

# THE FUTURE OF GREEN ENERGY IS NOW

Harness the Power  
of Renewable Energy  
and Work Toward a  
Low-carbon Future



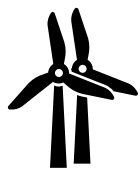
# DIGITAL ADVANCEMENTS AND THE FUTURE OF RENEWABLE ENERGY

Whether your business analyzes, designs, or constructs renewable energy power generation facilities or ensures their ongoing daily operation, Bentley provides solutions throughout your project's lifecycle.

This e-book will present several award-winning renewable energy projects that have relied on Bentley software to analyze, design, build, operate, and compete in today's rapidly changing global environment.

For nearly 20 years, Bentley has helped renewable power generation projects become nimble, sustainable, and innovative. With fully integrated multidisciplinary tools, Bentley software is cloud-based, scalable, flexible, and affordable.

LEARN MORE >



WIND



SOLAR



GEOTHERMAL



TIDAL



HYDROELECTRIC



BIOENERGY



HYDROGEN



# RENEWABLE ENERGY: AN OVERVIEW OF NOTABLE PROJECTS

Offshore Wind	Solar	Geothermal	Hydroelectric	Bioenergy	Hydrogen
<b>Fujian Changle Zone C</b>	<b>Noor II 200MW Parabolic Trough Solar Thermal Power Station</b>	<b>Main Power Generator for Geothermal Operations</b>	<b>Memve'ele Hydropower Station</b>	<b>DCO Green Energy Biomass Project</b>	<b>Hydrogen Cooling System</b>
China	Morocco	Iceland	Cameroon	United States	Poland
Wind farm project with the largest scale and largest capacity in the world. Geological conditions were extremely complex.	World's single largest solar power plant enables Morocco to provide nearly half of its energy from renewable sources.	Rapid development required drilling 100+ wells. Geologists encountered difficulty with compiling and analyzing all data quickly.	Complex station with an installed capacity of 211 MW with four single-capacity units of 52.75 MW and a water reservoir of 82.71 million cubic meters.	50 MW, wood-fired renewable power facility capable of generating 425,000 pounds of steam per hour.	Combined heat and power plant needed a hydrogen cooling system for a 300 MW gas turbine generator.
Resolved a series of technical and engineering issues with an integrated digital environment. Reduced costs by 30%.	Modeled and performed load analysis on irregular structures. Reduced design time by 200 hours. Saved more than CNY 1 million in material costs.	Created a 3D view of data, making it easier for scientists to build the conceptual models.	Saved modeling time and eliminated bottlenecks, shortening the design cycle from 3 months to 1 month.	Analyzed 2,400 tons of structural components and tested the stresses of high pressure and heat on the pipe system. Saved a combined 700 resource hours.	An open, connected data environment streamlined workflows. Saved time, facilitated efficient modeling processes, and automated generation of 2D deliverables.





# INNOVATIVE **PROJECTS**



Onshore and offshore wind power, solar, and geothermal sources contribute to generating clean and renewable energy. There are also many emerging energy sources like hydrogen, wave, and tidal energy that already show great promise.

Complementary power generation plants take energy from the ground, wind turbines, and solar arrays to generate electricity. From geothermal plants in New Zealand to photovoltaic power facilities in the mountains of China, Bentley provides solutions for designing, constructing, and ensuring the ongoing daily operations of cost-effective renewable energy sources.





# ONSHORE WIND

Considering the centuries-long use of windmills, onshore wind power generation is the oldest form of renewable energy. Today, Bentley’s multidiscipline engineering software is enabling organizations to site and construct wind farms in the most challenging terrains.

Learn more about how Bentley supports these onshore wind projects.

Project Name	Location	Engineering Firm / Technology User	Learn More	Project Highlights
Mountain Wind Farm	Chengde, Hebei, China	TBEA Xi’an Electric Design Co	<a href="#">Success Story</a>	Despite difficult terrain, completed in 15 months while saving CNY 3.8 million.
Macheng Caijiazhai Wind Farm Project	Machen, Hubei, China	Hubei Electric Power Design & Survey	<a href="#">Success Story</a>	Overcame mountainous conditions and saved CNY 100,000 during construction.
			<a href="#">Case Study</a>	
Hybrid Tower Project	Dezhou, Shandong, China	Xinjiang Goldwind Science	<a href="#">Case Study</a>	Optimized low wind turbines and saved CNY 900,000.
Senate Wind Farm	Texas, United States	Mortenson	<a href="#">Success Story</a>	Proved the project was possible in difficult terrain.
Wind Turbine Test Site	Netherlands	Ecofys	<a href="#">Success Story</a>	Potential \$4.3 million savings over its 20-year life.
Spring Valley Wind Farm	Nevada, United States	Mortenson	<a href="#">Success Story</a>	Minimized the footprint by 40% to reduce cultural, historical, and biological impact.





