MAKING THE GREEN PREMIUM WORK

Policy pathways for critical raw materials

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SUMMARY

Meeting the EU's climate and industrial objectives requires scaling the supply of critical raw materials (CRMs) while ensuring production complies with environmental, social and governance (ESG) standards. Yet greener extraction, processing and recycling remain structurally more expensive, and today's market conditions—marked by oversupply of low-cost, high-emission production and buyers' limited willingness to pay for sustainability—prevent these additional costs, the 'green premium', from being recovered. With supply security now central to EU industrial strategy, support for green CRM supply and demand can also reinforce long-term resilience by underpinning diversified supply chains.

A differentiated market for sustainable CRMs is unlikely to emerge without targeted regulatory intervention. Market-driven approaches such as separate price benchmarks for green CRMs are promising and gaining attention, but remain difficult to scale due to inconsistent definitions, limited traceability and insufficient liquidity. Exchanges can nonetheless play a supportive role by enhancing transparency, disclosure and verification of ESG claims, thereby lowering transaction costs and preparing the ground for premium market formation.

The report proposes a phased, two-tier policy strategy. Building on and harmonising existing CRM-relevant frameworks, the first tier would establish minimum market-access requirements—mandatory due diligence, traceability and environmental-footprint disclosure—across CRMs placed on the EU market, with the option of gradually introducing performance-based thresholds (maximum carbon intensity) for priority materials, including via a targeted expansion of CBAM. The second tier comprises conditional incentives for frontrunners adhering to high ESG standards. Public procurement, price or volume guarantees and other forms of offtake support can, when conditioned on robust and verifiable ESG performance, de-risk investment and create clear premium signals.

Given the global nature of CRM supply chains, EU measures should align with bilateral trade instruments, strategic partnerships and wider multilateral efforts—most notably the G7 initiative to on a standard-based global CRM marketplace—to ensure sufficient leverage and impact. Together, these actions can reduce competitive distortions, stimulate demand for sustainable CRMs and support a more secure and responsible CRM supply base for the EU.

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INTRODUCTION

As the EU remains committed to advancing its decarbonisation and sustainability agendas, several industrial sectors are struggling to reconcile climate ambition with economic viability. The cost premium associated with greening production processes – the *green premium* – combined with limited market capacity to absorb it often undermines the business case for greener production. From construction materials through to chemicals and metals, these challenges have led to growing calls for policy instruments, particularly demand-side or market-pull measures, to strengthen the business and investment case for sustainable industrial production.

Since the Draghi (2024) report and throughout the current political cycle, these calls have been reflected in several programmatic documents of the European Commission – from the Competitiveness Compass to the Clean industrial Deal. They can be found in sectoral action plans such as the Chemical Transition Pathway, the Automotive Action Plan and the Steel and Metals Action Plan. Taken together, these documents all underscore the EU's understanding that greening industry will require not just regulations and financial support, but also measures that encourage the uptake of greener products.

For critical raw materials (CRMs), the policy debate has been largely framed through the lens of economic security or strategic autonomy. This focus is understandable, considering that the concept of 'criticality' is rooted in a material's economic importance and supply risks. Lately, industrial policy initiatives like the Critical Raw Materials Act (CRMA) and the Net-Zero Industry Act have accordingly prioritised supply security, whether through supply-focused access to finance, import diversification, preparedness against disruptions, or incentives for circularity measures. The recently announced RESourceEU plan, reportedly modelled on the REPowerEU initiative, represents the next step in this supply-security agenda. It aims to coordinate demand aggregation, joint purchasing and strategic stockpiling of key materials, thereby strengthening collective resilience and negotiating power vis-à-vis dominant suppliers.

But as the recent turmoil in the nickel market has made apparent, the EU metals and minerals sector at large – including the CRM subgroup – also faces significant hurdles related to the green premium. While EU CRM extraction, processing and recycling operations are under pressure to decarbonise and uphold high environmental, social, and governance (ESG) standards, downstream manufacturers remain largely reluctant to absorb the resulting cost premium. This has prompted demand by market participants for policy instruments to address these price and volume uncertainties and reward sustainable production.

This CEPS In-Depth Analysis outlines policy options to stimulate premium markets for CRMs in the EU and globally. It begins by assessing current market trends and evidence on whether, and to what extent, manufacturers are willing to pay a green premium, as well as emerging attempts to establish premium pricing and market bifurcation. It then explores complementary regulatory and market instruments – including access requirements, conditional incentives, and international cooperation initiatives – before concluding with a realistic and phased pathway for policy action.

1. IS THERE A PREMIUM FOR GREEN CRMS?

The term 'green premium' generally refers to the additional costs of producing a certain product more sustainably. While broadly applicable, in the policy discourse the concept is often associated with the costs of decarbonising energy- and emission-intensive industries, including building materials (e.g. concrete and glass) and chemicals (plastics), as well as some transport segments (e.g. aviation and heavy duty vehicles). In the metals and minerals sector too, sustainable and responsible production pathways exist, whether through electrification, hydrogen, circularity or biodiversity and environment-friendly production processes. However, these might entail significant upfront investment and higher operating costs[1] – that is, a cost (green) premium.

Box 1. What is a 'green' material?

The term 'green' material is often used interchangeably with 'low-carbon', since carbon emissions tend to be the most visible and measurable metric. However, carbon intensity represents only one part of what determines whether a material is produced sustainably. Particularly in upstream segments (extraction and refining), sustainable and responsible production requires addressing a broader range of possible environmental and social impacts beyond carbon emissions. These safe water used and treatment, handling of mining residues local environmental impacts, labour conditions, community engagement, and wider governance practices.

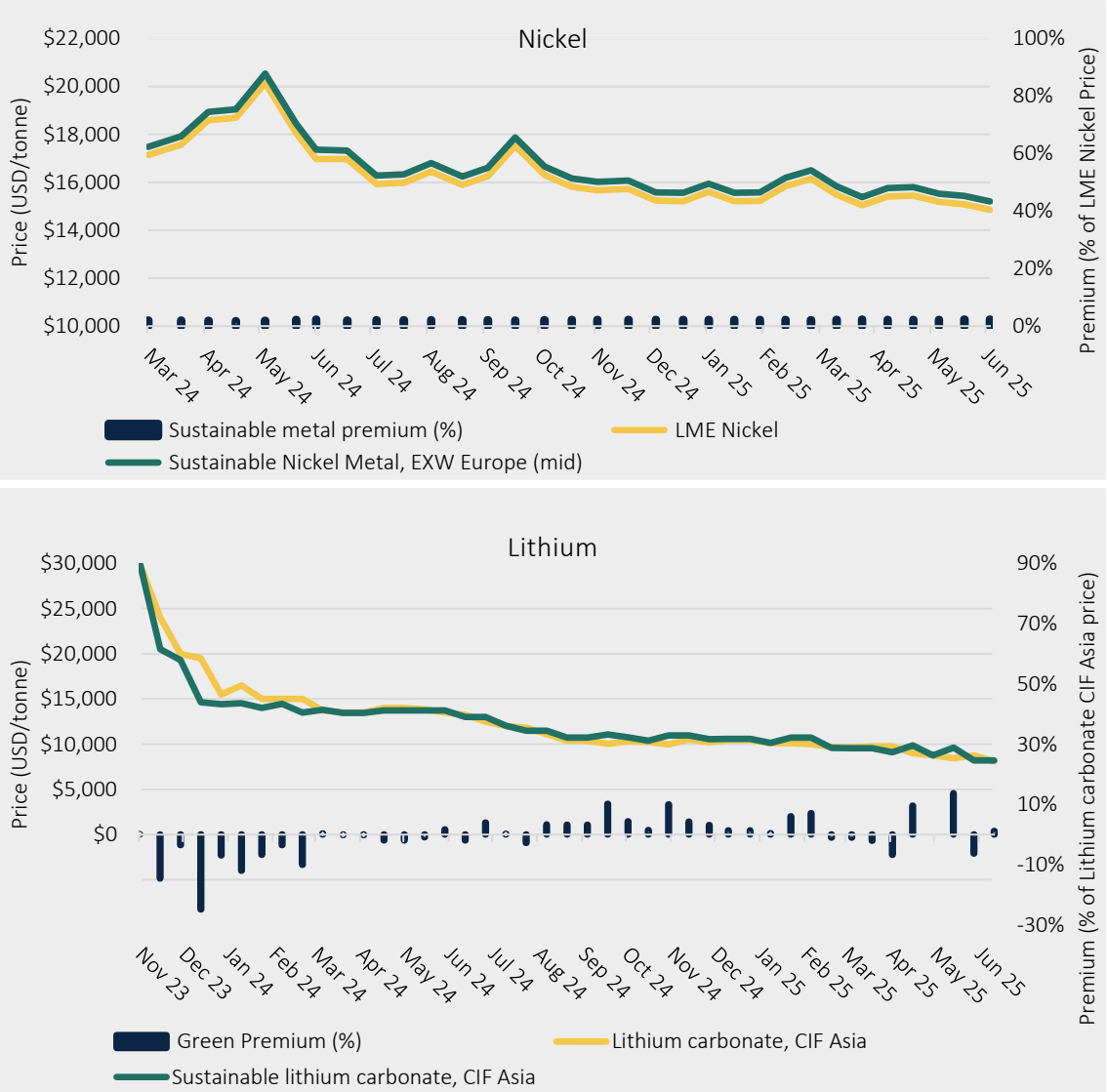
These costs collectively compound into what could more broadly be considered an ESG premium (although it could be argued that it represents the minimum fair and societally acceptable cost of producing a given metal or mineral, rather than a cost *premium*). While apparently nuanced, as explained in the following sections what ultimately qualifies a material as 'green' weighs on this whole discussion. Throughout this report, 'green' will be used to encompass broader ESG credentials.

While the green premium is primarily a supply-side cost gap – reflecting the extra production cost – it implicitly includes a demand-side dimension. Indeed, while sustainable minerals and metals production is technologically attainable and scalable, the limited willingness to pay for this green premium among downstream manufacturers is what ultimately weakens its economic feasibility. Figure 1 shows the example of nickel and lithium, plotting global spot prices against prices submitted from leading sustainable

[1] According to McKinsey (Eloot et al., 2024), full decarbonisation entails a 30%-40% increase in operating expanses for steel (H-DRI) and 10-20% for copper & lithium production.

producers[2]. These largely overlap, indicating that buyers currently recognise and reward little, if any, meaningful added value for greener supply. It should also be noted that, beyond cost considerations, ESG performance alone may also affect market access. In many CRM segments, offtakers impose strict technical specifications – such as purity, particle size, or alloy composition – that green producers must also meet. Where new sustainable production routes alter material characteristics, the pool of buyers able and willing to pay a premium may therefore be narrower than the total market for that material.

