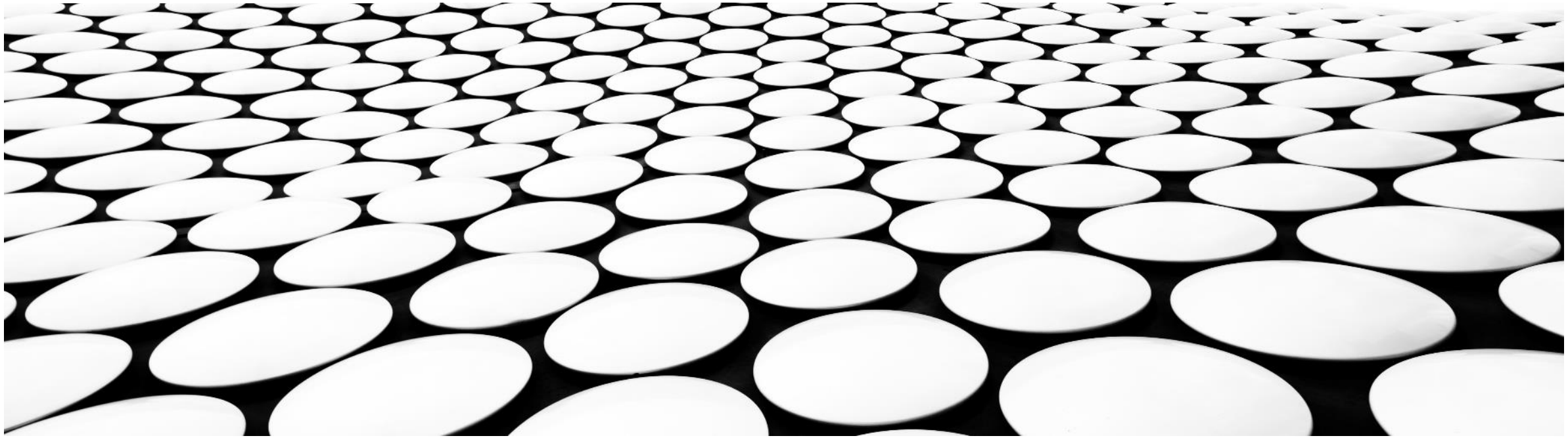
CALIFORNIA HYDROGEN BUSINESS COUNCIL



CHBC BRIEFING - THE BUSINESS CASE FOR LIGHT DUTY HYDROGEN STATIONS

JULY 15, 2021

HOUSEKEEPING

- Two Audio Options: Streaming Audio and Dial-In.
  - Streaming Audio/Computer Speakers (Default)
  - Dial-In: Use the Audio Panel (right side of screen) to see dial-in instructions. Call-in separately with your telephone.
- Question & Answers
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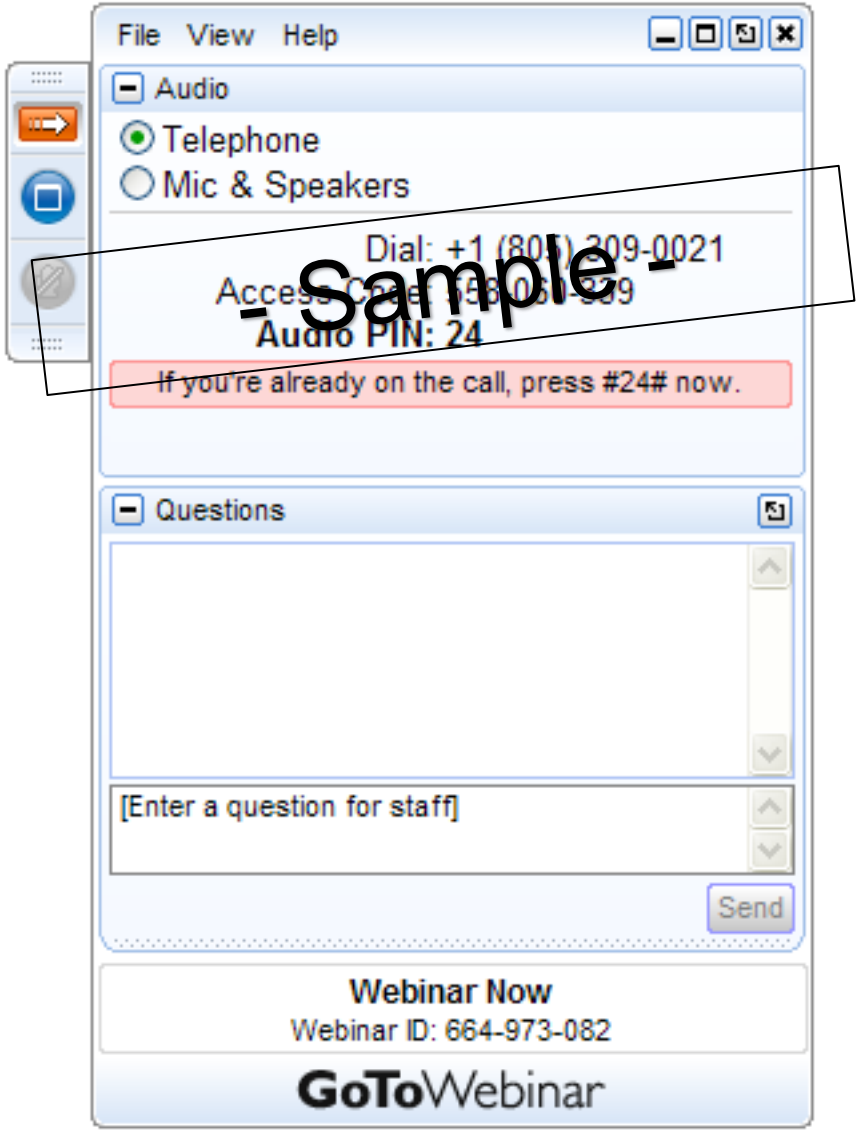

WEBINAR SPEAKERS

Bill Zobel
Executive Director
California Hydrogen Business Council

Gia Brazil Vacin,
Assistant Deputy Director
Governor's Office of Business and Economic Development

Dr. Andrew Martinez
Air Pollution Specialist
California Air Resources Board

Steve Ellis
First Element Fuel

Salim Rahemtulla
President
PowerTap Hydrogen

Al Burgunder
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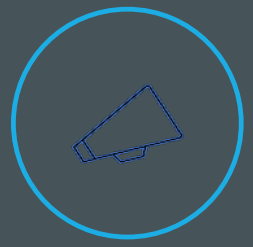
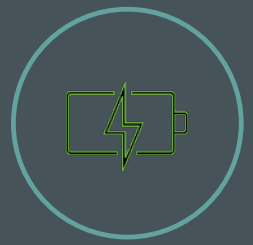


GOODS MOVEMENT, HEAVY-DUTY TRANSPORT, AND CLEAN PORTS

PUBLIC TRANSPORTATION

ENERGY STORAGE AND RENEWABLE HYDROGEN



CALIFORNIA HYDROGEN BUSINESS COUNCIL

- **Our Vision:**
  - CHBC is committed to advancing the commercialization of hydrogen in the energy and transportation sectors to achieve California's climate, air quality, and decarbonization goals.
- **Our Mission:**
  - Provide clear value to our members and serve as an indispensable and leading voice in promoting the use of hydrogen in the utility and transportation sectors in California and beyond.
- **Our Principals:**
  - Leadership, Integrity, Teamwork and Inclusion.
- **Our Objectives:**
  - Enhance market commercialization through effective advocacy and education of policymakers and policy influencers
  - Be "the" trusted "go to" resource on Hydrogen and Fuel Cell technology for policymakers and policy influencers
  - Accelerate market growth via networking opportunities and information exchange for the industry and its customers

OUR MEMBERS

CHBC Platinum Members

CHBC Gold Members

Silver

AST Advanced Structural Technologies, Inc.
Archaea Energy
Bennett — A Hines Corporation
Burckhardt Compression
BMW
cte
Chesterfield Special Cylinders
Chiyoda Corporation
Cashman Preload Cryogenics
Hofer — Neuman & Esser Group
Black & Veatch
energy independence now
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GINER
GM
gna — Gladstein, Neandross & Associates
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gtm technologies
ElDorado National - California
H2Safe
Hexagon Purus
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hypoint
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intertek — Total Quality. Assured.
Iwatani Group — Iwatani Corporation of America
JM — Johnson Matthey — Inspiring science, enhancing life
Kiewit
Landirenzo USA
LOOP
MAGNUM
New Flyer
NUVERA — Making hydrogen make sense.
PDC Machines
Port of Long Beach — The Green Port
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SMUD
Mpower
SAFCell
Sargent & Lundy
SunLine Transit Agency
Swagelok
Trillium — A Love's Company
TM
True Zero
WFT Winkelmann Flowform Technology — Fuel Systems
Worley — energy | chemicals | resources
Worthington Industries

