The Antwerp Declaration
for a European Industrial Deal

February 2026

Antwerp Declaration Monitoring Report

START EXPLORING →

Deloitte.

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- ACEA
- ASD
- Business Europe
- Cepi
- Cement Europe
- Cerameunie
- Chemskills
- Clariant
- Deloitte
- Digital Europe
- ECEG
- EFPIA
- Eula (Lime association)
- Eurofer
- Euromines
- Eurometaux
- European Aluminum Association
- European Climate Foundation
- European Joint Research Centre (JRC)
- European Investment Bank
- European Patent Office
- Euratex
- FEAD
- Fertilizers Eurpoe
- FostPlus
- Fuels Europe
- IISD
- INDUSTRIALL
- RESource Platform
- SolarPower Europe
- VCI (Verband der Chemischen Industrie)
- Wind Europe

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Table of abbreviations (A-I)

AVEs	Ad-valorem equivalents
AI	Artificial intelligence
B-READY	Business Ready
CAGR	Compound Annual Growth Rate
CBAM	Carbon Border Adjustment Mechanism
CCUS	Carbon capture, utilisation and storage
CCS	Carbon capture and storage
CCfD	Carbon contracts for difference
CEF	Connecting Europe Facility
CEPA	Comprehensive economic partnership agreement
CMUR	Circular Material Use Rate
COO	Chief operating officer
CPV	Common procurement vocabulary
CRM	Critical raw materials
CRMA	Critical Raw Materials Act
CTIP	Clean trade and investment partnerships
DB	Doing Business
DESI	The Digital Economy and Society Index
DPI	Domestic Production Index
DPP	Digital product passport
ECB	European Central Bank
EDIHs	European Digital Innovation Hubs
EIB	European Investment Bank
EIBIS	European Investment Bank investment survey
EIS	European Innovation Scoreboard
EPD	Environmental product declarations
EPR	Extended producer responsibility
ERDF	European Regional Development Fund
ESF	European Social Fund
ESCO	European Skills, Competences, Qualifications and Occupations
ESPR	Eco-design for Sustainable Products Regulation
EV	Electrical vehicle
ETS	Emissions Trading System
EXVI	External vulnerability index
FTA	Free trade agreement
GBARD	Government budget allocations on research and development
GCC	Gulf Cooperation Council
GDP	Gross domestic product
GERD	Gross domestic expenditure on research and development
GHG	Greenhouse gas
GII	Global Innovation Index
GPP	Green public procurement
GWP	Global-warming potential
IAA	Industrial Accelerator Act

Next →

Table of abbreviations (I-Z)

ICT	Information and communications technology
IMF	International Monetary Fund
IPCEI	Important Projects of Common European Interest
IRA	Inflation Reduction Act
ISCO	International Standard Classification of Occupations
JVR	Job vacancy rate
LCOE	Levelised Cost of Energy
LPI	Logistics Performance Index
LESS	Low Emission Steel Standard
LSEG	London Stock Exchange Group
MEAT	Most Economically Advantageous Tender
MFF	Multiannual Financial Framework
MFN	Most favoured nation
NDC	Nationally Determined Contributions
NGHM	National Green Hydrogen Mission
NSA	Non-standalone
NZIA	Net-Zero Industry Act
OECD	Organisation for Economic Co-operation and development
OITBs	Open Innovation Test Beds
PCF	Product carbon footprint
PCI/PMI	Projects of Common/Mutual Interest
PINE	Policy Instrument for the Environment
PISA	Programme for International Student Assessment
PLI	Production-linked incentives
PPA	Power purchase agreement
PPDS	Public Procurement Data Space
PTA	Preferential trade agreement
R&D	Research and development
R&I	Research and innovation
REE	Rare earth elements
RFNBO	Renewable fuels for non-biological origin
RMU	Relative market uptake
RRF	Recovery & Resilience Facility
RRP	Recovery & Resilience Plan
SA	Stand-alone
SAF	Sustainable aviation fuel
SDE++	Subsidie duurzame enrgie
SIA	Semiconductor Industry Association
SIGHT	Strategic Interventions for Green Hydrogen Transition
SME	Small-medium enterprise
SOE	State-owned enterprise
SPP	Sustainable public procurement
SRMs	Secondary raw materials
SWF	Sovereign wealth fund
TEFs	Testing and Experimentation Facilities
TRL	Technology readiness level
VC	Venture capital
WACC	Weighted average cost of capital
WBES	World Bank Enterprise Survey
WTO	World Trade Organisation

Prev

Foreword

Marco Mensink,
Director General,
Cefic

Frederik Debrabander,
Partner in Energy,
Resources & Industrials,
Deloitte

The Antwerp Declaration was launched in February 2024 as a call to restore European competitiveness, while safeguarding quality jobs for European workers and delivering on the objectives of the European Green Deal. Europe must remain a place where companies choose to invest, produce and grow.

Yet two years on, the situation on the ground is deteriorating. Cefic's recent closure study shows that chemical plant closures in Europe have surged sixfold since 2022, reaching a cumulative 37 million tonnes of capacity – around 9% of European production – and resulting in 20,000 direct job losses, with a further 89,000 indirect jobs at risk. At the same time, new investment has collapsed: annual announced capacity has fallen from 2.7 million tonnes in 2022 to just 0.3 million tonnes year-to-date in 2025. Closures now significantly outpace new investments.

These trends confirm what many companies are experiencing: the business case for operating and investing in Europe is under severe pressure. While initiatives such as the Clean Industrial Deal set a positive direction, current estimates suggest that only around 10% of the Draghi report's recommendations have so far translated into concrete policy action. The gap between ambition and delivery remains wide.

Monitoring is the foundation for informed dialogue, accountability and corrective action. By identifying remaining gaps and the enabling conditions required for a successful industrial transition, it provides valuable guidance for both policymakers and industry leaders as they make strategic decisions for Europe's industrial future.

Europe's industrial future is still in our hands. But without urgent, coordinated and impactful action this year, Europe risks further irreversible industrial erosion.

Foreword

Marco Mensink,
Director General,
Cefic

Frederik Debrabander,
Partner in Energy,
Resources & Industrials,
Deloitte

European industry is navigating an increasingly complex and demanding global landscape. Over the past two years, as Draghi has observed, conditions have in many respects deteriorated rather than improved, specifically for energy intensive sectors. At the same time, new investments and scale up of innovations is stalled. Yet, amidst these challenges, a notable change in mindset is emerging among policymakers, governance bodies, and business leaders. Encouragingly, decisive actions have been set in motion that should help steer Europe's industrial future in the right direction. The Industrial Accelerator Act, in particular, holds promise to positively impact the key performance indicators outlined in the Antwerp Declaration Monitoring Framework. Once the Act is fully published, Deloitte will undertake a thorough assessment to measure its precise impact.

With energy costs remaining high and global competition intensifying – especially from China, which shows no signs of slowing down – Europe must act swiftly and decisively. Nurturing its industrial capacity is essential not only to protect Europe's competitive position but also to preserve and rebuild the economic foundations and strategic autonomy crucial for long-term prosperity.

As European Commission President Ursula von der Leyen rightly emphasised: "Only what gets measured gets done." Building on the Antwerp Declaration Monitoring Framework, this first annual Monitoring Report offers a rigorous, data-driven evaluation of the EU's progress. Focusing on the enabling conditions that underpin a successful industrial transition, this report provides clear, data-driven insights to support evidence-based decision-making and help Europe regain its industrial competitiveness in a rapidly evolving global landscape.

Objective

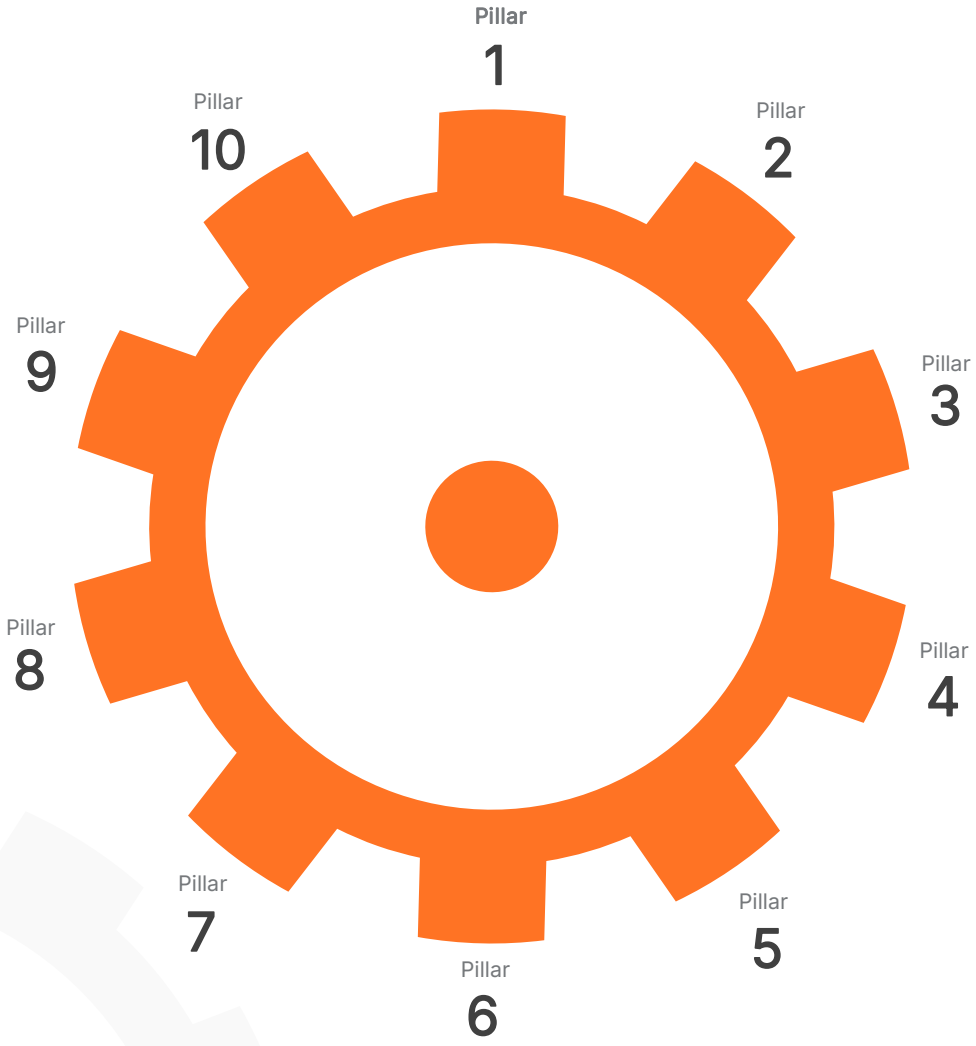
Antwerp Declaration Monitoring Report

This first yearly Antwerp Declaration Monitoring Report, commissioned by Cefic and prepared by Deloitte, provides a data-driven, evidence-based assessment of the EU's progress in implementing the 10 key pillars outlined in the Antwerp Declaration. Building on the established monitoring framework and its key performance indicators (KPIs), this report monitors progress on the Declaration's key asks, enabling a clear and concrete understanding of how the EU is advancing toward the ambitious goals of the EU Green Deal while safeguarding industrial competitiveness.

By focusing on the enabling conditions that underpin a successful industrial transition, the report lays the foundation for an evidence-based discussion on the next steps and actions to be taken to create a resilient, competitive European industry capable of leading in net-zero, low-carbon, and circular economy markets.

Through systematic collection and analysis of quantitative data, the report offers a transparent view of the EU's progress over time and benchmarks the EU's performance against major global peers such as the US, China, India, and the Gulf Cooperation Council (GCC). This international comparison provides valuable insights into the EU's relative position in the global transition and aims to inform targeted decision-making.

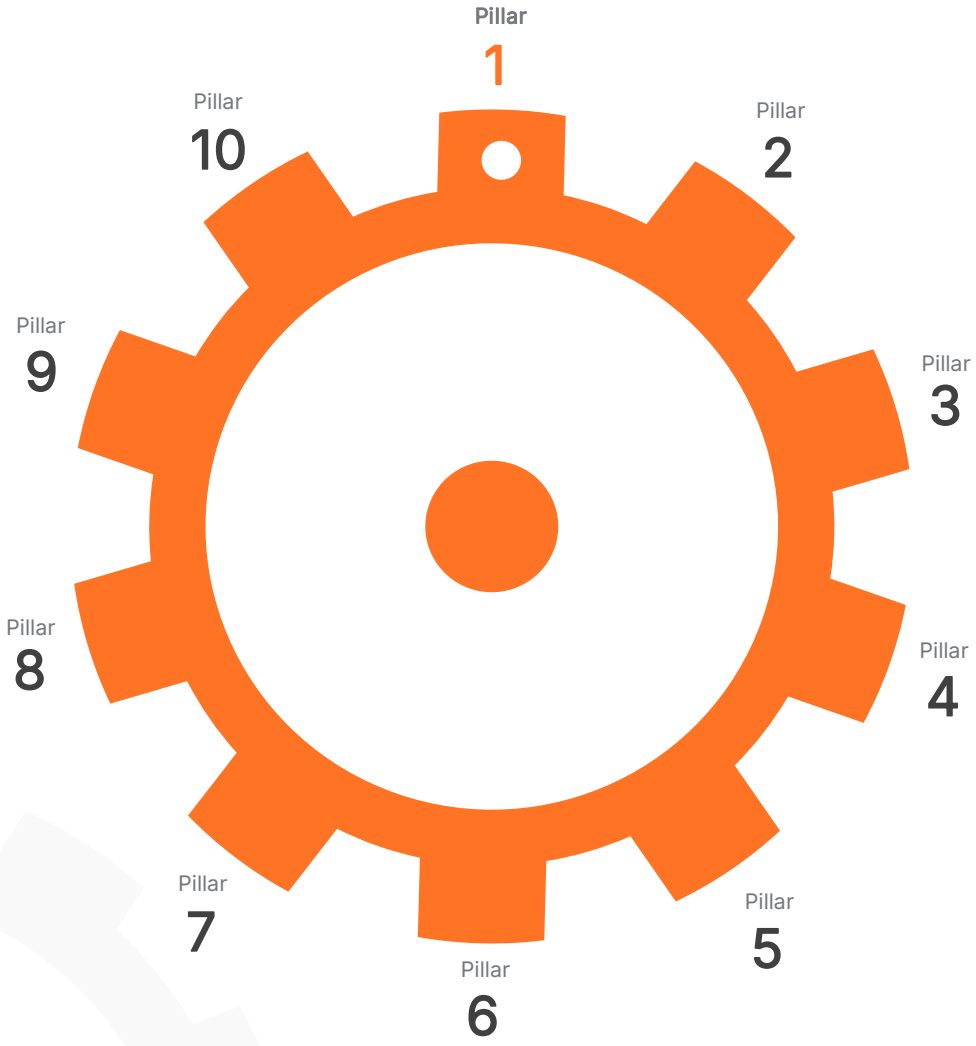
By transforming the Antwerp Declaration's strategic asks into concrete, measurable indicators, this report equips policymakers and stakeholders with robust evidence to track implementation, identify gaps, and prioritise actions. It aims to ensure the EU remains on course to meet its industrial and environmental ambitions while maintaining global competitiveness.



Key performance indicators per pillar

International benchmark →

Evolution of EU performance year-over-year →

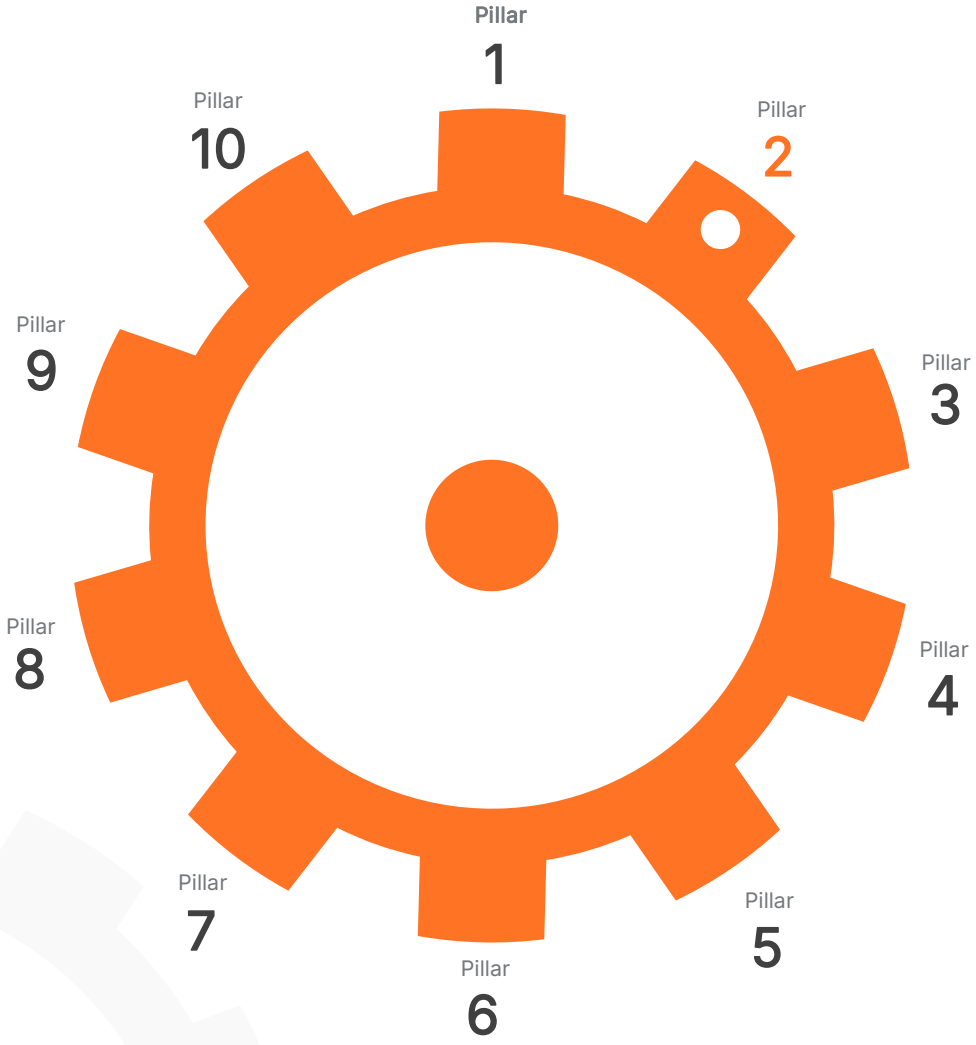


Key performance indicators per pillar

Pillar 1 Put the Industrial Deal at the core of the new European Strategic Agenda for 2024-2029 →

International benchmark →

Evolution of EU performance year-over-year →



Key performance indicators per pillar

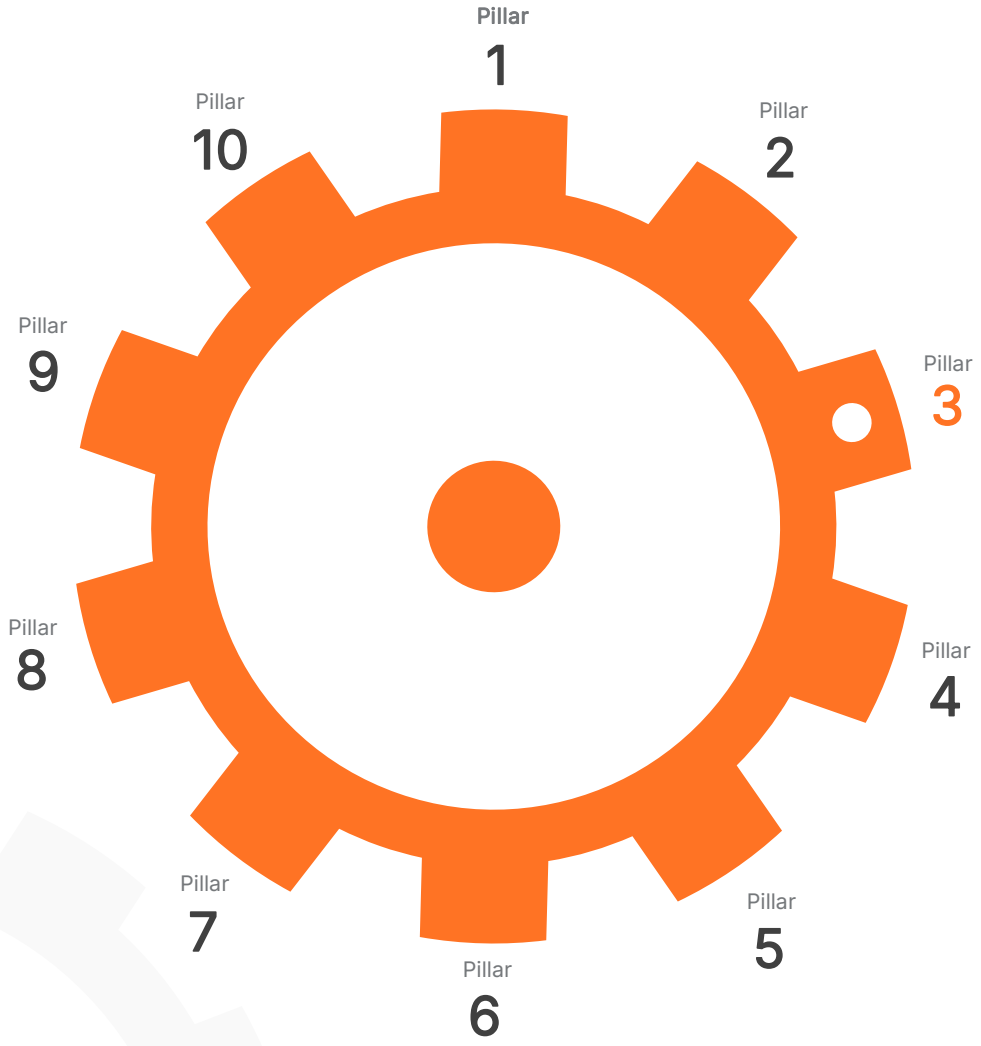
Pillar 2 Include a strong public funding chapter with a Clean Tech Deployment Fund for EIIs →

2.1 EU and Member States funding for climate-focused industrial projects →

2.2 Innovation Fund oversubscription rate →

International benchmark →

Evolution of EU performance year-over-year →



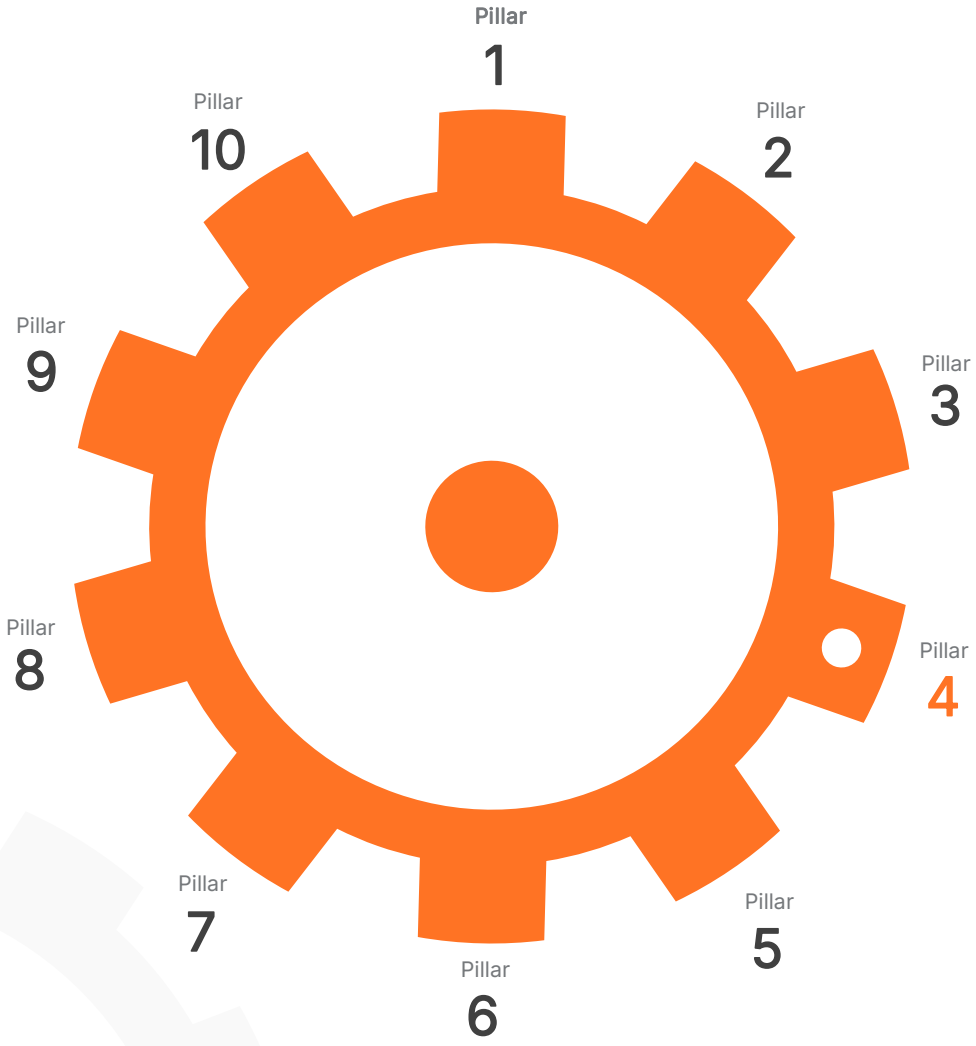
Key performance indicators per pillar

Pillar 3 Make Europe a globally competitive provider of energy →

- 3.1 Industry electricity and gas prices (with price component breakdown) →
- 3.2 New clean energy capacity by source (renewable and nuclear) →
- 3.3 Industry volume of power purchase agreements (PPAs) →

International benchmark →

Evolution of EU performance year-over-year →



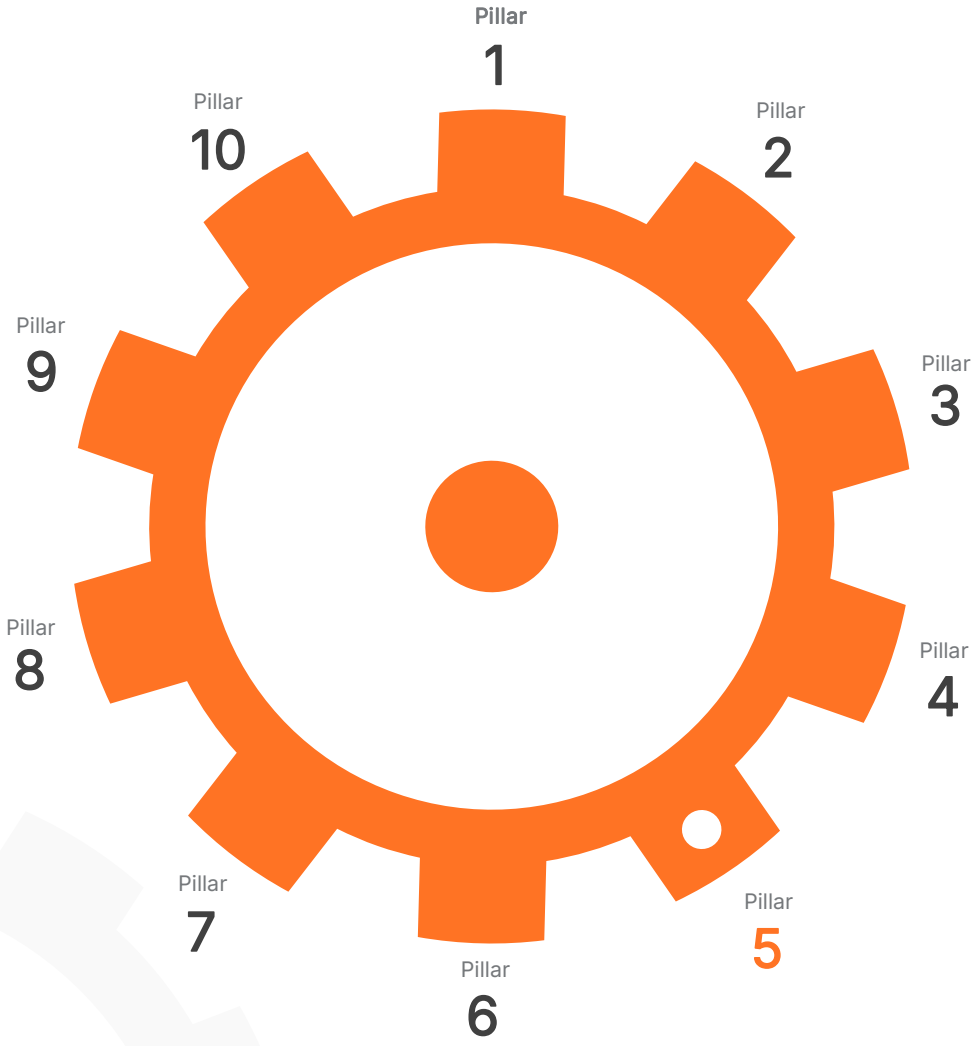
Key performance indicators per pillar

Pillar 4 Focus on the infrastructure Europe needs →

- 4.1 Investment in power grid infrastructure and storage as share of GDP →
- 4.2 Share of Member States reaching electricity interconnectivity target →
- 4.3 Key infrastructure projects (IPCEI and CEF) total funding in energy, digital, CCUS, and recycling →
- 4.4 Digital infrastructure →
- 4.5 Total CO_2 mineral storage and injection capacity →
- 4.6 Manufacturing occupations labour shortage →

International benchmark →

Evolution of EU performance year-over-year →



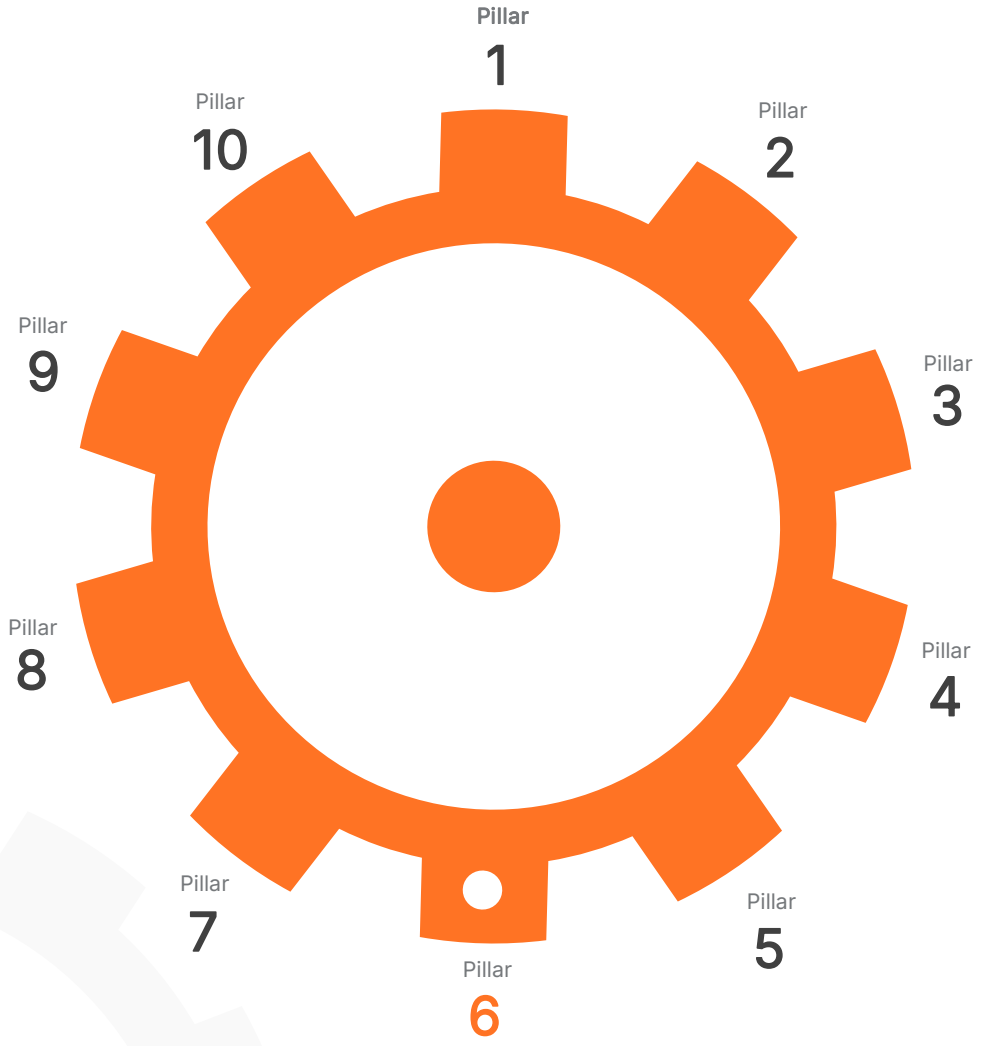
Key performance indicators per pillar

Pillar 5 Increase the EU's raw materials security →

- 5.1 External Vulnerability Index (EXVI) →
- 5.2 Domestic Production Index →
- 5.3 Biomass flows going into bioenergy and biomaterials →
- 5.4 Circular Material Use Rate (CMUR) →

International benchmark →

Evolution of EU performance year-over-year →



Key performance indicators per pillar

Pillar 6 Boost demand for net-zero, low-carbon and circular products →

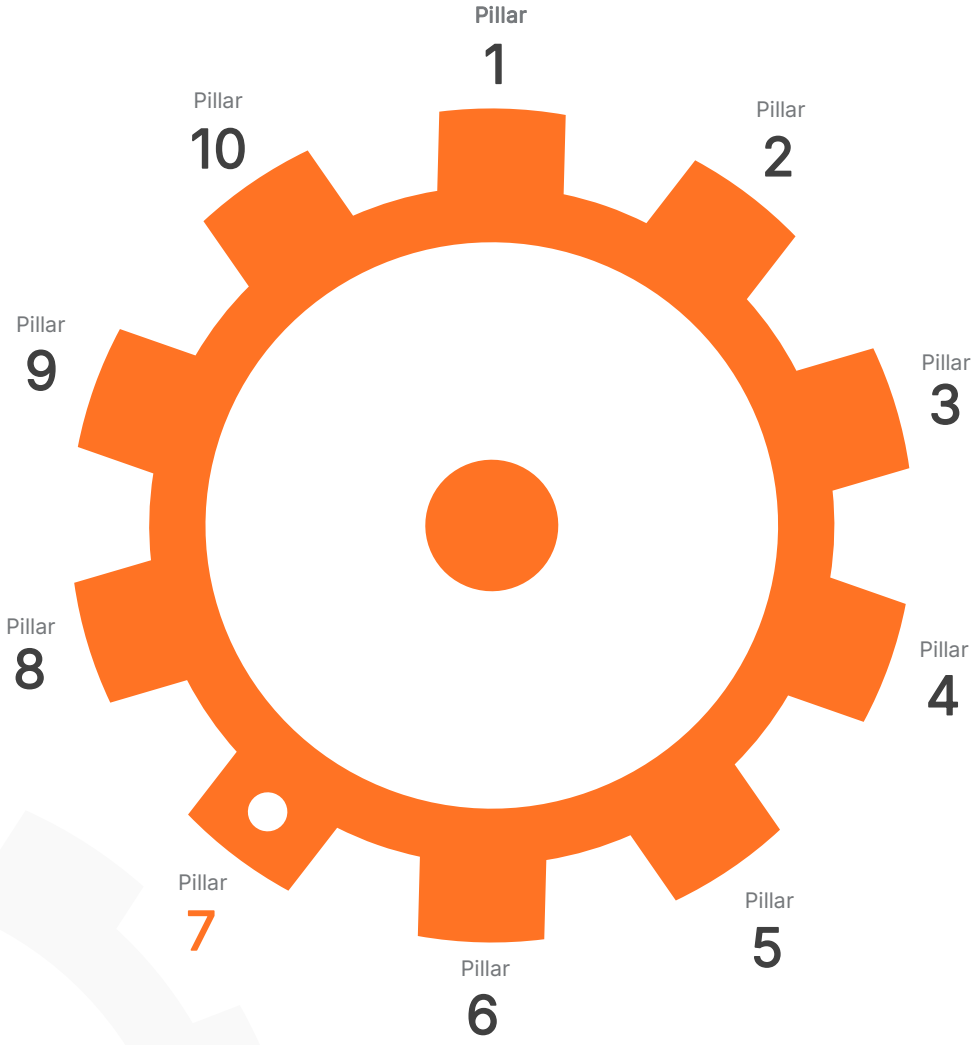
6.1 Public procurement contracts using sustainability-related criteria →

6.2 Export markets access through preferential trade agreements →

6.3 Consumer incentives and demand mandates driving markets for net-zero, low-carbon and circular products →

International benchmark →

Evolution of EU performance year-over-year →



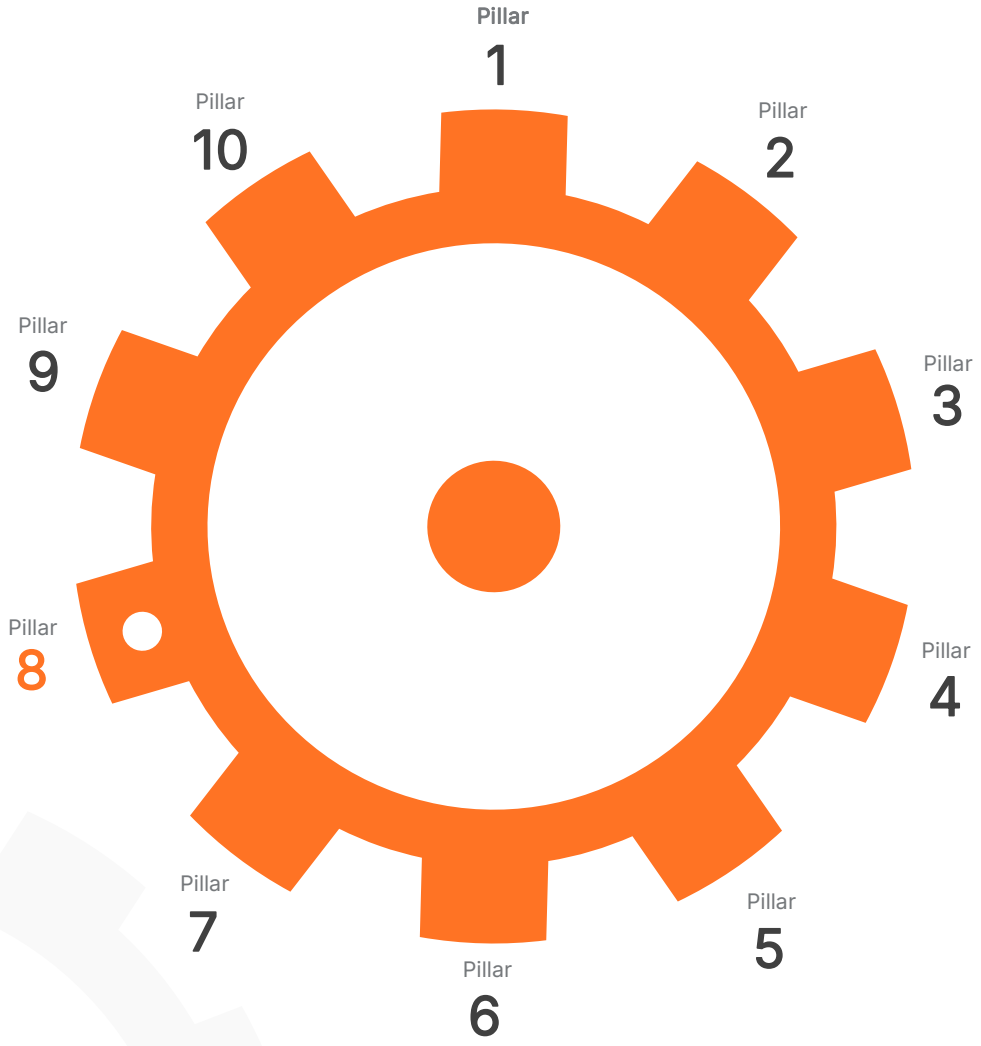
Key performance indicators per pillar

Pillar 7 Leverage, enforce, revive and improve the Single Market →

- 7.1 Trade between Member States (as share of EU GDP) →
- 7.2 Intra-EU trade of waste and recycled materials →
- 7.3 Internal market barriers costs →

International benchmark →

Evolution of EU performance year-over-year →



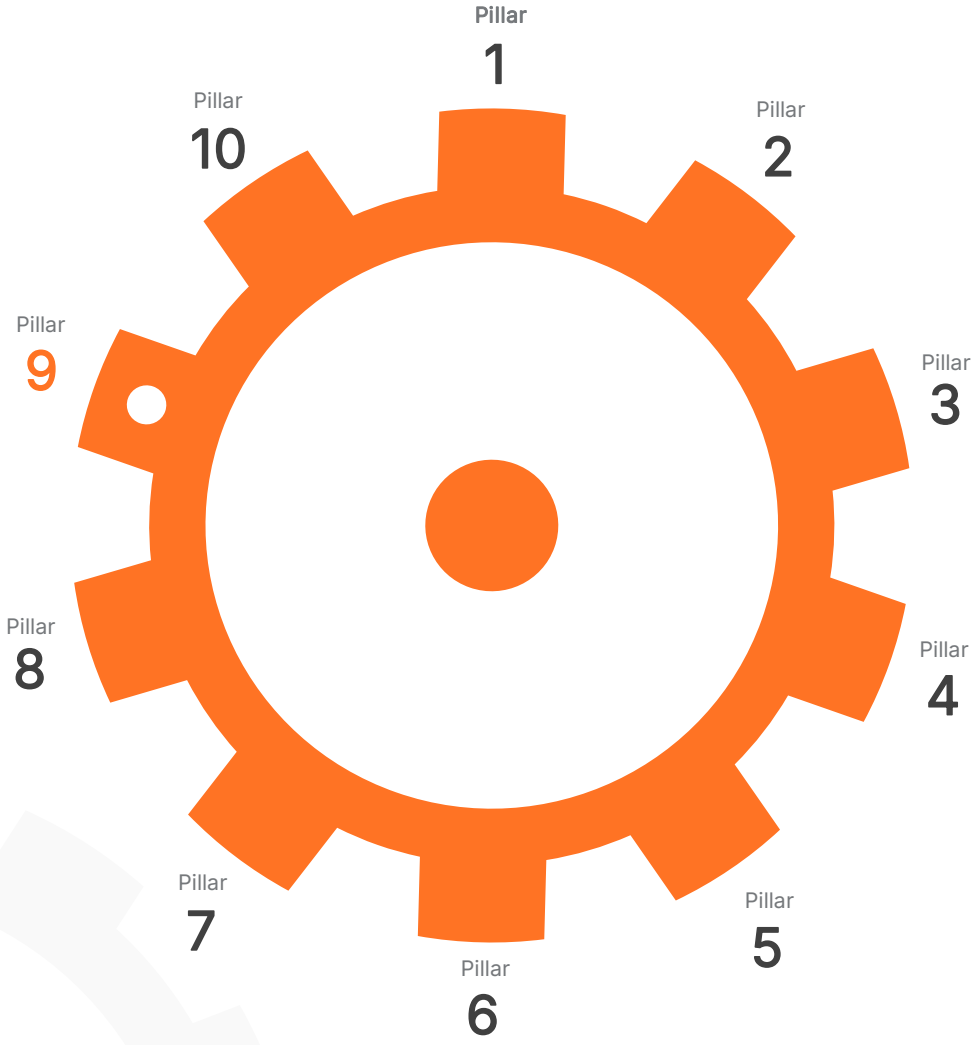
Key performance indicators per pillar

Pillar 8 Make the innovation framework smarter →

- 8.1 Cost of capital →
- 8.2 Patent applications and commercialisation rate for the industry →
- 8.3 EU and Member States budget allocations for research and innovation (R&I) →
- 8.4 Venture capital investment by stages (early, breakout, scale-up) and by key industrial segments →
- 8.5 Operational regulatory sandboxes →

International benchmark →

Evolution of EU performance year-over-year →



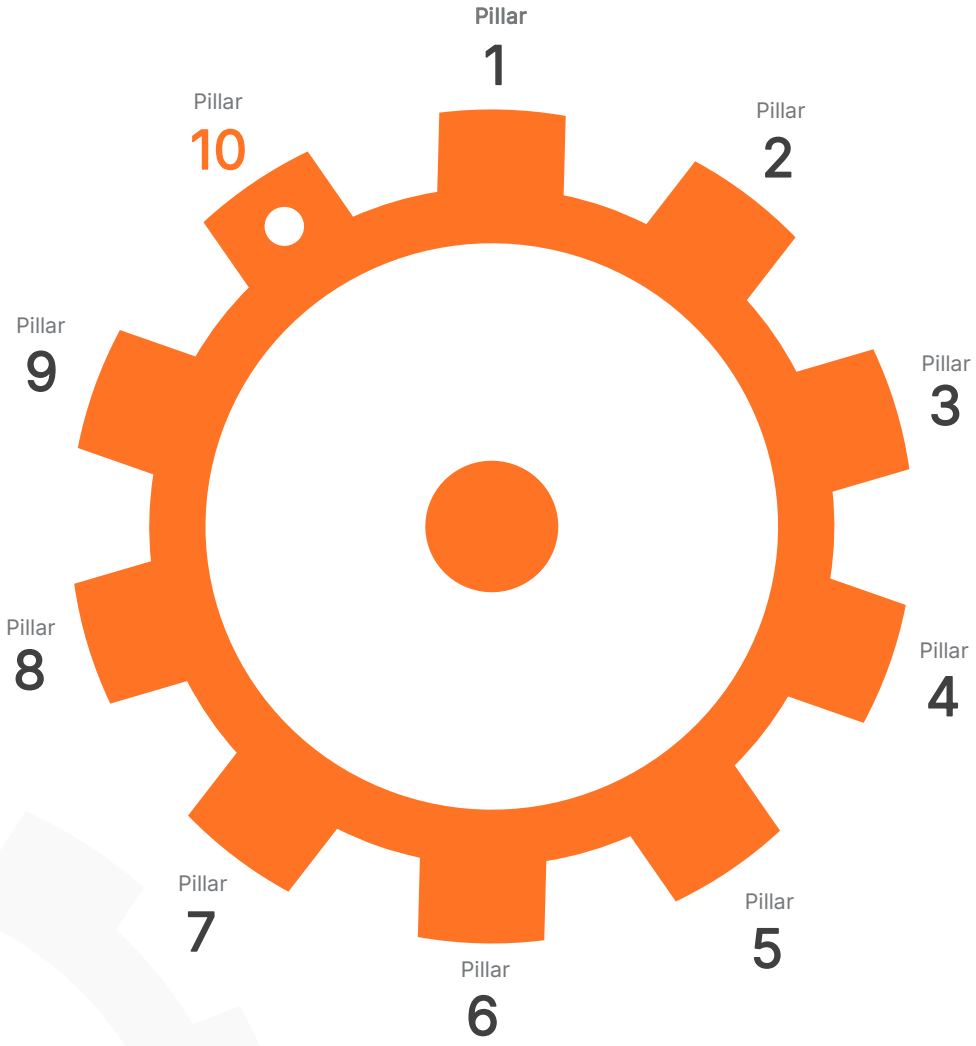
Key performance indicators per pillar

Pillar 9 A new spirit of law-making →

- 9.1 Cost of administrative burden →
- 9.2 Business regulations as an obstacle to firms →
- 9.3 Permitting time for key industrial projects →

International benchmark →

Evolution of EU performance year-over-year →



Key performance indicators per pillar

Pillar 10 Ensure the structure allows to achieve results →

International benchmark →

Evolution of EU performance year-over-year →

Executive summary

83%

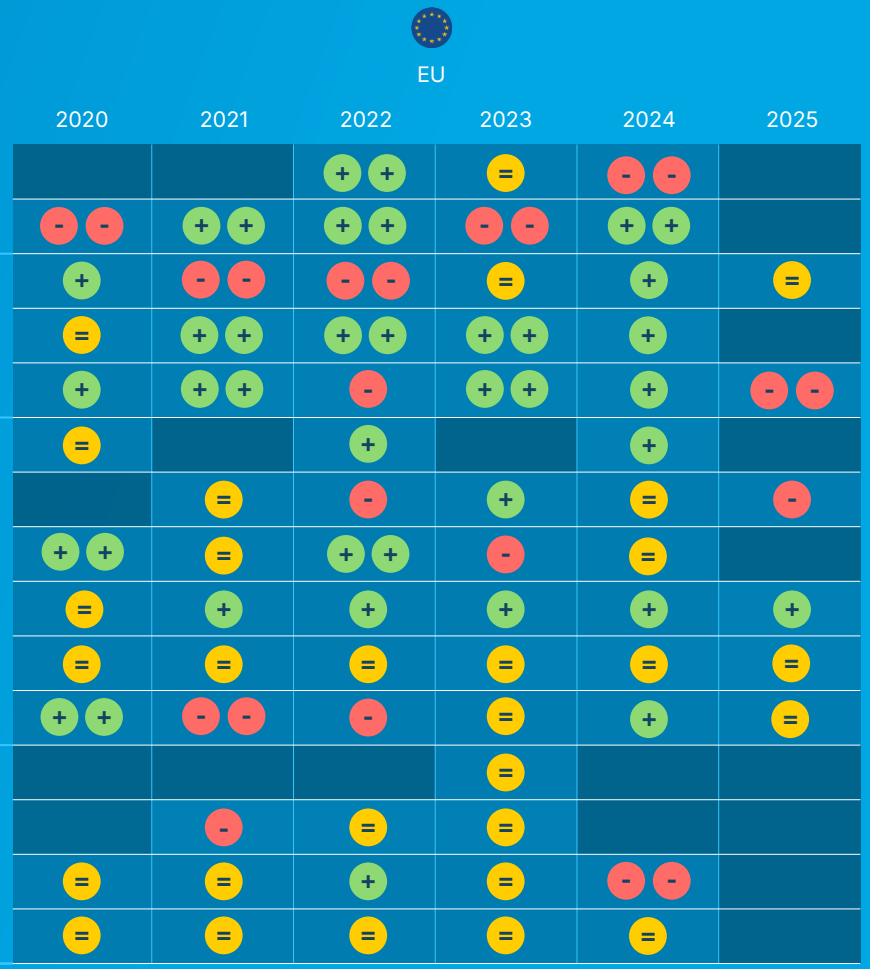
Competitiveness KPIs monitored for the EU showing no improvement or even deterioration

14%

Competitiveness KPIs benchmarked internationally demonstrating a very clear advantage for the EU

- **EU industrial users continue to face persistently high energy prices:** In 2025, the gas price went up with 13% and the electricity price plateaued. Compared to other regions, the EU gas price is 4.6 times higher than the US and the electricity price is 2.4 higher than China, the US and India.
- **The EU is expanding clean energy capacity but is outpaced by China and its PPA market remains small:** China now has 2.4 times the EU's clean energy capacity and is further accelerating, deploying clean power at 5 times the EU's rate. Cumulative EU PPA volumes represent only 6.4% of total clean energy capacity.
- **The EU struggles to deploy infrastructure at the required pace:** Despite increased grid investment, at par with the US but lagging China, the EU did not make significant progress on interconnectivity. Besides, connection queues, up to twice the waiting time in the US, are a clear bottleneck. The EU remains distant from CCS and H2 targets.
- **EU regulatory landscape is an increased barrier to investment and significant time is spent on compliance:** The proportion of EU firms identifying business regulation as a major barrier to investment has increased by 42% over the past three years. Senior staff dedicated to compliance is 1.5 times more vs the US and 11 times more vs China.
- **Funding shortfalls and complexity limit EU industrial transition:** Member States provide 75% of public funding, yet distribution remains uneven. Structural EU-level funding gaps, illustrated by the Innovation Fund which is five times oversubscribed, are further exacerbated by a complex and fragmented funding architecture.
- **Demand-side levers for low-carbon and Made in Europe products remain underutilized despite significant potential:** While public procurement accounts for 14% of the EU's GDP, there is no EU-wide mandatory green public procurement and a lack of harmonization of data and standards.
- **The EU remains structurally constrained by persistent raw material dependencies and limited domestic production:** The EU is fully import-dependent for more than half of critical raw materials. The EU leads with a circular material use rate of 12%, well above the global average, yet is faced with increased plastic recycling facility closures.
- **Improving the Single Market could significantly increase overall EU competitiveness:** Internal market barriers impose costs equivalent to tariffs of approximately 65% for goods and up to 100% for services. 61% of EU manufacturing exporters have reported compliance with varying standards and rules across Member States.
- **The EU's innovation framework lags the US and China:** Overall innovation performance ranks 20 percentage points lower than China, and 15 percentage points lower than the US. Deficiencies include a higher risk premium, significantly lower patent filings & venture capital activity, and inefficiencies in R&D spending despite individual successes among Member States.
- **The EU's trade strategy has expanded beyond traditional tariff and barrier removal:** The proportion of EU trade benefiting from preferential terms has grown with 29%. The number of EU trade defence cases, mainly concerning anti-dumping measures, has doubled over the past five years.

Evolution of EU performance year-over-year (1/2)



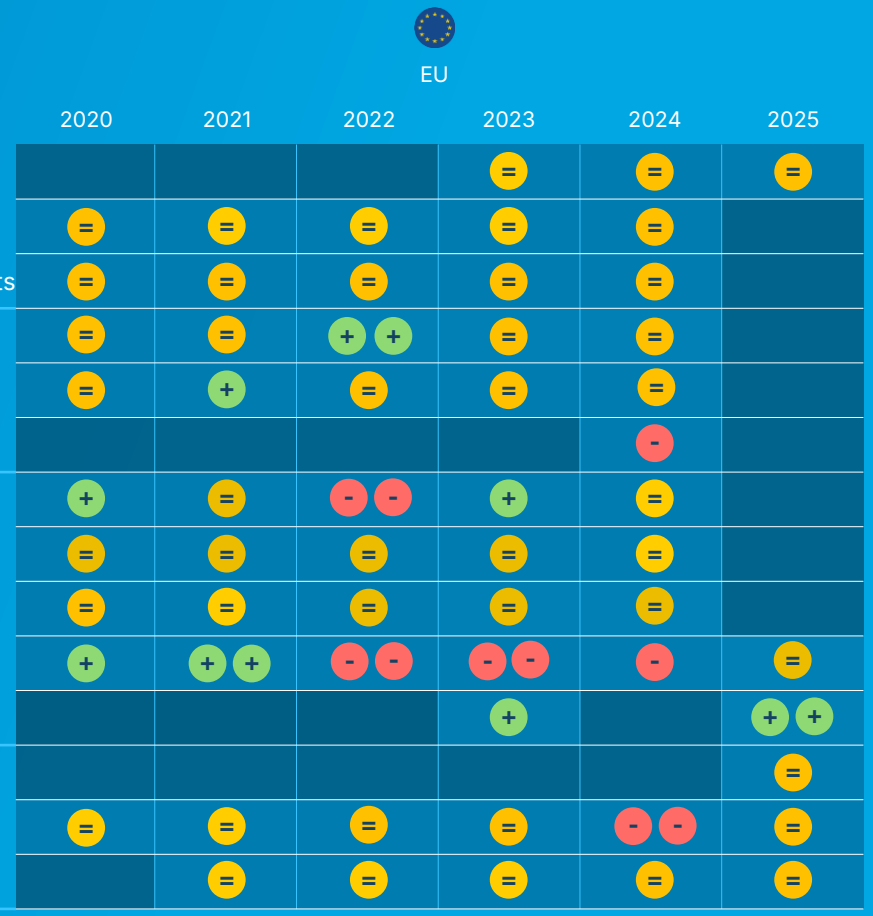
Prev 1 2 Next

Note: Analysis based on best data available. Additional details on the evolution can be found in appendix B.

- Worse than last year's performance
- Neutral or equal to last year's performance
- Better than last year's performance
- Significantly worse than last year's performance
- No data available
- Significantly better than last year's performance

International benchmark

Evolution of EU performance year-over-year (2/2)



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- Significantly better than last year's performance

International benchmark

International benchmark (1/2)

		EU	US	China	India	GCC
Pillar 2 Public funding	2.1 EU & Member States funding for climate-focused industrial projects	+	-	+	-	+
	2.2 Innovation Fund oversubscription rate					
Pillar 3 Energy	3.1 Industry electricity and gas prices (with price component breakdown)	- -	+ +	+	+	+ +
	3.2 New clean energy capacity by source (renewable and nuclear)	+	=	+ +	=	-
	3.3 Industry volume of power purchase agreements (PPAs)					
Pillar 4 Infrastructure	4.1 Investment in power grid infrastructure and storage as share of GDP	+	+	+ +	+ +	=
	4.2 Share of member states reaching electricity interconnectivity target					
	4.3 Key infrastructure projects (IPCEI & CEF) total funding in energy, digital, CCUS, and recycling					
	4.4 Digital infrastructure	=	+ +	+		
	4.5 Total CO_2 mineral storage and injection capacity	-	+ +	+	- -	+
	4.6 Manufacturing occupations labour shortage	+	-			
Pillar 5 Raw materials	5.1 External Vulnerability Index (EXVI)	=	-	+		
	5.2 Domestic Production Index	-	-	+ +	- -	- -
	5.3 Biomass flows going into bioenergy and biomaterials	+ +	-	+	=	- -
	5.4 Circular Material Use Rate (CMUR)	+ +	-	=	=	-

Prev 1 2 Next

Note: Analysis based on best data and most recent year available. Additional details on the comparison can be found in appendix B.

- Worse than average international performance
- Significantly worse than average international performance
- Neutral or equal to average international performance
- International benchmark not applicable
- No data available
- Better than average international performance
- Significantly better than average international performance

Evolution of EU performance year-over-year

International benchmark (2/2)

		EU	US	China	India	GCC
Pillar 6 Boost sustainable demand	6.1 Public procurement contracts using sustainability-related criteria	+	+	=	-	-
	6.2 Export markets access through Preferential Trade Agreements					
	6.3 Consumer incentives and demand mandates driving markets for net-zero, low-carbon and circular products	+	+	=	-	-
Pillar 7 Single Market	7.1 Trade between Member States (as share of EU GDP)	-	=	=		
	7.2 Intra-EU trade of waste and recycled materials					
	7.3 Internal market barriers costs					
Pillar 8 Innovation	8.1 Cost of capital	=	+	-	+	
	8.2 Patent applications and commercialisation rate for the industry	-	=	+ +	- -	- -
	8.3 EU and Member States budget allocations for research & innovation (R&I)	=	=			
	8.4 Venture capital investment by stages (early, breakout, scale-up) and by key industrial segments	- -	+ +	-	- -	- -
	8.5 Operational regulatory sandboxes	+ +	- -	+ +	- -	- -
Pillar 9 Regulation	9.1 Cost of administrative burden	-	+	+ +	-	-
	9.2 Business regulations as an obstacle to firms	-	+	+ +	- -	+
	9.3 Permitting time for key industrial projects	-	+	+	+	+

← Prev 1 2 Next →

Note: Analysis based on best data and most recent year available. Additional details on the comparison can be found in appendix B.

- \- Worse than average international performance
- \- \- Significantly worse than average international performance
- = Neutral or equal to average international performance
- International benchmark not applicable
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Evolution of EU performance year-over-year

Pillar 1 Industrial Deal
Pillar 2 Public funding
Pillar 3 Energy
Pillar 4 Infrastructure
Pillar 5 Raw materials
Pillar 6 Boost sustainable demand
Pillar 7 Single Market
Pillar 8 Innovation
Pillar 9 Regulation
Pillar 10 Enabling structure

Pillar 1: Put the Industrial Deal at the core of the new European Strategic Agenda for 2024-2029

We call for a comprehensive action plan to elevate competitiveness as strategic priority and create the conditions for a stronger business case in Europe. The action plan needs to include actions to eliminate regulatory incoherence, conflicting objectives, unnecessary complexity in legislation and over reporting. We ask to develop an Omnibus proposal to take corrective measures on all relevant existing EU regulations as the first piece of legislation to be presented in the next EU institutional cycle.

No KPIs were developed for this pillar as the asks have been met. Specifically, the Clean Industrial Deal is a core component of the European Strategic Agenda, and an Omnibus proposal was published in February 2025 revising EU regulations. Moreover, regulatory burden is directly addressed in the Antwerp Declaration Monitoring Framework under pillar 9.

Pillar 1 Industrial Deal

Pillar 2 Public funding

KPI 2.1 EU & MS climate funding

KPI 2.2 Innovation Fund oversubscription

Pillar 3 Energy

Pillar 4 Infrastructure

Pillar 5 Raw materials

Pillar 6 Boost sustainable demand

Pillar 7 Single Market

Pillar 8 Innovation

Pillar 9 Regulation

Pillar 10 Enabling structure

Pillar 2: Include a strong public funding chapter with a Clean Tech Deployment Fund for EIIs

Include a strong public funding chapter with a Clean Tech Deployment Fund for energy intensive industries closely coordinated with a simplified State Aid framework, while respecting the Single Market rules. This should allow public de-risking of private investment into clean technologies through both CAPEX and OPEX support, with guarantees to ensure the retention and creation of quality jobs in Europe and propose a competitive and sustainable tax level across Europe.

Pillar conclusions

The EU is progressively **strengthening enabling conditions for industrial decarbonisation and competitiveness** but faces **unstable progress and structural challenges compared to global competitors**. Public funding at EU level for climate-focused industrial projects increased between 2021 and 2024, driven primarily by the Innovation Fund's scale-up. Combined with variable national schemes, **EU and Member State funding totalled €72 billion over this period**, largely due to the national carbon contracts for difference (CCfD) programmes, such as Netherlands' SDE++ scheme and Germany's Klimaschutzverträge. This concentration reveals **volatility and uneven distribution of Member State contributions** but also demonstrates growing commitment to de-risk private investment.

The EU has adopted a strategic approach by introducing targeted Innovation Fund calls, dedicated tracks for sectors such as batteries and hydrogen, and project development assistance, creating a more predictable and supportive investment environment. However, **structural funding gaps and extensive and lengthy application procedures** constrain the EU's competitive position. **The Innovation Fund remains oversubscribed by several multiples of available budgets (513% in 2024)**, highlighting both the attractiveness of EU support and the widening funding gap.

The Recovery and Resilience Facility (RRF), the EU's largest post-pandemic funding instrument, committed up to €650 billion to support Member States' recovery with a strong green transition focus. By late 2025, Member States exceeded the minimum 37% climate spending target, averaging 42%, with approximately **€275 billion formally dedicated to climate-related measures**. Of this amount, over €72 billion was actually spent on climate initiatives between 2021 and 2024, led by France, Italy, Spain, and Germany, underscoring the scale and strategic importance of this funding stream.

Despite these advances, the EU faces a **substantial investment gap**. Estimates indicate an annual requirement of approximately €406 billion to meet 2030 climate goals, with some analyses, such as Draghi's, suggesting €450 billion per year to achieve the energy transition. This gap underscores that only large-scale, coordinated public funding can de-risk and mobilise the private investment necessary for the transition.

The EU's competitive position is further challenged by its **complex, fragmented multi-programme** funding architecture and continued reliance on carbon pricing, which increases costs and slows deployment relative to competitors. The US benefits from simpler, large-scale, state-directed instruments such as the 10-year tax credits under the Inflation Reduction Act (IRA), which could reach $800 billion due to the uncapped nature of many tax credits, although recent legislative changes have introduced uncertainty and weakened green investment momentum. China expands clean-technology manufacturing and deployment through coordinated five-year plans and sustained state support, widening its scale and cost advantages. India's mission-oriented industrial support schemes and the Middle East's sovereign wealth funds (SWFs) backed mega-projects further intensify competitive pressure on the EU.

