Senate Bill 671 Workgroup

Friday, March 24, 2023
10:00 am – 11:00 am
Via GoToWebinar

Agenda

- Update on Draft Top Freight Corridors and Zero-Emission Station Scenarios

Six proposed priority freight corridors

Potential priority freight corridors were identified by commodity flows, trip type, and likely vehicle used (by class and powertrain)

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NOT EXHAUSTIVE

By layering multiple inputs on top of Federal and state traffic data, freight flows could be segmented by the following factors:

1 Commodities[1]

Agriculture & food

Chemicals, rubber & plastic products

Construction & wood materials

Consumer goods

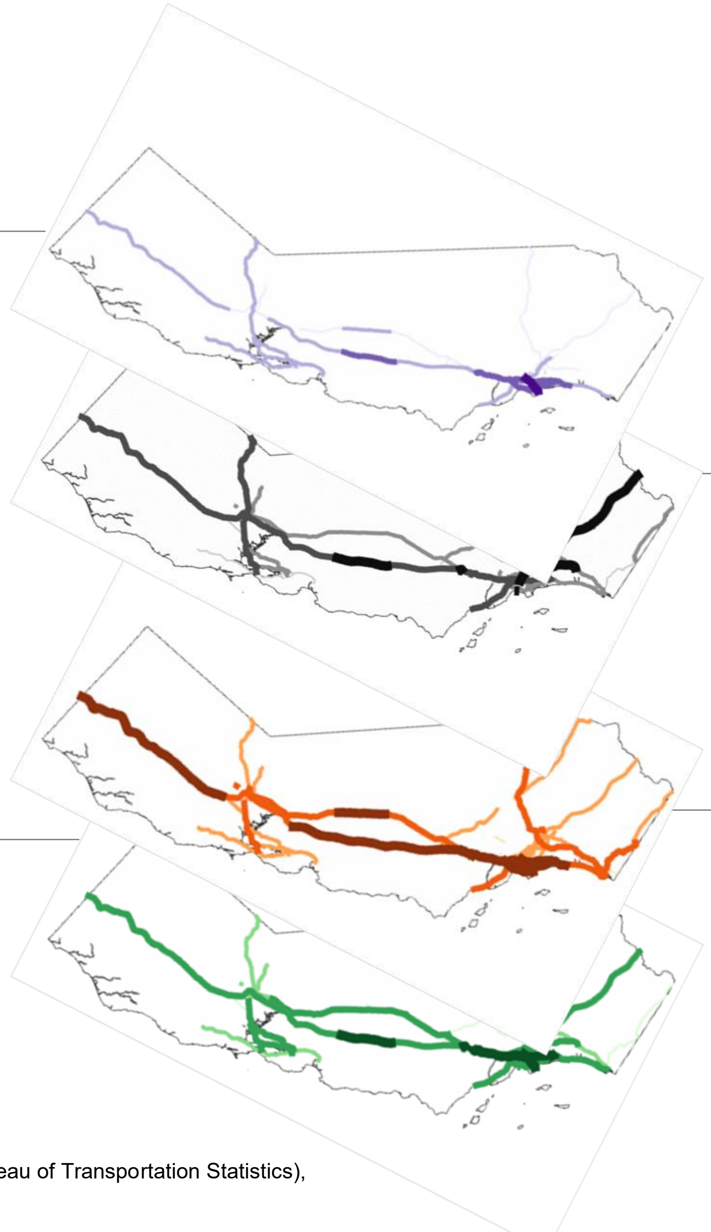
Fossil Fuels

Metals, metal products & hardware

3 Vehicle class[3]

Medium-duty trucks: Class 4-6

Heavy-duty trucks: Class 7-8



2 Trip type[2]

Urban

Regional

Long-haul

4 Projected powertrain mix[4]

Combustion engine

Battery electric vehicle

Fuel cell electric vehicle

1. FAF counts of trips by commodity
2. National trip type percentages applied to FAF corridor traffic
3. FAF counts of heavy and medium duty trucks (MDT and HDT)
4. National powertrain percentages applied to FAF corridor traffic counts

