



ENERGY

INFRASTRUCTURE

MINING & METALS

NUCLEAR, SECURITY
& ENVIRONMENTAL



BECHTEL ENERGY
**Decarbonization
Solutions**

The Decarbonization Challenge

Energy companies have developed considerable carbon reduction targets to face the challenge of global climate change head on. The roadmap can be very complex to design and implement a net-zero program within the short timeframe required to meet or exceed the terms of the Paris Climate Agreement.

There is no one-size-fits-all approach to achieving decarbonization targets. Goals are met by implementing a range of design, technology, construction, and operations solutions. Having the ability to accurately determine the overall cost/benefit impacts when planning a complex project design or retrofit an existing facility is key to executing a successful improvement program.

Identifying the optimum decarbonization measures requires knowledge of technological advances, the development of an action plan, the ability to build sustainably, delivering carbon-reducing assets integrated with policy and regulation landscape, and managing the execution of this roadmap cost-effectively. Having the capability to accurately forecast carbon emissions in current and future operations will help determine what carbon reduction efforts will be the most effective for each unique situation.

Establishing a Framework for Achieving Enterprise Goals

Decarbonization Solutions

At the core of Bechtel's offering lies our ability to conceptualize, design, and execute the entire range of solutions that can turn your "Net-Zero" vision into reality. Every project is unique, and so tapping into Bechtel's vast array of execution capabilities can help each project realize its full potential.

The key to setting your capital program is to develop a plan to implement project solutions that incrementally reduce greenhouse gas emissions over time.

Bechtel specialists can help you identify a phased approach that suits your goals and budget, taking into consideration the advancement of emerging technologies and the specific time constraints for your facility (turnarounds, design life, and alignment with other capital programs).

Expert Technical Solutions

Concept selection can be highly impactful in delivering results for your decarbonization pathways. Our technical specialists bring decades of technology experience and are continually shaping the next generation of low-carbon solutions for greener, cleaner, and safer facilities.

Framework Study Approach

Bechtel specialists are actively engaged in framework studies that can support the development of a capital project roadmap designed to meet your low-carbon objectives.

Project Delivery Focus

A sound capital project roadmap requires well developed plans from initial concept right through execution and startup. Our Bechtel specialists are renowned experts and further backed by decades of EPC know-how that results in practical programs for bringing your decarbonization objectives to reality.

Current State

Existing assets generate greenhouse gas emissions from a variety of sources and carbon-intense products.

