

# Hydrogen Solutions for Mobility

Statement of Qualifications

2023

# ENR2022

TOP 500  
TRANSPORTATION

- 1 Transportation
- 1 Airports
- 1 Highways
- 2 Bridges
- 2 Mass Transit and Rail
- 3 Marine and Port Facilities

# Discover AECOM

We are the world's premier infrastructure consulting firm — planners, designers, engineers, consultants and construction managers driven by a common purpose to deliver a better world. On projects spanning transportation, buildings, water, governments, energy and the environment, we partner with our clients to build legacies for generations to come.

At AECOM, we foster a workplace where inclusive and diverse teams can thrive, harnessing the power of technology and the entrepreneurial spirit of our people to deliver market-leading innovations. These solutions are built on our culture of ethics and safety that is defined by our integrity and goal of achieving zero work-related injuries.

## We believe infrastructure creates opportunity for everyone.

Whether it's improving your commute, keeping the lights on, providing access to clean water or transforming skylines, infrastructure powers possibilities to help people and communities thrive.

Across the globe, we **embrace sustainability** by striving to make a positive, lasting impact on society and the environment through ambitious commitments, such as our **science-based emissions reduction targets**. And through our **Blueprint for a Better World** corporate responsibility platform, our employees make a difference in partnership with nonprofit organizations to help bring enduring, scalable solutions to communities in need.

See how we deliver what others can only imagine at [aecom.com](https://www.aecom.com) and @AECOM.

## 2022 ENR Rankings

Environmental Engineering/Design	1
Environmental Science	1
Environmental Firm	2
Air Quality/Clean Energy	2
Chemical and Soil Remediation	2
Design Firm	2
Wastewater Treatment	2
Site Assessment and Compliance	3
Water	3

## \$13.1B

in Professional  
Services Revenue

## 50K

Employees  
Worldwide

More Information: [AskEnvironment@aecom.com](mailto:AskEnvironment@aecom.com)



## Energy Services | Enabling Hydrogen

### AECOM leverages a combination of direct Energy services with our supporting expertise in full infrastructure delivery for realisation of Hydrogen Projects

AECOM aspires to be the infrastructure partner of choice for clients seeking to adopt hydrogen solutions as part of their Net Zero transition.

Our Hydrogen offerings reinforce our wider infrastructure brand and support our decarbonised Energy priorities of Renewable Generation (including Offshore Wind) and associated Electrical Infrastructure (including Distributed Generation).

#### RENEWABLE ENERGY

- Green Hydrogen Electrolysis
- Hydro / Solar / Wind / Geothermal generation
- Tidal Energy / Marine (Off-shore)
- Biomass Co-generation / Energy from Waste

#### NEW FUELS

- Hydrogen fuelling infrastructure
- Carbon Capture Utilization and Storage
- Full Mobility / Transit services inc. fleet conversion
- DNO negotiation and stakeholder management
- Electric Vehicle Charging Infrastructure
- LNG / CNG / Biofuels

#### PROJECT DEVELOPMENT, PLANNING & CONSENTS

- Conceptual Design
- System/Feasibility Studies
- Energy and Sustainability Master Planning
- Energy Benchmarking, Engineering and Modelling
- Stakeholder Engagement & Outreach
- Licensing / Permitting
- Strategic & Enterprise Energy Management
- Utility Privatization

#### PM/CM

- Program/Project Management & Control
- Procurement & Construction Contracts
- Construction Management & Construction Support
- Facilities Optimization & Management

#### PROCESS ENGINEERING

- Hydrogen Electrolysis and Process
- Process Safety | HAZID-HAZOP
- Desalination
- Balance of Plant

- General Engineering and Design Services
- Industrial Facility Upgrades
- Traditional Generation

#### ENVIRONMENTAL SOLUTIONS

- Emissions & Combustion Products Control (Air Quality)
- Water Solutions / Sourcing / Abstractions / Treatment
- Wastewater Treatment
- Environmental, Social, Health Impact Assessment & Permitting
- Environmental Management Information Services
- Cultural Resources & Engagement
- Contaminated Land Management / Brownfield Redevelopment
- Public Involvement & Multi-Media Communication
- Geotechnical Survey and Design

#### ENERGY SOLUTIONS

- Electrolysis Solutions
- Energy as a Service (EaaS)
- Energy Savings Performance Contracting
- Utility Energy Services Contracting
- Integrated Value Chain Management
- Measurement & Verification
- Operations & Maintenance Services

#### ENERGY EFFICIENCY

- Continuous Commissioning
- Design Engineering
- Energy Audits
- Energy Efficiency Upgrades
- Energy Project Delivery
- Retro Commissioning
- Smart Buildings/High Performance Buildings
- Utility Incentive Programs

#### ENERGY DISTRIBUTION & STORAGE

- Hydrogen Storage & Distribution Solutions
- Transmission & Distribution (LV-MV-HV)
- Maritime / Interconnectors
- Battery Storage infrastructure development
- Pumped and other Energy Storage Solutions
- Micro Grids
- Routing / Siting Assessment
- Survey and Right-of-Way Support

#### SMART ENERGY

- Artificial Intelligence/Machine Learning
- Disaggregated Sensing and IoT
- Digitalization
- Predictive Maintenance
- Prototype Engineering
- R&D Program Management Support
- Smart Lighting Networks

#### ENERGY RESILIENCE

- Hydrogen Conversion Safety Consulting
- Carbon Capture Utilization and Storage
- Climate Adaptation & Resiliency
- Climate Change / Adaptation Solutions
- Flood protection
- Emergency Response Planning and Support
- Seismic Risk Assessment and Mitigation

#### ASSET RETIREMENT

- Facility Demolition, Decommissioning and Redevelopment
- Coal Combustion Residuals Management
- Nuclear Waste Management

## EPCM Services for Hydrogen



AECOM's capabilities drive success and cost savings in engineering, procurement, and construction management (EPCM) projects

### Overview

Across all components of the project cycle — pre- project planning (i.e, FEED) studies, design, build, finance, and operate — we are uniquely positioned to deliver a differentiated service, working globally and delivering locally. As a trusted partner, we draw together teams of engineers, planners, subject matter experts in geotechnical engineering, project and program managers, environmental specialists, technology providers, permitting specialists, cost and schedule specialists, consultants, procurement specialists, and construction specialists — all dedicated to finding the most innovative and appropriate solutions for our clients. Whether we serve clients at one phase of the project lifecycle or throughout it, our role is to apply creative vision, technical expertise, interdisciplinary insight, and local experience to address complex challenges in new and better ways.

AECOM's vast expertise in engineering, procurement, and construction provides our clients with a full-services-aligned approach for development and operations. We offer a full suite of services, including engineering, feasibility studies, permitting, procurement, logistics, project control, construction, and operations services, all geared to ensure timely and efficient project execution.

### Our Approach

AECOM's construction services experts provide our clients with an extensive range of pre-construction and construction- related services and solutions for projects of varying scope, budget, schedule, and complexity. As a project progresses – or increases in complexity – we customize our services to fit each client's unique needs and requirements. Our suite of services covers every aspect of a client's project, from planning to completion.

### PULL (SMART) PLANNING

AECOM's success in project delivery results from our focus on aligning the project activities with our client's goals. This alignment happens through extensive pre-project planning activities that begin many of our projects. The primary pre-planning activity consists of a "pull planning" sessions with AECOM and client participation. Through this session, the team develops the overall roadmap for the project, illustrating how the key activities and milestones will fit together to meet the project objectives. The roadmap evolves into a project work plan and schedule, providing a clear vision of the path to project success.

### HEALTH AND SAFETY EXCELLENCE

AECOM places the highest priority on the protection of safety and health of our employees, contractors, and stakeholders. Our safety culture is rooted in behavioral-based safety, both on and off the job, to ensure our safe habits achieve our safety

### Areas of Expertise:

#### PROCUREMENT

- Supply Chain Optimization
- Developing, Implementing, and
- Managing Procurement Plan
- Strategic Sourcing

#### CONSTRUCTION/CONSTRUCTION MANAGEMENT

- Constructability reviews
- Value engineering
- Cost estimating
- Scheduling and pull planning
- Sustainability strategizing and implementation
- Bid package preparation
- Procurement/Expediting/Logistics
- Document control
- Bid evaluation

- Field planning/supervision
- Safety programs/supervision
- QA/QC
- Closeout and warranty procedures
- Cost engineering and control
- Building commissioning
- Logistics planning
- Materials and equipment receiving and reporting
- Field construction engineering
- Surveying
- Contract administration
- Field trouble shooting
- Estimating
- Startup and commissioning



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## EPCM Services for Hydrogen *(continued)*

goals. We achieve sustainable safety excellence by commitment through the entire organization, from our chief officers through our field teams through:

- **Leadership Commitment** – Safety is the foundation of how we work in the field, at our project sites, and in our offices.
- **Behavior-Based Safety** – Our culture is rooted in a behavior based safety program, both on and off the job.
- **Training** – Safety and quality training are delivered starting on the first day of employment, then reassessed and renewed annually.
- **Continuous Improvement Driven by Results – Oriented Leadership** – Our recordable incident rates have declined steadily, even as our company has grown, diversified its services, and increased its geographic reach.

