



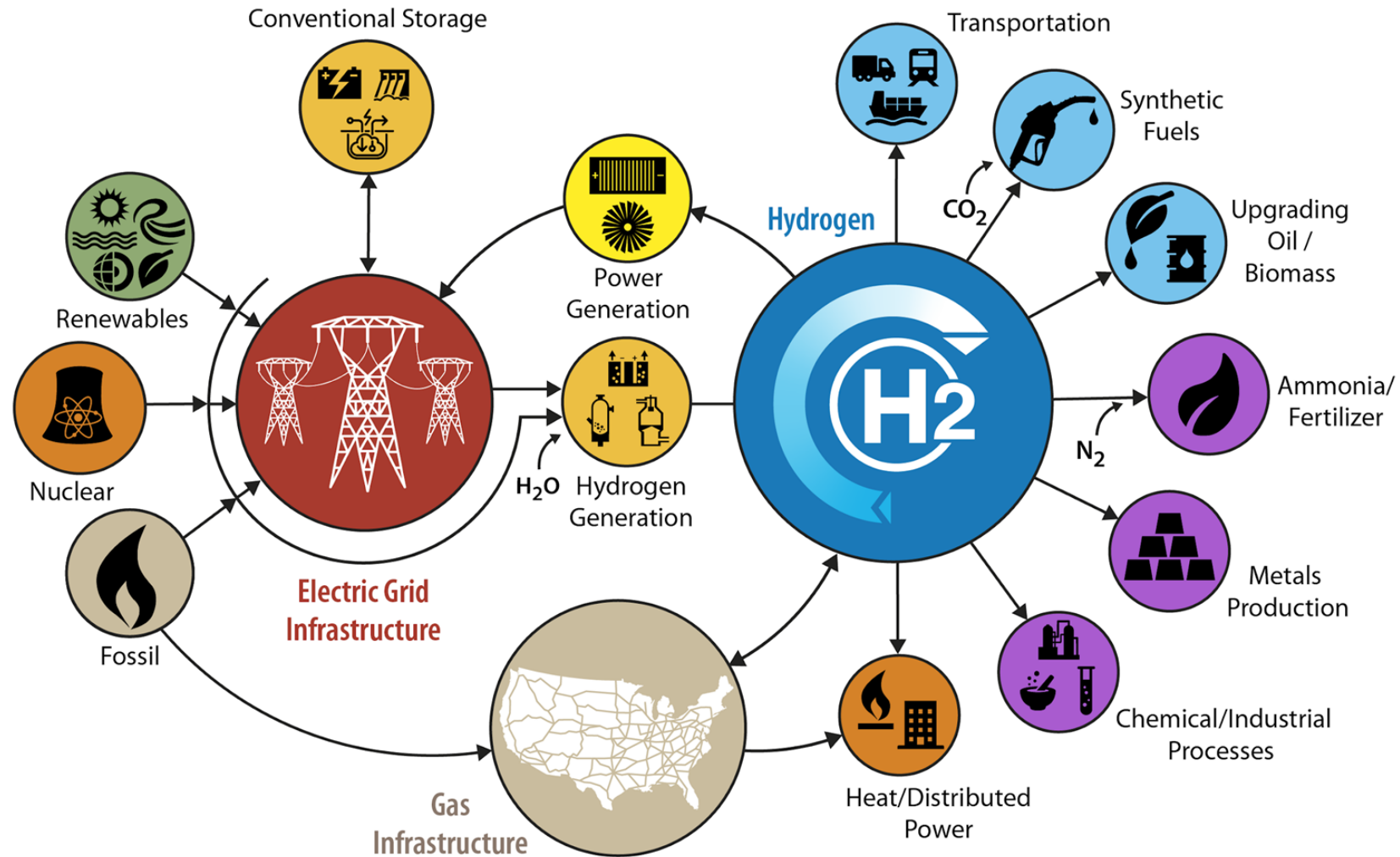
# Alliance for Renewable Clean Hydrogen Energy Systems (ARCHES) – California H2Hub

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Presentation for SMUD Board Meeting

September 2023

# Hydrogen can decarbonize the hard to decarbonize sectors





# ARCHES Mission

- **ARCHES** is a **public-private partnership** to create a **sustainable statewide renewable, clean hydrogen (H<sub>2</sub>) market and ecosystem** in California and beyond
- **ARCHES** utilizes **renewable resources** to produce hydrogen with the objective to **fully decarbonize the regional economy**
- **ARCHES** prioritizes
  - ❖ Environmental Justice
  - ❖ Equity
  - ❖ Economic Leadership
  - ❖ Workforce Development
  - ❖ Hydrogen Market Viability



