CLIMATE ACTION PATHWAY
INDUSTRY
Action Table

2020

ACTION TABLE STRUCTURE AND APPROACH

The purpose of this Industry Action Table document is to highlight specific, promotable, and time-bound actions with a sector-based approach, to deliver the 2050 Industry Vision outlined in the Executive Summary. This Action Table is organized by major industry sub-sectors. Each one is summarized, and a high-level system map and its change levers are described. "S-curves" show how the change levers can accelerate progress towards an exponential sector transformation. For each section, tables include recommended actions for selected actors[1] to take by 2021, 2025, 2030, and 2040, to achieve an outcome aligned with 1.5°C level of ambition by 2050. Existing initiatives supporting the actions of the UN Secretary General's 2019 Climate Summit are listed, followed by further references to related activities and analysis for each sub-sector.

The many sectors represented in the Industry Pathway have synergies with other major sectoral Pathways, especially Energy, Transport, and Human Settlements. There are also interrelationships between Industry sub-sectors, for example Steel and Aluminum with Metals and Mining. While not explicitly represented in pathways, Industry also intersects with health, water, and gender, and is critically linked to the efforts to advance a just transition.

CONTRIBUTIONS

Under the leadership of the High-Level Champions and through the Marrakech Partnership for Global Climate Action, the development of this Climate Action Pathway was led by the World Business Council for Sustainable Development (WBCSD) in collaboration with the International Chamber of Commerce, B Corporation, The B Team, Business for Social Responsibility (BSR), Cambridge Institute for Sustainability Leadership, CDP, Systemiq, International Renewable Energy Agency (IRENA), World Economic Forum (WEF), the We Mean Business Coalition, World Wide Fund for Nature (WWF)

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[1] Policymakers (national, subnational, local levels); Financial Institutions; Technology Providers and Innovators; Business and Service Providers; Civil Society

Stakeholders consulted include: *Allianz Global Investors, ArcelorMittal, Arup, BT, British Retail Consortium, C40 Cities, Cambridge University, Cambridge Institute for Sustainability Leadership, The Carbon Leadership Forum, The Climate Group, E3G, The Energy and Resources Institute (TERI), the Energy Transitions Commission, Ellen MacArthur Foundation, Ericsson, Generation Investment Management, Green Alliance, Greenpeace, UNFCCC Fashion Industry Charter for Climate Action, Global Efficiency Intelligence, Initiative for Responsible Mining Assurance (IRMA), GSMA, International Council on Mining & Metals (ICMM), ITUC Just Transition Centre, International Union for Conservation of Nature (IUCN), Ocean Conservancy, Mission Possible Platform, Plastics Europe, Responsible Steel, Royal Dutch Shell, SABIC, Stockholm Environment Institute, The Sustainability Consortium, Textile Exchange, Rocky Mountain Institute, UK Steel, Unilever, Waste and Resources Action Plan (WRAP), the World Steel Association, and the World Wide Fund for Nature (WWF).* **This document does not represent a consensus view.**

OVERVIEW - SECTOR STRUCTURE

Sectors within Industry Pathway

Aluminum	Apparel	Cement & Concrete	Chemicals	Fast Moving Consumer Goods
ICT & Mobile	Metals & Mining	Plastics	Retail	Steel

All sectors include both Mitigation and Adaptation/Resilience components

ALUMINUM

1. ALUMINUM - INTRODUCTION

- The aluminum action table outlines a set of necessary stakeholder actions to be taken in 2021, 2025, 2030 and 2040, to accelerate the transition to a net-zero carbon aluminum industry. **The necessary pathway is steep, but it is technically feasible**. It will involve considering regional and national specificities - and managing the risk of "carbon leakage". For the total mining and production process, total global average emissions vary somewhat, but most reported values are between 12 and 17 metric tonnes of CO_2 per tonne of aluminum. Globally, the aluminum industry is currently responsible for about 1.2 billion tonnes of CO_2 per year, equaling about 2% of total global emissions.

- More than 90% of aluminum emissions stem from the primary production process. **The emissions are increasing because of the growing demand for aluminum in a context where the supply of electrical energy generated from renewables is limited.** The global demand for primary aluminum is expected to increase from now to 2050 by about 20%, reaching nearly 80 million tonnes[2].

- The focus on three high-impact interventions, will be able to dramatically reduce industry emissions: Over 60% of the industry's carbon footprint is attributed to electricity consumption which currently is coming from fossil fuel sources. Therefore, the first avenue for decarbonization must be to maximize the use of renewable electrical energy in aluminum production as well as to deploy and scale carbon capture, utilization, and storage facilities (CCUS).

- About a third of the emissions stem from the processing of aluminum. The second key avenue for decarbonization is therefore the substantial improvement of existing technologies: There is a need to switch to technologies that can provide heat and steam without the use of fossil fuels and for the development, deployment and scaling up of carbon anode replacement technologies.

- Thirdly, the application of circular economy strategies - such as the increased collection and recovery of post-consumer scrap - can significantly reduce the need for carbon-intensive primary aluminum. Studies show that circular economy scenarios can significantly reduce

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[2] International Aluminium Institute

the demand for primary aluminum; in Europe it is estimated that about 50% of the continent's aluminum demand can be covered by recycled materials by 2050[3].

- Low-carbon aluminum is a potential key contributor to emissions reductions in international supply chains and to the transition to greener business models. "Demand for aluminum is driven by a transport sector that needs to improve fuel efficiency and reduce energy use and emissions through lighter cars, trucks and trains. The positive expansion in aircraft capabilities and size coupled with safe air travel has been greatly enabled by advances in aluminum technology. Furthermore, aluminum is a key to zero-energy buildings, solar applications and packaging that preserves food and drinks and requires less energy to transport"[4].

- However, currently there is no unified approach to what can be called "green aluminum". This needs to change in order to support demand creation for green aluminum and avoid cases of "carbon leakage" due to unequal regulatory requirements. The establishment of a low-carbon aluminum trading platform by the London Metal Exchange is a crucial step in the right direction as it provides for more transparency and brings low-carbon solutions closer to consumers. Collaborative pilot projects with key consumers (e.g., in the packaging and automotive industry) are ongoing, and more projects, demonstrating that the transition can work, are needed. Overall, the successful decarbonization of the aluminum industry will rely on joint action across the value chain from all stakeholders. Commitments by aluminum companies need to be made and concrete roadmaps developed, including the establishment of science-based targets (SBTs) for a 1.5⁰C pathway. Companies in the sector still face a number of challenges in setting up SBTs. Therefore, the Science Based Targets initiative (SBTi) is working on a project with the International Aluminum Institute (IAI) to identify barriers to and opportunities for science-based target setting, as well as options for next-generation resources[5].

- The purpose of this action table document is to highlight specific, promotable actions to deliver a decarbonization vision for this sector. In the pathway, industry averages are being used to reflect the trajectories of the sector. Different countries will develop at different speeds, based on their different starting points, policy frameworks, ambitions, and available technology. There may be deviations from the timeline

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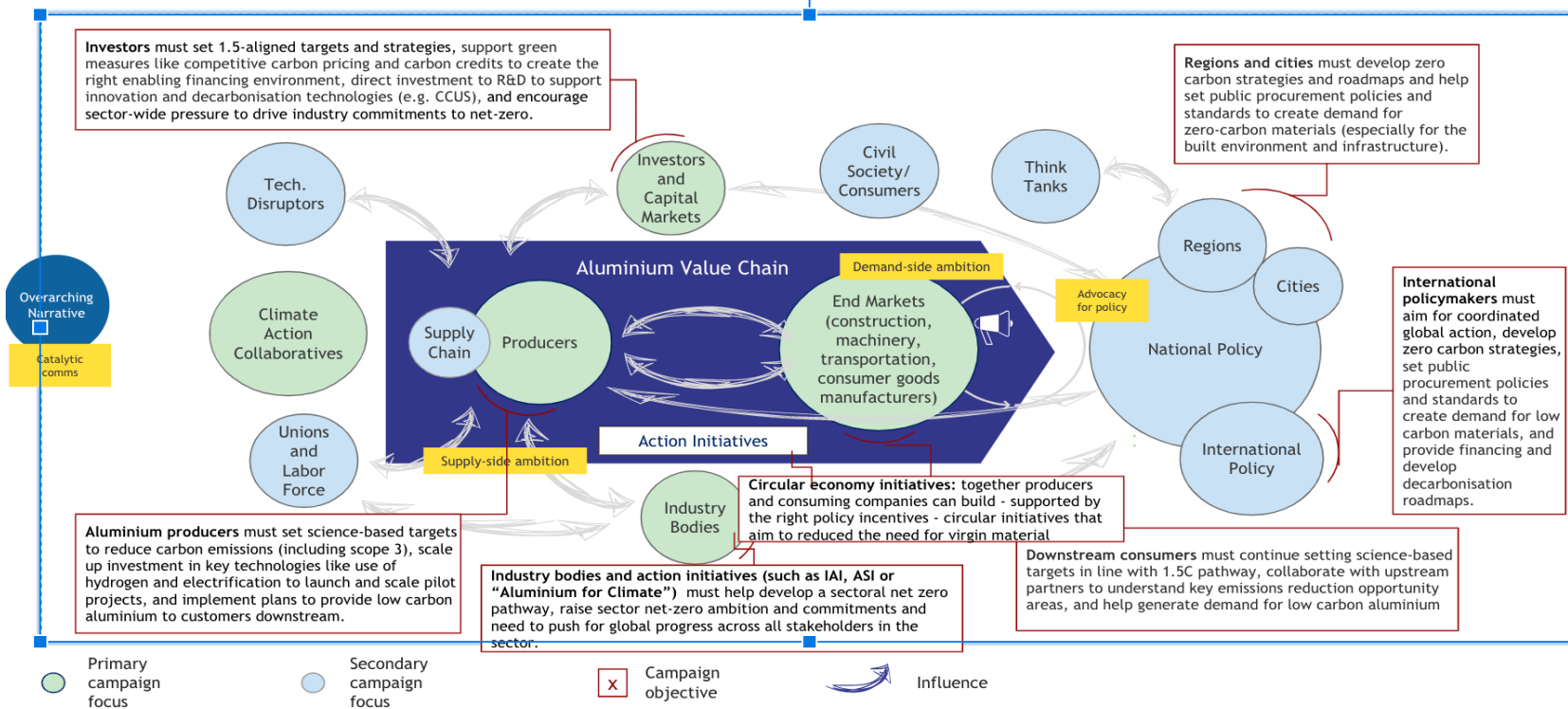
[3] Circular Aluminium Action Plan
[4] Aluminum Production in the Times of Climate Change: The Global Challenge to Reduce the Carbon Footprint and Prevent Carbon Leakage
[5] Science Based Targets – Aluminium Guidance

due to national specificities and geographical differences, but such deviation should not be perceived as a reluctance to support the transition of the sector.

2. ALUMINUM SYSTEM MAP

These stakeholders have complementary objectives to support the overall campaign for the aluminium industry to achieve net-zero emissions by 2050

Investors must set 1.5-aligned targets and strategies, support green measures like competitive carbon pricing and carbon credits to create the right enabling financing environment, direct investment to R&D to support innovation and decarbonisation technologies (e.g. CCUS), and encourage sector-wide pressure to drive industry commitments to net-zero.

Regions and cities must develop zero carbon strategies and roadmaps and help set public procurement policies and standards to create demand for zero-carbon materials (especially for the built environment and infrastructure).

International policymakers must aim for coordinated global action, develop zero carbon strategies, set public procurement policies and standards to create demand for low carbon materials, and provide financing and develop decarbonisation roadmaps.

Aluminium producers must set science-based targets to reduce carbon emissions (including scope 3), scale up investment in key technologies like use of hydrogen and electrification to launch and scale pilot projects, and implement plans to provide low carbon aluminium to customers downstream.

Industry bodies and action initiatives (such as IAI, ASI or "Aluminium for Climate") must help develop a sectoral net zero pathway, raise sector net-zero ambition and commitments and need to push for global progress across all stakeholders in the sector.

Circular economy initiatives: together producers and consuming companies can build - supported by the right policy incentives - circular initiatives that aim to reduced the need for virgin material

Downstream consumers must continue setting science-based targets in line with 1.5C pathway, collaborate with upstream partners to understand key emissions reduction opportunity areas, and help generate demand for low carbon aluminium

Tech. Disruptors

Investors and Capital Markets

Civil Society/ Consumers

Think Tanks

Regions

Cities

Overarching Narrative

Catalytic comms

Climate Action Collaboratives

Supply Chain

Producers

Aluminium Value Chain

End Markets (construction, machinery, transportation, consumer goods manufacturers)

Demand-side ambition

Advocacy for policy

National Policy

International Policy

Unions and Labor Force

Supply-side ambition

Action Initiatives

Industry Bodies

Primary campaign focus

Secondary campaign focus

[X] Campaign objective

Influence

3. ALUMINUM SECTOR CHANGE LEVERS

- **Policymakers:** Commitment from policy makers to ensure long term-access to renewably produced energy in aluminum production is essential to unleash the transition and investments necessary. International cooperation has a key role to play in creating technological and financial frameworks that support the transition pathway in a global and commoditized industry. High-emitting countries will need to work collaboratively with industry to design policies for an effective transition. There are several avenues policymakers can take to encourage decarbonization efforts, whether through the penalization of high carbon producers (including setting mandatory carbon reductions, establishing allowable carbon intensity criteria, establishing border carbon adjustments and emissions trading systems or tariffs) or incentivizing good practices (including subsidizing or incentivizing investment in renewable energy or CCUS projects).

- **Finance:** Sector-wide decarbonization will require investments of between USD 0.5 trillion and 1.5 trillion over the next three decades. Businesses need access to capital to retrofit parts of the current production capacity and invest in new production technologies as well as new energy sources and innovative sorting techniques. Investments in new smelting technologies and new low carbon smelters will be key drivers for improving performance, cost, and the implementation of climate resilient solutions. Businesses shall align their investments with solid 1.5^{0}C pathways. Investors on the other hand shall push asset owners to commit to or implement ambitious net zero emissions targets. Intensified joint action from public and private sector stakeholders is needed to increase funding for collaborative action on Research, Design and Development projects, e.g., for new technologies. Collaborative financing of projects (e.g., for renewable energy or CCUS), for example through regional collaboration, will reduce the costs and risks and will allow technologies to become viable at scale; this will include financing from private as well as public sources.

- **Technology providers and innovators**: Current technologies are not yet mature enough for aluminum producers to reach net-zero at a reasonable cost and at the speed required. Additional innovation is needed to improve existing and develop new technologies. There needs to be an immediate focus on the development and deployment of carbon free smelting processes (including inert anodes, CCUS) as well as

the provision of zero carbon heat and steam through the production process. Sectoral roadmaps need to be built which outline opportunities, including the use of hydrogen and CCUS in aluminum production processes.

- **Business and service providers**: Aluminum producers will need to make decarbonization commitments in line with a 2050 sectoral pathway which is due to be launched in 2021. The producers must strive to decarbonize the production of aluminum, from sustainable mining to low-carbon and carbon-free smelting. To speed up this process and create more of a level playing field, it would be very useful if the sector came together to establish a clear definition for "low carbon and green aluminum". This will also help to scale efforts like the London Metals Exchange spot-trading platform for low-carbon aluminum which has the potential to increase transparency in production and supply-chains.

The decarbonization roadmaps also need to include prioritized commitments and investment plans for future net zero emission manufacturing capabilities and for retrofitting existing plants. In parallel, companies need to recognize aluminum scrap as valuable input material and a way to decrease emissions and build the necessary infrastructure to realize this opportunity. Progress towards decarbonization will be faster if ongoing cross-industry pilot programs around green aluminum will be successful. More of such collaborations (e.g., with industries such as automotive, construction, packaging) paired with supportive public procurement rules and smart standard setting will be necessary to establish strong demand signals which will help to drive the scaling up of the production of green aluminum in the medium term.

- **Civil society**: Social demand for climate action and environmentally friendly products is changing the values of governments and NGOs and the behaviours of businesses. Civil society organizations play a key role in raising and strengthening public awareness and holding key actors accountable. The aluminum industry already has several organizations that are dedicated to the standardization, collection, and interpretation of data. The International Aluminum Institute (IAI) gathers and publishes cross-industry data and the Aluminum Stewardship Initiative (ASI) measures members' sustainability performance against a broader standard. Industry stakeholders need to intensify the collaboration with these organizations and commit to data disclosure in order to assess progress against set targets. Within the next 12 months the IAI plans to launch a sectoral pathway towards 2050, which will hopefully provide the impetus for a considerable share of global production to develop decarbonization ambitions, plans and roadmaps.

 <!-- Global Climate Action logo, top left -->

 <!-- Marrakech Partnership logo, top right -->

4. ALUMINUM SECTOR S-CURVE

The s-curve models the development of zero carbon aluminum production until 2050.

Zero Carbon Aluminium S-Curve model

100% zero emission carbon in 2050 will require 20% in 2035

Zero Carbon Aluminium S-Curve model

Zero Carbon Aluminium production as % of global production (in mio. tons)
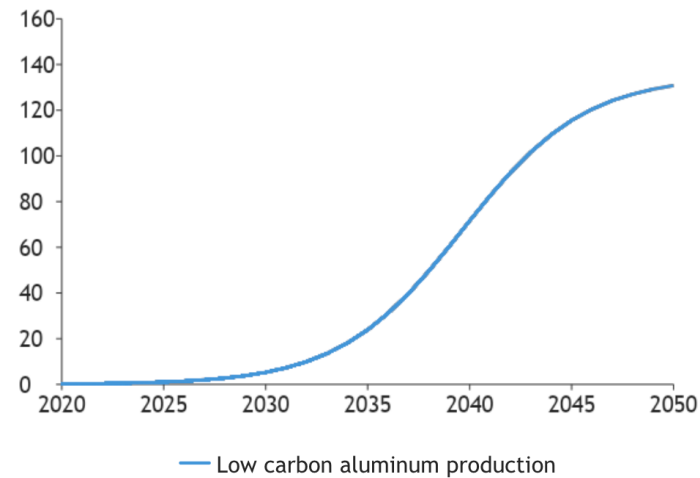
Low carbon aluminum production

Note: Based on a smoothed sigmoid curve forced to 100% at the end given the starting point.
Source: High Level Champions, 2020
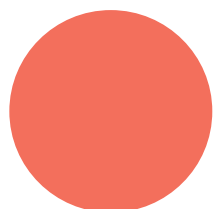
Aluminum action table

| NEXUS | Energy | Human settlements | Industry | Land use |

In the pathway, industry averages are being used to reflect the trajectories of the sector. Different countries will develop at different speeds, based on different starting points, policy frameworks, ambitions, and available technology. There may be deviations from the timeline due to national specificities and geographical differences, but such deviation should **not** be perceived as a reluctance to support the transition of the sector.

	By 2021 ▼	By 2025 ▼	By 2030 ▼	By 2040 ▼
Policymakers (national, subnational, local levels)				
Develop zero carbon strategies, set public procurement policies and standards to create demand for low or zero carbon materials and increase usage in low or	• Strategies & policies development initiated in main thematic areas such as: competitiveness / carbon leakage, technology / Innovation,	• Standards for product development developed at latest	• Integrated systems approaches established - between material / product procurement, resource efficiency (use	• Cradle to cradle materials traceability enabled

zero carbon applications, products & services (e.g., EV, green buildings, renewable power generation & transmission).	demand, and circular economy		phase) and circular economy	
Support the development of **novel technologies** in smelting (carbon free electrolysis) and refining & recycling (zero carbon heat & steam).		• Supportive policy frameworks are implemented • Competing carbon free smelting technologies close to market	• Deployment in new smelting capacity	• Retrofit to existing non-CCUS electrolytic cells
Mobilize progressive business and partner voices in priority countries & regions, ensuring 1.5°C- warming limit is a strategic goal.	• Buyers alliance launched	• Commitment to supply long term, reliable, competitive, firm, renewable or CCUS power to aluminum smelters	• New smelting capacity only using low / zero carbon power (grid & captive?)	• Existing grid-connected capacity to utilize
Encourage direct advocacy in priority countries, sub-national regions to develop zero carbon materials processing strategies and roadmaps.	• Commitments from policymakers to end fossil-fuel subsidies	• Commitment to supply long term, reliable, competitive, firm, renewable or CCUS power to aluminum smelters	• New smelting capacity only using low / zero carbon power	• Existing grid-connected capacity to utilize
Drive **downstream market pull** via value chain advocacy for initiatives at state, regions/cities levels	• Focus on accelerated EV deployment (network infrastructure, battery technology and fleet	• EV light-weighting standards – lifecycle-based approach	• Seek commitments from downstream to demand low carbon, in addition to supply side	• Support maximized collection & recovery of available scrap, while recognizing the limited availability of post-consumer scrap

which establish strong building codes for new and retrofit buildings and infrastructure (including cable and wiring standards), low-carbon materials standards and green procurement policies.	development) as part of "The Great Reset"		decarbonization (scope 3)	
Provide a clear coordinated, stable, and predictable policy framework on national & international level (e.g., G20) to enable investment in the right decarbonization pathway(s).	• Smelter lifetimes historically 30+ years, drawing constant electricity for whole of life	• Support investment in materials and alloy separation technologies		• Commitment to 95% post-consumer scrap collection across all segments: collect & utilize
Plan and support deployment of CCUS transport and storage infrastructure to enable carbon pricing policy and enable production of near-zero-carbon hydrogen.	• 2021-23: policy establishment for industrial clustering - shared CCUS services between industries (regional hubs) e.g., shared service benefit / tax benefit	• Initial deployment of CCUS to power generation units (China, India, GCC)	• Development of technology & deployment of CCUS to thermal units across alumina refining, casting & recycling processes	• Development of technology & deployment of CCUS to electrolytic cells (that use carbon anodes)
Energy Policy.		• Support accelerated deployment of (firm) renewable energy to the grid.	• Support (existing) smelter connection to (renewable) grids	• Support investment in new (greenfield) (renewable) grid-connected smelters, utilizing carbon-free electrolysis technologies

Allocate public funding for target-driven **research programs** with quantitative objectives 10-15 years ahead.	• Allocate funding to development of carbon anode free smelting technologies	• Allocate funding to reach clear progress between 2021 and 2025 in thermal energy replacement technologies (heat & steam), including electrification & hydrogen	• Allocate funding in refined primary aluminum production technologies (ore to metal route)	
Realize principle of "shared burden" of emissions along the value chain.	• Start discussing format of regulation	• Regulation ready for implementation	• Start implementing with full implementation towards 2035	• Maximize recovery - design and manufacture for value retention (extended "polluter pays"- idea)
Develop a **R&D and innovation framework** to facilitate new breakthrough technology development and encourage better coordination between actors along the value chain (including customers), industry, academia, service providers and energy sector.	• Technology innovation hubs initiated, potentially as part of aluminum clusters" to replace reduced R&D centers within companies	• Alloy development centers initiated, bringing together producers and customers • Focus on new markets for casting alloys	• Alloy standards and specifications amended to enable better recovery post-use and support markets for alloys of all quality	• Policies established to reduce remelting cycles pre-consumer
Work towards **implicit or explicit carbon prize** to ensure current energy and carbon policies do not have a significant impact on the			• Set carbon price of $60-100 per tonne of CO2	

competitiveness of decarbonizing the chemicals sector.				
Encourage industrial / corporate circular waste management practices that bring benefits to other sectors' decarbonization pathways	• Policies established to explore bauxite residue use in other industries, reducing energy and materials demand	• 10% bauxite residue reuse		
Set minimum baseline standard on ethical / responsible sourcing of metals through spot trading platform at London Metal Exchange (LME)	• LME rules understood by its listed brands and other interested market participants (e.g., suppliers, commodity trading houses etc.)	• Review of effectiveness of LME responsible sourcing rules. Consideration of inclusion of broader set of sustainability criteria	• Responsible sourcing criteria include baseline expectations for environmental factors (including emissions) for all metals, with possible target set for zero carbon (on a per metal basis)	• Work in progress to ensure all LME-listed metals, including aluminum, are on track for zero carbon targets
Develop Markets for post-consumer castings	• Strategies are being developed		• developed markets (and innovative applications) for post-consumer castings (from used internal combustion engine vehicles), as existing ICE opportunities for these alloys decline	

Financial Institutions

| Incentivization of investments in the transition | • Major institutional asset owners continue to push businesses to set net zero emissions targets, voluntarily disclose under TCFD
• Engage with a) national governments to build case for low carbon policies; b) value chain to incentivize collaborative action
• Explore/announce investment in cement companies with credible carbon neutral plans
• Leading investors explore investment and business cases for green cement / concrete facilities, within cross-sector collaborative efforts, and begin structuring
• Greater clarity established regarding the needed investment for concrete / cement sector's transition | • Major institutional asset owners continue to push businesses to set net zero emissions targets
• Participate in dedicated funding of first wave of commercial scale cement / concrete projects
• Continue engaging with value chain to encourage carbon neutral targets and mitigation
• Increase preferential investment in cement / concrete companies with credible plans | • Major institutional asset owners continue to push businesses to set net zero emissions targets
• Participate in dedicated investment of 10 commercial scale cement facilities
• Scale up preferential investment in low carbon-committed primary producers; begin divesting from carbon-intensive producers
• Investor alignment raises cost of capital for new carbon-intensive production facilities, increasing competitiveness of green and low carbon cement
• Public-private processes and techniques for managing stranded high carbon cement production assets institutionalized | • Public-private processes and techniques for managing stranded high cement/concrete production assets ramp down as regional supply/demand mismatches resolve |

Tie new **investment** to 2050 1.5°C pathway (e.g., rebuild of smelters, tech innovation, tie finance to performance: taxonomy)		• Develop clear plans to shift investment portfolios towards low-carbon infrastructure and technologies	• Investment in novel and circular business models (e.g. materials leasing) effectuated	
Increase availability of capital to **retrofit existing capacity**, connect to grid, add CCUS to power, thermal and electrolytic units				• 2050: 100% renewable or CCUS grid connected or captive renewables/CCUS
Encourage **public-private sector partnership** to bring technologies under development to commercial readiness	• Develop public-private partnerships to invest in Research, Design and Development projects	• Increase funding directed at driving innovation and maximize the likelihood of more fundamental breakthroughs	• Institutionalized financing mechanisms and incentive structures for industry decarbonization	

Technology Providers and Innovators

Continue to i**mprove energy efficiency** in own processes; new capacity utilizing best available technologies (BAT)	• All new capacity installed at best available technologies (BAT)		• Retrofit/improvement of 100% of existing capacity to perform at 2020 benchmark performance	
Direct process, thermal and auxiliary materials **emissions**	• 2021: Have a sector wide roadmap in place for how to achieve the goals, and ensure alignment with	• 2025: Sector broadly committed, and 10% reduction achieved	• 2030: At industry average, 30 % reduction achieved. Have an implementation map ready and each piece of	• Reduction of 60 to-70% of direct process, thermal and auxiliary materials emissions (roughly equivalent to scope 1 and 3, categories 1,3 and 4)

	related initiatives, e.g., TCFD, CDP, SBTI		• new technology is in pilot scale (minimum) • 2040: reduced direct emissions by 50% (industry average)	
CCUS realization	• 2021: Sectoral roadmap to outline opportunities for CCUS, technological challenges articulated - cross sectoral opportunities (e.g., with power or industrial clusters) explored	• technological challenges for CCUS to be overcome	• Development of technology & initial deployment of CCUS to electrolytic cells (that use carbon anodes)	• Development of technology & deployment of CCUS to thermal units across alumina refining, casting & recycling processes
Development of inert anode	• Create more transparency around various pilot projects on inert anodes – with a view to exchange lessons learned and speed up the development process	• Inert anodes: commercial process in place and used by several of world's top 10 producers		

Accelerate the processes of **electrification** as a key lever towards emissions reduction	• Develop draft policies by 2021	• Policies implemented:
		  - in alumina refining
		  - in casting & semis manufacture
		  - in recycling
				• at least 50% of all thermal processes grid connected with renewable power

