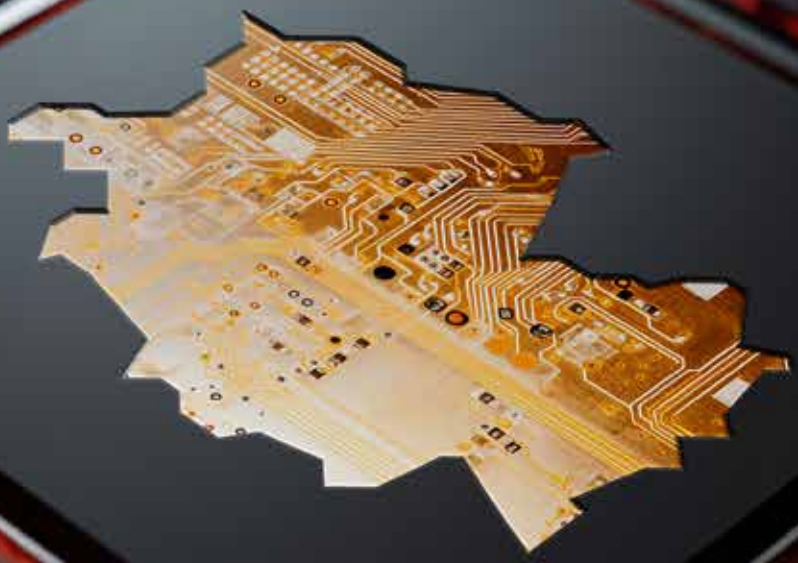
MARKETS

GERMANY

Insights into Europe's Biggest Economy 1/24

REMAKING MANUFACTURING

High-profile international investments in industrial manufacturing herald a bright future for "Made in Germany"



H_2 TO GO

A new generation of hydrogen-ready power plants drives Germany's H_2 economy

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Handwerk sector

Harnessing the proud tradition of skilled trades in Germany

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Handwerk tradition

Germany's skilled trades are an invaluable resource for international companies.

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Getting ready for H_2

A new generation of hydrogen-powered and hydrogen-ready power plants in Germany will require multi-billion-euro investments. Opportunities abound for cleantech manufacturers, consultants and suppliers.

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Excecutive Board: Julia Braune, Chairwoman/CEO, Dr. Robert Hermann, CEO

Director Corporate Communications: Andreas Bilfinger

Managing and Content Editor: Eva Forinyak

Editor: Jefferson Chase

Editorial Team Kammann Rossi/wortwert: Imogen O'Rorke, Christoph Hus, Jürgen Jehle

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Federal Ministry for Economic Affairs and Climate Action

on the basis of a decision by the German Bundestag

Photo: Illing & Vossbeck Fotografie

"Germany dominates semiconductor production in Europe. Rumors of its industrial demise have been exaggerated."

Dear Reader,

This edition of *Markets Germany* is all about making things — in Germany. Doom-mongers often say that manufacturing in Europe's largest economy has no future. The price of everything from labor to electricity is too expensive, they contend, for Germany to compete with other production locations. But recent major international expansion projects suggest otherwise.

In November, US pharmaceutical company Lilly announced that it will open a new production facility worth EUR 2.3 billion in the western German city of Alzey. Meanwhile, Taiwanese semiconductor manufacturer TSMC plans to construct a massive new EUR 10 billion chipmaking facility in the eastern city of Dresden.

In fact, Germany dominates semiconductor production in Europe — it has the greatest number of chipmaking megafab projects on the continent by a wide margin. Competition between countries to woo expanding businesses remains intense — that's to be expected — but rumors of Germany's complete industrial demise have been greatly exaggerated.

There are many advantages to manufacturing products in the heart of Europe. Proximity to customers, a burgeoning artificial intelligence start-up sector and a unique tradition of tradesmanship are just a few of the arguments in Germany's favor. So we hope this issue of our magazine makes you, our readers, think about whether you could be the next German success story, in manufacturing or otherwise.

Dr. Robert Hermann, *CEO*
Email: invest@gtai.de

ONE TO WATCH

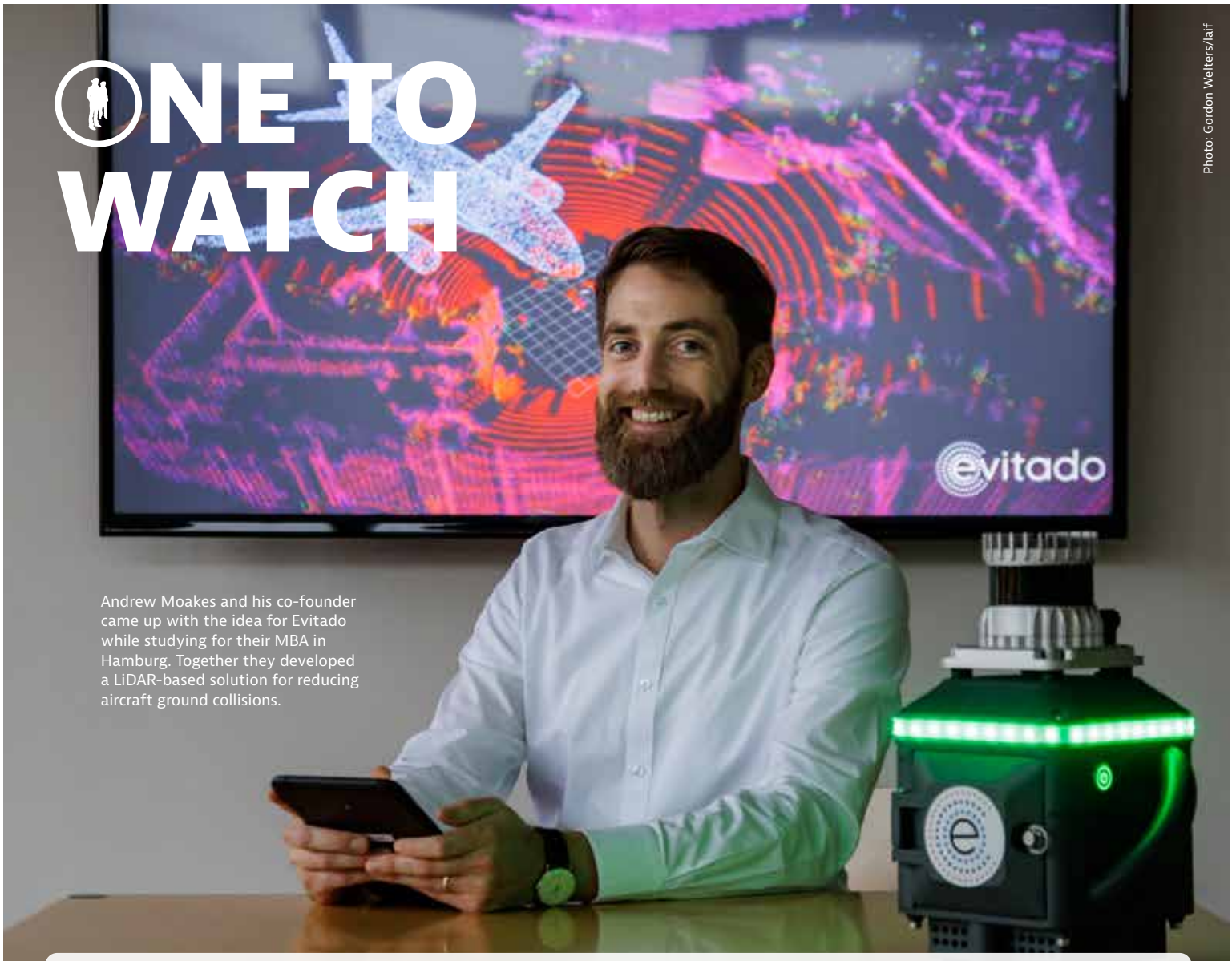


Photo: Gordon Welters/laif

Andrew Moakes and his co-founder came up with the idea for Evitado while studying for their MBA in Hamburg. Together they developed a LiDAR-based solution for reducing aircraft ground collisions.

ANDREW MOAKES: *CO-FOUNDER AND COO, EVITADO*

Every year the aviation industry spends billions of euros repairing aircraft damaged by ground collisions, so Andrew Moakes decided to do something about it. The engineer came up with the concept for Evitado while studying for his MBA at the Northern Institute of Technology Management (NIT) in Hamburg. Moakes and his co-founder Alex Kasinec first became aware of the problem while studying reports from the US Federal Aviation Administration and the International Air Transport Association IATA.Together the two American students developed a business plan for their master's thesis.

After graduating in 2019, they participated in the Airbus accelerator program bizlab, where they developed a prototype LiDAR sensor that can help warn of potential collisions. Today their clients includes notable names such as Lufthansa, Swissport and the US Air Force. "Hamburg, being a prominent aviation hub in North Germany, facilitated our market entry and networking within the industry, eliminating the need for extensive travel, making it the ideal environment for our business," says Moakes.

The sensor is attached to towing vehicles that move aircraft around on the ground. It not only measures distance, but also scans the aircraft's surroundings in three-dimensional space, collecting cloud data, making it far more advanced than ultrasonic sensors found in parking assist car systems.

"This technology is paving the way for autonomous aircraft towing, a key goal for us," comments Moakes. The start-up has since expanded to the US but Hamburg remains the primary hub for research, development, and production.

Quick facts

NAME	Andrew Moakes
JOB TITLE	COO
QUALIFICATION	M.Sc. Mechanical Engineering and Management, M.B.A Entrepreneurship/ Entrepreneurial Studies
COMPANY NAME	Evitado
LOCATION	Hamburg; Colorado, USA
INDUSTRY	Aviation
STAFF	Hamburg: 10 (6 full time, 4 students); USA: 2
CLIENT BASE	Airbus, Swissport, Dnata, DHL, US Airforce, French Airforce, Lufthansa

REMAKING MANUFACTURING

It's time to challenge the cliché that manufacturing in advanced economies in Europe is just too expensive. A series of high-profile business expansions show that "Made in Germany" is entering an exciting new era.

On August 8, 2023, the the Taiwanese Semiconductor Manufacturing Company (TSMC) announced that it would locate its first major European production facility in the eastern German city of Dresden. The news put an end to years of speculation that TSMC could go elsewhere.

So why did it choose Dresden? The company's leadership cited a couple of factors: "This investment demonstrates TSMC's commitment to serving our customers' strategic capacity and technology needs, and we are excited at this opportunity to deepen our long-standing partnership with Bosch, Infineon and NXP," said Dr. CC Wei, TSMC CEO, who also underlined Dresden's promise as a location for semiconductor innovation, particularly in the automotive and industrial sectors. "We look forward to bringing those innovations to life in our advanced silicon technology with the talent in Europe."

His words ran contrary to a number of doom-and-gloom reports published around the time. Germany was too expensive and too bureaucratic for manufacturing, the critics carped, and the country had been thrown into an energy crisis by Russia's war on Ukraine. TSMC disagreed. And they were not alone.

A proliferation of projects

Eli Lilly and Company is another business lured by the attractions of Europe's traditional manufacturing powerhouse. As one of the world's leading suppliers of injectable medical products and injection devices, the US pharma giant is establishing a presence in the western German city of Alzey with a manufacturing facility costing some USD 2.5 billion (EUR 2.3 billion).

Germany Trade & Invest (GTAI), the country's international business promotion agency, assisted Lilly with its expansion. "This project once again proves how attractive Germany can be as a location for manufacturing companies," says GTAI CEO Robert Hermann. And there are more large-scale projects like this in the pipeline. "Around two dozen companies are currently planning major investments in Germany with a total investment volume of around USD 80 billion," said German Minister for Economic Affairs and Climate Action Robert Habeck in August 2023.

In October, Habeck unveiled his strategy to further strengthen Germany as a top-tier location for the global manufacturing industry. The plan includes tax breaks and subsidies for business investments, accelerated expansion of renewable energies production and reduction of bureaucracy.

THE BOTTOM LINE

Confounding the naysayers, the future of industrial manufacturing in Germany remains bright and offers a plethora of opportunities for international businesses.

Looking to the future

There's no denying that rises in energy prices with Germany's rapid phase-out of Russian oil and natural gas have presented a major challenge. But today's prices are one thing; long-term strategy and future prospects are another.

"Companies that invest in production sites always take a long-term view," says GTAI director of mechanical & electronic technologies Oliver Seiler. "They look beyond current uncertainties such as fluctuating energy prices and see great potential in Germany as a location for modern manufacturing."

→

20.4%

Share of the manufacturing industry *in total gross value added in Germany*

Source: BMWK 2023

In the clean room of semiconductor manufacturer Vishay Siliconix Itzehoe, a technician inspects newly-minted silicon wafers under a special yellow-light lamp.

€2.25tr

Annual turnover of the ***manufacturing industry*** *in Germany*

Source: Destatis (November 2022 to October 2023)

5.6m*

Number of ***employees in the manufacturing industry*** *in Germany*

Source: Destatis (November 2023)
* companies with 50 or more employees

Photo: press Vishay Siliconix

"MODERN INDUSTRY IN EUROPE CAN ONLY BE COMPETITIVE IF IT IS HIGHLY AUTOMATED, CLIMATE NEUTRAL AND EFFICIENT."