Source: Highway Performance Monitoring System (Federal Highway Administration), Freight Analysis Framework (Bureau of Transportation Statistics), powertrain and vehicle class production and technology insights (2022)

Proposed Top Six Freight Corridors

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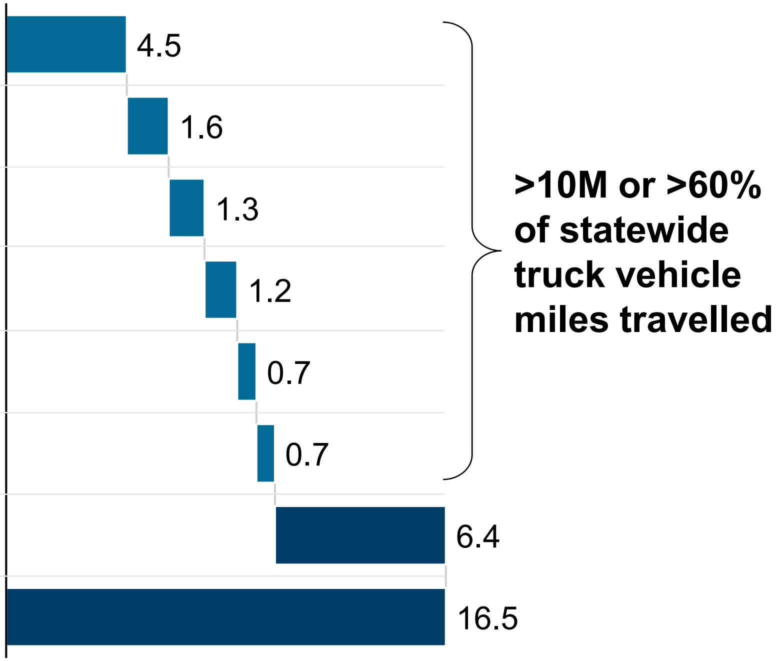
Further consideration of high truck vehicle volume but low truck VMT or <50 mile corridors may be necessary to complete charging and/or refueling infrastructure

Priority corridors for consideration
Ordered by truck VMT[1] – 2022 projected

- I-5 from the south border to north border (Oregon)[2]
- I-15 from LA to southeast border (Nevada)
- Route 99 from Red Bluff to Bakersfield
- I-10 from LA to southeast border (Arizona)[3]
- I-40 from intersection with I-15 to southeast border (Arizona)
- I-80 from San Francisco to northeast border (Nevada)[4]
- Other
- **Total**

Daily truck VMT on high-volume FAF links by corridor
Million miles



1. Vehicle miles travelled
2. The I-5 corridor includes the I-710 where it connects I-5 to the ports of Los Angeles and Long Beach, and the segments of I-405 and Highway 1 that connects I-10 and I-710 near the San Pedro Bay Ports. This corridor also includes the local roads that connect the I-5 to the Port of San Diego and to the US/Mexico border
3. The I-10 corridor includes the short segment of SR-47 that connects I-10 to the Port of Los Angeles, and the segments of I-405 and Highway 1 that connects I-10 and I-710 near the San Pedro Bay Ports
4. The I-80 corridor includes the short segments of I-580 and I-880 that connect I-80 to the Port of Oakland

Source: Highway Performance Monitoring System (Federal Highway Administration), Freight Analysis Framework (Bureau of Transportation Statistics)

Top Six Corridors – Key Connecting Routes

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PORT OF OAKLAND

The I-80 corridor includes the short segments of I-580 and I-880 that connect I-80 to the Port of Oakland

SAN PEDRO BAY PORTS

The I-5 corridor includes the I-710 where it connects I-5 to the Ports of Los Angeles and Long Beach, and the segments of I-405 and Highway 1 that connect I-10 and I-710 near the San Pedro Bay Ports. This corridor also includes the local roads that connect the I-5 to the Port of San Diego and to the US/Mexico border

The I-10 corridor includes the short segment of SR-47 that connects I-10 to the Port of Los Angeles, and the segments of I-405 and Highway 1 that connect I-10 and I-710 near the San Pedro Bay Ports

