

Sustainability as competitive advantage: Building a regenerative future

2025 TCS Digital Twindex Report Series



Foreword



Amit Bajaj
President,
TCS North America

Historically, ecological responsibility was assumed to come at the cost of business performance. As a result, sustainability was largely treated as a trade-off: good for reputation but difficult to reconcile with the demands of growth, efficiency, and shareholder value.

However, today's technology makes it possible for businesses to experience the best of both worlds. Digital twin ecosystems built on IoT, sensors, and AI (both embodied and digital) have drastically reduced the incremental cost of scenario planning, decision-making, and real-time action, resulting in smarter, more impactful decisions.

For example, a retailer can now dynamically adjust store temperature based on historical data, real-time traffic, and external conditions to balance comfort and efficiency, saving money and reducing environmental impact without compromising customer experience.

As these use cases proliferate, enterprises can balance priorities that once seemed in conflict, delivering growth and resilience while reducing environmental impact. Technology is helping leaders discover that sustainability can be an engine for competitiveness instead of a constraint.

Now, enterprises are embracing sustainability as a foundational value-creation principle that drives decisions across finance, operations, and technology. This shift reflects a broader recognition that climate and ecological risks are business risks, and that long-term resilience depends on how effectively organizations integrate sustainability into daily decisions.

The path forward requires redefining how value is measured and implemented. By harnessing AI, digital twins, and Green IT, organizations can lower costs, improve efficiency, and drive ecological renewal without compromising business objectives.

Technology enables organizations to do the right thing without slowing growth. In this way, leaders can bridge the gap between profitability and purpose, ensuring enterprises thrive in a more sustainable and regenerative future.

Executive champions

Featuring insights from TCS executives, clients, partners, and futurists, this issue of the TCS Digital Twindex illustrates how an ecosystem of technologies helps organizations manage complexity and embrace sustainability as competitive advantage.



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Ravi Prasad Nimmalapudi
Senior Director, Sustainability,
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David Kish
Futurist,
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Executive summary

This edition of the TCS Digital Twindex explores how enterprises can embed sustainability into their core operating models, aligning profitability with purpose while navigating complexity across supply chains, technology stacks, and global reporting requirements.

The sustainability leaders and experts featured here emphasize regeneration as the next frontier: going beyond impact reduction to actively restore systems and create new forms of value. The report highlights how digital twins and AI are reshaping visibility across value chains, enabling organizations to anticipate ripple effects, strengthen resilience, and balance efficiency with ecological responsibility.

Experts also underscore the importance of Responsible AI and Green IT, showing how to harness data ethically, minimize energy impacts, and ensure technology remains a driver of trust and long-term advantage.

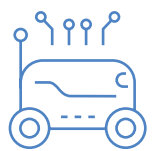
Together, these insights chart a practical, systemic path to Sustainable Value Added, helping enterprises thrive in a future where sustainability and competitiveness are inseparable.

Key findings



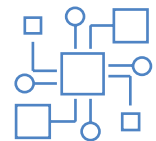
Investing in the future:

Organizations are shifting from compliance to regeneration, with sustainability integrated as a value creation principle.



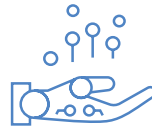
Accelerating the tech ecosystem:

Edge computing, AI, and digital twins help companies innovate in sustainability without compromising business objectives.



Visibility is critical:

Real-time visibility across the organization and suppliers enables lower emissions across the entire value chain, improves ESG compliance, and builds consumer trust.



Solving the AI question:

AI has significant utility for sustainability and cost-savings, but must follow Responsible AI tenets.



Green IT balances the equation:

Efficient infrastructure and sustainable software cut costs and emissions while enabling scale.



Bridging data and decisions:

Sustainability data strategy is moving beyond reporting to provide business-wide value.



Sustainable Value Added defines success:

Competitiveness will be measured by sustainability impact across the value chain.

Chapter 1: A regenerative revolution?

Regeneration is emerging as a lens for rethinking the systems that shape business and policy decisions. Regeneration calls for an evolution from reactive compliance to proactive stewardship, focusing on restoring and enhancing the systems that support both healthy living and healthy businesses.



Sustainability is really about the longevity of a business... To me, sustainability is about looking from a business standpoint, whether non-financial risks are going to inhibit your growth. Investors want to know what allows a company to keep going, to raise its ceiling, and to grow without being derailed by those risks.