Oliver Seiler, GTAI Director of Mechanical & Electronic Technologies

→ Seiler and his team are fielding extensive interest from international manufacturing companies that want to open new locations or expand existing production facilities. This trend is borne out by the data. The 2023 Kearney FDI Confidence Index also shows that businesspeople have great confidence in Germany's future viability. The index, which assesses which countries are likely to attract the most foreign direct investment in the coming three years, ranks Germany as the most attractive business location in Europe.

Europe's evolving heartland

Germany has traditionally been Europe's largest and most successful industrial country and has much to recommend it, including a rock-solid foundation of small to medium-sized enterprises (SMEs) upon which to build. At the same time, German manufacturing is changing with the times.

The European Union wants to see increased diversification and resilience and is encouraging production to be moved closer to home wherever possible. Germany is key to the implementation of this strategy. After all, bringing production facilities back to the highly developed industrialized countries of Europe requires the highest level of engineering skills, something for which Germany is also famous. "Modern industry in Europe can only be competitive if it is highly automated, climate neutral and efficient," says Seiler.

Manufacturing companies from all industries can find the necessary expertise and skills in Germany to master these challenges. The Competitive Industrial Performance Ranking of the United Nations Development Organization (UNIDO) has ranked Germany as the country with the world's most competitive manufacturing sector every year since 2001. The index evaluates 153 countries' capacity to produce and export manufactured goods, their technological progress and their global influence on manufacturing activity.

Microchips made in Germany

German excellence and innovation attracted not only TSMC, but also the US semiconductor manufacturer Wolfspeed. It recently announced plans to build the world's largest silicon carbide semiconductor factory in Ensdorf, Saarland. That "megafab" will cost USD 3 billion (EUR 2.8 billion) and will be located, together with an R&D facility, on the former site of a coal-fired power plant.

Then there's Intel, the US chipmaker that is investing EUR 30 billion in a factory in Magdeburg in eastern Germany. The decision to build one of the world's largest chip factories here was made primarily because Germany has a great tradition of industrial production, said Intel CEO Pat Gelsinger in autumn 2023.

At the ground-breaking ceremony of Vishay Group's new chip factory in Itzehoe, local officials get to work on an expansion of Vishay's production facilities.

Photo: picture alliance/dpa/Christian Charisius

Germany's long-standing industrial tradition is one of its main advantages as a location, regardless of energy price fluctuations. That's what drew the global semiconductor manufacturer Vishay Siliconix to Germany over 30 years ago. The US parent company Vishay Intertechnology group is currently investing EUR 374 million in the expansion of the production site in Itzehoe in northern Germany through its subsidiary Vishay Siliconix Itzehoe. Over 500 employees develop and manufacture semiconductor components for use in automotive, industrial and consumer electronics at the Itzehoe site, and the latest investment will create 150 new jobs.

"In Itzehoe, expertise, research, an attractive environment in the greater Hamburg area and the commitment of our employees come together to form a profitable unit," explains managing director Leif Henningsen. →

"WE ARE MANAGING MORE MAJOR PROJECTS THAN EVER BEFORE AT GERMANY TRADE & INVEST."

GTAI's consulting and service teams who specialize in finding industrial production sites in Germany are in high demand, says GTAI's deputy director of energy, building and environmental technologies Rob Compton.

Rob, Germany's economic structure with its multiple decentralized locations and industry clusters can initially seem confusing to foreign businesspeople. How can GTAI help?
ROB COMPTON: We are currently managing not only more, but larger expansion projects than ever before. For example, we are seeing a lot of interest from manufacturing companies working in all stages of the battery technology supply chain. Germany is clearly on its way to becoming the number one battery location in Europe. But the semiconductor industry and companies from the automation and robotics sectors are also showing great interest in Germany as a business location.

How do you support manufacturing companies in coming to Germany?
RC: For manufacturing companies, it's crucial to find suitable, often very large and well-equipped industrial sites — and quickly. We provide support in the search for suitable sites, organize location inspections and establish contacts with local partners. We also help ensure that approval and support from the national, regional and local authorities is fast and efficient.

The issue of subsidies is a pivotal one for industrial relocations worldwide. How does GTAI provide support in that regard?
RC: Our teams in Berlin provide expert advice on subsidies. They're familiar with the complex funding conditions, they provide detailed analysis to find out which programs are suitable for companies, and they help with the application process. To do this successfully, it is important that companies approach us at an early stage of their expansion projects — ensuring that they do not miss important deadlines or overlook criteria for subsidies.

Despite a global economic slowdown, Germany continues to attract major international business expansions.

Photo: Adobe Stock/เดิดดิ๊กจน์ ทิพพัย

Photo: Skeleton

FDI PERSPECTIVE: GROWING STRONGLY IN GERMANY

Estonian energy storage tech firm Skeleton Technologies, which has a main production site in Grossröhrsdorf near Dresden, is finding Germany a great place for partnerships. It's attracted a significant investment from Japanese trading and investment business conglomerate Marubeni. And it's also building a large supercapacitor plant in Markranstädt near Leipzig with the help of the German tech giant Siemens.

In October 2023, Siemens and Brazilian mining giant CBMM invested in Skeleton, with the concluded funding round exceeding EUR 300 million. The aim of the investment is to further expand the production capacities for Skeleton's "SuperBattery" — batteries that not only charge very quickly, but also have a longer life. Additionally, says the manufacturer, fewer rare raw materials are used during the production, as the company does not use cobalt, nickel, graphite or copper in production, but rather its patented carbon-based "Curved Graphene."

The production facility in Grossröhrsdorf, Germany, is the most modern ultracapacitor factory in the world and the largest of its kind in Europe. The new factory in Leipzig is scheduled to be completed at the end of 2024 and will have 40 times the capacity of the company's existing site, producing up to 12 million cells a year.

"We see significant potential in the field of electrification of heavy-duty commercial vehicles, electrified and hybrid vehicles as well as energy storage in the power grid," says Masayuki Omoto, COO of Marubeni's Next Generation Business Development Division. "We are convinced that our investment will help Skeleton to expand its capacity for mass production of the SuperBattery, bring it to market as quickly as possible and accelerate the company's growth."

Real-world applications such as batteries for powering elevators and mobile healthcare machinery and for electrified safety and autonomous functions in cars have already proven the competitive advantages of Skeleton's battery technology.

€300M
investment in latest round

12M
cells a year to be produced in Skeleton's German factory

1,000,000
charge-discharge cycles of each SuperBattery

Supercapacitor production is underway at Skeleton Technologies in Grossröhrsdorf, Germany. The Estonian energy storage company is building another plant near Leipzig.

→ Henningsen emphasizes the importance of collaborating with regional partners and suppliers as often as possible, praising the "high quality and reliability" of those partnerships. With a new, highly automated factory, the aim is to contribute to Europe's independence from other parts of the world in semiconductor production. "Our products will help to shape an even better future in the automotive and industrial sectors," he says.

Clean energy as a selling point

The availability of clean energy is another big attraction for manufacturers of electric vehicle (EV) batteries. After all, EV buyers need to know not only that cars run cleanly but that the parts have been sustainably produced.

That's one reason Swedish battery maker Northvolt is planning a major production facility in Germany.

Furthermore, the Luxembourg-based chemical company Livista Energy wants to build the first European lithium refinery in Germany. And US electric car manufacturer Tesla is also planning to expand its German "Gigafactory" in the town of Grünheide just outside Berlin for producing the latest generation of electric vehicles.

"The government's efforts to ensure that energy-intensive manufacturing companies are supplied with clean energy are playing an important role in all those projects," says Seiler. "Germany's commitment to forging ahead with the transition to clean energy is attracting industrial companies that are themselves adapting their production to be sustainable and climate neutral."

The sky's the limit

One such company is Deutsche Aircraft, owned by the Texas-based Sierra Nevada Corporation (SNC) since 2015. It has just invested EUR 80 million in a new, CO_2-neutral production facility in the eastern German city of Leipzig where it is pioneering innovative aircraft models that can fly using far more efficient, biofuel-compatible engines. "At Deutsche Aircraft, we take great pride in the construction of our state-of-the-art and climate-friendly final assembly line," says chief operating officer Nico Neumann.

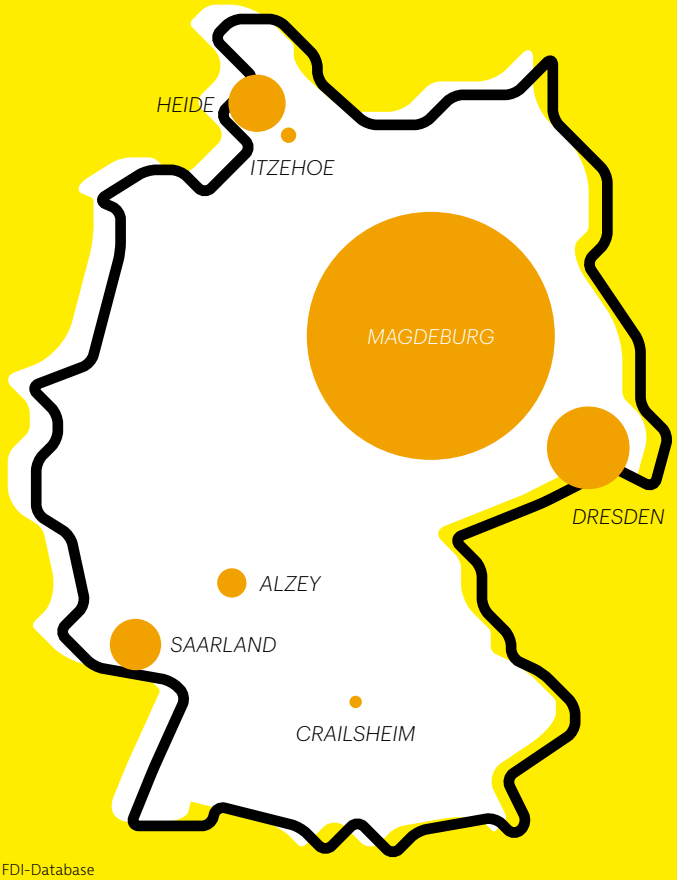
The assembly line will be built and operated in compliance with the best industry practices and sustainability principles. In addition, construction is underway on a production hall, a hangar for aircraft delivery, a logistics center and an administration building.

Sustainability on store shelves

International consumer goods companies are also focusing on Germany as a location for modern, sustainable and, above all, innovative manufacturing and product development. US company Procter & Gamble, for instance, is putting money into production facilities and logistics centers in Crailsheim and Berlin. →

MAPPING FOREIGN DIRECT INVESTMENT

Some large-scale manufacturing expansion projects in Germany



Source: GTAI, FDI-Database

Company	Location	Investment in €	Industry	Origin
Intel	Magdeburg	30 billion+	Semiconductors	US
TSMC	Dresden	10 billion	Semiconductors	Taiwan
Wolfspeed/ZF	Saarland	2.5 billion	Semiconductors	US
Vishay Intertechnology	Itzehoe	400 million	Semiconductors	US
Procter & Gamble	Crailsheim	130 million	Consumer goods	US
Lilly	Alzey	2.3 billion	Medical products	US
Northvolt	Heide	4.5 billion	Batteries	Sweden

→ "Many of our innovations and branded products are 'Made in Germany,'" says Gabriele Hässig, managing director of communications and sustainability at the subsidiary Procter & Gamble Service. "Pampers come from Euskirchen, Braun razors from Walldürn and Oral-B electric toothbrushes from Marktheidenfeld."

At the same time, the company is researching new approaches in Germany "to advance the transformation of industrial production for more climate protection." To this end, it opened a new innovation center — the Product Supply Innovation Center (PSIC) — in the Rhine-Main region in 2021. In close partnership with Germany's renowned Fraunhofer Society plans are being drawn up "to make our sites net zero by 2040 and provide cross-industry impetus for greater sustainability in production," says Hässig.

Despite momentary high energy prices, Germany has many strengths that are passed on to manufacturing companies based there.

"WE TAKE GREAT PRIDE IN THE CONSTRUCTION OF OUR STATE-OF-THE-ART AND CLIMATE-FRIENDLY FINAL ASSEMBLY LINE."

Nico Neumann, COO Deutsche Aircraft

For example, Procter & Gamble is taking full advantage of Germany's unique R&D environment, which includes extra-university research institutes like Fraunhofer, the Max Planck Society and the Helmholtz and Leibniz Institutes.

"This was also a basis for the decision to locate the PSIC in Germany," says Hässig, adding that the location offers "well-trained employees and, last but not least, proximity to other companies with a deep technological understanding of industrial production and mechanical engineering."

Such powerful endorsements are music to the ears of Germany's Minister for Economic Affairs and Climate Action. "We want to maintain Germany as a strong industrial location in all its diversity," Robert Habeck said recently, in the context of international investment. "From global corporations to medium-sized hidden champions and small businesses, and from the energy-intensive basic materials industry to mechanical and vehicle engineering and aerospace."

