SIEMENS

SIEMENS INFRASTRUCTURE TRANSITION MONITOR 2025

Inside **smarter buildings**

How innovations are saving costs and cutting emissions

Executive Summary

The Siemens Infrastructure Transition Monitor 2025 finds that buildings are increasingly recognized as strategic assets in the push toward net zero. Yet while technologies and strategies for decarbonization are advancing, progress remains uneven.

There is growing momentum behind energy efficiency in buildings – now the number one infrastructure priority for organizations over the next three years. Over half of respondents plan to increase investment in energy efficiency (57 %), smart building technologies (55 %), and building electrification (54 %). However, concerns about costs and access to capital persist – especially in the commercial real estate sector, where 60 % say decarbonization is too expensive.

Retrofitting is critical to decarbonizing buildings, yet the global rate of renovations remains below 1%, far short of the 2 % annual rate needed to meet net zero goals. Smart financing models such as Energy-as-a-Service are emerging as practical solutions.

Digitalization is one of the most powerful enablers: over half of respondents say digital tools have strong potential to cut costs (56 %) and emissions (53 %), and similar numbers say they are ready to implement autonomous building systems (54 %). The challenge now is to scale these solutions, remove financial and policy barriers, and coordinate action across the ecosystem.

What is the ‘infrastructure transition?’

The infrastructure transition is the transformation (between 2020 and 2050) of the structures and systems that keep our world functioning, particularly in the areas of energy, industry and the built environment.

The energy transition and the decarbonization of industry are the drivers of the infrastructure transition, and forward-looking technologies, policies, and leadership enable it.

The Siemens Infrastructure Transition Monitor (ITM) explores the state of the infrastructure transition, highlights its urgent priorities and lays the path ahead for business and government leaders.

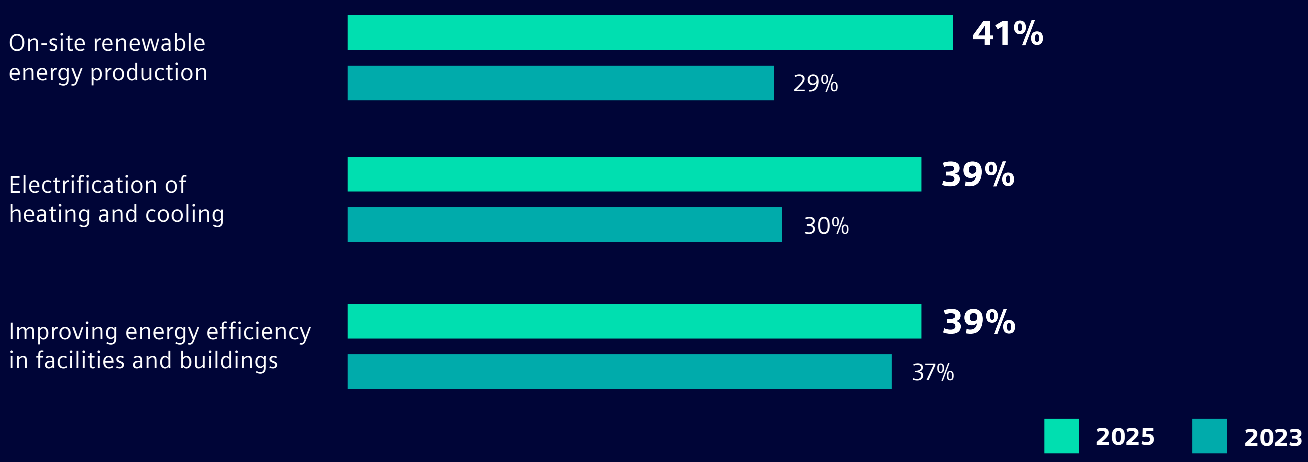
The ITM 2025 is based on a global survey of 1,400 executives from a wide range of industries, complemented by in-depth interviews with leaders and experts from around the world. This chapter explores the progress, priorities and issues involved in the decarbonization of buildings.

1 Start by using less: Cutting wasted energy from inefficient buildings

Since our last ITM survey, there has been mixed progress toward the infrastructure transition goals – a diverse set of outcomes that collectively define how the world's public and private infrastructure is evolving.

Compared with our previous findings in 2023, a higher proportion of respondents say that onsite renewable energy, and the electrification of heating and cooling, are now at a mature or advanced stage of development. But other areas have stalled, most notably improvements to energy efficiency.

