NTT DATA

NTT DATA Technology Foresight 2025

Trend 3: Digital sustainability for economic resilience

Envision resilience redefined by technology, harmonizing people, planet and prosperity.

Contents

Introduction

Digital sustainability for economic resilience is emerging as a critical part of modern business strategy, with organizations integrating environmental stewardship with economic growth.

This approach encompasses environmental, social and personal dimensions and follows the principle of ownership, fostering individual and collective responsibility. By adopting digital sustainability practices, organizations can improve their resilience, meet rising consumer expectations for ethical operations and contribute to global social equity and ecological balance, securing their long-term success.

Significance and impact on business

Digital sustainability not only supports ecological balance but also builds economic resilience, allowing organizations to adapt to shifting market demands and regulations. Studies reveal that businesses embracing sustainable practices see a boost in efficiency of up to 20%, along with significant reductions in operational costs, demonstrating the tangible benefits of integrating sustainability into core business strategies.

Key drivers

Technological advancements in AI, IoT and blockchain support digital sustainability by enabling efficient energy management, real-time environmental monitoring and greater supply chain transparency. These technologies empower organizations to amplify their sustainability initiatives, maintain competitiveness and address growing consumer demand for eco-conscious practices.

Digital sustainability introduces complex challenges, including balancing environmental justice with social equity, mitigating over-reliance on technology and navigating regulatory complexities. At the same time, it presents significant opportunities through inclusive solutions, resilient technologies and data-driven optimization that enable organizations to progress toward their sustainability goals.

Collaborative innovation across sectors offers the potential to foster long-term resilience, driving both economic and environmental progress.
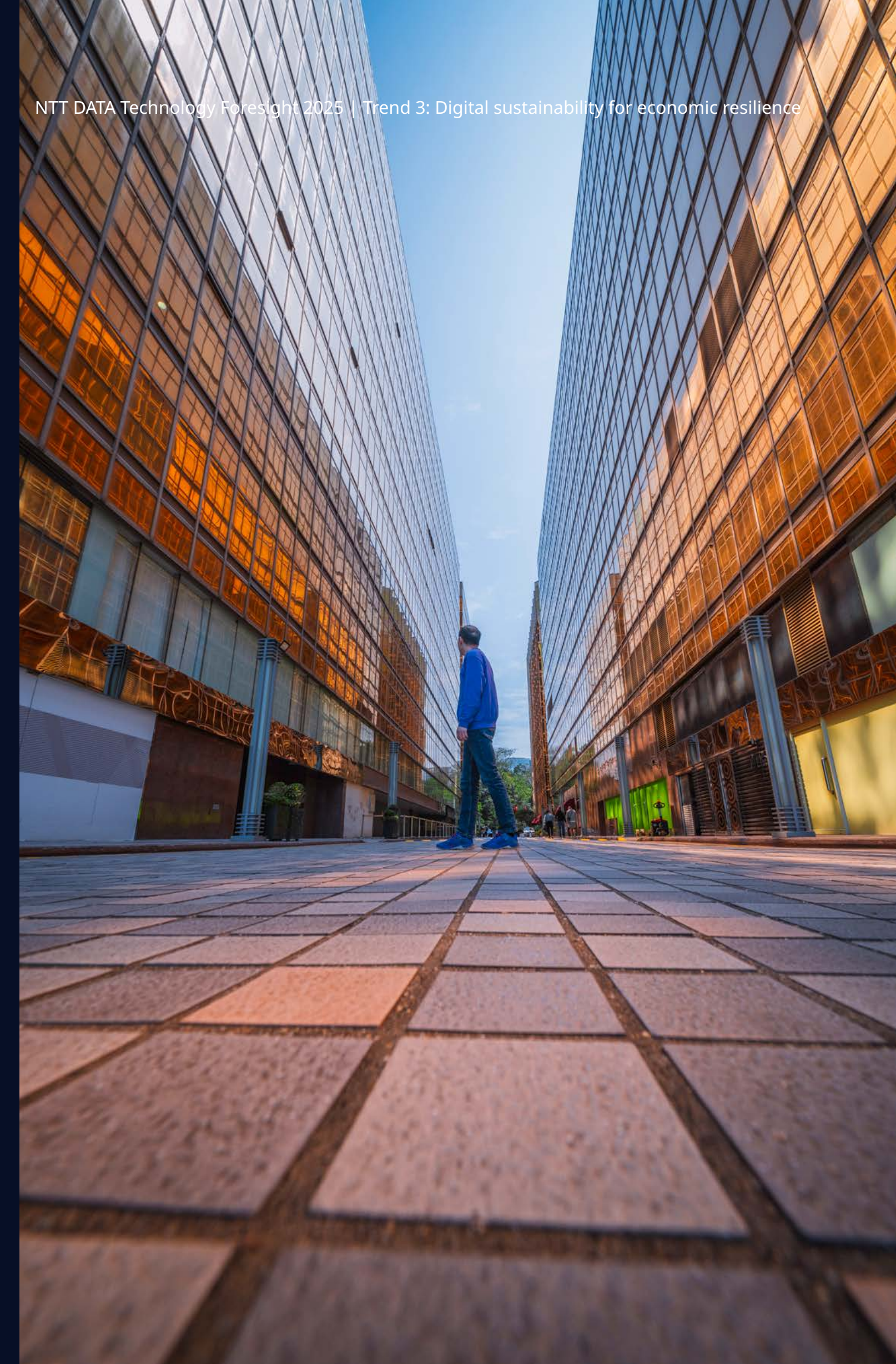
Technical explanation

In the face of pressing global challenges in a multi-polar world, such as climate change and resource depletion, digital sustainability is emerging as a foundation for building economic resilience. Key components include:

1. Digital optimization for energy and resources

Systems integrate IoT networks and AI-driven analytics to monitor and manage energy and resource flows in real time. These optimizations feed into predictive models used by resilience frameworks, ensuring a seamless connection between efficiency and readiness.

2. Human and territorial resilience

Data from sensors and digital twins, processed via ML, predicts and mitigates natural disaster risks. This ensures human and economic resilience by protecting supply chains and resources.

3. Economic resilience

Transparent and decentralized asset tracking stabilizes supply chain operations. Using digital optimization and circular economy principles, it supports sustainability by ensuring equitable access to resources during crises or disruptions.

4. Social and individual sustainability

Privacy-preserving methods and behavioral algorithms maintain individual wellbeing while addressing societal goals. These systems contribute data to align personal outcomes with societal resilience and environmental stability, supporting systemic sustainability efforts.

5. Systemic, integrated sustainability

Holistic platforms aggregate insights from economic and social systems to form an interconnected governance structure. Tools like systems mapping and simulations evaluate interdependencies, ensuring long-term sustainability and alignment.

> " Digital sustainability is rapidly shaping the future of economic resilience by integrating advanced technologies to improve resource usage, inspire innovation in circular-economy models and manage environmental impacts more efficiently.

Technology

Trusted data spaces enable a secure and interoperable data exchange between organizations, using advanced encryption and governance frameworks to promote transparency, improve collaboration and optimize resource usage while complying with data sovereignty regulations. This boosts operational efficiency, fosters innovation and supports sustainability goals across industries.

Smart grids integrate digital technologies such as sensors, IoT devices and AI algorithms to optimize the distribution and management of electric power. Through real-time data collection and dynamic demand response, these grids enhance the efficiency of energy use, minimize transmission losses, balance load more effectively and ease the integration of renewable energy sources.

Sustainable data centers use advanced cooling technologies, energy-efficient hardware, renewable energy, virtualization and dynamic resource allocation to reduce their environmental impact and carbon footprint, promoting greener cloud computing and supporting economically resilient business practices.

Remote sensing technologies employ high-resolution satellite and aerial imaging systems, along with advanced data processing algorithms, to monitor environmental and resource conditions. By analyzing multispectral and hyperspectral data, these platforms provide precise information on climate patterns, vegetation health, water resources and land usage, enabling accurate forecasting and informed decision-making that's essential for improving resource management and enhancing sustainability and economic resilience.

Business explanation

Digital sustainability for economic resilience integrates sustainability principles with advanced technologies, enabling organizations to achieve economic success while reducing their environmental impact. This megatrend is radically changing business operations through innovative solutions that enhance resource efficiency, boost transparency and drive ethical practices. By embedding sustainability into core strategies, organizations contribute to environmental health, build resilience and position themselves for long-term growth.

Key principles address current challenges while fostering a sustainable future:

For individuals

- Access to sustainable products empowers informed choices aligned with personal values.
- People enjoy a better quality of life through healthier environments and reduced ecological harm.

For companies

- Sustainable practices lead to significant cost savings and operational efficiencies, such as reduced energy and material waste.
- Organizations gain a competitive advantage through the ability to access sustainable finance and attract socially responsible consumers and investors.
- They can also achieve measurable reductions in greenhouse gas emissions and conserve natural resources.

For society

- Drives greater social equity through inclusive access to sustainable opportunities.
- Encourages innovation by aligning technological advancements with environmental goals.
- Promotes economic stability by fostering resilient and equitable growth for all stakeholders.

By leveraging digital technologies such as AI-driven analytics, blockchain for transparency, and IoT-enabled resource management, organizations can amplify their impact, aligning profitability with sustainability to create shared value for individuals, businesses and society.

Underlying concepts

Underlying concepts

This megatrend represents a pivotal shift in how organizations integrate sustainable practices with digital innovations to ensure long-term viability and adaptability in an increasingly interconnected world. As the urgency for environmental action grows, organizations must prioritize digital sustainability to remain competitive and responsible.

This approach is built upon several key pillars. Understanding these foundational aspects is essential for grasping the full scope of the megatrend, as they serve as the framework for achieving sustainable economic resilience in an increasingly digitized world.

