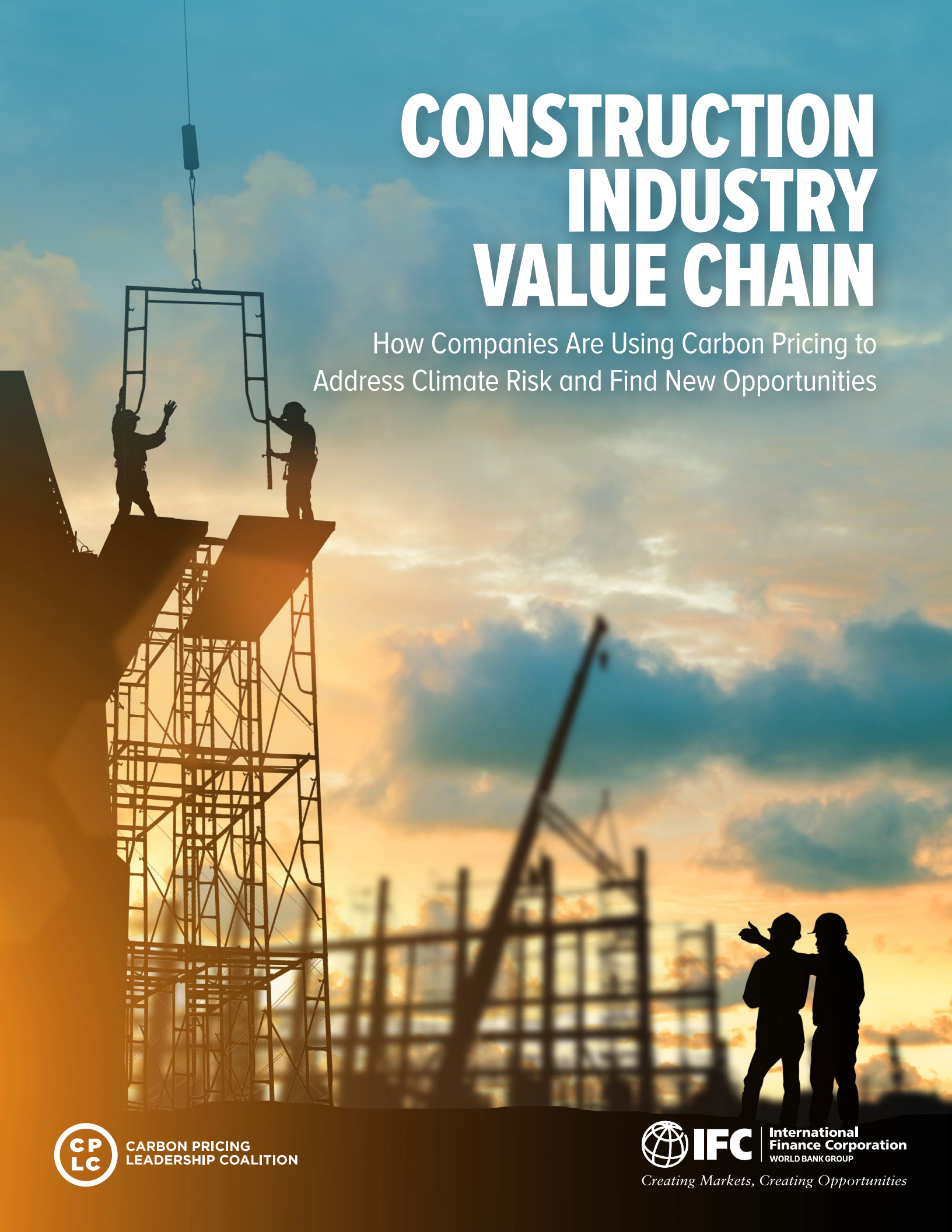

CONSTRUCTION INDUSTRY VALUE CHAIN

How Companies Are Using Carbon Pricing to Address Climate Risk and Find New Opportunities

CPLC CARBON PRICING LEADERSHIP COALITION

IFC International Finance Corporation WORLD BANK GROUP

Creating Markets, Creating Opportunities

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A unique initiative, the Carbon Pricing Leadership Coalition (CPLC) brings together leaders from national and sub-national governments, the private sector, academia, and civil society with the goal of putting in place effective carbon pricing policies that maintain competitiveness, create jobs, encourage innovation, and deliver meaningful emissions reductions. The Coalition drives action through knowledge sharing, targeted technical analysis and public-private dialogues that guide successful carbon pricing policy adoption and accelerate implementation. The Coalition encourages private sector climate leadership through sector-specific task teams, including for the construction industry and the banking sector.

The Coalition was officially launched at COP21 in Paris in December 2015. As of 2018, CPLC comprises 32 national and sub-national government partners, 150 private sector partners from a range of regions and sectors, and 67 strategic partners representing NGOs, business organizations, and universities. More information: https://www.carbonpricingleadership.org/

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2121 Pennsylvania Avenue N.W.
Washington, D.C. 20433
Internet: www.ifc.org

IFC, a member of the World Bank Group, creates opportunity for people to escape poverty and improve their lives. We foster sustainable economic growth in developing countries by supporting private sector development, mobilizing private capital, and providing advisory and risk mitigation services to businesses and governments. This report was commissioned by the Carbon Pricing Leadership Coalition (CPLC) through IFC's Climate Business Department. The CPLC secretariat is administered by The World Bank Group.

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This study reflects the views of the authors and does not necessarily reflect the views of the companies covered by the paper. The findings would, thus, not be binding on the companies studied.

EXECUTIVE SUMMARY

The global construction industry is the world's largest consumer of raw materials, and constructed entities account for between 25 and 40 percent of total carbon emissions in the world.[1] The industry is projected to grow at 4.2 percent annually between 2018 and 2023 in terms of market value,[2] with expansion opportunities in residential, nonresidential, and infrastructure projects. This expected growth and the imperative toward decarbonization[3] signaled by the Paris Agreement have created the impetus for sustainable construction. Construction companies are becoming increasingly accountable for their contribution to global emissions and are facing pressure from investors, banks, regulators, contracting authorities, and consumers to mitigate their climate risk and find new solutions to reduce their carbon footprint. In response, the industry is making inroads toward addressing these concerns.

What is the Construction Value Chain?

The value chain for any construction project is composed of specific variations within a fixed framework of distinct stages—design, production and conversion of raw materials into manufactured products, and construction itself. Each of these comprises its own internal stages, processes, stakeholders, and aspects that interact to bring a project to fruition. The distinctness of these processes, as well as the fixed-term, project-based nature of relationships along the supply chain, results in a highly fragmented industry structure.

Sustainability Along the Construction Value Chain

Companies across all sectors of the construction value chain are using methods such as internal carbon-reduction targets, development of innovative green products, advocacy for sustainability standards, and integration into the circular economy to embed sustainability into their operations and products. While the momentum toward sustainability is ubiquitous across the industry, it manifests differently in each sector along the value chain, as explored in this paper.

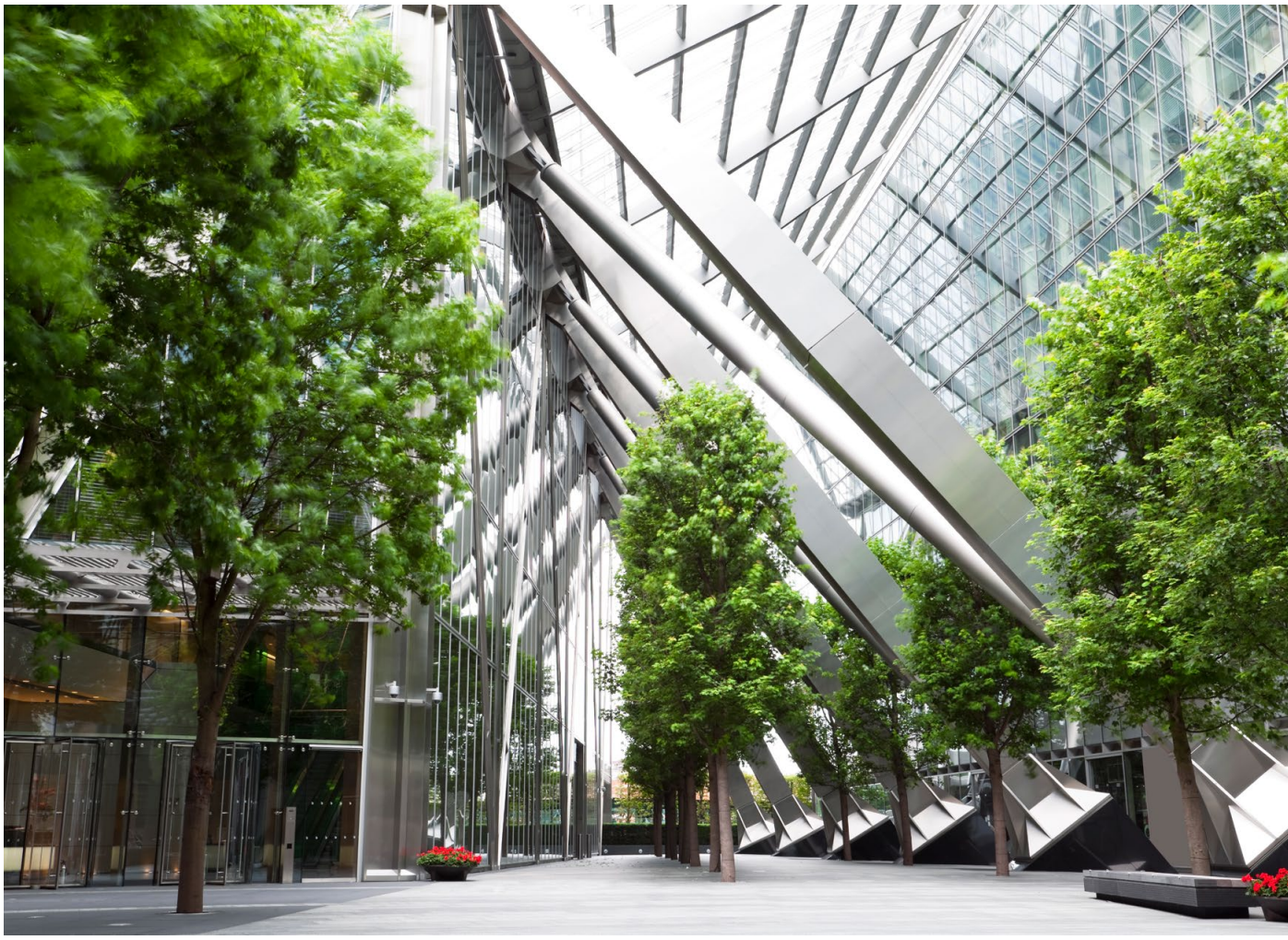
Construction Industry and Carbon Pricing

Internal carbon pricing has emerged as a preferred tool for businesses to measure, manage, and mitigate their climate risk to prepare for a future in which carbon pricing is a regulatory mandate, as well as reduce their carbon footprint. In 2017, almost 1,400 companies used an internal carbon price or planned to within two years, from only 150 in 2014.[4] This is due to the effectiveness of carbon pricing in quantifying climate risk exposure, communicating it to stakeholders, incentivizing low-carbon alternatives, and providing a revenue stream for investment in clean innovations.

