Competing with China's technological rise

Why Danish companies remain competitive

Executive summary

China's technological rise is reshaping competition

- China's trade advantages have shifted from lower- to medium- and high-technology products, which now account for almost 90% of its trade advantages.
- The overlap between Danish and Chinese trade advantages has increased from 37% to 48% over the past 25 years, pointing to intensifying competitive overlap between Danish and Chinese companies.
- China's technological rise is also reflected in R&D, where it now outspends Europe on corporate R&D.

Denmark's advantages are defensible but should not be viewed as permanent barriers

- Danish export specializations have proved more resilient than those of many European peers.
- Denmark competes less on scale and more on specialized technology, knowhow and strong market positions, particularly in wind, pharmaceuticals, enzymes, agriculture and flow control.
- This resilience is associated with strong positions in high-income markets, where customers place a premium on quality, advanced technology, and reliable service.

Denmark cannot win a scale competition; it must sustain its technological depth and differentiation

- Defend the segments where differentiation matters: Danish companies are strongest where regulation, reliability and lifecycle performance outweigh upfront price and create barriers to low-cost entrants.
- Keep investing in frontier innovation: Danish companies invest a larger share of sales in R&D than Chinese peers (6% versus 4%), with high-R&D-intensity firms accounting for 83% of Danish corporate R&D vs. 57% in China.
- Convert innovation into global commercial advantage: China's rapid growth in R&D and patent filings demonstrates its emergence as an innovation powerhouse. However, Chinese companies still file most patents domestically, while Danish companies maintain a clear lead in foreign patent applications, which are more costly and typically reflect innovations with global market potential.
- Capture more value beyond the product (hardware-as-a-service): Danish companies typically generate higher operation and maintenance (O&M) revenue per product than Chinese competitors, supporting premium pricing and resilience against cost-based competition.

China's move into high-tech industries

State-backed industrial policies have fueled a Chinese surge into high-tech sectors. This high manufacturing capacity drives competitive exports that challenge advanced economies and trigger global protectionism.

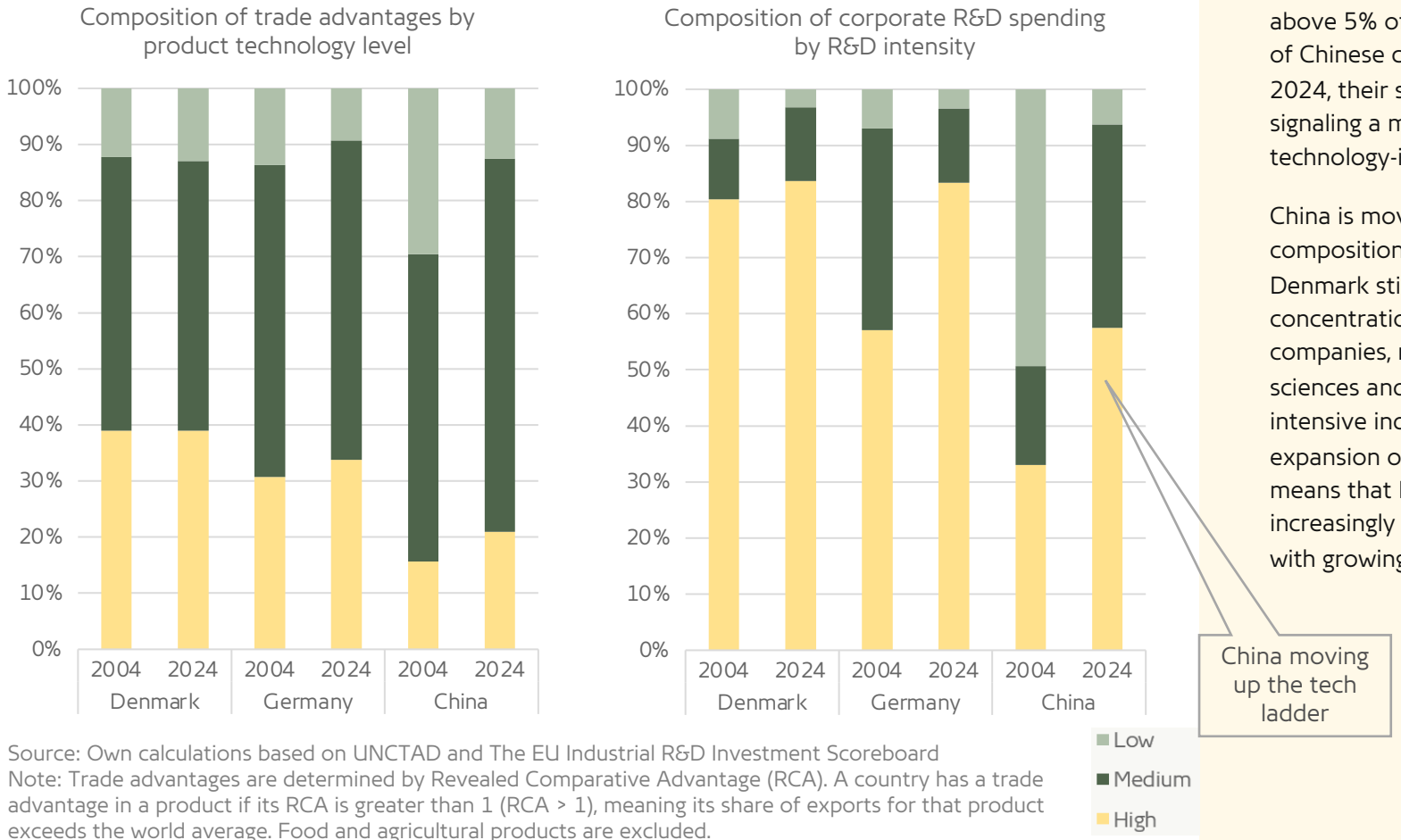
From low-cost to tech: China is moving rapidly up the value chain

China is moving beyond its traditional low-cost export model. Between 2004 and 2024, the share of China's trade advantages derived from low-technology products fell sharply, while the share derived from high-technology products increased from 15% to 21%.

The shift is even more pronounced in R&D. Companies with high R&D intensity – defined as R&D spending above 5% of sales – accounted for 33% of Chinese corporate R&D in 2004. By 2024, their share had risen to 57%, signaling a major reorientation towards technology-intensive industries.

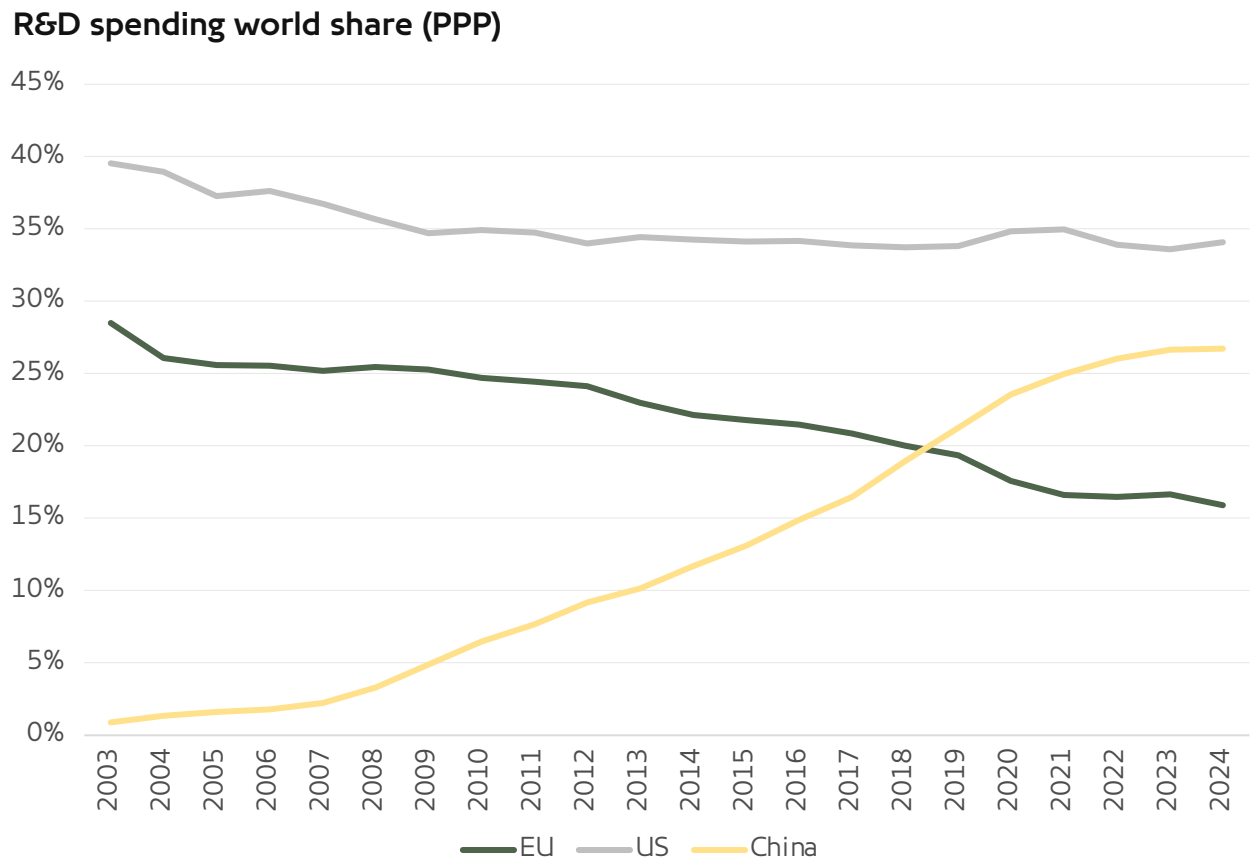
China is moving toward Denmark in the composition of corporate R&D, but Denmark still has a substantially larger concentration in high-R&D-intensity companies, reflecting its strength in life sciences and other knowledge-intensive industries. But China's rapid expansion of R&D in these sectors means that Danish companies will increasingly face Chinese competitors with growing technological capabilities.

China is shifting towards higher-technology products and technology-intensive R&D



Source: Own calculations based on UNCTAD and The EU Industrial R&D Investment Scoreboard
Note: Trade advantages are determined by Revealed Comparative Advantage (RCA). A country has a trade advantage in a product if its RCA is greater than 1 (RCA > 1), meaning its share of exports for that product exceeds the world average. Food and agricultural products are excluded.

