Agora Industry

ANALYSIS

Creating markets for climate-friendly basic materials

Potentials and policy options

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Analysis
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Preface

Dear reader,

Policies that shape demand for climate-friendly basic materials can be used to drive change for the industrial transition to net zero. So far, policy makers have focussed on the supply side of the transition: Carbon pricing and funding programmes have been key approaches to incentivise investments in climate-neutral production. Only recently the idea of creating "lead markets" via dedicated policies has emerged, to spur innovation, create demand for climate-friendly basic materials and thereby help support basic material industries. For sectors with high up-front investment costs, such as steel, cement or chemicals, establishing strong demand via lead markets must complement carbon pricing instruments, help de-risk early investments in climate-friendly production and limit reliance on subsidies. Lead market instruments can jointly kick-start demand for climate-friendly basic materials – including standards, carbon accounting and reporting, and embodied carbon limits. In this paper, we describe the concept of lead markets and discuss each of these instruments, their effects, strengths and weaknesses. We argue that the optimal policy mix depends on the relevant end-use sector. Governments would do well to consider these factors when designing an effective policy package to support industrial transformation from the demand side.

I wish you pleasant reading!

Yours sincerely,
Frank Peter
Director, Agora Industry

Key findings at a glance

1 **The revised EU Emissions Trading System calls for climate neutral basic materials by 2040 – this requires strong market demand from end-use sectors.** Two thirds of EU industrial greenhouse gas emissions come from steel, plastics, aluminium and cement. Decarbonising their production is crucial to achieve a climate neutral industry. In turn, 60 percent of the emissions of their production are linked to materials that go into buildings, construction, packaging and mobility. However, demand from these end-use sectors for climate neutral basic materials is currently insufficient, highlighting an important policy gap.

2 **Lead market instruments combine a suite of policy instruments that jointly kick-start market demand for climate-friendly basic materials.** First, clear standards establish a distinct, marketable product. Second, stringent carbon accounting and reporting provide the required trust and transparency for businesses and consumers. Third, labels and certification enable businesses and consumers to make more climate-friendly choices. Fourth, instruments such as green public procurement and embodied carbon limits create a specific market demand for climate-friendly materials.

3 **Using climate-friendly steel or cement increases the average cost of a building or car by only around one to three percent.** These marginal cost increases allow more consumers to make climate-friendlier choices and enable producers to recover additional costs directly from the market. This leads to a virtuous cycle: market growth becomes self-reinforcing and does not depend on direct government subsidies.

4 **Buildings and construction are one of the largest demand sectors for basic materials and a key entry pathway for creating lead markets.** Basic materials going into this sector alone account for around thirty percent of overall industrial emissions in the EU. Upcoming EU requirements such as the revised Construction Products Regulation and the Energy Performance in Buildings Directive are first starting points for demand-side instruments. These need to be implemented ambitiously and complemented with additional instruments such as financial incentives for climate-friendly and circular materials.

Content

Glossary

Term	Explanation
Circular materials and products	In this paper, circular materials or products encompass recycling, greater material efficiency (lightweight construction, substitution, loss minimisation) and the longer use of materials and products (extension of service life and reuse of components).
Climate-friendly	For the purposes of this paper, "climate-friendly" is an umbrella term used to describe the production of basic materials and products in a way that generates low, near zero and net zero emissions and thus a substantial reduction of CO_2 emissions, which is compatible with climate neutrality by the mid-century.
Demand-side instruments	(Policy) measures that target market demand for materials, products, or services – in the context of this analysis an increase in market demand for climate-friendly materials and products.
Embodied carbon emissions	The emissions of greenhouse gases associated with the production, consumption and disposal of materials used to manufacture or build a given product. Unlike lifecycle emissions, embodied carbon emissions do not include operational emissions associated with the use phase of the building (energy use). See also "Lifecycle emissions".
Green premium	The addition to the price needing to be paid by purchasers of basic materials or related goods to enable the manufacturer to recover the full cost of producing materials or goods with a higher environmental quality than the (typically more polluting) market reference product.
Lead markets	Markets that are created or supported by dedicated public policies to spur innovation by encouraging a leading share of market participants to adopt a certain type of product, material or a new design.
Lifecycle emissions	The combined Scope 1, 2 and 3 global warming potential of greenhouse gas emissions of given products from the beginning of the production value chain to the disposal of the final goods by the consumer.
Lead market instruments for climate-friendly basic materials	A suite of policy instruments that can jointly kick-start demand for climate-friendly basic materials. These encompass standards as well as carbon accounting and reporting to provide the level playing field for climate-friendly basic materials and inform consumers; labels to evaluate the environmental performance of different materials; and instruments that set targets for the use of climate-friendly materials, such as green public procurement.
Low-emission	Low-emission refers to a substantial reduction in CO_2 emissions of a specific material or product compared to a baseline. This CO_2 reduction can be calculated in absolute numbers or in relative terms, e.g. percentages.

Glossary

Term	Explanation
Near zero (emissions)	Near zero or near zero emissions refers to the reduction of net CO_2 equivalent emissions related to the material's or product's manufacture to a level very close to net zero (compared to today's levels), while a small quantity of residual emissions remains.
Net zero (emissions)	In the context of this paper, the term net zero, or net zero emissions refers to the compatibility of a material or product with climate neutrality, i.e. net zero CO_2 equivalent emissions are created by the material's or product's manufacture.
Overspecification	Reference to the fact that many buildings and infrastructure are often constructed with more materials than strictly necessary to achieve a given level of durability and structural performance.
Material efficiency	A measure of the extent to which a given input of materials into a production process leads to a corresponding output of material service value in that product. All else being equal, a more materially efficient product is one that uses fewer materials to provide the same or a higher level of material services than an equivalent product.
Supply-side instruments	(Policy) measures that target the market supply of materials, products or services – in the context of this analysis an increase in market supply of climate-friendly materials and products.

1 Introduction: The importance of scaling up demand for climate-friendly materials and products

An industrial transformation towards climate neutrality is needed along the entire industrial value chain, from build-up of infrastructure and climate-friendly production processes to the creation of lead markets for climate-friendly basic materials and end products. Policy incentives are necessary to transform both the supply of and demand for such materials and products. Supply-side policies support the cost competitiveness of investments in and operation of climate-friendly production processes with conventional processes. They encompass carbon pricing, various subsidy schemes, de-risking instruments, or technology standards. Demand-side instruments are helpful to support early movers in the downstream markets, develop value chains and familiarise purchasers, and demonstrate the feasibility of climate-friendly production solutions. Examples of demand-side instruments are standards, quotas, labels, certification, or green public procurement.

Carbon pricing as a leading instrument for transforming industrial production in Europe needs to be complemented by a policy mix

On the supply side, the recent ambitious revision of the European Emissions Trading Scheme (EU-ETS I) and the introduction of a Carbon Border Adjustment Mechanism (CBAM) have set a clear pathway and end point for the decarbonisation of Europe's heavy industry. Based on the revised mitigation trajectory, no new emission allowances would be issued in the EU-ETS I by 2039. Effectively, this means that energy-intensive industries responsible for producing Europe's basic materials will have to ensure that their processes generate net zero emissions by around this date. Adding urgency to the story, following the introduction of the CBAM, free allowances for key industrial sectors such as steel, basic chemicals, cement and aluminium will also be phased out from 2026 to 2034. Furthermore, CO_2 prices have seen historic highs in the past year, reaching 80–90 euros (EUR) per tonne of carbon dioxide (tCO_2) and are expected to rise to approximately EUR 130/tCO_2 by 2030 (IEA, 2023).

In the short run, existing carbon pricing – although important – still has its limitations if viewed as a unique policy instrument that is sufficient to ensure scaling up the supply of and demand for such materials. For example, important split incentives remain because the carbon price is often not reflected in key design choices for final products such as buildings or cars, which means that climate-friendly materials are not prioritised. In many cases, the marginal abatement costs at which these materials become competitive compared to their substitutes produced with conventional technologies do not yet match existing CO_2 prices in the EU-ETS I (see for example Agora Industry, FutureCamp, Wuppertal Institute and Ecologic Institut, 2022). Thus, climate-friendly basic materials typically come at a certain level of initially higher costs – the "green premium". For products sold in highly competitive and trade-intensive commodity markets such as steel or chemicals, such cost increments can significantly affect their ability to achieve mass market competitiveness.

Moreover, carbon prices can and do fluctuate. This is not necessarily a major concern for low capital investment costs, or in markets with low entry barriers. Many climate-friendly technologies do not fit this description, however. They are often highly capital-intensive, and also entail infrastructure costs required to supply them with renewable hydrogen, power or CO_2 capture, use and storage. Given the scale of these investments, investors face certain risks when carbon prices are too low and fluctuate over long payback periods.

Complementary policy instruments such as Carbon Contracts for Difference (CCfDs) can alleviate the challenge posed by the initially higher costs of

climate-friendly materials. By hedging these incremental costs, they can help create investment security for companies facing carbon pricing levels that would not yet otherwise justify these investments. In times of tight financial budgets, however, CCfDs can be complemented by other instruments to make the transition as efficient and market based as possible, given that subsidies may not be a sustainable solution in the long run.

Demand-side instruments can reduce the need for supply-side public financial support for the transition – at comparably small cost increases of one to three percent for climate-friendly end products for consumers

While the incremental cost of materials is likely to be initially higher with climate-friendly materials, all else being equal, these costs become a comparatively small part of the total costs when looking at the demand side – i.e. at the final product level, such as a building or car that consumers purchase. Research shows that building a house with climate-friendly cement as the main structural product increases the total project costs of the house by around one to three percent (Energy Transitions Commission, 2018; Agora Energiewende, Agora Industry, ifeu, Ramboll, forthcoming). Similarly, the incremental cost of a mid-sized new car made with climate-friendly steel is likely to increase by around one percent of the vehicle's show room price (CISL, Agora Energiewende, 2021).

Given this comparatively small cost increment, certain consumers may be more willing to pay the associated green premium. During the initial stages, the public sector is well placed to stimulate demand by guaranteeing the offtake of climate-friendly materials and products for public buildings, vehicles and infrastructure. Another relevant stakeholder group are businesses that can spur demand by using climate-friendly materials in their commercial real estate and corporate fleets. Nevertheless, and although (temporary) cost increases of using climate-friendly basic materials in end products are expected to be comparably low, policy makers need to ensure that less affluent consumers are protected in parallel in any case, for example by promoting social housing construction.

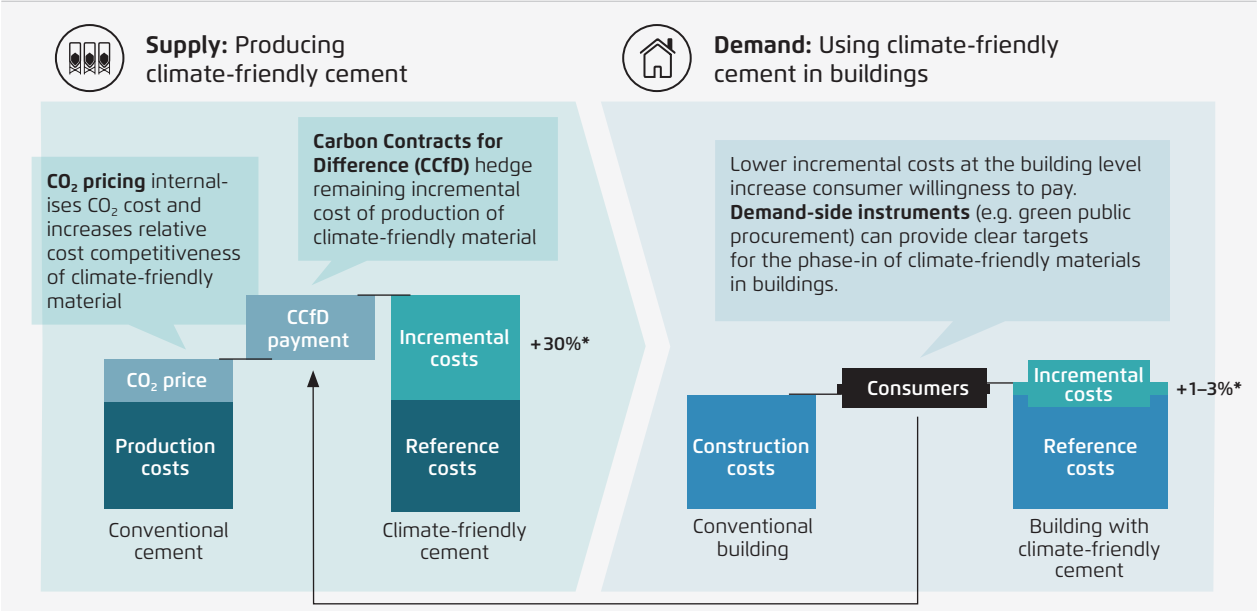
The resulting demand in turn reduces the need for future financing of the transition to climate-friendly cement or steel production through CCfDs or other subsidies. Thereby, not only the share of transition costs accounted for by the public budget is reduced, but also the overall costs of the transition compared to alternative policy approaches (see Figure 1). The reason is actually intuitive: investing in a market with robust and growing consumer demand makes for a better business case and less project risk, thus reducing the need for costly public subsidies. The faster the market emerges and a learning curve with climate-friendly production occurs, the faster cost reductions are expected to evolve.

From information supply to developing markets, demand-side instruments bring additional benefits for the industrial transformation

Moreover, cost is only one dimension. There are other important reasons for creating markets for climate-friendly materials and products. There is an array of demand-side instruments, from labels to green public procurement, each adding value to a different extent. Standards help enable or improve market access for climate-friendly materials. CO_2 accounting and reporting requirements inform and provide transparency for consumers. Labels and certification evaluate the carbon footprint of materials and final products. Thereby, they can inspire trust in the environmental footprint of materials and products and facilitate more climate-friendly purchasing decisions.

Other instruments such as carbon product requirements, embodied carbon targets, quotas or green public procurement can then be used to set targets and create incentives for the efficient use of climate-friendly and circular materials and products. Such instruments leverage other added values, including securing the offtake of and increasing the security of investment in

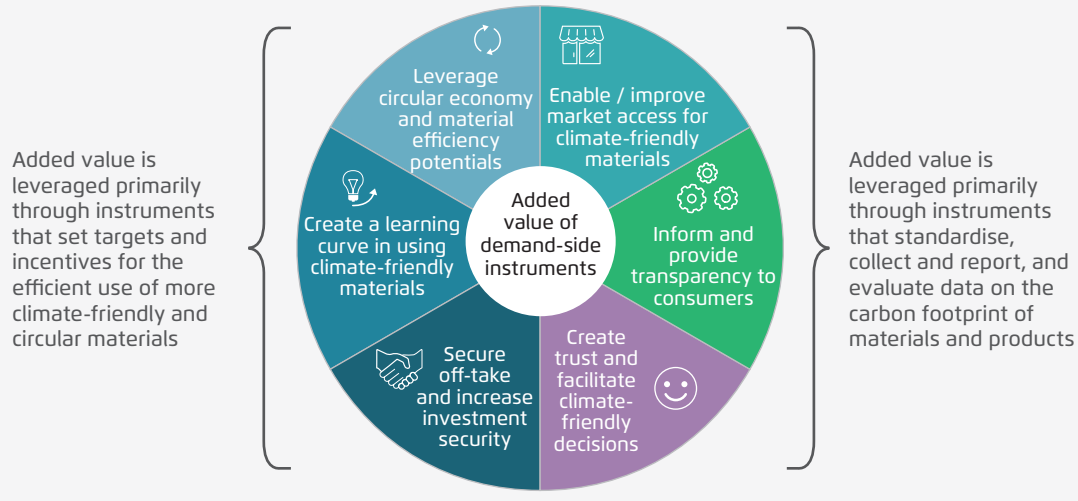
Long-term effects of demand-side instruments on the costs of industrial transformation → Fig. 1



Agora Industry (2024) based on Agora Industry, FutureCamp, Wuppertal Institutee, Ecologic Institute (2022) and ETC (2018). *Final incremental costs may differ depending on influencing cost factors such as CO_2 or electricity prices.

climate-friendly production, building a learning curve with new and climate-friendly materials and products and leveraging circular economy and material efficiency potentials (see Figure 2).

Benefits of demand-side instruments for lead market creation → Fig. 2



Agora Industry (2024)

Demand-side instruments can thus be a crucial missing piece of the puzzle for transforming industrial production as well as demand-side sectors.