Innovator

Anaerobe Systems — The Oxygen-Free Specialists
CHARM
CMB.TECH
community environmental services
DASH
Daylight Transport
electro-active technologies
DRIVE ON, LLC
Fuel Solutions
General Engineering and Research
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T2M
Tatsuno North America, Inc.
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VALUE IN MEMBERSHIP

- Active representation in all relevant California policy making venues
- A trusted and knowledgeable industry resource
- Access to policymakers, policy influencers and industry
- Track record of success
- Platform for industry collaboration
- Learn more: www.californiahydrogen.org

BECOME A MEMBER AND MAKE A DIFFERENCE
TOGETHER WE CAN INFLUENCE PUBLIC POLICY AND GROW YOUR BOTTOM LINE

NEXT UP:

Gia Brazil Vacin,
Assistant Deputy Director
Governor's Office of Business and Economic Development

California Hydrogen Business Council Briefing

The Business Case for Light-Duty Hydrogen Stations

July 15, 2021

Gia Brazil Vacin
California Governor's Office of Business & Economic Development (GO-Biz)

State Environmental Goals

Legislation and Executive Orders are steering the state towards zero-emission transportation

Climate	• 2045: 100% zero carbon electricity (SB 100) • 2045: Carbon neutral economy (EO B-55-18) • Aggressive investment and state action on climate (EO N-19-19)
Air Quality	• 2031: 80% reduction in smog-forming NOx
Zero Emission Vehicles (ZEVs)	• 2025: 1.5 million ZEVs (EO B-16-12) • 2030: 5 million ZEVs (EO B-48-18) • 2035: 100% ZEV new sales light-duty, drayage, and off-road (EO N-79-20) • 2045: 100% ZEV medium- and heavy-duty (EO N-79-20)
ZEV infrastructure	• 2025: 200 hydrogen stations and 250,000 electric vehicle chargers (EO B-48-18)

Vehicle and Fuel Regulations

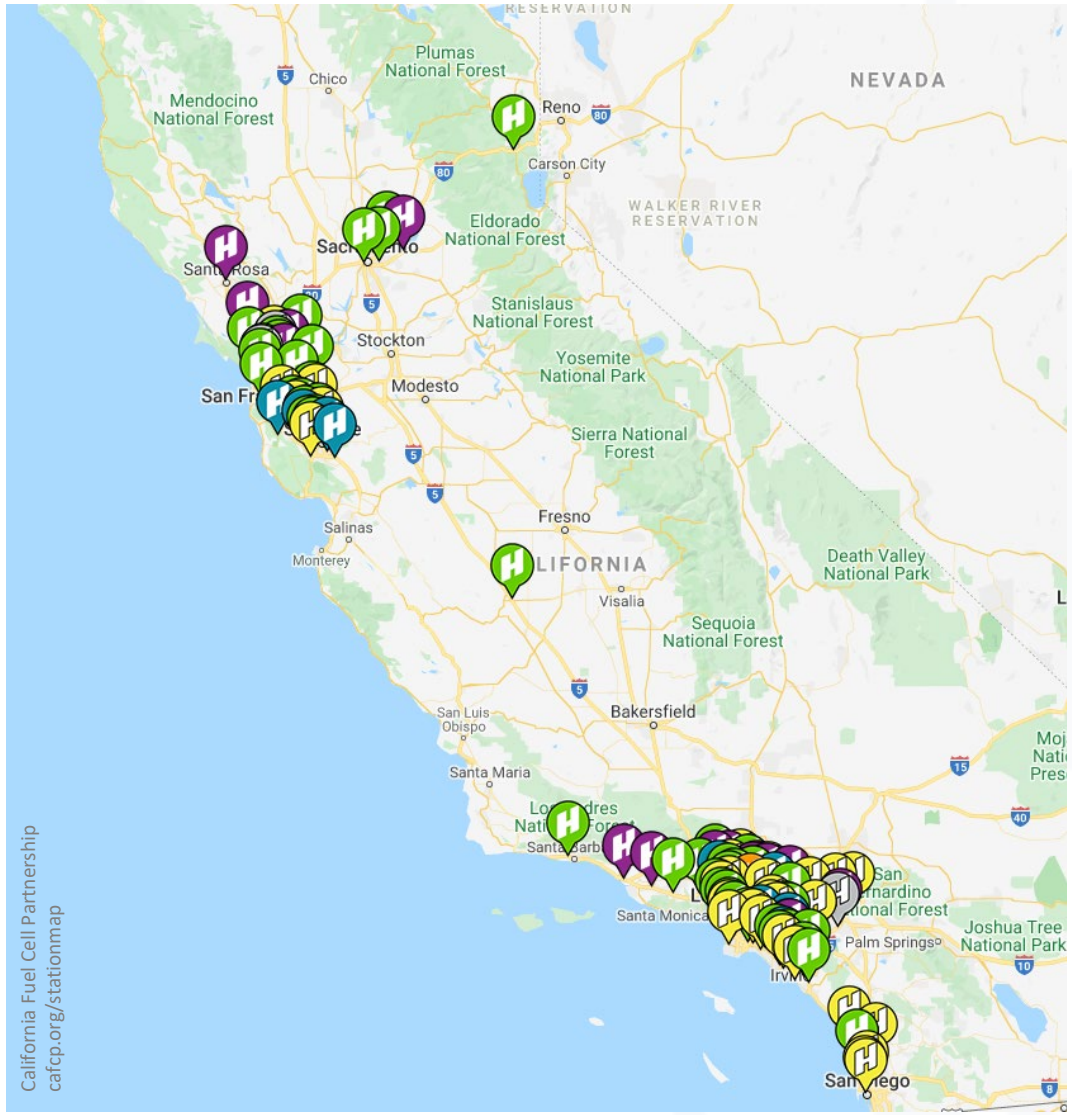
Regulations by the California Air Resources Board that advance light-duty zero-emission fuels & transportation

ZEV Regulation for Passenger Vehicles	• Requires automakers to generate or procure credits for plug-in hybrid, battery, and fuel cell electric vehicles
Low Carbon Fuel Standard ZEV Infrastructure Credits	• Hydrogen and DCFC stations generate credits for the capacity of the station • New high credit price: $200/Metric Ton CO_2e (Jan 2020)

California Comeback Plan

- SB 129 signed by Gov. Newsom on July 12, 2021
- ZEV investments:
  - $2.7B in 2021-22
  - $3.9B total over three years
- ~$300M to close the projected 2025 light-duty charging and fueling infrastructure gap
- $250M (2 years) manufacturing grants for ZEVs, ZEV components, and charging or refueling equipment
- $525M for CVRP; $400M (3 years) for Clean Cars 4 All and other clean transportation equity projects

Current CA Light-Duty Market



- 47 stations open to the public now
- Reach ~179 stations with earmarked state funds (23 private)
- Fuel cell electric vehicle (FCEV) sales/leases ~10,800

Challenges Remain…

- Infrastructure – need more, faster!
- Permitting timelines and variations among AHJs
- Technology hiccups
- Cost of hydrogen
- Hydrogen supply shortages and supply chain disruptions

…But There is Reason for Optimism

- Significant station progress since 2016
  - Higher capacity, lower cost
- 20-300% increase in renewable content
- Growing private investment (stations, H2 production)
- FCEV adoption curve following BEV early market
- CA budget; ZEV/H2 legislation

…And, we can achieve self-sufficiency!

