The Green Steel Market: Evaluating the OEM Business Case and the Role of Decarbonisation Targets as Strategic Drivers in the Automotive Sector

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Abstract

The steel sector accounts for approximately 7-8% of global greenhouse gas (GHG) emissions, and the automotive industry stands for a large part of its customer base. As Original Equipment Manufacturers (OEMs), such as Volvo, Mercedes and Scania etc., face tightening Scope 3 emission targets, evolving EU regulatory frameworks, and growing pressure to decarbonise their supply chains, the question of whether and how to adopt green steel has become strategically significant for the industry. Yet despite genuine demand intent, the green steel transition has stalled.

This study investigates the business case for green steel within the automotive sector, drawing on perspectives from OEM representatives, industry and policy experts, and steel producers. The empirical foundation consists of data from 19 semi-structured interviews across these groups. Two research questions guide the study: how OEMs construct a business case for green steel and what factors influence their willingness to pay a premium, and to what extent emission targets and EU regulatory frameworks drive green steel demand.

The findings show that the OEM business case rests on several distinct but interdependent drivers, including Scope 3 emission reduction aims, internal carbon pricing, risk management in relation to carbon pricing trajectory and supply security, as well as the commercial logic of fleet customer demand. However, the business case does not rely on commercial logic alone. The green premium constitutes a direct margin hit that OEMs in a low-margin competitive environment cannot absorb independently, and end-consumers are perceived as not willing to pay for it, making external mechanisms necessary to stimulate demand. Voluntary emission targets such as the Science Based Targets initiative operate differently depending on the actor: for most OEMs they function primarily as mechanisms for regulatory readiness rather than direct sourcing requirements, while for others they are currently the primary operative driver of green steel work in the absence of mandatory obligations. EU regulatory frameworks including the Industrial Accelerator Act and the Automotive Package signal decarbonisation ambition but fall short of creating the mandatory demand certainty that steel producers require to take final investment decisions. The absence of a standardised EU definition of green steel reinforces this, blocking procurement conversations and market formation simultaneously.

The study concludes that while demand intent is real, a structural coordination failure between actors across the supply chain and a lack of legal pressure prevent the transition from advancing. Neither voluntary commitments nor the current regulatory environment produce the sufficient simultaneous binding signals across the value chain that would allow final investment decisions to be taken and supply to scale. However, the coordination failure framing has limits: even with mandatory commitments, pricing captivity and a fundamental cost gap could persist. Addressing this requires not only stronger regulatory pressure but credible and long-term policy certainty over the investment horizons that green steel infrastructure demands.

Keywords: Green steel, Automotive sector, Europe, EU regulatory frameworks, Industrial Accelerator Act (IAA), Automotive Package, Coordination failure, SBTi, Willingness to pay, Green premium

Preface

This thesis was conducted as part of a Master's Degree in Industrial Engineering and Management at the Faculty of Engineering, Lund University, during the period from January to May 2026. It was carried out within the Division of Environmental and Energy Systems Studies, an interdisciplinary research group whose work spans technical and policy dimensions of climate-driven transitions, with particular focus on the decarbonisation of energy-intensive industry and its role in the broader energy system.

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Contents

Nomenclature

$B2B$	Business to Business
BEV	Battery Electric Vehicle
$BF-BOF$	Blast Furnace - Basic Oxygen Furnace
$CAPEX$	Capital Expenditure
$CBAM$	Carbon Border Adjustment Mechanism
CCS	Carbon Capture and Storage
$CO2$	Carbon Dioxide
$CSDDD$	Corporate Sustainability Due Diligence Directive
$CSRD$	Corporate Sustainability Reporting Directive
EAF	Electric Arc Furnace
$EBIT$	Earnings Before Interest and Taxes
EPD	Environmental Product Declaration
ESG	Environmental, Social, and Governance
$ESPR$	Ecodesign for Sustainable Products Regulation
$ESRS$	European Sustainability Reporting Standard
ETS	Emissions Trading System
EU	European Union
FID	Final Investment Decision
FMC	First Movers Coalition
GAR	Green Asset Ratio
GHG	Greenhouse Gas
GPP	Green Public Procurement
GWP	Global Warming Potential
$H2-DRI$	Hydrogen-based Direct Reduction Iron
HBI	Hot Briquetted Iron
HEV	Hybrid Electric Vehicle
IAA	Industrial Accelerator Act
ICE	Internal Combustion Engine
LCA	Life Cycle Assessment
$LCOH$	Levelised Cost of Hydrogen
$LCOS$	Levelised Cost of Steel
$LESS$	Low Emission Steel Standard
LOI	Letter of Intent
MLP	Multi-level Perspective
MoU	Memorandum of Understanding
$NG-DRI$	Natural Gas-based Direct Reduction Iron
OEM	Original Equipment Manufacturer
$OPEX$	Operating Expenditure
PCF	Product Carbon Footprint
ROI	Return on Investment
$SBTi$	Science Based Targets initiative
SSC	Steel Service Center
WTP	Willingness to Pay

1 Introduction

Decarbonising the steel sector is one of the most defining challenges of the industrial energy transition towards achieving net-zero emissions. Unlike electricity generation, where established low-carbon technologies are scaling rapidly, primary steel production remains structurally dependent on coal or fossil fuels, and the pathways to eliminating that dependency require capital investment at a scale and risk profile that markets have so far been unwilling to fund without external pressure. In Europe, that pressure is beginning to take shape through a combination of carbon pricing, supply chain disclosure requirements, and emerging industrial policy, but the shift from regulatory intent to commercial deployment of green steel has been slower than the net-zero trajectory requires.

The automotive sector has a special role in this transition. As the largest consumer of flat steel in Europe, it has the purchasing volume to function as a lead market for low-carbon steel. At the same time, it is itself under significant financial strain, navigating the cost of electrification, intensifying competition from Chinese manufacturers, and a tight profit margin landscape across most OEMs. Whether OEMs can or will absorb the green premium – or push it onto the end-consumers – under these conditions is an open question, and one that neither the literature on industrial transitions nor the policy debate around steel decarbonisation has adequately addressed from the perspective of the steel buyer in Europe.

This study examines that question directly. It investigates how OEMs construct a business case for green steel, what factors shape their willingness to pay a premium, and what role emission targets and EU regulatory frameworks play in driving demand. Drawing on qualitative interviews with OEM representatives, industry experts and steel producers, the study analyses decision-making processes, interpretations of regulatory pressure, and the structural conditions under which demand for green steel forms or fails to materialise.

2 Objectives and Aim

The aim of this study is to examine how OEMs construct a business case for green steel and to assess the extent to which emission targets and EU regulatory frameworks function as drivers of demand. The study does this by investigating the strategic, financial, and reputational factors that shape OEM willingness to pay (WTP) a green premium; how voluntary GHG emissions targets such as the Science Based Targets initiative (SBTi) and internal corporate commitments operate in practice in relation to procurement decisions; and how evolving EU regulatory frameworks are interpreted and acted upon by purchasing organisations. Since the green steel market is at an early stage, with product definitions contested and commercial availability limited, these questions cannot be resolved through quantitative or market-based analysis alone. A qualitative approach including deeper understanding of policy, legal mechanisms and their impact on business case logics is therefore necessary. In order to capture the institutional reasoning, competitive constraints, and regulatory interpretations that determine whether and how demand for green steel forms, the study draws on interviews with OEM representatives, steel producers, and industry and policy experts, analysed through framework analysis. In doing so, the study contributes empirical evidence on the demand-side conditions for green steel adoption from the perspective of the steel buyer.

2.1 Research Questions

Research Question 1

How do OEMs create a business case for green steel, and what factors influence their willingness to pay for a premium?

The focus areas regarding this question are:

- Substitutability with other decarbonisation measures
- Cost pass through and competitive positioning
- Risk management and long-term supply security

Research Question 2

To what extent do voluntary emission targets and EU regulatory frameworks drive the OEM demand for green steel?

This question investigates whether green steel is a necessity or an option for automakers. The focus areas regarding this question are:

- SBTi and internal emission targets
- Regulatory EU frameworks

- Interaction between voluntary targets and mandatory compliance

2.2 Delimitations

There are a number of delimitations of this study that have to be taken into account including geography, sector, product, production pathway, value chain and usage of the green steel term delimitations. These are essential to make the scope feasible and sufficient to address the research questions.

2.2.1 Geography, Sector, and Value Chain Delimitations

This study is geographically delimited to the European market, including both European-headquartered automotive OEMs and non-European manufacturers with sales, procurement or manufacturing operations in the region, thus being subject to or directly affected by the EU regulatory environment.

The sectoral scope covers both passenger car manufacturers and heavy-duty vehicle manufacturers. Both categories rely on flat steel in production and face similar business case considerations on green steel adoption, although differences in which regulations apply to which category are addressed where relevant in the analysis. Other sectors consuming steel (e.g. the construction sector) are not directly addressed but sometimes mentioned for contextual purposes.

In the value chain, only steel producers and automotive OEMs are focused on directly. Tiers, SSCs and end-consumers are not included in the interview sampling, since they are outside the scope of this study.

2.2.2 Product and Production Pathway Delimitations

The primary focus of this study is flat steel production since automotive steel demand is heavily concentrated in flat products. This study covers both primary and secondary steel production routes, as both are integral to the discussion of green steel in the automotive sector. The two routes are not fully separable since primary production always includes some share of scrap in the mix. Secondary production through scrap-EAF is already commercially deployed globally, but is still relevant since the green premium applies to it, and the OEM faces the same business case considerations regardless of production pathway. However, the primary focus of the coordination failure is H2-DRI-EAF, where investment barriers and the deployment gap are most acute. Other production pathways (such as use of CCS for BF-BOF) are included to create an understanding of different pathways to reduce GHG emissions in the production stage, but are not followed up on during the analysis. Additionally, the progressive pathways address only the iron and steelmaking process, and not the alloying elements and upstream input materials that carry their own embedded emissions, which are needed to create the steel used in the automotive sector.

2.2.3 Usage of the Green Steel Term

This study does not apply a fixed definition of green steel. The term is used to capture the whole spectrum of lower-carbon steel, where lower-carbon steel refers to steel produced with lower GHG emissions than conventional BF-BOF production, including both primary and secondary production pathways. The term is used interchangeably with lower-carbon steel and low-carbon steel throughout the report, and how different actors define green steel is viewed as an empirical question captured through the interview data. A more detailed description of how the concept is defined across industries and academic literature is provided in the background chapter, see *section 3.3*.

3 Background

This section provides the background necessary to understand the business case for green steel in the automotive sector and the factors driving demand, covering steel production pathways, steel's role in vehicle manufacturing, demand signal formation, the regulatory landscape, and current challenges regarding the definition of green steel.

3.1 Steel Production Pathways

Steel can be produced using many different methods, some of which have been used for a long time and some of which are relatively new in the context of steel. In this study they are referred to as conventional and progressive methods respectively, and they are means of primary and secondary production of steel. The primary path – creating 'virgin' or 'new steel' – refers to steel made from iron ore and the secondary path refers to production of steel made from recycled scrap in an Electric Arc Furnace (EAF) (EUROFER, 2024). The common denominator across all primary steelmaking routes is the reduction of iron ore, which is the removal of oxygen from iron compounds (Schlegel, 2023). In 2025 approximately 1,849 Mt of steel was produced globally (World Steel Association, 2026b). Ultimately, the steel sector stands for 7-8% of global GHG emissions (World Steel Association, 2025b).

3.1.1 Conventional Production Methods

The conventional production methods are used for primary and secondary production of steel and consist of BF-BOF, DRI-EAF and scrap-EAF. The flow of each method is illustrated in Figure 1, and as seen, the inputs of each method and phase differ between the alternatives. Consequently, this leads to e.g. different electricity and raw material needs, as well as different GHG emission output.

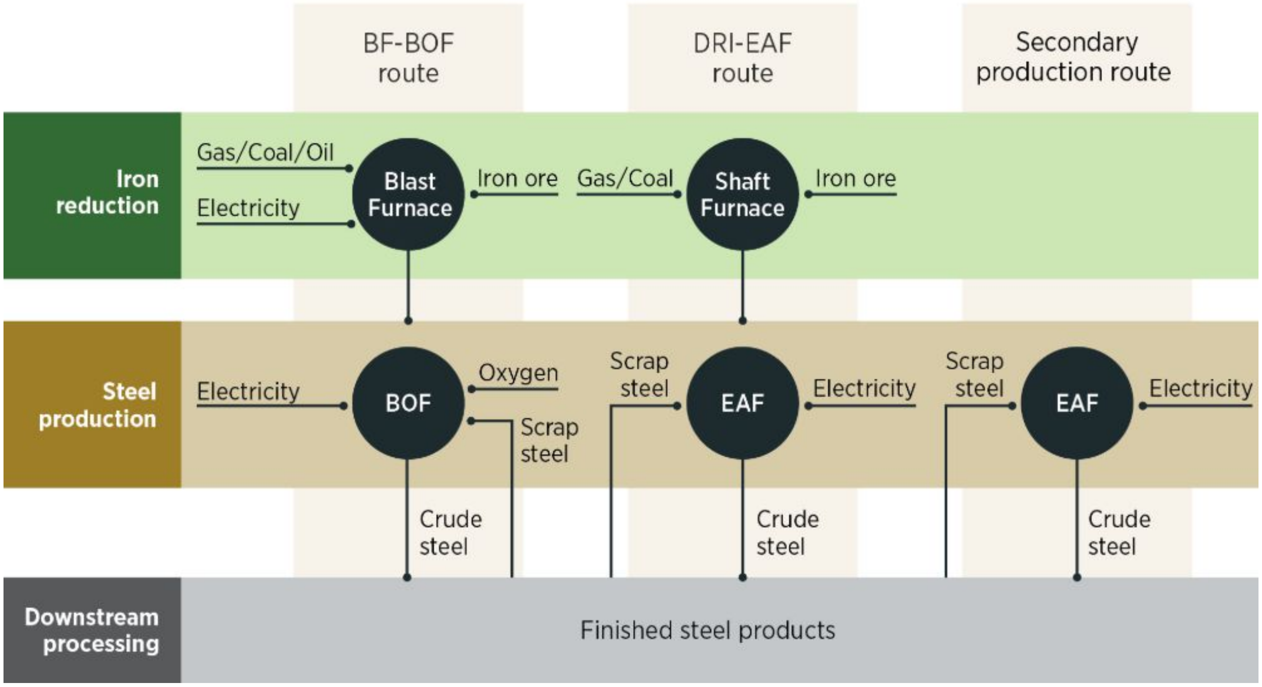

Figure 1: Conventional production methods for steel; BF-BOF, DRI-EAF and scrap-EAF (IRENA, 2024).

Blast Furnace - Basic Oxygen Furnace

The most common way of producing steel is through BF-BOF. It uses coke in the iron reduction phase, which creates high CO2 emissions, since coal reacts with oxygen in the iron ore. In the process coal is used to achieve the high temperatures needed to smelt the iron ore (EUROFER, 2024). In the next step the iron enters the BOF, where oxygen is added to oxidise unwanted constituents. In addition, scrap is used in the BOF as a cooling element, which takes up energy in the exothermic decarbonisation process (World Steel Association, 2021). In this process the iron turns to crude steel, usually containing 10-25% scrap (World Steel Association, 2021). In 2024, the method contributed to 70.4% of total steel production worldwide and the average CO2 intensity is 2.32 tCO2 per tonne of crude steel produced with BF-BOF (World Steel Association, 2025a). In the EU, 55% of steel is made using BF-BOF with an intensity of 2.0-2.2 tCO2 per tonne (Eurometal, 2025).

Natural Gas - Direct Reduction Iron - Electric Arc Furnace

The NG-DRI-EAF is the most prevalent alternative to the BF-BOF for primary steel production (World Steel Association, 2025a). This technique requires finer iron ore pellets and does not accept iron ore impurity to the same extent as the BF-BOF (International Energy Agency, 2020). When the iron ore is reduced in this process it is converted to solid sponge iron, which is different from the BF-BOF. Carbon monoxide and hydrogen serve as the reduction agents in this process – and they are called syngas – which in turn is created from natural gas, but could also be created from coal (International Energy Agency, 2020). The sponge iron is thereafter melted and processed in the EAF (IRENA, 2024). If the sponge iron is not melted directly in the EAF after the DRI process, it must be made into hot briquetted iron (HBI) to be less prone to oxidation during transportation (International Iron Metallics Association, n.d.). The average DRI-EAF CO2 intensity is 1.43 tCO2 per tonne of crude steel produced which is evidently lower than the CO2 intensity from the BF-BOF (World Steel Association, 2025a).

Scrap – Electric Arc Furnace

Secondary production of steel through scrap-EAF is the most energy-efficient and least emission-intensive conventional production method, with a CO2 intensity of 0.70 tCO2 per tonne of crude steel produced (World Steel Association, 2025a). In the process scrap is collected, sorted and loaded into the EAF where it is melted (Tomasoni et al., 2024). Through this method, steel at the end of its useful life can be recycled into new products, allowing for the chemistry to be either preserved to maintain existing structures or modified to create entirely new characteristics (World Steel Association, 2026a).

3.1.2 Progressive Production Methods

H2-DRI-EAF

Hydrogen-based Direct Reduction followed by Electric Arc Furnace steelmaking (H2-DRI-EAF) is a low-emission steel production route closely related to the conventional NG-DRI-EAF process. In this configuration, hydrogen replaces fossil-derived syngas as the reducing agent in the direct reduction of iron ore, significantly reducing carbon emissions (Hasanbeigi et al., 2024). The hydrogen is typically produced using renewable electricity via water electrolysis, in which electrical energy is used to split water molecules into hydrogen and oxygen. As a result, the emission intensity of hydrogen production is largely determined by the carbon intensity of the electricity supply (Wang et al., 2021).

When supplied exclusively with renewable electricity, process-related emissions can be reduced to approximately 0.1 tCO2 per tonne of crude steel produced. However, achieving such low emission levels is associated with substantially higher production costs, with estimates indicating a 54-72% increase in cost compared to the conventional BF-BOF production method (Agora Industry, Wuppertal Institute and Lund University, 2024).

Use of CCS for Conventional Methods

With CCS, conventional steelmaking methods like BF-BOF and NG-DRI-EAF can achieve lower CO2 emissions. For BF-BOF CO2 can be captured from the blast furnace gas stream or the flue gas from power generation. The effects of CCS are dependent on the configuration, with capture rates of 60-90% theoretically achievable despite a 25-27% higher production cost compared to conventional BF-BOF (Agora Industry, Wuppertal Institute and Lund University, 2024).

NG-DRI-EAF CO2 can be captured achieving up to 0.2 tCO2 emission reduction per tonne produced crude steel. This method has 25-54% higher production costs than conventional BF-BOF (Agora Industry, Wuppertal Institute and Lund University, 2024).

3.1.3 Production Paths Adding Up to Global Overcapacity

Even if BF-BOF accounts for the largest output in steel production, all production paths contribute to significant overcapacity in the steel industry today, meaning that there is more capacity at production sites than is annually used globally. The overcapacity puts downward pressure on price, which widens the gap between steel price and the costs of producing green steel. The overcapacity is often connected to China, but it affects the global steel price, making it difficult for steel producers to uphold their sales margin. Consequently, steel producers are fighting to keep up, facing a time of damaged financial health, which should instead revolve around investing in low-carbon alternatives (Algers, 2026).

In addition, policies today focus on supporting low-carbon projects instead of closing down existing conventional methods. Thus, there is a risk that 'greener' production only adds capacity to the overall system rather than replacing old methods. Naturally, this will increase supply even further. Hence, there is a risk that low-carbon steel, like green steel, will lack market space and the difference in price between conventional steel and low-carbon steel will persevere (Algers, 2026).

3.2 Steel in the Automotive Sector

Steel plays an important role in vehicle manufacturing and is primarily concentrated in flat products that are both technically demanding and highly dependent on primary production, making it an emissions-relevant material in vehicle production.

3.2.1 Background on Steel Applications

Steel can be broadly classified into two product groups: flat steel and long steel, which differ significantly in terms of end-use applications, production routes, and decarbonisation potential (see Figure 2). Flat steel comprises sheets, plates, and coils produced through hot and cold rolling of slabs, and is primarily used in industries such as automotive, shipbuilding, and household appliances. In these applications, surface quality, dimensional precision, and mechanical consistency are critical, resulting in strict specifications on steel chemistry and finish (World Steel Association, 2024; Zaccaro, 2024). Long steel products (e.g. rebar and structural sections) are predominantly used in the construction sector. Compared to flat steel, long products generally have less stringent requirements regarding surface finish and residual elements in the material. This makes it possible to manufacture long steel with a higher scrap share without compromising product performance (Zaccaro, 2024).

Figure 2: Long vs flat steel products (Sheffield Metals, 2018).

As a result, long steel production in Europe is already largely based on EAFs that use scrap as the primary input material. As known, scrap-based EAF production is significantly less emission-intensive than conventional BF–BOF steelmaking, particularly when combined with low-carbon electricity. Consequently, long steel production is not the primary target for hydrogen-based direct reduced iron (H2-DRI) technologies, as substantial emission reductions can already be achieved through existing scrap-based routes (Zaccaro, 2024). In contrast, flat steel production remains heavily dependent on primary ironmaking, as high scrap shares introduce residual elements such as copper and tin that negatively affect surface quality and formability. This makes flat steel considerably more difficult to decarbonise and positions H2-DRI combined with EAF as a key pathway for producing low-carbon flat steel (Ricardo Energy & Environment, 2024). The challenge of decarbonisation is therefore structurally concentrated in flat steel markets rather than in long steel (Zaccaro, 2024).

3.2.2 Steel's Importance for the Automotive Sector

Steel is a fundamental material in automotive manufacturing due to its strength, durability, and formability, accounting for approximately 50–66% of a typical passenger vehicle's mass depending on the model, segment, and powertrain (Bui et al., 2024). It is used across key vehicle systems, including the body-in-white (BIW), chassis, suspension, and powertrain components, as well as in body panels and structural frames where strength, stiffness, and crash performance are critical. Automotive steel demand is heavily concentrated in flat products, which are used in the BIW and outer panels due to stringent requirements on surface quality and formability. Long products represent a smaller share and are primarily used in components such as axles and structural reinforcements. Primary steel accounts for around 75% of steel used in vehicle manufacturing, while secondary steel from recycled scrap made in an EAF accounts for up to 25% (Bui et al., 2024). This distinction refers to the production route rather than total recycled content, as primary steelmaking processes such as BF-BOF also incorporate 10-25% scrap in the production stage, which is not classified as secondary steel (see *section 3.2.1*). The limited use of secondary steel is driven by strict material requirements, as contamination in post-consumer scrap restricts its use in high-grade applications. As a result, recycled steel in automotive production is predominantly sourced from post-industrial scrap with more consistent quality (Ricardo Energy & Environment, 2024).

3.2.3 Aluminium as a Potential Substitute

Aluminium is an increasingly important material in vehicle manufacturing. At roughly one third the density of steel while retaining comparable strength, it substitutes for steel in applications such as wheels, bumpers, suspension, and engine components. In BEVs it plays a particularly significant role, being used in battery cooling systems, charging infrastructure, and general lightweighting, since a lower vehicle weight directly extends range (European Aluminium, n.d.b). Compared to steel, aluminium has higher primary production emission intensity at 6.6 tCO2/t in Europe in 2023 and a global average of 14.8 tCO2/t (European Aluminium, n.d.a). In relation, European output is only 6% of global production and 60% of aluminium produced in Europe is secondary, reducing emissions by 89% (European Commission, Joint Research Centre, 2026).

3.2.4 The Automotive Sector's Role as a Driver for Green Steel

While aluminium plays a growing role in specific applications, decarbonising steel production remains critical given its dominant share in vehicle structure. In this context, the automotive industry plays a central role in driving demand for green steel. Automotive manufacturers are the largest consumers of flat steel in the EU, and steel component emissions generally account for 16-30% of vehicle production emissions, while Volvo reported that steel emissions contributed 33% of all production-related emissions of new Volvo cars in 2021 (Lead the Charge, 2025; Volvo Cars, 2022). For electric and hybrid vehicles that have low tailpipe emissions, steel accounts for a significant part of a vehicle's total lifecycle emissions. Therefore, as tailpipe emissions fall, the relative importance of steel emissions increases in order to achieve lower emissions of the vehicle's life-cycle. At the same time, the high value added per vehicle means that the cost premium associated with green steel can be diluted throughout the final product, resulting in a relatively small impact on the price of the end product. Techno-economic assessments indicate that H2-DRI-EAF steelmaking routes carry a production cost premium of around €200 per tonne of crude steel above BF-BOF (assuming 3$/kg H2 and excluding carbon pricing) (Hasanbeigi et al., 2024). Applied to a typical passenger vehicle containing approximately 900 kg of steel, this translates to a per-vehicle cost increase in the range of €150-200, which is consistent with reports suggesting that a 20-50% increase in steel production costs results in a less than 1% increase in retail price for a passenger car and slightly higher 1-2% for commercial heavy duty vehicles (Algers, Åhman and Nilsson, 2025; Ricardo Energy & Environment, 2024). These premiums are difficult to absorb at the steel producer level alone and therefore require downstream sectors to act as lead markets. Furthermore, the automotive industry has large purchasing power and a well-integrated supply chain with few actors, which makes traceability easier and enables stable relationships with steel producers. This combination of technical necessity, emission relevance, and economic absorptive capacity makes the automotive sector particularly well suited to act as a lead market for green flat steel, in contrast to the construction sector, where demand is dominated by long products and price sensitivity for embodied emissions remains high (Agora Industry, Wuppertal Institute and Lund University, 2024; Zaccaro, 2024).

3.3 The Current 'Grey Zone' of the Green Steel Definition

No universally accepted definition of green steel exists, leaving a "grey zone" in which credible decarbonisation commitments and far-fetched low-carbon claims coexist, undermining market transparency and complicating procurement for OEMs attempting to act in good faith.

3.3.1 Challenges with Defining Green Steel

There are many reasons why it is difficult to define green steel. Firstly, steel is not a homogeneous product where all steel has the same chemistry and the same shape. For instance, as has been described before, in the construction case, steel bars that are used in concrete reinforcements contain basic chemistry without addition of metal alloys, and are produced after one stage of rolling. On the other hand, in the automotive sector, thin flat sheets of steel contain various alloying elements to achieve extra strength, and they are created after multiple stages of rolling. Due to the process and chemistry differences they are not the same product, but still both go under the same name, steel. Secondly, there is a challenge of how scrap should be dealt with regarding its emissions footprint, since it is recycled into steel production. The volume of scrap used has an effect on the emission intensity of the steel product, and it can be used as input up to 100%. Thirdly, steel producers use different carbon accounting methodologies when reporting emissions intensity. Some methodologies might exclude GHGs other than CO2, while others do not. Some might, for instance, exclude downstream rolling processes, while others do not (Carvalho and Muslemani, 2025).

Consequently, it is becoming clear that defining green steel is far from easy. Still, the journey towards defining it and reaching consensus continues, see *section 3.7.6*.

3.3.2 Examples of Existing Green Steel Definitions

Since there is no unanimous definition of green steel (Blanco Perez et al., 2025), different researchers and companies define it in their own way, see Table 1.

Table 1: Examples of green steel definitions (Stegra, 2026; Zaccaro, 2024)

Source	Definition
Advances in Green Steel Making Technology - A Review (Singh and Rout, 2018)	"green steel is a new steelmaking process that lowers greenhouse gas emission, cuts costs and improves the quality of steel."
Opportunities and challenges for decarbonizing steel production by creating markets for 'green steel' products (Muslemani et al., 2021)	"the term 'green steel' will hereinafter be used to refer to steel products manufactured using less GHG-intensive production processes, and not to refer to products with lesser amounts of physical carbon content."
The prospects for 'green steel' making in a netzero economy: A UK perspective (Griffin and Hammond, 2021)	"'green steel' often refers to steelmaking that results in lower air pollutant emissions (e.g., CO, SOx, NOx, or PM2), wastewater contaminants, hazardous wastes (including arsenic, lead, and zinc), and other solid wastes."
Green steel: Synergies between the Australian iron ore industry and the production of green hydrogen (Wang et al., 2023)	"green steel (i.e., steel produced using hydrogen from renewable sources as the reducing agent)."
Can the cars we buy drive green steel production? (Elkerbout, 2023)	"green steel will simply mean 'steel produced in a way that is compatible with climate neutrality in the long run, i.e. close to zero GHG emissions'. Likewise, decarbonised steel means close to zero GHG emissions embedded in the steel, not the carbon grade related to steel quality characteristics."
Green Steel (Stegra, 2026)	"Green steel is steel produced with green hydrogen and renewable electricity instead of fossil coal."
What is green steel and why does the world need more of it? (World Economic Forum, 2022)	"green steel is the manufacturing of steel without the use of fossil fuels."

In the identified definitions there is a common emphasis, or indirect emphasis, on GHG emissions and emission intensity. However, other elements like wastewater contaminants, hazardous wastes etc., occur but are less frequent.

Since there is no overarching consensus regarding the definition, there is room for companies to brand their products as green even if their evidence lacks substance (SSAB, 2026). Furthermore, since green steel is chemically identical to conventional steel, thorough process monitoring is essential to verify credibility and ensure fair conditions on the green steel market (Zaccaro, 2024). Consequently, the unclear definition opens the gate for greenwashing and claims in that area have been apparent (Blanco Perez et al., 2025). Ultimately, the lack of a clear definition deteriorates market transparency and makes it difficult for investors to make informed decisions regarding green steel (Blanco Perez et al., 2025). To address these challenges, it is crucial to establish standardised definitions and robust certification procedures, as well as verification and reporting for green steel (Zaccaro, 2024).

