



CLEANTECH REALITY CHECK

Revitalising manufacturing in Europe

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REVITALISING MANUFACTURING IN EUROPE

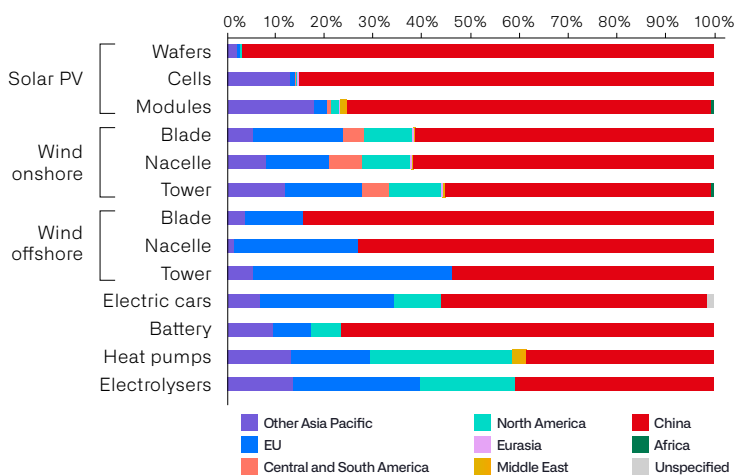
AVERTING INDUSTRIAL DECLINE: REVITALISING MANUFACTURING IN EUROPE

By **Ann Mettler**, Vice President - Europe and **Julia Reinaud**, Senior Director - Europe, **Breakthrough Energy**

- Europe is at a crossroads. In his analysis published in September 2024, Mario Draghi highlighted an “existential risk” and forecast Europe’s “slow agony” if it doesn’t radically change course to reverse declining productivity, investment, and innovation. Recent announcements only seem to confirm this dire prediction: industries are reducing production across Europe (Volkswagen¹, thyssenkrupp Steel²); announced investments are being cancelled or put on hold (Northvolt³, ACC Gigafactories⁴), and industrial output in Europe’s four largest economies is declining, with Germany, France, Italy and Spain having recorded a year-on-year drop in the production of capital goods and consumer durables.⁵
- There is no denying it: Europe is in crisis, one in which its established industrial base is eroding while new sectors fail to get off the ground. This is particularly concerning for cleantech where Europe’s ambitions are high, but the economic realities are sobering. As the recent bankruptcy of Northvolt reminds us, even with solid industrial policy in place, it is hard to scale up in Europe. Turning this situation around will be one of the overriding priorities of the new European Commission, which has recently unveiled the Competitiveness Compass and will soon produce the Clean Industrial Deal, two new (long overdue) economic and industrial policy programs. In a volatile security and fractured geopolitical environment, with looming threats of trade wars and deepening systemic competition, European policymakers have their work cut out for them.
- While the multitude of threats can seem overwhelming, they make sustaining the current manufacturing base and building out new capacity all the more important. The good news is that Europe has inherent strengths which it must now quickly capitalise on: one of the world’s most highly skilled workforces, supported by strong education systems and a robust healthcare infrastructure that fuels innovation and resilience. The EU and other European countries excel in the early stages of green innovation, together accounting for almost 27% of global cleantech patents between 2017–2021, ahead of Japan (21%), the US (20%) and China (15%).⁶ The key now will be to finally turn these assets into tangible economic outcomes, reasserting technology leadership and demonstrating that a resource-poor geography with now structurally higher energy prices as a result of the war in Ukraine can be the perfect springboard for clean, innovative manufacturing at scale.
- In this third series of our Cleantech Reality Check, we home in on three sectors of critical importance for Europe’s – old and new – industrial base. In the former camp, we analyse steelmaking, long a pillar of Europe’s industrial heritage, which faces a dual challenge: enhancing productivity in an intensely competitive global market that suffers from overcapacity, while also cutting emissions. In the latter category, we examine batteries and electrolyzers, two pivotal clean technologies vital to the world’s green transition and Europe’s competitiveness agenda, both of which are scaling far too slowly to meet ambitious targets and build out global market share.
- As we outlined in the first part of this Cleantech Reality Check series, our objective is to provide fact-based, real-time analysis of key technology and policy areas. This data-driven approach is complemented with key recommendations on how to improve performance and accelerate progress. As the following analysis indicates, while Europe faces formidable challenges in steel, batteries and electrolyzers, decisive action now can lead to a future turnaround in fortune.