Digital sustainability for economic resilience

Digital optimization for energy and resources

- Energy-system simulation
- Autonomous predictive maintenance
- Advanced energy storage
- AI-enhanced energy management
- New processing and network needs

Human and territorial resilience

- Distributed environmental monitoring
- Disaster prediction and management
- Urban design
- Resource tracking
- Crisis management

Economic resilience

- Climate risk assessment
- Learning and upskilling
- Energy management
- Inclusive and sustainable finance
- Transparent and circular supply chains

Social and individual sustainability

- Privacy enhancement
- Mental-health consultancy
- Gamification for inclusivity and sustainability
- Transparency within ethical AI
- Digital democracy

Systemic, integrated sustainability

- AI-supported remote teams
- Business optimization with policy simulations
- Enhanced business insights through systems mapping
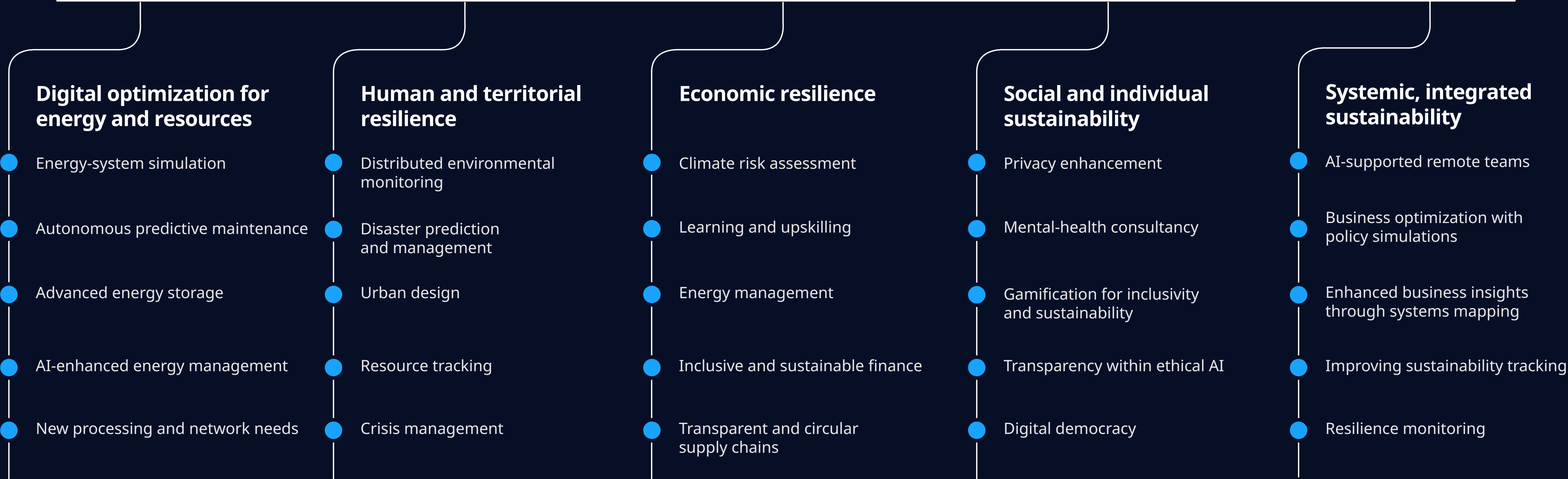- Improving sustainability tracking
- Resilience monitoring

Figure 1: Digital sustainability for economic resilience — underlying concepts and supporting trends

Underlying concepts

Digital optimization for energy and resources

Digital optimization for energy and resources focuses on using advanced technologies to improve sustainability in organizations. This approach integrates sustainability targets with stakeholder engagement and responsible consumption practices, improving the efficiency of energy and resource management. By prioritizing regulatory compliance, economic impact and social responsibility, businesses can lay the foundation for a sustainable future while optimizing resource use.

" Together, these subtrends demonstrate how digital optimization fosters smarter, more sustainable energy and resource management practices, aligning with broader sustainability goals essential for organizational success.
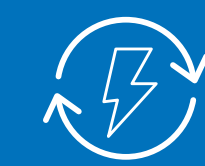
Energy system simulation

- Virtual replicas of energy systems create real-time models of physical energy infrastructures, enabling organizations to simulate and optimize performance continuously. This includes analyzing the topology of renewable power sources and a thorough historical and predictive analysis of energy production and consumption patterns.

- Using techniques such as digital twins, organizations can improve decision-making, increase operational efficiency and reduce their energy costs faster and with less risk.

Autonomous predictive maintenance

- As digital systems become capillary distributed on the edge and centralized cloud facilities become increasingly complex, autonomous operation and maintenance become key for overall optimization, helping improve service quality and reducing waste. Next-generation networks such as 6G, smart grids and industrial plants harness the capabilities of predictive AI.

- This proactive approach enables utility companies to reduce downtime and ensure reliable energy distribution, providing users with an uninterrupted power supply. Manufacturers can monitor machinery in real time to anticipate maintenance needs, prevent costly breakdowns and achieve higher efficiency and lower maintenance costs.

Advanced energy storage

- The widespread electrification of society is essential for achieving sustainability goals that deliver global results.

- When combined with the increased use of renewable power sources, this brings a sharper focus to energy storage. Next-generation, eco-friendly batteries and solutions will be needed for nearly every aspect of society.

- People can reduce their energy costs and become energy-independent through renewable systems like solar panels and home energy storage, as seen in the growing market for residential energy solutions.

AI-enhanced energy management

- Energy production and distribution are moving away from traditional models dominated by large power plants that rely on fossil fuels.

- The rise of smart grids (which manage diverse and unpredictable renewable sources) and small modular nuclear reactors, and the potential for nuclear fusion will require substantial support from AI for effective development and management.

- For instance, a community with solar panels and wind turbines can use AI to optimize energy distribution, maintaining stability by predicting production fluctuations and utilizing stored energy as needed.

New processing and network needs

- Sustainability hinges on waste reduction and resource optimization, necessitating advanced processing and lower energy consumption.

- For example, strategically placing data centers in cooler regions can reduce reliance on energy-intensive cooling, significantly lowering overall energy use.

- Coupled with innovations like photonic integrated circuits, these strategies illustrate how organizations can enhance efficiency, cut costs and minimize environmental impact.

- Embracing concepts like smart manufacturing further promotes these goals while advancing production with a smaller ecological footprint.

Underlying concepts

Human and territorial resilience

Human and territorial resilience refers to individuals' and communities' ability to adapt, recover and thrive in the face of environmental, social and economic challenges. This concept focuses on building the strength and adaptability of populations and their infrastructures to respond to crises. It's often referred to as "community and infrastructure robustness."

" To enable this level of proactive and integrated resilience, it's crucial that organizations embrace several key approaches.

1 Distributed environmental monitoring

The availability of low-cost sensors equipped with low-power onboard computing resources allows for the massive deployment of IoT smart devices over territories.

The goal is to collect real-time data on environmental conditions, such as air quality and humidity, to gain insights that support proactive resource management and risk mitigation.

For instance, real-time air-quality monitoring can alert residents to pollution spikes or hazardous conditions, allowing them to take necessary precautions, such as staying indoors or using air purifiers.

2 Disaster prediction and management

Utilizing AI algorithms to analyze extensive data sets allows organizations to anticipate and respond to natural disasters more effectively, improving community preparedness and resource allocation.

AI solutions improve situational awareness and reduce response times during emergencies, saving lives and resources while promoting resilient infrastructures and community safety. This technology appeals to socially responsible consumers and can significantly reduce economic losses through better preparedness and timely interventions.

3 Urban design

Virtual replicas of physical environments enable urban planners to simulate and optimize city infrastructure and services, enhancing decision-making and promoting sustainable development. This technology improves resource allocation and urban planning efficiency, creating more livable spaces while appealing to consumers who value smart-city innovations.

Digital twins of various complex systems deployed in cities will allow predictive and generative AI to act safely and efficiently while providing administrators with valuable systemic insights.

4 Resource tracking

Increasingly, consumers and businesses expect transparency and accountability in supply chains. They want assurance that resources are ethically sourced and sustainably managed.

Meeting these expectations requires traceability to reduce fraud, foster trust and promote responsible practices.

This also supports operational efficiency and cost reduction, as streamlined supply chains can significantly improve performance.

Blockchain technology is a key enabler, offering a secure and transparent way to verify each transaction, enhancing accountability and bolstering the credibility of sustainability claims throughout the supply chain.

5 Crisis management

Real-time data availability is crucial during crises. Large amounts of raw data need to be turned into useful and easily accessible information. Additionally, in crisis situations, information needs to be swiftly turned into insights that enable people to make informed decisions.

Together, IoT data collection, predictive AI that generates actionable insights, GenAI that provides recommendations and AR/VR that visualizes real-time scenarios will form the foundation for future innovative crisis management platforms.

Underlying concepts

Economic resilience

Economic resilience refers to organizations' and communities' ability to withstand and recover from economic shocks while maintaining sustainable operational practices.

Adopting resilient practices not only attracts environmentally conscious consumers but also strengthens an organization's overall economic resilience by enhancing stability, trust, competitiveness and adaptability in a fluctuating market.

" Establishing a comprehensive framework requires organizations to bring together several key practices.

Transparent and circular supply chains

- As consumers demand transparency in supply chains, there's a need for solutions that ensure ethical sourcing and sustainability. Clear traceability builds trust and reduces fraud. Adopting circular economy principles — like resource efficiency and closed-loop systems — minimizes environmental impacts.

- Blockchain technology enhances the secure verification of transactions, boosting the accountability and credibility of sustainability claims and ultimately fostering loyalty among environmentally conscious consumers.

- A study found that 94% of consumers are more likely to be loyal to a brand that offers complete supply chain transparency.

Inclusive and sustainable finance

- The rising demand for financial inclusion highlights the need for solutions that improve access to financial services for underserved populations.

- Intelligent financial-accessibility tools empower consumers to manage their finances and secure loans, fostering greater economic participation.

- At the same time, sustainable finance initiatives, like green loans and environmental, social and governance (ESG)-focused funding, promote environmental responsibility. By offering personalized financial advice and tailored products, these solutions build people's financial freedom while supporting a sustainable future.

Energy management

- As businesses increasingly prioritize sustainable practices, there's a growing need for solutions that optimize the use of renewable energy sources.

- Platforms for renewable-energy management help organizations integrate sustainable energy, enhance efficiency, reduce costs and minimize their carbon footprint.

- By adopting these technologies, organizations can improve their operational sustainability and contribute to a greener environment.

Learning and upskilling

- In today's evolving job market, organizations need a skilled workforce that can adapt quickly.

- Digital learning platforms provide personalized skill enhancement, with AI delivering adaptive, tailored learning paths.

- Microlearning programs featuring bite-sized modules boost employee retention and engagement and allow people to build their skills at their own pace.

- This fosters adaptability and innovation and improves organizations' economic resilience amid market shifts.

Climate risk assessment

- As organizations experience the impacts of climate change, they need tools that can help them anticipate environmental risks and vulnerabilities.

- Predictive analytics can help organizations proactively manage their climate-related risks. By analyzing historical weather patterns and socioeconomic data, this technology helps businesses enhance supply chain reliability and optimize resource allocation.

- For example, agricultural companies can optimize planting schedules based on weather forecasts, while insurance firms can enhance their risk assessments by developing tailored policies for clients facing climate threats.

Underlying concepts

Social and individual sustainability

Fostering wellbeing, community engagement and equitable access to resources is vital for building resilient societies. Understanding the interconnectedness of tools and platforms enables informed decision-making and responsible technology use, empowering individuals and communities.

" Collectively, these approaches promote ethical practices and resilience in an increasingly digital world.

Privacy enhancement

- Concerns about data breaches and privacy are on the rise, creating an urgent need for technologies that safeguard personal information.

- Privacy-enhancing technologies (PETs) meet this demand by protecting data, reducing the risk of breaches and fostering customer trust.

- These solutions not only enhance user privacy but also promote responsible data management, critical for a sustainable digital ecosystem.

- By adopting PETs, businesses can improve their reputation, ensure compliance with privacy regulations and protect users' personal data.

Mental-health consultancy

- The growing demand for mental-health support highlights an urgent need for tools that promote individual wellbeing.

