REDUCE CARBON AND COSTS WITH THE POWER OF AI

By Charlotte Degot, Sylvain Duranton, Michel Frédeau, and Rich Hutchinson

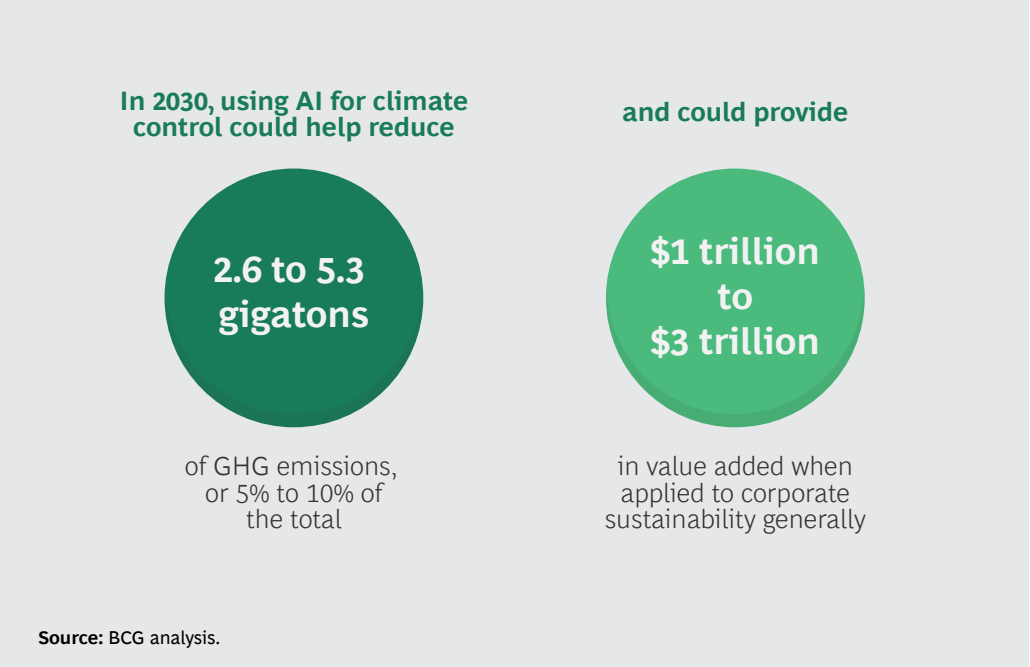
The pressure on businesses to respond to the threat of global warming is growing. Consumers, regulators, and investors alike are increasingly scrutinizing the climate impact of companies in every industry. In his January 2020 letter to CEOs, for example, Larry Fink, chairman and CEO of BlackRock, the world's largest asset manager, put companies on notice that investors—among other stakeholders—now expect full disclosure of companies' performance on a range of environmental, social, and governance factors.

But it's one thing for companies to pay lip service to the need to reduce their greenhouse gas (GHG) emissions. Taking concrete measures to make a difference, especially in today's pandemic-driven economic climate, is another matter entirely. The difficulty and expense of measuring the full extent of their carbon emissions, and then reducing or offsetting them, has forced many companies to delay the effort.

In this context, artificial intelligence (AI) can be a game changer. Its ability to deliver deep insights into multiple aspects of a company's carbon footprint and quick cost-cutting wins offers a promising route to accelerating sustainable transformation and reducing expenses in a time of need. And because their size gives them access to huge data sets—a key success factor for deploying AI—large companies are in an especially strong position to benefit from its power.

The Promise of AI

The threat of climate change is growing, and time is running out. Global GHG emissions currently total about 53 gigatons of carbon dioxide equivalent (CO_2e), according to the Carbon Disclosure Project. If we are to meet the goal of limiting the increase in average global temperatures to 1.5°C, as specified in the 2016 Paris Agreement, we must reduce those emissions by 50% by the end of this decade, according to the Science-Based Targets Initiative. In our experience with a number of clients, using AI can achieve 5% to 10% of that needed reduction—between 2.6 and 5.3 gigatons of CO_2e.



