Seizing the decarbonization opportunity in construction

As decarbonization initiatives gain momentum, construction players can benefit—but only if they view ESG as a strategic opportunity.

Jose Luis Blanco
Partner, Philadelphia
McKinsey & Company

Hauke Engel
Partner, Frankfurt
McKinsey & Company

Focko Imhorst
Associate partner, London
McKinsey & Company

Maria João Ribeirinho
Partner, Lisbon, Madrid
McKinsey & Company

Erik Sjödin
Partner, Stockholm
McKinsey & Company

As one of the world's biggest economic ecosystems, the construction industry has a major part to play in achieving global sustainability goals. Following the COVID-19 outbreak, we asked 100 senior construction executives what industry trends they expected to accelerate after the pandemic—and 53 percent cited sustainability. Furthermore, 10 percent of respondents said they had already increased investments in sustainability measures since the start of the crisis.[1]

Today's decisions will have a significant effect on the buildings segment in particular. With investors and capital markets increasingly prioritizing environmental, social, and governance (ESG) measures, more and cheaper capital is available for sustainable players—which we expect to be one driver of a rapid increase in demand for ESG-friendly buildings. In fact, the smart-buildings segment is expected to grow at a CAGR of 10 to 13 percent by 2025. Meanwhile, regulators in more than 50 countries have already established or are planning a form of carbon taxation.

This article explores construction's impact on greenhouse gas (GHG) emissions in the context of buildings, examining how the industry can decarbonize both existing projects and new builds.[2] It also illustrates how companies in the sector can benefit from approaching ESG as a strategic opportunity versus the traditional view that it is simply a cost that is hard to pass on to other players in the value chain (for example, tenants or developers).

Construction's impact on the environment

ESG factors are the key measures of sustainability and societal impact in construction. The environmental component addresses aspects ranging from air quality and energy management to a project's impact on biodiversity, waste, and water management. On this point, construction is directly or indirectly responsible for almost 40 percent of global CO_2 emissions from fuel consumption and 25 percent of GHG emissions overall.

GHG emissions from the construction ecosystem are mainly driven by two components: raw-materials processing for buildings and infrastructure (about 30 percent of total construction emissions per year, largely cement and steel) and buildings operations (about 70 percent). Given the lengthy life cycle of the average building, pre-2020 construction will account for 80 percent of the world's building stock by 2050. Therefore, it will be crucial over the coming years not only to decarbonize new buildings but also to retrofit existing stock to be more sustainable.

Specific retrofit decarbonization initiatives can be cost-effective

Taking a closer look at emissions from the operation of existing buildings, two factors are important: the energy efficiency of the building (thermal insulation and heating-control systems) and the energy source used for heating (such as using renewable electricity to drive heat pumps versus gas boilers). The latter is the priority for emission reduction; in the European Union, it's estimated that switching to renewable technologies in heating will account for 72 percent of emission reductions, supporting the pathway to net-zero emissions.[3]

This assessment shows that it is possible to reach net-zero emissions for operating buildings at an average cost of €5 per ton of CO_2, contributing substantially to the overall net-zero pathway that can be achieved at net-zero cost by 2050 in Europe. Given that the average building emits two tons of CO_2 per year, the average annual cost increase would be only €10 per dwelling per building per year—an increase to the average energy bill of approximately 1 percent.

Meanwhile, increased levels of insulation could still contribute around 20 percent of overall emissions

[1] See Timmy Andersson, Jonas Biörck, Jose Luis Blanco, Jan Mischke, Rob Palter, Maria João Ribeirinho, David Rockhill, Erik Sjödin, and Gernot Strube, "The next normal in construction: How disruption is reshaping the world's largest ecosystem," June 4, 2020, McKinsey.com.

[2] For more on future-proofing infrastructure, see our recent "2021 GII Summit: Project of the future." Of particular relevance are the sections on "Best ideas from the summit" and our "Sector roundtables," specifically around engineering, construction, and building materials, globalinfrastructureinitiative.com.