### AECOM'S PROCUREMENT MODEL IS CENTRALIZED, COLLABORATIVE AND DATA-FOCUSED, DESIGNED TO OPTIMIZE OUR SUPPLY CHAIN.

AECOM's procurement strategy takes a programmatic approach when procuring for single scope, higher scarcity, higher value services and engineered equipment, and a category approach where there is a clear pattern of heavy use across our large and diverse global portfolio. Both approaches are supported by a highly competitive, disciplined, strategic sourcing process supported by

a collaborative team comprised of experienced Technical Leads and Procurement Professionals to ensure AECOM is delivering best overall value to our clients.

This collaboration — combined with a disciplined, data-driven sourcing strategy, rigorous supplier accreditation process through our subcontractor pre-qualification and management tools, and clearly defining our award criteria based on client objectives— increases the likelihood of a smaller, well managed supply base, leveraged economy of scale, reduced commercial risk, more fixed pricing, reduced acquisition costs, greater buying specialization and more effective price negotiations. We believe leveraging both a programmatic and category approach delivers a balanced procurement strategy that capitalizes on AECOM having one of the strongest buying positions in the global design and consulting service industries.

### DEVELOPING, IMPLEMENTING, AND MANAGING PROCUREMENT PLAN

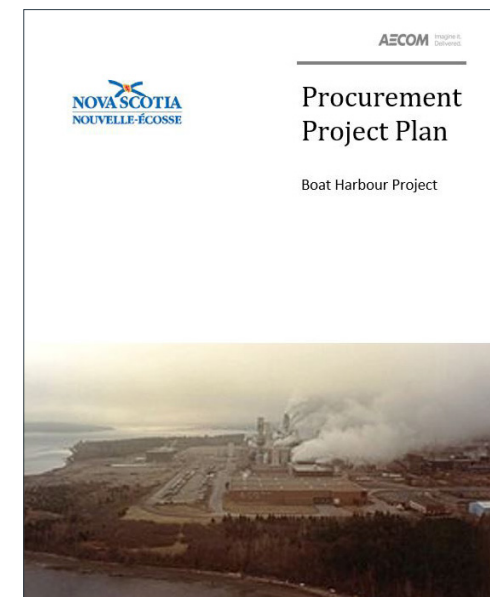
AECOM's projects are spread out over a diverse portfolio made up of tens of thousands of projects across our global geographies and business lines. This volume of work has led to the development and implementation of a menu of standardized procurement plans based on our client's needs. In addition to planning, our team of experienced Procurement Professionals can be deployed to manage end-to-end direct procurements as an agent to our clients.

### SUPPLIED MATERIALS/EQUIPMENT)

Over the years, AECOM has developed a best in class process to support the selection and management of external subcontractors and suppliers when sourcing for direct services, equipment or materials on behalf of our clients. The strategic sourcing process is intended to provide a framework, that if applied, could optimize value delivery through the sourcing process and supplier management. A well planned and executed strategic sourcing process will aid our clients in achieving their strategic objectives.

### Key AECOM Attributes

- Improve delivery
- Increase standardization
- Reduce commercial risk
- Greater access to supplier's scale, scope, technology expertise, and resources
- Improve profit
- Increase collaboration
- Improve supplier performance
- Ensure price reasonability
- Increase information sharing and efficiency gains
- Fewer relationships with more extensive long-term collaboration



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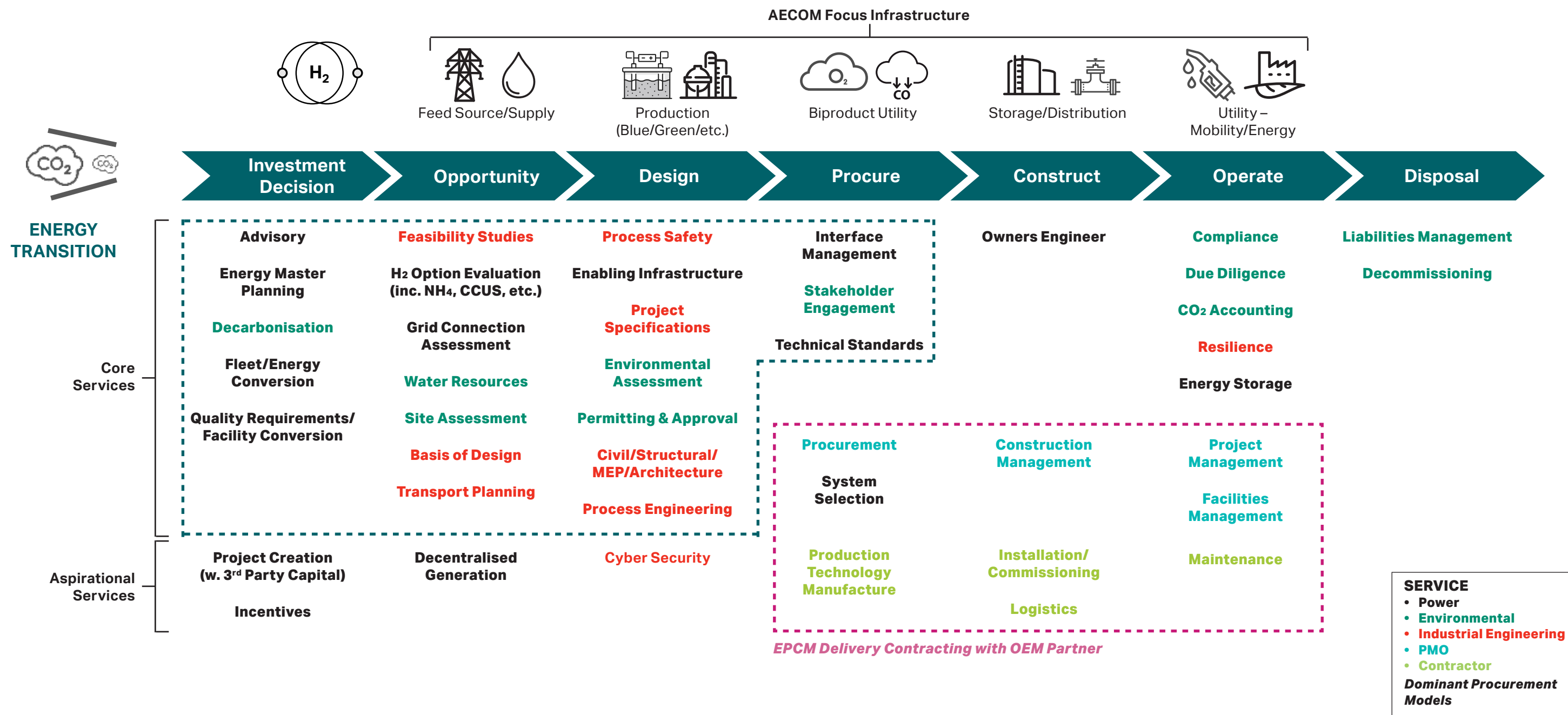
1. Plan Objectives and Overall Strategy
2. Project Procurement Organization
3. Procurement Responsibility
4. Materials Delivery Designation
5. Project Plan
6. Procurement Reporting
7. Project Procurement Plan Detail
8. Sole Source
9. Engineering Requisitions
10. Expediting
11. Supplier Data Status Reports
12. Logistics
13. Taxes and Duty
14. Customs Brokerage
15. Currency
16. Spare Parts
17. Capital Spares
18. Invoice Approval and Payment
19. List of Appendices
  - a. Procurement Organization
  - b. Project Good Sourcing Matrix
20. List of Reference
21. Record of Changes

### AECOM Supports the Lifecycle of Project Development and Delivery of Hydrogen Mobility Projects



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# Hydrogen | AECOM's Suite of Services





**Mobility**

# Mobility Markets

## 16% of global greenhouse gas emissions derive from the burning of hydrocarbons to operate our transportation systems

AECOM focuses on Transportation Decarbonisation and associated infrastructure development including decarbonised fuelling solutions like Hydrogen, synthetic fuels and bio-LNG. This includes provision of energy locally and efficiently in a sustainable manner that does not compromise future generations to deliver client business requirements.

- AECOM is trusted by public and private transit authorities, fleet operators and vehicle manufacturers to optimise the deployment of transport solutions tailored to the unique requirements of specific businesses. We leverage our proven infrastructure pedigree and technology relationships to ensure that the fuelling solutions for transportation are available at the right capacity, at the right time, in an affordable, safe manner where it is needed.

- As market leaders in built infrastructure, we integrate decarbonised transport solutions into existing and future Real Estate and transport developments, including integration of hydrogen vehicles into complex operations like airside haulage or marine applications.
- AECOM is working with retail fuel chains as engineering delivery partner to lead the conversion of their portfolio to adapt to the varying requirements of a full range of low and zero carbon fuels including LNG, Biofuels, Hydrogen and Electric Vehicle Charging.

We are supporting clients across Europe, the Americas, Asia and Africa and have led both the development of engineering standards as well as value improvement initiatives to substantially reduce the cost of Future Fuelling and delivery schedule whilst integrating safety

requirements. In execution, we have saved over \$300M of installation cost realising a return of investment of over 20% on deployed capital. Across a portfolio of thousands of stations, we manage the diverse requirements of stakeholders including permitting authorities, retailers, landlords, utilities and operators to ensure uptime availability of a full range of fuelling solutions adapting to the everchanging infrastructure requirements.

- We are solidifying global technology, financing, and wider provider partnerships in the Green Energy sector to accelerate and quantify the benefits of transport decarbonisation.