€72 billion

funding for climate-focused projects

513%

Oversubscription rate of Innovation Fund in 2024

€275 billion

RRF dedicated to climate-related measures

Pillar 1 Industrial Deal

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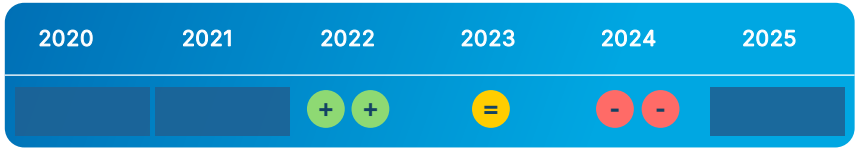
KPI 2.1 EU and Member State funding for climate-focused industrial projects

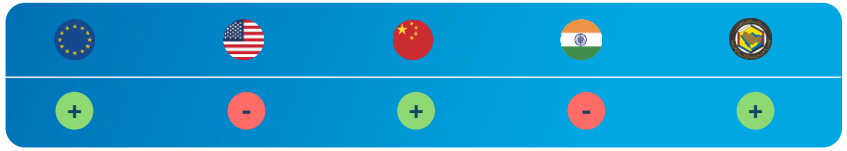
This KPI measures the total annual financial expenditure dedicated to climate-focused industrial projects, capturing the actual funds disbursed to support decarbonisation and clean-technology investments. This KPI captures actual funds disbursed for deployment, excluding research and development (R&D) projects. Funding sources include:

- EU-level centrally managed programmes: LIFE Programme, Innovation Fund, and InvestEU. These programmes are directly managed by EU bodies (European Commission, European Investment Bank under EU mandates, CINEA), ensuring funding flows directly to beneficiaries without national intermediaries.
- Member State funding: European Regional Development Fund (ERDF), Cohesion Fund, European Social Fund (ESF), and state aid mechanisms. These funds are channelled through national systems and complement EU-level programmes.

EU performance evolution



International benchmarking



Key takeaways

EU-level funding for climate projects rising sharply: EU-orientated public funding for climate-focused industrial projects is rising sharply, increasing from €2.4 billion in 2021 to over €6 billion in 2024, driven primarily by the expansion of the Innovation Fund. Member States' contributions, although larger overall and totalling approximately €72 billion alongside EU funds during this period, remain highly volatile and concentrated in a few national carbon contracts for difference (CCfDs) schemes, such as the Netherlands' SDE++ (subsidie duurzame energie) and Germany's Klimaschutzverträge.

Recovery and Resilience Facility (RRF) commits €650 billion: The RRF represents the EU's largest post-pandemic funding programme, committing up to €650 billion to support Member States' recovery with a strong emphasis on the green transition. By late 2025, Member States have exceeded the minimum 37% climate spending target, averaging 42%, with approximately €275 billion dedicated to climate-related measures. Between 2021 and 2024, over €72 billion was invested in climate initiatives across Member States.

Significant annual investment needs: The EU faces an annual investment need equivalent to €400-€450 billion per year, necessary to maintain competitiveness and ensure a successful energy transition. This investment is essential to modernise infrastructure and integrate renewables, requiring large-scale public funding to de-risk projects, as private capital alone cannot meet the scale and speed demanded.

Competitive pressure intensifies from global rivals: The EU's competitiveness challenge intensifies due to rising industrial costs from carbon pricing and complex, multi-programme funding mechanisms that slow deployment. Whilst the US Inflation Reduction Act (IRA) initially boosted clean-technology investment through long-term tax credits, recent implementation changes and shifting political priorities are weakening green investments. Meanwhile, China continues to expand clean-technology manufacturing and deployment through coordinated five-year plans and state-backed financing, increasing its scale and cost advantages and intensifying competitive pressure on the EU. India has adopted a mission-oriented model to build strategic domestic industries, and the Middle East is leveraging sovereign wealth funds and mega-projects to scale low-carbon energy capacity, highlighting that state-directed capital is reshaping global clean-technology leadership.

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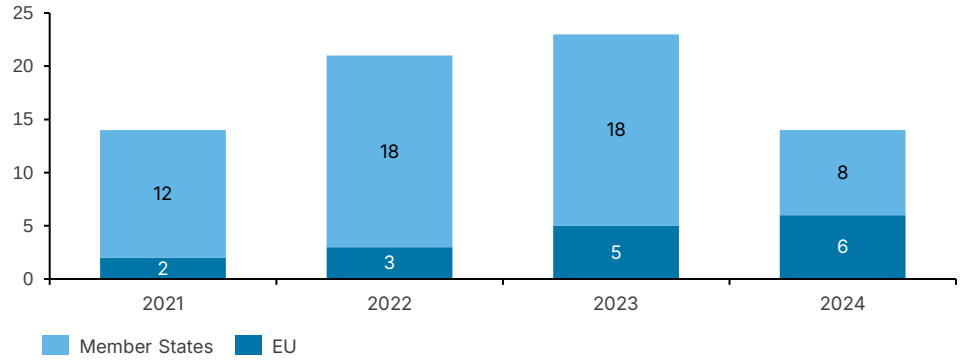
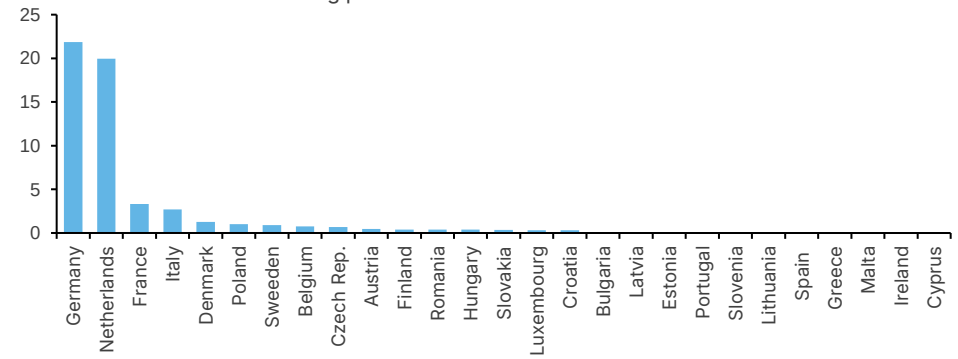
EU-level funding for climate projects more than doubled to €6 billion by 2024, driven by the Innovation Fund, while Member States' contributions remained volatile and nationally focused – bringing total climate investment to €72 billion over the period 2021-2024

EU & Member States funding for projects related to climate objectives in billion EUR



Source: Deloitte analysis, based on European Commission, 2025

Total funding per Member State in 2021-2024 in billion EUR



Source: Deloitte analysis, based on European Commission, 2025

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EU-level funding for climate projects has more than doubled, rising from approximately €2.4 billion in 2021 to €6 billion in 2024, driven primarily by the Innovation Fund's expansion from €1.2 billion to €5.4 billion (European Commission, 2025). In contrast, the LIFE Programme and InvestEU experienced declines in total funding allocations during the same period.

Member States' funding started substantially higher than EU funding but exhibited greater volatility. This variability reflects differences in fiscal capacity, policy priorities, and the timing of major climate-related investment programmes across Member States. Overall funding is primarily driven by national CCfDs and compensation mechanisms for indirect emission costs in energy-intensive industries.

Several Member States have introduced instruments to support deployment of mature clean-production technologies. The Netherlands operates the SDE++ scheme since 2020 to accelerate low-carbon technologies. Germany launched its CCfD programme Klimaschutzverträge in 2023. These programmes incentivise climate-friendly production in energy-intensive industries such as steel, cement, paper, and glass by bridging the cost gap between conventional and low-carbon processes.

The EU maintains limited funding instruments for mature clean production technologies (high-technology readiness level (TRL) projects), directing a significant share of public support toward low-TRL research at universities and academic institutions. According to the European Commission, a large portion of direct government funding supports basic academic research, distinguishing the EU's approach from major competitors such as the US, where funding more strongly targets commercial-scale, deployment-ready clean technologies (European Commission, 2025).

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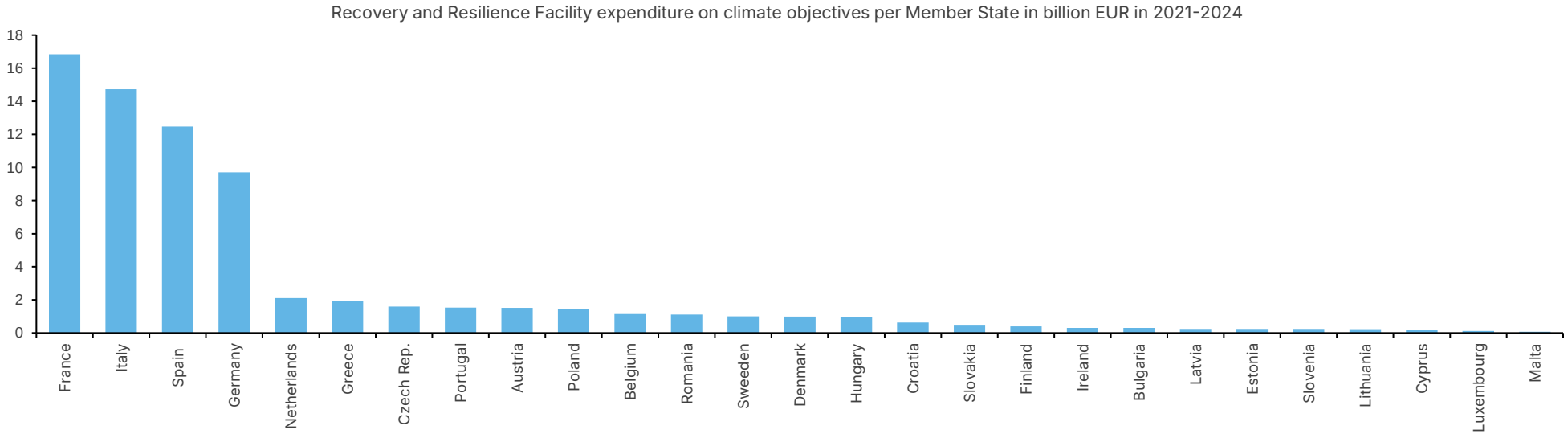
The RRF directs over €275 billion toward climate-related measures, with Member States investing more than €72 billion between 2021 and 2024, led by France, Italy, Spain, and Germany



Source: Deloitte analysis, based on European Commission, 2025

The RRF channels up to €650 billion in grants and loans to Member States' Recovery and Resilience Plans (RRPs), with at least 37% of spending dedicated to climate-related measures and an average of 42% achieved across countries by late 2025. This commitment translates into approximately €275 billion in climate expenditure, including €184 billion supporting energy-related reforms and investments that enhance energy efficiency, deploy renewables, modernise grids, and promote cleaner mobility, thereby advancing the REPowerEU agenda and reducing fossil fuel dependence (European Commission, 2025).

Between 2021 and 2024, Member States collectively invested over €72 billion out of the €275 billion in climate initiatives through the RRF, with France, Italy, Spain, and Germany accounting for €53.7 billion of this total, demonstrating concentrated leadership in climate-related investments within the EU.

Note: *The €72 billion referenced on this slide reflects a different scope than the €72 billion shown on the previous slide.*

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The EU, US, China, India, and the Middle East deploy distinct multi-year funding programmes mobilising public capital to drive industrial decarbonisation and clean technology manufacturing, reflecting diverse strategic priorities and financial tools

Currently EU investment levels are about €407 billion per year, while total annual investment needs are estimated at roughly €813 billion, leaving a climate investment deficit of around €406 billion per year to meet its 2030 targets in the energy, building, and transport sectors - a gap equivalent to 2.6% of EU GDP. Comparable estimates suggest that delivering the broader energy transition requires around €450 billion per year, including €300 billion for energy and clean technology deployment (I4CE, 2024; Draghi, 2024). The proposed 2028–2034 Multiannual Financial Framework (MFF), with a budget of nearly €2 trillion, aims to align EU spending with priorities such as resilience, competitiveness, and the green transition. It foresees 21% (€409 billion) for a new European Competitiveness Fund and includes a 35% climate and environment spending target. Within this framework, the EU is also advancing new tools to support industrial decarbonisation, notably the Industrial Decarbonisation Bank, which is expected to mobilise around €100 billion for large-scale clean industrial investments. The Bank would draw on Emissions Trading System (ETS) revenues, the Innovation Fund, and reinforced InvestEU instruments, and operate under the governance of the future Competitiveness Fund.

The US IRA of 2022 provides broad, long-term, technology-agnostic tax credits over 10 years that support domestic clean-technology manufacturing and reshoring, challenging EU competitiveness (World Resources Institute, 2022). While the IRA has not been formally repealed, the policy context shifted significantly with the start of the new presidential administration in January 2025. Early executive actions included the announced withdrawal from the Paris Agreement and the UN Framework Convention on Climate Change, alongside the announcement of a new "USA Energy Dominance" strategy, signalling a departure from federal climate objectives. At the same time, 2025 legislative changes under the One Big Beautiful Act accelerated phase-outs and amended compliance, introducing uncertainty in future investments, though core IRA incentives remain active (Influence Map, 2025; Inflation Reduction Act Tracker, 2025).

China uses centrally coordinated five-year plans to mobilise state capital through policy banks, provincial governments, and state-owned enterprises (SOEs), targeting an 18% CO_2 intensity reduction by 2025. State-backed low-interest loans and equity investments enable rapid scaling of solar, wind, and battery technologies, making Chinese clean-technology globally price-competitive and pressuring EU manufacturers. The upcoming 15th Five-Year Plan (2026–2030) will reinforce carbon peaking before 2030 and neutrality by 2060, focusing on green growth and advanced manufacturing (Climate Change Laws of the World, 2021; Hepburn et al., 2021; China Briefing, 2025).

India pursues energy security and industrial self-reliance via targeted production-linked incentives (PLI), direct investment, and policy-bank lending. The National Green Hydrogen Mission (NGHM), backed by INR 19.7 crore (~€2.3 billion) through 2030, aims for five million metric tonnes annual green hydrogen capacity with potential to reach 10 MMT per annum with growth of export markets. It includes an outlay of INR 17.5 crore for Strategic Interventions for Green Hydrogen Transition (SIGHT) Programme, which provides direct incentives for domestic electrolyser manufacturing and green hydrogen production. The PLI Scheme allocates INR 1.97 trillion (~€23 billion) across 14 sectors, including batteries and solar modules, incentivising domestic output and mobilising private investment to expand clean-technology manufacturing and decarbonisation (Government of India, 2024).

The Middle East leverages sovereign wealth funds (SWF) and mega-projects under Vision 2030 and regional green initiatives to diversify from oil. With over €7.7 billion in concessional financing and SAR 705 billion (~€179 billion) committed to flagship projects such as NEOM's green hydrogen plant, the region uses patient, large-scale state-directed capital and some of the world's lowest renewable energy costs to become the lowest-cost global producer of green hydrogen and ammonia (Saudi Public Investment Fund, 2024; Saudi Green Initiative, 2024).

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Global clean-tech leadership varies: the EU uses complex finance and regulation, the US relies on tax credits, China deploys state capital, India targets manufacturing incentives, and the Middle East invests heavily in mega-projects to diversify from oil

Framework	Time horizon	Announced budget	Mechanism type	Industrial strategy goal
Multiannual Financial Framework	2028–2034	€409 billion for the European Competitiveness Fund under MFF	Combination of EU funds, grants, and leveraged private investment (guarantees) and regulations (EU ETS, Carbon Border Adjustment Mechanism (CBAM))	First-mover advantage: set global standards and lead in high-technology innovation
US IRA	2022–2031	$370 billion in climate and energy measures (official budget estimate), but total spending could reach or exceed $800 billion due to the uncapped nature of many tax credits, which comprise the bulk of support	Primarily uncapped tax credits and direct payments (subsidies)	Reshoring: bring clean energy manufacturing back to the US While the IRA remains in force, the policy and implementation landscape has shifted since the change in US administration in January 2025.
China 14th Five-Year Plan	2021–2025	No single stated total budget	SOEs, central/local government investment, and industrial policy	National social and economic development goals; reduce external vulnerability and strengthen resilience: control supply chains via mass production and low cost
India Nationally Determined Contributions (NDC) & PLI Scheme	Until 2030 (NDC)	INR 1.97 lakh crore (~ €23 billion) for the overall PLI scheme (across 14 sectors)	NDC: production-linked initiatives, direct government investments (viability gap funding), policy bank lending and market-based mechanism. PLI: output-based incentive mechanism	Self-reliance: build domestic capacity to reduce import dependencies
Middle East Vision 2030 (Saudi Arabia)	2016–2030	No single stated climate budget. Over SAR 705 billion (~ €179 billion) committed to SGI programmes	Direct investment by SWF, mega-project funding, and export credit	Diversification: transition from oil exporter to green energy exporter

Source: Deloitte analysis

Industrial support levels vary significantly across major economies, both in scale and in the instruments used. Between 2005 and 2022, firms in China received industrial subsidies equivalent to an average of roughly 3% of annual revenues across key sectors, around ten times higher than levels in OECD Europe and three times higher than levels in OECD North America. Governments use a mix of grants, tax concessions and below-market borrowing, with the EU leaning more on grants, and the US on tax incentives, while China stands out both for the overall scale of support and its heavy reliance on below-market borrowing, reflecting a more state-directed industrial model (OECD, 2025).

Region	Industrial subsidies for 14 key industrial sectors, average for 2005-2022 (% of annual firm revenue)
China	~3%
OECD – Asia Pacific	~0.3%
OECD - Europe	~0.3%
OECD – North America	~0.8%
Other	~1%

Source: OECD, 2025

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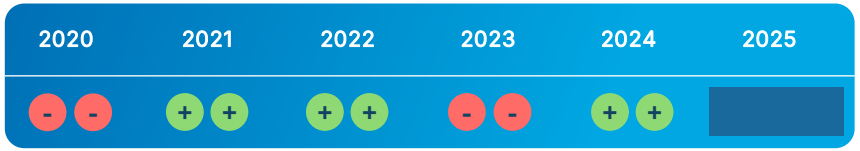
KPI 2.2 Innovation Fund oversubscription rate

The oversubscription rate is a key performance indicator measuring the ratio of total funding requested by applicants to the total funding available under the Innovation Fund. It is expressed as a percentage and calculated as:

Oversubscription rate = (Total funding requested – Total funding available) / Total funding available × 100%

This KPI provides insights into the competitiveness and attractiveness of the Fund. A higher oversubscription rate indicates strong demand and interest from project developers, signalling a healthy innovation pipeline. Conversely, it also reveals potential constraints in funding capacity, which can limit the number of projects supported.

EU performance evolution



Key takeaways

- **Persistently high oversubscription rates reveal structural funding gap**: Persistently high oversubscription rates illustrate the Fund's strong attractiveness and the private sector's readiness to scale climate technologies rapidly. At the same time, they reveal a structural funding gap between EU grant capacity and the growing volume of project demand.
- **Innovation Fund budgets increased with more targeted calls**: The EU has pragmatically increased Innovation Fund budgets (as shown in KPI 2.1 results) and introduced more targeted calls, including auctions, specific funding tracks (e.g., batteries, renewable fuels of non-biological origin (RFNBO) hydrogen), and project development assistance. These efforts aim to maximise the impact of limited public resources whilst encouraging greater private sector participation.
- **EU adopts targeted and selective funding approach**: The EU is fostering competitiveness by adopting a more targeted and selective funding approach, including tailored support for energy-intensive industries and acceleration of clean technology deployment. However, the resource-intensive application process creates high barriers for smaller applicants and contributes to strong oversubscription and low success rates.
- **Funding gap requires scaled public funding and complementary instruments**: This mismatch highlights the need to scale public funding and refine project-prioritisation mechanisms to ensure that the most impactful projects receive support. It also points to the importance of complementing grants with additional instruments (e.g., carbon contracts for difference (CCfD) instruments) to meet the growing project pipeline and sustain momentum in climate-technology deployment.

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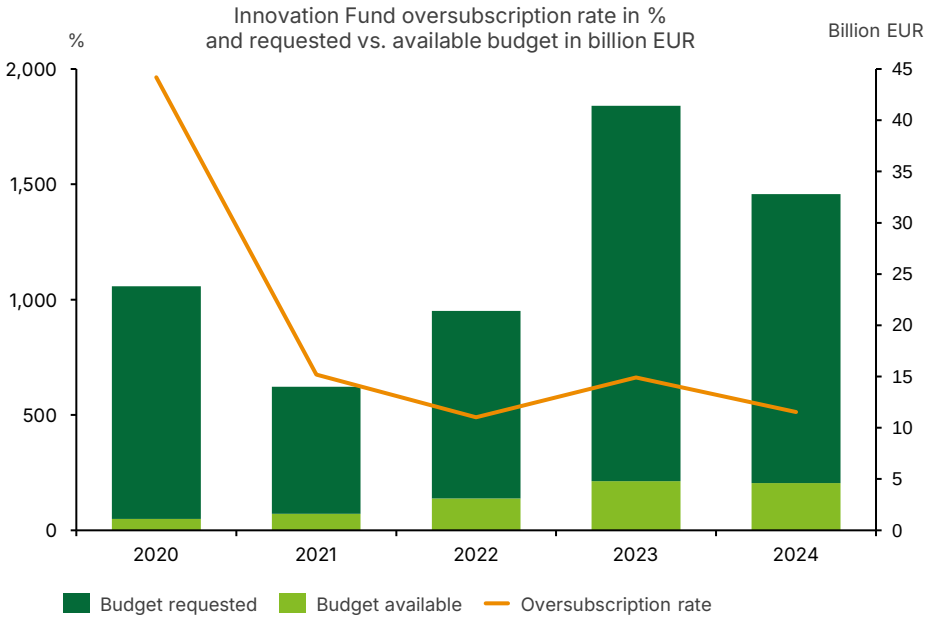
The Innovation Fund consistently faces high oversubscription, signalling strong demand but limited public funding



Source: Deloitte analysis, based on European Commission, 2025

The following table presents the oversubscription rate per funding call:

Year	Call name	Oversubscription rate
2020	1st Small Scale Call	900%
	1st Large Scale Call	2,070%
2021	2nd Small Scale Call	207%
	2nd Large Scale Call	707%
2022	3rd Small Scale Call	189%
	3rd Large Scale Call	500%
2023	IF23 Call for Net-Zero Technologies	515%
	IF23 Auction Renewable Hydrogen	1,400%
2024	IF24 Call for Net-Zero Technologies	804%
	IF24 Auction Renewable Hydrogen	307%
	IF24 Battery Call	60%

Source: Deloitte analysis, based on European Commission, 2025

The Innovation Fund experienced a very high oversubscription rate of nearly 20-fold in 2020, followed by a decline yet sustained high demand consistently exceeding 490% in subsequent years. This trend reflects an initial surge in project applications during the Fund's launch phase, stabilising at a highly competitive level thereafter.
The Innovation Fund has a highly demanding application process requiring strategic planning, technical rigor, and substantial resources. Proposals often involve 200–300 pages of documentation, including greenhouse gas (GHG) emissions calculations, feasibility studies, financial models, and business plans, taking 6–12 months, with some teams spending up to 3,000 staff hours and significant amounts on external consultants. The total timespan from preparing the application to financial close can reach up to six years, as data may be one to two years old and applicants have four years post-award to close. This high investment creates barriers for small and medium enterprises (SMEs) and smaller consortia, potentially limiting diversity, and contributes to strong oversubscription and low success rates, especially for projects with longer development timelines (Zero Emissions Platform, 2025).

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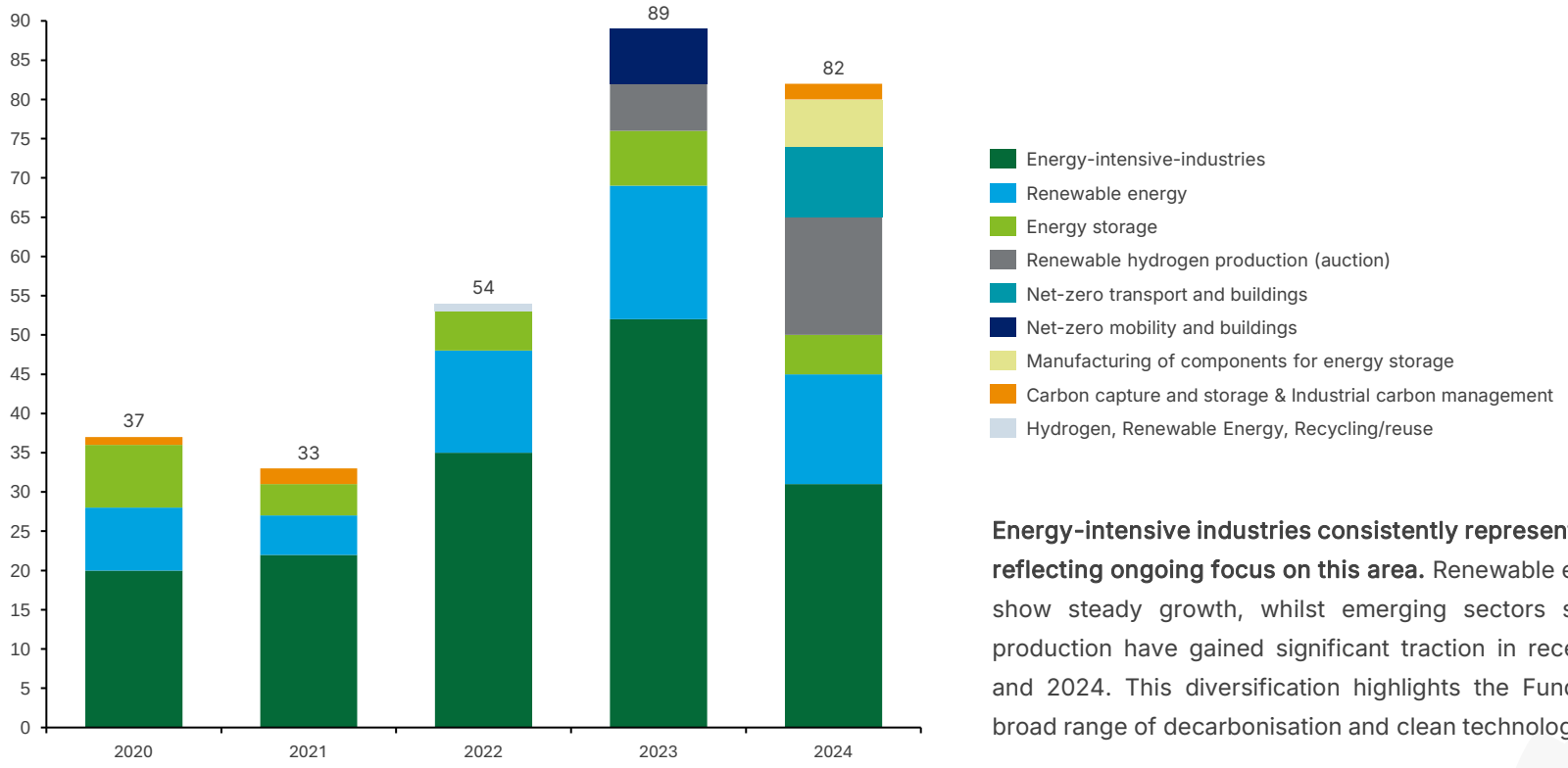
Energy-intensive industries remain the largest project focus, with steady growth in renewables, energy storage, and emerging sectors like renewable hydrogen production

Number of selected Innovation Fund projects by category (2020-2024)



Source: Deloitte analysis, based on European Commission, 2025

Energy-intensive industries consistently represent the largest share of projects, reflecting ongoing focus on this area. Renewable energy and energy storage also show steady growth, whilst emerging sectors such as renewable hydrogen production have gained significant traction in recent years, particularly in 2023 and 2024. This diversification highlights the Fund's expanding emphasis on a broad range of decarbonisation and clean technology solutions.

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Pillar 3: Make Europe a globally competitive provider of energy

The costs of energy in Europe are simply too high to compete and are not only driven by commodity prices but also by regulatory charges. The next European Commission needs to prioritise new projects for abundant and affordable low carbon renewable and nuclear energy. We need a real EU Energy Strategy with concrete actions that enable cross-border electrical power, grid expansion for hydrogen and other renewable and low-carbon molecules, and partnerships with resource-rich countries.

Pillar conclusions

The data reveals that the EU faces a significant competitive disadvantage driven by **persistently high industrial energy prices.** EU gas prices were below or equal to China's before 2021 but then surged sharply, surpassing both China and the US by 2025, **whilst electricity prices in the EU have consistently remained significantly higher than in these regions.** In 2025, EU electricity prices were around 2.4 times those in the US, China, and India and gas prices were almost five times higher than in the US, creating a major competitive disadvantage for EU industries. The gap is primarily **caused by the 'energy and supply' price component**, which dominates the price structure. This challenge is further compounded by the steady increase in non-recoverable taxes on industrial electricity since 2022, which have risen above pre-crisis levels. The volatility and elevated costs expose EU industry to financial shocks and fundamentally undermine its ability to compete in global markets.

In clean energy capacity, the **EU is expanding but remains outpaced by global competitors. China leads global clean energy with 1,879 GW** capacity in 2024, more than twice the EU's 799 GW, and a 15.7% CAGR. It added 368 GW in 2024, deploying clean power at five times the EU's rate while expanding fossil fuel capacity for flexibility. **The EU's growth, driven by solar and wind**, reached 72 GW in 2024 but is limited by nuclear decline and supply chain potential dependence on China. China's lower LCOE contrasts with higher costs in the EU and the US. India and the GCC show rapid growth from smaller bases, reflecting a broadening clean energy transition.

The **EU power purchase agreement (PPA) market reached 7.64 GW in 2025**, reflecting strong growth since 2015 but experiencing **a sharp 35% decline that year**, emphasising the need for more flexible, hybrid contract models to foster a mature and sustainable market. The average European PPA price stood at €46.20/MWh in 2025, with significant regional and sectoral variations, particularly impacting energy-intensive industries facing **cost and structural challenges.** Spain leads EU PPA volumes at 2.60 GW despite recent declines, while Germany's volumes fell sharply and Italy's continue to grow, highlighting the importance of tailored national policies and infrastructure. **Heavy industry and ICT sectors remain key drivers of PPA uptake**, even amid 2025 volume reductions, and solar energy leads growth, complemented by stable onshore wind and emerging offshore and hybrid renewable contributions.

Overall, the EU demonstrates important progress in clean energy deployment and market mechanisms but remains constrained by critical structural challenges. Persistently high energy costs, slower capacity growth compared to global leaders, and an underdeveloped PPA market limit the EU's ability to compete effectively. The dominance of the energy and supply prices in cost structures and the decline in nuclear capacity further exacerbate vulnerabilities. These factors collectively indicate that whilst the EU is advancing its energy transition, it currently lacks the full enabling conditions to position itself as a globally competitive provider of affordable, low-carbon energy.

2.4x

Higher electricity prices in EU than in the US, China and India

4.6x

Higher gas prices in EU than in the US

5x

EU's clean power growth is outpaced fivefold by China.

7.64 GW

Volume of industrial PPAs within the EU in 2025

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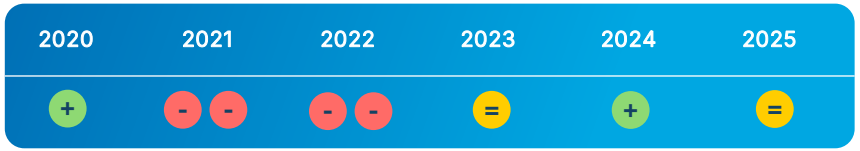
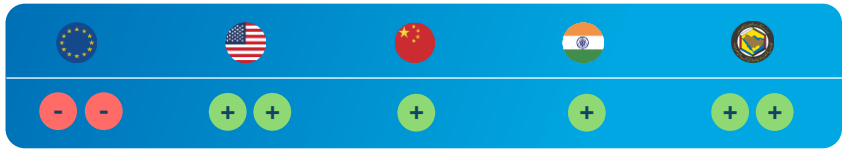
KPI 3.1 Industry electricity and gas prices (with price component breakdown)

This KPI tracks the all-inclusive industrial price for electricity and natural gas (in EUR/MWh) from 2015 to 2025. It benchmarks the EU industry's energy cost base against major global competitors (US, China, India) and analyses the EU cost breakdown by component (Energy & Supply, Network Costs, and Taxes/Levies) to identify primary drivers of competitive disadvantage.

EU performance evolution



International benchmarking



Key takeaways

- **EU electricity prices create a significant competitive barrier:** The EU electricity price for industry remains the highest among major regions, at €178.7/MWh in 2025 – about 2.4 times higher than the US, China, and India – creating a significant competitive disadvantage for EU energy-intensive industries.
- **Industrial gas prices exacerbate EU's cost disadvantage:** EU gas prices for industry are particularly uncompetitive, at €64.8/MWh in 2025, approximately 4.6 times higher than US prices, exposing EU industries to volatility and financial risk compared to global peers.
- **Persistent elevated energy costs post-crisis:** Both electricity and gas prices for industry in the EU remain substantially above pre-energy crisis levels, imposing a persistent and elevated cost burden on energy-intensive sectors.
- **Rising fiscal pressure from taxes and core energy costs:** Since 2022, non-recoverable taxes on industrial electricity have increased beyond pre-crisis levels, adding significant fiscal burden. At the same time, although the share of core energy supply costs (generation, gas commodity, and delivery services) has slightly decreased, these costs remain the primary driver of overall industrial energy prices. Together, rising taxes and sustained high energy supply costs intensify cost pressures, threatening the competitiveness and resilience of EU industries in the transition to net zero.

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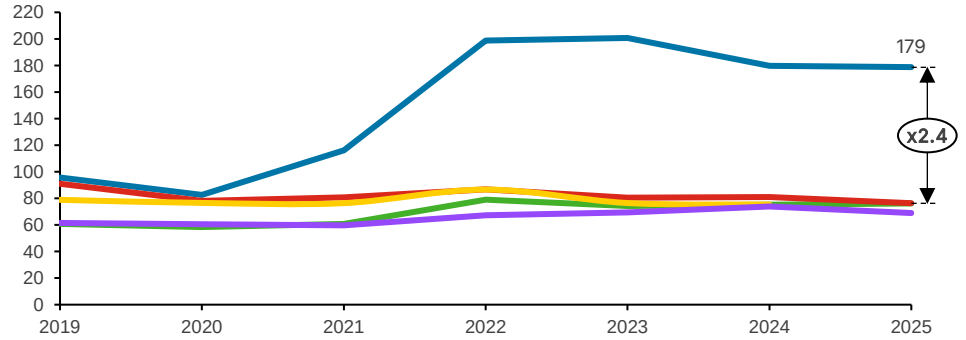
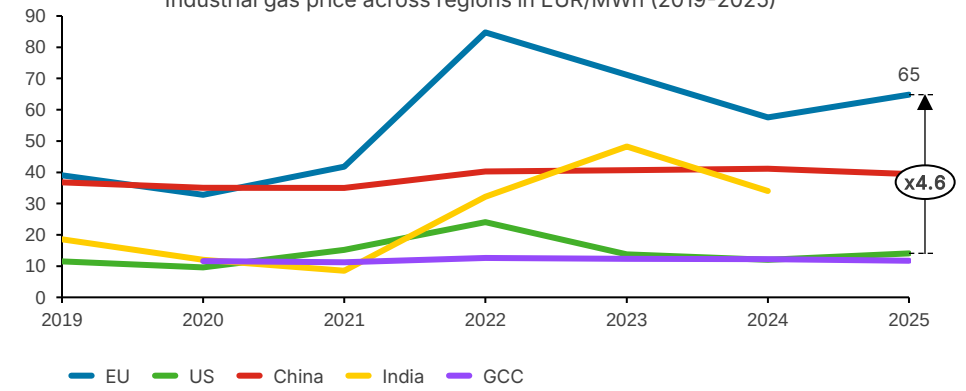
In 2025, the EU's electricity and gas prices were several times higher than in the US, China, and India, harming its industrial competitiveness

Industrial electricity price across regions in EUR/MWh (2019-2025)



Industrial gas price across regions in EUR/MWh (2019-2025)



Source: Deloitte, based on Eurostat, 2025; EIA, 2025; NDRC, 2025; GlobalPetrolPrices, 2025; ICED, 2025

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The EU electricity price (excluding VAT and other recoverable taxes) consistently remained the highest among benchmarked regions from 2019 to 2025, reaching €178.7/MWh, slightly down from the 2023 peak of €200.7/MWh but still significantly elevated. This price level represents a substantial competitive barrier. In 2025, the EU price was approximately 2.4 times higher than the US price (€76.2/MWh), the Chinese price (€76.4/MWh) and the Indian 2024 price (€75.4/MWh). It is also 2.6 times higher than the average of GCC countries. This cost difference means EU energy-intensive industries must overcome an average electricity price premium of over €100/MWh per unit consumed compared to these regions, compromising their ability to price products competitively on international markets.

The cost disparity is most severe for gas industrial price, creating a significant disadvantage against the US, which benefits from domestic supply. The US and GCC gas prices remained structurally low at €14.1/MWh and €11.7/MWh in 2025, compared to the EU gas price of €64.8/MWh. In 2025, the EU gas price was approximately 4.6 times higher than the US price and around 6 times higher than the GCC price. The EU price also remains substantially higher than in China (1.9 times) and India (2.3 times; based on 2024 data). Although lower than the 2022 peak of €84.8/MWh, the EU gas price remains elevated and volatile, making the EU industry highly vulnerable to financial shocks and fundamentally uncompetitive against US, Chinese, and Indian producers.

Overall, electricity and gas industrial prices in the EU in 2025 remain substantially above their pre-energy crisis levels, indicating a persistent cost burden for energy-intensive industries.

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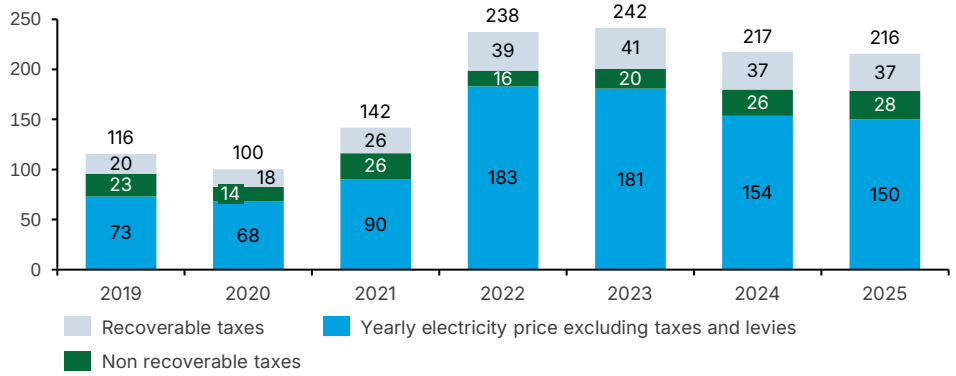
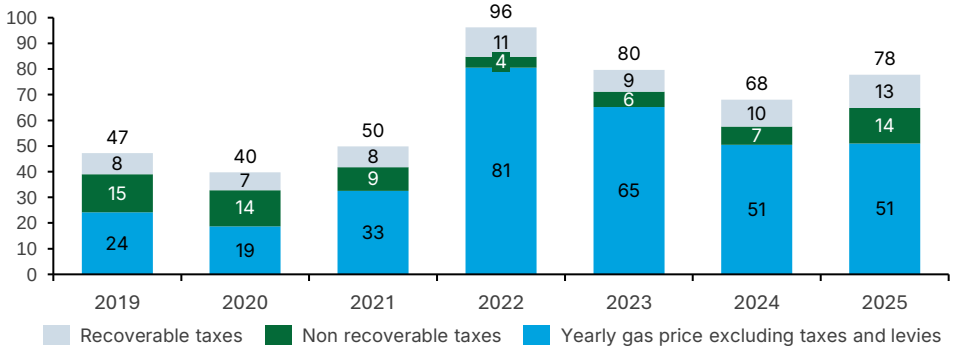
Post-2022, industrial electricity non-recoverable taxes have risen sharply, increasing fiscal pressure more than gas and risking EU industry competitiveness

Breakdown and evolution of non-recoverable and recoverable taxes in EU industrial electricity prices (2019–2025) in EUR/MWh



Breakdown and evolution of non-recoverable and recoverable taxes in EU industrial gas prices (2019–2025) in EUR/MWh



Source: Deloitte, based on Eurostat, 2025

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The industrial electricity price chart highlights a clear post-2022 energy crisis trend where non-recoverable taxes on industrial electricity have steadily increased, surpassing pre-crisis levels by 2025. Although the base electricity price (excluding taxes) peaked sharply in 2022 before easing, the continued rise in non-recoverable taxes adds significant cost pressure on industry. Recoverable taxes increased during the crisis but have since stabilised just below their peak. This persistent growth in non-recoverable taxes underscores a rising fiscal burden that could impact industrial competitiveness and resilience in the EU's transition to net zero and low-carbon production.

Regarding the industrial gas price, non-recoverable taxes fell significantly during the 2022 energy crisis, reaching a low point before rising again to near pre-crisis levels by 2025. Recoverable taxes increased during the crisis and have continued a moderate upward trend. In comparison, non-recoverable taxes on electricity also dipped during the crisis but have since rebounded more strongly, exceeding pre-crisis levels. This indicates that while both energy sources are experiencing increased fiscal pressure from rising non-recoverable taxes post-crisis, the impact is currently more pronounced for electricity.

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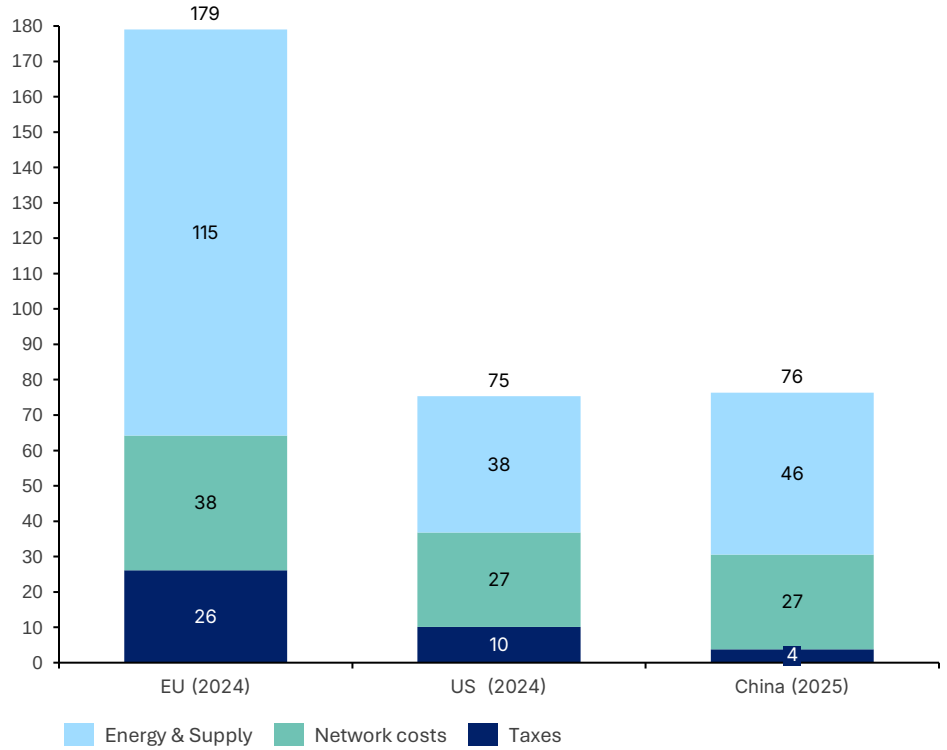
Energy and supply costs dominate electricity prices in the EU, US, and China, with the EU seeing the largest increase and highest taxes

Industrial electricity price breakdown by component in EUR/MWh: EU, US, and China



Source: Deloitte, based on Eurostat, 2024; EIA, 2025; China Briefing, 2025

Energy & Supply costs form the largest share in all regions – €114.8/MWh (64%) in the EU, €38.50/MWh (51%) in the US, and €45.82/MWh (60%) in China. Notably, the EU's Energy & Supply costs have more than doubled since 2019, rising from €51.9/MWh (52%) to €114.8/MWh (64%), an increase of €62.9/MWh (Eurostat,2025), reflecting significant growth in generation expenses.

Network costs represent 21% of the EU price (€38.1/MWh) but 35% in both the US (€26.68/MWh) and China (€26.73/MWh). In the EU, network costs have increased by nearly 46% since 2019, from €26.1/MWh (26%) to €38.1/MWh (21%), a rise of €12.0/MWh (Eurostat, 2025). In China and the US, these costs include transmission, distribution, line losses, and system operation fees, which make up a relatively larger portion of the total price compared to the EU.

Taxes are highest in the EU at 15% (€26.1/MWh), compared to 13% (€10.12/MWh) in the US and 5% (€3.82/MWh) in China, indicating a heavier tax burden in the EU's electricity pricing.

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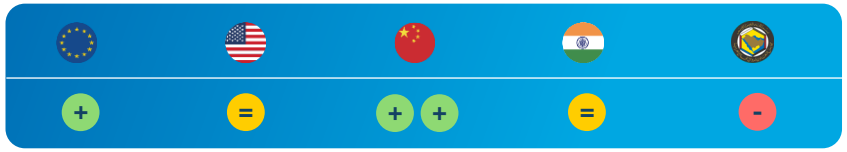
KPI 3.2 New clean energy capacity by source (renewable and nuclear)

The total new clean energy capacity for renewable and nuclear measures the net annual change in a region's power generation infrastructure, specifically focusing on renewable sources (bioenergy, geothermal, hydropower, marine, solar, wind) and nuclear power. It is a direct measure of the scale and pace of clean energy infrastructure build-out, critical for assessing industry resilience and long-term competitiveness in a net-zero economy.

EU performance evolution

International benchmarking



Key takeaways

- **China is the global leader in clean energy deployment,** with the largest capacity and fastest growth, achieving a 15.7% compound annual growth rate (CAGR) and annual additions reaching 368 GW in 2024.
- **EU and US grow more moderately:** The EU has accelerated its build-out pace steadily in recent years, reaching 72 GW of new capacity additions in 2024, while the US maintains a robust but steady addition rate, increasing to 44 GW in 2024.
- **Solar drives the transition but exposes supply chain vulnerability**: Solar power drives the clean energy transition in both the EU and China. In 2024, solar capacity accounted for 7.2% of the EU's total clean energy capacity, compared to 14.6% in China. This deployment gap underscores the EU's need to reduce supply chain dependencies, as high demand for components is met by Chinese manufacturers.
- **EU nuclear capacity decline offsets renewable gains**: The EU's net clean energy growth is constrained by a nuclear capacity deficit, with capacity declining in seven of nine years. The 3.5 GW retirement in 2023 exemplifies this trend, reducing clean power availability for industrial baseload demand and offsetting renewable gains.
- **Regional LCOE variations reveal China's cost advantage**: Significant regional variations in 2024 levelised cost of electricity (LCOE) for solar photovoltaic (PV) and wind highlight China's cost advantage, the EU's higher costs, the US's cost challenges – particularly offshore wind – and India's competitive positioning.
- China's **dual-track strategy** includes continued additions of fossil fuel capacity alongside clean energy, contrasting with the EU and the US's retirement phases, and securing both power flexibility and global clean technology market share.

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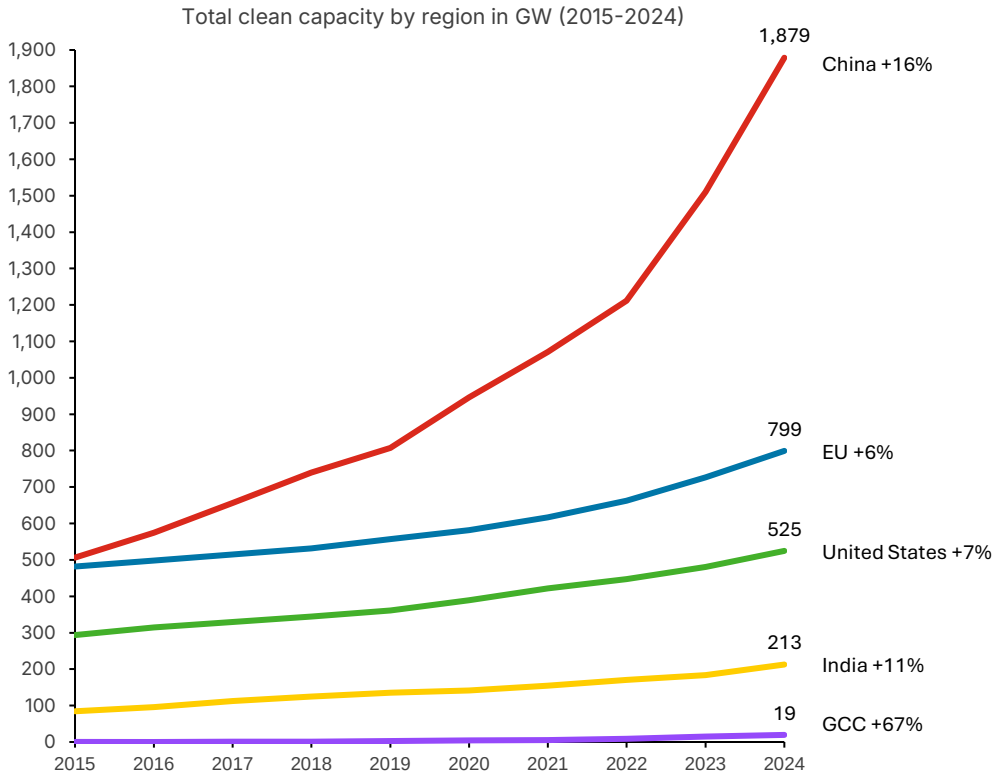
China leads the clean energy build-out with the largest capacity and fastest growth, while India and the GCC show rapid expansion, and the EU and the US grow more moderately from larger existing bases



Source: IRENA, 2025

China, the EU, and the US represent the largest clean energy markets with differing growth trajectories. In 2015, China and the EU had similar clean energy capacities. However, by 2024, China's capacity has surged to 1,879 GW – more than double the EU's 799 GW – and significantly ahead of the US's 525 GW. China's growth is reflected in a 16% CAGR, demonstrating its rapid expansion and market dominance.

The EU and the US have grown more moderately from their larger existing bases, with CAGRs of 6% and 7% respectively, indicating steady but slower new capacity additions relative to China's rapid build-out.

India and the GCC follow, showing rapid expansion from smaller bases. India's clean energy capacity grew from approximately 84 GW in 2015 to 213 GW in 2024, with 11% CAGR (excluding large hydro projects). The GCC, starting from a very low base, also increased its capacity significantly to 19 GW in 2024, signalling an accelerating clean energy transition.

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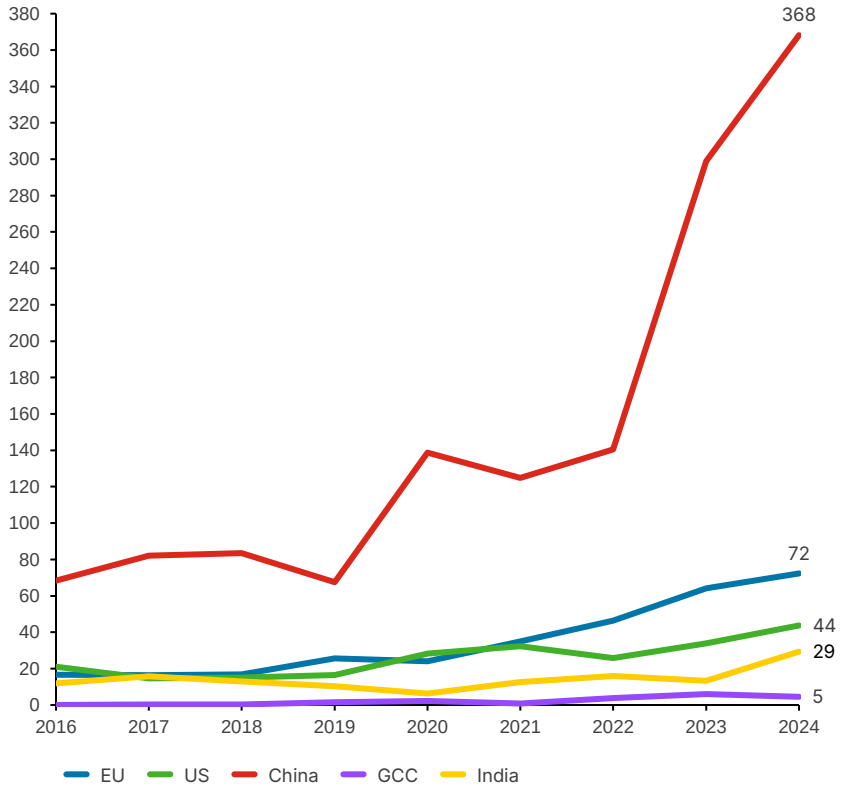
China dominates new clean energy capacity additions, accelerating sharply to 368 GW in 2024 and deploying clean power at five times the rate of the EU, followed by smaller additions in the US, India and the GCC, respectively

Annual total new clean energy capacity by region in GW (2016-2024)



Source: IRENA, 2025

China maintains market dominance, deploying more new capacity than all other regions combined in 2024 (IRENA, 2025). The most significant trend is recent acceleration, with new capacity additions escalating from 140 GW in 2022 to 368 GW in 2024, demonstrating commitment to accelerating its energy transition and cementing its global leadership position. China's ability to deploy clean power at five times the EU's rate secures its position as the global leader in both clean power generation and associated clean technology supply chains.

The EU demonstrates a clear and accelerating upward trend in annual new capacity. Additions remained relatively stable at 16–25 GW from 2016 to 2020. Since then, the build-out pace increased steadily, with additions of 46 GW in 2022, 64 GW in 2023, and 72 GW in 2024.

The US maintains a robust, steady pace, increasing from 21 GW to 44 GW over the same period. Importantly, the US administration is currently blocking new offshore wind leases pending a review of environmental, economic, and security concerns, as set out in a January 2025 presidential memorandum (The White House, 2025). India's annual clean additions were highly variable and relatively subdued until 2024, fluctuating between around 6 GW in 2020 and a peak of about 16 GW in 2022. However, 2024 reflects a significant acceleration to 29 GW.

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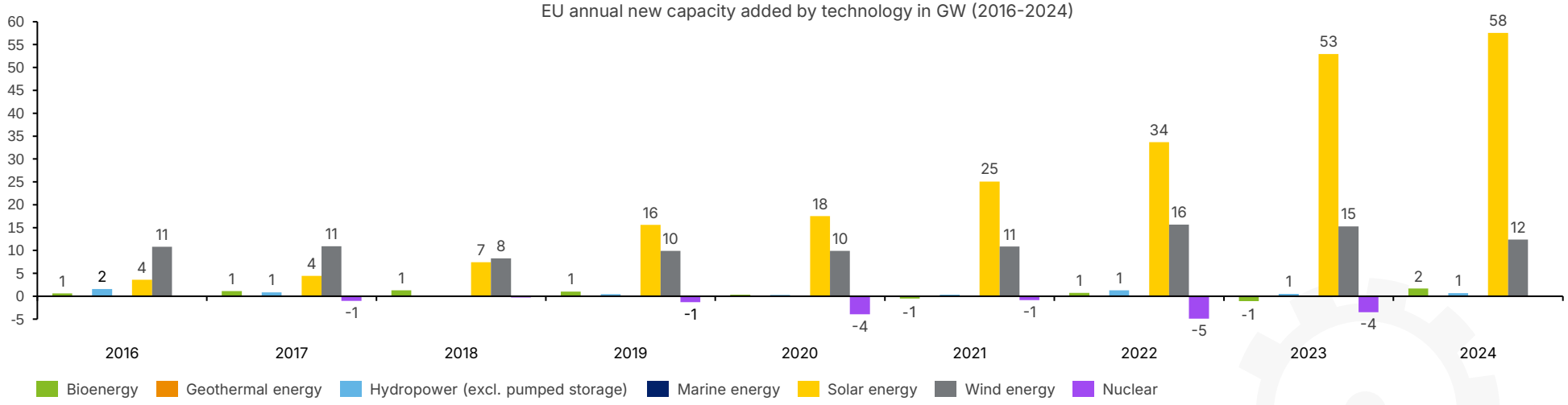
The EU's clean energy growth relies on expanding solar and wind but is slowed by declining nuclear capacity

The EU's annual new capacity by technology reveals strong focus on solar and wind. Overall clean energy growth is constrained by policies that restrict new nuclear investment and development.

- Solar dominance drives EU growth, rising from 3.6 GW in 2016 to 57.5 GW in 2024. While this surge demonstrates strong deployment, it exposes a strategic vulnerability: high demand for components is met by Chinese manufacturers.
- Wind energy provides steady new capacity, generally between 9 GW and 15 GW annually.
- Nuclear capacity declined most years, most notably in 2022 (−4.9 GW) and 2023 (−3.5 GW). These retirements reduce net clean power available for baseload industrial demand, offsetting renewable gains.

Note: Installed capacity does not fully capture generation potential as capacity factors vary by technology. Nuclear typically delivers more consistent output than variable renewables like solar and wind, which should be considered when evaluating their contributions.

EU annual new capacity added by technology in GW (2016-2024)



Source: IRENA, 2025

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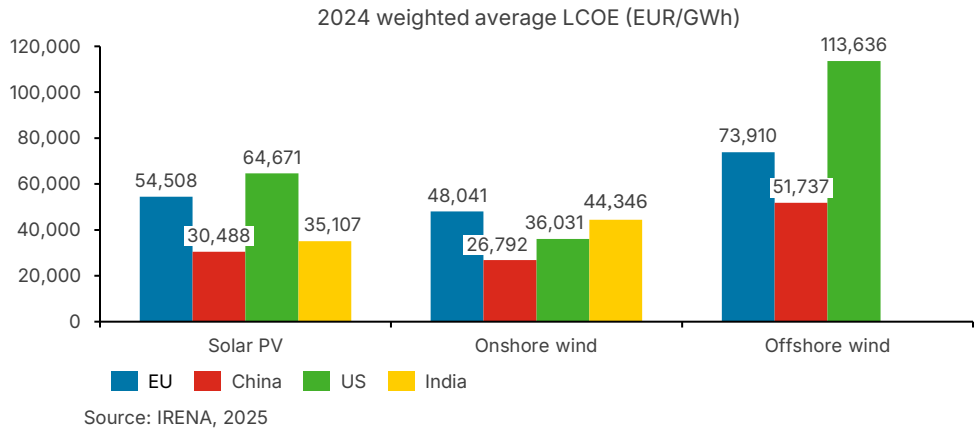
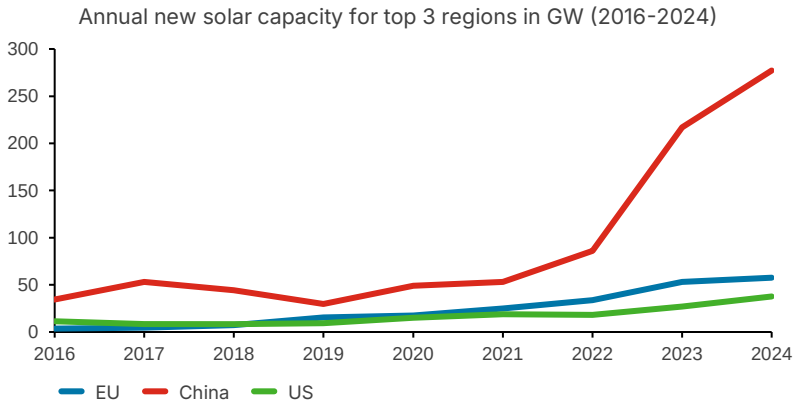
Regional variations in levelised cost of electricity (LCOE) highlight China's cost advantage in clean energy technologies



Source: IRENA, 2025



Source: IRENA, 2025

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The 2024 weighted average levelised cost of electricity (LCOE) data across regions reveals significant variations in clean energy technology competitiveness.

China demonstrates the lowest LCOE for both solar PV and onshore wind at €30,488/GWh and €26,792/GWh respectively, underscoring its cost advantage and supporting rapid capacity expansion.

The EU's LCOE for solar PV (€54,508/GWh) and onshore wind (€48,041/GWh) are notably higher, reflecting relatively higher costs that may impact competitiveness despite strong deployment.

The US shows the highest LCOE for solar PV at €64,671/GWh and offshore wind at €113,636/GWh, indicating cost challenges particularly in offshore wind development.

India's LCOE for solar PV (€35,107/GWh) and onshore wind (€44,346/GWh) position it competitively, although commercial offshore wind capacity is absent.

Solar deployment disparity reveals the competitive pressure. The EU's annual solar additions reached 57.5 GW in 2024 faster than the US's 37.7 GW but were substantially eclipsed by China's 277.2 GW. Despite the EU's strong deployment, the LCOE for solar PV in the EU is nearly twice as high as in China. This cost advantage supports rapid capacity expansion and reinforces the global leadership position in both clean power generation and clean technology supply chains.

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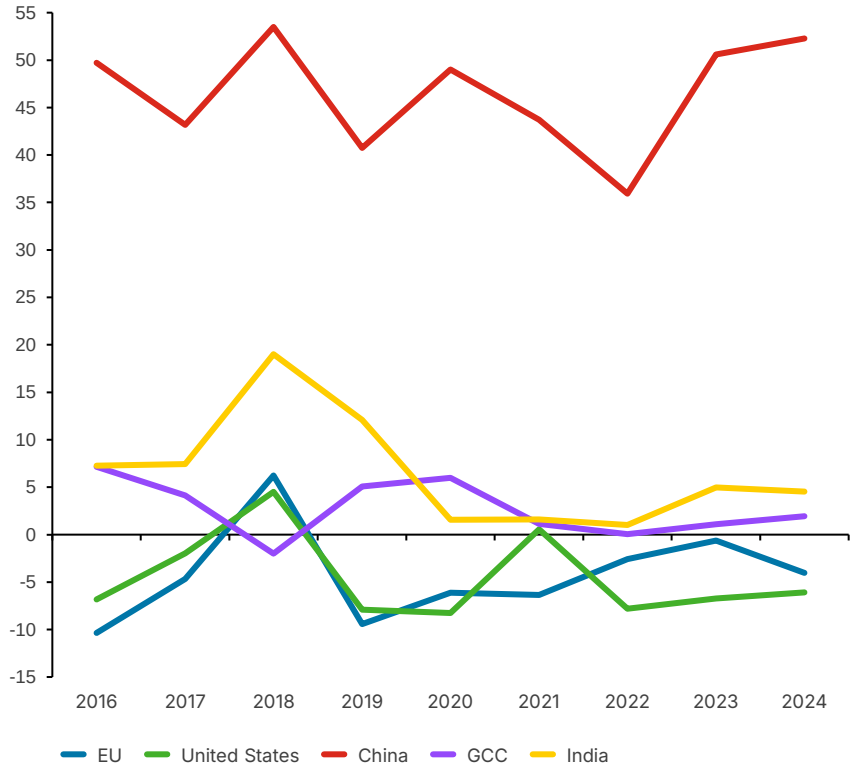
China leads global power capacity growth by expanding both clean and fossil fuel sources, unlike the EU and the US which focus on retiring fossil fuels

Annual new fossil capacity by region in GW (2016-2024)



Source: IRENA, 2025

While the EU, the US, and China pursue the clean energy transition, fossil fuel addition data reveals strategic differences. China's leadership is defined not solely by rapid annual clean energy deployment, but by dual-track expansion across the entire power sector. In contrast to the EU and the US, which are in fossil fuel retirement phases, China continuously adds significant fossil capacity. **This dual focus on expansion in both clean and traditional power sources establishes China's global capacity growth leadership and highlights the EU's ongoing need to both accelerate domestic clean technology deployment and strengthen supply chain resilience.**

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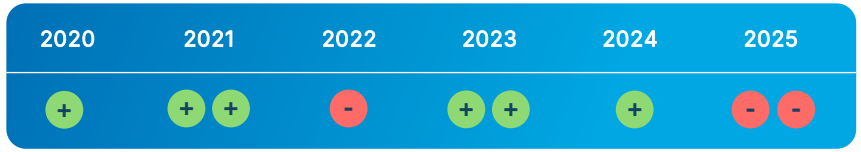
KPI 3.3 Industry volume of power purchase agreements (PPAs)

This KPI tracks the aggregated energy capacity (measured in GW) contracted through long-term power purchase agreements (PPAs) by industrial end-users with renewable or low-carbon energy producers across the EU between 2015 and 2025. Monitoring this volume is essential because PPAs provide industry with predictable, affordable long-term energy prices, thereby mitigating exposure to wholesale volatility and regulatory changes, which enhances global competitiveness. This dataset covers 23 of the 27 EU Member States and includes detailed information on PPA volumes by country, by 30 industrial sectors, and by technology type.

