In collaboration with
Boston Consulting Group

WORLD ECONOMIC FORUM

Net-Zero Challenge: The supply chain opportunity

INSIGHT REPORT

JANUARY 2021

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Five years after the adoption of the Paris Agreement, COVID-19 has reshaped the world and brought us to a crossroads. The health, social and economic consequences of this global pandemic on top of the increasingly urgent climate crisis have taken us to an inflection point. How we choose to respond to these crises will determine the pathway to our net-zero future. To succeed, the twin challenges of COVID-19 and climate change must be addressed together, with zero-carbon solutions ready to accelerate our recovery to a healthier, more resilient future.

In 2020, we saw a temporary drop in emissions as a result of COVID-19, at around 5–10% compared to 2019 – the largest since the Second World War. But to get on a long-term path to limit warming to 1.5°C, we need a structural transformation that achieves global emission reductions of this scale every year, not through crisis, but through a well-managed transition that protects livelihoods and builds a resilient, healthy, prosperous zero-carbon economy.

A chance to 'green the recovery'

The COVID-induced economic crisis gives the world a generation-defining window to bend the emissions curve and "build back better", creating decent zero-carbon jobs, driving innovation and growth, and strengthening resilience to systemic shocks. Failure to do so will result in stranded assets, dislocation and widening inequalities. Now is the time for governments to capitalize on the unique opportunity for stimulus packages to tackle COVID-19 recovery and climate change simultaneously.

The run-up to COP26, the 2021 United Nations Climate Change Conference, gives reason for renewed optimism. The UK and EU are both committed to achieving net-zero by 2050,[1] South Korea and Japan have recently committed to setting net-zero by 2050 targets, and China – the world's largest emitter – has committed to achieving net-zero emissions no later than 2060.[2] If the US were to deliver on President Biden's campaign promises, almost 75% of global GDP could have net-zero targets by early 2021.[3] Commitments by non-state actors are up as well. The number of net-zero pledges by subnational and corporate actors has roughly doubled in less than a year,[4] with more than 2,500 cities, states, regions, companies and investors now committed to credible targets to reach net-zero by 2050 at the latest.[5] The trend of investors supporting decarbonization has also held up, as the volume of green and sustainable bond issuance grew by another ~10% in 2020.[6]

Commitment to climate action is growing fast in all sectors of society. Now is the time to accelerate action and implementation.

Decarbonizing supply chains: the next level of corporate action

Last year's report on the Net-Zero Challenge[7] highlighted how much more individual actors – governments, corporations, investors and individuals – could do to bring down emissions, and many have heeded that call. This edition now puts a spotlight on a critical factor in achieving the targets they have set – decarbonizing supply chains.

Supply-chain decarbonization will be a "game changer" for the impact of corporate climate action. Addressing Scope 3 emissions is fundamental for companies to realize credible climate change commitments. It enables companies in customer-facing sectors to use their influence in supply chains to speed and support rapid decarbonization throughout the economy, and it can put pressure on suppliers in regions where governments do not (yet) do so. As 90% of the world's businesses are small and medium enterprises (SMEs), working with supply chains and connecting them with the appropriate tools – such as the recently launched SME Climate Hub[8] – is a vital part of the implementation of ambitious corporate climate action.

We call on all to act and join the Race to Zero, and hope that this report helps to provide guidance on how to move quickly on delivering on those goals.

"Climate change is the single greatest threat there has ever been to our planet and livelihoods. The World Economic Forum is dedicated to advancing action to decarbonize our economy and ensure a stable transition to a net-zero world.

At our Annual Meeting in January 2020, I invited all members to set a target to achieve net-zero greenhouse gas emissions by 2050 or sooner. This is our Net-Zero Challenge, spearheaded by our flagship climate action community, the Alliance of CEO Climate Leaders.

This report, co-authored with Boston Consulting Group, is the second in our series for the Net-Zero Challenge. It showcases the opportunity that all companies have for huge climate impact through action to decarbonize global supply chains.

Klaus Schwab, Founder and Executive Chairman, World Economic Forum

Executive summary

Addressing supply-chain emissions enables many customer-facing companies to impact a volume of emissions several times higher than they could if they were to focus on decarbonizing their own direct operations and power consumption alone – and achieving a net-zero supply chain is possible with very limited additional costs. This report shows how.

Among the major findings:

Many companies can multiply their climate impact by decarbonizing supply chains. For companies in most customer-facing sectors, end-to-end emissions are much higher than the direct emissions in their own operations (so-called Scope 1 and 2 emissions). By engaging suppliers to create a net-zero supply chain, companies can boost their climate impact, enable emission reduction in hard-to-abate sectors, and accelerate climate action in countries where it would otherwise not be high on the agenda.

Eight supply chains account for more than 50% of global emissions. Food, construction, fashion, fast-moving consumer goods, electronics, automotive, professional services and freight account for more than half of all global greenhouse gas emissions. A significant share is indirectly controlled by only a few companies.

Net-zero supply chains would hardly increase end-consumer costs. Around 40% of all emissions in these supply chains could be abated with readily available and affordable levers (<€10 [$12] per tonne of CO_2 equivalent),[9] such as circularity, efficiency and renewable power – with only marginal impact on product costs. Even with zero supply-chain emissions, end-consumer costs would go up by 1–4% at the most in the medium term.

But: decarbonizing supply chains is hard. Even leading companies struggle to get the data they need and to set clear targets and standards to which their suppliers must adhere. Engaging an often-fragmented supplier landscape is challenging – especially when emissions are "buried" deep in the supply chain, or when addressing them might require collective action at the industry level.

Our step-by-step guide shows nine major initiatives every company can undertake. Through interviews with several dozen global companies that lead the way in reducing supply-chain emissions, we have identified nine key actions: (1) build a comprehensive emissions baseline, gradually filled with actual supplier data; (2) set ambitious and holistic reduction targets, reducing emissions by (3) revisiting product design choices and (4) reconsidering (geographic) sourcing strategy; (5) set ambitious procurement standards and (6) work jointly with suppliers to co-fund abatement levers; (7) work together with peers to align sector targets that maximize impact and level the playing field; (8) use scale by driving up demand to lower the cost of green solutions; and – finally – (9) develop internal governance mechanisms that introduce emissions as a steering mechanism and align the incentives of decision-makers with emission targets.

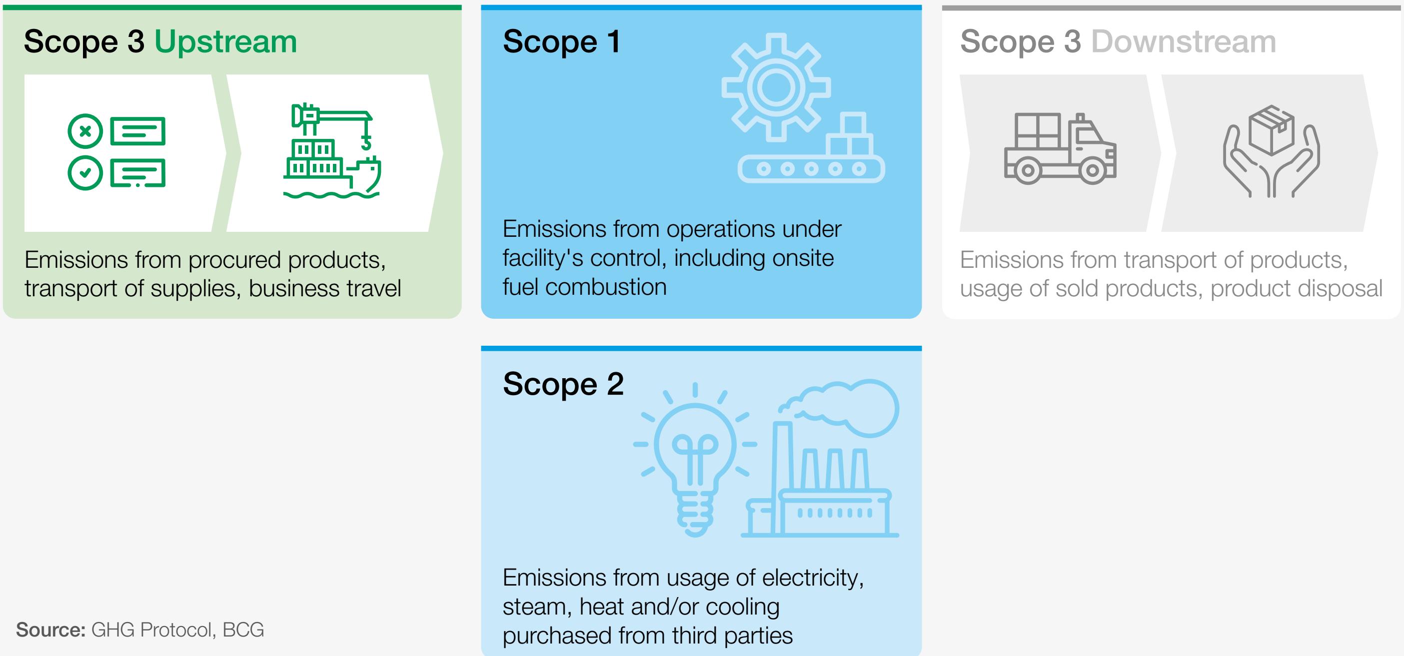
It is time to move.

FIGURE 1 | **Focus of this report**

Following the Greenhouse Gas Protocol Corporate Accounting and Reporting Standard, emissions are typically split into three scopes:[10]

- **Scope 1** covers the emissions from operations under a facility's control, including onsite fuel combustion.
- **Scope 2** covers the emissions from usage of electricity, steam, heat and/or cooling purchased from third parties.
- **Scope 3** covers upstream and downstream value-chain emissions. For the purpose of this report, we refer to Scope 3 upstream emissions as supply-chain emissions, covering procured products, transport of suppliers and business travel. For example, this covers emissions in the production of steel used in the car that an automotive original equipment manufacturer (OEM) produces. Scope 3 downstream emissions cover transport of products, usage of sold products and product disposal. For the same automotive OEM, this refers to the emissions from its cars being driven by customers.

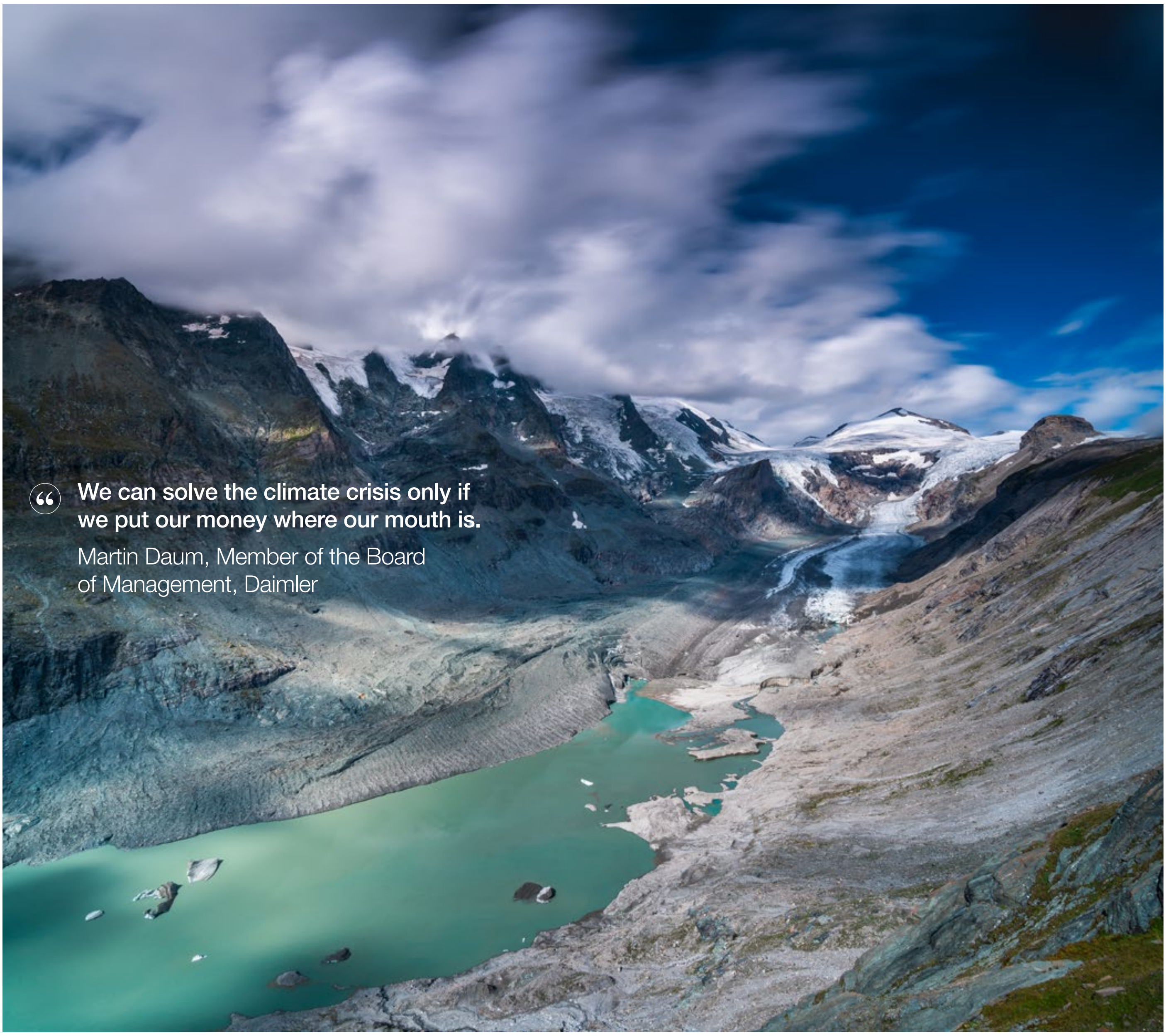
This report focuses on the supply-chain emissions that happen upstream from a company, often in the course of creating products or services that the company buys as well as on the Scope 1 and 2 emissions of the respective end consumer-facing companies – in the example above, this would cover the automotive OEM itself. The report does not address downstream emissions.



