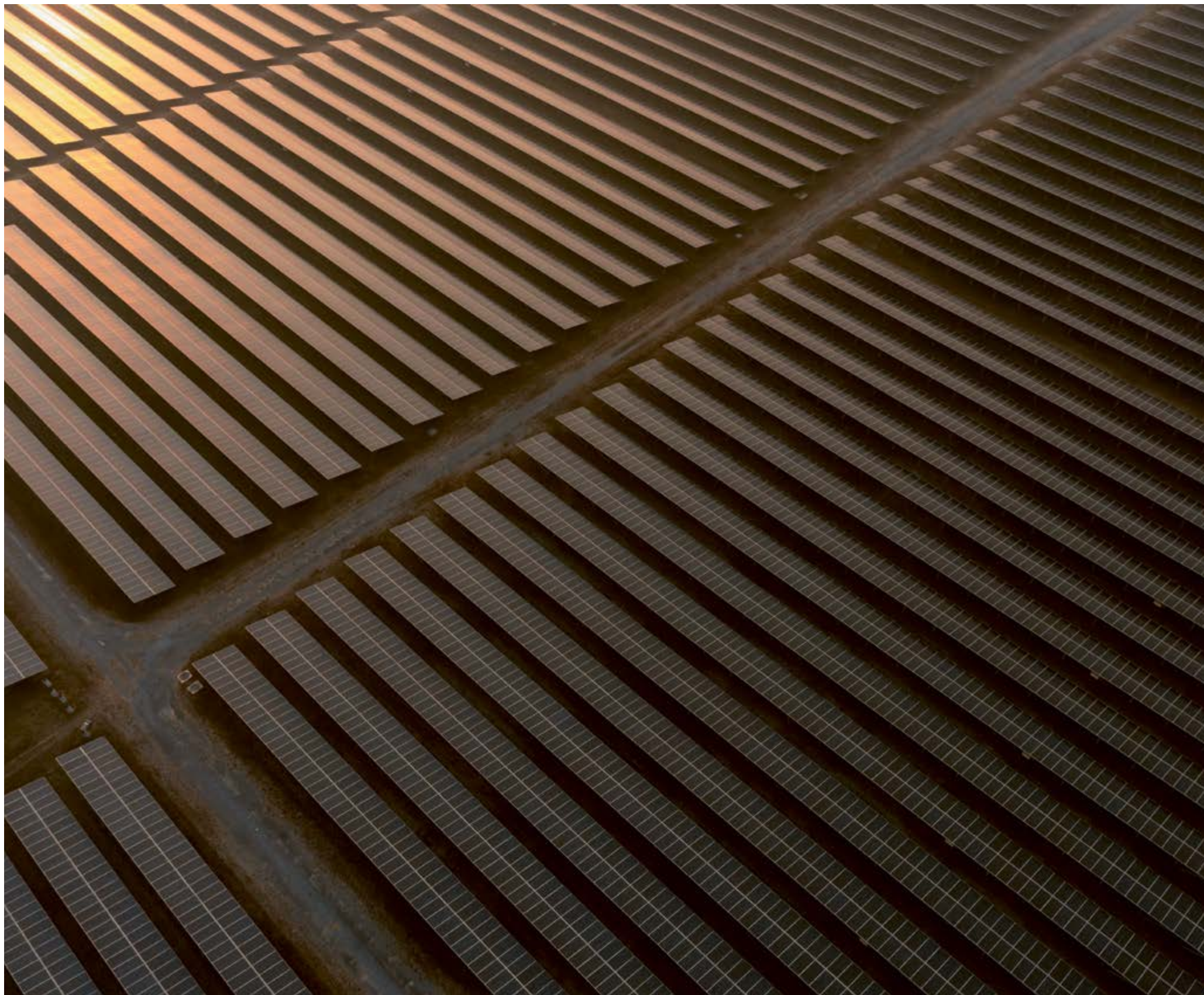
Photovoltaics from Europe for Europe

**What it Takes to Establish
a Competitive Solar Value
Chain in Europe**



Christian Hartel
President & CEO
Wacker Chemie

The economic order established in recent decades is currently experiencing a massive upheaval. The Russian war of aggression on Ukraine and Germany's dependence on Russian gas supplies have ruthlessly revealed that we need more speed in the implementation of the energy transition. Rising energy prices are an enormous burden – for society as a whole, but also for industry in particular.



