

HOW INTELLIGENT TECHNOLOGY CAN TRANSFORM THE STRUGGLE FOR SUSTAINABILITY

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For companies operating on a planet under mortal threat, no issue is more urgent than sustainability.

Less than ten years remain to achieve the 2030 Agenda for Sustainable Development, adopted by all United Nations member states in 2015. The 2030 Agenda sets out 17 sustainable development goals and an urgent call for action by all countries to tackle climate change and work to preserve the world's oceans and forests.¹ Meanwhile, the landmark COP26 Climate Summit in Glasgow in 2021 added additional gravitas to meeting the still unfulfilled climate goals of the Paris Accord. The transformation needed to achieve the world's ambitious targets will require new ways to create circular economies, to manage products and services over their entire lifecycle, to make cities ecologically smarter, to repair and protect complex interdependent ecosystems—and to mitigate the adverse environmental effects of the intelligent technologies that will be critical for achieving those objectives.

LIVING SYSTEMS FOR OUR LIVING PLANET

Consider the vast computing power of the cloud and the wide net cast by edge technologies (devices that enable computing to be done near the source of the data). The cloud is being put to work monitoring and analyzing a whole host of environmental and climate phenomena: ocean temperatures, rainfall patterns, the effect of soot and sulfate from cargo ships on air quality, and much more.² Amazon Web Services (AWS), for example, is seeing more organizations using its machine-learning services on dozens of climate-related projects, ranging from soil-data analysis and ocean-conservation efforts to forest preservation. Remote sensors and other edge technology make it possible to track water pollution, deforestation, and “dark fleets” of vessels whose fishing practices breach environmental regulations.

These cloud and edge technologies are being woven together into dynamic living systems—a boundaryless, adaptable approach to technology architecture—to take on a host of environmental challenges that threaten habitats, humans, and virtually every business in every sector.

For example, the Porsche, Audi, and Volkswagen brands are using an AI-powered early warning system to identify sustainability risks such as environmental pollution, human rights abuses, and corruption among direct business partners and at the lower levels of the supply chain.³ Since the pilot project began in October 2020, the three VW brands have been keeping an eye on over 4,000 suppliers. It’s hard to understate the potential of such systems since the typical multinational’s supply chain generates 5.4 times more emissions than its direct operations.⁴

The World Mosquito Program (WMP), a not-for-profit initiative, uses the cloud and AI to protect communities around the world from mosquito-borne diseases like dengue, Zika, Chikungunya, and yellow fever. The technique involves introducing into the mosquito population in disease-prone areas a natural bacteria called Wolbachia, which stops the spread of disease.⁵ WMP uses the cloud and machine learning in a key part of the process—pinpointing multiple high-impact release points within blocks of as little as 100 square meters.

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Dendra Systems helps companies like RioTinto restore ecosystems. Dendra drones, using swarm technology, map every square inch of the area to be restored and gather data, including erosion trends, that the company's ecologists and AI use to determine what seeding plan to pursue.

A number of stakeholders have joined forces to combat deforestation in the major cocoa-producing regions of the world. The clearing of primary forest cover causes significant increases in greenhouse gasses. One way to prevent it is to help farmers optimize yields on existing land. FarmGrow, established by the Rainforest Alliance and Grameen Foundation, supports cocoa farmers through an Android-based decision-making platform that helps them improve the productivity and long-term sustainability of their farms. Mars, maker of M&M's, Snickers, Mars bars, and many other global brands, and global cocoa trader Touton were among the first companies to embrace FarmGrow. Mars has declared a commitment to achieving a deforestation-free cocoa supply chain by 2025.⁶

Such systems will unlock troves of sustainability information and put more pressure on companies to use them for more accurate and granular disclosure of sustainability performance. As the threat of ecological catastrophe becomes increasingly clear, even investors with little emotional attachment to environmental issues are likely to pay careful attention to sustainability metrics—and companies will need to have in place living systems to provide them at an unprecedented level of specificity and transparency.