CONTACT

invest@gtai.de

US-owned Deutsche Aircraft wants to help usher in a new era of clean aviation with its CO2-neutral, sustainable aircraft production line in Leipzig.

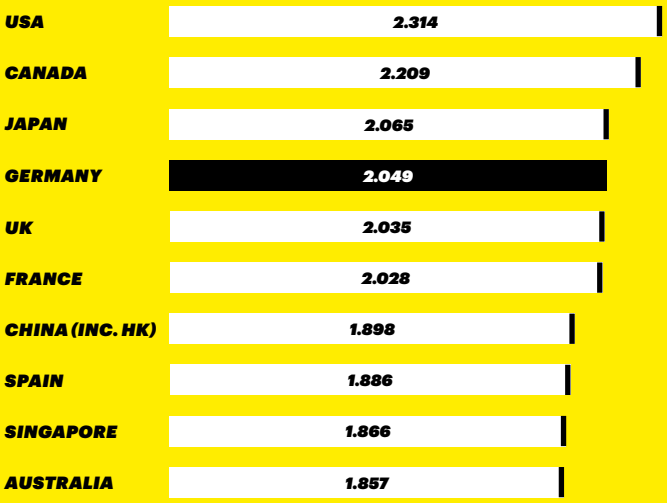
Photos: Deutsche Aircraft

GERMANY LEADS THE WAY IN MECHANICAL AND HIGH TECH ENGINEERING TO SUPPORT THE ENERGY TRANSITION AND INDUSTRY 4.0

Germany's undoubted manufacturing expertise, its location in the heart of Europe and its commitment to the green transition give it an edge as a place to do business.

Expanding to Germany

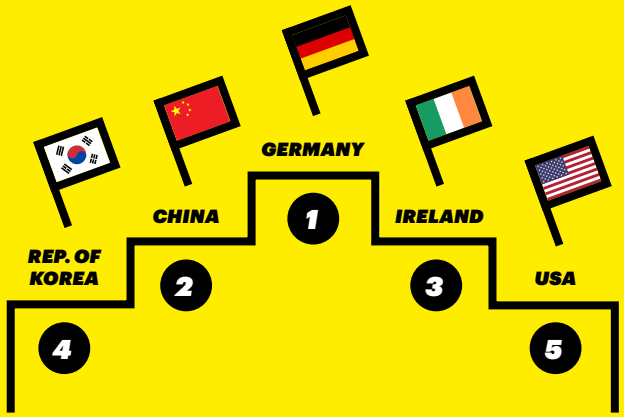
FDI attractiveness of different countries from an investor perspective (index)



Source: 2023 Kearney Foreign Direct Investment Confidence Index

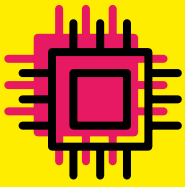
Manufacturing Champion

Countries with the world's most competitive industrial sector



Source: UNIDO 2023

Four manufacturing sectors with particularly good growth prospects in Germany



SEMICONDUCTORS

The demand for high-performance semiconductors from German and European industry is enormous.

BATTERIES

With high sustainable production credentials, Germany is Europe's clear number one battery production location.

CLIMATE-NEUTRAL MOBILITY

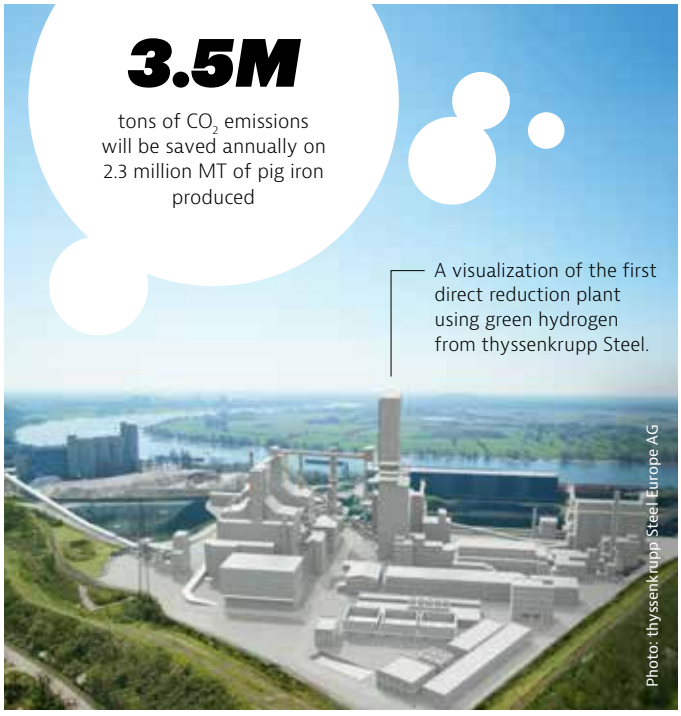
The German automotive industry and the aviation sector are investing big to advance the transition to climate-neutral mobility.

ROBOTICS / AUTOMATION

Germany is striving for greater autonomy and resilience in industrial production, which requires highly automated and smart, digital production.

IN BRIEF

The global business community admires the spirit of invention that drives the German economy. Here we highlight some of the most intriguing trends and research projects.



CLIMATE-NEUTRAL STEEL

Steelmaker to decarbonize with green hydrogen

Industrial group thyssenkrupp Steel Europe is planning to use a groundbreaking technique to power its steelmaking operations with green hydrogen.

Steel production heavily relies on fossil fuels and is therefore a major source of CO_2 emissions, but the company is trying to change that. In the first project of its kind, the Duisberg-based steel expert will build a hydrogen-powered direct reduction plant with two downstream melters. Unlike the traditional process, where pig iron is melted in a blast furnace using coal, thyssenkrupp will employ hydrogen to reduce iron ore in a solid state, before converting it into liquid pig iron in the melters.

The firm estimates that it can produce up to 2.3 million metric tons of carbon-neutral pig iron a year using 140,000 tons of green H_2, saving 3.5 million tons of CO_2 emissions. The new plants are expected to start operating in late 2026 and will be gradually converted to green H_2 from 2028. The project, tkH_2Steel, is being funded with EUR 2 billion from the German government and the state of North Rhine-Westphalia. It will help Germany achieve its climate targets and secure sustainable industrial jobs.

www.thyssenkrupp-steel.com

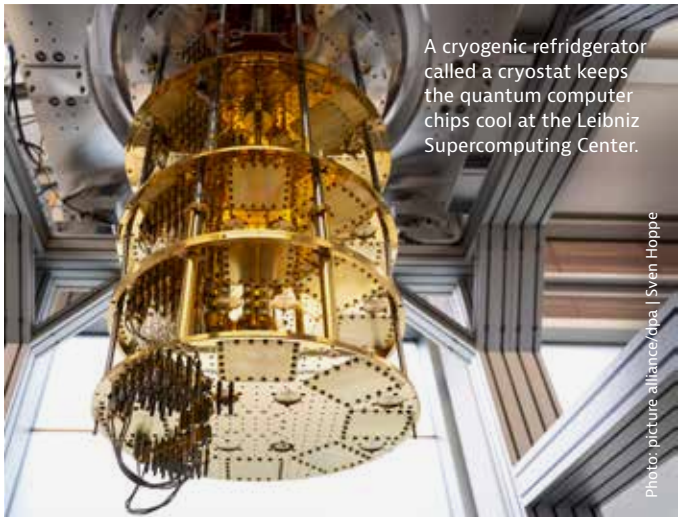
GREAT LEAP FORWARD

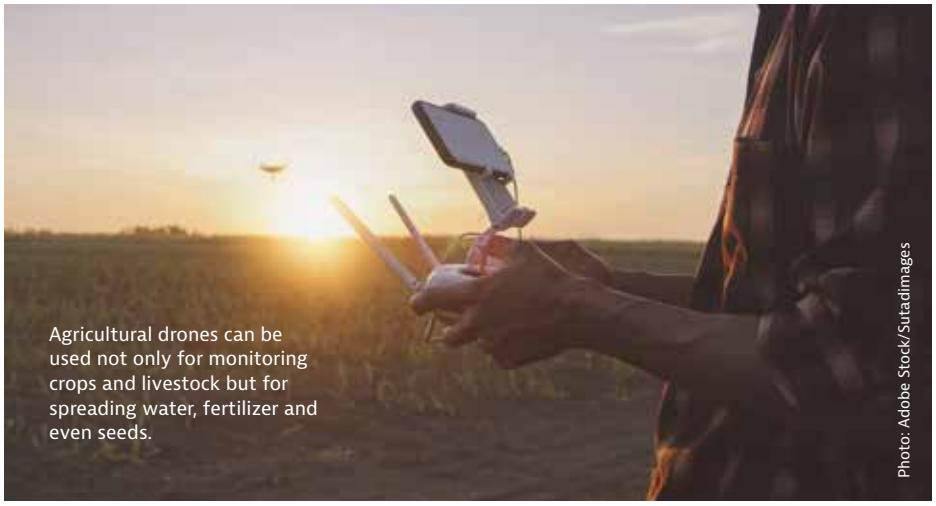
The German government is investing big in quantum computing to usher in a new era of industrial innovation

The German government, along with the country's leading scientific organizations, is putting EUR 3 billion into the development of quantum computers. EUR 2.1 billion will come from the government with research societies like the Fraunhofer Institute making up the difference. German start-ups will be major beneficiaries and are seen as crucial partners in the transfer of scientific findings into industrial applications.

Anna Christmann, German Government Commissioner for Digital Economy and Start-ups, and Government Coordinator of German Aerospace Policy, says: "Quantum technologies, and quantum computers in particular, are a key technology of the future with exciting potential applications — from climate modeling to drug development."

www.qci.dlr.de/en/upcoming-industrial-partnerships





Agricultural drones can be used not only for monitoring crops and livestock but for spreading water, fertilizer and even seeds.

Photo: Adobe Stock/Sutadimages

DIGITAL FARMING

Agriculture gets more sustainable and profitable using AI-based digital technologies

The farming sector faces major challenges from climate change, which is a growing cause of crop failures around the world, as well as the depletion of natural resources and the decline in biodiversity. To tackle these problems, scientists are exploring the potential of artificial intelligence.

At the Hofgut Neumühle training center near Kaiserslautern in southwestern Germany, for example, researchers and students from the Digital Farming department at the Technical University of Kaiserslautern are testing innovative AI-powered agricultural methods. By helping farmers analyze data and monitor animal behavior, intelligent algorithms can help make food production cheaper and more eco-friendly.

"Hofgut Neumühle is a model for sustainable arable farming and forage production and is also a contact point for interested members of the public and experts," says Johannes Steinfort, head of digitalization and field operations at the training center. The German Ministry of Food and Agriculture (BMEL) is investing EUR 70 million in 14 research projects across Germany to further explore AI's potential in crop and livestock farming.

www.hofgut-neumuehle.de
www.tinyurl.com/bmel-en

Photo: LEAG

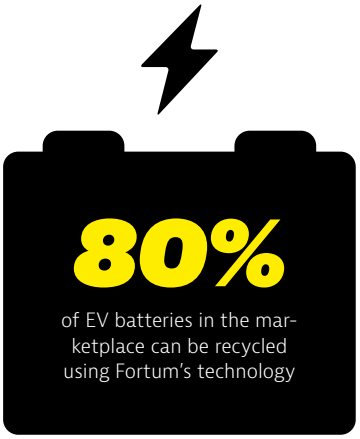
Thorsten Kramer (LEAG), Eric Dresselhuys (ESS) and a colleague hold their future: an iron redox flow battery.

GREEN POWERHOUSES

Long-term battery storage technology accelerates the transition to sustainable power

Electricity producer Leag has partnered with ESS, a US-based manufacturer of long-term energy storage devices. They're installing a 50 megawatt (MW) iron redox flow battery with a capacity of 500MW hours in the eastern German town of Boxberg in the Lusatia region, close to the Polish border. The novel batteries are mainly made of iron, salt and water, materials all readily available. They have a long lifespan and can store renewably sourced electricity for up to twelve hours. "The key to transforming the Lusatian coal producing region into part of Germany's green powerhouse is the development of cost-effective long-term energy storage," says Leag CEO Thorsten Kramer. "We are proud to be able to demonstrate iron redox flow technology on a large scale." Operations are expected to start in 2027.

www.Leag.de, www.Essinc.com



BANKING ON RECYCLING

Battery recycling firm chooses location close to motor industry hubs

Finnish company Fortum Battery Recycling is planning a major new recycling center in Artern, near Leipzig, in eastern Germany. The firm's technology makes it possible to recycle more than 80 percent of EV batteries. Using an innovative process, most of the battery's black mass, which consists of rare earth elements and metals, can be returned to the supply chain.

With its central location and close proximity to leading companies in the battery and automotive industries, the Artern Industrial Park is an attractive option for firms in the sector. Tero Holländer, head of business line batteries at Fortum Battery Recycling, says: "We see great potential in the Artern region and have already started talks with the local authorities about a development plan for the production of black mass."

www.fortum.com

CARBON EXTRACTION

A Saxony start-up is raking in prizes for producing environmentally useful chemicals from CO_2

enaDyne, a spin-off from the Technical University of Freiberg in eastern Germany, has built a plasma catalytic reactor that converts CO_2 into chemicals such as methanol or ethylene as well as e-fuels.