- Intelligent wellness applications use AI to provide personalized resources and interventions, such as mood tracking and cognitive behavioral therapy techniques, empowering users to proactively manage their mental health.

- Researchers from IBM and the University of California found that AI algorithms can detect mental illnesses with a 63 to 92% accuracy, depending on the AI technique and the quality of training data.

Gamification for inclusivity and sustainability

- Digital tools for skill development are increasingly addressing global challenges like inclusivity and sustainability.

- These platforms break down access barriers by offering flexible, scalable solutions for underserved communities, ensuring equal skill enhancement opportunities. Their digital nature also reduces reliance on physical resources, supporting environmental sustainability.

- For example, gamified learning platforms use engaging mechanics like rewards to motivate learners.

- One company reported a 50% increase in employee engagement, demonstrating the social and environmental impact of these tools.

Transparency within ethical AI

- The increasing reliance on AI systems underscores the need for transparency in decision-making. Transparency tools for ethical AI enhance our understanding of how decisions are made.

- This builds trust among users in sensitive areas such as hiring, loan approvals and healthcare diagnostics.

- This accountability promotes responsible AI use and supports a fair digital landscape where individuals feel informed and valued. The concept of "explainable AI" emphasizes the importance of clarity in automated decision-making, empowering users and building community trust in technology.

Digital democracy

- As communities seek to enhance democracy and civic participation, they need technologies that facilitate public engagement.

- Technology solutions for public engagement empower users by providing access to policy information and facilitating discussions, ensuring their voices are heard.

- These platforms enable participation in online polls, virtual town-hall meetings and petitions, making civic engagement more inclusive.

- By representing diverse perspectives, these tools foster community involvement and strengthen democratic processes.
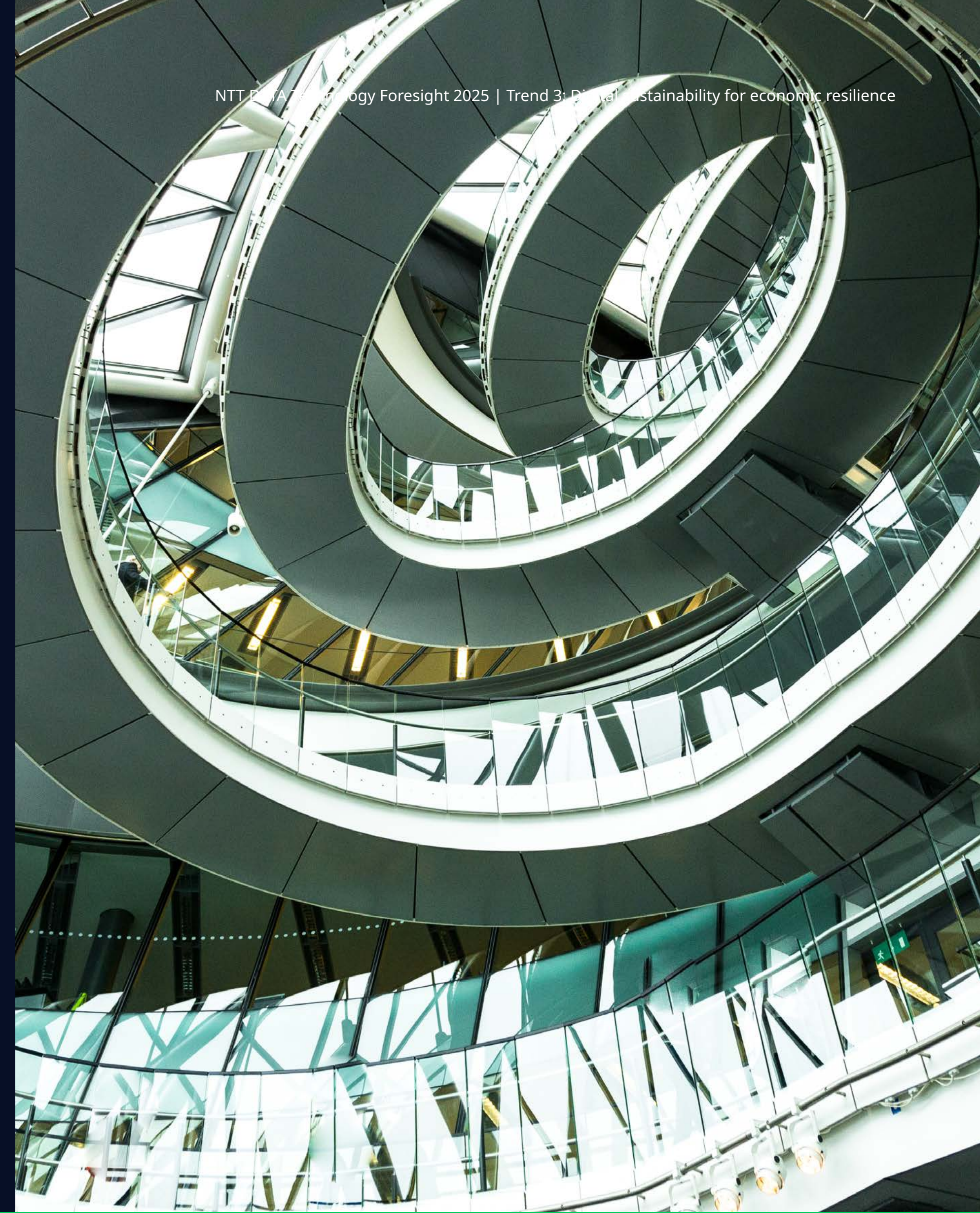
Underlying concepts

Systemic, integrated sustainability

Systemic, integrated sustainability recognizes the interconnectedness of social, environmental and economic systems to develop cohesive solutions. Often referred to as "comprehensive sustainability," this approach highlights the need to address multiple dimensions simultaneously to achieve lasting impact and resilience in communities and ecosystems.

"

Integrating these systems promotes a comprehensive understanding of sustainability that fosters lasting solutions and strengthens community resilience.

4 Improving sustainability tracking

As the demand for environmental impact transparency increases, organizations need reliable methods for tracking sustainability metrics. Blockchain offers a solution by enabling the secure and transparent tracking of environmental data, ensuring that sustainability claims can be verified and trusted.

For example, the Blockchain for Climate Foundation's BITMO Platform enables carbon credits to be issued and exchanged as tokens on the Ethereum blockchain, with each token representing one ton of carbon dioxide equivalent. This system ensures an immutable and auditable record of carbon offset transactions, promoting trust and efficiency in carbon markets.

5 Resilience monitoring

The need for enhanced resilience in various environments is driven by the increasing risk of disruptions, including natural disasters and system failures. Systems that leverage IoT devices and AI address this need by collecting and analyzing data for improved monitoring and response.

These systems provide users with real-time insights into potential disruptions, enabling them to take proactive measures to mitigate risks. By empowering users with data-driven insights, these technologies facilitate more efficient decision-making and bolster community preparedness, ultimately contributing to greater resilience.

Tech radar

Tech radar

In the constantly changing tech landscape, keeping up with the latest developments is essential, not just advantageous.

Continually analyzing technology trends and tracking their evolution will help you anticipate changes and prepare yourself for upcoming shifts.
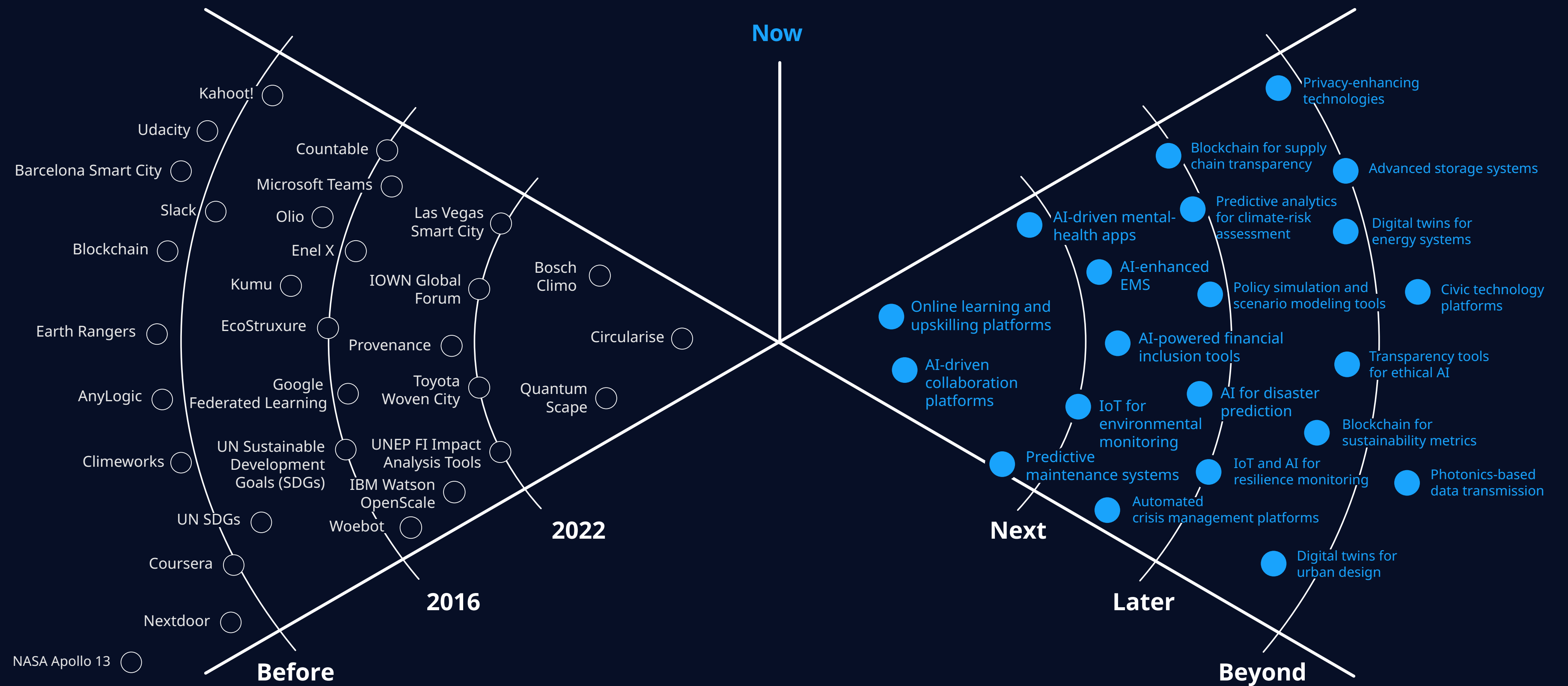

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UNEP FI Impact Analysis Tools
Climeworks
IBM Watson OpenScale
UN SDGs
Woebot
Coursera
Nextdoor
NASA Apollo 13

2022

2016

Before

Online learning and upskilling platforms
AI-driven mental-health apps
Privacy-enhancing technologies
Blockchain for supply chain transparency
Advanced storage systems
Predictive analytics for climate-risk assessment
Digital twins for energy systems
AI-enhanced EMS
AI-driven collaboration platforms
Policy simulation and scenario modeling tools
Civic technology platforms
AI-powered financial inclusion tools
Transparency tools for ethical AI
IoT for environmental monitoring
AI for disaster prediction
Predictive maintenance systems
Blockchain for sustainability metrics
IoT and AI for resilience monitoring
Automated crisis management platforms
Photonics-based data transmission
Digital twins for urban design

Next

Later

Beyond

Figure 2: Tech radar — past and future technology

Future tech: now and next

A **Online learning and upskilling platforms**
Digital education platforms deliver scalable and accessible solutions to help people build the skills they need in emerging industries and evolving job markets.