## Mobility | How We Help

AECOM takes an **end user-centric approach to transport decarbonisation** to ensure the transition to new systems is effectively and efficiently adopted. We connect critical stakeholders to improve the return on investment of programs and accelerate delivery.

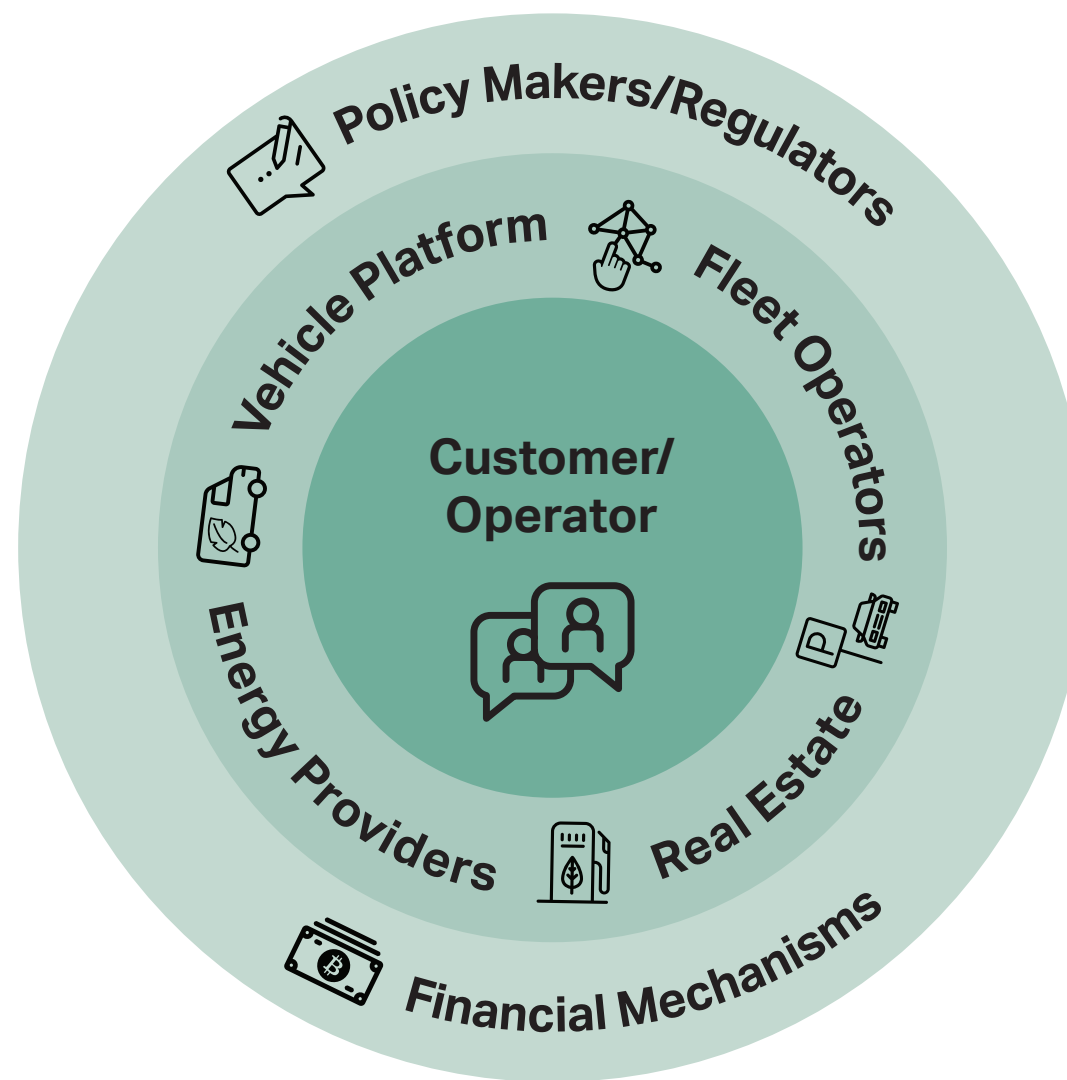


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**POLICY MAKERS/REGULATORS**  
We inform the **development and deployment of legislative controls** to transport decarbonisation and associated project development / operating requirements – This provides certainty in execution and schedule expediting opportunity for customers.

**VEHICLE PLATFORM**  
We bring **expertise across full suite of vehicles and fuel switching options** from hydrogen, surface based battery electric vehicles, through hybrid trucks into wider future fuel platforms. We support all mass transit systems as well as aviation and marine vehicle options. We work to understand the optimal deployment of alternative vehicle platforms in execution for operators, and directly support vehicle OEMs in provision of infrastructure to accelerate adoption by their customers.

**ENERGY PROVIDERS**  
AECOM has a pedigree in **delivery of energy systems and managing the interfaces and risks to existing infrastructure operation.** We appraise demand requirements and capacity availability in fuelling networks, electrical grids and development of upgrades both with and for energy suppliers. We deploy hardware and software solutions to smooth demand curves and reduce the total cost of operations. Our work is provided directly to those supplying energy and those operating hydrogen fuelling systems, leveraging regulatory relationships to expedite connections and smooth permitting requirements.



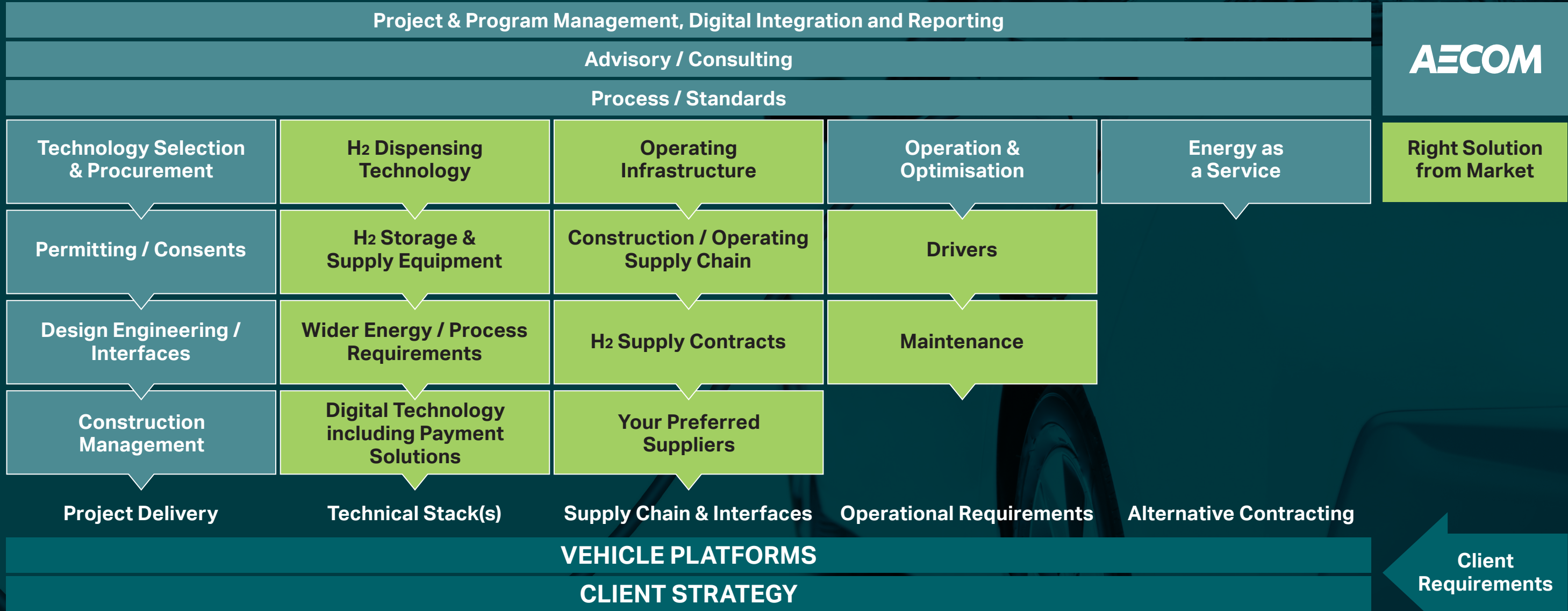
**FLEET OPERATORS**  
We **focus on understanding the performance criteria of our client's fleet and the energy demand required to operate it.** We offer direct capabilities with public transportation passenger requirements as well as personal mobility, logistics, freight haulage and industrial fleets. Our ability to retrofit operational infrastructure to existing portfolios or optimise fleet performance for off site energy needs inclusive of energy balancing, transport planning and route optimisation assures business continuity.

**REAL ESTATE**  
The backbone of AECOM's architectural and master planning skill sets allows for **development of transport and fuelling infrastructure into a full suite of operator archetypes** from simple fuel switching, to complex mixed retail sites, transit interchanges and industrial deployments. We offer the ability to forecast demand locations and plan networks across campuses, cities and regions to allow our customers to grow their networks.

**FINANCIAL MECHANISMS**  
We tailor our **project development approach to align with funding requirements and fiscal incentives sympathetic to operating models of client's systems.** This includes the ability to work in partnerships across the full suite of stakeholders from straight contractual service offerings to end to end energy as a service models. We provide direct support to those tendering for public / private operating tenders to expand their operations successfully.

