

# TOWARD CARBON-FREE CONSTRUCTION

JOSEPH NATARELLI AND ANIRBAN BASU

In late 2023, leaders from around the world met at the 28<sup>th</sup> meeting of the Conference of the Parties to the United Nations Framework Convention on Climate Change, also known simply as COP28. At the gathering, the president of the COP28, Sultan Al Jaber of the United Arab Emirates (UAE), got the festivities started by suggesting that there is “no science” indicating that a phase-out of fossil fuels is required to restrict global temperature increase to 1.5 degrees Celsius or 2.7 degrees Fahrenheit.<sup>1</sup>

As one would suspect, many delegates disagreed. As reported by *The Guardian*, more than 100 nations already support the phasing out of fossil-fuel usage.<sup>2</sup> Ultimately, the agreement attained at conference end and published by the United Nations signals “the beginning of the end” of the fossil-fuel era by laying the “ground for a swift, just and equitable transition, underpinned by deep emissions cuts and scaled-up finance.”<sup>3</sup>

As with many social issues, there exists an underlying tension between the achievement of broad societal goals and perceived individual eco-

nomical well-being. For nations specializing in oil production, the shift away from fossil fuels is something approaching an existential threat to their nations’ livelihoods. According to the U.S. Energy Information Administration’s International Energy Statistics database, the UAE was the seventh-largest total liquid fuels producer in 2022 in the world.<sup>4</sup> Among OPEC members, it ranked third largest.

For U.S. citizens, the shift away from fossil fuels also represents a source of inconvenience and added costs for many households. Most U.S. citizens enjoy the flexibility and associated range of their gasoline-powered V-6s and V-8s. They like their gas stoves, their propane grills, and the soothing rumble of their lawnmowers. Shifting to electrification would require abandoning many of the appliances and vehicles to which many U.S. citizens have become accustomed. The transition to their new way of life would also be expensive.

Still, for many onlookers, the world is engaged in a race regardless of how individual nations and households feel. If the movement toward cleaner, greener economic activity takes too long, the entire global community will suffer. While climate change skeptics exist, many leading scientists have concluded that the world will be fundamentally altered if global temperatures increase by 1.5 degrees

**Not only will construction firms assist in the installation of new technologies as part of a cleaner and greener future, but they will also help position the United States at the commanding heights of the global renewable energy economy.**

JOSEPH NATARELLI is Marcum LLP’s Managing Partner at the New Haven Office and a national construction leader.

ANIRBAN BASU is the chief construction economist at Marcum LLP and the CEO of the Sage Policy Group.

Celsius or more.<sup>5</sup> If that were to happen, some believe that between 70 and 90 percent of coral reefs around the world will die.<sup>6</sup> If the increase were to reach 2 degrees, that percentage rises to roughly 99 percent.<sup>7</sup> Currently, about half a billion people depend on those reefs for both food and earning a living, according to one report by Lauren Sommer, a climate correspondent for NPR.

## The technology that powers electric vehicles is rapidly finding its way into construction equipment, which represents an important aspect of greening construction.

There's more — others worry that the 1.5-degree Celsius increase would cause the Greenland Ice Sheet to collapse, altering ocean currents.<sup>8</sup> Degradation of the Amazon rainforest would accelerate creation of additional emissions, and flooding would become rampant, destroying waterfront communities and tax bases in the process. Even worse, some scientists believe that the world is destined to pass the 1.5-degree mark, changing the question to what can be done to get the globe back to desirable temperatures at some point in the tumultuous future.

### A Cleaner, Greener Construction Industry

In 2021, the Biden Administration passed the Infrastructure Investment and Jobs Act, a long-awaited federal response to the nation's infrastructure issues.<sup>9</sup> A signature element of the Act is substantial investment in the green economy. The

transition from fossil fuels to alternative, renewable energy sources may be awkward and expensive, but it also portends significant augmented activity for the U.S. construction industry. That is especially true if the nations of the world agree to collectively scale up financing for such efforts.

Not only will construction firms assist in the installation of new technologies as part of a cleaner and greener future, but they will also help position the United States at the commanding heights of the global renewable energy economy.

Data indicate that construction has much to contribute toward the greening of the economy, in part because it does so much environmental damage presently. According to the Global Alliance for Building and Construction, buildings and construction are jointly responsible for almost 40 percent of energy- and process-related emissions globally.<sup>10</sup> Environmental Protection Agency estimates from 2018 indicate construction and demolition generate more than 600 million tons of waste debris every year in the United States. That is twice as much as municipalities collected from homes and businesses in cities.<sup>11</sup>

At the heart of the shift toward a cleaner and more digital economy are electric-powered vehicles. The infrastructure bill strives to spur electric vehicle production, installation of charging stations, and production of batteries that drive this rapidly expanding segment. According to a White House statement, since 2021's onset, commercial enterprise has invested more than \$80 billion in relevant manufacturing processes.<sup>12</sup>

The technology that powers electric vehicles is rapidly finding its way into construction equipment, which represents an important aspect of greening construction. Volvo CE, the branch of

<sup>1</sup> Carrington, D. and Stockton, B., Cop28 president says there is 'no science' behind demands for phase-out of fossil fuels, *The Guardian* (Dec 3, 2023). Available at: <https://www.theguardian.com/environment/2023/dec/03/back-into-caves-cop28-president-dismisses-phase-out-of-fossil-fuels>.

