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Digital Solutions for Energy Production and Generation Infrastructure

Accelerating the energy transition

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Energy infrastructure, the fundamental driver of global industrial growth and economic development, is undergoing a radical transition that is driven by decarbonization, electrification, decentralization, and energy security needs.

This energy transition is now experiencing unprecedented global investment across all forms of energy production and delivery.

For over 40 years, a growing portfolio of Bentley products and solutions has improved innovation, optimization, collaboration, and mitigation of critical industrial-scale energy production infrastructure, helping to accelerate the transition to net zero by going digital.

Why Digital Twins Are Driving the Energy Sector

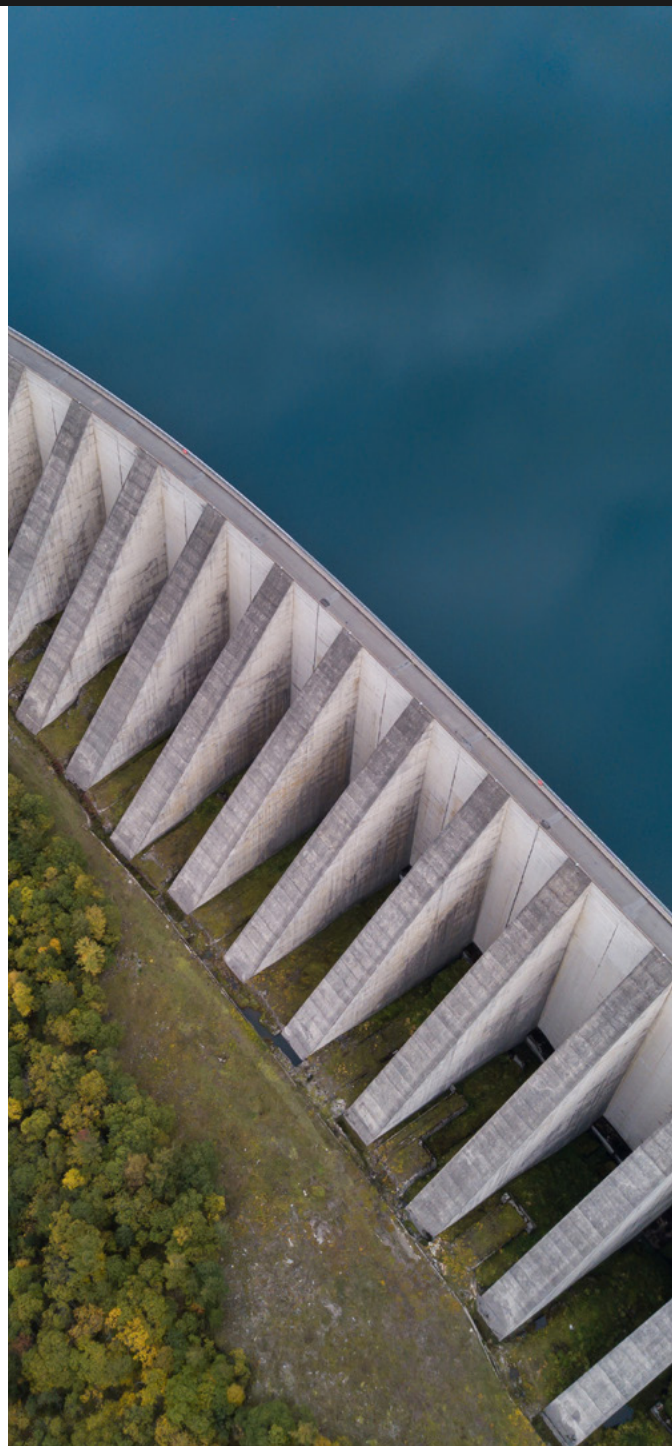
It is common knowledge that energy infrastructure is aging, difficult to update with reliable information, and often situated in remote locations. Meanwhile, new renewable and carbon-efficient energy projects are growing around the world as the energy transition accelerates. What is critical to both old and new energy projects is that they need to prioritize safety, reduce risk, enable effective decision-making, and save costs—both financial and environmental.

