

Briefing · May 2024

Seizing the clean tech opportunity in Germany

Key points:

- In 2023 USD 1.6 trillion was invested in energy transition technologies,
- Germany invested USD 89.12 billion in clean technologies in 2023, 29% of total EU investment
- Investment in renewables and battery storage could reach up to USD 5.68 trillion by 2050, representing a significant manufacturing opportunity for ready countries
- China, the US and the EU dominate the manufacture of clean technologies, with around 80–90% of global manufacturing capacity
- Though China leads on wind and solar, opportunities exist to carve out market share in other technologies such as batteries, heat pumps and electrolysers
- Germany is a European leader in battery and heat pump manufacture
- European businesses are calling for a more robust industrial plan to support competitiveness of manufacturing, including for the crucial clean technology sectors

The German economy was [in recession in 2023](#), and is only expected to have [low economic growth \(0.2%\) in 2024](#), the [weakest among G7 countries](#). Could manufacturing clean technologies build on Germany's existing industrial expertise and help rejuvenate this European economic powerhouse?

There is a growing global commitment to deploying renewable energy and other clean technologies. In 2023, global investment in renewable energy, electrified transport, energy storage and electrified heat totalled USD 1.6 trillion, with the EU-27 investing USD 309.6 billion (19%). Germany invested USD 89.2 billion, nearly 29% of the EU total.¹

Global investment in clean technologies is expected to grow as governments decarbonise their energy systems to meet emission goals for 2030 and 2050.

The IEA estimates that USD 1.81 trillion – USD 2.41 trillion will be invested in renewable technologies, and USD 2.66 trillion – USD 3.27 trillion in battery storage between 2022 and 2050. In contrast, investment in fossil fuels is expected to be only 7–14% of these figures over the same period.² Clean technology markets offer a huge economic opportunity for countries with the capabilities to manufacture the products needed.

¹ BNEF (2024) Energy Transition Investment Trends, [bnef.com](https://www.bnef.com)

² IEA (2023), World Energy Outlook, WEO extended data investment. These are the global figures for the Stated Policy and Announced Pledges scenarios.

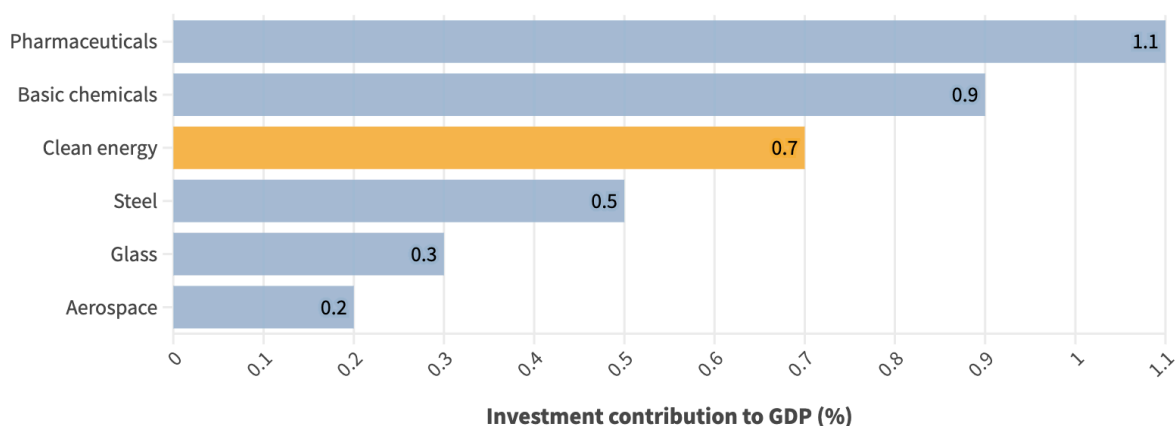
Clean technology manufacture as an opportunity for growth

China and the US dominate most established clean technology markets, and government support in those countries is designed to encourage the continued growth of domestic manufacturing. However, Germany also has a good track record of investing in the manufacture of new, clean energy technologies compared with many other countries. A new [report from the International Energy Agency](#) (IEA) on advancing clean technology manufacturing shows the opportunity continued support for this sector could provide the German economy.