This paper is structured as follows: Chapter II discusses potential sectors where lead markets may be successfully developed. In Chapter III, we outline a range of different instruments available on the demand side, their basic functions and respective advantages and disadvantages. Chapter IV focuses on the situation in Germany, specifically the buildings sector as a promising candidate for lead market instruments, and outlines options for an instrument mix design that complements the current regulatory framework. Chapter V concludes with an outlook, linking up to the debate on scaling up markets for climate-friendly basic materials globally.

2 Scaling up lead markets for climate-friendly basic materials: key end-use sector candidates and market dynamics

2.1 Identifying the right sectoral starting points is key for lead market creation

For successful lead market creation, it is important to identify appropriate sectors to start with. While there may be some niche markets or progressive companies willing to pay a premium for climate-friendly materials and products, it is not clear that this is the case for most downstream purchasers (CISL, Agora Energiewende, 2021). It is therefore key to identify those niche sectors to be able to effectively develop markets on the way to climate neutrality.

The most CO_2-intensive materials are steel, cement and concrete, aluminium, as well as basic chemicals and their derivatives (such as plastics, fertiliser). Together, these materials accounted for around two thirds of the 708 $MtCO_2eq$ industrial emissions in Europe in 2018 (Agora Industry, 2022). For these basic materials, relevant end-use sectors need to be identified as good candidates to create and scale up lead markets. This depends on key aspects: the volume of the demand for basic materials going into these sectors, the effect of incremental costs on the value of the final product and the consumer willingness to pay for climate-friendly products.

In the following analysis, we focus on buildings and infrastructure, automotive vehicles, shipping, packaging and domestic appliances as potential candidates for lead market development.

The first key characteristic that makes an end-use sector a suitable lead market sector is its high demand for basic materials

The first characteristic that positions an end-use sector as a good lead market candidate is its substantive demand for basic materials. Specifically, the construction (encompassing infrastructure and buildings), automotive and mobility, and packaging industries can be identified as key drivers of material consumption in terms of volume. Together, their value chains cover 60 percent of the GHG emissions generated from the production of these materials in the EU (Agora Industry, 2022)[1].

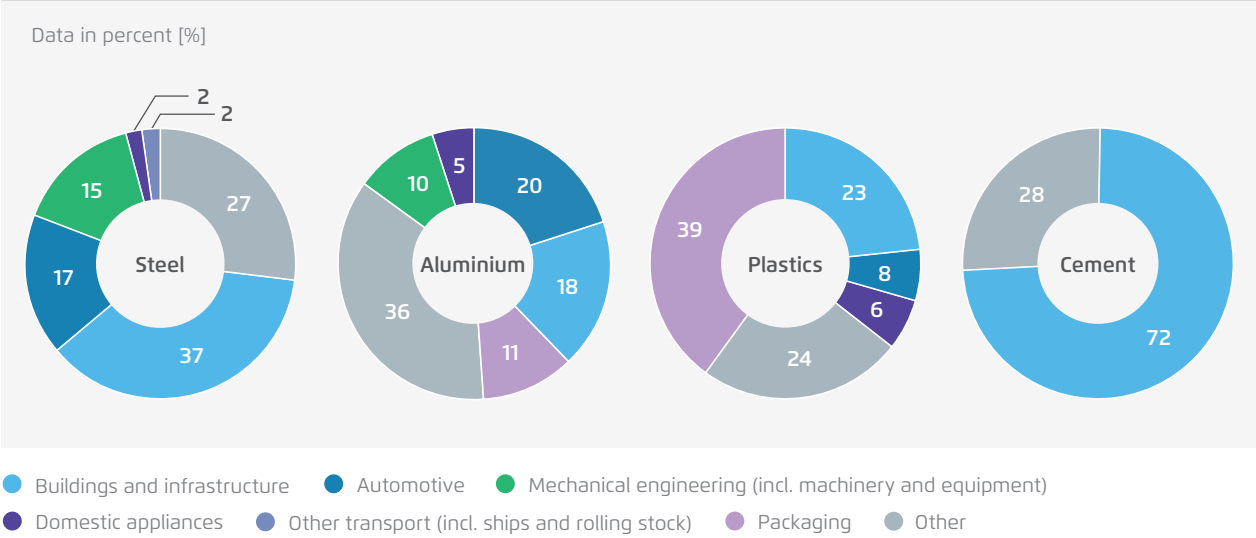
The construction sector – covering both infrastructure and buildings – accounts for around three quarters of the demand for cement in the EU in terms of volume and for around one quarter of demand for plastics (Cembureau, 2023; Plastics Europe, 2023). The automotive sector is a significant consumer of steel and aluminium, representing 17 percent and 20 percent of the demand for these materials in terms of production volumes, respectively (Eurofer, 2023; Ducker, 2023). Automotive also consumes around eight percent of plastics (Plastics Europe, 2023). Packaging consumes a vast amount of plastics – around 40 percent in the EU (Plastics Europe, 2023).

Ship building and repair is classified within the "other transport" category in steel consumption, which accounts for two percent of overall demand for steel (Figure 3). Shipping typically utilises a small proportion of flat steel in the form of quarto plates (seven percent of the EU annual production in 2022) (Eurofer, 2023). Compared to the demand for steel in other end-use sectors analysed here, however, steel demand for shipping constitutes only a very small fraction. However, globally, the shipping sector is forecasted to have a growing demand for hot rolled

1 For a breakdown for Germany, see p. 16 of Agora Industry, Systemiq (2023) Resilienter Klimaschutz durch eine zirkuläre Wirtschaft.

Energy-intensive materials use in key end use sectors for 2020, 2021 and 2022 (EU-27)

→ Fig. 3



Agora Industry (2024) based on Eurofer (2023), Cembureau (2023), CRU Group (2022), Plastics Europe (2023), Ducker (2023)

steel (UNFCCC, 2023). Domestic appliances use around five percent of plastics and aluminium, and two percent of steel in the EU (Plastics Europe, 2023; Eurofer, 2023). Along with the shipping sector, domestic appliances may therefore not be classified as large consumers of basic materials.

A further end-use sector, which may grow as a relevant consumer of basic materials in the course of the transformation is the clean tech manufacturing sector, including renewable energy manufacturing. However, limited data on the size of this market as a consumer of basic materials is available.

These end-use sectors also use different types of these materials. Steel used in construction and shipping, for example, is mostly secondary steel, made from scrap steel (UNFCCC, 2023). The automotive industry uses for the most part (primary) flat steel, making it one of the main demand side levers for incentivising investments in climate-friendly technologies in the production of flat steel. Hence, these sectors can play a complementary role in the creation of lead markets for climate-friendly basic materials, both for virgin materials, but also recycled materials (for instance, scrap steel for the construction and virgin steel for the automotive sector).

A second factor that makes an end-use sector a good lead market candidate is that it can absorb the additional cost of using climate-friendly materials

The incremental cost of climate-friendly materials onthe final product value on the market may vary, depending on the product and end-use sector. Understanding this is crucial to evaluate a manufacturer's ability to absorb or pass on the additional cost of sourcing climate-friendly materials. The influence of basic material costs on final product prices is not uniform, varying significantly across different value chains. In sectors like buildings and infrastructure, automotive vehicles, and packaging, this ratio tends to be low. For instance, the cost of conventional steel represents a mere fraction (less than two percent) of a car's final price. This means procuring climate-friendly steel might marginally increase the price of passenger cars by just less than one percent (Sandbag, 2024; WEF, 2021).

Similarly, in the plastics industry, the impact on consumer prices of reducing carbon emissions in ethylene production is negligible, with the price of a soda bottle increasing by no more than one percent (ETC, 2018). For buildings, estimates on the influence

of using low-emission cement or concrete on increasing the final price of a house range from less than one (IEA, 2020) to three percent (ETC, 2018). These modest price increases can make it easier for downstream companies to absorb the slightly elevated cost of climate-friendly materials or pass these on to consumers. In shipping, cost analyses have focused on the influence of alternative fuels on the final price (see ETC, 2018), not on the influence of using climate-friendly steel. Furthermore, no data on the influence of material costs on the final prices for domestic appliances are available.

Consumer willingness to pay for end products made with climate-friendly basic materials is a third key factor making an end-use sector a suitable lead market candidate

Related to the previous point on incremental costs, the end consumers', or downstream manufacturers' ability or "willingness-to-pay" for climate-friendly products is another important aspect. For downstream businesses directly selling to households, this can be linked with brand sensitivity or environmentally friendly consumption patterns. Most assessments of consumers' willingness to pay rely on surveys. In the automotive sector, a survey has shown that around 30 percent of consumers of electric vehicles may be more willing to pay for sustainably produced car batteries (Gehlmann et al., 2024) and that car buyers are willing to pay a price premium of around EUR 2 000 for a 20 percent CO_2 reduction per kilometre (Costa et al., 2018). In Germany, a survey has found that around 30 percent of participants would pay a sustainability premium for a car (Statista, 2023). The Boston Consulting Group (BCG) (2023) has found that around 85 percent of costumers stated that they would be willing to pay mark-up for a net-zero emissions car. BCG (2023) also conducted the analysis for home appliances, where the stated willingness to pay a mark-up was even higher (94 percent). In Germany, around 55 percent of washing machine consumers have reported a willingness to pay a 6 percent increase for a climate-friendly washing machine (BCG, 2023).

In the packaging sector, surveys indicate that around 50 percent of consumers are willing to cover the small extra costs linked with the use of low-emission materials (Accenture, 2019). For construction, around 30 percent of participants in a German survey indicate that they would be willing to pay a sustainability premium (Statista, 2023). In 2022, BCG has conducted a survey with costumers in the shipping sector. 82 percent indicated that they would be willing to be pay a three percent price premium for zero-carbon shipping (BCG, 2022).

While surveys can present an initial snapshot of the willingness to pay, it is important to note that the latter can vary especially for private consumers depending on factors such as the socioeconomic situation of a country or region. Policy design needs to take these additional factors into consideration. The willingness-to-pay typically decreases with rising price mark-ups (see BCG, 2023, for an example). It can also vary depending on the proximity between producers and end consumers across the value chain of the product and the ability to pass on the price premium to the final consumer. For instance, the steel supply chain frequently involves multiple intermediate stages of manufacturing. Steel is a fundamental input material utilised by various manufacturers, each with their own network of intermediaries and customers within the supply chain (Grubb et al., 2022). Frequently, manufacturers employing climate-friendly steel as a material do not directly sell the final product to end-users. The separation between climate-friendly steel producers and end-users of products incorporating climate-friendly steel presents a challenge in establishing a transparent chain of accountability across the manufacturing process. Facilitating information across the value chain is hence crucial to boost demand for climate-friendly materials.

The buildings and infrastructure, automotive and packaging sectors are most likely to be early champions for lead markets

Our analysis suggests that buildings & infrastructure, packaging as well as automotive identify as suitable candidates to start scaling climate-friendly

Analysis of the potential of end use sectors for lead market creation → Fig. 4

	Building and Infrastructure	Automotive vehicles	Shipping	Packaging	Domestic appliances
Basic material intensity					
Influence of material cost on final product value			no data available		no data available
Consumer willingness to pay					

- **High suitability for lead market development.** Share of EU-wide basic material demand: *at least 20%* of consumption of at least one basic material (volume in percentages, per year); Influence of basic material costs on the value of the end product: *less than 3%*; Willingness to pay: High (*over 50%* of consumers according to survey-based reviews indicate that they would pay a price premium)
- **Medium suitability for lead market development.** Share of EU-wide basic material use: *at least 10%* of consumption of at least one basic material (volume in percentages, per year); Influence of basic material costs on the value of the end product: *5–10%*; Willingness to pay: Medium (*up to 50%* of consumers according to survey-based reviews indicate that they would pay a price premium)
- **Low suitability for lead market development.** Share of EU-wide basic material demand: *less than 10%* of consumption of at least one basic material (volume in percentages, per year); Influence of basic material costs on the value of the end product: *from 10%*; Willingness to pay: Low (*up to 25%* of consumers according to survey-based reviews indicate that they would pay a price premium)

Agora Industry (2024) based on Eurofer (2023), Cembureau (2023), CRU (2022), Plastics Europe (2023), Accenture (2019), Ecorys SCS Group (2009), ETC (2018), UNFCCC (2023), SBTi (2023) and Sandbag (2024), BCG (2023), BCG (2022), Statista (2023)

lead markets in the EU (Figure 4). These sectors have the greatest potential due to a combination of high basic material intensity, limited incremental costs from materials, and a certain willingness to pay from consumers. This is also true for other sectors, including shipping and domestic appliances – although to a lesser extent.

Renewable energy manufacturing is expected to be a relevant lead market in the future

For future research, it may be worthwhile to investigate the potential of other sectors such as mechanical engineering , other mobility or clean tech manufacturing, such as renewable energy manufacturing, for lead market development. Sectors such as renewable energy manufacturing are projected to consume significant amounts of basic materials in the future – with the projected expansion of the renewable energy market, for example, the sector is expected to utilise 5 million tonnes of steel within the EU and the US by 2030 (Material Economics, ETC, 2021). However, more research on the influence of material costs on the final product value, and consumer willingness to pay is needed to assess these sectors' potential as lead market drivers.

2.2 Advancing the market for climate-friendly basic materials: Developments on the supply and demand side

On the supply side, technologies exist that can convert emission-intensive into climate-friendly basic material production

Looking at the production of relevant basic materials, technologies are or will be available that can steer these sectors to climate neutrality. In the steel sector, climate-friendly technologies based on the direct reduction of iron (DRI) are commercially available and can be deployed in the mid-2020s. Other relevant technologies that can play an important role in the transition to a climate-neutral steel sector include direct electrification and scrap-based

production (Agora Industry, 2023a). In chemicals production, electric furnaces or electric steam crackers to replace heat production based on fossil fuels are either already available or are currently in development (Agora Industry, 2023b).

In cement production, technological levers to reduce emissions include among others the reduction of the clinker-to-cement and the cement-to-concrete ratio, other circularity and material efficiency measures, electrification and carbon capture (Agora Energiewende, Wuppertal Institute, 2021). In the primary aluminium production process, decarbonisation efforts are highly dependent on a shift to recycling and on the decarbonisation of the power sector (Georgitzikis et al., 2021). New technologies are also being developed to reduce both the industry's energy consumption and emissions, such as new generation electrolysis technologies, or inert-anode technology (MPP, 2022; European Aluminium, 2020).

Companies have started initiating or announcing investments in climate-friendly technologies – yet, these fall short of the scale needed for a holistic industrial transformation

Production capacities for steel, cement and chemicals production in the EU will require significant reinvestments by 2030. For steel and chemicals production, these amount to around 50 percent of total production capacity; in the cement sector, these are estimated to be in the range of 30 percent (Agora Energiewende, Wuppertal Institute, 2021). Taking the steel sector as an example shows that there are encouraging signs for a transformation of the production fleet in Europe. Agora Industry (2023c) has tracked announcements for converting conventional steel production plants: By 2030, a cumulative capacity of around 50 million tonnes per annum for primary low-emission steelmaking has been announced across the EU, representing half of the EU's total steel capacity (Agora Industry, 2023c). However, these announcements need to be turned into final investment decisions which is only partially the case today. Further policy efforts on the supply and demand side are necessary to push the transformation further.