Source: GHG Protocol, BCG

1 A game changer for global climate action

Tackling supply-chain emissions offers companies the opportunity to multiply their climate impact several times over.



We can solve the climate crisis only if we put our money where our mouth is.

Martin Daum, Member of the Board of Management, Daimler

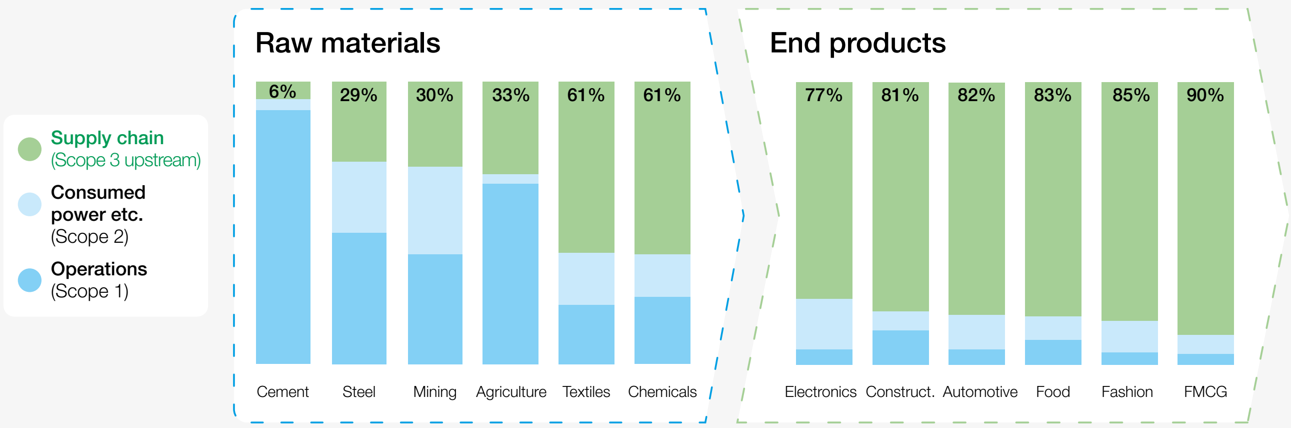
Taking an end-to-end perspective has come to dominate the debate, and more and more companies now disclose – and address – emissions across their whole supply chain.

Decarbonizing supply chains could be a game changer for global climate action with a potentially huge impact. Especially in customer-facing sectors where a company's direct emission footprint is relatively low, companies can address significantly larger emission volumes through their supply chains. For a consumer brand company such as Nestlé, only about 5% of its emission footprint is generated during direct operations (Scopes 1 and 2). Emissions generated by its suppliers are 10 times higher.[11]

The disparity is not limited to Nestlé. In many consumer-facing industries with long upstream value chains, Scope 1 (own operations) and Scope 2 (consumed power etc.) emissions, even when combined, fall far short of the emissions generated in the supply chain (see Figure 2).

FIGURE 2 **Emissions in supply chains often exceed operations**

Emission split in Scopes 1, 2 and 3 upstream for selected industries (CO_2e, 2019)



Note: Top companies selected based on number of reported Scope 3 upstream categories and industry fit; FMCG = fast-moving consumer goods
Source: CDP, BCG

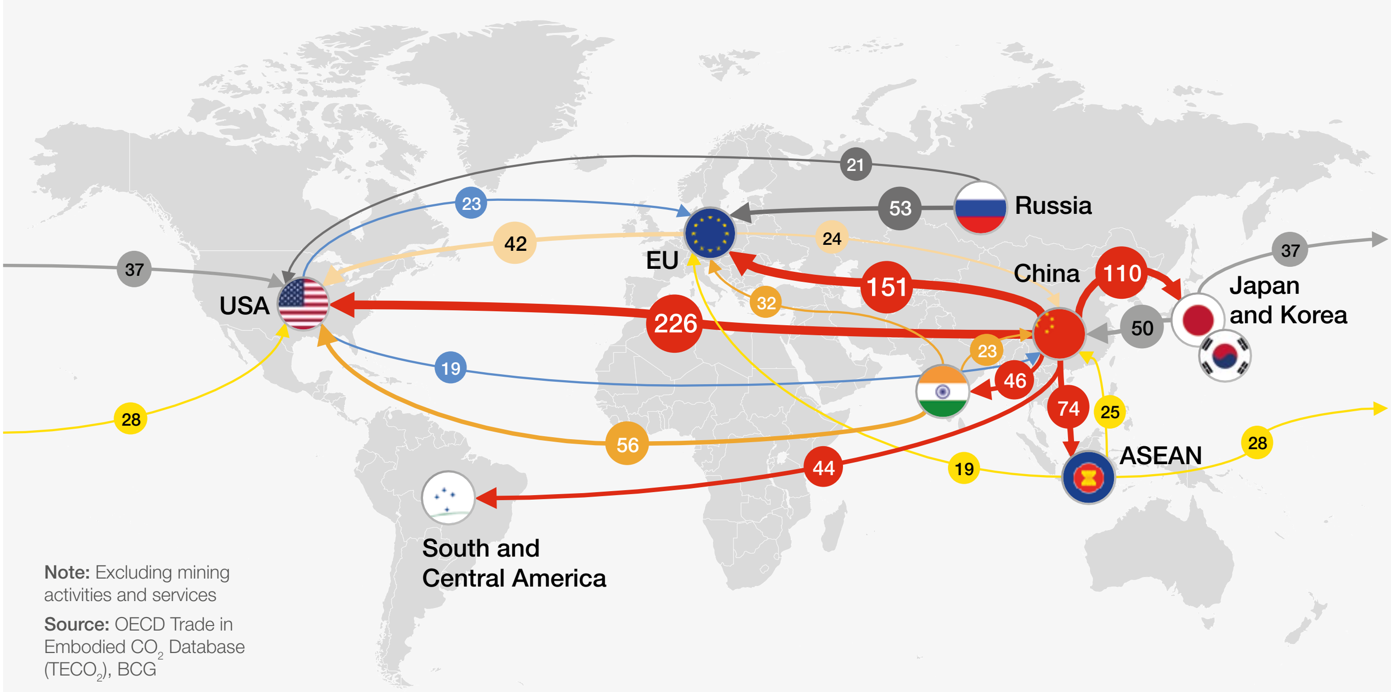
Because many supply chains are geographically dispersed, Scope 3 actions can have a favourable climate impact in countries where regulatory pressure is low. This is because of the degree to which business remains an international activity. Between 2015 and 2019 alone, global trade increased by 16%,[12] despite the neo-protectionist tendencies of some global actors. And, as trade in raw materials and finished products has become increasingly global, so has the reach of companies. Many engage with a complex international supplier base, giving them the opportunity to trigger emission reductions in countries with otherwise high carbon intensity and limited policy support.

An analysis of the major global trade flows shows that Western economies import significant volumes of emissions, especially from Asia (see Figure 3). This means that supply-chain measures put in place by relatively few end-consumer companies in Europe and the US can affect the emissions profile of growing Asian economies. Developments such as COVID-induced nearshoring efforts, the US/China trade war and the possible introduction of an EU carbon border tax could obviously change this regional spread in the future, but are unlikely to change the dynamic.[13]

> **Reducing the company's carbon footprint alone is not enough – enabling supply-chain emission reduction is a must-do.**
>
> Anirban Ghosh, Chief Sustainability Officer, Mahindra Group

> **We see the progression at CDP. At the beginning we mainly worked with sustainability functions. But over time this increasingly shifted out to procurement teams as well, thinking about the full supply chain.**
>
> Dexter Galvin, Global Director Corporations and Supply Chains, CDP

FIGURE 3 | Supply-chain action can address "imported emissions"

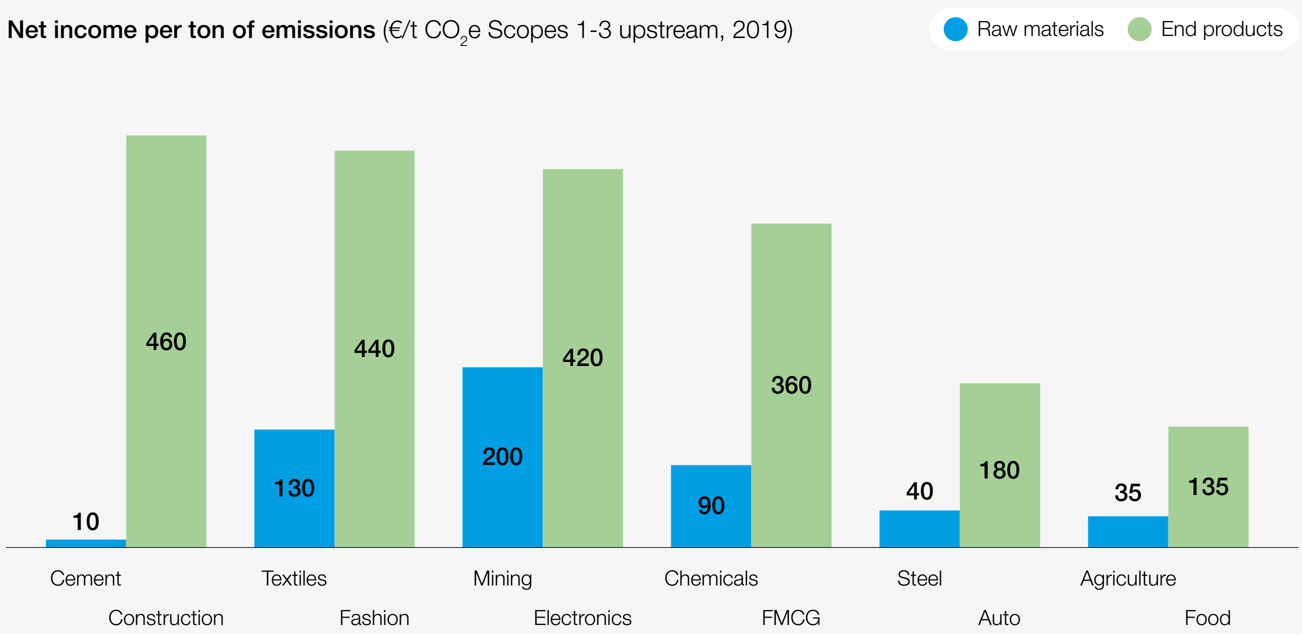


Note: Excluding mining activities and services

Source: OECD Trade in Embodied CO_2 Database ($TECO_2$), BCG

Finally, supply-chain measures can accelerate action in so-called hard-to-abate sectors. These sectors – including cement, steel, chemicals and heavy transport – generate low profits relative to the emissions they create and hence struggle to fund their relatively expensive decarbonization efforts. By contrast, consumer-facing companies are more profitable and can pass along decarbonization costs in increments felt much less by end customers (see Figure 4).