# ARCHES Goals

- Establish an exemplary **renewable, clean H<sub>2</sub> Hub in California by 2030**
- Kickstart **commercial viability of H<sub>2</sub>**
  - ❑ Focus on hard-to-decarbonize sectors: **Ports, Power, HD Transportation**
  - ❑ Initiate expansion to: **Heavy Industry, Aviation, Maritime, Agriculture, and others**
- Ramp production/offtake of renewable, clean H<sub>2</sub> from **30 MTPD / 11K MTPY to 500+ MTPD / 1.8M+ MTPY**
- Produce **measurable benefits** for California communities, with **robust monitoring**, and **strong accountability**
- Develop a **H<sub>2</sub> workforce** for California, and a **H<sub>2</sub> workforce development model** for the nation
- Be **ready to interconnect** with other H<sub>2</sub> Hubs no later than the end of 2030
- Bring delivered **cost of H<sub>2</sub> below diesel and other traditional fuels** in California by 2030
  
- **Meet CA and National carbon neutrality goals**

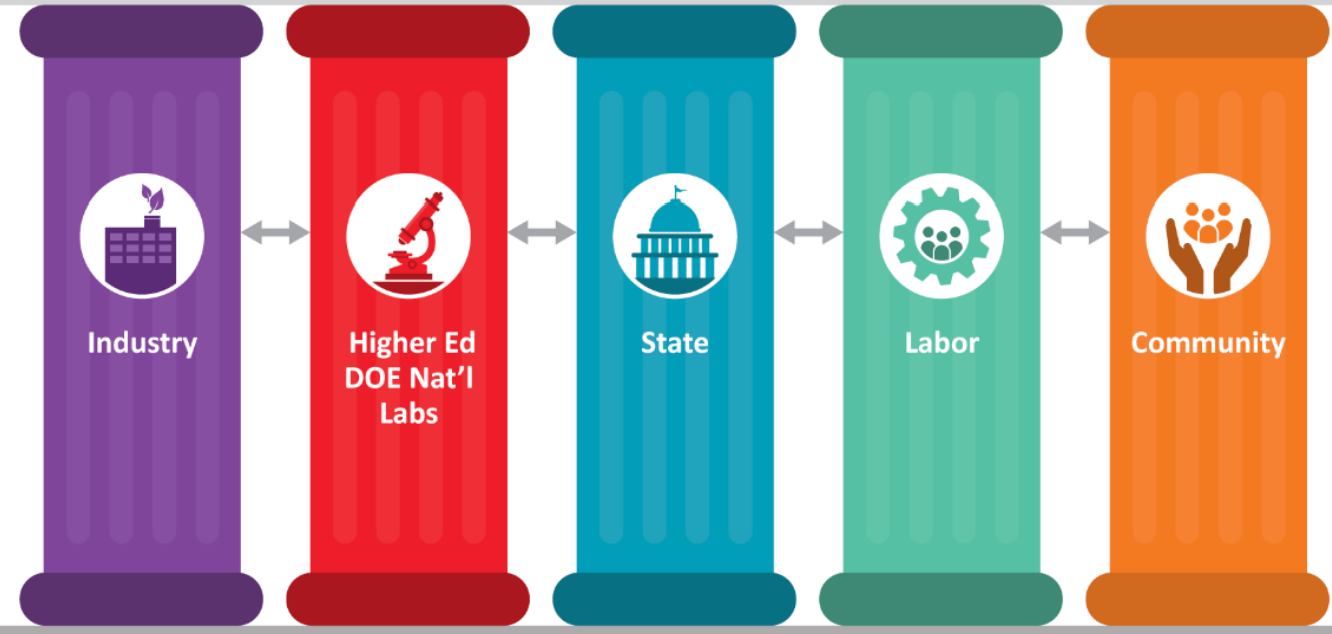


# ARCHES



## ARCHES Key Differentiators

- Infrastructure Availability
- Industry Readiness
- Offtake Resilience
- Market Catalyst
- Community Connectivity
- Delivery Certainty



## ARCHES Principles

- Statewide
- Green/Clean
- Stakeholder & Community Engaged
- Equity & Justice Centered
- Aligned with State Interests
- Solution-Oriented
- Objective & Unbiased
- Multi-dimensional
- Connected
- Delivery Certainty



# ARCHES Principles

## ✓ **Statewide**

Leveraging California's size and diverse geography and economy to produce, transport, store, and use H<sub>2</sub> at scale with multiple clusters of each, providing an ideal H<sub>2</sub> test-bed for the nation

## ✓ **Clean/Green**

California has long led the nation and the world in environmental innovation and policy and will do so again with clean, green H<sub>2</sub>

## ✓ **Stakeholder and Community Engaged**

Built-in and ensured at all stages of the process

## ✓ **Equity and Justice Centered**

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 H<sub>2</sub> economy and marketplace, and a cleaner, greener future.

