# GreenTech made in Germany 2025

GreenTech-Atlas for Germany

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GreenTech-Atlas for Germany



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# Summary & Conclusion



### **Summary**

The GreenTech Atlas 2025 demonstrates that the German GreenTech sector has long established itself as a key industry within the national economy. Many green technologies and services are already competitive and are poised to gain further relevance. The sector provides stable employment and contributes significantly to value creation. In 2023, GreenTech accounted for 9.0% of Germany's total gross value added (GVA), growing at an average annual rate of 4.7% since 2010—substantially outpacing other major industries. The sector employed 3.4 million persons in 2023, an increase of 800,000 compared to 2010. For comparison, the automotive industry-traditionally a core pillar of the German economy-employed around 1.1 million persons directly in 2023. Individual lead markets such as renewable energy systems, energy efficiency, and sustainable mobility also exhibit strong growth dynamics.

Germany's strong position in foreign trade further underscores the competitiveness of its GreenTech sector. While global demand for green products is expected to rise significantly in the coming years, global trade may decline due to rising trade tensions and protectionist policies. At the same time, international competition is intensifying. The German GreenTech sector is deeply embedded in global trade networks, with exports valued at €132 billion in 2023. Over half of these exports were destined for other EU Member States, making the European single market nearly six times larger than Germany's most important non-European export destination, the United States. In light of growing international competition and potential trade disruptions, the EU remains a critical export market for the German GreenTech industry.

In terms of global innovation, Germany's GreenTech sector has proven highly competitive. Between 2010 and 2023, Germany ranked among the top three countries for GreenTech patent filings, accounting for 16.5% of global patents in this sector—just behind the U.S. and Japan. However, China is rapidly catching up and is likely to join the top three in the near future. The most dynamic innovation segments include renewable energy systems and sustainable mobility.

### Conclusion

Projections suggest that the gross value added of the German GreenTech sector could nearly double by 2045, while the global import market for green technologies may quadruple. Sustained growth will depend on a stable demand base, driven in part by ambitious environmental and climate policies. In light of intense international competition in the GreenTech sector, maintaining and enhancing the competitiveness of German companies plays a crucial role. Based on the findings of the report, three strategic areas of action have been identified, requiring coordinated efforts from both public and private stakeholders:

- Advancing the transformation towards climate neutrality and a circular economy: Germany must continue along its current path, thereby strengthening the domestic GreenTech market. As with other strategic industries, robust domestic demand serves as a foundation for global competitiveness. Reliable regulatory frameworks aligned with climate and circular economy targets are essential to reinforce market incentives. Germany should advocate for a consistent transformation agenda at the EU level, which will also benefit the GreenTech sector by ensuring access to its most important export market.
- Seizing opportunities in emerging markets amid geopolitical shifts: Geopolitical tensions and increasing trade barriers between the EU, the U.S., and China are prompting companies to diversify their markets. Demand for green technologies is growing in many countries. Imports of green technologies rose by 20.7% annually in Cambodia and 15.3% in Vietnam between 2010 and 2022. Israel and New Zealand reported the same average annual growth rate of 13.1%, while India saw 12,0% annual growth in the same time period. Particularly since 2020, Indian imports of German goods have grown rapidly, doubling between 2020 and 2023 with an average annual growth rate of 25,0%. Interviews conducted for the GreenTech Atlas indicate strong future potential in parts of Africa and South America. Chile's GreenTech import market remains small but has been growing by 7.2% annually since 2010, with imports from Germany outpacing this at 7.4%. These figures suggest significant opportunities for German firms

in those markets. Policymakers can support the industry by negotiating free trade agreements and improving export conditions. Furthermore, German chambers of commerce abroad and export initiatives can provide companies with valuable market intelligence.

► Strengthening research and development to ensure long-term competitiveness: Germany's Green-Tech companies have delivered key innovations in various lead markets. The German GreenTech sector holds important patents in areas such as metal recycling, process efficiency, wind energy and smart factory solutions. German companies have also made important contributions in emerging technologies that are expected to gain significance in the future - for example CO<sub>2</sub> mitigation and storage technologies. To keep pace with global competitors-particularly in light of China's assertive innovation policy-Germany needs effective research funding, supportive conditions for startups, and strong public-private collaboration, that enable the development of innovative yet capitalintensive technologies.



