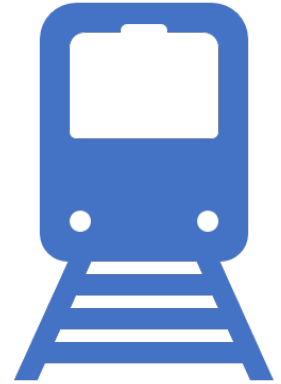


# H2@Rail Workshop California's Perspectives



Momoko Tamaoki  
California Department of Transportation  
March 26, 2019

The James B. Henry Center for Executive Development  
Lansing, MI



# California Air Quality and Climate Change Mandates

**2050**

Reduce GHG to 80 percent below 1990 levels

**2030**

Reduce GHG emissions to 40 percent below 1990 levels

**2020**

Reduce GHG emissions to 1990 levels

**2006**

AB 32  
California Global Warming Solution Act

# Sustainable Community Strategies

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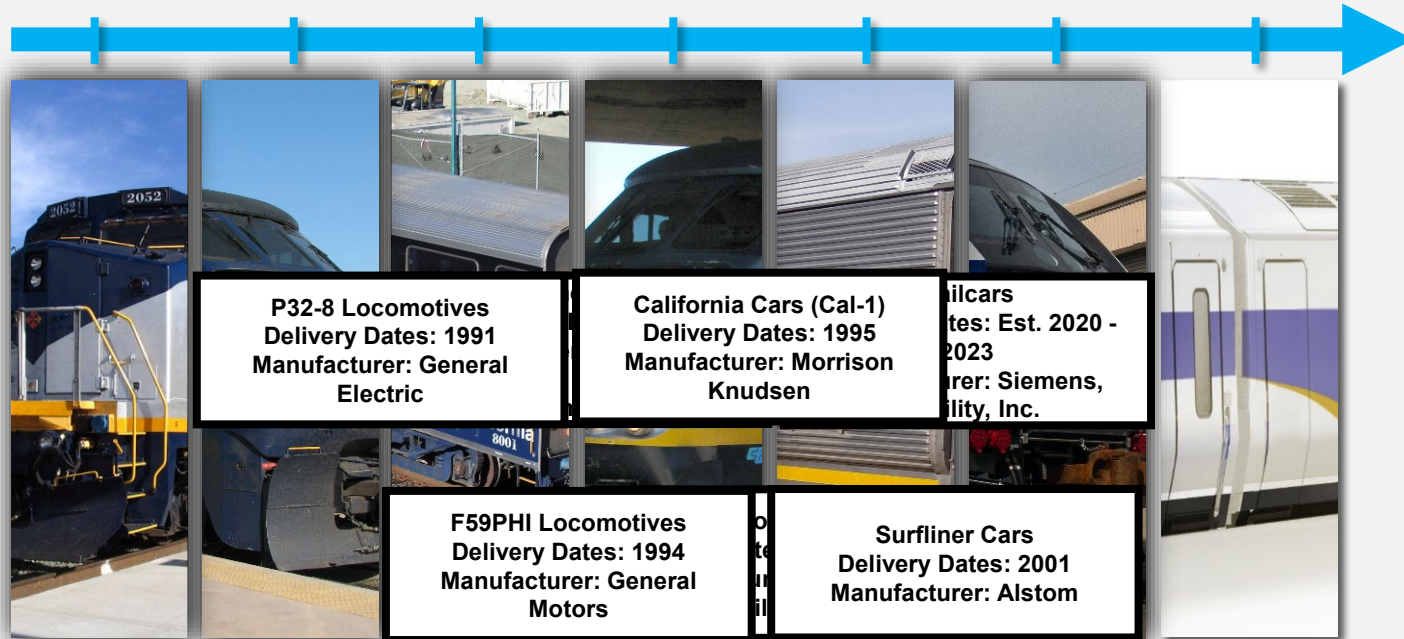


