Brightlayer report 2024

The evolution of digital transformation

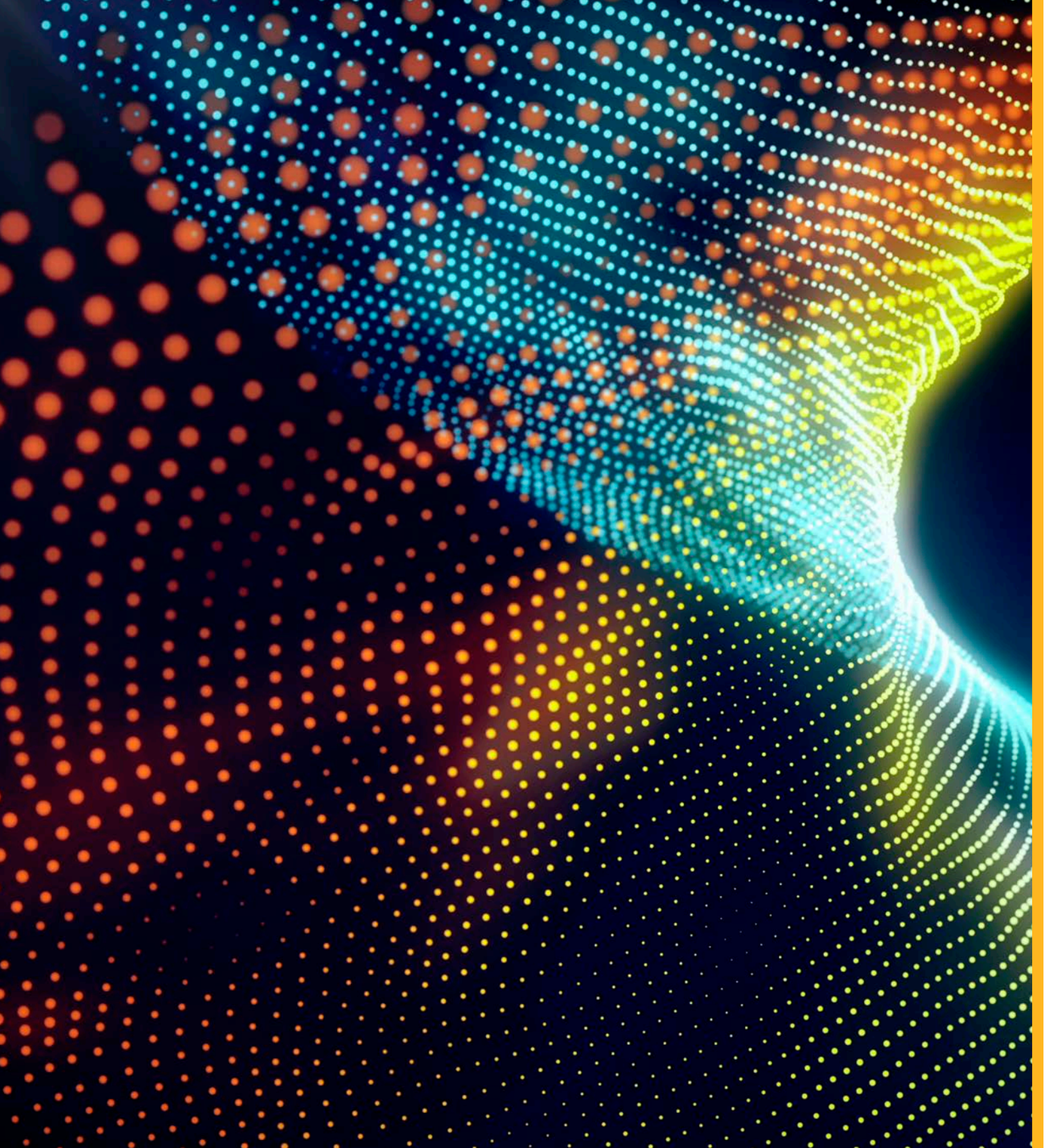
Adoption, execution and expansion in the wake of AI

Data collection and analysis by

451 Research

S&P Global
Market Intelligence

EATON
Powering Business Worldwide



Source: 2024 S&P Global Market Intelligence 451 Research and Eaton custom survey

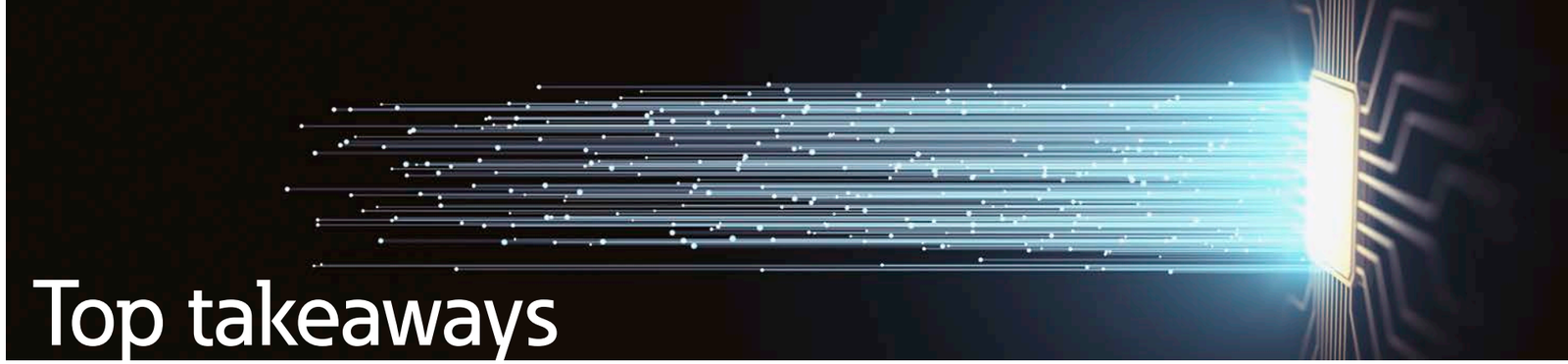
Introduction

Digital transformation has become an enterprise imperative like never before. That said, in the two years since S&P Global Market Intelligence 451 Research and Eaton fielded our first survey and report, the Intersection of Digital Transformation and the Energy Transition, global macroeconomic trends, geopolitical challenges and massive ongoing technology change have significantly altered the landscape. Yet, some things remain the same: Enterprises understand that digital transformation is not about adopting new technologies but about fundamentally changing how businesses operate and deliver value to customers.

Operational excellence and efficiency are paramount, with automation and real-time data analytics playing crucial roles in optimizing workflows, reducing costs and minimizing errors. Service and business innovation are equally important, as the integration of IoT and edge computing enables the creation of new products and services that enhance customer experiences and support agile business models. Managing energy and power resources to reach sustainability goals is another critical focus, with enterprises adopting renewable energy sources and deploying energy management systems to manage their carbon footprint and reduce operational costs.

In this 2024 report, the second in a series of surveys and analysis examining the role of digital technologies for business excellence and transformation, we look at what has changed in the past two years — and there's been a lot — and examine the best practices enterprises have adopted to achieve their digital transformation and energy and power optimization goals across four critical B2B sectors: manufacturing, utilities, building/facilities management and data centers.

To inform this analysis, Eaton and S&P Global Market Intelligence 451 Research commissioned an international web survey conducted in March and April 2024 of 1,381 respondents who are involved in their organizations' digital transformation efforts in eight countries across North America, Europe and the Middle East. See a complete description of the survey details in the Methodology section at the end of this report.



Top takeaways

Adoption of digital technologies and processes remained steady over the past two years, with some notable changes. Organizations are finding it easier to overcome the inertia of relying on legacy technologies and processes, signaling a step forward in their comfort level with digital change. And they've increased their digital skills via training and digital talent acquisition, laying the groundwork for ongoing improvements.

Use of digital tools to manage energy and power remains a top—and slightly growing—priority. Reaching sustainability goals remains a consistent digital driver, with efficiency, cost savings and power optimization increasing as a primary energy management focus in the face of macroeconomic challenges.

Cloud and cybersecurity remain the most-deployed digital technologies, with increased focus on AI emerging as the most significant new wildcard in the past two years. For industrial and energy-focused industries in particular, AI has the potential to make operations more intelligent and automated. In ranked order, 29% of respondents have predictive AI or machine learning (ML) in use or plan today, 26% generative AI, and 21% AI-enabled computer vision.

Sector takeaways:

- Manufacturers see promise in leveraging digital technologies — and increasingly AI — to optimize operations and improve maintenance processes.
- Utilities are coming to depend on digital technology to address growing load capacity demand, viewing it as a significant short-term aid to long-term grid expansion and renewables adoption.
- Building operators have a strong focus on meeting sustainability targets, even as changes in demographics, customer demand and working arrangements drastically change how they operate.
- Data center providers sit at the center of a data maelstrom, with rapid AI adoption driving demand for more powerful, plentiful compute power — even outstripping their need to address energy and power requirements.

Finally, even as these seemingly disparate sectors face their own unique opportunities and challenges, the degree to which they are interlinked and codependent is becoming more clear by the day. Soaring data center demand for power represents one of the utility sector's greatest challenges. Manufacturers of all sorts rely on ready access to power and compute resources, while the manufacture of increasingly autonomous and electric vehicles impacts utilities and data centers alike. Building owners, meanwhile, must adjust to a changing world, turning to digital insights as a bridge to the future.

The evolving state of digital transformation

Although the domains of technology and digital transformation are evolving rapidly, key enterprise adoption indicators — while high — have remained relatively flat over the past two years (see Figure 1). For instance, two years ago, 50% of respondents considered themselves to be in the "execution" phase of digital transformation, and that percentage is nearly the same in this year's study (47%). Similarly, the largest percentage of respondents (74%) reported some adoption of digital tools two years ago, compared to 78% today. One area that did show improvement is digital skills. In our previous survey, 22% of respondents said their organization had "strong" digital skills, which increased to 29% this year.

Key digital readiness indicators held steady – 2022 vs. 2024

	Digital commitment	
	Execution: 50%	47%
	Consideration: 47%	50%
	No strategy: 3%	3%

	Technology adoption	
	Broad: 22%	21%
	Some: 74%	78%

	Digital skills	
	Strong: 22%	29%
	Growing: 74%	64%

Figure 1: Enterprises are committed to digital, but still largely in the learning phase

Q. Which of the following best describes the status of your organization's operational digital transformation strategy?
Q. Which of the following best describes the status of your organization's adoption of technology tools, technologies, and solutions to support current or future operational digital transformation efforts?
Q. Which of the following best describes the capabilities and skills of the primary team implementing your organization's current or future operational digital transformation efforts?