Figure 1. Nickel and lithium prices, conventional vs sustainable



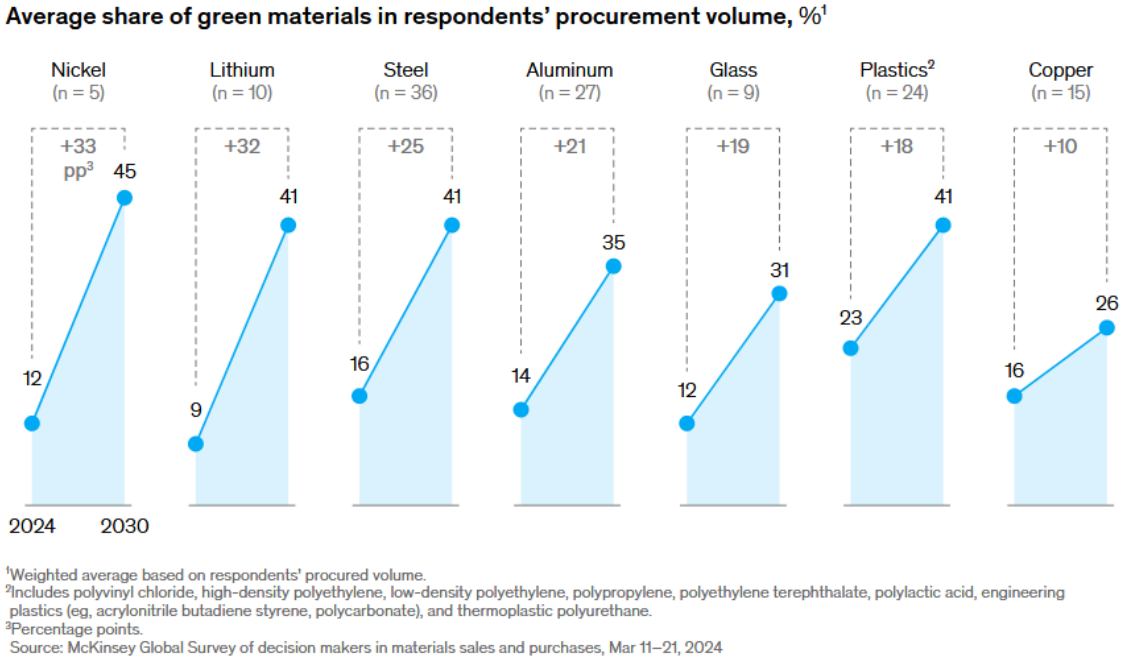
Source: Benchmark Mineral Intelligence (BMI).

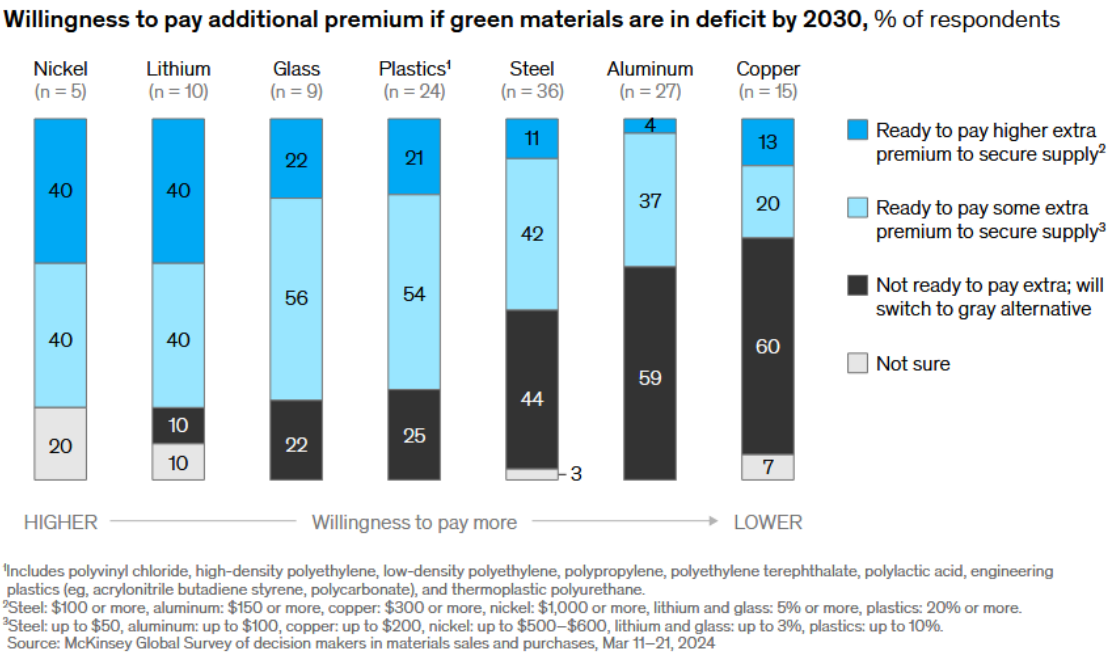
[2] An important nuance is that in the case of lithium, the most sustainable production routes also tend to be at the low end of the cost curve. As a result, producers using these routes generally benefit from higher margins and therefore face less pressure to demand a green premium in order to remain competitive.

Notes: LME Nickel is the exchange-traded reference price and Sustainable Nickel Metal refers to the spot transactions from leading sustainable producers. Lithium carbonate is the price for the main Chinese, Japanese and South Korean ports, while Sustainable Lithium Carbonate is assessed on a spot basis from high-ESG performers. Sustainable producers are those classified as 'Industry Leading' in BMI's Sustainability Index, scoring between 70 and 100 based on ESG performance. For more information, see BMI's price assessment methodologies on nickel and lithium (CIF – Cost, Insurance and Freight – means a delivered price to a region; EXW – Ex Works – a price at the seller's site, with transport and insurance not included).

Recent surveys carried out by McKinsey (Eloot et al., 2024; Hoffmann et al., 2024) add some important nuances to the above picture. The first is that despite the currently low willingness to pay for green premia, buyers generally report a positive trend in demand for green materials, which they expect to substantially increase in the short to medium term (Figure 2, top panel). This increase, reportedly driven by both own company commitments as well as (expected future) stricter regulatory requirements, is in turn expected to translate into higher willingness to pay for green premia (Figure 2, bottom panel). According to the assessment, for instance, with the share of green in lithium and nickel procurement reaching over 40% of overall of total material purchases by 2030 – a fourfold increase compared with current levels – 80% of buyers would be willing to pay at least some additional green premium (if green supplies were scarce).

Figure 2. Current and 2030 procurement preferences and willingness to pay a premium for different materials





Source: Hoffmann et al. (2024).

Notes: Steel and aluminium are not included in the list of CRMs. Bauxite, the primary aluminium ore, is part of the CRM group. Copper does not meet the CRM thresholds but is included on the CRM list as a strategic raw material.

A second insight emerging from the analyses is that the current (and expected future increase in) willingness to pay for green premia varies widely. It differs across material categories (a lower willingness is expected for base metals than for, e.g. lithium and nickel) and geography (the EU has shown generally higher green premia than the North American market). There are also divergences among buyers (with those in some sectors, such as automotive and energy equipment, standing out as having higher willingness to pay for green base metals) and even across buyers of the same commodity.

This heterogeneity could stem from several factors. The lower willingness to pay for some minerals and metals compared with others may partly reflect that emissions reduction is already more deeply integrated into certain mainstream production processes. Meanwhile, those with higher average emission profiles face higher 'residual' costs for additional abatement, making green premia more difficult to absorb. Differences across sectors might indicate the greater capacity to absorb – or pass on – the premium costs of green materials. The automotive industry, for example, has often emerged as a potential lead market for green basic materials (see Urban et al., 2024; Agora Industry, 2024). Indeed, some original equipment manufacturers (OEMs) have been making significant advancements towards sustainable material procurement, including by signing direct offtake agreements for upstream, low-carbon battery CRMs (see, for instance, Tesla and Stellantis).

It should be noted, however, that higher premia observed (or anticipated) for CRMs in the automotive sector are more likely to reflect near-term supply constraints or security-of-supply concerns than a genuine willingness to pay for ESG attributes. Following China's recent export controls on rare earth elements, some OEMs have reportedly been willing to pay premia of up to 30% in order to secure access to non-Chinese rare earth metals and magnets, while signalling that they would only pay 5%-10% on top of current market prices to access sustainably sourced magnets. Indeed, with growing profitability pressures on (non-Chinese) OEMs driven by the transition to electromobility, incentives to absorb green premia appear to be decreasing (Dietz et al., 2025).

While these emerging premia are tied to specific, restricted commodities rather than a broad, full-blown 'security premium', this market behaviour suggests that buyers are currently much more responsive to geopolitical and supply-risk signals than sustainability. As explained in the following section, sustainable and secure supply often largely overlap, meaning supply-risk premia may incidentally pull greener supply as an ancillary benefit. Still, they are not a substitute for dedicated policy tools that internalise sustainability costs, which remain necessary to reward ESG performance consistently.

1.1. SUSTAINABILITY VS SECURITY: BALANCING GREEN PREMIA WITH SUPPLY SECURITY GOALS

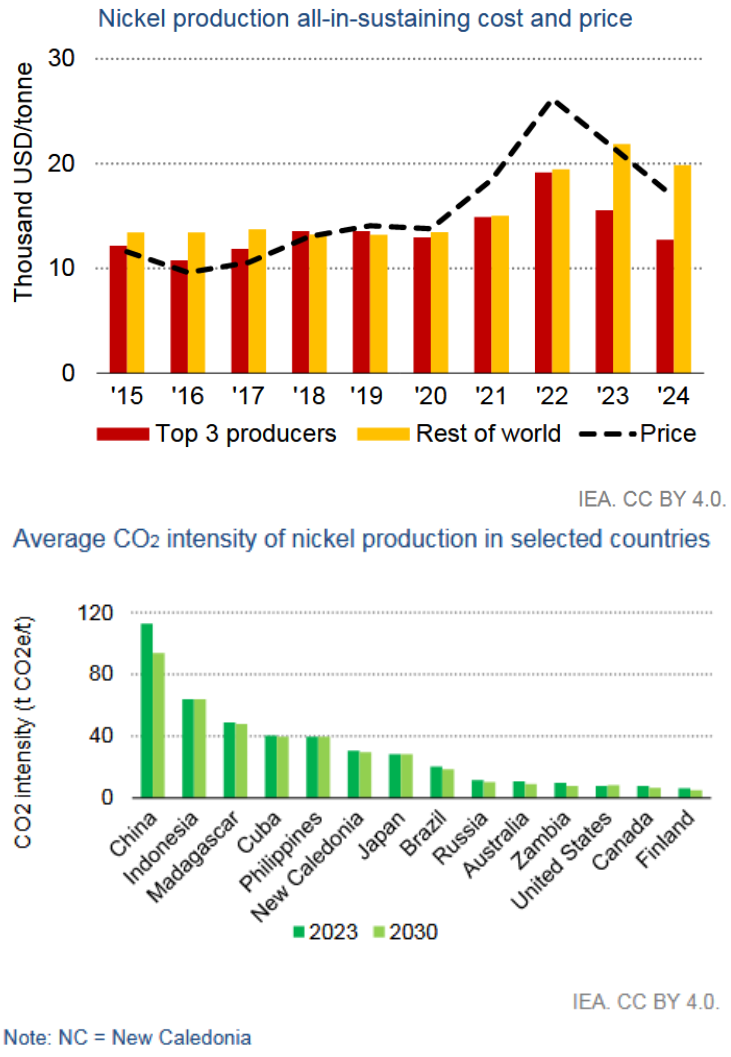
In the policy debate on CRMs, green premium-oriented measures have increasingly been called for in the context of rising pressure from low-cost production as a means to advance both sustainability and supply-security objectives. This connection stems from the high geographical concentration of many CRM supply chains. Thus, the reasoning is straightforward: since for several commodities dominant producers are also typically among the most carbon-intensive (see, for instance, the case of nickel in Figure 3), rewarding greener production via a 'geographically agnostic' green premium could enhance supply diversification, thereby strengthening supply security.