***Caltrans***®

# California Fleet


Name	Capitol Corridor	Pacific Surfliner	San Joaquin
Route	Auburn – Sacramento – Oakland – San Jose	San Luis Obispo – Santa Barbara – Los Angeles – San Diego	Oakland/Sacramento – Stockton-Fresno-Bakersfield
Route Mileage	168	350	364
No. of Daily Trips	Auburn-Sacramento – 1 Sacramento – Oakland – 15 Oakland – San Jose - 7	San Luis Obispo – Santa Barbara – 2 Santa Barbara to Los Angeles – 5 Los Angeles to San Diego - 12	Oakland-Stockton-Bakersfield – 5 Sacramento – Stockton-Bakersfield - 2
No. of Stations	18	29	18
Railroad Companies	Union Pacific/Locally Owned	Union Pacific/BNSF/Locally Owned	Union Pacific/BNSF
No. of Passenger Cars	Caltrans: 59 Amtrak: 6	Caltrans: 7 Amtrak: 50	Caltrans: 73 Amtrak: 9
No. of Cab Cars	Caltrans: 19 Amtrak: 0	Caltrans: 3 Amtrak: 10	Caltrans: 19 Amtrak: 3
No. of Locomotives	Caltrans: 25 Amtrak: 3	Caltrans: 14 Amtrak: 0	Caltrans: 25 Amtrak: 3

# Rolling Stock Procurement History in California



Most Bi-level equipment needs to be replaced by 2025

# Procurement Challenges & Decisions



Uncertain  
short / long-  
term demand



Fleet Availability  
and Utilization:  
big improvement  
potential



Aged and  
fragmented  
fleet



Network is  
not  
electrified



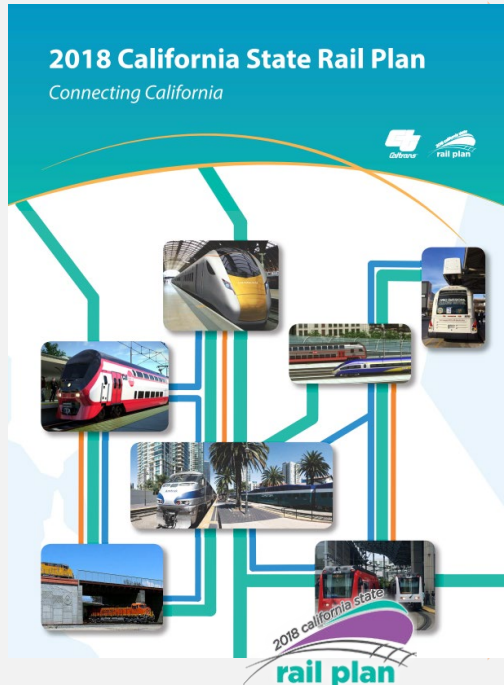
Operations and  
Maintenance  
standards not on  
par with other  
industries



Changing  
environment

# Fleet Planning – Partnering with Deutsche Bahn Group

## CA State Rail Plan



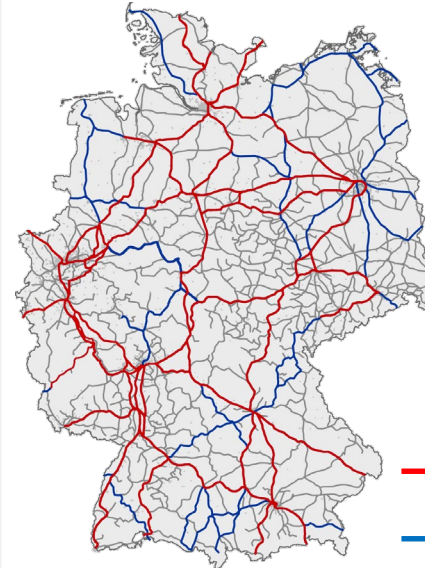
## Our partner Deutsche Bahn Group



Travelers per day in Germany (GER) 6.0 Mio

Trains per day (GER) 24,300

Overall Fleet (GER) 269 High-speed trains  
1,300 locomotives  
4,100 multiple-units



