



Deep Dive Analysis and Market Insights

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D2.2 – Deep Dive Analysis and Market Insights

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Glossary of terms

Item	Description
3D/4D	Three-Dimensional/Four-Dimensional
3GPP	3rd Generation Partnership Project
5G	Fifth Generation of Mobile Networks
AGV	Automated Guided Vehicle
AI	Artificial Intelligence
AIOTI	Alliance for AI, IoT and Edge Continuum Innovation
API	Application Programming Interface
AR/VR	Augmented Reality/Virtual Reality
ASIC	Application-Specific Integrated Circuit
BDVA	Big Data Value Association
CAM	Connected and Automated Mobility
CEI	Cloud-Edge-IoT
CIO	Chief Information Officer
DLT	Distributed Ledger Technology
DTC	Digital Twin Consortium
EBP	European Blockchain Partnership
EBSI	European Blockchain Services Infrastructure
eMBB	Enhanced Mobile Broadband
ERP	Enterprise Resource Planning
ESG	Environmental, Social, and Governance
EV	Electric Vehicle
FPGA	Field-Programmable Gate Array
FOSSA	Federated Open-Source Software Architecture
GDPR	General Data Protection Regulation
GEO	Geostationary Earth Orbit
GPU	Graphics Processing Unit
HARPS	High-Altitude Platforms
HPC	High-Performance Computing
ICT	Information and Communication Technology
IDSA	International Data Spaces Association
IDTA	Industrial Digital Twin Association
INSIDE	INSIDE Industry Association
IoT	Internet of Things
ITS	Intelligent Transport Systems
KPI	Key Performance Indicator
LEO	Low-Earth Orbit
LPWAN	Low-Power Wide-Area Network
MaaS	Mobility-as-a-Service
MEC	Multi-Access Edge Computing
MES	Manufacturing Execution Systems
ML	Machine Learning

mMTC	Massive Machine-Type Communications
M2M	Machine-to-Machine
NTNs	Non-Terrestrial Networks
OEM	Original Equipment Manufacturer
OEE	Overall Equipment Effectiveness
ORAN	Open Radio Access Network
OTA	Over-the-Air
OT	Operational Technology
RedCap	Reduced Capability
R&I	Research and Innovation
RFQ	Request for Quotation
ROI	Return on Investment
SDN	Software-Defined Networking
TSN	Time-Sensitive Networking
URLLC	Ultra-Reliable Low-Latency Communications
V2X	Vehicle-to-Everything

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Cloud-to-Edge-IoT; Market maturity, market forecast, orchestration, network infrastructure, AI, Energy, Mobility, Manufacturing, Ecosystem Large Scale pilots

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Executive Summary

This report presents the findings of a European enterprise survey examining the adoption, deployment, and scaling of Cloud-Edge-IoT (CEI) solutions. Conducted as part of the CEI-Sphere supporting action, the research is designed to provide market-driven insights that complement the technical work of the O-CEI and COP-PILOT large-scale pilots. Its objective is to assess real commercial needs, identify barriers to scale, and highlight conditions under which CEI solutions are most likely to progress from pilots toward sustainable market adoption.

CEI adoption is advancing, but unevenly across the stack

The survey confirms strong enterprise engagement with CEI-related technologies. IoT is already firmly established across industries, and AI/ML adoption is widespread, though often still applied to a limited extent rather than deeply embedded across operations. By contrast, edge computing, while widely recognized as a cornerstone of CEI, remains at an earlier stage of maturity. Only a small share of organizations report extensive edge usage today, even as many plan to expand adoption over the next 24 months.

This imbalance reflects a market that has largely addressed data collection and centralized analytics, but is still working through the architectural, operational, and organizational challenges required to distribute intelligence closer to physical assets. As a result, the greatest friction in CEI adoption is not at the device or application level, but in the enabling layers that connect, orchestrate, and govern distributed systems.

CEI use cases are delivering value in operationally critical domains

Across operational domains, CEI solutions are already being applied where real-time decision-making, resilience, and coordination are most critical. Energy management, mobility and fleet operations, and electric utility services are active areas of deployment. These domains are also central to many of the large-scale pilots supported by O-CEI and COP-PILOT, validating alignment between pilot focus areas and genuine enterprise demand.

In energy and utilities, CEI supports clean energy integration, flexibility services, grid optimization, and predictive maintenance. In mobility and fleet operations, CEI enables tracking, electrification management, and early exploration of Vehicle-to-Grid (V2G) use cases. While foundational applications such as monitoring and control are already in use, more advanced capabilities, such as large-scale flexibility markets, V2G at scale, and AI-driven automation, remain in a transitional phase, with strong interest but limited production deployment to date.

Scaling CEI remains primarily a platform and integration challenge

The Technical View highlights that the main barriers to CEI scale are no longer the availability of individual technologies, but the complexity of deploying, integrating, and operating CEI solutions across heterogeneous environments. Organizations consistently point to challenges related to IT/OT integration, orchestration across distributed edge environments, data governance, security, and skills gaps, particularly in edge architecture, AI/ML deployment, and cybersecurity for distributed systems.

Hybrid deployment models and operations in remote or intermittently connected environments are increasingly common, reinforcing the need for CEI solutions that are resilient, autonomous, and manageable at scale. These challenges converge at the enabling platform layer, which emerges as the critical bottleneck in moving from successful pilots to repeatable, production-grade deployments.

Ecosystem coordination, standards, and trust are decisive for scale

Beyond internal deployment challenges, the survey shows that ecosystem-level coordination remains uneven. While many organizations participate in collaborative pilots and industry consortia, engagement in standards development and open-source initiatives is more limited, often constrained by resource availability, integration effort, and unclear business value.

At the same time, enterprises express clear demand for greater interoperability, clearer standards alignment, and trusted mechanisms to assess solution maturity and compatibility. The strong interest in a CEI trust label reflects a broader need for transparency, comparability, and confidence in a fragmented market. These findings support ongoing efforts within the CEI-Sphere consortium to advance common frameworks, standardization, and voluntary trust mechanisms focused on the enabling layers of CEI solutions.

Market readiness depends on procurement confidence and governance

The Market Readiness findings show that procurement and governance considerations are central to CEI adoption beyond pilots. When evaluating CEI vendors, organizations prioritize integration with existing systems, security and compliance readiness, interoperability, scalability, and long-term reliability. Cost is important, but typically secondary to operational risk reduction, particularly in mission-critical environments.

Governance and sovereignty concerns further shape deployment decisions. Most organizations report explicit requirements related to data location, control over infrastructure and platforms, and avoidance of excessive dependency on non-EU vendors. Supply-chain transparency, regulatory compliance, and geopolitical risk are widely recognized across industries. Together, these factors indicate that governance and trust are not peripheral constraints, but foundational conditions for CEI scale in the European context.

Implications for large-scale pilots and CEI-Sphere

Taken together, the survey results indicate that the European CEI market is at a critical inflection point. Enterprise demand is clear, investment intent is strong, and the focus areas of the large-scale pilots align with real operational needs. However, scaling CEI solutions will depend on addressing platform-level challenges, strengthening ecosystem coordination, and building trust through standards, governance, and transparent assurance mechanisms.

In this context, CEI-Sphere's role as a supporting action is essential. By linking pilot outcomes to enterprise needs, standardization efforts, and trust-building initiatives, CEI-Sphere can help ensure that the lessons learned from large-scale pilots translate into reusable platforms, interoperable solutions, and credible pathways to commercialization. This report provides an evidence-based foundation to support that process and to inform stakeholders working toward a competitive, interoperable, and trustworthy European CEI ecosystem.

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1. Introduction

1.1 Purpose and Approach of this Document

The purpose of this document is to present and interpret the results of the CEI-Sphere market survey, with the aim of providing evidence-based insights into the current state and near-term evolution of Cloud-Edge-IoT (CEI) adoption in Europe. The report is intended to support the objectives of the CEI-Sphere project as a coordinating and supporting action, complementing the technical and pilot-driven work of the O-CEI and COP-PILOT large-scale pilot projects.

Specifically, this document seeks to identify real enterprise needs, priorities, and constraints related to CEI solutions, with a focus on factors that influence the transition from pilot deployments toward scalable, operational, and commercially viable solutions. By grounding the analysis in primary survey data from European enterprises, the report aims to provide a market-driven perspective that can inform pilot design, standardization activities, trust-building initiatives, and broader ecosystem coordination efforts within the CEI-Sphere consortium and the wider EUCloudEdgeIoT community.

The approach taken in this document is primarily descriptive and analytical. Survey results are presented through a series of figures and accompanying commentary that highlight key patterns, differences across industries, and areas of convergence. Rather than evaluating individual technologies or vendors, the analysis focuses on systemic issues affecting CEI adoption, such as deployment complexity, orchestration and integration challenges, skills gaps, ecosystem fragmentation, governance and sovereignty requirements, and procurement considerations.

To support clarity and coherence, the report is structured into thematic sections that reflect different dimensions of CEI adoption. The Strategic View establishes the overall adoption context and investment priorities. The Technical View is divided into two complementary parts, addressing deployment and operational challenges on the one hand, and collaboration, standards, and trust on the other. The Operational View examines how CEI solutions are applied in concrete use cases across energy, mobility, and utility domains, which are central to many large-scale pilots. Finally, the Market Readiness section explores procurement, governance, and sovereignty considerations that shape the conditions under which CEI solutions can scale beyond pilot environments.

This document does not seek to prescribe specific technical architectures or policy measures. Instead, it is intended to provide a shared evidence base that supports informed discussion and decision-making among project partners, pilot participants, standards bodies, and policymakers. By linking survey insights to the broader objectives of CEI-Sphere, the report aims to help bridge the gap between technical innovation, operational deployment, and sustainable market adoption of CEI solutions in Europe.

1.2 Structure of the Document

This document is structured to guide the reader from an overview of CEI adoption and strategy, through technical and operational realities, and toward the conditions required for CEI solutions to scale beyond pilot deployments and achieve broader market adoption.

Following this introductory section, the Strategic View provides a high-level assessment of CEI adoption across European enterprises. It examines the maturity of key CEI technologies, the use cases organizations are deploying or planning to deploy, investment intentions, and the business objectives driving CEI initiatives. This section establishes the overall market context for the analysis that follows.

The Technical View is divided into two complementary sections. The first, Technical View: Deployment and Operational Challenges, focuses on the practical difficulties organizations face when deploying and operating CEI solutions at scale. It addresses issues such as integration across IT and OT systems, orchestration of distributed edge environments, data and security management, skills gaps, and the realities of hybrid and intermittently connected deployments.

The second, Technical View: Collaboration, Standards, and Trust, examines ecosystem-level challenges, including participation in collaborative initiatives, adoption of standards and open-source software, and the role of trust mechanisms such as certification schemes and trust labels. Together, these sections highlight both the internal and external technical factors that shape CEI scalability.

The Operational View: CEI Use Cases in Practice examines how CEI solutions are applied in concrete operational domains where performance, resilience, and real-time decision-making are critical. It focuses on three areas that are central to many CEI-Sphere large-scale pilots: energy management, mobility and fleet operations (including electrification and V2G), and electric utility services related to energy flexibility. This section illustrates how CEI is delivering value today and where adoption is still emerging.

The Market Readiness section brings together findings on Procurement and Vendor Selection and Governance and Sovereignty. It explores how organizations evaluate CEI solution providers, which criteria most strongly influence procurement decisions, and how governance considerations such as data location, technical sovereignty, and supply-chain risk shape deployment choices. This section highlights the conditions that must be met for CEI solutions to move from pilot environments to scalable, commercially viable deployments.

The document concludes with section-level conclusions, an Overall Report Conclusion, and Final Remarks that synthesize the findings and reflect on their implications for large-scale pilots, standardization efforts, trust-building initiatives, and the broader European CEI ecosystem.

2. Methodology

This report is based on a primary quantitative survey conducted among European enterprises to assess the adoption, deployment, and scaling of Cloud-Edge-IoT (CEI) solutions. The survey was designed and administered as part of the CEI-Sphere project to provide an evidence-based view of enterprise needs, priorities, and constraints related to CEI technologies and use cases.

Survey design and scope

The study was conducted using a structured questionnaire and administered via computer-assisted telephone interviews (CATI). The questionnaire focused on organizations' current usage of CEI-related technologies, planned adoption over the next 24 months, deployment challenges, operational use cases, ecosystem participation, standards and trust considerations, procurement criteria, and governance and sovereignty requirements.

For the purposes of this study, CEI solutions were defined as end-to-end systems spanning IoT devices, edge computing, cloud platforms, data management, analytics, AI, and automation, rather than individual technologies in isolation. Respondents were instructed to consider CEI solutions in this holistic sense when answering survey questions.

Sample and respondent profile

The survey was conducted among 500 organizations across multiple European countries, including Belgium, Denmark, Finland, France, Germany, Italy, Netherlands, Spain and Sweden. The sample was structured to provide broad European coverage rather than country-level representativeness, with results analysed at the aggregate European level.

All participating organizations employed 50 or more people, with respondents drawn from a mix of mid-sized and large enterprises. Company size bands included organizations with 50–249 employees, 250–999 employees, and 1,000 or more employees. The sample also covered specific industries with a tendency to utilize CEI solutions and of particular interest to the O-CEI and COP-Pilot large-scale pilots. These included:

- Manufacturing
- Energy (including oil & gas and utilities)
- Resources (including agriculture and mining)
- Transportation and logistics

Within each organization, respondents were IT and operations decision-makers, typically at manager level or above, who are knowledgeable about their organization's use of IoT, edge computing, cloud platforms, and related technologies. Respondents were required to have direct involvement in, or influence over, decisions related to CEI or IoT-related projects.

Detailed distributions by country, company size, and industry are provided in the Appendix.

Screening and inclusion criteria

As an inclusion criterion, respondents were required to be from organizations that are currently using, planning to use, or actively considering the use of IoT. In practice, all respondents reported at least some current IoT usage. This reflects the high level of IoT penetration among medium-to-large European enterprises observed in prior research and ensures that survey results are grounded in organizations with relevant experience of CEI-related technologies.

No weighting was applied to the final dataset. Results are therefore presented as unweighted findings across the surveyed sample.

Data analysis and presentation

Survey results are presented primarily through descriptive statistics, including percentages and cross-tabulations by industry where relevant. Analysis focuses on identifying broad patterns, differences in emphasis across sectors, and areas of convergence that highlight common challenges and priorities.

The report does not attempt to forecast market size or growth quantitatively. Instead, it uses the survey results to assess relative maturity, perceived importance, and readiness to scale across different dimensions of CEI adoption. Qualitative interpretation is used selectively to provide context and to link findings to the objectives of the CEI-Sphere project and the large-scale pilots supported by O-CEI and COP-PILOT.

Limitations

As with all survey-based research, the findings reflect the perspectives of the respondents at the time of the study and are subject to the limitations of self-reported data. The results are intended to provide directional insight into enterprise attitudes and experiences rather than precise measurement of deployment scale or performance outcomes. Nevertheless, the breadth of the sample and the focus on decision-makers with direct CEI involvement provide a robust basis for understanding current market conditions and challenges.

3. Strategic View

The Strategic View examines how European enterprises are approaching CEI adoption, investment, and prioritization at a high level. It focuses on the maturity of key CEI technologies, the use cases organizations are already deploying, and how CEI fits into broader business and operational strategies. By establishing where adoption is already widespread and where it remains nascent, this section provides essential context for understanding both the opportunities and constraints shaping CEI deployment today.

In addition, the Strategic View explores how organizations are allocating investment and defining objectives for CEI initiatives. These insights help clarify whether CEI is primarily being pursued as a tool for incremental operational improvement, or as a foundation for more transformative, data-driven and automated business models.

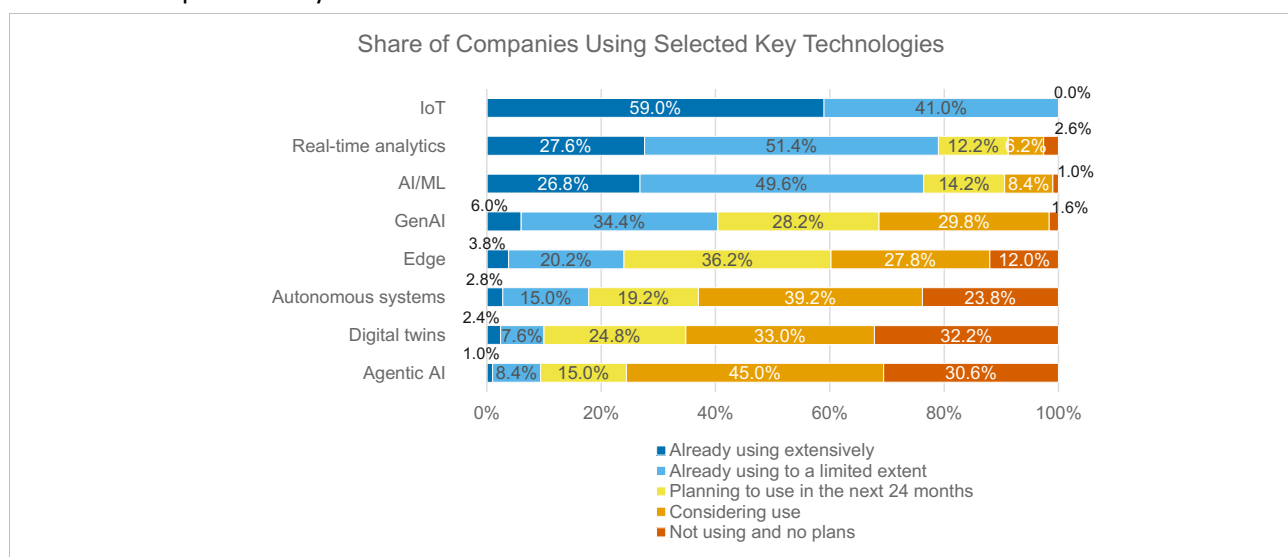
3.1 Adoption and Plans

The survey begins by assessing the current adoption of, and plans to adopt, CEI-related technologies across European enterprises. As an inclusion criterion, the survey excluded companies that were neither using, planning to use, nor considering the use of IoT. In practice, all respondents reported at least some current IoT usage. This is consistent with findings from previous IDC surveys, which typically show that only a very small minority of European enterprises, often no more than around 5%, have neither adopted IoT nor plan to do so.

Within this context, nearly three in five respondents report using IoT extensively, while the remainder are using it to a limited extent (see Figure 1). Other CEI-related technologies are also already in use by a majority of respondents, most notably real-time analytics, AI/ML, and GenAI. However, in contrast to IoT, most companies using these technologies today report doing so only to a limited extent, indicating that adoption is often still partial rather than deeply embedded across operations.

Despite the strong attention and hype surrounding GenAI in recent years, the results suggest that relatively few European enterprises have incorporated GenAI in a comprehensive way so far. Instead, most organizations report either limited usage or plans to expand their use over the next 24 months, highlighting that GenAI adoption is still in an early phase of operational maturity.

Edge computing stands out as a particularly important technology within the CEI stack, given its role in enabling low-latency processing, local autonomy, and more advanced future use cases. However, the survey shows that extensive edge adoption remains modest, at just 3.8% of respondents. A further 24.0% report using edge computing at least to a limited extent, while another 36.0% plan to adopt edge within the next 24 months, underscoring that edge computing remains more of an emerging capability than a mature one for most enterprises today.



Survey question: Is your organization currently using or planning to use the following technologies in the next 24 months?

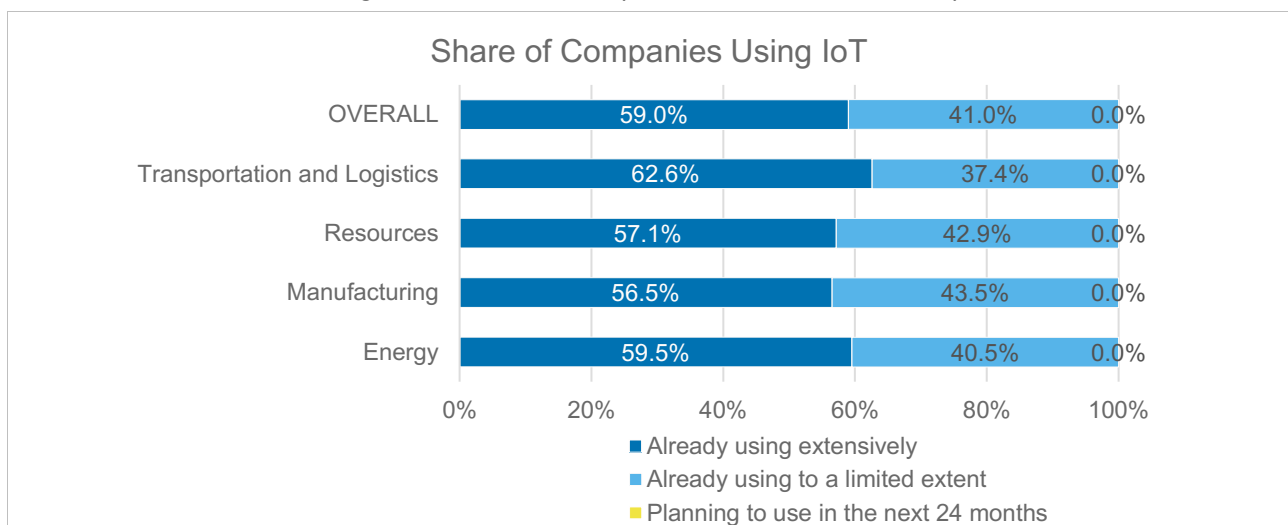
Source: IDC CEI-Sphere Survey, February 2025; n = 500; Base: Europe, all respondents

Figure 1 Companies Using CEI-Related Technologies

Looking across the industries included in the survey, IoT adoption levels are broadly similar, reflecting the maturity and widespread penetration of IoT technologies across European enterprises (see Figure 2). In all industries surveyed, the large majority of companies report current IoT usage, with only relatively small differences between sectors.

Transport and Logistics companies show higher shares of extensive IoT usage compared to overall industry segments, whereas manufacturing and resources companies show marginally lower levels of intensive use, though overall adoption remains high across all sectors.

These results reinforce the view that IoT has become a foundational technology across industries, with sectoral differences now being more a matter of depth of use than of basic adoption.



Survey question: Is your organization currently using or planning to use the following technologies in the next 24 months?

Source: IDC CEI-Sphere Survey, February 2025; n = 500; Base: Europe, all respondents

Figure 2 Companies Using IoT

Differences across industries become more pronounced when looking at edge computing adoption than they are for IoT (see Figure 3). While edge computing is still at an early stage overall, some sectors are clearly further ahead than others.

Manufacturing leads in extensive edge usage, reflecting its need for low-latency control, local analytics, and tight integration between IT and operational systems. The energy sector shows the highest overall share of companies either using or planning to use edge computing when limited usage is included, indicating strong momentum even if deep deployment is still limited.

By contrast, the resources industry trails in edge adoption, with far fewer companies reporting current usage. Transport and logistics also shows the lowest overall share of organizations using or planning to use edge computing, although even in this sector, more than half of respondents indicate either current usage or firm plans to adopt edge within the next 24 months.

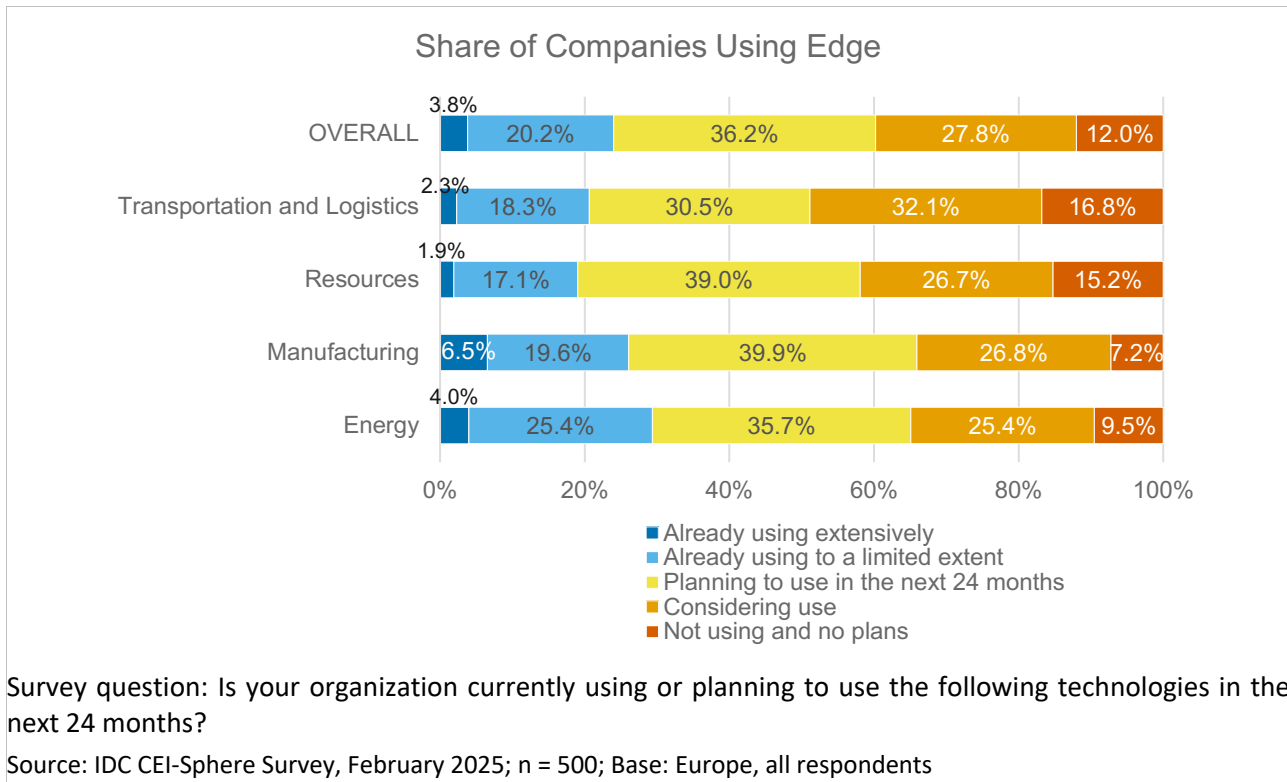


Figure 3 Companies Using Edge

AI/ML plays a central role in many CEI solutions, particularly as enterprises move beyond basic monitoring toward more advanced analytics, optimization, and automation. While early AI deployments were often cloud-centric, many CEI use cases increasingly rely on edge-based inference to support real-time analytics, low-latency decision-making, and local autonomy. This is especially relevant for use cases such as predictive maintenance, quality inspection, energy optimization, and autonomous or semi-autonomous systems, where responsiveness and reliability are critical.

