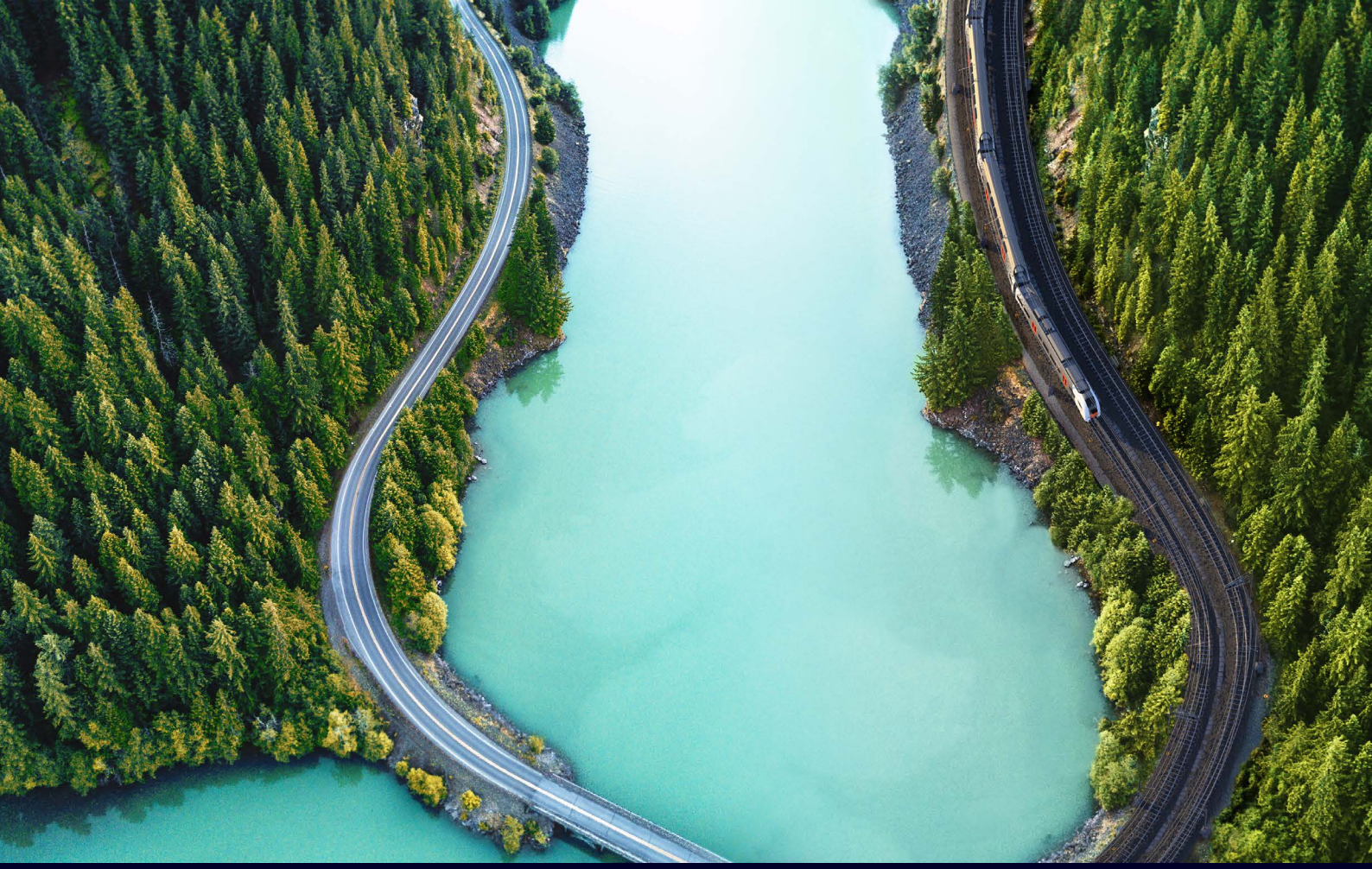


THOUGHT LEADERSHIP REPORT

A roadmap to **innovation-led sustainability**

How digital transformation can open up new pathways to sustainability for industry

SIEMENS

Index

INTRODUCTION

Welcome to innovation-led sustainability

The race is on. The businesses that most swiftly identify how to grow sustainably will transform their industries and secure enduring competitive advantage. The potential to move ambitiously, for the benefit of all stakeholders, is simply too valuable to ignore.

The challenge is a broad one. Sustainability requires organizations to work out how to meet their own needs without compromising the ability of future generations to do the same. They must invest in a greener future but maintain profitability, even though many new sustainable technologies do not yet have proven business cases at scale. This will include obvious imperatives such as decarbonization, emissions reductions and resource efficiency, but also wider ambitions around economic and social impact.

Businesses are confronting these issues – and they have to. Policymakers are increasingly setting decarbonization targets and requiring all businesses to report publicly on their progress. Stakeholders – from employees to investors and from customers to suppliers – are demanding positive change.

All companies must respond, but industrial energy faces particular challenges, since this usage accounts for 24% of greenhouse gas emissions globally[1]. In Europe alone, the industrial manufacturing sector emits 730 million tons of CO_2 equivalents every year[2]. And, while European organizations have made some improvements, the European Environment Agency forecasts only a moderate decrease of 6–8% in emissions in the years to 2030[3].

Still, what is so encouraging is that leading organizations are not focusing on sustainability only because they have been instructed to do so. Rather, they are driving change because they recognize the tremendous opportunity at hand. They see the potential for growth that creates new value for their businesses – for their investors, certainly, but also for people and the planet as a whole.

To fulfill that potential, a broad and growing range of digital solutions offer businesses new routes to sustainability. These solutions can reduce impacts and support new business models and opportunities. For those organizations determined to set an example on the climate agenda, sustainability and transformation will go hand in hand, securing societal benefit and competitive advantage.

In this report, we explore this possibility, considering how holistically applied digital solutions can deliver the sustainability gains that growing numbers of businesses are looking for.

1 https://ourworldindata.org/emissions-by-sector
2 https://www.eea.europa.eu/publications/trends-and-projections-in-europe-2021
3 Ibid.