— high speed

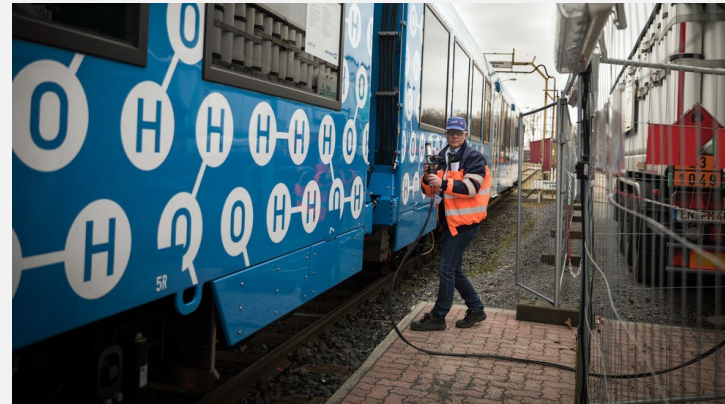
— other long distance

— regional



# Caltrans/DB Operational Analysis

- Caltrans/DB launched Operational Study on Capitol Corridor in January 2019
- Collected Technical Information from multiple carbuilders
- Alstom's iLint is one of the vehicles selected
- Viriato will be used for the study
- Final Report will aide the future procurement decision



# Sunline Transit Agency – Hydrogen Buses

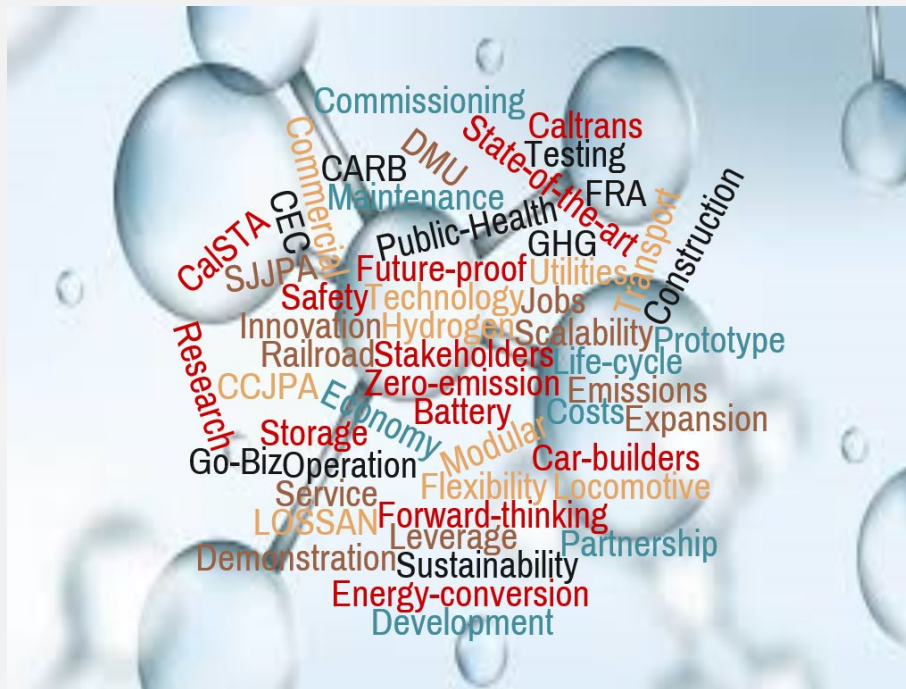


- 1<sup>st</sup> ZEB Procured in 2000
- 1<sup>st</sup> Fuel Cell Hybrid Procured in 2002
- Currently 7<sup>th</sup> Generation of Fuel Cell Bus
- Currently Operating 11 Hydrogen Buses
- Multiple Fund Sources to Support Hydrogen Buses
- SunLine is the “Test Bed” for Technology Development, Infrastructure and Commercial Operations
- CoEZET for Training