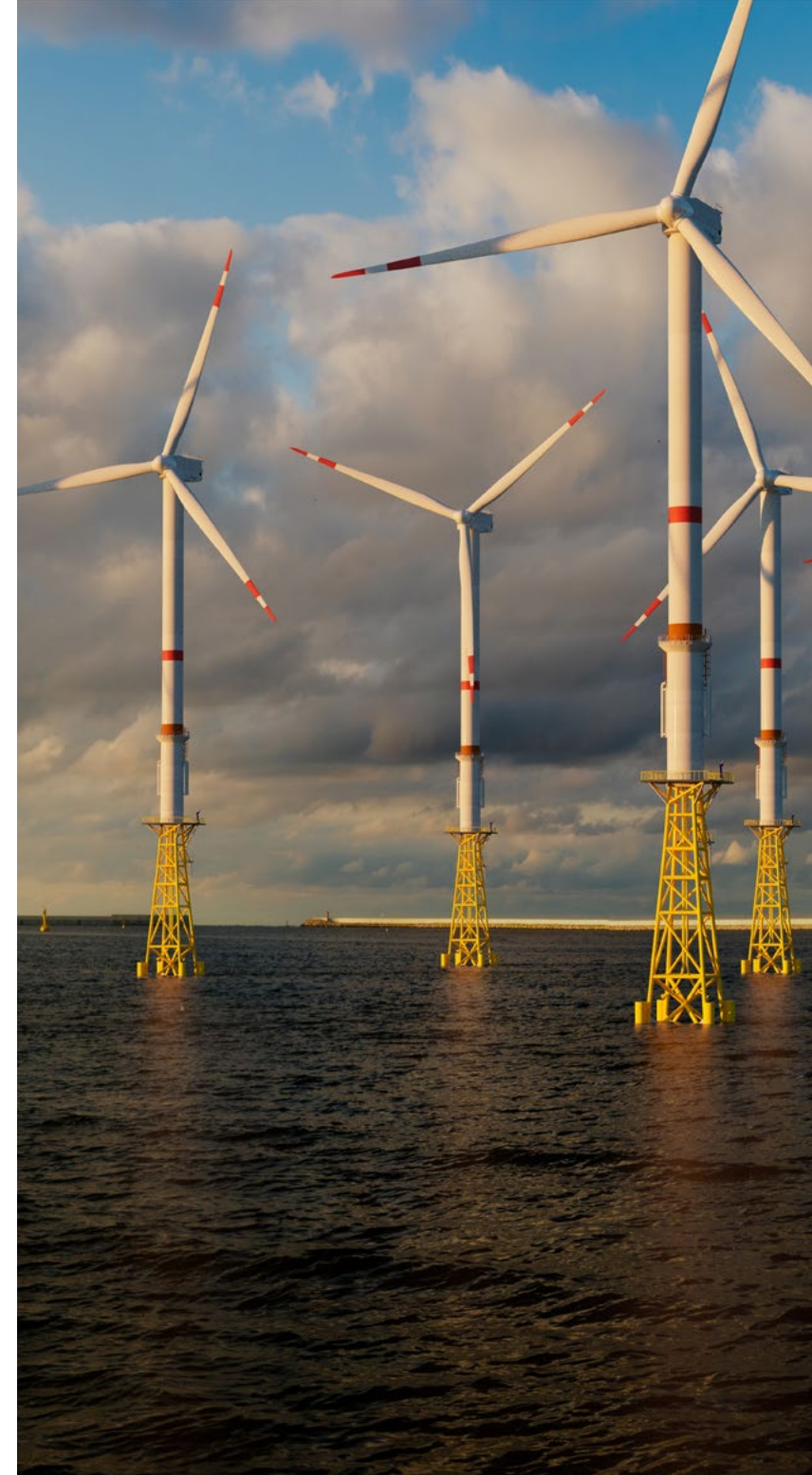


# OFFSHORE WIND

The fastest growing form of renewable energy, offshore wind has more capital spend planned than for any other sustainable form of power generation. Bentley technology is being used to streamline offshore wind projects, helping to deliver these projects in record time and under budget.

