Title

Oregon Fleet Turnover and Technology Projections

Authors
Jamhar, Jameel
Fulton, Lewis
Murphy, Colin

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Prepared By:

Jameel Jamhar, Lewis Fulton, and Colin Murphy

Energy Futures Research Program, UC Davis Institute of Transportation Studies

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Background

The UC Davis Institute of Transportation Studies (ITS-Davis) has been contracted by the Oregon Department of Environmental Quality to produce modeling and analysis of their Clean Fuels Program (CFP) to support future policymaking. To that end, we are developing an Oregon version of the Fuel Portfolio Scenario Model, which has been used to produce analyses of California's Low Carbon Fuel Standard—a similar policy, which served as a model for the CFP—to allow robust analysis of a variety of policy, technology, and economic scenarios.[1] Fuel Portfolio Scenario Model requires projections of future fuel demand across all categories of transportation fuel (liquid, gaseous, and electric) for all relevant scenarios.[2,3] To that end, we apply the Transportation Transitions Model (TTM) to project future vehicle fleet composition and activity, to develop the required projections of future fuel demand.

This report documents the work done to develop TTM projections of Oregon's vehicle fleet and activity, as well as results from this effort. Future publications will document the development of the Fuel Portfolio Scenario Model–Oregon model and the analysis of CFP compliance under the scenarios described below.

Methods

The TTM was developed and is maintained at the ITS-Davis, has been applied in prior transportation decarbonization analyses,[4,5] and is applied here to the Oregon statewide road vehicle context. The TTM projects annual fleet stock, vehicle sales, vehicle miles traveled (VMT), fuel consumption, and CO_2 emissions for 10 categories of light-, medium-, and heavy-duty vehicles, from the base year of 2024 through 2050. The year 2019 is used as a historical reference point to validate the consistency of model inputs against observed fleet conditions prior to the disruptions associated with the COVID-19 pandemic and subsequent supply chain effects on new vehicle markets. All model outputs are calibrated against Oregon-specific data sources, including Department of Motor Vehicles (DMV) registration records and Oregon CFP reported consumption targets, to ensure that the base year representation of the fleet is empirically grounded before projections are extended forward.

