Clean Technologies

Too slow

Clean technologies are the backbone of a decarbonised economy. It is vital to deploy the most effective climate solutions, and that citizens reap the benefits of green industrialisation.

4.8 Clean technologies

Past progress: The development of clean technologies in the EU was found to be too slow, which means there is no change to the progress classification of last year. While the EU research and innovation architecture remained vibrant, with significant public funding, private R&I spending was progressing too slowly in the period assessed. Investment in start-ups was growing, and the manufacturing base for more mature clean technologies continued to increase. However, private finance to these at-scale projects plateaued, risking continued progress.

Policy context: The EU has a range of policies which support research and innovation, manufacturing, and deployment of clean technologies. The Fit for 55 package creates the market conditions and future demand for clean energy, electric mobility, and other technologies. A range of funds and financial instruments are already in place to support clean technologies (Humphreys, 2023b). 2023 saw the proposal of the EU's Green Deal Industrial Plan (EC, 2023ar), a package of measures aimed at European clean technologies. With implementation expected by the end of 2024, their impact on the progress of EU clean technologies is yet to be assessed.

Areas of action: A holistic strategy is required to drive progress in clean technologies. Key actions include prioritising the full implementation of legislative initiatives like the Net Zero Industry Act, to streamline permitting processes and accelerate market entry. Additionally, leveraging mechanisms such as the proposed 'regulatory sandboxes' will facilitate the transition of research into market-ready solutions. Above all, addressing the absence of a cleantech investment plan should be a priority to mobilise private and public capital effectively. This should be pursued at the EU level to avoid a fragmentary state aid competition between Member States (MS), such as that seen under the current Temporary Crisis and Transition Framework (Humphreys, 2023a). Expanding the size and scope of the EU Innovation Fund, expanding the size of Horizon Europe, and leveraging EIB instruments such as guarantees and venture debt should be key pillars of such an approach.

Table 18: Progress on clean technologies towards the objective and enablers

OBJECTIVE	ENABLERS		
Developing manufacturing capacity & innovation leadership	Fostering research excellence	Bringing innovation to market using private resources	Increasing clean technology uptake
			

Note: Large circles show the progress classification of this year and small circles the one from last year's progress assessment. Arrows indicate positive or negative changes in classification. See Table 35 for further information.

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Table 19: Details on indicators' past progress and required change

2023 2024 ›	Historical data			Required change	
	Time period	Relative change p.a.	Absolute change p.a.	Benchmark	Absolute change p.a.
OBJECTIVE: Developing manufacturing capacity & innovation leadership					
Clean technology industry added value [bnEUR]	2015–2020 (Eurostat, 2023a)	4.6% per year	EUR 5.6 bn per year	n/a	n/a
Index of eco-innovation patents [Patents/Mhead/year]	2017–2022 (EC, 2023i)	-1.2% per year	-1.1 per Mhead per year	n/a	n/a
ENABLER 1: Fostering research excellence					
Index of Eco-Innovation related publications [Publications/Mhead/year]	2017–2022 (EC, 2023i)	4% per year	6.6 per Mhead per year	n/a	n/a
Public funds for environmental and energy R&D [% of GDP]	2016–2021 (IEA, 2024a)	5.6%-points per year	0.0%-points per year	n/a	n/a
ENABLER 2: Bringing innovation to market using private resources					
Private energy R&I spending [% of GDP]	2014-2019 (EC, 2024i)	1.9%-point per year	0.0%-points per year	n/a	n/a
Early-stage private cleantech investment [EUR]	2018–2023 (Cleantech for Europe, 2024)	47% per year	EUR 615 million per year	n/a	n/a
ENABLER 3: Increasing Clean Technology uptake					
Share of green public procurement [n/a]	n/a	n/a	n/a	n/a	n/a
Cleantech scale-up finance [EUR]	2018–2023 (Cleantech for Europe, 2024)	40.9% per year	EUR 1.5 billion per year	n/a	n/a
Battery manufacturing capacity [GWh/year]	2021–2023 (Bielewski et al., 2022; IEA, 2023d; T&E, 2024b)	131.1% year	91.5 GWh/year	550 GWh by 2030 (EC, 2023ah)	46.1 GWh/year → **0.5 times faster**

Note: Icons indicate progress classification of this year's progress assessment and coloured lines the change in classification; See Table 35 for further information. n/a indicates that data are not available.

Source: ©ECNO.