Companies in the construction industry are recognizing the role of carbon pricing in managing climate risk and carbon exposure, revealing opportunities for climate-smart business, and acting as a transition tool to incentivize low-carbon activities.[5] In addition, companies along the construction value chain need to manage their Scope 3 emissions by engaging with their supply chains on carbon pricing and emissions reduction tools. The high level of fragmentation and the disconnect between decision makers along the value chain necessitates the development of an integrated approach to carbon pricing for it to be most effective in enabling companies to achieve climate goals and reduce risk. That is, without industrywide support and coordination, the production of green products is not linked to the demand and valuation of these products further down the chain. Construction sector companies acting alone represent great initiative but would be significantly more effective at helping the industry meet climate targets with the support of and linkages to their counterparts along the value chain.

Current Carbon Pricing Practices by Companies across the Construction Value Chain

Twelve companies from sectors across the construction value chain, including aluminum, cement, glass, steel, infrastructure, construction services, and equipment manufacturing were interviewed for this paper. Their attitudes, existing initiatives, and future plans for carbon pricing were documented to reveal common concerns and themes surrounding carbon pricing in the value chain:



- Using carbon pricing to reduce the industry's carbon footprint **will work only if companies can remain competitive.**
- Companies would prefer to operate on a **level playing field** and seek the universal application of an external carbon price across their sectors, applicable to all actors.
- The challenges faced by companies in the construction value chain differ by **geography and jurisdiction.** No one solution is applicable across all business units or stages of the value chain.
- Companies seek assistance with **managing Scope 3 emissions** and engaging with their supply chain, and they need **standardized and comparable frameworks for scenario analysis.**
- The challenge of "socialization" faced by early movers has eased because of a **change in culture** brought about by recent advances such as the Paris Agreement and the Financial Stability Board's Task Force on Climate-related Financial Disclosures (TCFD) recommendations.
- Companies lack clarity on how to operationalize and standardize the implementation of an internal carbon price. Businesses are interested in **learning from the experiences** of other companies.
- All the companies surveyed advocated for the development of an **integrated carbon pricing mechanism** (additional Carbon Pricing Leadership Coalition [CPLC] analysis forthcoming in Fall 2018).

Introduction

The global construction industry is the world's largest consumer of raw materials, and constructed objects account for between 25 and 40 percent of total carbon emissions in the world.[6] The industry is projected to grow at 4.2 percent annually between 2018 and 2023 in terms of market value, with expansion opportunities in residential, nonresidential, and infrastructure projects.[7] In parallel, the Paris Agreement and its well-below-2 degrees Celsius target for global temperature increase[8] has signaled an imperative toward decarbonization in the public and private sectors,[9] including creating the impetus for a sustainable construction industry. With increasing populations, urbanization, and the fact that almost 75 percent of the infrastructure that will exist in 2050 has yet to be built,[10] the construction industry is expected only to expand, thus providing a significant opportunity to improve its efficiency and transition toward a low-carbon future.

Governments are taking their own steps to manage such opportunities, with 66 of the Paris Agreement signatories mentioning buildings as a key sector for mitigation targets.[11] Similarly, over 80 percent of all Nationally Determined Contributions (NDCs) include a focus on resilient infrastructure, also corresponding to Sustainable Development Goal (SDG) 9's intersection of infrastructure, energy, and housing,[12] and SDG 11 on sustainable cities.[13] At the same time, the private sector is also assuming responsibility.

The construction industry is already making inroads toward addressing its emissions, in response to these trends and the growing demand for green, low-carbon construction. Consumers of newly constructed buildings and infrastructure increasingly require the industry to meet standards of energy efficiency, responsible resource management, and resilience.

The International Financial Corporation (IFC) estimates an investment opportunity in green buildings totaling more than $16 trillion by 2030 tied to meeting the Paris Agreement and domestic policy targets in 21 key emerging markets.[14] Similarly, McKinsey estimates that annual investments of $3.3 trillion in infrastructure are needed worldwide to support the projected growth in GDP until 2030, of which 60 percent will be in emerging markets.[15] These trends provide an enormous opportunity to green the future construction of buildings and infrastructure through innovative low-carbon technologies, policies, and processes.

Companies have a growing sense of accountability for their contribution to global emissions, and they increasingly understand the risks that climate change and carbon exposure pose to businesses and the potential opportunities that exist for low-carbon solutions.

Companies along the construction value chain face pressure from investors, banks, regulators, and consumers to respond to concerns to mitigate their own carbon risk and find new solutions. To meet these demands, forward-thinking companies are exploring a variety of methods including, science-based targets, public and private procurement standards, standardized tools and measurements, building codes, certification systems for infrastructure, and lifecycle analysis of projects.

One approach that has gained significant momentum and prominence is carbon pricing. As of now, 51 carbon pricing initiatives including 15 in emerging markets, have been implemented or are scheduled for implementation. These include 25 emissions trading systems, mostly located in subnational jurisdictions, and 26 carbon taxes applied at a national level, generating a total collective value of US$82 billion in 2018.[16] In addition, internal carbon pricing is also increasingly being used as a key part of their low-carbon transition strategy by a growing number of businesses across sectors to prepare for imminent future regulations mandating carbon pricing. Internal carbon pricing has become a preferred part of companies' toolkits to measure, manage, and mitigate their climate risk because of its effectiveness in quantifying risk exposure; communicating it to relevant stakeholders, including investors; incentivizing low-carbon alternatives by pricing out carbon-intensive projects and investments; and providing revenue for investment in clean innovations. It is even more effective when supported by and used in collaboration with other financial and nonfinancial incentives to lower companies' carbon footprints. However, given the fragmented nature of the construction industry, there is a need for companies along the value chain to align their approaches to sustainability, and develop an integrated approach to carbon pricing.

This paper provides a framework for considering the construction value chain and explores existing attitudes and initiatives toward carbon pricing along it, with the objective of enabling companies to identify possible synergies and align their approaches to sustainability. Twelve of the Carbon Pricing Leadership Coalition's (CPLC) partner companies representing sectors across the construction value chain, including aluminum, cement, glass, infrastructure, equipment manufacturing, construction services, and steel were interviewed to understand their motivations and experiences as they attempt to implement carbon pricing and transition toward low-carbon construction. This paper seeks to supplement forthcoming analysis under the CPLC, expected in Fall 2018, on how to bring together all decision makers along the construction value chain to develop an integrated approach to carbon pricing that will allow companies to achieve their climate goals, and reduce their risk exposure and carbon footprint.

What is the Construction Value Chain?

To accurately allocate risk and align sustainability approaches, it is important to identify the actors that can assess, inform, and adapt their decision making to most effectively implement an integrated carbon pricing mechanism. However, construction projects differ by location and vary by type, from buildings to civil engineering projects to large-scale infrastructure, and they are directed by local conditions, purpose, regulations, codes, and resources that evolve with time. As such, the specific contexts of construction projects also have an impact on the requirements, composition, and significance of different stages and actors in the value chains for those projects. A holistic approach is needed to define the construction value chain so all relevant stakeholders can jointly develop a strategy for integrated carbon pricing and, more broadly, achieve their climate goals.

