Up to Code: Hydrogen Station Permitting, Market Trends, and Zero Emission Fleets

September 22nd, 2020

www.scag.ca.gov

SCAG™
INNOVATING FOR A BETTER TOMORROW

Agenda

1. Overview of Fuel Cell Electric Vehicle and Hydrogen Station Rollout
   Keith Malone, California Fuel Cells Partnership

2. Hydrogen Permitting Guidebook
   Gia Brazil Vacin, GoBIZ

3. SunLine Transit
   Lauren Skiver, SunLine Transit Agency CEO

4. Q&A

Housekeeping

1. Meeting length: 1 hour
2. This meeting is being recorded
3. All participant lines will be muted
4. At the end, there will be a Q&A session
5. If you have a question during the presentation, please type it into the chat box
6. We will log all questions and then voice a selection at the end of the presentation
7. A recording of this webinar and the PowerPoint slides will be available on the SCAG website. We will send a link to everyone who has registered after the event.

Overview of fuel cell electric vehicle and hydrogen station rollout

Keith Malone
California Fuel Cell Partnership

9/29/2020

CaFCP Members

— 20 years of collaboration —

California H2 stations in 2020, 2025 and 2030

100 hydrogen stations by ***2020***.
Funded by Assembly Bill 8 (2013).

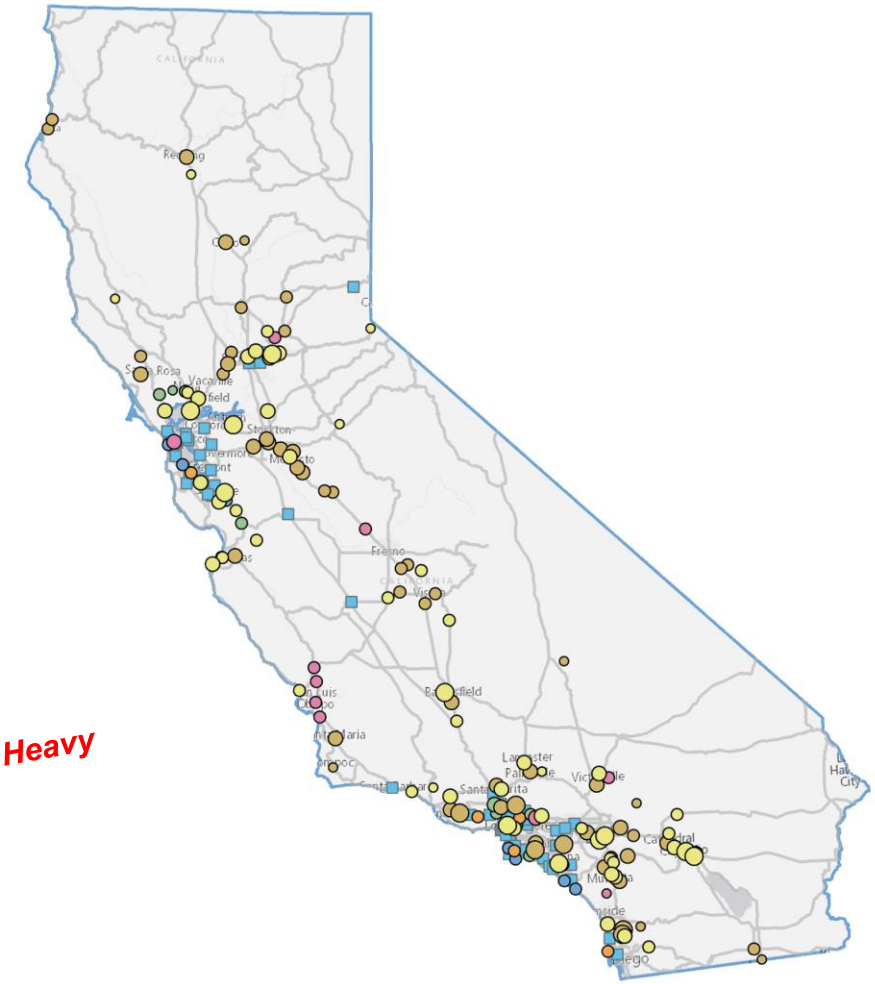
BY 2020
Funded
Light Duty

200 hydrogen stations by ***2025***, pursuant to the Governor's 2018 ZEV infrastructure Proposal.

BY 2025
Planned
Light Duty

1000 hydrogen stations by ***2030*** with favorable market conditions and state policies pursuant to the CAFCP 2030 vision. Will support 1,000,000 fuel cell electric vehicles.

BY 2030
Envisioned
Light, Medium and Heavy



Governor's goal of 5,000,000 zero-emission vehicles by 2030.

By the Numbers

Numbers as of September 1, 2020	Total
*FCEVs—Fuel cell cars sold and leased in US	8,573
FCEBs—Fuel cell buses in operation in California	48
***Hydrogen stations available in California	42
Fuel cell buses in development in California	7
Fuel cell shuttles in development in California	4
**Retail hydrogen stations in development in California	15

Breaking News!

- **+36 new stations funded**
- **More than 100 over the next several years**

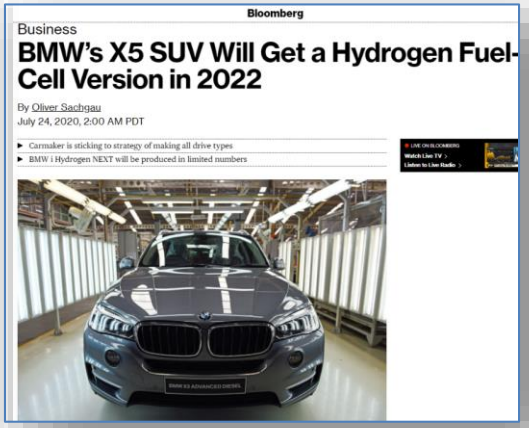
Fuel cell passenger cars on the road

- 312-380 miles
- 3-to-5 minute fill
- Makes electricity on board vehicle
- Extreme temperature performance
- Multi-unit dwellers and on-street parkers

- Meet all global safety specifications
- Most automakers have fuel cell tech

And more cars on the way!

Second-generation Mirai


Bloomberg

Business

BMW's X5 SUV Will Get a Hydrogen Fuel-Cell Version in 2022

By Oliver Sachgau

July 24, 2020, 2:00 AM PDT

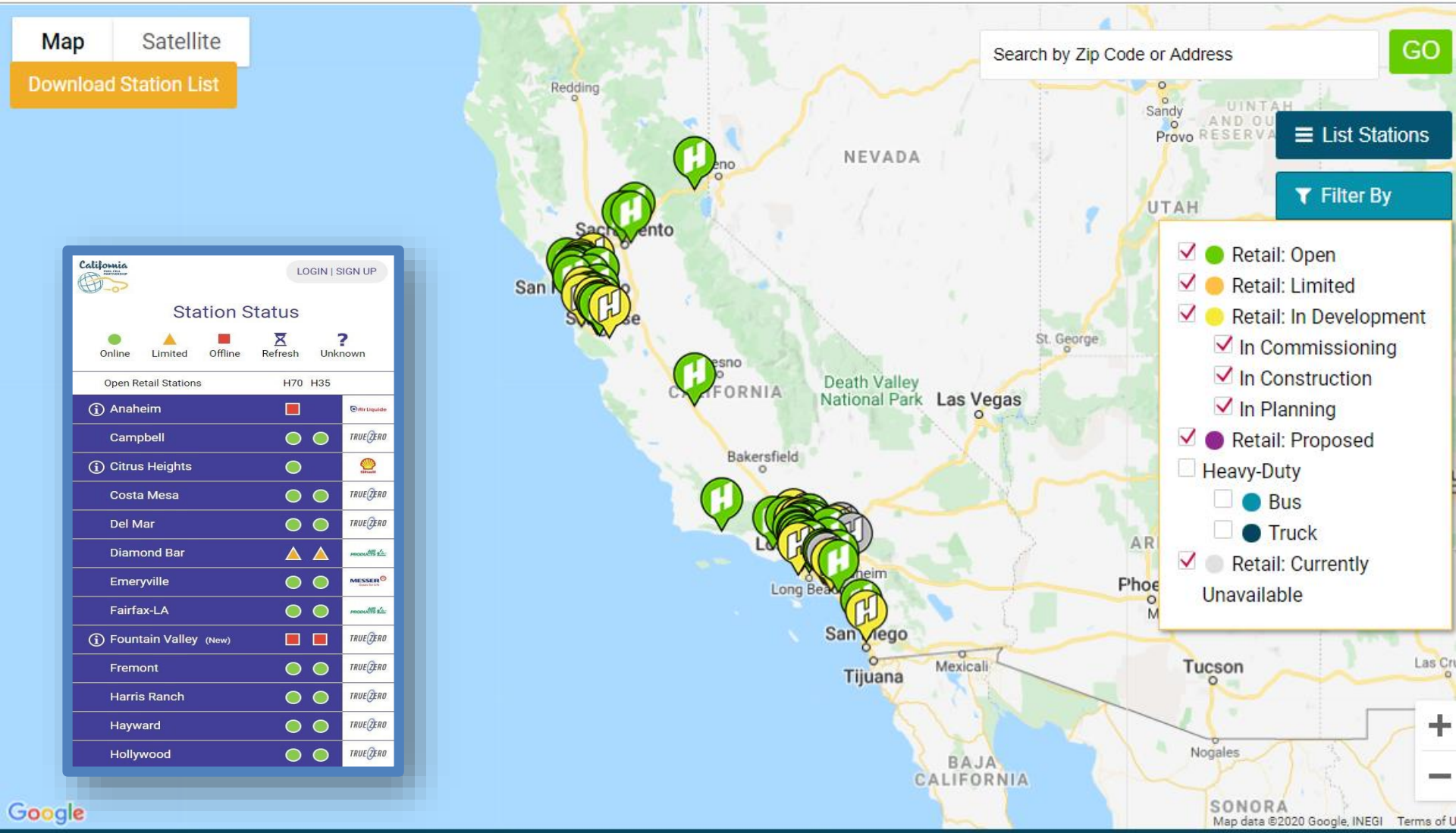
- Carmaker is sticking to strategy of making all drive types
- BMW i Hydrogen NEXT will be produced in limited numbers