The nickel market is a good example. Between 2023 and 2024, a rapid increase of low-cost and emission-intensive production capacity among leading global nickel producers (notably Indonesia, alone responsible for over 90% of the 2020-2024 growth) lowered nickel prices for a prolonged period. This rendered cleaner and more expensive nickel production in countries like Australia or Canada uncompetitive. According to the IEA (2025), 80% of producers' production costs outside the top three in volume terms (namely Indonesia, China and Russia) were above the prevailing price in 2024, while being significantly less emission-intensive (see Figure 3).

But similar dynamics have appeared in other mineral and metal markets more broadly. On the one hand, there is faster than expected growth of relatively low-cost supply in

major producing countries – where export-led policies and heavy subsidies often encourage projects to operate at market conditions otherwise not economically viable (OECD, 2025). On the other hand, a slowdown in some important downstream sectors, such as electric mobility, has resulted in production overcapacity, which in turn has weakened prices and complicated the economics of projects at the high end of the cost curve, notably greener ones.

Figure 3. Cost competitiveness and emission intensity of global nickel production



Source: IEA (2025).

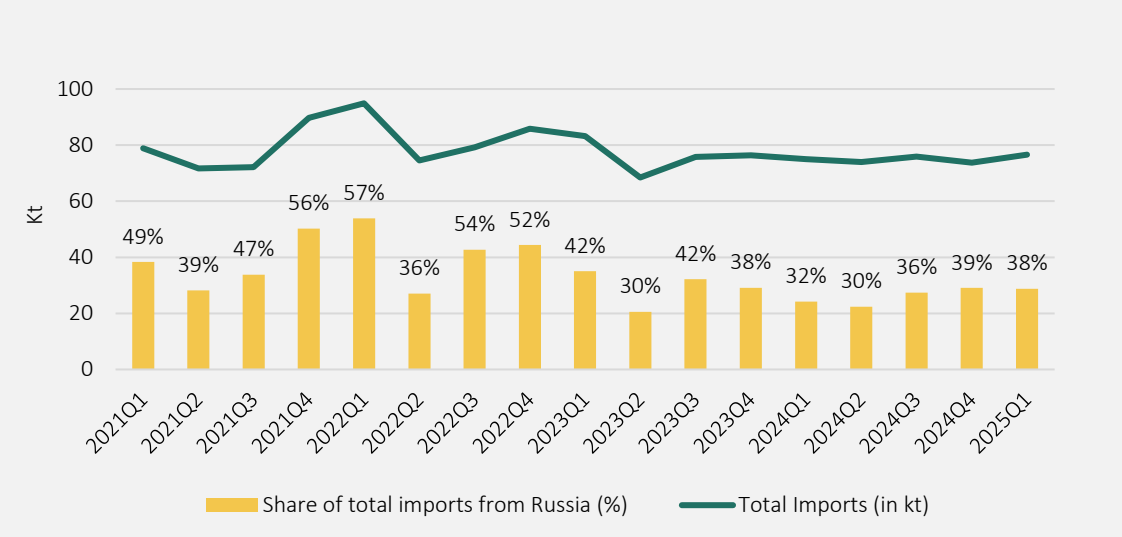
In principle, therefore, green premium support could help correct this imbalance by improving the competitiveness of cleaner producers, while promoting diversification away from dominant, high-emission sources. For example, the IEA (2025) calculates that a price premium of USD 4 000/t on top of the 2024 price (USD 16 812/t) could unlock 50% more supply outside the top producers, or 80% more with a USD 6 000/t premium.

This further reinforces and builds on the argument already made by the OECD (2023), which notes that improving responsible sourcing (e.g. via cooperation on due diligence) is ultimately more effective in ensuring long-term reliability and diversified supplies than short-term access strategies.

There are nonetheless some caveats to consider when pursuing security objectives via green premium-oriented policies, particularly when 'green' is solely determined on a carbon footprint basis. While EU-based production generally has lower emissions, some producers within dominant countries – such as hydropower-based nickel operations in Indonesia[3] – also exhibit relatively low-carbon profiles and could rapidly expand if the EU starts rewarding low-carbon attributes. In such a case, the worst performers might be excluded, but existing trade dependencies would likely persist.

Moreover, preferential treatment of low-carbon production might even risk increasing trade ties with low-carbon producers with lower scores in ESG dimensions other than carbon footprint, or with limited geopolitical alignment with the EU. For instance, this could reinforce reliance on Russian low-carbon (and yet highly polluting) nickel, which currently accounts for almost 40% of EU nickel imports and whose volumes have remained relatively stable in recent years (see Figure 4)[4].

Figure 4. EU nickel imports from Russia by volume (kt) and share of total imports



Source: Eurostat (Comext DS-045409), data as of 13/06/2025 (accessed 04/07/2025).

[3] Vale, one of the four largest Indonesian nickel-producing companies, has roughly half the emission intensity of the others thanks to 365 MW of hydropower capacity. The others are largely based on coal-fired production (Peh, 2024).

[4] Unlike the US and UK, which imposed sanctions on Russian nickel in April 2024, to date the EU has not imposed sanctions.

The above discussion highlights that the way 'green' is defined in terms of scope and stringency when devising premia (or market access – see Section 4) policies may have different implications for supply security. Overly light requirements solely based on a few environmental features (e.g. carbon footprint) may penalise the worst performers, but not so effectively diversify existing production structures (and could even rebalance them in favour of non-aligned EU producers). Yet, stricter criteria may complicate implementation, narrow the pool of eligible producers, and increase cost burdens for downstream manufacturers.

Notwithstanding the positive long-term benefits of sustainability-oriented measures for supply security and reliability, these should be carefully designed to balance short-term effects. They should also complement dedicated, security-oriented measures – such as diversification strategies, preparedness planning and stockpiling. These remain essential to addressing structural vulnerabilities of the CRM market that green premia mechanisms alone cannot resolve.

2. PRICE DISCOVERY AND THE ROLE OF MARKET EXCHANGES

One of the obstacles to the emergence of green premia in CRM markets is the limited availability of mechanisms enabling price discovery/transparency. In metal markets – and, in fact, commodity markets more broadly – pricing and price discovery can occur via one of the following mechanisms, which allow for progressively greater price transparency: bilateral negotiations, third-party index pricing or exchange trading (LME, 2023; Wu, 2024)[5].

In bilateral contracts, the parties directly negotiate product price, volume, and other conditions (e.g. delivery terms). This may take the form of one-off transactions or longer-term, recurring arrangements (see *offtake agreements*, Section 6). Prices can be fixed and entirely based on negotiations, or linked to spot prices or price indices. As negotiations take place privately, information on prices is often not disclosed, except for large transactions. This means that markets where pricing primarily occurs via bilateral negotiations – typically the case for small, nascent markets like most CRMs – are characterised by limited price transparency. Today, most CRMs are traded via bilateral contracts, hindering transparency and price discovery. Together with market concentration, this may also contribute to high market volatility.

Index pricing involves price reporting agencies establishing price indices on the basis of information gathered from producers (normally the largest within a certain market) on their transaction prices, which are then taken as a reference for bilateral negotiations, or even exchange-traded contracts. In general, the more concentrated a market is, the more difficult it is to establish reliable price indices. In some niche CRM markets, this has led to concerns over the high reliance on data points from large legacy producers retaining large market shares – e.g. in Asian markets – which may have significant power in influencing index prices and make it difficult for smaller or new market entrants to compete (Wu, 2024). More recently, some agencies have introduced separate 'sustainable' indices reflecting ESG performance, whereby separate price points are given based on information gathered from the best performing producers in ESG dimensions.

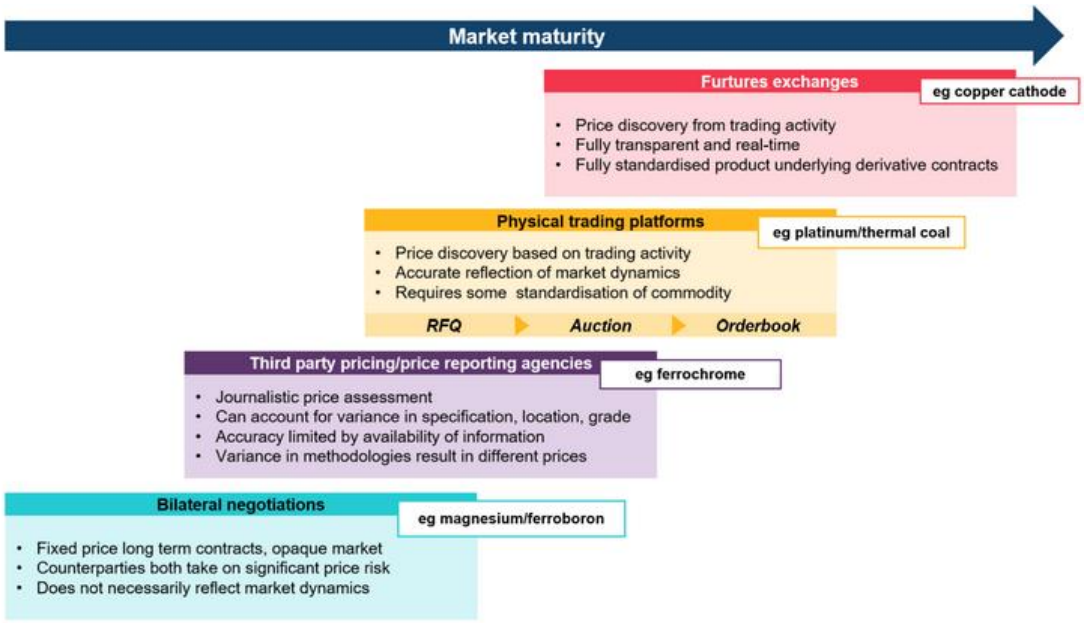
Exchanges like the London Metal Exchange[6] (LME) provide a common platform for trading, streamlining transactions and ensuring a high degree of price transparency.

[5] Actual transactions can either happen as part of exchange-traded or over-the-counter (i.e. bilaterally negotiated) contracts. In the latter case, parties may or may not revert to market exchange spot prices or third-party indices as a pricing mechanism, if available.

[6] The London Metal Exchange is the reference exchange platform for globally traded non-ferrous metals like copper, zinc and aluminium. Among CRMs, only nickel and cobalt futures are actively traded on the LME, while for others, like lithium, futures contracts are still nascent so they remain largely traded over the counter. For many CRMs, futures markets are de facto non-existent. Beyond the LME, other relevant CRM futures exchanges include the Chicago Mercantile Exchange (CME) in the US and the Guangzhou Future Exchange (GFEX) (Collins, 2024).

Platforms can be distinguished between those for physical trading, for immediate (spot) physical transactions based on customisable bids and offers, and futures exchanges, which facilitate contracts for future delivery of highly standardised products (i.e. those defined by a clear set of technical specifications) (LME, 2023). Futures exchanges offer broad market access, including to non-physical players, increasing market liquidity and mitigating market concentration and price volatility risks. The availability of derivatives like futures is generally a good indicator of market liquidity and maturity. CRM markets, however, remain relatively illiquid and are unlikely to reach the depth of, e.g. energy commodity markets in the near term (Anupama et al., 2025).

Figure 5. Market maturity curve of price discovery models



Source: London Metal Exchange (2023).