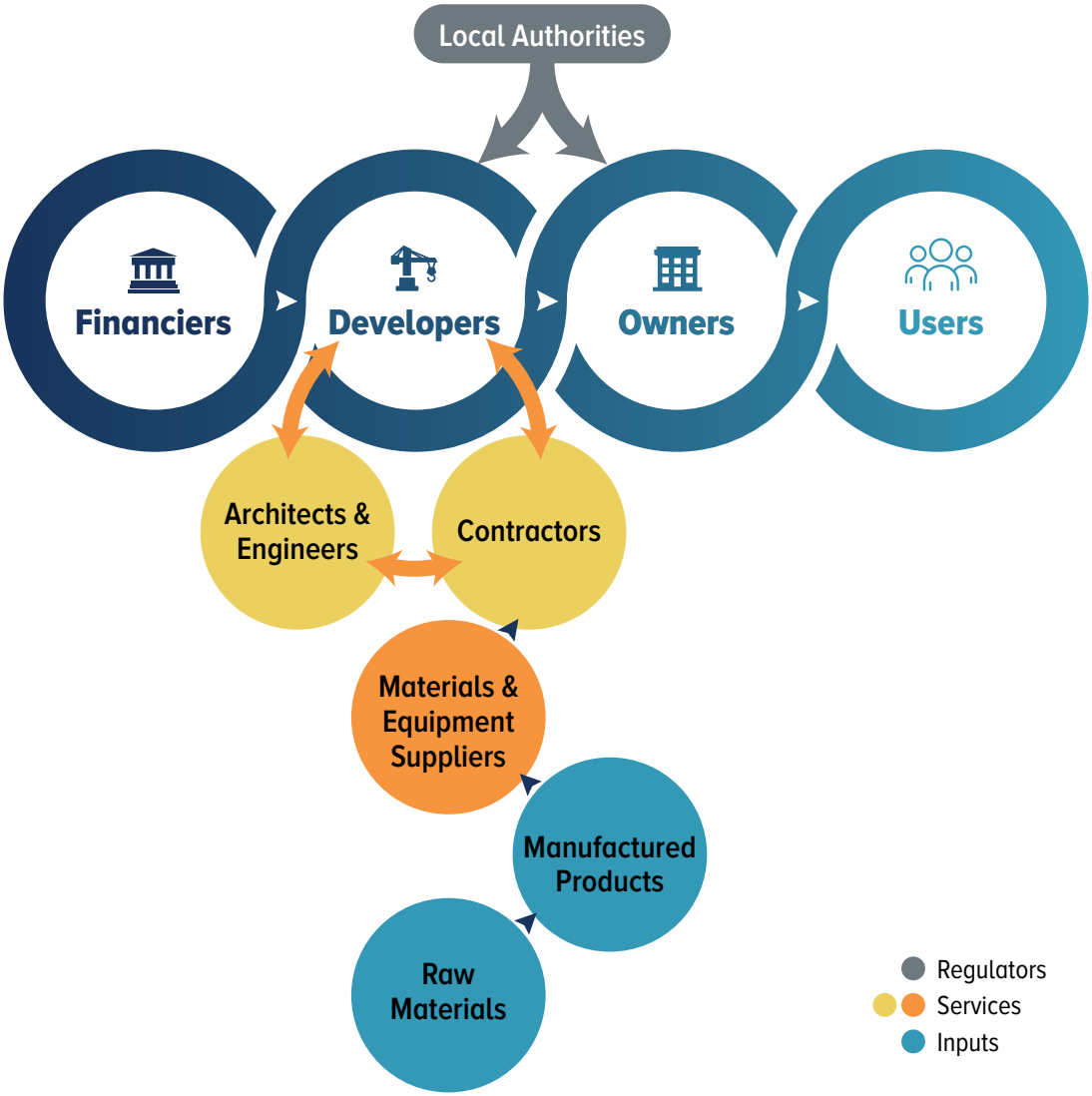
As the industry is integral to both national and global economic flows, several definitions of the construction value chain have been put forth, reflecting changing trends in technologies, processes, and projects. A review of the literature shows commonalities in definitions of construction supply chains. One definition[17] considers the value chain as a process that transforms raw construction materials into manufactured materials that are made into a final product. Another reflects the specialized nature of each project, with new technologies helping the construction industry evolve into an "engineer-to-order" format where each product is made specifically in accordance with customer preferences and requirements.[18] Despite the relatively niche use of engineer-to-order construction to date, it offers lessons for the broader construction industry. The operation of each phase as silos results in delays, missing information, and miscommunication, which is reflected in the fragmented nature of the construction value chain with its separate, unaligned sectors.

Others define the construction industry in terms of its distinction from manufacturing supply chains,[19] characterizing the industry's structure and function as one where the value chain converges all materials at the construction site to set up a de facto "construction factory" around a single, final, constructed project. The project is produced by repeatedly reconfiguring its organization and making use of temporary supply chains typified by instability,

fragmentation, and separation of design and construction stages.

This analysis considers the value chain for any construction project as variations arising within the fixed framework of three distinct stages: design, production and conversion of raw materials into manufactured products, and on-site construction. Each stage comprises internal phases, processes, and stakeholders that interact to bring a project to fruition. The major sectors in this industry—aluminum, bricks/clay, cement, glass, plastics, and steel—are supported by the ancillary activities of companies working with construction financing, legal firms, and the like. The final stage, on-site construction, may be for residential or commercial use and includes infrastructure, buildings, and industrial sites. The distinctness of these processes, as well as the fixed-term, project-based nature of relationships along the supply chain, result in a highly fragmented industry structure.

FIGURE 1: CONSTRUCTION VALUE CHAIN: ACTORS AND INTERACTIONS[20]



Absent from all the above definitions, is the deconstruction of a built structure. Despite its scope for sustainability and role in the circular economy and global decarbonization, deconstruction is not included in the analysis of the value chain in this paper. This is due to the long lifetimes of buildings and infrastructure, with deconstruction coming anywhere from 20 to 100 years later depending on the type of construction.[21] Given the contractual and project-based nature of relationships along the value chain, the deconstruction process would have its own value chain, with an entirely independent set of firms, suppliers, customers, and linkages as it takes place decades after the initial completion of the construction project. [22] The firms interviewed confirmed that the industry supply chain does not include the deconstruction stage in either business or design considerations.

While the framework for this analysis considers the value chain extending only to the completion of the construction process, a significant proportion of a building's emissions arise from its lifecycle use after construction, especially from energy consumption for electricity, heating, and cooling in buildings. [23] It is imperative to consider emissions from both use, as well as end-of-life deconstruction and recycling of construction materials as early as the design stage to ensure sustainability across the lifecycle of the project. Strong policy signals in this direction are being provided by upcoming regulations such as France's Thermal Regulation 2020.[24] This imposes low-carbon mandates throughout the lifecycle of buildings including energy consumption targets and end-of-life activities.[25]

As companies at different stages of the construction value chain develop sustainability initiatives, they need to identify which part of their operations account for the majority of their emissions, namely Scope 1 (direct emissions from owned or controlled sources), Scope 2 (indirect emissions from the generation of purchased energy), or Scope 3 (all indirect emissions that occur along their value chain, both upstream and downstream).[26] Scope 1 and 2 emissions are relatively straightforward to measure and manage. Estimating Scope 3 emissions is much more complex because of variations in reporting and metrics along value chains that are frequently fragmented and often draw from the informal sector in emerging markets, where there is a significant lack of information.[27] Since the largest source of emissions are often Scope 3,[28] it is important for companies to work to manage these value-chain-related indirect emissions as part of their overall efforts to reduce their carbon footprint.

Sustainability Along the Construction Value Chain

Construction companies are championing sustainability initiatives across the world. For example, through the Sustainable Housing Leadership Consortium leading companies from the industry have pledged to work together to make at least 20 percent of new housing developments in India go green by 2022.[29] The Cement Sustainability Initiative(CSI), launched by the World Business Council for Sustainable Development (WBCSD), brought together 25 major cement producers, accounting for 30 percent of global cement production, to pursue sustainable, business-positive development.[30] CSI is being succeeded by the Global Cement and Concrete Association (GCCA), which will continue to reflect and support the industry's commitment to sustainability.[31] The Aluminium Stewardship Institute (ASI) is a global standards setting and certification organization, that unites more than 60 members in the aluminum value chain to maximize the sector's contribution to a sustainable society.[32] The Global Alliance for Buildings and Construction has almost 100 members, ranging from national governments to private companies, trade associations, and research organizations committed to meeting the Paris Agreement targets.[33] Green buildings with a certification from Leadership in Energy and Environmental Design (LEED),[34] Building Research Establishment Environmental Assessment Method (BREEAM),[35] or Excellence in Design for Greater Efficiencies (EDGE, which is especially prevalent in emerging markets)[36] are already at a premium, and demand for sustainable construction is only increasing. McKinsey has identified a huge opportunity for construction "materials of the future," of which green materials and low-carbon technologies are integral parts.[37]

The various sectors of the construction value chain are demonstrating their awareness of the importance of embedding sustainability into their operations and products. This is apparent through their use of methods such as internal carbon-reduction targets, development of innovative green products, advocacy for sustainability standards, integration into the circular economy, and others. While sustainability measures have gained momentum across the industry, they manifest differently in each sector. Some broader sustainability trends in select sectors are outlined below.

Aluminium

Even though almost 75 percent of the aluminum ever produced is still in circulation today,[38] the demand for new aluminum continues to grow. The construction industry has a high demand for the material due to its durability, recyclability, flexibility, and light weight.[39] Over 63 million metric tons of primary aluminum were produced in 2017 alone.[40] Perfluorocarbon emissions from the production of primary aluminum represent the third-largest source of fluorinated greenhouse gas emissions in the industrial sector, and baseline emissions between 2010 and 2030 are projected to grow by 42 percent, from 26 million metric tons of carbon dioxide equivalent to 37 million metric tons.[41]

Investments in the production of metals and mining, including aluminum, are inherently long-term given the nature of the projects and the longer payback periods. Thus, investors looking to plan their investments in the industry need to account for longer-term trends, including likely policies in the future and consumer preference for sustainable production as well as resultant demand for low-carbon aluminum products.[42] Strategies that account for the long term, as well as the inherent profitability of reducing costs through more energy efficient production, have resulted in the growing demand for sustainable production. Such strategies are also providing the stimulus for market growth in recycled aluminum products[43]— annual output has quintupled from 5 million tons to almost 25 million between 1980 and 2015.[44] Recycling aluminum saves over 90 percent of the energy that would have been needed to produce the same amount of the metal from raw materials.[45] Green production of aluminum, made from renewable energy sources rather than fossil fuel, has also caught on, with industrial consumer-demand for lower-carbon products allowing producers to charge premium prices for their sustainable outputs.[46] Producers of aluminum from hydro-powered smelters in Norway, Russia, and Canada are gaining a competitive edge against producers relying on smelters powered by coal or gas.[47] Industry heavyweights such as Rusal, Alcoa, and Rio Tinto are already developing and advertising low-carbon primary aluminum,[48] while others are providing low-carbon guarantees for sustainably produced aluminum at modest premiums.[49]

Despite these efforts, current sustainability trends and initiatives in the sector will have to be greatly increased to meet climate targets while keeping up with aluminum demand from downstream industries such as construction, automobiles, and electronics.[50] These industries are already facing more pressure from regulators, investors, and consumers to engage in sustainable production and business practices, and new policies affecting the aluminum sector globally can be expected. The opportunity exists to meet increased demand with low-carbon aluminum, and tools such as carbon pricing provide an incentive for its use.