## Learn more about how Bentley supports these offshore wind projects.

Project Name	Location	Engineering Firm / Technology User	Learn More	Project Highlights
Fujian Changle Zone C	China	Fujian Yongfu Power Engineering Co., Ltd.	<a href="#">Success Story</a>	Overcame an extreme environment and complicated geology to reduce costs by 30%, saving more than CNY 400 million.
Use of Azure Digital Twins for Offshore Wind	Changwon, South Korea	Doosan Heavy Industries & Construction	<a href="#">Case Study</a>	A digital twin maximized energy production and reduced maintenance costs for existing facilities.
Three Gorges New Energy Dalian Zhuanghe III Offshore Wind Farm Project	Bohai Sea, China	Shanghai Investigation, Design & Research Institute Co., Ltd.	<a href="#">Success Story</a>	A digital twin shortened design by three months, overcame ice challenges, and saved CNY 50 million.
Jiangsu Wind Farm	China	POWERCHINA Huadong Engineering Corp. Ltd.	<a href="#">Success Story</a>	The largest wind farm in the world, establishing China as a global leader for wind energy.
Block Island Wind Farm Project	Rhode Island, United States	Keystone Engineering	<a href="#">Success Story</a>	This commercial offshore wind farm saved 20% of installation costs, and cut design time in half.
Virginia Offshore Wind Technology Advancement Project	Virginia, United States	Keystone Engineering	<a href="#">Success Story</a>	The first American offshore wind farm project proved offshore wind in the United States was cost-effective.
Leting Offshore Wind Farm Test Case	China	Guodian United Power Technology Co., Ltd.	<a href="#">Success Story</a>	Established the approach for Chinese offshore wind projects.





# SOLAR

Solar power generation projects are constantly introducing new technologies and ever larger facilities. Bentley technology helps optimize the land used to support these projects while improving project efficiencies and safety.

Learn more about how Bentley supports these solar projects.

Project Name	Location	Engineering Firm / Technology User	Learn More	Project Highlights
Suixian and Guangshui 80MWp Ground-based Photovoltaic Power Project	Hubei, China	PowerChina Hubei Electric Engineering Co., Ltd.	<a href="#">Success Story</a>	Reduced land required, saving more than CNY 800,000. Saved 30 days of construction. Used iTwin platform for operations digital twins, saving CNY 1 million.
Benban Solar Park	Benban, Egypt	PGESCO	<a href="#">Success Story</a>	One of the world's largest solar parks used ProjectWise to manage this massive project.
BuildLACCD	California, United States	Los Angeles Community College District	<a href="#">Success Story</a>	Achieved net zero energy usage through solar power.
Central Solar PS20 Power Plant	Sanlucar la Mayor, Spain	Energoprojekt Gliwice	<a href="#">Success Story</a>	Pioneered both solar technology and the use of 3D models to promote stakeholder engagement for the biggest solar plant at that time.







# SOLAR WITH STAAD

Bentley's leading structural analysis software is enabling solar power options that would otherwise be considered inconceivable.

**Learn more about how Bentley supports these solar projects with STAAD structural analysis software.**

Project Name	Location	Engineering Firm / Technology User	Learn More	Project Highlights
10MW Canal Top Solar PV Power Plant	West Bengal, India	Skeleton Consultants PVT	<a href="#">Success Story</a>	Determined how to install solar panels on the sides of a canal.
Tubular Steel Building	Dujana, Uttar Pradesh, India	APL Apollo Tubes Ltd.	<a href="#">Success Story</a>	Designed repeatable steel structure with solar panels on roof, reducing the amount of steel needed by 12 to 15%.
National Salt Satyagraha Memorial	Dandi, India	Sterling Engineering Consultancy	<a href="#">Success Story</a>	41 solar trees with 12 panels on each tree.
Solar Panel Design for Hospital	Varanasi, India	RAVI Renewable Energy and Lighting India PVT Ltd.	<a href="#">Success Story</a>	Optimized the design of a rooftop solar structure, including wind analysis.
Solar Panel Supporting Rooftop Structure	Dubai, UAE	Aryatech Marine & Offshore Services	<a href="#">Success Story</a>	Improved engineering analysis by 13%.
Noor II 200MW Parabolic Trough Solar Thermal Power Station	Ouarzazate, Morocco	Qingdao Hongrui Electric Power Engineering Consulting Co. Ltd.	<a href="#">Success Story</a>	World's single largest solar power plant. Modeled irregular structures, saving 200 hours of design time and CNY 1 million in materials.







