Up to Code: Hydrogen Station Permitting, Market Trends, and Zero Emission Fleets
September 22nd, 2020
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
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

Air Liquide
AngloAmerican
Iwatani
TOYOTA

California Air Resources Board
CALIFORNIA ENERGY COMMISSION
CHEVRON
Cummins
En
energy independence now

Hyundai
Honda

GM
NISSAN GROUP OF NORTH AMERICA
Shell

South Coast AQMD

BAE SYSTEMS
Ballard
Bay Area Air Quality Management District
cdfa
CEERT
Cte
Comdata

CSA Group
Fastech
FE Fuel

Hydronics
ITM Power
Energy Storage / Clean Fuel

IVYS Energy Solutions
KOBELCO

Look, inc.
National Fuel Cell Research Center
nic AMERICA

New Flyer of America
North American Smart Energy Week

Plug Power
Sandia National Laboratories

Sunline
Tatsuno
TOYOTA TSUSHO AMERICA, INC.

The Little Group
U.S. Department of Energy
Energy Efficiency & Renewable Energy

A Skagit Energy utility

— 20 years of collaboration —
California H2 stations in 2020, 2025 and 2030


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

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.

Governor’s goal of 5,000,000 zero-emission vehicles by 2030.
### By the Numbers

<table>
<thead>
<tr>
<th>Description</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>*FCEVs—Fuel cell cars sold and leased in US</td>
<td>8,573</td>
</tr>
<tr>
<td>FCEBs—Fuel cell buses in operation in California</td>
<td>48</td>
</tr>
<tr>
<td>***Hydrogen stations available in California</td>
<td>42</td>
</tr>
<tr>
<td>Fuel cell buses in development in California</td>
<td>7</td>
</tr>
<tr>
<td>Fuel cell shuttles in development in California</td>
<td>4</td>
</tr>
<tr>
<td>**Retail hydrogen stations in development in California</td>
<td>15</td>
</tr>
</tbody>
</table>

**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

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
Next-generation stations already coming online

- Stations 2-to-8 times larger than the earliest stations
- Station costs coming
- Station development timelines decreasing
Fueling a fuel cell electric car
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
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

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

<table>
<thead>
<tr>
<th>Executives</th>
<th>Analysts</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>10</td>
<td>0</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>17</td>
<td>6</td>
</tr>
<tr>
<td>7</td>
<td>2</td>
</tr>
<tr>
<td>8</td>
<td>4</td>
</tr>
<tr>
<td>8</td>
<td>1</td>
</tr>
<tr>
<td>9</td>
<td>4</td>
</tr>
<tr>
<td>21</td>
<td>7</td>
</tr>
<tr>
<td>8</td>
<td>3</td>
</tr>
<tr>
<td>64</td>
<td>28</td>
</tr>
<tr>
<td>75</td>
<td>9</td>
</tr>
</tbody>
</table>

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

“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

CTE Guidebook for Deploying Zero-Emission Transit Buses

Foothill Transit cost comparison of BEBs and FCEBs
References

- **KEY DOCUMENTS**
  - H2 stations list - [https://cafcp.org/sites/default/files/h2_station_list.pdf](https://cafcp.org/sites/default/files/h2_station_list.pdf)

  - CTE Guide for Deploying Zero-Emission Buses
  - Zero Emission Bus Rollout Plans in California – [www.cafcp.org/resources](http://www.cafcp.org/resources): key word is rollout

  - California Fuel Cell Revolution - [https://cafcp.org/sites/default/files/CAFCR.pdf](https://cafcp.org/sites/default/files/CAFCR.pdf)
  - U.S. Hydrogen Road Map (full report) - [https://cafcp.org/sites/default/files/Road%2BMap%2Bto%2BUS%2BHydrogen%2BEconomy%2BFull%2BReport.pdf](https://cafcp.org/sites/default/files/Road%2BMap%2Bto%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](https://cafcp.org/sites/default/files/Path-to-Hydrogen-Competitiveness_Full-Study-1.pdf)