Despite such ventures, however, a study by Climate Action Tracker found that the decarbonization of steel with currently available technologies, including a

greater shift toward a circular economy, would be insufficient to meet the targets of the Paris Agreement.[51] To meet the global goal, the study found that the industry needs to develop innovative production processes, such as electrolysis through renewable energy, carbon capture, and materials substitution.[52]

Cement and Concrete

The share of global greenhouse gas emissions from the cement industry nearly doubled between 1990 and 2010, from 2.8 percent to 5.5 percent, driven largely by the explosion of cement production in China.[53] As of 2017, the industry represents 7 percent of global carbon dioxide emissions and is the third largest consumer of energy. Cement is the key input for the production of concrete, which is the most consumed manufactured substance in the world and is integral to construction activity. [54]Concrete typically has an embodied carbon dioxide content of 50 kilograms to 150 kilograms per ton that is fully "paid off" early in the lifetime of concrete buildings because of gains from energy efficiency.[55] The production of cement and concrete is likely to continue rising, given the continuing economic development and growing need for construction in markets such as South Asia and Sub-Saharan Africa.[56] The International Energy Agency estimates a 12 percent increase in global cement production by 2050.[57]

CDP surveyed cement companies' exposure to high earnings risk from their emissions and found that the poorest-performing companies were the least supportive to carbon regulations and unprepared for a low-carbon future, and thus, the most exposed.[58] On the other hand, companies that had been reducing their emissions intensity over time were much better positioned to handle the transition risks toward a low-carbon economy, although the industry as a whole needs to seek longer-term solutions, such as carbon capture and low-carbon cement products.

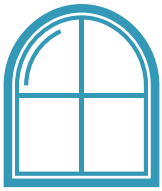
The cement and concrete industry is coming together to meet this challenge through forums such as the GCCA, which seek to explore the role of cement and concrete in sustainable construction. Concrete is helping to reduce life-cycle emissions from buildings, as its use can reduce energy consumption from heating and cooling by up to two-thirds.[59]

Individually, too, companies are applying increasingly stringent sustainability standards to themselves and engaging in the production of low-carbon cement, concrete, and related products. Large firms are making efforts to create efficiencies and sustainable policies. For example, LafargeHolcim has among the lowest emissions intensities and most robust reduction targets and Cemex has one of the highest utilization rates of alternative fuels in the industry.[60] The cement companies surveyed by CDP had reduced their emissions intensity by

1 percent each year over the last four years, but were still found to be incompatible with the commitments of the Paris Agreement.[61] However, the sector will need to more than double the rate of emissions intensity improvements to meet the 2 degree goal, highlighting the scope for significant changes in the industry's business practices.[62]

Innovative green cement and concrete products are also reaching the market. Some examples are high fly ash content concrete, which uses half as much water and lasts three times longer than other substitutes;[63] concrete that is reinforced with recycled plastic instead of energy-intensive steel;[64] and other "carbon-negative manufacturing processes" that substitute clinker with a more sustainable material.[65] However, such low-carbon cement and concrete products have seen low uptake along the value chain thus far. Adoption of such products can be encouraged by developing an integrated approach to sustainability across the value chain, which will help boost green construction.

Glass



Glass products for buildings account for 80 percent of the float glass[66] market, and building refurbishment accounts for 40 percent of global glass consumption, driven by the demand for increased energy efficiency of buildings.[67] A fully recyclable resource made from natural raw materials, glass is an inherently sustainable material that provides great environmental benefit from its ability to be recycled repeatedly in a closed loop.[68] Glass manufacturing produces extremely low quantities of solid waste, as a vast majority of glass waste is immediately recycled and reused as raw material.[69] Glass companies are recognizing the business opportunity reflected within the sustainable nature of their product and have come together to collectively advocate for stronger regulations and innovative solutions to encourage glass recycling. For example, the Glass Recycling Coalition's[70] members comprise glass manufacturers, processors, end-users, materials recovery facilities, and packaging companies. In addition, the Glass for Europe trade association advocated for a stronger mandate on building-glass recycling within the European Union's waste legislation.[71]

The biggest source of emissions from the glass sector comes from the melting process, which releases carbon dioxide through the use of fossil fuels in the process as well as the decomposition of raw materials.[72] Some of the best opportunities for companies to reduce their carbon impact come from switching to renewable energy sources in their melting activities and developing low-carbon, high-efficiency glass products for the construction sector. The latter is increasingly being used in buildings, with architects taking advantage of glazed glass's energy-saving properties that reduce energy consumption from heating and air conditioning.[73]

Plastics

Now the second-largest consumer of plastics, the construction industry is using the durable material and its derivatives with wide functionality to create more sustainable and resilient structures.[74] Plastic-reinforced concrete is increasingly used to reduce carbon dioxide emissions from construction projects, and plastic-reinforced carbon fiber is used to make buildings more resilient against earthquakes. Recycled plastic is also sometimes blended with previously unprocessed plastic and used as a sustainable construction material for green buildings.[75] Innovations in the sector include using carbon-negative plastics, which are made from greenhouse gas emissions converted into long-chain polymers, to make manufactured products for the construction industry, such as foam blocks and panels for buildings.[76] In January 2018, the Plastics Industry Association, a manufacturers trade association in the United States, adopted its first-ever sustainability statement, following the global trend toward responsible production.[77]

However, these innovative solutions and initiatives are a drop in the bucket given that 91 percent of all plastic is still not being recycled,[78] which highlights the urgent need for significant change in the industry. With the European Union,[79] Costa Rica[80] and many other countries considering bans on single-use plastics, there is an opportunity for the plastics industry to take advantage of its recyclable product and reposition itself as a low-carbon-intensity construction material for an increasingly sustainability-minded industry.

Steel

Conventional steel production is highly energy intensive. Each ton of steel produced, generates almost two tons of carbon dioxide.[81] It is one of the highest-emitting industries, accounting for about 7 percent of global carbon dioxide emissions.[82] The explosion of demand for green buildings and sustainable construction has, however, encouraged the steel industry to produce cleaner alternatives. Structural steel, for example, has one of the highest rates of recycled content and recyclability of any construction material, and the carbon footprint of its manufacturing process has decreased by 37 percent per ton since 1990. Both of these factors have encouraged its use in buildings seeking LEED certification.[83]

Industry-led sustainability initiatives are gaining momentum. For example, ResponsibleSteel[84]—the industry's first global multi-stakeholder standard and certification program—involves companies at all points along the steel supply chain. The steel industry is also developing low-carbon, sustainable products. One example is Hydrogen Breakthrough Ironmaking Technology (HYBRIT),

which substitutes hydrogen for coal in the steelmaking process, producing water instead of carbon dioxide.[85] The HYBRIT collaboration aims to develop a solution for fossil-free steel by 2035. Its initial deployment is expected to reduce Sweden's total emissions by 10 percent and Finland's by 7 percent. Design and technological improvements have increased productivity and energy efficiency of electric arc furnaces,[86] which produce steel by recycling ferrous scrap.[87] These are in use in many regions and have a significantly lower emissions profile.[88]

Building Codes and Standards

The sustainability practices being adopted across sectors producing inputs for construction are being complemented by efficiency measures in the design, planning, and final product stages. Regulations and building codes are encouraging low-carbon choices early in the construction process—at the design stage. For example, Jakarta's government has introduced a regulation requiring all large buildings, yet to be built or existing, to meet green building specifications.[89] Symbolic prestige and conditional requirements for access to finance are often drivers for achieving progressively higher sustainability standards, inspiring low-carbon alternatives in construction projects, for example not just a LEED Certification but a LEED Gold or LEED Platinum rating.[90] Likewise, BREEAM is an international provider of third-party certification of the sustainability performance of individual buildings and infrastructure projects, which incentivizes higher-performing assets by reflecting their impact on the built environment's lifecycle emissions.[91] Similarly, construction companies can use EDGE or ENERGY STAR certifications for efficiency to differentiate themselves from their competitors and position themselves as sustainability leaders.

Firms are increasingly conforming to sustainability standards, evidenced by over 32,500 commercial projects across 162 countries being LEED-certified by 2016[92] and almost 11 million square meters of BREEAM In-Use certified assets internationally as of 2017.[93] Similarly, EDGE has broadened its scope beyond new buildings to meet a growing demand for certification.[94] This trend is projected to continue, with the global sustainable construction materials market expected to grow annually by 11.6 percent in terms of value and 12 percent in terms of volume between 2017 and 2026.[95]

The construction sector is moving toward a more sustainable future, with industries along the value chain taking steps to lower their carbon footprint. However, even more needs to be done to align the sector's operations and practices with the Paris Agreement 2 degrees Celsius target. Carbon pricing can be an innovative, effective, and business-positive tool to help incentivize this.

The Business Case for Pricing Carbon

Around the world and across industries, the private sector is recognizing the relevance of and benefits from implementing an internal carbon price in their operations and cost calculations and using it as a guide for business decisions. The number of companies using an internal carbon price or planning to do so within the next two years has grown from 150 in 2014 to almost 1,400 in 2017.[96] Implementing an internal carbon price has a clear business case. It helps companies manage climate risk and carbon exposure, and reveals opportunities for climate-smart investments while acting as a transition tool to internally incentivize low-carbon activities.[97] It links a company's financial performance to its climate record, thus embedding sustainability into profitability and mainstreaming climate-smart decision making. In addition, external drivers, including regulatory compliance, corporate social responsibility, and preempting expected emission-control policies in jurisdictions of operation, are prompting the adoption of internal carbon pricing.