# GEOTHERMAL

With the acquisition of Seequent, Bentley has added a portfolio of software that enables energy companies to assess their reservoirs and reduce the risks from exploration and production of geothermal energy.

**Learn more about how Seequent, a Bentley company, supports these geothermal projects.**

Project Name	Location	Engineering Firm / Technology User	Learn More	Project Highlights
Five Geothermal Plants	New Zealand	Contact Energy	<a href="#">Video</a>	Faster resource appraisals, assessment, and reviews for the second-largest electricity generator in New Zealand.
Three Geothermal Plants	Indonesia	Supreme Energy	<a href="#">Video</a>	Saved time by making more informed decisions about the subsurface.
Main Power Generator	Iceland	Reykjavik Energy	<a href="#">Video</a>	Saved time on crunching well data, performing three times the amount of work in just half the time.
Explorative Study	Netherlands	EnerGeophy Consultancy and others	<a href="#">Case Study</a>	Geothermal potential for the Netherlands to replace its dependence on gas.

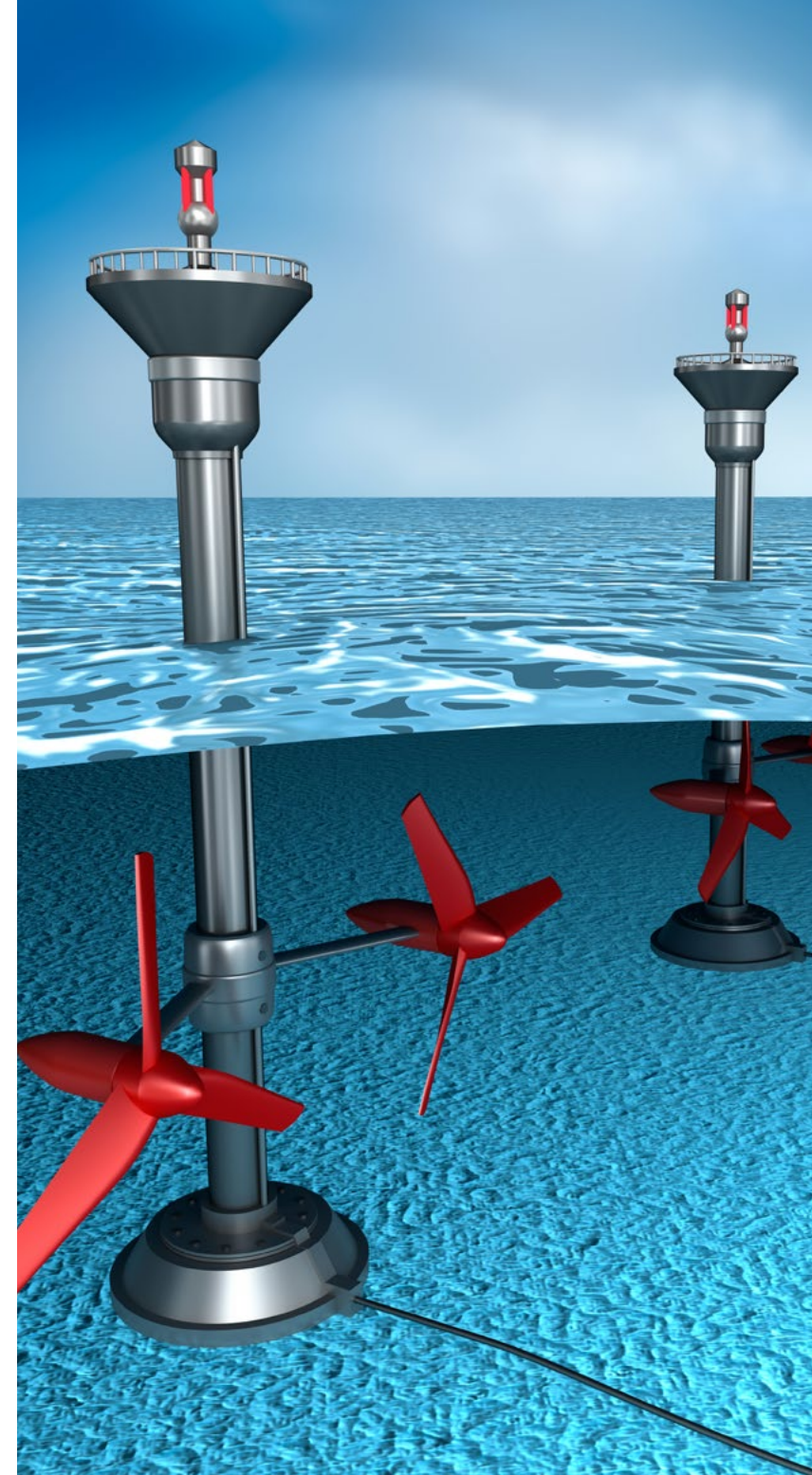


# WAVE AND TIDAL

The newest area of renewable power generation, advanced wave and tidal power technologies are being introduced at a rapid rate. The flexibility of Bentley's offshore analysis software is ideally suited to this rapidly evolving industry.

Learn more about how Bentley supports this wave and tidal project.

Project Name	Location	Engineering Firm / Technology User	Learn More	Project Highlights
Offshore New Energy Utilization Research and Development Project	China	Guodian United Power Technology Co., Ltd.	<a href="#">Success Story</a>	Prototype tidal power plant project used SACS for offshore structural design and engineering.







# HYDROELECTRIC

How can you improve the integration of information and better manage all engineering disciplines in the design and construction of complex hydroelectric power and dam infrastructure? Bentley's solutions enable design visualization and digital collaboration, so that teams can benefit from improved design coordination and analysis for all mechanical, civil, and structural elements.

## Learn more about how Bentley supports these hydropower projects.

Project Name	Location	Engineering Firm / Technology User	Learn More	Project Highlights