To do their job faster and more efficiently, energy utilities need innovative technologies and processes. Therefore, many of them are adopting digital twins. With digital delivery, projects are produced using digital models, data, and supporting field applications for energy infrastructure design, analysis, construction, and operations. Digital delivery incorporates streamlined processes to manage asset information as it changes through project development across the asset lifecycle. With this delivery method, it is easier to review the design intent and develop high-resolution 3D design visuals, providing improved design quality.

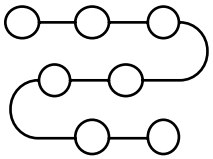
Digital twins can make a significant impact on reducing project cost overruns, and the 3D design enables designers to run what-if scenarios, such as structural or geotechnical, to test different conditions and optimize project cost before handover.

One of the main strengths of a digital twin is its ability to be a multidiscipline data collaboration and data management interface to various data sources, from 3D models and reality meshes, to data from IoT sensors, and to represent its near real-time status, working condition, or position. Throughout the lifecycle of an asset, a digital twin helps you to:

- Understand existing conditions
- Improve and accelerate design and construction workflows
- Increase asset reliability and performance
- Visually enhance collaboration



What Are the Benefits of Using Digital Twins?



In planning

- Assess and understand existing conditions above, on, and below ground
- Identify asset needs
- Identify project requirements
- Manage and mitigate risk
- Manage asset performance
- Optimize collaboration and coordination with stakeholders and citizens
- Understand financial impact early

In design, engineering, and analysis

- Accelerate project delivery
- Evaluate project impact
- Optimize collaboration and coordination with stakeholders and citizens
- Reduce risk, project costs, and delays
- Simulate design options
- Reduce redesigns and rework

What Are the Benefits of Using Digital Twins?

In construction and commissioning

- Improve safety and enable right-first-time construction
- Increase construction efficiency
- Manage project schedule versus performance
- Monitor and track progress
- Optimize collaboration and coordination with stakeholders and citizens
- Provide up-to-date documents
- Reduce on-site visits

In operations and maintenance

- Develop more repeatable assessment processes
- Ensure regulatory compliance
- Enhance worker safety
- Improve asset performance monitoring
- Lower asset operational costs
- Optimize collaboration and coordination with stakeholders and citizens
- Reduce on-site visits and asset downtime
- Virtually assess and document assets


Image courtesy of OQ Upstream

User Story

Hydrocarbons: OQ Asset Reliability Digitalization with Purpose

OQ Upstream, Oman
Project playbook: AssetWise®

OQ, an integrated energy company, operates and manages dozens of plants, thousands of assets, and over 4,500 kilometers of pipeline across Oman. To improve asset performance and reliability and ensure safe and reliable plant operations, OQ wanted to digitize asset management processes. Scattered paper asset data records and previous reactive maintenance methods proved costly and ineffective. OQ realized that they needed to establish a centralized digital asset performance management (APM) system.

They selected AssetWise Asset Reliability as their central asset data management platform, incorporating failure reporting and analysis, asset health indicators, and digital inspection strategies to enable corrective maintenance management. Their digitized APM system reduced asset failures and unplanned plant shutdowns, minimizing environmental risks of flaring. Based on APM implementation at one compressor site, the digital solution saved 14.8% in total maintenance costs and reduced functional failures by 50% to achieve an annual operational reliability growth of 4.3%. Continuing to digitize, OQ is integrating APM as part of their efforts to develop a digital twin.

Learn more


Image courtesy of Shell Gulf of Mexico Deepwater Group

User Story

Hydrocarbons: Deepwater Project Delivery Digital Platform

Shell Projects and Technology, Gulf of Mexico (also known as the Gulf of America)
Project playbook: AssetWise, iTwin®, SYNCHRO™

Shell identified a portfolio of projects in the Gulf to deploy an integrated project delivery digital platform, continuing top cost performance while also working toward meeting net zero carbon goals and further improving project cycle times for deep water projects. This end-to-end digitization from concept design, to handover, to operations presented challenges, including how to integrate multisourced data. To achieve their goal, Shell needed open, interoperable technology applications.

