McKinsey & Company

GLOBAL INFRASTRUCTURE INITIATIVE

Accelerating future-ready infrastructure: The best ideas from the 9th GII Summit

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Table of contents

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Executive summary	3
Shaping the energy transition	5
Infratech and and project delivery	8
Talent, workforce, and supply chains	11
Investing in infrastructure's energy transition	14
Participant list	16

Executive summary

At the 9th Global Infrastructure Initiative (GII) Summit, held February 27–29, 2024 in Dubai, global infrastructure executives convened to address the world's most pressing global infrastructure challenges. This year's summit focused on accelerating progress on future-ready infrastructure.

Infrastructure and energy leaders are at a pivotal juncture as they translate imperative sustainability needs into action. This mission is critical to achieving both global economic prosperity and sustainability objectives, and core to its success is a radical acceleration of project delivery.

Recognizing that collaboration and innovation are vital to shaping the future of infrastructure, leaders at the summit shared strategies for advancing progress across four pillars: shaping the energy transition; infratech and project delivery disruption; supply chain, talent, and workforce; and net-zero infrastructure investing.

Captured here is a synthesis of key ideas surfaced by participants at the GII Summit, meant to guide infrastructure leaders through the complex terrain of accelerated infrastructure development as they implement and scale effective solutions.

By the numbers:



site visits to explore how infrastructure is planned, financed, delivered, and operated at some of Dubai's leading organizations

Shaping the energy transition

The global price of carbon must increase to accelerate the pace of change for major emitters.

Reducing the carbon intensity of infrastructure must be a priority.

Innovative materials and construction methods can improve the efficiency, durability, and environmental sustainability of infrastructure projects.

Repeatability in design and construction are essential to quickly build green megaprojects.

2024 GII Summit The best ideas

Talent, workforce, and supply chain

Processing resources closer to the source will help remove carbon from the supply chain and leverage labor availability in emerging markets.

Gender diversity in employment could be a fruitful source for new talent; as such, companies can incorporate diversity and inclusion requirements into bid and tender contracts.

Ambitious leadership will be required for the bigger transformation.

Project owners, contractors, and parties trying to solve labor certainty all benefit from multiyear, multiproject frameworks that provide long-term stability of workforce employment.

Infratech and project delivery

Accelerating the deployment of generative AI will shorten turnaround times for design and optionality, thus cutting time and costs.

A clear taxonomy and global standard on digital twins by functionality and data scope will be essential to harness this technology for construction.

Digital technologies will help optimize infrastructure performance and enable predictive maintenance.

Digital tools and data in real estate will allow for better planning of green projects and monitoring of emissions.

Implementing smart-city initiatives, including smart grids and intelligent transportation systems, will help enhance urban infrastructure.

> The industry must develop a deep understanding of emerging technologies to adequately leverage them.

Investing in infrastructure's energy transition

Next-generation partnerships are critical to close the investment gap needed for infrastructure to create more win–win opportunities and mitigate rapidly evolving risks.

Collaborations between governments and private entities will help finance and implement infrastructure projects.

Better innovation across the board—with technology, partnerships, funding, supply chains, and regulations—will help the industry move forward.

Government-to-government supply chain management and cooperation will help expedite green infrastructure projects.

Politics and businesses should align on explaining the cost-benefit relationship to consumers and citizens.

Pillar 1: Shaping the energy transition



Emissions are on the rise even as trillions of dollars are spent on green infrastructure, demonstrating the importance of keeping sustainability at the center of every effort. The built environment is responsible for creating about 25 percent of total global greenhouse gas (GHG) emissions' and causing nearly 30 percent of biodiversity loss.² As such, the sector has ample opportunity to reduce its net-zero emissions, and to do so, it must overcome the challenges preventing progress. At the summit, there was broad consensus that the industry needs to move much faster in tackling these opportunities and challenges and that advancing the energy transition in an economically viable way is key to ensuring stability and growth in the long term.