Clean technology manufacturing by region⁷

GW, %, 2021



1: Source: VW's announcement: <https://www.carexpert.com.au/car-news/volkswagen-announces-future-layoffs-production-changes-to-cut-costs>

2: Source: Thyssenkrupp Steel announcement: <https://www.reuters.com/markets/commodities/thyssenkrupp-steel-reduce-production-capacity-cut-jobs-2024-04-11>

3: Source: Northvolt announcement: <https://www.reuters.com/markets/deals/northvolt-subsidiary-files-bankruptcy-2024-10-08/>

4: Source: ACC Gigafactory announcement: <https://www.automotive-logistics.com/battery-supply-chain/acc-halts-construction-of-two-european-gigafactories/45724.article>

5: Source: [Industrial production down by 0.3% in the euro area and by 0.1% in the EU](#) (2024), Eurostat

6: Source: Financing and commercialisation of cleantech innovation (2024), European Patent Office and European Investment Bank

7: Source: [The future of European competitiveness – A competitiveness strategy for Europe](#) (2024), Mario Draghi, based on data from IEA and Bruegel

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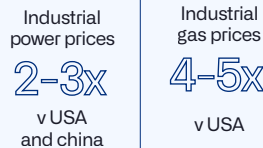
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As highlighted in the Draghi report¹ (2024), maintaining growth and productivity is an “existential challenge” for the EU. This reality check assesses five dimensions of EU industry competitiveness, before going in more depth in three key sectors from traditional industry (steel) and new clean technologies (batteries and electrolysers).

STAGNATING COMPETITIVENESS AND PRODUCTIVITY

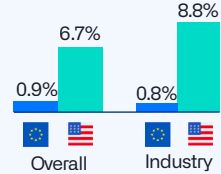
EU competitiveness and productivity have **stagnated over time**, and the **EU is falling behind** the U.S. and China. High energy prices, slower labour productivity growth, and a deteriorating trade balance, particularly in high-tech and energy-intensive sectors, underscore the EU's challenges in maintaining its global economic position.

Energy prices² 2022



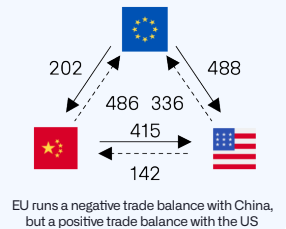
Labor productivity growth³

% between Q4-2019 and Q2-2024



Trade balance⁴

€ billion, 2023, goods only

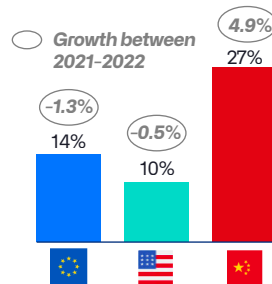


CONCERNING SIGNS OF MANUFACTURING DEINDUSTRIALISATION

Looking at the manufacturing sector, the EU shows **concerning signs of deindustrialisation** with a slowly declining manufacturing share of GDP, reduced employment in the sector, as well as increased site closures and relatively lower foreign direct investment (FDI) in its industry compared to the U.S. and China, which have fostered stronger industrial policies and attracted more investment in advanced manufacturing.

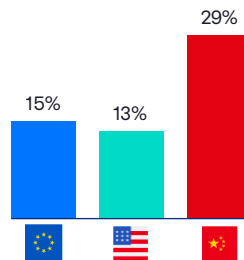
Manufacturing share of GDP⁵

% of GDP, 2022



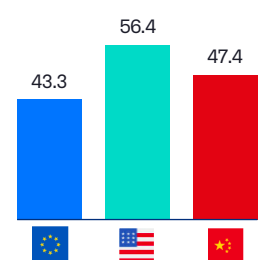
Employment in manufacturing⁶

% of total workforce, 2023



Foreign Direct Investment (FDI)⁷

FDI inflow directed toward manufacturing, € billions, 2023



BEST-IN-CLASS CARBON INTENSITY AND ENERGY EFFICIENCY OF INDUSTRY

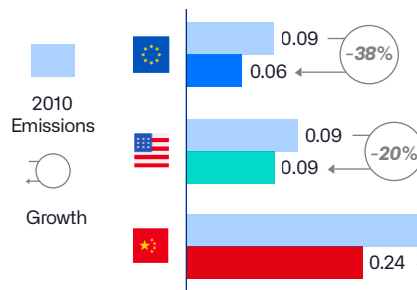
The EU has made **progress in reducing the carbon and energy intensity of its manufacturing and industry**, becoming less carbon intensive than the USA and China.

The reduction in carbon intensity is driven not only by a decrease in industrial activity but also by improvements in energy efficiency and production methods across Europe.

However, China is decarbonising and becoming energy efficient at a faster rate than the EU, aided by the very rapid rate of electrification in the past couple of years.