The growth of the clean energy sector means that manufacturing the technologies is increasingly important as an engine of economic growth: in 2023, investment in clean technology manufacture³ totalled around [USD 200 billion](#), more than 70% above 2022 levels. It made up about 4% of global GDP growth and nearly 10% of global investment growth.

To put the significance of investment in clean energy manufacturing in context, it accounted for [0.7% of global GDP in 2023](#), as much as global investment in steel and aerospace combined. In the EU, [clean energy manufacturing made up around 11% of GDP growth in 2023](#), and the clean energy sector as a whole made up over 30% of GDP growth.

Figure 1: Global investment contribution of key manufacturing sectors, 2023



Source: IEA



China is by far the leading player, and the sector plays a significant part in its economy.⁴ In 2023 clean technology [contributed 9% of China's GDP](#), making it the largest overall contributor to the country's GDP growth.

Competing in a global market

Together with China, the US and the EU dominate the manufacture of clean technologies, with around [80-90% of global manufacturing capacity](#). However, China is by far the largest

³ [This covers solar PV, wind, electrolysers, batteries and heat pumps](#)

⁴ The [Carbon Brief definition of clean energy](#) here includes nuclear power, railways energy efficiency and electricity grids, which are not part of this briefing.

player, particularly in the wind and solar photovoltaic (PV) sectors. The IEA does not expect this [dominance to be diminished in the short term](#). But there are opportunities to carve out market share in other technologies where China is not yet as strong.

While China was responsible for around 75% of total global investment in manufacturing clean technologies in 2023, this represented a lower proportion than in 2022 (85%). In contrast, investment from the [US and the EU grew to 16% from 11% in 2022](#), reflecting extensive new investments in battery manufacture in particular. Furthermore, investment in [electrolyser and heat pump manufacture in the EU and US](#) exceeded the investment in the same technologies in China.

The heat pump manufacturing sector in the EU was worth [EUR 21 billion in 2023](#). Germany is a leading producer, with nearly 40 heat pump manufacturers sited in Germany⁵ – second only to Italy – and production worth EUR 884 million, behind Sweden.⁶

[DNV estimates that electrolyser capacity](#) will increase to 465 GW by 2030 and 3,075 GW by 2050, while [Deloitte puts the value of the global market](#) for green hydrogen produced from electrolysis at USD 642 billion in 2030 and USD 1.4 trillion in 2050.⁷

Prospects look even better for the battery sector. As electricity systems decarbonise, storage technologies that complement the variability of some renewable resources will become increasingly important. Global electricity storage capacity is projected to grow rapidly from [39 gigawatt hours \(GWh\) in 2022 to 278 GWh in 2031](#).

The German market for energy storage, including batteries, was worth [EUR 15.7 billion in 2023, and is estimated to grow by 36% to EUR 21.4 billion in 2024](#). Germany is investing in battery manufacture directed both at the electric vehicle and the electricity markets. It plans to have over [400 GWh of manufacturing capacity by 2030](#). If this is achieved it will be the third-largest manufacturer in the world behind China and the US.

Job creation in clean technology manufacturing

The rapid expansion of clean energy investment means that employment growth in the sector following the pandemic exceeds growth in general employment. Global employment was around 1% lower in 2022 than in 2019, but [employment in the clean energy sector rose by over 15%](#) in the same period, while the number of fossil fuel-related jobs fell by 4%. The IEA expects that investment in clean energy as countries decarbonise means that the [increase in clean energy jobs will continue to outweigh losses in the fossil fuel industry](#).

[Germany leads the EU](#) in manufacturing clean technologies and in the number of jobs associated with this. IRENA estimates that there were [354,000 people employed in renewable energy and heat pumps alone](#) in Germany in 2022.

Specific technologies have different employment rates, reflecting where those technologies are manufactured as well as deployed. So, for example, [Bruegel estimates](#) that there are 346,000 full-time jobs in the solar PV sector in the EU, but that only 7% of these are related

⁵ [Bruegel estimates](#) that there are 24 manufacturers in Germany.

⁶ Heat pump sales dipped in 2023. This prompted some [Member States to write to the European Commission](#) demanding that it publish its delayed Heat Pump Action Plan and provide a clear framework for how to decarbonise the heat sector.

