Scope 3 Decarbonisation: Practitioner Challenges

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This research was conducted by Ramboll for the Voluntary Carbon Markets Integrity Initiative (VCMI). While research planning and report drafts were routinely reviewed and refined in collaboration with VCMI, Ramboll’s analysis and conclusions were developed independently.

Executive summary

As global efforts to mitigate climate change intensify, addressing scope 3 emissions has emerged as a critical focus for organisations across industries. Scope 3 emissions, which encompass indirect emissions occurring throughout the value chain, are often the largest and most complex source of corporate greenhouse gas emissions. Despite growing awareness and the establishment of reduction targets by many companies, significant barriers persist, hindering corporate decarbonisation progress. According to a recent survey from Science Based Targets Initiative, 50% of respondents self-reported to be "off track" for delivering their scope 3 target indicating that new solutions are needed to deliver results (SBTi, 2023)[1]. Failure to decarbonise scope 3 emissions jeopardises global climate goals, particularly those outlined in the Paris Agreement, which aims to limit global temperature rise to well below 2°C above pre-industrial levels, while pursuing efforts to limit it to 1.5°C. Inaction on these emissions may further exacerbate climate change, leading to further temperature rise and intensifying environmental impacts such as more frequent extreme weather events, rising sea levels, and ecosystem disruptions (IPCC, 2023)[2].

Additionally, companies will face investor pressure and risk regulatory penalties, reputational damage, and higher costs of financing.

Drawing on insights from surveys, interviews, and existing literature, this report describes which scope 3 categories are considered the most material to companies today, the barriers associated with those categories, as well as potential solutions to mitigate the aforementioned risks.

In doing so, it highlights cross-sector challenges that companies face, such as the limited availability and high costs of low-carbon alternatives, as well as industry-specific issues. By examining these barriers and exploring potential solutions, the report seeks to equip businesses, policymakers, and stakeholders with insights to accelerate scope 3 decarbonisation efforts.

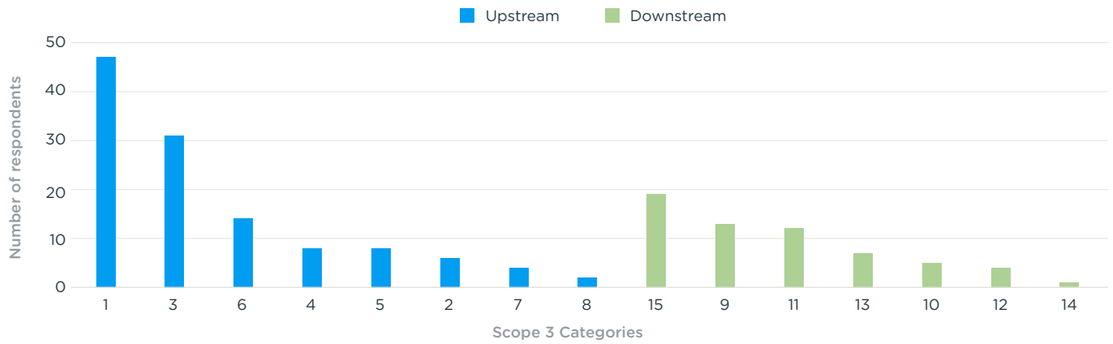
Upstream categories dominate scope 3 priorities

A global survey of 180 sustainability professionals formed the foundation of the analysis. Across sectors, the top two scope 3 categories account for approximately 80% of total scope 3 emissions, underscoring the impact that the barriers associated with these have on decarbonisation progress (CDP, 2024)[3]. To effectively assess the top barriers, each respondent identified their two highest-emitting scope 3 categories. Across sectors and regions, upstream categories of Purchased Goods and Services (Category 1) and Fuel- and Energy-Related Activities (Category 3) stood out as the most significant contributors to scope 3 emissions. Then respondents selected three barriers inhibiting decarbonisation in that category. This step was critical to ensure that the identified barriers align with the most significant sources of emissions.

Following the identification of the most material categories and barriers, we assessed solutions to barriers provided by respondents, including estimations on timelines and cost provided by participants in order to implement the solutions.

Overall, there is a noticeable imbalance between upstream and downstream categories, with greater emphasis placed on addressing upstream emissions. From a geographical perspective, Purchased Goods and Services was especially prominent in North America and Europe, while Fuel- and Energy-Related Activities was more prominent in Asia, Latin America and the Middle East. The regional variation between Category 1 and Category 3 likely reflects a combination of supply chain positioning, regional energy systems, data maturity, and economic structures.

Top material scope 3 category by number of responses



	Scope 3 category	Category name
Upstream	1	Purchased goods and services
	2	Capital goods
	3	Fuel- and energy-related activities
	4	Upstream transportation and distribution
	5	Waste generated in operations
	6	Business travel
	7	Employee commuting
	8	Upstream leased assets
Downstream	9	Downstream transportation and distribution
	10	Processing of sold products
	11	Use of sold products
	12	End-of-life treatment of sold products
	13	Downstream leased assets
	14	Franchises
	15	Investments

From the downstream categories analysed, Investments (Category 15) was also prominent, primarily driven by the financial services industry. Additionally, relatively infrequently selected categories, such as Processing of Sold Products (Category 10) and Use of Sold Products (Category 11), may have been expected to feature more prominently given their potential significance in certain industries.

Cross-sectoral and industry-specific barriers impede scope 3 progress

The results indicate that scope 3 decarbonisation is hindered by a combination of cross-sector and industry-specific barriers. However, not all barriers are equally important. Some barriers have a broader impact, affecting multiple sectors, and therefore influence larger levels of emissions globally. Additionally, certain industries, due to their distinct supply chains, faced more niche material categories and, consequently, more industry-specific barriers. Industry-specific barriers were still considered critical, given respondents scored them just as severe as more common cross-sector barriers. The tables below show the top ranked barriers both across sectors and within sectors.

Cross-sector top 10 barriers	Sectors impacted
Limited availability of technically-suitable low-carbon options ●	
Lack of control or influence over indirect suppliers ●	
High cost of low-carbon alternatives ●	
Supplier granular emissions data unavailability ●	
High costs of carbon-free energy and fuels ●	
Cost of implementing recycling/circular technologies and methods in-house	
Dependency on fossil fuel suppliers	
Cost of switching to electric / alternative fuel fleets	
Difficulty shifting direct supplier relationships	
High dependency on air and sea freight that has limited decarbonisation options	

Biotech · Consumer packaged goods · Professional services · Financial services · Retail
Real estate · Utilities and energy · Information technology · Manufacturing · Transport

Top barriers by sector		
Sector	**Priority barrier 1**	**Priority barrier 2**
Biotech	Cost of switching to electric / alternative fuel fleets	High dependency on air and sea freight that has limited decarbonisation options
Consumer packaged goods	Limited availability of technically-suitable low-carbon options ●	Cost of switching to electric / alternative fuel fleets
Finance	Lack of emissions disclosure by investees ●	Risk return concerns on green investments ●
Information technology	Cost of implementing recycling/circular technologies and methods in-house	Employee preference for air travel ●
Manufacturing	Limited availability of technically-suitable low-carbon options ●	Dependency on fossil fuel suppliers
Professional services	High costs of carbon-free energy and fuels ●	Lack of control or influence over indirect suppliers ●
Real estate	Difficulty monitoring tenant energy use	Tenant engagement challenges
Retail	Cost of implementing recycling/circular technologies and methods in-house	High cost of low-carbon alternatives ●
Transport	Lack of control or influence over indirect suppliers ●	Limited availability of carbon-free energy and fuels ●
Utilities and energy	High costs of carbon-free energy and fuels ●	Dependency on fossil fuel suppliers

● Orange text shows barriers that will be discussed in a cross-sector context

● Light blue text indicates sector-specific barriers not present in top 10 cross-sector barriers

To identify which barriers should be prioritised, the study used five specific factors from the survey data – how often the barrier was selected, prevalence of the barrier across sectors, barrier severity, historical emissions change of the respondent's company, and the respondent's perceived ability of their company to meet future targets. The findings from this study point to two main themes and five top barriers to scope 3 decarbonisation for companies today, with each barrier present in at least 8 sectors:

Top 5 cross-sector barriers	
Techno-economic barriers to upstream decarbonisation	**Supply chain coordination and emissions reporting**
Limited availability of technically-suitable low-carbon options	Lack of control or influence over indirect suppliers
High cost of low-carbon alternatives	Supplier emissions data unavailability
High costs of carbon-free energy and fuels	

In addition to cross-sector challenges, results pointed to unique obstacles within industries. For example, the financial services sector struggles with inadequate emissions disclosure by investees and balancing risk-return concerns for green investments. Real estate companies encounter significant challenges in monitoring tenant energy use and engaging tenants in sustainability efforts. Transportation companies are constrained by the limited availability of carbon-free energy and fuels, exacerbated by infrastructure and technological limitations.

Regional disparities also exacerbate challenges. While companies located in developed markets often benefit from government incentives and advanced frameworks, companies in emerging markets tend to face resource limitations including funding and technology, as well as knowledge gaps.

Results indicate positive perceptions of ability to overcome barriers

While respondents identified multiple high-impact barriers to scope 3 decarbonisation, results from this study also indicate that 70% of respondents perceive their company's ability to meet scope 3 targets was either adequate, good, or very good. Over 55% of respondents indicated scope 3 target dates between 2030 and 2040. This indicates that 2030 and 2040 targets could be within reach – provided perceptions accurately reflect the pace and feasibility of implementation and the current state of progress remains on course. Overall, this study reveals that respondents have a relatively positive perception of timelines necessary to implement solutions to address barriers with a moderate level of constraint.

65% of sustainability professionals in this study suggest that they could implement solutions to address barriers in the short-term (within 5 years) and another 20% could implement solutions in the medium-term (within 10 years). However, this is not necessarily the entire picture as implementation is contingent on other factors such as having the necessary resources and stakeholder support in place and many solutions to key challenges rely on significant structural changes beyond the control of individual firms. Overall, the specifics for how solutions could be achieved were fragmented across responses, regardless of sector or region.

Solutions fall within cohesive themes, but include broad ranges for cost and implementation timelines regardless of industry or region

The study assessed a wide range of solutions to overcome the top barriers identified, provided by survey respondents or interviews. Many of these solutions coalesced around thematic groupings related to costs, technological capabilities, and supplier engagement. Regional responses also exhibited thematic groupings related to available incentives and technologies, depending on market maturity.

Solutions to top cross-sector barriers	
Solutions for techno-economic barriers to upstream decarbonisation	**Solutions for supply chain coordination and emissions reporting**
Innovation and development	Collaboration and engaging suppliers
Partnerships and market mechanisms	Expanding or diversifying supplier base
Carbon credits and interim reductions	Embedding sustainability into contracts
Policy and regulation	Promoting supply chain proximity
Consumer demand and business model adjustments	Leveraging digital tools and software
	Standardisation of data collection processes

Addressing techno-economic barriers to upstream decarbonisation

Addressing the techno-economic barriers to upstream decarbonisation requires actionable steps, through company-level behavioural changes and broader structural shifts. The high costs and limited availability of low-carbon alternatives remain central challenges, but these challenges present opportunities for targeted intervention. Companies should focus on accelerating innovation to drive both the cost reduction and availability of low-carbon technologies. In addition, investments in R&D should be made for developing low-carbon materials and fuels, such as hydrogen and bio-based plastics, which will provide critical pathways for enabling upstream decarbonisation.
Policy interventions are equally critical in addressing systemic barriers yet appeared underplayed in survey responses.

While literature highlights the pivotal role of subsidies, carbon pricing, and government incentives in overcoming high costs and accelerating the adoption of low-carbon solutions, these structural changes received comparatively less attention. For instance, tax incentives for renewable energy adoption and direct government funding for green infrastructure projects have shown significant promise, but were not widely emphasised by respondents. Similarly, pilot projects that scale renewable energy and implement circular economy solutions demonstrate the potential for long-term market shifts and cost reductions through coordinated innovation and policy support, yet this was less prominently discussed in the survey findings.

Addressing supply chain coordination and emissions reporting barriers

Improving supply chain coordination and emissions reporting is vital to addressing scope 3 barriers. Embedding sustainability clauses into supplier contracts has proven effective, fostering collaboration and accountability while driving improvements in supplier engagement. Digital platforms play an important role in standardising data collection and enabling emissions transparency across supply chains. However, challenges remain, as many of the solutions proposed in the survey lacked the granularity needed to fully assess and compare the cost and implementation timeline estimates. This may indicate a knowledge gap in how companies translate high-level ambitions into actionable, scalable strategies. Estimates provided by companies vary widely based on ambition, geography, and revenue, further complicating efforts to present a cohesive strategy for addressing these issues.

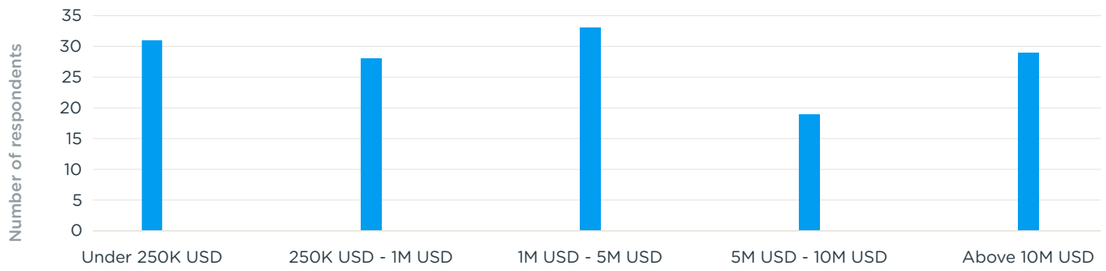
The variability in cost and timeline estimates across respondents suggests that companies may be navigating a degree of uncertainty in defining solution specifics. Some of this may stem from limited internal expertise, while in other cases, it could reflect the early-stage nature of many proposed initiatives. This uncertainty highlights the need for clearer industry guidance and knowledge-sharing to help businesses refine their cost and timeline estimates as they transition from planning to execution.

Collaboration among supply chain stakeholders is critical for large-scale decarbonisation. Co-investment in sustainable technologies and joint initiatives can align interests and foster accountability across value chains. By integrating digital tools with robust policy support and fostering deeper supply chain partnerships, companies can make meaningful progress in overcoming the barriers associated with supply chain coordination and emissions reporting.

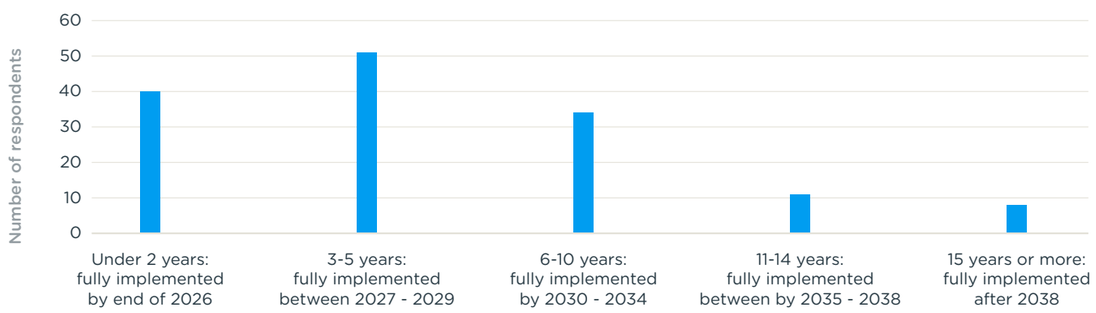
Specifics for costs and timelines for implementation were fragmented regardless of sector or regional similarities

The data reflected little consensus on implementation timelines and associated costs when solutions were analysed in aggregate. For all responses associated with each top barrier, the cost of individual solutions proposed always ranged from the low end (under 250K USD) to the high end (above 10M USD). Similarly, timelines ranged between under 2 years to more than 15 years, but nearly all responses were assessed to be achievable within the next 10 years. Moreover, there was no relationship between company size and cost of suggested solution.

Estimated costs for solutions addressing top 5 barriers

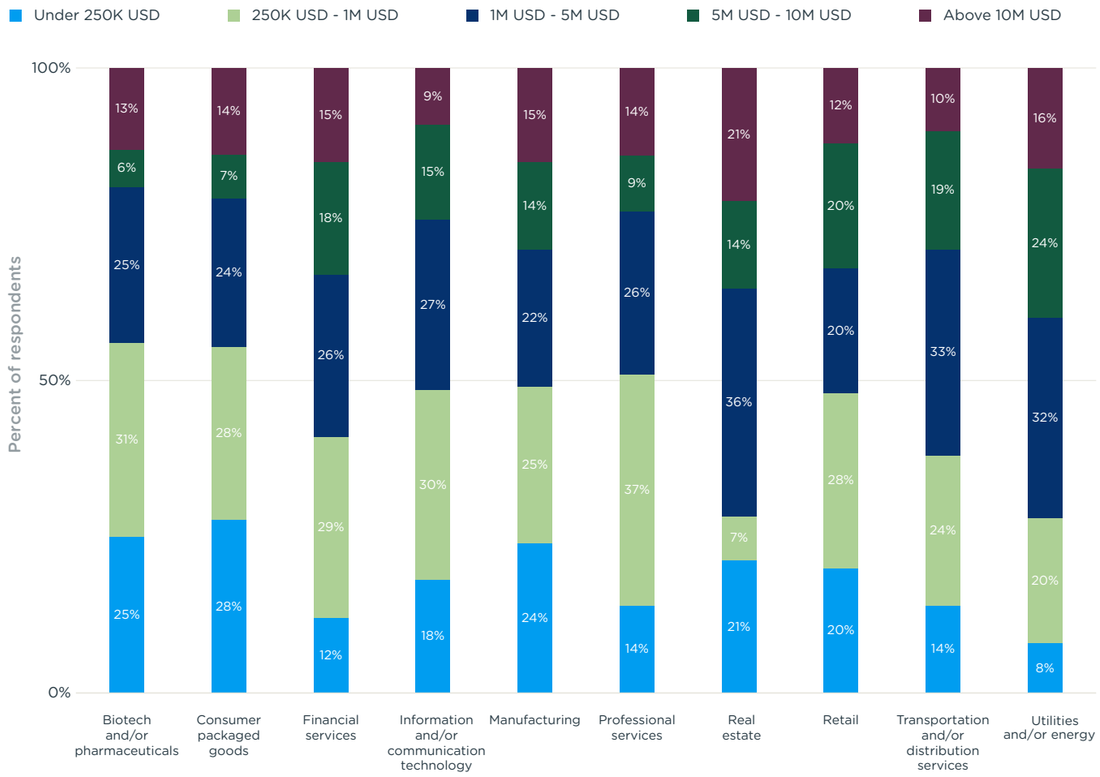


Estimated timelines for solutions addressing top 5 barriers



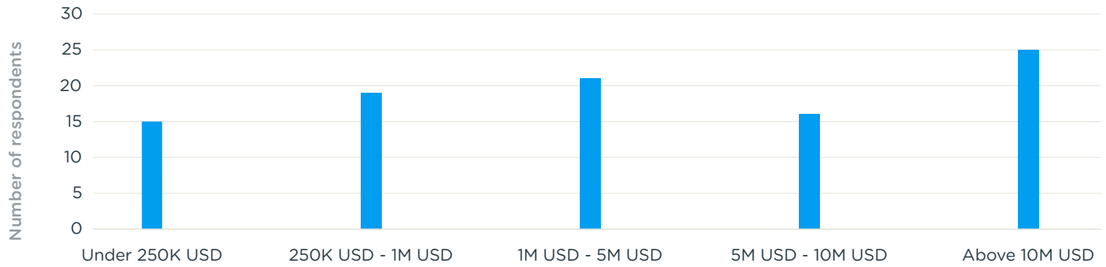
Across all sectors and solutions to all barriers, the average estimated solution cost was between **250K – 1M USD and 1M – 5M USD** categories. Across industries, the average cost varies between the two, indicating a relatively consistent expectation of solution costs across sectors, with retail, transportation, and utilities expected to be the most costly. Additionally, there was little regional variation, with the average falling within the same range.

Estimated costs for solutions addressing top 5 barriers

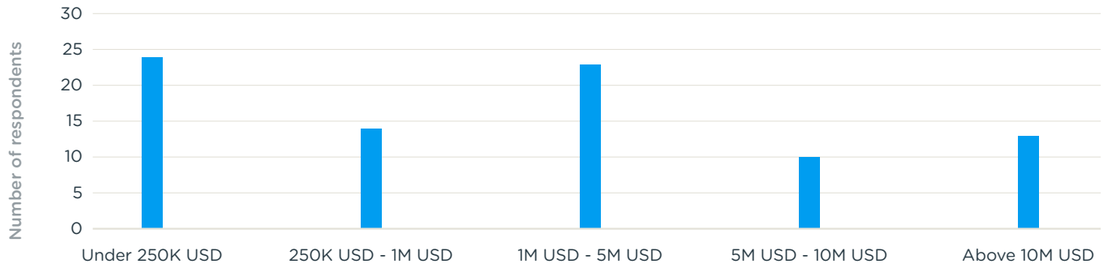


However, when examining top barriers by thematic groups, some trends emerge. The market believes techno-economic barriers will be more expensive to overcome compared to supply chain coordination-related barriers. Responses for techno-economic solutions most frequently estimated costs above 10M USD, while solutions addressing supply chain coordination barriers most frequently estimated costs under 250K USD. For both solution groups, the results did not follow a clear progression, suggesting a level of uncertainty in cost estimations across respondents.

Estimated costs for solutions addressing techno-economic barriers



Estimated costs for solutions addressing supply chain coordination barriers

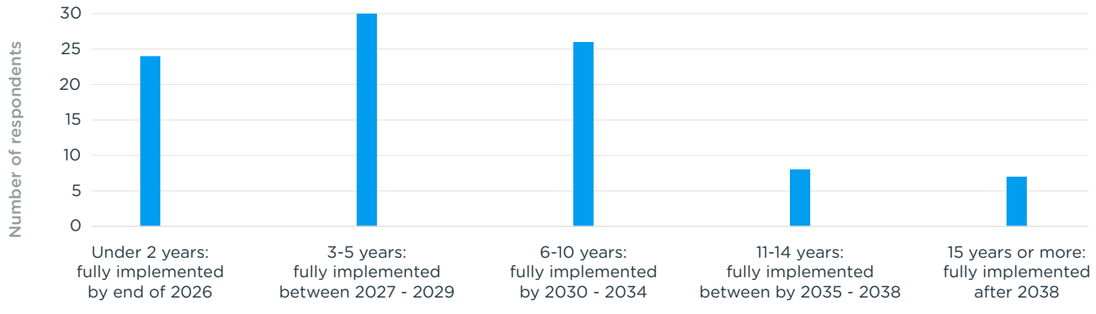


The supply chain coordination solutions typically focus on optimising existing processes or updating operating models rather than developing or deploying new technologies. This aligns with expectations, as improving operating models often demands fewer resources compared to the larger financial investments associated with new technological solutions for decarbonisation.

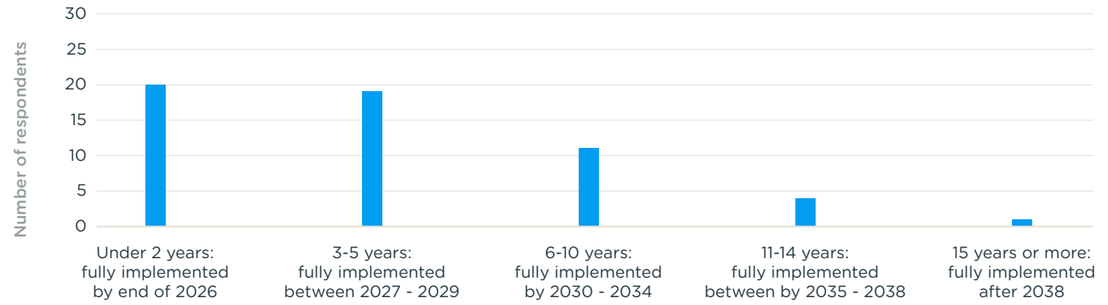
Timelines across both subsets of barriers were slightly more cohesive, but still ranged across the entire spectrum of possible answers (under 2 years to more than 15 years).

Across solutions for all top barriers, the majority of respondents estimated that it would take no more than 10 years to implement associated solutions, which aligned with survey-wide timelines. Similar to the results obtained in the costs analysis, respondents believe that techno-economic solutions will take longer to implement compared with supplier management and supply chain coordination solutions. This again aligns with expectations as techno-economic solutions may require the development, testing, and scaling of new technologies or infrastructure to fully implement.

Estimated timelines for solutions addressing techno-economic barriers



Estimated timelines for solutions addressing supply chain coordination barriers



Recommendations for next steps

Overall, this study provides a comprehensive analysis of the key barriers inhibiting scope 3 decarbonisation, identifying both cross-sector and industry-specific challenges. It examines linkages across sectors and regions while highlighting critical differences. By integrating survey data, interviews, and existing literature, the report offers a nuanced understanding of the most material scope 3 categories – Categories 1 and 3, the obstacles companies face – techno-economic and supply chain coordination, and potential solutions to overcome them.

