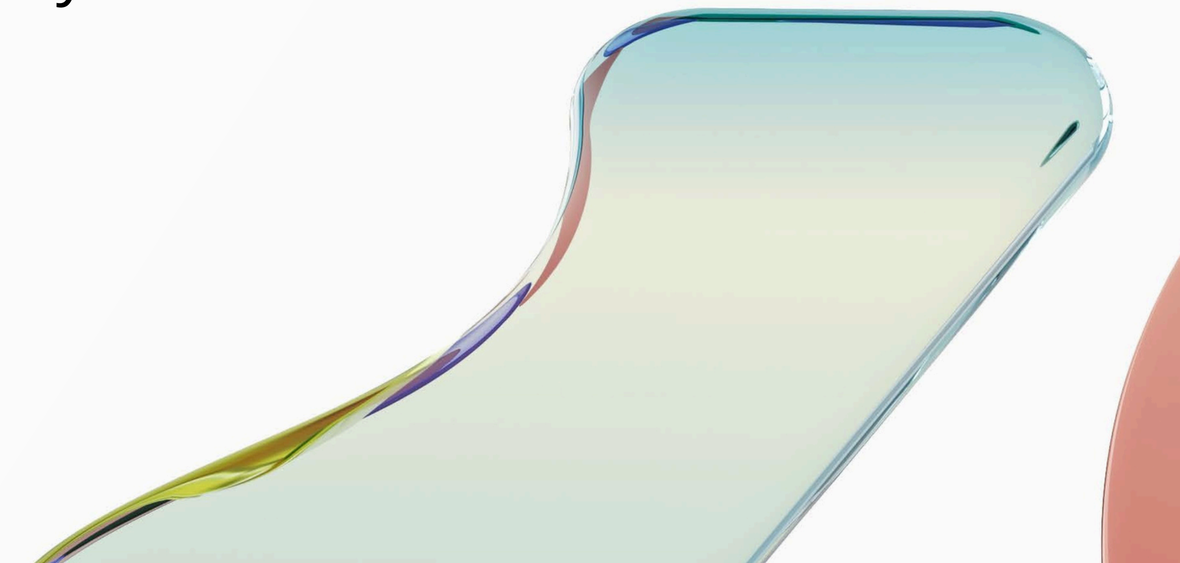
Your partner
in progress

Designing data center operations for tomorrow’s demand

Integrating reliability, safety and sustainability



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Where are we now?

With the anticipated explosive growth of AI, data storage is predicted to exceed **two hundred trillion gigabytes.**

47%

the projected increase in global internet users, rising from 5.35 billion in 2024[2] to an estimated 7.9 billion by 2029.

Critical infrastructure

Whether we are logging on for work, managing finances or heating our homes, individuals and organizations increasingly rely on the internet to conduct our day-to-day activities. We live in a society that is permanently online and connected. Industries from manufacturing to construction depend on the Internet of Things (IoT) to drive production and boost efficiencies. Doctors leverage data to improve patient outcomes. Banks use it to tackle fraud. Families turn to the Cloud to store their favorite memories. Organizations large and small use social media to attract new customers.

Under this backdrop data centers—the buildings that store and process the data we generate—have become an essential part of our society's fabric. In 2024, the UK government designated data centers as Critical National Infrastructure, becoming one of a growing list of countries—including the US—to acknowledge the criticality of these facilities, putting them on equal footing with water, energy and emergency services systems.[1] This designation recognizes the potentially devastating effects of data center outages and highlights the need to consider closely the future of data center development and management.

Opportunity

Every search, every download, every transaction requires more data to support our needs, with customer expectations around security and processing capability on the rise too. Global data storage is predicted to surpass 200 zettabytes[3] by 2025 to meet this demand.[4] When this internet usage is coupled with the explosive growth of artificial intelligence (AI) workloads, the pressure to boost data center capacity becomes immense.

Despite this pressure, the data center industry has an incredible opportunity to support this revolutionary technology. Where many sectors—such as healthcare—have needed to focus on retrofit to meet capacity and sustainability demands, we have a unique moment to design, build and operate efficient infrastructure now that will meet the emerging demand.

The data center industry must mitigate its environmental footprint and ensure resilience against extreme weather and rising temperatures, which could significantly impact operations.