GreenTech Sector: National and Global Markets for Environmental Goods and Services The GreenTech Atlas analyses the economic significance of various GreenTech products and services based on the Prognos envigos model. Structured around seven lead markets, the quantitative analysis covers persons employed, gross value added, import and export volumes, as well as patent applications. The following results first present the GreenTech sector as a whole before examining the individual lead markets in detail.

Figure 1

### Lead Markets of the GreenTech Sector



Prognos AG 2025

# **2.1. GreenTech as a Driver of the German Economy**

# Over 3.4 Million Persons Employed in the German GreenTech Sector

With more than 3.4 million persons employed, Green-Tech—an interdisciplinary cross-sectoral sector—is a major employer in Germany (Figure 2). For comparison: in 2023, the country's key automotive sector had approximately 1.1 million direct employees. Between 2010 and 2023, employment in the GreenTech sector

grew by around 800,000 persons. Its share of total national employment increased from 6.7% to 7.5% over the same period.

### GreenTech Outpaces Traditional Key Industries

A comparison over time between the GreenTech sector and traditional key sectors reveals a striking trend (Figure 3). While GreenTech has gained significant momentum—including strong growth during the COVID-19 pandemic—other sectors have exhibited noticeably weaker performances.

Figure 2



### Persons Employed in the German GreenTech Sector

Source: Prognos AG 2025, based on data from the Federal Employment Agency and the Federal Statistical Office.



### Trend in Persons Employed in Germany's GreenTech Sector and Comparison Sectors (Indexed 2010 = 100%)

Source: Prognos AG 2025, based on data from the Federal Employment Agency and the Federal Statistical Office.

# 314 Billion Euros in Gross Value Added and an Annual Growth Rate of 4.7%

In addition to the number of persons employed, gross value added also plays a central role in reflecting the performance of the GreenTech sector. The indicator measures the value of goods and services produced, minus the intermediate goods required and thus, represents the economic added value created by companies in the sector. The (price-adjusted) gross value added of the GreenTech sector in 2023 amounted to approximately 314 billion euros (Figure 4), which represented 9.0% of the total national gross value added. By comparison, the manufacture of machinery as well as the manufacture of motor vehicles both accounted for around 3.1% of gross value added.

Looking at the trend since 2010, a similar picture emerges as for the development of employment numbers. While the gross value added of the entire economy, price-adjusted, increased by about 3.1% per year, that of the GreenTech sector grew disproportionately strong, averaging 4.7% per year. The greatest dynamics were recorded in the lead markets of Renewable Energy Systems and Sustainable Mobility, with growth rates of 8.3% and 7.2%, respectively. Dynamic trends were also observed in the other lead markets.







### Political Decisions Will Shape the Sector's Potential Through 2045

Based on varying assumptions regarding future political and regulatory developments, we simulate three potential development pathways for the Green-Tech sector through 2045. These projections illustrate how the sector could evolve depending on whether current transformation trends continue, accelerate, or lose momentum. On the one hand, we modelled the development of gross value added in Germany; on the other, we examined potential future developments of the global market for green tech. The following section presents the scenarios for the German GreenTech sector. The scenario for the global market is available in the full (German-language) version of the study.

Our projections are based on two core variables. First, the general development of the overall economy, for which we rely on forecast data from the Prognos VIEW model. Second, we estimate future demand trends for the GreenTech sector under three distinct scenarios: Source: Prognos AG 2025, based on data from the Federal Statistical Office and the statistical offices of the 16 federal states. The values are adjusted for inflation and thus free from price effects. The reference year for price adjustment is 2015. The values presented are rounded to one decimal place.

### Scenario 1: Continuation of the Current Path – the German GreenTech Sector Continues Its Existing Growth Trajectory

This scenario assumes that the increase in demand for GreenTech solutions observed between 2018 and 2023 will continue at the same pace. For example, the expansion of renewable energy systems grew significantly up to 2023, and the projection assumes this trend will persist. On the supply side, this implies a rising share of GreenTech solutions in total economic output. All activities in the GreenTech sector are projected forward based on the trends from 2018 to 2023, extended through to 2045.