CALIFORNIA
Governor's Office of Business and Economic Development

Thank You!

gia.vacin@gobiz.ca.gov

916-730-6107

NEXT UP:

Dr. Andrew Martinez
Air Pollution Specialist
California Air Resources Board

HYDROGEN FUELING SELF-SUFFICIENCY STUDY

Summary of Analysis

Andrew Martinez, PhD
andrew.martinez@arb.ca.gov

CALIFORNIA
AIR RESOURCES BOARD

Motivation

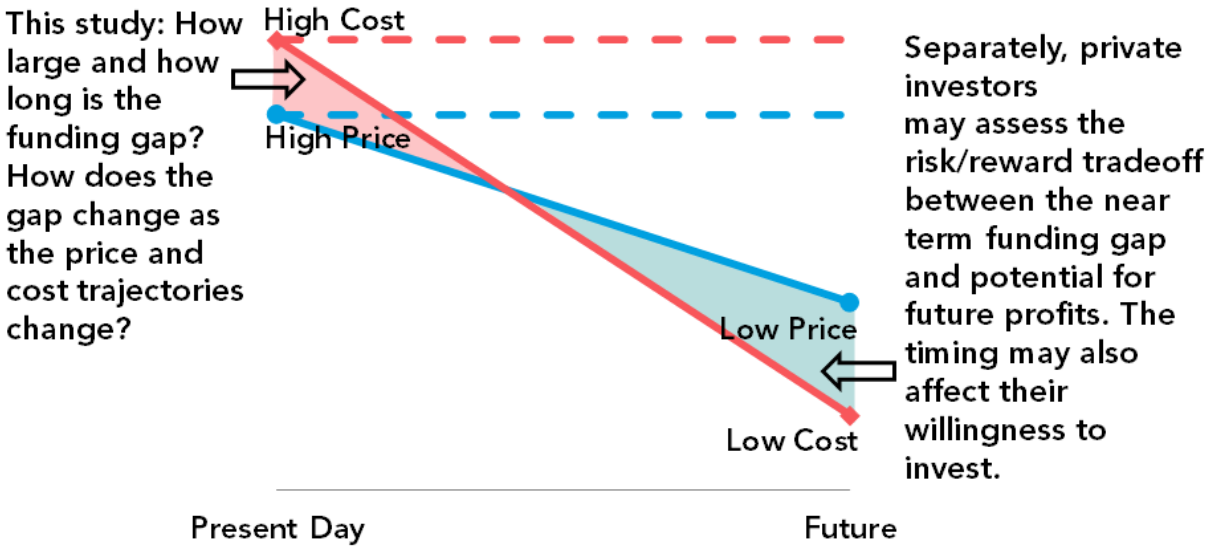
- AB 8 provides a funding mechanism for State support in developing light-duty hydrogen fueling stations.

- AB 8 also asks CARB and CEC to evaluate California's network development against a standard of financial self-sufficiency.

- CARB (with early collaboration from CEC) have developed a scenario analysis to characterize the **amount of State support** beyond AB 8 that leads to self-sufficiency and the **date of self-sufficiency**.

Fundamental Question

How will the market transition from high costs, high prices, and reliance on financial support to lower cost, lower price, and self-sufficiency?



Study Overview

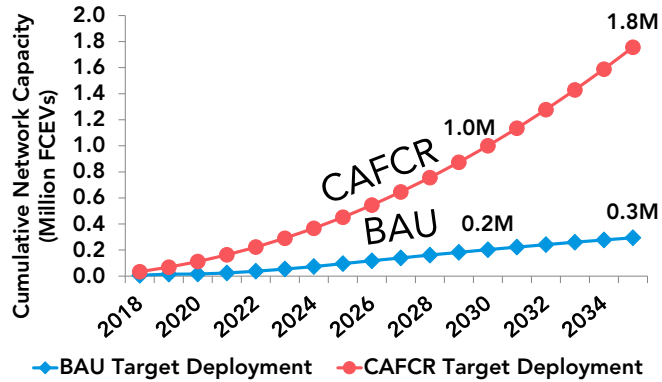
- CARB's method evaluates cash flows for future station network in various scenarios of deployment

- Can be realized through:
  - Growing economies of scale,
  - Policy direction (such as EO B-48-18, EO N-79-20, ZEV Regulation), and
  - Automaker commitment to FCEV deployment in California

- Study does not forecast likelihood or preference, but does quantify the cost and timing metrics

Primary Bounds of Scenarios

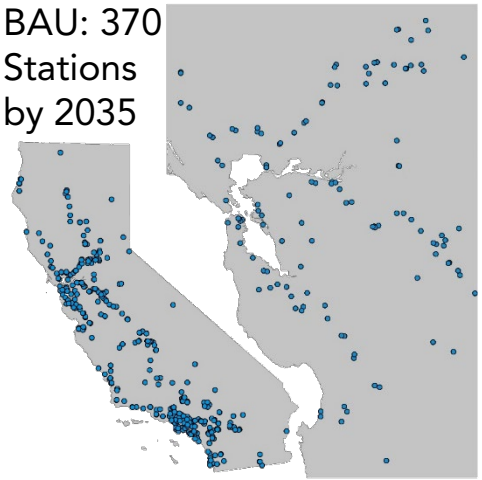
Vehicle deployment guides target number and capacities of stations



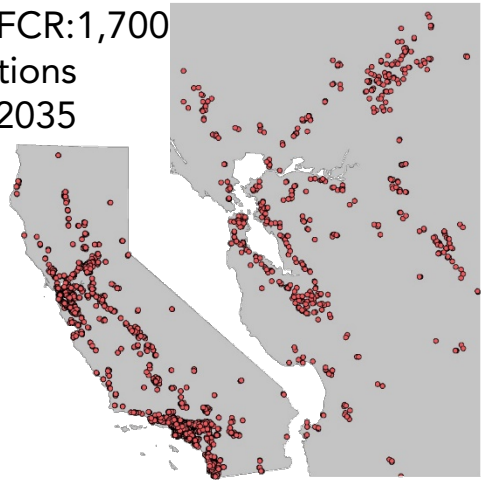
Upper Bound: Published Success Case

Lower Bound: Critically Limited Market

BAU: 370 Stations by 2035

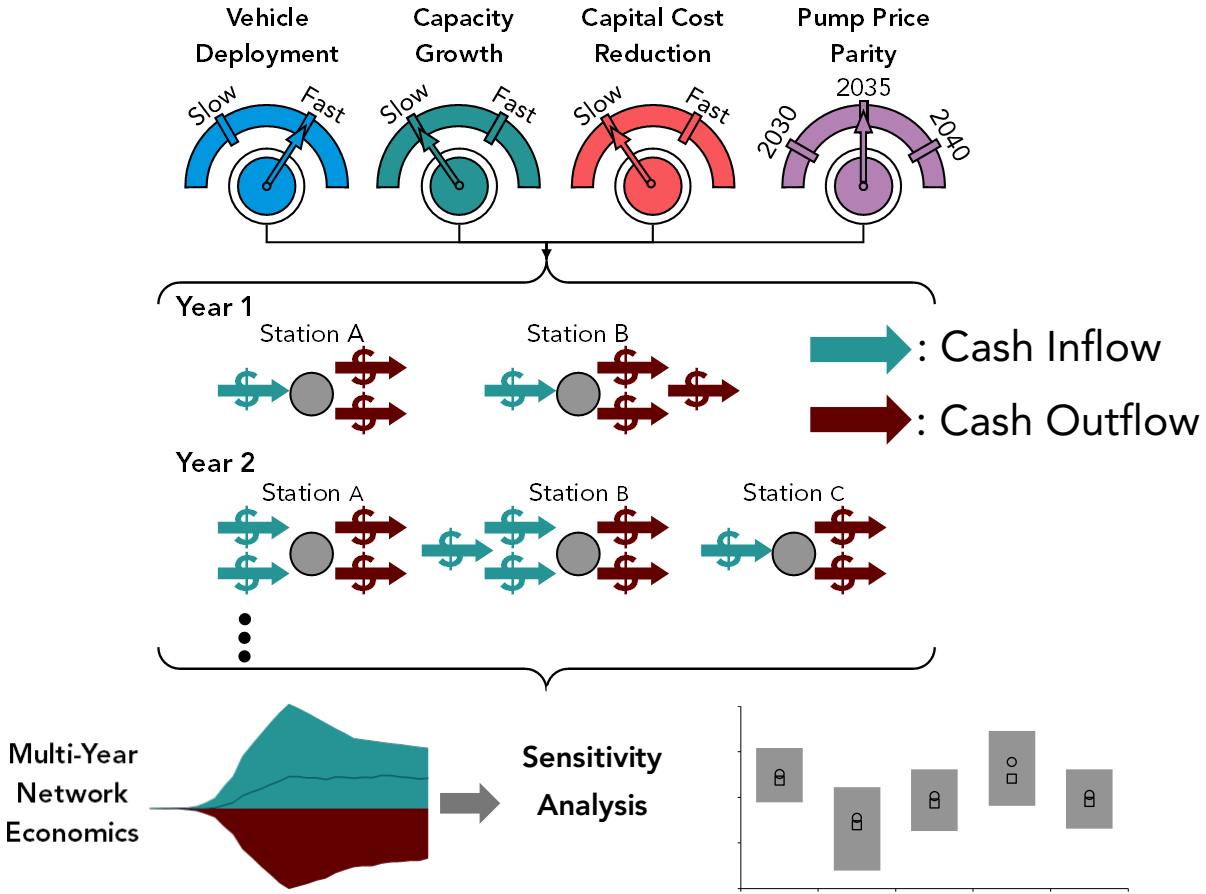


CAFCR:1,700 Stations by 2035



Method

Study built on a scenario analysis approach to estimate ranges of potential State support amounts and timing under various trajectories of progress



Method

840 Scenarios to cover possible ranges of key variables

- **Deployment Scale:** What FCEV volume do the State and industry plan for and how should a station fueling network be structured to meet the fuel demand?
- **Individual Station Utilization:** How will individual station utilization progress, based on local network maturity and deployed vehicles?
- **Station Development and Operations Costs:** How will capital and operational expenditures vary by station size and industry development?
- **Customer-Facing Price:** How can/will price at the pump change over time?
- **Station Finances:** What returns need to be achieved to keep development going?