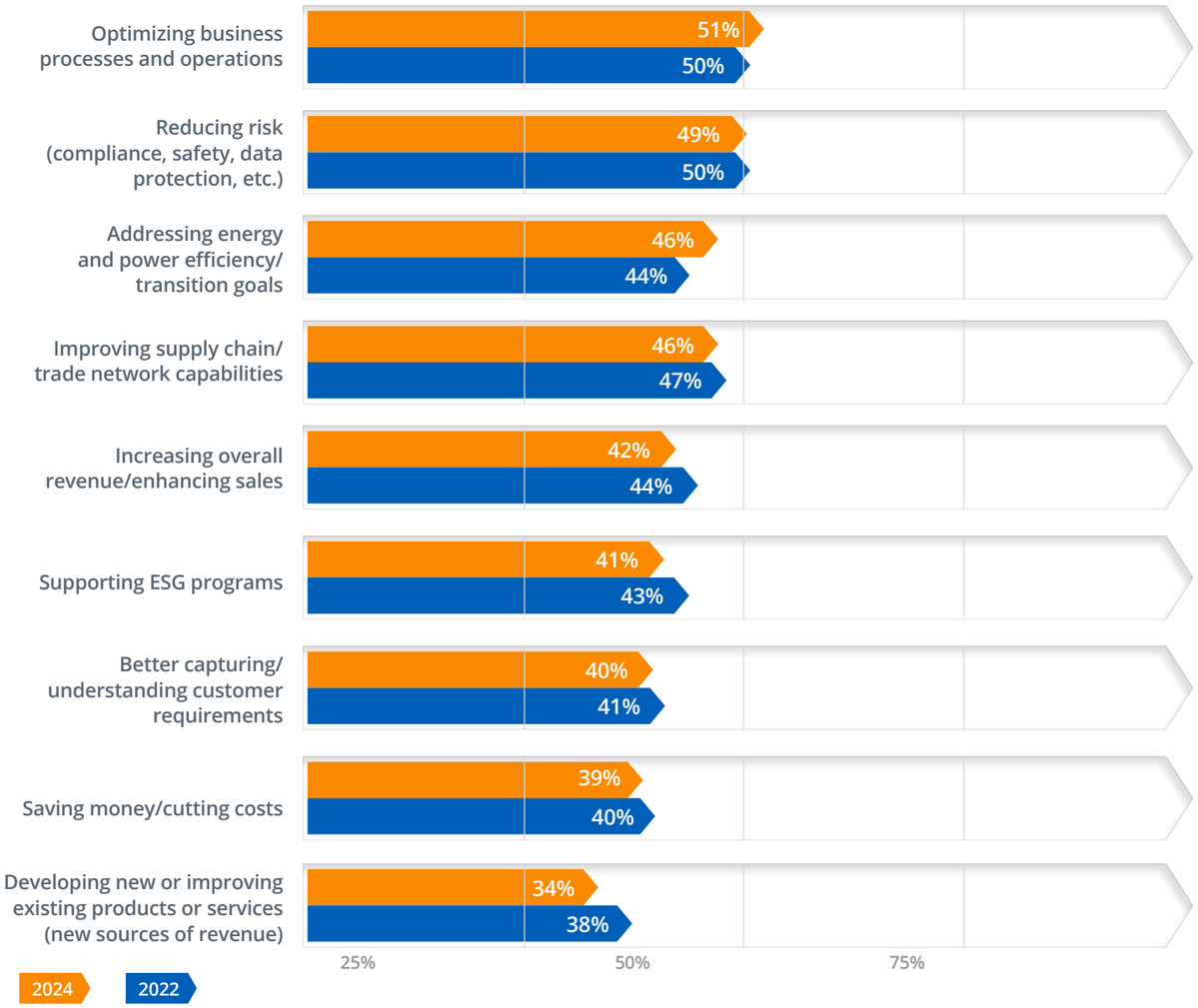
Base: All respondents – 2022 (n=1,001); 2024 (n=1,381). Sources: S&P Global Market Intelligence 451 Research and Eaton Digital Transformation Survey, 2022, 2024.

The question is whether greater improvement is likely. Overall, the picture looks bright. Just 3% of respondents said their organization has "no strategy" for digital transformation, and only 2% reported "no adoption" of digital technologies. That suggests the market is still in the learning stage, with strong intention to take advantage of digital tools and approaches. Those improved digital skills should help drive adoption further, while the emergence of new, user-friendly technologies — particularly generative AI — could encourage more companies to go digital and do so more quickly.

Digital drivers also remained relatively unchanged, indicating consistency of visions and goals. Optimizing processes and minimizing risk stayed steady as the top drivers. Addressing energy usage was among the few drivers to see at least an upward tick (see Figure 2).

Digital drivers

Figure 2: Optimizing operations and reducing risk are the top drivers of digital adoption



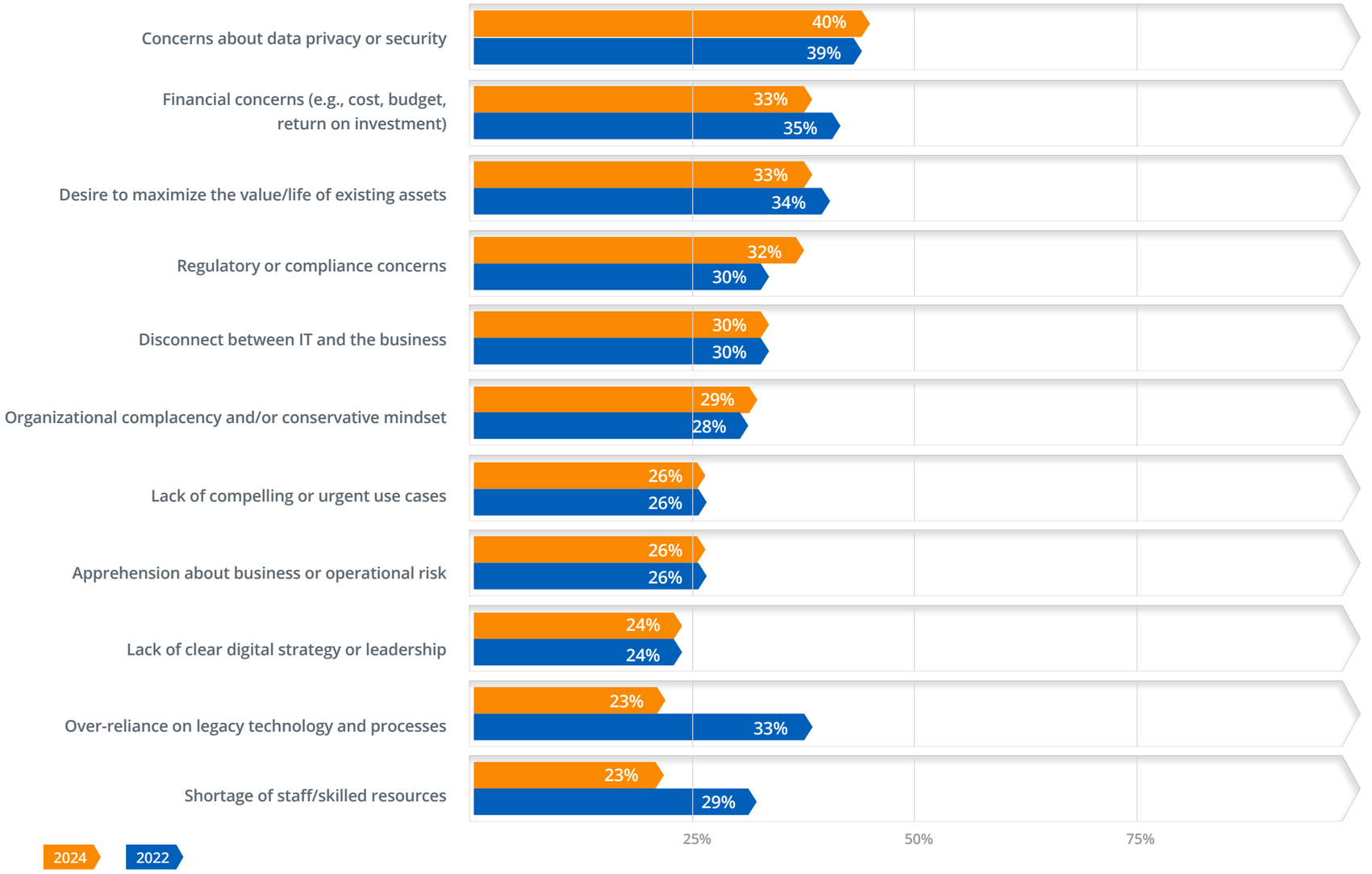
Q: Which of the following are drivers of your organization's current or future digital transformation initiatives?

Base: All respondents – 2022 (n=1,001); 2024 (n=1,381).

Sources: S&P Global Market Intelligence 451 Research and Eaton Digital Transformation Survey, 2022, 2024.

Digital inhibitors

Figure 3: Enterprises are improving digital skills and removing digital roadblocks



While the primary forces driving digital transformation forward remain relatively unchanged, at least two fairly critical inhibitors improved substantially over the past two years. Enterprises indicated they are less likely to face a digital skills shortage, the second time survey responses indicated improvements in this critical area. A more digitally skilled staff means more rapid adoption with fewer bumps in the road, multiplying its impact. At the same time, respondents also indicated they are less likely today to be dependent on — and reluctant to change — legacy technology and business processes (see Figure 3).

Many firms, especially in the industrial sector, design plants to be depreciated over the course of many decades, so the addition of new instrumentation and connectivity (i.e., IoT) to these brownfield deployments is an essential part of many digital transformations. By comparison, swapping in new systems can cause negative ripple effects, disrupting investment cycles, adding retraining requirements and putting mission-critical operations at risk. That fewer respondents view change — whether it be updating brownfield deployments or adding new greenfield plant — as a roadblock represents a major mind shift, and a potential instigator of digital change. Among the industries surveyed, commercial building and data center respondents were the least likely to cite digital skill shortfalls or a desire to keep legacy processes in place, making them more agile than their less nimble manufacturing and utility peers.

Q: Which of the following are challenges to the adoption of digital transformation within your organization?

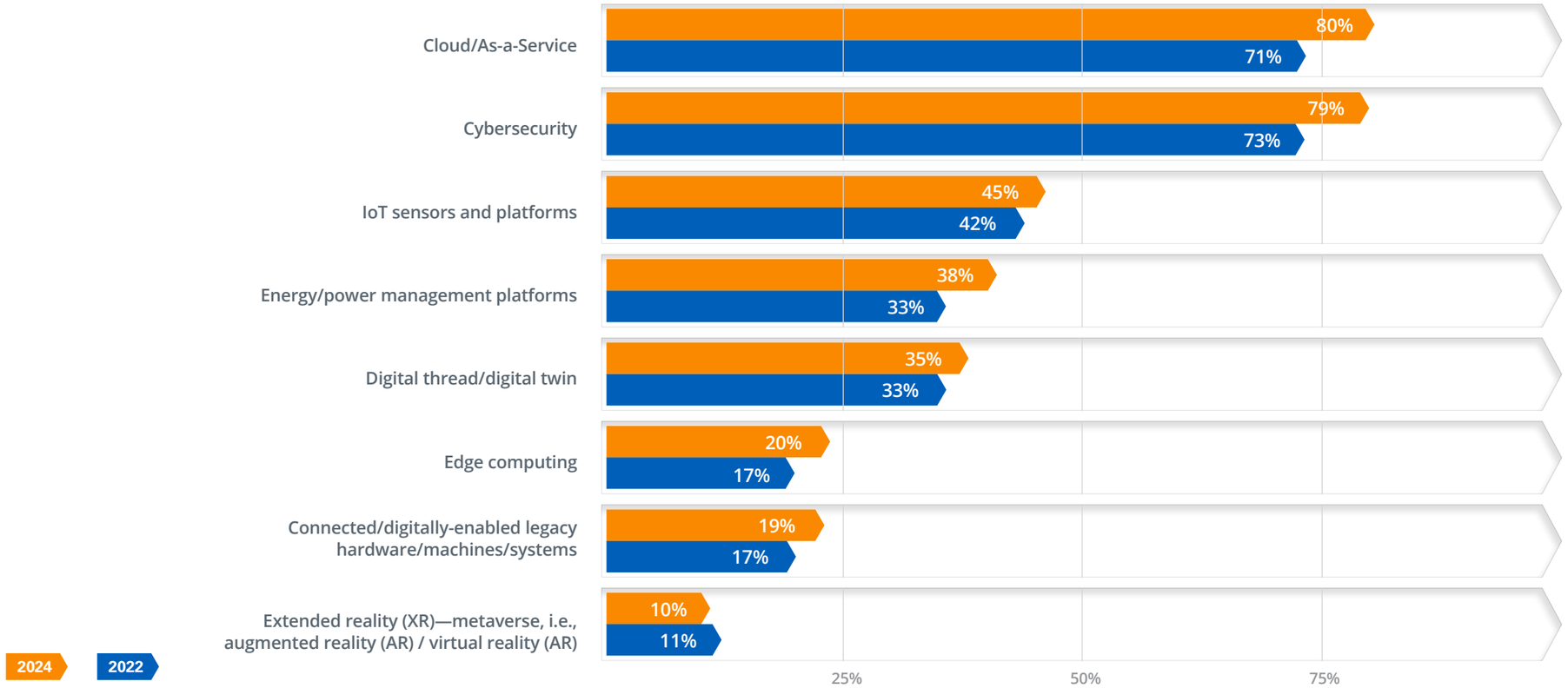
Base: All respondents – 2022 (n=1,001); 2024 (n=1,381). Sources: S&P Global Market Intelligence 451 Research and Eaton Digital Transformation Survey, 2022, 2024.