Respondents report being mature or advanced in infrastructure transition goals



Decarbonizing is inherently complex. Different materials and processes produce different emission levels across a building's lifecycle, from the carbon embedded in construction materials, through its years of operation and eventual demolition, repurposing, or recycling.

When it comes to new buildings, it is important to ask ourselves what constitutes good design in the era of transformation towards net zero buildings. "We've come through an era of excess, where buildings are needlessly complex or showy," says Edmund Fowles, Founding Director of Feilden Fowles Architects. "Developers have often relied on installing expensive systems to compensate for poor design, such as big glass facades that cause overheating, requiring the installation of a larger cooling plant."

Fowles and his team emphasize the value of passive design features – strategies that use the building's orientation, materials, and natural ventilation to regulate temperature and light, reducing the need for mechanical heating, cooling, and lighting systems. "It's not about ignoring technology – it's about using it wisely. You don't need a massive HVAC system if your design naturally cools and ventilates."

Building codes and regulations should increase mandated energy efficiency, carbon limits, and sustainable design practices. In the US, cities such as New York and Seattle are enforcing performance standards that require large buildings to reach net zero emissions by mid-century.[1, 2] The EU's updated Energy Performance of Buildings Directive promotes stricter energy performance benchmarks, while South Korea is systematically raising mandatory green building standards every five years under the Act on the Promotion of Green Buildings.[3, 4]

But governments must do more than simply pass laws. As Brian Motherway, Head of Energy Efficiency and Inclusive Transitions at the International Energy Agency (IEA), puts it, "You can have identical building codes in two countries but get very different outcomes depending on how well they're implemented and enforced. Capacity building and market development are just as important as the policies themselves."

Accelerating retrofitting

The IEA's Net Zero by 2050 Roadmap calls for retrofitting approximately 20 % of the world's existing building stock to reach zero-carbon-ready status by 2030. Zero-carbon-ready means buildings that are highly energy efficient, digitalized, fully electrified, and operate without onsite fossil fuels, while being ready to switch to zero-emissions energy sources as they become available (without the need for further upgrades).

Achieving this target requires an annual deep renovation rate exceeding 2 % through 2030 and beyond.[5, 6] However, the current global renovation rate is below 1 %, and most of these are shallow renovations that fall short of the transformation needed to decarbonize the world's existing building stock.[7]

Organizations must make different calculations when pursuing greenfield developments as opposed to retrofitting existing building stock. "For greenfield projects, the strategic and financial decisions favor smart and sustainable buildings," says Susanne Seitz, CEO Buildings at Siemens Smart Infrastructure. "They use less energy, need fewer people to operate, and can attract a premium from tenants. It's about smart investment and long-term cost savings."

Many retrofits offer a strong return on investment (ROI) but, as Seitz says, "Every building is different. ROI depends on how deep you need to go and what's already installed." Retrofitting an old, poorly insulated structure can yield quick and strong energy savings, while upgrading a newer, more efficient building is likely to deliver more modest returns.

