

Decarbonizing the Transportation Sector

This brief discusses key findings from the following report: Eleanor M. Hennessy, Madalsa Singh, Andrew Robert Berson, Inês L. Azevedo and Sarah D. Saltzer, "Pathways to Carbon Neutrality in California: Decarbonizing the Transportation Sector", Stanford Center for Carbon Storage and Stanford Carbon Removal Initiative, January 2023.

Direct emissions from the Transportation sector accounted for roughly 41% of California emissions in 2019. 70% of the direct emissions from the transportation sector are attributable to light duty vehicles and light duty trucks (LDVs and LDTs), while heavy heavy-duty vehicles (HDVs) account for 20%. Aviation, shipping, and rail account for 1%, 0.9%, and 0.4% respectively.

California has several ongoing policies including the Advanced Clean Cars II regulation which requires new passenger cars and light-duty trucks to be zero-emission by 2035. Similarly, CARB's Advanced Clean Truck Program requires all new medium- and HDVs sold in California to be zero-emission by 2035. Beginning in 2024, manufacturers seeking CARB certification for vehicles must achieve mandated annual sales percentages for medium- and heavy-duty ZEVs sold in California.

KEY FINDINGS

1. California needs to reduce emissions from the transportation sector, as transportation is the single largest contributing sector to the state's greenhouse gas emissions.
2. Sales of LDVs and LDTs may need to be 100% ZEVs starting immediately to meet full decarbonization of the ICE fleet by 2045.
3. As an alternative to requiring sales of new LDVs to be ZEV by 2035, if California were to start retiring all vehicles that are 11 years or older in 2023 and thereafter, the state could achieve a decarbonization of the fleet by 2045.
4. A simplified total cost of ownership analysis shows that the current trajectory of reducing battery costs and economies of scale will be sufficient to achieve cost parity between ICE and EVs.
5. Light heavy-duty trucks (LHD1 and LHD2) make up 59% of the HDV fleet and account for 26% of HDV CO₂e emissions, whereas heavy-heavy duty vehicles (T7, T7 OOS, T7 Port) make up 13% of the vehicle fleet and are responsible for 52% of HDV CO₂e emissions. T7 vehicles registered out of state or jointly registered in California and another state that drive within California make up only 5% of the HDV fleet and are responsible for 34% of heavy duty CO₂e emissions driven within the state. Thus, there is a need for a concerted effort between the state of California and other states to achieve a deep decarbonization of the HDV fleet.
6. Rapid growth in hydrogen demand is expected in some zero-emission scenarios. Total hydrogen demand will be between 1.5 and 4 Mt per year for the mixed and high hydrogen scenarios (HDV) and about 4 Mt per year (LDV) by 2045 for scenarios with high use of hydrogen in transportation.
7. Rapid growth in electricity demand is expected in all zero-emission scenarios. Total electricity demand could range from 55 to 90 TWh per year in mixed and high electrification scenarios for HDVs. A decarbonized and highly electrified LDV and LDT fleet by 2045 would require about 90 TWh per year. Emissions arising from increased electricity sector infrastructure are not included in this analysis.
8. The key conclusion from this work is that policy interventions will be needed to accelerate retirement of the existing vehicle stock and spur sales of ZEVs if decarbonization by 2045 is to be achieved.