Carbon pricing regulations currently cover 20 percent of global greenhouse gas emissions and this coverage is expected to expand as additional jurisdictions impose prices.[98] Given the growing likelihood of becoming subject to such regulations, companies are managing their risk exposure by implementing internal carbon prices now to not be caught unprepared. Making this transition allows companies to measure the cost of the externality, internalize and assign it to their emissions, and assess the corresponding impact on their businesses.

A key hurdle remains, however, surrounding the impact on a firm's competitiveness. Companies are concerned that implementing

an internal carbon price when their competitors are not may result in a self-imposed de facto tax that prices the company out of business. While an externally imposed carbon price from policy or regulation might partially resolve this issue, companies and policy makers worry that such policies could lead to carbon leakage, in which industries move somewhere with less stringent carbon policies.

Increasingly, however, companies are coming under pressure from investors to focus on managing their climate risk and carbon exposure. Measuring this risk and integrating it into business planning is becoming a necessity, especially after the release of the recommendations of the Financial Stability Board's Taskforce on Climate-related Financial Disclosures (TCFD). Companies are voluntarily exploring the adoption of carbon pricing as a means to implement TCFD recommendations.

A report by S&P Dow Jones Indices found that low-carbon versions of the S&P 500 and S&P Global 1200 outperformed their benchmarks from 2012 to 2017.[99] In addition to risk management, carbon pricing helps companies streamline their emission reduction efforts. Internalizing costs associated with a project's emissions can affect the project's rate of return, and hence tip the scales toward a cleaner alternative in financial terms. By assigning a financial value to sustainability, a carbon price helps companies make more responsible, climate-friendly choices and changes the financial calculus that incentivizes the use of fuels from high-carbon sources.[100] If done correctly, carbon pricing encourages companies to reward energy- and carbon-efficiency and allows companies, managers, and investors to compare and value projects and businesses based on their management of climate risk.[101]

If a carbon price is applied as an internal carbon fee, the revenue generated can be funneled toward investments in sustainable, climate-smart projects as well as research and development on future sources of green revenue. The revenue can also be used as part of an internal incentive structure for business units to work toward achieving a company's overall climate and emissions targets and for encouraging innovations in low-carbon processes and products.

Approaches to Implementing an Internal Carbon Price

Companies are exploring and implementing carbon prices in ways that best suit their business models, climate goals, geography, and company cultures.[102] Although the application of internal carbon pricing varies and is tailored to each company's needs, it is generally applied in the following ways:[103]

- **Shadow Price:** By forecasting expected carbon prices and incorporating these alongside other inputs and costs into their financial models, companies can stress test projects against a range of carbon price levels. This allows them to evaluate investments, manage risks, and guide their business strategy toward a low-carbon future. Companies can model carbon pricing across their project valuations to reveal the potential impact of risks such as stranded assets, and can use the results to inform strategic decision-decision making.
- **Implicit Price:** Companies can augment their decision making, capital allocation, and assessment of economic implications for specific climate targets by applying an implicit carbon price to their financial models. This is calculated as the marginal cost of abatement for emissions from the organization, such as the cost of regulatory compliance, or as a fixed value assigned per metric ton of emissions. This would reflect the cost of carbon in a company's profit and loss statement, highlight the cost of high carbon-intensity activities, and encourage lowering the emissions intensity of a company's operations. This price can also be used to assess the investment required to meet climate targets.
- **Internal Tax, Explicit Price, or Carbon Fee:** These are applied as charges to the budgets or fees to the earnings of business units for their emissions, thus providing financial incentives that redirect cash flow toward climate goals such as investment in clean technologies. Some companies funnel the "taxes" generated from carbon-intensive facilities or units into a central pool whose purpose is to increase research and investment in clean alternatives.

These[104] and other methods are being tailored and applied to the specific requirements of each company, taking into consideration their purpose, long-term goals, regulatory restrictions, and other characteristics.

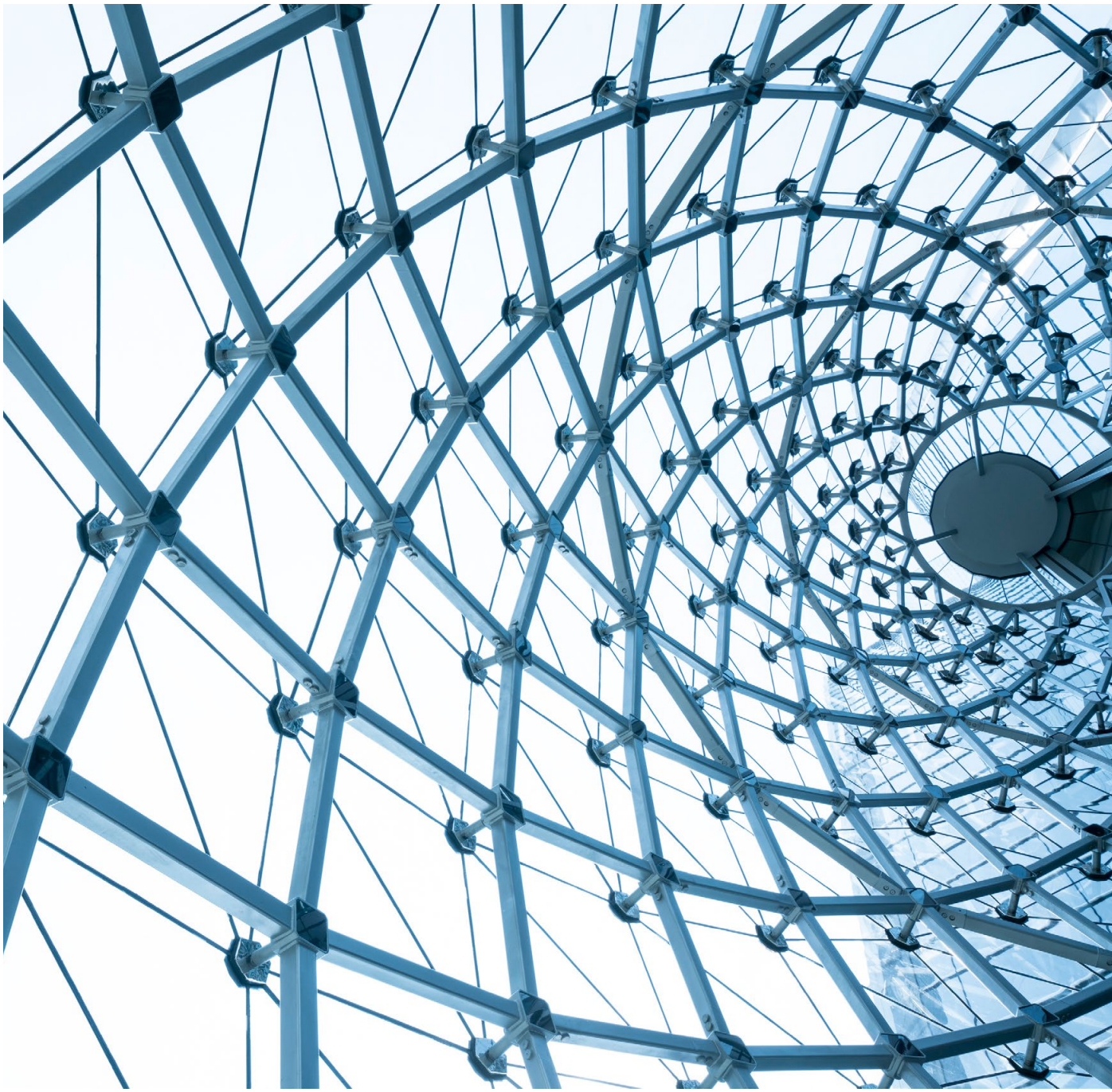
Construction Industry and Carbon Pricing

The business case for internal carbon pricing also applies to the construction industry. While companies operating along the construction value chain are subject to external carbon regulation in some jurisdictions, such as under the European Union Emissions Trading Scheme (EU ETS), many companies not subject to such policies are also recognizing the benefits of implementing an internal carbon price to manage future policy risk exposure and reduce their carbon footprint.

High-carbon-intensity sectors such as cement and steel have significant carbon cost exposure. Estimates suggest that the most carbon-intensive cement companies could face risk to their earnings before interest and tax of up to 114 percent from a minimal $10 per ton carbon price, compared to as low as 10 percent risk to more carbon-efficient cement companies from the same carbon price.[105] Moreover, since a significant part of a company's exposure to climate risk may come from its supply chain, it is increasingly important for companies to bring their suppliers into the fold and manage their Scope 3 emissions through direct and indirect engagement on carbon pricing and other tools for emissions reduction. Companies along the construction value chain are rising to the occasion, with many at various stages of the carbon price implementation process. Many such companies are engaging with each other to learn from peers' experiences about how best to operationalize such measures to maximize effectiveness.

It is important to emphasize, however, that the effectiveness of sustainability measures, including carbon pricing, is tempered by the fragmented structure of the construction industry. Relationships within the industry's supply chain are short-term, project based, and result in one-of-a-kind final products at the construction site itself.[106] This project-based fixed-term nature results in a fragmented structure and has precluded some of the consolidation and vertical linkages seen in other industries that result in cost and operational efficiencies.[107] Although buildings and infrastructure have emissions throughout their lifecycle, from construction to use, it is difficult for members of the value chain to be held accountable for total lifecycle emissions given the disconnect between the short-term nature of their contractual relationships and the long-term nature of the actual project. Actors at each stage of the value chain are not only incentivized to produce at the lowest cost regardless of carbon impact, but they are also not held accountable for the total emissions of the project or construction.

Consequently, the fragmented nature of the construction industry necessitates an integrated carbon pricing mechanism that ties together different players and sectors along the construction value chain. Without industrywide support and coordination, there is a



disconnect between the manufacture of green products and the demand and valuation for it further down the chain. Companies acting alone to develop sustainable construction practices, processes, and products are to be commended and represent great initiative, but they would be significantly more effective at helping the industry meet climate targets with support from and linkages with counterparts along the value chain, from beginning to end. There is thus a need to develop an effective, integrated carbon pricing mechanism that applies across the value chain to achieve tangible results.

