CLIMATE ACTION PATHWAY

INDUSTRY

Executive Summary

2020

Global Climate Action
United Nations Climate Change

Marrakech Partnership

VISION STATEMENT

It is 2050, and industries generate net-zero emissions while providing dramatically improved qualities of life for citizens, in line with the United Nations Sustainable Development Goals. Clean manufacturing of heavy and light commodities – from steel beams to bits and bytes – is achieved with a different geographical footprint and lower overall energy intensity than earlier in the century, driven by convergence of information and industrial technologies, business models, policy support, design and consumer choices, and investment requirements.

End-customers are able to access the goods and services they want and need without detrimental environmental or social costs. Better fundamental design – of cities, supply chains, data centres, vehicles and fleets, and consumer goods – has eliminated waste and brought materials into a fully circular life cycle. Investors and asset owners broadly prefer companies motivated by and aligned with socioeconomic and environmental imperatives, identifiable through enhanced transparency and disclosure of climate-related risks and opportunities. Technology entrepreneurs and first movers deliver rapid technology change, which cascades across sectors and value chains with the support of an enabling ecosystem of capital providers and more adaptable regulation. Independent data-driven measurement, tracking and accountability systems expose businesses misaligned with environmental and social outcomes, which have competed of late for a rapidly disappearing share of outdated real and financial markets. Policies have evolved to generate, reflect and reinforce these dynamics as they emerge, especially in providing legally binding, meaningful pricing of externalities.

Cumulatively, collective response to systemic constraints and emerging opportunities has interacted in positive feedback loops to rapidly generate more frugal, efficient, responsibly data-driven and socially and environmentally sound industries that support nature and biodiversity regeneration. Workers worldwide have been equipped with the tools and resources to proactively manage economic transitions and uncertainties, while holding rewarding healthy and decent jobs. Communities and industries have become more resilient to the significant effects of climate change and other natural disasters, as a result of mostly local renewable electrification and supply chain redundancies. Meanwhile, industrial sector transitions have delivered profound benefits for human and natural health: particulate matter and other forms of pollution have fallen dramatically as combustion of fossil fuels has eroded.

Quickly following an accelerated peak in developed economies' emissions, high growth developing countries have progressed along innovative development patterns even as populations continue to grow. As a result, industrial patterns of consumption and production fit well within the use of our planet's – available resources, in contrast to the early 2020s when annual consumption and production was 175 per cent of the resources our planet can sustainably renew in a year.

SYSTEM TRANSFORMATION SUMMARY

The Industry Climate Action Thematic Pathway represents a broad range of sectors including **Steel, Cement, Aluminium, Chemicals, Plastics, Metals & Mining, Retail, Fast-moving Consumer Goods, Apparel, and Information and Communications Technology (ICT) & Mobile.**

Decarbonizing these sectors is technically and economically feasible through action along pathways with three central components: (i) reducing materials and energy use; (ii) increasing the productivity of materials and energy use; and (iii) decarbonizing required production processes while implementing sustainable transitional solutions such as natural climate solutions where direct emissions reduction cannot be prioritized.[1] The relative emphasis on these components in near- to medium-term decarbonization efforts within each sector varies substantially, given the diversity of sectoral value chains and footprints and low-carbon economic development opportunities around the world. Yet, urgent action is required in and across sectors in order to reduce emissions by 30 to 45 per cent by 2030 and achieve net-zero emissions by 2050.

Fortunately, the fundamental levers driving sectoral decarbonization pathways across those components are manifold: whole-system design methods and practices – for example, in buildings, cities, data centres, and manufacturing processes – can obviate or make more efficient use of resources and energy without sacrificing quality, cost and resilience; stronger reuse and recycling of commodities and products to drive circular resource flows, rather than the low-leverage linear model of "take-make-waste"; substituting low- or net-negative carbon materials for carbon- intensive alternatives, and adapting practices where substitutes are not "perfect"; accelerating the demonstration and commercialization of breakthrough technologies, especially where they cascade from momentum in technology change today; a step change in the ambition and delivery of policies at every level, with emphasis on workforce support, product standards, mandates, subsidies, procurement, climate risk disclosure implementation and carbon-pricing; social dialogues to develop coherent policies and plans enabling social protection, skills training, redeployment, and community renewal; increased financial transparency, disclosure, innovation in instruments and institutional action to facilitate accelerated asset retirement, scaled investment, climate risk valuation, and just labour force transitions; data transparency, tracking, and accounting of commodities' carbon and other attributes through supply chains as a force multiplier of other levers; the preferential demand for verifiably low- to zero-carbon commodities by businesses, consumers and governments to pull solutions through supply chains; and civil society campaigns, calls to action, independent research and analysis, and community dialogues.

[1] Oxford University, "The Oxford Principles for Net Zero Aligned Carbon Offsetting"

To activate many of these levers, radical collaboration among multiple stakeholders – governments, businesses, asset owners, consumers and civil society – across value chains and across sectors will be essential to unlock exponential growth in technology deployment and behavioral change. These "s-curves" will be generated by mutually reinforcing feedback loops between the levers described above, enabled by collaboration anchored in commitments to net zero by 2050. Given the short timeframe available, this collaboration must target the fundamental transformation of industrial systems – not through incremental change, but by unpacking and redesigning them to be fit for purpose in the 21st century.

Steel

The global steel sector faces a steep but feasible pathway to decarbonization through collaboration between suppliers, customers, policymakers, and investors. Steel accounted for 3.6 gigatonnes of carbon dioxide equivalent ($GtCO_2e$) and 9 per cent of total energy-related emissions in 2019 (of which 2.6 $GtCO_2e$, or 7 per cent of total, are directly energy-related). The global steel market is characterized by a fierce cost competition and additional costs incurred from the needed transition will be challenging for the companies that are facing long asset lifetimes of 30 to 50 years and an excess primary production capacity of about 20 per cent of current production. China supplies 50 per cent of the primary market today – a share set to decline by around 20 per cent by 2050; meanwhile, India's demand is expected to grow by 40 per cent, tripling its share of the global total. Despite these shifts, most forecasts suggest a long-term growth outlook for both primary and secondary steel production, although this may be challenged in scenarios of significant dematerialization and materials efficiency/recycling[2] and accelerated behaviour change.[3]

Clear paths exist to decarbonizing steel by 2050 at minimal additional cost to end-customers. First, demand management can reduce primary steel required by 25 to 40 per cent by 2050 through improved design of buildings and cars, extended lifetimes, and reduced waste. To achieve this, customers, building owners and construction companies must demand, and/or cities and states regulate, adoption of material efficiency measures by designers and architects, enabled by accelerated turnover in building codes and standards. Building developers and owners and automobile manufacturers can adopt substitutes and new practices, i.e. longer building lifetimes, driven by changing consumer preferences and synergistic value opportunities (e.g. light weighting electric vehicles yields battery capacity and weight savings). Second, businesses and investors can lead investment in energy efficiency measures for near-term decarbonization of young assets (like those in India) through national or joint international initiatives incentivizing deeper efficiency gains against leading benchmarks. Third, businesses with policy and investor support can accelerate collaborative RD&D efforts to speed and scale deployment of low- to zero-commercial-scale production facilities. In the context of a potentially evolving production base, industrial strategies and social dialogues need to help communities manage and support technology transitions.