Hyperion XP-1

- Prototype
- 1,016-mile range
- 0 to 60 mph in 2.2 seconds
- Fueling in 5 minutes
- 300 units available

Hydrogen stations in California

La Canada Flintridge hydrogen station


Map
Satellite
Download Station List
Search by Zip Code or Address
GO
List Stations
Filter By
Retail: Open
Retail: Limited
Retail: In Development
In Commissioning
In Construction
In Planning
Retail: Proposed
Heavy-Duty
Bus
Truck
Retail: Currently Unavailable
California
LOGIN | SIGN UP
Station Status
Online
Limited
Offline
Refresh
Unknown
Open Retail Stations
H70
H35
Anaheim
Campbell
Citrus Heights
Costa Mesa
Del Mar
Diamond Bar
Emeryville
Fairfax-LA
Fountain Valley (New)
Fremont
Harris Ranch
Hayward
Hollywood
Redding
NEVADA
UTAH
Sandy
Provo
Sacramento
San Francisco
San Jose
Fresno
CALIFORNIA
Death Valley National Park
Las Vegas
St. George
Bakersfield
Long Beach
San Diego
Tijuana
Mexicali
Tucson
Nogales
BAJA CALIFORNIA
SONORA
Google
Map data ©2020 Google, INEGI

Next-generation stations already coming online

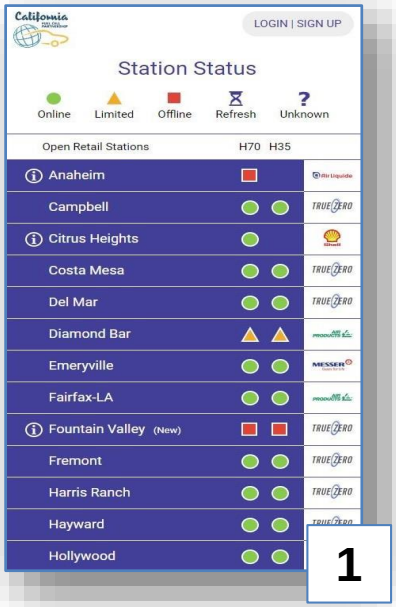
Fountain Valley

Oakland

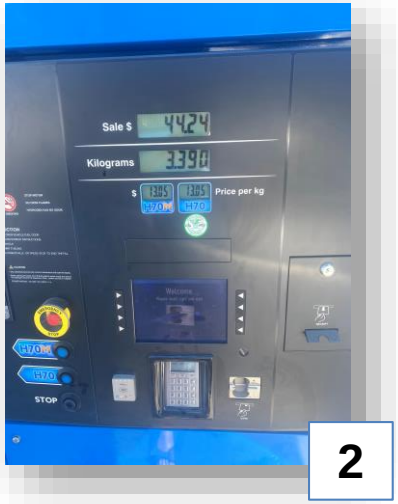
San Francisco

- Stations 2-to-8 times larger than the earliest stations
- Station costs coming
- Station development timelines decreasing

Fueling a fuel cell electric car



1



2

3

4

5

Another nozzle example

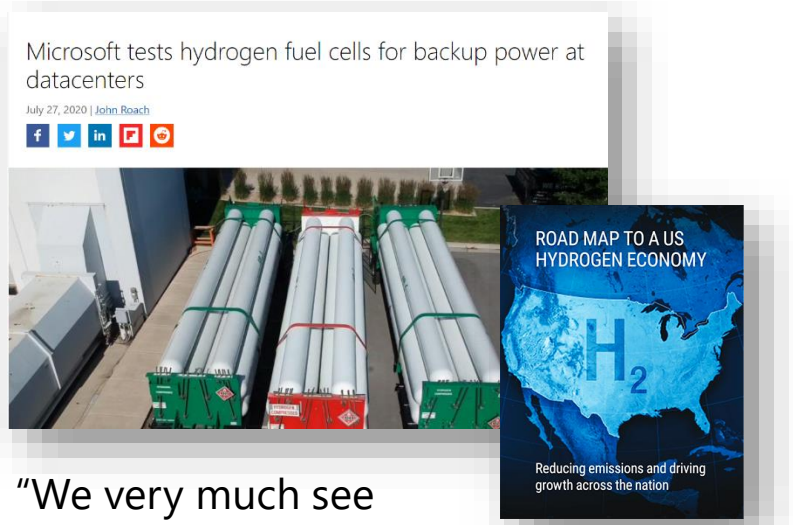
H2 fuel in California is on a renewable pathway

- ✓ 33% renewable content (2006)
- ✓ Low Carbon Fuel Standard
  - ✓ ZEV capacity credit
  - ✓ Renewable content increases to 40% (2019)
- ✓ Legislation re 100% renewable and decarbonized H2 fuel
  - ✓ Hydrogen Council goal for 2030

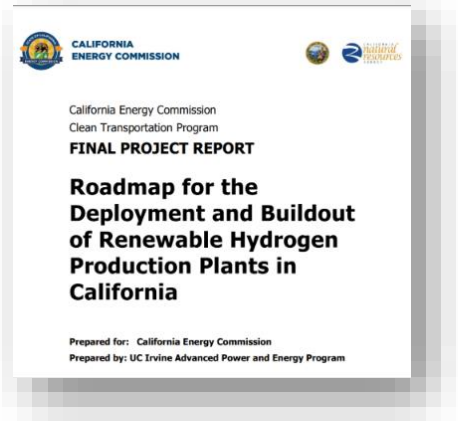
Hydrogen & Fuel Cell Activity – U.S.

Microsoft

- U.S. Hydrogen Road Map contributor
- Record of 48 hours powering data center servers



"We very much see ourselves as a catalyst in this whole hydrogen economy."



UC Irvine Road Map for Renewable Hydrogen Production

- Renewable hydrogen sector can reach self-sustainability by mid-to late 2020s

LCRI
LOW-CARBON RESOURCES INITIATIVE

GTI, EPRI and 18 utilities, including SoCalGas, SCE and Los Angeles DWP.

Hydrogen & Fuel Cell Activity - Global

Europe

- German H2 Strategy
  - South Korean investment response
- European H2 Strategy
- Increase in H2 chatter on European utilities earnings calls, from Q1 to Q2

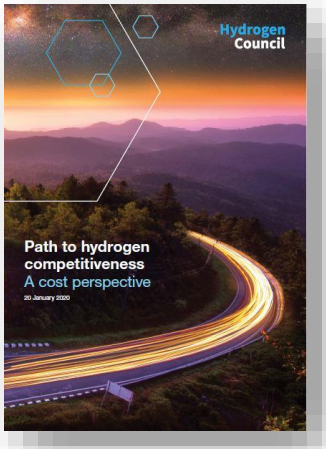
Hydrogen gains airtime during Q2 utility results calls

Mentions on Q1 call			Mentions on Q2 call	
Executives	*Analysts*		*Executives*	*Analysts*
0	0	E.ON SE	17	6
0	0	Enel SpA	7	2
1	0	Engie SA	8	4
1	0	Iberdrola SA	8	1
0	0	Naturgy Energy Group SA	9	4
10	0	Ørsted A/S	21	7
0	0	RWE AG	8	3
6	0	Snam SpA	54	25
3	0	Uniper SE	75	9