Crossroads

We are at an important decision point. Integrating new technology into existing infrastructure can introduce risks. The tight coupling of data center systems means that the interconnectivity and dependencies between the physical infrastructure, IT systems and software is complex. It is difficult to comprehend the potential impacts a single design change in one part of the system may have on another, particularly in the long term. For example, transitioning from traditional wet-cell batteries to newer Lithium-ion options may seem like a simple upgrade for space and maintenance savings. However, it is essential to consider the broader implications, including environmental factors and the ongoing effectiveness of fire-suppression systems.

As new technology emerges and we look to a future shaped by AI, one solution will not fit all. The key will be balancing short-term capacity gains and efficiency with long-term sustainability. This means avoiding shortcuts, which may harm operational integrity and compromise quality, as well as closely considering climate and sustainability impacts. Not only does the industry need to mitigate the environmental footprint of data centers—a hyperscale data center can use up to 200 million gallons of water per year to cool its hardware[5]—but it must also ensure its own resilience in the face of extreme weather patterns and rising temperatures, which could significantly affect operations. Thinking through these design and operational considerations now—as we embark on large-scale data center build programs that will be with us for decades to come—is critical, as is finding the talent and expertise to run and operate these facilities. When it comes to the fundamentals of sustainability, reliability and safety, the industry needs to see all operators collaborating and setting the standards that will support environmental goals, drive customer satisfaction and meet consumer demand. This is our chance to get it right.

A hyperscale data center can use up to **200 million** gallons of water per year for cooling, making sustainability a critical challenge

What next?