This study identified that barriers can be overcome through a variety of solutions to bridge the gap between corporate targets and current progress. Specifically, overcoming these barriers requires structured supplier collaboration through formal engagement programs, data-sharing mandates, and targeted training to improve emissions reporting and accountability. Piloting low-carbon material and fuel alternatives—such as bio-based inputs and electric vehicle fleets—can help demonstrate commercial viability and ease adoption challenges.

Additionally, companies should implement tiered incentive structures for suppliers, rewarding emissions reductions through procurement advantages. Given the challenge of fragmented data, centralised digital tracking tools should be more widely adopted by companies of all sizes to streamline collection, verification, and reporting of emissions-related data. Finally, collaboration on industry-wide and policy-driven solutions—such as co-funding advanced technologies and advocating for clean energy incentives— is a clear strategy for all companies to help scale decarbonisation efforts more effectively. Survey data indicates that solutions related to techno-economic barriers are likely to be more expensive and take longer to implement compared to supply chain coordination.

While this study successfully maps barriers and associated solutions in depth, the findings also highlight a fragmented landscape of cost and timeline estimates for solutions, with notable uncertainty around implementation feasibility. This underscores the need for additional research and pathway modelling to refine barrier-specific solutions, establish clearer cost benchmarks, and further evaluate implementation timelines necessary for effective decarbonisation. Future work should focus on quantifying the financial implications and effort levels of barrier-specific solutions. By advancing barrier and solution identification through pathway modelling, businesses, policymakers, and other stakeholders will be better positioned to reduce scope 3 emissions at scale.

02

Introduction and literature review

2.1. Objectives of this report

This report aims to support businesses, policymakers, and stakeholders in overcoming challenges related to scope 3 decarbonisation. The objectives of this report are as follows:

1. Identify key barriers:

a. To determine the primary barriers inhibiting scope 3 decarbonisation at a macro level and assess the impact of those barriers across various sectors and geographies
b. To prioritise barriers based on weighting criteria utilising five specific factors from the survey data – frequency of selection, sector spread, barrier severity, historical emissions change, and perceived ability to meet future targets.

2. Provide actionable recommendations:

a. To offer practical and actionable solutions to address the prioritised barriers.
b. Where possible, include estimated timeframes and costs for implementing these measures.

By achieving these objectives, this report seeks to provide a picture of the current state of scope 3 decarbonisation progress. In doing so, it aims to support efforts to accelerate overall progress by equipping stakeholders with the insights necessary for meaningful action.

2.2. Summary of the current state of knowledge on scope 3 barriers

As global emissions continue to exacerbate the effects of climate change, many organisations—including governments, regulatory bodies, NGOs, and private companies—are striving to tackle this. Historically, efforts have primarily focused on reducing emissions from companies' direct operations (scope 1) and purchased energy (scope 2). While some early movers began addressing value chain emissions (scope 3) nearly two decades ago, their focus has recently become more widespread as organisations consider that on average, scope 3 emissions comprise 75% of a company's total carbon footprint (CDP, 2024). Given the broader context and definition of scope 3 emissions, this carbon accounting component is particularly challenging to manage and reduce. While established frameworks and standardised methodologies exist for calculating and managing scope 1 and 2 emissions, scope 3 methodologies lag. Scopes 1 and 2 emissions are relatively easier to measure and report as they lie mostly within the operational sphere of a corporation.

Scope 3 emissions are significantly more complex and harder to determine (Busch et al., 2022; Dahlmann & Rohrich, 2019; Downie & Stubbs, 2012, as cited in Hettler., 2023)[4].

This gap is in part due to the sheer breadth and complexity of value chain emissions, which encompass everything from upstream supplier activities to downstream product use and disposal. Scope 3 emissions are exceedingly difficult to calculate and manage for sectors with complex value chains. The more steps in a value chain, the more difficult it is to calculate and manage scope 3 emissions. According to a recent study, companies have limited knowledge of their value chains and firms are still making significant efforts to map and assess the impact of their first-tier suppliers or customers. Only 15% of companies engage with further tiers of their value chains, suggesting that companies that have less visibility the broader and deeper supply chains stretch (Vieira et al, 2024)[5] . This complexity across sectors is compounded by varying regional approaches to climate targets, including national wealth, regulatory and policy regimes, cultural acceptance of climate targets, and the state of technological advancement and availability. As such, there has been much research and discussion about the challenges that organisations face when attempting to decarbonise their supply chains.

Available research has identified a myriad of barriers to scope 3 decarbonisation across and within sectors. For example, a 2014 study established four broad categories of barriers from a macro perspective — structural, regulatory, cultural, and contextual —while identifying a lack of financial incentives and ambiguity in the meaning of low carbon as the two most frequently mentioned challenges (Liu, 2014)[6] . Additionally, a study of six organisations in Europe and South Asia, found that supply chain decarbonisation was hindered by a lack of awareness, a lack of expertise, major upfront costs, and a resistant mindset (Zhang et al., 2022)[7] . Another study of four Norwegian healthcare companies identified key challenges, including a lack of concrete data, a lack of financial incentives, and the absence of standardised reporting, the difficulty of exerting influence or control due to a high number of suppliers (Andersen, 2024)[8]. The various studies found some common barriers throughout. The table below compiles a list of key studies and identified barriers to scope 3 decarbonisation.

Key studies and identified barriers to scope 3 carbonisation

Research	Research focus	Barriers
Zhu and Geng, 2013[9]	Extended supply chain practices for energy saving and emission reduction among Chinese manufacturers	• Insignificant financial gains • Lack of resources and capabilities • Lack of information
Liu, 2014	Low carbon production of industrial firms	• Lack of financial incentives • Ambiguity in the meaning of low carbon
Olatunji et al. 2019[10]	Carbon efficient supply chain in the manufacturing industry	• Different regulation • The awareness of consumers • The complexity of supply chain tracking
Zhang et al., 2022	Barriers to supply chain decarbonisation and strategies to overcome barriers	• Lack of awareness • Lack of expertise • Major upfront costs • A resistant mindset
Hettler, 2023	Barriers and enablers of corporate scope 3 emissions reporting and reductions	• Data quality issues • Lack of standardised reporting and frameworks • High transaction costs to capture and measure data
Andersen, 2024	Challenges faced by healthcare organisations in managing scope 3 emissions	• Lack of concrete data • Lack of financial incentives • Absence of standardised reporting
Qian, 2024[11]	Managing greenhouse gases in steel production, including inventory and strategic reductions	• Supplier and downstream consumer engagement • Variation in supplier practices • Data collection and management
SBTi, 2024[12]	Overview of the status and current practices of scope 3 target setting, while discussing challenges and opportunities	• Data availability and reliability • Limited influence over supply chain stakeholders • Adhering to the 67% boundary may result in the exclusion of high-climate-impact activities • Lack of sector-specific and regional contextualisation
CDP, HSBC, 2024[13]	Supply chain challenges and solutions for scope 3 decarbonisation	• Low supplier engagement and limited data transparency • High financial costs for mitigation and technology adoption • Misalignment between sustainability and procurement priorities

The existing bodies of research have provided the critical foundation in understanding scope 3 emissions and the barriers to decarbonisation. However, much of this research is limited in scope across several dimensions. Key studies often examine only a small number of participants and are, therefore, based on a limited set of primary data sources. Additionally, many studies focus exclusively on a single industry or region, which restricts the applicability of findings and may overlook cross-sector analysis and potential synergies from a solution perspective. Furthermore, some research does not specifically address scope 3 emissions, but discusses decarbonisation barriers more broadly, or focuses on scope 3 barriers overall that are not sector-specific. Supply chain decarbonisation presents its own set of unique challenges compared to scope 1 and scope 2 and should be studied as a distinct area of focus to address the complexities inherent in value chain emissions.

In summary, no studies were identified which comprehensively examine the most critical barriers to scope 3 decarbonisation within specific sectors and regions. These studies often do not assess the impacts of these barriers concerning potential decarbonisation outcomes. As a result, the barriers identified are not always connected to the most material scope 3 categories.

This research seeks to address these gaps by pinpointing the most material scope 3 categories by segment and linking them directly to the barriers that impede decarbonisation. We aim to examine not only these barriers but also potential solutions, associated costs, and the timeframes necessary for implementing these solutions. Our study aims to balance sector-specific insights with a broader perspective, enabling us to capture cross-sector linkages and consider dependencies holistically. While this study does not seek to provide definitive answers, it seeks to advance the discussion around the most pressing scope 3 challenges and provide insights that can guide future research and action.

03 Methodology

This study used a structured, multi-method approach to investigate barriers to scope 3 decarbonisation across diverse sectors and regions. The methodology combined a detailed literature review, survey, interviews with decarbonisation practitioners, and desktop research to ensure robust and actionable findings.

Literature review
The study began with an initial hypothesis on potential barriers to decarbonisation. From there, a comprehensive literature review was conducted to summarise existing knowledge on scope 3 barriers and identify research gaps. The selection of sources was guided by two main criteria. We specifically searched for sources that were highly cited and examined more recent sources even if they were not cited as frequently. This ensured there was a balance between established foundational knowledge and emerging trends or new insights in the field. The literature evaluated industry-specific papers and broader, cross-sector private-sector reports, enabling us to capture sector-specific challenges and overarching barriers that might affect multiple industries, ultimately setting the foundation for the survey design.

Survey design
Based on the initial hypothesis of barriers and further refinement from the literature review, a long list was developed of all potential barriers to scope 3 decarbonisation. These barriers were mapped across all scope 3 categories and used to inform the multiple-choice options for survey questions related to barriers (i.e., some barriers are only relevant to certain scope 3 categories). The survey questionnaire was structured to capture data across key variables, including:

- Regions of operation
- Industry classification
- Top two scope 3 categories
- Top three identified barriers to emissions reductions
- Proposed solutions, including estimated costs and timelines
- Perceived and actual progress on scope 3 reductions

The survey was designed to adapt dynamically to each respondent's previous answers, with subsequent questions based on prior responses. For instance, the set of potential barriers presented to respondents as multiple choice varied depending on the scope 3 category they selected as most material previously. Each barrier was then rated by respondents based on its perceived severity (e.g., significant, moderate, or insignificant).

Survey implementation and data cleaning
Survey responses were collected from 181 sustainability practitioners across industries and regions, and with varying levels of commitment to emissions reduction targets (see next section for a full overview of respondents). Responses were reviewed for completeness, consistency, and logical coherence. Ambiguous answers and outliers were flagged for further review or excluded as necessary to maintain data quality.

Interview process
In addition to the survey, 10 semi-structured interviews were conducted with decarbonisation practitioners from different industries to validate survey findings and gather qualitative insights.

Data analysis
Data analysis integrated survey responses, interview narratives, and desktop research. Descriptive demographic data were segmented to further refine the analysis, identifying trends where relevant by variables such as industry, region, or company size. Key steps included:

Interviews
Interview transcripts were coded, and results were grouped into key themes to identify recurring themes, key patterns, and industry-specific nuances. Cross-analysis was conducted to compare interview insights with survey findings, ensuring alignment or identifying discrepancies that required further examination. Interviews helped contextualise the quantitative survey results by providing real-world examples and explanations behind reported barriers.

Survey:
To arrive at the final list of barriers for solutions analysis, a four-step process was implemented:

1. Raw survey data assessment:
- Data was gathered from the survey where respondents selected the barriers, they faced in achieving scope 3 decarbonisation.
- Barriers were assessed based on the following information from the survey:
  - **Frequency of selection:** How commonly selected the barrier was across all respondents.
  - **Barrier severity:** The perceived difficulty of overcoming the barrier.
  - **Sector spread:** How many different industries were represented by the respondents choosing that barrier? This also helped to counterbalance the frequency of selection (i.e., if respondents from a sector that was disproportionately represented in the survey all selected the same barrier it would be over-represented, but the barrier would also score low on this factor).
  - **Actual emissions change:** Historic data from the respondents' companies indicating if their company had seen emissions rise or fall in recent years. Barriers cited by companies showing a lack of historical progress scored higher.
  - **Perceived future ability to meet targets:** Respondents' perception of their ability to meet their future targets. Barriers from companies who perceived an inability to meet future targets scored higher.

2. Normalisation of scores (1-10):
- Scores from the survey categories described above were normalised on a 1-10 scale to ensure comparability across responses and factors.

3. Application of weightings:
- The following weightings were applied to prioritise the barriers based on specific factors:
  - Frequency of selection: 40%
  - Actual emissions change: 15%
  - Perceived future impact: 20%
  - Barrier severity: 15%
  - Sector spread: 10%

4. Development of final list of barriers:
Barriers were ranked and consolidated into a final list, focusing on those with the greatest impact on emissions reduction across sectors.

About the solutions:
Potential solutions to address the top barriers were identified using insights from the literature review, survey results, interviews, and desktop research. In the survey, respondents were asked to provide one potential solution to each barrier indicated:
- If you were to propose one comprehensive solution for your company to implement to resolve each of these barriers, what would it be? Please provide detailed responses.

Respondents were also asked to report solutions to barriers already addressed:
- Which solutions did your company implement to successfully address [previously addressed barrier] in the past?

There were therefore two potential sources to inform this section from the survey:
- Actual solutions that companies have implemented towards specific barriers
- Potential, proposed solutions from sustainability practitioners

A simple methodology was then applied to screen, group, and analyse the solutions:
- Identification of themes
- Comparison of costs and timelines
- Comparison to interview content and literature where available
- Commentary using Ramboll experience

A note about costs and timelines:
As follow-up questions, respondents were asked the following mandatory questions:

If you were to make a very high-level estimate, what would be (or 'what was' for already implemented solutions) the total cost to your company to fully implement solutions to these barriers? With the following options:
- Under 250K USD
- 250K – 1M USD
- 1M – 5M USD
- 5M to 10M USD
- Above 10M USD

If you were to make a very high-level estimate, what would be (or 'what was' for already implemented solutions) the timeline for your company to fully implement solutions to these barriers? With the following options:
- Under 2 years
- 3-5 years
- 6-10 years
- 11-14 years
- 15 years or more

Addressing study limitations
This study acknowledges several potential limitations inherent to its methodology:
- **Sample representation:** While the survey aimed for broad representation across industries and regions, the sample size of 180 participants may not fully capture the diversity of perspectives in all sectors or geographic areas. Consequently, findings may reflect trends more relevant to certain industries or regions over others.
- **Focus on short-term challenges:** Respondents may exhibit present bias—a cognitive tendency to focus on immediate and pressing challenges rather than long-term systemic barriers. While this provides valuable insights into current obstacles, it may underrepresent structural or future-oriented challenges critical to achieving long-term scope 3 decarbonisation goals.
- **Limitations in timeline and cost estimates:** Assessing the timelines and costs of implementing identified solutions relies on self-reported data and estimates rather than robust modelled analysis. These estimates may vary significantly based on the company context and available information, potentially reducing the precision of the findings. To account for these limitations, the study integrated triangulation techniques, incorporating data from interviews and desktop research to validate survey findings. The analysis also sought to balance short-term and systemic challenges by emphasising barriers with significant long-term emissions reduction potential during the prioritisation process. Finally, all analytical processes, from survey design to barrier prioritisation, were documented with transparency to ensure reproducibility and credibility.

04 Barriers to scope 3 decarbonisation

4.1. Introduction

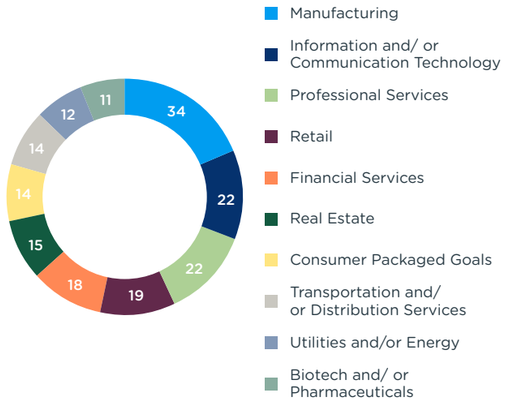
This chapter includes a review of the survey respondents, an overview of cross-industry trends, an examination of barriers specific to individual industries, and, where data allows, a regional breakdown of challenges. Together, these insights provide a nuanced understanding of the systemic, sectoral, and regional factors that are preventing organisations from addressing their most material scope 3 categories.

This section provides context for understanding the remainder of the report, as it frames the type of companies represented in the study and their maturity in addressing scope 3 emissions.

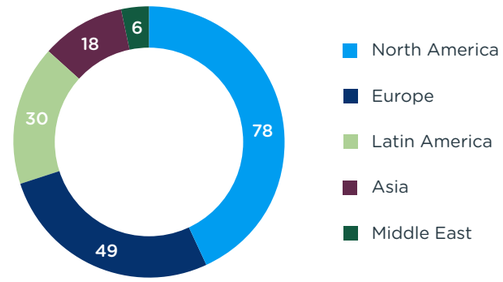
4.2. Survey results: understanding the respondents and their companies

The survey captured responses from 181 participants, representing a diverse array of industries and regions, which can be seen in Figure 2. This distribution highlights a strong regional representation from developed and emerging markets, ensuring diverse insights into the challenges and opportunities for scope 3 decarbonisation across global supply chains.

Industry distribution of respondents



Regional distribution of respondents



4.2.1. Scope 3 'maturity' of respondents

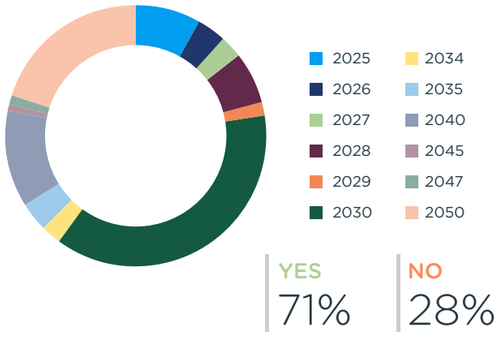
71% of respondents' companies have set scope 3 emissions reduction targets, while 29% have not yet done so. The timeline for these targets varies, with many aiming for completion between 2030 and 2040, though a smaller proportion have targets as early as 2025 or as late as 2050. When asked about their ability to meet stated scope 3 targets, responses were skewed toward "somewhat limited" (39%) and "adequate" (30%) with fewer respondents rating their ability as "good" (22%) and only low numbers describing it as "very good" (4%) or "very limited" (5%). This distribution highlights a predominant perception of moderate constraints rather than high confidence or severe limitations.

Regarding past progress on scope 3 emissions reductions, most respondents rated their performance as "as expected" (46%) or "below expectation" (36%) with far fewer indicating "above expectation" (13%) or "far above expectation" (4%). This distribution is similarly skewed, reflecting a general trend of companies feeling their progress has been average or underwhelming.

Actual emissions outcomes showed a mixed picture, with a substantial proportion reporting decreases in scope 3 emissions (46%), while many also reported increases (38%). The remainder (16%) reported no significant change, creating a largely bimodal pattern of progress. For those reporting changes, the most common magnitude was in the range of 0-10%, with fewer respondents reporting larger shifts. This skewed distribution suggests that most companies are experiencing incremental changes rather than substantial transformations. Over 35% of respondents who reported an increase in scope 3 emissions identified company growth or calculation methodologies (e.g., spend base) as the primary reason. In direct contrast, some note that emissions have decreased due to a decrease in overall revenue. Taken together, these findings reflect variability in scope 3 maturity and progress among companies, with most facing moderate challenges in achieving stated scope 3 targets and reporting incremental rather than significant improvements.

Findings reflect variability in scope 3 maturity and progress among companies, with most facing moderate challenges in achieving stated scope 3 targets and reporting incremental rather than significant improvements.

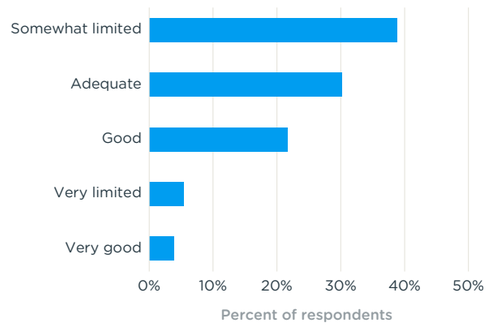
Respondents with scope 3 targets and target years



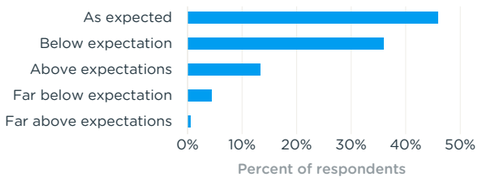
YES 71%

NO 28%

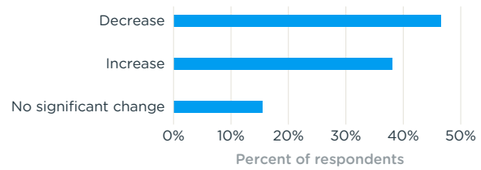
How would you describe your company's ability to meet stated scope 3 emissions reductions targets?



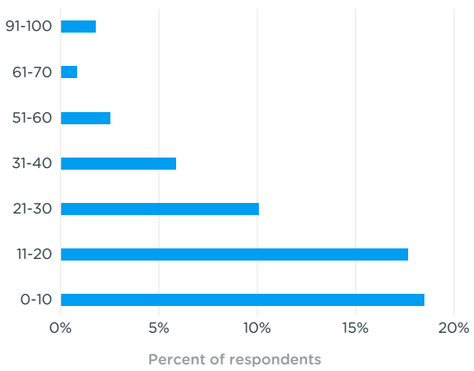
How would you describe your company's past progress on scope 3 emissions reductions?



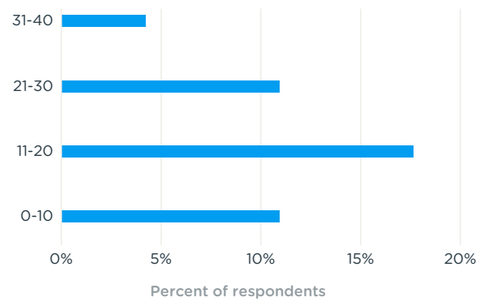
Did scope 3 emissions increase or decrease between the earliest year and latest year for which you have calculations?



By what percent do you estimate that emissions have gone down?



By what percent do you estimate emissions have gone up?



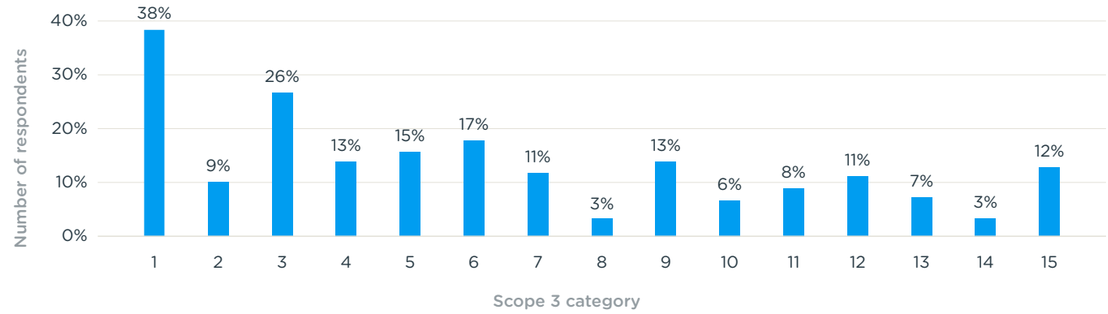
4.2.2 Material scope 3 categories

The survey asked companies to identify their most material (highest emitting) scope 3 emissions categories, as well as their second most material (next highest emitting). The results, displayed in the graphs below reveal trends in the prioritisation of scope 3 categories across industries.

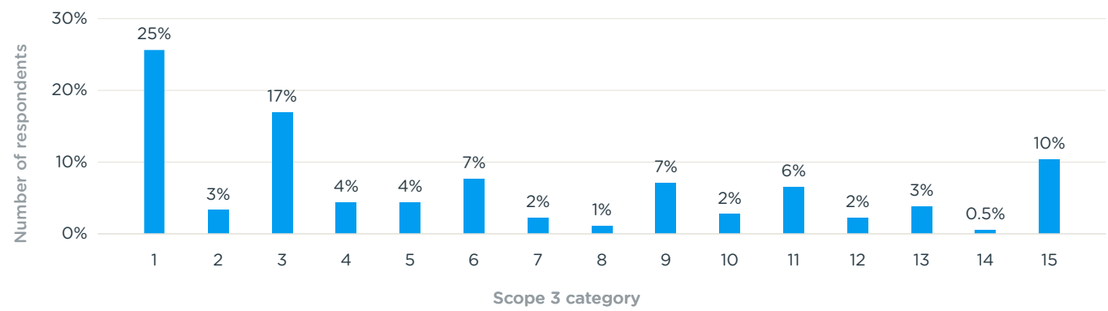
The most selected category, both for the most material and combined first and second most material was Purchased Goods and Services (Category 1). This category was identified as the most material by 26% of respondents and accounted for 38% of all combined responses, underscoring its dominant relevance across a wide range of companies. The second most selected category overall was Fuel- and Energy-Related Activities (Category 3), selected as most material by 17% of respondents and 26% of respondents as either 1st or 2nd most material. Investments (Category 15) also stood out as a key focus, being the most material for 11% of respondents, although this is driven by the respondents from the financial sector.

When considering only the most material category, Categories 1, 3, and 15 dominate, receiving the highest proportion of mentions. However, when the second most material category is included, the distribution becomes more balanced. While Categories 1, 3, and 15 still stand out, other categories—such as Capital Goods (Category 2), Use of Sold Products (Category 11), and Downstream Leased Assets (Category 13)—see a relatively equal boost in representation. This indicates that while companies tend to prioritise a few key categories as their top concern, their broader scope 3 considerations are more evenly distributed when secondary priorities are included.

