



# Hydropower & Dams









# Lowering carbon and creating a climate-resilient future with hydropower

## Navigating the rapids: Challenges and currents in hydropower and dams

Changes in precipitation patterns, regulatory requirements, aging infrastructure, and striking a balance between energy generation and environmental conservation are all top of mind. Efforts to address climate change have spurred heavy investments in renewable energy all around the world. At the same time, developing nations are searching for new sources of electricity and better ways of managing freshwater resources to meet the needs of their growing populations; while in more developed regions, operators are trying to optimize the value of their existing assets while maintaining reliability and safety.

Advances in technology and digitalization are opening a new era of possibilities and opportunities. Repowering and refurbishing existing facilities are more feasible, new and large projects are now more plausible, and hydroelectric energy storage is leading to increased grid reliability.

With so much riding on finding new sources of clean, affordable electric power, we push to develop innovative approaches and cost-effective solutions. The world's future may very well depend on overcoming these challenges and harnessing these valuable resources. With expertise that spans across the full hydroelectric value chain, we can help!



# Essential services, sound strategies

With the recent surge in non-dispatchable renewable generation, we offer tangible benefits to the electrical grid.

## Pumped storage hydropower

Pumped storage hydropower (PSH) is crucial for stabilizing electrical grids with increasing **renewable energy**. Acting like massive **batteries**, PSH stores energy until needed and provides essential grid services. These systems can be isolated or integrated with natural waterways. Engineering PSH projects requires expertise in high-head hydropower, involving **tunneling** and underground complexes. Operational specifics affect hydraulic design and equipment. Our experience ensures we manage in-situ stresses, provide precise equipment specifications, and use advanced digital tools for innovative, cost-effective PSH solutions.

## Greenfield hydroelectric developments

With many hydropower opportunities still untapped, these resources are vital for meeting baseload electricity needs. When existing infrastructure isn't viable, we collaborate to create innovative solutions. Key factors for successful hydroelectric projects include financing, site selection, stakeholder engagement, sustainable development, safety standards, and risk management. We assist developers and operators in both private and public sectors, offering comprehensive engineering design, procurement, and construction management services. Our goal is to minimize risks, maximize profitability, and tailor our services to complement the owner's team.

## Life extension: Redeveloping and rehabilitating

As hydropower facilities age, extending their lifespan and optimizing investment value is crucial. We assist with performance optimization, asset condition assessments, health evaluations, and risk-based investment planning. Our experts handle upgrades and refurbishments, including automation and controls. We offer full life-extension services, using tools like Grow3D, 7D digital twin, and proprietary software such as **HydroVantage™** and **VistaDSS™** to identify risks and optimize capital expenditures. When life extension isn't viable, we ensure safe and responsible decommissioning.

## Repowering and equipment upgrades

Risks and costs must always be weighed against the benefits of upgrading or replacing capital equipment. We've pioneered tools and techniques to measure the efficiency of turbines so you can determine the best plan for your operation based on up-to-date data.

Aging facilities face increased costs, making investment decisions and outcomes more uncertain. Our experts can aid in decision making and provide practical cost-effective solutions to maximize or extend the life of existing assets. If you are seeking to maximize the hydroelectric potential of existing sites, we can help perform a **condition assessment** and audits, provide recommendations, and engage in a wide range of engineering and project management services for both new and/or life-extension projects.

## Dam safety, risk and public safety

Globally, dam owners face challenging decisions to maintain aging assets, balancing safety with limited financial and human resources. They must invest wisely to maximize the value of their interventions. Under these circumstances, making well-informed choices is crucial. Hatch is at the forefront of dam safety worldwide, collaborating with clients and regulators to develop guidelines and best practices that protect both clients and the public. We have been instrumental in creating the Canadian Dam Association (CDA) guidelines, as well as several provincial, federal, and international standards.

Hatch excels in **risk-informed decision making**, which complements standards-based assessments. We work closely with our clients, providing key technical advice and guidance to meet dam safety principles and legislative compliance. Our extensive experience ensures that dam owners can make the best investment decisions, ensuring their dams are operated and maintained safely while extracting the most value from their resources.

In the past decade, best practices for public safety management around dams have evolved significantly. Hatch has been at the forefront of these developments, actively participating in key industry groups like the CDA, the United States Society on Dams, Association of State Dam Safety Officials, and International Committee on Large Dams. Our extensive experience ensures that public safety assessments are performed efficiently and meet industry standards. We offer comprehensive services, including site and risk assessments, developing public safety management plans, and creating full portfolio programs. Additionally, we specialize in designing multifunction public safety, debris, and ice booms, leading the charge in innovative public safety control measures.