On the demand side, downstream companies are starting to pledge to increase their use of climate-friendly materials – yet the demand signal could be even higher and the pledges vary in ambition and transparency

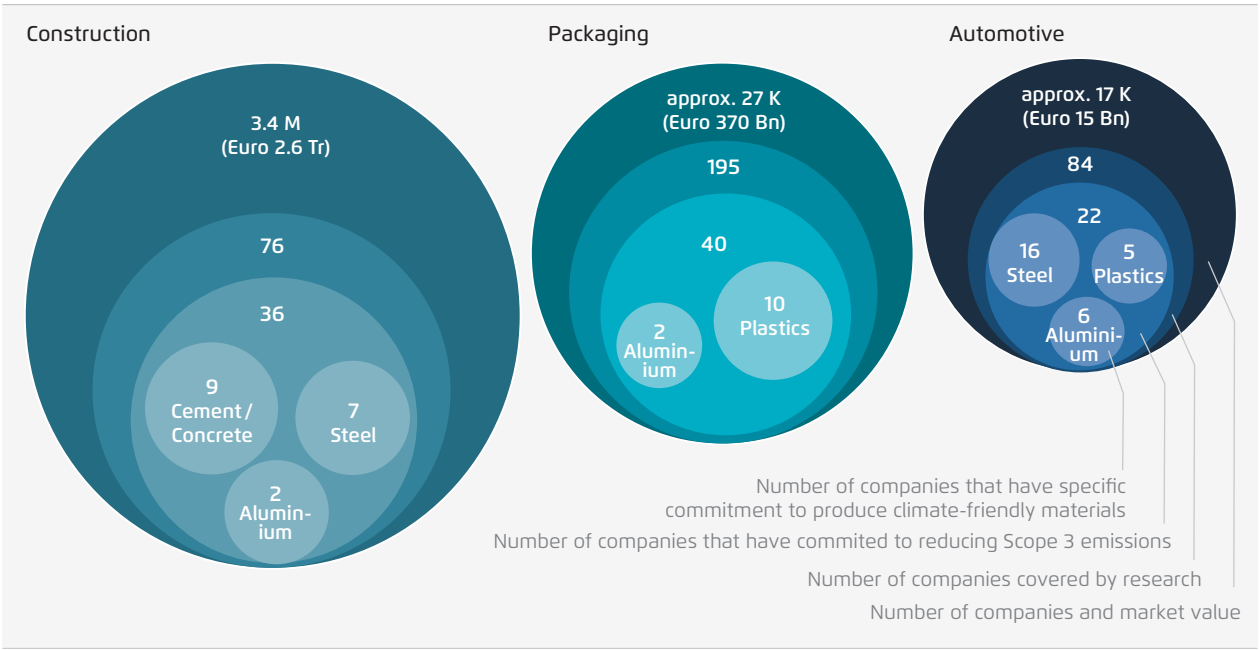
Many companies in relevant downstream sectors are committing to increasing their use of climate-friendly products. One notable and growing coalition of multinational companies with a goal to purchase near-zero basic materials is the First Movers Coalition (FMC) (FMC, n.d.). Another renowned initiative is the Science Based Targets Initiative (SBTi), with most members defining reduction targets for emissions from their value chain. The infrastructure industry is well represented as the third largest industry for validated targets (SBTi, 2023a).

However, existing initiatives fall short of fully expanding the market for climate-friendly materials. From the companies covered in our analysis (Figure 5), only a fraction has published specific targets on using climate-friendly basic materials. 11 percent of the companies reviewed in the scope of the research have made pledges to procure low-emission cement in the future and 19 percent of the car manufacturers have pledged to procure low-emission primary steel. Many companies are also not publicly reporting on progress on their midterm to long term targets. For instance, only half of companies aligned with the SBTi fully reported progress in 2022 (SBTi, 2023a). While the analysis shown in Figure 5 presents only a snapshot of the total companies in the end-use markets, it indicates that there is still potential to leverage more strongly the market power of these end-use sectors.

In addition, pledges to buy climate-friendly basic materials are characterised by a multitude of ambition levels and definitions for CO_2-reduced materials, ranging from "almost CO_2 free" to "low carbon". An example for this are some of the world's largest

Company pledges for use of climate-friendly materials in key end use sectors (EU-27)

→ Fig. 5



Agora Industry (2024) based on Blackridge Research & Consulting (2024), BoldData (2024), European Council (2024), European Union (2022), FMC (2023, 2024), HitHorizons (2022), MMR (2023), SBTi (2023); size of figures is indicative.

Demand pledges by automotive companies for steel with a reduced CO_2 footprint

→ Table 1

Steel consumer	Steel supplier	Demand pledges by automotive companies	Start of cooperation
General Motors	Nucor Corp	Using net-zero steel in future passenger vehicles	2022
Scania AB	H_2 Green Steel	Using sustainably produced steel	2025
Mercedes-Benz Group AG	H_2 Green Steel	Using over approximately 50 000 tons almost CO_2-free steel per year	2025
	SSAB	Using almost CO_2-free steel	2026
	Salzgitter Flachstahl GmbH	Using CO_2-reduced flat steel	2026
	Thyssenkrupp AG	Using CO_2-reduced steel	2026
BMW Group	H_2 Green Steel	Using CO_2-reduced steel	2022
	Salzgitter AG	Using low-carbon steel	2026
Volvo Group	SSAB	Using fossil-free steel	2021
Volkswagen AG	Salzgitter AG	Using low-carbon steel	2025
Ford Motor	Tata Steel Nederland B.V.	10% use of carbon neutral steel by 2030, carbon neutrality target by 2035	2023
	Thyssenkrupp Steel Europe AG		
	Salzgitter Flachstahl GmbH		

Agora Industry (2024) based on Ford Media Center (2022), H_2 Green Steel (2022, 2023), Lopez, J. (2021), Mercedes-Benz Group AG (2023a, 2023b), Salzgitter AG (2022a, 2022b), SSAB (2024).

automotive manufacturers' agreements to buy from future "climate-friendly" steel producers to reduce emissions within their supply chains (Table 1). While these commitments are a notable step, the various definitions hamper the effective comparison of the ambition level of these materials and products. Thus, these definitions need to be aligned across the board.

Challenges remain to fully scale up the supply of and demand for climate-friendly materials and products, which need to be addressed through an appropriate policy mix

The outlined developments on both the supply and demand side are significant steps – however, they do not yet amount to the scale needed to decarbonise these industries and reach carbon neutrality by 2045. We see some final investment decisions in the supply sectors, but not a full-fledged transformation towards climate neutrality of the entire production. And on the demand side, companies are starting to make pledges for using climate-friendly materials, but not sufficient to fully leverage the market power of the demand sectors.

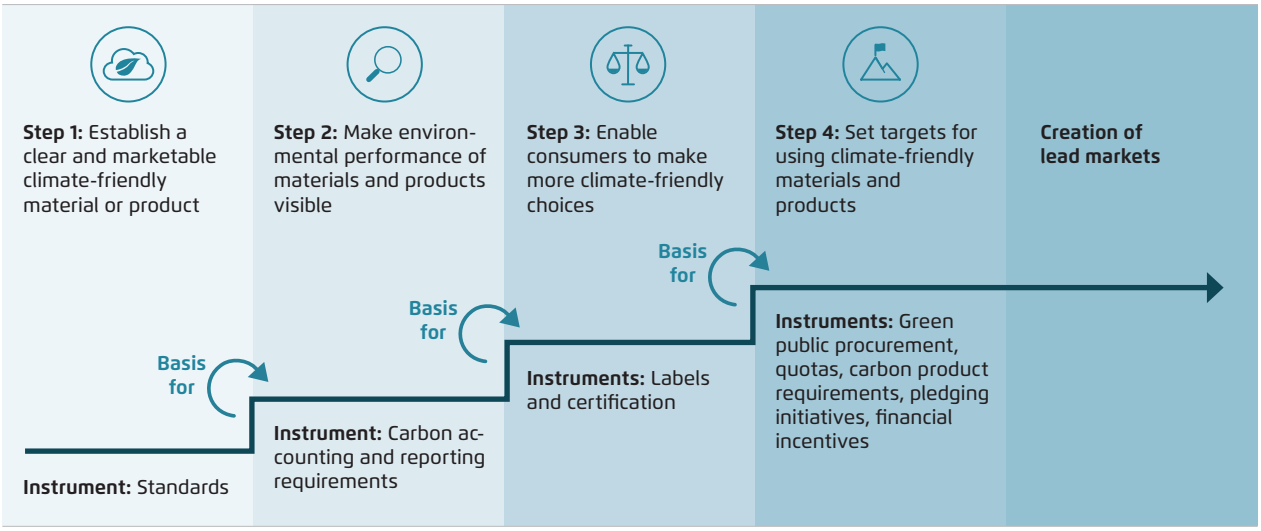
Policy efforts are needed both on the supply and demand side to accelerate the industrial transformation and help close the gap in supply and demand. Next to ambitious policies on the supply side – from carbon pricing to infrastructure build-up – demand-side instruments can reveal and leverage the necessary market demand. The appropriate demand-side instrument mix may differ depending on the specific end-use sector. The characteristics, drawbacks, and advantages of such instruments, namely standards, carbon accounting and reporting requirements, labels, green public procurement, carbon product requirements, quotas, financial incentives, and embodied carbon limits, are discussed in the next chapter.

3 Demand-side instruments for creating markets for climate-friendly basic materials: an overview

A series of demand-side instruments exists – each having its value depending on the scale and depth of development of markets for climate-friendly basic materials. Demand-side instruments should ultimately work towards creating a market and then building up scale for climate-friendly products. Which instrument is most effective depends on the stage of market creation.

In this section, we present a selection of instruments for creating lead markets in relevant downstream sectors. We discuss the rationale behind pros and cons of each instrument and provide examples of implementation across several jurisdictions. These instruments can be structured according to four broad categories: first, standards are necessary to allow for climate-friendly materials or products to become marketable. Second, carbon accounting and reporting requirements create the necessary data basis and inform consumers. Third, labels and certification evaluate the environmental performance of climate-friendly materials and products and enable consumers to make more climate-friendly choices, building on the data basis provided by carbon accounting and reporting requirements. Fourth, demand-side instruments can build on the previous categories to set targets for using climate-friendly materials and products, such as green public procurement or embodied carbon limits (Figure 6). Thus, these instruments build on each other in the four categories. For the instruments that set targets such as green public procurement or quotas, overlaps may exist in terms of their general goal. Chapter 4 proposes a policy package of complementary instruments for the buildings sector in Germany.

Suite of policy instruments for lead market creation → Fig. 6



Agora Industry (2024)

3.1 Standards

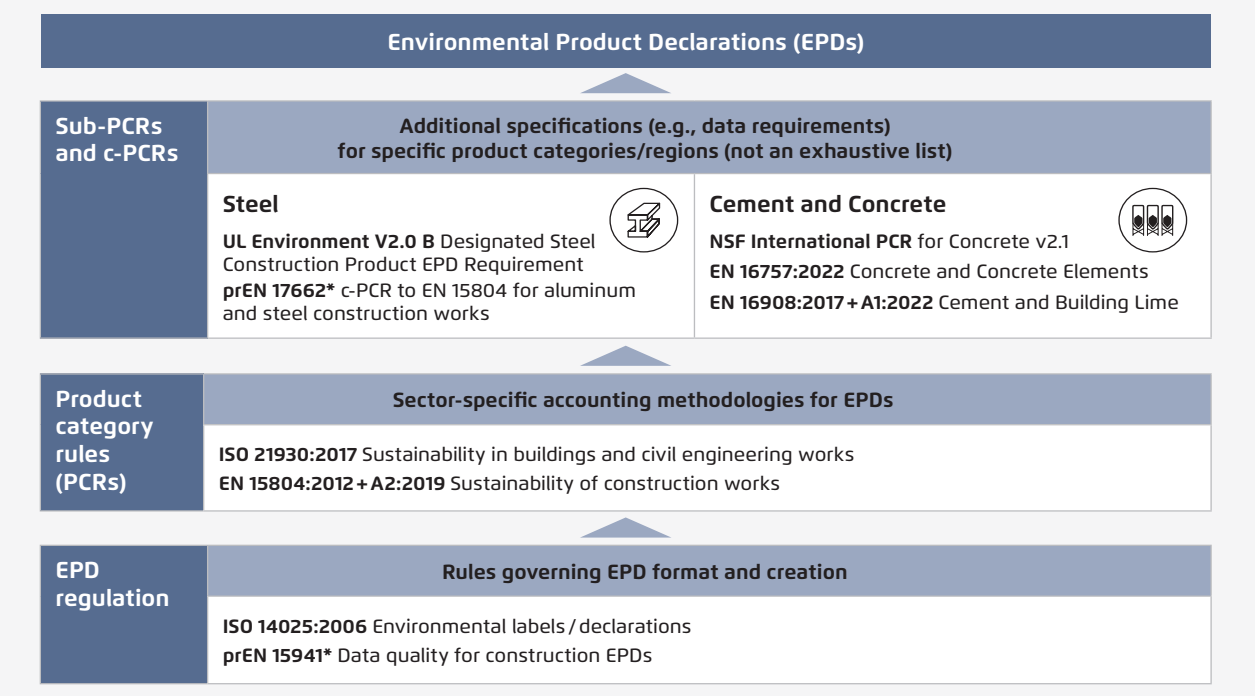
Rationale and instrument design

A standard is a measure for comparatively describing a product, the management of a process, the delivery of a service or the supply of materials (Agora Industry, 2023d). Standards underpin and provide guidance for all relevant steps for carbon accounting and reporting on the environmental impact of basic materials and products (see next section). This includes providing rules for the general reporting of emissions and other environmental indicators via Environmental Product Declarations (EPDs); laying out detailed requirements on how to conduct lifecycle assessments (LCAs) for measuring the environmental impact of specific products via Product Category Rules (PCRs); and setting out additional specifications via sub-PCRs for example for steel or cement and concrete (Figure 7). Standards in the basic materials sectors can be prescriptive (laying out the required material mix for a certain material) or performance-based (laying out what performance requirements the material should adhere to). In view of new material mixes with a lower CO_2 footprint and enhanced circularity emerging, performance-based standards are generally considered the preferable choice, as they allow for more innovation while ensuring that performance quality standards are still met. Standards exist at different governance levels, for example EN standards at the EU level, and ISO standards at the international level.

State of discussion and implementation

New EU regulation lays out important changes for standards underlying construction products such as cement. According to the revised Construction Products Regulation (CPR), current standards should move away from the currently prescriptive to a performance-based approach. At the international level, the Industrial Deep Decarbonisation Initiative has provided guidance for the future harmonisation of important standards underlying steel, cement and concrete in a white paper at the end of 2023 (IDDI, 2023).

Standards for collecting and reporting data on the environmental footprint of basic materials and products → Fig. 7



Industrial Deep Decarbonisation Initiative (2023)

Standards | Instrument details

Instrument type

- ☒ **Informational instrument**
- ○ Target-setting instrument

Standards define and enable the comparative evaluation of a process, material and product and thereby guide further instruments such as carbon accounting and reporting requirements.

Initiating actor

- ☒ **Regulatory authority**
- ○ Private sector

Regulatory authorities take a major role in developing standards for materials and products. However, often, industry representatives also participate in their development.

Coverage

Standards can measure relevant properties of processes, materials or end products. In the context of this paper, standards can for example cover key climate-related aspects such as the scope of emission included.

Decarbonisation lever

- ☒ **Production process transformation**
- ☒ **Switch to climate-friendly energy**
- ☒ **Material efficiency and substitution**
- ☒ **Use of recycled materials**

Timeline for implementation

Standards are necessary to enable market formation for climate-friendly materials and products with the necessary guidance in short run. The need to adhere to standards for consistent comparison of materials and products is however also valid, in the long run.

Lead Market **Mass Market**

Substitution potential

- ☒ **Low**
- ○ Medium

There is no substitution potential of standards with other instruments. They are needed as basis for all further demand-side regulation, including as guidance for carbon accounting and reporting requirements, and therefore highly complementary to the other instruments presented in this chapter.

Advantages and opportunities

→ Can create a level playing field for climate-friendly and circular materials and products (when standards are performance-based) and thus enhance trade and a global market for climate-friendly products and materials.

→ Enables the consistent measurement of key indicators such as CO_2 emissions of a material or product.

→ Harmonised standards across countries and regions can lead to a level playing field for the comparison of materials and products from different jurisdictions.

Disadvantages and hurdles

→ The use of non-harmonised standards for same materials and products results in lack of comparability.

→ When standards are prescriptive, they can prevent innovative materials and products with a reduced CO_2 footprint and enhanced circularity from entering the market.

→ Typical processes to overhaul standards tend to be too long to keep up with technological innovation.

