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Building the EU's Clean Industrial Future: Unlocking Investment through Lead Markets

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This report was prepared by the Industrial Transition Accelerator secretariat and E3G.

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Executive summary

Decarbonising heavy industry sectors, especially ammonia, aluminium, cement, and steel, is critical to meet the EU's proposed 90% net Greenhouse Gas (GHG) emissions reduction target by 2040, and climate neutrality by 2050. It is also a strategic economic imperative, supplying critical inputs to downstream sectors. Reducing their exposure to volatile fossil fuel markets by accelerating their transition will be vital to safeguarding Europe's industrial resilience, competitiveness and long-term prosperity. Our calculations suggest that **the EU's pipeline of commercial scale deep decarbonisation projects[A] in these sectors represents a €100bn investment opportunity.**

Yet progress is lagging: in these sectors, only two commercial-scale deep decarbonisation projects in the EU reached Final Investment Decision (FID) since 2024[01].

A major barrier to delivering clean industrial projects is the absence of robust markets for clean industrial products.02 Uptake remains limited, despite a relatively small impact on prices of end products from using clean materials and chemicals – for many products around 1% or less for a complete shift to using clean commodities. Pioneering companies have made voluntary commitments to procure green materials, but this voluntary demand on its own is not enough to catalyse large-scale investment and realise the EU's pipeline of projects. Without secure demand, projects struggle to secure long-term offtake agreements and remain bankable.

Following the Draghi report, the European Commission (EC) has set out the **Clean Industrial Deal (CID)**, a joint roadmap for competitiveness and decarbonisation. As part of this,[03] the CID targets lead markets to help scale up investments in clean commodity production, with a goal of driving economies of scale, reducing costs and making sustainable alternatives more accessible.

This study explores six possible lead markets for four key industrial commodities: clean ammonia, aluminium, cement and steel, and identifies policy instruments that can trigger uptake in these lead markets. Of the studied markets, four large end-use sectors stand out for their potential to generate significant demand with limited impact on final product costs. These are:

- **Automotive** (aluminium and primary steel),
- **Buildings** (cement and steel),
- **Infrastructure** (cement and steel) and
- **Fertilisers** (ammonia).

Other sectors like **renewables** and **defence** are too small (below 10% and 1% respectively as share of the EU clean production pipeline of the studied commodities) to create demand at scale, but may serve strategic roles. Public spending and security needs in these sectors could be leveraged to foster early demand, test standards, and build secure, homegrown value chains independent of volatile fossil inputs.

The EU's plans to activate public procurement and voluntary labelling for clean commodities is an important step forward, but on its own, it will not be sufficient to scale lead markets across all of these commodities. In cement and secondary steel making, public procurement could play a particularly significant role given the high share of government demand, but only if requirements are made sufficiently stringent and ambitious. Sector-specific policies are needed to unlock demand at scale across a broader range of sectors, such as:

- **Product mandates** where demand from the private sector is high (e.g. automotive and fertilisers).
- **Targeted subsidies** where managing the green premium could have social impacts (e.g. fertilisers/food), playing different roles along value chains.

A. Note this estimate includes ammonia, cement and only primary production of steel and aluminium (i.e. it excludes recycling plants)

- **Measures to mitigate competitive risks** where downstream products are exposed to international competition, such as local content requirements or ensuring equivalent standards are applied to imports.
- **Public procurement,** which is most effective where government works represents a high share of overall demand (e.g. construction, defence).
- **Voluntary labels** can also play a underpinning role by helping differentiate clean products and build consumer and market awareness, but they are unlikely to create demand at scale without binding requirements or economic incentives.

Successful lead market policies need to be ambitious but realistic. Ambitious in this context means incentivising enough demand to trigger investment at scale, while realistic means calibrating targets to the feasible pace at which clean production can ramp up. In practice, this could involve targeting a small share of demand at ambitious performance levels (e.g. near-zero emissions), while simultaneously applying progressively more stringent low-emission thresholds across a larger share of demand. The volume of demand that policies seek to unlock might also be ramped up gradually, providing industry players with long term visibility, but also ensuring industry has time to adjust. Lead market policies should be seen as part of a broader policy mix: as carbon prices rise and clean technologies mature, production costs will fall and the cost gap with conventional products will narrow. Over time, this means lead market provisions will become less central, and in some cases may no longer be needed, to sustain demand for clean production.

A balanced approach to strategic autonomy and competitiveness is crucial. The Clean Industrial Deal seeks to build demand for both clean and locally produced commodities. However, EU production will not always be the most cost-competitive option. For example, for electricity intensive commodities, strategic imports from renewable-rich[2] emerging economies (e.g., Brazil, India, and the MENA region) may be more cost effective than domestic production. Policymakers will need to balance strategic autonomy, cost advantage and supply chain resilience. Even within the EU, production costs vary significantly depending on access to cheap renewables, which makes location-based sourcing important. Encouraging production of the most energy-intensive commodities in European areas with abundant low cost renewables (e.g. Scandinavia or Iberia) can help reduce costs and enhance competitiveness of downstream producers. Local content requirements can also be applied to support domestic industries in order to maintain strategic autonomy.

Critically, maintaining fossil-based production is not a viable path to competitiveness. EU fossil production is already more expensive than global averages, and fossil energy costs remain high. The strategic opportunity lies in reducing fossil dependence and creating strong demand signals for clean products backed by supportive policy.

The success of lead market instruments in Europe will ultimately hinge on the EU's ability to combine climate ambition with political and economic realities. This means targeting sectors with high impact and high transition urgency, building public support through fair cost distribution, and aligning policy levers across trade, industrial, and regional policy. A smart, targeted and balanced set of instruments aligned with industry needs and climate targets is key to unlocking progress. The upcoming proposal for an Industrial Accelerator Act, to support, among other objectives, the creation of lead markets presents an opportunity for the EU to set out a robust lead market strategy. It should introduce clear and predictable demand-side measures that go beyond voluntary action, as outlined in this report, to unlock public and private demand for clean industrial products at scale. This is essential for Europe to secure investment and safeguard its competitiveness and security.

B. While access to low-cost renewables is a key factor, other advantages also matter, such as proximity to cost-effective CO_2 storage sites (e.g., for clean cement production) or access to high-quality raw materials (e.g., iron ore).

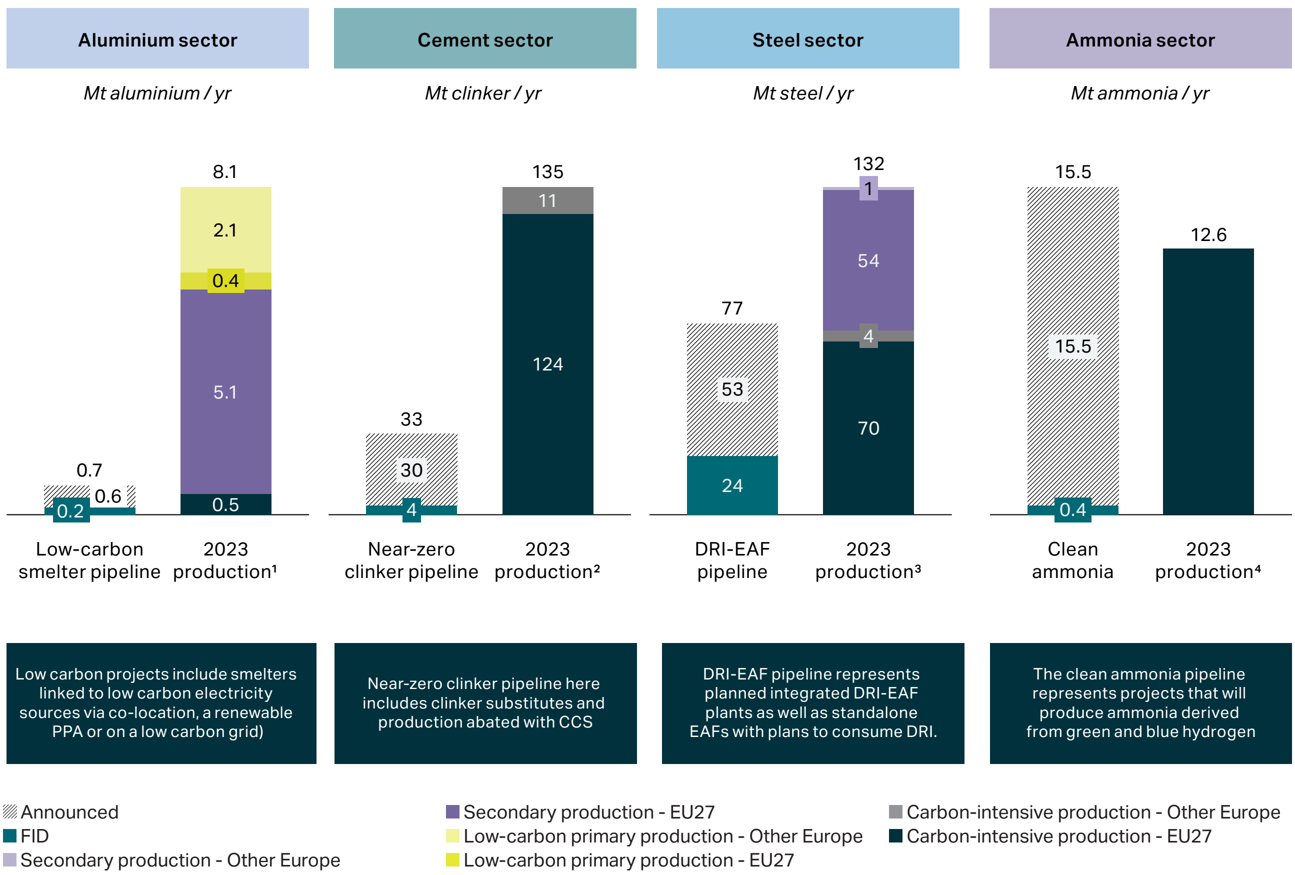
Introduction

Decarbonising heavy industry is not only essential to meet the EU's climate targets – it is also a strategic economic imperative. The EU base metals, cement and chemicals sectors are responsible for around 15% of total EU GHG emissions and are among the most challenging to decarbonise [04], due to high process emissions, energy intensity [05], and reliance on nascent technologies to eliminate the most emissions intensive steps in production. **Yet, these sectors also form the backbone of Europe's economy,** supplying critical inputs to downstream sectors. Reducing their exposure to volatile fossil fuel markets by accelerating their transition will be vital to safeguarding Europe's industrial resilience, competitiveness and long-term prosperity. Achieving the EU's emissions reduction target of 90% by 2040 and climate neutrality by 2050 will not be possible without a rapid transformation of these sectors [06].

The EU's pipeline of deep decarbonisation projects in heavy industry – spanning ammonia, cement, and primary aluminium and steel production – represents a close to €100bn investment opportunity, according to our calculations. Yet momentum is stalling: since 2024, only two deep decarbonisation projects in the EU reached Final Investment Decision (FID), the critical go-ahead for construction [07].

Figure 1

EU and EEA+UK pipeline of announced and past FID clean aluminium, cement, steel and ammonia projects compared to 2022/2023 total production capacities[C]



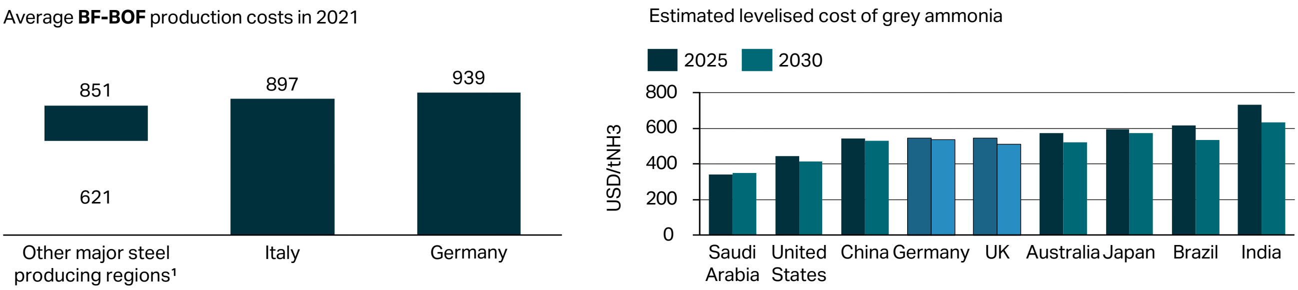
Sources: 2023 production figures are based on the following sources: **1.** Aluminium: USGS (2024), European Aluminium. **2.** Cement: CEMBUREAU (2025). **3.** World Steel (2024), Eurofer (2024), Bureau of International Recycling (2024). **4.** MPP calculation based on EU Hydrogen Observatory (2024). **Note** – all pipeline figures above include EU + EEA + UK. Tracking based on aggregation of publicly announced options and MPP analysis.

C. While most of the techno-economic analysis presented in this report focuses on technologies addressing the most emissions-intensive steps of production that could enable deep emissions reductions (e.g. low-carbon electricity for aluminium smelting, CCS for clinker production in cement, and green hydrogen-based steel or ammonia), the report also maps other mitigation options such as secondary production, clinker substitution, and blue hydrogen. Most lead market instruments discussed in this report are technology-agnostic and can support alternative pathways where these meet lead market criteria such as embodied carbon limits or green public procurement provisions

EU industry faces rising global competition, geopolitical tensions and persistently high energy costs. Global markets are increasingly flooded with fossil-intensive products with mounting overcapacity challenges in some sectors and regions (particularly steel and cement). **A continued focus on fossil-intensive production routes will be unsustainable not only environmentally, but also financially.** As Figure 2 shows, Europe's current fossil based steel (BF-BOF) and ammonia (via Steam Methane Reforming) production is already more expensive than in regions with cheaper fossil resources, and faces mounting global oversupply. Figure 3 illustrates a similar challenge for aluminium: fossil based production in Europe ranks among the highest cost globally, while hydropowered aluminium remains relatively competitive.

Figure 2

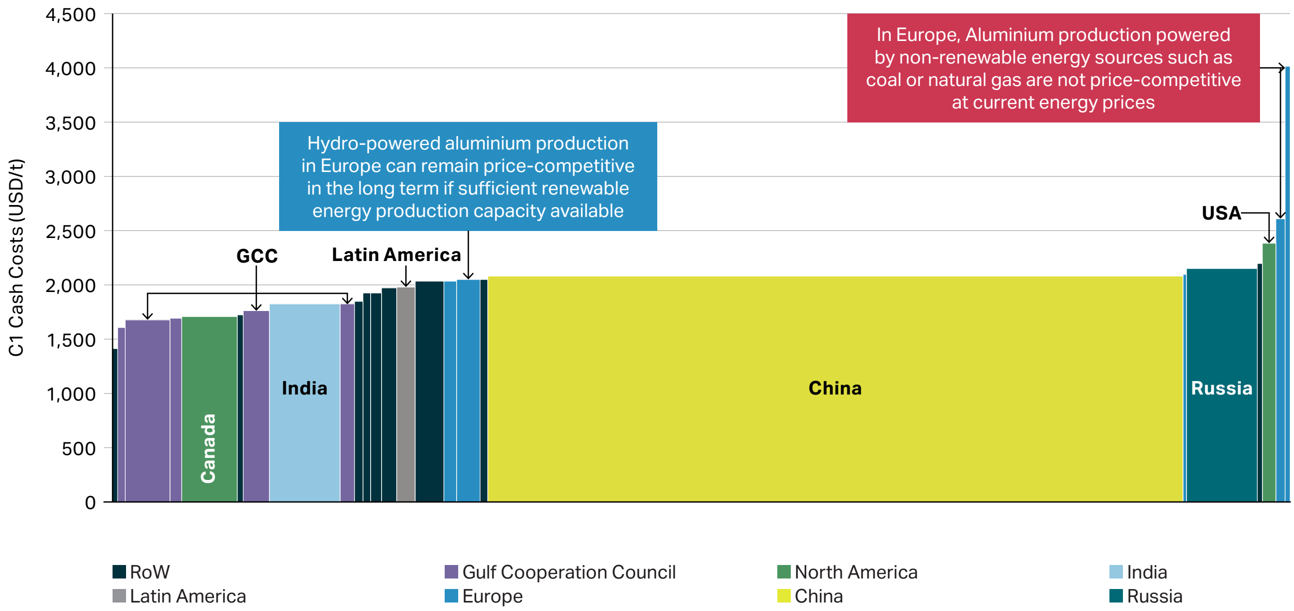
Average production cost of BF-BOF and EAF steel in 2021[14] and estimated levelised cost of grey ammonia (mid-range)[15]



Source: TransitionZero (2022) – Stranded asset and carbon pricing risks in the steel industry: BloombergNEF (2025) – Ammonia Levelized Cost Outlook 2025; **1.** other steel making regions in range include India, Russia, Brazil, China, Vietnam, Turkey, Ukraine, South Korea, United States, Mexico, Japan

Figure 3

Primary aluminium cost curve (Q1 2023)[16]

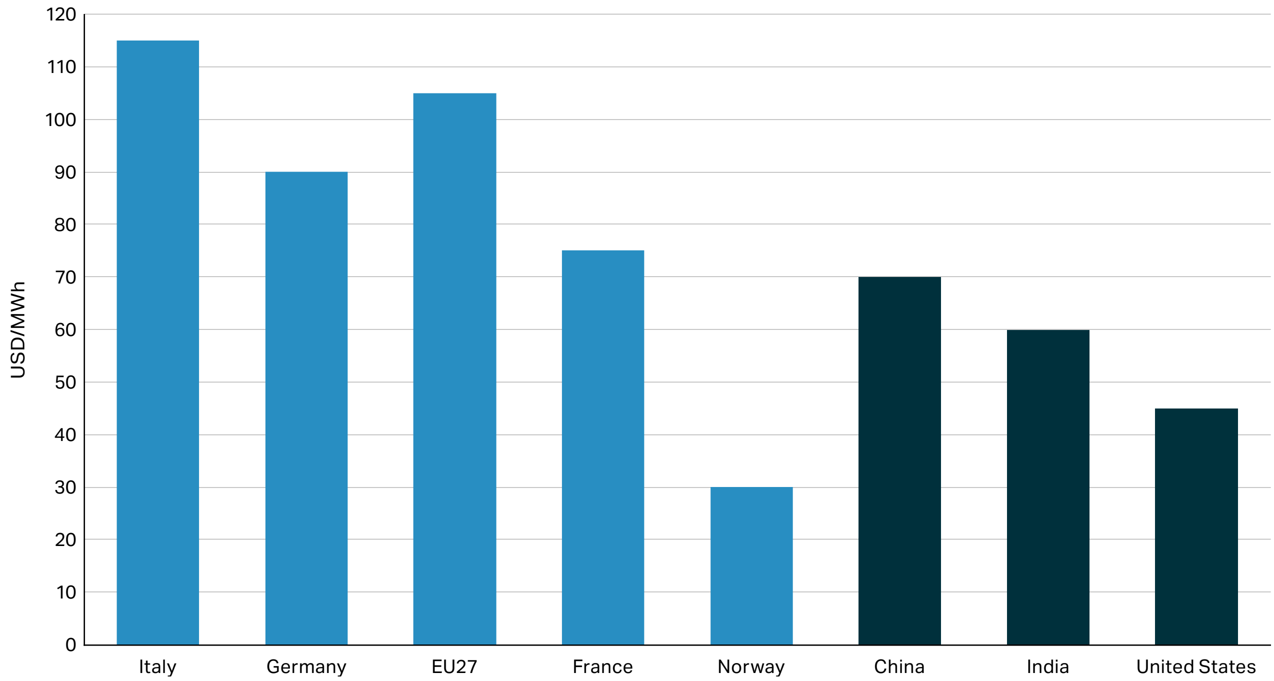


Source: Adapted from ERT (2024): Competitiveness of European Energy-Intensive Industries

The root cause is structural: Europe's energy prices, especially for natural gas and wholesale electricity, are consistently higher than those in China, India, and the United States, with Norway as the notable exception. This cost gap is expected to persist in the short to medium term (Figure 5).

Figure 4

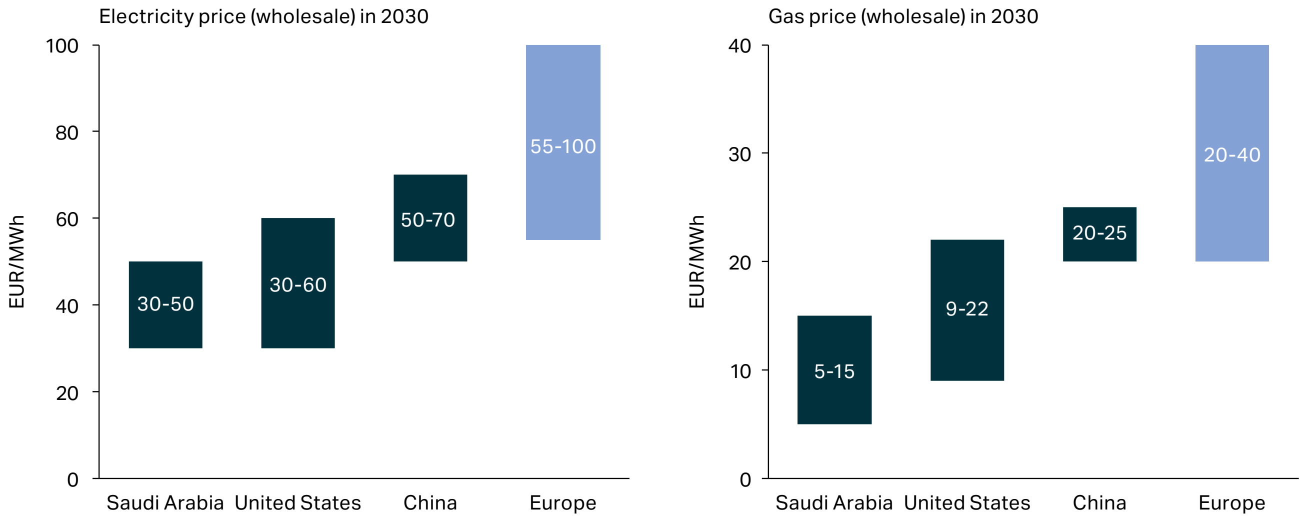
Estimated final electricity price for large industrial customers in energy-intensive industries in 2024[17]



Source: IEA (2025) – Estimated final electricity price for large industrial customers in energy-intensive industries, 2019-2024, IEA, Paris

Figure 5

Electricity and natural gas prices (wholesale) in 2030[18].