EU performance evolution



Key takeaways

- **EU PPA market reaches 7.64 GW of total volume in 2025**: Despite strong growth in EU PPA volumes since 2015, a sharp 35% drop in 2025 and ongoing market challenges highlight the need for more flexible, hybrid contract models to support a mature and sustainable renewable energy market.
- **European average PPA price stands at €46.20/MWh in 2025:** By October 2025, the average PPA price in Europe was €46.20/MWh, with significant regional and technology-based price variations, tariffs, particularly impacting energy-intensive industries with costs and structural barriers.
- **Spain leads EU PPA volumes with 2.60 GW in 2025 amid varied national trends:** Spain leads EU PPA volumes at 2.60 GW in 025 despite a recent decline, while Germany's volumes fall sharply after peaking in 2024. Italy continues to grow, supported by new national policies, and other countries show varied trends, underscoring the need for tailored policy and infrastructure to drive EU-wide PPA growth.
- **Heavy industry and ICT sectors drive EU PPA growth despite 2025 volume declines:** Heavy industry and ICT dominate PPA uptake, growing substantially since 2015 but facing volume reductions in 2025.
- **Solar energy drives fastest PPA growth**: Solar energy exhibits the fastest growth in PPA volumes, supported by cost reductions and scalability, while onshore wind remains a stable contributor. Offshore wind and hybrid renewables show more variable but growing roles.

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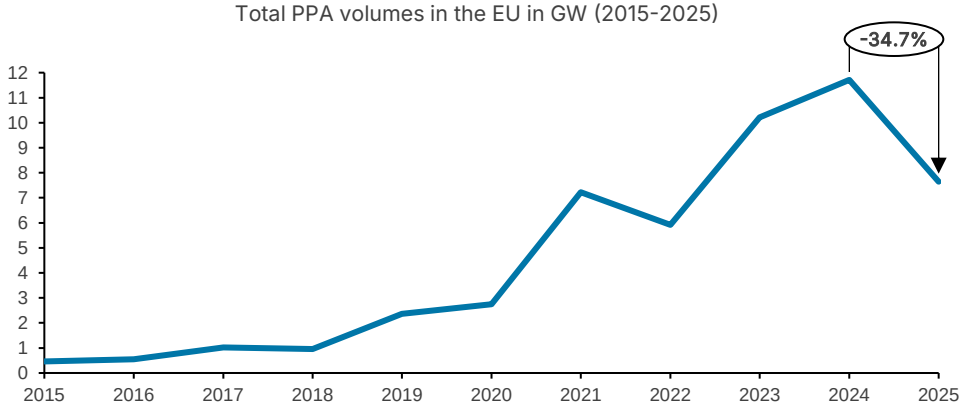
By 2025, EU PPA volumes have grown significantly but face a sharp 35% decline due to financing and structural challenges, prompting a shift toward more complex hybrid contract models

Total PPA volumes in the EU in GW (2015-2025)



Source: WindEurope, 2025

In 2025, the annual volume of PPAs amounted to 7.64 GW. PPA volumes signed by industry across the EU increased from 2015 to 2024. The cumulative volume of PPAs from 2015 to 2025 across the 23 covered Member States totals 50.81 GW.

The average volume of PPAs by EU Member States grew from 0.02 GW in 2015 to a peak of 0.51 GW in 2024, before declining to 0.33 GW in 2025. This upward trend reflects growing industrial demand for renewable and low-carbon energy, supporting the EU's transition to a competitive and sustainable energy market. **The EU PPA market experienced a significant decrease between 2024 and 2025, with deal volumes falling by approximately 35%.** This downturn is primarily attributed to deteriorating market conditions, including high financing costs, which have complicated price agreements (PV Magazine, 2025).

Structural bottlenecks, specifically slow permitting processes and insufficient grid infrastructure, continue to hinder project timelines, with the majority of EU Member States currently in breach of EU permitting legislation (SolarPower Europe, 2025). Furthermore, the rise of negative power price hours has introduced 'cannibalisation' risks, where a surplus of renewable energy during peak production times drives market prices down, reducing the value of the electricity being sold (Balkan Energy News, 2025).

The market for energy-intensive users remains underdeveloped due to financial and structural challenges, such as limited financial guarantees against counterparty risk and a cautious approach to managing price and liquidity risks. PPAs' impact depends heavily on contract structure; for instance, pay-as-produced models can expose buyers to significant price and volume risks. Despite these headwinds, the market is undergoing a transition toward navigating greater complexity, shifting away from simple pay-as-produced (PV Magazine, 2025). Progress toward a mature PPA market will rely on creating hybrid PPAs that combine flexible energy assets with aggregated supply and demand. These agreements should also integrate battery storage and adaptable offtake arrangements, which together can help overcome some existing challenges (European Commission, 2024).

Overall, while there has been substantial growth in PPA volumes in recent years, the sharp decline in 2025 marks a notable collapse in the market. The US market leads the EU, with cumulative PPA volumes twice as high (European Commission, 2024). However, 2023 was the first year during which the EU contracted more capacity in new PPAs than the US (based on BNEF data until November 2023). The cumulative volume of PPAs from 2015 to 2025, at 50.81 GW, also compares to the 799 GW of clean capacity in the EU (6.36%), highlighting that only a relatively small fraction of clean energy is currently contracted through PPAs.

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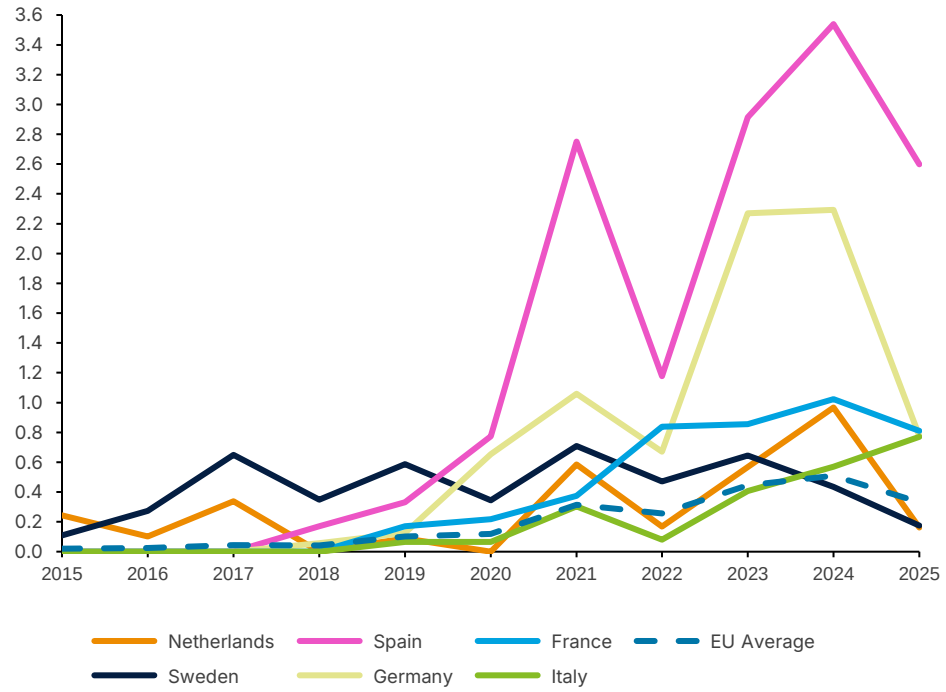
Spain leads EU PPA volumes at 2.60 GW in 2025, followed by Italy and France, with other top countries showing varied growth

EU industry PPA volumes: Top 6 countries vs. EU average in GW (2015-2025)



Source: WindEurope, 2025

Among top countries, Spain leads PPA volumes in 2025 with 2.60 GW, exceeding the EU average of 0.33 GW. However, this represents a decline from 3.54 GW in 2024, indicating some recent market contraction.

Germany shows robust growth, reaching a peak of 2.29 GW in 2024, followed by a decline to 0.78 GW in 2025. The country experienced an approximately 84% collapse in contracted solar volume during the first half of 2025, reflecting market saturation and cautious buyer behaviour amid increased negative price hours – 28% of solar output coincided with negative prices early in 2025. Elevated wholesale prices and risk premiums during the 2021-2023 energy crisis caused a spike in PPA prices, which have since declined as markets stabilised (European Parliament, 2026). Sweden, Netherlands and France also experienced variations and increases in volumes before a decline in recent years.. Italy continues to grow, reaching 0.77 GW in 2025, supported by new legislation introduced in June 2025 that established a national PPA negotiation platform and a state-backed guarantee. This aims to boost investor confidence and support Italy's goal of 70 GW new renewable capacity by 2030 (European Parliament, 2026).

Variations between countries underscore the importance of tailored policy frameworks and infrastructure investments to support PPA expansion across the EU, critical to achieving pillar 3's goal of making Europe a globally competitive provider of affordable, low-carbon energy.

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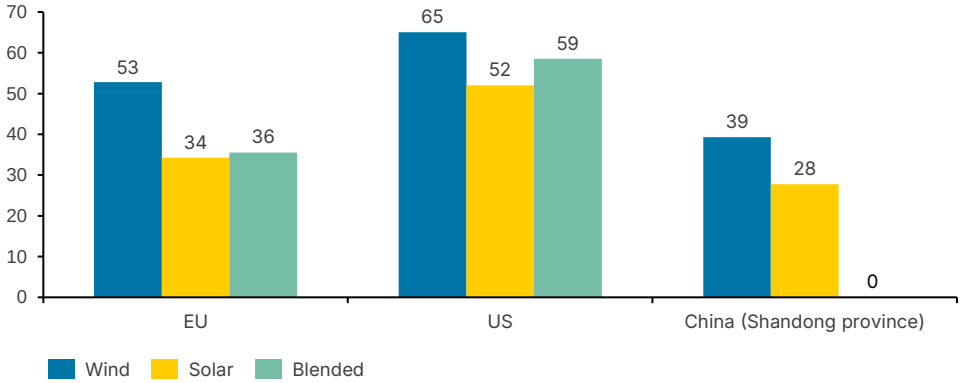
As of October 2025, EU PPA prices average €46.20/MWh amid regional disparities and industrial challenges, while US prices rise and China launches low-cost renewable auctions

Comparative analysis of solar, wind and blended PPA prices in EUR/MWh (2025)



Source: Deloitte based on PV Tech, PV magazine, Fitch Solutions, 2025

As of October 2025, the average price of a PPA in Europe stands at €46.20/MWh (Chapuis, 2025). This snapshot reflects a broader global market exhibiting distinct regional trends. It is important to note that the PPA market comprises a wide range of players, contract structures, and project sizes, all of which significantly influence pricing dynamics and cost outcomes.

In the EU, average solar PPA prices fell to €34.25/MWh by Q3 2025, a decline of 19.4% compared with the third quarter of 2024 (PV Tech, 2025). National variations remain substantial; for instance, Ireland's solar PPA prices (€120/MWh) are nearly four times those of Portugal (€33.46/MWh), a gap attributed to climatic differences and Ireland's rising demand from data centre expansions (PV Tech, 2025).

Energy-intensive industries, where electricity can represent up to 40% of production costs, face considerable challenges in adopting PPAs (European Aluminium, 2024). Barriers include shaping and firming costs, expenses to manage the variability of renewables to meet steady industrial demand (European Aluminium, 2024). PPA prices, closely linked to variable short-term wholesale markets and limiting their ability to be decoupled from fossil fuel fluctuations, see increased demand when wholesale prices rise, which can also prompt developers to seek higher contract prices, keeping costs elevated and challenging energy-intensive sectors (Eurofer, 2024; European Parliament, 2026).

In contrast to the EU, the US has seen rising PPA costs, with average solar prices increasing from €49.40/MWh in 2024 to €52.01/MWh in 2025, wind at €65.00/MWh, and blended averages at €58.51/MWh (Kennedy, 2025). This increase is driven by the 2025 One Big Beautiful Act (OBBA), which replaced long-term tax credits with a strict 2028 eligibility deadline, alongside 50% tariffs on key construction materials that raise capital costs passed on to buyers (Kennedy, 2025).

Meanwhile, China is transitioning to a competitive market-based system. In September 2025, Shandong province held its first major renewable auction under new reforms, awarding 4.9 GW capacity. Solar cleared at €27.71/MWh (CNY 0.225/kWh) and wind at €39.29/MWh (CNY 0.319/kWh), reflecting wind's more stable generation profile (Fitch Solutions, 2025). Although low solar prices raise concerns about project bankability, they establish a favourable price floor for industrial consumers, likely accelerating corporate PPA activity in China's load centres (Fitch Solutions, 2025).

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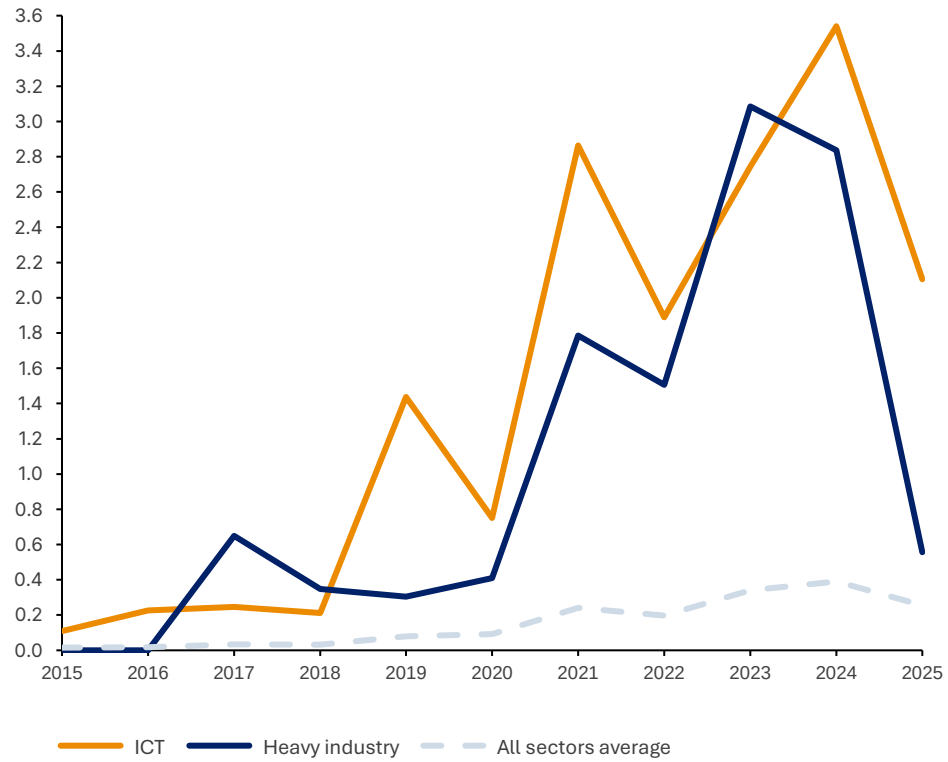
Heavy industry and ICT sectors lead the EU corporate PPA market, driving renewable energy growth due to their high energy needs and sustainability commitments

PPA volume growth of EU sectors vs. average sector trend (2015-2025)



Source: WindEurope, 2025

The distribution of corporate PPA volumes across EU sectors varies significantly, with heavy industry and ICT as the main drivers of market growth. Heavy industry's contracted PPA volumes grew from 0 GW in 2015 to 3.08 GW in 2023, reflecting its high energy intensity and need for long-term price stability to hedge against volatile energy costs and meet decarbonisation mandates. In 2024 and 2025, the chemicals, steel, glass, industrial gases, metals, and manufacturing industries were the primary drivers of PPA volumes of heavy industry, showing variations but overall growth, while sectors like cement, brick maker, packaging, industrial fermentation, construction, and transport continued to struggle with minimal or no PPA activity. Meanwhile, the ICT sector led in cumulative PPA volumes, expanding from 0.11 GW in 2015 to 3.54 GW in 2024, driven by the growth of data centres. For ICT firms, PPAs provide reliable, large-scale 24/7 power while supporting commitments to 100% renewable energy.

In early 2025 both ICT and heavy industry experienced a sharp decrease in contracted capacity, with ICT volumes falling to 2.11 GW and heavy industry to 0.56 GW. This decline is largely due to a combination of negative electricity spot prices and cannibalisation effects (European Parliament, 2026). Overall, high energy intensity and clear sustainability goals correlate strongly with leading PPA uptake, while other sectors increase participation more gradually. This variation highlights the need for tailored policies and market mechanisms to broaden PPA adoption, which is essential for the EU's energy transition and maintaining competitiveness.

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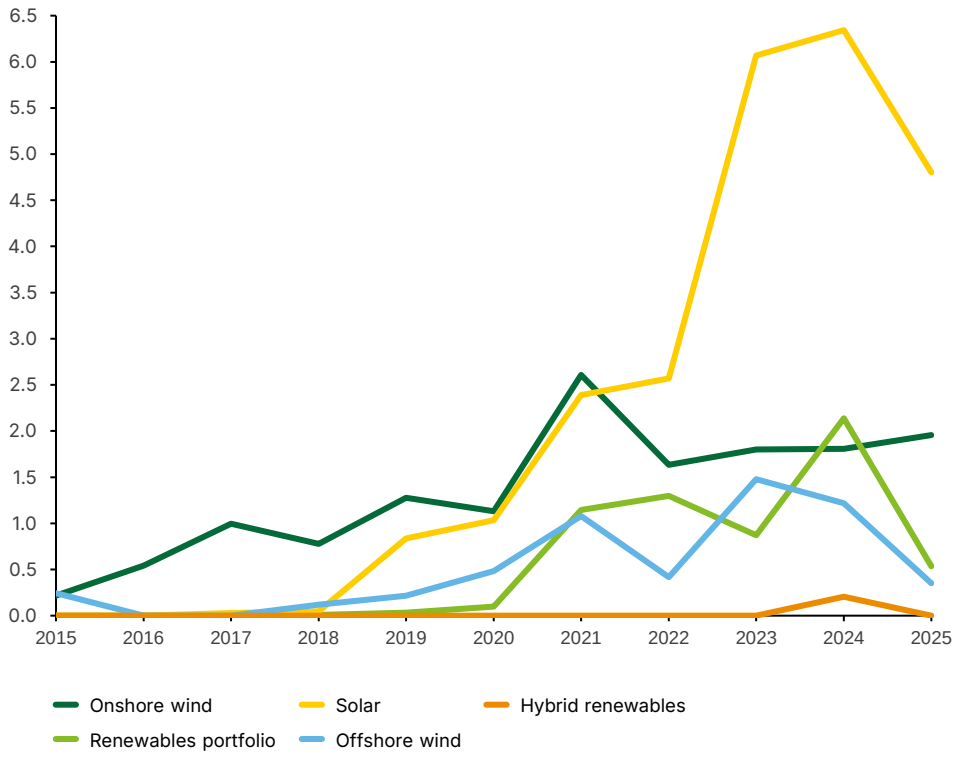
Solar and onshore wind lead PPA growth due to cost and scalability, while offshore wind and renewables portfolios show more variable trends, reflecting evolving market dynamics and the need for a diverse renewable energy mix in the EU

Evolution of volumes of PPAs for industry from 2015 to 2025 by technology (GW)



Source: WindEurope, 2025

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Analysis of PPA volumes by technology reveals distinct growth patterns across renewable energy sources. Solar energy demonstrates the most significant increase, rising sharply from near zero in 2015 to a peak of 6.34 GW in 2024, before a decline in 2025. It overtook onshore wind in 2021, before increasing significantly.

Onshore wind demonstrates steady growth, increasing from 0.22 GW in 2015 to approximately 2.0 GW in 2025, maintaining a strong position as a key renewable technology for industrial PPAs. Offshore wind shows a more variable trend, with growth peaking at 1.48 GW in 2023, followed by fluctuations and a decline to 0.35 GW in 2025, possibly reflecting project development cycles and regulatory factors.

The renewables portfolio category, covering PPAs with unspecified mixes of renewable assets, grew rapidly from 2020, peaking at 2.14 GW in 2024. Hybrids – single PPAs for combined technologies like solar-plus-storage – appear only in 2024 at 0.21 GW, showing early but limited adoption.

Overall, solar and onshore wind dominate the PPA landscape, driven by their maturity, cost competitiveness, and scalability. The variability in offshore wind and the rise of renewables portfolios highlight evolving market dynamics and growing sophistication of industrial renewable energy procurement. These trends underscore the importance of supporting a diverse technology mix to meet industrial demand and advance the EU's energy transition goals.

Additionally, in 2024, PPAs represented approximately 10.3% of new solar capacity additions (6 GW of 58 GW) and about 25.8% of new wind capacity additions (3.1 GW of 12 GW), underscoring their contribution to clean energy growth.

Note that capacity factors vary across technologies, influencing actual energy generation.

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Pillar 4: Focus on the infrastructure Europe needs

Target the Recovery and Resilience Facility and Structural and Regional Funds to integrate and build world-class EU energy, digital, CCUS and recycling infrastructures as soon as possible – make them Important Projects of European Common Interest. Debottleneck cross-border transport and develop trans-European networks. Remove permitting obstacles for industrial transformation projects. This transformation will also require significant numbers of skilled workers that are currently in short supply. Targeted programmes will be necessary to make these available quickly

Pillar conclusions

The EU **has increased energy infrastructure investment to 0.46% of GDP in 2024**, matching the US but below China's 0.62%. Despite **lower absolute spending** (€80 billion projected in 2025), it benefits from **one of the world's most resilient grids**, with blackout durations averaging 0.9 hours annually versus over 7 hours in the US. However, **long connection queues** (7 to 10 years on average vs 5 years in the US) risk becoming a bottleneck that could limit industrial growth and clean energy deployment, threatening future competitiveness. Additionally, only **14 of 27 Member States meet the 15% electricity interconnectivity target**. Major economies lag, limiting market integration and renewable deployment.

Addressing these challenges requires substantial public funding – the **EU has allocated €36 billion through IPCEI and CEF** (2015–2024) – primarily focused **on hydrogen infrastructure** and **digital innovation**. While CEF supports **grid interconnection and CCUS**, these investments remain modest relative to 2030 targets. The lack of large-scale recycling projects highlights a critical funding gap in circular economy infrastructure.

Digital infrastructure nears 100% 5G coverage by 2025, but key capabilities like **standalone 5G networks and low-latency edge computing remain underdeveloped**, restricting industrial digitalisation. These shortfalls deepen supply chain vulnerabilities as the EU's **semiconductor market share (~10%) lags global leaders.** Data centre capacity is also lagging **with 4.5 times more capacity in the US and 2.6 more in China.**

The limited scale of carbon capture and storage (CCS) capacity is particularly concerning. With **only 0.6 Mtpa of operational CO_2 storage**, the EU falls significantly short of the 50 Mtpa target for 2030 and lags behind global peers, reflecting a strong and urgent need to de-risk the full CCS value chain, increasing project bankability.

Similarly, labour market pressures are increasing in manufacturing. The **1.6% vacancy rate projected for 2025**, although lower than in the US, signals tightening skills shortages that could constrain future growth.

In sum, while the EU has laid important groundwork with targeted investments and resilient infrastructure, it faces interconnected strategic challenges in scaling cross-border grid interconnections, CCS, advanced digital infrastructure, and skilled labour supply. To maintain competitiveness and meet Clean Industrial Deal ambitions, the EU must increase investment levels and streamline project delivery, ensuring these elements work together as a cohesive whole.

0.46%
of GDP for grid and storage investment

€36
Billion of key infrastructure funding

0.6
Mtpa of operational CO_2 storage

1.6%
Job vacancy rate (JVR) in manufacturing

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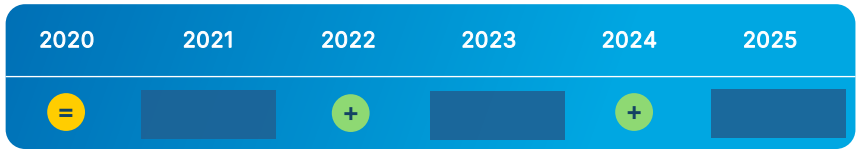
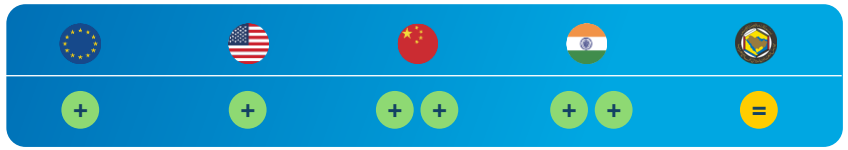
KPI 4.1 Investment in power grid infrastructure and storage as share of GDP

This KPI measures the financial priority a region places on its fundamental electricity infrastructure. It is calculated by taking the annual spending on grids and storage and expressing this spending as a percentage of the corresponding economy's gross domestic product (GDP). The purpose is to determine the structural commitment to infrastructure modernisation. A rising or sustained high KPI value signals proactive governmental and corporate investment aimed at future-proofing the energy system, directly supporting pillar 4's goal of building a world-class EU energy infrastructure.

EU performance evolution



International benchmarking



Key takeaways

- **EU investment reached 0.46% of GDP in 2024**: The EU's accelerated investment trajectory reached 0.46% of GDP in 2024 for power grid and storage infrastructure, marking increased commitment compared to the previous decade. This investment share matches the US's 2024 commitment, validating the EU's prioritisation of energy infrastructure. China leads at 0.62%, driven by the need for new transmission networks, whilst the EU focuses on modernising existing grids and enhancing cross-border interconnections. The EU's acceleration contrasts with slower growth in the Middle East, matching its investment share in 2024. India's investment declined to 0.56% by 2024 but the country remained ahead of most other regions, except the US.
- **Investment increase responds to European Grid Action Plan**: This investment increase responds to pillar 4 and the European Grid Action Plan's €584 billion target by 2030 (European Commission, 2023) this decade. The EU currently averages €64 billion annually (2023–2025), with €80 billion in 2025, exceeding the targeted €58.4 billion per year. However, some estimates suggest needs up to €89 billion annually (European Parliament, 2024), indicating sustained or increased investment is necessary.
- **EU must maintain acceleration to compete globally**: Although the EU is progressing, the scale of infrastructure deployment by global peers, especially the US and China, presents a competitive challenge. To secure a leading role in low-carbon industries and clean energy markets, the EU must maintain and accelerate investment, ensuring rapid development of an interconnected, resilient grid.
- **Grid connection backlogs remain a critical bottleneck**: Grid connection backlogs remain a critical bottleneck, with 1,700 GW of renewables stuck in queues and delays up to 13 years, threatening industrial competitiveness and Green Deal targets.
- **EU grid quality is strong but backlogs slow transition**: Whilst the EU's grid quality remains strong, these backlogs are slowing the clean energy transition, making accelerated investment essential to resolve capacity constraints.

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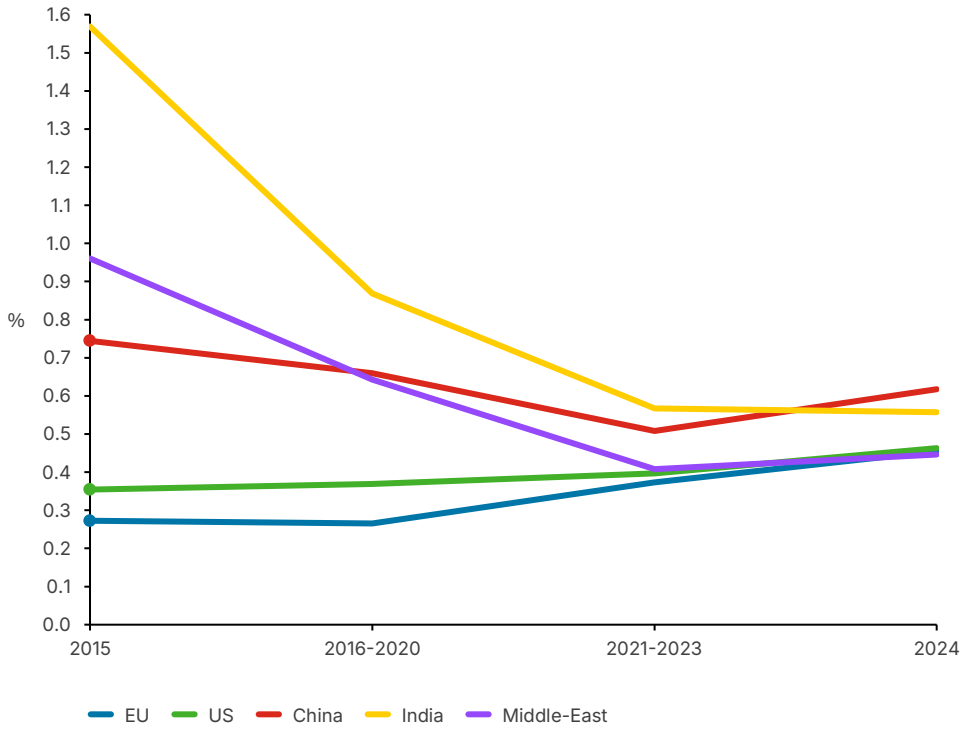
The EU historically under-invested in power grid and storage but has sharply increased investment since 2021, nearly matching the US by 2024, though still trailing China due to differing grid priorities

Investment in power grid and storage as share of GDP (2015-2024)



Source: Deloitte analysis based on IEA 2024; World Energy Investment Report 2024 & 2025

The analysis of power grid and storage investment relative to GDP shows the EU historically lagged behind major global competitors. From 2016 to 2020, the EU invested a low 0.27% of GDP, trailing the US (0.35%), China (0.74%), the Middle East (0.61%), and India (1.57%) in 2015. This under-investment reflected the EU's challenge in upgrading legacy grids for the energy transition.

Since 2021, the EU has accelerated its commitment, with investment rising to 0.37% (2021–2023) and 0.46% in 2024 – nearly double the previous decade's rate – supporting pillar 4 objectives. Meanwhile, India's investment declined to 0.56% by 2024, and the Middle East dropped to 0.41% (2021–2023).

In 2024, the EU matched the relative investment level of the US (0.46%) and the Middle East (0.45%), demonstrating a convergence in policy commitment with its North American peer. The investment focus in the US was primarily on enhancing grid reliability and upgrading old infrastructure (IEA, 2024), a challenge shared with the EU. Despite this progress, the EU continued to lag behind China, which maintained a lead at 0.62% in 2024. Whilst China's high investment reflects its massive scale of renewable deployment – commissioning as much solar photovoltaic (PV) in 2023 as the entire world did in 2022 (IEA, 2024) – its grid spending is largely dedicated to new networks (IEA, 2024). This is in line with investments figures of KPI 3.2. This strategy differs fundamentally from the EU's core grid challenge, where investment is focused on modernising existing, dense networks to accommodate distributed renewable energy and enhance cross-border interconnection (IEA, 2024).

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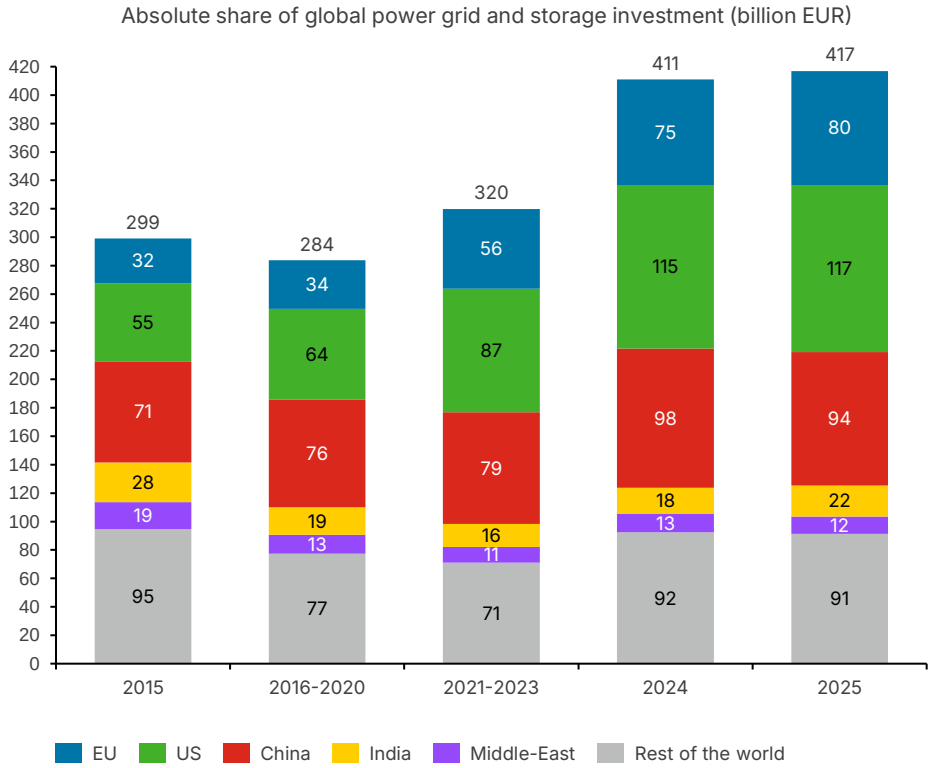
The EU has doubled its energy infrastructure investment to €80 billion by 2025, remaining behind the US and China in capital deployment



Source: Deloitte analysis based on IEA 2024; World Energy Investment Report 2024 & 2025
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Examining the absolute capital flows confirms the EU's accelerating commitment to modernising its energy backbone but underscores a significant scale-of-investment gap with its largest competitors.

The EU has consistently increased its absolute investment, moving from €31.55 billion in 2015 to a projected €80.06 billion in 2025, an increase of over 150%. This momentum is essential for streamlining cross-border transport and developing the critical trans-European Networks, as stipulated in pillar 4.

In absolute terms, the EU is the third-largest investor globally in this critical infrastructure but remains substantially behind both the US and China. In 2025, the US was projected to invest €117.48 billion, while China was projected to invest €93.99 billion. This disparity in capital deployment presents a challenge to the EU's ambition to rapidly build 'world-class' infrastructure and accelerate the industrial transformation projects.

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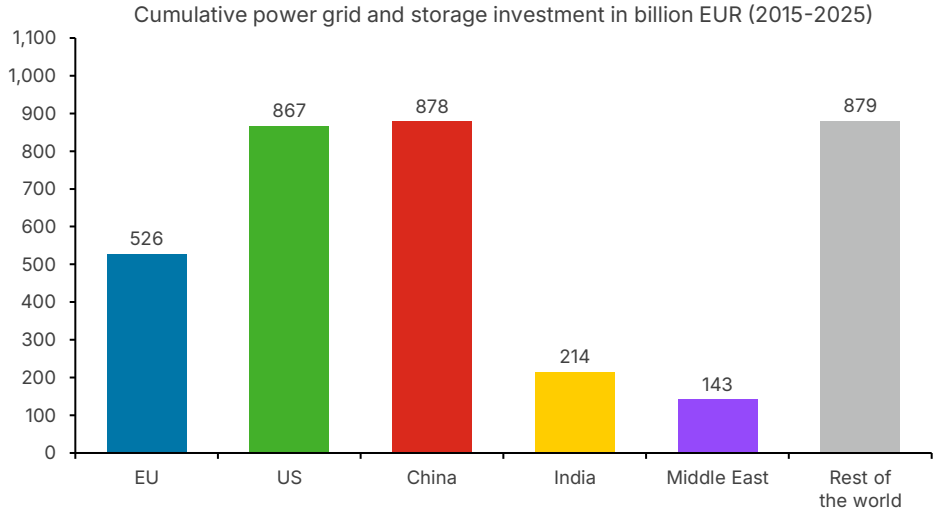
From 2015 to 2025, the EU invested €526 billion in power grids – third globally – but its highly resilient and efficient grid maximises value despite the lower investment compared to China and the US



Source: Deloitte analysis based on IEA 2024; World Energy Investment Report 2024 & 2025
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The analysis of cumulative investment in power grid infrastructure and storage from 2015 to 2025 highlights a scale-of-investment gap between the EU and its largest global competitors. Over this decade, the total global investment for the regions listed reached approximately €3.5 trillion, with the EU contributing €526.3 billion, a share of about 15.01%. While this represents substantial capital flow, it places the EU as the third-largest investor, behind the two regions: China (€877.7 billion) and the United States (€866.6 billion).

This gap in capital deployment presents a challenge to the EU's ambition to quickly streamline cross-border transport and develop the necessary trans-European Networks required for accelerating industrial transformation projects.

However, focusing solely on absolute investment overlooks the effectiveness derived from the European electricity grid's quality, suggesting an efficient deployment of capital. The European Commission states the EU has one of the world's most interconnected and resilient grids (European Commission, 2023). Targeted investments under pillar 4, including €6 billion annually in cross-border capacity, are projected to reduce generation costs by €9 billion yearly until 2040 (European Commission, 2023). This infrastructure also ensures higher reliability, with European blackouts averaging 0.9 hours versus over 7 hours in the US (DSO Entity, 2025). Independent benchmarks confirm EU grid readiness, ranking Germany first and Spain and Italy above the US (BloombergNEF, 2024). Most EU countries have decreased or maintained their unplanned minutes lost and frequency of interruptions over the last two decades (CEER, 2022). This stability is driven by the implementation of incentive-based regulatory schemes in 19 countries, which are designed to maintain or improve the Continuity of Supply (CoS) through financial rewards and penalties for operators. In the EU, 14 countries have an unplanned SAIDI (duration) below 100 minutes per year and 13 countries have a SAIFI (frequency) under 0.5 interruptions per customer (CEER, 2022). These metrics show that the EU's investments have improved the reliability of its power grid.

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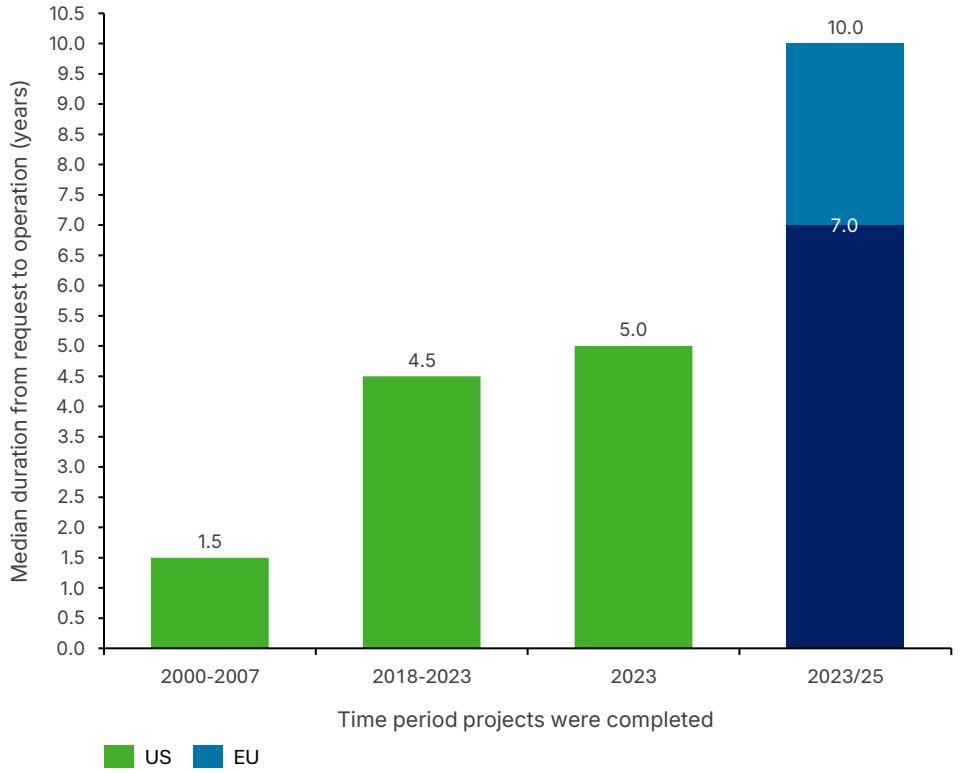
The EU is experiencing severe grid connection delays – averaging 7 to 10 years and up to 13 years in key markets – that pose a major bottleneck to clean energy projects and industrial growth

Grid connection speed: Median duration in the United States (2000–2023) vs. EU current average (2023–2025)



Source: Deloitte analysis based on Lawrence Berkeley National Laboratory, 2024 and Ember, 2025

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The EU faces a challenge due to an absolute investment gap in power grid infrastructure compared to major global competitors. However, this is more accurately framed as a significant risk to future competitiveness and a bottleneck to the Green Deal, rather than a failure of current grid resilience. The primary operational challenges relate to connection backlogs of projects waiting to access the grid. Approximately 1,700 GW of renewable capacity is currently stuck in connection queues across 16 countries (Beyond Fossil Fuels, 2025). These long connection delays risk making the grid a bottleneck in the clean energy transition.

Connection delays have become a major obstacle to industrial resilience and competitiveness in key global markets, with prolonged wait times for grid connections now stretching between seven and 10 years on average, and up to 13 years in some primary markets (Ember, 2025). These delays are increasingly undermining the pace of industrial development and market entry across regions. A significant driver of this challenge is the rapid growth in demand from large-scale data centres, particularly in major European hubs known as FLAP-D markets, where a high concentration of new data centre projects has led to severe grid congestion. Substations in these areas frequently cannot support requests for additional capacity, exacerbating connection backlogs (Ember, 2025). Similar trends are observed in the United States, where the typical time from connection request to commercial operation has more than doubled over recent years – from less than two years for projects completed between 2000 and 2007, to over four years for those built between 2018 and 2023, reaching a median wait time of five years for projects finalised in 2023 (Lawrence Berkeley National Lab, 2024).

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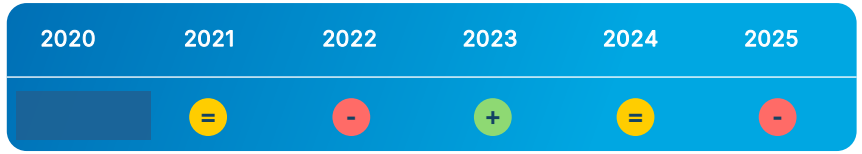
KPI 4.2 Share of Member States reaching electricity interconnectivity target

This KPI tracks the number of EU Member States whose electricity infrastructure can import or export at least 15% of their installed generation capacity, aligning with the EU's 2030 interconnectivity target. It measures progress in connecting national power grids, which is vital for a secure, affordable, and green energy system. The European Commission (DG ENER) calculates this KPI annually and uses it to support the EU's strategy to enhance energy security, integrate renewables, and ensure supply resilience across the continent.

EU performance evolution



Key takeaways

Five major industrial economies remain below 11% interconnectivity: Germany, Spain, France, Italy, and Poland remain below 11% interconnectivity, meaning the EU's core demand centres are poorly connected, preventing free power flow across the Single Market.

Member State achievement of 15% interconnectivity target is volatile and declining: Approximately 60% of EU Member States met the 15% electricity interconnectivity target in recent years. However, the return to 14 Member States in 2025, driven by Belgium and Romania dropping below the 15% threshold, confirms that maintaining this ratio is difficult, as domestic generation growth can outstrip infrastructure investment.

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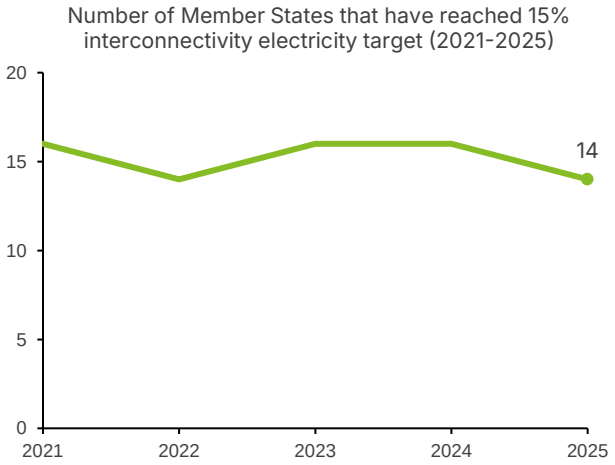
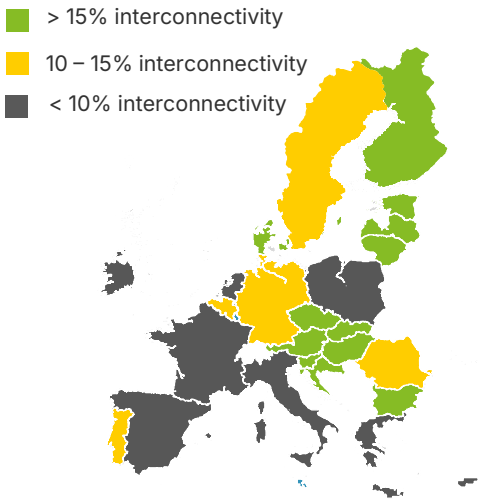
From 2021 to 2025, 14–16 EU Member States met the 15% interconnection target, with smaller countries consistently exceeding it and larger economies lagging, limiting full EU electricity market integration



Source: European Commission, 2025



Two groups stand out in electricity interconnectivity. A core group – including the Baltic States, Central Europe, Luxembourg, and Malta – consistently exceeds the 15% target, with Luxembourg reaching 95.7% in 2025, boosting supply security and renewables in smaller markets. In contrast, larger Member States like Germany, Spain, France, Italy, and Poland fall well below the target due to physical challenges, limiting EU market integration and connections between key industrial and transmission hubs.

The overall number of EU Member States meeting or exceeding the 15% interconnection target showed volatility between 2021 and 2025, consistently hovering between 14 and 16 countries (European Commission, 2025).

2021–2022 decline: The count dropped from 16 Member States in 2021 to 14 in 2022, as Belgium (16.1% to 14.8%), the Netherlands (16.3% to 13.7%), and Sweden (16.4% to 14.4%) fell below the 15% threshold. This shows the difficulty of maintaining the target. Meanwhile, Bulgaria surpassed it, increasing from 14.7% to 23.5% interconnectivity.

2023–2024 recovery and stability: The count rebounded to 16 Member States in 2023 and remained stable at 16 in 2024. This recovery resulted from Belgium (14.8% to 15.4%) rejoining the list and Romania (14.6% to 18.3%) crossing the threshold for the first time.

2025 decline: In 2025, data returned to 14 Member States after two countries dropped out. Belgium (15.9% to 13.5%) and Romania (16.3% to 12.7%) fell below the target again, signalling challenges in matching capacity growth with rising generation. Both expanded solar capacity, and Belgium also added wind (IRENA, 2025). For example, key Belgian infrastructure projects – like the Princess Elisabeth Island hub and reinforcement lines Ventilus and Boucle du Hainaut – are still underway. These upgrades are vital to support new cables to the UK (Nautilus) and Denmark (TritonLink) and maintain interconnectivity alongside domestic generation growth.

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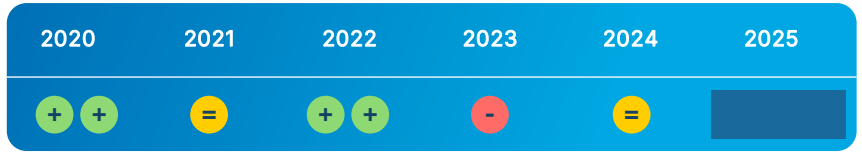
KPI 4.3 Key infrastructure projects (IPCEI & CEF) total funding in energy, digital, CCUS, and recycling

This KPI tracks total EU funding for key infrastructure projects critical to net-zero and industrial goals, from two main sources:

- **Important Projects of Common European Interest (IPCEI):** IPCEI is an instrument that facilitates approved public state aid from national budgets for projects in key strategic areas. For this KPI, we apply a broad definition of infrastructure that includes physical assets such as hydrogen pipelines and grids, as well as related production and deployment activities. The IPCEI covers six thematic areas relevant to this KPI, including hydrogen and digital cloud infrastructure and services.
- **Connecting Europe Facility (CEF) funding for Projects of Common/Mutual Interest (PCI/PMI):** CEF cover EU financial assistance for projects in energy (grid interconnection, gas pipelines, hydrogen infrastructure, storage) and carbon capture, utilisation, and storage (CCUS).

EU performance evolution



Key takeaways

€36.03 billion committed via IPCEI and CEF from 2015 to 2024: This reflects a major EU push for net-zero infrastructure. IPCEI (€28.2 billion) drives innovation and early deployment – including hydrogen, microchips, and storage – while CEF (€7.83 billion) funds market-ready projects and connectivity such as grid interconnection and CCUS transport.

Hydrogen receives two-thirds of IPCEI funding: Over two-thirds of IPCEI in scope of this KPI (€18.9 billion) is dedicated to hydrogen, with Hy2Infra (€6.9 billion) specifically building essential physical assets such as pipelines. Including the first significant CEF hydrogen deployment allocation of €0.26 billion in 2024, the total hydrogen funding amounts to €19.16 billion. The hydrogen network has €6.9 billion from Hy2Infra and €0.26 billion from CEF, making a total of €7.16 billion. This is still much less than the €34–49 billion needed for the EU's hydrogen network build-out by 2030 (Hydrogen Europe, 2024).

Digital funding supports green transformation but remains modest: The €9.3 billion in digital IPCEI funding is explicitly linked to green transformation, supporting the development of energy-efficient microchips and a resource-saving cloud-to-edge continuum. Digital funding (€9.3 billion) is modest relative to the estimated €55 billion annual investment required for the broader EU digital agenda (European Parliament, 2018).

CEF funding reflects strategic shift away from fossil fuels toward CCUS: Funding for gas pipelines has declined to near-zero, while the financial commitment to CCUS has accelerated significantly since 2020, validating its role as a strategic pathway for hard-to-abate sectors. Grid interconnection receives €5.01 billion, compared to the €584 billion total electricity grid investment needed by 2030 (European Commission, 2023). CCUS receives approximately €1.05 billion, against an estimated €6.2–12.2 billion needed for CO_2 transport infrastructure by 2030 (European Commission, 2024).

Recycling infrastructure lacks dedicated large-scale funding: Both IPCEI and CEF lack dedicated large-scale recycling projects.

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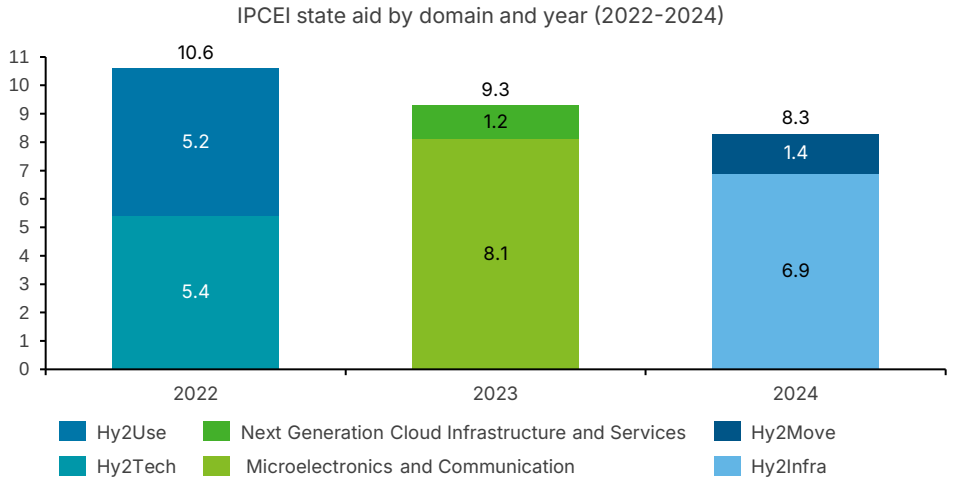
Distribution of the €28.2 billion IPCEI funding highlights strategic focus on hydrogen (€18.9 billion, 67%) and digital technologies (€9.3 billion, 33%) across six projects



Source: European Commission, 2025

Participation tier	Nr.	Countries
Max. participation (6/6)	3	France, Italy, Netherlands
Strong contributors (5/6)	4	Germany, Poland, Slovakia, Spain
Focused engagement (1-4/6)	13	Austria, Belgium, Czech Republic, Denmark, Estonia, Finland, Greece, Hungary, Ireland, Malta, Portugal, Romania, Sweden
Non-participating (0)	7	Bulgaria, Croatia, Cyprus, Latvia, Lithuania, Luxembourg, Slovenia

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The IPCEI instrument, with total funding of €28.2 billion across six areas, serves as a strategic tool to accelerate next-generation technologies across the EU (European Commission, 2025). The majority of this funding – €18.9 billion (67%) – is dedicated to the hydrogen value chain through four projects launched in 2022 and 2024. These projects cover: R&D for hydrogen generation, fuel cells, and distribution technologies (Hy2Tech); integration of hydrogen infrastructure in hard-to-abate industries (Hy2Use); development of hydrogen infrastructure including pipelines and storage (Hy2Infra); and hydrogen technologies for transport sectors (Hy2Move). The remaining €9.3 billion (33%) supports two key digital projects launched in 2023: microelectronics and communication technologies (€8.1 billion), which focus on innovative, energy-efficient electronics and manufacturing, and next-generation cloud infrastructure (€1.2 billion), aimed at creating a secure, interoperable European cloud-to-edge continuum. Digital funding (€9.3 billion) is modest relative to the estimated €55 billion annual investment required for the broader EU digital agenda (European Parliament, 2018).

The EU prioritises decarbonisation with early hydrogen projects in 2022, followed by digital projects in 2023. The 2024 hydrogen projects continue this focus, though overall investment is gradually decreasing.

Participation in the six IPCEI projects is broad, with 20 of 27 EU Member States involved. France, Italy, and the Netherlands participate in all projects, leading EU's industrial transition. Hydrogen projects have the widest participation (18 countries), while digital projects are more selective, with 14 in microelectronics and seven in cloud infrastructure. Germany shows cross-sectoral involvement. Seven Member States do not participate.

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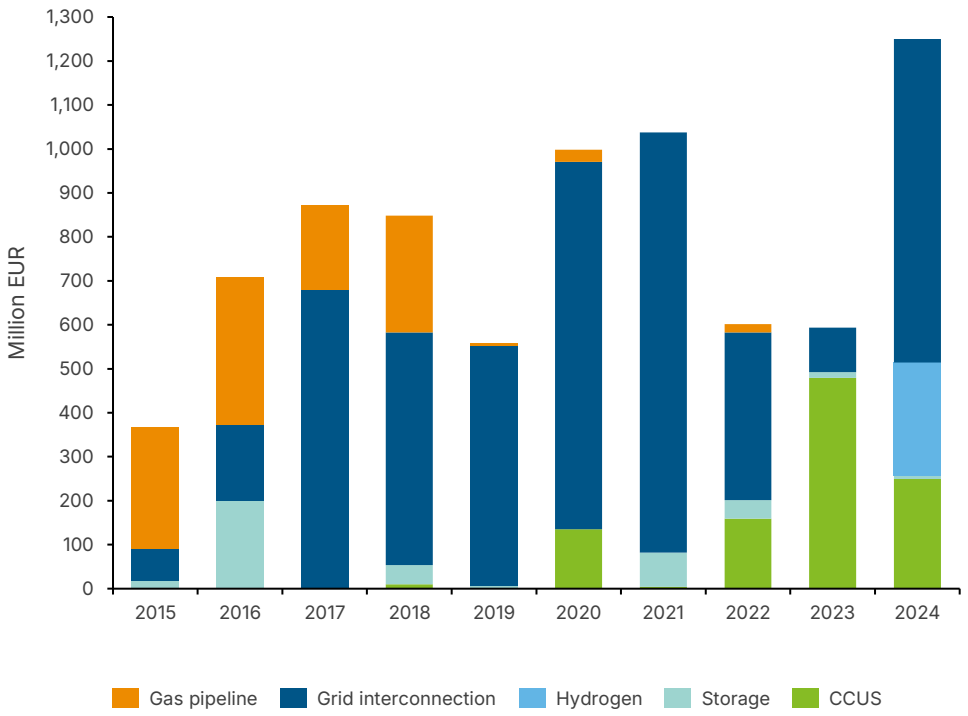
CEF funding of €7.83 billion highlights evolving priorities: strong support for grid interconnection, decline in gas pipelines, and emerging investments in hydrogen, storage, and CCUS

Annual CEF funding allocation by technology (2015-2024)



Source: Deloitte analysis based on European Commission, 2025

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CEF funding demonstrates a clear evolution in European energy infrastructure priorities over the 2015–2024 decade.

Grid interconnection: The most stable and highest-funded category (total: €5.01 billion). This category maintains significant annual allocation, demonstrating continuous commitment to building system resilience and ensuring reliable renewable energy integration. The funding is not very significant relative to the estimated €584 billion total electricity grid investment needed (this decade) by 2030 (European Commission, 2023).

Gas pipeline: Funding declined rapidly from 2018, reaching near-zero in the last four years. This provides clear evidence of capital reallocation away from fossil fuel infrastructure, confirming alignment with EU decarbonisation goals.

Hydrogen: Hydrogen received its first major CEF deployment allocation of €0.26 billion in 2024, signalling a shift from innovation to large-scale infrastructure like pipelines and storage. Combined with €6.9 billion from Hy2Infra, total funding reaches €7.16 billion – still well below the €34–49 billion needed for the EU's hydrogen network build-out by 2030 (Hydrogen Europe, 2024).

Storage: Storage represents a consistent, albeit smaller, investment area (total: €0.41 billion). The relatively low allocation confirms a sustained funding focus on projects essential for balancing the energy system and supporting grid stability as renewable penetration increases.

CCUS: Funding accelerated significantly since 2020, with peak commitments in 2023 (€0.48 billion) and 2024 (€0.25 billion). This upward trajectory validates CCUS's role as a funded strategic pathway for decarbonisng hard-to-abate industries. However, it remains small relative to the estimated €6.2–12.2 billion needed for CO_2 transport infrastructure by 2030 (European Commission, 2024).

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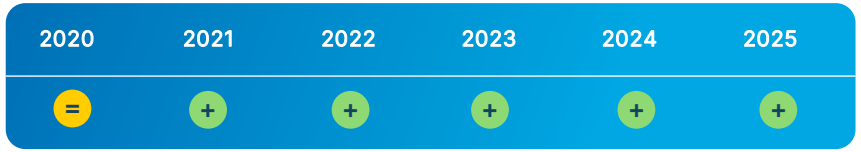
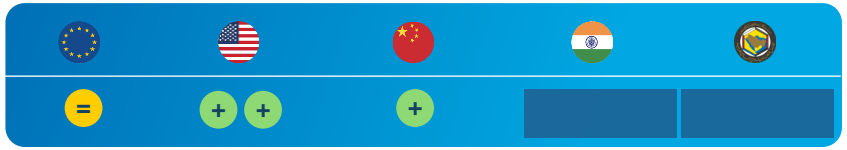
KPI 4.4 Digital infrastructure

This KPI monitors the EU's progress in developing critical digital infrastructure components essential for industrial resilience and competitiveness in the net-zero economy. It focuses on four specific areas: semiconductor market share, deployment of low-latency edge computing nodes, overall 5G network coverage and advanced 5G capabilities, and artificial intelligence (AI) infrastructure measured by data centre capacity. These four areas are inspired by the Digital Decade DESI framework. Together, these indicators provide a comprehensive view of the EU's ability to support digital transformation, secure supply chains, and enable cutting-edge technologies necessary for sustainable industrial growth.

EU performance evolution



International benchmarking



Key takeaways

- **EU made notable progress, but significant challenges remain**: The EU has made notable progress in digital transformation and infrastructure development, but significant challenges remain to fully support industrial resilience and competitiveness in the net-zero economy.
- **The Digital Economy and Society Index (DESI) score rose 55% from 2017 to 2022**: The EU's DESI score rose by 55%, showing steady digital infrastructure and integration improvements up to 2022.
- **Semiconductor market share remains low**: The EU's semiconductor market share remains low at approximately 9–11%, far behind the US and South Korea but ahead of Japan, Taiwan and China. Heavy reliance on non-EU suppliers and limited advanced chip production expose vulnerabilities in supply chains critical for industrial transformation.
- **Edge computing nodes accelerating but gap remains**: Deployment of low-latency edge computing nodes, vital for real-time industrial automation and AI applications, is accelerating, growing from 498 in 2022 to an estimated 3,712 by 2025 (95% CAGR). Whilst progress is promising, a substantial gap remains to reach the 2030 target of 10,000 nodes.
- **5G coverage expanding but advanced capabilities underdeveloped**: Overall 5G coverage in the EU reached 81% in 2023 and was projected to nearly meet the 100% target by 2025. However, advanced 5G capabilities such as standalone (SA) 5G remain underdeveloped, limiting the full potential of 5G for industrial use and digital transformation. In Q4 2024, the US achieved a median 5G SA download speed that was 1.7 times higher than Europe.
- **EU data centre capacity lags peers**: The EU lags behind the US and China in data centre capacity, hosting fewer centres with significantly lower installed capacity. The US has about five times, and China three times, more capacity. The EU's modest growth highlights the need for faster investment to stay competitive.

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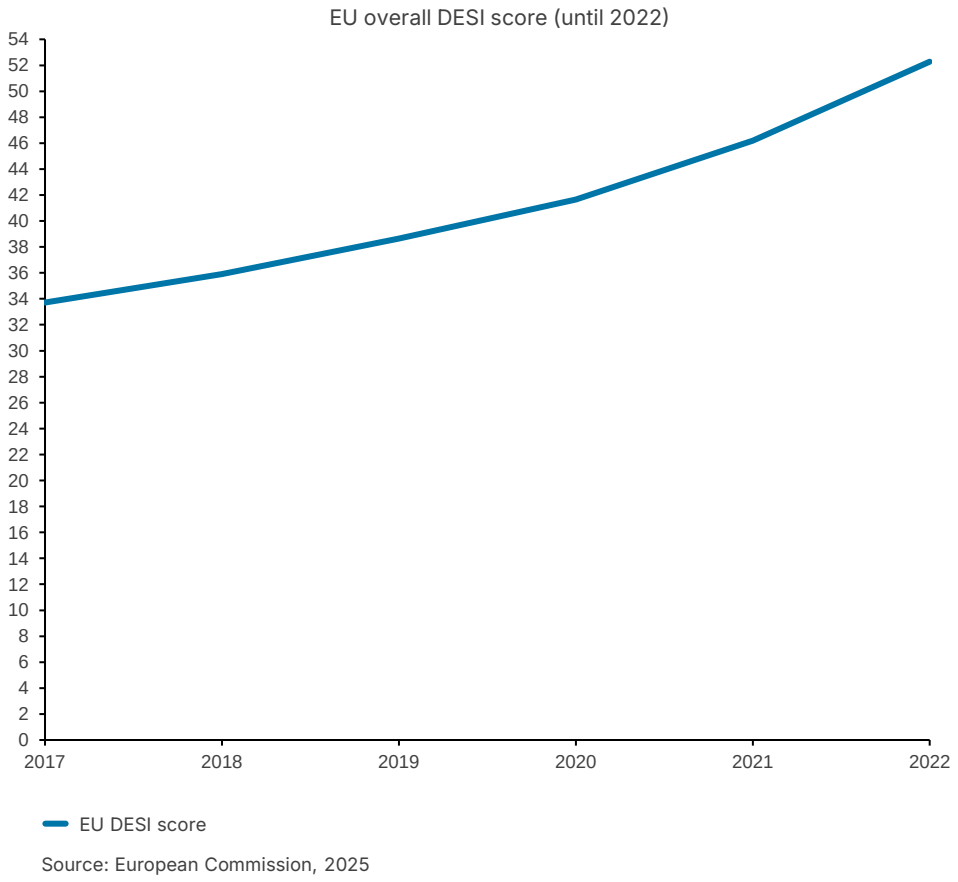
Between 2017 and 2022, the EU's DESI score rose 55%, prompting its 2023 update to monitor the Digital Decade Policy Programme 2030



Source: European Commission, 2025

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From 2017 to 2022, the EU's aggregated DESI score demonstrated a consistent upward trend, reflecting a sustained commitment to digital transformation (European Commission, 2022). The EU average score increased by approximately 55% (from 33.7 in 2017 to 52.3 in 2022). This growth indicates progress across key digital areas, including connectivity, human capital, and the integration of digital technologies by both businesses and public services. The improvement in DESI scores shows the strengthening of digital infrastructure, which is foundational for supporting advanced technologies.

In 2023, the European Commission updated the DESI score to serve as a monitoring tool for the Digital Decade Policy Programme 2030 (European Commission, 2023). This replaced the single composite score with a detailed, target-oriented dashboard focused on key digital infrastructure and technology indicators critical for industrial resilience and competitiveness in a net-zero economy.