<sup>2</sup> *Ibid.*

<sup>3</sup> "COP28 agreement signals 'beginning of the end' of the fossil fuel era," United Nations Climate Change (Dec 13, 2023). Available at: <https://unfccc.int/news/cop28-agreement-signals-beginning-of-the-end-of-the-fossil-fuel-era>.

<sup>4</sup> "UNITED ARAB EMIRATES," U.S. Energy Information Administration (Aug 28, 2023). Available at: <https://www.eia.gov/international/analysis/country/ARE>.

<sup>5</sup> Colbert, A., "Vanishing corals, part one: NASA data helps track coral reefs," NASA (June 22, 2023). Available at: <https://climate.nasa.gov/explore/ask-nasa-climate/3273/vanishing-corals-part-one-nasa-data-helps-track-coral-reefs/>.

<sup>6</sup> *Ibid.*

<sup>7</sup> *Op. cit.* note 5.

<sup>8</sup> Harvey, C. and E&E News, "Unless we cut emissions, ice sheets, forests and ocean currents are headed for catastrophe," *Scientific American* (Dec 6, 2023). Available at: <https://www.scientific>

[american.com/article/unless-we-cut-emissions-ice-sheets-forests-and-ocean-currents-are-headed-for-catastrophe/](https://www.scientificamerican.com/article/unless-we-cut-emissions-ice-sheets-forests-and-ocean-currents-are-headed-for-catastrophe/).

<sup>9</sup> "Fact sheet: The bipartisan infrastructure deal," the White House (Nov 6, 2021). Available at: <https://www.whitehouse.gov/briefing-room/statements-releases/2021/11/06/fact-sheet-the-bipartisan-infrastructure-deal/>.

<sup>10</sup> "The GlobalABC releases 2022 global status report for buildings and construction," Global Alliance for Buildings and Construction (Nov 9, 2022). Available at: <https://globalabc.org/news/globalabc-releases-2022-global-status-report-buildings-and-construction>.

<sup>11</sup> Berg, N., "How one NYC construction company saved 96% of its waste from the landfill," *Fast Company* (Feb 15, 2022). Available at: <https://www.fastcompany.com/90721680/how-one-nyc-construction-company-saved-96-of-its-waste-from-the-landfill>.

<sup>12</sup> "Fact sheet: Biden-Harris Administration bringing semiconductor manufacturing back to America," the White House (Jan 21, 2022). Available at: <https://www.whitehouse.gov/briefing-room/statements-releases/2022/01/21/fact-sheet-biden-harris-administration-bringing-semiconductor-manufacturing-back-to-america-2/>.

<sup>13</sup> "Volvo CE unveils 100% electric compact excavator prototype," *Volvo CE* (May 15, 2017). Available at: <https://www.volvoce.com/global/en/news-and-events/news-and-stories/2017/volvo-ce-unveils-100-percent-electric-compact-excavator-prototype/>.

the company that focuses on construction equipment, introduced its all-electric compact excavator in 2017.<sup>13</sup> The model, which has since gone through multiple upgrades and improvements, was estimated to be 10 times quieter and 10 times more efficient than a diesel-powered excavator of the same size. It also produces zero emissions.<sup>14</sup> Using two lithium-ion batteries, it can operate for eight hours before recharging. The current Volvo lineup also includes wheel loaders offering approximately eight hours of runtime capacity.

In 2019, Pon Equipment, a Norway-based company, collaborated with Caterpillar to convert a 28-ton Cat 323 Hydraulic Excavator to an all-electric version.<sup>15</sup> Costing around \$650k, the conversion unit uses a massive 300kWh battery weighing more than 3 tons. Using a standard industrial outlet, it requires approximately an hour of charging to provide an hour of usage. Caterpillar is clearly a believer in battery technology and has also made investments in the electric car company Fisker, which has initiated work on the development of solid-state batteries that can be used in construction settings.<sup>16</sup>

Wacker Neuson, a construction equipment manufacturer based in Germany, has developed a dual-powered excavator. Similar to the ones previously mentioned, the EZ17e runs on lithium-ion batteries that supply approximately seven hours of power.<sup>17</sup> What renders it unique and much more usable is that it can be plugged into a regular power outlet while in use.

Finally, Komatsu — based in Japan and with a history of developing hybrid-powered construction equipment that has helped diminish fuel con-

sumption by 40 percent — has developed its own electric-powered excavator.<sup>18</sup> Not only does their mini excavator cut emissions to zero, but it also reduces noise pollution and vibrations. That could allow construction to transpire during certain parts of the day (early mornings, evenings) without disturbing nearby residents and businesses.

