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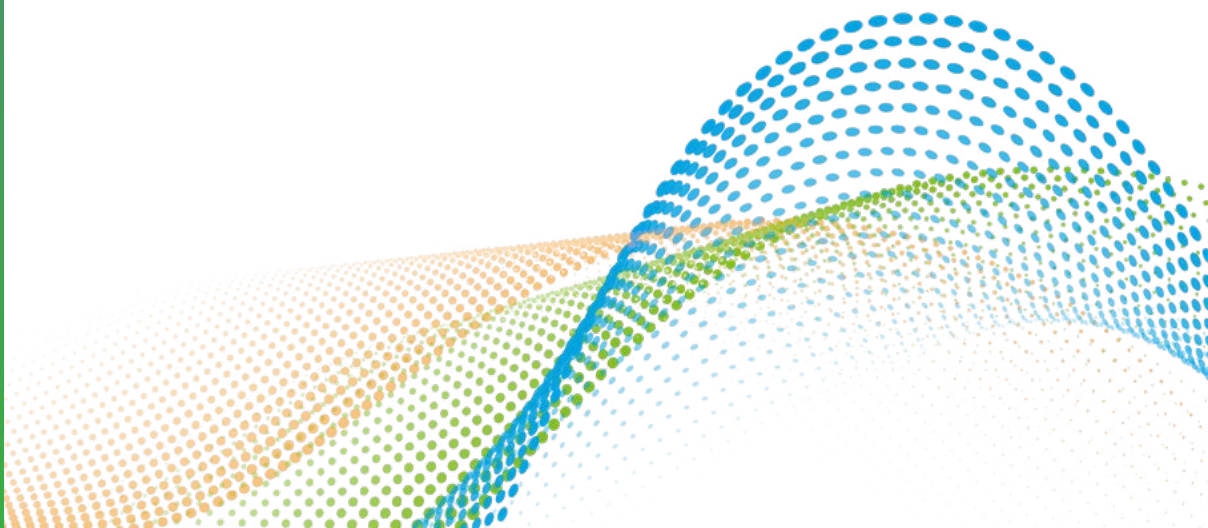
June 2023

Using Cloud to help combat climate change and become responsible producers and consumers (UN SDGs)



Contents

A rapidly industrializing world	03
Challenges of the industrial revolution	04
A paradigm shift in the way business is done	05
Where can Cloud fit in?	07
Overcoming business complexities in banking	10
Move towards Smart Manufacturing	12
Conclusion	14
About the authors	15
References	16



A rapidly industrializing world

The Industrial Revolution that began in the mid-1800s changed many aspects of human life by opening new opportunities, breaking away existing social hierarchies, and creating new jobs.

Today, we are in the nascent stages of the Fourth Industrial Revolution¹—advancement that can be characterized by economic growth², driven by increasing interconnectedness and automation, using emerging technologies like 5G, Internet of Things (IoT), and data analysis of previously inconceivable amounts of unstructured data. This progress, however, could be resulting in compute power that may be impacting our environment. This shift in energy consumption was neither anticipated and, as a result, not proactively designed to mitigate some of the unintended consequences. Some of these consequences are what this paper by Deloitte US will help to highlight, as well as present some pragmatic solutions that a number of businesses can deploy.