Geological Survey of Water Conservancy and Hydropower Engineering	Tibet, China	China Water Resources Beifang IDR	<a href="#">Success Story</a>	Overcame complex geography and geology, saving CNY 400,000 in survey costs and more than half of survey time.
Wuqiangxi Hydroelectric Power Station Expansion	Hunan, China	PowerChina Zhongnan Eng Corp	<a href="#">Success Story</a>	Reduced design time by two months, saving CNY 50 million.
Hanjiang Yakou Shipping Hub Engineering Project	Yicheng City, Hubei, China	Hunan Hydro & Power Design Institute	<a href="#">Success Story</a>	Shortened the construction period for this massive project by three months, saving CNY 30 million.
Hydroelectric Use of the Foz Tua Dam	Foz Tua, Portugal	Sacyr Somague	<a href="#">Success Story</a>	Effectively used 3D software capabilities for construction in hard-to-reach location.
Wugachong Reservoir Project	Guizho, China	China Water Resource Pearl River Planning Surveying & Designing	<a href="#">Success Story</a>	Faced complex topographic and geological challenges to solve drought issues and produce renewable energy.
Qiongzong Pumped Storage	Hainan Province, China	PowerChina Zhongnan Eng Corp	<a href="#">Success Story</a>	3D BIM saved more than CNY 122 million.
Kholombidzo Hydroelectric Power Plant	Province District of Blantyre, Malawi	COBA	<a href="#">Success Story</a>	Feasibility study and detailed engineering were used to geo-coordinate 14 models.
Longkaikou Hydropower Station	Jinsha River, Yunnan, China	PowerChina Huadong Eng Corporation	<a href="#">Success Story</a>	First hydropower station in China to employ BIM technology. Saved \$300 million, 10 months ahead of schedule.
Ribeiradio-Ermida Hydroelectric Project	Sever do Vouga, Aveiro, Portugal	COBA	<a href="#">Success Story</a>	First significant project on the Vouga River basin. Overcame complex geotechnical conditions and difficult topography, with integrated civil and equipment design.
Keeyask Hydroelectric Plant	Manitoba, Canada	Hatch	<a href="#">Success Story</a>	Streamlined construction of complex concrete structures and surrounding infrastructure.
Qingyuan Pumped Storage Power Station	China	Guangdong Hydropower Planning & Design Institute	<a href="#">Success Story</a>	Achieved 20% increase in design efficiency and cut project delivery cost by \$240,000.
Memve'ele Hydropower Station	Nyabissan, Cameroon	Beifang Investigation Design & Research Co. Ltd.	<a href="#">Success Story</a>	Reduced modeling time and eliminated bottlenecks with efficient parametric modeling.





