

The Steel and Concrete Transformation

2024

Market outlook on lower
emission steel and concrete

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STEELZERO

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About the report

This report, jointly prepared by Ramboll and Climate Group is based on a survey that aims to reveal the market demand and outlook for lower emission steel and concrete and whether major consumers of these materials such as the real estate, infrastructure, manufacturing, and energy sectors are willing to pay a price premium for them.

With some claiming that there is limited to no willingness to pay, the survey is intended to build transparency on this topic to support sound investment decisions and clearer business cases.

The survey also pinpoints some of the biggest barriers to adopting lower emission steel and concrete and the policies that could help accelerate and incentivise production and demand for lower emission steel and concrete.

Where survey respondents come from

The survey is based on input from 259 respondents from 42 countries with an over-representation of European-based organisations. Most respondents have indicated they have a direct influence on steel and concrete-related purchasing decisions. 21 sectors are represented in the survey, including major consumers of steel and concrete such as developers, manufacturers, utilities, and public sector organisations. Data collection concluded on 26 July 2024. The results were first presented at Climate Week NYC in September of 2024 with a view to inspiring further dialogue between producers, buyers, and policymakers to facilitate action, speed, and scale in advancing this critical area.

Aligning with the IEA and Climate Club

The findings are also being used by the International Energy Agency (IEA) in the context of their work as part of the Interim Secretariat for the Climate Club. The Climate Club is a high-ambition, intergovernmental forum aimed at accelerating industry decarbonisation, with now over 40 member governments.

The IEA analysis for the Climate Club will examine the role of both demand and supply-side policies in accelerating the industry transition, helping member governments understand their significance within broader policy frameworks for industry decarbonisation. The demand-side analysis is intended to better inform member governments on the status of relevant private and public sector activity, the importance and challenges of scaling up demand-side commitments, and the role of government support in advancing these efforts.

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It's time to
decarbonise
steel and
concrete



02

Foreword by Climate Group



Jen Carson
Head of Industry, Climate Group

The need to tackle climate change and accelerate the shift to lower emission materials is immediate. With steel and concrete production responsible for 15% of global greenhouse gas emissions, an ambitious and coordinated approach to decarbonisation is essential. The entire value chain must pull its weight and take decisive action, now. The need for this has never been clearer. It's time.

Encouragingly, the results discussed in this report show an increased readiness to purchase and use lower emission steel and concrete. Many organisations are prepared to navigate a premium for these materials, demonstrating a clear commitment to sustainability goals and an anticipation that the global business landscape will undergo a profound and inevitable shift. There are reasons for optimism - but challenges remain.

Leaders from steel and concrete-buying companies are actively collaborating through Climate Group initiatives like SteelZero and ConcreteZero, recognising that partnerships are critical to identifying and overcoming barriers to decarbonisation. It's important to recognise that no single solution will solve this challenge. Progress requires advancing multiple viable solutions rapidly, with the active participation of buyers, suppliers, investors and policymakers.

This report highlights the collective resolve needed to drive substantial change. It's a call to action for all stakeholders, not least public sector actors, to contribute to making lower emission materials the standard - the new business-as-usual, rather than the exception.

We thank all the survey participants for their valuable insights. Your input is essential as we work together to accelerate the transition to a sustainable future. Let's tackle this challenge with the urgency it demands, leveraging every opportunity to drive progress and achieve our shared objectives for a more sustainable and resilient world.



03

Foreword by Ramboll



Anna Ekdahl
Director for Energy-Intensive
Industries, Ramboll

Sustainable change is at the heart of everything we do at Ramboll. Our mission is to create sustainable societies where people and nature flourish. As one of the world's leading architecture, engineering, and consultancy companies, we are in business to contribute to the positive long-term development of societies by fulfilling our clients' visions and finding solutions to their most pressing needs.

A clear case in point is steel and concrete, two of the highest carbon-emitting and most extensively used materials but unfortunately, also two of the most complex markets when it comes to the global green energy transition desperately needed to stay in line with the Paris Agreement.

Lowering steel- and concrete-related emissions requires more than sky-high investments in new production facilities alone, it will demand a realignment of the entire sustainable energy ecosystem.

Grid owners will have to take on a more active role than ever before. Governments will have to shape financial incentives. Designers will have to come up with new solutions. Producers will have to make bold business decisions, and end users may need to accept a price premium until the market matures.

Collectively, these changes are colossal when viewed at global scale. They can only be realised with the help of technology, transparency, tenacity, and an unprecedented willingness to change.

The actions we take today to address climate change and biodiversity loss will have a profound impact on future generations and the health of our planet.

We look forward and are committed to engaging in ongoing dialogue on the transformation of energy-intensive industries. Let's continue to close the gap towards a more sustainable future – at a faster pace and on a greater scale.

One of the most important industrial transformations in the history of humanity.

From trains and wind turbines, to cars, bridges, buildings and all kinds of consumer products, steel and concrete form the backbone of modern industry. Yet their environmental cost is staggering.

Each year, iron and steel production generate 2.6 billion tonnes of CO₂, while concrete contributes another 2.3 billion tonnes. Together, they're responsible for roughly 15% of global emissions - 8% from steel and 7% from concrete¹.

Even more alarming is that while the technology already exists to decarbonise the production processes of both these materials, we have so far failed to make a dent in their overall carbon emissions. Despite a shared need for lower emission alternatives, steel and concrete are in fact two distinctly different markets.

As a largely global market, the steel sector is slowly progressing towards lower emission technologies. For instance, direct reduced iron (DRI) and electric arc furnaces (EAFs) using scrap are expected to reduce emissions and replace some coal-based blast furnace-basic oxygen furnaces (BF-BOFs) over the coming decades.

This transition requires huge quantities of renewable electricity. With this electricity not being available in many countries, the steel sector - historically able to secure reliable energy supplies from coal - therefore faces a complex challenge in obtaining the needed sustainable energy.

The steel sector has the power to bring a transformative increase in renewable energy production to fruition by collaborating with the entire sustainable energy ecosystem, for example through securing offtake agreements, and developing joint-ventures and partnerships.

Both the steel and energy transition require substantial capital investment, but traditional, high-emission steel and energy production demand enormous amounts of financing too. There are vast amounts of capital available around the world - it just needs redirecting.





The supply of concrete, on the other hand, is largely through local markets made up of many different actors contributing to raw material supply, cement and additive manufacture, concrete production and delivery.

Addressing the urgent need for emission reductions in concrete requires a multi-pronged approach involving the whole value chain: concrete producers can introduce alternative raw materials to substitute for the carbon-intensive clinker, engineers can explore ways to reduce the amount of cement used in concrete mixes, and designers can improve the efficiency with which concrete is used.

However, since cement production cannot be electrified in the same way as steel production, concrete production will likely be associated with residual emissions (i.e. those remaining after all other decarbonisation levers have been exhausted), which may be an appropriate target for Carbon Capture, Utilisation and Storage (CCUS) technologies, potentially in combination with oxyfuel kiln technology².

Although not a perfect “green” solution, it could be a viable one in some geographies. It is important that investment in CCUS does not divert attention and resources away from the development of truly sustainable groundbreaking emission reduction technologies.

Despite these inherent differences, the concrete and steel markets also share some important similarities.

Decarbonise both steel and concrete

Firstly, the collective decarbonisation of steel and concrete is an essential part of the transition to a low-carbon economy for future generations. Considering the enormous emissions associated with steel and concrete, one might argue that most net zero commitments being made by companies and nations, are in fact unachievable if we are not able to find new ways to decarbonise these two energy-intensive materials.

Secondly, the survey shows that the lower emission steel and concrete markets, as compared with the markets for conventionally produced steel and concrete, share a common characteristic of being less mature. We consider a market to be less mature if it lacks transparency, has no market equilibrium established, and where the connections between producers, buyers, investors, regulators, and energy partners are weak.

Securing renewables, boosting collaboration

Thirdly, what is evident for both lower emission steel and concrete is that this is a transition that, although not simple, is achievable. As these industries end their historic reliance on coal mining, securing the renewable electricity needed is vital. Both the steel and concrete industries have an opportunity to collaborate with the energy industry and bolster the clean energy transition whilst

securing their own future in a rapidly developing market.

Finally, for both lower emission concrete and steel, action, commitments, and collaboration are needed more than ever. Frontrunners are quickly putting together their business cases for lower emission materials, trailing and testing solutions, pushing the boundaries of what's possible – now. But they need backing from investors, governments, energy companies, and buyers willing to pay the right price.

This collaboration might be one of the most essential ingredients on the path to net zero. Willingness to pay comes with willingness to invest, innovate, and legislate in ways that accelerate and scale action for a sustainable future.

¹ Imperial College London: [‘Greening’ cement and steel: 9 ways these industries can reach net zero | Imperial News | Imperial College London](#)

² Oxyfuel technology is being piloted by [Holcim](#) and [Lhoist](#)

Organisations are ready to buy lower emission steel and concrete - Now!

Survey results: Conclusion #1

In flux – that is one way to describe the steel and concrete sectors of today. Over the last decade, key actors in both sectors have repeatedly gathered to discuss the future of lower emission materials and the scale of investments needed, technological challenges, associated green energy transition, and ways to connect the value chain in a concerted effort to find new and viable paths to decarbonisation.