Our key conclusions, detailed throughout the five chapters of this report, are as follows:

1. **The transition to sustainability is digital.** Your roadmap to sustainable growth is inextricably linked to your organization's digital transformation strategy and the partners through which you will deliver it.
2. **The whole will be greater than the sum of its parts.** Don't focus on individual solutions, even if they unlock sustainable growth. Rather, look at working with complementary tools and providers to accelerate your progress.
3. **Digital transformation is a process of continuous improvement.** Through an ongoing cycle of planning, implementation and evaluation, your organization can create virtuous cycles, constantly iterating for better results.
4. **Innovation-led sustainability will create new business models and revenue streams.** Digital technologies provide the way to secure these advances.
5. **You cannot do this alone.** Platforms and ecosystems provide your organization with a one-stop-shop for accessing multiple digital solutions from a community of suppliers and developers. The right combination of these solutions will vary according to your organization's specific needs.

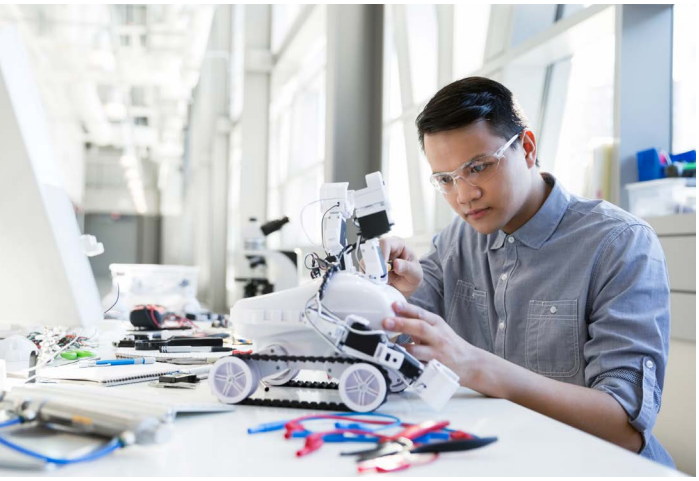
The bottom line is that by combining the real and digital world – meaning merging of physical and virtual worlds to create new environments and visualizations, where physical and digital objects coexist and interact in real time – every organization can create a virtuous cycle of sustainable growth.

To achieve that, it will be crucial to simplify the highly complex task of digital transformation – to scale solutions and bring together the numerous different technologies and partners. Industrial business platforms will be vital instruments in facilitating and accelerating digital transformation for the mutual benefit of all partners. They will enable organizations to collaborate across devices, applications and systems to build and integrate sustainability solutions in every area of their activities.

PART 1

Planning and iterating for **sustainability**

Sustainability must be central to the business's strategic vision, rather than an isolated (or even competing) activity.



These are not challenges to be mitigated, but opportunities to harness sustainability goals as a growth engine and, ideally, make them part of the business model and planning. Moreover, when businesses integrate their sustainability initiatives into digital transformation strategy, they will see an acceleration of both processes.

The starting point is to devise a route to sustainability. This will map out how to achieve ambitions such as net zero operations, identifying the tools that the organization requires and the platforms where these may be available. It will highlight potential partners for sustainability initiatives – Siemens' Xcelerator platform, for example, includes a marketplace to explore, educate, exchange, and purchase alongside a community of customers, partners, and experts. Such platforms can also provide inspiration, offering examples of initiatives successfully deployed elsewhere – at other organizations, or even in other industries – that might now be fit for purpose in a new setting.

A sustainability roadmap will also define achievable goals at appropriate stages – target dates for achieving set emission reductions or carbon neutrality are obvious examples. This will not be a journey the organization takes independently of other business objectives; instead, its sustainability roadmap is integral to the rest of its strategic planning.

Digital solutions will be required to enable that planning. For example, every organization will need to establish a baseline of where they currently stand on their key sustainability goals. For that, they will need tracking technologies such as sensors, edge computing, cloud solutions, data analytics, the Internet of Things (IoT), and artificial intelligence (AI). Connectivity is vital: without accurate data available across the enterprise, businesses will lack the visibility and transparency they need to set meaningful and achievable sustainability goals – and, later, to track their progress toward them (see Part 3 of this report).

Digital technology can also play a key role in assessing plans and products before they are implemented. Digital twins, for example, allow organizations to test sustainable solutions before they are even built. By conducting a virtual-reality, real-time representation of a new building, power grid, or even an entire city, it is possible to simulate, test, and fine-tune sustainability prototypes without sinking a single spade into the ground. The twin can replicate existing operations in digital form, so that project managers can understand the impacts of sustainability measures before going live.

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At one Siemens factory in Amberg, in northern Bavaria, the company used digital-twin technology to develop a sustainability path for the facility, in line with its ambitions to decarbonize its factories by 2030.

"We analyzed the factory in its current state: what the building looks like, [how much] energy the industrial processes consume, and the electricity, heating, and cooling needs of the facility," explains Stefan Niessen, Head of Technology Field Sustainable Energy & Infrastructure at Siemens Technology. "Then, we fed that data into a digital twin of the factory in order to design a multimodal energy system that develops a step-by-step path to decarbonization."

The applications of digital twins are not limited to planning and developing more sustainable factories, but can be applied to any aspect of the business. They can be used for simulating, producing, and optimizing any product or space – from prototype cars to airplane designs, and from buildings to whole cities. They even allow the possibility of testing out untried technologies such as hydrogen and electro-thermal to project their likely impact before progressing to full-scale implementation.

> You can run a virtual vehicle, or a digital twin of the vehicle, on a digital twin of a road.
>
> **Eryn Devola**
> Vice President of Sustainability, Siemens Digital Industries

Transportation is a good example, points out Eryn Devola, Vice President of Sustainability at Siemens Digital Industries. "You can run a virtual vehicle, or a digital twin of the vehicle, on a digital twin of a road," she explains. "This way, engineers can run through all possible what-if scenarios to find the best-possible solution before the first prototype of a car is even built."

Other types of digital simulation, including augmented and virtual reality, can add enormous value at the planning and development stage. For example, by asking workers to test proposed new production lines in virtual reality before moving to construction, it is possible to optimize staff health and safety conditions and productivity simultaneously.

The now-emerging real-time, immersive industrial metaverse will accelerate this transformation further. Digital-twin technology is the nucleus and key building block for this virtual world. AI-enabled, photorealistic, physics-based digital twins will drive efficiency and transform industries, taking industrial automation to a new level.