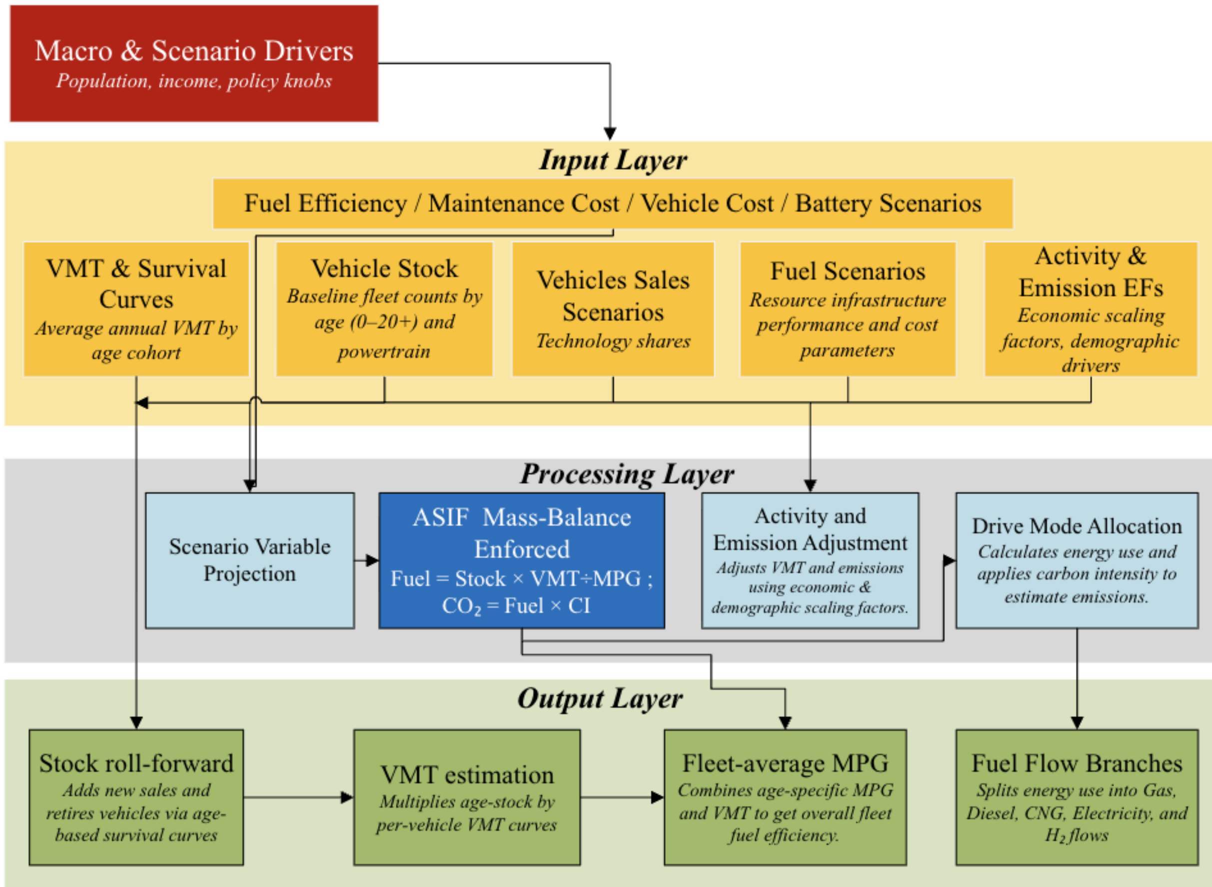


Figure 1: Transportation Transition Model (TTM) analytical framework. Three-layer workflow spanning input preparation, scenario processing, and output generation. Input layer components — including vehicle sales scenarios, VMT and survival curves, baseline vehicle stock, fuel scenarios, and activity and emission factors — feed into the processing layer, where scenario variable projection, ASIF mass-balance enforcement, activity and emission adjustment, and drive mode allocation are applied. The output layer generates annual fleet stock estimates through cohort roll-forward, VMT estimation, fleet-average MPG calculation, and fuel flow disaggregation across gasoline, diesel, compressed natural gas, electricity, and hydrogen pathways.

The TTM is a cohort-based stock-turnover framework that translates sales into stock levels, tracks stock aging and turnover, travel per vehicle, and energy use and emissions for different vintages. Thus, the TTM conceptualizes the vehicle fleet as a set of overlapping age cohorts, each defined by its model year of entry into the fleet. In each simulation year, the existing fleet is reduced by retiring vehicles according to age-specific survival probabilities, and new vehicle sales are added to the fleet according to externally specified technology adoption trajectories. This structure ensures that the full age distribution of the fleet is tracked continuously through time, which is essential for accurately computing fleet-wide fuel consumption and emissions, as both VMT and fuel efficiency vary systematically with vehicle age. The model is organized around an Activity–Stock–Intensity–Fuel (ASIF) carbon analytical backbone, in which total energy consumption in any given year is derived as the product of vehicle stock, per-vehicle VMT, and fuel energy intensity, with greenhouse gas emissions subsequently estimated by applying fuel- and electricity-specific carbon intensity factors. The TTM was rebuilt from a prior California spreadsheet application into a fully Pythonbased implementation for this study, yielding improvements in computational transparency, reproducibility, and maintainability relative to earlier spreadsheet-based versions. The framework can easily adapt to new data or amended policy assumptions without requiring structural changes to the core model logic, thanks to the codebase's modular design.