Note: These ports are key freight origin and destination points. Thus, they have been included in the freight corridors to reflect the need for infrastructure in and around them

Source: CTC Working Group, analysis of Freight Analytics Framework (FAF 5)

Zero emissions trucks could reduce annual tailpipe truck emissions along priority corridors by >50% by 2040[2]

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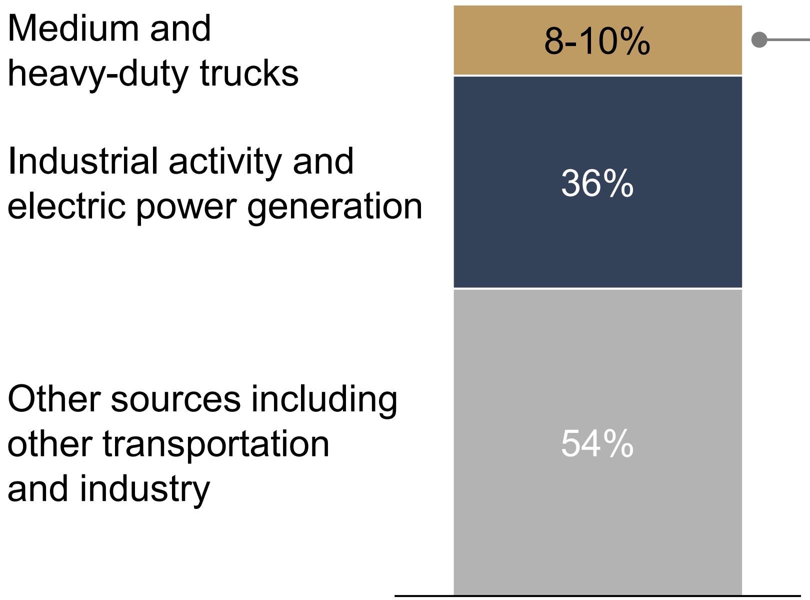
CA annual GHG emissions[3]
Both direct and indirect, business as usual projected 2040



Corridor tailpipe truck emissions with existing SB535 priority populations[1,2]

1. The Map Priority populations CES4 (CalEnviroScreen 4) 2022 shows disadvantaged community and low-income community designations. Disadvantaged communities are designated by the California Environmental Protection Agencies (CalEPA), Disadvantaged community designations
per Senate Bill (SB) 535 (De León, Chapter 830, Statutes of 2012). CalEPA identified the list of disadvantaged community census tracts and land areas available at CalEPA Climate Investments to Benefit Disadvantaged Communities webpage
2. Estimation of direct (tailpipe) emissions followed the following steps: (1) Forecast of VMT in 6 priority corridors (Source: Freight Analysis Framework / Federal Highway Administration, and Freight Booster, (2) Allocation of VMT 2024 and forecast by powertrain and truck type (Source: CARB – ACF Population), and (3) Multiply average emissions per powertrain and truck type by VMT (Source: Emission Rates 2024 (Running Exhaust Emissions) Statewide from EMFAC2017 Web Database)
3. California GHG emissions by sector found at CARB GHG Inventory 2022 Edition (Link) Please note: estimates from CARB do not include medium duty category so assumptions on range were applied. On the graph "Medium and heavy-duty trucks" include all on-road non-passenger transportation
4. Based on literature review of CARB Land Use Handbook (Link); Environmental Protection Agency reports (Link); OEHHA; UC Davis report; Health Effects Institute reports (Link); which found that almost all pollutants decay to background by 115-1500M from edge of road

Three potential scenarios were created to gauge zero-emission truck demand and their estimated resulting infrastructure needs

Approach for estimating total energy required and infrastructure needs for priority corridors

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Vehicle number

Goods movement

Projected truck volumes in 2025, 2030, 2035, 2040

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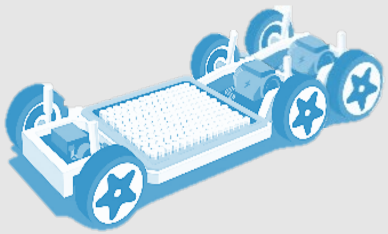
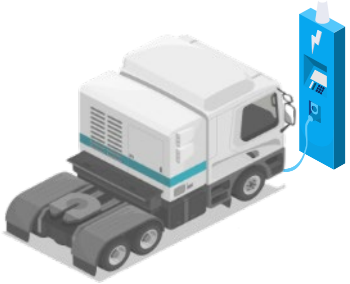
Powertrain