## Gates and penstocks

The importance of your gate equipment and penstocks cannot be overstated. Many of these pressure-retaining **structures** have aged to the point that both their reliability and structural integrity have been compromised. Hatch's wealth of expertise in the design, assessment, refurbishment, and replacement of gates and penstocks applies to all types, sizes, and geographical locations. We understand the unique characteristics of each site and the challenges associated with lost energy, dewatering, capital costs, and access.

## Small or run-of-river hydro

Developing or rehabilitating small run-of-river hydro projects demands the same expertise as large hydro but requires more creativity and innovation. Cost sensitivity is crucial, necessitating a focus on fundamentals and innovative approaches like modular powerhouses and off-site installations. Rehabilitation involves unique challenges, such as working within old structures and navigating permits and safety guidelines. Our experienced team addresses these challenges, offering customized solutions for greenfield developments, redevelopments, rehabilitations, or retrofits, ensuring economic viability and compliance with modern standards.

## Digital assets and digital twins

**Digital information management** enhances an asset's life cycle, from engineering to operations. As projects progress, a digital asset is developed, improving in quality and maturity, eventually forming a **digital twin**. This twin drives operational value by connecting to sensor networks and management systems, enabling simulation, analytics, and optimization. It provides easy access to trusted data and improves decision-making. By integrating engineered information into design, development, and operation, we offer expertise, consultation, and support to help owners and operators manage and reuse information throughout the plant life cycle.

## Alkali-aggregate reaction (AAR)

We are industry leaders in modeling and managing concrete growth in dams and powerhouses.

Through the successful execution of multiple assignments, our industry leading teams have developed proactive approaches to deal with the effects of concrete expansion due to AAR. This provides confidence to safely operate affected dams and powerhouses. Our practical long-term experience, combined with efficient numerical tools like GROW3D, provide a perfect combination to deal with AAR-affected structures. We have developed unique methods to address AAR-induced deformations, which affect overall dam safety, gate operation issues, and turbine/generator clearances, etc.

## Other capabilities include:

- Independent engineering
- Performance testing
- Rock mechanics and underground structures
- Operational support studies
- Regulatory support, permitting.









# Selected project experience

## Pioneering flood defense for community safety and resilience

Fargo Moorhead Floodway Authority, USA

The Fargo-Moorhead project is designed to protect the region from catastrophic flooding. Our team developed the 30-mile diversion channel and the 20-mile earthen embankment, which includes three gated control structures and two aqueducts. In addition, we conducted extensive environmental impact studies and secured necessary permits, ensuring the project met stringent regulatory standards. This project not only safeguards over 235,000 residents and their properties but also enhances the region's resilience against future flood events. By integrating innovative engineering with rigorous environmental care, the Fargo-Moorhead project demonstrates the critical role of comprehensive planning in community protection.

## Amplifying Manitoba's renewable energy capacity

Manitoba Hydro, Canada

The Keeyask Generation project has significantly boosted Manitoba's renewable energy capacity, providing sustainable power to thousands of homes. Hatch partnered closely with the client, providing comprehensive engineering services from initial design to execution, ensuring the successful delivery of the 695-MW generating station. We navigated complex regulatory requirements and designed the powerhouse, spillway, and infrastructure. Our innovative solutions and commitment to environmental stewardship helped overcome numerous challenges. The client's collaboration with our team was marked by a shared vision for community engagement and long-term energy solutions.





## Innovating flood control to enhance safety and sustainability in Peru

Consorcio Besalco-Stracon, Peru

The Quebrada El León Flood Control Works project in Peru is an award-winning project designed to mitigate the impacts of flash floods caused by El Niño events. We played a crucial role in developing the conceptual designs, conducting cost-benefit analyses, and securing environmental permits. Our innovative approach included a 20-kilometer canal designed to minimize maintenance and ensure flood waters avoid sensitive areas, significantly reducing costs and environmental impact. This project not only enhances public safety but also supports the local economy by protecting vital agricultural lands and infrastructure. This project stands as a testament to our ability to deliver impactful engineering solutions that safeguard communities and promote sustainable development.

## Transforming northern Peru with innovative irrigation and hydropower

Ministry of Agricultural Development and Irrigation of Peru, Peru.