SUSTAINABILITY IN SILICON

Digital twins provide another powerful intelligent technology for accelerating sustainability. Digital twins are used to model complex systems—from cars to cities to human hearts—and simulate their functioning with an accuracy that allows the user to go directly from the virtual model to creating a solution to the problem at hand without spending the years it normally takes to prototype and incrementally improve designs and systems.

Digital twins can help companies reduce their costs, resource use, and carbon footprint, and they can support disruptive innovation and agile, customer-centric, circular business models. Digital twins can help city planners coordinate complex urban systems—from traffic control to waste disposal to public parks—for greater efficiency and sustainability. Climatologists can use digital twins to understand how myriad factors are interacting to produce climate change and to identify urgently needed interventions.

In the commercial world, digital twins can deliver not only richer design options and rapid prototyping, but also greater production process efficiency, improved quality, better operational performance, asset life extension, and decommissioning of assets, and more robust supply chain scenario planning and resiliency. All of those benefits can contribute to a more circular economy. A full 100 percent of the world's top electric vehicle (EV) manufacturers, and 90 percent of the top drug and healthcare laboratories, use digital twin solutions. But the vast majority of private and public organizations globally have yet to pilot and scale such solutions. That's unfortunate, given the great promise digital twins hold for improved business and sustainability performance.

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TURNING AI FROM RED TO GREEN

Without a doubt, AI will be one of—if not the—driving technological force behind the world’s collective response to climate change. But advanced AI software, in some cases, worsens many of the environmental problems it aims to solve. That’s because the way in which AI software is developed can be extremely energy intensive. Consider an experiment conducted by Accenture researchers. They trained an AI model on a small, publicly available dataset of iris flowers. Using only 964 joules of energy, the AI model achieved accuracy of 96.17 percent in classifying the flowers’ different species. Achieving an additional 1.74 percent-point increase in accuracy required 2,815 joules of energy. That means the last 0.08 percent increase in accuracy took nearly 400 percent more energy than was required to reach 96.17 percent accuracy.

In another experiment, using a medium-size publicly available image dataset, the researchers showed that a 70 percent smaller subset of the training data could achieve nearly the same level of accuracy with a significantly lower energy cost. The model consumed 47 percent more energy when trained on the entire dataset compared to the smaller subset, but achieved less than 1 percent more accuracy. Moreover, the bigger and more unwieldy AI software becomes, the more energy required of the machines that run it, further increasing its carbon footprint.

In a highly influential study, a group of researchers led by Oren Etzioni, chief executive of the Allen Institute, proposed a shift toward what they call “Green AI,” which they define as AI research that is more environmentally friendly, as well as more inclusive.⁷

Green AI, Etzioni and his colleagues say, could actually move artificial intelligence in a more “cognitively plausible direction.” Why? Because the brain is highly efficient. A number of companies and researchers are now exploring the development of “neuromorphic chips”—computer chips designed to resemble the circuitry and electrical behavior of the neurons that make up biological brains. These chips are highly energy-efficient, just like the brain, because their neurons aren’t constantly firing, as occurs with traditional silicon technology, but activated only when they receive a spiking signal.⁸

Neuromorphic technologies will help solve business challenges that require AI at the edge, such as responsive voice control for vehicles, full-body gesture recognition for touchless interfaces, and on-board intelligence for assistive robotics. In a recent collaboration with an automotive client, our firm demonstrated that spiking neural networks running on a neuromorphic processor can recognize simple voice commands up to 0.2 seconds faster than a commonly used embedded GPU accelerator, while using up to a thousand times less power. This brings truly intelligent, low-latency interactions into play, at the edge, even within the power-limited constraints of a parked vehicle.

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While neuromorphic chips advance, there is also hope in replacing older CPUs (central processing units) with newer energy-efficient chip architectures, such as graphics processing units (GPUs) and field-programmable gate arrays (FPGAs). And Graphcore, a UK startup, has produced an Intelligence Processing Unit (IPU) that is even more energy-efficient than GPUs. The company has said that its IPU processes data ten to fifty times faster than GPUs, saving large amounts of energy.⁹

Carbon emissions can also be reduced by migration to the public cloud—as much as 59 million tons per year, according to our analysis.¹⁰ This represents a 5.9 percent reduction in total IT emissions and equates to taking 22 million cars off the road. This magnitude of reduction can go a long way in meeting climate change commitments, particularly for data-intensive businesses.