Looking at adoption by industry, AI/ML usage is already widespread across all sectors surveyed (see Figure 4). Manufacturing shows somewhat higher levels of extensive usage, while the resources industry lags slightly behind, but the overall differences are relatively modest compared with those observed for edge computing. In most industries, the majority of AI/ML deployments today are still reported as being used to a limited extent, suggesting that while AI/ML capabilities are broadly in place, there is still significant scope for deeper and more operationally embedded adoption.

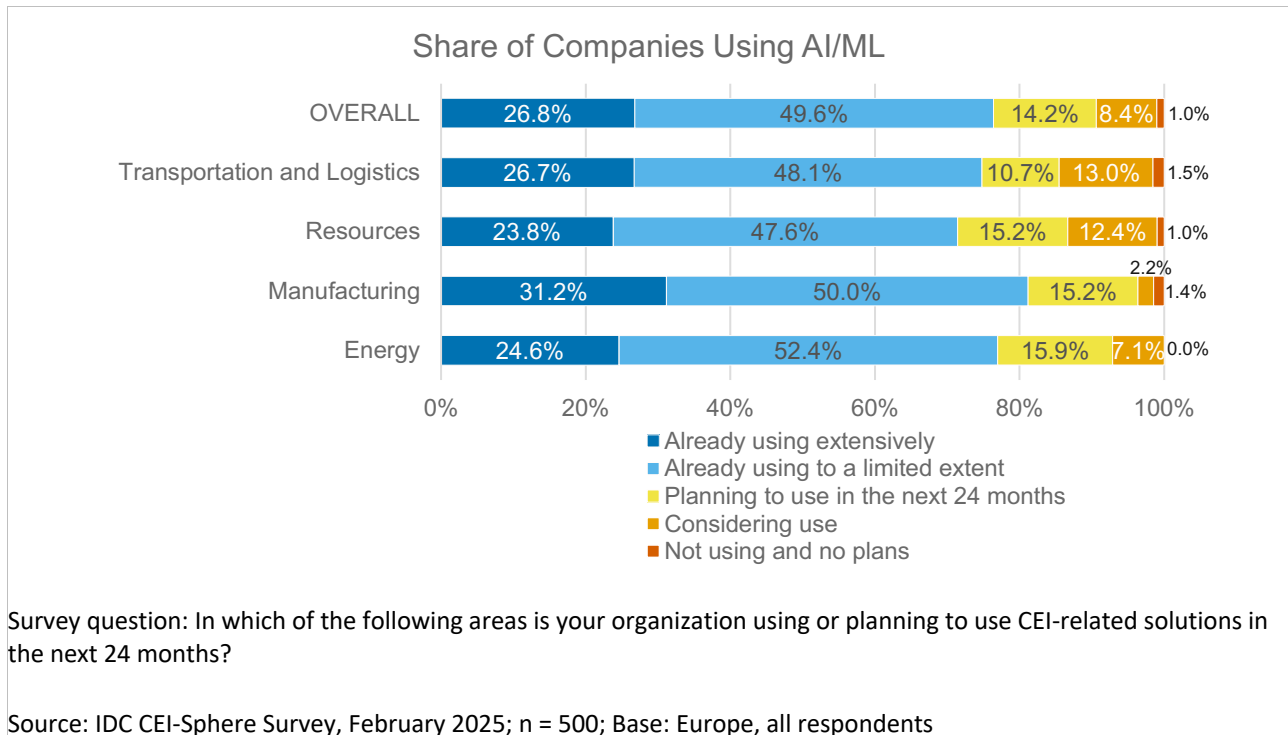


Figure 4 Companies Using AI/ML

Figure 5 provides a more use-case-oriented view of CEI adoption, highlighting where companies are already deploying end-to-end CEI solutions rather than individual technologies. The most widely adopted use cases today are those closely tied to operational visibility, control, and compliance.

Use cases such as regulatory compliance, remote monitoring and control, video security and surveillance, and process optimization and automation show the highest levels of current usage, with well over half of respondents already deploying these solutions. These use cases tend to be relatively well understood, easier to justify from a business perspective, and closer to existing operational processes.

By contrast, more advanced or ecosystem-oriented use cases, such as predictive maintenance, AI-enabled decision making, end-to-end product traceability, and autonomous systems, show lower levels of current deployment. However, many of these use cases exhibit strong forward momentum, with a large share of respondents indicating plans to adopt them within the next 24 months. This suggests a clear progression from monitoring-centric CEI deployments toward more automated, intelligence-driven applications.

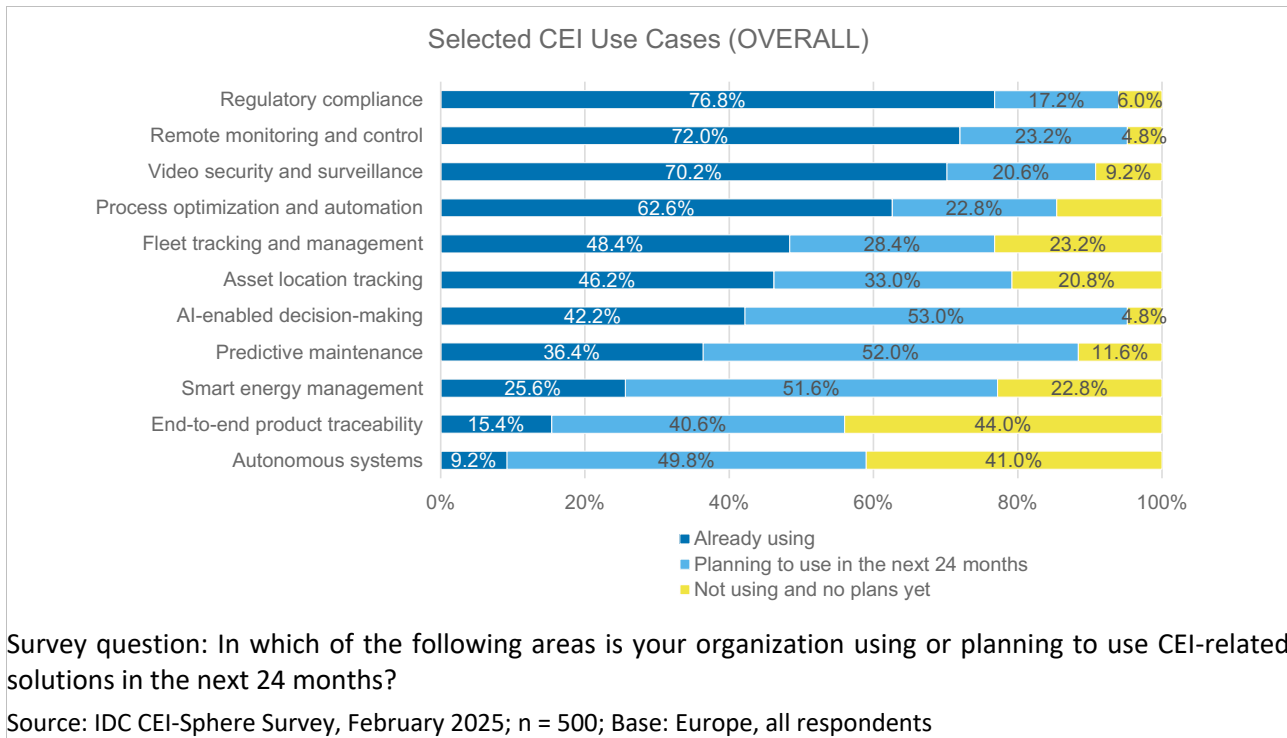
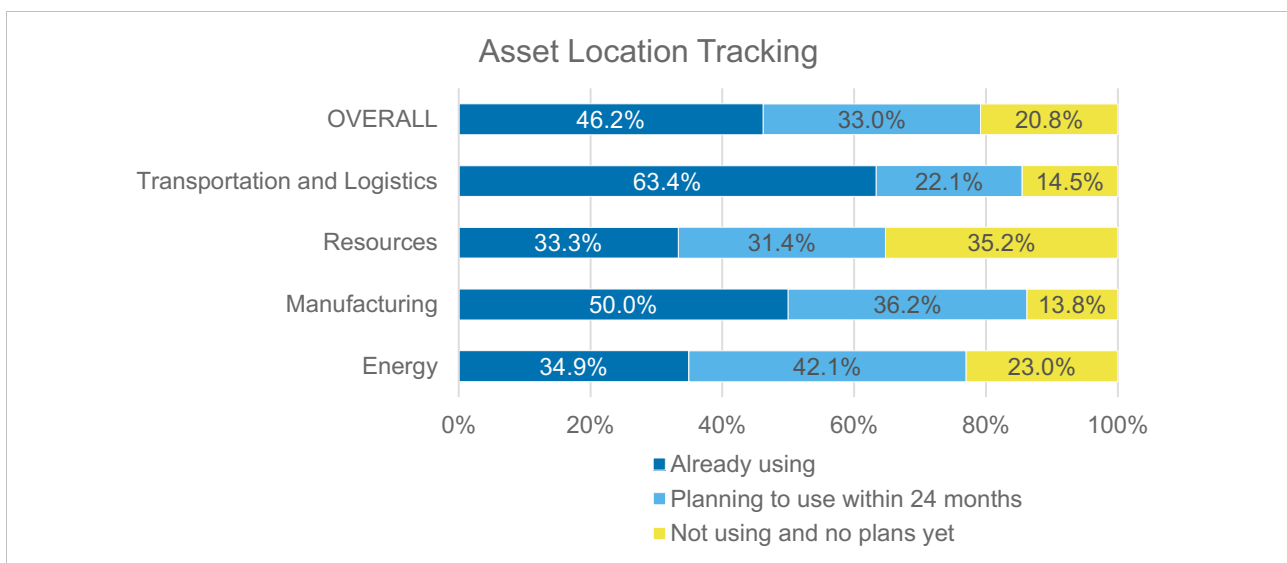


Figure 5 Companies Using Selected CEI Use Cases

Asset location tracking represents one of the more established CEI use cases, though adoption levels still vary across industries (see Figure 6). Overall, just under half of respondents report that their organization is already using asset tracking solutions, with a similar share either planning or considering adoption.

Transport and logistics companies lead in asset tracking adoption, reflecting the direct operational value of real-time visibility into vehicles, containers, and shipments. Manufacturing and energy companies also show relatively strong uptake, where asset tracking supports equipment management, maintenance planning, and operational efficiency across distributed sites.

The resources industry trails other sectors in current asset tracking usage, although a significant share of companies in this sector indicate plans to adopt such solutions. This pattern suggests that while asset tracking is a mature CEI use case in some industries, it still represents an important area of near-term expansion in others.



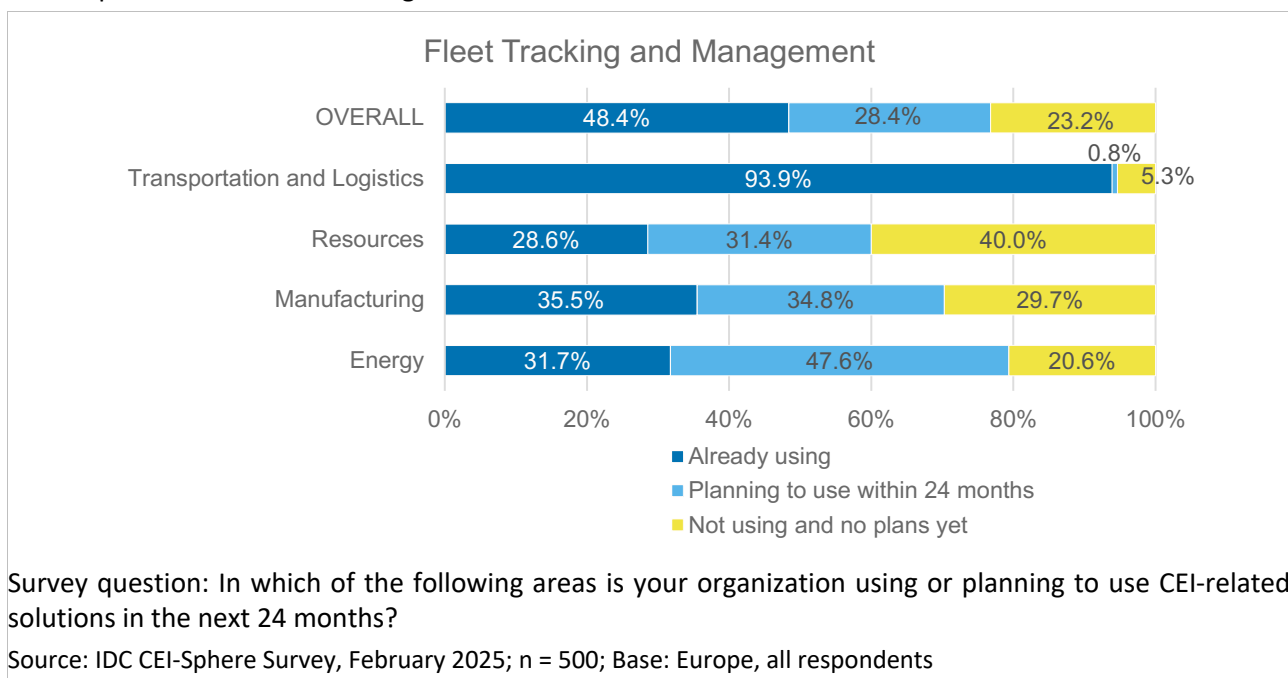
Survey question: In which of the following areas is your organization using or planning to use CEI-related solutions in the next 24 months?

Source: IDC CEI-Sphere Survey, February 2025; n = 500; Base: Europe, all respondents

Figure 6 Companies Using Asset Tracking Use Case

Fleet tracking and management is a relatively mature CEI use case, particularly in industries where vehicles and mobile assets are central to operations (see Figure 7). Adoption is highest in transport and logistics, where real-time fleet visibility, route optimization, and asset utilization deliver immediate operational benefits. Energy and manufacturing companies also show meaningful levels of usage, reflecting applications such as service fleets, maintenance vehicles, and internal logistics.

In contrast, fleet tracking adoption is lower in the resources industry, where fixed assets and site-based operations are more dominant. Even so, across all industries, a substantial share of respondents indicate either current usage or plans to adopt fleet tracking solutions, suggesting continued expansion of this use case as part of broader CEI strategies.



Survey question: In which of the following areas is your organization using or planning to use CEI-related solutions in the next 24 months?

Source: IDC CEI-Sphere Survey, February 2025; n = 500; Base: Europe, all respondents

Figure 7 Companies Using Fleet Tracking Use Case

Smart energy management is a less widely adopted CEI use case today, but one that shows strong future potential (see Figure 8). Current usage is most prominent in the energy industry, where organizations are already deploying CEI solutions to monitor, optimize, and balance energy consumption across assets and sites. Manufacturing companies also show moderate adoption, driven by energy-intensive production processes and sustainability objectives.

In other industries, smart energy management adoption remains more limited, though a sizable share of respondents indicate plans to deploy such solutions within the next 24 months. This pattern suggests that smart energy management is still transitioning from early deployments toward broader adoption, supported by increasing energy costs, decarbonization goals, and the growing availability of CEI-enabled optimization tools.

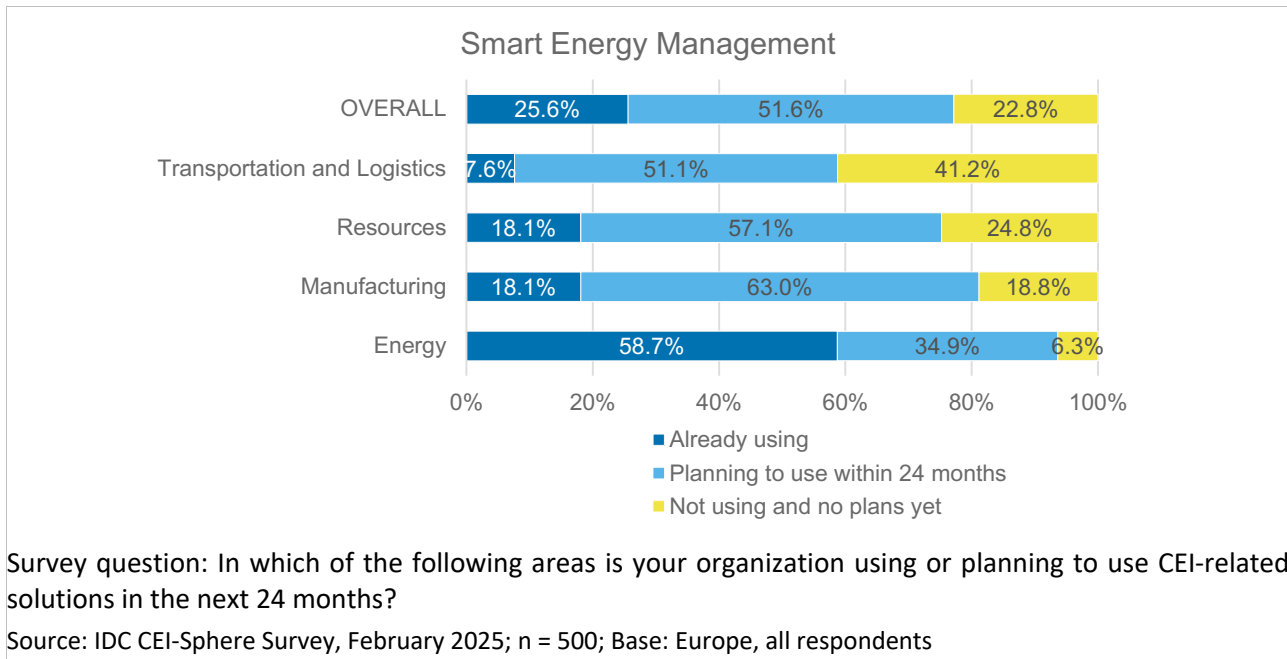


Figure 8 Companies Using Smart Energy Management Use Case

Among organizations using or planning predictive maintenance, AI-driven predictive maintenance is viewed as a high-priority capability within CEI strategies (see Figure 9). A large majority of respondents rate it as either a high priority or essential, underlining the strong business case for reducing downtime, extending asset life, and improving operational efficiency through data-driven maintenance.

This strong prioritization reflects the convergence of IoT, AI/ML, and edge computing within predictive maintenance use cases. As more enterprises move beyond basic condition monitoring toward automated and near-real-time decision-making, predictive maintenance continues to emerge as one of the most compelling and value-driven applications of CEI solutions.

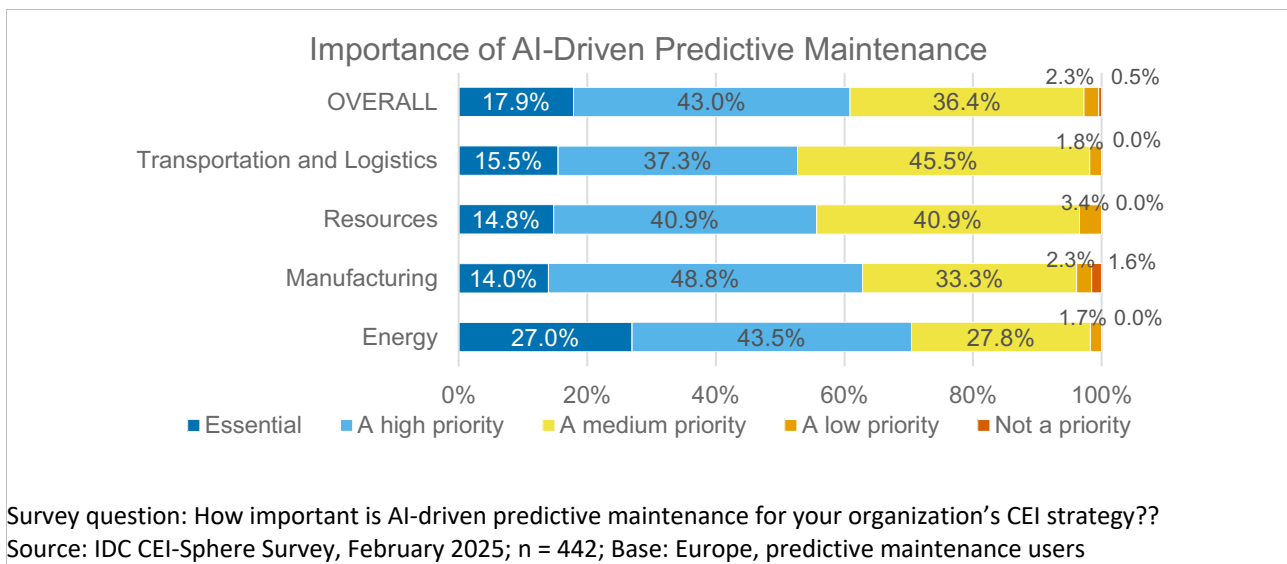


Figure 9 Importance of AI-Driven Predictive Maintenance

Most respondents expect their investments in CEI-related technologies to increase over the next 24 months (see Figure 10). Close to half of surveyed companies anticipate either a moderate or significant increase in CEI investment, while a much smaller share expect spending to decline. A substantial minority expect investment levels to remain broadly stable.

Overall, these results point to continued financial commitment to CEI initiatives, even as many organizations remain in relatively early stages of deployment for some CEI components, particularly edge computing and more advanced use cases.

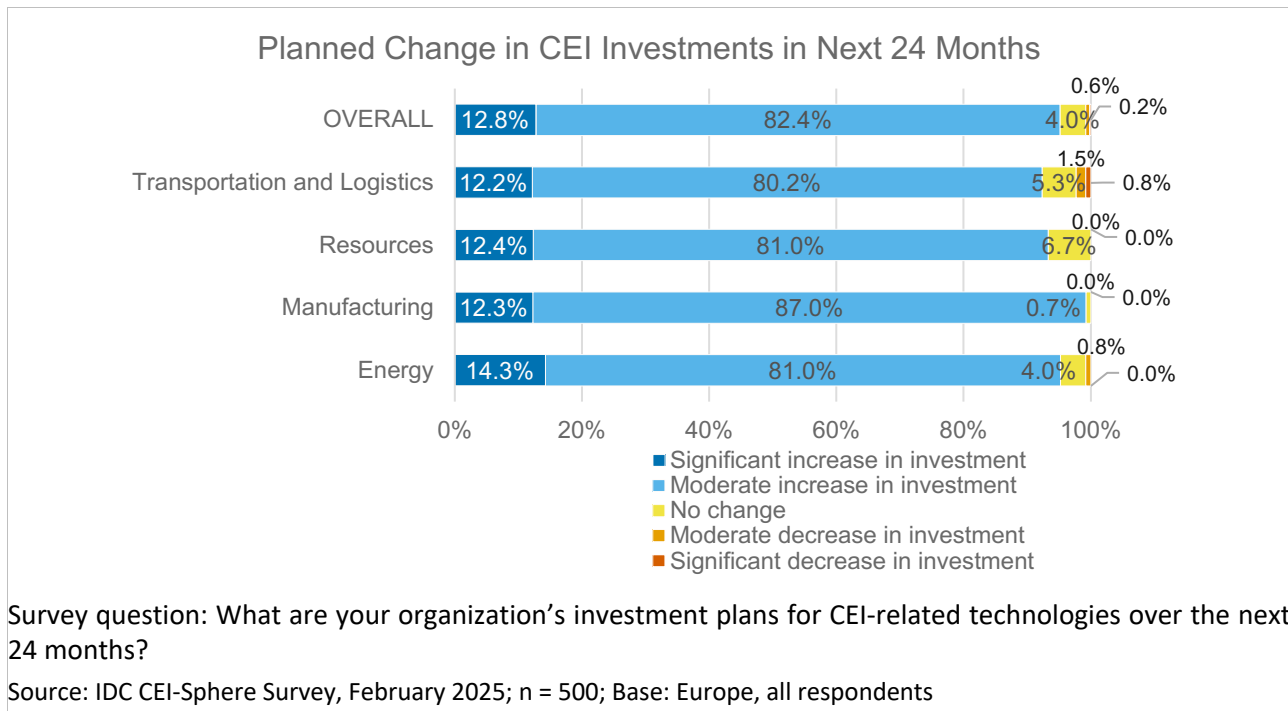


Figure 10 Planned Change in CEI Investments

3.2 Business Value

When asked about the objectives driving CEI investments, respondents most frequently point to operational efficiency improvements and cost reduction (see Figure 11). Objectives related to improved decision-making, resilience and risk management, and sustainability are also widely cited, reflecting the broad operational scope of CEI solutions.