In response to the growing calls for the market prices of metals and minerals to reflect real ESG costs, market participants have proposed creating a differentiated trading venue or pricing benchmark for green CRMs within established exchanges. Such market bifurcation could, in principle, smooth the path for premium CRM markets to emerge by enabling downstream manufacturers willing to pay the premium to source green materials based on commonly agreed definitions, metrics and reliable guarantees of the claims. Furthermore, by leveraging highly standardised contractual arrangements – a key added value of market exchanges – this approach would foster transparency and

efficiency, as well as reduce possible transactional costs associated with over-the-counter sourcing, potentially incentivising greener demand[7].

All the same, some possible hurdles could make this approach difficult in practice. For price or market bifurcation to take place – that is, for new benchmark contracts to be established within an exchange – there must be sufficient trade volume to ensure liquidity, sufficient product standardisation and sufficient demand for the product from potential buyers (Wu, 2024). As noted above, these conditions have not yet been met for CRM markets as a whole, which remain relatively concentrated, opaque and illiquid. In areas where futures markets are beginning to develop, some observers have argued that introducing new benchmark contracts / pricing systems could reduce or fragment liquidity. Instead, market exchanges should focus on ensuring liquidity and robust technical specifications, including by strengthening traceability and verification of ESG claims.

Another issue concerns, once again, the definition of 'green' or ESG-compliant products, and the limited fungibility of the metrics used to define it. While progress has been made towards convergence (Righetti et al., 2025), no standardised and universally accepted framework exists to measure and verify the environmental impact of mineral and metal production processes. Market participants may value different ESG attributes in different ways, leading to differing views on what should be included under the ESG framework. Limited convergence as to what ultimately qualifies a material as green, and the broad range of certification options with varying scopes and metrics, creates differentiation between product. This makes it difficult to pool materials into single, standardised contract and therefore limits liquidity[8]. In any case, it should be up to market participants and regulators to jointly develop definitions and methodologies, rather than market infrastructure providers.

[7] In a similar fashion, some have proposed establishing regionally-focused price benchmarks for critical minerals, in an effort to improve market transparency and support investment in green production. In the US, some have suggested creating, with government support, a benchmark contract for battery-grade CRMs, solely including producers from the US or potentially covering the whole North American region, to ensure sufficient volume and liquidity. In the EU, the Draghi (2024) report has recommended the creation of EU-based metal price benchmarks to reduce reliance on third-country benchmarks and better reflect ESG standards and responsible mining practices.

[8] These have been among the main stumbling blocks to the creation of a 'green (nickel) market' (see Box 2)

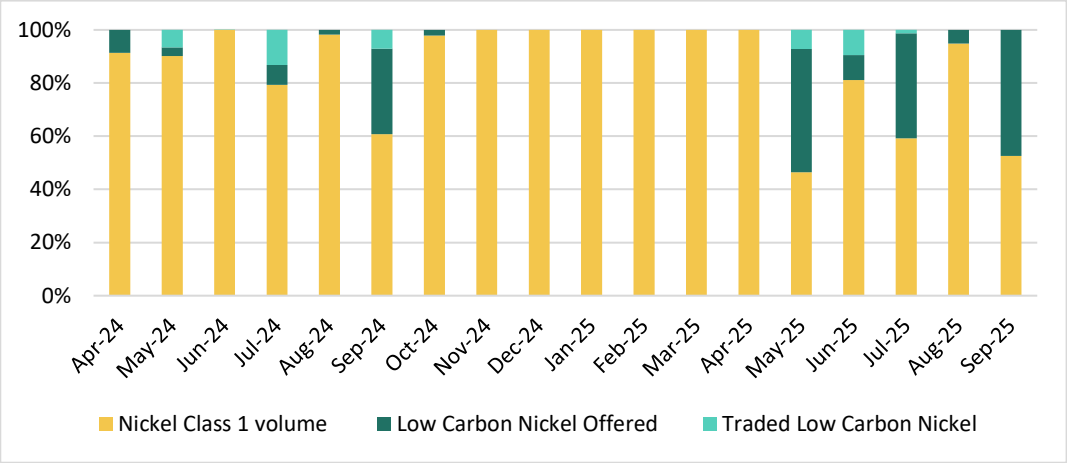
Box 2. The LME and green price premia

Over the last few years, the LME has made progress towards setting up green premium pricing for metals, while acknowledging the constraints outlined above. In 2020, the exchange began exploring the potential for dedicated pricing mechanisms for low-carbon metal contracts, starting with aluminium. It proposed a spot trading platform to allow market participants to trade non-standardised products certified via voluntary frameworks, including based on carbon emissions[9].

Despite some initial push back from green aluminium producers, which argued that commoditising green aluminium risked setting standards at the 'lowest common denominator', the platform was launched in 2021 in cooperation with Metalshub. Added to this, the LME expanded the LMEpassport system for the voluntary provision of and access to information on metal sustainability profiles, thereby improving transparency and enabling buyers to verify the sustainability of specific producers.

Amid renewed calls for low-carbon listings in the LME – particularly for nickel – in March 2024, the exchange noted that the low-carbon nickel market still lacked the volume as well as the necessary level of convergence over the definition of 'green' for it to be able to set up a dedicated green future contract. But it added that digital spot trading platforms could still be used by market participants to exchange nickel products with the desired ESG credentials. On the basis of these transactions, the LME provides low-carbon premium indices and sustainability-related pricing differentials (see Figure 6). This service, currently provided for nickel, is set to be extended to a wider range of metals (including copper, nickel and zinc) and incorporate a broader set of sustainability criteria, hence moving closer to an ESG premium.

Figure 6. Metalshub Nickel Class 1 trading volumes



Source: Metalshub (2025).

Note: Low carbon is defined as per the LME-prescribed threshold of 20 t of CO_2 equivalent (or less) across scope 1-3, based on the Nickel Institute's GHG emissions guidance.

[9] It should be noted that as of 2019, the LME had implemented a 'responsible sourcing policy'. This requires all LME-registered brands to adhere to the *OECD Due Diligence Guidance for Responsible Supply Chains of Minerals from Conflict-Affected and High-Risk Areas*, and maintain certifications for the ISO 14001 environmental management system and ISO 45001 occupational health and safety management system (or equivalent). These rules apply to all LME-exchanged products.

In light of this, the conditions for market bifurcation in CRM markets do not yet appear to be in place. Limited demand and liquidity suggest that fully-fledged green benchmark contracts are unlikely to develop at this stage of CRM market maturity. As discussed above, progress towards the discovery of green price premia is for now more likely to materialise via price indices, developed either by dedicated third parties or within exchanges, based on bilateral transactions. While still partial, these initiatives represent a positive step forward and provide useful reference points for both market participants and regulators.

In the end, exchanges respond to market signals, so in the absence of sufficient green demand it should be up to the regulator to create the conditions for this demand to emerge, which also hinge on the convergence of sustainability standards and definitions Only once there is such demand and a sufficient level of convergence on definitions can exchanges be expected to provide the infrastructure for trading.

That said, exchanges are not only reactive. Even without full market bifurcation, they can also support green demand creation by increasing the visibility of premia, improving market transparency, and developing mechanisms for participants to verify ESG claims. Strengthening ESG disclosure and reporting – currently largely voluntary – would not exclude participants but would foster the transparency needed for green markets to develop. The LME, for example, could progressively expand standardised disclosure requirements through the LMEpassport and encourage producers to use recognised chain-of-custody or sustainability assurance frameworks. Over time, clearer and more comparable provenance and ESG data would facilitate premium formation while avoiding risks to liquidity and market participation..

Here too, regulation could play an enabling a role. Reporting requirements should be aligned and supported by regulatory requirements. For instance, the LME recently introduced mandatory emissions reporting requirements for aluminium, to facilitate compliance with the Carbon Border Adjustment Mechanism (CBAM), effectively integrating CBAM criteria into its own reporting framework. This exemplifies how coordinated regulatory and market action can accelerate credible green pricing mechanisms.

3. TRACEABILITY AND HARMONISED ESG STANDARDS AS MARKET ENABLERS

Given the fungibility of most metals, buyers cannot distinguish greener products by appearance alone. Traceability systems create verifiable product histories that provide data on a material's origin, geographical path, chain-of-custody, and physical evolution – potentially including ESG metrics at each stage – across the supply chain (IEA & OECD, 2025). This visibility enables compliance with due diligence, market-access requirements and regulatory frameworks by making provenance and performance verifiable. As such, by supporting credible product differentiation on ESG performance, traceability can therefore support premium pricing for responsibly sourced inputs.

In recent years, traceability systems have expanded significantly. Some countries mandate traceability systems outright, while others drive its adoption through indirect incentives. Across the EU, multiple frameworks (see Table 1 and Box 3 in Section 4) drive the uptake of traceability through reporting obligations, chain-of-custody systems, and due diligence requirements. China's platform for battery recycling management and Rare Earth Management Regulations establish national product-tracing systems, yet strict data privacy rules hamper interoperability with international due diligence and traceability systems (Vandome & Dideberg, 2025). The clean-vehicle rules of the US Inflation Reduction Act (IRA) condition the granting of tax credits on verifying that the CRMs used to manufacture battery components are not sourced in a foreign entity of concern (currently China, Russia, North Korea, and Iran). This means that manufacturers need to perform detailed supply chain analysis – hence implement traceability systems – to access IRA subsidies.

Despite the rising traceability requirements, implementing traceability systems in mineral supply chains remains challenging. Costs are typically concentrated upstream, where miners and processors (particularly artisanal and small-scale miners[10]) can face significant upfront capital and operating expenses for tagging, data capture and digital platforms, despite much of the benefit accruing downstream (IEA & OECD, 2025). Various mechanisms can be used (e.g. QR codes, GPS tracking, blockchain, and geochemical fingerprinting), each with advantages and drawbacks and tailored to a commodity or policy objective. Blockchain is increasingly used to strengthen records integrity, but it requires specialised infrastructure, which might not be accessible to small operations without sufficient financing and capacity-building support (Vandome & Dideberg, 2025).

[10] Artisanal and small-scale miners supply a growing share of global minerals – according to the World Bank, their share has risen from 4% in the 1990s to 20% today, and in cobalt from 5% to 12% (as cited in Vandome & Dideberg, 2025). Yet such mining remains highly exposed to human rights and environmental harms, even though it also supports local communities and offers high potential for development.

Added to cost and technology barriers, fragmented or inconsistent standards used along the supply chain may limit interoperability and data exchange, particularly for ESG attributes that are more qualitative in nature (e.g. working conditions and community impacts) and more difficult to quantify. Visibility can be particularly limited midstream, where high market concentration, data protection regulations, and traders' reluctance to disclose sensitive corporate information may prevent data sharing. Blending materials such as synthetic and natural graphite during processing can also dilute material identities and complicate their tracking (IEA & OECD, 2025).

Addressing these issues requires robust design and phased implementation, and targeted solutions for technological and cost barriers, tailored to specific supply chains. Over time, well-designed traceability can lower administration, transaction, and compliance costs by standardising data and cutting errors and delays (IEA & OECD, 2025). Governments then can accelerate uptake by funding missing infrastructure at mines and processing sites – where capacity is often weakest – and by promoting interoperability protocols to facilitate data exchange. To create pull, the economic and regulatory incentives for downstream actors should reward participation.