Eric Weitzman
SVP, Senior Director,
Entity Intelligence, FactSet

“I see sustainability as a lens on how to operate... It means how do you have sustainability integrated as part of your operational excellence... really thinking ahead on what (the) economy looks like in the future.” – Marie Clara Buellingen, Head of Sustainable Investment Banking Americas, Societe Generale

When leaders embrace this perspective, they take a systemic approach to sustainability and how it aligns with business priorities.

“We still think ‘what can we do to make an impact’ when we should be asking, ‘what is the system we are a part of and how can we help it?’ Collective action should be the rule instead of the exception... At UN Global Compact, we convene companies to have that type of thinking.” – Amanda Gardiner, Executive Director, UN Global Compact Network USA

The regenerative opportunity for organizations is to adopt frameworks and methodologies that hold them accountable not only for minimizing impact, but also actively contributing to ecological renewal in sync with business priorities, technology adoption, and customers, partners, and employees.

“The beauty of accepting climate risk as business risk means (companies) will take more steps to reduce the risk.” – Hemakiran Gupta, Head of Global Sustainability Services, TCS



Businesses are looking to move from linear to circular, to become regenerative for the future... A lot of times, these regenerative capabilities are self-funding (which leads) to the C-suite viewing sustainability efforts in a different way.



Haley Price
Head of Sustainability,
TCS North America

To fully realize a regenerative approach, enterprises must shift from sustainability as a function to sustainability as an embedded governance model. This means metrics, structures, and teams responsible for oversight must all transform together.

“We believe true leadership is measured by the impact we create. By making sustainability part of every decision, we can drive progress today while safeguarding the world for tomorrow.” – Ravi Prasad Nimmalapudi, Senior Director, Sustainability, The Coca-Cola Company

Leading organizations are now integrating ESG priorities into financial planning, procurement policies, and technology roadmaps, infusing sustainability into every function. This includes measuring and optimizing resource usage, such as computing power and data center efficiency, and aligning with global standards like the UN Sustainable Development Goals.

Businesses must develop the ability to anticipate ripple effects, model cascading impacts, and act on signals from across their value chains. While navigating this complexity isn’t easy, organizations that attempt to do so also open the door to innovation. Modern operational challenges already require bringing multiple disciplines together. As finance, operations, design, IT, and people become even more entwined, organizations build resilience and sustainability at scale, ready to contribute to a regenerative future for us all.

Whether through greener IT infrastructure, cross-sector coalitions, or circular design principles, the path forward requires moving beyond individual performance metrics. The future of business and sustainability means embracing energy-system views, value chain modeling, and other systemic methodologies.

Chapter 2: A tech ecosystem for Earth's ecosystem

Emerging technologies are reshaping how businesses manage their footprint. Sensors, connected assets, and cloud platforms turn facilities, fleets, and networks into measurable systems. The same signals that drive productivity now reveal energy use, water intensity, and waste. When this data is organized and shared, it crosses functional boundaries and transforms insight into ecological impact.



Every time you are able to use less processing power, you directly impact your bottom line. Every single computing unit saved adds up to fewer servers, fewer data centers, and less expenditure... and less emissions, making the air we breathe cleaner!



Hemakiran Gupta
Head of Global
Sustainability Services,
TCS

"If we can bring the technologies that are available today and stitch them together with digital twins, AI, and sensors... organizations will build purpose-led, resilient businesses." – Hemakiran Gupta, Head of Global Sustainability Services, TCS

To translate intent into impact, the technology stack must be designed as an ecosystem: instrumentation that captures what matters, intelligence that recommends timely actions, and infrastructure that is efficient by default.

"(Each business) can evolve the practices which cause sustainability to be profitable for them... it's that maturity curve they follow... they are reducing their consumption, they are increasing their resiliency..." – Jayasree Kottapalli, Head of Sustainable Solutions – Communications, Media and Information Services, TCS

In practice, organizations should operationalize data from facilities, fleets, and products, applying models that forecast risks and optimize interventions. These models should be deployed efficiently, in a scalable and energy-aware fashion.



Every step a business takes to optimize how energy is sourced and used makes the whole system more resilient and sustainable: you're going to save money, but you're also helping create the energy infrastructure of the future.



Alison Wise
Founder and Principal,
Wise Strategies

"The ability to harness technology to take action as ecological issues are occurring is where the ability of AI will be transformative... (all these tools) enable us to move from corporate innovation to systems innovation." – David Kish, Futurist, TCS

In effect, leaders are equipped with the ability to make fewer, smarter, earlier decisions to minimize impact on the business, and the business's impact on the environment.