The digital toolbox gets a new wrench: AI

The technologies and tools organizations use to implement digital transformation are evolving and expanding quickly as well. In Figure 4, we compare the adoption changes over our two surveys, focusing on technologies that we asked about in both years. Cloud and cybersecurity deployment grew the most over the past two years, cementing those two critical technologies as linchpins of digital transformation. Cloud changes the economic and operational underpinnings of information technologies. Cybersecurity sits at the crossroads of digital opportunity and risk, ensuring that even as enterprises open up digitally, they protect themselves from theft and disruption.

Digital technology adoption

Figure 4: Cloud and cybersecurity are foundational digital tools for transformation



Q: Which of the following technologies, tools or applications have you deployed or plan to deploy in the next 12 months to support your organization's digital transformation?

Base: All respondents – 2022 (n=1,001); 2024 (n=1,381). Sources: S&P Global Market Intelligence 451 Research and Eaton Digital Transformation Survey, 2022, 2024.

There are further jewels to be mined from our exploration of digital technologies. We added three technologies in this year's survey, and one emerged as particularly significant. To support operational transformation, 78% of respondents indicated they plan to deploy a private wireless network. Connectivity is critical to digital transformation, and network options are proliferating, from campus Wi-Fi, to private cellular 5G and even so-called fixed wireless access offered by cellular operators to both home and, increasingly, business users. Both autonomous machinery and blockchain remain in the yet-to-be or never-to-be adopted stage, with only 20% of respondents saying they are using or plan to deploy them.

Finally, what about AI technologies such as ML, computer vision and — the popular new kid on the block — generative AI? It is important to distinguish between these approaches that, while not the only AI modalities available, are the ones most often used in operational environments. At the highest level is AI, the simulation of human intelligence processes by machines. Machine learning systems improve performance over time without being specifically programmed. Computer vision enables systems to interpret and make decisions based on images and videos. Generative AI systems can generate new content by learning underlying language and data patterns. While there are other AI approaches — including deep or neural learning and expert systems — machine learning, computer vision and GenAI are a good fit for industry applications that aim to learn complex processes, act in place of human sight, or create or consume content from machine instructions to product manuals.

In our 2022 survey, AI was a single category, and 27% of respondents reported that they had deployed or were planning to deploy AI. This year, we took a more fine-grained approach, including three AI-based categories: AI-ML predictive, the use of AI models to learn from change and anticipate necessary actions; generative AI, the use of large language models to generate content for conversational interfaces, enabling more natural interactions with machines and services; and computer vision, an offshoot of the larger category of video analytics that relies on machine sight to replace or augment worker oversight. The results (see Figure 5):

- **AI/ML predictive is most in use, in deployment or plan, selected by 29% of respondents.** However, that percentage rises to 43% of respondents in the manufacturing sector, which has deployed machine learning to automate assembly lines and improve maintenance programs.

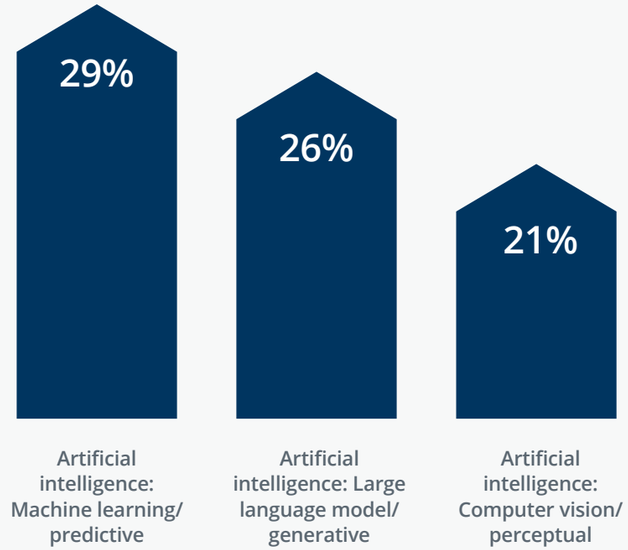
- **Generative AI is in deployment or plan by 26% of respondents, and it is deployed in relatively equal measure across the four sectors surveyed.** Generative AI is helpful in its own right, but it has the potential to be an even bigger change agent when coupled with AI/ML, building agents that can act on their own with intelligence and autonomy.

- **Finally, computer vision is planned or deployed by 21% of respondents, again largely equally across sectors.** It is perhaps most pertinent in manufacturing, where computer vision can help in sorting or quality control operations, but it has a place in other industries as well.

AI has great potential to contribute to digital transformation, bringing intelligence, automation and predictive capabilities to critical industry use cases. We explore the expected impact of the many flavors of AI as we dive deep into the transformation imperatives of individual industries below.

AI current + planned adoption – next 12 months

Figure 5: Multiple forms of AI/ML will play a key role in industrial transformation



Q. Which of the following technologies, tools or applications have you deployed or plan to deploy in the next 12 months to support your organization's operational digital transformation?

Base: All respondents – 2022 (n=1,001); 2024 (n=1,381). Sources: S&P Global Market Intelligence 451 Research and Eaton Digital Transformation Survey, 2022, 2024.

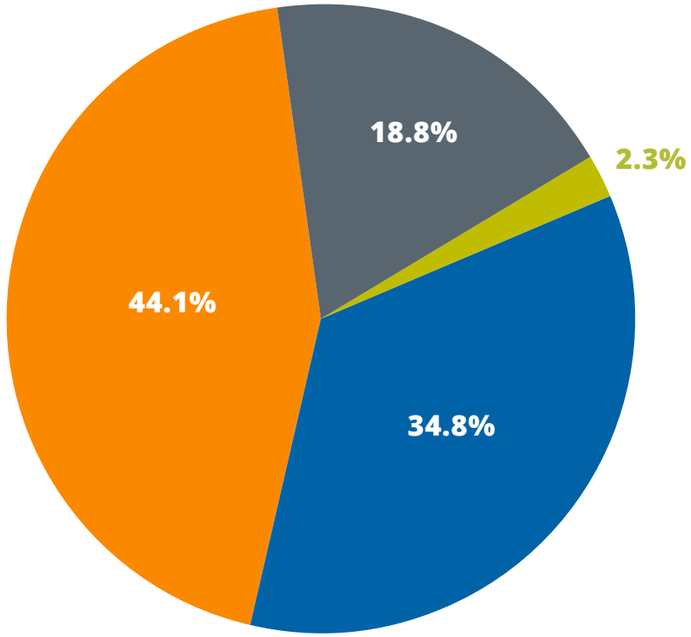
Deep dive: **Manufacturing**

The manufacturing sector is on a digital journey, driven by increased production volumes on one hand and better and more voluminous instrumentation of factory machinery and systems on the other. Those twin trends provide manufacturers with increasing amounts of digital data they can use to gain greater understanding and control of physical processes. Unlike the IT industry, where technology refreshes of equipment and software are frequent, a manufacturing plant often has a life span of many decades. While any new equipment will likely be digitally instrumented and connected, manufacturers must even more frequently apply industrial IoT solutions to existing plants (i.e., brownfield deployments). Indeed, today, digital budgets are more targeted at brownfield upgrades (cited by 41% of respondents) than installing entirely new equipment (35%) (see Figure M1).

When considering budgets directed toward ongoing operational improvement, what is your organization's primary decision driver?

- Replacement of older equipment with more digitally-enabled installation as part of an evolution toward OPEX services
- Brownfield digitalization of legacy equipment, as lack of CAPEX budget means replacement is not possible in short term
- OPEX focused on improving processes, rather than equipment, such as supply chain integration or connected worker, through digital transformation
- We see to minimize OPEX and 3rd party digital services, in favor of in-house operations

Figure M1: Propensity of brownfield vs. greenfield deployments



Q: When considering budgets directed toward ongoing operational improvement, what is your organization's primary decision driver?

(Base: Manufacturing respondents (n=345). Source: S&P Global Market Intelligence 451 Research and Eaton Digital Transformation Survey, 2024.

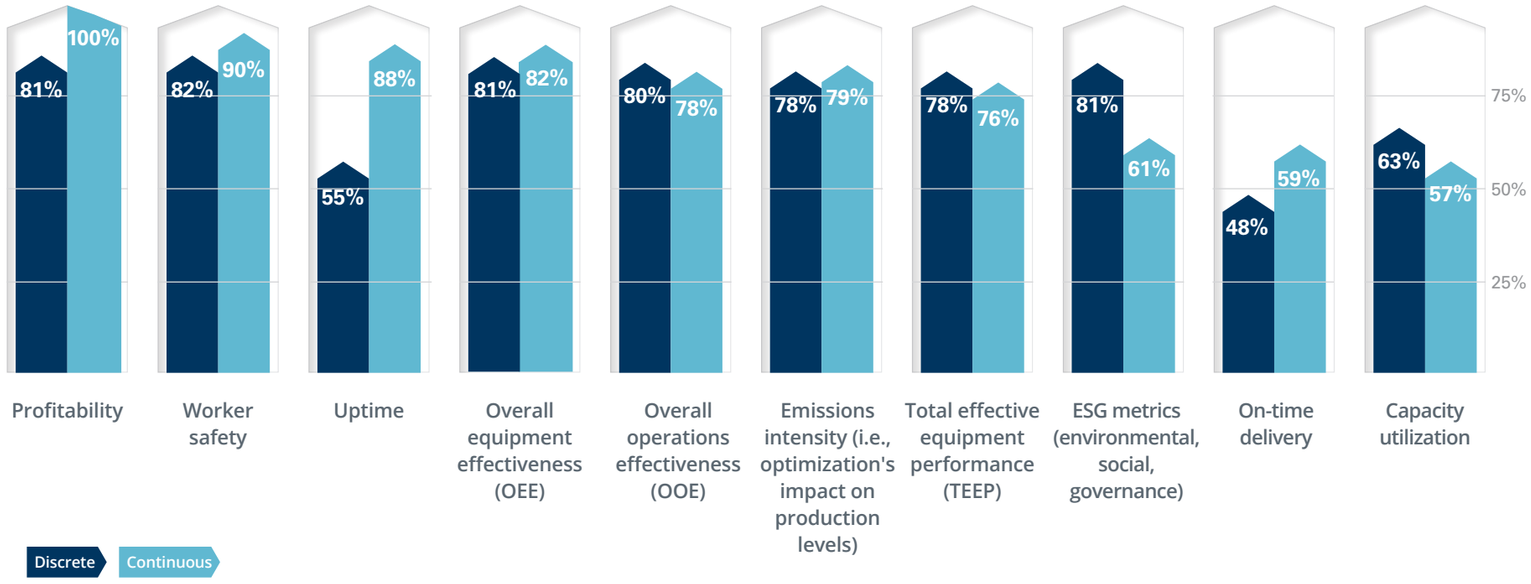
At the same time, through the evolution of industrial IoT and improved plant connectivity, the focus is now also turning toward the industrial workforce, with a goal of providing insights and support to facilitate and enhance their role in the system. Greater deployment of AI and machine learning is accelerating this trend, with manufacturers aiming to optimize efficiency via digital technologies while enhancing and augmenting — rather than replacing — technical staff and teams. In fact, 19% of survey respondents cited equipping their workers to be more connected as a primary operational improvement driver.

Digital manufacturing priorities

Manufacturers typically fall into two broad categories: discrete (combining components to make objects) or continuous process (processing raw materials and combining them in an unbroken production). Depending on what they are producing, manufacturers typically have a common set of key performance indicators (KPIs), though relative priorities differ based on the processes, opportunities and challenges of their operations. A manufacturer's highest-priority KPIs also strongly impact the direction of its digital transformation investments and strategies.