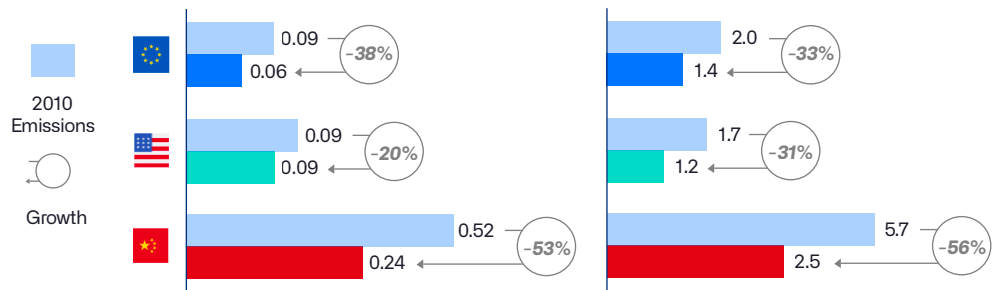
Carbon intensity of industry⁸

tons of CO₂ per € million, 2010 vs 2022

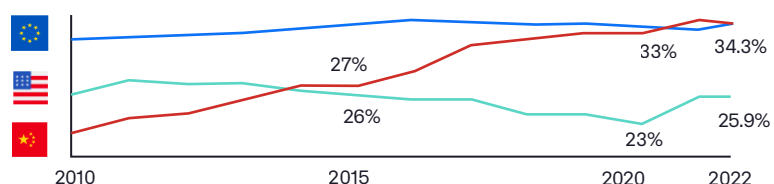


Energy intensity^{8,9}

tons of CO₂ per € million, 2010 vs 2022



Rate of electrification in industry¹⁰



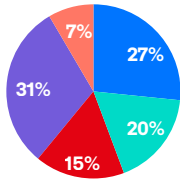
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EXCELLENCE IN CLEAN TECHNOLOGY INNOVATION DESPITE TRAILING IN STRATEGIC AREAS

Cumulative cleantech international patent family filings¹¹

2017-2021



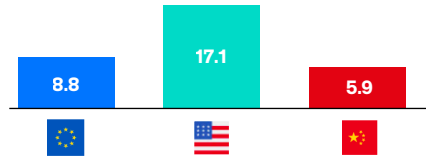
While Europe is one of the leaders in filing of patents, it is also the region that makes less use of them in real world applications

USA EU China Other Asia Pacific Rest of the world

In terms of **clean technology innovation**, the EU has **held on to its firm share of technology manufacturing** in several areas, excelling most in the wind industry. However, the EU is trailing behind or facing a risk of losing position for several technologies (batteries, heat pumps, solar PV), even to regions other than China, due to uncertainty regarding financing, demand and Europe's inability to scale.

Venture capital investment in clean technologies

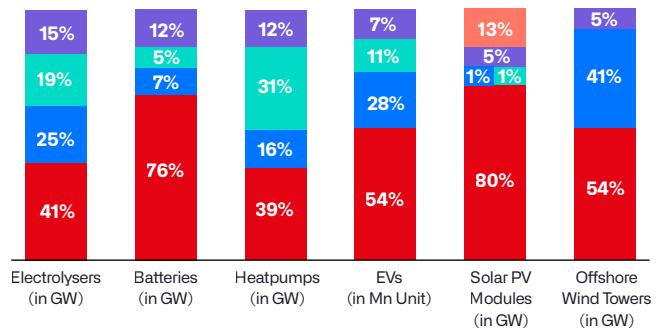
€ Billions, 2024¹²



China's investment might be underrepresented due to lack of publicly available data

Clean technology manufacturing capacity

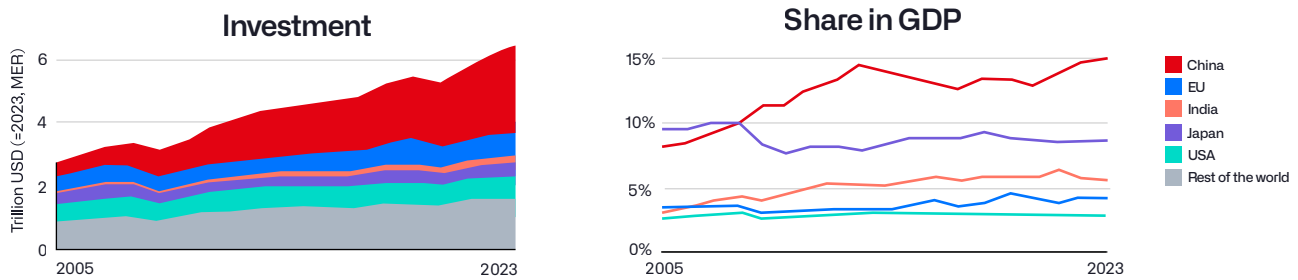
Operational capacity, % of total, 2021¹³



EU'S LAGGING INVESTMENT SHARE

Despite absolute growth in manufacturing investment, the EU's share of global manufacturing investment has dwindled compared to China's explosive growth. While the EU and US have maintained a relatively constant manufacturing investment share of GDP (around 3-4%), China's share has more than doubled to nearly 15%, and Japan, even after a contraction, maintains a higher share at around 9%.