Optimizing how energy is used and sourced can be a key to unlock immediate value while laying the groundwork for deeper change. Treating the data center, the plant, and the branch office as part of one energy system (procurement, storage, efficiency, and load shifting) will result in greater resiliency and cost stability.

Organizations are achieving this energy-level view with digital twins, Internet of Things (IoT), AI, and cloud technologies. Monitoring and managing energy consumption enables leaders to make smart calls to reduce carbon emissions and improve cost efficiency throughout the organization. This level of visibility and real-time control allows tight control to optimize functions like heating and cooling, manage intelligent tariffs, and ensure sustainability reporting, helping accelerate the path to net-zero.

Finally, good governance keeps the ecosystem healthy. That means transparent metrics, shared incentives, and an explicit plan to manage the environmental cost of technology itself: optimizing code paths, scheduling training to align with cleaner energy windows, tracking the embodied carbon of new hardware, and choosing architectures that minimize duplication.

With these foundations in place, digital twins convert data into operational foresight across facilities and supply networks.

Chapter 3: Digital twins and AI: Seeing and adapting

As AI accelerates, digital twins help organizations see and adapt to changing environmental and business imperatives. Real-world examples from wildlife conservation to urban traffic management demonstrate how sensors and digital twins can bridge ecological and human systems.



Technology can provide visibility into Tier 2 and Tier 3 suppliers, where sustainability risks are often hidden, allowing companies to anticipate risks, run simulations of potential impacts, and share tools with smaller suppliers who may not have those capabilities themselves, helping to improve the entire system.



Amanda Gardiner
Executive Director,
UN Global Compact
Network USA

With strong technology ecosystems, simulation and modeling grow from theoretical exercises to vital tools for long-term sustainability planning, and real-time responses. Consider supply networks as the next frontier. By linking vendor records and certifications into digital twin models, enterprises can reveal dependencies beyond tier one, stress-test “what if” scenarios, and embed results into procurement, design, and logistics.

“Digital twins are a powerful tool for sustainability acting as a predictive brain, that uses real time sensor data to optimize operations. They enable companies to identify inefficiencies, forecast risks and automate sustainable practices, in a virtual environment eliminating the need for wasteful physical trials. This synergy between digital twins and AI allows businesses to model and implement ecofriendly solutions paving the way for a more sustainable future.”

– Zeeshan Rashid, Global Head Advisory, Sustainability, Risk and Compliance, TCS

For many enterprises, the true complexity of their supply chains remains invisible. Raw materials may pass through dozens of suppliers and sub-suppliers, often with little transparency into environmental impact, energy usage, or sourcing practices. Digital twins offer a solution, not just as process simulators, but as living, data-driven mirrors of global supply ecosystems.

“Technology and business leaders are realizing for their businesses to be sustainable, their supply chain must be sustainable. They must have sustainable energy consumption, and sustainable operations. They must realize that sustainability is not just a climate change phrase.” – Jayasree Kottapalli, Head of Sustainable Solutions – Communications, Media and Information Services, TCS

Organizations are increasingly turning toward solutions that provide supply chain visibility and risk mitigation to track Environmental, Social, and Governance (ESG) performance and ensure compliance against a wide range of regulations, such as the EU Deforestation Regulation (EUDR). As solutions like these are adopted, it is essential they are accessible to both internal and external stakeholders, with the ability to easily onboard suppliers, manage carbon emissions, and report on ESG credentials to build trust and loyalty with consumers.

One of the world’s largest food companies achieved end-to-end visibility using TCS Envirozone®, helping it address ESG requirements and potential reputational impact around reporting for the Greenhouse Gas (GHG) Protocol around business units, brands, and raw materials across 186 countries.

These capabilities are especially critical in managing climate risk, where traditional patterns no longer apply. By using digital twins to create dynamic supply chain models, companies can trace carbon footprints, identify hotspots of waste or inefficiency, and evaluate vendors based on real-time sustainability metrics.



There is tremendous potential to leverage digital twins to map out entire value chains... if you tweak any one of those components, what are the ripple effects? Is it a catalyst to reduce emissions or do you create unintended consequences?