3.3.3 Current Voluntary Standards

There are a number of voluntary green steel standards, with the aim to add substance to the term. In this segment a few will be presented to get an understanding of how standards could work to classify the ‘greenness’ of steel.

ResponsibleSteel’s "International Production Standard"

The non-profit organisation ResponsibleSteel first launched its "International Production Standard" in 2022, aiming to promote responsible sourcing, production and recycling of steel (Blanco Perez et al., 2025; Carvalho and Muslemani, 2025). It works around 13 principles which cover GHG emissions reduction, responsible sourcing of raw materials, human rights protections, to name a few (Blanco Perez et al., 2025). To be certified by ResponsibleSteel, companies must check all boxes regarding the 13 principles (Carvalho and Muslemani, 2025). There are two types of ResponsibleSteel certifications. The first one ensures extensive management of ESG sustainability risks and is called "Core Site Certification", and the second one, "Steel Certification", requires companies to showcase progress in decarbonisation and responsible sourcing (Blanco Perez et al., 2025).

To be able to market or sell products with the Steel Certification, the products must have a Product Carbon Footprint (PCF) or Environmental Product Declaration (EPD) that clearly states the Global Warming Potential (GWP) using the cradle-to-gate methodology. Additionally, the standard requires that all GHG emissions, including all scopes, are accounted for, such as carbon dioxide, nitrous oxide, methane etc. (Blanco Perez et al., 2025)

ResponsibleSteel uses the sliding scale approach – inspired by IEA – when defining environmental performance levels, see Figure 3. The performance levels are divided into four categories where the least ambitious, progress level 1, starts at 2.8 tCO2e per tonne crude steel produced when the scrap share is set to 0%. Thereafter the threshold tightens, and the most ambitious level starts at 0.4 tCO2e per tonne crude steel produced when the share of scrap is 0%. In level 4, the scale declines to 0.05 tCO2e per tonne crude steel when 100% scrap is used which is in line with IEA’s net-zero emission production (Blanco Perez et al., 2025).

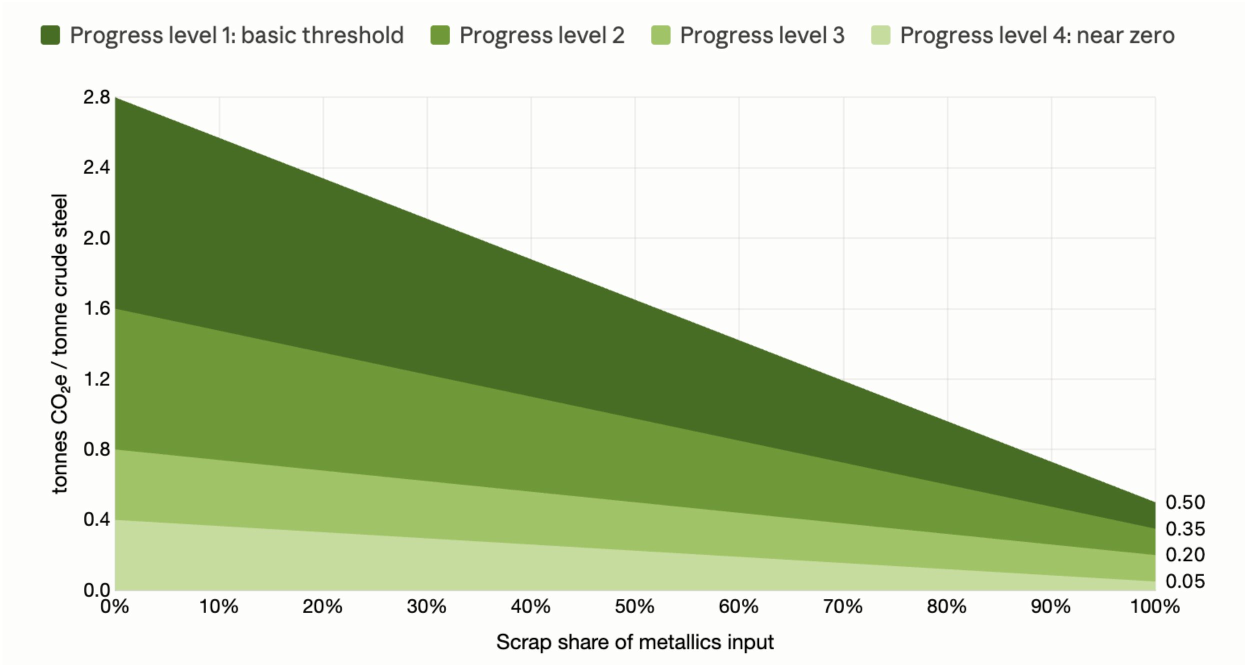

Figure 3: Environmental Performance Levels defined by ResponsibleSteel (Blanco Perez et al., 2025).

Global Steel Climate Council's "Steel Climate Standard"

The Global Steel Climate Council created the Steel Climate Standard in 2023 with the intention to guide the decarbonisation of the steel industry (Blanco Perez et al., 2025; Carvalho and Muslemani, 2025). The standard defines a product-specific emissions intensity direction, distinguishing long and flat products, anchored in IEA's net-zero emissions by 2050 scenario. The directions are illustrated in Figure 4 where the intensities decrease in a 'glidepath' (Blanco Perez et al., 2025). The fact that the standard recognises that long and flat products cannot be produced with the same carbon intensities is unique compared to other standards (Carvalho and Muslemani, 2025). If companies seek to be certified they need to create a customised decarbonisation trajectory, based on its baseline year emissions and the standard's glidepath. Then, the trajectory must showcase a minimum linear reduction in GHG emissions for certain products, aiming to qualify as low-carbon steel (Blanco Perez et al., 2025). Additionally, to be a member of the GSCC, companies must set science-based emissions targets, which opens up the option of applying for the standard (Carvalho and Muslemani, 2025).

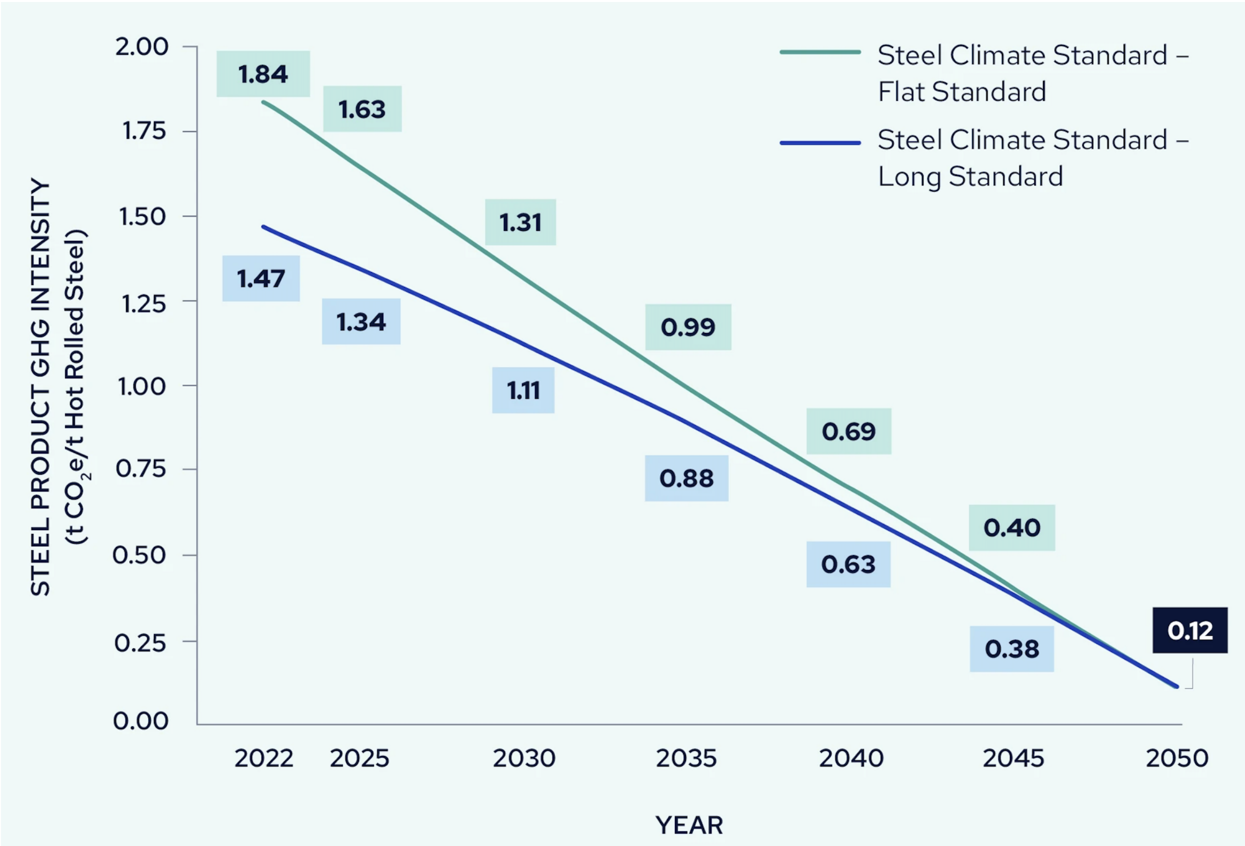

Figure 4: Flat and long steel product intensities according to the Steel Climate Standard (Global Steel Climate Council, 2024).

As seen in Figure 4, to receive a certification by GSCC for hot rolled steel in 2030 flat steel producers must demonstrate an average carbon intensity of 1.31 tCO2e/t produced, and long steel producers 1.11 tCO2/t (Global Steel Climate Council, 2024). When a company's product meets the standard, it is certified for three years, but the annual carbon intensity must be calculated and reported to the GSCC (Blanco Perez et al., 2025).

Low Emissions Steel Standard - LESS

The LESS standard was established in 2024 by the German Steel Association (Carvalho and Muslemani, 2025). It is managed by a Brussels-based entity – called LESS Association Internationale Sans But Lucratif (AISBL) – to oversee the implementation and governance of the standard (Blanco Perez et al., 2025; Carvalho and Muslemani, 2025). The standard focuses exclusively on GHG emissions intensity connected to steel products, and no other sustainability aspects (Carvalho and Muslemani, 2025). The standard labels steel products to a certain class, given their emission intensity and scrap share, based on PCF or GWP from EPDs, verified by an independent auditor (Carvalho and Muslemani, 2025). LESS uses the sliding scale and cradle-to-gate approach like ResponsibleSteel, but also includes steel refining, casting and hot rolling of steel products, as well as scope 3 emissions, e.g. emissions related to alloying agents (Blanco Perez et al., 2025; Carvalho and

Muslemani, 2025).

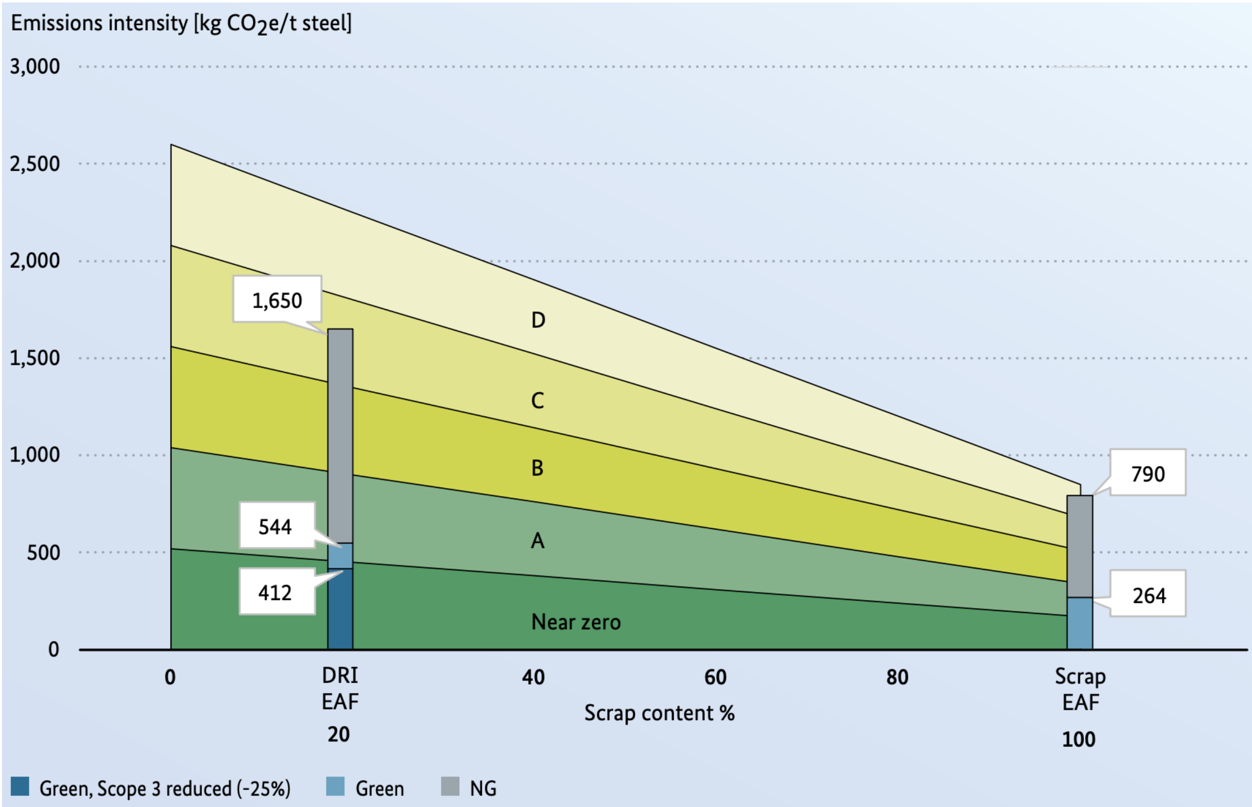

Figure 5: Threshold values for climate-friendly quality steel. Also, the different LESS classifications are shown (Federal Ministry for Economic Affairs and Climate Action (BMWK), 2024).

As seen in Figure 5 there are six classifications, including E which represents the area over D in the graph. The standard distinguishes between quality steel and structural & reinforcing steel, showing different thresholds for the two variants (Blanco Perez et al., 2025). Quality steel, shown in Figure 5, uses more alloying agents and therefore accounts for more upstream emissions than structural & reinforcing steel (Federal Ministry for Economic Affairs and Climate Action (BMWK), 2024), thus being more relevant in the automotive setting. Interestingly, it is seen in Figure 5 that, with a scrap share of 20%, the DRI-EAF with green hydrogen must also reduce upstream scope 3 emissions to reach the near zero classification. For steel produced with 100% scrap the threshold tightens even further, and merely using green electricity in the EAF is not enough. The reason for this is that the standard distinguishes between different production methods and acknowledges that scrap is a finite resource and that the usability varies, depending on the desired quality of the steel product (Federal Ministry for Economic Affairs and Climate Action (BMWK), 2024).

3.4 Green Steel Price Parity

Green steel price parity is reached when conventionally produced steel is equal in price to green steel, and there are many different factors that play a role in reaching parity.

3.4.1 The Green Premium

The green premium is the term that describes the difference in cost between a product that emits carbon and a product that does not (Gates, 2020). In the context of steel, it means the difference in cost between the conventional way of producing it and the progressive way of producing it, leading to lower GHG emissions. What is interesting about the green premium in reality is that it also includes a markup, set by the steel producer, on the basis that it creates additional value to the customer in terms of sustainability. Consequently, one part of the premium is motivated through increased costs, and one part is motivated through the green markup.

3.4.2 Levelised Cost of Steel

The levelised cost of steel (LCOS), stemming from the more general levelised cost of product (LCOP), calculates the fixed nominal unit price (or cost of a tonne crude steel) (Hasanbeigi et al., 2024; ICF and Fraunhofer, 2020). The method can be used to compare different steelmaking pathways in terms of cost and includes different cost elements (e.g. CAPEX, raw materials, labour, energy, fuel/hydrogen) (Hasanbeigi et al., 2024).

In Figure 6 it is seen that cheap green hydrogen plays a big role in whether green steel, such as H2-DRI-EAF, can compete with BF-BOF and NG-DRI-EAF regarding costs. However, in Europe the hydrogen price is still very high, with an average production cost of €7.4/kg (European Hydrogen Observatory, 2024). With an even higher sales price it shows that, in terms of hydrogen costs, the H2-DRI-EAF is far from parity with conventional methods. This – again – emphasises the importance of policy to lower hydrogen production costs in the region (Hasanbeigi et al., 2024). Furthermore, Figure 6 does not take carbon pricing (EU ETS) into account which will in practice increase the costs for BF-BOF and NG-DRI-EAF, and on imported steel from outside the EU the CBAM cost will have the same effect as the EU ETS.

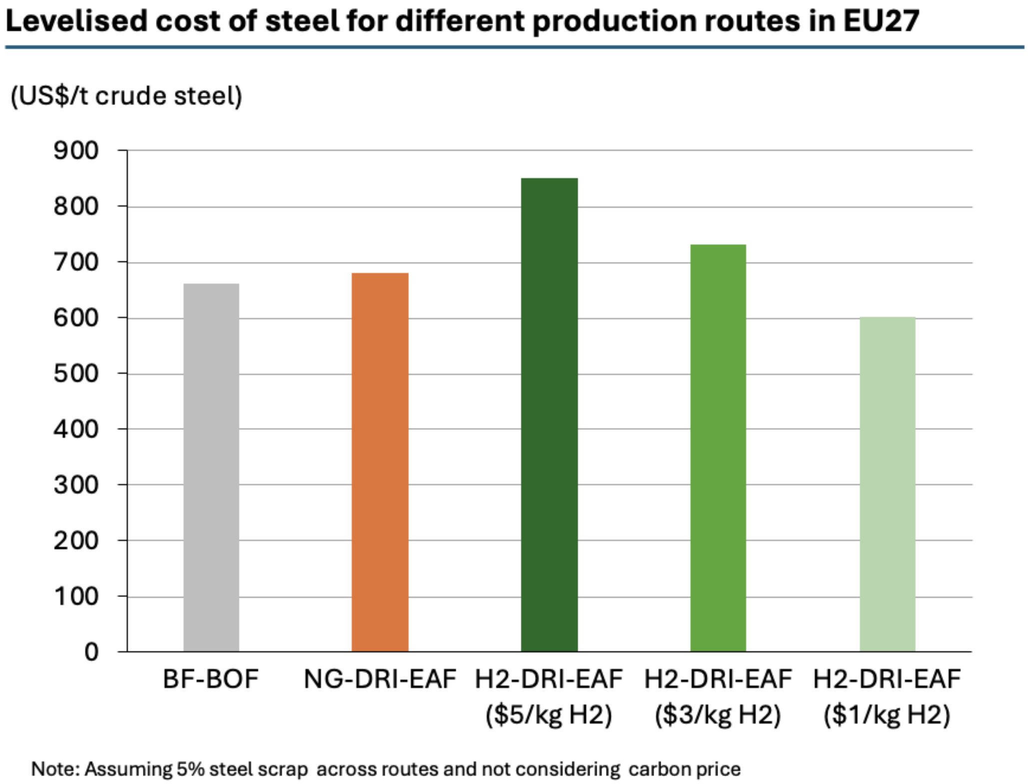

Figure 6: Levelised Cost of Steel for BF-BOF, NG-DRI-EAF and green H2-DRI-EAF in the EU, assuming 5 % steel scrap and no carbon price (Hasanbeigi et al., 2024).

When adding the carbon price to the equation, as seen in Figure 7, the parities between the conventional methods and the H2-DRI-EAF also change. For example, a carbon price at $50 shifts the parity to the right, making it possible to motivate a higher levelised cost of hydrogen (LCOH) for the H2-DRI-EAF path and still be competitive with conventional methods.

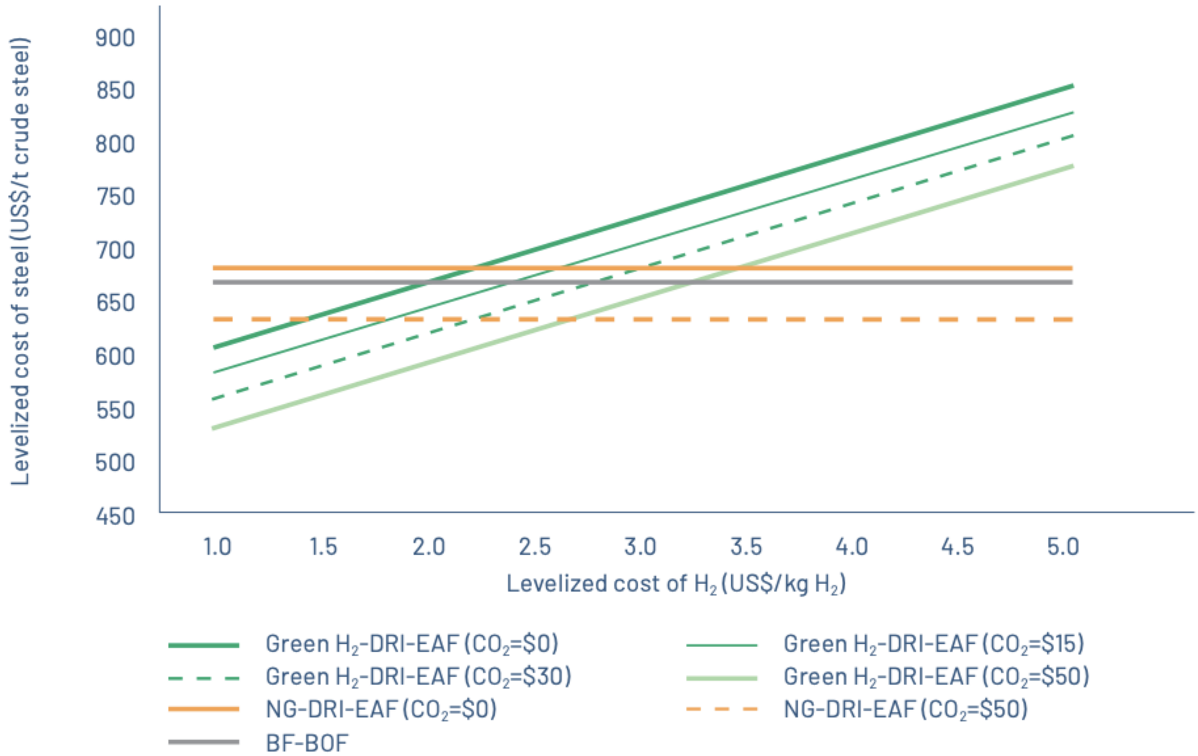

Figure 7: LCOS in EU with varied levelised cost of hydrogen and different carbon prices (Hasanbeigi et al., 2024).

Knowing that the carbon price is well over $50 (with a forecasted value of €126 – around $147 – in 2030) shows that parity can be achieved at a higher hydrogen price. With a carbon price of $75 the cost parity is achieved at a hydrogen price of $4/kg (Hasanbeigi et al., 2024). Thus, a mix of policy that advocates for improved hydrogen infrastructure support (including lower green electricity prices in Europe) and mechanisms that are already in place (e.g. EU ETS) will eradicate the green premium, at least the cost part, ensuring 'green' parity and paving the way for a greener steel industry.

The EU is doing a lot on the hydrogen area already (e.g. leveraging instruments like the Innovation Fund and the European H2 Bank to support large H2 projects). In 2024 the European H2 Bank auction awarded €720 million for projects in Finland, Portugal and Norway (Hasanbeigi et al., 2024). At the end of 2024 the second auction opened, offering a total budget of €1.2 billion (European Commission, n.d.e). However, only six out of the initial 18 projects were selected, leading to the European H2 Bank delivering €270 million instead of the €1.2 billion allocated. In essence, the amount of delivered funds decreased from the first to the second auction.

Interestingly, the second auction received 61 bids from the beginning, requesting €4.8 billion altogether, which indicates that the need for funding within the area is large but stringent criteria and regulatory uncertainty lead to unused funds, in this case €930 million (Fuel Cells Works, 2026a). The third auction opened in December

2025 with a total budget of €1.3 billion (European Climate, Infrastructure and Environment Executive Agency (CINEA), 2025). From the EU's side the regulatory barriers might need to be reconsidered, since the union's ambition within the area is clearly not the problem.

3.5 Power Dynamic and Mapping of Sales Flows in the European Automotive Sector

To understand where the demand for green steel arises in the automotive industry, it is important to map the flows from seller to buyer of steel in general. In this specific B2B context, as seen in Figure 8, all steel produced does not go directly to the OEM (based on sales data from a large steel producer in Europe). In this example, roughly 10% goes directly to the OEM while the rest takes another route via a Steel Service Center (SSC) and/or a Tier. Moreover, roughly 65% of the steel goes directly to tiers and roughly 25% goes directly to SSCs. It is assumed that the distribution of sales in Europe for other steel producers look similar as the percentages shown in Figure 8.

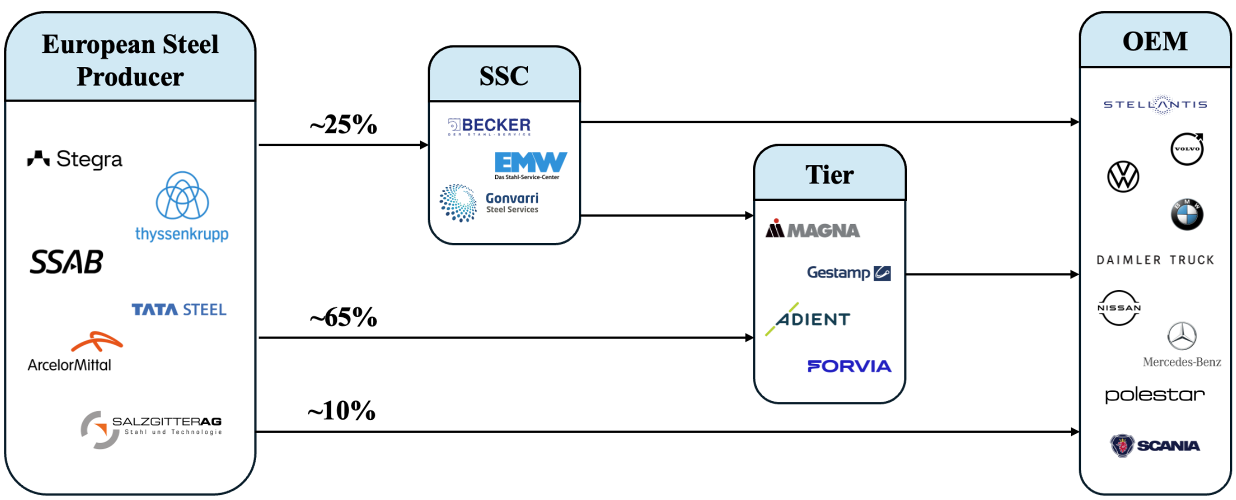

Figure 8: Distribution of sales in Europe to OEMs, Tiers and SSCs from European Steel Producer where the approximate percentages are taken from sales data from one large European steel producer. For visualisation, examples of firms at each stage are presented.

Furthermore, Figure 8 shows that nearly all steel finally ends up at the OEM which positions the OEM in a place of power. This means that the OEM sets the purchase specification for the entire chain, and in essence chooses suppliers (tiers and SSCs) that live up to it. Consequently, the functional specification from the OEM could be stated as "the component should only contain steel produced with < 0.05 kg CO2e/kg steel in Scope 1 and 2 of the GHG protocol", which automatically excludes tiers and SSCs that do not meet the OEM's requirements in the pre-qualification and supplier selection phases (van Weele and Rozemeijer, 2022). Indirectly, the OEM forces tiers and SSCs to buy steel that live up to the OEM's standard.

OEMs directly sign letters of intent (LOI) with steel producers to buy certain amounts of steel, e.g. Mercedes signed a LOI with Salzgitter AG in 2023 agreeing to source raw steel produced with green electricity (Salzgitter AG, 2023). Tiers and SSCs face a difficult situation when negotiating with steel producers on one side and OEMs on the other, usually ending up with paying higher prices upstream and receiving lower prices downstream (Koehl, 2025). Naturally, there is a ‘French fries principle’ in which price increases are passed on to the next part of the chain (van Weele and Rozemeijer, 2022), but the power of the OEM prevents the principle from proceeding to the next level. Due to this, it is becoming more and more common with pooling-by-retail where the OEM negotiates a price for all parts in the chain (Koehl, 2025). In France pooling-by-retail stands for 90% of all negotiations in automotive, while in Germany it is less than 50% (Koehl, 2025). In Sweden the concept of pooling-by-retail, also known as directed buy, is rare within the automotive sector but it is gaining momentum (Lindberg, 2026). Through this, all parts in the chain can rely on the OEM’s LOIs and purchasing department to secure its steel at a fair price, utilising economies of scale.

Ultimately, this shows that the decision power is concentrated at the OEM to transform to green steel in the chain. However, the question is still; where will the green premium be absorbed?