Powertrain choices and pace of adoption through 2025, 2030, 2035, 2040

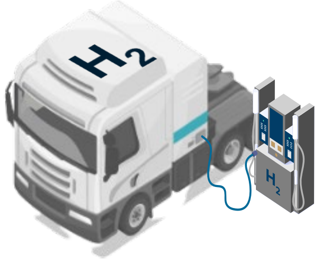


Vehicle and trip type[1]

Battery electric by vehicle type by trip type

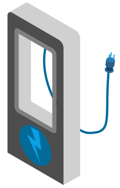


Hydrogen fuel cell by vehicle type by trip type

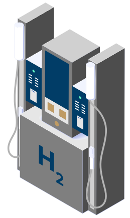


Infrastructure needs

Charging stations required per corridor



Fueling stations per corridor



1. Vehicle types include Medium-duty trucks (Class 4-6), Heavy-duty trucks (Class 7-8); Trip types include: urban, regional, long-haul

Source: CTC Working Group; infrastructure needs assessment excel and geospatial modelling include data and insights from UC Davis, California Energy Commission, California Air Resources Board, Freight Analytics Framework (FAF5), Gualco, I.H.S. Automotive, ACT Research, American Trucking Association, Energy Information Administration, Alternative Fuels Data Center, Fleet manager surveys

Battery Electric (BEV) and Hydrogen Fuel Cell (FCEV) Trucks are Typically Best Suited for Different Use Cases

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	Battery electric (BEV)	Hydrogen fuel cell (FCEV)
Vehicle class	Mostly medium duty (Class 4-6)	Mostly heavy duty (Class 7-8)
trip type	Mostly urban trips	Mostly long haul and regional trips
Infrastructure use case	Private; Public	Private; Public
Station typologies	Fleet hub; Public Overnight; Public Fast On-Highways	Fleet hub; Public Fast On-Highways

Source: CTC Working Group; Fleet manager interviews

Scenarios are Based on 3 Possible Cost Outcomes & Technology Choices

Key assumptions behind the three scenarios

	Accelerated battery electric adoption	Balanced adoption	Accelerated hydrogen fuel cell adoption
Cost of ownership	**Battery electric trucks become more cost effective over time** accelerating incorporation into commercial fleets	**Balanced adoption of zero-emissions technologies** over time	**Fuel cell trucks become more cost effective over time** accelerating incorporation into commercial fleets
Technology choice	**BEV trucks and charging become viable for long haul trips**	**No predominantly used technology across use cases;** BEV continues to be used mostly for medium duty short and regional trips, FCEV for heavy-duty and long haul	**FCEV trucks and refueling become a viable choice for short haul trips**

Source: CEC (California Energy Commission), Gualco, Balanced scenario includes data from I.H.S. Automotive, ACT Research, American Trucking Association, Energy Information Administration, Alternative Fuels Data Center, Fleet manager surveys