# SBCTA's DMU Conversion Project

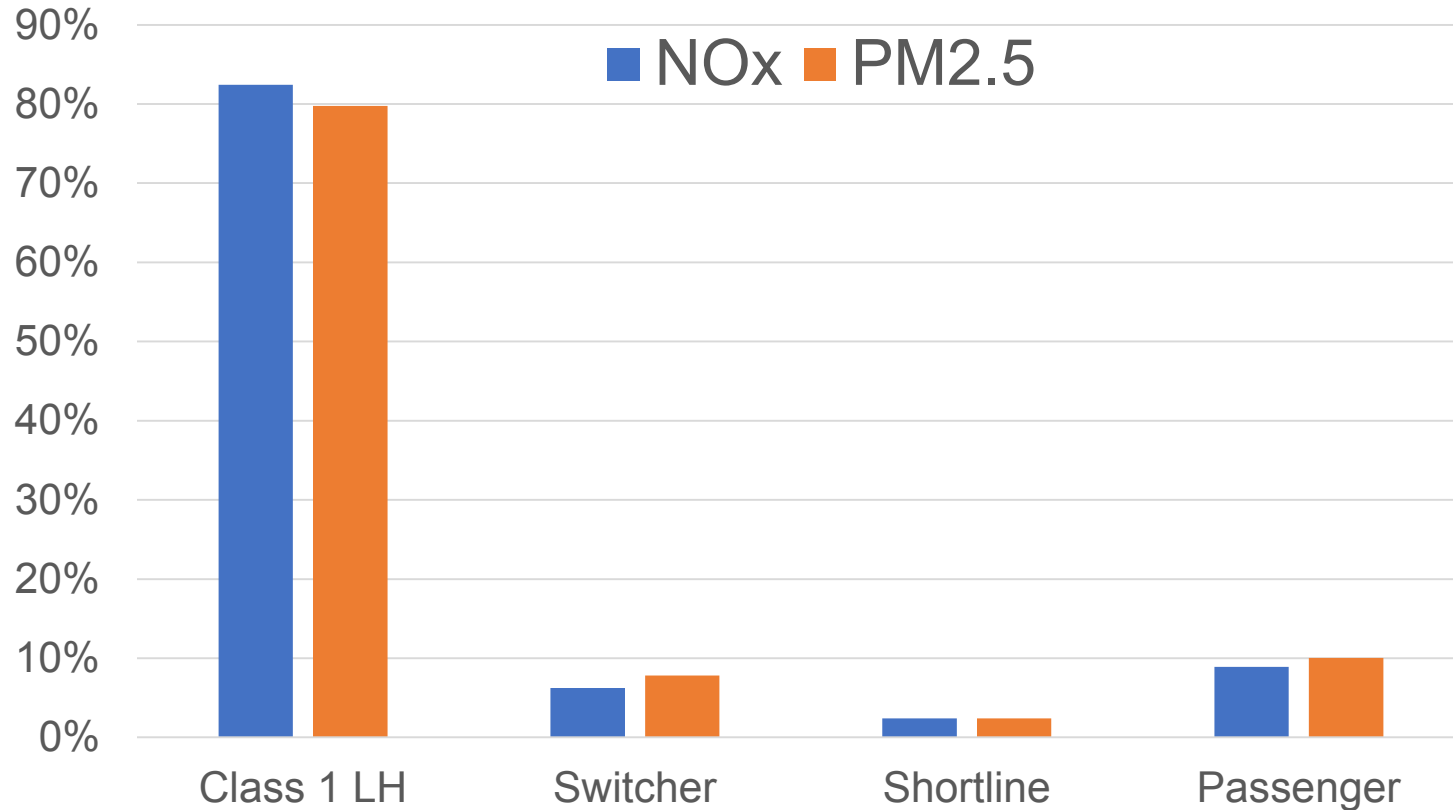


# Hydrogen On Passenger Rail Application R&D





# California Locomotive Emissions



# CARB's Locomotive Petition



- CARB petition to U.S. EPA (April 2017)
- Proposed new Tier 5 emission standards
- 7 Agencies submitted letters of support