[2] BCG and the World Economic Forum, "Metals and Mining in a Sustainable World 2050", IEA "Materials Efficiency Scenario"

[3] IPCC Special Report 1.5, International Institute for Applied Systems Analysis, "A low energy demand scenario"

By 2030, progress along several dimensions will be critical. **Cities and regions** must launch net-zero embodied carbon strategies, strengthened by collaborative mechanisms for learning and action like the Clean Construction Forum. Businesses and RD&D researchers must accelerate plans for breakthrough technology deployment through further demonstration of next-generation technologies and at least 10 commercial-scale, low- to zero-carbon production facilities. This pace of progress can be facilitated by support to initiatives like Mission Innovation and the Net Zero Steel Initiative, as well as through value chain collaboration between ambitious **businesses and policymakers** to realize new value pools by redesigning supply chains. These can help to clarify technology pathways for deployment at scale in the 2030s. **Investors** can increase pressure and support for wider uptake of net-zero commitments, while enabling an end to new coal-based production capacity in developing countries long before 2030 with innovative international funding support. In Europe, policymakers can increase carbon prices to more than USD 50/tonne to unlock fuel-switching and carbon capture investments, coupled with specific product requirements and/or border carbon adjustments. These investments can be supported by differentiating steel markets with non-profit certification and accounting regimes like Responsible Steel and COMET, emerging asset-level emissions transparency, and procurement commitments by **government and corporate steel buyers**. This can unfold against a backdrop of ramped-up production of fully scrap-based, recycled steel supply and demand enabled by better collection, sorting, and renewable electrification.

Concrete & Cement

Clear decarbonization pathways exist for the concrete & cement industry, but the need to abate both heat and process emissions means costs will be high relative to other heavy industries. The pathways will need to take into account differing regional and national scenarios and speeds. Global carbon emissions from concrete & cement are around 2.2 Gt per annum, with business as usual scenarios predicting a rise to 2.3 Gt per annum by 2050. These emissions originate from direct process emissions (1.2 Gt), heat emissions from fuel combustion (0.75 Gt) and the remainder from smaller indirect emissions in the supply chain. Current progress is slow due the absence of clear business cases for large scale investments in advanced technologies and a lack of interaction in a highly fragmented value chain to develop new innovative solutions and create clear demand signals[4].

Decarbonization of the concrete & cement industry will require alignment across the value chain. Research shows that a combination of decreased demand, increased energy efficiency and investment in breakthrough technologies will be required to fully abate the sector. Demand management analysis suggests that global primary demand could be reduced by up to 35% in a scenario where the potential of circular economy strategies is realized. This will be primarily driven by an increase in recycle and reuse, materials efficiency (e.g. using less concrete per square metre) and developing innovative materials for the built environment sector , such as cross laminated timber, which will have to respond to high performance standards[4]. Energy efficiency levers are primarily relevant for clinker production, and include strategies such as improving refractories and energy management processes within kilns. The accelerated uptake and use of alternative non-fossil

[4] ETC Making Mission Possible Cement Pathway

based fuels (e.g. residual waste) and materials (e.g. slag, fly ash or calcined clays) can deliver emissions reductions in the short term, buying time for development of options that are necessary in a low carbon transition.

Decarbonization technologies must tackle both heat and process emissions and three promising examples are increased use of biomass, lower clinker content and CCUS. The least costly solution is likely to vary by location, but in the absence of breakthroughs in concrete & cement chemistry, CCUS will likely be the only solution to abatement of process emissions. Cost-effective ways to decarbonise heat emissions will depend on the price of renewable energy in a particular region, and once hydrogen and electrified heat are fully scaled-up it could be that they will be more prominent.

A combination of public procurement incentives and end-users attempting to reduce the carbon footprint of their practices will drive demand for carbon-neutral concrete & cement. Policy frameworks relevant for the transition in the concrete and cement industry will be crucial to fuelling the search for longer term solutions and uptake of existing decarbonisation technologies and practices. Policy levers include carbon pricing as well as smarter regulation on concrete and cement producers and construction companies. A shift to a more circular approach and reduction of material input should also be driven by these players. Suppliers must work closely with stakeholders across the value chain to establish more transparent targets, implement standards for tracking and certifying embodied carbon and supporting increases in regional carbon prices[4]. Finance actors and policy makers will play a key role in supporting R&D efforts in promising technologies and allocating funds for large-scale pilots. Investment in CCUS is also critical due to the difficulties in completely eliminating all carbon across the concrete & cement value chain.

By 2030, governments and industry will take collaborative action to create favourable investment frameworks for accelerating the sustainable transition of the concrete & cement industry globally. All stakeholders will intensify collaborative action to increase implementation of state-of-the-art technologies and share best operating practices. Industry stakeholders will assess opportunities to use low-carbon technologies and will develop plant-level action plans to increase the speed and scale of deployment of such technologies. Governments will enable the establishment of clean-energy grids to support the use of fuels that are less carbon-intensive in concrete & cement kilns. Joint efforts are undertaken to review and establish building regulations and specifications aimed at achieving carbon neutrality of the built environment over its entire life cycle, including during the use phase and at end of life. CCUS facilities at commercial scale will be established through accelerated industry and regional collaborations and the right support from policymakers and researchers[5].

[5] CSI: "Technology Roadmap: Low-Carbon Transition in the Cement Industry"

Aluminium

The global aluminium sector faces a very steep but technically feasible pathway which will need to take into account differing regional and national scenarios. Producers as well as customers, policymakers and investors will need to invest to make this pathway a reality. No widely agreed decarbonization scenario exists in the global aluminium industry today. The global aluminium sector is currently responsible for about 1.2 billion tonnes CO_2/year, equivalent to 2 per cent of total global emissions. More than 90 per cent of the emissions stem from the primary production process, and two thirds are energy related. The global demand for primary aluminium is expected to increase by 50 per cent by 2050, reaching 107.8 million tonnes. The main growth drivers will be increasing demand in key applications, where aluminium's unique properties make it the innovative material of choice for the low carbon transition, including mobility, building and construction, and packaging.

The key routes that need to be pursued are clear. Decarbonizing the grid will be necessary to reduce the subsector's indirect emissions. **Electricity producers** can assist by offering electricity pricing incentives to aluminium producers using demand management systems. The aluminium subsector can in turn assist with grid decarbonization by providing flexibility services that would help integrate a higher portion of variable renewables. Participants all along the value chain (aluminium producers, engineers, construction companies and product manufacturers) can also adopt material efficiency strategies to reduce overall aluminium demand.

Collaboration between aluminium product manufacturers and waste collectors will ensure that manufacturing and end-of-life scrap is collected and transported back to the producers. That will increase the usage of the recycled aluminium in the production **R&D is needed** on innovative alternative production methods that reduce primary production process and combustion emissions; more energy-efficient equipment and operations would be beneficial. To make the transition happen in the aluminium industry, investments of between USD 0.5 trillion and USD 1.5 trillion will be required over the next three decades, equalling a cost of USD 30 to USD 100 per tonne of carbon. These investments could propel new smelting technologies, new low-carbon smelters as well as new technologies such as inert anodes, which are designed to make smelting carbon-emission free.

Strong demand signals will be key to support demand generation and accelerate the transition. The announcement by the London Metal Exchange in June 2020 to establish a spot-trading platform for low-carbon aluminium was an important step in this direction. This will further increase transparency in production and supply chains. Furthermore, the aluminium industry needs to ensure efficient equipment operations and maintenance, which will help guarantee optimal energy performance. This can be reinforced by implementing energy management systems. There is also an opportunity to work more directly with client companies in the main uptake industries such as construction, transport, electronics and packaging (pilots ongoing) which can help to make the case for low-carbon aluminium. As the aluminium market is a competitive and globally commoditized market, relevant **governments** could use fora like the G20/G8 processes to push for global solutions for a global

problem - in order to open the space for a better level playing field which would be a key condition for accelerated change in the sector. Engineers should consider reusability and recyclability in product design, and **policy makers** can assist by setting requirements and coordinating channels for end-of-life material reuse and recycling. Overall, a push by all stakeholders is needed to advance the large-scale demonstration and deployment of technologies that have already shown promise.

By 2030, there should be a functioning market for low-carbon aluminium, which allows for transparency, and allows for the launch of core sustainability contracts. The first net-zero smelting facility must be place and fully operational and several others are being built Through intensified collaboration, the industry should have an implementation map ready so that direct emissions can be reduced by 60 per cent. The currently existing plants would have to be retrofitted and improved to perform at 2020 benchmark performance. The potential of the circular economy must be fully deployed, by starting the full implementation of regulation that ensures that products are designed and manufactured for value retention. And, in North America and Europe, large-scale aluminium sorting and remelting plants should already be gaining back the full value from the recycling chain.