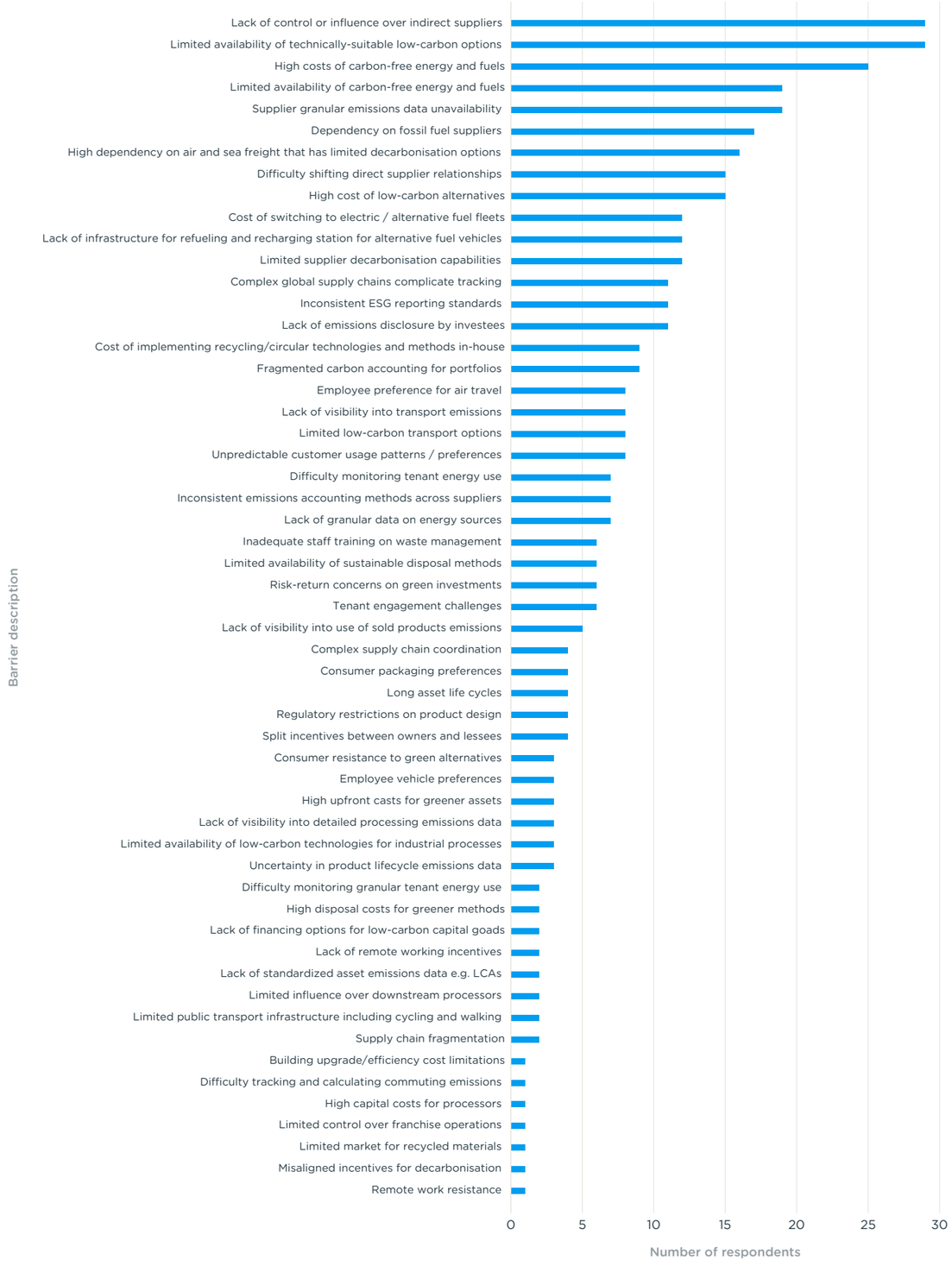
Most selected scope 3 categories (from 1st and 2nd most relevant)



Most selected scope 3 categories (most material only)



Barriers to decarbonisation for most material scope 3 category



4.3. Overview of barriers

The graph to the left shows the barriers indicated by respondents to decarbonising their most material scope 3 categories. Each bar represents the number of times that a particular barrier was selected.

The graph displays a clear pattern where the barriers to decarbonisation are distributed unevenly, with a steep decline from the most frequently selected barriers to those less frequently chosen. The highest-ranking barriers have a significantly larger count compared to the rest, creating a pronounced “long-tail” effect.

The top barriers, such as “Lack of control or influence over indirect suppliers”, “Limited availability of technically suitable, low-carbon options”, and “Lack of granular data on energy sources”, are widespread and commonly faced by respondents.

The shape of the graph highlights the existence of a few critical barriers that affect most respondents, alongside a diverse range of less prominent issues that may reflect more localised or sector-specific challenges.

4.3.1. Severity of barriers

As well as indicating barriers to progress, respondents provided a severity score for each barrier chosen. Respondents were asked, “How much do these barriers impact your company’s ability to make progress on emissions reductions in this category?” “This category” is the one previously selected (either most or second most material to their company’s scope 3). The options available to respondents were: 1: Not significantly – we can reduce emissions in [category] while this barrier is in place; 2. Moderately – we expect emissions to stay the same in [category] while this barrier is in place; 3. Significantly – we expect emissions in [category] to go up while this barrier is in place. This section examines severity at the cross-industry level.

When analysing both the frequency and severity, several trends emerge. The scatterplot reveals no clear relationship between how often a barrier was selected and its average severity rating. High-frequency barriers tend to cluster near the average severity score of approximately 2.28, while lower-frequency barriers show a wider range of severity scores.

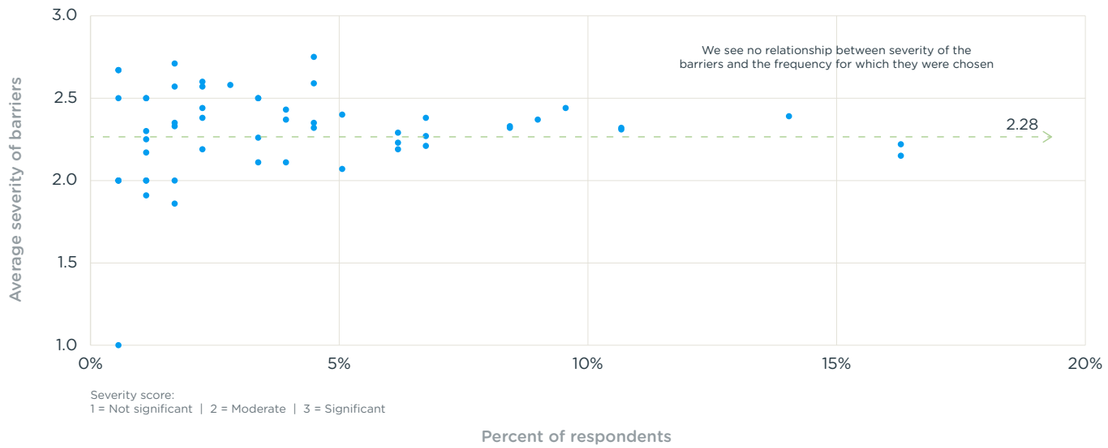
The severity distribution chart shows that many barriers fall within the moderate severity range (2.0-2.5). This indicates that most barriers are perceived as significant enough to hinder progress. Only three barriers fall below a severity score of 2.0, suggesting that even less frequently selected barriers are still meaningful obstacles.

Some infrequently selected barriers have notably high severity ratings, such as “Difficulty monitoring granular tenant energy use” (3.0) and “Remote work resistance” (2.8). These barriers are likely context-specific, impacting particular industries. While their severity ratings may be influenced by fewer respondents selecting them, these barriers highlight critical challenges and are discussed in sector-specific chapters.

Barriers that were selected more frequently, such as “Lack of control or influence over indirect suppliers” and “Limited availability of technically suitable, low-carbon options,” tend to have severity scores close to the average of 2.28. This suggests that as barriers become more widespread, their severity stabilises at a moderate level. These barriers represent significant obstacles that may require scalable, cross-industry solutions to unlock progress.

The overall clustering of severity scores in the moderate range highlights that severity should be primarily interpreted within industry-specific contexts. While severity scores provide a useful measure of impact at the cross-industry level, they are less effective as a differentiating factor across all companies.

Most selected scope 3 categories (from 1st and 2nd most relevant)



4.4. Regional and cross-sector analysis

The survey findings reveal clear trends regarding the most material scope 3 emissions categories across industries, while also highlighting sector-specific nuances. Category 1: Purchased Goods and Services emerged as the dominant scope 3 category across most sectors, reflecting the widespread reliance on upstream suppliers and procurement activities as major contributors to emissions. For instance, in manufacturing, 41% of respondents identified this category as their most material, while for consumer packaged goods, this figure was even higher, at 64%. Interestingly, Category 1 was selected at a much higher frequency in North America (37%) and Europe (29%) compared to other regions, which ranged from 0-10%. At the sector level, only one respondent in consumer packaged goods and manufacturing across Asia, Latin America and the Middle East selected Category 1 as a top barrier.

In addition, Fuel- and Energy-Related Activities (Category 3) consistently appear as a top category in sectors with significant energy requirements, such as utilities, and transportation and distribution services. Category 3 was a much larger concern for Asia (selected by 33% of respondents), Latin America (selected by 23% of respondents), and the Middle East (selected by 50% of respondents). North America and Europe fell between 4-12%. The regional variation in Category 1 and Category 3 likely reflects a combination of supply chain positioning, regional energy systems, data maturity, and economic structures.

While North American and European companies emphasise emissions from purchased goods and services due to their reliance on upstream suppliers and advanced data tracking, companies in Asia, Latin America, and the Middle East prioritise fuel- and energy-related activities due to an even greater reliance on fossil fuel-intensive energy production.

The prominence of Category 15: Investments in regions like North America and Europe reflect the maturity of their financial sectors, stricter regulatory requirements (SFDR, EU Taxonomy), and generally better access to emissions data from portfolio companies compared to Asia, Latin America, and the Middle East.

> The regional variation in Category 1 and Category 3 likely reflects a combination of supply chain positioning, regional energy systems, data maturity, and economic structures.

In addition to financial services, investment emissions are a large concern for Retail and Information Technology.

In tandem with common categories, the cross-sector analysis reveals a set of common barriers—namely lack of supplier control, limited availability of low-carbon alternatives, and data transparency challenges—highlighting systemic hurdles to scope 3 decarbonisation. Across all sectors, the lack of control or influence over indirect suppliers is one of the most frequently cited barriers. This challenge is particularly evident in industries with complex supply chains, such as manufacturing, consumer packaged goods, and retail, where companies rely on multiple tiers of suppliers.

Another widely shared barrier is the limited availability of technically suitable low-carbon alternatives, which is prominent in sectors such as manufacturing, consumer packaged goods, and real estate. These industries rely heavily on raw materials, such as fossil-based chemicals, construction materials, and packaging, for which viable low-carbon substitutes remain underdeveloped or prohibitively expensive. Financial challenges compound this issue, as the high costs of low-carbon solutions are reported across multiple sectors, including manufacturing, transportation, and retail. Even when alternatives exist, their premium pricing makes adoption difficult.

Data-related barriers, including inconsistent emissions accounting methods and lack of granular supplier data, also emerge as significant challenges across sectors. These issues are particularly acute in the financial services and information technology sectors, where accurate carbon accounting relies on emissions data from investees, suppliers, or end-users, but are generally persistent throughout.

While many common themes emerged from cross-sector analysis, sector-specific barriers, such as tenant engagement in real estate, illustrate the importance of understanding industry-specific dynamics and complexities.

4.5. Industry-specific insights

The following sections provide a sector-by-sector analysis of the barriers to scope 3 decarbonisation, as identified through survey responses and interviews. By examining the unique characteristics and challenges faced by different industries, the analysis aims to uncover sector-specific trends and insights about the barriers faced. The sectors covered in this chapter include:

Biotech and/or pharmaceuticals

Consumer packaged goods

Professional services

Financial services

Information and/or communication technology

Manufacturing

Real estate

Retail

Transportation and/or distribution services

Utilities and/or energy

Respondents selected a sector from the above list. For each sector, the most material scope 3 categories are discussed, as well as the key barriers faced, and any notable trends that emerged within and across sectors. However, it should be noted that at the sector-specific level, the sample size can become quite small, have impacted the level of confidence in the conclusions. The smallest sample size for a sector is 11 respondents, while the largest is 34. As such, the findings should be interpreted with caution, particularly for sectors with fewer respondents, and viewed as indicative rather than definitive.

4.5.1. Biotech and pharmaceuticals

The biotech and pharmaceutical sector survey respondents paint a picture of a sector with a strong commitment to scope 3 decarbonisation, with 80% of respondents having established scope 3 targets. However, maturity levels vary widely, as evidenced by a broad range of target dates and mixed perceptions of companies' abilities to meet these goals. While most respondents report tangible emissions reductions, with 60% indicating decreases and many achieving reductions of 30% or more, challenges persist. Around 30% of respondents report progress below expectations, and some have experienced increases or stagnation in emissions. These findings highlight that while many companies are making steady progress, systemic barriers—particularly in upstream supply chains and transportation—continue to hinder more ambitious reductions. This context is important for understanding the sector's material scope 3 categories and the barriers companies face in accelerating their decarbonisation efforts.

Top categories:

Overall, Purchased Goods and Services are indicated as the dominant scope 3 category for biotech and pharmaceuticals, across both survey and interview findings, while emissions from logistics (upstream and downstream transport and operations) and waste management represent significant but secondary priorities. The emphasis on these categories reflects the sector's reliance on supply chains and logistics, as well as the operational complexity of managing emissions from waste and end-of-life processes.

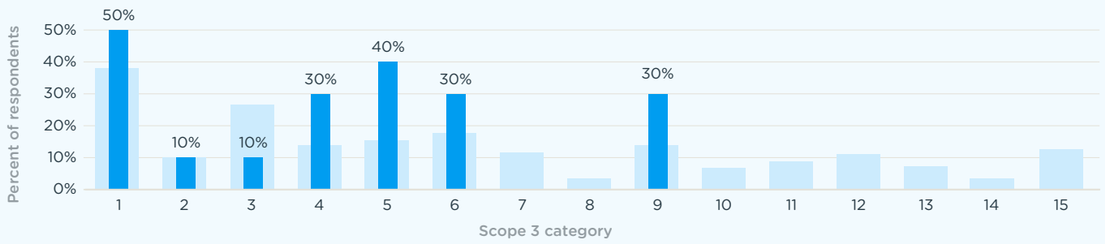
Category 1: Purchased Goods and Services is the most material scope 3 category for the biotech and pharmaceutical sector, identified by 50% of survey respondents as their most critical emissions source. This dominance aligns with the sector's reliance on upstream suppliers for raw materials, laboratory equipment, and production inputs. Interview findings strongly support this, with a practitioner emphasising that 85% of their total emissions are scope 3, predominantly from raw materials. The complexity of managing emissions across diverse and numerous suppliers further reinforces the central importance of this category.

Category 4: Upstream Transportation and Distribution and Category 9: Downstream Transportation and Distribution are the next most frequently selected categories, each identified by 20% of survey respondents as key contributors to scope 3 emissions. These findings reflect the significance of logistics in handling and delivering sensitive materials and products. Interviews add further depth by highlighting the importance of transportation emissions, particularly upstream, while also noting limited visibility into downstream logistics and product processing.

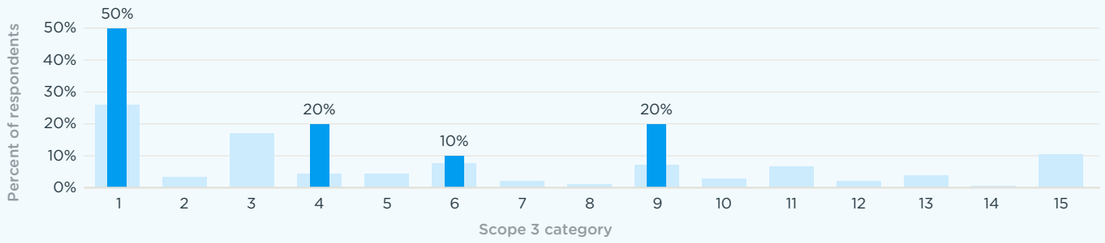
Category 5: Waste Generated in Operations was also one of the most relevant categories, with 40% of survey respondents identifying it as a top priority. This underscores the emissions impact of managing specialised or hazardous waste, which is often highly regulated. Although interviews did not explicitly focus on waste emissions, they acknowledged the emissions challenges tied to downstream product use and end-of-life treatment, potentially overlapping with this category.

The graphs below display the scope 3 categories identified as the most material and joint 1st and 2nd most material by respondents from the biotech and pharmaceutical sector (in comparison to the overall results from all sectors).

Most selected scope 3 categories (from 1st and 2nd most relevant)



Most selected scope 3 categories (most material only)



Barriers

Respondents from the biotech and pharmaceutical sectors identified several key barriers to decarbonising their most material scope 3 categories. The most frequently selected barriers reveal critical challenges concentrated in supply chain control, transportation decarbonisation, and supplier engagement. Interview findings align with these barriers while adding depth to the analysis, particularly regarding data quality, cost dynamics, and technological limitations.

The lack of control or influence over indirect suppliers was the most significant barrier, cited by half of all survey respondents and rated at a severity of 2.33. This reflects the sector's reliance on complex and independent supply chains, where enforcing decarbonisation efforts or tracking progress remains a persistent challenge. Interviewees reinforced this, highlighting upstream supply chain complexity, with companies managing thousands of suppliers and facing difficulties in tracking emissions across varied raw materials. Smaller suppliers were noted as particularly limited in their capacity to provide accurate carbon footprint data.

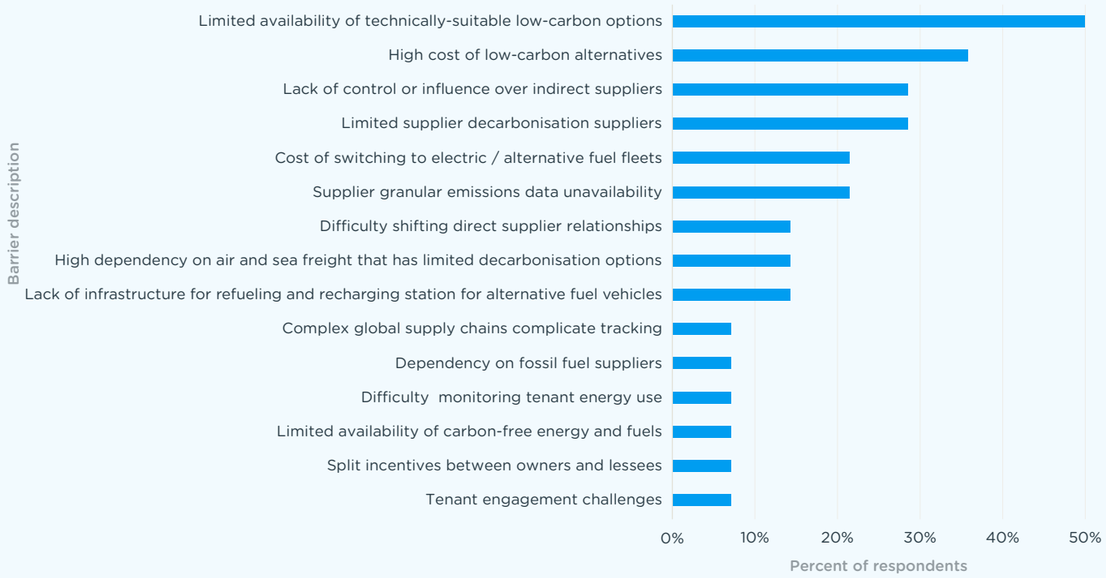
The cost of switching to electric or alternative fuel fleets was selected by 30% of respondents and rated the most severe at 2.88, emphasising the financial challenges associated with transitioning logistics operations to low-carbon alternatives. Similarly, the high dependency on air and sea freight, also identified by 30% of respondents and rated at 2.67, highlights the limitations of current decarbonisation options for long-distance and temperature-controlled transportation. Interviewees corroborated these findings, noting that logistics emissions, both upstream and downstream, are significant contributors, but they also emphasised limited visibility into downstream emissions as a critical gap, describing it as a "black hole" for data.

Another frequently cited barrier, also identified by 30% of respondents and rated at a severity of 2.67, is the lack of infrastructure for refuelling and recharging stations for alternative fuel vehicles. This systemic issue reflects the broader challenges companies face in adopting alternative fuels, as they are dependent on external infrastructure. Interview findings expanded on this theme, pointing to the sector's reliance on public-private energy infrastructure, such as hydrogen availability, to support decarbonisation efforts.

The limited availability of technically suitable, low-carbon options, identified by 20% of respondents and rated at 2.11, was also noted as a barrier but was less central compared to the top challenges. Interviewees elaborated on this, citing the dominance of fossil-based raw materials and the difficulty of finding viable substitutes. Trade-offs, such as land-use impacts with bio-based materials, were also flagged, highlighting the need for life cycle assessments (LCAs) to evaluate these alternatives beyond GHG emissions.

Additional insights from the interviews emphasise data quality issues in scope 3 accounting, with practitioners noting heavy reliance on secondary data and limited use of primary data (only 25%). Improving data transparency and supplier collaboration were identified as foundational challenges that underpin many of the sector's barriers. Furthermore, interviewees highlighted the commercial unviability of emerging technologies, such as carbon capture and low-carbon feedstocks, as another hurdle that limits the sector's ability to address key emissions categories effectively.

Biotech and pharmaceuticals: barriers to decarbonisation for most material scope 3 categories



4.5.2. Consumer packaged goods

The consumer packaged goods (CPG) industry survey respondents demonstrate a strong alignment with scope 3 decarbonisation efforts, with over 90% of companies having established scope 3 targets. However, there is diversity in target dates, ranging from 2025 to 2040, with nearly 60% opting for a 2030 target. While many companies express confidence in their ability to meet these targets, approximately one-third describe their capacity as "somewhat limited," signalling persistent challenges in scope 3 management. This is further reflected in companies' self-assessments of progress – a notable portion, around 50%, report falling below expectations, while only a small fraction achieved progress exceeding expectations.

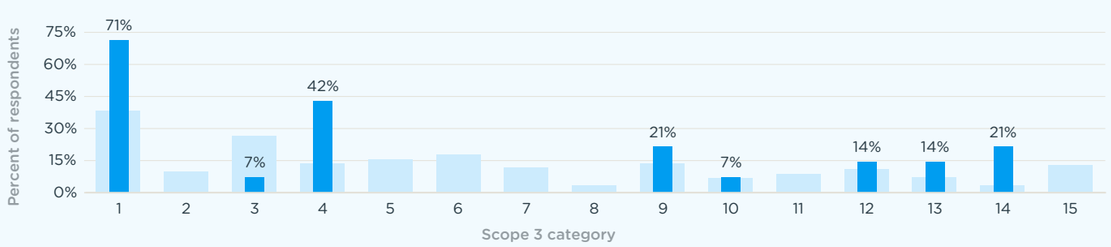
Top categories:

Overall, Purchased Goods and Services dominate the most material category for consumer packaged goods across both survey and interview results, followed by material contributions of transportation-related categories, both upstream and downstream. The interviews add depth by pointing to significant data challenges in tracking emissions and the sector's growing focus on e-commerce logistics.

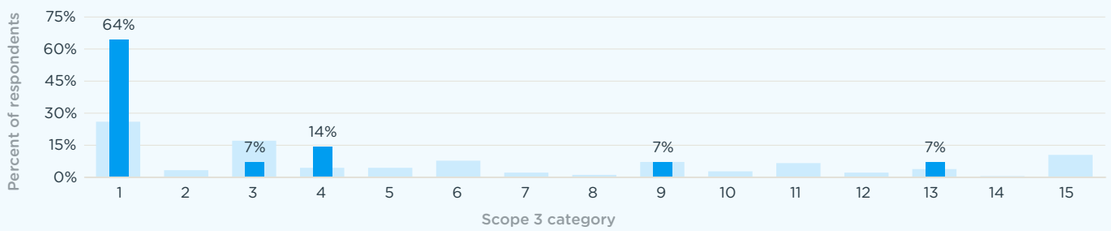
Category 1: Purchased Goods and Services was identified by 64% of survey respondents as their most material scope 3 category, increasing to 71% when combining the top two categories. This dominance underscores the sector's heavy reliance on raw materials such as agricultural products, plastics, and packaging, which often have substantial embodied emissions from resource extraction and energy-intensive production processes. Interview insights strongly align with this finding, emphasising that emissions from purchased goods and services dominate scope 3 emissions, particularly in material processing. Supplier collaboration was noted as essential but challenging, especially when working with smaller suppliers who often lack resources for emissions tracking.

Category 4: Upstream Transportation and Distribution was selected by 43% as either 1st or 2nd most material category. This highlights the sector's reliance on global supply chains and the significant emissions from trucking, shipping, and other logistics operations needed to transport raw materials and components over long distances. Interviewees confirmed the importance of upstream logistics, while also emphasising limited visibility into lower-tier suppliers, which complicates accurate emissions reporting.

