

ARCHES Alliance for Renewable Clean Hydrogen Energy Systems (ARCHES)

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ARCHES, DOE Hydrogen Program

DOE Project #OCED001

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Alliance for Renewable Clean Hydrogen Energy Systems



ARCHES **Principles**

Statewide

Leveraging California's size and diverse geography and economy to produce, transport, store, and use H₂ at scale with multiple clusters of each, provides an ideal H₂ test-bed for the nation

🕑 Green

California has long led the nation and the world in environmental innovation and policy and will do so again with clean H_2 .

Stakeholder and **Community Engaged**

Built-in and ensured at all stages of the process

Equity and Justice Centered Objective and Unbiased

Prioritized in all decisions with a focus on California's impacted, disadvantaged, low-income, and tribal communities.

Aligned with State Interests

To move California toward a robust H₂ economy and marketplace, and a cleaner, greener future.

Solution-Oriented

Focused on implementation with targeted research and innovation to achieve the DOE's \$2/kg 5-year goal and the administrations \$1/kg 10year goal.

Representing and ensuring the interests of all parties

Multi-dimensional

Considering all aspects of a successful H₂ economy.

Connected

Within California and other H₂ hubs.

ARCHES The Resilient H₂ Ecosystem for California



- **ARCHES DOE H2Hub = Tier 1** = DOE funding through H2Hub Program
- **Tier 2** = viable project but no DOE funding through the DOE H2Hub Program
- **ARCHES Ecosystem = Tier 1 + Tier 2**
- **Tier 2 is growing** through our open rolling RFP process



ARCHES **California's Clean Energy Commitments**

Clean Energy

- SB100 (100% clean energy)
- SB423 (firm zero carbon resources)
- SB1020 (interim clean energy targets)

Clean Transportation

- Exec. Order 79-20 (ZEVs)
- **ZEV Regulations**
- Advanced Clean Fleets
- Low Carbon Fuel Standard

Climate Change

- AB32
- SB32 (2030 Target)
- AB1279 (carbon neutrality)
- Governor/Scoping Plan Goals (sustainable aviation fuel, carbon removal, etc.)

Market Transitions

Cap-and-Trade Governor's infrastructure package and executive order **ARCHES Hydrogen** Hub selection

ARCHES **ARCHES from Feedstock to Off-take** - 2







Any proposed future work is subject to change based on funding levels



End Use Sector

POWER

PORT

TRANSPORTATION

Loss

ARCHES ARCHES Systems Approach Balances Production and Offtake Over Time





2023 Any proposed future work is subject to change based on funding levels

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ARCHES ARCHES Systems Approach Initiates Large Future Growth



ARCHES Life Cycle Assessment

Carbon Intensity & Human Health Impacts were modelled at the individual project level, the regional level, and at the hub level

System Boundary





Carbon Intensities of Produced Hydrogen by Region

Region	Carbon Intensity	Quantity	
	kgCO₂eq/kgH₂	MTPD	
Northern CA	-1.13	41	Northern Californi (NorCal)
Northern CA Valleys	2.15	185	
Southern CA Valleys	-6.03	140	
Southern CA	2.89	149	
Weighted Average	-0.15	515	

North Central Valley (NCV) South Central Valley (SCV) **Southern California**

(SoCal)

ARCHES Life Cycle Assessment: End Use

- Identify **primary products** or services
 - Transportation, Power, Ports
- Evaluate nameplate capacity and temporal variation in supply and demand
 - Energy content & efficiency of conversion
 - Emissions offset emissions from H2 supply





ARCHES Life Cycle Assessment: Impacts



Method from Los Angeles HyDeal analysis uses EPA BenMAP





ARCHES **Community Benefits Pathways Highlights**



- Focus on the most impacted communities
 - Many touchpoints and opportunities for engagement
- **Chief Community Officer** leading ARCHES CB efforts
 - Hub-level community benefits team with on-theground engagement and partnership
- Community Benefits Monitoring Team for accountability
- Labor and Workforce
 - \$229M in workforce development
 - PLAs for all projects
 - Broad educational collaboration: UCs, CSUs, California Community Colleges, and labor training institutes
- **Community Engagement and Support**
 - \$150M in direct community benefits
 - Local CB teams for local engagement and influence

ARCHES Growing a diverse, local workforce with high-road careers and family-sustaining wages





ARCHES **ARCHES Community Benefits Governance Gives Stakeholders** Input and Influence Ask to join the tribal nations, impacted **ARCHES Board** communities, organized labor, or cities and/or local governments advisory committees **Advisory Committees**



Participate in regularly scheduled Hub-Level CBWG meetings. May request participation of CBMT, hydrogen experts, project representatives and ARCHES leadership

Engage with the ARCHES Hublevel CB Team at LCBWG meetings and other events



Project-level

ARCHES **Project Timeline**



Any proposed future work is subject to change based on funding levels

Phase 4: Ramp-Up & Operate

DOE Funding to be negotiated, ~2-4 years

Summary

ARCHES

ARCHES is a **public-private partnership** to create a **sustainable renewable, clean hydrogen (H**₂**)** market and ecosystem in California and beyond by 2030

ARCHES' main goals are to:

- Kickstart the **commercial viability of H**₂
 - Focus on hard-to-decarbonize sectors: Ports, Power, Heavy-Duty Transportation
 - Initiate expansion to: Heavy Industry, Aviation, Maritime, Agriculture, and others
- Increase production/offtake of renewable, clean H₂ from **30 TPD** to **500+ TPD**
- Develop a comprehensive H_2 regulatory framework to accelerate H_2 deployment
- Produce **measurable benefits** for California communities, with **robust monitoring**, and strong accountability
- Develop a H₂ workforce for California, and a H₂ workforce development model for the nation, including a universal H₂ certification program as well as H₂ specific codes and standards
- Meet CA air quality and climate goals and work regionally and nationally to build out the H₂ marketplace and ecosystem.