California, Net-zero Rail by 2035
Caltrans’ Zero-Emission Strategy
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Caltrans

About Caltrans, DRMT
- Our vision is to make public transportation a viable option for all.
- Our mission is to provide measurable improvements to California’s integrated and sustainable public transportation system.
California is advancing decarbonization of the transportation sector – with several target years for various transportation modes

Zero emission vehicle target timeline

- **EO N-79-20 goal:**
  - 100% zero-emission off-road vehicle fleet, including rail
  - Trucks fully ZE by 2045 wherever feasible
  - In-state sales of new passenger cars and trucks 100% ZE from 2035

- **CARB IULR² goal:**
  - 50% Tier 4 by 2030
  - 100% Tier 4 by 2035
  - 50% ZE by 2040
  - 100% ZE by 2047
  - New rail vehicles must be ZE starting 2030

- **Innovative Clean Transit Regulation:**
  - New buses ZE from 2029 onwards
  - Bus fleets of public transit agencies fully ZE by 2040

- **Advanced Clean Cars II:**
  - Reduce CAP & GHG from cars beyond the 2025 model year and increase the # of ZEV
  - All new passenger vehicles sold in CA to be ZE by 2035

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(1) Off-road vehicle fleet must be zero-emission by 2035 according to EO N-79-20
(2) CARB in-use locomotive regulation (IULR) as passed April 27, 2023
Sources: CARB, Caltrans, Governor’s Office

Caltrans | Momoko Tamaoki | Assistant Division Chief | May 16, 2023
Caltrans has several initiatives for emissions reduction in California, including a passenger rail strategy and ZEMU\(^1\) procurement.

- **R&D efforts**
- **Reduce emissions on F59 PHI locomotives**
- **ZE Bus**
- **ZE Working Group**

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\(^1\) Fleet expansion with zero-emission multiple units (ZEMUs)  
\(^2\) Intercity fleet transition to ZE
California Intercity Passenger Rail
Zero-Emission Strategy
Caltrans | 2022
Caltrans developed a ZE strategy for California intercity passenger rail to reduce emissions and achieve zero emissions by 2035

Caltrans developed a ZE strategy to:

- Respond to urgent need and legislation / state mandates
- Set goals / targets and provide a structured approach to move towards ZE, incl. setting technological cornerstones
- Enable the launch of important initiatives and accelerate progress
- Provide leadership and guidance and serve as a positive benchmark for other railways to act quickly in a coordinated manner

Collaboration with passenger rail agencies to leverage expertise for successful California wide ZE implementation

(1) EO N-79-20 and CARBs in-use locomotive regulation
Our fleet: Caltrans provides the equipment for three intercity corridors – services are managed by regional Joint Powers Authorities

California's Intercity Passenger Rail

Intercity diesel-electric locomotive fleet

- **F59PHI (EMD)**
  - Year introduced: 1991 / 2001
  - Emission standard: Tier 2
  - Power: ~2200 kW

- **SC-44 (SIEMENS)**
  - Year introduced: 2017
  - Emission standard: Tier 4
  - Power: ~3300 kW
Primary power for Caltrans intercity fleet: renewable diesel to reduce emission and hydrogen to achieve zero-emission

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<th>Low-emission Transition</th>
<th>Zero-emission Technologies (incl. hybrids)</th>
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- **Status quo**: Emission targets cannot be achieved even with after-treatment systems
- **Feasible**: Emission reduction compared to regular diesel, likely transition technology, limited modifications needed
- **Possible**: Emission reduction compared to regular diesel, likely transition technology, limited current industry interest
- **Impractical (as stand-alone)**: Suited for hybrid solution but not suitable as sole power source for intercity due to long range requirements
- **Favored**: Most suited option for intercity service according to initial analysis
- **Impractical (for intercity)**: Requires large capital investment; most suitable for long distances/high frequency operations

(1) Considering system-wide electrification

Source: DB assessment

Caltrans strategy

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Rating: [Green: Excellent, Yellow: Good, White: Mediocre, Orange: Inferior, Red: Requirements not fulfilled]
Driving toward zero-emission intercity rail: Start with alternative fuels, upgrading to Tier 4 incl. energy efficiency, and Hydrail1

2020-2022
Develop and adopt ZE strategy in accordance with EO-N79-20
Set goals and provide a structured approach to move towards ZE, incl. setting technological cornerstones

2023
Entire fleet is operated on alternative fuel
Explore additional options to reduce emissions by the end of 2023

2027
Hydrogen pilot underway
Begin fleet conversion efforts toward hydraid

2035
Caltrans’s goal of fleet operation on ZE
Caltrans aims to exceed CARB requirements

Emission reduction per train mile compared to 2020 levels: ↓ GHG ↓ Criteria pollutants

(1) Adjustment of strategy possible, if technological breakthrough occurs

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Caltrans developed a concept for a possible ZEMU vehicle for a 4- and 5-car train aimed at expanding passenger rail service in California.

Possible ZEMU configurations

Caltrans targeted characteristics
- Hydrogen: long range & fast fueling;
- Batteries: power & enabling regenerative braking
- Passenger capacity: ~200 seats
- Max vehicle speed: 90 mph
- Max vehicle range\(^2\): ~1000 miles (4-car), ~800 miles (5-car)

Illustrative Example

(1) General illustrative concept based on SBCTA ZEMU  (2) Under favorable conditions  (3) Memorandum of Understanding
Valley Rail route from Merced to Natomas Airport
Route highlights and maps

Valley Rail route¹
- Route: Ceres-Merced & Lathrop-Ceres & Sacramento Extension
- # of stations²: 16 (1 existing, 15 planned)
- Distance³: 118.36 miles (190.48 km)
- Elevation (altitude):
  - Merced: 171.2 ft (52.18 m)
  - Natomas Airport is 39.37 (12 m); steepest grade (1%)

Elevation profile (elevation vs distance)

1. Valley Rail line includes Ceres-Merced Extension, Lathrop-Ceres Extension, and Sacramento Extension
2. Station locations are based on information provided in the Environmental Impact Reports. Added Atwater as a separate station from Livingston.
3. One Way

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Potential other routes for ZEMUs: Antelope Valley and Central Coast

**Antelope Valley route¹**
- Route: Lancaster to L.A. Union Station
- # of stations: 13 (12 existing, 1 planned)
- Distance¹: 76.6 miles (123.23 km)
- Elevation (altitude):
  - Lancaster 2354 ft (717.5 m)
  - L.A. Union Station 309 ft (94 m);
  - steepest grade (5.45%) 

**Central Coast route¹**
- Route: San Jose to Santa Barbara
- # of stations: 5
- Distance¹: 320 miles (514.5 km)
- Elevation (altitude):
  - San Jose 70 ft (21.34 m)
  - Santa Barbara is 10 ft (3 m);
  - steepest grade (2.47%) 

(1) One Way

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Thank you!
If you have any questions, please contact me.
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