Current Carbon Pricing Practices by Companies across the Construction Value Chain

Of the 1,400 companies implementing or looking to implement a carbon price before 2019, around 100 are from sectors along the construction value chain, including infrastructure, materials, construction services, and materials.[108] For this paper, twelve CPLC partner companies from sectors along the construction value chain were interviewed regarding their experiences with carbon pricing. Each of the companies surveyed is implementing carbon pricing per its own unique set of conditions, and all have faced their own challenges and successes in the process:[109]

Raw Materials & Manufactured Products

CEMEX (MEXICO)

Cemex, a manufacturer and distributor of cement and concrete, has introduced an internal carbon price of $30 per ton of carbon dioxide in its planning exercises to manage its climate risk and carbon exposure, align business strategy with climate targets, and identify opportunities for emissions reductions. Cemex sees both risk and significant opportunity in cap and trade schemes, with the expected carbon price driving the use of multiple tactics such as improvements to energy efficiency, switch to clean fuels, and the substitution of materials.[110] The carbon price is not a shadow price applied to all investment decisions, but rather, a risk management tool in business planning to give the company a better idea of its exposure to carbon risk.

While Cemex's current carbon pricing structure covers only its Scope 1 emissions, the company has put into place other measures and initiatives to reduce its Scope 2 emissions, including incentives to improve energy efficiency and increase the use of renewable energy. The company is engaging with its suppliers to manage its Scope 3 emissions by

asking them to follow a Sustainability Code at the country level. Despite the difficulty of measuring them accurately, Cemex uses the guidelines developed by the Cement Sustainability Initiative for effectively monitoring Scope 3 emissions to measure and report these to CDP.

Cemex has been following legislative proposals and advocating for a regulatory carbon price to be applied to cement companies and projects worldwide. It anticipates the strengthening of carbon policies across the world, particularly with emerging legislation in Latin America and other regions. While risk mitigation is done at a local level, Cemex is engaging with the issue of carbon pricing globally through its participation in organizations such as the CPLC.

DALMIA BHARAT CEMENT (INDIA)

Dalmia Cement has a production capacity of 25 million tonnes across 12 locations in India. In 2018, the group has been rated the best performer on low carbon transition readiness by CDP.[111] The company uses four key approaches to reduce its carbon footprint and climate risk exposure, in addition to regularly monitoring progressive targets. These include: the use of industrial waste as an alternative raw material for clinker substitution; electrical energy efficiency; thermal efficiency, and; the use of incinerable waste as an alternative fuel for its cement kilns. The company is keen to develop long term partnerships for research on technologies for Carbon Capture and Utilization.

Carbon pricing has been a key tenet of Dalmia Cement's strategy for thermal and electrical energy efficiency improvements. Its operations in India are subject to the government's implicit carbon pricing policies including the Perform Achieve and Trade scheme for the trading of energy efficiency certificates in high energy-use sectors,[112] and a Renewable Energy Purchase Obligation.[113] These implicit mechanisms, coupled with Dalmia Cement's membership of the CPLC, encouraged the company to announce an explicit shadow internal carbon price in 2015. The shadow price is applied on a project-by-project basis on low-return projects with a long payback period. The carbon price was piloted on a 9.2 MW waste-heat recovery plant, earlier considered financially unviable as the company had economical access to energy from its captive coal power plant. The application of a shadow price made the waste-heat recovery plant viable, and it was approved with significant support from the company's senior management and commissioned in 2018. The internal carbon price has paved the way for the company to develop two more waste-heat recovery plants and manufacture a new line of low-carbon cement.

Although carbon pricing is currently applied only to the subset of projects described above, the ultimate goal is to extend it to every project. The current price level of $11 per ton of carbon dioxide2, was calculated using scenario analysis that took into account expected future opportunities in carbon abatement. Reevaluating and increasing this price level is contingent on a favorable future policy environment that encourages a low carbon transition.

An estimated 90 percent of the company's raw material comes from captive mines, and Dalmia Cement uses guidelines developed in collaboration with the CSI to engage with its supply chain on sustainability. The construction industry in India comprises both the organized and unorganized sector, and Dalmia Cement is conducting awareness campaigns on climate impacts for its suppliers. They consider this sensitization as the first step towards introducing carbon pricing to the value chain.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LAFARGEHOLCIM (FRANCE/SWITZERLAND)

A leading manufacturer of building materials operating across 80 countries globally, LafargeHolcim's climate ambition is defined in its sustainable development program, of which climate is a key component. The company seeks to reduce its carbon emissions by 40 percent compared to 1990 levels and continue to be the most efficient and least carbon-intensive cement manufacturer. It also seeks to help prevent the release of up to 10 million tons of lifecycle carbon dioxide emissions from buildings and infrastructure annually through the use of its low-carbon products and solutions.

The company recognizes that it faces significant climate risk and carbon exposure as a global manufacturing business and identifies increased carbon pricing policies as one of the main risks for its business.[114] As such, LafargeHolcim is engaging with governments to advocate for consistent, fair, effective, and level-playing field regulations while internally preparing for future carbon pricing costs as economic pressure points.[115] To do so, it applies a carbon price of $31.19 per ton of carbon dioxide[116] in its operations as per the requirements of the regulatory carbon price in the jurisdiction of operations. The company does not apply a carbon price uniformly across all jurisdictions, but only in those where an external carbon price already exists or where it sees a future carbon price on the climate policy agenda. The carbon price is used to generate an integrated profit and loss statement, which simulates the impact of the company on a triple bottom line of people, profit, and planet. Further, instead of a blanket carbon price, LafargeHolcim is developing a new

internal carbon pricing tool to ensure the systematic accounting of carbon impact across a variety of scenarios for each project. The value of this tool is in the assessment of different levels of carbon pricing for each project, with carbon pricing acting as a variable tool for the evaluation of carbon exposure.

In addition, LafargeHolcim has significantly invested in developing several low-carbon products, including low-carbon clinker, cement, concrete, and binder technology, and is exploring opportunities in carbon sequestration. For example, the company has partnered with Solidia Technologies to develop a low-carbon cement and concrete technology that allows concrete to harden while sequestering carbon dioxide, which replaces water as a binder, thus capturing and reducing emissions by up to 70 percent in some cases. The company is also innovating new products that help reduce lifecycle emissions in buildings, such as Airium, a mineral foam insulating technology, and Ductal, an ultra high performance concrete.

RUSAL (RUSSIA)

As one of the largest aluminum companies in the world, sustainable development is a key part of Rusal's business strategy, which places significant emphasis on innovation, modernization, and improved environmental performance. Rusal is actively assessing its own climate risk and carbon exposure as well as the opportunities for sustainable products and low-carbon alternatives presented by climate change. The company is exploring the role of aluminum in helping sectors such as construction and transportation improve their own energy efficiency and performance.

Rusal has been implementing an internal carbon price, set at $20 per ton, as a mechanism to influence the decision-making process for investment in projects. This internal carbon price is applied to a new project's financial models to assess its exposure to carbon risk, including from potential carbon pricing policies. If the internalization of this carbon cost makes a project unprofitable, Rusal intends to either find a low-carbon alternative that makes the project profitable or reject it altogether. The carbon price is also used as a tool in the company's overall financial modeling to evaluate strategic decisions such as expansion, acquisitions, new buildings, decommissioning, and divestments. The company's operations within Europe are subject to the EU ETS, but it applies a price of $20, higher than what the EU ETS mandates. In addition, some of the company's new projects in Russia and abroad are also voluntarily implementing an internal carbon price. Rusal is also implementing the Aluminium Stewardship Initiative (ASI) Standard and ASI Chain of Custody Standard, to be independently audited and certified. The company recently developed and began applying a Business Partner Code for its suppliers to engage with them on sustainability.

The company has also developed a low-carbon aluminum product known as ALLOW, which uses clean hydroelectricity to deliver aluminum with a lower carbon emissions footprint, at less than one-third of the global average for aluminum production.[117] The company provides a low-carbon guarantee for the product, assuring customers that ALLOW's carbon footprint is less than four tons of carbon dioxide equivalent per ton of aluminum, accounting for all Scope 1 and 2 emissions from the smelter process. Despite the higher production costs associated with ALLOW, Rusal has seen customer interest in the product since introducing it to the market.

SAINT-GOBAIN (FRANCE)

Saint-Gobain manufactures and distributes building materials to create living spaces that combine comfort and sustainability. Its products include glass, insulation, and plasterboard that help improve energy efficiency in existing and new buildings, and the company develop lightweight solutions for construction with reduced carbon content.

Following its 2014 Energy, Atmospheric Emissions and Climate Change Policy, Saint-Gobain implemented carbon pricing in its operations in 2016 in all 68 countries where the company has a presence, many of which do not have carbon pricing requirements. Saint-Gobain's approach has been to adopt two parallel carbon prices, applicable to its Scope 1 and 2 emissions for investments, and Scope 1, 2, and 3 emissions for research and development projects. The first is for capital expenditure projects and energy-related investments to incentivize investment in energy efficiency equipment and manage the risk from a potential scenario where the company might face carbon pricing mechanisms other than the EU ETS, which would lead to higher operational costs.[118] The second, much higher carbon price is applicable to research and development projects, in a move to incentivize innovation in low-carbon products, processes, and technologies. Projects are structured so that their payback accounts for the carbon price, which has a significant impact on the projects with the higher research and development carbon price. The company is still receiving feedback on this initiative and will evaluate it to tailor and evolve the pricing structures as required.

SIEMENS (GERMANY)

Industrial manufacturer Siemens has an internal goal to halve the carbon footprint of its business operations by 2020 and be climate neutral by 2030, with all production facilities and buildings worldwide expected to achieve net-zero carbon footprints by then. The company has identified four pillars to achieve these goals: energy efficiency, decentralized energy systems, intelligent e-mobility solutions, and the purchase of electricity from renewable energy sources. These pillars are applicable across its operations, including for the production of construction materials, equipment, and concrete solutions. Siemens is bringing its supply chain into the fold, having developed its Code of Conduct for Siemens Suppliers and third-party intermediaries.