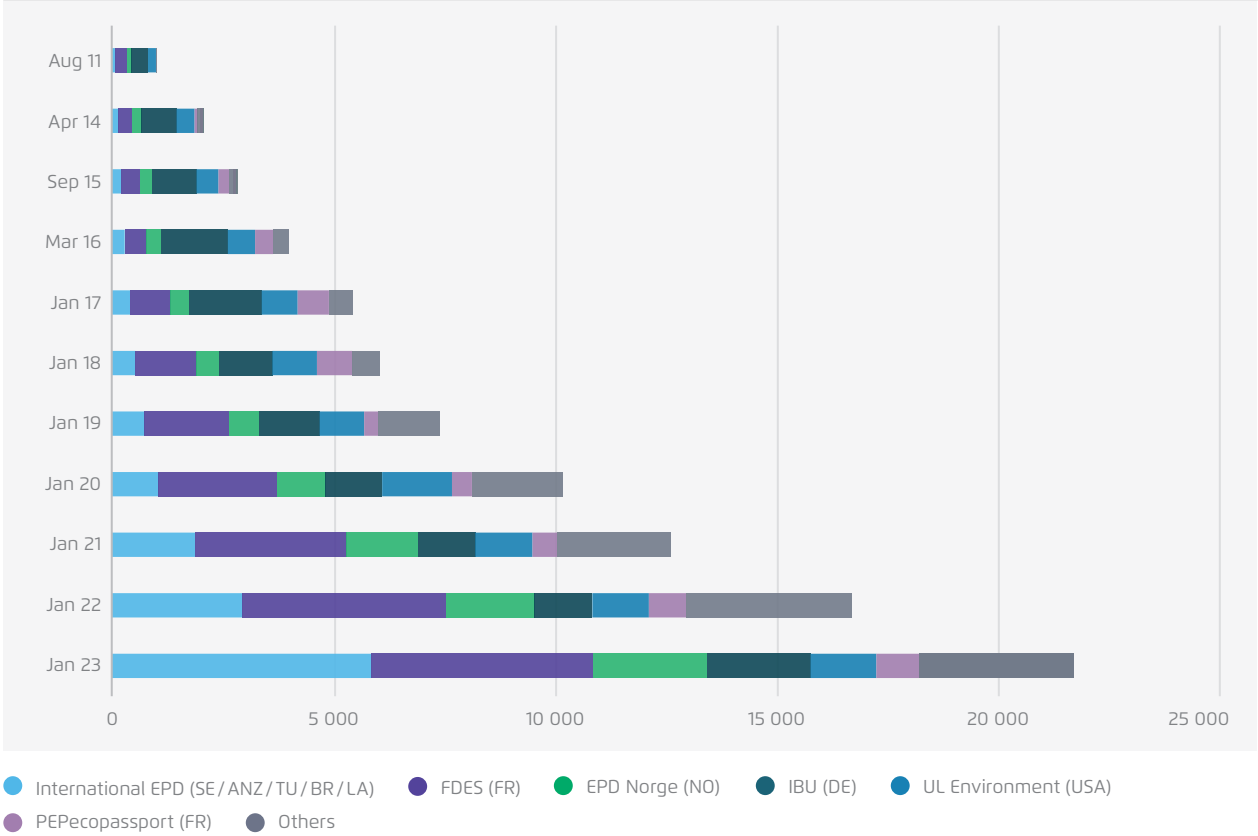
Agora Industry (2024)

3.2 Carbon accounting and reporting requirements

Rationale and instrument design

Carbon accounting and reporting requirements play a crucial role in enabling the development of key lead market instruments by providing valuable information on the environmental impact of materials and products over their life cycle – including their carbon footprint, energy consumption and resource depletion. Such requirements can thereby guide informed consumption decisions and drive climate-friendly choices. At the same time, material suppliers and manufacturers of end products have a vested interest in ensuring that innovations that effectively reduce the carbon footprint of their goods are clearly evident, both at product and company level. Identifying those materials and products with reduced carbon footprint requires benchmarks that are clear and transparent for measurement and comparison. A key means to generate reliable data is to use standardised approaches. Environmental Product Declarations (EPDs) are a globally used tool for reporting the environmental performance of products, including information on emissions, materials, resource use and other environmental impacts of a material or product across its life cycle. EPDs are developed in compliance with product category rules, laying out detailed reporting requirements for specific products and informed by ISO and EN standards (see previous section).

Rising numbers of construction product EPDs exemplify the growing importance of carbon accounting and reporting → Fig. 8



Eco Platform (2024)

Carbon accounting and reporting requirements | Instrument details

Instrument type

- ☒ **Informational instrument**
- ○ Target-setting instrument

Building on standards, carbon accounting and reporting serves as the information basis for all further demand-side instruments and is therefore a crucial basis for setting targets for the use of climate-friendly materials and products.

Initiating actor

- ☒ **Regulatory authority**
- ○ Private sector

Regulatory authorities take a key role in establishing and harmonising accounting and reporting requirements, which is desirable due to reasons of comparability and efficiency.

Coverage

Carbon accounting and reporting can cover different indicators from CO_2 intensity to resource depletion and different stages of a life cycle of both materials or final products.

Decarbonisation lever

- ☒ **Production process transformation**
- ☒ **Switch to climate-friendly energy**
- ☒ **Material efficiency and substitution**
- ☒ **Use of recycled materials**

Timeline for implementation

Carbon accounting and reporting requirements are both useful to underpin market formation for climate-friendly materials and products with the necessary information in the short run and inform consumers in the long run once markets have scaled.

Lead Market → **Mass Market**

Substitution potential

- ☒ **Low**
- ○ Medium

There is no substitution potential of carbon accounting and reporting requirements with other instruments. They are needed as basis for further demand-side regulation and are therefore highly complementary to the other instruments presented in this chapter.

Advantages and opportunities

→ Is a key enabling instrument for further demand-side instruments by providing information on the climate-related impacts of materials and products over their lifecycle.

→ Transparent and accurate reporting can inform climate-friendly consumption decisions.

→ Harmonised and accurate carbon accounting across jurisdictions results in enhanced comparability of the climate-related impacts of materials and products.

Disadvantages and hurdles

→ Lack of harmonised accounting and reporting, for example via EPDs, results in various, sometimes contradicting methods, adding administrative burden.

→ Access to transparent and product specific data can be limited and reporting relying on industry averages and generic data limits the accurate comparison of materials and products.

→ Carbon accounting assessments can be costly, complex and highly technical. Therefore, efforts to introduce new processes should be limited – rather, existing frameworks and standards should be used.

Agora Industry (2024)

State of discussion and implementation

In the buildings sector, access to data on construction products will be enhanced through the mandatory disclosure of EPDs (Figure 8), as mandated by the new Construction Product Regulation (CPR). Information on the lifecycle emissions of buildings will also be required by the European Performance in Buildings Directive (EPBD), from 2028 and 2030, respectively, contingent on the size of the buildings. A harmonised calculation and reporting methodology to comply with this requirement will be developed by the European Commission by the end of 2025. In addition, the EU Taxonomy requires the disclosure to investors and clients of the carbon footprint for large scale building projects (European Commission, 2020). In the automotive sector, the revision of the EU Batteries and Waste Batteries Directive introduces mandatory reporting of the lifecycle GHG emissions of electric vehicle batteries – which represent a large share of a vehicle's life cycle emissions (ICCT, 2022). A future delegated act from the Commission aims to harmonise calculation and reporting of the carbon footprint of electric vehicle batteries (EUR-Lex, 2023). In Germany, a government-convened expert group is currently developing harmonised methods for the transparent disclosure of CO_2 emissions across the automotive vehicle supply chain (Catena X, n.d.).

3.3 Labels and certification

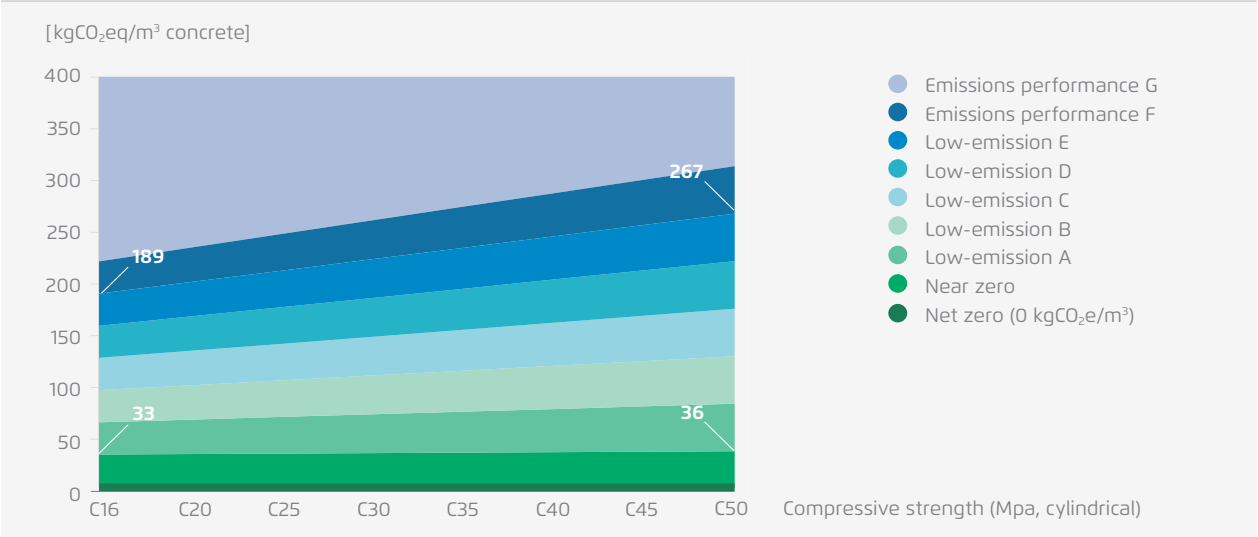
Rationale and instrument design

To define what counts as a climate-friendly material or product and to facilitate the creation of markets for climate-friendly basic materials and product, labels are an essential instrument. While standards describe a material or product, labels evaluate a material or product. They provide relevant and easily understandable information on the climate-related performance of a basic material or product. Labels can also entail benchmarks for further emissions reductions (i.e. thresholds), even to the extent of defining for example what constitutes a near zero or net zero tonne of material or product. These "shades of green" are an essential added value of labels as they enable the differentiation between various materials – from conventional to compatible with climate neutrality. Labels that measure the CO_2 impact of a material or product should ideally be underpinned by relevant and harmonised standards (see previous section) to inspire confidence in their climate-related performance. Ideally, labels for traded materials such as steel should also be agreed at an international level. Label design needs to consider sector specificities. In the concrete sector, for example, compressive strength nowadays influences the specific CO_2 intensity. This needs to be taken into account when designing the label, i.e. by setting different CO_2-thresholds depending on the compressive strength (Figure 9).

State of discussion and implementation

The EU has implemented labelling systems for certain energy appliances, including fridges and light bulbs (European Commission, 2021). Other labelling initiatives have focused especially on energy-intensive materials in construction. Several organisations working on the steel sector have made label proposals, including ResponsibleSteel, the International Energy Agency (IEA), and the German steel association *Wirtschaftsvereinigung Stahl* with its Low Emission Steel Standard (LESS). The First Movers Coalition (FMC) has provided definitions for cement and concrete with near zero emissions, while the IEA also proposed a label approach for cement in their G7 study in 2022 (IEA, 2022). These proposals typically differ in terms of aspects such as label design features and the value chain and emissions scope. Agora Industry (2023d) has published a guide to the existing proposals for steel, cement and concrete, as well as its own recommendations for aligning on labels at an international level.

Agora proposal for concrete labelling taking into account compressive strength → Fig. 9



Agora Industry (2023) based on IEA (2022)

Labels and certification | Instrument details

Instrument type

- ☒ **Informational instrument**
- ○ Target-setting instrument

Labels evaluate the environmental performance of a good and service. Thereby, they can be an enabling tool for further target-setting instruments such as Green Public Procurement (GPP) to purchase materials or goods defined as climate-friendly.

Initiating actor

- ☒ **Regulatory authority**
- ☒ **Private sector**

Both regulatory authorities and companies have issued labels in the past. It needs to be noted that labels unfold their full impact when implemented on a widespread basis for a large share of the market to enable comparability, which can only be achieved by the public sector

Coverage

Labels can be applied both to intermediary or final goods and services, including to specific materials (including steel, cement, concrete and plastics). For basic materials, they do not typically prescribe the use of specific technologies or strategies to reach more ambitious threshold levels.

Decarbonisation lever

- ☒ **Production process transformation**
- ☒ **Material efficiency and substitution**
- ☒ **Switch to climate-friendly energy**
- ☒ **Use of recycled materials**

Timeline for implementation

Labels are useful both for initiating and scaling up demand for climate-friendly basic materials in the short run and comparing materials in the long run once lead markets have scaled substantially and larger material shares are moving closing to near or net zero.

Lead Market → **Mass Market**

Substitution potential

- ☒ **Low**
- ○ Medium

The substitution potential of labels is low. They act as a link between standardised carbon accounting and reporting and target-setting instruments and are thereby highly complementary to other demand-side instruments.

Advantages and opportunities

→ Provides transparency on comparative climate-related impact of materials when differentiating between „shades of green" and helps facilitate climate-friendly choices

→ Provides confidence in environmental performance claims of companies when underpinned by credible standards

→ Can enable target setting through instruments such as carbon product requirements and green public procurement using label benchmarks

→ Can enable widespread comparison of a material or good when implemented by large share of national governments and for a large share of market

Disadvantages and hurdles

→ Requires standardisation and harmonisation in the way countries collect data to enable comparability

→ Can reduce transformation incentives for companies when using default or fall-back instead of primary data on CO_2 emissions

→ Too many labels can significantly reduce comparability of the climate performance of (traded) materials and products, adding complexity and (administrative) burden

Agora Industry (2024)

3.4 Embodied carbon limits

Rationale and instrument design

Embodied carbon limits place limits on the embodied emissions of a final product such as an automotive vehicle or building. For instance, for buildings, limits might be imposed on the kilograms of carbon dioxide by square metre ($kgCO_2/m^2$) of floorspace, covering the entire life cycle of a building or specific lifecycle stages such as the construction process or the use stage (Figure 10). Embodied carbon limits set the incentives at the downstream (final) product level to decarbonise materials, thereby complementing and filling in the gaps of other policy incentives at the upstream and midstream stages of the construction value chain. The main advantage of such a regulation is that, since it is material and technology neutral, it creates incentives for a full set of abatement levers across the project development stages. This includes, for example, circularity levers, such as material-efficient design, re use of construction materials, as well as prioritisation of climate-friendly materials. Successful implementation of embodied carbon limits depends on several steps, including the development of standardised accounting and reporting of data (see previous sections), and the training of energy consultants in carrying out LCAs.

State of discussion and implementation

In particular for the buildings sector in Europe, some embodied carbon requirements exist. The revision of the EU's Energy Performance in Buildings Directive (EPBD) includes requirements for member states to set targets and limit values for the life cycle emissions of all new buildings from 2030 on (EP, 2024b). Several EU countries have either already implemented such regulation or are in the process of doing so. The existing regulations vary in their applicability, LCA stages covered (Figure 10), building components, metrics, and limit value levels. For instance, the regulation in France covers a wider range of LCA stages, as opposed to the Danish regulation. The French policy is designed along a clear timeline: a phase-in period between 2022 and 2025 with easy-to-reach targets is intended to familiarise actors with the instrument, thresholds are then being tightened every three years from 2025.

State of embodied carbon regulation across Europe

→ Fig. 10

			Country	Denmark	Finland	France	Netherlands	Sweden
			Legal status	In force since 2023	Proposed, planned for 2025	In force since 2022	In force since 2018	In force since 2022
Product	Raw materials	A1		●	●	●	●	●
	Transport	A2						
	Manufacturing	A3						
Construction process	Transport to site	A4						
	Installation	A5			●			●
Use stage	Use	B1				●	●	
	Maintenance	B2						
	Repair	B3						
	Replacement	B4		●	●		●	
	Refurbishment	B5				●		
	Operational energy use	B6		●	○	○	○	○
	Operational water use	B7				○	○	
	Building induced mobility	B8						
Decon-struction, end of life	Demolition works	C1			●	●	●	
	Transport	C2						
	Waste management	C3		●	●	●	●	
	Final disposal	C4			●	●	●	
Beyond system boundary	Reuse-, recovery-, recycling potential	D1		◐	●	●	●	
		D2			◐			

● In scope of current Whole Life Carbon (WLC) legislation ◐ Reported as a separate value ○ Regulated in other policy measures

Agora Industry (2024) based on Steinmann et al. (2022)

Embodied carbon limits | Instrument details

Instrument type

- ○ Informational instrument
- ☒ **Target-setting instrument**

Embodied carbon limits set limit values for the embodied emissions of end products such as a building. The instrument strongly builds on standards and carbon accounting and reporting instruments as enabling instruments.

Initiating actor

- ☒ **Regulatory authority**
- ○ Private sector

Limits are typically set for an entire market of a final product, encompassing the different private actors in the market segment. Regulatory authorities are therefore best placed to implement such a policy.

Coverage

Embodied carbon limits set limits at the downstream (final) product level such as a car or building. They are typically placed on a significant, if not entire share of the final product market.

Decarbonisation lever

- ☒ **Production process transformation**
- ☒ **Material efficiency and substitution**
- ☒ **Switch to climate-friendly energy**
- ☒ **Use of recycled materials**

Timeline for implementation

Embodied carbon limits can take effect within a few years (lead market phase), after familiarising actors with the policy and establishing the necessary data basis. Limits become increasingly stringent at later stages until reaching limits in line with climate neutrality.

Lead Market → **Mass Market**

Substitution potential

- ○ Low
- ☒ **Medium**

Embodied carbon limits are highly complementary to and dependent on other instruments, including carbon accounting and reporting to provide the information basis. Setting limits at the final product level, the instrument fills the gaps of other instruments at the midstream level such as PCRs or quotas, although the limits can also stimulate decarbonisation of basic materials indirectly – hence, there is some overlap in policy goals.