Most selected scope 3 categories (from 1st and 2nd most relevant)



Most selected scope 3 categories (most material only)



Barriers

Respondents from the consumer packaged goods (CPG) industry identified several key barriers to decarbonising their most material scope 3 categories. The most frequently selected barriers reveal critical challenges concentrated in the limited availability of technically suitable, low-carbon options, high cost of low-carbon alternatives, lack of supplier control, limited supplier decarbonisation capabilities, and switching to electric fleets. Interview findings align with these barriers while adding depth to the analysis, particularly regarding data quality, methodology challenges, and supply chain misrepresentation.

The limited availability of technically suitable, low-carbon options stands out as the most significant barrier for the CPG industry, cited by 50% of respondents and rated a severity of 3.0. This highlights the difficulty of identifying alternative materials, technologies, or processes that meet operational and quality standards. Many of these options are underdeveloped or incompatible with existing systems. Interviews reinforced this challenge, emphasising the dominance of emissions from Purchased Goods and Services and the need for life cycle assessments (LCAs) to evaluate trade-offs such as land-use impacts.

The high cost of low-carbon alternatives, cited by 35% of respondents and rated moderately severe at 2.24, represents another critical challenge. Even when low-carbon materials or technologies are available, their premium pricing makes widespread adoption difficult, particularly for companies operating on tight margins. Interviewees corroborated this finding, noting that conducting LCAs or testing materials can cost between 10K USD and 350K USD. This financial burden is especially prohibitive for smaller companies, which often lack the resources to pursue decarbonisation at scale.

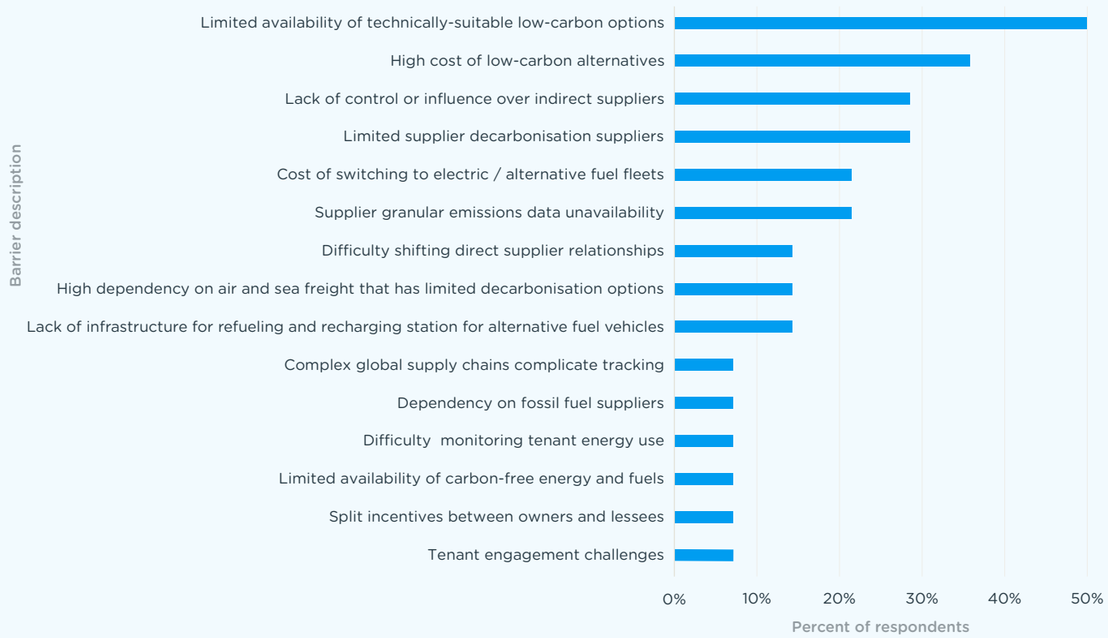
The lack of control or influence over indirect suppliers, cited by 28% of respondents but rated the least severe at 1.88, reflects the sector's reliance on extensive supply chains with multiple tiers. Many indirect suppliers lack the incentives or resources to prioritise emissions reductions. Interview findings echo this, emphasising limited visibility into Tier 4 and Tier 5 suppliers and the absence of harmonised emissions calculation methodologies. The disparity between datasets and standards further complicates efforts to engage suppliers and track emissions accurately.

Similarly, limited supplier decarbonisation capabilities, also cited by 28% of respondents and rated moderately severe at 2.18, reflect the lack of readiness among suppliers to adopt low-carbon practices due to infrastructure, expertise, or financial constraints. Interviewees highlighted the reliance on secondary data and the challenge of improving primary data collection from smaller suppliers, which slows progress across the supply chain.

Finally, the cost of switching to electric or alternative fuel fleets, cited by 21% of respondents and rated moderately severe at 2.07, underscores the financial and logistical burden of transforming transportation systems. This barrier involves not only the high initial investment in vehicles but also the costs of building the necessary infrastructure, such as charging or refuelling stations, which are not yet widely available. While the survey emphasises these financial challenges, interviewees added that logistical issues in transportation are secondary to emissions from purchased goods and services, which remain the dominant contributor.

Interviewees also introduced additional challenges not explicitly highlighted in the survey, such as the misrepresentation of materials in supply chains, including fraudulent practices like mislabelled recycled content. This issue undermines decarbonisation efforts by complicating the integrity and reliability of supply chain emissions data.

Consumer packaged goods: barriers to decarbonisation for most material scope 3 categories



4.5.3. Financial services

The financial services sector demonstrates moderate maturity in scope 3 decarbonisation, with 83% of respondents reporting established targets, with target dates of either 2030 or 2050. Most companies rate their ability to meet these targets as “somewhat limited” or “adequate,” indicating moderate confidence, while progress is generally described as “as expected”. Emissions trends reveal more extreme changes than other sectors, with many companies reporting changes beyond incremental levels. While several respondents estimate changes within ±10%, 70% of respondents are spread between 11% to 30% or -30% to -11%, reflecting a mix of meaningful progress and setbacks.

Top categories:

Overall, the results highlight the overwhelming importance of Category 15: Investments as the key scope 3 category for the financial services sector, with business travel and procurement emerging as secondary but relevant areas of focus.

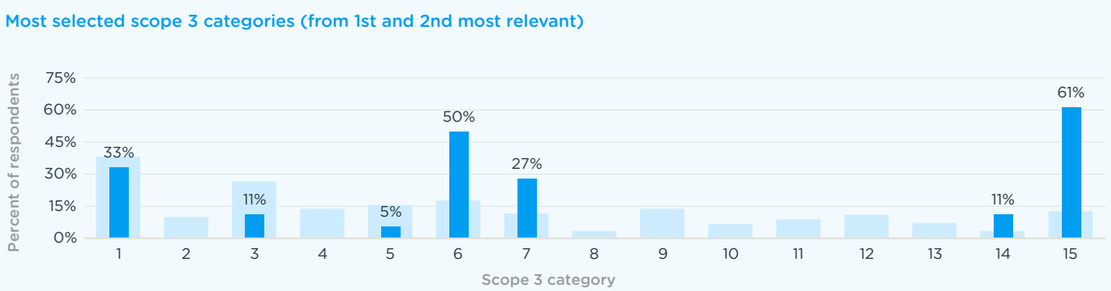
Category 15: Investments is overwhelmingly identified as the most material scope 3 category, selected by 61% as within their top 2 material categories.

This reflects the financial services sector’s reliance on investments as a key driver of emissions. Interview findings strongly align, emphasising the inclusion of portfolio companies’ emissions within Category 15 and highlighting the growing regulatory focus on these emissions through frameworks like CSRD and SFDR. This underscores the centrality of investments in the sector’s decarbonisation strategies.

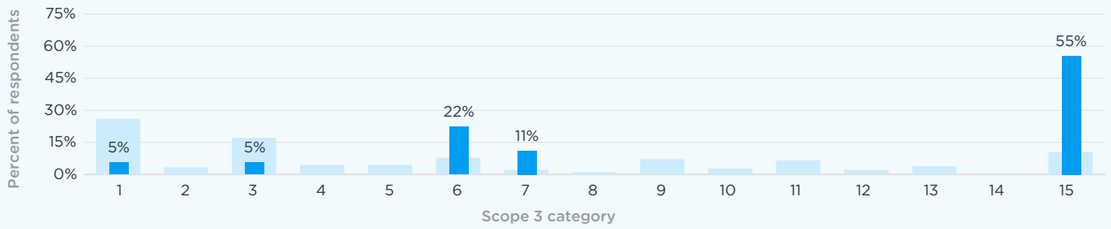
Category 6: Business Travel is the second most frequently identified category, selected by 50% of survey respondents as among the top two material categories. This highlights the emissions impact of frequent travel within the financial services sector, a characteristic of global operations.

Category 1: Purchased Goods and Services is less prominent but still notable, with 33% including it as either the first or second most material category. The category reflects emissions from office supplies, technology, and other procurement activities.

Most selected scope 3 categories (from 1st and 2nd most relevant)



Most selected scope 3 categories (most material only)



Barriers

Overall, the results show that emissions data and transparency barriers remain the primary hurdles for the financial services sector, with additional challenges arising from balancing profitability and sustainability in green investments.

Emissions data-related challenges dominate the barriers to scope 3 decarbonisation in the financial services sector. The lack of emissions disclosure by investees, cited by nearly 50% of respondents, emerged as the most significant obstacle. This reflects the sector’s reliance on investees to provide accurate and comprehensive emissions data, which is critical for assessing scope 3 emissions linked to investments. Interview insights align with this finding, emphasising poor data quality and reporting gaps within portfolio companies as major obstacles. Frameworks like CSRD and SFDR were identified as pivotal drivers in improving disclosure practices (in Europe) and harmonising reporting standards, underscoring their role in addressing this critical barrier.

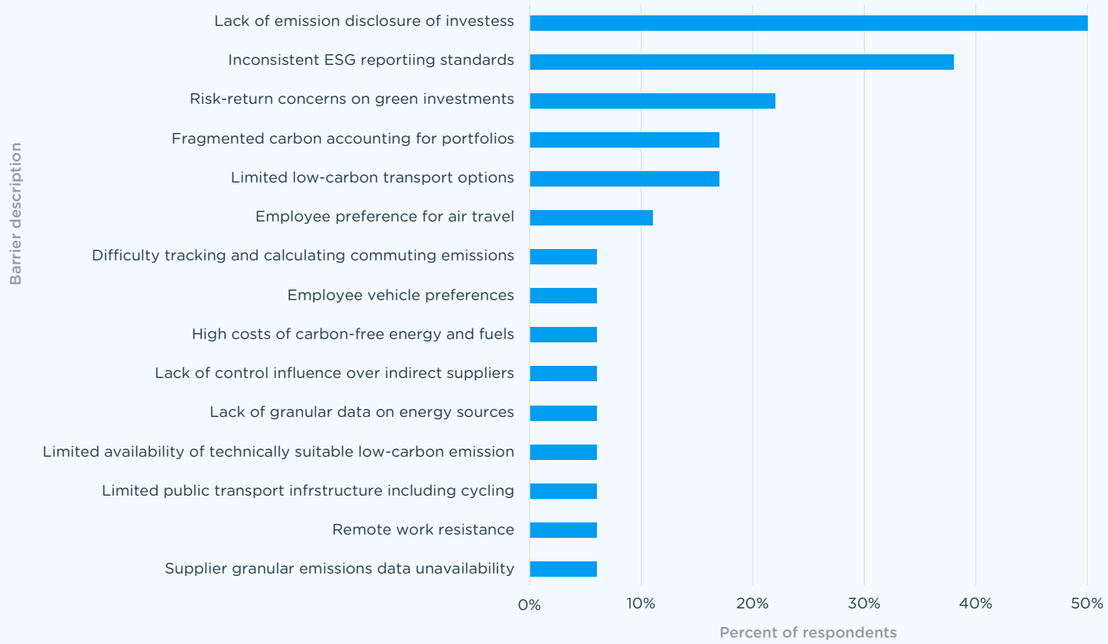
Similarly, inconsistent ESG reporting standards, also selected by nearly 50% of respondents, highlight the challenges posed by the absence of standardised frameworks, which complicate the aggregation, comparison, and tracking of emissions data across portfolios. Interviewees elaborated on this issue, noting the disparate methodologies and lack of harmonisation in emissions calculations. These inconsistencies hinder accurate carbon accounting and create significant barriers to managing portfolio-wide emissions.

Fragmented carbon accounting for portfolios, cited by approximately 25% of respondents, further emphasises the complexity of consolidating emissions data within diverse investment portfolios. Interview findings echoed this challenge, describing how inconsistent frameworks and limited primary data availability impede the ability to aggregate and assess scope 3 emissions.

Risk-return concerns on green investments were highlighted by 30% of respondents, reflecting a tension between aligning financial returns with sustainability objectives. Interviewees reinforced this, noting that investor expectations for profit-maximising decisions often conflict with decarbonisation goals, which still often come at a cost. They also highlighted regional differences in regulatory and financial drivers, with some markets prioritising financial gains over sustainability due to weaker regulations.

The interviews add additional depth to these findings by emphasising the growing importance of regulatory drivers like CSRD and SFDR (in a European context) in overcoming emissions data challenges. These frameworks are driving better emissions disclosure and influencing investment decisions, creating an evolving landscape for financial services institutions to address scope 3 barriers. Additionally, interviewees highlighted the role of active ownership, where financial institutions leverage board engagement and day-to-day influence to push for emissions reductions and improved data quality in portfolio companies.

Financial services: barriers to decarbonisation for most material scope 3 categories



4.5.4. Information and/or communication technology

The information and/or communication technology sector demonstrates notable engagement with scope 3 decarbonisation efforts, with approximately 73% of respondents setting scope 3 emissions targets, with target dates ranging from 2025 to 2050. When it comes to the ability to meet these targets, the sector shows a mixed outlook. Around 40% of respondents describe their ability as “somewhat limited,” though a significant portion feel their capacity is either “good” or “adequate”. Progress to date has been better than many other sectors, with a majority rating their progress as “as expected” and a significant number of companies reporting achieving reductions of either 10-30% and some reporting decreases of more than 50%. However, challenges remain, as over 20% report increases or no significant change in emissions.

Top categories:

The ICT sector exhibits one of the most varied sets of priority scope 3 categories among the sectors analysed, reflecting the diverse nature of its operations and value chain.

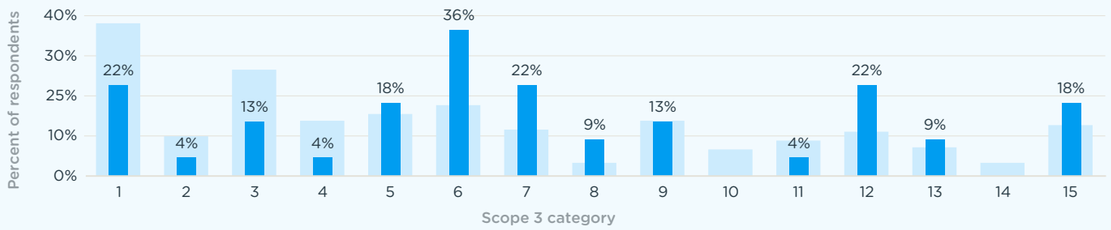
Category 6: Business Travel is the most frequently identified scope 3 category, selected by 36% of survey respondents as within the top 2 most material scope 3 categories. This highlights the sector’s continued reliance on business travel for physical collaboration, client engagement, and operational oversight.

Category 1: Purchased Goods and Services also ranks highly, identified by almost a quarter of survey respondents when both the first and second most material categories are considered.

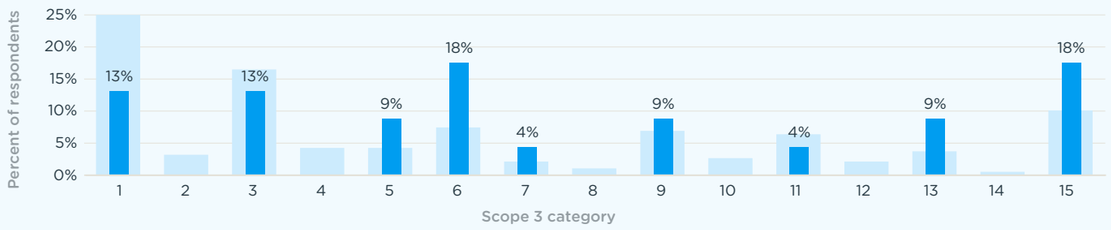
This category captures emissions from the procurement of hardware, software, and operational resources. The interviewee corroborated this focus, emphasising upstream emissions from materials like aluminium, semiconductors, and plastics, as well as the challenges of supplier engagement in addressing these emissions.

Other categories, such as Category 5: Waste Generated in Operations, Category 7: Employee Commuting, and Category 12: End-of-Life Treatment of Sold Products, were less frequently selected overall but stand out as notable areas of focus in the data (when top 1 and 2 categories were selected). Category 5, cited by 18% of respondents, reflects emissions associated with managing operational waste, including disposal and treatment processes, which can be energy-intensive. Category 7, also identified by 23% of respondents, highlights the emissions impact of employee commuting—a growing consideration in sectors with large workforces spread across global operations. Similarly, Category 12, selected by 23% of respondents, underscores the importance of addressing emissions from end-of-life treatment of sold products, a challenge noted in interviews due to limited visibility on downstream product use and disposal. These findings, combined with the sector’s top categories, reflect a distributed emissions profile that spans procurement, transportation, operational processes, and end-of-life considerations, underscoring the complexity of scope 3 management in ICT.

Most selected scope 3 categories (from 1st and 2nd most relevant)



Most selected scope 3 categories (most material only)



Barriers

The survey identified inconsistent ESG reporting standards as a notable barrier in the ICT sector, though its severity was rated moderately at 1.94. However, overall responses for this sector were fragmented, with each barrier receiving only one or two mentions. This lack of consensus likely reflects the diverse nature of the ICT sector, where business models, emissions sources, and operational challenges vary significantly across organisations. Key categories like Business Travel, Investments, and Purchased Goods and Services demonstrate this diversity, as companies focus on different aspects of their value chains.

The interview findings reinforce this fragmented landscape, particularly for hardware manufacturers within the sector. A key challenge cited in the interviews is upstream supply chain transparency: “We source components rather than raw materials, which makes tracing upstream emissions difficult”.

This highlights a barrier in emissions traceability, particularly for emissions-intensive inputs like mining, semiconductors, and plastics. While Purchased Goods and Services was identified as a significant scope 3 category in the survey, interviewees emphasised the complexities of engaging suppliers and obtaining accurate emissions data. Smaller suppliers often lack the resources to provide reliable carbon footprints, compounding the issue. The downstream emissions visibility challenge also emerged in the interviews: “We have little to no visibility on how our products are used or transported by resellers”.

This aligns with the survey’s findings that downstream categories, such as Transportation and Distribution, and end-of-life emissions are relevant. Fragmented logistics data, where forwarders subcontract to multiple parties, further complicates emissions tracking.

A recurring theme from the interviews is the sector’s reliance on data quality and traceability:

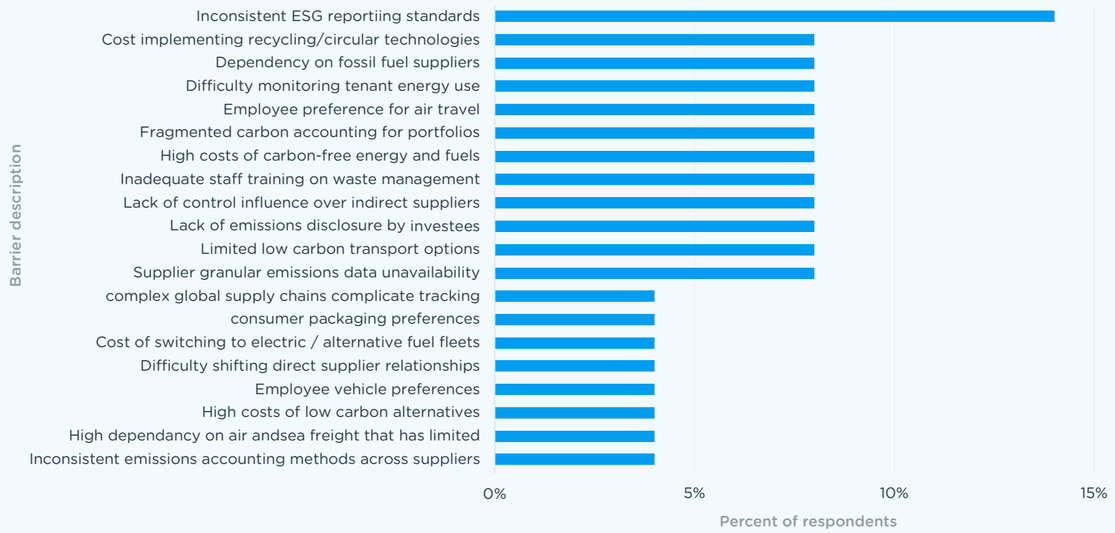
“Current data collection methods rely heavily on spend-based approximations” and “Poor supply chain traceability leads to misinformation, reducing data accuracy”.

While this was not explicitly highlighted in the survey responses, it helps explain the inconsistent ESG reporting standards identified as a significant barrier. The reliance on secondary data and the absence of standardised benchmarks exacerbates reporting challenges, particularly for companies operating across complex supply chains. The interviews also highlight the low adoption of low-carbon materials and technologies as a key barrier for manufacturers: “Switching to bio-based plastics introduces complexity, such as accounting for land-use changes,” and “Recycled aluminium requires significant testing to ensure product quality”.

This adds depth to the survey’s broader reflection of the limited availability of low-carbon options, particularly for companies that depend on materials requiring rigorous performance standards.

Overall, the survey results point to a fragmented set of barriers without clear consensus, which aligns with the ICT sector’s diversity in operations. The interview findings provide additional clarity, particularly for manufacturing companies, where barriers related to upstream supply chain complexity, downstream emissions visibility, and data traceability are particularly acute. These challenges may differ substantially for other ICT subsectors, such as software providers, data centre operators, or telecommunications firms, highlighting the need for tailored solutions across the sector.

Information and/or communication technology: barriers to decarbonisation for most material scope 3 categories



4.5.5. Manufacturing

The manufacturing sector shows moderate engagement with scope 3 decarbonisation, with nearly 59% of respondents having established scope 3 emissions targets. while 40%, have yet to set such targets, reflecting varying levels of prioritisation within the industry. Half of those with targets have set a target goal date of 2030. When evaluating their ability to meet these targets, most respondents cite “somewhat limited” capacity, though a notable percentage rate their ability as “adequate” or “good”. This sentiment aligns with self-assessments of historical progress, where many respondents describe their efforts as “below expectation,” though a significant portion report outcomes “as expected”. Only a small minority exceed expectations, indicating room for improvement across the sector. In terms of actual progress made, many companies achieved reductions of 10-30% but a significant number of respondents reported increases or no significant change in emissions, reflecting ongoing hurdles in decarbonising supply chains, energy use, and production processes.

Top categories:

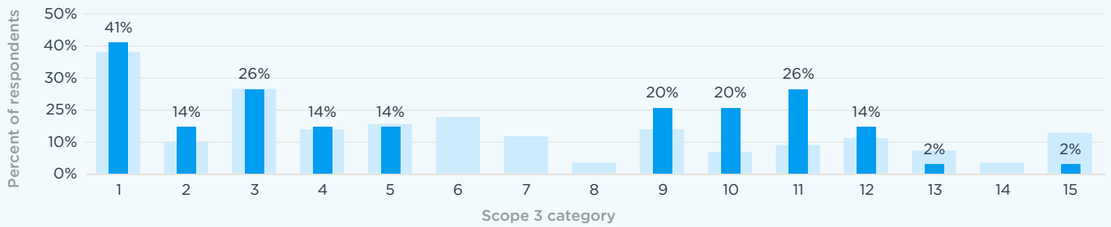
Overall, the results illustrate that upstream emissions from purchased goods dominate the manufacturing scope 3 profile, while downstream product use and logistics also play a critical role. Interview insights further emphasise the sector’s systemic challenges in managing complex supply chains and quantifying emissions beyond production.

Category 1: Purchased Goods and Services dominates as the most material scope 3 category for the manufacturing sector, selected by 41% of survey respondents when combining first and second rankings. This reflects the sector’s reliance on upstream supply chains for raw materials and components, which are often emissions-intensive due to extraction, processing, and transportation. The prominence of this category aligns closely with interview insights, where a chemicals manufacturer noted that scope 3.1 accounts for up to 75% of total emissions, largely driven by the extensive variety and volume of raw materials used. The interviewee highlighted the sheer scale and complexity of tracking emissions across “over 20,000 raw materials that are chemically or mechanically processed”.