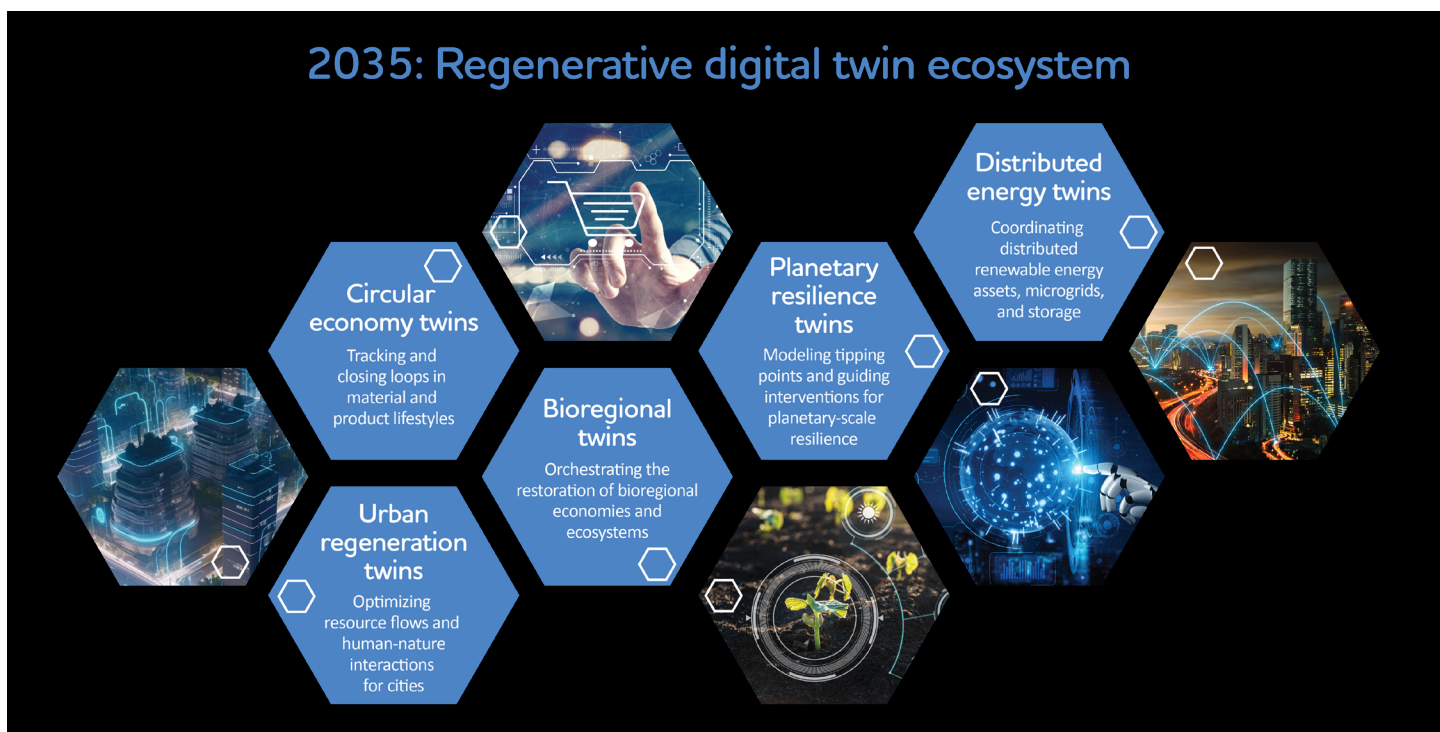


Marie Clara Buellingen
Head of Sustainable
Investment Banking Americas,
Societe Generale

The same digital twin ecosystem approach applies to cities and industries: common data layers, shared semantics, and interoperable services make it possible for utilities, manufacturers, and retailers to coordinate outcomes such as lower congestion, reduced waste, and faster restoration after disruptions.

With all participants acting in concert, coordinated by digital twins, organizations shift from periodic reviews to continuous adaptation; facilities tune energy loads hour by hour; planners rebalance logistics when weather, labor, or demand shifts; and city operators coordinate traffic, transit, and utilities as one interdependent system.

2035: Regenerative digital twin ecosystem



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We are part of the ecosystem... so when we look at artificial intelligence, we need to be looking at ecosystem intelligence.



Alison Wise
Founder and Principal,
Wise Strategies

At scale, effective twins demand disciplined data work: clarity on the question at hand, the minimum viable fidelity of the model, and the governance to share only what's permitted and useful. Organizations can start with targeted implementations such as an individual plant line, fleet segment, or port cluster, before scaling into larger models.

As models align to form real-time mirrors of an enterprise or city, they become strategy engines, bringing data closer to decision-making for leaders. Whether in a short-term crisis or long-term planning, executives are investing in AI and digital twins to map ripple effects across systems, reveal unintended consequences early, and coordinate action across partners.