Headline Findings

Self-Sufficiency Achieved by:

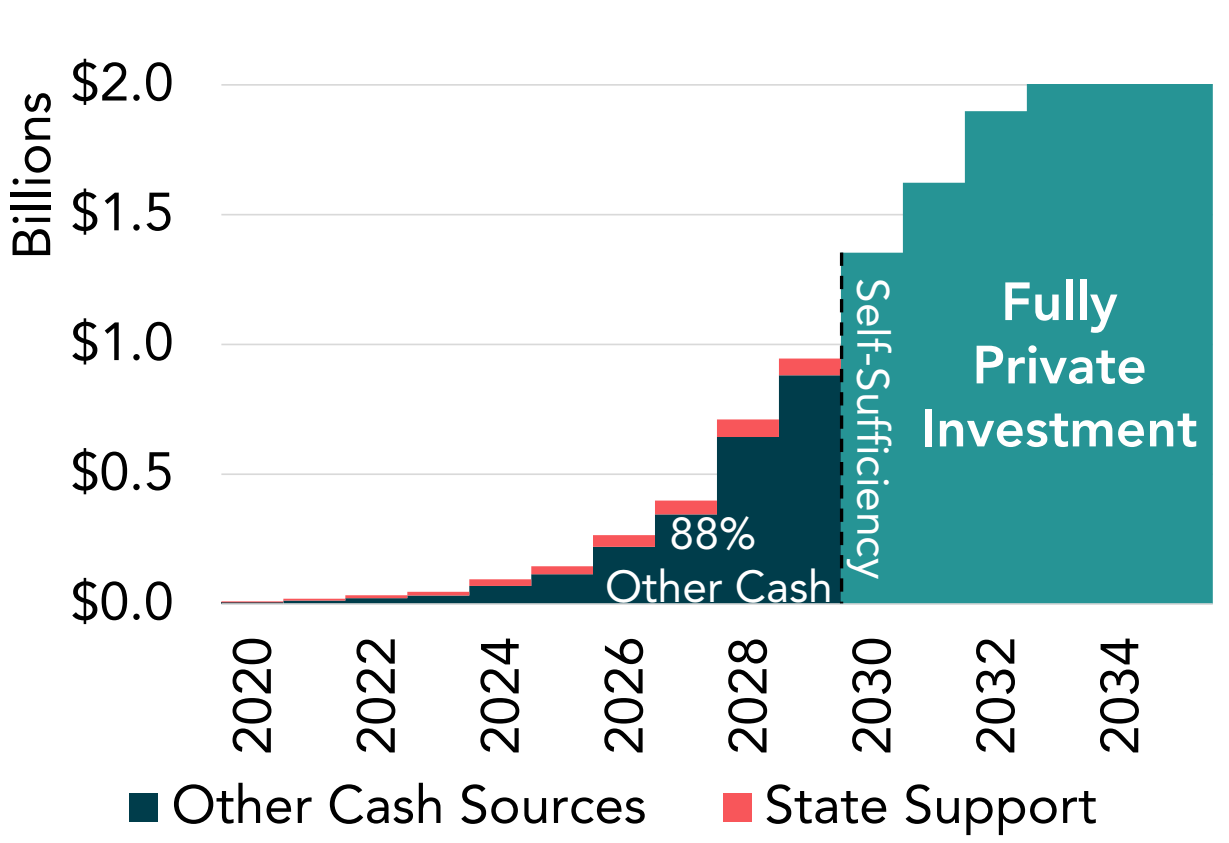
2030

With State Support up to:

- Self-sufficiency is possible with State support
- Industry supports the majority of network growth
- California's network growth rate drives its own economies of scale
- FCEV deployments need to keep up with network development to gain full benefit
- State support offers benefits to the consumer and may be sufficient to accelerate reductions in price at the pump

Industry Bears the Majority of Costs

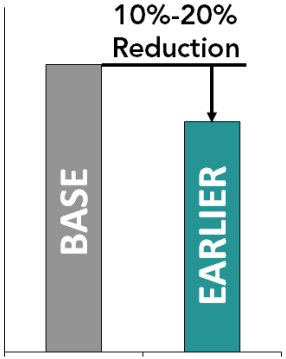
State support is a small part of the overall cost to develop the network to self-sufficiency



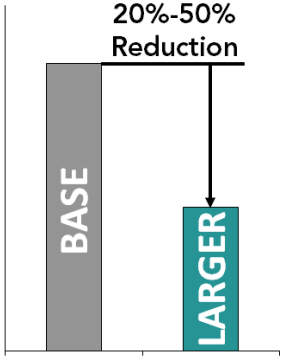
Network Development Sensitivities

Building more capacity earlier and faster more effectively builds economies of scale

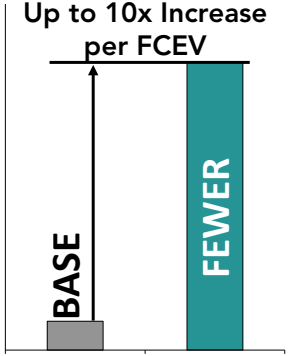
Stalled FCEV deployment can significantly increase need for State support



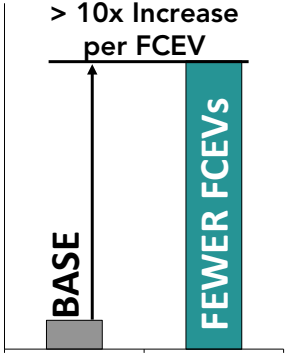
Accelerated Deployment Saves a Modest Amount