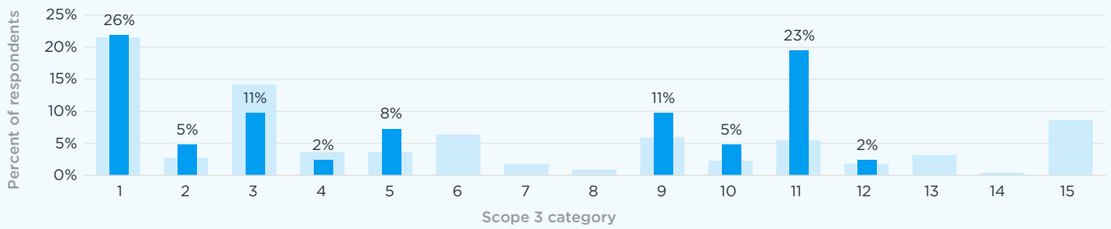
Category 11: Use of Sold Products also emerged as a key category, selected by 27% of survey respondents. This underscores the emissions generated during the life cycle and operational use of manufactured products, such as energy-intensive machinery or electronics. Interview insights revealed challenges in accurately quantifying emissions from product use and end-of-life treatment, with the interviewee stating: “We are manufacturing a small part of a much larger product, making proportional allocation nearly impossible”.

Other moderately selected categories include Category 9: Downstream Transportation and Distribution and Category 3: Fuel- and Energy-Related Activities, which highlight emissions generated from transporting raw materials and finished goods, as well as the energy required during production processes. These categories reflect the broader emissions impact across the manufacturing value chain.

Most selected scope 3 categories (from 1st and 2nd most relevant)



Most selected scope 3 categories (most material only)



Barriers

The results collectively highlight the diverse and interconnected barriers faced by the manufacturing sector, ranging from technological and financial hurdles to supply chain and data management challenges. Interviews further underscore the difficulty in addressing scope 3 emissions within a sector heavily reliant on fossil-based materials, complex supply chains, and transportation logistics. The chart below highlights a range of barriers to decarbonisation within the manufacturing sector, reflecting the sector’s complexity and diversity. The most frequently identified barriers include the limited availability of technically suitable, low-carbon options, unpredictable customer usage patterns and preferences, and high dependency on air and sea freight, each cited by approximately 15–20% of respondents. These barriers were rated as moderately severe to severe, with scores ranging between 2.13 and 2.39.

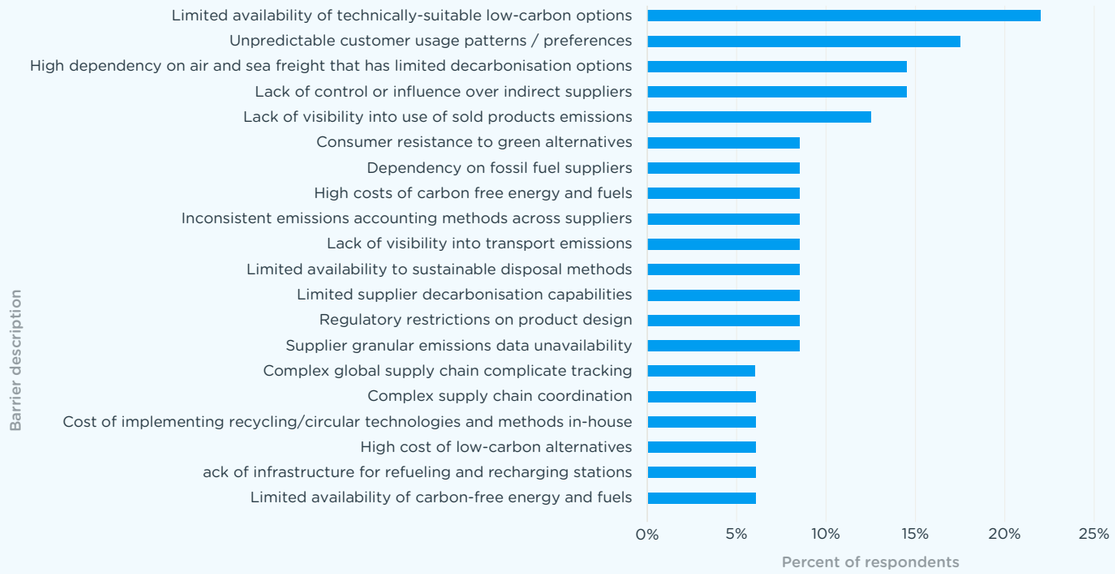
The prominence of technically suitable, low-carbon options aligns strongly with interview findings, where participants highlighted significant challenges in identifying and scaling alternative materials. A chemicals manufacturer noted, “[its] products are fundamentally fossil-based, creating an inherent barrier to achieving true decarbonisation,” while also emphasising that bio-based or recycled alternatives are often costly and deliver limited emissions reductions when considering full life cycle impacts. This reflects the sector’s reliance on innovation that is still distant from commercial viability.

The high dependency on air and sea freight was a top survey barrier. In the interviews, transportation was similarly identified as a critical contributor to scope 3 emissions, but interviewees underscored additional layers of complexity. As one participant shared: “Logistical challenges, such as fragmented downstream operations, limit our ability to track and manage freight emissions effectively”. This highlights not only dependency on freight but also the difficulty in obtaining reliable emissions data, especially across multi-tiered supply chains. Similarly, the lack of control or influence over indirect suppliers reflects another shared concern between survey respondents and interviewees. The interviews highlighted the sector’s reliance on suppliers to decarbonise their scope 1 and 2 emissions as a key barrier, with one participant noting: “We rely heavily on our upstream suppliers, but we lack the leverage to enforce their decarbonisation actions”. This reliance creates bottlenecks, as progress upstream directly impacts manufacturers’ ability to address their scope 3 emissions.

Financial challenges, such as the high costs of carbon-free energy and fuels, were identified in the survey and interviews. Participants from the chemical manufacturing sector stressed the cost pressures in a low-margin industry, with one interviewee explaining, “Investments in decarbonisation are difficult when operating on single-digit profit margins, and customers are unwilling to absorb green premiums”. This reinforces the financial barriers to implementing low-carbon solutions, particularly in price-sensitive markets.

The survey also highlighted inconsistent emissions accounting methods across suppliers as a notable barrier, which aligns with interview findings around data quality and traceability issues. One participant described the reliance on estimated data, stating: “All data today is heavily estimated, which introduces cascading inaccuracies through the supply chain”. The challenge of obtaining precise, primary data from suppliers further complicates efforts to track and reduce emissions effectively.

Manufacturing: barriers to decarbonisation for most material scope 3 categories



4.5.1. Professional services

The professional services sector survey respondents paint a picture of a sector with a moderate level of commitment to scope 3 decarbonisation, with 53% of respondents having established scope 3 targets. However, maturity levels vary, as evidenced by a range of target dates spanning from 2028 to 2050 and mixed perceptions of companies' abilities to meet these goals. Most respondents describe their ability as "somewhat limited," while fewer feel "adequate" or "good," highlighting significant challenges. While many respondents report slight emissions reductions, with changes typically within a modest range of 0–10%, others have experienced stagnation or increases. Progress is often described as "as expected" or "below expectation," underscoring the sector's struggle to achieve more transformative reductions. These findings suggest that while some incremental progress is being made, systemic barriers continue to hinder the sector's ability to scale up its decarbonisation efforts.

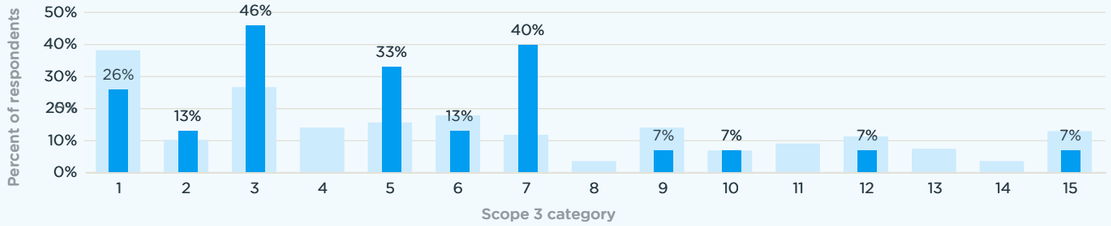
Material categories:

The survey results indicate a clear prioritisation of scope 3 categories among respondents from the professional services sector. When considering only the most material categories (lower graph), Category 3: Fuel- and Energy-Related Activities (40%) and Category 1: Purchased Goods and Services (20%) dominate. This highlights the sector's primary focus on emissions from energy consumption and procurement, which are likely significant contributors to their overall carbon footprint.

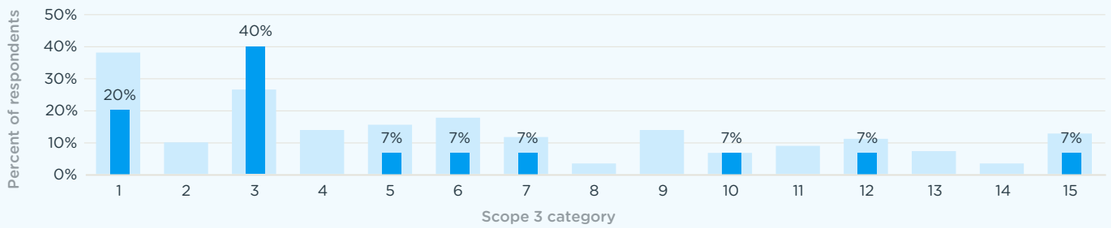
However, when respondents' second most material categories are included (top graph), additional categories emerge. Notably, Category 7: Employee Commuting and Category 5: Waste Generated in Operations gain traction, with 40% and 33% of respondents identifying them as material, respectively. This expanded focus reflects the sector's recognition of the emissions impact associated with commuting in employee-intensive organisations like hospitals and universities, as well as the importance of addressing waste management emissions.

These results suggest a tiered prioritisation approach within the sector, where energy use and procurement dominate initial decarbonisation efforts while commuting and waste management are acknowledged as critical secondary areas of focus. This layered understanding provides insight into the challenges and opportunities for decarbonisation within professional services.

Most selected scope 3 categories (from 1st and 2nd most relevant)



Most selected scope 3 categories (most material only)



Barriers

The graph highlights the primary barriers to scope 3 decarbonisation faced by the professional services sector. The most frequently identified barrier is the high costs of carbon-free energy and fuels, followed by the limited availability of carbon-free energy and fuels, each selected by over 25% of respondents. These findings underscore the sector's reliance on energy-intensive operations and the challenges associated with transitioning to cleaner energy sources due to financial and supply constraints. These barriers are perceived as moderately severe, with ratings of 2.58 and 2.33, indicating they significantly hinder progress.

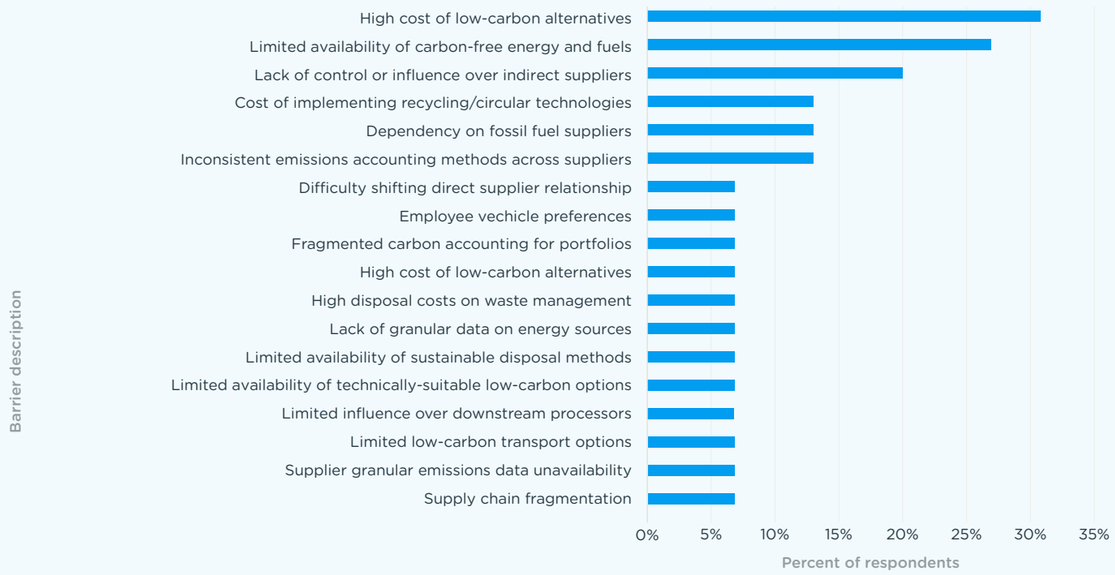
The lack of control or influence over indirect suppliers is another significant barrier, selected by around 25% of respondents and rated at 2.48 in severity. This reflects the complexity of managing emissions within extensive supply chains, where companies often struggle to influence upstream suppliers' practices effectively.

Additionally, the cost of implementing recycling and circular technologies and dependency on fossil fuel suppliers were identified by approximately 15–20% of respondents, with severities of 2.33 and 2.54, respectively. These barriers emphasise the financial and structural hurdles that hinder the adoption of sustainable waste management practices and alternative energy sources.

Other barriers, such as inconsistent emissions accounting methods across suppliers and difficulty shifting direct supplier relationships, are rated among the most severe at 2.67, highlighting their significant impact on emissions reduction efforts. These issues point to critical gaps in data consistency and the operational difficulties of engaging suppliers in decarbonisation initiatives.

Overall, the results point to a sector constrained by financial and supply limitations, particularly in energy and supplier engagement.

Professional services: barriers to decarbonisation for most material scope 3 categories



4.5.2. Real estate

79% of the real estate sector survey respondents report established scope 3 targets, with target dates mostly concentrated around 2030 and 2050, reflecting a mix of near-term and long-term ambitions. Most respondents describe their ability to meet these targets as “somewhat limited” (40%) or “adequate” (30%), while a smaller proportion consider it “good” (20%) or “very limited” (10%). Perceived progress aligns with this moderate confidence, with 30% describing their progress as “as expected,” though 40% report progress as “below expectation,” suggesting challenges in achieving reductions. Actual emissions trends also reflect mixed outcomes: while 35% of respondents report decreases, 30% report increases, and 25% observe no significant change. The proportion of respondents experiencing emissions increases highlights a gap between perceived and actual ability to decarbonise, indicating that while engagement with scope 3 decarbonisation is evident, many companies face difficulties translating intentions into impactful outcomes.

Material categories:

Overall, the survey and interviews align on the importance of emissions from leased assets, procurement of building materials, and energy-related activities as critical scope 3 categories. Interviews additionally highlighted the split incentives between owners and residents, the challenges of decarbonising construction, and retrofitting existing buildings.

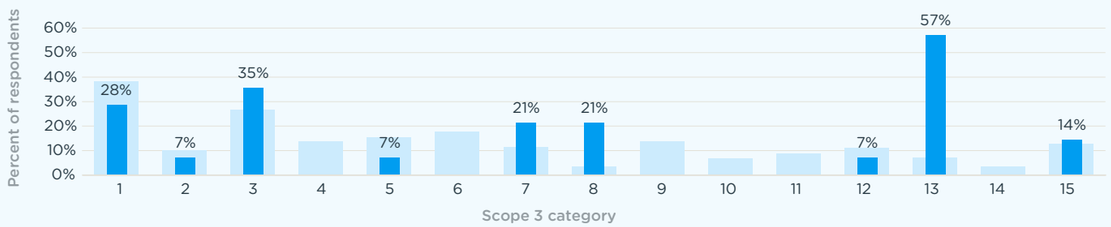
The survey identifies Category 13: Downstream Leased Assets as the most material category, selected by 57% of respondents when combining first and second-most material responses. This reflects the significant contribution of emissions from leased properties, particularly residential and office buildings. Interviews confirm this, with participants emphasising emissions from resident energy usage, including gas and electricity: “The largest component of our footprint is resident emissions”.

Category 1: Purchased Goods and Services was the next most cited, reflecting emissions from procurement activities like construction materials. Interviewees corroborated this, pointing to “embodied carbon in building materials” as a key source of emissions, but flagged the high costs of low-carbon alternatives as a significant barrier: “Low embodied carbon concrete comes with significant premiums”.

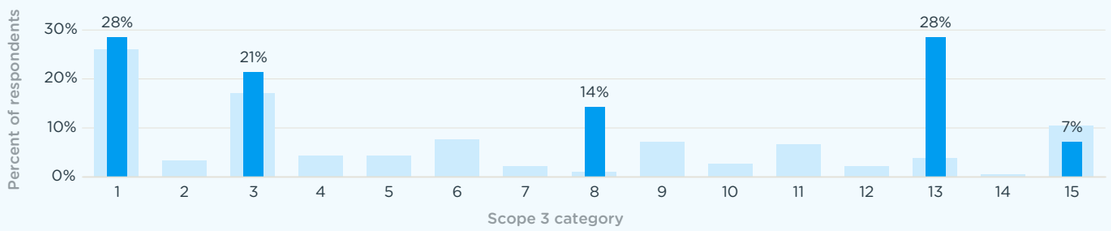
Category 3: Fuel- and Energy-Related Activities, identified by 36% of respondents, underscores the emissions linked to upstream energy production. Interview participants added that “electrifying existing buildings” remains complex, particularly when retrofitting older systems.

Less frequently selected categories like Category 8: Upstream Leased Assets, and Category 15: Investments, reflect niche but relevant emissions sources.

Most selected scope 3 categories (from 1st and 2nd most relevant)



Most selected scope 3 categories (most material only)



Barriers

Overall, the survey and interviews align on tenant engagement and energy monitoring as the most pressing barriers in the real estate sector, alongside financial constraints and supply chain challenges. Interviews highlighted the split incentives between tenants and owners, the difficulty of scaling low-carbon construction materials, and operational challenges tied to retrofitting existing buildings.

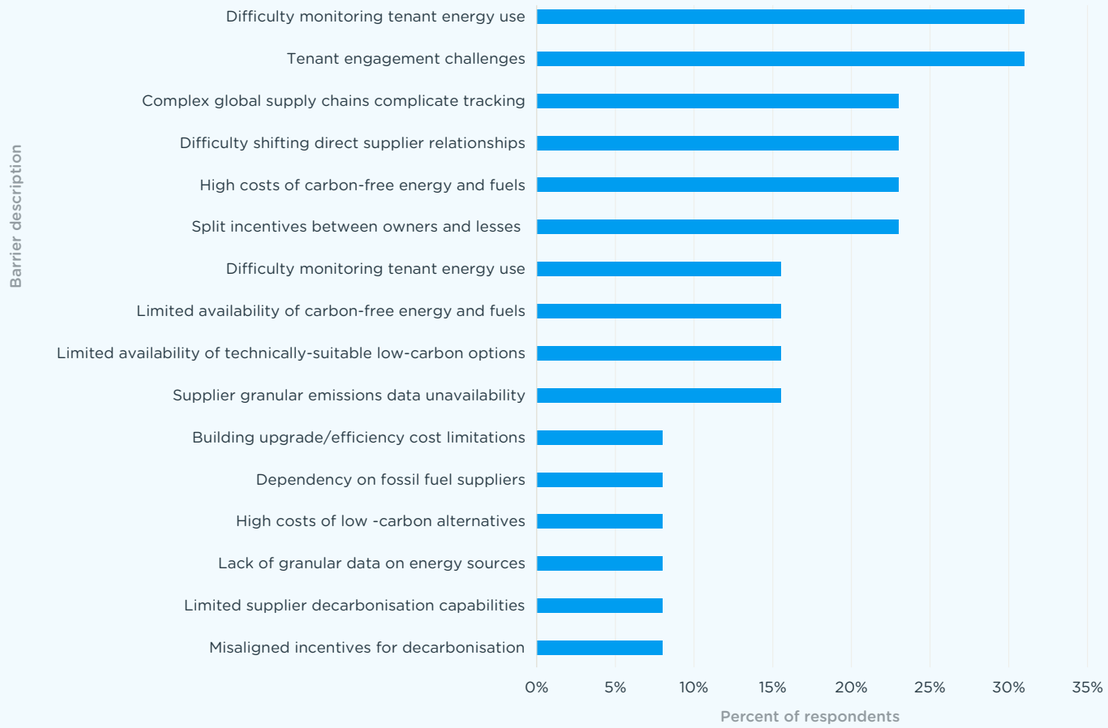
The survey identifies tenant engagement challenges and difficulty monitoring tenant energy use as the top barriers, each selected by over 30% of respondents and rated as moderately severe (2.19 and 2.25, respectively). Interviews confirm these findings, with participants pointing to resident emissions as a dominant part of the sector's footprint. Split incentives, where tenants benefit from efficiency upgrades while owners bear the costs, were frequently cited in an interview with a developer and investor: “Residents pay their own bills, so they reap the benefit of making efficient choices, but we don’t see the return”.

Financial constraints were another shared challenge, including building upgrade/efficiency cost limitations (rated 2.50) and high costs of carbon-free energy and fuels (rated 2.31). Interviewees expanded on this, emphasising the high premiums for low-carbon materials like concrete and the lack of demand to drive commercial viability: “Low embodied carbon materials are not yet viable without broader adoption”.

Supply chain challenges, including complex global supply chains and difficulty shifting direct supplier relationships, were also prominent in survey responses, although rated less severe (2.11 and 1.73). Interviews corroborated these challenges, citing “fragmented supply chains” and the difficulty of securing reliable emissions data, particularly for construction materials.

Additionally, the limited availability of technically suitable, low-carbon options (15% of respondents, rated 2.40) and operational barriers, such as retrofitting existing buildings, were highlighted in interviews. Participants noted that “electrifying older systems” remains particularly challenging due to technological and logistical constraints.

Real estate: barriers to decarbonisation for most material scope 3 categories



4.5.3. Retail

The retail sector survey respondents demonstrate decent engagement with scope 3 decarbonisation, with 72% reporting established targets, with mostly short-term target dates of 2025 to 2030. Most respondents rate their ability to meet these targets as “adequate” (40%) or “somewhat limited” (30%), while fewer consider it “good” (20%) or “very limited” (10%). Perceived progress is similarly optimistic, with 40% describing their past progress as “as expected” and about 30% as “above expectations”. However, actual emissions trends paint a more mixed picture: 40% of respondents report decreases, but 30% report increases, and 20% observe no significant change. While perceived ability and progress suggest moderate confidence in decarbonisation efforts, the significant proportion of respondents reporting emissions increases indicates a disconnect between expectations and outcomes. This highlights the variability in the sector’s decarbonisation performance, with some companies achieving meaningful reductions while others struggle to align progress with their targets.

Material categories:

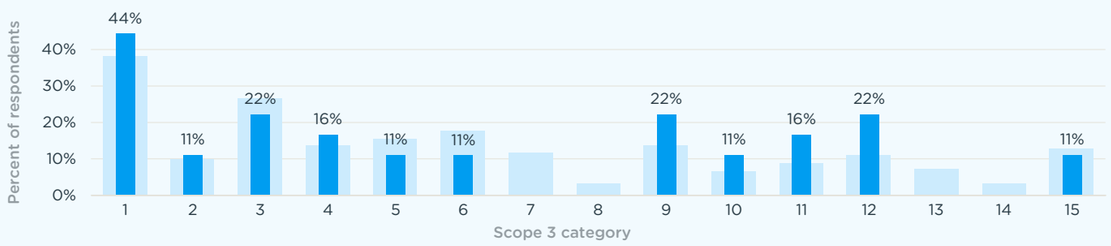
Overall, the survey and interviews align on the importance of Purchased Goods and Services as the dominant scope 3 category for the retail sector, while interviews provide additional insights into challenges related to product life cycles, material sourcing, and supply chain complexity. The broader spread of material categories reflects the diverse nature of retail operations, encompassing procurement, distribution, energy use, and end-of-life treatment of products.

The survey identifies Purchased Goods and Services as the most material category, emphasising the sector’s reliance on procurement for products sold in retail operations. This finding is strongly supported by interviews, which emphasise emissions from “material processing” and the dominance of purchased goods within the sector’s scope 3 emissions profile. However, interviewees highlight challenges with “supplier collaboration” and smaller suppliers lacking resources to provide accurate data, complicating decarbonisation efforts across the supply chain.

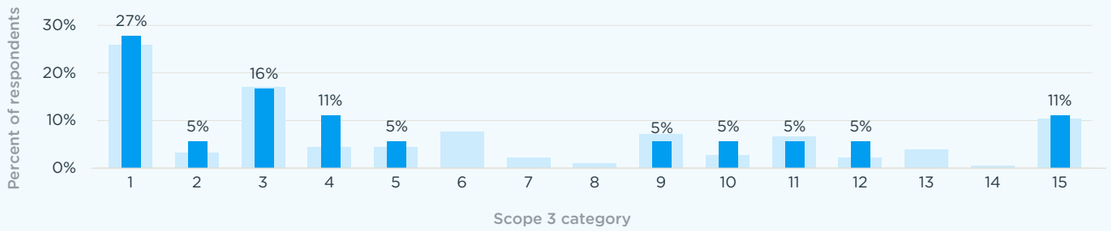
The survey also identifies Downstream Transportation and Distribution and End-of-Life Treatment of Sold Products as key categories, reflecting emissions from product distribution and environmental impacts post-consumer use.

Fuel- and Energy-Related Activities is another material category highlighted in the survey, likely underscoring the emissions associated with energy consumption in retail operations like stores and warehouses.