The Chavimochic project, a monumental irrigation initiative in northern Peru, is set to transform the La Libertad region. By capturing water from the Santa River, it will irrigate the Chao, Virú, Moche, and Chicama Valleys, while generating hydroelectric power. This ambitious endeavor aims to provide drinking water to 40,000 families and create 150,000 jobs. We have been instrumental in this project, offering key design and engineering expertise, conducting technical inspections, and developing a comprehensive project execution plan. The project emphasizes community engagement and has implemented new procedures to protect archaeological finds. With the potential to triple Peru's agricultural exports, Chavimochic is a key pillar in the region's social and economic development and once complete, will be the largest drip irrigation project in the world.



## The Lower Connecticut River relicensing for sustainable hydropower

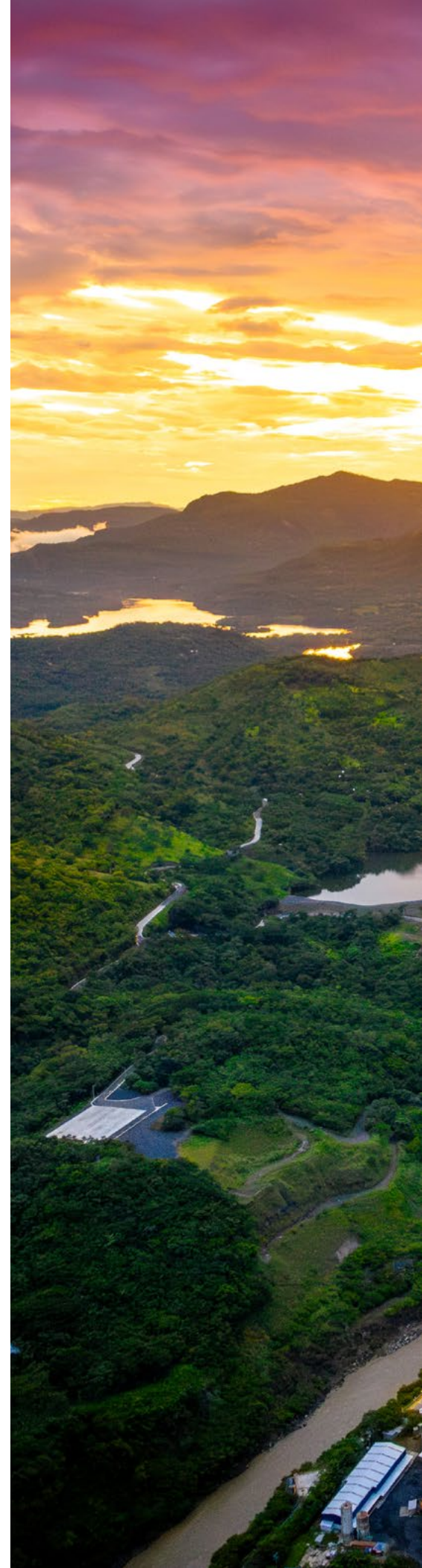
TransCanada Hydro Northeast Inc., USA

The Lower Connecticut River Relicensing Study is a comprehensive initiative aimed at securing a new Federal Energy Regulatory Commission (FERC) license for key hydroelectric projects in New Hampshire and Vermont. We played a vital role in assessing hydro system operations using hourly simulation models, ensuring efficient and sustainable energy production. Our team conducted extensive studies on the environmental impacts and operational effects on the riverine ecosystem, leading to significant ecological benefits. This project not only supports renewable energy goals but also enhances the ecological health of the Connecticut River by improving water quality and habitat conditions. The study exemplifies the importance of balancing energy needs with environmental care.