Participants sought to answer these key questions:

- How can the transition to renewable energy be accelerated?
- How can the construction process be decarbonized further?
- How can the industry scale up the physical assets needed to support hydrogen and electrification?

¹Building value by decarbonizing the built environment, McKinsey, June 12, 2023.

² Ho Ning Li, Song Lin, and Tai Wa Lo, "Accelerating action for biodiversity: what the built environment sector needs to do," GRESB, November 2, 2021.

The following key themes emerged:

- 1. *Reaching net zero is a "planned glide path," not a switch.* Participants highlighted the nonlinear nature of decarbonization and future-proofing assets. Small steps count, even in day-to-day operations; the industry cannot wait to stack hands for a centralized plan for decarbonization. Several participants highlighted an interest in biofuels as well as new technology that enhances safety and reduces costs and space constraints for nuclear energy.
- 2. *Replicability is essential.* Sufficiently accelerating renewable energy and green megaprojects to achieve sustainability targets hinges on replicating assets: stabilizing one design and then scaling it in a "plant as a product" approach. Participants discussed the idea of a hydrogen plant that comes out of the factory prefabricated, in a single size, shippable, and able to be assembled on-site in six months or less. This type of plant could reduce on-site engineering, procurement, and construction (EPC) costs, increase quality, and allow for modular scale-up. Similarly, participants discussed the potential value of a "project development and construction engine" that builds hundreds of projects rather than one project at a time. At the same time, it could support related processes, performance culture, tools, and talent needs.
- 3. *Ambitious innovation is needed to lower construction's carbon footprint.* While there is a great need for new green infrastructure assets, it is equally crucial to ensure that these projects are constructed and operated with minimal emissions. Net-zero construction commitments have accelerated considerably in recent years, and the industry has demonstrated a stronger understanding of risk, which has yielded more-profitable paths to decarbonization at scale. Substantial investment in the supply chain will also be needed to achieve these commitments, requiring changes to procurement frameworks and a focus on decarbonizing practices for critical materials, such as cement and steel, in a cost-effective way.



4. Commercial viability is critical. Throughout the summit, there was consistent debate about how to secure commercial viability, manage supply and demand, and retain investor confidence in green infrastructure sectors. In hydrogen, for example, breakout participants expected the green hydrogen premium over gray hydrogen to widen substantially over time, but they also agreed that forecasting hydrogen remains challenging because that premium has not yet been realized. Some pointed to the offshore wind industry as an example of mismatched risk and return, saying that more robust industry shaping is needed from the outset, including frameworks, incentives to adopt, and penalties for failure to move. Participants also discussed the need to establish carbon prices at a global level, with consideration to externalities, to help level the playing field.



Pillar 2: Infratech and project delivery disruption

A fast-growing infrastructure tech and start-up ecosystem is enabling more-efficient planning, delivery, and end-to-end asset management. At the same time, digital technologies and new industrialized approaches are altering traditional value pools, with new business models and revenue streams on the rise. At the summit, participants agreed that the rate of innovation is increasing and that infrastructure leaders will need to compress the time it takes for them to identify, pilot, and implement new technologies.

Participants sought to answer these key questions:

- What are the best strategies for construction firms and owner organizations to accelerate innovation?
- How can construction organizations adopt new technology successfully?
- How can value be created from digitalization?
- How can efficiencies be realized in project delivery to support acceleration?

The following key themes emerged:

 Clarify the definition and purpose of digital twins. Interest in digital twins, combined with rapidly advancing supportive technologies, is spurring market estimates for digital-twin investments of more than \$48 billion by 2026.³ In exploring how to harness this technology in construction, it became clear that there is no universal definition for a digital twin; the phrase has many disparate referents, which can create challenges with clarifying its applications and value. One prevailing definition stated that a digital twin has emulation, optimization, and simulation layers.