Chinese firms now account for a larger share of global corporate R&D spending than EU firms



Source: The EU Industrial R&D Investment Scoreboard

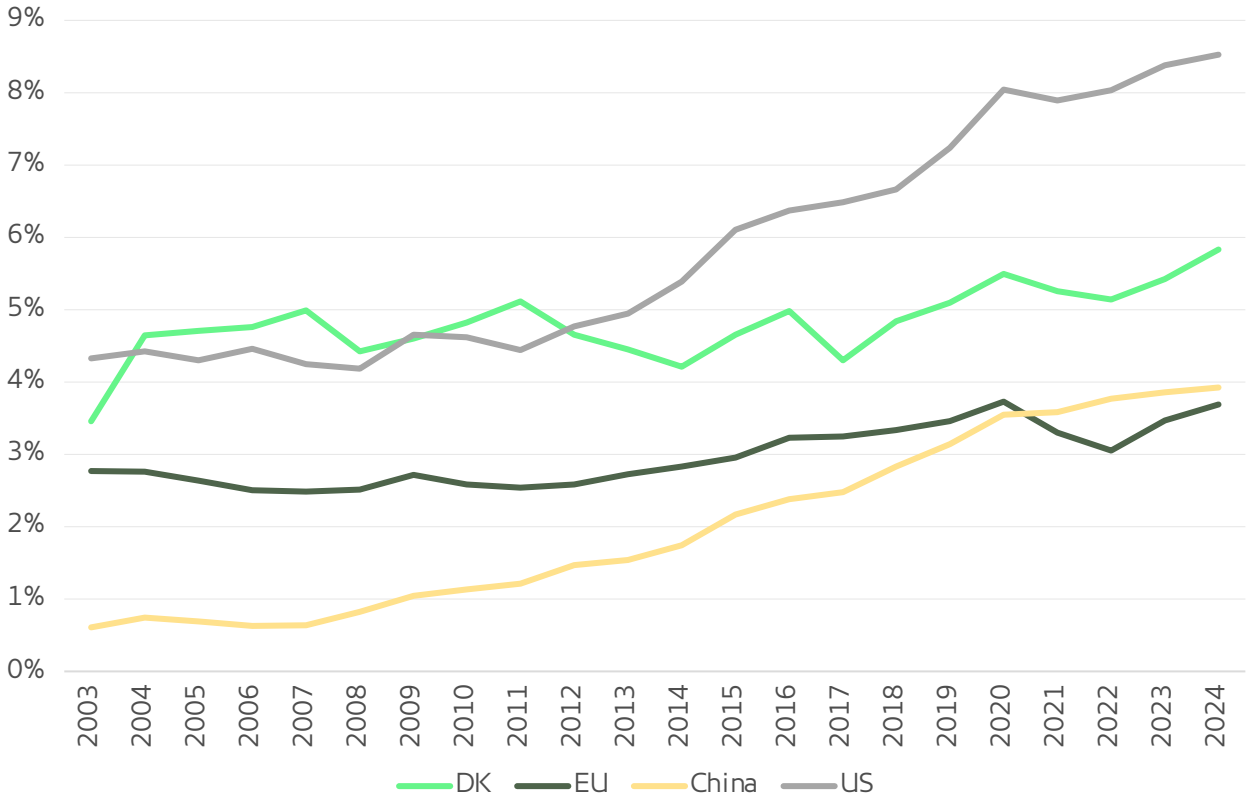
In terms of total R&D spending adjusted for Purchasing Power Parity (PPP), China has overtaken the EU, reflecting its ability to mobilize a vast pool of scientists, engineers and researchers at significantly lower costs than Western economies.

This scale advantage is increasingly translating into technological progress. China has moved beyond its traditional role as a manufacturing hub and is rapidly expanding its capabilities in strategic technologies such as AI, green technology and biotechnology.

For European companies, this marks a shift in the competitive environment. Scale alone does not guarantee innovation leadership, but China's ability to combine large-scale investment, engineering capacity and industrial policy is narrowing the gap in sectors where Europe has historically held an advantage.

At the company level, Danish firms invest more in innovation – but China is catching up

Share of net sales spend on R&D spending



Source: The EU Industrial R&D Investment Scoreboard

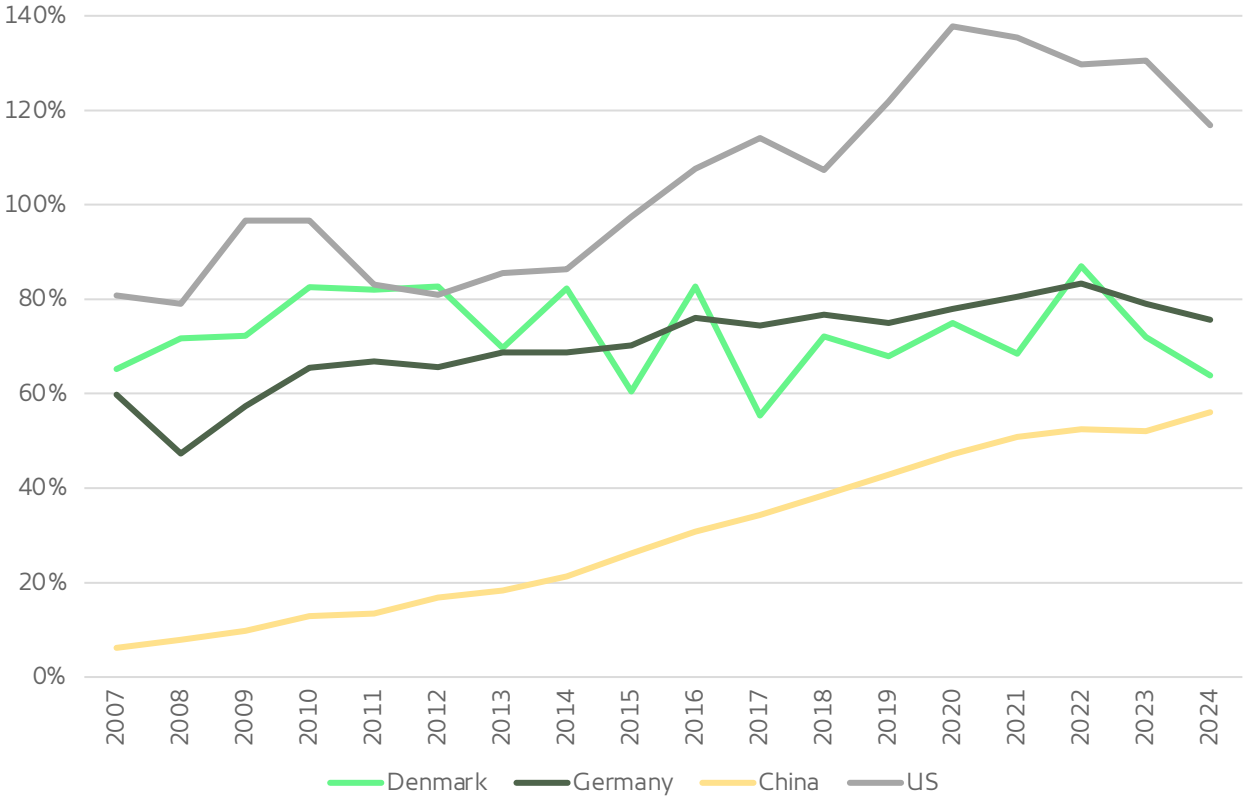
At the company level, Chinese R&D spending has also surged, driven by Beijing's aggressive corporate innovation mandates. Chinese companies now invest a larger share of net sales in R&D than the EU average – a gap that has closed steadily over time.

Denmark, however, retains a clear and stable lead in R&D intensity over China, consistently outperforming both Chinese companies and the broader EU average.

US companies maintain the highest R&D intensity of all. The US corporate R&D base is heavily concentrated in technology and software, where R&D-to-sales ratios are structurally high, while the large hyperscalers further lift the national average.

China is combining R&D capabilities with its existing strength in physical investment

R&D spending to capital expenditure ratio



Source: The EU Industrial R&D Investment Scoreboard

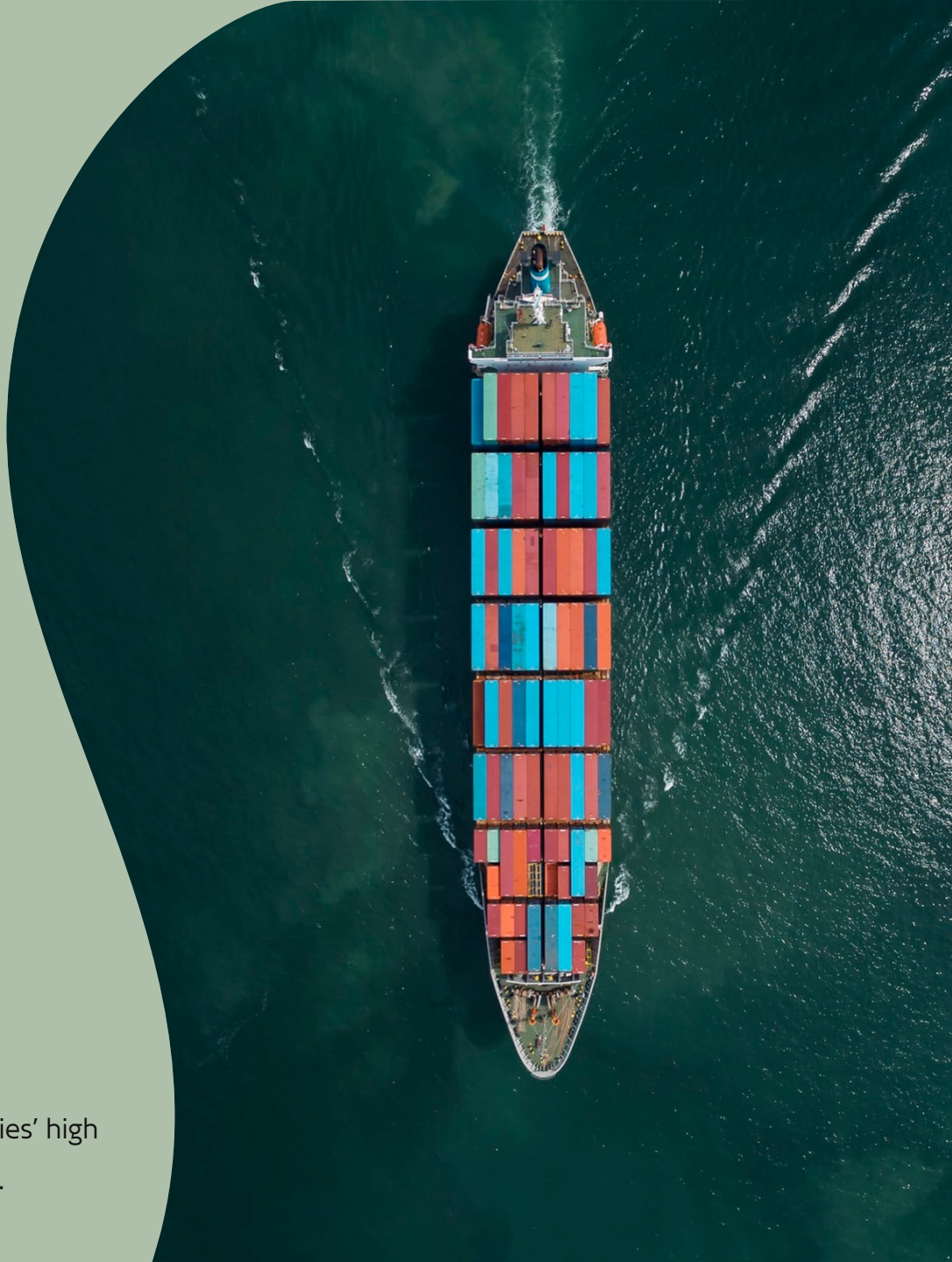
The ratio of R&D spending to capital expenditure shows how companies balance investment in research and physical assets. China's ratio has risen steadily over two decades and is approaching European levels, pointing to a shift towards R&D-intensive investment.