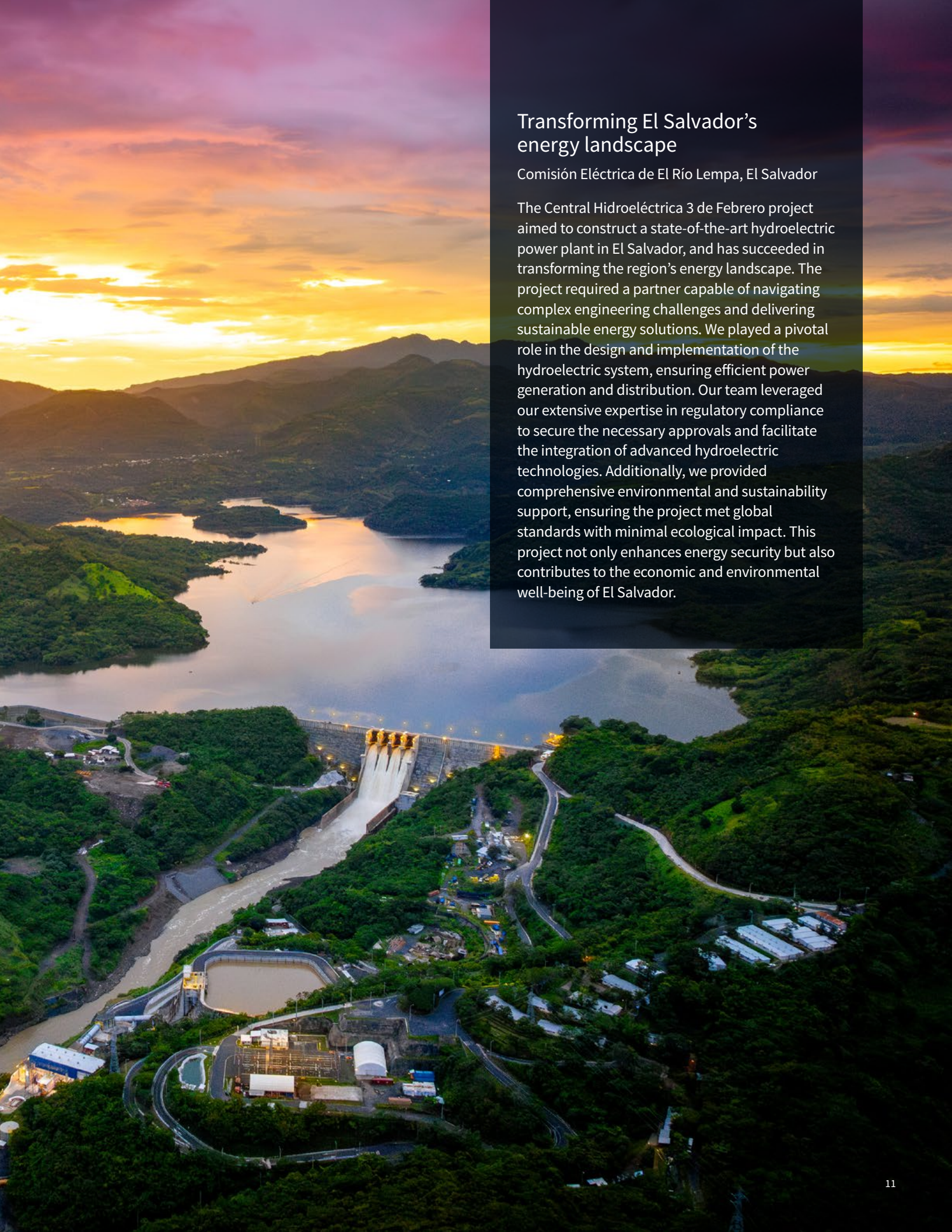
## Ontario's renewable energy revolution

TC Energy, Canada

The transformative 1,000-MW pumped hydropower storage project in Meaford, Ontario, is one of Canada's largest climate change initiatives. Our team provided design, investigation, planning, reservoir safety expertise, and advisory services for this advanced facility, which will deliver flexible, clean, and renewable energy to Ontario. We are conducting comprehensive environmental impact assessments and securing necessary permits to ensure the project meets stringent regulatory standards. This initiative will not only support Canada's renewable energy goals but also enhance the region's energy resilience and sustainability. By integrating progressive hydropower expertise and engineering with rigorous environmental care, the project underscores the critical role of innovative solutions in addressing climate change.







## Transforming El Salvador's energy landscape

Comisión Eléctrica de El Río Lempa, El Salvador

The Central Hidroeléctrica 3 de Febrero project aimed to construct a state-of-the-art hydroelectric power plant in El Salvador, and has succeeded in transforming the region's energy landscape. The project required a partner capable of navigating complex engineering challenges and delivering sustainable energy solutions. We played a pivotal role in the design and implementation of the hydroelectric system, ensuring efficient power generation and distribution. Our team leveraged our extensive expertise in regulatory compliance to secure the necessary approvals and facilitate the integration of advanced hydroelectric technologies. Additionally, we provided comprehensive environmental and sustainability support, ensuring the project met global standards with minimal ecological impact. This project not only enhances energy security but also contributes to the economic and environmental well-being of El Salvador.





## About Hatch

Hatch is a global engineering, project management and construction, and professional services firm. Whatever our clients envision, our professionals can design and build. With over six decades of business and technical experience in the energy, infrastructure, and mining sectors, we know your business and understand that your challenges are changing rapidly.

We respond quickly with solutions that are smarter, more efficient and innovative. We rely upon our 10,000 staff with experience in over 150 countries to challenge the status quo and create positive change for our clients, our employees, and the communities we serve.

[hatch.com](https://hatch.com)



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