Early Emphasis on Larger Stations Saves a Significant Amount

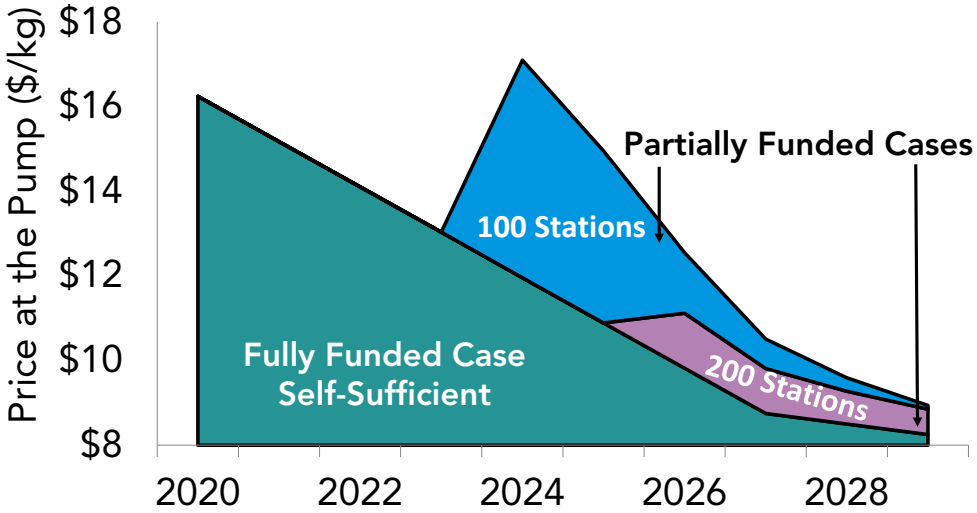


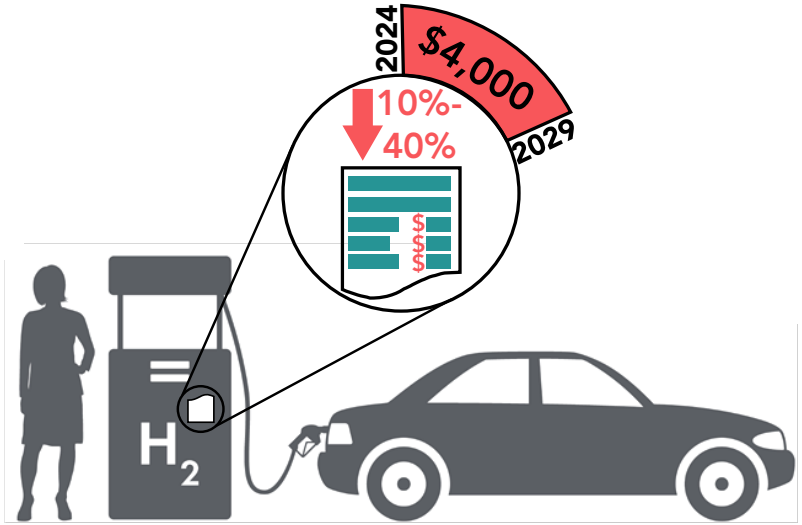
Investing for a Smaller Network Costs Much More for Fewer FCEVs



Low FCEV Deployment Causes Some of the Largest Increases in Cost and Timing to Self-Sufficiency

Consumers Benefit from State Support





CA's Investment Pace Drives Economies of Scale

=

200M

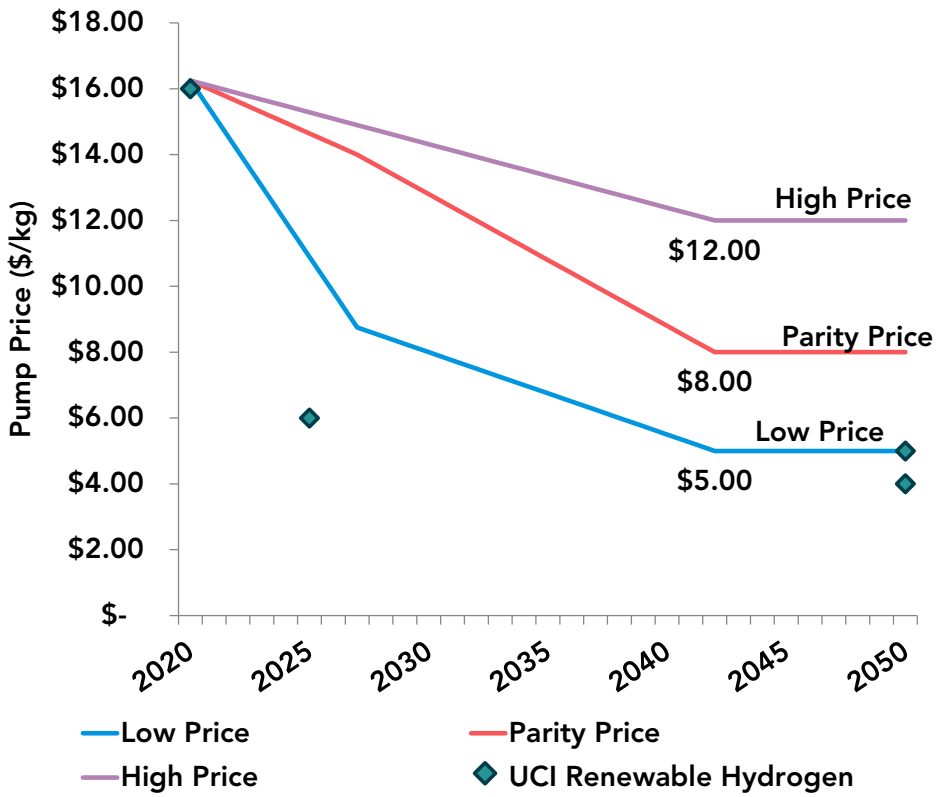
=

400M

- Larger-scale network growth creates opportunity for more vehicle deployment
- More vehicles equates to more fuel sales and balance effectively against high operational costs
- Even enhanced capital cost reductions transferred from other markets do not offset lost opportunity provided by growing operational economies of scale in the state

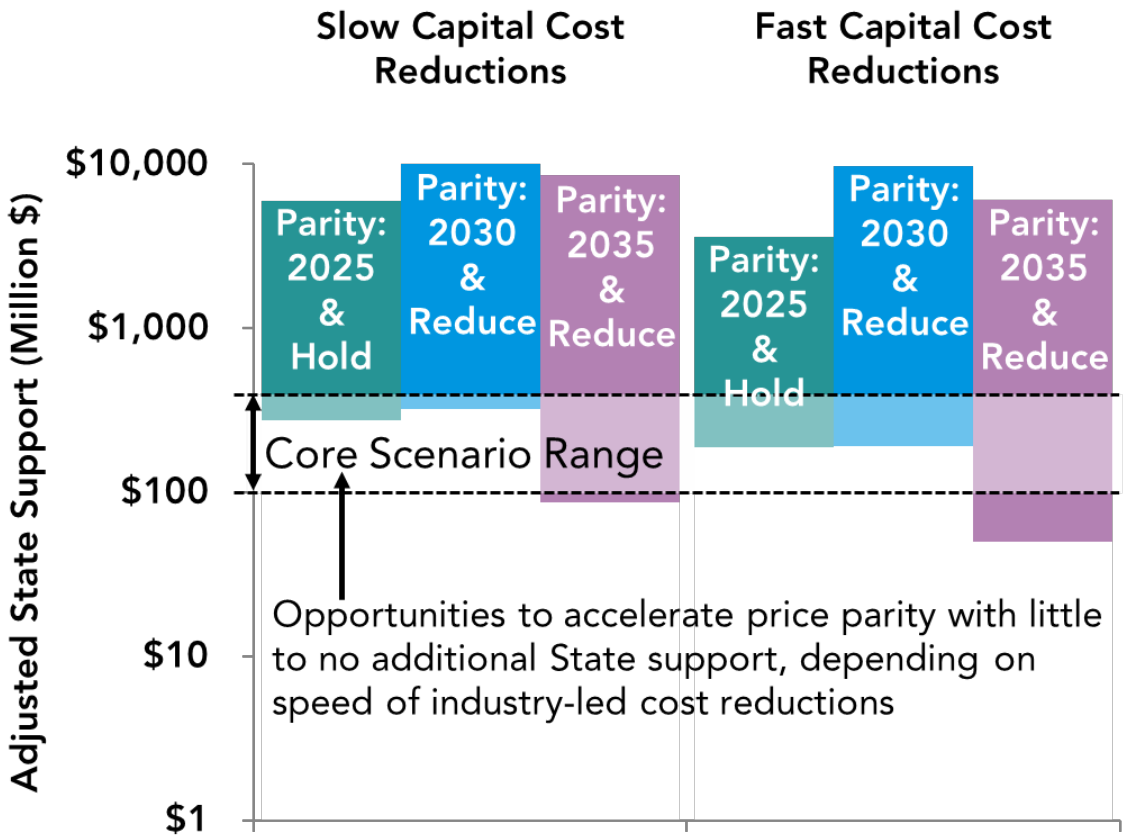
High Renewable Scenarios are Compatible with Self-Sufficiency

Hydrogen procurement cost and price at the pump assumed in this study align well with recent analyses of future renewable hydrogen costs