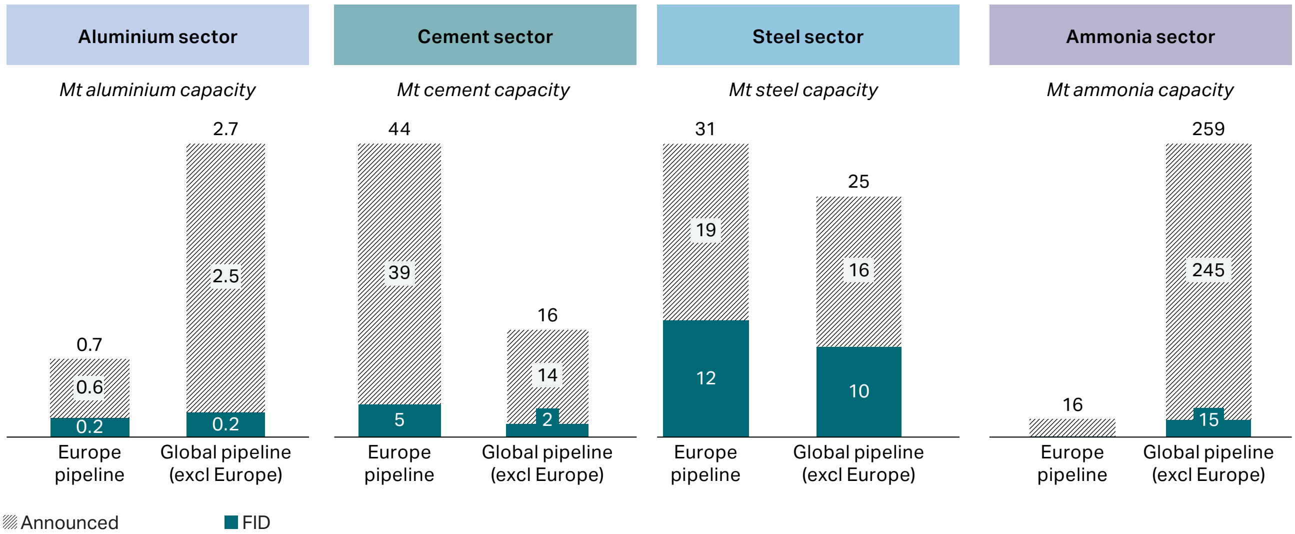


Source: Adapted from ERT (2024): Competitiveness of European Energy-Intensive Industries

At the same time, while Europe's relatively large pipeline of clean projects is stalling, emerging economies are gaining momentum, in many cases thanks to abundant, low-cost clean energy. One-third of all announcements and one-quarter of financed deep decarbonisation projects came from such emerging economies between November 2024 and April 2025.

Figure 6

Comparison of the European and Global clean project pipeline, and global production capacity by commodity[D].



1. In this figure, standalone EAF projects are not included to allow comparison with the latest values of the global pipeline of steel projects, cement production capacity is also shown rather than clinker capacity, so also differs from the previous figure. **Sources:** IRENA: Reaching Zero with Renewables: Aluminium Industry (2025); Global Energy Monitor: Global Cement and Concrete Tracker (2025); Global Energy Monitor: Global Iron and Steel Tracker (2025); Statista: Production capacity of ammonia worldwide from 2018 to 2023 (2024)

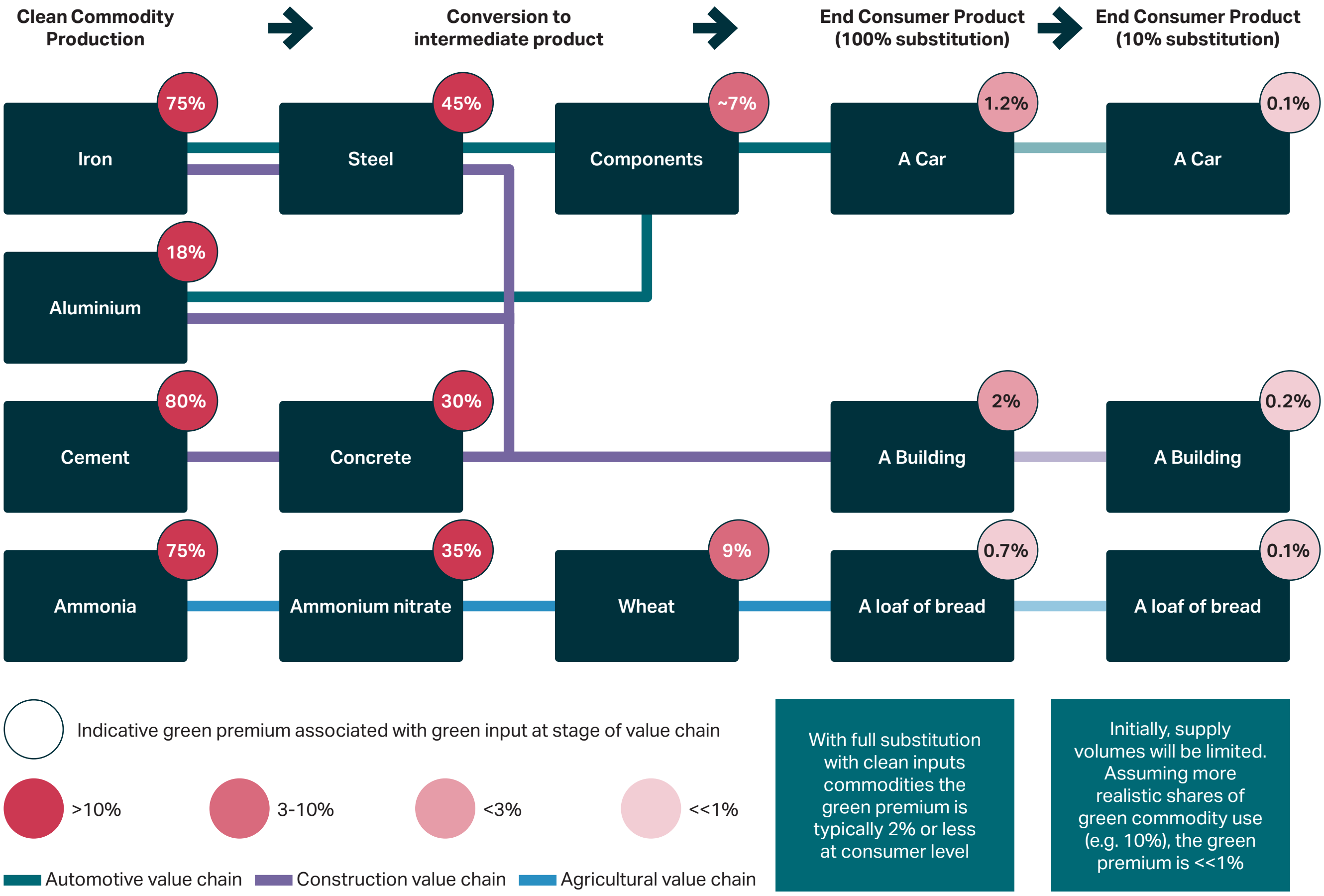
A major barrier to investment in these clean industrial plants is limited premium demand for clean products[08]. Without early demand, producers struggle to secure long-term offtake agreements that provide the revenue certainty needed to finance projects and reach final investment decisions. This challenge was underscored at COP29, where the Industrial Transition Accelerator, together with 50 global business and civil society leaders and a network of more than 700 financial institutions called on governments to introduce policies that create markets for clean commodities and help bridge the green premium[09].

Although green premiums are still high at the commodity production stage, they are progressively diluted along the value chain. This is because the cost of basic commodities is a small component of the end cost of many (though not all) consumer-level products. For many key end-uses, the green premium would be around 1%, even if carbon-intensive commodities are fully substituted with the clean commodities analysed in this paper, as shown in Figure 7. In practice, 100% substitution in these markets is unlikely in the near term, because supply will be limited. Assuming more realistic shares (e.g. 10% substitution), the green premiums at consumer level are well below 1%. Under a realistic design, policymakers can initially target a small share of usage of green commodities (e.g. 10-20%) and gradually ramp up ambition as supply-side technologies mature, supply increases, and costs come down.
By contrast, dependence on fossil fuels has proven

D. As of September 2025, in EU27+EEA+UK, 15 notable FIDs have been taken across the four sectors: Steel - 3 FIDs for DRI-EAF plants, 6 for standalone EAF plants; Cement - 2 FIDs for CCS projects (Heidelberg Brevik and Padeswood CCS), 1 FID for CCU (Cap2U in Lengfurt, Germany); Aluminium - 2 FIDs for primary aluminium (Alcoa San Ciprian smelter restart, extension of Alcoa Mosjøen smelter); Ammonia - 1 FID for CCS retrofit (Yara Northern Light in the Netherlands)

Figure 7

Indicative green premium cascade for clean commodities along automotive, construction and agricultural value chains in 2030, based on commodity production in low cost locations in Europe



Assumes 100% cost pass through, costs are based on productions in low-cost regions of Europe. Upstream costs are based on MPP analysis of data produced by BloombergNEF, MPP and Energy Transitions Commission – full assumptions can be found in the technical annex.

D. In practice, to spread this effect across products an appropriate chain of custody model like a tradeable credit or book and claim system would be needed.

a far greater inflation risk: in 2022, energy prices added around **6 percentage points** to EU headline inflation (roughly 60% of the total), with gas price shocks alone contributing up to **2 points**. The steady, predictable costs of cleaner materials pale next to the volatility of fossil-fuel-driven inflation.

Despite low end-consumer costs, voluntary demand remains limited. While coalitions of buyers willing to absorb the green premium have emerged, such as the First Movers Coalition and the SteelZero and ConcreteZero initiatives, they are still too small to drive economies of scale. These first movers have helped unlock a handful of commercial-scale projects, mostly in Europe, but they are not enough to underpin the broader wave of investment needed. This is mainly due to three factors:

- **Cost-competitiveness down the value chain:** This is the most critical barrier. Users of these commodities and derivatives compete on cost and struggle to purchase green inputs in bulk without a level playing field. This challenge is particularly acute in low-margin segments and those that are exposed to international competition - for example, fertilisers alone account for around 6% of average input costs for EU farmers and up to 12% for arable crop farmers – leaving little room to absorb increased costs. Moreover, most end-consumers do not yet prioritise low embodied carbon in purchase decisions. As a result, companies struggle to pass costs down the value chain.

- **Need for long-term off-take agreements:** Developers of deep decarbonisation projects need long-term offtake agreements (10+ years) to make their projects bankable, as financiers look for predictable revenue streams [10]. However, buyers of the resulting products often prefer shorter contracts to retain flexibility, especially in industries where future costs and technology pathways remain uncertain.
- **Fragmented and underdeveloped product standards:** Labels demonstrating the emissions embodied in products are still emerging and vary widely between regions and actors, and in some cases overlap or conflict. This fragmentation makes it challenging to demonstrate sustainability along the value chain and build trust in markets that products are genuinely clean.

Therefore, stronger policy intervention is needed to scale demand. The European Commission has recognised this need through the Clean Industrial Deal, which aims to decarbonise industry while strengthening EU competitiveness. In the short term, the announced EU Industrial Accelerator Act offers a valuable opportunity to put such demand-creation measures in place, helping align early market signals with the scale-up of clean production capacity and innovative technologies.

One of the central pillars of the Clean Industrial Deal is the creation of lead markets for green commodities[E].

Lead markets for clean commodities are downstream applications or sectors that are well positioned to adopt low-carbon versions of bulk commodities such as aluminium, cement, ammonia, and steel. These markets play a catalytic role by enabling early demand, driving investment and accelerating cost reduction through scale. The following criteria are used in this study to explore what could make an advantageous lead market:

- **Demand Share:** The application represents a substantial share of total commodity demand, sufficient to influence supply-side investment decisions and enable economies of scale.
- **Green Premium Impact:** The sector should be able to absorb or pass on the cost premium of green materials, typically through a low percentage increase in end-product cost (e.g., <1–3%), without significantly affecting market competitiveness or consumer demand.
- **Competitive Exposure:** Lead markets should ideally face limited exposure to international price competition or be protected by enabling policies (e.g. border adjustments or measures to level the playing field with imports) that reduce the risk of leakage or undercutting by cheaper, high-emission alternatives.

This approach has several advantages:

1. **Lead markets accelerate action beyond the carbon price signal.** In many sectors, Emissions Trading System (ETS) prices are still too low and uncertain to drive investment. Lead markets can be leveraged to send stronger, targeted signals that help first mover projects progress earlier than the current carbon price alone would justify, without increasing costs for the rest of the sector. They are therefore an excellent complement to carbon pricing.
2. **Lead markets drive scale and cost reductions.** By building early demand, they help emerging technologies deploy more quickly and bring down costs through economies of scale and learning effects.

E. Other key aspects include: (1) lowering industrial energy costs by encouraging tax cuts for electricity, streamlining permits for clean energy projects and expanding Power Purchase Agreements (PPAs) and Contracts for Difference (CfDs); (2) mobilising additional funding through a €100bn industrial decarbonisation bank, complemented by national support via state aid; and (3) Clean Trade and Investment Partnerships to secure access to raw materials, clean energy, and technologies from partner countries.

3. **Lead markets create space for clean European production to grow and contribute to strategic autonomy.** In a global market increasingly oversupplied with fossil-based materials, lead markets can give EU producers a protected foothold to scale clean, innovative alternatives and build future competitiveness. However, this outcome is not guaranteed, as it depends on how lead market measures are designed, (e.g. if applied where EU production is cheaper on a cost basis, or if they include made in Europe criteria).

Our analysis shows that automotive, buildings, infrastructure and fertilisers account for a significant share of demand for the upstream commodities explored in this study, making them effective end uses for scaling clean production, as seen in Figure 8. At the same time, smaller sectors like **renewables** and **defence** can play an outsized strategic and political role. Because the public sector can directly influence procurement and tendering procedures, such sectors could be used to test product standards and requirements. Furthermore, supporting domestic, fossil-free production in these sectors contributes to industrial resilience, security of supply, and innovation. Other end-use sectors not covered in this analysis – such as machinery, white goods, and packaging – may also offer additional opportunities to build demand and should not be ruled out.

Figure 8

Studied lead markets assessed against selection criteria

Lead market	Estimated 2030 green premium impact (100% substitution)	Sectoral demand as a share of EU consumption				Downstream sector exposure to competition	Expected EU demand growth trend for final product	Assessment
		NH_3	Alu	Cement	Steel			
Automotive	+1% (car)		37%		17%	High (downstream products i.e. car parts / vehicles are heavily traded)	↗	**Large** market for flat steel and aluminium
Buildings	+2% (indicative building)		18%	55%	24%	Low (downstream products i.e. buildings not traded)	↗	**Large** market, particularly for cement and flat steel products
Infrastructure	+1% (railway)			45%	12%[2]	Low	↗	**Large** market, particularly for cement and long steel products
Nitrogen fertilisers	<1% (loaf of bread)	>70%				High (downstream products e.g. fertilisers and food products are traded)	↘	**Large** market that is exposed to global competition
Renewables	+1.5% (cost of electricity)		<9%[1]		<2.5%	Medium	↗	**Niche** but growing market that help boost future green electricity demand
Defence	<1% (military tank)		<1%		<1%	Medium	↗	**Niche** market where policy-makers place high value on strategic autonomy

2030 Green Premiums are based on estimates from later in this report under low cost sourcing scenarios. Sectoral growth trends are inherently uncertain, and the trends above are indicative. These are based on the following sources: Automotive (growing modestly as of 2024 – based on Euronews (2025): EU new car registrations inch up in 2024 as successful Spain gives figures a boost); Infrastructure/Buildings (based on Filtch Solutions (2025): *Europe Construction Outlook: Moderate Growth Ahead*); Nitrogen fertilisers (based on a reduction of 20% in the use of nitrogen fertilisers by 2030, set out in the EU's Farm to Fork strategy); Defence (European Commission: White Paper for European Defence – Readiness 2030 (2025)); Wind (European Commission (2025): *In focus: Wind Energy Powering The Clean Transition*).

1. Estimate of the volume of aluminium contained in the annual solar capacity installed in the EU as the fraction of total EU aluminium demand. Considering solar capacity addition of 56GW, that solar PV needs 21 t/MW , total aluminium contained in the new solar capacity added in the EU is 1.2 Mt i.e., ~9% of EU aluminium demand. This is probably overestimating the actual direct EU consumption of aluminium for solar manufacturing because EU imports most of solar components (e.g., modules, inverters) in which aluminium is typically already embedded.

2. Note that most infrastructure demand for steel can be met using long products, which typically don't require crude steel, so infrastructure will drive limited demand for primary steel

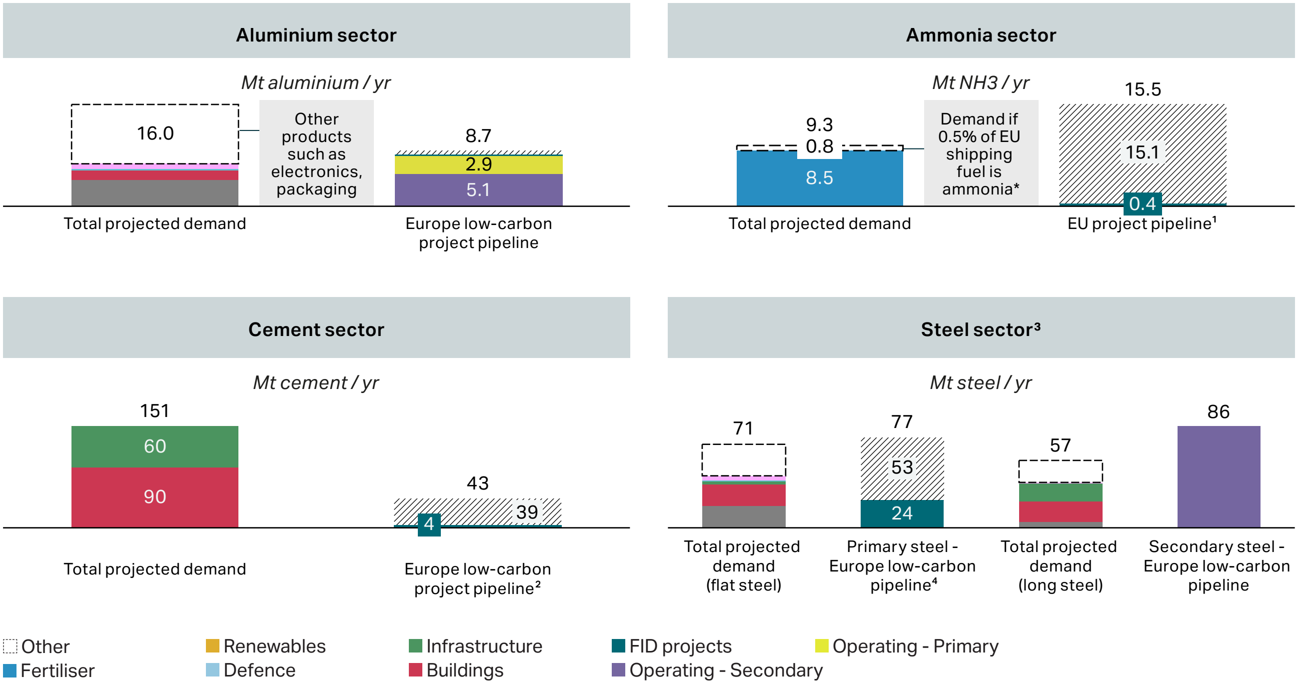
Sources: Agora Industry (2024): Creating markets for climate-friendly basic materials. Potentials and policy options; Fastmarkets (2024); CEMBUREAU (2025)

The level of demand targeted should be calibrated to the supply potential, as shown in Figure 5. For primary steel production, cement and ammonia, the identified markets can unlock a substantial share of the EU pipeline of projects (e.g. >20% of the pipeline of clean projects shown in Figure 9).

For recycled steel products and low-carbon aluminium, there is already a significant operational pipeline of projects. This means that simply creating lead markets in select downstream sectors may not be sufficient, particularly for aluminium, where potential lead markets are smaller than the current supply of clean material. In this case, different instruments may be needed to fully phase out fossil production. Alternatively, lead market efforts could focus on unlocking a niche for more nascent, very low-carbon production innovations, such as inert anodes for aluminium smelting.

Figure 9

Comparison of estimated demand for decarbonised commodities in the early 2030s compared to the current pipeline of clean projects in the EU27, UK and EEA



Unless otherwise stated, the demand shown represents projected demand for the relevant commodity within a given sector (e.g. the figure for fertilisers corresponds to all estimated demand for ammonia in the fertiliser sector in 2030). Initially not all of this demand can be satisfied by green supply, policies to create demand need to be carefully calibrated to ensure the necessary supply can be ramped up sufficiently quickly. Estimates correspond to the early 2030s. **1.** Europe pipeline is based on blue and green hydrogen projects and includes projects in Norway as well as EU 27 (source – MPP Project Tracker). **2.** Europe pipeline is based on planned CO2 capture and SCM projects. EU27 project pipeline figures would be 2.3 Mt/yr for FID and 38.8 Mt/yr for announced capacity. **3.** The breakdown of flat vs long steel products has been used as a proxy to estimate the demand for primary (linked to flat) and secondary (linked to long) steel. See technical annex for assumptions on the split between long and flat steel. **4.** Europe pipeline is based on planned DRI-EAF and standalone EAF projects. EU27 project pipeline figures would be 81 Mt/yr for operating capacity (secondary), 22.5 Mt/yr for FID and 47.2 Mt/yr for announced capacity. ***** FuelEU Maritime includes a clause stating that if by 2031 1% of uptake of RFNBOs has not been achieved, a mandate of 2% will apply from 2034, in practise e-ammonia would need to compete with e-methanol, so this is likely an overestimate.
Future steel consumption in automotive is based on T&E (2024): Cleaning up steel in cars: why and how? Aluminium demand is based on Ducker (2023): Aluminium content in passenger vehicles (Europe). Other sectors assume a relatively constant share of demand to today, apart from defence, fertiliser and renewables where assumptions can be found in the relevant sections

Bespoke policy measures will be needed to build demand within end use sectors. While the EU has established cross-cutting tools in place like the EU ETS, experience from other sectors shows that sector-specific instruments are crucial for scaling new technologies - as seen with feed-in tariffs for renewables or mandates for Electric Vehicles (EVs) and Sustainable Aviation Fuels (SAFs). These approaches can complement cross-cutting measures by addressing the unique barriers and opportunities along each value chain.

In industrial sectors, products compete primarily on cost rather than on sustainability criteria. Without policy-driven incentives, clean materials will not be able to compete and pass on these costs down the value chain. This report explores tailored instruments for each identified lead market based on the following criteria, see Figure 6 for more details:

- **Product mandates** are needed where demand from the private sector is high (e.g. automotive and fertilisers), as they create binding requirements that can drive large-scale market uptake of clean commodities.
- **Voluntary labels** can play a supporting role by helping differentiate clean products and build consumer and market awareness, but they are unlikely to create demand at scale without binding requirements or support.
- **Demand-side subsidies** for downstream products where the green premium could have social impacts (e.g. fertilisers and downstream food products), playing different roles along value chains. Where the green premium is very small, targeted subsidies may be warranted primarily to lower-income consumers.
- **Measures to mitigate competitive risks** where downstream products are exposed to international competition (e.g. automotive, fertilisers/food), such as local content requirements or demand side support.
- **Public procurement,** which is most effective where government represents a high share of overall demand (e.g., infrastructure, defence). This could also include incorporation of sustainability criteria into public tenders, for example, within Contracts for Difference (CfDs) auctions. Public procurement may also be able to play an initial role to test standards and emissions accounting methodologies, in public buildings and fleets (e.g. buses), but ultimately this is a much lower scale of demand than the private sector represents.

