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Tracking the EU Clean Industrialisation Process: A Focus on Batteries and Electric Vehicles

This article uses data from the Bruegel European Clean Tech Tracker to assess Europe's clean industrialisation in batteries and electric vehicles. It documents rapid growth in electric vehicle adoption, substantial investment in European electric vehicle and battery manufacturing, and the emergence of sizeable production capacity across the continent. European electric vehicle assembly capacity now exceeds domestic demand, while battery cell capacity remains below demand and dependent on foreign-owned facilities and imported inputs. Trade data show that the EU is a net exporter of electric vehicles but a net importer of batteries, highlighting both industrial strengths and upstream vulnerabilities. The evidence suggests that stable regulatory frameworks, including the 2035 zero-emission vehicle target, have supported investment, but that demand-side policies, diversified supply chains and proportionate trade measures will be needed to sustain competitiveness and reduce strategic dependencies.

Notwithstanding increasing geopolitical tensions at the global level and mounting pressures on the international climate agenda, the EU is committed to staying the course on the goals of the European Green Deal. But with a clear condition: that decarbonisation should not foster Europe's deindustrialisation but, on the contrary, should promote its industrial transformation.¹

In line with the Draghi report recommendations, the EU institutional cycle that began in 2024 is centred around the Clean Industrial Deal, an initiative aimed at facilitating the

clean transformation of Europe's established industries as well as the rise of new clean tech industries across the continent. All of this is combined with the central aim of marrying EU decarbonisation with economic competitiveness. The stakes are high: Europe's green strategy has been premised on green growth and new green jobs, so its political sustainability could be jeopardised if decarbonisation occurs alongside relative deindustrialisation.

As the Clean Industrial Deal is being implemented, it is key to monitor and report on progress over the next years. But Europe has traditionally had a major problem in this space, as it continues to lack comprehensive, coherent and timely data on industrial decarbonisation and clean tech manufacturing developments (McWilliams et al., 2025).

The lack of reliable information in this space represents a key vulnerability for political support for Europe's green transition, as the public debate could become focused on anecdotal negative cases amplified ad hoc to weaken support for climate policy. Instead, a more comprehensive illustration of the ongoing trends might tell a positive story about new opportunities arising from these developments across different regions in Europe.

With the objective of contributing to filling this important gap, Bruegel – the Brussels-based economic think-tank – launched the European Clean Tech Tracker (Bruegel, 2025), an open-access data platform aimed at providing a timely and policy-relevant overview of the main deployment, manufacturing, investment, employment and trade trends characterising the core clean technologies under-

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pinning Europe's green transition. This initiative is continually updated and also serves as a basis for a joint effort with the Rhodium Group to compare clean industrial trends in Europe, the United States and China (Delgado et al., 2024).

Building on the data in the Bruegel European Clean Tech Tracker, this article provides a concise illustration of Europe's main trends in what possibly represents the most important clean tech manufacturing sector: batteries and electric vehicles.

Road transport is the laggard of Europe's electrification, but electric vehicle adoption accelerates fast

It is often said that when it comes to energy, the future is electric. And this is correct: the energy transition mainly is an electrification story, with clean sources such as renewables and nuclear being the main drivers of the transformation. In this space, the EU has both good and bad news.

The good news is that the electricity system is decarbonising rapidly. In 2024, 71% of EU power generation came from clean sources: 24% nuclear, 17% wind, 13% hydro, 11% solar and 6% bioenergy. A decade earlier, the figure was 58%.

Solar power generation increased by 180 terawatt-hours (TWh), boosting its share of total electricity generation to 11% in 2024 from 4% in 2019. Hungary, Lithuania, Spain and Cyprus had the largest gains in solar's share of generation. Solar now provides over 20% of electricity in Hungary, Luxembourg, Greece and Spain.