B **AI-driven collaboration platforms**
Intelligent platforms enable seamless collaboration across industries and sectors, supporting projects and communication with advanced tools.

C **Predictive maintenance systems**
AI and IoT are employed to monitor equipment, predict potential failures and schedule maintenance, reducing downtime and improving operational efficiency.

D **AI-driven mental-health apps**
AI tools provide personalized mental-health support through chatbots, behavior tracking and cognitive behavioral interventions.

E **IoT sensors for environmental monitoring**
Interconnected sensors provide real-time data on environmental conditions such as air quality, water levels and weather patterns, enabling proactive management.

F **AI-enhanced energy management systems (EMS)**
AI is used to optimize energy consumption, stabilize power grids and balance energy supply and demand, making renewable energy integration more efficient.

G **AI-powered financial inclusion tools**
ML algorithms analyze alternative data to provide financial services, such as microloans and banking, to underserved populations.

H **Automated crisis management platforms**
AI-driven systems coordinate emergency responses, allocate resources and manage crises in real time, enhancing preparedness and efficiency.
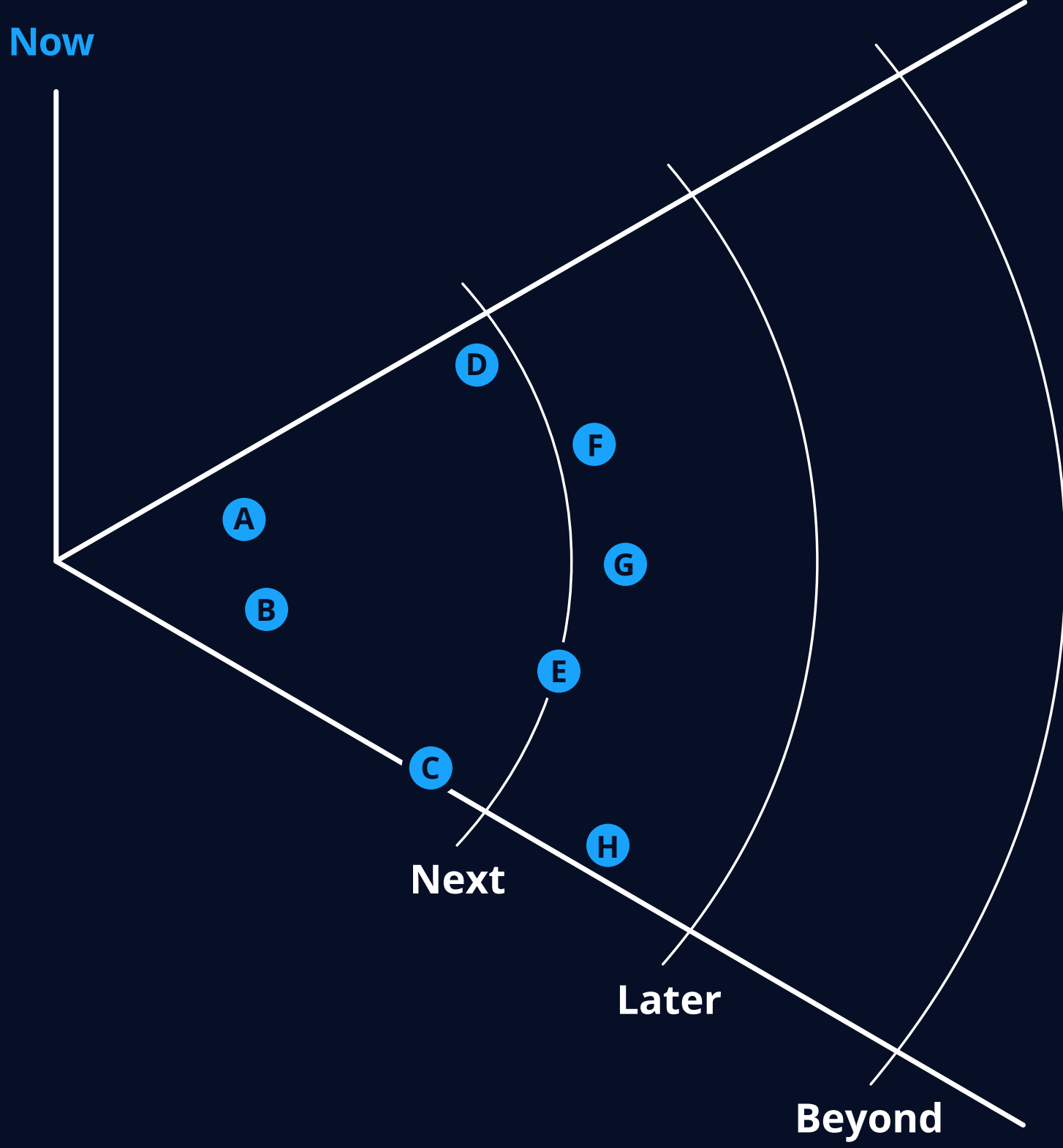
Figure 3a: Tech radar — future technology

Future tech: next, later and beyond

I **Blockchain for supply chain transparency**
Distributed ledger systems enable the secure and transparent tracking of goods and resources throughout supply chains, ensuring accountability and resilience.

J **AI for disaster prediction and management**
ML models analyze data to predict natural disasters and support efficient preventive strategies, minimizing human and economic losses.

K **Predictive analytics for climate-risk assessment**
Data-driven tools analyze environmental and economic information to predict climate risks, supporting informed decision-making for investments and policies.

L **Policy simulation and scenario modeling tools**
AI and data analysis tools model the potential impacts of policies, helping policymakers create adaptive and effective solutions.

M **IoT and AI-integrated resilience monitoring systems**
IoT sensors and AI are integrated to monitor critical infrastructure and systems, enhancing their ability to withstand and recover from disruptions.

N **Privacy-enhancing technologies (for example, federated learning)**
Advanced data privacy techniques ensure sensitive information is processed locally, preserving individual privacy while enabling secure data analysis.

O **Blockchain for sustainability metrics**
Blockchain technology tracks environmental and social impact metrics securely, ensuring transparency and accountability in sustainability initiatives.

P **Digital twins for urban design**
Virtual models of cities simulate infrastructure development, population growth and environmental impacts, aiding in the design of more sustainable urban environments.
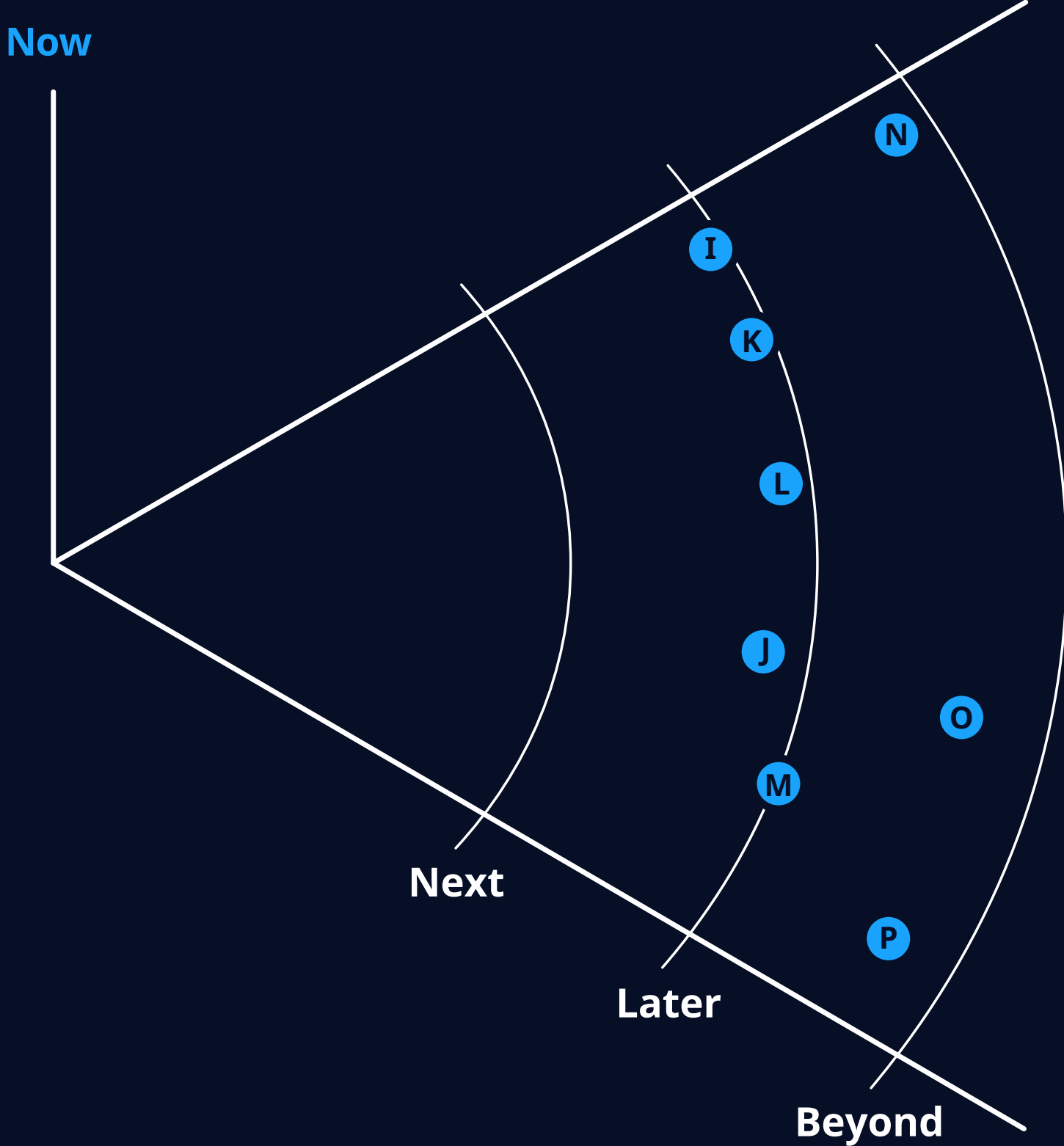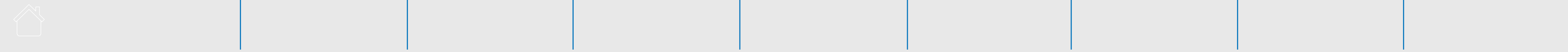
Figure 3b: Tech radar — future technology

Future tech: later and beyond

Q **Transparency tools for ethical AI**
Frameworks and tools ensure AI systems are explainable, fair and accountable in their decision-making processes.