By contrast, objectives such as enabling new revenue streams or launching new products and services are mentioned less frequently. This suggests that, for most organizations today, CEI investments are still primarily justified on the basis of internal operational benefits rather than externally facing innovation or revenue generation.



Figure 11 Objectives of CEI Investments

3.3 Critical CEI-Enabling Technologies

Figure 12 highlights which technologies respondents consider most critical for enabling CEI solutions at scale. Rather than focusing solely on individual components, respondents emphasize capabilities that support coordination, intelligence, and interoperability across distributed environments.

Technologies such as AI/ML at the edge, advanced edge orchestration, and federated or shared data approaches rank among the most frequently cited enablers. This reflects the growing recognition that scaling CEI solutions depends not only on deploying devices or compute resources, but also on managing complexity across edge, cloud, and organizational boundaries.

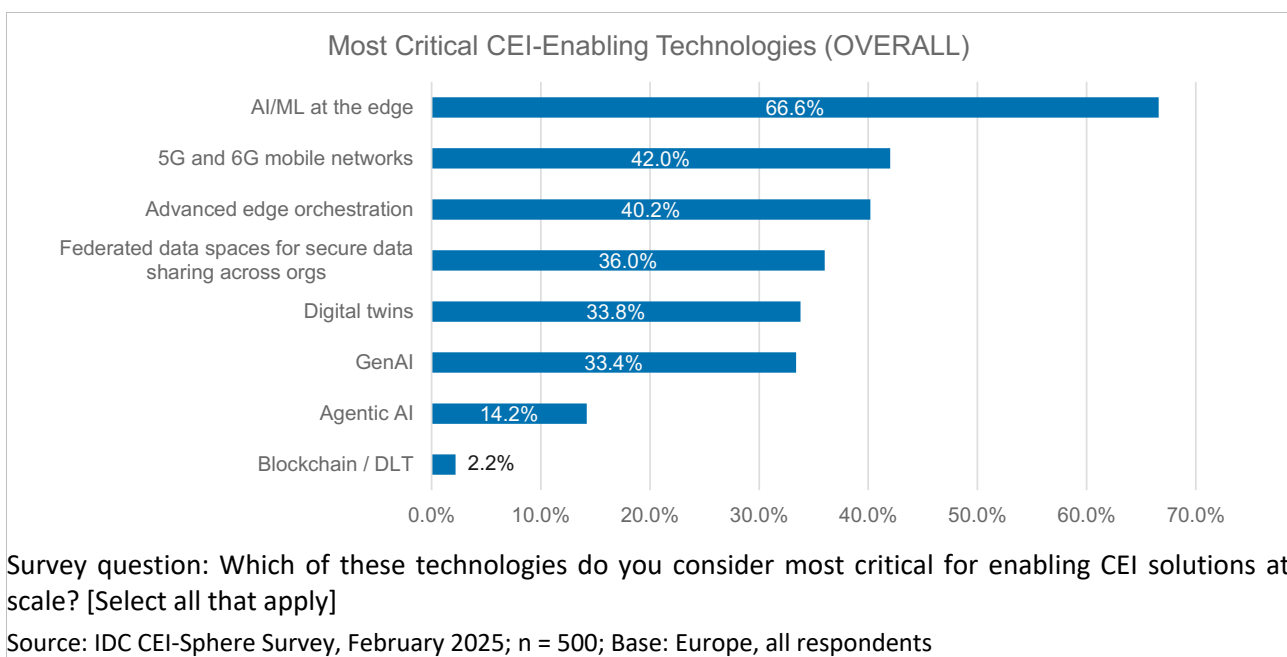


Figure 12 Most Critical CEI-Enabling Technologies

Looking at critical CEI-enabling technologies by industry, the overall patterns are broadly consistent across sectors (see Figure 13). In all industries, respondents emphasize technologies that support intelligence, coordination, and scalability across distributed environments, rather than isolated point solutions.

Some differences do emerge at the margins. Manufacturing and energy companies place slightly greater emphasis on edge-related capabilities and orchestration, reflecting their more advanced requirements for real-time control and distributed operations. However, the similarities across industries are more striking than the differences, suggesting a largely shared view of what is needed to scale CEI solutions effectively.

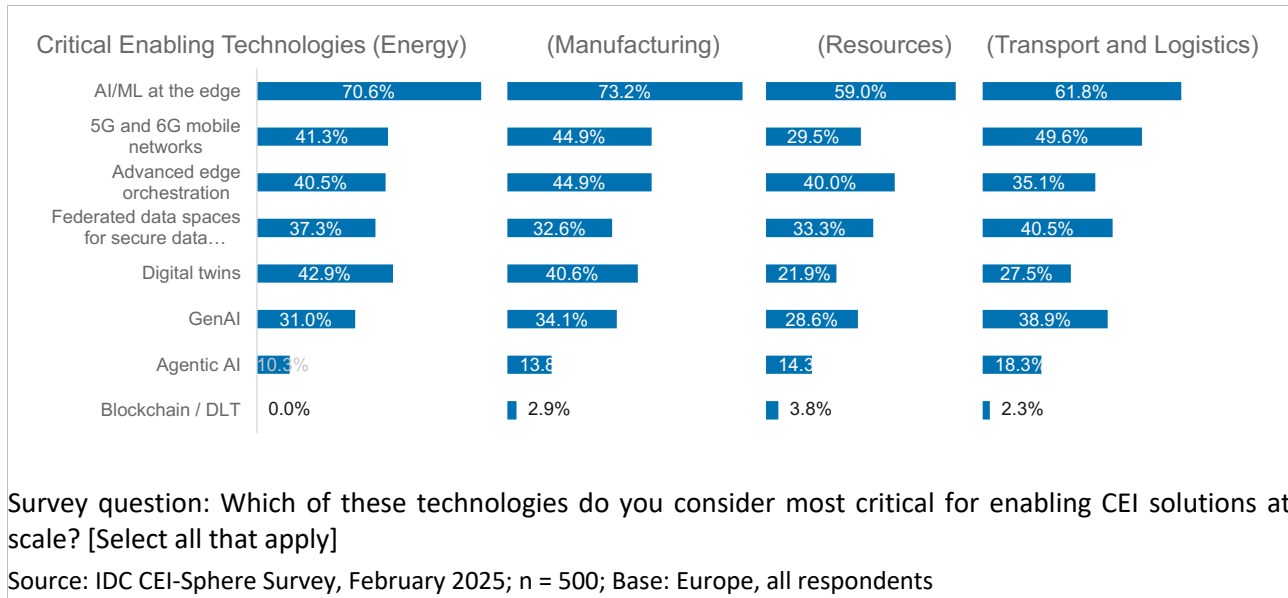


Figure 13 Most Critical CEI-Enabling Technologies by Vertical

3.4 Strategic View Conclusions

The survey results show that CEI adoption in Europe is progressing unevenly across the technology stack. While IoT is already firmly established and AI/ML adoption is widespread, edge computing remains at an earlier stage of maturity, despite strong planned adoption over the next 24 months. This imbalance reflects a market that has largely addressed data collection and analytics, but is still working through the architectural, operational, and organizational challenges required to scale distributed intelligence closer to physical assets.

At the same time, enterprises are already deploying CEI solutions in a range of operational use cases, particularly those focused on monitoring, control, and compliance. More advanced, intelligence-driven use cases, such as predictive maintenance, autonomous systems, and end-to-end traceability, show lower current deployment but strong forward momentum. Together, these findings suggest that the CEI market is transitioning from early adoption toward a phase where scalability, integration, and operational robustness will increasingly determine success.

4. Technical View: Deployment and Operational Challenges

While CEI technologies are increasingly available, deploying and operating CEI solutions at scale remains a significant challenge for many organizations. CEI architectures must span heterogeneous environments, including IoT devices, on-premises and on-device edge systems, networks, and centralized cloud platforms, often across multiple sites and geographies. This technical complexity is compounded by the need to integrate CEI solutions with existing IT and operational technology (OT) systems, while maintaining security, performance, and reliability.

To better understand these challenges, the survey examined the technical and operational barriers organizations face when deploying CEI solutions. This includes issues related to system integration, orchestration across distributed edge environments, data and security management, skills gaps, and the realities of operating CEI systems in hybrid and intermittently connected environments. Together, these factors provide insight into why many CEI initiatives struggle to move from pilot deployments to scaled, production-grade solutions.

4.1 Deployment Challenges

When asked about the biggest challenges in deploying CEI solutions, respondents point most frequently to integration-related and scaling challenges (see Figure 14). Integrating CEI solutions with existing IT and OT systems, scaling deployments beyond pilot projects, and achieving interoperability across vendors and platforms all rank among the most commonly cited obstacles.

Challenges related to data management, security and compliance, and cost of deployment are also widely reported. Taken together, these results highlight that the primary barriers to CEI adoption are less about individual technologies and more about managing complexity across heterogeneous environments and organizational boundaries.

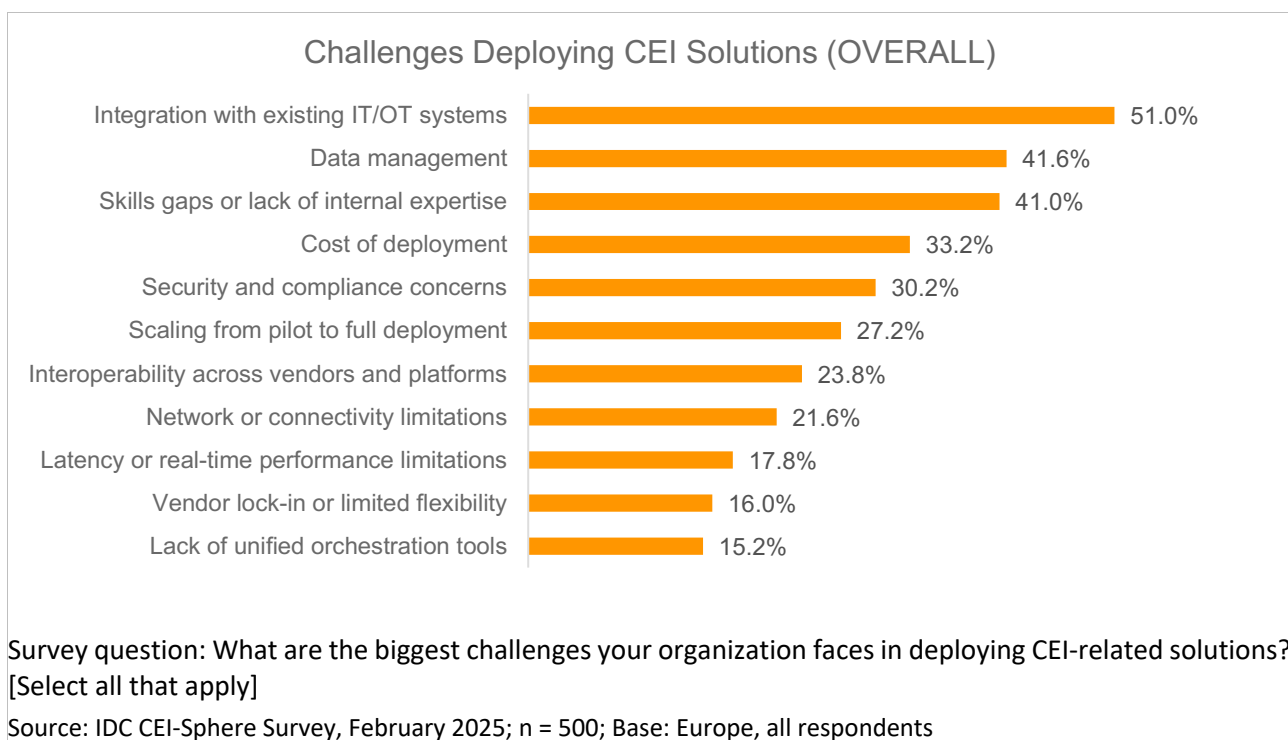


Figure 14 Challenges Deploying CEI Solutions

Data-related issues represent a major subset of the broader CEI deployment challenges (see Figure 15). Respondents most often cite difficulties related to data governance and compliance, data interoperability, and sharing data across partners and ecosystems. Managing data volumes and ensuring timely access to data across distributed environments also remain significant concerns.

These findings underline the central role of data in CEI solutions and the difficulty of operationalizing data flows across edge, cloud, and organizational boundaries, particularly when multiple stakeholders are involved.

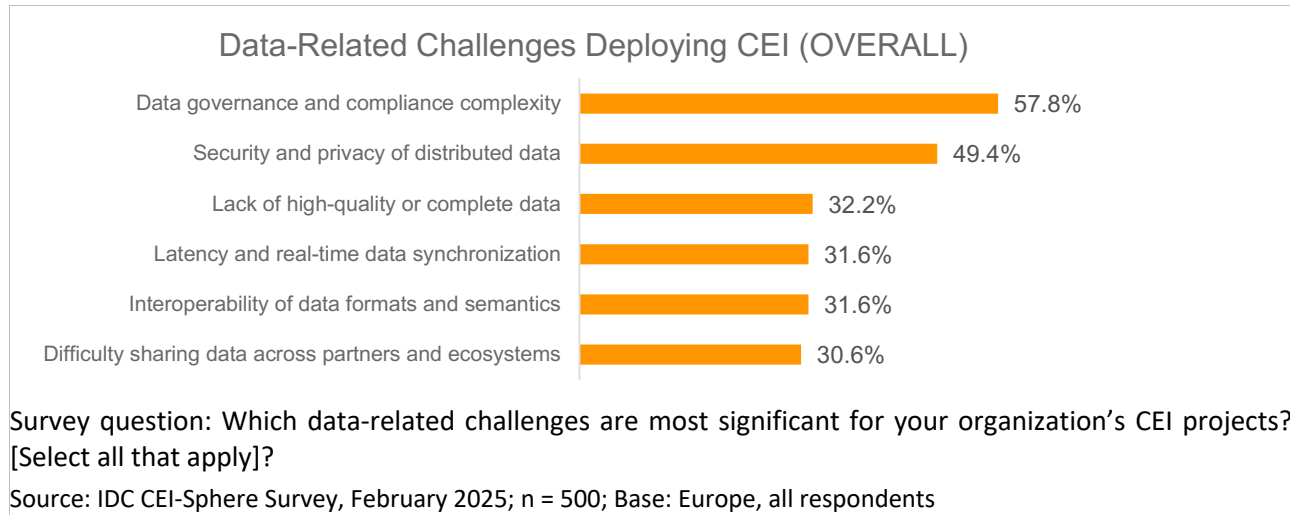


Figure 15 Data-Related Challenges Deploying CEI

Security concerns are another prominent barrier to CEI deployment (see Figure 16). Respondents express particular concern about vulnerabilities in edge devices, risks during data transmission, and the integration of IT and OT security models. Security weaknesses in orchestration and management tools are also frequently mentioned. The distributed nature of CEI architectures, spanning devices, edge nodes, networks, and cloud platforms, amplifies security complexity and increases the attack surface, making end-to-end security assurance a critical requirement for CEI adoption.

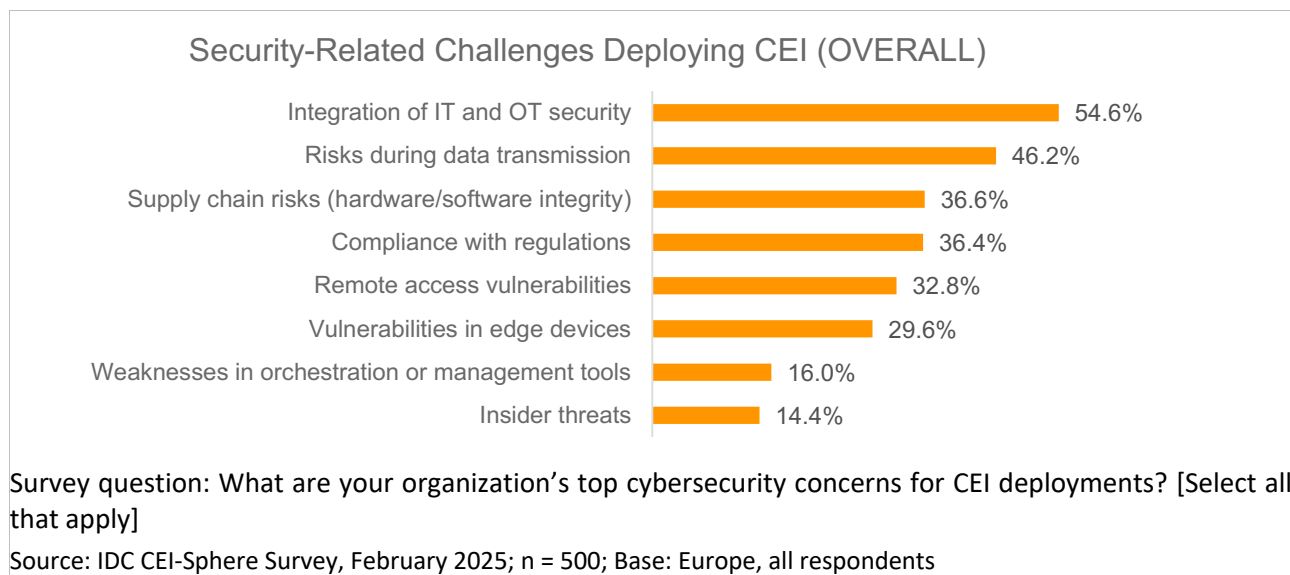


Figure 16 Security-Related Challenges Deploying CEI

Integration challenges cut across nearly all aspects of CEI deployment (see Figure 17). Respondents highlight difficulties in integrating edge and cloud systems, connecting IoT devices with enterprise applications, and managing data flows across distributed environments. Aligning IT and OT systems, as well as integrating security consistently across these domains, also remains a major challenge.

These integration issues reinforce the view that CEI deployment is primarily a systems-engineering challenge, requiring coordinated solutions that span technologies, vendors, and organizational silos rather than isolated point integrations.

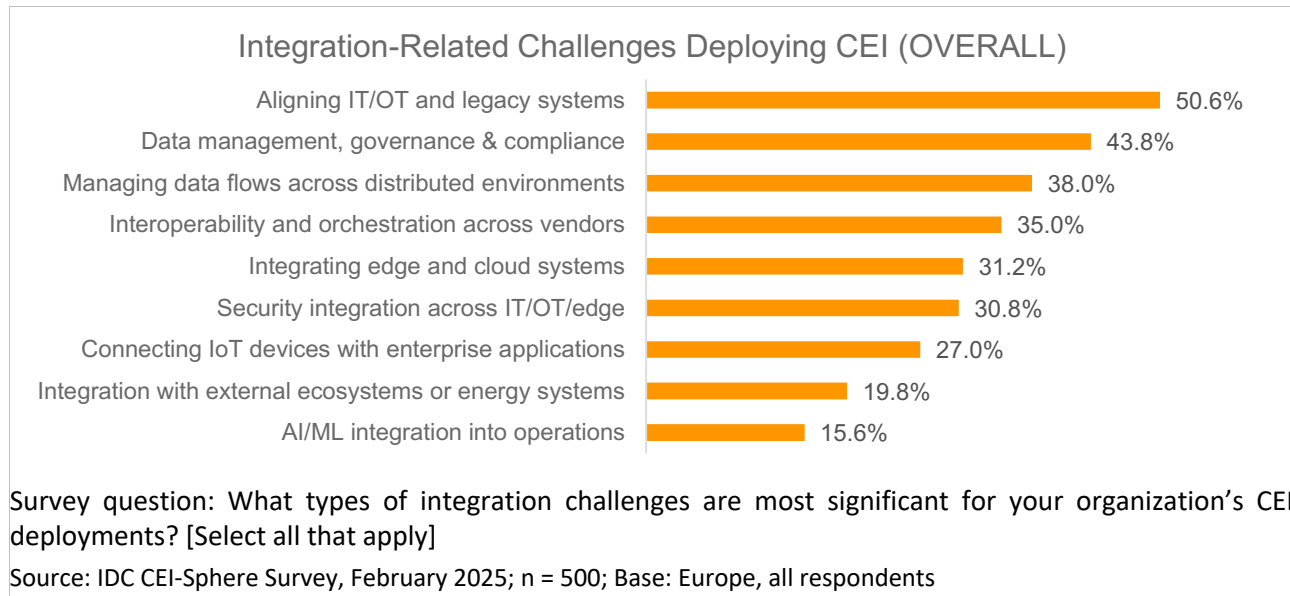
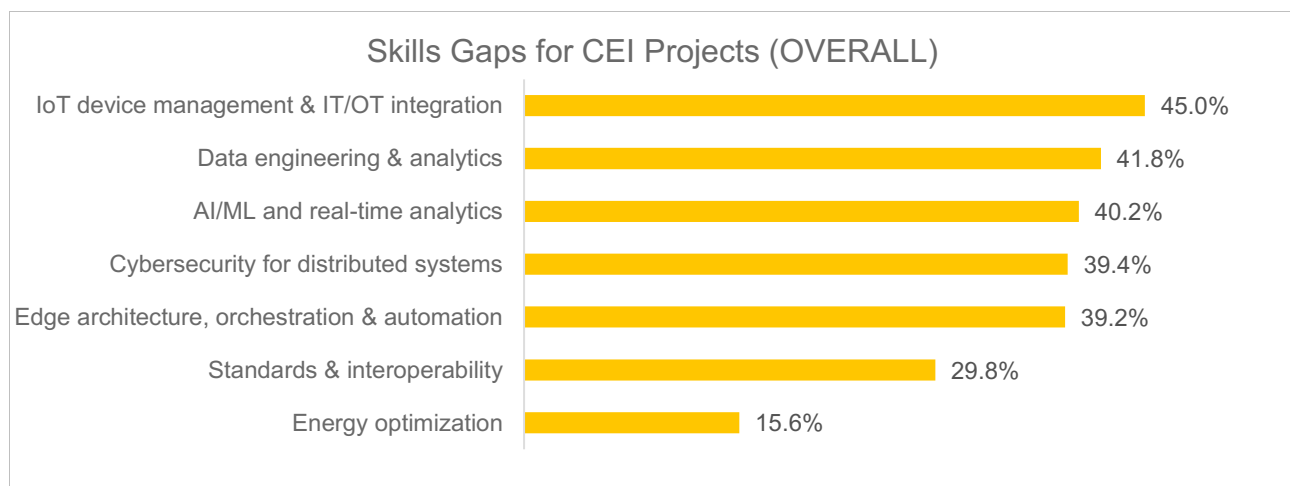


Figure 17 Integration-Related Challenges Deploying CEI

4.2 Skills Gaps

Skills shortages represent a significant barrier to CEI deployment across European enterprises (see Figure 18). Respondents most frequently point to gaps in edge architecture, orchestration, and automation, followed closely by AI/ML and real-time analytics, and data engineering and analytics. Cybersecurity skills for distributed systems are also widely cited as difficult to source or develop.

These results suggest that CEI challenges are not limited to technology availability, but extend to the ability of organizations to design, deploy, and operate complex, distributed solutions at scale.



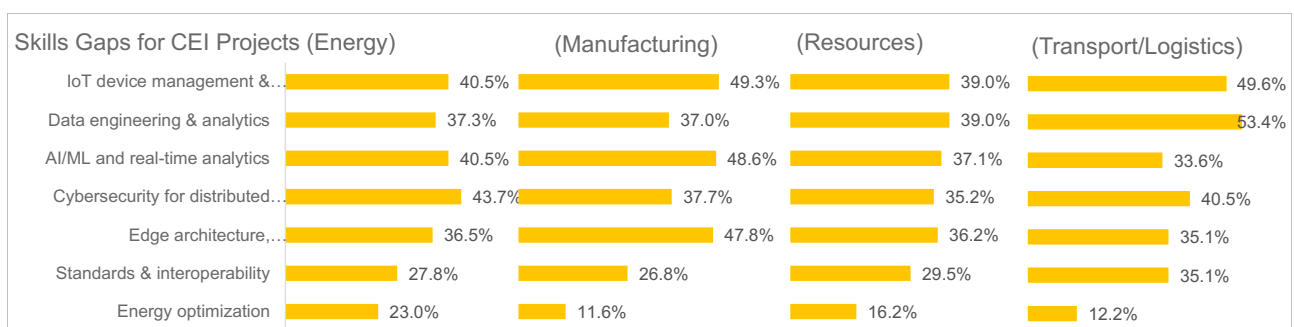
Survey question: Which skill areas are most difficult for your organization to address (either through internal development or recruitment) for CEI-related projects? [Select all that apply]

Source: IDC CEI-Sphere Survey, February 2025; n = 500; Base: Europe, all respondents

Figure 18 Skills Gap for CEI Projects

While skills gaps are evident across all industries, some differences emerge by sector (see Figure 19). Manufacturing and energy companies report particularly acute shortages in edge orchestration and AI-related skills, reflecting their more advanced deployment ambitions and operational complexity.

By contrast, skills gaps appear somewhat less pronounced in transport and logistics and resources, though shortages remain significant across all industries. Overall, the similarities across sectors outweigh the differences, indicating that CEI-related skills constraints are a broadly shared challenge rather than a vertical-specific one.



Survey question: Which skill areas are most difficult for your organization to address (either through internal development or recruitment) for CEI-related projects? [Select all that apply]

Source: IDC CEI-Sphere Survey, February 2025; n = 500; Base: Europe, all respondents

Figure 19 Skills Gap for CEI Projects by Vertical

4.3 Edge Orchestration

Figure 20 illustrates where respondents expect most computing for their CEI projects to be located over the next 24 months. Rather than a wholesale shift to either edge or cloud, the dominant model is a hybrid approach, combining edge and cloud or central datacentre resources.

