



Improving sustainability and smarter resource use with IoT technology





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As ocean levels rise and extreme weather events happen more often, urgency grows to limit activities that contribute to potentially disastrous, ongoing changes to the planet's climate.

Earth's urban centers, which will add another 2.5 billion people by 2050¹, are major contributors to climate change, as cities consume more than three-quarters of the world's energy and produce more than 60 percent of greenhouse gas emissions.

Against this backdrop, sustainability has moved well beyond being a buzzword to becoming a vital principle for organizations around the world. Sustainability refers to the ability of something to maintain itself over time, but in the context of the global environment, sustainability means meeting our own needs without compromising the ability of future generations to meet their own needs.

As large governmental bodies try to reach global agreements, companies and regional governments increasingly are stepping up. By pledging to reach carbon neutrality and reduce consumption of limited resources, they can improve everyday lives by reducing pollution and other harmful environmental effects.

Beyond those enormous benefits, sustainability efforts can generate business value. Several of the world's largest banks have committed to invest trillions of dollars in clean technologies and sustainable development². Looking forward, 40 percent of respondents in a recent survey said they expect their company's sustainability programs to generate modest or significant value in the next five years³. The best approach to achieving sustainability isn't the same for every organization. But incorporating technological solutions into sustainability plans can accelerate the time it takes for an organization to reach its desired outcomes and realize benefits.

1. Renewable energy production and efficient distribution

2. Creating smarter, more carbon-neutral places to live and work

3. Enhancing quality of life

4. Improving agricultural/food sustainability

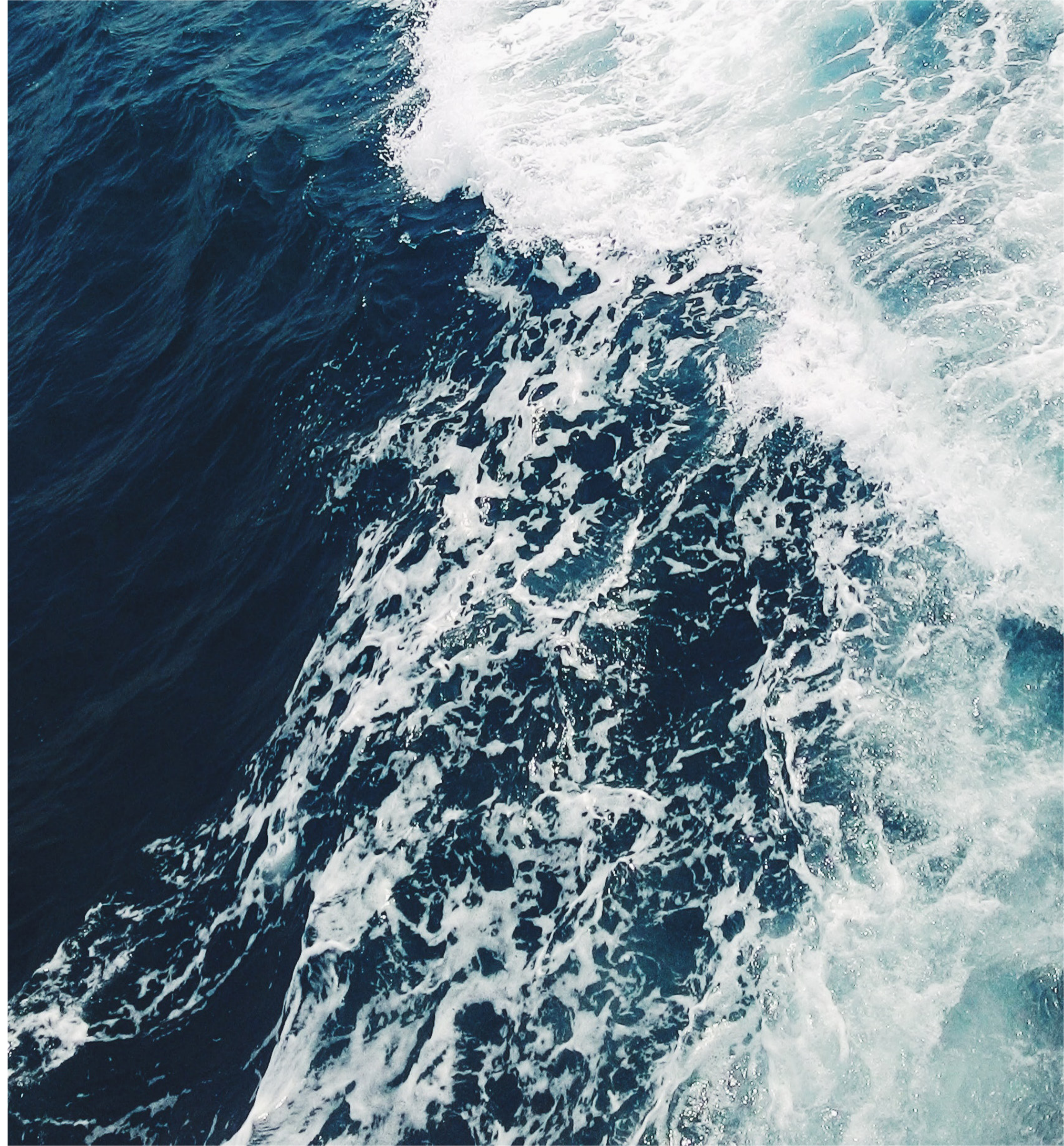
Technologies that can drive sustainable shifts