The framework monitors industrial transformation under pillar 4 using four KPIs from the Digital Decade DESI:

- Semiconductors: EU's share of global chip production, indicating technological sovereignty and security of industrial control components
- Edge nodes: Deployment of low-latency (<20 ms) localised data processing, enabling real-time automation and autonomous industrial operations
- 5G coverage: Extent of wireless network availability supporting industrial connectivity
- AI: Replaced the original AI usage indicator with regional data centre capacity to better capture AI infrastructure challenges

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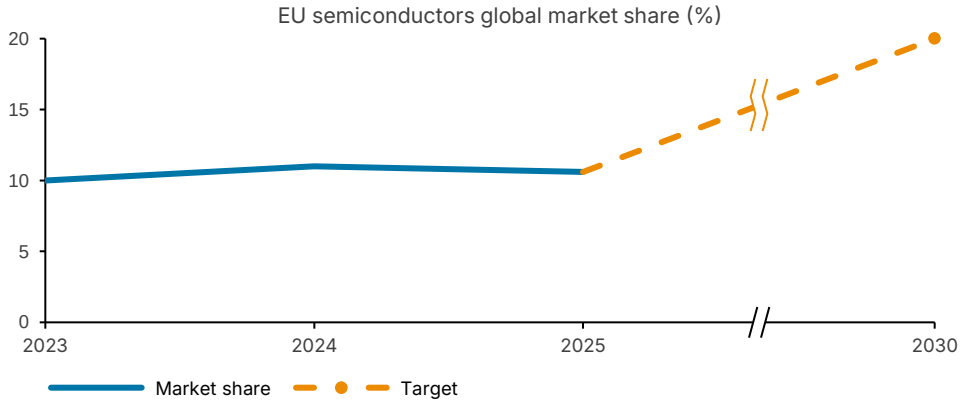
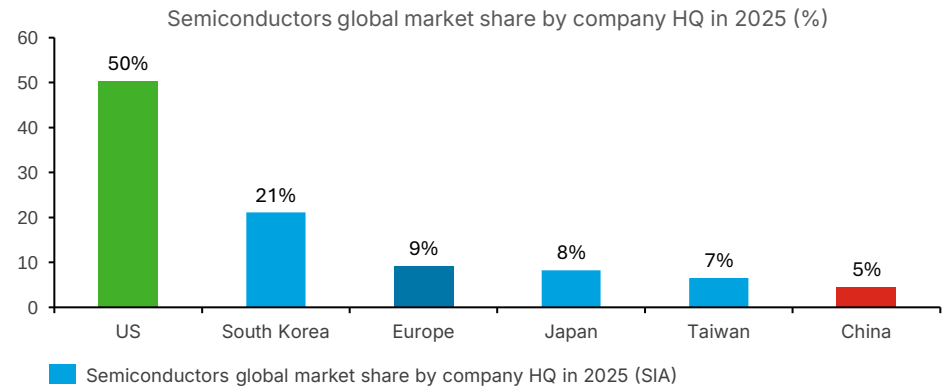
The EU's semiconductor market share remains around 10%, prompting major initiatives to double it to 20% by 2030 and strengthen industrial resilience amid global competition and supply risks



Source: Deloitte analysis based on European Commission (Digital Decade reports), 2025



Source: SIA, 2025

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The EU's semiconductor market share, measured in revenues across the value chain relative to the global market, has demonstrated limited initial movement in the early years of the Digital Decade, hovering between 10% and 11%. Although EU revenues showed relatively greater resilience in 2024 compared to the global market contraction, this near stagnation reflects intense global competition and underscores the massive challenge ahead. The Digital Decade target of 20% by 2030 requires a doubling of market share (European Commission, 2023; 2024; 2025). Independent benchmarking from the Semiconductor Industry Association (SIA) shows the EU currently holds approximately 9.2% of global market share, closely matching the EU's own estimate of 10.6%. This is well below the US (50.4%) and South Korea (21.1%), highlighting the EU's struggle for technological sovereignty. With 80% of suppliers based outside the EU and heavy reliance on East Asia for advanced chip production (below 10 nm), the EU's supply chains remain vulnerable to geopolitical risks and disruptions. This gap threatens the secure, resilient supply needed for the industrial transformation envisioned in the Antwerp Declaration (Semiconductor Industry Association, 2025).

To tackle these weaknesses, the EU has launched major initiatives such as the EU Chips Act, mobilising over €100 billion, and the Important Project of Common European Interest on Microelectronics and Communication Technologies (IPCEI ME/CT), securing more than €21 billion in funding (European Commission, 2023). These initiatives, including four advanced pilot lines, aim to strengthen EU design, manufacturing, and research and development (R&D) capabilities. Despite encouraging investment, structural issues, such as information and communications technology (ICT) skills shortages and limited advanced production, continue to hinder progress. Meeting the 2030 target is crucial for securing the competitiveness and resilience of key European industries highlighted in the Antwerp Declaration (European Commission, 2024; European Commission, 2025).

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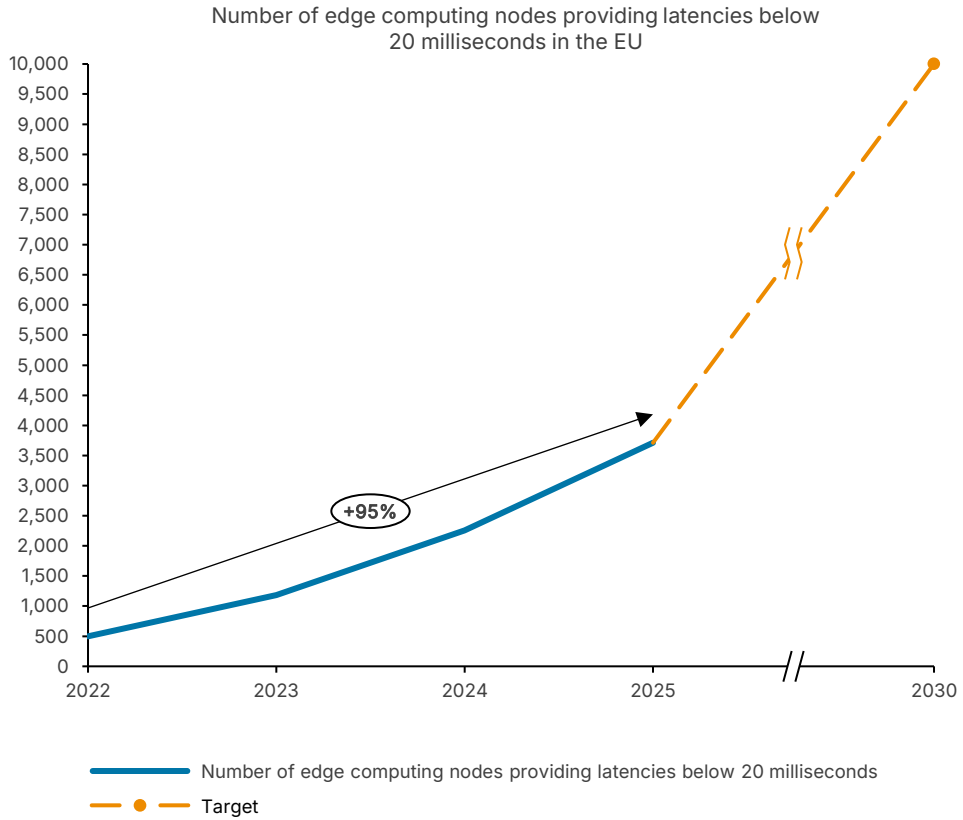
Secure edge nodes with ultra-low latency are growing rapidly, reaching 3,712 by 2025 toward the 2030 target of 10,000, supported by EU policies, 5G, and major funding like the 2024 IPCEI



Source: Deloitte based on European Commission (Digital Decade reports), 2025

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Secure, sustainable edge nodes with ultra-low latency (<20 ms) are key to monitoring digital infrastructure resilience and enabling real-time industrial applications such as autonomous systems and predictive maintenance.

The data reveals an accelerating trend in deployment, starting from a very early stage in 2022 (498 nodes) and surging to an estimated 3,712 nodes by 2025 (European Commission, 2025). This growth is recognised as one of the areas demonstrating comparatively high levels of progress toward the challenging Digital Decade target of 10,000 nodes by 2030. However, despite this momentum, a substantial gap remains, necessitating continued acceleration to close the gap within the next five years (European Commission, 2023; 2024; 2025).

For the Antwerp Declaration's goals, the deployment of this low-latency infrastructure is a prerequisite for achieving widespread adoption of technologies such as industrial Internet of Things (IoT) and AI, which underpin the transition to a high-efficiency production model. To sustain this deployment and reach the 2030 objective, the EU is leveraging key policy actions and market synergies. A strong, acknowledged relationship exists with 5G roll-out, which provides the necessary high-bandwidth wireless connectivity to maximise the utility of distributed edge infrastructure.

Major public funding, including the 2024 IPCEI on Cloud Infrastructure and Services, aims to commercialise technologies by 2027, with future projects such as a new IPCEI for computing infrastructure and the SIMPL Project to support open, scalable cloud-to-edge platforms (European Commission, 2023–2025).

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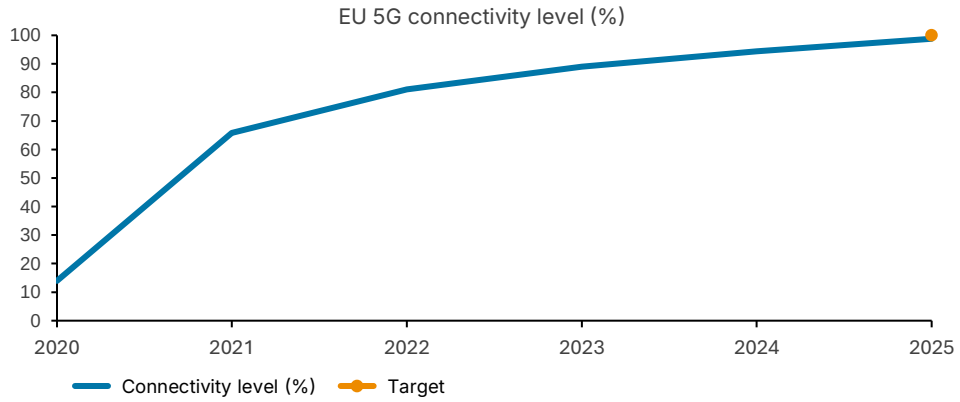
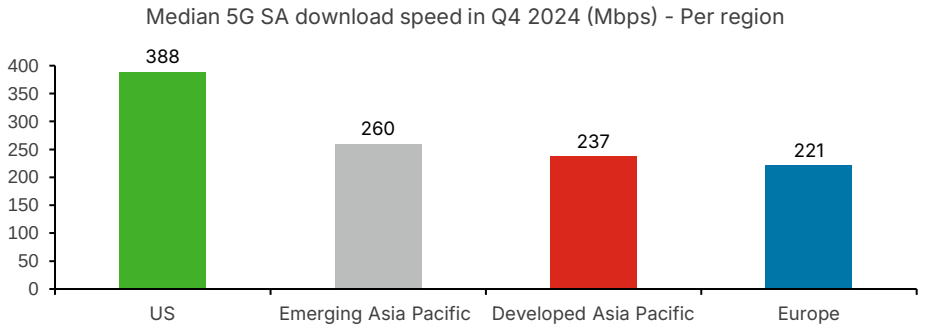
By 2025, the EU is targeting 98.8% 5G coverage but lags in standalone 5G, prompting investments to meet 2030 targets



Source: Deloitte analysis based on European Commission (Digital Decade reports), 2025



Source: Deloitte analysis based on Ookla, 2025

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The EU has rapidly expanded 5G coverage and was projected to reach 98.8% by the end of 2025, mainly through non-standalone (NSA) networks using existing 4G infrastructure and key pioneer bands (700 MHz, 3.6 GHz, 26 GHz) (European Commission, 2025). However, quality remains a constraint: mid-band 5G (3.4–3.8 GHz) covered only 51% of populated areas in 2023, and standalone (SA) 5G – with ultra-low latency, high reliability, and advanced features such as network slicing – is not yet widely deployed, limiting full economic benefits (European Commission, 2025).

Globally, the EU trails leaders such as China, India, and the US in SA roll-out (European 5G Observatory Report, 2025). Within the EU, operators such as MasOrange, O2 Telefónica, and Vodafone Germany are advancing 5G SA, but progress is uneven and deployment data is limited (European Commission, 2025).

Ookla data shows 5G SA delivers significant performance gains over NSA, yet the EU lags peers in key metrics. In Q4 2024, the EU's median 5G SA download speed was 221.17 Mbps, below the US (388.44 Mbps) and Asia-Pacific regions, though 57% faster than EU NSA networks. Factors such as the US's multi-band spectrum strategy and Asia's geography and urbanisation contribute to superior speeds (Ookla, 2025).

Southern European countries (Spain, Portugal, Greece) have become more active in 5G SA compared to the Nordic countries, which led the initial NSA roll-out. Despite regional progress, advanced SA features such as carrier aggregation remain limited to few operators, mainly outside the EU (Ookla, 2025). The EU's policy response addresses this quality gap with targeted investment and updated 5G indicators, including Quality of Service metrics, aiming for gigabit connectivity and full 5G capabilities by 2030 (European Commission, 2025).

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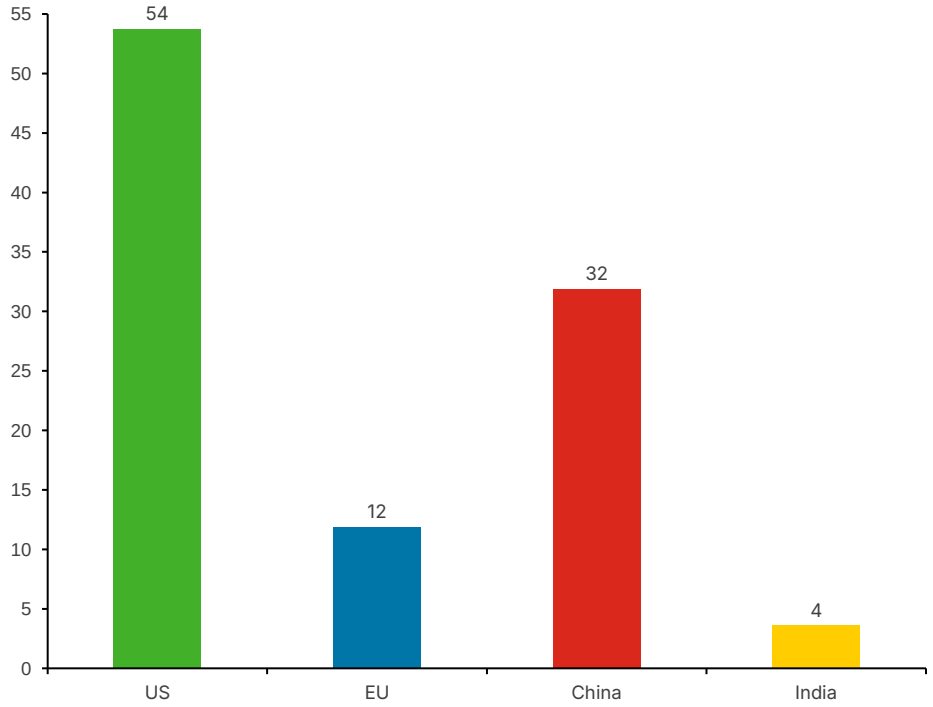
The EU trails the US and China in data centre capacity for AI, with China rapidly expanding large-scale facilities

Installed data centre capacity in GW per region in 2025



Source: VisualCapitalist, 2025

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A key component for AI development and deployment is the physical infrastructure, primarily data centres. The EU currently hosts 2,250 data centres, significantly fewer than the United States, which has 4,203 data centres as of November 2025. China, by contrast, has only 381 data centres but operates facilities with substantially higher installed capacity than the EU at 31.9 GW compared to 11.9 GW and lower than the United States' 53.7 GW (Data Center Map, 2025; Visual Capitalist, 2025). This highlights that although China has fewer data centres, it focuses on large-scale, high-capacity infrastructure, whereas the EU's smaller number of data centres also corresponds with lower overall capacity.

China's data centre sector is rapidly expanding, with electricity consumption estimated at over 100 TWh in 2024 and projected to potentially double by 2027 (IEA, 2025). This growth is driven by the country's aggressive digitalisation and AI ambitions, with data centres and 5G networks contributing significantly to electricity demand increases. The wide range of consumption estimates, from 77 TWh to 270 TWh in 2022, reflects considerable uncertainty but underscores the scale of China's infrastructure investment (IEA, 2025).

In contrast, the EU's data centre capacity and growth are more modest, with electricity demand trends influenced by uncertainties in energy-intensive industries and the pace of industrial recovery (IEA, 2025). The EU's ability to compete in AI and digital infrastructure depends on addressing these challenges by accelerating investments in high-capacity data centres for infrastructure projects as outlined in pillar 4 of the Antwerp Declaration.

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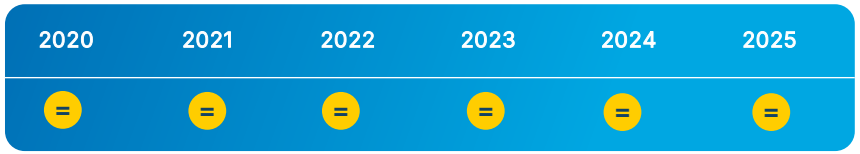
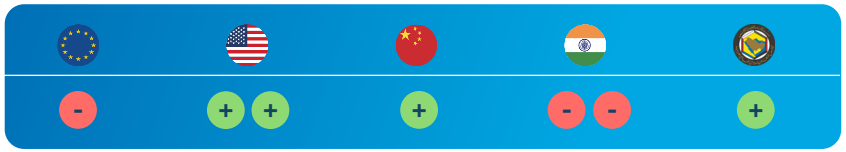
KPI 4.5 Total CO_2 mineral storage and injection capacity

This KPI tracks the total CO_2 mineral storage/injection capacity in million tonnes per annum (Mtpa) of fully operational CCS projects.

EU performance evolution



International benchmarking



Key takeaways

- **EU operational capacity represents only 1.62% of global aggregate**: The EU's operational CO_2 storage capacity of 0.6 Mtpa, provided by four projects, reveals a profound gap against the dominance of the US (25.7 Mtpa) and China (7.3 Mtpa), which is rapidly accelerating. China's rapid scale-up and the US's market dominance indicate their respective industries are better positioned to leverage CCS as a key decarbonisation lever.
- **Massive scaling required to meet 2030 NZIA target**: The current EU capacity must scale by a factor of over 82 times to meet the Net-Zero Industry Act (NZIA) target of 50 Mtpa by 2030.
- **Enhanced Oil Recovery (EOR) distorts global CCS comparison**: EOR accounts for 79% of global CCS projects, fundamentally distorting the benchmark. Unlike the US and the GCC, the EU lacks pre-existing, commercially driven EOR infrastructure. Consequently, the EU's slower deployment pace results from building more challenging, less commercially driven dedicated storage capacity from scratch.
- **India shows strong CCUS potential despite zero operational capacity**: India currently has no operational CO_2 storage projects but is progressing to pre-commercial pilots and supportive policy and research frameworks enabling future scale-up.

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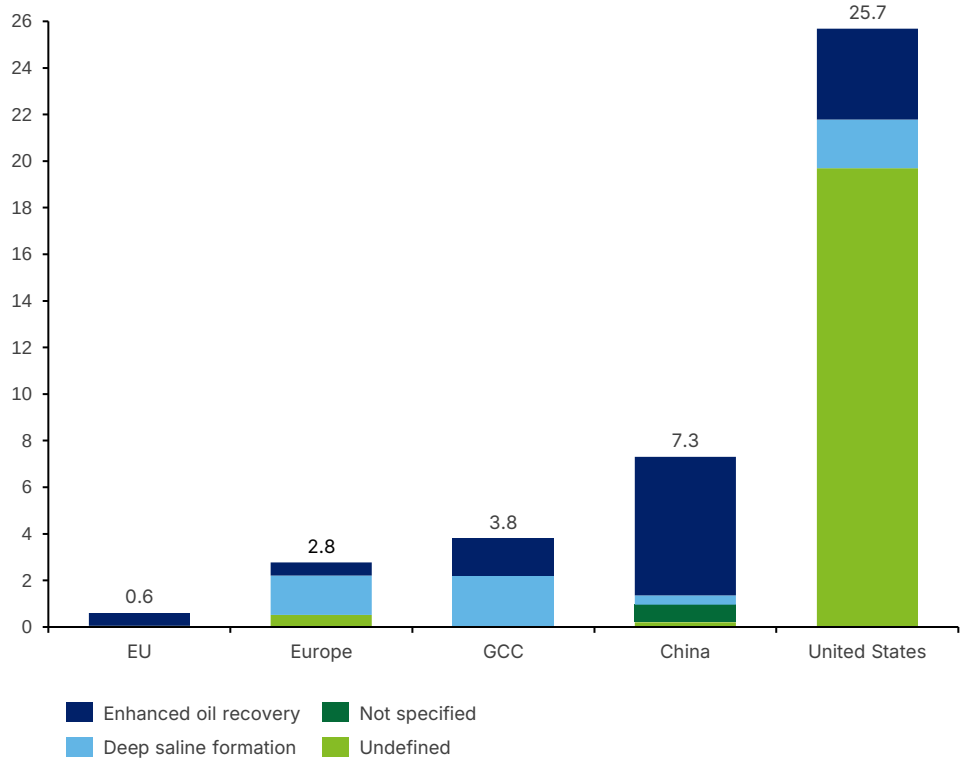
The US leads global CO_2 storage capacity, while the EU's capacity remains very low

Operational CO_2 storage capacity (Mtpa) by storage type and region in 2025



Source: Deloitte analysis based on Global CCS Institute, 2025; Clean Air Taskforce, 2024

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Operational CO_2 storage capacity varies widely by region and storage type. The EU has very low capacity, with only 0.6 Mtpa from enhanced oil recovery (EOR) and minimal other storage. In contrast, the US, China, and the Gulf Cooperation Council (GCC) have much higher capacities. Broader Europe's capacity is about 2.8 Mtpa in 2025, driven mainly by Norway's deep saline projects and Iceland's expanding initiatives, showing strong regional geological potential despite EU deployment challenges.

The US leads globally with total capacity of 25.7 Mtpa, including 3.9 Mtpa from EOR. A notable portion of US capacity is currently classified as undefined, which, based on 2024 data, largely comprises EOR projects. While this reassessment introduces some uncertainty, it does not diminish the fact that EOR initially drove the majority of CCS capacity growth, particularly in the US.

China demonstrates strong EOR presence, while the GCC region balances EOR with significant deep saline formation storage. EOR – where captured CO_2 is injected into mature oil fields to increase fossil fuel yields – is the most common CCS use globally, accounting for 79% of projects as of 2023 (European Union Institute for Security Studies, 2025).

Countries like the US, with strong petrochemical sectors, benefit from established expertise and infrastructure in oil and gas, making EOR deployment profitable and scalable. This is boosted by government incentives like the Inflation Reduction Act (European Union Institute for Security Studies, 2025). Consequently, much US CO_2 storage capacity reflects fossil fuel economics rather than just industrial decarbonisation.

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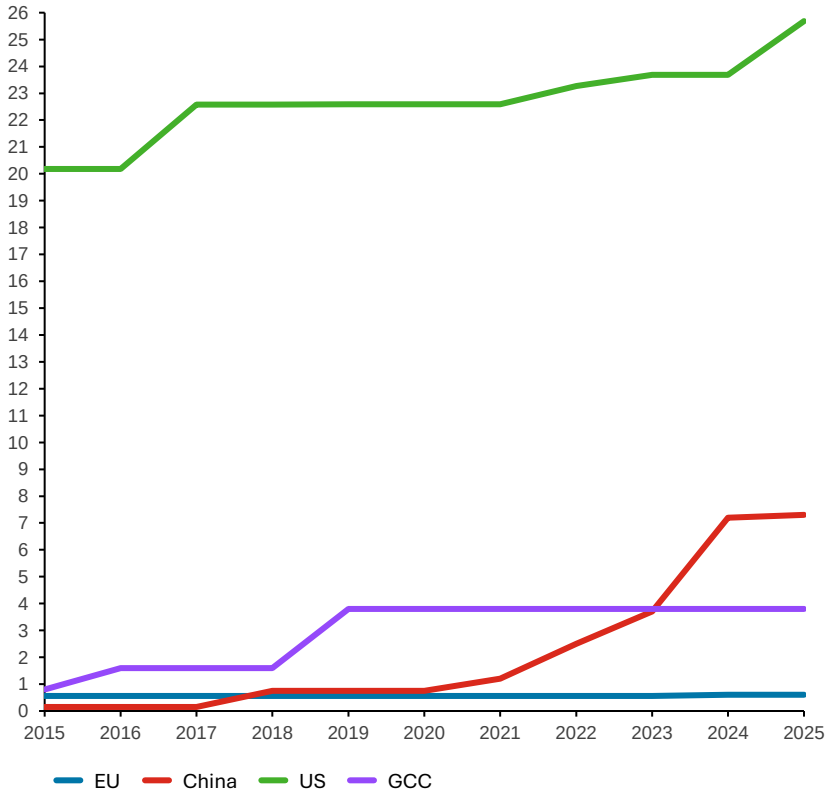
Over the past decade, the US and China have rapidly expanded their CO_2 storage capacities to lead globally, while the EU's capacity has remained minimal, highlighting a significant gap in meeting its ambitious 2030 climate targets

Operational CO_2 storage capacity (MTPA) (2015-2025)



Source: Global CCS Institute, 2025; Clean Air Taskforce, 2024

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Cumulative CO_2 storage capacity over the past decade shows distinct regional trends. The EU's capacity remained largely flat at approximately 0.6 Mtpa from 2015 to 2025, supported by a few long-standing EOR projects, with minor additions in 2024. This low capacity highlights a significant gap compared to global peers and underscores the challenge of meeting the EU's 2030 NZIA target of 50 Mtpa (European Commission, 2024).

The US leads globally with 25.7 Mtpa in 2025, adding over 5 Mtpa since 2015, including a notable 2 Mtpa increase in 2025, supported by the highest number of operational projects (29 sites).

China rapidly expanded its capacity from 0.75 Mtpa in 2020 to 7.3 Mtpa in 2025, reflecting large-scale deployment and a broad project base (20 sites), making it the second-largest operational region.

The GCC experienced rapid early growth from 0.8 Mtpa in 2015 to 3.8 Mtpa by 2019, driven by a few high-capacity projects, with capacity remaining stable since then.

India has no operational CO_2 storage projects but demonstrates strong CCUS potential. Recent progress includes a 2022 Niti Aayog policy report, three National Centres of Excellence, and the development of a CCUS R&D roadmap in December 2025 (Department of Science & Technology, 2025). Four interministerial task forces work on CCUS development and safety (Global CCS Institute, 2024).

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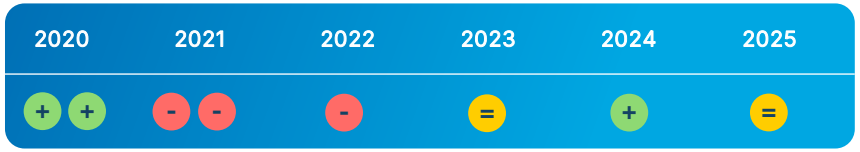
KPI 4.6 Manufacturing occupations labour shortage

This KPI tracks shortages in manufacturing sector occupations using definitions from Cedefop and the European Skills, Competences, Qualifications and Occupations (ESCO) classification system, which standardises European occupations and skills to support labour market integration. Labour shortages are measured through the job vacancy rate (JVR) from Eurostat, reflecting unmet labour demand and skill mismatches. Cedefop's skills intelligence informs employment trends and skill gaps. Addressing these shortages aligns with pillar 4's focus on skilled workers, particularly as green transition and digitalisation reshape skill needs.

EU performance evolution



International benchmarking

Key takeaways

- **EU JVR increased from 0.9% to 1.6% over past decade**: The JVR increased in the EU from 0.9% in 2014 to 1.6% in 2025, indicating labour demand increased and the market tightened over the last 10 years. A 1.6% JVR is considered moderate for the manufacturing sector, a mature sector with typically lower employee turnover, and the rate nearly doubled in the last decade. Additionally, five Member States report major shortages in green-skilled jobs.
- **EU manufacturing labour shortages lower than US**: The EU records a lower JVR than the US, with 1.6% in 2025 compared to a 4.3% job opening rate for industry in general in the US (U.S. Bureau of Labor Statistics, 2025). This indicates job shortages are higher in the US than in the EU.
- **Manufacturing sector accounts for 17.7% of EURES job vacancies**: The manufacturing sector records the second-highest share of EURES job vacancies at 17.7%, after administrative and support service activities (Cedefop, 2025).
- **Vacant positions require medium to high education and expertise**: The most required skills for vacant jobs are associated with medium to high levels of education and expertise. Among 570 green skills and knowledge in the ESCO dataset, 57.62% are sector-specific, 29.12% are cross-sector skills, and 12.23% are occupation-specific (Lagorio, Colombo, Cimini, & Gaiardelli, 2024).
- **Structural skills mismatch drives labour shortage**: The manufacturing labour shortage is rooted in a structural skills mismatch, intensified by lack of coordinated planning, where the significant supply of workers released from factory closures fails to meet the specific demand for skills necessary for the green and digital transition.
- **Programme for International Student Assessment (PISA) 2022 scores:** There are significant regional differences in education quality, with the EU and the US outperforming the GCC countries but trailing China, underscoring the need for targeted skills development to address manufacturing labour shortages.

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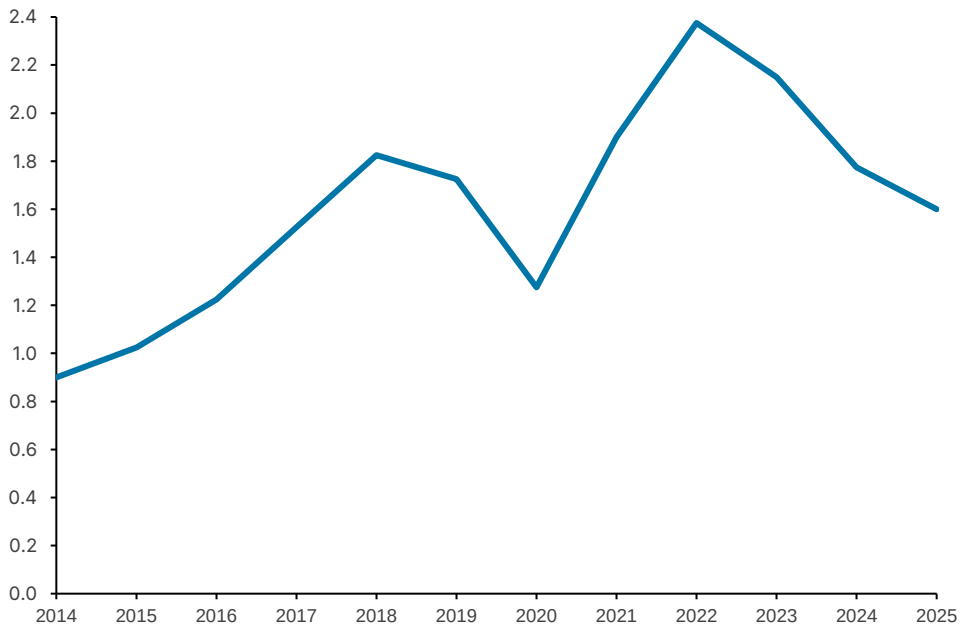
Moderate but rising JVR in EU manufacturing highlights growing labour shortages

Evolution of the annual JVR in the manufacturing sector in the EU between 2014 and 2025 (%)



Source: Eurostat, 2025

In 2025, 1.6% of manufacturing jobs in the EU were vacant. A 1.6% JVR is considered moderate for the manufacturing sector, a mature sector with typically lower employee turnover, and the rate nearly doubled in the last decade. Since 2014, the JVR increased in the EU from 0.9% to 1.6% in 2025. A similar trend is observed across all sectors. This indicates labour demand exceeds labour supply, signalling labour shortages in the manufacturing sector. Labour demand strengthened and the market tightened over the past 10 years. The Netherlands presents the highest JVR in the EU in 2025, with 4% of manufacturing jobs vacant. Additionally, five Member States have indicated substantial shortages in occupations that demand green skills, which are essential for promoting sustainability and fulfilling the objectives of the Clean Industrial Deal.

In comparison, the US job opening rate for industry in general amounted to 4.3% in August 2025, representing 7,227 job openings (U.S. Bureau of Labor Statistics, 2025). The US Bureau of Labour Statistics defines the job openings rate as the number of job openings on the last business day of the month as a percent of employment plus job openings. According to the 2025 US job opening rate, the labour shortage is higher in the US than in the EU.

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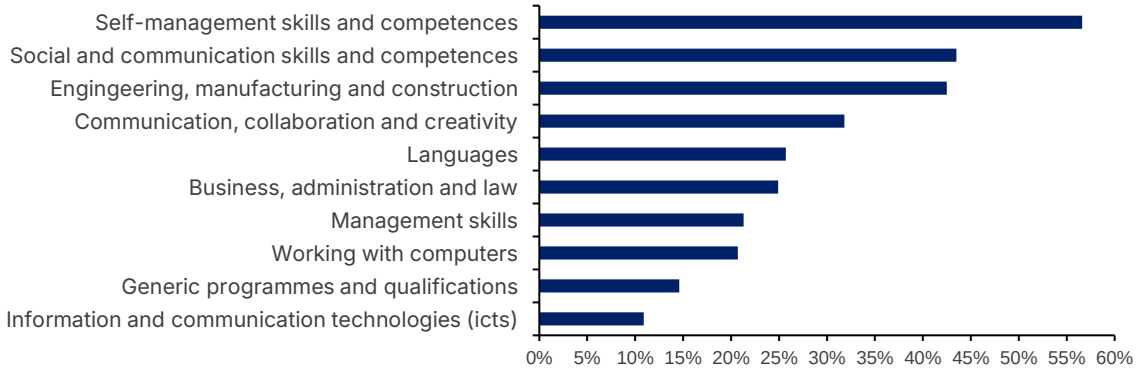
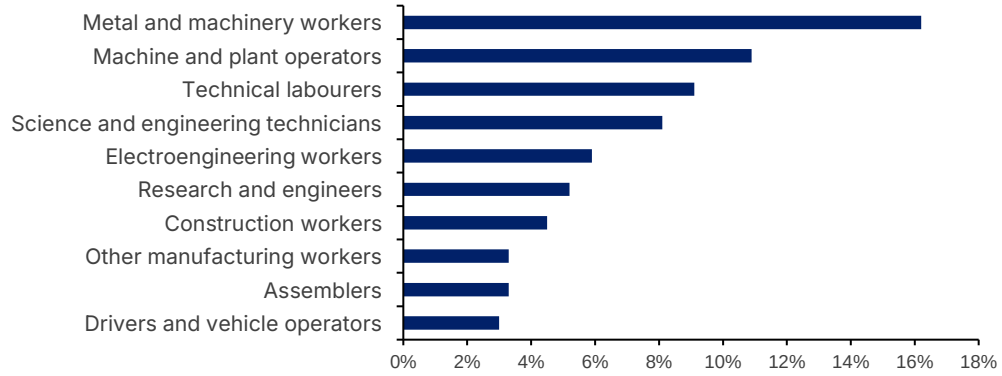
Manufacturing job vacancies dominated by technical skills and higher education requirements

Top 10 most requested skills for job vacancies in the manufacturing sector: level 1 ESCO (%)



EURES manufacturing job vacancies by occupation group (2-digit ISCO)



Source: Cedefop, 2025

The manufacturing sector records the second-highest share of EURES job vacancies at 17.7%, after administrative and support service activities with 18.1% (Cedefop, 2025). Engineering, manufacturing, and construction rank as the third most-requested skill, demonstrating the need for high expertise and education.

The 10 most-requested skills for manufacturing job vacancies align with the ranking of EURES manufacturing job vacancies by occupation group. The top six occupation groups with manufacturing job vacancies are associated with technical skills and specific education requirements: metal and machinery workers; machine and plant operators; technical labourers; science and engineering technicians; electro-engineering workers; and research & engineers. This is supported by 2023 EU manufacturing employment data, which shows that only 18% of workers have a low educational level.

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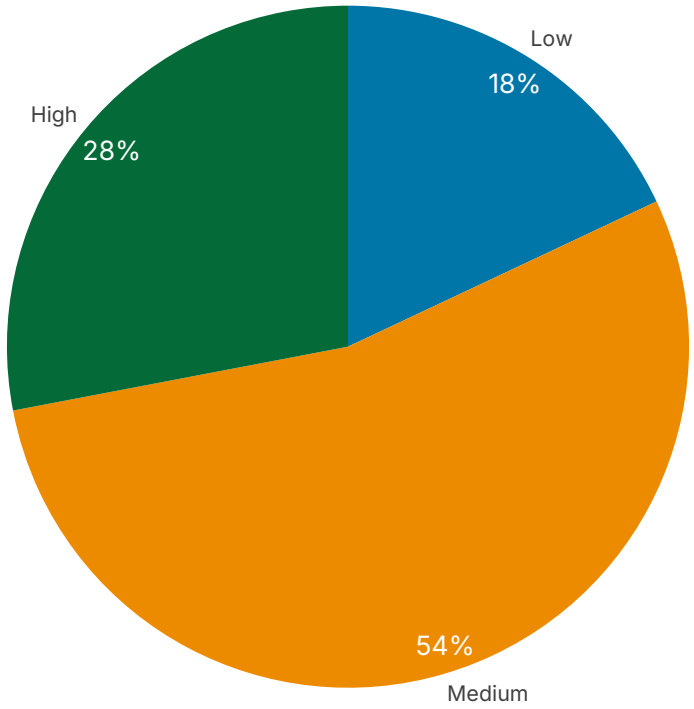
Specialised green skills are vital for sustainable manufacturing, while the EU's job losses and skills mismatch require coordinated reskilling to meet demand

Employment in the EU manufacturing sector by educational level, 2023



Source: Cedefop, 2025

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Specialised green skills are essential across the five critical manufacturing areas to drive sustainable transformation. Lagorio et al. (2024) identify these critical manufacturing areas as product-process design, big data analytics and AI, supply chain management, circular economy, and energy management. Each area demands specialised green skills, including environmental impact assessment, waste management, data analysis, eco-design, and expertise in renewable energy technologies (Lagorio, Colombo, Cimini, & Gaiardelli, 2024).

Among 570 green skills and knowledge in the ESCO dataset, 57.62% are sector-specific, 29.12% are cross-sector skills, and 12.23% are occupation-specific (Lagorio, Colombo, Cimini, & Gaiardelli, 2024). This indicates that a variety of educational programmes and trainings must be provided to fulfil all green skills associated with the manufacturing sector.

The EU experienced a significant release of workers from the traditional manufacturing sector, losing approximately 853,500 manufacturing jobs between 2019 and 2023 (European Trade Union Confederation, 2024). However, this increase in labour supply does not resolve the underlying skills deficit. The European Trade Union Confederation (ETUC) attributes these job losses to insufficient support for EU industry, resulting in nearly 1 million jobs being shut down (European Trade Union Confederation, 2024).

The core challenge is a structural skills mismatch: lack of coordinated labour market planning drives widespread labour and skills shortages across sectors, even amid major transformation efforts (Syndex, 2025). Consequently, displaced workers represent a significant reskilling challenge that must be addressed to meet demand for specialised skills.

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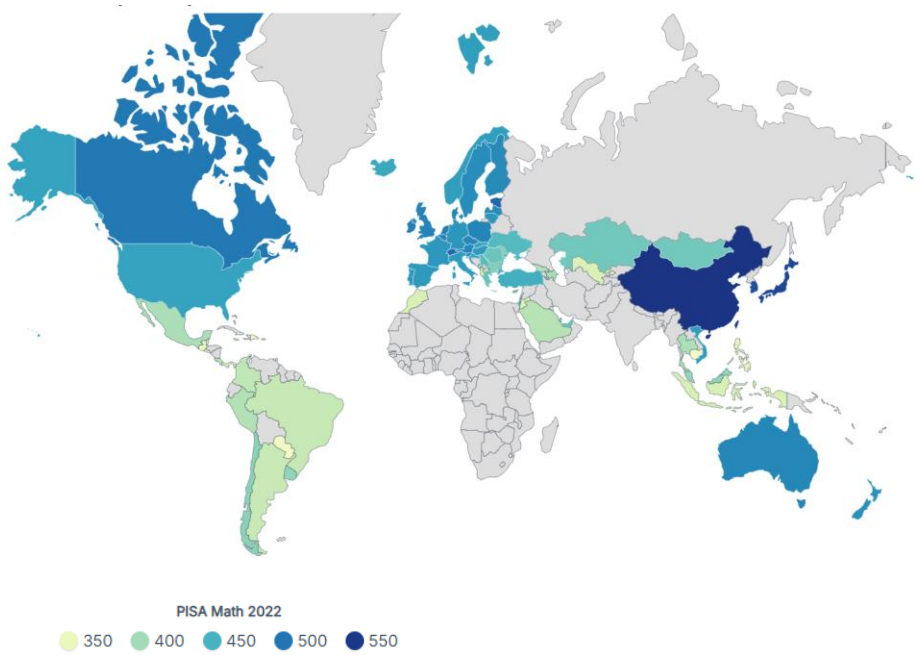
PISA scores reveal education gaps impacting manufacturing labour supply across regions

PISA score 2022



Source: World Population Review, 2022

The PISA, conducted every three years by the OECD, evaluates 15-year-old students' critical thinking and problem-solving skills in mathematics, science, and reading across over 65 countries, covering 90% of the global economy (World Population Review, 2022). PISA scores are widely regarded as an indicator of how well education systems prepare students for the demands of the 21st-century knowledge economy, which directly impacts the availability of skilled labour in advanced sectors such as manufacturing.

In the 2022 cycle, the EU27 average score was 471.4, slightly above the US score of 465 but significantly below China's 552. Among GCC countries, available data show lower averages: Saudi Arabia (389), Qatar (414), and the UAE (431), with a combined average of 411.3. These disparities in educational outcomes reflect differing capacities to supply the manufacturing sector with adequately skilled workers, contributing to the structural skills mismatches and labour shortages observed across regions. Enhancing education and training aligned with evolving manufacturing needs remains critical to addressing these shortages and supporting industrial competitiveness.

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Pillar 5: Increase the EU's raw materials security

Increase the EU's raw materials security through scaling up domestic mining, sustainable processing and recycling capacity for crucial raw materials, combined with new global partnerships. Scale up renewable carbon and circular carbon feedstocks, including the expansion and fast permitting of advanced chemical recycling technologies. Develop a Circular Carbon Strategy that incentivises Carbon Capture and Utilisation (CCU), biobased feedstocks, base metals, minerals, and advanced materials necessary to reach the aims of the EU Green Deal. Free trade agreements or other types of agreements should secure vital supplies for industry, enable access to new markets and increase exports. The EU should look at all policy instruments against unfair competition to ensure a real level playing field for EU industries both on the domestic and international markets, including carbon leakage protection.

Pillar conclusions

The EU has made strategic progress in enhancing competitiveness under pillar 5 but remains structurally constrained by **persistent raw material dependencies and limited domestic supply capacities**. The External Vulnerability Index (EXVI) positions the **EU's critical raw material vulnerability between China's low-risk status and the high vulnerability of the US**, reflecting ongoing import reliance and exposure to supply shocks. The Domestic Production Index confirms **minimal EU extraction and processing of core transition materials** such as lithium, cobalt, and copper, far below levels required to meet 2030 targets. The EU produces, on average, around 30% of its domestic demand for CRMs, with more than half of these materials being fully import-dependent **China's dominance in extraction, processing, and manufacturing** continues to pressure EU industry competitiveness, whilst the US, India, and the GCC increasingly attract global investments through strong incentives such as the US Inflation Reduction Act (IRA).

EU domestic natural gas production, vital as feedstock for energy-intensive industries, has declined by 66.7% since 2015, exacerbating supply dependencies and cost pressures. Regarding bio-based raw materials, the EU relies on domestic sugar beet for bio-industrial uses, whereas palm oil is predominantly imported, highlighting the need for sustainable sourcing. Although in its infancy, the EU leads globally with the highest share (just over 1%) of biomass-derived plastics but faces scaling challenges amid rising market demand.

At the same time, the EU is putting in place important enabling conditions that strengthen its long-term competitiveness and build resilience, particularly **in circularity and innovation**. The Circular Material Use Rate (CMUR) indicates that whilst the **EU leads benchmark regions with 12.2% circularity, well above the global average of 6.9%,** performance varies significantly across Member States. The forthcoming Circular Economy Act (2026) **targets doubling circularity to 24% by 2030** through robust regulatory and market incentives that reduce dependency on virgin imports and promote high-value recycling. However, circularity has increased by only one percentage point in nearly a decade, signalling that the **EU is not on track to meet the 2030 target at the current pace**.

Overall, the EU strengthens its enabling conditions and outperforms global benchmarks in circularity and bio-based innovation, yet achieving strategic autonomy requires overcoming limited domestic resource availability, slow permitting processes, and intense global investment competition, particularly in critical raw materials essential for the Green Deal.

0.28
EXVI in 2023

0/34 CRMs
Sufficient domestic production

66.7%
Decrease in natural gas production

CMUR x2
by 2030

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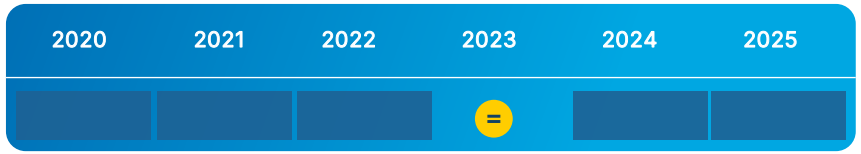
KPI 5.1 External Vulnerability Index (EXVI)

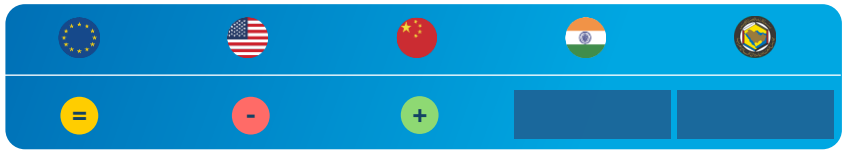
The EXVI for raw materials provides a critical benchmark of trade dependencies and supply chain risks for the EU, the US, and China. The EXVI is a composite indicator measuring the external vulnerability of an economy by assessing trade dependencies and competitive weaknesses related to raw materials. It evaluates risks of supply chain disruptions by analysing factors such as import concentration, reliance on foreign markets, and global trade competitiveness.

The index ranges from 0 to 1, where 0 represents low vulnerability and 1 indicates high vulnerability.

EU performance evolution



International benchmarking



Key takeaways

US faces highest external vulnerability; China lowest: The EXVI reveals that the US currently faces the highest external vulnerability in critical raw materials, reflecting significant import dependence and supply risks. China exhibits the lowest external vulnerability, benefiting from strong domestic production and diversified supply chains, reducing its exposure to external shocks. The EU is positioned between these two, with ongoing challenges in reducing import reliance, highlighting supply chain vulnerabilities.

EU must accelerate domestic capacity and diversify sources: To strengthen resilience, the EU should accelerate the expansion and permitting of advanced chemical recycling technologies, develop a Circular Carbon Strategy, and secure vital raw materials supply through trade agreements. A continued focus on diversifying import sources and enhancing domestic capacities are key next steps to reduce vulnerability and support the EU Green Deal ambitions.

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The EU's EXVI remained stable at 0.28 in 2022 and 2023, indicating consistent exposure to raw materials supply risks

The EU's EXVI remained stable at 0.28 in 2022 and 2023, indicating consistent exposure to raw materials supply risks. Despite policy efforts to improve access to critical materials, the EU has made limited progress in expanding domestic production, refining capacity, and streamlining permitting processes.

In contrast, the US EXVI decreased slightly from 0.32 to 0.31, reflecting initial advancements in developing domestic mining, processing, and clean technology supply chains. Nevertheless, the US remains the most dependent on foreign processing capacity and raw material imports, maintaining exposure to potential supply disruptions.

China holds the lowest and steady vulnerability score of 0.24, demonstrating its dominance in processing and refining critical materials such as lithium, graphite, and rare earth elements, which insulates its industries from global supply shocks and foreign dependencies.

These findings highlight that whilst the EU faces a regulatory burden and competitiveness challenges related to raw materials supply, there remains room for improvement to enhance supply chain security and reduce import dependencies.

EXVI	2022	2023
EU	0.28	0.28
US	0.32	0.31
China	0.24	0.24

Source: Connell Garcia, & Ho, 2025

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KPI 5.2 Domestic Production Index (DPI)

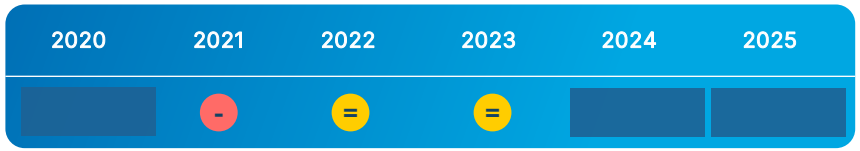
The DPI measures domestic industry's ability to meet domestic demand for critical raw materials (CRMs) under the Critical Raw Materials Act (CRMA). It quantifies the share of domestic production in total supply, showing how effectively domestic producers reduce reliance on external suppliers and strengthen supply chain resilience against market volatility, trade disruptions, or geopolitical tension. The index is calculated using the following formula:

DPI = Domestic production / (Domestic production + Imports – Exports)

If DPI = 1 → domestic production covers all domestic demand
If DPI < 1 → domestic production is inferior to domestic demand, leading to imports
If DPI > 1 → domestic production exceeds domestic demand, leading to exports

The DPI for the EU was calculated using 2020–2023 data for 11 of the 19 CRMs with domestic production, out of the 34 covered by the CRMA, due to data limitations.

EU performance evolution



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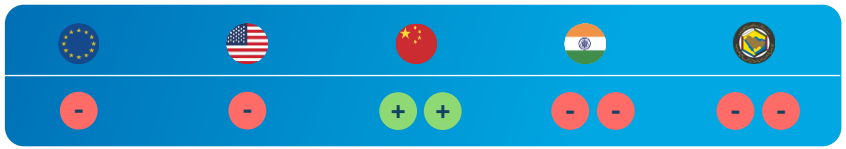

Key takeaways

- **EU domestic supply of CRMs is very limited**: The DPI shows the EU's domestic supply of many CRMs essential for the green transition and other strategic sectors (e.g., lithium, cobalt, copper, rare earth elements (REEs), platinum group metals (PGMs), phosphorous) is very limited, exposing a structural vulnerability in strategic autonomy. Although the EU has set clear, ambitious targets for extraction, processing and recycling, current progress indicates these goals will not be met by 2030 without significant increases in primary production and recycling.
- **EU natural gas production declined 66.7% since 2015**: EU domestic natural gas production, vital feedstock for energy-intensive industries, has declined by 66.7% since 2015, increasing supply dependencies and cost pressures. The EU relies on domestic sugar beet for bio-industrial raw materials, whilst palm oil remains mostly imported, highlighting the need for sustainable sourcing.
- **China dominates the critical raw material value chain**: China's dominance in extraction, processing, and manufacturing of CRMs creates deep EU dependency across the value chain for key decarbonisation technologies such as electric vehicles (EVs), wind turbines, and energy storage systems. China's export-licensing controls add supply uncertainty, rising risks of delays, and higher costs.
- **US uses major government financing to attract investment**: The US remains import-reliant but uses major government financing, including the Inflation Reduction Act (IRA) and defence spending, to attract investments, potentially outcompeting EU efforts to support similar projects. However, recent policy shifts have introduced uncertainty about these incentives' future.
- **India and GCC expanding the CRM value chain**: India and the GCC are using their own industrial policies and capital to expand their share of the CRM value chain. For the EU, they serve both as diversification partners and as competitors for global investment in new extraction and processing capacity.

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The EU remains highly dependent on concentrated global suppliers for CRMs and is currently off track to meet its 2030 CRMA targets, despite strong policy ambition and leadership in circularity

Critical Raw Material	Domestic Production Index					Circular Material Use Rate
Name	Status	2020	2021	2022	2023	Latest available data
Antimony	🔴	-	-	-	-	58%
Arsenic	🟡	0.89	0.97	0.74	0.73	
Aluminium primary	🟡	0.29	0.27	0.18	0.16	
Bauxite	🔴	0.09	0.09	0.09	0.15	
Baryte	🟡	0.38	0.36	0.54	0.41	
Beryllium	🔴	-	-	-	-	28%
Bismuth	Limited production; trade data unavailable					31%
Boron/borates	🔴	-	-	-	-	46%
Cobalt	🔴	0.13	0.11	0.17	0.10	31%
Coking Coal	🟡	0.38	0.31	0.33	0.28	
Copper	🔴	0.23	0.21	0.23	0.21	
Feldspar	🟡	0.50	0.41	0.42	0.57	72%
Fluorspar	🟡	0.47	0.51	0.51	0.51	
Gallium	🔴	-	-	-	-	2%
Germanium	🔴	-	-	-	-	14%
Hafnium	🔴	-	-	-	-	37%
Helium	Limited production; trade data unavailable					2%
Heavy rare earths	🔴	-	-	-	-	0%
Light rare earths	🔴	-	-	-	-	
Lithium	Limited production; trade data unavailable					0%
Magnesium	🔴	-	-	-	-	14%
Manganese	🔴	0.05	0.03	0.03	0.03	43%
Natural Graphite	🟡	0.46	0.41	0.37	0.28	8%
Nickel - battery grade	🔴	0.24	0.11	0.18	0.22	45%
Niobium	🔴	-	-	-	-	8%
Phosphate rock	Limited production; trade data unavailable					10%
Phosphorous	🔴	-	-	-	-	7%
Platinum group metals	Moderate production; trade data unavailable					
Scandium	🔴	-	-	-	-	27%
Silicon metal	🔴	-	-	-	-	
Strontium	Moderate production; trade data unavailable					
Tantalum	Limited production; trade data unavailable					24%
Tatanium metal	🔴	-	-	-	-	
Tungsten	Limited production; trade data unavailable					50%
Vanadium	🔴	-	-	-	-	34%

Source: British Geological Survey, 2025; Eurostat, 2025; Deloitte analysis, 2025
Note: *The analysis focuses exclusively on the mining and extraction stage within the value chain; A '-' indicates zero domestic production.*

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The EU's self-sufficiency in CRMs remains limited, with none of the materials reaching a DPI of 1 or higher, indicating insufficient domestic capacity. Several materials show moderate DPI values, reflecting partial coverage but continued reliance on imports. Most materials critical to the energy transition have low DPI values, highlighting strong dependence on international suppliers for batteries, renewables, and advanced manufacturing.

This dependence is exacerbated by global supply concentration: China controls 68% of REEs and 70% of graphite; the Democratic Republic of Congo accounts for 74% of cobalt; Indonesia nearly 50% of nickel; and Australia 47% of lithium (Draghi report, 2024). Governance risks in these countries, including weak labour and environmental standards and political instability, further threaten EU supply security (Directorate-General for External Policies, 2023). The European Central Bank warns that reliance on third-country suppliers for dual-use minerals such as cobalt, magnesium, and lithium poses strategic risks to the green transition and EU defence capabilities.

The EU is off track to meet the CRMA 2030 targets, which require 10% of consumption from extraction, 40% from processing, 25% from recycling, and no more than 65% from a single third country. Despite policy ambition, extraction and processing capacities remain insufficient (Business Europe, 2023). Most CRM projects are in early stages and face permitting delays and local opposition. Copper is the only CRM currently on track, whilst lithium projects could cover over half of EU demand by 2030, though still uncertain.

Whilst the EU leads in regulatory efforts to promote circularity, recycling capacity for complex CRMs, such as REEs in magnets, remains limited. High energy costs constrain energy-intensive industries from refining and processing CRMs, and fragmented, slow permitting across Member States creates delays and investor uncertainty, weakening competitiveness. Circular material use rates vary widely due to technical and economic challenges.

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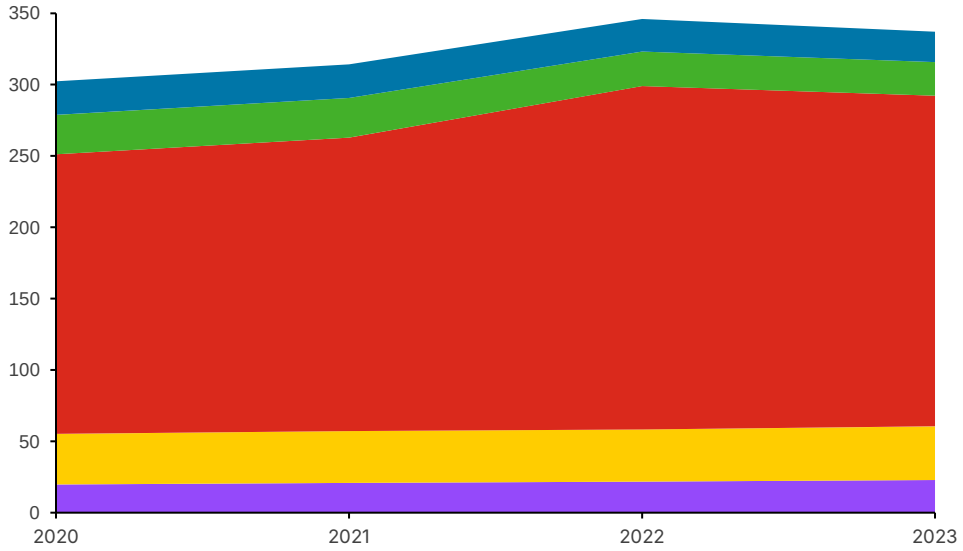
The EU has relatively limited domestic production capacity compared with China's dominant share among the countries and regions in scope

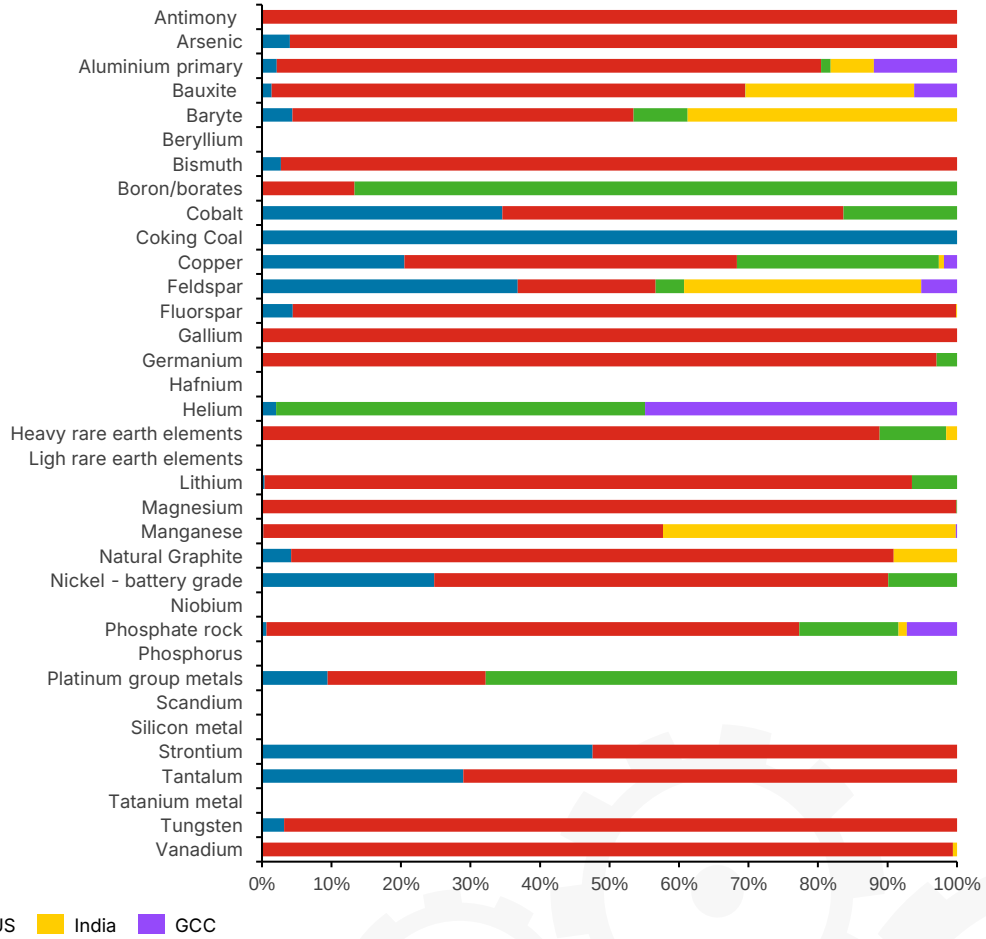
The total annual domestic production of the 34 materials covered by the CRMA reveals the stark contrast between the EU's domestic output and the market shares held by China. Not all Member States produce every material, and production volumes vary significantly across the EU. This data underscores the structural supply-chain vulnerabilities the EU faces and the urgent need to expand domestic mining and processing capacity.

Total CRM domestic production by country/region (Mt) (2020-2023)



Source: British Geological Survey, 2025; Deloitte analysis, 2025
Note: *Coking coal is shown only for the EU, as other countries report coal in aggregate and do not provide a separate category for coking coal.*

Domestic production share of CRM by country/region (2023)



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The EU, US, India, and GCC must expand domestic production and forge strategic partnerships to reduce dependency, while addressing China's dominant control over critical raw material processing and supply

The EU produces less than 7% of most CRMs and depends heavily on external processing and manufacturing, creating structural supply-chain vulnerabilities (Draghi, 2024). Domestic mining expansion offers significant potential, with lithium and REEs deposits capable of meeting a substantial share of EU demand by 2030. The discovery of over one million tonnes of rare earth oxides in northern Sweden and planned mines could reduce reliance on China, which currently supplies over 90% of EU REEs demand. The EU's lithium resources, totalling approximately 20 million tonnes of contained lithium oxide (Li_2O), could supply 50–100% of domestic demand through five to ten mines by 2030. Nickel and cobalt production could cover 15–25% of demand if projects advance (Draghi, 2024). Although silicon metal is critical for clean technologies, EU production has nearly vanished, with most plants closed or idled, leaving the region highly dependent on external suppliers, such China, which recognise the strategic importance of maintaining silicon production (industriAll, 2025). Strategic international partnerships combined with increased domestic mining will strengthen EU supply security and competitiveness.

China dominates CRMs processing, controlling approximately 90% of REEs refining and separation capacity, and producing 90% of magnesium metal and 99% of battery-grade graphite (JRC, 2025). Recent export controls on heavy rare earths and other CRMs, along with technology export restrictions, intensify the EU's dependency on China for inputs vital to military, aerospace, medical, and clean-technology sectors. This situation underscores the urgent need for the EU to meet its domestic processing targets.

The US has domestic reserves and mining infrastructure for some metals but remains fully import-dependent on key battery materials, such as graphite, and relies on foreign processing for rare earths (US Geological Survey, 2025). The US mandates immediate action to maximise domestic mineral production, emphasising critical minerals, uranium, copper, and other strategic resources to strengthen national security, reduce reliance on foreign suppliers, and support key industries such as infrastructure, and clean technology. Federal agencies are tasked with expediting permitting, prioritising mineral-rich lands, facilitating public-private investment, and coordinating loans, grants, and technical assistance to accelerate commercial mining, processing, and development of derivative mineral products.

India currently depends entirely on imports for core energy transition materials, sourcing over 60% of rare earths from China. The National Critical Mineral Mission aims to complete 1,200 domestic exploration projects by 2030–2031 and produce at least 15 critical minerals domestically. It also targets acquiring 50 mining assets globally and fast-tracking regulatory approvals. The NCMM includes a recycling incentive scheme with a budget of INR 1,500 crore (USD 170 million) to recover 400 kilotonnes of materials (IEA, 2025).

The GCC countries are rapidly developing domestic CRM production to diversify economies and boost industrial resilience. Initiatives aligned with Saudi Vision 2030, the UAE's industrial plans, and Oman's mining expansions focus on building competitive supply chains for metals and minerals essential to the energy transition, advanced manufacturing, and digital industries.