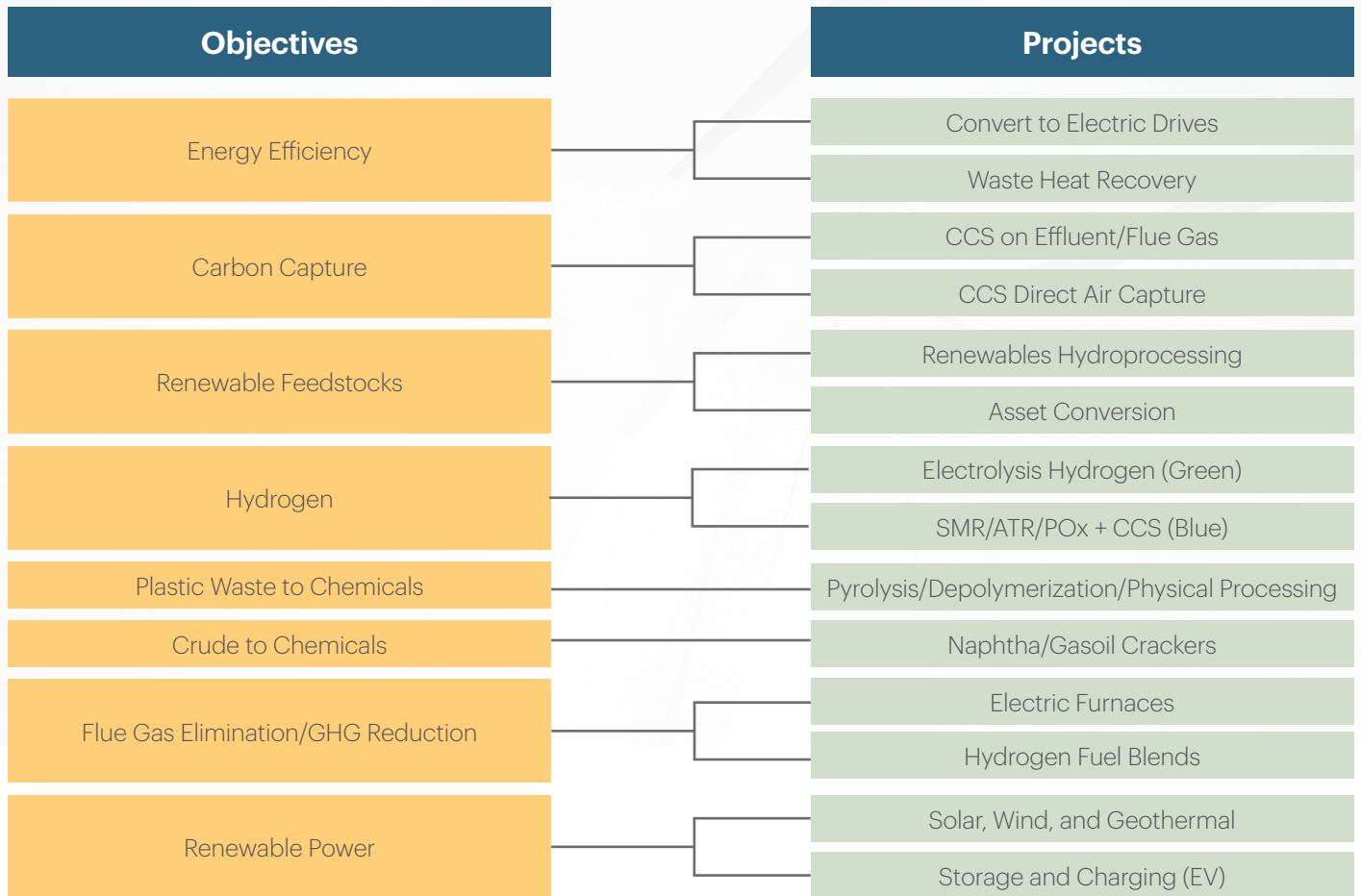


It Begins with Technology Selection

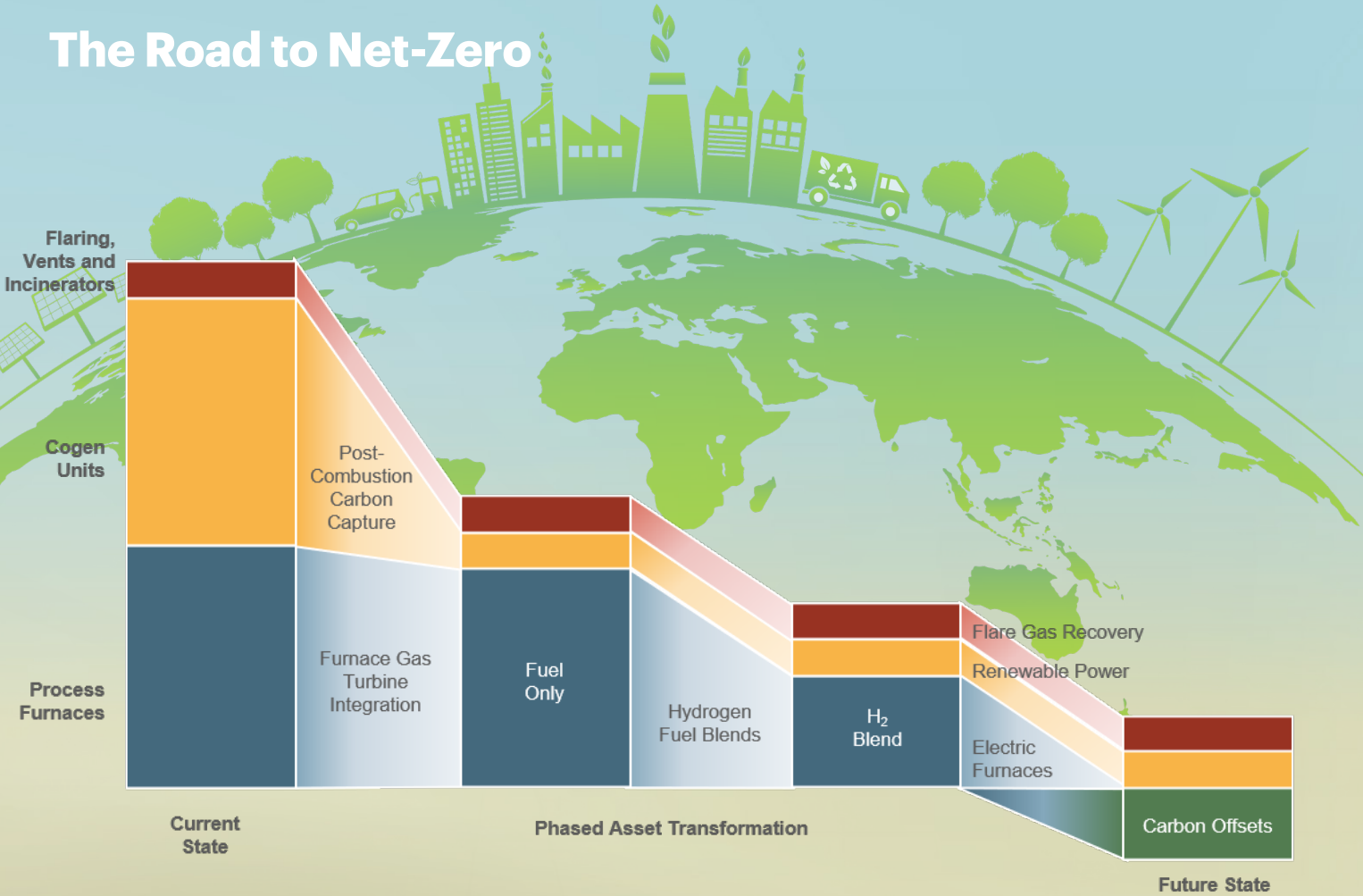
We believe decarbonization of even the most challenging asset is achievable through a variety of pathways using either proven or breakthrough technologies. Operators must evaluate the range of pathways available them as they establish a plan to meet their goals, and each pathway can have a range of outcomes. Understanding these pathways takes a team of experts with knowledge of not only the solutions, but the current state of the assets and the cost to implement each solution.