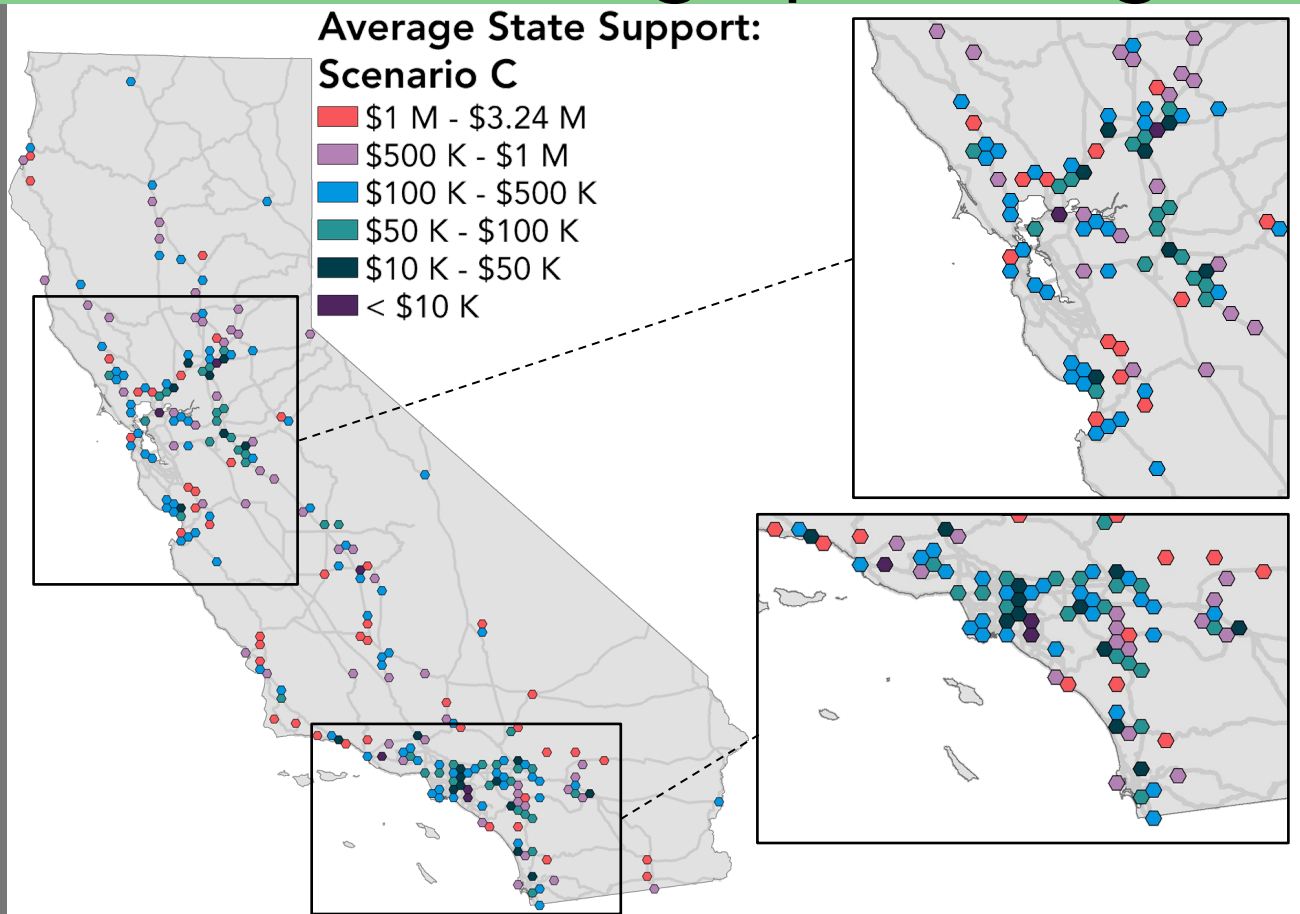
Price Parity with Gasoline within Decade Possible

State support amounts up to $300M may also be sufficient to advance price parity with gasoline earlier than 2040, depending on other market conditions



Geographic Insights

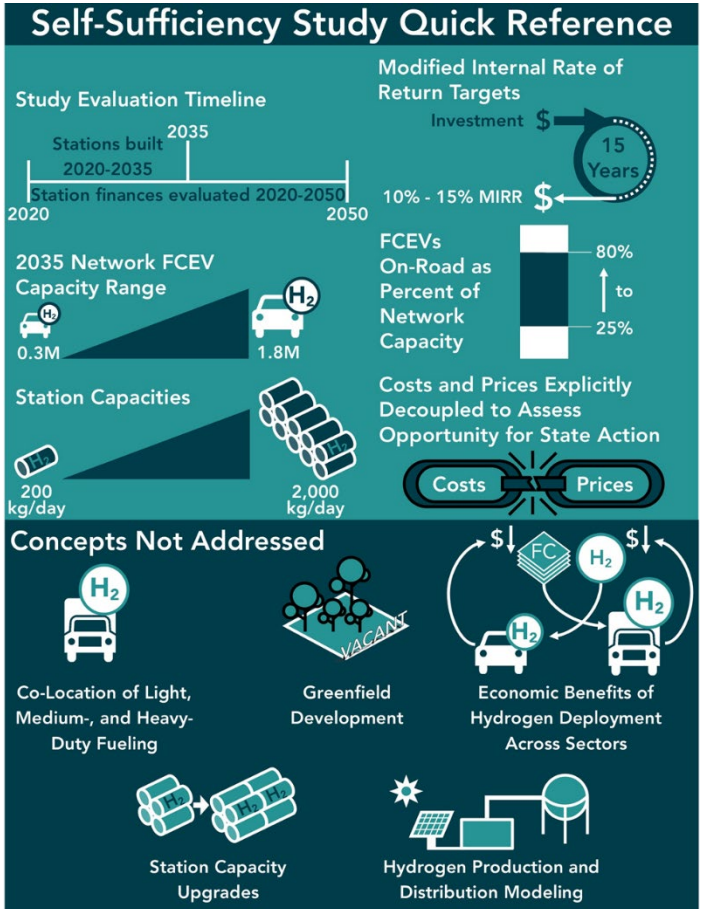
More need in remote areas and along CA-99 corridor, but core urban areas also require support