Although Siemens is not yet applying an internal carbon price across its operations, it has developed a framework and begun activities toward this end. In addition, although there is not yet an active price signal throughout the company to achieve its goal of carbon neutrality, some activities covered by the four pillars named above come with a price premium, such as buying clean but more expensive renewable energy, which is accepted as an implicit cost for carbon reduction.

Siemens is considering a shadow price for its suppliers as part of its dialogue and engagement with its supply chain, which might be applied to the purchasing volume from each supplier based on their geographic location and regulatory jurisdiction.

Construction Services

ELLISDON (CANADA)

As a construction project management company with few emissions from its operations, EllisDon does not have an internal carbon price, but it is working with governments, companies, and coalitions such as the CPLC to advance the carbon pricing agenda. It views regulations such as the goal for all new homes in Ottawa to be net zero carbon by 2030 as indication that the construction industry is moving toward carbon neutrality, with carbon pricing as an important tool to aid in the transition.

EllisDon is developing a Carbon Accounting Tool to track emissions throughout the lifecycle of new building as well as retrofitting projects, from design to operation. This tool will be part of the process of transforming the market without pushing it to stall during the transition to carbon neutrality by incentivizing low-carbon alternatives through the valuation of emissions.

MOTT MACDONALD (UK)

Mott MacDonald, a global engineering, management, and development consultancy, is working with its clients to dispel myths surrounding carbon management while identifying it as a key focus area in the earliest stages of a project to drive down capital and operational costs. Together with its partners, in 2016 Mott MacDonald coauthored PAS 2080, the world's first carbon management standard for infrastructure. A voluntary standard, PAS 2080 offers a suite of tools and methodologies to businesses in the construction sector, who can adopt it in the manner that works best for them from a sustainability and competitiveness point of view. While attaining accreditation might be difficult, PAS 2080 provides guidance for businesses seeking to implement low-carbon solutions.

Beyond the cost implications of potential carbon risk exposure, Mott MacDonald's clients are recognizing the financial and reputational benefits of sustainable operations and decision making. Already the picture has changed, with climate, resilience, and carbon-oriented due diligence seeing an upswing for projects—beyond simply meeting performance standards. In addition, the release of the TCFD recommendations has especially urged larger companies, with longer-term planning such as five-year-plan reports, to go beyond existing regulations and prepare for a carbon-averse future. Companies are increasingly engaging with their value chains along these lines, with low-carbon and sustainability clauses written into contracts and procurement processes.

Mott MacDonald is helping its clients with a low-carbon transition and sees a significant scope for improvement and action ahead. While Scope 3 emissions are beginning to be considered all along the value chain, they are still largely unmanaged because of the complexities of measuring the impact from a company's value chain, both upstream and downstream. Appropriate tools to measure and manage these emissions need to be developed. Construction companies, developers, and projects are taking lifecycle cost considerations more seriously, but this is slower in those areas or projects where the builder or client is not the operator. Whereas the

company has observed that its clients and the market recognize the complexity of the climate issue and worry about reputational and other impacts, there is still a lack of clarity on what needs to be done and how to do it. The TCFD's recommendation for scenario analysis has begun to create some direction, but there is still a lack of understand regarding what it means in practice.

The company advocates carbon pricing as an effective tool for providing the clarity and transparency that the construction industry needs, especially for investors and insurers. It considers carbon pricing to be the approach that will push the construction industry toward zero carbon. Mott MacDonald believes that a shift in decision making across the value chain will require effective carbon pricing that reflects the social cost of carbon. The company will work with TCFD and other reporting initiatives to create greater transparency for investors, insurers, and other actors on carbon exposure and risk.

Project Developers & Construction Equipment

ACCIONA (SPAIN)

Acciona, an infrastructure and renewable energy project developer and manager, has been carbon neutral in Scope 1 and 2 emissions since 2016 and intends to continue reducing its emissions in accordance with science-based targets. The company established a Sustainability Committee in 2009 and launched a new Sustainability Master Plan in 2016 that will guide its strategy until 2020. It has been implementing a carbon price since 2008 and considers it to be an essential tool for decarbonizing its business. Acciona has been subject to the EU ETS since 2009.

In 2015, Acciona established an additional internal shadow price for new and future investments to assess and mitigate its climate risk and carbon exposure. Acciona considers unaccounted negative externality costs from greenhouse gas emissions to be a market failure, and the company expects the carbon price to correct this. Thus, the latest shadow price is integral to the company's risk mitigation strategy going forward.

Acciona established an internal offset price in 2016, that ensured compliance with the company's carbon neutrality objective. Since then, the company has compensated its annual non-avoided GHG emissions through the acquisition of UNFCCC certified emission reductions resulting from the development of social and environmentally responsible projects in emerging economies.

The company's carbon neutrality commitment as well as its internal carbon price initiatives are enabling it to raise internal awareness and introduce measures including: incremental emission reduction targets aligned with the Science Based Targets framework, sourcing 100 percent of its electricity supply from renewable energy sources in its energy business division, and additional investments in social and environmentally responsible projects fostering low carbon innovation.

GROUPE ADP (FRANCE)

With an aim to achieve carbon neutrality by 2030, French airport infrastructure developer, owner, and operator Groupe ADP launched an internal carbon price in early 2017 that it implemented as a shadow price on the operation of three Paris airports to encourage low-carbon decision making and operational efficiency. This internalization of carbon cost has been part of an effort to anticipate the risks and consequences of the trend of tightening carbon policies, which the company expects will continue. The company is employing a strategy that started with a price of $23 per ton of carbon dioxide in 2017,[119] intended to familiarize and comfort investors, with the implicit assumption that this price level will likely evolve over time. Although initially the carbon price was applicable only to projects worth over 3 million euros, it now applies to the operations of all projects with any energy impact as of March 2018. Until now, the focus of Groupe ADP's carbon price has been on energy efficiency in its infrastructure project operations; however, there is an ongoing internal discussion on whether an internal carbon price might also be applicable to the actual

construction of its projects and, if so, how it might be best implemented.

Groupe ADP is managing its Scope 1 and 2 emissions by purchasing energy from Engie, which has been committed since 2016 to ensuring that 60 percent of its electricity comes from renewable sources.

MAHINDRA & MAHINDRA (INDIA)

The Mahindra Group has implemented a hybrid form of carbon pricing, with both shadow and explicit pricing, in its automobile activities and is studying how this might be replicated in its construction activities. The Mahindra Group considers carbon pricing to be a useful tool to evaluate the exposure of its projects and investments to transition risk as well as incentivize innovations in low-carbon alternatives to meet the company's broader sustainability goals. Its current carbon price has been determined as an abatement cost for greenhouse gas emissions that would have a material impact on decision making. The price has been arrived at by considering the group's current energy efficiency and sustainability commitments as well as exposure to potential climate policies.

Although its construction activities are not subjected to a carbon price as yet, a price premium is already embedded through energy efficiency and other sustainability measures. Learning from its experiences with applying carbon pricing to its other operations, the Mahindra Group is priming its construction activities for the same by engaging with its supply chain on sustainability within a broader context. Suppliers and contractors are given training through workshops that aim to build their capabilities and help them understand the business case for environmentally responsible decision making, including through measuring and disclosing their own carbon footprints. The company is a founding member of the Sustainable Housing Leadership Consortium and applies several other initiatives to embed sustainability within its construction and real estate projects, such as building resilient, energy-efficient Smart Cities.

TATA GROUP (INDIA)

The Tata Group has a corporationwide code of conduct that covers sustainability and is applicable to Tata Group companies, and all their suppliers as well. The code, which is qualitative in nature, contains language surrounding Environmental, Social and Governance criteria. From 2008 to 2015, the Tata Group held an internal carbon footprint reduction exercise. This was followed by the creation of an internal task force on carbon pricing, made up of regulators, C-suite executives, and those with experience aligning the Tata Group's operations with the EU ETS for their European steel manufacturing.

Tata Group has a federalist structure, so it allows each company in the group considerable autonomy on whether and how to apply carbon pricing to their operations to help achieve their carbon reduction and abatement targets. The Tata Sustainability Group has created and disseminated internal guidance on carbon pricing for the entire Tata Group that is valid till 2020, after which the price and

structure will be reevaluated for adoption if and as each individual company sees fit.

Of significant relevance to the construction value chain is the adoption of carbon pricing by Tata Steel, currently priced at $15 per ton. This price was calculated by estimating the required investment needed to achieve its internal emissions targets within a specific time frame while still remaining competitive. Tata Steel evaluates its investments and projects based on two levels of internal rate of return, one with and one without carbon adjustment. Those projects that meet the internal hurdle rates for both are passed immediately. Those that have a low-carbon-adjusted internal rate of return are judged on a case-by-case basis at the board level.

The Tata Group's approach to sustainability, however, takes a broader view than only carbon pricing, and the group is attempting to educate its clients about a value-in-use concept. The group operates under the philosophy that sustainable products and their use can be justified and marketed on normal business and economic grounds through, for example, arguments for lower fuel consumption, better lifetime mileage, greater strength, and longer lifespan of the products. In the group's experience, its clients are willing to pay a higher premium for such qualities, and greater sustainability is thus embedded within rather than separate from business decisions, strategy, and product choices.

Common Considerations across Companies

Companies across all sectors of the construction value chain have had some common experiences and questions arising from their experiences of implementing carbon pricing, despite the differences in their approaches and the fragmented nature of the industry. These are broadly grouped in two, sometimes-overlapping, areas of concern. The first, covering carbon pricing as a regulation that is externally imposed, and the second surrounding the obstacles faced when implementing a voluntary internal carbon price.