Collaborative Review of Available Solutions

Supported by world-renowned experts, our depth of technology experience and technology development capabilities, and a suite of in-house licensed technologies, we examine innovative solutions together with our clients to establish a solid plan. We evaluate the application of proven technologies, emerging technologies – and innovative combinations of both – to reduce greenhouse gas emissions of new and existing assets. Bechtel specialists are continually tracking developments in energy technologies to establish a framework for full techno-economic evaluation.



The Road to Net-Zero



Decarbonization Master Plan Framework

Bechtel can offer a comprehensive feasibility study. Our subject matter experts are focused on delivering for our customers as they tackle the challenges of the energy transition. Bechtel delivers optimized solutions to help our customers realize lower capital costs, shorter times-to-market, and projects with lower carbon emissions:

- **GHG source identification** – Expert knowledge of refining, petchem, and power generation facilities.
- **Technology selection** – Technology neutral and ability to access best solutions.
- **CAPEX estimates** – Robust estimating tools based on real-world project execution.
- **Sustainable delivery** – A focus on delivering our projects sustainably and as carbon-neutral as possible.
- **Master planning** – Proven capabilities in delivering complex master plans for a broad range of commercial, industrial, residential, and infrastructure programs.

Evaluate

Gather data on types and sources of emissions. Establish a full picture of the current operating assets.

Analyze

Our SMEs are involved in a broad range of industries. Identify potential reduction targets based on:

- Source type
- Available technology
- Technology readiness level
- Operational best practices

Prioritize

We apply in-house process simulations and cost estimating tools to compare the cost/benefit of the identified solutions.

Carbon intensity calculations and CO₂ equivalents are estimated to rank options using an agreed set of parameters.

Plan

A program of capital projects identified based on priority, capital spend over time, and a conceptual schedule to align with facility turnaround schedules.

Execute

Design, procurement, and construction of projects in a staged program.

Greenfield facilities, revamps, or in-plant modifications.

Bechtel Technical Expertise

Experienced subject matter experts engage on the front end of project development to assess technologies and process configurations and to provide advanced technical solutions. Subject matter experts are experienced in executing technology assessments, concept appraisals, solution selections, techno-economic feasibility studies, and pre-FEEDs. They are responsible for evaluating new technologies and advising our customers on strategies to improve industrial facilities to lower carbon emissions.

	Specialty	Years Experience	Hydrogen	Carbon Capture	SMR / ATR / POX / Gasification	Renewable Chemicals	Geological Studies	Study Management
Rao Atmuri	Green Hydrogen/ Ammonia	30+	✓		✓			✓
Sarvesh Bhavaraju	Study Manager	25+	✓	✓				✓
David Chaplin	Process	35+	✓	✓	✓			✓
Martin Curtis	Carbon Capture	25+	✓	✓	✓			✓
Cor Van Egmond	Olefins	25+	✓	✓		✓		✓
Bill Elliot	Post-combustion Carbon Capture	35+		✓				✓
John Gulen	Power Plant Decarbonization	30+		✓	✓			✓
Tom Jones	Chemical Technology	35+	✓			✓		✓
Charles Kimtantas	Emerging Technologies	40+	✓	✓	✓			
Andrei Sorin	Carbon Capture (Bantrel)	25+		✓	✓			
Martin Taylor	Pre-combustion Capture	20+		✓	✓			
Stewart Taylor / Matthew Waterman	Geological	25+ 30+					✓	



Gas Processing

Operators are evaluating new technologies to reduce emissions. Bechtel has been active in this space for 40 years and built more than 30 amine-based CO₂ removal units in the last 15 years – including the largest in the world.