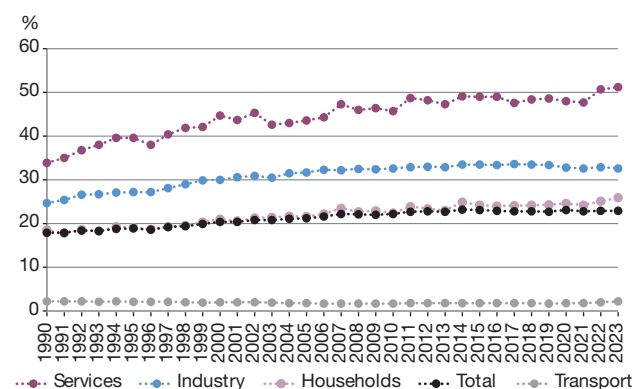
Wind power output grew by over 100 TWh, making wind responsible for 17% of EU electricity in 2024, up from 13% in 2019. The Netherlands, Finland, Sweden and Estonia had the largest gains in wind's share of generation. Wind now accounts for more than half of electricity generation in Denmark, 45% in Lithuania, 37% in Ireland and 30% in Portugal.

Nuclear generation has remained stable. Only Slovakia, Czechia, Finland, Bulgaria and Romania have slightly increased the share of nuclear generation over the last five years. France remains the nuclear leader at 68% of its electricity mix, followed by 62% in Slovakia and over 40% in Hungary, Bulgaria, Belgium and Czechia.

Meanwhile, over the last five years, coal declined by 180 TWh and gas by 140 TWh.

The bad news is that this remarkable transformation of the EU electricity generation mix has not yet been matched

Figure 1
EU share of electricity in final energy consumption by sector



Source: Bruegel European Clean Tech Tracker.

with a significant increase in the EU electrification rate (i.e. the share of electricity in final energy consumption). This indicator has stagnated at around 23% since 2010. While this trend is aligned with the situation in the US, it must be noted that over the same period, China has managed to increase its electrification rate from 13% to 29%.

The EU's lack of progress in electrification represents a key bottleneck in the energy transition process. To give a sense of the challenge here, recall that according to the European Commission's 2040 Communication Impact Assessment, reaching EU climate targets requires the electrification rate to hit 51% by 2030 and 62% by 2050 (European Commission, 2024).

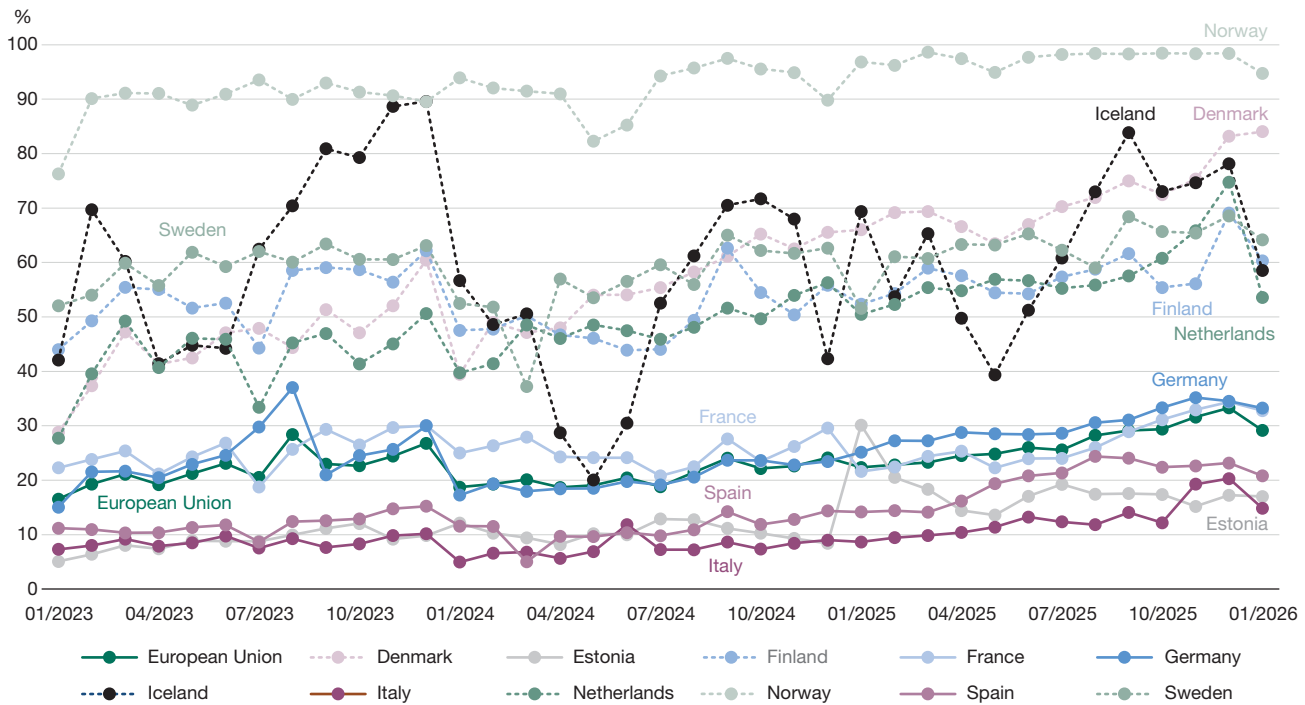
To understand the EU's stagnant electrification trend, it is necessary to unpack it at the sectorial level (see Figure 1). Since 1990, services have electrified steadily, reaching a 51% electrification rate today. Albeit slower, the households and industry sectors have also slowly electrified, reaching a rate of 26% and 33%, respectively.