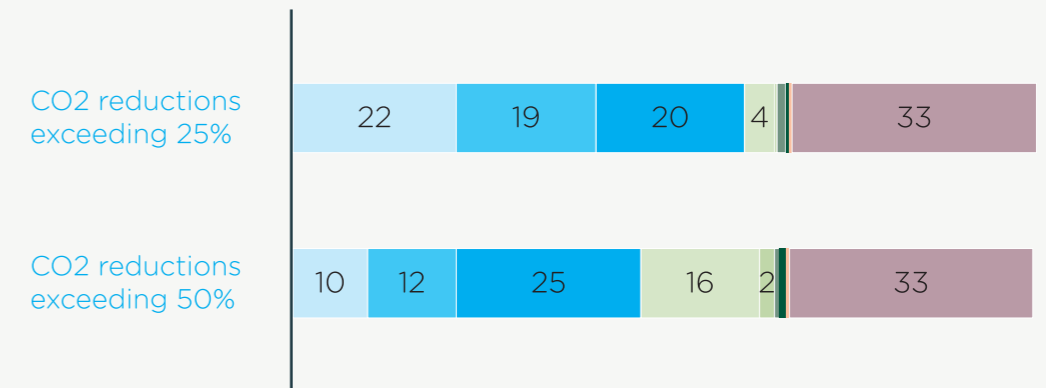
The buyers of steel and concrete are also evolving, innovating, and exploring avenues to future proof their supply chains. Decarbonisation is increasingly an essential part of corporate strategy in the run up to 2030, with thousands of companies globally committing to ambitious climate targets, with many promising their shareholders and stakeholders that they will achieve net zero emissions by 2050 at the latest.

A major concern remains whether and how these pledges will translate into action and a willingness to navigate a price premium for lower emission materials.

What value do buyers of steel and concrete really place on these lower emission materials? Are they prepared to transform their supply chains to support a net zero pathway? Are their commitments to sustainability crucial enough for them to be willing to alter their cost structures? Are the buyers ready to transform their supply chains for the net zero pathway? Are their commitments

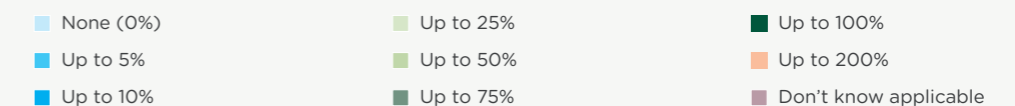
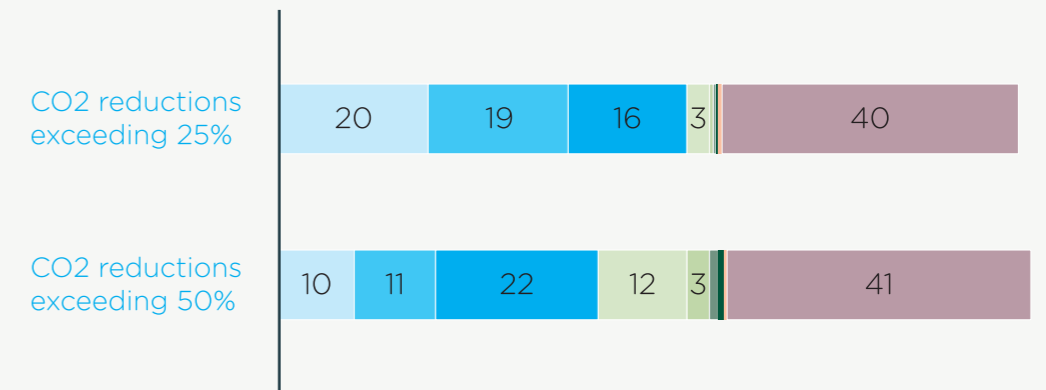
Steel

With CO2 reductions exceeding 25% and 50%, compared to conventional materials, what percentage price premium would your organisation be willing to pay for lower emission steel and concrete in the next 1-5 years?

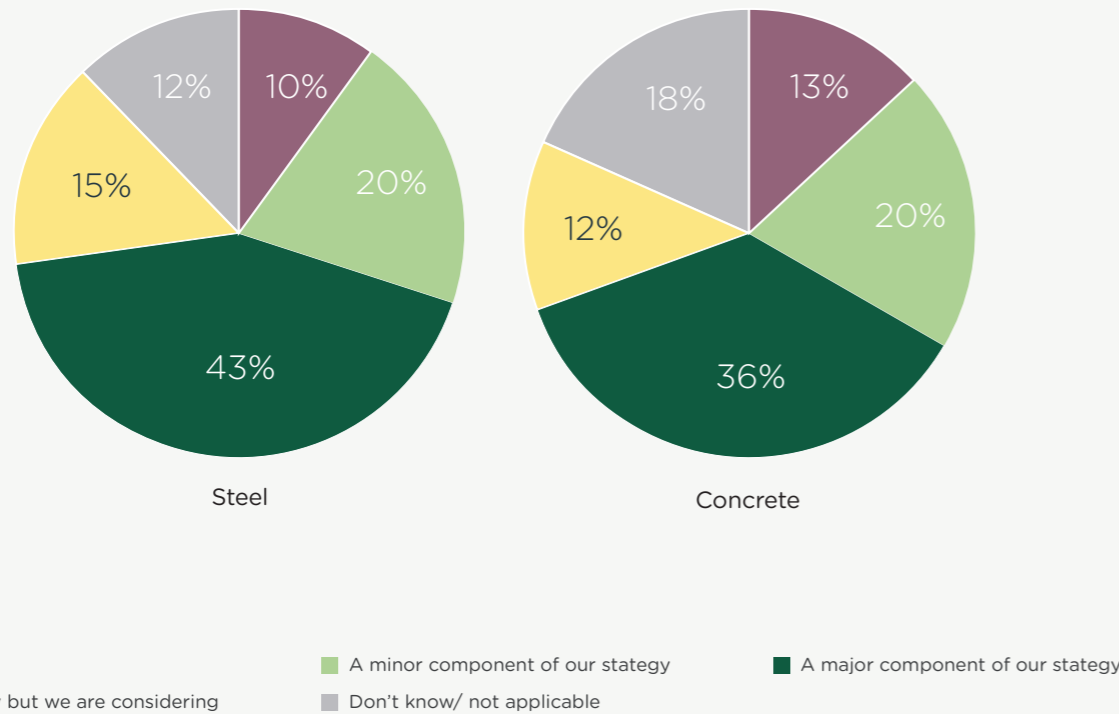


Concrete

With CO2 reductions exceeding 25% and 50%, compared to conventional materials, what percentage price premium would your organisation be willing to pay for lower emission steel and concrete in the next 1-5 years?



Is procuring/specifying lower emission steel/concrete part of your carbon reduction strategy for addressing your company's emissions (scope 3)?



so important for their products, their brand, and their sense of responsibility that they are willing to alter their cost profiles? In our 2024 survey, the willingness to pay looks promising, and many respondents clearly indicate that their organisations are ready to purchase these lower emission materials.

Half of respondents ready to pay more for CO2 reductions above 50%.

For steel, 45% of respondents say that they are willing to pay a premium for CO2 reductions exceeding 25%, and 57% would be willing to pay a premium for CO2 reductions exceeding 50%. Similarly, for concrete, 40% of respondents say that they are willing to pay a premium for CO2 reductions exceeding 25%, and 49% would be willing to pay a premium for CO2 reductions exceeding 50%. These results are hugely promising – they show that about half of respondents are ready and willing to step up and prioritise lower emission steel and concrete, not in the distant future, but now.

They want to integrate these materials into their current and near-term pipeline of projects. It is also worth highlighting that 10-20% of respondents (depending on emission reductions) state that their organisation is not currently willing to pay any kind of premium for lower emission steel and concrete. Roughly a third of respondents stated that they do not

know their organisation's willingness to pay, or do not know the exact kind of premium that they would be willing to pay.

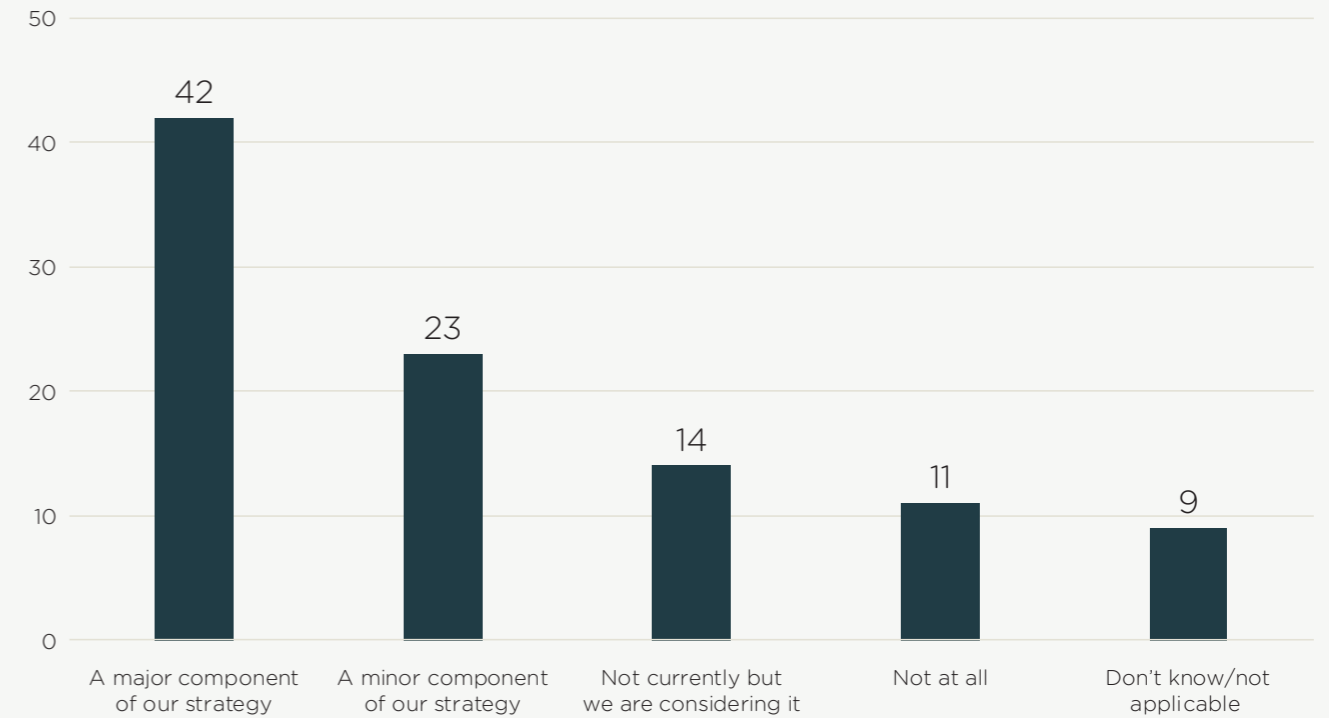
This implies that there is still a deep knowledge gap among buyers and a steep learning curve to navigate complexities around issues such as the sourcing, procurement, insurance, and risk management of lower emission materials.