A significant share of respondents expect computing to be located mostly at the edge or split between edge and cloud, reflecting the growing importance of low-latency processing and local decision-making alongside centralized analytics and coordination. Fully edge-only or cloud-only models remain less common, indicating that most enterprises anticipate operating across multiple layers of the CEI continuum.

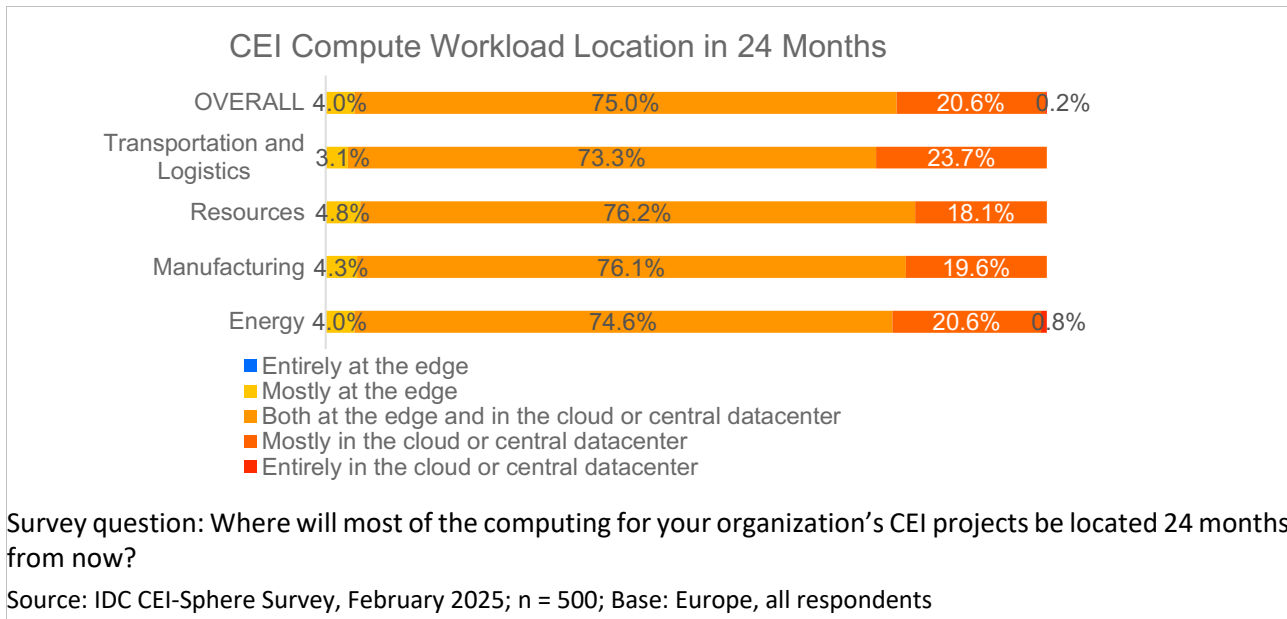


Figure 20 CEI Compute Location in 24 Months

Figure 21 shows the edge deployment models that organizations expect to use for CEI workloads over the next 24 months. On-premises edge deployments, such as equipment located at factories, sites, or facilities, are the most widely cited model, reflecting the need for low-latency processing and local control close to physical assets. On-device edge, embedded directly in machines, vehicles, or sensors, is also widely used or planned, particularly in environments where real-time responsiveness is critical.

In addition to enterprise-controlled edge environments, many respondents also anticipate using cloud provider edge zones and telecom operator MEC, though adoption levels are lower than for on-premises and on-device models. This mix of deployment models reinforces the expectation that CEI architectures will remain heterogeneous, spanning multiple edge locations rather than converging on a single dominant model.

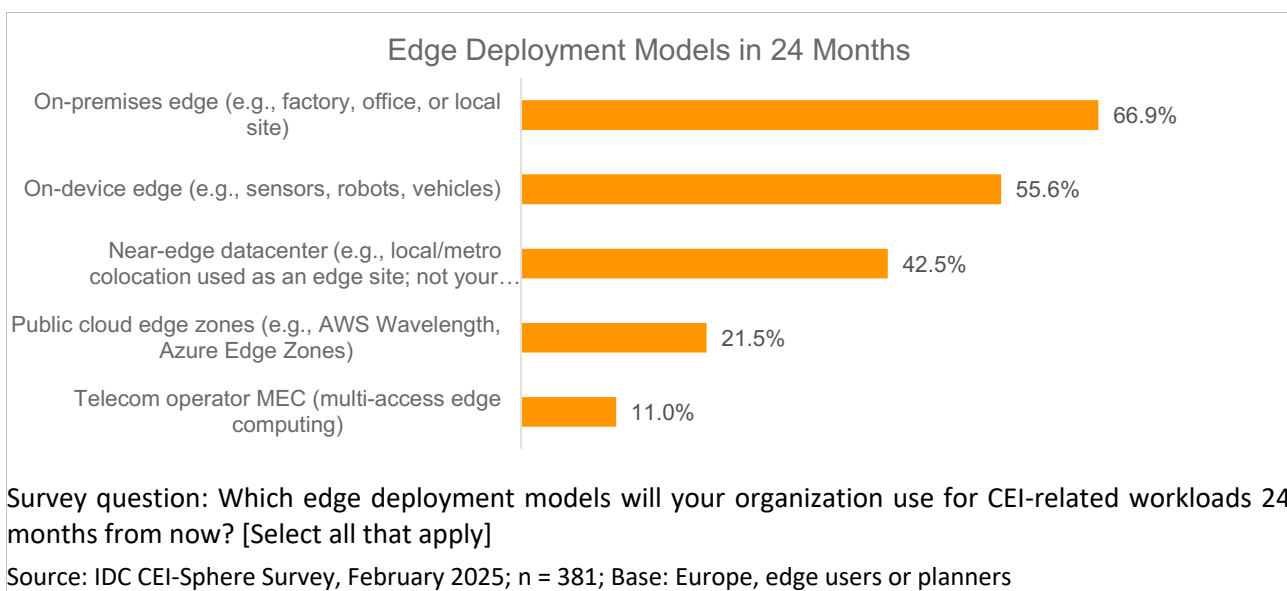


Figure 21 Edge Deployment Models

Orchestrating CEI workloads across distributed edge environments presents significant challenges for many organizations (see Figure 22). The most frequently cited issues relate to managing distributed applications across multiple sites, integrating edge environments with cloud and enterprise systems, and ensuring security and compliance across edge nodes.

A lack of unified orchestration platforms and concerns around vendor lock-in or limited interoperability are also commonly mentioned. These results underline the operational complexity of CEI deployments, particularly as organizations scale beyond isolated edge use cases to multi-site, multi-vendor environments.

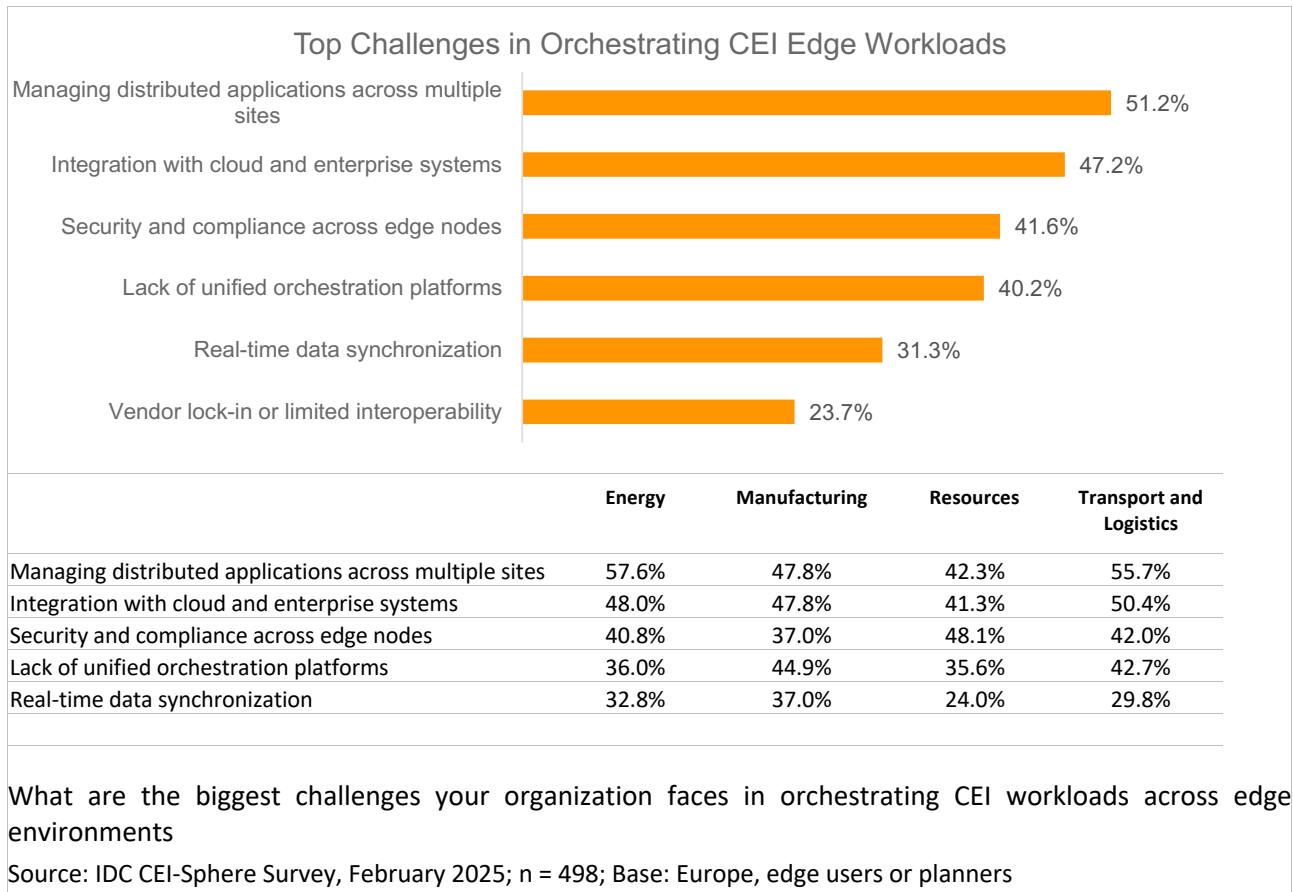
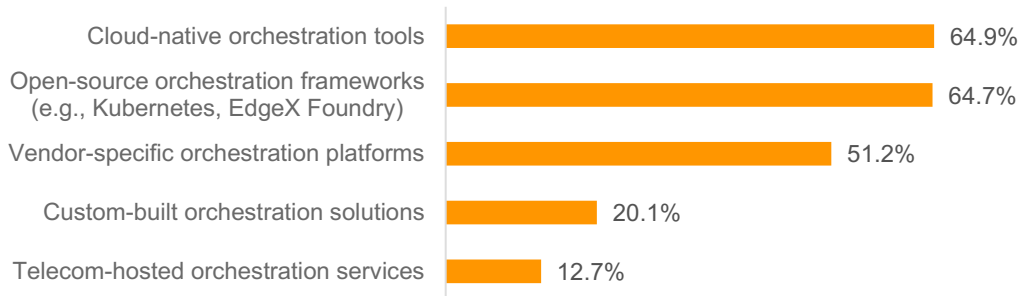


Figure 22 Challenges Orchestrating CEI Workloads

Figure 23 illustrates the types of orchestration tools and platforms organizations are using or planning to use for CEI deployments. A wide range of approaches is evident, including vendor-specific platforms, cloud-native orchestration tools, and open-source frameworks such as Kubernetes-based solutions.

The diversity of orchestration tools reflects the early stage of market convergence in this area. Many organizations appear to be combining multiple approaches rather than relying on a single, unified orchestration solution, highlighting ongoing fragmentation in the CEI orchestration landscape.

CEI Orchestration Tools in Use or Planned within 24 Months



Survey question: Which types of orchestration tools or platforms does your organization currently use or plan to use for CEI deployments in the next 24 months? [Select all that apply]

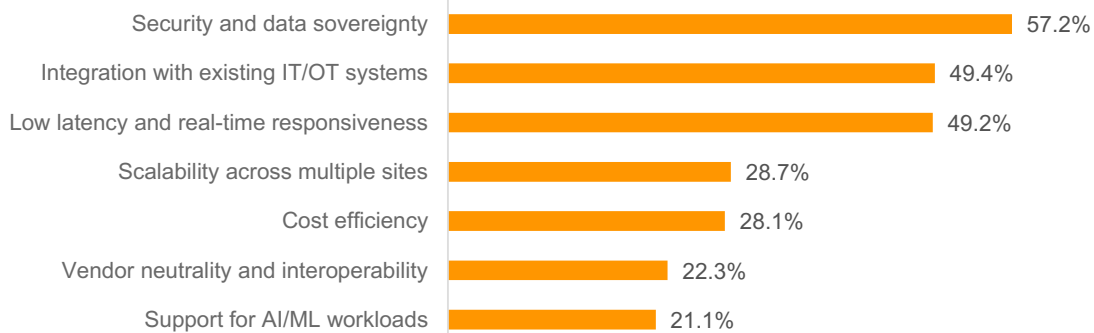
Source: IDC CEI-Sphere Survey, February 2025; n = 500; Base: Europe, edge users or planners

Figure 23 CEI Orchestration Tools in Use

Figure 24 highlights the criteria organizations consider most important when selecting edge infrastructure for CEI workloads. Respondents most frequently emphasize low latency and real-time responsiveness, scalability across multiple sites, and integration with existing IT and OT systems, reflecting the operational demands placed on edge environments.

Security-related considerations, including data sovereignty and protection, also rank highly, alongside concerns around cost efficiency and support for AI/ML workloads. Taken together, these priorities suggest that organizations are looking for edge infrastructure that can be deployed and operated consistently across distributed environments, while meeting stringent performance, security, and integration requirements.

Top Priorities When Selecting Edge Infrastructure for CEI Workloads



Survey question: What are your organization's top priorities when selecting edge infrastructure for CEI workloads? [Select all that apply]

Source: IDC CEI-Sphere Survey, February 2025; n = 500; Base: Europe, edge users or planners

Figure 24 Top Priorities When Selecting Edge Infrastructure

A significant share of respondents report operating in remote or intermittently connected environments where CEI solutions must function without continuous cloud connectivity (see Figure 25). This includes locations such as industrial sites, energy assets, transport corridors, and rural or offshore operations.

These conditions place additional demands on CEI architectures, increasing the importance of local processing, resilience, and autonomous operation at the edge. The prevalence of such environments helps explain why many organizations prioritize edge computing and hybrid deployment models rather than relying solely on centralized cloud resources.

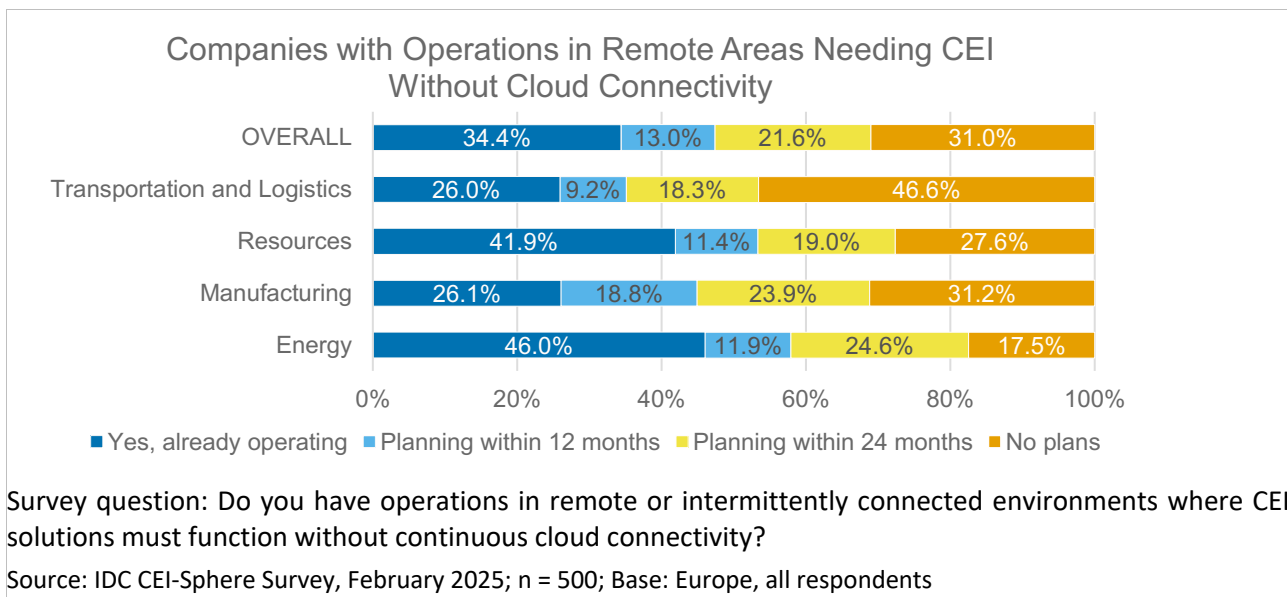


Figure 25 Companies Operating in Remote Areas Needing CEI Without Cloud Connectivity

4.4 Deployment and Operational Challenge Conclusions

The Technical View section on Deployment and Operational Challenges highlights that the primary barriers to CEI adoption are no longer the availability of individual technologies, but the complexity of deploying and operating CEI solutions at scale. Integration across IT, OT, edge, and cloud environments; orchestration across distributed sites; and consistent security and data governance emerge as the most persistent challenges across industries.

Skills shortages further compound these issues, particularly in areas such as edge orchestration, AI/ML deployment, and cybersecurity for distributed systems. At the same time, the prevalence of hybrid deployment models and operations in remote or intermittently connected environments underscores the need for CEI solutions that are resilient, autonomous, and manageable across heterogeneous infrastructures. Overall, the findings point to the enabling platform layer, rather than endpoints or applications, as the critical focus area for advancing CEI maturity.

While these deployment and operational challenges affect individual organizations directly, scaling CEI solutions also depends on broader ecosystem alignment around collaboration models, standards, and trust mechanisms, which are addressed in the following section.

5. Technical View: Collaboration, Standards, and Trust

Beyond technical deployment challenges within individual organizations, the successful scaling of CEI solutions also depends on effective collaboration across ecosystems. CEI deployments frequently involve multiple vendors, platforms, and stakeholders, making interoperability, shared standards, and trust between parties critical enablers of adoption. Without common approaches to integration, data sharing, and governance, CEI solutions risk becoming fragmented and difficult to scale across organizational boundaries.

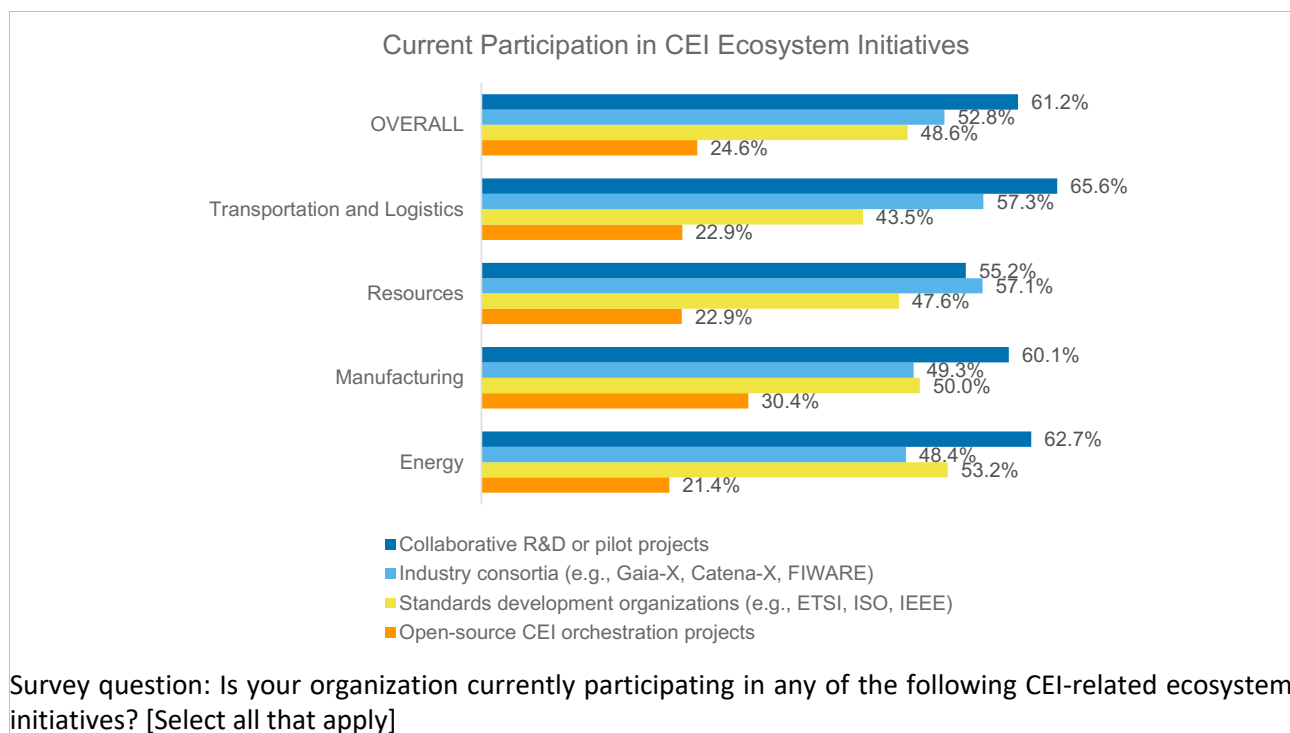
To explore these ecosystem-level challenges, the survey examined enterprise participation in CEI-related collaboration initiatives, the role of open standards and open-source software, and the importance of trust mechanisms such as certification schemes and trust labels. These topics address a different, but complementary, dimension of the Technical View, one focused not on how CEI systems are engineered, but on how they are aligned, governed, and trusted across a broader and increasingly interconnected CEI landscape.

5.1 Ecosystem Collaboration

CEI solutions are inherently multi-stakeholder, often spanning device vendors, platform providers, network operators, cloud providers, system integrators, and end users. As CEI deployments scale beyond isolated pilots toward production environments, collaboration across ecosystems becomes increasingly important, not only to share knowledge and reduce duplication, but also to address interoperability, data sharing, and trust across organizational boundaries. For this reason, the survey explored the extent to which enterprises are already participating in CEI-related ecosystem initiatives, as well as the barriers they face in doing so.

Figure 26 shows the extent to which organizations are participating in CEI-related ecosystem initiatives. A significant share of respondents report involvement in at least one type of collaborative activity, most commonly collaborative R&D or pilot projects and industry consortia. Participation in open-source projects and formal standards development organizations is less widespread, though still present among a meaningful subset of respondents.

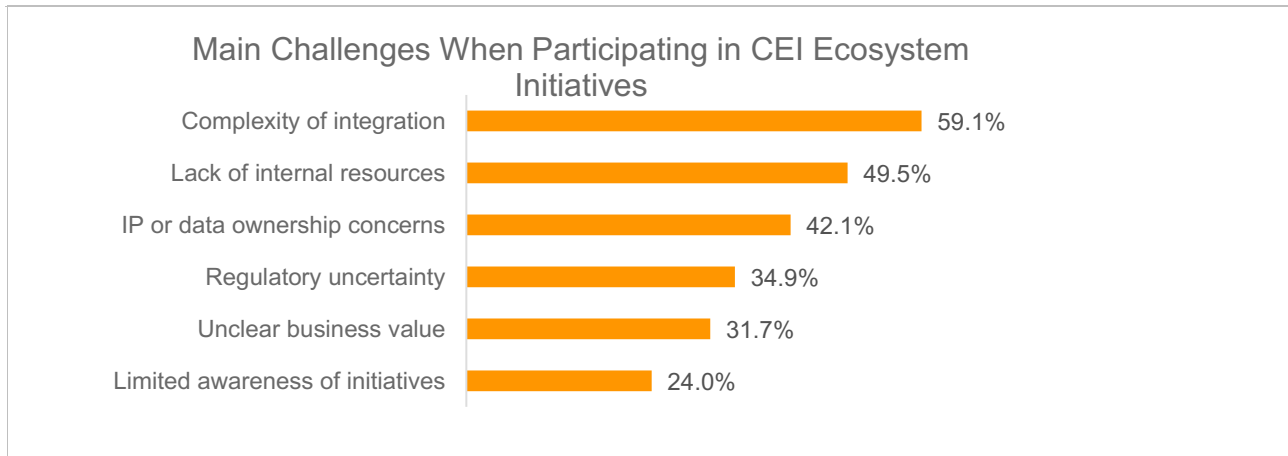
At the same time, a sizeable proportion of companies report no participation in CEI ecosystem initiatives at all. This suggests that while ecosystem collaboration is already playing an important role for some organizations, particularly those engaged in pilots, broader participation remains uneven across the market.



Source: IDC CEI-Sphere Survey, February 2025; n = 500; Base: Europe, all respondents

Figure 26 Participation in CEI Ecosystem Initiatives

Among organizations that participate in CEI ecosystem initiatives, several barriers limit deeper or broader engagement (see Figure 27). The most frequently cited challenges include a lack of internal resources, unclear business value, and the complexity of integration required to participate effectively in collaborative initiatives. Concerns related to data ownership and intellectual property, as well as limited awareness of relevant initiatives, are also commonly mentioned. These challenges help explain why ecosystem participation remains selective, despite widespread recognition of its importance for scaling CEI solutions.



