Navigating the *digital frontier*

Transforming utilities through customer-centric innovation and advanced technologies

Capgemini

Will you join the dots or create *smart grids* at scale?

The future of utilities will be smart and connected.

Utility companies have deployed physical assets and operated them for decades, but now the race is on to create smarter and more connected assets and infrastructure. This allows utility providers to make their operations more efficient, agile, and secure while developing new services for customers and creating new sources of value.

At the same time, the need for more environmentally sustainable approaches and decarbonized energy prompts the need for radical change. A technological shift is required to reach these objectives where digital (data and AI) plays a pivotal role – in the planning, deployment at scale, and running of the smart assets and infrastructure.

All this means a massive re-invention of the utilities sector. In this document, we'll look more closely at the driving factors for these changes, what suitable investment planning and delivery look like, and considerations regarding achieving operational excellence, next-generation asset and infrastructure maintenance, and what all this means for the customer.

What a *smart future* means for utilities:

- Investment decisions have clear plans, are made according to data, and are aligned to business outcomes.
- Streamlined asset maintenance by tailoring plans to the specific conditions of individual assets, thereby maximizing their efficiency.
- Asset usage (and failure management) is supported by AI and predictive insights. Operational efficiency can be measured and realized through clear and actionable KPIs.
- Proactive customer engagement, creating value through innovative services that benefit customers and operators, e.g., behind-the-meter insights.
- Connected assets are the norm, incorporating IoT into both customer and company assets, providing secure and uninterrupted data.
- Flexible business applications that absorb change without major disruption to service, operations, or customers.
- Innovation is routine and new business models can be adopted without significant business disruption.

Vision of the smart grid

Optimized

- Investment decisions are judged based on risk and value
- Investment decisions are aligned with business outcomes
- Full transparency from investment plan project initiation
- Maintenance plans are optimized for asset life and operational efficiency
- Maintenance completed on the first visit

Delivery focused

- Capital projects run as efficient operations
- Partners and clients collaborate to ensure successful delivery
- Improving efficiency by reflecting the financial position as the project progresses
- Partners contribute to asset commissioning and data acquisition, with the impact on future investments assessed.