A part of their decarbonisation strategies

We also asked respondents whether lower emission steel and concrete are of strategic importance to their organisation. 63% replied that lower emission steel is a component of their carbon reduction strategy for addressing scope 3 emissions.

The equivalent figure for lower emission concrete is 56%. These findings raise important questions for the value chain: Which producers are going to step up and meet the demand? Are incumbent players going to be able to pivot quickly enough, as innovators enter the market? Which investors are going to support not only research, development and innovation but, most importantly, rapid commercialisation and scaling. Who is going to break with tradition and accelerate forwards to create a new low emission business-as-usual. Nevertheless, tying corporate climate pledges to the

Is procuring/specifying low emission materials such as lower emission steel and concrete part of your brand strategy to position yourself as a leader in sustainability?



ability to secure lower emission steel and concrete could help lock in critical supply-demand feedback that will support and influence the direction of the industry.

be working on the assumption that the supply chain will provide lower emission materials at no extra cost.

Boosting reputation and brand

Beyond strategy, many companies are also looking to lower emission materials for branding purposes. These materials are used to differentiate themselves in the market as well as to meet the expectations of shareholders, customers, employees and society at large. 42% of respondents regard lower emission steel and concrete as a "major component" of their brand strategy, while only 11% say not at all.

Despite being seen as levers for both decarbonisation and brand differentiation, it is worth noting that there appears to be a discrepancy between the strategic importance organisations attribute to lower emission steel and concrete and the actual willingness to pay for them. For example, 63% say that lower emission steel is a component of their decarbonisation strategy, yet only 45% would be willing to pay for emissions reductions of 25%.

Some organisations have potentially laid out a path to decarbonisation or envisioned a sustainable brand but are yet to assess the cost associated with this transformation, pointing again to a knowledge gap - or they may simply

“The world needs – and wants – to transition to the use of low carbon steel and concrete. There’s no lack of desire from owners, designers, builders and tenants, but there is a lack of supply-chain investment into growing production capacity. This ClimateGroup + Ramboll study underlines the leadership now required to transition us to a sustainable world – all regional governments must do three things – A) incentivise industry to transition manufacturing to low-carbon steel and concrete, B) mandate the specification of these materials now, and C) mandate the use of these materials by 2027. With global leadership, we can do this.”

Jason Langer
Managing Director – North America, Robert Bird Group

“C2CA is one of many young companies offering low-carbon alternatives to cement, sand, and aggregates. As demand for sustainable construction materials grows, it’s clear that new materials must compete on both cost and quality with traditional options. This balance is central to C2CA’s strategy, proving that sustainability can go hand-in-hand with affordability and industry standards.”

Thomas Petithuguenin
Chief Executive Officer, C2CA Technology B.V.

“U. S. Steel’s customers have expressed interest in lower emissions steels, strengthening the business case for investing in the steel industry’s transition to satisfy domestic demand. We became the first steel company in North America to join Responsible Steel – the industry’s standard for consumers wanting to be confident that the steel they use has been sourced and produced responsibly.

One year later, our Big River Steel facility in Arkansas became the first site in North America to receive a Responsible Steel site certification. We are also starting to implement carbon capture and utilisation technology at our Gary Works facility.

These are significant milestones as we move towards our 2030 goal of a 20% reduction in GHG emissions, and ultimately towards net zero emissions by 2050.”

Erika L. Chan
Head of Sustainability, U. S. Steel.



The market is accelerating, yet fundamental barriers still exist

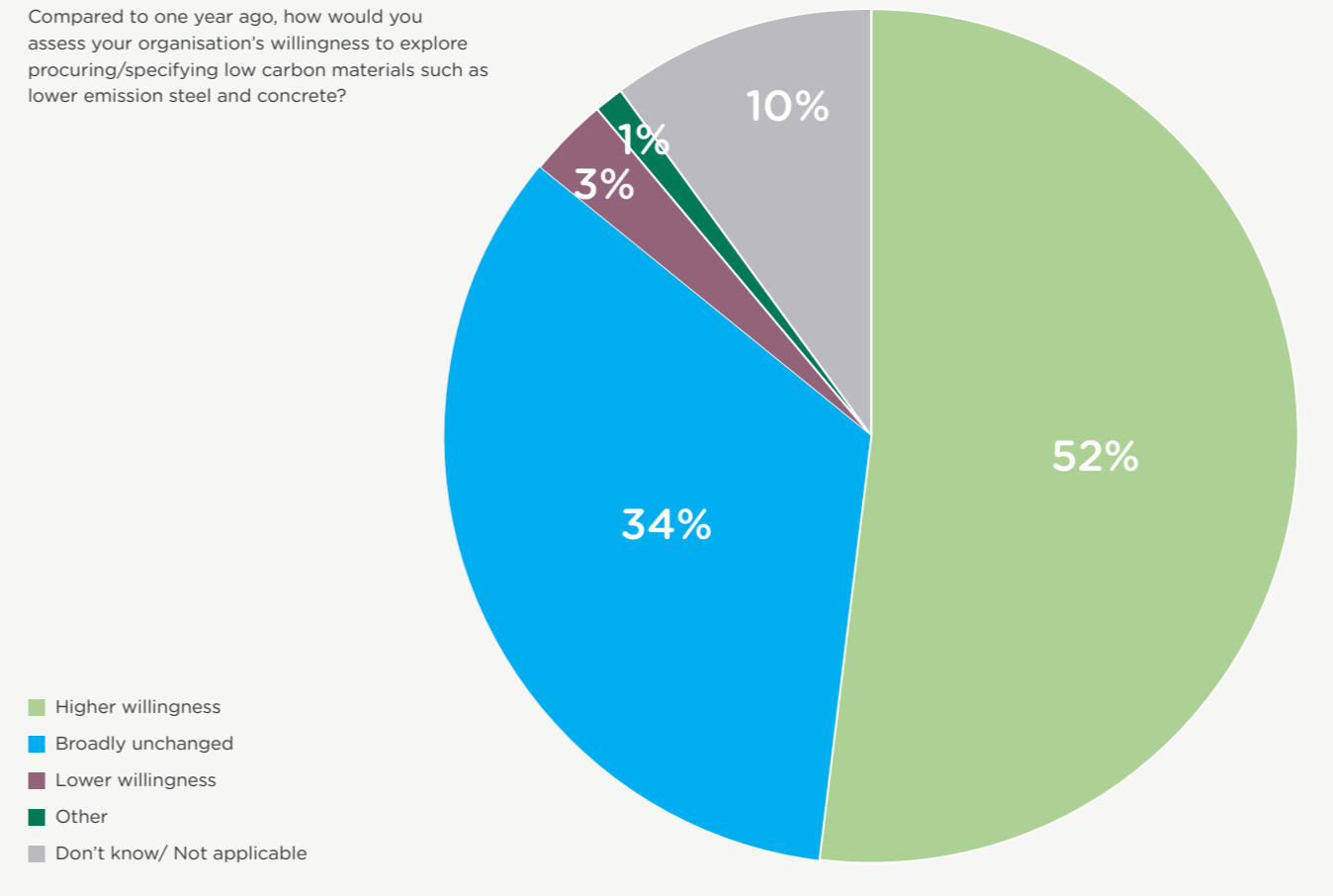
Survey results: Conclusion #2

While the willingness to pay varies across sectors and geographies, the growing interest in lower emission materials sends the signal that organisations are increasingly ready to act. Compared to one year ago, 52% reported a higher willingness to explore the procurement of lower emission materials. 34% remained the same, and only 3% saw a declining willingness. At the same time, the survey highlights key barriers that need to be overcome in the coming years to facilitate the adoption and scaling of lower emission steel and concrete.