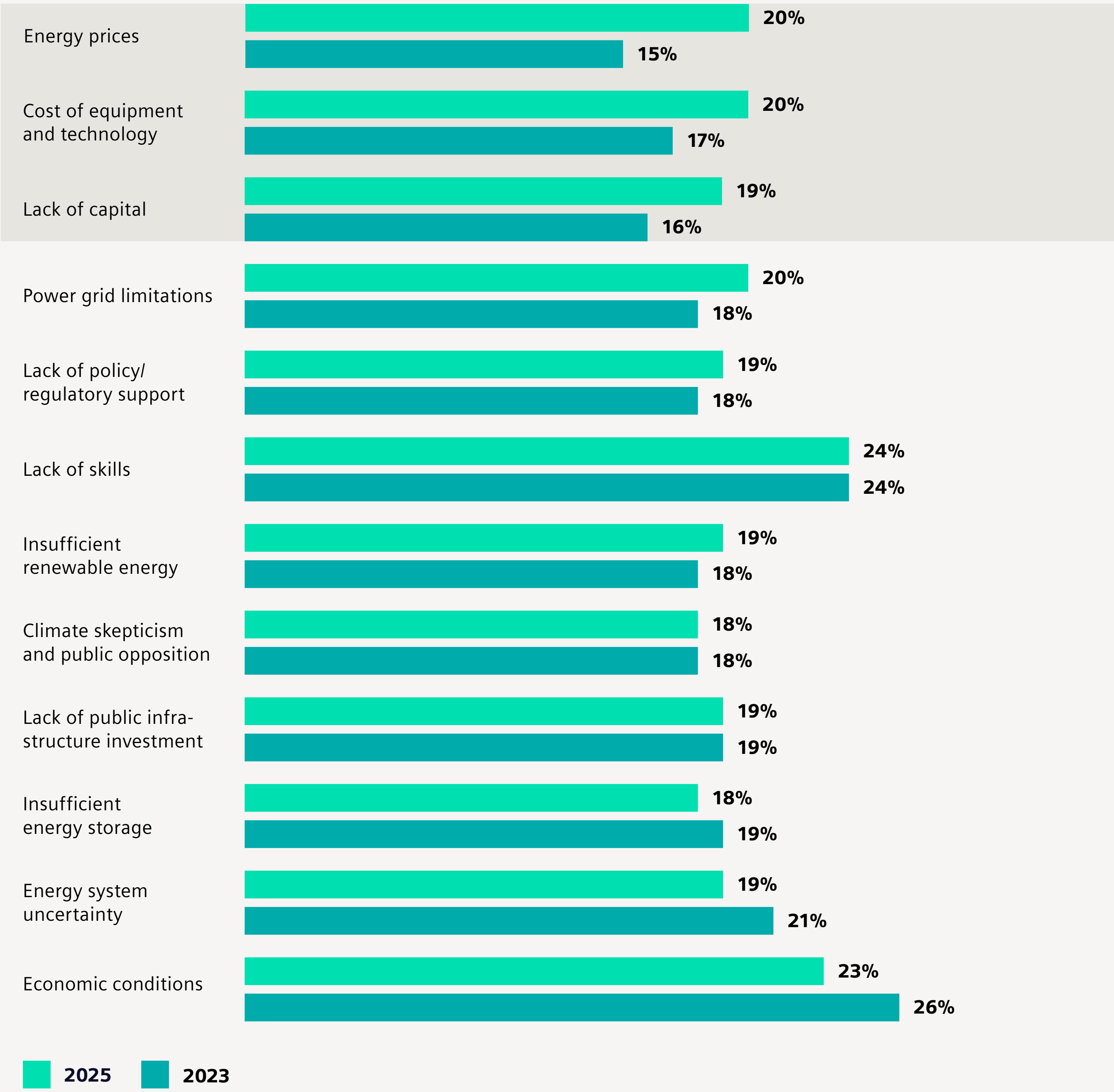
This variability underscores the need for tailored retrofit strategies, supported by smart financing models and policy incentives[8]. Not many jurisdictions have the right framework in place, which is perhaps one of the reasons why 60% of respondents from the real estate sector in our survey say that decarbonization is too expensive, far above the cross-sector average of 49 %.

Access to capital is also an issue, with only 33 % of those in real estate saying that they have adequate access to finance for decarbonization, again far below the overall average (47 %).

[1] https://www.axios.com/2024/01/09/building-decarbonization-local-law-97-new-york-climate-change
[2] https://www.axios.com/local/seattle/2024/01/26/buildings-net-zero-emissions-2050-law
[3] https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=LEGISSUM%3A4743091
[4] https://biz.chosun.com/en/en-realestate/2025/01/01/L4NSQ6HO2VGJZE6337UMGGV6B4/
[5] A deep renovation is a comprehensive building upgrade that typically improves energy performance by 60 % or more, bringing the building close to zero-carbon-ready standards.
[6] https://www.iea.org/reports/renovation-of-near-20-of-existing-building-stock-to-zero-carbon-ready-by-2030-is-ambitious-but-necessary
[7] Shallow renovations involve limited improvements that yield modest energy savings, often less than 30 %.
[8] https://energyefficiencyhub.org/wp-content/uploads/2024/09/Deep-Retrofit-Models-Report-web-version.pdf

This is not helped by tax systems that favor new builds over retrofits. “In the UK, if you build a new residential property, you pay no Value-added-tax (VAT). But you do pay VAT on refurbishing an old building,” says Fowles. “So the tax policy discourages reuse – even though we all know it's the better environmental choice.” The UK is far from alone in this regard – many countries have tax policies that fail to support, or actively disincentivize, the decarbonization of existing buildings. Financial pressures slow progress towards net zero, and these appear to have increased over recent years. We asked survey respondents which factors most slow down their sector’s transition to clean energy, and the three areas that have seen the greatest increase since 2023 are all financial: lack of capital, cost of equipment and technology, and energy prices.

Factors that slow the transtion: Growing finanical concerns are the biggest difference between 2023 and 2025



Reasons for optimism

However, there are reasons to be optimistic. In addition to progress made, respondents also told us which infrastructure transition goals they believe should have the highest priority for their organization over the next three years. Improving the energy efficiency of buildings – the infrastructure goal with the lowest absolute progress, and little change since 2023 – is now the number one priority.