Manufacturing sector investment by country/region, 2005-2023.¹⁴



This disparity is particularly evident in clean technology, where China's dominance has been growing.

In the rest of this Cleantech Reality Check series, we will take a closer look at three key sectors that are among the most important for Europe's decarbonisation efforts: primary steelmaking, battery manufacturing, and electrolyser production.

Notes: 1. EU competitiveness: Looking ahead - European Commission (Draghi, 2024), 2. Data derived from average spot market price in relevant countries from 2022-2024, 3. Sourced from Labour productivity growth in the Euro area and the United States: short and long-term developments, labour productivity in \$ per hour, from 2019 to mid 2024 (ECB Economic Bulletin, 2024) 4. For goods only, including non-industrial goods. Sourced from EuroStat, EU-US Trade Data by Consilium, USA Census Data for Trade. 5. Data sourced from latest data available for Share of manufacturing in gross domestic product (GDP) from Our World in Data by Global Change Data Lab 6. Data sourced from latest data available for Manufacturing jobs as a share of total employment from Our World in Data by Global Change Data Lab. 7. FDI is derived for manufacturing sector, including non-industrial goods. Data is derived from multiple sources, including EUR-Lex and US Bureau of Economic Affairs. 8. Carbon intensity is derived from Greenhouse Gas Emissions from Industry from International Energy Agency and GDP contribution from manufacturing data from Our World in Data by Global Change Data Lab. 9. Energy intensity is derived from Energy Consumption in Industry from International Energy Agency and GDP contribution from manufacturing data from Our World in Data by Global Change Data Lab. 10. Rate of Electrification is derived from electricity portion in final power consumption in Industry, from International Energy Agency. 11. Sourced from European Patent Offices' Financing and Commercialisation of Cleantech Innovation report (2024). 12. A Cleantech Investment Plan for European Competitiveness: How the EU can become the industrial and climate leader of the next decades (Cleantech for Europe, 2023). 13. Based on available data from Draghi Report and European Commission, 2024, which are based on IEA, Bruegel, 2024. 14. IEA (2024), Energy Technology Perspectives 2024

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- The EU's industrial leadership faces a critical juncture. Steel, the backbone of its industrial base, is losing its global edge due to supply constraints, project cancellations, and reduced capacity, all while navigating an increasingly uncertain and volatile international trade environment. Meanwhile, batteries and electrolyzers—essential technologies for the energy transition with multi-billion-dollar market potential—struggle to compete with cost leaders like China.
- This Cleantech Reality Check outlines the urgent steps needed to safeguard the EU's position in industrial manufacturing, particularly in clean technology. It emphasises ensuring that the EU's leadership in research and development translates into tangible industrial success, preserving its competitiveness in the global race for innovation.

OFF-TRACK



ON-TRACK

IRON & STEEL

Off Track: Decarbonising European steel is crucial for reducing emissions, preserving jobs, and maintaining technological leadership. European governments have provided unprecedented public support to the sector for capital expenditures, but operational costs (especially energy) remain a serious concern. Decisions on first-of-a-kind (Foak) projects are facing delays, with project developers citing low confidence in the current CBAM design to level the playing field and insufficient premiums for low-emissions production as challenges to investment decisions. Currently ~50% of the 10Mt H2-DRI capacity at FID is at risk of delays and cancellation following statements from project developers.

Required capacity by 2030

15-20 Mt
of low-carbon primary steel

Projects reaching announcements and FID

<1 Mt operational, 10 Mt H2-DRI capacity has reached FID, however 50% are at risk of delays or cancellation.