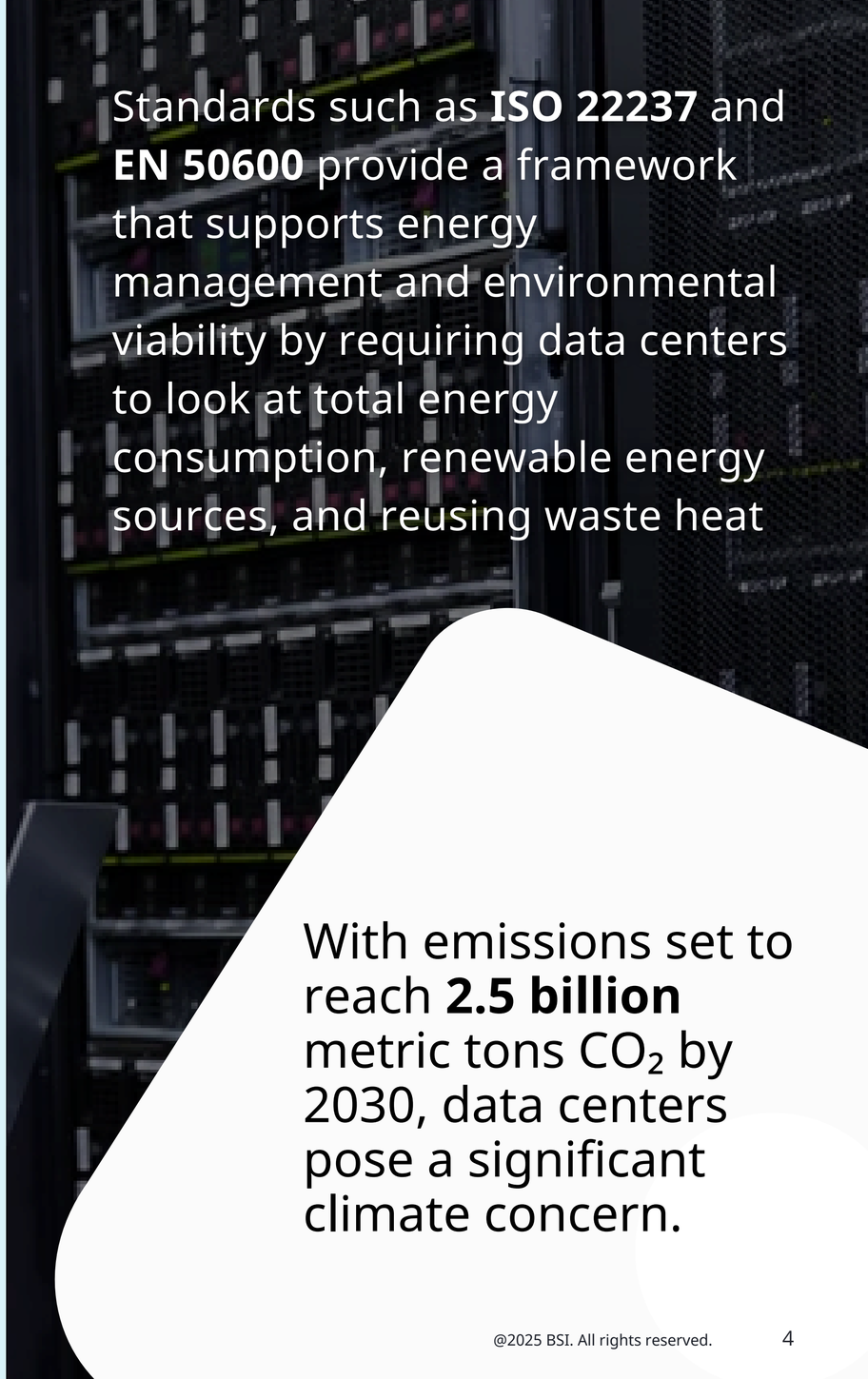
Powering standards

The first step is to adopt globally recognized design standards suited for critical infrastructure. Europe has seen the implementation of the EN 50600 standard covering aspects of data center design, power, security, cooling and sustainability, with its counterpart, the ISO 22237 series, also addressing building construction, power distribution, communications cabling, security and protection.

While allowing for flexibility on strategy, EN 50600 sets specific standards related to energy management and environmental viability, requiring data centers to look at total energy consumption, renewable energy sources and reusing waste heat.

Power is—and will remain—a considerable challenge for data centers. New large data centers require electricity equivalent to 750,000 homes[6]. Optimizing energy usage remains an urgent need, with concerns surrounding the grid's ability to meet energy demand during peak periods. In addition, consideration needs to be given to the impacts data center emissions may have on climate change, with their emissions projected to reach 2.5 billion metric tons of CO2 equivalent by 2030.[7]

The EN 50600-4-6 standard encourages facilities to reuse energy externally and provides metrics on how to measure it. We are already seeing examples of data centers that have been integrated into district heating systems, ensuring that the heat they generate does not go to waste. However, practical challenges, such as contractual obligations and liability concerns, are complicating this seemingly simple solution. Clear standards and guidelines that underpin best practice will help drive innovation in design and support the growth of the industry.



Standards such as **ISO 22237** and **EN 50600** provide a framework that supports energy management and environmental viability by requiring data centers to look at total energy consumption, renewable energy sources, and reusing waste heat

With emissions set to reach **2.5 billion** metric tons CO_2 by 2030, data centers pose a significant climate concern.

Protection

Managing external security threats, as well as internal and external environmental threats, like flooding and overheating, must also be top of mind as we meet demand for data storage. Standards such as ISO 22237 provide an initial framework for prioritizing protection in design with requirements and recommendations for active and passive measures.