Figure 10

Mapping of policy measures explored by sector against selection criteria[F]

Sector	Is public procurement or publicly run auctions a large driver of demand	Is the private sector a large driver of demand?	Is there a potential social impact?	Is the downstream sector heavily exposed to global competition?
Automotive		Y – Mandates for embodied carbon reduction/use of green metals		Y – Mitigate competitive exposure risks
Buildings	Y – Green Public Procurement of building materials	Y – Embodied carbon/ whole life carbon limits	Y – Concessional finance for low-embodied carbon social housing	
Infrastructure	Y – Green Public Procurement of construction materials			
Nitrogen Fertiliser		Y – Clean ammonia consumption requirements downstream products (fertilisers/food)	Y – Demand side subsidies to support use of green fertilisers	Y – Mitigate competitive exposure risks
Renewables	Y – Inclusion of sustainability criteria into public tenders			
Defence	Y – Green Public Procurement requirements in procurement			

F. The policy interventions mapped and assessed in this report are not exhaustive. Additional lead market instruments could be envisaged, including cross-sectoral or combinable approaches. Examples might include labelling schemes or book-and-claim / tradable credit systems designed to enable market recognition or exchange of low-carbon material attributes.

When designing and implementing these measures, policymakers will need to balance several trade-offs:

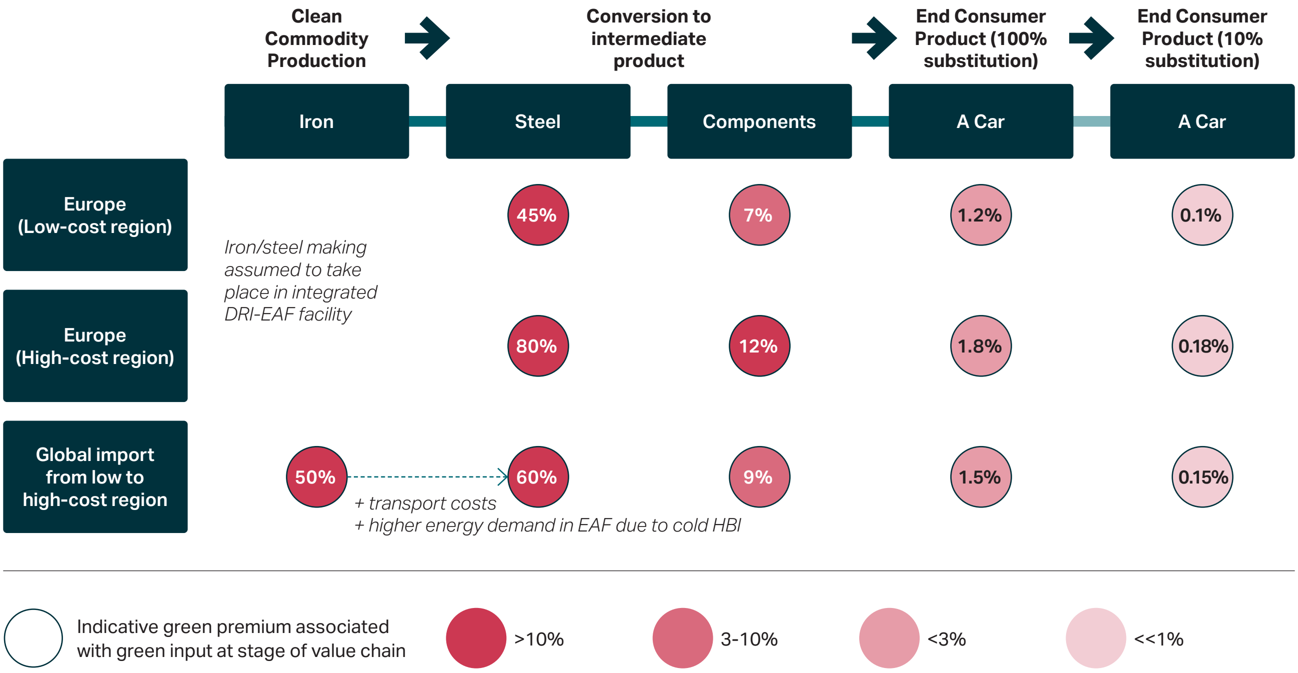
1. **Ambition and achievability.** Demand-side measures and standards that underpin them should be ambitious enough to drive industrial transformation, while remaining practical and implementable. Policies should initially target modest volumes of demand, calibrated against the pipeline of investable projects, and ramp up over time. Product standards and qualifying criteria can also become more stringent over time, as availability of affordable clean inputs (e.g. clean hydrogen) improves.
2. **Robustness and regulatory coherence.** Lead market policies must be underpinned by credible, consistent, and enforceable standards. This requires a careful balance: standards must be robust enough to build trust in clean products, yet designed in a way that enables implementation across sectors and borders. Harmonising rules across the internal market and building on existing frameworks, such as monitoring systems under the EU ETS, can help ensure integrity while reducing duplication and complexity.
3. **Regulatory burden and Small and Medium Enterprise (SME) participation.** Product-level emissions disclosure can impose disproportionate costs on SMEs, especially in fragmented value chains. To avoid exclusion, policies should enable simplified compliance through standardised templates, pre-certified data, and shared digital tools such as the EU Digital Product Passport. Large buyers can cascade verified data down the chain, while specific exemptions or targeted financial support, such as vouchers for Life Cycle Assessment (LCA) services or grants for compliance tools, can help SMEs adapt.
4. **Managing the green premium along the value chain.** The green premium is significant at the production stage for all of the commodities studied, with varying levels depending on technology used and the geographical location of production, but becomes increasingly small in downstream stages. Despite this, it can be challenging to pass costs along the value chain, particularly for mid-stream sectors that face tight margins or strong international competition. To minimise friction, requirements can be applied as close to end products as possible, where costs are more easily absorbed. The trade-off, however, is that the demand signal to producers becomes less direct. A balanced approach may combine downstream measures with targeted interventions upstream. Where needed, subsidies or financial support could also help manage impacts.
5. **Jobs and social implications.** Industrial transition policies should be designed to maximise employment and regional opportunities, while managing potential disruptions in existing industrial areas and communities. Policymakers will need to quantify job impacts across value chains, identify where reskilling and workforce support are most needed, and ensure that public funding and private investment reinforce local economic resilience. Embedding social considerations early can strengthen public support and ensure long-term political viability of these measures.
6. **Cost and strategic autonomy.** The Clean Industrial Deal aims not only to drive demand for clean commodities, but also *to strengthen EU-based production and supply chain resilience.* This aligns with recent EU policies, such as the Net-Zero Industry Act, which aims to meet at least 40% of EU clean tech demand through domestic production and reduce reliance on single non-EU suppliers. In her 2025 State of the Union speech, Commission President Ursula von der Leyen also highlighted "made in Europe" criteria as a crucial part of lead market creation. However, production costs for energy-intensive clean commodities will depend heavily on the cost of renewables and/or CCS. In geographies without these advantages, producing clean ammonia, iron, and aluminium can be significantly more expensive (see Figure 7 for an illustrative example). While these higher costs only have a minor effect on final consumer prices, they can put pressure on intermediate producers in the value chain, particularly when they compete in global markets. To manage this, the EU must balance between three different approaches:
   A. **Maximising use of its own resource endowment** by incentivising production of the most electricity-intensive clean commodities in areas with low renewable costs (e.g., Iberia or Scandinavia). These resources are limited (e.g. due to limited available land and renewable build out rates), so they will not be able to satisfy all demand alone.

B. Build mutually beneficial clean trade and investment partnerships with countries rich in renewable resources (e.g. Brazil, Egypt, Australia, India) to help source clean inputs. These partnerships can ease cost pressures, diversify supply, and support the resilience of Europe's industrial base while accelerating the global transition to a clean economy.

C. Strengthen local production through protective measures, accepting cases where costs are higher than in international markets in return for strategic autonomy. This can be combined with clean lead market creation measures, in particular to support early movers.

Figure 11

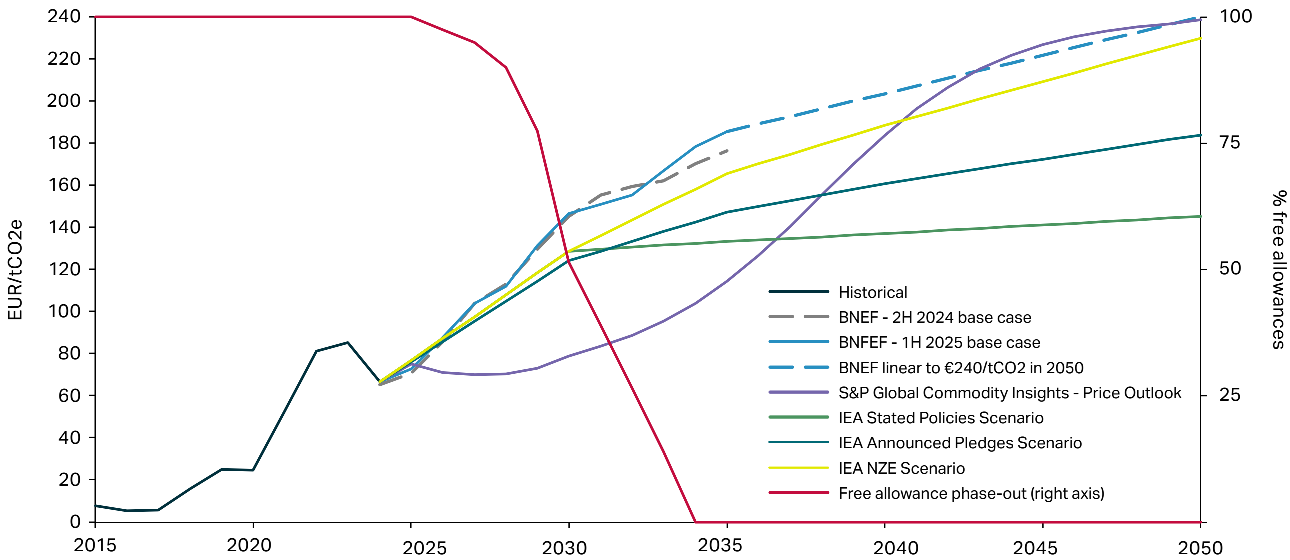
Estimated cost pass through dependency on geography where input green commodity was produced (iron-automotive value chain example – shown with 2030 cost estimates)



Over time, rising EU ETS carbon prices will narrow the green premium that lead markets help bridge today. With CBAM and the phase-out of free allowances, carbon costs are set to climb, around €150/tCO_2 by 2030 (BNEF)[11] or €130/tCO_2 (IEA)[12], increasing pressure on high-carbon production. By 2034, free allowances will be phased out and CBAM fully aligned with the ETS, the industries covered in this analysis will pay a carbon price on 100% of their emissions. While forecasts differ on the pace, the direction is clear: carbon pricing will progressively close the cost gap, reducing the need for lead markets to provide a permanent financial advantage.

Figure 12

Historical and forecast EU emissions allowance price



When combining the decrease in the production cost of green commodities (mainly due to hydrogen cost reductions) and the increase in the production cost of conventional fossil-based commodities due to increase carbon pricing, it is expected that cost parity should be reached between 2030 and 2040 for ammonia (Figure 13), steel (Figure 14) and cement (Figure 15), depending on the CO_2 price scenario and the origin of green production.

Figure 13

Evolution of green and grey ammonia production cost and import in Europe under different CO2 price scenarios.

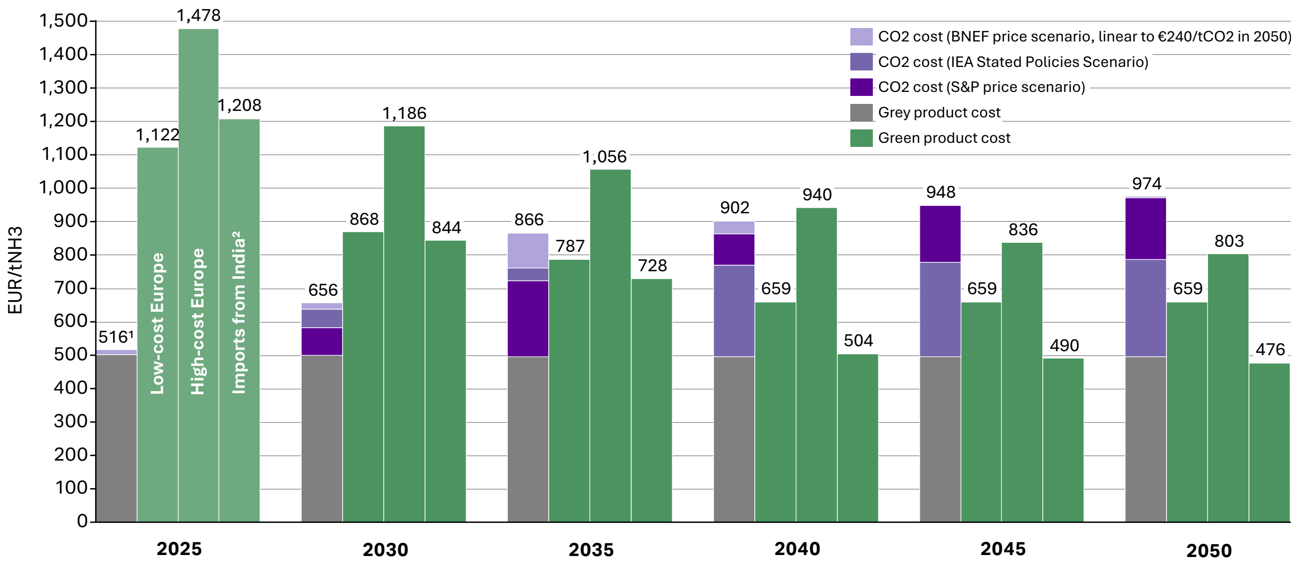


Figure 14

Evolution of green and grey steel production costs in Europe under different CO2 price scenarios.

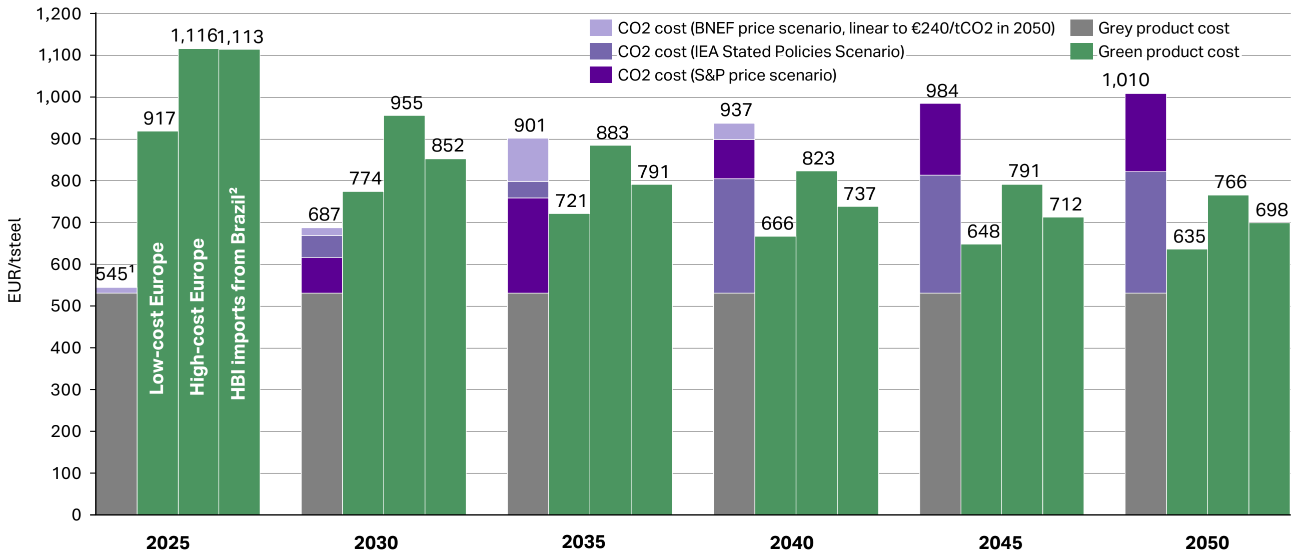
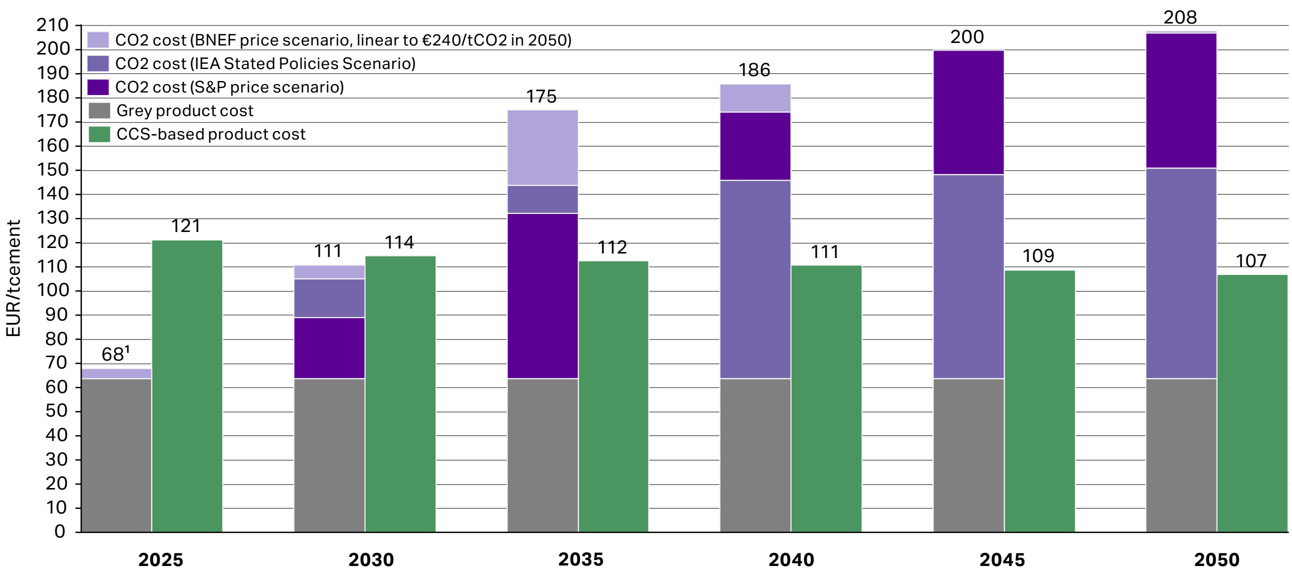


Figure 15

Evolution of CCS and non-CCS based cement production costs in Europe under different CO2 price scenarios.



In the following chapters, we assess each lead market, identifying where intervention is most needed and effective. Each policy is evaluated for its cost allocation, political viability, competitiveness and trade impacts, as well as enforceability[13].

Automotive Sector

Simplified value chain

	Steel-making	Aluminium-making	Component manufacturing	Auto manufacturing	Retail and end-use
Green premium (assuming 100% use of low carbon products, based on low cost EU production)	45%	+18%	+4-7%[1]	+1%	+1%
	The green premium significantly diminishes down the value chain				
Competition distortion risk	High (partially mitigated by EU ETS & CBAM)		High	High	
	Most of the value chain is exposed to international competition, but only upstream is (somewhat) protected from carbon leakage by CBAM				
EU trade deficit / surplus	Increasing trade deficit		Decreasing trade surplus		
Key issues	• High green premium at production stage • Limited supply of near-zero steel/ aluminium • Need for long-term offtake agreements		• Thin margins, limited ability to absorb costs • Challenge for SMEs to manage additional compliance burden (embodied carbon reporting)	• Balancing cost pass-through vs. competitiveness (in view of strong competition from abroad) • Securing supply under uncertainty • Need to manage multiple regulations alongside vehicle CO_2	• Inflation pressure on consumer spending • Low consumer confidence • Consumer price sensitivity, especially in mass-market segments

1: 4% is based on estimate below for closures and 7% is based on estimate for a car body

Figure sources here[19]

Verdict

The EU automotive sector is well-positioned to form a strong lead market for clean metals, including clean primary steel and aluminium. Completely shifting this demand to green materials would add around 1% to the cost of a typical car – a small price for a big leap forward. The key challenge is managing competitiveness impacts on a sector that already faces stiff competition from abroad.

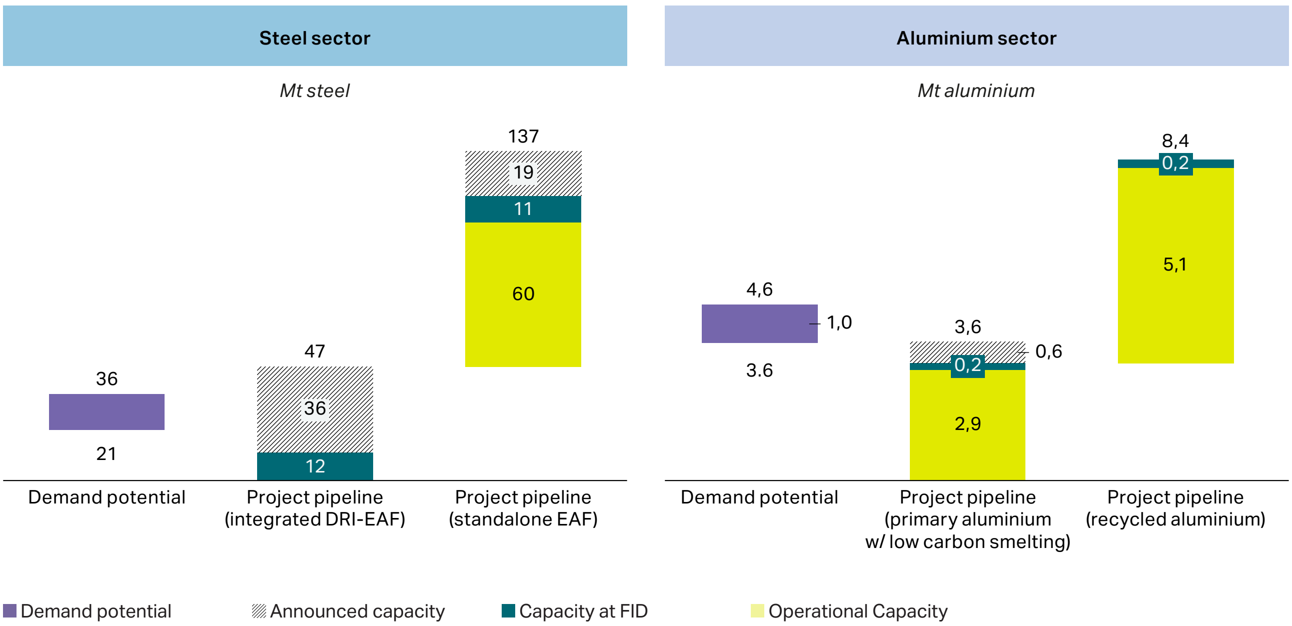
Scale: [High] 36 MT/yr of steel (equivalent to around 75% of the EU's integrated DRI-EAF pipeline's capacity) and 3.4 MT/yr of aluminium

Steel: Automotive production predominantly requires flat steel products, which are mostly produced using primary steel. This analysis assumes that 85% of the steel needed is primary steel, with 15% coming from recycled steel (see the steel technical annex for more information). Currently, the EU automotive sector consumes 36 MT/yr, equivalent to ~75% of the EU's integrated DRI-EAF pipeline's capacity, as illustrated in Figure 16. However, increased lightweighting of cars could reduce steel usage, and increase use of aluminium, reducing the quantity of steel demand to ~21 Mt/yr. Other studies suggest higher incorporation of recycled steel in vehicles may be possible (e.g., up to 40%[20]).