[3] For more, see Paolo D'Aprile, Hauke Engel, Godart van Gendt, Stefan Helmcke, Solveigh Hieronimus, Tomas Nauclér, Dickon Pinner, Daan Walter, and Maaike Witteveen, *How the European Union could achieve net-zero emissions at net-zero cost*, December 3, 2020, McKinsey.com.

reductions by improving energy efficiency and thus reducing demand—as well as compounding the positive effects of renewable heating sources. Thus, the most significant shifts in EU heating systems include moving 40 percent of residential and commercial buildings to heat pumps by 2050 (versus 2 percent now), 33 percent to district heating (versus 12 percent now), 15 percent to biogas or hydrogen boilers (versus 0 percent now), and 10 percent to solar thermal as an add-on technology (versus 2 percent now).

Reducing the emissions impact of new builds

New building construction is responsible for more than 2.5 gigatons of CO_2e globally (5 percent of total GHG emissions). Concrete and steel processing represents the largest share (60 percent) of embodied carbon because of the large quantities of each material incorporated in a typical structure and their energy-intensive production processes.[4]

Reducing emissions for new builds requires a different approach than that of decarbonizing building operations. Regulations for new builds are currently tightening, requiring higher levels of insulation: for example, new buildings in the European Union are now subject to the Energy Performance of Buildings Directive. With this in mind, the decarbonization of materials can be achieved through a combination of several measures:

— lowering demand for primary resources through design and process optimization (including reduced waste, improved building footprints, and limited overspecifications), and by increasing closed-loop circularity for materials and components (including increased usage of scrap material and reduced recycling-yield losses)

— shifting commonly used materials and equipment to alternatives that are more energy efficient, including substitution with low-carbon materials, higher-performing materials, and electrification of heavy equipment

— reducing emissions during production of required materials, including increased production efficiencies, electrification of processing equipment, and technology advancements

— using generative design to create outcome-based designs that help frame and clarify how different materials and design choices can lower GHG emissions

— pushing toward productization of projects, modularization, and off-site construction to reduce the overall footprint of the construction process

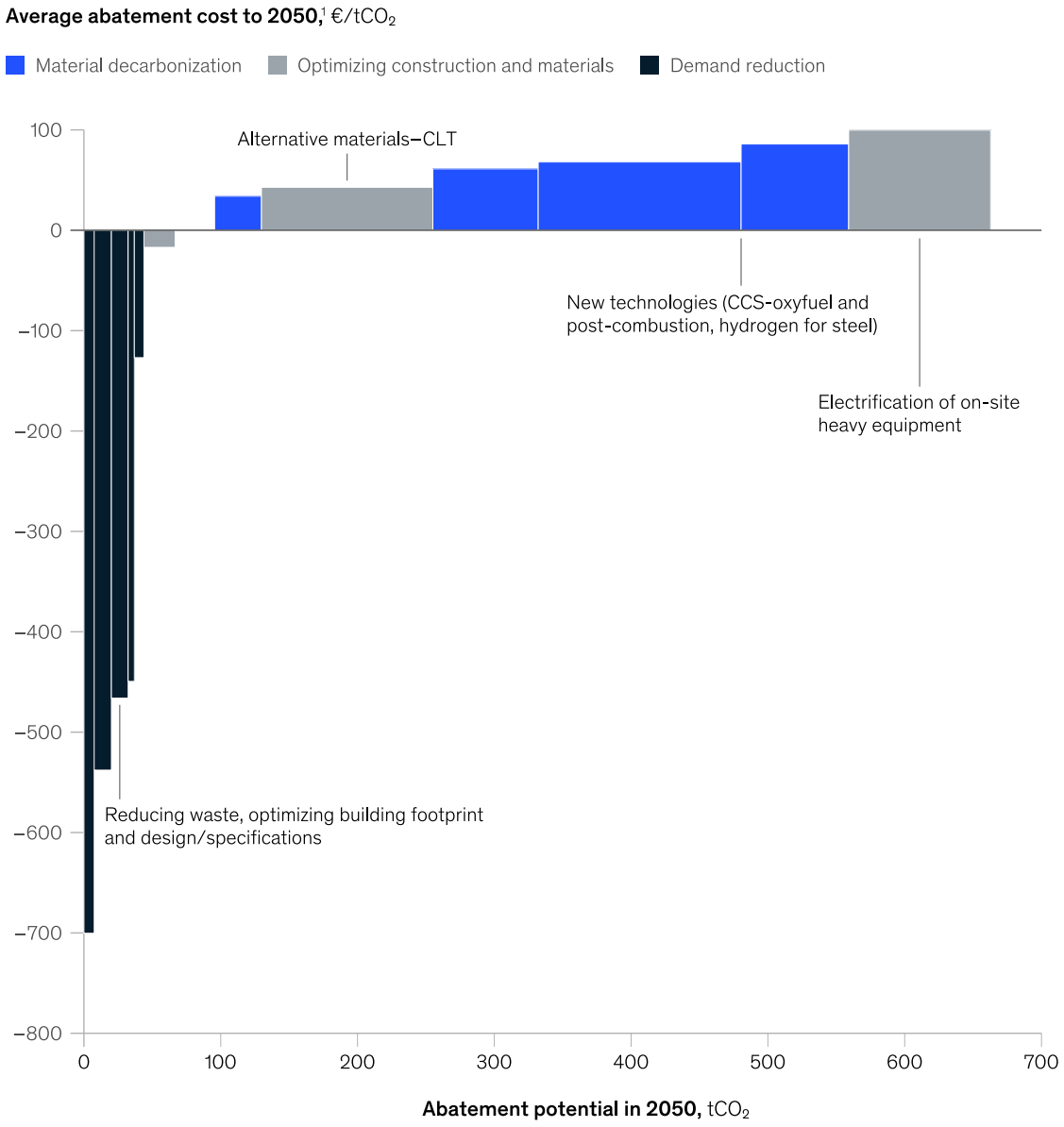
We modeled a potential abatement pathway for materials and construction processes, taking as an example a European residential building (five stories, 500-square-meter footprint), to assess the optimal combination of the principal measures (exhibit). This model was based on input from our global pool of sector experts and the latest scientific literature.