For instance, all continuous process manufacturers indicated they believe profitability to be one of the most important KPIs to optimize, followed by worker safety (91%) and uptime (89%). In comparison, just 55% of discrete manufacturers cited uptime as a critical KPI while 82% reported that tracking ESG targets is a priority (see Figure M2).

Figure M2: Digital manufacturing metrics to optimize differ by manufacturer type



Q: Of the KPIs your organization tracks, which ones are most important to work to optimize, i.e., have the most significant impact on the business? Base: Manufacturing respondents (n=345). Source: S&P Global Market Intelligence 451 Research and Eaton Digital Transformation Survey, 2024.

Those numbers reflect their respective operational and digital priorities. Continuous manufacturers need a constant flow of product matching a recipe throughout; they are unable to easily stop and start due to temperature, pressure and other attributes. By comparison, a discrete process can absorb small breaks in processing for repairs and upgrades and get back online quickly. Meanwhile, continuous processes are often more energy-intensive than discrete manufacturing, and the cost of replacing equipment and processes to address energy efficiency accounts for the lower priority placed on ESG and sustainability metrics.

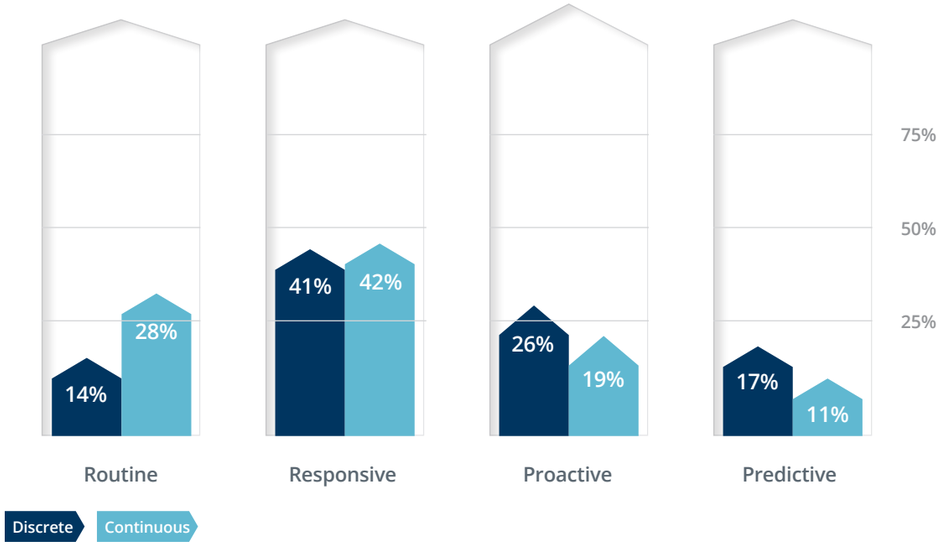
People in the process: maintenance

Optimizing runtime operations is critical, so manufacturers also look to leverage data insights to boost their maintenance programs. Traditional maintenance is based on statistically calculated routines. Condition-based maintenance, based on insights derived from machine and environmental data that impacts equipment condition, can make maintenance a more responsive and proactive endeavor. Finally, by leveraging advanced analytics and AI models, maintenance can become predictive; manufacturers can anticipate problems even as a machine appears to be running as usual, enabling even more informed prioritization of limited maintenance personnel.

Moving to more digitally driven maintenance processes is a journey, and as with plant operations above, different types of manufacturers make that journey at different paces. Overall, the largest percentage of manufacturers are in the responsive stage, counting on data insights to make them less reactive but not fully putting their maintenance programs in the hands of algorithms. That said, discrete manufacturers are more aggressive than their continuous process peers in moving to more data-driven maintenance approaches, with more opportunity to repair individual plant components and the ability to start, stop or slow down production, which is more disruptive in continuous process manufacturing (see Figure M3).

Maintenance program digital maturity

Figure M3: Discrete manufacturers more likely to be proactive and predictive in their maintenance



Q: How would you best categorize the maturity of your maintenance program?

Source: S&P Global Market Intelligence 451 Research and Eaton Digital Transformation Survey, 2024. (Base: Manufacturing Respondents, n=345)

Manufacturers cited some common concerns about modernizing their maintenance programs, regardless of the type of manufacturer. Missing critical information is the top challenge, indicating that there is still a long way to go in digitizing plants. The next most-cited barrier is organizational/workforce resistance to technology. This is often forgotten in a drive toward technology improvements — people still matter in the process and must be equipped with necessary tools and training, as well as have a willingness to work with the results.

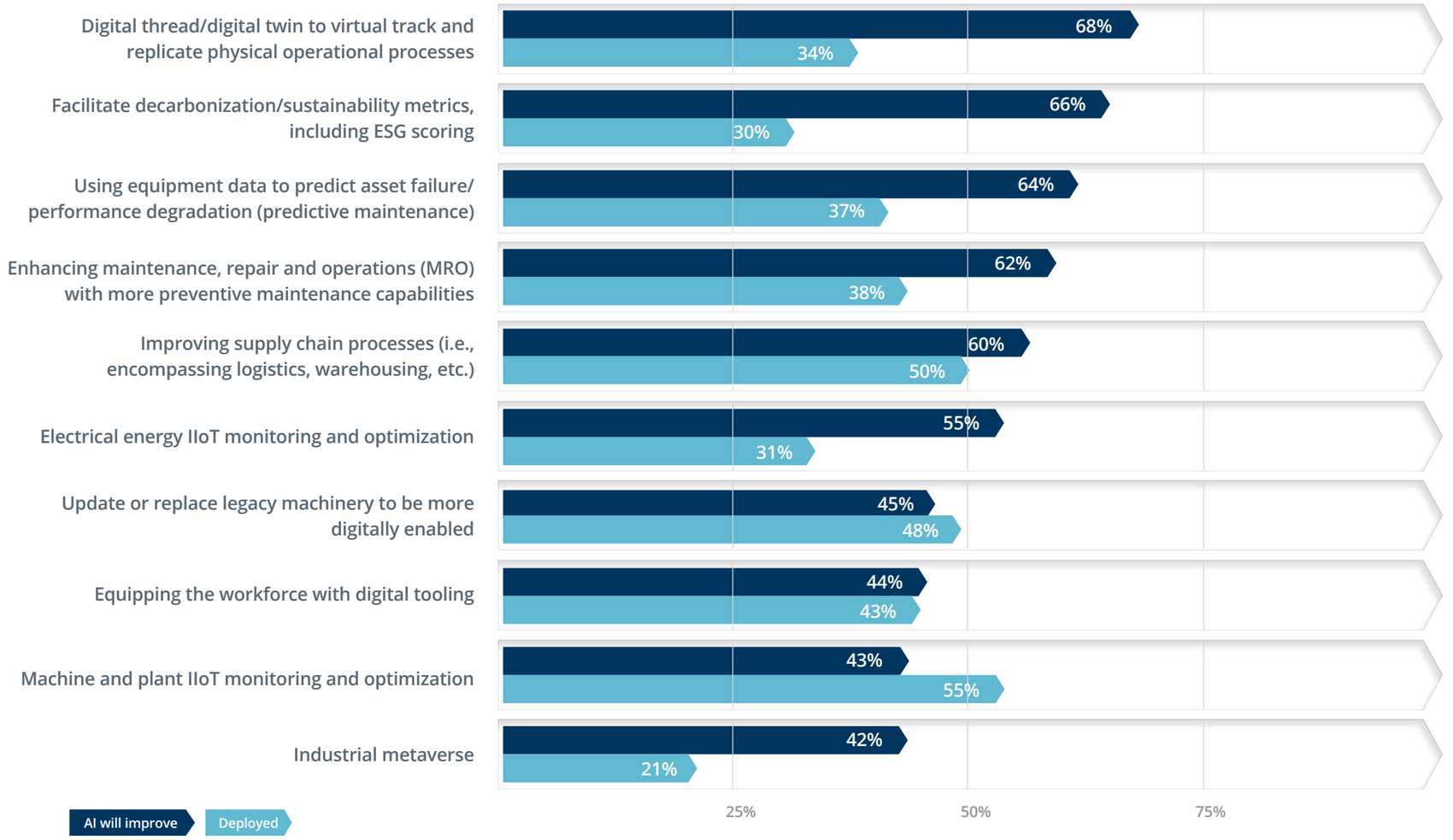
While skepticism about predictive maintenance is relatively high among manufacturers in general, continuous processors trust predictive maintenance offerings even less (with 48% citing it as a challenge) than discrete manufacturers (36%). Keeping a continuous process running is about achieving an ongoing balance of adjustments to remain in the "golden recipe" window within long production runs, which in turn drives routine maintenance approaches and less expectation of predictive maintenance.

AI in manufacturing

AI has been prevalent in manufacturing for many years with predictive-style machine learning (ML) applied in plants to help them operate more efficiently. Increased amounts of data due to ongoing plant digitization, however, makes it even more challenging to interpret and derive context to be of benefit to increasingly digitally connected workforces. The recent consumer interest in generative AI based on large language models and prediction are beginning to make their way into industrial applications. As personnel begin to understand and apply these technologies to industrial use cases — such as troubleshooting manuals, work orders and support interactions — trust and reliance on AI as a decision-making tool will begin to grow. Though many will see AI as a silver bullet to solve all problems, some use cases will benefit from AI more than others. Perhaps most notably, the digital use cases expected to be most impacted by AI — such as digital twins, decarbonization and predictive maintenance — are also among the least widely deployed (see Figure M4). This indicates an expectation that AI can solve those things that many have yet to implement, which may be wishful thinking, though it is likely to become an essential way to support engineers and mitigate workforce and skills shortages.

Deployed use case and AI expectations

Figure M4: Use cases like digital twin and predictive maintenance are expected to be improved with the addition of AI capabilities



Q: Digital use cases deployed today/expected impact of AI on use cases.

Base: Manufacturing respondents (n=345).

Source: S&P Global Market Intelligence 451 Research and Eaton Digital Transformation Survey, 2024.

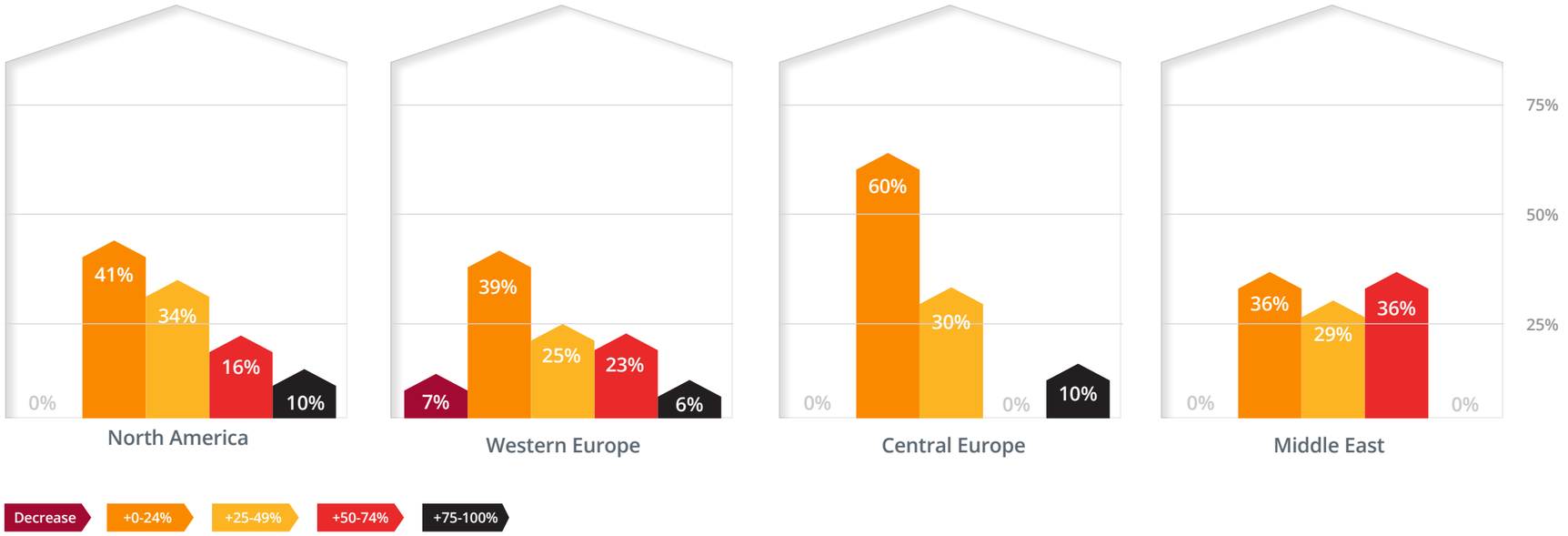
Deep dive: **Utilities**

Digital transformation is proving to be a critical enabler for the utility sector, which must balance the transition to more renewable energy resources against growing service demand. While utilities will build out the grid and add new energy resources over the course of the coming decades, data-driven insights delivered today can squeeze more performance out of the grid while helping to better bullet-proof operations.