### Scenario 2: Climate-Neutral and Circular Germany the German GreenTech Sector Gains Additional Momentum

This scenario reflects an ambitious transformation pathway, in which Germany consistently moves toward net greenhouse gas neutrality and the full implementation of a circular economy by 2045. For technologies that have not yet experienced strong demand growth but are essential to achieving climate and circularity targets, we assume significantly accelerated uptake. For instance, while the production of heat pumps increased only modestly between 2018 and 2023, reaching climate neutrality would require approximately a tenfold increase in installed units. Scenario 2 assumes that the comprehensive transformation results in heightened demand for German GreenTech goods. It also strengthens export-oriented GreenTech providers, as innovation is promoted and the global competitiveness of German companies is reinforced.

### Scenario 3: Stagnation in Transformation Technologies – the German GreenTech Sector Falls Short of Its Potential

This scenario simulates a stagnation in demand for the technologies and services essential to achieving climate and circularity targets. Two developments could trigger such a trend: First, political shifts could weaken the regulatory focus on climate and sustainability, reducing demand for GreenTech solutions. Second, while demand for green technologies may remain high, German providers could lose competitiveness, leading to a growing market share for foreign suppliers. All three scenarios project an absolute increase in gross value added by 2045, but the scale of growth differs considerably (see Figure 5).

In Scenario 1, the continuation of current trends leads to an increase in GVA from 314 billion euros to 526 billion euros. With an annual growth rate of 2.3%, the sector significantly outpaces the overall economy (1.1% p.a.). The GreenTech sector's share of total economic output rises from 9.0% in 2023 to 11.0% in 2045.

Scenario 2 results in substantially stronger demand for GreenTech goods and services, particularly through 2035, compared to Scenario 1. Under this pathway, the sector reaches a GVA of 622 billion euros by 2045, growing at an annual rate of 3.1% and expanding its share of the total economy to 13.0%.

In contrast, Scenario 3 still projects an increase in GVA to 424 billion euros for the GreenTech sector. However, this remains far below the sector's potential. With an annual growth rate of just 1.3%, only slightly above the overall economic trend (1.1% p.a.), the GreenTech sector's share of total economic output remains stagnant at 9.0%.

### Figure 5



Source: Prognos AG 2025



Trend of the Global Market (2010-2022) and German Exports (2010-2023), Nominal, Total and for the GreenTech Sector (Indexed 2010 = 100%)



The global import data is available only up to 2022, while the German export data includes values for 2023 as well. Source: Prognos AG 2025, based on data from the Federal Statistical Office.

# 2.2. International Trade in GreenTech Continues to Grow

# GreenTech Is a Key Driver of Germany's Export Performance

In 2023, the export volume of the German GreenTech sector reached 132 billion euros—accounting for 8.5% of total German exports. The significant economic importance of the sector, also demonstrated in terms of gross value added in chapter 2.1, is clearly reflected in foreign trade as well. GreenTech plays a crucial role in driving the growth of Germany's export economy (see Figure 6).

While the development of total German exports and GreenTech exports followed a parallel trend until 2019, a clear divergence has emerged since then: GreenTech exports have outpaced overall export growth and are now a key engine of export expansion.

The GreenTech sector weathered the economic uncertainty of the COVID-19 pandemic more robustly than the overall economy. In 2020, the first year of the COVID-19 crisis, the GreenTech sector managed to maintain its export level, while overall German exports declined by nearly 10%. This divergence in performance became more pronounced over the following two years. While total exports gradually recovered, GreenTech exports followed a much steeper growth trajectory. This trend continued—albeit at a slightly slower pace—even during the crisis year of 2023, in contrast to Germany's total exports, which declined that year.

### German GreenTech Exports Benefit from Surging Global Demand

The strong performance of German GreenTech exports is closely linked to the surge in global demand for environmental technologies. Since 2020, the global market—measured by total worldwide imports—has shown remarkable growth momentum (see Figure 7). German companies were largely able to respond to this rising demand and keep pace with the export growth, which is a noteworthy achievement, especially when compared to other sectors. Nonetheless, company surveys and expert interviews in our report reveal increasing international competition.



Target Markets of the GreenTech Sector by Export Volume from Germany in 2023, in Billions of Euros, with Growth (nominal) 2010-2023 in % p.a.

Source: Prognos AG 2025, based on data from the Federal Statistical Office. The values are rounded to one decimal place. Target markets within the EU are highlighted in light green.