"We are laying the foundations for a more environmentally friendly chemical industry," says co-founder Philipp Hahn. The company's invention won the Federal Agency for Disruptive Innovations' Carbon-to-Value-Challenge, receiving just under EUR 3 million. Its plasma catalytic reactor was also awarded the 2023 IQ Innovation Prize Central Germany. Preparations are currently underway to test the system in an industrial setting, and a pilot plant is expected to be up and running by the end of 2024.

www.enadyne.de

NORTHEASTERN GERMANY IS READY

THE INTERVIEWEE

Born in 1977, **Michael Kellner** has been a member of the German Bundestag since 2021. Since December 8, 2021, he has been Parliamentary Secretary of State at the Ministry for Economic Affairs and Climate Action, and since 2022 the German Commissioner for Small and Medium-Sized Enterprises. Between 2013 and 2022 he was political managing director for Alliance 90/The Greens at national level.

Since the oil embargo against Russia began, the industrial areas around the Schwedt and Leuna refineries as well as the port districts of Rostock and Greifswald/Lubmin have undergone rapid change. Their economies were heavily dependent on Russian oil, but the government is now committed to their green transformation. Why focus on these four regions now?

MICHAEL KELLNER: We believe these regions can become pioneers of the green transformation in Germany. Before Russia invaded Ukraine, it was clear to many companies in the northeast that the focus on fossil fuels had no future. And since the Russian invasion of Ukraine, this has become even more apparent. All four of these industrial areas have accepted this challenge and are now beginning to actively shape change. That's why it's so important that the government supports them now. With the right impetus, they can become role models and thus also drive other regions in Germany forward. We believe they can strengthen the country's ability to transform.

How is the government supporting green transition in these regions?

MK: Until the end of 2021, Russia was Germany's main supplier of oil. The embargo prohibiting imports of Russian oil therefore made very high demands of Germany in terms of maintaining the security of supply of this fuel, which is still vital to the population and the economy. The two eastern German refinery sites Leuna and Schwedt were facing major challenges in this regard, because until the beginning of the war, they were fully and directly supplied with Russian oil via the Druzhba pipeline.

Against this background, the German national government is pursuing three objectives: maintaining security of supply in Germany, sustaining value creation and employment at the refineries in the face of the negative effects on the local economic structure caused by the Russian war of aggression against Ukraine, and strengthening the future viability of the sites.

With four very favorable industrial locations well-served by green energy and government funding incentives, the northeast is crucial to a carbon-neutral Germany, argues Michael Kellner, Parliamentary State Secretary at the German Ministry for Economic Affairs and Climate Action.

In September 2022, in the interest of maintaining production and ensuring a successful transition, it launched a comprehensive future package for eastern German refineries and ports consisting of various structural and economic measures. At the heart of the future package is a special program under the Joint Federal/Länder Task for the Improvement of Regional Economic Structures (*Gemeinschaftsaufgabe "Verbesserung der regionalen Wirtschaftsstruktur"* — GRW). As a central instrument of regional structural policy in Germany, the GRW is designed to initiate a wave of modernization through private and public investment based on its holistic approach — the promotion of corporate investments, the promotion of business-related infrastructure, and further measures to strengthen the attractiveness of a region for business. In order to boost the transition locally, the area covered by the GRW special program, which is to run until 2032 with a pot of EUR 750 million, includes the districts where the Schwedt and Leuna refineries are located: Uckermark in Brandenburg, and Saalekreis and Burgenlandkreis in Saxony-Anhalt (due to its close proximity to Leuna). The city of Rostock, the Rostock district and the Vorpommern-Greifswald district in Mecklenburg-Vorpommern also form part of the Assisted Area.

The Transformation Taskforce at Germany Trade & Invest (GTAI) is also a part of the future package and is supporting its goals. The Taskforce has analyzed the regions' potential and is supporting the recruitment and settlement of international companies.

THE BOTTOM LINE

The German government is supporting four industrial regions in their "green transformation" with renewable energy supply, infrastructure and a package of support for key industries including refineries, engineering and maritime logistics.

Can you give an example of the operational challenges these regions are now facing?

MK: Let's take the refinery in Schwedt, which employs some 1,200 people. Immediately after the Russian invasion, it was important to ensure the refinery's continued operation, because if the refinery doesn't run, it makes losses and jobs are at risk. The government has launched several parallel measures to support the facility. For example, it is planned that

→

Photo: Fraunhofer UMSICHT

A model of a biorefinery: a sustainable alternative refinery where plant biomass is broken down into raw materials to be utilized in a wide variety of products such as biofuels.

→ the pipeline from Rostock to Schwedt will be upgraded and its capacity increased, and this connection to the port in Rostock makes it easier to supply the refinery with oil. What is more, the government has managed to use the Druzhba pipeline for other purposes. In the past, Russian oil flowed through the pipeline directly to Schwedt, but oil from Kazakhstan is now flowing through it instead. The refinery can also order additional oil via the nearby Polish port in Gdańsk.

Why would foreign businesses be attracted to these four regions?

MK: There are a whole lot of reasons! Let's start with the location. The existing industrial areas will continue to grow in the next few years. Several hundred hectares of industrial space will be added — including in Schwedt, Leuna, and the Greifswald region, and attractive industrial areas are being developed near Rostock along the future ONTRAS hydrogen pipeline too.

Then there's the transport side of things. Many of the locations are particularly well connected. Goods can be transported directly from the factory by road, rail or water — a major advantage for mass production.

In addition, property prices in northeastern Germany are cheaper than in the rest of the country. The regions benefit from well-trained, skilled workers, and there is great openness to industrial projects. These regions are also particularly attractive for businesses that want to reduce their carbon footprint and rely on locally generated green electricity. Northeastern Germany produces more green electricity with offshore and onshore wind turbines and photovoltaic systems than is currently consumed in the region.

What role do innovative technologies play in the regions?

MK: Besides green electricity and several large industrial plants, the future technology of hydrogen will be a driver of innovation locally. A hydrogen hub is currently being built in Rostock, and work is being done there on hydrogen production and distribution infrastructure. A large plant for the production of green hydrogen is also planned in Lubmin.

At the same time, work is starting on a 900-kilometer hydrogen network in Germany. The lines will connect producers, storage facilities and consumers of green hydrogen. Put simply, the regions are ready for transformation, and are very attractive to international companies that want to actively participate in the energy transition and lead the way.

What kinds of companies do you think will be drawn to these areas? Where are the big opportunities?

MK: This depends on the location and the company's plans. Port regions like Rostock are of course attractive to all companies that produce large volumes and want to transport their goods quickly by sea. Besides manufacturers, the port is also attractive for companies that want to participate in the new energy infrastructure sector. In the Greifswald region and near Berlin, conditions are ideal for companies that need a lot of space.

Schwedt, on the other hand, is a classic refinery location, and its on-site equipment is optimal for industrial projects. Companies from the process industry in particular will find good conditions here. Of particular interest is the fact that the Schwedt location is being expanded significantly. In addition to the existing industrial park, more than 100 hectares will be developed as an industrial area and a high-voltage power line with 380 kilovolts will be built. Schwedt is therefore also perfect for companies that, on the one hand, need a lot of space and, on the other, want to rely on green, regional electricity.

And then the region around Leuna offers chemical locations with excellent infrastructure. Bio-based chemistry and PET recycling are future growth industries in the region.

Several international firms have already settled in the regions. One example is Finnish firm UPM in Leuna — is this a good model for others to follow?

MK: Absolutely! The region and UPM will benefit equally from the firm's arrival there. Leuna offers excellent conditions for biochemical companies, and UPM recognized this and is using the opportunity to build the world's first biorefinery. I see the decision as forward-looking. It creates additional value chains and offers opportunities for local companies and those that want to settle in Saxony-Anhalt in the future. Leuna and UPM are working together to show what the chemical industry locations of the future could look like.

How much research is being done locally and by which institutions?

MK: Research institutions play a central role in the transformation. There are already many innovative companies in the northeast, and we hope that even more innovators will settle there too. But the technology centers of tomorrow can only be created in collaboration with universities and research institutions. I am therefore particularly pleased that the German Aerospace Center (DLR) has chosen Leuna as a center for research into power-to-liquid (PtL) technology. Schwedt supports aspiring young companies in their research and innovation work. The start-up laboratory there is partly funded by the Federal Ministry of Economic Affairs and Climate Action, so we have an optimal R&D environment there.

CONTACT

verena.schueren@gtai.de
GTAI Director
Taskforce Transformation

OPPORTUNITIES
IN THE NORTHEAST

Germany's industrial powerhouses in the east have been earmarked by the Federal Government for "green transformation" from renewable energy and e-mobility to maritime innovation, engineering and biorefineries for e-fuels.

ROSTOCK

Population: 429,000
(Rostock district: 218,000[4];
Rostock city: 211,000[5])

Important economic sectors: maritime industry, ship engine and mechanical engineering, wind energy, food, electrical engineering/electronics, biotechnology, medical technology

VORPOMMERN-GREIFSWALD

Population: 236,000[6]

Important economic sectors: maritime industry, energy industry, health services, bioeconomy, food industry, information and communication industry, metal construction, tourism

UCKERMARK

Population: 118,000[1]

Important economic sectors: energy technology, paper industry, mineral oil processing, transport/mobility/logistic, metal, tourism, health industry

SAALEKREIS

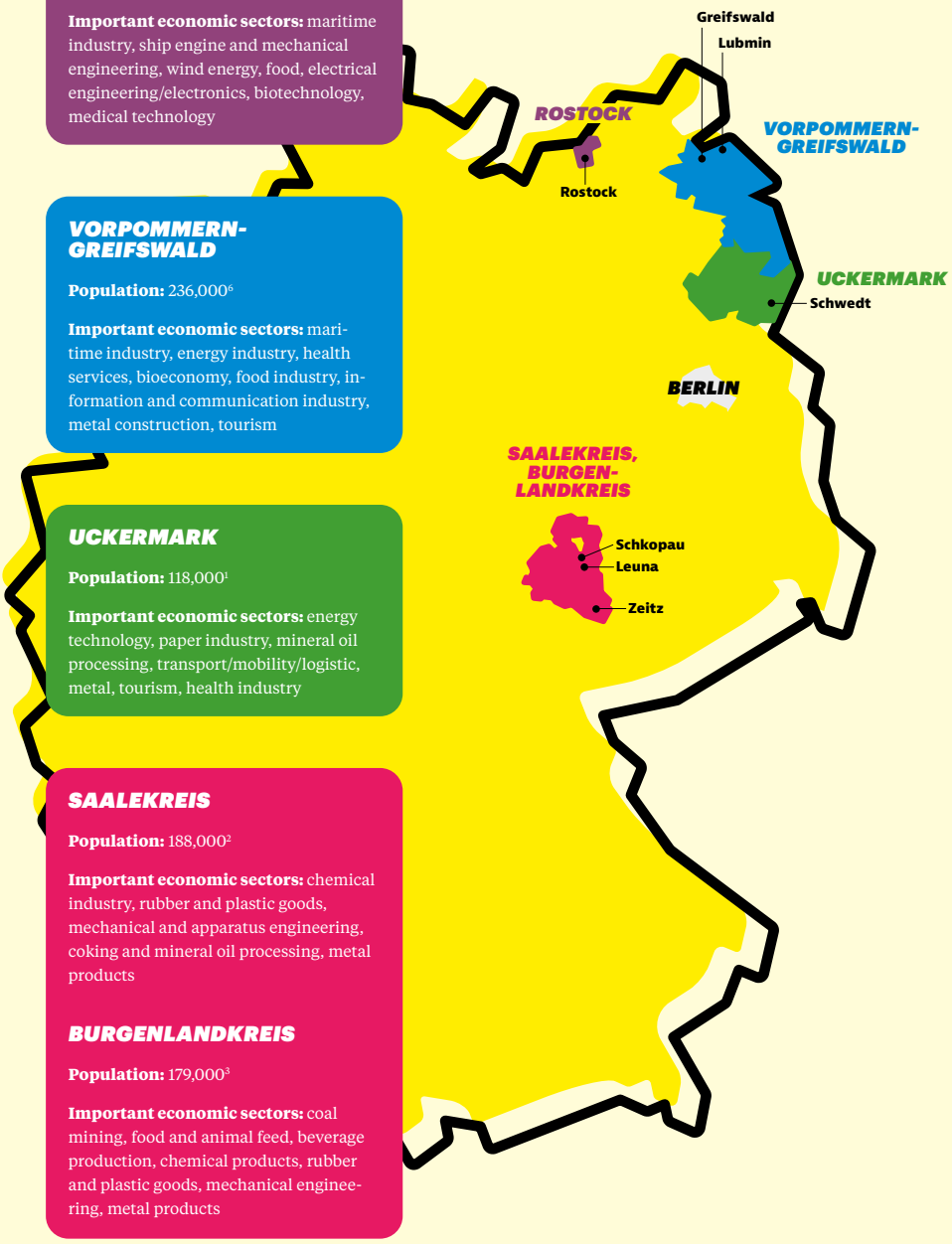
Population: 188,000[2]

Important economic sectors: chemical industry, rubber and plastic goods, mechanical and apparatus engineering, coking and mineral oil processing, metal products

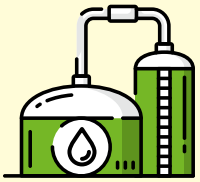
BURGENLANDKREIS

Population: 179,000[3]

Important economic sectors: coal mining, food and animal feed, beverage production, chemical products, rubber and plastic goods, mechanical engineering, metal products

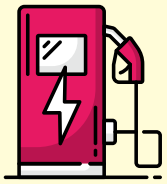


Sources: 1) Landkreis Uckermarck, 2) Saalekreis, 3) Burgenlandkreis, 4) Landkreis Rostock, 5) Stadt Rostock, 6) Landkreis Vorpommern-Greifswald



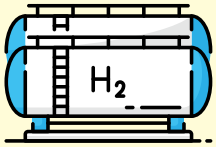
SCHWEDT

The city is located northeast of Berlin directly on the Polish border and is a traditional location for refineries. This makes it particularly appealing to entrepreneurs in processing sectors. The area approved for industrial development is being expanded significantly so that more companies can settle there. Since the Russian invasion of Ukraine, the situation at the local refinery has stabilized and delivery routes have been diversified.