Industrial revolutions through the ages

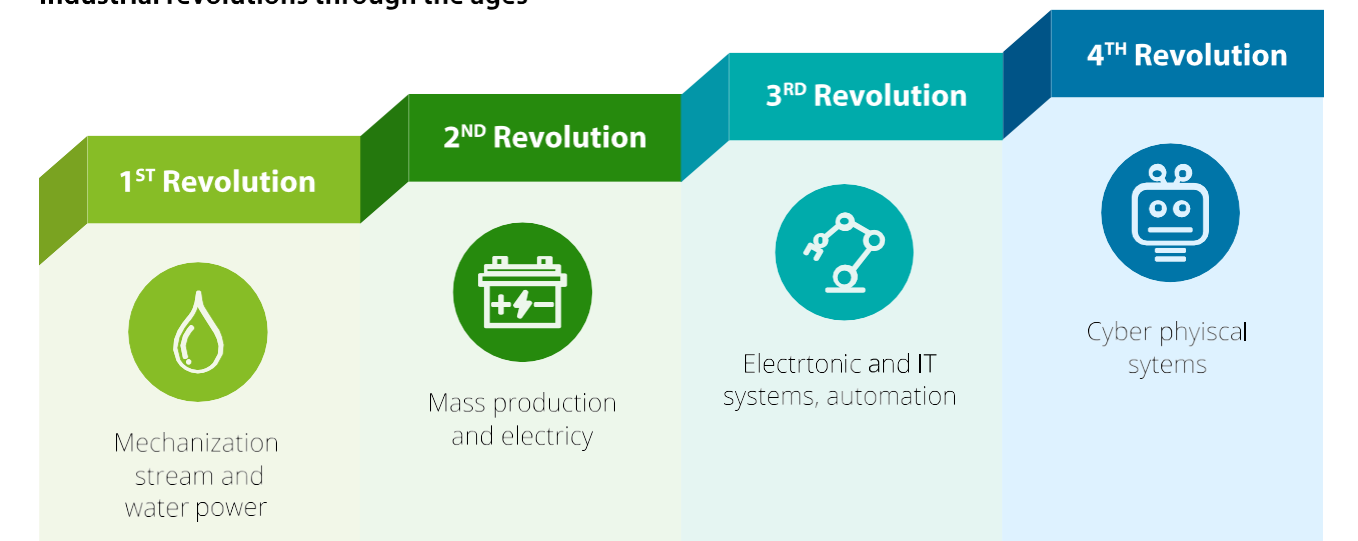


Figure 1 Source: Deloitte.

Challenges of the Industrial Revolution

Climate change and an increase in production and consumption

With globalization, the First Industrial Revolution spread rapidly, culminating into the current Fourth Industrial Revolution. With these technological changes, however, came environmental repercussions. The adverse impact of the Industrial Revolutions can be understood across four key dimensions³ as defined by the World Economic Forum:



Planet

- Research⁴ conducted by the National Aeronautics and Space Administration (NASA) shows that industrial and technological changes over the last 151 years have led to 48% increase in atmospheric levels of CO₂
- Another study⁵ by NASA's Goddard Institute for Space Studies (GISS) shows that average global temperatures rose by at least 1.9° Fahrenheit in the past 143 years since 1880, with the rate of temperature change more than doubling (to 0.32° Fahrenheit) since 1981⁶



People

- From 1970 to 2020, global population levels went up by 111%⁷—from approximately 3.7 billion to almost 7.8 billion people. If the global population increases to 9.6 billion people by 2050, resources equivalent to that from three to four earths⁸ will likely be required to meet our current consumption patterns
- With the global market size for cobalt expected to double between 2021 and 2030⁹ to meet its growing demand as a raw material for rechargeable batteries, the Democratic Republic of Congo, which contributes almost 70%¹⁰ of the global cobalt supply has seen human rights violations and allegations of low wages, long hours, poor health benefits, and discrimination¹¹



Prosperity

- The top 10% of the world's population owns 76% of the world's total wealth and takes in 52% of the world's total income¹². In contrast, the poorest half of the world's population earns just 8.5%¹³ of the world's total income and possesses only 2% of the world's total wealth
- Inequalities in income and wealth are connected to ecological inequalities and unequal contributions to climate change; the top 10% of emitters across the world are responsible for almost 50% of all emissions, while the bottom 50% produce only 12% of the total emissions¹⁴



Principals of governance

- Historically, a lack of oversight and the absence of governing councils for Corporate Social Responsibility in businesses have likely led to environmental degradation, irresponsible production, and social inequality¹⁵
- Even though 92% of S&P 500 companies published Environmental, Social and Governance (ESG) reports in 2020¹⁶, the lack and standardization of data can make it difficult to verify and compare ESG reports, with just 9% companies¹⁷ are actively using software for ESG data collection, analysis and reporting



A paradigm shift in the way business is done

A paradigm shift is likely needed if future generations are to reap the rewards of society's technical progress. However, this progress cannot be at the continued cost of People, Planet and Prosperity. It could be time for “business as usual” to develop a new normal.