On one hand, participants cited common challenges with digital twins, such as data availability and governance failures, fragmented life cycles, and resistance to embracing change. On the other hand, common enablers of success include sharing data and having open conversations across the ecosystem, distributing the risk among commercial stakeholders, and combining historical data with live data for a more holistic picture. In general, participants coalesced around the notion of a digital twin that focuses on one or two specific applications, such as maintenance or traffic management, instead of a digital twin that aims to do it all.

2. Advance the adoption of new technology.

When it comes to improving the adoption of technology in the industry, participants pointed to learnings from other industries. For example, the automotive industry engages suppliers with the benefits of technology adoption, and in the aerospace industry, asset owners often provide highly prescriptive data standards. Across the construction value chain, leaders can seek to update traditional mindsets, processes, behaviors, and capabilities to usher in new ways of working. Visionary leadership and proof of reliability are essential. Clear guidance should come from the top-for instance, from appointed chief technology officers (CTOs) or chief information officers (CIOs), who can manage according to robust KPIs. Moreover, owners of capital projects can use collaborative contracting models to require-and provide incentives for-constructors to hit target productivity learning curves based on the application of new technologies, perhaps by offering companies multiyear, multiproject agreements.



3. Prioritize data validation over interoperability.

APIs and technology itself can create interoperability issues, GII Summit participants noted, but if the underlying data are invalid, so too is the output. One participant made the point that the interoperability challenge may be solved by the time of the next GII Summit: AI has become advanced enough to help process and structure data, whereas ensuring the integrity of data is likely to remain an area that leaders should prioritize. Good data validation will rely on a structure that meets an organization's specific needs, established by investments in data scientists and an open data model that supports access. Focusing on issues such as safety, on which stakeholders tend to be uniformly aligned, can help solidify support for a use case and overcome reluctance to share data.

³For more on digital twins, see Kimberly Borden and Anna Herlt, "Digital twins: What could they do for your business?," McKinsey, October 3, 2022; "What is digital-twin technology?," McKinsey, July 12, 2023.



- 4. Develop systems to support AI use. The expanding use of AI is squeezing an already insufficient supply of data centers. Major advancements in construction technology are needed to double data center capacity and address this shortage. Increasing the uptake of AI in infrastructure will require more-standardized data, an upskilled labor force, and functionality across the full ecosystem (not just the big EPCs). As one speaker put it, "People think innovation is easy, but no matter what the tech does, there needs to be process and human changes. Innovation is not an 'aha moment' but hours of application." AI will not replace engineers, participants agreed, but it can augment intelligence via simulations that inform decisions and enable communication.
- 5. The industry needs a more nuanced view of modularization's benefits. Taking a more manufacturing-focused or industrialized approach to project delivery can help compress timelines by 20 to 50 percent while reducing costs by up to 20 percent.⁴ But when it comes to adopting new approaches such as modular construction, the industry has an interface problem: all the components exist, but they don't fit together well. Adoption will increase only when modular's advantages are demonstrable and investors are clearly insisting on it. That is not the case today. To articulate the benefits of modular more clearly, the industry needs a more nuanced view on modularization, demonstrating where and when it truly adds value and how that value can be captured. ()

⁴Jose Luis Blanco, Dave Dauphinais, Garo Hovnanian, and Rob Palter, "Making modular construction fit," McKinsey, May 10, 2023.

Pillar 3: Talent, workforce, and supply chains



Recent years have been unsettling to global supply chains. One leader said, "It feels a little like we've been guinea pigs to a mad macroeconomist." The COVID-19 pandemic kicked off a series of shocks: demand for services plunged to zero, followed by a massive rush for supply and a subsequent spike in inflation and interest rates. Geopolitical fragmentation has also created complexity for sustainability goals, with one participant pointing to the disrupted supply of China-manufactured solar components as an example.

Adding further pressure is the growing labor gap in infrastructure, with one estimate saying the United States will need to attract half a million new construction workers in 2024 to balance supply and demand.⁵ Summit participants uniformly agreed on the importance of recruiting and retaining the talent needed to advance decarbonization and digital objectives.