Chemicals

In chemicals, various decarbonization pathways and roadmaps exist (pending the Science-Based Targets initiative (SBTi) chemicals roadmap, due later in 2020), but more sector collaboration is needed to realize large-scale technology demonstration and drive ambition among key players. The global chemicals sector is responsible for 5 per cent of total global emissions (1.5 Gt total direct emissions per year), and 60 per cent of total direct CO_2 emissions come from a small number of primary chemicals: ammonia (30 per cent) and plastics (30 per cent).[6] Global chemical sales have increased exponentially over the last two decades, with Asia accounting for 60 per cent, and production largely focused in China, the United States and the Middle East.[7] Open collaboration is key for the sector to grow sustainably; as of September 2020, 4 of the top 50 global chemical companies have committed to net-zero carbon emissions by 2050 or sooner, with only one of these net-zero targets validated through the **Science-Based Targets initiative** (SBTi).[8]

Key actors throughout the system have important roles to play to support the decarbonization of the chemicals sector to 2050. Policymakers should continue to raise ambition for existing carbon emissions reduction commitments (e.g. 50–55 per cent emissions reduction by 2030 per European Union Green Deal) and promote significant investment in public–private partnerships and R&D programmes to boost technological capacity for pilot projects on key technologies such as electrification, low-carbon hydrogen, and CCUS. **Finance stakeholders/investors** should promote widespread use of product certification and finance public-private R&D investment in sustainable

[6] Mission Possible Platform, "Reaching net-zero carbon emissions from harder-to-abate sectors by mid-century: sectoral focus plastics", 2018.
[7] UNEP, "Global Chemicals Outlook II", 2016.
[8] High-Level Climate Action Champion analysis, 2020.

chemical production to deliver such technology pilot projects. **Technology** is a key enabler for the sector, enabling various key decarbonization routes, including: upstream fuel and feedstock switching (petrochemical feedstock accounts for 12 per cent of global oil demand);[9] chemical process improvement (e.g. through electrification and carbon capture, use and storage (CCUS),, although it is worth noting that despite being the largest industrial energy consumer, the chemicals sector ranks third among industrial CO_2 emitters, behind cement and steel); and more efficient product use and end-of-life management (e.g. chemical and mechanical recycling). **Chemical producers** should ensure that reporting and disclosure are in line with the Task Force on Climate-related Financial Disclosures and participate in more collaborative opportunities across the sector on key technological solutions and pilot projects, such as the Mission Possible Platform Low-Carbon Emitting Technologies Initiative, and other leading industry associations, such as the International Council of Chemical Associations. **Customers** should respond to supply-side innovation and incentivize procurement of low-carbon, certified chemical products. Each and every sector of the global economy benefits from the chemicals sector, so both demand- and supply-side businesses must set long-term net-zero emissions reduction to 2050 or earlier, supported by short/mid-term targets recognized by SBTi.

By 2030, global chemical sales are expected to double from those of 2017, with demand largely driven by Asia (70 per cent), specifically China (50 per cent). Businesses and RD&D professionals must accelerate plans for breakthrough technology deployment through further demonstration of next-generation technologies, with at least two large-scale biomass demonstration projects, several large-scale CCUS and clean electrification (1–10 tonnes/hour) and plastic waste (50–200 kilo tonnes) demonstration projects in operation in prioritized regions, with a proliferation of large-scale low-carbon hydrogen demonstration projects on a global scale. Policymakers and the investor community must support an increase in carbon prices to USD 60–100 per tonne to unlock the investment required to facilitate such technology deployment at scale.[10]

[9] IEA, "The Future of Petrochemicals", 2018.

[10] Mission Possible Platform, "Reaching net-zero carbon emissions from harder-to-abate sectors by mid-century: sectoral focus plastics", 2018.

Plastics

In plastics, various decarbonization pathways and roadmaps exist (pending the SBTi chemicals roadmap, due later in 2020), but more cross-industry collaboration is needed to reduce plastic demand, promote circularity throughout the value chain, and drive ambition across the sector. The global plastics sector accounts for 30 per cent of the global chemicals sector emissions (1.5 Gt total direct emissions per year). Plastics is a complex sector due to the wide range of materials and products used by different demand markets, although the primary use is polyethylene terephthalate for packaging. Demand for plastics has outpaced that of all other bulk materials (such as steel, aluminium or cement), and upstream production will nearly triple over the next 30 years (322 Mt in 2015 to 818 Mt projected in 2050), with a corresponding rise in emissions (732 Mt CO_2 in 2015 to 2,105 Mt CO_2 projected in 2050).[11] Downstream, plastic waste remains a global challenge; current commitments by governments and industry only reduce the annual volume of plastic flowing into the ocean by 7 per cent by 2040 and do not significantly curb the projected growth in plastic production.[12] Solutions vary by end-market and geography, but a globally coordinated approach to key issues like product design and waste management is key to realize and deliver solutions locally.

Key actors throughout the system have important roles to play to support the decarbonization of the plastics sector to 2050. Policymakers should establish and promote international circular product redesign principles (Ellen MacArthur Foundation's Global Plastic Protocol advocates for such coordination) and ensure that ambitious waste management tax structures are in place (e.g. China is looking to implement an Extended Producer Responsibility policy framework in 2025). **Finance stakeholders/investors** should support an incentivized secondary plastics market (e.g. with Extended Producer Responsibility fees and appropriate carbon pricing). Interventions are particularly key in the East Asia and Pacific region, which accounts for approximately 60 per cent of mismanaged plastic waste.[13] **Technology** is a key enabler for the sector, enabling various important decarbonization routes including: reducing demand as a primary measure (e.g. restricting single-use plastic wherever possible and then encouraging a circular economy for plastics through recycling and reuse); improving energy efficiency of production; decarbonizing the production process (e.g. through electrification and CCS); and decarbonizing feedstock (e.g. through alternative feedstock use). **Supply-side and demand-side businesses** should: set ambitious industry commitments (e.g. the Ellen MacArthur Foundation Global Commitment to 2025); increase reporting and disclosure in line with the Task Force on Climate-related Financial Disclosures; use circular product redesign principles (using less plastic or alternative materials where possible); and set long-term net-zero emissions reduction to 2050 or earlier, supported by short/mid-term targets recognized by SBTi. Finally, **civil society** has a key role to play in strengthening public awareness of the externalities or "hidden costs" of carbon-intensive plastic production and poor waste management (e.g. biodiversity impacts), through campaigns, media coverage, and calls to action.

[11] Mission Possible Platform, "Reaching net-zero carbon emissions from harder-to-abate sectors by mid-century: sectoral focus plastics", 2018.
[12] The Pew Charitable Trusts and SYSTEMIQ, "Breaking the Plastic Wave", 2020.
[13] Our World in Data, "Plastic Pollution", 2018.

By 2030, policymakers must support measures to ensure zero plastic in the ocean and push key regions to raise ambition for existing recycling targets (e.g. European Commission and 100 per cent plastic packaging recyclable and 60 per cent plastic recycling targets by 2030), along with establishing clear national policy to standardize material inputs to enable circular design and increase the use of recycled content in plastic products. Businesses and RD&D professionals must accelerate plans for breakthrough technology deployment through further demonstration of next- generation technologies, and help raise ambition across the value chain in key trade associations and leading plastic networks/initiatives. Policymakers and the investor community can support an increase in carbon prices to USD 60–100 per tonne to unlock the investment required to facilitate such technology deployment at scale.