Advantages and opportunities

→ Incentivises various decarbonisation strategies across project development stages (including material efficiency, reuse of material) due to material and technology neutrality of instrument.

→ Has potential to drive deep transformation in the entire final product sector due to the scope of application.

→ Can indirectly also lead to decarbonisation of CO_2-intensive basic material industries while providing full flexibility on how to reach limits.

Disadvantages and hurdles

→ Missing, inconsistent or non-harmonised data can impede implementation of embodied carbon limits.

→ Capacity building to familiarise relevant stakeholders with ways to comply with the limits will be necessary.

→ Some lifecycle stages (e.g. end-of-life incineration) are difficult to be reliably estimated, but can have significant influence on carbon impact.

→ Capacity needs to be built to verify LCA assessments.

Agora Industry (2024)

3.5 Carbon product requirements

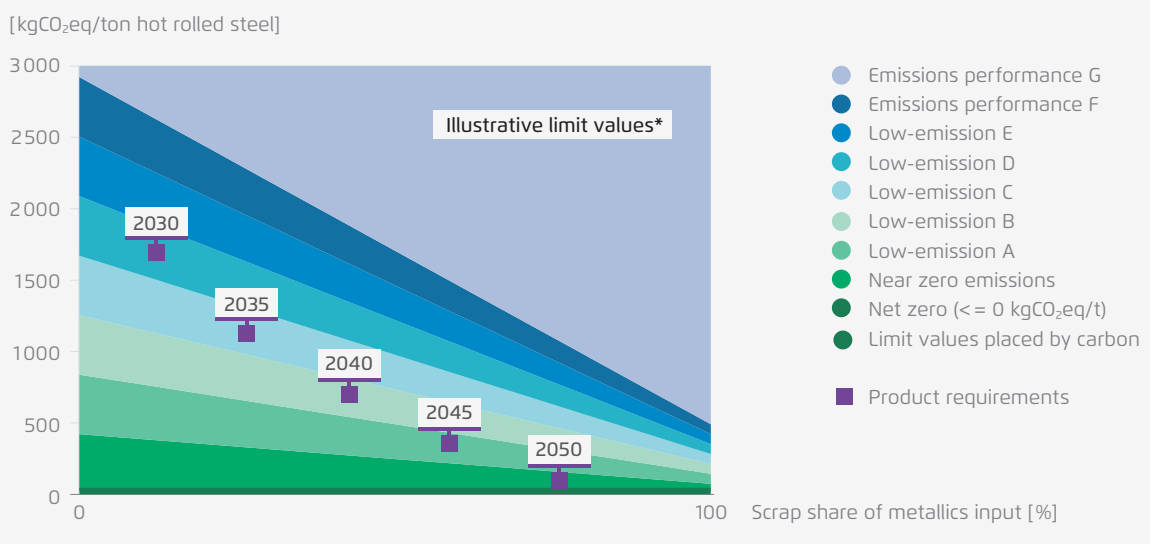
Rationale and instrument design

In the context of this paper, carbon product requirements (CPRs) refer to policies that impose regulatory and legally binding limit values on the total quantity of (embodied) greenhouse gases emitted during the production of basic and intermediate materials. This is conceptually related to embodied carbon limits for final products. In this case, however, the idea is to impose the limits directly on the basic material and/or intermediate products. For instance, embodied emissions limits would be imposed per tonne of cement or concrete rather than the building or bridge. An important element to consider with such requirements is that they would, in principle, apply equally to all marketable products – as the term "requirements" indicates. Limit values for emissions would generally be set initially at or close to existing average performance levels in the sector and then gradually lowered until they eventually reached a level compatible with climate neutrality. Label thresholds could be used to set these limits (Figure 11). A main added value of this instrument is that it could be implemented at an international level to converge on a common policy approach for the decarbonisation of traded materials (Agora Industry, forthcoming).

State of discussion and implementation

International carbon product requirements according to the basic design outlined in Figure 11 have not been implemented for basic materials yet. Relevant examples for proxy regulations are the revision of the Ecodesign for Sustainable Products Regulation (ESPR) and Construction Product Regulation (CPR). Both aim to define requirements for the environmental performance of key product groups with high CO_2 footprints, including materials such as iron and steel, aluminium, chemicals, and construction products (EP, 2024a; EP, 2024c). Carbon product requirements are also discussed in international climate forums, such as the OECD Climate Club.

Thresholds in steel labelling as limit values for carbon product requirements → Fig. 11



Agora Industry (2024) based on Agora Industry (2023c) and IEA (2022). Note: *Limit values only refer to CO_2 intensity, not to scrap share.

Carbon product requirements | Instrument details

Instrument type

- ○ Informational instrument
- ☒ **Target-setting instrument**

Carbon Product Requirements set progressively stringent limit values on the embodied emissions of a certain intermediary material, for example a tonne of steel or cement.

Initiating actor

- ☒ **Regulatory authority**
- ○ Private sector

Since carbon product requirements would apply to all producers of a given material within a market, only regulatory authorities can implement them.

Coverage

CPRs are applied to intermediary materials (e.g. steel, cement or chemicals), but do not typically prescribe the use of specific technologies or strategies to reach more ambitious threshold levels. Limits are placed on the entire market for the material. CPRs unfold their full potential when implemented internationally.

Decarbonisation lever

- ☒ **Production process transformation**
- ○ Material efficiency and substitution
- ☒ **Switch to climate-friendly energy**
- ☒ **Use of recycled materials**

Timeline for implementation

CPRs should be established early on in the lead market phase to enable ratcheting down limit values over time once the market has scaled substantially.

Lead Market → **Mass Market**

Substitution potential

- ○ Low
- ☒ **Medium**

There is some substitution potential for CPRs. They place embodied emission limit values on intermediary materials. There is some policy overlap with embodied carbon limits, which could also be set for selected final products containing these intermediary materials. CPRs can be complementary to labels and could build on proposed emissions performance label thresholds that are being developed at the international level.

Advantages and opportunities

- → Incentives to reduce emissions affect all producers in the market, resulting in high level of emission reductions.
- → Allows countries to converge on common sectoral decarbonisation approach and move beyond leakage or subsidy instruments.
- → Grants high degree of visibility on the performance levels required at given point in time.
- → Creates a business case for investments in climate-friendly production of basic materials assuming the political stability of the instrument.

Disadvantages and hurdles

- → Due to potential scope of instrument, setting initially very ambitious limits would be difficult.
- → Provides no particular incentive to go beyond minimum performance requirements in CPR regulation.
- → Could lead to lack of technological learning and early-infrastructure build-out as well as supply chain bottlenecks due to missing early movers.
- → Could face complexities to ensure WTO compatibility.

Agora Industry (2024)

3.6 Minimum low-emission and recycled content quotas in final products

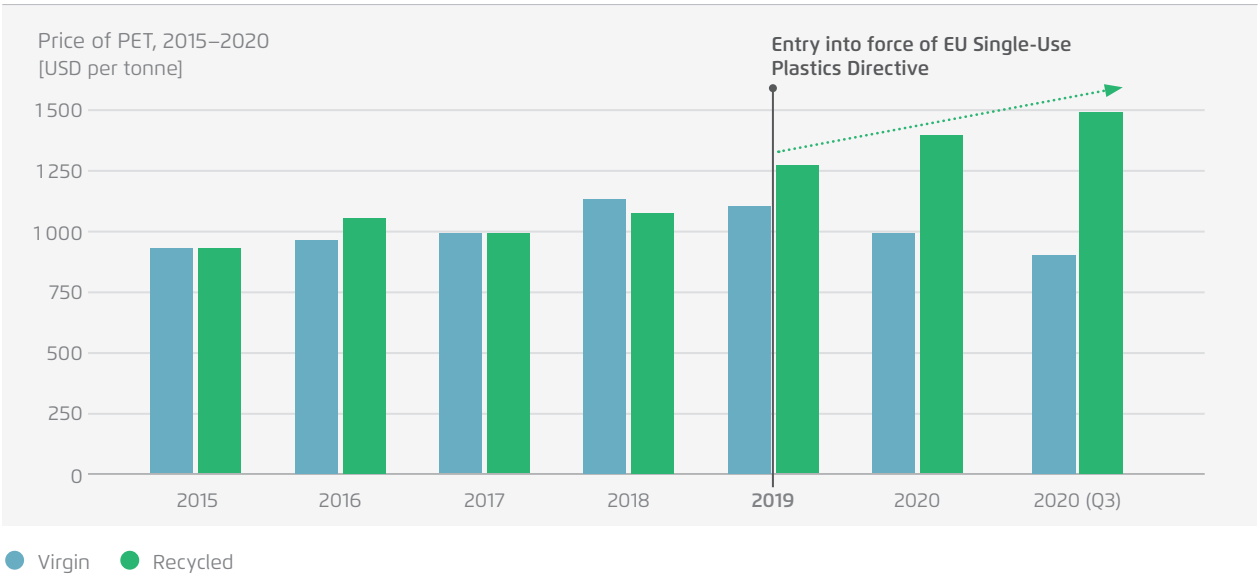
Rationale and instrument design

Quotas refer to the idea that final products based on CO_2-intensive basic materials would be required to contain a minimum share of materials with low or near zero emissions. From a certain date, for example, final products such as roads, buildings, ships, packaging or even certain appliances might be required to be produced using a specific percentage of materials with low or near zero emissions. Final products not fulfilling these requirements would not be allowed to be sold on the market. This contrasts with other forms of policy interventions such as carbon product requirements for basic materials, which are more ambitious in terms of scope, because they would cover all the materials used in the entire market for a specific product. Quotas can also be defined for the proportion of recycled material in a final product with a view to boosting demand for circular materials, such as recycled plastics (see Agora Industry, 2023b). As it is important to avoid creating false incentives for additional production waste and the production of so-called post-industrial recyclates, the focus would need to be on recyclates from end-consumer waste (private and commercial waste, known as post-consumer waste).

State of discussion and implementation

Quotas for recycled basic materials have been adopted under the EU's Single-Use Plastics Directive in 2019. This requires PET beverage bottles sold in the EU to contain at least 25 percent recycled plastic from 2025 and at least 30 percent recycled plastic from 2030 (EUR-Lex, 2019). Initial evidence suggests that this measure has already been effective in driving demand for recycled PET (Figure 12). The key bottleneck seems to be a lack of high-quality supply of recycled PET throughout the EU (CISL, Agora Energiewende, 2021), underscoring the importance of addressing demand- and supply-side barriers in parallel. Further relevant regulation includes the EU Ecodesign Directive, as part of which ecodesign requirements will be laid down for a broader range of product groups. This will include energy-intensive basic materials such as steel and will cover aspects related to material efficiency and recycling.

Recycled content quotas and demand for recycled PET plastics → Fig. 12



Agora Industry (2024) based on Agora Industry (2022)

Minimum low-emission and recycled content quotas in final products | Instrument details

Instrument type

- ○ Informational instrument
- ☒ **Target-setting instrument**

Quotas set targets for final products with a significant share of CO_2 intensive basic material (e.g. steel) to contain a minimum share of low-emission or near zero version of the material. They can also set targets for increased use of recycled materials in final products.

Initiating actor

- ☒ **Regulatory authority**
- ○ Private sector

Quotas are typically defined by a regulatory authority for a specific material in a final product. However, in some cases, also companies can define quota targets for materials contained within their final products.

Coverage

Quotas cover a small share of a certain material, e.g. steel, within a defined final product, e.g. a car. This means that all car producers would need to buy a certain amount of low-emission or near zero steel or recycled material to comply with the quota.

Decarbonisation lever

- ☒ **Production process transformation**
- ○ Material efficiency and substitution
- ☒ **Switch to climate-friendly energy**
- ☒ **Use of recycled materials**

Timeline for implementation

Quotas are best conceived as a temporary or short-term instrument to spark investments in climate-friendly production, until more comprehensive regulation takes over.

Lead Market **Mass Market**

Substitution potential

- ○ Low
- ☒ **Medium**

There is some substitution potential for quotas. Quotas and carbon product requirements both regulate the embodied emissions of a certain material, albeit with different focus and scope. Quotas can be complementary to labels and could build on proposed emissions performance label thresholds that are being developed at the international level.

Advantages and opportunities

→ Provides a clear and certain demand signal if the goal is to create lead markets for specific material.

→ Creates more investment certainty for climate-friendly production of a certain material than other, material-neutral strategies such as total embodied carbon limits on buildings.

→ Quotas can be designed to promote only the best performing materials within a material category and thereby spur investments in production compatible with climate neutrality.

Disadvantages and hurdles

→ Instrument insists on one strategy (i.e. using a specific climate-friendly material amount), therefore not creating other incentives to decarbonise, including material efficiency or substitution.

→ Focus on a single (primary or recycled) material increases pressure on supply and can create bottlenecks.

→ Risks cross-product competition effects due to focus on specific material, which can lead product manufacturers to shift to materials without quota targets.

→ The limited availability of high-quality recyclates needs to be addressed (e.g. for scrap steel; plastic pipes)

Agora Industry (2024)

3.7 Mandatory green public procurement (GPP)

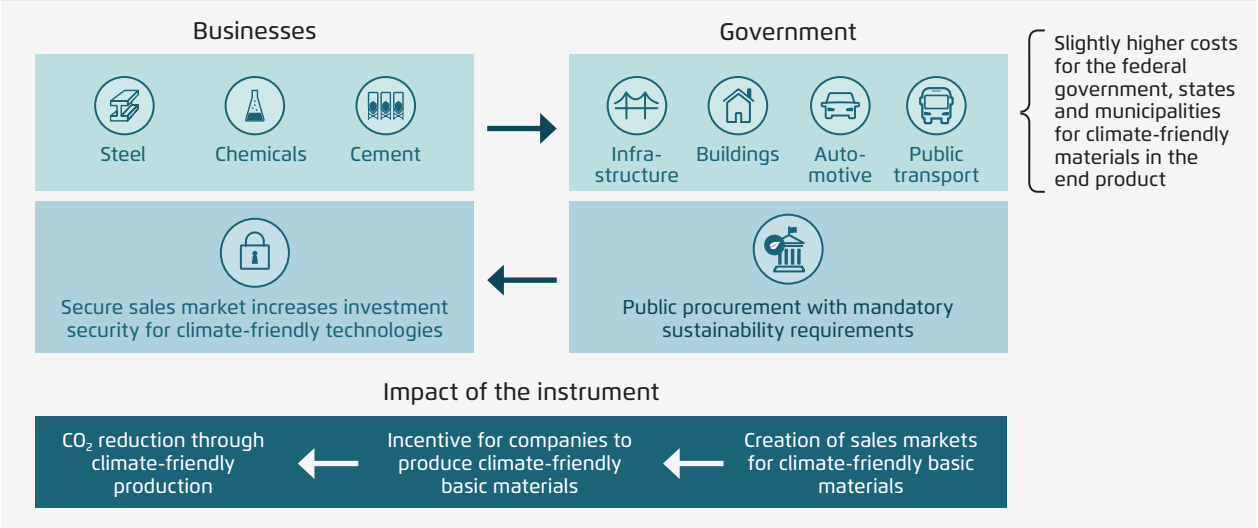
Rationale and instrument design

Green public procurement (GPP) refers to the purchasing by public authorities of goods and services with reduced environmental impact. The policy can be targeted at specific materials such as steel or concrete or can be material neutral and target embodied carbon emissions, for example at the project level. There is thus not a general rule that GPP must be applied to the intermediary or final product level – i.e. crude steel or buildings. However, the policy tends to be technology neutral in the sense that it does not prescribe the use of a certain technology to comply with public procurement requirements so that producers have flexibility in terms of how they achieve emission reductions. While GPP is a policy that typically impacts the national or subnational level, requirements for the use of climate-friendly materials and products can also spur trade in these materials products and thus in theory indirectly help incentivise a transformation in other countries, too.

State of discussion and implementation

While green public procurement is typically implemented at the national or subnational levels, efforts are also underway to define requirements at both the EU and international levels. In the construction sector, the Industrial Deep Decarbonisation Initiative (IDDI) is worth mentioning. The IDDI has proposed several pledge levels relevant to public procurement that member countries can sign up to, ranging from the disclosure of embodied carbon in cement, concrete and steel in public construction projects to requirements for procuring materials with near-zero emissions for signature projects. At the EU level, the EU Commission will introduce sustainability requirements for green public procurement under the Construction Products Regulation and the Ecodesign for Sustainable Products Regulation. Moreover, various national and subnational jurisdictions have implemented noteworthy GPP programmes. One is California, which has set emission limits for selected materials, including structural steel and flat glass, that must not be exceeded in public works projects. In the Netherlands, bidders for public projects are required to use a life cycle assessment tool to calculate the environmental impact of their proposal. The total impact is then converted into a cost indicator which reduces the quote of the bidder.