100% removal of GHG emissions from electricity by 2050 (via renewables, CCUS)	• Establish the sectoral commitment to the 2050 goal of "100% removal of GHG emissions from electricity by 2050", including 3-5 global frontrunners published clear roadmaps for: a) grid connected producers: uptake of green energy, b) captive/self-generated: commitment to connect their smelters & power stations to grid	• 2025: elaboration of company & regional strategies (e.g., China, Middle East)	• 2030: Company Roadmaps - by 2030	
Explore the potential of renewably produced hydrogen as a replacement fuel for thermal processes	• Opportunities for hydrogen use in aluminum processes articulated as part of sectoral roadmap • R&D spending dedicated on a 100% calcining process using hydrogen	• Pilot plant (alumina refining) operational	• Commercial availability of hydrogen combustion units in refining, casting, and other thermal processes	
Alloy sorting technology & deployment		• investments in building alloy sorting capacity	• closed loop alloy sorting streams has become the norm	

Business and Service Providers

Improve product design to enable increased energy and materials efficiency	• Commitments made towards full material traceability	• Mixed materials management strategies implemented from customers • Material leasing strategies elaborated		• Materials full traceability achieved
Recycling	• Recognize aluminum scrap as valuable input material and a way to decrease emissions across industry	• Define recycling roadmap with estimations of needed infrastructure, investment needs, R&D etc.	• Have large scale aluminum sorting and remelting plants gaining back full value from recycling; start implementation in Europe or North America	• 95% collection rates for end-of-life products and full value recovery of collected scrap
Companies are setting targets for emissions reductions, allocating adequate staff time and funding to explore and implement decarbonization solutions and working with others along the value chain to ensure that emissions reduction is maximized.	• 2021: 10% of global production committed to net zero aligned pathway			

Objective				
Develop (sectoral and corporate) **roadmaps to net-zero carbon emissions by 2050 (including scope 3)**, including recycling and clear specifications of how transitional solutions will be phased out over time. This will build on IAI pathway to 2050, technological scenarios that need development.	• "Sector GHG pathway" to 2050 finalized by IAI • Scrap availability & potential articulated (IAI Material flow model) • Technological scenarios developed (IAI GHG Pathways WG) • Electrical energy, thermal processes & aluminum specific processes quantified (IAI)	• 75% of global production committed to roadmap	• 100% of global production commitment	
Towards Net Zero manufacturing		• First Net Zero Smelter fully operational	• by 2030 - 10 % of global production capacity • gate to gate (including electrolysis and casting) but likely not including upstream (alumina •	• by 2050 - Net Zero primary aluminum product • cradle to gate (100% renewable energy, zero emissions electrolysis - e.g., inert anode), zero emission alumina (electrification with renewables, and /or hydrogen), zero emission transport of products, electrification of casting processes, zero emission auxiliary materials (e.g., caustic soda)
Develop cross sectoral **partnerships** which can deliver greater **materials efficiency and circularity** and will create **demand** for green products and services e.g., make commitments to 'green purchasing' of	• Commitment from consuming companies/sectors to source % of their supply from sustainable (certified) sources	• Shift towards service-oriented approach implemented • 10% materials traceability	• Material leasing models implemented • 50% materials traceability	• 100% materials traceability • 100% sustainable sourced metal commitment

industrial/building components.				
Develop market infrastructure for transparency, pricing and trading allows participants to realize financial value at London Metal Exchange (LME)	• Launch of LME platforms to enable (i) disclosure of sustainability rated metrics by metal owners / producers and (ii) spot trading platform to facilitate the pricing and trading of metal on the basis of sustainability criteria	• Strong liquidity and market interest established for low carbon aluminum • Data used to launch new contracts / products / platforms to support market segment growth	• Core sustainability contracts launched on central exchange platform (or amendments made to existing contracts)	• Work on track to ensure all exchange-traded contracts are "sustainable" – as defined by the market demand
Design for reuse and recycling - establishment of systems for original equipment manufacturers		• OEMs have system in place to keep separate alloys of differing qualities in the pre-consumer scrap recovery process	• Standard established for OEMs to incentivize separation of scrap at end of product life	

Civil society

Push for **adequate labelling** of lifecycle and embedded carbon intensity of products and services to create traceability and be a		• Technologies development beyond labelling – real time and user-oriented data; articulation of responsibility by	• Consumer carbon budgets in place that account for full lifecycle	

powerful tool for strengthening consumer awareness.		consumers to take action (post purchase), not just at point of sale; this includes driving behaviour, waste management & recycling, product integration as well as standardization		
Non-profits, NGOs support the development of regional roadmaps				• Consumer demands have mainstreamed development of circular business models in developed and developing countries • Social dialogue models proven, standardized, and scaled across communities to support just transition
Strengthen transparency regarding emissions disclosure and reporting	• IAI refined carbon footprint guidance and scope 3 guidance published (2021) • ASI's updated Performance Standard released for public consultation	• 25% industry disclosure of emissions in line with IAI guidance	• 50% industry disclosure of emissions in line with IAI guidance	• 100% industry disclosure of emissions in line with IAI guidance

ALUMINUM - EXISTING INITIATIVES

Mission Possible Platform: Aluminum for Climate	An initiative of high-ambition CEOs under the Mission Possible Platform which was launched in 2019 with a view to developing low-carbon smelting and refining processes, increasing renewable energy sourcing, and increasing recycling rates.
International Aluminum Institute	Association of aluminum producers, representing more than 60% of global aluminum production
Aluminum Stewardship Initiative	Launched to foster greater sustainability and transparency throughout the aluminum industry
London Metal Exchange – Responsible Sourcing Initiative	The LME has introduced responsible sourcing requirements for all brands listed for good delivery on the LME
International Council on Mining and Metals (ICMM)	International Council on Mining and Metals (ICMM) was founded in 2001 to improve sustainable development performance in the mining and metals industry. That includes the Material Stewardship Facility.
AluQuebec Cluster	The Quebec aluminum industrial cluster is a non-profit organization with a mission to foster synergies between stakeholders at the national and international levels and aluminum industry stakeholders in Quebec
Business Ambition for 1.5C	UNGC Secretariat campaign asking businesses to set science-based targets aligned with limiting global temperature rise to 1.5C above pre-industrial levels.
Science Based Targets Network	Collaborative initiative between CDP, UNGC, WRI, WWF, and WMB to help companies develop and set science-based targets.
We Mean Business Coalition	Global non-profit coalition working with the world's most influential businesses to take action on climate change, catalyzing business leadership to drive policy ambition and accelerate the transition to a zero-carbon economy.

Leadership Group for Industry Transition (LeadIT)	Accelerating the transition of all industry sectors to low carbon pathways to reach net-zero carbon emissions by 2050.
Climate Action 100+	Investor network to ensure the world's largest corporate greenhouse gas emitters take necessary action on climate change.

ALUMINUM - FURTHER REFERENCES

https://sciencebasedtargets.org/aluminium/	
https://www.european-aluminium.eu/vision-2050/	

APPAREL

1. APPAREL - INTRODUCTION

The purpose of this action table document is to highlight specific, promotable actions to deliver the vision for the Industry thematic area, with a sector-based approach focused on apparel.

The apparel sector is a highly GHG-intensive industry, with estimated emissions of up to 2.1 billion tonnes of CO_2 annually, or 4% global total. More than 70% of the emissions come from upstream activities, particularly energy-intensive raw material production, preparation, and processing. The remaining 30% are generated by downstream activities such as transport, packaging, retail operations, usage, and end-of-use.[6]

High-demand growth for apparel of up to 63% 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%.[7] Under its current trajectory, the apparel industry will miss the 1.5°C pathway by 50% – only 17% of the market by revenue is covered by an SBTi or UNGC Business Ambition 1.5 classification, whilst only 11% apparel companies have set out a 1.5°C commitment under either scheme.[8]

Key carbon impact areas for the apparel sector are echoed across all industry reports and include 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 to produce 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% of abatement potential lies in decarbonizing upstream operations, 20% lies in brands' own operations, and 20% relies on encouraging sustainable consumer behaviour. Other analysis shows that roughly 250 million tonnes of CO_2e could be reduced through a 50% shift to renewable energy in Tier 2 and 3 producers.
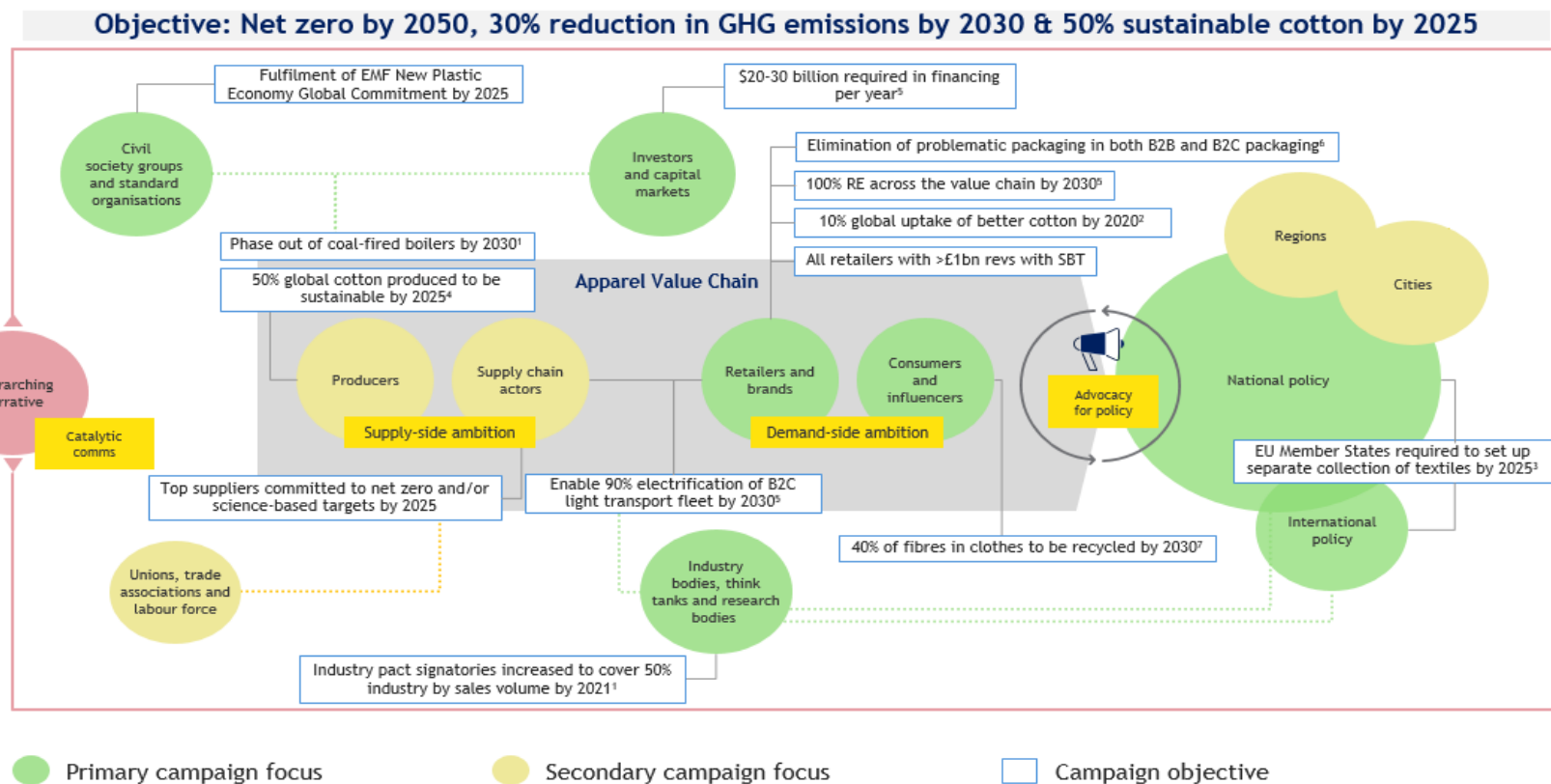
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[6] McKinsey and GFA. 2020. Fashion on Climate
[7] Ellen MacArthur Foundation. 2017. A New Textiles Economy
[8] Climate Champions analysis of Orbis Financial data extract for company sector revenues

This action table draws insight primarily from existing industry information collated by the COP 26 Climate Champions' team. Key organizations working on apparel sector decarbonization analysis as well as industry representatives have been consulted on this iteration of the milestones, and this consultation will continue until February 2021.

2. APPAREL SYSTEM MAP

Objective: Net zero by 2050, 30% reduction in GHG emissions by 2030 & 50% sustainable cotton by 2025

Source: [1] UNFCCC Fashion Charter for Climate Action; [2] Better Cotton Initiative; [3] Policy Hub; [4] Textile Exchange; [5] GFA; [6] Fashion Pact; [7] Quantis
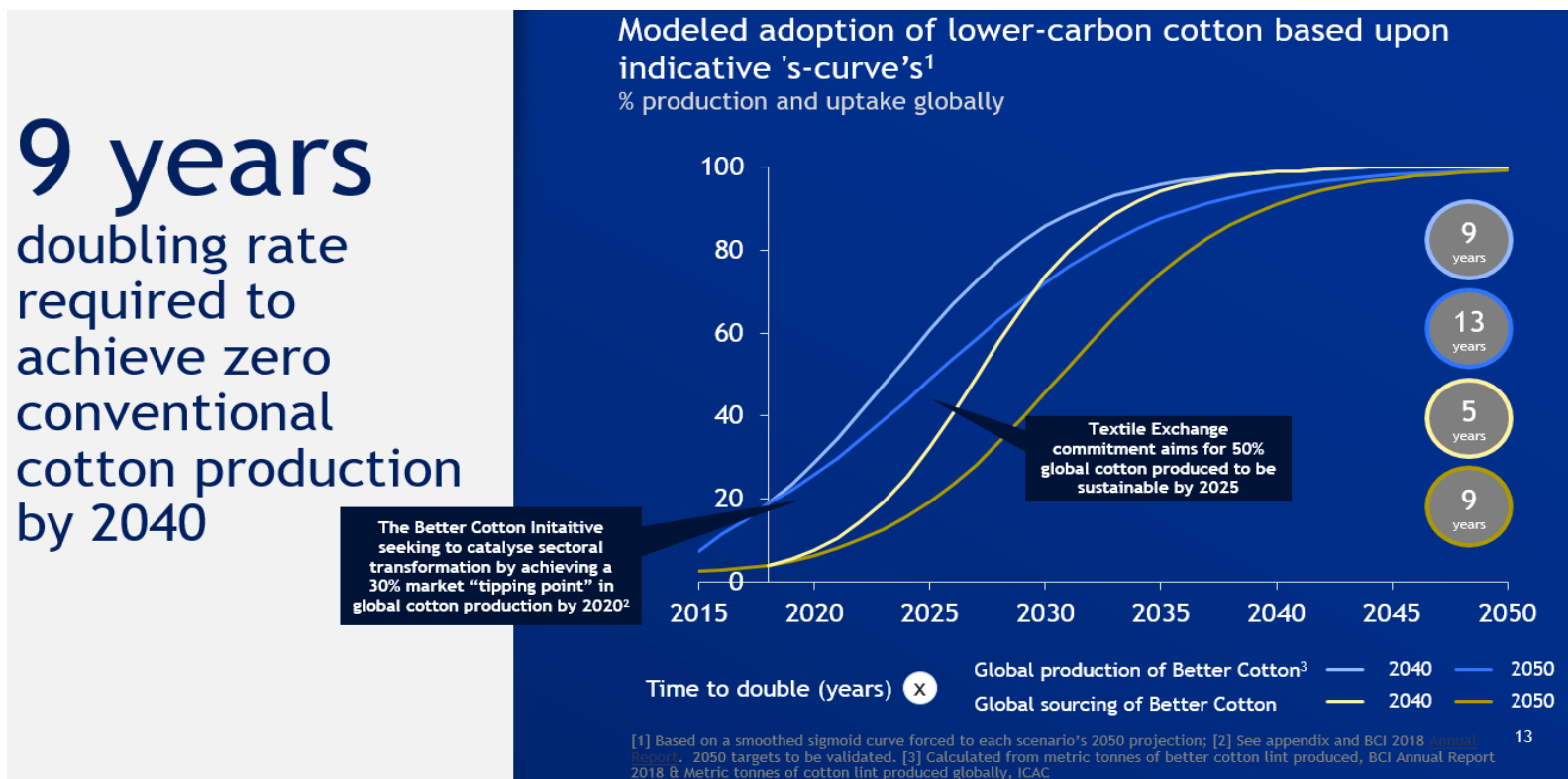
3. APPAREL CHANGE LEVERS

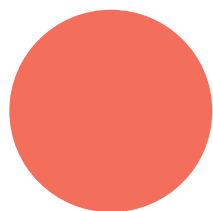**Key levers of change, interventions required and feedback loops**

- **Policy** has a key role in supporting energy decarbonization by catalyzing investment, developing incentives for manufacturers to move towards renewable tariffs, strengthening extended producer responsibilities and penalties for 'fast fashion', improving recycling infrastructure and standardizing taxonomies restoring and protecting land, ensure 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.

- 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 fibers for garment production, mechanical and biological fiber recycling techniques, and virtual and augmented reality concepts, which may support reductions in overall consumer demand.

- Business: **Supply** chains 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, 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 garnet utilization rates particular to "fast fashion" business models, through

campaigns and calls-to-action, addressing research gaps and improving information around sustainable choices. Civil society actors can also influence policy by advocating for climate-supportive legislative change, working towards systems transformation, driving collective action, and holding actors to account.

4. APPAREL S-CURVE

9 years doubling rate required to achieve zero conventional cotton production by 2040

Modeled adoption of lower-carbon cotton based upon indicative 's-curve's[1]
% production and uptake globally

The Better Cotton Initaitive seeking to catalyse sectoral transformation by achieving a 30% market "tipping point" in global cotton production by 2020[2]

Textile Exchange commitment aims for 50% global cotton produced to be sustainable by 2025

Time to double (years) Ⓧ

Global production of Better Cotton[3] — 2040 — 2050
Global sourcing of Better Cotton — 2040 — 2050

[1] Based on a smoothed sigmoid curve forced to each scenario's 2050 projection; [2] See appendix and BCI 2018 Annual Report. 2050 targets to be validated. [3] Calculated from metric tonnes of better cotton lint produced, BCI Annual Report 2018 & Metric tonnes of cotton lint produced globally, ICAC

The s-curve modelled for apparel describes the adoption of lower-carbon cotton as a substitute to traditionally produced cotton. Textile Exchange's commitment aims for 50% global cotton produced to be sustainable by 2025.

APPAREL ACTION TABLE

NEXUS	Energy	Human settlements	Industry	Land use	

SDGs: 5 GENDER EQUALITY, 7 AFFORDABLE AND CLEAN ENERGY, 8 DECENT WORK AND ECONOMIC GROWTH, 9 INDUSTRY, INNOVATION AND INFRASTRUCTURE, 11 SUSTAINABLE CITIES AND COMMUNITIES, 12 RESPONSIBLE CONSUMPTION AND PRODUCTION, 13 CLIMATE ACTION, 14 LIFE BELOW WATER, 15 LIFE ON LAND

	By 2021 ▼	By 2025 ▼	By 2030 ▼	By 2040 ▼
Policymakers (national, subnational, local levels)				
Standardize definitions for measurement of GHG emissions, circular design impacts and waste taxonomies, with reference to existing industry data sources, standards, and practices	• N/A	• N/A	• N/A	• N/A

Support global transition to **low-carbon transport, renewable energy, and energy efficiency** through incentives	• 50% Fashion Charter policy barriers addressed per year within focus markets (Fashion Charter)	• N/A	• N/A	• N/A
Support global transition to low-carbon transport by **supporting investment in new technologies**	• N/A	• N/A	• Provide right regulatory incentives to enable 90% electrification of B2C light transport fleet (McKinsey & GFA)	• N/A
Incentivize **low-carbon materials sourcing and** recyclability in design and implement recycled content requirements through improved farming regulations, incentives, and capacity building through direct engagement	• N/A	• N/A	• N/A	• N/A
Ensure a national level transition to a **decarbonized energy grid and mix**	• N/A	• N/A	• China to generate 50% of total electricity in 2030 from non-fossil fuels incl. renewables plus nuclear (WRI & AII)	• N/A
Create **incentives for improved performance and innovation** from fashion companies, through interventions such as start-up and technological investment, market	• N/A	• N/A	• N/A	• N/A

access requirements and extended-producer responsibility measures			
Improve recycling by incentivizing recyclability in design, implementing recycled content requirements and scaling investment in recycling and take-back infrastructure	• N/A	• EU Member States required to set up separate collection of textiles by 2025 (Policy Hub)	• $20-30 billion required in financing per year by 2030 (BCG, Fashion for Good) • N/A
Increase scope and regularity of environmental audits (incl. energy performance requirements) in the sector	• N/A	• N/A	• N/A • N/A

Financial Institutions

Support development of new investment vehicles like **public-private partnerships** to invest in R&D projects on innovation priorities and supply chain transformation	• N/A	• N/A	• N/A • N/A

Partner with policymakers and industry to increase inflow of capital to **catalyze and scale solutions** for a low-carbon economy throughout the sector, including capacity-building with non-financial actors	• N/A	• N/A	• $20-30 billion required in financing per year by 2030 (BCG, Fashion for Good)	• N/A
Shift investment portfolios towards brands with robust environmental credentials, and support accurate and effective ESG assessments	• N/A	• N/A	• N/A	• N/A
Invest to enable **sustainable transport solutions**	• N/A	• N/A	• Investments in more demand-focused regional supply chains or nearshoring which will enable transition to 90% sea and 10% air transport mix, and 90% electrification of B2C light transport fleet (McKinsey & GFA)	• N/A
Institutionalize financing mechanisms and incentive structures for industry decarbonization	N/A	• N/A	• N/A	• N/A

Technology Providers and Innovators

Reinforce **credibility of standard certification** for fibers through technological innovations (e.g., traceability)	• N/A	• N/A	• N/A	• N/A
Accelerate the development of "next generation" preferred fibers (e.g., man-made cellulose fibers and bio-based synthetics)	• N/A	• N/A	• N/A	• N/A
Maximize energy efficiency across apparel manufacturing (Tiers 1-3)	• N/A	• N/A	• 5-10% efficiency gain in the spinning, weaving, and knitting stages, through motor and air pressure modifications in machinery, shift from wet to dry processing, adoption of technologies that consume less energy (McKinsey and GFA) • 80% energy efficiency improvement in wet processing (McKinsey and GFA)	• N/A

			• 30% efficiency gain across heating, ventilation, and air conditioning-related equipment and 20% efficiency gain in sewing machines and new technologies equipment upgrades (McKinsey and GFA) • 60% improvement in energy efficiency (Quantis)	
Innovate to increase sustainable **transport solutions**	• N/A	• N/A	• 90% electrification of B2C light vehicles transport fleet, improve battery technology and enable rapid digitization (McKinsey and GFA)	• N/A
Increase innovation in development of **mechanical and chemical recycling** technologies	• Baseline: less than 1% of all textiles worldwide are recycled into new textiles (EMF)	• N/A	• N/A	• N/A
Reduce overproduction through investment in new technologies and improved forecasting	• N/A	• N/A	• Reduction of overproduction from 20% to 10% through improvement in demand forecasting technology and stock management (McKinsey and GFA)	• N/A

			• Reduce ecommerce return rates from 35% to 15% (McKinsey and GFA)	

Business and Service Providers

Commit to reducing GHG emissions and to a net zero target. Quantify, track, and publicly report emissions to best standards of measurement and transparency	• N/A	• N/A	• 45% reduction in GHG emissions across scope 1, 2 and 3 (Fashion Charter)	• Net zero GHG emissions across scope 1, 2 and 3 by 2050 (Fashion Charter)
Reduce GHG emissions in own operations (scopes 1 and 2)	• N/A	• N/A	• 80% efficiency gain in retail operations through switch to LED lighting. Reduce energy consumption across heating, ventilation, and air conditioning equipment in retail operations (McKinsey & GFA)	• N/A
Source 100% renewable energy (scope 2)	• N/A	• N/A	• 100% renewable energy across own operations (Fashion Pact)	• N/A

Reduce GHG emissions in the supply chain (Tiers 1-3)	• N/A	• N/A	• 45% GHG emissions reduction in Tier 1-3 (Sustainable Apparel Coalition)	• N/A
Shift to 100% renewable energy in manufacturing (Tiers 1-3)	• N/A	• N/A	• 100% renewable energy across the value chain (McKinsey and GFA) • 60% renewable energy across the value chain (Quantis)	• N/A
Maximize material efficiency and reduce waste in the supply chain (Tiers 1-3)	• N/A	• N/A	• 1-2% improvement in the waste generated in the transition from fiber to textiles and in cutting waste in the garment manufacturing stage through better design and modern cutting techniques, reduce scrap production in fabric manufacturing from 12% to 1% (McKinsey and GFA)	• N/A
Eliminate coal in textile mills and manufacturing facilities (Tiers 1-2)	• N/A	• No new coal fired boilers in Tier 2 suppliers (Fashion Charter)	• Phase out of coal fired boilers (Fashion Charter) – under discussion	• N/A
Reduce GHG emissions in the value chain (Tier 4)	• Release Climate+ reduction roadmap with fiber-specific guidance (Textile Exchange)	• 15-20% reduction in GHG emissions from core materials by 2025 (Textile Exchange)	• 45% reduction in GHG emissions across all materials by 2030 (Textile Exchange) • 25% of key raw materials are from lower climate impact sources (Fashion Pact)	• N/A

Decarbonize material production through improved production practices and changing material mix	• 10% cotton taken up by retailers and brands to be more sustainably produced (Better Cotton Initiative) • Soil health policy developed, and soil health module of Cotton Impact Initiative rolled out (Textile Exchange)	• 50% global cotton produced to be sustainable (Textile Exchange) • 114 companies committed to sourcing 100% sustainable cotton (Sustainable Cotton Challenge - Textile Exchange)	• 20% energy efficiency improvements for polyester production through switch from coal to electric boilers (McKinsey & GFA) • 40% reduction in use of pesticides and fertilizers in cotton cultivation (McKinsey & GFA) • Sustainable cotton initiatives delivering on positive carbon impact through regenerative practices (Textile Exchange)	• N/A
Scale the use of existing preferred materials	• Release Preferred fiber and Material Mix (PFMM) report with comprehensive guidance on preferred fibers (Textile Exchange)	• Minimum of 300 brands with a preferred fiber strategy being tracked through the Corporate Fiber and Materials Benchmark (CFMB) program (Textile Exchange)	• Move to mix of 20-30% recycled polyester (rPET) usage and an 11% adoption of alternatives such as organic, recycled or bio-based materials. 10% organic cotton usage, 10% improved man-made cellulose fiber (MMCF) usage (McKinsey & GFA) • 25% of key raw materials are from lower climate impact sources (Fashion Pact)	• N/A
Reduce GHG emissions in freight	• N/A	• N/A	• Recalibrate to 90% sea transport and 10% air transport across the industry (McKinsey & GFA)	• N/A

			• Baseline: transport mix is 83% sea transport and 17% air transport (McKinsey & GFA)	
Improve packaging material mix and reduce unnecessary plastics	• N/A	• Elimination of problematic and unnecessary plastics in B2C packaging (Fashion Pact) • Ensure at least half of all plastic packaging is 100% recycled content for B2C (Fashion Pact)	• Increase in recycled content usage in corrugated boxes to 80% and default to 3ply. Halve use of polybags and use 80% recycled low-density polyethylene content (McKinsey & GFA) • Ensure at least half of all plastic packaging is 100% recycled content for B2B (Fashion Pact) • Elimination of problematic and unnecessary plastic plastics in B2B packaging (Fashion Pact)	• N/A
Redirect products from landfill and increase optimal recycling	• N/A	• N/A	• Increasing recycling from 17% to 30% and increase closed loop recycling rate from 1% to 5% (McKinsey and GFA) • 40% of fibers in clothing to be recycled (Quantis)	• N/A
Address consumer use phase GHG emissions impacts	• N/A	• N/A	• Consumers to skip 1 in 6 washing loads, wash half of loads at below 30°C and substitute every sixth dryer use with open air drying (McKinsey & GFA)	• N/A