Data compiled on Aug 14, 2020.
Frequency of mentions of the word "hydrogen" during quarterly earnings calls for the first and second quarters.
Source: S&P Global Market Intelligence analysis

Headlines…

- As China moves to dominate the EV industry, Britain frets about energy security
- Britain lacks a clear hydrogen strategy



- 91 members, including new member, Microsoft
- Chinese version released

"Economic recovery measures should support large scale initiatives that can accelerate cost competitiveness of hydrogen"

-Hydrogen Council

Heavy Duty: Bus & Truck

Light duty needs heavy duty; heavy duty needs light duty

Fuel Cell Electric Trucks

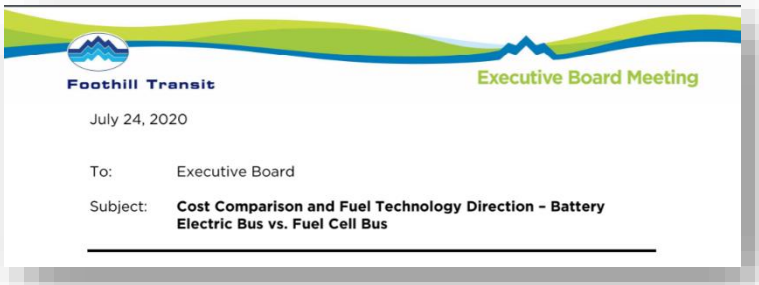
- Advanced Clean Truck rule
- Fueling infrastructure projects
  - 3 heavy duty H2 stations
    - More being announced
  - Ontario, Wilmington and Port of Long Beach
  - 1-2 temporary fuelers
- CARB & CEC Heavy Duty ZEV funds
  - Include heavy duty infrastructure

The Other Electric Bus

Advanced Clean Transit regulation

- Transit buses on zero-emission pathway
- First wave of Zero Emission Bus Rollout Plans submitted

Foothill Transit cost comparison of BEBs and FCEBs



Foothill Transit

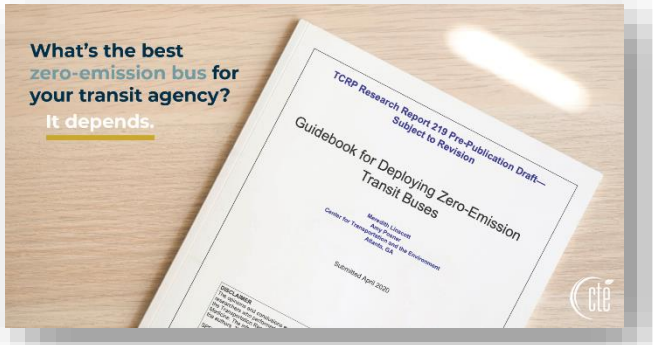
Executive Board Meeting

July 24, 2020

To: Executive Board

Subject: **Cost Comparison and Fuel Technology Direction – Battery Electric Bus vs. Fuel Cell Bus**

CTE Guidebook for Deploying Zero-Emission Transit Buses



References

- **KEY DOCUMENTS**
- California stations map (light duty) (PDF) - https://cafcp.org/sites/default/files/H2-Stations-CA-map-Open-Funded-2020.pdf
- H2 stations list - https://cafcp.org/sites/default/files/h2_station_list.pdf

- Fuel Cell Bus Road Map - https://cafcp.org/sites/default/files/2019-CaFCP-FCEB-Road-Map.pdf
- CTE Guide for Deploying Zero-Emission Buses
- http://cte.tv/guidebook-release/
- Zero Emission Bus Rollout Plans in California – www.cafcp.org/resources: key word is rollout

- California Fuel Cell Revolution - https://cafcp.org/sites/default/files/CAFCR.pdf
- U.S. Hydrogen Road Map (full report) - https://cafcp.org/sites/default/files/Road%2BMap%2Bto%2Ba%2BUS%2BHydrogen%2BEconomy%2BFull%2BReport.pdf
- Hydrogen Council-Path to hydrogen competitiveness A cost perspective (full study) - https://cafcp.org/sites/default/files/Path-to-Hydrogen-Competitiveness_Full-Study-1.pdf

- **CAFCP PAGES**
- Station Map – www.cafcp.org/stationmap
- SOSS (station operational status system) – http://m.cafcp.org
- Resources – www.cafcp.org/resources
- News clips – www.cafcp.org/news

Keith Malone
kmalone@cafcp.org

Powered by the fastest molecule on earth!™

Hydrogen Station Permitting Guidebook

CALIFORNIA
Governor's Office of Business and Economic Development

September 22, 2020

GO-Biz Overview

Business Investment Services

International Affairs

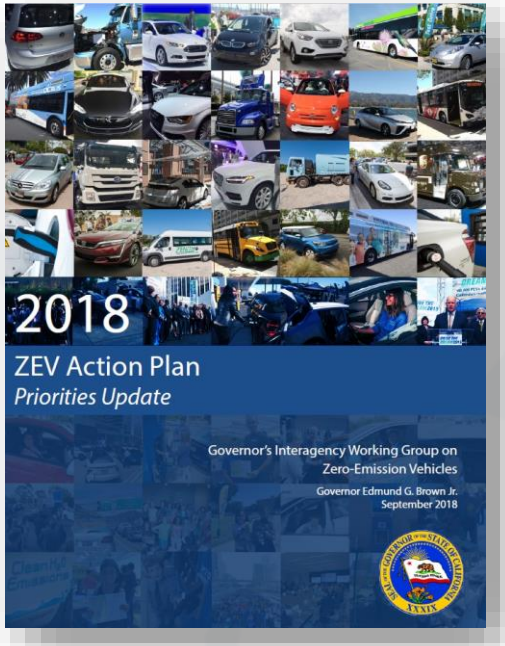
Small Business

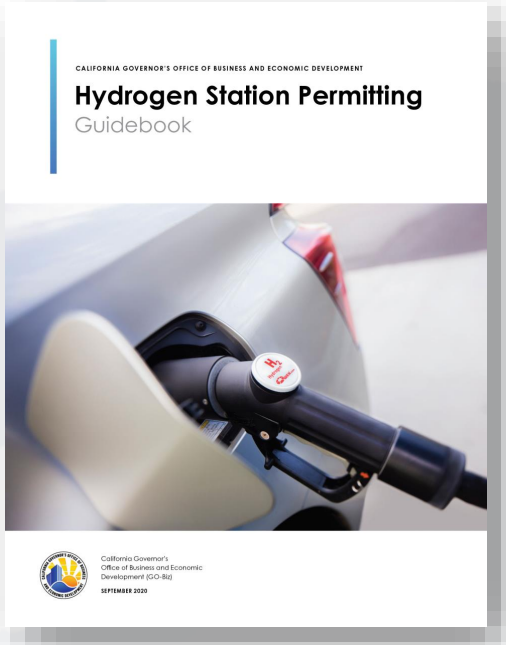
Permits

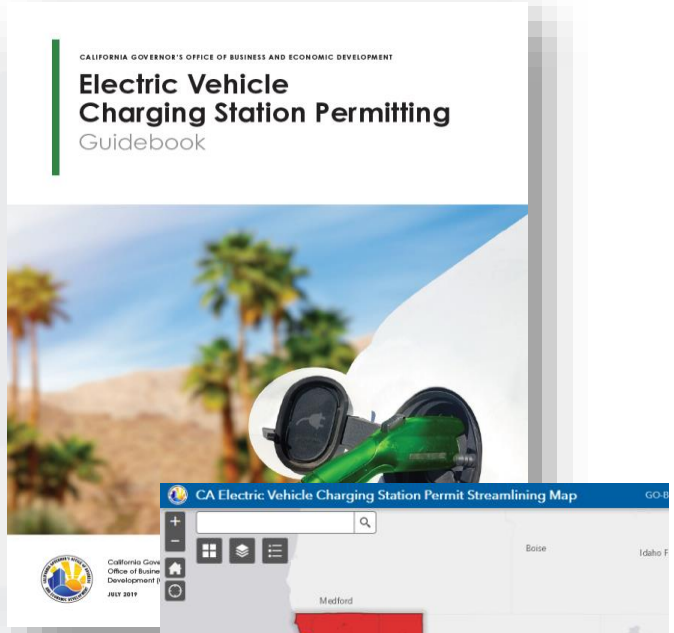
Zero Emission Vehicle Market Development

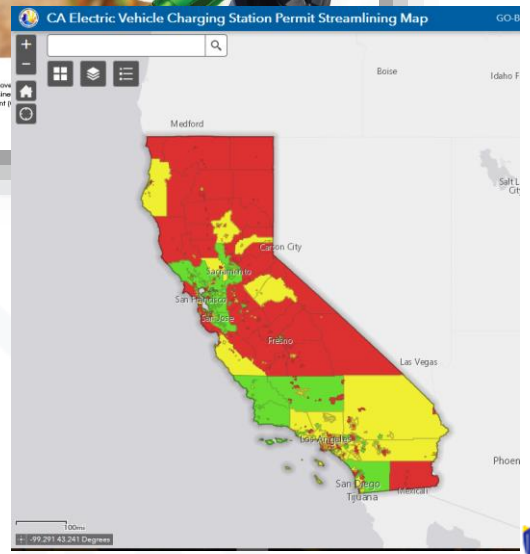
Infrastructure & Economic Development Bank (I-Bank)