The Internet of Things (IoT) and artificial intelligence (AI) can help achieve sustainability by providing data and analytical insights into how resources are being used, where leaks or faults are affecting consumption, and where efficiency or production can be improved. Such technologies also can simplify ways to automate or control sustainability.

AI can take data from IoT systems and guide actions that will save energy and resource use. Digital Twins technology, an IoT platform, creates digital models of real-world things that construct even more detailed insights for understanding how to drive sustainable operations.

The potential amount of resources saved by deploying and intelligently using these technologies is significant. A 2021 study estimated that IoT solutions could save up to 8x the energy they consume by 2030 while also reducing carbon dioxide emissions and water usage⁴.

34% of organizations are prioritizing sustainability goals in the next year.



Renewable energy
production and
efficient distribution



Electricity generation is a significant source of pollution, with the sector producing 25 percent of all U.S. greenhouse gas emissions as of 2019⁵. Vehicles are the only bigger contributor of harmful emissions. IoT and AI technology can be applied to help production plants to operate as efficiently and cleanly as possible. These digital tools also are becoming part of renewable energy production facilities. For example, a wind farm is using the modeling capabilities of digital twins technology to maximize energy production, reduce maintenance costs, and improve the design of future wind turbines. The technology also constantly monitors for any problems, an important benefit for wind farms, which are often located on remote hillsides or offshore. Additionally, utilities are using IoT solutions to monitor and manage electricity transmission and distribution grids to achieve maximum efficiency, direct additional power to certain areas as demand fluctuates, and detect outages as soon as possible.

73%

of IoT adopters see it as very important for progress toward sustainability goals, but only 43% are adopting IoT to achieve those goals.




Real-time monitoring of power plants and facilitation of electricity trades to balance supply with demand are complex tasks that require effective handling of large amounts of data. [smartPulse](#) uses IoT and AI technologies to manage these workloads, along with power plant planning and cost management strategies. With Microsoft Azure-based platforms and tools, smartPulse software gives energy companies the ability to manage imbalances in a financially favorable way.



The long turbine blades created by [Siemens Gamesa Renewable Energy](#) are among the largest one-piece composite structures in the world and require perfectly smooth surfaces to operate at peak performance. Any flaw in the composite layers that form the blades can affect other layers, reduce performance, slows down production, and increases costs.

Siemens Gamesa worked with Microsoft and adopted a solution based on Azure IoT and augmented by a range of interconnected Azure technologies. Now, laser-augmented reality and high-resolution machine vision scans blades as they are formed, shows technicians where to position material layers, and gives immediate feedback about potential flaws.