Participants sought to answer these key questions:

 How can organizations maintain the pace of infrastructure planning and rollout amid economic and geopolitical volatility?

⁵"ABC: 2024 construction workforce shortage tops half a million," ABC, January 31, 2024.

- What are the most effective ways to connect materials and labor to projects where they are most needed?
- How are leadership roles changing in the context of this uncertainty?
- How can the industry attract new talent pools to increase the workforce?

The following key themes emerged:

1. *Embed success into the overall project development and delivery culture.* To manage the impacts of volatility, participants discussed the need to forge deeper supply chain partnerships that are less transactional and more enduring. These relationships should foster a genuine interest in collaborators' needs and create win–win situations. As one person said, "You get what you deserve for how you show up." One investor shared that before any project starts, they always do workshops with contractors to fully understand their objectives, build trust, and enable communications about risks.

In allocating and managing risk, participants also discussed stepping back from a project-level view and taking a more systems-level view. As one leader said, "[Two deals are never the same...], but the challenge is being able to look at the mechanisms for risk allocation used in previous situations and apply them in the context of new delivery."

2. *Inspire talent, retain them, and help them be more productive.* Leaders discussed their efforts to recruit large numbers of new employees who are motivated by opportunities to deliver sustainability solutions; keep water, power, and transport systems running; and touch the lives of millions of people. Walking the talk was viewed as equally important for talent retention. As one CEO remarked, "The values you communicate [in recruiting] must be true in reality." The talent shortage has also reinvigorated the need to close the construction productivity gap by helping the existing workforce be as productive as possible with new digital and Al tools.⁶

⁶For more, see "Reinventing construction through a productivity revolution," McKinsey Global Institute, February 27, 2017; Jose Luis Blanco, David Rockhill, Aditya Sanghvi, and Alberto Torres, "From start-up to scale-up: Accelerating growth in construction technology," McKinsey, May 3, 2023.



- 3. *Prioritize diversity in every part of the workforce, and attract new talent pools.* Infrastructure sectors face a persistent gender gap, with female representation accounting for less than 20 percent in leadership positions.⁷ Several participants emphasized the need to increase female participation and tap into other historically underrepresented talent pools. Doing this successfully requires senior leadership to assume real responsibility for the progression of underrepresented groups throughout their organizations and to invest in role modeling and sponsorship. In frontline workforces, participants shared how measures such as a four-day work week, suitable on-site facilities, and government-mandated gender parity requirements ("putting gender on the tender") have made a meaningful difference. Attracting new talent pools to the industry in general can increase the workforce while fostering a more diverse culture.
- 4. The role of the infrastructure CEO has evolved. Over the past 15 years, the infrastructure CEO's role and top priorities have changed immensely.⁸ While talent supply remains an evergreen challenge, CEOs must now prioritize carbon neutrality, rely increasingly on the C-suite, and maximize value in technology investments. Participants also cited the responsibility for managing the pace of change, succession planning, and clear growth ambitions, which requires knowing when to slow some efforts and accelerate others. CEOs must also learn to manage third-party capital and the increasing levels of stakeholder engagement and public scrutiny.

⁷ Global gender gap report 2023, World Economic Forum, June 20, 2023.
⁸ The changing role of the infrastructure CEO," McKinsey, February 13, 2024.



13

Pillar 4:

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The energy transition is a monumental undertaking that requires significant capital investments in energy assets and enabling infrastructure, with \$3.5 trillion of new spending needed on low-emissions assets each year until 2050.⁹ Infrastructure investors and funds have an opportunity to deploy trillions of dollars globally in this decade alone, but the path ahead is not straightforward. The set of opportunities is broadening far beyond traditional renewables to include, for example, sustainable aviation fuels and hydrogen corridors, and there are significant geographical nuances in where and how to invest.