# Mobility | How it comes together...

## FLEET OPERATING REQUIREMENTS



# Environmental Permitting and Planning

## SERVICES

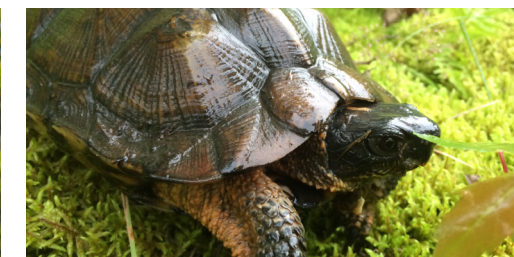
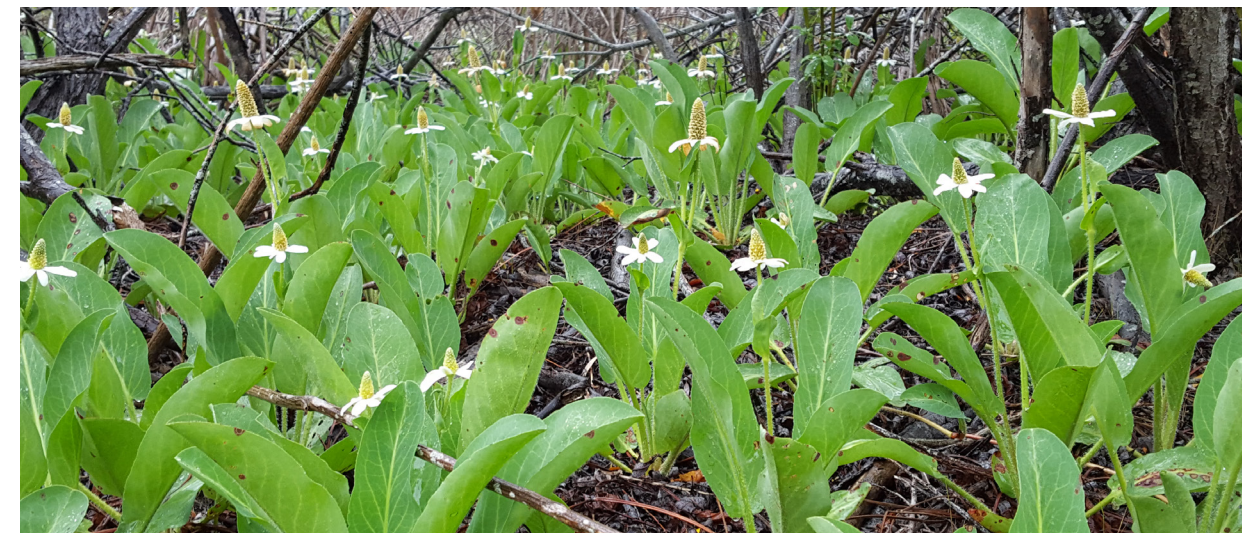
- Siting, Project Feasibility and Permitting Strategy
- Digital Engagement (PlanEngage) Digital Data Management
- Environmental Policy Development
- Environmental/Social Impact: EIA/EIS/ESHIA/CEQA/NEPA/SEPA
- Baseline Field Studies/Ecology
- Next-Gen Digital Data Capture Technology
- Project Permitting Program Management
- Environmental Mitigation, Monitoring and Planning
- Regulatory Permitting/Negotiation
- Traditional and Virtual Stakeholder/Public Engagement
- Visual and Noise Impact Assessment, Modeling
- Fate and Effects Transport/Dispersion Modeling
- Program Management for Large Programs

Understanding a proposed project's potential environmental and social impacts and regulatory constraints is critical to the development of timely and cost-effective project plans, evaluative studies, sound engineering designs, effective stakeholder management and successful permitting.

By anticipating and addressing permit requirements early on in the project design, we help implement a permitting strategy, development schedule and mitigation plans that expedite permit acquisition and compliance. Expert regulatory negotiations throughout the project help resolve technical and external stakeholder issues and create favorable permit conditions while achieving the ultimate goals of maintaining project schedules and ensuring compliance.

This method has contributed to successful projects for a broad range of government, energy (oil and gas, wind, solar, tidal), industrial, waste disposal, utilities, mining and real-estate clients worldwide. For example, our thorough approach helped us prepare one of Australia's largest and most comprehensive environmental impact statements and technical studies for a mining expansion project.

Across our broad impact analysis, assessment and permitting practice, our experience serves to achieve our clients' goals, ensuring they are operating according to their own business requirements as well as complying with regulatory requirements.



Learn more about AECOM's Environmental Permitting and Planning Digital Tools and Innovations

<https://innovating-environment.aecom.io/>

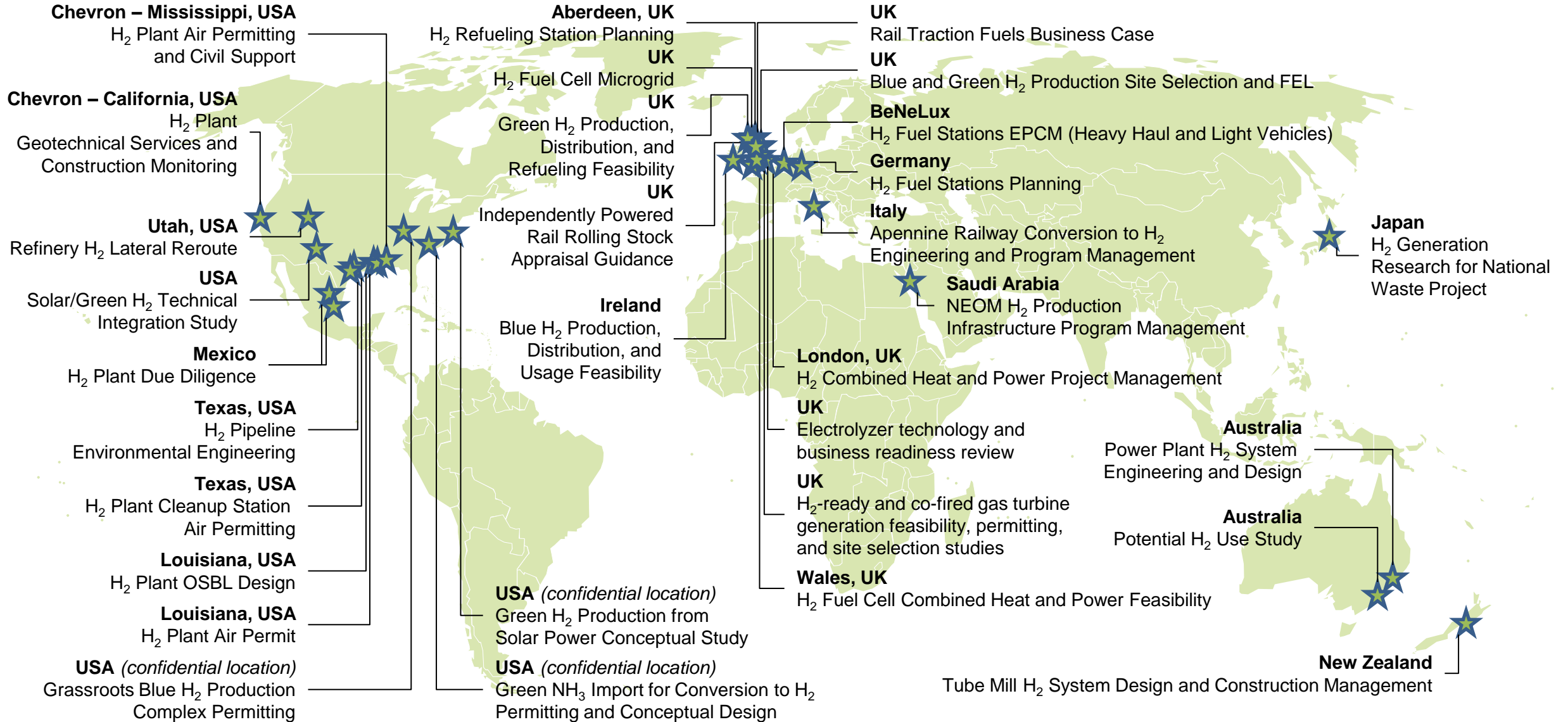
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# AECOM Experience

Active in over 500 green  
Hydrogen projects globally

# AECOM Representative Hydrogen Projects across the Globe



# Global Hydrogen Fueling Station Program Delivery



### Project Overview

AECOM have supported the client in the design, permitting, procurement, project, construction and facilities management of their global mobility portfolio for over six years. In our role as engineering delivery partner we have led the conversion of their portfolio to adapt to the varying requirements of a full range of low and zero carbon fuels including LNG, Biofuels, Hydrogen and Electric Vehicle Charging.

### Work Performed

We support the client across Europe, the Americas, Asia and Africa and have led both the development of engineering standards as well as value improvement initiatives to substantially reduce the cost of Future Fuelling as well as the delivery schedule whilst integrating safety requirements. In execution we have saved over \$300M of installation cost realising a return of investment of over 20% on deployed capital.

Across a portfolio of thousands of stations we manage the diverse requirements of stakeholders including permitting authorities, retailers, landlords, utilities and operators to ensure uptime availability of a full range of fuelling solutions adapting to the everchanging infrastructure requirements.