# CA Sustainable Freight Action Plan



CALIFORNIA  
**SUSTAINABLE  
FREIGHT**  
ACTION PLAN



## Governor's Executive Order B-32-15

- Improve freight efficiency
- Transition to zero emission technologies
- Increase economic competitiveness

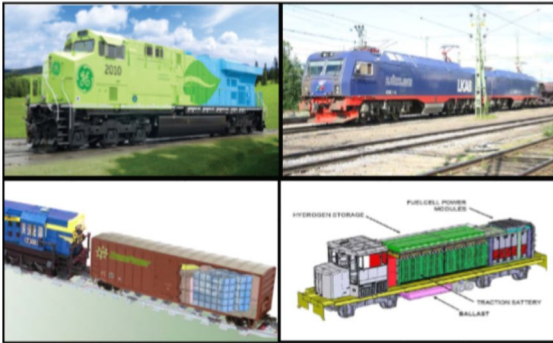




# CARB Technology Assessment



## TECHNOLOGY ASSESSMENT: FREIGHT LOCOMOTIVES



November 2016

- Multiple technologies assessed
- No Clear Path to zero
- Major challenges in line haul application

# Freight Locomotive Requirements



	Switcher	Line Haul
Power Characteristics & Requirements	Sporadic peak at 1,006-2,300hp (750-1,715kW)	Extended operation at >4,000hp (>3MW)
Refueling Range/Time	8-16 hours	1,000 miles
Size	Constrained by Locomotive Envelope	

# Zero Emission Locomotive Challenges



Application	Battery	PEM Fuel Cell	SO Fuel Cell
<b>Line Haul</b>	Uncertain? (Range)	Uncertain? (Power)	Possible?
<b>Switcher</b>	Probable?	Probable?	Possible?

# CARB Incentives



## AQIP

Criteria pollutant  
and toxics  
reductions

## Carl Moyer Program

SIP emission  
reductions

## Community Air Protection

Criteria, toxics,  
GHG reductions  
for communities

## Low Carbon Transportation

GHG reductions  
and AB 1550  
benefits

## VW Mitigation Trust

NOx mitigation

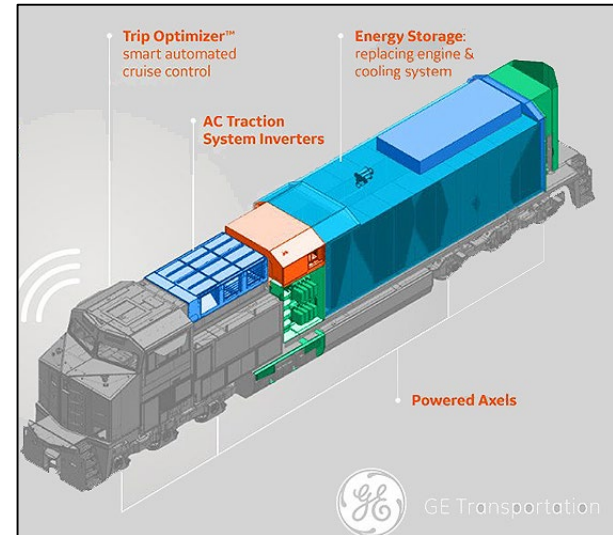
## Prop 1B Goods Movement

NOx and PM  
reductions in  
freight corridors

Open to variety of  
zero-emission  
locomotive  
technologies  
including fuel cell.