Zero Emission Vehicle Market Development



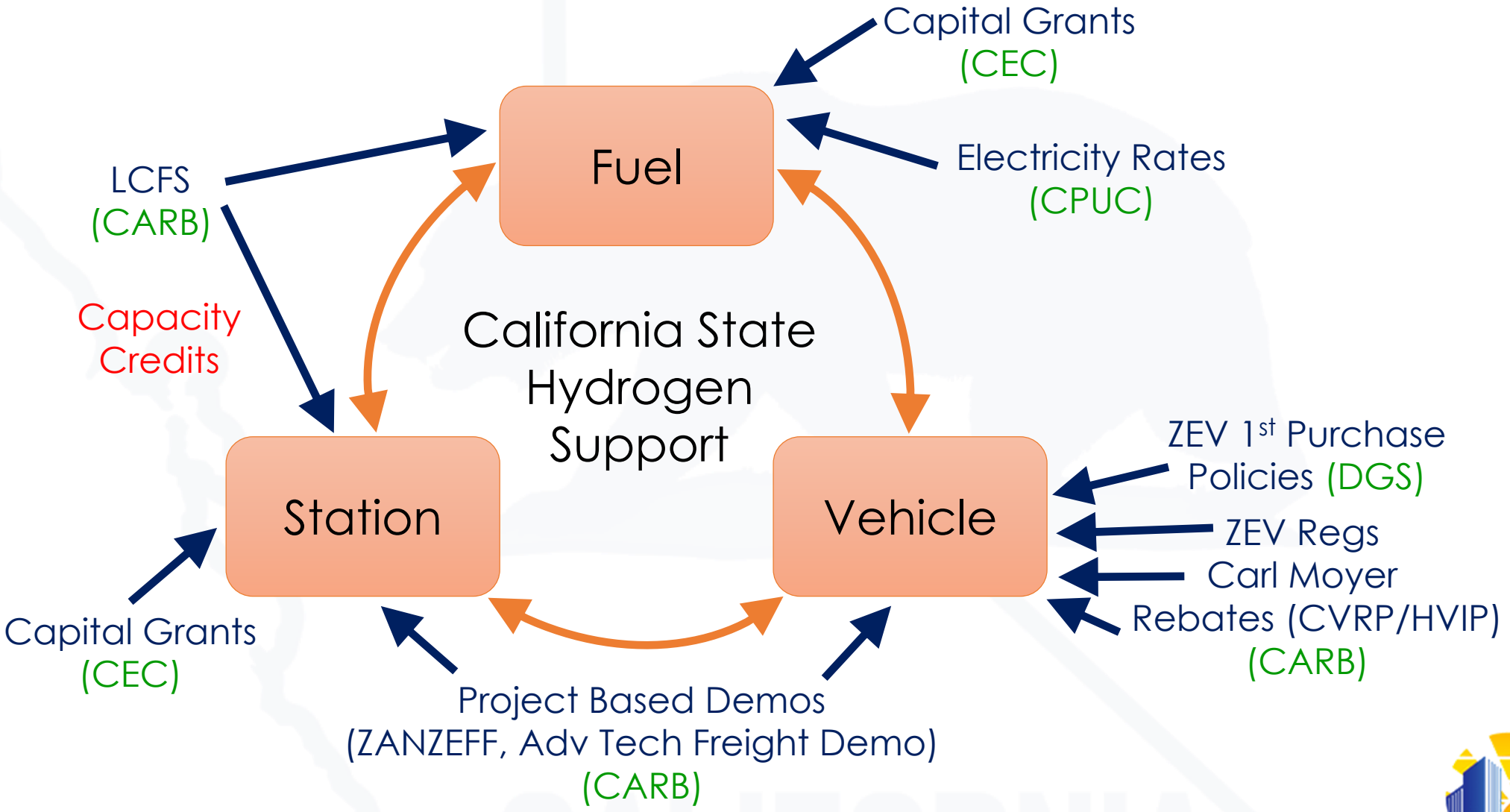


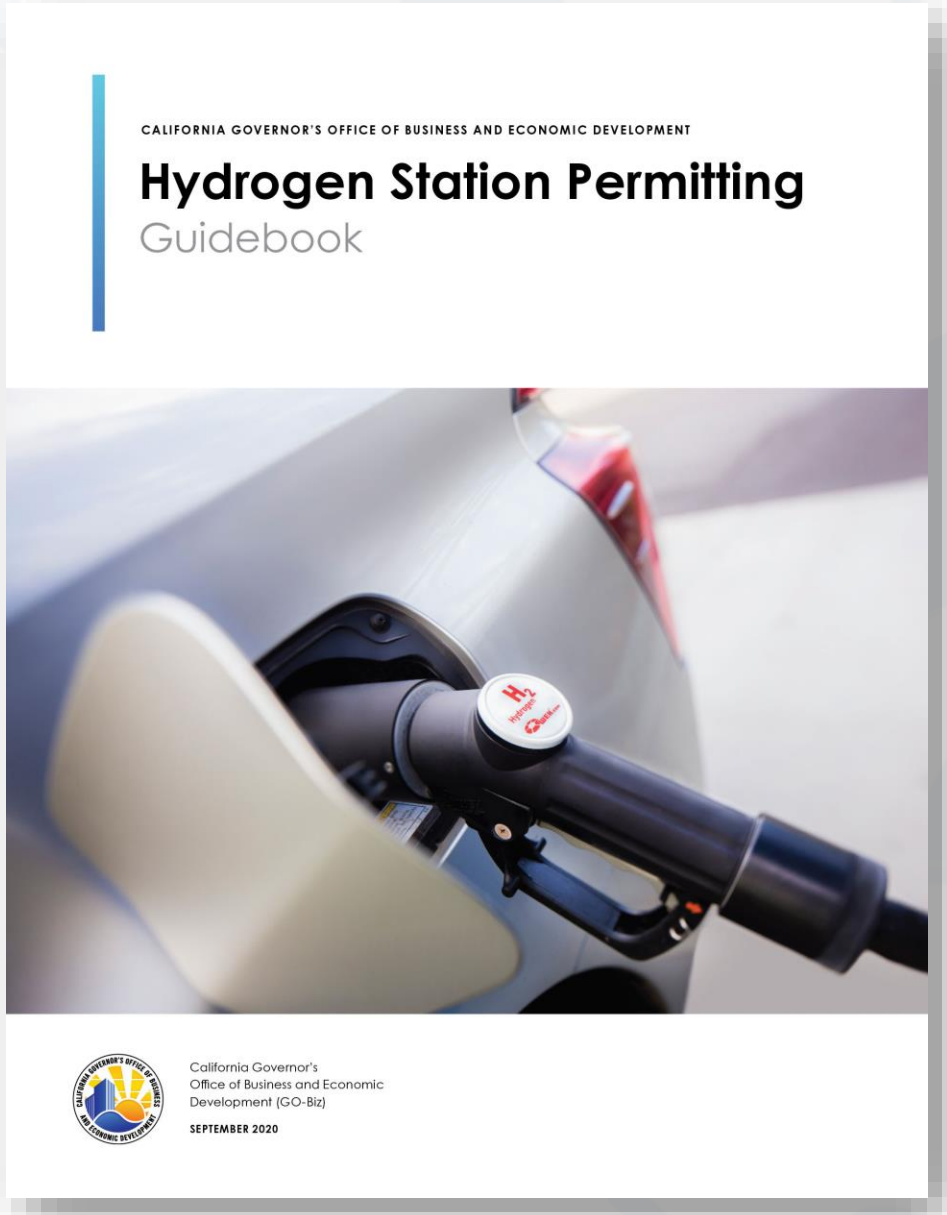




- State agency alignment and coordination
- Industry collaboration and collective problem-solving
- ZEV-related business support
- Fueling infrastructure permitting assistance
- Existing and proposed regulatory navigation assistance

California Policy Context





Guidebook Topics

- **Part 1:** ZEVs in CA, market progress, new guidebook additions
- **Part 2:** Hydrogen and FCEV Ecosystem
- **Part 3:** Station Development Phases and Process
- **Part 4:** Additional Topics
  - i.e., safety planning, C&S, and human resources
- **Part 5:** Perspective on the Future Market
- **Part 6:** Additional Resources
  - i.e., permitting checklist, relevant C&S, setbacks, grid connection, contacts