Improving energy efficiency in facilities and buildings is now the top priority

Priority ranking	2025	2023
Improving energy efficiency in facilities and buildings	1	7
Electrification of transport and fleets	2	1
Recycling and reusing waste, materials and inputs	3	9
On-site renewable energy production	4	5

Major initiatives to improve energy efficiency can be found around the world. For example, the UAE has launched a decarbonization program that will retrofit 60 government buildings with advanced energy-efficiency technologies. The initiative targets a 27% reduction in energy and water consumption, which is projected to deliver emissions savings of approximately 15,400 metric tons of CO_2.

Our survey also finds that many organizations intend to improve the sustainability of their building stock in the year ahead, including over half planning to increase investment in energy efficiency (57%), building technologies (55%), and electrification (54%). Energy efficiency is often the best place to start when decarbonizing buildings, both from a financial and strategic perspective. "Our approach is to tackle mitigation first. Use less energy as soon as possible, then electrify infrastructure and move toward 100% clean energy. This makes full decarbonization more practical," says Dr. Sean Woolen, Assistant Professor, Department of Radiology and Biomedical Imaging at the University of California, San Francisco, where he is co-leading the organization's sustainability initiative.

Although there are efficient, cost-effective measures available to improve energy efficiency, few countries or industries have harnessed their potential at scale. Many hospitals already have automated systems to sense room occupancy, but it is less common to have systems anticipating usage patterns and adjusting HVAC and lighting accordingly. After hours, those rooms are often empty and still running at full settings," says Woolen. "The technologies needed to address this are mature enough. Applying them at scale in healthcare could deliver massive savings."

Financing the shift: CapEx-free transformation

Energy-as-a-Service (EaaS) models are powerful enablers of building decarbonization, particularly in sectors facing long investment cycles, aging infrastructure, and limited capital budgets.

By shifting from traditional capital expenditure (CapEx) to an operating expenditure (OpEx) model, EaaS eliminates the need for large upfront investments. Instead, building owners enter into long-term service agreements where efficiency upgrades are financed by the guaranteed energy savings and CO_2 reductions they deliver.

This model accelerates ROI without straining cash reserves. EaaS also makes sustainability investments more viable by aligning costs with performance outcomes. For example, a university can retrofit outdated campus buildings and pay through energy savings over time. By linking payments directly to verified energy savings and emissions reductions, EaaS minimizes risk while driving measurable climate impact.

By Cristina Gamboa, CEO,
World Green Building Council

PARTNER INSIGHT

Why building regulations are a critical driver of decarbonization

Constructing or retrofitting buildings to be energy efficient is increasingly seen by world leaders and intergovernmental organisations as the most immediate and cost-effective decarbonization lever.

A recent UN report highlights that the sector has the potential to cut 11 % of global emissions by 2035 – equivalent to taking one billion cars off the road for a year.

As such, building regulations have become a critical driver of decarbonization, with countries across the globe introducing regulations that target both operational and embodied carbon (associated with construction and transportation). However, despite this progress, according to a 2024 IEA report over 50 % of new global construction is not covered by building codes.

National climate action plans often fail to adequately support the implementation of these regulations. Under the Paris Agreement, each country submits Nationally Determined Contributions (NDCs) – or national climate action plans – to outline their strategy to reduce greenhouse gases.

While the vast majority (84 %) of NDCs reference the buildings sector, less than 10 % provide any in-depth detail on buildings, and only a small majority (54 %) mention energy efficiency in buildings at all.

We believe governments should integrate the buildings sector into NDCs. This can be supported by tools such as our NDC Scorecard for Sustainable Buildings. This digital tool that helps governments and wider stakeholders to identify best practice policy measures that should be contained within a country’s climate action plan and their national policy framework.

Current NDC commitments leave us well short of the goal to keep global warming close to 1.5 °C. Being bold on buildings offer us the opportunity to get much closer to that goal, but only if they do not remain a blind spot in our climate response.