Objective: Developing manufacturing capacity & innovation leadership

Indicators:
- Clean technology industry added value
- Index of eco-innovation patents

Past progress: The ECNO indicators tracking progress on this enabler show progress on the growth of the clean technology industrial base was steady, yet too slow, while the performance of the research ecosystem declined. The steady growth of the clean technology industrial base was hampered by problems of access to finance (Tech for Net Zero, 2021), slow permitting times (EC, 2023e), and increased competition from the United States and other jurisdictions (Jansen et al., 2023). The decline in the performance of the research sector is harder to attribute a cause to, although regular cuts to EU research funding (Zubașcu, 2024) could be a contributing factor.

Policy context: The past year has seen the EU conclude interinstitutional negotiations on key pieces of legislation for clean technologies, under the umbrella of the Green Deal Industrial Plan (EC, 2023ar). Of the three pieces of legislation introduced as part of the Plan (incl. the Net Zero Industry Act, Critical Raw Materials Act (CRMA), and the Strategic Technologies for Europe Platform), the Net Zero Industry Act (NZIA) has the potential to significantly improve EU progress in developing its domestic clean technology industry. However, its impact remains to be seen, as it is yet to be implemented.

When looking at the next generation of clean technologies, the EU has a wide-ranging research policy architecture which supports researchers and cleantech start-ups. The most notable of these is the support through Horizon Europe, as well as the European Institute of Innovation & Technology, European Research Council, and European Innovation Council, among others (Humphreys, 2023b). Fresh support to research and innovation is also expected through the NZIA and its establishment of 'regulatory sandboxes' at MS level. Alongside this EU-level support, there are a range of national programs, such as the German Energy Efficiency and Renewable Energy programme (KFW, 2024) and the French Investments for the Future programme (ADEME, 2021). Indeed, the majority of public finance for R&D comes from these national-level programs, with Member States' contributions (EUR 117 billion in 2022 (Eurostat, 2024g)) greater than comparable EU-level programs (EUR 2.2 billion in 2022 (EC, 2024f)).

Areas of action: The full implementation at MS level of the Net Zero Industry Act should be a priority, as it will address some of the barriers which slow the progress of clean technologies, such as long permitting times. The 'regulatory sandboxes' found in the NZIA can support the accelerated transformation of research excellence into innovative products. However, the lack of a public cleantech investment plan limits the EU's progress in this building block. The private investment landscape for clean technologies still comes with structural weaknesses and could be improved by strategic investment (Detzner et al., 2023). Therefore, proposing an effective answer at the EU level to the question of investment is of crucial importance.

Enabler 1: Fostering research excellence

Indicators:

- Index of Eco-Innovation related publications
- Public funds for environmental and energy R&D

Past progress: Progress on maintaining EU research excellence in the clean technology sphere remained robust over the period assessed but is threatened by a lack of finance. Although eco-innovation patent activity was down, the European clean technology research environment remained active. Europe's progress on publication of research activity was on track, with a spike in activity observable in the most recent datapoint of 2022 (increasing almost 17% year-on-year). However, while researchers continue to push the boundaries of the state of the art, they do so in an environment that is increasingly financially constrained. Public funding allocated to environmental R&D has been assessed as on track, although continues to lag levels seen in the US and China (Matthews, 2024).

Policy context: As discussed, the EU-level public architecture for supporting research and development/innovation is developed and well-financed. Horizon Europe is the most significant of these bodies. It is threatened by cuts, as evidenced during the 2024 mid-term budget negotiations, which saw the fund reduced by EUR 2.1 billion (Zubașcu, 2024). The proposed Strategic Technologies for Europe Platform's (STEP) top-up of EUR 0.5 billion to Horizon Europe (complemented with EUR 2.13 billion of redeployment and use of decommitted amounts) was cancelled in the same negotiations. Beyond the addition of the concept of 'regulatory sandboxes' in the NZIA, there has not been a significant regulatory push to support clean technology innovation with new instruments or programmes.

Areas of action: While the Horizon programme is well-financed, it could be supported with much more capital to have yet a greater impact. To illustrate this, the current programme's predecessor, Horizon 2020, required a further EUR 159 billion to fund all proposals judged 'above the quality threshold' (EC, 2024l). Forthcoming EU debates (expected to begin in earnest 2025) on the successor to Horizon (known as FP10) should foreground the need to increase research funding for clean technologies. In the worst case, current levels should be defended, as evidenced by the recurring phenomenon of redirecting R&D funding to support other priorities.