3.6 Demand Signals for Green Steel in Automotive

To make investments in green steel possible, there has to be a demand from the market. Major steel buyers, such as the automotive industry, have to send demand signals to steel manufacturers and financiers to mitigate the risk of their investments and for them to secure financing. According to Energy Transitions Commission and Material Economics (2021) there are three possible models of demand signals for green steel: direct offtake, future purchase commitments, and indirect demand signals. They are complementary and buyers of steel can engage in a combination of them. The first two are most relevant for OEMs because they directly shape procurement, while the third operates through aggregated downstream pressure. Figure 9 maps the commitments of major European OEMs across these categories.

OEM	Direct offtake	Future purchase commitment	Steel specific/comments	Net-Zero
Ford	MoUs with Tata Steel, Salzgitter, Thyssenkrupp, unspecified volumes and time plan (Oct 2022)	Member of FMC, committing to >10% near-zero steel procurement volumes by 2030	States green steel important to meet 2035 ambitions	Carbon neutrality globally by 2050 covering operations and value chain; reports approved 2035 SBTi targets (Scope 1-2: -76% by 2035 vs 2017)
Mercedes-Benz	Equity owner in Stegra and agreement of 50k tonnes per year; Purchasing H2-DRI-EAF steel from SSAB; LOI agreement for CO2 reduced with Salzgitter	Member of ResponsibleSteel; Intent to purchase >200k tonnes of CO2-reduced steel from European suppliers annually by 2030	Explicit low-CO2 steel sourcing ambition by 2030; Closed-loop recycling active with Stegra	Carbon neutral across value chain by 2039 (Scope 1-3)
BMW	Agreement with Salzgitter from low-CO2 steel from 2026; Stegra from 2026; Equity in Boston Metal; Added HBIS (China) for green steel from 2023/2026	Aims to meet >40% of European plant steel demand with low-CO2 steel by 2030	50% recycled content by 2030; ~50% of US/Mexico flat steel requirements now supplied via Scrap-EAF	Climate neutral across value chain by 2050; interim Scope 3 targets; SBTi aligned; New 2035 milestone: reduce 60 million tons CO2e vs 2019
VW	Salzgitter low-CO2 steel from late 2025; MoU with ThyssenKrupp start in 2028; MoU with Vulcan Green Steel, Oman up to 300k tonnes annually (NG-DRI-EAF) for EU plants from 2027	Weak/implicit through supply chain decarbonisation programs; Stake in Stegra via Scania	No quantified low-CO2 primary steel target. Focus on recycled content and supplier decarbonisation. Green steel targeted for Trinity model (2026)	Net-zero by 2050 (earlier neutrality ambition for EU production). Scope 1-3 covered; Global production sites target neutrality by 2040
STELLANTIS	No major publicly announced primary green steel offtake	Weak - primarily supplier engagement framework; 40% reduction target for CO2-eq of BEV purchased parts by 2030	No quantified green steel procurement target; Business reset announced Feb 2026 addressing transition pace	Net-zero carbon by 2038 (Scope 1-3)
RENAULT	Agreement with ArcelorMittal for low-carbon steel (EAF-based); Usibor 1500 XCarb in serial production (Sept 2025) for R5, A290, and R4 models	Using scrap-EAF in production, moderate engagement with suppliers for primary, but limited quantified commitment	Recycled content ambition; limited explicit primary green steel target; Target 33% recycled content by 2030	Carbon neutrality in Europe by 2040; globally 2050. Scope 1-3 covered
VOLVO Cars	Supply agreement for SSAB Zero used in components for EX60 (Scrap-EAF); deliveries began 2025	SteelZero member; Implicit through public commitment to scale near-zero steel in future models	Explicit commitment to source near-zero steel; 100% renewable steel for all models launched in 2030 or later	Climate neutral by 2040 (Scope 1-3). SBTi validated. Interim target to reduce lifecycle emissions per car
VOLVO Group	Collaboration with HYBRIT, received pilot batches; Long-term agreement with Stegra from 2026	Founding member of FMC, committing to >10% near-zero steel procurement volumes by 2030	Use of Scrap-EAF steel in commercial vehicles; pilot trucks delivered with HYBRIT steel	Net-zero value chain emissions by 2040 (Scope 1-3)
SCANIA	Contract with Stegra for delivery from 2027; agreement with SSAB to 100% decarbonise steel deliveries by 2030 with (H2-DRI-EAF) from 2026	Founding member of FMC; Explicit 2030 supply-chain target of 100% green steel; Made mandatory purchasing requirement for European production since Sept 2023	Public ambition for 100% fossil-free steel by 2030 (in own operations and vehicles)	Net-zero across value chain by 2040 (SBTi aligned)
Polestar	Letter of intent with SSAB (2022) to explore fossil-free steel for the Polestar 0 project. No binding volume agreement publicly announced.	SteelZero member	No quantified green steel procurement target. Aluminium prioritised before steel as near-term abatement	Climate-neutral car by 2035 (Polestar 0 project, revised from 2030). Net-zero per car sold by 2040 (Scope 1-3)

Figure 9: European OEM targets and demand signals (ArcelorMittal, 2026; Automotive Manufacturing Solutions, 2025; BMW Group, 2022a, 2025; Ford Motor Company, 2022; Mercedes-Benz Group, 2023; Scania, 2023b; Stegra, 2023; Stellantis, 2026; Volkswagen Group, 2024; Volvo Group, 2023).

3.6.1 Direct Demand Signals in Automotive

Direct demand signals can take the form of bilateral offtake agreements which means that two parties enter an agreement to purchase green steel several years in advance. These types of agreements are often used in the energy sector, for example when actors place orders on renewable energy supply several years before a project becomes operational. This gives financial stability to the supplying company and acts as a safety when they finance their projects e.g. from banks. For steel, these direct demand signals are most clear and actionable when they come from companies that directly procure large amounts of steel, such as automotive OEMs (Energy Transitions Commission and Material Economics, 2021). Direct demand signals can also take the form of a joint venture (co-investment) between a steel manufacturer and a steel buyer. This represents the highest risk initially but the steel buyer has a greater possibility to shape the market and larger upside potential when making an early move into low-carbon steel (Energy Transitions Commission and Material Economics, 2021). The report further states that for green steel, the procuring company would have to define green steel as a strategic priority at the executive level to drive these changes in procurement from regular steel due to green steel having a premium over regular steel. Generic CO2 reduction criteria could be insufficient as there are other alternatives to achieve these emission reductions with a lower short-term cost. Hence, a specific strategic commitment at the executive level is needed to incentivise the procurement of low-CO2 steel (Energy Transitions Commission and Material Economics, 2021).

Many automakers and steel producers have signed a so-called Memorandum of Understanding (MoU), a formal non-binding agreement that outlines the intentions and mutual understanding between parties and often serves as a preliminary step towards a binding contract. Some have signed binding offtake agreements but the quantity of steel and the timeline of delivery is still uncertain due to many projects being delayed. Therefore, the nature of these 'binding' contracts is complex; however, they show that there is demand for green steel from the European automotive industry. The type of steel in these contracts also varies. The contracts for primary steel are mostly for H2-DRI-EAF and some for NG-DRI-EAF with ambition to transition to hydrogen at a later stage, which is arguably the more feasible solution for many steel producers, e.g. in Germany. Regarding secondary steel there are some contracts for scrap-EAF. SSAB and Volvo have an agreement to deliver SSAB Zero (which is produced with <0.05 kg CO2 / kg steel for Scope 1-2) for use in the new Volvo EX60. Additionally, this helps Volvo towards their goal of having 30% recycled content across their fleet and use 35% scrap based in production by 2030 (Volvo Cars, 2025). BMW also has a similar goal of using 50% steel scrap by 2030 (BMW Group, 2022b). In this way, the driving factor for using secondary steel from scrap-EAF is that the technology is already widely deployed and if produced using renewable energy, a customer can increase its share of recycled content while using low-carbon steel in its vehicle production. Beyond contractual agreements, several OEMs have taken equity positions in green steel producers, including Mercedes-Benz and Scania, both investors in Stegra, which represents a stronger demand signal than offtake agreements alone (Scania, 2023a; Stegra, 2023).

3.6.2 Future Purchase Commitments in Automotive

The second type of demand signal, a future purchase commitment, is not directed to any specific supplier but instead conveys a willingness to procure low-carbon steel to the market as a whole. This allows an OEM to signal anticipated demand while retaining the flexibility to evaluate suppliers, technical specifications, and pricing before entering binding offtake agreements. However, for such commitments to function as credible demand signals, they must be made public and, ideally, aggregated across multiple buyers. Initiatives such as SteelZero, led by the Climate Group in partnership with ResponsibleSteel, aim to coordinate and aggregate corporate commitments by requiring members to transition to 100% net-zero steel by 2050, with 50% of steel used in production being low-carbon steel by 2030. By consolidating dispersed demand and aligning it around common definitions of low-carbon steel, such initiatives aim to strengthen the investment case for breakthrough production capacity (Energy Transitions Commission and Material Economics, 2021; The Climate Group, n.d.).

Volvo Cars was the first automotive OEM to join SteelZero and was later joined by Polestar (The Climate Group, n.d.). Scania, Volvo and Ford are members of First Movers Coalition (FMC) and therefore committed to source low-CO2 steel for at least 10% of their annual production by 2030 (World Economic Forum, 2026). Further, some OEMs have made their own individual commitments. BMW says that it will meet more than 40% of its steel need for European plants with low-CO2 steel by 2030 (BMW Group, 2022b). Scania has said that it will buy 100% green steel by 2030, although it is not fully clear what emission intensity of steel this translates to (Scania, 2023b). Both initiatives and individual future purchase commitments create demand signals for steel. Although the lack of a unified definition of green steel makes it hard to understand the real demand for primary and secondary steel types, it shows a general ambition of OEMs to decarbonise their material sourcing.

3.6.3 Indirect Signals in Automotive

The last and weakest type of demand signal can emerge from actors beyond the OEM itself, by a much broader pool of public and private companies that buy steel-made components from intermediaries. Although these signals do not provide the certainty of an offtake to a specific steel producer, they can help grow the future market for low-carbon steel more rapidly than direct offtake agreements themselves. If significant aggregated volumes can be demonstrated, they could give developers of low-carbon steel and their financiers greater confidence in the scale of future demand and thereby support investment decisions (Energy Transitions Commission and Material Economics, 2021). In the automotive context, indirect signals may originate from vehicle buyers, public procurement authorities, or large corporates with SBTi targets that include supply chain emissions.

SBTi serves as a means to create a clear path, in line with climate science, for organisations to achieve reduction in GHG emissions (Science Based Targets initiative, n.d.b). It creates trust between the company, its shareholders, investors and customers which signals that combatting GHG emissions is on the agenda. From Q4 2025 to Q1 2026 the SBTi Automotive Sector Net-Zero Standard is piloted, creating a new framework to set science-based targets for car and car parts producers (Science Based Targets initiative, n.d.a). The new framework forces automakers to look beyond tailpipe emissions, assessing scope 1, 2 and 3 emissions across their supply chain. It involves an 'aggregated indicator' which combines scope 1, 2 and 3 emissions (Science Based Targets initiative, n.d.a), preventing companies to be 'green' in one scope at the expense of another. Additionally, the standard presents criteria for auto parts manufacturers to focus on reducing GHG emissions from material sourcing (Science Based Targets initiative, 2025), e.g. steel. In essence, the SBTi and the new standard proposal offer a holistic way of reducing GHG emissions for automotive companies, favouring the adoption of low-carbon materials such as green steel.

Many automotive OEMs have adopted Scope 3 upstream emission reduction targets through SBTi, which cover emissions embedded in purchased materials. Although these targets rarely specify individual inputs, they create pressure to reduce the carbon intensity of key materials. As steel accounts for approximately 16–30% of the embedded emissions in vehicle production, such targets can indirectly generate demand for low-carbon steel. When adopted across multiple OEMs, these targets can aggregate into a meaningful market signal for green steel. By integrating embodied carbon criteria into vehicle procurement or ESG reporting frameworks, these actors increase pressure on OEMs to reduce upstream material emissions, including those from steel. While these commitments are non-binding at the steel level, they can expand the addressable market for low-carbon vehicles and create reputational and competitive incentives for OEMs to secure greener material supply.

Indirect signals can also originate downstream in the value chain. Large corporate fleet buyers increasingly include emissions criteria in procurement to reduce their own Scope 3 emissions or meet internal climate commitments. Fleet customers make up around 60% of new car sales in Europe year 2024, and 25% of new car registrations in Europe are registered to companies with more than 100 vehicles. Large fleets are therefore an important market for automotive companies as seen in Figure 10 with the premium OEM brands having the highest corporate sales share (Transport & Environment, 2025). Companies with large fleets are also often the ones that have to report Scope 3 emissions under CSRD *(see section 3.7.3)* which means that the emissions for the vehicles they buy for their fleets matter. Although the focus currently is on electrification and reducing tailpipe emissions, these ambitions could later incentivise automakers to lower the embedded steel emissions of vehicles. Public procurement can reinforce this mechanism. The proposed Industrial Accelerator Act (IAA) aims to create lead markets for clean industrial products by introducing climate criteria in public procurement. One proposed measure requires that at least 25% of steel used in public procurement meet low-emission thresholds, which could indirectly stimulate future demand for green steel in automotive supply chains (Vela, 2026).

The report further argues that the effectiveness of future purchase commitments and indirect demand signals

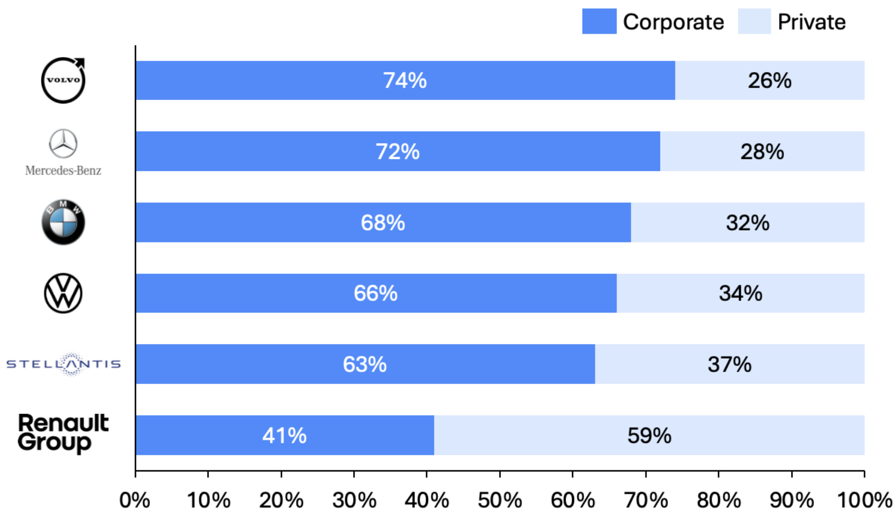

Figure 10: Corporate and private sales share by OEM in year 2025 (Transport & Environment, 2025).

depends on coordination and transparency. When several commitments are aggregated through industry initiatives such as SteelZero or public procurement frameworks, they can approximate the scale effect of direct purchasing commitments. At the same time, standardised definitions of low-carbon steel and credible lifecycle accounting are necessary to translate downstream climate ambitions into actionable requirements for steel makers. Without such alignment, indirect signals are symbolic rather than catalytic. These initiatives can also align shareholders on a joint definition of low-carbon or green steel which would establish clear goals for technology development of steel makers (Energy Transitions Commission and Material Economics, 2021).

In conclusion, many OEMs have signed contractual agreements with steel producers for the delivery of both primary and secondary green steel. Especially for H2-DRI-EAF steel it is still unclear when these proposed volumes will be delivered due to many projects being delayed and postponed (as mentioned in *section 3.8*). The offtake agreements in addition to the equity investments of some automakers in innovative low-carbon steelmaking technologies send strong demand signals for green steel. Further, the future purchase commitments through individual OEMs or initiatives can be aggregated to show future demand and commitment from the automotive industry to decarbonise although it is unclear how these ambitions will materialise due to the current projection of supply, non-existence of an EU green steel label, and mandatory sourcing requirements from the EU.

3.7 The Regulatory Context

In the context of steel within the automotive sector, there are a number of policy elements that affect the market transition towards greener alternatives. To understand this market transition, it is important to obtain a holistic view by understanding the main policy elements within the EU.

3.7.1 EU Emissions Trading System

EU ETS was established in 2005 with the aim to bring down GHG emissions in the EU while generating funds to finance the green transition. It relies on a cap and trade system where the cap sets the limit of GHG emissions that can be emitted under the scope of the system, where steel production is included in the scope of industrial manufacturing. The cap is expressed in allowances where one allowance accounts for the right to emit one tonne of CO2eq. The allowances can be traded, and annually the amount of allowances in the system decreases. Companies that are covered by the system must report their emissions, and hold enough allowances to meet their annual emissions. Otherwise, they will be subject to large fines (European Commission, n.d.a).

Within the EU ETS, free allowances are currently distributed to energy-intensive industries to maintain their global competitiveness, but they are decreasing each year (European Commission, n.d.a). Companies that emit less GHG emissions can sell their allowances to companies that are in need of them. The price of allowances is set by the EU carbon market based on the supply and demand principle, operating within robust oversight rules (European Commission, n.d.a), and therefore it varies, which is seen in Figure 11. Since the allowances are gradually decreasing the supply is as well (European Commission, n.d.a), leading to a price increase over time, which in turn affects the price of steel from conventional production methods for OEMs. The market functions in an orderly manner compared to other financial markets and the most common traders are energy companies, industrial companies, covered by the system, but also banks on behalf of smaller companies and emitters (European Commission, n.d.d).

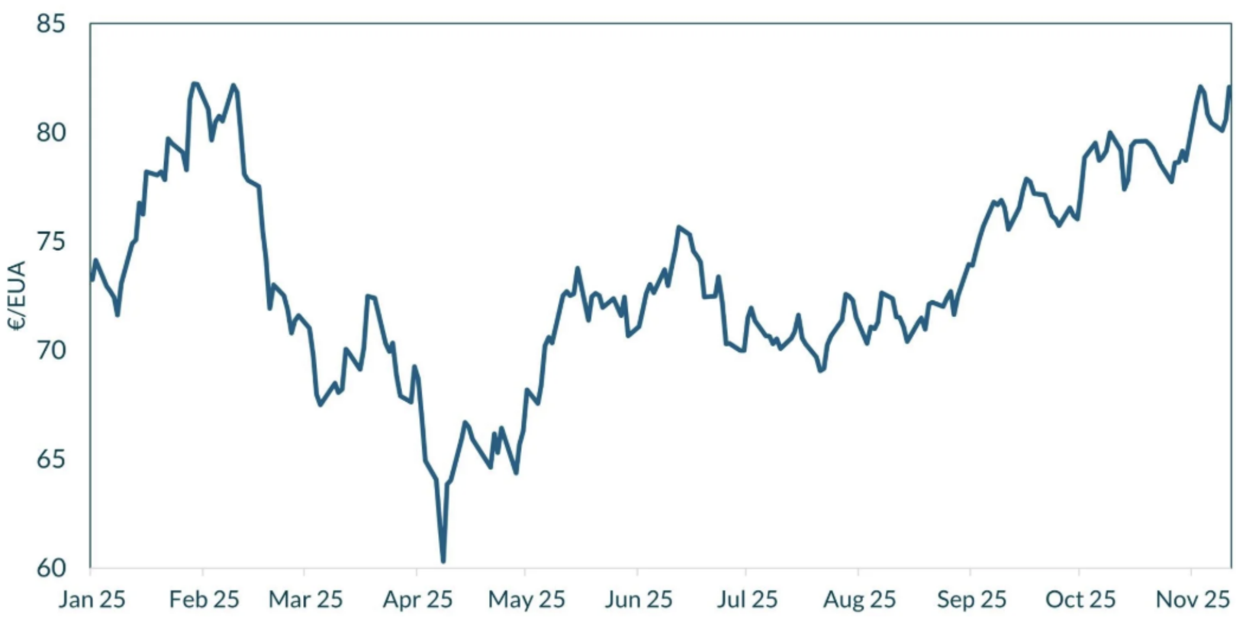

Figure 11: Prices of EU Allowances (EUA), Jan-Nov 2025 (Grey Epoch, 2025)

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In January 2026 the price exceeded €90/EUA, partly due to uncertainty and in response to the geopolitical situation of Trump's threat of tariffs to some EU countries and the UK (Yermolenko, 2026). Instantaneous uncertainties might bring up the price; however, forecasts predict that the average EUA price could reach €126/EUA in 2030 (Yermolenko, 2026), making it expensive for high-emitting companies like steel producers using BF-BOF.

3.7.2 Carbon Border Adjustment Mechanism

CBAM is an EU tool to set a fair price on carbon emitted in production outside of EU, that enters the EU, encouraging cleaner production outside the union and preventing carbon leakage (European Commission, n.d.b). Going live in January 2026, the mechanism forces importers to pay for carbon emissions, which was not the case before (Källström and Sayeenathan, 2026). Essentially, CBAM mirrors the effect that the EU ETS has for EU producers (Källström and Sayeenathan, 2026) onto imports of foreign goods, which levels the playing field between EU and non-EU firms. The mechanism is planned to be expanded downstream from January 2028, to approximately 180 steel and aluminium products, including finished goods like e.g. car doors (S&P Global Commodity Insights, 2026). This is an interesting loophole that, until the mechanism expands, high-emission steel can be used to produce finished goods (like the car door mentioned), outside the EU, that can later be imported, being exempt from the mechanism.

In EU ETS free allocations are being gradually reduced for CBAM-covered sectors like steel, and will be completely phased out by 2034 (International Carbon Action Partnership, n.d.), see illustration in Figure 12. Consequently, CBAM is gradually phased in, reaching full effect after 2034.

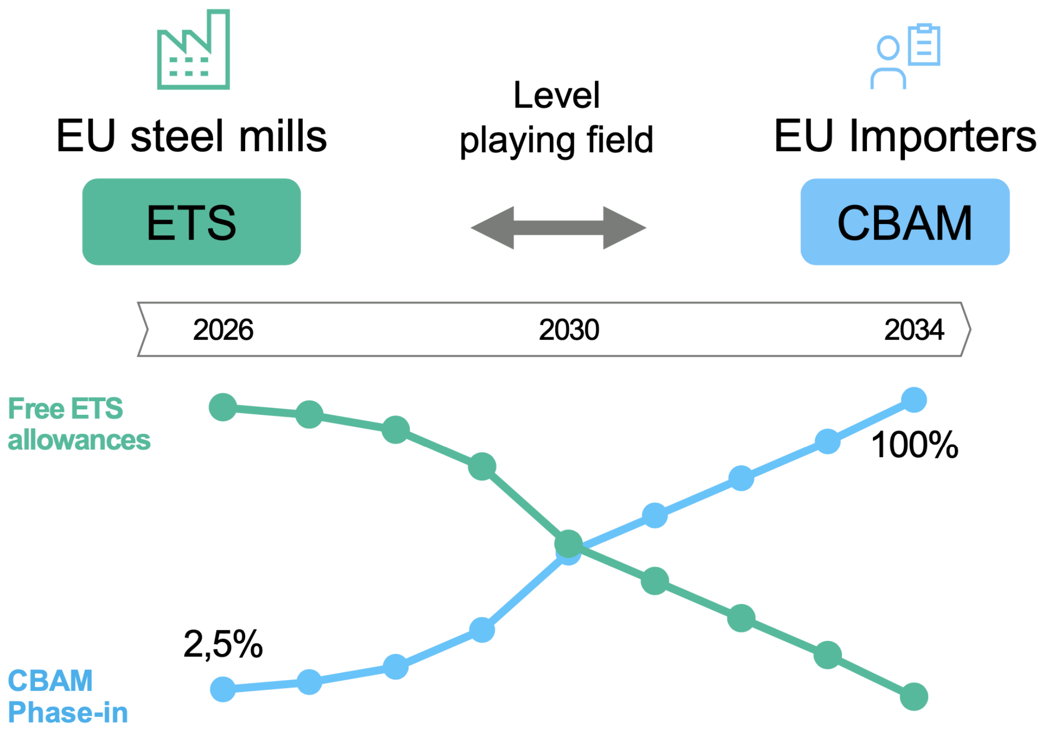

Figure 12: Phase-out of free allowances EU ETS and phase-in of CBAM (Källström and Sayeenathan, 2026).

CBAM prevents high emissions connected to imports; however, it raises short-term costs and risks pushing prices upward before low-carbon steel is affordable at scale. Ultimately, in the automotive sector it means higher input costs and increased sourcing complexity. (S&P Global Commodity Insights, 2026)

The CBAM cost is calculated as:

$$C_{CBAM} = ((E_e - B \times F_{CBAM}) \times P_{ETS}) - P_{origin} \tag{1}$$

Table 2: CBAM Cost Calculation Parameters (Källström and Sayeenathan, 2026)

Parameter	Symbol	Unit	Description
CBAM Cost	C_{CBAM}	€/t	Total cost of CBAM.
Embedded Emissions	E_e	tCO_2e/t	Embedded emissions to be verified by EU verifier. If no actual values are available, default values will be used.
CBAM Benchmark	B	tCO_2e/t	Standardised intensity value for the product. May change over time and is calculated assuming relevant precursor.
CBAM Factor	F_{CBAM}	%	Percentage phase-out of free ETS allowances.
EU ETS Price	P_{ETS}	€/t	Average quarterly carbon price in 2026 and average weekly carbon price from 2027.
Origin Carbon Price	P_{origin}	€/t	Deductible credit for prices paid abroad. Currently no ETS-systems accepted.

The elements of the CBAM cost, which is seen in equation 1, show how tight the CBAM is interlinked with EU ETS, where both the CBAM factor and EU ETS price affect the cost heavily. For embedded emissions, actual values are used merely if the supplier has provided verified emissions data, verified by a third-party verifier, otherwise, default values for each country are used (Källström and Sayeenathan, 2026). For benchmark values the actual values are based on production routes and precursors, while the default values differ depending on product and production route such as BF-BOF, DRI-EAF and scrap-EAF (Källström and Sayeenathan, 2026). The mechanism therefore pushes non-EU suppliers towards gathering data, being more transparent and lowering their emissions, using actual values to still be competitive in the European steel market. Furthermore, EAF is likely to be the production route where CBAM has the lowest impact (Källström and Sayeenathan, 2026).

3.7.3 Corporate Sustainability Reporting Directive

The first wave of reporting under CSRD started in 2024, for large companies, and thereafter it has been a continuous roll-out to smaller companies (Finansinspektionen, 2025). Thus, it applies to multiple OEMs within the EU. Through the directive, companies are forced to establish a sustainability report, anchored in the European Sustainability Reporting Standards (ESRS), disclosing sustainability information such as impacts, risks, targets, and ESG data (Dečman, 2025; European Parliament and Council of the European Union, 2022). This includes scope 3 emissions, where steel, as known, accounts for a significant share in the automotive sector, between 16-30% of a car's embodied CO2 emissions. However, the extent of CSRD is lightened by the Omnibus package, making companies with more than 1,000 employees and a net turnover greater than €450 million the only ones subject to the directive (Council of the European Union, 2025). For the remaining companies the reporting will be voluntary. Additionally, the Omnibus package reduces complexity and simplifies ESRS (European Commission, 2025c), making it easier for firms to report sustainability.

Since sustainability reporting has become mandatory for some firms through CSRD, transparency is enforced.

Consequently, companies cannot hide behind poor values, since what is branded by the company can also be verified in the sustainability report. Ultimately, if the sustainability ambition is serious and acted upon, brand value is increased.

While the focus has been on reducing GHG emissions, the focus might shift towards initiating innovations such as recycled content or use of low-carbon steel which will have a greater effect on perceived brand value when focus shifts away from GHG emissions. Disclosure of recycled content is becoming a mandatory requirement within CSRD, which will further drive the focus to scrap (Carvalho and Muslemani, 2025), increasing the demand for it.

3.7.4 Corporate Sustainability Due Diligence Directive

The CSDDD aims to create sustainable and responsible behaviour throughout companies and their entire supply chains. By, among other things, addressing the environmental impact of their actions within and outside of Europe, it signals the clear strategic direction the EU is moving towards regarding sustainability. (European Commission, n.d.c)

Moreover, companies with more than 5,000 employees and a net turnover greater than €1.5 billion are the only ones subject to the directive (Council of the European Union, 2025). These companies must showcase that their sustainability efforts are grounded in reality rather than just reporting. Even if the Omnibus package has postponed full compliance to mid-2029, CSDDD remains one of the cornerstones of the European Green Deal (Council of the European Union, 2025). It works alongside other EU regulation and directives, such as CSRD, to transform business practices all over the continent (KPMG International, 2024). For the automotive industry, this shift is particularly interesting, as the directive enforces actions regarding the environmental footprint where steel represents a significant share.

3.7.5 EU Taxonomy

The taxonomy defines criteria that determine if an investment is in line with the net-zero goal of 2050 (European Commission, 2025b). Under the CSRD large companies must report what percentage of their revenue, CAPEX and OPEX, that is aligned with the EU taxonomy (Deutscher Nachhaltigkeitskodex, 2025). When OEMs use green steel aligned with the EU taxonomy, they increase the Green Asset Ratio (GAR) of their lending banks and investors, thereby attracting ESG-mandated capital. In turn, this creates better financial terms, such as lower interest rates and flexible terms, while at the same time strengthening the OEM's sustainable branding towards end-consumers. Again, it helps OEMs to avoid being accused of greenwashing in their branding, supported by the EU taxonomy.