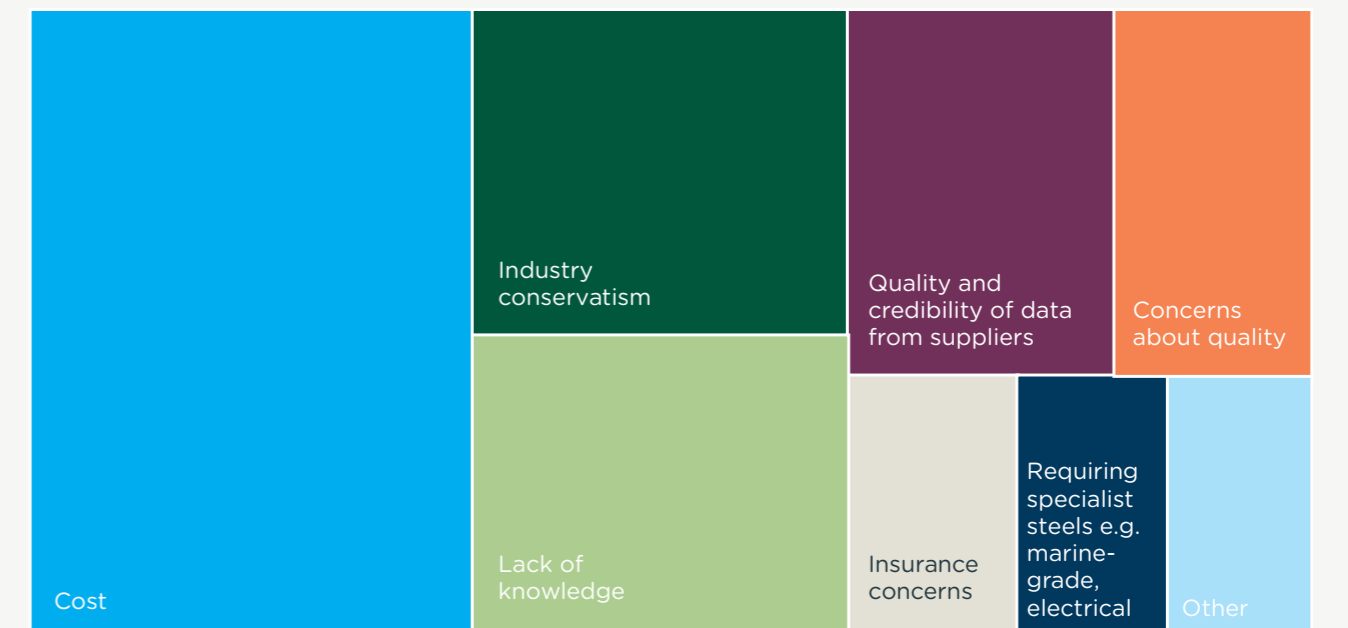
Not surprisingly, cost takes first place as the biggest barrier with 84% of respondents indicating that they see this as key to holding back large-scale uptake. However, other significant barriers continue to exist, including industry conservatism (indicated by 37% of respondents), lack of knowledge (33%), quality and credibility of data from suppliers (29%), and concerns about quality of the lower emission materials (22%).

On the subject of cost, depending on the sector, project or product, it is possible that some companies may be able to adopt lower emission steel and concrete whilst keeping overall end costs down. For example, the construction sector can utilise strategic design to lighten the quantity of materials used in a project, offsetting potential costs associated with using lower emission steel and concrete, and energy companies have the buying power needed to secure offtake agreements, securing the materials needed

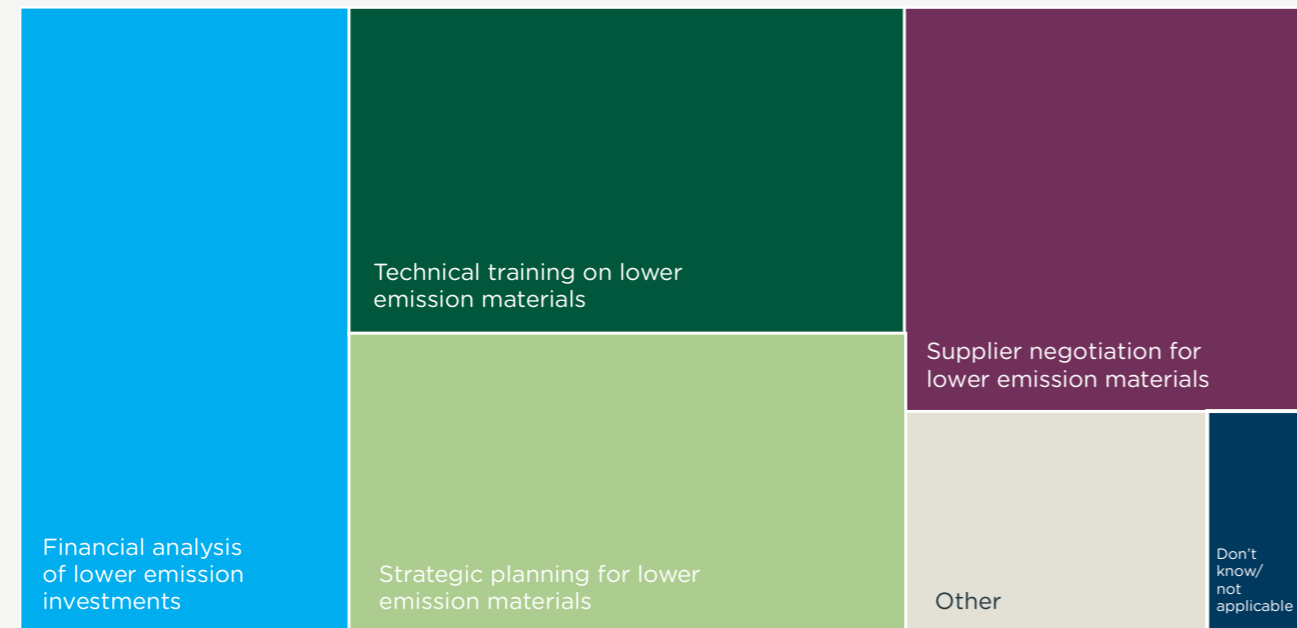
Compared to one year ago, how would you assess your organisation's willingness to explore procuring/specifying low carbon materials such as lower emission steel and concrete?



What do you see as the top three barriers for large-scale adoption of lower emission steel and concrete?



Are there specific training or knowledge enhancements that would benefit your organisation to effectively integrate lower emission steel and concrete into your operations?



in large quantities at negotiated prices.

When asked specifically about the lack of knowledge of lower emission materials, and the possible measures to overcome this barrier, respondents pointed towards areas such as technical training, strategic analysis, and financial analysis as the most effective levers.

Interestingly 40% of respondents also indicated a need to strengthen their organisation's ability to negotiate with suppliers, a typical trait of an immature market where sellers and buyers are yet to establish a transparent dialogue, and where a market equilibrium has yet to be reached.

Although these significant barriers exist and have prevented faster adoption and growth of the market – a general upskilling across value chains is expected in the coming years with suppliers, buyers, investors, and legislators becoming increasingly aware of the different paths to decarbonisation as well as the cost and associated complexities.

Non-profit initiatives such as SteelZero and ConcreteZero are working to improve data transparency, supply chain engagement, reporting, and methodologies with a view to increasing the granularity and credibility of information that is flowing across the supply chain around embodied-carbon emissions data for steel and concrete.

In 2024, for example, SteelZero and ConcreteZero completed the first beta reporting exercise for these two material streams, an effort that will continue and scale in 2025 onwards.

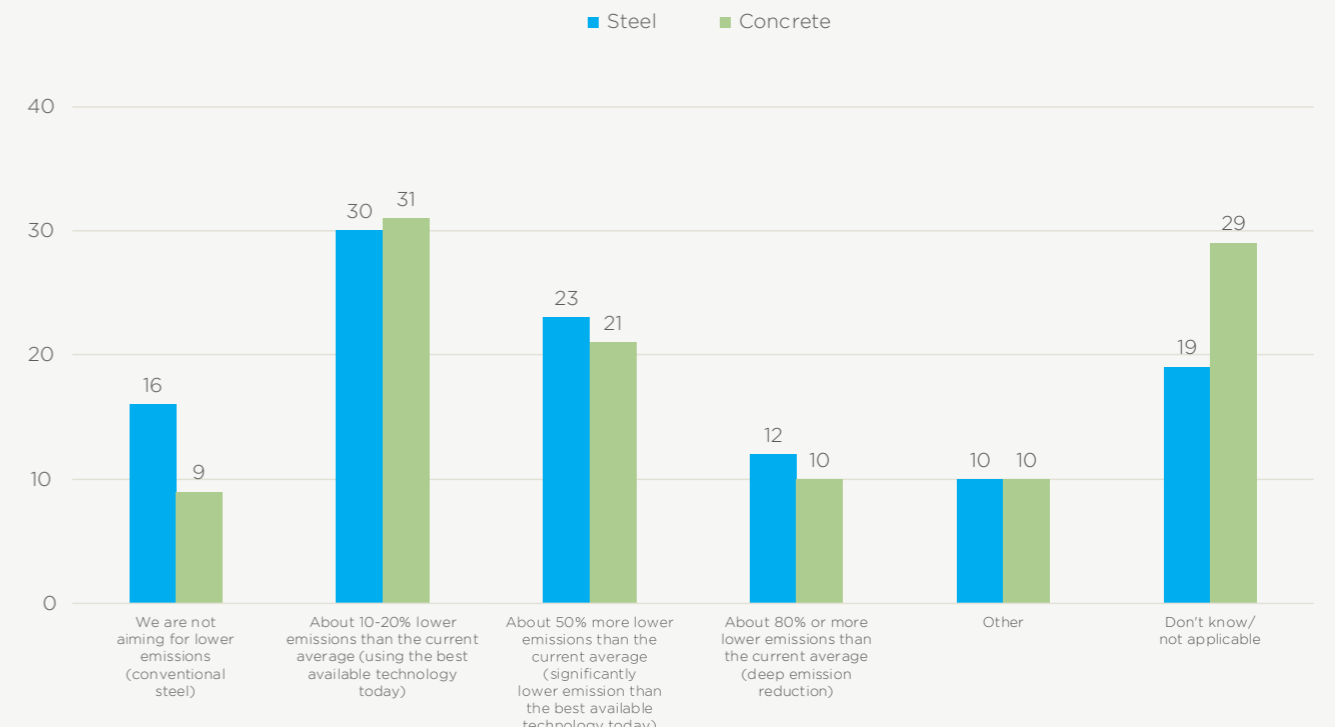
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Lower than expected ambitions

A notable additional barrier to progress is the level of emissions reductions that some buyers have reported they are currently aiming for. To halve overall global emissions by 2030, significant and consistent reductions of more than 20% will be needed for steel and concrete.