## ✓ **Solution-Oriented**

Focused on implementation and innovation to achieve DOE's Hydrogen Shot goals and market liftoff

## ✓ **Objective and Unbiased**

Representing and ensuring the interests of all parties

## ✓ **Multi-dimensional**

Considering all aspects of a successful H<sub>2</sub> economy

## ✓ **Connected**

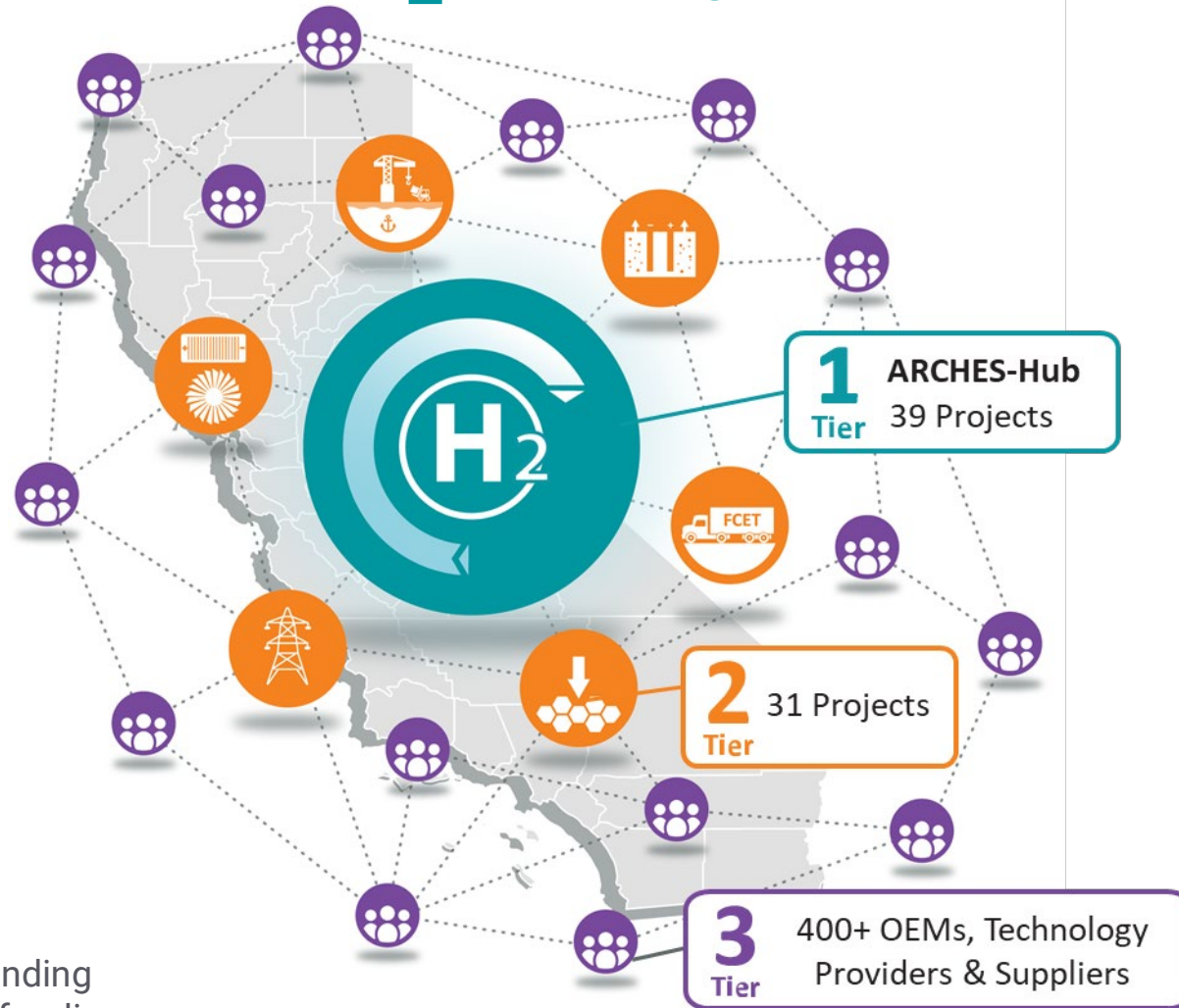
Within California and other H<sub>2</sub> Hubs

## ✓ **Delivery Certainty**

Execute projects on time, in scope, within budget



# The Resilient H<sub>2</sub> Ecosystem for California



Tier 1 = w/DOE funding  
Tier 2 = w/o DOE funding

All partner projects will be subrecipients and have a signed partnership with ARCHES H2 LLC, except for FCET procurements.