3 Scenarios of Zero-Emission Freight Infrastructure Needs

2025-2040

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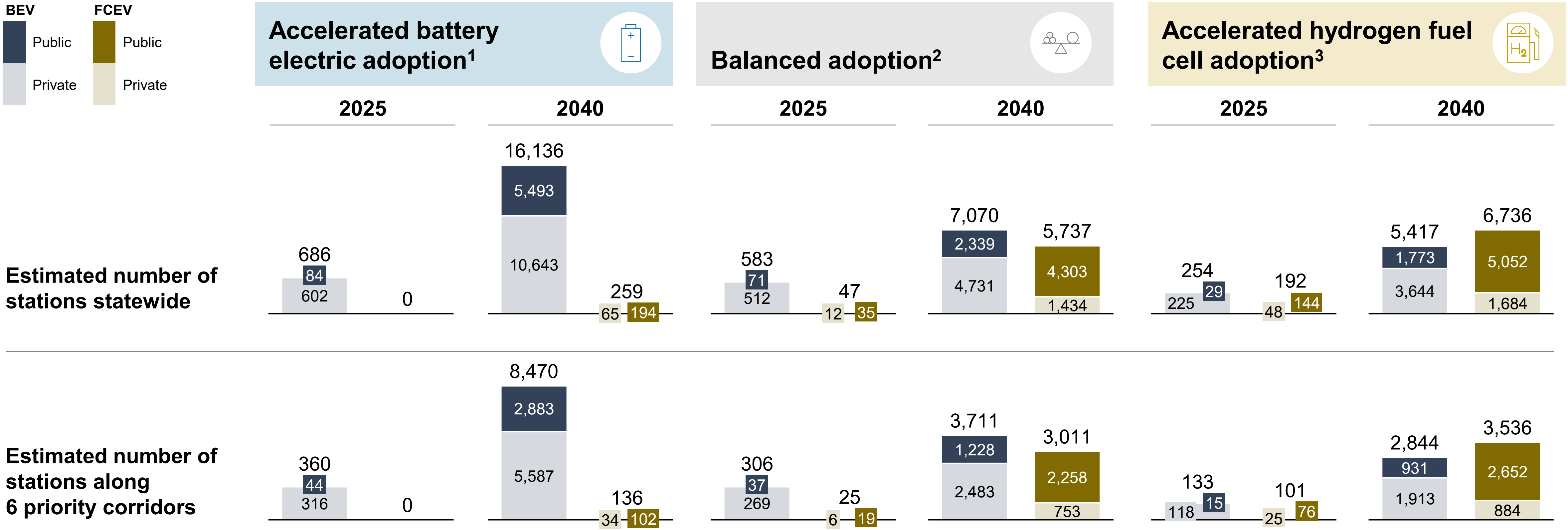

1. CEC (California Energy Commission)
2. Balanced scenario includes I.H.S., ACT Research, American Trucking Association, Energy Information Administration, Alternative Fuels Data Center, Fleet manager surveys
3. Gualco
4. Other cross-cutting input assumptions include utilization, battery efficiencies, number of chargers per station, charging efficiencies, charging capacity factors, trip type, public vs. private etc.

Note: BEV – Battery electric vehicle; FCEV – Hydrogen fuel cell electric vehicle; powertrain adoption curves applied to California Air Resources Board (CARB) vehicles number projections