That new normal could be “sustainable business”. Many companies have started incorporating sustainability objectives and practices into their strategy and operations with positive impacts like reduced energy consumptions, development of green products that reduce waste, and higher employee motivation. Consumers are also making buying decisions based on sustainable product purchases. Additionally, an objective assessment and strategy to achieve sustainability is increasingly becoming a fiduciary mandate. This could increase business complexity if enterprises do not adopt sustainable business practices. To simplify this complexity, Deloitte offers four lenses to help view the categories of this complexity.

Compliance and regulation:

Environmental, Social and Governance (ESG) adherence is one of the growing necessities for publicly listed companies. For instance, the US Securities and Exchange Commission (SEC) is updating its rules for listed companies to disclose emissions across the value chain, highlighting the need for companies to examine their emissions across scopes 1, 2 and 3. Scope 3 emissions, attributed to a business's upstream and downstream value chain, can be difficult to accurately calculate. The European Union's Corporate Sustainability Reporting Directive¹⁸ (CSRD) goes further, requiring large companies to disclose their emissions footprint alongside other environmental impacts including water, biodiversity, and circularity. CSRD also requires organizations to obtain third party assurance on this data to ensure its validity.

Mounting losses across supply chains:

Suppliers are estimated to incur losses worth US\$1.26 trillion¹⁹ due to climate change, deforestation, and water insecurity by 2026, impacting global supply chains.

Rising costs to meet higher consumption:

To help meet increasing consumption patterns, businesses are producing more products than ever, resulting in unprecedented levels of carbon emissions. Higher carbon emissions are associated with higher business costs owing to higher consumption of energy, having a direct impact on the bottom line.

Consumerism and credit ratings:

Credit rating agencies are incorporating ESG metrics to help increase transparency for investors, with businesses exploring new funding options like ‘green investing’ and ESG bonds. Consumers are adopting more sustainable lifestyles²⁰ and becoming more conscious of the carbon footprint of the goods and services they consume.

Businesses are under pressure

from stakeholders across the value chain to operate more sustainably. The United Nations outlines its 17 Sustainable Development Goals²¹ as a blueprint to frame and outline global imperatives. While addressing all of these as a business would be both admirable and ambitious, we focus on two of the goals that to prioritize for businesses to reduce emissions:



Climate Action:

Taking urgent action to combat climate change and its impacts



Responsible Consumption and Production

Ensure sustainable consumption and production patterns

Sustainability can be a competitive advantage and a function of staying in business. As such, at a minimum, businesses should gain an understanding of their current state Greenhouse Gas Emissions (GHG) and production patterns across their supply chains to help identify opportunities to reduce emissions and drive responsible consumption.

Where can Cloud fit in?

Setting up sustainable operations has become one of the key strategic goals of CEOs. Brands that are seen as sustainable are seen to be attracting more customers and securing government incentives. However, tracking progress against these goals may require both strategic intent and operational rigor. Technology, especially Cloud, can play a critical role in helping Chief Experience Officers (CXOs) understand how to become more sustainable.

Cloud computing has proven to have a positive impact on the entire value chain of a business, ranging from product development to customer acquisition, to providing services. With wide adoption of technological advancements such as 5G and IoT to better serve end users, data centers across various industries are expected to account for 14% of the world's CO2 emissions by 2040²². Public Cloud providers leverage economies of scale across their data centers to help optimize their IT operations, hardware and software, and energy utilization; these benefits can be passed on to customers. For instance, Amazon Web Services' (AWS) infrastructure that is 3.6 times more energy efficient than the median of US enterprise data centers²³. AWS' data centers also rely on evaporative cooling, rather than compressors, and is on the path to use 100% renewable energy by 2025, 5 years ahead of its initial goal. In fact, AWS data centers are now committed to achieving a water positive position in seven years²⁴. In addition to helping

enterprises achieve sustainability, Cloud may also help businesses become more agile, improve development experience, replace capital expenses (CapEx) with operating expenses (OpEx), and reduce the time to market.