3.7.6 Industrial Accelerator Act

On 4 March 2026, the European Commission released a proposal – called Industrial Accelerator Act (IAA) – to increase demand for low-carbon products and European made products (e.g. low-carbon steel) in sectors that are strategically important to the EU economy (e.g. automotive) (European Commission, 2026a,c). The proposal is anchored in the Draghi report, and among other things it introduces low-carbon and made-in-EU criteria for public procurement regarding industrial products such as aluminium, cement, and net-zero technologies like solar, batteries, wind, nuclear and heat pumps. For steel the low-carbon criteria is covered solely and not the made-in-EU one (European Commission, 2026a). Low-carbon steel requirements are included for steel used in automotive, when subject to public procurement and other public intervention (European Commission, 2026c).

The Voluntary Label of Low-carbon Steel

One part of the proposal was to present a voluntary label of steel, thought to be based on the sliding scale approach. It did not appear, and instead it is stated that the upcoming act of steel products under the Ecodesign for Sustainable Products Regulation (ESPR) – expected in late 2026 – will set the elements needed for the labelling (European Commission, 2026b). It will take into account the varying characteristics of primary and secondary steel production, rewarding circularity, by thresholds decreasing with the increased share of recycled content (European Commission, 2026b). This move considers environmental impacts beyond GHG emissions which contributes to a more holistic view, however, Europe is desperate for clarity within the area and needs clarity now, not another delay (Vela, 2026).

Addressing Public Procurement and Public Support Schemes

The IAA sets a minimum 25% low-carbon requirement in public procurement and public support schemes (e.g. at least 25% of the steel in a car must be low-carbon to be eligible to the scheme), which might sound good, but knowing that approximately 45% of the EU steel production comes from EAF (that generates lower emissions) one can question whether the act will lead to change or merely formalisation of existing production patterns in general (Vela, 2026). Hence, the effect of this will be decided on how low-carbon is defined, regarding primary and secondary steel production. If defined progressively, public procurement criteria could have an effect on the use of green steel (e.g. in buses), to make them eligible in public procurement, thereby driving demand through large volumes. Without the "Made-in-EU" criteria it also means that the 25% quota can be achieved by steel produced from all around the globe. And again, the act does not specify what low-carbon means, making it difficult for firms to take action.

Is It Enough to Create Lead Markets?

One of the three main sub-problems the IAA were to address was the lack of lead markets for European low-carbon industrial products (e.g. low-carbon steel) (European Commission, 2026b). Even if thresholds were set, connected to GPP, a disproportionate cost exemption was introduced alongside them, meaning that if a low-carbon product exceeds the price of the cheapest alternative by more than 25% in public procurement or 30% in public support schemes, the emission requirements can be bypassed (European Commission, 2026b). In other words, as long as the green premium remains within these thresholds, GPP could be an effective mechanism for creating lead markets for low-carbon steel.

Facilitating Permitting Processes

Apart from stimulating demand directly, the act aims to facilitate permitting processes by streamlining and digitalising them for industrial projects (European Commission, 2026a). Regarding steel, this means that the IAA proposes a fully digital "one-stop-shop" (which is a centralised administrative unit) and sets a maximum 18-month timeline for permitting energy-intensive decarbonisation projects, such as transitioning to H2-DRI-EAF (European Commission, 2026a,c). To prevent administrative bottlenecks, it introduces the principle of tacit approval, where intermediate steps are automatically considered approved if authorities do not respond within the set time frame. Additionally, member states will designate Industrial Acceleration Areas, which are strategic manufacturing clusters that benefit from pre-cleared, area-wide environmental assessments and prioritised access to energy infrastructure. These measures are designed to provide the legal certainty and speed necessary to make major green steel investments viable and improve the resilience of European supply chains, thereby paving the way for increased supply.

3.7.7 Automotive Package Proposal

In December 2025, the EU Commission presented the Automotive Package with the goal to support the transition to clean mobility. Among other things, the proposal suggests that the tailpipe emissions reduction target of 100% after 2035 should be reduced to 90%, where the remaining 10% will be compensated through low-carbon steel made in the EU, or e-fuels and biofuels (European Commission, 2025a). Low-carbon steel can be used to compensate up to 7% (Transport & Environment, 2026).

The total potential of primary green steel in 2030 is 34 Mt which is sufficient to meet the demand of 26 Mt steel in the automotive sector in 2025, see illustration in Figure 13. In the scenario of reaching full compensation (7%) through low-carbon steel the automotive sector would need 13 Mt of low-carbon steel, which is also sufficient given the potential (Transport & Environment, 2026).

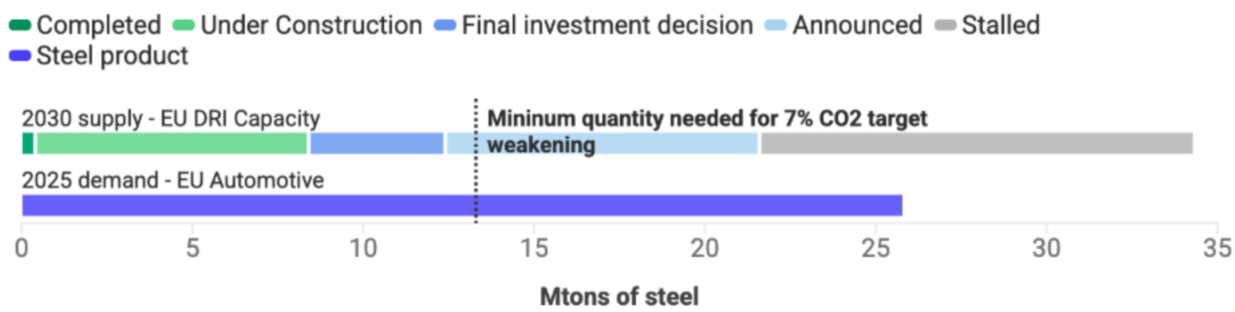

Figure 13: The steel demand in the automotive sector 2025 compared to the total potential of primary green steel in 2030 (Transport & Environment, 2026).

The additional cost of adding green steel to a car is estimated at €100 per vehicle in 2035. By paying the green premium, the OEM earns a green steel credit, estimated at €700. The €700 represents the total amount in EU CO2 non-compliance fines, currently set at €95 per g/km, that a carmaker avoids paying for each vehicle by using the low-carbon steel credit to lower their fleet-wide emissions average. Thus, the OEM saves €600 as a result of the compensation act. To this, it is important to note, that the credits for low-carbon steel do not represent further emissions savings since they are already covered in the ETS system for the steel producers. (Transport & Environment, 2026) It opens the door for OEMs to calculate emissions savings, from the ETS1 to their advantage, without making any additional climate progress. The regulatory reward of €700 to the OEM, could therefore be seen as a gift to pursue production of hybrids and combustion engine cars, which is counterproductive, to say the least, in the effort towards net-zero. However, it would undoubtedly increase the demand for green steel in the sector. Additionally, OEMs that have already completely transitioned to EVs by 2035 – thus having no tailpipe emissions – will not receive credits for using low-carbon steel, which questions the commission's commitment in supporting first movers in the stride towards net-zero.

Note that the current proposal lacks a precise technical definition for low-carbon steel, creating significant regulatory ambiguity regarding which production methods will qualify for emissions credits.

3.8 Why Have Green Steel Projects Been Stalled in Europe?

Several green steel projects have recently been stalled in Europe and there are multiple reasons why. ArcelorMittal announced in 2021 that their H2-DRI-EAF plant with 2.3 million tonnes per year capacity in Gijon, Spain, would be operational in 2025. However, due to lack of energy availability and slow development of hydrogen infrastructure, the project was stalled (GMK Center, 2026). This is not unique to ArcelorMittal. Thyssenkrupp, which is the largest steel producer in Germany, suspended a tender in March 2025 for 2.5 million tonnes of green hydrogen annually to its plant in Duisburg, simply because it was too expensive. In this context, producing green steel and making a profit do not go hand in hand (GMK Center, 2026). Furthermore, SSAB's new steel mill in Luleå is delayed by a year, to the end of 2029, since Svenska Kraftnät cannot complete reinforcements of the transmission grid in time to support sufficient electricity supply (SSAB, 2025). Consequently, lack of cheap electricity in Europe is partly the reason for the stall, and the differences between the countries are immense (GMK Center, 2026). One light in the dark is that the Swedish start-up Stegra recently received €1.4 billion in additional funding to complete the construction of Europe's first H2-DRI-EAF factory, in a time when several projects in Europe have been cancelled (Fondahn, Mannes and Ringstrom, 2026).

Naturally, the demand for green steel that exists needs supply that meets it, and currently that supply is not met due to energy infrastructure delays and high electricity prices. As a consequence, first-mover OEMs have become more careful not to run too far ahead of regulators and policy before they can be supported. While policy is guiding them to decarbonise, there is a huge lack of 'pull' mechanisms like Green Public Procurement (GPP) and financial incentives that can support first movers instead of exposing them to the green premium alone (Björsne and Cederlund, 2025; Zaccaro, 2024). There are four automotive companies that are a part of the first movers coalition (FMC) regarding steel, Volvo Group and Scania for HDVs, and Ford and GM for passenger cars (World Economic Forum, 2026). These firms are currently in a stage of strategic hesitation, waiting for market shifts and policy to support them in their way forward (Björsne and Cederlund, 2025).

Furthermore, the stall of green steel projects is visualised in Figure 14, where the announcements of new projects have been decreasing in recent years (with zero in 2025) (Fondahn, Carey and Mannes, 2026).

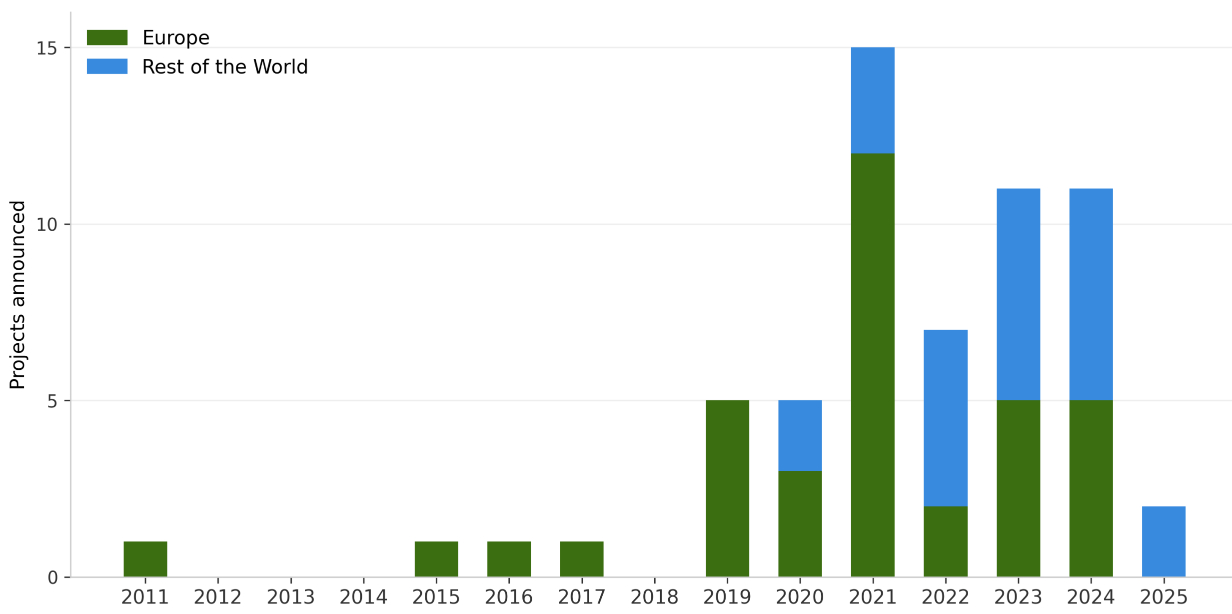

Figure 14: Annual announcements of green steel projects in Europe and the rest of the world between year 2011-2025 (Fondahn, Carey and Mannes, 2026)

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To switch from BF-BOF to H2-DRI-EAF investments (CAPEX) of billions of euros are needed, and many firms use a cautious step-by-step approach, investing in EAFs which can be loaded with scrap (and later on with reduced iron), before investing in the DRI processes (Fondahn, Carey and Mannes, 2026). That is because, as known, the hydrogen sector is struggling with cost inflation and increasing financing expenses which affects the hydrogen price (Basirat, 2024). With these facts in mind, there is no question of why green steel projects have been stalled in Europe lately.

4 Theory

This section presents the theoretical frameworks used to interpret the empirical findings, covering sustainability transitions through the Multi-level Perspective and transition pathways, as well as the valley of death framework, which together provide the analytical foundation for understanding why the green steel transition has stalled and what conditions are needed to move it forward.

4.1 Sustainability Transitions

There are a few aspects that distinguish sustainability transitions – such as moving from conventional steel to green steel – from other transitions. Firstly, sustainability transitions are goal-oriented, addressing continuous environmental problems, while other historical transitions often are seen as emergent, exploring commercial opportunities of new technologies. In this context private actors are reluctant to address sustainability transitions since they are related to a collective good – sustainability – thus opening the door for the free rider problem. Therefore, the involvement of public authorities and civil society is vital to drive the change and to support greener options (Geels, 2011).

Secondly, the fact that sustainability transitions do not always offer enhanced user benefits, like in the performance and quality of green steel, makes the transitions special. This detail shows that it is unlikely for these sustainability transitions to take place without intervention regarding economic frame conditions like subsidies and regulatory frameworks. Hence, changes in policy are key for sustainability transitions to succeed, which will naturally face resistance from incumbent stakeholders (Geels, 2011).

Third, the domains where sustainability is most needed, such as transport and energy, are characterised by large firms. These firms often sit on complementary assets which makes it possible for them to test and support new innovations. Even if large firms are rarely frontrunners, they have the capabilities to accelerate transitions by supporting them with complementary assets and resources. To achieve this, there is a need for strategic reorientation of incumbents to look beyond existing systems (Geels, 2011).

Sustainability transitions are dependent on different perspectives, such as technology, policy, economics, and public opinion. The Multi-level Perspective (MLP) addresses this complexity by presenting transitions as structural changes that appear when external forces destabilise a dominant system, paving the way for new innovations to take hold.

4.1.1 The Multi-level Perspective on Sustainability Transitions

The MLP conceptualises overall dynamic patterns in socio-technical transitions. It observes transitions as an interplay of three analytical levels: niche, socio-technical regime/system, and an exogenous socio-technical landscape. The niche level refers to radical innovations (e.g. green steel), the socio-technological regime refers to the established practices and rules that stabilise existing systems (e.g. OEMs buying steel produced by traditional methods, legally binding contracts, acceptable price range of steel, existing regulations, etc.), and the exogenous socio-technological landscape which is influenced by inputs from outside the system (e.g. macro-economic patterns, societal values, political ideologies, energy prices etc.).

The unsustainable regime is often subject to lock-in mechanisms where sunk costs (such as already implemented BF-BOFs), economies of scale, and competencies obstruct sustainable transition. In Figure 15 the interactions between the different levels are shown. Higher levels (on the Y-axis in Figure 15) are more stable, having a higher number of actors and a higher grade of alignment between them. The regime level is the primary focus in the model since transitions are defined as changes from one regime to another. The landscape and niche levels are defined in relation to the regime, where the first is the external environment that influences the connection between regime and niche(s), and the latter are practices that deviate substantially from the existing regime (Geels, 2011).

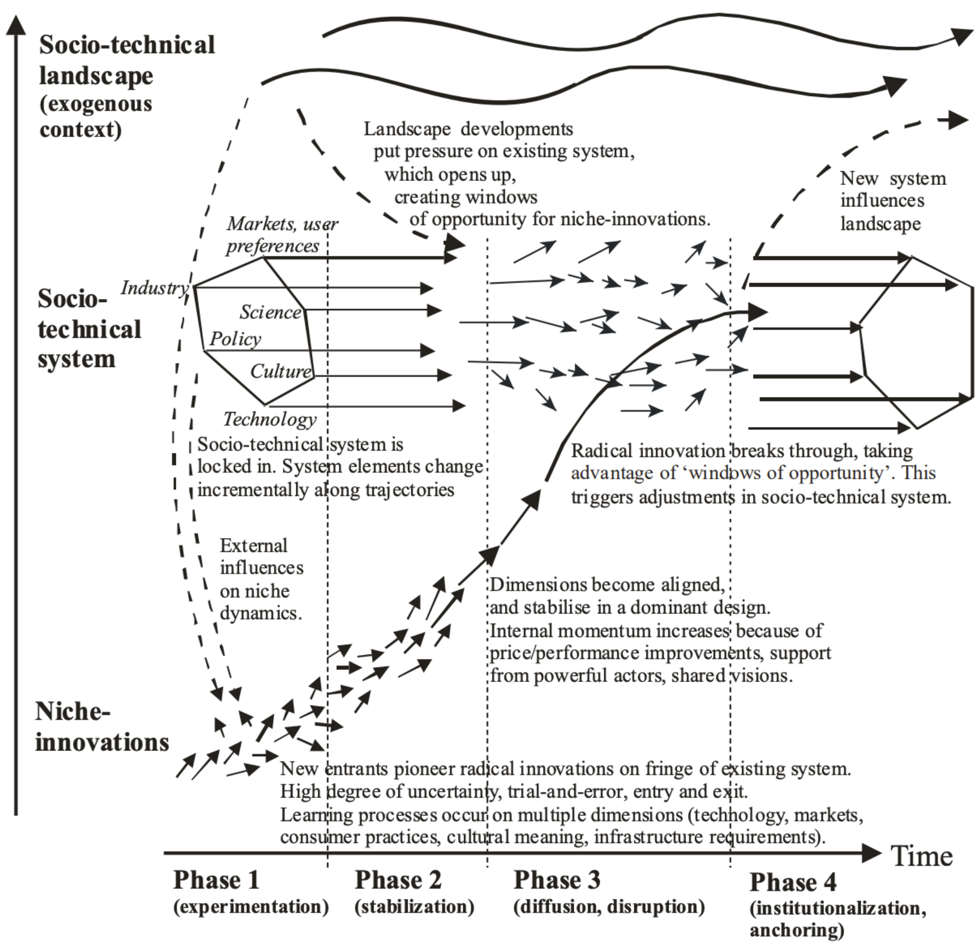

Figure 15: The Multi-level Perspective on transitions (Geels, 2024)

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Experimentation Phase

In the first phase (experimentation), innovations occur in niches, far away from the main system. Protected spaces are created from the niches which shelter the development from the competitive environment of the main market. Simultaneously, the progression and developments in the existing system continues, illustrated by the straight lines in Figure 15 (Geels, 2024). Regarding steel, this means that while the green steel projects (such as H2-DRI-EAF through e.g. HYBRIT) were initiated, the development of traditional methods progressed as well (such as further development of scrap-EAF or use of CCS for conventional methods).

Stabilisation Phase

When green steel enters the second phase (stabilisation), it gets established in one or more market niches, making it possible to get more reliable flows. At this stage the design gets more and more solid, providing a set product specification and best practice formulations. However, the innovation faces problems against the existing system that keep on developing due to the profound lock-in mechanisms. Moreover, the niche innovation is still more expensive in the stabilisation stage than the existing options and the uncertainties continue to loom large (Geels, 2024). Given the state of green steel and the previously mentioned price premium, it is currently – to some extent – stuck in the stabilisation stage.

Diffusion and Disruption Phase

The third phase (diffusion, disruption) offers diffusion of the innovation into mainstream markets, competing directly with the incumbent regime. Partly, the diffusion relies on internal niche-related aspects such as production costs, economies of scale, and support from powerful stakeholders (Geels, 2024). Therefore, having lead firms (as the OEMs connected to FMC), access to low energy prices and fast development of hydrogen infrastructure to decrease costs and increase supply of green steel is essential to enter the diffusion phase. On the other hand, the exogenous socio-technical landscape plays an important role for an innovation to put pressure on the regime in this stage. The landscape (e.g. phase-out of free allowances in EU ETS and increasing carbon price pushing the cost of traditional steel upwards) leads to tensions for the regime dispersing its former firm state, as seen through the diverging arrows in Figure 15. Furthermore, the phase is also characterised by business struggles for entrants and incumbents where some existing firms reorientate and some reach their downfall, a potential consequence of adjustments of policy goals and instruments like subsidies, taxes, and regulations (Geels, 2024). Hence, support from automotive lead firms through initiatives like FMC, along with existing and upcoming EU regulation (such as EU ETS, CBAM, CSRD, CSDDD, Automotive Package Proposal, and IAA) is a prerequisite to – fully – push green steel into the diffusion phase.

Institutionalisation and Anchoring Phase

In the last phase (institutionalisation, anchoring), the new system replaces the old one, and becomes the new professional standard. The transition is not only about the individual technology or innovation (e.g. green steel), it includes complementary innovations (e.g. energy efficient hydrogen production), new business models (e.g. circular economy) and infrastructure adjustments (e.g. robust energy grids and hydrogen pipelines) (Geels, 2024).

Ultimately, this model works as a tool to understand how different perspectives (e.g. technology, actors, policy, and economics) are interrelated to build the business case for green steel.

4.1.2 Transition Pathways

The typology of transition pathways further builds on the MLP and provides a deeper understanding of the timing and nature of multi-level interactions (Geels and Schot, 2007). Different timing of interactions result in different outcomes, and especially it relates to timing of occurrences in the landscape. In a situation where the niche innovation (e.g. green steel) is not yet fully developed – and the landscape changes (e.g. rising carbon costs as discussed above) – the transition path will be different than in a scenario where it is fully developed.

Given the different stages of stabilisation, shown in Table 3, green steel is stuck in stage 2. That is motivated through the support from powerful actors (e.g. actors in the automotive sector connected to FMC, signing LOIs). However, the stall of green steel in Europe has counteracted price/performance advancements, leaving green steel in the beginning of the learning curve due to low volumes produced. Thus, entrance into the third stage has not yet been apparent.

Table 3: Indications of stabilisation concerning timing of interactions (Geels and Schot, 2007)

Stabilisation stage	Description
1	The learning process has stabilised in a dominant design
2	Powerful actors have joined the support network
3	Price/performance improvements have progressed and there are strong expectations of further improvement (e.g. learning curves)
4	The innovation is used in market niches, and amount for more than 5% of market share

Furthermore, the relationship that the innovation has to the regime differs depending on whether its intention is to replace the regime (competitive relationship) or to simply act as an addition to the existing regime (symbiotic relationship) (Geels and Schot, 2007). Within the theory five combinations of this and the time perspective are presented, see Table 4.

Table 4: Pathways combining different nature and timing of interactions, highlighting the Reconfiguration pathway (Geels and Schot, 2007)

Pathway	Timing of landscape change	Nature of interaction
Reproduction Process Path	No landscape change	Niche innovations may occur but will not break through if the regime is stable
Transformation Path	Happens when the niche innovation is not fully developed and there is moderate landscape pressure	Symbiotic: Outsiders pressure the regime to modify rules
De-alignment and Re-alignment Path	Sudden and large change, niche innovations are not developed	Competitive: The regime collapses (de-alignment) and lack of stable rules lead to many niche innovations emerging. Eventually one becomes dominant and a new regime is created (re-alignment)
Technological Substitution Path	Specific shock/avalanche change when niche innovations have developed fully	Competitive: The niche innovation will replace the existing regime
Reconfiguration Path	Ongoing pressure and niches are developed	Symbiotic: Adopted as add-ons to solve problems

The niche innovation is fully developed with respect to H2-DRI-EAF and scrap-EAF. However, the landscape is not as firm (due to factors such as climate change, stakeholder demands, uncertainty in the world with war in Ukraine and the Middle East), building up ongoing pressure. Given the fact that incumbents on the market – like Thyssenkrupp, ArcelorMittal, SSAB, Tata Steel, Salzgitter – are also the ones embracing green steel it could be seen as an add-on to the existing regime. Consequently, the transition to green steel in Europe is following the reconfiguration pathway.

4.2 Beyond the Valley of Death

The MLP and transition pathways frameworks establish that green steel is a niche innovation stuck at the early stabilisation stage. What those frameworks do not account for is the investment mechanism that keeps it in that position. The concept of the valley of death, which addresses underinvestment in low-carbon industrial technologies in the demonstration stage, partly offers a perspective to understand this (Nemet, Kraus and Zipperer, 2016). Rather than focusing on the demonstration phase alone, the movement from the demonstration phase to the early deployment and diffusion (looking beyond the valley of death) is interesting in this case, see Figure 16. Moreover, here, the conditions and particular challenges that arise in the valley of death theory remain relevant in the case of green steel, which has passed that phase but has not yet reached commercial deployment at scale.

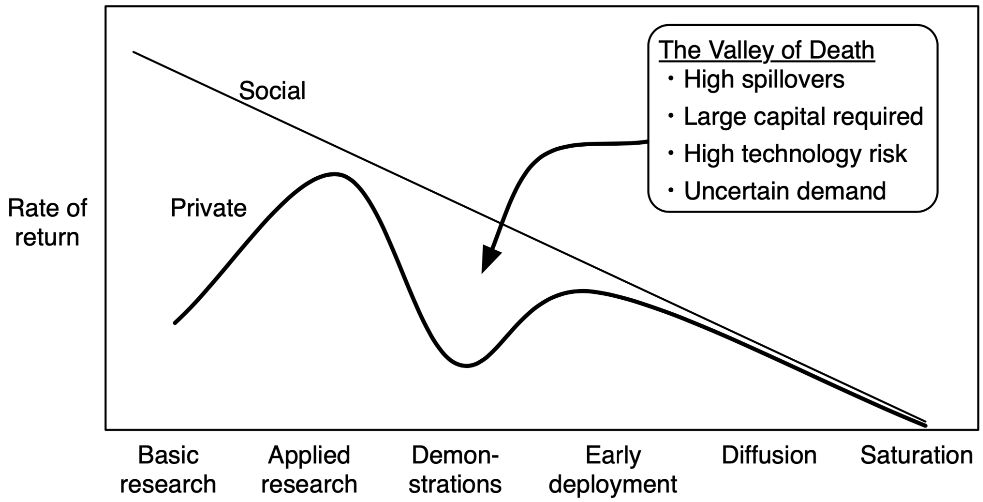

Figure 16: Innovation stages in relation to the shift in funding, where the valley of death is shown in the demonstration stage (Nemet, Kraus and Zipperer, 2016). In the context of green steel the movement towards early deployment and diffusion is more relevant.

The theory outlines four conditions: low appropriability, scale, radicalness, and fragile demand pull (Nemet, Kraus and Zipperer, 2016). Low appropriability, which means that firms are being reluctant to fund their projects alone due to the risk that knowledge will spill over to competitors who will free-ride on the technology, is not that relevant in this context after exiting the demonstration stage. However, the other three conditions remain relevant when demonstration is complete.

Scale

When upscaling, new problems are often identified that were not visible at low volumes (Nemet, Kraus and Zipperer, 2016). For instance, moving to large scale production in the H2-DRI-EAF pathway (e.g. to fulfil OEM green steel demand) introduces complexity with respect to hydrogen supply and energy infrastructure (identified in *section 3.8*) which were not apparent to the same extent at low scale. In essence, the demonstration showed that the process works, but it did not guarantee that the production system would operate in an economically sound way to deliver the volumes the market requires.

Radicalness

Radical innovations are linked to more uncertainty over whether they will prove feasible, economical, and reliable (Nemet, Kraus and Zipperer, 2016). The interesting aspects for green steel are its economic viability and reliability since they relate more to the uncertainty of input costs of elements in the production process rather than whether the process works. With energy price volatility within and across regions in the EU, producers of steel through H2-DRI-EAF cannot establish – with confidence – what their cost of production will be, making it hard to price the steel. Without that confidence, commitments that are made upstream, like hydrogen tenders and long-term energy contracts, become too risky to follow through on. Thus, as established in *section 3.4.2*, the green steel parity is dependent on the development of the electricity price that no single actor controls, making the reliability of the production pathway uncertain even if the technical feasibility has been there for years.

Fragile Demand Pull

Fragile demand pull in the theory shows that incentives to invest are weak when the expectation of the payoff is uncertain, and it is especially difficult for innovations that rely on government action to be profitable (Nemet, Kraus and Zipperer, 2016). The authors further add that, *"It is quite clear that weak credibility about government commitments to future policies has been a problem in climate policy (Koch et al., 2015). Where payoffs depend on policies, and especially if lags between investment and payoffs are long, weak policy credibility can make demand pull 'fragile' and thus weaken incentives for demonstration investments"* (Nemet, Kraus and Zipperer, 2016).

When applying this dynamic to green steel, which has already exited the demonstration phase, it works in the same way. The time lag between a final investment decision of an H2-DRI-EAF facility and full production that is up and running is evidently measured in years, given the projects that are seen in Europe today (some presented in *section 3.8*). Thus, steel producers that commit today, do so to a cost and revenue environment they cannot observe. Furthermore, policy revisions that change the direction and ambition of policy frameworks (e.g. the Automotive Package reducing the target of tailpipe emissions beyond 2035) make it even harder, as investments being made under one policy might not hold when ambition shifts. The EU policy environment (raised in *section 3.7*) signals decarbonisation ambition, but it does not create the certainty that steel producers need to make investment decisions, nor what OEMs need to make firm procurement commitments for green steel at large volumes.

The concepts of Scale, Radicalness, and Fragile Demand Pull clearly work in a setting beyond the valley of death, which is where green steel is at the moment. As was known from the MLP analysis, green steel is stuck in the early stabilisation stage, and this investment logic is a key factor of why that is the case. This situation is something that voluntary targets and EU regulatory frameworks have not yet resolved.