Our survey reflects those challenges, led by load growth. Because the industry is so locally driven — organized and regulated by region and facing unique service demands based on location — its challenges are best viewed locally as well. For example, utility load growth in the next 5-10 years, across all regions, is expected to average 35%, led by the Middle East at 37%, Western Europe and North America both at 36%, and Central Europe and the Nordics at 27%. Sorting through the numbers more closely, on average, 41% of utilities expect load demand to grow up to 24%, while 29% expect growth between 25% and 49%. In Western Europe, 29% of utilities expect load demand to grow more than 50% whereas roughly a third of utilities in the Middle East expect load growth above 50% (see Figure U1).

As our survey reflects a point in time, expectations may rise as the route to the all-electric society will likely lead to a surge in demand driven by the electrification of transport and industry, population growth and a changing climate.

Figure U1: Expected load demand growth within the next 5-10 years by region



Q. By your best estimate, how do you anticipate your load demand changing in your service area in the next 5-10 years?

Base: Utilities respondents (n=346).

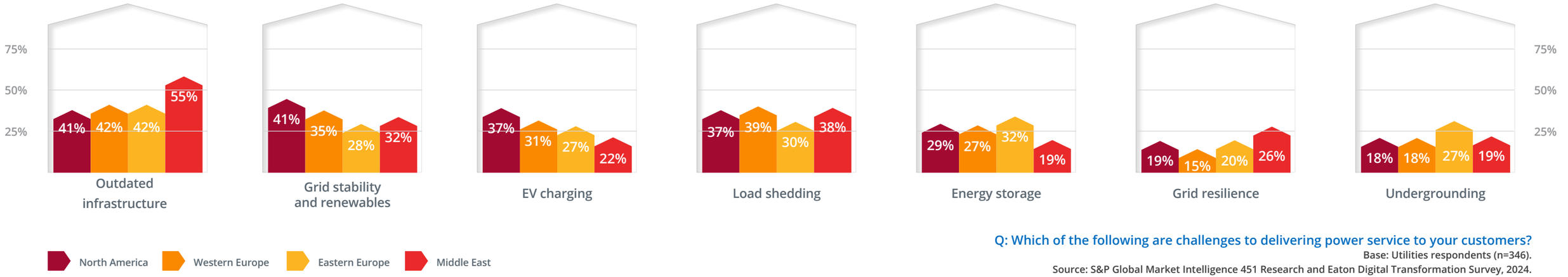
Source: S&P Global Market Intelligence 451 Research and Eaton Digital Transformation Survey, 2024.

Not surprisingly, expected drivers of load growth also differ across regions. Utilities in urban areas expect more growth from the electrification of transport than those in rural areas. Not every utility has a power-intensive industry in its service area, and regional data center growth and other macro trends can significantly impact the outlook. In general, utilities primarily expect growth of load demand to be generated by organic growth of residential, commercial and industrial demand (cited by 38% of utilities), followed by electrification of transport (32%) and electrification of industry (25%).

Grid challenges

In the energy transition, utilities face a range of challenges to keep the lights on while accommodating growth, both operational and organizational. Respondents see the biggest operational challenge as the transmission and distribution infrastructure being too light or outdated to service increased electricity demand, according to 44% of utilities. Maintaining grid stability while adding more distributed energy resources comes in second in Northern America, according to 41% of respondents, while load shedding when there is too much renewable energy takes second place in Western Europe (39%) and the Middle East (39%). Those in Central Europe and Nordics indicated the availability of energy storage to be their second biggest challenge (33%).

Figure U2: Top operational challenges to power continuity



Q: Which of the following are challenges to delivering power service to your customers?

Base: Utilities respondents (n=346).

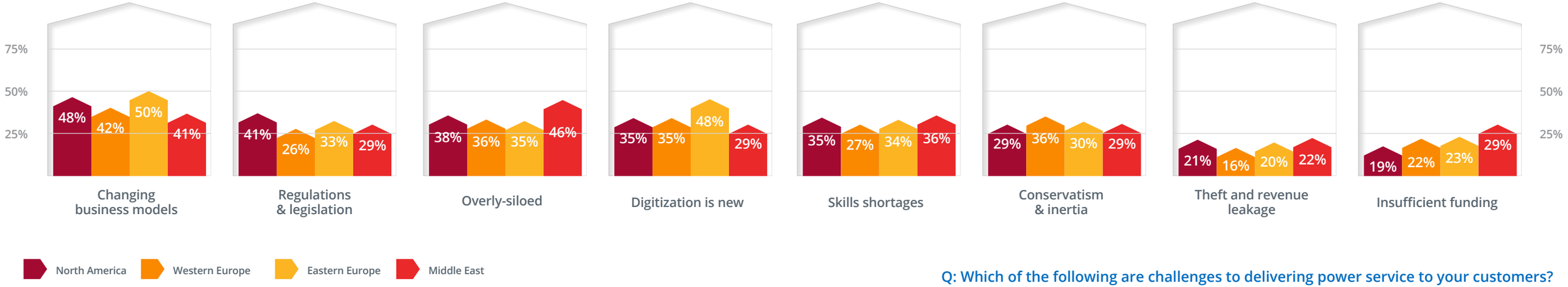
Source: S&P Global Market Intelligence 451 Research and Eaton Digital Transformation Survey, 2024.

But utilities face more than just operational challenges. Given the pace of the energy transition and rapidly changing technologies, utilities also face significant organizational challenges.

At the top of that list is changing business models — driven by smart meters, more sophisticated customers and the move to performance-based regulation — cited as the number one challenge by 45% of utilities (see Figure U3). Other operational challenges are more localized:

- In Northern America, changing and/or inconsistent regulations and legislation (cited by 42% of respondents) is seen as an additional inhibitor.
- In Central Europe and the Nordics, digitalization is a major challenge, with 47% of utilities viewing it as new, unknown and/or risky.
- In the Middle East, utilities indicate overly siloed organizations to be their number one challenge (45%).

Figure U3: Organizational challenges to power continuity



Q: Which of the following are challenges to delivering power service to your customers?

S&P Global Market Intelligence 451 Research and Eaton Digital Transformation Survey, 2024. Base: Utilities respondents (n=346).

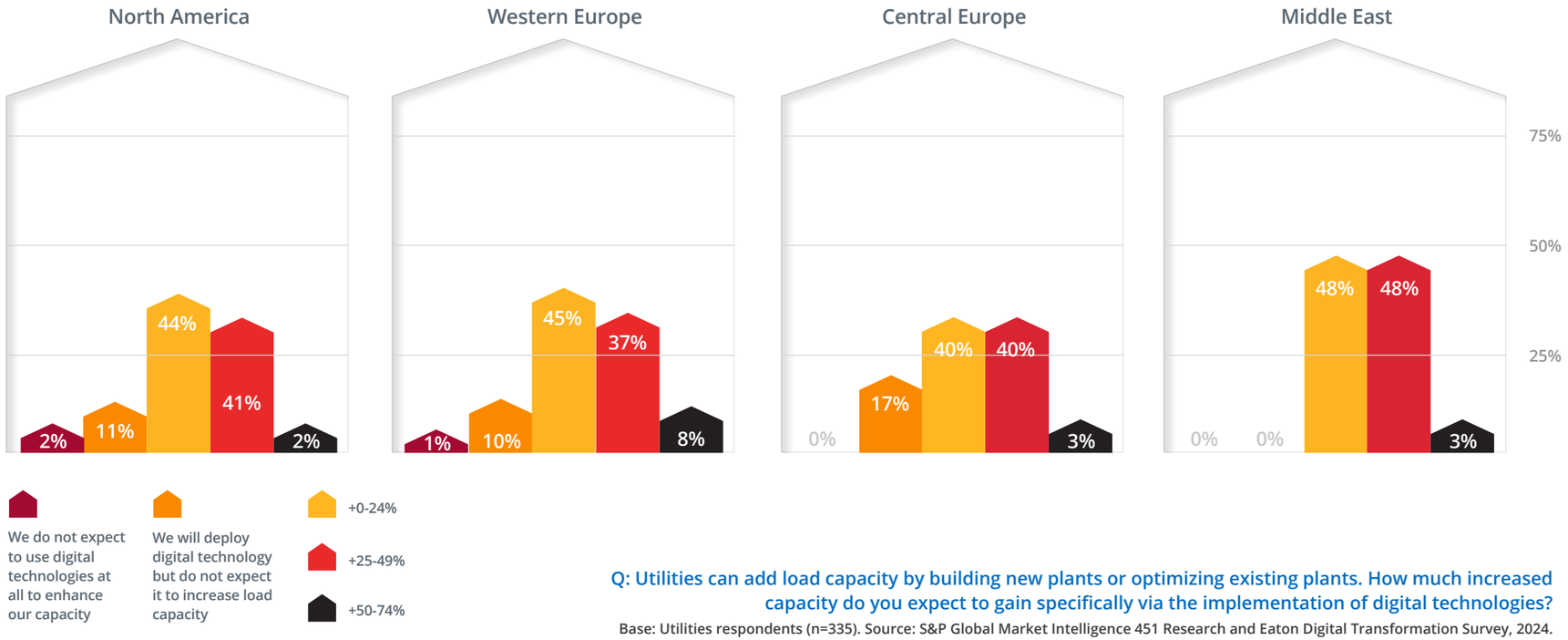
Digital is key to change

Given the surging demand for power via organic growth and the electrification of transportation and industry, utilities must increase their power supply and expand the capacity of the existing power grid. Adding renewable capacity, energy storage and grid upgrades have traditionally been the focus of discussions to address this challenge, but the reality is that most physical grid expansion projects take years to complete, and adding distributed energy resources can endanger grid stability. For these reasons, the discussion has turned to digitalization, which utilities see as critical to the expansion of grid capacity (see Figure U4).

On average, utilities expect digitalization can increase their load capacity on their existing T&D infrastructure by 26%. Digging deeper, 44% of utilities expect digitalization of operations to result in up to 24% extra capacity on the existing grid; another 40% anticipate gains between 25% and 49%.

How does digitalization assist utilities in meeting their grid challenges? Digitally driven use cases that will help add capacity include capacity forecasting and management, demand forecasting and response, outage detection and failure probability monitoring, predictive maintenance, demand planning, and vegetation analysis. In each of these cases, data-driven insights can help utilities significantly stretch current grid capacity, enabling them to better match supply and demand, anticipate and forestall outages, and more proactively maintain critical equipment.

Figure U4: Extra grid capacity on current infrastructure through digitalization



Q: Utilities can add load capacity by building new plants or optimizing existing plants. How much increased capacity do you expect to gain specifically via the implementation of digital technologies?

Base: Utilities respondents (n=335). Source: S&P Global Market Intelligence 451 Research and Eaton Digital Transformation Survey, 2024.