LEUNA

The refinery in Leuna is also used to process Russian oil. Today, the chemical sites west of Leipzig are taking a different path, and the world's first biorefinery is being built in Leuna. Leuna is also a research center for synthetic e-fuels.

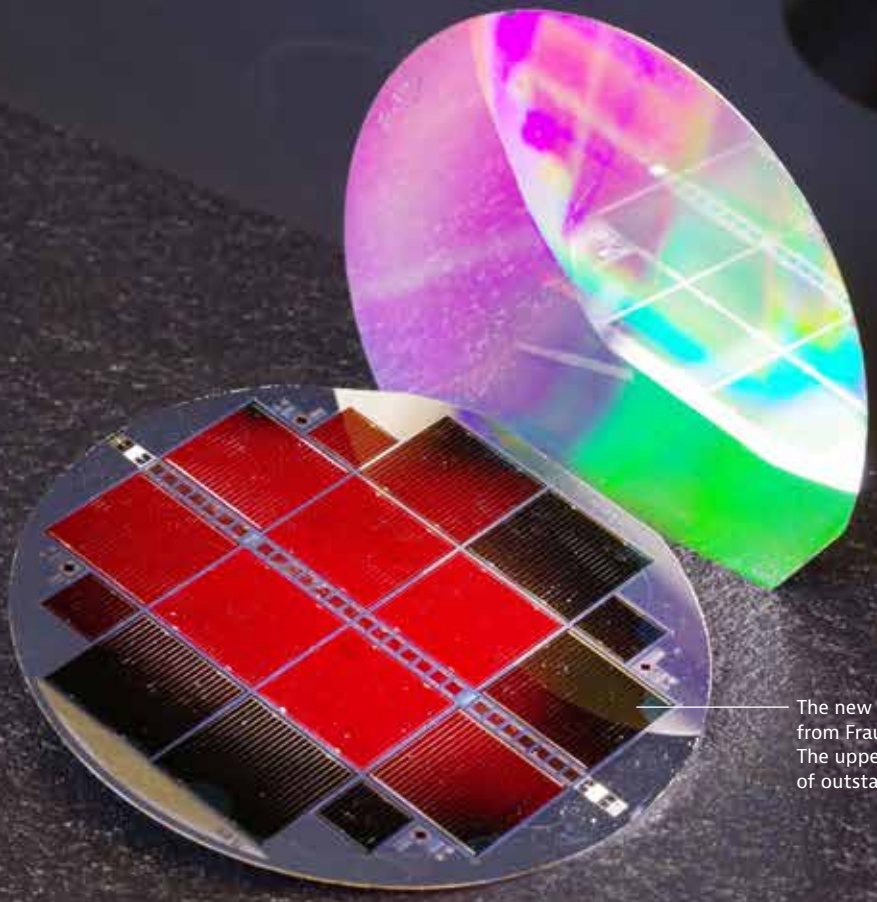


ROSTOCK, GREIFSWALD AND LUBMIN

The port cities on the Baltic Sea are developing into the new energy hub of northern Germany. There are plans to build an electrolysis plant for producing climate-neutral hydrogen in the port of Rostock. From there, hydrogen can flow directly to companies and consumers via a pipeline. An LNG terminal is already in operation in Greifswald. Attractive real estate for industry and commerce is being built south of the port locations in the interior, including south of Rostock along Autobahn 19 and in the Berlin-Stettin Industrial Park.

PUSHING SOLAR PERFORMANCE

German research institutions are extending the boundaries of photovoltaic cells, setting efficiency record after efficiency record. This scientific excellence makes Germany one of the leading international locations for photovoltaics.



The new III-V/silicon tandem solar cell from Fraunhofer ISE with 35.9% efficiency. The uppermost sub-cell glows red, a sign of outstanding material quality.

Photo: Fraunhofer ISE/Michael Schachtner

On September 29 last year, researchers at the Fraunhofer Institute of Solar Energy Research (ISE) in the southern German city of Freiburg had reason to celebrate. Together with colleagues from the Dutch NOW Institute AMOLF, they set a new solar cell efficiency record of 36.1 percent with their novel multijunction cell based on silicon and special semiconductor materials. To put that achievement into perspective, a typical efficiency rate for silicon-based domestic solar panels is 15 to 20 percent.

Fraunhofer ISE is globally renowned for its achievements in the field of solar photovoltaics (PV); and for the last two years, the institute has been working on an ambitious project called 50 Percent, funded by the German Ministry for Economic Affairs and Climate Action. It aims to develop the first solar cell with 50 percent efficiency.

At the end of May 2022, using a new anti-reflection coating, Fraunhofer researchers increased the efficiency of four-junction solar cells to a record 47.6 percent.

"We are thrilled with this result, which was achieved only one year after the opening of our new Center for High Efficiency Solar Cells," said Fraunhofer ISE department head Frank Dimroth in a statement. "In our research, we aim to make concentrating photovoltaics even more efficient and competitive, as we believe that this is the most sustainable form of renewable electricity generation."

Fraunhofer ISE is not Germany's only record-breaking PV research institute either; there's also the Helmholtz-Zentrum Berlin (HZB), the Karlsruhe Institute of Technology and the Forschungszentrum Jülich. "The efficiency records of German research institutes are remarkable and demonstrate a unique photovoltaic expertise," says GTAI energy expert Maja Grunert.

This vital solar energy know-how is then transferred to industry through commercial solar networks including Solarvalley Central Germany and Solar Cluster Baden-Wurttemberg. The high level of investment in solar R&D shows how well this model is working. "Investment in photovoltaic research and development in Germany has more than doubled since 2013," says Grunert.

High hopes for perovskite

Silicon is not the only solar material in focus. Researchers around the world are working on new types of crystalline cells made from the mineral perovskite. Perovskite is the most promising frontrunner in solar research, as the cells achieve efficiency levels similar to silicon solar cells, but can be produced more cost-effectively and easily.

At the HZB, a team of researchers has succeeded in increasing the efficiency of perovskite solar cells to a particularly high level — from an initial four percent to almost 33 percent. This was achieved in a relatively short period for research of 13 years. "We have been able to set these efficiency records because we started researching perovskites very early on and covered the entire value chain from basic research to industry," comments Professor Rutger Schlatmann of the HZB.

Innovative PV solutions are also being researched in southeast Germany. Karl Leo, professor at the Dresden University of Technology, is pioneering a new type of organic solar cell composed of carbon-rich compounds that can be used in settings where conventional silicon cells are unsuitable. Flexible organic thin-film solar technology could be mounted on contoured moving objects such as cars or airplanes, for example, and wrapped around objects like pillars. However, organic photovoltaics (OPV) is still a niche technology and has a long way to go in terms of efficiency. "In the long term, it has the potential to match the performance of conventional silicon technology," explains Leo.

Thanks to research in Dresden, Germany leads the way in OPV. The German start-up Heliatec, for instance, is the first company in the world to manufacture organic solar cells in series production."Because we hold the patents, we can ensure that the novel solar cells are manufactured here in Germany," Leo says.

THE BOTTOM LINE

Highly innovative institutes and efficient knowledge transfer to industry make Germany a center of photovoltaic research. The installed PV capacity of the country is growing at a record pace.

CONTACT

maja.grunert@gtai.de
GTAI solar expert

GERMAN GOVERNMENT DRIVING PACE OF SOLAR EXPANSION

MORE THAN 1M

Number of new solar installations in Germany in 2023

14 GW

Output of new solar installations in Germany in 2023

80%

Increase in demand for PV systems in Germany

Source: Bundesverband Solarwirtschaft BSW

MAKING GERMANY HYDROGEN-READY

THE INTERVIEWEE

Bastian Olzem is division manager of the Generation and System Integration Division at BDEW, the German Association of Energy and Water Industries.

Germany is to build a new generation of hydrogen-powered and hydrogen-ready power plants. The plans, announced by the German government in August 2023, will require multibillion-euro investments and should start as soon as reasonably possible, argues Bastian Olzem from the German energy industry association BDEW.

Why are hydrogen-powered power plants so important for Germany's energy future?

BASTIAN OLZEM: Germany has a clear roadmap for phasing out coal-fired power generation. However, when coal-fired power plants go offline, we will continue to need flexibly controllable power plants for the foreseeable future to keep the grid stable. Hydrogen-powered facilities can make an important contribution here by compensating for the drop in renewable energies at times when the wind doesn't blow or the sun doesn't shine.

The government is drawing up a power plant strategy to promote and accelerate the development of hydrogen power plants. What does that involve?

BO: The current plans envisage three building blocks. The first concerns "hydrogen sprinter" power plants — gas turbines that run on green hydrogen. The second group is "hydrogen hybrid" plants: innovative generation concepts where, for example, solar and wind farms are equipped with an electrolyzer that converts excess electricity into hydrogen (H_2). The gas can temporarily be stored and converted into electricity for feeding into the grid as and when required. These two components are intended to create controllable generation capacities of 4.4 gigawatts (GW) each. The tenders shall be completed by 2028.

The third component to be put out to tender is the construction of "H_2-ready power plants," with a total of 6 GW of newly built capacity. In addition, there are existing power plants that have been earmarked as suitable for conversion, which are expected to produce an additional 4 GW. From 2026 onwards, another 5 GW could be added, if required.

These are ambitious goals and the timeframe is tight. What size of investment and deadline are we talking about here?

BO: The investment requirement for the power plants alone is likely to be in the range of tens- to approximately hundred-billions of euros. The planning and construction of such power plants takes four to eight years, depending on the location and technology, so the tenders must therefore be made as soon as possible.

Photos: picture alliance/dpa/Jan Woitas, BDEW

Germany's first hydrogen-ready power plant went into operation on 23 October 2023 in Saxony. The pump hall for district heating in the new CHP plant (pictured) has two gas turbines capable of burning hydrogen, each with an electrical output of 62.5 MW, while a huge hot water storage tank holds 43,000 cubic meters of water for piping to the city of Leipzig.

But that's not all. There will also be a need for further investment.

Where do these additional opportunities lie?

BO: In order for the power plants to be able to fulfill their task, the development of infrastructure for the production and transportation of green hydrogen must also be promoted at the same time. Hydrogen networks, intermediate storage, electrolyzers and large-scale storage are needed. There will be plenty of scope in all these areas for manufacturers of the relevant technologies, consultants and suppliers. Electrolyzers are one of the key sector coupling technologies.

What is "sector coupling" and what technologies does it require?

BO: Sector coupling aims to interlink different energy consumption sectors and thereby increase the use of renewable energies throughout all sectors. For example, it's about ensuring that electrical energy from the power grid can be used in the transport sector or to provide heat, which allows energy to be used much more efficiently and flexibly. To make this possible, we need many new power-to-gas systems and power-to-heat systems for direct electric use as well as heat pumps for the integration of environmental heat.

Is the new government strategy enough for companies to start pinning investments on?

BO: The government's power plant strategy sets the framework conditions and should provide the planning security that companies in this sector are currently waiting for. It is an initial spark for investments and will result in wider expansion and conversion steps in the energy system. A wide range of investment opportunities are emerging for companies and investors, including those from abroad: from electricity generation plants to power plants, electrolyzers and power-to-heat systems.

What further developments should international investors keep an eye on?

BO: A crucial question for the conversion plans is about when sufficient quantities of (somewhat environmentally friendly) blue and (completely climate-neutral) green hydrogen will be available, and at what price. This is particularly important given that the hydrogen power plants built today will have fewer and fewer hours of use as renewable energy generation, storage and transport networks expand in future. Models are therefore needed to determine how prices for blue and green hydrogen will be set and how the flexible performance of hydrogen power plants will be rewarded. To that end, various fuel funding models are currently being discussed in Germany and Europe.