## The European Single Market Is the Backbone of German GreenTech Exports

Ten of the 15 most important export destinations for German GreenTech products are located within the EU (see Figure 7). The European Single Market thus serves as the backbone of Germany's GreenTech foreign trade. In 2023, exports to EU countries accounted for nearly 72 billion euros—equivalent to almost 55% of total German GreenTech exports.

### Germany Is Well Positioned in Key International Demand Markets

A major driver of the positive trend in German exports is the dynamic development of the global market. In our analysis, the global market is defined as the total volume of GreenTech imports by all countries. To assess the potential for German suppliers, it is useful to examine the import volumes of individual countries more closely.

Global demand is by far dominated by the three largest markets: the United States, Germany, and China. The German domestic market ranks as the second largest in the world and continues to grow significantly. This indicates that substantial sales opportunities remain for German companies within their home market as well.

Other global import markets follow at a considerable distance. While European markets are present, they do not hold the same significance in global demand as they do among the top destinations for German GreenTech exports. Within the EU, German Green-Tech companies typically command particularly high market shares. In contrast, global demand highlights the growing importance of certain Asian markets. In addition to China, key markets include Japan, South Korea, and India. In these countries, the German market share tends to be below average. For instance, in Japan—the world's fifth-largest market—Germany's market share was below 4,0% in 2022.

Despite the challenges of market entry, all global import markets offer potential for growth in German GreenTech exports. Among the 15 largest GreenTech markets, India is the most dynamic, even outpacing the U.S., with an annual growth rate of 11.5% since 2010. Particularly smaller markets show a highly dynamic trajectory in demand development (see also strategic areas in conclusion).





#### The 15 Most Important Import Markets for the GreenTech Industry Worldwide in 2022

Source: Prognos AG 2025, based on the Prognos World Trade Model / UN COMTRADE Imports in billion euros with growth rate 2010-2022 in % p.a., nominal. Markets in the EU are highlighted in dark green, and the German market is highlighted in light red. The values are rounded to one decimal place.

#### Figure 9

### Top 5 Growth Markets of the Global GreenTech Market 2010-2022



Source: Prognos AG 2025, based on the Prognos World Trade Model / UN COMTRADE Growth in % p.a., with imports in 2022 in billion euros, nominal. Markets in the EU are highlighted in dark green. The values are rounded to one decimal place.

### **Top Export Performer: Sustainable Mobility**

An analysis of export data reveals that the seven lead markets of the GreenTech sector contribute with different shares to export dynamics. The lead market of Sustainable Mobility plays a particularly prominent role. More than 40% of total GreenTech exports originate from this lead market (Figure 10). The importance of the automotive industry to Germany's exports is therefore also evident within the GreenTech context electric passenger cars are the most significant export product. However, other goods such as rail vehicles also play a crucial role.

Overall, exports from the Sustainable Mobility lead market have experienced tremendous growth: since 2010, exports have increased by nearly 13% per year, resulting in a fivefold increase. As of 2022, Germany accounted for nearly 17% of global trade in the lead market.



Germany's Export Volume to Leading Markets in Billion Euros in 2023, with Growth from 2010-2023 in % p.a., nominal

Source: Prognos AG 2025, based on data from the Federal Statistical Office The values are rounded to one decimal place.

### Lead Market Circular Economy Tops Global Demand

From a global demand perspective, the lead market Circular Economy shows a similar pattern, compared to Sustainable Mobility (see Figure 11). It accounts for a very large share of global demand and experienced strong growth between 2010 and 2023.

However, the Circular Economy lead market holds an even more prominent position. This reveals a divergence from the focus areas of German exports. In 2022, over 250 billion euros worth of goods were traded in this lead market, primarily including secondary raw materials, waste, and renewable resources.

## 2.3. The German GreenTech Sector: A Key Global Driver of Innovation

# Germany Ranks Among the Top 3 Countries for GreenTech Patents.

More than half of all patent applications in the Green-Tech sector originate from just three countries: the United States, Japan, and Germany (see Figure 12). U.S. companies account for the largest share, with a strong focus on innovation in the lead markets of Energy Efficiency and Renewable Energy Systems.