⁷ Electrolysers use electricity to split water into hydrogen and oxygen. If renewable energy is used the hydrogen is classed as zero carbon 'green' hydrogen.

to manufacturing. In contrast, of 416,000 jobs in the heat pump sector, 56% are related to manufacturing, reflecting the greater market share for heat pump manufacture in the EU. As manufacturing capacity grows, so too do job opportunities. For example, some 161,000 people are employed in the EU's heat pump sector, with [an average of six jobs](#) created per thousand units of heat pump manufacturing capacity. There is additional job creation potential for the installation and maintenance of heat pumps.

The role of policy frameworks

Investor perceptions of government support for new manufacturing facilities will influence investment decisions about where to locate new projects. Governments around the world are increasingly including financial and other incentives in their industrial strategies to help reduce the costs of production and encourage the expansion of new industries in their domestic manufacturing sectors.

The drive to develop strategies to support clean technologies is [evident in the EU](#). It has a key role in setting the frameworks to support the emergence of new, clean manufacturing industries. The [Green Deal Industrial Plan](#) is designed to make net zero manufacturing industries in the EU more globally competitive, including by helping to finance clean technology innovation, manufacture and deployment. The EU has also [adopted rules](#) to encourage investment in manufacturing clean technologies such as wind, solar, batteries and heat pumps. In this context, the European Commission recently [approved Germany's EUR 2.2 billion State Aid scheme](#) to help decarbonise domestic industrial production processes, opening new market opportunities to provide renewable energy technologies.

However, these measures pale in comparison with the frameworks in the US and China, where billions are being directed at encouraging clean technology manufacture.

China's Five Year Plans set out the strategic direction for the development of the economy. The [most recent Plan](#) sets out political support to promote research, innovation and manufacturing, and enhance international competitiveness across the economy, including for "new energy". These strategic goals are [supported by robust policies](#) designed to ensure that they are met successfully.

The [Inflation Reduction Act](#) (IRA) in the US, provides tax credits for producing solar PV, wind and battery components. The IRA also provides a tax credit for investing in manufacturing facilities across the range of clean energy technologies.⁸ It authorises an [estimated \\$738 billion](#) for energy and climate measures⁹. As a result of its incentives, investment in clean technology manufacturing rose from [USD 19 billion in 2022 to USD 49 billion in 2023](#).

The risks posed by the strength of industrial policies in competitor countries are increasingly being felt in other markets, including Germany, which has long relied on its reputation as an industrial powerhouse to attract investment. For example, Swedish company Northvolt has recently begun construction of a [gigafactory near Heide](#) which will use renewable power to produce up to 60 GWh of battery capacity and employ around 3,000 people. However, both Northvolt and Tesla, the two largest battery manufacturers in

⁸ The [investment tax credit](#) reduces tax liability up to 30% of eligible investment costs, provided that the project meets certain wage and apprenticeship requirements. The credit value can be extended up to 50% if projects are located in local communities and meet requirements for using US-produced components (known as the domestic content requirement).

⁹ In contrast, the recently agreed [Strategic Technologies for Europe Platform](#) has allocated EUR 1.5 billion targeted at the European Defence Fund, and with the aim of supporting clean technologies by leveraging funds in other EU programmes.

Germany, have said that [they might scale back their plans in Germany](#) in order to allow them to concentrate on the US market instead.

Business is increasingly recognising that the measures in place at EU level are not yet enough to drive the expansion of clean technologies industries, and have called on the EU to go beyond the Green Deal Industrial Plan by introducing a stronger [European Industrial Plan](#) to boost competitiveness.

In the 2000s, Germany had healthy solar PV and wind power manufacturing sectors, producing panels and turbines for the domestic and export markets. However, the [solar panel sector collapsed around 2012](#) as a result of competition from China and a change in the support mechanism for new solar PV installations. The onshore wind sector grew until around 2016, when foreign competition and a fall in domestic deployment following policy changes meant that [the sector shrank as well](#). This resulted in a dramatic decline in market share and employment in both manufacturing and installation segments.

Having lost the lead in wind and solar, will the country be able to preserve it in heat pumps and batteries? A new industrial strategy is needed if Germany is to preserve and expand its current leadership in these growing clean technology sectors.