Role of public procurement for lead market creation → Fig. 13



Agora Energiewende, Wuppertal Institute (2019)

Mandatory green public procurement (GPP) | Instrument details

Instrument type

- ○ Informational instrument
- ☒ **Target-setting instrument**

Green public procurement sets targets and criteria for the use of climate-friendly materials and products in public tenders.

Initiating actor

- ☒ **Regulatory authority**
- ○ Private sector

Regulatory authorities are the only implementing actors for this instrument.

Coverage

Green public procurement typically introduces criteria for purchasing climate-friendly materials, products or services for public sector projects, including public infrastructure, buildings or fleets. GPP targets can be introduced at national, subnational or multilateral levels.

Decarbonisation lever

- ☒ **Production process transformation**
- ☒ **Switch to climate-friendly energy**
- ☒ **Material efficiency and substitution**
- ☒ **Use of recycled materials**

Timeline for implementation

The instrument is both useful and impactful in the lead and mass market phase. Especially in the initial phases of market formation for climate-friendly materials and products, GPP can have added value by developing new markets and acting as a first mover.

Lead Market → **Mass Market**

Substitution potential

- ○ Low
- ☒ **Medium**

Green public procurement hinges on definitions of the climate-friendly property of materials and products via labels and is therefore complementary to the latter. There is also a need to collect data or establish tools to calculate the environmental footprint of materials, products, or projects. Depending on the specific design of the GPP policy, there can be some policy overlap with CPRs, quotas or embodied carbon limits.

Advantages and opportunities

- → Mandatory green public procurement enhances investment security in climate-friendly production.
- → Can act as first mover in creating demand for climate-friendly materials and developing markets by familiarising suppliers and project developers with new and climate-friendlier practices.
- → Accelerates learning curve with use and upscaling of new technologies and thereby typically reduces costs.
- → Achieves significant GHG reductions by steering public share of demand for basic materials and products into climate-friendly alternatives.

Disadvantages and hurdles

- → Scalability is limited as the instrument only covers a certain share of the market.
- → Lack of data on the carbon footprint of goods and services can be challenge in nascent stages of GPP implementation.
- → Administrative capacities need to be built to consider climate-related aspects in procurement.
- → Public procurement is often taking place at the municipal level with limited capacities to implement new requirements.

Agora Industry (2024)

3.8 Private-sector pledging systems

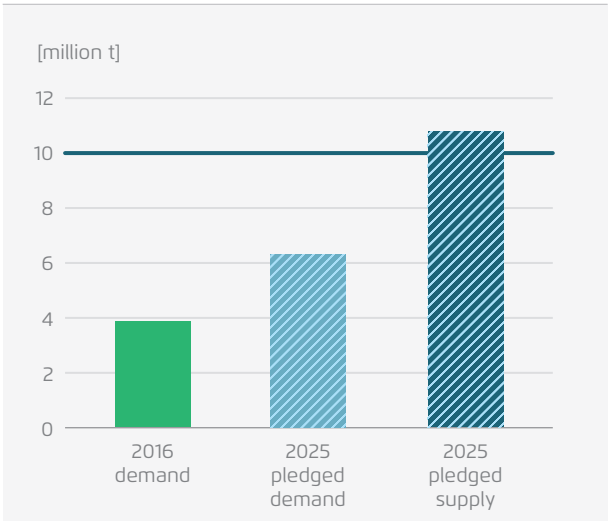
Rationale and instrument design

Private-sector pledging systems can be another way to promote demand for climate-friendly basic materials. Under private-sector pledging systems, governments or private initiatives act as facilitators to help reveal hidden market demand for climate-friendly materials to potential suppliers and consumers. Effectively, potentially favourable buyers and sellers in a given market are gathered together and encouraged to make public pledges or commitments to buy or sell, respectively. The purpose is to help facilitate the formation of markets for climate-friendly products by aggregating sufficient private demand and demonstrating a willingness to pay on the part of a critical mass of private purchasers.

State of discussion and implementation

As chapter 2 has shown, first initiatives of private-sector pledges already exist. The public-private partnership First Movers Coalition (FMC) mentioned earlier in this paper is one relevant example. While there is no doubt that the FMC process is helpful in creating an initial demand signal, the level of demand remains too small and fragmented at the global scale to drive the scale of investment in steel, concrete and aluminium that is currently necessary. At a more systematic level, and in the context of the European Strategy for Plastics in a Circular Economy, the EU sought to spur early-stage demand by creating a private-sector pledging system. One of the rationales for doing so was a lack of demand for recycled plastics, identified by the strategy as a key factor inhibiting the cost effectiveness of scaling up value chains for and investments in a high-quality collection and recycling infrastructure. The European Commission asked industry to submit voluntary pledges to ensure that products on the EU market would contain a total of ten million tonnes of recycled plastics by 2025. A status review of pledges revealed in 2019 that the system had led to pledged increases in demand for recycled plastics of approximately 60 percent by 2025, compared to 2016 levels, with increases across all plastic types. However, it remains to be seen whether these pledges will be fully realised (CISL, Agora Energiewende, 2021). The cumulative pledged demand also fell significantly short of the pledged supply of 11 million tonnes by 2025 (Figure 14).

Recycled plastics: historical demand vs pledges (for 2025) → Fig. 14



CISL, Agora Energiewende (2021) based on European Commission (2019)

Private-sector pledging systems | Instrument details

Instrument type

- ○ Informational instrument
- ☒ **Target-setting instrument**

Private sector pledges promote demand by pledging to buy climate-friendly materials and showing associated willingness to pay. It needs to be noted that targets to buy a certain share of materials are not binding – in comparison to other target-setting instruments such as quotas or mandatory green public procurement.

Initiating actor

- ○ Regulatory authority
- ☒ **Private sector**

In principle, the private sector is the driving force behind the pledges. However, the public sector can nudge the private sector to start pledging by offering further support measures to help facilitate the projects. These might include increased visibility, public loans, loan guarantees, or accelerated permitting approval.

Coverage

Private sector pledges can cover a certain material or product and be formulated at a regional or global level. Especially companies with margins (such as large-scale vehicles or luxury segments) may be able to pay the green premium and suited for pledging systems.

Decarbonisation lever

- ☒ **Production process transformation**
- ○ Material efficiency and substitution
- ☒ **Switch to climate-friendly energy**
- ☒ **Use of recycled materials**

Timeline for implementation

Private sector pledging systems are especially useful in the initial phases of market formation for climate-friendly materials or products until more binding demand side measures take over.

Lead Market → **Mass Market**

Substitution potential

- ☒ **Low**
- ○ Medium

The substitution potential of the instrument is low given that the pledging systems are voluntary in nature and thereby no overlap with other (public) target setting instruments is created. Private pledges are complementary to other measures targeting the public share of a market for a certain material or product.

Advantages and opportunities

→ Complements public procurement commitments to help achieve larger scale.

→ Can sometimes be deployed at greater speed than public procurement commitments due to typically more complex decision-making processes at public level.

→ Helps break the chicken and egg problem of missing demand due to missing supply by revealing key information publicly.

→ May be helpful to reveal information to governments for setting up more legally binding measures as next step.

Disadvantages and hurdles

→ Targets are not binding for companies unless backed by contractual agreements.

→ Pledges can be made on conditions – if these are not met, then true commitment and quantity of pledges will be less than face value.

→ Certain companies on demand side may not be willing or able to pay a sufficient green premium.

→ Demand for climate-friendly materials may be too small or too fragmented across large geographic area to justify investment into a specific site.

→ Pledges may not meet ambition level necessary to achieve climate neutrality if not based on reliable and transparent standards and accounting requirements.

Agora Industry (2024)

3.9 Financial incentive schemes for reusing and recycling materials

Rationale and instrument design

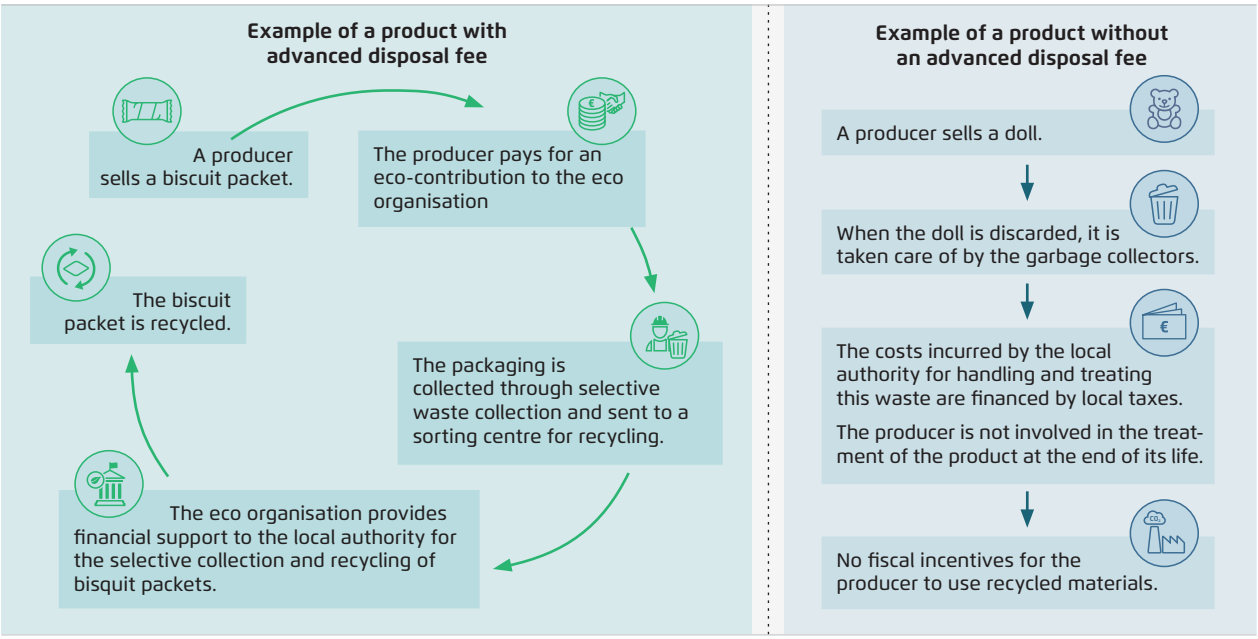
Similar to quotas, financial incentive schemes can be particularly valuable for scaling up a clearly defined "type" of climate-friendly materials, such as recycled materials. Such instruments may create not only an incentive but also a revenue stream for more circular practices. This could either be implemented via a credit system, such as a premium/penalty system for the use of recycled materials, or a tax on resource use. These systems reward end products that have circular designs and, at the same time, would contribute to developing resource efficiency, reuse, and recycling solutions.
In the packaging sector, for example, this could be an instrument to grant credits for waste recycling to companies that use a high proportion of recycled materials. With these credits, they could gain access to advantages such as financial incentives or greater customer acceptance. Such financial incentives could be financed via a fund, for example a raw material fund. One way to create this fund could be to have distributors of poorly recyclable products pay into the fund.

State of discussion and implementation

One example of a financial scheme is the "plastic tax" implemented by the EU since 2021 that requires member states to pay a levy of 0.80 euros per kilogram of non-recycled plastic packaging waste. In Germany, the government announced in early 2024 that it would be passing on the existing plastic levy – currently generating 1.4 billion euros and financed by the federal budget – on to plastics manufacturers and distributors from 2025 or 2026, as is the case in other European countries (BPA, 2024).

In France, companies in the packaging sector can receive a premium or face a penalty based on criteria such as their usage of recycled material. This adjustment is applied to their financial contribution to a state-accredited third party ("eco-organisation") for each product sale, ensuring proper post-use treatment funded by the company (Figure 15) (Ministère de la Transition écologique et de la Cohésion des territoires, 2024). This follows an advanced disposal fee approach that has been widely implemented across EU countries in the packaging sector (Urban Agenda Platform, 2024).

Bonus-malus system for re-use and recycling of materials in France → Fig. 15



Agora Industry (2024) based on Ministere de la Transition Ecologique (2024)

Financial incentive schemes for reusing and recycling materials | Instrument details

Instrument type

- ○ Informational instrument
- ☒ **Target-setting instrument**

Financial schemes promote demand for re-using and recycling materials by either raising the costs of primary materials use (through a tax or penalty) and / or lowering the cost of recycled materials (through a credit or bonus).

Initiating actor

- ☒ **Regulatory authority**
- ○ Private sector

Financial schemes either in the form of a tax or a credit system are implemented by regulatory authorities.

Coverage

Financial incentive schemes are typically applied to the end product level, for example packaging.

Decarbonisation lever

- ☒ **Production process transformation**
- ○ Material efficiency and substitution
- ☒ **Switch to climate-friendly energy**
- ☒ **Use of recycled materials**

Timeline for implementation

Financial schemes are especially useful in the initial phases of market formation for climate-friendly materials or products until more binding demand side measures take over.

Lead Market → **Mass Market**

Substitution potential

- ○ Low
- ☒ **Medium**

Financial incentives schemes are complementary to other measures targeting efficient and circular production processes. The substitution potential is medium. Financial incentives are not necessarily a basic element of other target-setting instruments such as quotas. However, they can have the same policy goal as quotas, by incentivising an increased use of circular materials.

Advantages and opportunities

- → Enhances the potential for circular and resource-efficient practices.
- → Financial incentives can grant market access opportunities and greater customer acceptance to companies using a higher proportion of recycled materials.
- → Can be designed in a technology agnostic way.
- → Can be linked with an advanced disposal fee approach, to cover the costs of end-of-life treatment for specific sectors such as packaging.
- → Depending on the design, schemes can be cost-neutral for the public budget.

Disadvantages and hurdles

- → A tax on primary resource use in certain sectors (e.g. construction) can be politically sensitive given the current economic constraints.
- → The premium/penalty system must be based on ambitious thresholds for the share of recycled materials, else it may not be efficient in driving ambition.
- → Focuses on promoting only limited practices within the full range of circular practices (re use and use of recycled materials).

Agora Industry (2024)

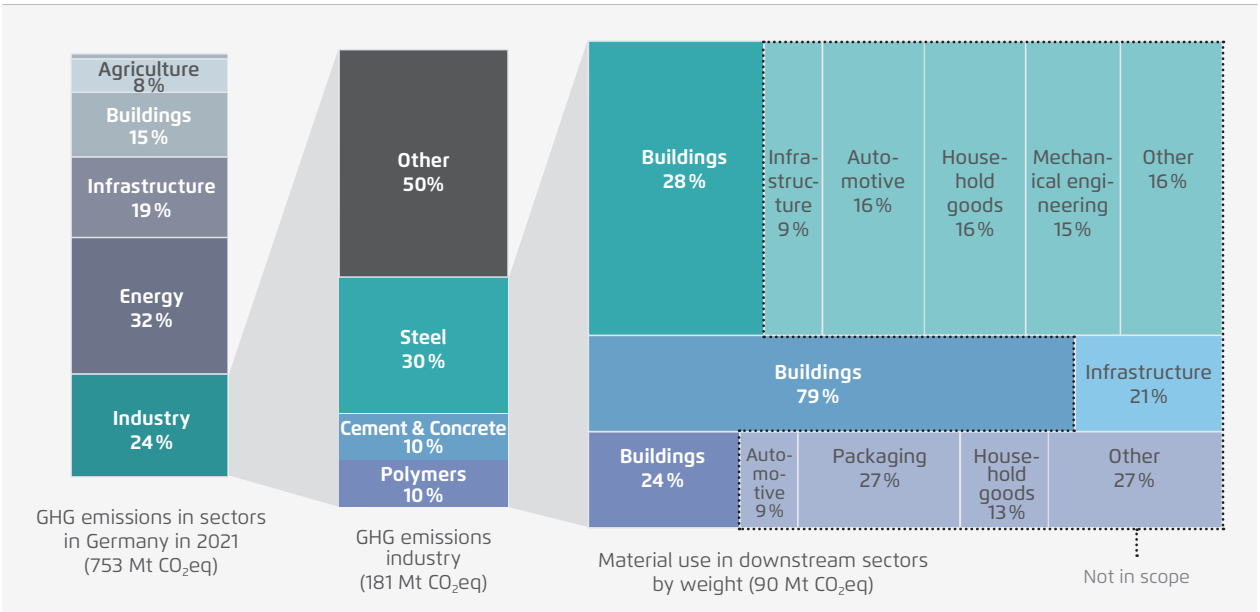
4 Case study: Demand-side policy mix for the buildings sector in Germany

4.1 The buildings sector as a major end-use sector for basic materials and source of embodied emissions

In Germany, the buildings sector is the single most important consumer of basic materials, and thus a major source of embodied carbon emissions. It accounts for most of the emissions linked to cement and concrete production, around a third of those linked to steel (which is mostly scrap steel) and a quarter of the emissions generated by basic chemicals (Figure 16). In 2021, embodied emissions from steel, concrete and polymer use in the buildings sector generated around 34 million tons of GHG emissions (Agora Industry, Systemiq, 2023). Further relevant materials contributing to embodied emissions in buildings include glass, insulations materials, and sand-lime brick (Dena, 2023).