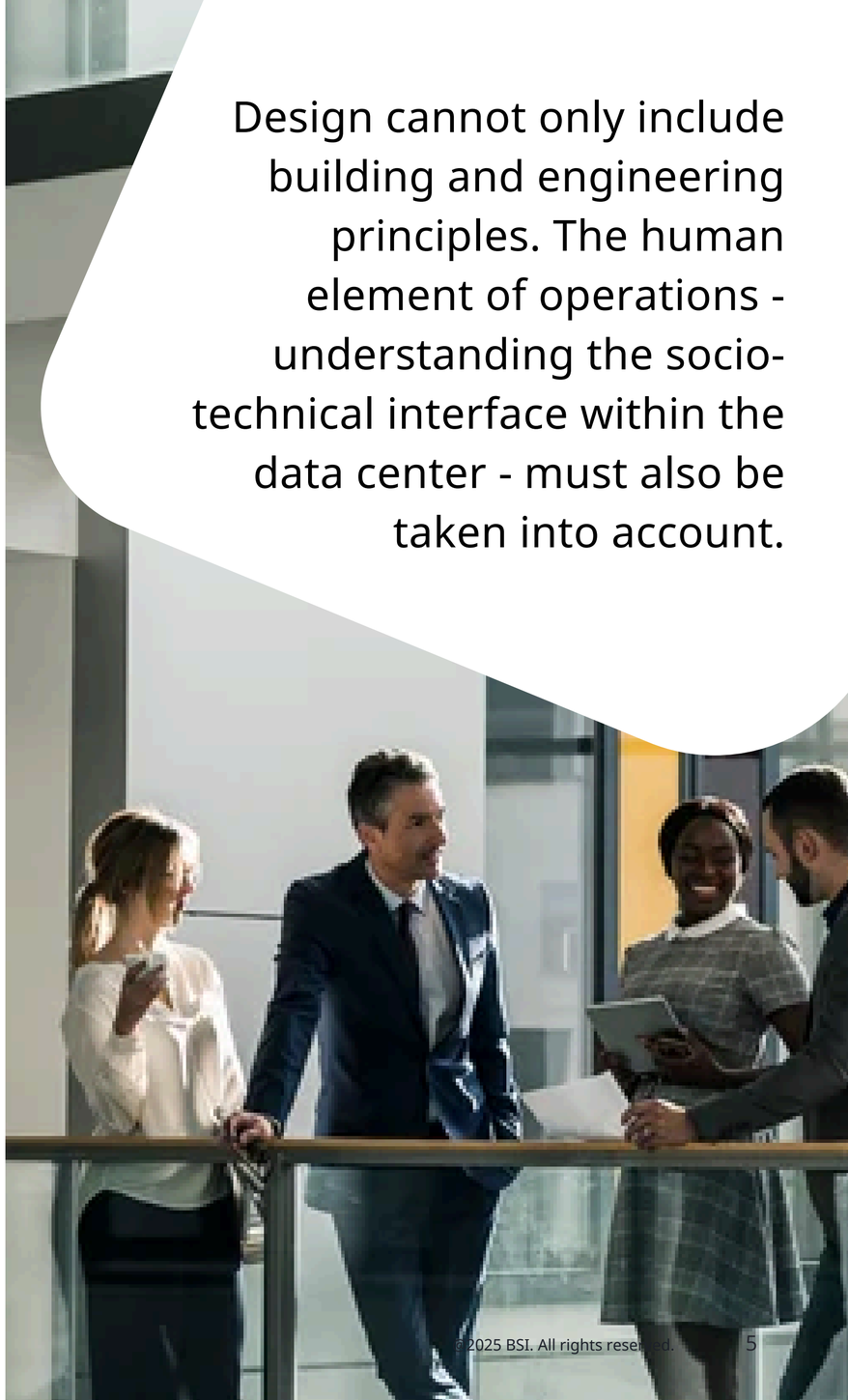
It is impossible to disconnect this challenge from climate risk. In regions like Western Europe, for example, extended heatwaves are pushing the limits of traditional cooling systems that have not been designed to handle rising temperatures, and some data centers have found themselves hiring mid-scale commercial cooling fans to address the issue. As we look forward, we need greater dialogue on how we can overcome these threats.

People matter

Design cannot stop with building and engineering principles. More must be done to improve understanding of the socio-technical interface within a data center, ensuring that critical control systems are designed to be clear and intuitive to the people who regularly interact with them.

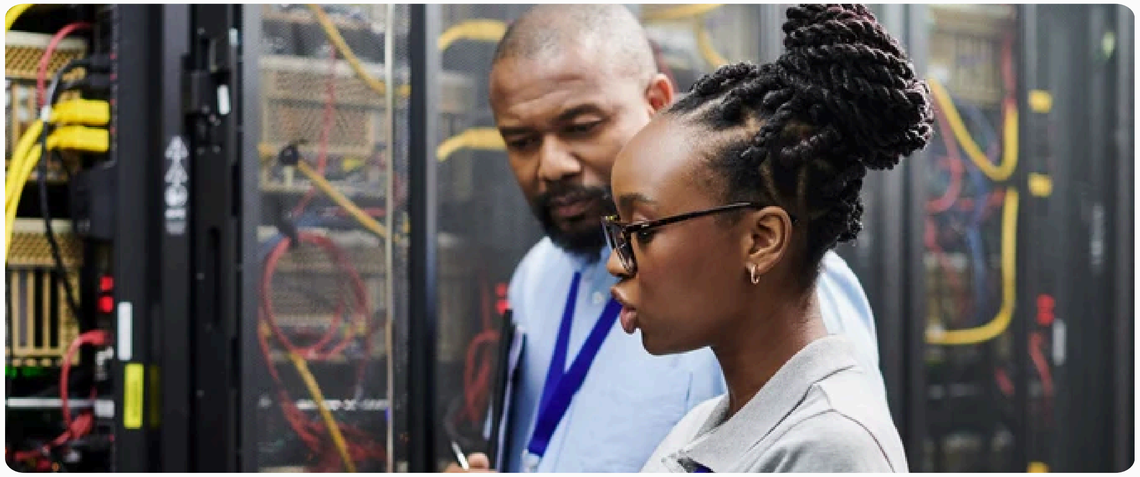
Some early discussion among operators on Health, Safety and Environment (HSE) standards could go further, and we need more parties—including hyperscalers—to join the conversation. For instance, data center standards might mandate the color coding of electrical systems, as opposed to labelling switch-rooms with long, alpha-numeric codes that can be easily mixed up. In addition, data centers might consider adopting flat structures for high-risk activities and involving more stakeholders in the design process. This would ensure everyone can contribute to the way work is being performed. When you consider the ‘value-chain’ dynamics data centers depend on, with many experts independently running specific assets and systems, this becomes especially important. We cannot ignore the human element of operations, if new designs are to work in practice.