On the contrary, the transport sector has been slow to electrify. As shown in Figure 1, the overall electrification rate of the sector stands at 2%, with nearly all of it coming from electrified rail. Road transport, the key segment in the sector, is still dominated by oil, and its electrification rate is today below 1%. This is a major stumbling block in the EU's decarbonisation process, as passenger cars generate more than half of the emissions from the EU transport sector, which accounts for 29% of total EU greenhouse gas emissions (EEA, 2024).

The adoption of electric vehicles (EVs) is the primary means by which the transport sector can electrify. Trans-

Figure 2

Electric vehicle share of total new vehicle registrations among European frontrunners (dash lines) and largest markets (solid lines)



Source: Bruegel European Clean Tech Tracker.

port electrification is slow because EV adoption has been relatively slow across Europe and because there is a large fleet of existing internal combustion engine cars, which takes time to turnover. The EU has passed regulation that has set the target of reaching 100% zero emission vehicles on the roads by 2035, but it will still take many years after this for the fossil stock to be fully depleted.

Part of the reason for slow EV adoption is that European manufacturers have struggled with cost competitiveness. Few European EV models sell below €30,000 and the average remains above €50,000. High upfront costs, inadequate charging infrastructure and an uneven rollout across EU countries hold back adoption, especially by middle- and lower-income households. The EU has also imposed tariffs on pure battery electric vehicles imported from China, the source of the cheapest EVs in the world. This is done to support European manufacturers but has the consequence of reducing the availability of affordable models to domestic consumers.

Slowly but surely, EV adoption is, however, accelerating across Europe. A record number of EVs was registered in Europe in 2025, helped by the growing availability of

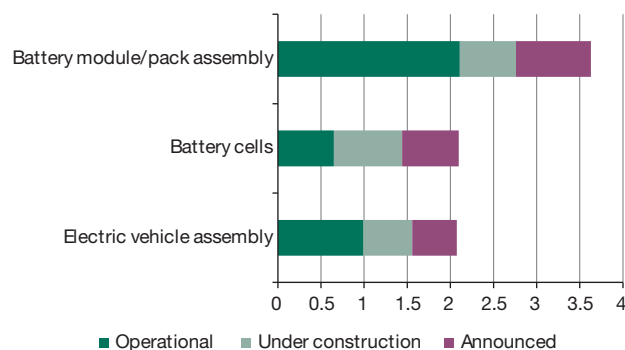
affordable models. By the end of 2025, EVs are consistently representing one quarter of new car registrations monthly. Frontrunners include Norway, Iceland, Denmark, Sweden, Finland and the Netherlands. Each one of these countries has shown steady EV growth over the past two years and today have EV shares above 55% (Figure 2).

The four largest markets – France, Italy, Germany and Spain – account for two-thirds of vehicles sold across the EU. Progress in these four will be crucial for determining overall EU progress. In each, adoption has accelerated since the end of 2024 (Figure 2). Germany has returned as a growth market following the abrupt cancellation of EV consumer purchase subsidies at the end of 2023. While EV shares in Italy are growing, they remain slow and off the necessary progress for meeting the 2035 zero emission regulation.