An aerial photograph of a modern city skyline at dusk. The sky is a mix of blue and orange, with scattered clouds. In the foreground, a prominent building with a facade of vertical blue slats is visible. The background shows a dense cluster of high-rise buildings. A dark blue semi-transparent rectangle is overlaid on the left side of the image, containing white text.

**Creating smarter,
carbon-neutral places
to live and work**

Buildings are significant contributors to climate-changing causes, with the construction and operation of buildings creating 38 percent of total energy-related emissions of carbon dioxide around the world⁶. Lighting, heating and cooling, and other activities inside office buildings, houses and high-rise residential structures, and even large buildings such as factories and stadiums are vital for everyday living, but they leave an impact.

It's possible to reduce that impact, however, by constructing with more sustainable materials and adopting solutions that help to reduce the carbon footprint of buildings while keeping them comfortable for the people who live and work in them. IoT technology, digital twins modeling, and AI can employ data-driven strategies to improve resource efficiency, for example.

Digital twins solutions have proven especially useful in planning and managing buildings, as they allow for the creation of custom defined, detailed digital representations that can be used to gauge the possible effects of different designs or sustainable management techniques.

IoT systems also can connect and automate lighting and climate-control systems in ways that reduce energy usage. Implementing such solutions in one large building can make a difference. A city full of buildings and municipal infrastructure using such technology can make a tangible difference in energy consumption and carbon emissions.

Vasakronan

Sweden's largest real estate company, [Vasakronan](#) is a global leader in sustainability that demonstrates such practices are good for business. By adopting IoT and digital twins solutions for its commercial and office properties, Vasakronan has seen energy cost savings.

Vasakronan aims to become climate neutral across all of its business, including construction efforts and tenant activities. To perform complex analysis on what actions are most beneficial in lowering environmental impacts, the company deployed Azure Digital Twins and ProptechOS, a building operating system designed by Idun Real Estate Solutions that uses Microsoft Azure IoT Hub, Azure IoT Edge, and Power BI.



[Energy Metrics](#) makes a cloud-based smart energy monitoring and control solution that is designed to boost facilities' energy efficiency and air quality while also reducing costs. The company's solution runs on Microsoft Azure IoT Hub, capturing millions of data points and working with devices such as smart wireless thermostats and smart light switches. The solution can reduce energy use and costs and be controlled remotely using customers' existing wireless and IT systems. In addition to monitoring and improving energy efficiency and air quality at facilities, the solution can reduce operational expenses and maintenance visits through equipment monitoring.



Enhancing quality
of life

The often-overlooked infrastructure in our communities, from public lighting to water systems, can work more efficiently or safely when incorporating IoT sensors, AI, and related technologies. These smart systems can turn on and off streetlights, digitally monitor water quality and consumption, and even help traffic engineers figure out and automatically adjust traffic signals to keep vehicles moving at ideal speeds. IoT solutions also can keep transit passengers informed about when to expect buses or trains to arrive.

The benefits include better monitoring of how resources such as electricity and water are consumed and insights into how to reduce that consumption, saving local governments money and reducing their greenhouse gas emissions. Additionally, connected devices such as streetlights or critical stormwater system components can notify city employees in real time when a light burns out or a valve fails. While not as critical to public safety, IoT sensors and data analytics are even helping to monitor and control grass-growing conditions in a sports arena to ensure the field is optimal for professional play.

50% of IoT adopters expect to reach carbon net zero by 2025



Automating the quality of indoor air quality keeps buildings comfortable and healthy for residents or workers inside without requiring manual checks. [ICONICS](#), an automation software provider, partnered with [Sysinno](#), to create an [air quality monitoring solution](#) that uses Azure to monitor and provide information on temperature, humidity, and carbon dioxide levels in a building. When any of those measurements fall outside preset levels, the solution controls the HVAC system to increase airflow, warm or cool the building, and even turn on air purifiers.