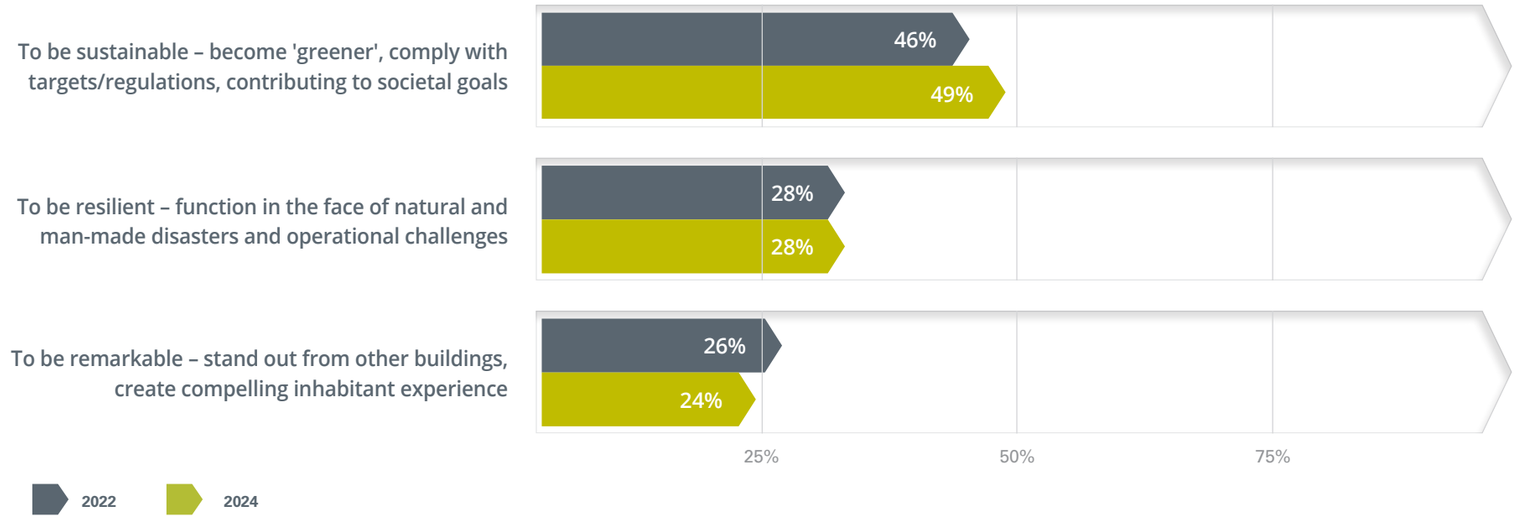
Deep dive: **Commercial and institutional buildings**

In 2024, building owners and operators are at the confluence of major societal factors, from the emergence of flexible hybrid work environments to the requirement to facilitate energy efficiency upgrades. To flourish in this rapidly changing environment, facility managers are taking stock of their building inventory, including downsizing in favor of more connected, energy-efficient buildings. Commercial building tenants, meanwhile, are focused on managing hybrid work arrangements and providing an enhanced employee experience to retain top talent and ease return-to-office mandates.

C&I building digital opportunities and challenges

As in 2022, most building owners in this year's survey cited sustainability as their primary smart building driver, a function of regulatory mandates, societal priority and the long-term operational cost savings associated with going green (see Figure B1).

Figure B1: Sustainability ranks highest among smart building drivers



Q: When considering your organization's plans to upgrade building function/capabilities using digital technologies, which of the following drivers would you consider to be the primary motivation?

Base: Building respondents (n=345).

Source: S&P Global Market Intelligence 451 Research and Eaton Digital Transformation Survey, 2024.

While sustainability ranked above the desire to be resilient or remarkable for the group as a whole, digital drivers varied by building size. For instance, large building respondents were significantly more likely (64%) than their medium (43%) and small building (26%) peers to cite sustainability as their chief motivator for smart building initiatives. Smaller building respondents were more likely to focus on being remarkable (47%) as their primary motivator in their effort to create a compelling, personalized occupant experience for building users.

Cost remains the top barrier to smart building deployments, with 52% of respondents citing return on investment or cost benefit analysis as a hindrance to deployments. Small building owners, meanwhile, are more likely than their peers to be challenged by the complexity of digital technology or the need to meet regulatory mandates, likely because small building owners tend to be more resource-constrained.

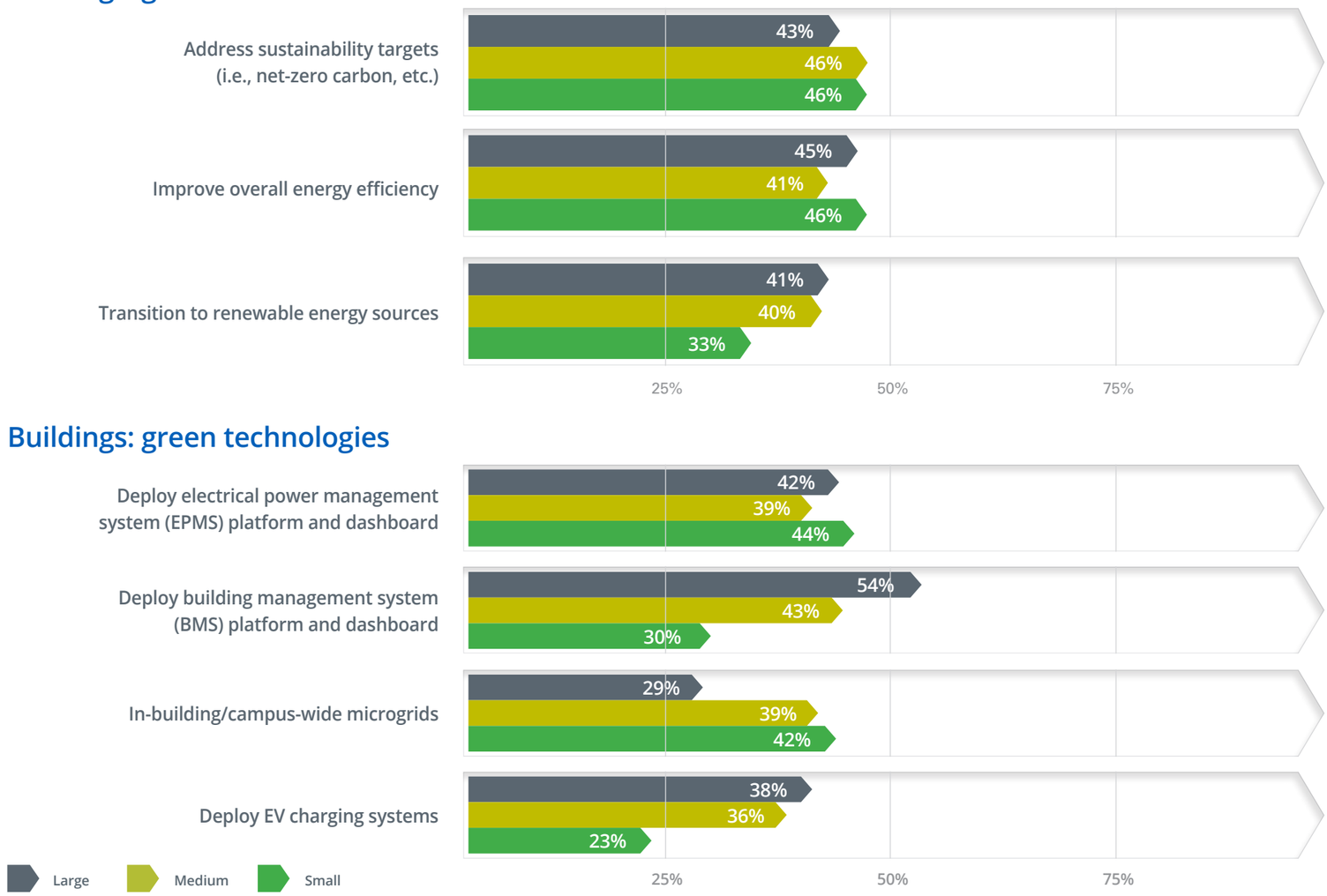
C&I building use cases: outcomes and technologies

In pursuit of sustainability improvements, building owners focus on digital-enabled initiatives such as improving energy efficiency, reducing environmental impact and increasing their use of renewables. A range of technologies can help them achieve those goals (see Figure B2).

While small building owners may lag their larger peers in terms of technology adoption to achieve green goals, it's not for lack of interest in going green. Small buildings exceed their larger counterparts in deployments in two of three main sustainability outcomes: addressing sustainability targets and improving overall energy efficiency.

Medium and large building owners, meanwhile, are more likely to deploy new digital technologies to aid them in reaching their sustainability goals. These include deploying building management systems, installing EV charging infrastructure and pursuing a transition to renewables.

Figure B2: Small building respondents diverge from medium and large peers on green technologies



Q: Which of the following energy- and power-specific smart building use cases have you deployed or plan to deploy in the next 12 months within your organization?

Base: Building respondents (n=345).

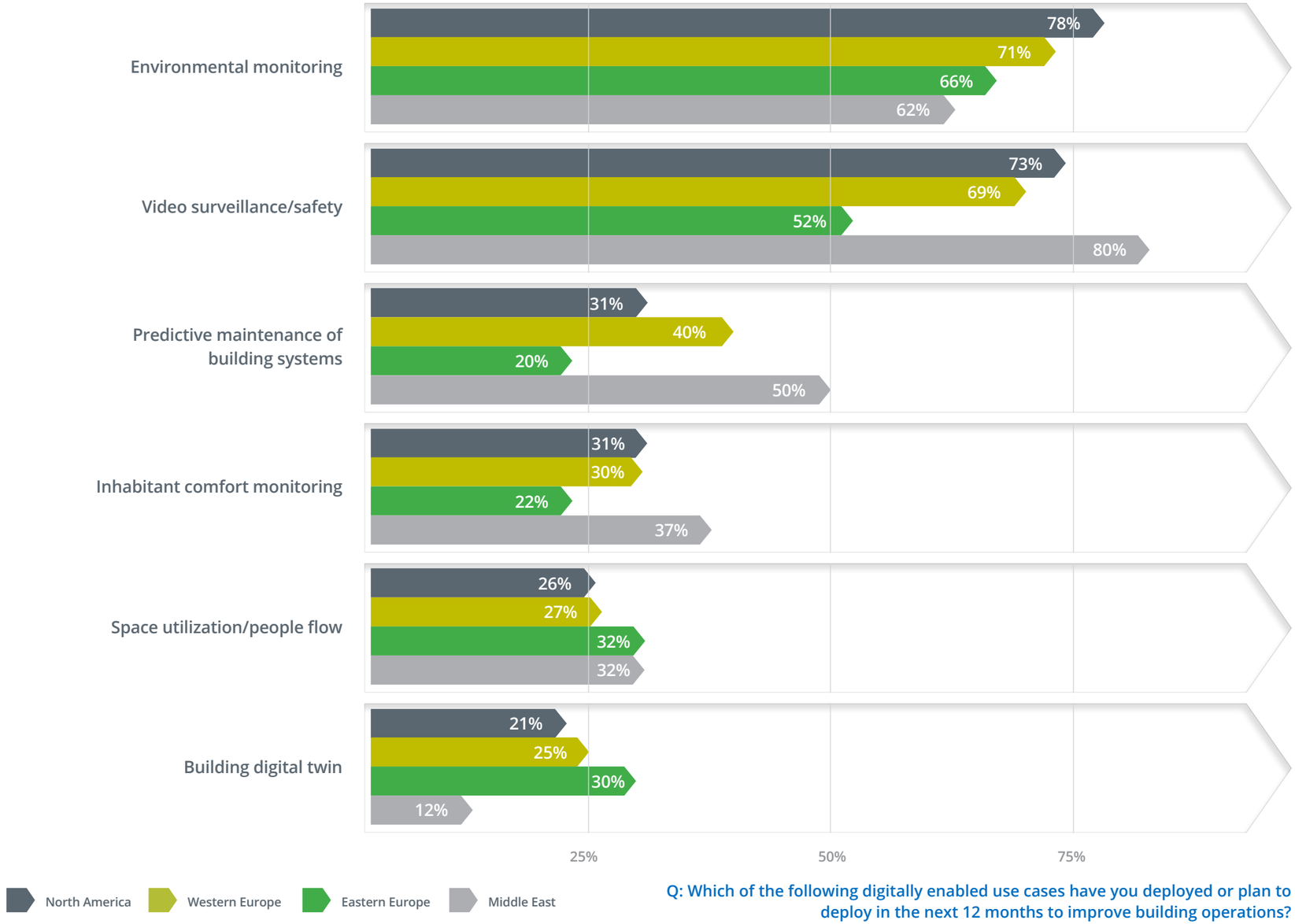
Source: S&P Global Market Intelligence 451 Research and Eaton Digital Transformation Survey, 2024.