- **CAFCP PAGES**
  - Station Map – [www.cafcp.org/stationmap](http://www.cafcp.org/stationmap)
  - SOSS (station operational status system) – [http://m.cafcp.org](http://m.cafcp.org)
  - Resources – [www.cafcp.org/resources](http://www.cafcp.org/resources)
Keith Malone

kmalone@cafcp.org
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

- Fuel
  - California State Hydrogen Support
  - Capacity Credits
  - LCFS (CARB)
  - Capital Grants (CEC)
  - Electricity Rates (CPUC)
- Station
  - Capital Grants (CEC)
  - Project Based Demos (ZANZEFF, Adv Tech Freight Demo) (CARB)
- Vehicle
  - ZEV 1st Purchase Policies (DGS)
  - ZEV Regs
  - Carl Moyer
  - Rebates (CVRP/HVIP) (CARB)

Rebates (CVRP/HVIP) (CARB)
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

**Pre-Application Outreach**
- ASAP

**Planning Review**
- 1 Day - 6 Months

**Building Review**
- 1 Day - 6 Months

**Construction**
- 3 - 9 months (Actual Avg. ~9 Months*)

**Commissioning**
- 1 - 3 Months (Actual Avg. ~2.5 Months)

**Design Process**
- Detailed Package Submission
- *Planning Approval*
- *Design and Architecture Review*
- *Planning Application Submittal*
- *Conditional Use Permit or Other Discretionary Approval*
- *Public Meeting*
- Re-Submittal
- Comment Package Pick-Up
- *Response to Comments*
- *AHJ Review*
- *Encroachment Permit*
- Construction
- Milestone Inspections (As Required by State Building Codes)
- Notice of Completion
- Final Inspection/Approval
- Station Developer Commissioning
- Third-Party Validation

**Operational**
- Open
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!
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_ANA.xlsx

• AB 8 reports

• 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

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

**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

300 miles
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

Electrical efficiency up to 45%

System efficiency up to 95%
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 FC Shuttle Buses (Pilot Project)**
- **5 awarded through VW Mitigation Settlement and vehicle replacement funds**
- **5 awarded through EPA TAG**

**El Dorado National**
- Ballard
- US Hybrid
- BAE

**New Flyer**
- Ballard
- Cummins Hydrogenics
- Siemens
Hydrogen Fueling Station Overview

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

Proton/Nel PEM Electrolyzer
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

Jan 1, 2020
100% ICE buses Low-NOx

Jul 1, 2023
ICT Rollout Plan Submission Deadline

Jan 1, 2026
25% of New Purchases are ZEB

Jan 1, 2029
100% of New Purchases are ZEB

Jul 2020
SunLine ICT Rollout Plan Target Submission

Jan 1, 2040
100% ZEB Fleet

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

<table>
<thead>
<tr>
<th>Status</th>
<th>Funding Source</th>
<th>Current SunLine Activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Application Approved</td>
<td>VW Mitigation / LowNo / STA / FTA</td>
<td>VW Funding received for 3 FCEBs (<strong>$1.2 million</strong>)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>LowNo (<strong>$624K</strong>)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>STA (<strong>$657K</strong>) and FTA 5339 &amp; 5307 (<strong>$1.59M</strong>)</td>
</tr>
<tr>
<td></td>
<td>EPA AirShed Grant</td>
<td>Funding approved for 5 FCEBs (<strong>$5.9 million</strong>)</td>
</tr>
<tr>
<td></td>
<td>CEC – H2 Ride</td>
<td>Funding Approved for 4 FCEBs shuttle buses (<strong>$4.3 million</strong>)</td>
</tr>
<tr>
<td>Application Submitted</td>
<td>VW Mitigation / LowNo / STA / FTA</td>
<td>VW Funding pending approval for 2 FCEBs (<strong>$800K</strong>)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>LowNo (<strong>$416K</strong>)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>STA (<strong>$438K</strong>) and FTA 5339 &amp; 5307 (<strong>$1.03M</strong>)</td>
</tr>
</tbody>
</table>
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
A Focus on Workforce Development

**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
Thank You!

Lauren Skiver
CEO/General Manager
SunLine Transit Agency

lskiver@sunline.org