2 Intelligence at work: How digital tools are redefining building performance

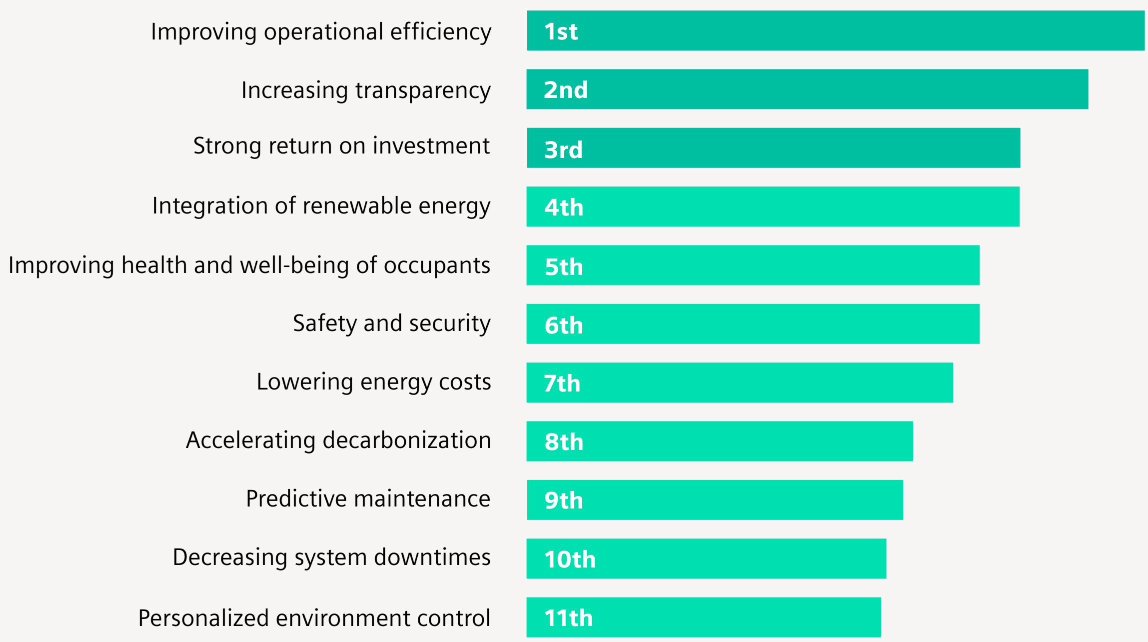
Over half of respondents say digitalization has strong or transformational potential to reduce costs (56 %) and improve energy efficiency (55 %). But digital building technologies also provide operational intelligence, enable smarter transformation strategies, and unlock new operational models such as predictive maintenance and autonomous optimization.

"Digital control systems have revealed entirely new ways to think about energy management," says Brian Motherway of the IEA. "AI will push that even further, but it doesn't replace the need to get the basics right, like choosing efficient equipment, passive design measures, smart buildings, and strong appliance standards." Motherway's point underscores multi-pronged strategies organizations need to use to improve energy efficiency – a blend of passive, active, simple and advanced strategies are needed to decarbonize the built environment.

However, to formulate an effective strategy, organizations first need to understand the current energy and emissions impact of their buildings, systems, equipment and appliances. But only half of respondents (50 %) say they have the data they need to make decarbonization decisions.

"Unfortunately, many organizations don't even know what's installed in their own buildings – they don't know the models of equipment, the firmware versions installed, or the condition of appliances," says Susanne Seitz from Siemens Smart Infrastructure. "Driving the understanding of the status quo unleashes the opportunity to plan future refurbishment, manage a recall, implement upgrades, identify energy-heavy assets, or implement predictive maintenance." Survey respondents agree – increasing transparency is seen as the second-biggest benefit of installing smart building technologies.

Top benefits of smart buildings: improved efficiency, increased transparency, and strong ROI



In a healthcare setting, transparency and visibility are foundational to reducing energy use. At the University of California, San Francisco, the implementation of building energy management systems revealed that MRI and CT machines were among the most energy-intensive devices. “MRI machines often run 24/7 to stay cool and scan-ready – even when not being used,” explains Dr. Sean Woolen, from the University of California. By identifying these high-consumption areas, Woolen’s team could make major energy and emissions savings by powering down outpatient MRI systems overnight, installing low-power standby modes for quiet periods, and ensuring HVAC systems are not operating in unoccupied rooms.

Transformative ecosystems

The platforms that enable smart buildings are also an increasingly powerful driver of infrastructure transformation, particularly those that bring together a broad ecosystem of providers and solutions. According to our research, only 42 % of organizations consider themselves mature or advanced in building collaborative digital ecosystems with partners and suppliers. Digital building platforms provide integrated environments that unify ecosystem participants, disparate systems, data sources, and workflows into a single intelligent interface.