Aluminium: Around 3.4MT of aluminium was used by the automotive sector in 2023, approximately 37% of EU primary aluminium demand. This is projected to grow to around 3.6-4.6MT by 2030, driven by lightweighting and the use of more aluminium in EVs.

Figure 16

Comparison of overall demand for steel and aluminium in the automotive sector in the early 2030s versus the clean project pipeline in the steel and aluminium sectors.



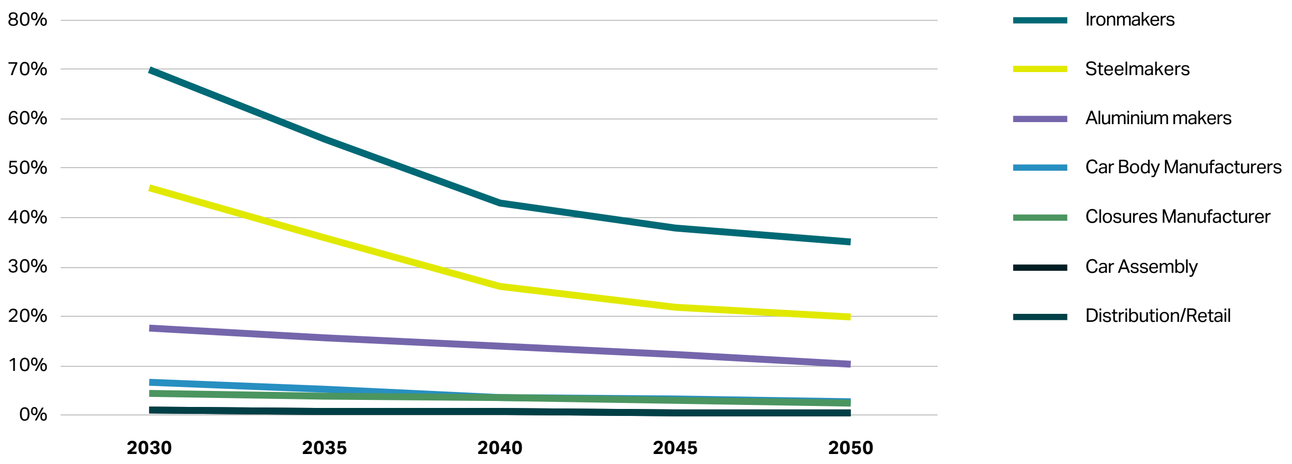
Note that the above pipeline figures include the UK and EEA countries as well as the EU. This is particularly important for aluminium, where a significant share of primary production in EEA countries like Norway and Iceland

Cost impact on end product: [Low] ~1% for full replacement of steel and aluminium in an indicative vehicle, assuming 100% cost pass through, and sourcing of steel from a low cost EU region. An indicative SUV contains ~1.35 tonnes of steel and 0.2 tonnes of aluminium[21]. We estimate that the 2030 green premium for producing clean steel and aluminium is significant, at 45% and 18% respectively for each material, as shown in Figure 18. Such costs are expected to be achievable where lower-cost clean hydrogen can be produced for the ironmaking stage (e.g. Iberia/Scandinavia).

In the midstream of the value chain, we assess the impact on midstream products, assuming a 100% use of clean aluminium and steel is used. For a car body, where most of the steel is used, the estimated premium is around 7%. Similarly, for closures (which use a significant share of the aluminium in a car), we estimate a 4% green premium. At the end product level, the increase in green premium is estimated to be ~1%[22]. However, in the near term, a lower share of use of clean materials (e.g. 10%) would increase the product cost by much less than 1%, as illustrated in Figure 18. Full assumptions underpinning this analysis can be found in the technical annex.

Figure 17

Estimated green premium (%) from using clean steel and aluminium, by segment of value chain 2030 - 2050

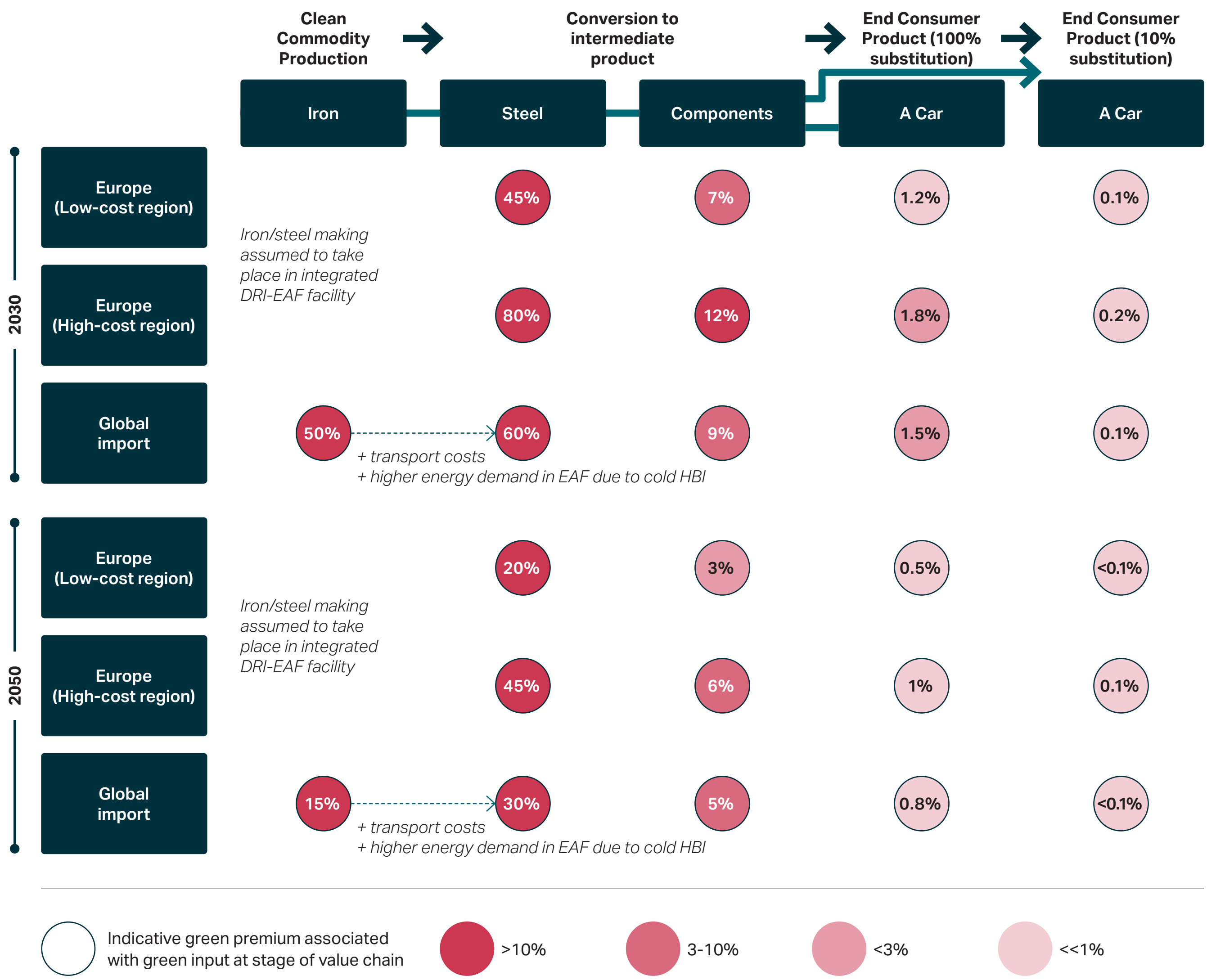


Sensitivity to commodity sourcing: The green premium associated with clean steel and aluminium production can vary significantly depending on the cost of clean hydrogen and electricity. The table below shows the cost impact under three different sourcing scenarios for producing clean hydrogen for use in ironmaking: (1) European regions with relatively high renewable costs (€5.9/kgH2 in 2030 and €3.5/kgH2 in 2050); (2) European regions with low costs (€4.3/kgH2 in 2030 and €2.6/kgH2 in 2050); and (3) cheap global locations (€4.1/kgH2 in 2030 and €2.4/kgH2 in 2050)[G23]. In the global import scenario, hot briquetted iron is transported into Europe rather than produced in an integrated DRI-EAF plant, requiring remelting and additional costs at the steel-making stage. This illustrates how location choices and trade strategies will be decisive for competitiveness: securing access to lower-cost renewables and clean hydrogen (either domestically or through imports) can substantially reduce the green premium, creating a trade off between strategic autonomy and sourcing the cheapest inputs.

G. These European cost estimates are also within the bid levelised RFNBO hydrogen cost production ranges of the European Hydrogen Bank's first auction for Germany and Spain, the high and low cost EU regions this is based on.

Figure 18

Impact on green premium from steel production in locations with varying projected clean hydrogen costs



To translate these insights into action, policymakers will need a toolbox of targeted interventions that create strong demand signals for clean metals in the automotive sector. Below, two potential approaches are outlined. This would build on existing momentum: Several automakers have already made commitments to procure reduced and near zero emissions steel[24].

Intervention #1 Product Mandates: Introduce regulations that aim to gradually increase the share of clean steel and aluminium in vehicles sold in the EU. Similar approaches already exist in other sectors, such as blending mandates for Sustainable Aviation Fuels. Over time, these requirements could be tightened as clean material availability increases and costs decline. This intervention could take different forms including:

A. **Targeted clean metal mandate:** Mandate a minimum share of clean steel and aluminium in vehicles that becomes more stringent over time. This option would send a direct signal to materials manufacturers. However, it may come with a risk of material substitution, whereby materials outside of the mandate could be substituted for materials within its scope, which could reduce emissions savings.

B. **Embodied emissions cap:** Set a cap on the total embodied carbon of a vehicle. This approach would help prevent unintended consequences, such as substituting regulated materials with cheaper, high-emission alternatives that are not in scope of a targeted mandate (e.g. in option (A)). However, it would require a robust and harmonised life cycle assessment (LCA) methodology covering the materials in a vehicle, and would come with some uncertainty for clean material producers, as manufacturers could choose different pathways to meet the target. For example, manufacturers could meet the ceiling primarily by increasing the use of recycled steel, which would reduce emissions, but dilute the demand signal for primary steel.

C. **Combined approach:** A hybrid model could be adopted, combining an overall emissions ceiling with targeted mandates for specific materials. This would balance flexibility with certainty and help mitigate substitution risks, but may require multiple levels of reporting.

Key considerations

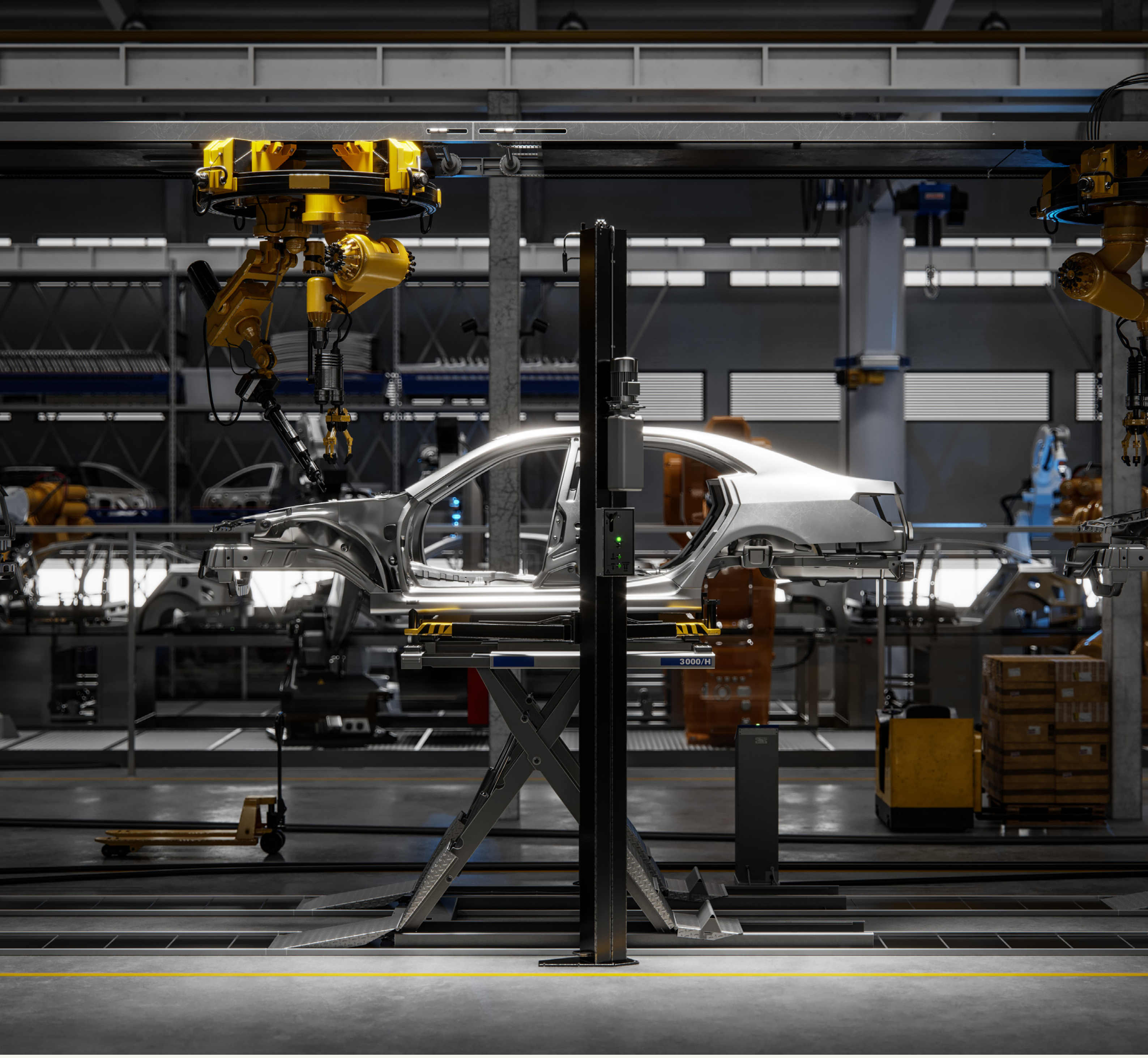
1. **Managing costs over time:** The cost burden would initially fall on manufacturers and then be passed on to consumers. However, under a low-cost sourcing scenario, the impact on the cost of a typical vehicle is projected to remain modest (around 1% by 2030 for low cost-material sourcing scenarios, even with 100% substitution). In practice, to ensure achievability, the emissions ceiling or clean metal requirement would need to start at an achievable level and be made more stringent over time as supply ramps up, data is collected, and supply chains adjust. We estimate the cost of completely bridging the green premium for 10% of automotive steel and aluminium demand to be between €560 – 890 million euros per year in 2030[H].
2. **Managing downstream impacts:** Applying the mandate close to the point of sale (covering both domestic and imported vehicles) would help level the playing field. This approach mirrors the logic of the CBAM, ensuring that importers face equivalent requirements and preventing carbon leakage. However, if EU-based OEMs are required to fully transition to clean materials while competitors in export markets are not, competitiveness could be affected for exports. In 2024, the EU exported around 4.5 million cars out of a total production of about 11.4 million, representing an export share of around 40%[25]. Therefore, complementary measures to address this risk may be needed.
3. **Building political support:** Securing political support will require careful engagement with the automotive industry to address concerns around additional requirements, given intense international competition. Member States with significant car manufacturing industries, such as Germany, Italy and Poland, have previously sought flexibility in related regulations, such as in the EU's CO2 emission performance standards for cars and vans[26]. A gradual approach that targets both imports and European cars equally, along with the right incentives, will likely be needed.
4. **Implementing the measure:** Enforcement would require the development and monitoring of robust standards, including for imported vehicles. The existing CO2 regulation for cars[27] already requires the EC to develop a voluntary LCA methodology for cars and vans, which could serve as a foundation for a mandatory framework.

Intervention #2 Demand Side Subsidy: Offer tax credits or subsidies to offset the green premium for vehicles using low-carbon materials. This mirrors incentives already used for Electric Vehicles[28]. Models to do this are emerging, but are often based on integrating embodied carbon emissions into requirements for Electric Vehicle subsidies. For example, France currently allocates subsidies for zero emission vehicles based on criteria including embodied carbon[29], and similar systems are being introduced by the UK[30] and Japan[31].

Key considerations

1. **Managing costs over time:** Governments would need to fund the subsidies, and would need to carefully ramp up targeted levels of demand against budgetary constraints. The required subsidies could be reduced over time as the cost gap narrows. It is important to note that demand side subsidies may not be the most efficient subsidy model, for example, auction-based mechanisms[32], likely further upstream (e.g. for hydrogen producers/off-takers, or iron production) may offer more efficient alternatives, as these can leverage consumer willingness to pay, but provide a less certain incentive. We estimate the cost of completely bridging the

H. Note that this is an order of magnitude estimate, based on using the green premiums above as upper and lower bound. Costs are expected to vary significantly on a project-by-project basis, and exact subsidy needs would need to be underpinned by detailed cost assessments.



green premium for 10% of automotive steel and aluminium demand to be between €560 – 890 million euros per year in 2030[F].

2. **Managing downstream impacts:** A consumer-facing subsidy can help level the playing field with more carbon intensive products. However, if this causes OEMs to shift all production to use green materials they may still face higher costs for exports that don't benefit from the subsidy.
3. **Building political support:** manufacturers are likely to support demand-side subsidies. Given that tax policy is a member state competence, developing an efficient system would require careful coordination at EU-level, along with early engagement to reach the unanimity required for tax-related initiatives. Vehicle manufacturers have already called for more EU-level harmonisation for EV tax incentives to ensure a level playing field.
4. **Implementing the measure:** Such demand side subsidy schemes would likely fall under member state responsibilities, and this would require coordination to achieve sufficient scale (both on underpinning standards, and level of support).

Construction Sector

Simplified Value Chain

	Upstream			Midstream	Downstream
	Cement	**Concrete**	**Steel-making**	**Building construction**	**Post construction**
Green premium (assuming 100% use of low carbon products)	+80%	+30%	+45%	+2%	+2%
	The green premium diminishes down the value chain. The majority of this is associated with deep decarbonisation of cement supply via CCUS.				
Competition distortion risk	Medium (partially mitigated by CBAM)		High and partially mitigated by EU ETS & CBAM	Low	None
	Cement and concrete are a significantly less internationally traded commodities than other sectors Downstream products (buildings and infrastructure) are not widely internationally traded				
EU trade deficit / surplus	Decreasing trade surplus (modest)		Increasing trade deficit	N/A (localised)	N/A (localised)
Key issues	• Limited access to low carbon infrastructure for key inputs (e.g. CCS for abating clinker production) • Limited premium demand • High energy costs			• Relatively low demand the EU construction sector • More demand for long rather than flat steel products • Need for coherent and robust standards and LCA methodologies to demonstrate sustainability credentials • Significant number of SMEs who may struggle with additional administrative burden	• High interest rates may depress end consumer demand • Need for coherent and robust standards and LCA methodologies to demonstrate sustainability credentials

*Green premium estimate corresponds to primary production only

The EU construction sector is a major consumer of cement and steel. Construction accounts for almost all cement consumption and approximately 53MT/yr of steel demand. A large share of overall construction demand (~60%) is estimated to be derived from secondary steel[33], meaning construction could drive demand of approximately 21MT/yr of primary steel and 32Mt/yr of recycled steel per year. Most steel consumed in infrastructure construction is used in long products, with use of flat products concentrated in building construction. Given the different material needs, this section addresses these segments separately[34].

Buildings

Verdict

The building sector is an ideal lead market for clean cement and a promising option for clean primary steel. Building construction accounts for 55% of the EU's cement consumption and a 24% share of steel. While buildings also use other materials which can complicate targeting decarbonisation of specific materials, the overall end-product impact of using near-zero carbon materials is low, leading to roughly a 2% cost premium.

Scale: [High] 63 Mt/yr of cement (larger than the EU pipeline of clean projects), 36 Mt/yr of steel demand (split between flat and long products) and 2 MT/yr of aluminium.

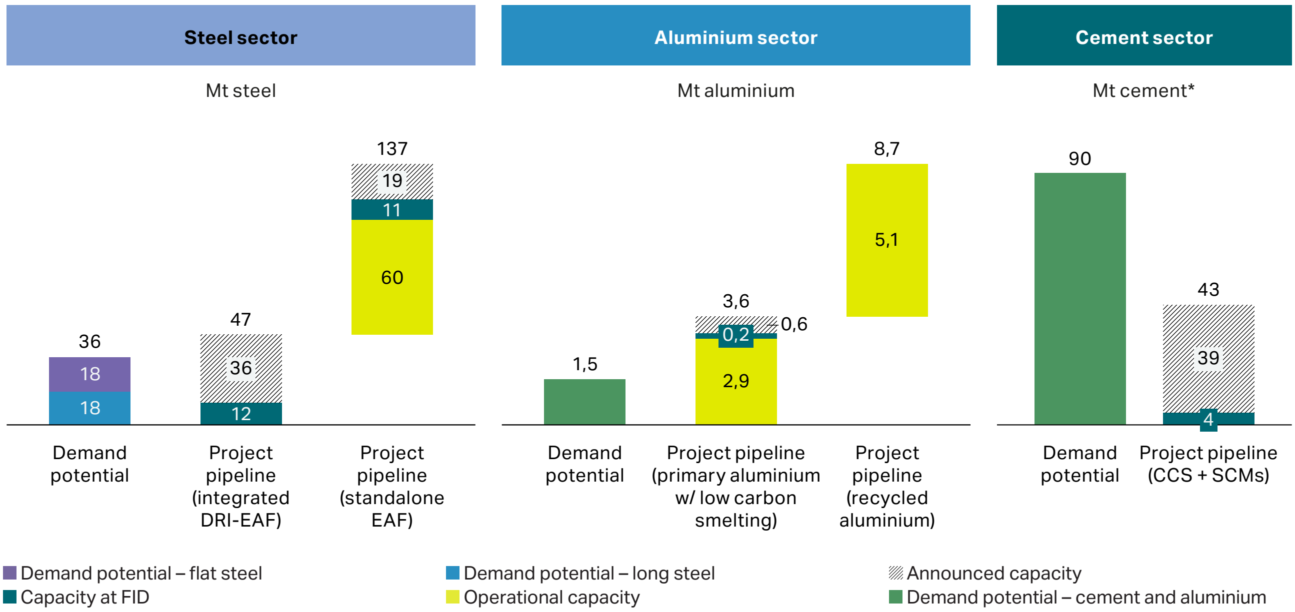
Aluminium: the building sector consumes ~2Mt/yr of aluminium annually in the EU[35].

Cement & Concrete: Buildings consume approximately 60% of the EU's ~150Mt/year cement demand, making them a key driver for clean cement uptake[36].

Steel: Buildings account for a significant share of construction steel demand, with an estimated 50-50 split between flat and long products, as shown in Figure 19[37].