China is combining its traditional strength in physical investment with rapidly growing R&D investment. Its largest companies are therefore increasingly allocating resources between physical assets and innovation in ways that resemble their European peers. This suggests that China's scale advantage is increasingly complemented by technological capabilities, narrowing one of the traditional distinctions between Chinese and European companies.

Denmark's ratio is more volatile, reflecting investment cycles among a few large companies. The recent decline coincides with Novo Nordisk's substantial increase in capital expenditure to expand production capacity. US companies maintain a higher ratio than European and Chinese peers, though it has declined as AI infrastructure needs increase capital expenditure

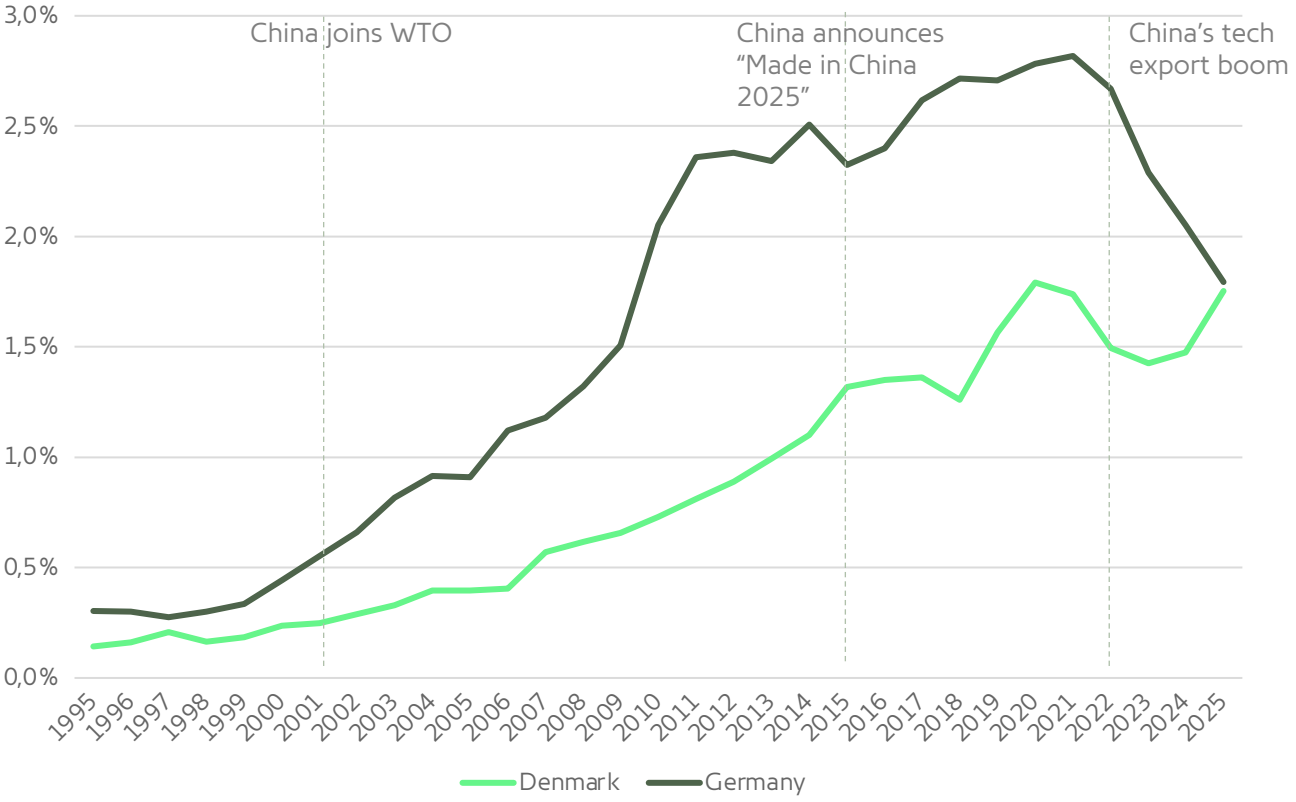
Danish specialization and adaptation counter China's expansion

China's ascent is reshaping global competition. Danish companies' high specialization makes them more resilient than European peers.



The China shock evolves: German peak vs. Danish persistence

Exports to China as percentage of GDP



Source: IMF

The first China Shock, following China's 2001 WTO accession, had varied effects across Europe. Export-oriented economies like Germany benefited significantly from rising Chinese demand, reflected in the sharp increase in German exports to China as a share of GDP.

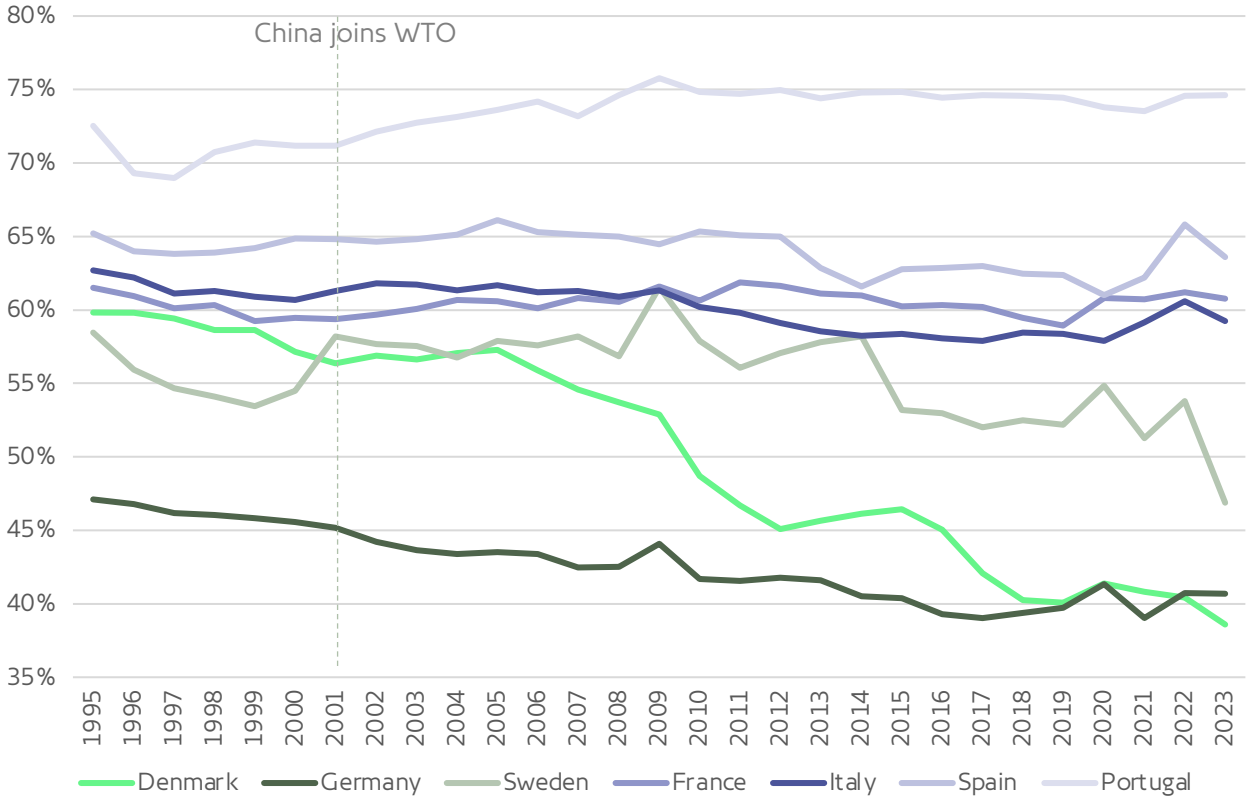
Denmark benefited less from this first wave. Its export base was less concentrated in capital goods and more specialized in pharmaceuticals and enzymes. While this limited immediate gains from China's boom, it reduced direct exposure to competition, resulting in a far more gradual growth in exports to China.

The second China Shock presents a different challenge. As China has moved into increasingly advanced manufacturing, its companies are becoming more direct competitors to established European producers. This structural shift helps explain the recent divergence in the chart: while German exports to China have dropped sharply since the 2021 peak, Danish firms have remained more resilient, supported by their concentration in specialized sectors characterized by technological complexity, IP, and regulatory barriers.

Thus, Denmark benefited less from China's first boom, but this also meant less direct exposure when China became a competitor.