#### Global Market Demand in Leading Markets in 2022 in Billion Euros, with Growth from 2010-2022 in % p.a., nominal

Source: Prognos AG 2025, based on the Prognos World Trade Model / UN COMTRADE The values are rounded to one decimal place.

### Figure 12

## Shares of the Top 6 Countries in Total GreenTech Patents Between 2010 and 2023, in %, with Distribution Across GreenTech Leading Markets



Source: Prognos AG 2025, own calculation based on PATSTAT. The values are rounded to one decimal place.

# A Look into the Lead Markets: Green Solutions Make an Impact

## 3.1. Circular Economy: The Backbone of the GreenTech Sector

### The Circular Economy Lead Market Employs the Most Persons and Generates the Highest Gross Value Added

In terms of employment, the Circular Economy is the largest lead market within the German GreenTech

sector: over 1 million persons work in this market (see figure 13). With nearly 90 billion euros in gross value added, the Circular Economy contributes more than any other lead market to the Green Tech sector. However, its growth rate for persons employed is below the average for the overall GreenTech sector. Since 2010, the number of persons employed in this lead market has grown by about 1% per year.

Figure 13

Number of Persons Employed in the Lead Market of Circular Economy and by Market Segments in 2023 (in parentheses, annual growth since 2010) and Gross Value Added (price-adjusted)



Source: Prognos AG 2025, based on data from the Federal Employment Agency and the Federal Statistical Office The values are rounded to one decimal place.

### Materials for Material Recovery Dominate the Global Market and German Exports

The total global imports of the Circular Economy lead market exceeded a quarter trillion euros in 2022, making it the largest international demand market for the GreenTech sector. The lead market was also significant for German exports, amounting to nearly 23 billion euros in 2023. However, the growth dynamics of exports in this lead market have been below average, with an annual growth rate of 2.2% since 2010 compared to the entire GreenTech sector with 3.9%.

### The Classic Circular Economy Drives Innovation

In the global innovation race, Germany is competitive in the Circular Economy lead market, holding a 16% share of global patents and ranking second behind the U.S.. The patent registration trend has been positive since 2010. From an innovation perspective, waste treatment and recycling, with a 43% share of the lead market's patents between 2010 and 2023, represent the most important market segment.

Looking deeper into the innovation activities of various market segments, notable patent topics can be identified. The most important patent topic in the lead market from 2010 to 2023 in terms of absolute patent numbers is the "Use of Waste Materials for Cement Production." Germany leads this patent topic internationally, with nearly 23% of global patents.

Also relevant in the German innovation landscape is the market segment of circular processes, which includes measuring and control technology for efficient manufacturing. This is the segment where Germany holds the strongest global position in the Circular Economy: with 30% of global patent applications, Germany is far ahead of its two main competitors, the U.S. and Japan.

## 3.2. Energy Efficiency Solutions: GreenTech Companies Reduce Environmental Impacts and Energy Costs

### The Demand for Energy Efficiency Solutions Is Steadily Increasing

Since 2010, the Energy Efficiency lead market has developed with above-average dynamism: the number of persons employed increased by 3.0% annually, reaching over 400,000 persons employed in 2023. Even more dynamic has been the development of gross value added, with an average annual increase of 5.6%.

### Potential for Export of Energy Efficiency Technologies Not Fully Tapped

The global demand for energy efficiency technologies has been booming since 2010, with worldwide imports (global market) growing by over 10% annually. In 2022, the value of traded goods in this lead market reached nearly 160 billion euros. This growth exceeds both the overall economy and the remaining Green-Tech sector. German exports have also shown positive development. With nearly 20 billion euros in exports, Germany accounted for approximately 12% of global demand.

### Providers of Efficiency Technologies for the Manufacturing Industry Are Particularly Innovative

Despite already holding a strong position in international comparison, German patent filings increased further, reaching over 40% more filings in 2020 than in 2010. Almost 60% of German patents in this lead market focus on the energy-efficient optimization of production processes. With a 14% share of global patents, Germany ranks second behind the U.S.. A particular significant technology area is the process control, measuring and regulation technology, which accounts for over 50% of all German patents in the lead market. This technology involves capturing manufacturing processes in detail and providing controlling interventions. Within the GreenTech sector, this area ranks second in German patent filings. While annual patent applications in process control, measuring and regulation technology in Germany doubled between 2010 and 2020, they increased eightfold in China during the same period. This remarkable dynamism has allowed China to surpass Germany, moving it to third place.