In relation to steel, 35% of respondents (31% for concrete) are aiming for bold emissions reductions of between 50% and 80% that are in line with this. However, 16% of steel buyers are not seeking any emissions reductions at all (9% for concrete). For steel, 30% of respondents (31% for concrete) are aiming for modest emissions reductions

When procuring lower emission steel/concrete, what level of emissions reduction are you aiming for today?



of 10-20%, which is already relatively straightforward to target.

This indicates that while there is substantive and growing demand for lower emission materials, too many buyers' are not ambitious enough when it comes to reducing their emissions. SteelZero and ConcreteZero members commit to using or procuring 100% net zero materials by 2050 and meeting interim targets designed to stretch their ambition, and act as stage gates to the deep decarbonisation required.

“As one of the world's largest system suppliers to the food, beverage, and pharmaceutical industries, we rely heavily on stainless steel.”

To successfully implement our ambitious sustainability strategy and maximise its impact, we are already actively seeking low carbon emission stainless steel in the market.

However, transforming steel production to meet this demand is a monumental challenge, that requires collaboration among producers, distributors, and service centers within our supply chain. To drive this necessary transformation, global standards and third-party certifications are urgently needed to establish a consistent understanding of the sustainability requirements that stainless steel and its producers must meet in the future.”

Sebastian Zingsheim
Senior Director, Sustainable Procurement & Supply Chain,
GEA Group AG



07

Swedish Steel Construction Research Foundation

The Swedish steel industry realised nearly ten years ago that the transition to fossil-free steel production was absolutely necessary. The industry's climate emissions must be reduced as steel is crucial to being able to build the sustainable society. The steel industry must not least show the younger generations that it belongs to the future.

This insight was praised by politicians nationally and locally, at the same time as the physical, technical and economic conditions – high-quality ore, renewable energy, research academy, investors, established world-leading steel companies with markets in 140 countries – were excellent. Customers began to increasingly demand “green value chains” and the interest today in fossil-free steel in various forms is significant, which is also confirmed by the present report.

SSAB started the HYBRIT project in 2016 and has today developed technology for efficient fossil-free steel production. SSAB is investing heavily to convert the entire Nordic production system to fossil-free steel production and has already started supplying fossil-free steel to customers on a smaller scale. Customers such as Volvo Group, Epiroc, PEAB, SKANSKA and Lindab are already using the fossil-free steel in vehicles, heavy machinery, buildings and consumer products, and there is great interest in the technology.

Since 2020, Stegra's (previously H2 Green Steel) first new plant is under construction in Boden in northern Sweden. They will produce green steel by 2026, using green hydrogen and green iron to slash emissions by up to 95%.

The Swedish steel industry is a world leader in advanced steels and develops highly refined steels with exactly the properties that are in demand. What is happening now in Sweden is well on its way to fundamentally changing the iron and steel industry - new technical solutions that improve our environment and simplify life from generation to generation.

Business leaders everywhere are calling for change

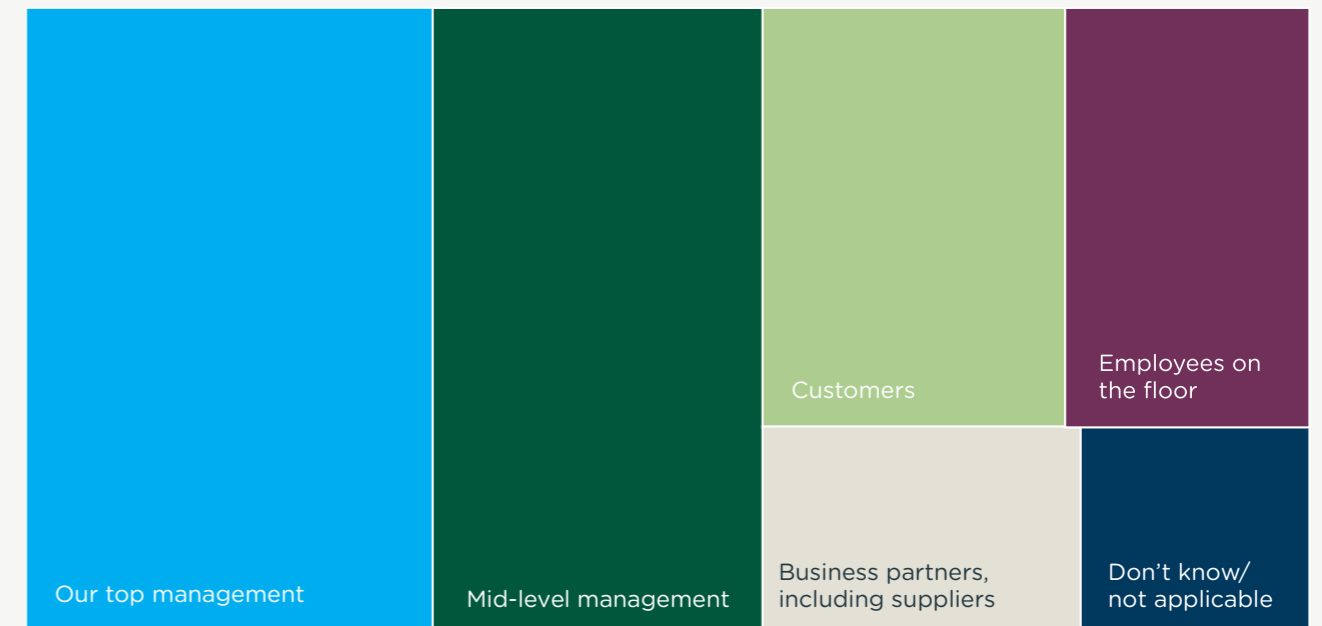
Survey results: Conclusion #3

Radical market change rarely occurs without visionary business leaders challenging the boundaries of existing technology, and actively advocating innovative and groundbreaking solutions. But it also takes time and dedicated effort for strategic direction to trickle down and impact the entire organisation, something that is reflected in the above responses regarding barriers.

In our survey, we asked respondents to indicate who in their organisation is pushing the most for lower emission steel and concrete. 55% of respondents said top management, 44% said mid-level management, and 22% said employees on the floor. Moreover, 41% cited external pressures, with 27% saying customers, and 14% saying business partners, including suppliers.

What we clearly see is that that top managers remain key to setting the strategic direction and driving traction. However, it remains to be seen whether organisations' strategic ambitions and carbon reduction targets will be implemented at an operational level where cost considerations will continue to prevail unless funds are specifically ring fenced or KPIs introduced for procuring lower emission materials.

Who in your organisation is advocating the most for low carbon alternatives such as lower emission steel or concrete? (Respondents were able to select between one and three options)



“Green steel will become the new normal. But today the market is in its infancy and it is still difficult to achieve a sufficient price premium.

In addition to affordable clean hydrogen and energy, we need to build green lead markets.

The German Steel Association proposed a generally applicable “Low Emission Steel Standard”, short LESS, in order to make these lead markets transparent and fair.”

Erika Mink-Zaghloul
Head of Government & Regulatory Affairs,
thyssenkrupp Steel

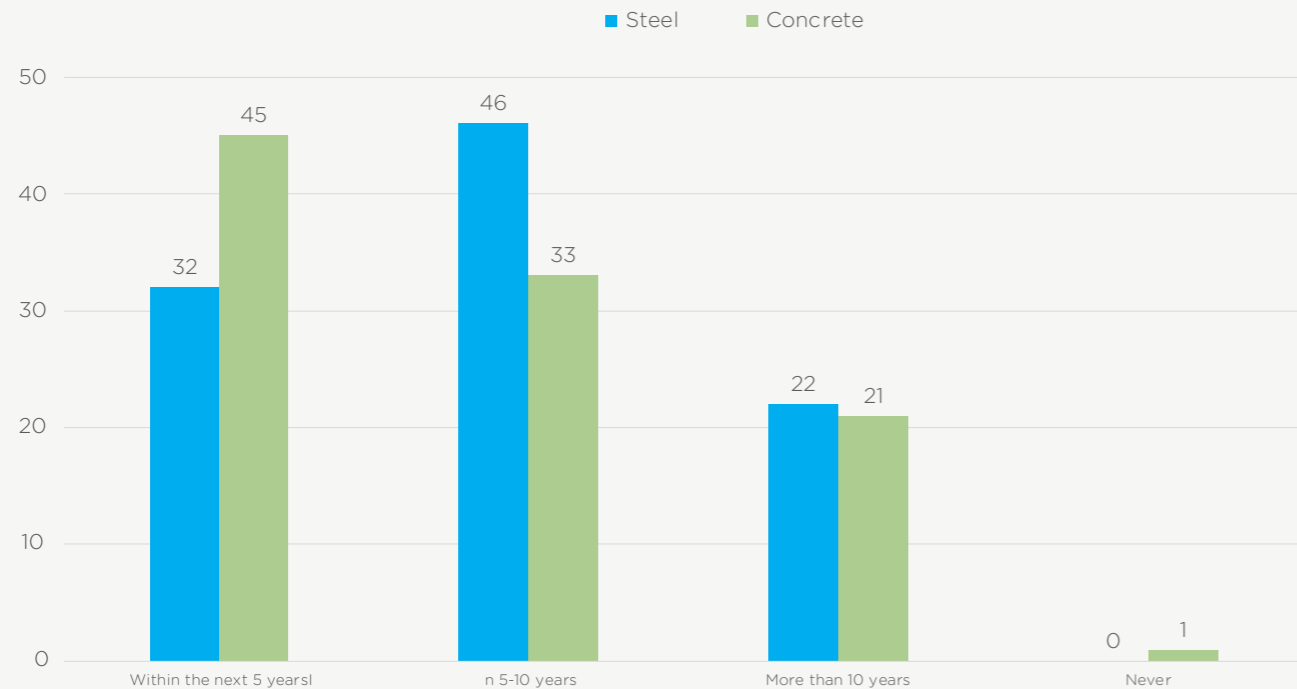
“In May 2023, we announced a strategic collaboration to reduce the embodied carbon in Hang Lung’s Westlake 66 development in Hangzhou by incorporating low carbon recycled concrete aggregate and low carbon concrete bricks.