Denmark has moved up the value chain as Chinese competition has intensified

Low-technology manufacturing as a share of total manufacturing



Source: Own calculations based on Eurostat

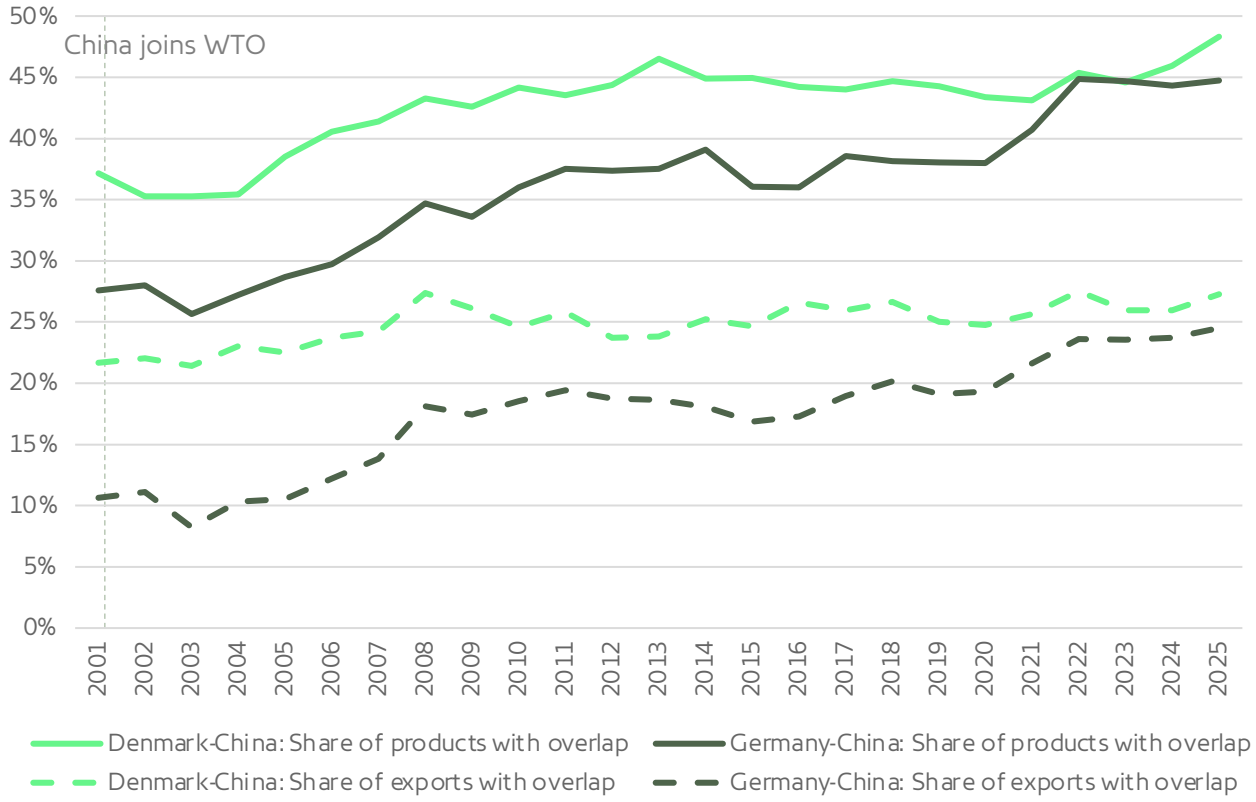
Following China's WTO accession, Northern European economies – particularly Denmark – adapted by reducing their reliance on low-technology manufacturing and expanding into more knowledge-intensive industries.

Strong innovation capabilities, flexible labor markets and specialization in advanced manufacturing helped support this transition. Consequently, low-technology manufacturing as a share of total industrial output declined substantially, signaling a successful upward shift in the global value chain.

Southern European economies generally underwent a much slower structural transformation, leaving them relatively more exposed to competition in lower-technology industries. Although firms upgraded in several sectors, lower-technology manufacturing remained relatively more important, leaving these economies more exposed to intensified competition from Chinese producers.

Danish trade advantages remain resilient despite an early overlap with China

Trade advantage overlap between Denmark/China and Germany/China



Source: Own calculations based on UNCTAD
Note: Trade advantage = products with RCA > 1.

Many European countries have seen their export advantages hollowed out as China has gained a comparative edge in advanced manufacturing. Despite initially benefiting from China's WTO accession, Germany has experienced a gradual erosion of its competitive position. Around the millennium, Germany and China shared a revealed comparative advantage (RCA > 1) in just 28% of product codes, compared with 45% today. The value of these overlapping products has likewise increased from 11% to 25% of German export value.

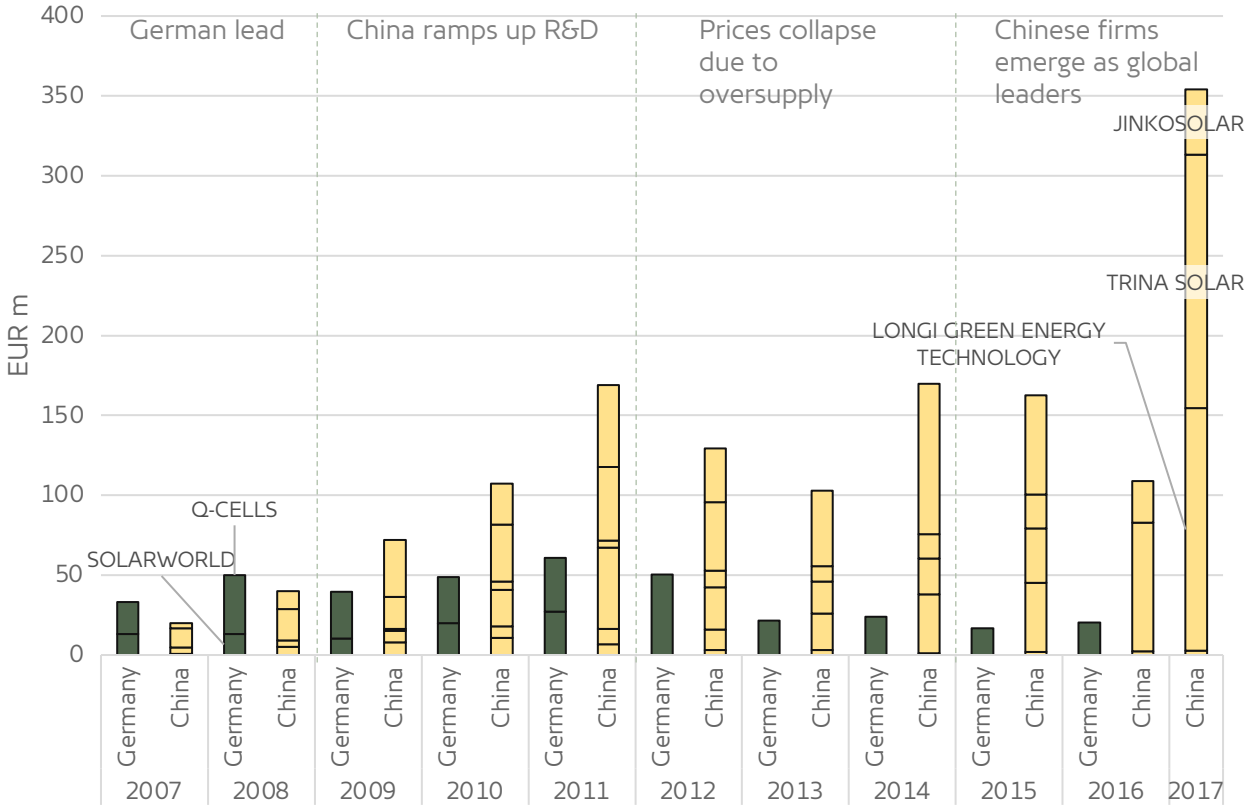
Conversely, Denmark's trade advantages have proven more resilient despite a higher initial overlap with China. The value-weighted overlap with China has been broadly flat since 2016, in contrast to Germany's continued rise to 25% of export value. The absolute gap between Denmark and Germany has therefore narrowed substantially since 2001, as Germany's overlap has caught up from a much lower starting point. This resilience is consistent with Denmark's concentration in niche sectors characterized by long product qualification cycles.

Sustaining leadership in Danish niches

As Chinese rivals scale, Denmark's future growth depends on defending core niches where we hold deep technological and global leadership.

Lessons from solar: How China turned scale and R&D into industry leadership

R&D spending of leading German and Chinese solar manufacturers



Source: The EU Industrial R&D Investment Scoreboard

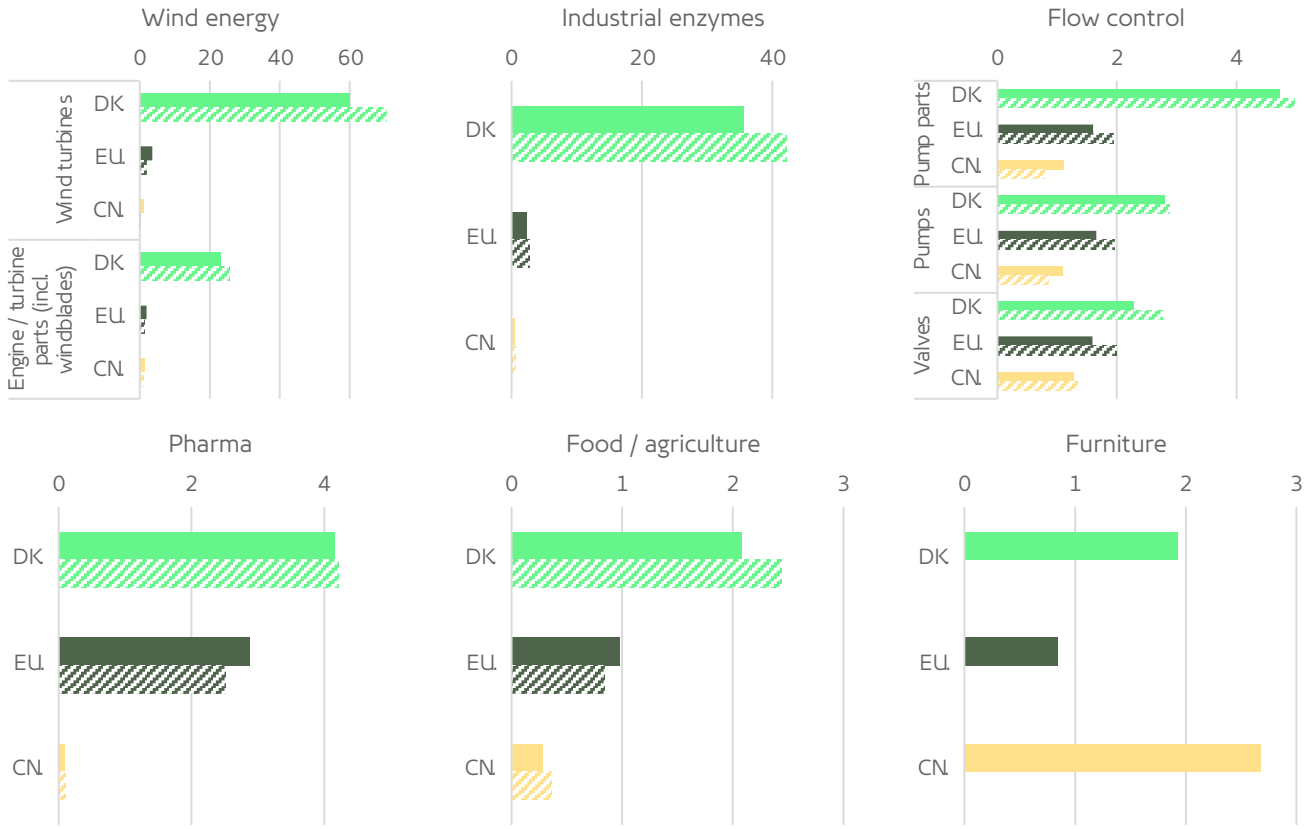
In the 2000s, European solar manufacturers, concentrated in Germany's "Solar Valley", were global technological leaders. Chinese manufacturers initially competed through lower costs, but industrial policy and access to financing helped them rapidly expand production and R&D investment.