Leveraging, amongst others, PlantSight and AssetWise ALIM, Shell developed a digital platform that provides a single source of truth from project conception through delivery of a digital twin for operations and beyond. Working in an integrated digital environment optimizes data access, visualization, and remote collaboration, improving efficiencies, reducing time for project teams to find information by 50%, and eliminating work duplication. By digitizing workflow orchestration and supporting end-to-end project delivery, Shell expects to see significant productivity gains and cost savings. The PlantSight digital twin solution can be scaled as projects expand, or new ones arise.

Learn more


Image courtesy of POWERCHINA Hubei Electric Engineering Co., Ltd

User Story

Solar: Suixian and Guangshui 80mwp Ground-Based Photovoltaic Power Project

POWERCHINA Hubei Electric Engineering Co., Ltd., Guangshui, Hubei, China
Project playbook: OpenBuildings®, OpenRoads™, ProjectWise®, SYNCHRO

When POWERCHINA Hubei Electric Engineering was hired as the engineering, procurement, and construction contractor to deliver an 80-megawatt ground-based photovoltaic power station, they faced several challenges concerning saving land, capacity, optimizing design plans, geological issues, environmental concerns, project quality, time constraints, and costs. All these challenges helped them realize that they needed a lifecycle digital twin application. As a result, choosing a proper location for the photovoltaic array, booster station, access road, and the transmission line was critical to produce an optimal design.

POWERCHINA Hubei selected OpenBuildings Designer and OpenRoads for 3D modeling, as well as ProjectWise for collaborative design management. Using the robust solution, they were able to reduce design errors and manual verification, which produced a more efficient design. The solution optimized the design scheme, reducing land occupation and avoiding 40 potential rework scenarios to save more than CNY 800,000. Integrating SYNCHRO 4D accelerated construction by approximately 30 days. They used the iTwin Platform to automatically generate digital twin models, avoiding approximately CNY 1 million in costs had the digital twins been developed at the operation stage.

Learn more

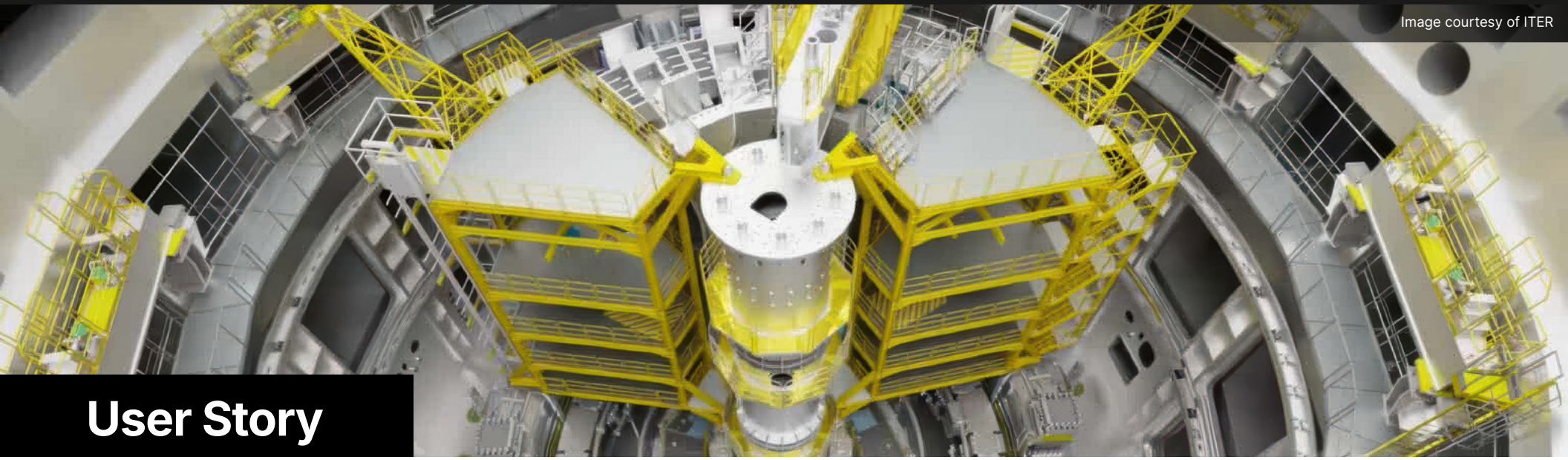


Image courtesy of ITER

User Story

Nuclear Fusion Power Generation: The World's Largest Tokamak, A Magnetic Fusion Device