It is true that quick and pragmatic political decisions have brought short-term stability to Germany's and Europe's security of supply. But to regain global competitiveness and successfully follow the path toward climate neutrality, more than ad hoc measures are required. What is needed is a long-term response to both the climate crisis and the energy crisis, as well as a toolbox that is reliable in terms of planning and investment, in order to actually achieve the goal of climate neutrality by 2045. A look at the USA and the Inflation Reduction Act passed there last year makes it clear: Europe is in acute danger of losing touch with investments in a climate-neutral future.

“A look at the USA and the Inflation Reduction Act passed there last year makes it clear: Europe is in acute danger of losing touch with investments in a climate-neutral future.”

“At present, apart from polysilicon production, a solar value chain hardly exists in the European Union. At the same time, huge capacities are already up and running in Asia.”



Independent through climate-neutral technology

In response to the disruption of the global energy market caused by Russia's invasion, the European Commission presented the REPowerEU plan in May 2022. This is now becoming more concrete with the CleanTech Europe forum and the Solar PV Industrial Alliance. The aim is to ramp up the production of climate-neutral technologies in Europe much faster. In the field of solar energy, around 60 gigawatts of photovoltaic capacity must be installed across the EU – every single year!

The chemical industry plays a key role in climate protection and sustainable energy supply in two ways. On the one hand, it is a facilitator, a driving force. A good example of this is the polysilicon we produce at Wacker Chemie: Without this material, there would be no solar cells, and without solar cells, there would be no energy transition. On the other hand, chemistry is also energy-intensive, intrinsically so, because in chemistry molecules are broken down and reassembled. That requires large amounts of energy.

Our globally largest production site in Burghausen, for example, accounts for 0.5 percent of Germany's electricity requirements and about 1 percent of the country's gas consumption. Our plant is among the most energy-efficient in the world, but in the end, we come up against the laws of nature in thermodynamics, which cannot be overridden. This is why energy prices remain the key issue on which everything else turns.

The challenge of China's monopoly position

At the same time, electricity prices at an internationally comparable level are one of the most important prerequisites for establishing a complete and competitive solar industry in Europe. At present, apart from polysilicon production, a solar value chain hardly exists in the European Union. At the same time, huge capacities are already up and running in Asia. As for solar crystals and wafers, almost 100 percent of global capacity is located in Asia. For solar cells and modules, the figure is between 75 and 80 percent. The challenge is therefore to build up an industry in competition with a region where the complete value chain already exists on a very large scale and which today has a de facto monopoly position at several stages of the value chain.

Admittedly, energy has never been cheap in Europe. That's why our production sites are trimmed for utmost efficiency, but there are limits. Compared with the USA or China, the price of electricity in Germany is currently three to five times higher. Such large differences cannot be compensated for in the long term with efficiency measures. Under these conditions, it is practically impossible to operate the first stages of the solar value chain in a commercially viable way. This applies to polysilicon production and crystal pulling. These processes are very energy intensive. At current electricity prices, we will not see any investments in Europe at these stages of the value chain.

Politicians must finally take action and will be judged by whether this country has the right business environment, and that also includes energy at reasonable prices. As decarbonization progresses, energy needs will continue to grow as more and more processes are electrified. For this reason, it is even more important to produce renewable energy in ever greater amounts. Because green electricity is not only the cleanest form of energy, it is also the cheapest.

The need for clean, cheap energy

To put it in a nutshell: We need reasonably priced green energy in large quantities. This will not happen overnight. The government is on the right track with its legislation for accelerating expansion of renewable energy and grid infrastructure. But there is still a lot of work to be done. Time is running out, and our industry cannot wait. That's why Wacker has been advocating for years for an industrial electricity price to bridge the gap until sufficient green energy is available.