Survey question: What are the main challenges your organization faces in participating in CEI ecosystem initiatives?
[Select all that apply]

Source: IDC CEI-Sphere Survey, February 2025; n = 499; Base: Europe, organizations participating in CEI-related ecosystem initiatives

Figure 27 Challenges Participating in CEI Ecosystem Initiatives

5.2 Standards

As CEI solutions scale across sites, organizations, and ecosystems, the role of open standards and open-source software becomes increasingly important. Standards are critical for enabling interoperability across heterogeneous infrastructures, avoiding vendor lock-in, and supporting trusted data sharing across organizational boundaries. Open-source software, meanwhile, plays a key role in accelerating innovation, fostering transparency, and providing common building blocks for CEI platforms. To better understand how these mechanisms are being used in practice, the survey examined the extent to which enterprises are adopting standards and open source in their CEI deployments, as well as the barriers they encounter.

Figure 28 shows the types of open standards that organizations are currently using or planning to use in CEI deployments. Respondents most frequently cite standards related to interoperability, edge orchestration, and data governance and sharing, reflecting the practical challenges of connecting systems across edge, cloud, and organizational domains.

Standards focused on semantic interoperability and security and trust frameworks are also used or planned by a significant share of respondents, though adoption is somewhat less widespread. Overall, the results suggest that enterprises recognize the importance of standards in principle, but that adoption remains uneven across different layers of the CEI stack.

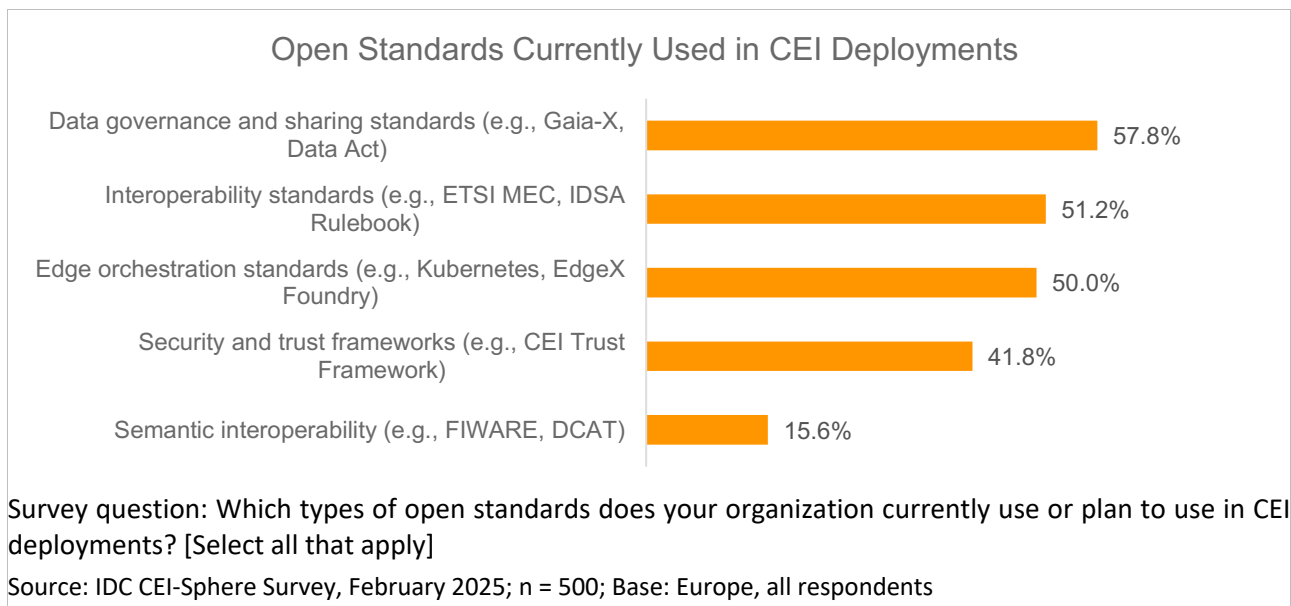


Figure 28 Open Standards Used in CEI Deployments

Open-source software already plays a meaningful role in many organizations' CEI strategies (see Figure 29). A substantial share of respondents report that open source is either central or important to their approach, even if they are not actively contributing code. This highlights the widespread reliance on open-source components as foundational infrastructure within CEI solutions.

At the same time, a notable proportion of respondents indicate that open source plays only a limited role, or is not relevant to their CEI strategy. This split suggests that while open source is a key enabler for many CEI deployments, its strategic importance varies considerably depending on organizational capabilities, risk appetite, and sourcing models.

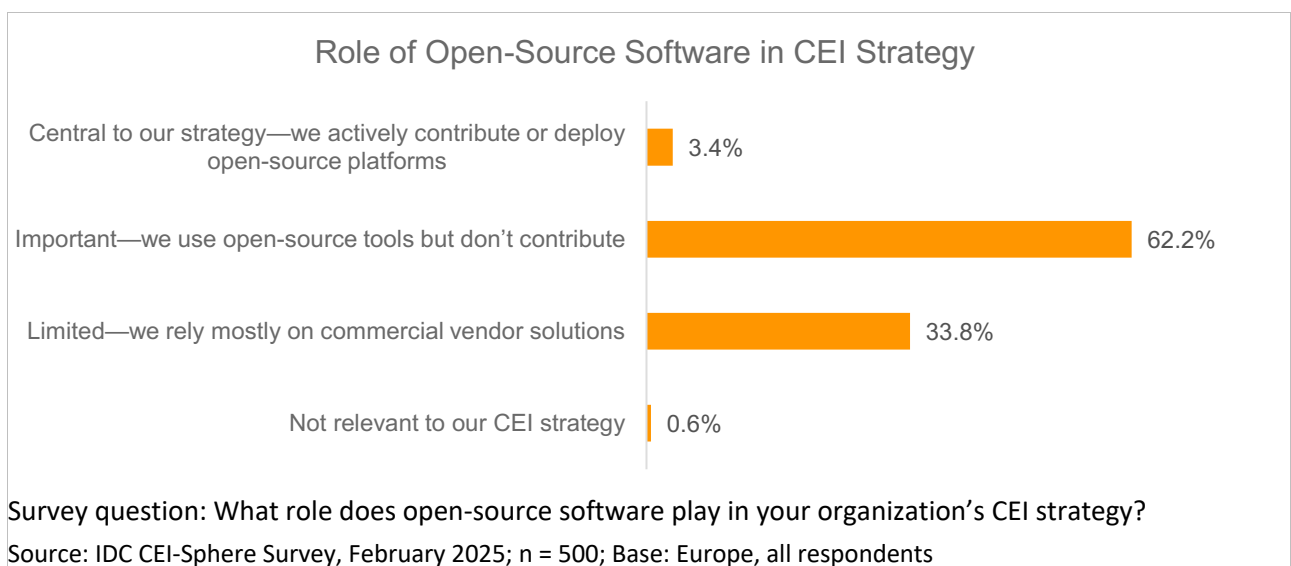


Figure 29 Role of Open-Source Software in CEI Strategy

Despite broad recognition of their benefits, organizations face several barriers when adopting open standards and open-source tools for CEI projects (see Figure 30). The most frequently cited challenges include lack of internal expertise, integration complexity, and concerns around security and compliance.

Uncertainty related to licensing, intellectual property, and long-term support is also commonly mentioned, helping to explain why some organizations remain cautious about deeper reliance on open approaches. These barriers indicate that wider adoption of standards and open source will depend not only on technical maturity, but also on clearer guidance, tooling, and assurance mechanisms.

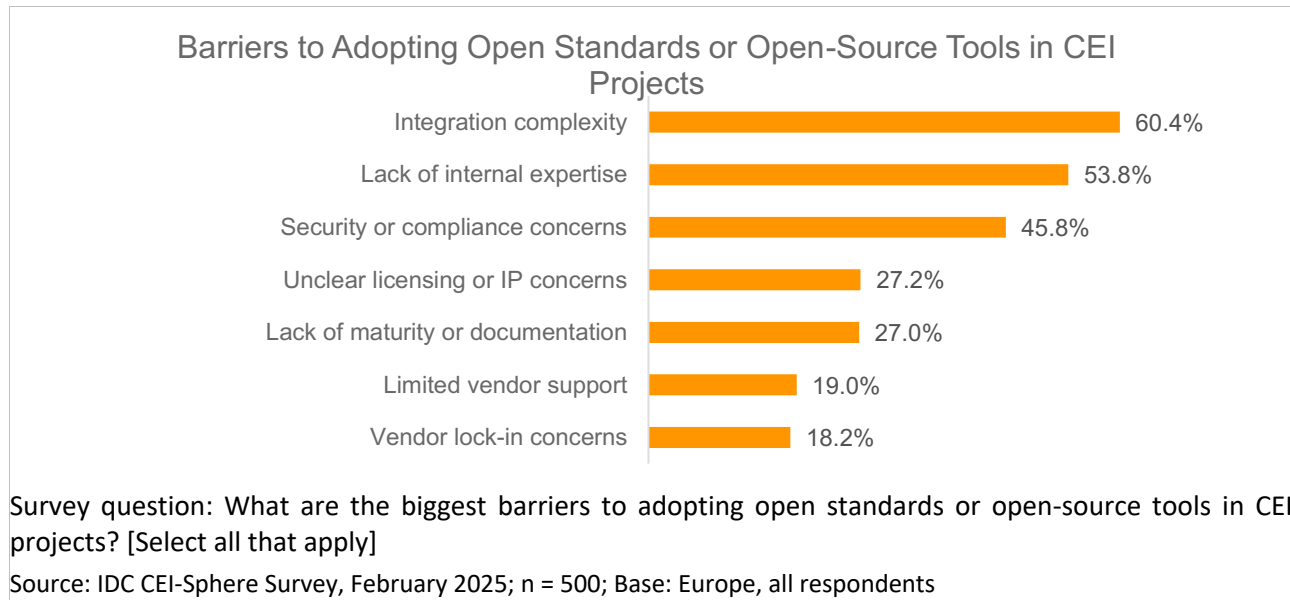


Figure 30 Barriers Adopting Open Standards or Open-Source Tools in CEI

5.3 Trust Label

As CEI solutions scale across distributed environments, vendors, and ecosystems, trust becomes a critical factor in technology selection and deployment. Enterprises must assess not only technical capabilities, but also security, interoperability, compliance, data sovereignty, and long-term reliability, often across complex, multi-vendor solutions. In this context, certification schemes and trust frameworks can play an important role in reducing uncertainty, supporting vendor comparison, and accelerating adoption. To explore this issue, the survey examined which trust mechanisms enterprises value today, and whether a dedicated CEI trust label could influence decision-making.

Figure 31 shows the types of certification and trust frameworks that organizations consider important when selecting CEI solutions. Respondents most frequently point to industry-specific compliance standards and EU-based certification schemes, reflecting the importance of regulatory alignment and established assurance mechanisms.

At the same time, open-source community validation and vendor self-certification are also cited by a meaningful share of respondents, indicating that trust is assessed through a mix of formal certification and more informal signals. A notable minority report having no formal certification requirements, suggesting that trust expectations vary widely across organizations and use cases.

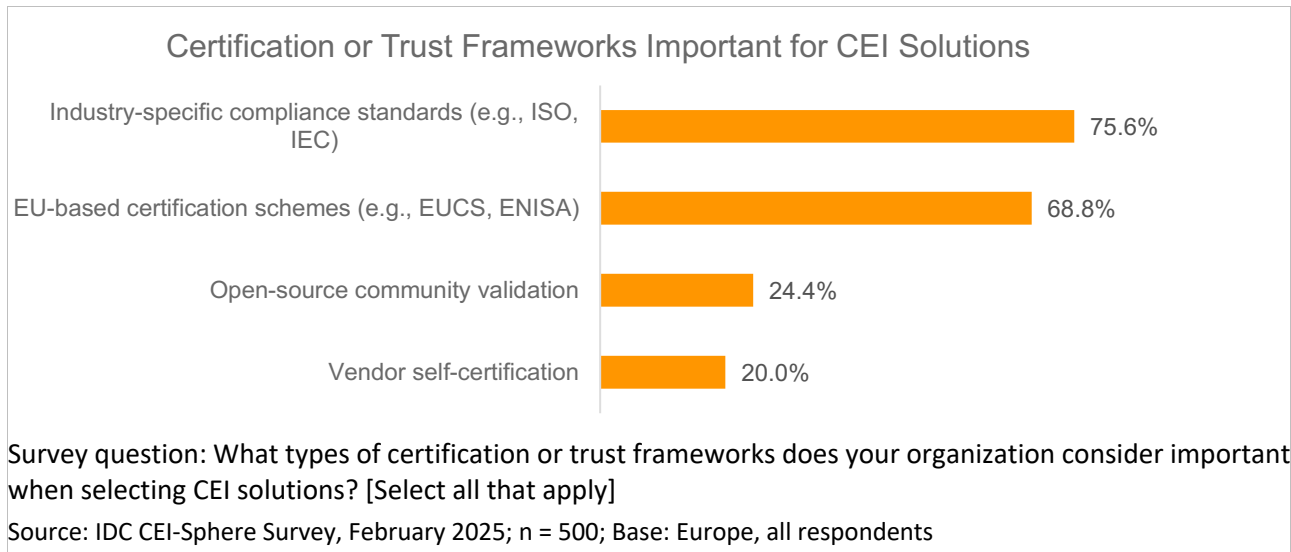


Figure 31 Certification or Trust Frameworks Important for CEI

Figure 32 illustrates the perceived impact of a CEI Trust Label on the selection of CEI vendors across various sectors. The data reveals that an overwhelming majority of respondents - ranging from 93.3% to 96.6% - consider the Trust Label to have a moderate or high impact on their vendor selection process. This is consistent across all sectors, including Transportation and Logistics, Resources, Manufacturing, and Energy, with the Manufacturing sector showing the highest sensitivity at 96.6%. Only a small percentage of respondents, between 1.4% and 6.7%, perceive the Trust Label as having low or no impact. This underscores the significant value organizations place on trust and certification frameworks when evaluating CEI vendors, reinforcing the critical role of formal assurance mechanisms in shaping vendor selection decisions.

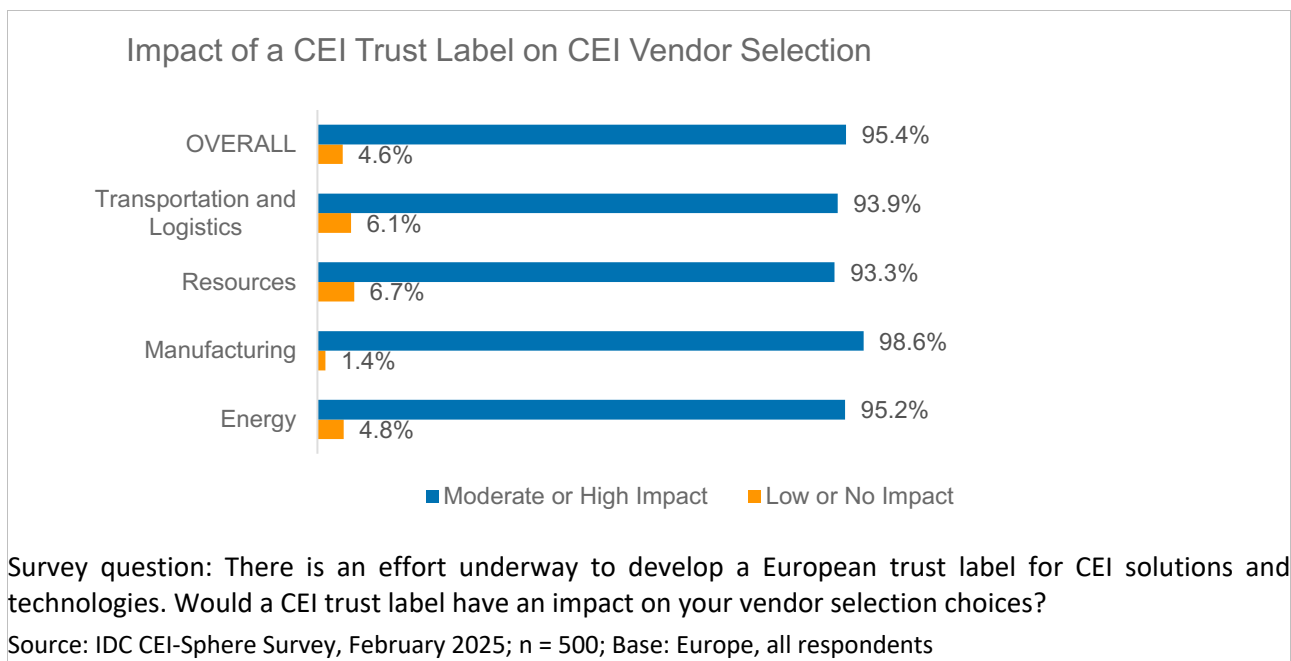


Figure 32 Impact of a CEI Trust Label on CEI Vendor Ecosystem

Figure 33 highlights the specific market challenges that respondents believe a CEI trust label could help address. The most frequently cited issues include lack of transparency in vendor capabilities, difficulty comparing solutions across vendors, and uncertainty around standards compliance.

Fragmentation of orchestration platforms and limited interoperability across multi-vendor environments are also commonly mentioned. Together, these responses point to trust gaps that stem less from individual technologies and more from ecosystem complexity and the absence of clear, comparable signals of maturity and compatibility.

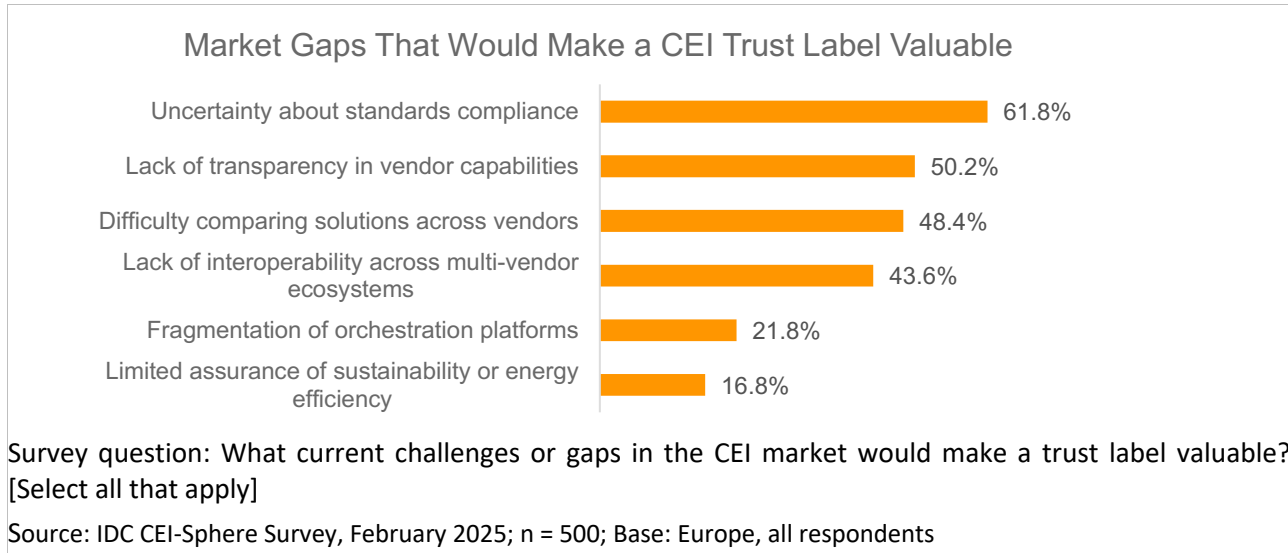


Figure 33 Reasons for a CEI Trust Label

Respondents express clear preferences regarding the features that should be included in a CEI trust label (see Figure 34). The most frequently cited features relate to verification of standards compliance, data sovereignty and security assurances, and certification of orchestration capabilities.

Additional priorities include vendor transparency, documentation quality, and open-source compatibility, reflecting the need for trust mechanisms that address both technical robustness and ecosystem openness. These preferences suggest that an effective CEI trust label would need to span multiple dimensions, from technical interoperability to governance and transparency.

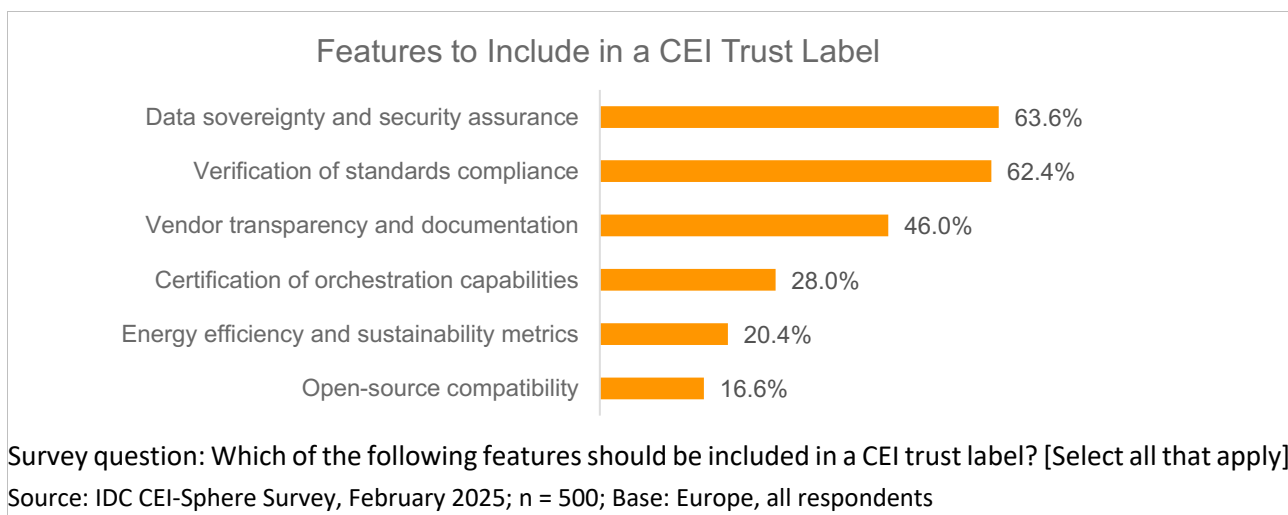


Figure 34 Features to Include in a CEI Trust Label

5.4 Collaboration, Standards, and Trust Conclusions

CEI solutions are inherently ecosystem-driven, yet the survey shows that enterprise participation in CEI-related collaborative initiatives remains uneven. While many organizations engage in pilot projects and industry consortia, participation in standards development and open-source initiatives is more limited, often constrained by resource availability, integration complexity, and unclear business value.

At the same time, respondents clearly recognize the importance of open standards, interoperability, and trusted platforms for scaling CEI deployments. The strong interest in a dedicated CEI trust label reflects a broader need for clearer signals of maturity, compatibility, and reliability in a fragmented market. Taken together, these results suggest that greater alignment around common platforms, standards, and trust mechanisms will be essential to reduce risk, simplify adoption, and support broader ecosystem participation.

6. Operational View: CEI Use Cases in Practice

This section examines how CEI solutions are being applied in concrete operational domains where performance, resilience, and real-time decision-making are critical. It focuses on use cases in energy management, mobility and fleet operations, and electric utility services, areas that are central to many of the CEI-Sphere large-scale pilots.

By looking at how organizations deploy CEI solutions in these domains today, and where adoption is expected to grow, the section illustrates how CEI is moving from experimental pilots toward operational systems with direct business and infrastructure impact.

6.1 Energy Management

Energy management represents one of the most concrete and operationally critical application areas for CEI solutions. Rising energy costs, decarbonization targets, and increasing volatility in supply and demand are pushing organizations to adopt more data-driven, automated approaches to managing energy production and consumption. CEI architectures, combining IoT, edge computing, cloud platforms, and AI, enable real-time monitoring, optimization, and coordination of energy assets across sites and, increasingly, across organizational boundaries. To assess how far this transition has progressed, the survey explored current and planned adoption of CEI solutions for energy management across different industries.

Figure 35 shows whether organizations currently operate, or plan to operate, clean energy production for their own use, such as solar or wind generation. A meaningful share of respondents already operate clean energy assets, while an additional group indicate plans to do so within the next 12 to 24 months.

Taken together, these results indicate that on-site or self-managed clean energy production is becoming increasingly common among European enterprises, creating new operational requirements for monitoring, optimization, and integration with broader energy management systems.