Storage

Storage and compression of CO₂, LNG and hydrogen can be complex. Bechtel has over 50 years of experience building cryogenic storage systems.

LNG

Operators are evaluating a range of decarbonizing strategies. Bechtel's LNG Technology Center of Excellence can help develop a decarbonization solution for any asset.

Pipeline

Hydrogen and CO₂ pipeline infrastructure will be a key enabler for many solutions. Bechtel's pipeline group has developed more than 50,000 miles of pipeline transporting all types of industrial fluids.

Decarbonizing Project Delivery through Predictive Data Analysis

At Bechtel, we are addressing this challenge through our proprietary strategic carbon assessment platform that calculates the cost and impact of execution strategies that will result in carbon, water use, and waste reduction and track carbon reduction efforts. The platform assesses technologies as well as advanced design, technology, supply chain, construction, and operations data to provide predictive analysis of overall carbon reduction outcomes.

Using this data, customers can build custom carbon and waste reduction solutions that allow them to confidently deliver on their decarbonization and economic targets. The platform also enables customers to compare the environmental and cost benefits and determine what impact these initiatives will have on their project's CO₂ profile during operations.

Mega Refinery

Role: Conceptual Study

Bechtel conducted a carbon capture study to assess decarbonization opportunities for a confidential site. The study analyzed major point sources, CC technologies, and storage/ disposition options with conceptual cost estimates.

LEEDS (Low Energy Ejector Desalination System)

Role: Technology Development

LEEDS can treat produced water and other high total dissolved solid (TDS) wastewaters for reuse using less energy than other treatment solutions on the market. Treated water can be utilized for beneficial reuse in water scarce regions.

Blackrock Wind, West Virginia

Role: EPC

Blackrock Wind will include 23 Siemens-Gamesa SG 5.0-145 wind turbines on 107.5-meter-tall towers, producing 115 MW of electricity at the point interconnection to the First Energy electrical grid.

Refining & Petrochemicals

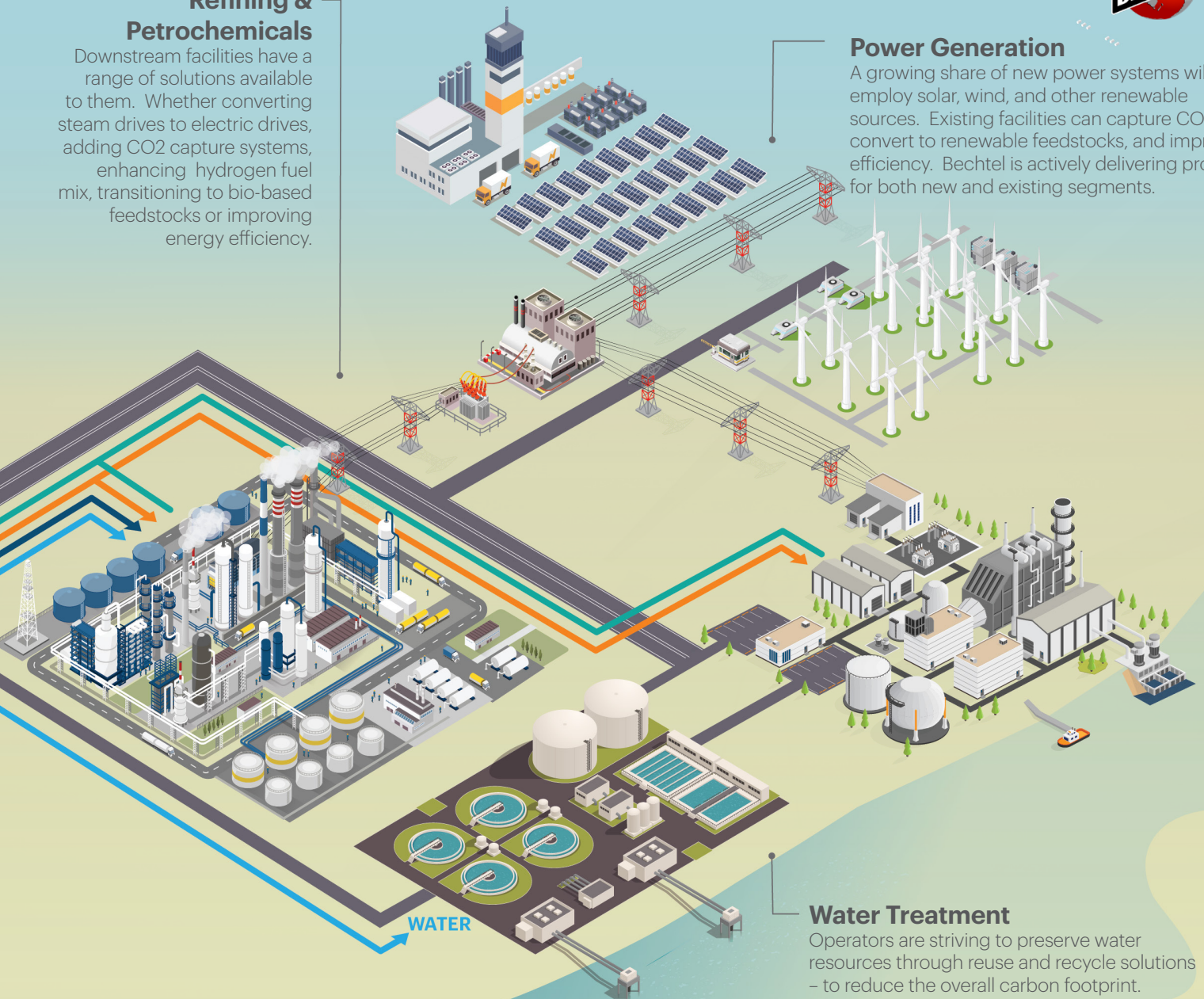
Downstream facilities have a range of solutions available to them. Whether converting steam drives to electric drives, adding CO2 capture systems, enhancing hydrogen fuel mix, transitioning to bio-based feedstocks or improving energy efficiency.