Capacities: Europe's growing ecosystem for electric vehicle manufacturing

As the deployments of EVs continue to accelerate across Europe, the manufacturing side of the story is increasingly under the policy spotlight. The automotive industry

Figure 3
European manufacturing capacity relative to demand

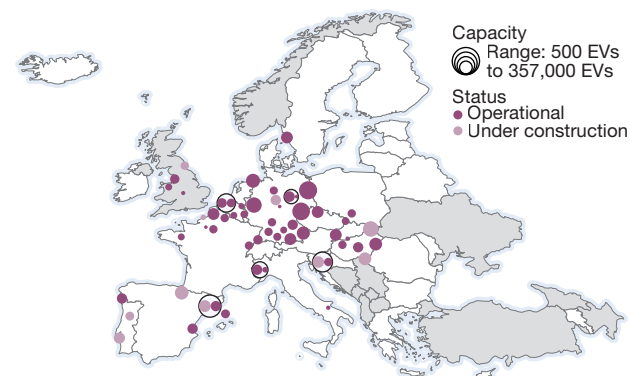


Source: Bruegel European Clean Tech Tracker.

is a structurally important segment of the EU's economy, and retaining a competitive manufacturing basis in Europe during the transformation from internal combustion engine (ICE) cars to EVs is a top political priority at both national and EU levels. Unsurprisingly so: the automotive sector is a major employer, directly and indirectly providing jobs for 13.8 million Europeans, representing around 6% of total EU employment. Around 2.6 million people work directly in the manufacturing of motor vehicles, which is 8.5% of the EU's manufacturing employment (Draghi, 2024). The automotive industry contributes 8% of European manufacturing value added, and it has a €117 billion surplus in (extra-EU) trade, which corresponds to approximately one-fifth of the value of automotive production. The sector is also an important source of input demand from upstream industries, such as metals, chemicals, plastics and textiles, and it generates demand in downstream sectors, including ICT, repair and mobility services (Draghi, 2024; Letta, 2024). In short, it plays a central role in the European economy, therefore ensuring that Europe becoming a leader in EV manufacturing is a core proposition of the Clean Industrial Deal.

Companies have invested over €30 billion into European plants for the assembly of electric vehicles since 2017. This has been encouraged by the demand certainty created by the EU's 2035 zero emission regulation. Consequently, European facilities today have the capacity to assemble more than 4.5 million vehicles annually. This is substantially larger than domestic demand, which is closer to 2.5 million vehicles annually; indeed, capacity is approximately double domestic demand (Figure 3). It is also larger than capacity in the US. Growing competition from Chinese imports and the drop in exports to the US fol-

Figure 4
Electric vehicle manufacturing capacity by facility status



Source: Bruegel European Clean Tech Tracker.

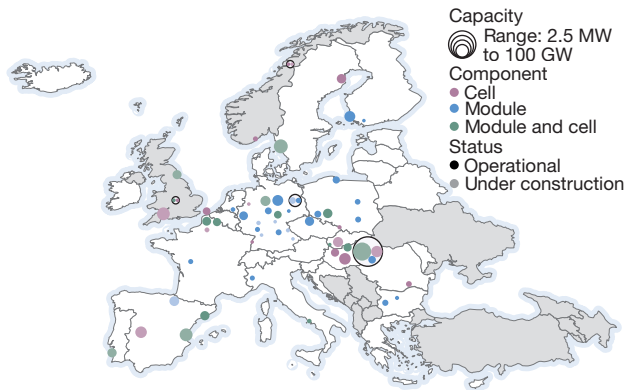
lowing the imposition of additional tariffs underscore the large capacity relative to demand.

Figure 4 displays all electric vehicle sites – either operational or under construction as tracked by the European Clean Tech Tracker. Germany has by far the largest capacity at over two million EVs annually. This includes the greenfield facility constructed by Tesla near Berlin as well as retrofitted facilities from Volkswagen, BMW and Mercedes Benz. France and Spain also have substantial capacity, both greater than 400,000 EVs annually. Additional notable facilities under construction include a Volvo facility in Slovakia (250,000 capacity), a Volkswagen retrofit in Navarre, Spain (180,000) and a new BYD facility in Hungary (150,000).