# BIOENERGY

Bioenergy projects help eliminate the footprint left behind by material production and transportation, construction, debris, and waste removal by generating power from waste wood otherwise destined for landfills. Bentley software has helped users create intelligent 3D models to use in design reviews, clash detection, and virtual walkthroughs, as well as to produce deliverables required for construction and operation.

## Learn more about how Bentley supports these bioenergy projects.

Project Name	Location	Engineering Firm / Technology User	Learn More	Project Highlights
Biomass Combined Heat and Power Project	Qingyuan County, China	Hangzhou Bole Computer Technology	<a href="#">Success Story</a>	Integrated design saved 20% in modeling time. AssetWise ALIM expected to save CNY 1 million annually. This is China's first small intelligent digital power plant.
DCO Green Energy Biomass Project	Albany, Georgia, United States	ESI Inc.	<a href="#">Success Story</a>	Wood-fired generator for Procter & Gamble. STAAD.Pro and AutoPIPE saved 700 hours in design time.
Tyseley Resource Recovery Centre	United Kingdom	MWH Global	<a href="#">Success Story</a>	The first power generation project from waste wood in the UK. The project included plant and building models.
DOE Biomass Cogeneration Facility	Aiken, South Carolina, United States	ESI Inc.	<a href="#">Success Story</a>	Replaced coal with biomass energy on the project using AutoPIPE. The project reflected the new use of 3D models instead of 2D.
Meath Energy-from-Waste (EFW) Project	Duleek, Ireland	MWH Global	<a href="#">Success Story</a>	ProjectWise was used to coordinate designs across multiple applications.







# HYDROGEN

Hydrogen is a key component of future energy systems, especially when it is produced without carbon dioxide emissions. As a result, energy demand for hydrogen production could ultimately exceed that for electricity production today. From an edible oil refining complex that includes a hydrogenation plant in India to a hydrogen cooling system in Poland, Bentley software helped bring them to life. Bentley can support the design, construction, and ongoing daily operations throughout your hydrogen facility's lifecycle as well.

## Learn more about how Bentley supports these hydrogen projects.

Project Name	Location	Engineering Firm / Technology User	Learn More	Project Highlights
Executive Design of the Pipelines for the Hydrogen Generator Cooling System	Stalowa Wola, Poland	Energoprojekt-Katowice, SA	<a href="#">Success Story</a>	An open environment streamlined workflows and saved significant time. ProjectWise, OpenPlant, OpenBuildings Designer, and AutoPIPE were chosen for the project.
Sheel Oil & Fats Plant	Gandhidham, Gujarat, India	Saunrachana Strucon	<a href="#">Success Story</a>	Used STAAD to achieve the economical design of a 64-meter tall plant including several service floors.
GGSR Hydrogen Generation Unit Reformer Package	Bathinda, Haryana, India	Larsen & Toubro Hydrocarbon Engineering Limited	<a href="#">Success Story</a>	Large, complex project, using Bentley tools for visualization and structural engineering. Streamlined workflows in addition to saving resources hours and costs.



# HELPING TO BUILD THE **FUTURE OF RENEWABLE ENERGY**

As the renewable energy industry continues its upward trajectory, and as concerns about climate change and the demand for cleaner energy sources continue to accelerate, there will be greater emphasis on analyzing, designing, building, and operating infrastructure projects that support the generation of clean energy from natural resources.

Bentley's proven multidiscipline software delivers groundbreaking solutions for complex projects through a combination of engineering design and analysis software coupled with a complete understanding of the terrain, environment, and geology on which the asset is to be built. Since Bentley's applications are fully integrated, cloud-based, and scalable – and you only pay for what you use – it is easy to get started with solutions that support your project's entire lifecycle.

To learn more, or to watch a video, [click here](#).

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