Metals & Mining

In metals & mining, accelerated action is needed to boost sustainable mining practices and drive portfolio shifts, and more value chain collaboration is required to address scope 3 emissions downstream and drive ambition across the sector. The global mining industry – responsible for 4 per cent to 7 per cent of total global greenhouse gas (GHG emissions – is early on its journey to set emission reduction goals and faces pressure to build climate resilience. As of September 2020, 5 of the top 20 global mining companies by market capitalization have committed to net-zero carbon emissions by 2050 or sooner (operational scope only) with only one target validated through the SBTi.[14] Demand signals need to come from a wide range of end-markets, including infrastructure and urban development, power and electricity, mobility, manufacturing, retail/consumer, and telecommunications..

Key actors throughout the system have important roles to play to support the decarbonization of the metals & mining sector to 2050. Policymakers should set clear, ambitious emissions reduction targets in-country and encourage political collaboration across regions – for example, through initiatives such as the Intergovernmental Forum on Minerals, Mining and Sustainable Development. **Finance stakeholders/investors** should establish widespread industry use of responsible mining standards, such as the Initiative for Responsible Mining Assurance (IRMA), and promote leading industry initiatives (e.g. the World Bank Climate Smart Initiative). **Technology** is critical for the sector, enabling various key decarbonization routes, including: boosting renewable energy supply and storage (as mining emissions are largely driven by electricity supply); driving operational efficiency improvements; increasing electrification; and encouraging recycling and new business models. **Supply-side miners and producers** should: ensure leadership participation in sectoral sustainable mining initiatives, such as the International Council on Mining and Metals (ICMM); align with a decarbonization agenda through increased emissions disclosure; ensure sustainable portfolio management and reprioritization (as the production of minerals such as

[14] High-Level Climate Action Champion analysis, 2020.

graphite, lithium and cobalt will increase by 500 per cent by 2050 to meet growing demand for clean energy technologies);[15] maximize collaborative supply chain investment in sustainable mining activity (particularly key since 80 per cent of copper production in Chile, a critical mineral for the green transition, is located in water-stressed areas, and by 2040 it will be 100 per cent);[16] boost renewable energy supply/storage capacity; and set ambitious decarbonization targets to 2050. Finally, **civil society** has an important role to play by continuing to expose the hidden environmental and social costs of unsustainable mining practices on biodiversity and local communities, and by holding producers to account.

By 2030, all mining companies should make public commitments to renewable energy sourcing to ensure that 50 per cent of global mine electricity is supplied by renewables. Major mining companies must demonstrate significant reductions in GHG emissions/energy use and continuing improvements in Environmental, Social and Governance (ESG) performance through disclosure of independent, third-party audit using mechanisms such as IRMA. (Please refer to the Steel and Aluminium sections for more detailed information by commodity.)

Retail

In retail, global action and leadership are required to establish key milestones for the sector and to ensure delivery through effective collaboration, with the United Kingdom's 2020 efforts to set out a national Climate Roadmap setting a strong example. The retail sector includes businesses engaged in the sale without transformation of new and used goods, mainly to the general public, for personal or household consumption or use. No comprehensive study has recently been conducted on the emissions impacts of the sector globally, with regards to retailing activities specifically, or the cumulative emissions profile of retail companies. A total of 10 per cent of the market by revenue is covered by an SBTi or United Nations Global Compact (UNGC) Business Ambition 1.5 classification, while only 4 per cent has set out a 1.5°C commitment under either scheme.[17]

As a downstream and consumer-facing industry, the retail sector is in a key position to influence not only consumption behaviours and patterns but also the activities of its suppliers and the consumer goods industry, by setting ambitious scope 3 targets and improving capabilities to measure and track them effectively. Further strategies to decarbonize the retail sector include operating efficient, net-zero sites powered by renewable energy, moving to zero-carbon logistics, sustainably sourcing raw materials, and helping customers live low-carbon lifestyles.

Key actors throughout the system have important roles to play to support the decarbonization of the retail sector. **Policymakers** have a key role in supporting whole life-cycle decarbonization for

[15] World Bank, "Minerals for Climate Action: The Mineral Intensity of the Clean Energy Transition", 2020.
[16] McKinsey, "Climate risk and decarbonization: What every mining CEO needs to know", 2020.
[17] Climate Champions analysis of Orbis Financial data extract for company sector revenues

buildings, creating incentives for moving towards renewable energy tariffs, improving building efficiency through enhanced certification requirements for landlords, supporting infrastructure for customer and logistics vehicle electrification, supporting regenerative agricultural practices, restoring and protecting land, and helping consumers lead low-carbon lifestyles, for instance through action on plastic packaging. **Supply chain actors** react to signals set by retailers, as they look to align with their buyers' decarbonization agendas. In meeting the commitments set by those agendas, suppliers may set science-based or net-zero targets, increase their level of disclosure, invest in R&D, and engage their own suppliers further upstream. Retailers can influence **demand** on the consumer side through product design changes, material substitution, environmentally positive advertising and marketing and information-sharing at the point of sale, and creating a positive feedback loop with the rest of the supply chain.

Civil society plays a role in strengthening public awareness of the externalities or "hidden costs" of carbon-intensive practices, through campaigns and calls to action, addressing information gaps to influence sustainable purchasing choices. **Finance and the investor community** can spur the development, scaling and uptake of critical technologies and reallocate capital from old, carbon-intensive assets and practices towards greener ones – for instance, through the development of energy-efficient and circular buildings. Mechanisms such as preferential interest rates, guarantee schemes and risk-sharing facilities can help drive this. **Technology and innovation** are needed to deliver climate-smart solutions. Focus areas for retail will be in the electrification of heavy-goods vehicles (HGVs), designing green and circular buildings, scaling supply chain traceability solutions, and shifting to natural refrigerants and more efficient refrigeration. The development of energy storage systems for the on-site production of renewable energy or, alternatively, the deployment of smart grids to distribute the energy surplus from variable renewable energy sources are other key focus areas.

By 2030, whole life-cycle carbon emissions from buildings must be significantly reduced, with all new buildings as nearly-zero-energy buildings and emissions intensity ($kgCO2e/m^2$), following reduction trajectories for commercial real estate as set out by the Carbon Risk Real Estate Monitor global pathways. A total of 100 per cent of renewable energy must be sourced at all sites, with 100 per cent Light-Emitting Diodes (LEDs) adopted in new buildings, and 80 per cent in existing buildings. To meet the requirements of the European Union F-Gas Regulations by 2030, hydrofluorocarbon refrigerant gases must be reduced by 79 per cent. By 2030, retailers must have transitioned their entire large-goods vehicle (LGV) fleets to 100 per cent zero carbon and made significant progress in decarbonizing both last-mile logistics and their HGV fleets. Retailers must ensure zero deforestation from major commodities, that farmland under regenerative practice in their own supply chains is doubled, and that food waste is cut by 50 per cent at the retail level. On the consumer side, retailers should increase sales of circular products by 50 per cent, provide climate information on all products, and eliminate problematic plastic packaging.

Fast-Moving Consumer Goods

Although the fast-moving consumer goods (FMCG) sector is well represented in climate leadership at the individual brand level, no global decarbonization roadmap has been identified for the sector, and existing efforts to baseline carbon emissions are poor. An often-cited figure, based on McKinsey analysis, suggests that the sector is responsible for an estimated annual **33GtCO2e emissions**, or 60 per cent of global total. The same analysis suggests a future expected industry growth rate of 5.3 per cent per annum for the next two decades, and that the sector must reduce emissions by more than 50 per cent in order to meet 2050 targets required to maintain warming at below 1.5°C.[18]

As a downstream industry with an increasing share of direct-to-consumer route-to-market channels, the FMCG sector is in a key position to influence consumption behaviours and diets through ingredient sourcing, product design and category choices. More than 80 per cent of FMCG GHG emissions lie within supply chains, yet only 25 per cent of companies currently engage their suppliers to address these emissions, creating an opportunity to influence upstream emissions with stronger scope 3 target-setting and monitoring.[19] Further strategies to decarbonize the FMCG sector include tackling commodity-driven deforestation, reducing food waste, reducing the use of harmful refrigerants, moving to zero-carbon logistics, and addressing the growing issue of plastic waste.