FIGURE 4 | Consumer-facing industries often have greater financial means

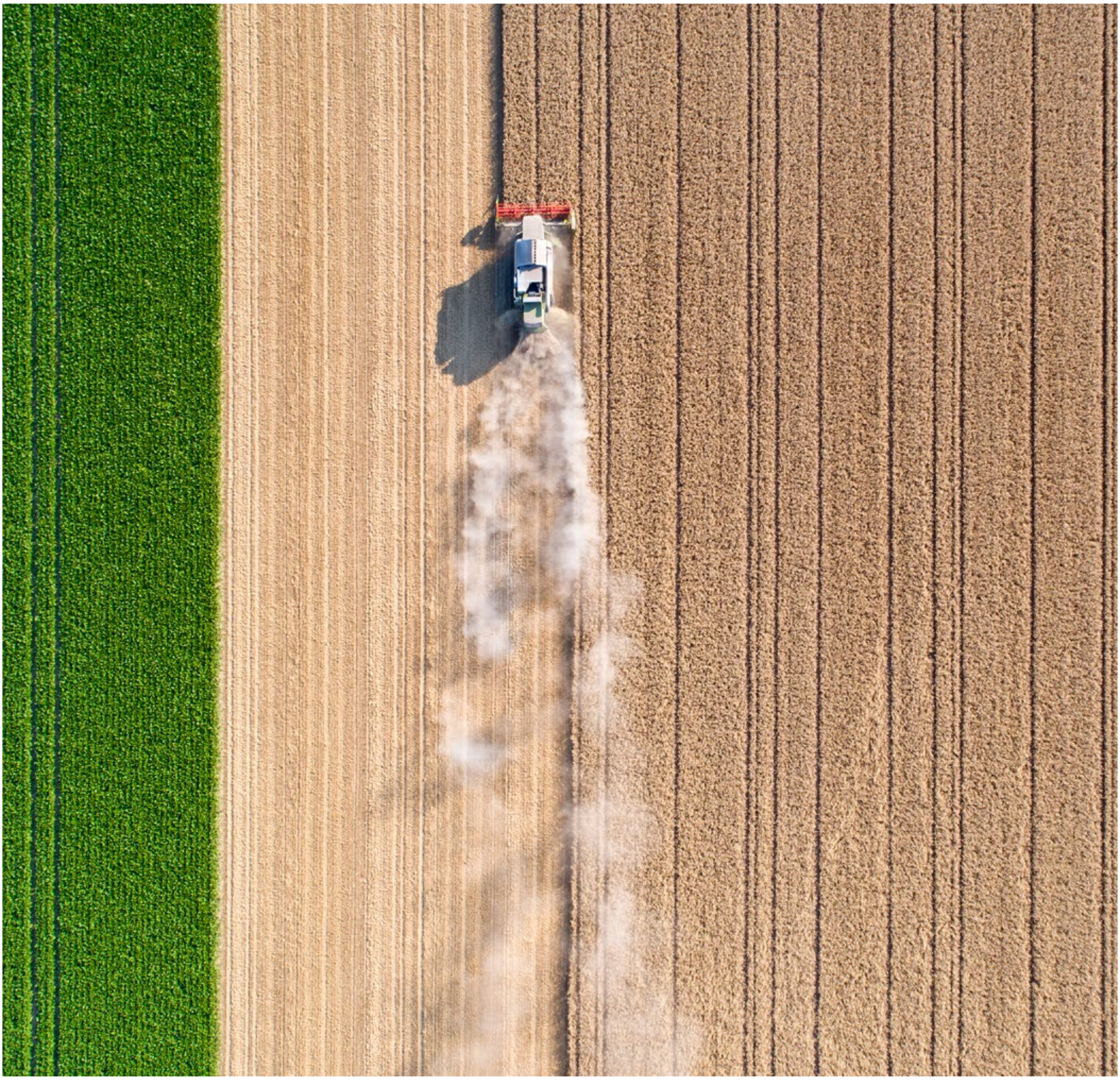


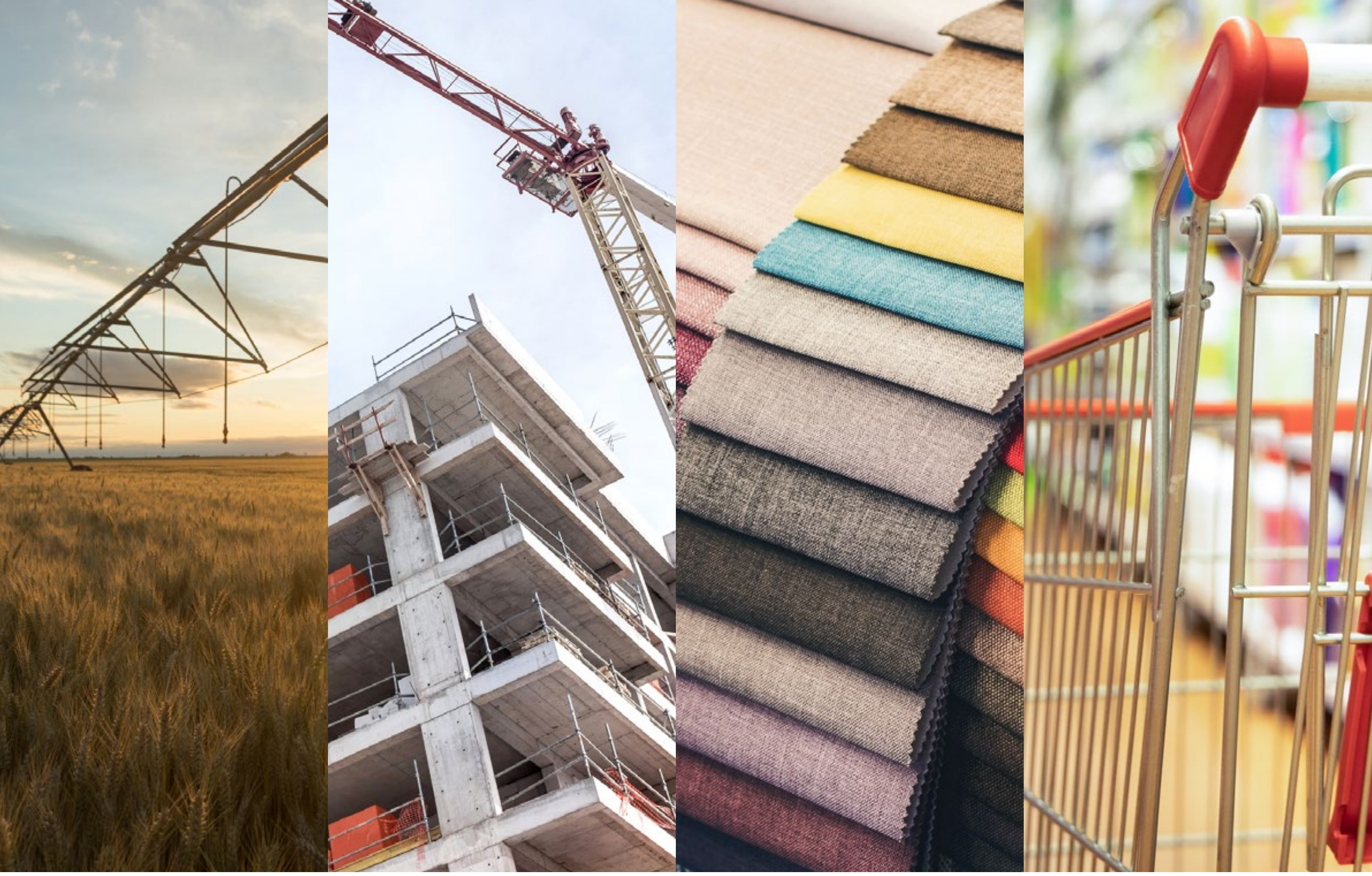
Note: Top companies selected based on number of reported Scope 3 upstream categories and industry fit; FMCG = fast-moving consumer goods

Source: CDP, BCG

2 The ‘big eight’

Across the eight major value chains that drive global emissions, solutions are already available to get us to net-zero.

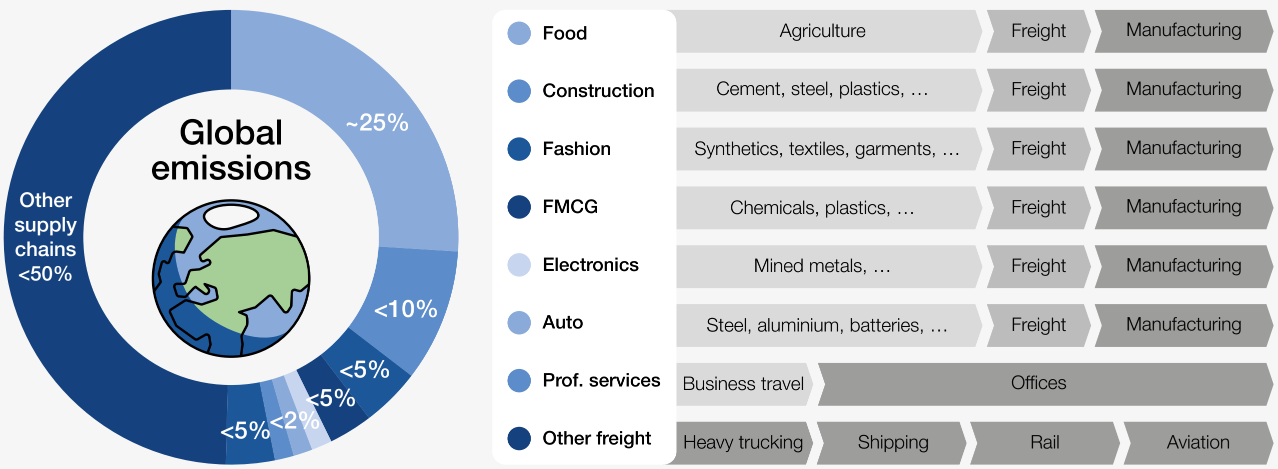




Eight supply chains – from raw materials to end-product manufacturing – account for more than half of all global greenhouse gas emissions. Food alone accounts for around a quarter – the most of any supply chain in the world. Construction has the next-biggest footprint, at 10% of global emissions, followed by fashion, fast-moving consumer goods (FMCG), electronics, automotive production, professional services, and freight (see Figure 5).[14] In automotive production in particular, the challenge will only grow over time. As car fleets electrify to address the sector's even larger downstream emissions, energy-intensive battery manufacturing could escalate the carbon footprint upstream.[15]

FIGURE 5

Eight supply chains are responsible for more than 50% of global emissions

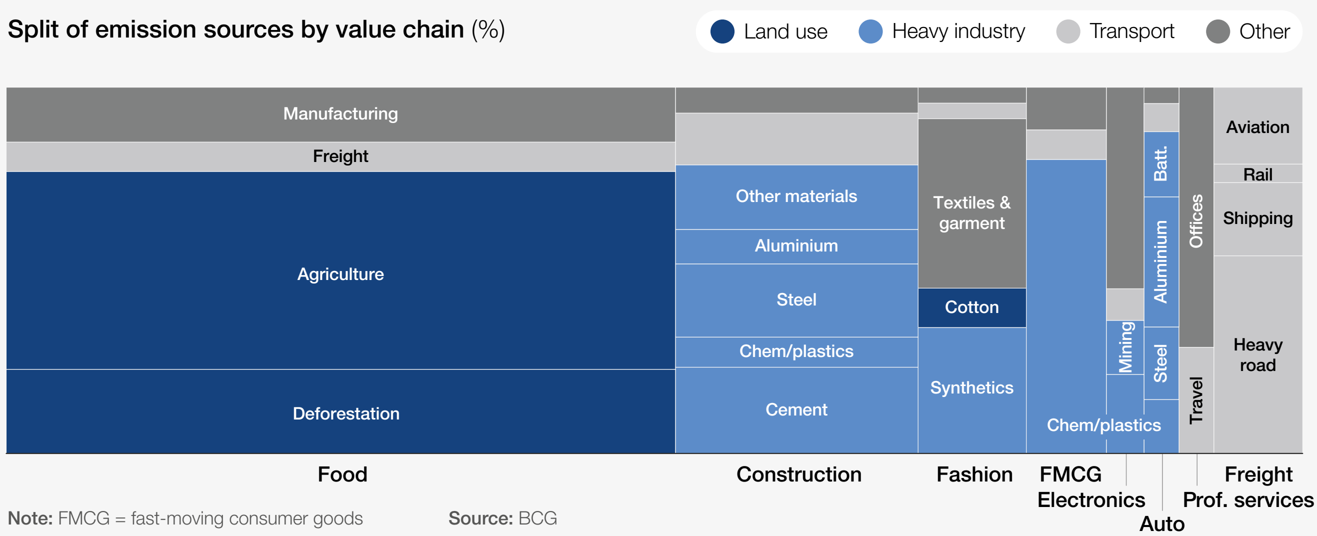


Note: Only selected value chain steps are shown here; value chain steps not shown at scale; FMCG = fast-moving consumer goods

Source: BCG

Raw material inputs from land use and heavy industries (including agriculture in the food supply chain, cement in construction, plastics in FMCG, and metals in automotive production) drive the majority of emissions. Operational manufacturing and freight are smaller in comparison (see Figure 6). This is driven by several factors. The first is the sheer energy intensity of widely used input materials such as steel, other metals, cement and plastics, all of which typically require substantial amounts of high-temperature heat. Secondly, many intermediary industries (fashion and electronics, in particular) are located in areas with a very high-emission energy mix, tilted more towards lignite, hard coal and oil than towards renewables or natural gas. The third factor applies primarily to agriculture and is an intrinsic part of the output product. Livestock grazing and other forms of cultivation are responsible for significant emissions of methane and nitrous oxide, both powerful greenhouse gases.

FIGURE 6 **Land use and heavy industries drive most emissions**



Note: FMCG = fast-moving consumer goods

Source: BCG

How can these supply chains move to net-zero? Decarbonizing each will require a different combination of eight major abatement levers – listed here in ascending order of average cost (see Figure 7):

- **Circularity/recycling:** increasing the share of recycled materials.

- **Material and process efficiency:** lowering the amount of waste and/or improving efficiency in the production process to reduce power and/or heat consumption. This can be done by using the newest available process and heat technologies (such as motors, drives, pumps or ovens), more efficient process steering, by using waste heat from other processes, or reducing material waste in production.

- **Renewable power:** switching to renewable energy for power. This is achievable through self-generation of wind and solar power or bioenergy, or through renewable power procurement with (virtual) power-purchase agreements (PPAs) or certificates.

- **Renewable heat:** replacing coal, gas and oil in industrial heat and steam generation. Alternative sources include biomass, large-scale heat pumps, power-to-heat and solar thermal for low-temperature heat, and biogas or hydrogen for high-temperature heat applications.

- **New processes:** introducing and/or switching to new (production) processes. An example is switching from blast furnaces to electric arc furnaces using direct reduced iron for steel production. Another example is moving to green hydrogen-based fertilizer production.

- **Nature-based solutions:** increasing the use of sustainable agricultural practices (such as more precise fertilization, reducing tilling, planting cover crops and using nitrification inhibitors), moving to deforestation-free agriculture and implementing carbon-removal levers for emissions that cannot be avoided otherwise (such as reforestation, restoration of mangroves and peatland, soil sequestration and biochar production).

- **Fuel switch:** converting any remaining combustion processes to greener solutions (such as battery-electric or hydrogen-powered trucks) or green fuels (such as biofuels and e-kerosene in aviation or green ammonia in shipping).

- **Carbon capture, utilization and storage (CCUS):** capture unavoidable carbon emissions from processes and/or combustion, for example, in cement carbonization.