R **Digital twins for energy systems**
Virtual representations of energy systems monitor performance, predict failures and simulate improvements for greater efficiency and sustainability.

S **Advanced storage systems**
Energy-storage technologies, such as solid-state batteries, enable safer, longer-lasting solutions for renewable-energy systems and electric vehicles.

T **Civic tech platforms for digital democracys**
Technology platforms empower citizens to engage in public decision-making, enhancing government transparency and promoting inclusive governance.

U **Photonics-based data transmission and processing**
The use of light instead of electricity to transfer and process data reduces energy consumption and improves processing speeds, making it ideal for energy-intensive operations in data centers and communication networks.
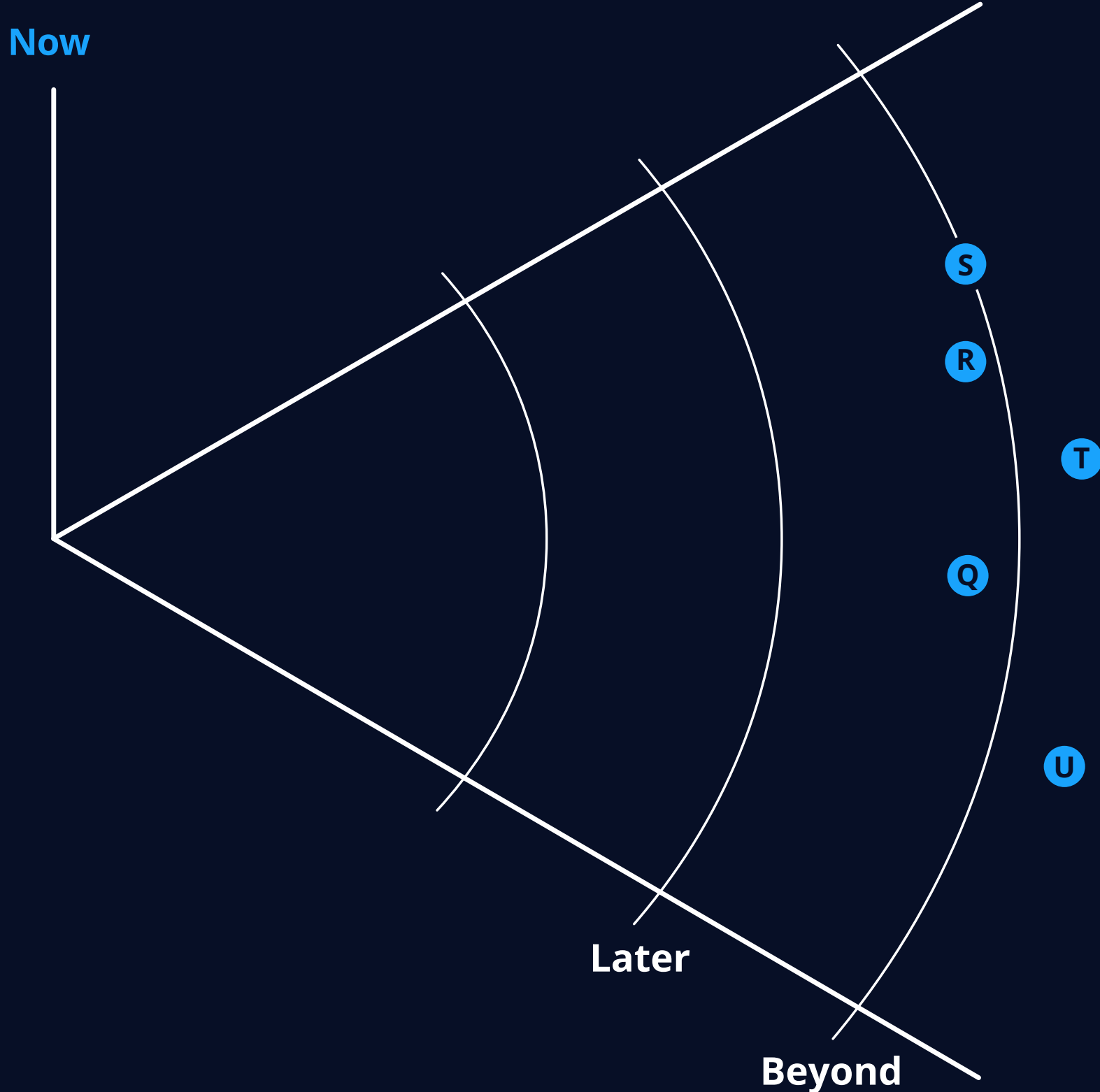

Figure 3c: Tech radar — future technology

R&D highlight

R&D highlight

Digital twins for a sustainable future

NTT is committed to driving sustainability for people and the planet through cutting-edge technology and strategic partnerships. Central to its efforts is the Innovative Optical and Wireless Network (IOWN), a groundbreaking communication infrastructure leveraging photonics for ultralow power consumption, exceptional capacity and near-zero latency.

By integrating IOWN with advanced simulation technologies, like digital twins, NTT delivers real-time insights that enable smarter, more efficient resource management.

NTT's Space Environment and Energy Laboratories have developed a comprehensive Earth modeling system that serves as a global-scale digital twin. This technology combines extensive simulation and observational data to forecast environmental changes, such as extreme weather and climate trends, supporting proactive adaptation strategies and building resilience to environmental risks.

In collaboration with Waseda University, NTT spearheads initiatives fostering a "Love of the Earth," aiming to develop a sustainable society. These efforts include:

1 **Protective sustainability**
Conserving energy and ecosystems to mitigate environmental impacts

2 **Proactive sustainability**
Innovative energy solutions and sustainable food systems that address global challenges

Digital-twin technologies underpin these initiatives, offering data-driven, real-time solutions that improve energy efficiency, optimize resources and reduce ecological footprints. Through its holistic vision and multidisciplinary expertise, NTT empowers communities to address environmental, energy and societal challenges, creating a resilient, inclusive and thriving future.
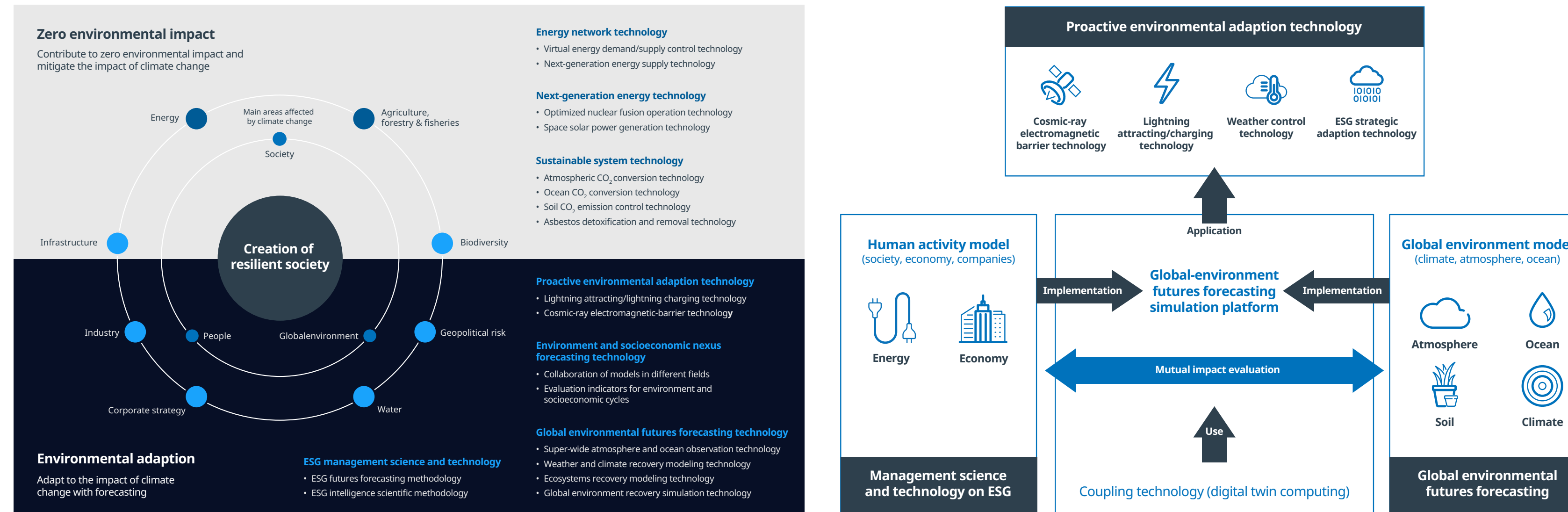

Figure 4: Digital twins for a sustainable future

(Left) Adapted from: *NTT Technical Review* Vol. 22 No. 3 Mar. 2024 | (Right) Adapted from: *NTT Technical Review* Vol. 21 No. 2 Feb. 2023

Quantification

Relevant financials

The energy-management software market is expected to grow from

$48.68 billion in 2024 to $241.56 billion by 2037, with a CAGR of

13.7%

The market for AI in disaster risk management was valued at

$479.5 billion in 2023 and is predicted to reach $2,150.1 billion by 2031, with a CAGR of

21.3%

during the forecast period of 2024–2031.

The blockchain supply chain market, which includes resource tracking applications, is valued at

$2.08 billion in 2024 and is expected to grow at a

29.14%

CAGR, reaching $9.77 billion by 2030.

The environmental monitoring market was valued at

$14.4 billion in 2024, with a CAGR of

5.7%

expected between 2025 and 2030.

The value of the global market for AI in mental health was estimated to be

$1.13 billion in 2023, with a CAGR of

24.1%

expected between 2024 and 2030.
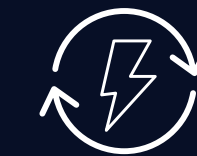
The global federated learning market, a key component of PETs, was valued at

$133.1 million in 2023 and is projected to grow to $311.4 million by 2032, with a CAGR of

10.2%

The global market for advanced energy-storage systems was valued at

$12.80 billion in 2023 and it is expected to surpass $31.72 billion by 2033, with a CAGR of

9.5%

between 2024 and 2033.

Use cases

AI-powered microgrid coordination

Industry: Public sector; energy and utilities

AI-driven systems manage localized energy-generation sources, autonomously balancing supply and demand to enhance resilience and promote renewable-energy integration. This supports energy independence, crucial for sustainable development.

Business value

1 Enhances energy independence

2 Supports the transition to renewable sources

3 Improves local energy security

> " AI-powered microgrid coordination systems balance supply and demand locally, enhancing energy independence and renewable integration.

Digital twins for urban planning

Industry: Telecommunications, media and technology

Using virtual models of urban environments to simulate changes enables planners to optimize infrastructure and enhance city resilience against climate challenges, allowing for proactive adaptation to environmental issues.