Actors throughout the system have important roles to play in supporting the decarbonization of the FMCG sector. **Policymakers** play a role in accelerating the deployment of low-carbon logistics, investing in circular economy solutions, eliminating deforestation, extending producer responsibility for waste and plastic packaging, supporting regenerative agricultural practices, restoring and protecting land, and helping customers to lead low-carbon lifestyles. **Supply chain actors** upstream and in the agriculture sector react to signals set by FMCG companies as they look to align with their buyers' decarbonization agendas, thus forming a key feedback loop. Strengthening standard certification for soft commodities by investing in producer capacity-building will enable brands to preserve integrity in reporting on scope 3 emissions. Supply chains should be transparent, traceable and working towards a goal of zero natural deforestation. **Demand on the consumer side** can be influenced by FMCG through category innovation (e.g. in alternative proteins as a substitute for meat), product design changes (e.g. to increase shelf-life), carbon labelling, and environmentally positive advertising and marketing of brands, creating a positive feedback loop with the rest of the supply chain. **Civil society** plays a role in strengthening public awareness of the social and environmental externalities or "hidden costs" of carbon-intensive practices, such as the loss of natural habitats as a result of deforestation. **Technology and innovation** are needed to deliver climate-smart solutions. Focus areas for FMCG will be in the electrification of heavy-good vehicles, eliminating natural gas from heating and cooling processes, scaling supply chain traceability solutions, developing low-carbon last-mile delivery for growing e-commerce services, overcoming

[18] IPCC & McKinsey, 2016.
[19] Of companies that report to CDP.

technical barriers to recycling, designing products which minimize in-use consumer emission footprints, developing effective substitutes for plastic, and shifting to natural refrigerants and more efficient refrigeration.

By 2030, FMCG companies must ensure zero deforestation from sourcing of major commodities, that farmland under regenerative practice in their own supply chains is doubled, and that food waste is cut by 50 per cent within own operations and at the consumer level. Sales of circular and plant-based products should increase by 50 per cent, with climate information appearing on all products. In accordance with the Ellen Macarthur Foundation's Plastics Pact, problematic plastic-packaging should be eliminated. Of remaining plastic packaging, 100 per cent should be reusable, recyclable or compostable, and recycled content should be significantly increased. To meet the requirements of the European Union F-Gas Regulations by 2030, hydrofluorocarbon refrigerant gases must be reduced by 79 per cent. By 2030, FMCG companies must have transitioned their entire LGV fleets to 100 per cent zero carbon and made significant progress in decarbonizing both last-mile logistics and their HGV fleets. Finally, 100 per cent of renewable energy must be sourced at all sites, with 100 per cent of LEDs adopted in new buildings, and 80 per cent in existing buildings.

Apparel

In apparel, various carbon assessments and analyses exist, however further cross-industry collaboration is required to build consensus around decarbonization milestones and a shared narrative on addressing focal areas. The apparel sector is a highly GHG-intensive industry, with estimated emissions ranging from 1.2 billion to 3.9 billion tonnes of CO_2e annually, or 2–8 per cent of the global total. More than 70 per cent of the emissions come from upstream activities, particularly energy-intensive raw material production, preparation and processing. The remaining 30 per cent are generated by downstream activities such as transport, packaging, retail operations, usage and end of use.[20]

High demand growth for apparel of up to 63 per cent is anticipated over next 10 years in some emerging markets. This follows the trajectory of the past 15 years, where global production of clothing doubled despite garment utilization dropping by 36 per cent.[21] Under its current trajectory, the apparel industry will miss the 1.5°C pathway by 50 per cent.

Key carbon impact areas for the apparel sector are manufacturing and fibre production, which includes the sourcing of material alternatives to high-carbon fibres such as cotton, the procurement of renewable energy, and the phase-out of coal for the production of industrial heat. As a downstream and consumer-facing industry, the sector is in a key position to influence consumption patterns as well as in-use impacts, and so the circular economy should continue to be leveraged as a key enabler of behavioural change. Overall, 60 per cent of abatement potential lies in decarbonizing

[20] Fashion on Climate, McKinsey and GFA, 2020
[21] A New Textiles Economy, Ellen MacArthur Foundation, 2017

upstream operations, 20 per cent lies in brands' own operations, and 20 per cent relies on encouraging sustainable consumer behaviours. Other analysis shows that roughly 250 million tonnes of CO2e could be reduced through a 50 per cent shift to renewable energy in tier 2 and 3 production.[22]

Key actors throughout the system have important roles to play in decarbonizing the apparel sector. **Policymakers** have a key role in supporting energy decarbonization by catalysing investment, developing incentives for manufacturers to move towards renewable tariffs, strengthening extended producer responsibilities and penalties for "fast fashion", improving recycling infrastructure, standardizing taxonomies, restoring and protecting land, ensuring that coal used for the production of industrial heat is phased out in a timely manner, taking action on microfibre pollution in oceans, enabling circular economy initiatives, and helping consumers lead low-carbon lifestyles. **Supply chain actors** are influenced by the scope 3 commitments of downstream and customer-facing apparel brands, forming a key feedback loop. Helping create favourable policy environments for renewable energy procurement in key producer markets and strengthening standard certification for crops such as cotton by investing in producer capacity-building will enable brands to preserve integrity in reporting on scope 3 emissions. **Demand on the consumer side** can be influenced through changes in product design, material substitution, greater investment in recycling, repair and reuse of clothing at end of life, and the promotion of "greener" consumption habits at the point of sale and through advertising and marketing, thus creating a positive feedback loop with the rest of the supply chain. **Civil society** plays a role in strengthening public awareness of the externalities or "hidden costs" of carbon-intensive practices – for instance, the high waste volumes and low quality and hence low garment utilization rates particular to "fast fashion" business models. **Finance and the investor community** can spur the development, scaling and uptake of critical technologies and reallocate capital from old, carbon-intensive assets and practices towards greener ones. Philanthropic capital can also support capacity-building and investment in producer markets. **Technology and innovation** are needed to deliver and scale synthetic, recycled and alternative fibres for garment production, mechanical and biological fibre recycling techniques, and virtual and augmented reality concepts, which may support reductions in overall consumer demand.

By 2030, the apparel industry must meet a USD 20–30 billion financing requirement, to fund and scale the innovative technologies needed to unlock a circular textiles economy. Overall, businesses must meet UNFCCC Fashion Charter's headline commitment to reduce emissions across all scopes by 30 per cent by 2030. Brands must source 100 per cent renewable energy across their value chains and achieve 80 per cent efficiency gains in retail operations and across heating, ventilation and air-conditioning equipment. In terms of material mix, more than 50 per cent of global cotton produced must be sustainable by 2030, with use of alternatives such as recycled polyester, organic and bio-based materials significantly increased. In promoting changes in consumer buying patterns and the

[22] Roadmap to Net Zero, World Resources Institute and Apparel Impact Institute, 2020

shift to more circular behaviours, brands must trade one in five garments through circular business models and reduce e-commerce return rates to 15 per cent (from 35 per cent).

Information and Communications Technology (ICT) & Mobile

Leading ICT and mobile businesses have already substantially decarbonized by switching to renewable energy suppliers, investing in energy efficiency improvements, and supporting suppliers to do the same. These sectors account for approximately 1.4 per cent of global GHG emissions. They can decarbonize rapidly and have the huge potential to act as change agents for other sectors. They established their own pathway in line with a 1.5°C scenario with SBTI, working with the United Nations International Telecommunication Union (ITU), mobile industry association, and the Global eSustainability Initiative. Over 20 per cent of ICT and mobile sectors have set 1.5°C SBTs or committed to the UN Global Compact Business Ambition for 1.5°C. The ITU pathway requires reductions from subsectors ranging from 45 per cent to 62 per cent between 2020 and 2030 for network and data centre operators, with further work ongoing for other subsectors. This and other pathways make clear the **heavy reliance on a switch to renewable energy** – it is estimated that 80 per cent of carbon reductions can be achieved by operators and their suppliers buy switching to renewable energy.