The challenges faced by companies in the construction value chain differ by **geography and jurisdiction.** The variance in the degree of strictness of carbon policies across jurisdictions has a material impact on methods and measurement. Even in areas without carbon pricing mandated by regulation or policy, the success that a company has in implementing an internal carbon price varies by location. This is because jurisdictions have more or less organized supply chains, different levels of maturity in their markets of operation, varying access to new technologies and less carbon-intensive resources, and ranging degrees of consumer awareness. As a result, the same methods and approaches that are effective for a company in some of its business units might not be as successful in others. Similarly, what works for a company in one part of the value chain in the same jurisdiction will not be equally applicable for a company operating at another stage of the process.

Achieving sustainability goals through carbon pricing will only work if companies are able to remain **competitive.** Carbon leakage is a significant concern, with companies reluctant to operate in jurisdictions with high carbon pricing regulations, and potentially moving their operations to regions without such regulations that eat into profits. Similarly, companies also hesitate to voluntarily implement high internal carbon prices that could price themselves out of the market, resulting in the application of internal carbon prices that are too low to have material impact on decision making. The incentive for companies to implement an internal carbon price depends on its impact on business. Although carbon pricing has been acknowledged as an effective risk management tool, the costs begin to outweigh the benefits in areas with small margins and high price sensitivity.

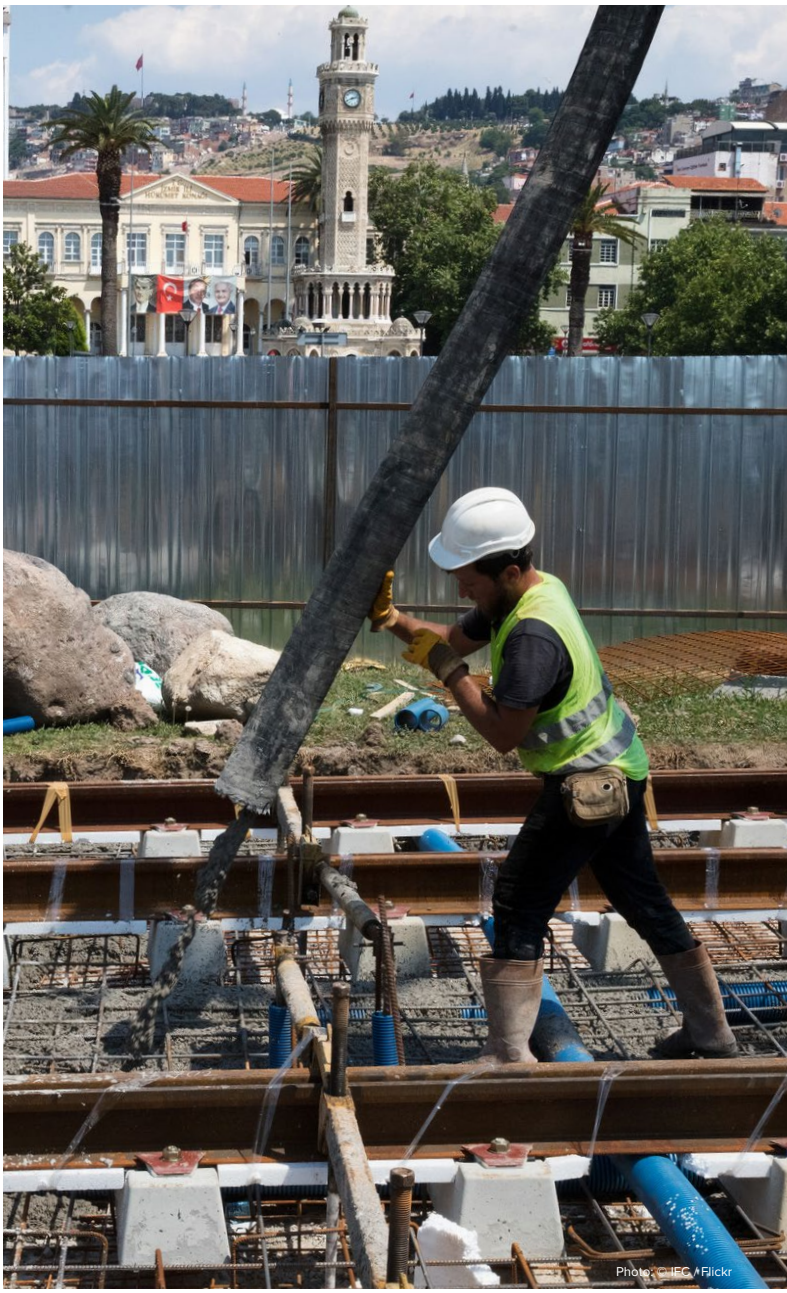
In a similar vein, although companies are using carbon pricing as an internal risk mitigation tool, they would prefer the universal application of an external regulatory carbon price across their industries. Consistent, predictable, and fair regulation that is applicable to all firms operating in the sector or jurisdiction, would **create a level playing field,** and address some of the concerns about competitiveness.

While these companies are at various stages of implementing an internal carbon price, almost all of them identified the need for assistance in **managing their Scope 3 emissions** and engaging in structured and effective ways with their supply chains. Measuring, monitoring, and evaluating Scope 3 emissions were identified as common challenges across the companies and will be an essential next step toward decarbonization. Targets and levels for judging contractors will need to be developed, as well as supplier codes of conduct that can be quantitatively evaluated. In addition, the companies identified the need for **standardized and comparable frameworks for scenario analysis** as well as for rating suppliers by their low-carbon credentials.

For early movers, one of the biggest challenges faced by the proponents of carbon pricing has been the "socialization" of the concept among the finance and business executives. However, the Paris Agreement, the successful application of carbon pricing policies across several national and subnational jurisdictions, and, most recently, the release of the TCFD recommendations have all helped bring about a **change in culture.** The private sector is now aware and accepting of the business case for carbon pricing and is increasingly enthusiastic about mainstreaming it as a tool for risk management.

The biggest missing link for companies is the lack of a clear idea about how to operationalize and standardize the implementation of an internal carbon price. Businesses are interested in **learning from the experiences of other companies,** both from within their sector and across the construction value chain, of implementing and institutionalizing carbon pricing. This includes lessons in integrating carbon pricing into business models as well as in communicating the benefits of carbon pricing to stakeholders and investors concerned about competitiveness.

Finally, the companies surveyed unanimously advocated for the construction value chain to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come together and develop an **integrated carbon pricing mechanism** that could be applied along the value chain to cover lifecycle emissions from construction projects. The companies also acknowledged the need for a strong and holistic climate-policy approach. While carbon pricing provides a policy push, market-led sustainability initiatives must be incentivized by creating conducive policy and business environments, such as through procurement standards.

The Role of the Carbon Pricing Leadership Coalition

Collaboration between companies along the construction value chain is essential for helping the industry meet its sustainability goals and support low-carbon, high-resilience transformation. An analysis by the Boston Consulting Group and World Economic Forum found that companies in the highly fragmented construction industry rely on a "seamless interplay of all participants along the value chain and throughout a project's life cycle,"[120] belying the need for greater cooperation and coordination along the value chain to enhance productivity and achieve common goals such as reducing their collective carbon footprint.

Despite a traditionally fragmented structure comprising different sectors with strong players, the construction industry has recently seen a number of large, consolidating mergers and acquisitions because of a strong global economy and housing market.[121] Analysis by PWC suggests that this trend is driven by the increasing size and complexity of construction projects, which create a premium for technical expertise and capacity, resulting in higher average transaction values that incentivize industry players to continue to seek value and win such contracts.[122] This is a clear indication that companies are coming together in the industry, be it through mergers or by collaborating in forums such as the CPLC to achieve their climate objectives. Given that climate change poses a risk globally and across all sectors, there is a need to bring together the entire construction industry value chain to collaborate on issues of sustainability, decarbonization, and carbon pricing.

Through the CPLC, companies are collaborating on sector-specific approaches to carbon pricing, including in the construction, banking, and maritime industries. These efforts are supported by developing targeted knowledge products, including guidance to assist companies with implementing and institutionalizing best practices and webinars for companies to share their experiences on carbon pricing.

In a recent webinar, as part of a series on internal carbon pricing hosted by the CPLC and Yale University, it was observed by presenters from Unilever that one company's Scope 3 emissions are another company's Scope 1. That is, if at every stage along the construction value chain, every company manages its direct Scope 1 and 2 emissions, the added complexity of measuring and mitigating indirect Scope 3 emissions is greatly reduced. Doing so makes the industry's collaborative effort to decarbonize itself significantly more effective.

The CPLC is well placed to help companies along the construction value chain address some of the key concerns identified. It has convened a Construction Value Chain Task Team, comprising of companies from various

sectors in the industry as well as relevant strategic partner organizations to help shape the agenda of carbon pricing along the value chain. This includes an effort to develop an integrated approach to applying carbon pricing and assess its impact on decision-making processes across the value chain through a lifecycle analysis of a variety of construction projects.

As a coalition that includes members from business, government, and civil society, it is uniquely positioned to convene organizations representing all stakeholder interests. The CPLC facilitates companies' sharing of experiences and best practices for operationalizing internal carbon pricing with others that are looking to learn and apply these lessons to their own efforts. It also provides a forum for private companies to engage with governments to ensure the development of well-designed carbon pricing policies to help create a level playing field.

As part of this function, the CPLC is supporting the launch of a High-Level Commission on Carbon Pricing and Competitiveness, which will be a platform to discuss the concerns voiced by companies on the implications for their competitiveness if they stand alone in implementing an internal carbon price (therein effectively taxing themselves). The Commission will comprise global business and thought leaders and be supported by an expert Advisory Group. The work will involve wide consultation with industries on the impact of carbon pricing on their competitiveness and will help to demystify the issue through an evidence based approach.

Finally, the CPLC provides a forum for private companies to engage with governments to ensure the development of well-designed carbon pricing policies to help create a level playing field.

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