Switch to lower GHG business models and consumer offers (e.g., rental)	• N/A	• N/A	• 1 in 5 garments traded through circular business models (McKinsey and GFA) • Grow rental market share to 3% from 1%, refurbishment model market share to 2% from 1% and re-commerce model market share to 12% from 7%. Ensure repairs increase product life by 25% (McKinsey and GFA)	• N/A
Civil Society				
Increase number of apparel producers and retailers **actively engaged in sustainability initiatives**	• N/A	• 2025 growth target for participation in Textile Exchange programs: 2025 sustainable cotton challenge, transitional cotton challenge, CFMB, Impact Incentives, rPET challenge, Climate+ target (Textile Exchange)	• 2030 growth target for participation in Textile Exchange programs: 2025 sustainable cotton challenge, transitional cotton challenge, CFMB, Impact Incentives, rPET challenge, Climate+ target (Textile Exchange)	• N/A
Develop a strategy including targets and plans to advocate for the development of **policies and laws** to empower climate action in the fashion industry, especially in supply	• 50% Fashion Charter policy barriers addressed per year within focus markets (Fashion Charter)	• N/A	• N/A	• N/A

chains. Track progress against these plans				
Expand **capacity-building efforts** in producer countries in collaboration with other stakeholders	• Roll out Impact Incentives to support farmers in zero deforestation and regenerative practices (Textile Exchange)	• N/A	• Reduce fertilizer and pesticide usage in cotton cultivation by 40% through improved practices such as targeted spreading (McKinsey & GFA) •	• N/A
Promote changes in **consumer buying patterns and shift to more circular behaviours,** for instance through better communication of on-garment sustainability information and care instructions	• N/A	• N/A	• N/A	• N/A
Signal demand for new technical and financial innovations to investor community	• N/A	• N/A	• N/A	• N/A
Convene coalitions, networks, forums, and events to drive progress against environmental objectives, and champion climate action throughout the industry	• N/A	• N/A	• N/A	• N/A

APPAREL - EXISTING INITIATIVES

United Nations Framework Convention on Climate Change Fashion Charter for Climate Action	Vision launched at COP24 by the UNFCCC, the multilateral environmental agreement, for a net-zero fashion sector by 2050 and with the intermediary goal of achieving a 30% reduction in GHGs by 2030
Consumer Goods Forum	Global industry body driven by membership of over 400 retailers and consumer goods companies in over 70 countries, convening environmental commitment around deforestation, food waste, refrigeration, and raw materials sourcing
Science Based Targets initiative	Collaborative initiative between CDP, UNGC, WRI, WWF, and WMB to showcase companies that set science-based targets consistent with the level of decarbonization required by science to limit warming to less than 1.5°C compared to pre-industrial temperatures
We Mean Business Coalition	Global non-profit coalition working with the world's most influential businesses to take action on climate change, catalyzing business leadership to drive policy ambition and accelerate the transition to a zero-carbon economy
World Economic Forum	Global membership-based organization convening the world's largest corporations across a number of platforms and initiatives, including for the reduction of carbon emissions
RE100	RE100 brings together influential businesses committed to 100 % renewable energy. This initiative is led by the Climate Group in partnership with CDP
EV100	An initiative to accelerate the transition to electro-mobility by 2030
EP100	A voluntary initiative where corporations pledge to double their energy productivity within 25 years of a chosen baseline. This initiative is led by the Climate Group in partnership with the Alliance to Save Energy
Carbon Disclosure Project	A global non-profit that manages a disclosure platform for companies, cities, and other entities on environmental issues including climate change

Clean Cargo	A working group representing over 80% of global container cargo carried and with over 75 shipper, carrier, and freight forwarder members, focused on improving environmental performance in marine container transport using standardized tools for measurement, evaluation, and reporting	▶
World Resources Institute	Global research organization working at the nexus of environment, economic opportunity, and human well-being	▶
Organization for Economic Co-Operation and Development	International organization working with governments, policymakers, and citizens on establishing evidence-based international standards and finding solutions to a range of social, economic, and environmental challenges	▶

APPAREL - FURTHER REFERENCES

Special Report: Global Warming of 1.5°C, Intergovernmental Panel on Climate Change	**Link**
Climate Action Playbook, UNFCCC Fashion Charter for Climate Action, 2020	**Link**
Fashion on Climate: How the Fashion Industry can Urgently Act to Reduce its GHG Emissions, McKinsey and GFA, 2020	**Link**
Roadmap to Zero, Zero Discharge of Hazardous Chemicals	**Link**
Fixing Fashion: Clothing Consumption and Sustainability, House of Commons Environmental Audit Committee, 2019 (UK)	**Link**
A New Textiles Economy, Ellen MacArthur Foundation, 2017	**Link**

The Future of Circular Fashion: Assessing the Viability of Circular Business Models, Accenture and Fashion for Good, 2019	**Link**
The State of Fashion 2020 Coronavirus Update, McKinsey, 2020	**Link**
Financing the Transformation in Fashion, Boston Consulting Group and Fashion for Good, 2020	**Link**
Valuing our Clothes: the cost of UK fashion, Waste and Resources Action Plan, 2017 (UK)	**Link**
The Policy Hub, Global Fashion Agenda, Sustainable Apparel Coalition and Federation of European Sporting Goods Industry	**Link**
CottonUP Guide, Cotton2040 and C&A Foundation	**Link**
Copenhagen Fashion Summit, Global Fashion Agenda	**Link**
Cotton2040, Forum for the Future	**Link**
Sustainable Clothing Action Plan, Waste and Resources Action Plan	**Link**
European Clothing Action Plan, European Commission	**Link**
New Circular Economy Action Plan, European Commission, 2020	**Link**
2020 Circular Fashion System Commitment, Global Fashion Agenda	**Link**
2025 Sustainable Cotton Challenge, Textile Exchange	**Link**
Platform for Accelerating the Circular Economy, World Economic Forum	**Link**

Partnership for Cleaner Textiles, IFC and World Bank	Link
Supply Chain Initiative, Carbon Disclosure Project	Link
Higg Index, Sustainable Apparel Coalition	Link
Clean by Design, Apparel Impact Institute	Link

CEMENT & CONCRETE

1. CONCRETE & CEMENT - INTRODUCTION

A clear decarbonization pathway exists for the cement and concrete industry; however, it will take a more ambitious and coordinated effort from all stakeholders to achieve adequate progress in time.

The current global demand for cement, the main ingredient of concrete, is expected to rise from 4.2 billion tonnes per year to 4.7 billion tonnes in 2050. Global CO2 emissions from the cement and concrete industry amount to around 2.2 gigatonnes per year, with a business-as-usual scenario predicting a rise to 2.3 gigatonnes by 2050[9]. The emissions originate from direct process emissions (1.2 gigatonnes), heat emissions from fuel combustion (0.75 gigatonnes) and from smaller indirect emissions in the supply chain[10]. The starting point for the transition is challenging: Most of the CO2 emissions result from the unavoidable chemical process in the cement production (known as calcination) and the development of new technologies to decarbonize cement and concrete might not be scalable for years[11]. It is therefore believed that "cement is almost certain to be the most difficult and costly sector of the economy to decarbonize"[12]. To date, Progress in the sector so far has been limited, also due to the lack of interaction in a highly fragmented value chain, non-aligned policy frameworks and the lack of investment in improving existing technologies as well as in developing innovative solutions. In order to make the transition happen, a combination of decreased demand, increased energy efficiency and more investments in breakthrough technologies will be required.[13].

Cement is a the second most consumed product in the world (after water). It is a key product in the built environment, and therefore the decarbonization ambition for the cement and concrete sector has to be grounded in a "systems approach" for the built environment. This includes developing a focus to reach net zero emissions for buildings and infrastructure in a life-cycle approach, which will need to be promoted through the revision of building standards and the establishment of procurement guidelines by public and private sector stakeholders. Establishing this

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[9] Technology Roadmap – low carbon transition in the cement industry, IEA & CSI
[10] Mission Possible - Sectoral Focus Cement, ETC
[11] Laying the Foundation for zero-carbon cement
[12] Mission Possible - Sectoral Focus Cement, ETC
[13] A sustainable future for the European Cement and Concrete Industry

clear demand signal will support an accelerated adaptation of low carbon cement and concrete products.

The content of this pathway needs to be aligned with the Marrakech Partnership Pathway for Human Settlements. In this space, there is an urgent need to create value chain collaborations, establish shared vision and engage actors on the demand side. Therefore, international cooperation will play a significant role in driving key businesses along the value chain to set science-based targets and net zero commitments.

2. CONCRETE & CEMENT SYSTEM MAP

These stakeholders have complementary objectives to support the overall campaign for cement & concrete industry to achieve net-zero emissions by 2050

Investors must set 1.5-aligned targets and strategies, support green measures like competitive carbon pricing and carbon credits to create the right enabling financing environment, direct investment to R&D to support innovation (e.g. alternative materials) and decarbonisation technologies (e.g. CCUS), and encourage sector-wide pressure to drive industry commitments to net-zero.

Regions and cities must develop zero carbon strategies and roadmaps and help set public procurement policies and standards to create demand for low carbon materials.

Tech. Disruptors

Investors and Capital Markets

Civil Society/ Consumers

Think Tanks

Overarching Narrative

Catalytic comms

Climate Action Collaboratives

Aluminium Value Chain

Supply Chain

Producers

Demand-side ambition

End Markets (construction, machinery, transportation, consumer goods manufacturers)

Advocacy for policy

Regions

Cities

National Policy

International Policy

International policymakers must develop zero carbon strategies, set public procurement policies and standards to create demand for low carbon materials, and provide financing and develop decarbonisation roadmaps.

Unions and Labor Force

Action Initiatives

Supply-side ambition

Industry Bodies

Circular economy initiatives need to be developed with all partners in the value chain.

Concrete & Cement producers must set science-based targets to reduce carbon emissions (including scope 3), establish clear roadmaps scale up investment in key technologies like use of hydrogen and electrification to launch and scale pilot projects, and implement plans to provide low carbon materials

Industry bodies such as GCCA need to establish a clear pathway towards net zero, help raise company commitments, facilitate stronger sector collaboration and push for a global debate that recognizes different starting points and speeds of development.

Downstream consumers (the built environment industry) must continue to set science-based targets in line with 1.5C pathway, collaborate with upstream partners to understand key emissions reduction opportunity areas, and help generate demand for low carbon cement/concrete

○ Primary campaign focus   ○ Secondary campaign focus   [x] Campaign objective   ↗ Influence

3. CEMENT AND CONCRETE CHANGE LEVERS

Finding ways to produce carbon neutral cement and concrete is a major contribution to a sustainable built environment. This action table is directly related to the action table for the Human Settlements sector.

- **Policymakers**: The establishment of global and national roadmaps for the cement and concrete industry are an urgent priority; the Swedish roadmap for "fossil free competitiveness" is a good example thereof[14]. In the second half of 2021 the Global Cement and Concrete Association (GCCA) will launch its sectoral roadmap, which will be building on commitments already issued by several industry frontrunners and provide a strong framework for implementation. At the same time the sector needs to contribute to and will benefit from changes in policy frameworks for the built environment. Joint efforts are required 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 the end of life. Driving a strong demand signal through public and private procurement policies to use green cement and concrete for infrastructure projects will help to increase the demand for these products. This will foster an environment for decarbonization. At the same time, there are important opportunities to reduce overall global demand for cement and concrete through improvements in material efficiency within the building sector combined with greater reuse and recycling of cement. [15] Governments should also enable the establishment of clean energy grids to respond to increasing energy needs associated with advanced technologies such as (CCUS) and support the use of fuels that are less carbon intensive in cement kilns. The development of strategies for national roadmaps for CCUS is also recommended. Finally, work needs to be done to ensure that the uptake of CO2 by concrete in the built environment is reflected in national inventories. The ambition is to ensure that a group of 10 leading countries report this as a memo item in their national inventories by 2025.

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[14] Roadmap for Fossil-free Competitiveness
[15] Mission Possible - Sectoral Focus Cement, ETC

- **Finance**: Work needs to be done to establish greater clarity on the investment needed for the cement and concrete sector to speed up the transition. This must include targeted, long-term public-private initiatives in order to support this highly competitive process industry to overcome the current inertia. The situation is complicated, as the development of technologies such as CCUS or "carbon-cured concrete" could take up to 10 years. Currently, the pressure for action is increasing; investments in new facilities, infrastructure upgrades and new technology toned to be prioritized. However, any major step towards decarbonization such as using hydrogen or electricity in heat production will again increase production costs significantly[16]. This implies that an explicit or implicit carbon price of roughly USD100 per tonne of CO2 will be necessary to drive decarbonization in the cement and concrete industry at sufficient speed. The potential to allocate public funding to kickstart and support the transition needs be investigated. Any use of public funding for innovation in the built environment sector should be distributed in a broad, material-neutral way. This will avoid incorrect priorities and uneven competition. It will also stimulate the opportunity to develop technical construction solutions with combinations of several materials.[17]

- **Technology providers and innovators**: A technology leap for cement manufacturing is needed to decarbonize the sector. Although many of the relatively straightforward gains have already been made, there is still scope for improvement in energy efficiency. Cement and concrete producers toned to immediately establish and update their strategies for best available technologies and lay out transition plans for outdated plants by 2030. China has become a centre of innovation in this space, Europe, and the United States, among others, are e.g., starting to lag behind on energy efficiency, due to the continuing use of older equipment.[18]. Another important avenue is the substitution of fossil fuels by residual (non-recyclable) waste, for example biomass. This has proven to be an extremely successful strategy to affect change in the short term. A key challenge is to ensure the availability of biomass on a sustainable basis. Furthermore, there is a need to continuously develop the options for clinker substitution and the scaling up of its usage while more radical options, such as the introduction of novel and carbon-negative cements, are still under development. While this is a potentially very impactful and cost-effective solution, the deployment is still hampered by a lack of demand for lower-clinker cement and the uncertain availability of substitute metals in certain geographies.

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[16] Laying the Foundation for zero-carbon cement
[17] Roadmap for fossil-free competitiveness
[18] Making concrete change - innovation in low-carbon cement and concrete

To prevent process emissions from industry from being released into the atmosphere, there is a need to develop efficient, commercially viable large-scale solutions to utilize carbon dioxide in industrial processes (CCU) and to store carbon dioxide geologically (CCS). The key challenges will be the capital investment required in the absence of clear policy frameworks. Therefore, long-term public and private initiatives need to be established to develop national roadmaps which can provide planning security for industry and enable industry collaboration on a large scale. Significant initiatives will be required in research and development; therefore, pre-competitive research networks such as Innovandi have to be strengthened.

- **Business and service providers**: As a global industry association, GCCA will launch a sector roadmap in 2021 which will lay out detailed plans to reduce the sector's CO2 footprint and work towards delivering carbon-neutral concrete by 2050**.** While several frontrunners in the industry have announced clear targets, the industry as a whole faces a dilemma: there is pressure from the public and financial investors to abate quickly; however, there is no economic rationale yet to do so. This can only be tackled in a two-pronged approach. On the one hand, cement and concrete suppliers need to sign up to net zero commitments, develop roadmaps and strategies and continue to invest in technological improvements. Announcements about the establishment of the first net zero carbon cement production plant in 2030 have been made; more of these lighthouse projects are needed. Suppliers also need to work on a broadened offering for "green cement", for which it would be useful to establish a clear standard with minimum requirements. In the next decade, the availability of green cement and concrete should be ensured in all markets globally.

On the other hand, cross-sectoral collaborative action needs to be intensified with all key stakeholders driving materials demand in the built environment, which also will positively affect the demand for green cement. Suppliers must work closely with the whole value chain to establish more transparent targets, implement standards for tracking and certifying embodied carbon and supporting increases in regional carbon prices. Business and innovative service providers can also close the existing gaps to successfully implement circular economy strategies and shift towards more circular approaches (increase in recycle & reuse, materials efficiency, material substitution) and the accelerated reduction of material input.

- **Civil society**: Social demand for climate action and environmentally friendly products is changing the values of governments and NGOs and the behaviours of businesses. Civil society organizations play a key role in raising and strengthening public awareness and holding key actors accountable. Efforts are needed to educate the broader public about the need to shift to "green materials" in the built environment,

also to increase the social acceptance of higher costs related to these. In this regard, the action table also suggests working closely with city networks such as C 40 to ensure commitment from cities to developing embodied carbon strategies.

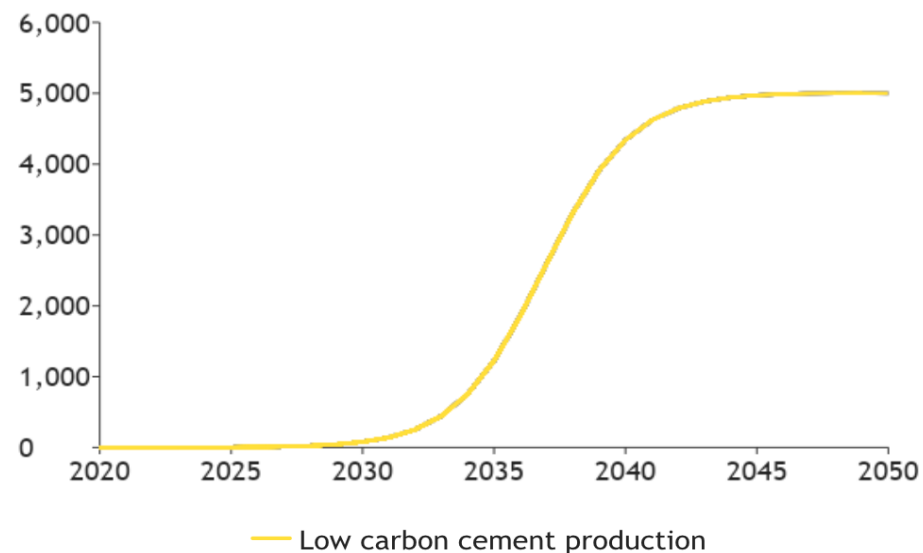## 4. CEMENT AND CONCRETE S-CURVE

Zero Carbon Cement S-Curve model

100% zero emission carbon in 2050 will require 25% in 2035

Zero Carbon Cement S-Curve model

Zero Carbon Cement production as % of global production (in mio. tons)

— Low carbon cement production

Note: Based on a smoothed sigmoid curve forced to 100% at the end given the starting point.
Source: High Level Champions, 2020
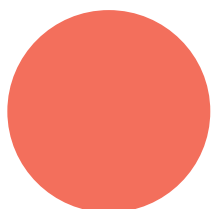
CEMENT AND CONCRETE ACTION TABLE

NEXUS	Energy	Human settlements	Industry	Land use
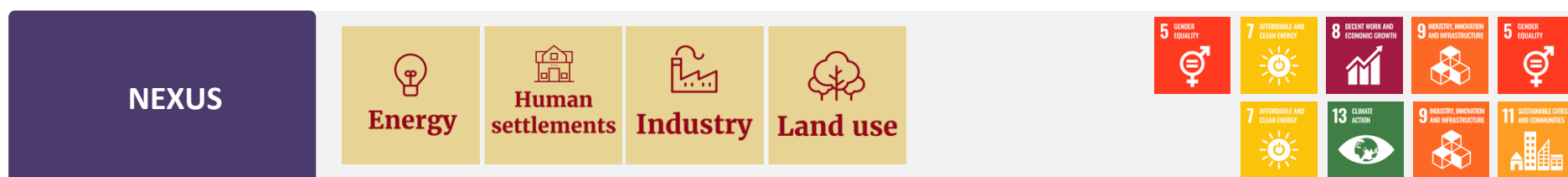
This Pathway is building on all the great work various organizations and individuals have been contributing over so far. In the pathway, industry averages are being used to reflect the trajectories of the sector. Different countries will develop at different speeds, based on different starting points, policy frameworks, ambitions, and available technology. There may be deviations from the timeline due to national specificities and geographical differences, but such deviation should **not** be perceived as a reluctance to support the transition of the sector.

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	By 2021	By 2025	By 2030	By 2040
Encourage direct **advocacy in priority countries, sub-national regions to develop zero carbon materials**	• Global Cement and Concrete **Roadmap** to be published: targets and timelines to carbon neutral concrete by 2050	• Regional/ national cement roadmaps to be updated/ published	• Progress against Global Cement and Concrete Roadmap reported • Roadmaps are updated	• Progress against Global Cement and Concrete Roadmap reported • Roadmap updated

processing **strategies** and roadmaps.	• Establish China & India "competitiveness and low carbon" dialogue, including on cement industry"			
Develop zero carbon strategies, set public procurement policies and standards to demand for low or zero carbon and resilient whole life solutions for built environment assets (national, subnational & local - countries, states, regions), including recycled materials	• Agree and publish strategy and timeframe for Paris-aligned procurement policies to reduce whole life carbon. • Publish Paris-aligned procurement policies. Establish method of measurement of carbon impact for publicly procured built environment assets. • This needs to be alongside standards and procurement rules that build resilience to current and future climate risks • Initiate collation of library of projects in order to establish benchmarks.	• Publish standards (targets) based on library of projects. • Update procurement policies	• Update standards (targets) based on library of projects. • Update procurement policies	• Update standards • Update procurement policies
Adoption of use of Environmental Product Declarations (EPDs) in procurement to choose supply of material which are identical in terms of performance		• All manufacturers have published Environmental Product Declarations for 40% of their product range (WGBC, Bringing Embodied Carbon upfront, 2019)	• All manufacturers have published Environmental Product Declarations for their product range	

Energy: Accelerate the processes of electrification as a key lever towards emissions reduction	• Develop draft policies	• Producers have developed strategies for electrification of processes and transport • Implemented policies		• Ensured industrial access to abundant and competitively priced renewable energy to meet increasing energy needs linked to low-carbon technologies • 100% renewable energy usage for electricity
Plan and support deployment of **CCUS** transport and storage infrastructure	• Develop policies that promote cooperation between government and industry to develop CO_2 transport and storage infrastructure.	• Government investments done in infrastructure to support CCUS		
Accounting for Uptake of CO_2 by concrete in built environment in national inventories		• Group of 10 leading countries to report as memo item in national inventories	• 2030 IPCC guidelines are updated	
Move towards lower **carbon intensity fuels & biomass**		• 30% substitution of fossil fuels by waste derived fuels (as a percentage of energy mix). • Countries have policies in place to ensure waste collection, pre-treatment, and sorting for fuel substitution by cement industry	• 60% alternative fuels in OECD countries being used, 20% in emerging economies	

Development of low carbon cement & concrete standards	• Continue to develop cement standards to incorporate new cements, recognizing the criticality of safety and resilience.		• Develop **concrete** standards to incorporate performance requirements in lieu of minimum cement contents, recognizing the criticality of safety and resilience.	
Incentivization of investments in the transition	• Major institutional asset owners continue to push businesses to set net zero emissions targets, voluntarily disclose under TCFD • Engage with a) national governments to build case for low carbon policies; b) value chain to incentivize collaborative action • Explore/announce investment in cement companies with credible carbon neutral plans, • Leading investors explore investment and business cases for green cement facilities, within cross-sector collaborative efforts, and begin structuring • Greater clarity established on the needed investment for concrete/cement sector's transition	• Major institutional asset owners continue to push businesses to set net zero emissions targets, voluntarily disclose under TCFD • Participate in dedicated funding of first wave of commercial scale cement projects • Continue engaging with value chain to encourage carbon neutral targets and mitigation • Increase preferential investment in cement companies with credible plans	• Major institutional asset owners continue to push businesses to set net zero emissions targets, voluntarily disclose under TCFD • Participate in dedicated investment of 10 commercial scale cement facilities • Scale up preferential investment in low carbon-committed primary producers; begin divesting from carbon-intensive producers • Investor alignment raises cost of capital for new carbon-intensive production facilities, increasing competitiveness of green and low carbon cement • Public-private processes and techniques for managing stranded high carbon cement production assets institutionalized	• Public-private processes and techniques for managing stranded high cement steel production assets ramp down as regional supply/demand mismatches resolve

Enable production and storage of **renewable energy**/ renewable energy infrastructure, and increase % used in production.	• Develop strategy to use renewable energy for indirect energy in cement manufacture and related processes	• Implement strategy to use renewable energy for indirect energy in cement manufacture and related processes		• Eliminate indirect energy emissions through renewable energy sources where available
Continue to improve **energy efficiency** in own processes.	• Cement producers to updated / developed strategies for adoption of Best Available Technology and implementation	• Transition plans in place to close plants that are using outdated / energy inefficient plants (e.g., wet kilns)	• Inefficient plants (e.g., wet kilns) closed	
Development of commercial-scale CCUS as a key innovation priority, to capture CO2 from production of materials		• Several technologies have been commercialized. • Best available technology in concrete production is adopted to permanently store CO2	• Full-scale CCUS technology piloted and ready for industrial-scale deployment	
Increase use of waste heat recovery		• 80% of clinker lines have waste-heat-recovery		
Strengthen research and knowledge exchange	• Continue to strengthen Innovandi – the Global Cement and Concrete Research Network to reduce carbon emissions in cement and concrete production (launched and supported by GCCA)	• Extend the Innovandi research program or similar programs to reduce carbon in the design and use of concrete	• Have 50% of global cement production included/affiliated to research network	
Commitment to reduce scope-1 carbon intensity	• All global market leaders are committed to reducing scope 1 emissions intensity below	• 30% substitution of fossil fuels by waste derived fuels (as a percentage of energy mix);	• -40% in CO2 intensity (kg CO2/t cementitious) on a 1990 basis (using existing technology)	• 2040: cement to clinker ratio of 0.70 (according to IEA **ETP** 2020 Sustainable development scenario)

	500Kg CO2 / t cementitious material by 2030	Policies in place that substitute this target		
Strengthen circular economy approaches	• Assess material efficiency measures in GCCA Roadmap • Identify clear circular economy strategies and evaluate impact thereof (part of GCCA Roadmap)	• Increased use of recycled materials (concrete and demolition waste) • Efficiency in the use of cement in concrete. Improvements in concrete quality control.	• GCCA Concrete Guidelines became a global industry standard for material efficiency and reduction of waste	
Toward Net Zero manufacturing	• Market leaders committing to large-scale industrial pilots in the use of advanced technologies such as CCUS in at least one region	• Technological & financial feasibility achieved for several large scale industrial CCUS projects (with government commitment and support)	• First 3 Net Zero Cement Plants in operation in North America and/or Europe	
Development & Availability of low carbon cement & concrete in all markets globally - also by local companies	• Availability of low carbon cement & concrete offering in target markets by global market leaders	• 2025: Construction codes and standards are adapted to incentivize procurement and usage of low carbon cement & concrete (aiming at public procurement ~30% usage of low carbon products)	• Availability of low carbon cement & concrete in all markets globally - also by local companies. Market share approx. 30%	• net zero cement & concrete available on the market worldwide (without offset)
Develop roadmaps towards carbon neutral concrete towards a net zero world: including provision of measures for climate risk	• Manufacturers of cement to establish targets in global sectoral 1.5° aligned roadmap (e.g., as required by Global Cement and Concrete Association for their Full Members) and publicly report: covering >30% of global cement production	• by 2025: Producer Company Targets to accord with industry roadmap (Global Cement and Concrete Association 2050 Roadmap) and publicly report • 2025: 50% of global production committed to global roadmap	• By 2030: Have an implementation map ready and each piece of new technology in pilot scale (minimum)	

		• 50% of global production have assessed climate risk in their business and value chains; strategy in place for mitigation		
Non-profits, NGOs support the development of regional roadmaps Labor unions push for energy efficiency and green investments as part of COVID bailouts, just transition policy support Campaigns for material efficiency and design methods 5.4. Launch consumer-facing campaigns		• Consumer demand generation campaigns accelerate development of circular business models • Product certifications, and accounting methodologies are mainstreamed and implemented, • Facilitate diffusion of material efficiency and design tools and processes into 5% of new buildings demand in high growth developing countries, as well as implementation of enabling building codes and standards	• International campaigns for circular, zero embodied carbon, infrastructure, and assets	• Consumer demands have mainstreamed development of circular business models in developed and developing countries • Social dialogue models proven, standardized, and scaling across communities to support just transition
Mobilization of city governments to increase demand for carbon neutral concrete	• at least 50 cities join the Clean Construction Forum to start taking action on embodied emissions and clean construction over the year to follow	• 300 city governments have taken action on embodied emissions and clean construction, for instance by developing embodied carbon strategies in a community of practice and/or adopting regulations to mandate/incentivize low-carbon materials and		

		materials efficiency, such as materials reuse and recycling		

CEMENT AND CONCRETE - EXISTING INITIATIVES

GCCA - Global Cement and Concrete Association	Industry association with global representation. membership accounting for nearly 50% of global cement production capacity.
National & regional concrete/ cement associations (all are GCCA affiliates)	The national and regional concrete/cement associations are GCCA affiliates (incl. CEMBUREAU, FICEM, MPA etc.)
We Mean Business Coalition	Global non-profit coalition working with the world's most influential businesses to take action on climate change, catalyzing business leadership to drive policy ambition and accelerate the transition to a zero-carbon economy.
Leadership Group for Industry Transition (LeadIT)	Accelerating the transition of all industry sectors to low carbon pathways to reach net-zero carbon emissions by 2050.
Climate Action 100+	Investor network to ensure the world's largest corporate greenhouse gas emitters take necessary action on climate change.
Net Zero Asset Owner Alliance	Group of asset owners working to transition their investment portfolios (more than 2.4 trillion USD globally) to net-zero GHG emissions by 2050 consistent with a maximum temperature rise of 1.5°C.
WBCSD Built environment project	Program that looks at the whole built environment value chain and the impact of all materials in it.