The ICT & Mobile **sectors accelerate change in other sectors**, and have the potential to help them to decarbonize and improve their resilience – their enablement effect. They are also a valuable channel for enabling agency in their end-users, who number more than 5 billion. To deliver on this potential, they must move quickly on renewable energy in their own operations and supply chains in order to decarbonize the internet –forming a "green cloud" – and improve circularity in end-user products.

For resilient, decarbonized ICT and mobile sectors, action is required in four areas that will drive exponential change within their own systems and the wider economy. **Operational Efficiency** – ICT and mobile operators consume large amounts of electricity in their direct operations. Commercial feedback loops continue to drive efficiency improvements; reducing costs of renewables and policy changes in many markets will accelerate the adoption of renewable energy. At the same time, operations must be resilient against increasing extreme weather events and rising sea levels. **Supply Chain** – The recognition that the supply chain may be responsible for over half of its total end-to-end value chain emissions drives operators pursuing SBTs to partner with suppliers on their emissions reduction programmes, addressing disclosure and target-setting. Such programmes cover emissions reduction activities, including energy efficiency, renewables uptake, process efficiency, reducing material waste, smarter logistics, reduced packaging, and raw materials with lower embodied carbon, among other. **Devices and e-Waste** – Enterprise customers and consumers of ICT devices are increasingly demanding low-carbon, low-waste products. This is driving equipment suppliers not only to drive emissions reductions in their supply chains, but also to innovate in ways that move from a linear economy to a circular one: extending their products' use phase and expanding options for reuse and recycling. **Enablement** – ICT and mobile sectors recognize the commercial opportunities in decarbonization and resilience in other sectors. From Social Media, e-commerce and the Internet

of Things, through to AI, 5G, Blockchain and Digital twins, ICT is changing the way the economy works. These changes will increasingly drive efficiencies in other sectors, from Energy to Transport, the Built Environment, Health, to Agriculture. The right policy environment is required to ensure that these efficiencies deliver more resilience and faster decarbonization and not an acceleration of carbon-intensive activities.

Policymakers can support the ICT and mobile sector transformation with continued support for the energy sector to move towards 100 per cent renewables, and to enable direct procurement by the sector globally of additional renewable energy capacity, driving demand from the sector's own operations and supply chains. Policy changes are also required to stimulate circular economy innovation for ICT devices. For the ICT and mobile sector to enable wider resilience and decarbonization across the economy, policies that incentivize dematerialization and encourage rollout of high-speed digital connectivity are key. **Finance** and investment are needed to support and scale up "clean technology" innovation and to create markets for renewable energy across multiple sectors. **Technology** and innovation are critical to deliver the step-change efficiency improvements needed to continue to support accelerating growth of data across networks and services. **Business** and services must get behind the switch to renewable energy and decarbonization of operations through campaigns such as RE100, EV100 and EP100. Older, less efficient technologies must be decommissioned. Device and service product information is needed to inform consumers of the CO_2e content of their purchases. With the above changes, **civil society** can get behind policies and businesses that decarbonize ICT, promote a "clean internet" and enable the transformation of other sectors in the economy.

By 2030, it must be possible for operators in these sectors to purchase renewable energy directly at a price that reflects the lower wholesale costs of renewables, and policy incentives for the switch to renewable energy must be implemented. Solutions must be developed for the sectors' remote sites and fleets to operate with renewable energy. Policies need to be enacted that will encourage the dematerialization of business processes – and a shift from products to services – in all sectors of the economy to leverage ICT's ability to decarbonize well beyond its own operations. High-speed digital connectivity needs to be extended to support remote working and inclusiveness. Business models must be launched that provide zero-carbon use by consumers, and customers need to know the carbon impact of the products and services they purchase. The majority of ICT devices must be reused or recycled.

MILESTONES TOWARDS 2050

	By 2021	By 2025	By 2030	By 2040
Steel	• 20 major construction, automotive, infrastructure, other end-customer companies have set 2030 green steel procurement commitments	• A substantial portion of all new construction is covered by gradually increasing targets for net- zero embodied and operational emissions • Differentiated low- to zero-carbon markets are established	• At least 10 commercial-scale low- to zero-carbon steel facilities in place	• More efficient building design, reuse, and high utilization buildings and transport avoid nearly 400 Million Metric Tonnes (MMT) per annum production of steel. • Green commercial steel facilities are operational and producing 500MMT total annual capacity
Concrete & Cement	• A sector wide roadmap in place to reach a net zero by 2050 ambition		• First integrated Net Zero cement plant fully operational	• 5 of top 10 cement producers being carbon negative
Aluminum	• A sector wide roadmap in place to reach a net zero by 2050 ambition	• 10% of global production committed to roadmap	• First Net Zero Smelter fully operational • Core sustainability contracts launched on central exchange platform at LME's low-carbon Aluminium exchange	• Recycling: collection rates for end-of-life products is 95%; recovery of collected scrap is at full value
Chemicals	• Chemical companies align net zero target ambition and reporting with SBTi roadmap	• Technology readiness level of at least two key decarbonization technologies increased	• Food waste is halved per capita in the European Union (through efficient fertilizer use) • Carbon price of USD 60–100 per tonne CO_2 is in place • Several large-scale pilot projects are in-flight across key technology	• Global demand mechanism is established for green chemical supply • There is a proliferation of large-scale demonstration projects on a global scale • 100,000 kilotonnes of waste are recycled into chemicals and plastics

Plastics	• China establishes leading Extended Producer Responsibility policy framework for plastic waste • European Union single use plastics ban	• Problematic or unnecessary plastic packaging is eliminated (100% of plastic packaging to be reusable, recyclable, or compostable) • 55% recycling is taking place across the European Union	• No plastics are in the ocean • 60% recycling is taking place across the European Union • Carbon price of USD 60–100 per tonne CO_2 is in place • Several large-scale pilot projects are in-flight across key technology solutions	• All major geographies have a plastic recycling bill in place and have met set targets • 65% recycling taking place across the European Union (by 2035) • >50% total energy demand is emission-free • 100,000 kilotonnes of waste is recycled into chemicals and plastics
Metals & Mining	• All leading mining companies participate in key sector initiatives/networks (e.g. ICMM) • UK to join the World Bank Climate Smart Mining Initiative	• Major mining companies have all of their mines independently verified as reducing GHG emissions/energy use and are measured against leading external ESG standard (e.g. IRMA)	• 50% of global mining electricity supplied by renewables • Major mining companies have all mines show further reductions in emissions through 3rd party audits	• Major mining companies have majority of their mines certified against leading ESG standard (e.g. IRMA) • All major countries with mining operations to participate in leading financing initiatives (e.g. World Bank Initiative)
Retail	• Retailers with >$1bn in revenues set an SBTi with comprehensive scope 3 targets • All new buildings to be zNEBs by 2020 (European Parliament) • Zero food waste to landfill by 2020 (Vision 2020)	• Top suppliers committed to net zero and/or SBTs • Plastics Pact targets observed (EMF)	• LGV fleets at 100% zero carbon • 100% RE sourced at all sites • 100% LEDs in new buildings • On-pack climate information on 100% products • 50% reduction in food waste at the retail level (Champions 12.3)	• Industry at 100% net zero carbon • HGV fleets at 100% zero carbon • Use only low impact refrigerant gases (max 150GWP) for all systems
Fast- moving consumer goods	• FMCG companies with >$1bn in revenues set an SBTi with comprehensive scope 3 targets • 100% sustainable palm oil (RSPO)	• Ensure top suppliers committed to net zero and/or SBTs • Plastics Pact targets observed (EMF)	• Zero deforestation major commodities • On-pack climate information on 100% products • Double farmland under regenerative practice • 50% reduction in food waste at the	• HGV fleets at 100% zero carbon • Net zero agricultural production • Protect 50% land

			consumer level (Champions 12.3)	
Apparel	• Expand signatory base to cover 50%+ brands by sales (Fashion Charter) • $1 billion green bond issuance from brands	• 50% global cotton produced to be sustainable (Textile Exchange) • EU Member States required to set up separate collection of textiles by 2025 (Policy Hub)	• 30% emissions reduction across all scopes (Fashion Charter) • $20-30 billion required in financing per year (BCG, GFA)	• Net zero GHG emissions across scope 1, 2 and 3 by 2050 (Fashion Charter)
ICT & Mobile	• Set target dates no later than 2040 for operators to run 100% on RE	• Policy incentives for ICT to enable other sectors to decarbonize	•	• Sector operations 100% on RE