THE CITY OF VALENCIA

When the city of Valencia in Spain launched a lighting upgrade to make the historic city more pedestrian-friendly, city officials also wanted to lower energy costs and minimize wasted light. That second factor was particularly important in Albufera Natural Park in Valencia, where excess light can disrupt wildlife and plants. [Schröder](#), a leading lighting solution provider, upgraded the city's network of 107,000 light fixtures, and [Codit](#), a cloud integration solutions provider, tied Microsoft Azure IoT technologies into the Schröder platform. As a result, the city reduced its electricity consumption, saving millions of euros in the first year alone and reducing greenhouse gas emissions by 8 percent. The new fixtures are designed to direct light away from wildlife, and the onnected fixtures alert city workers when there's a failure.

Improving agriculture and food production



Farmers are viewed as innate experts on how to determine the best crops to grow depending on everything from the condition of the soil to the predicted weather. In the past, such decisions were based largely on educated guesses.

Today, however, agricultural decisions are increasingly driven by technology and data. From tractors and combines that can identify how much yield farmers are getting to planting equipment that relays information about soil characteristics, those resources are helping to grow better, more plentiful crops while also guiding sustainable growing practices. Those trends explain why the market for AI products and services in agriculture is growing at a compounded annual rate of more than 28 percent through 2024, according to Research and Markets.

In regions of the world where agriculture is prevalent, AI technology has led to greater profitability in the farms. But using IoT and machine learning to gather data on crops and their farm environments can also inform decisions that lead to reduced pesticide use or more efficient watering practices. For example, crop monitoring devices that measure moisture can accurately determine when and how much to water the plants. Computer vision technology can detect when weeds or pests are threatening a growing area.

IoT and AI technology is even contributing to the development of self-driving tractors at a time when farm labor shortages are becoming more common.

The logo for North Carolina State University, featuring the text "NC STATE UNIVERSITY" in white, bold, sans-serif capital letters on a red rectangular background.

The [N.C. State Plant Sciences Initiative](#) (N.C. PSI), an agricultural research initiative based at North Carolina State University, is using faster and more efficient data management to tackle some of agriculture's biggest challenges. Potential benefits from this IoT-assisted research initiative are enormous, including predictive food analytics, increased food safety, and boosting crop yields.

Working with Microsoft Azure and SAS Analytics, the N.C. PSI has equipped research teams to collect actionable data from the plants themselves. The team relies on a portfolio of advanced technologies based in the cloud, including Microsoft Azure, Microsoft Teams, SAS Analytics, Azure IoT, and Azure FarmBeats.



Boosting production of food helps feed the world, but it takes effective packaging to safely ship staples to consumers. Tetra Pak is using technology to better process food and ships it in sustainable and recyclable packaging.

[Tetra Pak](#) uses Microsoft Azure IoT Hub to provides a holistic view of productivity, safety, and quality data on a global scale. Employees at the company's facilities use the insights from IoT Hub and surfaced in Power BI to work more efficiently. Today, 24 IoT-enabled Tetra Pak facilities access monthly factory data in near-real time, which helps employees to quickly pinpoint potential issues.

Start accelerating your sustainability plans

As sustainability becomes an imperative for more organizations, innovations that enable us to live and work in more sustainable ways keep expanding. The potential of IoT, AI, computer vision, and related technologies offered by Microsoft and its partners to improve efficiency, reduce emissions, conserve vital resources, and even grow more food is still being realized.

Microsoft Azure IoT allows developers to connect, analyze, model, and automate a wide range of industry-specific solutions from the edge to the cloud. The Azure platform and suite of IoT, AI, and digital twins tools can help to transform businesses, manage utilities to reduce waste, or reduce the time it takes to develop and launch sustainably oriented apps. Solutions from our ecosystem of partners can assist in turning business goals into achievable results by generating valuable insights, enabling automation, and controlling actions to reduce the use of our planet's resources. Learn more about how Microsoft [Azure IoT](#) can help your organization.



Sources

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