Figure 19

Comparison of overall demand for steel, aluminium, and cement in the buildings sector in the early 2030s versus the clean project pipeline

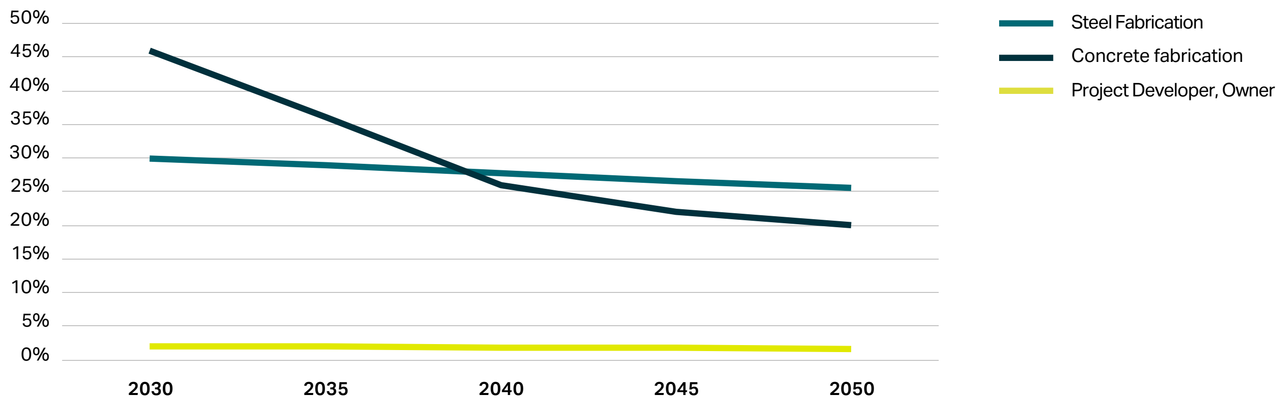


*Based on share of emissions captured by CCS, or SCM substitution potential, scaled to overall pipeline
Note that the above figures include the UK and EEA countries in addition to the EU. This is particularly important for aluminium, where a significant share of primary production is in EEA countries like Norway and Iceland.

Cost impact on end product: [Low] Using a representative example, a six-storey, 4,000 m^2 office building in a prime location, construction requires roughly 2,700 tonnes of concrete and 200 tonnes of steel. Assuming the green premiums shown above, the impact on the cost of a building is expected to be ~2% in 2030, falling to ~1.6% by 2050, as shown in Figure 20. Most of the cost is driven by decarbonised cement because this is the dominant material used. Full assumptions underpinning this analysis can be found in the technical annex.

Figure 20

Green premium from green steel and concrete across building construction value chain



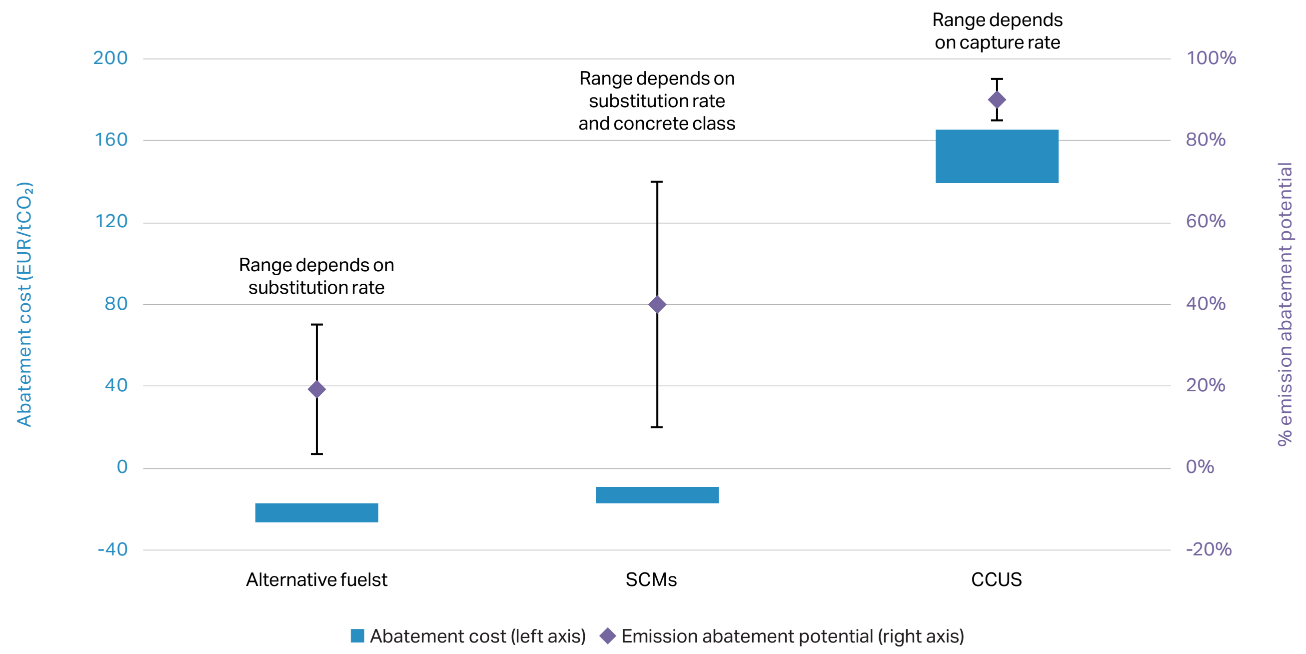
Sensitivity to decarbonisation pathway: The above estimate assumes decarbonisation of cement is achieved using CCS to abate process emissions, as illustrated in Figure 22. In practice, particularly in the near term, partial decarbonisation through more efficient material use, material and clinker substitution and fuel switching is expected to be significantly lower cost (and in some cases even cost-reducing), with a green premium increase for an end product <<1%. However, these measures face limits: for example SCM availability varies by geography and type of substitute, and current technical requirements can constrain their use. They also cannot deliver full decarbonisation of cement (see technical annex for more details on SCMs). For technology-neutral instruments such as embodied carbon limits on buildings, this means low-cost abatement options are likely to dominate in the early phases, while progressively stricter standards will drive uptake of higher-cost technologies needed for further emissions reduction over time.

To translate these insights into action, policymakers will need a toolbox of targeted interventions to create demand signals for clean materials use in the buildings sector. A possible approach is outlined below.

Intervention #1 Embodied carbon limits on buildings: This would set maximum embodied carbon thresholds for new buildings that become more stringent over time, encouraging use of clean materials. Other measures (e.g. a requirement to use a given share of clean materials in a building) are also available, but because a wide range of construction materials could be used in buildings, there is a significant risk of substitution with cheaper materials outside the mandate (which may be more, or less emissive). Such limits are already set to come into place under the Energy Performance of Buildings Directive (EPBD), which requires Member States to develop national roadmaps for setting limit values for Global Warming Potential (GWP) of new buildings with targets from 2030. Countries like France, Denmark, Sweden and the Netherlands have already introduced mandatory reporting and such GWP thresholds[38]. To effectively stimulate

Figure 21

Abatement cost and % emissions abatement potential of cement decarbonisation levers[41]



the market for clean construction materials, the EU should work with Member States to ensure ambitious implementation of this measure. Harmonised implementation would provide an EU-wide demand signal and prevent fragmentation of national approaches.

Key considerations

1. **Managing costs over time:** The cost of this measure would fall on industry and consumers. In the early phases, where the requirements would be less stringent, costs would likely be significantly lower, because thresholds could be met by using lower cost levers such as SCMs and alternative fuels. A more limited cost decline for full displacement of the studied materials (than in other end products) is expected by 2050 because CCS costs are anticipated to see more modest decrease than other technologies explored in this report.
2. **Managing downstream impacts:** Downstream, the regulation would apply to buildings, which aren't internationally traded. Further upstream, cement is mostly locally produced and used because it has a relatively low value to weight ratio, limiting exposure to international competition.
3. **Building political support:** Some upstream construction material producers and associations[39] have supported thresholds for embodied carbon in buildings. Additional measures to manage the green premium and ensure cost pass-through could help address the concerns of the downstream construction industry, which already has low profit margins. Regulatory burden may also be a particular issue for resource constrained SMEs, and in some cases (e.g. the Netherlands), support has been provided to help with manage this (e.g. by funding the creation of Environmental Product Declarations)[40]. Additional flexibilities or demand-side subsidies could also be needed to mitigate member state concerns over potential regressive impacts, e.g. on the cost of social housing.
4. **Implementing the measure:** The revised EPBD requires Member States to develop national roadmaps for setting limit values for GWP of new buildings, including targets from 2030, providing a good basis for demand signals. To ensure this presents a suitably significant demand signal to move the EU's pipeline of projects, ambition and harmonisation may be required across member states. Whole lifecycle carbon limits may be needed to manage substitution risks and may need to be introduced gradually – starting with the most crucial material classes and widening the scope over time – to manage the complexity of materials within a building.

Infrastructure

Verdict

The infrastructure sector is a strong lead market for clean cement, and clean recycled steel. Infrastructure projects account for a significant share of construction material use and are often publicly procured, making green public procurement (GPP) a very promising lever. This sector can be instrumental in scaling up clean cement and recycled steel production, but is less suited to build demand for primary clean steel, given its reliance on long steel products and recycled inputs.

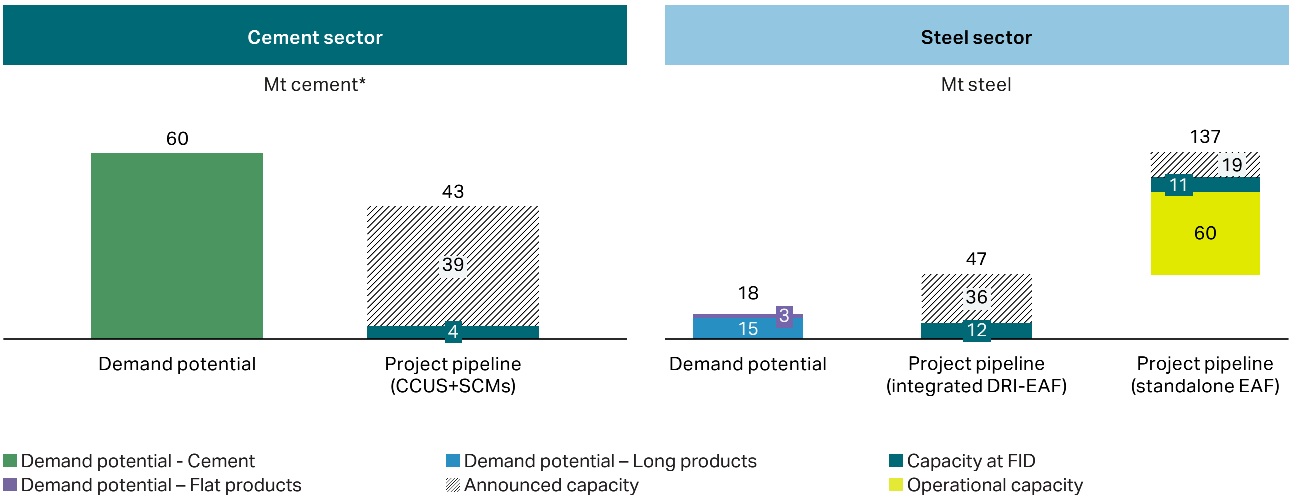
Scale: [High] 60Mt/yr of cement demand and 18 Mt/yr of steel demand (predominantly long products).

Cement: around 40% of the EU's annual cement consumption is used for infrastructure projects (such as roads, bridges, tunnels, ports, dams, etc.)[42]. Infrastructure is therefore a key target for accelerating the uptake of clean cement.

Steel: accounts for approximately 18 Mt/yr of steel demand, primarily long products, as opposed to flat steel, as shown in Figure 23. Here we assume approximately a 15% share of flat steel product consumption (see Steel Technical Annex).

Figure 22

Comparison of overall demand for cement and steel in the infrastructure sector in the early 2030s versus the green project pipeline



*Based on share of emissions captured by CCUS, or SCM substitution potential, scaled to overall pipeline. Note that the above figures include the UK and EEA countries. This is particularly important for aluminium, where a significant share of primary production is in EEA countries like Norway and Iceland.

Cost impact on end product: [Low] The table below, Figure 23, shows a range of estimates of the cost increase of using clean cement for a range of signature projects across different countries. As with the buildings example, this estimate is based on the use of CCS, which is a relatively expensive lever, with limited overall volumes in the near term. These estimates are consistently around 1% or less for a final project. If a realistic share of such clean cement is used (e.g. 10%) for these examples, the green premium impact on the final project is significantly below 1% across these examples.

Figure 23

Signature European projects, total cost and estimated cost impact of using clean cement as an input at 100% substitution and 10% substitution rates

Example	Final cost (€bn)	Volumes of concrete	Green premium (100% substitution)	Green premium (10% substitution)
Eurotunnel, France/UK	~15	1,900,000 m3	<1%	<<1%
Gotthard Base Tunnel, Switzerland	~11	2,000,000 m3	<1%	<<1%
Viaduc de Millau Bridge, France	~0.4	90,000 m3	<1%	<<1%
Crossrail (Elizabeth Line), UK	~21	1,000,000 m3	<1%	<<1%
Terzo Valico dei Giovi High-Speed Rail, Italy	~9	3,500,000 m3	~1%	<1%
Stuttgart 21 Railway, Germany	~11	1,500,000 m3	<1%	<<1%

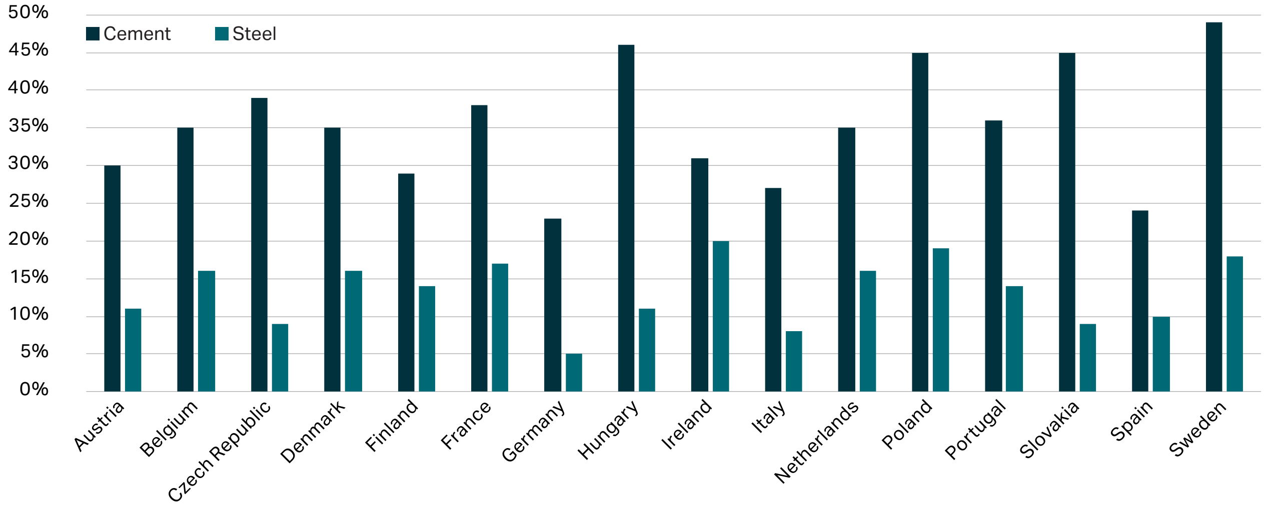
To translate these insights into action, policymakers will need a toolbox of targeted interventions to create demand signals for clean materials use in the infrastructure sector. A green public procurement based approach is outlined below.

Intervention #1 Green Public Procurement (GPP): This intervention would require public agencies to use a share of clean materials in public projects (especially infrastructure), and to set out a roadmap committing to procure a share of near-zero carbon cement or steel for select projects as soon as possible[I]. Green procurement requirements can establish carbon limits on (1) the raw material, (2) the project, or (3) a combination of both. In (1), specific technology pathways can be favoured to drive significant emission reductions or achieve other objectives, e.g. scaling emerging decarbonisation technology solutions. It may be necessary to limit project level emissions to avoid risk of unsuitable material substitutions that increase overall project emissions. The potential market for cement through public procurement could represent up to 31% of the entire EU cement market, and up to 45-50% in some countries (figure 24). The share for clean steel is projected to be lower, accounting for about 11% of consumption, the majority of this (85%+) would be long products, which are more likely to be derived from recycled steel[43]. Note these figures include public buildings as well as infrastructure (though green public procurement can be applied to both).

I. This would align broadly with IDDI pledge level 4, but may need to occur post-2030 where countries do not have access to such commodities. In these cases roadmaps would be leveraged to set out a path to achieving this ambition.

Figure 24

Share of cement and steel use in public procurement of construction in EU countries in 2019



Key considerations

1. **Managing costs over time:** The cost falls on governments agencies who would have to procure low carbon construction materials at a premium. As with other sectors, initially measures could target a relatively small share of overall demand, and ramp up over time.
2. **Managing downstream impacts:** Construction outputs are not internationally traded, and in this case, procurement rules apply only to localised public buyers, therefore, there is limited risk of downstream competitive distortions. As with the building sector, it may be necessary to support SMEs to navigate the regulatory burden associated with demonstrating compliance.
3. **Building political support:** There is broad support among member states, with countries like France and Germany having actively called for the use of GPP. Early engagement may be needed to ensure member state alignment on the proposed level of harmonisation and public budgets' ability to absorb the green premium. Additional measures to manage the green premium and ensure cost pass-through could be needed to address the concerns of the downstream construction industry due to its low profit margins.
4. **Implementing the measure:** In order to maximise the scale of impact, demand would need to be aggregated across member states and individual agencies. The EU can harmonise legislation, allowing some coordination among member states, but implementing in individual government agencies and driving multi-agency coordination may prove more challenging. The Commission is currently drafting the implementing legislation for the Construction Products Regulation and the Ecodesign for Sustainable Products Regulation, which could form the basis for more harmonised used of green procurement criteria, along with the upcoming revision of the Public Procurement Directive.

Fertiliser

Simplified Value Chain

	Upstream		Midstream	Downstream
	Ammonia production	**Fertiliser production**	**Crop production**	**Food processing and retail**
Green premium (assuming 100% use of low-carbon products)	69%	33%	8%	0.7%[H]
	The green premium diminishes down the value chain. The majority of this is associated with green ammonia production and depends on its location			
Competition distortion risk	High and partially mitigated by EU ETS & CBAM		High	Low
	Most of the value chain is exposed to international competition, but only upstream is (somewhat) protected from carbon leakage by CBAM			
EU trade deficit / surplus	Trade deficit		Varies across products	Trade surplus
Key issues	• Supply chain disruptions - geopolitical risks and import reliance, need to diversify in light of recent price shocks • High natural gas costs		• Supply chain disruptions and increased costs • Limited ability of farmers to afford higher costs and operate under environmental legislation • Hesitence from the farming industry, including lack of awareness that clean fertiliser use does not impact crop yields • Lack of traceability of green attributes along value chain	• Interest rates and inflation make increased food costs challenging • Limited traceability of clean attributes in products linked to the fertiliser and ammonia production • Lack of traceability of green attributes in food products linked to original fertiliser production

In practise varies by end product - 0.7% premium is based on an indicative loaf of bread
Figure sources here[44]

Verdict

The fertiliser sector offers a high-impact opportunity to scale clean ammonia. It dominates ammonia consumption in the EU today, fertiliser production could serve as an early market for clean ammonia. The estimated impact on downstream prices for studied products, such as a loaf of bread, is modest, at <1% by 2030, but fertiliser remains a major input cost for farmers with a significant green premium. While international competition in food and fertilisers poses challenges, targeted support across the value chain can help manage the green premium.

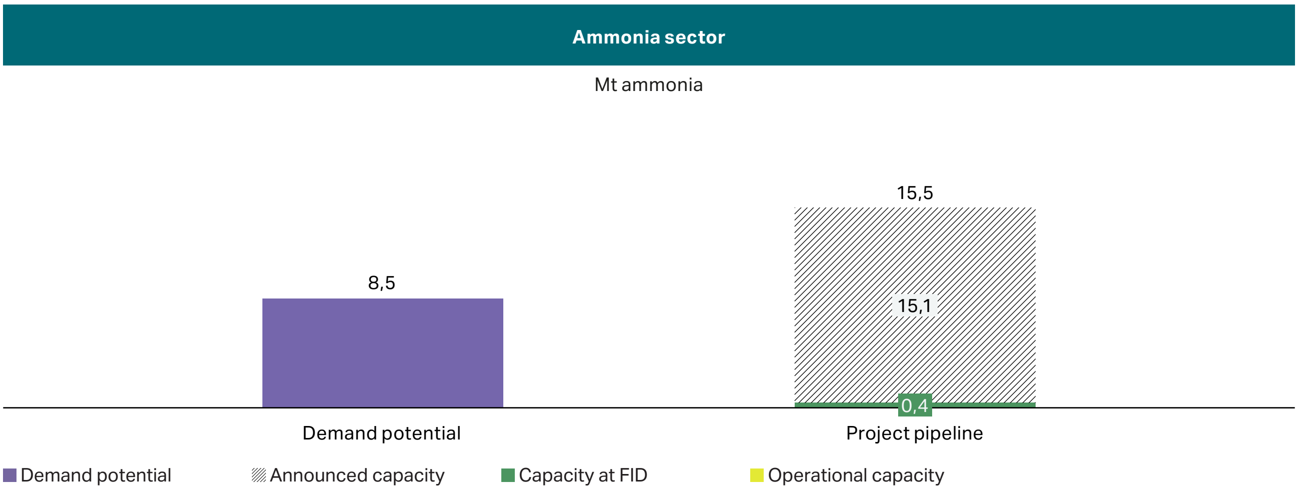
Scale: [High] around 8.5MT/yr of ammonia

In 2022, roughly 8.9MT/yr of nitrogen fertiliser was used in the EU agricultural sector, translating to ~11MT/yr of embodied ammonia[J].The current pipeline of announced clean ammonia projects in the EU represents ~15.5MT/yr , as illustrated in Figure 25. In addition, many projects from outside the EU are targeting imports into Europe. By 2030, the EU's Farm to Fork Strategy45 targets a reduction of fertiliser use of 20%. Factoring in such a reduction in overall demand, the EU fertiliser sector represents roughly 8.5MT/yr demand for ammonia, equivalent to 60% of the pipeline of EU clean projects.

The current pipeline of clean ammonia projects significantly exceeds projected demand from the fertiliser sector, which remains the dominant consumer of ammonia today. To date, only one commercial-scale blue ammonia project has reached FID, around 3% of the announced capacity. While fertilisers will be a key early market, additional large-scale demand from sectors such as shipping will be essential to help more of this pipeline progress. It is also possible that not all announced projects will proceed to completion, given market and policy uncertainties.

Figure 25

Comparison of overall demand for ammonia in the fertiliser sector in the early 2030s versus the green project pipeline in the ammonia sector



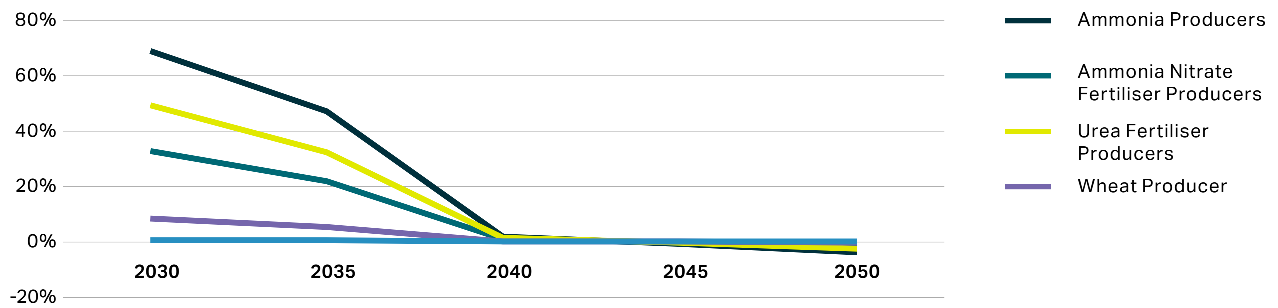
Sources: project pipeline based on MPP aggregation of public announcements

J. Nitrogen fertilisers are typically accounted for by the weight of Nitrogen that they contain. This estimate of embodied ammonia uses a conversion factor of 17/14 from Nitrogen (N) to ammonia (NH3).