BRUSSELS AND BERLIN SUPPORT POWER PLANT STRATEGY

The German government's planned power plant strategy is a behemoth of a project that serves as a role model for restructuring the energy supply throughout Europe. The goal is nothing less than the climate neutrality of the entire electricity sector, which is being sought not only in Germany but also at the European Union (EU) level.

The European Commission is therefore closely involved in the German government's planning. During intensive negotiations with the European Commission, the Federal Ministry for Economic Affairs and Climate Action (BMWK) laid the foundations for ensuring that funding for power plant construction also complies with EU aid law.

"The main pillars of decarbonization are renewable energy, flexibility in the system and storage, but also controllable power plants for a few hours of the year. The conversion and decarbonization of the fossil power plant fleet is therefore the next key step," said Robert Habeck, German Minister for Economic Affairs and Climate Action in summer 2023.

He added: "It is therefore all the more important that we have defined the framework for hydrogen power plants with the European Commission."

CONTACT

heiko.staubitz@gtai.de
GTAI hydrogen expert

PRINTING SUSTAINABILITY

Additive manufacturing — a.k.a. 3D printing — can help manufacturing companies conserve resources and save costs. So it's a perfect fit as Germany looks towards a sustainable future.

A 3D-printed antenna bracket prototype for the Sentinel 1 satellite. The Technical University of Munich (TUM) together with Oerlikon and Linde have developed aluminium-based light metal alloys for use in aerospace and automobiles.

Photo: Quelle: EOS | Anwendung: RUAG

Sustainability is everywhere in Germany — not only on the ground but in the skies above.

Satellite manufacturer Airbus Defence and Space, for example, needs to make its products smaller and lighter while increasing functionality. To do that, ADS works with Oerlikon AM, a German subsidiary of the Swiss technology group Oerlikon, which specializes in additive manufacturing.

Oerlikon develops and builds antenna components that weigh 90 percent less than traditionally manufactured parts, thus saving on fuel needed to transport them into orbit. Additive manufacturing also makes production more energy efficient and reduces consumption of raw materials. The company maintains a site in Barleben near the eastern German city of Magdeburg.

"Germany is a very good location for AM applications," explains Hendrik Alfter, Managing Director of Oerlikon AM Germany. "The manufacturing industry is a particularly strong German sector with a strong focus on high-quality and high-value products. The proximity to our customers is, therefore, an important location advantage."

THE BOTTOM LINE

With its history of manufacturing and increased focus on sustainability, Germany is a prime location for international additive manufactuing companies looking to expand.

AM technology supports sustainability by helping companies shorten transport routes. "The more intermediate products and components can be manufactured using AM, the less often these parts have to be transported over long distances," says Dr. Prof. Ing. Kristian Arntz, Chair of Manufacturing Technology and Machine Tools at Aachen University of Applied Sciences. "It also gives industrial companies greater control over the supply chain and reduces risks."

A big and expanding market

The German government's prioritization of sustainability is creating a market for sustainable AM applications. Part of the German economics ministry's remit, after all, is climate action.

"The topic of AM is becoming even more of a focus in Germany," says Peggy Görlitz, senior

project manager for Automation and Robotics at Germany Trade & Invest (GTAI). "This makes Germany increasingly attractive as a location for internationally active AM companies. And more and more companies are focusing on sustainability."

In the year 2022, AM solutions in Germany generated around EUR 2.1 billion of revenue — a 17 percent increase compared to 2021. Such growth levels have attracted business expansions from all over the world in recent years, led by companies from the US, China, France and Switzerland.

Research excellence

Such companies find no shortage of research and development partners. Germany has been at the forefront of scientific R&D in the field for a long time. Take alloys, for instance. AM printers can make components that previously required expensive metals, such as cobalt, and conventional production methods. But now, ferrous alloys based on cobalt and silicon can be used instead.

"In this way, companies can save resources and reduce costs," explains Arntz.

Germany's unique landscape of practically oriented research institutes that operate outside of the university system is at the heart of this development. Institutes like the Fraunhofer Institute for Additive Manufacturing (IAPT) and the Fraunhofer Insitute for Laser Technology (ILT) specialize in various aspects of AM and offer a host of exciting opportunities for companies.

"In Germany, research institutes and companies continue to work together to develop innovative solutions," Arntz says.

FDI PERSPECTIVE: THE TUM-OERLIKON AM INSTITUTE

The close collaboration between universities and the private sector in Germany is a big location advantage

In 2022, in partnership with the Technical University of Munich (TUM), the Swiss company Oerlikon AM launched the TUM-Oerlikon Advanced Manufacturing Institute in Garching near Munich. At the new facility, nearly 80 Oerlikon professionals and TUM counterparts pioneer advanced manufacturing technologies. The Swiss manufacturer has committed EUR 7.5 million to this collaboration for the first five years of the project. Equipped with an overall annual budget of EUR 3 million, the institute researches both processes and materials. One focus is on the powders used in 3D printers to produce metal components. The process of making these powders is currently very energy intensive, and the institute intends to change that. It's one way of making 3D printing more sustainable.

COMPANY
Oerlikon AM

LOCATIONS IN GERMANY
Barleben, Garching

NUMBER OF EMPLOYEES
148 in Germany

CONTACT

peggy.goerlitz@gtai.de
marie-christin.menke@gtai.de
GTAI experts for Mechanical & Electronic Technologies

THE FUTURE OF LEARNING

AI applications are transforming the educational landscape around the world. Europe and Germany have been slow off the mark, creating a clear opportunity for solutions from international providers.

Go to a classroom in one of Germany's roughly 32,500 schools, and you'll find lots of highly qualified instructors and various teaching aids. What you won't find, however, is potentially one of the most useful tools of all: artificial intelligence. That's a situation Thomas Schmitt, senior AI expert at Deutsche Telekom Foundation, wants to change.

"AI solutions are currently underutilized in classrooms and schools in Germany," Schmitt says. "This might be changing soon, especially with applications that will likely be developed for concept-based learning as well as segments outside of purely cognitive abilities."

Schmitt's foundation supports education, research and technology projects. In their recent report "AI@Education," which compared global research and product development activities, they found a strong correlation between technological developments in a country and the willingness to use AI for education purposes. In the US and China, the adoption of AI in education has been pretty dynamic, but Europe lags behind. For instance, Germany only has only a few silo research projects and market-established applications in this field.

This suggests there's considerable developmental potential for AI-supported learning technologies at every level of primary and secondary education in Germany. For example, data mining and analytics can help optimize processes such as evaluation and school planning. In classroom teaching, AI can enable new methods of assessment, grading, tutoring and classroom management. Smart learning applications can allow for more personalized formats and integrate assistance systems. AI is also useful for automated predictions, performance assessments and learning recommendations.

The future is now

Demand for machine learning, natural language processing, automatic speech recognition, learning analytics and educational data mining in German schools is highly likely to grow in the long term. But right now, it is intelligent tutoring systems that are, in Schmitt's words, "a particularly promising growth area." They include applications like China-based Squirrel AI Learning, which simulates human pupil-teacher relationships by giving students personalized learning plans and tailored one-on-one tutoring.

THE BOTTOM LINE

The use of artificial intelligence in German education is still in the kindergarten stage, so there's lots of potential and room for international companies with innovative solutions.

As many advanced countries struggle with a shortage of education professionals, these services provide an important ancillary function. Germany currently needs at least 14,466 additional teachers, and as many as one in five students are considering after-school tutoring, according to a survey conducted by German provider Studienkreis. Automated assessment could prove to be a big help in monitoring students' learning behavior.

Hypermind, a project by the German Research Center for Artificial Intelligence (DFKI) and the University of Kaiserslautern-Landau, has developed an intelligent database that tracks and analyzes students' eye movements in order to identify learning difficulties and personalize their learning process.

Another growth market to watch is adaptive learning and recommendation systems. Cloud service providers, such as Watson Education Classroom, help teachers deliver adaptive learning to improve student outcomes. Educators can search and share learning content, including lesson plans, tests and worksheets.

"Learning software that adapts to students' individual needs is gaining importance in Germany," says Kiana Frank, manager for Trend and Innovation Scouting at GTAI. "The demand for online learning platforms is growing steadily, especially due to the changes in the education landscape caused by the COVID-19 pandemic."

Challenges and advantages

Germany and the rest of the EU have far stricter data protection laws than China or the US. That makes development more complicated but also brings competitive advantages. Applications developed in the heart of Europe have a far greater chance of conforming to standards all over the world. Collaborating with institutions like the DFKI is a great way of gaining insights on how to develop AI that stays within European rules and regulations.

Students at Leipzig University's Center for Teacher Education and School Research create a video explainer about rainbows in a classroom full of smart technology.

Photo: picture alliance/dpa/Waltraud Grubitzsch

GERMAN EDUCATION IS A REGIONAL RESPONSIBILITY

Education is the responsibility of the 16 regional states that make up the Federal Republic of Germany. Educational institutions use public tendering procedures, so AI application providers must go through a public procurement process to win contracts. The system is designed to be fair and provide opportunities for all companies wanting to enter the market.

The lack of central directives and a convoluted tendering process can complicate entry into the education market in Germany. On the other hand, companies that master these complexities will find themselves well positioned to exploit the growing demand in the sector, and ultimately to shape the future of learning in Europe's largest market.

CONTACT

asha-maria.sharma@gtai.de
GTAI expert for AI

The architects of the Federal Republic of Germany in the late 1940s were keen on ensuring that no one political party or entity would have complete control over education, so they devolved that responsibility to the 16 regional states. This allows decisions to be made close to the place and the people affected.

The German constitution outlines which compulsory subjects and standards the federal government is responsible for through the Standing Conference of Ministers of Education and Culture (KMK). Meanwhile, the application of those standards and subjects in school and higher education settings is largely left to the regional states. For example, national standards are set for German and mathematics in primary school and for German, mathematics, foreign languages and most STEM subjects in secondary school. However, the states are given considerable freedom to set their own general curricula, design their arts subjects, sports and general studies, and to choose their own content, objectives and teaching methods.

This separation of tasks between the KMK and the regional states works well because it allows for cooperation between national and local governments and plays to their respective expertise.

A SMART PLACE TO SET UP

You don't need to be based in Silicon Valley to find success as an artificial intelligence start-up. Germany has a few exceptional locational advantages that are making global investors sit up and take notice. Here are two of its success stories.

NavVis

DIGITAL TWINNING OF THE BUILT ENVIRONMENT

When Felix Reinshagen and his fellow co-founders chose Munich as a location for their AI venture NavVis, they were going against the grain.

"Many people told us it would be to better to set up our company in Silicon Valley, mainly in order to get better access to VC investors", Reinshagen recalls. He chose to ignore those arguments — for three good reasons.

"Firstly, we had close ties here with our alma mater, the Technical University of Munich," he says. "This gave us access to top people from the university and the research institutes, even in the early development phase." Secondly, the proximity to customers in the manufacturing industry and large building operators was crucial in developing the company's solutions. Third and finally, the start-up found international investors who were willing to invest in Munich. Business angel and prominent Silicon Valley investor Don Dodge opened doors for the start-up to investors who recognized the potential of the B2B company.

NavVis supplies spatial data and digital twin software to service providers and enterprises seeking to create photorealistic digital twins of their built environment. It uses something called "reality capture technology" and its digital factory solutions increase organizational operability, productivity, agility and profitability. "Our investors see the potential that lies in our patent portfolio and in our clear focus on engineering and industrial applications."

More strategic investors, including the Japanese company Kozo Keikaku Engineering (KKE) and European venture funds CIPIO Partners, Yttrium, MIG, BayBG and Targetpartners, have come on board. And NavVis's solutions have attracted a pool of large and medium-sized corporate clients in Europe, US, China and Japan.

The company now operates in New York, Los Angeles, Shanghai and Birmingham. Despite these successes, Reinshagen is the first to recognise that "the starting point for our success was clearly Munich."

COMPANY NAME NavVis
HEADQUARTERS Munich
PRODUCT/SOLUTION Reality capture technology (photorealistic digital twins of built environment)
CEO Felix Reinshagen
FOUNDED May 2013
www.navvis.com

NavVis VLX 3 is a wearable mobile mapping system that delivers reality capture data to laser scanning professionals for complex sites.

Photo: NavVis

A TWAICE technician prepares batteries for testing using their AI-supported analytics plaform for improving energy storage design.

Photo: TWAICE

TWAICE

BETTER ELECTRIC BATTERY ANALYTICS

When asked why he founded his company in Germany, TWAICE CEO Michael Baumann replies: "Excellent universities, many young international talents and successful manufacturing industry companies, especially from the automotive industry. We found everything we needed for a successful launch here."

Baumann has developed an AI-supported battery analytics platform to help improve battery and energy storage system design. Due to the current boom in electromobility and the trend towards climate-friendly technology, there is a great demand for TWAICE's services.