FIGURE 7 **Eight levers to abate supply-chain emissions**

		Average costs	Maturity
Circularity/recycling	Less virgin material production	< €10/t CO_2e	
Material and process efficiency	Less material usage and energy consumption	< €10/t CO_2e	
Renewable power	Power from renewable sources (e.g. solar, wind)	< €10/t CO_2e	
Renewable heat	Heat from renewable sources (e.g. biomass, power)	€10–100/t CO_2e	
New processes	New production processes (e.g. H_2-DRI for steel)	€10–100/t CO_2e	
Nature-based solutions	Avoiding deforestation, more sustainable agriculture	€10–100/t CO_2e	
Fuel switch	Transport: switch to green fuels, batteries, hydrogen	> €100/t CO_2e	
Carbon capture	Capture carbon and recycle or store it underground	> €100/t CO_2e	

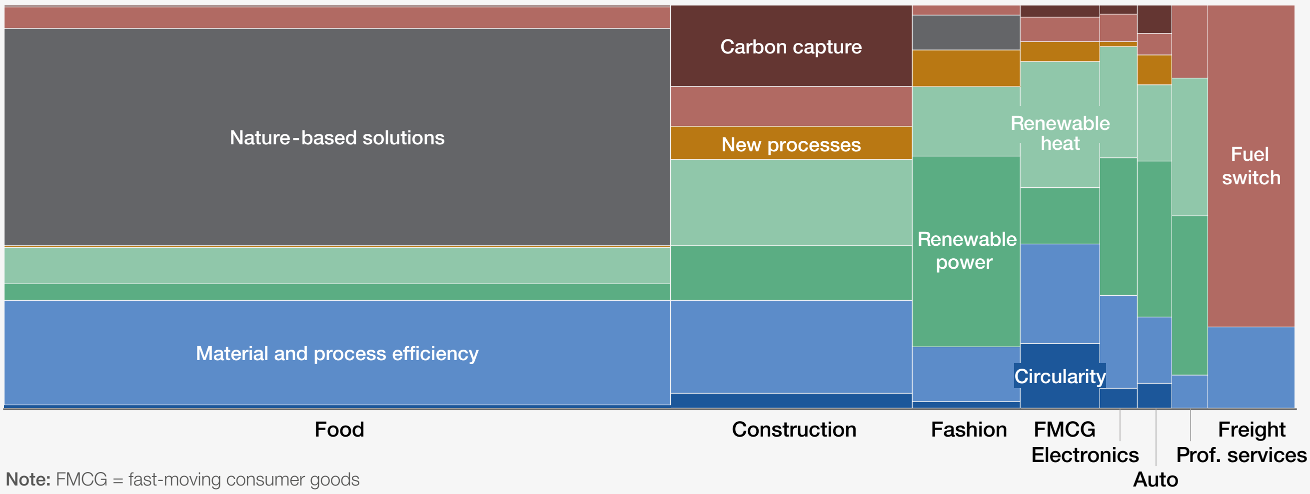
Ready in 5–10 years
Ready today

Source: BCG

Many of these levers are readily available today – with very affordable or even positive economics. Increasing material and process efficiency often results in cost savings with comparably short payback times, even in jurisdictions that do not levy a price on carbon. Renewable power usually comes with a small surcharge, but the difference is narrowing given the significant cost improvements in recent years. Only the full decarbonization of heavy industry and freight through low-carbon heat, new processes, carbon capture and green fuels still implies high costs and the implementation of technologies not yet available at scale (see Figure 8 and Appendix for more details).[16]

FIGURE 8 **The impact of levers varies strongly across supply chains**

Share of abatement lever potential by value chain (%)

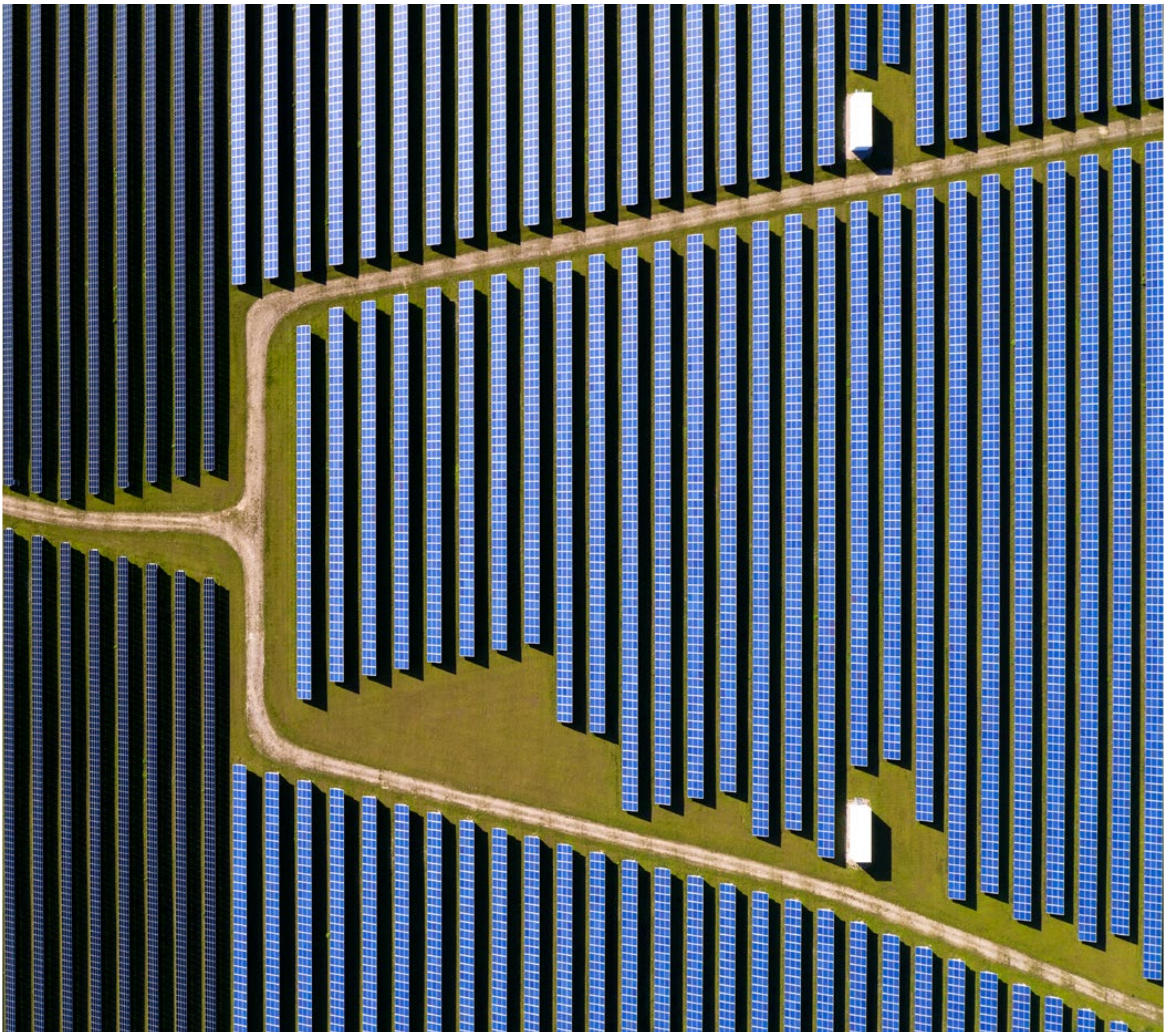


Note: FMCG = fast-moving consumer goods

Source: BCG

3 Encouraging economics

The costs of deep decarbonization across supply chains are surprisingly low and result in an increase of only 1-4% on end-consumer prices.



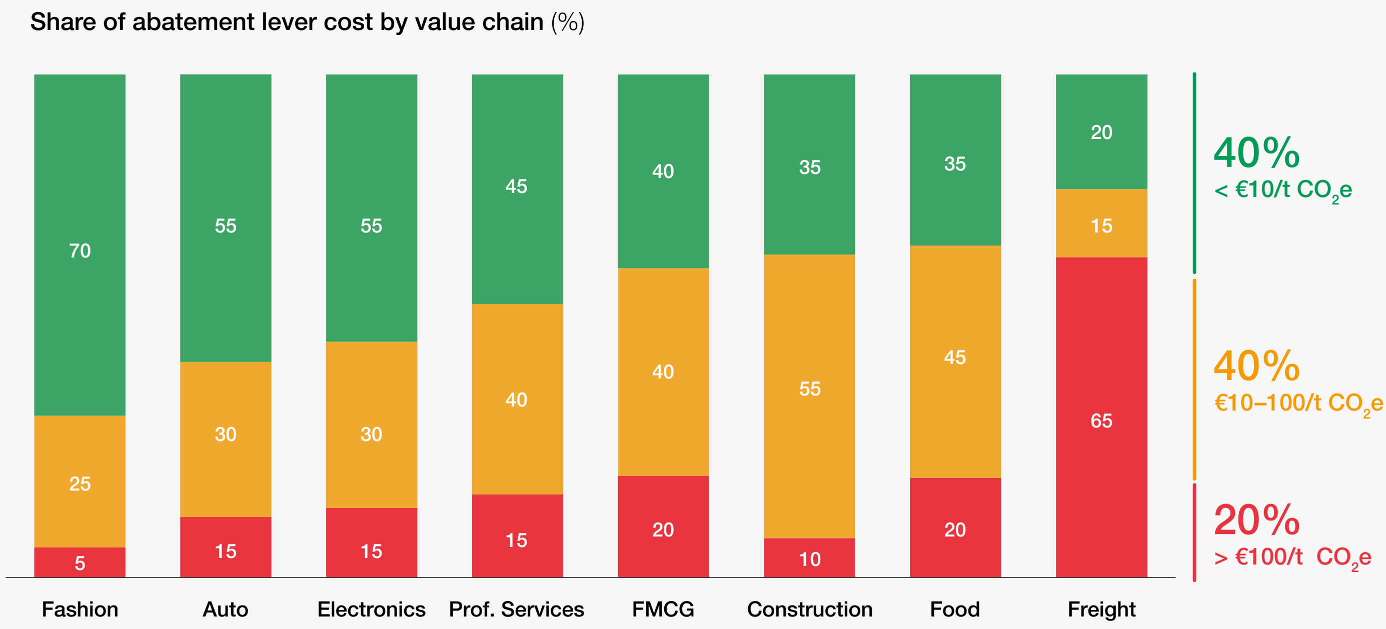
Along with insufficient regulation, costs are often cited as a major reason why companies do not bring down their emissions. This argument is increasingly flawed. Around two-fifths of all emissions in the analysed supply chains could be abated with readily available and affordable levers such as circularity, efficiency and renewable power. And even net-zero supply-chain emissions are achievable with very limited impact on product costs in the medium term.

A significant share of emissions can be eliminated at little to no cost

Many of the abatement technologies described above are not only readily available, but already highly affordable (see the Methodology section for more details). Across the analysed supply chains, ~40% of all emissions could be eliminated with measures that either yield savings (for example, by implementing efficiency measures) or come at abatement costs below €10 per tonne of CO_2e (for example, switching to renewable power) – see Figure 9. Material and process efficiency improvement levers have especially fast payback periods, often within three to five years.

It should be noted that the costs for renewable generation refer to the corporate perspective. Once entire supply chains and systems move to 100% renewable power, there would likely be additional costs from grid infrastructure and renewable backup capacity investments required to support the system.

FIGURE 9 **~40% of emissions can be abated at very low costs**



Note: FMCG = fast-moving consumer goods
Source: BCG

> **At Dalmia Cement, we follow the business philosophy of "clean and green is profitable and sustainable". One of the objectives of our carbon-negative roadmap is to prove that the cost of inaction will be much higher than the cost of deep decarbonization.**
>
> Mahendra Singhi, Managing Director and Chief Executive Officer, Dalmia Cement

> **There are many things you can do with paybacks of only ~3 years – we are now looking at what else is possible with a longer payback horizon, and that offers even more potential.**
>
> Yashovardhan Lohia, Chief Sustainability Officer, Indorama Ventures

Another ~40% of emissions would cost between €10 and €100 per tonne of CO_2e to abate. Today, this includes most low-temperature renewable heat technologies (such as biomass, heat pumps, power-to-heat and biogas in some countries). By the second half of this decade, the same abatement cost will apply to battery- or hydrogen-based road logistics, as well as carbon capture, utilization and storage (CCUS) in a few processes with high flue gas concentration. While it is likely that costs in these applications will decline with increasing adoption, it is unlikely they will ever be economic. In ambitious regions such as the EU, measures in this cost bracket might be covered by medium-term carbon price levels.[17] In other regions, the measures would require willingness from downstream players to bear some of the cost.