4.3 Theoretical Synthesis

The theoretical analysis shows that green steel sits in the early stabilisation phase of the MLP on sustainability transitions: powerful actors – including several OEMs through the FMC – have joined the support network, but price and performance improvements have not yet progressed sufficiently to initiate diffusion. The transition follows a reconfiguration pathway, meaning incumbent steel producers are themselves embracing the shift as an add-on to the existing regime rather than being displaced by new entrants, which reduces the disruptive pressure that would accelerate the change. The valley of death framework complements the MLP by explaining the investment mechanism that keeps green steel stuck in the stabilisation phase. Green steel has passed the demonstration stage, but scale, radicalness, and fragile demand pull continue to obstruct the path to commercial deployment – making the transition dependent on conditions that no single actor in the value chain controls. Together, the two frameworks position green steel not as a technology that has failed to develop, but as one caught between a regime that has not yet fully destabilised and a niche that has not yet scaled, where the investment conditions required to bridge that gap remain structurally unmet.

5 Methodology

This chapter outlines the methodological choices underlying the study. It presents the research approach and design, data collection methods, analytical procedures, and considerations related to research quality and ethics.

5.1 Research Approach and Design

This study adopts a qualitative research design to understand how automotive OEMs construct a business case for green steel. The research focuses on strategic reasoning, interpretations of regulation, organisational decision-making, willingness to pay, and the framing of green steel within a sample of European automotive OEMs. These issues concern processes and meanings rather than measurable variables, making a qualitative approach appropriate (Bell, Bryman and Harley, 2022). The study follows an interpretive approach, focusing on how organisations understand and respond to regulatory pressure, climate targets, and market developments, and how these perceptions shape strategic decisions. The concept of "green steel" is not treated as a defined label due to a lack of specific unifying criteria. Rather, it is something that is defined and interpreted differently across steel producers, automotive OEMs, and steel associations in an international context. An abductive research approach is applied using existing theoretical frameworks, including MLP, transition theory, and the valley of death theory, to guide the analysis. At the same time, empirical findings combined with literature review and document analysis may refine these perspectives. Therefore, the research process involves iterative movement between theory and empirical materials. The study is framed as a qualitative case study of a sample of the European automotive-steel ecosystem under the current EU decarbonisation policy framework. The case is bounded by the European regulatory context, the automotive sector as a major steel consumer, and the emerging green steel market. The aim is analytical rather than statistical generalisation. The findings are intended to contribute to theoretical understanding of how decarbonisation targets and regulatory instruments shape demand formation and business case development in industrial transitions.

5.2 Data collection

Data collection was done in two parallel streams, (1) a literature review and document analysis, and (2) semi structured interviews.

5.2.1 Literature Review and Document Analysis

A literature review and document analysis were conducted prior to and in parallel with the interviews. This stage was necessary to build sufficient background knowledge of the regulatory and market context and to design relevant interview questions. The literature review was undertaken to build a theoretical and conceptual understanding of the topic and to provide the foundation for the background on steelmaking processes and relevant transition theories. It primarily consisted of peer-reviewed academic articles such as (Algers, 2026; Muslemani et al., 2021; Wang et al., 2023).

The document analysis focused on understanding the current regulatory and market landscape. Documents analysed included EU policy and legislative proposals, corporate sustainability reports, publicly stated corporate commitments, and industry reports (e.g. Agora, Material Economics, World Steel Association). These sources were used to map policy, emission targets, procurement strategies, and public positioning related to green steel among automotive OEMs and steel producers. Document analysis continued alongside the interviews to enable triangulation, verification and comparison against stated commitments. When new information emerged during interviews, relevant documents were revisited to ensure consistency and analytical alignment. Given the rapidly evolving regulatory environment and ongoing industrial developments, priority was given to the latest version of publications and policy documents to ensure that the analysis reflected the current state of the European green steel market.

5.2.2 Semi-structured Interviews

Semi-structured interviews were used as the primary method of data collection. This approach was considered appropriate as the study aims to understand strategic reasoning, organisational decision-making and interpretations of regulatory developments. Such topics require flexibility and the possibility to probe responses in depth, while ensuring comparability across respondents, which is obtained by semi-structured interviews (Bell, Bryman and Harley, 2022).

Interviews were conducted with individuals within three groups:

- Industry and policy experts
- Automotive OEMs
- Steel producers

Industry and policy experts refer to individuals at industry associations, academic researchers or individuals that are in other ways deemed to have expert knowledge of the topic. The sampling approach was designed to target stakeholders close to the green steel value chain.

The interview questions were developed and structured around the core themes of the research questions, including:

- The role of emission targets and Scope 3 strategies
- The influence of EU regulatory frameworks
- Business case considerations and willingness to pay
- Perceived risk and strategic positioning

- Definitions and framing of green steel

The interview questions were adapted to each interview group while covering the same thematic areas to ensure comparability. The complete interview questions can be found in Appendix A1 and A2.

Sampling of Expert Interviews

To identify relevant experts within the green steel and automotive industry in Europe, a multi-stage sampling strategy was used. The sampling process consisted of two main steps: (1) identifying relevant organisations active in the green steel and automotive policy space, including industry associations, NGOs, academic institutions, and research bodies, with initial guidance from supervisors at Lund University; and (2) identifying individuals within these organisations whose roles or research focus made them likely to provide expert insight into the research questions, with selection based on expertise in EU climate and industrial policy, decarbonisation pathways for the steel industry, governance initiatives and standards related to low-emission steel, or automotive supply chains and the role of materials in vehicle decarbonisation.

These experts were selected based on their deemed expertise within the following areas:

- EU climate and industrial policy affecting the steel and automotive sectors
- Decarbonisation pathways for the steel industry
- Governance initiatives and standards related to low-emission steel
- Automotive supply chains and the role of materials in vehicle decarbonisation

Experts were drawn from organisations including Agora Industry, the World Steel Association, and research institutions such as the Oxford Institute for Energy Studies and the University of Gothenburg. A snowball sampling technique was also employed, whereby interviewees referred the researchers to other individuals with relevant expertise. In these cases, suggested contacts were assessed against the same eligibility criteria as the initial sample. Potential interviewees were contacted through their institutional email addresses. In total, 16 experts were contacted, of whom nine agreed to participate. Nine expert interviews were ultimately conducted and included in the analysis. Expert quotes and insights were anonymised in section 6. All interviewed industry and policy experts are presented in Table 5.

Table 5: Experts and researchers interviewed.

Interview ID	Organisation
E1	Climate and Energy Policy Institute
E2	Academic Researcher
E3	Academic Researcher
E4	Steel Association
E5	Transport and Climate Research Institute
E6	Steel Association
E7	Transport and Climate Research Institute
E8	Academic Researcher[a]
E9	Climate and Energy Policy Institute

[a] Due to scheduling constraints, this interview was conducted in writing rather than as a live conversation. The interviewee was provided with the same set of questions used in other expert interviews, and the responses were used in the analysis on the same basis as the live interviews.

Sampling of OEM Interviews

For the OEM interviews, a purposive sampling strategy was applied. The sampling process consisted of two main steps: (1) identifying relevant automotive OEM companies operating in Europe, including both passenger car manufacturers and heavy-duty vehicle producers, in line with the scope of the study; and (2) identifying individuals within each selected company whose roles related to sustainability, procurement, materials strategy, regulatory compliance, or corporate climate strategy, and who therefore possessed knowledge relevant to the research questions.

When relevant OEMs had been identified, we consulted our supervisors at SSAB regarding potential existing business relationships. Of 16 selected companies, SSAB had established relationships with eight of them. In cases where such relationships existed, SSAB facilitated introductions and shared contact details of relevant individuals who were contacted through email. For the remaining eight companies, direct outreach was conducted via email.

The final OEM sample included six companies. A total of seven interviews were conducted with eight individuals: one OEM was represented in two separate interviews, and one interview had two participants from the same OEM. No selection filters were applied based on specific emission targets, formal climate commitments, or participation in voluntary initiatives (e.g. SteelZero, ResponsibleSteel, First Movers Coalition). The intention was to capture variation in organisational approaches, levels of climate ambition, and readiness to adopt green steel. This allowed the study to reflect a broader spectrum of perspectives within the European automotive market rather than focusing solely on frontrunners. All interviewed OEMs are presented in Table 6.

Table 6: OEM representatives interviewed.

Interview ID	OEM Organisation
O1	Mid-range passenger car OEM
O2	Heavy-duty vehicle OEM
O3	Premium passenger car OEM
O4	Premium passenger car OEM
O5	Premium BEV OEM
O6	Mid-range passenger car OEM
O7	Heavy-duty vehicle OEM
O8	Heavy-duty vehicle OEM

Sampling of Steel Producer Interviews

For the steel producer interviews, a purposive sampling strategy was applied. The sampling process consisted of two main steps: (1) identifying European steel producers that had publicly communicated ambitions, investments, or pilot projects related to low-emission or "green" steel production, this was based on publicly available sources such as sustainability reports, press releases, and industry announcements, and (2) identifying individuals within the selected companies whose roles were connected to decarbonisation strategy, business development, customer engagement, sustainability, or policy affairs. These positions were considered most likely to provide insight into production pathways, customer demand, pricing considerations, and interactions with OEMs. In total, five steel producers were identified as relevant to the scope of the study. Within these five steel producers, a total of seven individuals were contacted, two steel producers agreed to participate in interviews and three interviews were conducted as one steel producer was represented by two representatives in two separate interviews. Contact was established through email and in one case a reference from an expert that was interviewed.

The intention was not to obtain a statistically representative sample of European steel producers, but rather to include a variety of actors actively engaged in the transition towards low-emission steel production. This ensured that interviewees could provide informed perspectives on supply-side readiness, perceived demand from OEMs, and the role of regulatory frameworks in shaping investment decisions. See Table 7 for steel producer interviews.

Table 7: Steel producer representatives interviewed.

Interview ID	Organisation
S1	Steel producer
S2	Steel producer
S3	Steel producer

5.3 Data Analysis

The interviews were analysed using an approach similar to framework analysis initially presented by Ritchie and Spencer (1994) and further developed by Gale et al. (2013). Framework analysis was selected as it provides a structured way of comparing perspectives across interviews while remaining open to themes that emerge inductively. This suited our study as expert, OEM and steel producers views were compared on the same set of topics *(see the focus areas for each research question in section 2).*

The interviews were semi-structured, conducted from a prepared interview guide that covered the topics relevant to the research questions, with the interviewer free to probe further or follow up on responses where this seemed analytically useful. Each interview was recorded with the consent of the interviewee and transcribed using the AI-assisted transcription tools Klang.ai for interviews in Swedish and Otter.ai for interviews in English, with the transcripts then reviewed manually for accuracy. A thematic framework was then developed, drawing deductively on the research questions and inductively on themes that emerged across the interviews. The thematic framework served as the index against which interview content was systematically categorised. Categorised content was then charted into matrices in Excel, with each row representing a theme and each column representing an interviewee. This made it possible to compare responses across cases for any given theme and to identify points of convergence and divergence between expert, OEM and steel producer perspectives.

The matrices and themes that emerged formed the subsections of the Result and Analysis (Chapter 6). From the interviews, relevant themes to address were selected based on two criteria: salience, meaning topics that emerged consistently across multiple interviews and where convergence between interviewees indicated a robust finding, and distinctiveness, meaning views that diverged from the consensus or offered a perspective that the other interviews did not capture.

5.3.1 The Use of AI

AI transcription tools were used in transcribing the interviews, which were all conducted online. When transcripts had been manually validated, they were exported and saved. The generative AI tool Claude assisted in creating the matrix structure in which the interview findings and themes were populated, as well as in scanning the transcripts for recurring patterns and divergent responses. All interpretations, theme selections, and final analytical claims were made by the authors. During the data analysis stage, the use of AI also assisted in information handling such as searching through transcripts for information on request of the authors and proof-reading and validating claims against the underlying interview material. All quotes, claims and insights were always validated manually against the interview transcripts by the authors.

6 Results and Analysis

This section presents the findings from the interview analysis, structured around the two research questions covering how OEMs build a business case for green steel and the extent to which emission targets and regulatory frameworks drive demand. The subsections under each research question represent the main themes that emerged from the framework analysis.

6.1 How Do OEMs Create a Business Case for Green Steel, and What Factors Influence Their Willingness to Pay a Premium?

This section of the results and analysis investigates to what extent green steel is necessary for OEMs to reach their goals, the engagement with primary versus secondary green steel and investigates where in the value chain the green premium can be absorbed. The section also covers how the macroeconomic environment affects the green steel transition.

6.1.1 Green Steel as a Decarbonisation Pathway for OEMs

A consensus throughout the interviews, both with experts and OEMs, is that steel is one of the unavoidable upstream emission hotspots. Steel typically accounts for around 25-30% of total vehicle production emissions and remains the dominant material by mass in most vehicle bodies (see *section 3.2.2*). Although the view on green steel and the level of priority varied depending on the type of automaker, the consensus was that green steel is unavoidable for long-term decarbonisation. For one premium BEV OEM, green steel is identified as necessary to reach CO2 emission targets per vehicle sold by 2040, while noting that emissions from the production of EV batteries and aluminium currently make up the majority of production emissions (Interview O5). For premium OEMs manufacturing ICE engines, the focus is mainly to electrify their cars and reduce tailpipe emissions. A premium OEM manufacturing both hybrid and BEVs states that once tailpipe emissions are addressed, the focus will shift to materials that dominate the embedded emissions, where steel accounts for around 25% (Interview O3). The common view across interviews of both experts and OEMs is that the easier abatement opportunities such as electrification of the fleet are prioritised before decisions on green materials are tackled. This also makes sense from a branding perspective, as it may be easier to capture value from an electric car made with green steel than from an ICE car with high tailpipe emissions and low production emissions, since tailpipe dominates during the lifecycle. When reflecting on the timing of green steel adoption, some OEMs state that green steel is not necessary to meet their near-term emission targets, while all OEMs state that it is important for the long term, highlighting that regardless of brand or product mix, green steel is necessary for the automotive sector to meet targets. This is consistent with the expert views gathered, which generally confirmed that *"for serious long-term decarbonisation, green steel is not optional"* (Interview E8).

When OEMs were asked to score the strategic importance of green steel relative to other decarbonisation measures on a scale of one to five, the majority scored it in the upper end (see Table 8). The table reflects the views gathered from OEM interviews; while the transition to electric powertrains remains the primary focus, green steel is positioned as the next critical step to address production emissions in the longer term.

Table 8: OEM scoring of the strategic importance of green steel relative to other decarbonisation measures (1 = low, 5 = high).

Interview ID	Score	Comment
O1	4	Second on the agenda after the shift from combustion to battery
O2	4-5	Top priority is the shift from combustion to battery; green steel ranks just after
O3	4-5	Score 4 or even 5 if secondary green steel is included
O4	4-5	Difficult to rank against other levers, but 4-5 on its own; primary lever for Scope 3.1 once tailpipe is addressed
O5	3-4 short term, 4-5 long term	Strategic importance increases with the time horizon
O6	3	Rises with executive attention; the IAA increases appetite but also creates regulatory uncertainty
O7	5 (Scope 3.1)	Score is for Scope 3.1 specifically; electric truck remains the primary overall decarbonisation strategy

Aluminium as a Partial Substitute

To better understand the relative importance of green steel, it is useful to compare it to a substitute that was often mentioned, aluminium. While aluminium can replace steel in some applications, safety requirements, performance constraints, and cost make it an incomplete substitute for the structural components that make up the bulk of a vehicle body. This limitation is particularly important for non-premium vehicle producers, who lack both the margin and the brand positioning to absorb a material shift towards aluminium at scale. One mid-range OEM representative confirmed that green steel *"will be part of the target, because the impact is massive"*, adding that aluminium substitution is not a meaningful alternative given that the company is not a premium manufacturer (Interview O1). Other OEMs state that the reason to use aluminium is for reasons other than direct decarbonisation; it is favourable in certain applications, such as mega casting, where many small components can be combined into one large component, which reduces complexity, reduces cost and makes production more efficient (Interview O5).

However, aluminium decarbonisation can present an easier near-term abatement opportunity than steel for some OEMs, specifically those with higher aluminium usage and production plants in Asia. Premium manufacturers tend to be more aluminium-heavy, while the bulk of other vehicle bodies are built predominantly with steel (Interview E5). A representative from a premium BEV OEM with manufacturing operations in China explained that standard aluminium sourced in China carries around 20 tonnes of CO_2 per tonne, and that switching to aluminium smelted with renewable electricity brings this down to around 6 tCO_2/t, while recycled aluminium can reach as low as 1 tCO_2/t (Interview O5). The interviewee noted that this reduction is less pronounced for aluminium sourced in Europe, where the grid is already cleaner, but that for their specific case aluminium currently offers the best return in terms of CO_2 reduced per euro spent. By comparison, the emissions difference between conventional BF-BOF steel and H2-DRI-EAF steel runs from around 2.32 to 0.1 tonnes of CO_2 per tonne, as established in *section 3.1.1 and 3.1.2*. Steel still dominates the vehicle by volume (50-66% of car mass, see *section 3.2.2*), however, so even a modest reduction in its emissions intensity translates into a large absolute effect at the vehicle level. A transport and climate research expert observed that the aluminium decarbonisation problem is *"maybe easier than for steel"* since it primarily requires substituting to renewable electricity in the smelting step, whereas primary green steel depends on green hydrogen availability which remains uncertain in the EU (Interview E5).

Taken together, these views show that aluminium decarbonisation does not displace steel as a structural requirement. Regardless of brand positioning, product mix, or sequencing of decarbonisation levers, green steel is a non-negotiable part of the long-term decarbonisation pathway for the automotive sector. The implication for RQ1 is that a target-driven internal demand for green steel exists inside OEMs that does not depend on individual consumer willingness to pay. This demand is anchored in the OEMs' own targets, whether through SBTi commitments, internal climate goals, or anticipated EU regulation, and it operates whether or not the commercial case for any single vehicle programme closes on consumer logic. It is partly visible in the offtake agreements OEMs have already signed *(see section 3.6.1)*. The strength and timing of this internal demand depends on how binding the underlying targets actually are, a question taken up directly in *section 6.2* on SBTi and EU regulatory frameworks. The findings show that green steel is a structural requirement, but the question is when and how that requirement converts into contracted volume, which is where the cost pass-through dispute, the procurement architecture, and the demand pull mechanisms come in.

6.1.2 Primary vs Secondary Green Steel

As previously explained, primary steelmaking is what drives emissions, especially in Europe where the traditional BF-BOF route is dominant and therefore steel is necessary for automotive companies to decarbonise. Addressing this issue at its source is the aim of H2-DRI-EAF. However, secondary green steel through scrap-EAF already has significantly lower emissions, particularly when the electricity used comes from renewable sources, and supply exists today at a lower price than primary green steel. For OEMs beginning to decarbonise their steel sourcing, the scrap-EAF route is the natural first step. The supply chain relationships sometimes already exist, the production process is established, and in the absence of a clear green steel standard that distinguishes primary from secondary, scrap-EAF wins on both cost and emissions intensity. One mid-range OEM made this sequencing explicit: *"between 2025 and 2030 we will develop as much scrap-EAF as possible and after 2030, between 2030 and 2035, developing new supply"* referring to the procurement of steel types (Interview O1). The logic is straightforward: use what is available and affordable now, then transition to primary green steel as it becomes commercially viable.

A further opportunity lies in closed-loop scrap systems. OEMs generate substantial volumes of high-quality post-industrial scrap from their own stamping and forming operations, and feeding this back to steel partners allows them to increase recycled content in their purchased steel, lower its emissions intensity, build meaningful long-term relationships with steel producers, and in some cases reduce input costs. As one interviewee noted, *"by using post-industrial waste it is easier to guarantee higher quality [...] the scrap can be scrap that they send back from their own production"* (Interview O5). A steel association representative pointed to this as a structural lever: *"the sorting must become better. So OEMs could, for example, support the producers or recyclers in sorting to have closed loop approaches"* (Interview E6).

Several major OEMs have set explicit recycled content targets for steel that make closed-loop scrap systems not just an environmental opportunity but a procurement obligation. Volvo Cars targets 35% scrap-based steel in production by 2030 and BMW aims for 50% recycled steel content by the same date (see *section 3.6.1*). These targets create a direct commercial pull for scrap-EAF supply independent of whether a green steel label exists. Not all OEMs follow this logic however. One premium BEV OEM noted that they do not set recycled content targets for steel, since the supply chain risks that drive recycled content targets in other materials, such as human rights concerns in magnet production, do not apply to steel in the same way. For steel, the priority is emissions intensity rather than recycled content as such, meaning that primary green steel via H2-DRI would be equally or more welcome if supply were available (Interview O5). This divergence is analytically relevant for RQ1: whether scrap-EAF or primary green steel forms the core of an OEM's green steel business case depends significantly on how that OEM frames the problem: as a circularity commitment, an emissions target, or a need to support the development of new green steel supply.

The constraint, however, is that scrap-EAF cannot cover the full spectrum of automotive demand. The automotive sector requires high-grade flat steel with tight surface and chemistry specifications, and post-consumer scrap introduces contaminants such as copper that compromise these properties (as established in *section 3.2.2*). A representative from a mid-range OEM was direct about the proportions: *"if you are just taking automotive grade using secondary routes, maybe you can address something like 15-20% of automotive grades [...] I will need to have primary routes for 85% of remaining grades"* (Interview O1). The challenge is therefore not developing new supply routes from scratch but identifying which applications can technically accept scrap-EAF steel, as the interviewee explained: *"for sure scrap-EAF is more easy because the process is already existing. So this is a question of discussion we have with our partners to have technical validation to be sure this is technically compatible with our spec"* (Interview O1). Circularity is part of the motivation too: *"our scraps will be valorised directly in the EAF of our partners, which is also very important in our commitment to have circularity in materials for automotive industry"* (Interview O1). This constraint is real, but steps are being taken to expand the application of scrap-EAF in production. EAF quality has improved substantially in recent years, with advances in copper filtration making scrap-based production for automotive grades increasingly viable. A climate and energy policy expert pointed to the US and an Italian producer as evidence that the barrier is already being overcome in practice: *"apparently it's absolutely possible. And* *similarly, in the US, where we have a preponderance of EAFs over coal based steel, they still build cars out of that steel. So it's doable"* (Interview E9). The current recycled content share in European cars nonetheless sits below 10%, reflecting both historical quality constraints and limited investment in closed-loop systems (Interview E7). This is beginning to change, with OEMs increasingly investing in recycling infrastructure and deep dismantling processes: *"there is a lot of movement, a lot of research. Now companies investing in this, OEMs investing in recycling. So I think in the next couple of years, I think we'll see the results"* (Interview E7).

On the supply side, beyond the quality constraint, there is also a volume problem. Even if copper filtration and sorting improve to the point where scrap-EAF can serve a larger share of automotive grades, the total availability of scrap in Europe is not sufficient to replace primary production across the sector. One premium OEM representative was direct about this: *"the supply cannot be met in any demand projection I've seen solely by scrap based steel making. So there is a gap. We need the primary, it's abundantly clear"* (Interview O3). Primary green steel is therefore necessary not only because scrap cannot meet all quality specifications, but because there simply is not enough of it. This raises the question of how primary green steel breaks through commercially when scrap-EAF is cheaper, widely available, and already qualifies as lower-emission steel without any distinguishing label. The answer from OEMs is not a preference for one route over the other but a structured optimisation across both dimensions. One premium OEM explained that price alone does not decide: *"it's cost, if it's a trade-off between recycled content and CO2, but if it's not a trade-off, then it's not only up to cost"*, both recycled content and CO2 intensity are assigned an internal price, and the procurement decision is optimised across both in each sourcing case (Interview O4).

Further, the distinction between primary and secondary routes may itself become less meaningful over time. A steel industry expert observed that producers are already beginning to blend DRI and scrap within the same EAF: *"in the future, what we believe, and also the industry believe, there is no clear distinction anymore between secondary and primary steel production. This will merge"* (Interview E6). A producer might for example use 50% DRI and 50% scrap for a specific flat product depending on what the OEM requires in terms of recycled content and what the market conditions allow. The relevant question for OEMs is therefore not which route was used but what emissions intensity and recycled content the product achieves. This convergence does however create a practical problem. Without a green steel standard that specifically rewards primary production, and with H2-DRI-EAF supply still very limited in Europe, OEMs have no strong reason to wait for primary green steel when scrap-EAF already qualifies as lower-emission, is widely available, and costs less. As scrap-EAF quality improves and becomes viable for more automotive grades, the preference for secondary production in the near term is likely to grow. The risk is that primary green steel producers end up without the demand signal they need to justify the large investments required to build H2-DRI-EAF capacity. As one expert put it, the balance between the two routes is something *"the market, in the end, will decide on"* (Interview E6), though several interviewees suggested that without a label or policy that actively rewards primary green steel, the market alone may not be enough to drive the full transition the sector needs.

Read through the lens of the MLP framework introduced in *section 4*, the primary versus secondary distinction captures something important about how the green steel transition is unfolding. Secondary green steel via scrap-EAF enters the regime as an add-on to existing procurement relationships and production processes, it fits without forcing structural change. Primary green steel via H2-DRI-EAF needs new infrastructure, new supplier relationships, and new commercial models. That asymmetry explains why scrap-EAF is already entering sourcing decisions while primary H2-DRI-EAF remains at early stabilisation and it points directly to the tension between voluntary adoption and structural transformation that *section 6.2.1* takes up in relation to SBTi and regulatory frameworks.

6.1.3 The Cost Pass-Through Dispute: Expert Assumption Versus OEM Margin Reality

A recurring claim in reports is that producing a vehicle with green steel adds less than 1% to the end price of the car, and slightly higher for HDVs, if the full cost is passed through to the consumer (see *section 3.2.4*). The expert interviews broadly supported this claim. A transport and climate research expert noted that the impact runs to a few hundred euros per car at most, which is modest against a sticker price in the tens of thousands (Interview E5). Another expert stated that at 100 euros extra on a 35,000 euro car, consumers would not notice and OEMs should simply pass the cost on (Interview E1). However, on the OEM side they disagreed with these assumptions, and the reasons they gave point to something more fundamental than disagreement over a number.

When asked how the additional cost of green steel could be passed through to customers, no OEM said it could be done through vehicle pricing on all cars. One premium OEM, represented by two interviewees, answered that it was not possible due to competition, with one of them adding that if regulation forced the issue, the cost would have to be absorbed internally (Interview O3; Interview O4). An HDV OEM stated they would prefer high volumes over a premium-only strategy but acknowledged premium models could be a starting point, though it is not currently being pursued (Interview O2). A premium BEV OEM framed the question as strategic rather than commercial, noting that its customers do not expect to pay more (Interview O5), while a mid-range OEM said it was dependent on product management and unclear (Interview O6). Notably, no OEM in this study expressed confidence that customers would voluntarily pay extra for a car made with green steel. The route argued in some of the reports was that the cost should be pushed on premium models initially, however, even premium OEMs interviewed stated *"our analysis says they're not prepared to pay more"* referring to their customers (Interview O3).

Part of the explanation is that green steel is invisible in the finished product. Customers can see a seat fabric made from recycled plastic, and they see it every time they use the vehicle. Contrary to this, they cannot see that the steel in the body of the car was produced with hydrogen rather than coal, and as one premium OEM representative put it, the visible things are what customers pay for: *"customers are not prepared to pay extra for these kind of things [...] things like recycled PET bottles in the seat fabrics, or this deco on the* *instrument panel that's made from oyster shells [...] they see them every day. They touch them, they feel them [...] but if we're just talking about the numbers, we want to decarbonise the car, they're not the drivers for that"* (Interview O3). An expert at a transport and climate research institute described the same challenge from a communication angle, stating that explaining green steel to a consumer requires first explaining why conventional steel is a climate problem at all, and that this is a long argument to make at the point of sale (Interview E7). Throughout the interviews, it became clear that even sustainability-orientated customers may not rank green steel highly relative to other commitments they can see, such as responsible mineral sourcing for batteries, recycled interior materials, or the switch to a BEV. For a material to support a price premium, its value has to be clear to the buyer, and green steel currently is not.

This communication problem is reinforced by the absence of a standardised EU green steel label. Without an agreed definition, OEMs cannot easily anchor a claim in a recognised standard, and they face reputational risk from making claims that could later be challenged as greenwashing. The macroeconomic environment further narrows the room for a potential cost pass-through. Currently, the European automotive market is under severe competitive pressure, partly from lower-cost Chinese BEV producers, and consumer attitudes to sustainability have shifted, which is not unique to the automotive industry. A representative from a steel producer described the change directly, noting that over the past five years the dominant concern on people's agenda has moved from saving the climate to personal and geopolitical security, and that the willingness to pay a premium for sustainability in the private car market is not what it was (Interview S2). Another expert made essentially the same point from a different angle, describing the period of strong climate buy-in from 2019 as a long hangover that is now over, with society currently *"really not bothered"* about sustainability and industrial decarbonisation being pursued through the back door rather than with a social mandate (Interview E1). A climate and energy policy expert described the broader structural issue that sits under this: *"I think it's difficult to push the entire premium onto the consumers. I think that all the OEMs are just feeling the crunch at the moment. There are obviously additional problems around that, which include just a substantially oversaturated market in the EU [...] that has nothing, or almost nothing, to do with actually having cars produced with green steel. It's a general market problem"* (Interview E9). The same pressure is visible inside the premium segment itself. A premium OEM representative pointed to the same competitive pressures more concretely, noting that low-cost Chinese BEVs have made the market hyper-sensitive around cost, and that the price war has now reached into the premium segment itself (Interview O4). Further, another expert confirmed that the crisis in the European automotive market is deeper than outside observers tend to appreciate (Interview E7). These views of both experts and OEMs conclude that the European automotive market is highly competitive and a cost pass-through to the end consumers, even in the premium segments, is currently very difficult.