A similar volume of investment since 2017, again over €30 billion, has delivered a healthy ecosystem for manufacturing battery cells and modules in Europe. As of 2025, European facilities have the capacity to manufacture around 250 GWh battery cells, which is close to two-thirds of domestic demand (Figure 3). Poland and Hungary are the most relevant battery manufacturers of Europe, both with over 80 GWh capacity (Figure 5). These existing facilities are largely owned by South Korean companies, with LG Energy, SK Innovation and Samsung SDI early leaders in lithium-ion technologies (Figure 6). As Korean investment has slowed, a wave of Chinese battery investment is arriving. The largest is the potential €7.3 billion investment by CATL to construct a 100 GWh facility in Debrecen, Hungary. Eve Energy is another notable investor.

The EU has tried to develop home-grown battery champions. The company Northvolt is an infamous example that

Figure 5
Battery manufacturing capacity by facility status



Source: Bruegel European Clean Tech Tracker.

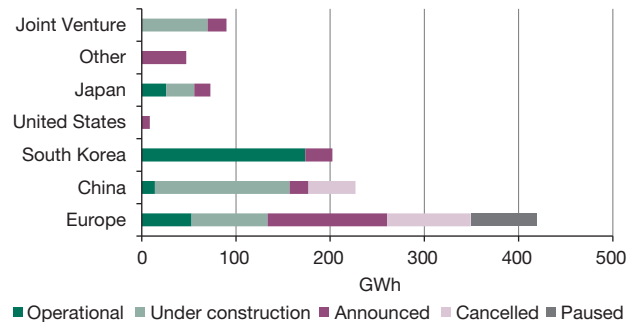
eventually declared bankruptcy. Its landmark €4 billion investment in Skellefteå (Sweden), launched in late 2018, received unprecedented public support. The company secured a US \$5 billion loan backed by both the European and Nordic Investment Banks alongside commercial lenders to expand the site, which remains the largest green loan ever raised in Europe (Northvolt, 2024). Despite financial difficulties, the Skellefteå plant did begin operations and is currently being sold to the US firm Lyten (Business Wire, 2025).

France is home to the other two operational battery cell facilities of European company origin. Verkor operates an 8 GWh facility in Dunkirk, while the Automotive Cells Company joint venture runs a 13 GWh plant in Douvrin. Further projects are under construction by PowerCo (Volkswagen) and Volvo, with the latter currently searching for a new partner to complete its Gothenburg (Sweden) facility following Northvolt's collapse.

Investments: Deconstructing €72 billion since 2017

Since January 2017, we estimate that companies have invested €38 billion into European battery manufacturing facilities and a further €34 billion into electric vehicle facilities. The European Clean Tech Tracker (see Box 1) tracks 293 individual investments made into 214 European facilities. Battery manufacturing investments have grown steadily over time, from less than €300 million quarterly in 2017 to over €2 billion quarterly by 2025 (Figure 7). Electric vehicle investments have also grown over time. A spike in real investments is noted over the period 2020 to 2022, which was driven by Tesla's large investment at Grünheide.

Figure 6
Battery cell capacity, by status and owner headquarters in GWh



Source: Bruegel European Clean Tech Tracker.

Across both battery and EVs, annual investment has grown from around €1 billion in 2017 to over €10 billion by 2024. European EV investment has matched US levels without matching subsidies, demonstrating that regulatory certainty (the 2035 ban on internal combustion engine