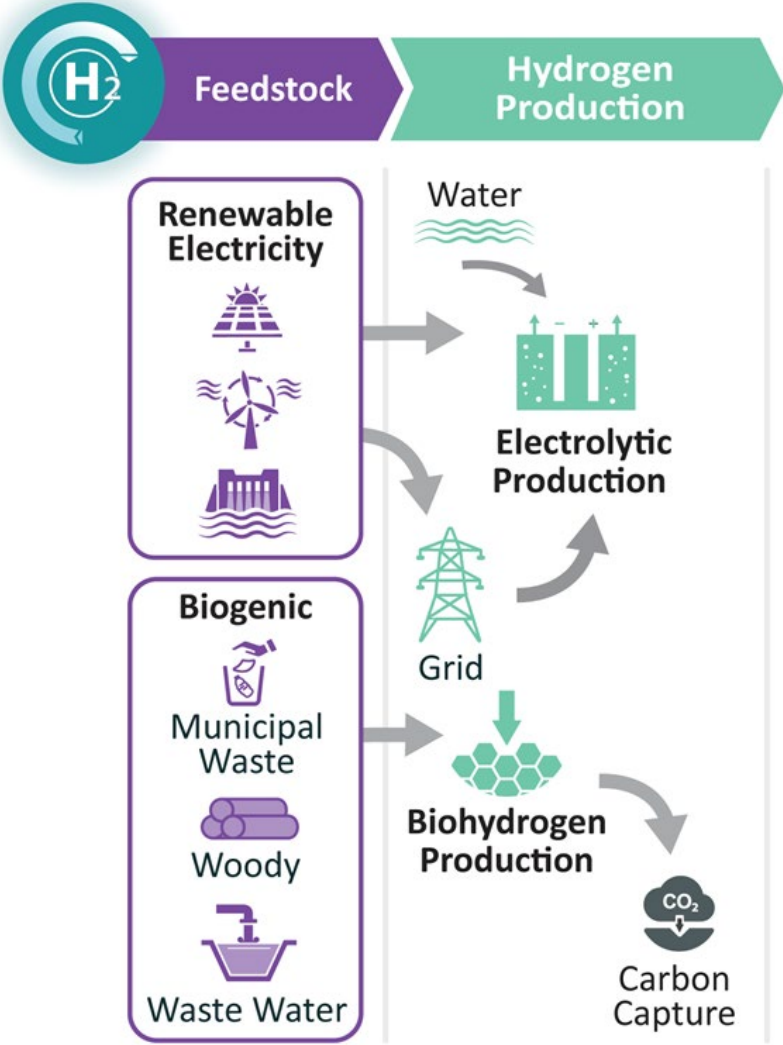
# ARCHES Hydrogen Flow





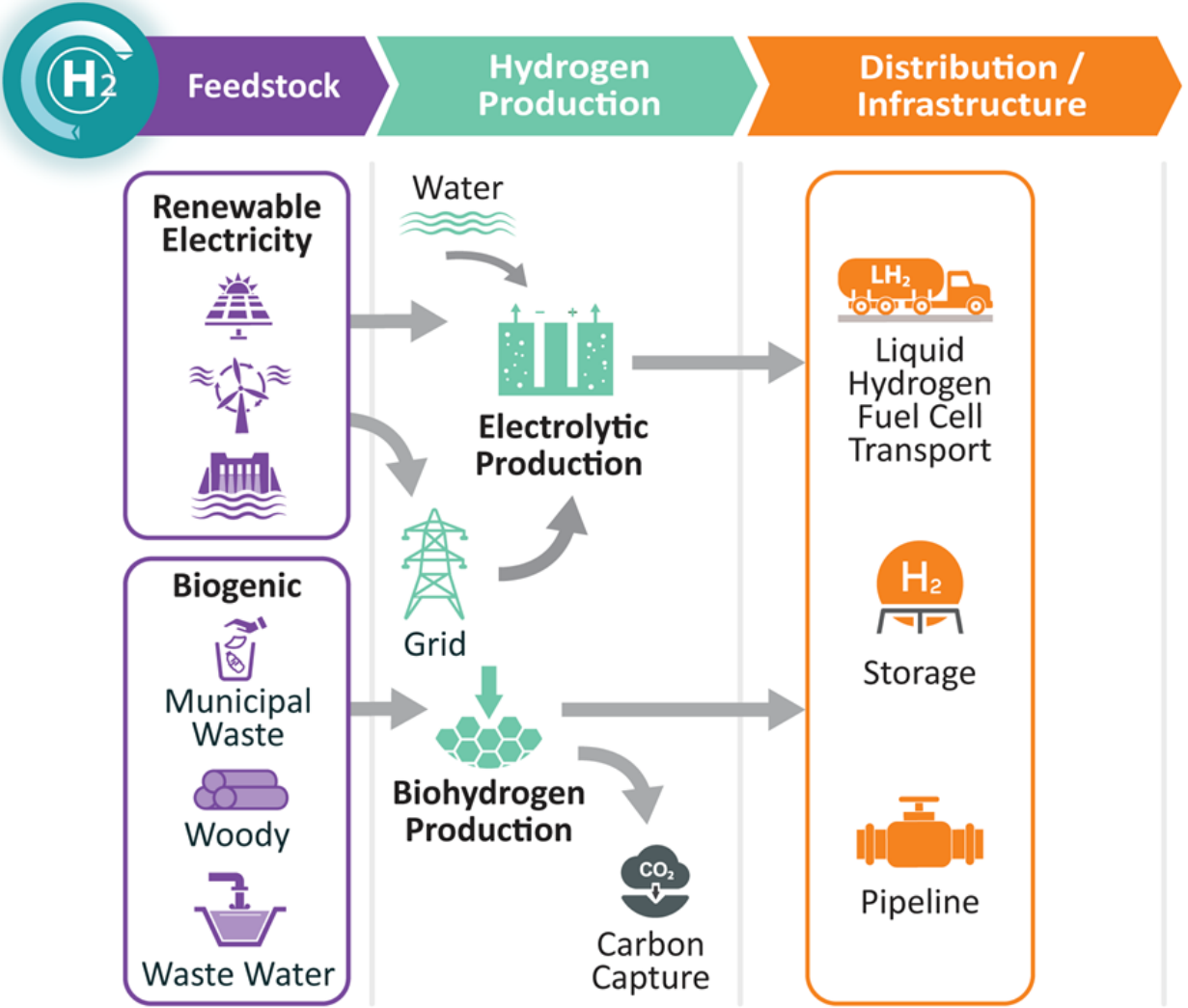


# ARCHES Hydrogen Flow