Concrete Sustainability Council	CSC results from the planned or partly already recognized recognition by international systems for assessing the sustainability of buildings. ▶
Innovandi	Industry led consortium that ties together the cement and concrete industry with scientific institutions to drive and support global innovation ▶

CEMENT AND CONCRETE - FURTHER REFERENCES

Mission Possible Platform: Reaching net-zero carbon emissions from Harder-to-Abate sectors by 2050	**Link**
Ellen MacArthur Foundation & Material Economics: Completing the Picture: How the Circular Economy Tackles Climate Change	**Link**
Fraunhofer ISI: Industrial innovation: Pathways to deep decarbonization of industry	**Link**
World GBC: Bringing Embodied Carbon Upfront	**Link**
CNCA/C40: Embodied Carbon Policy Framework	**Link**
ETC: China 2050 A fully developed rich zero carbon economy	**Link**
CEMBUREAU: 2050 carbon neutrality roadmap	**Link**
WBCSD: Transforming the Built Environment	**Link**
C40- Clean Construction Forum	**Link**

CHEMICALS

1. CHEMICALS – INTRODUCTION

The purpose of this Action Table document is to highlight specific, promotable actions to deliver the vision for the Industry thematic area, with a sector-based approach focused on chemicals.

The global chemicals sector – responsible for 5% total global emissions (1.5 Gt total direct emissions per year) – faces a necessary but challenging path to decarbonization. About 60% of total direct CO_2 emissions from the sector come from two primary chemicals: ammonia (30%) and plastics (30%).[19] However, as of November 2020, only <10% of the top 50 global chemicals companies have committed to net–zero carbon emissions by 2050 or sooner, and only two of these net–zero targets are committed through the Science-Based Target initiative (SBTi). [20]

There are several routes to decarbonizing the chemicals sector. Upstream fuel and feedstock switching (e.g., to waste or bio–based inputs) is key, as petrochemical feedstock accounts for 12% of global oil demand.[21] Chemical process improvements, such as increased electrification, use of low-carbon hydrogen, and carbon capture, use and storage (CCUS) are also critical. Finally, more efficient product use downstream (such as reduced fertilizer user) and end–of–life management (through chemical and mechanical recycling) is necessary. Petrochemicals production is driven by China, the United States, and the Middle East; despite being the largest industrial energy consumer, the chemical sector ranks third among industrial CO_2 emitters (behind cement and steel).[22] Therefore, renewable electricity and the use of low–carbon hydrogen will be crucial to decarbonize production. More information on these topics can be found in the Energy Thematic Pathway.

This Action Table draws together insights from a number of existing decarbonization pathways, roadmaps, and guidance for the chemicals sector, supported by a multi-stakeholder consultation process across the Marrakech Partnership Industry Thematic Group. For more information, please see "**Further References**".

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[19] Mission Possible Platform and the Energy Transitions Commission, reaching net zero carbon emissions from harder-to-abate sectors by mid-century: Plastics sectoral focus, https://www.energy-transitions.org/publications/mission-possible-sectoral-focus-plastics/
[20] High-Level Climate Action Champions team research, November 2020.
[21] IEA, The Future of Petrochemicals, https://www.iea.org/fuels-and-technologies/chemicals
[22] IEA, The Future of Petrochemicals, https://www.iea.org/fuels-and-technologies/chemicals

2. CHEMICALS SYSTEM MAP

These stakeholders have complementary objectives to support the overall campaign for the Chemicals industry to achieve net-zero emissions by 2050

Investors must set 1.5-aligned targets and strategies, support green measures like competitive carbon pricing and carbon credits to create the right enabling financing environment, direct investment to R&D to support chemical decarbonisation technologies (e.g. CCUS), and encourage sector-wide pressure to drive industry commitments to net-zero.

Regions and cities must develop zero carbon strategies and roadmaps and help set public procurement policies and standards to create demand for low- or zero-carbon materials.

International policymakers must develop zero carbon strategies, set public procurement policies and standards to create demand for low/zero carbon materials, and provide financing and develop decarbonisation roadmaps.

Chemical producers must set science-based targets to reduce carbon emissions (including scope 3), scale up investment in key technologies like use of hydrogen and electrification to launch and scale pilot projects, and implement plans to provide low- to zero-carbon materials to customers downstream.

Industry bodies must help raise sector net-zero ambition, push for consistency between progressive company positions and those of wide trade groups, and facilitate stronger sector collaboration.

Downstream consumers must continue setting science-based targets in line with 1.5C pathway, collaborate with upstream partners to understand key emissions reduction opportunity areas, and help generate demand for low carbon materials e.g. through a 'material buyers' group.

Legend:
- Primary campaign focus
- Secondary campaign focus
- [X] Campaign objective
- Influence

3. CHEMICALS CHANGE LEVERS

- **Policy** and international cooperation have a key role to implement subsidies, mandate taxes (like carbon pricing), support public Paris Agreement-aligned procurement, encourage R&D investment, and establish/promote standards. These policies can shape the market and change incentives for finance. Policymakers must ensure that clear carbon emissions reduction ambition is established (such as the 50-55% emissions reduction by 2030 captured in the EU Green Deal)[23] and advocate for clear enabling policy for industry transition at scale. They should direct public funding to support pilot technology projects for electrification, low-carbon hydrogen, and CCUS and promote significant investment in public-private partnerships and R&D programs to boost technological capacity to deliver on such pilots.

- **Finance** stakeholders are able to reallocate investment between sectors, between businesses, and between technologies through public finance, private finance, and blended finance mechanisms, driving feedback loops between key stakeholder groups in the chemicals ecosystem. Finance is critical to scale up new, climate-smart technologies and move away from old, carbon-intensive technologies. Financiers and investors should encourage widespread use of product certification and/or the development of a chemical "buyers' club" to direct demand and help broker public-private R&D investment in sustainable chemical production to deliver key technology pilot projects.

- **Technology** is a key driver for improving performance, cost, and social acceptance of new, climate resilient solutions in chemical businesses. Technology solutions across the sector range from increased use of biomass as a chemical input, development and use of CCUS, increased use of electrification and low-carbon hydrogen, and boosted waste processing capacity.

- **Businesses** acquire political capital, market share, and organizational resources, which are key resources of influence to help change available options in the market, respond to civil society expectations, and drive incentives for policy. Supply-side chemical producers should align with a decarbonization agenda through increased reporting and disclosure in line with the Task Force on Climate-related Financial Disclosures (TCFD) and set long-term net zero emissions reduction to 2050 or earlier supported by short/mid-term targets recognized by SBTi (including scope 3 emissions). They should realize this ambition by actively participating in collaborative decarbonization initiatives

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[23] European Commission, State of the Union 2020, https://ec.europa.eu/commission/presscorner/detail/en/IP_20_1599

with partners and peers. Demand-side business should help incentivize procurement of low-carbon, certified chemical products by supporting a green chemicals "buyers' club" or certification mechanism, and also align net–zero target–setting with SBTi.

- **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 research gaps and improving information around sustainable choices. Civil society actors can also influence policy by advocating for climate–supportive legislative change, working towards systems transformation, driving collective action, and holding actors to account.

4. CHEMICALS S-CURVE

The s-curve models the overall emissions reduction pathway for the Dutch chemical industry, leveraging the roadmap for the Dutch chemical industry towards 2050 published in 2018.[24] The proposed percentage emissions reduction targets from the Dutch chemical sector towards 2050 are in line with the European Union goal to realize an 80-95% emissions reduction by 2050 compared to 1990. This target translates to 60-70 M tonne CO2e reduction in absolute terms in 2050, framed as ambitious and conservative scenarios.

Dutch chemical sector emissions reduction pathway in line with EU targets, based upon indicative 's-curve'
CO$_2$ reduction (M tonnes)

Chemicals action table

NEXUS	Energy	Human settlements	Industry	Land use								

SDGs: 2 Zero Hunger · 3 Good Health and Well-Being · 6 Clean Water and Sanitation · 7 Affordable and Clean Energy · 8 Decent Work and Economic Growth · 9 Industry, Innovation and Infrastructure

	By 2021	By 2025	By 2030	By 2040
Policymakers (national, subnational, local levels)	• Develop zero carbon strategies, set public procurement policies and standards to create demand for low or zero carbon materials (national, subnational, and local - countries, states, regions). • Plan and support deployment of carbon capture transport and storage infrastructure to enable carbon pricing policy and enable production of low-carbon hydrogen.	• Leading countries, states, and regions with clear net zero carbon strategy and roadmap in place. • Continue to advocate for an implicit or explicit carbon price to ensure current energy and carbon policies do not have a significant impact on the competitiveness of decarbonizing the chemicals sector.	• Major countries, states, and regions with clear net zero carbon strategy and roadmap in place. • Widespread acceptance and use of competitive carbon price at 60 euro per ton. • Food waste halved per capita in the EU by 2030.	• All countries and major states and regions with clear net zero carbon strategy and roadmap in place.

	- Develop a suitable support framework for the development of bio-based chemistry by providing clear direction and criteria on use of biomass. - Encourage a more dynamic EU emissions trading system (ETS) with allocation based on actual production and including indirect emissions. - Develop a R&D and innovation framework to facilitate new breakthrough technology development and encourage better coordination between industry needs and academic research. - Prioritize food waste reduction by improving use efficiency of ammonia fertilizer.			
Financial Institutions	- Align target ambition and reporting process with SBTi roadmap and sector guidance (due end of 2020). - Encourage government-backed financing structures and public procurement pressure, using public procurement to create demand for low-carbon chemical products.	- Top global chemical companies align with climate-related financial disclosure practices per TCFD. - Major investors with a 1.5 target and engagement strategy in place. - Allocate public funding for target-driven research programs with quantitative	- All major chemical companies align with climate-related financial disclosure practices per TCFD. - Significant share of investors with a 1.5 target and engagement strategy in place.	- All chemical companies align with climate-related financial disclosure practices per TCFD. - All key investors with a 1.5 target and engagement strategy in place.

	• Encourage public-private sector partnership to bring key technologies under development to commercial readiness (e.g., biomass utilization, CCUS, electrification, low-carbon hydrogen, waste processing). • Develop adequate financing schemes and pilot support mechanisms for the adoption of energy efficient and low carbon technologies. • Endorse and promote the Task force for Climate-related Financial Disclosures (TCFD) recommendations. • Encourage investors to set 1.5C targets themselves and encourage strategic companies they invest in to do the same.	objectives 10-15 years ahead (key research areas include biomass, process improvements, CCUS).		
Technology Providers and Innovators	• Invest in biomass supply solutions to aid a biobased feedstock switch. Note: Must only be considered where alternative decarbonization routes are least available. • Support commercial-scale carbon capture and use technologies as a key innovation priority. • Accelerate the processes of electrification as a key lever	• Technology readiness level of at least two key technologies increased (manufacturing of platform intermediates: biomass to bio-ethylene, biomass to bio-syngas). • Technology readiness level of 2 key CCUS technologies (e-cracker, low-carbon hydrogen beyond water-	• At least 2 large-scale biomass supply demonstration projects in operation in prioritized regions. • Several large-scale CCUS demonstration projects in operation in prioritized regions. • Several large-scale clean electrification	• Proliferation of large-scale biomass supply demonstration projects on global scale. Conversion of biomass into a broad set of chemicals enabling gross decarbonization of the sector (>90% GHG emission reduction). • Proliferation of large-scale CCUS demonstration projects on global scale.

	towards emissions reduction (75% of chemical company emissions come from energy use). • Develop and scale up low-carbon hydrogen production technologies. • Develop plastic waste processing technologies.	electrolysis) increased. Prerequisites include reinforcement or construction of new grid networks to support a significant increase of clean energy demand. • Several large-scale low-carbon demonstration projects in operation in prioritized regions. • Technology readiness level of 10 key technologies for mechanical and chemical recycling increased	demonstration projects (1-10 tons/h) in operation in prioritized regions. Prerequisite: Access to sufficient and affordable green energy. • Proliferation of large-scale low-carbon hydrogen demonstration projects on global scale. • Several large-scale (50-200 kilo tons) plastic waste demonstration projects in operation in prioritized regions.	• Proliferation of large-scale clean electrification demonstration projects on global scale. Shift of energy input from fossil fuels to emission free energy, >50% of total energy demand emission free. • Multiple commercial-scale low-carbon hydrogen plants. • Proliferation of large-scale demonstration projects on global scale. Recycling of 100,000 kilo tons of waste into chemicals and plastics.
Business and Service Providers	• 20% of global chemicals sector set science-based targets in line with 1.5^{o}C pathway in line with SBTi chemicals sector guidance (currently approx. 10%). • Improve product design to enable increased energy and materials efficiency. • Manage use of fertilizers through reduction or more efficient use; key influencer of ammonia demand but beyond industry control (requires systemic changes within the food supply chain).	• Significant share of global chemical companies set science-based targets in line with 1.5^{o}C pathway • Continue to lobby for more ambitious carbon pricing (60-100 euro per ton).	• All major chemical companies set science-based targets. • Widespread acceptance and use of competitive carbon price at 60 euro per ton.	All chemical companies set science-based targets in line with 1.5^{o}C pathway.

	• Use lobbying capacity to advocate ambitious international agreements on carbon pricing (see Policy for more). • Invest in R&D projects, especially pilot plants, focused on key technology priorities (e.g., biomass, CCUS, electrification, waste processing, low-carbon hydrogen).			
Civil Society	• Engage with consumers on food waste reduction to reduce the amount of food required and subsequently fertilizer (ammonia) needs. • Push for adequate labelling of lifecycle and embedded carbon intensity of products and services to create traceability and enable consumer awareness • Advocate for increased membership/uptake of key sector initiatives/programs/trade associations.	•	•	•

CHEMICALS - EXISTING INITIATIVES

Business Ambition for 1.5C	UNGC Secretariat campaign asking businesses to set science-based targets aligned with limiting global temperature rise to 1.5C above pre-industrial levels.
Science Based Targets Network	Collaborative initiative between CDP, UNGC, WRI, WWF, and WMB to showcase companies that set science-based targets.
We Mean Business Coalition	Global non-profit coalition working with the world's most influential businesses to take action on climate change, catalyzing business leadership to drive policy ambition and accelerate the transition to a zero-carbon economy.
World Business Council for Sustainable Development (WBCSD) Chemicals Group	Global, CEO-led organization of over 200 businesses working together to accelerate the transition to a sustainable world. Chemicals Group brings together 12 companies to drive sustainable solutions across value chains, to influence cross-sectoral systems transformation.
Leadership Group for Industry Transition (LeadIT)	Accelerating the transition of all industry sectors to low carbon pathways to reach net-zero carbon emissions by 2050.
Climate Action 100+	Investor network to ensure the world's largest corporate greenhouse gas emitters take necessary action on climate change.
Mission Innovation	Dramatically accelerate public and private global clean energy innovation, including doubling their current research and development investments in the sector over 5 years.
Net Zero Asset Owner Alliance	Transition investment portfolios (more than 2.4 trillion USD globally) to net-zero GHG emissions by 2050 consistent with a maximum temperature rise of 1.5°C.
Mission Possible Platform Collaborative Innovation for Low-Carbon Emitting Technologies	Accelerates the development and upscaling of low carbon emitting technologies for chemical production towards a marked reduction in greenhouse gas (GHG) emissions in the chemical industry.
World Economic Forum Chemicals & Advanced Materials Program	Exclusive community of peers. Partners in the community take an active role in the industry transformation and advance multi-stakeholder initiatives to deliver greater sustainability, resilience, and performance into a variety of socioeconomic systems.

Together for Sustainability (TfS)	Joint initiative and global network of 26 chemical companies, delivering the de facto global standard for environmental, social and governance performance of chemical supply chains.	▶
Sustainable Process Industry through Resource and Energy Efficiency (SPIRE)	European Association of cement, ceramics, chemicals, engineering, minerals and ores, non-ferrous metals, pulp and paper, refining, steel, and water sectors to ensure the development of enabling technologies and best practices along all the stages of large-scale existing value chain productions that will contribute to a resource efficient process industry.	▶

CHEMICALS - FURTHER REFERENCES

Mission Possible Platform: Reaching net-zero on carbon emissions - Plastics	Link
Mission Possible Platform: Reaching net-zero on carbon emissions	Link
Fraunhofer ISI: Pathways to deep decarbonization of industry	Link
CISL: Industrial Transformation 2050	Link
CEFIC: European chemical industry roadmap (to 2030)	Link
WBCSD: SDG chemical sector roadmap	Link
VNCI: Dutch chemical industry roadmap	Link
UK government: Chemicals sector decarbonization strategy	Link
Mission Possible Platform: Low Carbon Emitting Technologies initiative	Link

European Commission: Circular Economy Strategy	**Link**
IEA/ICCA/Dechema: Technology Roadmap	**Link**
IEA: The Future of Petrochemicals	**Link**

FAST-MOVING CONSUMER GOODS

1. FAST MOVING CONSUMER GOODS - INTRODUCTION

The purpose of this Action Table document is to highlight specific, promotable actions to deliver the vision for the Industry thematic area, with a sector-based approach focused on fast-moving consumer goods (FMCG).

GHG emissions for the FMCG sector are estimated to be 33 Gt CO2e annually while the industry is expected to grow at an average of 5.3% each year for the next two decades. The industry must reduce emissions by more than 50% to meet the 2050 targets required to maintain warming at below 1.5⁰C. The industry is doing well relative to retail when it comes to commitments. A total of 32% of the market by revenue is covered by an SBTi or UNGC Business Ambition 1.5 classification, whilst 11% have set out a 1.5⁰C commitment under either scheme, compared to 10% and 4% respectively in the retail industry.[25]

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 behaviour and diets through ingredient sourcing, product design and category choices. More than80% of FMCG GHG emissions lie within supply chains, yet only 25% companies currently engage their suppliers to address these emissions, creating an opportunity to influence upstream emissions with stronger scope 3 target-setting and monitoring.[1, 26]

Further strategies to decarbonize the FMCG sector include tackling commodity-driven deforestation, reducing food waste, reducing the usage of harmful refrigerants, moving to zero-carbon logistics and addressing the growing issue of plastic waste.

As of August 2020, no global decarbonization roadmap has been identified for the FMCG sector. The action table featured in this document therefore draws insight from a variety of sources, including the British Retail Consortium's Climate Action Roadmap for the UK retail sector launched November 2020.[27] Where indicated, it also includes targets and actions from pathways in sectors adjacent to FMCG. For more information on these initiatives, please see **'Further References'**.
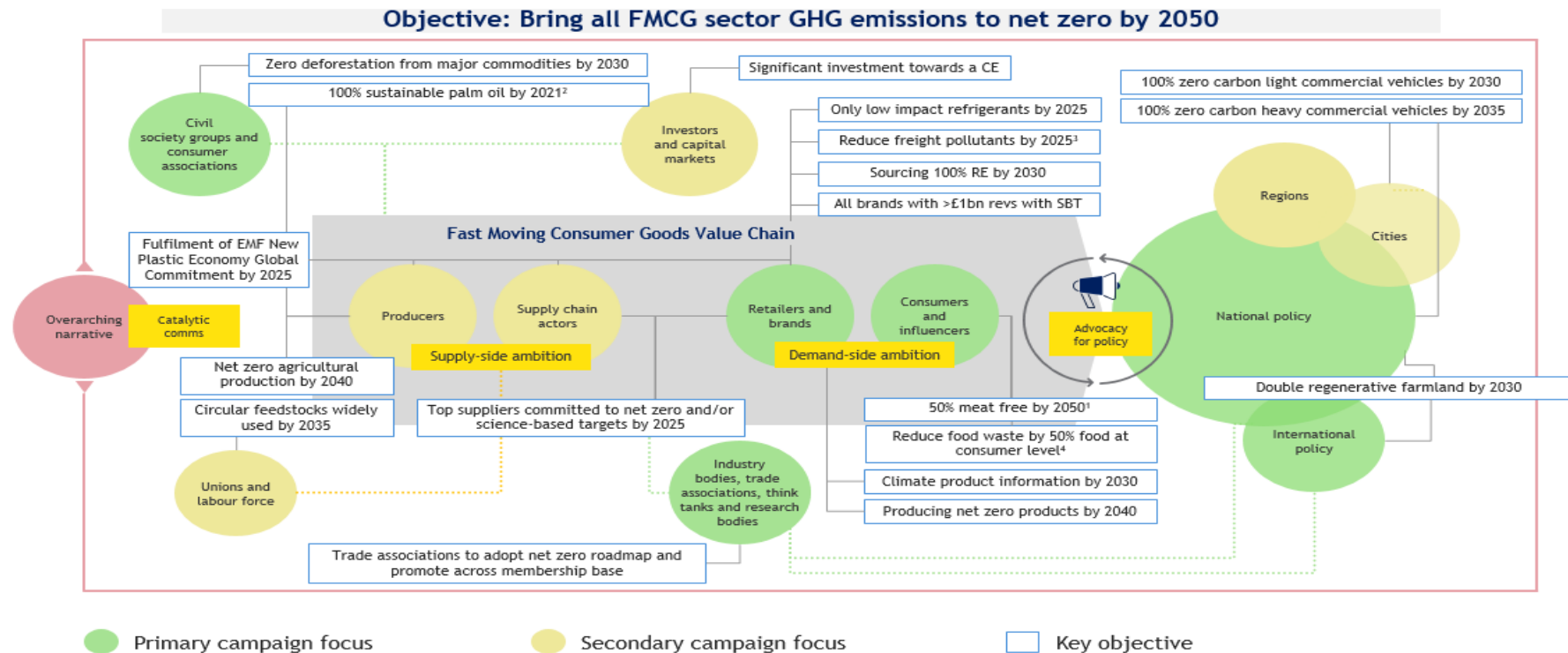
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[25] Climate Champions analysis of Orbis Financial data extract for company sector revenues
[26] Of companies that report to CDP
[27] British Retail Consortium, 2020, Climate Action Roadmap, https://brc.org.uk/climate-roadmap/

2. FAST-MOVING CONSUMER GOODS SYSTEM MAP

Objective: Bring all FMCG sector GHG emissions to net zero by 2050

Zero deforestation from major commodities by 2030
100% sustainable palm oil by 2021[2]

Significant investment towards a CE
Only low impact refrigerants by 2025
Reduce freight pollutants by 2025[3]
Sourcing 100% RE by 2030
All brands with >£1bn revs with SBT

100% zero carbon light commercial vehicles by 2030
100% zero carbon heavy commercial vehicles by 2035

Civil society groups and consumer associations

Investors and capital markets

Regions
Cities

Fast Moving Consumer Goods Value Chain

Fulfilment of EMF New Plastic Economy Global Commitment by 2025

Overarching narrative
Catalytic comms

Producers
Supply chain actors
Supply-side ambition

Retailers and brands
Consumers and influencers
Demand-side ambition

Advocacy for policy

National policy

Net zero agricultural production by 2040
Circular feedstocks widely used by 2035

Top suppliers committed to net zero and/or science-based targets by 2025

50% meat free by 2050[1]
Reduce food waste by 50% food at consumer level[4]
Climate product information by 2030
Producing net zero products by 2040

Double regenerative farmland by 2030

International policy

Unions and labour force

Industry bodies, trade associations, think tanks and research bodies

Trade associations to adopt net zero roadmap and promote across membership base

● Primary campaign focus　　● Secondary campaign focus　　☐ Key objective

Source: [1] Eat-Lancet Commission; [2] RSPO; [3] Global Green Freight Action Plan; [4] Champions 12.3

3. FAST-MOVING CONSUMER GOODS CHANGE LEVERS

- **Policy** has a key 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.

- **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. Mechanisms such as preferential interest rates, guarantee schemes and risk-sharing facilities can help scale up the much-needed technologies.

- **Technology** and innovation are needed to deliver climate-smart solutions. Focus areas for FMCG should be in electrifying 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 technical barriers to recycling, designing products which minimize in-use consumer emissions footprints, developing effective substitutes for plastic and shifting to natural refrigerants and more efficient refrigeration.

- **Business: Supply** chain actors upstream and in the agricultural sector react to the signals set by FMCG companies, as they look to align with their buyer's decarbonization agendas, 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 (for instance in alternative proteins as a substitute for meat), product design changes (for instance 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, through campaigns and calls-to-action, addressing

research gaps and improving information around sustainable choices. Civil society actors can also influence policy by advocating for climate-supportive legislative change, working towards systems transformation, driving collective action, and holding actors to account.

