



Protecting Public Health through Rail Decarbonization

Ajay Mangat, Transportation and Toxics Division
FRA Rail Decarbonization Workshop, Denver, CO, May 16-17, 2023



CARB leads California's fight against air pollution and climate change, protects public health, and promotes clean, energy-efficient fuels and technology.

North American Rail is Different

- Freight dominated
- Privately owned tracks
- Double stacked containers
- Low traffic density, little to no electrification
- Long trains

Importance of Freight in California

1/3 of California
GDP



5 million jobs



California's Environmental Leadership

 **100% ZEV sales** by 2035

Full transition to **ZEV drayage trucks** by 2035 

 Full transition to **ZEV buses & heavy-duty long-haul trucks** by 2045* 

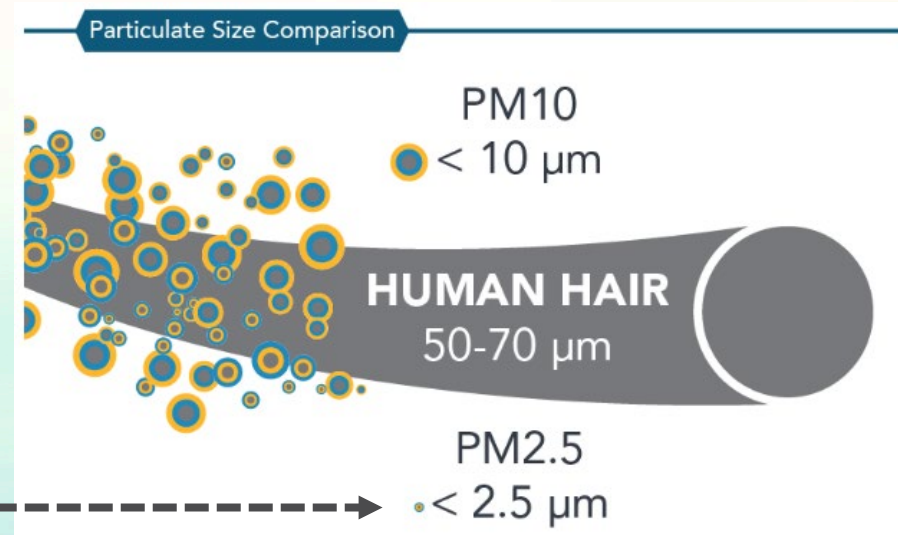
 Full transition to **ZE off-road equipment** by 2035*

*where feasible

Diesel Exhaust

Diesel exhaust is a complex mixture of:

- Diesel particulate matter (DPM)
 - Subset of PM_{2.5}
 - Over 40 known cancer-causing compounds
- Gaseous pollutants, including:
 - Volatile organic compounds
 - Oxides of nitrogen (NO_x)



<https://ww2.arb.ca.gov/resources/overview-diesel-exhaust-and-health>

<https://ww2.arb.ca.gov/resources/inhalable-particulate-matter-and-health>

Rail-Related Health Impact Analysis

- CARB estimates cases of adverse health outcomes related to PM_{2.5} exposure:
 - Cardiopulmonary mortality
 - Hospitalizations for cardiovascular & respiratory illnesses
 - ER visits for asthma