### Client

Supermajor Oil & Gas Client

### Location

Global

### Contract Value

Confidential

### Years

2017-present



More Information: [AskEnvironment@aecom.com](mailto:AskEnvironment@aecom.com)

# Engineering, Procurement, and Construction Management (EPCM) Services for Green Hydrogen Production Facility



AECOM's design, engineering, and construction management work on this project is helping to advance the availability of green hydrogen, which is experiencing rapid demand for its outstanding sustainability and versatility.

## Project Overview

Plug Power, a domestic leader in green hydrogen, has announced they plan to design and construct 500 TPD of green hydrogen production facilities in the US in the next 3-5 years. Project Gateway is one of the first sites and it will be used as a template for future facilities. AECOM initially served as the engineer of record but was awarded EPCM services to complete this new facility.

## Production Process

In the green hydrogen production process, electrolyzers break down deionized (DI) water from a combined reverse osmosis/DI water treatment process into hydrogen and oxygen. The bulk oxygen is vented and the wet hydrogen gas from the electrolyzer is de-oxygenated, cooled, and dried. Hydrogen gas is sent to the hydrogen liquefier units where it is pre-cooled with refrigerated nitrogen. The N2 re-liquefaction system is integrated within N2 refrigeration, N2 expander compressors, and pre-cooling perlite cold box system. The pre-cooled hydrogen undergoes ortho-para conversion to minimize boil-off in the liquid product. Hydrogen gas is liquefied using a hydrogen gas compression/expansion refrigeration loop. Hydrogen is also used as a refrigerant in a closed loop within the vacuum insulated cold box exchanger to achieve desired temperature for hydrogen liquefaction. Liquid hydrogen is moved to storage for transportation. Hydrogen flash gas is captured and recycled to minimize loss.

## Client Benefits

- **100% SUSTAINABLE:** green hydrogen does not emit polluting gases either during combustion or during production.
- **STORABLE:** hydrogen is easy to store, which allows it to be used subsequently for other purposes and at times other than immediately after its production.
- **VERSATILE:** green hydrogen can be transformed into electricity or synthetic gas and used for commercial, industrial or mobility purposes.
- **DEMAND:** the demand for domestic green hydrogen is forecasted to quickly outpace production capacity.

## Work Performed

AECOM is providing EPCM services for the completion of this new facility. Project Gateway will be a new, grassroots green hydrogen production facility in Alabama, New York. This new facility will include electrolysis, liquefaction, water treatment, storage/loadout, and all utilities for a 74 TPD facility. AECOM's engineering scope includes design of the production trains comprised of substations, rectifiers, electrolyzer arrays, H2 deoxo-dryer unit, liquefaction system, and N2 systems. The project is being executed on a fast-track basis with a targeted startup date of Train 1 in the summer of 2024.

From this project, AECOM is getting firsthand design experience for commercial scale green hydrogen production from electrolysis. This project employs Plug Power-owned technologies (electrolyzers and liquefaction) which are being implemented in green hydrogen production facilities around the world. In the US, this is one of the first commercial applications to be installed.

### Client

Plug Power

### Location

New York, USA

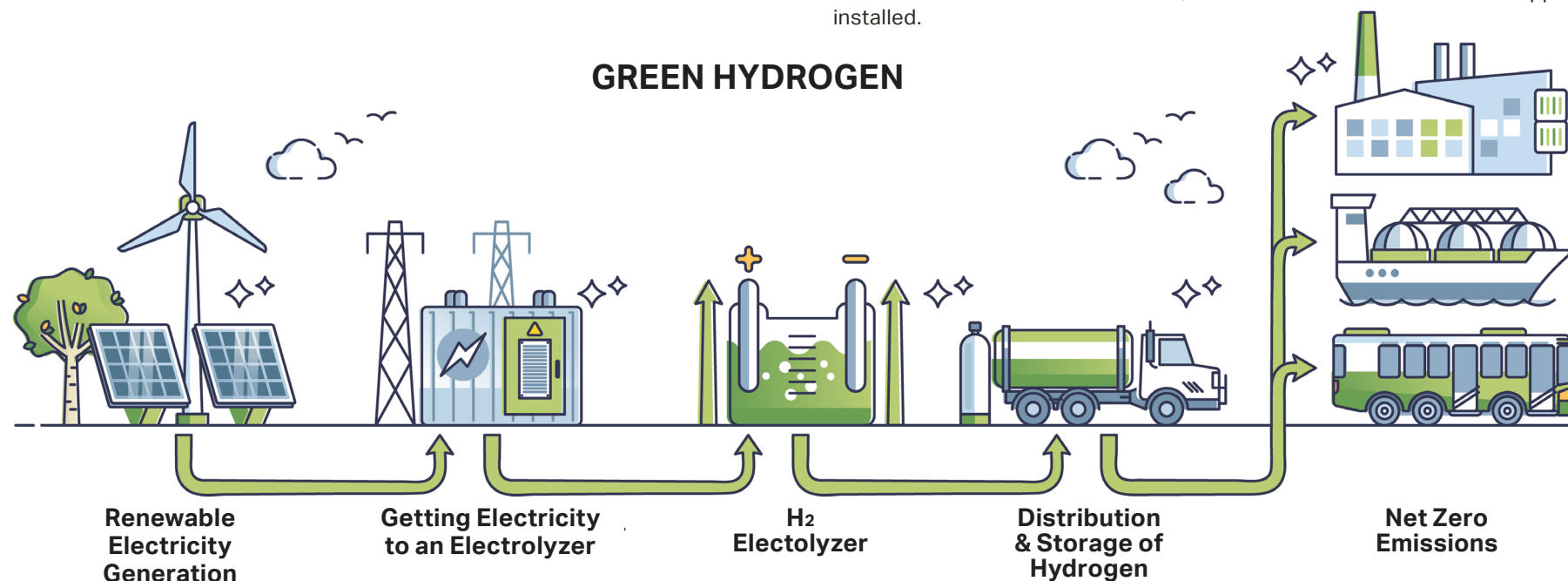
### Contract Value

Confidential

### Years

2022-present

More Information: [AskEnvironment@aecom.com](mailto:AskEnvironment@aecom.com)



## Engineering and Design for SureSource H2 Trigeneration System



Our expert engineering and design expedited this important project that will serve as a model for decarbonization in the transportation industry.

### Client

FuelCell Energy

### Location

California, USA

### Contract Value

Confidential

### Years

2023 (planned startup date)

### Project Overview

FuelCell Energy, Inc. (FCE) has expanded upon its commercially deployed Molten Carbonate Fuel Cell (MCFC) technology to arrive at a process that generates electricity, high-purity hydrogen and thermal energy from directed biogas. This process, known as the SureSource H2 Trigeneration system, has been successfully demonstrated twice at sub-MW scale. AECOM is providing detailed engineering and design services for the project.

### Client Benefits

- AECOM delivered the project on a highly compressed schedule
- The team's design of a skid-based process minimized on-site construction
- Our highly coordinated interaction with the technology provider, vendors and subcontractors was critical to minimizing schedule.
- This project will produce green hydrogen, power and hot water from directed biogas – largely for use in the fueling of fuel-cell vehicles, furthering use of technology for decarbonization in the transportation industry.

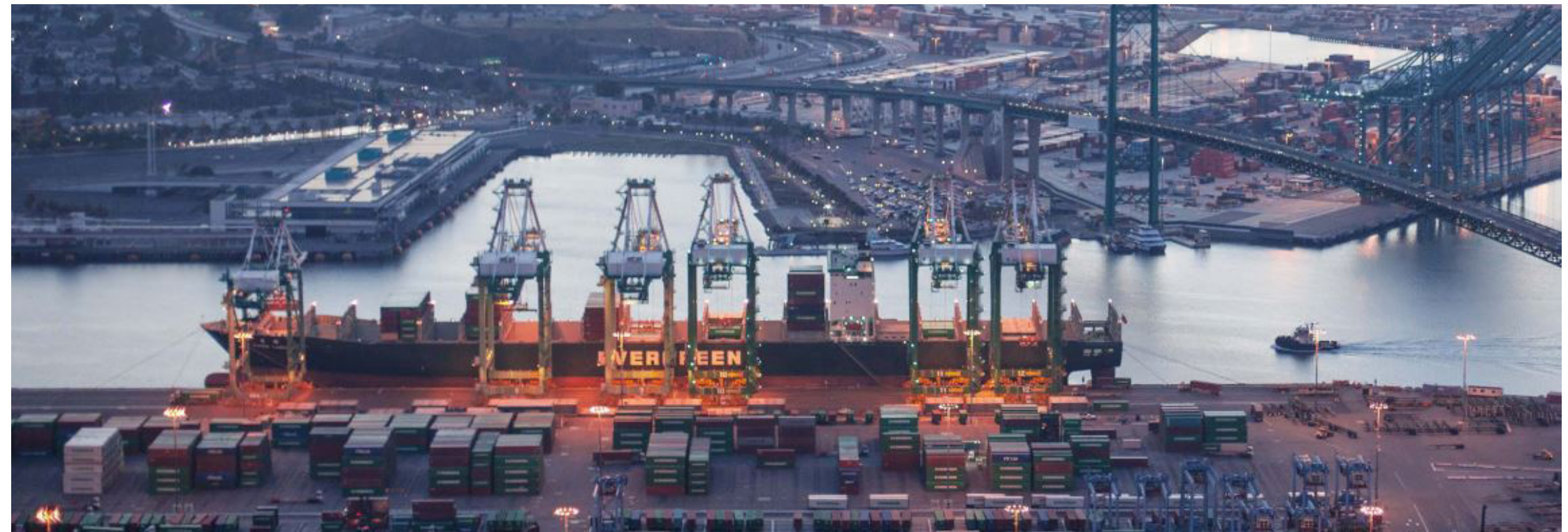
### Work Performed

The SureSource H2 system at the Port of Long Beach in California will use directed biogas from an existing pipeline as the fuel, and the high-purity and moderate pressure hydrogen will be utilized by Toyota in fuel cell-based cars and trucks offloaded at the port. In addition to producing up to 1,270 kg/day of green hydrogen, the process will generate 2.3 MW of electricity, up to 0.5 MMBtu/hr of thermal energy, and water. Excess electricity will be sold to Southern California Edison (SCE) under California's BioMAT feed-in tariff program.