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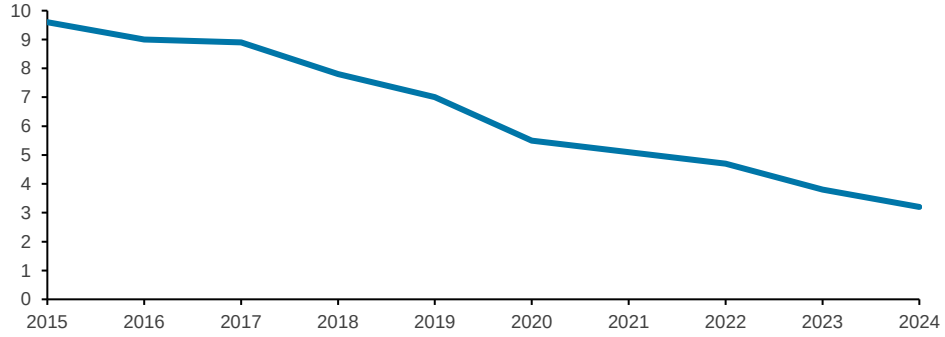
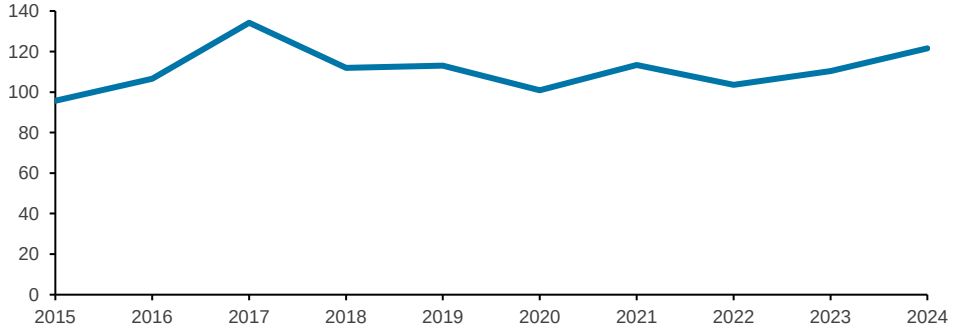
Declining domestic natural gas production and shifting biobased raw material policies are reshaping the EU's industrial feedstock landscape and supply dependencies

EU natural gas domestic production in billion m^3



Source: Eurostat, 2025

Production of sugar beet in the EU in Mt



Source: Eurostat, 2025

Natural gas remains a critical feedstock for the EU's energy-intensive industries, especially the chemical sector, accounting for approximately 38% of feedstock consumption in 2023 (Cefic, 2025). Domestic natural gas production declined by 15% in 2024 compared to 2023 and has fallen by 66.7% since 2015, intensifying supply dependencies and increasing production costs for EU industries. This decline significantly impacts the EU's industrial cost structure and reliance on external suppliers.

Bio-based raw materials are vital for the EU's industrial decarbonisation, with sugar beet, predominantly produced within the EU, showing resilient output, increasing from 96 million tonnes in 2015 to 122 million tonnes in 2024. The EU produces approximately half of the world's sugar beet, supporting emerging bio-industrial uses such as bioethanol, biochemicals, and bio-based polymers, thereby advancing circular bioeconomy value chains (European Commission, 2025). By-products such as beet pulp are increasingly valorised for energy and industrial applications beyond food. In contrast, the EU relies heavily on imports of palm oil and palm kernel oil, several million tonnes annually, mainly from Malaysia and Indonesia, for food, oleochemicals, and historically biodiesel feedstocks. Recent EU policies, including the Renewable Energy Directive II and deforestation-free product regulations, are reducing palm oil use and imports for biofuel production whilst tightening sustainability requirements, reshaping its role in EU industrial biomass supply chains (Biofuels International, 2025).

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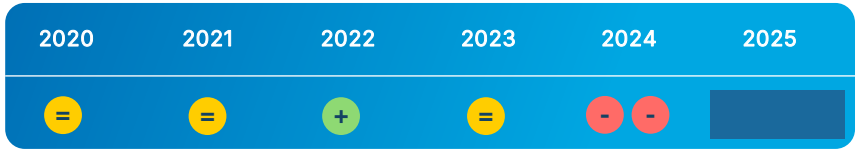
KPI 5.3 Biomass flows going into bioenergy and biomaterials

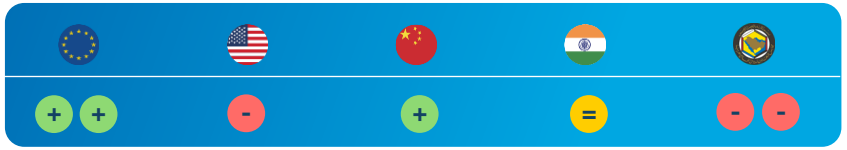
This KPI tracks the amount of biomass (production within the EU and net imports) that is used for energy generation (i.e., bioenergy) or used to produce materials for non-food/feed and non-energy generation purposes (i.e., biomaterials). This includes biomass from agricultural, aquatic, forestry, and recovered/recycled sources. The measurement focuses on the net dry matter content.

Access to bioenergy and biomaterials is important for industries to achieve their climate and circularity objectives. A secure supply of biomass increases investor confidence by lowering operational risks, enabling long-term planning, and scaling bio-based industrial projects.

EU performance evolution



International benchmarking



Key takeaways

- **Total biomass production in the EU reaches approximately 898 million tonnes** dry matter, based on latest available estimates, with food and feed dominating at 48%, followed by energy at 19% and biomaterials at 12%. Forestry supplies most biomass for biomaterials and energy, while agriculture primarily provides biomass for food, feed, and biofuels.
- **Heating and cooling account for about 75% of bioenergy consumption**, while bioelectricity and transport biofuels constitute the remainder. Bioethanol and biodiesel, mainly derived from food and feed crops, dominate transport biofuels. Biomaterials demand is led by solid wood products and pulp/paper; advanced biomaterials such as bioplastics and biochemicals grow rapidly but still represent a small share.
- **EU strategies position biomass as a critical renewable resource for decarbonisation and circular economy objectives** but acknowledge rising sustainability challenges. Competition among food, energy, and material uses, limited sustainable biomass availability, and ecosystem pressures necessitate careful resource allocation and systemic approaches. Improvements in biowaste recovery and utilisation for bioenergy enhance circularity and reduce waste disposal impacts.
- **Global and EU biomass-derived plastics production has increased in recent years**, reflecting a shift toward sustainable material applications despite short-term market fluctuations. The EU holds the highest share of biomass-derived plastics in total plastics production compared to benchmark regions. However, absolute production volumes remain low, leaving significant potential for global competition in the renewable carbon market.
- **Biomass-based electricity accounts for around 6% of EU power generation**, the highest share among benchmark regions. Biomass-based biofuels remain a stable renewable energy source for industrial process heat in the EU, with consumption increasing modestly from 2020 to 2023.

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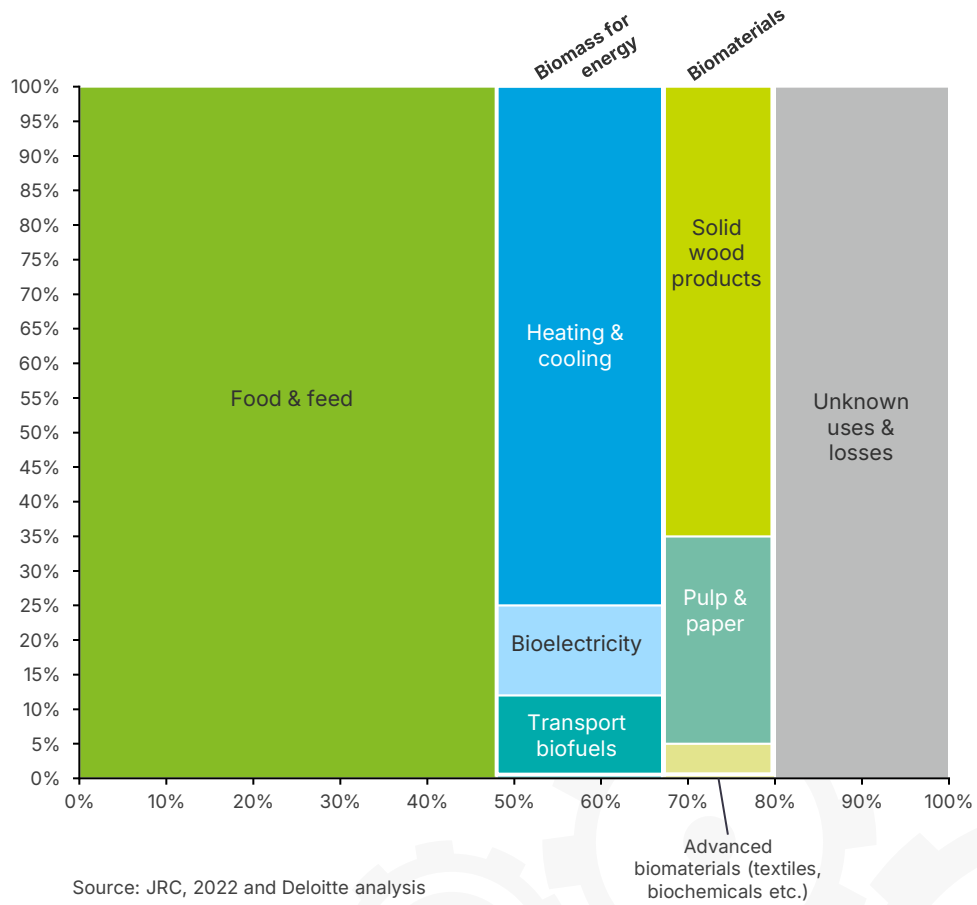
Biomass production and consumption in the EU grow slowly, with traditional sectors dominating use and policy driving sustainable expansion amid resource and environmental constraints

Biomass production and consumption in the EU grow slowly, underscoring biomass's central role in EU's evolving bioeconomy. Total biomass production in the EU reached approximately 898 million tonnes dry matter, based on latest available estimates, and biomass flows appear to have remained broadly stable in recent years. Biomass use in the EU remains heavily concentrated in traditional sectors. Food and feed dominate demand at 48%, biomass for energy represents 19%, and 12% is directed toward biomaterials. The remaining 20% corresponds to unknown uses and system losses (JRC, 2022). Biomaterials refer to biomass input used for non-food, non-energy material applications. Solid wood products, including construction materials and furniture, dominate biomass demand in material sectors. Pulp and paper represent the second largest biomass use for materials, while advanced biomaterials such as textiles and biochemicals remain a small but rapidly growing share. Biomass for energy covers biomass used for energy generation, with heating and cooling comprising roughly 75% of bioenergy consumption. Bioelectricity and transport biofuels account for approximately 13% and 12%, respectively (European Commission, 2019).

Biomass uses in the EU (based on latest available estimates)



Source: JRC, 2022 and Deloitte analysis

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EU biomass policy prioritise sustainable mobilisation of agricultural, forest, and biowaste resources to balance decarbonisation, energy security, and circular economy goals

Agriculture is the EU's main biomass source, with production remaining stable from 2018 to 2022. Most agricultural biomass supports food and feed, while around 25% is used for other uses such as biofuels, primarily bioethanol and biodiesel derived from cereals, sugar beet, and oil crops. Bioethanol production reached approximately 5.3 billion litres in 2022, representing about 5% of total cereals and sugar beet use. Advanced biofuels from residues remain marginal but are expected to grow under EU sustainability policies (JRC, 2025).

Biowaste is an increasingly important biomass source. In 2021, the EU-27 generated about 73 Mt of solid and 11 Mt of liquid food waste. Since 2012, biowaste generation has remained stable, while recovery rates have increased to around 90%, supporting circular economy goals. Most recovered biowaste fuels bioenergy pathways such as anaerobic digestion for biogas and biomethane.

EU strategies consistently frame biomass as both a regulating service, notably a carbon sink, and a provisional service supplying renewable energy, food, and materials. Policies including RED II/III, REPowerEU, the Bioeconomy Strategy, and the Circular Economy Action Plan position biomass as a key lever for decarbonisation and energy security, with strong expectations for increased mobilisation of agricultural and forest residues, biowaste, and other sustainable feedstocks. These policies acknowledge constraints such as limited sustainable biomass availability, sectoral competition – especially among energy, chemicals, and food – and environmental degradation risks if demand rises unchecked. The Transition Pathway for the Chemical Industry explicitly highlights scalability challenges in shifting to bio-based production. Overall, EU policy places high and expanding expectations on biomass for bioenergy and biomaterials, while emphasising the need for careful resource allocation, sustainability safeguards, and systemic approaches to avoid trade-offs and ensure environmentally and socially viable biomass flows. Recent assessments emphasise the importance of ensuring environmentally sustainable expansion as agricultural and forest ecosystem pressures intensify. Overall, biomass use remains skewed toward energy rather than material applications.

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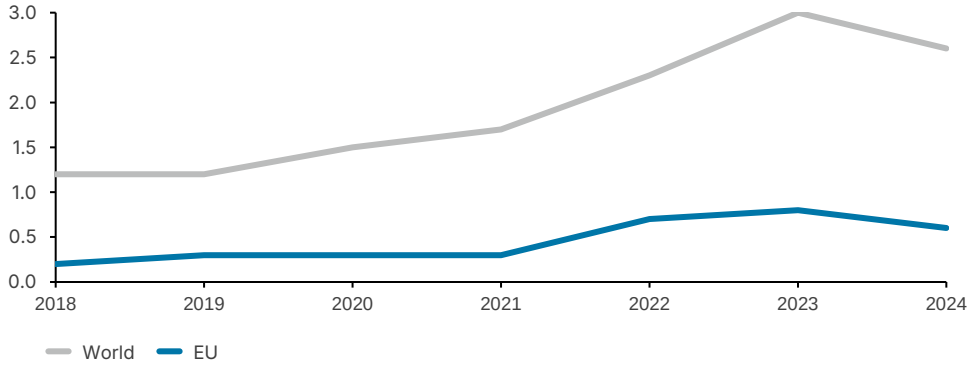
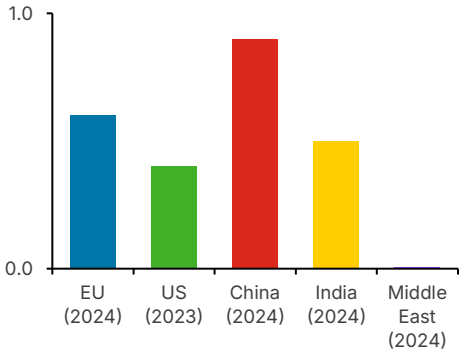
The EU leads global growth in biomass-derived plastics, advancing sustainable materials while facing scaling challenges amid rising market demand

World and EU biomass-derived plastics production evolution (Mt) (2018-2024)

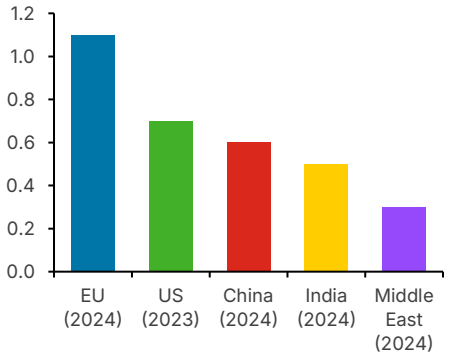


Source: Plastics Europe, 2025

Biomass-derived plastics total production (Mt)



Share of bioplastics in total plastics production per region (%)



Source: Plastics Europe, 2025; PLASTICS, 2023

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Biomass-derived plastics represent a strategically important segment within the EU's biomaterials landscape, reflecting the increasing volume of biomass channelled into material applications. Biomass-derived plastics include bio-based and bio-attributed plastics (Cefic, 2025). The EU's strong starch production capacity and net exporter status of bio-based polymers drive this market, which is expected to grow approximately 4% annually.

Global biomass-derived plastics production increased from 1.2 Mt in 2018 to a peak of 3.0 Mt in 2023, before moderating to 2.6 Mt in 2024, with bio-attributed plastics included from 2022 onwards. EU production followed a similar trend. These trends indicate a steady increase in biomass flows into biomaterials, particularly biomass-derived plastics, which offer an alternative to fossil-based plastics. Short-term production dips reflect market adjustments, but the overall trajectory confirms an expanding role for biomass in material applications within the EU and globally (Plastics Europe, 2025).

The EU leads globally with the highest share of biomass-derived plastics, demonstrating the most advanced industrial adoption of biomass feedstocks. Although the absolute share remains just over 1% of total plastics production, the EU's early adoption supports raw material security and reduces fossil carbon dependency. However, significant challenges in scaling production limit the current foundation for large-scale expansion (Cefic, 2025; Plastics Europe, 2025).

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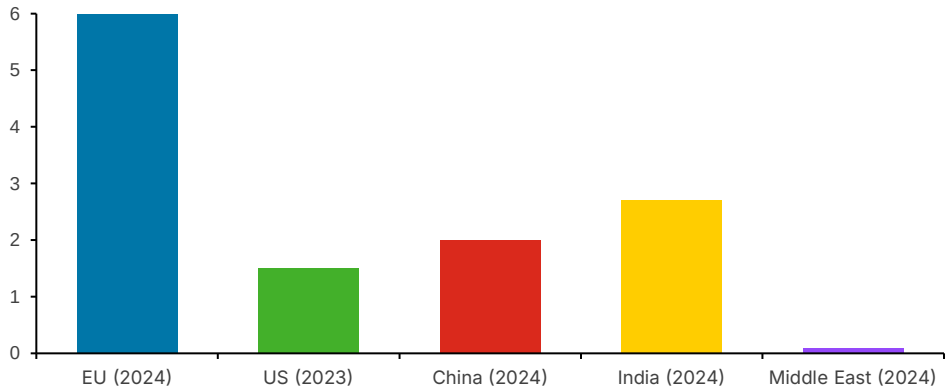
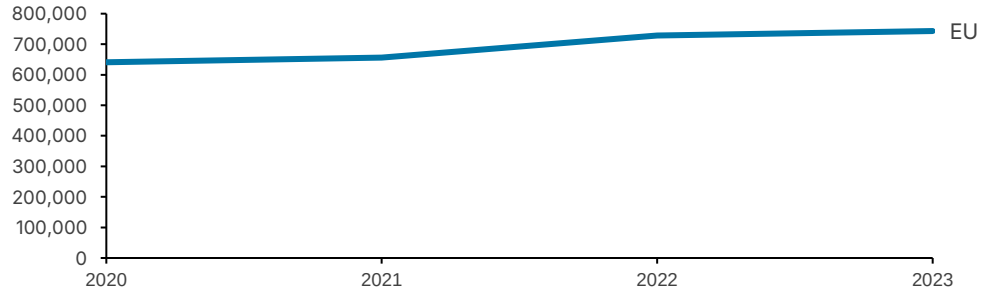
Biomass-based electricity and biofuels together provide a stable and growing renewable energy supply playing a critical role in decarbonising energy-intensive industries

Biomass-fuelled electricity generation as % of total electricity generation



Source: IEA Bioenergy, 2024; Bioenergy International, 2022; EMBER, 2025

Final energy consumption of biofuels in the manufacturing industry (terajoule NCV) in the EU (2020-2023)



Source: Eurostat, 2025

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Biomass-based electricity generation accounted for approximately 6% of gross electricity production in the EU in 2022, underscoring biomass's important role in industrial decarbonisation and renewable energy supply. Industry consumed 35.4% of the EU's final electricity in 2023, with electricity representing about one-third of industrial final energy consumption, making its decarbonisation highly impactful (IEA, 2025; IEA Bioenergy, 2024). This indicator tracks the share of biomass (solid biomass, biogas, renewable municipal waste) in total gross electricity generation, reflecting biomass mobilisation to support low-carbon power for energy-intensive industries and enhancing raw material security under pillar 5.

Biofuels provide a stable and essential renewable energy source for industrial process heat across the EU, particularly in biomass-rich Member States and energy-intensive industries. This analysis includes solid biofuels, charcoal, liquid biofuels, and biogases consumed in the manufacturing sector (NACE C), excluding non-energy uses such as construction materials and biolubricants. Solid biofuels encompass charcoal, fuelwood, wood residues, black liquor, bagasse, animal waste, vegetal materials, and the renewable fraction of industrial waste. Charcoal is a manufactured fuel produced through the pyrolysis of wood and vegetal materials. Eurostat data show that biofuels consumption in EU industry remained broadly stable from 2020 to 2023. The reported 16% increase reflects a combination of a slight rise in actual consumption and improved reporting by Member States, confirming biofuels' continued role in the EU's industrial energy mix (Eurostat, 2025).

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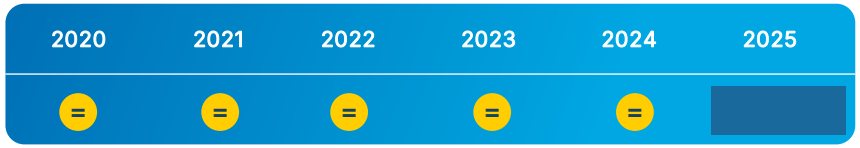
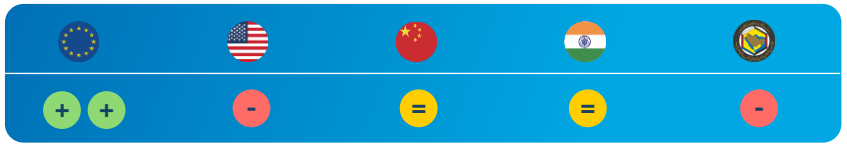
KPI 5.4 Circular Material Use Rate (CMUR)

The CMUR measures the share of material recycled and fed back into the economy, thereby saving extraction of primary raw materials, in overall material use. It is defined as the ratio of the circular use of materials to the overall material use. The overall material use is measured by summing up the aggregate domestic material consumption and the circular use of materials. The CMUR is expressed as a percentage and is calculated as: **CMUR = (Secondary material input / Total material input) × 100**
A higher CMUR value indicates a relative increase in the use of secondary materials versus primary materials, thereby reducing the environmental impacts associated with primary material extraction.
This KPI covers all material inputs including metals, plastics, paper, glass, and construction materials. It reflects the extent to which the economy is transitioning toward circularity by reducing reliance on virgin raw materials and increasing resource efficiency.

EU performance evolution



International benchmarking



Key takeaways

- **EU outperforms global circularity average**: The EU performs better than the global circularity matrix, which declined from 7.2% in 2018 to 6.9% in 2021 and performs better than the benchmark when comparing material-specific indicators, such as plastic packaging recycling.
- **Significant disparities exist across Member States**: Substantial variations in CMUR exist across EU Member States, ranging from 32.7% in the Netherlands to 1.3% in Romania in 2024. Whilst some countries such as the Netherlands ameet the 2030 EU target, progress is uneven, highlighting the need for tailored national strategies.
- **Circular Economy Act aims to double circularity rate by 2030**: The forthcoming Circular Economy Act, expected in 2026, represents a pivotal step toward establishing a single market for secondary raw materials and scaling up the supply and demand of high-quality recycled materials. Anchored in the Competitiveness Compass and the Clean Industrial Deal, this legislation aims to double the EU's circularity rate from 12.2% in 2024 to 24% by 2030, driving progress toward a resource-efficient, low-waste, and climate-neutral economy and positioning the EU as a global leader in circular innovation.
- **EU fosters competitiveness through circular innovation**: The EU is enabling competitiveness by fostering innovation in recycling technologies, setting ambitious regulatory frameworks, and creating market incentives for circular material use. These efforts contribute to reducing dependency on imported raw materials, enhancing industrial resilience, and aligning with the EU Green Deal's goals.
- **Greater circularity requires reduced material consumption**: Achieving greater circularity requires both higher recycling rates and reduction in overall material consumption, particularly of resource-intensive materials such as non-metallic minerals and metals. Additionally, cutting the use of fossil-based materials and improving the sustainability of biomass production are critical to further reducing environmental pressures.

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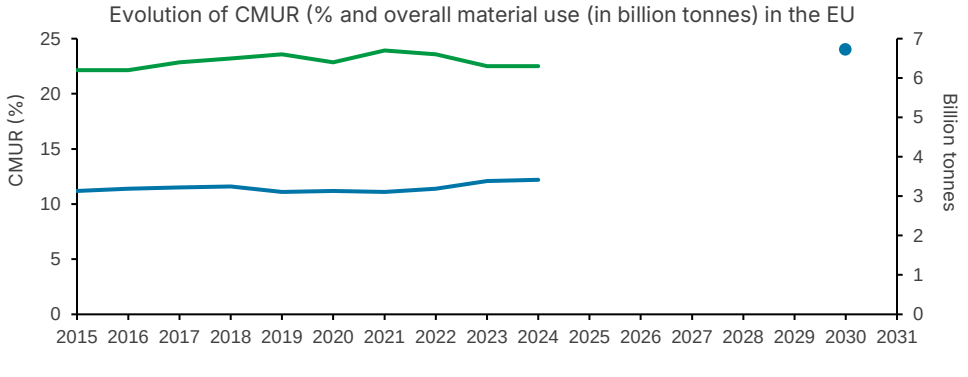
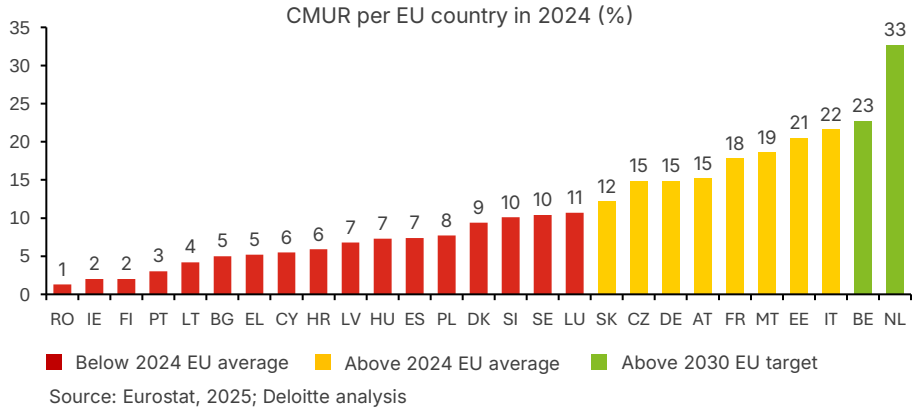
The EU's CMUR remains stable but insufficient, with wide Member State disparities and ambitious targets requiring accelerated progress to lead the global transition



Source: Eurostat, 2025; Deloitte analysis



Source: Eurostat, 2025; Deloitte analysis

The EU's CMUR remained broadly stable between 2015 and 2024, fluctuating narrowly from 11.1% to 12.2%, reflecting limited progress in circularity despite policy efforts. Annual figures show modest variations, with 2023 and 2024 slightly higher than earlier years but no sustained upward trend. The slight fluctuations primarily result from changes in overall material use, indicating that the circular content of the EU economy has remained consistent over the decade.

The EU's Circular Economy Act, set for adoption in 2026, aims to double the circularity rate to 22.4% by 2030 and establish a single market for secondary raw materials, increasing supply and demand for high-quality recycled materials across Member States. The Clean Industrial Deal further strengthens this ambition, targeting a 24% circularity rate by 2030 to enhance the EU's competitiveness and leadership in the circular economy. However, current progress remains insufficient to meet these targets as the EU economy continues to operate predominantly in a linear manner.

Substantial variations in CMUR exist across Member States, ranging from 32.7% in the Netherlands to 1.3% in Romania in 2024, reflecting significant disparities in national recycling capacities and material consumption patterns. The Netherlands surpasses the EU's 2030 target by more than seven percentage points, demonstrating that high recycling rates are achievable within the Single Market.

Global circularity data reveal a decline in the share of secondary materials from 7.2% in 2018 to 6.9% in 2021, underscoring the EU's stronger performance relative to the global average (Circularity Gap Report, 2025).

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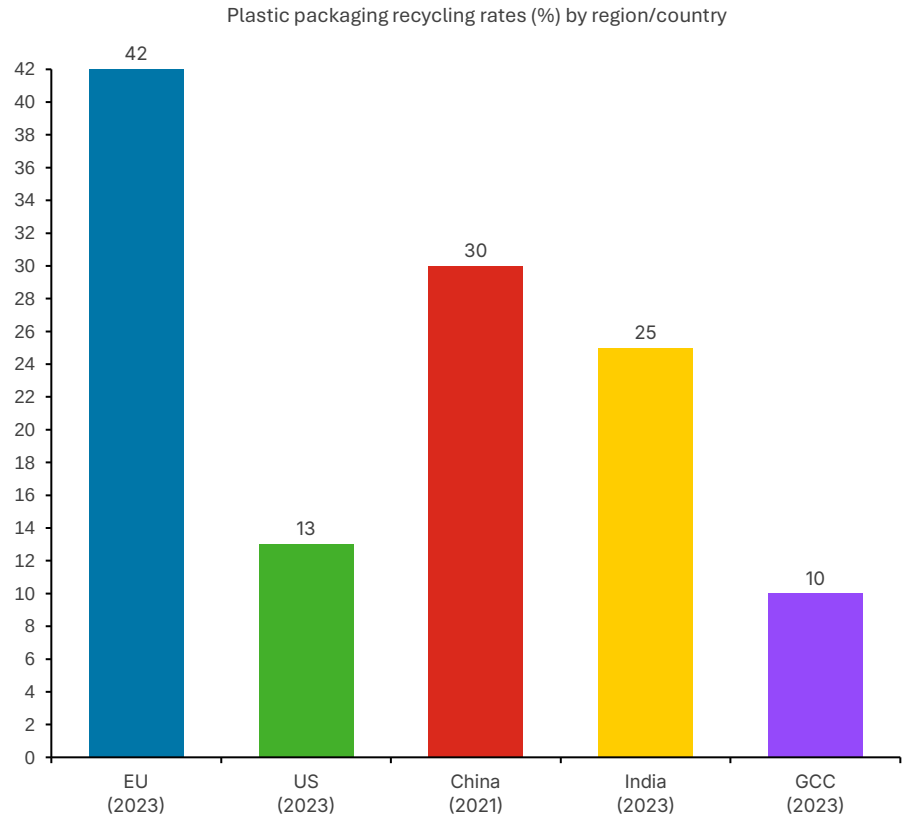
The EU leads global plastic packaging recycling with a 42.1% rate, significantly outperforming other major economies



Source: Eurostat, 2025; U.S. Plastic Pact, 2023; The State Council the People's Republic Of China, 2021; IPP Annual Report, 2023; Gulf Petrochemical & Chemical Association, 2023

The EU-27 led major economies in plastic packaging recycling, achieving a 42.1% rate in 2023, which highlights its stronger industrial recycling capacity and regulatory framework (Eurostat, 2025). The US recorded a 13.3% recycling rate (U.S. Plastic Pact, 2023). China's rate was approximately 30% in 2021 due to rapid industrial growth but uneven infrastructure (The State Council – The People's Republic of China, 2022). India's estimated rate reached 25% based on partial state data (India Plastics Pact, 2023). The Gulf region recycled only 10% of plastic waste, indicating a significant potential for improvement (Gulf Petrochemicals and Chemicals Association, 2023).

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Pillar 6: Boost demand for net-zero, low-carbon and circular products

Empower consumers (businesses and private) to choose net-zero and circular products, based on transparent product and environmental carbon footprints. Lead the way through public procurement and private buyer initiatives endorsed by the EU. Expand the scope of the Net Zero Industry Act and the Critical Raw Materials Act. Grow sales potentials by improved market access in international markets.

Pillar conclusions

The assessment of the market for net-zero, low-carbon, and circular products relies on three key performance indicators (KPIs): (1) public procurement contracts applying sustainability criteria; (2) export markets access through preferential trade agreements (PTAs); (3) consumer incentives and demand mandates driving markets for net-zero, low-carbon and circular products.

The KPIs reveal that the EU is more advanced in developing markets for net-zero, low-carbon, and circular products compared to other major regions. That said, **demand-side levers remain underutilised yet hold significant potential. Green public procurement (GPP) could transform the market if harmonised** across the EU, where public procurement accounts for approximately 14% of GDP (European Commission, 2024). Both the EU and the US face similar challenges related to fragmented public procurement systems, which constrain the effective use of green public procurement as a demand-side lever.

The EU's trade strategy has shifted decisively from liberalisation and tariff reduction **towards prioritising geopolitical resilience, supply chain security, and targeted instruments such as clean trade and investment partnerships** (CTIPs). PTA market coverage increased by approximately 29% since 2019, with over 50% of EU exports now directed to these markets. The PTA market uptake index rose to 1.7 in 2024, demonstrating that **PTA partner markets offer nearly twice the advantage for EU exporters** compared to non-PTA markets.

Consumer incentives within the EU have established foundational support but have not yet generated sustained market growth for net-zero, low-carbon, and circular products, indicating the need for demand mandates. Whilst the EU and the US have implemented a broad range of consumer incentives, China and India focus on industrial incentives, and the GCC countries remain at early stages.

The EU maintains low external tariffs and aims to eliminate internal tariffs within its Single Market to promote internal trade. Nevertheless, **internal trade barriers persist and hinder full market integration.** The EU also applies robust trade defence measures, including anti-dumping and anti-subsidy tariffs, to protect its industries.

29%

PTA market coverage increase since 2019

4x

The EU Member States have on average about 4x more consumer incentives than the US states

41%

Share of G20 countries with which the EU has PTAs in force

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Broader market instruments context: The EU Emissions Trading System drives decarbonisation but global imbalances risk disadvantaging European industry

The Emissions Trading System (ETS) serves as a pivotal mechanism for achieving net-zero goals by creating a demand push for low-carbon products, effectively bridging the financial gap between high-emission commodities and greener alternatives. In the EU, this system is entering a transformative phase in 2026 as the supply of free allowances declines and carbon prices are projected to remain between €85 and €100 per tonne (Yermolenko, 2026). This shift compels industries to view decarbonization as a competitive necessity rather than a mere regulatory burden, a transition further bolstered by the Carbon Border Adjustment Mechanism (CBAM). By ensuring that carbon-intensive imports like steel and hydrogen face equivalent pricing, CBAM protects the market for low-carbon products manufactured within the EU (Fastmarkets, 2025).

On the global stage, carbon pricing is rapidly evolving from a European exception into an international standard, characterized by varying degrees of regional maturity. The EU has effectively set a global benchmark with CBAM, incentivizing other regions to accelerate their own climate frameworks to maintain trade compatibility. China currently operates the world's largest ETS by volume, expanding its focus from the power sector to heavy industries like aluminium and cement to stimulate energy-efficient production (ICAP, 2025). While the US lacks a federal ETS, it relies on successful regional markets such as California's Cap-and-Trade program and the Regional Greenhouse Gas Initiative in the Northeast to funnel billions into clean energy (Office of the Governor, 2025; RGGI, 2025). Meanwhile, India is transitioning toward a compliance-based system through its Carbon Credit Trading Scheme to incentivize its industrial base, and GCC nations like Saudi Arabia and the UAE are launching voluntary exchanges to align their massive hydrogen and solar investments with global green-premium markets (Bansal, 2026; VCM, 2024).

While CBAM addresses carbon costs for imports, it does not currently offer rebates for EU exports. This creates a cost disparity, as EU manufacturers face domestic carbon pricing that international competitors in external markets do not. Consequently, this lack of an export adjustment may reduce the price competitiveness of EU goods in global trade. (The Grantham Foundation, 2025)

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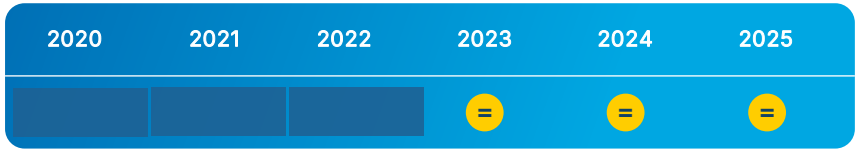
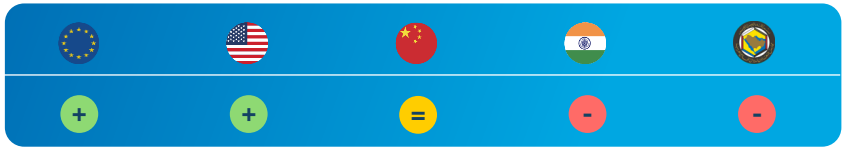
KPI 6.1 Public procurement contracts using sustainability related criteria

This KPI measures progress in integrating sustainability criteria into public procurement. The Public Procurement Data Space (PPDS), developed by the European Commission, provides the best available data by consolidating procurement information from the EU and Member States. The PPDS focuses on strategic procurement, defined by the Commission as awarding contracts to promote innovative, green, and social procurement (EC, 2017). For this KPI, only green public procurement contracts relevant to the manufacturing sector, identified by specific Common Procurement Vocabulary (CPV) codes, are included.

EU performance evolution



International benchmarking



Key takeaways

- **Pronounced lack of harmonisation across the EU:** Fragmented data, varying reporting thresholds, and the absence of unified mandatory or voluntary measures create a pressing need for harmonised reporting standards in green public procurement.
- **Untapped market potential:** Public procurement accounts for 14% of the EU's GDP. Embedding green procurement mandates can foster markets for low-carbon, net-zero, and circular products, as demonstrated by Lithuania's success in stimulating demand for green cement and alternative fuels.
- **Clear criteria are essential:** Without harmonised standards, such as product carbon footprint (PCF) or global warming potential indicators, green public procurement cannot effectively drive demand for net-zero, low-carbon, and circular markets. The examples of Lithuania and the Netherlands show that mandating green procurement with specific requirements successfully stimulates these markets.
- **Global divergence in maturity:** The GCC and India remain at early stages with no standardised systems. China's centralised approach facilitates widespread adoption, but green public procurement remains secondary to economic growth priorities. The US faces similar challenges to the EU: lack of harmonisation and fragmented reporting systems.

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Public procurement accounts for 14% of the EU's GDP, offering significant potential to accelerate Europe's market for net-zero, low-carbon, and circular products

Public procurement is one of the key drivers for market expansion for net-zero, low-carbon, and circular products. It accounts for nearly 14% of the EU's GDP, underscoring its role in shaping demand across sectors (EC, 2024). The public sector represents 31% of the cement market and 11% of the steel market, highlighting the significant potential of green public procurement to stimulate sustainable material demand (Wyns, 2019). However, the EU lacks mandatory GPP standards, limiting this tool's impact. Lithuania and Slovenia have introduced mandatory GPP, demonstrating early leadership.

The 2014 Public Procurement Directives regulate procurement in the EU but do not require GPP. These Directives (2014/24/EU and 2014/25/EU) permit the Most Economically Advantageous Tender (MEAT) criterion, enabling the inclusion of environmental factors such as CO_2 emissions to influence award decisions (EC, 2014). The EU is progressing towards mandatory GPP to support industrial and climate goals (Puiu, 2025). That said, the European Commission's 2025 evaluation report acknowledges limited GPP uptake and stakeholder concerns over coherence and implementation challenges in strategic procurement (EC, 2025).

Since the 2024 Net Zero Industry Act (NZIA), public procurement must include environmental criteria, covering footprint, circularity, or manufacturing excellence, for 19 strategic net-zero technologies, including photovoltaics, sustainable biogas, and grid technologies. The Ecodesign for Sustainable Products Regulation (ESPR) empowers the Commission to set mandatory GPP criteria for broader product categories such as textiles, steel, and furniture (EC, 2024).

The 2014 Directives are under review, with a legislative proposal expected in Q4 2026. It is anticipated that strategic criteria, encompassing green, social, and innovation aspects, will become mandatory, moving beyond price as the sole award criterion. It will also address strategic autonomy, resilience, and simplify procedures for SMEs (AFCL, 2025; Nicoli, 2025). The Industrial Accelerator Act is expected to require public authorities to prioritise sustainability, resilience, and circularity over lowest price.

To facilitate these procurement decisions, the emergence of standardized certification frameworks, such as the Low Emission Steel Standard (LESS) and the proposed EU Steel Label, provides the necessary transparency for authorities to distinguish between conventional and low-carbon products based on verifiable emissions intensity and scrap content.

The EU increasingly positions public procurement as a strategic tool to advance decarbonisation, mitigate supply chain risks, and promote European industries (Hermwille & Leipprand, 2024). Improved data and monitoring frameworks, such as the PPDS and Digital Product Passports (DPP), support this shift.

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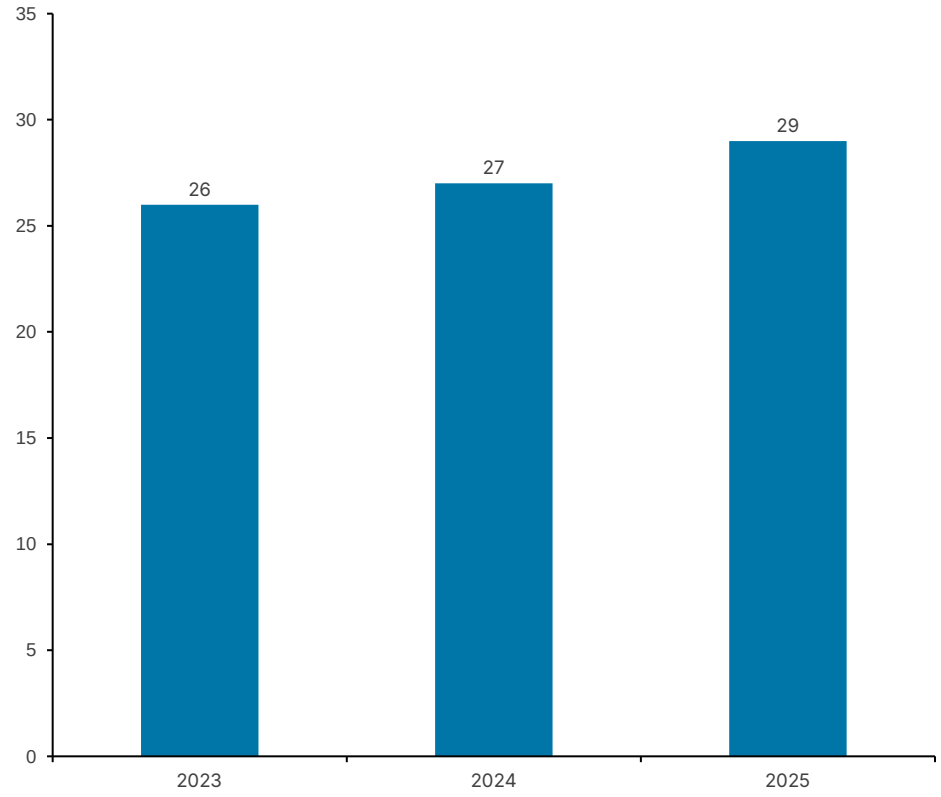
Despite a slight increase, green public procurement remains vastly underused across the EU

Share of public procurement reported by PPDS including 'reduction of environmental impacts'



Source: PPDS, 2025

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Despite progress, public procurement underutilises green and strategic procurement potential. The PPDS tracks strategic procurement, defined by innovation, social, and green pillars, with this KPI focusing on green procurement. Since 2023, strategic procurement is traceable via integrated e-forms. Green procurement shows slight improvement since 2023, reflecting growing importance. However, inconsistent reporting across Member States limits PPDS' comprehensiveness.

Lithuania exemplifies ambitious GPP targets, mandating 100% green public procurement contracts from 2023. Green procurement rose from 3.3% in 2020 to 95.2% in 2024. In practical terms, this transition has had a profound impact on products such as green cement. Cement producers must submit Type III Environmental Product Declarations (EPD) declaring global-warming potential (GWP), with green cement defined around 683 kg CO_2 eq. (Cembureau, 2020). AB Akmenės Cementas, Lithuania's sole cement manufacturer, phased out coal fuel, replacing it with 90% alternative fuels. Demand for low-carbon solutions has spurred innovation from companies such as Concretus Group and INHUS. Lithuania's GPP mandate created a guaranteed market for advanced low-carbon products, demonstrating demand-driven environmental and economic benefits.

The Netherlands leads in green public procurement with its 'CO2 Performance Ladder', a system that adjusts bid prices based on environmental costs to favour sustainable bidders, an approach now also adopted by other Member States, underscoring the Netherlands' leadership. In construction, 90% of civil projects and 69% of office tenders included environmental commitments in 2024, especially for eco-friendly concrete. The Netherlands and Ireland are the only EU states setting limits on embodied carbon in materials like concrete and steel, with fixed CO2 emission costs. (ECOS, 2024)

A contrasting example, Belgium's 2024 public transport tender illustrates missed opportunities. De Lijn awarded a €43 million contract for 92 electric buses to Chinese manufacturer BYD. The tender decision faced criticism due to its heavy emphasis on price, which accounted for 70% of the evaluation criteria, whilst post-purchase guarantees and sustainability were weighted at only 20% and 10%, respectively. BYD's bid was 20% cheaper but ranked last on sustainability and guarantees (Pepermans, 2024). Stricter GPP rules could have ensured environmentally superior products and supported European manufacturers.

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The EU lacks harmonised GPP standards and India has no unified framework, China adopts a procurement strategy focused on SMEs

The following table assesses the maturity of the integration of green public procurement in the benchmarked countries.

Countries	Key conclusions	Context
EU	Growing importance of GPP, no mandatory requirements	• **No mandatory GPP in place but is expected in 2026** • **Lack of harmonization of data and reporting**, due to various thresholds and national laws • **Clear upward trend to include GPP**, both at EU level and at Member States' level. This integration is motivated both for achieving **environmental goals** and for building **resilient supply chains**

India	No plan to unify methods, no significant movement in initiatives	• **No unified**, comprehensive national **framework** for GPP
		• **Lack of effective monitoring** system for GPP
		• Stakeholders **prioritise short-term costs** and view green products as **more expensive**
		• Early stages for some initiatives:
		  ○ The Department of Expenditure established the Task Force on Sustainable Public Procurement in 2018
		  ○ The State of Punjab introduced dedicated green public procurement guidance documents in 2024 (Erizaputri and Bechauf, 2024)

China	Centralized approach easing public procurement, strategy not prioritizing environment	• Procurement activities are **mandated** to **follow two designated lists** issued by the Ministry of Finance and the National Development and Reform Commission (Cao et al., 2022) • Public procurement strategy follows **sustainable public procurement** (SPP), which mandates that procurement must serve national policy goals in 3 categories: environmental protection; promoting SMEs; assisting underdeveloped and minority areas. Under the environmental protection category, products are assessed by the two aforementionedlists, which focus on energy efficiency and environmentally friendly products • **SPP principles are legally grounded** in Article 9 if the Government Procurement Law • There is a **clear upward trend in the uptake of SPP**, but it is **mainly focused on SMEs**. In fact, a study examining 40,0000 public procurement contracts has found that although 82% use SPP, the majority is based on SMEs, while the **lowest share** is attributed to circularity • The key factor behind China's robust adoption of SPP is its **centralized**, **top-down governance** approach

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The US faces challenges similar to the EU, whereas the GCC recognises GPP's potential but lacks an integrated procurement framework

The following table assesses the maturity of the integration of green public procurement in the benchmarked countries.

Countries	Key conclusions	Context
GCC	Potential is recognised; progress recorded in implementing sustainability in regulations	• There is a **need to develop an integrated strategic procurement framework** that moves beyond compliance towards a more strategic approach to fully realise its potential (Schreiber et al., 2020) • **2 primary factors** drive green public procurement: the need to **reduce reliance on fossil fuel** reserves and oil revenues, and **regulatory modernization** aimed at formalising and standardising procurement processes • Saudi Vision 2030 and the Government Tenders and Procurement Law **promote responsible sourcing** • UAE signed the **Green Public Procurement Pledge**, with the latest target for 2030 requiring the procurement of a proportion of cement and/or crude steel from near-zero emission production for key projects • Since the signature, UAE's Ministry of Energy and Infrastructure has implemented a **Sustainability Procurement Policy** ensuring that all products and services procured by said ministry meet stringent sustainability criteria (IDDI, 2025)
US	Decentralized system complicates the reporting of GPP	• **Similar challenges to those in the EU** • **Decentralised system** adds further complexity to adhering to green public procurement principles • **Individual agencies**, such as government departments, often follow **different procurement procedures** since they each have their own procurement officers • **Monitoring** of **sustainable procurement remains weak**, as many agencies lack the data systems necessary to distinguish green purchases from standard ones (Morales et al., 2023)

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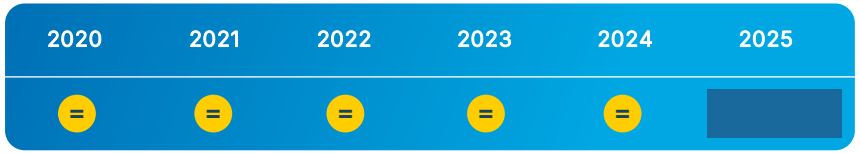
KPI 6.2 Export markets access through preferential trade agreements

This KPI assesses the effectiveness of the EU's preferential trade agreements (PTAs) by tracking two sub-indicators. First, the PTA coverage indicator compares the EU's exports to PTA markets with the EU's exports to the world. Second, the relative market uptake index compares the EU's import share in PTA markets with the EU's import share in non-PTA markets. PTAs are evaluated under pillar 6 because they facilitate market access and can support the growth of net-zero, low-carbon and circular products in the future.

EU performance evolution



Key takeaways

- **Exports to PTA partners increased by 29% since 2019**: Exports to PTA partners have increased by approximately 10–15 percentage points since 2019, reflecting the growing coverage and utilisation of PTAs and indicating that a larger share of EU trade now benefits from preferential terms.
- **EU holds consistently higher import share in PTA markets**: The EU has consistently held a higher import share in PTA markets (index >1), driven by newly active deep agreements. This strong result demonstrates that PTA countries import twice as much from the EU as from other countries.
- **CTIPs offer flexible, non-binding trade agreements**: Although clean trade and investment partnerships (CTIPs) are non-binding instruments, they are easier to negotiate and establish and secure access to vital resources and foster a market for net-zero, low-carbon, and circular products. It is essential to closely monitor the effectiveness of these agreements to determine whether they achieve their intended objectives.

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The efficiency of the EU's preferential trade agreements has improved since 2019, driven in part by a strategic shift in the EU's trade policy towards prioritising preferential partners

PTAs in the EU have evolved significantly over time. While historically their primary aim was to liberalise trade flows by lowering tariffs and removing basic barriers, modern PTAs have become broader in scope. They now frequently encompass a wider range of issues beyond traditional trade, including public procurement, intellectual property rights, and regulatory cooperation. Alongside these broader elements, current agreements also prioritise economic resilience and the reduction of strategic vulnerabilities in supply chains. Sector-specific approaches within trade agreements offer further potential to enhance resilience and supply-chain objectives.

Despite this strategic evolution, the EU remains heavily reliant on imports for green energy products, exposing supply chain vulnerabilities. For example, in 2023, the EU imported €19.7 billion worth of solar panels, with China supplying 98% of these imports. This concentration highlights a critical dependency on a single partner for a key transition technology, underscoring the need to diversify energy partnerships (Eurostat, 2025).

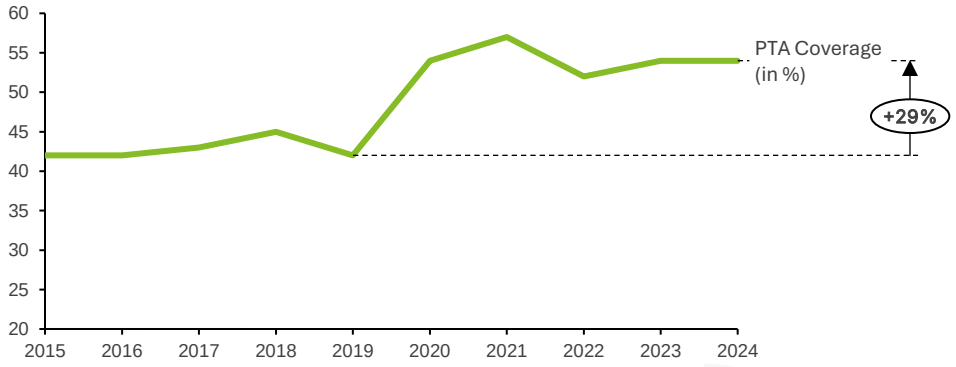
In contrast, the EU's wind energy sector is performing strongly. Wind turbine exports reached €2.8 billion in 2024, 41% higher in value and 28% higher in volume than in 2023, reinforcing the EU's competitive position in this technology (Eurostat, 2025).

The **first sub-indicator** measures the share of EU exports directed to PTA partners relative to total EU exports worldwide. This metric quantifies market access, export concentration, and resilience within preferential trade frameworks. The KPI is calculated as follows:

PTA Coverage = (EU exports to PTA markets / EU exports to World) × 100

Between 2015 and 2019, the PTA export share remained stable, ranging from 42% to 45%, as no significant agreements were signed. It then rose sharply to 54% in 2020, peaked at 57% in 2021, and stabilised at a higher level of 52% to 54% during 2022 to 2024. The 2020 shift reflects the impact of Brexit, which reclassified UK trade from intra-EU to extra-EU flows. Concurrently, the conclusion of major PTAs with Japan, Vietnam, and Singapore contributed to the rise in exports to PTA partners.

PTA coverage - Share of EU's exports to PTA markets vs world



Source: Deloitte analysis based on UN Comtrade, 2025
Note: *Only trade in goods is considered. PTAs are considered as per their date of entry into force. It must be noted that not all provisions are applicable as of day one of the PTA's entry into force.*

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The EU's import share is significantly higher in PTA markets as opposed to non-PTA markets, showing the efficiency of PTAs

The **second sub-indicator**, the PTA relative market uptake (RMU) index, compares the EU's import share in PTA markets with its import share in non-PTA markets. This index indicates whether PTAs provide a measurable competitive advantage, with values above 1 signalling positive effects. The RMU index is calculated as follows:

PTA Relative Market Uptake = (EU import share in PTA market / EU import share in non-PTA market) × 100

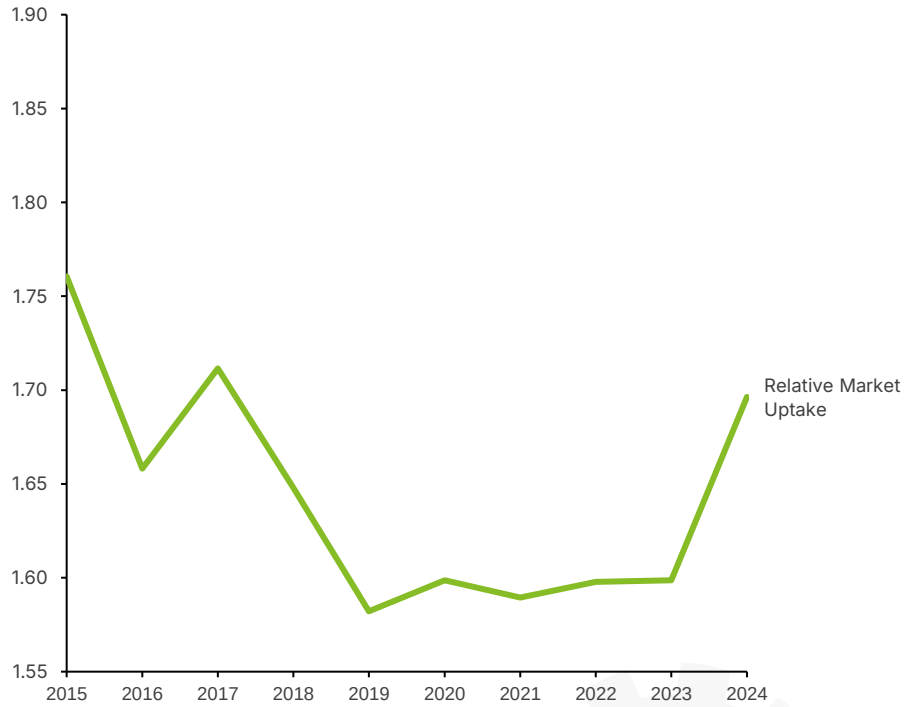
To calculate the EU import share in the PTA market, imports from the EU to PTA partners are divided by total imports from the world to PTA partners. Similarly, the EU import share in the non-PTA market is calculated by dividing imports from the EU to non-PTA countries by total imports from the world to non-PTA countries.

If RMU = 1 → Neutral effect: PTAs have no measurable effect on the EU's export competitiveness compared to baseline trade rules. The EU's exports to PTA markets equal the EU's exports to the world.

If RMU < 1 → Negative effect: PTAs are inefficient or counterproductive. An RMU of 0.5, for example, means the PTA market is only half as advantageous as a non-PTA market. The EU's exports to the world are higher than the EU's exports to PTA markets.

If RMU > 1 → Positive effect: PTAs successfully boost the EU's competitiveness. An RMU of 2, for example, means PTA countries have two times higher chances of importing goods from the EU rather than from other countries.

Relative market uptake – EU's import share in PTA markets vs EU's import share in non-PTA markets



Source: Deloitte analysis based on UN Comtrade, 2025
Note: *Only trade in goods is considered.*

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The EU's robust relative market uptake index reflects increasingly strong partnerships and is expected to strengthen further as new agreements progress through negotiations

In 2024, the EU held a 22% import share in PTA markets and a 13% share in non-PTA markets, resulting in an RMU index of approximately 1.7. This indicates that **the EU is nearly twice as successful trading with PTA partners compared to non-PTA countries, demonstrating the effectiveness of PTAs.** Between 2015 and 2024, the index consistently exceeded 1, ranging from 1.58 to 1.76, reflecting a sustained competitive advantage of 50% to 76% in PTA markets.

In 2024, PTA countries driving this index include Norway, Switzerland, Serbia, and Bosnia-Herzegovina, where the EU's import share ranged between 53% and 56%. This strong market presence largely reflected their geographical proximity to the EU. Conversely, larger economies with established trade agreements but located farther away, such as Japan and South Korea in the Asia-Pacific region, show significantly lower EU import shares of approximately 11%.

Amongst countries without current trade agreements, the EU maintained notable import shares in nations with historical ties to Europe. For example, in 2024, the EU's import share was 72% in Cabo Verde and 31% in Senegal. In contrast, the EU's import share remained relatively low in major economies such as China (excluding Hong Kong and Macao) at 10%.

Although outcomes vary among countries in the same region, the case of Central Asia clearly shows the difference between Kyrgyzstan, which does not have a PTA with the EU, and Kazakhstan, which does. In 2024, the EU's import share was 6% in Kyrgyzstan versus 18% in Kazakhstan, demonstrating PTAs' potential to effectively boost market access.

The 2024 slight increase in the PTA relative market uptake index primarily reflects the implementation of new or updated PTAs that immediately enhance EU market access. Notably, the EU–New Zealand PTA, which entered into force in May 2024, has removed tariffs and simplified rules, providing EU exporters with an immediate advantage. Geopolitical tensions and supply chain disruptions accelerated diversification into preferential markets: in 2024, exports to PTA partners grew by 1.4%, compared to 0.7% growth in non-PTA countries, contributing to the index's rise. Preferential terms thus protect and expand the EU's import share in PTA markets amid intensifying global competition. Stronger enforcement of agreements, including the removal of 44 trade barriers in 2024, further improved practical market access and competitiveness (EC, 2025).

In 2025, the EU expanded its global trade network significantly, concluding negotiations for the Comprehensive Economic Partnership Agreement (CEPA) with Indonesia in September. This agreement will eliminate over 90% of import duties and grant access to a market of 270 million consumers (Strangio, 2025). In 2026, the EU expects to finalise or advance negotiations with India, Thailand, the Philippines, and Malaysia, whilst ratification of the EU–Mercosur FTA (Free trade agreement) is still in progress in January 2026. These agreements are projected to drive substantial trade growth. For instance, the India deal alone could double bilateral trade within five years, whilst securing critical raw materials and reinforcing supply chain resilience across the Indo-Pacific and Latin America (Santander Research, 2025). The India agreement is expected to be mutually beneficial through tariff reductions. It will boost EU exports to India, particularly in machinery, automobiles, chemicals, and clean technology products. Conversely, India will gain enhanced access to the EU market, especially in textiles, chemicals, and pharmaceuticals (Gupta, 2025).

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The EU has trade agreements in force with 41% of the G20 economies

The EU has trade agreements in force with 41% of the G20 entities and is negotiating with 6 more, covering around 76% of the group. This demonstrates that the EU's trade agreements are well targeted globally. However, major markets like China and the US remain outside these agreements.

G20 countries	Status of trade agreement		Details
Argentina	🟡	In progress	EU-Mercosur agreement is currently being ratified
Australia	🟡	In progress	Negotiations for an EU-Australia trade agreement launched in 2018
Brazil	🟡	In progress	EU-Mercosur agreement is currently being ratified
Canada	🟢	In force	Comprehensive Economic and Trade Agreement (CETA) provisionally applied since 2017
China	🔴	No trade agreement	There are no official trade agreements in force
France		*N/A*	*N/A*
Germany		*N/A*	*N/A*
India	🟡	In progress	Currently being negotiated, expected in early 2026
Indonesia	🟡	In progress	In progress, currently in the ratification phase. The Comprehensive Economic Partnership Agreement (CEPA) has been signed in September 2025 and is expected to fully enter into force in January 2027
Italy		*N/A*	*N/A*
Japan	🟢	In force	Global Agreement in force since 2019
Mexico	🟢	In force – being modernised	Global Agreement in place since 2000, modernization negotiations in progress. Agreement in principle reached in 2018
South Korea	🟢	In force	FTA in force since 2015
Russia	🔴	No trade agreement	There are no official trade agreements in force
Saudi Arabia	🔴	No trade agreement	There are no official trade agreements in force
South Africa	🟢	In force	Economic Partnership Agreement provisionally applied since 2016
Turkey	🟢	In force	Customs union in force since 1995
United Kingdom	🟢	In force	Trade and Cooperation Agreement in force since 2021
United States	🔴	No trade agreement	There are no official trade agreements in force
European Union		*N/A*	*N/A*
African Union	🟡	Partially in force	Out of the 55 countries of the African Union, 18 have Trade Agreements already in force, with 13 being adopted or ratified, representing approximately a 56% coverage

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Clean trade and investment partnerships (CTIPs) represent a novel approach to EU trade agreements, featuring streamlined procedures and a focus on clean technology products

In addition to the PTA agenda, the European Commission established clean trade and investment partnerships (CTIPs) in 2025. These non-binding, flexible agreements aim to strategically enhance the EU's industrial competitiveness through international cooperation. Known as 'mini trade deals' for their speed and adaptability, CTIPs complement traditional PTAs by avoiding lengthy ratification processes. Their primary objective is to align the EU's external policy with industrial goals, focusing on diversifying and de-risking supply chains to reduce dependency on specific countries. CTIPs secure reliable access to critical raw materials, clean energy, and clean technology.

CTIPs promote a global environment for clean investment and strengthen the EU's leadership in clean technology value chains. They combine three pillars, rules, regulatory cooperation, and investment, to support partners' decarbonisation efforts, promote EU-aligned standards, and ensure reciprocal business opportunities for EU companies.

To date, the EU has formalised one CTIP, with South Africa, effective since November 2025. This agreement focuses on investment, the clean energy transition, skills and technology development, and advancing strategic industries across the supply chain. The CTIP is supported by a Global Gateway Investment Package totalling €4.7 billion, including €303 million in EU grants (Van der Ven & Azevedo, 2025).

As this is the first CTIP to be signed, it is essential to monitor specific partnership elements to evaluate its impact. Given that CTIPs are non-binding, assessing whether they actively deliver results is critical. Key evaluation criteria include whether trade and investment flows foster mutually beneficial industrialisation, as intended (Sullivan, 2025). Currently, communication on CTIPs and their details remains limited, necessitating vigilant oversight.

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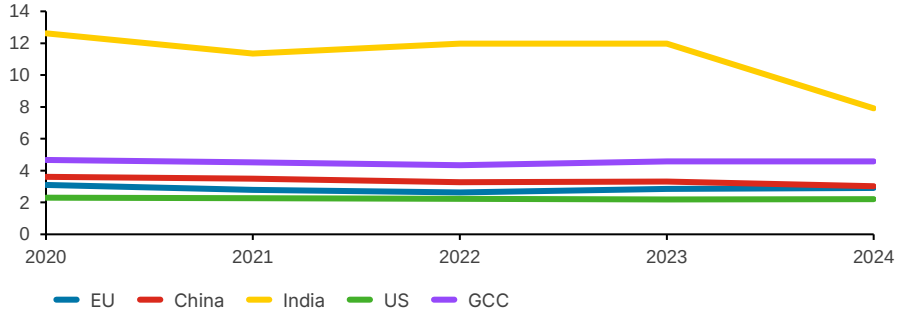
Broader trade context: The rise of discriminatory trade policies and the 2025 rupture

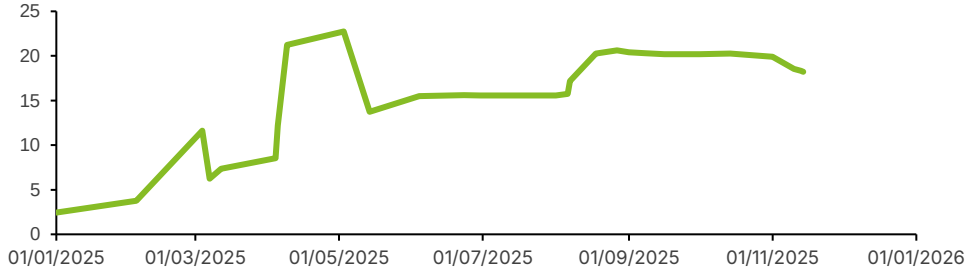
The year 2025 marked a decisive rupture in the international trading system. The US' decision to introduce high and broadly applied tariff barriers represented a clear break with the WTO-based trade framework and long-standing principles of tariff bindings and non-discrimination (The Budget Lab, 2025). As a result, the US average effective tariff rate – unlike developments in most jurisdictions – rose sharply, reaching levels unprecedented in the post-World War II period.