In response to market shifts and anticipating future sustainability in Cloud scaling challenges, Deloitte has developed an end-to-end Green Migrations approach. Using a suite of Cloud-native tools built on AWS, Deloitte's Green Migration suite helps clients plan for, quantify, and achieve measurable carbon reductions. As an example, to help a leading Australian university fulfil its commitment of becoming carbon neutral by 2025, Deloitte Australia recently collaborated with AWS to help the university achieve 100% renewable energy supply and reduce its carbon footprint by replacing on-campus data centers with AWS' public Cloud infrastructure²⁷.

Deloitte approaches this Green Migration in the following steps:

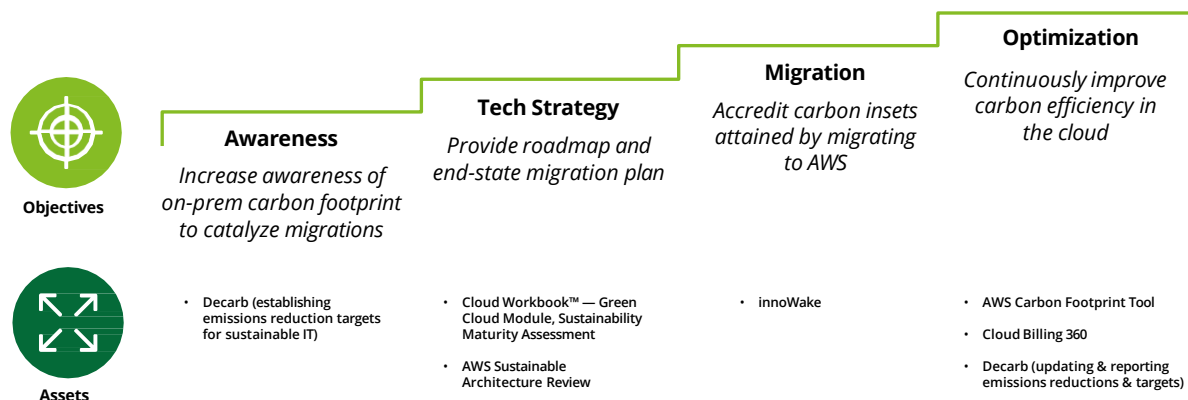
- 1 Building awareness:**
Making businesses aware of their on-premises carbon footprint to catalyze migrations
- 2 Tech Strategy:**
Providing a roadmap for the future state tech strategy and end-state migration plan to reduce emissions and become more sustainable
- 3 Migration:**
Leveraging sustainable architecture, green coding principles and automating code conversion to Cloud migrations
- 4 Optimization:**
Continuously improve carbon efficiency in the Cloud



For each of these steps, Deloitte has dedicated tools to help accelerate the assessment and analysis required to achieve sustainability. For instance, the Green Cloud Capability, a part of Deloitte's Cloud Workbook™^{M28} calculates and presents the green benefits of Cloud migration such as reduction in carbon footprint and savings in power cost and consumption.

Deloitte's innoWake™ solution helps clients achieve their vision of application modernization. Legacy systems can be costly and resource-intensive to operate, and they can often deliver diminishing efficiency. Modernization can help to evolve from legacy code to a more efficient and green code, further contributing to emission reductions.

Figure 2 Deloitte's Green Migration approach and suite of tools and accelerators to help clients achieve their sustainability goals.