A prominent role in the process control, measuring and regulation technology area is played by the patent topic "Process Efficiency", which accounts for around a fifth of all patent filings in the lead market in Germany. In the "Smart Factory" patent topic, Germany leads the global innovation competition with a 30% share. Patent applications for the topics "Process Efficiency" and "Smart Factory" grew at a significant annual rate of over 10% until 2020.

### Figure 14

Number of Persons Employed in the Lead Market of Energy Efficiency and by Market Segments in 2023 (in parentheses, annual growth since 2010) and Gross Value Added (price-adjusted)



Source: Prognos AG 2025, based on data from the Federal Employment Agency and the Federal Statistical Office The values are rounded to one decimal place.

Number of Persons Employed in the Lead Market of Renewable Energy Systems and by Market Segments in 2023 (in parentheses, annual growth since 2010) and Gross Value Added (price-adjusted)



Source: Prognos AG 2025, based on data from the Federal Employment Agency and the Federal Statistical Office. The values are rounded to one decimal place.

### 3.3. Renewable Energy Systems: Demand Is Rapidly Increasing

### The Renewable Energy Market Has Been Booming Since 2014

Since 2010, the number of persons employed in the Renewable Energy Systems lead market in Germany has grown by an average of 2.3% annually. Between 2012 and 2015, the sector lost many employees, especially in the German photovoltaic (PV) industry. However, from 2015 onwards, a positive trend resumed, driven by the dynamic trend of installed wind and PV capacities. Between 2018 and 2023, the average annual growth rate reached 6.3%. The growth of gross value added has been even more dynamic, increasing by an average of 8.3% annually between 2010 and 2023.

### Germany as a Net Importer of GreenTech for Renewable Energy Systems

The development of Germany's exports is marked by fundamental shifts within the lead market. In 2010, German exports in the Renewable Energy Systems lead market accounted for approximately 14% of global demand. By 2022, however, this share had decreased to less than 8%. This dramatic loss of market share is a result of diverging trends in German exports compared to global demand. While global demand grew at an annual rate of over 5% since 2010, nearly doubling, German exports in this lead market have grown at a rate of under 1% per year.

## Wind Power Replaces Photovoltaics as Germany's Innovation Driver

Germany continues to be a global leader in innovation within the technology area of wind power. It holds a share of 23% of worldwide patents in this area, ranking almost equally with the leading innovator, Denmark, and accounting for nearly twice as many patents as the U.S.. However, a contrast exists between the two key technologies for renewable energy: wind power and solar technologies. While Germany's innovation in wind power declined after 2014, it experienced a significant resurgence starting in 2017. On the other hand, Germany's solar technology area, which also faced a decline in patents after 2014, has never fully recovered, while China's has consistently grown in innovation. By 2020, China had nearly caught up with Germany in solar technology patents.

Storage technology, particularly in the area of electrochemical energy storage, remains the second-largest market segment within Germany's GreenTech industry. Germany holds a dominant position in this market segment, but other industrial nations, such as Japan, Korea, and the U.S., are even more specialized in this segment. Nevertheless, Germany stands out in the patent topic of "thermal storage", where it commands a global market share of 25%.



## 3.4. Mitigation and Protection Technologies: Preservation of Soils and Air – and Societally Relevant Infrastructure

### The Climate Adaptation Market Segment is Set to Grow Substantially in the Future

The lead market demonstrates slow growth in terms of the number of persons employed, with an annual growth rate of around 1%. With approximately 180,000 persons employed, this lead market is the smallest within the entire GreenTech sector. The same applies to its gross value added, which amounts to approximately 18 billion euros.

### Global Demand for Mitigation Technologies Is Highly Dynamic

Foreign trade in mitigation and protection technologies is experiencing above-average dynamism—both in terms of German exports and the global market. In 2022, German exports accounted for 16.9% of global demand. Worldwide, demand grew by an average annual rate of 8.5%, reaching nearly threefold of its 2010 level. Key drivers of this growth were the technology areas of filtration systems and catalysts, as well as measurement technologies and related services all of which tripled in market volume.