FCE completed Front End Engineering Design (FEED) for this project and AECOM provided detailed engineering and design services through the procurement, fabrication and construction phases of the project.

### Services Provided

- Detailed engineering and design:
  - Mechanical, Structural, Electrical, Instrumentation & Controls
- Development of Issue-for-Bid (IFB), Issue-for-Fabrication (IFF) and Issue-for-Construction (IFC) packages
- Engineering support during construction







# Enabling Infrastructure

# Enabling Infrastructure for Hydrogen



From the early planning stages through to construction, we combine our broad global reach with our strong regional presence to implement industry best practices and deliver effective local solutions across the entire life cycle of vital hydrogen infrastructure.

## Areas of Expertise

- Strategy & Planning
- Engineering & Design
- Construction
- Operations & Maintenance
- Decommissioning & Closure

## Our Approach

Around the world, AECOM plans, engineers and oversees construction on complex and essential hydrogen transport and manufacturing infrastructure. With more than 80 years of infrastructure design and development experience, we've gained an in-depth understanding of the infrastructure industry and its intricate commercial and policy drivers. We work with some of the world's leading public and private organizations, helping them deliver hydrogen infrastructure.

## Experience

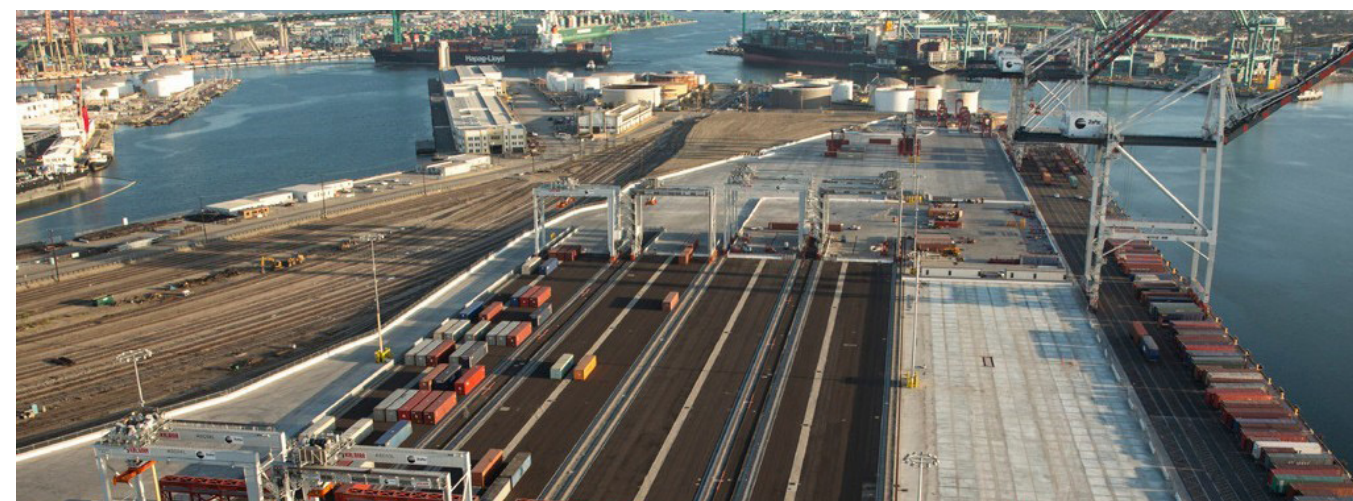
We focus on applying the right skills at the right time to deliver successful projects around the world. We have a large portfolio of experience that includes due diligence, planning, design, engineering and construction projects across a range of locations and facilities worldwide. We collaborate with our clients to provide high-quality, well-managed professional services that meet their program and budget goals.

## Transforming Innovative Ideas Into Real-world Solutions

Our client relationships are built on an appreciation of business needs and a proven record of innovative and cost-effective project development. From the early planning stages through to construction, we combine our broad global reach with our strong regional presence to implement industry best practices and deliver effective local solutions across the entire life cycle of infrastructure.

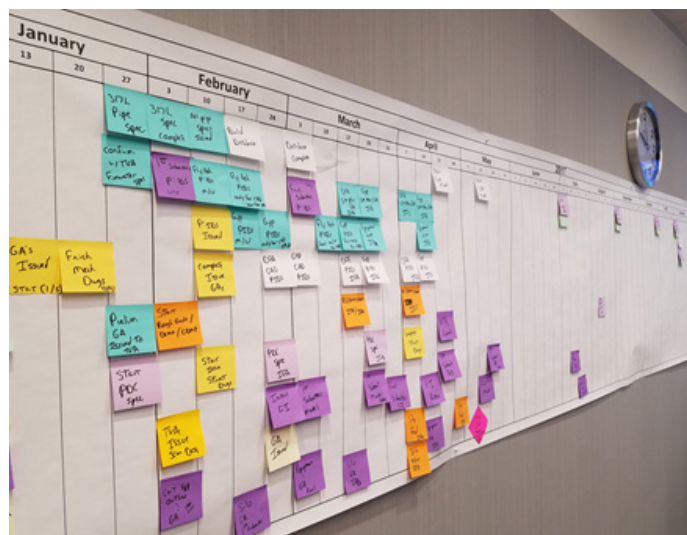
## Key AECOM Attributes

- **Innovation is key** when it comes to hydrogen projects. Our approach enables us to achieve best-value solutions over the entire life cycle of a project.
- Our planners, simulation and logistics specialists, engineers, architects and economists are at the forefront of energy, industrial, pipeline and transportation trends. We've built our reputation on **incorporating new technologies** in projects throughout the Americas.



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# Pre-FEED and Concept Design for Hydrogen



Whatever the project requirements, AECOM assembles an experienced and talented team of engineering and support professionals who employ tested and proven processes and state-of-the-art tools that positions projects for an efficient, streamlined detailed design stage and eventual overall success.

## Overview

We understand that a sound project foundation begins with a focused front end engineering design execution approach. Regardless of project type and complexity, we provide a multi-disciplinary approach that is supplemented with a structured work process and industry professionals with over 25 years average experience.

## Our Approach

For more than 80 years AECOM has successfully demonstrated the benefit of employing a well-planned FEED effort, the result, meeting Project or Program objectives both in cost and schedule.

The AECOM FEED Model deploys a three-gate process referred to as Front-End Loading (FEL), these gates are:



The purpose of the FEED process is to:

- Engage all the client and AECOM stakeholders early in the project assuring better project definition in scope, design definition, schedule, and cost.
- Preparation of the basis for detailed design, procurement as well as construction, commissioning, startup, and operation.

## HANDOFF TO DETAILED DESIGN

At the conclusion of FEED, AECOM arranges all of the project definition documentation into a well-organized and complete package that can be transferred directly to the AECOM detailed design team and utilized to finalize procurement, construction documents and plans, commissioning and startup. The AECOM FEED team remains available for consultation and to provide any needed clarifications to the detailed designer as they work through the development of the detailed design documents.

## FRONT-END LOADING (FEL)

We are heavily committed to a disciplined FEL effort on our projects. Our project methodology and business focus is driven toward intense teamwork with our clients in the early project phases to achieve the best possible project definition. By proactively driving the decision-making process, we provide high quality estimates, schedules and workflows without large expenditures.

FEL involves significant consensus building and project team buy-in to scope areas as the project concepts are developed, requiring extensive communication — something we have the systems and protocol in place to make happen.