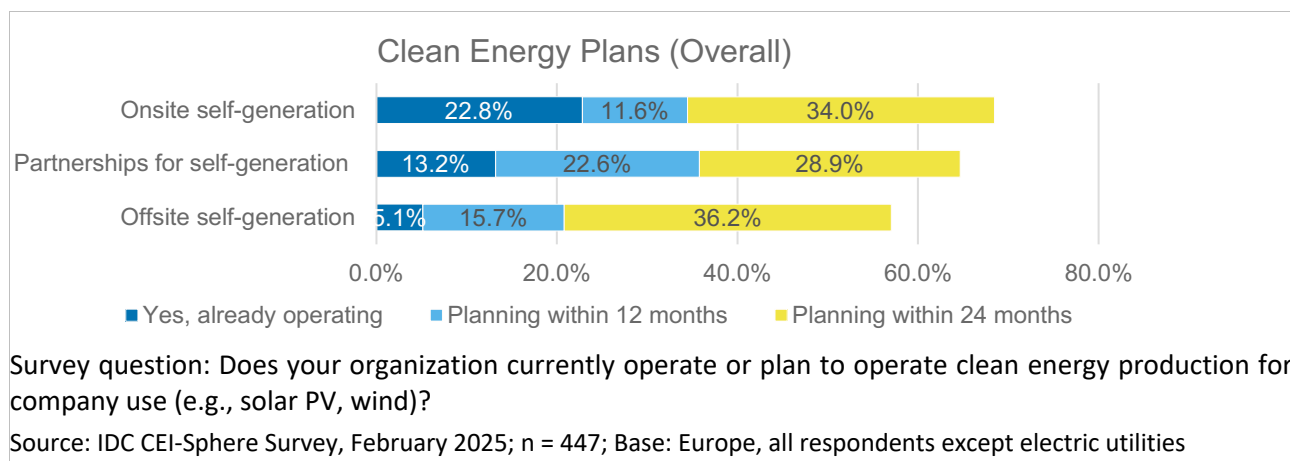


Figure 35 Clean Energy Production Plans ()

When viewed by industry, clean energy production plans vary noticeably across sectors (see Figure 36). Energy and manufacturing companies are more likely to already operate, or plan to operate, clean energy assets, reflecting both regulatory pressures and the energy-intensive nature of their operations.

Other industries show lower current adoption, but still report meaningful levels of planned investment. This suggests that while clean energy production is most advanced in certain sectors, it is increasingly relevant across a broad range of industries.

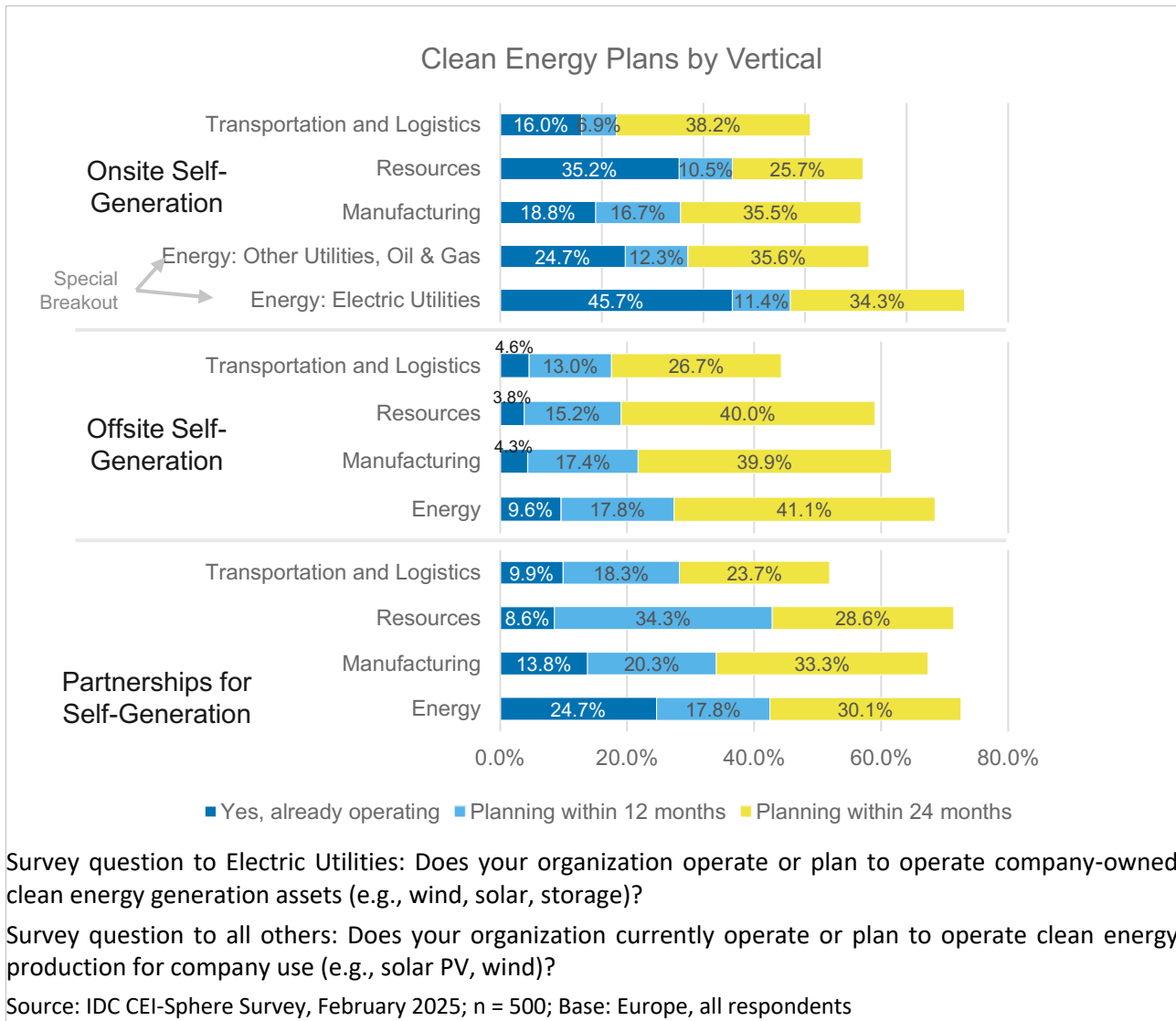


Figure 36 Clean Energy Production Plans by Vertical

Figure 37 focuses specifically on on-site clean energy generation by industry. Here again, energy and manufacturing companies lead, with a higher share of organizations already operating on-site generation assets compared with other sectors.

On-site generation introduces additional operational complexity, including the need to balance generation and consumption locally, manage intermittency, and integrate energy assets with existing operational systems. As adoption expands, these requirements further increase the relevance of CEI-enabled energy management solutions.

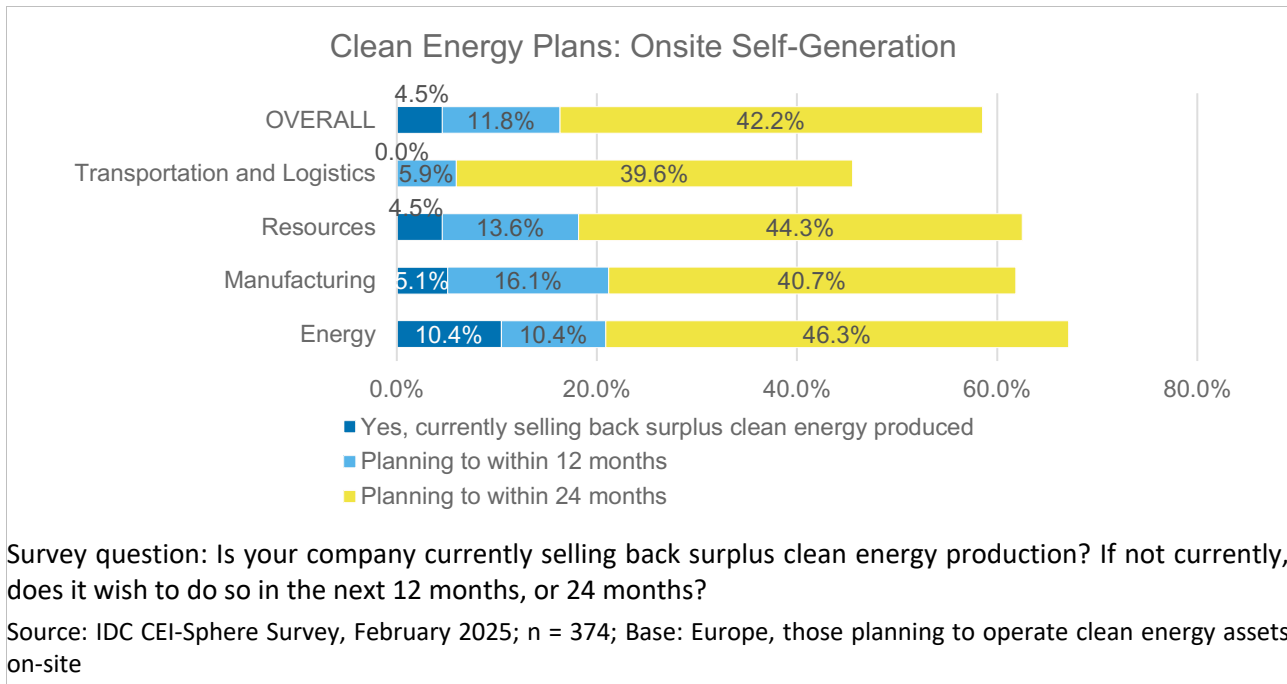


Figure 37 Clean Energy Production Plans: On-Site Generation by Vertical

Figure 38 illustrates the specific energy-management use cases for which organizations are using or planning to use CEI solutions. The most commonly cited applications relate to energy efficiency and cost reduction, real-time monitoring and optimization, and predictive maintenance of energy-intensive equipment.

More advanced use cases, such as AI-driven energy forecasting, dynamic energy optimization, and integration of distributed energy resources, are less widely deployed today but show strong planned adoption. This pattern reflects a progression from basic monitoring toward more automated and intelligence-driven energy management approaches.

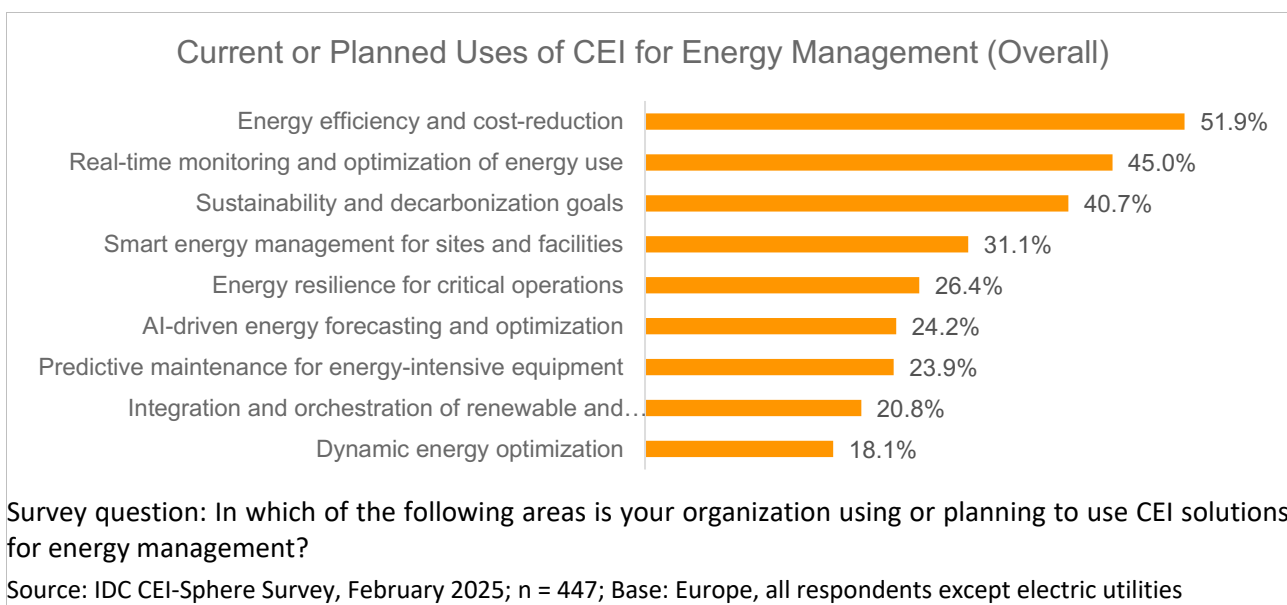


Figure 38 Planned Uses of CEI for Energy Management

Among electric utilities, CEI solutions are already being applied to a range of grid-operation and flexibility use cases (see Figure 39). Common applications include integration and orchestration of distributed energy resources, grid forecasting and congestion management, and condition-based or predictive maintenance of grid assets.

While adoption levels vary by use case, the results indicate that utilities are actively exploring CEI-enabled approaches to improve grid resilience, support renewable integration, and enable more flexible and responsive grid operations.

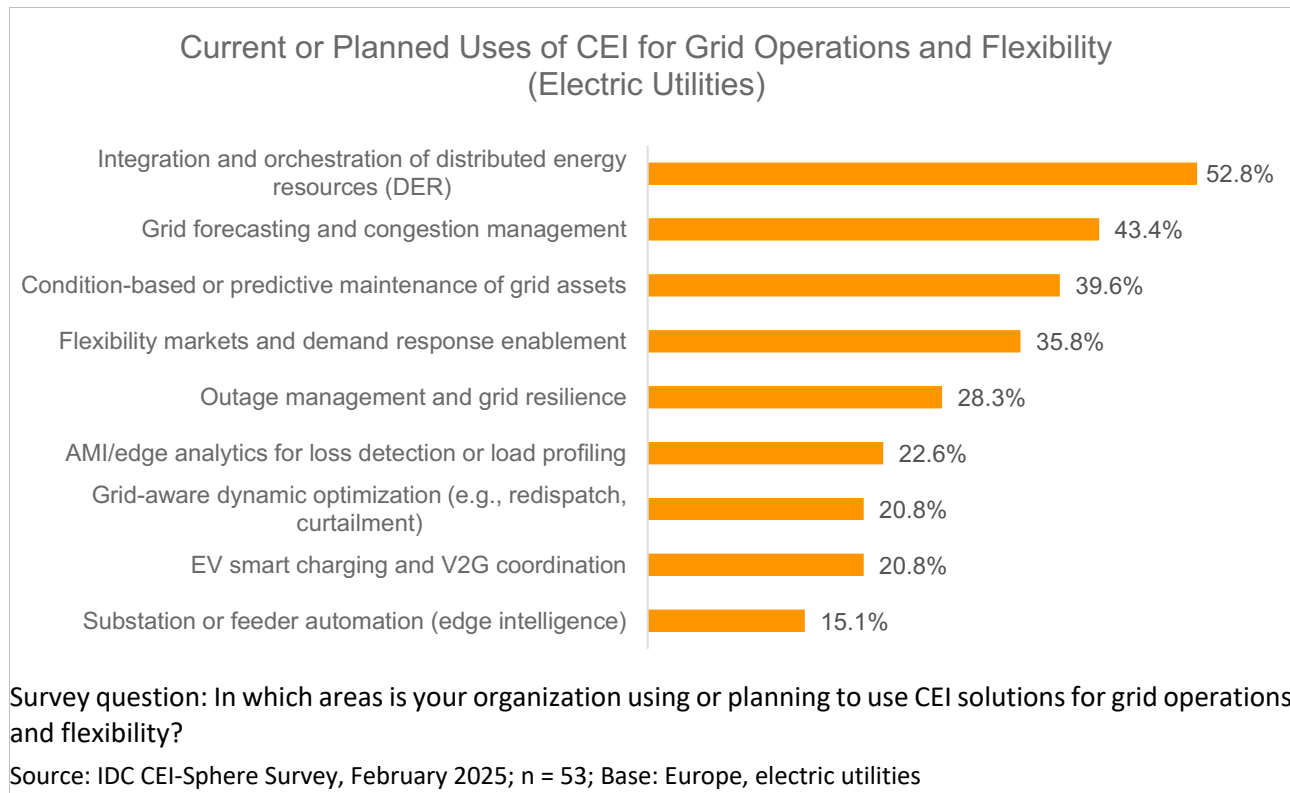


Figure 39 Electric Utilities: Usage of CEI for Grid Operations and Flexibility

6.2 Vehicles and Fleet Operations

Mobility and fleet operations represent another major operational domain where CEI solutions are being applied to improve efficiency, sustainability, and real-time decision-making. From vehicle tracking and optimization to electrification and energy integration, CEI architectures enable the collection and processing of data from mobile assets, often under demanding conditions such as wide geographic distribution and intermittent connectivity. As electrification progresses, fleet-related CEI use cases are also increasingly intersecting with energy management and grid interaction. To understand how organizations are positioned in this transition, the survey examined fleet size, electrification levels, and interest in emerging use cases such as Vehicle-to-Grid (V2G).

Figure 40 shows the distribution of vehicle fleet sizes among surveyed organizations. A majority of respondents report operating some form of vehicle fleet, though fleet sizes vary widely, ranging from small fleets with fewer than 25 vehicles to very large fleets with hundreds or thousands of vehicles.

This wide distribution highlights the diversity of fleet-related operational contexts addressed by CEI solutions, from relatively simple fleet management scenarios to highly complex, large-scale fleet operations that require advanced monitoring, analytics, and optimization capabilities.

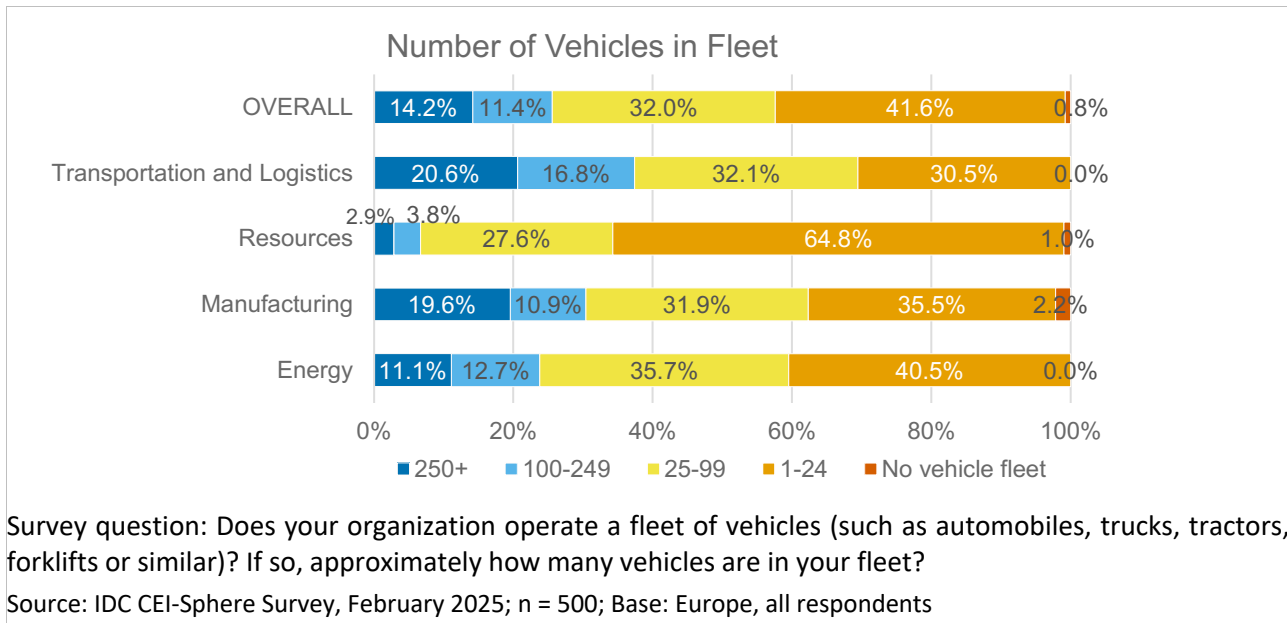


Figure 40 Size of Vehicle Fleets

Figure 41 illustrates the current level of electrification across vehicle fleets. At present, most organizations report that electric vehicles make up only a small share of their total fleet, with many fleets having little or no electrification today.

These results indicate that, while fleet electrification is underway, it is still at an early stage for most organizations, suggesting that operational practices, infrastructure, and supporting digital solutions are still evolving.

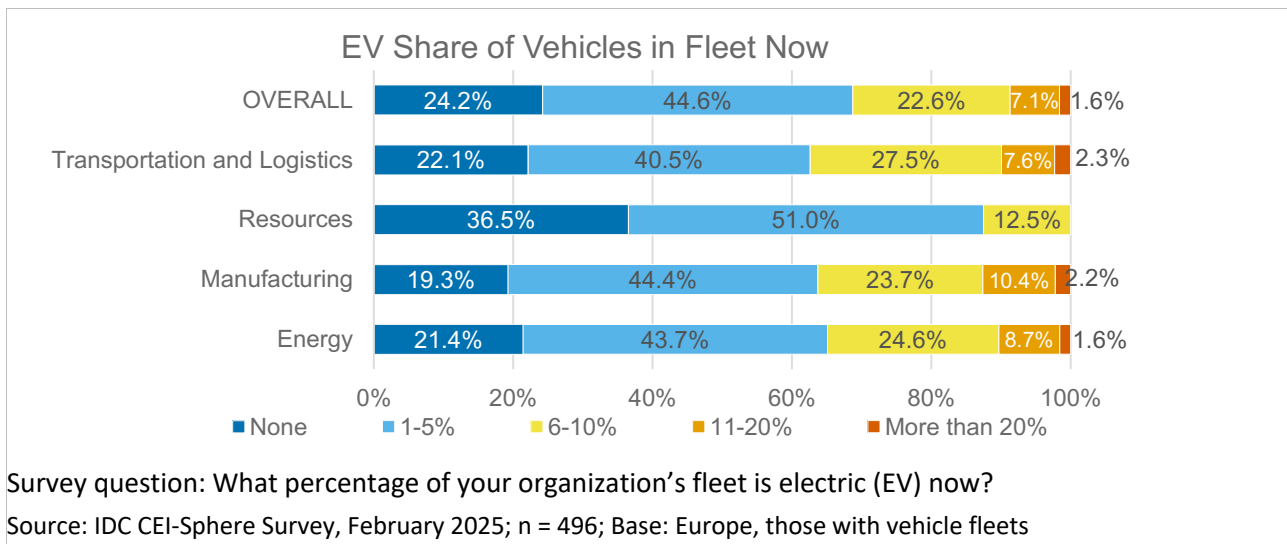


Figure 41 Electrification of Vehicle Fleet (EVs) Now

Looking ahead, respondents expect a significant increase in fleet electrification over the next 24 months (see Figure 42). Many organizations anticipate that EVs will represent a materially larger share of their fleets compared with today, indicating accelerated adoption plans.

This expected growth suggests that fleet electrification is moving from pilot-scale deployments toward broader rollouts, with implications for charging infrastructure, energy management, and the integration of mobility data into wider CEI systems.

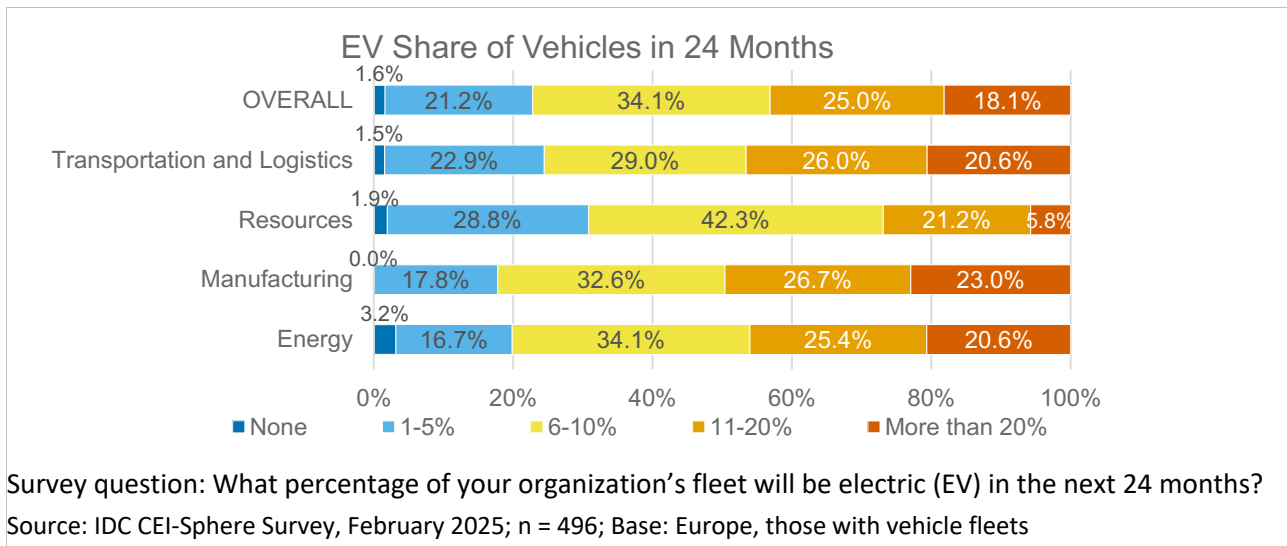


Figure 42 Electrification of Vehicle Fleet (EVs) in 24 Months

Figure 43 examines organizational interest in participating in Vehicle-to-Grid (V2G) programs, where electric vehicles can supply energy back to the grid in exchange for compensation. Among organizations with vehicle fleets, interest in V2G is mixed, with a sizeable share expressing neutrality or uncertainty, while others indicate a willingness to participate under the right conditions.

This distribution suggests that, although V2G is recognized as a potentially valuable use case, many organizations are still assessing its business case, operational implications, and technical readiness.