ITER, Saint Paul-lez-Durance, France
Project playbook: iTwin and SYNCHRO

New infrastructure, especially critical infrastructure, is designed and built to include a broad variety of digitally enabled components and materials. Digitally enabled infrastructure assets are meant to provide and even consume a rich stream of data from day one. This data includes not only asset status, but also operational data such as automatic incident detection, air quality and temperature, and energy consumption. The ITER project is building the largest tokamak fusion reactor in the world, with the goal to assess the feasibility of this energy source for large-scale, carbon-free energy generation. This project is a remarkable example of an infrastructure asset that needs to be digitally enabled by design, as it cannot operate without an AI system that is fed by an extensive array of sensors to safely control the plasma inside the nuclear fusion reactor.

Learn more

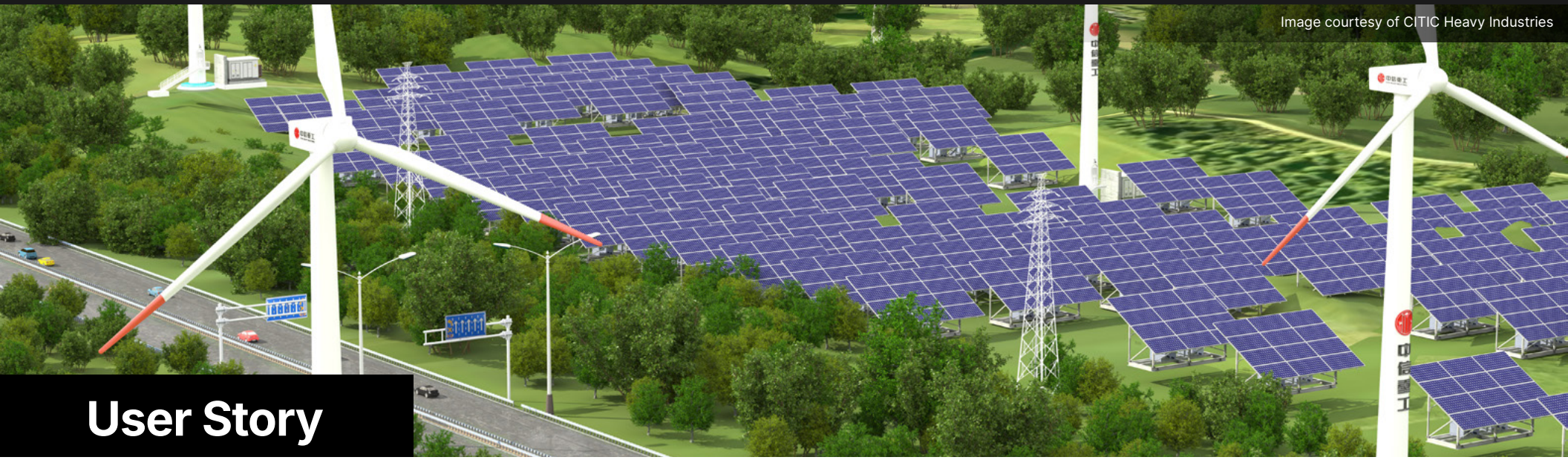


Image courtesy of CITIC Heavy Industries

User Story

Offshore Wind and Solar: Wind and Photovoltaic Power Integration Project in Xindian

CITIC Heavy Industries, Xindian, China
Project playbook: OpenBuildings, OpenPlant®, PLAXIS®, SACS™, SYNCHRO

With the design stage complete, CITIC Heavy Industries is constructing key components of a wind power and photovoltaic power integration project in Xindian. Consisting of 14 wind turbines, it will generate 1.2 million kilowatts of power. It is a transformative project in the region, as it integrates AI, Internet of Things (IoT), and advanced communication technologies to help empower China's low-carbon energy transition.