When looking at the construction stages, embodied carbon emissions of buildings result from material use in construction, renovation, deconstruction, and demolition of buildings. Embodied emissions today typically contribute around 20 to 25 percent to the GHG lifecycle footprint of buildings, i.e. to their overall emissions, including energy-related operational emissions over the building's lifetime. However, this share can increase up to 45 to 50 percent for highly energy-efficient buildings (Röck et al., 2020). Going forward and with more energy-efficient buildings – which would consume less energy over their lifetime – the share of embodied in overall emissions is set to increase over time. In the EU, around 60 to 70 percent of the embodied carbon is emitted upfront, through the materials used for initial building construction (SBTi, 2023b).

Buildings as main use sector of energy-intensive basic materials (Germany) → Fig. 16



Agora Industry, Systemiq (2023), Umweltbundesamt (2022), Mission Possible Partnership (MPP) (2022)

Prioritising climate-friendly building materials is a key strategy to reduce embodied carbon and it can be done in a cost-effective way

A range of abatement levers exist to reduce the embodied carbon of buildings. These include (Figure 17):

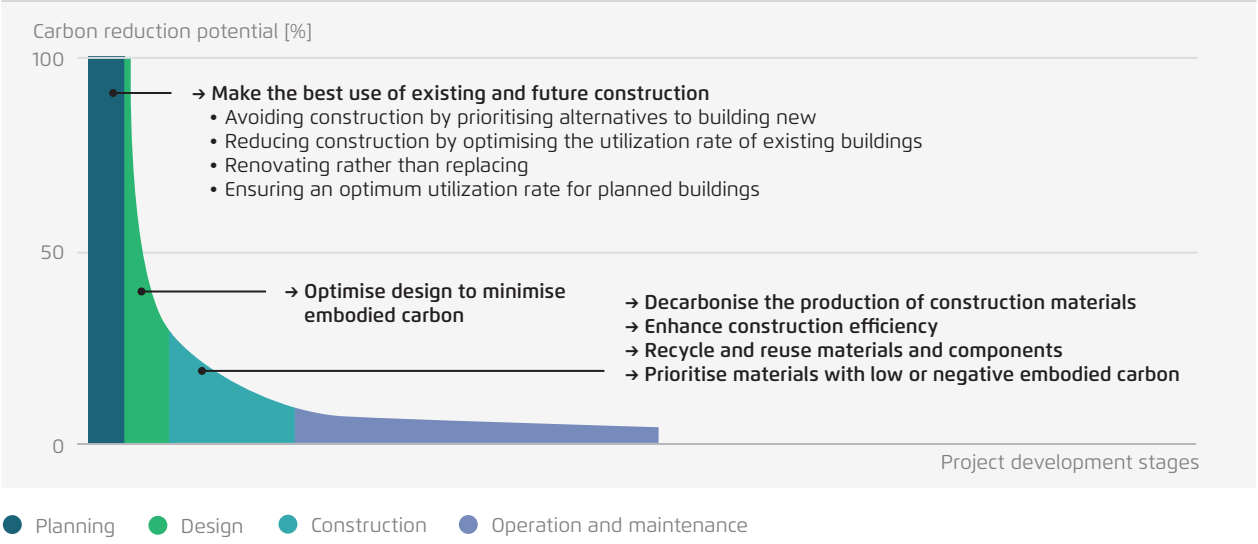
1. Making the best use of existing and future construction. This includes avoiding construction by prioritising alternatives to building new; reducing construction by optimising the utilisation rate of existing buildings; renovating rather than replacing and ensuring an optimum utilisation rate for planned buildings;
2. Optimising building design to minimise embodied carbon;
3. Decarbonising the production of construction materials;
4. Enhancing construction efficiency;
5. Recycling and reusing materials and components;
6. Prioritising materials with low or negative embodied carbon.

With regards to embodied carbon emissions, the planning and design phases are decisive. Hence, policies aimed at reducing the embodied carbon of buildings also need to target these phases (Shifting Paradigms, 2023). Other key strategies, as mentioned, are to decarbonise construction materials production, recycle and reuse materials and prioritise climate-friendly materials (Figure 17). These strategies are also within the focus of this analysis. In addition, it is important to note that there are other important abatement levers that also need to be addressed, but which are beyond the scope of this analysis (esp. making the best use of existing and future construction).

Decarbonising material production is expected to bring about price increases in the medium term. However, with rising carbon prices in the EU-ETS I along with growing availability of renewable energy carriers and infrastructure, the relative costs begin to shift. By 2040, near-zero emission materials such as steel or cement are expected to be produced at comparable costs to conventional materials, and by 2050, these materials are projected to be cost-effective across the board (Agora Energiewende, Agora Industry, ifeu, Ramboll, forthcoming).

In most cases, using climate-friendly materials adds only a small fraction to the overall construction costs. Rootzén and Johnsson (2017) found that using

Potential of embodied carbon regulation at different project development stages → Fig. 17



Shifting Paradigms (2023)

lower-carbon cement-making, while doubling the cost of cement, would add less than one percent to the costs of a residential building. The Energy Transitions Commission (2018) found that using climate-friendly concrete would be around 30 percent more expensive, adding 15 000 US dollars or three percent to the price of a house. According to the IEA (2020), costs for using decarbonised cement would increase house prices by less than one percent.

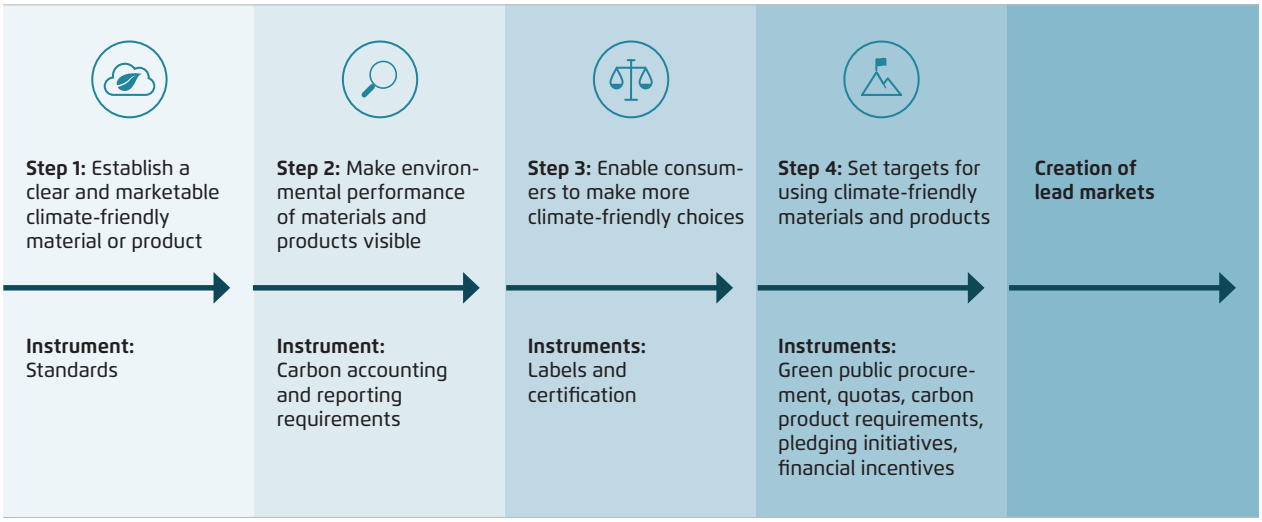
4.2 Status quo of demand-side policy instruments for the buildings sector in Germany

Several existing regulations and initiatives at national and EU levels are relevant to support the development of lead markets for climate-friendly building materials in the German buildings sector. However, as the following section shows, the current policy framework leaves loopholes and incentives to scale from lead markets to mass markets are missing. In addition, some EU-level requirements leave a great level of flexibility for national implementation, which can hamper their effectiveness. The analysis is structured according to the different steps necessary for lead market creation (Figure 18).

Step 1: Establish a clear and marketable climate-friendly material or product

EU-level developments indicate a shift towards more innovative, performance-based standards for building materials. However, challenges for a level playing field for climate-friendly and circular materials in Germany remain. The revised European Construction Product Regulation (CPR) indicates a move away from the current prescriptive approach (prescribing the basic composition of a material instead of requirements regarding its performance) to performance-based cement and concrete standards, which would allow climate-friendly and circular materials to enter the market at a larger scale (Alliance LCCC, 2023). However, this still needs to be implemented properly. For example, a recent proposal from the EU Commission to provide guidance for the current standardisation process on cement indicates that a prescriptive approach could be retained (ECOS, 2024). At national level, the German government has launched the *Normungsroadmap Circular Economy* with buildings as one of its focus areas, in order to further develop standards on circular building practices. It assesses the status quo of standards in the field of circular economy and provides recommendation for future improvement (DIN, DEK, VDI, 2023). The further development and implementation of these norms is critical for

Policy instruments for lead market creation → Fig. 18



Agora Industry (2024)

enabling circular practices to spread. With a view to the national context, especially the existing concrete norms need to be revised to enable a level playing field for climate-friendly and circular concrete. Lastly, standards for construction materials still lack international harmonization. This provides a challenge to the comparability of internationally traded materials and leads to fragmented markets.

Step 2: Make environmental performance of materials and products visible

At the buildings level, EU regulation introduces calculation and disclosure requirements. Reporting requirements laid out in the revised Energy Performance of Buildings Directive (EPBD) will apply to the life cycle global warming potential (GWP) of new buildings with a use area of over 1000 m^2 from 2028 and for all new buildings from 2030 (EP, 2024b). However, there is no harmonised EU reporting methodology required by EU law to assess a building's life cycle emissions, as the reporting framework LEVEL(s) and EN15978 are voluntary (see European Commission, 2023a). This means different companies use different Environmental Product Declarations (EPDs) tools available on the market with slightly different methodologies. The European Commission will develop such a methodology, which would however not be mandatory (EP, 2024b).

For building materials, the necessary data infrastructure based on carbon accounting requirements as well as calculation and reporting guidelines is currently being developed at EU level. The revised Construction Product Regulation (CPR) introduces mandatory declaration for manufacturers on the environmental information of their products (cement and other construction products) in the form of Global Warming Potential (GWP) and via Environmental Performance Declarations (EPDs). This will apply to products covered either by a harmonised standard developed by European standardisation organisation, or European Technical Assessments (ETAs) (EP, 2024c). Together with the revision of the Ecodesign for Sustainable Product Regulation (ESPR) – regulating amongst others iron and steel, aluminium, and chemicals – the CPR also mandates the use of Digital Product Passports (DPP)[2] enabling B2B information sharing along the value chain of the product, including on climate-related aspects (EP, 2024a). One challenge is the lack of availability of product-specific data, and the use of industry averages, preventing the possibility to adequately compare different materials. In Germany, a circularity index is planned, as part of the implementation of a digital building resource passport, similar to a digital product passport. It will provide information on the recyclability of building materials and components. Companies' digital readiness across sectors, especially for SMEs, is currently limited, making it difficult to collect product-level data (Neligan et al., 2023).

Step 3: Enable consumers to make more climate-friendly choices

At the buildings level, Germany has a number of certifications in place – yet no labelling system exists which allows comparability of all buildings on the market, from conventional ones to the ones compatible with climate neutrality. Certification such as the German state label „Quality Seal Sustainable Buildings" (*Qualitätssiegel Nachhaltiges Gebäude, QNG)* identifies buildings with low life cycle emissions, which has been a requirement for new public buildings to be granted subsidy loans under the *Bundesförderung für Effiziente Gebäude (BEG)* since March 2023. This, however, applies to only tiny fraction of buildings in the public market. In addition, the German "Assessment System for Sustainable Buildings" (*Bewertungssystem Nachhaltiges Bauen, BNB)* provides a voluntary standardised assessment framework to certify sustainable residential and non-residential buildings, covering different life cycle phases. While these certification systems provide a starting point, what is lacking is a labelling system that can cover and assess all buildings on the market.

At the materials level, standardised emissions performance labels for important basic materials, including cement and steel, are currently missing.

2 The information disclosed by a DPP will be decided in secondary legislation.

At the international level, the lack of internationally harmonised label systems for materials (e.g. steel, cement) hampers comparability of traded basic materials. From 2023 onwards, a stakeholder process on green lead markets took place at the German Federal Ministry for Economic Affairs and Climate Action (BMWK). As a result, in April 2024, the German steel association *WV Stahl* announced the introduction of a Low Emission Steel Label (LESS), which is flanked by the BMWK (WV Stahl, 2024). In May 2024, the BMWK published its concept paper for lead markets for climate-friendly basic materials. A special focus in the paper lies on the Ministry's proposals for labels for steel, cement and basic chemicals. The ministry is also flanking other efforts from industry that seek to drive forward definitions, including the plastic pipe association (BMWK, 2024).

Step 4: Set targets for using climate-friendly materials and products

At the buildings level, the revised EPBD requires member states to introduce limit values on the embodied carbon of new buildings through a roadmap by 2027, with limit values applying from 2030. At the national level, the Federal Government announced an integration of a life-cycle approach in the Building Energy Act *(Gebäudeenergiegesetz, GEG)* from January 1st 2025 (BMWSB, 2022). As the EPBD does not set concrete requirements on the level of ambition of future embodied carbon targets for new buildings, it is important that the German government implements the upcoming requirements ambitiously.

Existing national provisions on public procurement and upcoming requirements at EU level still leave room for improvement. At the German federal level, the *Allgemeine Verwaltungsvorschrift Klima* (AVV Klima) is relevant. However, it is heavily focused on operational energy emissions, less on embodied emissions from buildings. No clear and binding requirements with regards to embodied emissions exist. In addition, other aspects such as limited staff capacity at municipal level pose challenges for effective implementation. At EU level, the new CPR will introduce mandatory sustainability requirements for public procurement projects. These can, however, be waived if the costs are 10 percent higher than procuring conventional building materials. For the plain materials level, this threshold is relatively lenient, depending on how the material costs are calculated.

Targeted incentives for enhanced circularity in the buildings sector are lacking in the current regulatory framework in Germany. Existing regulation such as the Circular Economy Law *(Kreislaufwirtschaftsgesetz)* is heavily focused on the waste sector. The national circular economy strategy *(Nationale Kreislaufwirtschaftsstrategie)* as another overarching strategy is available in draft status and covers the buildings sector, but is still in development. While some of the measures mentioned above (e.g. embodied carbon limits) may also incentivize circular materials indirectly, there is still a lack of explicit incentives for an enhanced use of circular materials.

Upcoming EU requirements on the performance of basic materials such as steel or chemicals are still in the design phase – a sufficient level of ambition will be crucial. The revised ESPR and CPR will introduce performance requirements for specific product groups (such as steel and cement). These requirements are planned to cover the entire life cycle of a product and will include aspects such as material use, energy and resource efficiency, durability, reparability, and reusability. The European Commission will first prioritise materials with the highest carbon footprint, i.e. iron, steel, aluminium, chemicals. The levels of ambition of future product performance requirements are still to be developed by the European Commission. Thus, it is crucial that these requirements reflect the necessary ambition to effectively expand the market for climate-friendly materials and products (EP, 2024a).

4.3 A policy package for climate-friendly building materials: Impulses for a demand-side instrument mix in the buildings sector in Germany

Creating lead markets demands a policy mix that sets strong incentives and clear guidelines for market

actors to invest in climate friendly materials and production processes. As the previous section has shown, the existing policy framework needs to be strengthened and complemented with additional instruments, to generate an efficient demand-side policy package (Figure 19). Throughout all of the steps outlined below, it is important to provide ongoing financial support and training opportunities to professionals to support with the implementation of requirements (e.g. on embodied carbon) and establish consulting networks for private persons to help familiarise with new instruments (e.g. labels).