Key Market Development Trends

- **Since 2015, when the market launched…**
- Growing hydrogen **awareness and support**
  - In CA, among local officials and fire & safety officials; globally, up to national governments
  - 1000s of 1st responders in CA have been trained to effectively manage an event
- 50% reduction in average station **development time** (> 4 years to < 2 years)
- Moving toward **liquid hydrogen** to increase capacity and reduce costs
- Improving **gaseous hydrogen** technologies as well
- Growing **network utilization**. Several stations exceeding daily nameplate capacity
- More than 2X increase in higher capacity **heavy-duty bus and truck fleet stations**
- Increasing **private sector investment**
  - Stations, H2 production & supply, and light- to heavy-duty vehicles

Key Market Development Trends

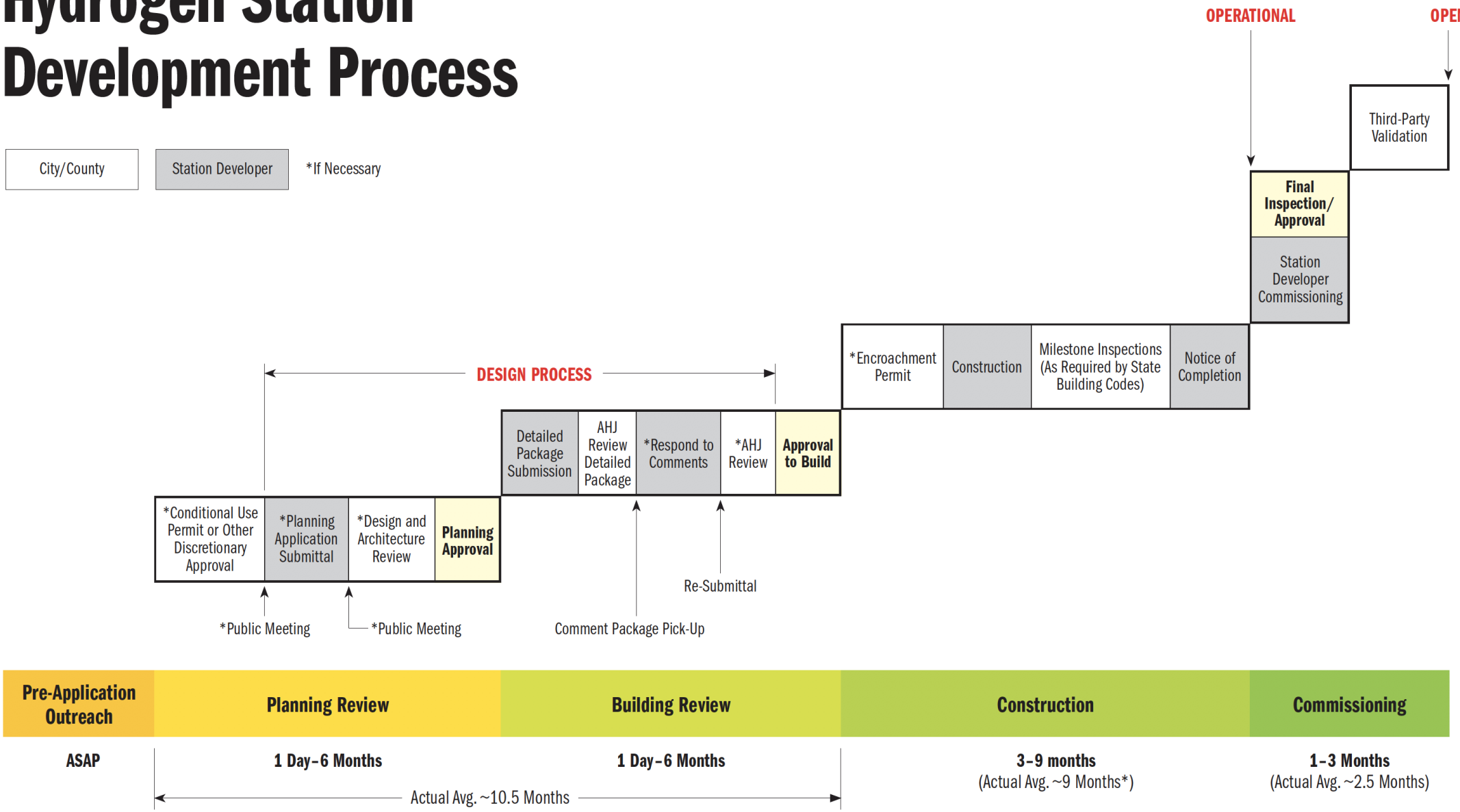
- **Significant Progress Since 2016…**
- **3-8x Increase in Station Capacity**
  - 2016: ~180-400 kg/day
  - 2020: ~1,200-1,600 kg/day
  - Largest stations able to fill 4 cars simultaneously
- **Station Cost**
  - 40% decrease in station costs
  - 80% decrease in $/kg/day
- **60% Reduction in Cost per Vehicle Enabled**
  - 2016: $6K per vehicle
  - 2020: $2.4K per vehicle
- **Cost Share**
  - 2016: state put up 70% of the capital cost
  - 2020: industry is bringing 70%
- **20%-300% Increase in Renewable Content**

Hydrogen Station Development Process

Five development phases:

1. Pre-application outreach
2. Planning review
3. Building review
4. Construction
5. Commissioning

Hydrogen Station Development Process



Phase 1: Pre-Application Outreach

- In this phase
  - Secure site control
  - Establish communication and permitting pathway
- Best practices and pitfalls
  - First impressions matter
  - The earlier the better
  - Discover items that could delay permitting

× Don't assume pre-application meetings are unnecessary

Phase 2: Planning Review

- In this phase: planning approval (often most time-consuming step)
  - Zoning; Architectural Review; CEQA; Initial Fire Review; Initiate utility connection process
- Best practices and pitfalls
  - ✓ Be thorough, but concise in communications
  - ✓ Clearly understand parking and site circulation requirements
  - ✓ Plan for noise
  - ✗ Utility connection design and installation can stall a project; engage the electrical utility early!

Phase 3: Building Review

- In this phase: approval to build
  - Complete, detailed plans (structural, mechanical, electrical)
  - Electrical approval is a key milestone
  - CA Building Standards Code review to ensure safe installation and operation
- Best practices and pitfalls
  - ✓ Balance detail with simplicity
  - ✓ Maintain consistency in the inspection process
  - ✖ You don't have to go it alone

Phase 4: Construction

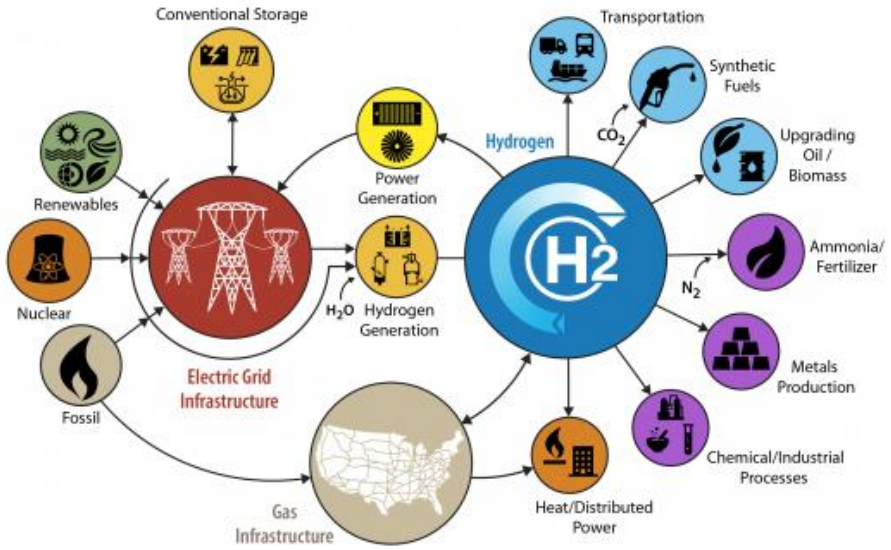
- In this phase: station construction
  - Encroachment permits (if needed)
  - Developer builds the station and files notice of completion
  - AHJ performs inspection(s)
- Best practices and pitfalls
  - ✓ Clearly understand all encroachment permits that may be needed
  - ✓ Perform work in progress (WIP) inspections

Phase 5: Commissioning

- In this phase: operational to open
  - Station developer commissioning
  - Hydrogen fuel quality testing
  - Fueling protocol confirmation
  - Commercial testing
  - Opening the station for public use
- Best practices and pitfalls
  - ✓ Regularly communicate commissioning timeline and progress to key agencies and stakeholders

Looking Forward: H2 & FCEVs in California

- State is firmly committed to ZEV success; and, success hinges on leadership at the local level
- Infrastructure: building bigger and faster
- Vehicles: more makes and models (light, medium, and heavy duty)
- Supply: increasing (in-state) production of renewable hydrogen
- Key Results:
  - Self-sustaining market
  - Equitable access to clean mobility
  - High-quality, green jobs
  - Cleaner air for all Californians!