CITIC collaborated with Bentley to dramatically reduce construction time for such a substantial wind and solar project. Bentley's technology helped them overcome the immense technical and economic challenges that often come with offshore projects.With Bentley's solutions, the construction period is set to be shortened by around 20%. The savings that CITIC generate will reduce project costs by more than CNY 5 million. CITIC were also able to substantially increase the return on investment by reducing maintenance costs and optimizing output. In fact, procurement costs were reduced by about 5%, construction costs by 2% to 3%, design costs by 8%, and ongoing operation and maintenance costs of equipment by about 3%.

Learn more

Image courtesy of Cornish Lithium

User Story

Geotechnical Energy Storage: Reducing the Environmental Impact of Lithium Extraction with Subsurface Modelling

Cornish Lithium, United Kingdom
Project playbook: Oasis montaj®, Seequent® Central, Leapfrog® Geo, Leapfrog Works

Cornish Lithium's innovative and sustainable approach to lithium extraction sets a new standard for more environmentally friendly lithium exploration. By creating 3D geological models with Leapfrog, integrating geophysical data with Oasis Montaj, and managing their models and data using Seequent Central, they reduced their drilling to a single exploration borehole in a site through the accuracy of their predictions, and minimized their environmental impact.

Software from Seequent, the Bentley Subsurface Company, was essential to the exploration process, helping make it more eco-friendly non-invasive by digitizing archival data with the use of geophysical data sets to create 3D geological models. Oasis montaj allowed them to process the geophysics, while Leapfrog helped with the visualization of the models. All geotechnical information was then brought into Seequent Central, which allowed easy transfer of work and collaboration among different teams, particularly tracking version control. The whole process allowed Cornish Lithium to access new sites more quickly using only one borehole, minimizing the impact of exploration.

Learn more


Image courtesy of Yuba Water Agency

User Story

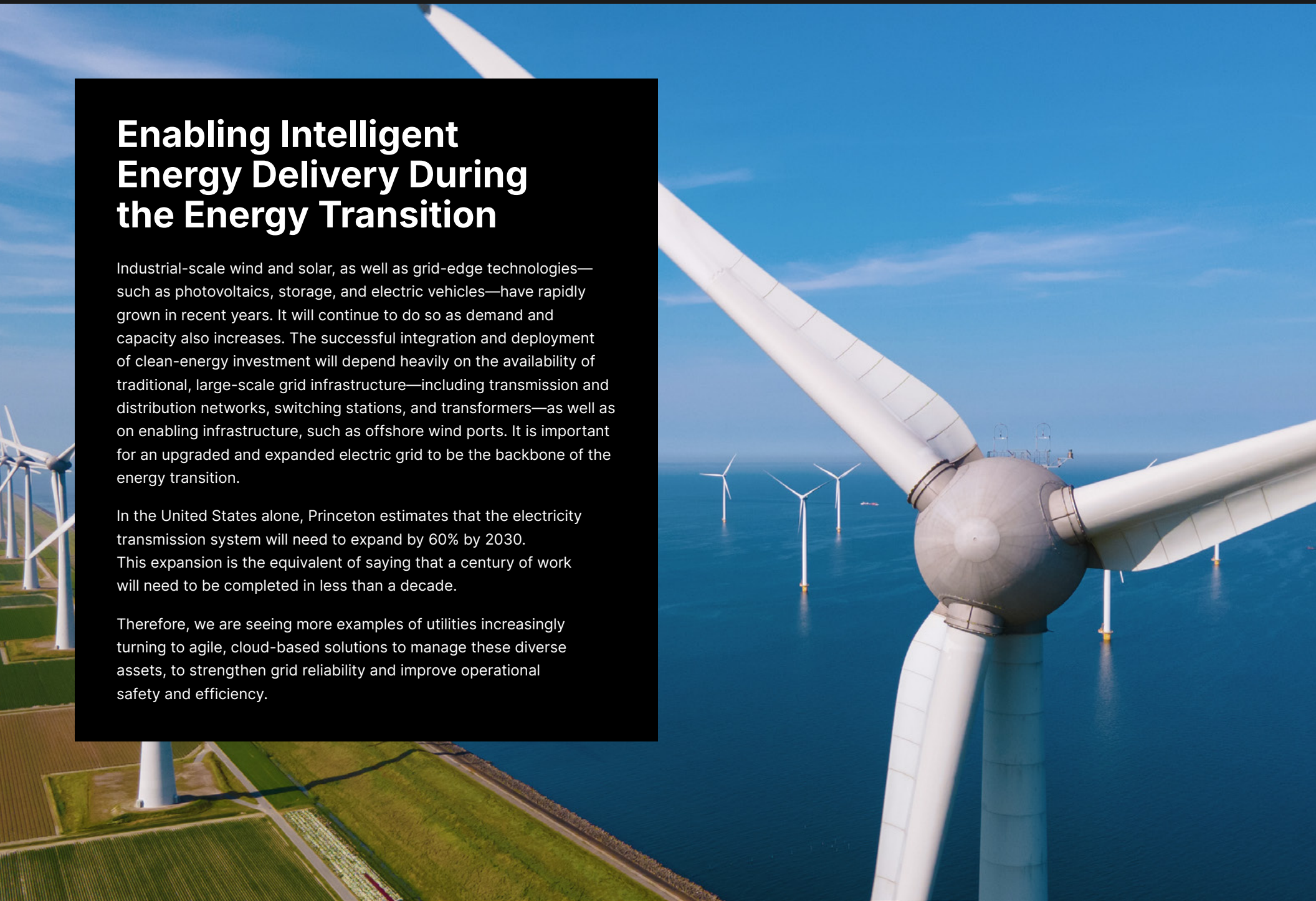
Hydropower: A Digital Revolution at New Bullards Bar Dam