Full decarbonization requires very costly measures

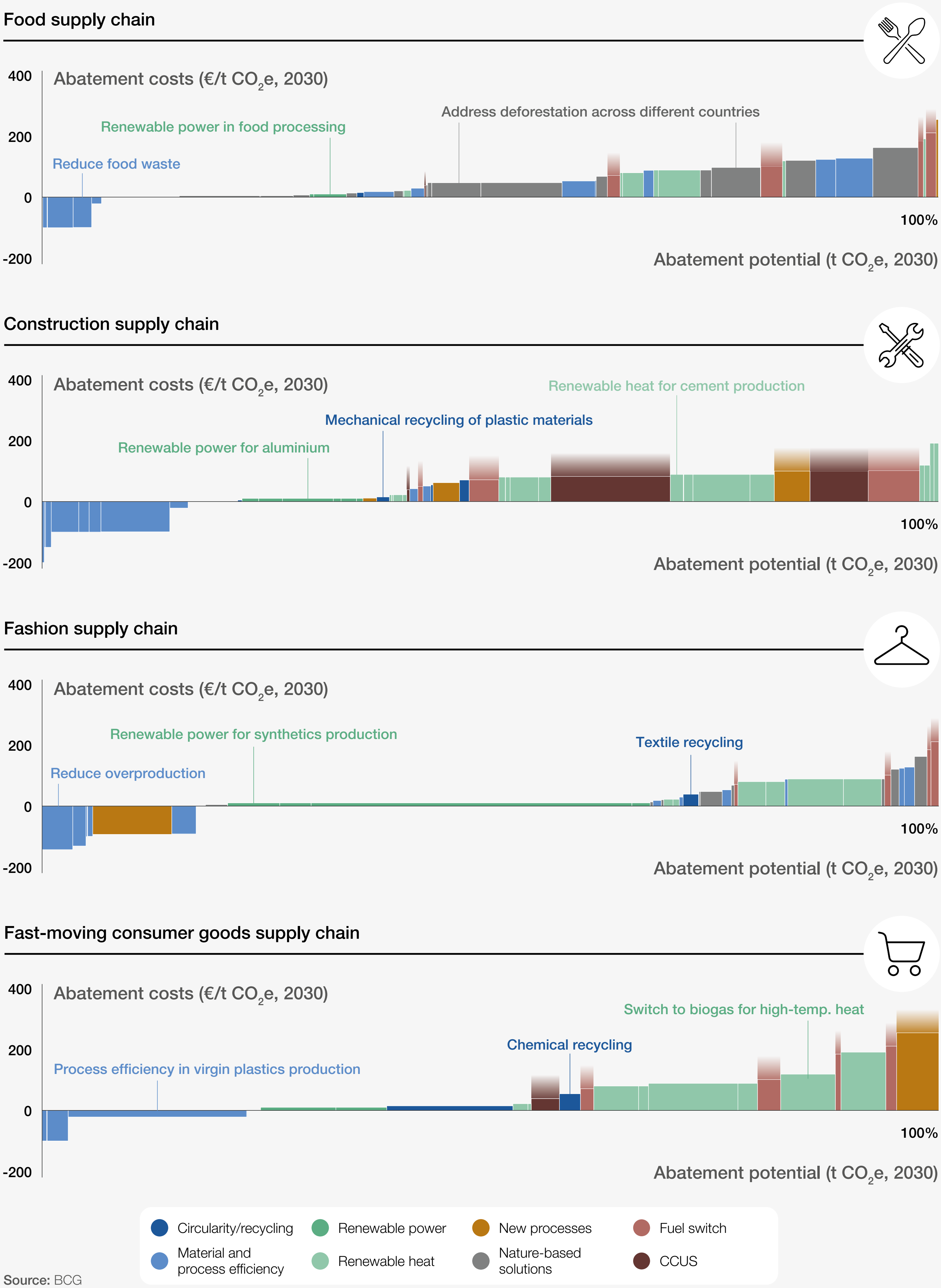
In most sectors, full decarbonization would require implementing even costlier measures. Especially in hard-to-abate industry and transport sectors, moving to net-zero emissions will require the use of technologies that are not yet mature and are therefore very expensive. This includes the use of green hydrogen for the production of zero-carbon steel and green fertilizer, renewable high-temperature heat in process industries such as chemicals and cement, and green fuels for aviation and shipping. Costs may come down once these technologies achieve scale (as a comparison, the cost of solar photovoltaics has declined by around 80% in the past 10 years).[18] But it is prudent to assume they will remain comparatively expensive.

For more details of the abatement levers and associated costs across each of the major supply chains, see Figure 10 and the Appendix.

“ At first glance, it’s often hard to understand which decarbonization levers are economically viable – both new market mechanisms and technologies need to be developed across many industries and geographies to support a low-carbon economy.

Jörg Unger, Senior Vice-President Corporate Technology, BASF

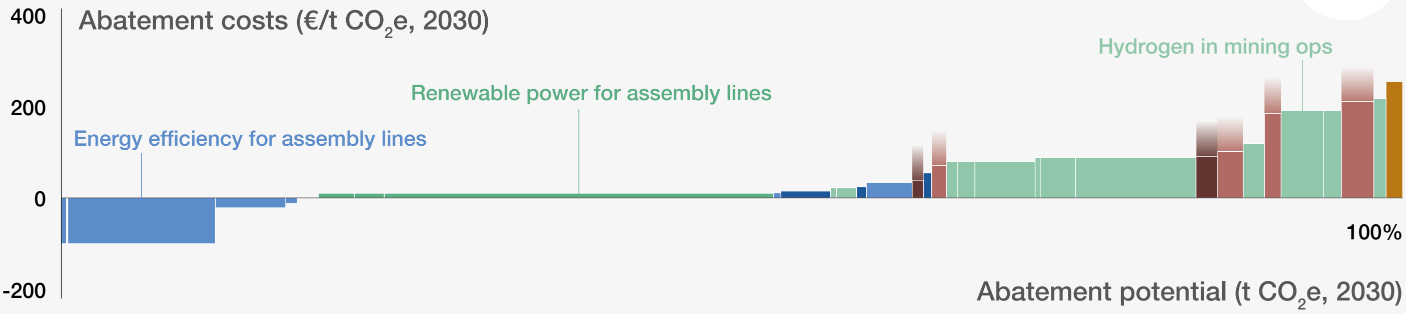
FIGURE 10 | Abatement cost curves for each sector



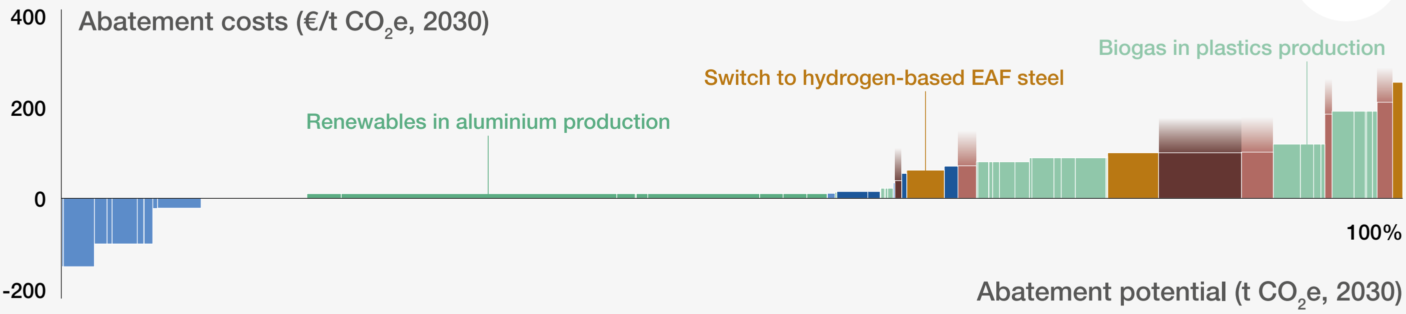
Source: BCG

FIGURE 10 | **Continued**

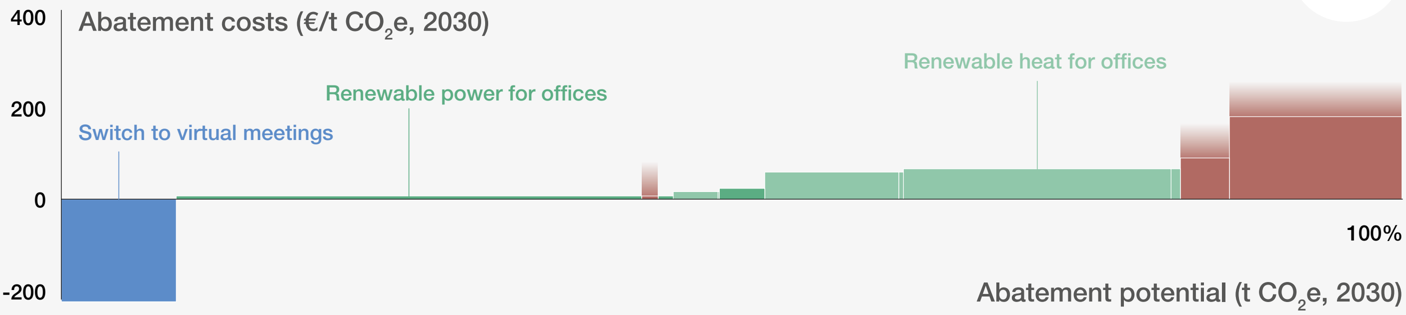
Electronics supply chain



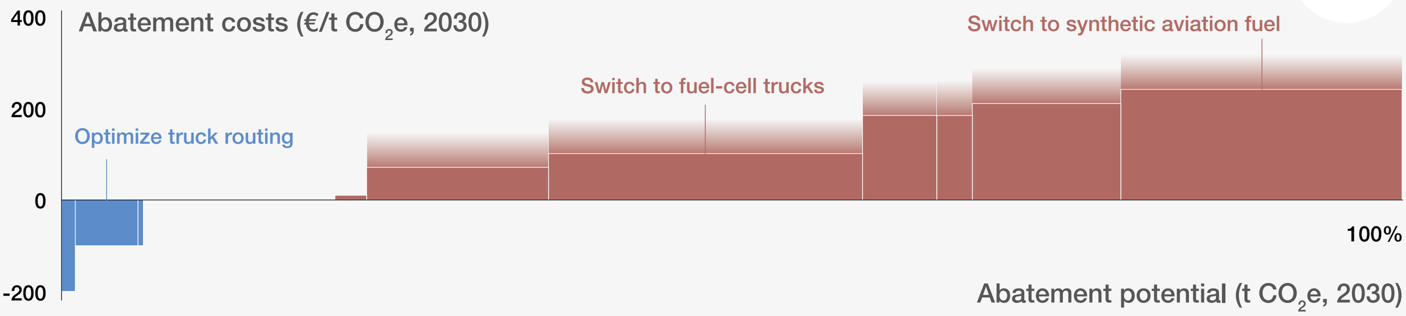
Automotive supply chain



Professional services supply chain



Freight supply chain



- Circularity/recycling
- Material and process efficiency
- Renewable power
- Renewable heat
- New processes
- Nature-based solutions
- Fuel switch
- CCUS

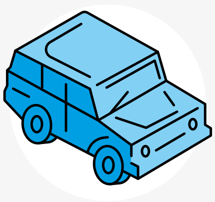
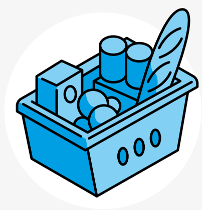
Source: BCG

Costs for end consumers are very limited

Companies willing to invest in these costly measures are in reality risking little in terms of impact on end-consumer prices. Raw materials represent only a small share of final product prices – about 20% of a car and no more than 10–20% of a pair of trainers. Even with ambitious upstream reduction targets, the impact on end price is relatively low – no more than 1–4% in the medium term if zero supply-chain emissions is the goal (see Figure 11). Decarbonization costs may appear high for some producing industries, but they are relatively affordable for end consumers.

How can this be? An example helps illustrate the maths. Consider the steel used in a medium-sized (€30k) family car – besides aluminium, the biggest current contributor to its upstream emissions. Bringing down emissions in steel production is expensive and moving to zero-carbon steel would increase production costs significantly. But as steel accounts for less than €1k equivalent of the car's final sales price, the mark-up this triggers would still account for less than 1% of the total cost.

FIGURE 11 **Zero upstream emissions possible at low consumer costs in the medium term**

Automotive	Fashion	Food	Construction	Electronics
				
€500	€1	€1	€5k	€3
<2% avg. cost increase on a €30k car	<2% avg. cost increase on a €40 pair of jeans	<4% avg. cost increase on a €20 shopping basket	<3% avg. cost increase on a €150k home	<1% avg. cost increase on a €400 personal device

Source: BCG

Companies have an upside

Given these low costs, supply-chain decarbonization actually offers companies an upside. Especially in Western countries, survey-based studies indicate that more than 50% of consumers are willing to pay more for sustainable products.[19] Point-of-sale studies of different consumer goods products indicate that in some customer segments, sustainable products sell well even with premiums of around 40% – far from what would be required to achieve zero-emission supply chains.What's more, this segment is growing fast. Demand for sustainably marketed products grew around seven times faster than the demand for their conventionally marketed counterparts over the past five years.[20]

> **We need to educate consumers that buying a green product is often an option they have, that the extra price is often comparatively small, but the extra impact they have with this responsible choice is significant.**
>
> Stefan Doboczky, Chief Executive Officer, Lenzing

> **We have witnessed a growing demand from customers who are willing to spend more on products with less carbon intensity to reach their own low-carbon goals.**
>
> Hak-Cheol Shin, Chief Executive Officer, LG Chem

4

Overcoming barriers

Taking action is hard – companies lack transparency and broader industry and government support, but these hurdles can be overcome.

Why is supply-chain decarbonization not already being done?

A variety of factors have prevented companies from trying to reduce emissions in their supply chains (see Figure 12). One common problem is that many companies still have limited transparency about these emissions in the first place – and the mechanisms for establishing greater transparency at the supplier level are still immature. This lack of transparency means the economics of decarbonization are obscured, leading to the perception that optimizing for sustainability may interfere with the goals of increasing performance or lowering costs.

More importantly, implementing decarbonization levers is really very challenging. At many companies, emissions are distributed widely across countries and tier n suppliers (including suppliers and suppliers of suppliers). Such complexity makes it challenging to get to net-zero emissions – especially given the scant attention paid, so far, to Scope 3 emissions from industry ecosystems and regulators.