Crucially, the effectiveness of a traceability system also hinges on the presence of clear and comparable ESG metrics – that is, harmonised ESG standards. Yet currently, the landscape of ESG standards for CRMs is highly fragmented, creating uncertainty for the industry and potentially hindering the ability to track and compare ESG performance along CRM value chains. Efforts to consolidate existing frameworks are under way, such as through ISO/PC 348 'Sustainable Raw Materials'; however, opinions diverge on how far harmonisation should go (Righetti et al., 2025). Policy could have a role in supporting common methodologies, highlighting key 'hotspots', avoiding lowest-common-denominator compromises, and ensuring convergence across national frameworks. Ultimately, without shared international benchmarks and strong cooperation at the international level (see Section 7), and trusted assurance and verification mechanisms, it might be difficult for premium pricing to emerge.

4. MINIMUM MARKET ACCESS REQUIREMENTS AS A REGULATORY FLOOR

Given the challenges highlighted above, regulatory measures are likely necessary to stimulate uptake of green, premium CRM markets. One key approach would be for regulators to set minimum, standards-based requirements for market access. Given the size of the EU single market, by conditioning access on compliance with predefined ESG threshold criteria, certified according to agreed standards, the EU could exert influence on both domestic and foreign producers, promoting a level playing field and encouraging improvements in ESG performance.

Importantly, and especially given the implicit supply security implications of any market access limitation, such conditionalities should serve as minimum ESG 'floors' designed primarily to exclude the worst performers, rather than to reward the top ones. For the same reason, setting criteria (in terms of scope, obligated parties, etc.) requires careful consideration of possible cascading effects on end products, ease of verification and implementability. And particularly for CRMs, it calls for reflection on the possible risks of exacerbating existing supply constraints.

In practice, market access requirements for metals and minerals could take several forms. They could entail obligations for products to embed minimum recycled content, or to comply with other minimum thresholds on environmental performance (e.g. carbon footprint requirements). They could involve direct obligations for manufacturers, e.g. to undertake due diligence or to report/disclose relevant information. Obligations might stem from material-specific provisions (e.g. the Conflict Mineral Regulation or CBAM[11]) or product-specific ones (e.g. the Battery Regulation or CRMA provisions on permanent magnets). Or they could arise from broader frameworks like the Corporate Sustainability Due Diligence Directive (CSDDD). For CRMs, Table 1 presents an overview of the EU's main ESG-based requirements for market access.

[11] The sectors covered include iron & steel, cement, fertilisers, aluminium, hydrogen, and electricity. The Commission has adopted a simplification package in 2025 and is consulting on a targeted expansion (including downstream goods) and anti-circumvention rules.

Table 1. The EU's main ESG-based requirements for market access for CRMs

Legislation	Scope (materials/products)	Market access requirement	Disclosure & reporting obligations
Conflict Minerals Regulation (2017/821)	Tin, tantalum, tungsten, gold (3TG); only tungsten and tantalum are CRMs	Mandatory, OECD-aligned supply-chain due diligence for importers	Reporting of due diligence policies and actions
Battery Regulation (2023/1542)	Batteries (cobalt, lithium, nickel, natural graphite)	- Maximum carbon footprint thresholds (2028)* - Minimum recycled content requirements - Mandatory, OECD-aligned due diligence on raw materials value chains (2027)**	- Mandatory carbon footprint declaration (2025) - Battery Passport - Performance class declaration (2026)
Critical Raw Materials Act (CRMA, 2024/1252)	All 34 CRMs	Minimum recycled content requirement for permanent magnets (by 2031)***	- Permanent magnets-specific reporting obligations (label, recycled content share) (by 2027) - Environmental footprint declaration (scope TBD)
Carbon Border Adjustment Mechanism (CBAM, 2023/956)	Iron & steel, cement, fertilisers, aluminium, hydrogen, and electricity. Aluminium (bauxite) is a CRM.	Carbon levy equivalent to EU ETS costs	Emissions reporting for imported products

Source: Authors' compilation from official EU legislation

Notes: For CRMs, the table highlights the main EU ESG-based requirements for market access. It does not include all applicable regulations, such as REACH or those on Waste Shipment or Ecodesign, which may also affect producers' operations or disclosures. *Calculation methodologies to be finalised. **EC guidelines expected in 2026. ***Rules for the calculation of recycled content expected in 2026.

As shown in the table, all the instruments entail disclosure or reporting obligations[12]. These are useful and necessary, as they create an incentive for companies to cease business relations with suppliers associated with adverse ESG impacts. By shaping investment and sourcing decisions, they can de facto indirectly lead to the market exclusions of poorly performing producers.

[12] On top of these, broader frameworks on corporate-level due diligence and sustainability reporting – most notably the CSDDD and Corporate Sustainability Reporting Directive – impose disclosure and risk-management obligations which also affect EU producers and manufacturers.

That being stated, they do not create outright market-entry barriers nor do they per se prevent market access. Currently, only one of the above policy instruments imposes 'hard' ESG floors, though only to subgroups of CRMs and in some cases, these are yet to be formally implemented. This means that, for most CRMs, there are no binding ESG criteria for EU market access yet, so producers with low ESG performances can still sell in the EU market (as long as they provide disclosures or comply with procedural due diligence). As recommended by Draghi (2024), mandated disclosure requirements are key to enhancing transparency, which also affects investment decisions. Fundamentally, this is also a condition for the establishment of a green premium.

Across reporting provisions, CRMA's environmental footprint declarations offer an important step towards stronger ESG conditionalities. According to Article 30, companies placing primary, processed or recycled CRMs on the market might be required to provide an environmental footprint declaration. The exact calculation rules will be set in secondary legislation, and will have to include GHG emissions. The obligation will only apply to CRMs with a high environmental footprint, and only where it is deemed 'necessary and proportionate' and 'no more trade-restrictive than necessary' to achieve the EU's climate and environmental objectives, ensuring that supply security is not disproportionately affected. The group of CRMs for which the obligation will apply will be defined on the basis of a European Commission evaluation to be submitted by November 2026.

Once the rules for the calculation of the environmental footprint are defined, they could evolve into direct market-access conditionalities, by providing the basis for imposing restrictions on the imports of non-compliant materials. As suggested by Draghi (2024), this could take the form of either penalties (tariffs), as under the CBAM, or outright bans on CRMs above a certain threshold. Of course, the latter might be more impactful but would have more ramifications for supply security. The challenge lies in finding the right balance in terms of scope, timing, and thresholds to ensure effectiveness without undermining economic or security objectives.

Beyond this, consistency and alignment of calculation methodologies across different legislation (e.g. carbon footprint rules), as well as ease of implementation and verification are critical. The Battery Regulation (see Box 3) demonstrates that even setting minimum access requirements can be a challenging endeavour, which is why initial focus should be on key verifiable measures. Verifiability is particularly difficult when materials are embedded within intermediate and final products, which constitute the vast majority EU CRM imports. This underscores the importance of mandatory due diligence as well as traceability and environmental footprint disclosure as complementary tools.

Box 3. Illustrative example: the Battery Regulation

The Battery Regulation sets requirements for batteries entering the EU market. Provisions on due diligence, traceability and sustainability could serve as key features in the development of a green premium market for CRMs.

On the requirements for due diligence and traceability, OEMs must establish due diligence policies as well as identify social and environmental risks across their supply chains, along with measures to mitigate them. Environmental risks must address a range of issues, including GHG emissions, water pollution, waste and impacts on biodiversity. Social risks must cover areas such as occupational health and safety, child and forced labour. Due diligence policies must be based on internationally recognised standards. In addition, companies will need to trace material flows from the point of sourcing through all subsequent stages of the supply chain and upload this information (along with a due diligence report) into the battery passport, a digital tool aiming to improve transparency and traceability across battery supply chains.

Taken together, the above requirements can help create a market where all producers meet some minimum requirements, while also enabling those applying high environmental and ethical standards to distinguish themselves and justify a green premium price. In anticipation of the forthcoming requirements, some OEMs have started developing due diligence policies and implementing traceability across their supply chains.

While pockets of progress can be seen from existing cases, several gaps remain in terms of commitments to fulfil certain due diligence aspects (e.g. on deforestation) (T&E, 2025). Additionally, the legal entry into force of the due diligence rules has been delayed as part of the Omnibus IV package, highlighting the complexities involved in implementing these new regulatory measures.

On the sustainability front, the Battery Regulation is set to introduce minimum life-cycle carbon footprint requirements. These will evolve over time from an initial requirement for disclosing a battery's carbon footprint to the eventual introduction of maximum carbon footprint thresholds that batteries must not exceed in order to enter the EU market. By promoting transparency and accountability over the carbon footprints of batteries, the regulation has the potential to enable low-carbon batteries and raw materials to differentiate themselves in the market and justify a green premium. Challenges related to data consolidation and verification (see Rizos & Urban, 2024) suggest that it may take time for the market to fully adapt and for these requirements to become effectively enforceable.

5. PUBLIC PROCUREMENT AS A CONDITIONAL SUPPORT INSTRUMENT

While market access requirements could in theory exclude the poorest performers, they might not by themselves create sufficient demand pull for frontrunners exceeding (and to exceed) the minimum ESG performance level. Demand creation and conditional incentives would address this gap by linking preferential treatment or financial support to higher ESG performance. These instruments could take various forms, from targeted public procurement to market-based de-risking tools such as price or volume guarantees.

This section focuses on public procurement as the main non-fiscal lever for demand and local content requirements as conditionalities to align ESG with resilience. Other tools, such as targeted financial incentives (e.g. grants or tax credits conditional on ESG benchmarks), could complement this approach but are not discussed here in detail.

Given its substantial share of overall demand for goods and services[13], public procurement is often considered the single most powerful, demand-side instrument to shape lead markets for greener products. After years of debate over the underutilisation of this tool for boosting green markets, the EU is now in the process of reforming the existing regulatory framework for public procurement, which is primarily governed by two directives[14]. As highlighted by the Clean Industrial Deal, among the key objectives of the reform is to shift away from relying solely on price as the primary criterion in public procurement decisions, and incorporate non-price criteria such as sustainability, resilience and minimum EU content requirements.

These efforts follow previous initiatives such as the Net-Zero Industry Act, which envisages the introduction of minimum sustainability requirements for procuring net-zero technologies. Resilience, sustainability criteria and EU content requirements for the public procurement of energy-intensive products, including steel and non-ferrous metals, as well as for downstream users (automotive, construction, and machinery), are to be introduced by the Industrial Accelerator Act.

Public procurement procedures may establish eligibility criteria for the conditions to participate in the tendering process. This instrument could go beyond setting baseline market access requirements by preferentially rewarding suppliers that demonstrate robust sustainability practices. This could be operationalised by giving extra weight to ESG-certified products in award criteria or, where appropriate, excluding bidders without recognised certifications. Looking at low carbon alone, the carbon footprint classes in the Battery Regulation could serve as a concrete basis for differentiating suppliers in

[13] Recent estimates indicate that public procurement accounts for about 14% of the EU's GDP.

[14] See Directive 2014/24/EU on public procurement and the Utilities Directive 2014/25/EU.

procurement procedures, enabling public buyers to reward products with lower environmental impacts and thus increase market incentives.

However, a dilemma in setting reward criteria for sustainability practices concerns the selection of parameters, and their verifiability. Ideally, these should not only cover the carbon footprint but also a broader range of environmental impacts and ethical sourcing considerations. Yet, at a practical level, collecting a wide variety of data from different sources and ensuring their comparability is a challenging task, even when considering only the carbon footprint as previously discussed (Rizos & Vu, 2024). As such, it might be prudent to begin with a set of simple, verifiable parameters as minimum requirements (e.g. on ethical sourcing[15]), while continuing to engage in international efforts to align definitions, standards and metrics. This could lay the groundwork for a stepwise approach to introducing clear award criteria on sustainability in procurement processes over time.