FAST MOVING CONSUMER GOODS ACTION TABLE

NEXUS	Energy	Human settlements	Industry	Land use	Transport

	By 2021	By 2025	By 2030	By 2040
Policymakers (national, subnational, local levels)				
Support **energy decarbonization**	• Support on-site renewable generation • Provide incentives for landlords to move to renewable tariffs • Support electrification of heating systems			

Improve **building efficiency**	• Drive building efficiency through green building certification standards and enhanced building efficiency requirements • All commercial buildings to be 70-80% more energy-efficient and all new buildings must be nearly-zero energy buildings (nZEBs) by 2020 (European Parliament)			
Support **infrastructure for electrification**	• Support investment in recharge infrastructure for electric goods vehicles • Support R&D and deployment of low carbon solutions for heavy goods transport, including incentives to accelerate adoption of new technologies			
Support **regenerative and decarbonized agricultural practices**	• N/A	• N/A	• Double farmland under regenerative practice • Remove & store 100GT of CO2EQ in healthy soil & increase soil carbon by 1%/year	• Net zero agricultural production in the UK (NFU)
Restore **degraded lands**	• N/A	• N/A	• Restore 350mn hectares of degraded lands	• Restore 500mn hectares of degraded lands
Protect land	• N/A	• N/A	• Protect 30% land	• Protect 50% land by 2050
Act on **plastic packaging** (relevant for "Businesses and Services Providers")	• N/A	• Take action to eliminate problematic or unnecessary plastic packaging (EMF) • Take action to move from single use towards reuse models where relevant 100% of plastic packaging to be reusable, recyclable, or compostable (EMF) • Set an ambitious recycled content target across all plastic packaging used (EMF)	• N/A	• N/A

Business and Service Providers

Measure and report GHG emissions effectively	• FMCG companies with >£1bn in revenues set an SBTi with comprehensive Scope 3 • GHG measurement and reporting, specifying how offsets will be phased out	• Adopt an internal cost of carbon of >£20/tonne	• Raise internal cost of carbon >£50/tonne
Influence supplier action on climate	• N/A	• Ensure top suppliers committed to net zero and/or SBTs • Collect Tier 1 manufacturing GHG data from top suppliers	• Collect product GHG data from top suppliers	• N/A

Move to zero carbon logistics	• N/A	• Run advanced fuel efficiency programs for distribution fleet and drivers • Collect GHG performance data from logistics providers to inform decision-making • Reduce GHGs and other freight pollutants by 2025 (Green Freight Action Plan)	• Encourage network/route sharing for optimized efficiency • Transition LGV fleet to 100% zero carbon	• Transition last mile logistics to 100% zero carbon • Transition HGV fleet to 100% zero carbon
Sustainably source raw materials	• Set up to regularly report progress on tackling supply chain deforestation • 100% sustainable palm oil (RSPO)	• Support for regenerative agriculture and GHG mitigation on farm • Run programs with suppliers to accelerate decarbonization activities	• Zero deforestation from major commodities (beef and leather, cocoa, palm oil, timber*, pulp* and paper*, rubber, soy) • * - sourced from sustainably managed forests • Embed sustainable design principles in raw material and product specifications	• Net zero agricultural production from farms • Source >90% circular feedstocks • Implement carbon dioxide removals projects and ensure verifiable results
Help customers to live low carbon lifestyles	• Roll out campaigns to encourage low carbon behaviours • Run employee engagement programs on climate	• Increase proportion of plant-based food sales in the UK by 50%	• Increase sale of circular products by 50% • Provide product climate information to customers on 100% products	• Have net zero products account for 80% sales

Technology Providers and Innovators

Adopt **LEDs**	• N/A	• Install 100% LEDs in all new buildings (e.g., stores and warehouses)	• Install or retrofit 80% LEDs in existing buildings	• Install or retrofit 100% LEDs in existing buildings
Operate **efficient sites powered by renewable energy**	• N/A	• Largest CPGs to source 50% renewable energy from PPAs • Power all new buildings with renewable energy	• Source 100% renewable electricity (no gas usage)	• Source renewables for all sites' energy needs
Eliminate **hydrofluorocarbon refrigerant gases**	• N/A	• Use only low impact refrigerant gases (max 150GWP) for all new refrigeration installations	• Reduce HFCs by 79%, to meet EU F-Gas Regulation	• Prevent 70bn tonnes CO2e by 2050 (Kigali Amendment) • Use only low impact refrigerant gases (max 150GWP) for all systems
Reduce **whole lifecycle carbon emissions of buildings** (see Human Settlements pathway. Also relevant for "Businesses and Services Providers")	• All commercial buildings to be 70-80% more energy-efficient and all new buildings must be nearly-zero energy buildings (nZEBs) by 2020 (European Parliament)	• 32.4 kgCO2e/m² GHG intensity by 2050 in a 1.5^0C scenario and 39.7 kgCO2e/m² in a 2° scenario (CRREM)	• 22.4 kgCO2e/m² GHG intensity by 2050 in a 1.5^0C scenario and 29.2 kgCO2e/m² in a 2° scenario (CRREM)	• 9.0 kgCO2e/m² GHG intensity by 2050 in a 1.5^0C scenario and 16.0 kgCO2e/m² in a 2° scenario (CRREM)

Civil society

Tackle **food waste** (Also relevant for "Businesses and Services Providers")	• Zero food waste to landfill by 2020 (Vision 2020)	• Reduce post-farm food waste by 20% in the UK (Courtauld Commitment) • Halve food waste from CPGs (Consumer Goods Forum)	• 50% reduction in food waste globally at the retail and consumer levels (Champions 12.3)	• 50% reduction in food waste globally (EAT-Lancet)
Ensure **sustainable diets**	• N/A	• N/A	• Right diet for 9bn (EAT-Lancet)	• Right diet for 10bn by 2050 (EAT-Lancet)

Financial Institutions

Support development of new investment vehicles like **public-private partnerships** to invest in R&D projects on innovation priorities and supply chain transformation	• N/A	• N/A	• N/A	• N/A
Partner with policymakers and industry to increase inflow of capital to **catalyze and scale solutions** for a low-carbon economy throughout the sector	• N/A	• N/A	• N/A	• N/A

Shift investment portfolios towards brands with robust environmental credentials, and support accurate and effective ESG assessments	• N/A	• N/A	• N/A	• N/A
Institutionalize financing mechanisms and incentive structures for industry decarbonization	• N/A	• N/A	• N/A	• N/A

FAST-MOVING CONSUMER GOODS - EXISTING INITIATIVES

Consumer Goods Forum	UNGC Secretariat campaign asking businesses to set science-based targets aligned with limiting global temperature rise to 1.5C above pre-industrial levels.
The Sustainability Consortium	Collaborative initiative between CDP, UNGC, WRI, WWF, and WMB to showcase companies that set science-based targets.
World Wildlife Fund	Global non-profit coalition working with the world's most influential businesses to take action on climate change, catalyzing business leadership to drive policy ambition and accelerate the transition to a zero-carbon economy.
Business Ambition for 1.5C	Global industry body driven by membership of over 400 retailers and consumer goods companies in over 70 countries, convening environmental commitment around deforestation, food waste, refrigeration, and raw materials sourcing.
Science Based Targets initiative	Global non-profit organization working to transform the consumer goods industry by partnering with leading companies to define, develop and deliver more sustainable products.

We Mean Business Coalition	International non-governmental organization working to minimize negative human impacts on the environment.
World Business Council for Sustainable Development	UNGC Secretariat campaign asking businesses to set science-based targets aligned with limiting global temperature rise to 1.5C above pre-industrial levels.
World Economic Forum	Collaborative initiative between CDP, UNGC, WRI, WWF, and WMB to showcase companies that set science-based targets consistent with the level of decarbonization required by science to limit warming to less than 1.5°C compared to pre-industrial temperatures.
United Nations Framework Convention on Climate Change	Global non-profit coalition working with the world's most influential businesses to take action on climate change, catalyzing business leadership to drive policy ambition and accelerate the transition to a zero-carbon economy.
RE100	Global, CEO-led organization of over 200 businesses working together to accelerate the transition to a sustainable world.
World Green Building Council	Global membership-based organization convening the world's largest corporations across several platforms and initiatives, including for the reduction of carbon emissions.
EP100	Multilateral environmental agreement setting non-binding limits on greenhouse gas emissions for individual countries.
Cool Coalition	RE100 brings together influential businesses committed to 100 % renewable energy. This initiative is led by the Climate Group in partnership with CDP.
EV100	Non-profit organization and global network of national Green Building Councils in over 70 countries worldwide.
Clean Cargo	A voluntary initiative where corporations pledge to double their energy productivity within 25 years of a chosen baseline. This initiative is led by the Climate Group in partnership with the Alliance to Save Energy.

FAST-MOVING CONSUMER GOODS - FURTHER REFERENCES

Climate Action Roadmap, British Retail Consortium, 2020	Link
Special Report: Global Warming of 1.5°C, Intergovernmental Panel on Climate Change	Link
Executive Summary: Fast Moving Consumer Goods, Carbon Disclosure Project, 2019	Link
Opportunities for the Consumer Goods Sector, Ellen MacArthur Foundation	Link
Low Carbon Solutions for a Sustainable Consumer Goods Sector, Consumer Goods Forum, 2017	Link
Improving Supply Chain Resilience to Manage Climate Change Risks, The Sustainability Consortium and HSBC (2020)	Link
The Climate Pledge, Amazon	Link
Carbon Disclosure Project Supply Chain initiative	Link
Montreal Protocol, United Nations Environment Program	Link
Technical report on energy efficiency in HFC-free supermarket refrigeration, Environmental Investigation Agency, 2018	Link
Fashion Charter for Climate Action, United Nations Framework Convention on Climate Change	Link
Partnerships for Forests, Global Resources Initiative	Link

Roundtable on Sustainable Palm Oil	Link
Courtauld Commitment 2025, WRAP (UK)	Link
Healthy Diets from Sustainable Food Systems, EAT-Lancet Commission	Link
Champions 12.3	Link
Sustainable Food Systems and Diets: A Review of Multi-Stakeholder Initiatives, World Wildlife Fund, 2018	Link

ICT AND MOBILE

1. INFORMATION AND COMMUNICATIONS TECHNOLOGY (ICT) AND MOBILE - INTRODUCTION

The purpose of this Action Table document is to highlight specific, promotable actions to deliver the vision for the Industry thematic area, with a sector-based approach focused on ICT and Mobile. It provides normative pathways of the industry as a reference for policymakers, and non-state actors such as investors and industry leaders.

ICT and Mobile sectors account for approximately 1.4% of global GHG emissions[28]. They can decarbonize rapidly and act as change agents for other sectors. The COVID experience has shown how ICT and Mobile are critical for resilience, able to support large changes in work patterns without step changes in energy usage[29]. The sectors established their own decarbonization pathway in line with a 1.5°C scenario with the SBTi, working with the UN's International Telecommunication Union (ITU), mobile industry association (GSMA), and the Global eSustainability Initiative. This pathway requires reductions from sub-sectors of 45-62% between 2020 and 2030 for network and data center operators, with further work ongoing for other sub-sectors. This and other pathways emphasize the importance of a switch to renewable energy – it is estimated that 80% of carbon reductions can be achieved by operators and their suppliers switching to renewable energy. Over 20 % of ICT and Mobile sectors have set 1.5°C SBTs or committed to the UN Global Compact Business Ambition for 1.5°C[30]. While ICT and Mobile sectors continue to grow, there are wide variations in forecast energy requirements[31]. In any future scenario they must also deliver exponential efficiency improvements[32][33], decarbonize their own operations, and work with their supply chains[34] to reach net zero emissions by 2050 at the latest.

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[28] [Greenhouse gas emissions trajectories for the information and communication technology sector compatible with the UNFCCC Paris Agreement](), ITU, 2020

[29] [COVID-19 Network Traffic Surge Isn't Impacting Environment Confirm Telecom Operators](), GSMA, 2020

[30] Climate Champions analysis of Orbis Financial data extract for company sector revenues, 2020

[31] [Comparison of Several Simplistic High-Level Approaches for Estimating the Global Energy and Electricity Use of ICT Networks and Data Centers](), International Journal of Green Technology, 2019

[32] [The Energy and Carbon Footprint of the Global ICT and E&M Sectors 2010–2015](), Sustainability, 2018

[33] [Data centres & networks](), International Energy Agency, 2020

[34] [Apple commits to be 100 percent carbon neutral for its supply chain and products by 2030](), Apple, 2020

These 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 over 5 billion end-users.

To deliver on this potential they must move quickly on renewable energy in their own operations and supply chains, to decarbonize the internet and improve circularity in end-user products.

2. ICT AND MOBILE SYSTEM MAP

The stakeholders in the ICT and Mobile ecosystem include a complex supply chain, original equipment manufacturers for network equipment and consumer devices, operators of networks and data centers, and internet and other service providers that run on the operators' networks and facilities; finally, there are public sector, enterprise, and consumer customers. System changes to support resilience and decarbonization are driven by investors, customers, employees, and the companies themselves. Maximum leverage is achieved by a focus on efficiency improvements and switching to 100% renewable energy throughout the value chain.
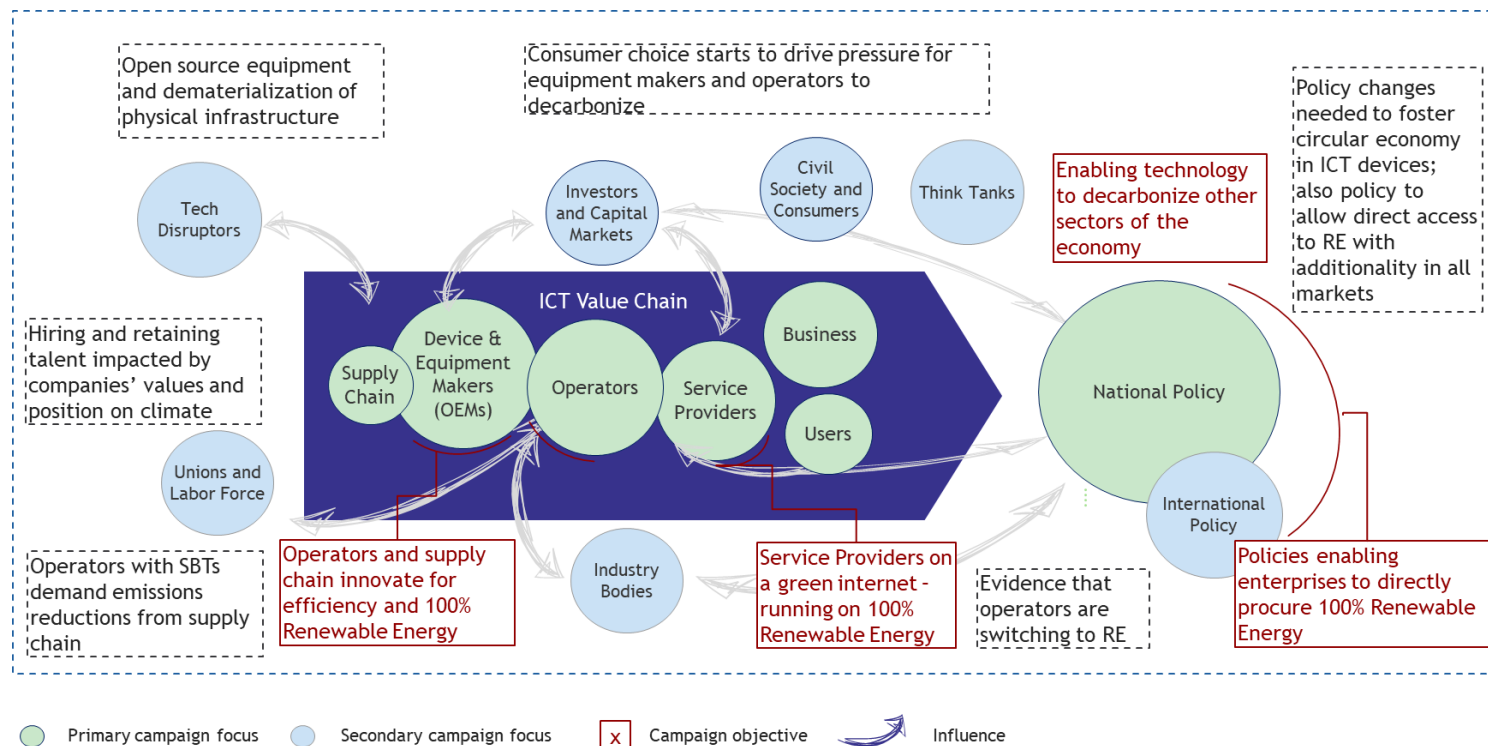
3. ICT AND MOBILE CHANGE LEVERS

For resilient, decarbonized ICT and Mobile sectors, action is required in four areas, which benefit from, or create feedback loops that will drive exponential change within their own systems and the wider economy.

Mobile & ICT Priority Focus Areas

Enabling emissions reduction, resilience and adaptation in other sectors of the economy and in society

Supply-chain emissions

Efficiency and renewable energy in direct operations

Devices & e-waste reduction
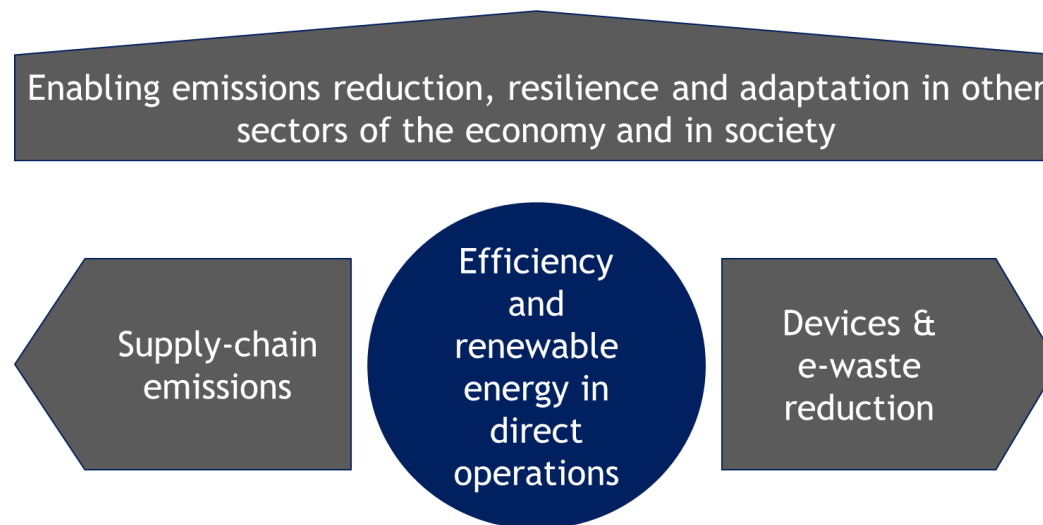
- **Policy:** ICT and Mobile sectors recognize the commercial opportunities in enabling decarbonization and resilience in other sectors. From social media, e-commerce, and the Internet of Things, through to AI, 5G, Blockchain and Digital twins, ICT is changing the way the economy works. These changes will increasingly drive efficiencies in other sectors including Energy, Transport, Human Settlements, Health and 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. For example, policies that favor the sharing economy, and promote a shift from material

products towards virtualized services, can reduce waste and support economic growth at the same time as decarbonization. This would in turn provide a further driver for decarbonization of the ICT and Mobile sectors themselves.

- **Operational efficiency** – ICT and Mobile operators consume large amounts of electricity in their direct operations, which translates in many cases to be one of their largest operating costs. With each new generation of technology, such as 5G mobile, like 3G and 4G before it, there are new demands on power consumption as network traffic volumes continue their exponential growth. Commercial feedback loops demand that power costs be contained through efficiency improvements and the retirement of less efficient legacy systems. At the same time, in support of cost containment, the decreasing price of renewables in many markets will accelerate RE adoption.

- **Supply chain** – Equipment manufacturers' and supply chain emissions represent over half of the total end-to-end value chain GHG footprint for Operators. As they pursue SBTs, they will partner with suppliers on their emissions reduction programs, focusing on their disclosures and target setting. Such programs cover emissions reduction activities including energy efficiency, renewables uptake, process efficiency, reducing material waste, smarter logistics, reduced packaging, raw materials with lower embodied carbon, etc.

- **Devices & e-waste** – Customers – public sector, enterprises, and consumers – for ICT devices are increasingly demanding low-carbon, low-waste products. This is driving equipment suppliers, not only to achieve 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 re-use and recycling, for example.

4. ACCELERATING ADOPTION OF RENEWABLES FOR ICT AND MOBILE - S-CURVES

Transformations do not occur in straight lines. Tipping points are reached after periods of little or no change, and they lead to accelerating exponential shifts towards a point of saturation. The lead indicator of transformation in the ICT sector is the adoption of renewable energy.

Already big consumers of electricity, the sectors' renewable energy purchases are driving additionality in markets where enterprises can contract directly – e.g., in 2019, the Renewable Energy Buyers Alliance reported that in 2019 half of additional renewable energy capacity (approximately 5GW) that they tracked was purchased by ICT and telco businesses[35].

The renewable energy share is growing strongly: many leading ICT and Mobile businesses are already demonstrating 100%. Decentralized operations, e.g., running mobile radio antennae in remote operations where grid supply is unreliable or unavailable, currently rely on diesel generators. And policy changes are required in markets where direct purchases of renewable energy, reflecting the lower costs of solar and wind, are not available. With such support, a goal of 100% renewable energy by 2040 is achievable.

Modelled % of RE based upon indicative 's-curve' for whole ICT sector

% RE in Operations

Some major ICT & Telco brands already at 100%

Challenges for mobile in providing network coverage for remote regions, e.g. off-grid

ICT currently increasing RE by approx. 2-5% YoY

China, Korea, Japan are key to unlocking RE for operators and supply chain

* Sources: IRENA, Eikon, CDP

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[35] Renewable Energy Buyers Alliance Deal Tracker, 2020
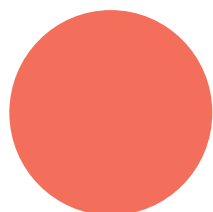
ICT AND MOBILE ACTION TABLE

| NEXUS | Energy | Human settlements | Transport | Industry | | | | | | |

SDG icons: 7 AFFORDABLE AND CLEAN ENERGY, 9 INDUSTRY, INNOVATION AND INFRASTRUCTURE, 10 REDUCED INEQUALITIES, 11 SUSTAINABLE CITIES AND COMMUNITIES, 12 RESPONSIBLE CONSUMPTION AND PRODUCTION, 13 CLIMATE ACTION

	By 2021 ▼	By 2025 ▼	By 2030 ▼	By 2040 ▼
Policymakers (national, subnational, local levels)	• Publish COVID recovery plans addressing the role of digital in delivering zero-carbon economic growth.			
	• Announce policies to increase digital access to all citizens to enable maximum digitization of developed and developing economies, encompassing data privacy and security considerations.	• Enact policies for mass digitization: rebalance sector-specific taxes on digital infrastructure; support digital literacy initiatives, and locally relevant content.	• Digital divide reduced in developed and developing world.	

	• Develop framework to recognize the enablement effects of ICT and Mobile to enhance resilience and support decarbonization of other sectors.	• Implement measures to record and credit ICT and Mobile sector for enablement benefits to clean growth in other sectors.		
	• All G20 countries commit to providing PPA-type sourcing of renewable energy (RE).	• All G20 countries provide PPA-type sourcing of RE.		
	• Publish requirements for data centers to run 100% on RE by 2030.		• European data centers run 100% on RE.	• Data centers globally running 100% on RE.
	• Develop guidance about the energy proportionality of digital applications, e.g., cybercurrencies.	• Implement policy on energy proportionality of digital applications.		
	• Draft policies enabling circular economy to increase re-use and recycling of ICT and Mobile devices and equipment.	• Set new circular economy targets and policies for ICT and Mobile devices including public procurement of refurbished devices.	• Verify effective circular economy public procurement policies, case studies, and e-waste reductions.	
Financial Institutions	• The role of Finance is principally related to promoting investment in net zero ICT and Mobile businesses, creating markets for RE across multiple sectors, and supporting clean tech innovation within these sectors. Finance will also be required funding new business opportunities for ICT and Mobile to enable increased resilience and decarbonization in other sectors and to clarify what constitutes green finance in these cases.		
	• Innovate to continue delivering exponential operational efficiency improvements.	• Launch business models to decarbonize end-user device electricity consumption, e.g.		

Technology Providers and Innovators		incentives for consumers to purchase RE.		
	• Develop enablement propositions targeted at other sectors requiring rapid decarbonization or increased resilience, e.g., Energy, Transport, Human Settlements.	• Launch enablement propositions and business cases for other sectors to deliver quantified resilience or decarbonization benefits. • Establish standardized platforms for communication, automation, and artificial intelligence that other industries can use to reduce their emissions.	• Implement full connectivity in all industries as a default requirement in products with a climate impact potential.	
	• Develop RE self-generation solutions for remote sites.	• Deploy at scale RE self-generation solutions for remote sites.	• Apply Artificial Intelligence machine learning solutions in operations to balance availability of RE with local battery storage.	• Operate remote sites with 100% zero carbon operations.
Business and Service Providers	• Companies commit at scale to net zero by the 2040s. • Companies commit at scale to RE100 no later than 2040. • Sector companies with large vehicle fleets commit at scale to EV100 no later than 2030.	• Supply chain companies commit at scale to RE100 no later than 2040.	• Sector operators become net generators of RE. • Sector companies with large vehicle fleets run 100% zero emission vehicles.	• 100% of sector energy from RE. • Sector becomes net generator of RE.
	• Initiate decommissioning of older generation technologies (e.g., Mobile 3G) to accelerate efficiency gains.	• Continue to support exponential growth in data volumes, without large increases in power consumption.	• Older generation technologies decommissioned.	

	• ICT and Mobile businesses publish circular economy strategies to reduce e-waste.	• Majority of digital products are designed with circular economy in mind.	• All technology products designed with circular economy in mind.	
	• Sector leaders develop tools to give agency to end consumers, join Count Us In. • Sector leaders advocate for broad climate friendly policy changes.	• Sector leaders combat internet misinformation on climate change and provide access to climate action best practice.		
	• ICT and Mobile devices provide consumers and enterprises with emissions information for purchase and use of equipment and services.	• ICT and Mobile companies offer zero-carbon branded products and services.		
Civil society	• Clean internet campaign – raise consumer and employee awareness of ICT businesses on 100% RE.	• Consumers drive acceleration of circular business models.		
	• ICT and Mobile employees' campaign for acceleration of sector decarbonization.			

ICT & MOBILE - EXISTING INITIATIVES

Business Ambition for 1.5C	UN Global Compact campaign well supported by ICT and Mobile sectors, asking businesses to set science-based targets aligned with limiting global temperature rise to 1.5C above pre-industrial levels.
Science Based Targets initiative	Collaborative initiative between CDP, UNGC, WRI, WWF, and WMB to showcase companies that set science-based targets. Basis for target setting consistent with the ITU pathway.
We Mean Business Coalition	Global non-profit coalition working with the world's most influential businesses to take action on climate change, catalyzing business leadership to drive policy ambition and accelerate the transition to a zero-carbon economy.
EV100	Establish electric vehicles as the mainstream solution by 2030. Relevant for decarbonization of operators' fleets.
RE100	Procure 100% of electricity from renewable sources. Supported by major ICT brands.
Step Up Declaration	Technology-focused initiative with approximately 20 members – aims to reduce greenhouse gas emissions across all economic sectors and ensure a climate turning point by 2020.

ICT & MOBILE - FURTHER REFERENCES

1.5C Business Playbook	**Spin-off from Exponential Roadmap – part of SME Exponential Race to Zero. Now complemented by the SME Climate Hub**
Exponential Roadmap	**Digital industry and other sectors' roadmap to half emissions each decade.**
Global eSustainability Initiative Smarter 2030 and Digital with Purpose Movement	**Digital with Purpose describes how ICT companies engage in SDG delivery and with a specific focus on net zero.**
GSMA Enablement Report	**Global Mobile operators' industry association estimating mitigation benefits in wider economy.**
ITU ICT Sector Pathway	**Greenhouse gas emissions trajectories for the information and communication technology sector compatible with the UNFCCC Paris Agreement, developed jointly by ITU, GSMA and GeSI for SBTi.**
Mobile Sector Guide to Setting Climate Targets	**Guidance developed by the GSMA to help mobile operators apply the ICT sector pathway to create their own targets.**
Transform to Net Zero	**Initiative founded by 10 leading brands in multiple sectors including Microsoft in ICT. Aims to deliver guidance and business plans to enable a transformation to net zero emissions.**
Climate Pledge	**Commitment founded by Global Optimism to deliver 'Paris 10 years early'. Members are multi-sector, and include Amazon and US telco, Verizon.**
Going "All In" – A Climate Policy Guide for Business Leaders	**Climate Voice's summary of nine key policies for businesses to advocate on climate action**
Digital Technology and the Planet	**Royal Society report on the enabling role of digital technology in climate action**

METALS & MINING

1. METALS & MINING – INTRODUCTION

The purpose of this Action Table document is to highlight specific, promotable actions to deliver the vision for the Industry thematic area, with a sector-based approach focused on Metals & Mining. For more information on Steel and Aluminum specifically, please refer to the respective sector pathways.

The global mining industry, which is responsible for 4-7% total global GHG emissions,[36] is early on its journey to achieve emission reduction goals and faces pressure to build climate resilience. As of November 2020, 5 of the top 20 global mining companies have committed to net zero carbon emissions by 2050 or sooner (operational scope only) with only one target validated through SBTi. 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.

The key routes to decarbonization include boosting renewable energy supply and storage (as mining emissions are largely driven by electricity supply); operational efficiency improvements; electrification; recycling; and new business models. Electricity and low-carbon hydrogen use will be key to decarbonize production. More information on these topics can be found in the Energy Thematic Pathway.

This action table draws together insights from a number of existing decarbonization pathways, roadmaps, and guidance for the mining sector and a multi-stakeholder consultation process across the Marrakech Partnership Industry Thematic Group. For more information on these initiatives, please see "**Further References**".

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[36] McKinsey & Company, Climate Risk and Decarbonisation: What every mining CEO needs to know, January 2020, https://www.mckinsey.com/~/media/McKinsey/Business%20Functions/Sustainability/Our%20Insights/Climate%20risk%20and%20decarbonization%20What%20every%20mining%20CEO%20needs%20to%20know/Climate-risk-and-decarbonization-What-every-mining-CEO-needs-to-know.ashx.

2. METALS & MINING SYSTEMS MAP

These stakeholders have complementary objectives to help establish 50% carbon emissions reduction and 50% renewable energy supply by 2030

Investors must set 1.5-aligned targets and strategies, divest from fossil fuel portfolios, encourage carbon financial disclosure, and establish sector-wide pressure to drive industry commitments to net-zero.

Cities and regions must support renewable energy infrastructure development and storage solutions, commit to green procurement, and protect local community and biodiversity priorities.

Overarching Narrative

Catalytic comms

Tech. Disruptors

Investors and Capital Markets

Civil Society/ Consumers

Think Tanks and Research

Climate Action Collaboratives

Metals & Mining Value Chain

Supply Chain

Producers

Demand-side ambition

End Markets (construction, equipment, transportation, power, retail, consumer)

Advocacy for policy

Regions

Cities

National Policy

International Policy

Action Initiatives

Supply-side ambition

Unions and Labor Force

Industry Bodies

Producers must increase commitments to disclose emissions (e.g. through TCFD), set science-based targets to reduce emissions and boost renewable energy supply and storage through participation in key RE initiatives (RE100, EP100, EV100).