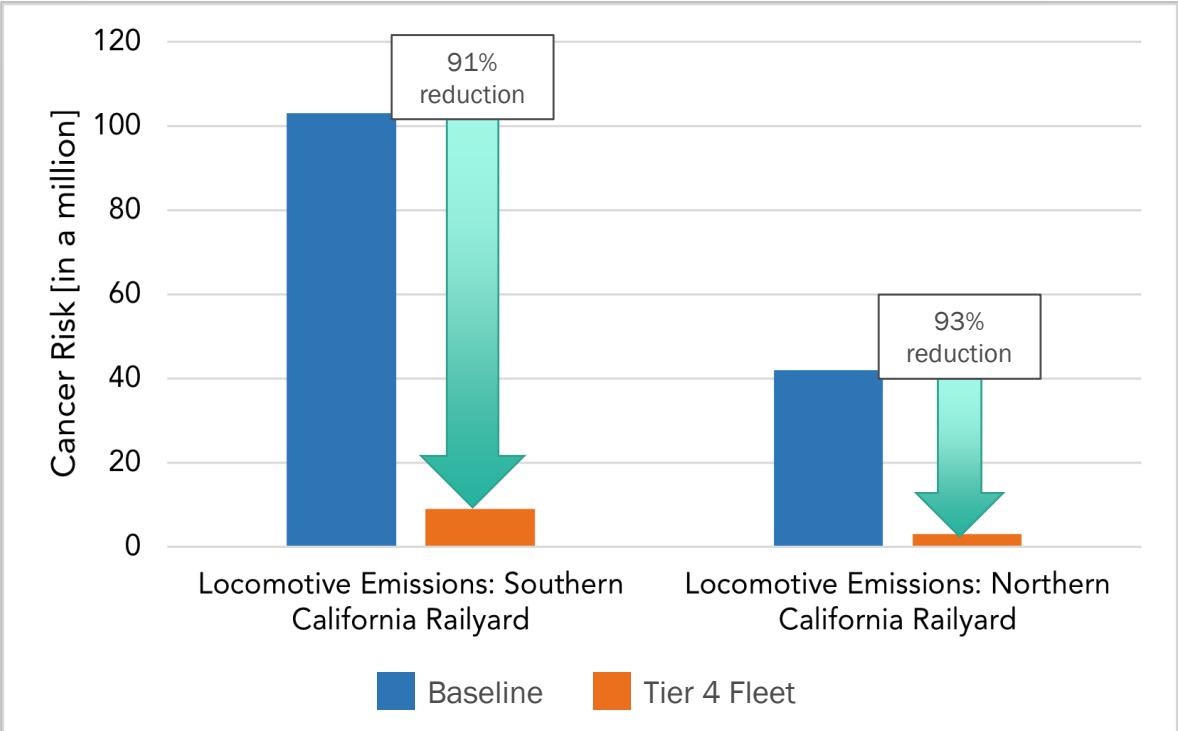
For more detail, please visit:

<https://ww2.arb.ca.gov/resources/documents/carbs-methodology-estimating-health-effects-air-pollution>

- Estimated burden of health impacts from CA locomotives (cumulative for 2020-2050, with business as usual, statewide):
 - 6,000+ deaths
 - 2,000+ hospitalizations
 - About 3,000 ER visits



Cancer Risk Reduction Near Railyards



In-Use Locomotive Regulation



Prioritize emission reductions in communities disproportionately impacted by locomotive emissions



Decrease locomotive emissions by increasing turnover to Tier 4 and cleaner locomotives



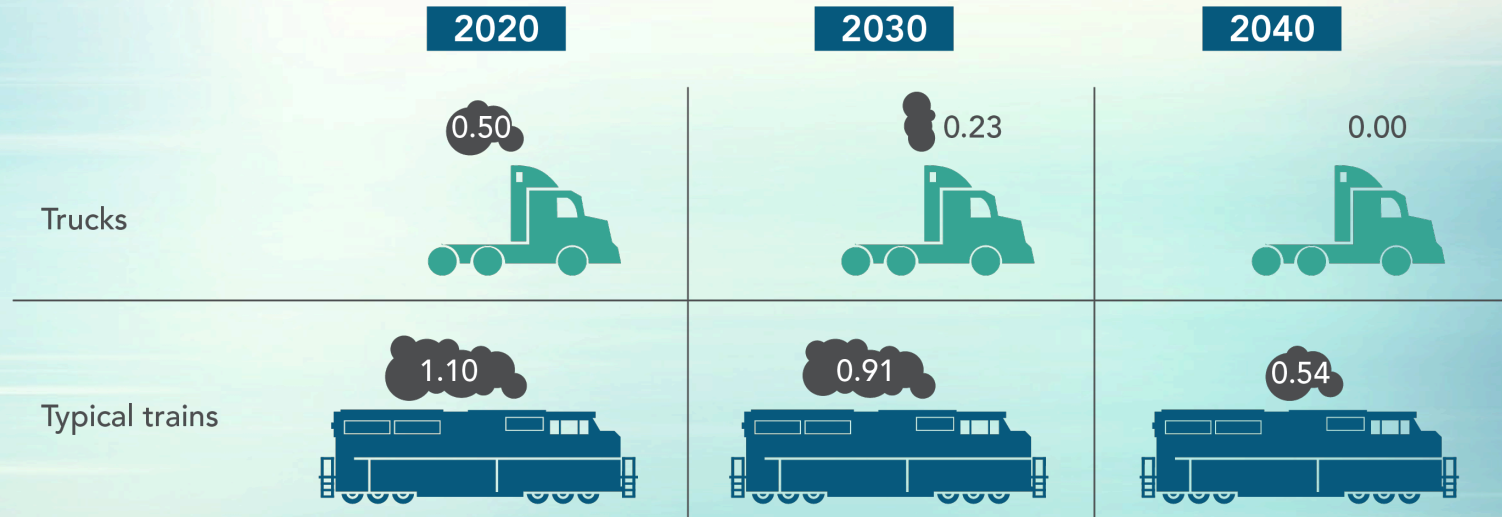
Move toward Zero Emission Locomotives in California