Trade weighted average most favoured nation (MFN) rate between 2020 and 2024



Source: World Trade Organisation, 2026

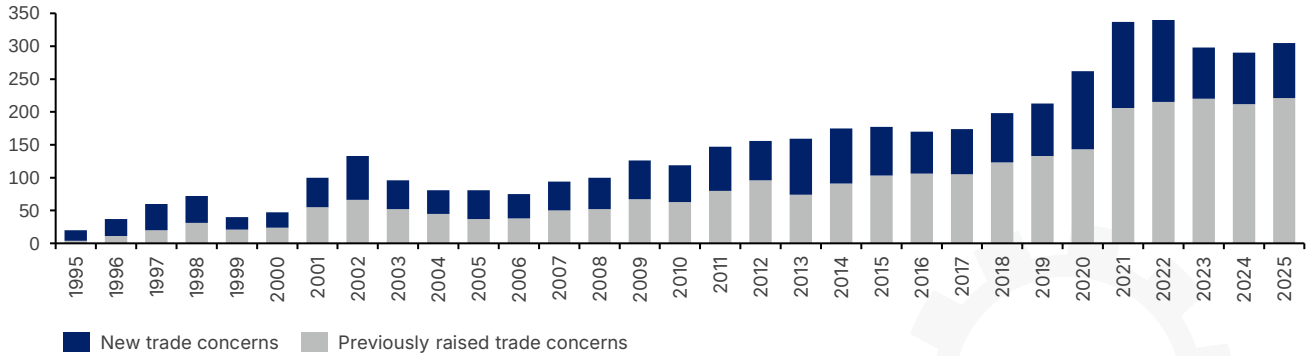
Trade weighted average MFN rate in the US in 2025



Source: World Trade Organisation, 2026

While 2025 stands out as a watershed moment driven by US tariff escalation, **the global trading system is overall faced with increasingly higher levels of friction due to trade irritants** (World Trade Organisation, 2026). Unlike the recently implemented US tariffs, many of these policy measures are classified as non-tariff measures, which can significantly impact international trade in goods. These measures are playing an increasingly important role in shaping global trade by influencing trading partners as well as the volume and composition of traded goods.

Number of trade concerns raised by year between 1995 and 2025



Source: World Trade Organisation, 2026

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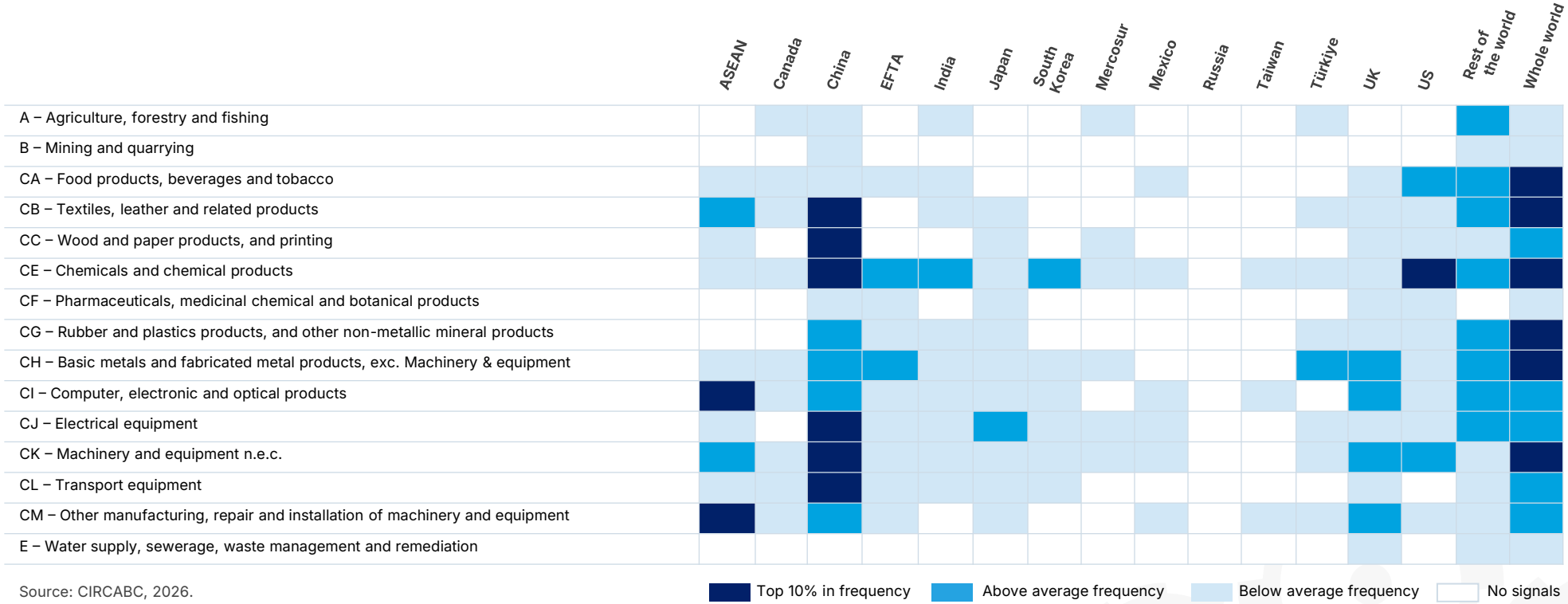
Broader trade context: The rise of discriminatory trade policies and the 2025 rupture

In addition to the US tariff policy, the state-induced non-market practices, particularly by China are a key challenge for the global trade system. Extensive Chinese state support and industrial policy interventions have contributed to substantial overinvestment, leading to oversupply in several sectors. As indicated under KPI 2.1, industrial subsidies, as a share of annual firm revenue, were on average ten times higher in China than in Europe between 2005 and 2022 (OECD, 2025). In the absence of sufficient domestic demand, excess production is increasingly being directed toward external markets, intensifying competitive pressures on foreign producers. These pressures have been further amplified by trade diversion resulting from the new US tariff barriers, as displaced trade flows are redirected toward alternative markets.

Heat maps illustrating the frequency of upward deviations from established trading patterns from June 2025 to January 2026, per product codes and import regions



Source: CIRCABC, 2026.

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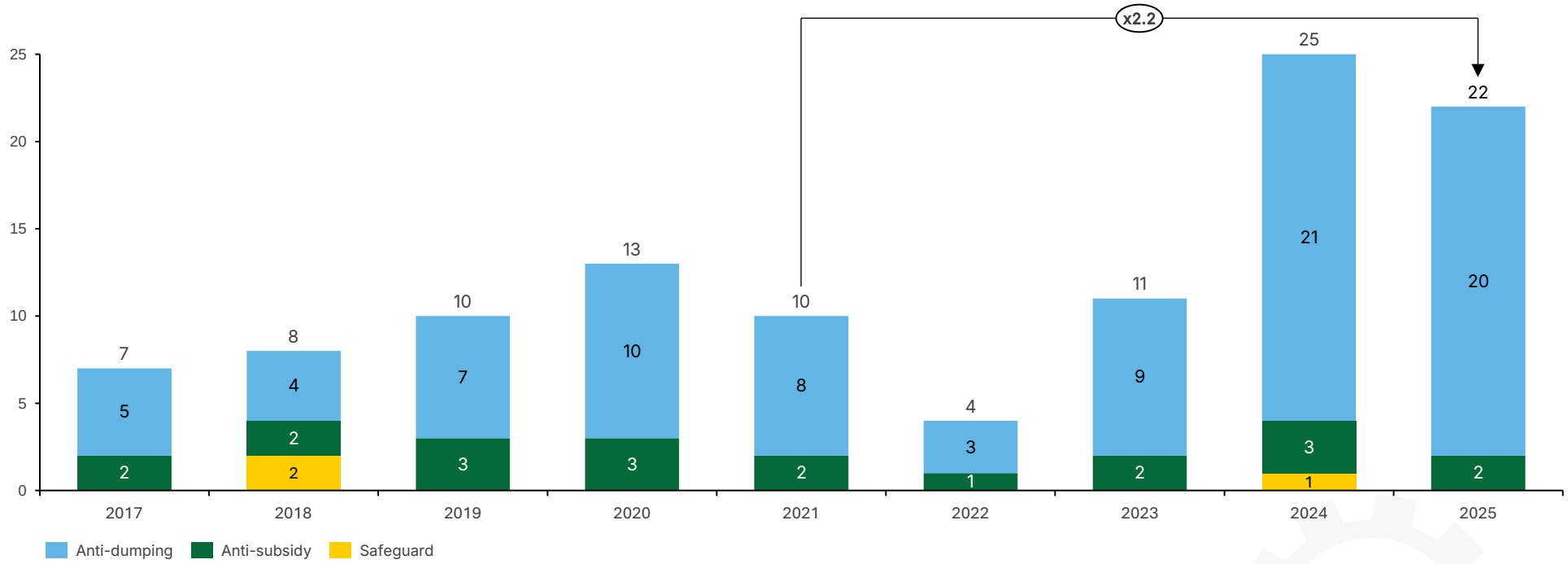
Broader trade context: The rise of discriminatory trade policies and the 2025 rupture

In response to these pressures, the EU has significantly stepped up its use of trade defence instruments, i.e., anti-dumping, anti-subsidy, and safeguard investigations, in 2024 and 2025 (European Commission, 2026). A recent example of EU trade defence action is the anti-subsidy measure imposed on Chinese EVs (Hancock, 2024).

Initiation of EU trade defence cases between 2017 and 2025, including anti-dumping, anti-subsidy and safeguard measures



Source: Cefic, 2026; Directorate-General for Trade and Economic Security, 2026

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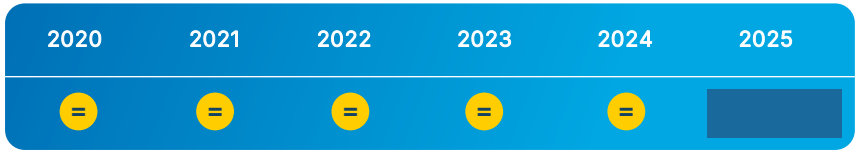
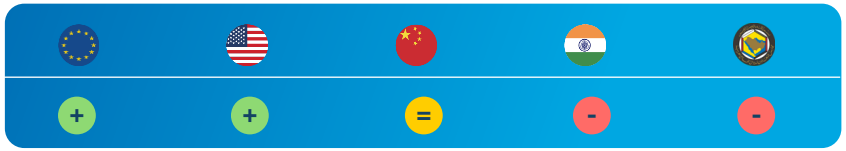
KPI 6.3 Consumer incentives and demand mandates driving markets for net-zero, low-carbon and circular products

This KPI tracks the number of consumer incentives for energy efficiency and circular economy per Member State, using data from the OECD's Policy Instruments for the Environment (PINE) database. It includes measures such as VAT reductions, electric vehicle exemptions, renewable energy tariffs, tax credits, and conservation payments. For this analysis, only incentives classified under 'circular economy' and 'energy efficiency' are counted. Once the PINE database includes monetary values in Q2 2026, the KPI will integrate a financial dimension. This KPI also examines demand mandates as a complementary approach to consumer incentives, drawing on qualitative data gathered for the analysis.

EU performance evolution



International benchmarking



Key takeaways

- **EU Member States** show **significant variation** in the availability of consumer incentives for electric vehicles, solar panels, heat pumps, recycling, and other sustainable services.
- The **US** stands out with a **notably higher** and **more diverse range** of consumer incentives, driven largely by **state-level initiatives**.
- The PPDS contains limited information regarding consumer incentives in **China**, **India**, and the **GCC** countries. These regions primarily **prioritise** environmentally beneficial **incentives targeted** at **industrial players**.
- Although **consumer incentives** are **vital** for creating the **initial foundation** for net-zero, low-carbon, and circular products in Europe, they are not yet stimulating market growth. This **necessitates** promoting **demand mandates** for specific green manufacturing products.

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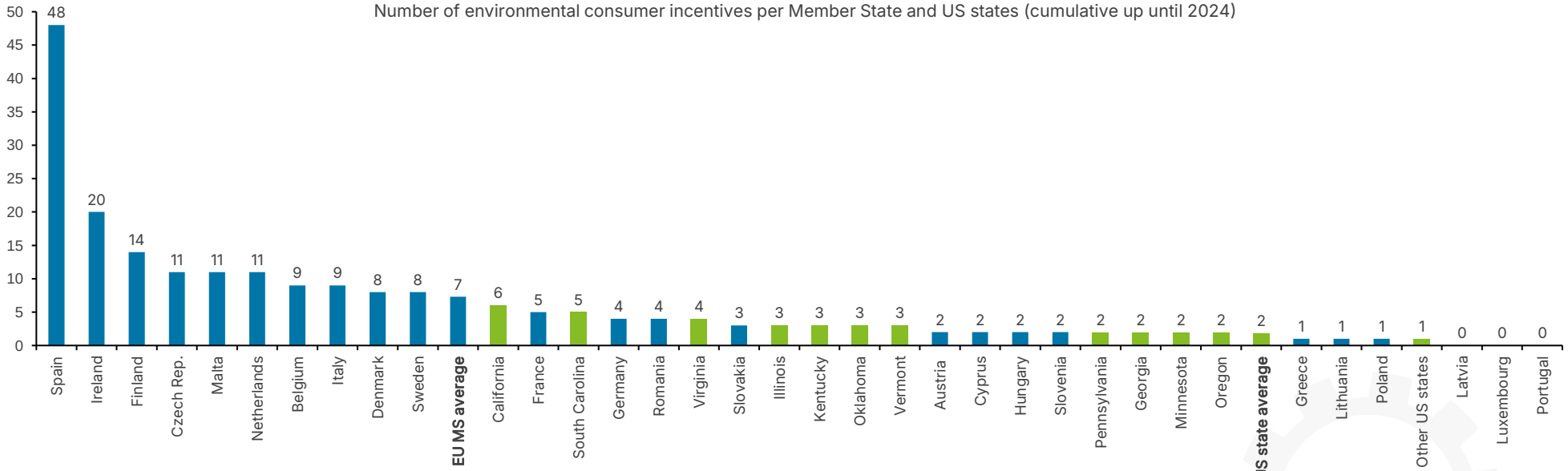
EU Member States show significant variation in consumer incentives promoting environmental benefits

Significant variation in environmentally beneficial incentives exists across EU Member States. Spain, Ireland, and Finland lead in offering the highest number of incentives, grants, tax credits, and tax reductions, targeting actions from energy efficiency improvements to public transport use (OECD, 2025). Spain primarily deploys tax credits aimed at consumers, focusing on personal vehicle choices and renewable energy-powered homes, including electric vehicles (EVs). Ireland ranks highly due to extensive grants supporting environmentally beneficial measures, particularly homeowner retrofitting projects (OECD, 2025). Conversely, Luxembourg, Latvia and Portugal report zero consumer incentives in the PINE database. Luxembourg, despite strong grants and taxes for green technology development, lacks specific consumer incentives (OECD, 2025). Energy efficiency dominates the EU incentive landscape, led by Spain and Ireland's focus on home retrofitting. The EU average per Member State, seven incentives, is about four times higher than the US state average, at 1.8 incentives.

Number of environmental consumer incentives per Member State and US states (cumulative up until 2024)



Source: OECD, 2025
Note: *Other US states include AZ, AR, CO, CT, DE, FL, HI, IN, KS, LA, MD, NH, NJ, NY, TX, UT, WA, WI*

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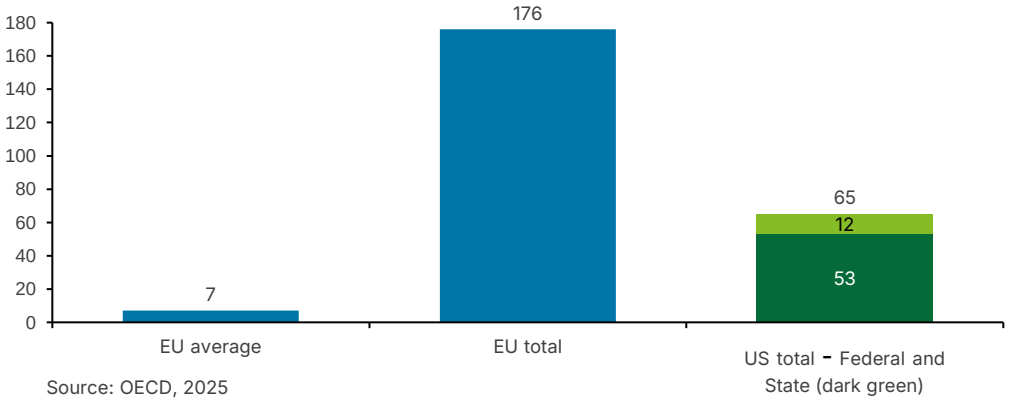
China and India prioritise producer-focused incentives, while the US leads in consumer environmental incentives

The PPDS database does not provide complete data for China, India and the GCC. **India and China implement incentives but prioritise industrial support over direct consumer measures**. For example, China's strategy focuses on supply-side dominance by providing massive grants, tax concessions, and below-market credit directly to manufacturers. This system allows Chinese firms to scale rapidly and lower production costs at the business level, ensuring that global market prices are kept artificially low before the product reaches the consumer (Bickenbach et al., 2024). Between 2009 and 2022, China spent $28 billion in tax incentives for electric vehicles for both producers and consumers; these subsidies were phased out in 2022 as the market matured, with China accounting for half of global EV (electric vehicle) sales (Yu, 2023). China therefore combined strong producer and consumer incentives to drive market growth until it achieved global leadership.

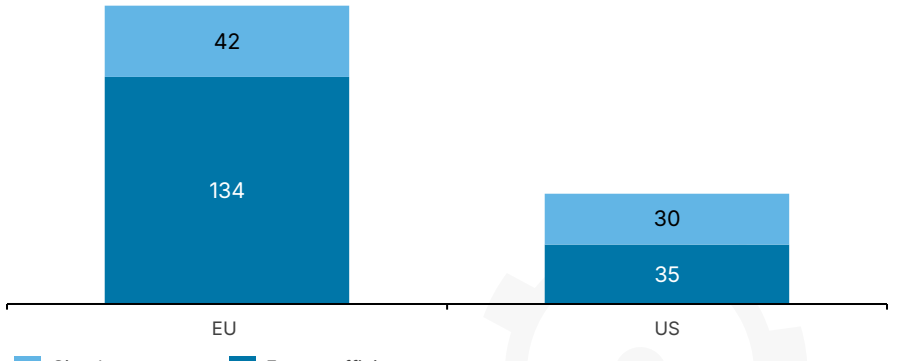
India's Production Linked Incentive (PLI) scheme forms a central element of the government's strategy to enhance competitiveness and promote self-reliance. Although the scheme does not specifically target environmental products, it provides financial incentives to domestic manufacturers of EVs, batteries, and solar panels. While China phased out its incentives in 2022, India's automotive-sector PLI scheme will continue until at least 2028 (Ministry of Heavy Industries, 2024). Although the Gulf countries are absent from the PINE database, some incentives exist, mainly in personal transportation. Since 2023, Oman applies a 0% VAT rate on EVs and spare parts, whilst the UAE offers free EV charging at designated stations. Nevertheless, consumer incentives remain limited across the Gulf. In 2021, a survey indicated residents' willingness to change behaviour to mitigate climate change, highlighting significant potential to expand incentives in EV adoption, energy-efficient housing, and recycling (Hildebrandt, 2021). While the US counts 65 consumer incentives in total, these incentives predominantly originate from state governments. Notably, 53 of the 65 incentives reported in the PINE database come from state level, and vary between tax credits for plastic recycling, solar-powered homes, and clean-fuel vehicles (OECD, 2025).

Number of environmental consumer incentives in the EU and the US (cumulative up until 2024)



Source: OECD, 2025

Number of consumer incentives per region per type (cumulative up until 2024)



Source: OECD, 2025

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EU consumer incentives build a strong foundation for sustainable markets. Paired with demand mandates, they help ensure market certainty, stimulate investment, and accelerate the growth of sustainable materials

EU consumer incentives currently encourage purchasing environmentally beneficial products and services, establishing a broad foundation for market growth. This foundation shapes consumer preferences and signals demand for sustainability. However, these incentives do not directly target materials produced by energy-intensive industries. Consumer incentives provide a necessary base for low-carbon, net-zero, and circular markets but require coupling with demand mandates to ensure market pull and impact. Whilst the former sets the stage by providing green requirements for insulation, electric vehicles, renewables, etc., the latter provides the crucial market certainty for manufacturers. For example, regulations mandating minimum shares of green steel in final products create direct market pull to scale production and reduce costs. Demand mandates establish demand certainty, encourage investment, enable economies of scale, and support development of a robust market. Said mandates can be structured in diverse ways, such as specifying mandatory shares of green materials, setting minimum thresholds for circular content, or imposing obligatory product carbon footprint criteria.

EU manufacturing firms are currently facing significant challenges from energy prices substantially higher than in competing regions, causing site closures and relocation abroad. In this context, demand mandates emerge as a vital instrument to provide certainty of demand within the EU. The Industrial Transition Accelerator report underscores demand mandates' critical role for clean materials and chemicals, especially aluminium, steel, cement, and ammonia. Transitioning to clean steel and aluminium would increase car costs by approximately 1%, whilst low-carbon cement adds approximately 2% to building costs, demonstrating sustainable materials' affordability (ITA, 2025; Deloitte Netherlands, 2025).

To prevent the substitution of domestic industrial capacity with cheaper imports, these demand mandates are increasingly being coupled with 'Made in Europe' resilience criteria, as outlined in the Net-Zero Industry Act (NZIA), which reward products based on their contribution to the EU's security of supply and environmental excellence. Indeed, the NZIA provides the legal framework to ensure that 40% of the EU's net-zero technologies are manufactured within Europe.

The EU mandates sustainable aviation fuel (SAF) to constitute 2% of aviation fuels at EU airports by 2025, rising to 70% by 2050. In 2024, SAF accounted for 0.6% of EU aviation fuel (EASA, 2025).

China's Civil Aviation Administration launched its first SAF pilot programme in late 2024 to align with international decarbonisation standards (CAAC, 2024). India plans SAF mandates targeting 1% for international flights by 2027 and 5% by 2030 (Hussain, 2025). The US Buy Clean initiatives require construction materials with lower embodied carbon, with states such as California and Maryland setting maximum global warming potential (GWP) limits (Tilak, 2023). China has mirrored this strategy through its Green Building action plans, which now mandate that 100% of new urban buildings must meet green standards by 2025, creating a massive captive market for low-carbon cement and steel. The GCC countries have yet to adopt demand mandates for green manufacturing.

EU demand mandates often focus on circularity, exemplified by the Battery Regulation and Packaging Waste Regulation, which impose binding recycled content targets. The EU Battery Regulation mandates product carbon footprint (PCF) declarations, labels, and CO_2 thresholds for EVs and large industrial batteries to promote low-carbon products.

A recent example of a demand mandate is the Automotive Package introduced in December 2025, which requires car manufacturers, from 2035 onwards, to reduce tailpipe emissions by 90%, with the remaining 10% to be offset through the use of low-carbon steel produced within the EU or by employing e-fuels and biofuels (European Commission, 2025).

Strong synergy exists between EU demand mandates and public procurement requirements (see KPI 6.1). Green public procurement supports initial market development, such as green steel plants and technologies, whilst demand mandates drive widespread industrial adoption in the private sector.

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Pillar 7: Leverage, enforce, revive and improve the Single Market

Leverage, enforce, revive and improve the Single Market for the transition of integrated value chains, including measures to address increased fragmentation caused by national implementation of European legislation. Create a single market for waste and recycled materials and also a true European energy market. Improve enforcement of existing measures focusing on imports.

Pillar conclusions

Internal market barriers persist within the Single Market, while improving the single market could increase overall EU competitiveness. This is reflected by the 41% growth in the share of intra-EU trade as a proportion of EU GDP over the past decade, alongside a stable situation in the intra-EU trade of waste and recycled materials – highlighting the need to further exploit a single market for waste and recycled materials. Moreover, total primary raw materials consumption exceeds traded waste volumes where only 5% of the raw materials consumed is traded as waste in the EU, this vast disparity underscores the difficulties in managing and trading waste within the EU due to these barriers.

Current fragmentation undermines the Single Market's effectiveness. In 2024-2025, 61% of EU manufacturing exporters reported compliance with varying standards and rules across Member States (European Commission, 2025). Removing regulatory barriers could generate €644 billion in annual economic benefits by 2032 (European Added Value Unit, 2023). These figures demonstrate that the EU has not yet established the enabling conditions necessary for a fully competitive single market.

The European Commission's Single Market Strategy (May 2025) directly addresses these barriers. The strategy targets ten priority barriers and aims to simplify, strengthen, and unify the single market through smarter implementation of EU rules and stronger links between EU funding and market reforms (European Commission, 2025). The Commission projects that successful implementation will increase EU GDP by 3-4% and create 3.6 million jobs (European Commission, 2025). If executed effectively, this strategy should reverse the negative trends identified in pillar 7's analysis.

644 B€

Removing regulatory barriers could generate 644 B€ in annual economic benefits by 2032

61%

Of EU manufacturing exports report varying standard and rules across Member States

3-4%

Projected increase in EU GDP with the Successful implementation of the Single Market Strategy

5%

Only 5% of the raw materials consumed are traded as waste in the EU

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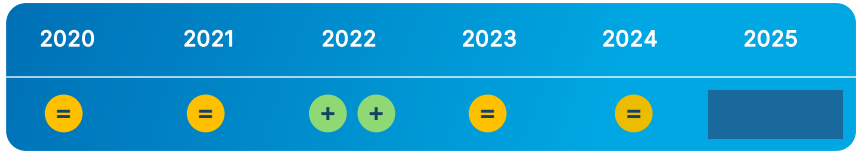
KPI 7.1 Trade between Member States (as share of EU GDP)

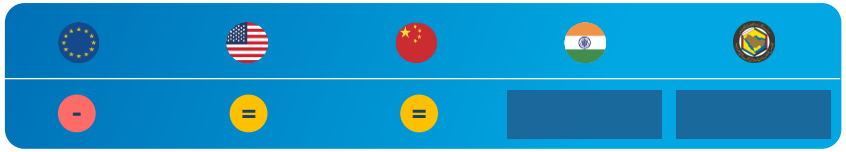
This KPI measures intra-EU trade as a percentage of total EU GDP – the value of goods and services exchanged between Member States relative to total EU economic output. Trade is measured by the average of import and export flows in trade value (EUR). This data is extracted from Eurostat and calculated as a share of EU GDP.

Measuring intra-EU trade's share of GDP is essential to evaluate the single market's strength better. A robust single market drives integrated value chains, which strengthens Europe's industrial sector.

EU performance evolution



International benchmarking



Key takeaways

Intra-EU trade integration deepened significantly: Intra-EU trade's share of EU GDP increased by 41% between 2014 and 2024, reaching 32.87% in 2024 (Eurostat, 2026). This demonstrates heavy economic interdependence among Member States, with intra-EU trade driving a substantial portion of EU economic activity.

EU market integration lags behind the US and China: The EU exploits its internal market in goods at 29% in 2022, below the US (34%) and China (34%) (Eurostat, 2026; U.S. Department of Transportation, Bureau of Transportation Statistics, 2025; Che et al., 2023). This gap indicates untapped trade potential within the single market. While the EU pursues competitiveness improvements, these results reveal the need for further efforts to remove trade barriers and strengthen political integration among Member States to unlock single market trade potential. See KPI 7.3 for detailed barrier analysis.

Trade is concentrated consistently among largest Member States: The top five Member States – Germany, the Netherlands, France, Italy, and Belgium – account for over 50% of total intra-EU trade in goods and services (Eurostat, 2026). Germany consistently accounts for 21–23% of intra-EU trade in goods (2014–2024) and 16–17% of trade in services (2014–2024), making it the largest contributor (Eurostat, 2026).

Machinery and transport equipment dominate trade: The three most-traded product categories by value are: (1) machinery and transport equipment (35%); (2) chemicals and related products (17%); (3) manufactured goods (14%) (Eurostat, 2025).

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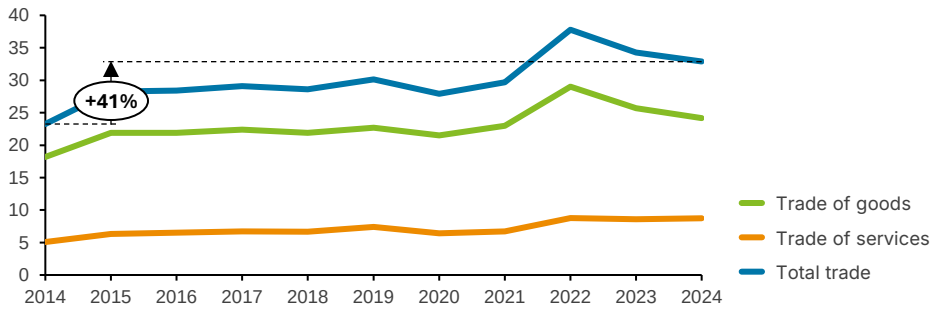
Intra-EU trade consistently increased, by 41% in total since 2014, with a peak in 2022 following the Ukraine war

Share of EU GDP represented by trade between EU Member States (%)

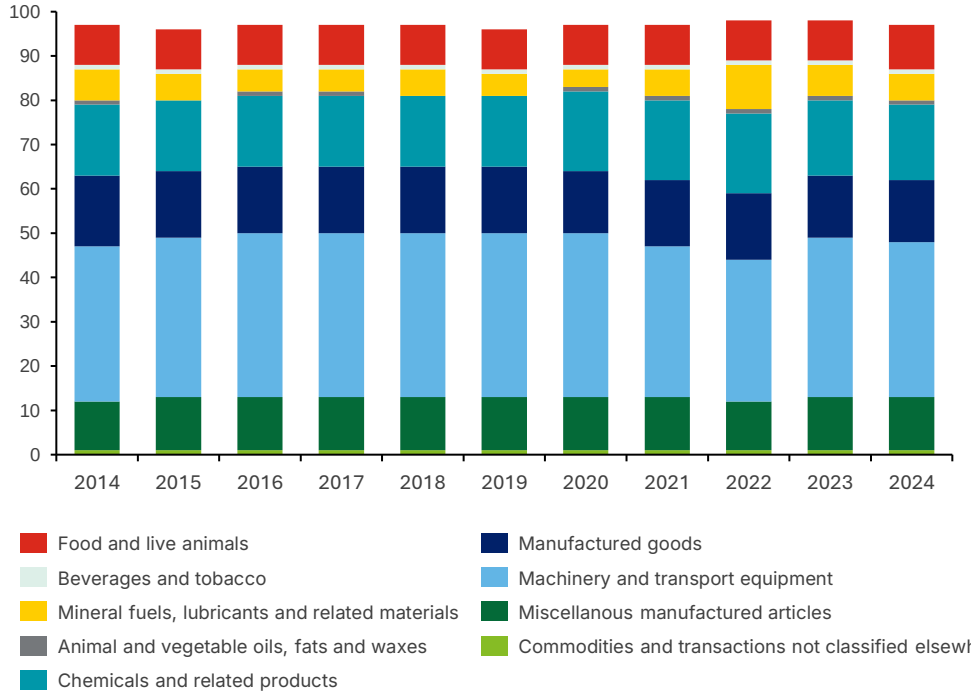


Source: Eurostat, 2026; World Bank Group, 2025; Deloitte analysis, 2025

Intra-EU trade increased by 41% in total since 2014, with a peak in 2022 following the Ukraine war. Intra-EU trade represented 32.9% of EU GDP in 2024, an increase of 41% compared to 23.3% in 2014. This growth trajectory reversed in 2022–2023, declining by 9% as inflation, rising interest rates, and decoupling between GDP and trade values took hold (European Central Bank, 2025). The Ukraine war amplified this downturn through energy supply shocks and heightened geopolitical uncertainty (Siemplenski Lefort, 2022; Pisani-Ferry, 2022). Intra-EU goods trade fell to 24.2% of GDP in 2024 – a 6% decline from 2023. Intra-EU trade of services slightly increased by 1.6% over that same period.

The EU's focus on internal trade of goods falls behind its major peers: 29% in 2022 versus 34% for both the US and China (Eurostat, 2026; U.S. Department of Transportation, Bureau of Transportation Statistics, 2025; Che et al., 2023). This positions the EU as a less integrated market for goods than China the US.

Intra-EU trade of goods per product type between 2014 and 2024 (%)



Source: Eurostat, 2026

Machinery and transport equipment dominate intra-EU goods trade at 35%, followed by chemicals (17%) and manufactured goods (14%). These three categories represent the core of internal trade flows.

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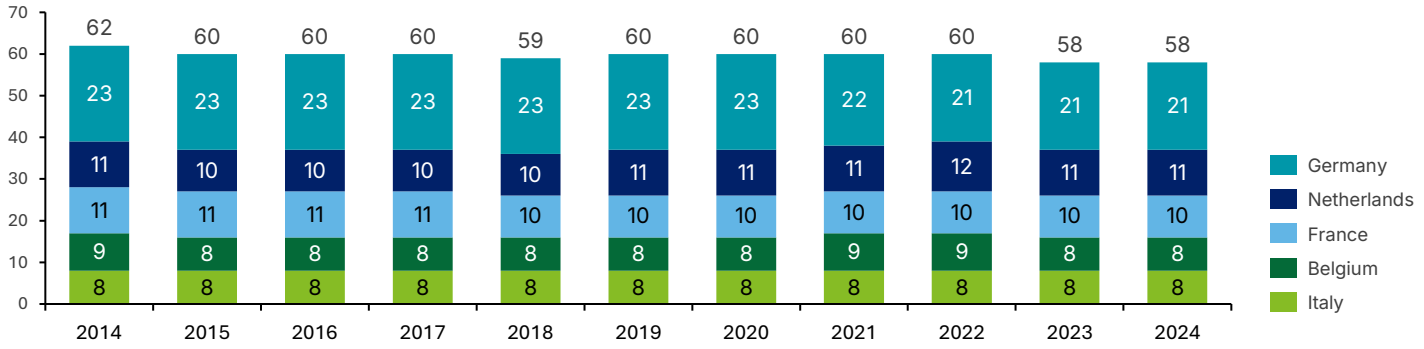
Five EU Member States account for well over 50% of total intra-EU trade in goods and services

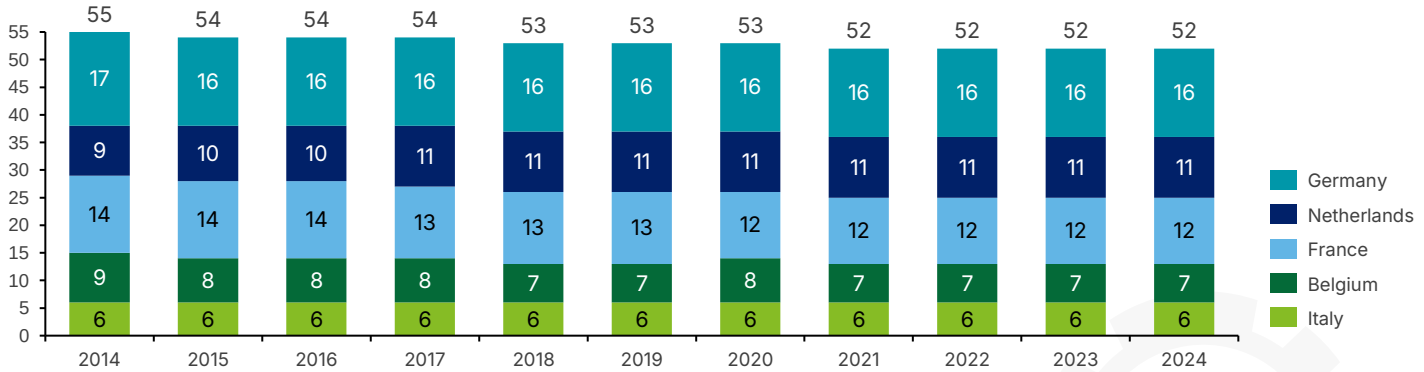
Germany, the Netherlands, France, Belgium, and Italy lead intra-EU trade in both goods and services. Germany remains the largest contributor, consistently accounting for 21–23% of intra-EU trade in goods (2014–2024) and 16–17% of trade in services (2014–2024) (Eurostat, 2026). The Netherlands and France rank as the second-largest traders in intra-EU goods and services, maintaining this position throughout 2014–2024 (Eurostat, 2026). These five countries collectively account for 58% of total intra-EU trade in goods (2024) and 51% of total intra-EU trade in services (2024) (Eurostat, 2026).

Top 5 intra-EU Member States trading in goods (%)



Source: Eurostat, 2026

Top 5 intra-EU Member States trading in services (%)



Source: Eurostat, 2026

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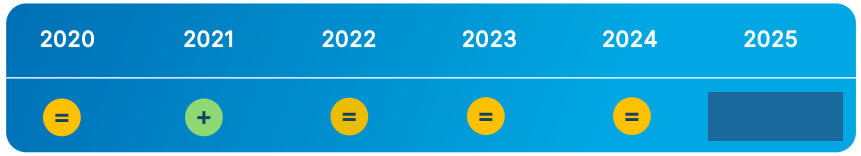
KPI 7.2 Intra-EU trade of waste and recycled materials

This KPI measures the volume of waste and recycled materials traded between Member States, disaggregated by material type. Recycled materials include metals, plastics, paper, and other waste materials. Data is extracted from Eurostat's 'Trade in waste by type of material and partner' dataset, with the 'Intra-EU27' geopolitical entity selected to capture intra-EU trade flows. The dataset provides disaggregation by waste type and total waste volume in tonnes.

Tracking intra-EU waste and recycled materials trade aligns with pillar 7's objective to establish a single market for these materials – a critical step in enhancing EU competitiveness. Intra-EU waste and recycled materials trade underpins the circular economy, secures critical raw material supply, and supports a more resilient industrial base.

EU performance evolution



Key takeaways

- **Intra-EU waste trade volumes remained relatively stable over the past decade**: Intra-EU waste trade remained relatively stable between 2014 and 2023 (Eurostat, 2025). Although a waste trade market exists within the EU, it has not expanded over the last ten years, indicating untapped market potential.
- **Enabling conditions drive market growth**: Plastic waste trade increased by approximately 28% between 2014 and 2023, rising from 4.6 million tonnes to 5.9 million tonnes (Eurostat, 2025). This growth demonstrates that when enabling conditions are provided – such as the Single EU Plastics Directive and Plastic Packaging Tax – markets expand accordingly.
- **Significant gap between raw material consumption and waste trade**: Only 5% of the raw materials consumed are traded as waste in the EU, with total primary raw materials consumed amounting to 6.3 billion tonnes in 2023 versus a total of 124.6 million tonnes of intra-EU waste volumes traded (Eurostat, 2025). This gap reveals substantial barriers to waste handling and trade within the EU, as identified in the Single Market Strategy.
- **Market fragmentation impedes waste trade expansion**: Fragmentation within the intra-EU waste market stems from multiple barriers: lack of harmonized EU definitions for by-products, inconsistent Extended Producer Responsibility (EPR) schemes across Member States, and limited EU-wide end-of-waste criteria (European Commission, 2025).
- **Single Market Strategy addresses waste trade barriers**: The European Commission's Single Market Strategy outlines actions to create a unified waste market, including facilitating cross-border waste shipments for recycling; establishing harmonized frameworks for end-of-waste and by-product status; and enabling adoption of EU-wide end-of-waste criteria for priority waste feedstocks (European Commission, 2025).

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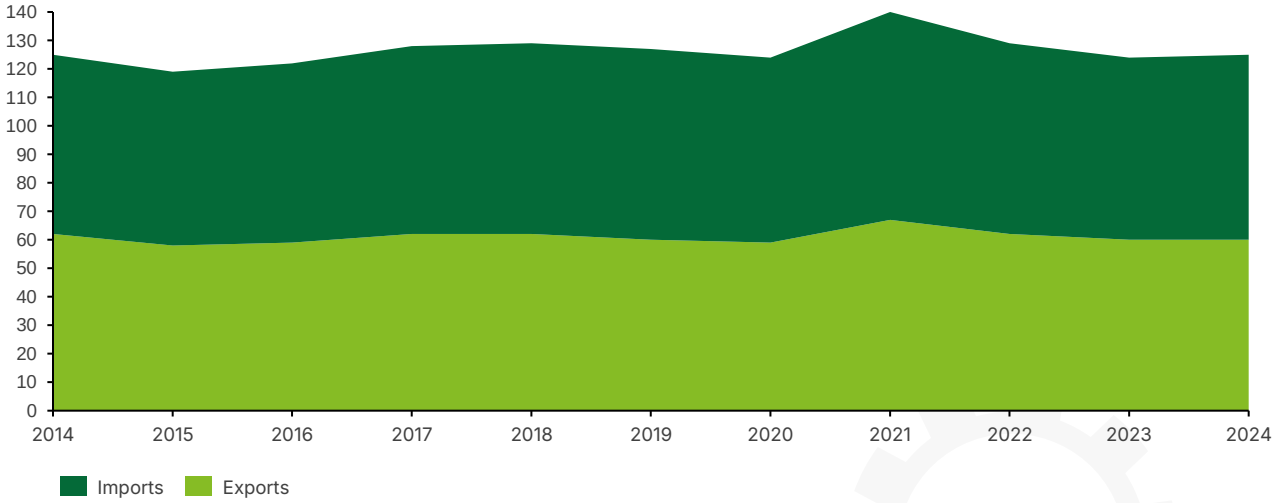
The intra-EU waste trade market has not faced further development over the last ten years with volumes of trade remaining relatively stable between 2014 and 2024

Intra-EU waste trade volumes remained relatively stable over the past decade, with 125.1 million tonnes in 2014 and 125 million tonnes in 2024 (Eurostat, 2025). This stability applies across all waste categories, including secondary raw materials (SRMs) such as plastic, paper, cardboard, and metals. Relative to primary raw materials consumed – 6.3 billion tonnes for the EU in 2023 – intra-EU waste trade volumes are 20 times smaller (Eurostat, 2025).

Despite overall stability, intra-EU waste trade experienced volatility from 2020 to 2023. Trade volumes surged approximately 14% between 2020 and 2021, rising from 123.5 million tonnes to 140.4 million tonnes, driven primarily by economic recovery following the initial COVID-19 slowdown (Eurostat, 2025). Following 2020's lockdowns and production halts, the 2021 industrial rebound generated increased waste volumes and demand for SRMs derived from waste.

Subsequently, trade volumes declined approximately 11% between 2021 and 2024, falling from 140.4 million tonnes to 125 million tonnes – returning to 2014 levels (125.1 million tonnes) (Eurostat, 2025). This decline resulted from market correction, specifically declining average prices for secondary materials across multiple material types in 2023 and 2024. Reduced profitability diminishes the financial incentive for cross-border waste shipments. Minor differences between imports and exports reflect varying statistical collection processes among Member States, particularly differing reporting thresholds applied to imports.

Evolution of intra-EU waste trade between 2014 and 2024 (million tonnes)



Source: Eurostat, 2025

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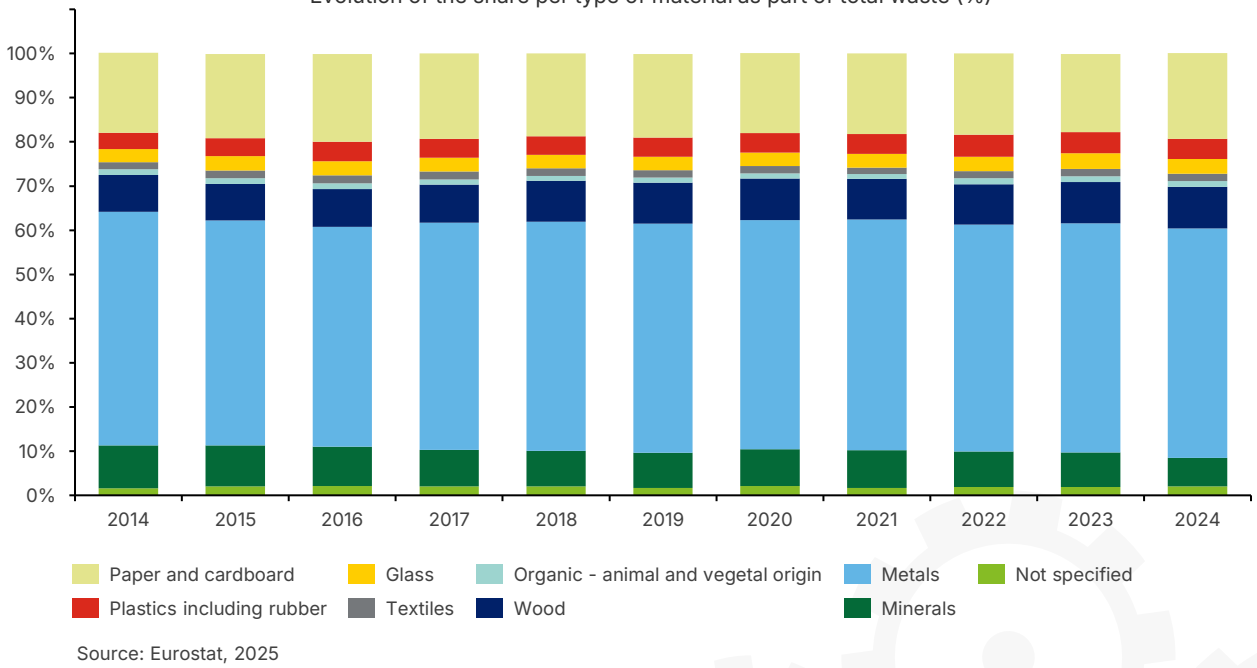
When enabling conditions are provided, a market is further exploited. Under the Single Market Strategy additional enabling conditions may be implemented to further expand the market for intra-EU waste trade

Metals waste consistently represents the largest share of traded waste, reflecting high industrial demand and established recycling chains. Conversely, intra-EU plastic waste trade demonstrated an increasing trend over the past decade, rising by approximately 24% from 4.6 million tonnes in 2014 to 5.7 million tonnes in 2024 (Eurostat, 2025). This growth reflects the implementation of enabling policies: the Single EU Plastics Directive, Plastic Packaging Tax, and voluntary commitments from the Ellen McArthur Foundation. This demonstrates that **when market conditions and enabling policies align, waste trade expands.**

Stability in total intra-EU waste trade and consistency in material-type shares reveal market fragmentation. This fragmentation stems from multiple barriers: the absence of harmonized EU definitions for by-products, which impedes production circularity; inconsistent EPR scheme requirements across Member States; and limited development of EU-wide end-of-waste criteria and by-product status (European Commission, 2025).

In response, the European Commission published the Single Market Strategy, which outlines the creation of a unified waste market. Key actions include facilitating cross-border shipments of waste feedstocks for recycling; establishing a leaner, harmonized framework for achieving end-of-waste and by-product status; and enabling adoption of EU-wide end-of-waste criteria for priority waste feedstocks (European Commission, 2025).

Evolution of the share per type of material as part of total waste (%)



Source: Eurostat, 2025

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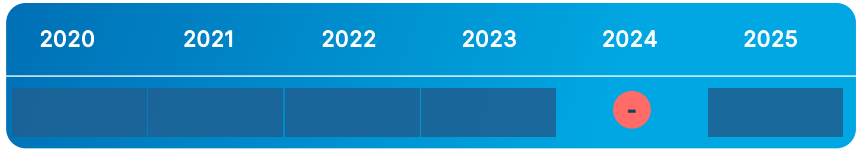
KPI 7.3 Internal market barriers costs

This KPI measures internal market barriers within the single market. Given its multifaceted nature, this KPI integrates qualitative and quantitative data. The primary metric is the Single Market Scoreboard's assessment of directive transposition, which evaluates proper implementation of EU rules by Member States. This is complemented by the European Investment Bank (EIB)'s annual investment survey, providing a comprehensive view of internal market barriers.

EU performance evolution



Key takeaways

- **Internal tariffs due to internal market barriers:** The European Central Bank estimates that internal market barriers impose costs equivalent to tariffs of approximatively 65% for goods and up to 100% for services (Bernasconi et al., 2025).
- **Manufacturing exporters report widespread compliance fragmentation**: 61% of EU manufacturing exporters reported in both 2024 and 2025 that they must comply with varying standards and rules across Member States (European Investment Bank, 2025). This demonstrates significant Single Market fragmentation.
- **Regulatory barrier removal generates substantial economic benefits**: Removing remaining regulatory barriers within the Single Market could generate a minimum of €644 billion in annual economic benefits by 2032 (European Added Value Unit, 2023). Addressing trade facilitation barriers and regulatory complexity alone could increase EU GDP by €228–€372 billion annually (European Added Value Unit, 2023).
- **Complete Single Market exploitation is essential for competitiveness**: A strong and competitive EU industry depends on full exploitation of the Single Market and "the removal of all barriers related to the free movement of goods, services, people, capital and data" (Business Europe, 2025).
- **Member State transposition performance deteriorated in 2024**: EU Member States are not properly implementing Single Market directive rules. Overall transposition performance declined in 2024, with only four Member States (Germany, Hungary, Malta, and Romania) improving performance compared to eight in 2023, while eleven Member States experienced worsening performance (European Council, 2025).

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Internal market barriers persist within the EU Single Market, and enabling conditions remain underexploited

A recent ECB analysis determined that **internal market barriers impose costs equivalent to tariffs of approximately 100% for services and 65% for goods (Bernasconi et al., 2025).** This joins the International Monetary Fund (IMF)'s estimates with costs equivalent to tariffs of around 110% and 44% for services and goods respectively, stemming from regulatory differences, administrative procedures, and restrictions on cross-border movement within the EU (International Monetary Fund, 2024). To assess those barriers, the 2025 EIB Investment Survey (EIBIS) asked EU firms whether their key product is subject to diverging requirements, standards or consumer protection rules between EU countries. **61% of EU exporters in the manufacturing sector reported that they must comply with varying standards and consumer protection rules between EU Member States**. This coincides with the 2024 EIBIS result (European Investment Bank, 2025).

The overall performance across all transposition indicators, coupled to the results from EIBIS showcase that Single Market barriers remain within the EU and that the enabling conditions to remove them are not yet fully exploited. It is estimated that removing the remaining regulatory barriers within the Single Market could generate a minimum of 644 billion euros in economic benefits per year by 2032 (European Added Value Unit, 2023). Compared to the 2023 EPRS study, an additional 2.8 trillion euros could be generated by 2032 following the complete policy action implemented over a 10-year horizon. For example, it is estimated that addressing the current barriers to trade facilitation as well as the complexity of regulatory procedures obstructing the free movement of goods could generate an increase in GDP between €228 billion to €372 billion per year (European Added Value Unit, 2023).

According to Business Europe (2025), a strong and competitive EU industry is dependent on the complete exploitation of the EU Single Market and "the removal of all barriers related to the free movement of goods, services, people, capital and data".

To ensure proper transposition of Single Market directives, the European Council set out different performance indicators and associated targets. A Member State's performance across all transposition indicators is calculated by scoring each of the 6 performance indictors in the table below as follows: red = -1; yellow = 0; and green = +1.

Single Market Scoreboard – Performance indicators

Indicator values	Green	Yellow	Red
1 . Single Market transposition deficit	≤1%	/	> 1%
2. Change over the last 12 months (change in the number of outstanding Single Market directives)	Decrease	No change	Increase
3. Number of long-overdue Single Market directives (2 years or more)	0	/	> 0
4. Transposition dela for overdue Single Market directives (in months) 5. Single Market conformity deficit	< average - 10%	Average ±10%	> average +10%
6. Duration of infringement proceedings for late transposition of Single Market directives (in months)	≤12 months	>12 months ≤18 months	>18 months

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EU Member States performance deteriorated overall in 2024

Overall, EU Member State performance deteriorated in 2024. Only four Member States – Germany, Hungary, Malta, and Romania – improved performance compared to eight Member States in 2023, while eleven Member States experienced declining performance (European Council, 2025). This deterioration reveals a critical gap: although Single Market directives are legal instruments designed to strengthen single market functioning, their transposition at national level is not achieving intended objectives. Member States are not implementing directive rules properly, undermining the Single Market's effectiveness.

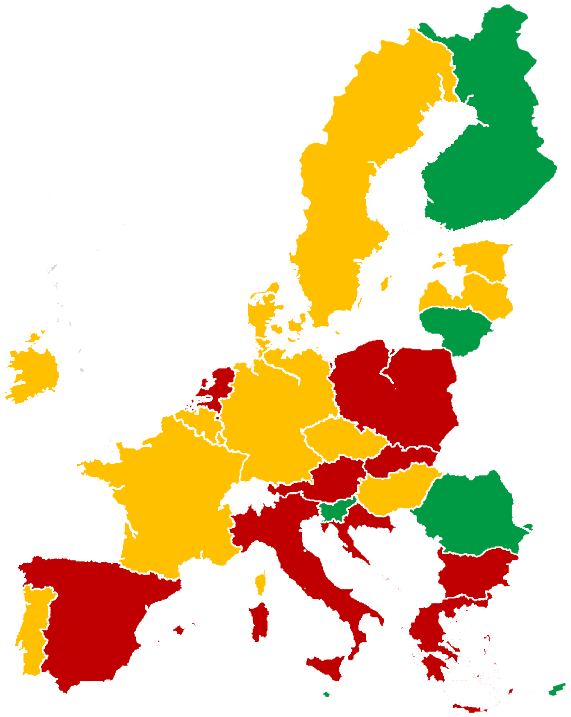
The colours on the map to the right represent the sum of these scores:

Green 2 or higher = above average

Yellow -1, 0 or 1 = average

Red - 2 or lower = below average

Overall performance across all transposition indicators of Single Market directives between 12/2023 and 11/2024



Source: European Council, 2025

Country	Overall performance
Austria	
Belgium	
Bulgaria	
Cyprus	
Czech Republic	
Germany	
Denmark	
Estonia	
Greece	
Spain	
Finland	
France	
Croatia	
Hungary	
Ireland	
Italy	
Lithuania	
Luxembourg	
Latvia	
Malta	
Netherlands	
Poland	
Portugal	
Romania	
Sweden	
Slovenia	
Slovakia	

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Pillar 8: Make the innovation framework smarter

Make the innovation framework smarter, including fostering high-quality science, technological innovation, and collaborative policies that prioritize openness and pragmatic outcomes while embracing innovative approaches like regulatory sandboxes. Promote digitalisation as a prerequisite for groundbreaking research to enhance efficiency. Protect IP rights to bring a competitive advantage to Europe. Focus on the transfer from demonstration to innovation and first of a kind commercial technologies.

Pillar conclusions

The EU's innovation framework lags behind the US and China for several reasons. First, despite similar weighted average cost of capital (WACC) levels, the EU's higher risk premium (**5.6% versus 3.9% in the US and 2% in India**) in 2024 make **equity investment less attractive, reflecting a riskier market perception**. This likely **dampens innovation investment in the EU**, consistent with the European Commission's findings on barriers to capital market integration and efficiency (Directorate-General for Financial Stability, Financial Services and Capital Markets Union, 2025).

The **EU trails China and the US in overall innovation performance, according to the European Innovation Scoreboard,** though it outperforms India, with a score 15% lower than the US and 20% lower than China in 2025. Nonetheless, several EU Member States are individually performing better than China and the US. Patent filings illustrate this disparity: China leads with over 17 times the EU's recorded applications and more than three times those of the US in 2024. While the EU steadily increased R&I funding from EU, R&D allocation from Member States, and private sector spending, the **US and China proportionally invested more**. Between 2014 and 2023, gross domestic expenditure on R&D (GERD) as a GDP share grew faster in the US and China. Although governmental budget allocations as GDP share are equivalent in the US and EU, the innovation performance remains lower within the EU, indicating a potential less efficient budget allocation towards innovation.

Venture capital investment further highlights the gap. **The US dominates venture capital (VC) funding across all stages and relative to GDP, with the EU third and far behind**. This reflects **the US's more mature VC market, technology leadership** (e.g., OpenAI, xAI), **and more risk-tolerant entrepreneurial culture, driving its dominance in new unicorns.**

Lastly, despite the introduction of regulatory sandboxes within industrial innovation, **the impact of regulatory sandboxes is difficult to determine, as it is scattered, and regulatory frameworks vary across regions**. Within the EU, the requirements under the AI Act and the NZIA, coupled with Member State examples, showcase the **benefits to sustainable innovation and competitiveness** that **regulatory sandboxes** can create when provided within the **field of energy and industry**. Overall, the enabling conditions to create a smarter, more competitive environment for European manufacturing firms remain underdeveloped.

5.6%

Risk premium for the EU compared to 3.9% in the US

x17

China files x17 more patent direct applications than the EU in 2024

15%

Lower overall innovation performance than the US

3rd

Position for the EU in VC funded companies

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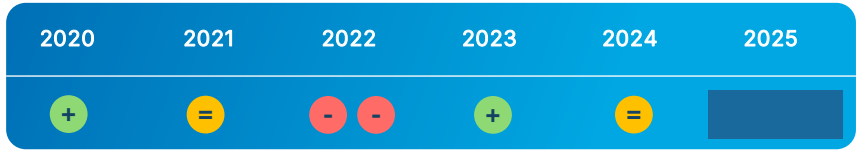
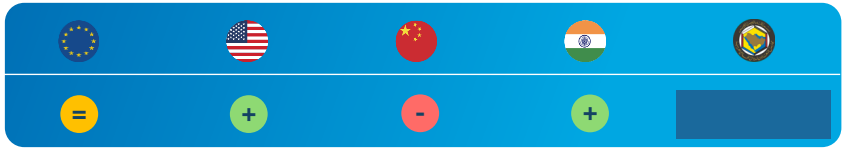
KPI 8.1 Cost of capital

This KPI monitors the WACC across EU industries alongside the 10-year government bond yield, providing a comprehensive comparison of capital costs between the EU and other regions. The 10-year bond yield serves as the risk-free cost of capital, offering a macro-level benchmark, while the WACC reflects industry-specific financing costs. The WACC represents the average expected return a company must pay to debt and equity holders, weighted by their share in the capital structure (Fernando, 2025). The WACC directly influences a company's ability to finance innovation and growth. At the industry level, the WACC indicates the minimum required return and average risk profile. Data on 10-year bond yields for the EU, the US, China, and India over the past decade were sourced from official government sources. The WACC data from 2014 to 2024 for the EU, the US, and emerging markets (including India and China) were obtained from the Damodaran database, compiling the average industry-level WACC based on New York University Professor Damodaran's methodologies. The risk premium is calculated based on both metrics and represents the difference between the WACC and the 10-year bond yield.

EU performance evolution



International benchmarking



Key takeaways

- **Global bond markets shifted from near-zero to elevated yields**: Over the past decade, global bond markets transitioned from near-zero rates (Euro Area and US) to higher yields – approximately 4.5% for the US and 3% for the Euro Area (Central Bank Data, 2024). Significant yield gaps persist between the Euro Area/US and India, while China maintains a unique, internally driven low-yield path. The European Central Bank and the Federal Reserve have not planned interest rate changes (European Central Bank, 2025; Federal Reserve, 2025).
- **WACC increased substantially across regions:** The average WACC increased from approximately 6% in 2014 to 8.5% in 2024 for both the US and Europe (Damodaran, 2024), reflecting global inflation and monetary policy responses.
- **European companies face higher capital costs than US and Indian counterparts**: Although the WACC remains similar for the US, Europe and India (around 8.5% in 2024), the European risk premium is higher than the US and India (5.6% versus 3.9% for the US and 2% for India in 2024). This indicates that the European market is perceived as riskier, making equity investment less attractive than in the US or India. Higher capital costs may reduce EU innovation investments compared to the US and India.

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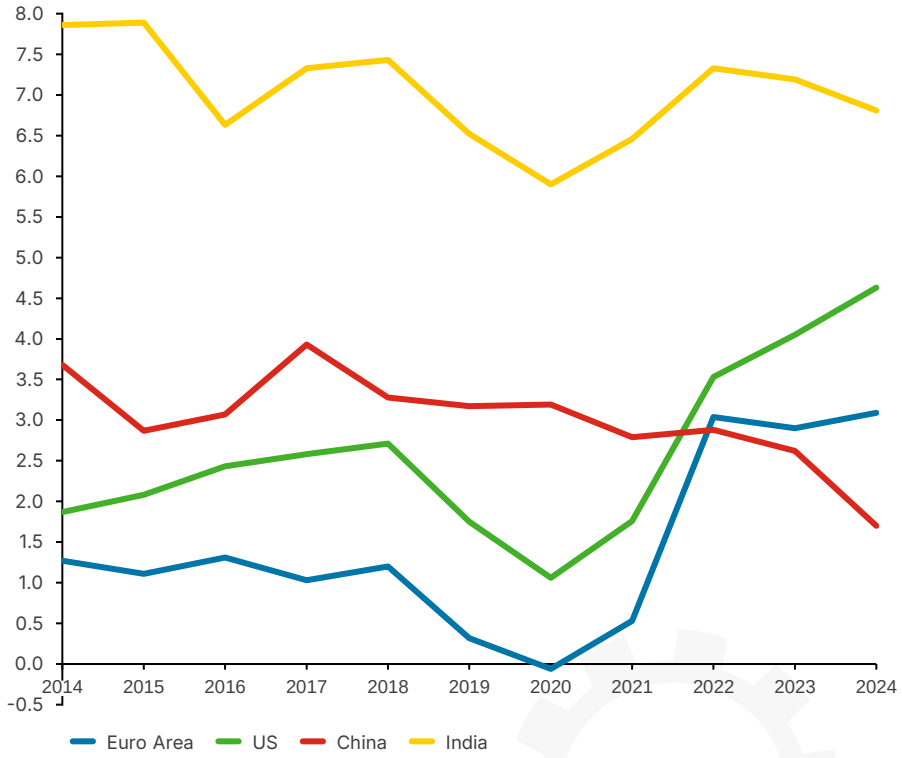
Global bond market shift from an environment of near-zero rates toward an era of higher yields, except for China following a low-yield path

The 10-year bond yield rates remain relatively low for the euro area, the US, and China compared to India. However, the evolution between 2014 and 2024 reveals high volatility, particularly for the US. Developed markets (EU and US) exhibit relatively lower 10-year yields, while China stands out with a decreasing yield – approximately 50% decline – compared to the EU and the US, which doubled to tripled over the past decade (Central Bank Data, 2024). This turning point appeared between 2021 and 2022.

China's low bond yields reflect investor demand for safety amid the property crisis and deflationary pressures, contrasting sharply with US and EU economies, where elevated interest rates combat inflation (Siang Ng, 2025). India's higher yields reflect greater inflation and a higher risk premium stemming from country-specific risk.

The European Central Bank maintains its key interest rates unchanged, as inflation remains stable, and close to the 2% medium-term target (European Central Bank, 2025). Monetary policy decisions remain data-dependent. The US Federal Reserve monitors a wide range of information – labour, inflation, and global developments – and is prepared to adjust policy as needed to address risks to its objectives (Federal Reserve, 2025).