For example, its AI-powered software enables companies to analyze the condition of lithium-ion batteries in electric vehicles in real time and predict their lifespan. That means they can optimize technical parameters to extend battery life.

TWAICE connects sensor and physical data (as well as data-driven battery models), which enables it to close the loop between product development and application, but also to create new services like predictive maintenance.

Baumann predicts there will be a "battery supercycle" that will fundamentally change the entire value chain. "We believe the transformation to a battery-powered world will reach maximum impact when critical decision-making is backed up by rock-solid data," he says.

Despite the challenging global economic environment in recent years, TWAICE has been able to grow and open additional locations in both Paris and Chicago. "We want to establish ourselves, here in Germany, as the world market leader for battery analytics software," Baumann says.

This confidence convinced his investors, including the New York-based investment firm Coatue. "International investors see Germany, as we do, as an important engineering and deep-tech location with good growth prospects," says Baumann.

For companies coming fresh to the field of battery technology research, access to young talent is particularly important. Germany's excellent education and university system offers very good conditions to source the right talent. "That's why we also train our own experts, in close cooperation with universities and research institutes, so that we can continue to grow." This year, TWAICE hopes to take on board more investors to continue its impressive growth trajectory.

COMPANY NAME TWAICE
HEADQUARTERS Munich
PRODUCT/SOLUTION AI-supported battery analytics platform
FOUNDED 2018

ONE-BILLION-EURO GERMAN VC GROWTH FUND

Venture capital is a central pillar of the German government's plans to support innovative young companies. At the end of 2023 the Ministry for Economic Affairs and Climate Action (BMWK) announced that its public–private initiative called Growth Fund Germany (*Wachstumsfonds Deutschland*) had reached its ten-digit target.

Established to accelerate the financing of start-ups and technologically innovative firms, it's now one of Europe's largest venture capital funds and is backed by the national government, the state economic bank KfW and more than twenty institutional investors, including insurance and wealth management companies.

"With significant participation of many private institutional investors, we were able to swift reach our goal of one billion euros," said Minister Robert Habeck in a statement in November. "It speaks to Germany's strength as a business location that the Growth Fund Germany has reached that goal in a difficult macro-economic environment. The first investments have been made so that part of the fund is already having an effect on the venture capital market."

Kerstin Rohde advises public and private companies in EU state aid law, grant and subsidy law at PwC. She specializes in regional and R&D subsidies, Important Projects of Common European Interest (IPCEI), SGEI and public infrastructure projects.

"We need IMMENSE INVESTMENT."

Photo: PwC/Kerstin Rohde

To achieve its goal of becoming climate neutral, Germany must build and expand production capacity for strategically important transformation technologies. Kerstin Rohde, a specialist in EU state aid law and subsidies at PwC Legal, explains how international companies based in Germany can obtain public subsidies for their projects.

Companies based in Germany can benefit from government funding allocated for transformation technologies. Can you tell us more about this initiative and what potential applicants can expect?

KERSTIN ROHDE: Before the German Federal Constitutional Court's decision reversing the allocation of EUR 60 billion in pandemic support funds to Germany's Climate and Transformation Fund ("KTF-Judgment") on November 15, 2023, the German government had budgeted around EUR 3 billion by the end of 2025 for funding companies that invest in the development of climate-friendly technologies in Germany. The EU has established a legal framework for this called the Temporary Crisis and Transition Framework (TCTF) that will enable member states to grant large subsidies under relatively simplified conditions. But individual states must first create the right legal structures and funding programs to grant support to local companies.

What's the current investment funding situation like in Germany, where private investment is match-funded by the government?

KR: The federal funding directive to strengthen the battery value chain publicly announced on September 25, 2023, is a good example of this — where the development of capacities for the extraction, further processing and refinement of battery raw materials, among other things, will be subsidized. To make the economy climate neutral, we need immense investment into building and expanding production capacities for transformation technologies. In this respect, investment funding is a good first step. However, November's KTF-Judgment has led to considerable uncertainty regarding the investability of such projects. Nevertheless, the transition towards a climate-neutral economy and society remains a priority for Germany. The announced funding for Northvolt in Heide (Schleswig-Holstein) is a good indicator for that.

What are the key data here?

KR: A maximum of 15 percent of the qualifying corporate investment is funded, up to a ceiling of EUR 150 million per company. In certain parts of Germany, known as assisted areas, as much as 20 percent and up to EUR 200 million are achievable.

TCTF UNPACKED

At the beginning of the war in Ukraine, the European Commission (EC) launched a legal framework to enable member states to cushion the impact of the energy crisis — the Temporary Crisis and Transition Framework (TCTF). It sets out the conditions under which investments in EU countries could be supported to reduce the EU's dependence on fossil fuels. In March 2023, the framework was expanded to include subsidies for certain transformation technologies.

The transformation of Europe's energy system is urgently needed in two respects. On the one hand, it will end the EU's dependence on fossil fuels from Russia, which — as the EC puts it — are used as an "economic and political weapon." On the other, the transformation contributes to tackling the climate crisis. So, extending the aid scheme to include transformation technologies is the next logical step.

Source: BMWK

When will the funding start?

KR: Given the KTF-Judgment, the government and the federal states will have to agree which budgets or initiatives the funds are allocated to, and they must do this as quickly as possible, as the TCTF framework only runs until December 31, 2025. All funding must be granted by then.

Some funding has already begun, as the Northvolt example shows. The federal funding directive to strengthen the battery value chain and the procedure laid out here serves as a template for future funding. Companies were obliged to submit their projects for funding under this initiative by the beginning of November for an eligibility assessment. As of today, there are no explicit consequences of the KTF-Judgment affecting funding for this initiative. Ultimately, it's the projects that are strategically important for Germany as a business location that will get funded.

And what if the demand for grants greatly outstrips the amount of funding available?

KR: Because the funding is limited, only projects that meet the funding criteria are considered. The funding body specifies the criteria, such as the economic feasibility of the project or its unique contribution to securing the value chain. Projects that are not selected can also apply for funding from other programs (assuming the government continues to run them after the KTF-Judgment and the new budget). Depending on their economic importance and alignment with political goals, it's certainly possible that there will be additional funding opportunities for transformation technologies at the federal and state level. As I mentioned before, the transition towards climate neutrality is likely to remain one of Germany's top goals.

Are there any other rules that apply specifically to international companies operating in Germany?

KR: As with all funding from the Federal Republic of Germany, you must maintain a subsidiary under German law with its registered office in Germany. After all, German or EU subsidies are designed to benefit the country, and not flow into a company that is only on the market here for a short time, rakes in subsidy money and then disappears back abroad after a few months. That's why it's standard practice that subsidy guidelines contain an earmarking clause which says anyone who receives a subsidy agrees to stay here for five years. As a rule, however, this is only a formality, because we are talking about a pro-rata investment subsidy of 15 percent. The company has to shoulder the rest on its own. Ultimately, if you set up an operating facility and invest tens of millions yourself, you'll be in it for the long run.

CONTACT

michael.schnabel@gtai.de
GTAI expert for financing

A HANDY BUSINESS LOCATION

The skilled trades and craft sector — or *Handwerk* as it's known in Germany — is a unique, tried-and-true branch of the country's economy — and an invaluable resource for businesses setting up in the heart of Europe. So what's behind this very German sector and idea?

In November 2023, skilled tradesman and specialist craftsmen from all over Germany gathered together for a unique event — the *Deutsche Meisterschaft im Handwerk* or German Craft Championship. It's the biggest awards ceremony of its kind in Europe and a testament to how highly the trades are valued in the Federal Republic.

German President Frank-Walter Steinmeier was on hand in person to congratulate the winners across all the different categories — from metalworkers, technicians and heating engineers to carpenters and bakers.

While Handwerk is steeped in history, the sector is anything but a relic. It still forms a central branch of the economy. After all, the approximately one million trades firms in Germany generate turnover of some EUR 730 billion per year.

Over 130 professions make up the highly skilled Handwerk sector, spanning a wide range of industries and disciplines. In addition to the trades named above, the category includes bricklayers, roofers, mechatronics engineers, garden designers, chocolatiers and hairdressers.

"Companies from Germany and abroad value these trade specialists as proven suppliers and service providers," says Michael Olma, expert for foreign economics at the German Confederation of Skilled Crafts (ZDH). The Handwerk sector, he says, has an international reputation for high quality and an ability to provide pragmatic and creative solutions to complex technical problems.

Dual vocational training system

Olma argues that Germany's approach to training for the trades is unique. That's because training in technical and skilled trades is strictly regulated and associated with stringent quality control. "This provides a kind of a guarantee of expertise for anyone hiring a German craft professional," says Olma.

If you want to work as a carpenter, electrician or car mechanic in Germany, you must first pass through a rigorous dual vocational training program. Apprentices complete a three-year course, with one year spent in a training school learning about the theoretical foundation of their future trade, then two years getting further training and practical experience at a company.

Trainers must be certified by the Chambers of Crafts and Trades. The chambers monitor the quality of instruction and check that apprentices have necessary skills. At the end of their training, all aspiring tradespeople must pass demanding examinations before they can seek employment.

Professional development doesn't have to end with the apprenticeship either; tradespeople can continue to get new qualifications and add to their skill set. If they go on to pass higher exams, they can become "master craftspeople" This qualification is crucial for tradespeople looking to set up a licensed business: 53 skilled

→

THE BOTTOM LINE

Germany has a tried-and-tested system of tradesmanship unique in Europe. That's a huge benefit for international companies setting up in Europe's largest economy.

Photo: Heiko Specht/laif

WHERE TRADECRAFT MEETS INDUSTRIAL ENGINEERING

Otmar Ternes, the owner and MD of the Limbach Maschinen company in Mendig, Rhineland-Palatinate, in western Germany, often has to explain to international customers what the term *'Handwerk'* actually means. His company manufactures specialized machines and systems for companies in the conveyor and process engineering sector. Many of Limbach's customers assume the firm is an industrial manufacturer rather than a traditional craftsmanship business.

The boundaries between engineering and tradecraft are often fluid in Germany. Ternes and his company deliver customized products for companies in sectors with particularly high demands, such as power plant operators, steel construction companies and factory owners. "For me, Handwerk means above all that the owners completely stand behind their products and services and ensure that everything runs smoothly," says Ternes. "Handwerk means one hundred per cent reliability, around the clock, if necessary."

His customers — mostly large industrial groups from the Czech Republic, Switzerland and Austria — certainly appreciate Limbach's dedicated approach. Internationalism is also part of the company's culture. For important customers like the chemical company Bayer, his craftspeople often travel as far afield as Shanghai.

Photo: Limbach

WOODWORK FOR THE HIGH SEAS

When shipping companies contact Frank Geimer, owner of the shipping carpentry firm Weingarten, with an order, time is of the essence. The skilled tradespeople at his factory workshop in Herschbach in western Germany modernize and restore boat interiors for shipowners from all over the world. "Winter is peak season for us," explains Geimer, since many shipping companies take a winter break for a few weeks. This is a particularly important time for cruise ships, which must be serviced and repaired as quickly as possible.

The Weingarten workshop has master carpenters and twenty other specialist trade professionals producing customized wooden interiors. "We've specialized in carrying out as many production steps as possible on site at the factory," explains Geimer. "This allows us to refurbish the ships very quickly and efficiently at docks across Europe." Geimer's international customers appreciate the firm's efficiency and speed. But it's the high quality, flexibility and reliability of skilled carpenters that really makes the difference.

Photo: Heiko Specht/laif

ILLUMINATING THE WORLD

The skilled crafts company Maas + Roos Signage develops and produces illuminated signs for international companies at its 30,000-square-meter production plant in Hilpoltstein, southern Germany. "A signage system has to have perfectly homogeneous illumination," explains Alexander von der Grün, CEO and co-founder of the company. His partner and co-owner Sebastian Gemählich adds: "Illuminated signs are an important part of a company's brand image and have to look the same all over the world — despite different technical standards." Maas + Roos therefore places great emphasis on quality management and training. "We produce customized products manufactured in many individual steps and electrified by specialists," says von der Grün. "That's why we need three different, highly specialized Meister ('master') training courses within the company."

Maas + Roos employs and trains master craftspeople for illuminated signage, metal construction and electrical installation. International companies such as IKEA and Rolex initially commissioned the firm to stage their logos as illuminated advertising in Germany. They were so impressed by the quality of their work that they now use its tradespeople for jobs in different countries across the globe. "We are very proud to bring German craftsmanship to so many places around the world," says von der Grün.

Photo: Maas+Roos

→ professions in Germany require individuals to reach the level of master before they can run their own companies.

The qualification is equivalent to a bachelor's degree — and many entrepreneurs proudly display their own certificates and those of their employees on the walls of the company.

This carefully designed training process ensures that expertise, compliance and upskilling are an integral part of the trades sector in Germany. Delivering poor or mediocre work, or running a "cowboy" operation, runs contrary to a true craftsperson's sense of honor.

The "economic powerhouse next door"

Germany's skilled trades and crafts businesses are typically small- or medium-sized, and mostly owner-operated. Company founders are directly responsible for delivering outstanding products and services — and it's not uncommon to find hands-on owners, still plying their trades in workshops, kitchens or construction sites.