Power Generation

A growing share of new power systems will employ solar, wind, and other renewable sources. Existing facilities can capture CO2, convert to renewable feedstocks, and improve efficiency. Bechtel is actively delivering projects for both new and existing segments.

Water Treatment

Operators are striving to preserve water resources through reuse and recycle solutions – to reduce the overall carbon footprint.



New Build BECCS — US, UK, Italy

Role: Conceptual Study for confidential customer

Bioenergy with carbon capture and storage study evaluating the integration of a biomass conversion project and site infrastructure to turn a power station carbon negative' by utilizing carbon capture technology to remove the carbon dioxide from the flue gas.

Sherman Carbon Capture, Texas

Role: Front-end Engineering Design

Bechtel is conducting a comprehensive FEED study for a retrofit carbon capture and compression plant add-on to Panda Energy Fund's existing natural gas-fired gas turbine combined cycle power plant in Texas.

NextDecade Carbon Capture, Texas

Role: Front-end Engineering Design

The FEED scope is for an emission reduction and carbon capture facility (ERCCF) at their Rio Grande LNG (RGLNG) Project to be built in Brownsville, Texas. When complete, this will be one of the largest carbon capture and sequestration facilities in North America, reducing greenhouse gas emissions and the GTG operating costs.

Nacero Gas to Gasoline Project, Texas

Role: Front-end Engineering Design

The project will convert natural gas from the Permian Basin into gasoline blendstock and mixed liquified petroleum gases. In comparison to gasoline derived from crude oil, this process will produce sulfur-free gasoline, reducing carbon intensity and pollution without additional costs to consumers.



The Right Partner

Class-leading Project Delivery

We believe our customers' projects are an investment in the future.

We help our customers deliver projects of purpose that create a lasting positive legacy. These are projects that create jobs and grow economies; improve the resiliency of the world's infrastructure; connect communities to resources and opportunity; get us closer to net zero; tackle critical environmental challenges to protect people and the planet; and accelerate progress to make the world a cleaner, greener, and safer place.

Bechtel is a trusted engineering, construction, and project management partner to industry and government. Differentiated by the quality of our people and our relentless drive to deliver the most successful outcomes, we align our capabilities to our customers' objectives to create a lasting positive impact.

Since 1898, we have helped customers complete more than 25,000 projects in 160 countries on all seven continents that have created jobs; grown economies; improved the resiliency of the world's infrastructure; increased access to energy, resources, and vital services; and made the world a safer and cleaner place.

Bechtel serves the Infrastructure; Nuclear, Security & Environmental; Energy; and Mining & Metals markets. Our services span from initial planning and investment through start-up and operations.

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