We assume that the duration of this transition phase will probably be in the order of about ten years. At that point, photovoltaics and wind power will have to ensure that our electricity prices are competitive from a global perspective. It can't take longer than that, otherwise we'll end up in a permanent subsidy spiral and competition with other regions will no longer be about our technology and the quality of our products, but about how generously state subsidies flow. That's why we're talking about a temporary transformation electricity price.

In a working paper, the German Ministry for Economic Affairs and Climate Action is now proposing a bridge electricity price of 6 cents per kilowatt hour for energy-intensive industrial companies that compete internationally. This is without doubt a step in the right direction. However, implementation – i.e. an adopted law – is still pending.

“We need reasonably priced green energy in large quantities. This will not happen overnight.”

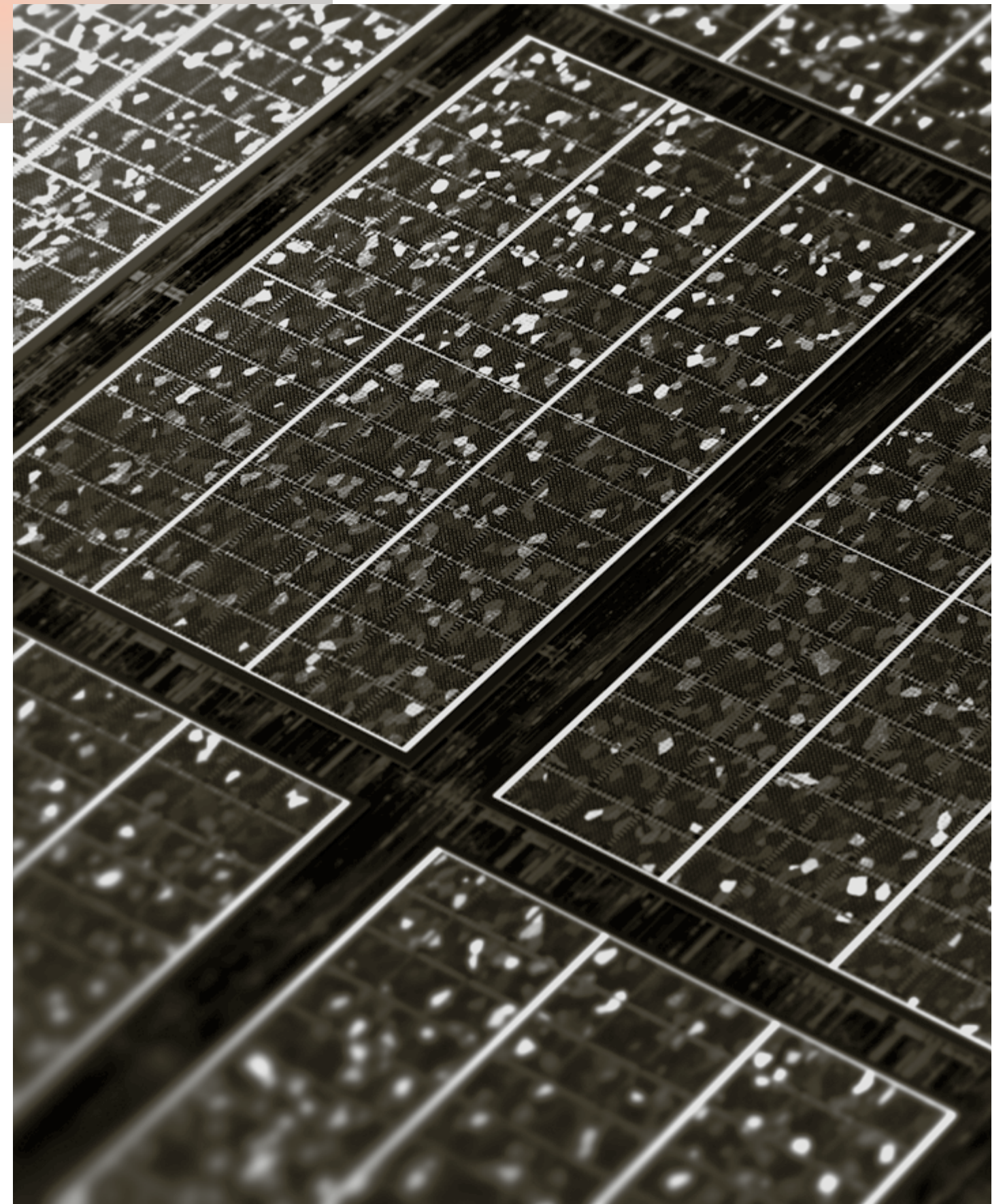
“Society benefits from a European solar industry in the form of well-paid jobs and technology development.”