An important note is that these arguments rest on the assumption that OEMs have analysed their customer segments and their price sensitivity correctly. It may be possible that consumer attitudes shift and that their willingness to pay is greater than current OEM analysis suggests. Even allowing for that, the consistent message from this study is that if the consumer cannot be asked to pay, the question becomes whether the

OEM itself can afford to absorb the cost and treat green steel as a brand-level investment. When one premium OEM representative was presented with this argument directly, the response was clear. The representative acknowledged the argument commonly made by researchers and experts, that 2% of a 60,000 euro vehicle price is a manageable amount for a manufacturer to swallow, before explaining why the theory does not work in practice: *"when you look at profit margins for even premium automakers like ourselves, you know, 8% would be a good EBIT number. And that's just a straight reduction in EBIT. So it doesn't pass through in the way that they're setting that up"* (Interview O3). A second representative from the same OEM confirmed the same dynamic, noting that when EBIT margins are as thin as they have been in recent years, absorbing additional material costs simply is not possible (Interview O4). A mid-range OEM described the procurement reality: *"in automotive industry, every year in procurement, believe me, we are having arbitration for one euro, two euro savings. Because 200 euro if you don't give it to the customers, this is a direct margin. If you apply 200 euro by 2 million cars, you have 400 million euro"* (Interview O1). From these interviews, it becomes clear that there exists no margin for an OEM to absorb additional costs in such a highly competitive market environment.

One scenario in which absorption would become more realistic is if regulation imposed the same cost on all OEMs at the same time, removing the first-mover disadvantage. An expert noted that the argument for spreading the premium across production was more persuasive five years ago, when general cost pressure across the industry was lower, and that in today's environment of broad margin compression voluntary action by any single actor carries a higher price (Interview E2). The implication is that voluntary adoption is structurally penalised in a sector where no manufacturer can afford to raise its cost base unilaterally. It is worth setting this OEM narrative against a degree of expert scepticism. A transport and climate research expert questioned whether automotive margins are genuinely as thin as OEMs suggest, pointing out that profitability has not collapsed in recent years to the extent that the cost-pass-through argument implies (Interview E5). Another expert took a similar position from a different angle, arguing that from the outside, passing 100 euros on to a consumer buying a 35,000 euro car looks straightforward, while acknowledging that OEMs describe more complexity once costs aggregate across the supply chain (Interview E1). This scepticism is important. The OEM cost argument is grounded in real margin pressure and real competitive dynamics, but in a sector where procurement culture is by design organised around cost minimisation, it can also function as a convenient justification for not moving first. The consistent position across OEM interviews is that current margins leave little room to absorb the green premium voluntarily, and the structural implication drawn from conducting these interviews is that without a regulatory mechanism imposing the same cost on all producers simultaneously, no single actor has an incentive to move first.

The interviews converged on a clear conclusion: the commercial logic for green steel does not close on its own. Several major European OEMs have signed offtake agreements and invested substantially in the green steel supply chain, indicating that demand intent has existed for some years (see *section 3.6.1*), yet that intent has stalled rather than translated into contracted volumes at scale. The recently launched Volvo EX60 illustrates the point: even with green steel in the product, it is not positioned as a central consumer-facing message

(Interview S2). The commercial logic appears to be more about brand consistency, supplier relationships, and internal emissions targets than about a premium the end consumer is expected to recognise or pay for. If end-consumers will not pay and OEM margins cannot absorb, the gap has to be filled from somewhere else. The conclusion drawn by several interviewees is that market mechanisms and public support will be needed to move green steel from ambition to contracted volume at scale. As one expert put it: *"I think it's going to be very difficult to get around having some form of public funding support also for any of these measures, whether it's OPEX and certain production routes, or CAPEX for ramping up production and transition. The money has to come from somewhere. What we don't see is that private capital is moving enough in that direction to warrant that"* (Interview E9).

These findings map directly onto the regime lock-in described in *section 4*. The procurement culture of negotiating over single euros per component, the inability to pass cost on to consumers, and margin structures that leave no room for absorbing the green premium are not separate problems. They are three expressions of the same underlying condition: a regime whose competitive dynamics and financial logic leave no space for voluntary first-mover action. As the MLP framework would predict, this kind of lock-in cannot be overcome by the niche innovation alone. The consistent message from both OEM and expert interviews, that external market mechanisms and public support are required, is therefore not a matter of preference but a structural consequence of how the incumbent regime is built, and it sets the terms on which the regulatory analysis in *section 6.2* must be read.

6.1.4 The Potential for Green Steel to Enter a Sourcing Decision: Timing, Transparent Pricing, and Internal Carbon Accounting

This section answers a different part of RQ1 than the cost pass-through section. Where *section 6.1.3* asked whether green steel can be afforded, this section asks how it gets into a sourcing decision at all when the commercial logic is difficult. The three sub-themes are linked by one question: what determines whether green steel moves from being a conceptual premium cost to being an actual line in a procurement contract.

The Timing Aspect

From interviews, it emerged that vehicle programmes in the automotive sector are planned years in advance. Within that timeline, the timing of conversation of green steel is critical. A representative from a steel producer noted that securing a green steel agreement with an OEM is considerably easier when engagement begins at an early stage of a new vehicle programme, before a firm cost budget has been locked in. In that window, the supplier can frame green steel not as a cost increase but as a contribution to the vehicle's emissions profile and a branding asset for the OEM, an argument that carries weight when the programme is still being shaped. Once a budget has been set, the same material becomes visible only as a line-item premium against an already fixed cost baseline, making it far harder to justify. As the interviewee put it, in the case of the new Volvo

EX60, early engagement meant that SSAB had the opportunity to motivate and sell a green steel solution for that vehicle (Interview S2). The implication is that the timing of commercial conversations, not just their content, is a structural determinant of whether green steel enters a vehicle programme at all.

The Lack of Transparent Pricing

The second condition for potential green steel deal is whether the steel producer can offer a transparent price model, and the interviews revealed a more basic problem first. Several OEMs said that steel producers have not yet been able to give them a firm price or volume for primary green steel at all. A premium OEM representative explained that every conversation with the new green steel producers ended without a committed price per tonne: *"every time we talk to those guys, they never advance the cost. They never tell us, okay, this is the price per tonne we can commit on [...] it's a sign that you can't just commit on it, because if they had been cheap, or if they had been reliable, or if they had been competitive, they would have already advertised the price"* (Interview O4). A mid-range OEM representative explained the same problem from the board's perspective: *"how can I manage any offtake with my board if I don't know what price I will pay in two, three or four years"* (Interview O1). A mid-range OEM said the same thing from a volume angle, noting that they try to source steel below a certain emissions threshold but cannot get it in the volumes they need (Interview O6). The gap between announced green steel supply and steel that can actually be contracted is therefore wider than the public picture suggests, and it creates a circular problem: the OEM cannot commit without a price, the steel producer cannot give a price without project certainty, and the project cannot reach certainty without OEM commitments.

Even when a price eventually does emerge, there is a second problem. OEMs want to see how the premium is built up so that they can defend it internally. An HDV OEM representative made this point clearly, arguing that some steel producers are *"shooting themselves in the foot"* by not offering transparent cost structures and that if they were more open with structured pricing built on actual input costs, the internal case for green steel would be easier to make (Interview O2). The same interviewee observed that steel producers appear to assume OEMs do not care about the underlying cost structure, when in reality the opposite is true, procurement is built on cost breakdowns and the absence of one is itself a barrier (Interview O2). A related concern was raised by several OEMs: they acknowledge that green steel has higher production costs and are willing to pay those costs, but they do not want to be charged both for a higher price of conventional steel (due to ETS rise) and for a sustainability markup on top of that. A mid-range OEM representative made this argument explicitly, proposing a cost-plus contract structure in which the steel producer's CAPEX is amortised on a fixed financing schedule and only the variable input costs such as iron ore and electricity move with the market. This would produce a near-flat green steel price that the OEM could defend against the rising ETS-exposed traditional price: *"if I'm paying a market price, including ETS on which I put on top of that premium for being low carb still, I don't understand the business model"* (Interview O1). A premium OEM representative made the same point in more general terms, describing the goal as reaching a cost-plus margin position where pricing is built up from structural costs rather than determined by commodity-market distortions: *"what we would like to get to is a cost plus margin position, where there is fair pricing for all"* (Interview O3). The underlying message is that OEMs are not rejecting the green premium as such, but rejecting a pricing logic in which they are effectively charged twice, once through ETS-inflated commodity baselines and again through a sustainability markup on top. This objection is, however, contingent on the current carbon price level. As the EUA price rises and free allowances are phased out toward 2034, the cost gap narrows mechanically: conventional BF-BOF steel becomes more expensive through ETS exposure while green steel producers can sell surplus allowances, partially offsetting their production costs. At a sufficiently high carbon price, the room for a discretionary sustainability markup shrinks accordingly. The paying-twice problem is therefore most acute in the current transition phase, and its resolution is tied directly to the pace of carbon price escalation, a dynamic discussed further in *section 6.2.2*. Steel producers have started to respond to this. A representative from one steel producer noted that the industry is moving toward offtake agreements with clearer price models tied to observable parameters such as ETS developments, partly in direct response to OEM feedback that non-transparent pricing is hindering procurement conversations (Interview S2). Still, the underlying problem remains unresolved. Without firm prices and committed volumes, OEMs cannot plan their sourcing in advance or incorporate green steel into their forecasting, and for green steel to enter a sourcing decision at all, steel producers will need to offer both the firm commitments and the transparent pricing that procurement divisions require to commit in return.

Internal Carbon Accounting

The third condition is internal. Even when green steel is available at a transparent price and the conversation happens at the right point in the programme cycle, the OEM still needs a mechanism to decide whether the premium is worth paying. Several OEMs stated that they apply internal carbon pricing models when procuring materials, meaning that they apply an internal price for CO2 emissions avoided when comparing material sourcing decision. This is how CO2 reduction gets translated into a comparable value against other options. A premium OEM representative explained that price alone does not decide, both recycled content and CO2 intensity are assigned an internal price, and the procurement decision is optimised across total cost of ownership in each sourcing case: *"We get CO2 targets. So we don't always go for the cheapest. We also have a price on carbon, and therefore we put it in. We put it in the business case, if I have a cheap blast furnace from Brazil, cheaper than my EAF, let's say in Sweden, okay, but what is the cost? The CO2 cost of this, not only transportation, but also manufacturing"* (Interview O4). The same interviewee explained how the calculation is applied at component level, with each application receiving a structured price for both dimensions that the procurement team then computes into the supplier comparison: *"you put a price on what is our internal price of one tonne of CO2 and what is the price of 1% more recycled content in that component? [...] each application, they give me a price [...] then I put that in, I compute it in my beat sheets"* (Interview O4). For internal carbon pricing to function in practice, the OEM also needs an auditable system that ties supplier emissions data to component-level procurement. Another representative from the same OEM described a system in which suppliers contractually commit to a CO2 footprint for each component delivered, creating the traceable basis on which internal carbon pricing decisions can be made and defended (Interview O3). A mid-range OEM representative described a similar mechanism applied through the GHG Protocol framework. The procurement function uses a baseline emission factor of around 2.5 tonnes of CO2 per tonne of conventional European BF-BOF steel, against which each potential supply option, whether scrap-EAF, NG-DRI-EAF, or H2-DRI-EAF, is compared to calculate the absolute CO2 saving. A confidential internal cost-per-tonne-of-CO2-avoided threshold then determines whether the switch is worth making: *"we have some calculation to estimate what is the cost to avoid one tonne of CO2, and to say, below this cost, we can have a look on it. Higher than this cost, no way"* (Interview O1). These internal carbon pricing mechanisms allow green steel to be evaluated against cheaper, higher-emission steel, and an OEM's internal carbon price determines at what price point green steel becomes a feasible alternative.

To better understand how green steel currently ranks as a decarbonisation lever, OEMs were asked to compare it against other measures in terms of CO2 reduction per euro spent. The answers were mixed. The common answer was that it depends on the specific sourcing situation. A premium OEM representative noted that offers for scrap-based green steel have varied considerably between suppliers, with some representing good value and others far from it, and that each case has to be assessed on its own terms rather than generalised due to the fact that sourcing works differently across regions and vehicle programmes (Interview O3). Another representative from the same OEM framed it as a case-by-case decision rather than a ranking of decarbonisation levers, noting that the approach is to push on every material category where value can be found rather than picking only the cheapest alternative (Interview O4). The lack of a specific ranking is consistent with how internal carbon pricing works. Because procurement decisions are made on a total cost of ownership that combines price, internal CO2 cost, recycled content, and supplier reliability, no single lever dominates. Whether green steel ranks favourably depends on the OEM's internal carbon price, the carbon footprint of alternatives, and the specific components being sourced. Green steel will not enter a sourcing decision because it is the cheapest CO2 reduction alternative, but rather because the OEM has either set an internal carbon price high enough to make green steel competitive or committed to a broader strategy of decarbonising its material use. These underlying factors have to be incentivised somehow to accelerate the adoption of green steel from the procurement perspective.

A further observation emerged on whose internal carbon price actually gets applied. Many automotive OEMs are part of larger groups that procure at a higher level than the individual brand, which means that internal carbon pricing decisions are not always made within the brand the consumer interacts with. A premium BEV OEM representative explained that their company does not source materials directly. Sourcing is handled by the parent group, which means that procurement of green steel is contingent on alignment within the larger group rather than on the brand's own ambition (Interview O5). This works in both directions. On the one hand, the smaller brand benefits from group-level scale, since combining its volumes with those of the parent makes a green steel deal more viable than it would be at brand level alone. The same interviewee gave a concrete example, where the brand wanted to use a specific low-emission steel product in a particular component, found that the parent was already considering the same procurement, and ended up with the volume aggregated across both, reaching a larger number of vehicles than the brand could have achieved on its own (Interview O5). On the other hand, a brand with stronger climate ambition cannot move alone if the larger group is not yet ready to follow, captured by the same interviewee with the observation that convincing the bigger ship to change course can be the harder part of the work (Interview O5). The implication is that the unit of analysis for green steel adoption is often the group rather than the brand, and that frontrunner brands within larger groups remain constrained by what their parent group is willing and able to procure. Therefore the low supply availability of green steel can be seen as a downside or that the product is not mature enough for large brands to demand it at large scale yet.

6.1.5 Fleet Customers May Become the Commercial Pull Mechanism

The previous findings showed that individual customers do not want to pay for green steel in cars and OEMs cannot absorb the additional cost. During interviews, one premium BEV OEM noted that fleet customers may be able to create the pull mechanism needed to adopt green steel in the automotive sector. The interviewee said, *"I think that fleet customers increasingly would want to have green steel in their cars"*, explaining that they make up more than two thirds of their customer base in some markets. Further, the interviewee noted that fleet customers set high requirements because their own internal climate goals capture company cars as Scope 3 emissions, and that questionnaires from these customers may start including green steel within the next couple of years: *"I would not have a hard time seeing that"* (Interview O5). A climate and energy policy expert also confirmed this idea: *"Corporate fleets, I think, in Germany, make up a very large percentage, like a majority of cars. And so if the German government were to, for instance, mandate green steel in all corporate fleet vehicles, this would be a huge driver of demand for green steel."* (Interview E1). This is in line with what was covered in the background, 60% of new car registrations in Europe are corporate and 25% of new registrations are for companies with fleets of over 100 vehicles. The fact that large corporate fleet buyers include emission criteria when procuring vehicles to reduce their Scope 3 emissions represents an important potential driver for green steel, given the large share of the market they constitute. Premium OEMs have a higher share of corporate sales in general, with Volvo at 74% for instance *(see section 3.6.3)*. As the premium segment generally has higher margins, and the percentage effect of green steel on car price falls as vehicle price rises, it is probably the most likely segment to absorb or pass on the cost to individual consumers. However, fleet procurement operates through institutional negotiation rather than retail pricing, so the driver for fleet customers is not consumer willingness to pay but rather procurement criteria tied to corporate climate commitments.

However, Scope 3 reporting alone is unlikely to be sufficient to drive green steel sourcing specifically. Fleet customers can satisfy Scope 3 obligations through multiple levers, including electrification, offsetting, or supplier substitution on other inputs, making green steel one option among many rather than a required response. The pressure Scope 3 creates is real but diffuse and substitutable. Whether fleet customers currently have the supply chain visibility to distinguish between green steel produced within the EU and that produced elsewhere remains an open operational question, but the direction of travel is clear. A stronger and more direct demand signal would therefore require either binding procurement criteria or incentive structures that make green steel the preferred option rather than merely a permissible one.

The same climate and energy policy expert pointed to several places in the EU regulatory architecture where such a mandate could be located. The Clean Corporate Fleets initiative and the Automotive Package Proposal were identified as potential locations for green steel mandates (Interview E1). The Automotive Package, established in *section 3.7.7*, currently allows up to 7% of remaining tailpipe emissions in 2035 to be compensated through low-carbon steel, but does not impose this on corporate fleet vehicles specifically. The IAA, established in *section 3.7.6*, does not currently include a mandatory emissions target for green steel either, although the expert noted that this could be introduced through a delegated act tied to public procurement criteria (Interview E1). Beyond mandates, demand can also be activated through national incentive structures that reward fleet customers for sourcing EU-made green steel, which would avoid the captivity problem by making green steel procurement commercially attractive rather than compulsory. The premium BEV OEM representative pointed to this dynamic directly: *"Fleet customers would want to have EU-made green steel to collect any possible incentives if governments in some countries would give them"* (Interview O5). How such incentive structures would be designed, which level of government would administer them, and how they would interact with existing EU state aid rules remains unclear.

This combination of fleet customer interest, policy locations available for mandates, and incentive structures that could favour EU-made green steel suggests that the fleet customer pathway is one of the more developed near-term routes to turning demand intent into real purchasing volumes. Whether it materialises depends on whether EU and national policymakers attach binding green steel criteria to one or more of the available regulatory instruments, rather than on whether OEMs or fleet customers individually want the product.

6.1.6 Risk Management

Risk management presents a different perspective on the green steel business case from the cost pass-through and procurement architecture discussions above. Rather than asking whether the premium can be absorbed or passed on, it asks whether early engagement with green steel reduces an OEM's exposure to future costs and constraints. The answer from the interviews is not straightforward. Early engagement can reduce regulatory, supply, and carbon pricing risk if mandates and tighter ETS conditions materialise as expected, but it introduces a different set of commercial, reputational, and strategic risks, if they do not. Determining which angle dominates depends on how an OEM reads the regulatory trajectory, and as one climate and energy policy expert noted, that reading has shifted considerably since the early 2020s, when OEMs were actively securing offtake agreements in anticipation of mandates that have since failed to materialise (Interview E1).

The case for early engagement rested on three arguments that surfaced across expert and OEM interviews. The first is ETS exposure. As the carbon price rises and free allowances are phased out (as established in *section 6.2.2*), the cost gap between conventional BF-BOF steel and lower-emission alternatives narrows. OEMs that have already built supply relationships, validated specifications, and signed long-term contracts will be better placed when that gap closes than those that have waited. An academic expert stated: *"early engagement helps OEMs understand supply availability, product claims, contracting structures, and technical qualification before these issues become more urgent. It can reduce exposure to future carbon pricing and potential supply bottlenecks once demand scales"* (Interview E8). An HDV OEM representative confirmed this, describing take-or-pay agreements with producers as a bet that early adoption pays off as regulation tightens and carbon pricing rises (Interview O2). The second argument is supply security. Green steel from primary H2-DRI-EAF routes is expected to remain constrained through the late 2020s. OEMs that engage early can lock in future offtake before supply becomes scarce, while late movers may face higher prices or unavailability. The same expert noted that *"once lower-emission steel becomes a scarce strategic input, access, quality assurance, and long-term contracting become central [...] sustainability goals are often implemented through a supply-security lens"* (Interview E8). The third argument is regulatory readiness. OEMs that have already built the internal procurement systems, supplier relationships, and data infrastructure for green steel will be better prepared when regulation eventually mandates sourcing thresholds. One expert noted that early movers profit when regulation kicks in, with a clear lead market advantage over those who act late (Interview E7).

However, a strong counter-argument emerged from multiple OEM interviews, suggesting that market volatility has transformed early commitment into a potential strategic liability. This caution comes partly from a lack of market maturity for green steel. As one OEM representative noted: *"early engagement is difficult because there isn't a product to assess yet, and there isn't defined pricing yet"*, and confirmed the company had not signed contractual offtake agreements of the kind that would lock in specific volumes and prices (Interview O3).

Beyond this, there is a deeper systemic concern that green steel could increase the pressures already facing the European automotive industry. In a world of geopolitical volatility and margin compression, some interviewees even framed green steel as a potential catalyst for industrial decline rather than a solution: *"a few years ago, I would have said yes, nowadays, the world is so volatile that I don't know if tomorrow green steel becomes a risk for the whole German automotive industry to collapse. I can tell you that in no time, green steel will be out of the window"*, a representative from a premium OEM stated (Interview O4). A mid-range OEM made the same point more directly: *"I don't know if there is any risk mitigation to applying green steel currently, you know, currently there is so much risk on the market, green steel would not be my priority"* (Interview O6). Further, one representative from an HDV OEM framed early engagement less as an immediate sourcing priority and more as a tool for future-proofing, stating: *"this activity is done in order to prepare the future, but we don't know yet when we would be forced to change our supply chain"*. The representative emphasised that the objective is to monitor the landscape so that the company can *"adapt anytime"* and avoid falling behind competitors, particularly as ESG regulations are frequently *"modified, updated, [or] sometimes cancelled"* (Interview O8). The underlying point is that using early green steel adoption as a risk management strategy only holds if the broader industry context is stable enough to support those commitments. In a world where geopolitical pressures, Chinese competition, and margin compression are simultaneously squeezing European OEMs, green steel stops being a hedge against regulatory risk and starts being its own source of competitive risk, particularly if it raises costs at a moment the industry cannot absorb them as discussed above.

This puts the risk management discussion in the same position as the cost pass-through and procurement architecture discussions: without mandatory requirements, the business case does not close on its own. Early engagement reduces risk when mandates materialise, but in their absence it creates new ones. Most OEMs have drawn the logical conclusion, maintaining supplier relationships and monitoring the market rather than committing to binding volumes. That wait-and-see posture feeds directly into the coordination failure described in *section 6.2.5*, where each actor holds back waiting for others to move first. For RQ1, risk management can motivate early supplier engagement and internal capability building, but it is unlikely to close the business case without a clearer regulatory signal that the cost of waiting now outweighs the cost of acting.

6.2 To What Extent Do Emission Targets (SBTi/Internal) and EU Regulatory Frameworks Drive Demand for Green Steel?

The question of whether voluntary emission targets and EU regulatory frameworks drive demand for green steel, and whether green steel is a necessity or an option for OEMs, is more abstract than a simple yes or no. Examining the role of SBTi and internal targets, EU regulatory frameworks, and the interaction between them shows that the instruments exist, the ambitions are real, and the direction is right, but that does not mean that the commitment is there. What emerges across the interviews is a narrative of contradictory signals without mandates, frameworks without enforcement, and intent without enough certainty to realise investments or purchasing decisions.

6.2.1 Voluntary Targets as Drivers of Early Demand and Regulatory Readiness

Of the interviews in which this question was addressed directly, the majority states that voluntary targets (e.g. SBTi) function as preparation for mandatory compliance in the future rather than a direct driver of green steel adoption (Interview E1, E4, E6, E7, E8, E9, O1, O3, and O4). It sets a direction where companies need to incorporate climate work into their business department and to think through their decarbonisation strategy, *"every time you have climate pass through a business department it is valuable in and of itself [...] but it is up to governments to mandate this stuff, as we have seen, 50-60 years of knowing about climate change, has done* *nothing to lower emissions"* is stated by one expert (Interview E1). From the OEM side, one representative mentions that their strategy towards net-zero was already in place before adopting SBTi, the commitment did not drive the strategy, it gave third-party credibility to the already existing ambition, stating *"we were already on that path [...] it's not that SBTi pulls us in that direction. It's that we headed there, and we've used them to support us and show the world that we were already on this track"* (Interview O3). Another expert raises a different dimension, *"I suspect that companies choose to set SBTi targets because of marketing... It's something that is positive when they market themselves, perhaps not so much to customers, I think more to investors actually"* (Interview E4). In that sense, the voluntary targets work as a way to showcase robust climate plans to investors, making them more keen to invest in and provide more beneficial terms to the OEM. Additionally, even if companies (e.g. steel producers) do not set voluntary targets for future compliance on purpose, the process of gathering data and performing LCAs through voluntary targets make them better prepared for future compliance, *"we can see that now for example with CBAM, our members who have been working for a long time with LCA and with CO2 data collection and such, they are clearly more prepared for this when they must report their emissions within CBAM"* one expert at a steel association mentions (Interview E4). Hence, non-EU steel producers can through voluntary targets be more prepared for CBAM, lowering the embedded emissions parameter in the CBAM equation (as was seen in equation 1), and thereby take advantage of lower actual values than the otherwise higher default values, leading to a lower CBAM cost. This argument is further strengthened by another expert stating that voluntary targets work as a bridge to mandatory EU regulation in practice since they are moving faster, *"voluntary targets usually move faster than regulation and help firms build internal capabilities before formal compliance. They encourage data collection, supplier engagement, and early procurement experimentation. Regulation then hardens the environment by changing incentives and creating consequences for those who lag behind"* (Interview E8). In essence, the speed of the voluntary targets makes the OEMs set their trajectory, and regulation forces those, who have not yet found that direction, to wake up.

These insights are tightly tied to the reconfiguration path in the transition pathway theory, where incumbent actors adopt the niche innovation as an add-on, not a replacement. The relationship between the steel producer and the OEM shows the stability of the regime in the reconfiguration pathway. Established purchasing patterns, such as directed buy with well-known steel producers, proceed. However, the product is updated to include the niche innovation (green steel) as a technical add-on. In this, voluntary targets create the credibility needed for the transition and they allow OEMs to demonstrate to the regime actors (including e.g. investors and the EU) that their strategic ambitions are anchored in science. Voluntary commitments act as a credibility anchor to the ongoing reconfiguration of the industrial regime.

Furthermore, two OEM representatives state that the voluntary targets sit ahead of regulation since there are no legal mandates on sourcing for either passenger cars or HDVs, meaning that voluntary targets are the primary operative driver for green steel work at the moment (Interview O2 and O5). The HDV OEM representative further mentions that *"our decarbonisation requirement on the purchased material is to support* *our science-based targets. It is a 'purchasing pitch' towards reaching science based targets. [...] For steel, regulations have not steered the way at all, it is science based targets, that are voluntary, that drive our climate work right now"* (Interview O2). A steel producer representative shares the view, *"in the current situation the voluntary targets has driven the adoption of green steel"* (Interview S1). On this topic an expert states that the SBTi forces steel producers to have short term commitments and not merely 2050 ones, *"as far as I know, for the steel sector, if you want SBTi targets, you need to have at least a short term commitment by 2030 which is a good thing since it forces companies to not think at 2050 only, which always is an excuse to postpone commitments and action. If you need to look at 2030, which is really tomorrow, then you need to take action. In that sense I think it can be very useful.*" (Interview E5). On the other hand, another expert is sceptical of whether SBTi commitments are genuinely put high up on companies' agenda, arguing that its adoption has largely been driven by marketing and that companies, if it does not pay off, would do what they can to avoid following through on their commitments (Interview E6).

What is consistent among almost all the interviewees is the fact that without eventual mandatory requirements, voluntary targets will not produce the volume needed to make the transition to green steel completely, even if they contribute to some demand in an early stage.

6.2.2 The EU Regulatory Ambition and Enforcement Gap

The EU ETS Backbone and the Necessity of a Firm Phase-Out and CBAM Phase-In

Five of the interviewees name the EU ETS as the most important policy instrument of the green steel transition (Interview E2, E8, O2, S2, and S3), and others state it as central (Interview E5 and O4). Its importance is evident, since it is raised as a factor from all interview groups. One expert mentions that *"EU ETS is the backbone and single-handedly the most important factor"* on how OEMs assess and think about steel for the future (Interview E2). A steel producer representative states that *"If you just look at the EU ETS, which I still think is the most important instrument, which has sort of served us well, where they have now found and begun to get it up to a sufficient level that means you need to start making these investment decisions to actually transition"* (Interview S3), which shows that the trading system is the main reason for change. An OEM representative strengthens this view, that it has an effect even if decisions are not forced, saying that *"today there is not one single current regulatory measure that is forcing us into anything, so because the market is basically deciding it for us, for example, in the ETS or the CBAM, the ETS makes grey steel more expensive which basically makes green steel more competitive, and therefore the business case goes in favour of the green steel"* (Interview O4). The EU ETS has over many years stayed firm, showing a clear trajectory for the steel producers. Thus, the scheduled phase-out of EU ETS free allowances, alongside the simultaneous phase-in of CBAM, must remain a firm commitment to provide a clear long-term signal (Interview E1, E5, O2, and S3), *"EU ETS is another critical battle, to preserve the functioning of it. Preserve the phase out of the free allowances for the steel sector, making sure that the price of conventional steel also goes up because of* *the emissions"* one expert states (Interview E5). An HDV OEM representative agrees, *"the ETS is going to be important. That is, not giving in to the pressures that exist now and relaxing those requirements"* (Interview O2).