In light of these complexities, participants sought to answer these key questions:

- How can investors effectively navigate energy transition investment opportunities and develop a sophisticated understanding of risk?
- How can stakeholders help accelerate and ensure the availability of adequate renewable-energy capacity?
- What mechanisms exist to recalibrate risk and value and establish profitable paths to decarbonization?

⁹ "The net-zero transition: What it would cost, what it could bring," McKinsey Global Institute, January 2022.

The following key themes emerged:

- 1. Investing in renewable-energy projects has become much more complex. Costs for renewable-energy projects have fallen dramatically: for example, over the past decade, solar costs have dropped 90 percent.¹⁰ As such, the focus has shifted from engineering excellence with little regard for commercial arrangements (predictable feed-in tariffs 20 years ago, for instance) to commercial excellence and downstream uses (what generated power will be used for). This presents a risk and opportunity landscape that one speaker described as "quite complex, even for sophisticated investors." As a CEO put it, "Investors need much more capability around stakeholder alignment to make money, not just Excel spreadsheets." Energy transition projects will also involve a swath of new technologies, such as battery deployments, adding one more dimension of complexity; and distribution infrastructure, including the power grid, will need to be updated, which presents challenges with planning and permitting.
- 2. There is a large opportunity in green energy sources for the scale-up of digital infrastructure. This challenge is considerable, according to participants, and is less an issue of financing and more an issue of pure execution. One planned new data center, for example, will require one gigawatt of zero-point energy consumption, and it is not clear how that capacity can be delivered sustainably. Nevertheless, \$200 billion is invested in cloud infrastructure annually by the four largest players in the space, and cloud providers have committed to decarbonizing the energy supply for their data center capacity by 2030.¹¹ Demand for energy capacity will increase even more as generative AI use expands.
- 3. *Manage investor risk with larger portfolios made up of small projects rather than large individual projects.* Investors can consider taking on some of the supply chain risks incurred between signing a request for proposal (RFP) and project delivery. For example, investors can lock in delivery of needed equipment imminently at current prices versus waiting and speculating on falling prices. Overall, many investor opportunities are multilocal, midsize, and closely interlinked with local, regional, and global regulations; as a result, they often do not fit neatly into traditional risk/return categories (for example, "core" versus "core-plus"). One leader pointed out that climate risk cuts across many asset classes, saying that "capital markets are broken when it comes to climate risk and energy transition."
- 4. The appetite for green infrastructure is enormous, but funding sources remain unclear. At several investment-focused breakouts, summit participants were eager to engage with the question of "who pays?" Several participants made the point that users and taxpayers are ultimately likely to bear the costs for green infrastructure and that there should be more transparency and communication regarding this topic, with clear prioritization of efforts that provide the best return at the lowest cost. Returns could be optimized by focusing on solutions that consider the natural infrastructure strengths of each region rather than by standardizing solutions across all markets. There was also discussion of a potential infrastructure credit that is flexible—and not purely project-based financing.
- 5. *Investors' ambitions and capital requirements are high.* Overall, summit participants expressed widespread recognition of the scale of the opportunity and challenge. As one participant put it, "The world is your oyster, but it is so complex that it requires a lot of capital and collective action." Another executive, representing a large investor, shared that they saw potential at the intersection of decarbonization and energy security (for example, through hydrogen corridors) but emphasized the importance of robust regulatory frameworks in establishing confidence. That said, while many green technologies still rely on regulatory support to be commercially viable, those that are "in the money" today already represent a sizable investment opportunity, and customers are increasingly willing to pay the green premium. ()

¹⁰Christopher W. Avery et al., "The fifth national climate assessment," NCA5, 2023.

¹¹ Joy Wiltermuth, "Al boom in data centers has top tech companies spending more than major oil companies on capex," MarketWatch, March 4, 2024.

Participants

Global leaders in infrastructure and capital projects joined us from February 27 to 29, 2024 in Dubai to accelerate progress on future-ready infrastructure.

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