Industry bodies must help raise sector net-zero ambition, push for increased emissions reporting and disclosure, and facilitate stronger sector collaboration.

International policymakers must legislate competitive carbon pricing, end fossil fuel subsidies, and foster cross-regional collaboration.

Primary campaign focus   Secondary campaign focus   X Campaign objective   Influence

3. METALS & MINING CHANGE LEVERS

- **Policy** and international cooperation have a key role to implement subsidies, mandate taxes, support Paris Agreement-aligned public procurement, encourage investment, and establish/promote standards, particularly in a sector with a complex geographical and political landscape. These policies can shape the market and change incentives for finance. Policymakers should set clear emissions reduction ambition and ensure that clear policy guidance is in place for national governments, with increased emphasis on political collaboration across operating geographies through initiatives like the Intergovernmental Forum on Mining, Minerals, Metals and Sustainable Development. They should also encourage enabling policy for industry transition at scale, including competitive carbon pricing, renewable energy storage and supply provision, as well as wider environmental regulation particularly in key mining operating regions.

- **Finance** stakeholders are able to reallocate investment between sectors, between businesses, and between technologies – driving feedback loops between key stakeholder groups in the mining ecosystem. Finance is critical to scale up new, climate-smart technologies and move away from old, carbon-intensive technologies and practices. A leading industry example is the World Bank Climate Smart Initiative. Investors and financiers must help promote widespread industry use of responsible mining standards such as the Initiative for Responsible Mining Assurance; and encourage collaborative supply chain investment collaboration on sustainable mining activity by leading industry initiatives like the International Council on Mining and Metals.

- **Technology** is a key driver for improving performance, cost, and social acceptance of new climate-resilient solutions. For the mining sector, these solutions include transport and process electrification, and increased renewable energy supply and storage (like solar Photo Voltaic). Technology is critical for upstream mining companies to green their operations and provide competitive, climate-smart metals and minerals to their customers downstream.

- **Businesses** acquire political capital, market share, and organizational resources, which are key to change available options in the market, respond to civil society expectations, and drive incentives for policy. Supply-side mining companies must align with a decarbonization agenda through increased emissions disclosure and set explicit net-zero commitments (including scope 3 where relevant) formalized through SBTi. They must ensure focus on sustainable portfolio management and reprioritization, noting climate-smart mineral demand

increases to 2050.[37] Finally, they should boost renewable energy supply/storage, as the sector has the potential to target 50% mine electricity supplied by renewables in 2030.[38]

- **Civil society** plays a role in strengthening public awareness of the externalities or hidden environmental and social costs of unsustainable mining practices on biodiversity, water use, and local communities. NGOs, researchers, thinktanks, and others should continue to run awareness campaigns, launch calls to action, address research gaps and improve information around sustainable choices, ultimately holding key actors to account.

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[37] World Bank, Climate-Smart Mining: Minerals for Climate Action, https://www.worldbank.org/en/topic/extractiveindustries/brief/climate-smart-mining-minerals-for-climate-action#:~:text=A%20new%20World%20Bank%20Group,demand%20for%20clean%20energy%20technologies.
[38] Rocky Mountain Institute, Sunshine for Mines: A Brighter Vision for Sustainable Resources, January 2020, https://rmi.org/sunshine-for-mines-a-brighter-vision-for-sustainable-resources/#:~:text=Our%20new%20goals%20are%3A,supplied%20by%20renewables%20by%202030.

4. METALS & MINING S-CURVE

One key route to decarbonizing the mining industry is boosting renewable energy supply and storage, as mining emissions are largely driven by electricity supply. Therefore "percentage of renewable energy" has been modelled as a lead indicator for the mining industry s-curve. The analysis assumes an overall objective to achieve 50% renewable energy supply by 2030 and assumes 5% renewable energy penetration globally in the mining sector.[39]

Modeled renewable energy supply for global mine electricity to 2050* based upon an indicative 's-curve'

Data presented on a smoothed forced sigmoid curve

It is necessary to ensure 50% of global mine electricity is supplied by renewables by 2030 in order to put the mining industry on a 1.5°C pathway[1]
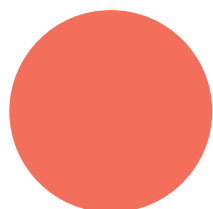
Using the s-curve of transformation philosophy, 100% renewable penetration is achievable in ~2048, in line with global and in-country commitments required to achieve net zero carbon emissions by 2050[2]

*Modelled using RMI "50 by 2030" objectives: targeting 50% of global mine electricity supplied by renewables by 2030
1. Overall objective to achieve 50% renewable energy supply by 2030 from Rocky Mountain Institute. Assuming proxy of 5% renewable energy penetration in global mining sector (source: Navigant Research finds that renewable energy use in the mining industry will increase from less than 0.1% to 5% and up to 8% in 2022.
2. In line with various clauses within the Paris Agreement, to be agreed at COP26

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[39] Navigant Research, Renewable Energy in the Mining Sector, October 2013, https://www.prnewswire.com/news-releases/renewable-energy-in-the-mining-industry-229707941.html. Navigant Research finds that renewable energy use in the mining industry will increase from less than 0.1% to 5% and up to 8% in 2022.

METALS & MINING ACTION TABLE

NEXUS	Energy	Human settlements	Transport	Industry	Land use

	By 2021 ▽	**By 2025** ▽	**By 2030** ▽	**By 2040** ▽
Policymakers (national, subnational, local levels)	• Ensure policy frameworks enable cost-effective innovation for key initiatives (e.g., renewable energy solutions, solar PV, recycling). • Adopt more innovative approaches to environmental regulation to build climate resilience, through performance-based regulation specifying targets for environmental performance, environmental impact assessments, and economic incentives. • Establish laws and regulations for mine closure that prevent large environmental legacies and public	• All leading mining companies to adopt leading practice guidance on environmental regulation. • All leading mining companies to adopt leading practice guidance on sustainable mine management and closure e.g., International Council on Mining & Metals Integrated Mine Closure guide. • Drive carbon prices towards 60 euro per ton in the EU, with some allowance for	• Continued financial assistance to support scale-up of zero-carbon commercial scale production capacity for key commodities like steel and aluminum. • Significant ramp-up in advocacy for social dialogues and other support requirements for workforce facing mine or plant closure. • Widespread acceptance and use of competitive	• Ongoing advocacy for further competitive carbon pricing (below 60 euro per tonne). • Strong regulations and incentives in key producing and manufacturing regions reduce energy-intensive primary production and promote zero-carbon mining operations and secondary production of key commodities.

	costs, through mine abandonment and build climate resilience. • Integrate national mining sector strategies with other national plans/ policies, through land use, infrastructure, human resource development and education. • Drive shift to more circularity, reuse, and remanufacturing by ensuring recycling regulation, defining economic benefits for the recycling sector, and ensuring holistic LCA assessments. • Provide government funds to act as sustainable investors to enable changing business models and developing new technologies. • Explore forums to share knowledge on just transition experiences from other sectors and co-launch social dialogues. • Increased use of government guidance on mining policy, like that produced by the International Institute of Sustainable Development (IISD).	competitive low-carbon commodities like steel. • Continue to support and expand multi-stakeholder social dialogues.	carbon price at 60 euro per tonne.	
Financial Institutions	• Encourage investors to set 1.5°C targets themselves and encourage strategic companies they invest in to do the same.	• Key global investors with a 1.5°C target and engagement strategy in place. • Major institutional asset owners continue to push	• Major institutional asset owners continue to push businesses to set net-zero emissions targets,	• All major investors with a 1.5°C target and engagement strategy in place.

	• Support the Task force for Climate-related Financial Disclosures (TCFD). recommendations and divest from businesses with continued heavy reliance on fossil fuels. • Major institutional asset owners continue to push businesses to set net-zero emissions targets, voluntarily disclosed under TCFD. • Support R&D investment to support technology and innovation development on key solutions such as e.g., electric vehicles and renewable energy supply. • UK joins the World Bank Climate Smart Mining Initiative. • Improve transparency of fiscal revenues, which include disclosure of mining contracts and revenue flows.	businesses to set net-zero emissions targets, voluntarily disclosed under TCFD. • Top global mining companies align with climate-related financial disclosure practices per TCFD. • Boost visibility and membership of the World Bank Climate-Smart Initiative. • All ratings agencies incorporate environmental, social and governance (ESG) factors into ratings methodologies.	voluntarily disclosed under TCFD. • All major global mining companies align with climate-related financial disclosure practices per TCFD. • Significant share of commercial financiers and asset owner portfolios are climate-aligned.	• All mining companies align with climate-related financial disclosure practices per TCFD. • Vast majority of commercial financiers and asset owner portfolios are climate-aligned.
Technology Providers and Innovators	• Invest in developing a renewable/zero emission power supply (e.g. through green PPAs, storage, etc.). • Reduce on-site emissions from mines by improving energy efficiency (e.g., using more fuel-efficient diesel engines). • Reduce on-site emissions from mines through direct or indirect electrification of mining processes	• Transport collision avoidance technology available to mining companies (ICMM Innovation for Cleaner Safer Vehicles Program).	• 50% of global mine electricity supplied by renewables by 2030 (Rocky Mountain Institute goal).	• First GHG emission-free surface mining vehicles introduced (ICMM Innovation for Cleaner Safer Vehicles Program).

	(e.g., use of low-carbon hydrogen fuel, electrifying gas appliances, truck electrification).			
Business and Service Providers	• Encourage major mining companies to verify and ultimately audit GHG reduction at mining sites. • Reprioritize portfolio to manage reduced demand for commodities (e.g., met coal and iron ore in light of increased 'green steel' market driven by increased recycling rates). • Reprioritize portfolio to manage increased demand for climate-smart minerals (e.g., EVs and battery storage driving increases in demand for nickel, cobalt, lithium, rare earths and aluminum, lead). • Reprioritize portfolio to manage mixed demand for other minerals (e.g., copper: growth driven by EVs/ wind turbines/ solar panels/ batteries; coal demand decline as power sector switches to wind, solar, nuclear; uranium increases due to nuclear-power growth). • Mining companies set science-based targets (an absolute/intensity target in line with absolute contraction). • Align governance and remuneration structure with low-carbon	• Major mining companies should have all of their mines independently verified as reducing GHG emissions/energy use and be measured against a comprehensive, rigorous ESG standard (e.g., IRMA). • Key major global mining companies set a science-based carbon emissions reduction target in line with SBTi.	• Major mining companies have all mines show further reductions in GHG emissions/energy use and continuing improvements in ESG performance through disclosure of independent, 3rd party audit. • All major mining companies align with climate-related financial disclosure practices per TCFD. • All major global mining companies set a science-based carbon emissions reduction target in line with SBTi. • Most construction, automotive, infrastructure, and other end-customers have set net-zero by 2050 commitments covering scope 3 emissions.	• Major mining companies should aim to have the majority of their mines certified as meeting the most comprehensive and rigorous ESG standard for mining (e.g., IRMA). • Major mining companies well-positioned to deliver 500% increased demand for climate-smart minerals by 2050. • All major mining companies set clear, ambitious CO_2 emission reduction targets, leveraging SBTi in line with 1.5°C pathway. • All mining companies align with climate-related financial disclosure practices per TCFD.

	objectives; mining companies should take action to support policies that help achieve a low-carbon transition incl. report transition risks, financial remuneration policy, withdraw from associations (per TCFD). • 20 major mining companies agree formally to create a non-competitive innovation eco-system with the purpose of accelerating decarbonization of the global mining sector to achieve Paris 2050 goals.			
Civil Society	• Support development of regional roadmaps. • Launch consumer-facing campaigns in sectors in key segments to build demand for low-carbon commodities. • Work with industry to develop science-based target methodology. • Influence policy makers through pressure and thought leadership, launching campaigns, and raising awareness of key issues/topics to drive the right policy and decision-making. • Help link communities, government, and industry to ensure inclusive	• Strengthen and scale consumer demand generation campaigns. • Encourage leading mining companies to take other critical steps – see Business & Services actions table.	• Build and launch international campaigns for circular, zero-carbon infrastructure, assets, and products. • Support social dialogue convenings at local and regional levels to manage impending stranded assets and community jobs transitions.	• Mainstreamed customer demands have mainstreamed development of circular business models in developed and developing countries. • Social dialogue models proven, standardized, and scaling across communities to support just transition.

	economies and job creation/protection. • Promote sustainable consumer behaviour, encouraging a preference for recycled products, reusing products, and alternative ownership models. • Advocate for increased membership/uptake of key sector initiatives/ programs amongst leading mining companies.		

METALS & MINING - EXISTING INITIATIVES

Powering Past Coal Alliance	Advance the transition away from coal power generation without CO2 emission reductions.
Leadership Group for Industry Transition (LeadIT)	Accelerating the transition of all industry sectors to low carbon pathways to reach net-zero carbon emissions by 2050.
Business Ambition for 1.5C	UNGC Secretariat campaign asking businesses to set science-based targets aligned with limiting global temperature rise to 1.5C above pre-industrial levels.
Science Based Targets Network	Collaborative initiative between CDP, UNGC, WRI, WWF, and WMB to help companies develop and set science-based targets.
International Council on Mining & Metals (ICMM)	International organization dedicated to a safe, fair, and sustainable mining and metals industry bringing together 27 mining and metals company members and over 35 national, regional, and commodities association members.

Initiative for Responsible Mining Assurance (IRMA)	Offers true independent third-party verification and certification against a comprehensive standard for all mined materials.	▶
Intergovernmental Forum on Mining, Minerals, Metals & Sustainable Development (IGF)	Supports more than 75 nations committed to leveraging mining for sustainable development.	▶
World Bank Climate-Smart Mining Initiative	Helps resource-rich developing countries benefit from the increasing demand for minerals and metals, while ensuring the mining sector is managed in a way that minimizes the environmental and climate footprint.	▶
Transitions Pathway Initiative (TPI)	Global, asset-owner led initiative which assesses companies' preparedness for the transition to a low-carbon economy.	▶
Extractive Industries Transparency Initiative (EITI)	Global standard to promote the open and accountable management of oil, gas, and mineral resources.	▶
World Economic Forum (WEF) Mining and Metals Industry Community	High-level group of peers dedicated to ensuring the long-term sustainability of the mining and metals industry and value to society, comprising chief executives and chairs from partner organizations.	▶

METALS & MINING - FURTHER REFERENCES

World Economic Forum: Mining & Metals in a Sustainable World 2050	**Link**
Rocky Mountain Institute: Decarbonization Pathways for Mines	**Link**
World Economic Forum (WEF): Digital Transformation Initiative: Mining & Metals Industry	**Link**
UNDP: Managing mining for sustainable development	**Link**

118

Transition Pathway Initiative (TPI): Carbon Performance Assessment in the Diversified Mining Sector	**Link**
European Copper Institute (Copper Alliance): Copper's Contribution to a Low-Carbon Future	**Link**
ICMM: Adapting to a change climate - building resilience in the mining and metals industry	**Link**
The Warren Centre: Zero Emission Copper Mine of the Future	**Link**
UNDP, CCSI, SDSN, WEF: Mapping mining and the SDGs	**Link**

PLASTICS

1. PLASTICS – INTRODUCTION

The purpose of this Action Table document is to highlight specific, promotable actions to deliver the vision for the Industry thematic area, with a sector-based approach focused on plastics.

The global chemicals sector – responsible for 5% of total global emissions (1.5 Gt total direct emissions per year) – faces a necessary but challenging path to decarbonization. Sixty percent of total direct CO_2 emissions from the sector come from two primary chemicals; ammonia (30%) and plastics (30%).[40] Demand for plastics has outpaced that of all other bulk materials (such as steel, aluminum or cement), and production will nearly triple over the next 30 years (322Mt in 2015 to 818Mt projected in 2050), with a corresponding rise in emissions (732Mt CO2 in 2015 to 2,105Mt CO2 projected in 2050).[41] However, as of November 2020, <10% of the top 50 global chemicals/plastic producer companies have committed to net zero carbon emissions by 2050 or sooner, with only two of these net-zero targets committed through SBTi.[42] Refer to the FMCG and Retail pathways for more information on the top plastic users (largely packaging).

There are several routes to decarbonizing the plastics sector. Addressing demand is key, through restricting single-use plastic wherever possible and then encouraging a circular economy for plastics through recycling and reuse. Improving energy efficiency and decarbonizing the production process through solutions like electrification and CCUS are also key. Finally, decarbonizing feedstock through alternative inputs such as waste and biomass are part of the solution to reducing emissions. Electricity and low-carbon hydrogen use will be key to decarbonize production; more information on these topics can be found in the Energy Thematic Pathway. Biomass solutions are also prioritized for plastics (and aviation) to compensate for end-of-life emissions. Solutions vary by end-market and geography, but a globally coordinated approach on key issues like product design and waste management is key to realize and deliver solutions locally.

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[40] Mission Possible Platform and the Energy Transitions Commission, reaching net zero carbon emissions from harder-to-abate sectors by mid-century: Plastics sectoral focus, https://www.energy-transitions.org/publications/mission-possible-sectoral-focus-plastics/.
[41] Mission Possible Platform and the Energy Transitions Commission, reaching net zero carbon emissions from harder-to-abate sectors by mid-century: Plastics sectoral focus, https://www.energy-transitions.org/publications/mission-possible-sectoral-focus-plastics/.
[42] High-Level Climate Action Champions team research, November 2020.

This action table draws together insights from a number of existing decarbonization pathways, roadmaps and guidance for the plastics sector and a multi-stakeholder consultation process across the Marrakech Partnership Industry Thematic Group. For more information, please see "**Further References**".

2. PLASTIC SYSTEM MAP

These stakeholders have complementary objectives to support the overall campaign for the Plastics sector to achieve net-zero emissions by 2050

3. PLACEMENT CHANGE LEVERS
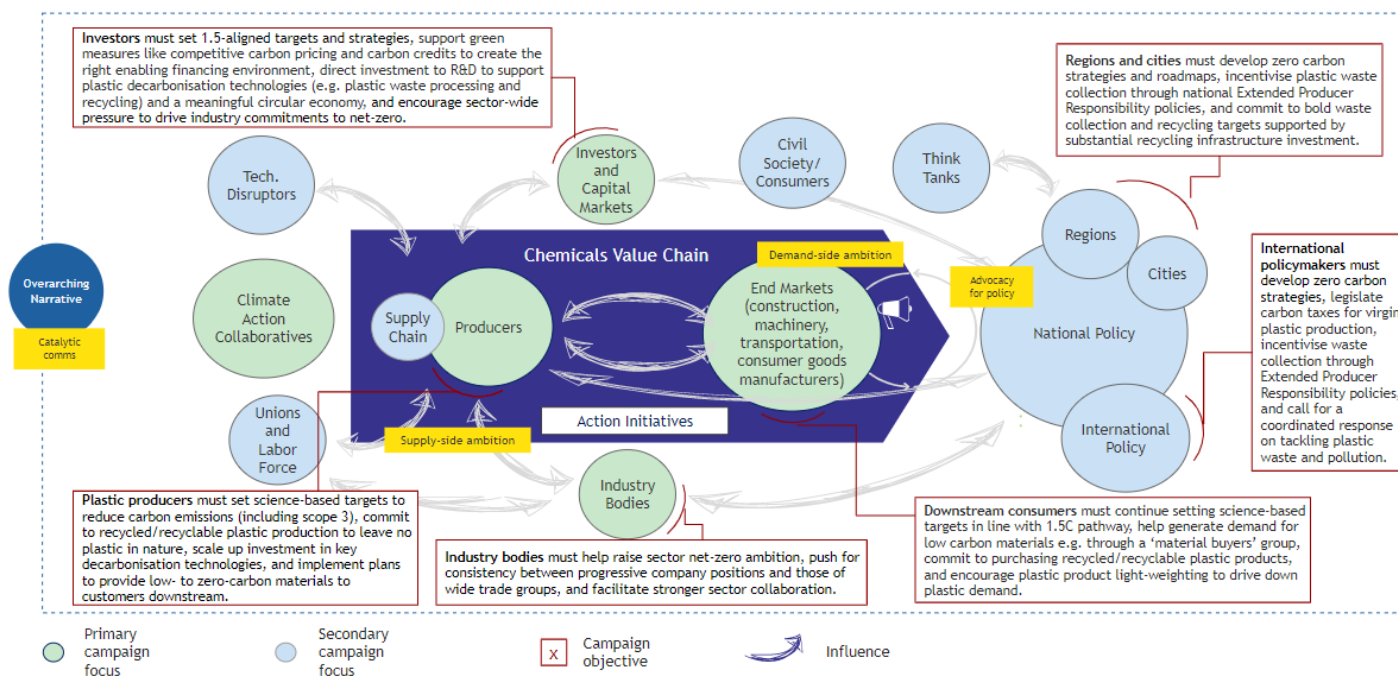
3. PLASTICS CHANGE LEVERS

- **Policy** and international cooperation have a key role to implement sustainable subsidies, mandate taxes like Extended Producer Responsibility fees (EPR), support public procurement, encourage investment, support new emergent technologies, and establish/promote standards. These policies can shape the market and change incentives for finance. Policymakers should ensure that clear carbon emissions reduction ambition is established, such as that of 50-55% emissions reduction by 2030 per EU Green Deal, at minimum.[43] They must also ensure that policies deliver on existing circular economy and waste management targets, such as the EU Commission 100% plastic packaging recyclable and 60% plastic recycling targets by 2030[44]. They should also support sector efforts like Ellen MacArthur Foundation's Global Commitment and zero problematic plastic targets to 2025)[45], and ultimately define longer-term policy actions beyond 2025–2030 with more interim milestones set to 2050. Critical policies include ambitious carbon pricing (EUR 60 per ton minimum) and tax structures like EPR (China is looking to implement an EPR policy framework in 2025)[46].

- **Finance** stakeholders are able to reallocate investment between sectors, between businesses, and between technologies, through public finance, private finance, and blended finance mechanisms – driving feedback loops between key stakeholder groups in the plastics ecosystem. Finance is critical to scale up new, climate–smart technologies and move away from old, carbon–intensive technologies. Investors must help incentivize a secondary plastics market with appropriate taxes (like EPR), carbon pricing, and recycling infrastructure, and encourage consumers to demand "green" products such as sustainable packaging.

- **Technology** is a key driver for improving performance, cost, and social acceptance of new, climate resilient solutions for businesses upstream (producers), midstream (processors) and downstream (buyers). Technology solutions across the sector range from increased use of biomass as a chemical input, development and use of CCUS, increased use of electrification and low-carbon hydrogen, and boosted waste processing capacity.

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[43] European Commission, State of the Union 2020, https://ec.europa.eu/commission/presscorner/detail/en/IP_20_1599.
[44] European Commission, A European Strategy for Plastics in a Circular Economy, https://ec.europa.eu/environment/circular-economy/pdf/plastics-strategy-brochure.pdf.
[45] Ellen MacArthur Foundation, Global Commitment, https://www.ellenmacarthurfoundation.org/our-work/activities/new-plastics-economy/global-commitment.
[46] Ocean Conservancy, Plastics Policy Playbook, https://blog.oceanconservancy.org/wp-content/uploads/2019/10/Plastics-Policy-Playbook-10.17.19.pdf.

- **Businesses** acquire political capital, market share, and organizational resources, which are key resources of influence to change available options in the market, respond to civil society expectations, and drive incentives for policy. Supply-side and demand-side stakeholders should align with a decarbonization agenda, making ambitious industry commitments and disclosing emissions in line with TCFD. They should promote circular product redesign, using less plastic or alternative materials where possible, and commit to significant R&D investment in key technologies like CCUS and waste processing to reduce emissions where production continues. Finally, they should set long-term net-zero emissions reduction to 2050 or earlier, supported by short/mid-term targets recognized by SBTi.

- **Civil society** plays a role in strengthening public awareness of the externalities or "hidden costs" of carbon-intensive plastic production and poor waste management, such as biodiversity impacts, through campaigns, media coverage, and calls to action. Civil society actors can also influence policy by advocating for climate-supportive legislative change, working towards systems transformation, driving collective action, and holding actors to account.
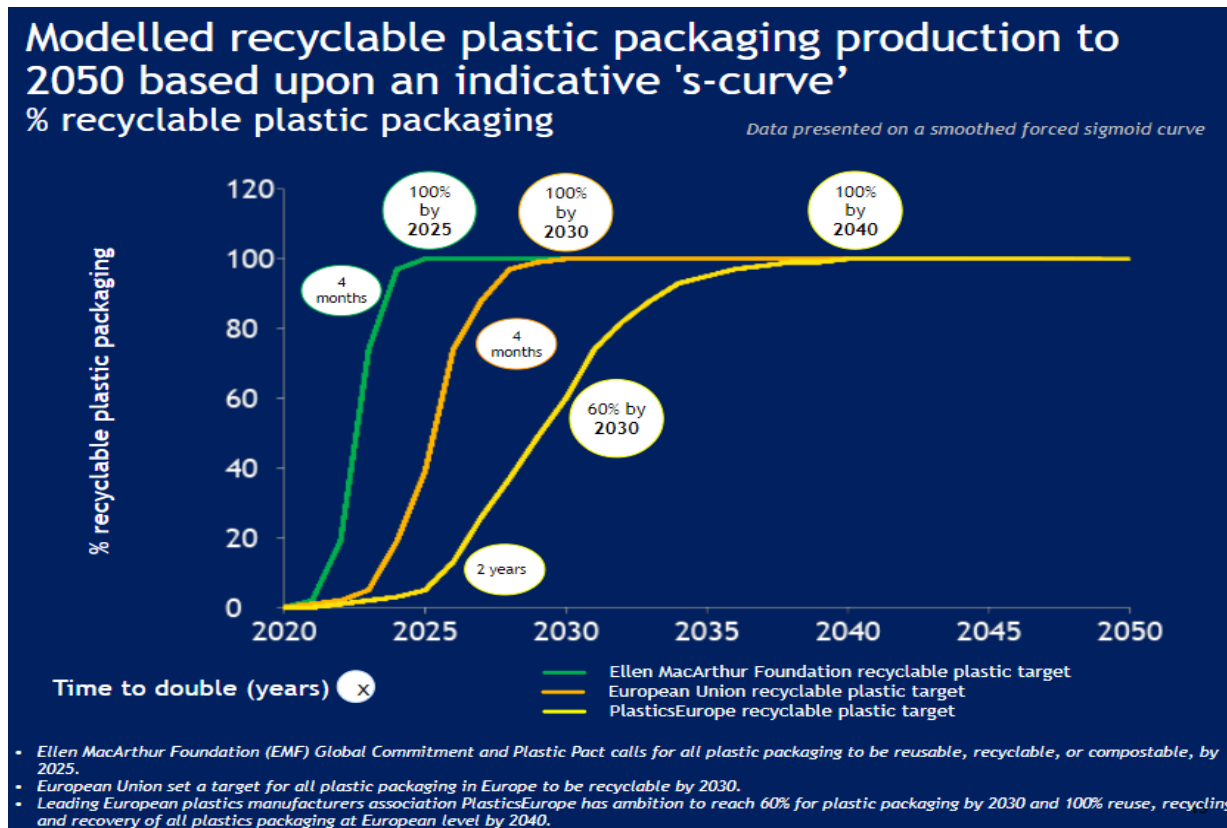
4. PLASTICS S-CURVE

One key route to decarbonizing the plastics sector include reducing demand for single-use plastic (e.g., by increasing recyclable packaging). Therefore "percentage of recyclable plastic packaging" has been modelled as a lead indicator on an s-curve for the plastics sector. The different curves are based on scenarios of differing ambition, based on commitments made within the sector. The Ellen MacArthur Foundation Global Commitment and Plastic Pact calls for all plastic packaging to be reusable, recyclable, or compostable, by 2025.[47] The European Union set a target for 100% of plastic packaging in Europe to be recyclable by 2030.[48] The Brussels-based association of European plastics manufacturers PlasticsEurope made a Voluntary Commitment to ensure high rates of reuse and recycling with the ambition to reach 60 percent

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[47] Ellen MacArthur Foundation, New Plastics Economy Global Commitment, https://www.newplasticseconomy.org/projects/global-commitment.
[48] European Union, A European Strategy for Plastics in a Circular Economy, https://ec.europa.eu/environment/circular-economy/pdf/plastics-strategy-brochure.pdf.

for plastic packaging by 2030. This will help achieve our goal of 100 percent reuse, recycling, and recovery of all plastics packaging at European level by 2040.[49]

Modelled recyclable plastic packaging production to 2050 based upon an indicative 's-curve'
% recyclable plastic packaging

Data presented on a smoothed forced sigmoid curve

- Ellen MacArthur Foundation (EMF) Global Commitment and Plastic Pact calls for all plastic packaging to be reusable, recyclable, or compostable, by 2025.
- European Union set a target for all plastic packaging in Europe to be recyclable by 2030.
- Leading European plastics manufacturers association PlasticsEurope has ambition to reach 60% for plastic packaging by 2030 and 100% reuse, recycling and recovery of all plastics packaging at European level by 2040.