THANK YOU

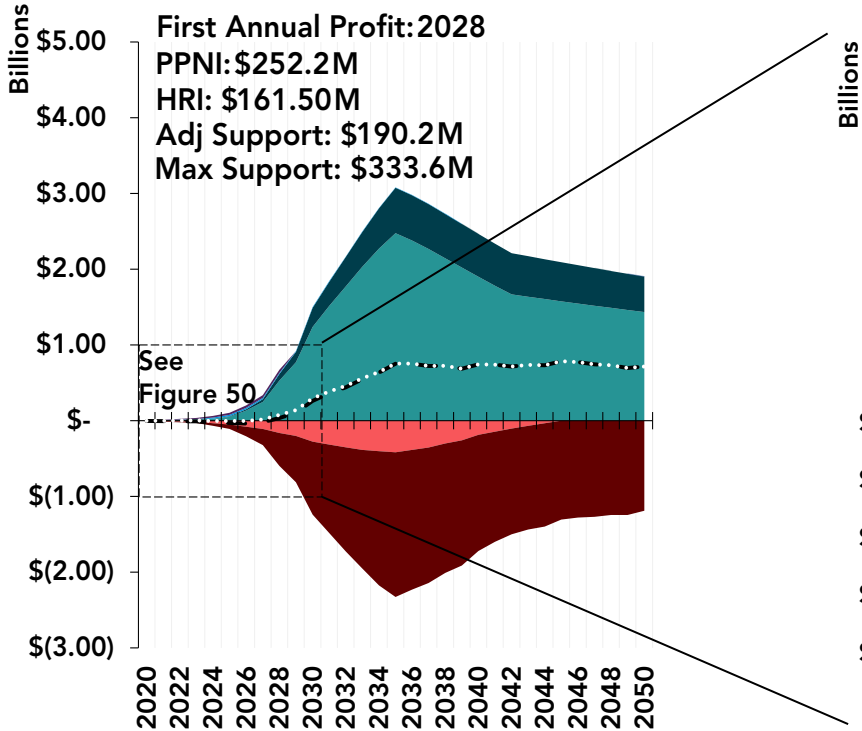
Study Context

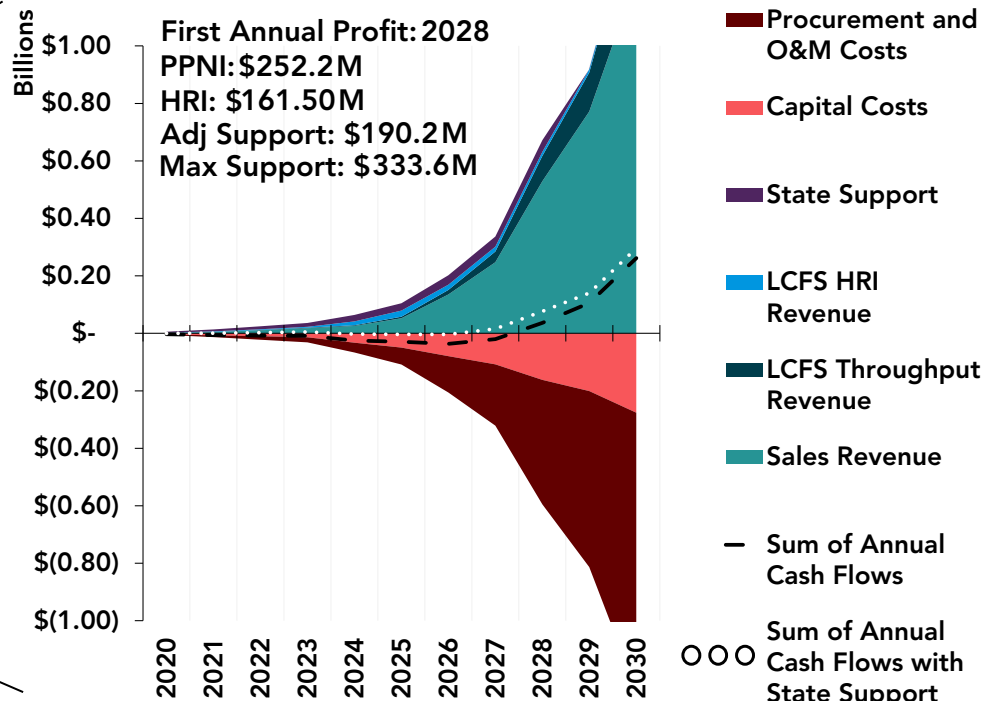
This Study Does	This Study Does Not
• Estimate cost and timing to reach self-sufficiency of hydrogen fueling network	• Attempt to predict the future trajectory of FCEV and hydrogen industry economics
• Evaluate many scenarios to develop probable ranges of cost and timing	• Predict future cost trajectories for hydrogen fuel or hydrogen station equipment
• Assume the State has an interest in establishing a self-sufficient hydrogen fueling network	• Determine whether or not the State should support establishing a self-sufficient hydrogen fueling network
• Assume costs and revenues affect the balance of station economics	• Develop a traditional pricing model based on costs and margins
• Assume total revenues can be influenced by State support	• Specify or explicitly model the mechanisms that may force prices and costs lower or higher
• Estimate the additional State support needed to reach a point where costs and revenues enable self-sufficient network development	• Determine the form of the support that should be used



Defining Self-Sufficiency Date and Support

- Self-sufficiency date identified by ability of **network as a whole to maintain a profit** without additional State intervention beyond LCFS. Support amount based on the gap between costs and revenues accounting for returns up to the self-sufficiency date.

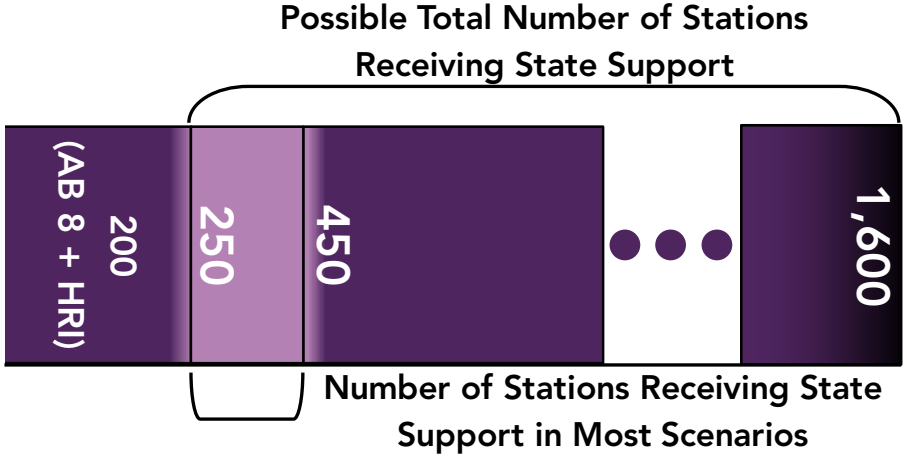


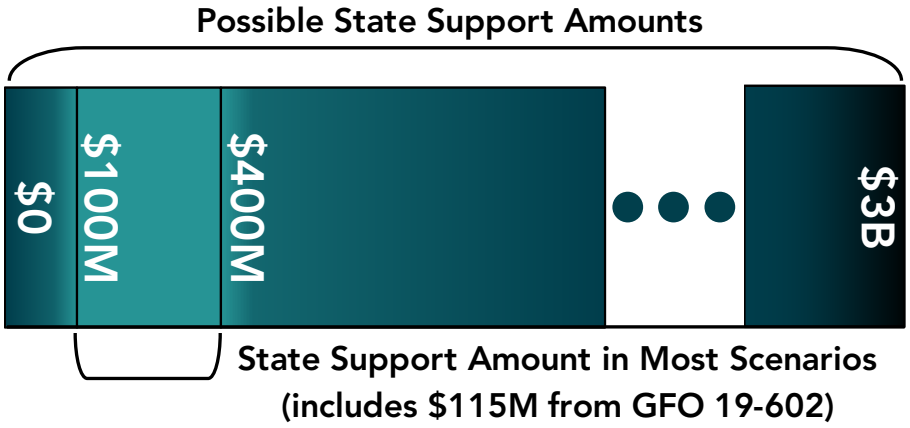


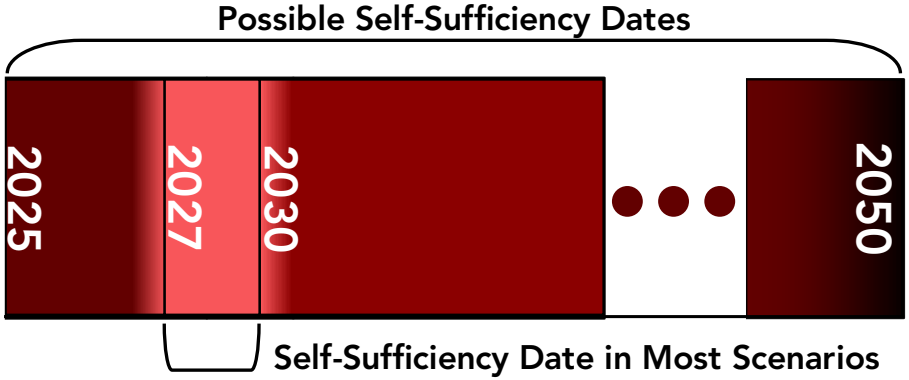
Ranges and Estimates of Core Results

Core results based on *Revolution*:

- Include 180 scenarios
- 1.8M FCEVs by 2035
- 1,700 hydrogen fueling stations







Illustrative Examples

These example scenarios are not comprehensive, but illustrate the types of considerations of cost and revenue streams that affect the self-sufficiency date and support amount

Scenario A

"Industry Leads the Way"

- Rapid Cost Reductions
- Pump Price Parity Delayed to 2040

Support Amount:

Self-Sufficiency Date:

Scenario B

"Parity in the Decade"

- Rapid Cost Reductions
- State Support Increased to Enable Price Parity by 2030

Support Amount:

Self-Sufficiency Date:

Scenario C

"Government Ahead of Industry"

- Cost Reductions Stalled
- State Support Increased to Enable Price Parity by 2030