Operations teams face persistent challenges: equipment failures, disconnected systems, limited resources, and complex tools. Digital platforms counter these by enabling virtual walkthroughs, remote system access, and proactive maintenance. They offer secure, user-friendly tools that can help organizations extend asset life, reduce downtime, and enhance operational resilience.

CASE STUDY: HEALTHCARE

How smarter systems drive sustainability in hospitals

The San Juan de Dios Hospital in Seville, Spain was designed with a dual mission: deliver exceptional patient care and meet the highest standards of sustainability. To achieve this, the hospital had to fully digitalize its building operations using an integrated building management platform.

All core systems – including HVAC, lighting, fire safety, and security – are centrally managed through Siemens’ Building Management platform and Siveillance Suite. Digital services powered by AI allow the hospital to detect faults, reduce operational alarms, and extend equipment life. Smart controllers and energy-efficient automation enable intelligent energy management, resulting in annual energy cost savings of around 35 %, with further improvements anticipated.

Remote digital services play a crucial role in optimizing performance, supporting predictive maintenance, and driving additional operational efficiency. The result is a safe, reliable, and flexible hospital environment, with annual savings through data-driven performance analysis. This case demonstrates how smart digital systems are not just supporting sustainability – they are transforming the way buildings operate.

CASE STUDY: HIGHER EDUCATION

A smart and simple approach to cutting emissons

Leading-edge technologies are setting new standards for building efficiency and performance, but it is important to note that decarbonizing buildings is often possible without advanced technologies or large investments.

The University of Toronto Scarborough Campus (UTSC) is taking major strides toward its goal of carbon neutrality by 2050 by making its existing systems work smarter. UTSC used a data-driven Existing Building Commissioning approach to optimize its Environmental Science and Chemistry Building, a facility with a geo-exchange heating and cooling system.

A key issue was inefficiency in the building's heat recovery chiller, which led to higher-than-expected natural gas use. Working with Siemens and local utility partners, UTSC fine-tuned equipment operations, adjusted setpoints, and implemented advanced control strategies – all without disrupting campus activity.

The results were impressive: a 33 % reduction in natural gas consumption, a 4 % drop in electricity use, and more than 1,094 tons of CO_2 equivalent in annual emissions savings. This case shows how smart and simple strategies can have a major impact on infrastructure transition goals. The project is an important model for how universities can scale decarbonization through digitalization and efficiency, even in older buildings.

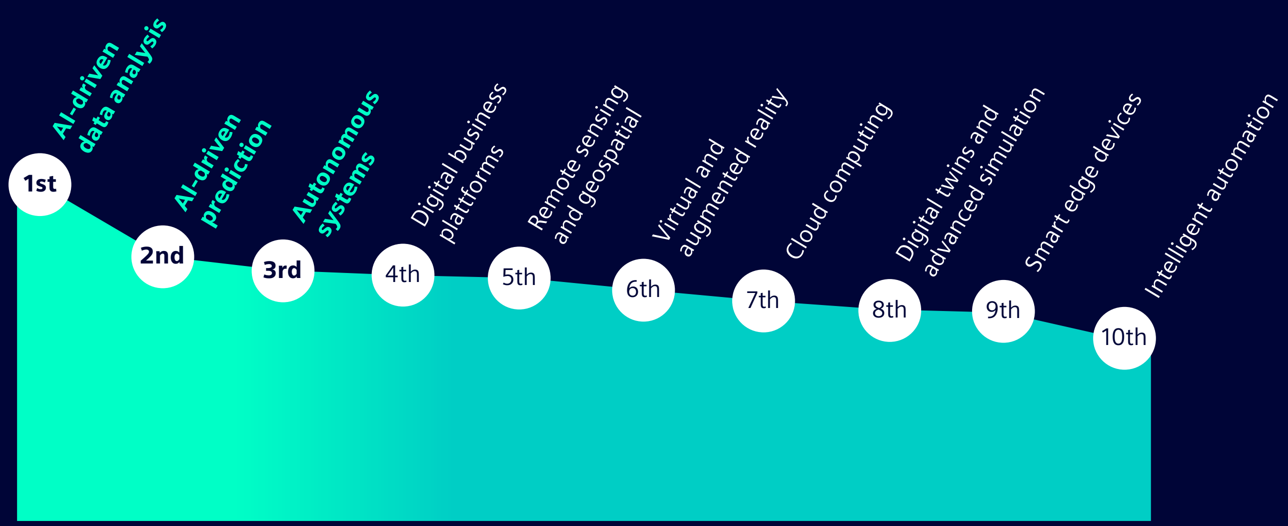
3 Autonomous systems: Smart buildings can get much smarter

In our research, the top three digital technologies identified by respondents as having the most significant impact on decarbonization are all AI-driven – highlighting the growing recognition of AI's role in optimizing energy use, forecasting emissions, and enabling intelligent infrastructure.