Source: BCG analysis.

Meanwhile, BCG studies show that the potential overall impact of applying AI to corporate sustainability amounts to $1.3 trillion to $2.6 trillion in value generated through additional revenues and cost savings by 2030.

This added-value figure for companies does not take into account changes in the price of carbon offsets. That number, currently set at around $30 in the EU Emissions Trading System, could double by 2030. BCG expects to spend $80 per ton by 2030 on high-quality, permanent GHG removal as part of its Net Zero pledge. At this increased price level, the value of reducing GHG emissions through the use of AI would represent an additional savings of $208 billion to $424 billion for all companies globally. If carbon offset prices rise even higher over the coming years, AI opportunities will surely represent even greater savings.

How It Works

The great strength of AI lies in its ability to learn by experience, collecting massive amounts of data from its environment, intuiting connections that humans fail to notice, and recommending appropriate actions on the basis of its conclusions. Companies looking to reduce their carbon footprint should turn the AI spotlight on all three components of the effort:

- **Monitoring Emissions.** Companies can use AI-powered data engineering to automatically track emissions throughout their carbon footprint. They can arrange to collect data from operations, from activities such as corporate travel and IT equipment, and from every part of the value chain, including materials and components suppliers, transporters, and even downstream users of their products. AI can exploit data from new sources such as satellites. And by layering intelligence onto the data, AI can generate approximations of missing data and estimate the level of certainty of the results.

- **Predicting Emissions.** Predictive AI can forecast future emissions across a company's carbon footprint, in relation to current reduction efforts, new carbon reduction methodologies, and future demand. As a result, they can set, adjust, and achieve reduction targets more accurately.

- **Reducing Emissions.** By providing detailed insight into every aspect of the value chain, prescriptive AI and optimization can improve efficiency in produc-

A STEELMAKER CUTS EMISSIONS AND COSTS WITH AI

Recently, a global steel producer wanted to optimize its production processes to reduce carbon emissions and lower costs. In the course of just six months, we implemented AI-based process controls designed to eliminate waste and reduce energy intensity. Thousands of sensors collect billions of data points, which are then fed into the control system's algorithms. This enables the company to precisely calculate and predict energy needs and track and reduce sources of waste.

Since implementing these controls, the company has pursued a subset of initiatives that have already achieved carbon emissions decreases of 3%, representing approximately 230,000 tons of CO_2 per year, along with cost reductions of $40 million—a significant benefit for a company with $8 billion in revenue.

As impressive as these gains are, the company had already made significant progress in optimizing its operations before adopting these changes. We calculate that AI would have a much greater impact for the industry as a whole, helping steel companies reduce their emissions by 5% to 10% and their costs by 1%. If every steel company achieved such reductions, the industry would emit 200 million to 400 million fewer tons of CO_2 each year.

tion, transportation, and elsewhere, thereby reducing carbon emissions and cutting costs.

In short, AI can help large companies reduce their environmental impact while also alleviating the financial pressure they face as they emerge from the COVID-19 crisis.

Industries that can benefit from this approach include industrial goods (see the sidebar "A Steelmaker Cuts Emissions and Costs with AI"), transportation, pharmaceutical, consumer packaged goods, energy and utilities (see the sidebar "AI-Powered Sustainability at a Large Oil and Gas Company"), and others.

Reaping the Benefits

To gain these benefits, company leaders must make it a top priority to target areas with high carbon emissions and significant costs—especially those with a potential payback period of less than 24 months. Even the practice of AI uses large amounts of energy, and companies should subject its emissions, too, to analysis. (See the sidebar "Mitigating AI's Carbon Footprint.") We recommend that companies adopt a three-pronged approach:

- **Aim high.** Use AI to improve the visibility of carbon emissions across the value chain. Then determine where to apply the technology to reduce the footprint, starting with the largest sources of carbon emissions and costs.
- **Start small.** In designing your AI approach, use prototypes and pilots, to create a strong basis for further learning and development. Use the minimum viable product (MVP) concept to

AI-POWERED SUSTAINABILITY AT A LARGE OIL AND GAS COMPANY

A major European oil and gas company was facing production losses

due to unexpected problems with machinery and to dependence on control systems that followed a report-and-react approach. To compensate for the losses, the company had to increase production, leading to higher emissions and increased costs.