Even as businesses move from planning to implementation, connecting projects, often via edge computing, to data analytics and AI, tools will continue to offer valuable insight. IoT technologies provide a constant reading of assets' current performance. As this data feeds through into control systems and other applications, areas of inefficiency can be identified and focused upon, encouraging a routine of perpetual improvement.

CASE STUDY

How GeoPard Agriculture is helping farmers build sustainable business models

Cloud-based GeoPard Agriculture uses big data and cutting-edge analytics technologies to promote sustainable, biodiverse crop-farming methods. Its work enables farmers to rethink their business models and plan for greater sustainability and profitability simultaneously.

"Sustainability is a fundamental part of precision agriculture," says Dmitry Dementiev, Co-Founder of the business. "It's about how to optimize work in your field to make it sustainable in the long term."

To deliver that goal, GeoPard sources information from a wide range of data sets, including satellite imagery from the European Space Agency and NASA; topographical data from public-sector authorities; and operational inputs from farmers, including soil analysis and drone imagery.

The aim is to build highly detailed 3D maps of agricultural land. GeoPard's analytics can then advise farmers on the right crop mix, ideal planting locations, precise amount of fertilizer and nutrients required, and which fields should be rested and when. Farmers can request different outputs tailored to their goals – for example, to maximize crop yields while also promoting biodiversity, improving sustainability, and moving toward carbon farming.

"Farming is about planning, but there are 500 different parameters that might influence your yield, and [varying] weather conditions mean you cannot directly compare one year with the next," says Dementiev. "If the farm is not balanced and sustainable for the long term, it will not be as profitable as it could be. Planning for that with data-driven understanding of the potential of your fields is so valuable."

PART 2

Implementation: Starting to connect the real and digital worlds for sustainable success

There is no rule for businesses outlining which technological and digital solutions to prioritize as they pursue their sustainability goals. On the contrary: it is about choosing the right components – modular and interoperable.

Selecting from a broad range of digital solutions that can then be implemented in coordination offers exciting possibilities, but the optimal combination will be different for each business.

The key here is to recognize that connecting the real and digital worlds does not only mean digitizing certain processes, but also embracing more holistic transformation. The challenge is to find or develop solutions that both tackle a single, isolated problem and can work across a whole business or ecosystem. One challenge may follow the next, but the big picture remains crucial and solutions must be compatible. It will also mean working with partners to jointly accelerate digital transformation tailored to the business's specific goals. Business platforms such as Siemens Xcelerator provide a single space within which to find these solutions.

One likely constant is a need for tools that enable organizations to manage their energy and power systems efficiently. Such software can provide critical solutions as organizations seek to measure the integrated operational performance of their technology-supported networks and respond with precise manual and automated adjustments. And it can operate both at individual facilities and across broader networks – potentially unifying whole districts or cities. Indeed, digital transformation will need to incorporate sustainable networks connecting multiple components across separate sites.

In Wunsiedel, northern Germany, a town known for its annual Luisenberg festival, **SWW Wunsiedel GmbH**, the local utilities company, has embarked on an ambitious project to build a renewables supply network. "Wunsiedel is no longer just a festival town; it's also an energy town and is on its way to becoming a smart city," explained Karl Willi Beck, Wunsiedel's then Mayor.

SWW Wunsiedel GmbH's initial project encompasses power and heat generation, storage, control, and protection systems, and energy efficiency. Going forward, it envisages a power-to-gas or power-to-liquid plant, as well as pooling solutions involving battery storage and an electrolysis system. Crucially, every component of the system will be connected digitally by Siemens' industrial IoT solution, which collects and stores operational data and then makes it available to systems operators who use it to optimize efficiency and sustainability. In this sense, says Marco Krasser, Managing Director of SWW Wunsiedel, "Digitalization is not Facebook, Twitter, and the rest – in reality, it is the basis on which we will optimize our lives."

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Digital-twin technologies continue to support that objective. One good example of that is **Expo City Dubai**, built for the first Expo to be held in the Middle East and intended as a blueprint for smart cities worldwide. Today, long after completion, a digital twin of the site enables its management teams to optimize operations, reduce carbon emissions, conserve water and energy, and enhance visitor comfort and security. Operators monitor the digital twin through a web-based smart city app that generates a constant feed of actionable insight from connected systems across the site.

The ambition in such projects is to create an eternal feedback loop – a virtuous cycle of continuous learning and improvement. "Digitalization and digital

solutions are catalysts," says Michael Combach, Vice President at Siemens Advanta Consulting. "They boost the impact and effectiveness of companies' sustainability actions."

Finding new ways to ensure that every organization can pursue its sustainability goals through such projects will also become more important. With the accessibility of high-end solutions on digital business platforms, this digital transformation is becoming deeper and broader. And the evolution of a real-time, immersive industrial metaverse offers even more. Industrial companies of all sizes will be able to create closed-loop digital twins with real-time performance data to run hardware-in-the-loop simulations and AI-accelerated automation processes. This way, businesses can make decisions in real time and in confidence by connecting vivid real-time worlds with physics-based digital models.

An example is the **Digital Native Factory** from Siemens Motion Control in Nanjing, which already comes close to being a 'meta factory.' "From the first idea until the start of production, every step was digitally supported," explains Stefan Krug, Head of Lean Digital Excellence & Project Manager of SNCnew, Siemens AG. "We built up a detailed model of the factories step by step."

> We simulated the performance of the new factory even before we poured the first concrete.
>
> **Stefan Krug**
> Head of Lean Digital Excellence & Project Manager of SNCnew, Siemens AG

The digital twin was built from a combination of factory data, production-line data, performance data, and buildings information from the existing sites. "We simulated the performance of the new factory even before we poured the first concrete. We could plan the dimensions of the building, the material flows, and the required media supplies, such as nitrogen, power, and IT far more precisely," Krug explains.

Plant operators could walk through the site virtually using virtual reality glasses, and give feedback to fine-tune the final design. Each step in the planning process was generated, tested, analyzed, and optimized in the digital world – to guarantee the most efficient construction and later production. As a result, productivity could be improved by 20%, volume flexibility by 30%, and material replenishment by 50%, and it made the factory more resource-efficient and sustainable on the way.