PROGRESS

In the steel sector, progress is building on several fronts. Growing awareness of improved design potential grows, as more efficiently designed buildings become mainstream – for example, the 128-story Shanghai Tower, which shrank structural systems by 24 per cent. The European Union Green Deal's Circular Economy Action Plan will revise materials' recovery targets in waste and integrate the European Union Sustainable Finance Framework with the required life-cycle assessment in public procurement (improving on California's Environmental Product Declaration requirements). Innovation in alternative materials markets is accelerating, as cross-laminated timber demand booms in both mid- and high-rise buildings (e.g. a 350-metre wood tower planned in Japan). In addition, 5 per cent of global production capacity is now covered by commitments to net zero by 2050 through the recent announcement by ArcelorMittal, the world's largest steel producer. Driven by renewable energy's role as the cheapest form of energy on earth, direct and indirect electrification of primary and secondary steel production is set to increase through the 2020s: three commercial-scale production facilities envisioning the use of green hydrogen have been announced for delivery this decade. The Clean Construction Forum, led by the City of Oslo and supported by C40, will leverage the collective purchasing power and political clout of cities to develop a market for low-emission construction materials and construction equipment, matched by the SteelZero Initiative's announcement of low-carbon steel procurement commitments among the private sector. These are facilitated by increasing transparency of steel supply chains embodied by the multi-stakeholder Responsible Steel standard launched last year.

In the concrete & cement sector, 2020 has seen the launch of the Global Cement and Concrete Association's 2050 Climate Ambition for carbon-neutral concrete by 2050 and the European Cement Association's 2050 Carbon Neutrality Roadmap. Several of the top-producing companies have clear ambitions launched for carbon neutrality in 2050; Indian producer Dalmia raised that ambition mid-2019 by announcing the target of being carbon-negative by 2040. Overall, nearly one third of global production is in line with the targets of the Paris Agreement. Generally, progress will need to be achieved faster compared to recent years; the industry has delivered a 19 per cent reduction in carbon emissions per tonne compared to 1990. Important are the increasing signals from the technology front around memoranda of understanding being signed to scale up efforts in the field of CCU/CCS.

In the aluminium sector, progress needs to pick up speed. Recent months have seen net zero announcements from several key sector players, among them Rio Tinto. There is a growing schism between companies that see clean aluminium as a market opportunity with higher prizes and producers that are less willing to change along this pathway. Certainly, if producers are serious, they need to be looking beyond the issue of power generation. Ultimately, large investments are needed in new smelting technologies. Several innovations exist, such as inert anodes, which are designed to make smelting carbon-emissions-free. More collaboration and policy support are needed to ensure proper scaling up and higher impact. The newly announced commitment by China to achieve carbon neutrality by 2060 could be a real game-changer, as half of all global aluminium production is coming from China, with the majority of the production being still fossil-based.

In the chemicals sector, more progress is needed to raise net zero ambition amongst key players. Scope 3 is a particular challenge, given the length of value chains across the many demand sectors the chemicals industry serves. Leading global chemical companies have begun to set science-based targets that meet broad Science Based Targets initiative (SBTi) criteria but as of September 2020, only 4 of the top 50 global chemical companies have committed to net zero carbon emissions by 2050 or sooner, and only one of these targets is validated through SBTi. SBTi is currently developing sector-specific methods and guidance for chemical companies to set science-based targets, which should elicit more ambitious commitment through 2021. The majority of technologies required to decarbonize the chemicals sector - like carbon capture utilization and storage (CCUS) or low-carbon hydrogen - remain in pilot or pre-commercial stages. Therefore, leading initiatives like the Mission Possible Collaborative Innovation for Low-Carbon Emitting Technologies in the Chemical Industry, bringing together 20 leading chemical companies, play a key role to align on and realise large-scale technology demonstration

In the plastics sector, more work is needed to reduce demand in order to mitigate emissions through production upstream and reduce plastic waste downstream**.** Current commitments by governments and industry only reduce the annual volume of plastic flowing into the ocean by 7 per cent by 2040 and do not significantly curb the projected growth in plastic production. There has been more progress promoting reuse and recyclability, particularly for plastic packaging, with leading initiatives like the Ellen MacArthur Foundation Global Commitment representing 20 per cent of all plastic packaging produced globally (plus governments and non-state actors) calling for a circular economy on plastics and commitment from the European Commission that all packaging in the EU market will be reusable or recyclable by 2030. There is increasing recognition that the existing international legal framework governing plastic pollution is fragmented and ineffective, to the extent that the UN Environment Assembly intends to facilitate negotiations on an International Plastics Treaty next year (2021). But more ambitious policy and regulation on plastic production and waste management, combined with more support and funding in local regions and cities to ensure effective recycling infrastructure and funding is available, is critical.

In the metals & mining sector, there is ongoing pressure to accelerate the transition to a low-carbon economy. The sector has a key role to play in supplying the 'climate-smart' minerals and metals needed for the energy transition, from batteries (e.g. cobalt and lithium) to energy storage (e.g. aluminium and copper). Boosting renewable energy supply and storage is critical, as mining emissions are largely driven by electricity. Goldcorp's pilot all-electric gold mine has the potential to reduce annual GHG emissions for the mining company by 70 per cent. Long-term vision and leadership are also key. Leading miners like Anglo American, Rio Tinto, and BHP Billiton have made net zero by 2050 commitments across their own operations, Vale has taken their own net zero commitment a step further with a target validated through SBTi, and coal-miner Glencore has taken a bold step committing to reducing absolute scope 3 emissions by 30 per cent by 2035. Leading sustainable mining coalition the International Council on Mining and Metals (ICMM) and mining standard Initiative for Responsible Mining Assurance (IRMA) also play key roles in raising ESG performance across the mining sector, and in October 2020 IRMA published their first public audit report on Carrizal Mining (a miner in Mexico). Continued effort is needed to align this progress with a decarbonization agenda in line with a 1.5C trajectory.

In the retail sector, there have recently been some encouraging examples of progress from policy and industry actors. In Britain, the industry association British Retail Consortium developed a 2020 Climate Roadmap, detailing actions required from policy and business actors, signposting towards key initiatives and launching net zero targets across all scopes. Over 50 of their members have committed to the plan, which includes milestones for action for 2025, 2030, 2040 and 2050 across key areas such renewable energy, low carbon logistics, sustainable sourcing and consumer behaviour. This has been supported by public policy requests to the UK government in support of the targets, building on recent legislation such as that prohibiting illegal deforestation for UK companies. Elsewhere in the world, in terms of best performance at a regional level, 30 per cent North American retail companies by market revenue are covered by an SBT or UNGC Business Ambition 1.5 classification whilst in Oceania, 21 per cent have set out a 1.5 degrees commitment under either scheme.[23]

In the FMCG sector, no global decarbonization roadmap had been identified as of November 2020, although the British Retail Consortium's 2020 Climate Roadmap, whilst developed with a predominantly retail focus, features many areas of common relevance. Various civil society and industry actors are leading on topics such as plastics and packaging, food waste and deforestation, whilst brands are increasingly directing research and innovation resources towards solving for these issues. In terms of the level of industry commitment, 32 per cent of the market by revenue is covered by an SBT or UNGC Business Ambition 1.5 classification, whilst 11 per cent have set out a 1.5 degrees commitment under either scheme.[24] In terms of best performance at a regional level, 53 per cent North American FMCG companies by market revenue are covered by an SBT or UNGC Business Ambition 1.5 classification whilst in Latin America, 41% have set out a 1.5 degrees commitment under either scheme.[25]

In the apparel sector, system-wide collaboration is required to reduce emissions to net zero by 2050 across all scopes and by at least 30 per cent by 2030. In terms of commitments, only 17 per cent of the market by revenue is covered by an SBT or UNGC Business Ambition 1.5 classification, whilst 11 per cent apparel companies have set out a 1.5 degrees commitment under either scheme. In terms of best performance at a regional level, 43 per cent European apparel companies by market revenue are covered by an SBT or UNGC Business Ambition 1.5 classification whilst in Latin America, 22 per cent have set out a 1.5 degrees commitment under either scheme.[26] Efforts are ongoing to develop a commonly-accepted approach of segmenting the apparel value chain so that the source and volume of emissions is better understood and more commonly quantified across the industry. Several key multi-stakeholder organizations convened by UNFCCC Fashion Charter are working on decarbonization analysis in a cross-industry consultation that will continue until February 2021.