Size isn't the only factor that impacts technology adoption. We found variances in smart building use-case adoption based on geography. For example, respondents in North America and Western Europe cited environmentally focused smart building deployments more than other regions, while Middle East respondents are deploying video surveillance more than those in other geographies (see Figure B3). Central Europe and Nordic respondents lagged their peers in the application of all but two use cases: space utilization/people flow and the deployment of a building digital twin. Digital twins, though nascent, offer promise in optimizing building management and energy efficiency from planning to operations through the integration of real-time data across multiple physical systems into a single interactive platform that replicates physical operations. The Central Europe leadership in digital twins could be attributed to leapfrogging legacy technologies in favor of newer approaches, or because of top-down or government-led initiatives to modernize infrastructure.

AI in buildings

Artificial intelligence is also playing a growing role in the building sector. In a smart building optimized by and for AI, one may expect demand-responsive heating and cooling, energy supply optimization, and highly personalized in-building user experiences (Figure B4).

Figure B3: Geographies diverge on traditional smart building technology adoption



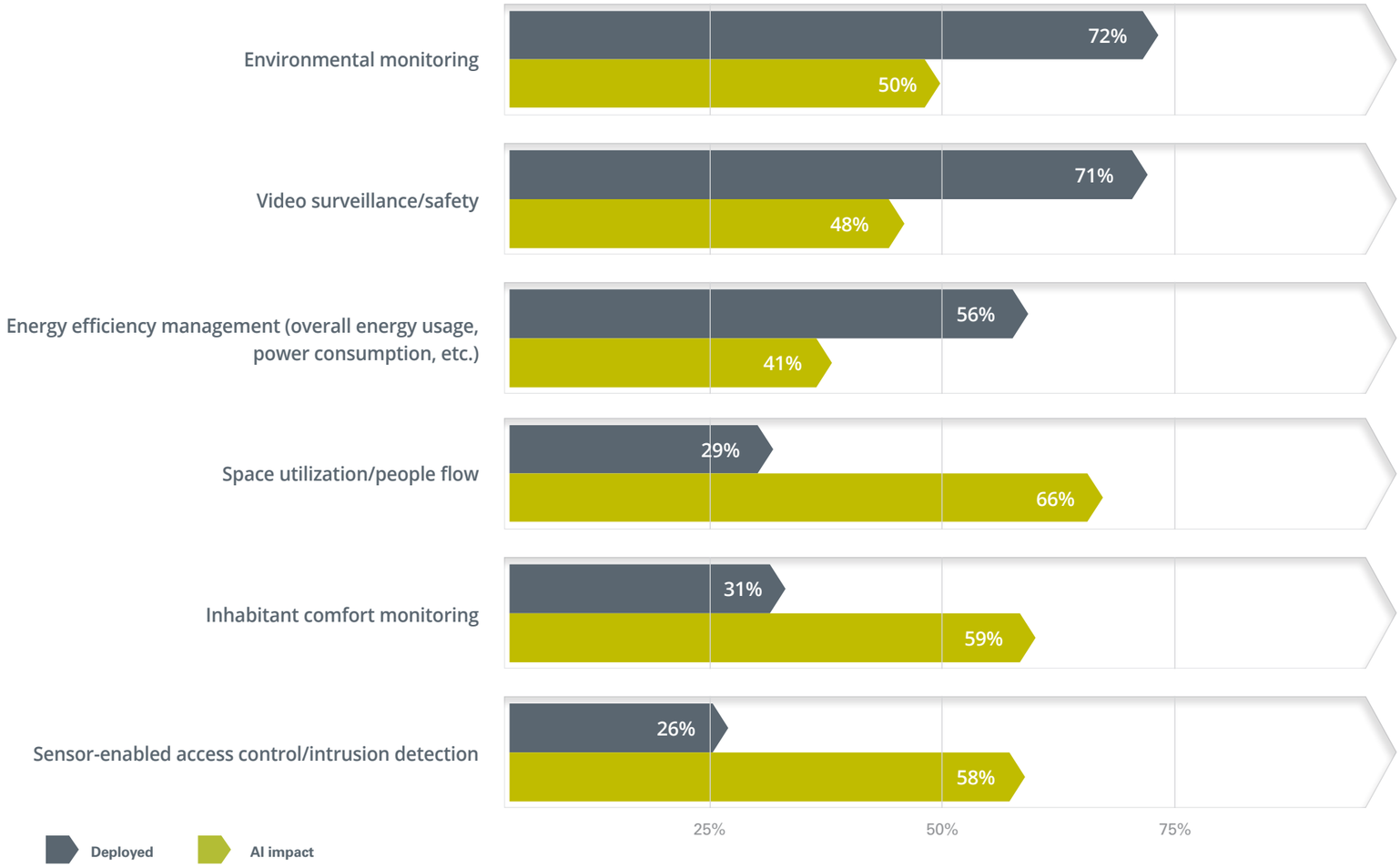
Q: Which of the following digitally enabled use cases have you deployed or plan to deploy in the next 12 months to improve building operations?

Base: Building respondents (n=345). Source: S&P Global Market Intelligence 451 Research and Eaton Digital Transformation Survey, 2024.

The building use cases with the highest anticipated AI impact include people-centric applications, such as space utilization/people flow (66% of respondents citing a high level of AI impact), inhabitant comfort monitoring (58% AI impact) and sensor-enabled access control/people flow (58% AI impact). Yet those use cases are also among the least-deployed today, according to our survey. This points to both the promise of AI-driven smart building applications and the relatively longer road to adoption.

Given both the opportunities and risks of placing AI at the center of tomorrow's smart buildings, owners and operators must carefully consider their digital drivers and goals and then work with technology vendors to examine how AI may help them reach those outcomes. Although there is significant hype surrounding AI's capabilities in less commonly deployed use cases, implementations reveal more subtle impacts due to real-world complexities, integration challenges or overestimated expectations. Setting achievable goals — such as reducing energy cost through optimization in the first year — and being transparent about potential hurdles can align expectations with reality and lead to more sustainable long-term implementations.

Figure B4: AI impact and smart building deployments



Q: For the use cases you selected, which ones do you trust to be influenced or enhanced by artificial intelligence (AI) technologies?

Base: Building respondents (n=345).

Source: S&P Global Market Intelligence 451 Research and Eaton Digital Transformation Survey, 2024.

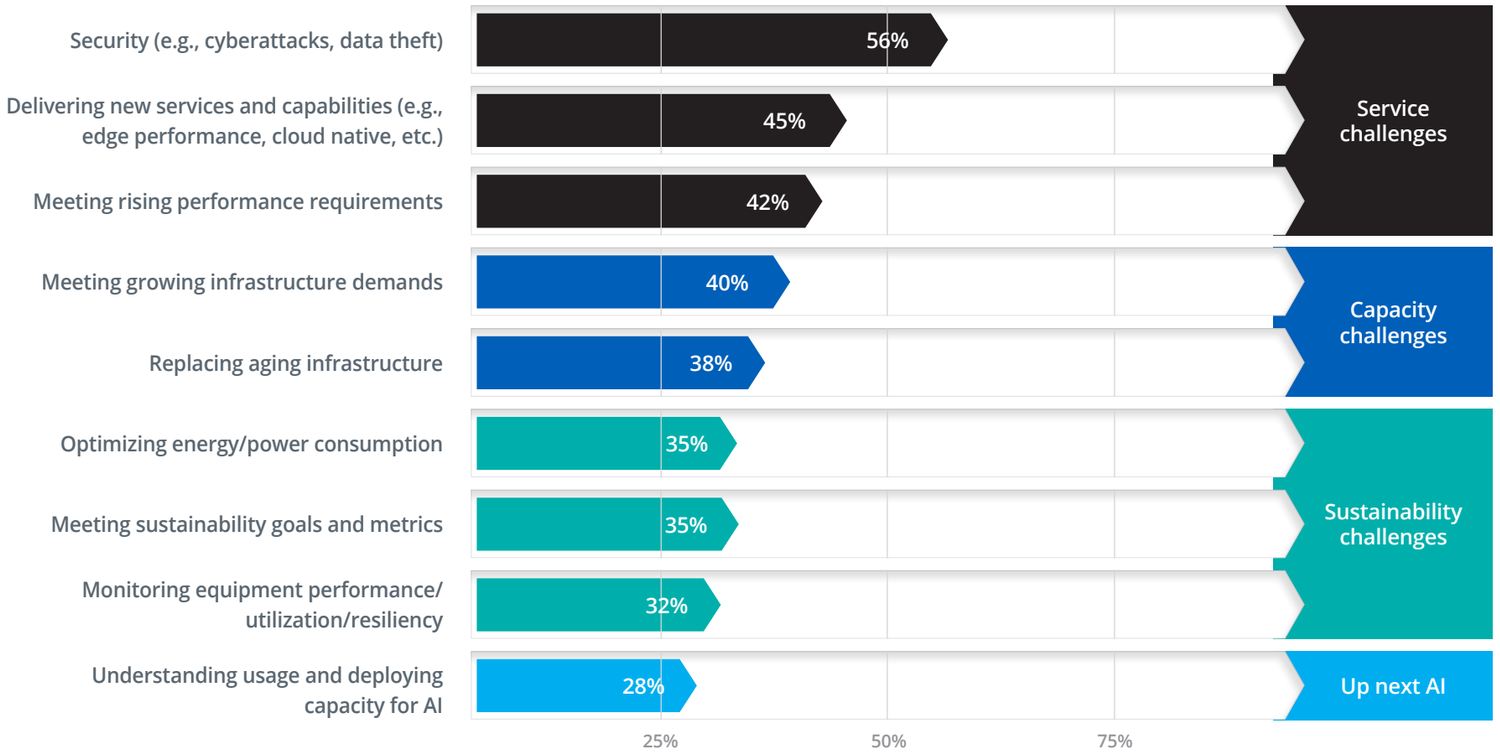
Deep dive: **Data centers**

Data center operators today — whether commercial providers or enterprises running their own data centers — sit at a tipping point of great change. Just two years ago, terms such as "ChatGPT" and "GenAI" were mentioned mainly in data scientist circles; today, they resonate with nearly every end user, driving massive new data volumes from the edge to the cloud. That data tsunami comes on top of a decade of IoT growth, particularly at industrial firms, where equally large amounts of machine and sensor data have been set free from operational environments to be stored and analyzed in data centers small and large.

These demand and capacity challenges arrive at the same time that data center sustainability is under heavy scrutiny. Data centers are the great energy consumers of the 21st century, replacing factories and cities, with an almost endless thirst for electricity and a dire need to optimize power, cooling and heat utilization. With government, regulators and businesses increasingly focused on sustainability, data center operators are embracing greener technologies and practices, including integrating renewable energy sources, optimizing cooling systems and implementing advanced energy management solutions. And they must do all of this without compromising on service reliability and security or incurring prohibitive costs.

Our survey results reflect that range of challenges, with service-oriented needs (such as ensuring security and delivering new capabilities) at the top followed by an array of capacity- and demand-related challenges (see Figure D1). Notably, just 35% of all data center respondents cited meeting sustainability goals in this year's survey, a slight drop from 37% two years ago. Even more surprising, however, is that the same percentage (35%) of data center respondents in Western Europe, where carbon targets are more pressing, cited sustainability as a challenge facing their operations.