Box 1 Investments in the European Clean Tech Tracker

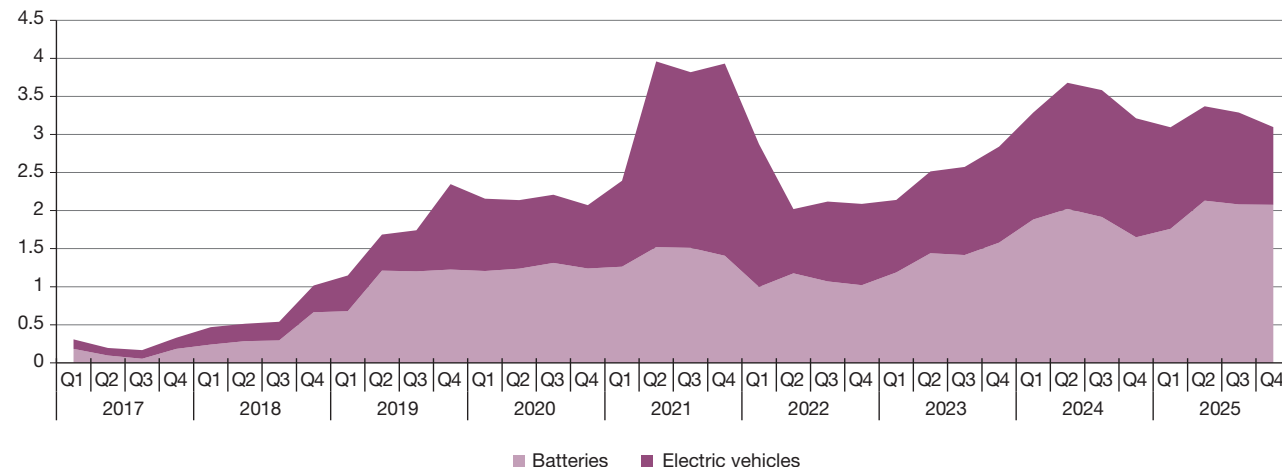
Part of the European Clean Tech Tracker is an initiative to track and establish a database of clean technology manufacturing investments.

Investments cover both new facilities and the expansion or conversion of existing sites, especially relevant for electric vehicle assembly lines. Investments are tracked from when they are first publicly announced, through when final investment decisions are made or construction begins to when projects are completed or, occasionally, are cancelled.

The database is constructed by transforming text data contained in company press releases and news reports into a knowledge graph framework. The transformation is assisted by several fine-tuned instances of the gpt-4o-mini model. Specifically, the models provide a first pass over text data and a v0 version of the database. The result is a collection of project timelines describing key investment events linked to primary text sources, which we then verify.

Figure 7
Real quarterly European manufacturing investments

in billion euros



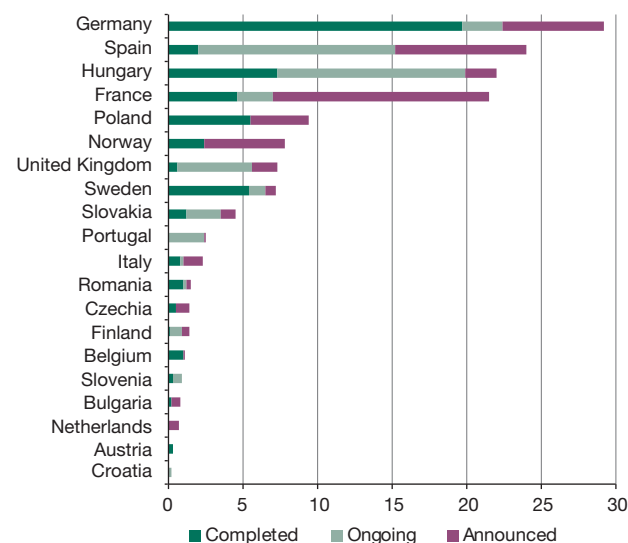
Source: Bruegel European Clean Tech Tracker.

(ICE) vehicles, CO₂ standards) can substitute for direct subsidies.² The contrast is stark with US battery investment, which surged after Inflation Reduction Act subsidies but now faces Trump-era uncertainty. This validates Europe's regulatory approach: stable frameworks outlast volatile subsidies. Germany was an important destination for early investments. As of 2025, Hungary and Spain are

2 <https://www.bruegel.org/analysis/transatlantic-clean-investment-monitor-4-electric-vehicles>

Figure 8
Investment in batteries, electric vehicles and solar manufacturing by country

in billion euros



Source: Bruegel European Clean Tech Tracker.

the two European hotspots for ongoing manufacturing investments (Figure 8).