Yuba Water Agency, California, United States
Project playbook: iTwin Capture, iTwin IoT

Yuba Water are committed to the safety and efficient, reliable operations of the New Bullards Bar Dam. They sought to modernize the dam monitoring system by collecting continuous, real-time operational data, to better understand its overall performance, especially during inclement weather and seismic events.

They worked with iTwin Ventures portfolio company, Niricson, to capture a 3D reality mesh from thousands of drone-captured images and then process it in Bentley's iTwin Capture. They then associated the photorealistic model with the dam's monitoring devices to visualize the sensor data in real time. The resulting digital twin visualizes, analyzes, and provides automated decision support, as well as thorough dashboards and reporting on structural integrity and reliability. Compared to a conventional monitoring system, the digital twin approach provides 1,000 times more data monitoring points per week and has significantly improved data accuracy and risk assessment. It allows the team to closely monitor the structure, working toward the agency's ultimate goal of ensuring public safety and protecting the surrounding environment.

Learn more



Enabling Intelligent Energy Delivery During the Energy Transition

Industrial-scale wind and solar, as well as grid-edge technologies—such as photovoltaics, storage, and electric vehicles—have rapidly grown in recent years. It will continue to do so as demand and capacity also increases. The successful integration and deployment of clean-energy investment will depend heavily on the availability of traditional, large-scale grid infrastructure—including transmission and distribution networks, switching stations, and transformers—as well as on enabling infrastructure, such as offshore wind ports. It is important for an upgraded and expanded electric grid to be the backbone of the energy transition.

In the United States alone, Princeton estimates that the electricity transmission system will need to expand by 60% by 2030. This expansion is the equivalent of saying that a century of work will need to be completed in less than a decade.

Therefore, we are seeing more examples of utilities increasingly turning to agile, cloud-based solutions to manage these diverse assets, to strengthen grid reliability and improve operational safety and efficiency.

Advancing Energy Production Infrastructure

Digital technology to help guide you towards infrastructure intelligence and being future ready.

Bentley's proven multidiscipline software delivers innovative solutions for complex energy production projects around the globe through a combination of engineering design and analysis software. Since Bentley's applications are fully integrated, open, and scalable, it is easy to get started with solutions that support your project's entire lifecycle.

Learn more