This technique engages stakeholders through interactive models, enabling community feedback

Business value

1 Facilitates informed decision-making through simulation

2 Improves resource allocation and climate preparedness

3 Reduces costs related to infrastructure failures

Blockchain-enabled renewable-energy trading

Industry: Manufacturing

Implementing blockchain technology facilitates peer-to-peer energy trading between consumers and producers of renewable energy. This decentralized approach promotes efficient energy distribution, reduces transmission losses and incentivizes the adoption of renewable sources.

Business value

1 Increased efficiency by minimizing losses through decentralized energy trading

2 Peer-to-peer trading boosts investment in renewable energy

> " Blockchain-enabled energy trading incentivizes renewable adoption, minimizes losses and promotes efficiency.

City environmental monitoring

Industry: Public sector; energy and utilities

Smart-city solutions utilize IoT-based environmental monitoring to track air quality and predict potential environmental risks in urban areas. This technology helps local governments take proactive measures to ensure healthier and safer living conditions for residents.

Business value

1 Attracts businesses and residents to healthier urban environments

2 Supports regulatory compliance and sustainability goals

Circular manufacturing with digital twins

Industry: Industry and services

Creating digital replicas of manufacturing processes optimizes product lifecycles, enabling the design of longer-lasting, recyclable products with minimal environmental impact. This approach fosters longevity, integrates secondhand marketplaces, reduces waste and encourages innovation while enhancing sustainability efforts and meeting regulatory requirements.

Business value

1 Ethical sourcing builds consumer confidence

2 Meeting sustainability demands boosts market competitiveness

" Digital twins for circular manufacturing enable recyclable designs, reduce waste and meet sustainability goals while boosting competitiveness.

IoT-based precision agriculture

Industry: Agriculture

Deploying IoT devices to monitor soil conditions, weather patterns and crop health in real time enables farmers to optimize resource usage, reduce waste and enhance crop yields, leading to increased profitability by ensuring more reliable and abundant harvests.

Business value

1 Efficiently allocates water and nutrients, reducing costs and environmental impact

2 Provides real-time data to anticipate issues, minimize crop loss and ensure reliable harvests

Intelligent water and waste management

Industry: **Industry and services**

IoT sensors optimize resource use in waste and water management by identifying maintenance needs and improving collection routes. AI-powered waste-sorting systems automate recyclables separation, boosting recycling rates and reducing contamination. Together, they conserve resources, lower costs and enhance waste-management efficiency.

Business value

1 Optimized resources and automation lower operational costs

2 Improved recycling rates promote environmental responsibility

> " AI and IoT revolutionize waste and water management by optimizing resources, cutting costs, and boosting recycling efficiency.

Use cases

Success case

United States | Public sector

City of Las Vegas: shaping the future of urban living

Business need

Las Vegas is a bustling metropolis known for its vibrant tourism and rapid growth, but this success brings challenges such as soaring energy demands, increasing traffic congestion and complex sustainability goals.

City leaders recognized that without a strategic approach to resource management, Las Vegas would face escalating carbon emissions, compromised air quality and a diminished quality of life for residents.

To transform Las Vegas into a model of urban resilience, the city sought a digital solution capable of balancing growth with sustainability, optimizing energy use and enhancing public safety — all while setting an example for cities worldwide.

This ambitious vision required an intelligent network to integrate and manage urban resources in real time, paving the way for a greener, safer and smarter Las Vegas.

Solution

NTT DATA partnered with the City of Las Vegas to create a sophisticated smart-city infrastructure powered by IoT, edge computing and AI-driven analytics.

The solution integrates data from city assets — traffic systems, lighting and parking — to create a connected urban ecosystem that anticipates, responds to and optimizes resource use. With IoT sensors embedded across the city, edge devices analyze data locally to reduce latency, ensuring real-time insights for critical functions like energy and traffic management.

This enables adaptive lighting that dims when streets are empty, traffic-flow optimization to reduce emissions and predictive maintenance for infrastructure longevity.

The platform empowers city officials to monitor and adjust resources instantly, offering a transformative, scalable model for sustainable urban management.

Outcomes

The City of Las Vegas has established itself as a leader in smart, sustainable urban development. Through enhanced energy efficiency, reduced emissions and improved traffic flow, the initiative has not only cut costs but also enriched the quality of life for residents and visitors alike, setting a new standard for cities seeking a sustainable future.

Startups

Startup radar

In this section, we review a selection of startups relevant to digital sustainability for economic resilience, based on our observations, partnerships and investments.

Tala
Mobile app for accessible financial services in emerging markets

GridBeyond
AI-powered platform for optimizing distrubuted energy resources

Kibsi
Computer-vision platform for real-time process optimization and monitoring

One Concern
AI-driven resilience analytics for disaster risk management

Qsee
Advanced analytics and AI for optimizing manufacturing processes

VeChain
Blockchain platform for enhanced transparency and sustainability of supply chains

Lightmatter
Photonics-based computing solutions for enhanced data processing

Volocopter
All-electric vertical takeoff and landing (eVTOL) aircraft

Edge Delta
Federated learning platform for enhanced DevOps and security analytics

UGO
Robots and management platform for integrating humans and automation

Pol.is
Open-source platform for real-time, large-scale conversations

JEPLAN
Recycling technology for clothes and plastics in a circular economy

NTT DATA investments

Fiddler AI
Enterprise platform for monitoring and improving AI models

Celona
Private 5G networks for low-latency wireless connectivity

NTT DATA partnerships

Jupiter intelligence
Climate risk analytics platform for actionable insights and resilience

Observation

Figure 5: Investment in digital sustainability for economic resilience startups

Startups

Observation

Lightmatter

Founded in 2017, this photonic computing company develops hardware that uses light for data processing and transmission. This approach addresses the limitations of traditional electronic chips, offering significant improvements in speed and energy efficiency. Lightmatter's product lineup includes a photonic computing platform designed for neural networks and a photonic interconnect that facilitates high-bandwidth, low-latency data movement between processors.

Stage
Series D

Funding
$822 million

Valuation
$4.4 billion

Industry
**Cross-industry**

One Concern

Founded in 2015, One Concern is a resilience analytics company that leverages AI and ML to assess and mitigate risks associated with natural disasters and climate change. By integrating hazard science with advanced AI models, it provides organizations with actionable insights to uncover vulnerabilities and enhance decision-making processes. Its platform offers tools for risk selection, mitigation, pricing, scenario analysis and risk management, enabling clients to build resilience against environmental threats.

Stage
Series B

Funding
$119.2 million

Valuation
Not disclosed

Industry
Public sector; energy and utilities
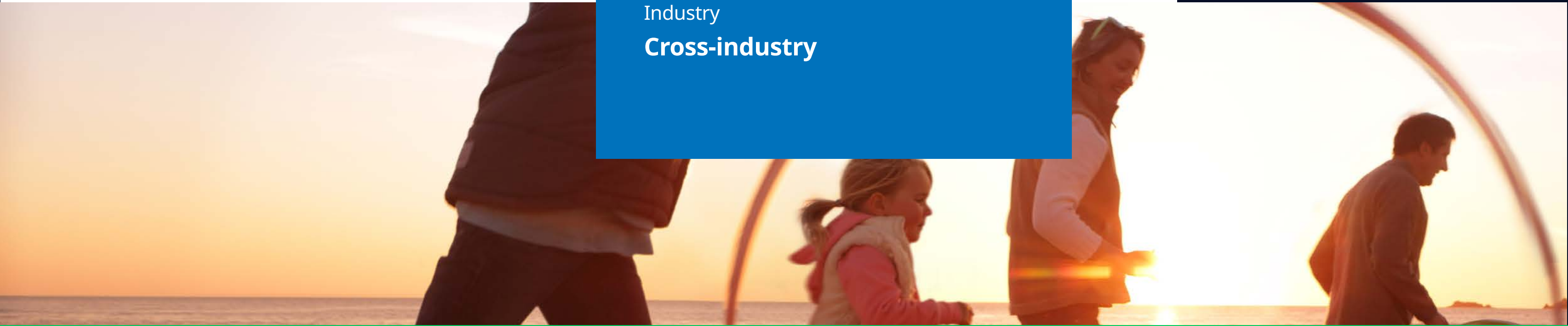
GridBeyond

Founded in 2010, GridBeyond specializes in optimizing distributed energy resources through its AI-powered platform, enabling businesses to enhance energy efficiency, reduce costs and support grid stability. It facilitates the seamless participation of various assets — such as industrial loads, generation units and storage systems — in energy markets. This approach generates new revenue streams for clients and contributes to the transition toward a sustainable, low-carbon energy future.

Stage
Series C

Funding
$95.6 million

Valuation
Not disclosed

Industry
Public sector; energy; manufacturing

Tala

Founded in 2011, Tala is a global financial technology company that provides accessible financial services to underserved populations in emerging markets. Through its mobile app, Tala offers instant credit, payments, savings and transfer services, enabling users to manage their financial lives seamlessly. The company leverages advanced technologies, including AI and ML, to deliver personalized financial experiences and promote economic inclusion.

Stage
Series E

Funding
$372 million

Valuation
$800 million

Industry
Financial services

VeChain

Founded in 2017, VeChain is a blockchain platform that enhances supply chain transparency and sustainability. It enables businesses to monitor product origins and movements in real time using IoT technologies, ensuring ethical sourcing and reduced environmental impact. VeChain's solutions assist organizations to digitize eco-friendly practices and comply with environmental regulations.

Stage
Series B

Funding
$300 million

Valuation
$3.5 billion

Industry
Manufacturing; retail; logistics

Pol.is

Founded in 2014, Pol.is is an open-source platform designed to facilitate large-scale, real-time conversations among diverse groups. Utilizing advanced statistics and ML, it enables participants to share opinions and ideas, with algorithms identifying consensus and highlighting areas of disagreement. This approach aids in better decision-making and has been employed globally by governments, academics and organizations to engage citizens in policy development and public discourse.

Stage
Not applicable

Funding
Donations

Valuation
Not disclosed

Industry
Public sector

Edge Delta

Founded in 2018, Edge Delta offers a federated learning platform that allows organizations to use distributed analytics to identify and remediate potential DevOps and security incidents. This approach improves accuracy and speed and delivers higher levels of security and privacy than traditional centralized systems.

Stage
Series B

Funding
$81 million

Valuation
$500 million

Industry
Cross-industry

Jupiter Intelligence

Founded in 2017, Jupiter Intelligence offers climate-risk analytics that turn sophisticated climate science into actionable data. Their solutions, such as ClimateScore Global, deliver high-resolution, forward-looking analyses of various climate risks, enabling businesses to enhance resilience and comply with regulatory disclosures.

Stage
Series C

Funding
$87.2 million

Valuation
$1 billion

Industry
Public sector; energy; manufacturing; financial services

Fiddler AI

Founded in 2018, Fiddler AI is a pioneer in enterprise-model performance management. Data scientists, MLOps teams and lines of business use Fiddler to monitor, explain, analyze and improve their models and build trust in AI.