Cost impact on end product: [Low] Despite a relatively high green premium at the fertiliser production stage, 33% for ammonium nitrate and 49% for urea (based on imported green ammonia from low-cost producers), the impact on final food products (especially those that undergo processing steps) is minimal. For example, the cost increase for a loaf of bread is estimated at 0.7% in 2030, other studies[46] suggest similar results for a range of products (tomatoes, potato fries, milk, cheese etc.). However, until the green premium is reduced it remains significant in the mid-stream of the value chain (e.g. for intermediate crop production) due to the significant cost contribution of fertilisers to crop costs – such cost impacts could be reduced through optimisation in fertiliser application and other levers, but appropriate support mechanisms to help manage the green premium are likely to be needed. Furthermore, cost impacts could be further managed by initially targeting a small share of demand as supply ramps up and costs come down – an initial 10% use of clean ammonia would result in increases of below 0.1% in our example. By 2050, the green premium could become negligible if green hydrogen costs can be reduced close to parity with grey hydrogen (which is currently projected for the lowest cost regions of the world). Full assumptions underpinning this analysis can be found in the technical annex.

Figure 26

Green premium (%) of using green ammonia for fertiliser value chain stakeholders 2030-50



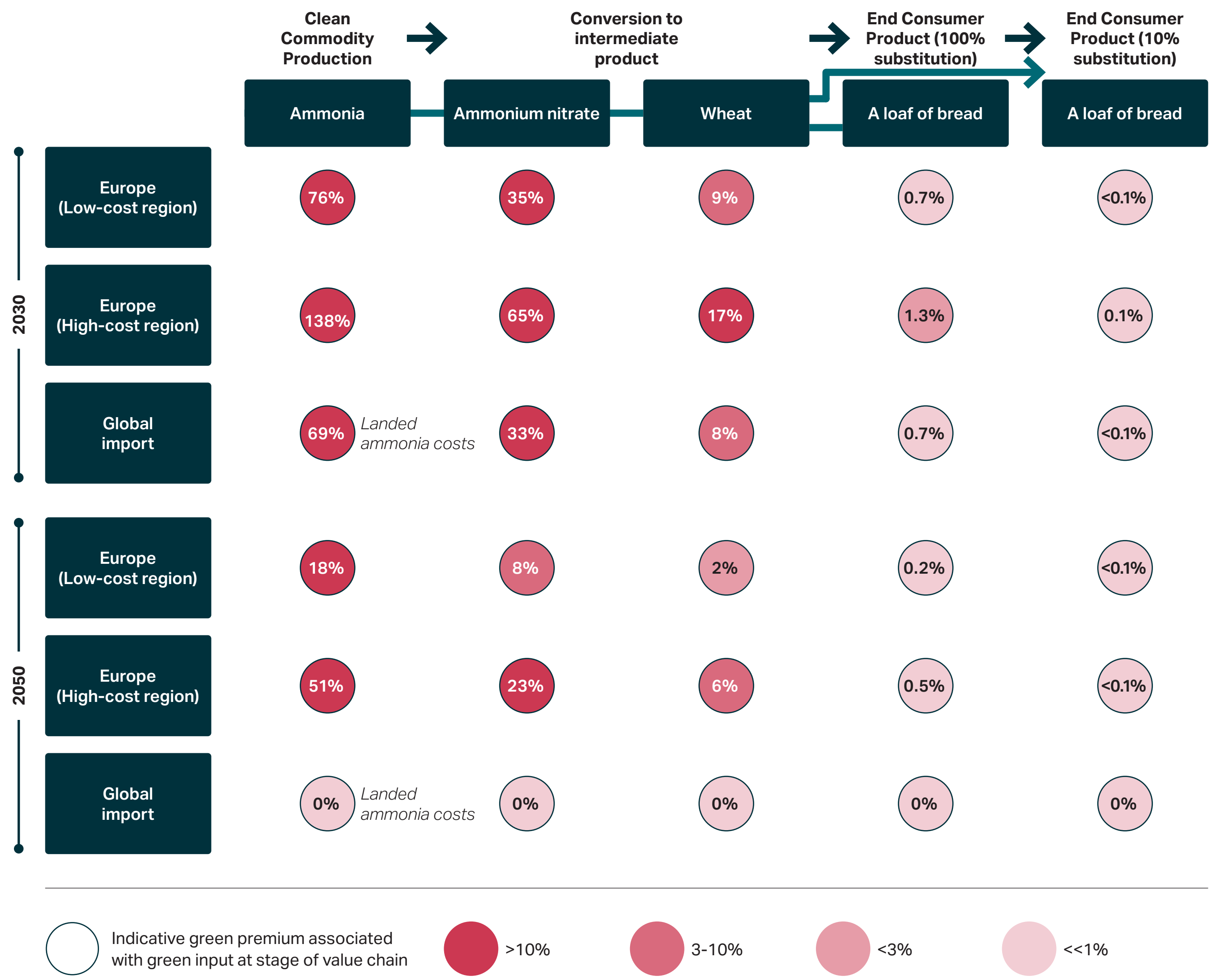
Source: Ammonia figures are based on BloombergNEF (2025): Ammonia Levelized Cost Outlook, cost pass through assumptions can be found in the technical annex

Sensitivity to ammonia sourcing: The production cost of clean ammonia is expected to vary significantly depending on the location of production, the production pathway and the local cost of producing clean hydrogen. The table below shows the cost impact based on different sourcing scenarios for producing green hydrogen for use in ammonia production. The scenarios are Regions of Europe with relatively high renewable costs (€5.9/kgH2 in 2030 and €3.5/kgH2 in 2050); European regions with low costs (€4.3/kgH2 in 2030 and €2.6/kgH2 in 2050); and cheap global locations (€3.1/kgH2 in 2030 and €1.5/kgH2 in 2050[K])[47] – transport costs to Europe are assumed to be ~€90/tNH3. This analysis focuses on green ammonia, which constitutes the majority of the clean ammonia project pipeline. Nonetheless, alternative pathways such as blue ammonia may also contribute to decarbonising fertiliser production. To ensure genuine emissions reductions, the blue hydrogen used for blue ammonia production needs to be subject to robust guardrails, including high carbon capture rates and stringent controls on upstream methane leakage, which can otherwise undermine its climate benefits[48].

K. Source - ammonia costs based on BloombergNEF (2024): Hydrogen Levelized Cost Outlook 2025, additional cost pass through assumptions can be found in the technical annex

Figure 27

Impact on green premium from clean ammonia production in locations with varying renewable energy costs



To translate these insights into action, policymakers will need a toolbox of targeted interventions that create clear, credible demand signals for clean ammonia. Below, possible approaches are outlined.

Intervention #1 Mandatory product decarbonisation: Under the Renewable Energy Directive (RED III), the EU requires member states to use a share of green hydrogen derivatives in industry (up to 42%), including in the production of nitrogen fertilisers[49]. Because RED III is a directive, Member States design the implementation measures. A range of measures are being considered, including mandatory schemes for industrial users in the Netherlands[50] and Romania[51], and subsidy schemes in Germany[52]. However many countries are putting in place reduced requirements (for example the Netherlands is exploring a 4% requirement[53]). Although these measures create demand for green hydrogen and their derivatives, they do not on their own create downstream demand for clean fertilisers which has been flagged as a significant policy risk[54].

As an option to help address this, we explore applying requirements for using clean ammonia either to fertilisers (both imported and domestically produced), or by introducing food product-level requirements-initially by labelling, but moving towards mandatory requirements- for fertiliser decarbonisation or for specific food products where the green premium is low.

Key considerations

1. **Managing costs over time:** Under this model, the cost of clean ammonia would be distributed down the value chain, either by incentivising downstream purchase of clean fertilisers or to food products derived using them. For the latter option, such measures could be targeted towards products where the green premium is especially low, or measures could initially target a relatively small share of overall demand to keep costs low, and ramp up over time as the cost premium of clean fertilisers is reduced.
2. **Managing downstream impacts:** Ensuring that imports of fertilisers/food are required to comply with the same standards as domestic production could help address risks associated with the green premium, particularly because at these stages of the value chain the green premium is significant and these sectors are exposed to international competition. Despite being a net importer of fertilisers, the EU also exports a significant amount of fertiliser (e.g. it exported 9.5 million tonnnes in 2024) and food (exporting €235.4 billion of agri-food products in 2024, a net surplus), so careful design will be needed to ensure export competitiveness isn't affected.
3. **Building political support:** New measures will need to be designed carefully, given the potential difficulties farmers may face to absorb the green premium due to slim profit margins and the challenges in adopting green regulation targeting farmers at EU-level in recent years. This intervention seeks to reduce this risk by creating a market for reduced carbon fertilisers or food products. In practise it may be more effective to mitigate risks to farmer competitiveness by extending requirements downstream, further than fertilisers (e.g. to food processors, wholesalers or distributors). In this case, measures will likely need to be introduced gradually and paired with subsidies to ensure cost pass-through.
4. **Implementing the measure:** The EU has already developed standards for clean hydrogen production pathways. In order to enforce this regulation, certification would need to be extended downstream and overseen by a regulatory agency. Although extension downstream may help reduce the impact on competitiveness, it will require regulating a wide range of diverse products which will increase complexity. Crucially, success of this policy would depend on being able to verify the use of clean fertilisers in food imports. Such a system could be based on organic food labelling schemes that have been developed by the EU. Efforts would need to be made to ensure that demonstrating compliance is not over-burdensome, particularly given the number of SMEs across the sector.

Intervention #2 Demand-side subsidy: This intervention would reduce the cost of green fertilisers using a demand side subsidy. This would make green fertilisers more affordable for farmers and help create demand. In practise, a number of subsidy tools have been developed in the EU and beyond to support adoption of clean hydrogen and its derivatives that can be applied in parallel or as an alternative[55].

We estimate the cost of completely bridging the green premium for 10% of the EU's fertilisers to be between €290 – 580 million euros per year in 2030[L]. It is worth noting that upstream hydrogen production is already receiving support through mechanisms like the EU Hydrogen Bank (€2 billion) and national schemes such as Germany's Carbon Contracts for Difference (CCfDs), which may contribute to overall support.

Key considerations

1. **Managing costs over time:** In this case, subsidies would either be increased or repurposed to incentivise the use of green fertilisers in the agricultural sector. Such an intervention would fall on the EU's budget.
2. **Managing downstream impacts:** Subsidising green fertilisers would improve their competitiveness relative to fossil-based options, and create an incentive for their use in food production. As with other measures, it will be important to ensure that accessing such incentives wouldn't dramatically increase administrative burden. It is also key to ensure that subsidies do not over-subsidise fertilisers, as this could lead to overapplication, increasing nitrogen pollution, therefore the exact model of subsidy would need to be carefully considered.

L. Note that this is an order of magnitude estimate, based on using the green premiums above as upper and lower bound. Hydrogen costs are expected to vary significantly on a project-by-project basis, and exact subsidy needs would need to be underpinned by detailed cost assessments.

Auction instruments such as green market makers that make use of consumer willingness to pay may be a promising model[56].

3. **Building political support:** Support for demand-side subsidies for green fertilisers is likely to come more easily than other green regulations in the agricultural sector in recent years, as it can help manage costs. Nonetheless, measures should still be designed carefully to ensure that farmers benefit fairly from repurposed or increased subsidies. If existing subsidies were repurposed from other areas, it may need to be done gradually to manage potential resistance from those accustomed to them, along with support to farmers who wish to transition to green fertilisers.
4. **Implementing the measure:** Implementing and verifying green fertiliser use across a fragmented agri-food sector, dominated by SMEs, may be relatively complex, and would need to be underpinned by a robust fertiliser standards and verification systems. It may therefore be simpler to provide subsidies further upstream (e.g. at the ammonia production stage).

Renewable Energy

Simplified value chain (based on offshore wind)

	Upstream			Midstream		Downstream
	Steel making	**Cement making**	**Concrete making**	**Component Manufacturing**	**Wind turbine Construction**	**LCOE**
Green premium (assuming 100% use of low-carbon products)	+45%	+80%	+30%	+4-10%	+2%	+1.5%
	The Green premium diminishes down the value chain, but is still sizeable for components of wind turbines, which are widely traded globally					
Competition distortion risk	High [partially mitigated by CBAM & ETS]	Medium [Partially mitigated by CBAM & ETS]		Medium	Localised	
	The upstream part of the value chain is particularly exposed to international competition, and it is (somewhat) protected from carbon leakage by CBAM					
EU trade deficit / surplus	Increasing trade deficit	Modest trade surplus (decreasing)		Trade surplus	Localised	
Key issues	• Global overcapacity of steel • Weak demand in the EU • High energy costs • Need for robust standards and emissions accounting methodologies to demonstrate sustainability attributes across the value chain			• EU wind turbine manufacturers are currently running at no margin, or are loss making • Challenge sourcing green inputs for specific components • Challenge for SMEs in value chain to manage additional compliance burden (embodied carbon reporting) • Need for robust standards and emissions accounting methodologies to demonstrate sustainability attributes across the value chain		• Need to recoup additional costs of clean materials (e.g. via increased strike price) • Need for robust standards and emissions accounting methodologies to demonstrate sustainability attributes across the value chain

Figure sources here[57]

Verdict

The renewable energy sector is a niche but growing market for clean metals and cement. In the 2030s, total demand across the whole sector could be equivalent to up to 7-10% of the EU green steel pipeline, and up to 3% for low-carbon cement. The green premium is expected to be manageable downstream for developers and end consumers of electricity.

Scale: [Medium] 4.5-7.5 MT/yr of steel, 8.2 MT/yr of concrete and 0.6-1.1 MT/yr of aluminium

The EU renewables sector is expected to significantly expand by 2030. The material demand estimates below are based on the targets and assumptions set out in Figure 28.

Steel: demand from EU wind and solar deployment could reach 4.5-7.5 MT/yr, equivalent to 6-11% of the EU clean steel pipeline.

Concrete: demand from wind alone could require around 8.2 MT/yr, or 3% of the clean EU pipeline.

Aluminium: demand from solar could reach 0.6-1.1 MT/yr. Most of the manufacturing of solar panels deployed in the EU (~85%[58]) currently occurs abroad (especially within China), so the impact of reducing the embodied carbon within solar panels may drive decarbonisation of aluminium outside of Europe.

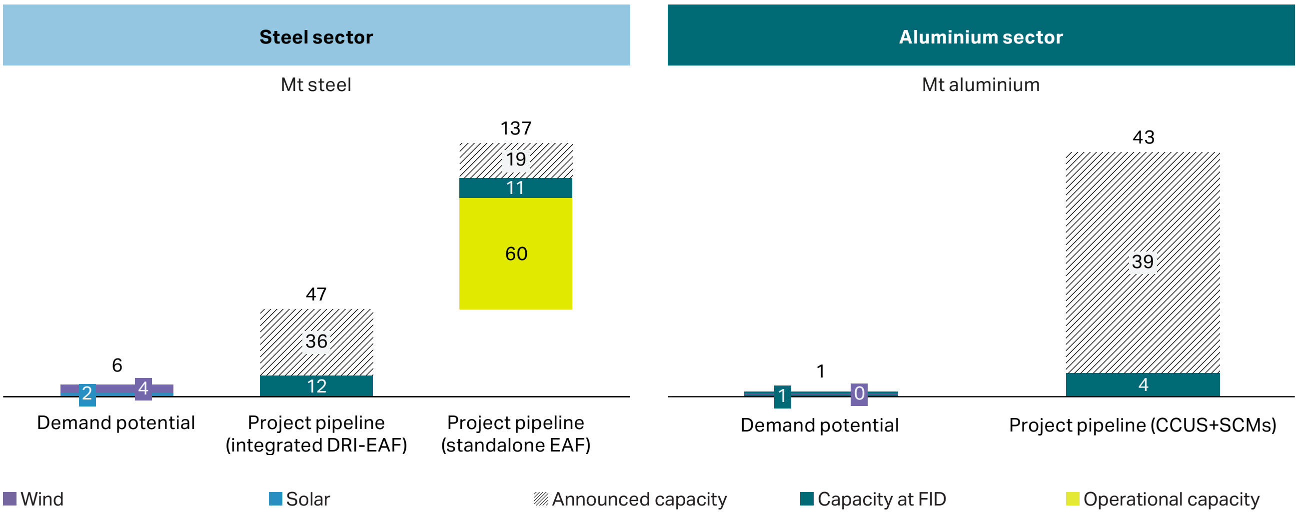
Figure 28

Targeted capacity additions and implicit material demand by generation type in 2030

Sector	Capacity additions (2030)	Material intensity	Material demand (MTPA) by 2030	% of EU clean pipeline
Wind (steel)	24-38 GW/yr (85% onshore – 15% offshore)[63]	120 t/MW (onshore)[64] 173 t/MW (offshore)[65]	3-5	4-7%
Solar (steel)	70 GW/yr[66]	60-105 t/MW	1.5-2.5	2-3.5%
Wind (concrete)	24-38 GW/yr	380 t/MW (onshore) 260 t/MW (offshore)	8.2	3%
Solar (aluminium)	70 GW/yr	30-50 t/MW	0.6-1.1	8%

Figure 29

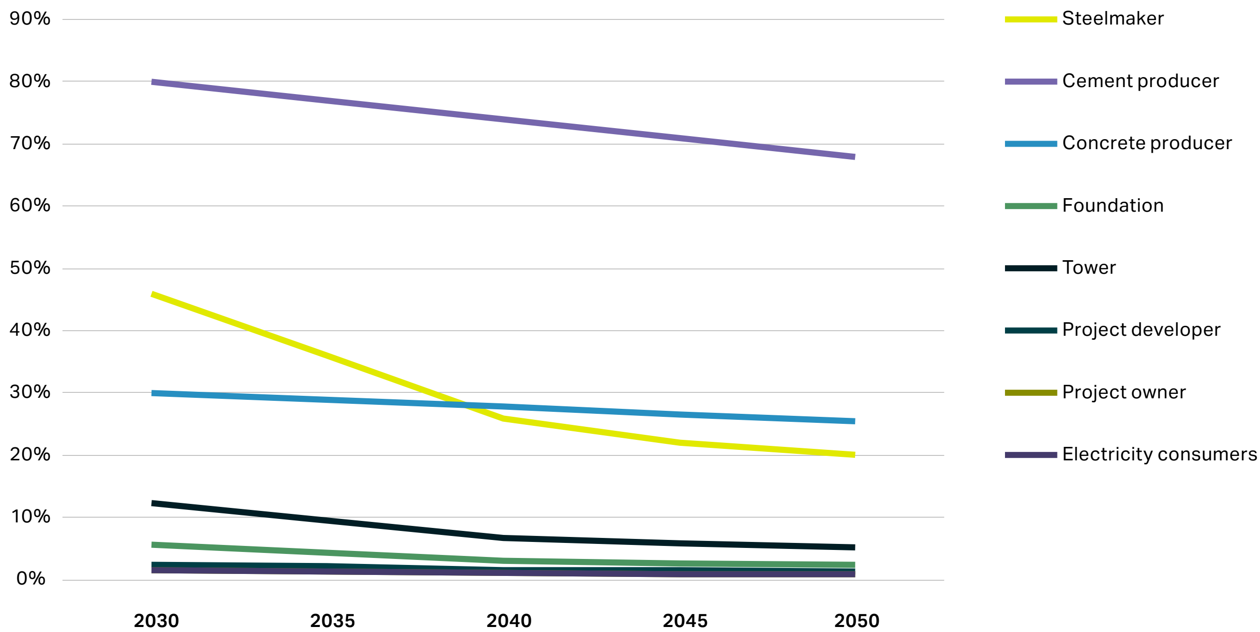
Comparison of overall demand for steel and aluminium in the renewables sector in the early 2030s versus the green project pipeline in the steel and aluminium sectors



Cost impact on end product: [Low] Taking a 10MW offshore wind turbine as an example, we estimate that the combined premium from using clean steel and concrete can be as high as 9-15% for intermediate components of the value chain (e.g. tower manufacturing). However, this is only one component of overall project costs. At a project level, we estimate the cost increase to be approximately 1.5-2.5%. (Figure 30). For end consumer electricity costs, these are diluted further because wind is only part of the generation mix, and additional grid tariffs and charges further dilute the impact on end costs. Full assumptions underpinning this analysis can be found in the technical annex.

Figure 30

Green premium (%) of green steel and concrete for value chain stakeholders 2030-2050

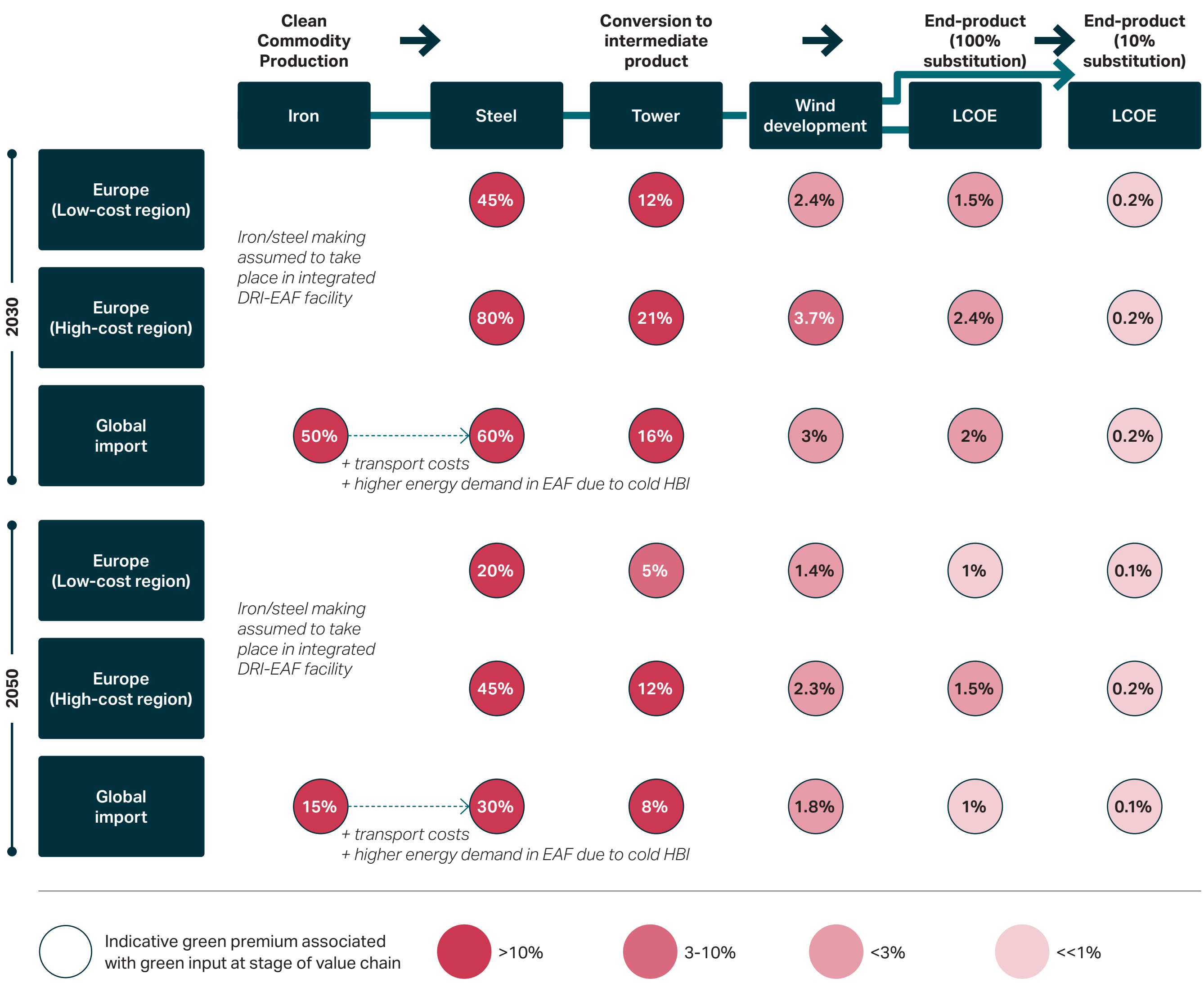


Note: This is a low-cost scenario, where component manufacturing stages happen in the cheapest locations (e.g., Iberia).