[49] PlasticsEurope, Plastics 2030 Voluntary Commitment, 2018, https://www.plasticseurope.org/en/newsroom/press-releases/archive-press-releases-2018/plastics-2030-voluntary-commitment#:~:text=The%20European%20plastics%20manufacturers%20are,Norway%20and%20Switzerland%20by%202040.
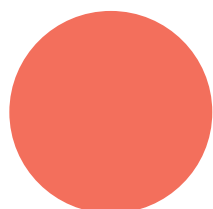
PLASTICS ACTION TABLE

| NEXUS | Energy | Industry | Land use | | Energy | 3 GOOD HEALTH AND WELL-BEING | 2 ZERO HUNGER | 7 AFFORDABLE AND CLEAN ENERGY | 8 DECENT WORK AND ECONOMIC GROWTH | 9 INDUSTRY, INNOVATION AND INFRASTRUCTURE |

	By 2021	By 2025	By 2030	By 2040
Policymakers (national, subnational, local levels)	• Develop zero carbon strategies, set public procurement policies and standards to create demand for low or zero carbon materials (national, subnational & local - countries, states, regions). • Endorse and commit to key industry programs addressing product recyclability and reuse (e.g., Ellen MacArthur Foundation Global Commitment) • Government to support business R&D agenda to decarbonize the	• Leading countries, states, and regions with a clear net zero carbon strategy and roadmap in place e.g., Rwanda & 16% emissions reduction by 2030 & plastic bag ban in 2008. • Realize objectives of key industry programs e.g., Ellen MacArthur Foundation Global Commitment by 2025. All plastic packaging to be recyclable.	• Major countries, states, and regions with a clear net zero carbon strategy and roadmap in place e.g., formalized through a UN Treaty on plastic pollution. • Establish ambitious regulations on product recyclability across all major regions. • Mandate certain materials/technologies for packaging applications (e.g., coffee pods/tea bags/fruit	• All countries and major states and regions with a clear net zero carbon strategy and roadmap in place • Establish ambitious regulations on product recyclability across all regions. • Impose and gradually tighten embedded carbon intensity standards on packaging, appliances,

	production process, focusing on early-stage demonstration and first industrial-scale pilots of technologies (e.g., low-carbon hydrogen, CCUS) and biomass. • Tighter regulation on products (e.g., single use), material use and reuse, product design, waste mgmt., recycling, (e.g., EU single use plastics ban due 2021, Convention on Plastic Pollution scheduled 2021). • Establish clear and transparent standards to better understand how to accomplish carbon intensity standards, with specific guidance on plastic alternatives/substitutes. • Set implicit or explicit carbon price to ensure current energy and carbon policies do not have a significant impact on the competitiveness of decarbonizing the chemicals sector. • China to establish EPR policy framework in 2020. Encourage India, Philippines, Vietnam to push for formal EPR regulation (Ocean Conservancy Plastics Policy Playbook)	• Policymakers establish a target to reduce single-use plastic packaging by 50% by 2050 with specific emphasis on reuse. Launch a UN Treaty on plastic pollution with targets to 2030/2040. • China to implement EPR policy in 2025. • Use regional policy insights to drive national policy on material standardization, circular design, and use of recycled content. • Encourage leading geographies to set ambitious plastic recycling targets e.g., EU 55% recycling by 2025. • Streamline polymer types and product designs to facilitate reuse and recycling.	labels made from compostable materials). Ensure 60% plastic is recycled in the EU by 2030. • Widespread acceptance and use of 60 euro per ton of CO_2 carbon. • Zero plastics in the ocean by 2030 (e.g., WWF Resource Plastic initiative). • Establish clear national policy to standardize material inputs to enable circular design and increase use of recycled content in product design. • Establish clear national policy to standardize material inputs to enable circular design and increase use of recycled content in product design. • Push leading geographies to raise ambition for existing targets e.g., EU 60% recycling by 2030 and encourage new targets to be set. • Incentivize for packaging as a service based on reuse, with innovative financing and material leasing models.	and other manufactured products by introducing fees for externalities on virgin plastics to correct price balance. • Global financed plastic waste collection with measures that increase the provision of financing and ongoing funding to improve waste collection (e.g., EPR using packaging material fees, landfill fees, etc.) • Use national policy insights to drive international policy on material standardization, circular design, and use of recycled content (e.g., EMF Global Plastic Protocol). • All major geographies with a plastic recycling bill in place and set targets met e.g., EU 65% recycling by 2035.

	• Encourage sub-national/ regional policy to standardize material inputs to enable circular design and increase use of recycled content in products. • Incentivize for recycling and treatment markets to increase demand for post-consumer plastics (e.g., California Assembly Bill 943 mandating recycling content). • Support product standardization and simplification by promoting global plastic criteria for product/packaging design and waste management (e.g., design current packaging/products for recycling, set minimum recycled content commitments). • Public/policy support for biomass development should transition away to high priority sectors where possible (e.g., aviation and plastics).			
Financial Institutions	• Incorporate "plastic risk" in financial and ESG assessments. • Encourage investors to set 1.5°C targets themselves and encourage strategic companies they invest in to do the same.	• Key global investors with a 1.5°C target and engagement strategy in place. • China to implement EPR policy in 2025 • Increase statutory targets to drive continued progress (e.g.,	• Achieve a value-driven system for recovery and recycling of packaging and use of plastic waste as feedstock-based on enhanced material value and policy innovation	• All major investors with a 1.5°C target and engagement strategy in place. • Global financed plastic waste collection through use of taxes/levies/bans

	- Encourage India, Philippines, Vietnam to push for formal EPR regulation once China establishes EPR policy in 2020. - Support policy actions that enable a fee structure to favor secondary/recycled plastics i.e., incentives for recycling industry, preferential procurement, virgin material tax to develop and incentivize recycling and treatment markets. - Promote financial guidance on plastic recyclability e.g., by endorsing and committing to key industry programs e.g., EMF Global Commitment. - Support the Task-force for Climate-related Financial Disclosures (TCFD) recommendations.	collection, reuse, recycling, recycled content targets). - Realize objectives of key industry programs e.g., EMF Global Commitment by 2025.	- All major plastic producers and users align with climate-related financial disclosure practices per TCFD. -	(e.g., Extended Producer Responsibility policy using packaging material fees, landfill fees, etc.) - All plastic producers and users align with climate-related financial disclosure practices per TCFD.
Technology Providers and Innovators	- Invest in biomass supply solutions to aid a biobased feedstock switch. Note: For consideration where alternative decarbonization routes are least available. - Support commercial-scale carbon capture and use technologies as a key innovation priority. - Increase the use of renewable energy and electrification as a key	- Technology readiness level of at least two key biomass technologies increased (manufacturing of platform intermediates: biomass to bio-ethylene, biomass to bio-syngas). - Technology readiness level of 2 key CCUS technologies (e-Cracker, low-carbon Hydrogen	- At least two large-scale biomass demonstration projects in operation in prioritized regions. - Several large-scale CCUS demonstration projects in operation in prioritized regions - Several large-scale clean electrification demonstration projects (1-10 tons/h)	- Proliferation of large-scale biomass demonstration projects on global scale. Conversion of biomass into a broad set of chemicals enabling gross decarbonization of the sector (>90% GHG emission reduction).

	lever towards emissions reduction in plastic production. • Develop and scale up low-carbon hydrogen production technologies. • Develop plastic waste processing technologies (e.g., through chemical and mechanical recycling).	beyond Water-Electrolysis) increased. Prerequisites: Reinforcement or construction of new grid networks to support a significant increase of clean energy demand. • Several large-scale low-carbon hydrogen demonstration projects in operation in prioritized regions • Technology readiness level of 10 key technologies (mechanical and chemical recycling) increased.	• in operation in prioritized regions. Prerequisite: Access to sufficient and affordable green energy. • Proliferation of large-scale low-carbon hydrogen demonstration projects on global scale. • Several large-scale (50-200 kilo tons) waste plastic processing demonstration projects in operation in prioritized regions.	• Proliferation of large-scale CCUS demonstration projects on global scale. • Proliferation of large-scale clean electrification demonstration projects on global scale. Shift of energy input from fossil fuels to emission free energy, > 50% of total energy demand emission free. • Proliferation of large-scale plastic waste processing demonstration projects on global scale. Recycling of 100,000 kilo tons of waste into chemicals and plastics. • Multiple commercial-scale low-carbon hydrogen plants.
Business and Service Providers	• Promote business commitment to key industry programs on circular economy e.g., EMF Global Commitment. • Align target ambition and reporting process with SBTi roadmap (due 2020), with [X] key upstream, midstream, and	• Realize objectives of key industry programs e.g., EMF Global Commitment by 2025. • Rapidly scale up system innovations including new delivery models (reuse-refill), reverse logistics, incentives for packaging recovery.	• Expand system innovations globally (e.g., reuse, new delivery models, bio-benign substitutes, measures to minimize microplastic emissions). • All major plastic producers explicitly adopt eco-design principles and all plastic	• All major upstream, midstream, and downstream companies' businesses set science-based targets and net zero by 2050 commitments. • All plastic producers explicitly adopt eco-

	downstream companies committing to SBTi.	• Leading plastic producers explicitly adopt eco-design principles and all plastic packaging used is evidenced as necessary (e.g., for shelf life).	packaging used is evidenced as necessary (e.g., for shelf life).	design principles and all plastic packaging used is evidenced as necessary (e.g., for shelf life).
	• Industry players individually and jointly invest in R&D projects that will develop and drive down cost of supply side decarbonization technologies and promote innovation.			
	• Develop product standardization e.g., through limiting mixing of materials, limiting use of additivities, advanced adhesives, shift to recyclable polymers, advanced marking, and tracking systems... and recycling processes.			
	• Increase disclosure and reporting in line with TCFD recommendations.			
	• Adopt eco-design principles to improve primarily reusability, then recyclability, and the use of recycled content, with an overall reduction in use of unnecessary and excess packaging.			
	• Business to drive R&D agenda, focusing on early-stage demonstration and first industrial-scale pilots of technologies to become cost-effective in the future.			

	• Help drive consumer behaviour and purchasing change e.g., improved labelling, economic incentives, and customer communications.			
Civil Society	• Encourage NGOs, associations, academics, financial institutions, others to support key industry programs on circular economy e.g., EMF Global Commitment. • Advocate for increased membership/uptake of key sector initiatives/ programs *(see Existing Initiatives or Systems Map for more).* • Continue to advocate for measures to severely limit the production and use of plastic packaging and prompt reuse (e.g., Greenpeace, European Climate Foundation).	• Endorse and commit to key industry programs e.g., EMF Global Commitment by 2025: Eliminate problematic or unnecessary plastic packaging. Move from single use towards reuse models where relevant 100% of plastic packaging to be reusable, recyclable, or compostable. Set an ambitious recycled content target across all plastic packaging used.	•	•

PLASTICS - EXISTING INITIATIVES

Business Ambition for 1.5C	UNGC Secretariat campaign asking businesses to set science-based targets aligned with limiting global temperature rise to 1.5C above pre-industrial levels.
Science Based Targets initiative (SBTi)	Collaborative initiative between CDP, UNGC, WRI, WWF, and WMB to showcase companies that set science-based targets.
We Mean Business Coalition	Global non-profit coalition working with the world's most influential businesses to take action on climate change, catalyzing business leadership to drive policy ambition and accelerate the transition to a zero-carbon economy.
World Business Council for Sustainable Development (WBCSD)	Global, CEO-led organization of over 200 businesses working together to accelerate the transition to a sustainable world.
Leadership Group for Industry Transition (LeadIT)	Accelerating the transition of all industry sectors to low carbon pathways to reach net-zero carbon emissions by 2050.
Mission Innovation	Dramatically accelerate public and private global clean energy innovation, including doubling their current research and development investments in the sector over 5 years.
Net Zero Asset Owner Alliance	Transition investment portfolios (more than 2.4 trillion USD globally) to net-zero GHG emissions by 2050 consistent with a maximum temperature rise of 1.5°C.
Ellen MacArthur Foundation New Plastics Economy	Applying the principles of the circular economy, the initiative brings together key stakeholders to rethink and redesign the future of plastics, starting with packaging.
Alliance To End Plastic Waste (ATEPW)	Founded by companies that make, use, sell, process, collect and recycle plastics, with a 5-year ambition to divert millions of tons of plastic waste in more than 100 at-risk cities, improve livelihoods for millions, and contribute to a circular economy.

Global Plastic Action Partnership (GPAP)	Brings businesses, international donors, national and local government, community groups and world-class experts together to collaborate on beating plastic pollution by fast-tracking circular economy solutions in coastal countries. Convened by the World Economic Forum (WEF).	▶
Bioplastic Feedstock Alliance (BFA)	Science-driven organization which aims to evaluate diverse bioplastic feedstocks to better understand the potential sustainability opportunities of each, convened by the World Wide Fund for Nature (WWF) and several global leading consumer brand companies.	▶
World Wide Fund for Nature (WWF) ReSource: Plastic	Partnership with businesses to redesign the sourcing, use and disposal of plastics, focused on 100 companies that could prevent 10m tonnes of plastic waste, part of their flagship No Plastic in Nature campaign.	▶

PLASTICS - FURTHER REFERENCES

Mission Possible Platform: Reaching net-zero on carbon emissions - Plastics	Link
Mission Possible Platform: Reaching net-zero on carbon emissions	Link
Fraunhofer ISI: Pathways to deep decarbonization of industry	Link
CISL: Industrial Transformation 2050	Link
CEFIC: European chemical industry roadmap (to 2030)	Link
WBCSD: SDG chemical sector roadmap	Link
VNCI: Dutch chemical industry roadmap	Link
UK government: Chemicals sector decarbonization strategy	Link

Mission Possible Platform: Low Carbon Emitting Technologies initiative	**Link**
European Commission: Circular Economy Strategy	**Link**
Ocean Conservancy: Plastics Policy Playbook	**Link**
Ellen MacArthur Foundation: New Plastics Economy	**Link**
Ellen MacArthur Foundation/WRAP: Plastics Pact (UK)	**Link**
WWF: No Plastics in Nature business guidebook	**Link**

RETAIL

1. RETAIL - INTRODUCTION

The purpose of this Action Table document is to highlight specific, promotable actions to deliver the vision for the Industry thematic area, with a sector-based approach focused on retail.

No comprehensive study has been conducted on the emissions impacts of the retail[50] sector globally, with regards to retailing activities specifically, nor the cumulative emissions profile of retail companies. However, the indirect emissions of retail businesses however, account for a factor of seven within the supply chain and a factor of three across products' life cycles. A total of 10% of the market by revenue is covered by an SBTi or UNGC Business Ambition 1.5 classification, whilst only 4% have set out a 1.5⁰C commitment under either scheme, compared to 32% and 11% respectively in the fast-moving consumer goods industry.[51]

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.

This action table draws insight primarily from the British Retail Consortium's Climate Action roadmap for the UK retail sector announced in November 2020.[52] It also includes targets and actions from pathways in sectors adjacent to retail. For more information on these initiatives, please see '**Further References'**.
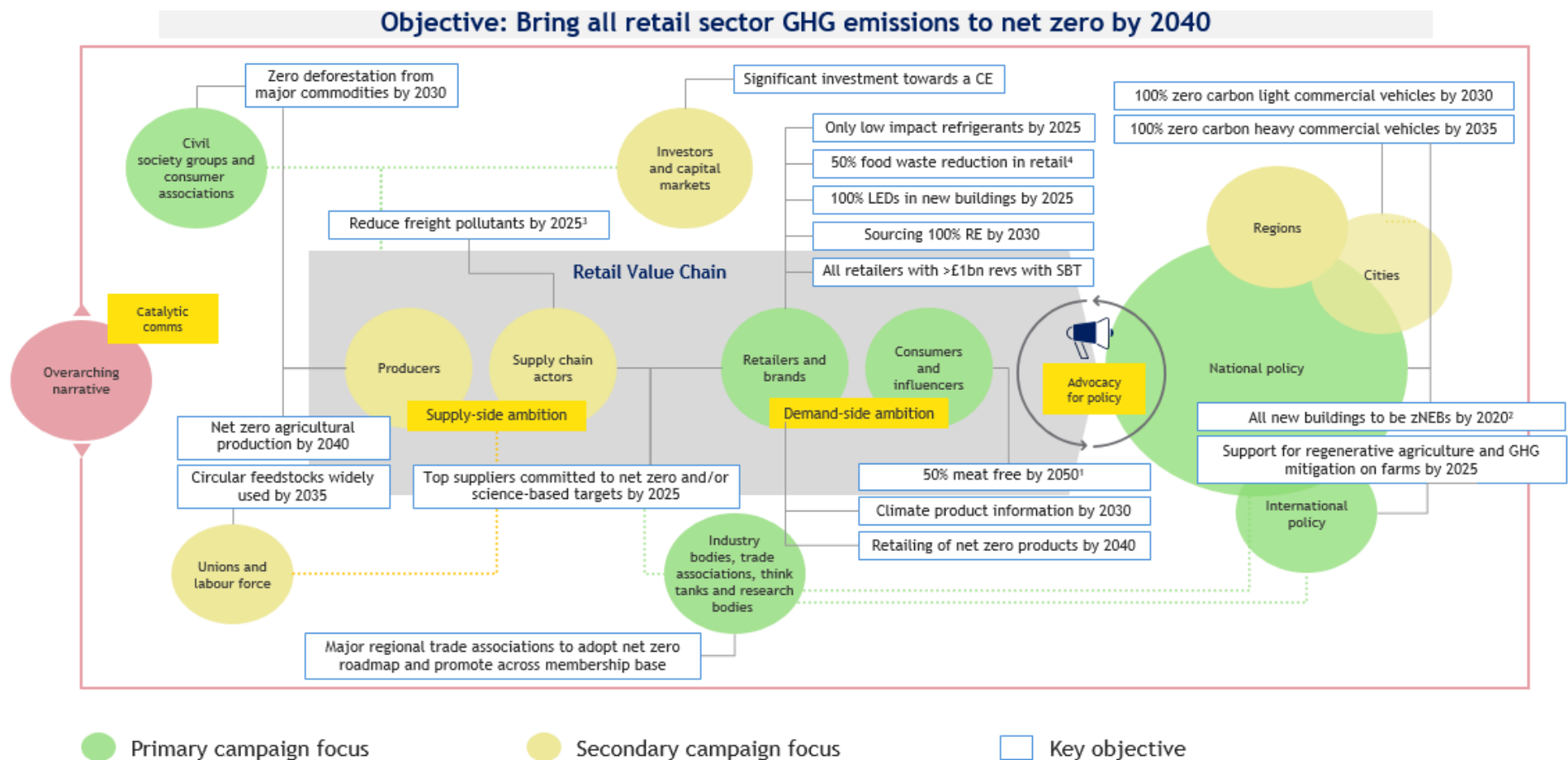
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[50] The Retail sector includes businesses engaged in the sale without transformation of new and used goods, mainly to the general public, for personal or household consumption or use
[51] Climate Champions analysis of Orbis Financial data extract for company sector revenues
[52] British Retail Consortium, 2020, Climate Action Roadmap, https://brc.org.uk/climate-roadmap/

2. RETAIL SYSTEM MAP

Objective: Bring all retail sector GHG emissions to net zero by 2040

Retail Value Chain

- Zero deforestation from major commodities by 2030
- Significant investment towards a CE
- Only low impact refrigerants by 2025
- 50% food waste reduction in retail[4]
- 100% LEDs in new buildings by 2025
- Sourcing 100% RE by 2030
- All retailers with >£1bn revs with SBT
- 100% zero carbon light commercial vehicles by 2030
- 100% zero carbon heavy commercial vehicles by 2035
- Reduce freight pollutants by 2025[3]
- Net zero agricultural production by 2040
- Circular feedstocks widely used by 2035
- Top suppliers committed to net zero and/or science-based targets by 2025
- 50% meat free by 2050[1]
- Climate product information by 2030
- Retailing of net zero products by 2040
- All new buildings to be zNEBs by 2020[2]
- Support for regenerative agriculture and GHG mitigation on farms by 2025
- Major regional trade associations to adopt net zero roadmap and promote across membership base

Bubbles: Civil society groups and consumer associations; Investors and capital markets; Overarching narrative; Catalytic comms; Producers; Supply chain actors; Supply-side ambition; Retailers and brands; Consumers and influencers; Demand-side ambition; Advocacy for policy; Regions; Cities; National policy; International policy; Unions and labour force; Industry bodies, trade associations, think tanks and research bodies

Legend: Primary campaign focus · Secondary campaign focus · Key objective

Source: [1] Eat-Lancet Commission; [2] European Parliament; [3] Global Green Freight Action Plan; [4] Champions 12.3

3. RETAIL CHANGE LEVERS

Key levers of change, interventions required and feedback loops

- **Policy** has a key role in supporting whole lifecycle decarbonization for 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.

- **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 scaling of the much-needed technologies.

- **Technology** and innovation are needed to deliver climate-smart solutions. Focus areas for retail will be in the electrification of heavy-good vehicles, 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

- **Business**: **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. **Demand** on the consumer side can be influenced by retail through product design changes, material substitution, environmentally positive advertising and marketing and information-sharing at the point-of-sale, 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 and by addressing information gaps to influence sustainable purchasing choices. Civil society actors can also
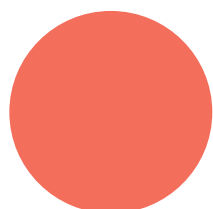
influence policy by advocating for climate-supportive legislative change, working towards systems transformation, driving collective action, and holding actors to account.

Value chain of the building and construction system[53]

As building occupants, retailers oversee a key hotspot for building system-related carbon emissions. This diagram has been used to illustrate interdependencies within the system, where stakeholders are part of two connected and converging flows: the *building value chain* and the *influencer value chain*. Emissions for retailers under this model, as "Owners" or "Occupants", would fall under scope 1 or scope 2 emissions. Please see also Built Environment pathway.

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[53] Building System Carbon Framework, WBCSD, 2020

NEXUS	Human settlements	Industry	Land use	Transport		Energy	3 GOOD HEALTH AND WELL-BEING	5 GENDER EQUALITY	7 AFFORDABLE AND CLEAN ENERGY	9 INDUSTRY, INNOVATION AND INFRASTRUCTURE

	By 2021 ▼	**By 2025** ▼	**By 2030** ▼	**By 2040** ▼

Policymakers (national, subnational, local levels)

Support **energy decarbonization** (see Human Settlements pathway)	• Support on-site renewable generation by retailers and landlords • Provide incentives for landlords to move to renewable tariffs • Support electrification of heating systems			
Improve **building efficiency** (see Human Settlements pathway)	• Drive building efficiency through green building certification standards, enhanced requirements for landlords, at beginning and end of lease and embodied carbon focus in the construction and renovation of buildings • Enact measures to enable the refurbishment of existing buildings on the high streets • All commercial buildings to be 70-80% more energy-efficient and all new buildings must be nearly-zero energy buildings (nZEBs) by 2020 (European Parliament)			

Support **regenerative and decarbonized agricultural** practices	• N/A	• N/A	• Double farmland under regenerative practice • Remove & store 100GT of CO2EQ in healthy soil & increase soil carbon by 1%/year	• Net zero agricultural production in the UK (NFU)
Restore **degraded lands**	• N/A	• N/A	• Restore 350mn hectares of degraded lands	• Restore 500mn hectares of degraded lands
Protect land	• N/A	• N/A	• Protect 30% land	• Protect 50% land by 2050
Act on **plastic packaging** (Also relevant for "Businesses and Service Providers")	• N/A	• Take action to eliminate problematic or unnecessary plastic packaging (EMF) • Take action to move from single use towards reuse models where relevant 100% of plastic packaging to be reusable, recyclable, or compostable (EMF) • Set an ambitious recycled content target across all plastic packaging used (EMF)	• N/A	• N/A

Business and Service Providers

Measure and report GHG emissions effectively	• Retailers with >£1bn in revenues set an SBTi with comprehensive Scope 3 • GHG measurement and reporting, specifying how offsets will be phased out		• Adopt an internal cost of carbon of >£20/ton	• Raise internal cost of carbon >£50/ton
Influence **supplier action** on climate	• N/A	• Ensure top suppliers committed to net zero and/or SBTs • Collect Tier 1 manufacturing GHG data from top suppliers	• Collect product GHG data from top suppliers	• N/A
Move to **zero carbon logistics**	• N/A	• Run advanced fuel efficiency programs for distribution fleet and drivers • Collect GHG performance data from logistics providers to inform decision-making • Reduce GHGs and other freight pollutants by 2025 (Green Freight Action Plan)	• Encourage network/route sharing for optimized efficiency • Transition LGV fleet to 100% zero carbon	• Transition last mile logistics to 100% zero carbon • Transition HGV fleet to 100% zero carbon
Sustainably source **raw materials**	• Set up to regularly report progress on tackling supply chain deforestation • 100% sustainable palm oil (RSPO)	• Support for regenerative agriculture and GHG mitigation on farm • Run programs with suppliers to accelerate decarbonization activities	• Zero deforestation from major commodities (beef and leather, cocoa, palm oil, timber*, pulp* and paper*, rubber, soy) * - sourced from sustainably managed forests	• Net zero agricultural production from farms • Source >90% circular feedstocks • Implement carbon dioxide removals projects and ensure verifiable results

			• Embed sustainable design principles in raw material and product specifications	
Help customers to live low carbon lifestyles	• Roll out campaigns to encourage low carbon behaviours • Run employee engagement programs on climate	• Increasing proportion of plant-based food sales in the UK by 50% • Ensure at least 25% of parking spaces used by store customers have access to EV charging	• Increase sale of circular products by 50% • Provide product climate information to customers on 100% products • Ensure EV charging points are available at all stores for customers	• Have net zero products account for 80% sales
Technology Providers and Innovators				
Adopt **LEDs**	• N/A	• Install 100% LEDs in all new buildings (e.g., stores and warehouses)	• Install or retrofit 80% LEDs in existing buildings	• Install or retrofit 100% LEDs in existing buildings
Operate **efficient sites powered by renewable energy**	• N/A	• Largest retailers to source 50% renewable energy from PPAs • Power all new buildings with renewable energy	• Source 100% renewable electricity (no gas usage)	• Source renewables for all sites' energy needs

Eliminate **hydrofluorocarbon refrigerant gases**	• N/A	• Use only low impact refrigerant gases (max 150GWP) for all new refrigeration installations	• Reduce HFCs by 79%, to meet EU F-Gas Regulation	• Prevent 70bn tonnes CO2e by 2050 (Kigali Amendment) • Use only low impact refrigerant gases (max 150GWP) for all systems
Reduce **whole lifecycle carbon emissions of buildings** (see Human Settlements pathway. Also relevant for "Businesses and Services Providers")	• All commercial buildings to be 70-80% more energy-efficient and all new buildings must be nearly-zero energy buildings (nZEBs) by 2020 (European Parliament)	• 32.4 kgCO2e/m² GHG intensity by 2050 in a 1.5ºC scenario and 39.7 kgCO2e/m² in a 2°C scenario (CRREM)	• 22.4 kgCO2e/m² GHG intensity by 2050 in a 1.5ºC scenario and 29.2 kgCO2e/m² in a 2°C scenario (CRREM)	• 9.0 kgCO2e/m² GHG intensity by 2050 in a 1.5ºC scenario and 16.0 kgCO2e/m² in a 2°C scenario (CRREM)

Civil society

Tackle **food waste** (Also relevant for "Businesses and Services")	• Zero food waste to landfill by 2020 (Vision 2020)	• Reduce post-farm food waste by 20% in the UK	• 50% reduction in food waste globally at the retail and consumer levels (Champions 12.3)	• 50% reduction in food waste globally (EAT-Lancet)
Ensure **sustainable diets**	• N/A	• N/A	• Right diet for 9bn (EAT-Lancet)	• Right diet for 10bn by 2050 (EAT-Lancet)

Financial Institutions

Support development of new investment vehicles like **public-private partnerships** to invest in R&D projects on innovation priorities and supply chain transformation	• N/A	• N/A	• N/A	• N/A
Partner with policymakers and industry to increase inflow of capital to **catalyze and scale solutions** for a low-carbon economy throughout the sector	• N/A	• N/A	• N/A	• N/A
Shift investment portfolios towards brands with robust environmental credentials, and support accurate and effective ESG assessments	• N/A	• N/A	• N/A	• N/A
Institutionalize financing mechanisms and incentive structures for industry decarbonization	• N/A	• N/A	• N/A	• N/A

RETAIL - EXISTING INITIATIVES

Consumer Goods Forum	Global industry body driven by membership of over 400 retailers and consumer goods companies in over 70 countries, convening environmental commitment around deforestation, food waste, refrigeration, and raw materials sourcing.
The Sustainability Consortium	Global non-profit organization working to transform the consumer goods industry by partnering with leading companies to define, develop and deliver more sustainable products.
Business Ambition for 1.5C	UNGC Secretariat campaign asking businesses to set science-based targets aligned with limiting global temperature rise to 1.5C above pre-industrial levels.
Science Based Targets initiative	Collaborative initiative between CDP, UNGC, WRI, WWF, and We Mean Business to showcase companies that set science-based targets consistent with the level of decarbonization required by science to limit warming to less than 1.5°C compared to pre-industrial temperatures.
We Mean Business Coalition	Global non-profit coalition working with the world's most influential businesses to take action on climate change, catalyzing business leadership to drive policy ambition and accelerate the transition to a zero-carbon economy.
World Business Council for Sustainable Development	Global, CEO-led organization of over 200 businesses working together to accelerate the transition to a sustainable world.
World Economic Forum	Global membership-based organization convening the world's largest corporations across several platforms and initiatives, including for the reduction of carbon emissions.
United Nations Framework Convention on Climate Change	Multilateral environmental agreement setting non-binding limits on greenhouse gas emissions for individual countries.
RE100	RE100 brings together influential businesses committed to 100% renewable energy. This initiative is led by the Climate Group in partnership with CDP.
World Green Building Council	Non-profit organization and global network of national Green Building Councils in over 70 countries worldwide.