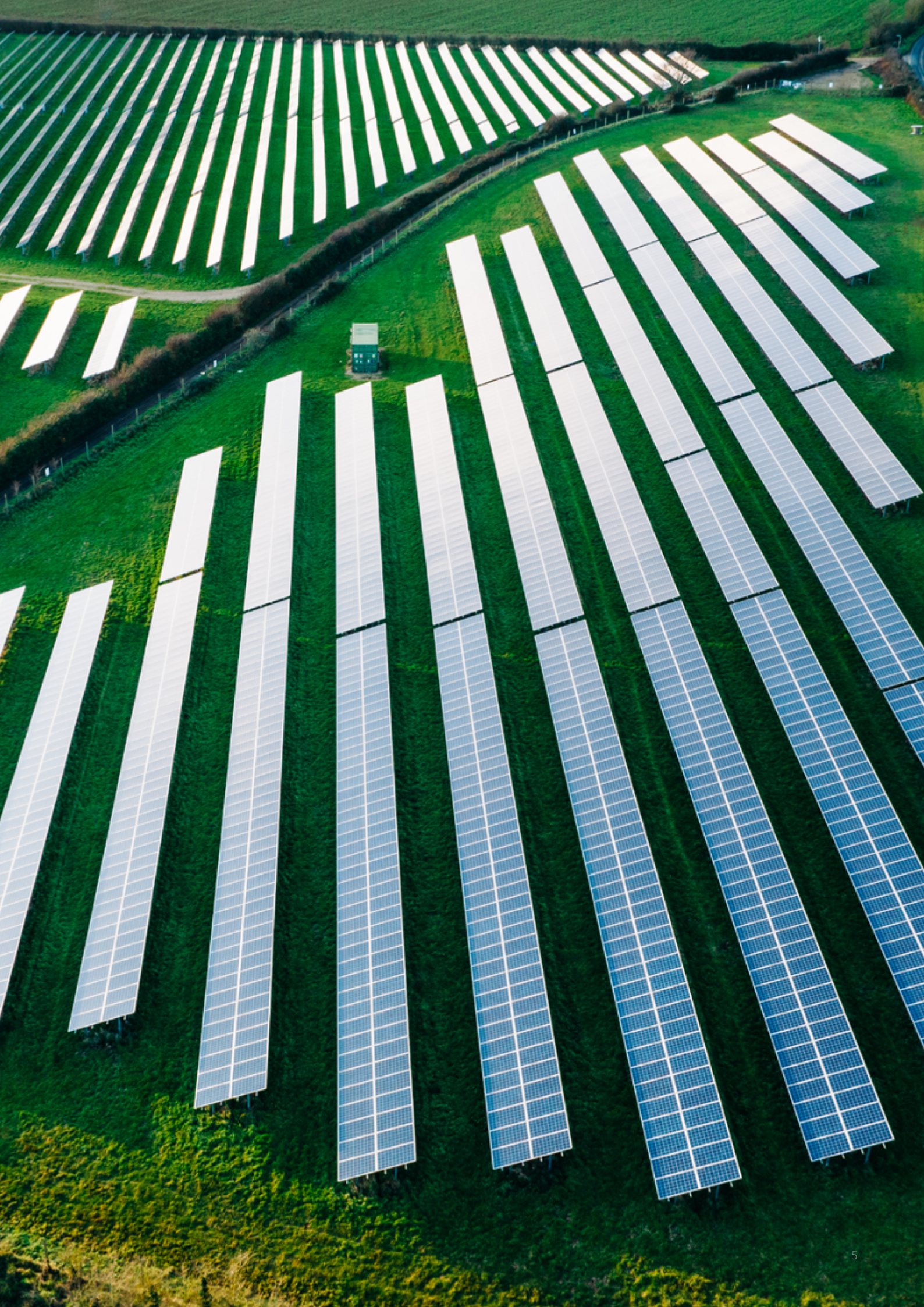
Enabling

- Digital assets that support efficient operations and continuous monitoring
- Continuous feedback on asset performance to monitor outcomes
- Investment plans are regularly updated to reflect new priorities
- Organization remains agile to tackle unplanned challenges
- Edge-based computing supports IoT to drive improved asset data intelligence

External trends are prompting a *paradigm shift* in business models.

Market forces and environmental pressures are forcing significant investment in new technology and infrastructure. While delivering positive outcomes has never been more important, managing complexity, while staying on time and on budget, is challenging, especially as global financial conditions become more difficult. Utilities are placing operational efficiency as a top priority that must be improved across the service area and asset base, extending asset life where possible. But how do they set themselves up to address this challenge? Technology can assist them in the efficient management of assets, reducing the risk of asset failure and increasing the resilience of the services they provide, but understanding the best way to deliver, integrate, and run this technology is the challenge of the moment.

Technology developments are disrupting traditional markets, forcing utilities to adapt the way they deliver services and serve customers, but how can they most effectively master this technology and use its full potential while staying on top of the latest trends in the utility sector?



The external pressures are being applied by many different factors or trends. According to the 24th annual World Energy Markets Observatory (WEMO) report from 2022, the main trends can be summarized as follows:

1. Diversity of asset types

Distributed energy includes:

- Solar (generation)
- Wind (generation)
- Hydrogen (generation and storage)
- Batteries (generation and storage)
- Methane (generation and storage)
- Heat pumps
- Electrical vehicle (chargers and mobile batteries)

2. Huge increase of asset numbers

These new types of assets are being deployed at a very large scale. In comparison, where utilities have been used to manage tens of thousands of assets from an automation standpoint, we are talking about millions of them in the near-future era.

3. Mobility – a new paradigm

Electric vehicles, in addition to being a new asset type, are also introducing a new pattern on the grid. As a result, utilities must balance the grid more quickly and at a lower level to include a higher number of variable assets and forecast consumption and storage.

4. New type of services

T&D operators, with the paradigm shift and the set of new consumption patterns, must deal with various new services:

- Beyond the meter: manage end customer production/ consumption (prosumer)
- Reinforce load/demand real-time balance
- Flexibility, demand response, storage, capacity management
- Energy-as-a-service, due to the mobility paradigm
- Peer-to-peer: edge mediation between end customers
- Connected microgrid or community that could be operated by utilities

5. Increasing number of stakeholders involved in grid management, in addition to regulators, electric system operators, and sometimes asset owners

The number of participants involved in the management of the distribution grid is increasing:

- Renewables operators, prosumers
- Virtual power plant provider (both in terms of flexibility and asset optimization)
- Public network microgrids (communities, campus, hospitals) connected to the grid

In addition, there are higher expectations on the delivery of energy.