Source: Deloitte

As one of the leading Cloud service providers, AWS has demonstrated how they can aide enterprises in learning more about their current carbon footprint, improve monitoring of waste and emissions, and complement business reporting on sustainability. AWS' existing capabilities include:

1

Building awareness:

As the first step, businesses' journeys on AWS can be accelerated by building business cases

2

Building a Tech Strategy:

Enterprises have been innovating their processes and products to help deliver better value to customer and business growth. However, many of these processes and products are based on "traditional business models," i.e., "Take, Make and Waste". It may be imperative to help businesses shift towards a circular economy within their value chains. Some examples where Cloud can be successfully used across the value chain include:

- a. **Banking:** Enhance customer experience, reduce emissions, and reduce end-to-end costs
- b. **Manufacturing:** Optimize manufacturing output, profitability, and sustainability
- c. **Mining:** Monitor, control and optimize resource consumption by leveraging renewable energy and recycling water
- d. **Agriculture:** Optimize genetics for higher yields with fewer inputs (like genomics, connected farms)

3

Enabling Migration:

AWS can offer equivalent compute capability as on-premises data centers with up to 88% lower carbon footprints²⁹. Additional benefits of adopting AWS include direct reduction in Cost of Goods Sold (COGS), IT staff productivity, business resilience, and enhanced customer experience

4

Driving Optimization:

Opportunities to disrupt businesses can be explored with circular business models tightly coupled with digital capabilities. For instance, paperless claim processing can help reduce the turnaround time for insurance claims, while reducing the industry's carbon footprint. Through collaboration, consulting firms, global system integrators and local governments, policies can be influenced that encourage enterprises to join sustainability initiatives like predicting de-forestation using artificial intelligence (AI) and machine learning (ML), making Greenhouse gas (GHG) emission reports mandatory, and working with governments to empower agri-tech with digital capabilities

AWS can help enable customers to build sustainability solutions through a very broad and deep set of capabilities in AI, ML, IoT, data analytics, to help reach organizations reach their sustainability goals. Tools offered by AWS, that map to the Deloitte Green Migration approach includes:

		Driving Migrations	Building Awareness	Tech Strategy	Driving Optimization
Initiatives/Enablers	AWS Services	<ul style="list-style-type: none"> • AWS Platform & Services: • Compute • Storage • Data • AI/ML 	<ul style="list-style-type: none"> • IOT • Data lake • AI/ML • Quick Sight • Industry Solutions 	<ul style="list-style-type: none"> • IOT • Data lake • AI/ML • Quick Sight • Industry Solutions 	<ul style="list-style-type: none"> • IOT • Data lake • AI/ML • Quick Sight
	AWS Tools	<ul style="list-style-type: none"> • AWS Customer Carbon Footprint Tool • AWS Well-Architected Sustainability Pillar 	<ul style="list-style-type: none"> • AWS Well-Architected Sustainability Pillar 	<ul style="list-style-type: none"> • Amazon Sustainability Data Initiative • AWS Data Exchange • OS-Climate 	<ul style="list-style-type: none"> • Amazon Sustainability Data Initiative • AWS Data Exchange • OS-Climate

Source: AWS

Overcoming business complexities in banking

Banking institutions have undergone a shift in the last decade. Electronic statements have replaced some physical statements, and online banking has reduced the need for physical branches, which in turn has reduced costs, and consumption of fuel and electricity.

Banks face new challenges. The SEC is making it mandatory for businesses to be transparent about their ESG metrics. However, no clear reporting standard has been adopted across banks, making it difficult to track ESG goals and metrics. It is further complicated by the difficulty to capture the actual impact of Scope 3 emissions, which are attributed to indirect sources such as upstream and downstream value chains. Customer behavior is also shifting post-pandemic, creating many first-time mobile banking users. Wells Fargo saw a 35% increase³⁰

in remote check deposits and a 50% growth in online wire transfers. However, most banks continue running their applications on their own data centers, which often have carbon footprints and collectively consume nearly 1% of the global electricity demand³¹.