### Strong German Specialization in Air Pollution Control Technologies on the Global Market

Within the lead market for mitigation and protection technologies, the air pollution control segment plays a dominant role in patent activity, accounting for 90% of the total lead market. Germany ranks third globally in this segment with an 18% share of world patents only behind the U.S. and Japan. These patents originate almost exclusively from filtration and catalyst technologies.

A key patent focus in air pollution control is "exhaust gas treatment through selective catalytic reduction," a technology aimed at reducing nitrogen oxide emissions. Between 2010 and 2023, Germany filed more than twice as many patents as second-ranked Japan. In the closely related topic of "preservation and improvement of air quality," Germany leads the world with 21% of all patents.

Additionally, "carbon capture and storage" (also referred to as Carbon Capture and Use - CCU or Carbon Capture and Storage - CCS), particularly for unavoidable greenhouse gas emissions in sectors like steel and cement production, ranks as the third most significant patent topic within this lead market. Germany also holds a global lead in the closely related, fast-growing patent topic "exhaust flow regulators"—technological components that regulate the volume of exhaust gases—with a 36% share of global patents.

### Figure 16

Number of Persons Employed in the Lead Market of Mitigation and Protection Technologies and by Market Segments in 2023 (in parentheses, annual growth since 2010) and Gross Value Added (price-adjusted)

	Growth 2010-2023		Persons Employed by Market Segment
183,600 Persons Employed	+1.0 % p.a.	Noise reduction and air purification technologies	61,000 (2.1 %)
		Climate adaptation	114,200 (+0.4 %)
18.1 Billion € Gross Value Added	₩ +3.1 % p.a.	Soil protection technologies and remediation	8,400 (+0.9 %)

Source: Prognos AG 2025, based on data from the Federal Employment Agency and the Federal Statistical Office. The values are rounded to one decimal place.

Number of Persons Employed in the Lead Market of Sustainable Forestry and Agriculture and by Market Segments in 2023 (in parentheses, annual growth since 2010) and Gross Value Added (price-adjusted)



Source: Prognos AG 2025, based on data from the Federal Employment Agency and the Federal Statistical Office. The values are rounded to one decimal place.

### 3.5. Sustainable Forestry and **Agriculture: Strengthening** the Resilience of Ecological **Systems**

### **Sustainable Agriculture** Is Gaining Importance

Nearly 300,000 persons are employed in the lead market for Sustainable Forestry and Agriculture. The lead market is experiencing steady growth, with real gross value added increasing by an average of 3.7% per year.

### The U.S. Is Importing Increasing **Volumes of German Wood-Based Construction Materials**

In 2022, international trade in products from the Sustainable Forestry and Agriculture lead market amounted to nearly 130 billion euros. The development of the global market has occurred in waves, a pattern that is

also evident-though somewhat less pronouncedin German exports from this lead market.

### Wood Processing as a Showcase Industry

While the lead market for Sustainable Forestry and Agriculture is not generally considered patent-intensive, Germany holds a comparatively large number of patents internationally. This is especially true for the core segment of wood processing and wood-based materials, where Germany accounts for 36% of global innovations-more than in any other GreenTech segment.

In the area of wood-based materials, Germany filed four times as many patents between 2010 and 2023 as Italy, its closest competitor. German companies are responsible for 74% of innovations related to "veneered wood applications" and 62% in the second most important topic, "processing of veneered and engineered wood." The latter only gained significant relevance globally in recent years, with patent filings in 2020 up 42% compared to 2010.





# **3.6. Sustainable Mobility:** Gaining Ground

### E-Mobility: Growth Engine of the GreenTech Sector

The lead market Sustainable Mobility is the second-largest lead market within Germany's GreenTech sector both in terms of employment and value creation. Over 800,000 persons are employed in this lead market, which has recorded an average annual growth rate of 5.1% since 2010. No other lead market demonstrates such dynamism in employment numbers. The gross value added increased by 7.2% per year since 2010.

### Electric Vehicles: Germany's Most Important GreenTech Export

Within Germany's GreenTech exports, the lead market for Sustainable Mobility plays a pivotal role. In 2023, it accounted for 41% of total sector exports, making it by far the most significant export market. From around 11 billion euros in 2010, exports grew at an average annual rate of nearly 13%, reaching over 54 billion euros by 2023.