The first step toward a sustainable cloud-first journey begins with selecting a carbon-thoughtful provider. Cloud providers set different corporate commitments towards sustainability, which in turn determine how they plan, build, power, operate, and retire their data centers. AWS's expansive infrastructure is 3.6 times more energy efficient compared to median US enterprise data centers, largely due to efficient servers and high-capacity utilization rates. The company's water-cooled facilities actively measure water efficiency and select conservation options in the context of regional climate patterns and local resources. Google currently utilizes a carbon-intelligent computing platform that shifts timing of non-urgent data center workloads to times when low-carbon sources of energy are most plentiful. The company has made a bold commitment to operate its data centers carbon-free 24/7 by 2030. Microsoft, carbon neutral since 2012, has committed to shifting its data centers to 100 percent renewable energy by 2025 through power purchase agreements (PPAs). Microsoft Azure's customers can even access a carbon calculator that tracks emissions associated with their own workload on the cloud.

Our analysis of the largest public cloud service providers shows average enterprise-owned-to-cloud migrations can lead to an impressive 65 percent energy reduction and 84 percent carbon reduction.¹¹ Companies drive even greater carbon reductions through cloud-native architectures and deployments. Our analysis shows that customizing applications to be cloud-native can stretch carbon emission reduction to 98 percent, another example of Green AI's enormous environmental promise.

THE MOST IMPORTANT DIFFERENTIATOR OF ALL

Unless the world takes meaningful action, deadly heat waves, severe droughts, violent weather and flooding, plant and animal extinctions, and the dying off of coral reefs that support fisheries around the globe will grow in intensity and frequency. These are not speculative scenarios. Many of the technologies we've been discussing here—especially cloud/edge monitoring systems and AI-driven modeling—have given these climate predictions unprecedented precision.

As the effects of climate change become more immediate, sustainability will increasingly be top of mind for billions of people. For companies, that means sustainability will become one of the most compelling differentiators of all. While governments, politicians, and other officials continue to set often toothless aspirational goals, companies can take concrete, consequential actions now, as automakers are doing by shifting production to electric vehicles. Talent, customers, and investors—all acutely aware of the stakes in a way they never have been before—will gravitate in ever larger numbers to companies that excel in terms of sustainability.

The advantages that sustainability leadership brings will drop straight to the bottom line. Our research shows that sustainability strongly correlates with superior financial performance. Between 2013 and 2019, companies with consistently high ratings for environmental, social, and governance (ESG) performance enjoyed 4.7 times higher operating margins than low ESG performers over the same period. High performers generated 2.3 times higher annual total returns to shareholders than their peers. Even as global markets faced tremendous pressures and volatility, companies with high ESG scores continued to outperform, experiencing less volatility and generating a cumulative relative return 6.3 percent higher than bottom performers.¹²

Over the next two decades, as climate change becomes impossible for even the most casual observer to ignore, we are likely to see this performance gap widen for sustainability-first companies. But to maintain their lead, companies must begin to immediately embrace the twin imperatives of using technology as a sustainability catalyst while also making technology more sustainable.

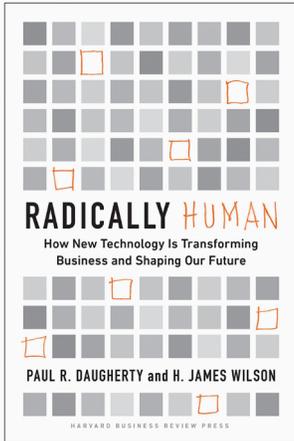
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While not all solutions should be tech solutions, modern technology is, without doubt, one of the most potent and scalable tools for accelerating positive change in our world, especially when coupled with strong policy and healthy guardrails for human safety and dignity. **The stakes couldn't be higher; the opportunity couldn't be greater.** 📖

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