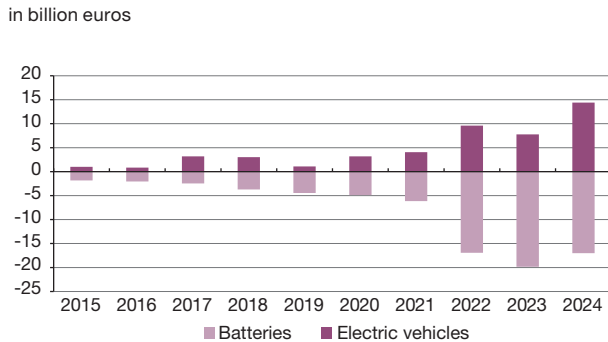
Trade: Electric vehicle export success supported by battery imports

In 2024, the EU exported €38 billion in EVs while importing €24 billion, yielding a €14 billion surplus. The EU imported €28 billion in batteries and exported €11 billion, leading to a €17 billion deficit (Figure 9). Since 2021, a trend towards net exports of EVs and imports of batteries has been noted. This resonates with capacities in the EU, with an overcapacity for manufacturing EVs relative to domestic demand while battery manufacturing capacity is two-thirds of demand. For EV exports, major destinations include the United States, the United Kingdom and Norway. Most battery imports come from China.

Across all clean technologies, the EU exported more than €80 billion value in 2024. The bloc benefits from open trade both for maintaining these exports and for imports that facilitate value added further along value chains. The import of batteries to produce electric vehicles is a prime example. The pattern across clean technologies is consistent: Europe excels at deployment and system integration, maintains competitive positions in higher value-added products, but depends heavily on external suppliers for critical components and earlier supply chain stages. The strategic question is not whether to trade, but how to reduce critical dependencies while maintaining the openness that enables European firms to compete globally.

The continued export of electric vehicles from Europe is threatened by the withdrawal of the US as a reliable trad-

Figure 9
EU net exports of batteries and electric vehicles globally
 in billion euros



Source: Bruegel European Clean Tech Tracker.

ing partner. The UK and US have together been the two most important partners for taking EU exports. President Trump's narrative since taking office and the eventual imposition of tariffs have coincided with a reduction of EV exports to the US. Exports to the US have fallen from consistently over €1 billion monthly between 2023 and mid-2025 to around €200 million in recent months.

Policy insight

This article has illustrated that when it comes to EVs and battery manufacturing, things are moving fast in Europe. Tens of billions of euros have been invested in manufacturing facilities, with additional tens of billions awaiting final investment decisions. To enable these investments, it is of paramount importance to ensure stable framework conditions – starting with clear climate policy goals and sectorial targets. The recent adoption of the new 2040 climate target is very welcome in this regard. It is now important to avoid weakening key provisions that have been driving investment in the sector, starting with the 2035 ICE ban. Clean tech manufacturing investments require confidence spanning decades. Europe's advantage lies in predictability. The US has demonstrated both the benefits of strong policy and the risks of volatility. Europe should offer what America cannot: stable, long-term frameworks resistant to electoral cycles.

Europe's annual manufacturing capacity of four million EVs and its status of a net exporter of EVs demonstrate that the continent can deploy clean technologies at scale. But more needs to be done now. Demand-side policies must match supply-side subsidies. Regulatory frameworks must provide stability, matching their stringency. Trade policies must use partnerships to secure supplies while keeping European firms competitive. Regional strat-

egies must embrace industrial restructuring towards areas with energy cost advantages.

For a continent long dependent on imported fossil fuels, clean industrialisation offers the most credible path to jobs, competitive companies and rising living standards. The Clean Industrial Deal has identified the right priorities (McWilliams & Tagliapietra, 2025). What Europe needs now is rapid implementation. While fostering its manufacturing capacities, Europe must address critical dependencies where single suppliers dominate. And the solution to this is strategic partnerships and diversification, rather than protectionism. Trade defense measures, when necessary, should be deployed, but proportionally. Incoming foreign direct investment in EVs and battery manufacturing can be made conditional on employment standards, cybersecurity, local value creation and technology transfer – and this conditionality can be first applied while providing national and EU subsidies to these manufacturing projects.

Ultimately, Europe finds itself at a decisive moment. The fundamentals are strong: a world-class industrial base, proven capacity to scale clean technologies, and a regulatory environment that, when consistent, creates powerful incentives for innovation. But the window of opportunity is narrowing. If Europe wants to lead in the next industrial age, it must turn strategy into action at the pace of its competitors. The choice is not between openness and autonomy, but between shaping global markets and adapting to rules set by others. A confident, outward-looking Clean Industrial Deal – anchored in stability, partnership and fair competition – is Europe's best chance to secure prosperity and climate leadership for the decades ahead.

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