This incredibly diverse sector excompasses small, regionally active one-person businesses all the way up to highly specialized, internationally oriented companies with multiple locations. The skilled trades are sometimes described as the "economic powerhouse next door" because the companies are often deeply rooted in their local economies, where they are an important building block for regional success.

German tradespeople can also be surprisingly cosmopolitan. Handwerk has a tradition of "travelling years," where after completing their first examination, tradespeople leave the company to "wander" from place to place and company to company, sometimes across national borders, all the time gathering expertise and picking up new skills.

It is a tradition "that has existed in this country for centuries and is still practiced in some skilled trades sectors today," explains Olma. He adds: "The main aim is for craftspeople to familiarize themselves with new working practices, foreign places, regions and countries and to gain life experience."

A competitive advantage

This rotational training system also benefits international companies setting up shop in Germany, says GTAI expert Karl-Martin Fischer. "It benefits suppliers and service providers looking for partner companies for their customer service." He cites a few of the most popular trade requirements: "Construction trades-

GERMAN HANDWERK IN FIGURES

Skilled trades and craftspeople make sure the wheels of industry keep turning. Germany prizes its extremely diverse Handwerk sector and ensures a high level of expertise.

1 M

Number of Handwerk firms in Germany

5.7 M

Number of people who work in Handwerk in Germany

29%

Share of apprentices employed in Handwerk in Germany

350,000

Number of apprentices that learned a craft in the German Handwerk in 2022

€735 B

Annual turnover of the Handwerk sector in Germany

Source: Zentralverband des deutschen Handwerks (ZDH) and government project 'Make it in Germany'

people who build factory buildings, electrical engineers who plan energy-efficient company headquarters, food tradespeople who supply company canteens, or shopfitters who set up showrooms."

In Fischer's experience, "international companies are always impressed by the expertise, specialist knowledge and experience that these companies bring to the table as partners and service providers," adding: "This is especially true when customized products and solutions are required."

Modern trades for the future

Traditional crafts, with their reputation for artisanal, customized and often regional outputs are sometimes viewed as the antithesis of modern, mechanized, mass market industry. However, in Germany, tradesmanship and industry work closely together in areas such as toolmaking or mechanical engineering, where industrial firms need specialized, one-off instruments (see box 3).

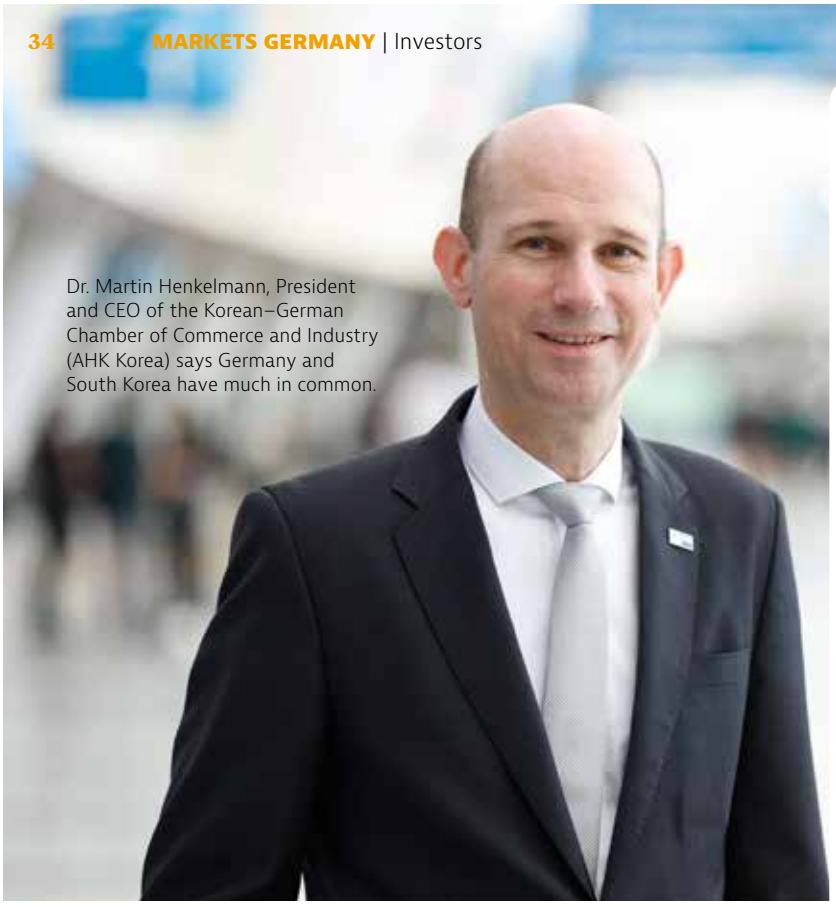
And while Handwerk is a venerable, centuries-old tradition, its practitioners work at the cutting edge of modern technology. Digitalization has been fully integrated into skilled trades sectors for some time, for example, with the use of drones to survey building sites and the creation of virtual 3D prototypes of tools for industrial companies, while heating and air conditioning technicians today rely on AI-powered predictive maintenance.

Looking to the future, trade professionals with "green skills" will be a key partner in the transition to a climate-neutral economy and the expansion of green tech. Clever toolmakers will be needed to fabricate specialist components and digital management and maintenance systems for green energy firms; skilled tradespeople will be called upon to insulate and renovate homeowners' properties, fit solar panels, exploit geothermal energy, make urban landscapes more climate resilient and so much more.

"German craftsmanship is a unique specialty that's known the world over," says Karl-Martin Fischer. "And it's a location benefit that international companies should recognize and take advantage of."

CONTACT

karl-martin.fischer@gtai.de
GTAI expert for the skilled trades and craft sector in Germany



Dr. Martin Henkelmann, President and CEO of the Korean–German Chamber of Commerce and Industry (AHK Korea) says Germany and South Korea have much in common.

"WE FORESEE EVEN MORE TRADE, INVESTMENT AND RESEARCH OPPORTUNITIES IN THE COMING YEARS."

South Korea and Germany share a similar history, common economic strengths and a robust tradition of trade. Dr. Martin Henkelmann, President and CEO of the Korean–German Chamber of Commerce and Industry (AHK Korea), shares with us what the future may hold.

Photo: Korean-German Chamber of Commerce and Industry (AHK Korea)

South Korea and Germany are both globally renowned for their manufacturing capabilities. So how do South Korean companies view Germany in terms of expansion?

MARTIN HENKELMANN: Germany has been an attractive investment location for South Korean companies over the past decades, as indicated by data from the Import-Export Bank of Korea. Between 2015 and 2022, South Korean companies invested around USD 3.4 billion in Germany: USD 1.4 billion went to the manufacturing sector, and nearly USD 900 million to banking and insurance. The wholesale sector has also strongly benefitted in the past decade. Germany's appeal to South Korean investors is down to its strong reputation, its economic and political stability and parallels in the two countries' history.

What advantages does Germany offer as a business location?

MH: South Korean companies seek proximity to their major clients and their largest market within the EU, which is why many have established their European headquarters in Germany. Collaborations in research and product development with German businesses and research institutions are also appealing. Furthermore, the quality of life in Germany for the Korean families who come over with the companies is valued highly, particularly since many regions have strong Korean communities.

Which sectors in Germany are particularly appealing?

MH: The "classical" sectors such as automotive, chemicals and mechanical engineering remain important for South Korean companies, while we see growing interest in pharmaceuticals, medical devices and digitalization. The growing popularity of South Korean products — particularly consumer goods — in the European market is also making South Korean companies seriously consider Germany when they set up their European hubs and logistics systems. Furthermore, in alignment with the global push for decarbonization, South Korean enterprises — like German businesses — are actively seeking sustainable solutions. Therefore, South Korean enterprises with solutions will present them to German clients while others use experience, knowledge and infrastructure in Germany to achieve their ESG and RE100 targets.

2023 was a year of considerable geopolitical turbulence. How has this affected South Korea's approach to global economic relations?

MH: The rise of South Korea from one of the poorest nations in the 1950s to one of today's economic powerhouses is strongly linked to South Korean businesses engaging in international trade. Therefore, South Korean companies have a strong interest in free trade and an effective international rule-based order. South Korean enterprises have a long-standing experience with the ups and downs of inter-Korean relations and these changes have not stopped South Korea's economic development. Much more of concern for South Korean companies are the global tensions, supply chain instability and trade restrictions hindering the flow of goods.

At the same time, South Korean enterprises have been diversifying their supply chains and markets for years, including a heightened focus on the ASEAN region. They also appreciate the reliability of doing business in markets of value partners such as the European Union and the United States. As the Korean–German Chamber of Commerce and Industry, we foresee even more trade, investment and research opportunities between the two nations and their companies in the coming years.

CONTACT

info@kgcci.com
KGCCI – AHK KOREA

joachim.weber@gtai.de
GTAI director Executive Unit Strategic Partnerships and liaison to the German Chambers of Commerce Abroad

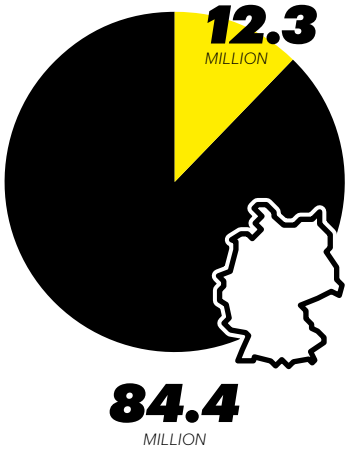
How Germany Works
ATTRACTING SKILLED LABOR

Germany eases immigration criteria for skilled workers

On November 18, 2023, new rules came into force under Germany's Skilled Immigration Act and the new EU Blue Card that make it easier for non-EU nationals to live and work in Germany. University graduates with a job offer and an annual salary of EUR 43,800 can qualify for a residence permit for employment. Those in professions where the need for skilled labor is greatest (for instance in STEM disciplines) only need to earn around EUR 39,683. IT specialists do not have to possess a university degree if they can show they have three years of professional experience. Permanent residence permits can be granted after just 21 months if candidates learn German. The new rules are expected to make it easier for companies in Germany to acquire skilled labor from abroad.

MORE THAN 1 IN 7 ARE IMMIGRANTS

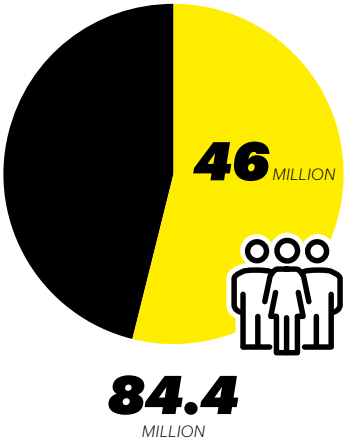
Share of foreign nationals of the total polulation in Germany



Source: Destatis

SKILLS SHORTAGE IN AN OLDER POPULATION

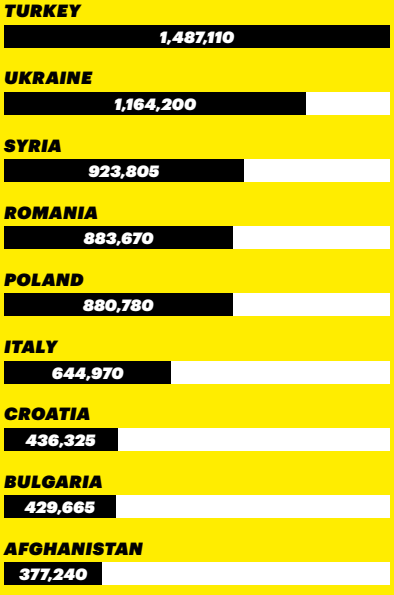
Share of employed people of the total polulation in Germany



Source: Destatis

HIGH NUMBERS OF EU AND NON-EU MIGRANT WORKERS

Countries of origin of foreign nationals living in Germany (2022)



Source: Statista

FOREIGN WORKERS TEND TO SETTLE IN GERMANY

Share of Blue Card holders who stay in Germany over the long term (more than five years)

Source: GTAI

GERMAN CITIZENSHIP

Number of people who were naturalized in Germany in 2022

Source: Destatis

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Germany Trade & Invest (GTAI) is the foreign trade and inward investment agency of the Federal Republic of Germany. We advise and support international companies planning to expand into the German market and assist German companies seeking to enter global markets.

Our consulting services for international companies looking to expand and seeking to establish an own subsidiary or branch office in Germany include:

- Assistance with finding the right site location for their business
- Information on financing and incentives for businesses
- Tax and legal information on setting up a company
- Information, data and statistics about key industries in Germany

All investment-related services and inquiries are treated with the utmost confidentiality and are provided free of charge.

Get in touch with our Investor Support Service Team

Sarah Gholiha
sarah.gholiha@gtai.de

Alexander Walter
alexander.walter@gtai.de

Germany Trade & Invest
Friedrichstraße 60, 10117 Berlin
T. +49 30 200 099-0
info@gtai.de