Most selected scope 3 categories (from 1st and 2nd most relevant)



Most selected scope 3 categories (most material only)



Barriers

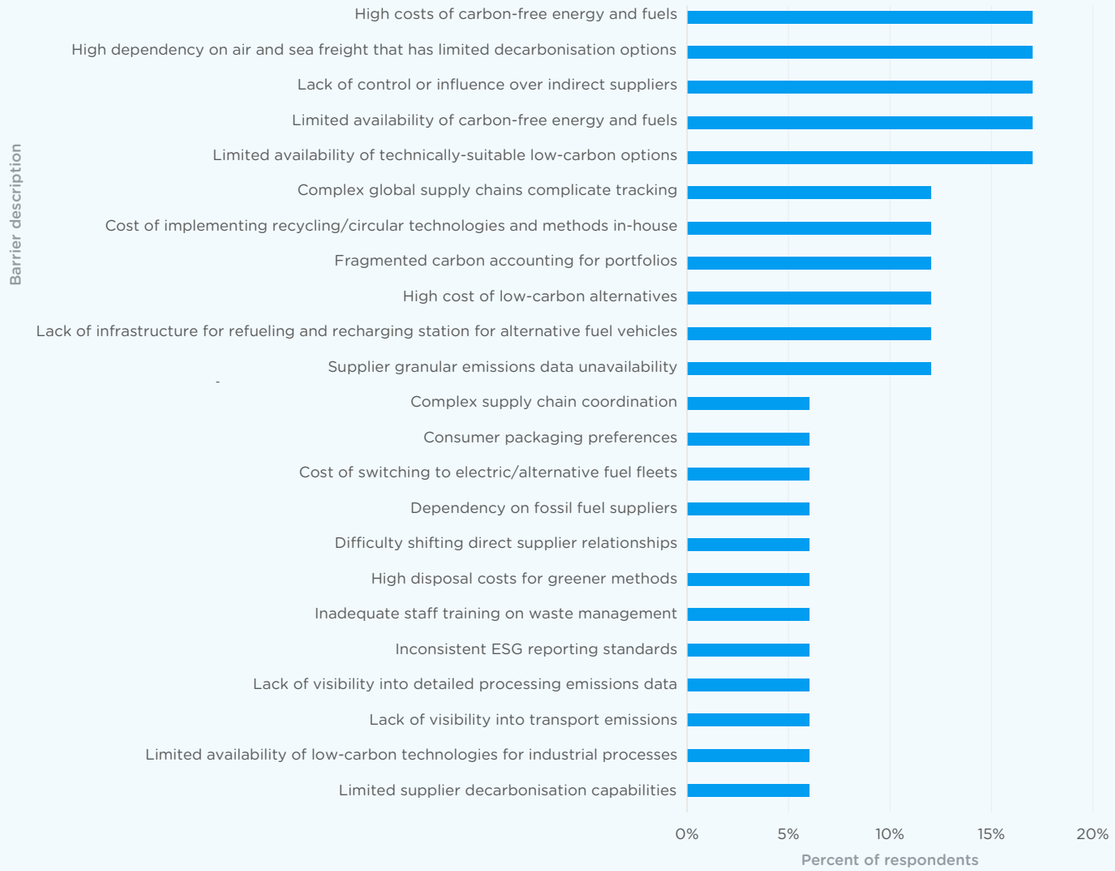
Overall, the survey and interview findings align on the critical barriers for the retail sector, particularly those tied to financial constraints, supply chain complexities, and operational challenges. Interviews expand on these issues by emphasising data availability and harmonisation challenges, as well as the difficulty in engaging smaller suppliers and ensuring transparency across global supply chains.

The survey highlights the high costs of carbon-free energy and fuels and the limited availability of low-carbon options as prominent financial barriers, each rated at 2.3 in severity. These findings align with interview insights, which cite “significant costs for low-carbon materials” and challenges faced by smaller companies in adopting greener practices. Interviews add that “regulatory frameworks” could play a role in addressing these costs, but current financial incentives are insufficient to drive widespread adoption.

Supply chain challenges, including high dependency on air and sea freight and lack of control over indirect suppliers, were also emphasised in the survey, with severities of 2.3 and 2.11, respectively. Interviewees confirmed these difficulties, highlighting “limited visibility into global supply chains” and “fraud in material sourcing” as significant barriers. They also pointed to the “need for harmonisation in emissions calculation methodologies”, which complicates supply chain decarbonisation efforts and creates inefficiencies in tracking emissions.

Additional barriers identified in the survey included such as the cost of implementing circular technologies and the lack of infrastructure for recharging/refuelling.

Retail: barriers to decarbonisation for most material scope 3 categories



4.5.4. Transportation and/or distribution services

The transportation and/or distribution services sector survey respondents demonstrate moderate engagement with scope 3 decarbonisation, with 71% reporting established targets between 2025 and 2030. Respondents largely rate their ability to meet these targets as “adequate” (50%) or “somewhat limited” (30%), while a smaller proportion view their ability as “very good” (20%). Perceived progress aligns with this moderate confidence, with 40% of respondents describing their progress as “as expected” and 30% reporting it as “above expectations,” though 20% indicate it is “below expectation”.

Actual emissions trends reveal mixed outcomes: 40% of respondents report increases in emissions, while 30% report decreases, and 20% observe no significant change. The magnitude of emissions changes varies, with many reporting shifts within ±10%, but a considerable share indicating larger reductions of 21–30% or increases of 31–40%. These results suggest a partial disconnect between perceived and actual ability to decarbonise. While many respondents express confidence in their progress, the substantial proportion reporting emissions increases highlights ongoing challenges in achieving consistent reductions.

Material categories:

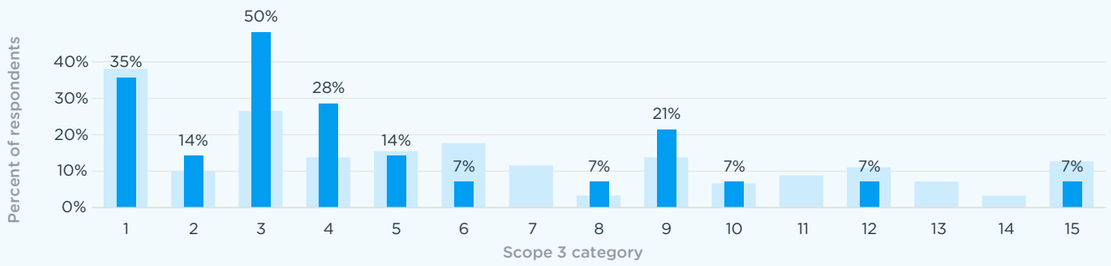
Overall, the survey and interviews both highlight the critical importance of energy-related emissions in the transport and distribution sector, while also revealing differences in the specific priorities and challenges faced by stakeholders.

The survey provides a broad perspective across the sector, while the interview focuses on rail manufacturing, offering more niche insights into the product life cycle and customer adoption challenges.

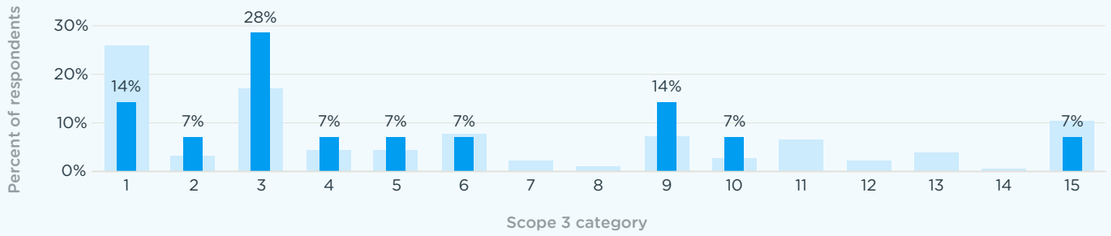
The survey identifies Fuel- and Energy-Related Activities as the most material scope 3 category, selected by 50% across the top two rankings. However, the interview places greater emphasis on the lifetime emissions of sold products, (in this case diesel locomotives), which make up “97% of scope 3 emissions” for the manufacturer interviewed. This divergence highlights differences in priorities between energy use during operations (survey focus) and product life cycle emissions (interview focus).

The survey also highlights Purchased Goods and Services (36%) and Downstream Transportation and Distribution (21%) as significant scope 3 categories. While the interview mentions Category 1 (Purchased Goods and Services), it states that it represents “only a small portion of total scope 3 emissions” for the manufacturer. This suggests that the prominence of this category in the survey likely reflects the broader sector’s reliance on procurement and logistics rather than rail-specific manufacturing priorities.

Most selected scope 3 categories (from 1st and 2nd most relevant)



Most selected scope 3 categories (most material only)



Barriers

The transportation and distribution services sector faces significant barriers to scope 3 decarbonisation, reflecting the sector’s reliance on traditional energy sources, logistical complexity, and the financial burden of transitioning to low-carbon alternatives. Survey respondents most frequently cited the limited availability of carbon-free energy and fuels and dependency on fossil fuel suppliers, each selected by over 20% of respondents. These barriers underscore the sector’s dependence on conventional energy infrastructure and the challenges of adopting cleaner energy alternatives. Both barriers were rated moderately severe, with scores of 2.38, emphasising their substantial impact on decarbonisation progress.

Additional barriers highlighted by the survey include the cost of switching to electric or alternative fuel fleets and the lack of infrastructure for refuelling and recharging stations for alternative fuel vehicles, cited by 15–20% of respondents. These reflect the financial and logistical challenges of deploying low-carbon technologies, with severity ratings ranging from 2.17 to 2.33.

Insights from interviews reinforce and expand on these findings. The limited availability of hydrogen and biofuels, as well as the lack of supporting infrastructure, were emphasised as critical barriers, particularly in the rail subsector. This aligns with survey findings but adds nuance by highlighting the interdependence of regulatory frameworks and infrastructure development. For example, the absence of rail-specific policies compared to trucking and aviation delays investment in alternative fuels and associated technologies.

The survey results point to the high costs of carbon-free energy and fuels as a prominent barrier. Similarly, interviews noted the financial challenges associated with transitioning to hydrogen, with interviewees citing “cost competitiveness” as a decisive factor for customer adoption. Additionally, the interview provided a unique perspective on managing risks in R&D investments, with manufacturers balancing the development of new technologies against customer demand and regulatory timelines.

The interview touched on the long lifespans of rail assets (common throughout the sector with other transport modes too), which complicate emissions reductions. Retrofitting existing locomotives to use cleaner fuels was highlighted as a potential interim solution, addressing barriers related to the cost and timeline of full fleet replacement.

Transportation and/or distribution services: barriers to decarbonisation for most material scope 3 categories

4.5.5. Utilities and/or energy

The utilities and/or energy sector survey respondents show lower than average engagement with scope 3 decarbonisation, with 58% reporting established targets and varied timelines, including key dates in 2028, 2029, 2030, and 2050. Respondents were split on their ability to meet these targets, with 40% indicating “somewhat limited”, and 52% describing it as either “good” or “adequate”. Perceived progress is mixed, with most describing it as “as expected,” or “below expectation”. Actual emissions trends highlight challenges, with the most cited category being an increase of 11–20%, alongside a relatively even distribution across other ranges, including both increases and decreases. This suggests an optimism to meet targets not matched by previous performance.

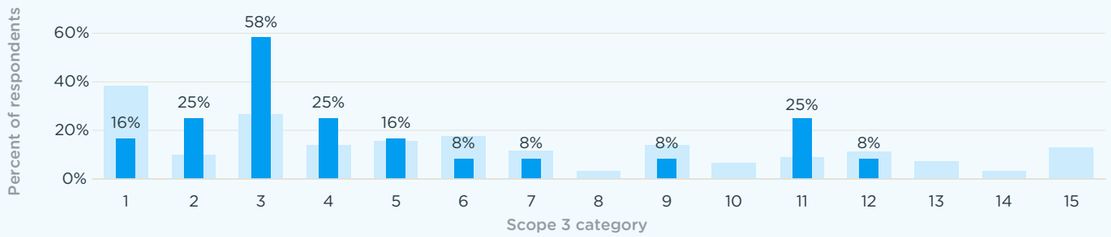
Material categories:

The Fuel- and Energy-Related Activities category dominates scope 3 emissions for the energy and utilities sector, identified as the most material category by 42% of survey respondents and cited by 58% when the top two rankings are considered. This underscores the sector’s reliance on energy-intensive operations and the emissions associated with upstream energy use and production. While the survey responses highlight this category as central, it is worth noting that the interviewee—representing an offshore wind company—focused more on emissions from steel production and marine vessels, which may not fully align with the broader sector’s perspective on scope 3 priorities.

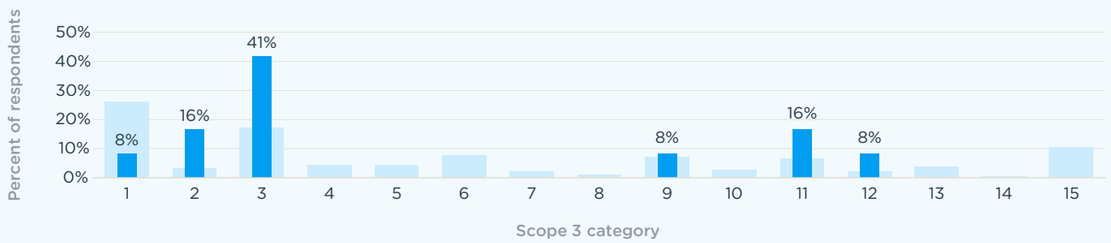
Purchased Goods and Services and Use of Sold Products are also notable categories, with 25% of respondents selecting each as either the most or second-most material category. These categories reflect emissions from the procurement of materials like steel for construction and the downstream impacts of sold energy products during their use phase. Interviews emphasise the emissions-intensive nature of material sourcing, particularly steel, which dominates the sector’s upstream emissions and poses challenges due to cost and limited low-emission alternatives.

Upstream Transportation and Distribution, selected by 17% of survey respondents as the most material category, highlights the importance of emissions from supply chain logistics.

Most selected scope 3 categories (from 1st and 2nd most relevant)



Most selected scope 3 categories (most material only)



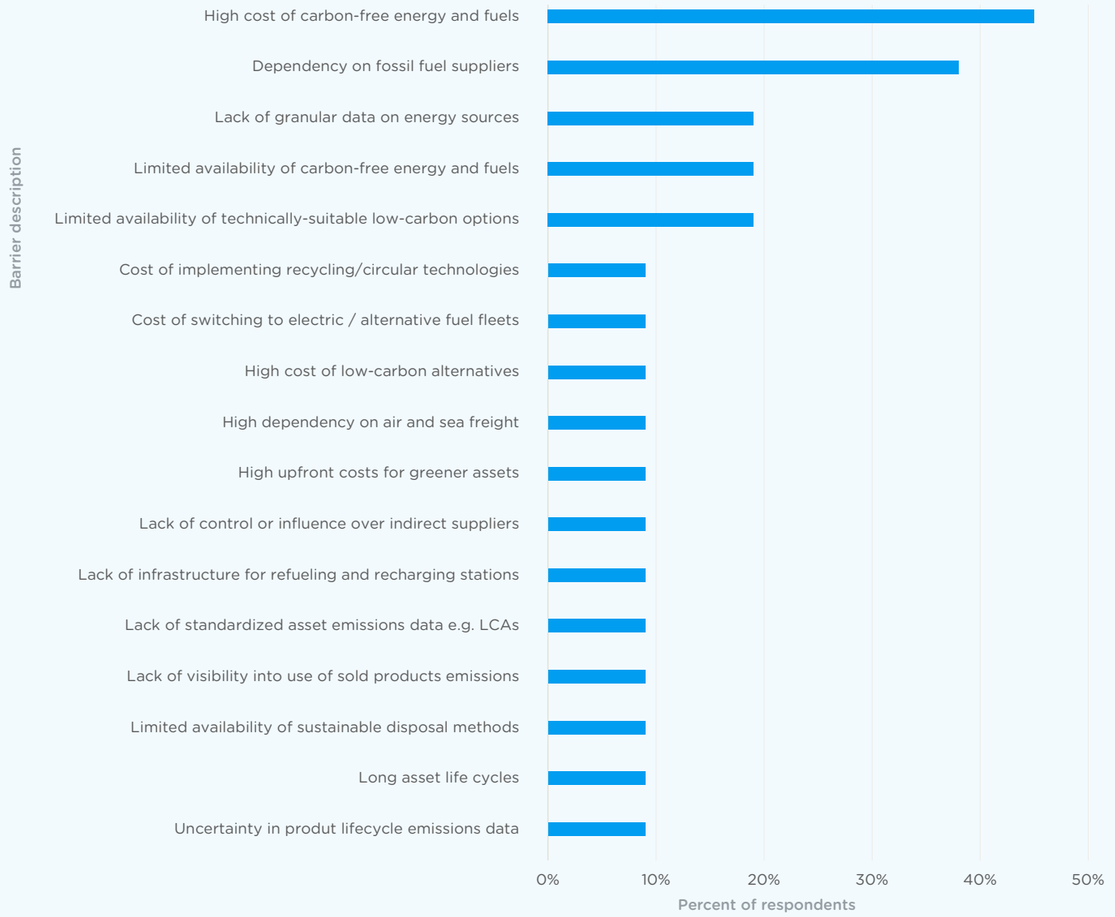
Barriers

Overall, the survey and interviews highlight a sector constrained by financial pressures, supply challenges, and data limitations. However, the interviews provide additional insights into dependencies on suppliers, lacking policy support, and the lack of uptake of circular solutions.

The energy and utilities sector faces significant financial and operational challenges in its efforts to decarbonise scope 3 emissions. The most frequently cited barriers include the high costs of carbon-free energy and fuels and the dependency on fossil fuel suppliers, each selected by over 30% of survey respondents and rated moderately severe at 2.48. These barriers reflect the sector’s reliance on traditional energy sources and the substantial financial constraints associated with transitioning to cleaner alternatives. Interviews reinforced these findings in an offshore wind context, highlighting the prohibitive costs and limited availability of low-emission steel and cleaner marine fuels like hydrogen and methanol for offshore operations.

Other notable barriers include the lack of granular data on energy sources, limited availability of carbon-free energy and fuels, and limited availability of technically suitable, low-carbon options, each selected by around 20% of respondents. These were rated with severity scores ranging from 2.33 to 2.64, reflecting their considerable impact. Interviewees further emphasised the challenge of improving data quality, particularly in transitioning from spend-based to activity-based emissions calculations. They also noted the misalignment of decarbonisation timelines between the energy sector and key suppliers, such as steel and marine industries, which often target 2050 for achieving emissions reductions, creating additional hurdles for sectors aiming for earlier targets (e.g., some offshore wind players targeting 2040).

Utilities and/or energy: barriers to decarbonisation for most material scope 3 categories



05 Barrier prioritisation

While the previous chapter focused on the broader analysis of all identified barriers, a key objective of this study was to move beyond identification and toward actionable solutions. To accomplish this, the barriers were prioritised using five factors that provided an indicator for their overall impact:

Prioritisation factor	Rationale for inclusion
Frequency of selection	To understand which barriers are most encountered across the survey sample, highlighting widespread issues that affect a significant number of companies.
Sector spread	To identify barriers that are shared across multiple industries.
Barrier severity	To prioritise barriers that were perceived as particularly challenging to overcome.
Actual emissions change	To prioritise barriers cited by companies with limited historical emissions reduction progress, focusing on factors that may directly impede measurable scope 3 decarbonisation outcomes.
Perceived future ability to meet targets	To address barriers highlighted by companies that foresee challenges in meeting future decarbonisation goals, ensuring solutions address forward-looking concerns and strategic gaps.

Prioritisation was guided by the need to balance breadth and depth, ensuring that prioritised barriers were both broadly applicable across sectors and deeply impactful on decarbonisation progress within each sector. This approach recognises that not all barriers are equally influential; some represent isolated challenges, while others resonate across industries and fundamentally play a larger role in impeding scope 3 emissions reductions.

The resulting prioritised barriers were grouped into either cross-sector categories or sector-specific barriers.

Cross-sector barriers:

Techno-economic barriers to upstream decarbonisation:

- Limited availability of technically suitable, low-carbon options
- High cost of low-carbon alternatives
- High costs of carbon-free energy and fuels

Supply chain coordination and emissions reporting:

- Lack of control or influence over indirect suppliers
- Supplier granular emissions data unavailability

Industry-specific barriers:

- **Finance:** Lack of emissions disclosure by investees, and risk-return concerns on green investments
- **ICT:** Employee preference for air travel
- **Real estate:** Difficulty monitoring tenant energy use, and Tenant engagement challenges
- **Transport:** Limited availability of carbon-free energy and fuels

The top barriers provide insight as to where companies are feeling the pain points the most as well as where efforts could be concentrated to achieve meaningful progress in scope 3 emissions reductions. A clear theme emerged across sectors around the upstream supply chain, with organisations recognising the urgent need for accelerated technology development to make low-carbon alternatives viable and cost-effective. Equally significant is the necessity for all supply chain actors to engage more deeply in the decarbonisation agenda, emphasising the importance of collaboration and shared accountability. Additionally, the growing focus on carbon reporting literacy highlights a need for enhanced data transparency and capacity-building across the value chain. Together, these findings underscore that overcoming these barriers is not only about innovation but also about fostering alignment and shared understanding across the entire ecosystem.

06

Potential solutions to scope 3 decarbonisation barriers

The search for solutions to barriers in addressing scope 3 emissions remains a complex and evolving field. This chapter aims to illuminate some potential pathways while acknowledging that it cannot offer definitive answers. Central to this discussion is an exploration of costs and timeline estimates—areas where the data collected from this study is only indicative. These estimates are included to fill gaps in understanding, recognising their limitations in precision and reliability. While broader decarbonisation models for industries exist, their scope does not provide the granularity needed to evaluate specific claims highlighted in our survey. This study's goal is to advance the conversation by examining available insights and identifying opportunities for further exploration.

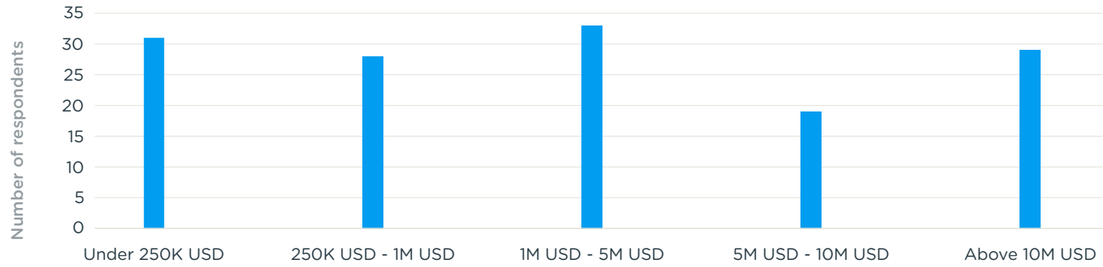
The survey responses reflect a range of approaches to overcoming the barriers. The below sections provide a detailed analysis of the top five cross-sector barriers identified, including the recommended solutions and their associated costs and timelines. It also considers these factors in the context of various sectors and geographical nuances. The analysis aims to highlight relevant themes for how respondents have successfully addressed this barrier and explore suggested (not implemented) solutions from survey respondents and interviewees.

6.1. Costs and timelines of solutions

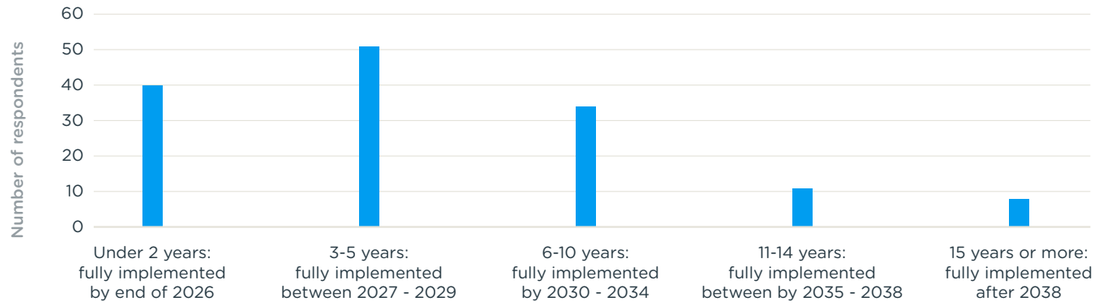
This section presents the estimated timelines and costs for the solutions proposed by survey respondents to address key scope 3 decarbonisation barriers. The analysis first considers overall costs and timelines across all solutions, then examines variations by industry and region, and finally evaluates them concerning specific barriers identified. Results presented here should be treated cautiously, as this data is based on self-reported estimates for unimplemented solutions. The accuracy of cost and timeline projections has not been tested.

When looking at only the solutions addressing the five key cross-sector barriers identified, the data showed a lack of trends on implementation timelines and associated costs when barriers were analysed in aggregate. For all the top barriers identified, responses always ranged from the low end (under 250K USD) to the high end (above 10M USD) to address the same barrier. Similarly, timelines ranged from under 2 years to more than 15 years, but the majority of responses were assessed to be achievable within the next ten years.