In addition, any procurement award criteria intended to support a green premium market must be underpinned by a clear policy objective that carefully weighs the benefits and trade-offs. If the goal is to anchor EU (or allied) supply for security or resilience, relying solely on sustainability requirements may be insufficient. In the EU, local production has traditionally been incentivised via sustainability criteria, on the assumption that domestic EU production is inherently more sustainable. But as also noted above, sustainability requirements alone do not per se prevent sourcing from non-EU countries. If sustainability criteria were to apply to the procurement of green technologies, given the concentration of manufacturing capacity in extra-EU countries, they might even end up reinforcing dependencies. Pairing sustainability requirements with proportionate local content provisions (discussed below) is therefore more likely to deliver on both sustainability and resilience goals.

[15] The OECD (2021) guidance for responsible sourcing is one such example.

5.1. LOCAL CONTENT REQUIREMENTS

The idea of introducing local content, or EU preference, requirements to support EU-based production has recently gained renewed attention, particularly in the EV and battery value chains. Preferential procurement rules for local producers have been widely used in recent years to promote domestic industrial development and/or offer protection against foreign competition, including for emerging green manufacturing sectors. Historically, EU policymakers have been cautious about adopting such measures, showing limited enthusiasm for explicit local content requirements due to concerns about trade compatibility and market distortions[16]. Crucially, these criteria could attach not only to public procurement but also to public funding.

There are different possible pathways for introducing local content requirements. Domestically, these are often devised as minimum conditions to access government incentives (e.g. subsidies) or to receive preferential treatment in public tenders. A notable example is the 2022 US IRA, which conditions tax credits for electric cars on sourcing battery minerals and components domestically, or from countries with free trade agreements (FTAs) or dedicated Critical Mineral Agreements. Similarly, China has long applied local content rules to support domestic manufacturing of wind turbines, requiring 70% Chinese-made parts to qualify for public tenders. It recently proposed a 20% price advantage for domestically produced industrial products in government procurement.

Local content criteria can also be embedded as rules of origin under FTAs, to determine whether the product can benefit from the preferential tariff treatment set by the FTA. For example, the United States-Mexico-Canada Agreement has specific rules of origin that determine the conditions under which products can be regarded as 'originating' from one of these countries and hence qualify for preferential tariff treatment (currently, the mandatory threshold is 75% local production content). The EU also has FTAs with CRM-relevant rules of origin; under the EU-UK Trade and Cooperation Agreement, 45% of the components in cars entering the EU must be made in either the UK or the EU, to avoid a tariff.

Even so, there are caveats to consider. For one, up- and midstream production capacity in the EU is limited or, for some CRMs, virtually non-existent. This makes EU content requirements at the raw materials level difficult to design and implement, and potentially increases supply and cost pressures downstream. To mitigate this, requirements should be narrow in scope, time-limited, phased and verifiable. Practical initial application could target metals with meaningful EU capacity (steel), and/or intermediate components or final products – e.g. permanent magnets, battery modules/packs, and cathode/anode

[16] For example, out of 5 330 local content measures implemented in 57 countries between 2009 and 2024 in the automotive sector, only 7% have been implemented in Europe (Pardi et al., 2025.).

active materials. It should clearly prioritise sectors and scope (e.g. ring fencing to specific, strategic technologies) with phased thresholds tightening over time[17].

An additional approach, echoing the US IRA, would be to allow eligible partner countries (e.g. FTA partners with equivalent ESG and traceability rules) to qualify for incentives, whether for subsidies (as in the IRA) or for accessing public tenders. With robust conditionalities and verification, this would also be an effective way to leverage (public) market and subsidy access for green extra-EU production and to level the playing field.

[17] The EU approach seems to be going in this direction. For example, the second European Hydrogen Bank auction required bidders to demonstrate limits on Chinese-sourced components at stack level use by more than 25%. Similarly, the Industrial Action Plan for the European Automotive Sector discusses how trade agreements could reward products meeting certain preferential rules of origin. For batteries, the plan sets the target of 50% value added, which might indirectly also favour local CRM sourcing.

6. OFFTAKE SUPPORT AND DE-RISKING INSTRUMENTS

A further category of conditional incentives comprises standards-based commercial instruments for risk mitigation. These mechanisms operate through contractual or market-based structures to stimulate demand and could be used to provide revenue certainty for producers meeting high ESG standards. By linking commercial transactions to sustainability performance, they could create predictable market signals and reduce price and volume risks that currently discourage investment in greener production.

6.1. OFFTAKE AGREEMENTS

Given their capital-intensive nature, the economic viability of metal and mineral projects depends on a high degree of visibility over future demand (i.e. offtake certainty). Market visibility is crucial for project bankability, as both public and private lenders typically require minimum guarantees of long-term profitability before committing to invest. To reduce future demand risks, it is a consistent practice in the sector to sign offtake agreements before the start of a project. Sometimes referred to as advanced purchase agreements or advance market commitments[18], these consist of contractual agreements between a producer and a buyer whereby the latter commits to purchase a set volume of the product at an agreed or market-indexed price, over a certain period in the future (or a commitment by the producer to provide the possibility for the buyer to do so).

Offtake agreements provide benefits to different market participants. For investors, they provide certainty over future project revenues, and hence hedge against market risk (the higher the risk, for example in the case of nascent (green) products, the longer the agreement duration required to hedge against it). For producers, they help reduce operational and development risks. For buyers, they provide security over continued supply of the product. Currently, a large share of exchanges in the metals and minerals sector occur as part of offtake agreements – the alternative being one-off transactions on spot markets. These can be signed across all stages of the value chain – between miners and processors, between processors and manufacturers, etc. (Wu, 2024).

The specifics of these agreements can vary significantly depending on the technical specification of the product, market maturity, market transparency, price volatility, etc. The duration can span from a few months to 10 or more years. The price can be fixed, indexed to spot prices (e.g. metals traded on the LME, with the LME price as a benchmark), or involve a combination of the two. For (partly) indexed prices, the

[18] This term is typically used for the specific situation in which an agreement is signed before there is any existing production capacity of a certain product. When the producer does not yet have ongoing production, it is referred to as an advance market commitment. This entails an offtake agreement or offtake backstop (see above) before production begins, i.e. it guarantees demand for products that de facto do not yet exist, something that is not yet commercially available. It is used for markets that are yet to emerge (Jacobs, 2024; Jacobs et al., 2024).

agreement can also include price ceilings or floors as safeguards for both producers and buyers (Wu, 2024). Importantly, while possibly making use (if available) of exchange-traded prices as benchmarks, offtake agreements represent direct and highly customised bilateral contracts between producers and buyers. While exchanges like the LME offer various types of contracts to hedge against risks, including futures and options, these are highly standardised to ensure liquidity and market efficiency.

Although offtake agreements can significantly enhance the investment case for low-carbon or green projects, they are often difficult to secure – particularly for producers in relatively small, high-risk markets such as CRMs, or for green variants of conventional materials.

- From a volume perspective, some buyers might be reluctant to enter long-term offtake agreements due to risks of being locked into rigid structures that are not flexible enough to adapt to changing market dynamics (IEA, 2025). Some use cases of these materials, e.g. clean technologies, tend to have highly dynamic markets, where rapid technological innovation adds to uncertainty regarding future, long-term material demand by downstream manufacturers (e.g. in EV batteries and magnets' chemistries[19]). This can generate misalignment between the buyer's need for flexibility and the producer's demand for the certainty required to ensure the feasibility and bankability of the project.

- From a price perspective, the paucity of price benchmarks for non-exchange-traded commodities (i.e. most CRMs) may restrict the opportunities to hedge against price risks. Indeed, some of these markets are characterised by a high degree of supply concentration, low liquidity and opaque pricing systems, increasing their exposure to price manipulation and price volatility. In these cases, both producers and buyers may prefer to manage price risks through price indexation or other hedging tools, but the absence of an exchange platform offering such options limits the opportunities to do so. While offtake agreements based on fixed prices remain an option, both parties may be reluctant to lock in specific price levels in volatile conditions, increasing the risk of contract renegotiation or abandonment if market prices move significantly.

In light of these challenges, in emerging markets with higher price and demand risks, governments can devise support mechanisms to take on some of these risks in volume

[19] For instance, the battery market has experienced rapid growth in the market share of lithium manganese iron phosphate – from 25% in 2021 to 40% in 2023 – and an increasing number of OEMs are relying on rare earths-poor/free motors (Eloot et al., 2024).

and price. Operationally, these would take the form of either price support (or price stabilisation) mechanisms or volume guarantees.

6.2. PRICE STABILISATION MECHANISMS

A first group of instruments to backstop price risks are price stabilisation (or price support) mechanisms. Well-known examples are Contracts for Difference (CfDs), widely used to support low-carbon projects in the power sector[20]. More specifically, there are two fundamental types of CfDs:

a) **two-sided CfDs**, consisting of contracts between a producer and public authority where, based on a pre-negotiated reference price (typically determined through action), the producers sell products in the market and settle the difference between the market (spot) price and the reference price with the public authority. That is, if the market price is higher than the reference price, the producer pays back the difference (also referred to as 'clawback'); if it is lower, it gets compensated for the difference. Depending on the design, the reference price can be set as either a single value or a *price range,* with a *price floor* (under which the producer is compensated) and a *price ceiling* (above which the producer pays the difference to the government); and

b) **one-sided CfDs** (or **price floors**), work in a similar way to two-sided CfDs, with the exception that the pre-negotiated reference price only acts as a price floor (meaning the producer is compensated for the difference between the price floor and the market price when the latter goes below the former).

Irrespective of the design, price stabilisation mechanisms can be effective tools to secure future revenue streams, by reducing uncertainties, favouring offtake and encouraging investment in projects (Ason & Dal Poz, 2024). Having government backing for price risks via price support can accelerate negotiations between producers and offtakers (but does not do away with the need for producers to have an offtake already under negotiation or an interested offtaker at the table). Producers, depending on their risk profile, can decide not to commit all of their production capacity under CfD schemes, and keep a certain degree of exposure to spot markets (Wu, 2024)[21].

[20] In the reform of the EU electricity market design adopted in 2024, CfDs are recognised as a default instrument for Member States to provide state aid in new generation of low-carbon electricity (from wind, solar, geothermal and nuclear energy, as well as from hydropower without reservoirs). See Article 19(d)(1) and (4) of Regulation (EU) 2019/943 of the European Parliament and of the Council of 5 June 2019 on the internal market for electricity (recast), as amended by Article 2(9) of Regulation (EU) 2024/1747.

[21] CfDs are not the only price support mechanisms. For example, a government could back auctions, should these be chosen by producers as their pricing mechanism. In this case, a producer would sell a certain volume via action, and if

In a context of declining market prices and high volatility, various stakeholders and observers have called for the adoption of price stabilisation mechanisms like CfDs, particularly in the form of price floors, to hedge against price risks in CRM markets (Draghi, 2024; IEA, 2025). Reflecting this growing momentum, the G7 is reportedly considering the introduction of a joint price floor mechanism for rare earths to counterbalance China's market dominance (*Reuters*, 2025). In the US, following interest and support for these tools as expressed in April 2024 by respondents to a Request for Information from the Department of Energy's Office of Manufacturing and Energy Supply Chains, the mechanism has recently been implemented for a large rare earth project (see Box 4).