In December 2023, we became the first real estate company in mainland China and Hong Kong to join the global SteelZero initiative, and committed to procuring 50% lower emissions steel by 2030.

Data transparency, supplier engagement and a demand signal are essential for decarbonisation, and we are optimistic about the prospects for all three in China.”

John Haffner
Deputy Director – Sustainability of
Hang Lung Properties

In your primary sector and geographic market, when do you expect that lower emission steel and concrete will become standard materials for new projects/products?



The pace of change

Survey respondents indicated that they expected the market to develop rapidly, with 32% of respondents expecting lower emission steel to become the standard material for new projects or products within the next five years. Another 46% of respondents estimate five to ten years. Not a single respondent said never.

For concrete, respondents are even more optimistic. Here, 45% believe that lower emission concrete will become the standard material for new projects or products within the next five years. Only 1% said never.

Although this makes for optimistic reading – and certainly a testament to two sectors that are both preparing for and expecting radical change within the coming years – many challenges need to be resolved for this transformation to take place at pace and scale.

We cannot simply hope for this kind of a seismic shift away from existing, polluting technologies and towards emerging, cleaner solutions. Furthermore, subjectivity surrounding the definition of ‘lower emission’ may continue to confuse and temper the real carbon savings that the respondents would appear to expect. To address this, the SteelZero and ConcreteZero commitments set clear, quantified, and timebound interim (2030), as well as end-goal (2050 at the latest), targets

for procurement of 50% lower emission and 100% net zero steel and concrete respectively.

“Ørsted was the first energy company to set a science-based target of net zero emissions across its full value chain by 2040. We did this even though carbon emissions from offshore wind are 99% lower than those from coal, manufacturing, constructing, and operating an offshore wind farm still emits carbon.

Approximately 50% of our emissions from offshore wind are linked to manufacturing steel. To tackle this, Ørsted has as an example strengthened our partnerships with Dillinger to procure lower emission heavy-plate steel for offshore wind foundations.

This enables Ørsted to secure long-term steel capacity, diversify its supply chain further, deliver on expected future customer demand, and get on track toward delivering the net-zero wind farms of tomorrow.”

Ørsted on taking action towards net zero wind farms



Governments must act quickly to help de-risk innovation

Survey results: Conclusion #4

How can governments across the globe help to accelerate and de-risk the adoption of lower emission steel and concrete? This is one of the major questions facing regulators today, and as with any type of industrial transformation, market forces and policy levers must work in tandem.

For example, the SteelZero Global Policy Principles set out six clear areas that governments must address to support the global decarbonisation of the steel industry.

Governments are asked to:

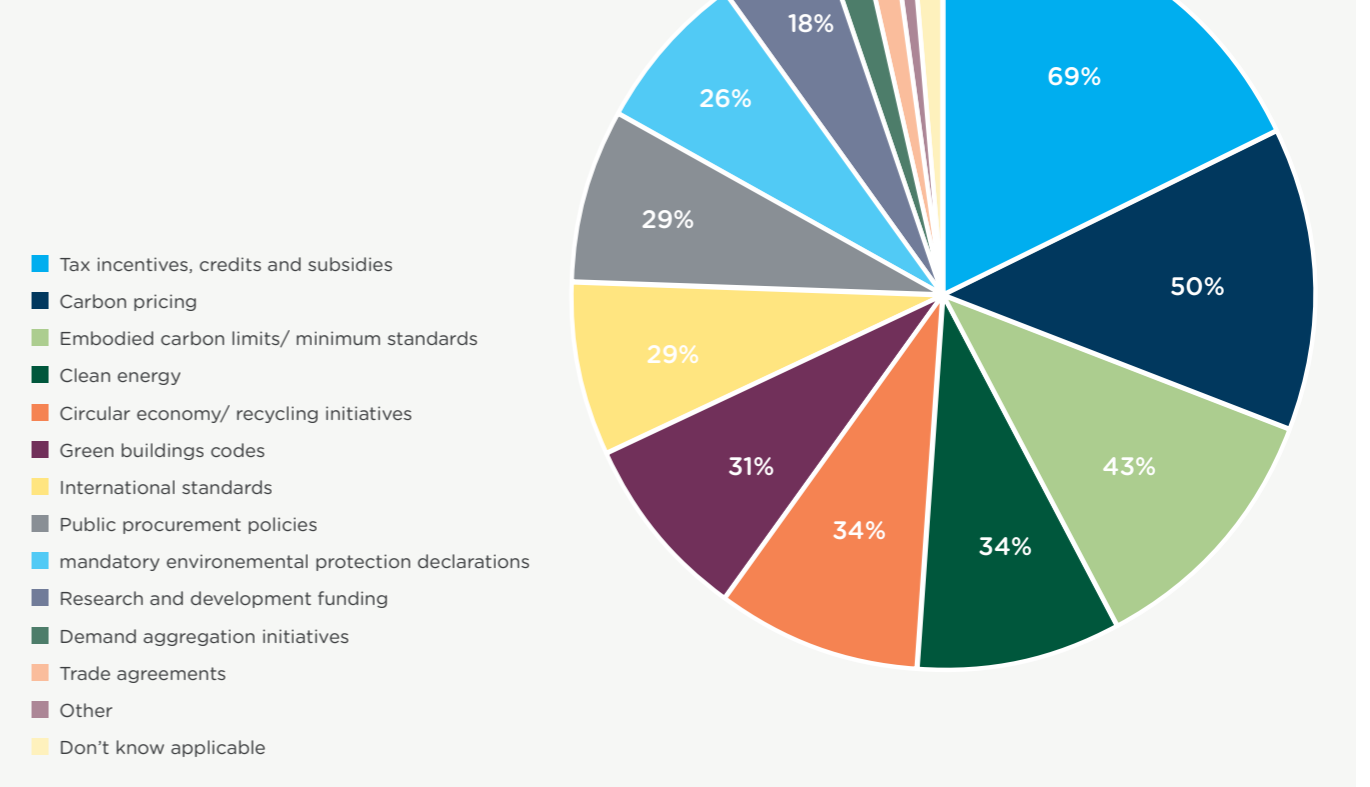
- Promote a global standard and definition on what low emission and net zero steel is
- Support the public sector in using low emission and net zero steel in current and future projects
- Get businesses to measure and report on the carbon emissions associated with the steel they use
- Encourage better use of steel in the first place while ensuring that steel can be easily recycled
- Set expectations on what is needed from steelmakers to drastically cut carbon emissions
- Create a level playing field for net zero steel in global markets.

To illustrate the approach that governments can take, EU regulations such as the Renewable Energy Directive II (RED II) on green fuels and the EU Taxonomy, aim

³ [H2 Green Steel raises more than €4 billion in debt financing for the world's first large-scale green steel plant - H2 Green Steel \(cision.com\)](#)

⁴ [Swedish National Debt Office works with H2 Green Steel regarding a green credit guarantee - Riksgälden.se \(riksdagen.se\)](#)

What government policies would be most helpful to you to accelerate private procurement of lower emission steel and concrete? (Respondents able to select between one and five options)



to accelerate the green transition of so-called hard-to-abate sectors, while ensuring producers select the most sustainable options possible. In the US, the Inflation Reduction Act has also significantly accelerated investments in clean energy.

What is certain, is that meeting ambitious sustainability targets globally requires not only bold action, but also a society-wide approach sustained by long-term government commitment. In our survey, we asked respondents to share their thoughts on which government policies would help them accelerate private procurement of lower emission steel and concrete.

The responses show the broad spectrum of policies and initiatives that will individually and collectively contribute to this multifaceted transformation. Crucially, many of the most important pieces of the decarbonisation policy puzzle are not directly linked to steel and concrete. Respondents highlighted carbon pricing (indicated by 50% of respondents), embodied carbon limits (43%), clean energy policies (34%), circularity initiatives (34%), and green building codes (31%), to name a few examples.

What stands out most in the survey is the strong call from organisations everywhere for a supportive environment to facilitate the adoption of lower emission steel and concrete, specifically through tax incentives, credits, and subsidies (as indicated by 69% of respondents).

A case in point: In early 2024, Stegra (formerly H2 Green Steel) announced having raised more than €4 billion in debt financing for the world's first large-scale green steel plant in northern Sweden. The company explained that the international banks providing the senior debt will be lending in part under a green credit guarantee provided by Riksgälden³ (The Swedish National Debt Office).

The Riksgälden endorsed the company, then still named H2 Green Steel, saying in a press release that "H2 Green Steel's investment in a green steel plant in northern Sweden aims to drastically reduce emissions of carbon dioxide and other greenhouse gases in the steel, which has the potential to generate significant environmental and climate benefits⁴."

On the incentives side, a growing number of governments are considering how to accelerate the adoption of lower emission materials, for example, by revising tax structures to impose higher taxes on non-renewable materials thereby encouraging buyers to adopt sustainable alternatives. Simultaneously, renewable energy often receives tax exemptions, fostering a virtuous cycle where environmentally friendly practices are economically advantageous. This approach not only aligns with national goals but reshapes the economic landscape of the energy-intensive industries, incentivising a more sustainable future.