Figure D1: Data centers face service, capacity and sustainability challenges



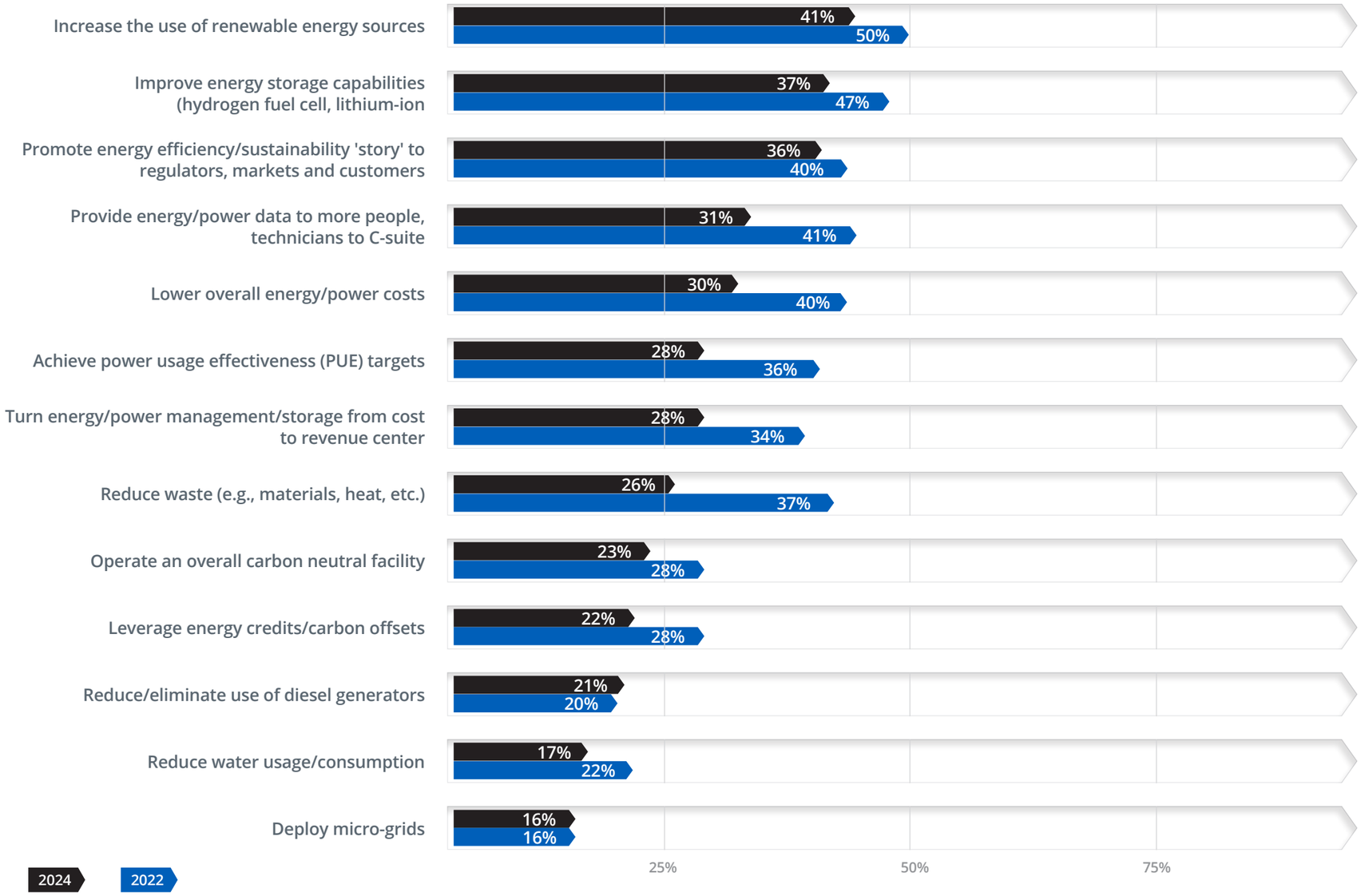
Q: Which of the following are challenges your organization faces in operating its data centers?

Base: Data center respondents (n=345). Source: S&P Global Market Intelligence 451 Research and Eaton Digital Transformation Survey, 2024.

Sustainability concerns less prominent

That a concern for sustainability challenges lags both service and capacity challenges in 2024 becomes even clearer as we look at sustainability-specific data center goals. Two years ago, data centers placed a greater relative emphasis on sustainability projects and goals. Today, challenged by the service capacity demands of AI, IoT and edge computing, that green focus has receded, with a smaller percentage of data respondents prioritizing data center sustainability goals across the board compared to two years ago (see Figure D2).

Figure D2: Compared to just two years ago, and in the face of growing demand, data center sustainability goals are less prominent



Q: Thinking specifically about the efficiency and sustainability of your data center, which considerations or goals guide your organization's efforts today?

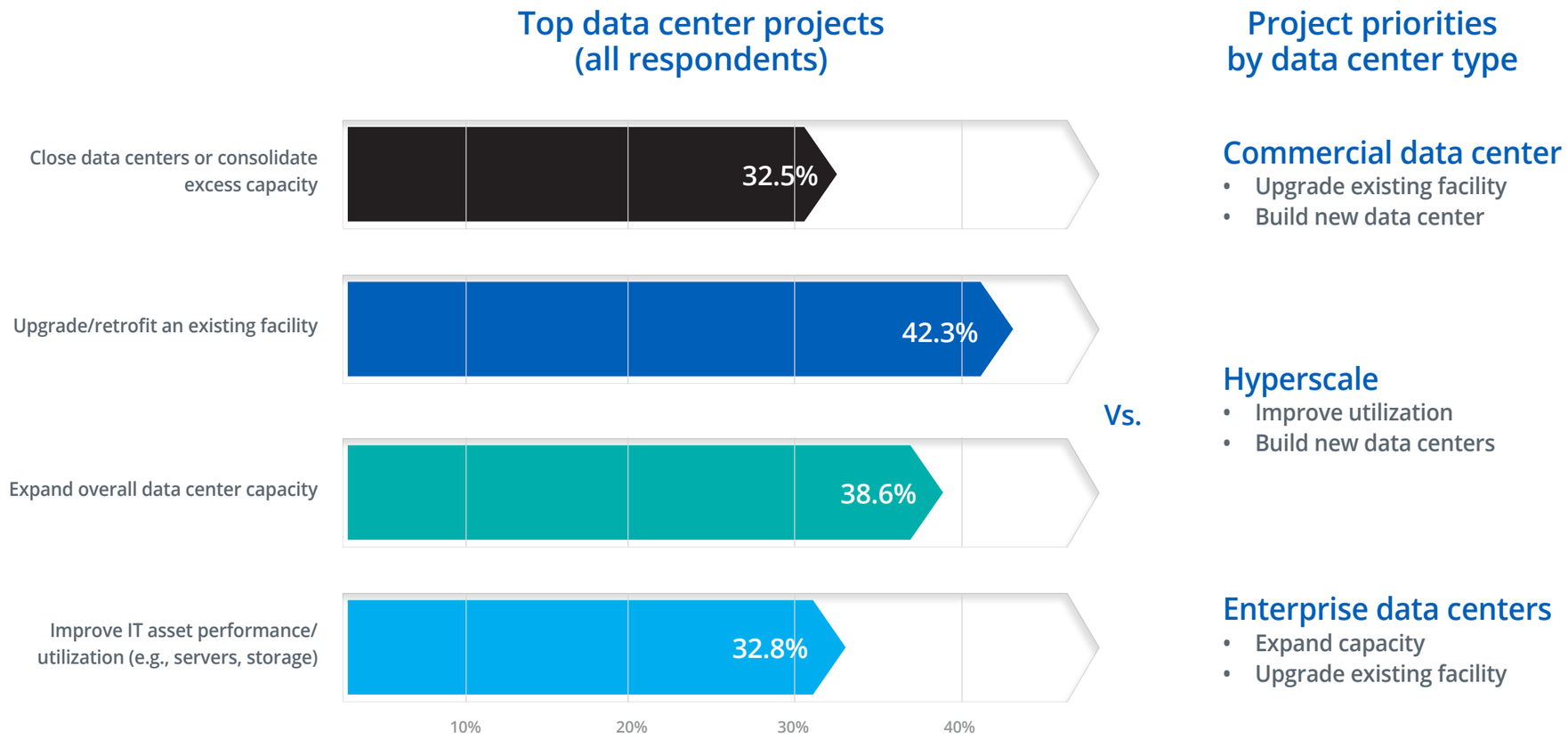
Base: Data center respondents (n=345). Sources: S&P Global Market Intelligence 451 Research and Eaton Digital Transformation Survey, 2022, 2024.

Of the different types of data center operators we surveyed — including hyperscalers, regional/colocation providers and local/edge operators — only the cloud hyperscalers emphasized sustainability to the same degree they did two years ago, placing increased use of renewables, reduced use of diesel generators and decarbonization among their project priorities.

The obvious question is how to explain these results, given that sustainability remains a high point of focus in the sector. One explanation is that addressing environmental and decarbonization issues is now commonplace and well understood, making it less of a "challenge" for data center operators, especially when they are also faced with exploding, AI-driven demand. While a requirement, addressing sustainability issues is no longer a problem to be solved but, rather, a strategy to be executed.

At the same time, it is critical to understand exactly where the attention has shifted. The answer is primarily to data center projects focused on addressing demand and capacity challenges. The top four data center projects prioritized over the next 12 months are pitched in that direction, emphasizing facility upgrades, capacity expansion and improvement utilization (see Figure D3). Different types of operators emphasize different points, but the focus on amping up capacity remains the one constant.

Figure D3: Data center operators are scaling up to meet growing demand



Q: Which of the following data center projects, if any, is a priority for your organization over the next 12 months?

Base: Data center respondents (n=345). Source: S&P Global Market Intelligence 451 Research and Eaton Digital Transformation Survey, 2024.

Data center use cases and AI

Data center operators are not only inundated with customer data, but data about their own operations as well. By incorporating sensors and instrumentation systems — from network to compute to cooling and more — data centers gain the ability to use data to optimize their own facilities, improve service levels and reduce costs. Today, the top digital use cases in deployment by data center operators are led by cyberattack/data theft prevention, predictive maintenance of data center equipment, and data center surveillance and control.

Notably, data center providers — typically tech-savvy operations in their own right — look forward to the impact that AI can have on their operations. According to our survey, they foresee AI not only making their network, system and power monitoring more predictive, but also becoming elemental in enabling data center digital twins, providing a real-time visualization of their facilities that can become the living, breathing hub of their operations center.

Summary

As we saw in our first digital transformation survey, industries such as manufacturing, utilities, building/facilities services and data centers are both emboldened and challenged by digitalization. The pace of adoption remains steady, although the most significant drivers and opportunities have evolved. Optimizing operations and cutting costs remains a major focus, with energy and power management a critical component in these sectors. At the same time, it's critical to note that many companies are still near the starting line, with major advancements such as generative AI just now coming to the fore. Being open to digital change while building long-term digital capabilities and scoring near-term wins is the best approach as the enterprise digital transformation journey continues.

Methodology

This report is based on a commissioned web survey conducted in March/April 2024. The respondents were qualified based on their responsibilities in their organization's operational digital transformation and their influence on the purchase of technology solutions enabling it. Respondent companies were from diverse industries and company sizes of 100+ full-time employees. Total sample size for the study is 1,381 (US, n=300; Canada, n=120; Mexico, n=120; UK, n=120; France, n=120; Germany, n=120; The Netherlands, n=120; Italy, n=120; Denmark, n=44; Finland, n=42; Switzerland, n=34; UAE, n=66; Saudi Arabia, n=55).

Roles of the respondents fit into one of four eligible industry sectors: building/facilities services; data center owner/provider (including colocation and edge); manufacturing/industrial; and utilities. Survey respondents were at the director level and above in IT, operational technology, facilities management and energy/sustainability roles. Respondents were screened to be purchase decision-makers for embedded operations technology, having some sort of responsibility or connection in their role to operations technology for the site/facility. Their connection to operations technology could be either for IT or other mechanical ops. The survey was executed blindly — i.e., the survey sponsor name was not revealed to the participants at any stage of the project.

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