Stage
Series B

Funding
$65.1 million

Valuation
$150 million

Industry
Cross-industry

Startups

NTT DATA partnerships

Qsee

Founded in 2018, Qsee specializes in enhancing manufacturing processes through advanced analytics and AI. Its software solutions enable manufacturers to make data-driven decisions, improving productivity, reducing operational costs and minimizing environmental impact.

Stage
Pre-seed

Funding
$605,000

Valuation
Not disclosed

Industry
Manufacturing

Celona

Founded in 2019, Celona specializes in private 5G networks, providing reliable, low-latency wireless connectivity essential for modern automation and smart city initiatives. Its solutions enable efficient communication among devices, leading to optimized energy consumption and reduced operational costs. In manufacturing environments, Celona's technology supports the seamless operation of autonomous robots and AGVs, enhancing productivity while minimizing energy usage.

Stage
Series C

Funding
$100 million

Valuation
Not disclosed

Industry
Manufacturing; public sector; energy

Kibsi

Founded in 2021, Kibisi is a computer-vision platform that transforms video data into actionable insights, facilitating the real-time monitoring and optimization of processes. In manufacturing, Kibsi's platform oversees production lines, detects defects and ensures quality control, reducing waste and improving resource efficiency. By integrating with existing camera networks, Kibsi provides insights into energy usage patterns within facilities. This data enables organizations to identify inefficiencies and implement energy-saving measures.

Stage
Seed

Funding
$9 million

Valuation
Not disclosed

Industry
Manufacturing; public sector; energy

Startups

NTT DATA investments

JEPLAN

Founded in 2007, JEPLAN develops recycling technology for clothing and plastics. The company offers circular economy technology and projects designed for multiple industries, focusing on producing clothes and plastic bottles using recycled materials. It also establishes collection points in collaboration with retail and apparel brands to gather discarded clothing.

Stage
Not disclosed

Funding
$60 million

Valuation
Not disclosed

Industry
Cross-industry; retail

Volocopter

Founded in 2011, Volocopter specializes in urban air mobility and operates in the aerospace industry. The company develops all-electric vertical takeoff and landing (eVTOL) aircraft designed to provide quiet, sustainable and emission-free air transportation solutions. Volocopter's primary offerings include the VoloCity air taxi for urban environments and the VoloRegion for regional connectivity, alongside VoloIQ, an AI-powered digital platform that supports the operational aspects of its eVTOL fleet.

Stage
Series E

Funding
$544.4 million

Valuation
Not disclosed

Industry
Automotive; manufacturing

UGO

Founded in 2018, UGO focuses on integrating humans and robots to support sustainable work styles across various industries. The company offers robots capable of autonomous navigation and remote operation, which can be used in a hybrid manner for a wide range of tasks. UGO's robot management platform facilitates the use and customization of robots for different operational needs. Its solutions cater primarily to sectors facing severe labor shortages, such as security, inspection, caregiving, retail and warehouse operations.

Stage
Not disclosed

Funding
$8.89 million

Valuation
Not disclosed

Industry
Cross-industry

Future scenarios

As industries transform, new value chains emerge and technological advancements grow exponentially, companies must navigate complex, evolving landscapes.

Future scenarios and GenAI-powered personas allow organizations to explore possible futures, simulate realistic business environments and minimize risk through scenario-based planning.

Uncertainties represent what we cannot know, but identifying them can reduce the risks of blind spots down the road.

Future scenarios

Uncertainty: commitment to decarbonization

Zero-carbon sprint

What if rapid decarbonization becomes a global priority?

Breakthrough technologies and urgent policy shifts will drive swift reductions in emissions. Economies will transform through green energy and circular practices, significantly reversing environmental degradation. This scenario also sees thriving green industries, improved public health from reduced pollution and an acceleration of global innovation.

Slow burn to sustainability

What if decarbonization efforts remain slow and inconsistent?

Slow progress in decarbonization will force communities to prioritize disaster response as climate impacts intensify. Advanced prediction tools, decentralized energy systems and local collaboration will drive resilience. If global mitigation lags, adaptive measures will foster innovation and strengthen community bonds, offering a pathway to long-term sustainability.

Future scenarios

Uncertainty: global collaboration

The united front

What if nations come together to solve climate challenges with unprecedented global unity?

Governments, industries and civil society could align globally to tackle climate change. Binding agreements, shared resources and collaborative technologies may lead to coordinated climate action. The positive outcomes of these actions include equitable resource distribution, widespread technological innovation and global resilience against climate risks.

Innovators in isolation

What if fragmented geopolitics dominates the climate landscape?

If international relations fray, countries may pursue individual agendas. Progress will vary across nations, but localized solutions will emerge as some nations become innovation hubs. These nations will pioneer effective policies and technologies, providing valuable models for others despite the lack of global alignment. Competition among nations will also spark advancements in strategies for renewable energy and climate adaptation.

Conclusion and next steps

Conclusion and next steps

Think about this

Sustainability isn't just about reducing environmental harm — it now requires a **holistic approach** that integrates environmental, economic and social dimensions. Organizations must address these interconnected challenges to create lasting impact.

How does your organization currently support personal wellbeing, social equity and economic stability alongside environmental goals?

Actions in one area of sustainability often ripple into others, creating **interdependencies** that need to be managed effectively. Systems mapping and analysis tools help optimize these interconnected domains.

Are you leveraging such tools to identify and align these interdependencies effectively?

Advanced technologies offer immense potential to drive sustainability goals but must be **balanced with ethical considerations** to ensure social inclusiveness and address privacy concerns. Equity, accessibility and privacy must be central to digital innovations.

How are you aligning your digital sustainability efforts with these principles?
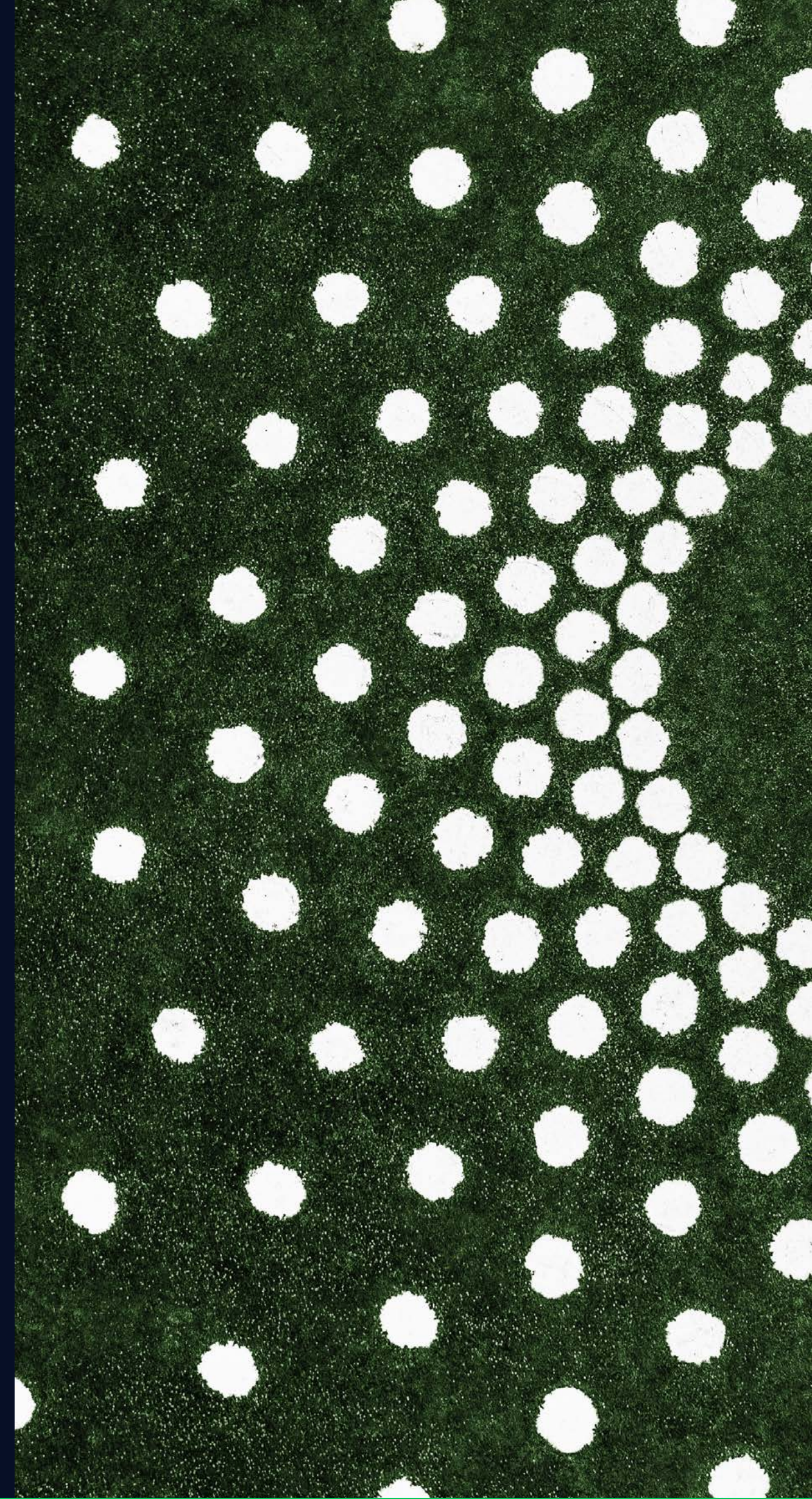
Conclusion and next steps

Do this next

5 minutes

Identify environmental priorities

Identify one high-risk environmental area or process where IoT and AI tools can provide immediate insights for real-time monitoring and disaster prediction.

5 days

Pilot upskilling platforms

Launch a pilot program using an online learning platform to train employees on how to use sustainability tools such as AI-driven energy systems and blockchain-based transparency solutions.

5 weeks

Deploy policy-simulation tools

Adopt and integrate AI-powered policy-simulation tools to model the long-term impacts of your sustainability initiatives and ensure informed decision-making across departments.

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Global Content Hub		Global

References and sources

Trend 3: Digital sustainability for economic resilience

- Grand View Research. AI In Mental Health Market Size, Share, Growth Report, 2030.

- Grand View Research. Environmental Monitoring Market Size & Share Report, 2030.

- InsightAce Analytic Pvt. Ltd. Global Artificial Intelligence in Disaster Risk Management Research Report.

- Market.us. Global federated learning market 2023–2032.

- Mishi, M. BloombergNEF. US is top climate-tech financier in 2024. China led last year.

- Precedence Research. Advanced energy storage systems market size, share, and trends 2024 to 2034.

- Precedence Research. AI in energy market size, share and trends 2023 to 2034.

- Precedence Research. Cloud sustainability market size, share and trends 2024 to 2034.

- Research and Markets. Blockchain supply chain market by components, type, utility, verticals – global forecast 2025–2030.

- Research Nester. Energy management software market: global market size, forecast, and trend highlights over 2025–2037.