There's Benefit to Focusing on a Minimum Viable Network First

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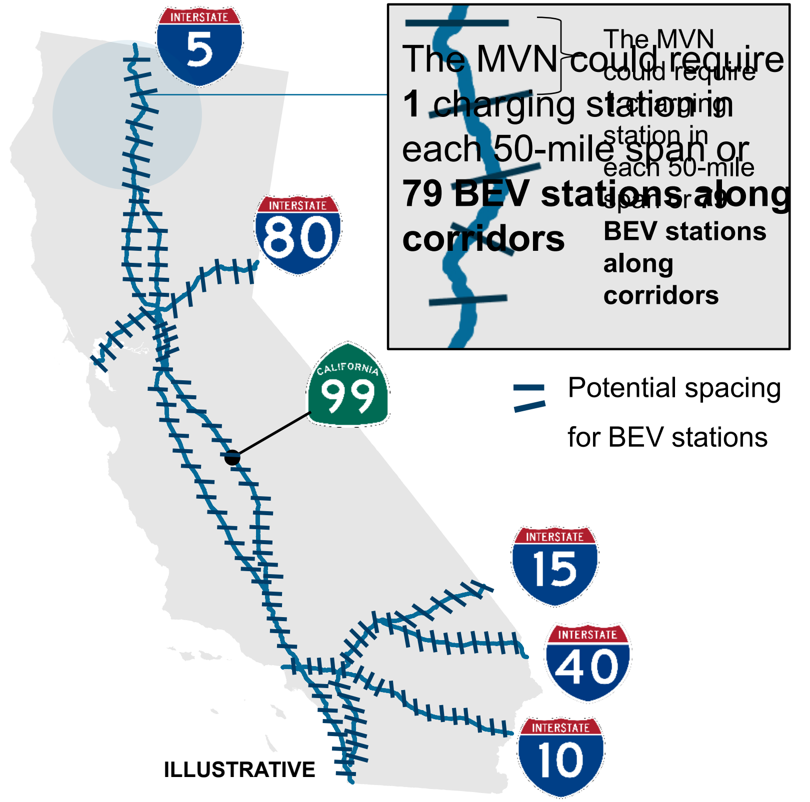
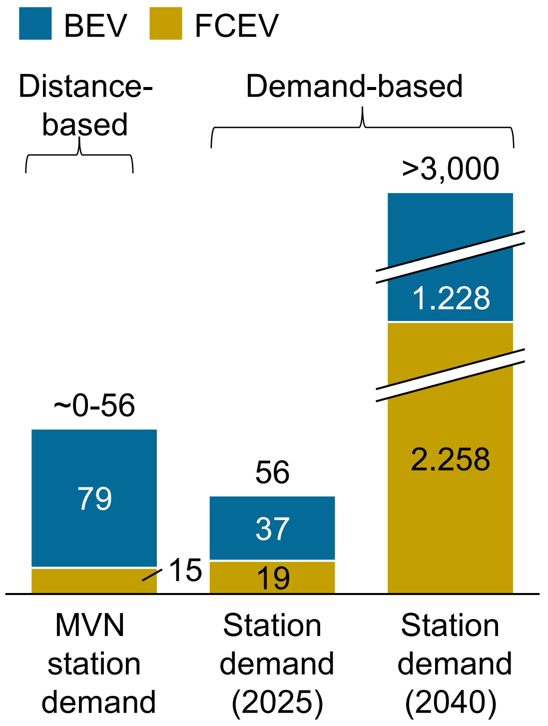
BEV MVN[1]



FCEV MVN[2]

The minimum viable network could be underutilized in the early years but in future years, public zero-emissions infrastructure demand could surpass the MVN[3]



1. BEV maximum spacing was calculated to ensure that a poor-performing BEV truck would pass an average of 1.5 charging stations over the course of the truck's practical range (60% of it's theoretical maximum range)
2. FCEV maximum spacing was calculated to ensure that an FCEV truck with a conservative range [estimated as 400 miles based on published ranges for multiple fuel cell trucks: Nikola One (500 mi), Quatron QHM (435 mi), Volvo (621 mi)] would pass an average of 1.5 charging stations over the course of the truck's conservative range
3. All numbers in this charts reference the Balanced scenario of the three potential powertrain adoption scenarios

CTC is considering key origin or destination points, existing infrastructure and submitted potential projects in this assessment