The design of price support mechanisms can be complex, notably in setting the reference price(s), duration and scope in a cost-efficient manner. Setting the appropriate level of price support requires clear visibility of historical and possibly future price trends, which – as discussed before – might be lacking in CRM markets, particularly for non-exchange-traded materials or evolving (green) production (IEA, 2025; SAFE, 2024). If the reference price is not properly set, the mechanisms risk being highly costly to implement[22].

Added to this, some experts have cautioned that these mechanisms have inherently high risks of distorting market and investment signals and should therefore be limited in scope and duration. For example, they should not be used to protect industries from structural boom-and-bust cycles, which would lead to over-subsidising uneconomical projects. Furthermore, price support might risk weakening incentives to improve efficiency or reduce production costs. As such, price support should only be made available for relatively short periods (e.g. for the first three to five years of new operations), and ring-fenced to policy-relevant projects (i.e. EU strategic projects). Specific provisions could clarify additional conditions under which price support would be triggered (e.g. under 'predatory pricing practices').

6.3. VOLUME GUARANTEES

Volume guarantees – also known as offtake backstops – are policy instruments designed to reduce demand risks. When these are in place, the government acts as a 'buyer of last resort', meaning it commits to purchasing the product at a pre-agreed minimum price if market-driven demand falls short (Wu, 2024). This provides a safety net against sudden demand shifts or prolonged periods of stagnation in price or demand. It also addresses *project-on-project* risks, i.e. the risk that a not-yet-established downstream project (e.g. battery manufacturing), which has already committed to purchasing a certain volume of

the highest bidding price is not sufficient to cover the producer's costs (or a pre-agreed price floor), the government would pay the difference between the highest bidder and the floor to the producer (Wu, 2024).

[22] BMI has estimated that in the US lithium market a price floors ranging around USD 19 000 to USD 35 000 a tonne could cost between USD 676 m and USD 7.5 bn over the period 2025-2029.

material (battery-grade critical minerals) in the future, is not eventually realised. Similar to price stabilisation mechanisms, volume guarantees provide a minimum degree of revenue certainty and are therefore well suited to supporting capital-intensive operations in emerging and/or highly uncertain markets.

If the public purchase is triggered, acquired materials can be stored via actual or 'virtual' warehousing. The former case can entail either contractual agreements with private entities that have the capacity to store the materials (for example, the LME) or – if available – the use of publicly managed material reserves (more on this below). In the second case, the materials would remain stored at the producer's site, provided it has capacity to do so (Jacobs, 2024; Wu, 2024).

The feasibility of coordinating offtake backstops with strategic reserves ultimately depends on what the objective of these reserves is – i.e. whether they are set up as simple physical material stockpiles acting as a 'shock absorber' during supply disruptions, or whether they are meant to have a more active market–price stabilisation role (Righetti & Rizos, 2024). Should the latter be the case, the government could purchase the materials from producers under a volume guarantee mechanism in situations of market oversupply, low prices or limited offtake opportunities and store them in reserves. The materials would then be released at times of material shortages and/or price spikes.

Linking the two systems might nonetheless present implement challenges, partly because of some intrinsic technical limitations that come with the set-up of stockpiling mechanisms. Given the limited shelf life of certain materials, for instance, it is not guaranteed that the materials purchased during periods of low prices through backstops could eventually find a market, should these periods extend significantly. These issues do not apply uniformly across all materials, however, and could be partly offset by active inventory management and rotation, though these require institutional capacity. This underlines the need for volume guarantees, like price stabilisation mechanisms, to be carefully designed in order to balance effectiveness with cost-efficiency.

Box 4. Lessons from across the Atlantic: the MP Materials-US Department of Defence PPP

In July 2025, the US Department of Defence (DoD) signed a public-private partnership (PPP) agreement with MP Materials, a vertically integrated rare earth company operating in Mountain Pass (California), the second-largest rare earth mine in the world. The company operates rare earth separation and processing facilities, and is expanding into permanent magnet manufacturing, with plans to establish the world's second-largest magnet production plant.

The PPP entails the use of a wide range of policy mechanisms, from direct financial support to demand side measures. While there are no indications of any of the measures being conditional on meeting certain environmental thresholds, the partnership (or some aspects of it) could serve as example to replicate in the EU. In more detail, the agreement includes:

- on the supply side, direct financial support in the form of equity investment (USD 400 m from the DoD plus a warrant giving the DoD the option to purchase additional stocks) and loans (USD 1 bn in project finance for the magnet manufacturing facility, including from commercial banks, and USD 150 m from the DoD for separation activities); and
- on the demand side, a 10-year price floor commitment at USD 110 per kg of NdPr produced (whether used for magnet manufacturing, sold or stockpiled; the current market price is USD 60 per kg) and a 100% DoD offtake commitment for the magnet manufacturing facility for the first 10 years of operation.

6.4. MATCHMAKING AND THE 'GREEN MARKET MAKER' APPROACH

Another form of support would have the government taking on an intermediary role between producers and buyers – ranging from passive facilitation to active market intervention. At the 'lighter' end, governments could establish a centrally managed matchmaking platform, where producers and buyers along the value chain signal their willingness to either buy or sell a certain type of material, with the government facilitating information exchange between the interested parties. This could help aggregate demand and supply, facilitate transactions, and enhance market and price transparency.

This in fact is the idea behind the recently launched EU Energy and Raw Materials Platform. The platform serves three main objectives: (i) support information sharing on demand and supply; (ii) organise calls of interest (i.e. matchmaking) for collected demand and supply bids; and (iii) gather and share information, and possibly connect undertakings with available funding opportunities.

The platform currently covers three sectors: green hydrogen, strategic raw materials (SRMs) and gas markets. It builds on the experience of the EU Energy Platform, established in 2022 to reduce dependency on Russian gas, and its AggregateEU joint purchasing service. The platform will initially pilot the hydrogen sector via the hydrogen mechanism, which will operate under the European Hydrogen Bank, to support market development. Later, the SRMs and gas mechanisms are expected to play a more active role in joint purchasing, allowing multiple undertakings to negotiate collectively. According to the Clean Industrial Deal, joint procurement of raw materials will eventually be conducted by a dedicated EU critical raw materials centre, set to be launched in Q4 2026 – though it remains unclear whether this will fall under the current platform's Raw Materials Mechanism.

A more proactive form of intervention is the 'Green Market Maker' model. Here, the public entity not only facilitates exchanges, but actively purchases the green product – typically at the lowest available cost or from the most cost-efficient producers via competitive tender. It resells the product on the market to buyers with the highest willingness to pay. Unlike simple matchmaking platforms, therefore, the government directly intervenes in price formation, takes on risk, and facilitates market development by absorbing the green premium. Market makers typically also provide for a high degree of flexibility, allowing for long-term contracts on the buyers' side and short-term contracting at the selling point. As such, they address the volume risk for the seller, providing the certainty required to mobilise investment, as well as buyers' physical delivery risks, meaning the risk associated with supply shortfalls.

In the EU, the H2Global initiative in Germany is a prominent example of a green market maker. Germany's government-backed funding mechanism supports the import of renewable hydrogen (and its derivatives) via a double auction model. More specifically, a dedicated body awards long-term purchase agreements (typically 10 years) to extra-EU producers via competitive tenders, allowing for the most cost-efficient allocation of public support. It resells the product in the EU via short-term contracts negotiated at market prices. Differences between the long-term offtakes and sales are covered by federal grants. This mechanism guarantees demand for the most competitive producers, reducing revenue risks.

Given the possible temporal and spatial mismatch between product acquisition and sale, similar to offtake backstops, a precondition for this kind of mechanism is the possibility for the government to store the material, whether by means of physical or virtual reserves (Jacobs, 2024).

7. INTERNATIONAL TRADE AND COOPERATION INSTRUMENTS

As discussed above, the relevance of the EU market for downstream CRM-containing products means that strengthening minimum market access requirements could effectively influence the ESG performance of major producing countries. However, given the global nature of metal and mineral markets, the EU cannot create a premium market in isolation. Beyond EU market-entry rules, its leverage is stronger if these are embedded into international trade and cooperation frameworks. By integrating sustainability and resilience criteria into trade agreements and cooperation mechanisms, the EU can extend its influence beyond its borders and help drive higher standards globally.

7.1. TRADE AGREEMENTS AND STRATEGIC PARTNERSHIPS

Government-to-government agreements such as FTAs or partnership agreements provide frameworks to set out rules of engagement and cooperation with trading partners. The EU has increasingly leveraged trade or cooperation instruments in its CRM strategy, primarily to diversify and secure CRM import routes, guided by near- or friend-shoring principles (Righetti & Rizos, 2024). A recent trend is the inclusion of energy and raw materials (ERM) chapters in recent EU FTAs with resource-rich countries. These contain dedicated (critical) raw materials provisions aimed at facilitating trade and eliminating trade distortions, including binding obligations such as tariff reductions, removal of import/export monopolies, and limitations on domestic pricing interventions (e.g. dual pricing policies).

ESG principles and green industrialisation in partner countries are also typically framed as objectives of ERM chapters, although these tend to focus on supply security rather than on sustainability. Different observers have noted that sustainability provisions are often vague, non-binding, and limited in enforceability (Baršauskaitė et al., 2025; Blot, 2024; van der Ven et al., 2024). Some ERM chapters require environmental impact assessments for projects requiring authorisation, but they do not impose due diligence obligations on all mining projects. Trade and sustainable development chapters partly compensate for this by providing broader sustainability provisions, but their general scope may not address the specific challenges of the mining sector (van der Ven et al., 2024).

In light of this, some have suggested incorporating stronger and/or binding provisions on ESG issues, building on robust standards, to ensure a level playing field. This should encompass requirements that address ESG concerns. For example, T&E (2024) recommends strengthening ERM chapters by incorporating mining-specific due diligence requirements, aligned with international standards (e.g. the *OECD Due Diligence Guidance*). It further calls for including them more widely in project-specific environmental impact assessments, possibly with expanded scope and mandatory follow-

up action. In addition, FTAs could make more frequent use of targeted carve-outs (i.e. exemptions given to trade partners, e.g. on dual pricing policies) to provide more policy space to pursue local value added, but conditional on adherence to ESG standards and prevention of export restrictions.

In establishing conditions for 'ESG-compliant' trade under FTAs, it should be noted that stricter ESG requirements may impose burdens on the exporting countries, including higher compliance costs and increased competition with EU companies already meeting high standards. ESG requirements might be perceived as a cost factor rather than an opportunity, and local producers might lack the resources to make the necessary transformations (Bauer et al., 2025). Also, some trade partners might prioritise broader economic development over ESG objectives, meaning excessive focus on ESG might limit EU investment potential in trading partners' capacities (Acheampong & Logan, 2025). Even when extra-EU producers recognise the benefit of improving ESG performance in accessing the EU market, they often need guidance to do so effectively. The EU can support this through partnership-driven strategies that build capacity, provide technical assistance and reduce compliance burdens.

Strategic partnerships with resource-exporting countries are becoming another central instrument of the EU's CRM strategy. These 'soft power' instruments take the form of (non-binding) memoranda of understanding (MoUs), typically followed by roadmaps outlining steps to operationalise cooperation. This makes them more flexible than (and hence complementary to) conventional FTAs, as they cover issues beyond trade – such as financial support, R&I and technical cooperation, including on ESG (Righetti & Rizos, 2024).