This, in turn, could allow more construction projects to be delivered on time. For instance, in Baltimore, home to the firm that authors these articles, no site work, demolition, pile driving, or construction can be done within 300 feet of a dwelling between 9 p.m. and 7 a.m.<sup>19</sup> Electric-powered equipment could change that, perhaps even allowing more flexible scheduling for construction workers, driving up recruitment, productivity, and profitability in the process.

## Modular's Moment at Last

Construction is infamous among the pantheon of industries with respect to its resistance to change. It is associated with slow productivity growth and modest evolutions in the mechanisms by which its services are delivered. The reluctance to change is evident in the industry's adoption of modular building, which is reflected by the fact that modular's market share gains have been incremental rather than revolutionary.

That may be about to change, and environmental conditions have much to do with that. The environmental implications of construction extend beyond waste produced. Noise pollution from construction sites disrupts local ecosystems, including impacting wildlife communication and behavior. The industry also stands as a major global consumer of resources. This fact is highlighted by European Union data indicating that building construction consumes 40 percent of materials and primary energy while generating 40 percent of waste.<sup>20</sup> Traditional construction techniques also impact water quality by injecting diesel, fossil fuels, paints, solvents, and other toxic chemicals into the environment.

This is where modular construction comes in. By prefabricating components in a controlled factory setting, modular building minimizes waste, reduces on-site construction activities, and, as a result, significantly lowers overall environmental impacts. A noteworthy study by Professor Mohammed Al-Hussein at the University of Alberta reveals that modular construction could cut carbon dioxide emissions by 43 percent on standard projects.<sup>21</sup> This reduction is attributable to effi-

**Construction is infamous among the pantheon of industries with respect to its resistance to change.**

<sup>14</sup> *Ibid.*

<sup>15</sup> Kane, M., "Pon Equipment reveals electric Caterpillar excavator," *InsideEVs* (Jan 29, 2019). Available at: <https://insideevs.com/news/342491/pon-equipment-reveals-electric-caterpillar-excavator/>.

<sup>16</sup> "Fisker Inc. announces strategic investment from Caterpillar Ventures," PR Newswire (Oct 22, 2018). Available at: <https://www.prnewswire.com/news-releases/fisker-inc-announces-strategic-investment-from-caterpillar-ventures-300734774.html>.

<sup>17</sup> "Tracked Zero Tail Excavator EZ17e: Fully electric and full performance," Wacker Neuson. Available at: <https://www.wackerneuson.com/cemea/products/tracked-zero-tail-excavator-ez17e>.

<sup>18</sup> "Tyrone testing loader that could boost production while cutting emissions," *Freeport-McMoran* (Dec 1, 2022). Available at: <https://www.fcx.com/node/1911>.

<sup>19</sup> "Title 9 Noise Regulation." Available at: <https://www.nonoise.org/lawlib/cities/ordinances/Baltimore,%20Maryland.pdf>.

<sup>20</sup> Sizrirci, B., Fseha, Y., Cho, C., Yildiz, I., and Byon, Y., A review of carbon footprint reduction in construction industry, from design to operation, *National Library of Medicine* (Oct 14, 2021). Available at: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8540435/>.

<sup>21</sup> Al-Hussein, M., Manrique, J.D., and Mah, D., "Comparison between modular and on-site construction," *Integrated Management & Realty Ltd.* (Sept 2009). Available at: <https://growthzonesitesprod.azureedge.net/wp-content/uploads/sites/2452/2021/06/NorthRidgeCO2Report.pdf>.

cient use of resources and reduced construction time associated with modular methods.

## Electrification's Limitations

There are several obvious limitations toward the move to electrification. One is that many firms have made massive investments in existing technologies, and abandoning that physical capital would prove very expensive. After all, much of this equipment was financed, with the intent being to pay off debt by using the revenue generated by the use of the equipment. Simply moving toward battery-powered equipment would generate balance sheet quandaries.

Another obvious and perhaps even more severe limitation is battery life. Chris Sleight, managing director at Off-highway Research, indicates in a recent article that the global market for electric-powered construction equipment is presently quite small. There were, for example, only approximately 1,000 electric construction vehicles sold last year in a market encompassing more than 1 million machines.<sup>22</sup>

That said, while the revolution has yet to arrive, evolution has begun. More electric products are hitting the market. Battery life is being ex-

tended. Contractors may want to forge strategies to determine when and if it makes sense to shift from fossil-fuel powered construction equipment to what stands to be the next generation of construction's physical capital.

Such talk is more than idle fantasy. IDTechEX, an independent market research firm based in England, reports that the global electric construction market could reach \$105 billion over the next 2 decades.<sup>23</sup>

## Looking Ahead

The transition to battery-powered transportation and a greener construction industry has begun. With more policymakers focused on supporting a greener and cleaner economy, contractors who transition relatively quickly to environmentally friendly construction vehicles and equipment may carry more favor with policymakers and procurement officers. This could help to drive both demand and market share expansion. Admittedly, the underlying technology is yet to be fully refined and is often quite expensive. Accordingly, while the transition to a more digital, battery-fueled economy has begun, the transition is presently awkward, pricy, and in many instances, gradual. ■