At scale, AI becomes both the intelligence behind these twins and a major input to manage responsibly.

Chapter 4: The AI question

AI is top of mind for leaders as both the question and the answer when it comes to the future of sustainability.

On one hand, an adaptive mindset means building resiliency and ensuring efficient, sustainable operations. In pursuit of this, many organizations are investing in the productivity gains and amplification of knowledge work that human-centric AI can provide.

“The use of AI to gather data quickly and get a summary of companies and their suppliers, distributors and customers, to quickly get a sense of the entire ecosystem, would have been difficult years ago. Now investors and researchers can see where (sustainability) dependencies are across companies and their suppliers.” – Eric Weitzman, SVP, Senior Director – Entity Intelligence, FactSet



The future won't be won by the biggest servers or fastest models. It will be won by those who align cognitive judgment, computational speed, and ecological context into coherent action.



Kevin Benedict
Futurist,
TCS

However, the high energy requirements of compute-intensive AI projects have been well established. So, if AI is the future, sustainability must be as well. These forces must co-exist in harmony. The foundational building block to reaching this harmony is data. Data, how it is managed, stored, activated, and applied with intent, plays a role in each element of the regenerative vision experts have outlined in this report.

“What excites me (about GenAI) is turning data into action. Companies have a lot of ESG data, often not stored well, not used meaningfully. AI lets you go beyond reporting to truly equip teams with the ability to use data strategically, magnifying the impact their choices can have on sustainability practices.” – Amanda Gardiner, Executive Director, UN Global Compact Network USA

Many experts point to a gap between sustainability data and insights. For years, organizations have been gathering and storing enormous amounts of data related to sustainability initiatives. However, the primary use of this data was reporting against regulations. While this is highly important, organizations must take their sustainability data beyond reporting to unlock business-level insights.

The TCS SDI (Sustainability Data and Insights) framework aims to help bridge this gap, turning data into fuel to drive sustainable solutions and prove their positive impact across the enterprise and ecosystem alike. The first step is to assess sustainability objectives such as Sustainable Development Goals (SDGs) and Environmental, Social, and Governance (ESG) policies. Next, the SDI strategy should guide a target operating model which includes creating data definitions, managing data from various sources, and designing SDI architecture. Finally, organizations should extend their SDI framework to add advanced features such as an AI and machine learning knowledge base, and digital twin simulations.

A large global medical technology company used the TCS SDI framework to analyze more than 200 Corporate Sustainability Reporting Directive (CSRD) elements, resulting in 30 recommendations to design and optimize its ESG strategy.

Finally, to balance the positive impacts of AI with the associated energy expenditure and other risks (whether they be related to privacy, cybersecurity, or other factors), Responsible AI frameworks are required. The TCS 5A Framework for Responsible AI suggests that organizations harness data ethically, guiding AI implementations around the TCS SAFTI tenets of Secure & Reliable, Accountable, Fair & Ethical, Transparent & Explainable, and Identity & Privacy Protection.

“It seems clear that every successful business will be using AI in the future. This means that every business must have a specific approach in place to ensure that their AI efforts are responsible, ethical, and ultimately help to make the world a better place.” – Haley Price, Head of Sustainability, TCS North America

Guiding AI implementations under these tenets helps to ensure that data is gathered ethically and applied responsibly, making AI a net good not only in business operations but in how it impacts the daily lives of consumers everywhere.



Chapter 5: Balancing the equation

How can organizations mitigate the potential energy impact of increasing their use of AI while also realizing the full operational benefits AI promises?

Green IT is the practical counterweight to AI's energy appetite. Purpose-built data centers and applications which can access and activate data at greater efficiency, and lower energy expenditure, balance the equation.

To accomplish Green IT, a lifecycle approach is required. Organizations should start at procurement and continue optimization through operations to end-of-life around two primary criteria: power usage efficiency (PUE) and data center infrastructure efficiency (DCiE).

A leading financial institution partnered with TCS to drive a Green IT strategy, leading to enterprise-wide adoption and application-specific energy savings of up to 54%. This effort also reduced greenhouse gas emissions on a level analogous to planting over 400 trees while saving enough energy to power 10 households for a year.

As digital transformation projects progress and new software is deployed, it's important to plan capacity and monitor utilization around the above criteria at each step of the way. In response, organizations can notice constraints and take actions such as virtualizing and consolidating server rooms, network links, and other infrastructure.

A green approach to software development and management means embedding energy efficient design, adaptive energy-wise applications, no-code-low-code options, containerization, and location-independent agile methodologies to reduce the carbon footprint of the development process.