Elsewhere, low-code software platforms featuring pre-build integrations and other tools will enable users lacking deep technical knowledge to develop apps and interfaces at speed. This will boost businesses' agility, enabling them to quickly respond to changing market conditions and remaining competitive. The benefits of low code include democratization of software development (citizen developers), ease of use, faster time to value, reduced costs, and accelerated transformation.

CASE STUDY

The University of Birmingham harnesses digital solutions

The University of Birmingham has set up a 'Living Lab' to capture data from its building technologies, estates infrastructure, and energy plants at its campuses in the UK and Dubai. The insights gleaned from this will drive R&D and support teaching.

The project uses tools including digital sensor and analytics technologies, AI, decentralized energy generation and storage, and renewable energy. All of these support the university's sustainability targets on an ongoing basis. The institution has made significant progress in sustainable operations, including achieving its 2020 target of reducing carbon emissions by 20%. But Professor Tim Jones, Provost and Vice-Principal, believes that, through capturing and analyzing far more data about the impacts of its activities, the university will be able to accelerate its decarbonization program even further.

"This will enhance our student experience and create new research and innovation opportunities while significantly reducing our carbon footprint," says Jones.

PART 3

Monitoring and analyzing data to create **cycles of success**

As businesses advance toward sustainability, they need more accurate ways of measuring progress – both to check that they are on track to achieve their milestones, and as part of reporting on sustainability initiatives to key stakeholders.

While transparency and accountability are crucial for both internal and external audiences, achieving them may not be straightforward. "We tend to underestimate the effort that goes into the monitoring and tracking of achievements, and the setting of all targets," warns Klaus Luetzenkirchen, Vice President Environmental Protection at Siemens.

The good news for businesses that have embraced digital transformation as a sustainability driver is that these initiatives will provide much of this evidence. Moreover, this data is now more accurate and timely than ever before. Industrial edge-computing solutions ensure that data can be processed immediately at the plant or machine where it is generated. Such solutions not only measure sustainability progress, but also provide valuable insight into measures to increase resource and energy efficiency and productivity.

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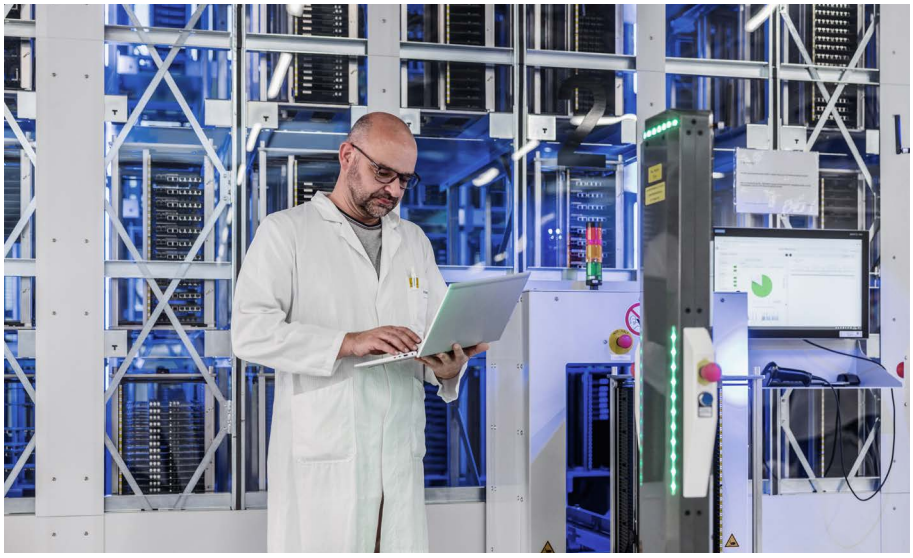
>
> **Klaus Luetzenkirchen**
> Vice President Environmental Protection, Siemens



> The digital transformation is essential but, actually, it's going to give you a platform from which to meet all the sustainability requirements.

Martin Powell
Head of Sustainability & Environmental Initiatives Americas, Siemens Financial Services

At Siemens' **Electronic Works Amberg** facility, the traditional approach to inspecting finished products relies on an automatic X-ray machine, but this limits capacity because each new machine costs €500,000. The alternative is AI. Data from sensors on the production line is transferred to a cloud through a controller and an edge device, where a trained algorithm processes the information, allowing it to assess whether soldered joints on the circuit board are free from faults. The benefits include reduced waste and more energy-efficient use of production-line capacity, as well as lower costs.

Such projects are a reminder of how the implementation of initiatives for digital transformation generate spin-off benefits: operational gains such as optimized throughput and cycle times, for example, come with sustainability benefits. "The digital transformation is essential but, actually, it's going to give you a platform from which to meet all the sustainability requirements," says Martin Powell, Head of Sustainability & Environmental Initiatives Americas at Siemens Financial Services.

Some new digital solutions provide enhanced data capabilities explicitly to boost sustainability. For example, Siemens' SiGREEN takes an ecosystem-based approach to emissions data, enabling reliable tracking of the carbon footprint of a product across the entire supply chain.

The initiative employs the open Estainium network, which uses a distributed ledger to enable manufacturers, suppliers, customers, and partners to exchange product carbon-footprint data in a secure environment. Using SiGREEN, this data can be aggregated to give the 'true' carbon footprint of a product – thereby giving businesses new insights into how to reduce that footprint. Most industrial businesses depend on estimates of their supply-chain emissions based on static average figures, but innovations such as SiGREEN provide dynamic data that builds a precise, real-time status assessment.

Another example lies in the digital tools that enable businesses to track and trace assets and inventory and ensure minimum downtime of expensive assets. In large organizations, this has the potential to drive significant improvements in cost and productivity because assets can be made available across the business, ensuring operational continuity and efficiency of resource use.

CASE STUDY

How Coca-Cola Europacific Partners is measuring supply-chain data to drive sustainability

Coca-Cola Europacific Partners (CCEP), the world's largest Coca-Cola bottler, is working on a big challenge: its sustainability targets, including an ambition to reach net zero by 2040, will require collective action to reduce emissions.