Rapid expansion created economies of scale and learning effects, allowing Chinese firms to narrow the technology gap while driving a massive increase in global capacity. The resulting oversupply triggered a severe price war, with panel prices falling by around 70%. European manufacturers struggled to remain competitive, and a wave of exits further eroded Europe's manufacturing scale and investment capacity.

Chinese manufacturers continued to expand and invest through the downturn, eventually emerging as dominant global producers. The solar industry illustrates how an initial cost advantage can become self-reinforcing when scale, learning and continued investment reinforce each other. For European industries exposed to similar cost competition, maintaining sufficient scale and investment capacity can therefore be critical to preserving technological capabilities and market position.

Danish companies retain leadership in core sectors despite Chinese competition

Revealed comparative advantage (RCA) index of key industries



Source: Own calculations based on UN Comtrade
Note: Trade advantage = products with RCA > 1.

Solid color: 2024
Shaded color: 2014

Despite China's rapid move up the value chain, Danish companies have retained strong comparative advantages in several of the country's most important export industries. Denmark remains highly specialized in wind energy, industrial enzymes, pharmaceuticals, food and agriculture, and flow control, where comparative advantages have remained broadly stable over the past decade.

In contrast, China has made only limited progress in most of these sectors, despite significant increases in R&D spending and industrial policy support. A common feature of these industries is that they compete less on production scale and more on accumulated know-how, regulatory compliance, and long-term customer relationships. These characteristics create barriers to entry that are difficult to replicate quickly and reduce the importance of low-cost manufacturing as a competitive advantage.

While China is likely to strengthen its capabilities over time, the evidence suggests that Danish companies continue to occupy leading positions in many of the high-technology industries that underpin Denmark's export competitiveness.

Danish exports target premium markets, while China captures lower-income segments

Share of exports to low-, middle- and high-income countries

Source: UN Comtrade, Statistics Denmark
Note: Trade values for the EU account solely for external trade (extra-EU). Because the extensive trade between wealthy EU member states is omitted, the EU's total share of exports to high-income countries appears lower.

Despite increased overlap between Danish and Chinese competitive strengths, the two countries remain positioned differently in global markets. Although Danish and Chinese companies increasingly compete in the same industries, they often serve different customer segments.

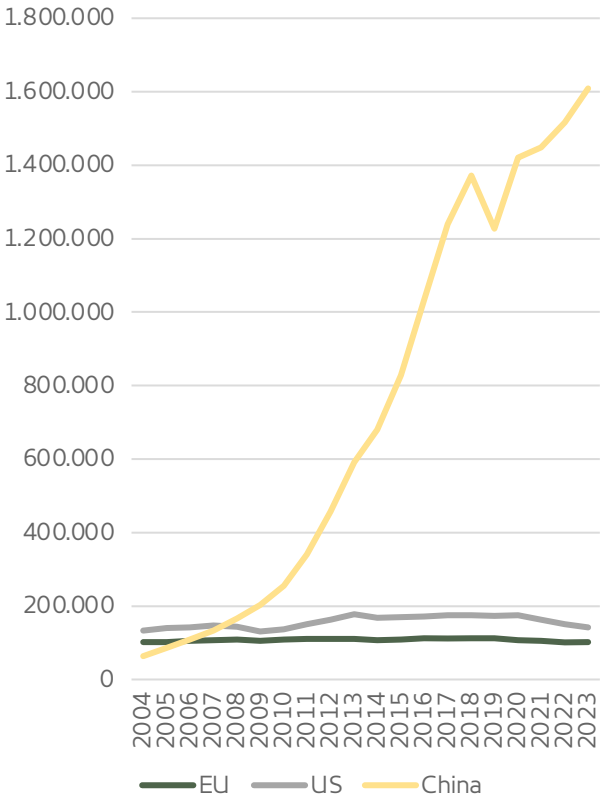
Chinese exports are more concentrated in lower-income markets, where cost competitiveness, production scale, and speed to market are key.

Danish companies typically concentrate in higher-income segments. This market positioning is consistent with Danish firms competing more heavily on technology, quality, regulatory compliance and service rather than on upfront cost. This is evident in pharmaceuticals and wind energy, where demand centers in higher-income economies.

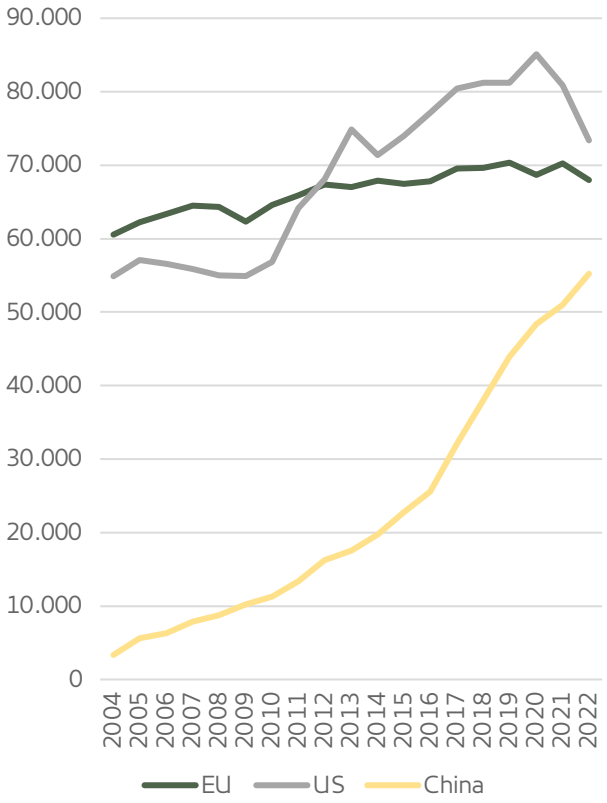
Consequently, Danish exports are disproportionately directed toward upper-middle- and high-income markets, whereas Chinese exports remain heavily concentrated in lower-income markets.

China's innovation output is enormous, but IP internationalization lags

Total patent applications



Foreign patent applications



Source: WIPO
Note: The data is based on patent families.

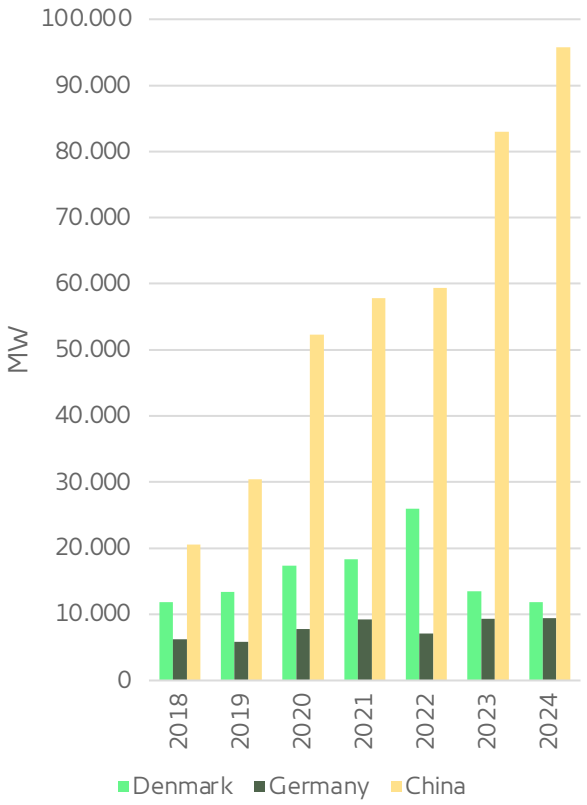
China's transformation into a global innovation leader is evident not only in its rapidly growing R&D expenditure, but also in its expanding patent activity. Since the mid-2000s, China has experienced an unprecedented surge in patent applications, far surpassing both the EU and the US in total filings. This reflects the scale of China's innovation and its increasing technological capabilities.

A more revealing indicator is foreign patent applications, which are substantially more costly and therefore generally indicate that companies consider an invention sufficiently important to protect beyond their domestic market. Here, the US and the EU continue to maintain a clear lead, suggesting that Western companies retain an advantage in protecting innovations for international markets. One factor behind this gap is that many Chinese companies have historically prioritized securing intellectual property within their large domestic market rather than seeking international protection.

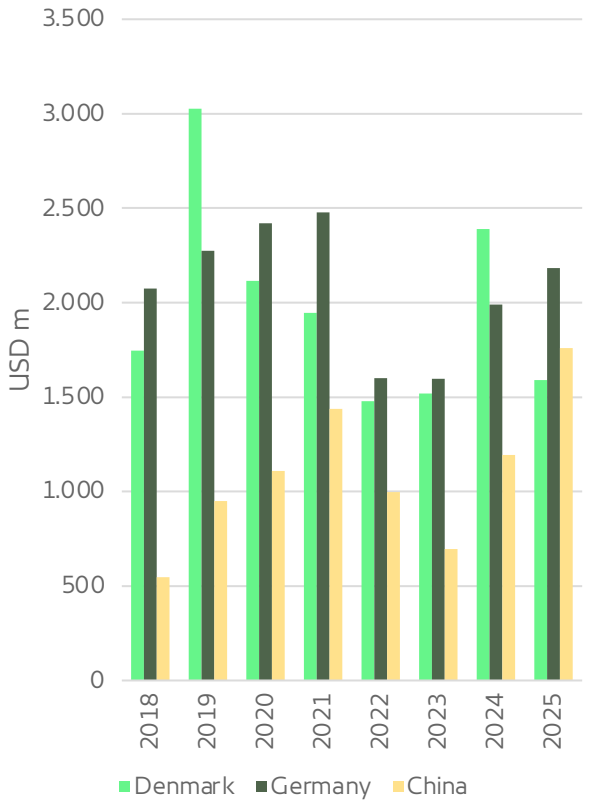
Nevertheless, China's rapid growth in foreign patenting indicates that this advantage is gradually narrowing as Chinese firms become increasingly oriented towards international markets and strengthen their protection of technologies abroad.