# Electromobility as the Powertrain of the Future

Sustainable Mobility also stands out as the lead market with the highest innovation dynamics in the

German GreenTech sector. In 2019 and 2020, German companies filed around 50% more patents than in 2010. Innovation efforts are concentrated in the segment of sustainable mobility and drive technologies, which ranks third across the entire sector in terms of patent activity. Key innovation drivers are propulsion and vehicle technologies, accounting for 45% and 9%, respectively, of all patents in this lead market reflecting the industry's shift toward electromobility, particularly among major automotive suppliers.

Despite intense global competition, Germany holds a strong position internationally, ranking second after Japan with a 21% share of global patents in this lead market. In the patent topic of "hybrid vehicles", Germany claims a notable 27%, ahead of competitors like China and France and nearly on par with Japan. In the critically important topic of "energy storage for electromobility", Germany also stands out, filing more than twice as many patents as China—surpassed only by Japan.

In the segment of intelligent traffic management systems and infrastructure, Germany is also well positioned. The segment accounts for roughly one-fifth of patents in the entire lead market, with patent output in traffic management technologies having doubled between 2010 and 2020.

## Number of Persons Employed in the Lead Market of Sustainable Mobility and by Market Segments in 2023 (in parentheses, annual growth since 2010) and Gross Value Added (price-adjusted)

	Growth 2010-2023		Persons Employed by Market Segment
815,900 Persons Employed	+5.1 % p.a.	Bicycle industry	29,600 (+1.3%)
		Environmentally friendly mobility and propulsion technologies	251,600 (+14.2%)
		Intelligent traffic management systems and infrastructure	119,200 (+4.9%)
61.6 Billion € Gross Value Added	<u>ال</u> +7.2 % p.a.	Environmentally friendly logistics and mobility services	415,500 (+2.7 %)

Source: Prognos AG 2025, based on data from the Federal Employment Agency and the Federal Statistical Office. The values are rounded to one decimal place.



## 3.7. Water Management: Protecting the Essential Resource

### Water Management: An Established Lead Market in Germany

With over 320,000 persons employed, Water Management represents a significant lead market of Germany's GreenTech sector. However, its growth has been modest, with employment increasing by only 1.3% annually since 2010. In contrast, value creation has developed more dynamically, with an average annual growth rate of 3.8%.

### **Rising Demand in Emerging and Developing Countries**

Germany maintained a strong global market position in 2022, accounting for approximately 15,0% of worldwide exports in the Water Management lead market. However, global growth outpaces German export performance, as future potential lies largely in developing countries outside Europe—markets where German companies are still underrepresented and have not yet fully tapped their growth opportunities.

German exports are primarily focused on water and wastewater infrastructure and wastewater treatment technologies. The latter has shown the highest growth dynamics, with annual growth of 4.7%.

### **Consistent Innovation in Wastewater Treatment and Purification**

Between 2010 and 2023, 64% of patent applications in Water Management were attributed to the segment of water extraction, treatment, and wastewater processing, making it the most innovative segment in the lead market. This is largely driven by the wastewater treatment technology, where Germany accounts for 13% of global patents—second only to the United States. German companies lead globally in the patent topic of "biological wastewater treatment," with a 16% share of the relatively unconcentrated global market.

The smaller segment of water extraction and purification has followed a clear growth trajectory. While Germany filed 40% fewer patents than the innovation leader in 2010, it surpassed the U.S. for the first time in 2020. Germany's innovation focus in this market segment lies in "chemical and technical water purification systems," where the country—alongside the U.S.—holds a 20% global patent share.

The second most important market segment is infrastructure for water, wastewater, and flood protection. Germany plays a prominent international role here, contributing 30% of global innovations between 2010 and 2020. This leadership is primarily driven by water and wastewater network technologies, which represent 90% of the segment. Key innovations relate to sanitary systems, notably "shower drainage technology," where Germany holds a 34% global patent share —making it the undisputed leader in this field.

Figure 19

Number of Persons Employed in the Lead Market of Water Management and by Market Segments in 2023 (in parentheses, annual growth since 2010) and Gross Value Added (price-adjusted)



Source: Prognos AG 2025, based on data from the Federal Employment Agency and the Federal Statistical Office.

The values are rounded to one decimal place.





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