Rewarding investments and subsidies

In the end, of course, the decisive factor is that such investments and the necessary state subsidies are worthwhile for society, and I am convinced that this will be the case. First of all, society benefits from a European solar industry in the form of well-paid jobs and technology development. Another important point is a certain independence. We see where too much dependence can lead with gas and oil through Russia's war against Ukraine. I think there is a growing awareness in society that we need to reduce the risks arising from dependencies. For a certain resilience and independence, we also have to be prepared to put our money where our mouth is.

A further crucial aspect is sustainability in production. If we produce polysilicon in Germany, for example, we are up to 50 percent better in terms of CO₂ emissions than our Asian competitors. This applies in the same way to many production stages in the solar value chain. For climate protection, it is important that we pay attention to sustainability in production, and we are also improving this by building up a solar industry in Europe.

The establishment of a European solar value chain to complement global capacities therefore makes sense for many reasons: from an environmental, economic and social perspective. All in all, it is a positive business case for the whole economy that will pay off in the long run and increase Europe's resilience. This makes it all the more important to create the right conditions now. In essence, these are above all the massive expansion of renewable energies and, for the transition phase, ensuring internationally competitive electricity prices in the form of an industrial electricity price. ■



About this publication

The periodical of The Stern Stewart Institute

27th Edition, September 2023
Published half-yearly

Publisher and Chief Editor

Gerhard Nenning

Board of The Stern Stewart Institute

John Deferios
 Benedikt Franke
 Susanne Klatten
 Gerhard Nenning
 Markus Pertl
 Susanne Pertl
 Daniela Schwarzer

Managing Editor

Anja Deucker

Editorial Support

Charlotte Kotowski

Design Production and Artwork

KW NEUN Agentur für Visuelle Kommunikation GmbH

Printing

Industrie-Druck Haas

The opinions, beliefs and viewpoints expressed by the various authors in this publication do not necessarily reflect the opinions, beliefs and viewpoints of the editorial staff or of The Stern Stewart Institute. The publisher accepts no responsibility for errors, omissions or the consequences thereof.

The Stern Stewart Institute e.V.

Salvatorplatz 4
 80333 Munich
 Germany
 T +49 89 242071 0
 F +49 89 242071 11
 E info@sternstewartinstitute.com

sternstewartinstitute.com
tssi.org

Picture Credits

istockphoto / imaginima (p. 8), Vepar5 (p. 11), gorodenkoff (p. 12/13), Jackie Niam (p. 14/15), sufiyan huseen, Adam Smigielski (p. 16), branslav_bubanja (p. 18/19), Achim Schneider / reisezielinfo.de (p. 23), Freezingtime (p. 24/25), iiievgeniy (p. 26), Mack15 (p. 28/29), Reinhard Krull (p. 30/31), goler0 (p. 36/37), Makhnach_M (p. 38/39), Timothy Messick (p. 50/51), SHansche (p. 54), manus1550, namussi (p. 60), EpicStockMedia (p. 63), tacojim (p. 65), a-r-t-i-s-t, amtitus (p. 66/67), PlotPhoto (p. 84/85), MANOJ KUMAR DAS (p. 86), NiPlot (p. 89).

All other images are property of the authors or companies.

Illustrations by KW NEUN.