- Increase network resilience
  - Against frequent, recurring climatic events (e.g., wildfires, flooding, hurricanes)
  - Secure criticality of energy availability due to the extension of the usage (SAIDI, SAIFI)
- Deliver more efficiently
  - Optimize network design by limiting the number of connections (copper saving)
  - Increase performance (never-ending requirement) Improve flexibility
  - To manage intermittency of renewables due to their increased proportion in the energy mix
  - Be more agile in implementing new/ evolving use cases/ services
  - Shortening deployment at scale on the edge
- Secure reliability in a new network architecture
  - From centralized to decentralized generation
  - From one-way to two-way flow
  - Guarantee the level of service (geopolitical tensions, autonomy)
  - Strengthen cybersecurity

The journey to smart *digital grids*

Today's utility trends are having a dramatic impact on the management of the distribution grid – utilities' transformation is on a radical change path.

In the past, utilities managed everything centrally:

- Production was centralized
- Distribution network was one way
- End users were consumers
- Storage was almost non-existent
- Production was permanently connected to the grid
- Many, if not most, activities were done manually

Today, the distribution network is decentralized, which leads to the following:

- Production is hybrid and scattered across the territory
- Distribution network works both ways
- End users are prosumers, using energy they produce or injecting it into the grid
- Storage is taking an important role
- Production and storage assets are sometimes disconnected from the grid
- Some assets start to be mobile in their connection to the grid
- Almost all high- and medium-voltage grids will be automated rapidly

Tomorrow, a distributed network will be the norm:

- Huge increase of small-size storage (V2G, P2G, and battery)
- Production and storage assets will go on and off the grid
- Off-grid systems can run independently from the grid
- Automation of low-voltage grid will be mandatory
- Near real-time management of the grid will be needed with a complex and changing pattern to manage (intermittency and decentralization)
- The complexity of the management of the grid will require a high level of automation (still under the supervision of humans)
- Network convergence (electric, gas, heating, cooling, hydrogen)

Decentralization of the distribution network

Step 1

Centralized

Step 2

Decentralized

Step 3

Distribute

Share of software will grow from 15% of the modernization cost to about 35%.

The technology and solutions need to evolve as the pressure to move to more sustainable and decarbonized energy is becoming higher. This not only encompasses utilities but also their entire provider ecosystem. This change will have to be deployed at scale and with respect to each utility, which will have its own path based on constraint, regulation, and unique priorities, with the software toolset needed to manage such deployment. As a result, CapEx is expected to double, and the share of software will grow from 15% of the modernization cost to about 35%.

Effective capital programs meet *efficiency-driven* asset and operations management – digital core for utilities, with SAP®

There are three pillars to Capgemini's Digital Core for Utilities, enabled by SAP® S/4HANA®:

1. Capital Investment planning and delivery enabled by SAP Enterprise Portfolio and Project Management (EPPM)

2. Operational excellence across business operations and assets delivered by SAP Enterprise Asset Management (EAM)

3. Business Agility by embracing new technology to support business and IT operations across the enterprise.

These three pillars are designed to help utilities start, restart, or break through barriers on the journey to smart grids – together, they help form the answers to the following questions:

Why?

- What are our business ambitions and how does this program align with our strategy?
- Why would this program help my business achieve its strategic objectives?
- What are the expected benefits or business outcomes?
- Are my executives aligned on program ambitions?

What direction?

- How do I assess where I stand today compared to my peers and market trends?
- How do I define the future direction of operating data and IT models to target?

What targets?

- How do I define the targets to implement to enable future maturity achievement?
  - Business operating model (organization and processes),
  - Data and analytics models
  - IT architecture and applications models
- What are the high-level business impacts compared to current models?

How and when? What benefits?

- How do I define a transformation roadmap as achievable and feasible considering dependencies and influential business events that can affect transformation timing?
- How do I define project organization and governance?
- How do I build a change and adoption strategy?

Let's go together.

- How do I align key stakeholders on scoping outcomes and next steps?
- How do I mobilize and engage business stakeholders?
- How do I create a corporate momentum?