Costs for solutions addressing top 5 barriers

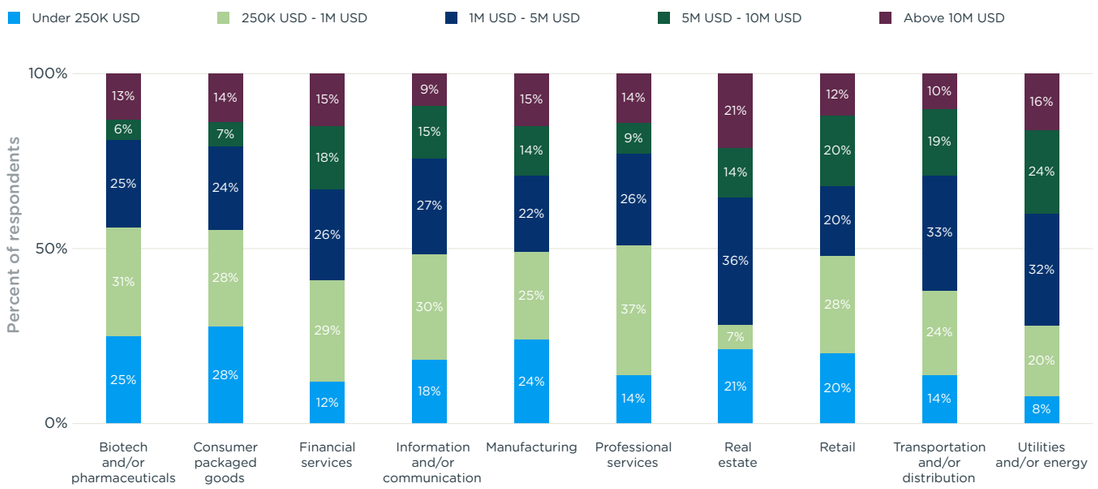


Timelines for solutions addressing top 5 barriers



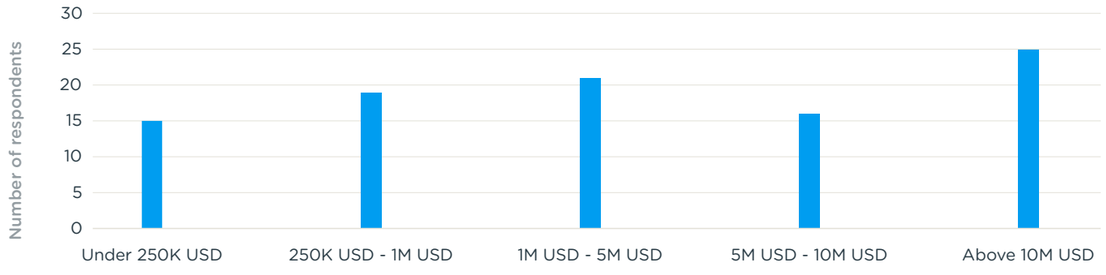
Across all sectors and solutions to all barriers, the average estimated solution cost was between **250K – 1M USD and 1M – 5M USD** categories. Across industries, the average cost varies between the two, indicating a relatively consistent expectation of solution costs across sectors, with retail, transportation, and utilities expected to be the most costly. Additionally, there was little regional variation, with the average falling within the same range.

Estimated costs for solutions addressing top 5 barriers

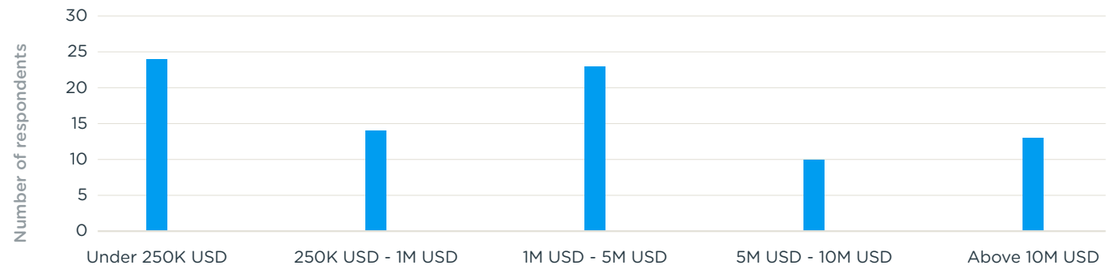


However, when examining top barriers by thematic groups, some trends emerge. The market believes techno-economic barriers will be more expensive to overcome compared to supply chain coordination-related barriers. Responses for techno-economic solutions most frequently estimated costs above 10M USD, while solutions addressing supply chain coordination barriers were generally estimated between 250K USD – 1M USD and most frequently estimated under 250K USD. For both solution groups, the results did not follow a clear progression, suggesting a level of uncertainty in cost estimations across respondents.

Costs for solutions addressing techno-economic barriers



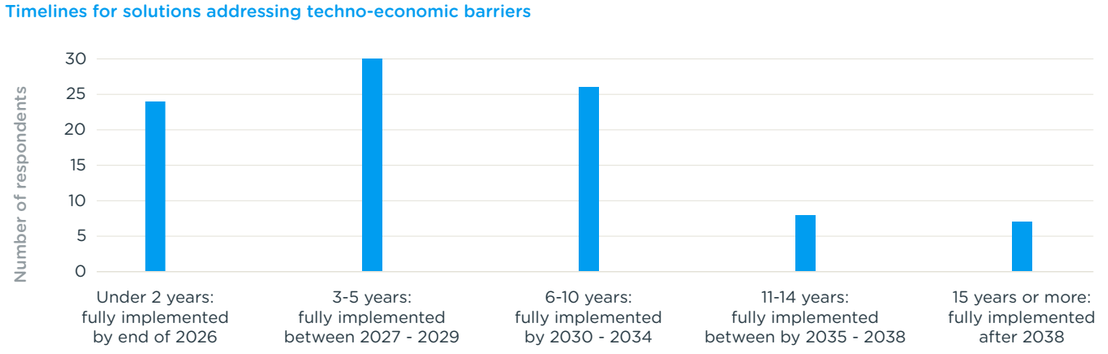
Costs for solutions addressing supply chain coordination barriers



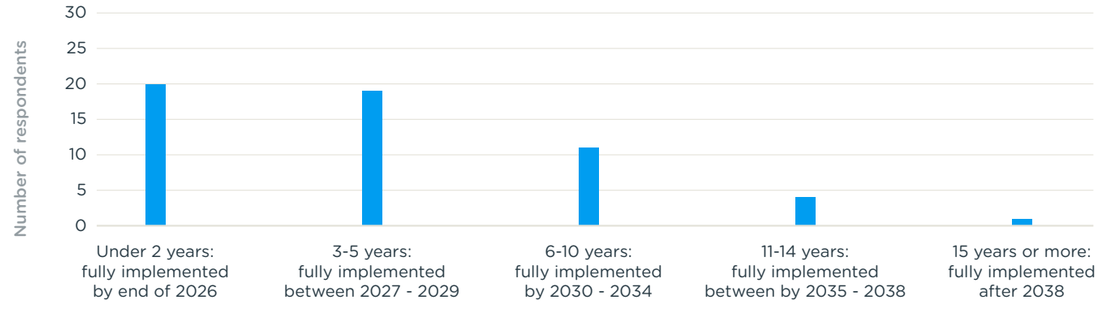
The supply chain coordination solutions typically focus on optimising existing processes or updating operating models rather than developing or deploying new technologies. This aligns with expectations, as improving operating models often demands fewer resources compared to the larger financial investments associated with new technological solutions for decarbonisation.

Timelines across both subsets of barriers were slightly more cohesive but still ranged across the entire spectrum of possible answers (under 2 years to more than 15 years). Across solutions for all top barriers, most respondents estimated that it would take no more than 10 years to implement associated solutions, which aligned with survey-wide timelines. Similar to costs, techno-economic solutions will take longer to implement compared with supplier management and coordination. This again aligns with expectations as techno-economic solutions may require the development, testing, and scaling of new technologies or infrastructure to be fully implemented.

Timelines for solutions addressing techno-economic barriers



Timelines for solutions addressing supply chain coordination barriers



6.2. Techno-economic barriers to upstream decarbonisation:

6.2.1. Introduction

Three of the top cross-sector barriers all relate to the techno-economic barriers to upstream decarbonisation. These were limited availability of low-carbon options, high costs of alternatives, and the expense of carbon-free energy, and were widely reported across sectors and regions. In the survey, the limited availability of suitable low-carbon options was the most frequently cited challenge, with nearly one-third of respondents identifying it as critical, while the high costs of both low-carbon alternatives and carbon-free energy were cited by 15% and 20% of respondents, respectively. These barriers are deeply interconnected; for instance, the high cost of low-carbon alternatives often stems from limited availability, while the financial burden of carbon-free energy amplifies the overall challenge of adopting sustainable solutions.

Rooted in both technological limitations and economic constraints, these barriers are critical to addressing emissions in scope 3 categories, particularly 3.1 (purchased goods and services) and 3.3 (fuel- and energy-related activities).

The limited availability of technically suitable, low-carbon options emerged as the most significant across all sectors in the weighting exercise, with nearly one-third of respondents identifying it as a critical challenge for addressing scope 3.1 Purchased Goods and Services and 3.2. Capital Goods. The availability of low-carbon solutions is uneven, with service-based sectors less affected than those reliant on difficult-to-decarbonise materials such as steel and concrete. This issue emphasises the pressing need for innovation and supply chain collaboration to accelerate accessibility to sustainable alternatives.

As well as pure availability, cost considerations of the low-carbon alternatives were also a top barrier across sectors. While not the most frequently cited, the high cost of low-carbon options held significant weight in terms of severity and connection to respondents who had poorer historical performance on emissions reductions. Sectors like manufacturing and consumer packaged goods find it particularly challenging to balance sustainability goals with financial feasibility.

Furthermore, only a small fraction of organisations reported progress in addressing this barrier, underlining the need for innovative financial and collaborative strategies.

Similarly, the financial burden associated with carbon-free energy and fuels remains a critical hurdle. This barrier, tied exclusively to scope 3.3 emissions, was selected by one-fifth of respondents, reflecting its widespread impact. The prohibitively high costs limit adoption across supply chains, particularly for businesses operating with narrow profit margins. The challenge is compounded in competitive markets were passing on additional costs to consumers is not feasible. However, it was a barrier that many respondents have begun to address, showing that there is ongoing progress here.

These interrelated barriers underscore the complexity of achieving upstream decarbonisation. Limited availability and high costs of low-carbon solutions, whether in materials or energy, hinder companies' ability to make meaningful progress. Below is a summary of the proposed and implemented solutions addressing these barriers, as well as a discussion incorporating insights from the literature.

These barriers are deeply interconnected; for instance, the high cost of low-carbon alternatives often stems from limited availability, while the financial burden of carbon-free energy amplifies the overall challenge of adopting sustainable solutions.

6.2.2. Results from survey responses

The barriers of limited availability of technically suitable, low-carbon options, the high cost of low-carbon alternatives, and the expense of carbon-free energy and fuels represent interconnected challenges that require multi-faceted solutions. Insights from survey responses demonstrate a breadth of strategies to address these systemic issues, which span technological innovation, market mechanisms, and policy interventions.

Survey respondents addressing the availability of low-carbon options and the high cost of alternatives identified three primary solution categories: Innovation and development, partnerships and market mechanisms, and carbon credits. Solutions addressing the high cost of carbon-free energy and fuels introduced additional strategies, including electrification, fleet and logistics optimisation, and leveraging policy incentives. Together, these approaches reflect the diversity and complexity of solutions required to overcome decarbonisation barriers.

Innovation and development

Innovation lies at the core of addressing both availability and cost barriers. Solutions in this category focus on creating, testing, and scaling low-carbon technologies or transforming existing systems. Costs range widely, from low-cost initiatives like material scouting and testing (under 250K USD) to high-cost investments such as acquiring hydrogen buses, conducting large-scale research, or electrifying fleets (exceeding 10M USD). Timelines similarly vary, with short-term actions achievable in under two years and medium-term research and development initiatives requiring six to ten years or more.

Electrification represents a significant aspect of this category. Investments in electric vehicles (EVs), charging infrastructure, and battery technologies were reported as transformative solutions but often required substantial capital and extended timelines. For instance, large-scale projects like battery-electric bus adoption in the U.S. or Australia involve costs exceeding 10M USD and spanning up to 15 years. However, such investments offer long-term emissions reductions and represent critical pathways for sectors like transportation and logistics.

Costs range widely, from low-cost initiatives like material scouting and testing (under 250K USD) to high-cost investments such as acquiring hydrogen buses, conducting large-scale research, or electrifying fleets (exceeding 10M USD).

Partnerships and market mechanisms

Collaboration across supply chains emerged as a vital strategy, enabling organisations to align resources, share expertise, and scale decarbonisation efforts. Costs for partnership-driven solutions typically range between 250 and 1M USD, with timelines of three to five years. Examples include adjusting procurement strategies to prioritise low-carbon materials, developing long-term supplier contracts to stabilise costs, and pooling demand for green technologies. It was unclear however how effective these solutions would be in fully addressing the barriers.

Fleet and logistics optimisation often intersects with partnerships, involving collaborative efforts to improve routing efficiency, upgrade vehicle fleets, or transition to low-carbon logistics solutions. These strategies, while resource-intensive, demonstrate significant emissions reduction potential. Respondents noted costs exceeding 1M USD for transformative logistical upgrades, particularly in sectors like retail and transportation. For example, partnerships with technology providers to integrate fleet electrification and improve last-mile delivery efficiency have proven effective in reducing emissions over the medium to long term.

Carbon credits and interim reductions

While not a direct solution to availability issues, many respondents saw offsets as an interim strategy for driving climate finance into activities that reduce and/or remove carbon when low-carbon options are inaccessible or unaffordable. Reported costs for carbon credit strategies typically fell between 250K USD and 1M USD, with timelines ranging from short-term actions like purchasing verified credits to medium-term efforts such as developing new carbon credit pathways. Examples included companies in the U.S. biotech sector leveraging carbon credits as stopgap measures while awaiting the commercialisation of low-carbon materials.

Electrification and infrastructure development

Electrification and the development of supporting infrastructure represent capital-intensive but impactful solutions. These projects often exceed 10M USD and span timelines of 15 years or more. Examples included integrating renewable energy into operations, constructing EV charging networks, and transitioning to low-carbon industrial processes. Medium-cost efforts, such as electrifying light-duty vehicle fleets or adopting energy-efficient equipment, were also noted, requiring investments of 250K USD – 1M USD over three to five years. Data-driven diagnostic measures complement electrification efforts, enabling organisations to identify inefficiencies and optimise energy use. Energy audits, for instance, were reported as short-term solutions costing 250K USD – 1M USD and completed within two years. These audits often lay the groundwork for more extensive decarbonisation initiatives.

Electrification and the development of supporting infrastructure represent capital-intensive but impactful solutions. These projects often exceed 10M USD and span timelines of 15 years or more.

Policy and regulation

State incentives and regulatory frameworks were suggested to be crucial enablers for both availability and cost barriers. Medium-cost solutions, such as leveraging subsidies or tax credits, typically required 250K USD – 1M USD in investments and timelines of three to five years. Italian respondents emphasised the importance of such policies in supporting renewable energy adoption, while U.S.-based projects highlighted the role of the Inflation Reduction Act in financing large-scale electrification and low-carbon infrastructure projects.

Policy also plays a key role in addressing the high costs of carbon-free energy. Subsidies for renewable energy production, carbon pricing, and incentives for infrastructure development were repeatedly cited as critical. For example, respondents leveraging favourable local policies in Italy reported implementing renewable energy projects at lower costs and within shorter timelines.

Consumer demand and business model adjustments

Strategies to foster consumer willingness to pay for low-carbon products and adjust business models to align with decarbonisation goals were prominent. Branding efforts, demand pooling, and education campaigns were highlighted as tools to create market conditions that justify the green premium. For instance, targeting sustainability-focused customers required investments under 250K USD for short-term efforts or 1M USD – 5M USD for medium-term strategies spanning three to five years Adjusting business models to capture the green premium also involved leveraging customer demand to justify investments in carbon-free energy or low-carbon alternatives. This strategy aligns closely with fostering market readiness for emerging technologies, particularly in sectors like consumer goods and real estate.

6.2.3. Discussion

Both the survey responses and literature identify collaboration and government support as central to addressing the barriers of limited availability and high costs of low-carbon technologies, alternatives, and fuels. Survey respondents emphasised partnerships and market mechanisms to source low-carbon options, while the literature highlights the pivotal role of policy, infrastructure development, and technological progress. Comparing and contrasting these perspectives reveals both alignment and gaps in strategies.

Survey findings highlighted a business-led focus on innovation and collaboration as key to addressing availability barriers. Respondents frequently cited partnerships with suppliers, adjustments to procurement strategies, and incremental improvements like energy audits as solutions. These actions align with the literature's emphasis on leveraging market mechanisms to improve access to low-carbon technologies. However, the survey placed significantly less emphasis on systemic policy interventions. For example, respondents seldom mentioned carbon pricing or large-scale infrastructure investment, which are central themes to overcoming availability barriers in the literature (IEA, 2023)[14].

Cost-related barriers in the survey responses leaned heavily on financial mechanisms, such as subsidies and supply contracts, to reduce immediate economic pressures. Literature complements this by emphasising the long-term need for stabilising supply chains and scaling production to drive down costs. For instance, the IEA's 2023 Net-Zero Roadmap documents an 80% decline in aggregate costs for solar PV, wind, heat pumps, and batteries over the past decade (IEA, 2023). This aligns with survey findings, where respondents noted progress in addressing cost barriers, but also points to a gap: The survey rarely addressed the structural drivers of these cost reductions, such as public investment in R&D and manufacturing capacity.

The costs of decarbonising fuel-intensive sectors provide a stark contrast between the two perspectives. Survey respondents acknowledged the high costs of electrification and logistics optimisation but generally approached these as incremental business investments. Literature, by contrast, frames these challenges as requiring large-scale systemic shifts. MissionGreenFuels highlights the need for cheap electricity and low-cost electrolyzers to make green hydrogen competitive and stresses the importance of integrating green fuels with existing energy systems (MissionGreenFuels, 2024)[15]. While survey respondents mentioned infrastructure development, it was often in the context of short-term operational improvements, rather than the large-scale integration envisioned in the literature.

Scaling renewable energy capacity is another area where survey and literature insights partially align.

Respondents frequently cited progress in adopting renewable energy solutions, but their focus was primarily on leveraging existing incentives and reducing operational costs. Literature, such as the IEA's 2024 World Energy Outlook, underscores the urgency of expanding renewable capacity to nearly 10,000 GW by 2030 and highlights gaps in clean energy supply chains and investment flows (IEA, 2024)[16]. These structural challenges are underexplored in the survey responses, which focused more narrowly on immediate business actions rather than systemic market transformations. The Technology Readiness Level (TRL) framework provides a useful lens to contrast the two perspectives further. Survey respondents emphasised solutions in the mid-TRL range, such as partnerships for sourcing green materials or implementing renewable energy projects. These actions align with the literature's focus on scaling mid-TRL technologies, but the literature also stresses the critical role of public policy in bridging the "valley of death" for these technologies. For example, while green hydrogen and sustainable aviation fuels (SAFs) were mentioned in the survey as high-cost solutions, the literature provides greater depth by emphasising the role of subsidies and cross-sector collaborations in accelerating their adoption (MissionGreenFuels, 2024).

Regional disparities offer another point of contrast. Survey respondents from developed markets frequently cited policy-driven solutions, such as leveraging the U.S. Inflation Reduction Act or European Green Deal incentives. However, emerging market respondents were more focused on resource-constrained initiatives, such as low-cost energy audits and material scouting. Literature, particularly the IEA's Net-Zero Roadmap, highlights the need for international cooperation to address these disparities, ensuring equitable access to funding, technology transfer, and capacity-building in emerging economies (IEA, 2023). This broader systemic view was largely absent from the survey results.

The interdependence between availability and cost barriers is evident in both survey responses and literature but with differing emphases. Survey respondents highlighted consumer-driven demand generation and short-term partnerships to reduce costs, while the literature points to structural enablers and aligning decarbonisation efforts across sectors. These examples underscore the need for integrated approaches that combine short-term business strategies with long-term systemic changes.

In conclusion, the survey responses provide valuable insights into business-led solutions and incremental actions, but they often lack the systemic and policy-oriented focus found in the literature. While both perspectives recognise the importance of collaboration and innovation, the literature provides a more comprehensive view of the structural changes needed to overcome availability and cost barriers. Addressing these gaps will require integrating robust policy frameworks with business-driven initiatives to accelerate the transition to a low-carbon economy.

6.3. Supply chain coordination and emissions reporting

6.3.1. Introduction

Two of the top barriers were broadly related to supply chain coordination and management. Specifically, they were indirect supplier engagement and supplier emissions unavailability, which were always connected to Category 1 (Purchased Goods and Services). These barriers are deeply intertwined as a lack of supplier influence is often a direct cause of poor supplier emissions data. Indirect supplier engagement was the most frequently cited barrier, highlighted by 28% of survey respondents, covering all sectors and regions except the Middle East. The intricate nature of global value chains—with their multitude of partners, suppliers, and service providers—hinders coordination and collaborative initiatives often essential for driving decarbonisation. This lack of cohesion often leads to slow progress, which came across strongly in the interviews and surveys. This complexity is compounded by suppliers' varying levels of capability, awareness, and resources to adopt low-carbon practices, creating systemic challenges in reducing emissions.

Additionally, supplier emissions data unavailability was identified as the fourth most critical barrier to decarbonisation. It was selected by nearly 14% of respondents across all regions with the majority concentrated in North America and Europe and nearly all sectors except for utilities. The complexity of global value chains, coupled with variability in supplier capabilities and resources, compounds the difficulty of obtaining accurate, reliable emissions data. This lack of data transparency and granularity often results in reliance on estimations or incomplete reporting, which came through in the survey data and interviews, and ultimately hinder organisations' decarbonisation efforts. The survey data and insights presented here underline the importance of addressing this barrier as a cross-industry priority. Effective solutions will require robust strategies to foster supplier collaboration, enhance transparency, and improve data-sharing mechanisms.

6.3.2. Results from survey responses

Several themes and groups have been identified from the survey respondents addressing indirect supplier management and supplier data unavailability. These responses were categorised into six themes: collaboration and engagement with suppliers, expanding or diversifying the supplier base, embedding sustainability into contracts, supply chain proximity, leveraging digital tools and standardising data collection processes. These solutions have been analysed by the indicated cost, timeline, sector, and country to provide additional details and context.

Collaboration and engagement suppliers

Many respondents focused on fostering better collaboration with their suppliers. Reported strategies include changing the collaboration model, engaging third-party influencers, working directly with suppliers to resolve second-tier issues, or encouraging them to adopt SBTi and passing the responsibility further down the chain. These approaches emphasise the importance of strong relationships and alignment with suppliers to drive decarbonisation. Supply chain engagement strategies were typically regarded as more complex and therefore were associated with higher costs (250K USD – 1M USD). Sectors like manufacturing and retail, which manage large supplier networks, often highlighted the need for supplier engagement.

Expanding or diversifying the supplier base

Another common approach involves expanding or diversifying the supplier base to include partners who are more aligned with sustainability goals. Respondents emphasised the value of finding new suppliers who are already committed to decarbonisation, which can reduce the complexity of engaging existing suppliers.

Embedding sustainability into contracts

Embedding sustainability clauses into supplier contracts was frequently reported as a mechanism for driving compliance and accountability. By making sustainability commitments contractual, organisations aim to formalise expectations and foster long-term alignment with their suppliers. Embedding sustainability clauses was generally associated with medium-term timelines of 3-5 years.

Promoting supply chain proximity

Some respondents highlighted the importance of promoting geographic proximity within their supply chains to improve control and reduce emissions. This approach focuses on optimising supplier networks to enable more direct engagement and oversight. One example of this came from a respondent in the Mexican CPG sector. Similar to supplier engagement, promoting supplier proximity was typically associated with higher costs (250K USD – 1M USD). Promoting supply chain proximity often required medium-term timelines (3-5 years), suggesting that they require significant planning and business model changes to implement.

Leveraging digital tools and software

Respondents highlighted the adoption of digital tools and platforms, such as emissions tracking software and automation to streamline data collection and improve transparency. These tools were reported to facilitate better data management and sharing and validation, which enhanced the accuracy and reliability of supplier-reported emissions data. Building out digital tools capabilities was seen as more resource-intensive endeavor, requiring 3–5 years for full implementation.

Standardisation of data collection processes

Some respondents emphasised the importance of developing standardised data collection processes and aligning with and implementing available frameworks. These approaches can simplify the reporting process for suppliers and improve the comparability and consistency of emissions data across the supply chain. Sectors like manufacturing and retail, whose supply chains like have many diverse suppliers, emphasise the importance of standardising data collection.

Embedding sustainability clauses into supplier contracts was frequently reported as a mechanism for driving compliance and accountability. By making sustainability commitments contractual, organisations aim to formalise expectations and foster long-term alignment with their suppliers. Embedding sustainability

6.3.3. Discussion

While some respondents identified other potential strategies, such as increased regulation to mandate emissions reporting and improved estimation methodologies, many suggested solutions mirrored strategies already implemented by others, including updating contractual obligations, supplier engagement, digital tools, and standardisation. This widespread recognition highlights these approaches as effective pathways to address the lack of granular supplier emissions data. Costs and timelines for suggested solutions were similar to those of implemented strategies.