Evolution of the 10-year bond yield between 2014 and 2024 across the euro area, the US, China and India (%)



Sources: European Central Bank, 2025; The Wall Street Journal, 2025

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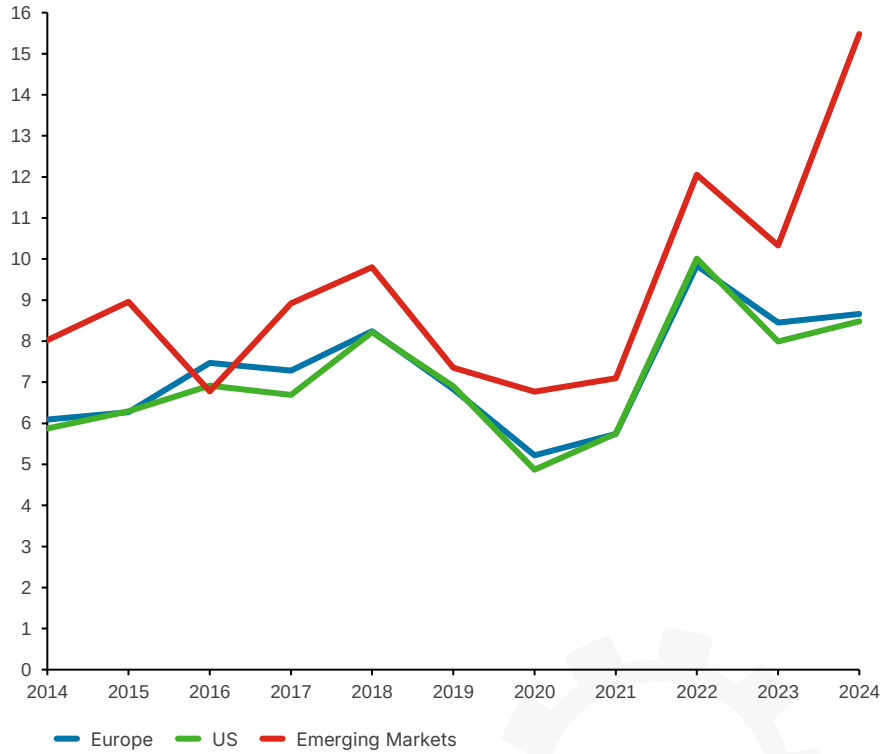
The average WACC across regions increased from 6% to approximately 8.5% between 2014 and 2024 for the US and Europe

The average WACC remains lowest for the US across the past decade, while emerging markets exhibit higher average WACC compared to both the US and Europe (Damodaran, 2024). The lower average WACC for the US and the EU stems from more liquid capital markets, lower perceived risk-free rates, and stronger currencies (USD and EUR). Emerging markets historically exhibit a higher average WACC due to higher country-specific premiums, higher cost of equity, and typically higher cost of debt.

The most notable WACC shift occurred between 2021 and 2022, with the WACC nearly doubling. This resulted primarily from global inflation rise and associated central bank monetary responses. A sharp increase in the risk-free rate drove the WACC increases through higher cost of debt and cost of equity.

Evolution of average WACC across all industries between 2014 and 2024 across Europe, the US, and emerging markets (%)



Source: Damodaran, 2025
Note: *The WACC is calculated in USD.*

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European companies face a higher risk premium than the US and India

European companies operate in a higher-risk capital environment than US and India companies, although average WACC across all industries remains similar. The European risk premium exceeds the US and India (5.6% versus 3.9% for the US and 2% for India), indicating that the WACC is high relative to the risk-free rate in Europe compared to the US (Damodaran, 2024). This implies that capital is more expensive than bonds in Europe, while the US and India reflect stronger appetite for equity investment, despite a close to identical nominal WACC (approximately 8.5%). Consequently, higher capital costs may reduce EU innovation investments compared to the US and India.

Comparison of the risk premium across all regions in 2024 (%)

Region	Total market WACC (without financials)	10-year government bond	Risk premium
Europe	8.66%	3.09%	5.57%
US	8.48%	4.63%	3.85%
China	10.08%	1.7%	8.38%
India	8.8%	6.81%	1.99%

Sources: Damodaran, 2025; European Central Bank, 2025; Wall Street Journal, 2025

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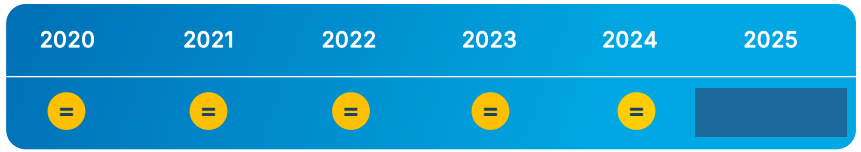
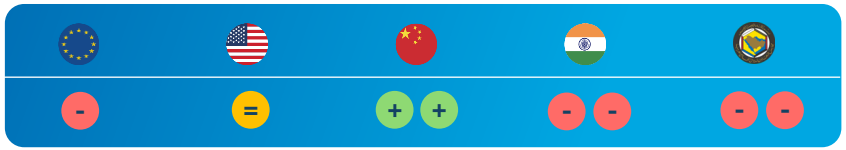
KPI 8.2 Patent applications and commercialisation rate for the industry

This KPI measures the total number of patent direct applications, the number of patent publications per field of technology, and the European Innovation Scoreboard (EIS) coupled with the number of unicorns to measure the commercialisation rate. In finance, the term 'unicorn' describes a privately-owned start-up with a valuation of over $1 billion (Corporate Finance Institute, 2025). The EIS provides a comparative assessment of the research and innovation performance of EU countries, making it a comprehensive proxy (Directorate-General for Research and Innovation, 2025). Unicorn companies signal a massive commercial breakthrough often protected by intellectual property (IP), including patents (Dennemeyer Group, 2025).

EU performance evolution



International benchmarking



Key takeaways

- **China dominates the patent landscape with 17 times more applications filed in the region than within the EU**: China dominates the patent landscape, filing over 17 times more patent direct applications and PCT applications than the EU and more than three times those of the US. Between 2015 and 2024, its patent filings grew by 73%, driven largely by targeted industrial policies and a more accessible patent system compared to the EU and the US.
- **US records approximately three times more filed patents than EU**: The US consistently records about three times more patent direct applications than the EU, likely due to the simpler enforcement of patents through a centralised federal court system, unlike the complex national enforcement of European Patent Office (EPO) conventions.
- **Electrical engineering leads in most regions; mechanical engineering dominates in EU**: Electrical engineering leads patent publications in all regions except the EU, where mechanical engineering is dominant. This indicates that the EU and the US focus proportionally more on electrical machinery and computer technology, whilst transportation holds the largest share of patent-based innovation overall.
- **EU innovation performance trails China and US by up to 20 percentage points**: According to the European Innovation Scoreboard, the EU's innovation performance trails China and the US by up to 20 percentage points but surpasses India.
- **North America leads in unicorn launches**: North America's lead in launching new unicorns stems from a mature and deep venture capital market in the US (see KPI 8.4), technology leadership (e.g. OpenAI, xAI), and a more risk-tolerant entrepreneurial culture.
- **US and China emerge as stronger innovators than the EU**: Considering all factors, the US and China emerge as stronger innovators than the EU.

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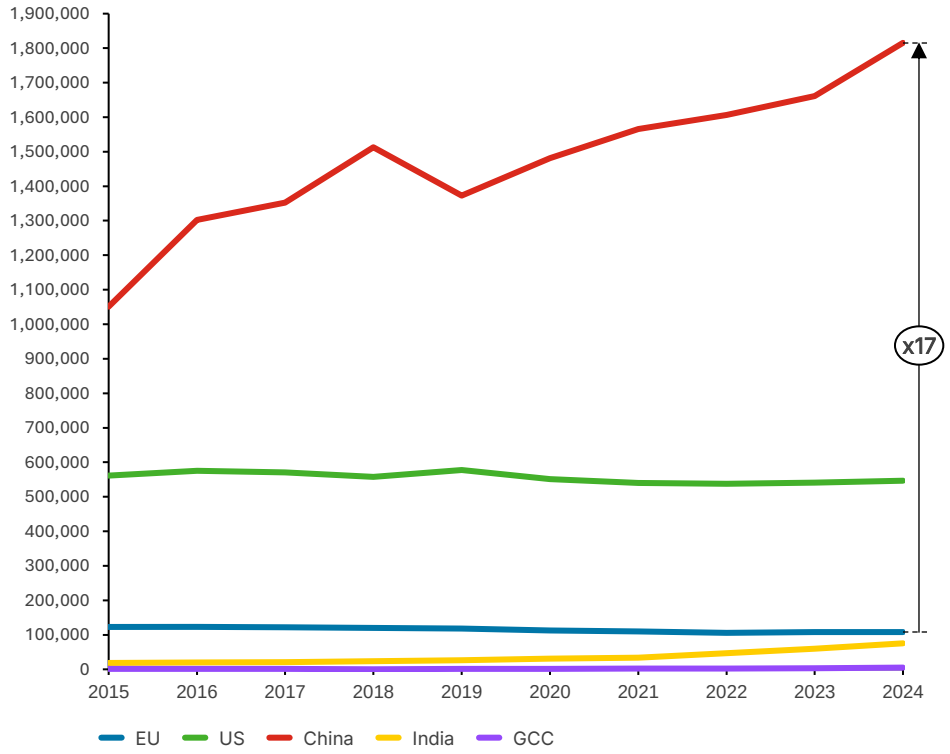
China dominates the patent landscape, with over 17 times more applications filed within the country than within the EU and more than three times those filed within the US

China significantly surpasses the EU and the US regarding the number of patent direct applications and PCT applications filed within the country each year. China records over 17 times more patent direct applications and PCT applications than the EU and more than three times the number recorded by the US. Between 2015 and 2024, the US consistently accounted around five times as many patent applications filed as the EU. The number of patent applications filed per year has remained relatively stable for both the US and the EU during this period, whereas China has experienced exponential growth of 73%, increasing from 1,051,043 patent direct applications and PCT applications in 2015 to 1,815,425 in 2024. The GCC lags far behind with 1,136 to 5,030 patent direct applications and PCT applications between 2015 and 2024. It is important to note that this view takes into consideration the number of patents filed by filing office. Considering other metrics, such as the number of patent families by applicant's origin, may lead to different orders of magnitude across the different regions.

China's consistent lead in patent direct applications is primarily driven by its targeted industrial policies and differences in patent system structures and incentives. For several years, the Chinese government has provided substantial monetary subsidies to support patent filings, covering a significant portion of the official fees (He, 2021). Additionally, the Chinese patent system includes utility model patents, which have a lower inventive step requirement and do not undergo substantive examination before granting (Yang, 2022). Finally, China's national industrial policy, implemented by the China National Intellectual Property Administration, aims to establish the country as a technological leader, notably by setting ambitious patent volume targets (Drug Patent Watch, 2025).

Evolution of the total number of patent direct applications and PCT applications per region between 2015 and 2024



Source: WIPO Statistics Database
Note: *These totals are WIPO estimates using data from all EU Member States, US, Chinese, Indian, and GCC patent offices. Totals include applications filed directly at national and regional offices. This differs from the data source used for the patent publications per region, leading to differences in totals. Furthermore, data regarding India may be incomplete.*

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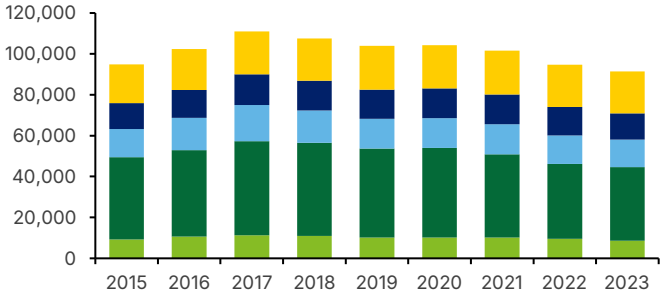
Electrical engineering represents the dominant field of technology, except for the EU publishing more patent publications within the field of mechanical engineering

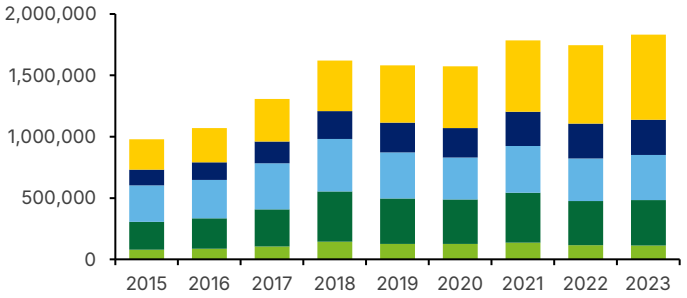
In 2023, electrical engineering accounted for over 35% of patent and PCT publications in the US, China, and India, making it the leading technology field in those regions (WIPO Statistics Database, 2025). In contrast, the patent and PCT publications within the EU were dominated by mechanical engineering, representing 39% of its total. Between 2015 and 2023, patent publications rose in the US and China, remained stable in the EU, and declined in India.

Evolution of the total number of patent and PCT publications filed in the EU per field of technology between 2015 and 2023



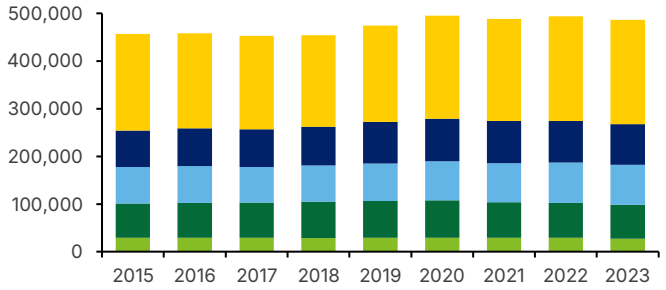
Source: WIPO Statistics Database.

Evolution of the total number of patent and PCT publications filed in China per field of technology between 2015 and 2023



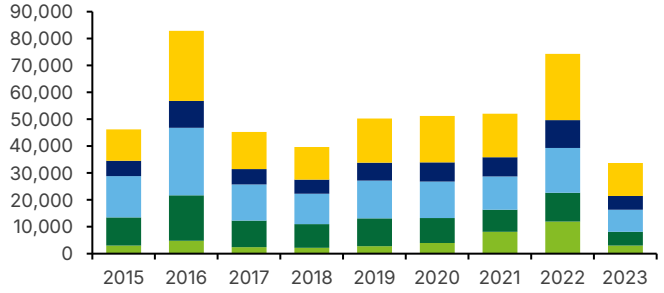
Source: WIPO Statistics Database.

Evolution of the total number of patent and PCT publications filed in the US per field of technology between 2015 and 2023



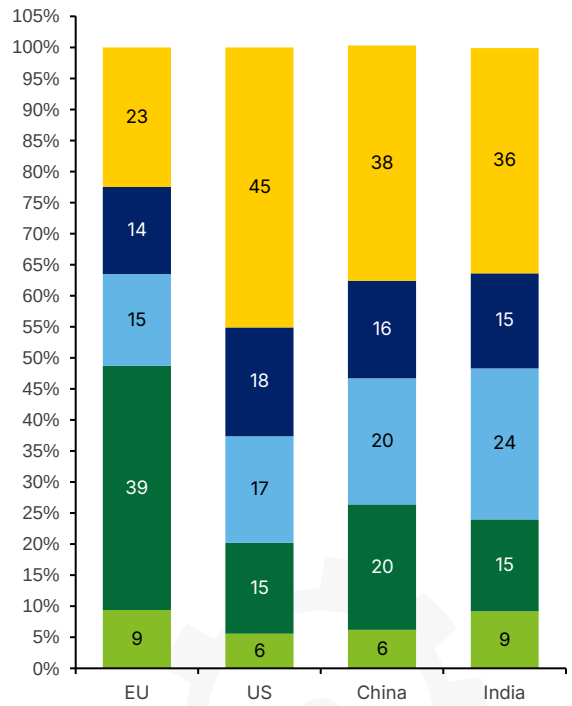
Source: WIPO Statistics Database

Evolution of the total number of patent and PCT publications filed in India per field of technology between 2015 and 2023



Source: WIPO Statistics Database

Share of technology fields per region in 2023 (%)



Source: WIPO Statistics Database

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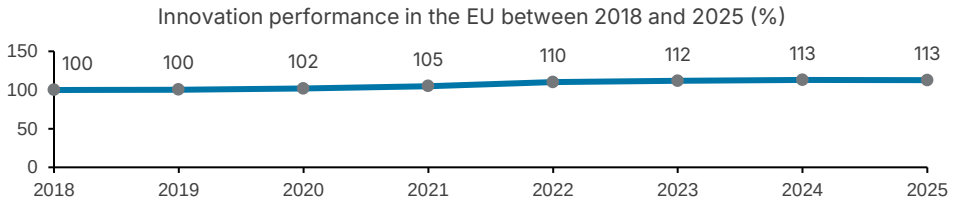
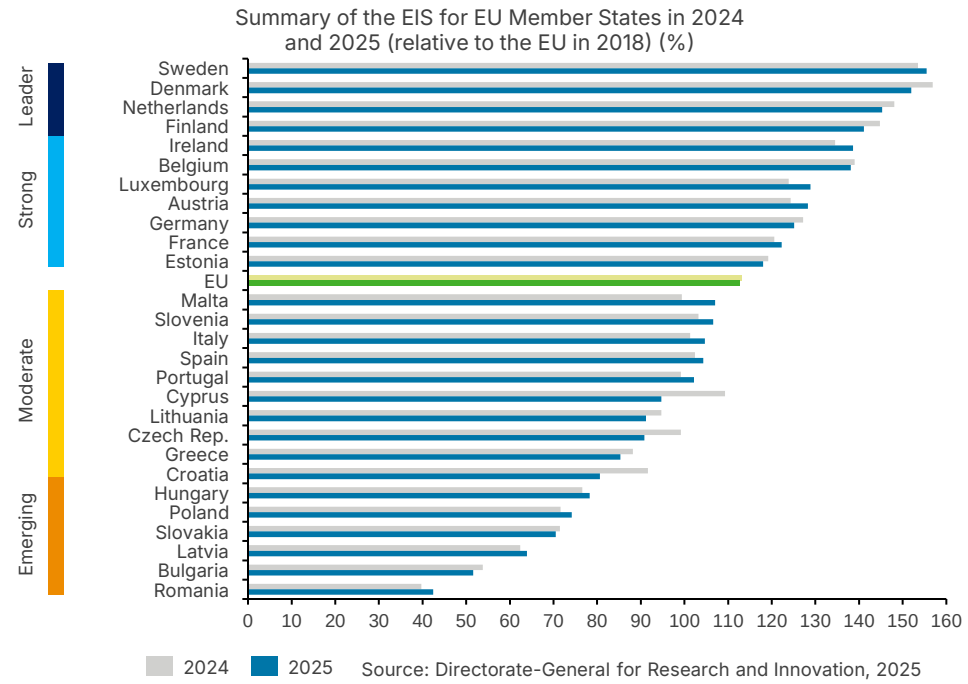
Innovation performance in the EU, as measured by the EIS, has increased by 12.6% since 2018



Source: Directorate-General for Research and Innovation, 2025



Source: Directorate-General for Research and Innovation, 2025

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Innovation performance in the EU, as measured by the EIS, has increased by 12.6% since 2018. The EIS is calculated based on a total of 32 indicators, divided into four main categories and 12 dimensions (Directorate-General for Research and Innovation, 2025). All EU Member States have improved their innovation performance over this period, with variances in the degree of increase. Nevertheless, between 2024 and 2025, the EU's innovation performance decreased by 0.4%. This indicates that the EU's innovation performance remains strong, but growth has been slowing down (Directorate-General for Research and Innovation, 2025).

The EIS categorises EU Member States in four innovation groups based on their scores:

Innovation Leaders: performance is above 125% of the EU average

Strong Innovators: between 100% and 125% of the EU average

Moderate Innovators: between 70% and 100% of the EU average

Emerging Innovators: below 70% of the EU average

In 2025, Sweden was ranked the most innovative EU Member State, succeeding Denmark, which held the top position from 2020 to 2024 (Directorate-General for Research and Innovation, 2025). The Netherlands and Finland also remain Innovation Leaders, whilst Ireland, Belgium, Luxembourg, Austria, Germany, France, and Estonia are classified as Strong Innovators.

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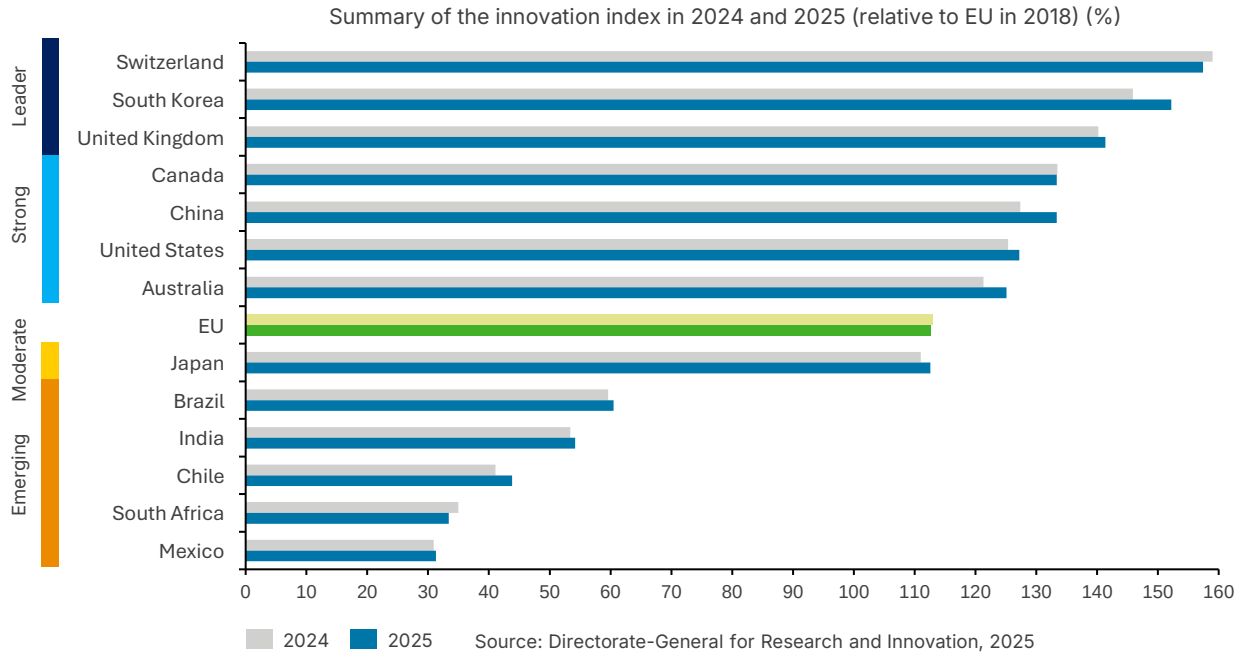
The EU's lower innovation index is due to its moderate and weaker performance among global competitors, ranking lower across several variables used in the EIS index calculation

The EIS identifies the EU's main global economic competitors in innovation performance as South Korea, Canada, China, the US, and Australia. Conversely, the EU outperforms Japan, Brazil, India, Chile, South Africa, and Mexico. South Korea remains the most innovative global competitor in 2025, outperforming the EU by 39.6 percentage points (Directorate-General for Research and Innovation, 2025). Significantly, South Korea, China and the US have not only outperformed the EU but have also improved at a faster rate over the long term (2018–2025). Within Europe, Switzerland is the most innovative country, followed by the UK, which is now categorised as a leader (Directorate-General for Research and Innovation, 2025). The Global Innovation Index (GII) 2025 echoes these findings, listing the top 10 most innovative economies as: 1. Switzerland, 2. Sweden, 3. US, 4. Republic of Korea, 5. Singapore, 6. United Kingdom, 7. Finland, 8. Netherlands, 9. Denmark, 10. China (WIPO, 2025).



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The EU's lower innovation index is due to its moderate and weaker performance amongst global competitors, ranking lower across several variables used in the EIS index calculation, such as R&D expenditure in the business sector (5th), direct and indirect government support of business R&D (5th), PCT patent applications (5th), and innovative SMEs collaborating with others (last) (Directorate-General for Research and Innovation, 2025).

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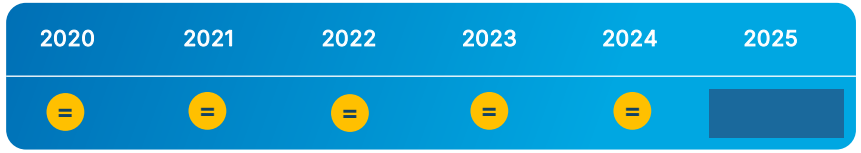
KPI 8.3 EU and Member States budget allocations for research and innovation (R&I)

This KPI tracks total annual budget allocated to R&I and R&D at both EU and Member State levels. It covers EU programmes managed by the European Commission (Horizon Europe and Horizon 2020) and Member State funding based on government budget allocations for R&D (GBARD) from Eurostat. Data is presented in billions of euros (B€) and as a share of GDP. Where GBARD data is unavailable, complementary Eurostat data on GERD compares overall R&D investment across the EU, the US, and China. Analysis focuses on GERD within the business enterprise sector, reflecting enterprises' R&D activities (Eurostat, 2025).

This KPI illustrates public financial commitment to technological and energy innovation, demonstrating the EU's role in fostering industrial innovation

EU performance evolution



International benchmarking

Key takeaways

The EU increased R&D investment but lags proportional growth in the US and China: The EU steadily increased R&I project contributions and GBARD and GERD spending from EU level, Member States, and the private sector. However, the US and China are investing proportionally more in innovation (Eurostat, 2025). Between 2014 and 2023, GERD as a share of GDP grew faster in the US and China, although the EU's absolute R&D spending in 2014 exceeded China's.

China achieved sharpest GERD growth in the business enterprise sector: China's GERD within the business enterprise sector increased from 1.36% of GDP in 2014 to 2.18% in 2023, surpassing the EU by over 0.5 percentage points (Eurostat, 2025). This reflects China's strong commitment to R&D investment across private and public sectors.

Business enterprise sector dominates R&D funding in the EU, the US, and China: The business enterprise sector represents the largest share of GERD in the EU and the US, as well as in China, demonstrating that the three regions rely more heavily on private sector funding for R&D than on public sector expenditure (Eurostat, 2025).

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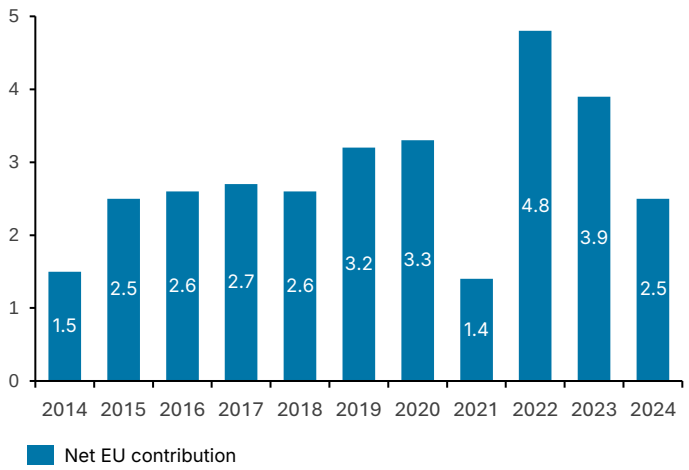
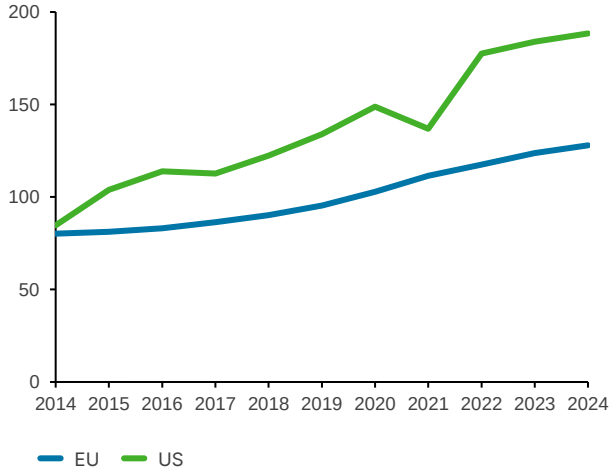
The largest share of budget allocations stems from Member States, which rose steadily between 2014 and 2024

Evolution of the net EU contribution for R&I projects per signature year between 2014 and 2024 (billion EUR)

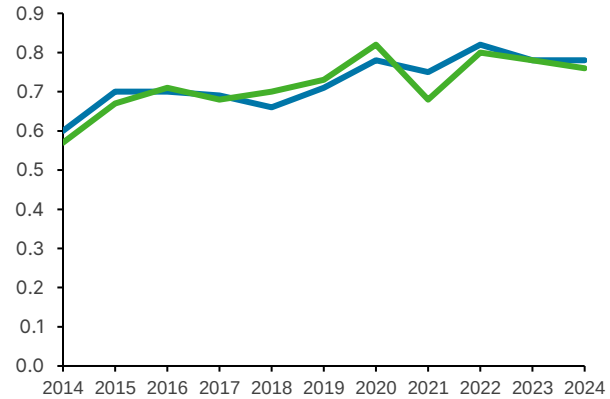


Source: European Commission, 2025

Evolution of the GBARD between 2014 and 2024 in the EU and the US (billion EUR)



Evolution of the GBARD between 2014 and 2024 in the EU and the US (% of GDP)



Sources: Eurostat, 2025; World Bank Group, 2025

Between 2014 and 2024, the EU allocated nearly €31 billion to R&I projects. Contributions declined sharply in 2021, peaked in 2022, and have since declined, reflecting budget constraints and possible programme shifts that reduced average grant sizes (Science Europe, 2024). The EU funding programmes included are H2020 and Horizon Europe (European Commission, 2025).

EU Member States' GBARD rose steadily from €80.2 billion in 2014 to €127.9 billion in 2024 (Eurostat, 2025). The US grew consistently, increasing from €84.7 billion to €188.4 billion over the same period, with notably sharper growth. In absolute terms, the US leads in both GBARD and GERD. Between 2014 and 2024, GBARD (B€) grew by 60% in the EU and by 122% in the US (Eurostat, 2025). However, **as a share of GDP, the GBARD in both regions is similar,** rising from approximately 0.52% in 2014 to 0.75% in 2024.

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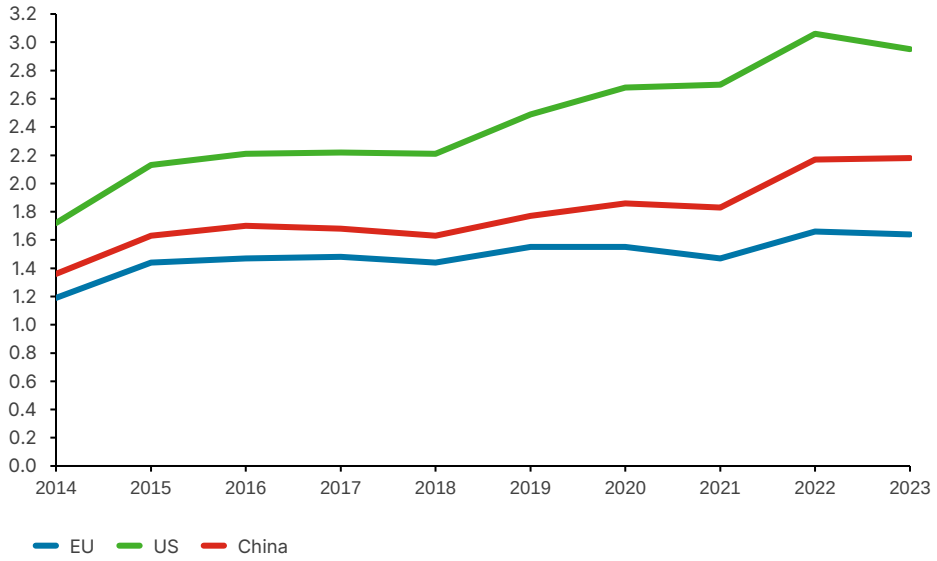
The EU, the US and China rely more heavily on private sector funding for R&D than on public sector expenditure as the business enterprise sector represents the largest share of GERD

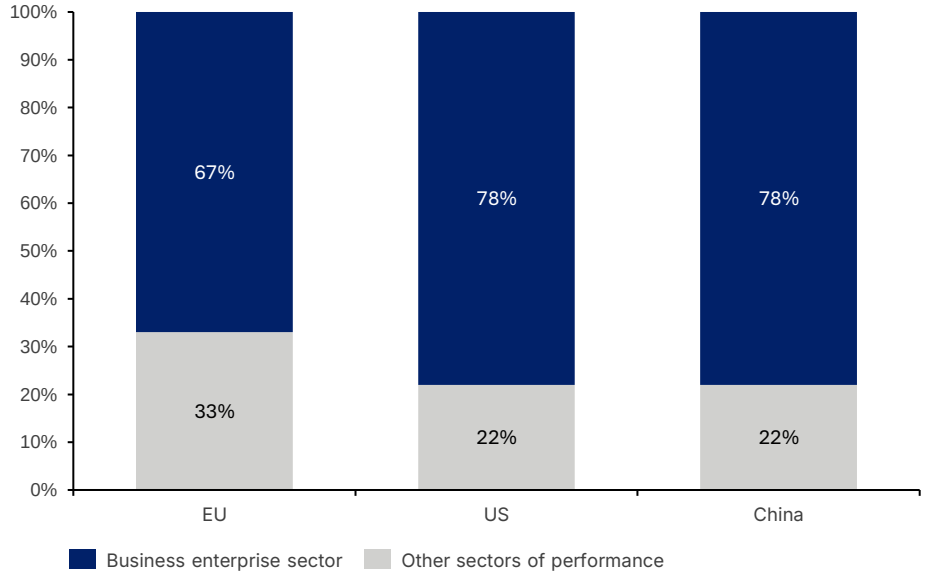
Evolution of the GERD for the business enterprise sector between 2014 and 2023 in the EU, the US and China (% of GDP)



Sources: Eurostat, 2025; World Bank Group, 2025

When analysing the share of GDP dedicated to GERD, the US surpasses both the EU and China (Eurostat, 2025). The difference between the US and the EU is three times larger for GERD than for GBARD, indicating that US R&D investment depends heavily on private sector funding. Between 2020 and 2023, China's growth in GERD as a share of GDP increased more sharply than the EU's.

Share of GERD represented by the business enterprise sector in 2023 in the EU, the US and China (%)



Source: Eurostat, 2025

In 2023, the business enterprise sector accounted for approximately 67% of total GERD in the EU and 78% in the US and China (Eurostat, 2025). This demonstrates that the three regions rely more heavily on private sector funding for R&D than on public sector expenditure.

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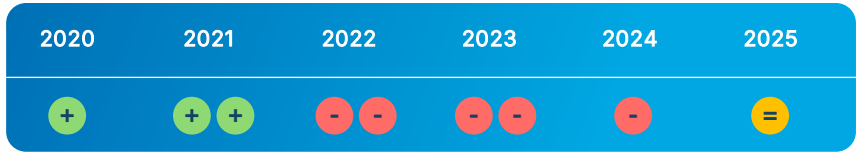
KPI 8.4 Venture capital investment by stages and by key industrial segments

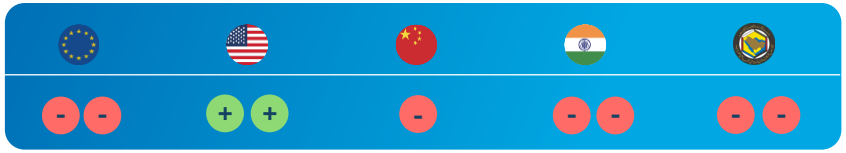
This KPI tracks total VC investment in early-stage (€100 million and above) and later-stage rounds, focusing on industrial segments defined as climate tech. It reveals capital flows into start-ups and scale-ups across growth phases, indicating expansion potential and funding access in the EU. It also highlights sectors attracting investment, signalling emerging technological advances and market leaders.

Data are sourced from the London Stock Exchange Group (LSEG) workspace, covering VC investments over the past 10 years in the EU, the US, China, India, and the GCC. Additional qualitative and quantitative industry insights were gathered from Dealroom and relevant publications for deeper analysis.

EU performance evolution



International benchmarking



Key takeaways

- **The US dominates VC investment across all stages:** The US remains the country attracting the largest amount of venture capital (VC) funding across all investment stages over the past 10 years in both absolute values and share of GDP (LSEG, 2024). While China ranks second, the US leads substantially compared to all other regions, including the EU.
- **The US market is more active in start-up development and technology investment**: The US market remains more active in start-up development and new technology investment than the EU and other regions (LSEG, 2024). This aligns with Draghi (2025) findings that innovative companies seek US VC funding, identifying expansion in the large US market as more profitable than entering fragmented EU markets.
- **The VC landscape does not reflect China's clean energy leadership**: The VC landscape does not capture China's dominant position in clean energy investments. While the US leads VC climate tech investment, followed by Europe, this pattern reverses when considering total annual clean energy investment.
- **China dominates clean energy investment**: China dominates the clean energy investment landscape, investing 56% more than the EU and 114% more than the US in 2024 (IEA, 2024).

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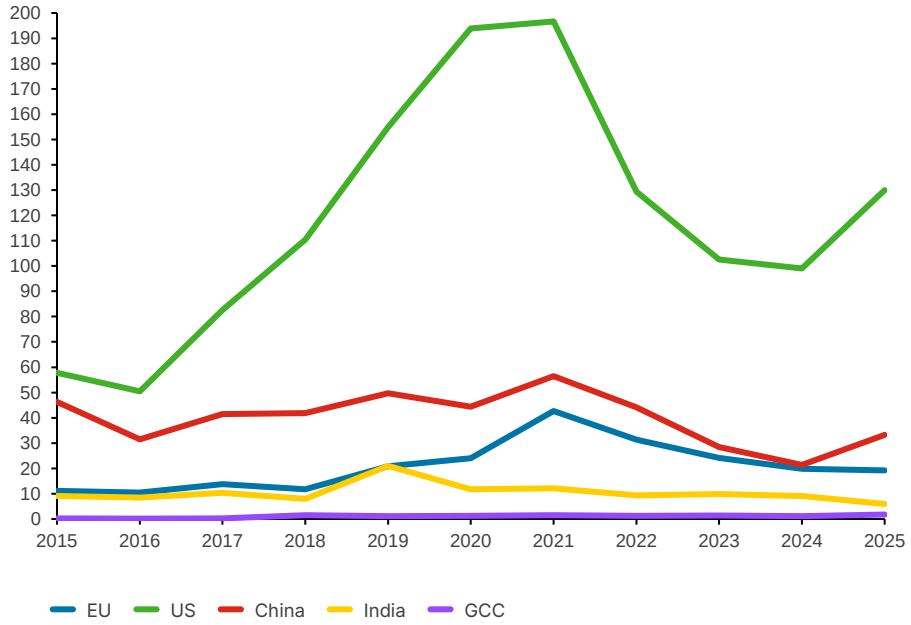
The US remains the country attracting the largest amount of VC funding across all investment stages over the last 10 years

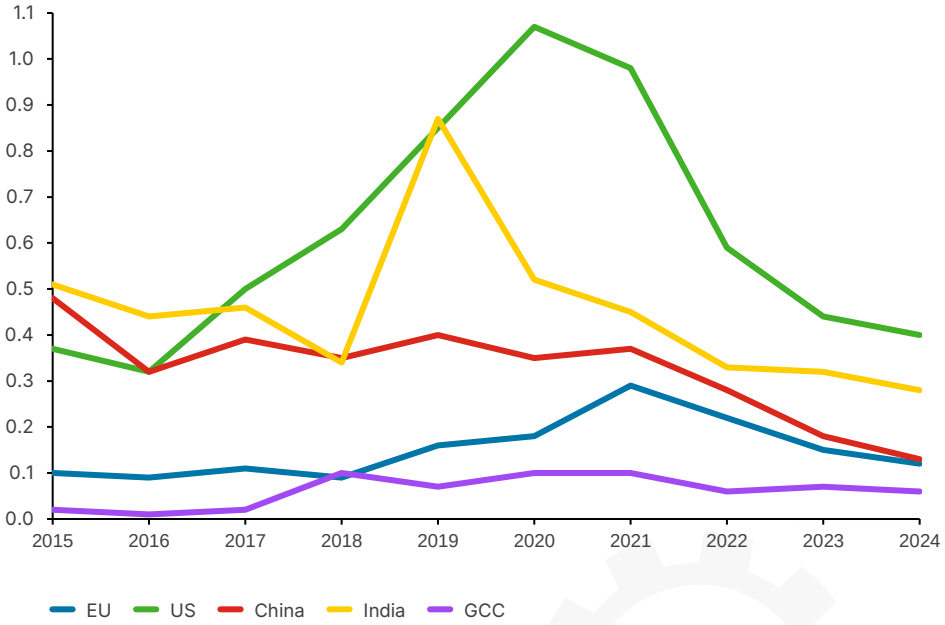
Over the past decade, across all VC investment stages (seed, early stage, expansion, and later stage), the US has remained the highest VC funding receiving country in absolute amounts (LSEG, 2024). This holds true in relative amounts, as demonstrated by VC investments as a share of GDP between 2015 and 2024.

Evolution of VC funding (seed, early stage, expansion, and later stage) across the EU, the US, China, India and the GCC between 2015 and 2025 (billion EUR)



Source: London Stock Exchange Group, 2025

Evolution of VC funding (seed, early stage, expansion, and later stage) across the EU, the US, China, India and the GCC between 2015 and 2024 (% of GDP)



Source: London Stock Exchange Group, 2025; World Bank Group 2025

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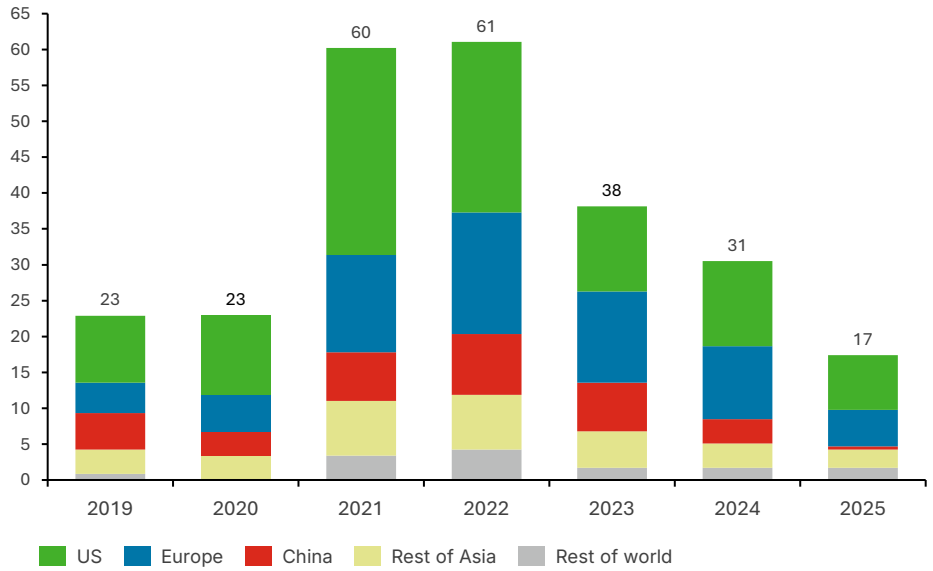
Europe overall is investing largely, surpassing the US in 2023 for climate tech VC funding. Although the US leads in VC clean investment tech, China surpasses both the US and the EU in total clean energy investment

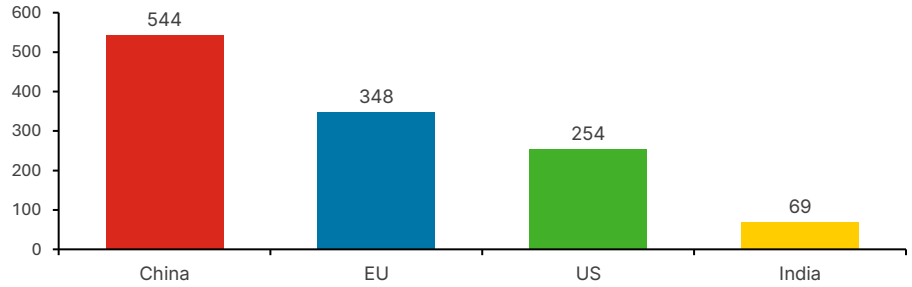
VC investment in climate tech per region between 2019 and 2025 (billion EUR)



Source: Dealroom 2025

Regarding climate tech, defined as "an array of technology solutions designed to address climate change and its environmental effects" (Dealroom, 2025), **Europe overall invests substantially, surpassing the US in 2023 for climate tech VC funding** (LSEG, 2024). Europe and the US remain the largest sources of climate tech VC investment compared to other regions. Global VC funding shares going to climate tech have more than tripled over the past decade.

Annual investment in clean energy per region in 2024 (billion EUR)



Source: IEA, 2024; *Annual investment in clean energy by selected country and region, 2019 and 2024*
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VC investment data in climate tech understates China's massive investments in climate-energy sectors. China leads globally, accounting for 40% of global renewable energy capacity (Wesley Hill, 2025) and dominating EV production with 70% of the market (IEA, 2025).

According to IEA 2024 estimates, annual clean energy investments are €544 billion in China, €348 billion in the EU, €254 billion in the US, and €69 billion in India (IEA, 2024). These figures cover renewable power, grids and storage, nuclear, energy efficiency, and low-emission fuels. While US clean energy investment has generally risen over seven years, certain sectors – clean manufacturing, sustainable aviation fuel (SAF), green cement, and carbon management – experienced declines between 2024 and 2025 (Clean Investment Monitor, 2025; Giacobone, 2025).

Most clean energy funding originates from sources beyond VC. Although the US leads in VC climate tech investment, China surpasses both the US and the EU in total clean energy investment, investing 56% more than the EU and 114% more than the US in 2024 (IEA, 2024).

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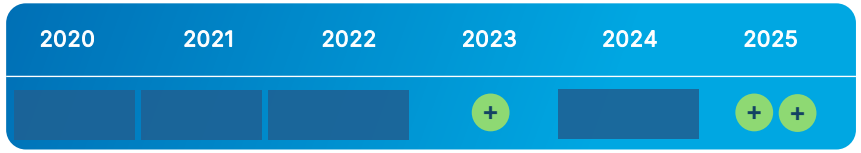
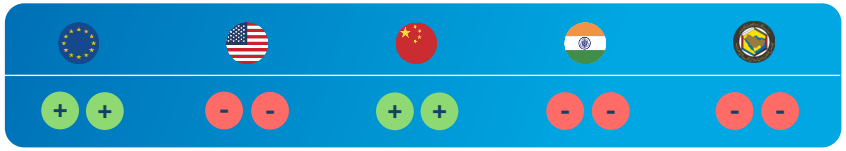
KPI 8.5 Operational regulatory sandboxes

This KPI measures the number of operational regulatory sandboxes in the EU. Regulatory sandboxes offer a controlled environment where businesses can test innovative products, services, business models, or technologies under relaxed regulatory conditions before full-scale implementation. Regulatory sandboxes therefore support entrepreneurship, providing the innovative boost needed in the EU.

EU performance evolution



International benchmarking



Key takeaways

- **Regulatory sandbox launches are accelerating internationally**: The creation and use of regulatory sandboxes are accelerating internationally, with 76% of the regulatory sandboxes identified in 2020 being created within two years.
- **Interoperable Europe Act to ease sandbox launch**: The Interoperable Europe Act aims to ease the launch of sandboxes across the EU, which should lead to the creation of additional sandboxes.
- **China leads with 194 sandboxes; the EU has around 100**: China has the highest number of sandboxes (194), followed by the EU (130) and the US (14). As regulatory approaches vary across jurisdictions, a comprehensive comparison of sandboxes is difficult.
- **Financial services remain the primary sector**: Financial services remain the primary sector for sandboxes. This is highlighted by the Draghi report's recommendation to use regulatory sandboxes – especially for AI – to foster innovative applications across multiple industries.
- **AI Act and NZIA requirements drive sandbox expansion**: The requirements under the AI Act and facilitation mechanisms under the NZIA, coupled with the examples of GreenLab and the Northern German Regulatory Sandbox, showcase the benefits to innovation, competitiveness and a sustainable transition that regulatory sandboxes can create when provided within the field of energy and industry.
- **Impact difficult to measure**: Despite the introduction of regulatory sandboxes within industrial innovation, the impact of regulatory sandboxes is difficult to determine as it is scattered, and regulatory frameworks vary across regions.

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A rapid global growth in the use of operational regulatory sandboxes to foster innovation

A 2020 analysis found 73 regulatory sandboxes worldwide, across 57 jurisdictions, with 56% established within two years, reflecting rapid global growth in sandbox use to foster innovation, primarily in financial services (Congressional Research Service, 2025; The World Bank Group, 2020). A regulatory sandbox provides temporary regulatory relief to test new products, services, or business models with fewer constraints. Its goal is to assess the risks and opportunities of innovations and create an appropriate regulatory framework to support them (OECD, 2025).

Within the European Economic Area (EEA), in 2023, there are 41 innovation hubs (covering all 30 countries, mostly launched 2016–2019) and 14 sandboxes in 12 countries (mostly launched 2020–2021), all within the financial sector (European Insurance and Occupational Pensions Authority, 2023). According to the Member State Survey on regulatory sandboxes, conducted by the Commission in 2025, 130 regulatory sandboxes exist across 25 EU Member States. The EU AI Act requires each Member State to establish at least one national AI sandbox by August 2026 (Carvão, 2025; Future of Life Institute, 2025). The EU NZIA also includes sandboxes to accelerate the development of 19 net-zero technologies (The European Parliament and the Council of the European Union, 2024). The EU Interoperability Act, effective from August 2025, introduces rules for interoperability sandboxes to promote cross-border implementation and knowledge sharing, though none are yet established (The European Parliament and the Council of the European Union, 2025; European Commission, 2025).

Internationally, regulatory sandboxes exist in the US, India, China, and the GCC. Fourteen US states have sandboxes, 11 are industry-specific and three are open to all state-regulated activities (Institute for Reforming Government, 2024). The Reserve Bank of India (RBI) launched its first fintech-focused sandbox in 2019 (Dayal, 2024), and later regulatory sandboxes for securities market innovation, insurance sector and digital communication under recent telecom law were introduced. By 2022, China had 194 sandbox pilot projects across financial services, technology products, and capital markets, significantly boosting financial efficiency through technological innovation (Bu, Jin, Wang, Tang, & Li, 2025). The GCC hosts eight sandboxes across Saudi Arabia, the UAE, Qatar, and Oman (Riyadh Region Municipality, 2025; United Arab Emirates, 2024; Qatar Central Bank, 2025; Central Bank of Oman, 2025).

Based on the most recent data and compared to 2020, the number of regulatory sandboxes created increased drastically, mostly implemented within the financial sector, and under the fintech umbrella.

Overview of the most recent number of operational regulatory sandboxes across each region

Region	Most recent data
EU	130 sandboxes (2025)
China	194 sandboxes (2022)
US	14 sandboxes (2024)
India	4 sandboxes (2024)
GCC	8 sandboxes (2025)

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Despite the introduction of regulatory sandboxes within industrial innovation, the impact of regulatory sandboxes is difficult to determine as it is scattered, and regulatory frameworks vary across regions

Although the financial sector remains predominant in the application of regulatory sandboxes, sandboxes also arise within other industries. Several EU Member States already have sandboxes, with applications within industrial innovation. These different examples showcase the benefits to innovation, competitiveness and a sustainable transition that regulatory sandboxes can create when provided within the field of energy and industry. **Despite the introduction of regulatory sandboxes within industrial innovation, the impact of regulatory sandboxes is difficult to determine as it is scattered, and regulatory frameworks vary across regions**.

Member State	Industrial innovation sandbox application
Estonia	Accelerate Estonia is a programme with a broad scope, covering projects spanning from circular economy to health and defence. As of April 2025, Accelerate Estonia had finished 18 projects and had three active projects (Future of Life Institute, 2025).
Germany	Germany's approach uses "experimentation clauses" in sector-specific laws, allowing temporary regulatory exemptions. The draft Regulatory Sandboxes Act sets common principles and standards for these exemptions (Future of Life Institute, 2025). Additionally, the Federal Ministry of Economic Affairs and Energy created the Northern Germany Regulatory Sandbox with a €52 million budget from April 2021 to March 2027. It aims to explore regulations supporting green hydrogen integration in industry, transport, and heating, while boosting Northern Germany's industrial base, sustainability, and competitiveness (Fraunhofer Institute for Wind Energy Systems, 2025; International Renewable Energy Agency, 2025).
Netherlands	The Dutch sandbox will concentrate on delivering regulatory guidance while maintaining full compliance with legal obligations (Future of Life Institute, 2025).
Poland	The Draft Act on Artificial Intelligence Systems includes provisions for regulatory sandboxes to support innovation while maintaining appropriate oversight of AI systems (Future of Life Institute, 2025).
Denmark	In 2021, the Danish government designated GreenLab as a unique regulatory test zone in Europe, exempting it from existing electricity regulations. This enables GreenLab to trial high renewable energy integration solutions, generating insights to advance Europe's green transition in storage, fuels, agriculture and industry (International Renewable Energy Agency, 2025).

Beyond regulatory sandboxes, innovation is supported by mechanisms such as Open Innovation Test Beds (OITBs) and living labs. OITBs provide shared access to facilities and services required for developing, testing, and scaling nanotechnology and advanced materials in industrial environments (Light Coce, 2025). Living labs offer real-world, collaborative environments for research and experimentation, ensuring solutions are practical and user-centred (Directorate-General Connect, 2023). Under the EU Artificial Intelligence Act, specialised Testing and Experimentation Facilities (TEFs) provide large-scale sites for testing advanced AI solutions across Europe. These projects will receive over €220 million in funding from the European Commission and Member States over five years. Four sector-specific TEFs exist, including 'AI-MATTERS' in manufacturing (Future of Life Institute, 2025). Additionally, over 150 European Digital Innovation Hubs (EDIHs) operate as regional one-stop shops, helping companies and public organisations increase competitiveness by delivering technical testing, innovation support, and digital skills development (Future of Life Institute, 2025).

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Pillar 9: A new spirit of law-making

Let entrepreneurship thrive to find the best solutions to overcome challenges. Legislation should create incentives for businesses to invest in clean technologies. Avoid that the EU Green Deal policy targets are followed by prescriptive and detailed implementing regulations. Prevent over reporting, ensure coherence, stay tuned with industrial reality and integrate legislative proposals through a stronger Secretariat General and Regulatory Scrutiny Board which systematically applies a Competitiveness Check and a European Innovation Stress Test against which each new legislation and policy initiative should be evaluated. Use robust data and scientific evidence for effective policymaking. Assess the cumulative impact of legislation.

Pillar conclusions

Complex administrative procedures impede the competitiveness of the EU manufacturing sector. These complexities arise from the EU's high standards in areas such as quality of life, health, and environmental protection. **Prioritising quality over quantity**, it is essential to develop **high-standard policies** backed by **efficient procedures** to maintain Europe's standards. Currently, energy-intensive industries are facing **heavy administrative burden**; for EU manufacturing firms, the related costs are estimated at 0.9% of turnover. A 2025 study on the competitiveness of the EU chemical industry reports that regulatory costs have steadily increased since 2014 and now represent approximately 12–13% of the sector's total added value (Cefic, 2025).

In 2025, **34% of EU firms identified business regulation as an obstacle to investment**, a **record high** in the European Investment Bank Investment Survey (EIBIS). For example, the **average permitting time** for **manufacturing** projects in the EU **ranges from one to three years**, longer than in benchmarked regions. The **Draghi Report** highlights three compounding factors: **frequent changes in EU legislation**, **complexity** in national **transposition**, and a **disproportionate regulatory burden** on **SMEs** (Draghi, 2024).

Internationally, administrative efficiency in China and the **US contrasts with the EU's performance**. China reportedly streamlines, simplifies, and digitalises procedures that support entrepreneurship and business competitiveness; firms perceive lower regulatory burden and obtain faster construction permit approvals. The US's 'check the box' approach enables firms to reduce the time senior staff spent managing regulatory compliance. EU senior staff dedicate an average of 8.9% of their time to compliance work, compared to 5.9% in the US and 0.8% in China, representing nearly 1.5 time as much as the US and over 11 times more than China.

The **European Commission recognises** the **need to simplify** the regulatory environment. The EU introduced the 'one-in, one-out' principle in 2021 to ensure that **any new administrative burden** introduced by legislation is **offset by an equivalent reduction** in existing burdens (European Commission, 2024). Under the **Better Regulation agenda**, the EU targets a reduction in administrative burden of at least 25% for businesses and 35% for SMEs by the end of the current mandate (European Commission, 2025). The Commission supports this target with simplification packages projected to save €37.5 billion (European Commission, 2025). **Between January and July 2025**, the **Commission proposed simplification initiatives,** including six omnibuses, estimated to reduce administrative costs by €8.6 billion, **representing 22% progress towards the simplification target** as of July 2025 (European Commission, 2025).

Despite these measures, the KPIs in this pillar show that EU firms face high regulatory burden and lengthy permitting times, and a rising share of firms perceive business regulation as an investment barrier. These factors weigh on the competitiveness of EU manufacturing.

11x

EU senior staff allocates 11x more time to regulatory compliance than Chinese counterparts

34%

EU firms identified business regulation as an obstacle

22%

Progress made towards simplification target as of July 2025

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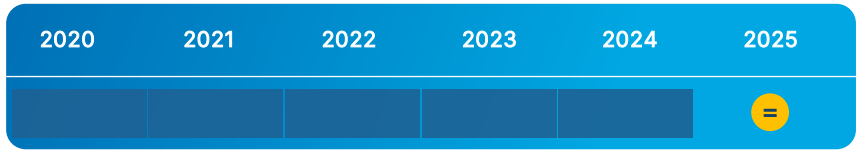
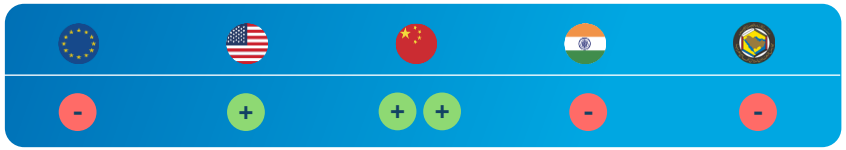
KPI 9.1 Cost of administrative burden

This KPI tracks the proportion of staff within manufacturing firms dedicated to fulfilling regulatory requirements. It uses the European Investment Bank Investment Survey (EIBIS) for the EU and the US, and the World Bank Enterprise Survey (WBES) indicator on senior management time spent on government regulatory requirements for international comparison. This KPI assesses regulatory burden and its implications for competitiveness in the manufacturing sector.

EU performance evolution



International benchmarking



Key takeaways

- The **administrative burden** is **significant** for **energy-intensive industries**. In fact, for EU manufacturing firms overall, it is estimated to **amount to 0.9% of the industry's turnover**.
- The **EU lags behind China and the US in regulatory efficiency**. In China, streamlined, one-stop services greatly reduce the time needed to meet regulatory requirements. In the US, many regulatory tasks are delegated to administrative staff rather than senior management. Consequently, EU senior managers **spend an average of 8.9%** of their time on regulatory duties, **approximately 1.5 times more than** their **US** counterparts, who spend 5.9%, and **over 11 times more** than in **China**, where senior managers dedicate just 0.8%.
- Significant disparities across EU Member States reveal **a lack of harmonised administrative processes.**

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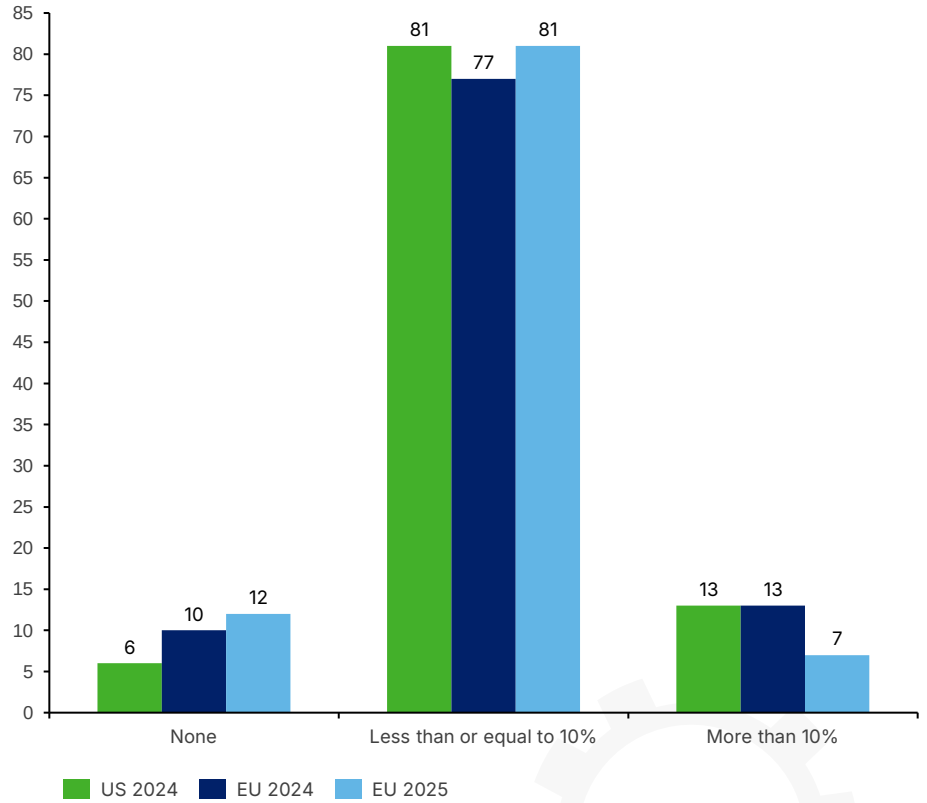
In 2025, EU manufacturing firms hire less staff to comply with regulatory requirements and standards than in 2024

According to the EIBIS data presented below, the **EU is experiencing slightly less burden than the US, as 10% of firms surveyed declared having no staff hired to meet regulatory requirements** as opposed to 6% in the US. Comparing the 2024 data with the 2025 results reveals a positive trend in the EU, with fewer firms reporting that they have hired staff for compliance purposes. This administrative burden is also transposed to a 'cost of compliance', approximated by wage cost for the EU data. In fact, according to the latest EIBIS (2025), the staff hired to meet regulatory requirements within EU manufacturing firms amounts to 0.9% of their turnover. The same data shows that in the EU, the highest cost of compliance is experienced by SMEs, with 1.8% of their turnover being allocated to hiring staff to meet regulatory requirements. EIBIS 2024 provides the latest EU–US comparison, while EIBIS 2025 (EU-only) shows a lower share of compliance staff, with 12% of firms reporting none versus 10% in 2024. Moreover, a 2025 study by Cefic on the competitiveness of the EU chemical industry indicates that regulatory costs have steadily increased since 2014 and now represent approximately 12–13% of the sector's total added value (Cefic, 2025).

Share of firms expressing percentage of staff hired to meet regulatory requirements



Source: EIBIS, 2025

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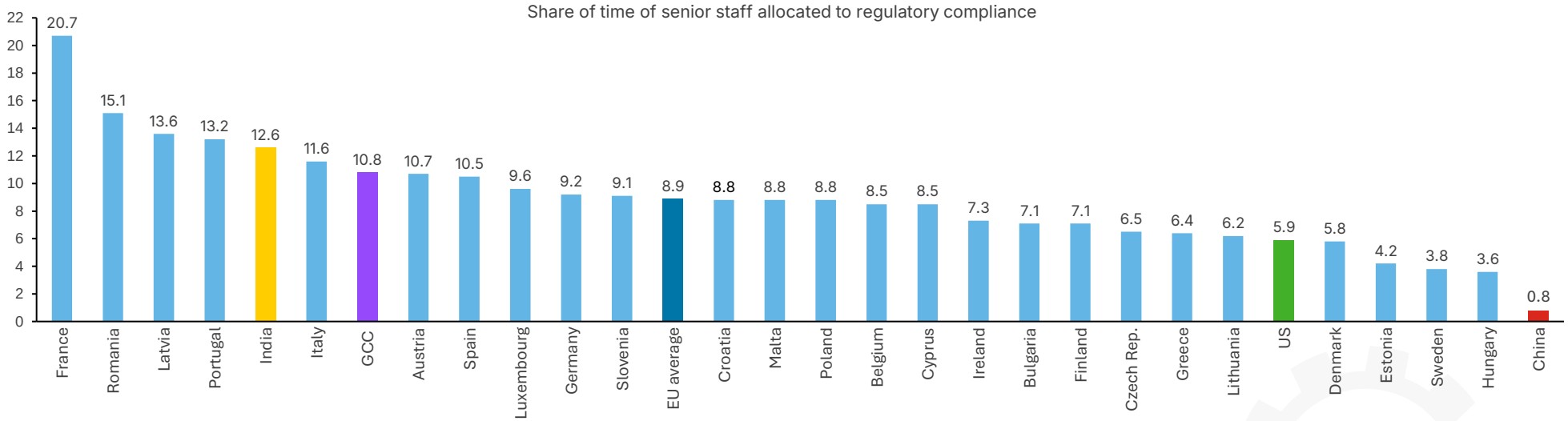
The US and the EU hire a comparable share of regulatory staff, yet US senior staff devote less time to compliance

World Bank data shows that **senior staff in the US allocate a significantly lower share of their time to regulatory compliance than their counterparts in the EU.** Differences in regulatory approach explain this gap: the EU emphasises high-level principles that require greater senior management involvement, while the US relies on detailed, rule-based regulations that firms often operationalise through 'check-the-box' processes delegated away from senior staff (Rasmussen, 2025). In the EU, Chief Operating Officers (COOs) and senior management more frequently interpret regulations and take compliance-related decisions, whereas US firms concentrate these tasks at lower organisational levels (Rasmussen, 2025). Since 2017, US regulatory policy has focused on systemic reduction, aiming to lower the overall cost base, reduce friction, and alleviate staff time and personnel burdens through targeted deregulation. In 2025, the US government launched the 10-to-1 Deregulation Initiative, directing federal agencies to eliminate at least 10 existing regulations for every new regulation introduced, with the stated aim of shrinking the volume of federal rules and reducing regulatory burden (US Government, 2025).