Most MoUs also explicitly mention cooperation on ESG standards, normally with the objective of aligning the partner country's regulatory framework with the EU's and international standards. A clear example is the EU-Australia MoU, which commits both parties to:

> *Closely cooperate on [ESG] standards and assessments and coordinate in international fora, where appropriate including to … align international mineral pricing with high ESG standards; strengthen supply chain transparency and promote market recognition for high ESG standards; strengthen market opportunities and projects for EU and Australian industry players with strong responsible mining credentials.*

Similar language appears in other MoUs, signalling political recognition of the importance of ESG principles. Yet, critics argue that these generally remain vague and aspirational provisions. The lack enforcement and monitoring frameworks has so far led to very little

concrete progress, notably in terms of EU private-sector involvement (Gherasim, 2024; T&E, 2023; Karkare, 2025; Logan, 2024). On ESG-related provisions more specifically, some argue that these are likely to be overshadowed by vested interests, possibly curtailing the policy room of exporting countries to implement high ESG standards (Baršauskaitė et al., 2025).

In the long run, the effectiveness of these partnerships in supporting 'premium' market depends on their ability to mobilise investment and secure offtake for production with high ESG performance – achievements that remain limited to date. The proposed clean trade and investment partnerships could offer an opportunity to complement existing FTAs and strategic raw materials partnerships with stronger, binding clauses on ESG standards.

7.2. MULTILATERAL COOPERATION

As seen above, the EU can promote ESG-compliant practices abroad and hence level the playing field through own market-access conditionalities or bilateral (trade or cooperation) agreements. But these would only apply to foreign production destined for the EU market. Since metals and minerals are highly globalised markets, coordination via multilateral initiatives could potentially achieve a broader and longer lasting impact. More countries adhering to common standards would increase leverage, while also requiring significant cooperation to align definitions, criteria, and priorities. Multilateral action could also help mitigate competition pressures that may arise under conditions of resource scarcity or supply constraints.

Central to this effort is the emergence of a high-standard, global CRM marketplace. Initially advanced by the US, calls for such joint efforts have recently been reiterated by the G7 group in its Critical Minerals Action Plan. It refers to the need to build 'standards-based markets' that can 'reflect the real costs of responsible extraction, processing, and trade of critical minerals'. The action plan also envisages the development of a roadmap establishing minimum thresholds to access this standards-based market, with traceability being a key tool. Key questions remain: what criteria should define access or incentives, which materials should be prioritised, how (or under what institutional framework) such coordination should converge, and how verification and enforcement should be organised.

Similar to the rationale outlined above for the EU, multilateral coordination could go in the direction of setting minimum common (market or procurement) access criteria, or joint conditional support for strategic projects. Either way, strong conditionalities in terms of ESG principles should be guaranteed in order for a green premium to develop.

So far, multilateral initiatives in the CRM domain have mostly focused on mobilising investment. The Minerals Security Partnership (MSP), launched in 2022 as a consuming countries-driven framework for cooperation, essentially aims at diversifying value chains and pooling investment towards (extra-China) projects with high ESG standards. Under the MSP umbrella, the MSP Forum – stemming from the EU's earlier proposal of a raw materials club – aims to complement the MSP mandate by including producing countries and advancing policy cooperation beyond project investment. Within its 'policy dialogue' workstream, the Forum also explicitly seeks to address policies on sustainability, including 'pricing challenges related to high ESG standards'.

Still, the MSP is very much driven by security rather than sustainability objectives. And even in mobilising capital the MSP has not shown much progress so far, partly due to the fragmented and small nature of supported projects and their limited strategic value (Baskaran & Schwartz, 2025). Linking financial support more directly to offtake agreements – as in Japan's JOGMEC model – could help align investment incentives with market demand. A G7 critical minerals fund, as suggested by Baskaran & Schwartz (2025), could provide such a mechanism, tying funding to concrete offtake commitments and ensuring stronger downstream industry participation. Continued mobilisation of capital into high ESG performance projects in line with its core mandate, should remain its priority.

As mentioned above, an alternative, potentially more effective approach to foster ESG-compliant markets is setting joint access requirements. Countries could set minimum market-entry conditions based on harmonised standards (e.g. maximum carbon-footprint thresholds[23]), with either outright bans or common penalty mechanisms (i.e. external tariffs) for products failing to comply. Criteria should be country-independent, i.e. they should be set in a way that incentivises producers to try to access the market and should ensure WTO compliance (Cernicky et al., 2024). Initially, a narrow remit in terms of both scope and threshold – e.g. carbon footprint alone – would make it easier to reach agreement among members, while preventing excessive market disruptions. As argued for EU market access requirements, the overall rationale should be the exclusion of the worst performers. Once there are sufficient buy-in criteria, the threshold and scope could be expanded, e.g. to minimum due diligence requirements.

In principle, the MSP – and the MSP Forum in particular – could offer a basis for coordinating standards-based, market access rules. However, as seen above, its mandate

[23] For example, T&E (2024) calculates that setting that a joint maximum threshold of 30-40 kg CO_2 per kg of nickel entering the EU, US, Japan and South Korea would suffice to create a market for low-carbon nickel production.

remains largely focused on increasing diversification and mobilising investment (although in projects with high levels of ESG performance).

Going beyond the CRM club proposed by the European Commission, Draghi (2024) proposes the creation of a G7+ critical raw materials club. Its participants (G7 countries + relevant countries like Australia and South Korea) would 'facilitate the coordination of market behaviour among members in line with geopolitical and economic security concerns'. This club idea – which appears to be under consideration by the European Commission – would focus, inter alia, on providing 'a long-term perspective on fair prices for raw minerals'. These 'could be in the form of off-take agreements and include provisions on how to adjust prices to evolving market conditions and prevent back-selling via cheaper offers'. As recent initiatives show, these currently appear to be the more realistic avenue.

A different – or complementary – approach would be for these countries to jointly establish a separate, dedicated entity that would take on some of this coordinating effort, notably with regard to definitions and criteria. Initially proposed by the International Resource Panel (UNEP, 2020), an international agency on minerals and metals modelled around the International Energy Agency, could among others be tasked with fostering capacity building and technology transfer initiatives, providing R&D support, and crucially, advancing harmonisation of standards. A strong, third-party institution would be highly beneficial in driving standardisation efforts – along with already active bodies and initiatives like the UN Critical Energy Transition Minerals' Panel, OECD, and ISO – and necessary for establishing an international monitoring and verification authority (Gherasim, 2024). Such an initiative could also be tasked with developing CBAM-like measures, such as a raw materials adjustment mechanism, applying penalties to imports not complying with agreed minimum standards (Global Council for Responsible Transition Minerals, 2025).

CONCLUSIONS AND OUTLOOK

Greening metals and minerals production, including CRMs, comes with higher capital and operating costs – a green premium. This reflects investment to decarbonise production processes, ensure robust environmental and social safeguards, and advance circularity. Under current market conditions – marked by overcapacity of low-cost, emission-intensive supply, slowdowns in key downstream markets and high volatility in prices – manufacturers appear hesitant to absorb green premia, though often willing to pay a 'supply security premium'. While this may incidentally pull greener supply as a side benefit, it does not do away with the need for policy mechanisms that internalise sustainability costs. Clear commercial advantages for higher ESG performance are needed through a differentiated market for sustainable CRMs. Ultimately, such measures would not only strengthen sustainability but also enhance long-term supply security.

A credible green-premium market for CRMs is unlikely to emerge without regulatory intervention. Market-driven solutions such as the set-up of dedicated price benchmarks for green CRMs within market exchanges have been widely discussed. Yet in the absence of robust standards and definitions, verifiable traceability systems, and consistent demand signals, such initiatives remain insufficient or premature. Until CRM markets mature, market platforms like the London Metal Exchange can still play a constructive role by encouraging traceability, standardising reporting and verifying sustainability claims. Delivering credible traceability will require not only harmonised standards, but also practical support for upstream and smaller producers, so that data collection and verification requirements remain feasible across the value chain. Public policy will, in parallel, need to drive the conditions for premium CRM demand and create the foundations for differentiated markets.

This analysis has laid out a phased, 'two-tier' pathway towards a premium market. The first tier would focus on setting minimum market-access requirements, to level the playing field and exclude the worst performers from EU market access. These baseline mandatory requirements should initially focus on mandatory due diligence, traceability, and disclosure of the environmental footprint, applying to the widest possible range of CRMs or CRM-containing products entering the EU market. For a prioritised subgroup of strategic materials, these could then evolve into performance-based thresholds (e.g. maximum carbon intensity), phased over time to avoid excessive market disruptions.

Existing, CRM-relevant frameworks — such as in the Battery Regulation, the CRMA, or CBAM — already establish partial requirements in this direction, yet they remain fragmented, unevenly enforced, and limited in scope. Alignment and consolidation across these frameworks, in terms of carbon footprint methodologies, and disclosure and due diligence obligations, remain key priorities to ensure ease of implementation and

verifiability. A targeted expansion of CBAM could help internalise the carbon dimension of CRM production, starting with mature and trade-exposed materials such as nickel, before potentially broadening to other CRMs.

While these 'baseline' requirements could curb the worst performers, they might not sufficiently support the best ESG performers with credible rewards. A second tier of instruments is therefore needed to reward those who exceed baseline standards through targeted, conditional incentives. Market instruments like public procurement, and price or offtake guarantees – conditional on verifiable ESG performance – can help create a transparent and durable premium signal.

The forthcoming revision of the EU Public Procurement Directive and the Industrial Accelerator Act offers an immediate opportunity to introduce sustainability and resilience criteria into tender procedures. A stepwise, time-bound implementation of EU preference criteria, carefully prioritised by sector, could support both sustainability and security with limited cost pressures and market distortions. Dedicated de-risking and offtake support mechanisms – including price or volume guarantees and matchmaking platforms – could provide a credible market signal for sustainable CRMs, helping to unlock private investment and stabilise returns in early project stages.

Importantly, both tiers hinge on robust and harmonised standards and verification systems. A uniform definition of what constitutes 'green' is a precondition for product and price differentiation. Equally, effective traceability and verification mechanisms are indispensable to ensure that claims reflect reality and that access requirements can be enforced, especially where CRMs are embedded in complex value chains. Without trust in standards and verification, neither market access rules nor incentives can operate effectively. Furthermore, incentives for circularity, efficiency, and substitution strategies remain crucial levers for pursuing both sustainability and supply resilience strategies, and must be framed as core elements of both. These should also be complemented by strong traceability measures to ensure that secondary materials genuinely reduce dependencies and environmental impact.

EU action alone will have limited impact, but the leverage of its single market could be amplified through alignment with trade and cooperation partners. Bilateral agreements and strategic partnerships could be used more effectively to advance ESG objectives. Multilateral coordination across jurisdictions would reduce the risk of competitive distortions, provide greater certainty for investors, and strengthen the demand signal for sustainably sourced CRMs. Initiatives such as the Minerals Security Partnership should continue efforts to drive investment into projects with high ESG performance, though with financing more closely tied to offtake agreements. Other platforms, particularly with G7 and OECD partners, could better serve as a basis for convergence on joint, minimum

access requirements and frameworks. In the longer term, proposals such as an international agency on minerals and metals could institutionalise this role.

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