To rectify the problem, we redesigned the control system to implement a machine-learning-based predict-and-act approach and created an integrated operating center to unify the views on all plant equipment. We also encouraged the company to adopt a change management strategy to foster the adoption of the new tools.

The new end-to-end system uses a number of machine-learning models, including tools that predict maintenance problems and CO_2 emissions for each production unit. This capability enables plant engineers to predict the energy consumption and emissions of all of their units for the next three to five hours—and to isolate, analyze, and fix any unit responsible for excess emissions.

As a result, the company lowered its carbon emissions by 1% to 1.5%, representing 3,500 to 5,500 tons of GHGs per year, and reduced its costs by approximately $5 million to $10 million. The system also achieved 87% accuracy in predicting equipment failures and had an 80% success rate in forecasting emissions anomalies.

By scaling up this AI-powered tool and using machine learning to replicate it across machines and plants, oil and gas companies can gain a comprehensive, real-time view across all of their production operations.

design a workable AI system, and then iterate on it, integrating feedback to make it better.

- **Scale fast.** Scale up the MVP solution and transform the organization around it to increase its impact. Invest in building core capabilities and enablers in parallel with scaling up the MVP. These should focus on developing enabling tech platforms at scale, defining new ways of working, and implementing the organization and governance models needed to align AI and overall strategy.

Act Now

AI has already demonstrated its near-term value in helping companies reduce their GHG emissions and cut costs. By generating a positive ROI, often within a year, it should quickly become a financial benefit to companies, rather than yet another cost. We believe that AI can be especially valuable now, as companies recover from the COVID-19 crisis, in lowering costs and beginning the transition to a low-carbon future.

In the longer term, as the price of carbon emissions rises and as advances enable AI to tackle more complex climate issues, the technology will become increasingly important in mitigating the effects of global warming.

Now is the time for leading companies to begin reaping the benefits of AI. Aim high, start small, and scale fast.

MITIGATING AI'S CARBON FOOTPRINT

As valuable a tool as AI can be in helping companies account for and reduce their carbon emissions, running AI programs contributes to the problem. In 2019, researchers at the University of Massachusetts estimated that the energy required to train a state-of-the-art natural-language processing algorithm to produce human-like text would generate more than 270,000 kilograms of CO_2 emissions.

Since then, the power of state-of-the-art technology has become much greater: OpenAI's latest version of its AI model, called GPT-3, is hundreds of times more powerful than last year's model and produces the same amount of GHG emissions as a car being driven more than 700,000 kilometers.

The lesson: exponential increases in AI's algorithmic complexity and the growing adoption of AI solutions throughout the economy and society require AI practitioners to find ways to mitigate the technology's environmental footprint.

That's the goal of CodeCarbon, a combined effort of BCG Gamma; Mila, a world-leading AI research institute in Montreal founded by Turing Award recipient Yoshua Bengio; Pennsylvania's Haverford College; and Comet.ml, a collaboration platform for machine learning.

CodeCarbon automatically captures the information needed to estimate CO_2 emissions due to computing, enabling users to track, record, and visualize the emissions released in the course of every experiment and across multiple projects.

It also provides visibility into the levers that developers can pull to reduce their footprint. This in turn allows them to design more frugal and more efficient algorithms, position their servers in locations where producing power generates the lowest level of emissions, and choose the most efficient hardware for their systems. By pulling these levers, data scientists can reduce the emissions released in training algorithms by up to ten times. And because CodeCarbon is an open-source program, users can contribute to its further development.

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