“For a successful industrial transformation, climate friendly basic materials that can be found at the beginning of many value chains – such as steel and cement – must be introduced to the market already in the 2020s. And, they must be competitive. The demand for these climate-friendly, but initially higher-priced, materials will need to be strengthened with various instruments.

To this end, in May 2024 the German Federal Ministry for Economic Affairs and Climate Action introduced a concept for the creation of green lead markets. The approach set out in this concept supports the fostering of demand for these materials and complements other transformation instruments such as the carbon pricing. Ultimately, it should reduce the need for subsidies in the long term.

Funding instruments such as investment support programmes and Climate Contracts for Difference are being put in place to kick off investments in key climate-friendly technologies, creating a reliable framework for competitive and sustainable value creation in Germany.

A key element is the understanding that recognised definitions and labels are needed to distinguish climate-friendly basic materials from conventionally produced ones and to be able to market them.

Demand for new climate-friendly materials can be boosted by public procurement policies and/or through regulatory requirements such as gradually increasing minimum requirements or quotas for the emission intensity. Such measures are being discussed currently at EU level as well, for example as part of the new Ecodesign for Sustainable Products Regulation (ESPR) and the Construction Product Regulation (CPR).

The BMWK-concept on green lead markets entails concrete definitions for climatefriendly steel and cement and a proposal for definitions for ammonia and ethylene which were co-developed in a stakeholder process ‘Lead markets for climatefriendly raw materials’ (2023) with industry, science as well policy and civil society side.

The definitions provide the basis for labelling and certification initiatives, such as the recently presented private sector initiative LESS (Low Emission Steel Standard) of the German Steel Association .

The medium and long-term goal is not only to develop lead markets nationally, but also to think European and ultimately as globally as possible with ambitious, harmonised and verifiable standards. To this end, the BMWK is currently actively contributing to different forums and initiatives such as the Climate Club, the IEA Working Party on Industrial Decarbonisation (WPID) and the Industrial Deep Decarbonisation Initiative (IDDI).”

**German Federal Ministry for
Economic Affairs and Climate Action**

Investing in industrial decarbonisation

Five questions for Greg Falzon, Partner & Co-Head of Investments, AIP Management



Greg Falzon
Partner and Co-Head of Investments,
AIP Management

ABOUT GREG FALZON

Greg Falzon is Partner and Co-Head of Investments at AIP Management. He has worked in infrastructure for over 20 years and brings broad experience across infrastructure debt and equity investment.

Greg oversees the origination and execution of investments at AIP, with a particular focus on debt investments and industrial decarbonisation. Before joining AIP, he was the Co-Head of European Infrastructure at Bank of Montreal, and previously, Managing Director of Royal Bank of Canada's infrastructure debt advisory team in London, where he was responsible for structuring and sourcing debt for infrastructure assets and businesses.

Greg, this survey sets out to explore the market demand for lower emission steel and concrete. How does the level of demand look from an investment perspective?

First, I want to say that I'm really pleased to see that the decarbonisation of energy-intensive industries is gathering pace, and I'm also very pleased to see manufacturers, buyers, and regulators are making efforts to accelerate the necessary transition to lower emission steel and concrete.

From an investment point of view, however, the big question is how we can take nascent business models – which are usually more suited for higher risk money such as venture capital or private equity – and structure them in a way that allows access to the huge volume of capital that currently sits with institutional investors. This is necessary given the typical scale of projects in these industries and is by no means an easy task, but we are starting to see examples that it can be done.

What questions are institutional investors typically looking for answers to?

What they are typically seeing are four challenges with industrial decarbonisation. The first is of course the huge scale of these projects. With lower emission steel, for example, you are looking into an extremely large and complex construction project with all the risks of cost overrun and delays associated with mega projects.

Then, you must assess the operational business model and whether you think it can generate robust cash flows. As part of this you have to consider policy measures around carbon taxes and other incentives that can have a significant impact on the competitiveness of the entire industry.

Finally, there is of course the willingness to pay for these products, the so-called 'green premium'. Does it exist? And can you really depend upon it? Those are the kinds of questions that will all have to go into the investment appraisal.

So how do you manage to bridge the gap between manufacturers, buyers and investors?

Besides assessing all the complexities of construction, what will ultimately stand out in a final investment decision is the quality and reliability of future cash flows both in terms of ongoing input costs and the revenue stream. And when it comes to revenues,

if you want to be able to rely on something, what you ideally want is a signed offtake agreement with a highly creditworthy counterparty to provide a satisfactory level of certainty to bank on it in your base case.

In general, if you're aiming for an efficient capital structure, you need to control risk and provide investors with a business case where construction risks are adequately managed and revenue streams have been contracted to the largest possible extent.

The good news is that it can be done, as we have seen with for example Stegra (formerly H2 Green Steel) in Sweden. The fact that the company has managed to secure offtake that spans the first period of operation is a very strong demonstration that there is indeed a willingness to pay, and that there is a demand in the market.

For an institutional investor, this is a very important 'proof of concept' that helps to derisk the entire investment.

How do you see these early examples of a willingness to pay being translated into a wider adoption of lower emission steel and concrete?

As I see it, there are three trends right now pointing in the right direction: First, while most energy transition investors have historically focused on the renewable energy generation side, we see investors increasingly focusing on the consumption side, such as transportation, heating and industrial decarbonisation, where there is still a huge volume of capital that needs to be deployed.

Secondly, what is also very positive is that there are in fact early adopters who are willing to pay a green premium, this helps pathfinder projects move forward which in turn make it much harder for the legacy industry to claim that it can't be done. This action from first movers plays a vital role in reducing perceived risks and should catalyse progress more broadly.

Finally, I also see that more buyers are not only willing to pay a premium, but also willing to enter longer offtake agreements and thus are flexing their normal time horizons of short-term contracts in order to secure supply. This also helps to create this kind of virtuous circle by which actors in the energy-intensive industries support each other and finally start to align to unlock the progress we need to enable the green transition.

In your view, what does the future look like for lower emission steel and carbon?

On the upside, thousands of companies around the world are right now making pledges towards significant carbon reductions, and although some might question these commitments, we are beginning to see a shift in the market towards lower emission materials, which is something that investors are monitoring closely.

On the downside, we still live in a world where companies can use the environment as a free, or at least cheap, public sewer for emissions, and full transition of these industries will not happen whilst it remains cheaper for them to do so by not being charged for their externalities.

This is of course where governments play a role. I really hope that one day we will get to the point where these externalities are properly accounted and charged for, in which case no green premium for steel and concrete would even be necessary as the dirty alternative would not be cheaper for them.

ABOUT AIP MANAGEMENT

AIP Management is an infrastructure investment manager for institutional investors focused on direct investment into energy transition assets.

The company makes direct investments into assets and businesses that enable the energy transition in Europe and North America focusing on end-to-end decarbonisation. Core sectors include power generation, energy storage, industrial decarbonisation, and electrified transport.

With a proven track record since 2012, AIP Management has secured commitments totalling EUR 8 billion and invested EUR 7 billion.

In January 2024, AIP announced that it has led the mezzanine financing of Stegra (formerly H2 Green Steel) providing EUR 300 million towards the construction of the world's first large-scale green steel plant in Boden, Northern Sweden.



Powering the green energy transformation

Four questions for Anna Ekdahl, Ramboll's Director for the decarbonisation of energy-intensive industries



Anna Ekdahl
Director for Energy-Intensive
Industries, Ramboll

ABOUT ANNA EKDAHL

Anna Ekdahl leads Ramboll's efforts to help energy-intensive industries transition to a secure, affordable, and sustainable energy supply, using advanced technologies such as residual heat recovery, carbon capture, power-to-x, electrification and other fuel conversion solutions

Anna, you've had a chance to read the survey results featured in this report. What were your initial thoughts?

My initial thought is that more companies than I thought are willing to pay for lower emission materials and thus take part in the transition to a low emission economy; however, from an energy perspective I also want to stress how complex and expensive this transition is.

The Energy Transitions Commission, for example, recently underlined the need for a \$1.1 trillion annual investment in grid infrastructure until 2050 to attain the global net zero emissions objective . And that is just the grid investment side!

Then, there are the technical, commercial and environmental complexities, which also need to be addressed. Already, we see that green hydrogen and green electricity will not be able to meet communicated demands, something that will only get worse in the coming years. It is sometime easy to communicate ambitions, when you scratch the surface everything is not in place to back up the claims.

It's important that companies can challenge statements and see through hypes to properly understand risk. Effectively, what we are looking into is a complete transformation of the entire energy ecosystem to decarbonise the world's energy-intensive industries – so we need to start moving the needle now.

What options do exist to decarbonise energy intensive industries?

What most decarbonisation projects are communicating right now is wind power and green hydrogen, which is of course a good strategy if it was not for the fact that this energy is currently not available. The extreme electricity consumption that this transition to hydrogen entails means that a massive increase in electricity production and the power grid is required, which must be financed and realised in a way that is both economically justified for society and does not jeopardise the competitiveness of companies.

The magnitude of this change means that there would be significant consequences for society if these hydrogen investments do not materialise or are smaller than planned. To give you an example from Northern Europe,

Germany's four major steel electrification projects alone will require over 20 GW of new wind capacity by 2030. To put this into perspective, this is 125% of current installed electricity capacity in the entire country of Denmark.

The good news, however, is there are several other energy supply options with risk profiles that are significantly different to green hydrogen. For example, hydrogen production does not solely rely on electricity; it can also be derived from natural gas. And bio-syngas is a third option.