For banks to meet some of the changing consumer patterns in a sustainable way, there are three areas for impact: increasing digitization, carbon footprint reduction, and Cloud adoption.



Increasing digitization

Increased digitization across the value chain can reduce operational inefficiencies and associated carbon footprint. Opportunities may include an increased use of chatbots, paperless processing of claims and loans, and digital transactions.



Assessment of current state carbon footprint

An evaluation of businesses' current carbon footprint can help identify primary abatement pathways to prioritize emissions reduction programs. While Scope 3 emissions are difficult to measure directly, secondary research, estimations and market studies provide interim mechanisms to prioritize supplier choices.



Adoption of public Cloud

Cloud adoption may have benefits of modernizing applications, reducing energy consumption and associated carbon footprint, and increasing agility to help compete with evolving customer needs and preferences.

Source: Deloitte

Migration to Cloud can help financial institutions reduce their carbon emissions by 88%, with public Cloud providers like AWS leveraging environmental economies of scale. With Cloud, organizations tend to use 77% fewer servers, 84% less power, and tap into a 28% cleaner mix of solar and wind power versus their own data centers³². Additionally, Cloud adoption can present financial savings. The Financial Industry Regulatory Authority (FINRA), an American organization regulating brokerage firms and exchange markets, avoided costs worth US\$100 million³³ by moving its technology to AWS servers.

To migrate workloads to Cloud, banks may not need to start from scratch—there are tools that can help simplify this journey. The Green Cloud Capability developed by Deloitte's Cloud Workbook™ can help businesses get a better understanding of their current state carbon footprint and the impact of migrating workloads to Cloud on carbon footprint. In an assessment that Deloitte US conducted for an American financial services firm, a reduction of

23,000 metric tons of carbon dioxide equivalent (MTCO2e) in scope 2 GHG emissions was identified by migrating workloads across 9 data centers to Cloud. This was equivalent to the client planting 280,000 trees and taking 1,300 cars off the roads. Deloitte's ConvergePROSPERITY³⁴ is another tool that can help banks increase the value delivered to their customers. A Cloud-based solution, it can help banks personalize their offerings, scale up, and increase revenue.

To help achieve net-zero aspirations and GHG emission reduction targets, clients can use the Deloitte FocalPoint ESG solution on AWS to help evaluate their current organizational emission levels and provide granular insights on the high-impact opportunities to reduce emissions across their value chain. Deloitte's FocalPoint provides access to different analytical methodologies that can be customized to the available data and generate insights focused on material Scope 3 emission categories for the client which can help them choose the right suppliers based on their Sustainability goals.

Move towards Smart Manufacturing

One of the greatest impacts of the industrial revolution can be observed across the manufacturing industry. With advancements in technology in production techniques, manufacturing is now characterized by mass production and mass consumption.

Today, the manufacturing and production sector alone contributes to 16% of the global Gross Domestic Product (GDP)³⁵. However, as a sector, it is one of the largest contributors of carbon emissions, accounting for 23% of the total direct Green House Gas emissions in US³⁶. In Europe manufacturing is one the largest emitters of GHGs, emitting 880 million tonnes of carbon dioxide³⁷ annually. With businesses competing

for consumers' attention, they are creating more personalized and localized variations of products³⁸, leading to wastage of raw material. This consequently can lead to an indirect increase in the carbon footprint. Several changes throughout the manufacturing value chain could address the reduction of GHG emissions without negatively impacting value creation:

Evolving with industry 4.0 and adopting smart manufacturing

Emerging technologies like Cloud computing, artificial intelligence, additive manufacturing, and machine learning that constitute Industry 4.0 can help early adopters become more efficient with managing waste. Along with recent developments in the field of artificial intelligence (AI), AI could help achieve 79% of Sustainable Development Goals (SDGs)³⁹. Smart Manufacturing builds on the larger digital transformation driven by Industry 4.0. Using a technology-driven approach, Smart Manufacturing leverages the Internet of Things (IoT), Big Data analytics, and computerized controls to help automate operations, gather data to optimize manufacturing processes.