## Areas of Expertise:

### PRE-FEED DELIVERABLES

- Site Health and Safety Plan
- Project Design Basis/Project Objectives Defined
- Project Scope Document
- Basis of Design Documentation/Design Criteria Set
- Project Management Plan (PXP)
- Updated Project Controls Plan
- Critical Milestones Defined
- Project Procedures
- Update Process Description
- Preliminary Scope Documents
- Initial Tie-in Plans
- Written Discipline Scopes
- Utility Summary & Infrastructure Requirements
- Control Systems Philosophy/Control Logic
- SMART Planning Work Process Map
- EPC Schedule- Level III FEL 3
- Risk Mitigation Plan
- Class 4 Feasibility Estimate – Maturity Matrix for (+-20%)
- FEL 2/Pre-FEED Summary Report

### FEED PACKAGE DEVELOPMENT

- Identify and Select Concepts
- Provide Cost Data to Guide Business Decisions
- Prepare Project Basic Documentation
- Definition of Scope of Work
- Process Modeling

- Equipment Specification & Sizing
- Requisitions for Long-lead Equipment
- Cost Estimating
  - Team building/alignment sessions
  - Scoping (programming)
  - Site and geotechnical information
  - Basic data
  - Engineering flow diagrams:
    - Process flow
    - Material of construction
  - Design pressure/temperature
  - Environmental issues
  - Piping and instrumentation diagrams
  - Electrical single-line diagrams
  - Process control strategy
  - Major equipment specifications
  - Instrument definition
  - Project estimates

### FEED SERVICES AND DELIVERABLES

- Conceptual and feasibility studies
- Process descriptions and flow diagrams
- P&ID development
- Energy and material balances
- Equipment choice, design and specifications
- Equipment performance arrangements
- Controls philosophy/control logic
- Engineering and construction estimates and schedules
- Long lead procurement and constructability
- Start-up and commissioning services

## Pre-FEED and Concept Design for Hydrogen *(continued)*



### Key AECOM Attributes

- The benefit of using AECOM is our experience of front end development work processes further enables our development of achievable, realistic and predictable project outcomes.
- A continued focus on constructability is an essential and integral part of the way we do business. By incorporating techniques into our projects, we have continually demonstrated that constructability offers the largest single opportunity to reduce total installed and long-term O&M costs, as well as providing the best possible project definition.
- Our FEL development is focused on meeting the challenge at-hand under the guidance of our best practices, such as value engineering and constructability. We work with our clients to develop project scopes and estimates while considering return on investment, critical path mitigation and contracting strategies.



# Hydrogen Production



AECOM has a deep bench of engineers that have completed conceptual designs to detailed engineering for hydrogen compression and storage, steam systems, power generation, and other balance of plant utilities.

## Areas of Expertise

- Hydrogen Safety
- Hydrogen Transportation
- Hydrogen Storage
- Hydrogen Use Cases

## Overview

Hydrogen has been manufactured from fossil fuels for decades and there are established procedures for compressing, storing, and transporting it, however Green Hydrogen, electrolysed from water and zero emission when powered by 100% renewable sources, has yet to be commercialised at scale. Green Hydrogen is an emerging zero emission energy source that will be a key fuel to support decarbonisation. The situation is moving fast with electrolyser manufacturers in the US, Western Europe and China vying on product, production capacity and project size on an almost weekly basis. Successful project delivery will require these new electrolysers to be safely integrated into hydrogen storage and transport systems.

## Our Approach

AECOM has completed numerous feasibility studies for new process technologies involving hydrogen production, gas processing, and CO<sub>2</sub> capture; these have been to inform national government policy, in support of our large oil and gas clients, or to inform the thinking of the new breed of private developers. We recently completed a white paper about green hydrogen production from solar power for one such private developer to better understand the pathway to developing such a facility. The paper covered the technical production aspects, process safety, permitting, and reporting. Technical considerations included solar power generation profiles, electrolyser selection and performance, water demand, wastewater, and hydrogen compression, storage, and transportation. Process safety included discussions about PSM (OSHA requirements), flaring hydrogen, safely venting oxygen, and electrical area classification. Environmental sections included the applicable permits and regulations that would apply to a green hydrogen facility in California

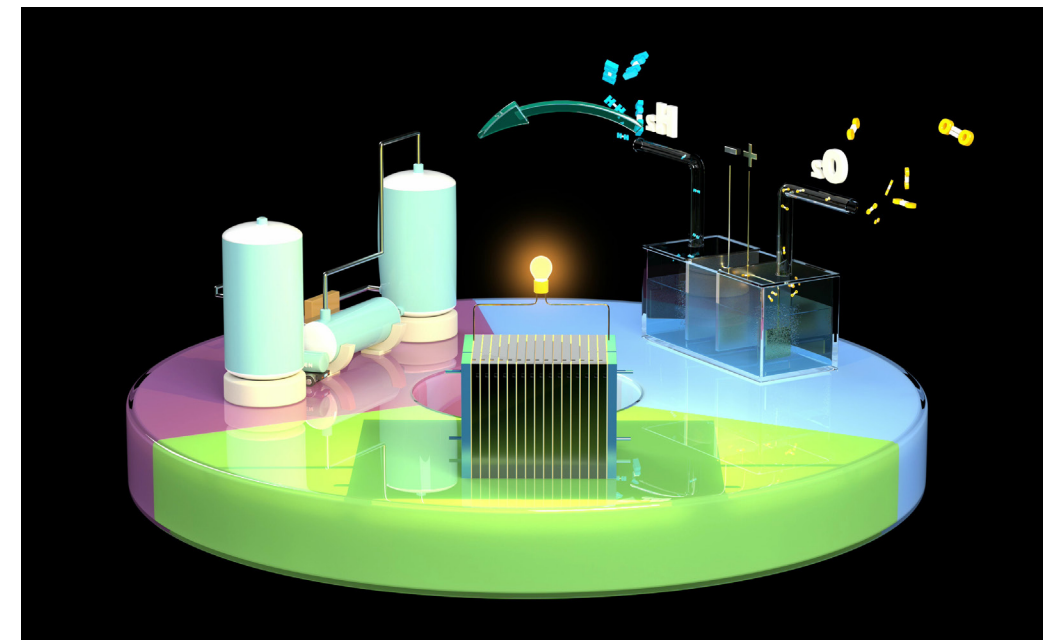
## Areas of Expertise

**HYDROGEN SAFETY.** For AECOM, the delivery of safe hydrogen projects is core and we have a very active Process Safety Management team with years of hydrogen experience, and this experience will be critical as we expect to see green hydrogen projects in environments with little or no prior explosive risk exposure.

**HYDROGEN TRANSPORTATION.** Projects will require an extensive expansion of hydrogen transportation infrastructure including pipelines and shipping. AECOM has an experienced pipeline group that can support evaluations of hydrogen pipeline infrastructure; they have delivered numerous hydrogen plant and pipeline designs in the Gulf Coast of the US associated with refineries.

**HYDROGEN STORAGE.** Subsurface gas storage may be a component of the hydrogen ecosystem. AECOM has designed pressure control stations to assess gas withdrawal flow rates that meet the design conditions at all field pressures, to include the late season reduced storage pressures. In addition, we can help developers and operators manage risk to stored hydrogen stability from the presence of sulphides, carbonates and other impurities that may be in the existing geosphere and could potentially create instability of the storage cavern or the stored hydrogen.

**HYDROGEN USE CASES.** As volumes of supply increase, green hydrogen will have many uses. We have evaluated business cases for the use of hydrogen in many of these applications such as: the rail industry, for peaking power, both as pure hydrogen and mixed with NG; for heavy goods logistics; and the role that electrolysis can have in decarbonising the water industry. One such example is support to hydrogen and battery traction trials in the UK where we developed the business case assimilating asset lives, rail infrastructure network characteristics, technological advances, and key contractual insertion points. We supported the client, the UK Department of Transport, in bilateral discussions to understand the supplier landscape, appetite and readiness to perform trials, and helped develop specifications for the trial in terms of new instructions for tenderers and contract development.





# Global Advisory

# Global Advisory for Hydrogen



As agnostic experts in the deployment of hydrogen technologies, we help appraise the suitability of decarbonised energy models and then facilitate the transition to the right hydrogen solution safely, cost effectively and in a manner that does not compromise existing business operations.

## Areas of Expertise

- Writing the Standard
- Advising Adoption
- Technology Agnostic Experts
- Project Delivery Partnerships
- Production to Utility Capability
- Strong Public and Private Sector Relationships

## Our Approach

As the world's trusted infrastructure consulting firm, AECOM seeks to partner with clients to solve the most complex challenges and build sustainable legacies for generations to come. We enable customers to evaluate, develop and deliver the benefits of integrating clean hydrogen seamlessly across a suite of decarbonised energy solutions into existing and future infrastructure. We are creating jobs, enabling the energy transition and improving the world in which we live.

AECOM are not a producer, handler or direct user of hydrogen: We enable customers to evaluate, develop and deliver the benefits of integrating hydrogen seamlessly across a suite of decarbonised energy solutions into existing and future infrastructure.

## Key AECOM Attributes

- Proven ability to develop business cases for hydrogen projects and implement on an integrated basis on behalf of clients (design, consenting, procurement, project management, commissioning and handover).
- Leaders in deploying complex infrastructure, developing regulatory guidance / operating standards, and engaging stakeholders successfully.
- Focus on enabling and interface works and work in partnership or as owners engineer to manage process technology for production / utilisation. Additional capabilities in water / waste for complete solution
- Tailor offering from advisory through design into procurement and construction management.