Sensitivity to commodity sourcing: The green premium of steel can vary depending on the cost of clean hydrogen at the ironmaking stage. The table below shows the cost impact based on different sourcing scenarios for producing clean hydrogen for use in ironmaking. The scenarios are based on: Regions of Europe with high renewable costs (€5.9/kgH2 in 2030 and €3.5/kgH2 in 2050); European regions with low costs (€4.3/kgH2 in 2030 and €2.6/kgH2 in 2050); and cheap global locations (€4.1/kgH2 in 2030 and €2.4/kgH2 in 2050)[59]. In the global import scenario, hot briquetted iron is transported into Europe rather than produced in an integrated DRI-EAF plant. It therefore needs to be remelted and incurs additional costs at the steel-making stage.

Figure 31

Impact on green premium from clean ammonia production in locations with varying renewable energy costs



To translate these insights into action, policymakers will need a toolbox of targeted interventions that create clear, credible demand signals for clean materials in the renewables sector. Below, a possible approach is outlined.

Intervention #1 Non-price criteria in contracts/ tenders: This intervention would involve governments integrating non-price criteria incentivising the use of clean steel and concrete in renewable energy projects (e.g. limits on embodied carbon, or directly rewarding the use of clean materials). Similar non-price criteria are increasingly used in national auctions in Germany, France and the Netherlands[60] to support factors such as ecological impact, system integration and local content.

Key considerations

1. **Managing costs over time:** Depending on national electricity system design, the costs associated with the use of green materials could be borne by consumers, or by government. The most common financing instruments support mechanisms that fall under competitive bidding processes for support for new renewable generation in the EU are Contracts for Difference (CfDs). Using clean materials may lead to a small increase in the strike price offered in such auctions. Given most electricity is priced on a marginal basis, with gas or coal plants often setting the marginal price, it is likely that such an increase in a CfD strike price would increase support scheme costs rather than directly raise market prices. Such support schemes are predominantly financed by levies/ charges on electricity bills, but are sometimes paid for via taxation which determines how the costs would be passed on. Given the relatively marginal project level cost, and that renewables are only one component of the electricity system, the premium associated with the use of green materials (especially deployed at limited volumes initially) would be a very small component of overall system costs.
2. **Managing downstream impacts:** Criteria must apply equally to imported and domestic materials to avoid trade distortions. Administrative complexity should be minimised, especially for SMEs involved in the supply chain.
3. **Building political support:** Cleantech manufacturers have often shown support for stronger demand signals for clean commodities[61]. However, the wind industry faces cost pressures (particularly in recent years) and may struggle with additional requirements without incentives (e.g. associating use of clean materials with a bonus on the strike price)[62]. Engagement with member states will also be crucial to find alignment on non-price criteria, as costs would need to be passed on to consumers or taxpayers.
4. **Implementing the measure:** Although EU-level policy makers can encourage integration of non-price criteria into such tenders, it may be challenging to set harmonised criteria for clean steel and concrete across member states and implement them across a large number of auctions. The EU's Net-Zero Industry Act sets out a requirement to assess sustainability when evaluating renewable energy auctions. This could serve as an initial basis for including embodied carbon limits in auction criteria.

Defence

Verdict

Niche lead market for metals. The defence sector is increasingly seen as a potential lead market for green materials in Europe, particularly because spending in this sector is expected to ramp up, with a strong case for domestic supply chains given the security angle. However, for the studied commodities, the green demand creation potential of this sector is limited because of the relatively small volumes involved. The green premium for complex end products is expected to be low. However, a diverse range of specialised materials and complex end products will be needed, making it challenging to aggregate a demand signal across end uses. Defence may be instrumental in testing new low carbon materials and rolling out standards, as well as an important reason to secure resilient supply chains of materials.

Green demand creation potential: [Low] Uncertain, estimated at <1Mt/yr per year for aluminium and steel[M]

Steel: As an example, tanks are a steel-intensive military product, requiring roughly 60 tonnes of high-quality steel per tank[67]. Public estimates suggest that the EU currently has 6,000-7,000 main battle tanks[68]. Were EU countries to significantly increase procurement to c. 1500 tanks per year, likely far more than current production, this would still only represent a small share of the green steel sector pipeline at 82.5KT/yr.

Aluminium: the number of fighter jets across Europe (including non-EU Member States) air forces is currently estimated to be ~1700[69]. At least 750 additional fighter jets are estimated to be currently ordered[70]. Assuming each fighter jet requires 3 tonnes of aluminium[71], doubling the EU's total air force to 2030 would represent an aggregated demand signal of ~600kT of aluminium per year, again very small compared to the overall scale of the aluminium sector.

Although these volumes are relatively low, procurement of final products is driven by the public sector. Defence may therefore prove a strategic lead market, where policymakers can test standards for new clean products, and or procure limited volumes produced with more nascent innovations (e.g. anode decarbonisation technologies for aluminium production).

The figure below shows estimated demand volumes and green premiums for a range of military products under high uptake assumptions. Assumptions underlying this analysis can be found in the technical annex.

Figure 32

Green premium (%) of clean aluminium and steel in selected military equipment

	Cost increase on final product (100% use of low carbon steel/aluminum)	Uptake assumptions	Uptake assumptions
	<1%	30,000 per year (assuming a CAGR of 3.8% to 2030)	0.26 Mt of steel per year
	<<1%	460 per year (10 times the 1997-2014 yearly average)	1,380 tonnes of aluminium per year
	<<1%	1,500 per year (2x today's fleet by 2030)	82,500 tonnes of steel per year
	<10%	70 per year	31,500 tonnes of aluminium and 140,000 of steel per year

M. Note that cement is not considered in this section, as its consumption likely falls under the infrastructure and buildings sections set out earlier in this report

Cost impact on end product: [Varying] For highly complex end-products like tanks and fighter jets, the impact of green steel and aluminium usage on the final green premium is estimated to be minimal, at <0.05% for a military tank and fighter jet in 2030. However, for other equipment, like ships, using clean aluminium alloys and steel could drive up to a % increase in the cost of a final product[72] (based on a non-military vessel).

To translate these insights into action, policymakers will need a toolbox of targeted interventions that create clear, credible demand signals for clean metals in the defence sector. Below, a possible approach is outlined.

Intervention #1 Green Public Procurement: This intervention would place embodied carbon limit requirements on the procurement of equipment for the military and defence sector. The equipment in scope would likely have a significant share of steel or aluminium in its make-up, such as tanks, trucks and fighter jets.

Key considerations

1. **Managing costs over time:** The green premium associated with the clean steel and aluminium would be covered by member states' defence procurement budget. It is expected that as defence expenditure increases, overall procurement will continue to ramp up, thereby increasing the total demand and spend for green materials.
2. **Managing downstream impacts:** In recent years, there has been a shift towards procuring an increased share of military equipment from abroad, and the EU has set out ambitions to increase the share of domestic production of military equipment. If domestic production is prioritised, this policy is unlikely to drive production of materials in jurisdictions with less stringent environmental policies. If this shifts all production (including exported equipment) produced in the EU to be green, then this may drive a minor reduction in competitiveness unless other jurisdictions adopt similar standards.
3. **Building political support:** Policymakers will likely see this as an opportunity to support domestic producers and improve domestic industrial base. Early member state engagement will be crucial to manage potential sensitivities around national security. The sector is already heavily standardised and making use of existing systems and methodologies could help address manufacturers' concerns around additional regulatory complexity. Careful coordination will be necessary to ensure balance between environmental requirements with standards that extend beyond the EU, such as NATO standards.

Implementing the measure: This policy and the underlying carbon accounting and reporting methodology would ideally be harmonised between member states to maximise the scale that could be reached. It would require detailed emissions accounting methodologies to be developed for a range of end products that rely on specialist alloys and other complex materials which may be a challenge. Military procurement is generally planned with long lead times, which means that new measures for clean defence procurement may take a long time before starting to have an impact.

Technical Annex:

Status of the EU's supply and demand

Aluminium

Origin of current supply
Aluminium is produced through two different routes:

- The primary route, based on an electrolysis process and
- The secondary route based on the recycling of aluminium scrap.

Both types of production are important because scrap volumes for secondary aluminium making are not sufficient to meet all expected growing demand, and in addition some applications have very high purity requirements which may not be met by unsorted scrap, such as electrical cables.

Since the 2008 financial crisis, the EU27 has been experiencing a decline in primary aluminium production and increased reliance on imports. Today, primary imports make up about half of EU27 aluminium supply, around 40% comes from domestic scrap recycling and the remaining ~10% comes from domestic primary production. Since the Russian invasion of Ukraine, the resulting increase in energy costs has further exacerbated the situation and five European smelters have been shut down due to increased electricity prices.

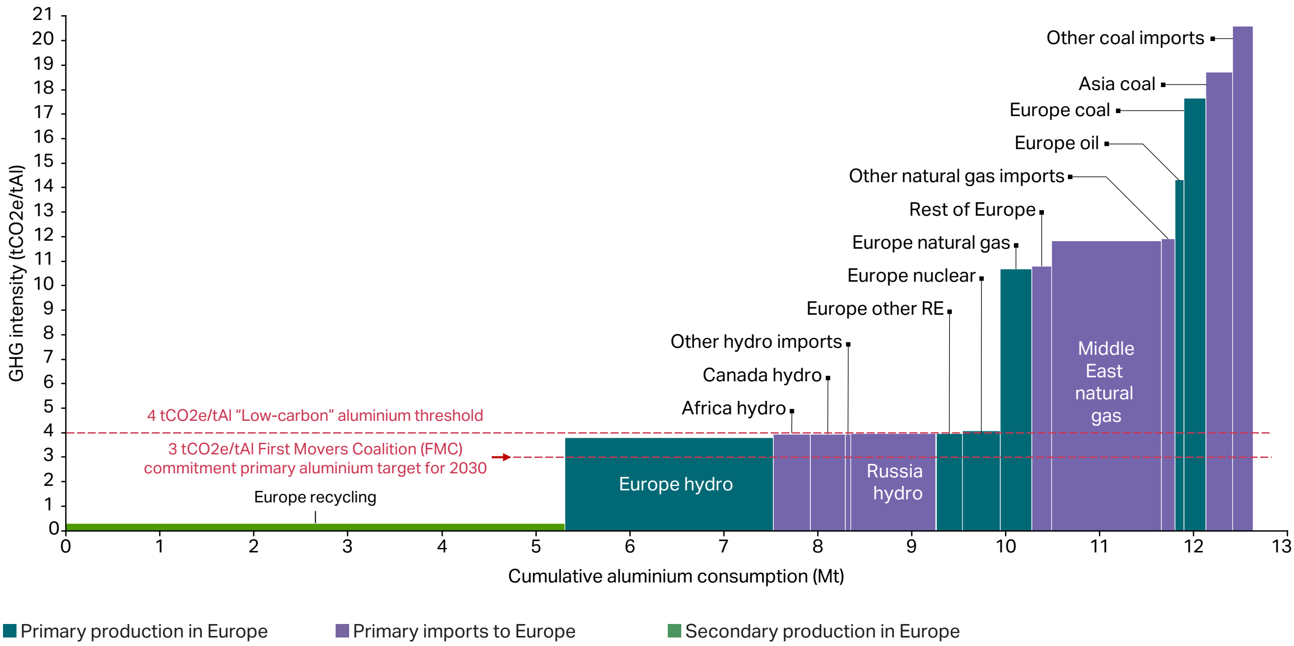
The production process of primary aluminium is very electricity-intensive, causing electricity to represent about 2/3 of the emissions of the global value chain and 30-40% of aluminium production costs. However, the emission intensity of primary aluminium highly depends on the electricity generation source, ranging from less than 4 tCO2e/tAl for renewables or nuclear to more than 20 tCO2e/tAl for coal-based power generation. The origin of primary aluminium is essential in determining the emission intensity of the EU27 primary aluminium supply. below provides an estimate of the GHG intensity distribution of primary aluminium consumed in Europe in 2021. It appears that almost 2/3rd of the EU27 supply of primary aluminium is from clean sources i.e. using electricity supplied usually from hydropower, but also nuclear and other renewables. The remaining supply has a much higher emission intensity (> 10 tCO2e/tAl) and mainly comes from imports of natural gas and coal-based primary production.

Green aluminium project pipeline
Around 2/3rd of the EU27's existing aluminium capacity uses clean sources of electricity, and the EU has two smelters that have financed plans to switch to renewable generation. In addition, one new project for primary aluminium has been announced in Europe in 2024: the Arctial project, in partnership with Rio Tinto, is studying the feasibility of a 550 kt/yr smelter in Kokkola, Finland. Alcoa also plans to restart its 230 kt/yr smelter in San Ciprián, Spain, aiming to complete its restart by mid-2026[73] with new wind PPAs representing 75% of the plant's power requirements. The combined capacity of these two smelters represent only about 5% of the current EU27 aluminium consumption, so it is likely that EU27 will remain heavily dependent on primary imports in the short to mid-term. Beyond this, there are no identified new projects with announced plans to switch electricity supply to clean sources. However, Europe is piloting a few technologies targeting process decarbonisation that can reduce emissions even further, but these projects are primarily at pilot stage.

In the short term, incentivising demand for lower carbon aluminium (i.e. in the 4 tCO2e/ tAl and lower range), is likely to have a limited impact on most EU consumers and to increase imports from regions with clean primary capacities like Mozambique and Canada. The more CO2-intensive EU producers (typically Germany) could be incentivised to procure new renewable PPAs.

Figure 33

Estimated emissions intensity of supply of aluminium to the EU



Source: ITA analysis based on data from: European Aluminium (2024) – Net-Zero by 2050: Science-Based Decarbonisation Pathways for the European Aluminium Industry; European Aluminium (2024) – Environmental Profile Report for the European Aluminium Industry, **1.** Here, Europe includes EU27, UK and EFTA (Norway, Iceland, Switzerland)

Ammonia

Origin of current supply
Unlike the other input products discussed here, almost all of the EU's supply of ammonia is currently derived from one route, the Haber-Bosch process which converts hydrogen and atmospheric nitrogen to ammonia. Although hydrogen can be also derived from coal gasification the EU's production and import are dominated by production from steam methane reformation. Today the vast majority of ammonia usage is in the fertiliser sector, with some used for production of other chemicals. 20% of the EU's ammonia is currently imported, while 80% is produced domestically.

The EU's grey ammonia production capacity was estimated to be 17.7 Mt in 2023, and the region imported an additional 2.5Mt ammonia to meet its domestic needs. Ammonia producers continue to face challenges related to high energy costs in Europe compared to low cost producers such as U.S. Primary suppliers to EU include Trinidad & Tobago, Algeria, Russia, Egypt and U.S. accounting for about 75% of the imports. Russia, despite sanctions, continues to export ammonia fertilisers to EU, though in reduced volumes compared to before Russia-Ukraine war.

Clean ammonia project pipeline
The EU has a significant pipeline of clean ammonia projects. 15.5Mt/yr of capacity is announced but not operational yet, and only one commercial scale plant has reached FID[74]. 80% of the announced project capacity is based on green hydrogen production via electrolysis of water, while the remaining 20% is based on production of blue hydrogen (using CCS to capture emissions from methane reformation)[75]. There are also many announced projects globally (e.g. up to 75%) that are targeting export of ammonia to the EU[76].

Cement

Origin of current supply
Around 163 Mt of cement was consumed in the EU in 2022[77]. The conventional concrete production cycle starts with manufacturing the key ingredient, clinker, which is typically blended with other Supplementary Cementitious Materials (SCMs) to produce various cement types. Cement is combined with aggregates, water, and further SCMS to form concrete. Clinker constitutes, on average, only 11% of the mass of concrete and 4% of the total cost, but it accounts for 88%[78] of the total Scope 1 and 2 emissions of the industry.

Clinker is made from a mix of two raw components: limestone and clay. Limestone calcination generates process CO2 emissions, which account for roughly 60% of the sector's emissions. Because this CO2 is released through a chemical reaction, it cannot be eliminated by increasing efficiency or changing fuel. Around 30% of the sector's emissions come from high-temperature heat generation and the transformation of limestone with the other raw materials inside the kiln.

Clean cement project pipeline
SCMs and fuel switching are two options for cement producers to reduce their emissions that are likely to be cheaper in the near-term compared to investing in CCS technologies, but are limited in the extent of the emissions reduction that they can achieve.

SCMs are a range of products that can substitute clinker. Unlike CCS, the utilisation of SCMs is not expected to add a substantial green premium to the final product and materials like blast furnace slag, fly ash, and limestone have already been used in cement blending for a long time. While the impact of a CCS-based cement on the final cost of a construction project is already relatively limited, lower-clinker cement is expected to have even less of an impact. For that reason, the reduction of the clinker content is a rapidly deployable solution and can contribute to significant abatement in the short- to mid-term before deeper emissions cuts from CCS can be achieved. The main barriers to the mass utilisation of SCMs are restrictive construction codes and inertia in adapting construction practices. The availability of blast furnace slag and fly ash - two conventional SCMs making up around 10% of today's cement composition in Europe - is also expected to decrease with the phase out of blast furnaces for steel production and coal power plants. CEMBUREAU, the European Cement Association, is targeting to move from an average clinker content of 77% today to 74% by 2030 and 60% by 2050[79]. It is worth noting that other studies consider much more aggressive reduction in the clinker ratio, aiming for as low as 50% or even 40% on average by 2050[80].

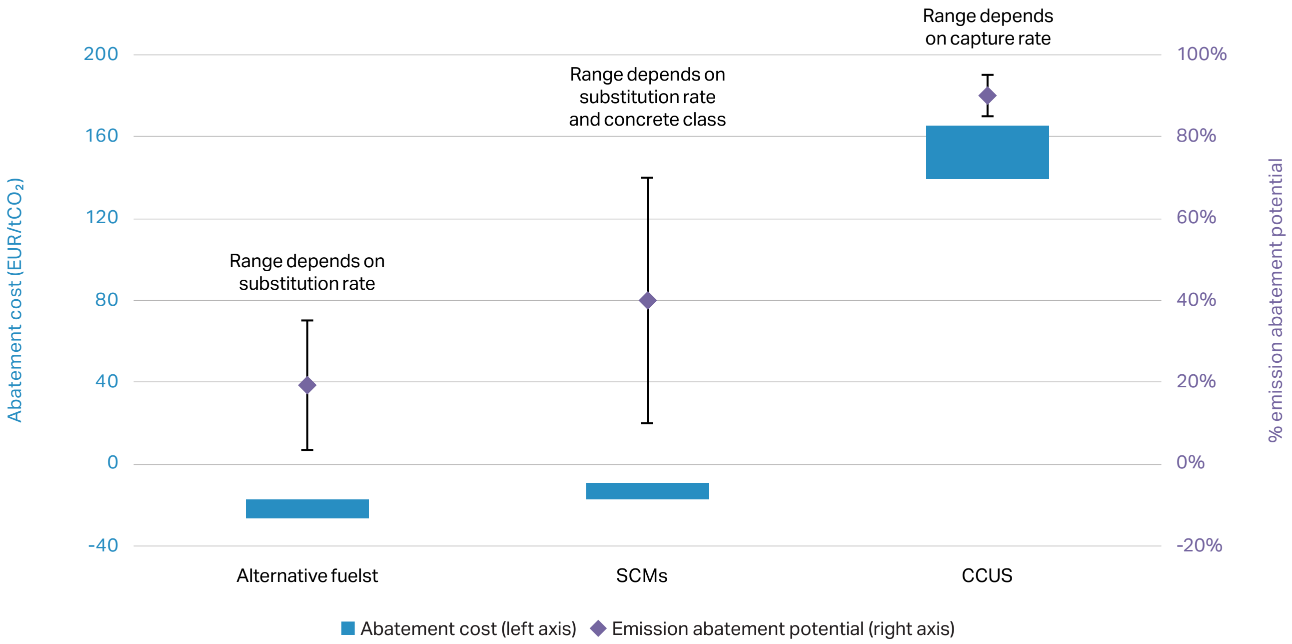
Meeting the 2050 clinker-to-cement ratio target of 60% would generate considerable emission savings across the EU. Based on current cement consumption levels of 163 Mt and assuming an average CO_2 intensity of 0.81 t of CO_2 per tonne of clinker, reducing clinker content from 77% to 60% would avoid over 22 Mt of CO_2 annually. This translates into a roughly 22% cut in total sector emissions. These reductions are relatively cheap and can likely be implemented on a shorter timescale than most CCS projects.

Fuel switching is also expected to contribute meaningfully to emissions reduction, especially in the short term, through increased use of waste-derived fuels and use of biomass, a common practice in many cement kilns. In the EU-27 cement industry, more than half of the heat energy comes from biomass and non-recyclable waste fuels, with some kilns running on close to 100% alternative fuels. Historically, this transition has been driven more by cost savings than climate considerations because the wastes now used to prepare the fuels often have no economic value by those who generate it. This is why the cost of waste acquisition is often close to zero, or even negative in some instances (e.g. the cement industry gets paid to offtake and process the waste). Waste transport, handling, preparation and air pollution control add some costs but it often remains manageable compared to conventional fuels, particularly in locations where fossil energy is expensive. As a result, fuel switching should not come with a major cost increase to cement and in some cases could even reduce production costs slightly. In jurisdictions with a carbon pricing mechanism such as Europe, switching to alternative fuels with a biomass content proves even more cost effective since it reduces fossil CO2 emissions and therefore the carbon cost component. Key barriers to this lever are the sourcing of waste fuels and permitting, and regulation. By 2050, CEMBUREAU is aiming for an average of 95% alternative fuel usage in cement production.