FIGURE 12 **Addressing upstream emissions is hard, with several barriers**

Source: Interviews with 40 climate-leading CEOs and their teams and experts in Q3+4 2020, BCG

Transparency is still insufficient

Few companies disclose their Scope 3 emissions. Those that do often need to develop estimates based on information such as weight, quantity and spend for procured materials, as well as emission factor databases based on country averages. For companies with sometimes tens of thousands of individual products and significant turnover in their supplier bases, the challenges are daunting. Some even struggle to understand who their tier n suppliers are in the first place, especially when looking beyond their tier 1 suppliers.

Even knowing who the suppliers are does not guarantee reliable data. Despite the sophisticated digital procurement and enterprise resource planning tools used in the market, a fully functional and widely accepted infrastructure for sharing environmental data is still only at the development stage. As a result, data interfaces with suppliers are still generally manual and unreliable.

Finally, there are many ways for peers to look at their Scope 3 emissions. Some companies consider "cradle-to-gate", that is, from the very beginning of the supply chain until just after production, while others report "cradle-to-point-of-sale". Still others are "cradle-to-grave" in their analysis, meaning they include emissions in customer use and end-of-life emissions from landfill or recycling.[21]

The lack of transparency upstream feeds into a lack of trustworthy certifications or standards by which to assess and communicate sustainability efforts to customers. This makes peer comparisons harder and leaves consumers confused instead of helping them make (more) sustainable product choices.

We really need a good answer on what should be considered within our Scope 3 definition – we need to focus on what business can realistically influence.

María Mendiluce, Chief Executive Officer, We Mean Business

Without labelling standards, we will have an increase in misleading sustainability marketing, which will create mistrust and cheapen genuine efforts to do right by the planet.

Rob Cameron, Head of Global Public Affairs and Sustainability, Nestlé

Decarbonizing supply chains is challenging

For many companies, supply-chain emissions are distributed across hundreds or even thousands of individual tier n suppliers in many different countries around the globe. They are also not static, as parts of the supplier base can change year-on-year. This makes addressing supply-chain emissions an extremely difficult task.

There are also organizational problems that make monitoring and tracking upstream emissions difficult. Procurement teams may be unaware of low-carbon alternatives when they make purchasing decisions. It is difficult to manage procurement criteria without a clear hierarchy or internal alignment, and the incentive structures in procurement teams are not geared to sustainability today. In some cases, bringing down emissions requires intense, long-term engagements with individual suppliers. Not all procurement organizations are set up for this.

One of our big challenges is how to get a view on the hundreds of thousands of farmers in our supply chains, but we see that as an opportunity for more and more direct farmer engagement.

Greg Downing, Sustainability Director, Climate, Cargill

You have to remember that in fashion, there can be thousands of small family-run garment businesses, spread across the value chains, that are supplying brands.

Laila Petrie, Chief Executive Officer of 2050, and Joint Chair, UNFCCC Fashion Industry Charter for Climate Action

Even where companies do manage to engage most of their important suppliers, triggering action can be challenging. Suppliers may not be aware of the available levers. Even if they are, they may be anxious about potential costs and the scale of investment required. For margin-challenged heavy industry players, investing in deep decarbonization without long-term offtake guarantees can be a significant investment and technology risk. In agriculture, farmers may need to invest upfront and "rest" the land, with short-term hits to yields, before they can manage their processes more sustainably. Without reassurance from the market that customers will pay more for their produce, or that they will be paid for the carbon they sequester, this can be daunting and lead to inaction.

Companies often struggle with a clear mandate for the sustainability function to engage with procurement on supply-chain emissions – they are most often still focused on their direct operational footprint rather than taking a supply chain lens.

Cynthia Cummis, Director, Private Sector Climate Mitigation, World Resources Institute, and Steering Committee Member, Science Based Targets initiative

It takes five years to see an impact with a change in the way land is managed. You cannot expect a farmer to take that risk alone, without knowing that she or he will be compensated for it.

Alexandra Brand, Chief Sustainability Officer, Syngenta

Support from industry ecosystems and regulators is limited so far

Where the costs of decarbonization are high and enabling infrastructure is needed (e.g. for low-carbon transportation), actors within a single supply-chain relationship may not be able to fund the full transition. If one automotive player supports a steelmaker to decarbonize its processes, all other car makers would benefit from access to that greener steel without funding the required process change. It is understandable that a company would not want to bear the full cost of an investment that would benefit its rivals – and this risk has kept some Scope 3 initiatives from launching. Ecosystem initiatives are trying to overcome this inertia in many sectors, but few have had a significant impact on emissions to date.

Companies also often cite a lack of government policy support or sector-level targets from industry bodies as inhibitors. Both of these can make the hurdle for first movers unnecessarily steep.

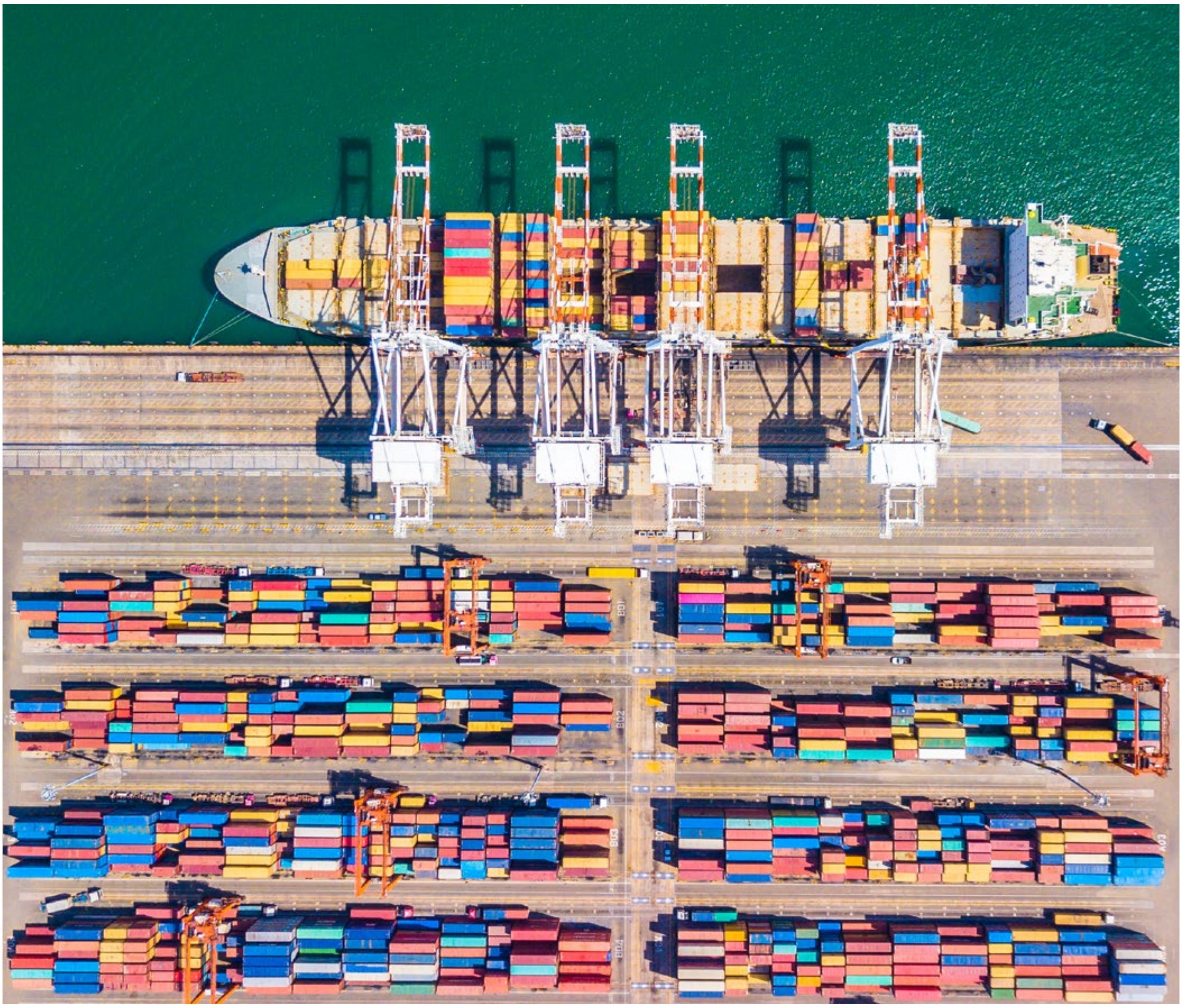
We need to have the infrastructure set up that enables low-carbon transport – we must work with our ecosystem to jointly make change in greener freight happen.

Henrik Henriksson, President and Chief Executive Officer, Scania

5

Decarbonizing supply chains: a corporate guide

Climate leaders can take nine steps to tackle supply-chain emissions.



Fortunately, many of the obstacles can be overcome. Nine initiatives can enable companies to tackle emissions in their supply chains (see Figure 13).

FIGURE 13 **Nine supply-chain initiatives chief executive officers should push for**

Create transparency

1. Build value chain emissions baseline and exchange data with suppliers
2. Set ambitious reduction target on Scopes 1–3 and publicly report progress

Optimize for CO_2

3. Redesign products for sustainability
4. Design value chain/ sourcing strategy for sustainability

Engage suppliers

5. Integrate emissions metrics in procurement standards and track performance
6. Work with suppliers to address their emissions

Push ecosystems

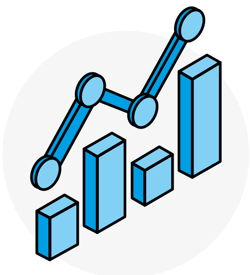
7. Engage in sector initiatives for best practices, certification, advocacy…
8. Scale-up "buying groups" to amplify demand-side commitments

Enable your organization

9. Introduce a low-carbon governance to align internal incentives and empower your organization

Source: Interviews with 40 climate-leading CEOs and their teams and experts in Q3+4 2020, BCG

5.1 Create transparency



Action 1: Build a value-chain emissions baseline and exchange data with suppliers

Establishing a comprehensive emissions baseline is crucial. Supply-chain emissions can be calculated with different levels of granularity. More granular data should be used for tier 1 suppliers, and for products, components or commodities that contribute the most emissions.

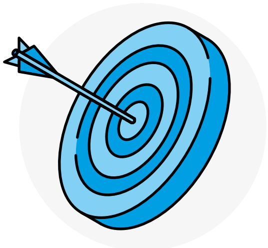
As an initial step, companies can match their procurement spending to global emission factors databases. There are several software solutions and databases available that offer a quick match of procurement data to environmentally extended input-output factors, building a high-level view on the overall supply-chain footprint. In a second step, accuracy can be improved through using a volume-based approach or by using a regional view – segmenting suppliers by location, and making specific estimates based on the regions in which suppliers operate.

For the most accurate level of transparency, climate leaders can tailor their estimates through the use of full life-cycle analyses of key products and by developing supplier-specific assumptions (at least for their "emission hotspots"). These assumptions typically cover adjustments for differences in energy mix across facilities, different material emissions by process steps and/or different volumes of waste production per site. A dataset this specific often needs to be provided by the suppliers themselves. Carlsberg, for example, combines direct supplier data with region-specific estimates to create a detailed view of its Scope 3 emissions.[22]

An effective technique is to exchange data with suppliers directly, building a specific view of the top suppliers that account for the majority of spend. Dow, Siemens, Arçelik and others are currently setting up a life-cycle emission data-sharing pilot for a washing machine along the entire supply chain ("cradle-to-gate") under the umbrella of the World Economic Forum. Daimler is piloting a blockchain system to capture material information throughout the supply chain, including the share of recycled materials, emissions and other information.[23]

> **For the data to be meaningful it needs to be on project-level – we need to be able to make decisions based on it.**
>
> José Luis Blasco, Global Sustainability Director, Acciona

> **It is not enough to use generic sources of data – it is not detailed enough to act upon. We developed a more granular baseline and understood SKU [stock-keeping units]-level information about energy mix, share of recycled content etc. This allows us to have discussions with management teams across the Group to identify specific local reduction initiatives.**
>
> Simon Boas Hoffmeyer, Senior Director Sustainability, Carlsberg Group



Action 2: Set ambitious reduction target on Scopes 1–3 and publicly report progress

Once they have transparency on their supply-chain emissions, companies should set a public 1.5°C-aligned target and/or net-zero target across all emissions scopes and understand what this means for their business. In most cases, targets are achievable at very little cost. Where no widely accepted target pathways exist (e.g. where the Science Based Targets Initiative [SBTi] has not yet confirmed a sector pathway), companies should aim to develop pathways with others in their sector.

Several financial institutions have done this by joining the SBTi expert advisory group, the Net-Zero Asset Owners Alliance and/or the 2° Investing Initiative (2DII).[24]

Companies should also actively cascade their targets through their supply chains. For example, sports goods retailer Decathlon is aiming to get 90% of its suppliers (by spend) to set science-based targets by 2024.[25]

BOX 1

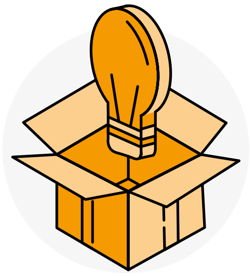
Emissions reporting and science-based targets at Carlsberg

Carlsberg has a target to reduce its "beer-in-hand" footprint by 30% by 2030. ("Beer-in-hand" includes refrigeration emissions in bars and shops, as well as emissions that happen in its supply chain or in distribution.) Approximately ~85% of emissions are out of Carlsberg's direct control, so the company works with suppliers to encourage a commitment to science-based targets. As of February 2020, 110 suppliers in Carlsberg's supply chain had already made a commitment.