Source: H2@Scale, Department of Energy

Looking Forward: Investing in the H2 System

- Growing global awareness and incorporation of hydrogen into energy transition plans
  - e.g., European Union, Germany, Korea, Japan, China, Australia, British Columbia
- Key Question: How do we best invest in the hydrogen system?

Other Useful Resources

- GO-Biz Zero Emission Vehicles: https://business.ca.gov/industries/zero-emission-vehicles/
- CEC GFO 19-602 NOPA: https://www.energy.ca.gov/sites/default/files/2020-09/NOPA_GFO-19-602_09-04-2020_ADA.xlsx
- AB 8 reports
  - CARB Annual Evaluation of Fuel Cell Electric Vehicle Deployment & Hydrogen Fuel Station Network Development (August 2020): https://ww2.arb.ca.gov/resources/documents/annual-hydrogen-evaluation
  - CEC/CARB Annual Assessment of Time and Cost Needed to Attain 100 Hydrogen Refueling Stations in California (December 2019): https://ww2.energy.ca.gov/2019publications/CEC-600-2019-039/CEC-600-2019-039.pdf
- Hydrogen Tools Portal: h2tools.org
- CaFCP station map: https://cafcp.org/stationmap
- CaFCP SOSS: https://m.cafcp.org/

Thank you!

Gia Brazil Vacin

gia.vacin@gobiz.ca.gov

Toolbox Tuesday: Hydrogen Permitting Guidebook

Today's Transit for Tomorrow's World

Lauren Skiver
CEO/General Manager
SunLine Transit Agency

About SunLine Transit Agency

SunLine Operations
372 Employees

Routes

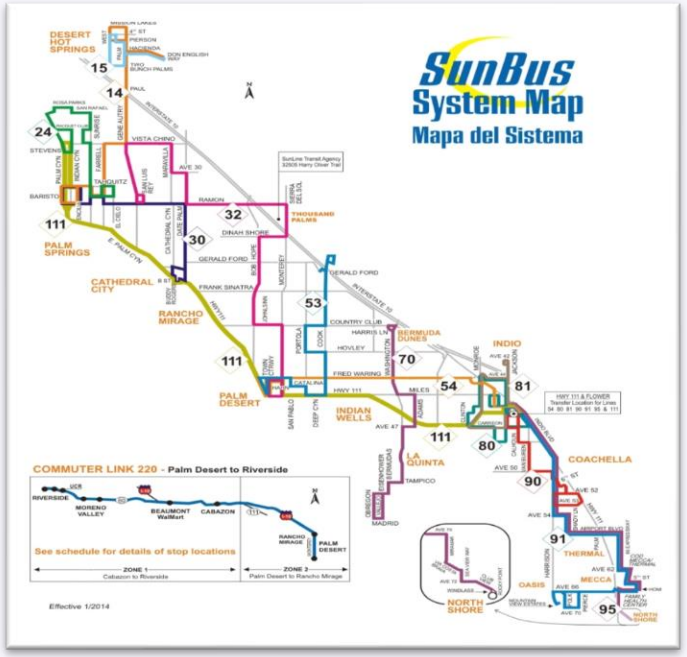
- 14 fixed routes
- 1 express route
- 1 regional route
- ADA Paratransit

Fleet

- 61 CNG
- 17 Hydrogen Electric Fuel Cell
- 4 Electric Battery BYD
- 39 CNG Paratransit Vehicles

Revenue Miles vs. Passenger Trips

- 4.3 million revenue miles
- 4.5 million passenger trips



Why Did SunLine Choose Hydrogen?

Fuel Cells Enhance the Performance of Electric Buses

300 miles

High daily ranges
FCEBs excel on long routes and routes with frequent service

Fast refueling at depot
FCEBs are compatible with fueling islands and restrictive schedules

Full route flexibility
FCEBs are a 1:1 replacement for ICE buses and are not tied to on-route infrastructure