A powerful example is grid-interactive buildings, which communicate with and respond to the energy grid in real time. External signals (such as electricity price or carbon intensity) trigger shifts in the building's energy consumption (e.g., by moving systems to low power modes), or changes to on-site energy generation or storage systems, while sustaining occupant comfort and operational efficiency.

Thomas Kiessling, Chief Technology Officer, Siemens Smart Infrastructure, explains how grid-interactive buildings can save costs while supporting grid stability, "Most utilities charge in 15-minute intervals. If a building receives a peak warning on a summer afternoon, the system can relax its cooling intensity for 30–60 minutes, thereby avoiding peak charges without impacting comfort. It's fully automated, saves money, and helps utilities avoid expensive upgrades. It's a great example of how smart buildings support the energy transition."

AI is expected to have the biggest positive impact on decarbonization



The next frontier: Buildings that think for themselves

Smart buildings are the foundation for more advanced operations. AI-powered solutions are evolving into autonomous systems. Autonomous systems can perform tasks and make decisions entirely on their own. They can be applied to whole systems (e.g., HVAC, lighting, security) or to individual subsystems or devices.

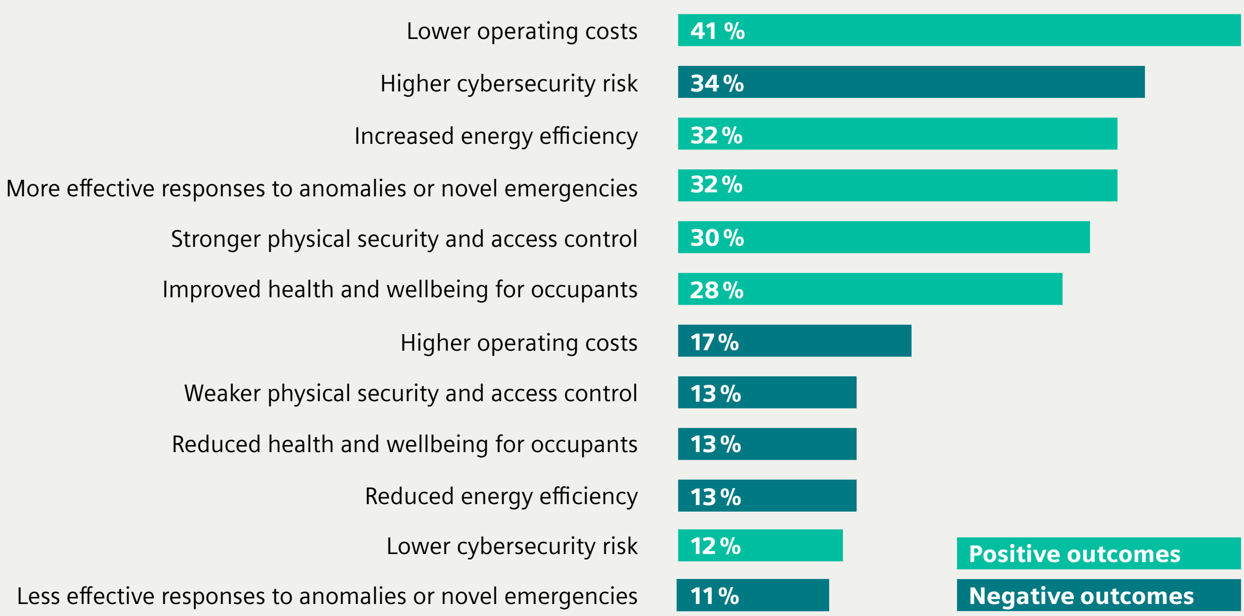
Compared to the previous generation of intelligent automation, autonomous systems are fully independent and typically more capable, equipped with advanced AI that can learn on its own and make decisions based on new data.

Survey respondents expect positive outcomes from autonomous systems in buildings. Lower operating costs are the biggest benefit, but many also anticipate increased energy efficiency, more effective responses to anomalies, stronger physical security, and improved health and wellbeing for occupants.

But respondents also expect greater cybersecurity risk. In fact, this was the second most common choice among the list of expected outcomes of autonomous systems in buildings.