To establish transparency, Carlsberg has teamed with The Carbon Trust to develop an advanced supply-chain emission calculation model. The model uses supplier-specific emissions data (which is available for >50% of emissions). This comes from suppliers' individual primary data for the materials they supply to Carlsberg. Where this is not available, Carlsberg looks to develop estimates based on material and location-specific factors.[26]

Carlsberg adheres strictly to guidance for developing a standardized and transparent footprint from three levels: (1) The GHG Protocol for Scopes 1, 2 and 3; (2) the Beverage Industry Environmental Roundtable sector-specific guidance; and (3) the European Commission's Product Environmental Footprint Category Rules on beer-specific guidance.[27] Carlsberg has co-developed and invested in improving the methodologies for more than half a decade to create consensus, consistency and transparency for the sector.

5.2 Optimize for CO_2



Action 3: Redesign products for sustainability

Design choices can help bring down supply-chain emissions. In many industries, companies need to differentiate between products in series production and those in development. For in-series products – where fundamental changes are hard to make – leaders try to lower the energy footprint in suppliers' operations and increase the share of recycled input materials. For example, Dell has continued to increase the share of recycled end-of-life electronics and ocean-bound plastics in its products, while improving the repairability and recyclability of products to create a closed-loop system.[28]

For new products, the options are wider. Companies can fundamentally design products for sustainability by using greener materials, cutting waste, reducing product variance, increasing recyclability, improving repairability and switching manufacturing processes to lower-carbon ones. For example, Tesla has continually improved its product specifications to reduce total cable length with each subsequent model, requiring less input material, reducing weight and extending battery lifespan.[29] Similarly, the World Economic Forum's Circular Cars Initiative is set up to minimize waste and maximize recyclability.[30] Some companies take even more radical approaches. For example, the German meat processor Rügenwalder Mühle has driven a major (and successful) portfolio shift towards vegetarian alternatives for processed meat products in recent years.[31]

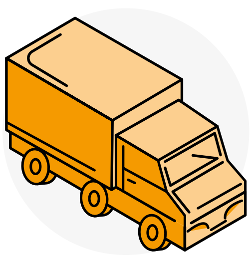
BOX 2

Companies are rethinking product design choices

Examples from industry suggest two areas of sustainable product design that companies are pursuing:

1. **Working across the supply chain to lower the environmental impact of products.** The life science company Merck has developed several greener, bio-based solvents using renewable resources (e.g. waste cellulose) and is also addressing the problem of plastic waste. By redesigning its sterile filtration system, Merck avoids using funnels, thereby reducing plastic by up to 48% and packaging size by up to 73%. Its redesign also reduces transported weight, shelf space requirements and the amount of waste created (including biohazardous waste).[32] Similarly, Unilever is moving from petrochemical-based surfactants to renewable and biodegradable alternatives. For a dishwasher liquid, the company found that its new formulations lead to better cleaning performance and less environmental impact across the supply chain. It also has a refill bottle of cleaning spray that uses biodegradable ingredients and a novel safety mechanism to mix concentrated product with water in the refill – thereby avoiding transport costs and emissions.[33]

2. **Responding to customer demand for materials to solve environmental problems.** BASF has developed nitrogen stabilizers for agriculture. The stabilizers allow plants to more effectively use fertilizers and thus increase yield potential by up to 12% while reducing ammonia losses by up to 90%. The changes help farmers reduce their emissions significantly.[34]



Action 4: Design value chain/sourcing strategy for sustainability

Companies should also consider emissions in their value-chain design choices, for example by rethinking their make-or-buy decisions and by limiting the need for long-range logistics. INGKA Group (IKEA) invests in resources important for the company's long-term development – such as sustainable energy, wood and recycled materials. The company now owns and directly manages ~243,000 hectares of forestland in the US and Europe.[35] Similarly, "nearshoring" can both reduce logistics emissions and improve supply-chain resilience to potential shocks – ever more relevant in a post-COVID world.

5.3 Engage suppliers

Action 5: Integrate emissions metrics in procurement standards and track performance

Setting procurement standards for suppliers is one of the most powerful direct levers to address upstream emissions. Strong standards link practices – such as a specific share and quality of renewable power, required levels of process efficiency or a required share of recycled materials – to procurement decisions. Two principal approaches exist:

– **Impose standards:** companies can define a preferred set of standards and require their suppliers to use them in tenders. This is simple and easy to monitor and ensures that standards align with company priorities. On the other hand, some standards may be difficult for selected suppliers to implement. For example, sector-specific science-based target pathways are not yet available in some industries, so it may be difficult for some suppliers to commit to one. Generally, alignment on an industry level can help to make implementation easier.

– **Require suppliers to set standards:** some companies prefer to let suppliers set standards themselves. For example, Walmart's Project Gigaton initiative does not impose standards; instead, it allows suppliers to set specific, measurable, achievable and appropriate emission reduction goals for themselves. As of last year, suppliers had avoided a cumulative 230 million tonnes of CO_2e.[36] This approach helps ensure standards are achievable but is more complex to monitor and may be incompatible with highly ambitious net-zero targets.

Beyond defining procurement standards, supply-chain emission reductions often require more intensive supplier collaboration – to educate suppliers about decarbonization levers, provide technical advice, enable longer-term asset upgrades and cultivate continuous improvement.

Finally, companies should introduce sustainability metrics into competitive tendering processes and reward climate action among suppliers; for example, through better payment terms. Puma is working with BNP Paribas to offer a supplier financing programme that rewards social and environmental standards.[37]

> **Our suppliers have to show commitment and progress to achieve renewable energy as part of the supply package – we have webinars on the business case for this and it inspires action.**
>
> Dimitri de Vreeze, Co-Chief Executive Officer and Managing Board Member, Royal DSM

BOX 3

Supply chain "pinch points"

Directly engaging suppliers is especially impactful at the pinch points along the supply chain, since a few individual companies are able to have an outsize role.

'Scale is super-important – if you are only 10% of a supplier's business they will likely not change – you need critical mass to get movement.'

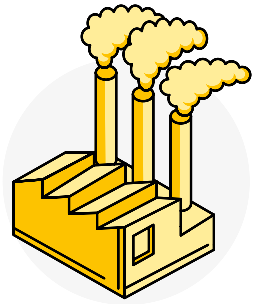
Marc Engel, Chief Supply Chain Officer, Unilever

In the food value chain, for instance, four major grain traders today account for more than 75% of global demand. If these four defined joint standards on agricultural emission-intensity and deforestation-free agriculture, and took joint action with their suppliers, they could by themselves affect a significant portion of global emissions. Another example: The London Metal Exchange is the global trading platform for metals, and would therefore be in a position to trigger transparency across the entire industry and impose climate standards across the value chain.

'We are increasing transparency, on a voluntary basis, of relevant supply-chain information from mine to end product and providing greater access to sustainably produced metal so the market has the ability to make trading decisions on the basis of that information.'

Matthew Chamberlain, Chief Executive Officer, London Metal Exchange

> With help from others, we developed an inclusive supplier engagement programme that is designed to deliver impact by building a broad tent – getting everyone going on practical actions.
>
> Kathleen McLaughlin, Executive Vice-President and Chief Sustainability Officer, Walmart



Action 6: Work with suppliers to address their emissions

In many cases, reducing upstream emissions will require working directly with suppliers on joint abatement and circularity projects. Many companies already engage in initiatives on supplier education, technical support and methodology sharing, especially in relation to efficiency initiatives. For example, Danone provides a training programme for farmers to improve costs and move to sustainable farming practices.[38] Google helps suppliers to identify value-generating energy efficiency opportunities and supports them to implement these at office sites.[39]

In cases where reducing emissions requires suppliers to make financial commitments, companies may need to share the risk through co-investment, offtake agreements or joint decarbonization initiatives. This is especially important in industries where decarbonization requires significant investments in technology that is still immature. But it is also relevant for decarbonization measures that are already economic. For example, Energy Efficiency Services Limited (EESL) in India – in partnership with the Indian government – uses a pay-as-you-save model to support companies in implementing efficiency measures, thereby removing the need for a company to make any upfront capital investment.[40]

> **We started developing a supplier efficiency programme where we shared our own best practices with suppliers and others.**
>
> Clay Nesler, Vice-President Global Energy and Sustainability, Johnson Controls

> **EESL utilizes the approach of bulk procurement, demand aggregation and monetization of savings, which makes adoption of energy-efficient technology lucrative for the entire value chain.**
>
> Rajat Sud, Managing Director, Energy Efficiency Services Limited (EESL)

BOX 4

HYBRIT: a cross-supply-chain project for emission-free steel

In 2016, steel manufacturer SSAB, mining company LKAB and utility company Vattenfall started a joint venture to create HYBRIT. HYBRIT aims to replace coking coal with hydrogen to enable the production of fully emission-free steel. Decarbonizing steel is one of the major challenges in global climate action – a result of the industry's high carbon and capital intensity, low margins and limited low-carbon technology alternatives. These are not barriers that any single player can overcome on its own. As such, collaboration between suppliers and producers is a crucial enabler for reducing the risk associated with initial investments.

The HYBRIT pilot phase has an estimated cost of ~€230 million (including a ~€60 million grant from the Swedish government); the goal is to make steel available to customers within 10 years. Its joint venture ownership structure helps reduce the financial exposure of each partner and integrates each of their capabilities into the project. If all goes as planned, this pilot will help drive innovation and bring down the cost of sustainable steel production, benefitting the entire sector.[41]

Apple's Supplier Clean Energy Program aims to reach 100% clean energy in its supply chain by 2030 and has resulted in ~8GW of clean energy commitment. As part of the programme, Apple is directly investing in renewable generation in China and aggregating demand for clean energy across its supplier base.[42] Similarly, Maersk and H&M have jointly developed an initiative that enables low-carbon shipping of H&M products through the use of biofuels.[43]

BOX 5 | **Pushing for material impact in renewable power**

The number of corporate commitments to climate action and their level of ambition have increased significantly in recent years – and procuring green power is a key element in all of them. As voluntary procurement of renewables becomes more prevalent, it is critical that companies aim for their purchases to make a material impact on the energy landscape. Ensuring that the renewable energy purchased is "additional" – i.e. it would not otherwise be available to the system – is the most direct way to contribute to the "greening" of power networks. Companies can ensure "additionality" by building their own renewables on- or near-site, signing direct or virtual power purchase agreements (PPAs, vPPAs) or directly investing in new renewable projects with bundled certificates.

Where these options to add renewable capacity to the grid do not exist (e.g. where the regulatory landscape does not allow for the signing of PPAs) companies can engage in policy advocacy to drive change at the system level. They can also send a demand signal to the energy market by buying unbundled certificates of origin (CoOs) or renewable energy certificates (RECs or iRECs) that provide additional income streams to green power projects already in development. While CoOs and RECs do not necessarily fund new projects, they can increase the bankability of existing renewables and lead to more being built in the future.

As companies think about the standards they set for suppliers to use renewable power, they should bear in mind how they can ensure maximum impact. Some forward-thinking companies are supporting suppliers to buy into PPAs, and bodies such as the Renewable Energy Buyers Alliance (REBA) can help navigate this landscape. Establishing an industry standard for the level of material impact achieved with different renewable purchasing methods would be a helpful way to give companies transparency on the level of "additionality" or impact they are achieving, and help to build pressure on governments that put blockers on renewables development.

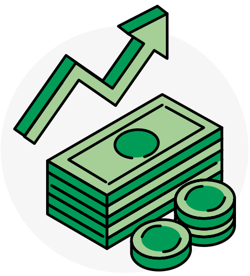
5.4 Push ecosystems

Action 7: Engage in sector initiatives for best practices, certification, traceability, policy advocacy…

Sector initiatives are another way for ambitious companies to increase their impact. Similar to some of the supply-chain actions described above, this is especially relevant for players in sectors reliant on capital-intensive decarbonization solutions that would be prohibitively expensive for a single company. Ambitious companies should thus put pressure on industry bodies and other organizations to establish sector-level targets for climate action. In doing so, they can move the entire sector and their supply chains, and allay concerns regarding competitiveness. For example, AP Moller-Maersk has been publicly appealing for more climate action in the shipping sector and is recognized as a leader in enabling sector-level targets.[44] Maersk has joined forces with several partners to set up an independent research and development centre focusing on zero-carbon shipping.[45]

Leading companies can also join forces in cross-sector policy groups to change the wider context for decarbonization across value chains. Common policy recommendations provide a strong message that business wants support to decarbonize. For example, Sony recently urged the Japanese government to lower barriers to renewable energy in the country and has threatened to move its factories abroad if the Japanese government does not act. The electronics company Ricoh, the cosmetics business Kao, and the fund manager Nissay are supporting Sony's push.[46] The Carbon Pricing Leadership Coalition – aimed at expanding carbon pricing policy across the world – consists of various governments and also many private-sector players in sectors such as mining, energy, construction, aviation and professional services. Advocacy is especially important in heavy industry sectors where governments are frequently huge buyers, such as cement and steel. In these sectors, a mandate for public procurement of green equivalents can really move the needle.

> **The International Maritime Organization has a role to play in helping the shipping industry create transparency and close the competitiveness gap between fossil and renewable fuels. This work must start as a matter of urgency – time is of the essence and we know that defining global market-based measures will take time.**
>
> Ole Graa Jakobsen, Vice-President and Head of Fleet Technology, AP Moller-Maersk



Action 8: Scale-up "buying groups" to amplify demand-side commitments

Demand-side commitments can also be a tool to encourage investments in decarbonization technologies. The World Economic Forum's Mission Possible Platform aims to bring together value-chain players to establish collaborative projects and build demand for green cement, steel, chemicals and transport solutions. Scaling up corporate offtake commitments to greener products can spur sector-level action.[47] Taking a different approach, the members of the Oil and Gas Climate Initiative (OGCI) jointly invest in hub projects for scaling carbon capture and storage technologies as they have identified this as one of the major levers for decarbonization in their sector.[48]

Leading companies are also joining forces with supply-chain partners and with a broader ecosystem of regulators and policy-makers to create markets for green solutions and sign offtake agreements to make green solutions more economical. For example, the Clean Skies for Tomorrow Coalition (part of the Mission Possible Platform) engages airlines and companies with significant business travel to bundle offtake for sustainable aviation fuels and works with the International Air Transport Association (IATA) and governments in leading countries to set mandates and develop distribution infrastructure for such fuels.