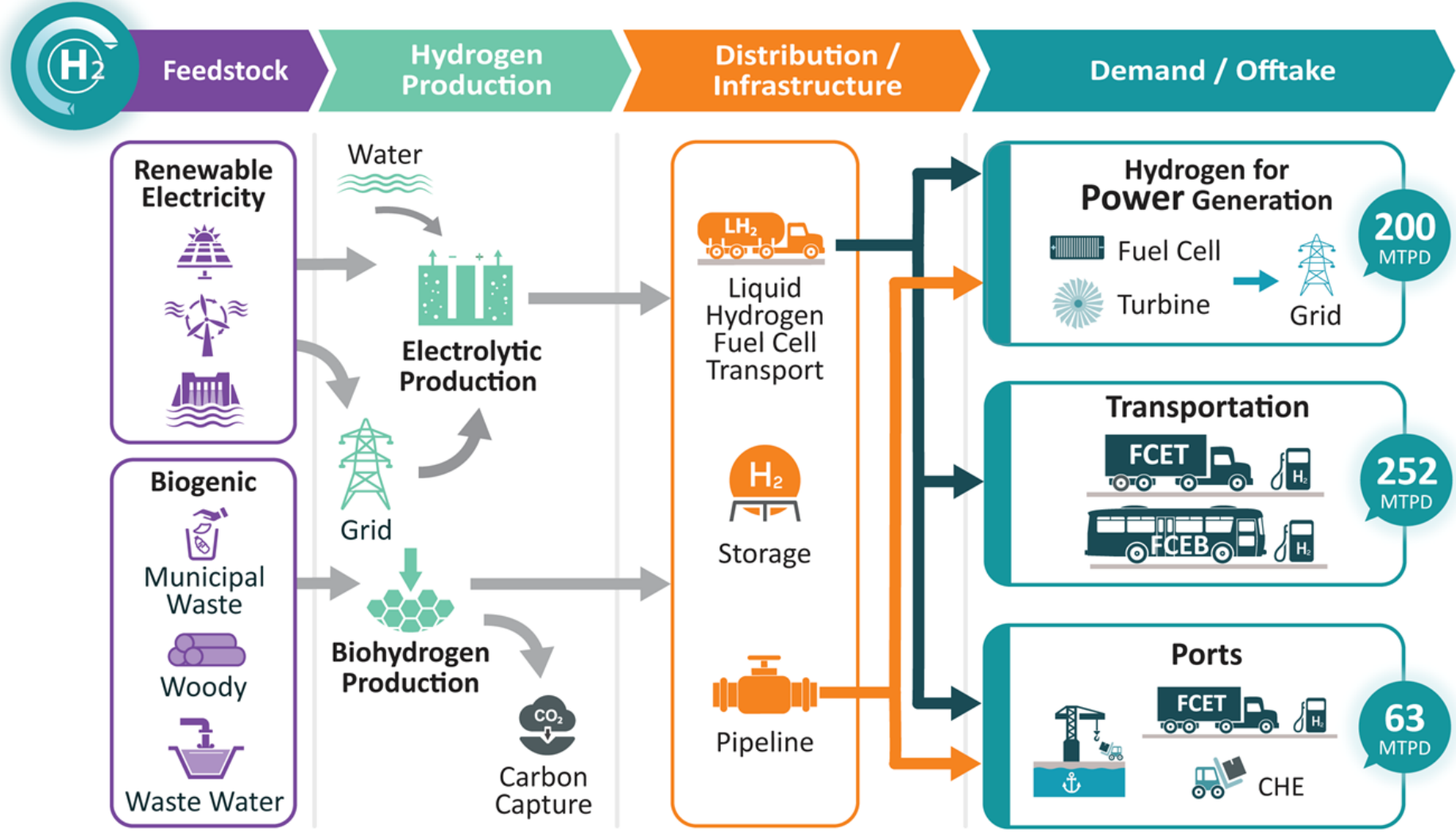


# ARCHES Hydrogen Flow



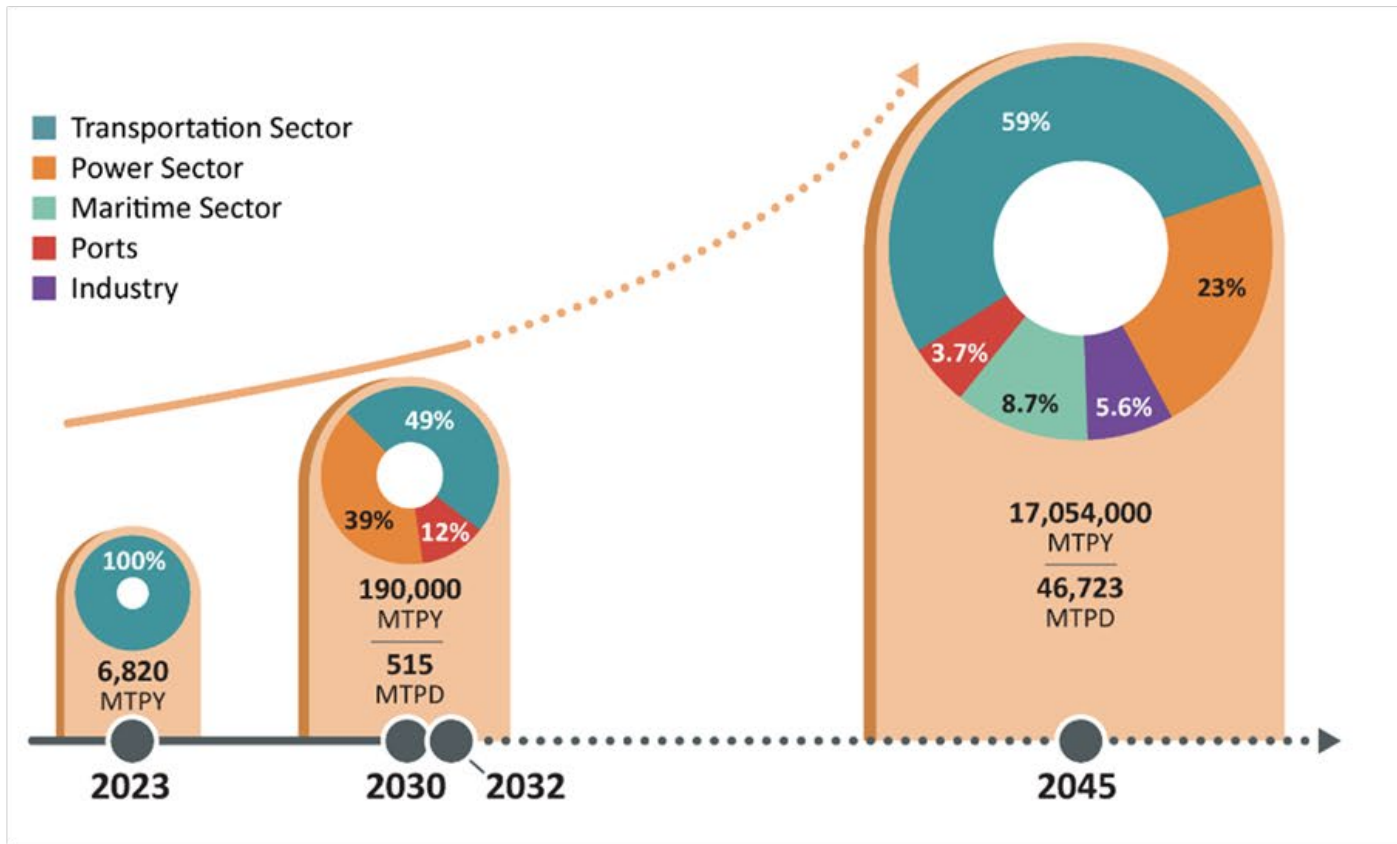
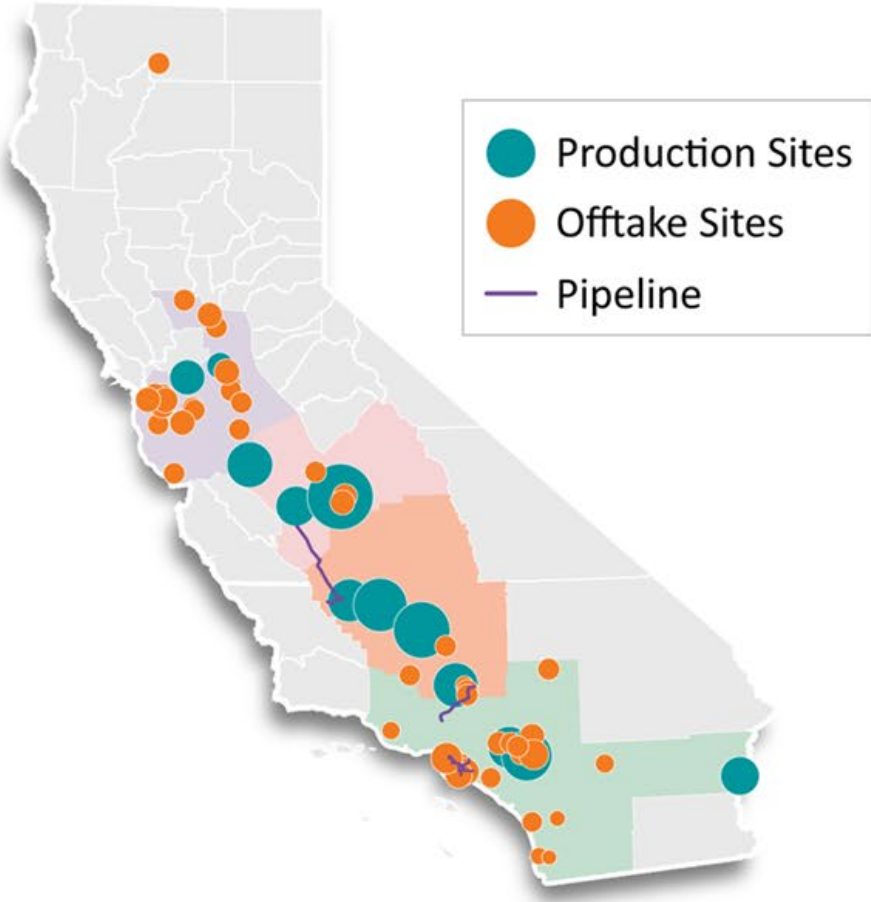


# ARCHES Hydrogen Flow





# ARCHES Systems Approach Initiates Large Future Growth





# ARCHES Achieves Market Liftoff

## DEPLOYMENT

Average delivered H<sub>2</sub> cost to end use kg

**\$7.65**

w/o any PTC



**\$5.04**

with PTC & LCFS

**165**



Miles of new H<sub>2</sub> pipeline (30 existing)