The pathway toward zero-carbon buildings at zero cost increase may require rethinking basic principles and combining existing and alternative materials. The optimal mix of these will vary for different buildings and locations. Analysis for the building referenced in the exhibit (mainly based around well-known and more established levers) suggests that most abatement potential comes from reducing upstream emissions in the material-production process (45 percent) and shifting to alternative materials and equipment (40 percent). A relatively small abatement potential comes from lowering demand, including primary resources (a

[4] For more on embodied carbon, see Lynelle Cameron, "Data to the rescue: Embodied carbon in buildings and the urgency of now," *Voices on Infrastructure: The project of the future*, September 2020, globalinfrastructureinitiative.com.

Exhibit

The decarbonization pathway may require a rethink of basic principles and a combination of existing and alternative materials.



Note: The horizontal axis shows the abatement potential of the technology switches. The vertical axis displays the average abatement cost as €/tCO_2 for each switch.

[1]The mentioned costs are aggregated for the eventual technology; the switches originate from multiple other technologies; relatively low reduction from district heating due to relatively high baseline (compared to heat pumps) and high amount of switches from gas boiler to district heating.

Source: Decarbonization Pathway Optimizer

total of 15 percent). Thus, the pathway suggests that a significant share of these measures would bring cost savings to the industry.

No single player in the ecosystem can tackle emissions alone. The construction ecosystem is highly fragmented, with many steps along the building life cycle. Although each player in this highly complex ecosystem can make a difference and capture opportunities, collaborative efforts among various stakeholders are likely to yield the best results. Ultimately, this means that, depending on the asset type, each stakeholder has unique opportunities to make an impact on emissions at multiple stages of the life cycle.

A longer version of this article, "Call for action: Seizing the decarbonization opportunity in construction," can be read on McKinsey.com.

Jose Luis Blanco is a partner in McKinsey's Philadelphia office, **Hauke Engel** is a partner in the Frankfurt office, **Focko Imhorst** is an associate partner in the London office, **Maria João Ribeirinho** is a partner in the Madrid office, and **Erik Sjödin** is a partner in the Stockholm office.

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