Enabler 2: Bringing innovation to market using private resources

Indicators:

- Private energy R&I spending
- Early-stage private cleantech investment

Past progress: Bringing cutting edge research ideas in the field of clean technologies to market requires not only public support but the interest and investment of the private sector. Private investment in R&I was progressing far too slowly through 2023, with companies unwilling to take a risk on future innovations with uncertain returns – even with some Member States subsidising such investment (W&K Grant Thornton, 2021). However, once a prototype has left the lab and is being brought to market by a start-up or other small-scale innovator, the financing landscape looked more promising. Private early-stage finance, or 'seed' and 'series A' finance in start-up terminology, was on track, with an inflation adjusted increase of 105% between 2020 and 2023, and an average annual increase of 164% from 2011 on.

Policy context: One of the EU's principal instruments for supporting private sector investment in R&D and early-stage companies, with a focus on the deployment and demonstration of new and/or improved clean technologies, is the EU Innovation Fund. The Innovation Fund disburses grants through regular calls for projects, and its small-scale and medium-scale calls are important resources for crowding in private capital in growing start-ups (Humphreys, 2023b). The EIB's InvestEU and Venture Debt programs are also valuable financial instruments in supporting early-stage projects and de-risking investors. R&I investment is, as already mentioned, covered by a wide range of EU programs, of which Horizon is the largest. The impact of these public programs at catalysing private investment is uncertain. One long-unresolved EU policy debate, which could support the future progress of EU private finance for start-ups and innovators, is the completion of the Capital Markets Union (Demertzis, 2023). By breaking down the barriers making it more difficult for investors to support projects in other Member States, European venture capital could become more available across the EU.

Areas of action: As part of discussions for the next EU Commission mandate in 2024, serious consideration should be given to better financing EU financial instruments which catalyse public investment in R&D and the demonstration of early-stage clean technologies. Increasing the size of the Innovation Fund and completing the Capital Markets Union would be two important policy steps towards this. Attention should also be given to the oft-overlooked field of Innovation Procurement, where government purchases can support the access to market of the next generation of clean technologies (EC, 2024g).

Enabler 3: Increasing clean technology uptake

Indicators:

- Share of green public procurement
- Cleantech scale-up finance
- Battery manufacturing capacity

Past progress: The most significant contribution to European decarbonisation by clean technologies is represented in the manufacturing and deployment of the most mature and market-ready solutions, with progress having been mixed in recent years. Recent data on the manufacturing capacity for the clean technology with the greatest investment needs (EC, 2023w), batteries, show that growth was on track. However, this progress may be at risk as scale-up finance for clean technologies shows signs of reaching a plateau in the period assessed, with scale-up finance for clean technologies slightly declining over the past two years (which is even greater when adjusting for inflation, at 26%). Rising interest rates (Partington, 2023), difficult economic conditions (Marshall, 2023), and the increasing attractiveness of the American market, where clean manufacturing investment had grown 171% a year since the Inflation Reduction Act (Bermel et al., 2023), are all contributing factors to this trend.

Policy context: The continued growth of clean technology manufacturing is dependent largely on continued investment. Yet policy also plays a significant role, whether it be regulation which creates the market conditions and expected demand for clean technologies (demand pull measures) or investments and subsidies which can de-risk and crowd-in private capital (supply push measures). The EU policy architecture is strong in the former case (Fit for 55), weaker in the latter. The NZIA and Critical Raw Materials Act (CRMA), with their EU production targets for clean technology supply chains, is another policy signal to investors. However, without concrete flanking measures to ensure adequate investment, their impact remains to be seen. The NZIA also introduces sustainability and resilience criteria to renewables auctions and public procurement calls, although as currently designed their impact in supporting greener EU cleantech manufacturers is likely to be marginal. However, when it comes to investment, the EU has not followed the example of the US, or, for that matter, of China, Canada, Japan, or South Korea, in using public subsidies to accelerate private investment (Bermel et al., 2023). While investment platforms such as the Innovation Fund or InvestEU are significant sources of public finance at the EU level (Humphreys, 2023b), 2023's proposed STEP fund delivered almost nothing in the way of targeted finance for clean technologies (Simon, 2024), contributing little to bridging the investment deficit (Calipel et al., 2024).

Areas of action: To encourage the use of green public procurement to accelerate clean technology uptake, an ambitious implementation by Member States of the NZIA sustainability and resilience criteria is important. Similarly, ensuring that Member States abide by and have the resources to process permitting claims for factories in line with the NZIA and prioritise efforts to tackle structural skills shortages for these factories, is also a way to tackle the non-price barriers to the further expansion of the cleantech industrial base. Furthermore, an ambitious cleantech investment plan as a priority for the next EC could mobilise new resources at the European level and harmonise governance structures, making financing clear and predictable.