Emission Reduction by 2037 in 2022 State SIP Strategy



Truck Comparison

Total PM_{2.5} Emissions in Communities within 20 Miles of the Ports



PM_{2.5} emissions in pounds moving 260 containers 20 miles using average California trucks vs average locomotives in California.

Switchers

- Technologies
 - Battery Electric
 - Fuel Cell
- Demonstrations
 - Union Pacific:
 - Wabtec FLXswitch
 - Progress Rail EMD Joule
 - Pacific Harbor Line
 - Progress Rail EMD Joule
 - Sierra Northern Railway
 - Hydrogen Fuel Cell



Line Haul Locomotives

- Technologies
 - Hybrid Consist
 - Fuel Cell
- Demonstration
 - Wabtec FLXdrive
 - Canadian Pacific H20L
 - Caterpillar-BNSF-Chevron



Coordination



- Federal Agencies
- State Agencies
- Industry
 - Railroads
 - OEMs
- Passenger Agencies

Wabtec
 Home > Locomotive > Alternative Fuel Locomotives >

FLXdrive

Bringing together application expertise and performance optimization, Wabtec is developing a hybrid consist to save fuel and reduce emissions

Watch **Wabtec**

Home > Newsroom >

Wabtec and GM to Develop Advanced Ultium Battery and HYDROTEC Hydrogen Fuel Cell Solutions for Industry

FLXdrive is battery electric. Leveraging coupled with optimization demonstration fuel and re

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Progress Rail is proud to offer the EMD® Joule series of fully battery-powered locomotives, including the SD70J-BB model boasting more than double the energy storage of competing products.

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EMD® JOULE BATTERY ELECTRIC LOCOMOTIVES

Joule
 Battery-Electric Locomotive

GM to engineer and supply its Ultium battery and HYDROTEC hydrogen fuel cell systems for Wabtec freight locomotives

PITTSBURGH June 15, 2021 — Wabtec Corporation (NYSE:

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Sierra Northern

California Energy Commission awards Sierra Northern Railway Team nearly \$4,000,000 to test Hydrogen Switcher Locomotive

Now a Sierra Northern Zero-Emission Hydrogen Powered Switcher Ready for Service

Equipped with 200 kW Hydrogen Storage and 50 Storage Units

AMPS IS2-70 ZERO EMISSIONS SWITCHER

AMPS IS2-70 ZERO EMISSIONS SWITCHER AMPS legacy of innovation in rail and hybrid electric power generation has resulted in their latest product, the 100% battery electric IS2-70 zero emissions switcher...

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Caterpillar, BNSF and Chevron Agree to Pursue Hydrogen Locomotive Demonstration

December 14, 2021

SIEMENS

H2goesRail - project with

Together with Deutsche B

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Mile Marker: A Caltrans Performance Report, Issue 1, 2022 | All Aboard to the Future

All Aboard to the Future



Hydrogen power is coming down the track for California's rail fleet

Call to Action



- Unprecedented opportunity for ZE
- Widespread coordination among railroads, OEMs, and agencies is necessary
- Time is Now.