Over 90% of CCEP's value-chain greenhouse gas emissions come from its supply chain. So CCEP is asking its suppliers to set their own science-based carbon reduction targets, shift to 100% renewable electricity, and start sharing their carbon footprint data. But with supplier numbers in six figures including those beyond tier 1, tracking the impacts of those partners is tough. Working with them to reduce emissions is even more difficult.

Ralf Peters, CCEP's Vice President for Procurement, says digital solutions can help. "If you want to be ahead of the curve or among the early adopters, then you need to innovate," he argues.

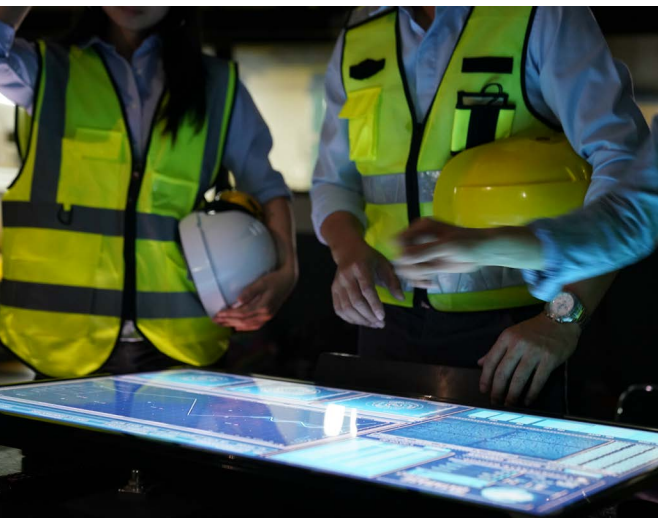
In this spirit, CCEP is building a digital platform on which it asks suppliers to post key data – on their performance on standards such as the EcoVadis ratings, but also on broader criteria such as evaluations of unfair trade practices. This enables the firm to identify suppliers that could jeopardize its targets (or, worse, its sustainability and ethical profile), and then work with them to improve their performance using a science-based target process.

"Then it becomes more digital," Peters adds. "Once you have identified where emissions come from and agreed on a science-based target with your strategic supplier, who has been validated and is on the journey with you, you start to exchange data. You move from using industry averages to supplier-specific emission factors."

PART 4

Building new business opportunities through **innovation-led sustainability**

Investment in sustainability was once seen primarily as a business cost – a necessary regulatory burden. However, the path to net zero is now recognized as having the potential to lead to new revenue-generating opportunities – and even to a fundamental improvement in how the business operates.



Municipal waste management can be transformed into a profit center and can contribute to a circular economy.

Waste management provides one example. For most organizations, waste disposal used to be a cost center – and a concerning one, because waste-management companies' charges and landfill taxes are on the rise. However, new models are emerging, says Siemens' Eryn Devola, that allow companies to reduce the loss of resources through greater circularity and more efficient waste management – therefore saving costs of disposal.

"We're talking to a start-up that takes all the waste out of a municipality and pays a fee for that trash," she says. "They divide all the waste into different streams – metal, plastics, fibers, and so on – and then find secondary uses." Such models are supported by a growing range of digital solutions, from smart bins that can weigh different types of waste to automation technologies that use virtual reality and image-recognition software to identify garbage. Even e-trading platforms for waste are emerging.

Municipal waste management can be transformed into a profit center and can contribute to a circular economy. Moreover, the aim is typically to supply manufacturers in the area, facilitating local production of goods and reducing emissions generated by long-distance transportation.

Digital tools can enable organizations to connect and engage with partners in new ways. Low-code solutions that enable individual communities and small businesses to develop their own apps that are tailored to their specific needs are one way to underpin such connections. The **Mendix** platform, for example, offers solutions for business projects that require the design and launch of new apps where software-development expertise is not available in house.

Finally, the industrial metaverse offers new opportunities for people to interact and collaborate to solve real-world problems and deliver improvements and cost savings for designing, producing, and operating real-world assets. This will unlock new savings and efficiencies because we can do things virtually before we do them for real.

More radically, more and more businesses are considering new or alternative business models, recognizing that the traditional 'make, consume, and dispose' model is unsustainable. Rather than manufacturing disposable products that are sold in a one-off transaction, businesses are building ongoing relationships with their customers that can extend to a contract to maintain the product with regular servicing – and eventually, perhaps, to refurbish it.

This 'as-a-service' concept benefits the manufacturer's revenue model, providing a greater proportion of recurring, predictable income rather than a single upfront payment. Relationships with key customers become more enduring and rewarding. There are clear benefits for customers, too, including lower costs, easier scalability, access to new releases and upgrades, and the possibility of experimentation and proof-of-concept projects.