Adoption of circular economy

A circular economy can help reduce wastage of products and raw material through reuse, sharing, repairing, refurbishing, and recycling existing materials and products to leverage the highest possible value for as long as possible. A circular economy can help improve labor utilization, reduce raw material inventory, and optimize production. A circular economy can help us reduce our consumption and people's needs can be fulfilled with just 70% of the materials the world currently uses⁴⁰.

Application of digital lean manufacturing

Lean manufacturing is a technique aimed to help minimize manufacturing waste and enhance productivity by removing all activities that do not add value to the overall process⁴¹. With Digital Lean Manufacturing, manufacturers can build on lean principles and leverage new technologies such as machine learning and predictive maintenance to help reduce carbon emissions and advance the Sustainable Development Goals towards sustainable production and consumption. Digital lean manufacturing can improve quality by up to 35%, reduce costs by up to 20%, and improve safety and sustainability by up to 10%⁴².





With the adoption of technology across manufacturing, the global IoT in manufacturing is expected to grow by approximately 25% from 2022 to 2030⁴³ which would result in an increase in the data that is stored by devices connected to the internet for analytics. This data is often stored in silos and in self-managed data centers. By shifting to Cloud, organizations can improve their supply chains' efficiency, reduce the amount of energy consumed in datacenters, improve forecasting, and automate processes to gain a competitive advantage. According to a Gartner Smart Manufacturing Survey, 84% of manufacturing businesses have a smart manufacturing strategy to help them increase competitiveness, but only 49% of them have started implementing, or deployed the strategy⁴⁴. Evidently, moving to Cloud to enable smart manufacturing can help drive efficiencies and savings across people, planet and prosperity.

Deloitte's Smart Factory Accelerator⁴⁵ is a manufacturing solution that helps to simplify the process of synchronizing people, assets, and operations to help enable a connected platform for businesses. Smart Factory includes a suite of multiple applications hosted on Cloud that help businesses schedule and track materials, monitor machine health, and dispatch job assignments in real time—simplifying visual management and helping ensure that resources and people are in the right place at the right time. Not only has Smart Factory driven improvements in our clients' bottom line⁴⁶, but also can help bring down consumption by eliminating waste. Smart Factory can help improve asset efficiency by approximately 20% and product quality by ~30%. Smart Factory has also helped Deloitte's clients reduce costs by ~30%, while helping improve safety and sustainability by ~10%.





Conclusion

There are many motivations that have spotlighted the importance of sustainability in recent years, and it is evident from the [2022 Deloitte CxO Sustainability Report](#) that businesses no longer consider this a nice-to-have but instead, one of the Board level priorities. While advancements in technological solutions can help with scale, supply chain transparency, and global regulatory standardizations are still very much forming, and consumerism with societal good is clear. Action should be taken now in order to change how business is done. Technology is one of the key enablers to help achieve sustainability goals. From digitizing and automating operations across the value chain, to reducing waste and reducing carbon emissions, a sustainable technology foundation can help accelerate the ability for businesses to create a lasting impact— for our people, our planet, and overall prosperity.

While businesses may require an operational transformation to accomplish this, there are avenues that can be started now. Deloitte has developed accelerators, tools, and services that, along with engaging Cloud service providers such as AWS, can act as the catalyst for businesses to embark on their sustainability journey. Deloitte is committed to driving sustainability for its clients and has invested US\$1B in its Sustainability and Climate⁴⁷ practice to help clients achieve sustainability goals. To meet Amazon's Climate Pledge commitment to reach net-zero carbon by 2040, AWS is committed to running its business in an efficient way to reduce its impact on the environment, and Amazon is on path to power its operations with 100% renewable energy by 2025, 5 years ahead of the original goal. Collaborations across engagements and joint development of tools and services can help bridge the techno-functional gaps that might exist in enterprises' current practices, helping businesses become more sustainable. Together we can help accelerate our mutual paths towards a more sustainable future.

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