# CARB Locomotive Demonstrations

- 2 current demonstration projects
  - Line Haul: Battery Electric Hybrid Consist
  - Switcher: Battery All-Electric
- Challenge for Locomotive Projects
  - Timeline
  - Cost
  - Emission reduction requirements



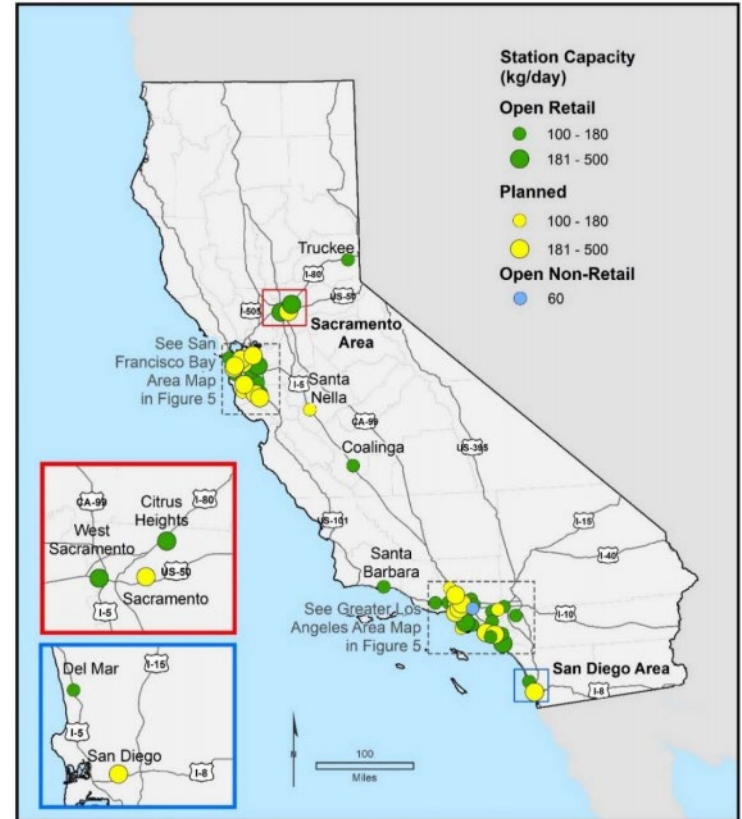




# California Energy Commission - ARFVTP

AB-8 allocates \$20M/yr to establish at least 100 public hydrogen stations. End of 2018:

- 38 stations open to the public
- 26 stations in development
- Funded network will provide 17,000 kg/day of nameplate capacity
- Funded two new renewable hydrogen production facilities





# California Energy Commission – R&D

- Growing interest in hydrogen as long term energy storage to support an increasingly renewable and variable grid.
- Potential for hydrogen to electrify sectors that would be difficult to address with battery-electric, including rail and marine.
- FY19-20 Natural Gas Research Program Budget Plan (\$24M/yr) has a research initiative for fuel cell demonstrations in locomotive and harbor craft applications at California ports.
- California ports are key targets for decarbonizing freight and reducing air pollution. There are opportunities to shared infrastructure across trucks, cargo handling equipment, cars, and potentially rail and marine.





**CALIFORNIA**

Governor's Office of Business  
and Economic Development

# Job Growth and Economic Development (GO-Biz)

- **Hydrogen Cost Reduction**
  - Rail is part of a comprehensive strategy to drive down the price of hydrogen
    - Reducing hydrogen kg price point will support development of H2 technology
- **Job Creation - Scalability**
  - Creates opportunities for local businesses
  - Developers estimate over 500 jobs (short- and long-term) created in California from funded light duty hydrogen stations
    - Outside of the currently existing 39 light duty hydrogen stations, there are 25 hydrogen stations that are in development
- **Tax Revenue**
  - Sales tax, property tax, income tax



# Questions?



## California Air Resources Board Contacts

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Reducing Rail Emissions in California Webpage:

<https://ww2.arb.ca.gov/our-work/programs/reducing-rail-emissions-california>



# Questions?

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# Questions?

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