[23] Climate Champions analysis of Orbis Financial data extract for company sector revenues

[24] A high degree of sensitivity (50%+) must however be noted regarding the denominator or industry market size used for this calculation. Due to the industry's high fragmentation and proportion of private players, the true baseline is expected to be higher than that observed through publicly-available financial data, and so sector progress is likely to be lower than that reported here.

[25] Climate Champions analysis of Orbis Financial data extract for company sector revenues.

[26] Climate Champions analysis of Orbis Financial data extract for company sector revenues.

In the ICT & mobile sectors, net-zero commitments are accelerating. Companies representing over 50 per cent of global mobile revenues are committed to setting science-based targets, and over 20 per cent have set a 1.5°C target or have committed to the UN Global Compact Business Ambition for 1.5°C. Notable brands in ICT and mobile have already matched their energy use with 100 per cent renewable energy supplies and supported their supply chains to do the same. More work is needed to increase use of renewable energy in the ICT supply chain, and challenges remain in decarbonizing remote operational sites for mobile, where diesel generators provide power. ICT devices represent over 50 per cent of emissions in the sector, and more work is needed to: provide more consumer information about product emissions; continue to extend their life cycles; and make them more easily refurbished and reusable. The opportunities for the ICT and mobile sectors to decarbonize the wider economy are increasingly recognized, and further policy support would encourage a faster switch from high-carbon products to low-carbon, efficient digital solutions, provided that the sectors continue to decarbonize their own operations, products and services. Resilience is being built into ICT and mobile sectors as they adapt to a warmer world and more frequent extreme weather events.

INDUSTRY COMMITMENTS AND INITIATIVES

- Over 1,100 companies have signed up to the Race to Zero campaign to send a resounding signal to governments that businesses, cities, regions, universities and investors are united in meeting the Paris goals and creating a more inclusive and resilient economy. These companies have made a commitment through one or more of the following initiatives:
    - 1.5 C Business Pledge: The 1.5 C Business Pledge represents a call to action for leading companies to step up and commit to setting science-based targets aligned with limiting global temperature rise to 1.5°C above pre-industrial levels.
    - The Climate Pledge: A joint initiative between Amazon and Global Optimism, The Climate Pledge was founded on the conviction that global businesses are responsible, accountable, and able to act on the climate crisis, and that doing so would transform societies and what's possible with collective action. The Climate Pledge brings together the far-reaching capabilities of the most ambitious and forward-thinking actors in global enterprise, to galvanize meaningful change. It's the opportunity for companies to join a community of leading businesses, all committed to the transformational action that can protect the global economy from the disruptive risks associated with climate change.
    - Exponential Roadmap initiative: The Exponential Roadmap Initiative brings together organisations which are taking action in line with the 1.5°C ambition, ranging from technology innovators, scientists, companies and NGOs, with the mission to accelerate climate action exponentially.
    - B Corp Climate Collective: The B Corp Climate Collective is a group of Certified B Corporations working together to take action on the climate emergency. Recognizing its unique and powerful role as purpose-driven businesses to reverse climate change, the

collective is working to identify concrete steps to accelerate climate mitigation and to work collectively, as individual companies, and through cross-sector collaboration and public advocacy.

- SME Climate Hub : The SME Climate Hub is a pioneering initiative that aims to streamline the path for small and medium-sized enterprises (SMEs) to become climate-resilient businesses. The one-stop shop allows SMEs to make the internationally recognized SME Climate Commitment, access practical tools and resources to measure and help curb emissions, and unlock valuable commercial incentives. The SME Climate Hub is an initiative of the International Chamber of Commerce, the Exponential Roadmap initiative, the We Mean Business Coalition, and the UN Race to Zero campaign.

- Over 1,350 companies, representing nearly USD 19.3 trillion – or one quarter of global gross domestic product (GDP) – are taking bold climate action through the We Mean Business Coalition's Take Action campaign. Major initiatives include:
  - SBTi
  - WBCSD's SOS1.5
  - RE100
  - EV100
  - Business Ambition for 1.5°C.
- The Mission Possible Platform is a coalition of public and private partners working on the industry transition to set heavy industry and mobility sectors on the pathway to net-zero emissions by mid-century.
- Over 1,300 companies, including more than 100 Fortune Global 500 companies with collective annual revenues of about USD 7 trillion, have disclosed through the use of **internal carbon pricing,** or plans to implement internal carbon pricing within two years.
- Over 2,100 chambers of commerce, representing millions of businesses worldwide, have joined the International Chamber of Commerce's Chambers Climate Coalition, committing to set climate targets aligned with the 1.5°C goal and reaching net-zero emissions by no later than 2050.
- Climate Leadership Now, a new guide from the We Mean Business coalition, lays out the coalition's shared vision for what corporate climate leadership needs to look like in this critical decade.

FACTS & FIGURES

Industry represents the largest end-use sector, both in terms of final energy demand and GHG emissions. Its direct CO_2 emissions currently account for **about 25 per cent of total energy-related and process CO_2 emissions**, and emissions increased at an average annual rate **of 3.4 per cent** between **2000 and 2014,** significantly faster than total CO_2 emissions.[27]

It is **technically and economically possible** for hard-to-abate industrial sectors to reach net-zero emissions by mid-century at a cost of less than **0.5 per cent** of global GDP and with minor impacts on consumer living standards.[28]

Currently, **around 40 nationally determined contributions** include actions and plans in relation to heavy industries, such as cement, chemicals, iron and steel.[29]

In any feasible path to a net-zero carbon economy, **electricity's share** of total final energy demand will rise from today's **20 per cent** to over **60 per cent** by 2060.

Transitional solutions, such as natural climate solutions, will be particularly important in heavy industry, where many zero-carbon solutions are not yet market-ready.[30]

Achieving a net-zero CO_2 emissions economy will require an increase in global hydrogen production from a 60 Mt annual capacity of carbon-intensive hydrogen production today to between 580 and 900 Mt annual capacity of low- or zero-carbon hydrogen by mid-century.[31]

The real economy actors that have joined the Race to Zero campaign now cover over half of global GDP, a quarter of global CO_2 emissions and over 2.6 billion people, representing a 66 per cent increase in commitments since COP25.

SMEs represent 90 per cent of business worldwide and are vital to global supply chains, which represent 5.5 times more emissions than a company's direct emissions.[32]

[27] Source: IPCC 1.5°C Report
[28] Energy Transition Commission, Making Mission Possible; Delivering a net zero economy
[29] Mission2020 , https://mission2020.global/.
[30] Industrial transformation 2050, Pathways to Net-Zero Emissions from EU Heavy Industry.
[31] Energy Transition Commission, Making Mission Possible; Delivering a net zero economy
[32] Source: https://www.cdp.net/en/research/global-reports/global-supply-chain-report-2019