Design cannot only include building and engineering principles. The human element of operations - understanding the socio-technical interface within the data center - must also be taken into account.



The future

With new data centers being brought online, and existing ones being retrofitted, designs must continue to address current, and anticipate future, environmental and regulatory challenges.



Designing for the future

The world is changing at a rapid rate, and it is difficult to predict how technological advancements in AI and IT hardware, for example, will continue to shape demands on data centers into the future. That said, with generative AI set to become a $1.3 trillion market by 2032, power demands on servers can be expected to increase exponentially and the industry must design data centers to support tomorrow's technology[8].

As more data centers are built, they will generate more heat and emissions, while using more water. This will lead to potential increases in environmental concerns, along with corresponding legislation. Germany already mandates that 10% of heat generated by data centers must be reused by 2027, and by 2026 all data centers with a nominal connected load of over one megawatt will need to be certified to the ISO 50001 Energy Management standard. As new data centers are brought online and existing ones are retrofitted, we must design with continued environmental challenges in mind and anticipate future regulatory changes.

Data centers could play a pivotal role by becoming "prosumers," feeding power from their battery reserves back into the grid.[9] Innovations like this could deliver data centers that serve as critical infrastructure in more ways than one. On the other hand, promising solutions such as small modular reactors (SMRs) could enable data centers to operate independent of the grid. Still wider concerns surrounding site positioning and a lack of nuclear talent need to be addressed before these can become large-scale solutions.

Collaboration is key

As we look to the future, the industry must work together to understand and navigate best practice, improve standards and take the opportunity todesign critical infrastructure that continues to serve society.

This means collaborating with operators as well as designers to ensure maintenance issues are addressed; energy companies to help optimize power effectiveness; governments to develop regulation; and people working on the ground to ensure facilities are purpose-fit for day-to-day management.

From the simplest design considerations, such as locating valve controls so they are accessible for maintenance, to investing in technologies that can drive risk-based and strategic maintenance plans, the industry has much to gain from combining knowledge and expertise from across the value chain.

As we embark on a generational build program to meet demand for data storage and processing, we will be much stronger if we are working as one. This starts with industry-led forums to drive standards, encourage transparency and improve clarity on performance metrics, which will allow us to reap the benefits of increased innovation, ensuring long-term sustainability, reliability and safety.

This whitepaper is the first in a series on the future of data centers by BSI and CBRE.

About the authors

BSI

Through utilizing its knowledge in the development of standards, and how to embed these to enhance performance, BSI is uniquely positioned to apply its global, pan-industry expertise to many of the challenges companies and organizations faced yesterday, face today, and will face tomorrow.

CBRE

CBRE Data Center Solutions has access to unparalleled insights into market dynamics, trends and innovations through the management of over 700 data centers across more than 50 countries. This unique visibility enables us to understand evolving needs and bring together diverse best practices that mitigate organizational risk. while our strong partnership enhances our collective ability to drive solutions. Together, we are committed to bringing communities of industries and agencies together to drive unbiased consensus on the best routes forward and support the advancement of data center design and management.