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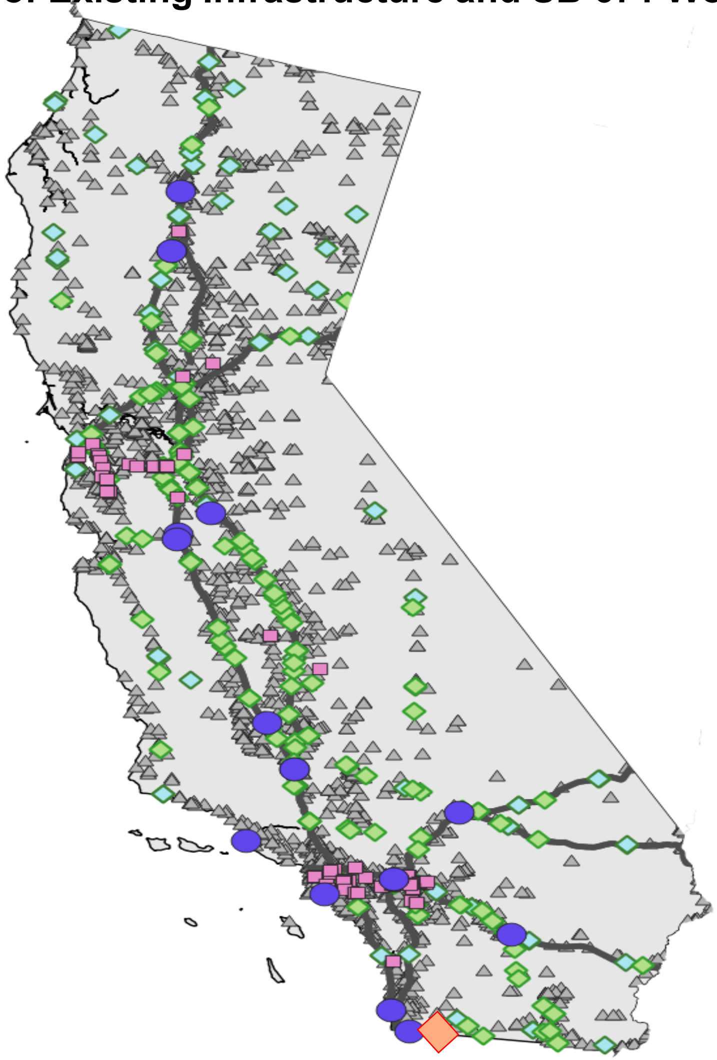
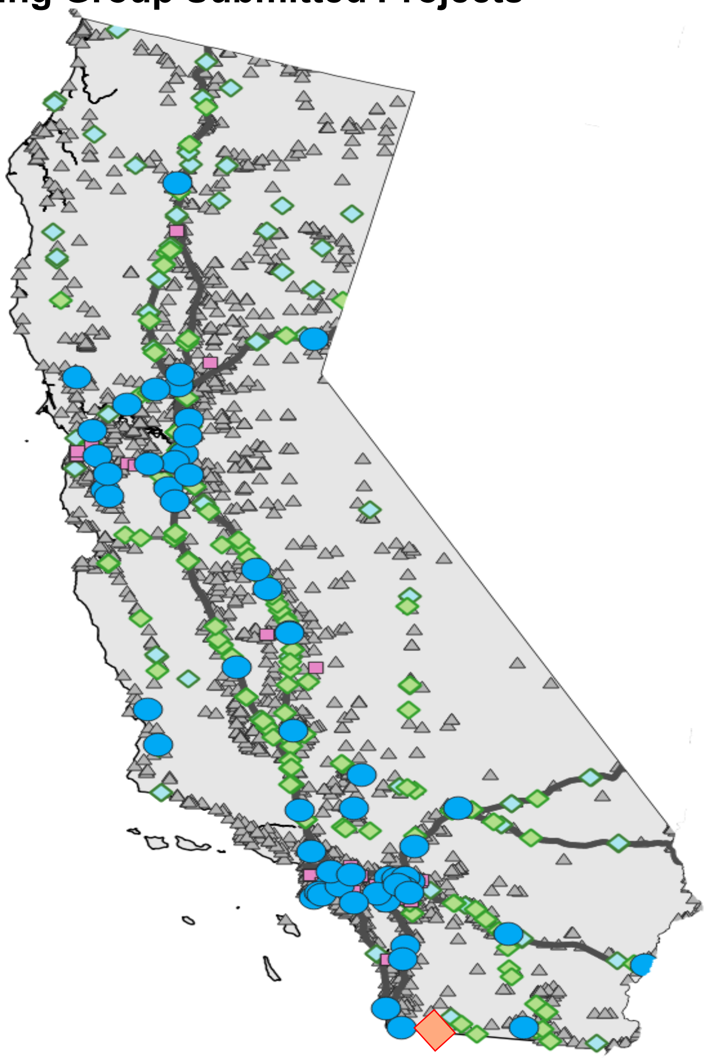
Maps of Existing Infrastructure and SB 671 Working Group Submitted Projects





- Submitted/existing BEV charging infrastructure
- Submitted/existing FCEV charging infrastructure
- Existing logistics warehouses
- Existing substations/utilities infrastructure
- Public truck parking
- Private truck parking
- Additional key origin or destination points

Source: 79 BEV and FCEV potential infrastructure locations submitted to SB 671 working group, existing logistics warehouses submitted to CTC working group from private sector. Truck parking locations from CalTrans Truck Parking study, existing substations from the Homeland Infrastructure Foundation Level Database

Next Meeting:
June 2, 2023

Thank you!