Required additions to 2030

Additional 5-10 Mt capacity in addition to projects with FID secured

Cost premium and cost competitiveness

20-40% gap
(cost increase over conventional European primary steel production)
550-600 €/t for conventional route
700-850 €/t cost for green route

What has been working well

- Carbon pricing set to close the cost premium gap
- Initial demand signals and advanced market commitments
- Foundations for low-carbon technology are in place

What is has not been working well

- High electricity and low-carbon electrolytic hydrogen prices undermine EU competitiveness
- Slow progress of retrofit projects compared to greenfield builds
- Insufficient demand from key steel-intensive sectors

BATTERY MANUFACTURING

At Risk: With planned capacity expansions, the European battery manufacturing sector demonstrates potential to achieve the Net Zero Industry Act's 400 GWh/yr domestic demand target by 2030. However, realising this potential requires a doubling of manufacturing capacity from the 200GWh/yr operational today and addressing significant challenges that are reversing momentum: project cancellations and delays, a persistent cost gap with China and the US, a technological disadvantage, and slowing demand from the automotive sector all threaten EU competitiveness.

400 -550 GWh
of battery production capacity

~200 GWh/yr operational
~350-400GWh/yr total operational expected by 2026
1,500-1,800 TWh announced by 2030

Completing existing planned capacity

20-30% gap (cost in €/kWh)

	EU	vs	China
LFP	65-75	vs	40-50
NMC	71-86	vs	60-70

- Targets for phase out of ICE car sales
- Offtake commitments from the automotive industry
- Strong EU-level support for the sector

- Loss of momentum in EV registrations and project cancellations
- Cost gap with chinese manufactured batteries
- Reliance on imported battery minerals

ELECTROLYSER MANUFACTURING

At Risk: Electrolyser manufacturing is crucial for Europe's energy security, industrial decarbonisation, and technological leadership. While major support has been mobilised through initiatives such as the Innovation Fund, IPCEI, and European Hydrogen, underutilisation risks loom as low-carbon electrolytic hydrogen projects lag behind manufacturing capacity growth.

REPowerEU targets 10 Mt/yr while the EU Hydrogen Strategy set the ambition of 40GW, ~5-6Mt/yr of domestic renewable hydrogen by 2030. REPowerEU is unobtainable with current capacity. Yet, today's ~9GW/yr production capacity and pipeline could put us on the path to meet the 40GW target if we see a seismic ramp up in demand to overturn low utilisation rates.

15-20 GW/yr
of electrolyser production capacity

9 GW/yr operational in 2025
4 GW/yr reached FID and under construction

up to 7-11 GW additional production capacity added, depending on demand realisation

70-80% gap (cost in €/kW)

	SYSTEM PRICE	STACK PRICE
ALK	400-750 €/kW	100-150 €/kW
ALK	1,900+ €/kW	300-500 €/kW
PEM	2,000+ €/kW	550-750 €/kW

- Strong EU technological leadership
- Comprehensive policy framework established
- Significant manufacturing capacity in place










- Slower than anticipated low-carbon electrolytic hydrogen demand
- Overcapacity and heavy subsidies from international competitors
- Risks in raw materials supply

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ARE THE ENABLING CONDITIONS FOR RAPID SCALE UP IN PLACE?










DEMAND ENVIRONMENT ENCOURAGES EARLY OFFTAKE

-    Lead markets are fostered with targets and financial support (i.e., tax breaks, auction mechanisms) — In place and sufficient
-    Sufficient GHG reduction targets and technology phase out dates for downstream markets — In place and insufficient
-    Minimum EU content requirements for manufacturers and product buyers — Missing

SUPPLY ENVIRONMENT ENABLES ECONOMIES OF SCALE

-    Credible production targets are legislated, setting an ambitious but feasible horizon
-    Financial support with preferential planning & permitting adequately levels the playing field
-    Technology, skills and enabling infrastructure (e.g., grid capacity, EV charging) is mature to meet required scale up — No applicable

MARKET IS FACILITATED AND COORDINATED

-    Uniform EU-wide green product definitions, standards and regulation
-    Non-price sustainability and resilience criteria defined for downstream markets
-    Voluntary market instruments and mechanisms are established

ACTION AGENDA Key actions and interventions areas to develop the EU manufacturing in key sectors

1

IRON & STEEL

- Ensure policy ambition and continuity for investor confidence

2

- Accelerate affordable low-carbon energy access

3

- Develop solutions to improve market financing conditions by earmarking ETS revenues

4

- Stimulate demand through green product standards and public procurement

BATTERIES

- De-risk strategic battery manufacturing investments

- Incentivise local battery demand and prioritise EU content

- Strengthen raw material supply resilience through domestic sourcing, diversification and recycling infrastructure.

ELECTROLYSERS

- Strengthen domestic demand certainty for low-carbon electrolytic hydrogen via creation of lead markets and de-risking mechanisms

- Further Europe's technological lead

- Level the playing field against imports

- Bridge the cost gap