Conclusion: Sustainability, profitability, technology

Sustainability is embedded in how resilient businesses operate.

"We are quickly moving from an era of ambiguous risks to a cascade of profound realities that are increasingly defined by existential threats. Are our systems, companies, institutions and leaders ready to embrace these dramatic shifts and design the future in real time? It's our generational opportunity to think and act systemically—especially at the fundamental nexus of water, food and energy—and combine AI, digital twins and human creativity to urgently model, test and choose the future we want." — J. Carl Ganter, Managing Director, Circle of Blue; World Economic Forum, Global Future Council on the Energy Nexus

The leaders in this report show that progress happens when data is treated as an asset, models are built to answer specific questions, and incentives align across functions and partners. The result is holistic transformation across the enterprise that allows organizations to clearly define the balance they must strike in managing energy and ecosystem impact while maximizing innovation.





If we think about the complexity of the world today, sustainability represents a collective challenge. It's not something that any one organization can solve... you need to collaborate across boundaries.



David Kish
Futurist, TCS

"Today, SVA stands for Shareholder Value Added, which measures the incremental value of a business to its investors. In the future, SVA may also be seen as Sustainable Value Added, measuring the incremental value added through sustainability." – Zeeshan Rashid, Global Head Advisory, Sustainability, Risk and Compliance, TCS

A sustainable and profitable future will rely on advancements in technology and a systemic reset. Leaders will embrace a new definition of sustainability and turn complexity into competitive advantage.

"You don't win the future by trying to do it alone. You win by building systems where many intelligences align—human, machine, and ecological. The ability to orchestrate all three of them is no longer a competitive edge, it's the price of admission." – Kevin Benedict, Futurist, TCS

As the world walks this path, we will explore new ways of measuring, monitoring, and optimizing the entire value chain that exists between businesses, their suppliers, and their customers. We will see the entire ecosystem imagined as a digital twin of the world, with every business and every person playing their part.

The first steps are clear: harness technology to fund innovation and balance impact. Digital twins to monitor energy expenditure already exist. AI can streamline transformation of legacy systems and fund itself. Building from here means treating data centers, plant, and office branches, brick-and-mortar stores, as one unified and connected system.

"Businesses that have no sustainability strategies will not exist in the future... just like businesses that did not have a digital strategy do not exist today." – Haley Price, Head of Sustainability, TCS North America



About the report

This edition of the TCS Digital Twindex Report explores how sustainability, once seen as a cost center, is emerging as a driver of competitiveness, resilience, and regeneration. It captures how organizations are harnessing digital twins, AI, IoT, and Green IT to move beyond compliance and embed sustainability as a foundational value-creation principle. The conversations reveal how enterprises are shifting from incremental efficiency gains to systemic transformation, aligning profitability with purpose across supply chains, operations, and governance.

The report is grounded in qualitative research, developed through curated, future-focused conversations between TCS clients, ecosystem partners, senior leadership, and futurists. These dialogues surfaced the priorities and provocations shaping how businesses confront climate and ecological risks as business risks, and how technology enables them to model, test, and choose sustainable futures in real time.

The TCS Digital Twindex Report reflects TCS' vision for sustainability at scale—offering a strategic lens into how organizations can harness technology not only to reduce costs and emissions, but to regenerate systems, build resilience, and thrive in a more sustainable and competitive economy.

About Tata Consultancy Services (TCS)

Tata Consultancy Services (TCS) (BSE: 532540, NSE: TCS) is a digital transformation and technology partner of choice for industry-leading organizations worldwide. Since its inception in 1968, TCS has upheld the highest standards of innovation, engineering excellence and customer service.

Rooted in the heritage of the Tata Group, TCS is focused on creating long term value for its clients, its investors, its employees, and the community at large. With a highly skilled workforce of over 600,000 employees in 55 countries and 202 service delivery centers across the world, the company has been recognized as a top employer in six continents. With the ability to rapidly apply and scale new technologies, the company has built long term partnerships with its clients – helping them emerge as perpetually adaptive enterprises. Many of these relationships have endured into decades and navigated every technology cycle, from mainframes in the 1970s to Artificial Intelligence today.

TCS sponsors 14 of the world's most prestigious marathons and endurance events, including the TCS New York City Marathon, TCS London Marathon and TCS Sydney Marathon with a focus on promoting health, sustainability, and community empowerment. TCS generated consolidated revenues of over US \$30 billion in the fiscal year ended March 31, 2025.

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