Wind energy: China leads in scale, but lags in exports

Annual turbine installations by vendor HQ



Annual turbine exports by country



Source: S&P Connect, International Trade Centre

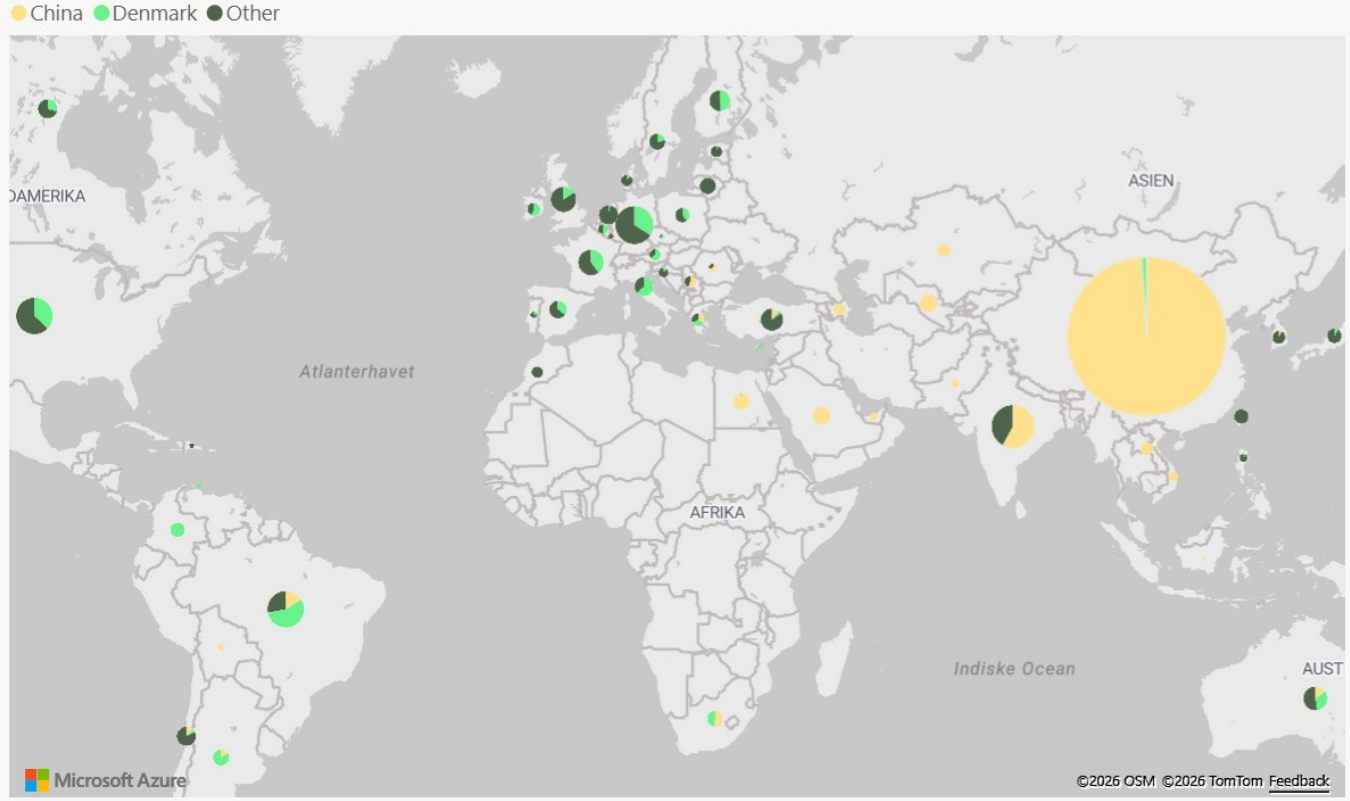
The global wind energy industry is undergoing a structural transformation. Chinese manufacturers now dominate production volumes, supported by a vast domestic market with annual installations roughly ten times greater than Danish or German competitors.

Despite this scale advantage, Chinese wind turbine exports remain broadly comparable to Denmark's and Germany's. This reflects different growth models: European manufacturers rely on international markets, whereas Chinese firms historically focused on domestic demand.

Having secured their home market, Chinese suppliers are accelerating international expansion, intensifying competition in price-sensitive segments. However, European manufacturers still benefit from established customer relationships, extensive service networks, and strong positions where reliability, regulatory compliance, and lifecycle performance are key. As the next slide shows, these factors enable European suppliers to retain strong competitive positions despite China's rapid rise.

Wind energy: China dominates emerging markets, but Danish turbines hold the West

Wind turbines installed in 2024 (color indicates vendor headquarter location)



Source: S&P Connect
Note: Bubble size indicates capacity installed in MW.

Danish wind turbine manufacturers continue to dominate Western markets. Suppliers like Vestas lead installations across Europe and North America.

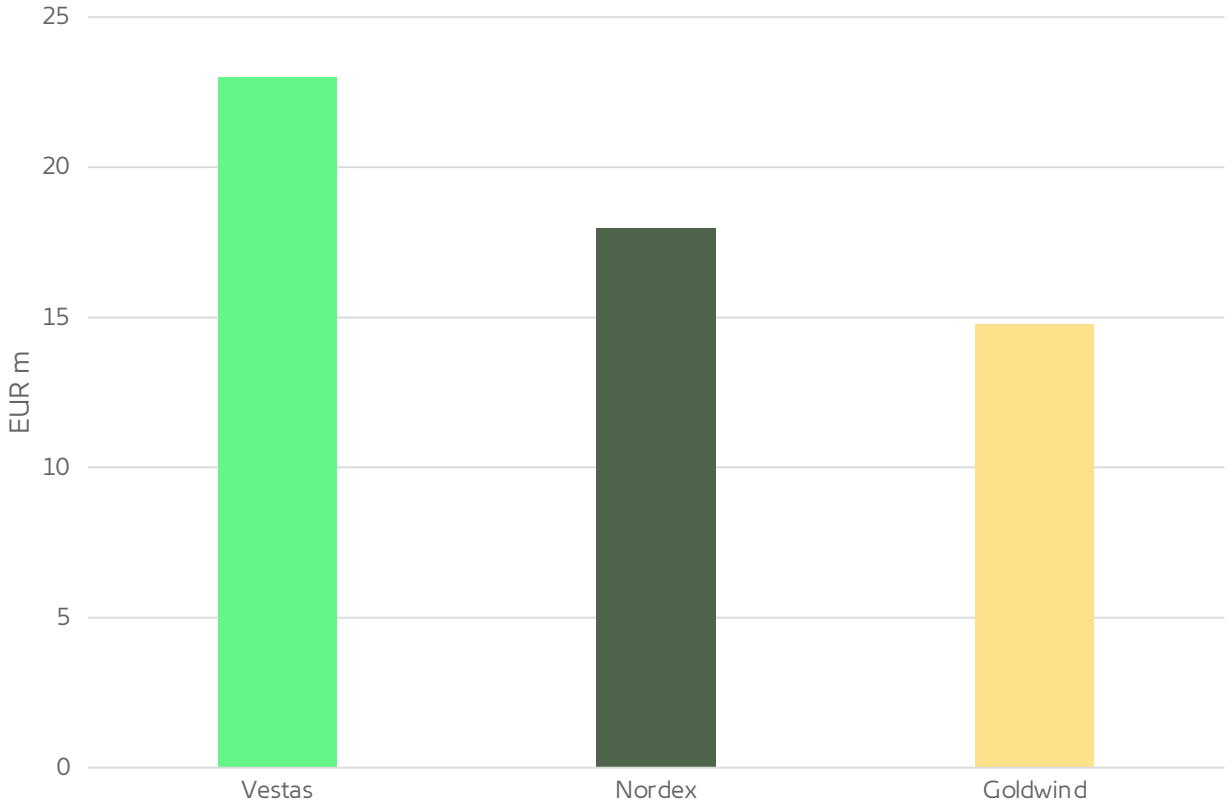
Meanwhile, regulatory scrutiny of Chinese suppliers has intensified. Concerns over state subsidies, market distortions, and infrastructure security have led Western governments to introduce measures that raise market entry barriers.

In contrast, Chinese suppliers dominate their domestic market and expand rapidly across price-sensitive emerging economies. Supported by large-scale production and competitive costs, companies like Goldwind and Envision are strengthening their presence in Africa, Asia, and Latin America. As domestic competition intensifies, international expansion is becoming a vital growth strategy.

The result is a growing geographical divide: European manufacturers remain strongest in advanced economies, while Chinese suppliers gain market share in developing economies where cost play a greater role in procurement decisions.

Wind energy: Danish lifetime servicing counteracts Chinese price undercutting

Service revenue per installed GW



Source: Own calculations based on company filings

European and Chinese wind turbine manufacturers operate under different commercial models regarding Operations and Maintenance (O&M) monetization. Among the major suppliers, European manufacturers like Vestas typically generate significantly higher O&M service revenue per installed gigawatt (GW) than Chinese peers like Goldwind.

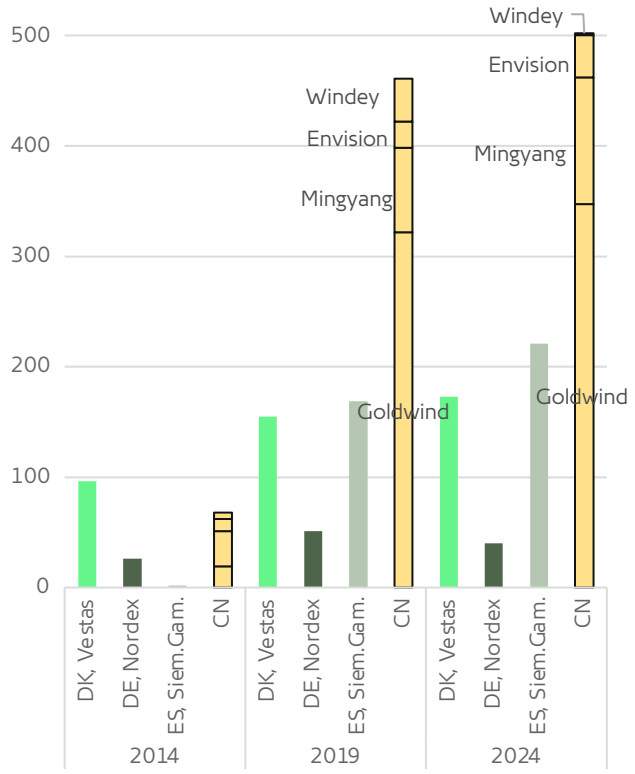
Western developers typically opt for comprehensive, multi-decade service agreements with strict performance guarantees to secure project financing from Western financial institutions.