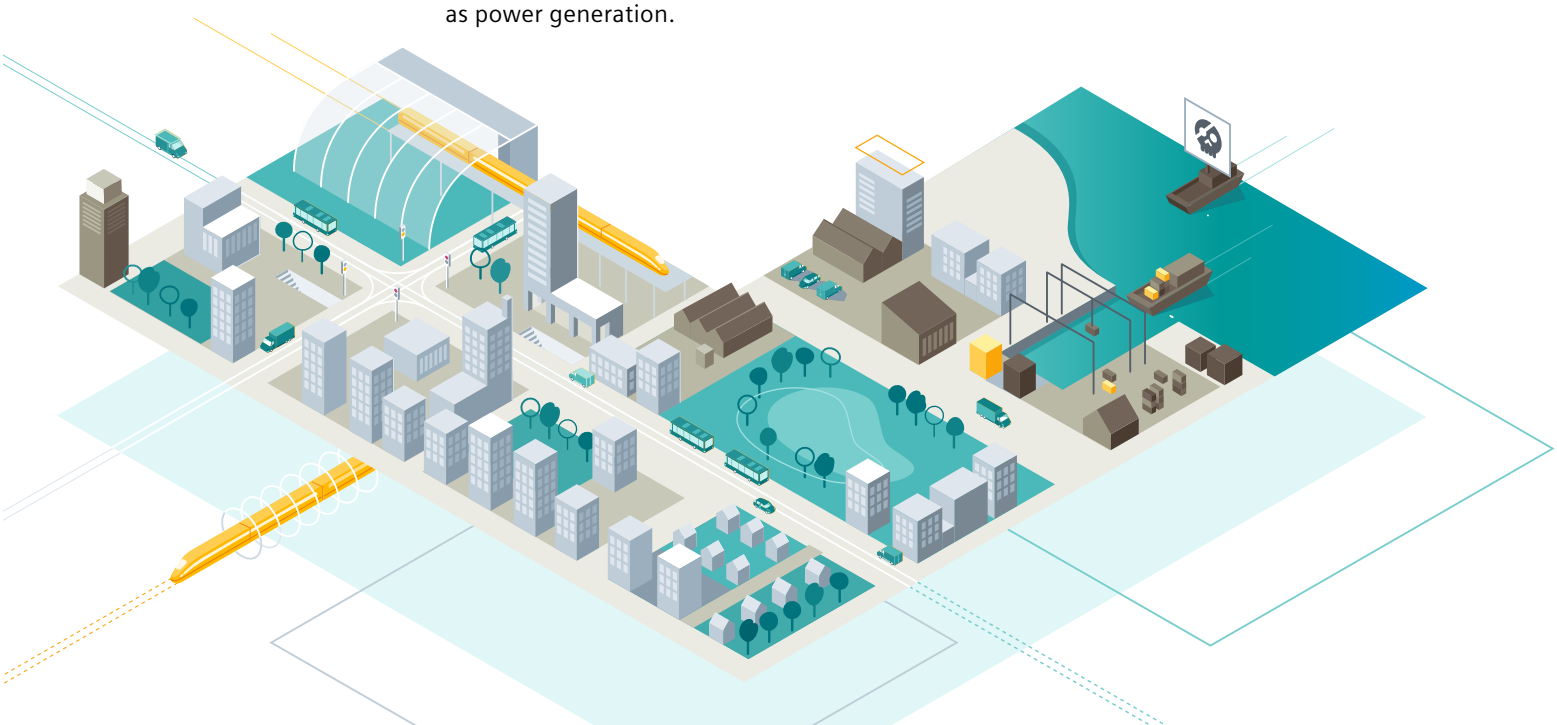
Businesses are building ongoing relationships with their customers that can extend to a contract to maintain the product with regular servicing.

In this world, hardware and software become constantly upgradable. Over time, third parties and partners may be invited to add their products and services, making for an even broader portfolio of open and interoperable technology. Think in terms of 'everything-as-a-service.' In the transportation space, for example, **Siemens' Mobility as a Service** apps and tools enable cities and public transport operators to integrate modes of transport and functions spanning trip planning, booking, ticketing, and payment.

For such models to work effectively, the manufacturer needs to be able to monitor the performance and condition of its equipment as customers use it.

IoT sensors provide the manufacturer with constant feedback on product use and can anticipate potential issues. In the aerospace industry, for example, providers such as Rolls-Royce and Pratt & Whitney are shifting to **as-a-service models**, selling their engines on the basis of variables such as usage time, with maintenance- and performance-tracking built into the deal. Such models are only possible because these manufacturers have access to performance and status data. Predictive analytics, using AI technologies, provide further benefits.

This will be an important principle as businesses install new capacity in areas such as power generation.



CASE STUDY

How You Mawo built a new digital business model for the eyewear industry

The founders of You Mawo felt it was time for change in the eyewear industry. Established manufacturers were producing thousands of generic pairs of glasses using mass-production techniques with huge inefficiencies and waste volumes. A new, more sustainable model was necessary.

The new model was built around You Mawo's innovative use of facial-recognition software in designing a pair of glasses that can be personalized for each customer. The product is made using an additive manufacturing process that employs 3D printing, rather than an industrial production line.

"Without building digital solutions, it's impossible to do what we are doing," says Daniel Szabo, Co-Founder of You Mawo. Its glasses are produced from polyamide powder, and any powder left over after printing can be reused in the production process. Szabo argues that because each pair of glasses is bespoke, their useful life is extended, which reduces long-term consumption.

"Most people think we are an eyewear company, but actually we are a tech company," says Szabo. You Mawo's additive manufacturing process is largely automated and can scale up easily, allowing the business to open new sites around the world as demand in local markets supports them.

"You can use the same workflow for all kinds of consumer goods and have the same impact," adds Szabo. "You extend the lifecycle because you have a good quality product for a good price. You produce it locally, just in time, and close to the consumer."

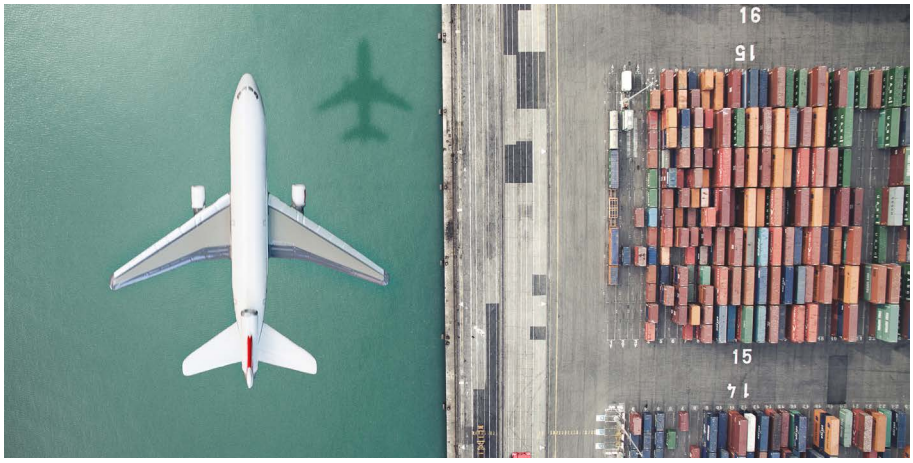
The impact of this business model has been impressive. You Mawo has been climate neutral since January 2021, with independent research suggesting that a pair of glasses made by You Mawo produces just a third of the carbon emissions produced in conventional eyewear manufacturing.

> Without building digital solutions,
> it's impossible to do what we are doing.

Daniel Szabo
Co-Founder, You Mawo

PART 5

Accelerate transformation through an ecosystem-based model



All of the individual digital technologies discussed in this paper (and more) offer exciting possibilities for driving sustainable growth models. But true transformation requires those solutions to be brought together to create a multiplier effect. Integration of every process across information and operational technologies – and even the full supply chain – will hugely accelerate the shift to sustainability.