1 Investment *planning* and *delivery*

The transition to renewable energy sources, such as solar and wind power, is causing significant disruption. While the benefits of these energy sources are clear, they also pose challenges for utilities as they are not always predictable. The sun does not always shine, and the wind does not always blow, making it necessary for utilities to be more flexible to meet energy requirements.

To address these challenges, utilities must make investments to prepare for the future and meet the demands of the existing network. This is a cornerstone of Digital Core, as we believe that continuous investment is necessary for utilities to manage the transition to becoming a smart grid operator. However, investments must be made in a smart way that prioritizes business outcomes, delivering benefits to the business and the customer.

Once the investment decisions have been made and the budget approved, the focus shifts to delivering the project within the defined time frame and budget. The challenge is to ensure that the project is delivered successfully while also gathering and maintaining digital information that allows for efficient asset management and operational efficiency. One of the key considerations for utilities when delivering projects is managing financial positions and ensuring that the funds allocated reflect the progress of the project. This creates a “golden thread” of transparency between the investment plan and project execution, which provides confidence that the organization is moving in the right direction.

To drive operational efficiency, it’s important to work with partners to address all efficiencies in the delivery process. Project delivery

must be managed efficiently by optimizing supply chains to deliver resources and materials when they are needed, minimizing delays and overruns.

Partners must also be bound by new obligations to deliver digital assets that will support intelligent asset management, improved asset life, lower maintenance costs, and efficient resource allocation. However, this can only be enabled if the intelligence is built into the asset and there's a framework in place to pull the information required to evaluate and make decisions.

As assets are handed over, it's important to have access to all relevant data to drive operational efficiency and maintenance activities. This requires a shift from a transactional and finance-focused Approach to one that is transparent and that describes the asset, its expected behavior, and the parts necessary for its continued operation. Making use of this information during asset operation is one of the keys to delivering improved operational efficiency.

Overall, by embracing transparency, risk and value-based investment decisions, and intelligent asset management, utilities can successfully navigate the challenges presented by the transition to renewable energy and ensure a successful and efficient transition to a sustainable energy future.

2 Operational *excellence*

Utilities are responsible for operating large numbers of assets, ranging from thousands to hundreds of thousands, many of which are essential for the reliability of the service and network. These assets require ongoing maintenance, which presents a significant challenge given the geographic diversity and scale of the operations. Therefore, utilities need to focus on achieving operational efficiency to ensure that maintenance is carried out in the most efficient manner. This involves not only performing regular maintenance but also optimizing maintenance budgets to increase the useful life of the asset.

One of the key challenges that utilities face is the primarily reactive approach to asset maintenance, where often things fail before they are identified as problematic. To overcome this challenge, they must design maintenance plans that are optimized to increase the useful

life of the asset based on both the manufacturer's recommendations and the experiences of other customers. They must prioritize their work based against critical asset risk using KPIs to monitor and understand their position. Embedding data analysis and real-time monitoring within the process and system is crucial to identifying problems before they appear and/or escalate.

Using SAP® as a tool for managing assets means that, you can keep track of smart grid conditions in real-time from a single source. This data can then be used to enhance asset planning and reduce lifecycle costs, as well as plan for predictive maintenance. The result is not only improved asset efficiency with equipment running at optimal levels but also reduced downtime due to efficient predictive maintenance.

Another challenge is predicting where to allocate resources based on potential challenges, especially in large geographical areas, for instance, storms or other freak weather occurrences. To overcome this challenge, utilities must be more intelligent in the use of limited resources to meet the operational challenges. The advanced analytics and dashboard tools that are offered by SAP® make it easier to identify trends, anomalies, and areas of concern in energy consumption. Predictive analytics combined with variable weather data can help utilities identify high-risk service areas, allowing preemptive resource allocating and, maximizing their ability to respond to emergencies.

Worker safety is another critical consideration in the utility industry. Utilities must ensure that workers adhere to safety policies, especially in situations where worker safety is high risk: high-voltage cables, offshore wind farms, and other remote assets pose significant health and safety risks. Utilities can also make use of technology to avoid sending workers to dangerous locations, such as remote assets, by monitoring them remotely.

In summary, operational efficiency, predictive maintenance, resource allocation, and worker safety are critical considerations for utilities to ensure the reliability of their services and networks. By embedding data analysis, real-time monitoring, and integrating technology, they can optimize maintenance plans and resource allocation to minimize downtime and ensure worker safety.