The kind of cutting-edge thinking that is happening in the Mission Possible Platform around economics, technologies and science gives one comfort that things will move.

Sanjiv Paul, Vice-President Safety, Health and Sustainability, Tata Steel

BOX 6

The Mission Possible Platform and Clean Skies for Tomorrow

The World Economic Forum's Mission Possible Platform is a coalition of businesses and expert organizations committed to reducing emissions from heavy industry and mobility by creating and delivering technology, policy, and financing solutions. The platform focuses on seven sector coalitions, including Clean Skies for Tomorrow in aviation.[49]

The coalition was established to address the "chicken and egg" challenge, where neither individual producers nor consumers are willing (or able) to carry the initial cost burden of scaling sustainable aviation fuels (SAF). The coalition is developing measures to stimulate demand and drive supply, promoting customer opt-in schemes, allowing customers to offset travel emissions, and aggregating demand from large air travel customers with high climate ambitions. This collective demand for carbon-neutral air travel can provide future offtake certainty for SAF, making fuel production investments easier to finance and thereby helping to scale SAF technologies and reduce future costs. In parallel, the initiative advocates for governments and airports to mandate SAF quotas to help the transition.[50]

Clean Skies has also been sharing knowledge and methodologies with members of industry consortia and encouraging direct investment in new facilities for SAF alongside more traditional fuel manufacturers. For example, the International Airlines Group (IAG) has committed to net-zero emissions by 2050 alongside a €325 million commitment to develop sustainable fuel supply chains. This includes direct investment in a flagship facility, Altalto, in collaboration with Velocys, IAG and Shell.[51]

5.5 Enable your organization

Action 9: Introduce low-carbon governance to align internal incentives and empower your organization

Companies aiming to decarbonize their supply chains need to change the way they operate. They require more comprehensive data exchange with suppliers and need to set up an organization capable of engaging them on their carbon emissions, as well as integrating emissions into procurement standards and decisions – and aligning targets and incentives in their organization to emission reduction targets. All of this requires governance.

Companies should try to link up core business functions on decarbonization. For example, automotive supplier ZF Friedrichshafen appointed a cross-functional sourcing board to link carbon emissions to purchasing, logistics, quality and other functions.[52] When the focus of decarbonization efforts is the upstream footprint, functions such as product development, procurement, finance, strategy and sustainability may be involved. Companies need to organize themselves in such a way that targets and accountabilities are fully aligned. They should strive to reduce the number of interfaces between functions involved in climate-related topics, increasing automation, reducing process complexity and enhancing process standards wherever possible.

In procurement, companies should set up technical teams able to engage suppliers and conduct training on their decarbonization levers and economics. Inditex has made sustainability one of its main priorities for internal training; for example, in terms of opportunities for introducing circularity into product design.[53]

Finally, companies need to align internal targets, funding allocations and incentives to their decarbonization targets. They should embed emission targets into their purchasing strategy and ensure overall reduction targets are adequately cascaded across units in the organization. Where emission reduction may result in higher spending, they need to develop mechanisms for releasing funds – for example, through internal carbon pricing mechanisms. They should align internal incentives to decarbonization targets; for example, by making them a factor in variable compensation. The Carbon Disclosure Project (CDP) found that around half of Europe’s largest firms already link their executive pay to climate change.[54] Similarly, companies can link their procurement key performance indicators (KPIs) and team compensation to supply-chain decarbonization initiatives.

“ Data collection between life-cycle analysis and Scope 3 teams is often not synchronized – they should be closely connected to create an effective overview of the baseline.

Christoph Meinrenken, Research Scientist at the Earth Institute, Columbia University

6 Time to move

Achieving a net-zero supply chain will have a major impact in the fight against climate change – companies must take action now.

Supply-chain decarbonization presents a giant and as-yet untapped opportunity for international climate action. It can enable companies with relatively small direct emission footprints to have a significant impact on a global scale. It can enable end consumers to bear the costs of decarbonizing hard-to-abate industries and transport sectors by spreading the costs throughout the value chain. It can enable companies selling goods in Europe and the US to affect the emissions of process industries in Asia. It gives power to climate-conscious consumers. And it does all this with very limited cost impacts on final products. In most industries, economics are not a meaningful barrier to moving to net-zero supply-chain emissions.

Upstream decarbonization, however, is hard and takes time. It will require companies to change the way they design products, how they choose and engage with suppliers – and how they govern their own organizations. Leading companies are already addressing some of these challenges. It is time for others to start doing so, too.

Appendix: Details per supply chain

- Circularity/ recycling
- Material and process efficiency
- Renewable power
- Renewable heat
- New processes
- Nature-based solutions
- Fuel switch
- CCUS

Food

Split of emissions by lever

Within the food supply chain, less than 2% of emissions can be reduced via circularity in plastics packaging. Approximately 25% of emissions can be abated through material and process efficiency levers. These include the reduction of food waste, nitrogen-optimized feeding and increasing the productivity of low emission-intensity fertilizers. Renewable energy for power and heating can provide another ~15% emissions savings, mainly at the food-processing and packaging stage. The biggest bucket (~55% of total emissions) needs to be tackled via nature-based solutions. About 20% of emissions are caused by deforestation and should be addressed by moving to deforestation-free agriculture, e.g. via projects in relevant countries that provide the financial means to protect large forests from being converted into cropland and that provide alternatives to logging for the local population. The remaining ~35% are inherent to agriculture and cannot be reduced any further – they need to be addressed through reforestation, restoration of mangroves and peatland, soil sequestration, biochar production and other levers. About 5% of emissions need to be addressed via fuel switch for more carbon-efficient transport means.

Construction

Split of emissions by lever

Within the construction supply chain, ~5% can be abated by introducing circularity in cement, aluminium or plastics from demolition waste or via increasing the share of scrap in existing electric arc furnaces. Some 20% of emissions can be tackled through material and process efficiency levers such as cement clinker substitution, and more efficient transport vehicles. Renewable power and heat, e.g. for aluminium production or at the construction site, account for another ~35%. Introducing new processes, e.g. switching steel production to less carbon-intensive processes (such as changing from blast furnaces to using direct reduced iron in electric arc furnaces), reduces ~10% of construction emissions. Another ~10% can be abated with fuel switches in low-carbon transport. The last ~20% of all construction emissions need to be tackled through carbon capture, utilization and storage technologies (CCUS), mainly from the cement and steel production.

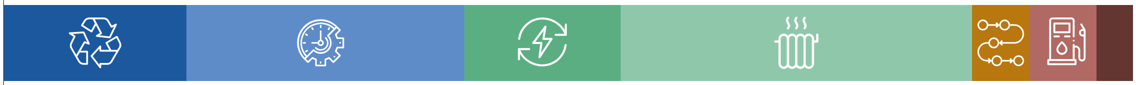
Fashion

Split of emissions by lever

Less than 2% of all emissions in fashion can be reduced by recycling. Some ~15% can be abated by putting pressure on suppliers to increase process efficiency – with upgrades to less energy-consuming machinery for sewing, spinning, weaving and knitting. Switching production to renewable power sources alone abates an additional ~45%, as emissions within the textile and garment production process are mainly driven by the high shares of fossil-derived energy (e.g. lignite, hard coal, gas and oil) within the domestic energy mix of production countries. The remaining heat consumption would need to be shifted to renewable heating, saving another ~20%. Introducing new processes, e.g. moving from wet towards dry processing technologies, can save another ~10%. An additional ~10% of all fashion emissions – part of those from agriculture – need to be addressed via nature-based solutions, e.g. growing cotton more sustainably. The last 2% or so can be tackled via fuel switches for low-carbon transport.

FMCG

Split of emissions by lever



In fast-moving consumer goods (FMCG), ~15% of emissions can be avoided with circularity by mechanically and chemically recycling plastics, thereby lowering demand for virgin feedstock. Another ~25% can be saved by improving process efficiency across the supply chain. Renewable power accounts for another ~15% of emissions. As most underlying chemical production processes for plastics require both low- and high-temperature heat, switching to renewable heat (e.g. heat pumps or biogas) would be needed for ~30% of emissions. The last ~5% each can be tackled with new processes (e.g. moving to bio-based plastics), fuel switch in transport, and CCUS for remaining chemical process emissions.

Electronics

Split of emissions by lever

In electronics, ~5% of supply-chain emissions can be addressed through circularity, e.g. recycling plastic as input material. Larger potential comes from material and process efficiency improvements, accounting for ~20% of potential savings, especially in manufacturing and mining. Some 35% of emissions can be abated through renewable power, and ~30% through (mostly low-temperature) renewable heat. Less than 2% can be abated with new processes (e.g. bio-based plastics) and CCUS on residual plastics emissions. About 5% will need to be addressed through fuel switch in transport.

Automotive

Split of emissions by lever

Renewable power represents the largest abatement lever, with ~40% mainly from within the aluminium, glass and battery production processes. About 20% of automotive emissions can be addressed with renewable heat, e.g. by switching to green heat for drying processes within battery cell manufacturing. Roughly 10% of emissions can be tackled with new processes, e.g. switching from a blast furnace to an electric arc furnace route in steel. Another ~5% can be addressed through fuel switch to low-carbon transport, e.g. switching combustion trucks to battery-electric and hydrogen-powered versions. The last ~5% need to be abated via CCUS, mainly in steel production through addressing the remaining blast furnace emissions.

Professional services

Split of emissions by lever

About 10% emission reductions are possible by reducing travel and switching to virtual meetings – a routine that has become customary in recent months.[55] The bulk of emissions can be tackled by procuring renewable power (~40%) and renewable heat (~35%) for in-office consumption. The remaining reduction (~15%) needs to come from net-zero business travel, e.g. by switching from conventional jet fuel to renewable fuels and switching local transport to battery-electric cars.

Freight

Split of emissions by lever

In freight, the number of straightforward levers is more limited. Over a timeline of the next 10–15 years, only around 20% of emissions can be reduced through low-cost efficiency levers, such as improved design of vessels, better aircraft aerodynamics, more efficient trucks and improved routing. The bulk of emissions have to be eliminated by switching to electric solutions or renewable fuels – fuel-cell and battery trucks on road, biofuels or green ammonia in shipping, as well as bio- or e-fuels in aviation.

Methodology

Emissions split per supply chain: Analyses of emission splits of supply chains were based on companies' most recent responses to CDP. Member companies voluntarily disclose on an annual basis to CDP, thus our dataset from 2020 represents 2019 reporting data. The data includes both quantitative emissions disclosed for Scopes 1, 2 and 3 and a qualitative survey in which companies respond to questions on a broad range of topics, from climate governance to target-setting and investment in abatement initiatives. For this report, we matched the provided CDP classification of companies in industry, sector and activity to the eight focus supply chains. To ensure better comparability and to disregard companies that did not calculate certain upstream categories, we selected only those responses with data for six or more of the eight Scope 3 upstream categories as defined by the GHG Protocol. This led to a subset of 320 companies across all supply chains that build the data for the initial figures.

Abatement cost curves per supply chain: The report considers the costs per tonne of CO_2e in 2030, thus capturing likely cost decreases from learning curves in leading green technologies not yet readily available at scale. For example, the cost of green hydrogen – produced through electrolysis powered with renewable energy – will likely drop by about a third by 2030. However, assumptions for cost decreases and potentials have been developed with a conservative approach. For each of the eight supply chains covered in this report, we have conducted a comprehensive literature review across academic research papers, industry reports, market-leading company publications and further studies.

We collected emission splits across supply-chain steps and potential levers to tackle these emissions. Further, we compared and reviewed the collected assumptions on reduction potentials and costs and complemented them with figures collected from various decarbonization projects that Boston Consulting Group (BCG) has conducted with clients across different sectors. Finally, we conducted several expert workshops to challenge and adjust all assumptions and to agree on a conservative yet optimistic view on costs. Of course, there is some uncertainty in these numbers as they reflect projections from now to 2030. Moreover, not all cost assumptions are equally certain, as we note in some graphics included in this study. For the ones that are especially critical, e.g. hydrogen or CCUS, we highlighted this with an additional shade on top of the bars for the costs. While figures were developed from a conservative company-level approach, if full value chains decarbonize, this might lead to some additional system costs. This holds true especially for the power system, e.g. for stranded assets replaced by renewable capacity and the integration cost of load balancing and renewable backup at a certain scale.

End-consumer cost impact: For each cost estimate on end-consumer products, we have collected a bucket of different products with their respective supply-chain emissions and average prices. The products in this bucket include a variety of different products within the same category, e.g. several different garments for fashion, several different electronics devices etc. This provides us with a range of cost increases for decarbonising the category, and we take an average of those cost increases for our estimates. For this, we employed the comprehensive literature review from the abatement cost curves and further BCG project experience. In addition, we were able to gain access to the Carbon Catalogue, a product-carbon-footprint database of a research team at Columbia University's Research Program on Sustainability Policy and Management as well as CoClear.[56] From these buckets, we derived an average cost increase and applied this to the exemplary products.

Barriers to action and corporate guide: We based the insights of this report on interviews with 25 chief executive officers and their teams around the world as well as 14 industry and/or academic experts.

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