However, no organization or technology provider can put in place such a comprehensive response entirely by itself. Sustainable innovation is most likely to come from partnerships in which businesses combine technology and share expertise. That enables them to pursue growth and develop new business models while decarbonizing their operations, minimizing their waste, and maximizing their resources – all of which are pressing challenges for business leaders.

Such partnerships can be immensely powerful, driving benefits for multiple stakeholders. At Aspern Smart City Research, for example, collaboration of this type is delivering multiple benefits for towns and cities (see box below). At another collaboration between **Siemens and Mercedes**, multiple partners are working together on digital manufacturing and efficient automation in the car production process, and simultaneously harnessing more sustainable and energy-efficient production methods in the automaker's plants.

These expansive networks draw together expertise from across the ecosystem. "If I'm the one that says, 'I have the data in a building,' and if I now make it available to others who are smarter about the shopping experience in a mall or, say, operating the elevators, I become part of the ecosystem," says Johannes Thul, Senior Director Strategy at Siemens Smart Infrastructure. "Siemens brings data together to optimize the building, and if customers allow, partners can profit from the data to optimize their core areas within the building."

The number of these more extensive ecosystems is growing. In northern Germany, for example, Siemens is involved in a project to develop energy-distribution grids optimized for renewable-energy sources and connections. It spans 21 different ecosystem participants, offering expertise in areas such as grid management, rural and urban planning, and components manufacturing, and also involves two non-governmental organizations.

Some partnerships will be more about socially conscious collaboration than commercial endeavor. Groups such as **Corporate Eco Forum** and **The Climate Pledge** bring together like-minded public and private organizations to forge new business strategies for sustainability. Organizations such as the **Science Based Targets initiative** (SBTi) and the **World Economic Forum** provide further support.

Data exchange is another area where ecosystems can create value. In automotive, for example, the **Catena-X** network is building a continuous data exchange for contributors from across the industry's value chain. The aim is to develop an operating system with standardized protocols that govern end-to-end data chains and create collective intelligence banks to serve several use cases, including securing data sovereignty and interoperability.

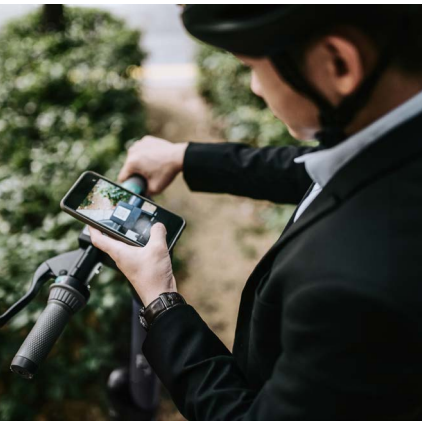
The best ecosystems will promote and support growth, efficiency, resiliency, flexibility, user experience, and sustainability. This will reduce time to market and time to scale. By sharing best practice, every member of the ecosystem can nourish their digital transformation with a wider range of expertise than is available to any of them individually.

The best ecosystems will promote and support growth, efficiency, resiliency, flexibility, user experience, and sustainability.

Each participant brings with them clients to connect with other members of the ecosystem, giving those clients access to a wider range of expertise and a one-stop-shop for solutions, and creating new value for all. A healthy ecosystem is a mutually supportive community of experts focused on delivering superior solutions for clients.

To offer the greatest benefit, ecosystems will also require organizations to work with new partners – including close competitors. That could become uncomfortable, particularly when it comes to data sharing in industries that are highly protective of their intellectual property. Solutions such as Estainium, which use a low-energy blockchain to enable data sharing while protecting security and confidentiality, will be crucial to easing these new relationships.

Above all, says SWW Wunsiedel's Marco Krasser, every organization in the ecosystem must focus on shared long-term goals, regardless of setbacks. "Set your destination and keep going until you have reached it, rather than giving up at the first issue," he says. "This is new territory, and with that comes the possibility of failure. The important thing is to get back up."



How do organizations gain entry to these ecosystems of partners – particularly small and medium-sized businesses that may struggle to build them for themselves? Industrial business platforms such as Siemens Xcelerator make them accessible through a single platform. The aim is to provide a central point of discoverability for organizations looking for tailored and comprehensive digital solutions to the challenges they face. Crucially, Siemens Xcelerator features Siemens' own solutions, and those from third parties such as developers and software providers, available through an open and flexible ecosystem that brings users and technology partners together.

The solution and service offering on such platforms must be structured in the right way in order to be simple and easy to navigate – around the business challenges they address, such as decarbonization, asset management, and energy efficiency. They must be interoperable, ensuring that solutions work seamlessly together. They must be flexible, with modular offerings so that organizations can pick what they need and scale as they grow. And they must be open – based on standardized application programming interfaces (APIs).

CASE STUDY

How Aspern Smart City Research is driving value through multidisciplinary collaboration

The Aspern Smart City Research (ASCR) project provides an on-the-ground example of value creation and mutual benefit when partners collaborate to fulfill shared sustainability ambitions – in this case, to develop solutions for more efficient and climate-friendly urban energy systems. The project was launched in 2013 by Siemens Austria, Wien Energie, Wiener Netze, and the City of Vienna, and now involves more than 100 researchers from various disciplines.

"We call it sector coupling," says Robert Grüneis, ASCR's General Manager. To illustrate what is possible, he uses the analogy of a modern smartphone, which delivers previously segregated services, including communications, entertainment, photography, and e-shopping, through a single device. We should think of buildings and cities as having the same potential, Grüneis argues.

"Energy efficiency is not just the use of a renewable energy resource," he says. "We have to coordinate different demands and find the appropriate resource. Often, the best solution lies in an energy system where a building is used for commercial purposes and for residential. The use of data, modern technologies, and AI helps us to bring users, renewable resources, and the technology itself together – to 'talk' with each other. Then energy efficiency comes to life."

By building these networks and collaborations, Grüneis says, you receive a greater aggregate return, with each partner's expertise contributing toward efficiency, resiliency, flexibility, and user experience. "The challenge here is to achieve alignment of interests, but that's a good thing, and it's been very successful," he adds. "Challenge enriches every single system."

Energy efficiency is not just the use of a renewable energy resource. We have to coordinate different demands and find the appropriate resource.