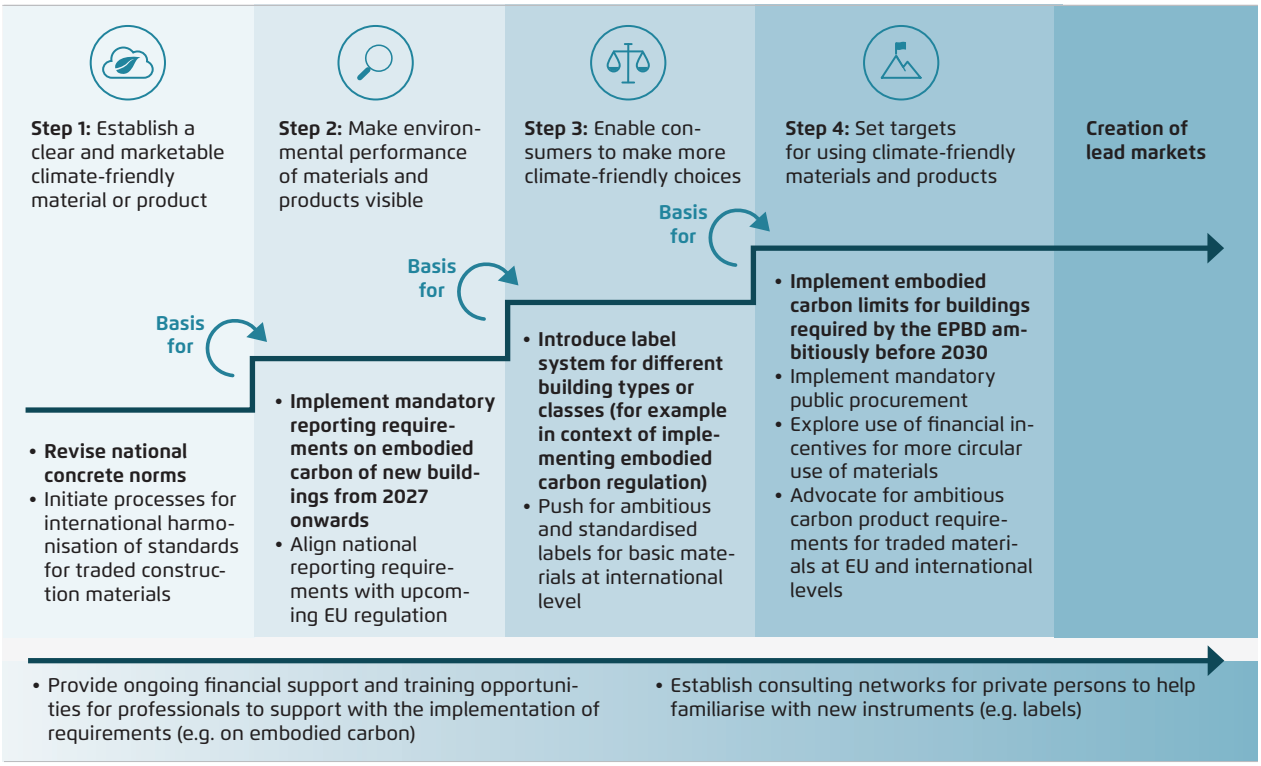
Step 1: Establish a clear and marketable climate-friendly material or product

Revise national concrete norms and initiate processes for international harmonisation of standards for traded construction materials. At the national level, the German government should push for a revision of relevant DIN standards for concrete, moving from a prescriptive towards a more performance-based approach. To internationally harmonise relevant standards (for example EN 15804 and ISO 21930) the Federal Government could initiate coordination especially with China, Japan and Korea, and relevant EU member states (e.g. France, Italy, Poland) and the USA on relevant standards. Existing efforts within the Industrial Deep Decarbonisation Initiative to provide guidance for harmonisation of these standards could be a suitable anchor point to continue the discussion. At EU level, the approach towards more performance-based standardisation in the Construction Product Regulation (CPR) should be assured in current standardisation processes.

Step 2: Make environmental performance of materials and products visible

Implement EPBD regulation on reporting requirements ambitiously. The German government should

Demand-side policy mix for the German building sector → Fig. 19



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aim for a more ambitious implementation timeline than set in the Directive: While the EPBD mandates that Member States publish a roadmap by 2027, Germany should aim for publishing a roadmap by the end of 2026 and introducing carbon accounting requirements for all new public buildings and buildings with a use area of over 1000 m² already from 2027 on. Implementing reporting requirements for all new buildings should then be aimed for already from 2028 on. To reduce bureaucratic burden, alignment should be sought with the EU's delegated act on a common reporting methodology, which has been announced for the end of 2025. Thereby, the German government should lie its focus on upfront embodied carbon emissions[3] and disclose them through the energy performance certificate (EPC) of the building (Agora Energiewende, Agora Industry, ifeu, Ramboll, forthcoming). A phase-in period of reporting requirements prior to setting embodied carbon limits from 2029 can allow for enough data collection, familiarising the industry and stakeholders along the value chain with the regulation. The German government could also evaluate where product specific data could be required – especially where processes have a high impact on the final emissions of a product. Here, it is important that existing accounting frameworks and schemes are being used, in order to reduce additional reporting requirements.

Align national reporting requirements for materials and products with upcoming European regulation. The ESPR and CPR mandate carbon accounting for product groups including steel and cement. These reporting requirements also include the establishment of digital product passports (DPPs), although their exact design and scope will still need to be defined. The German government's plans to introduce a digital building materials passport should be closely aligned with the development of the digital product passport at EU level in order to ensure compatibility between the instruments and efficient implementation for market actors. An option could be to bundle information required by the EU level and the national level into one passport in the future, depending on whether and how such a national passport is introduced. Digital product passports should be both practice-oriented and manageable for small and medium-sized companies (SMEs). To this end, the federal government should develop suitable funding instruments, especially for SMEs to support companies in using digital product passports (see also Agora Industry, Systemiq, 2023).

Step 3: Enable consumers to make more climate-friendly choices

Introduce a label system for different building types or classes. Such a labelling system could be designed akin to the design of labels at the material level, differentiating between "shades of green" – from conventional buildings to buildings compatible with climate neutrality. Such a label could be introduced in the context of implementing embodied carbon requirements mandated by the EPBD to disclose the carbon footprint of buildings in the Energy Performance Certificates (EPCs). The labels could also be included directly on the EPCs in the future. The Federal Government could also explore integrating a future label into the QNG and the BNB and base future certification on attaining a certain threshold rating within the label.

Push for ambitious and standardised labels for basic materials at an international level. For traded materials, ensuring international comparability of these materials is key to enable a level playing field. The German government should push for a swift introduction of ambitious labels at the international level, while ensuring that different starting points and means to support the transformation of developing and developed countries are considered. In the meantime, Germany could pilot the introduction of labels at a national level to gain first experience in implementing such an instrument, while committing to aligning its approach with future ambitious labels developed in international fora. An entry point for piloting labels at the national level could be the proposals presented in the ministry's concept paper on lead markets. It is also important that future labels

3 kg CO_2 eq./m²a, covering at least LCA phases A1-A3 and B4 – as these constitute the most carbon intensive phases, as well as the phases with the most available data.

for construction products such as cement are both available for products targeting professionals (e.g. downstream companies), but also end consumers (e.g. private persons) since a share of such products is also bought for private use.

Step 4: Set targets for using climate-friendly materials and products

Implement EPBD regulation on embodied carbon limits for buildings ambitiously. A possible strategy would be to introduce embodied carbon limits for new public buildings and buildings with a use area of over 1 000 m^2 from 2029 and for all remaining types of new buildings, such as warehouse buildings, from 2030. Ideally, these limits would at least cover the upfront embodied carbon emissions (LCA phases A1-A3). Limit values should be progressively tightened to steer embodied carbon levels in the buildings sector towards climate neutrality. Germany should aim for a sub target on the embodied carbon of materials (kg CO_2 eq./m^2). Placing differentiated sub targets on the embodied carbon and on the energy demand of buildings has the advantage to support decarbonisation in both fields – material use in the construction phase and energy use in the use phase of a building. The Federal Government should develop a roadmap on how to introduce embodied carbon limits by the end of 2026.

Implement mandatory green public procurement to establish the public sector as an ambitious first mover. The German government should revise the public procurement requirements for taking into account climate impacts by making them mandatory. Through including targets for the embodied carbon of emission-intensive materials such as steel or concrete used in public projects, their environmental impacts can be brought more into focus. This could be achieved for example by establishing limit values for the embodied carbon content for these materials. To set targets under such a policy design, label thresholds could be used. Alternatively, targets for a "labelled" material, e.g. climate-friendly steel, could be implemented. The German government should also provide ongoing training opportunities to public procurement professionals at all levels on the implementation of climate-related requirements. A stepwise approach to implementation could also be taken by piloting mandatory requirements for public procurement in "sandbox" projects or at the subnational level. It is important that municipalities are provided sufficient (financial and personnel) resources to fulfil the required tasks. Research at the EU level shows that the incremental costs for implementing GPP by using climate-friendly steel or cement are minimal (with about 0.2-0.5 percent) (Brussels School of Governance, 2024), while public procurement constitutes a significant demand segment for climate-friendly materials. This is an important factor in times of scarce public budgets.

Explore use of financial incentives for more circular use of materials. Setting such incentives can help to balance the incremental costs that circular materials and products are facing in the short run due to the need to build new value chains and infrastructure and the use of new technologies. To incentivise the use of recycled materials, Germany could introduce a credit or bonus system for companies or building owners using a high share of recycled materials. With these credits, they could be granted access to advantages such as financial incentives. These could then be financed through a fund solution. This fund solution could for example be generated through payments of those companies that produce poorly recyclable products.

Advocate for ambitious carbon product requirements for traded materials at EU and international levels. New EU requirements on the embodied carbon of construction products (ESPR and CPR) provide Germany a chance to set standards across the EU and push for ambitious yet feasible future regulation. At the international level, the German government could advocate for the introduction of carbon product requirements, which would effectively set embodied emission limits on a defined set of materials and thereby effectively drive more polluting goods out of the market in the long run. This would enable policy makers to converge on a common policy approach for trade-intensive materials. International label thresholds can be used as a basis for agreeing on a common ambition level.

5 Outlook: Scaling up markets for climate-friendly basic materials globally

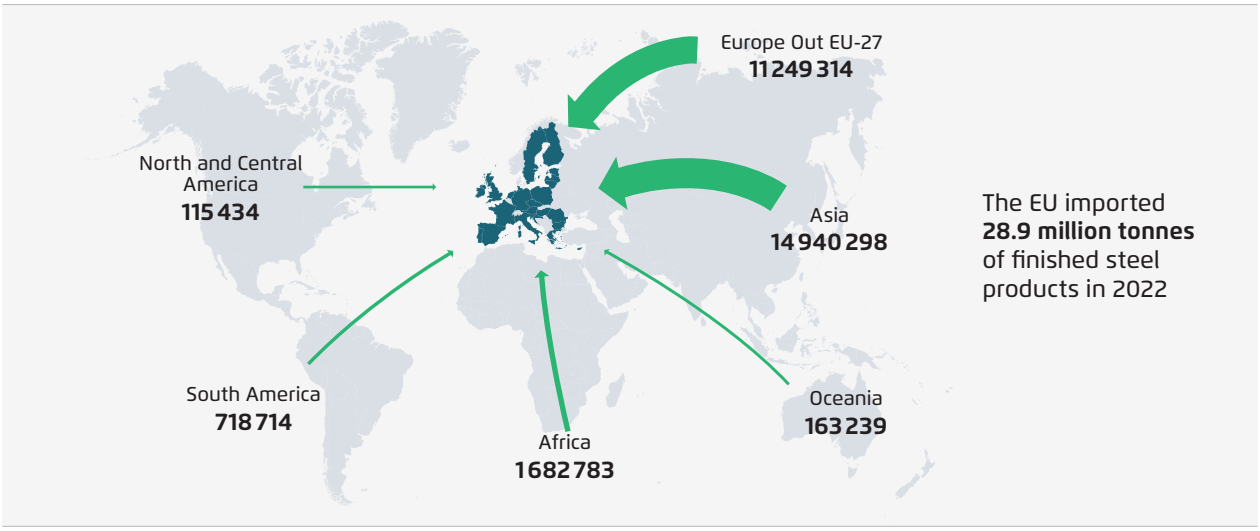
Leveraging the scale of Europe's markets can not only stimulate climate-friendly domestic industrial investment but also, crucially, foster sustainable global value chains. There is significant trade in emission-intensive basic materials, with most of the materials being produced in large industrialised emerging countries. Around half of the finished steel products imported by the EU in 2022 came from Asia, for example (Figure 20).

Emerging countries will need to develop their own lead markets to decarbonise their industries, especially because their capacity to subsidise production to go climate-friendly at scale will sometimes be more limited than in more advanced economies with lower shares of production. However, given the traded nature of emission-intensive basic materials and products, lead markets that promote demand not just for climate-friendly materials and products produced locally but also for – at least a share of – imported products can have positive spillover effects for decarbonisation at the global level. As the EU remains a net importer of CO_2-intensive materials, it can also use trade to extend the European Green Deal globally, using domestic demand to inspire investments in climate-friendly production *and* the creation of lead markets abroad. To ensure an equitable and yet resilient transition, a balance should be struck between fostering *domestic and international* lead markets.

Recent developments indicate that policy makers become increasingly aware of the need to enable trade in climate-friendly basic materials – yet, ambitious agreements are missing

With low-emission and near zero production of materials as steel or cement emerging globally, the need to enable trade in these materials becomes increasingly pressing. Some relevant political initiatives include the *Climate Club*, which was fully launched at COP28, focusing on the decarbonisation of basic materials such as steel and cement and related trade in these materials. The US and EU

Total steel imports to the EU → Fig. 20



Eurofer (2023)

agreed to work on a *Global Agreement on Sustainable Steel and Aluminium (GASSA)* back in 2021, although the negotiations on scope and agenda of the agreement have not been concluded. Especially at the level of intermediary materials that are widely traded internationally, such as steel, an agreement on what counts as climate-friendly is necessary to ensure a level playing field.

These policy developments show that policy makers are eager to move forward. However, what is still missing are global and ambitious agreements on the design of lead market policies. Getting these policies right from the outset and agreeing on common and ambitious standards and labels at the material level can accelerate the international development of lead markets.

Harmonised lead market instruments across countries can lead to a more efficient transition towards climate neutrality and reduce trade frictions

Common lead market approaches can create a level playing field between participating jurisdictions and help avoid a multiplicity of approaches that results in an increased administrative burden and unclarity for consumers. Different levels of ambition regarding the limiting of CO_2 emissions in intermediary materials or final products may result in trade frictions and carbon leakage risks.

Instruments such as the CBAM or subsidies for climate-friendly production such as CCfDs or the Inflation Reduction Act (IRA) may mitigate these issues, at least in the short run. By implementing common lead market policies such as labels and carbon product requirements for certain materials, countries can overcome trade frictions and carbon leakage risks in the longer run by agreeing on a common way forward, thereby rendering instruments such as CBAM or subsidies less relevant (Agora Industry, forthcoming).

As we move towards the implementation of demand-side instruments, enabling conditions need to be addressed in order to unlock the instruments' full potential. Besides working towards internationally harmonised standards for climate-neutral basic materials, the availability of high-quality, product-specific and comparable primary data to underpin information on the environmental properties of products needs to be improved. Such data is essential for consumer-facing companies to be able to reliably market more climate-friendly products, for example. It is vital for policy makers to work towards finding solutions in these areas while developing demand-side instruments. Clearly, sufficient skilled workforce is necessary for implementing lead market policy measures – both, at the regulatory level (such as for green public procurement) and at the technological level (such as creating innovative, climate-friendly building materials).

For each of the policy instruments outlined in this report, detailed questions about implementation will need to be answered and tailored to the specific context at hand. Our analysis *Labels for climate-friendly basic materials* (Agora Industry, 2023d) outlines potential compromise approaches to allow steel, cement and concrete labels to move forward at the international level. An upcoming study on embodied carbon regulation analyses how embodied carbon limits may be implemented in Germany, specifically focusing on limits for new buildings (Agora Industry, Agora Energiewende, ifeu, Ramboll, forthcoming).

Finally, this analysis has focused on creating lead markets for climate-friendly basic materials as a pull factor for investments in climate-neutral production processes. A further effective emissions reduction lever clearly is to simply to consume less materials in the first place. With regards to the buildings sector in Europe, for example, reusing or renovating existing buildings can be assumed to be more climate-friendly than constructing new buildings with climate-friendly materials.

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Agora Industry develops scientifically sound and politically feasible concepts for successful pathways to a climate-neutral industry – in Germany, Europe and internationally. The organisation which is part of the Agora Think Tanks works independently of economic and partisan interests. Its only commitment is to climate action.

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