Available research supports these findings. Supplier engagement and training programs are essential for bridging gaps in emissions data and fostering sustainable practices. Research identifies six key strategies, including effective communication, trust-building, and tailored supplier guidance, which significantly improve scope 3 emissions management (Butt et al., 2024)[17]. Initiatives like the Carbon Disclosure Project (CDP demonstrate that companies actively engaging suppliers are 6.6 times more likely to set 1.5°C-aligned emissions targets (We Mean Business Coalition, 2024)[18]. Additionally, platform business models are increasingly valuable in fostering collaboration and innovation, providing shared access to tools and AI-powered analytics for sustainability efforts (Jorzik, et al., 2024)[19].

The World Economic Forum emphasises decarbonising supply chains by committing to green product offtakes, demanding stronger supplier commitments, co-shaping and co-investing with suppliers, and deploying large-scale support programs (WEF, 2024)[20]. This aligns with respondents' suggestions but provides greater detail, such as aligning suppliers to 1.5°C pathways, committing to green offtakes, scaling supply upstream, and co-funding decarbonisation efforts.

Furthermore, sustainability clauses in supplier contracts, increasingly driven by legislation like the Corporate Sustainability Reporting Directive (CSRD), are proving effective in improving supplier performance and ensuring compliance (EcoVadis, 2019)[21]. Localising supply chains also significantly reduces scope 3 emissions; for instance, sourcing 30% of textile suppliers locally resulted in a 669-ton CO_2 reduction over two years, with a projected 20,122-ton decrease over the next decade (BUJSE, 2023)[22].

Survey findings provide additional insights into sectoral and geographic nuances. Respondents with implemented solutions often demonstrated higher resource availability and policy support, enabling transformative projects such as transport fleet electrification and charging infrastructure construction, particularly in the United States and Australia. Conversely, respondents proposing unimplemented solutions tended to emphasise regulatory measures, market mechanisms, and subsidies, reflecting financial constraints and reliance on external factors. For example, companies in Italy highlighted power purchase agreements and energy audits, while those in the UAE and Mexico focused on incremental strategies like supplier changes and fleet transition targets. These patterns underscore the importance of tailoring strategies to regional and sectoral contexts to ensure effective implementation.

Sectoral differences also emerged, with manufacturing and retail respondents prioritising large-scale engagement and standardisation, while service-oriented sectors like finance placed less emphasis on these strategies due to fewer direct supplier dependencies. Respondents in the Real Estate sector found success overcoming data gaps using proxy data and estimate guidance, suggesting robust methodologies in this sector compared to others.

Research findings align closely with survey responses, emphasising the importance of supplier engagement, training, and digital tools as key strategies for addressing emissions data gaps. However, survey results reveal that unimplemented solutions often rely more heavily on systemic approaches and external dependencies, such as carbon markets or expanded subsidies, indicating barriers related to financial feasibility and readiness for operationalisation. This highlights a gap in awareness or adoption of advanced technological solutions and suggests the need for further research and analysis as companies continue to iterate on solutions.

6.4. Industry-specific analysis

For barriers that ranked among the top two within an individual sector but did not appear in the top 10 cross-sector barriers, we have conducted a sector-specific analysis. These cover the following:

- **Financial services:** Lack of emissions disclosure by investees, and risk return concerns on green investments
- **ICT:** Employee preference for air travel
- **Real estate:** Difficulty monitoring tenant energy use, and Tenant engagement challenges
- **Transport:** Limited availability of carbon-free energy and fuels

6.4.1. Financial services

Introduction

The Financial Services industry faces significant barriers to decarbonisation and while the survey elicited a wide variety of responses, lack of emissions disclosure by investees and risk-return concerns on green investments were determined most critical. These barriers were largely unique to the industry. Investees often fail to provide transparent and reliable greenhouse gas emissions data. This could be due to inadequate reporting frameworks, reluctance to disclose potentially sensitive data, or insufficient resources to measure emissions accurately. Additionally, green investments often face higher perceived risks and lower returns compared to traditional investments due to higher upfront costs ("green tech is often capital intensive"), longer payback periods, unproven technologies, and uncertain market conditions. In response to these challenges, several solutions were proposed with some respondents beginning to overcome barriers with both. Both barriers pertain to challenges within Category 15: Investments.

Results from survey solutions

Lack of emissions disclosure by investees

For lack of emissions disclosures by investees, according to respondents, solutions cluster around three main themes including the use of estimates, increased regulation, and better collaboration with investees. Regarding costs, responses range from under 50K USD to 5M USD, with 50% indicating that costs will fall between 250K USD and 1M USD. Similarly, timelines range from under 2 years to as many as 14 years for implementation, with 65% indicating implementation would take between 3 and 5 years. Firms estimating longer implementation times are recommending improved collaboration with investees, which often involves time-consuming efforts such as building consensus, aligning reporting frameworks, and supporting investees in developing the tools and skills for emissions tracking and disclosures.

A quarter of Financial Services respondents believe that they have successfully addressed the barrier – mainly using estimations or proxy data to achieve results. Some were able to implement successful strategies in under 2 years, while costs varied which is likely a product of the number of investments or the diversification of investments. Many respondents identified regulation as another avenue to break down the barrier; identified costs could be associated with updating compliance systems, lobbying or advocacy, and training. Interestingly, these responses came from not only the US and UK but the EU as well, which implies that even the global leader could potentially benefit from additional policy levers.

Risk-return concerns on green investments

For risk-return concerns on green investments, respondents highlighted solutions focused on promoting long-term investment horizons, reducing the cost of capital, internal carbon pricing, and government subsidies. Internal carbon pricing incentivizes lower-carbon investments by assigning a monetary value to greenhouse gas emissions, effectively adding a "cost" to emissions-heavy investments. This makes low-carbon or green investments more financially attractive in comparison, improving their risk-return profile. Cost estimates for addressing this barrier range from under 250K to over 10M USD, with the majority (approximately 60%) identifying costs between 1M and 5M USD. Timelines vary widely, from under 2 years to over 14 years, with most respondents estimating implementation between 3 and 10 years.

Of the respondents in Financial Services who identified risk-return concerns on green investments as a barrier, approximately 45% reported progress in addressing risk-return concerns on green investments, primarily by introducing internal carbon pricing mechanisms or lowering the cost of capital to make green investments more competitive, and ultimately improve the risk-return profile. In other cases, increasing the investment time horizon also helped successfully address the barrier.

Insights from literature

Available research largely supports the survey findings while identifying gaps in some areas. Specifically, it highlights the importance of transparent emissions reporting for accurate decision-making. For instance, a 2024 paper notes that a lack of investee emissions disclosures complicates scope 3 decarbonisation for investors, as it hinders accurate assessment of carbon footprints and limits the ability to influence sustainable practices across investee firms (Mejia and Kajikawa, 2024)[23]. Another 2024 paper emphasises the need for standardised reporting to enhance the quality and comparability of scope 3 emissions data from investee companies (IGCC, 2024)[24]. It suggests that consistent disclosure practices can mitigate data gaps and improve investors' ability to improve climate performance.
For risk-return concerns on green investments, a 2024 study indicates that integrating carbon pricing into investment decisions enhances the financial performance of green investments by accurately assessing carbon risks, influencing portfolio strategies, and aligning with sustainability goals, ultimately leading to better risk management and potential returns (Hu, 2024)[25].

Recommendations

Overall, while existing literature aligns with key survey insights, there is a clear need for more empirical data on implementation costs, timelines, and indirect benefits to strengthen evidence-based decision-making in financial services. Further research is needed to assess the accuracy of estimates in emissions disclosures, to better understand strategies to lower the cost of capital and to understand the impacts of carbon pricing on risk returns for investors.

6.4.2. Information and/or communication technology

Employee preference for air travel

Introduction

Employee preference for air travel in the ICT sector refers to the tendency of employees to choose air travel over alternative, lower-carbon modes of transportation, such as trains or buses, even when viable options exist. This barrier is particularly relevant in the ICT sector, where global operations, frequent client engagements, and the need for rapid response often make air travel the default option. Factors such as the convenience, speed, and perceived necessity of air travel are reinforced by the sector's fast-paced and efficiency-driven culture, which frequently prioritises time savings over sustainability considerations. Scope 3 category 6 – Business Travel – was the third most selected scope 3 category, and companies from many sectors face the challenge of employees preferring air travel due to ease and cost. In the survey, ICT, professional services, and financial services particularly dominated this barrier.

Results from survey solutions

To address the challenge of employee preference for air travel, organisations have proposed solutions across three primary themes: green travel policies, internal carbon targets, and online remote tools. These solutions aim to reduce reliance on air travel by influencing organisational practices, encouraging behavioural change, and leveraging technological advancements.

One proposed solution involves the implementation of green travel policies, such as guidelines that ban air travel for "unnecessary" business trips. For example, a German company suggested this policy-driven approach, which seeks to redefine what constitutes essential travel within the organisation. By establishing formal restrictions, employees are encouraged to consider alternative modes of transportation or virtual collaboration. This solution is estimated to cost under 250K USD and is expected to take 3–5 years to fully implement, reflecting the time required to establish and enforce new travel norms effectively.

Another approach focuses on internal carbon targets, where departments are held accountable for reducing their carbon footprints. A U.S.-based organisation proposed committing every department to a 10% reduction in emissions within the first year. This solution emphasises measurable progress and accountability while integrating sustainability into the company's operational goals. With a low estimated cost of under 250K USD and a short implementation timeline of under 2 years, this strategy offers a practical and scalable way to encourage employees to limit air travel and adopt lower-carbon alternatives.

Finally, several organisations highlighted the use of online remote tools as a technological solution to replace in-person meetings and reduce the need for frequent travel.

Two Canadian respondents proposed adopting digital collaboration platforms to maintain productivity without relying on air travel. These solutions are estimated to cost between 250K USD and 1M USD, with implementation timelines of under 2 years. By enabling seamless virtual communication, this approach aligns with modern workplace trends and offers an efficient alternative to traditional travel-dependent practices.

Insights from literature

Available research largely supports the survey findings while identifying gaps in some areas. Specifically, it highlights the role of employee travel preferences in driving emissions within the ICT sector and the potential for digital tools and policy interventions to mitigate this impact. A recent study underscores the climate mitigation potential of teleworking, noting that a shift toward remote work can significantly reduce business travel emissions by (Tao et al., 2023)[26]. It emphasises that behavioural shifts and company policies promoting virtual collaboration are critical to lowering the sector's reliance on air travel.

Similarly, a 2021 study explores strategies for reducing emissions from long-distance business travel (Li et al., 2021)[27]. The findings indicate that many corporate trips can be effectively replaced with virtual participation, aligning with survey responses suggesting that digital collaboration platforms are a viable solution. The study highlights the need for corporate travel policies that prioritise remote meetings over air travel whenever feasible to drive emissions reductions.

A recent report from the UK Government, Greening ICT, further supports these findings, documenting how a digital-first approach has significantly reduced air travel among government employees (Department for Environment, 2022)[28]. The report notes that the adoption of e-conferences increased from 18.3 million in 2020 to 38 million in 2022, demonstrating the effectiveness of digital solutions in minimising business travel. This aligns with survey responses that pointed to the role of internal carbon targets and remote collaboration technologies in addressing air travel emissions.

While research highlights the effectiveness of green travel policies, internal carbon targets, and digital collaboration tools in reducing air travel, it also suggests that organisational culture and ingrained travel habits present ongoing barriers. Studies emphasise the need for sustained behavioural change efforts and clear company policies to ensure long-term reductions in emissions from business travel (Tao et al., 2023; Li et al., 2021; Department for Environment, 2022).

6.4.3. Real estate

Introduction

The real estate sector faces highly sector-specific barriers. Its unique barriers to decarbonisation seldom came across for other sectors. While a wide range of barriers were evaluated, the two most critical were difficulty monitoring tenant energy use and tenant engagement challenges, both of which pertain to Category 13: Downstream Leased Assets. Potential solutions to these issues vary in complexity, cost, and implementation timelines but demonstrate the potential to drive meaningful progress.

Results from survey solutions

Difficulty monitoring tenant energy use

Monitoring tenant energy use presents challenges because energy is often shared across units and not easily separable. Many buildings lack individual meters for each tenant, which means they are disconnected from their consumption. In other cases, energy usage is metered at the tenant level and billed directly to the tenants meaning the property owner does not have direct access to meter readings. In mixed-use spaces, tenants may have vastly different energy requirements (e.g., office, retail, and restaurants) which can make standardised monitoring difficult. Solutions cluster around three main themes: installation of submeters and smart metering technologies, green lease provisions and regulatory requirements for tenant disclosures. Most solutions for this barrier were provided by respondents located in North America, specifically the US and Canada, with some in the UK. Respondents in the US emphasised better access to data through submetering and technology. While Canada and UK respondents stressed a more holistic approach to technology, legislation, and sustainable lease agreements.

Approximately 40% of respondents who work in the Real Estate sector reported overcoming this barrier, largely through the installation of submeters or the adoption of smart metering systems, which were specifically used in North America. These solutions enable tenants to access direct energy use data, fostering greater transparency. Costs were generally proportional to timelines for these respondents. They were estimated at 250K USD to 1M USD for projects under 5 years and 1M USD to 5M USD for project timelines between 5 and 10 years. Additionally, one respondent in the UK successfully implemented green lease provisions to overcome the barrier, which took between 6 and 10 years to implement.

Tenant engagement challenges

Tenant engagement barriers come in a variety of forms. Tenants' priorities do not always align with those of the owner. For example, retail storefronts may keep doors open to attract potential customers leading to higher heating and cooling costs. Additionally, real estate companies may not always have effective methods for communicating with tenants, especially in residential buildings. Lastly, there may be cultural resistance, and tenants may not be inclined to adopt new habits, such as shutting off lights and recycling. Addressing tenant engagement challenges involves solutions such as tenant engagement programs, green lease provisions and increased regulation.

Roughly 30% of respondents identified progress in tackling this barrier, often through tailored incentive programs. Respondents also note that starting small – one portfolio at a time – can lead to successful outcomes. Other respondents proposed regulation. A Canadian respondent suggested regulatory requirements will play a critical role in fostering tenant engagement related to energy management. Another respondent in the UK pointed to a carbon tax, which would force improved tenant engagement. Lastly, a US respondent seeks to align firm sustainability goals with tenant goals through green lease provisions.

Insights from literature

One proposed solution, green lease provisions, shows promise for addressing both barriers as they often have terms that require tenants and landlords to collaborate on energy efficiency goals, which helps to address both monitoring energy consumption and tenant participation in sustainability efforts in tandem. By aligning both parties' interests and incentivising energy-saving practices, green leases create a framework where energy usage can be actively tracked and reduced, fostering better tenant involvement and more efficient energy management. Respondents indicated that green lease provisions have been effective in overcoming difficulties related to monitoring tenant energy usage. These leases facilitate the sharing of energy data and create a mutual incentive to adopt energy-efficient technologies, thereby enhancing energy performance across the building. Recent research tends to corroborate these survey findings. Research from a 2020 study found that implementing green leases in commercial office spaces could result in energy savings ranging from 11% to 22%. The study estimates that green leases could yield 17.8B USD in annual energy savings across all commercial leased space in the U.S. (White, et al., 2020)[29].

While many of the respondents propose smart metering, with some seeing successful results that encourage energy savings by giving tenants the ability to track and adjust their energy use, some studies only indicate marginal energy savings. Specifically, a study published in the International Journal of Sustainable Development and Planning evaluated the effectiveness of smart meters in parts of Europe. The research found that smart meters enabled energy savings of up to 4.5% among residential customers, with continuous feedback contributing to persistent savings (M. Bauer, et al., 2018)[30]. This suggests that smart metering can lead to some energy reductions. however, the effectiveness of smart meters depends heavily on the type of feedback provided and consumer engagement.

Recommendations

The Real Estate sector should look to a three-pronged approach to overcome tenant engagement and tenant energy monitoring barriers incorporating green lease provisions, smart metering and improved engagement programs to communicate initiatives and create buy-in.

6.4.4. Transportation and/or distribution services

Limited availability of carbon-free energy and fuels

Introduction

This barrier is particularly challenging given the sector's reliance on fossil fuels for mobility and freight. Unlike other industries that can leverage operational efficiency improvements or electrification more readily, transportation requires scalable low-carbon alternatives such as hydrogen, biofuels, or advanced renewable energy sources. However, these alternatives face hurdles including high production costs, limited infrastructure, and technological immaturity. For example, hydrogen requires substantial investment in both production facilities and distribution networks, while biofuels often compete with food production and have supply chain complexities. These challenges make the transition to carbon-free energy both capital-intensive and logistically demanding.

Respondents identified two major themes in potential solutions: investing in new technologies and collaborating with governments to create policy incentives. However, less than 10% of respondents in the transportation sector reported successfully addressing this barrier, indicating the difficulty of overcoming it within current market and policy conditions.

Results from survey solutions

Survey respondents highlighted three main approaches to addressing the limited availability of carbon-free energy and fuels. One respondent from the United States reported investing in the development of alternative energy technologies, such as hydrogen fuel cells. While this strategy shows promise, the timeline for full implementation was estimated to be 10-15 years, reflecting the long-term nature of such initiatives. In contrast, a respondent from the EU noted progress using government-mandated carbon credits, allowing the company to offset the absence of carbon-free fuels in the short term while continuing to explore low-carbon options. Another respondent from the UK highlighted collaboration with government bodies to co-develop renewable energy infrastructure, such as charging stations for electric vehicles. This partnership was deemed critical for overcoming infrastructure bottlenecks that hinder the adoption of alternative energy sources. These varied approaches underscore the complexity of addressing this barrier, with solutions ranging from immediate mitigation strategies to long-term investments in technological and infrastructure development.

Insights from literature

Existing research aligns with survey findings, highlighting the significant challenges posed by limited carbon-free fuel availability. A 2022 study by the International Renewable Energy Agency found that while hydrogen could play a transformative role in the transportation sector, its production costs remain prohibitive, requiring significant public and private investment to scale (IRENA, 2022)[31]. Similarly, research on biofuels suggests that while they can serve as a lower-emission alternative to fossil fuels, their long-term effectiveness in decarbonisation varies widely depending on feedstock and production methods. Lifecycle emissions and production costs differ significantly across biofuel types, and although they are generally more expensive than fossil fuels, policy incentives are key to supporting their deployment.

Recommendations

To overcome the limited availability of carbon-free energy and fuels, the transportation sector must adopt a multi-faceted approach. Scaling up R&D investments in technologies like hydrogen and advanced biofuels is critical to creating scalable, cost-effective solutions. Public-private partnerships can accelerate infrastructure development, such as charging networks and renewable energy distribution. Policymakers should expand incentives, including tax breaks and carbon credit programs, to reduce financial barriers and encourage adoption. Stronger regulatory frameworks, such as renewable fuel standards, will also be essential to support the transition. By combining innovation, collaboration, and policy support, the sector can address this systemic barrier and advance decarbonisation efforts.

07 Annexes

7.1. Timelines

Timeline	Definition
Short-term	Up to 2 years
Medium-term	3 – 10 years
Long-term	11+ years

7.2. Barrier's explanation

The following table provides general definitions for each identified barrier to decarbonisation to aid understanding; however, survey respondents were not provided with these definitions while answering the survey, and their responses were based on their interpretations of these terms.

Barrier	Explanation
High cost of low-carbon alternatives	The price of cleaner technologies and solutions is often higher than conventional options, making adoption costly.
Limited availability of technically suitable, low-carbon options	There may not be sufficient low-carbon solutions that meet the specific technical requirements of industries.
Difficulty shifting direct supplier relationships	Companies face challenges in switching to more sustainable suppliers due to contracts, costs, or supply reliability concerns.
Lack of control or influence over indirect suppliers	Organisations struggle to manage emissions from suppliers further down the supply chain (Tier 2, Tier 3, etc.).
Supplier granular emissions data unavailability	Difficulty in obtaining precise emissions data from suppliers hinders accurate carbon accounting.
Inconsistent emissions accounting methods across suppliers	Differences in how suppliers measure and report emissions create inconsistencies in data collection.
Complex global supply chains complicate tracking	The global and interconnected nature of supply chains makes tracking emissions across different regions and suppliers difficult.
Limited supplier decarbonisation capabilities	Suppliers lack the knowledge, resources, or infrastructure to reduce their emissions.
Long asset life cycles	Capital-intensive assets, such as industrial equipment, have long lifespans, delaying the transition to cleaner alternatives.
High upfront costs for greener assets	Although sustainable assets may have long-term benefits, their initial investment costs can be prohibitive.
Lack of standardised asset emissions data, e.g., LCAs	Inconsistent life-cycle assessments (LCAs) across industries hinder comparability and informed decision-making.

Barrier	Explanation
Lack of financing options for low-carbon capital goods	Limited availability of loans, incentives, or investment for decarbonisation projects slows adoption.
Dependency on fossil fuel suppliers	Some companies remain reliant on suppliers that predominantly use fossil fuels, making it hard to decarbonise.
High costs of carbon-free energy and fuels	Renewable energy and alternative fuels are often more expensive than fossil fuels.
Limited availability of carbon-free energy and fuels	Access to renewable electricity, hydrogen, or biofuels can be constrained by geography and infrastructure.
Lack of granular data on energy sources	Companies struggle to track and verify the energy mix used by suppliers or facilities.
Lack of visibility into transport emissions	Emissions from freight and logistics may not be fully tracked or reported, leading to underestimation.
High dependency on air and sea freight that has limited decarbonisation options	These transport modes have fewer viable low-carbon alternatives compared to road or rail.
Cost of switching to electric/ alternative fuel fleets	Transitioning company fleets to EVs or hydrogen vehicles requires substantial investment.
Lack of infrastructure for refueling and recharging stations for alternative fuel vehicles	The availability of charging stations and alternative fuel depots remains limited.
Limited availability of sustainable disposal methods	Proper recycling or disposal options for sustainable products are often insufficient.
Cost of implementing recycling/ circular technologies and methods in-house	Developing internal systems for circular economy practices can be expensive.
Limited market for recycled materials	Demand for recycled materials may be weak, limiting incentives for waste reduction.
Consumer packaging preferences	Customers' expectations for packaging, such as plastic durability, may conflict with sustainability goals.
Inadequate staff training on waste management	Employees may lack knowledge on best practices for waste reduction and recycling.
Supply chain fragmentation	Decentralised and complex supply networks make emission tracking and coordination difficult.
Employee preference for air travel	Staff often favor flights for business travel, which has a high-carbon footprint.
Limited low-carbon transport options	Companies and employees may lack access to sustainable commuting or logistics solutions.

Barrier	Explanation
Lack of remote working incentives	Organisations may not promote work-from-home policies, which could reduce commuting emissions.
Difficulty tracking and calculating commuting emissions	Gathering accurate data on employee travel habits is challenging.
Limited public transport infrastructure, including cycling and walking	Poor transit and non-motorized transport options make low-carbon commuting difficult.
Remote work resistance	Some employees or employers resist flexible working arrangements that could cut emissions.
Employee vehicle preferences	Staff may favour personal or company vehicles with high emissions instead of greener alternatives.
Lack of EV charging	Inadequate charging infrastructure at workplaces discourages electric vehicle adoption.
Difficulty monitoring granular tenant energy use	Landlords and businesses struggle to track energy consumption at a detailed level.
Misaligned incentives for decarbonisation	Incentive structures may not prioritise or reward emissions reductions.
Tenant energy use preferences	Tenants may choose energy sources based on cost rather than sustainability.
Building upgrade/efficiency cost limitations	Retrofitting buildings with energy-efficient technologies is expensive.
Lack of visibility into detailed processing emissions data	Companies struggle to track emissions at each stage of product processing.
Limited influence over downstream processors	Businesses have little control over emissions from their product processors.
Complex supply chain coordination	Managing emissions across multiple suppliers and regions is difficult.
High capital costs for processors	Upgrading processing facilities to low-carbon technologies is costly.
Limited availability of low-carbon technologies for industrial processes	Certain industries lack commercially viable clean alternatives.
Consumer resistance to green alternatives	Customers may not be willing to pay a premium or change behaviours for sustainable products.
Lack of visibility into use of sold products emissions	Tracking the emissions from product use phase is challenging.
Regulatory restrictions on product design	Compliance requirements may limit sustainable innovation in product design.
Unpredictable customer usage patterns/preferences	Variability in how consumers use products affects emissions estimates.

Barrier	Explanation
Uncertainty in product life cycle emissions data	Difficulty in assessing full emissions impact across a product's life.
High disposal costs for greener methods	Sustainable waste management can be expensive.
Tenant engagement challenges	Encouraging tenants to adopt sustainable practices can be difficult.
Split incentives between owners and lessees	Building owners may not invest in efficiency upgrades if tenants pay utility bills.
Lack of green lease standards	Standardised agreements to encourage sustainability in leased properties are lacking.
Complexity in emissions data collection	Gathering and verifying emissions data is resource intensive.
Franchisee reluctance to invest	Franchise businesses may resist investing in decarbonisation due to cost concerns.
Inconsistent sustainability standards	Differing frameworks across industries complicate compliance.
Limited control over franchise operations	Parent companies may struggle to enforce sustainability measures across franchises.
Fragmented carbon accounting for portfolios	Investors and companies face challenges in tracking emissions across diverse assets.
Lack of emissions disclosure by investees	Investors may not receive full emissions data from the companies they fund.
Risk-return concerns on green investments	Investors may perceive sustainable projects as financially risky.
Inconsistent ESG reporting standards	Variability in Environmental, Social, and Governance (ESG) reporting makes comparisons difficult.

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