Robert Grüneis
General Manager, Aspern Smart City Research

CONCLUSION

Toward continuous **transformation**

No one is suggesting that achieving sustainability is straightforward. But while businesses face one of the most challenging transitions to a greener economy, a combination of ambition, imagination and practical thinking can result in progress.

Siemens' own example is a case in point. In 2015, it was among the first large industrial companies to declare a goal of achieving net zero CO_2 emissions by 2030. By 2021, it was more than half way toward that target. Siemens has accelerated that commitment and enhanced it to the entire value chain by joining the Science Based Targets initiative last year to be in line with the 1.5-degree target. Commitments for 2030 include a 100% electric vehicle fleet; to use only renewable energy; to own or lease only net zero carbon buildings; and to reduce suppliers' emissions by 20%, targeting a net zero supply chain by 2050.

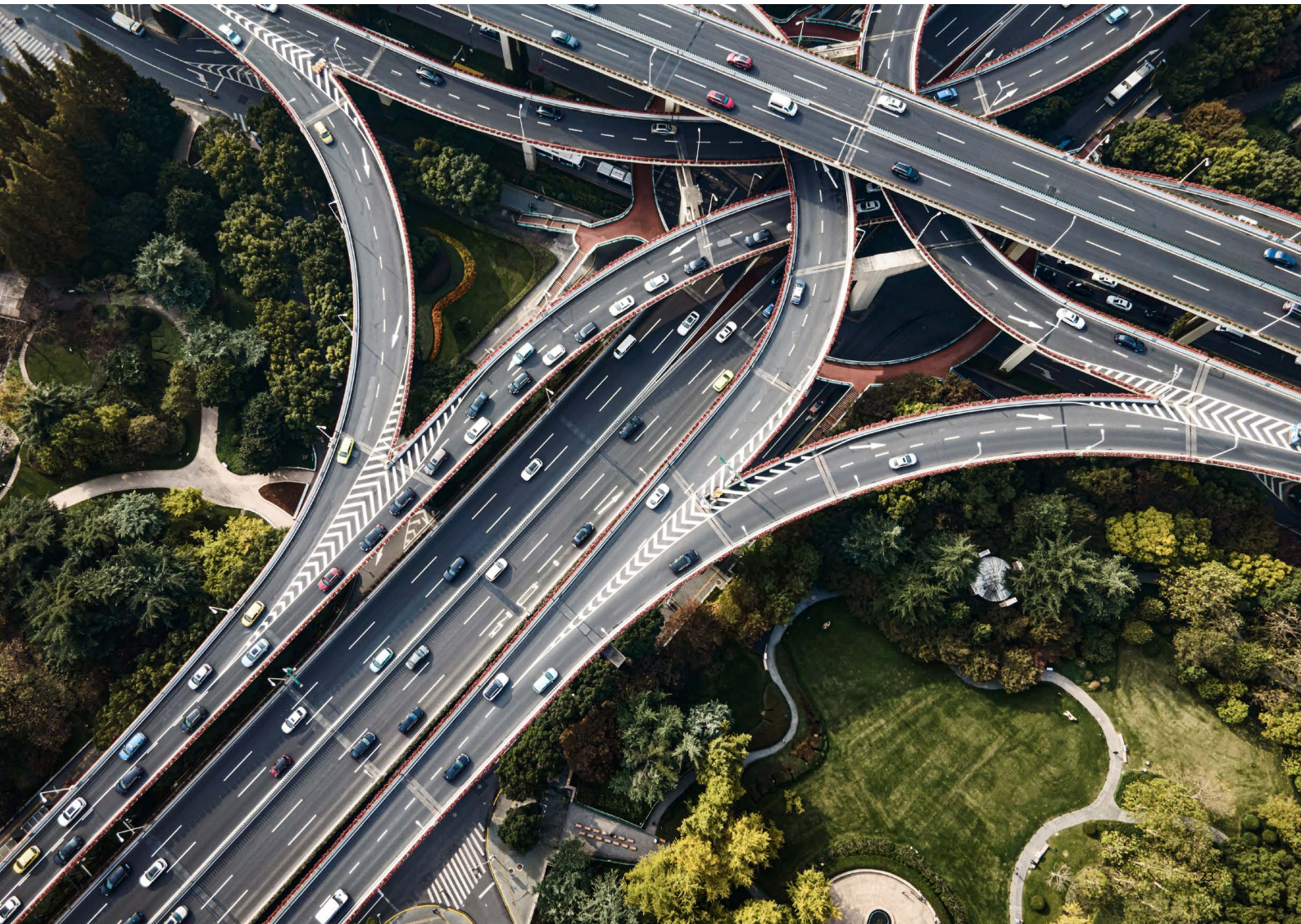
There will be new obstacles along the way. For example, digital transformation will require increased use of energy-intensive data centers, which add to the organization's carbon footprint rather than reduce it. But here, too, there are potential solutions: in Estonia's capital Tallinn, for example, Siemens Smart Infrastructure and Greenergy Data Centers have built a **new data center** incorporating software and operational technology that will lower energy usage, ensure thermal protection, and deliver resilience.

The key is to recognize that shifting to sustainable growth is an exercise in continuous transformation – and that digital technologies will enable and accelerate every stage of this process. As organizations plan their change, execute on this strategy, and evaluate their achievements, digital solutions have the potential to create continuous improvement.

Moreover, this will be a shared endeavor. Critical partners, a strong ecosystem, and access to industrial business platforms will give every organization, however large or small, the ability to leverage the expertise and experience of multiple providers to build comprehensive solutions – and to do so quickly and at scale.

Digitalization will put sustainability within reach, and now is the time to get started. You can take the initiative by:

- **Planning for sustainability with shared goals.** Agree your sustainability objectives and align them with the business's strategic agenda for digital transformation.
- **Implementing the right tools.** Focus on how a combination of digital solutions will accelerate progress toward sustainable growth.
- **Measuring for optimization.** Create feedback loops that provide continuous improvement.
- **Renewing the value proposition through innovation.** Focus on how digital transformation can drive business-model change and create new value for sustainable growth.
- **Creating an ecosystem.** Explore partnerships and platforms such as Siemens Xcelerator to accelerate your digital transformation and sustainability strategy.



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