EP100	A voluntary initiative where corporations pledge to double their energy productivity within 25 years of a chosen baseline. This initiative is led by The Climate Group in partnership with the Alliance to Save Energy.	▶
Cool Coalition	A unified front that links action across the Kigali Amendment, Paris Agreement and Sustainable Development Goals. It will inspire ambition, identify solutions, and mobilize action to accelerate progress toward clean and efficient cooling.	▶
EV100	An initiative to accelerate the transition to electro-mobility by 2030.	▶
Clean Cargo	A working group representing over 80% of global container cargo carried and with over 75 shipper, carrier, and freight forwarder members, focused on improving environmental performance in marine container transport using standardized tools for measurement, evaluation, and reporting.	▶

RETAIL - FURTHER REFERENCES

Special Report: Global Warming of 1.5°C, Intergovernmental Panel on Climate Change	**Link**
Decarbonizing strategies of the retail sector following the Paris Agreement, Energy Policy, 2019	**Link**
Climate Action Roadmap, British Retail Consortium, 2020 (UK)	**Link**
The Climate Pledge, Amazon	**Link**
Carbon Disclosure Project Supply Chain initiative	**Link**
Montreal Protocol, United Nations Environment Program	**Link**

Technical report on energy efficiency in HFC-free supermarket refrigeration, Environmental Investigation Agency, 2018	**Link**
Global Decarbonization Pathways, CRREM	**Link**
Building System Carbon Framework, WBCSD	**Link**
Fashion Charter for Climate Action, United Nations Framework Convention on Climate Change	**Link**
Courtauld Commitment 2025, WRAP (UK)	**Link**
Partnerships for Forests, Global Resources Initiative	**Link**
Global Powers of Retailing, Deloitte, 2020	**Link**
Alliance to End Plastic Waste	**Link**
New Plastics Economy, Ellen MacArthur Foundation	**Link**
Plastics Pact, Ellen MacArthur Foundation and WRAP (UK)	**Link**

STEEL

1. STEEL - INTRODUCTION

The purpose of this Action Table document is to highlight specific, promotable actions to deliver the vision for the Industry thematic area, along a pathway for steel sector decarbonization.

The global steel sector – which was responsible for 9% of global energy-related emissions, or 3.6 Gt CO_2e, in 2019 – faces a challenging but necessary and urgent path to decarbonization. Of this total, 2.6 Gt CO_2e, or 7% of energy sector emissions and 28% of industrial emissions, was closely associated with direct emissions generated in production of the nearly 1,900 million metric tonnes of crude steel, of which nearly three-quarters was from iron ore using metallurgical coking coal. Indirect emissions from electricity and heat generation account for another 1.0 Gt CO_2e. This includes the electricity consumed by finished steel production, and the scrap steel recycling through electric arc furnaces powered by grid electricity that accounts for 600 million metric tonnes of production. Roughly 53% of steel was produced in China, with the European Union (9%), India (6%), and the United States (5%) the next largest producers.

There are three major components to pathways for reducing global emissions from the steel sector: (i) managing steel demand; (ii) improving the productivity of steel once in use; and (iii) decarbonizing the production of steel. The relative balance of these components will have significant implications for the speed and disruptiveness of the transition for the steel industry and its employees, and the pace of decarbonization, in the context of a capital-intensive and globally competitive commodity sector.

This action table draws together insights from a wide array of existing decarbonization pathways and a multi-stakeholder consultation to derive immediate actions in the next one to five years, and in the long term, for mitigating global emissions from the steel sector. These actions are aspirational, noting the limited potential for a narrowly sectoral approach to deliver steel decarbonization by 2050 as evidenced by the 2020 IEA Iron and Steel Technology Roadmap. This report recently found that the steel sector would not realize net zero before 2070. For more information on these sources, please see "**Further References**".

2. STEEL SYSTEM MAP

Actors| Key stakeholders for Steel
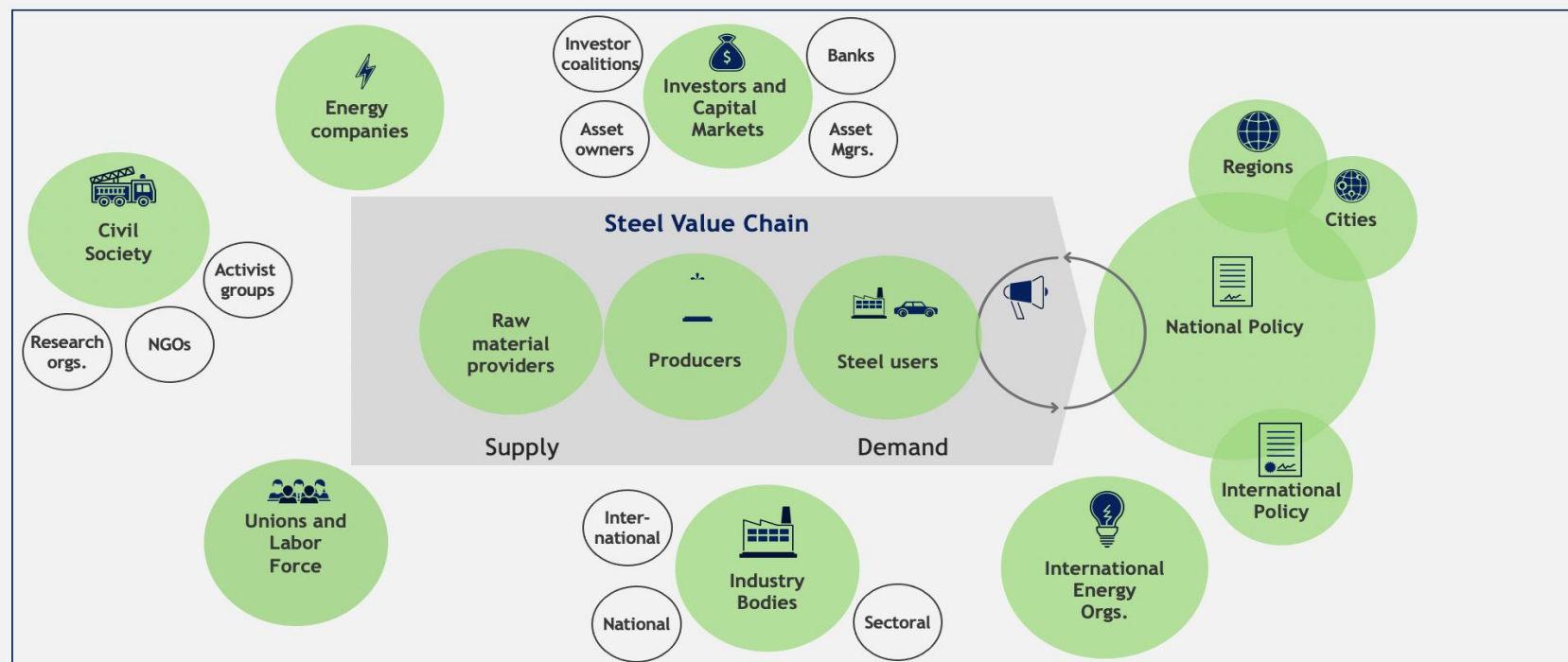
3. STEEL CHANGE LEVERS

Clear paths exist to decarbonizing steel by 2050 at minimal additional cost to end customers. Emerging dynamics could drive these changes on a 2050-aligned timeline. An extended recovery from COVID could encourage uptake of enhanced energy and material efficiency schemes to increase resiliency, with fast-growth developing countries shifting onto capital-efficient, digitalized development models featuring high asset utilization. Concerns over extended supply chains and job insecurity could strengthen the case for protective trade measures and re-shoring, with government outlays for domestic, low-carbon steel production facilities that create or sustain jobs.

- **Businesses:** Designers and architects can help to design buildings and cars for longer lifetimes and reduced waste, reducing primary steel demand 25-40% by 2050. To achieve this, customers, building owners and construction companies must demand, and/or governments regulate, **utilization of material efficiency measures and low carbon materials**. Building developers and owners and automobile manufacturers can **adopt substitutes alongside new practices**, (i.e., designing for cross-laminated wood or tension-based structures) driven by changing consumer preferences and synergistic value opportunities (i.e. vehicle light weighting electric vehicles yields battery capacity and weight savings). Convergence of net zero commitments, fast-moving technologies, and improved design practices could **spark elevated demand for zero-carbon steel**; for example, reduced overspecification of steel can enable adoption of low carbon steels at zero net cost, driven by building customer, investor-owner, and/or policy requirements. Growing digitalization and remote sensing capabilities could integrate end-to-end product tracking and accounting through value chains to end customers—where additional costs of decarbonized steel are marginal—thus creating premium markets that underlie a lasting business case for decarbonized steel. Finally, business can **collaborate with governments and green finance** to develop at least ten commercial-scale production facilities this decade, equivalent to 1% of global primary production.

- **Policy**: Policy support can accelerate **collaborative R&D efforts** to speed and scale deployment of low- to zero-commercial scale production facilities. This can be further incentivized by policies that **create downstream demand** through lifecycle emissions standards, preferential procurement of green steel for buildings and automobiles, and other regulatory or trade measures (i.e., carbon border adjustments) can help to create a level playing field for low carbon steel. At the local level, targets to reduce embodied carbon significantly

this decade can be set, and cities and states can share emerging best practices i.e., evolving codes and standards to deliver against those targets. **Collaboratively developed industrial strategies** using social dialogues between industry, finance, and communities can further help to manage and support technology transitions in communities with expensive and carbon-intensive assets. Overarching and long-term policy frameworks will provide price support for retrofits or, alternately, asset retirement, as with "technology sunset" policies.
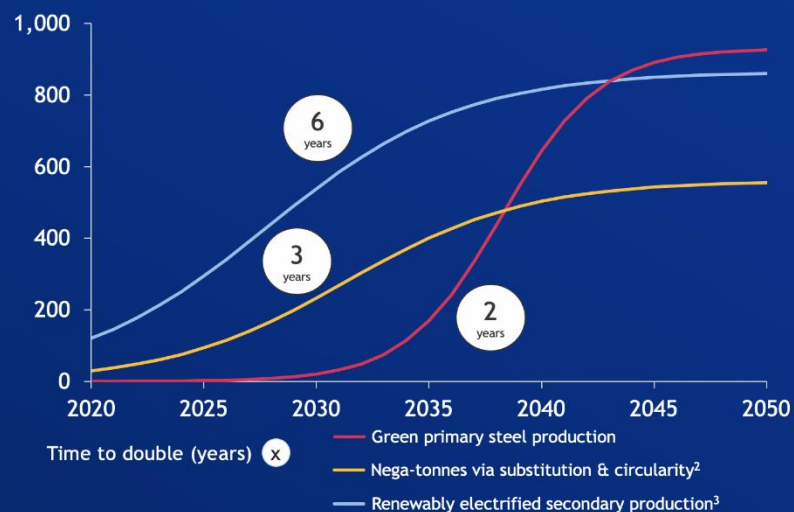
- **Finance:** Where production assets are still very young, as in India, investors can support efficiency schemes like Perform Achieve Trade that raise energy efficiency standards by incentivizing businesses to adopt new measures. Where assets are older, investors can search for opportunities to **invest in new and retrofitted green steel production capacity** supplying viable markets like automobiles and buildings, especially where differentiated markets for low-carbon steel exist. Asset managers and owners can continue to **call for enabling actions** like supportive policy and business adoption of science-based net zero emissions targets, while contributing to value chain collaboration to support delivery against those targets. Public and multilateral finance institutions can **support feasibility studies** and investment in renewable hydrogen-based green steel production in locations where renewables resources are particularly strong.

- **Technology:** Additional innovation is required to accelerate the development and deployment of breakthrough technologies like molten oxide electrolysis and carbon capture and storage. As technologies become technically proven like those currently announced, demonstration projects can further increase technology confidence and competitors' "fear of missing out", leading to more demonstration projects with policy support, further increasing technology confidence, and further strengthening policy and investor support for new commercial-scale deployments.

- **Civil society:** Over the near- to medium-term, growing social and investor pressure on companies to reduce emissions alongside renewables cost reduction can incentivize action within the industry. Organizations can also facilitate cross-value chain collaboration between mining, energy, and steel companies, and the development of shared pathways and roadmaps for action to deliver net zero by 2050.
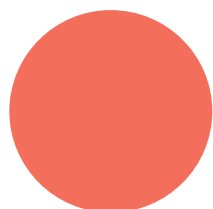
4. STEEL S-CURVE

2-6 year
doubling rates required to achieve efficient, green steel markets by 2050

Competing views of global steel market evolution based upon indicative 's-curve's[1]

Million tonnes per annum

Time to double (years) ⓧ

— Green primary steel production
— Nega-tonnes via substitution & circularity[2]
— Renewably electrified secondary production[3]

STEEL ACTION TABLE

NEXUS	Energy	Human settlements	Industry	Land use		

	By 2021	By 2025	By 2030	By 2040
Policymakers (national, subnational, local levels)	• National governments 1) advance conversations at among top ten producing countries to manage global primary steel production and address trade issues, i.e., carbon trade adjustment mechanisms 2) commit to substantially deepen cross-border support for technology RD&D (i.e., molten oxide electrolysis), demonstration (H-DRI, CCUS) and open-source learnings	• Top 10 producing countries set agreed terms and requirements for green steel public procurement and "technology sunset" policies • EU regulators drive carbon prices toward 60 euro/ton with some free allowances to support competitive low carbon steel; elsewhere policy makers implement graduated product standards • G7 countries institute green steel product requirements	• "Technology sunset" policies take effect to limit new carbon-intensive (or at least retrofit-ready) production facilities • Continued, significant contributions to funding pools and blended finance mechanisms to support scale up of zero carbon commercial-scale production capacity • Further strengthen building codes and standards in developing countries	• Institute and raise carbon prices with supporting trade measures • Mass rollout of content regulations (tradeable quota or certificate system) to increase shares of zero emissions steel • Continued massive contributions to funding pools and blended finance mechanisms to support scale up of zero carbon commercial-scale production capacity

	3) Develop multilateral agreement to implement efficiency schemes with supportive financing 4) form a "circular green steel buyers' club" to determine LCA emission standards, require product-specific declarations (EPDs), shared minimum procurement schedules, and circularity policies 5) Share knowledge on just transition experiences from other sectors and co-launch social dialogues • 10 regional governments announce plans to require environmental product disclosure (EPDs) for construction projects, co-launch regional reuse centers and protocols • At least 50 city governments respond to need for climate resilience and other political priorities to join the Clean Construction Forum to start taking action on embodied emissions and clean construction over the next year	• Provide subsidy support to 5-7 commercial scale green steel facilities, of which 3-4 are in high growth developing countries like India • 60 regional governments announce requirements for environmental product disclosure (EPDs) for construction projects, co-launch regional reuse centers and protocols • 300 city governments respond to need for climate resilience and other political priorities to take action on embodied emissions and clean construction, i.e., by developing embodied carbon strategies in a community of practice and/or adopting regulations to mandate/incentivize low-carbon materials and materials efficiency, such as materials reuse and recycling • Support multi-stakeholder social dialogues	• 150 regional governments announce requirements for environmental product disclosure (EPDs) for construction projects, co-launch regional reuse centers and protocols • 1000 city governments have developed and launched zero embodied carbon strategies in a global community of practice, have adopted regulations to mandate/incentivize steel reuse and recycling • Significant ramp up in support for social dialogues and financial needs in communities expecting to face plant closure • Light weighting requirements in China reduce domestically manufactured automobiles' steel content by a factor of six (BNEF) • Indian and South-Southeast Asian light weighting, building efficiency and urban design policies adopted	• Further strengthen building codes and standards in developing countries • 10,000 city governments have developed and implemented embodied carbon strategies contributing to net zero embodied carbon in all new buildings • In China, strong regulations and incentives continue to reduce primary production and scale up secondary production as steel stocks mature • In India, policies support new zero carbon primary production growth using innovative technologies (i.e., direct electrolysis)

Financial Institutions				
	• Major institutional asset owners continue to push businesses to set net zero emissions targets, voluntarily disclose under TCFD • Engage with 1) national governments to build case for low carbon policies; 2) value chain (mining companies, customers) to incentivize collaborative action • Explore/announce investment in steel companies with credible net zero plans, green energy providers • Track and support launch of social dialogue processes in carbon-intensive, high cost/low resource steel producing communities • Support city and building owner initiatives strengthening material efficiency • Undertake development of a methodology by which to define and pursue "climate aligned" asset and investment portfolios	• Major institutional asset owners continue to push businesses to set net zero emissions targets, voluntarily disclose under TCFD • Structure blended finance / sustainable investment programs to fund early commercial scale assets • Launch technology risk assessment methodologies to begin raising cost of capital for new high carbon facilities • Increase preferential investment in steel companies with credible net zero plans • Mainstream participation in social dialogue processes in carbon-intensive, high cost/low resource steel producing communities • All ratings agencies incorporate ESG into ratings methodologies, begin requiring disclosures on climate risk	• Major institutional asset owners continue to push businesses to set net zero emissions targets, voluntarily disclose under TCFD • Participate in dedicated investment of 10 commercial scale steel facilities • Scale up preferential investment in NZ-committed primary producers; begin divesting from carbon-intensive producers • Investor alignment raises cost of capital for new carbon-intensive production facilities, increasing competitiveness of green and low carbon steel • Public-private processes and techniques for managing stranded high carbon steel production assets institutionalized • Significant share of commercial financers and asset owner portfolios are climate aligned	• Investments and retirements in low carbon steel production capacity continue to scale, exceed $1 trillion • Public-private processes and techniques for managing stranded high carbon steel production assets ramp down as regional supply/demand mismatches resolve • Commercial financiers and asset owner portfolios are largely climate aligned

Technology Providers and Innovators	- Enhanced RD&D support for industrial-scale demonstration of greenfield and brownfield zero-carbon steel technologies - Additional low carbon steel commercial scale plants enter feasibility studies - Stakeholders strengthen collaboration on RD&D progress through WSA Global Technology Innovation Expert Group, Mission Innovation industry mission - Models for real-time grid carbon intensity for EAFs launched with five companies in developed markets	- More efficient building design tools and practices begin to scale across global platforms - Accelerate international RD&D on low- to mid-TRL steel technologies (i.e., direct electrolysis, CCUS) and share insights - Bring near-zero carbon material and design alternatives entering into mainstream - Enhanced RD&D support for industrial-scale demonstration of greenfield and brownfield zero-carbon steel technologies - Begin feasibility studies and/or construction on at least 10 commercial scale green steel facilities	- OEMs/steel partnerships deliver 20MMT per annum production capacity green commercial steel facilities - Next generation commercial-scale facilities (aqueous or molten-oxide electrolysis) under feasibility assessment - Further refinement and scale near-zero carbon material and design alternatives	- OEMs/steel partnerships deliver 400MMT per annum production capacity green commercial steel facilities - Next generation commercial-scale facilities deployed - Further refinement and scale near-zero carbon material and design alternatives
Business and Service Providers	10% of steel producers by volume have net zero by 2050 commitments - Leading global producers engage in cross-value chain and -sectoral collaborations and partnerships to identify, invest in new value pools i.e., Baowu Steel Metallurgy Alliance - Companies with young fleets issue aggregated energy	60% of steel producers have SBTI-backed net zero by 2050 commitments and are disclosing in line with TCFD - Demand consortia scale up and adopt fixed, pooled purchase agreements - Leading global producers engage in cross-value chain and -sectoral consortia to invest in value pools. i.e., linked to demand consortia	- All steel producers commit to SBTI-backed net zero by 2050 across scopes 1-3 and are disclosing in line with TCFD - First movers reach FID and/or construction for at least 10 commercial-scale production facilities - Producers are actively developing alternative business models and investment cases	- Producers' production asset retirement and turnover on track to deliver net zero production by 2050 - Green steel procurement targets among end-users reach a majority of annual production - Secondary and finished goods steel manufacturers' scope 1 emissions reduced by 100% in developed

	- efficiency bonds through domestic/multilateral funding windows - Customers and suppliers boost net zero commitments with specific scope 3 targets - 20 major construction, automotive, infrastructure, other end-customers set voluntary green steel procurement by 2030 commitments - 5 leading secondary steel producers co-develop and sign on to real-time grid carbon intensity measurement, tracking, accounting platform - Secondary and finished goods steel manufacturers deepen participation in renewables/PPA markets for direct contracting	- Major construction, automotive, infrastructure, other end-customers have set % green steel procurement by 2035 commitments - Secondary and finished goods steel manufacturers sign (virtual) renewable PPAs to reduce scope 1 emissions by 10% in developed countries - Design and architecture firms adopt tools and processes for optimizing building designs for low carbon and circular steel use, i.e., track embodied carbon on design optioning, build carbon disclosure into contract language	- Secondary and finished goods steel manufacturers scaling adoption of (virtual) renewable PPAs - Most construction, automotive, infrastructure, other end-customers have set net zero by 2050 commitments covering scope 3 - Automakers' electrification and vehicle sharing business models contribute to reduced demand, incentivizing alternative materials and utilization patterns - 100% steel producers reporting and disclosing in line with TCFD	- countries with support of long duration storage technologies - Proven business / value chain models for green steel markets brought to maturity - Producers in high scrap supply markets rapidly shifting production bases to renewably electrified secondary production - Secondary and finished goods steel manufacturers scaling adoption of (virtual) renewable PPAs or otherwise decarbonizing with lower carbon grid electricity
Civil Society	- Non-profits, IOs, NGOs support development of regional roadmaps, i.e., TERI - Labor unions push for energy efficiency and green steel investments as part of COVID bailouts, just transition policy support	- Build up consumer demand generation campaigns - Support integration of Life Cycle Inventory datasets - Scale demand-facing consortia development campaigns in key segments	- Scale diffusion of material efficiency and design tools and processes to 50% of new demand in developing countries - International campaigns for circular, zero embodied	- Consumer demands have mainstreamed development of circular business models in developed and developing countries - Social dialogue models proven, standardized, and

	- Develop independent real-time grid carbon intensity measurement, tracking, accounting - Launch consumer-facing campaigns in sectors in key segments to build demand for low carbon steel - Support the refinement and launch of product certifications and accounting methodologies connected to asset-level carbon intensity measurements - Work with industry to develop science-based target methodology - Increase educational resources and easy to use tools that allow for real-time comparative LCA during the design and specifications process	- Product certifications, i.e., Responsible Steel, and accounting methodologies are mainstreamed reach implementation, supporting development of differentiated green steel markets - Facilitate diffusion of material efficiency and design tools and processes into 5% of new buildings demand in high growth developing countries, as well as implementation of enabling building codes and standards - Support the development of an independent nature-based solutions standard and functioning offsets market	- carbon, infrastructure, and assets - Scale demand-facing consortia development campaigns in key segments - Support social dialogue convenings at local and regional levels to manage impending stranded asset and community jobs transitions, especially in developed countries	scaling across communities to support just transition

STEEL - EXISTING INITIATIVES

Business Ambition for 1.5C	UNGC Secretariat campaign asking businesses to set science-based targets aligned with limiting global temperature rise to 1.5C above pre-industrial levels.
Science Based Targets Network	Collaborative initiative between CDP, UNGC, WRI, WWF, and WMB to help companies develop and set science-based targets.
We Mean Business Coalition	Global non-profit coalition working with the world's most influential businesses to take action on climate change, catalyzing business leadership to drive policy ambition and accelerate the transition to a zero-carbon economy.
Leadership Group for Industry Transition (LeadIT)	Accelerating the transition of all industry sectors to low carbon pathways to reach net-zero carbon emissions by 2050.
Climate Action 100+	Investor network to ensure the world's largest corporate greenhouse gas emitters take necessary action on climate change.
Net Zero Asset Owner Alliance	Group of asset owners working to transition their investment portfolios (more than 2.4 trillion USD globally) to net-zero GHG emissions by 2050 consistent with a maximum temperature rise of 1.5°C.
Center for Climate-Aligned Finance	An "engine room" to help financial institutions partner with their clients, industry leaders, and key buyers to develop practical and scalable solutions to the barriers to climate alignment.
Mission Innovation	Dramatically accelerate public and private global clean energy innovation, including doubling their current research and development investments in the sector over 5 years.
Mission Possible Platform Net Zero Steel Initiative	A diverse group of leaders from public, private and civil society sectors working to build a trusted fact base and coalition to support policy and investment decision-making across countries and sectors.
SteelZero	A global initiative by the Climate Group in partnership with ResponsibleSteel that works with leading organizations to send a powerful signal to steel producers, investors, and policymakers to accelerate the transition to wide scale production of net zero steel.

Responsible Steel	An international, multi-stakeholder standard for responsible production for steelmaking and processing sites.	▶
COMET (Coalition on Materials Emissions Transparency)	An alliance to create a universal greenhouse gas (GHG) calculation framework for the mineral and industrial supply chains.	▶

STEEL - FURTHER REFERENCES

Mission Possible Platform: Reaching net-zero carbon emissions from Harder-to-Abate sectors by 2050	Link (Steel Appendix)
Ellen Macarthur Foundation & Material Economics: Completing the Picture: How the Circular Economy Tackles Climate Change	Link
Fraunhofer ISI: Industrial innovation: Pathways to deep decarbonization of industry	Link
World GBC: Bringing Embodied Carbon Upfront	Link
CNCA/C40: Embodied Carbon Policy Framework	Link
TERI/ETC: Towards a Low Carbon Steel Sector in India	Link
CEEW: Sustainable Manufacturing for India's Low-carbon transition	Link
RMI/ETC: China 2050: A fully developed, rich zero carbon economy	Link
Ellen Macarthur Foundation: The circular economy opportunity for urban and industrial innovation in China	Link

Material Economics: Industrial Transformation 2050 – Pathways to Net zero Emissions from EU Heavy Industry	**Link**
CLG Europe: Forging a carbon-neutral heavy industry by 2050: How Europe can seize the opportunity	**Link**
Grattan Institute: Start with steel – a practical plan to support carbon workers and cut emissions in Australia	**Link**
IEA Iron and Steel Technology Roadmap 2020	**Link**
IEA: Material Efficiency in Clean Energy Transitions	**Link**
McKinsey: Decarbonization of industrial sectors: the next frontier	**Link**
IDDRI: Deep Decarbonization Pathways Project	**Link**