Learn more

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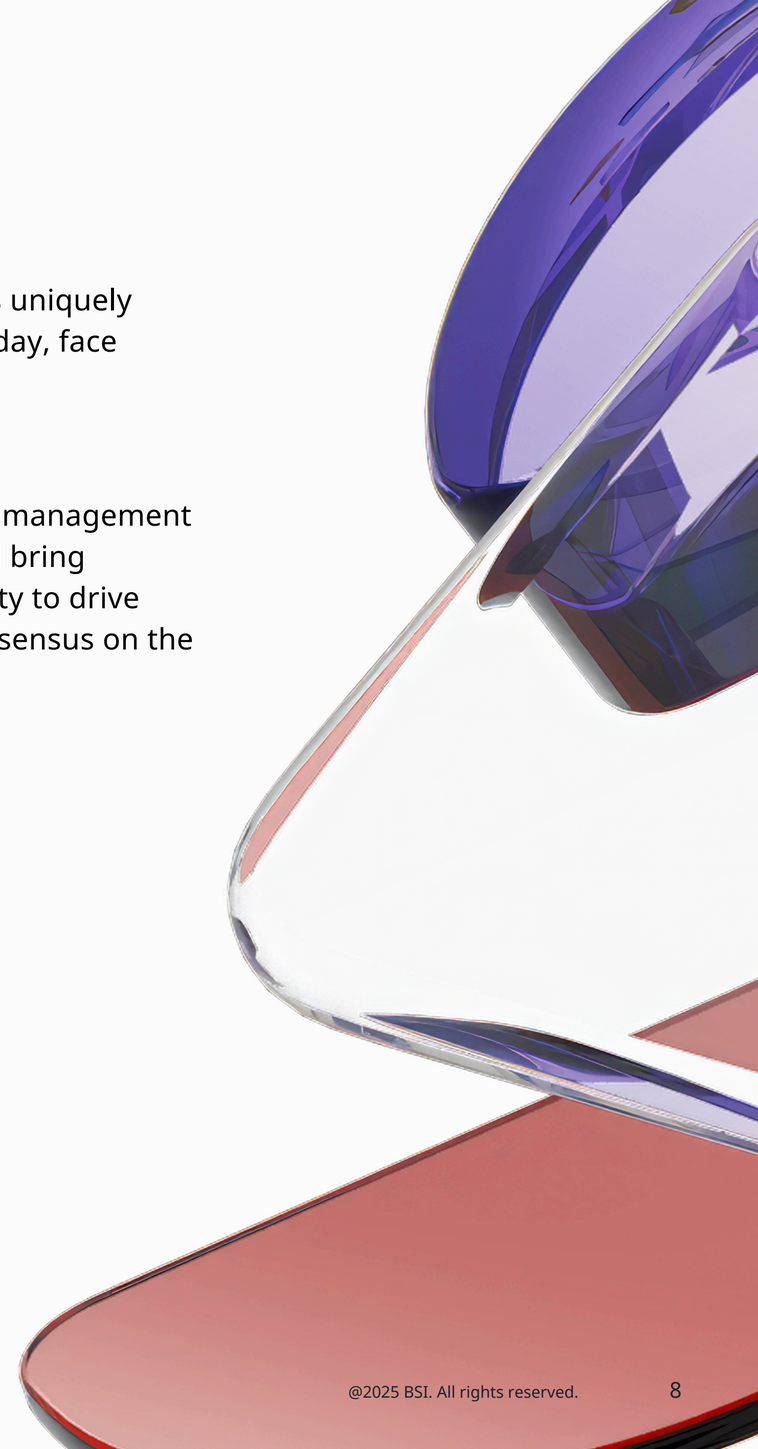

Endnotes

1. Source: UK Gov: Data centres to be given massive boost and protections from cyber criminals and IT blackouts.
2. Source: Forbes: Internet Usage Statistics in 2024.
3. One zettabyte is equivalent to 1 trillion gigabytes
4. Source: Cybersecurity Ventures: The World Will Store 200 Zettabytes Of Data By 2025.
5. Source: CIO: EU moves toward regulating data center energy and water use.
6. Source: Reuters: Data centers could use 9% of US electricity by 2030, research institute says.
7. Source: The Guardian: Data center emissions probably 662% higher than big tech claims. Can it keep up the ruse?
8. Source: Bloomberg: Generative AI to Become a $1.3 Trillion Market by 2032, Research Finds.
9. A “prosumer” is a consumer who is also a producer.