Even if the EU ETS creates the basis of the green steel transition, the EUA price, alone, is still far too low to close the gap between steel produced from traditional methods and progressive ones. *"At the moment, producing green steel with hydrogen price of around four euros per kilogram is going to result in around 220 euros extra per tonne than BF-BOF. So that would mean that you would have to get a carbon price of around 220 euros to level that out. And as an automotive company said to me last week, that's not politically salient, you'd have riots in the streets. So then you're dependent on other things"* (Interview E1). Given this it is clear that the EU ETS serves as the backbone, but it cannot move the market in isolation.

CBAM - Closes One Gap and Creates Another

The CBAM works as a plaster on a wound, since the EU ETS cannot extend carbon costs outside the union (Interview E2). As has been previously mentioned, the mechanism forces non-EU firms to adjust their production processes, and lower emissions, to still be competitive on the EU market. It certainly lowers emissions from steel and increases the supply of green steel on the steel market, which is characterised by huge global overcapacity (as mentioned in *section 3.1.3*), but it raises another issue, concerning resilience and the European market. *"We have historically been the most open market, particularly from China and other Asian countries that produce. They are state-subsidised and dump their steel on the European market, which has caused the import share to go from roughly 10–12% fifteen years ago to over 30% today. This means that the utilisation rate at European steel mills is actually below what is required to be profitable"* one steel producer representative mentions (Interview S3). The same thoughts echo from another expert from a steel association who mentions that *"I think CBAM doesn't hold China from dumping green steel. That doesn't hold them back to just subsidise the green steel production, and just bring very cheap low emission steel on the European market"* (Interview E6). This concern is not hypothetical: China is accelerating green steel production through H2-DRI-EAF while European projects stall. China Baowu Steel Group recently commissioned a 1 Mt H2-DRI-EAF plant, and the country has already surpassed its 2025 green hydrogen production target while reducing hydrogen costs by 40% over five years (Fuel Cells Works, 2026b; Yermolenko, 2025). This positions Chinese manufacturers on two fronts: embedding lower-emission steel into exported vehicles such as BYDs ahead of any future CBAM extension to finished passenger cars, and exporting green steel directly into the European market at a price and emissions intensity profile that undercuts domestic producers – the latter already actionable under the existing CBAM framework. However, both interviewees raise the ongoing discussion of the European Parliament regarding safeguard steel tariffs as a means to tackle this problem (Interview E6 and S3). The steel producer representative describes tariff-free quotas with tariffs on volumes above a certain threshold, to handle the overcapacity and dumping of subsidised steel (regardless of emissions intensity) on the European market, leading to foreign green steel facing the same import ceiling as traditional steel (Interview S3). On the other hand, one OEM representative notes that they would prefer competition on green steel within the EU, including from non-EU firms, since tariffs that target steel regardless of emission intensity protect high-emitting incumbents within the EU without rewarding the transition (Interview O2). Another OEM representative states, *"their capacity, specifically in China, to invest in the low-carbon process will maybe be much more important than in Europe, and maybe more fast and whatever for the climate global goals. I don't care where we produce steel, it could be in Europe or in US or in China. At the end, this is a global impact for the planet. I understand safeguard to protect steel production in Europe [...] the risk of this safe world is that we will be disconnected from all other technologies, evolution that we could find in other markets"* (Interview O1). Again, it should be mentioned that CBAM applies only to raw steel and does not cover imported components or finished cars as of today, the latter of which remains excluded even after 2028.

CBAM, regardless of the debate on European resilience and protection from non-EU competition, drives demand for green steel indirectly through price. By raising the cost of high-emission steel imports, it narrows the gap between traditional steel and green steel on the European market, leading to a decrease in the green premium that lands on the OEM. Consequently, as the green premium falls, the business case of green steel towards the automotive sector strengthens, especially since OEMs are as cost-focused as they are.

The Quiet Force of CSRD, CSDDD, and the EU Taxonomy

While interviewees did not explicitly evaluate CSRD, CSDDD or the EU Taxonomy, several describe things that these instruments are designed to activate (Interview E5, E6, O3, O4, and O6). The three instruments established in *section 3.7.3-3.7.5*, could be seen as a chain, where CSRD makes supply chain emissions visible through mandatory reporting, the EU Taxonomy converts that visibility into financing value by enabling green bonds and improving the GAR of lending institutions, and CSDDD is designed to convert reporting into legal accountability by requiring companies to act on supply chain impacts rather than merely disclose them. The first part of this chain is already observable in practice. A mid-range OEM states that Scope 3 upstream emissions are getting more and more important, *"now we are more or less monitoring our complete supply chain [...] we are actually trying to monitor to get all the relevant data, we are obliged to publish our ESG report, so a lot of work is currently going on with this one"*, explicitly identifying the sustainability report as the primary lever for addressing green steel at this stage (Interview O6). This illustrates precisely what CSRD is designed to produce, transparency that forces companies to map and measure supply chain emissions as a precondition for action. Consequently, that enforced transparency makes it easier for investors to make informed decisions. A researcher from a transport and climate research institute argues that investor attention to portfolio carbon exposure is increasing and that companies ultimately do what shareholders want, *"I think investors are getting more attention towards their portfolio, and this also translates to cars. So if you know that a car producer uses more than average coal based steel, more than the industry average, for example, then that would be another pressure point [...] in the end, companies do what the shareholders want"* (Interview E5).

Two further OEM representatives describe another link in the chain, green bonds tied to CO2 reduction targets covering both electrification and materials that create capital market obligations making green material procurement (e.g. green steel) a financial commitment rather than a purely voluntary commitment. This is precisely the mechanism the EU Taxonomy is designed to activate; it converts sustainability ambition into structured financial obligations, by enabling green bonds and improving the GAR of banks. One representative, describing the connection between green bond obligations and steel sourcing decisions, states that *"there is a linkage there that's very clear"* (Interview O3) and another confirms that green financing linked to CO2 targets creates a requirement that goes beyond public relations (Interview O4), without either naming the EU Taxonomy explicitly, yet what they describe is its intended effect in practise. Note that this bond mechanism is different from lending rate incentives, which do not yet exist in practice.

A representative from a steel association argues that if banks were to offer lower interest rates for OEMs reducing their Scope 3 emissions through green steel procurement, it would improve the business case for green steel, but that financial institutions are currently unwilling to accept the lower margins this would require (Interview E6). The representative suggests that state-backed institutions could link green steel procurement to subsidised interest rates as an industrial policy tool. The EU Taxonomy creates conditions for preferential treatment of sustainable investments at the bank level, but as the representative's idea shows, this has not yet resulted in lower interest rates for OEMs sourcing green steel.

Ultimately, CSRD's scope has been narrowed by the Omnibus package, and CSDDD, introduced in *section 3.7.4* as the instrument designed to convert reporting into legal accountability, has been delayed to 2029, meaning the enforcement link that would impose company action on what they disclose is absent when the green steel market needs it the most.

6.2.3 The Automotive Package Proposal: Demand Creation, Gift to Laggards or Both?

Materials Directly Enter the Automotive Policy Conversation

Many interviewees, across the three interview groups, hold the automotive package as an important driver for OEM demand for green steel (Interview E1, E5, E6, E7, E8, O1, S2, and S3). A representative from a steel association categorises the automotive package as the most important regulatory framework on steel related sourcing decisions, highlighting the low-carbon steel credit (Interview E6). At the same time, the representative acknowledges that OEMs that have already transitioned to EVs do not gain the low-carbon steel credit when using green steel, *"That is a black box right now for me [...] one could integrate a kind of pooling option between the OEMs for green steel, so that, for example, let's say Volvo keeps its strategy on fully electric vehicles. But they also want to use green steel that they can kind of offset, or pool together with somebody else, to reach the target, so to have a bigger flexibility. But that is very hard to say what impact this will have"* (Interview E6). A representative from an OEM also states that there is no pooling of the credits, meaning that the credit is useless for OEMs that has transitioned to EVs (Interview O3). Beyond this the representative raises a deeper concern, having already divested its ICE division the OEM finds that a policy framework that reintroduces ICE flexibility creates new development costs on platforms already discontinued, while at the same time offering no credits to offset green steel adoption, squeezing margins from both sides (Interview O3). A transport and climate research expert extends this issue to the systemic level, arguing that the flexibility design of reducing the target of tailpipe emissions to 90% beyond 2035 is problematic, *"if you keep changing the rules every two or three years, then you don't have enough stability of the rules to invest, right? And so if they think, okay, maybe I can get out of this, they don't invest. And it's a self fulfilling prophecy. You arrive at two years from where you have to reach the target, or on the year where you have to reach the target, and you say, I cannot reach the target. And yeah, we roll back regulation"* (Interview E5). Despite these concerns, an academic expert firmly states, *"whether one agrees with the design or not, the signal is clear: materials are entering the automotive policy conversation much more directly"* (Interview E8).

A climate and energy policy expert mentions that the demand signal of the package is already visible in the market, saying that it has forced OEMs to think through where they will source green steel from and whether the volume will exist (Interview E1). Furthermore, the expert says that steel producers reach out to the institute asking *"is there enough? Like, can we say to automotives that we can do this?*, just to get a figure from an independent source to stand behind, even if they have the numbers already. The numbers add up, as was also discussed in *section 3.7.7*, *"the automotive package has turned out to be, like a really key moment in driving demand"* (Interviewee E1). A representative from a steel producer says that the package *"is good and it's needed"*, and that along with voluntary actions it is important to force the change to some extent as well (Interview S3). A mid-range OEM representative raises the issue of insufficient supply availability in this context, *"if we don't have 50 million tonnes of low-carbon steel in Europe, the impact will be a very strong inflation of cost due to shortage capacity and the fact that everyone want to get some local steel to have the benefit of the incentive. My point, I'm not sure to drive the market with this kind of incentive package"* (Interview O1). Instead, the representative wants to see a roundtable solution where the European Commission, automotive industry, steel producers, and energy producers collaborate to align the ecosystem towards a cost-based price. Without this, the representative fears that high green premiums will make the OEMs uncompetitive, destroying car sales volumes which both automotive and industries rely on to uphold profit. Another mid-range OEM states that the automotive package and the IAA have increased their interest of green steel, by elevating green steel procurement onto the agenda in top management, but it is blocked by insufficient supply availability and regulatory inconsistency (Interview O6). The OEM representative says that they try to source steel with an emissions threshold of 0.7 tCO_2 per tonne, but they cannot secure it at the required volumes. Regarding the regulatory inconsistency, the OEM representative mentions the contradiction between the automotive package and the IAA where the automotive package include the made-in-EU criteria while the IAA does not (Interview O6). Consequently, the procurement team does not have a coherent framework to build their strategy on, which makes it difficult to make progressive decisions.

The information presented in *section 6.1.4* regarding the engagement with green steel in an early stage of a vehicle program is relevant here as well. Since procurement decisions on vehicle programs entering production in 2033-2035 are made in the next couple of years, the Automotive Package is expected to shape purchasing decisions soon, even if it is not yet seen in purchasing volumes. Given this, the package engages OEMs in conversations of green steel, entering strategic sourcing conversations where procurement decisions are made. However, the full effect of how the Automotive Package actually translates into demand for green steel remains to be seen. Yet, one expert explicitly argues that the starting date of the Automotive Package is too far ahead to genuinely work as a lead market instrument, *"If you want to build a lead market, it has to start from 2030 on [...] all we can do is bet on the proposal, the automotive package proposal, and move the starting day to 2030"* (Interview E7).

A Gift to Laggards? - Who the Demand Signal Reaches

A scenario of the low-carbon steel credit was portrayed in *section 3.7.7*, where the value of the green steel credit (estimated based on CO2 non-compliance fines) was put in relation to the estimated additional cost of green steel. A transport and climate research expert confirms the calculations on the credit and expresses that it will contribute to 15 Mt of annual low-carbon steel demand, a figure the representative argue both BMW and Volkswagen have confirmed goes in line with their own internal calculations (Interview E7). This shows that the figure is not only an independent projection, but a figure OEMs have validated themselves privately, strengthening the effect of the package. A further transport and climate research expert was asked whether the credit is a gift to laggards the answer was clear: *"absolutely, 100% agree. It's really a gift to the laggards"* (Interview E5). The other expert agrees, *"it's not perfect, it's not ideal, because it's partly diluting the uptake of electromobility"* (Interview E7). This view is interesting, and it is examined further in Figure 17, including the potential pooling option that was discussed in the previous segment, even if no pooling mechanism is defined in the current proposal.

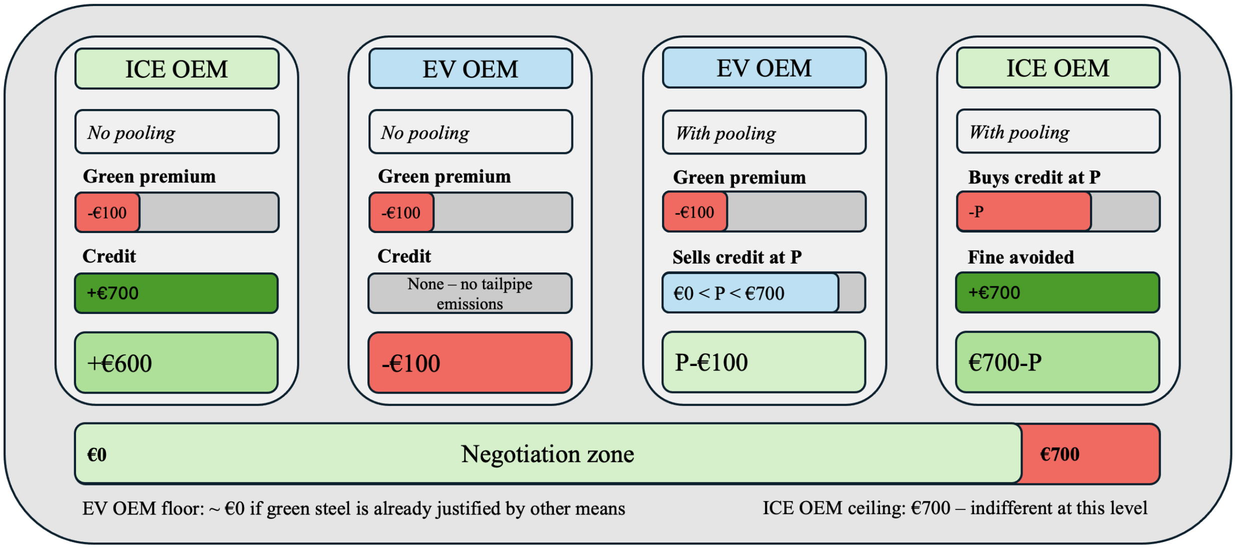

Figure 17: Scenarios of the low-carbon steel credit given pooling or no pooling, where the price of the credit (P) is determined by bilateral negotiation. The total surplus is €600 per car in both scenarios. Pooling merely redistributes it between ICE OEMs and EV OEMs, it does not create more value.

Since compensation is restricted to tailpipe emissions, OEMs that produce ICE or HEV cars will benefit the most. In the scenario of no pooling, which is the case the package proposal presents, an ICE OEM faces a cost-saving of €600 and an EV OEM faces a cost-increase of €100 per car by purchasing low-carbon steel. If pooling would be integrated into the proposal, an EV OEM could sell their credits, gained from using low-carbon steel in their cars, to OEMs that generate tailpipe emissions. As seen in Figure 17, where the price is set through bilateral negotiations*, the expected price range would be €0 < P < €700. The reason why the lower boundary is set to €0 instead of €100 (which would be sound given the additional cost of low-carbon steel) is that the seller might see benefits in other areas (e.g. SBTi commitments, green bonds, CSRD reporting) that justifies the cost. Therefore, it is up to the negotiating parties to decide on an appropriate credit price that signals its value. Thus, the outcome per car of the EV OEM (P - €100) and the ICE OEM (€700 - P) can vary heavily following the price span. As the proposal currently stands, the credit exclusively favours ICE and HEV OEMs since no pooling mechanism is defined. Even if pooling were introduced, it would broaden the demand signal to include EV OEMs, generating additional demand, but the underlying incentive structure would remain misaligned with a net-zero trajectory, the instrument rewards those who cling on to combustion engine production longest rather than those who transitioned earliest.

Another aspect raised by two OEM representatives is that steel producers would adjust their pricing of green steel upward, knowing the regulatory value it gives their customers (Interview O1 and O3). This would

*P, in this example, is determined through bilateral negotiation. For instance, it could also be issued into a registry, and traded on a market or through a broker, similar to the EUA, where supply and demand determine the price. That would ultimately change the outcome.

ultimately apply to the credits through the Automotive Package as well. One premium OEM representative states that if mandatory content requirements were introduced, buyers would be *"held to ransom on the price"* (Interview O3). The other adds that *"steel mills are very smart, they will give a premium in regards of the penalty we could face or incentive we can save"*. This pricing dynamic would add further complexity, to a scheme whose incentive logic is already structurally misaligned, and erode the cost-savings the mechanism is designed to create. Furthermore, this pricing concern is acknowledged by a climate and energy policy expert who observed that the auto industry lobbied explicitly against mandatory green steel content in the legislative processes of both the Automotive Package and the IAA, accepting voluntary flexibility while resisting quotas (Interview E9). The climate and energy policy expert states, *"we did see quite a lot of pushback from the auto industry saying, no, this is right now, not what we want, the voluntary side, yes, but they want to do it on their own terms"* (Interview E9). Thus, what the two OEM representatives express in terms of potential price captivity following mandates is not solely an anticipated risk, but the position the industry took in the most relevant EU policy processes recently.

As previously established in *section 4.1.2*, the green steel transition is following a reconfiguration pathway, where green steel is adopted as an add-on to the existing regime rather than replacing it. As also covered in *section 4.1.1*, pushing green steel fully into the diffusion phase requires both support from automotive lead firms and EU regulatory frameworks, where the Automotive Package is one. In that sense the instrument contributes to the diffusion conditions needed for green steel; by creating direct demand which facilitates its movement along the learning curve and provides the investment certainty that steel producers require to scale production. However, by integrating green steel into the compensation conversation of ICE production rather than accelerating the shift away from combustion engines, it simultaneously stabilises the automotive regime against the landscape pressure needed for its own transformation. Hence, the Automotive Package is an enabler of green steel diffusion and at the same time a weak transition instrument for decarbonisation of the transport sector, advancing one reconfiguration while slowing another.

6.2.4 The IAA and the Standardisation Gap: How the Absence of a Definition Blocks Market Formation

The absence of a unanimous definition of green steel is one of the most consistently raised obstacles across all interviews, named by experts, steel producers and OEMs as a structural barrier that prevents market formation even when clear demand intent exists. The IAA was anticipated to resolve this. Released in March 2026, it was expected to provide either a label or an emissions threshold for low-carbon steel that could serve as a reference for procurement teams. The publication was described by a climate and energy policy expert as *“a slight disappointment when it comes to what we were expecting, what we were hoping, in terms of a label”*, where the label and definition was deferred to the upcoming ESPR, expected towards the end of 2026 or into 2027 (Interview E1). Still, the climate and energy policy expert argues that the direction — a sliding scale approach that distinguishes primary and secondary production routes, with mass balance likely to be accepted — is now reasonably clear. However, the absence of a formal label at the moment when the

Automotive Package and the IAA together are generating procurement interest means that OEMs are being asked to contract for something they cannot yet define.

In the absence of an EU definition, each OEM has developed its own internal framework. The result is a fragmented market in which the same material can qualify as green steel under one company's criteria and not under another's. One OEM procurement representative opens the interview by directly flagging the problem, *"let's define green steel first, because there are thousands of definitions"*, and notes that they have made its own definition because a process of reaching consensus risks being shaped by lobbying towards a weaker standard that would fall short of the company's own ambitions (Interview O4). The same representative expresses the integrity risk regarding the mass balance practice, sometimes labelled as green steel in the market, which in the representative's view is *"as green as running a diesel"* (Interview O4), a characterisation that illustrates how the definition absence enables claims that undermine market credibility. An academic expert confirms the same concern from a risk management perspective, noting that a standardised definition would reduce the risk of perverse incentives and what he calls *"creative accounting"* by actors attempting to get round honest emissions reductions (Interview E2). Another academic expert confirms that the commercial value of green steel for branding purposes only holds if the underlying claim is solid, *"the commercial value only holds if claims are robust. If the definition is vague, the same visibility that helps with branding can quickly become a reputational risk"* (Interview E8).

The internal definitions that OEMs have developed in the absence of a common standard reflect different strategic priorities and reveal a deeper disagreement about what the transition to green steel is actually for. One HDV OEM representative notes that their earliest definition from 2018-2019 was anchored in H2-DRI, and that the LESS standard currently reflects their view in the best way, a standard that rewards primary route decarbonisation and applies a penalty for high scrap shares, on the basis that it is the primary production path where the largest emissions reductions occur (Interview O2). The same representative is sceptical about an EU-mandated definition, arguing that the loudest voices in Brussels tend to be those with the worst green transition prospects and that the outcome would likely favour incumbents over first movers. Another mid-range OEM representative takes a different position, using the GHG Protocol as an internal framework rather than prioritising a certain production pathway, tracking emissions intensity against their current 2.5 tCO2/t reference and seeking reductions across scrap-EAF, NG-DRI and H2-DRI routes depending on availability and cost (Interview O1). Thus, for them, flexibility across production routes is the priority, an EU definition that restricts low-carbon steel to H2-DRI only would exclude the circularity-based reductions that form the first step of their decarbonisation pathway. As discussed in *section 6.2.3*, another mid-range OEM is attempting to source steel at around 0.7 tCO2/t steel but cannot secure supply at the required volumes, and is also constrained by internal procedures that prohibit purchasing mass balance steel until the EU formally approves the methodology, meaning that even the limited supply that exists cannot be procured (Interview O6).

The standardisation gap also creates a specific problem for the Automotive Package and the IAA proposals, operating simultaneously with different criteria. As already established in *section 6.2.3* the Automotive Package includes a made-in-EU criteria for low-carbon steel to qualify for the credit, while the IAA dropped the made-in-EU requirement for steel before publication, making it impossible to build a single sourcing strategy that satisfies both. This ambiguity regarding the made-in-EU criteria also connects back to the CBAM-problem concerning resilience (mentioned in *section 6.2.2*) where Asian countries dump steel on the European market. Additionally, still no one knows what low-carbon means in practice, which further enforces the regulatory ambiguity. When an academic expert is asked whether a standardised EU definition or label would increase the strategic or commercial value of green steel for OEMs the answer is clear, *"Yes, substantially. A standardised definition or label would reduce confusion, lower due-diligence costs, and make internal decision-making easier across procurement, legal, sustainability, and communications teams. It would also help steel producers by making claims more comparable and potentially more financeable. One of the clearest messages coming through recent work is that buyers want simplicity and comparability, not another layer of marketing terminology"* (Interview E8). A steel producer representative expresses that the definition and label debate has been ongoing for many years, the industry cannot find a compromise, and it would be better if the EU Commission or some other authority simply decided (Interview S3).

The label of the delegated act of ESPR, will – when it arrives – be a significant moment, and its likely design is probably already clear enough to provide some investment certainty (Interview E1). But the delay means that the period in which the Automotive Package and the IAA are shaping procurement conversations the most is also the period in which the definition landscape is the most absent. The consequence for demand is that without a shared definition, OEMs cannot ensure that the functional specifications they write carry a credible low-carbon claim. This matters at scale since, as established in *section 3.5*, the specification of the entire supply chain is often unified and communicated by the OEM through the directed buy process, aggregating into the volume signal that steel producers need to justify investment decisions. Without definitional clarity, that signal loses its credibility. At the same time, steel producers cannot make comparable claims, financiers cannot assess what they are funding, and regulators cannot enforce thresholds. Each of these failures blocks a different part of market formation, and together they explain why demand intent alone is insufficient to move the green steel market forward. As established in *section 4.1.2*, green steel is currently in the early stabilisation stage, where powerful actors have joined the support network but price and performance improvements have stalled partly because the niche lacks the institutional anchoring that a common definition would provide. Moreover, the concern is not only that the institutional anchoring has been delayed, but also that what arrives might not be in the form the market requires. A climate and energy policy expert monitoring the ESPR process notes that the Joint Research Centre's current steel class methodology positions some coal-based steel making into the same category as EAF production, which means that a buyer of class B steel under the proposed groups would satisfy procurement criteria while delivering poor climate outcome (Interview E9). As the representative puts it, *"it would give off-takers an incentive to buy Class B steel because it still looks pretty good on the face of having a sticker that goes from A to D or E and being able to put a B on a product* *has a nice advertising effect, but actually doesn't have a very positive climate outcome"* (Interview E9). The label is therefore not only absent, but risks arriving in a form too weak to enforce change.

The demand intent presented across this section is real, but it is currently running ahead of the institutional infrastructure needed to convert that intent into contracted volumes. Until a definition exists, green steel remains a strategic ambition that the market cannot yet fully act on.

6.2.5 The Coordination Failure

Across ten of the interviews conducted, including all interview groups, the coordination failure, or named components of it, emerges as the primary barriers to green steel deployment (Interview E1, E2, E3, E5, E8, E9, O2, O7, S1, and S3). When addressing the coordination failure described in this section, it primarily applies to the primary production route of H2-DRI-EAF. Secondary production through scrap-EAF is already commercially deployed globally, and not dependent on hydrogen infrastructure, even if it is dependent on electricity prices as previously discussed.

From Technology Readiness to Deployment Deadlock

It is known from previous sections that the demand intent for green steel is real and that the technology for progressive production is already there. Thus, the issue is now deployment, not innovation. What has also been discovered, is that collectively these conditions are not sufficient. The structural barrier is not a lack of willingness but a coordination failure that no single actor can resolve alone, and which voluntary targets and individual OEMs, are structurally incapable of breaking.

The starting point for understanding the coordination failure is the production economics established in *section 3.4*. The LCOS gap between H2-DRI-EAF and BF-BOF is driven primarily by green hydrogen costs, and the conditions for cost parity require a combination of lower hydrogen prices and a carbon price high enough to penalise traditional production to the extent needed. These conditions remain unmet in Europe today, where the EUA price falls short of the level required to close the gap at high hydrogen costs. An expert frames that the problem is not only the high initial investment costs but a coordination problem along the entire value chain, *"it is a coordination problem along the value chain. You need to invest both in these expensive new processes, but at the same time, you need the expansion of fossil-free electricity, for example"*, and that kind of simultaneous commitment across multiple actors is something the market cannot solve by itself (Interview E3). One steel producer representative gives a wider explanation of the situation, *"I think it's illustrated quite well by the high-level political discussions of recent weeks, most recently at the summit with heads of state and government in Brussels. In Europe, we are in a situation where we are still heavily dependent on fossil fuels. You've had Germany betting on shutting down nuclear power and bringing in gas. That went south. So you're in a position where energy prices are very volatile and generally quite high. Then, the Commission is betting on this hydrogen revolution that was supposed to happen, which hasn't really happened either. So I think that* *as these many projects got underway, people realised that it's very difficult to find a business case for this. And that is primarily because the input is too expensive. Now, we're talking on a general European level, at least that's my perception. Furthermore, I think people have mistakenly attacked the ETS and carbon pricing"* (Interview S3). The struggle with hydrogen infrastructure is not only a European issue. An HDV OEM representative explains that the reason why Japanese steel producers have not taken the step of investing in DRI plants is that hydrogen availability in Japan is too uncertain, and that this will not change without a clear governmental decision on hydrogen production and pipeline infrastructure, *"hydrogen is the key, if availability or some strategic governmental decision arrives on how to produce hydrogen and how the infrastructure of the pipeline will be prepared, then steel mills will make a strong step to make a strategy to shut down current BF to be replaced by DRI"* (Interview O7). Since the same issue contributes to the European project stall documented in *section 3.8*, it confirms that it is a structural failure of the H2-DRI-EAF transition pathway rather than a contingent European policy failure, and ultimately it affects the supply of green steel in the region. Consequently, the demand for green steel is negatively affected if the realisation of it, through supply, seems out of reach.

The Chicken-and-Egg Problem

Another part of the coordination problem is described by a transport and climate research expert, *"I think it's a chicken-and-egg problem. On the demand, the automaker say there's no production, and the steel producer say there's no demand. I cannot invest because nobody will buy it. And so we're in this short circuit of inaction"* (Interview E5). That builds on the strategic hesitation that characterises the green steel market towards the automotive sector, as mentioned in *section 3.8*, since neither steel producers nor OEMs feel certain enough about the trajectory of the market, which is essential for long-term investment decisions. In essence, steel producers need offtake certainty to take final investment decisions (FIDs), OEMs will not sign binding offtake agreements without supply certainty and price visibility, and financiers will not fund projects without offtake. A climate and energy policy expert frames the same deadlock from the investment side, *"it's a chicken-and-egg problem [...] Who goes first? Somebody dropping tremendous amounts on CAPEX in transitioning or setting up new capacity, or is the auto industry and other industries willing to up their OPEX considerably to produce greener cars?"* (Interview E9). One green steel producer representative explicitly states the importance of this in regards to their operations, *"we have already sold over 50% of our volumes for the first 5-7 years, which was a prerequisite for reaching financing [...] the price follows market price and then there is a firm green premium on top of that"* (Interview S1). Additionally, the representative mentions that to secure the deals at an early stage the OEM purchasing departments had to be bypassed since they could not produce the strategic commitment required to finance a multi-billion euro FID, *"it was very much CEO to CEO strategy"* (Interview S1). The representative further adds that several OEMs became equity owners in the project, thereby being both owner and customer (Interview S1). OEMs receive certainty in terms of price, however, they are merely entitled to supply when and if it arrives, leaving the commitment conditional on delivery timelines that remain uncertain.