Challenging terrain
FCEBs excel on hilly terrain and steep grades

Extreme climates
FCEBs excel in all weather, from cold winters to hot summers

Vehicle Weight
Significant reduction in vehicle weight

Infrastructure Costs Comparison

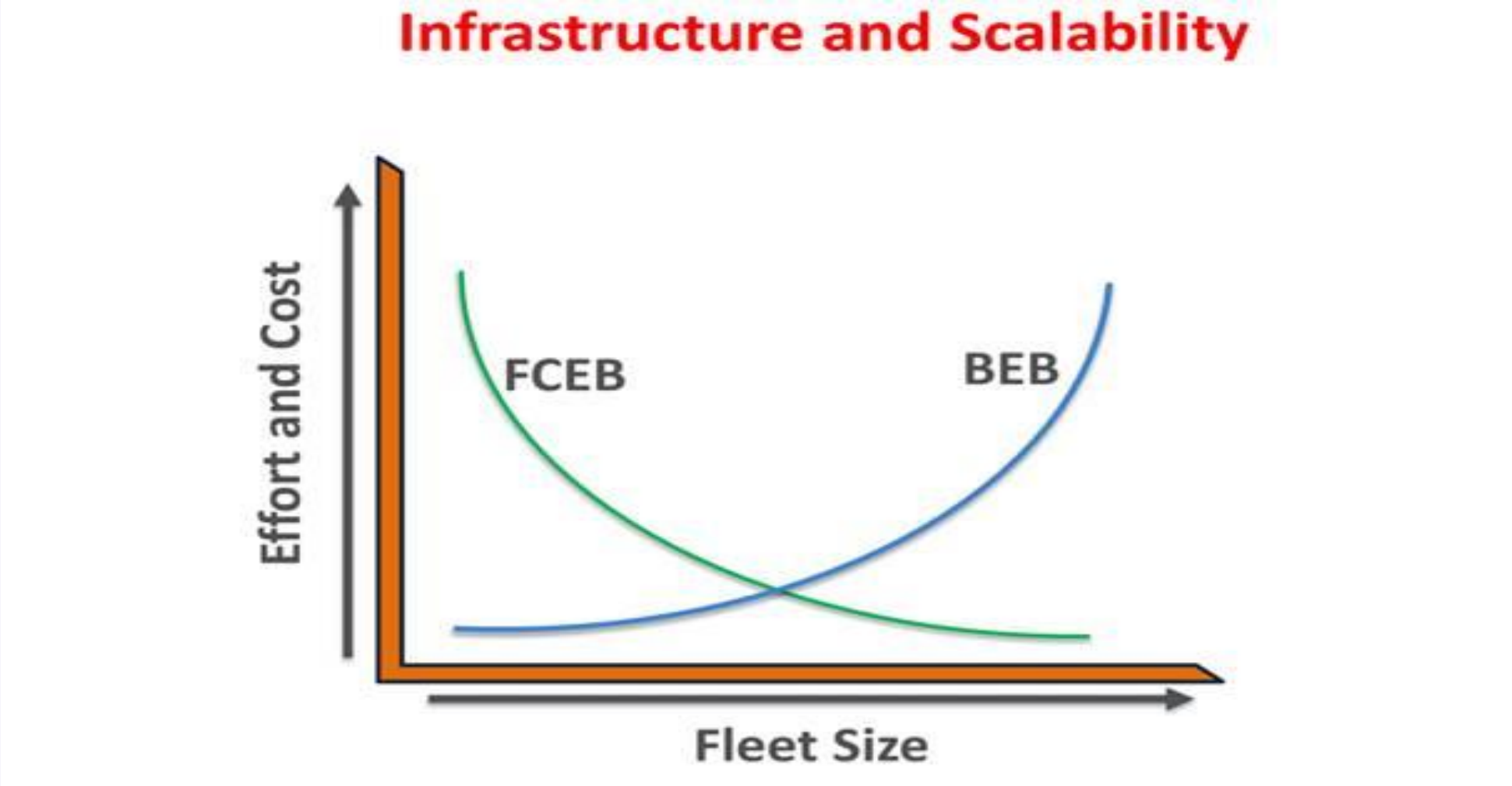


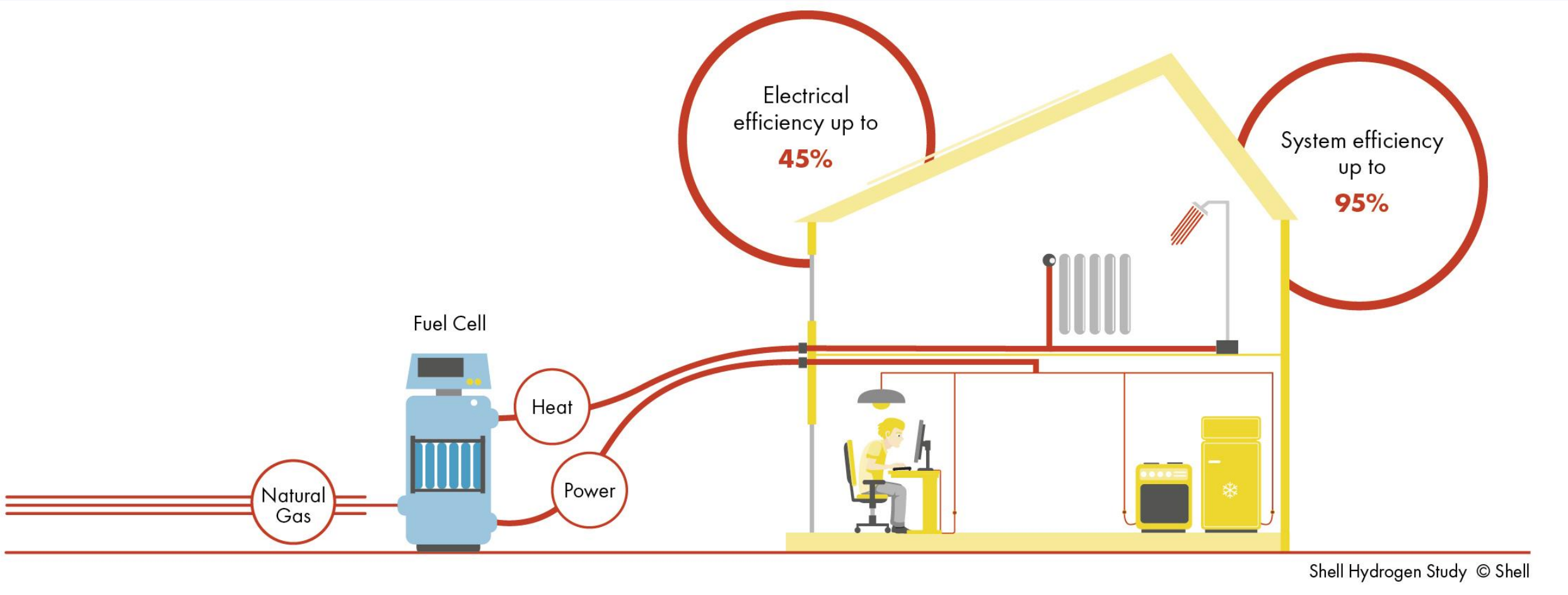
Chart Furnished by The Center for Transportation and the Environment

Hydrogen as a Power Source

Why it Makes Sense

- **H2 only generates water, electricity and heat when converted to electricity**
  - No Greenhouse Gas or dust particulates
- **H2 Fuel Cells have an efficiency of 50% to 60% when producing electricity alone**
  - FCs have an efficiency of 80% to 90% when waste heat is recycled
  - Combustion engines have a 20% to 30% efficiency
- **Storage/Portability**
  - Secondary energy made from the decomposition of CNG, petroleum, coal and water
  - When liquified to -263°C its volume is reduced to 1/800. When compressed in a high pressure tank it is easy to store and transport
- **Flexibility**
  - Generated energy can be converted into hydrogen
  - Hydrogen can be stored as liquid or gas and converted back to electricity

Hydrogen as a Power Source



Hydrogen as a Power Source

- **Hydrogen based transport is expected to reach the break-even point by 2025**
  - Factors that will determine this goal are source energy prices, infrastructure, education and willingness, regulatory frameworks

- **Hydrogen can make the most sense in the short term for large, long range vehicles**
  - Buses, trains, trucks, rideshare and marine
  - Hydrogen is already an economically viable alternative to BEB technology for these vehicle types

SunLine's Zero Emission Fleet & Fueling Infrastructure

ZEB Fleet

4-BYD

11

El Dorado National

- Ballard
- US Hybrid
- BAE

New Flyer

6

- Ballard
- Cummins Hydrogenics
- Siemens

- *4 FC Shuttle Buses (Pilot Project)*
- *5 awarded through VW Mitigation Settlement and vehicle replacement funds*
- *5 awarded through EPA TAG*

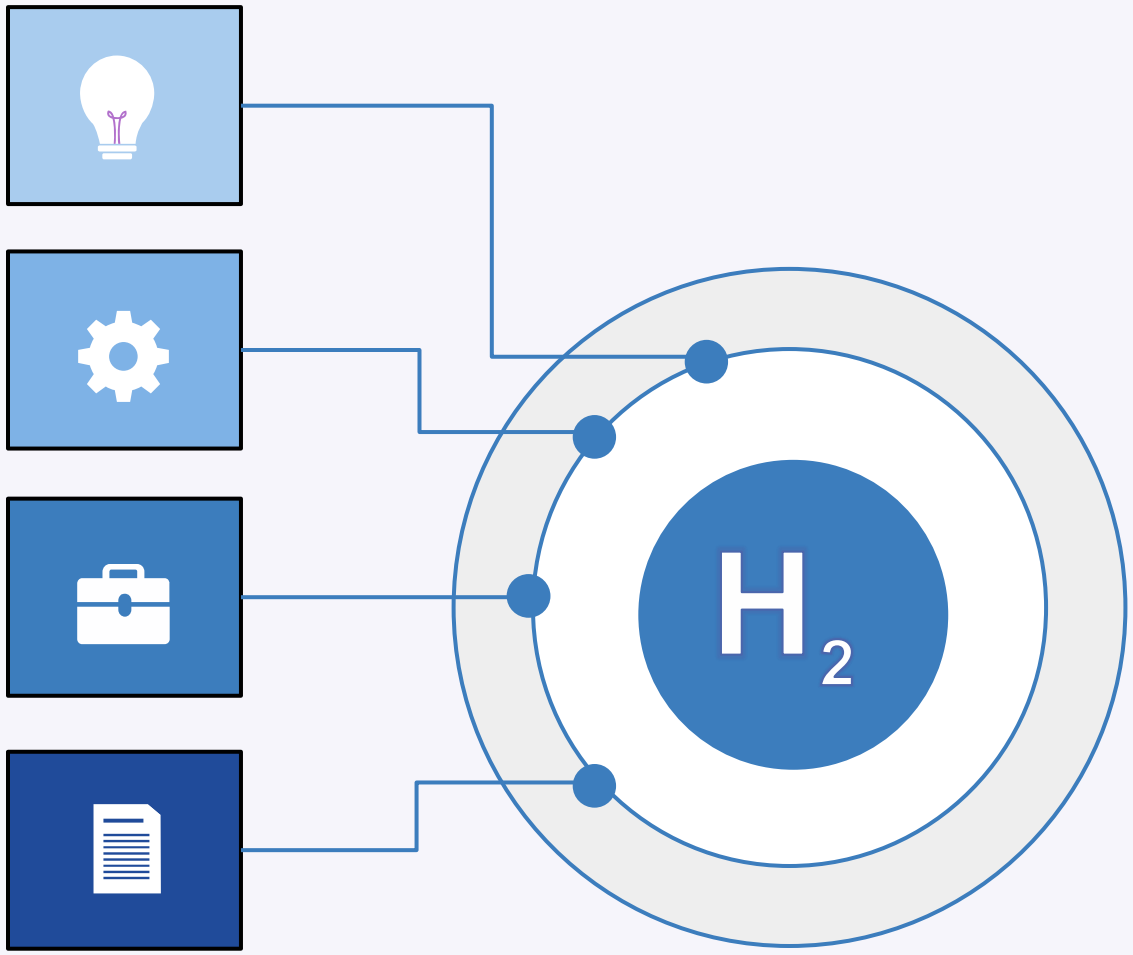
Hydrogen Fueling Station Overview

Proton/Nel PEM Electrolyzer

- 900 Kg per day production
- 380 Kg use per day
- 2 dispenser fast fill rate
- $8.7 Million CARB Grant