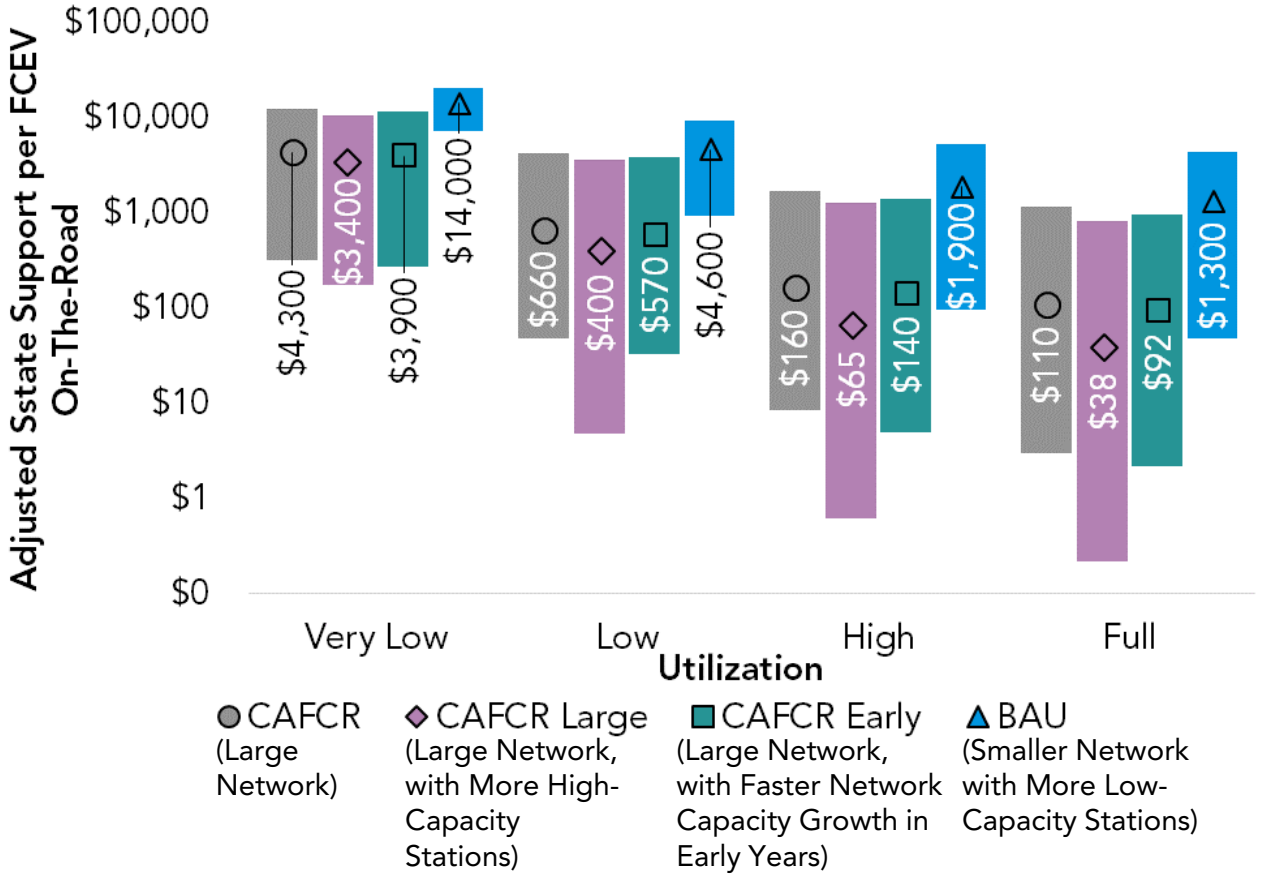
Support Amount:

Self-Sufficiency Date:

Network Development Sensitivities

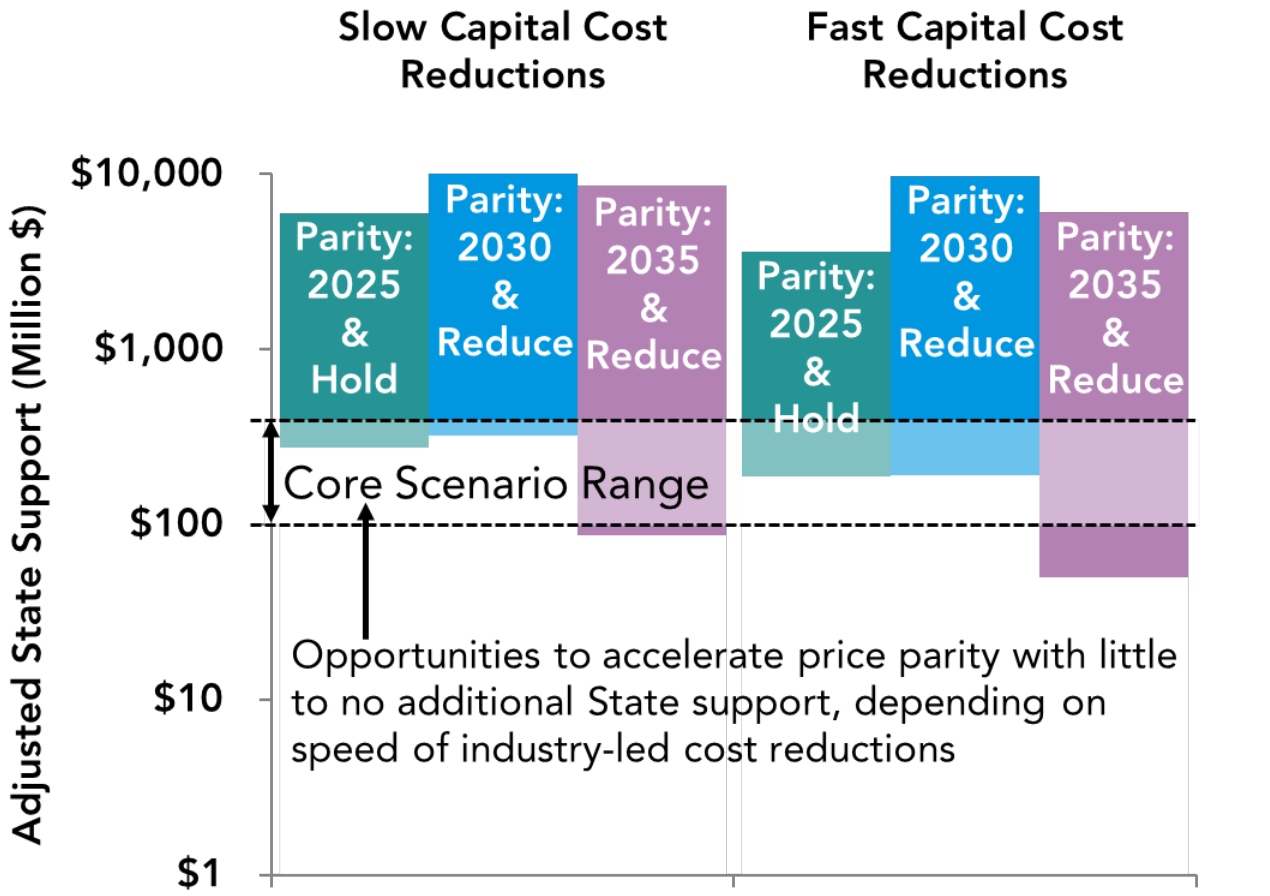
Building more capacity earlier and faster more effectively builds economies of scale

Stalled FCEV deployment can significantly increase need for State support



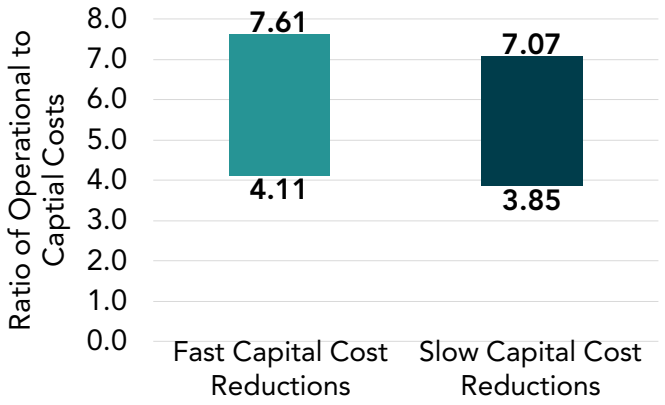
Advancing Price Parity at the Pump

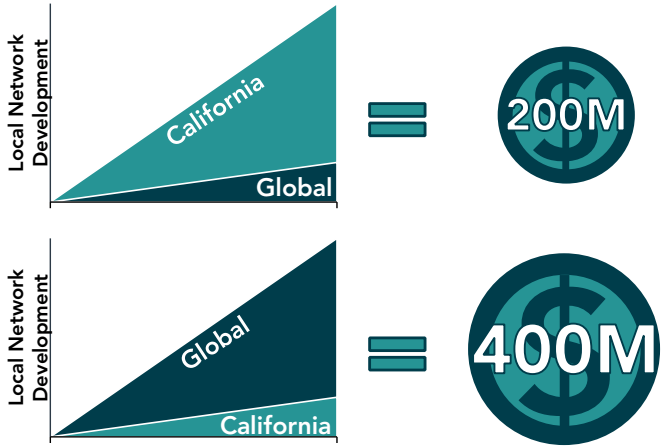
If industry-led cost reductions are fast, opportunities may exist for State support of $300M to achieve self-sufficiency *and* accelerate price parity at the pump



Operational Costs Drive Economies of Scale

Operational costs present greater opportunity to drive economies of scale and reduce State support amounts than capital costs





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PANEL DISCUSSION

- Submit your question in the Q&A Panel on your right.

Bill Zobel
Executive Director
California Hydrogen Business Council

Gia Brazil Vacin,
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Governor's Office of Business and Economic Development

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