**~5,500**



Class 6 & 8 trucks

**-0.15**

kgCO<sub>2</sub>/KgH<sub>2</sub>



Average life-cycle carbon intensity

**1,080**



Transit buses

Heavy-duty HRS

**66**

Public



**24**

Private/Transit

**232**



Port cargo handling equipment

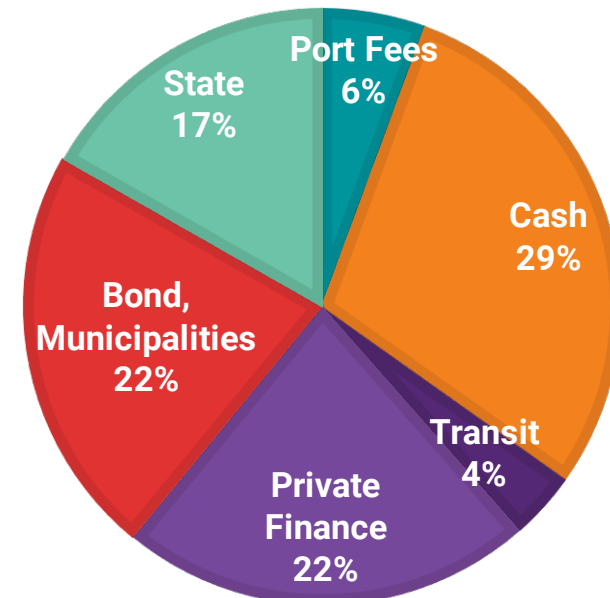
## Hydrogen production by region

REGION	Cost including delivery/storage and before incentives	Carbon Intensity	Quantity
	\$/kgH <sub>2</sub>	kgCO <sub>2</sub> eq/kgH <sub>2</sub>	MTPD
N. Central Valley	7.36	2.15	185
S. Central Valley	7.37	-6.03	140
SoCal	5.91	2.89	149
NorCal	5.97	-1.13	41
Weighted Average	6.99	-0.15	515

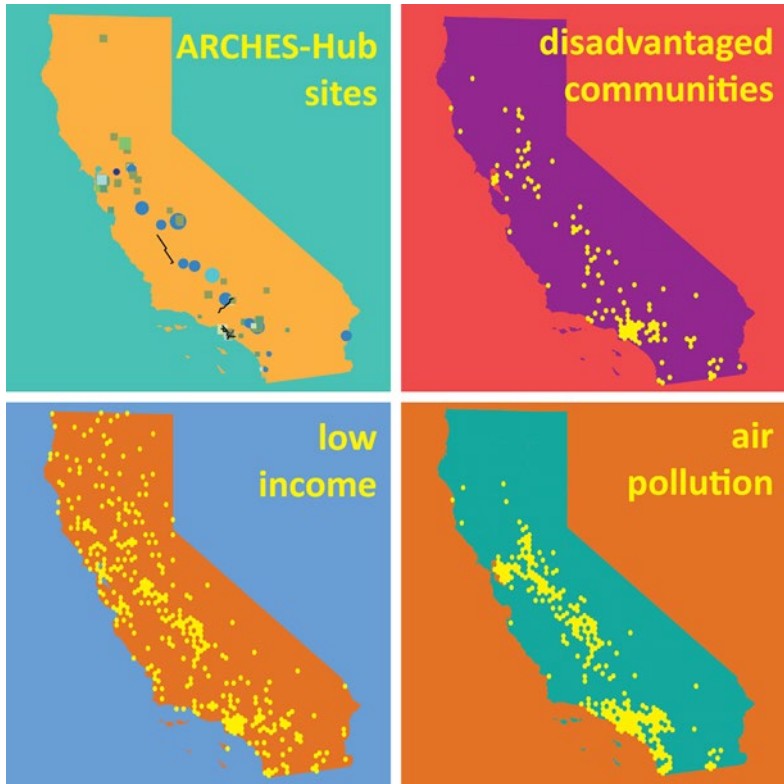
\$1.25B DOE funds unlock

\$11.3B :

9X return over 8 years



# Disadvantaged Communities Will Benefit



\*EJ40 database and CalEnviroScreen

**COMMUNITY**

- ▲ **\$2.95 billion** Economic value of increased health\* and associated health costs savings per year
- ▲ **222,400** Number of jobs created per year
- ▼ **2,097** Fewer hospitalizations for respiratory & cardiac illness per year
- ▼ **13,292** Fewer work loss days per year
- ▼ **6,900** Nitrogen oxide net emissions avoided MTPY
- ▼ **239** Sulfur dioxide net emissions avoided MTPY
- ▼ **326** Particulate matter net emissions avoided MTPY
- ▼ **48** Fewer premature deaths per year
- ▲ **\$380 million** Invested in community benefits & workforce development

\$150M in direct community benefits

\$229M in workforce development

\*Reduced premature death, asthma, cancer risk, missed work days

**Questions?**