Hydrogen Fueling Station Lessons Learned

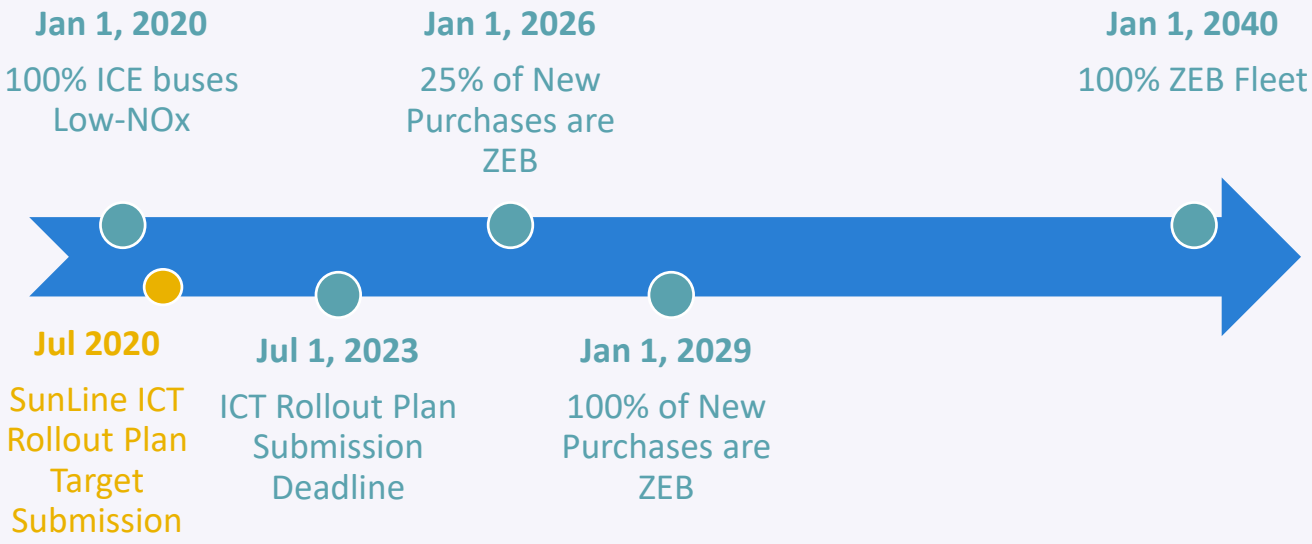
- Ensuring utilities were able to support project
- Ensuring we have personnel with the right credentials to execute the project
- Correctly estimating the amount of civil work involved
- Establishing a performance based statement of work



ICT – Zero Emissions Bus Rollout Plan

ICT Rollout Plan Timeline

ICT Regulation Timeline for a Small Agency



SUNLINE WILL BE THE FIRST TRANSIT AGENCY IN THE STATE/COUNTRY TO TRANSITION THEIR FLEET TO 100% ZERO-EMISSION VEHICLES

- Fixed Route Fleet 100% ZEB by **FY-2035** – 67 FCEBs, 18 BEBs
- Paratransit Fleet 100% ZEB by **FY-2031** – 39 FCEBs, 0 BEBs

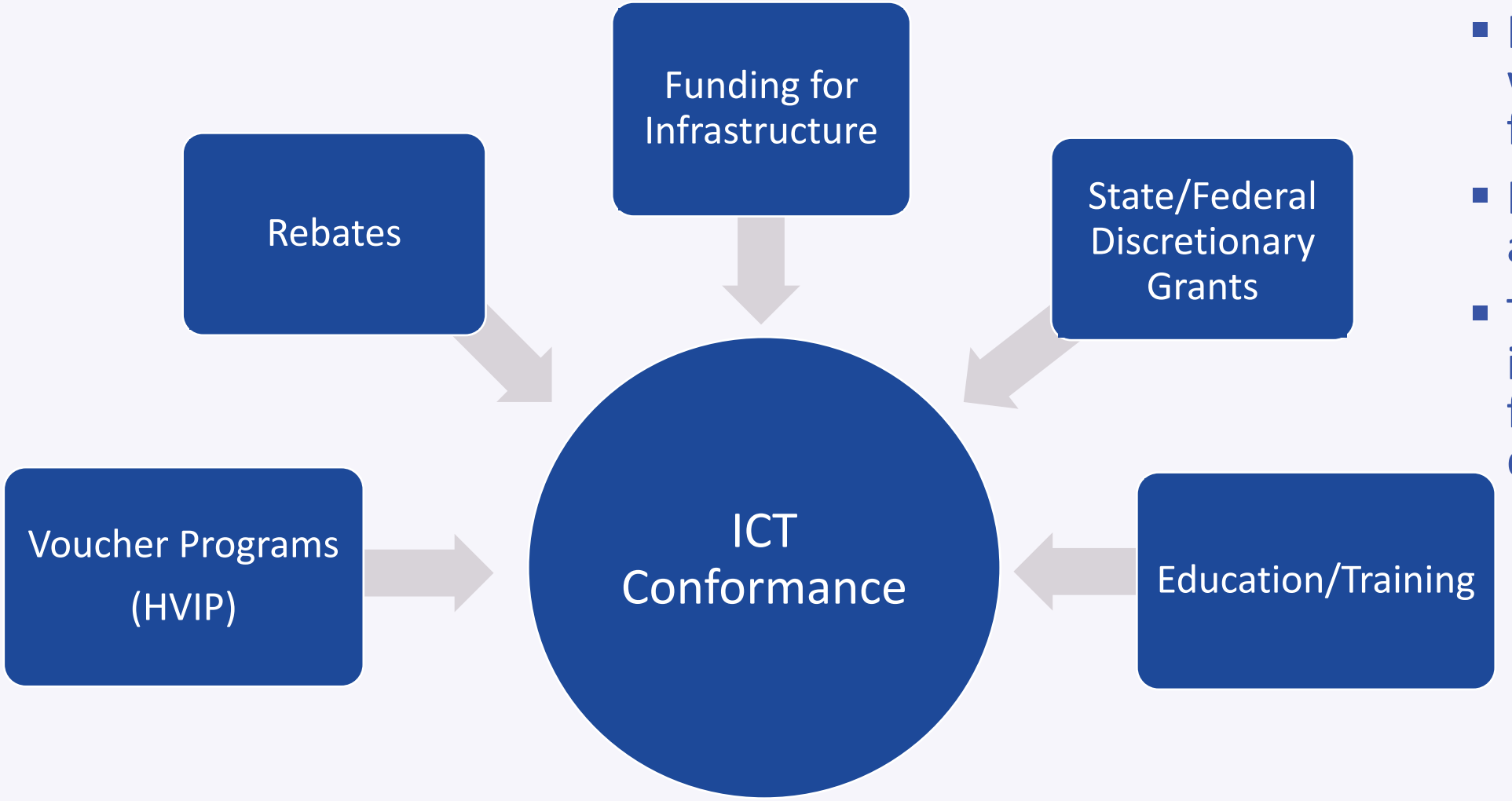
Funding Approach

Deploying zero-emission buses enables SunLine to unlock additional funding sources

- Targeted use of federal (5307 & 5339) and state funds following transition plan adoption schedule
  - Estimated **$106.5 million** available over duration of plan
- Special funding from competitive grants and voucher programs will make up the balance
  - Successful track record in securing funding and delivering successful projects

Status	Funding Source	Current SunLine Activities
Application Approved	VW Mitigation / LowNo / STA / FTA	VW Funding received for 3 FCEBs ($**1.2 million**) LowNo ($**624K**) STA ($**657K**) and FTA 5339 & 5307 ($**1.59M**) ON ORDER
	EPA AirShed Grant	Funding approved for 5 FCEBs ($**5.9 million**) PENDING CONTRACT EXECUTION
	CEC – H2 Ride	Funding Approved for 4 FCEBs shuttle buses ($**4.3 million**) PENDING CONTRACT EXECUTION
Application Submitted	VW Mitigation / LowNo / STA / FTA	VW Funding pending approval for 2 FCEBs ($**800K**) LowNo ($**416K**) STA ($**438K**) and FTA 5339 & 5307 ($**1.03M**) ON ORDER

Resource Requirements



- ICT Conformance will require funding
- Investments have already been made
- Training will be an important factor for workforce development

West Coast Center of Excellence In Zero Emissions Technology & Renewable Energy

West Coast Center of Excellence
IN ZERO EMISSION TECHNOLOGY & RENEWABLE ENERGY

A Focus on Workforce Development

West Coast Center of Excellence
IN ZERO EMISSION TECHNOLOGY & RENEWABLE ENERGY

Mission

- To provide a transition pathway for current employees employed to operate and maintain carbon based vehicle and infrastructure by providing training on ZEB technologies
- To attract the next generation of technology technicians to be ready for green jobs being developed today and into the future

Vision

- For every investment in technology, there should be a focused investment in training. The West Coast Center of Excellence in Zero Emission Technology and Renewable Energy will be an instrumental resource for the State of California and the WORLD…

Steps for a Successful ZEB Deployment

- Zero Emission Policy/Vision
- Master Facility Plan
- Established Relationship with Utility Providers
- Internal Champions
- Invest in Technician Training

Advisory Board

West Coast Center of Excellence
IN ZERO EMISSION TECHNOLOGY & RENEWABLE ENERGY

NOVA BUS

NEW FLYER OF AMERICA

GILLIG

GreenPower Bus
The Future of Transportation

RIO HONDO COLLEGE

Cummins

BYD

PROTERRA

SunLine TRANSIT AGENCY

BALLARD®

ENC
REV GROUP

Thank You!

Lauren Skiver
CEO/General Manager
SunLine Transit Agency

lskiver@sunline.org