Alternatives and risk profile can vary significantly across regions. Realistically, companies need to look at a combination of solutions, or even interim solutions. It is not easy, but it is doable. Thankfully, we are already seeing frontrunners showing the way.

Besides the front-runners and innovators, how do you see the entire industry moving forward?

Access to capital, clear regulation and political stability are all essential, assuming those factors are in place, the thing that will accelerate the decarbonisation of energy intensive industries is collaboration. For example, to secure sustainable energy, companies must learn to collaborate with the entire sustainable energy ecosystem.

In Europe several decarbonisation projects have already been paused due to grid constraints and delayed dialogues, which is something we absolutely must avoid. Traditionally, many grids have not been allowed to invest on prognosed demand, but only current demand, which is an extra incentive to start the discussion early in the process.

To all manufacturers, I would say: start considering production, distribution, and storage of several energy carriers to meet your demand in terms of risk, cost, and environmental footprint of your end-product. You will be dependent to on third parties for your energy supply, and they are also doing this for the first time, so start the discussion early.

How do you see the willingness to pay for lower emission steel and concrete as a lever for the green energy transition?

The willingness to pay is very important. Together with the increased cost of emissions going forward, it is essential for justifying the business cases to achieve lower emissions. With this survey we see not only a current openness from customers to pay for lowering scope 3 emissions but also strong indications that the willingness is increasing over time, that achieving sustainability commitments are dependent on access to lower emissions materials but that knowledge level still needs to be increased.

The increased level of knowledge will promote measures to lower emissions from core processes over other less substantial measures. This is a clear incentive for the industry and their value chain, investors, and governments to accelerate investments.

To the buyers I would say: stand by your net zero commitments, don't let complexity stop you, and don't be tempted to push back your 2030 goals because you fear it cannot be done. Now that we know there is a willingness to be part of the solution, with a premium cost we also see that there is a willingness to collaborate, and a willingness to bring all our expertise together to accelerate progress. There is always a way forward.

When evaluating decarbonisation measures, Ramboll typically employs a hierarchical approach to decarbonisation: a methodical ranking of the most effective and feasible solutions for achieving successful decarbonisation. The prioritisation sequence is as follows:

1. Reducing overall energy demand through energy and resource efficiency measures and digitisation
2. Recycling energy streams when possible, such as heat recovery from one part of the process to another or to an external off-taker
3. Exploring paths to supply your energy need with renewable sources, either from the grid or on-site production. Electrification is more widely applicable than most think, just make sure to match it with electricity supply that is renewable and match your consumption patterns. Other options include hydrogen and biofuels.
4. Applying further measures (such as carbon capture and storage (CCS) or other removal technologies) as a last resort in hard-to-abate sectors.





“While the buildings sector has made significant strides in reducing operational carbon emissions, we must also focus on the challenge of reducing embodied carbon.

In the UK buildings sector alone, by thinking differently about some of the most carbon intense materials, we believe it is possible to remove as much as 1 million tonnes of CO₂e annually, the equivalent to the annual CO₂ uptake of 40 million trees, though that is just the start.

We already have the technology and expertise available to do this; however, we need to systematically identify material and carbon savings and utilise a targeted collaborative approach to deliver them.

Whilst this alone will not take us to a net zero position, it will make a significant contribution and, importantly, establish the processes and design culture that will allow us to identify and unlock future technologies.

It might also be one of the most effective ways to offset the ‘green premium’ of lower emission materials, i.e. using more expensive lower carbon materials, but using them more efficiently.

I think it is important that more companies are willing to pay a premium to tackle carbon reduction, as the survey shows. But I think it would be amazing if any extra cost could be eliminated altogether through smarter and wiser design choices.”

Paul Astle
Decarbonisation Lead, Ramboll

“The findings in this report highlights the urgency and the importance of listening to the customer voice when it comes to supporting the decarbonisation of steel and concrete production.

With the right policy choices, it is clear that governments have an opportunity to turn a willingness to pay for lower emissions steel and concrete into firm orders, but to get there we need to tackle the barriers that exist. Some of these are structural; these are conservative, cost sensitive and highly competitive industries.

Governments can help by learning from SteelZero and ConcreteZero members and committing to ambitious, measurable and timebound targets.

Secondly we need to find ways to link steel and concrete with broader decarbonisation of economy and society.

Let’s work together to create a level playing field and ensure that the development of new low-carbon infrastructure to support the energy transition helps to boost the market for lower emission steel and concrete.”

Andrew Forth
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The key takeaway from this survey is that there is a willingness to pay and demand-side readiness for lower emission steel and concrete. There is increased interest in these materials, compared to a year ago, spurred on by support from top management, the inclusion of specific lower emission materials in organisations' decarbonisation strategies, and expectations of rapid policy and future legislative requirements.

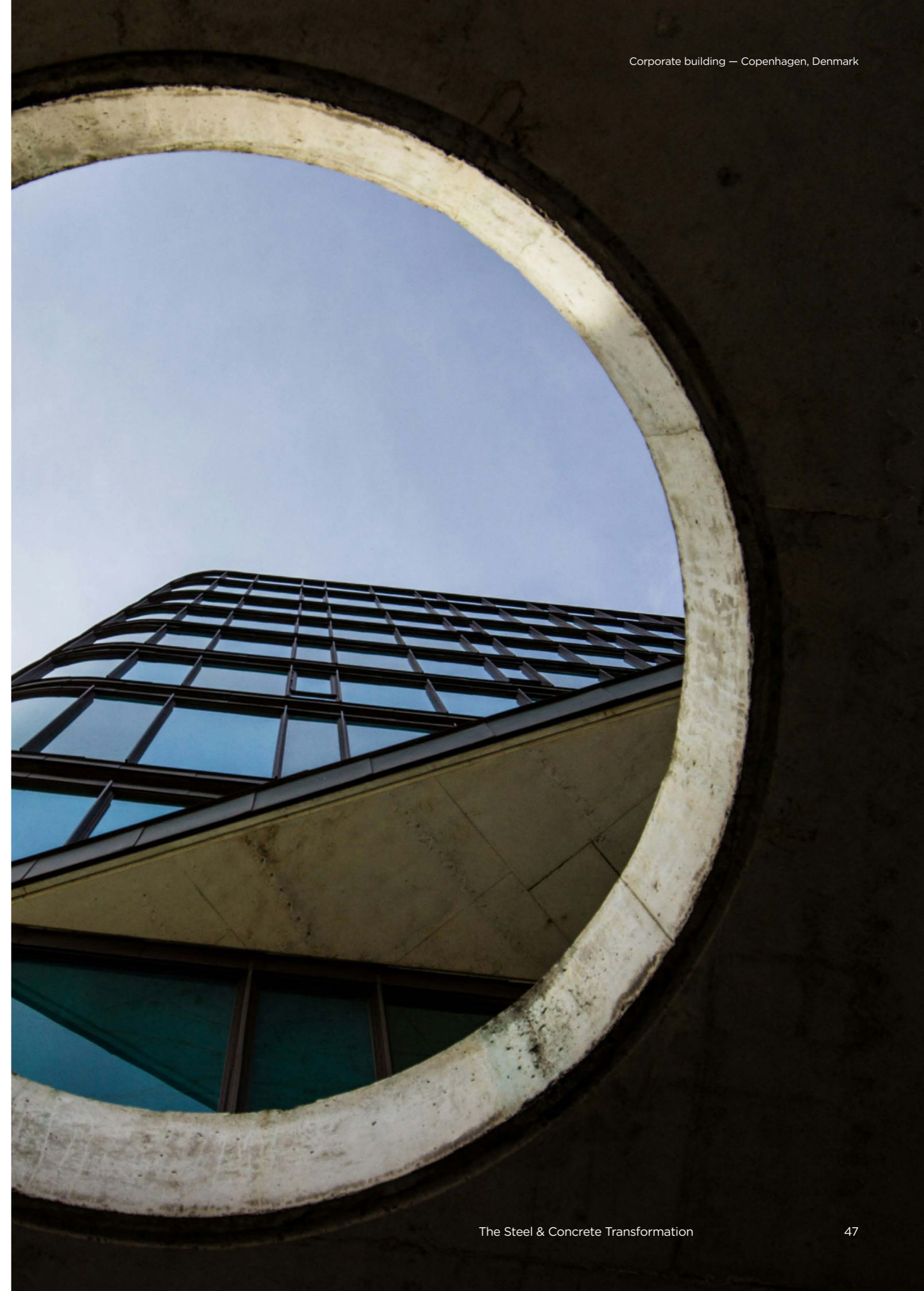
Particularly notable are the findings that approximately half of survey respondents (40-57% depending on the level of CO2 reductions sought across steel and concrete) are willing to pay a premium for using lower emission materials. Buyers are ready to step forward now.

Survey respondents did highlight significant barriers, with cost, industry conservatism, and lack of knowledge standing out as the most notable hurdles to enabling mass scaling and widespread availability of lower emission materials. There are a range of avenues and mechanisms available to immediately address these areas, not least responding to one of the calls to action specifically highlighted in the findings of this survey, namely, that organisations want to see proactive supportive policy measures swiftly put in place.

Without such interventions and incentives, we are unlikely to see rapid scaling of lower emission steel and concrete in the near future.

Not only is bold cross-sector collaboration needed to decarbonise steel and concrete by 2050, clear and robust policies must be implemented by international, national, and local authorities.

Progress is being made, but it cannot come fast enough. With this survey we have demonstrated that there is indeed a meaningful and immediate willingness to pay a premium for lower emission steel and concrete and that leaders everywhere are calling for action - not in a decade, not in a year, but now.



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