Conversely, in the Chinese domestic arena, asset owners frequently unbundle service agreements from initial procurement. These state-owned utilities often assume long-term maintenance in-house or utilize localized, lower-cost servicing frameworks.

Consequently, while Western suppliers rely on these predictable service portfolios to stabilize cash flows against cyclical turbine sales, Chinese suppliers optimize for high-volume asset deployment and upfront capital expenditure efficiency.

Wind energy: European firms lead global commercialization despite Chinese catchup

Total patent applications



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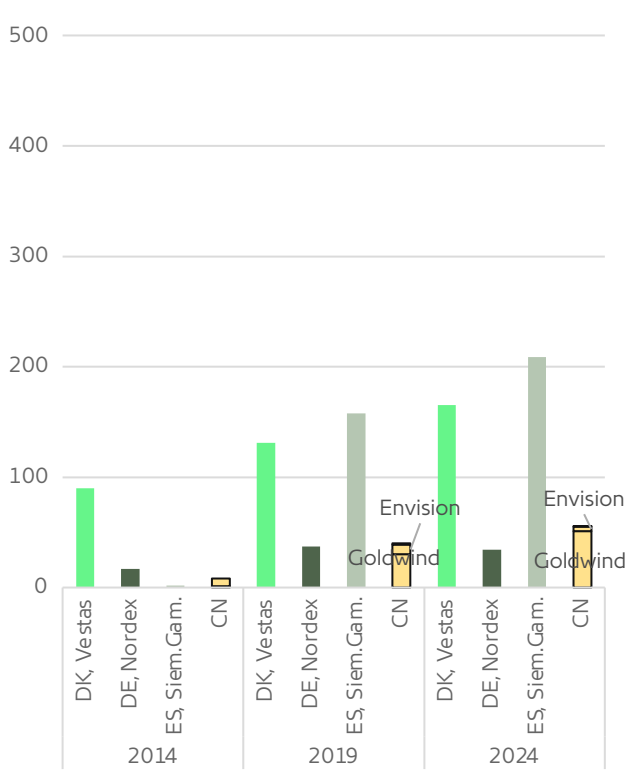


Source: Lens
Note: The data is based on patent families.

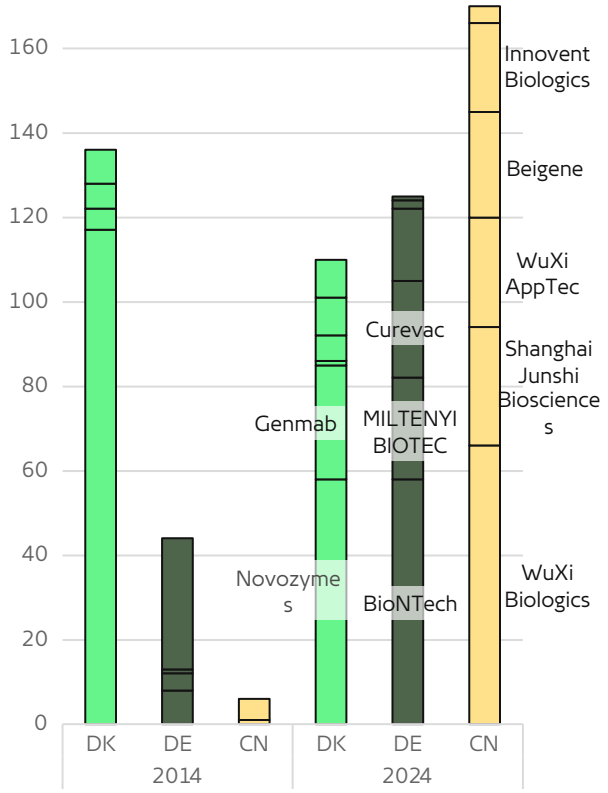
China's rapid technological progress is clearly visible in the wind turbine industry. Over the past decade, Chinese manufacturers have dramatically increased patent activity, with suppliers like Goldwind, Mingyang, Windey and Envision filing more patents than European counterparts. This reflects China's large domestic market, growing R&D investment and continued technological upgrading.

A different picture emerges regarding foreign patent applications. Despite dominance in total filings, Chinese manufacturers file significantly fewer patents abroad than leading European suppliers like Vestas and Siemens Gamesa. International patenting is more costly and typically reflects an intention to protect technology in foreign markets. The gap therefore suggests that Chinese manufacturers have historically focused more heavily on their domestic market, while European manufacturers have developed more internationally oriented IP portfolios.

As Chinese manufacturers expand internationally, foreign patenting is likely to increase. Nevertheless, European manufacturers still have a substantial lead in protecting their technologies across international markets, even as Chinese competitors rapidly close the gap in overall patent activity.

Biotech: Chinese biotech innovation is catching up, but global commercialization still lags

Total patent applications



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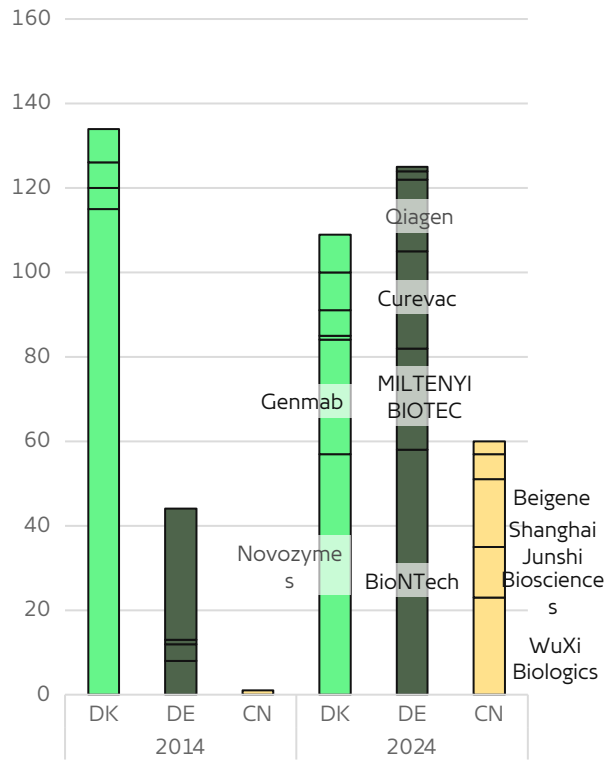


Source: Lens
Note: The data is based on patent families.

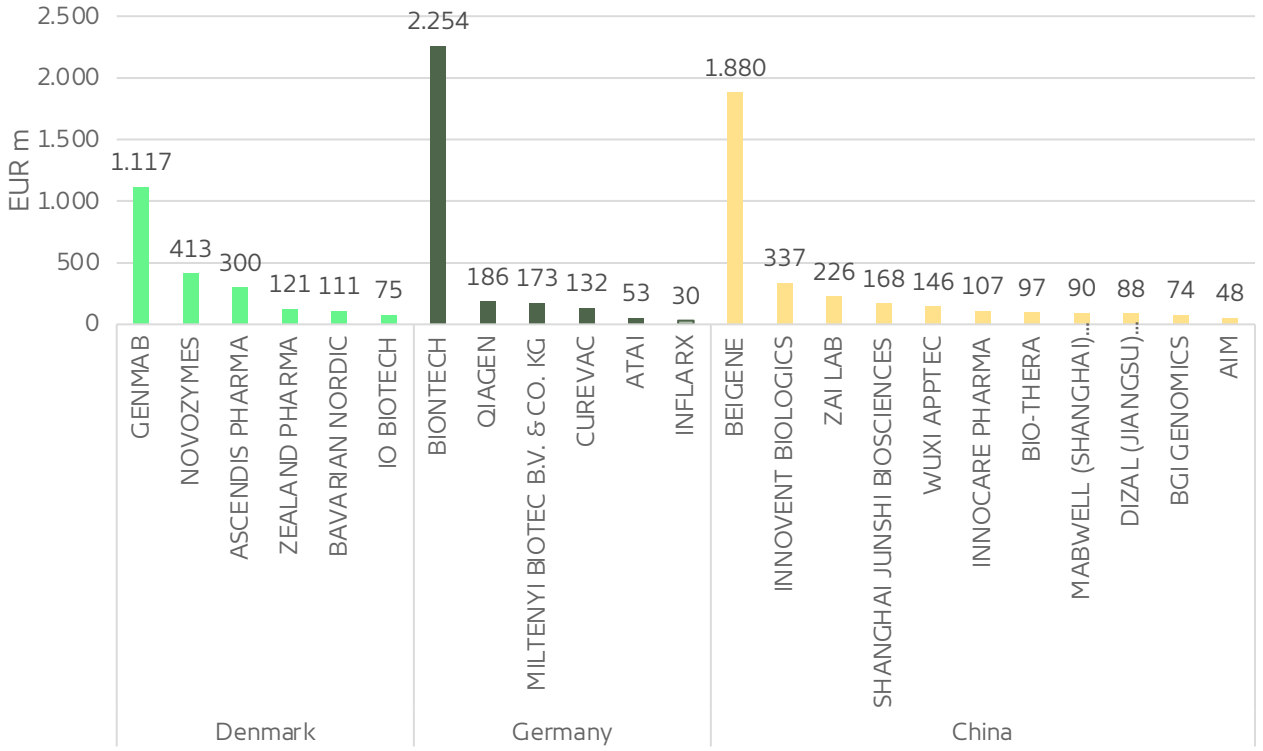
The biotech sector highlights both the growing competitive challenge from China and the continued strength of Danish companies. Between 2014 and 2024, leading Chinese biotech companies substantially increased their patent output, reaching levels comparable to or exceeding those of leading Danish and German companies.

However, Chinese innovation remains less internationally protected. While Danish companies typically seek patent protection across major global markets, only around one-third of Chinese patent families are filed internationally. This suggests that Chinese companies remain more domestically focused and have yet to internationalize their IP portfolios to the same extent as Danish firms.