This could be a view that many people have towards any new digital technology. But most organizations have now spent decades adapting to ever-evolving digital technologies and cyber threats. "Cybersecurity needs to be tailored to ensure autonomous systems do not create new vulnerabilities," says Seitz. "As we move towards autonomy, we need to stay transparent about how systems work and how data is secured." Knowing this is perhaps why few survey respondents are held back by security issues. Only 27 % say they avoid many digital tools due to cybersecurity risks, and over half (54 %) say they're ready to implement autonomous building systems.

Mostly positive outcomes are expected from autonomous buildings, but respondents also see higher cybersecurity risk



Most agree the benefits of autonomous buildings outweigh the costs

59%
The benefits of autonomous systems in buildings outweigh the costs.

59%
No matter how advanced technologies become, occupants will still demand human oversight over building operations.

58%
The use of autonomous systems in buildings will play a crucial role in reducing greenhouse gas emissions.

54%
My organization is ready to implement autonomous systems in our buildings.

51%
My organization will make significant investments in autonomous systems for buildings in the year ahead.

Conclusion: Accelerating transformation

Our research suggests there is growing recognition of buildings as strategic assets in the infrastructure transition. Technologies such as AI, digital platforms, and autonomous systems are moving us beyond incremental gains toward transformational possibilities. They enable buildings to anticipate demand, interact with the grid, and optimize performance in real time. However, creating the technology is not enough. Implementation, enforcement, cross-sector collaboration, and capability-building will be just as critical as innovation itself.

Organizations are unlocking the potential of integrated strategies, but progress is uneven, and financial constraints are significant. Energy efficiency has moved to the top of the agenda, and organizations recognize that digital solutions will enable them to operate more intelligently, efficiently, and adaptively.

Existing buildings are not just legacies of past decisions; they provide an opportunity to make new and better decisions for the future. The tools to decarbonize our buildings already exist: passive designs, smarter technologies, better data, new financing models, and stronger policy frameworks. What's needed now is the focus and coordination to use them effectively to accelerate a full-scale transformation.

About the research

The ITM 2025 is based on a global survey of 1,400 executives from a range of sectors and countries, supplemented by in-depth interviews with senior leaders and experts. This edition builds on the inaugural ITM conducted in 2023, providing updated insights into the evolving landscape of energy infrastructure and decarbonization.

We would like to extend our sincere thanks to our interviewees and survey respondents for their time and insights in support of ITM 2025.

Interviewees

Dr. Ganesh Das
Chief – Collaboration and Innovation, Tata Power Company

Sabine Erlinghagen
CEO Grid Software, Siemens Smart Infrastructure

Jan Fassbender
Head of Global Facilities and Engineering, One Human Pharma, Boehringer Ingelheim

Edmund Fowles
Founding Director of Feilden Fowles Architects

Daniela Haldy-Sellmann
SVP and General Manager Energy and Natural Resources Industries, SAP

Thomas Kiessling
Chief Technology Officer at Siemens Smart Infrastructure

Brian Motherway
Head of Energy Efficiency and Inclusive Transitions at the International Energy Agency

Andreas Schumacher
Executive Vice-President Strategy, Mergers & Acquisitions, Infineon Technologies

Susanne Seitz
CEO Buildings, Siemens Smart Infrastructure

Dr. Sean Woolen
Assistant Professor, Department of Radiology and Biomedical Imaging, University of California, San Francisco

Survey Sample Breakdown

Organization size

50-249 employees	290
250-499 employees	290
500-999 employees	350
1000-4999 employees	270
5000+ employees	200

Seniority

C-suite executive (or equivalent)	200
Reports directly to a C-suite executive	500
Manager reports directly to a C-suite executive	700

Sector

Government	Energy	Transport	Technology	Health	Industrials	Consumers	Real estate
100	241	140	189	100	352	184	94

Published by
Siemens Switzerland Ltd.

Smart Infrastructure
Global Headquarters
Theilerstrasse 1a
6300 Zug
Switzerland
Tel +41 58 724 24 24

For the U.S. published by
Siemens Industry Inc.

3617 Parkway Lane
Peachtree Corners, GA 30092
United States

We create technology to transform the everyday, for everyone. Our world is changing at an unprecedented rate. Demographic change, urbanization, glocalization, environmental change, resource efficiency, and digitalization are presenting new challenges and opportunities.

Siemens Smart Infrastructure addresses these topics by combining the real and the digital worlds.

Our technology transforms infrastructure, across buildings, electrification, and grids, at speed and scale, enabling collaborative ecosystems to accelerate our customers digital journey to become more competitive, more resilient, and more sustainable.

siemens.com/smart-infrastructure