Investment Decision

Opportunity

Design

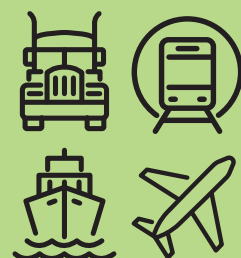
Procure

Construct

Operate

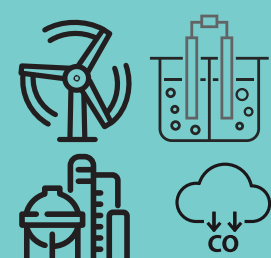
Disposal

## MOBILITY



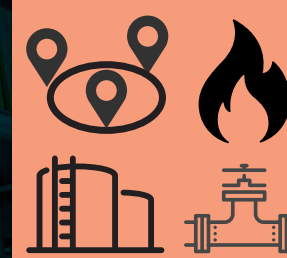
Proven EPCM credentials in Hydrogen storage and dispensing to full suite of transit customers and energy providers

## PRODUCERS



Market leading permitting excellence, enabling new developments inclusive of all supporting infrastructure and tie ins (including renewable generation/electric infrastructure links/ CCUS/process water). Supporting FEED/OE role for delivery of hydrogen and associated intermediaries

## HUBS



Recognised place building and industrial skills enable development of integrated energy hubs including all supporting infrastructure. Advisory through planning to delivery potentially including "as a service" models for distributed

# Global Advisory for Hydrogen *continued*

## Areas of Expertise

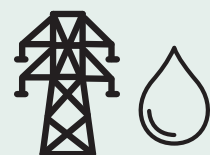
- **WRITING THE STANDARD.** As leaders in the field of deployment of complex infrastructure we are developing regulatory guidance and operating standards for the manufacture, transportation and use of hydrogen (and hydrogen carriers such as ammonia). This position puts us in ideal place to share global best practice and deploy these standards efficiently. We are able to engage stakeholders successfully and understand the implications of adoption by ultimate clients and associated incentives for doing so.
- **ADVISING ADOPTION.** AECOM helps clients understand if hydrogen (or an alternative) is the right solution to their specific challenge. We develop business cases for hydrogen projects, informed by our track record of implementing comparable projects on behalf of our customers. We draw down our design, consenting, costing, procurement, project management, commissioning and handover skills to understand and mitigate risk. Our ability to understand the synthesis of economic, social and environmental considerations of new industries combined with our engineering pedigree guides our stakeholder engagement process successfully.
- **TECHNOLOGY AGNOSTIC EXPERTS.** AECOM are not a producer, handler or direct user of hydrogen: We enable customers to evaluate, develop and deliver the benefits of integrating hydrogen seamlessly across a suite of decarbonised energy solutions into existing and future infrastructure. As agnostic experts in the deployment of technology we help appraise the suitability of decarbonised energy models facilitating the transition to the

right solution safely, cost effectively in a manner that does not compromise existing business operations. We align the enabling infrastructure requirements of developments for optimised operation of all forms of hydrogen projects.

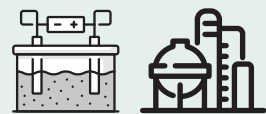
- **PROJECT DELIVERY PARTNERSHIPS.** AECOM act as your Delivery Partner across the lifecycle of hydrogen projects. We provide end to end advisory, project development and delivery services for infrastructure requirements on an integrated basis. AECOM have permitted more hydrogen infrastructure than any of our peers. Our global hydrogen engineering centre of excellence provides cost effective expertise to our local design teams. Our knowledge of the supply chain informs our world renowned procurement, project management and construction management teams to commission and deliver a full range of hydrogen infrastructure safely where it is needed.
- **PRODUCTION TO UTILITY CAPABILITY.** AECOM have successfully enabled some of the worlds leading clean hydrogen production facilities from electrolytic combination with offshore wind and hydropower to integrated chemical synthesis of hydrogen with associated carbon capture and storage technologies. AECOM have a particular pedigree in decarbonisation of transport systems and the associated hydrogen mobility infrastructure.
- **STRONG PUBLIC AND PRIVATE SECTOR RELATIONSHIPS.** Through our strong Public and Private sector relationships we are focussed on successfully positioning hydrogen hubs and delivering the full spectrum of integrated infrastructure requirements.



## AECOM Focus Infrastructure



Feed Source /  
Supply



Production  
(Blue/Green/etc.)



Biproduct  
Utility/Storage



Storage/  
Distribution



Utility – Mobility/  
Heating/Energy

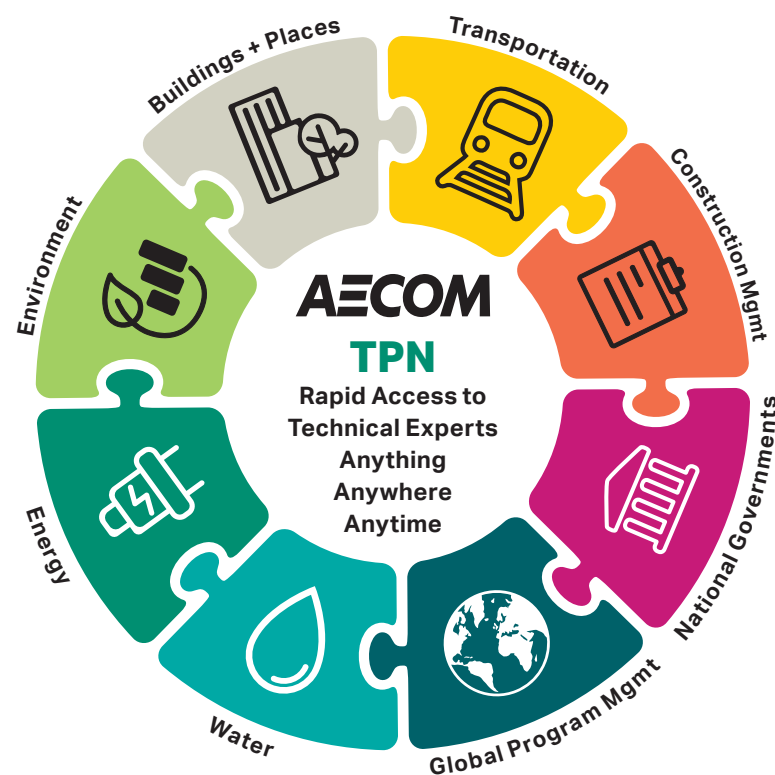


# AECOM's Technical Practice Network (TPN)

Driving Continuous Improvement of Technical Capabilities, Client Solutions and Professional Development

**Our TPN connects employees, clients and project needs in accessing the global talent and capability of nearly 47,000 experts to problem-solve and develop innovative solutions.**

AECOM's TPN ensures technical excellence in the engineering and environmental services we deliver to clients. Our TPN is a virtual community of dedicated professionals working together to drive continuous improvement of technical capabilities in key practice areas:



The success of our project work — and AECOM — depends upon leveraging the best expertise of our staff. The TPN fosters learning, technology transfer and professional collaboration across our global offices, effectively bringing staff together along technical lines of interest. The TPN unlocks the combined potential of all of our people and supplies tools to enhance innovation, productivity and efficiency — creating technical advances and ultimately achieving the best technical and cost effective solutions for clients.

AECOM's TPN includes 81 global Technical Practice Groups (TPGs), including over 22 TPGs focused on our engineering and environmental business. The TPGs disseminate technical knowledge and practice-specific experience through an extensive library of technical resources, company-wide technical webinars, participation at industry-leading seminars, and supporting technical vendor presentations. Each TPG maintains a globally-accessible collaborative website with technical documents, health and safety best practices, and a forum for questions and discussions.

AECOM encourages employees to perform to high technical standards and rewards staff for incorporating innovation into projects and publications. Through TPN's sharing of best practices across technical groups and geographies, our clients and project teams benefit from innovation achieved on our projects around the world, and our people benefit from training, career development, and access to leading projects and opportunities.

- Air Quality
- Cultural Resources/Heritage Management
- Data Management
- Due Diligence
- Ecological Management
- Energy Advisory & Efficiency
- Environmental Health & Safety Compliance
- Environmental Impact Analysis
- Environmental Management Information Systems
- Environmental Site Characterization
- Industrial Process & Future Fuels
- Marine Environmental Management
- PFAS
- Remediation Construction and Operation
- Remediation Strategies
- Renewable Energy & Storage
- Resilience & Climate Change
- Social Performance & Human Rights
- Strategic Communications & Public Consultation
- Sustainability Services
- Transmission & Distribution
- Waterway Revitalization/ Contaminated Sediments

More Information: [AskEnvironment@aecom.com](mailto:AskEnvironment@aecom.com)

## Our AECOM TPN:

### CONNECTS

Technical staff around the world and leverages technical expertise for client solutions by identifying and sharing best practices and experience.

### EDUCATES

Staff and clients through technical webinars, highlighting AECOM experience, technical leadership and innovations, and industry trends.

### ANSWERS

Questions, fosters discussions, and serves as a resource library of technical presentations, reference documents and health and safety best practices.

### EXCHANGES TECHNOLOGY ON DEMAND

Staff requests information and experience in real time — reaching thousands of global staff.

### COLLABORATES/ENGAGES

Staff across geographies and business units in 'virtual villages' to share ideas, knowledge and experience.

### FOSTERS/MENTORS

Employee excellence in growing and developing professionally, while attracting new and retaining highly talented technical staff.



## ABOUT AECOM

AECOM is the world's trusted infrastructure consulting firm, delivering professional services throughout the project lifecycle – from advisory, planning, design and engineering to program and construction management. On projects spanning transportation, buildings, water, new energy and the environment, our public- and private-sector clients trust us to solve their most complex challenges. Our teams are driven by a common purpose to deliver a better world through our unrivaled technical and digital expertise, a culture of equity, diversity and inclusion, and a commitment to environmental, social and governance priorities. AECOM is a Fortune 500 firm and its Professional Services business had revenue of \$13.1 billion in fiscal year 2022. See how we are delivering sustainable legacies for generations to come at [aecom.com](https://aecom.com) and [@AECOM](https://twitter.com/AECOM).

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