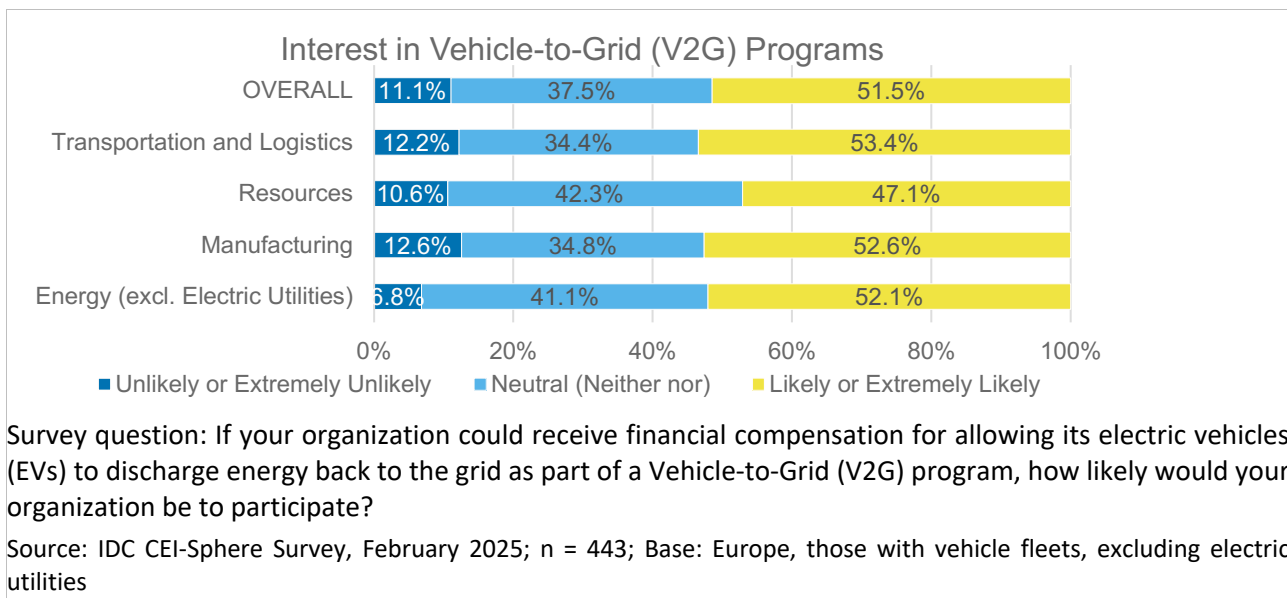


Figure 43 Interest in Vehicle-to-Grid (V2G) Programs

6.3 Electric Utilities

Electric utilities play a central role in the evolution of CEI solutions, and they are a key focus of many of the large-scale pilot projects supported by the CEI-Sphere initiative. Utilities are facing growing operational complexity as they integrate distributed energy resources, support renewable generation, manage increasing electrification of transport, and enable new forms of energy flexibility. Addressing these challenges requires CEI solutions that can operate reliably across highly distributed infrastructures, support real-time coordination, and meet stringent requirements for security, resilience, and regulatory compliance. To better understand how utilities are approaching these challenges, the survey examined their current and planned use of CEI solutions for flexibility services, managed charging, and Vehicle-to-Grid (V2G) applications.

Figure 44 shows the extent to which electric utilities currently offer, or plan to offer, energy flexibility programs for prosumers, such as demand response, dynamic tariffs, or participation in virtual power plants. A meaningful share of utilities already offer such programs, while many others indicate plans to introduce them within the next 12 to 24 months.

This pattern suggests that flexibility services are moving beyond pilot initiatives and becoming a more mainstream component of utility strategies, supported by CEI solutions that enable real-time monitoring, control, and coordination of distributed assets.

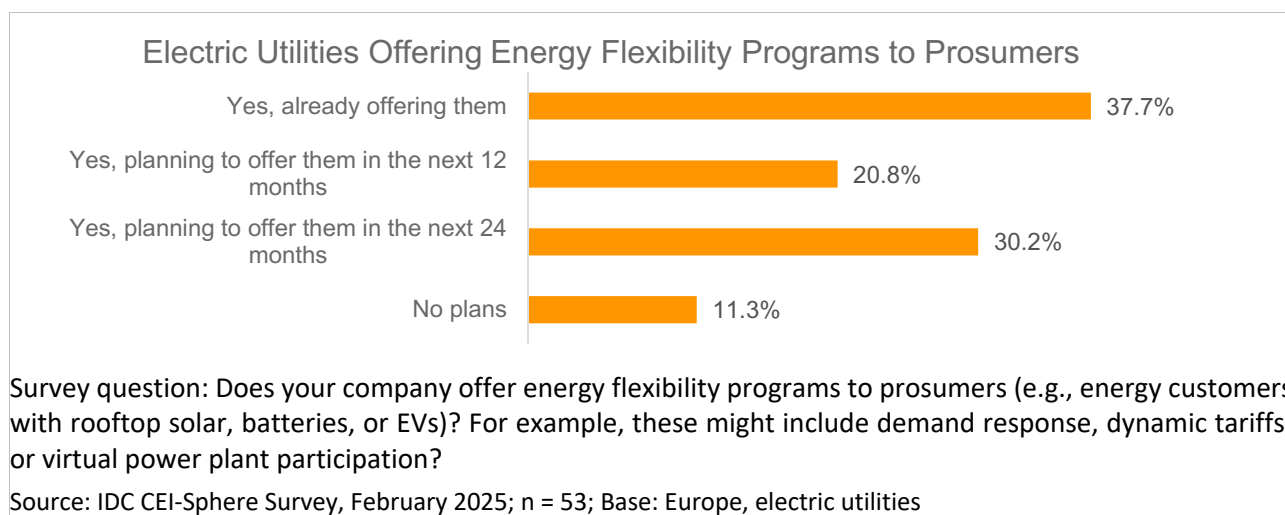


Figure 44 Electric Utilities Offering Energy Flexibility Programs

Figure 45 explores how electric utilities encourage, or plan to encourage, participation in energy flexibility programs. Financial incentives and dynamic pricing are the most commonly cited approaches, reflecting their direct impact on customer behaviour.

Utilities also report using customer engagement tools, education and awareness campaigns, and simplified enrolment processes, highlighting the importance of user participation and behavioural change alongside technical enablement.

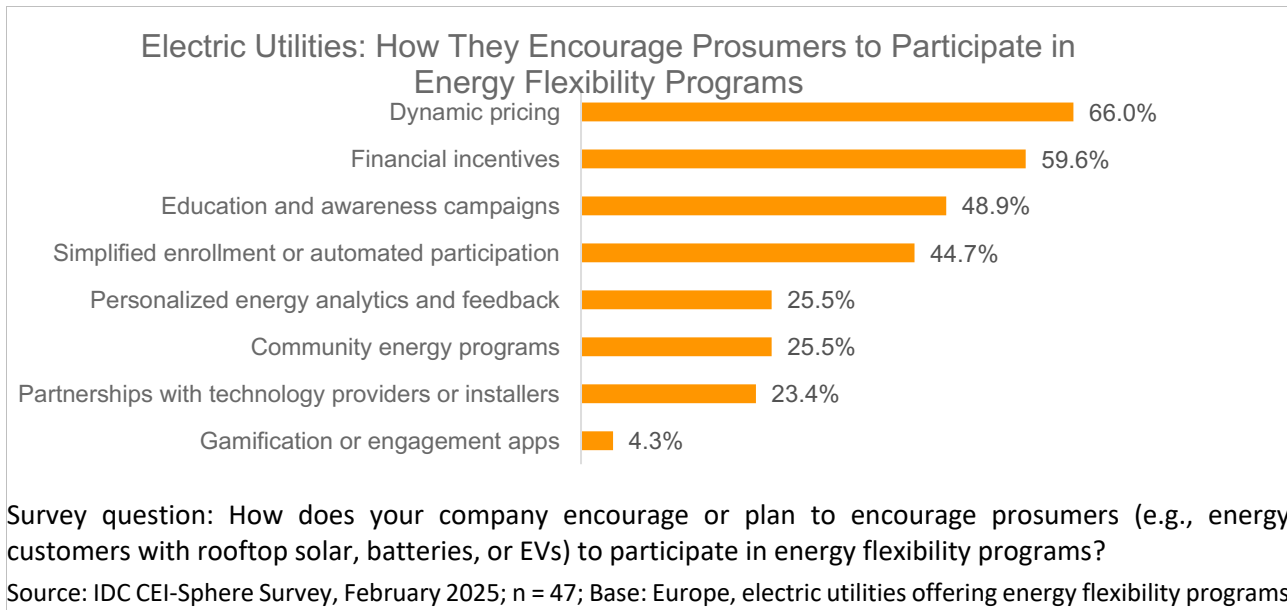


Figure 45 Electric Utilities Encouraging Participation in Energy Flexibility Programs

Figure 46 focuses on utility incentives related specifically to managed EV charging. While some utilities already offer discounts or incentives to customers who allow charging schedules to be managed for grid optimization, a larger share report plans to introduce such programs in the near term.

This indicates growing recognition of EV charging as both a grid challenge and an opportunity, particularly as fleet and consumer EV adoption accelerates.

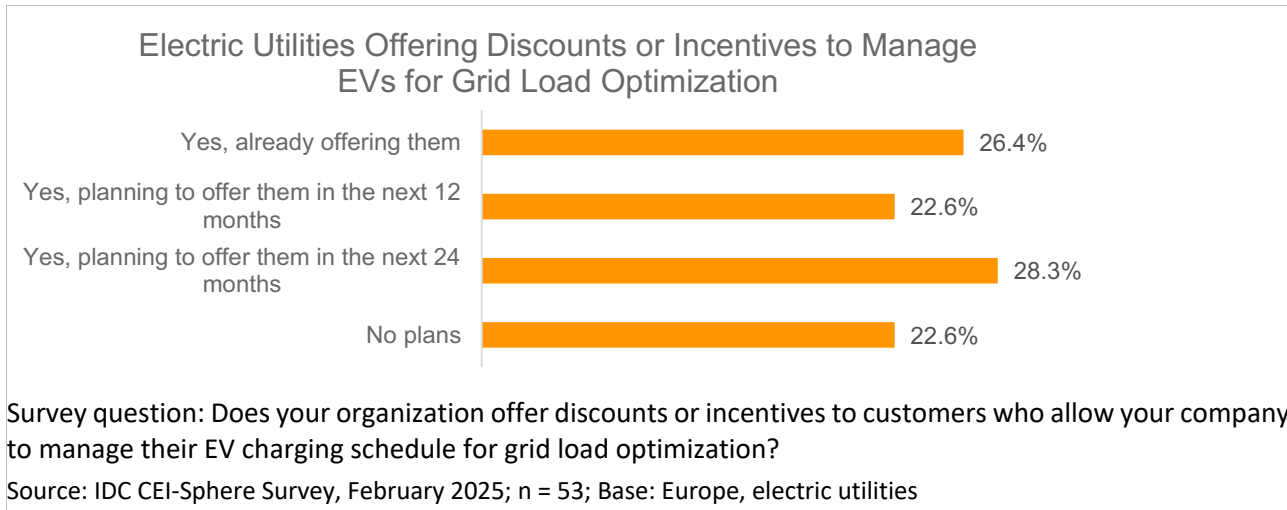
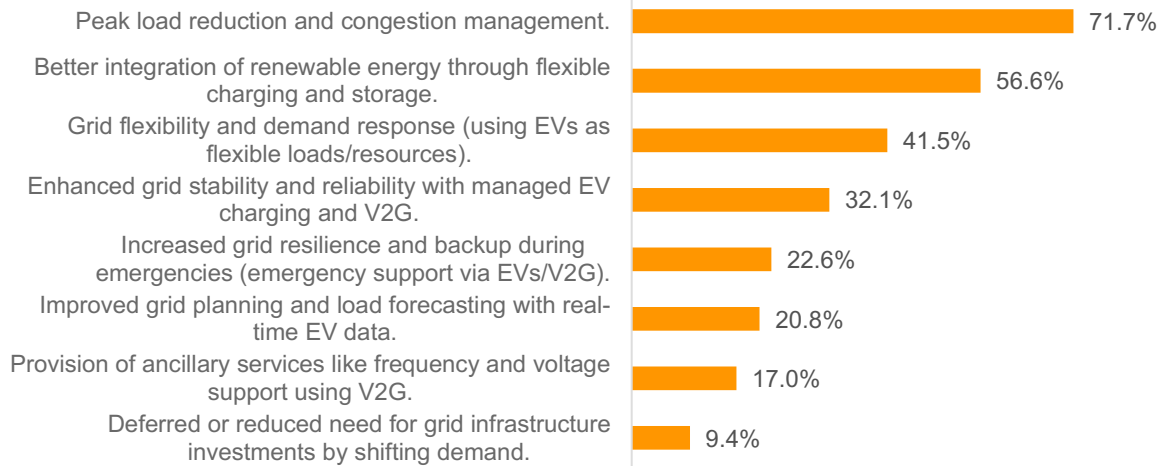


Figure 46 Electric Utilities Offering Discounts for EV Management

Figure 47 highlights the benefits electric utilities associate most strongly with V2G services. Respondents most frequently cite grid flexibility, peak load reduction, and improved integration of renewable energy as key advantages.

Additional benefits include enhanced grid stability, deferred infrastructure investments, and improved grid planning through real-time data. These responses indicate that utilities see V2G not only as a customer-facing service, but as a strategic tool for managing increasingly complex and distributed energy systems.

Electric Utilities: Top Benefits of V2G



Survey question: Which benefits of V2G are most important for your organization?

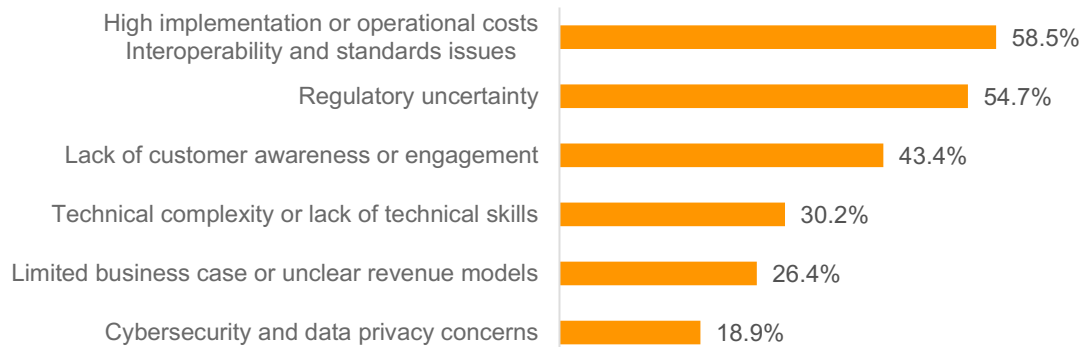
Source: IDC CEI-Sphere Survey, February 2025; n = 53; Base: Europe, electric utilities

Figure 47 Electric Utilities: Top Benefits of V2G

Despite clear interest in V2G, utilities identify several barriers to scaling these services beyond pilot projects (see Figure 48). The most commonly cited challenges include regulatory uncertainty, technical complexity, and unclear business models or revenue streams.

Concerns around cybersecurity, data privacy, and interoperability and standards are also prominent. These barriers help explain why V2G remains largely at the pilot stage today, despite its perceived benefits and long-term potential.

Electric Utilities: Main Barriers to Scaling V2G Beyond Pilot Projects



Survey question: What are the main barriers to scaling V2G services in your organization beyond pilot projects?

Source: IDC CEI-Sphere Survey, February 2025; n = 53; Base: Europe, electric utilities

Figure 48 Electric Utilities: Barriers to Scaling V2G Beyond Pilots

6.4 Operational View Conclusions

The Operational View demonstrates that CEI solutions are already being applied across several critical operational domains, particularly in energy management, mobility and fleet operations, and electric utility services. In these areas, CEI enables real-time monitoring, optimization, and coordination across distributed assets, supporting objectives such as efficiency improvement, resilience, decarbonization, and flexibility. These domains are also central to many of the CEI-Sphere large-scale pilots, underscoring the strong alignment between pilot activities and real operational needs in the market.

At the same time, the survey results show that many operational CEI use cases are still in a transitional phase. While foundational applications such as monitoring, control, and basic optimization are already in use, more advanced capabilities, such as large-scale flexibility services, V2G integration, and AI-driven automation, remain at an earlier stage of adoption. Scaling these use cases will depend on overcoming persistent technical and organizational challenges, particularly around orchestration, integration, reliability, and governance. Overall, the findings suggest that CEI is moving steadily from pilot environments toward operational deployment, but that sustained progress will require solutions that are robust, interoperable, and designed for real-world operational complexity.

7. Market Readiness: Procurement and Governance

As CEI initiatives progress from pilots toward scaled deployment, market readiness becomes a critical consideration. Organizations must be able to procure CEI solutions with confidence, assess vendors consistently, and ensure that governance, sovereignty, and supply-chain risks are adequately addressed.

This section examines how enterprises evaluate CEI vendors in practice and how concerns related to data sovereignty, technical control, and supply-chain risk influence deployment decisions. Together, these factors provide insight into the conditions under which CEI solutions are most likely to move beyond pilots and achieve broader market adoption.

7.1 Procurement and Vendor Selection

Figure 49 shows the criteria organizations consider most important when evaluating CEI solution vendors. Respondents most frequently emphasize integration with existing IT and OT systems, security and compliance readiness, and support for open standards and interoperability.

Additional criteria such as scalability and performance, vendor reputation and trust, and support and service-level agreements are also widely cited. Cost and pricing flexibility remain important, but they tend to rank alongside, rather than above, technical and operational considerations. Overall, these results suggest that CEI procurement decisions are driven primarily by risk reduction and long-term operability rather than by upfront cost alone.

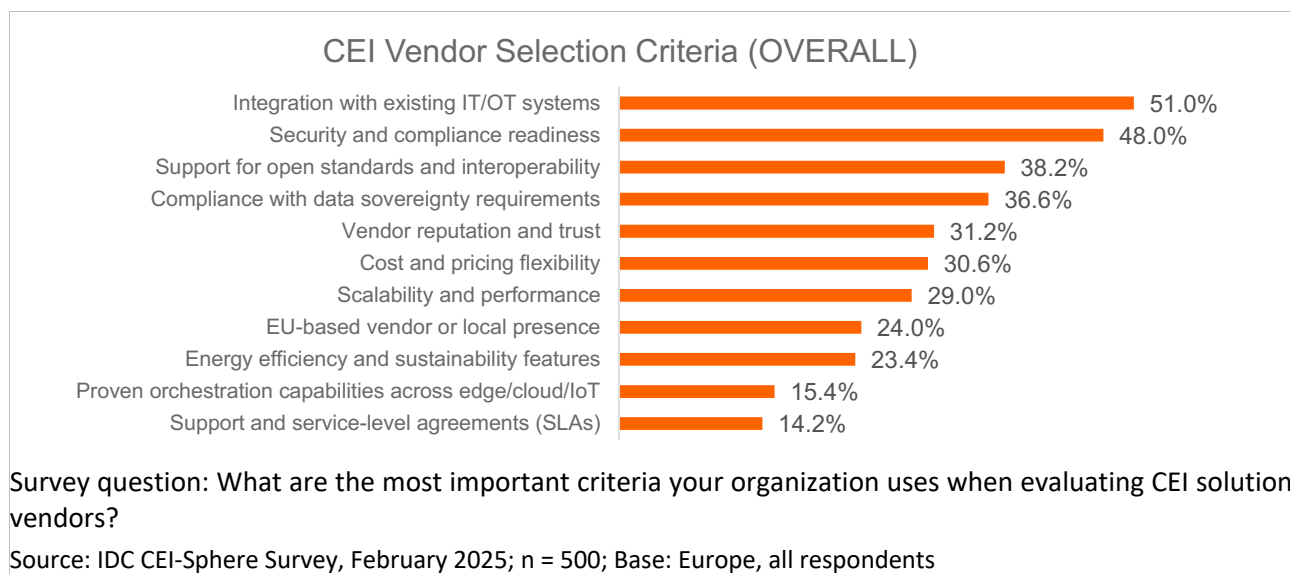


Figure 49 CEI Vendor Selection Criteria - Overall

Among energy-sector respondents, vendor selection criteria closely mirror the overall market but with heightened emphasis on security, reliability, and integration with existing systems (see Figure 50). Support for open standards and data sovereignty requirements also ranks particularly high in this sector.

These priorities reflect the critical nature of energy infrastructure and the regulatory and operational constraints under which energy organizations operate, reinforcing the need for robust, interoperable CEI solutions.

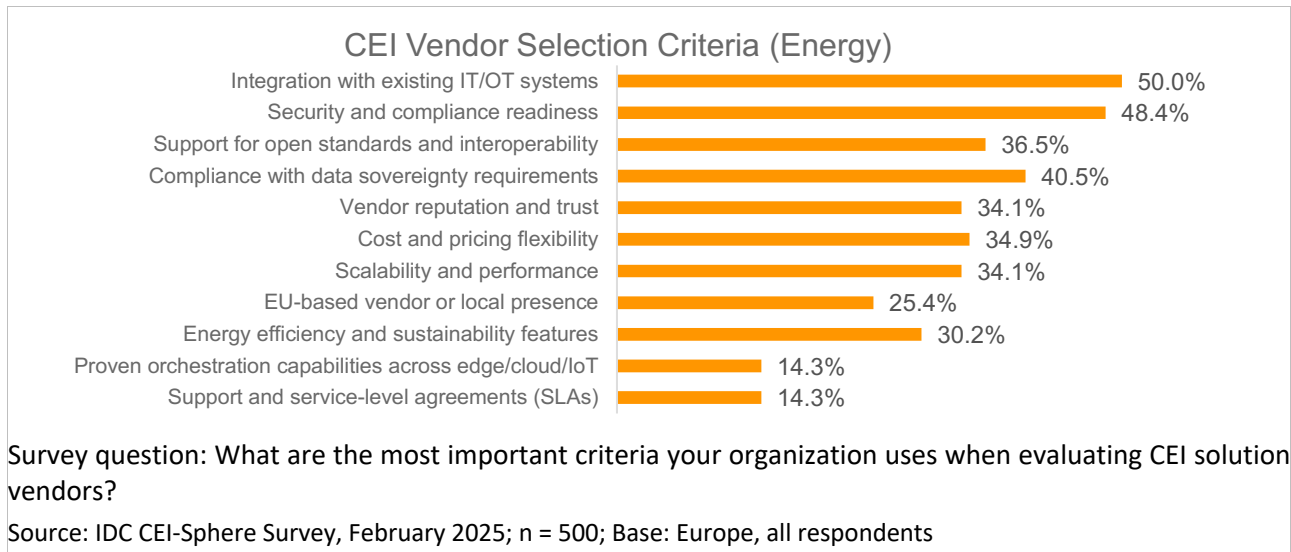


Figure 50 CEI Vendor Selection Criteria – Energy

Manufacturing organizations also prioritize integration, security, and scalability when selecting CEI vendors (see Figure 51). In addition, manufacturing respondents place strong emphasis on performance, low latency, and support for automation-oriented use cases, reflecting the real-time demands of production environments.

While cost remains a consideration, the results indicate that manufacturers are primarily focused on selecting CEI solutions that can be reliably integrated into complex operational settings and scaled across multiple sites.

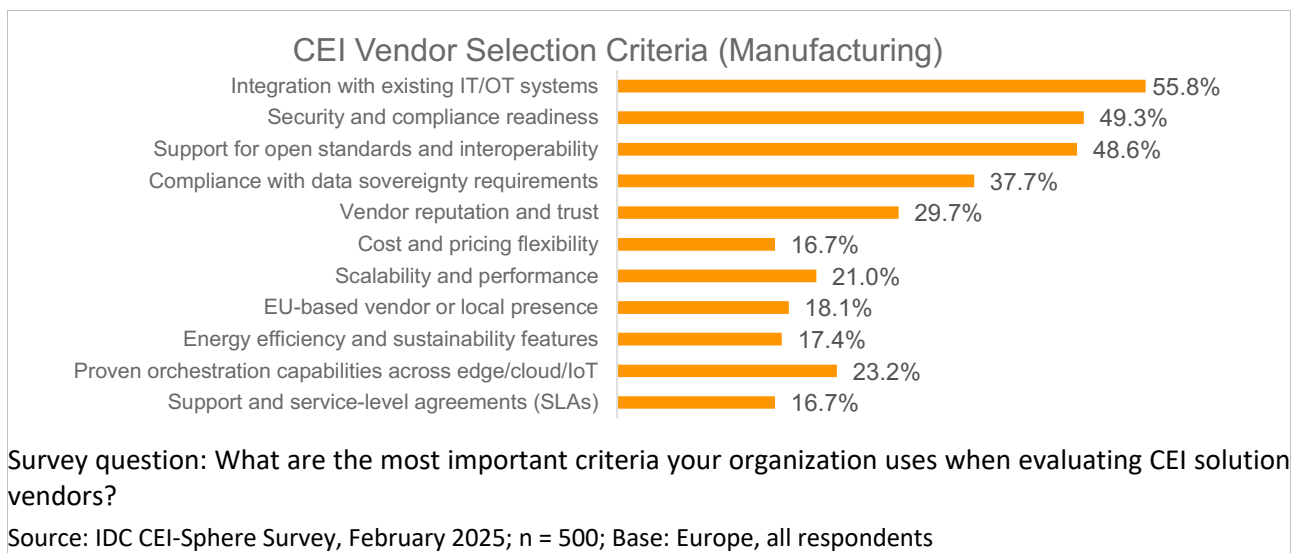


Figure 51 CEI Vendor Selection Criteria – Manufacturing

For organizations in the resources sector, vendor selection priorities largely mirror those seen across the overall sample (see Figure 52). Integration with existing systems, security and compliance, and reliability remain the most important criteria.

Compared with some other industries, resources companies place relatively less emphasis on advanced orchestration or automation capabilities, reflecting the more gradual pace of CEI adoption in this sector. However, baseline requirements around robustness, security, and long-term operability remain central.