Source: World Bank Enterprise Survey, 2025
Note: *The World Bank Enterprise Survey operates on a three-year rotation cycle, resulting in each country having a different baseline year. Consequently, the most recent available edition was used for analysis.*

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Firms in India and the GCC countries face heavy regulatory burden, while China's digitalisation and simplification have reduced staff time spent on compliance

WBES data indicates that **firms in India and the GCC face significant regulatory burden when dealing with government requirements, while Chinese firms experience extremely low regulatory burden.** Specifically, senior staff in India allocates 12.6% of their time to regulatory compliance, and those in the GCC allocate 10.8%. By comparison, Chinese senior staff dedicate only 0.8% of their time to regulatory compliance. SMEs in India must adhere annually to over 1,450 regulations, indicating a high intensity of regulatory obligations. The Government of India initiated digitalisation and regulatory simplification to ease the administrative burden. (TeamLease RegTech, 2025)

In the GCC, firms report high regulatory burden, with complex procedures, particularly for tax compliance. The region ranks second after Latin America and the Caribbean in time spent by companies on completing tax payments (World Bank, 2025).

China has progressed in digitalising and simplifying administrative procedures since the establishment of the State Administration for Market Regulation (SAMR) in 2024, including one-stop government services platforms that reduce steps and visits required to complete procedures (Qi, 2024).

For example, firms now update business information in a single step, down from seven steps, cutting total processing time by six working days. (Qi, 2024)

Firms in the EU dedicate significantly more senior staff time to meeting government regulations. France exceeds the EU average, with 20.7% of senior staff time devoted to regulatory compliance. French labour regulations impose stricter requirements on firms with 50 or more employees, which has been identified as a growth deterrent that encourages firms to remain at 49 employees. The Banque de France estimates that the costs associated with these 'taxes on firm size' contribute to an economic downturn exceeding 3% in the French manufacturing sector (Garicano et al., 2017).

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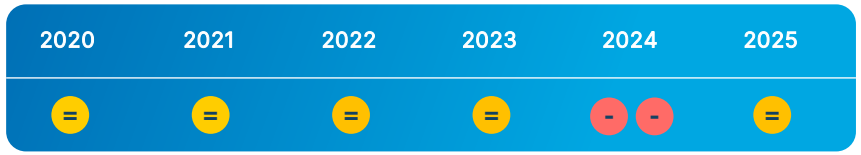
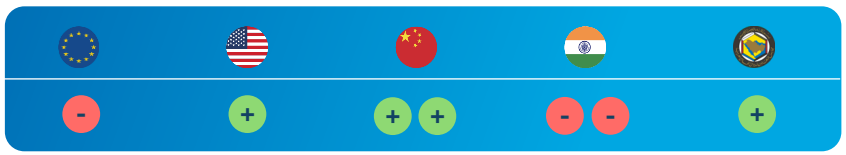
KPI 9.2 Business regulations as an obstacle to firms

This KPI measures the percentage of firms that identify business regulation as an obstacle to investment. It is based on data from the EIB Investment Survey (EIBIS) for the EU and the US. For international analysis, the World Bank Enterprise Survey is used to assess business regulation in India, the Gulf Countries and China. It measures regulatory constraints by reporting the share of firms that consider business licensing and permits to be a major or very severe constraint.

EU performance evolution



International benchmarking



Key takeaways

- EU firms **increasingly perceive business regulation** as a **major barrier**, with 34% citing it as such in 2025, reflecting a growing regulatory burden highlighted by the Draghi report.
- Internationally, **China stands out** for its **streamlined processes** due to government reforms, whereas India faces significant regulatory complexities.
- Across Europe, **regulatory constraints vary widely between Member States** but are **generally more stringent** than in China and the US, at par with the GCC countries, and less severe than in India.

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EU manufacturing firms increasingly perceive business regulation as a barrier to investment, as opposed to US firms

EU manufacturing firms view business regulation as a major investment barrier while US firms generally see it as a minor obstacle. In fact, 2025 EIBIS reveals the share of EU firms identifying business regulation as a major obstacle has risen to 34%, the highest share to date.

The Draghi Report notes that EU regulatory burden has substantially increased, counting approximately 13,000 EU legislative acts adopted between 2019–2024. By comparison, US federal activity in the same period counted approximately 3,500 laws and approximately 2,000 resolutions.

This increase in the EU is driven partly by the absence of a quantitative EU framework to evaluate costs/benefits of new legislation and inconsistent assessment of national transposition impacts.

To alleviate this burden, the Draghi report recommends reducing reporting requirements by at least 25%, and up to 50% reduction targeted specifically for SMEs. (Draghi, 2024)

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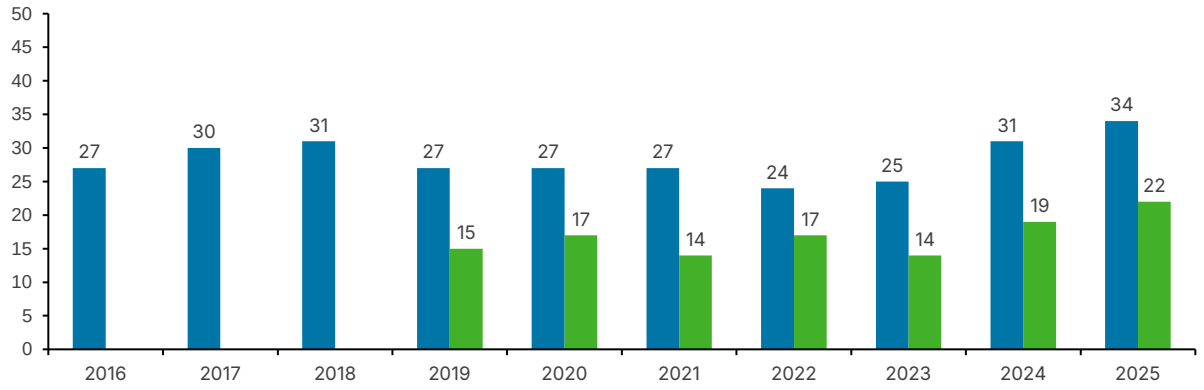
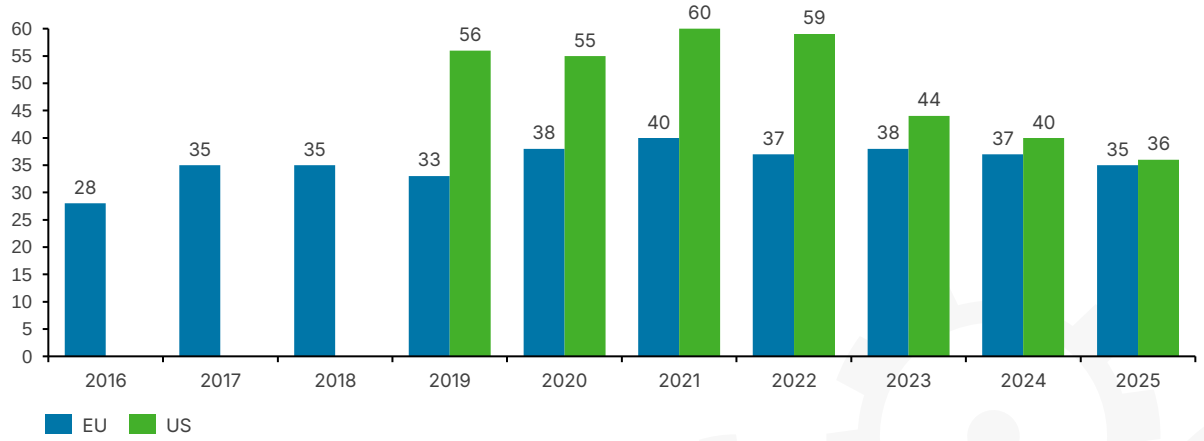
Share of firms identifying business regulation as a **major** obstacle



Share of firms identifying business regulation as a **minor** obstacle



Source: EIBIS, 2025

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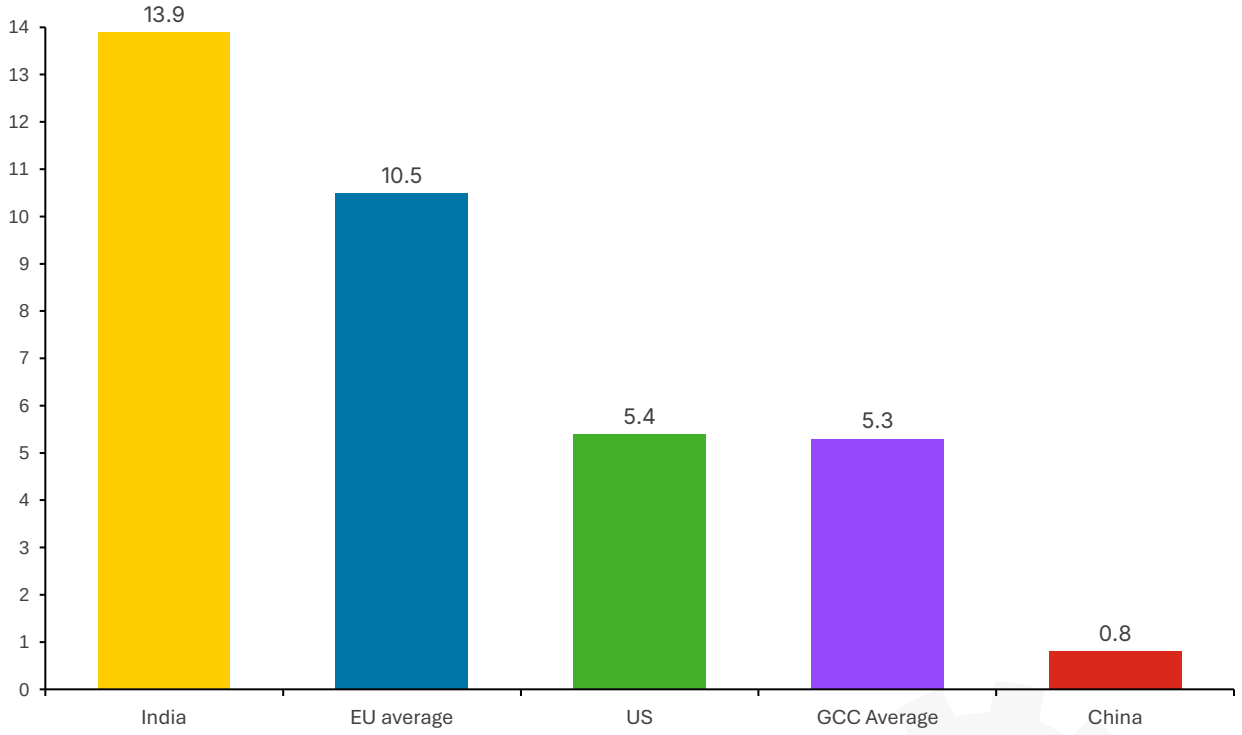
EU firms face far greater licensing hurdles than China, the GCC, and the US

Data from the World Bank Enterprise Survey reveals that **EU firms view business licensing and permits as a major or very severe constraint, significantly more so than firms in China, the GCC, and the US.**

China ranks most efficient on this KPI, driven by comprehensive reforms and one-stop service approach that streamlines regulatory applications (Qi, 2024). India faces complex, multi-layered administration causing longer processing times (typically three to six months) and higher costs (Ministry of Finance, 2020). In Saudi Arabia, the digitalisation of services through e-government portals for the Ministry of Investment and the Ministry of Commerce have simplified the licensing process (Invest Saudi, 2025). In addition to fostering foreign investment through a low regulatory burden, Bahrain is renowned for offering one of the most liberal business environments in the GCC. It features a straightforward business registration process supported by dedicated institutions such as the Economic Development Board and the online Sijilat portal (Kingdom of Bahrain, 2025).

Share of firms identifying business licensing and permits as a major or very severe constraint



Source: World Bank Enterprise Survey, 2025
Note: *The World Bank Enterprise Survey operates on a three-year rotation cycle, resulting in each country having a different baseline year. Consequently, the most recent available edition was used for analysis.*

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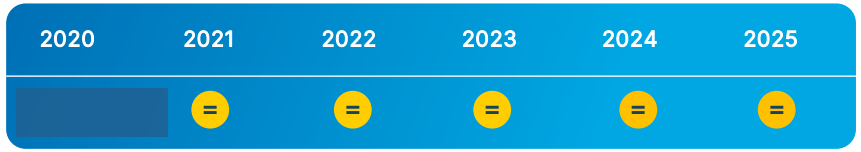
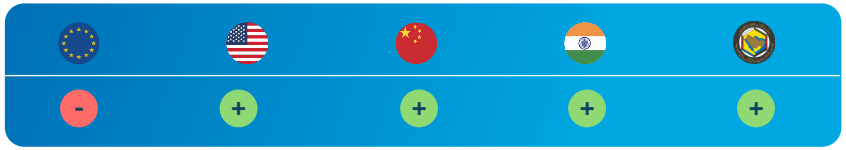
KPI 9.3 Permitting time for key industrial projects

This KPI tracks the average time that companies require to secure the necessary permits and approvals for major industrial projects. The timeframe is calculated from the submission of the application to the final approval by public authorities or courts. Data for this indicator is gathered through a survey conducted by Business Europe and from the World Bank's Doing Business (DB). Business READY (B-READY) is the World Bank's updated index, replacing the Doing Business (DB) report. As more economies are incorporated into B-READY, this KPI will progressively reflect the most current data. In the interim, the latest corrected data from the Doing Business report is used for international comparisons.

EU performance evolution



International benchmarking



Key takeaways

- The EU generally experiences **significant permitting** times for manufacturing projects, often ranging from **one to three years**.
- The most time-consuming phase in the EU is the **waiting time related to obtaining construction permits from public authorities**, which accounts for the majority of delays in 70% of EU Member States.
- China, the US, India and the Gulf Countries all perform better than the EU in this indicator, highlighting a critical need in the EU to **streamline administrative processes** across government levels to reduce permitting timelines and improve efficiency.

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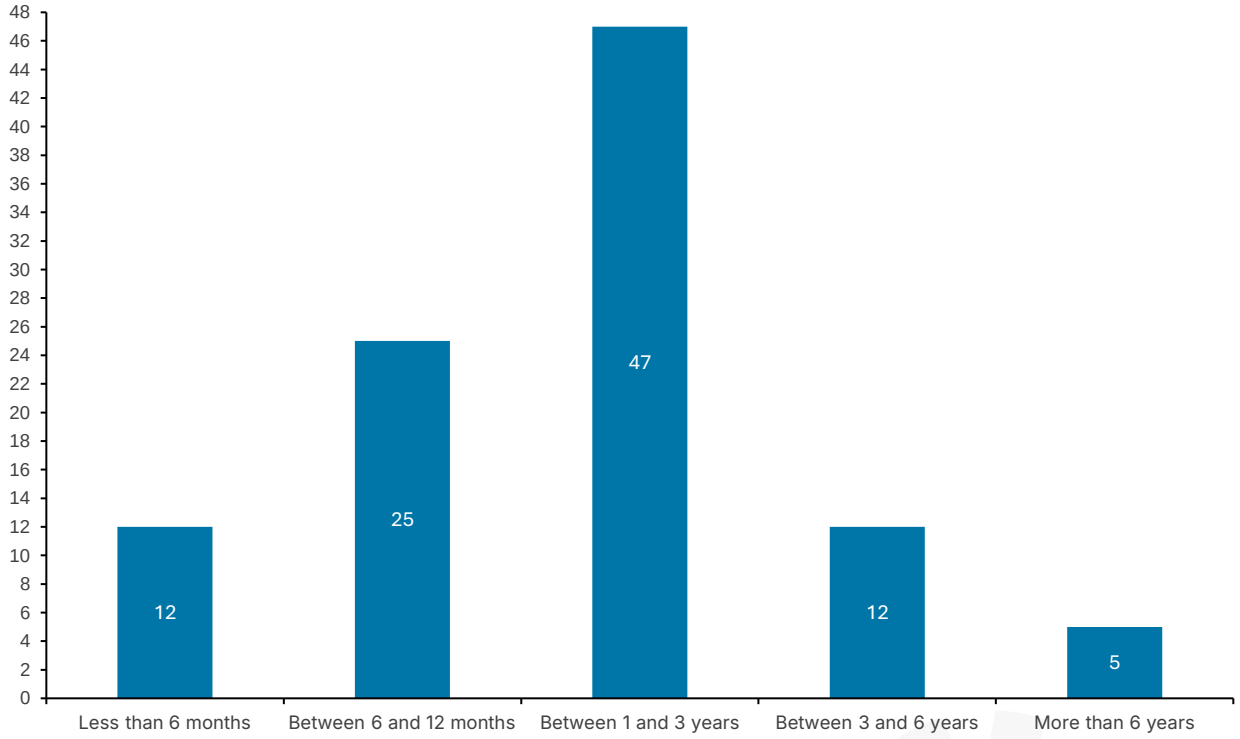
EU firms are experiencing lengthy and complex procedures to obtain industrial permits

According to a study by Business Europe, for a large share of EU firms (47%) it took one to three years to complete the permit approval process, not counting for potential court appeal, annulment and re-approval procedures. Business Europe analysis also reveals the complexity of industrial permitting, specifically noting between five and 10 different authorities involved in the process. Delays in approval can be attributed to the need of consulting these different authorities from EU and national levels. Moreover, Business Europe's study noted the lack of digitalisation and qualified staff, which results in slow response time and failure to meet mandatory deadlines.

To address this challenge, the EU's Net-Zero Industry Act, alongside the Industrial Accelerator Act, directly target this issue. Notably, strict maximum timeframes for granting permits for Net-Zero strategic projects have been set, with the duration varying between nine and 18 months depending on the nature of the manufacturing project (EC, 2023).

Share of EU manufacturing firms per permitting time in 2023



Source: Business Europe, 2023

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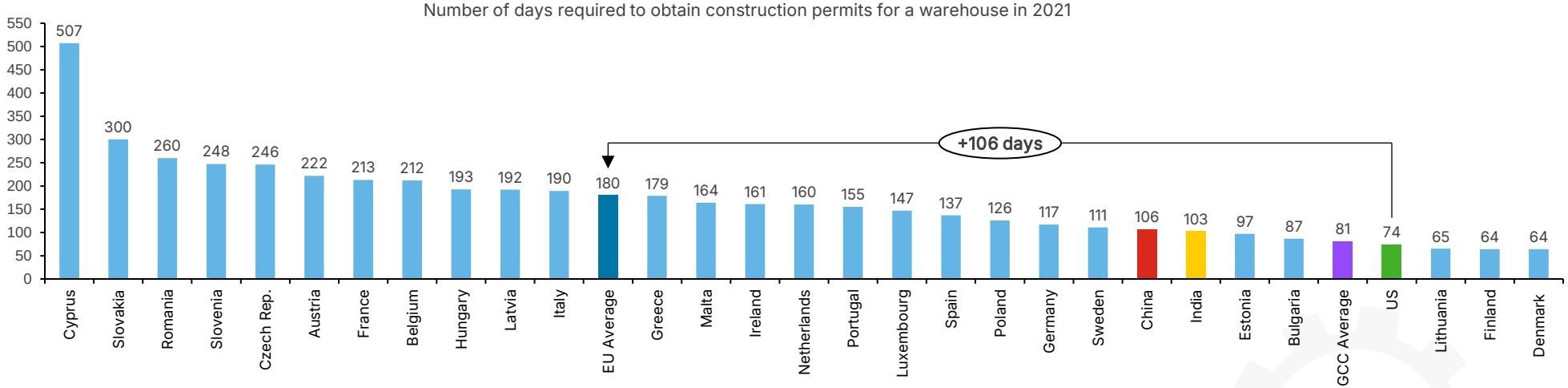
The primary permitting processes bottleneck for EU firms is delays when dealing with public authorities, resulting in an average of 180 days to obtain a construction permit

Data from Doing Business confirms that in the **EU, the lengthiest part of the permitting process is dealing with public authorities** to secure construction permits. This is the longest step for 70% of Member States.

In contrast, in China, the process of requesting and obtaining a construction project planning permit from the Bureau of Planning and Land and Resources takes 17 days out of a total 125.5 days. In China, India, Kuwait, Oman, Saudi Arabia, and the US, most permitting time is spent on safety approvals rather than construction authorisation from public authorities. China has reduced administrative costs and permit times through digitalisation and simplification. India's complex administrative layers cause multiple inspections, but permitting time remains shorter than the EU average. In the US, city-level responsibility and standardised building codes speed up permitting and encourage competition (Clark et al., 2025). In the GCC, permitting times are much shorter than in the EU, due to prioritising permitting efficiency in national strategies like Saudi Vision 2030 and UAE Centennial 2071 (Nadem, 2024)(UAE Government, 2021).

Number of days required to obtain construction permits for a warehouse in 2021



Source: Doing Business, 2021

Prev 1 2 3 Next

Pillar 1 Industrial Deal
Pillar 2 Public funding
Pillar 3 Energy
Pillar 4 Infrastructure
Pillar 5 Raw materials
Pillar 6 Boost sustainable demand
Pillar 7 Single Market
Pillar 8 Innovation
Pillar 9 Regulation
Pillar 10 Enabling structure

Pillar 10: Ensure the structure allows to achieve results

Install a First Vice-President responsible for the delivery of the European Industrial Deal and for ensuring the seamless integration of legislation and alignment with the agenda of the next European Commission, overseeing the key DGs for the Industrial Deal in one integrated approach.

Pillar conclusions

No KPIs were set for this pillar as the asks were already addressed by the European Commission: Teresa Ribera, Stéphane Séjourné and Wopke Hoekstra have been tasked with leading the Clean Industrial Deal. Moreover, this monitoring framework responds to the needs of pillar 10 by ensuring a structure to track progress for Europe's competitiveness.

Conclusion

The Antwerp Declaration Monitoring Report assesses whether the EU is establishing the necessary conditions to ensure both industrial competitiveness and a successful green transition. This first progress report assesses these enabling conditions across the 10 strategic pillars of the Antwerp Declaration, touching on public funding, energy security, infrastructure, raw materials, market demand, Single Market integration, innovation, and regulatory efficiency.

Overall, 83% of key competitiveness indicators show stagnation or decrease, while deindustrialisation accelerates as companies move operations to lower-cost regions. EU peers are moving faster. China has established the most effective enabling conditions for industrial competitiveness by driving robust innovation, ensuring a simplified regulatory framework, securing reliable raw material supply chains, and adopting an integrated production-push and demand-pull approach. The US presents a well-rounded profile, exhibiting strong leadership in innovation and energy while contending with notable dependencies on raw materials and diminished funding for climate-related industrial initiatives. The GCC and India reveal a more nuanced picture, marked by notable competitiveness gaps alongside distinctly different economic structures and dynamics. India experiences constrains on industrial competitiveness due to high capital costs, limited innovation, and regulatory burdens. The GCC advances through state-led green energy mega-projects under efficient regulation, but innovation and data transparency remain weak.

This first report establishes a baseline: the EU has the tools, capital, and talent, but competitiveness now depends on the efficiency of the enabling conditions. As an annual exercise, the following editions will continuously monitor the 29 KPIs to track progress in key areas. They will assess whether committed investments become operational capacity, regulatory simplification reduces burdens, Member State coordination strengthens the Single Market, the energy cost gap narrows, and raw material security improves.

Appendix A

Appendix B

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Appendix A

Appendix B

Appendix C

Appendix D

Appendix E

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KPI #	2020	2021	2022	2023	2024	2025	Rationale for EU evolution
2.1		14.36	21.21	23.03	13.67		The combined funding in billion euros from the EU and Member States steadily increased from 2021 to 2022, resulting in a '++' score, remained stable from 2022 to 2023, and decreased significantly in 2024, giving a '--' score.
			47.22%	8.49%	-40.43%		
2.2	1,964%	675%	490%	663%	513%		The annual oversubscription rate of the Innovation Fund was particularly high in 2020, resulting in a '--' score. Between 2020 and 2022, the oversubscription rate declined by more than 20% annually, earning a '++' score in those years. In 2023, the oversubscription rate increased again, leading to a '--' score, before declining in 2024, which restored the '++' score.
	--	-65.63%	-27.41%	35.31%	-22.62%		
3.1	57.70	79.00	141.70	135.93	118.73	121.75	In 2020, electricity prices and gas prices fell, resulting in a '+' score on average. In 2021 and 2022, sharp price increases led to significant negative scores ('--'). In 2023, minor overall changes gave a stable score ('='). In 2024, price declines resulted in a moderate positive score ('+'). In 2025, stable electricity prices and moderate gas price rises led again to a stable score ('='). Note that electricity and gas prices have been averaged to provide a balanced view on energy.
	-14.84%	34.01%	86.96%	-7.52%	-14.72%	5.93%	
3.2	24.11	34.90	46.45	64.10	72.31		In 2020, new clean energy capacity decreased by 6.04%, resulting in a stable score ('='). In 2021 and 2022, substantial increases of 44.73% and 33.12% led to positive scores ('++'). In 2023, growth remained strong at 38.00%, earning another '++' score. In 2024, the increase slowed to 12.80%, resulting in a '+' score.
	-6.04%	44.73%	33.12%	38.00%	12,80%		
3.3	2.74	7.23	5.92	10.22	11.71	7.54	In 2020, PPA volumes increased by 16.1%, resulting in a positive score ('+'). In 2021, volumes surged by 163.3%, earning a strong positive score ('++'). In 2022, volumes declined by 18.1%, leading to a negative score ('-'). In 2023, volumes rose again by 72.6%, with a '++' score. In 2024, growth continued moderately at 14.6%, scoring '+'. However, in 2025, volumes dropped sharply by 35.6%, resulting in a significant negative score ('--').
	16.09%	163.28%	-18.07%	72.64%	14.60%	-35.62%	
4.1	0.27		0.37		0.46		Between 2016 and 2020, investment in power grid infrastructure as a share of GDP slightly decreased by 2.5%, resulting in a stable score ('='). From 2020 to 2023, investment rose by 18.59% each year, earning a positive score ('+'). From 2022 to 2024, growth continued with a 10.39% increase each year, also scoring '+'.
	-2.5%		18.59%		10.39%		

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Materiality thresholds
Difference with the previous year is equal or superior to 10% → '+' ; '-'
Difference with the previous year is equal or superior to 20% → '++'; '--'
Difference with the previous year is less than 10% → '='

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KPI #	2020	2021	2022	2023	2024	2025	Rationale for EU evolution
4.2		16	14	16	16	14	In 2022, the number of Member States meeting the 15% electricity interconnectivity target fell from 16 to 14, resulting in a negative score ('-'). In 2023 and 2024, the number rose back to 16, earning a positive and stable score. In 2025, it dropped again to 14, leading to another negative score ('-').
			-12.5%	14.28%	0%	-12.5%	
4.3	998.3M	1.04B	11.2B	9.89B	9.55B		In 2020, key infrastructure funding increased by 79.4%, earning a strong positive score ('++'). Growth slowed in 2021 with a 3.9% rise, resulting in a stable score ('='). In 2022, funding surged by 979.9% (IPCEI), scoring '++'. However, in 2023 and 2024, funding declined by 11.7% and 3.5%, leading to a moderate negative score ('-') in 2023 and a stable score ('=') in 2024.
	79.4%	3.9%	979.9%	-11.7%	-3.5%		
4.4	38.6	41.7	46.2				From 2020 to 2022, scores follow the DESI index's steady growth (respectively '=', '+' and '+'). For 2023 to 2025, the score is based on three KPIs: semiconductor market share, which stagnated; the number of edge computing nodes, showing strong growth; and 5G deployment, which is steadily increased. Additionally, data centre capacity rose, supporting overall digital development progress during this period ('+').
	8.0%	10.8%	13.2%				
4.5	0.56	0.56	0.56	0.56	0.61	0.61	From 2020 to 2023, the cumulative operational CO_2 storage capacity remained steady at 0.56 MTPA, resulting in stable scores ('='). Since the increase between 2023 and 2024 is approximately 8.93%, which is below the 10% threshold, the score remained '='. In 2025, no operational capacity was added.
		0%	0%	0%	8.93%	0%	
4.6	1.28	1.90	2.38	2.15	1.78	1.60	In 2020, JVR fell by 26.1%, scoring '++' (positive). In 2021, it rose by 49.0% ('--'), and in 2022 by 25.0% ('--'), resulting in negative scores. In 2023, it decreased by 9.5% ('='), in 2024 by 17.4% ('+'), and in 2025 by 9.9% ('='), reflecting moderate to stable improvements.
	-26.09%	49.02%	25%	-9.47%	-17.44%	-9.86%	
5.1			0.28	0.28			The EXVI remained stable at 0.28 between 2022 and 2023, resulting in an '=' score.
				0%			

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Materiality thresholds
Difference with the previous year is equal or superior to 10% → '+' ; '-'
Difference with the previous year is equal or superior to 20% → '++'; '--'
Difference with the previous year is less than 10% → '='

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KPI #	2020	2021	2022	2023	2024	2025	Rationale for EU evolution
5.2	0.31	0.27	0.28	0.28			The figures represent the domestic production index for 26 of the 34 critical raw materials for which data were available and the index could be calculated. EU performance declined from 2020 to 2021, scoring a '-', and remained largely stable between 2021 and 2023, showing no significant change, which corresponds to a '=' score for the period.
		-11.71%	5.02%	-1.15%			
5.3							Due to limited data on total biomass flows, biomass-derived plastics production and biofuels consumption are used as proxies. Both indicators remained stable through 2021. In 2022, biomass-attributed plastics showed a sharp increase due to an expanded scope that included bio-attributed plastics, making the data non-comparable with previous years. Biofuels increased by 11% resulting in a '+' score in the total performance. From 2022 to 2023, both proxies remained stable resulting in a '=' score. For 2024, only biomass-derived plastics data are available, showing a 25% decrease and corresponding to a '--' score.
	0%	1.21%	11.00%	8.13%	-25.00%		
5.4	11.2	11.1	11.4	12.1	12.2		The EU CMUR showed very small fluctuations below 10% between 2019 and 2024 , resulting in a '=' score.
	0.90%	-0.89%	2.70%	6.14%	0.83%		
6.1				26%	27%	29%	The database used for this KPI (PPDS) shows a slight increase in performance in the last three years. However, considering that the increase is less than 10%, it resultz in a '=' score.
					3.8%	7.4%	
6.2	1,598	1,589	1,597	1,598	1,696		The EU's performance has remained relatively stable in the last five years. The progression shown on the left reflects the relative market uptake (RMU) index, increasing slightly year-on-year, resulting in a '=' score. When looking at the TA coverage KPI, the progression is showing similar results, expressing a stable trend: 54% coverage in 2020 and 2024.
		-0.5%	0.5%	0.06%	6.12%		
6.3	35	36	37	38	39		The results presented for this KPI are cumulative up until 2024. However, a deeper look into the data in the OECD's PINE database indicates that the EU is continuously adding new consumer incentives that are related to energy efficiency and circular economy. The slight increase is exemplified by a '= '.
		2.8%	2.7%	2.7%	2.6%		

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Materiality thresholds

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Difference with the previous year is equal or superior to 20% → '++'; '--'

Difference with the previous year is less than 10% → '='

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KPI #	2020	2021	2022	2023	2024	2025	Rationale for EU evolution
7.1	27.91%	29.68%	37.78%	34.28%	32.87%		The share of EU GDP represented by intra-EU trade increased non-significantly between 2019 and 2021 leading to a '=' score for both years. It increased more significantly in 2022, leading to a '++' scoring. Finally, it decreased non-significantly in 2023 and 2024, as compared to 2022, leading to a '=' for both years. 2025 data was not available at the time of writing.
	-7.35%	6.36%	27.28%	-9.28%	-4.09%		
7.2	123	140	130	125	125		Intra-EU trade of waste and recycled materials (in million tonnes) slightly decreased between 2019 and 2020, scoring a '='. It then increased more significantly between 2020 and 2021, scoring a '+'. Finally, it remained relatively stable between 2021 and 2024, scoring a '='. No data was published at the time of writing for 2025.
	-3.15%	13.82%	-7.14%	-3.85%	0%		
7.3							A yearly evolution is not available for this KPI except the difference between 2023 and 2024. This KPI is measured by the overall performance of the six transposition performance indicators, as part of the EC's Single Market and Competitiveness Scoreboard. According to the data provided by the EC and the different indicators, the overall EU performance decreased between 2023 and 2024.
8.1	5.28%	5.21%	6.8%	5.55%	5.57%		This view is based on the evolution of the risk premium, which represents the cost of capital combined with the government bond yield. In this case a decrease in risk premium is viewed as a positive evolution while an increase is perceived as a negative evolution. The risk premium between 2019 and 2020 significantly decreased, scoring a '+' and then remained relatively stable between 2020 and 2021, scoring a '='. Between 2021 and 2022, the risk premium significantly increased, scoring '--'. Finally, it decreased between 2022 and 2023, scoring '+', and remained relatively stable between 2023 and 2024, scoring a '='.
	-18.89%	-1.33%	30.52%	-18.38%	0.36%		
8.2	112.27	109.47	105.7	108.37	108.2		The number of total patent direct applications and PCT applications filed within the EU (in thousands) remained relatively stable between 2019 and 2025 with a few variances (inferior to a 5% change) over that period, scoring '=' throughout the whole period.
	-4.78%	-2.49%	-3.45%	+2.53%	-0.16%		

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Difference with the previous year is equal or superior to 10% → '+' ; '-'
Difference with the previous year is equal or superior to 20% → '++'; '--'
Difference with the previous year is less than 10% → '='

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KPI #	2020	2021	2022	2023	2024	2025	Rationale for EU evolution
8.3	0.78%	0.75%	0.82%	0.78%	0.78%		This is based on the evolution of the GBARD data. The share of EU GDP represented by GBARD remained relatively stable over the last five years, scoring '=' throughout that whole period. This indicates that Member States are proportionally not allocating more spending on GBARD.
	9.86%	-3.85%	9.33%	-4.88%	0%		
8.4	23.97	42.68	31.29	24.2	19.82	19.22	This is based on the sum of the different VC stages analysed in B€, based on data extracted from the London Stock Exchange Workspace. The amount of VC funding increased between 2019 and 2020, scoring a '+'. It significantly increased the subsequent year, scoring a '++'. Between 2021 and 2023, this amount significantly decreased, scoring '--' over that period. Then, between 2023 and 2024 it still decreased but to a smaller extent, scoring a '-'. Finally, between 2024 and 2025 it remained relatively stable, scoring a '='.
	14.94%	78.01%	-26.69%	-22.66%	-18.01%	-3.03%	
8.5				14		130	Based on the different data elements extracted, it is assumed that the number of regulatory sandboxes continuously increased over the 2019-2025 period as around 130 sandboxes were recorded in 2025 compared to 14 in 2023. However, a yearly evolution is not available. Hence it is assumed that this increase was exponential and thus represents a material increase between 2023 and 2025.
9.1					1.03	0.95	The EIBIS data, only available since 2024, shows that the EU performed slightly better in 2025 as opposed to 2024 when looking at the share of staff hired to meet regulatory requirements. To calculate the difference between both years, a weighted average of all categories from the graph was calculated. The category 'none' = 0, ≤10% = 1, >10% = 2. The figures on the left are the result of the weighted average calculated for each year, reflecting a slight positive trend '='.
						-7.8%	
9.2	27%	25%	24%	25%	31%	34%	According to EIBIS data, the number of firms in the EU that perceived business regulations as a major obstacle increased in 2018. However, it has declined in 2023 and has continued to decline ever since. In fact, in 2025, the EU scored the lowest of all years for which data is available. That said, all years are shown with a '=' expect for 2024, with a negative increase of 24%, resulting in a '--'.
		-7.4%	-4%	-4.1%	24%	9.6%	
9.3							The data for this KPI comes from a 2023 survey conducted by Business Europe. Therefore, the assessment of the EU's performance over time is qualitative. Qualitative information discussed in the KPI's text reflect that no significant improvements have been noted since 2020, hence a '-' score.

● reported figure

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Materiality thresholds

Difference with the previous year is equal or superior to 10% → '+' ; '-'

Difference with the previous year is equal or superior to 20% → '++'; '--'

Difference with the previous year is less than 10% → '='

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KPI #	Rationale for international benchmark	
2.1	The EU has significantly increased funding for climate projects in recent years, supported by the RRF and measures to simplify procedures, resulting in a '+' score. China's state-driven plans and the Middle East's mega-projects also deliver strong regional performance, earning a '+'. In contrast, recent US legislative changes and the roll-out of the Inflation Reduction Act indicate a setback in climate objectives, while India remains in the early stages of funding climate-oriented projects, resulting in a '-' score for both countries.	2025
2.2	No benchmark	N/A
3.1	The EU received a '--' score due to its consistently high electricity prices – over 2.4 times higher than in the US, China and India – posing a major competitive barrier. EU industrial gas prices are also particularly elevated and volatile, reaching nearly five times the US price. The US scored '++' reflecting its structurally low and stable electricity and gas prices, supported by abundant domestic gas supply, which provides a strong competitive advantage. China and India scored '+' due to their relatively lower energy prices compared to the EU, supporting better industrial competitiveness. The GCC countries constantly demonstrate low and stable energy prices, scoring a '++'.	2025
3.2	The EU scored '+' reflecting its large existing capacity and an accelerating but moderate growth rate (5.8% CAGR) in new clean energy additions. The US scored '=' due to a steady growth pace (6.7% CAGR) alongside a substantial capacity base. China received a '++' score driven by its dominant scale and rapid expansion, reaching nearly 1,879 GW by 2024 with a strong 15.7% CAGR, significantly outpacing other regions. India scored '=' reflecting its good growth rate (10.8% CAGR) but lower absolute capacity compared to other regions, indicating steady but less pronounced expansion. The GCC scored '-', reflecting a very low starting point and fluctuating additions.	2024
3.3	No benchmark	N/A
4.1	The EU scored '+' reflecting its recent acceleration in investment from 0.27% of GDP pre-2021 to 0.46% in 2024, matching the US and surpassing the GCC, despite a historical lag. The US also scored '+' due to steady investment focused on grid reliability and upgrades, maintaining a similar share of GDP as the EU. China received a '++' score, reflecting its significantly higher investment level (0.62% of GDP in 2024) driven by large-scale deployment of new grid networks. India scored '++', recognising its initially very high investment share that has declined but remains above average. The GCC scored '=' due to a declining investment share now almost matching EU and US levels.	2024

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KPI #	Rationale for international benchmark	
4.2	No benchmark	N/A
4.3	No benchmark	N/A
4.4	The EU scored '=' reflecting steady progress in digital transformation and 5G coverage but facing challenges in advanced 5G deployment, semiconductor market share, and data centre capacity compared to peers. The US scored '++' due to its strong leadership in semiconductor production, extensive 5G standalone networks, and the largest data centre capacity, underpinning its digital infrastructure advantage. China scored '+' reflecting rapid expansion in 5G standalone networks and large-scale, high-capacity data centres despite a smaller number of facilities. The US and China's advanced digital infrastructure contrasts with the EU's more modest growth and capacity, while the EU's score recognises ongoing improvements but also highlights areas needing accelerated investment to support industrial competitiveness.	2025
4.5	The EU scored '-' due to its very low operational capacity of 0.6 Mtpa in 2025, reflecting minimal growth and a significant gap compared to global peers. The US received a '++' score, recognising its dominant capacity of 25.7 Mtpa supported by numerous operational projects and strong government incentives, primarily driven by enhanced oil recovery (EOR). China scored '+' for its rapid recent expansion to 7.3 Mtpa and broad deployment across 20 sites. India scored '--' reflecting the fact that no projects are currently in operational state. The GCC scored '+' due to their stable capacity of 3.8 Mtpa since 2019, supported by a small number of high-capacity projects and early rapid growth.	2025
4.6	The EU's job vacancy rate (JVR) was lower than that of the US, at 1.6% in 2025, earning a '+' score, compared to the US industry-wide job opening rate of 4.3%, which received a '–' score. This suggests that job shortages are more severe in the US than in the EU.	2025
5.1	The EXVI highlights that the US currently faces the highest external vulnerability in critical raw materials, earning a '-' score, China exhibits the lowest external vulnerability benefiting from strong domestic production, receiving a '+' score, and the EU is positioned in between, leading to a '=' score, with ongoing challenges in reducing import reliance, highlighting supply chain vulnerabilities.	2023
5.2	China dominates domestic production of critical raw materials, earning a '++' score. The EU and the US perform similarly to each other but well below China, with initiatives underway to expand domestic CRM production and a relatively limited range of materials produced each receiving a '–' score. India and the GCC are in the early stages of production with limited material diversification, leading to a '--' score.	2023

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KPI #	Rationale for international benchmark	
5.3	The EU receives a '++' score due to its consistently strong performance, combining the highest share of biomass-derived plastics in total plastic production with high bioelectricity generation. China scores a '+', driven by the largest absolute production, despite slightly below-average bioelectricity. The US receives a '–' score as average biomass-attributed plastics and very low bioelectricity offset its high total production. India performs at the benchmark average, while the GCC shows the weakest performance across all indicators.	2023-2024
5.4	The EU has nearly double the CMUR compared to the global average circularity index and the highest plastic packaging recycling rate, earning a '++' score. China and India have plastic packaging recycling rates close to the average, resulting in '=' scores, while the US and the GCC show the lowest performance, receiving a '–' score.	2021-2023
6.1	With a score of '+', the EU and the US are both performing well, with high ambitions but no harmonised system. On the other hand, the GCC and India are at early stages in this regard, hence the '-' scoring. In China, the centralised system permits an easier uptake of mandatory public procurement rules. China has a framework for sustainable public procurement, but no great focus on green public procurement, hence a '=' score.	2025
6.2	No benchmark	N/A
6.3	This KPI measures both consumer incentives and demand mandates. For demand mandates, all countries are at the early stages. Therefore, the scoring reflects only consumer incentives. The EU and the US have a high number of consumer incentives as per the PINE database, hence both regions were attributed a score of '+'. A '=' score has been attributed to China, where incentives for certain products have been phased out since 2022 as they have proven successful. In India and the GCC, incentives for climate are more often focused directly at industries rather than consumers, hence a low score in this indicator '-'.	2024
7.1	The EU receives a '-' score as its share of GDP represented by intra-EU trade is lower compared to international performance. The US and China perform relatively at average ('='), and no comparable data exists for the GCC and India, thus left out of the international benchmark analysis.	2022
7.2	No benchmark	N/A
7.3	No benchmark	N/A

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KPI #	Rationale for international benchmark	
8.1	The EU scores '=' as it is performing relatively at the same level as the international benchmark average. This view is based on the evolution of the cost of capital combined with the government bond yield, represented by the risk premium. In this case, a lower risk premium compared to the average is seen as positive. The US and India score '+' as their risk premium is lower than the international benchmark average. China on the other hand, has a higher risk premium than all other regions, scoring '-'. There is no data available for the GCC.	2024
8.2	The EU scores '-' as it performs below the international benchmark average. The US score '=' as despite being second in place concerning the recorded number of patent applications, they lag far behind China. China scores '++' as they outperform all regions significantly in the number of recorded patent applications. India and the GCC score '--' as they record a significantly low number of patent applications compared to the international benchmark average.	2024
8.3	The EU and the US score '=' as both the EU and the US are performing roughly equally while no GBARD data is available for India, China and the GCC regarding. This is based on the GBARD data provided by Eurostat.	2024
8.4	The EU, India, and the GCC receive a '--' score as the amount of VC recorded is significantly lower than the international benchmark average. The US score '++' as they outperform all regions significantly. China scores '-', performing worse than the average international performance, but less significantly than the EU, India, and the GCC.	2025
8.5	The EU and China receive a '++' score as both regions significantly lead in the number of regulatory sandboxes. The US, India and the GCC record a significantly lower number of regulatory sandboxes compared to the international benchmark average, thus receiving a '--' score.	2025
9.1	China spends minimal senior staff time on regulatory requirements, earning a '++' score. The US also performs well with a low share of time dedicated to compliance, receiving a '+'. The EU, with a higher share of staff focused on regulatory tasks, is assigned a '–' score. Both the GCC and India face heavier administrative burdens, resulting in a '–' score.	2025
9.2	Business regulation is seen as a major obstacle for 34% of EU firms, leading to a '–' score. In contrast, US firms perceive regulation as a minor obstacle, earning a '+'. India's complex regulatory system results in a '–' score. China's reforms have reduced administrative burden, meriting a '++', while the GCC's digitalisation efforts have eased regulation, resulting in a '+'.	2025
9.3	EU firms experience longer permitting times, reflected in a '–' score. Other regions – China, India, the GCC, and the US – have shorter permitting durations and each receive a '+' score.	2023

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Appendix C – Scope (geographical, industrial, etc.)

Geographical scope

- The primary geographical focus of the analysis is the **EU-27**.
- Where EU-27 data are not available, **Europe** has been considered as a proxy.
- The international benchmarking includes the **United States of America, People's Republic of China, Republic of India, and the Gulf Cooperation Council (GCC) states**, where data are available for all or some of these regions.
- The **GCC countries** covered in the analysis are the **Kingdom of Bahrain, State of Kuwait, Sultanate of Oman, State of Qatar, Kingdom of Saudi Arabia, and the United Arab Emirates**. In cases where data for the **GCC** are not available, the **Middle East** has been considered instead.

Industrial scope

- The analysis focuses on **manufacturing industries classified under NACE Rev. 2, Section C**, which covers **manufacturing activities**, including the physical or chemical transformation of materials, substances, or components into new products.
- Particular emphasis is placed on **energy-intensive industries (EIIs)**, including:
    - Iron and steel
    - Non-ferrous metals (e.g., aluminium)
    - Chemicals
    - Cement
    - Glass
    - Pulp and paper
    - Refining
- Where sector-specific data or analysis for EIIs are not available, the analysis refers to **industry in general**.

Time scope

- The overall analysis covers a **10-year period (2015–2025)**.
- The assessment of **EU performance and international benchmarking** focuses on the **most recent five years (2020–2025)**.
- When data for the full reference period are not available, the **most recent available data** have been used.

KPI scope

Given that no KPIs were developed for pillar 1 and 10, as the asks have been met, these are not included in the data-driven assessment in this report.

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Appendix D – Rationale for KPI revisions

Pillar	KPI	Rationale for KPI revision
Pillar 3	3.2 – New clean energy capacity by source (renewable and nuclear)	KPI 3.2 has been revised from the initial focus on total clean energy production investment reaching final investment decision (FID) to measuring total new clean energy capacity for renewable and nuclear sources, expressed in gigawatts (GW), including a breakdown by energy source. This KPI captures the net change in installed power generation capacity year-on-year, reflecting tangible progress in the energy transition. The geographical scope includes the European Union, the United States, China, India, and the Middle East, with data coverage spanning from 2015 to 2024. Data is sourced primarily from the International Renewable Energy Agency (IRENA) Renewable Energy Statistics 2025 dataset, which provides end-of-year installed capacity figures in megawatts (MW) for bioenergy, geothermal, hydropower (excluding pumped storage), marine, solar, wind, and nuclear energy. The KPI calculation uses the difference in installed capacity between consecutive years to determine new capacity additions. Additional data on fossil fuel capacity and levelised cost of energy (LCOE) from IRENA supports comparative analysis and cost alignment, with currency conversions applied to harmonise USD/kWh to EUR/GWh.
Pillar 4	4.2 – Share of Member States reaching electricity interconnectivity target	KPI 4.2 has evolved from measuring the ratio of import capacity to installed generation capacity to focusing on the share of Member States achieving the EU's 15% electricity interconnectivity target by 2030. This change aligns the KPI with the EU's official goal, making it a more relevant and straightforward indicator of progress toward a fully integrated and resilient EU electricity grid.
	4.3 – Key infrastructure projects (IPCEI & CEF) total funding in energy, digital, CCUS, and recycling	KPI 4.3 has evolved from the initial focus on total funding allocated to key infrastructure Important Projects of Common European Interest (IPCEIs) in energy, digital, CCUS, and recycling, to now also include funding from the CEF projects. The KPI measures the state aid financial commitment in billion euros from 2015 to 2024, covering both hydrogen and digital technologies, as well as EU financial assistance for CEF Projects of Common/Mutual Interest (PCI/PMI) across domains such as grid interconnection, hydrogen, gas pipelines, storage, and CCUS.
	4.4 – Digital infrastructure	KPI 4.4 has been modified from the initial focus solely on the DESI composite score to a more granular assessment aligned with the European Commission's Digital Decade Policy Programme 2030. The initial DESI score, tracked from 2017 to 2022, provided a high-level overview of digital infrastructure. From 2023 onwards, the KPI monitors four specific infrastructure-related indicators critical for industrial competitiveness and resilience under pillar 4: EU semiconductor market share, deployment of edge computing nodes with latencies below 20 milliseconds, 5G network coverage, and AI infrastructure measured by data centre count and capacity. Based on expert consultations, this reflects a better state of EU digital infrastructure developments.

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Appendix D – Rationale for KPI revisions

Pillar	KPI	Rationale for KPI revision
Pillar 4	4.6 – Manufacturing occupations labour shortage	KPI 4.6 replaces the previous 'Green transition occupations shortage' KPI by concentrating specifically on labour shortages within manufacturing occupations. In the absence of a single comprehensive data source directly measuring shortages in green-related skills, this KPI combines labour shortage data from the EURES database with green skills classification from the ESCO database, linking occupations to green skills through a qualitative matching process. Supplementary insights into employment trends and skill gaps are provided by CEDEFOP's skills intelligence and forecasts. The primary quantitative measure is derived from Eurostat's 'jvs_q_nace2' dataset, which reports quarterly job vacancy rates (JVR) for manufacturing under the NACE Rev. 2 classification. The KPI calculates the annual average JVR from 2014 through the first two quarters of 2025 for all EU-27 countries.
Pillar 5	5.4 – Circular Material Use Rate (CMUR)	Following expert consultation, the initially proposed KPI, 'Waste collected and sorted for recycling,' was reconsidered due to its broad scope and the lack of suitable, consistent datasets to support reliable measurement. This led to the adoption of the 'Circular Material Use Rate' KPI, which aligns with the EU's Circular Economy Action Plan and the broader objectives of the European Green Deal.
Pillar 6	6.2 – Export markets access through preferential trade agreements	The initial KPI, 'Access to export markets through free trade agreements (FTAs) for net-zero, low-carbon, and circular products,' was adjusted after expert consultations identified challenges in directly tracking trade volumes for these materials. While end products such as solar panels and electric vehicles can be monitored, tracking the underlying materials such as green steel remains difficult. As a result, the revised KPI evaluates the coverage of preferential trade agreements together with their market uptake. The term preferential trade agreement was chosen to encompass a larger definition of trade agreements that go further than solely FTAs (e.g., Economic Partnership Agreement, Partnership and Cooperation Agreement, etc.).
	6.3 – Consumer incentives and demand mandates driving markets for net-zero, low-carbon and circular products	The original KPI title, 'Total amount of funding allocated to consumer incentives for net-zero, low-carbon, and circular products,' was revised to more accurately reflect the data presented. The KPI now includes both quantitative data from the OECD's PINE database on consumer incentives and qualitative information on demand mandates. Additionally, from Q2 2026 onwards, PINE will incorporate financial data, allowing for more precise tracking of funding allocated to these incentives.

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Appendix D – Rationale for KPI revisions

Pillar	KPI	Rationale for KPI revision
Pillar 7	7.3 – Internal market barriers costs	Due to the multifaceted nature and complexity of quantifying the overall cost, the original KPI, 'Cost of internal market barriers,' was revised. It has been replaced with 'Internal market barriers costs' to enable a more qualitative and focused analysis of the most significant market obstacles. This is measured by the overall performance of the six transposition performance indicators provided under the Single Market and Competitiveness Scoreboard.
Pillar 8	8.2 – Patent applications and commercialisation rate for the industry	Following expert consultation, it was determined that the commercialisation rate component of the original KPI, 'Patent applications and commercialisation rate for the EU industry,' cannot be reliably calculated using publicly available data. Typically, this requires survey-based or proprietary data collection methods. Therefore, the European Innovation Scoreboard, combined with the number of unicorn companies established, has been adopted as a proxy to assess innovation levels within the EU and facilitate comparison with other regions.
	8.3 – EU and Member States budget allocations for research and innovation (R&I)	The original KPI, 'EU and Member States budget allocations for research and innovation (R&I) in the manufacturing sector,' was modified due to the lack of sufficiently granular data specific to the manufacturing sector. Instead, government budget allocations for R&D (GBARD) have been utilised as an aggregate indicator of budgetary support directed toward the private sector.
Pillar 9	9.2 – Business regulations as an obstacle to firms	The original KPI, 'Manufacturing firms indicating business regulation as a barrier to investment,' was slightly revised to incorporate all relevant data sources, rather than relying solely on the EIBIS dataset. The updated title reflects both the information from the EIBIS dataset and the supplementary data provided by the WBES.

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Appendix E – Assumptions & limitations

KPI #	Assumptions & limitations
2.1	This KPI covers EU funding from the Innovation Fund, LIFE, and InvestEU, as well as Member States funding from ERDF, CF, ESF, and State aid. Only projects relevant to climate, environmental, or decarbonisation objectives were included. Due to data limitations, manufacturing companies could not be consistently identified; therefore, all beneficiary types were included. State aid data from Romania, Slovenia and Spain are excluded. Where Member States were incomplete, averages and estimates were used. State aid provides comprehensive information on Member State funding, through the data may not be fully exhaustive. Additional analysis assessed Member State use of the MMF. Expenditure data (in € million) were extracted from Eurostat. Climate-related shares were estimated using Member State–specific proportions from the RRF Scoreboard, applied to annual Eurostat expenditure.
3.1	To ensure comparability, assumptions were made for unit conversions (e.g., converting thousand cubic feet to MWh) and for currency exchange rates when prices were reported in non-euro currencies. These conversions rely on average exchange rates for the relevant periods, which may not fully capture short-term fluctuations. Additionally, tariff structures and taxes vary across countries, which could introduce estimation bias. Data for electricity and gas prices for industry spans from 2019 to 2025 for the EU and the US, while for India the coverage extends until 2024. This KPI uses two separate Eurostat datasets – one for total industrial electricity and gas prices, and another for their components. Differences in methodology and assumptions may cause minor discrepancies between total prices and component sums. For comparisons with the US and China, component mapping is required as datasets use different terminology, which may affect accuracy. The gas price data for the GCC region is based solely on information from Bahrain due to the unavailability of comparable data for other GCC countries. Therefore, the representation of the GCC region in the analysis may not fully reflect the regional variation in gas prices.
3.2	This KPI relies on the IRENA dataset, which, despite its comprehensive and internationally recognised nature, aggregates data from multiple sources including national statistics, industry reports, and news articles, potentially introducing inconsistencies or reporting lags. The exclusion of pumped storage from hydropower capacity may slightly underestimate total renewable capacity additions. Assumptions made during unit conversions (MW to GW) and currency exchange rates for LCOE data (USD to EUR) may introduce minor inaccuracies. Original capacity figures reported in megawatts (MW) were converted into gigawatts (GW). EU-wide averages were calculated by averaging volumes across the reporting countries annually.
3.3	The dataset excludes four EU Member States (missing countries are Cyprus, Estonia, Latvia and Malta), which may introduce a slight bias in the EU PPA volumes. In this dataset, hybrid PPAs are treated as a single PPA encompassing combined technologies, such as solar plus storage or wind plus solar. Renewable portfolio PPAs refer to long-term agreements, typically signed by corporates with utilities that own a broad portfolio of renewable assets.
4.1	This KPI relies on investment data from the International Energy Agency (IEA) and GDP data from the World Bank, which may have differences in reporting standards and timeliness. Currency conversion assumptions based on annual average USD/EUR exchange rates may introduce variability due to exchange rate fluctuations. The aggregation of diverse grid and storage investments by the IEA may mask differences in investment scope across regions. Averaging GDP over multi-year periods can smooth short-term economic changes affecting investment intensity. The 'rest of world' category is calculated residually, potentially obscuring variations within non-benchmark regions. Reporting lags and data availability from these sources may impact the KPI's accuracy and timeliness. The dataset covers the European Union, the United States, China, India, and the Middle East (Middle East countries cover: Saudi Arabia, Iraq, United Arab Emirates, Iran, Kuwait, Qatar, Yemen, Syria, Jordan, Oman, Bahrain, Lebanon). Please note that the GDP for the Middle East has no data available for some the analysed years for Yemen (2015 to 2024), Syria (2023 and 2024) and Lebanon (2024).

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Appendix E – Assumptions & limitations

KPI #	Assumptions & limitations
4.2	The KPI depends on data reported by national TSOs and aggregated by ENTSO-E and DG ENER, which may vary in reporting accuracy and timing across Member States. Note that the interconnection capacity utilisation takes into account connections of EU countries to non-EU countries.
4.3	The manual classification of CEF projects introduces potential subjectivity, and some projects' scopes may evolve, affecting inclusion criteria. Additionally, the KPI does not capture investments outside the IPCEI and CEF frameworks, potentially underestimating total infrastructure financing. Data availability and updates up to 2024 for CEF limit the KPI's ability to reflect the most recent developments or emerging projects.
4.4	The semiconductor market share data, sourced from the benchmark analysis (SIA), refers to Europe rather than strictly the EU, which may slightly overstate or understate the EU's actual market position. The 2025 5G connectivity figures are projections rather than actual observed data, which may affect the accuracy of near-term assessments.
4.5	Only fully operational storage projects within the defined geographical scope are included. Data sources include the CCSI an CATF databases. The Ravenna project in Italy, included from CATF data but absent in CCSI, highlights potential discrepancies between databases. Regional differences in reporting transparency and project classification may affect comparability. The analysis of EOR shares is limited by the availability and granularity of project-level data. Additionally, multiple projects flagged as enhanced oil recovery (EOR) by CCSI in 2024 were marked as N/A or 'not specified' in 2025, suggesting a possible ongoing re-evaluation of project classifications.
4.6	Data sources include Eurostat, EURES, ESCO, and CEDEFOP. This KPI faces challenges due to the qualitative nature of linking green skills from ESCO to job vacancies reported in EURES, which may introduce subjectivity and limit precision. The absence of a unified skills observatory means data integration remains incomplete, though future developments by the European Commission's Joint Research Centre (JRC) may improve this. The Eurostat job vacancy data is unadjusted for seasonal or calendar effects, which could influence short-term fluctuations. Data coverage ends mid-2025, limiting insights into the most recent labour market developments.
5.1	The dataset used for this KPI is based on information from the Annual Single Market and Competitiveness Report for the EU, the US and China. To ensure consistency with EU Single Market publications, only these regions/countries are considered in this report. The data used in this analysis cover information up to 2023. Updates for 2024 data will only become available after the publication of this report; therefore, any developments or trends emerging in 2024 are not reflected.

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Appendix E – Assumptions & limitations

KPI #	Assumptions & limitations
5.2	The dataset used to calculate this KPI is based on the British Geological Survey Report (2025) and Eurostat data (2025). The most recent data available refer to the year 2023. As of now, there is no announced date for the availability of 2024 data.
6.1	The dataset used for this KPI, the Public Procurement Data Space (PPDS), presents multiple limitations to consider when using the data. The PPDS aims to address the fragmentation of information by combining data from the TED database with national platforms. However, as the platform was developed in 2024 and is still in its early stages, data quality requires improvement. While the PPDS includes more contracts than the TED database by incorporating Member State data, it has not fully resolved the threshold bias. Without mandatory reporting for all public procurement, this bias cannot be eliminated. As of 2025, PPDS includes data from Austria, Germany, and Finland, with plans to add Italy, Portugal, Latvia, Slovakia, and Cyprus within the year. France, Romania, Bulgaria, the Czech Republic, Estonia, Denmark, and Slovenia have expressed interest in joining in the coming years.
6.3	The OECD's PINE database, which serves as the source for this KPI, provides information on the types of incentives available to consumers. However, it does not always offer comprehensive data, particularly historical records. For example, the data from the US is insufficiently complete to support a reliable historical comparison. Additionally, financial details regarding these incentives are expected to become available in Q2 2026. Data for China, India and the GCC is incomplete, which has been addressed in the text of the KPI. This update will allow the next edition of the Antwerp Declaration Monitoring Framework to include an analysis of funding allocated to consumer incentives.
7.1	At the time of writing, the datasets used for this KPI from Eurostat do not provide data for 2025. Concerning the international comparison, two datasets were available for the US in 2022, the Commodity Flow Survey and The Freight Analysis Framework, both provided by the US Bureau of Transportation Statistics. As the latter is model-based, it was selected as source for US data.
7.2	At the time of writing, the datasets used for this KPI from Eurostat do not provide data for 2025. Thus, 2025 data will not be added in the report because of a lack of availability.
7.3	The dataset used for this KPI is multidimensional. As this KPI is multidimensional, it is not possible to provide an overarching view regarding the performance of internal market barriers. Rather, this is a qualitative KPI providing insightful information across the different dimensions taken into consideration.
8.1	The dataset used for the cost of capital does not disaggregate between India, China and the GCC countries but only provides historical data for the cost of capital for emerging countries as a whole. This leads to a less robust international benchmark as only the 10-year government bond yield is used for these regions in combination with the cost of capital for emerging markets. Hence, the international benchmark is less granular for India, China and the GCC. 2025 data was not available at the time of writing.

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Appendix E – Assumptions & limitations

KPI #	Assumptions & limitations
8.2	The totals displayed for the number of patent applications are WIPO estimates, using data from all EU Member States, US, Chinese, Indian and GCC patent offices. Totals include applications filed directly at national and regional offices. This differs from the data source used for the patent publications per region, leading to differences in totals. As the commercialisation rate of patents is not publicly available, other metrics are used to further measure the level of innovation.
8.3	GBARD data is not available for China, India and the GCC. This leads to a less robust international benchmark as a performance comparison cannot be conducted with those regions.
8.4	Differences in methodologies arise between LSEG, Bloomberg, and Dealroom. Hence, some discrepancies may arise when comparing the results outlined in this report with Bloomberg or Dealroom analyses.
8.5	The Member State Survey on regulatory sandboxes, conducted by the Commission in 2025 has not yet been published. Hence, the data provided behind the total of 130 regulatory sandboxes is not yet publicly available.
9.1	The dataset for this KPI is sourced from EIBIS. While the KPI provides data for both the US and the EU in 2024, it covers only the EU for 2025. Therefore, the quantitative data presented for 2025 in KPI 9.1 text reflects solely the EU's performance.
9.2	The dataset used for complementarity and international benchmarking, sourced from the World Bank Enterprise Survey (WBES), is not suitable for historical comparisons. This is due to the fact that the WBES operates on a three-year rotation system, resulting in differing baseline years across countries, which prevents direct comparison. Therefore, the data presented in KPI 9.2 is drawn from the most recent WBES version available for each economy as of the end of 2025.
9.3	The data from Business Europe is based on a 2023 survey, which may reflect outdated trends; therefore, it is supplemented with additional qualitative research. For international benchmarking, data from DB and B-READY are utilised. However, since B-READY does not yet cover many economies, the latest available data from DB is used in the interim. It is anticipated that data for the benchmarked economies and the majority of EU Member States will be included in the B-READY 2025 edition, at which point the monitoring will be updated accordingly. The B-READY 2025 data visualisation portal is expected to launch in early 2026, facilitating the update of specific data points.

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