This strategy shows viability but the demand signals that existed have now weakened, *"you can see from history what happened so the OEM started buying up green steel offtake in like 2022 because they presumed that there would be big, large scale EU-wide legislation around mandates for green steel, and legislation that would ensure that they had to procure a certain amount of green steel by a certain date. And so they were all getting in early to get the lowest prices possible whilst offtake was still plentiful, or future offtake was still plentiful, because the less the supply, the higher the price. So yeah, they were doing that, but now they don't see those mandates coming down the pipeline, and they don't see the legislation being very strong or even impactful to the market. I mean, the IAA is just a big bunch of words. So I think that their risk management strategy is now wait and see which is kind of we're back to where we started. We're back to the to the starting block"* (Interview E1). The early demand signal – anchored in strategic determination – that was about to solve the chicken-and-egg problem faded out when the landscape did not create sufficient support for the transition. The result is a state of strategic hesitation that has not triggered the FID wave needed to move green steel from the stabilisation stage toward deployment at scale into the diffusion phase.

The Systemic Character of the Wait-and-see

Perhaps the chicken-and-egg problem, through its bilateral deadlock, is the most visible expression of the coordination failure, but it does not end there. The logic operates through several parts of the system. For starters, banks do not offer lower lending rates for OEMs reducing their scope 3 emissions through green steel procurement, as established in *section 6.2.2*. The same logic extends to equity investors. A climate and energy policy expert who has participated in earnings calls for both steel producers and OEMs notes that green steel does not occur as a topic from institutional investors unless capital investment in the billions is on the table, and that quarterly returns are in focus that prevents long-term commitments, *"investor expectations matter only in the negative at the moment, whereas featured, what we see is that they just want steel producers and carmakers to meet ROI expectation, and that's it"* (Interview E9). This short-termism that affects both steel producers and OEMs works against the long-term commitments required to solve the coordination failure. Moreover, voluntary targets give validation and credibility to OEM claims, as was explained in *section 6.2.1*, but do not produce the offtake volumes needed to make FIDs viable. The definition gap (raised in *section 6.2.4*) shows that even where demand exists, purchasing teams have a hard time writing functional specifications, that carry a low-carbon claim, that steel producers can deliver on. These bilateral deadlocks are possible to sort individually, but together they create a system of nodes where the rational answer of each actor is to wait for the others. One academic expert describes the dynamics, *"the policy mix still does not fully solve the classic green steel problem: high upfront investment, uncertain premium capture, and inconsistent definitions in the market. So I would say EU policy is becoming more supportive of demand creation, but it still needs stronger coordination between climate policy, industrial policy, and market standards if it wants to turn pilot demand into large-scale offtake"* (Interview E8). The coordination failure is therefore not a bilateral problem between the steel producer and the OEM that can be solved in isolation, the build-up of factors have generated a system-level wait-and-see condition.

The Landscape Has Not Applied Sufficient Pressure

What keeps the system in this wait-and-see condition is the lack of sufficient landscape pressure to make the current state more costly than the transition. As mentioned in *section 6.2.2*, the EU ETS is deemed to be the most important policy instrument of the green steel transition since it imposes a cost trajectory on carbon-intensive traditional production methods over time that no actor can negotiate away or escape from. The instrument has reached a point where investment decisions need to begin, not a level where they are forced, and this gap constitutes the space where the coordination failure now lives and thrives. The policy instruments that have been introduced apart from the EU ETS (the Automotive Package, the IAA, CSRD, and others) create demand signals in the right direction, but as established in *section 6.2.2-6.2.4*, none of them create the mandates that would remove conditionality from both sides of the deadlock. Strengthening these signals into enforceable requirements is, however, not straightforward. As raised in *section 6.2.2*, Chinese and other Asian producers – that do not operate under the same carbon obligations as in the EU – have increased their market share in the European steel market through state-subsidised production. The OEM side of this is captured by a mid-range OEM representative, *"at the end, if we're not competitive, we are not selling cars. If we are not selling cars, we don't have volume. If we don't have volume, you don't have a steel to sell"* (Interview O1). This shows the interdependency of the value chain where any policy that raises the cost of steel production in EU without applying equivalent pressure on imported steel risks disadvantaging European steel producers, and any policy that raises the cost of European vehicle production without applying equivalent pressure on imported cars risks disadvantaging European OEMs, primarily against Chinese vehicle producers who do not face the same obligations and requirements. This policy issue is therefore not only connected to ambition but also to calibration, where the landscape pressure must be strong enough to enforce transition but at the same time not place European actors in a position of disadvantage globally. The power of the landscape is what will truly make the green steel transition come to life, one academic expert frames it plainly, *"if there isn't policy that actually creates demand and ensures that emissions are properly priced, I don't think this will happen"* (Interview E3).

Stuck in The Stabilisation Stage: Answering the RQ Through the Lens of Coordination Failure

The coordination failure ultimately reveals the gap between demand intent and certainty, and this gap addresses both research questions. The OEM business case has revealed several things: fleet customers are demanding scope 3 emissions reductions, green bonds create finance obligations for the OEM, SBTi anchors strategic direction, and early engagement with green steel and its producers offers advantages in terms of risk management. However, as this section has discovered, the business case is dependent on conditions that the OEM cannot control, such as supply availability, price visibility, and regulatory stability. Therefore, it creates the intent but not the commitment that steel producers need to take long-term FIDs of green steel projects. In terms of the beyond valley of death framework that was established in *section 4.2*, green steel has passed the demonstration phase but has not yet reached deployment at scale. The scale condition of the framework means that new infrastructure complexities arise in the midst of upscaling, which was not seen before. The radicalness condition means that the energy price volatility prevents the reliability of progressive production pathways. Furthermore, the fragile demand pull condition means that structural uncertainty is implicated when investment payoffs are dependent on policy action, and this becomes especially complex when policy actions risk being revised. The window of opportunity in the early 2020s where OEMs committed, green steel producers secured offtakes, powerful actors joined initiatives like FMC and SteelZero, is exactly what the MLP theory describes, where pressure from the landscape aligns regime actors towards the niche innovation. That window closed without triggering full diffusion into main markets due to the absence of mandates. Green steel remains in the early stabilisation phase at stage 2 within that phase, as was established in *section 4.1*, the support network has taken shape but price advancements have stalled due to the coordination failure preventing the required volumes to reach stabilisation stage 3. As was noted in the start of this section this argument applies primarily to the route of H2-DRI-EAF since secondary production through scrap-EAF is already deployed commercially, even though it faces its own problems in terms of electricity prices and scrap content quality and availability.

To answer research question 2 directly; emission targets and EU regulatory frameworks drive demand intent but not demand certainty, they are necessary but not yet sufficient, and not yet clear or robust enough for actors to act on them decisively. For OEMs with serious long-term decarbonisation commitments, green steel is a necessity rather than an option, especially when tailpipe emissions are already eliminated. As stated in *section 6.1.1*, *"for serious long-term decarbonisation, green steel is not optional"* (Interview E8). However, it is a necessity they cannot yet act on at scale, which the coordination failure establishes. Voluntary targets – through frameworks like SBTi – build capability, give third-party credibility to strategic climate ambitions, and keep green steel on corporate agendas, contributing to demand in an early stage. However, neither regulatory frameworks nor voluntary targets produce the simultaneous, mandatory commitments across the value chain that solve the coordination failure and allow the supply of green steel to scale. Until supply scales, demand cannot materialise, since OEM WTP only exists where supply certainty exists, and supply certainty requires the kind of landscape pressure that the current policy mix has not yet forced, despite its ambition.

7 Discussion

This study investigates the business case for green steel within the European automotive sector, and to understand the role of emission targets and EU regulatory frameworks in generating OEM demand. The aim was to understand OEM decision-making on green steel procurement and to explain why demand intent has not translated into demand certainty. The two research questions are answered with empirical grounding across a diverse sample of industry and policy expert, OEM, and steel producer perspectives, and the findings are rich. At the same time, due to the study's scope, several questions that surfaced in the data could not be pursued within the current research design.

7.1 The Business Case and Its Limits

The most significant contribution of the study is not a single finding but the structural deviation it reveals between how the business case for green steel is framed externally and how it is experienced internally by OEMs. Prior literature has often modelled the green premium as an affordable addition to vehicle cost, typically framing it as less than 1% of final vehicle price and therefore something a sufficiently motivated manufacturer could absorb or pass on to the end-consumer. The OEM interviews dismantle this framing and add a new dimension to it. Procurement in automotive manufacturing is not organised around vehicle price as a unit, it is rather organised around margins. A material cost increase of around €200 per tonne at low margins is a direct and measurable reduction in profit. The numbers, when applied at high volumes, produce cost differentials in the hundreds of millions of euros. This finding does not mean that external analysts are wrong about the size of the premium; it means they have modelled it against the wrong baseline. The implication for future research is that studies of green steel WTP should look more into the OEM-side margin structures as their baseline, not vehicle price, and that policy instruments designed to create demand at the OEM level should be calibrated against margin sensitivity rather than consumer price elasticity.

The cost pass-through finding also has a dimension that the study surfaces but does not fully resolve. Some experts expressed scepticism about the OEM margin constraints, noting that competitive dynamics shift, that consumer attitudes to sustainability may recover from the current low-engagement period, and that OEMs may be overstating the difficulty of absorption to maintain a negotiating position with both steel producers and regulators. This scepticism cannot be entirely dismissed, however, the study does not have the data to pursue it. What can be said is that the OEM position is consistent across OEMs with different market positions, procurement structures, and stated climate ambitions, which makes it unlikely that negotiating tactics alone explain why so many different organisations say the same thing. Another question, noted in the results but not resolved there, is whether OEMs have actually tested the assumption that consumers cannot absorb the premium, or whether the impossibility of cost pass-through has become a default position repeated across the industry rather than a conclusion drawn from a solid analysis. The study's results acknowledge that the argument rests on OEMs having correctly assessed their customers' price sensitivity, which is in practice not established. What remains unsolved is whether the OEM margin analysis correctly portrays consumer WTP, particularly in fleet and premium segments where price sensitivity may be lower than OEM procurement teams assume.

7.2 Targets, Regulation, and the Coordination Failure

The study finds that voluntary frameworks function primarily as mechanisms for regulatory readiness and strategic direction, shaping the conditions under which sourcing decisions are made rather than directly driving them. The rewarding contribution to the study lies in the distinction between demand intent and demand certainty as separate categories. Voluntary targets are effective at maintaining the first. They keep green steel on corporate agendas, create an environment of Scope 3 data gathering, and provide third-party credibility for climate commitments that financial stakeholders and fleet customers increasingly require. What they cannot produce is the binding, simultaneous commitment across the value chain that steel producers need to take long-term FIDs. The practical implication is that voluntary frameworks should not be dismissed because they fail to drive procurement of green steel directly, nor credited with more than they can deliver. They are doing preparatory work that mandatory regulation will eventually need to build on, but that mandatory regulation cannot be replaced by them.

The coordination failure is one of the study's central concepts, but it deserves direct scrutiny. The basis for it rests on what interviewees say rather than on what they do, and that distinction matters. The main actors in the value chain point at each other as the reason commitment is not possible: OEMs cannot commit without supply certainty, steel producers cannot invest without demand certainty. This is consistent with a genuine structural deadlock, but it is equally consistent with a situation where no actor faces sufficient pressure to move and the coordination problem functions as a convenient justification for inaction. The study's design cannot distinguish between these two situations. Furthermore, if the problem were primarily one of coordination, a sufficiently strong mandate should in principle solve it by forcing simultaneous commitment across the value chain. Yet several interviewees, including OEM representatives, indicated that even under mandatory content requirements they would face pricing captivity from steel producers and insufficient supply availability. That suggests the underlying constraint may be less about coordination and more about a fundamental gap between what green steel costs to produce at scale and what the automotive value chain can absorb or push on to end-consumers, a price problem that institutional design cannot solve on its own. The coordination failure framing is analytically useful, but it may be overstating the degree to which the transition would unlock if the right policy signals were in place.

The absence of a standardised EU definition of green steel is consistently raised across the interviews as a procurement blocker, but it is worth questioning how much of a blocker it actually is. Voluntary standards already exist, including LESS and ResponsibleSteel's International Production Standard (see *section 3.3.3*), among other frameworks, all of which OEMs could use to anchor functional specifications in procurement today. If the definitional gap were the primary barrier, these frameworks would be sufficient to initiate procurement at scale. The fact that these standards are already in use without triggering purchasing volumes suggests that the definition is not necessarily the binding constraint. The deeper issue is that OEMs do not see sufficient additional value from sourcing steel that meets the more ambitious standard levels, since the commercial, regulatory, or reputational reward for doing so has not yet revealed itself. Perhaps, for less climate ambitious OEMs in particular, the absence of a formal definition becomes a convenient scapegoat, a way to avoid procurement commitments that the existing voluntary standards would already permit, until a mandatory framework forces their hand. OEMs and steel producers broadly understand what lower-emissions steel looks like and where it can be sourced, even if H2-DRI-EAF supply remains scarce at scale today. What is missing is not the label but the commercial incentive to pay for it at current price differentials. A standardised EU definition would reduce transaction costs, enable green financing, ensure credible claims, and create a common basis for mandatory instruments. Therefore, it is not irrelevant. But solving the definition gap alone would likely remove one stated justification for inaction, but the underlying price and margin problem would remain untouched. The EU definition may therefore function less as a trigger of action and more as commercial safety, a credible reason to defer commitment until the regulatory environment removes the financial risk that voluntary action currently requires each actor to bear alone.

Additionally, both the IAA and the Automotive Package are proposals by the EU Commission, not yet established law. Neither has been voted on or formally adopted by the European Parliament and Council, and both remain subject to amendment, delay, or rejection through the legislative process. The demand signal that several interviewees attributed to the Automotive Package, the elevated management attention it has generated within OEM procurement functions, and the calculations that have led OEMs and independent sources to internally validate figures on green steel volume demand, all rest on a proposal that may not pass in its current form, or at all. Thus, steel producers are being asked to take FIDs against a cost and revenue environment shaped partly by mechanisms that do not yet have legal force. The OEM representatives who described strategic interest in green steel as partly driven by regulatory preparation are preparing for a regulatory outcome that remains genuinely uncertain. If these instruments are weakened in the legislative process, delayed significantly, or designed with thresholds insufficient to alter sourcing behaviour, the already fragile demand pull identified in this study becomes more fragile still. On the other hand, if they are strengthened or their start dates are moved earlier, the coordination failure described could be partially dissolved. The findings should therefore be read not as a stable description of regulatory impact but as a description of how a rapidly evolving and unresolved legislative environment was understood by market participants at this specific moment in time.

The central question is no longer whether the transition will occur, but at what velocity it will unfold, and which actors will have positioned themselves to shape, rather than merely absorb, its consequences.

7.3 Methodology Considerations

Several methodological considerations must be addressed regarding the reliability and generalisability of the findings produced through this study's qualitative framework analysis design.

Regarding reliability, respondent bias from interviews with representatives from OEMs and steel producers must be acknowledged. Interviewees may have presented their company's position on green steel and related topics more favourably than in reality, particularly given that procurement decisions and internal carbon pricing carry commercial sensitivity. Interviewer bias is a further consideration, the authors' background in industrial engineering and management, with specialisation in supply chain management, energy and sustainability, may have shaped how probing questions were framed, even though a standardised question set was applied across each interview group. Framework analysis partially mitigates these risks through structured cross-case comparison steps, but residual subjectivity in interpretation stages cannot be fully eliminated.

Regarding generalisability, framework analysis is not designed to produce statistical generalisability; rather, it aims to produce analytical generalisability, meaning whether the patterns identified can highlight dynamics beyond the specific interviews conducted. The findings are bounded to the European automotive context and the current regulatory landscape, and should be interpreted accordingly. The OEM sample covers a range of vehicle categories and strategic positions, however it does not include all major European OEMs. For example BMW, Mercedes-Benz, Volkswagen Audi Group, and Stellantis, large and influential manufacturers in terms of market share and policy engagement, are not represented, and their position on the green steel business case may differ substantially from what is captured in the interviews. A broader set of automotive OEM perspectives could therefore modify some of the conclusions drawn in the analysis. The steel producer sample is similarly limited: of five identified producers, only two agreed to participate, yielding three interviews. While the producers included are actively engaged in the green steel transition and provide substantive supply-side perspectives, the sample does not represent the full range of European producer positions, and conclusions about supply-side dynamics should be read with that constraint in mind.

The absence of a standardised green steel definition created interpretive variance across interviews. This was handled by treating the definition as an empirical question in the interview question set, and by discussing green steel in broad terms that included the full spectrum of lower-carbon production routes. It is possible that some interviewees framed their responses around different product realities. However, it is important to note that this limitation is partly structural rather than a result of the methodology. The definitional ambiguity present in the interviews mirrors the real-world condition at the policy level, where no binding EU definition exists yet, and the variance in how interviewees understood and used the term is itself part of what the study is examining.

The three-group structure with experts and researchers, automotive OEMs, and steel producers functions as a form of triangulation and should be seen as a strength of the study. Sampling across these three types of actors further enabled cross-perspective validation and highlighted discrepancies that single group sampling would not have produced. The most analytically significant of these was the divergence between expert assumptions about cost pass-through and OEM margin reality, where experts consistently framed the green steel premium as a minor consumer-facing cost while OEMs described it as not possible to pass onto consumers and a direct hit to margins that would be detrimental in the current competitive environment. These types of discrepancies emerged from the comparative structure of the analysis and form a substantive part of the study's contribution.

7.4 Further Research

Several opportunities for further research emerge directly from the study's findings, situated at a moment in time when both regulatory frameworks and market conditions are shifting rapidly. The most pressing is the follow-up on the IAA and the Automotive Package, as well as the delegated act of the ESPR regarding the label. As discussed in *section 7.2*, both the IAA and the Automotive Package remain Commission proposals at the time of writing, and the demand signals OEM representatives attribute to them rest on legislative outcomes that are still open. Therefore, a follow-up study conducted after the legislative processes have concluded would allow researchers to test how stable OEM commitment to green steel procurement is when regulatory expectation translates into an either stronger or weaker form than anticipated. Given that the demand pull is already fragile, even a slight weakening of policy instruments could set back the transition of green steel, and at the same time a strengthening of the proposals could accelerate it. The same logic extends to other regulatory frameworks discussed in this study, including EU ETS and CBAM, where future research should monitor whether the ambition levels and timelines remain intact as political and economic pressures mount, given that any dilution of carbon pricing trajectories would directly weaken the OEM business case for green steel identified here.

Beyond the regulatory dimension, future research should empirically test the cost pass-through assumption. This study touches upon but cannot resolve whether OEMs have genuinely assessed consumer WTP for a green premium, or whether the impossibility of absorption has become a default position reproduced across the automotive sector without customer-facing validation. Research combining procurement margin data with consumer survey evidence, particularly in fleet and premium segments where price sensitivity may differ from what OEM procurement teams assume, would provide a more complete picture of where the true constraint lies. Another research possibility is to observe how OEM procurement behaviour changes as the supply of green steel increases – when H2-DRI-EAF projects in Europe reach commercial deployment – since the coordination failure, as described, is conditioned on supply scarcity. Finally, the geographic scope of this study is limited to the European market, including both European-headquartered automotive OEMs and non-European manufacturers with procurement or manufacturing operations in the region, thus being subject to or directly affected by the EU regulatory environment, and the Japanese context that emerged in *section 6.2.5* illustrates that the structural conditions differ substantially in other markets where green steel supply will not be available for a longer period of time. Comparative research across OEM geographies and supply-chain configurations would deepen understanding of which features of the business case and coordination failure identified here are specific to the European regulatory context and which reflect more general structural dynamics in the relationship between the automotive industry and the steel transition.

8 Conclusion

This study set out to understand how European automotive OEMs construct a business case for green steel and to what extent emission targets and EU regulatory frameworks drive demand. The findings reveal a market characterised by genuine intent and structural stall.

On the first research question, the business case is real but incomplete. OEMs recognise green steel as a non-negotiable part of their long-term decarbonisation pathway, particularly as electrification removes tailpipe emissions and embedded material emissions become the dominant remaining challenge. The internal drivers are tangible but conditional: fleet customers are beginning to include material emissions in procurement criteria, internal carbon pricing allows the green premium to be weighed against other decarbonisation levers, and early engagement offers regulatory readiness advantages if mandates materialise. Under current conditions of margin compression and geopolitical volatility, however, most OEMs have drawn back from binding commitments. The green premium is a direct margin hit that cannot be passed to consumers in a highly competitive market, and without a level regulatory playing field voluntary absorption is penalised. The commercial logic does not close on its own.

On the second research question, voluntary targets and EU regulatory frameworks drive demand intent but not demand certainty. SBTi operates differently depending on the actor: for most OEMs it functions as a mechanism for regulatory preparation, while for others it is currently an operative driver of green steel work in the absence of mandatory sourcing obligations. In both cases it builds capability and credibility without producing the binding simultaneous commitments that steel producers need to take FIDs. The EU ETS is the most important structural instrument but the EUA price remains far below the level needed to close the price parity gap at current hydrogen costs. The Automotive Package creates the most direct demand signal to date, yet rewards ICE OEMs disproportionately and excludes EV-only OEMs from its credit mechanism. The IAA disappointed by deferring a green steel label to a future ESPR delegated act, leaving procurement teams without the definitional clarity needed to act.

These findings point toward a coordination failure as the central mechanism behind the transition's stall: steel producers need offtake certainty to take FIDs, OEMs will not commit without price visibility and supply certainty, and financiers will not fund projects without offtake. The current policy mix generates intent without resolving the conditionality that sustains *the wait-and-see*. However, that framing has limits. Even with mandatory commitments across the value chain, pricing captivity and supply constraints could persist, pointing to a cost gap that institutional design alone cannot close.

The gap between demand intent and demand certainty cannot be closed through voluntary action alone. Mandatory requirements calibrated against margin sensitivity rather than consumer price elasticity, accompanied by a clear and enforceable green steel definition, are necessary conditions for breaking the stall and closing the OEM business case for green steel.

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10 Appendix

A1. Interview Questions to Automotive OEMs

1. Background & Context

- Can you briefly describe your role and responsibilities in relation to material sourcing, sustainability, or regulatory compliance?
- What are the biggest challenges today in using green steel?
- How would you describe your company's engagement with green steel?
- Do you have an internal definition of green steel (emission intensity max?)

2. Drivers of Demand: Targets & Regulation

2.1 Internal emission targets (company goals, SBTi)

- How important are Scope 3 upstream emission targets in shaping material sourcing decisions within your organization?
  - Binding constraint
  - Strategic ambition
  - Reporting exercise
  - Limited influence
- Is green steel explicitly identified internally as a lever to meet those emission targets and do you have a target for using green steel?
- Could your emission targets be met without green steel? If so, through which alternative measures?
- How do you view using secondary green steel such as scrap EAF over primary green steel like NG/H2-DRI?

2.2 Voluntary vs mandatory drivers

- Do you currently view green steel adoption primarily as a compliance necessity or a voluntary strategic choice?
  - Clearly necessary
  - Transitioning towards necessary
  - Primarily voluntary
  - Mostly symbolic
- How do voluntary targets (e.g. SBTi) relate to mandatory EU regulation in practice? Do they push you

ahead of regulation or mainly prepare you for future compliance?

2.3 EU regulatory frameworks

- Which regulatory framework has the greatest impact on steel-related sourcing decisions?
- How does the Automotive Package Proposal affect your interest in using green steel?

3. Timing, Adoption & Policy

- What would make green steel (primary and secondary steel) a mandatory sourcing requirement internally?
- How effective do you perceive current and proposed EU policy instruments in supporting demand for green steel?
- What factors would most accelerate the adoption of green steel within your organization?
  - Lower price premium
  - Clear standards and labeling
  - Stronger regulation (carbon pricing)
  - Public procurement demand
  - Increased supply availability
  - Consumer demand

4. Business Case for Green Steel

4.1 Evaluation criteria & willingness to pay

- When evaluating green steel, what factors are most important internally when deciding whether it is worth paying a premium?
  - CO_2 reduction potential
  - Branding and market differentiation
  - ESG reporting and investor expectations
  - Risk management and supply security
- When comparing green steel to other decarbonisation levers, how cost-effective do you perceive it in terms of CO_2 reduction per euro spent?
- What price premium would you be willing to pay for green steel? (Threshold)

4.2 Cost pass-through & competitive positioning

- Do you see a branding advantage in using green steel in your vehicles that justifies paying a premium?
- To what extent is it possible to pass higher steel costs on to customers?
  - Through vehicle pricing (all)
  - Through premium models only
  - Absorbed internally
  - Not possible due to competition
- The premium of green steel is expected to increase the end-price of a car by less than 1%? Is that something your customers would accept?
- Could you justify absorbing the cost from a branding perspective?
- How important is the use of green steel for ESG reporting, or investor relations?
- Would a standardized EU definition or label for green steel increase its strategic or commercial value for your company?

4.3 Risk management & long-term strategy

- Do you view early engagement with green steel as a way to manage long-term risks in relation to:
  - Regulatory uncertainty
  - Carbon pricing
  - Future supply constraints

5. Closing Reflections

- Compared to other decarbonisation measures, how strategically important is green steel currently for your organization?
  - Score from 1 (low importance) to 5 (high strategic importance)
- Is there anything you believe policymakers or steel producers misunderstand about OEM demand for green steel?
- Is there anything else you would like to add that we have not covered?

A2. Interview Questions to Experts and Steel Producers

1. Background & Context

- Can you describe your research/working focus and describe your connection to the steel industry and the automotive sector (OEMs) as customers?
- What are the biggest challenges today in using green steel?
- How would you generally describe OEMs' engagement with green steel?
- How would you define green steel if you have to (emission intensity max?)

2. Drivers of Demand: Targets & Regulation

2.1 Internal emission targets (company goals, SBTi)

- How important do you believe that Scope 3 upstream emission targets are in shaping material sourcing decisions for OEMs'?
  - Binding constraint
  - Strategic ambition
  - Reporting exercise
  - Limited influence
- To what extent is green steel necessary for OEMs' to meet their emissions targets?
- Could those targets be met without green steel? If so, through which alternative measures?
- How do you view secondary green steel such as scrap EAF over primary green steel like NG/H2-DRI?

2.2 Voluntary vs mandatory drivers

- Do you currently view green steel adoption primarily as a compliance necessity or a voluntary strategic choice?
  - Clearly necessary
  - Transitioning towards necessary
  - Primarily voluntary
  - Mostly symbolic
- How do voluntary targets (e.g. SBTi) relate to mandatory EU regulation in practice? Do they push OEMs' ahead of regulation or mainly prepare for future compliance?

2.3 EU regulatory frameworks

- Which regulatory framework has the greatest impact on steel-related sourcing decisions?
- How does the Automotive Package Proposal affect their interest in using green steel?

3. Timing, Adoption & Policy

- What event or threshold would make green steel a mandatory sourcing requirement internally for OEMs'?
- How effective do you perceive current and proposed EU policy instruments in supporting demand for green steel?
- What factors would most accelerate the adoption of green steel within the Automotive sector?
  - Lower price premium
  - Clear standards and labeling
  - Stronger regulation (carbon pricing)
  - Public procurement demand
  - Increased supply availability

4. Business Case for Green Steel

4.1 Evaluation criteria & willingness to pay

- When evaluating green steel, what factors do you believe are most important when deciding whether it is worth paying a premium?
  - CO_2 reduction potential
  - Branding and market differentiation
  - ESG reporting and investor expectations
  - Risk management and supply security
- When comparing green steel to other decarbonisation levers, how cost-effective do you perceive it in terms of CO_2 reduction per euro spent?
- What price premium do you believe is feasible for green steel?

4.2 Cost pass-through & competitive positioning

- Do you think that there exists a branding advantage for the OEMs when using green steel that justifies a premium?
- To what extent is it possible to pass higher steel costs on to customers?

  - Through vehicle pricing (on all cars)
  - Through premium models only
  - Absorbed internally
  - Not possible due to competition
- The premium of green steel is expected to increase the end-price of a car by less than 1%? Why do you think it is still so hard to adopt green steel?
- Could OEMs absorb the cost from a branding perspective?
- How important is the use of green steel for ESG reporting, or investor relations?
- Would a standardized EU definition or label for green steel increase its strategic or commercial value for OEMs?

4.3 Risk management & long-term strategy

- Do you view early engagement with green steel as a way to manage long-term risks?
  - Regulatory uncertainty
  - Carbon pricing exposure
  - Future supply constraints

5. Closing Reflections

- Compared to other decarbonisation measures, how strategically important is green steel currently for OEMs' do you believe?
  - Score from 1 (low importance) to 5 (high strategic importance)
- Is there anything you believe policymakers or steel producers misunderstand about OEM demand for green steel?
- Is there anything else you would like to add that we have not covered?