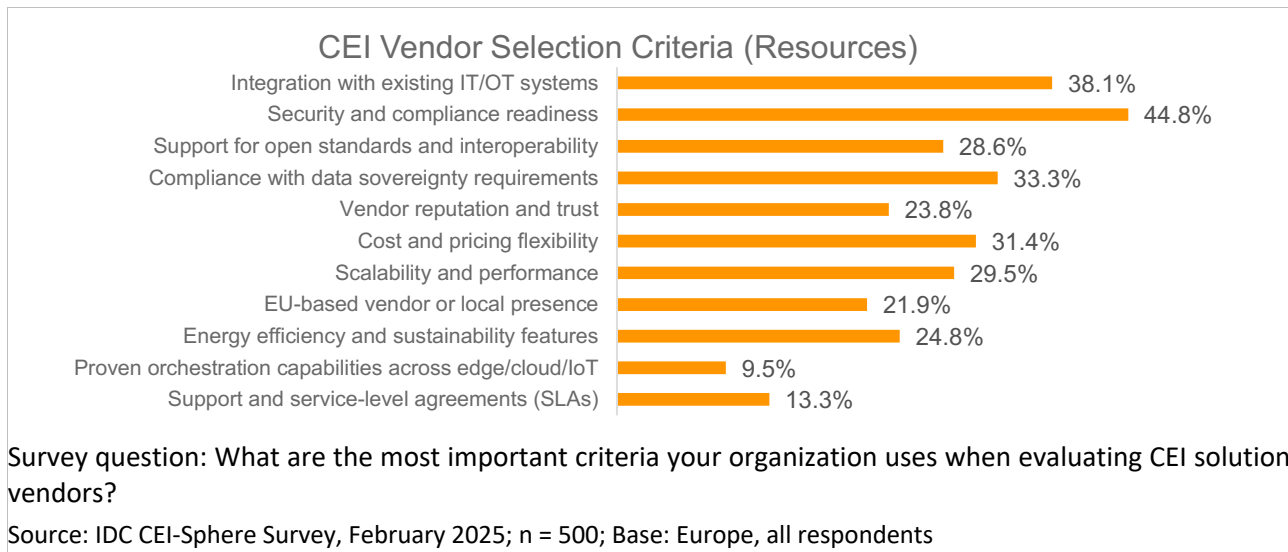


Figure 52 CEI Vendor Selection Criteria – Resources

In transport and logistics, vendor selection criteria again align closely with the overall results, with strong emphasis on integration, security, and scalability (see Figure 53). Compared with other industries, transport and logistics organizations tend to place relatively greater importance on cost and pricing flexibility, reflecting competitive pressures and thinner operating margins.

At the same time, performance and reliability remain critical, given the operational impact of downtime and service disruption in fleet- and logistics-driven environments.

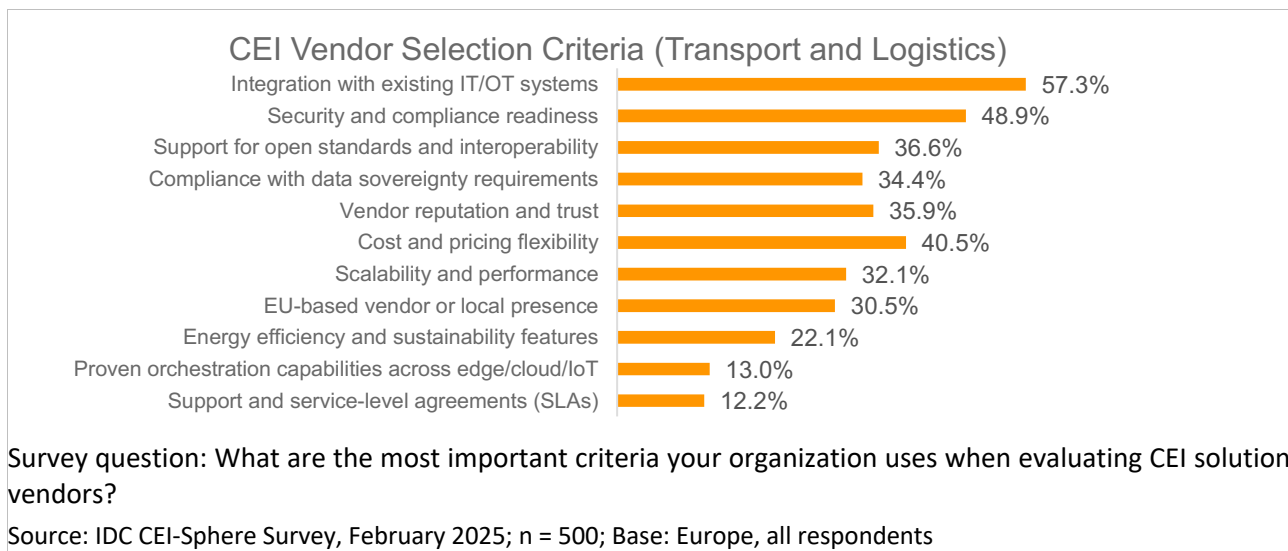


Figure 53 CEI Vendor Selection Criteria – Transport and Logistics

Figure 54 highlights differences across industries for one of the most consistently important selection criteria: integration with existing IT and OT systems. While integration is a top priority across all sectors, the emphasis is particularly strong in energy and manufacturing, where CEI solutions must operate within complex, mission-critical operational environments.

This contrast helps explain why integration challenges recur throughout the survey results and why platform-level interoperability remains a central concern for CEI adoption.

Integration with Existing IT/OT Systems (CEI Vendor Selection Criteria)



Survey question: What are the most important criteria your organization uses when evaluating CEI solution vendors?

Source: IDC CEI-Sphere Survey, February 2025; n = 500; Base: Europe, all respondents

Figure 54 CEI Vendor Selection Criteria – Integration Response

Figures 55–57 provide additional vertical comparisons for specific selection criteria. While some differences are visible by industry, the overall patterns are consistent with the results shown above, reinforcing the conclusion that CEI procurement priorities are broadly shared across sectors, with variations mainly in emphasis rather than direction.

Support for Open Standards and Interoperability (CEI Vendor Selection Criteria)



Survey question: What are the most important criteria your organization uses when evaluating CEI solution vendors?

Source: IDC CEI-Sphere Survey, February 2025; n = 500; Base: Europe, all respondents

Figure 55 CEI Vendor Selection Criteria – Open Standards Response

Vendor Reputation and Trust (CEI Vendor Selection Criteria)



Survey question: What are the most important criteria your organization uses when evaluating CEI solution vendors?

Source: IDC CEI-Sphere Survey, February 2025; n = 500; Base: Europe, all respondents

Figure 56 CEI Vendor Selection Criteria – Vendor Reputation Response

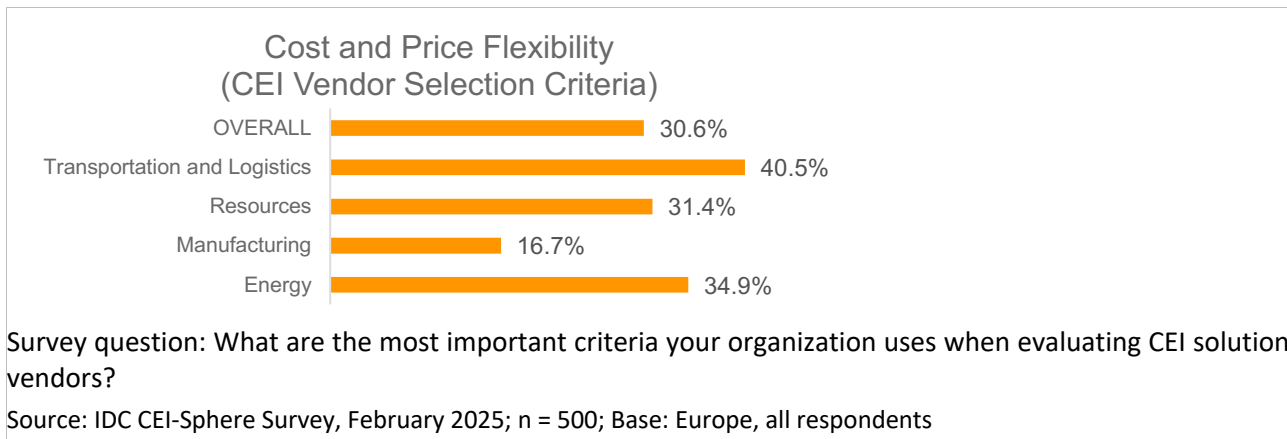


Figure 57 CEI Vendor Selection Criteria – Cost/Price Flexibility Response

7.2 Governance and Sovereignty

As CEI solutions become more distributed, interconnected, and critical to core operations, governance and sovereignty considerations play an increasingly important role in deployment and procurement decisions. Organizations must address where data is stored and processed, how platforms and suppliers are governed, and how supply-chain risks are managed across complex, multi-vendor environments. These issues are particularly salient in Europe, where regulatory requirements, data-sovereignty concerns, and strategic autonomy objectives shape technology choices. To explore how enterprises are approaching these questions in practice, the survey examined requirements related to data location, technical sovereignty, and technology supply-chain risk.

Figure 58 shows whether organizations have specific requirements or preferences regarding the location of data used in CEI-related projects. A clear majority of respondents indicate that they do have such requirements, most commonly specifying that data must remain within the EU, within trusted jurisdictions, or on premises.

Only a minority report having no specific data-location requirements. This highlights that data sovereignty is not a niche concern, but a mainstream consideration shaping how CEI solutions are designed, deployed, and selected.

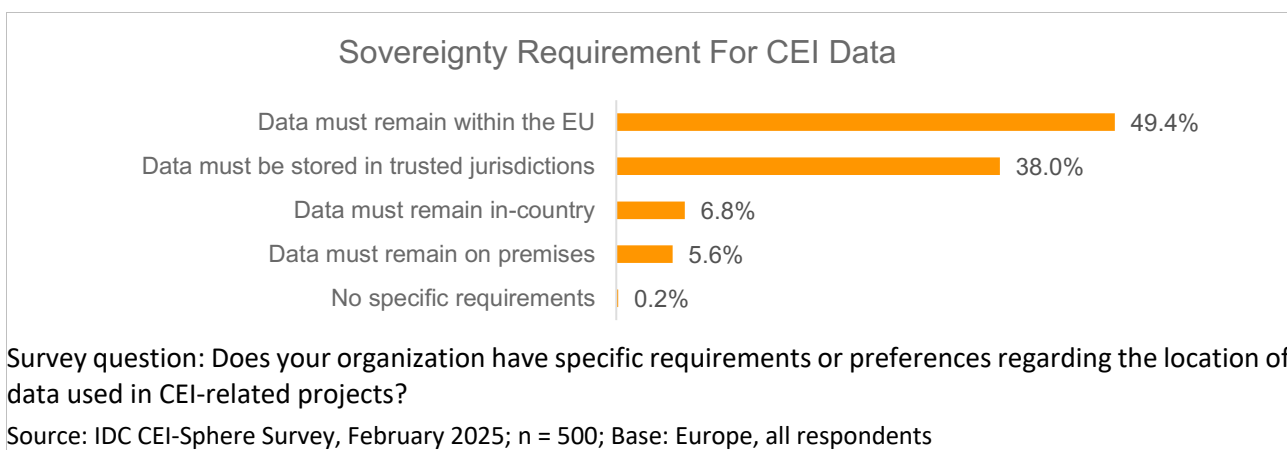


Figure 58 Sovereignty Requirements for CEI Data

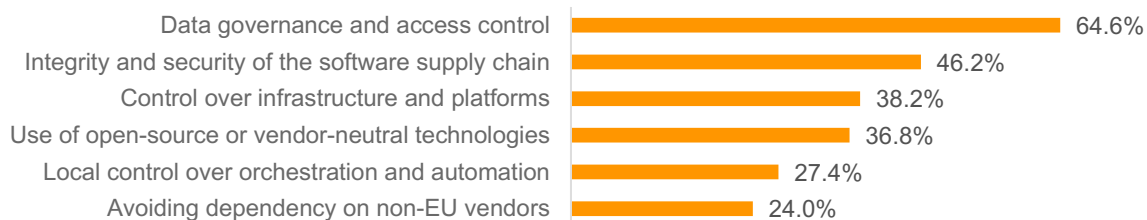
Figure 59 examines which aspects of technical sovereignty are most important for organizations' CEI strategies. Respondents most frequently emphasize control over infrastructure and platforms, data governance and access control, and avoiding dependency on non-EU vendors.

Use of open-source or vendor-neutral technologies and local control over orchestration and automation are also cited by a substantial share of respondents. Together, these results indicate that sovereignty concerns extend beyond data location to include broader questions of control, dependency, and long-term resilience of CEI solutions.

Governance and sovereignty considerations are central to CEI deployment decisions across European enterprises. Most organizations report explicit requirements regarding data location, control over infrastructure and platforms, and avoidance of excessive dependency on non-EU vendors. These concerns extend beyond compliance, reflecting a broader focus on long-term resilience, transparency, and supply-chain risk management.

Supply-chain risks related to hardware provenance, vendor accountability, and geopolitical disruption are widely recognized across industries, reinforcing the need for clearer governance frameworks and trusted solutions. Overall, the findings indicate that governance and sovereignty are not peripheral constraints, but foundational requirements that must be addressed alongside technical and operational considerations in CEI initiatives.

Most Important Aspects of Technical Sovereignty for CEI Strategy



Survey question: Is your organization currently using or planning to use the following technologies in the next 24 months?

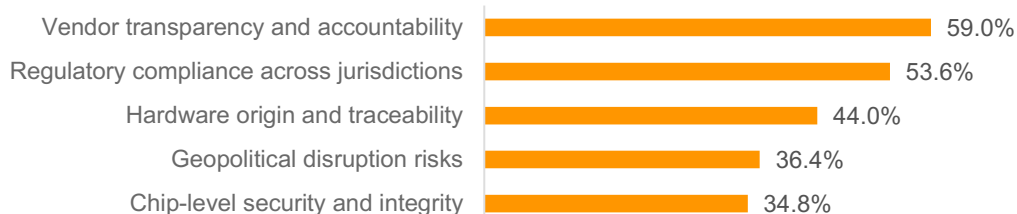
Source: IDC CEI-Sphere Survey, February 2025; n = 500; Base: Europe, all respondents

Figure 59 Importance of Technical Sovereignty for CEI Strategy

Figure 60 highlights the technology supply-chain risks respondents consider most relevant for CEI deployments. Commonly cited concerns include vendor transparency and accountability, hardware origin and traceability, and regulatory compliance across jurisdictions.

Geopolitical disruption risks and software supply-chain integrity are also mentioned by a significant share of respondents. These concerns reflect growing awareness of the dependencies embedded in CEI infrastructures and the potential operational impact of supply-chain disruptions.

Supply Chain Risks Most Relevant to CEI Deployments



Survey question: Which technology supply chain risks are most relevant to your organization's CEI deployments? [Select all that apply]

Source: IDC CEI-Sphere Survey, February 2025; n = 500; Base: Europe, all respondents

Figure 60 Supply Chain Risks Most Relevant to CEI - Overall

Looking at supply-chain risks by industry, the overall pattern remains consistent across sectors (see Figure 61). Energy and manufacturing organizations tend to place greater emphasis on hardware integrity, regulatory compliance, and operational resilience, reflecting the critical nature of their infrastructures.

Other industries show similar concerns, albeit with slightly different emphasis. Overall, the similarities across industries outweigh the differences, underscoring that supply-chain risk is a broadly shared governance challenge for CEI deployments.

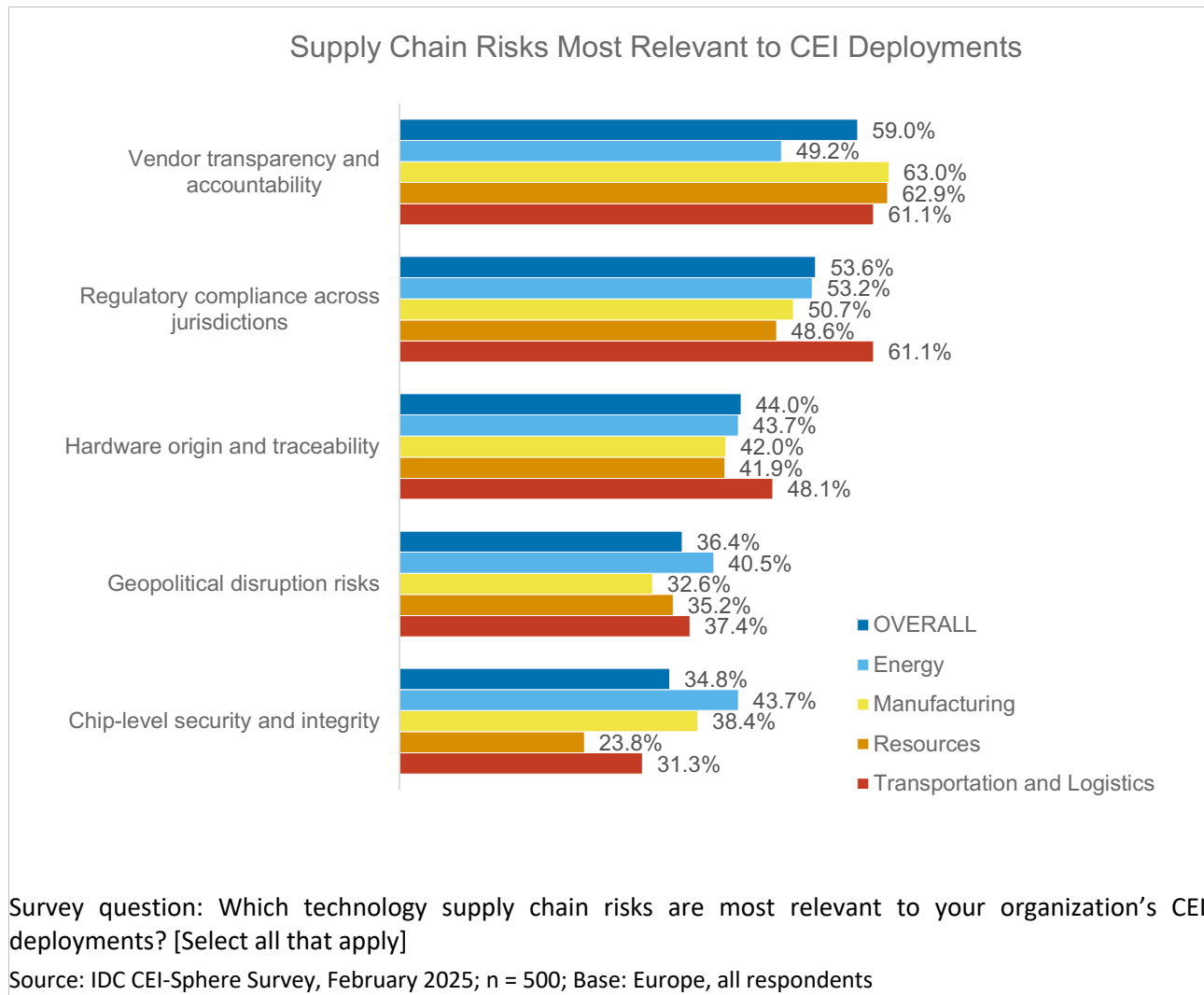


Figure 61 Supply Chain Risks Most Relevant to CEI – By Vertical

7.3 Market Readiness Conclusions

The Market Readiness section highlights that the ability to scale CEI solutions beyond pilots depends not only on technical feasibility, but also on procurement practices, governance frameworks, and confidence in vendors and platforms. Organizations evaluating CEI solutions place greatest emphasis on integration with existing systems, security and compliance, interoperability, and long-term reliability. These priorities reflect a focus on risk reduction and operational continuity, particularly as CEI solutions are deployed in mission-critical environments.

Governance and sovereignty considerations further shape market readiness. The majority of organizations report explicit requirements related to data location, control over infrastructure and platforms, and avoidance of excessive dependency on external suppliers. Concerns around supply-chain transparency, regulatory compliance, and geopolitical risk are widely shared across industries. Together, these findings indicate that market readiness for CEI is closely tied to trust, governance, and transparency. Addressing these dimensions, through clearer standards, trusted platforms, and well-defined assurance mechanisms, will be essential to enable broader adoption and commercialization of CEI solutions emerging from large-scale pilot projects.

8. Conclusion

This survey provides a comprehensive view of the current state of Cloud-Edge-IoT (CEI) adoption across European enterprises, highlighting both clear progress and persistent barriers to scale. The results show that while foundational technologies such as IoT and AI/ML are already widely adopted, the broader CEI stack remains uneven in maturity. In particular, edge computing, orchestration, and large-scale integration across distributed environments continue to lag behind enterprise ambitions, despite strong planned investment and clear recognition of their importance.

Across operational domains, CEI solutions are already delivering tangible value, especially in energy management, mobility and fleet operations, and electric utility services. These areas, central to many of the large-scale pilots supported by O-CEI and COP-PILOT, illustrate how CEI enables real-time monitoring, optimization, resilience, and flexibility in complex, mission-critical environments. At the same time, more advanced use cases such as large-scale flexibility services, Vehicle-to-Grid (V2G), and AI-driven automation are still emerging, underscoring the transitional nature of the market as it moves from pilots toward operational deployment.

The Technical View highlights that the main obstacles to CEI scale are no longer the availability of individual technologies, but the difficulty of deploying, orchestrating, and operating CEI solutions across heterogeneous infrastructures and organizational boundaries. Integration challenges, skills gaps, security concerns, and the need to manage hybrid and intermittently connected environments all contribute to friction between pilot success and production-grade deployment. These challenges consistently point to the enabling platform layer, rather than endpoints or applications, as the critical bottleneck in the CEI ecosystem.

Beyond deployment within individual organizations, the survey reveals that ecosystem-level coordination remains a decisive factor in CEI adoption. Participation in collaborative initiatives, standards development, and open-source projects is uneven, often constrained by limited resources, integration complexity, and unclear business value. At the same time, enterprises express strong demand for greater interoperability, clearer standards alignment, and trusted mechanisms to assess solution maturity and compatibility. The interest in a CEI trust label reflects a broader need for transparency, comparability, and confidence in a fragmented and rapidly evolving market.

Finally, the Market Readiness findings show that procurement and governance considerations are central to the transition from pilots to commercial deployment. Organizations prioritize integration, security, interoperability, and long-term reliability when selecting CEI solutions, while data sovereignty, technical control, and supply-chain risk are widely recognized as foundational requirements rather than secondary constraints. These factors are particularly salient in the European context and play a key role in determining whether CEI solutions can be adopted at scale.

Taken together, the survey results confirm that the CEI market is at a critical inflection point. There is clear demand for CEI solutions and strong alignment between enterprise needs and the focus areas of the large-scale pilots. However, realizing this potential will depend on addressing platform-level challenges, strengthening ecosystem coordination, and building trust through standards, governance, and transparent assurance mechanisms. In this context, CEI-Sphere's role as a supporting action, linking pilot outcomes to real commercial needs, standardization efforts, and trust-building initiatives, is essential to enabling the transition from experimentation to sustainable market adoption.

As next step, the above-described market findings will be shared and confronted with selected industrial stakeholders of LSPs to identify existing gaps between the market and LSPs realities. Results of this gap analysis will be documented in the final report, D2.3 (Gap Analysis, GTM guidelines and recommendations) due at the end of the project (M30).

9. Final Remarks

The findings of this survey underline both the progress made and the work still required to realize the full potential of Cloud-Edge-IoT (CEI) solutions in Europe. Enterprises across industries are clearly committed to CEI adoption, with strong investment intent and growing deployment across strategic, technical, and operational dimensions. At the same time, persistent challenges around deployment complexity, ecosystem fragmentation, governance, and trust continue to shape the pace and direction of adoption.

In this context, the role of large-scale pilots is especially important. The pilots developed within O-CEI and COP-PILOT are operating at the frontier of CEI deployment, addressing real operational requirements in areas such as energy management, mobility, grid flexibility, and distributed automation. As the survey results demonstrate, these domains are closely aligned with genuine market needs, but they also expose the technical, organizational, and governance barriers that must be addressed for CEI solutions to scale beyond pilot environments.

CEI-Sphere's role as a supporting action is therefore not only to observe these developments, but to help translate pilot experience into broader market impact. By connecting enterprise demand with pilot outcomes, standards activities, and trust-building initiatives, CEI-Sphere can help ensure that lessons learned from large-scale pilots contribute to reusable platforms, interoperable solutions, and clearer pathways to commercialization. This includes supporting the development of common frameworks, encouraging ecosystem collaboration, and contributing to the design of voluntary trust mechanisms that address enterprise concerns around interoperability, security, and sovereignty.

Looking ahead, the transition from pilot projects to sustainable market adoption will depend on continued coordination between technology providers, enterprises, standards bodies, and policymakers. Addressing platform-level bottlenecks, strengthening trust across ecosystems, and aligning technical innovation with governance and procurement realities will be essential. The insights presented in this report are intended to support that process, providing evidence-based guidance to stakeholders working to advance a competitive, interoperable, and trustworthy European CEI ecosystem.

Appendix: Survey Sample Profile

The survey sample structure is shown in the following tables.

Country	n	%
Belgium	18	3.6%
Denmark	23	4.6%
Finland	22	4.4%
France	90	18.0%
Germany	90	18.0%
Italy	90	18.0%
Netherlands	52	10.4%
Spain	90	18.0%
Sweden	25	5.0%
Total	500	100%

Figure 62 Survey Sample by Country

Company Size	n	%
50–299 Employees	140	28.0%
250–999 Employees	175	35.0%
1000 + Employees	185	37.0%
Total	500	100%

Figure 63 Survey Sample by Business Size

Industry Sector	n	%
Energy	126	25.2%
Manufacturing	138	27.6%
Resources	105	21.0%
Transportation and Logistics	131	26.2%
Total	500	100%

Figure 64 Survey Sample by Vertical