- Ritchie, R. Bloomberg. Carmignac sees energy transition fueling inflation this decade.
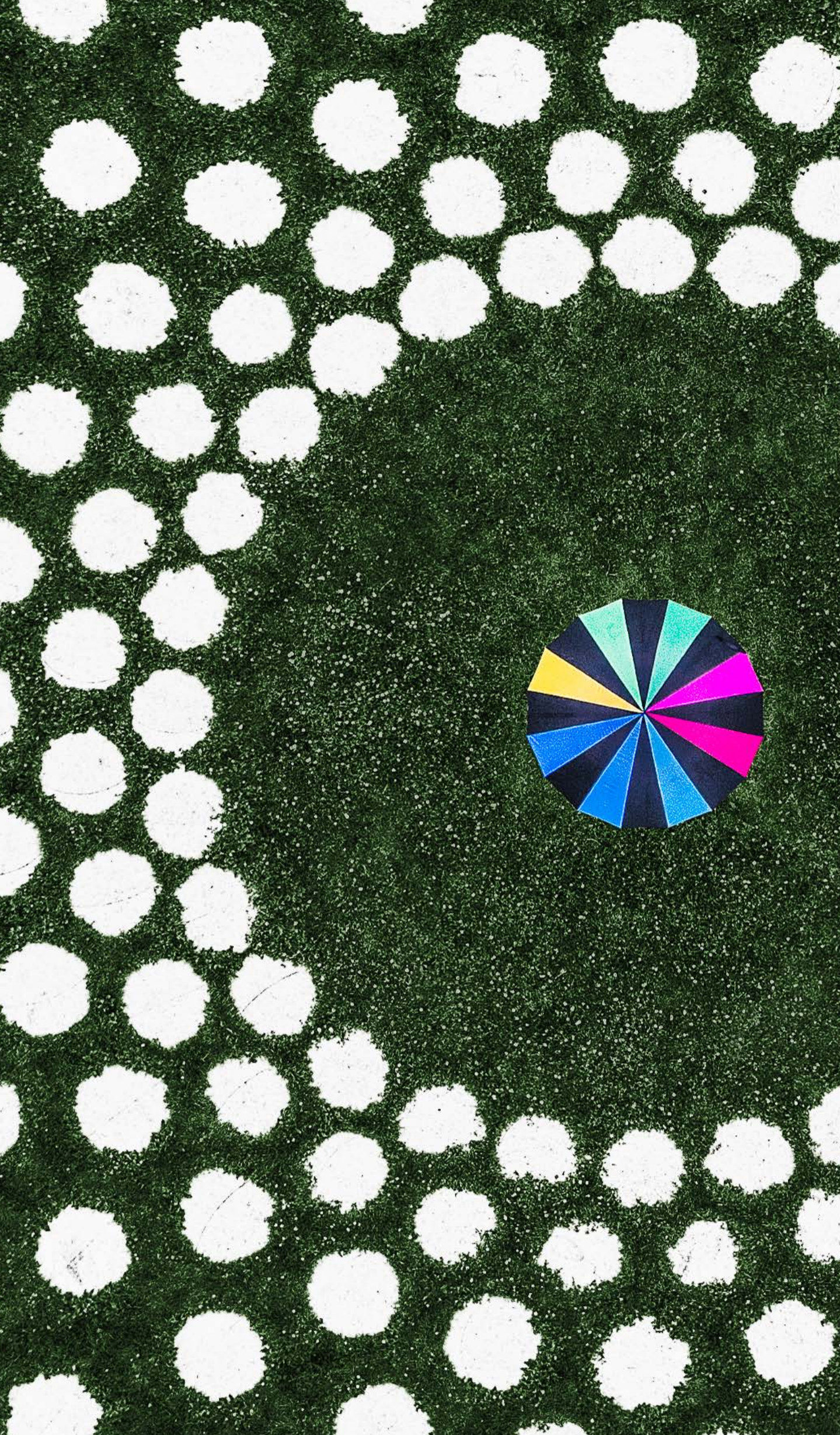
Glossary of key terms

Enhanced humans

People and machines are collaborating to shape a future where human potential isn't limited by time, task or knowledge.

Ambient intelligent experiences

Technologies like AI, spatial computing and automation are fundamentally changing how organizations connect with their audiences across different touchpoints.

Digital sustainability for economic resilience

A new business strategy is emerging where organizations integrate environmental stewardship with economic growth and assign individual and collective responsibility.

Cognitive cloud convergence

By integrating advanced cloud computing technologies with AI and human cognitive abilities, organizations can improve operations, enhance decision-making and understand their data in real time.
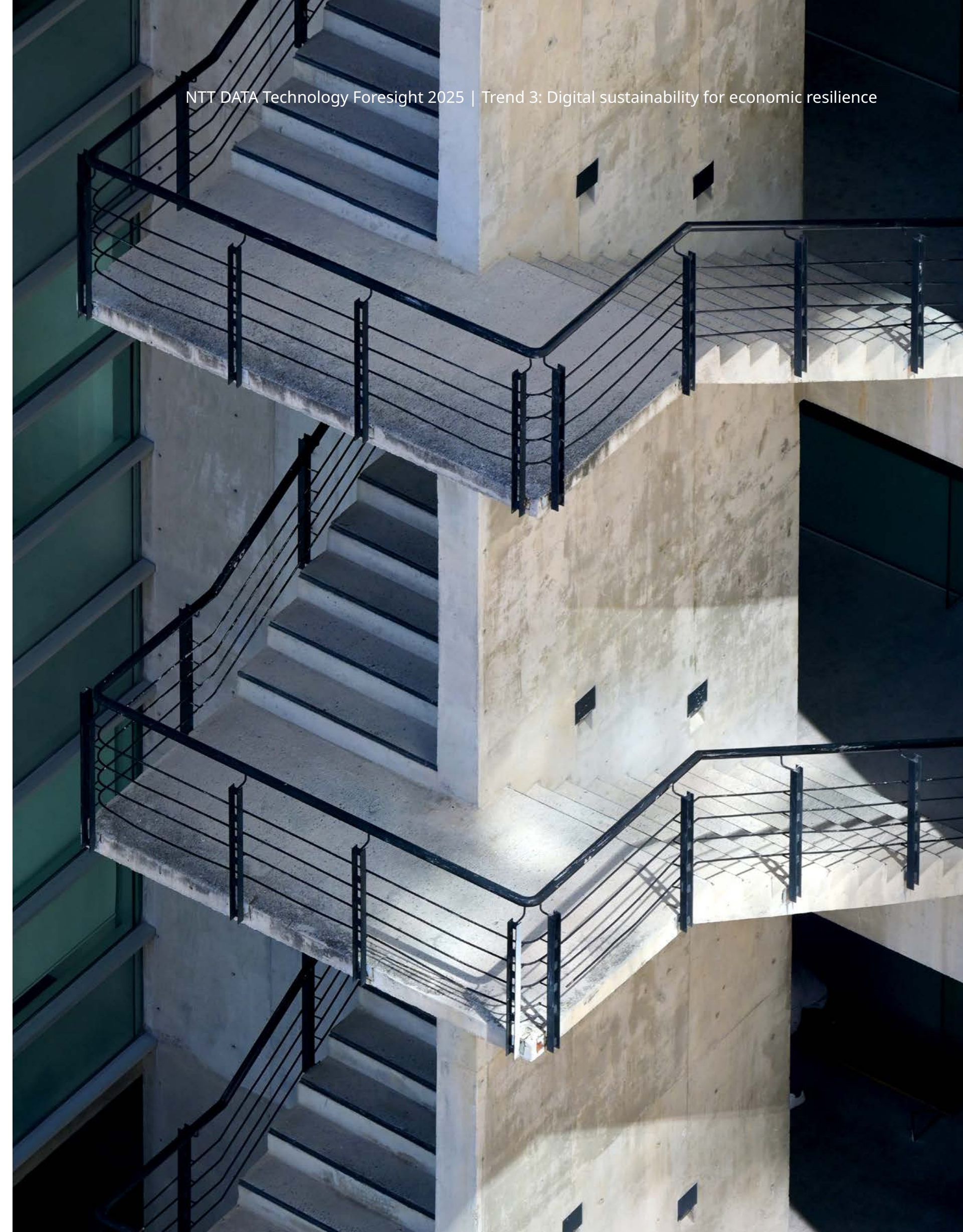
Accelerated security fusion

A new business strategy is emerging where organizations integrate automated incident response and AI-driven threat detection to adapt dynamically to emerging threats and build cyber resilience.

List of abbreviations

ADR	attack detection and response	**CRQ**	cyber risk quantification
AGV	automated guided vehicles	**CSIRT**	computer security response team
AI	artificial intelligence	**CSPM**	cloud security posture management
AIASE	AI-augmented software engineering	**CX**	customer experience
AIOps	AI for IT operations	**CVE**	common vulnerabilities and exposure
AMR	autonomous mobile robots	**DevSecOps**	development, security and operations
API	application programming interface	**DDoS**	distributed-denial-of-service
AR	augmented reality	**DoT**	deep learning of things
ASIC	application-specific integrated circuit	**DSP**	data security platform
AutoML	automated machine learning	**EMS**	energy management systems
AWS	Amazon Web Services	**ESG**	environmental, social and governance
BAS	breach and attack simulation	**eVTOL**	electric vertical takeoff and landing
CDN	content delivery network	**FPGA**	field programmable gate array
CERT	computed emergency response team	**GenAI**	generative AI
CGI	computer-generated imagery	**GPU**	graphics processing units
CGM	continuous glucose monitor	**GPT**	generative pretrained transformer
CI/CD	continuous integration and continuous delivery or deployment	**IAM**	identity and access management
CNAPP	cloud-native application protection platform	**IDE**	integrated development environment
CPS	cyber-physical systems	**IOWN**	Innovative Optical and Wireless Network
CPU	central processing unit	**IPA**	intelligent personal assistant
		IRM	integrated risk management

List of abbreviations

ITRM	IT risk management		**RemOps**	remediation operations
ITSM	IT service management		**RPA**	robotic process automation
IoT	Internet of Things		**RFID**	radio frequency identification
LIME	Local Interpretable Model-Agnostic Explanations		**SaaS**	software-as-a-service
LLM	large language model		**SHAP**	Shapley Additive exPlanations
MAG	multiagent generative system		**SSL**	secure sockets layer
MDR	managed detection and response		**STEM**	science, technology, engineering and math
MFA	multifactor authentication		**TPU**	tensor processing unit
MLOps	machine learning operations		**UAV**	unmanned aerial vehicle
ML	machine learning		**VA**	virtual assistant
MR	mixed reality		**MLOps**	machine learning operations
NLP	natural language processing		**VoC**	voice of the customer
OEM	original equipment manufacturer		**VR**	virtual reality
OT	operational technology		**XIoT**	extended IoT
PaaS	platform-as-a-service		**XOps**	cross-functional operations
PET	privacy-enhancing technology			
PDE	provider data extractor			
PQE	post-quantum encryption			
PRM	proactive risk management			
RAG	retrieval-augmented generation			

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