CCS is expected to play a crucial role in the long-term decarbonisation of the cement sector, particularly because over 50% of the sector's current emissions arise from the chemical reaction involved in clinker production, which cannot be abated through fuel switching or efficiency improvements. CCS can capture both process and combustion emissions, making it a critical solution to achieve net-zero targets. However, bringing CCS to market at scale remains challenging. Unlike other lower-cost levers, it involves significant capital and operating costs and requires a supporting infrastructure for transport and storage of the captured CO2. As illustrated in below, CCS is expected to add a much larger premium to cement and concrete. Because this is expected to require considerable financial incentives to bring projects to FID, the sections above focus primarily on this lever. Importantly, CCS is assumed to be limited to a select number of plants where economics, infrastructure access and storage options are in place.

Figure 34

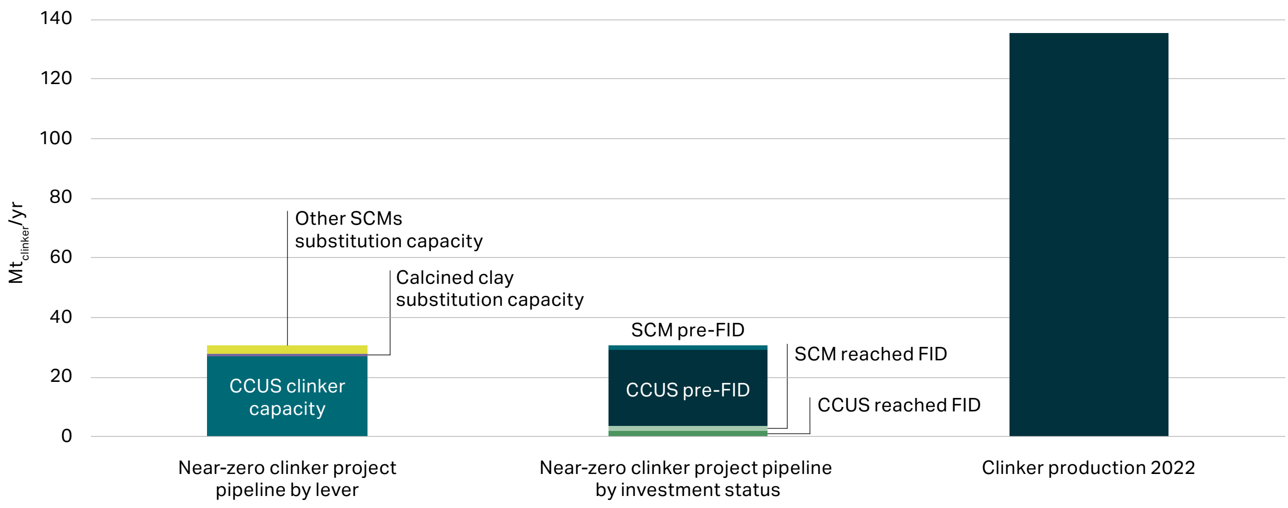
Abatement cost (EUR/tCO2) and % abatement potential per lever



The combined pipeline of CCS and SCM projects holds the potential to decarbonise or substitute around 20-25% of the current EU27 clinker production, but only about 10-15% of this has passed a FID. Most of the cement pipeline waiting for an FID is related to CCS projects. It is important to note that SCM projects are not systemically advertised in the public domain and therefore very difficult to track accurately. Hence, it is likely the SCM project pipeline presented in the figure below is underestimated. Also, SCM projects such as calcined clay or incorporation of natural pozzolans are much less CAPEX-intensive and more rapidly deployable than typical CCS projects.

Figure 35

Near-zero clinker project pipeline in EU27 compared to current clinker production



Although cement is usually a locally traded commodity due to its relatively low weight-to-value ratio, trade volumes are growing, particularly in the EU. Between 2016 and 2023, EU cement and clinker imports rose from around 2 Mt to 9.3 Mt, a more than fourfold increase[81]. At the same time, EU exports dropped from approximately 24 Mt in 2016 to 10.9 Mt in 2023. This shift highlights a growing reliance on foreign supply, with major imports originating from Turkey (35.8%), Algeria (19.2%), and Ukraine (12.6%). While bulk trade of finished cement will remain constrained by shipping costs, trade in clinker and SCMs is expected to continue rising. One important nuance is that much of the recent import growth is driven by Ukrainian producers exporting to border countries such as Poland, because of the domestic demand collapse in Ukraine. For example, in the first half of 2024, Poland imported more cement from Ukraine than it did in 2023[82].

Steel

Status of the EU steel supply and demand
Today, 120-125 Mt of steel is consumed annually in the EU. This is derived from two production routes:

- Over half of this is primary steel produced via the **Blast Furnace route (BF-BOF):** This is the most CO2 intensive process in the modern steel supply chain because it relies on the use of coal.
- The remaining half of production is derived from recycling scrap in an **Electric Arc Furnace (EAF).** This has c. 10-20% of the emissions of BF-BOF route.

These steel types are typically used to make two sorts of products:

Flat products such as hot rolled coils and sheets. While not a universal rule, flat steel products require high purity steel, limiting the amount of recycled steel they can use, so they often create demand for primary steel and hence iron production, which is currently dominated by the BF-BOF route. Flat products are used heavily in the automotive, and mechanical engineering sectors. The EU has a 10Mt/yr trade deficit for flat products, which primarily originate from regions with less efficient BF-BOF routes and higher emissions than European crude steel.

Long products, such as beams, rebars and wire rod. Recycled steel is currently used for most of these products. Long products are used heavily in the construction sector, particularly for civil engineering projects.

A material flow analysis study conducted on flat products in Europe[83] has been used as a basis to estimate the share of flat versus long steel products used in a variety of sub-sectors. The study provides a detailed estimate of flat steel volumes consumed in each main sectors and subsectors in Europe 2013. Because the quantities are reported in Mt or iron and some losses occur during the conversion of iron to steel, values have been rescaled in Mt of steel to match total flat steel demand reported by Eurofer in 2013[84]. These flat volumes in Mt of steel have then been compared against the total volume of steel in each sector using Eurofer's categorisation. It is assumed that the split of flat versus long steel products has not significantly evolved since then. Final results are presented in the table below.

Figure 36
Estimated share of flat and long steel products in Europe by sector

Sector	Share flat products	Share long products
Automotive	81%	19%
Other transport	23%	77%
Domestic appliances	94%	6%
Tubes	54%	46%
Construction, of which	38%	62%
Buildings	*50%*	*50%*
Infrastructure	*13%*	*87%*
Mechanical engineering	91%	9%
Metalware	85%	15%
Miscellaneous	70%	30%
Total	**63%**	**37%**

A more recent draft report from the Joint Research Centre[85] supports the order of scale of these estimates, especially for the building sector.

Origin of current supply

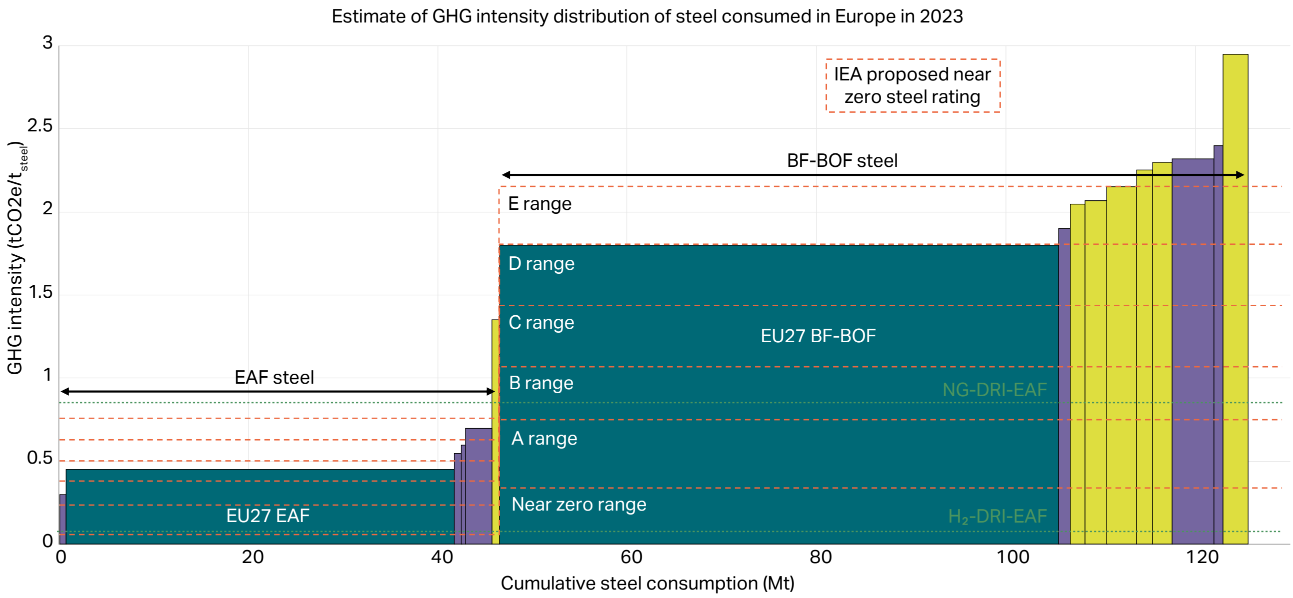
The figure below shows an estimate of the carbon intensity distribution of the EU27's current steel supply, overlayed with the IEA proposed steel emissions rating system. Most of the EU27 BF-BOF steel production ranks between the D and E range in this analysis, while most imports rank E or above. This is due to higher efficiency of EU27 BF-BOFs and a slightly more CO2 intensive fuel mix in trading partners. Similarly, for EAF steel, most EU production ranks in the C range, while imports mostly have a D/E range or higher. This is primarily due to the EU's lower CO2 electricity mix compared to trade partners. The global steel industry has been in a situation of consistent overcapacity since around the 2008 financial crisis. The global steel capacity utilisation rate is now sitting around 75-80%, below what is considered a financially healthy and sustainable rate, around 85-90%. The bulk of excess capacity is generated by China: it is estimated that the Chinese unused production capacity is comparable to the total steel production capacity of India or Japan.

Clean steel project pipeline

As set out above, nearly half of the EU's steel supply is derived from using steel recycling EAF route. Planned EAF capacity in the EU27+UK could add an extra 20 – 30 Mt/yr of capacity (~20-25% of current EAF capacity). In future, availability of scrap could become a limiting factor in the expansion of recycled steel use in EAFs. Even with strict restrictions on scrap exports, EU steelmakers could see a tightening on scrap supply leading to increased competition on the scrap market between new and historical EAFs. Improvement of scrap recycling could improve this scenario – some studies estimate that ~25% of annual scrap (~34 Mt) is currently lost as waste[86].

Figure 37

Estimate of GHG intensity distribution of steel consumed in Europe in 2023, overlayed with IEA proposed near zero steel rating



Source: MPP Analysis based on: Global Efficiency Intelligence (2022) - Steel Climate Impact; World Steel Association (2024) - Sustainability Indicators 2024 report; JRC (2022) - Greenhouse gas intensities of the EU steel industry and its trading parters; IEA (2022) - Achieving Net Zero Heavy Industry Sectors in G7 Members. To estimate this distribution, it has been approximated that flat products are produced from the BF-BOF route and long products from EAF route.

Recycling scrap through EAFs therefore won't be able to scale to satisfy all of the EU's steel demand, and can't produce all of the necessary products for downstream industries. To fill this gap, a pipeline of announced green primary iron projects has developed. These projects make Direct Reduced Iron (DRI) as a lower-carbon which can be combined with scrap in a EAF to produce green steel. DRI uses either natural gas or hydrogen to reduce iron ore. Using natural gas offers around 50% reduction versus BF-BOF and using clean hydrogen can reduce the emissions to near zero. While few have committed to use 100% clean hydrogen from the onset, most DRI projects state plans to transition to clean hydrogen upon favourable market conditions.

Three main DRI project types have been announced: (1) the replacement of CO2-intensive blast furnaces with an integrated DRI-EAF plant, (2) the construction of a greenfield standalone DRI plant that will sell low-carbon Hot Briquetted Iron (HBI) [a "transportable" form of DRI] to other steelmakers and (3) the replacement of blast furnaces with standalone EAFs supplied with steel scrap and external HBI. The aggregation of all the announced projects as of end 2024 is illustrated in figure 38 (for green iron, or DRI) and 39. (for green steel).

The EU's DRI pipeline is now equivalent to over half of current EU iron production, although only roughly 20% has reached a Final Investment Decision (FID). Note that all DRI projects (either integrated DRI-EAF or standalone DRI) are taking place in EU27 countries, and no other European countries such as Norway or the UK. Thus, it is also relevant to compare the DRI pipeline (~46Mt) to the iron production in EU27 (~65-70Mt). As of September 2025, however, three major DRI initiatives in Europe have faced significant setbacks. ArcelorMittal has abandoned its planned DRI projects in Germany and France, while LKAB has postponed its fossil-free sponge iron project in Sweden to the 2040s[87]. Additionally, Thyssenkrupp has suspended its green hydrogen tender for its planned DRI plant due to high costs[88]. These developments underscore the serious challenges currently facing the EU steel industry in its transition toward low-carbon production.

Integrated DRI-EAF and standalone EAF lead to similar remarks. The main difference would be that more than 30% of the pipeline capacity has passed an FID. This is due to the higher proportion of standalone EAF projects having reached an FID, which is to be expected as low-carbon DRI is a much less established technology than EAFs and it is still quite difficult for developers to find a business case. Taken together, the announced pipeline of primary steel projects in the EU represents close to €50bn of investment opportunity, waiting to be unlocked.

- EU steel imports typically have higher CO_2 content than EU27 production (both BF-BOF and EAF steel). The world has a significant overcapacity of fossil steel production. Policies to incentivise use of low carbon steel can support domestic producers in the short term.
- Almost 50% of the EU's steelmaking capacity is from recycled steel, which has a low carbon footprint but is not suitable for all end uses.
- The **EU has the world's largest pipeline of DRI projects,** but only three have reached an FID, in part because it comes with a significant premium. Realising this pipeline represents a **€50bn investment opportunity.**
- Policies could act as strong demand signals (currently lacking) for EU steel project developers, and precipitate Final Investment Decisions for green capacities already the pipeline. If untailored, demand policies could exacerbate competition on steel scrap in Europe. To avoid it and maximise decarbonisation impact on primary steelmaking, policies should sectors that consume higher quality flat steel produced via the BF-BOF route, **typically automotive and electrical equipment.**

Figure 38

Green iron project pipeline in Europe (to be commissioned around 2030-2035)

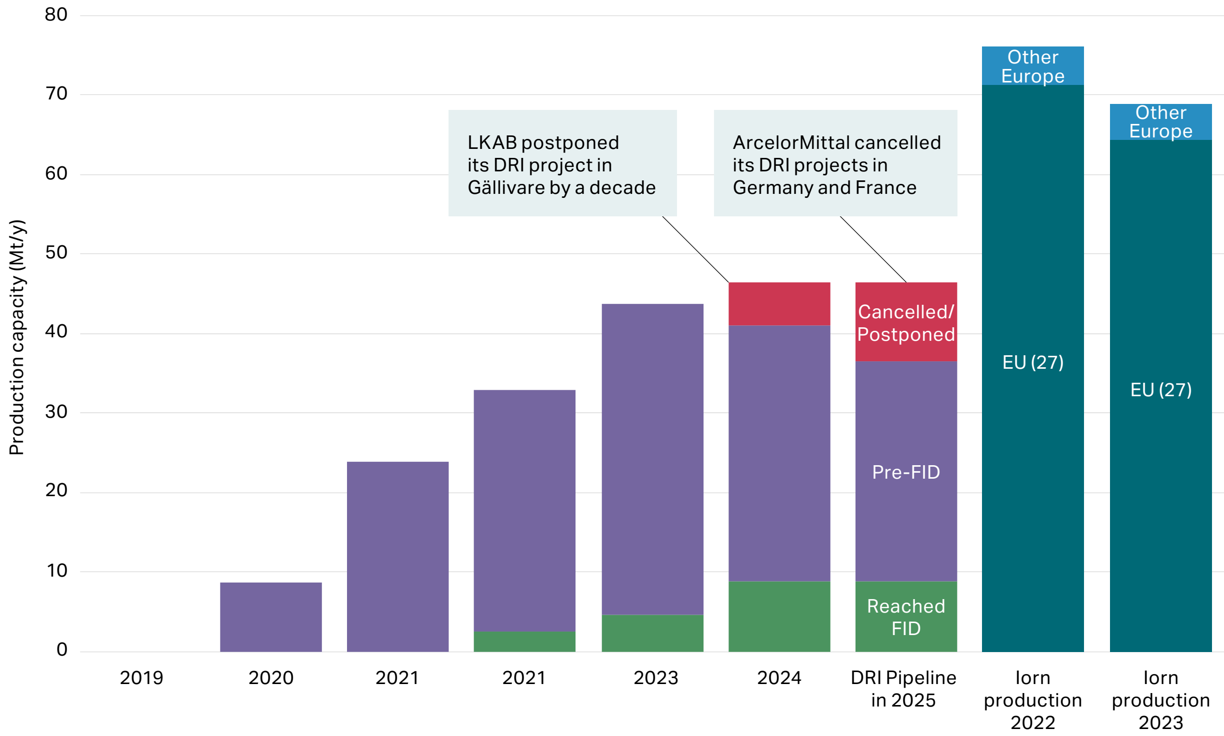
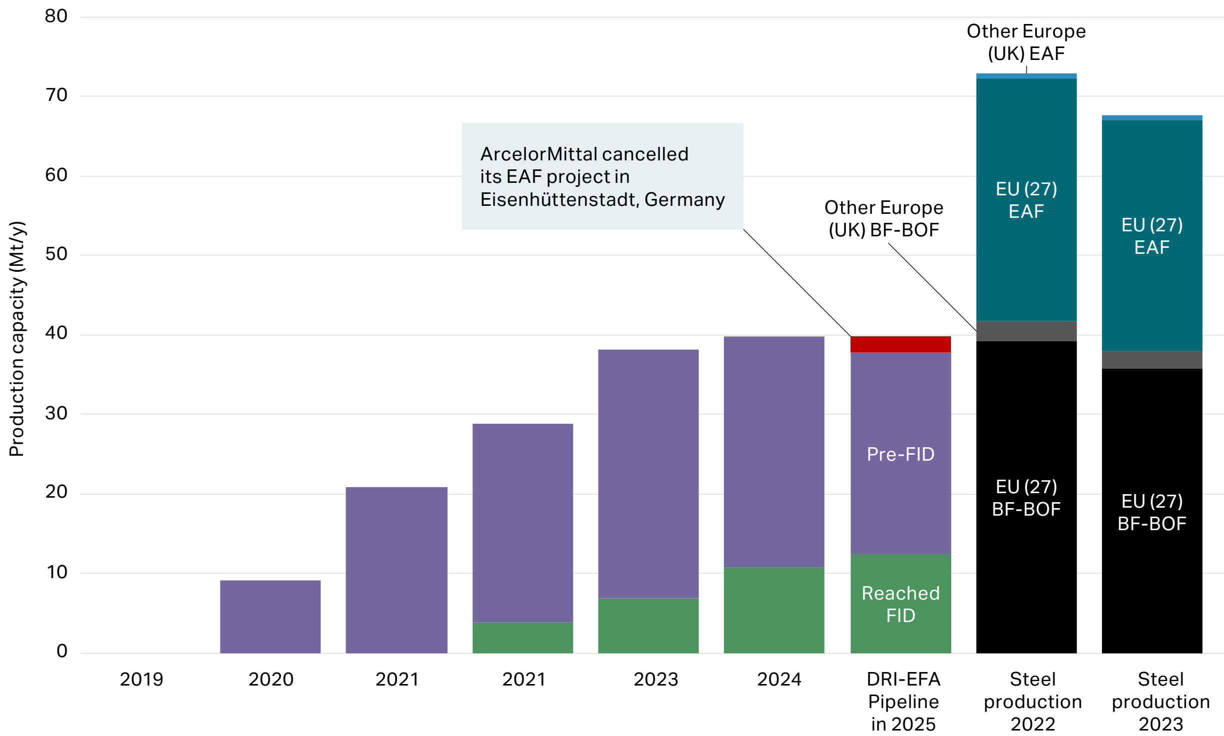


Figure 39

Green steel project pipeline in Europe (to be commissioned around 2030-2035)



Technical Annex:

Status of the EU's supply and demand

Key assumptions underpinning the cost pass-throughs show in previous chapters are tabulated below. Across all calculations, we assume a 100% cost pass-through.

Input costs

Commodity	Scenario	Year 2030	2035	2040	2045	2050
Green premium as % of grey cost[89] - ammonia						
Ammonia green premium	High cost EU	138%	113%	90%	69%	51%
Ammonia green premium	Low cost EU	76%	59%	33%	26%	18%
Ammonia green premium	Low cost import (including transport costs)	69%	47%	2%	0%	0%
Cost pass through assumptions – ammonia						
Cost contribution of ammonia to fertiliser costs	%	47%	47%	47%	47%	47%
Cost contribution of nitrogen fertilisers to wheat[90]	%	25%	25%	25%	25%	25%
Cost contribution of wheat to the cost of bread[91]	%	7%	7%	7%	7%	7%
Cost and green premium assumptions – aluminium and steel						
Base steel cost	EUR/t	530	530	530	530	530
Base aluminium cost	EUR/t	1500	1500	1500	1500	1500
Steel	High cost EU	80%	67%	55%	49%	45%
Steel	Low cost EU	45%	36%	26%	22%	20%
Steel	Low cost iron import (including cost of remelting)	60%	49%	39%	34%	32%
Aluminium	%	18%	16%	14%	12%	10%
Automotive cost pass through assumptions						
Aluminium per car	T/car	0.21	0.21	0.21	0.21	0.21
Steel per car body	% of total steel	65%	65%	65%	65%	65%
Car body share of car cost[92]	%	16%	16%	16%	16%	16%
Closures cost as share of car cost	%	4%	4%	4%	4%	4%
Base car cost	EUR/car	34,000	34,000	34,000	34,000	34,000
Share of primary steel	%	85%	85%	85%	85%	85%
Steel per car	T/car	1.15	1.15	1.15	1.15	1.15

Input costs

Commodity	Scenario	Year 2030	2035	2040	2045	2050
Cost assumptions – concrete						
Concrete	% green premium	30%	29%	28%	27%	26%
Buildings cost pass through assumptions						
Building cost[N]	EURm	14	14	14	14	14
Concrete	tonnes per building	2720	2720	2720	2720	2720
Typical share of concrete as share of building cost	%	5%	5%	5%	5%	5%
Steel per building	t/building	200	200	200	200	200
Primary steel per building	t/building	100	100	100	100	100
Wind power cost pass through assumptions						
Primary steel intensity for wind turbine	t/MW	173	173	173	173	173
Primary steel intensity for wind turbine tower	t/MW	42.7	42.7	42.7	42.7	42.7
Concrete intensity for wind turbine	t/MW	256	256	256	256	256
Cost of tower[93]	EURm/MW	0.08	0.08	0.08	0.08	0.08
Wind LCOE	EUR/kWh	0.07	0.07	0.07	0.07	0.07
Military equipment cost pass through assumptions						
Steel per tank	t/unit	60	60	60	60	60
Cost of tank[94]	EURm/unit	10	10	10	10	10
Aluminium per jet	t/unit	3	3	3	3	3
Cost of jet[95]	EURm/unit	22	22	22	22	22

N. Based on indicative 4000 square meter office building

Endnotes

01 These projects are Stegra's steel plant in Boden and Power4Steel – Source: Mission Possible Partnership (2025): Global Project Tracker
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