3 Business *Agility*

In the realm of business agility, the choice of the right digital enabler holds the key to transformative impacts on investments, grid asset productivity, and overall business agility for utilities. The digital enabler serves as the cornerstone, orchestrating the integration of advanced technologies to optimize operational efficiency and strategic decision-making. Investments in cutting-edge solutions driven by the right digital enabler can unlock unprecedented value, ensuring a substantial return on investment while future-proofing utility operations.

Grid asset productivity experiences a paradigm shift under the influence of a well-chosen digital enabler. The synergy between data-driven insights and smart technologies allows utilities to proactively manage and maintain their grid assets. Predictive analytics, enabled by the digital enabler, empowers utilities to forecast maintenance needs, mitigate potential failures, and maximize the operational lifespan of assets. This not only enhances asset productivity but also fosters a more resilient and adaptive grid infrastructure, capable of meeting the evolving demands of the modern energy landscape.

Business agility, a cornerstone of digital excellence, is amplified through the strategic adoption of the right digital enabler. The enabler acts as a catalyst for streamlined processes, efficient data management, and rapid decision-making. With real-time insights and analytics at their fingertips, utility companies can dynamically respond to market changes, regulatory requirements, and customer needs. This heightened agility positions utilities to navigate uncertainties with resilience and capitalize on emerging opportunities, ensuring sustained success in a rapidly evolving digital era.

Beyond the data – we understand what it is and what it takes to be an intelligent enterprise.

The journey toward building smart infrastructure is a long and complex one. This is why it is essential to have a strategic partner who can provide a comprehensive range of services to address the coordination of the entire ecosystem. Having different partners for different areas of the process can cause coordination issues, which can lead to delays in the process and potential cybersecurity issues.

Capgemini is an experienced partner that offers a full range of services including consulting, PMO, software integration, and engineering. Whether dealing with embedded software design for a smart substation or the electronics that are needed to perform input-output functions within the substation, it is still necessary to manage the legacy systems. Replacing everything at once is neither practical nor possible, instead, we need to be able to manage the existing environment while introducing new hardware. We provide a model and a roadmap that can manage the replacement of your legacy assets. At Capgemini, we understand the complexities involved in building smart infrastructure and have the expertise to provide tailored solutions that meet the specific requirements of your smart infrastructure goals efficiently and effectively.

Capgemini and SAP®

SAP® S/4HANA® and New Generation Solution Offerings

- **950+** S/4HANA Clients transformed worldwide
- **Unique SAP S/4HANA offerings:** Business Transformation, Multi-Pillar S/4HANA Architecture (MPSA), Move to Cloud Offerings, Wedge Offerings, Data and Insights, Business Assurance, People Transformation & Enablement, Intelligent Enterprise
- Digital Industry SAP® S/4HANA® Assets
- **Industry Path Solutions:** pre-configured on S/4HANA in the cloud, complementary to model company
- **SAP S/4HANA Cloud** for Utilities
- Certified SAP use cases and accelerators
- **Green Core with SAP Solutions:** a set of solutions built on top of SAP applications that provide greater visibility and control for organizations by measuring the financial, economic, and social impact of their IT, operations, and wider value chain.

950+

S/4HANA Clients transformed worldwide

About Capgemini

Capgemini is a global business and technology transformation partner, helping organizations to accelerate their dual transition to a digital and sustainable world, while creating tangible impact for enterprises and society. It is a responsible and diverse group of 340,000 team members in more than 50 countries. With its strong over 55-year heritage, Capgemini is trusted by its clients to unlock the value of technology to address the entire breadth of their business needs. It delivers end-to-end services and solutions leveraging strengths from strategy and design to engineering, all fueled by its market leading capabilities in AI, cloud and data, combined with its deep industry expertise and partner ecosystem. The Group reported 2023 global revenues of €22.5 billion.

Get the future you want | www.capgemini.com

Engage with our experts to ignite innovation and drive impactful results for your business.

James Forrest
Executive Vice President DSP • Technology Services - Offer Sponsor, Digital Core for Utilities

Elisabetta Spontoni
Executive Vice President - Group Offer Leader for Digital Core

To know more, please visit

https://www.capgemini.com/services/enterprise-management/digital-core-with-sap-s-4hana/

MACS_2024_PREM