The gap is nevertheless narrowing as Chinese companies increasingly file patents abroad. Danish biotech companies still hold an advantage in turning innovation into globally protected technologies with commercial relevance across multiple markets. China's growing international patent activity signals increasing competitive pressure, but Denmark remains well positioned in the global commercialization and protection of biotech innovation.

Biotech: Denmark competes on R&D peaks, not R&D breadth

Biotech R&D spending (companies with annual spending greater than EUR 30m)



Source: The EU Industrial R&D Investment Scoreboard, 2024

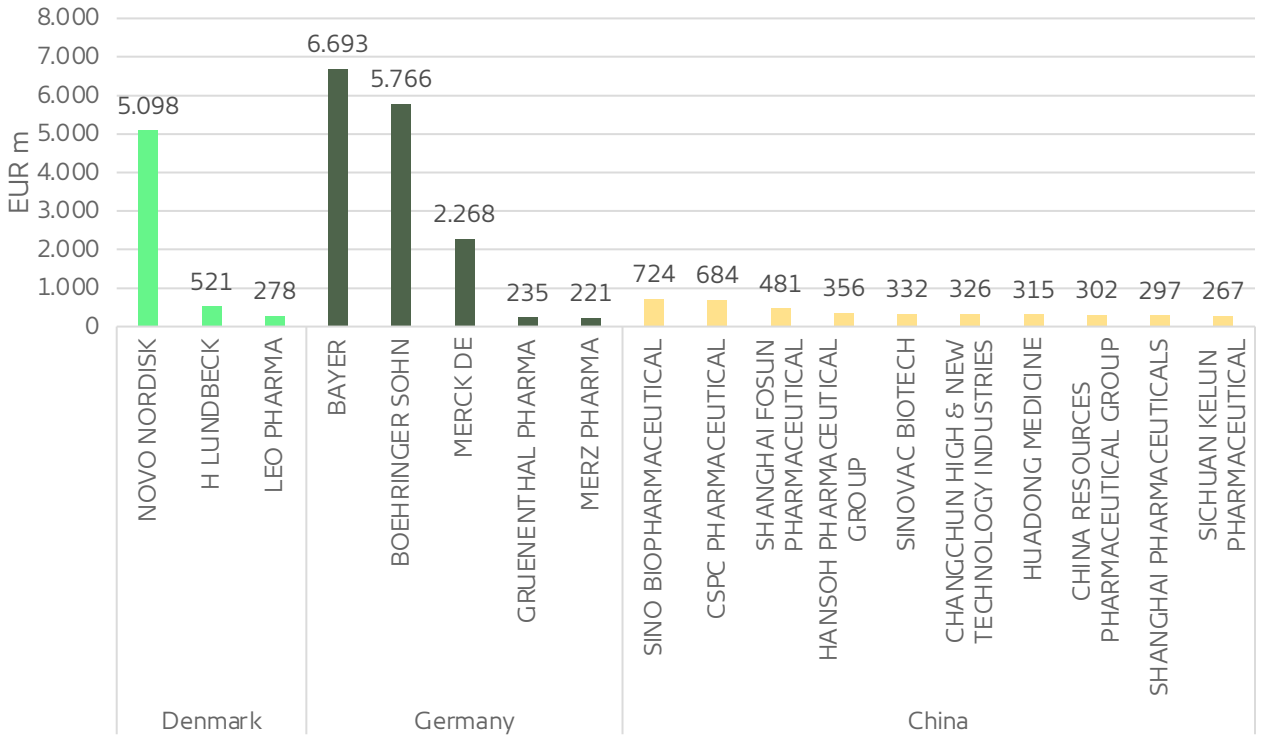
Leading Danish biotech companies match or surpass their Chinese peers in R&D investment, but China has developed a much broader base of mid-sized biotech companies. This gives China greater breadth across technologies, while Denmark's biotech strength is concentrated among fewer, highly specialized companies.

This difference reflects different innovation models: China's large domestic market, state-backed investment and emphasis on rapid commercialization have supported the emergence of a broad field of mid-sized companies across multiple areas. This creates a large pool of companies capable of developing and scaling new technologies.

Denmark has instead built deep expertise in selected niches where companies can leverage decades of accumulated know-how and proprietary technologies. This specialization allows leading Danish companies to sustain R&D capabilities at a scale comparable to the largest Chinese peers. Denmark's strength therefore lies less in the breadth of its biotech ecosystem than in the depth and global competitiveness of its leading companies.

Pharma: Europe's leading companies have exceptional R&D scale

Pharma R&D spending (companies with annual spending greater than EUR 200m)



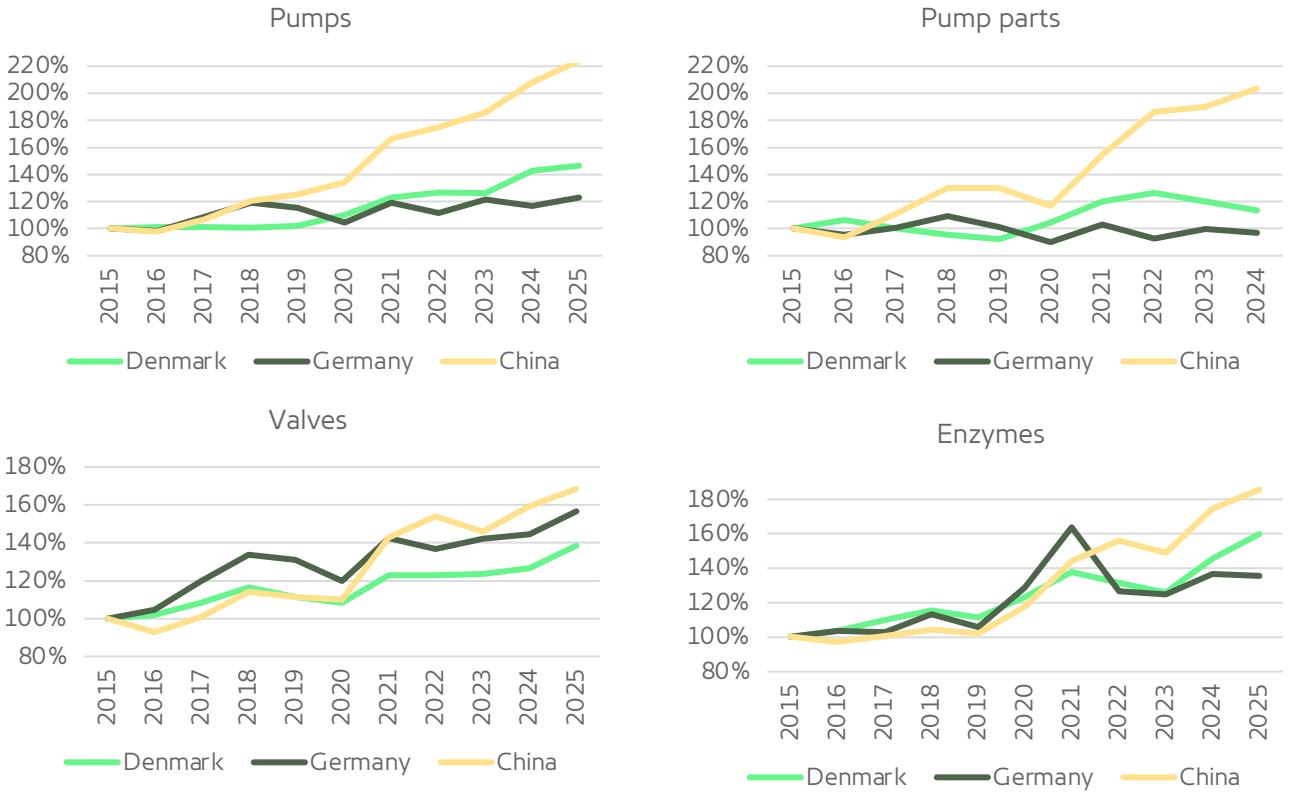
Source: The EU Industrial R&D Investment Scoreboard, 2024

The difference between Europe's leading companies and China's broader R&D ecosystem is even more pronounced in pharma. A single European market leader such as Novo Nordisk invests more than €5 billion annually in R&D – exceeding the combined R&D spending of several leading Chinese peers. This illustrates the different structure of the two innovation systems: China has built R&D capacity across a broad ecosystem, while Europe has several companies operating at exceptional scale at the technological frontier.

Denmark and Germany's competitive advantage rests on decades of accumulated scientific expertise, proprietary technologies, and strong commercialization capabilities in highly regulated therapeutic areas. These strengths create high barriers to entry that are difficult to replicate quickly. Although China is steadily closing the gap through ecosystem scale and rising R&D investment, leading European pharmaceutical companies remain strongly positioned in high-value segments of the global industry.

Other Danish niche sectors keep growing despite rising Chinese competition

Growth in exports (2015 = index 100)



Source: International Trade Centre

China's expansion into higher-technology products has intensified competition across many industries. Yet Denmark performs strongly in several globally competitive niches, demonstrating that technological leadership remains an effective competitive advantage. Sectors like pumps, valves, and industrial enzymes recorded solid export growth over the past decade despite increasingly capable Chinese competitors.

While Chinese exports expanded more rapidly, Danish exports also grew, indicating that Chinese industrial upgrading has not displaced Danish companies from core markets. However, the development of Danish exports generally relies on a few key companies.

Especially within the enzymes industry Danish exports have performed well. Denmark's export curve accelerated sharply after 2023, nearly matching China's growth index by 2025. This surge is driven by Novonesis which captured high-margin demand and double-digit growth in emerging markets.

Appendix: Notes and methodology

- Manufacturing technology intensity: Manufacturing sectors are classified using OECD's classification for technology intensity.
- Patent family: A patent family is a collection of patent applications or granted patents that cover the same invention and are linked by a common priority date.
- Product technology classification: Products are classified according to the Lall technology classification (developed by economist Sanjaya Lall in 2000), which groups products by technological intensity, with minor revisions.
- Revealed comparative advantage (RCA): A country has a revealed comparative advantage in a given product if the product's ratio in the country's total exports exceeds the ratio for world exports. The RCA index shows a country's export share divided by the world's export share. An RCA score above 1 indicates a comparative advantage and a score of 2 means the export share is twice the world average.
- R&D intensity tiers: Companies are categorized individually into R&D intensity tiers based on their specific R&D expenditures as a percentage of net sales. The thresholds follow the EU Industrial R&D Investment Scoreboard classification: Low (< 2%), Medium (2% – 5%), and High (> 5%).
- The EU Industrial R&D Investment Scoreboard: The dataset covers the world's 2.000 largest corporate R&D investors and an additional 800 EU-based companies.

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