The modeling framework draws on several primary data sources to characterize the Oregon vehicle fleet and calibrate model inputs. Oregon Department of Motor Vehicles (DMV) registration records form the foundation of the base year fleet characterization. The creation of comprehensive fleet age distributions for both the light-duty and heavy-duty vehicle segments is made possible by these records, which include vehicle age, fuel type, and motive power classifications. Age-specific retirement probabilities from the California Air Resources Board's Emission Factor (EMFAC) model are combined with observed fleet retirement data from Oregon DMV records to create vehicle survival curves. Vehicle miles traveled inputs are sourced from EMFAC for the light-duty vehicle sector and from the EPA Motor Vehicle Emission Simulator (MOVES) Oregon database for the heavy-duty vehicle sector. Fuel consumption calibration targets are drawn from Oregon CFP 2024 reported values, which serve as the primary benchmark against which model energy demand outputs are validated prior to scenario projection.

Table 1: Primary data sources and their application within the Oregon TTM modeling framework

Data Source	What It Provides	Used For
Oregon DMV Registration Records	Vehicle age, fuel type, motive power classification	Base year fleet stock and age distribution
EMFAC (California Air Resources Board)	Age-specific survival curves, VMT by age cohort, new vehicle fuel economy	LDV survival curves, VMT inputs, fuel economy assumptions
EPA MOVES Oregon	Age-specific VMT fractions, HDV fuel economy, vehicle class distributions	HDV VMT inputs and fleet characterization
Oregon CFP 2024 Reported Values	Fuel consumption by fuel type (gasoline, ethanol, diesel, biodiesel, compressed natural gas, electricity)	Calibration benchmark for base year energy demand validation
NHTSA VIN Decoder	Individual vehicle drivetrain classification	Correcting plug-in hybrid vehicle misclassification in DMV records

Abbreviations: CFP, Clean Fuels Program; DMV, Department of Motor Vehicles; EPA, Environmental Protection Agency; HDV, heavy-duty vehicle; LDV, light-duty vehicle; NHTSA, Nationa Highway Traffic Safety Administration; VIN, vehicle identification number; VMT, vehicle miles traveled.

Table 2: Vehicle segments included in the oregon TTM fleet model.

Vehicle Segment	Description
Car	Passenger automobiles, including sedans, coupes, and hatchbacks registered for personal use
Light Truck	Light-duty trucks, SUVs, crossovers, and pickup trucks with a gross vehicle weight rating (GVWR) below 8,500 lbs
Long Haul	Class 7–8 heavy-duty combination trucks primarily engaged in interstate and long-distance freight movement
Short Haul	Class 7–8 heavy-duty combination trucks operating over shorter regional distribution corridors
MD Vocational	Class 4–6 medium-duty vehicles engaged in specialized commercial and service operations, including utility, construction, and municipal activities
MD Delivery	Class 4–6 medium-duty trucks engaged in last-mile and regional package and freight delivery operations
HD Vocational	Class 7–8 heavy-duty vehicles engaged in specialized vocational applications such as construction, utility service, and heavy commercial operations
Transit Bus	Heavy-duty buses operated within public urban transit systems
HD Pickup	Class 2b and 3 heavy-duty pickup trucks and vans with a GVWR over 8,500 lbs, used for both commercial and personal purposes

Prior to scenario projection, a series of data quality checks were performed on the Oregon DMV registration records to ensure the accuracy of base year fleet composition inputs. This procedure revealed a discrepancy in the DMV dataset's classification of plug-in hybrid electric vehicles (PHEVs), where a portion of PHEV registrations were misclassified as a result of unclear motive power coding. The National Highway Traffic Safety Administration (NHTSA) Vehicle Identification Number (VIN) decoding database was used to cross-validate these records.[6] This database offered authoritative drivetrain classification at the individual vehicle level, enabling the correction of misclassified records before model initialization. Additionally, inspection of the fleet age distribution revealed a higher-than-expected share of older vehicles in the pickup truck segment relative to other vehicle classes. To account for this, the EMFAC-derived survival curves for the pickup segment were adjusted to better reflect the observed age structure in the Oregon DMV data.

Scenario Definitions

The modeling framework is applied across four policy scenarios that span a range of plausible technology adoption trajectories for Oregon's vehicle fleet through 2050. All scenarios share a common base year of 2025 and diverge from that point based on differing assumptions regarding the pace of electrification, the stringency of regulatory targets, and the degree to which federal and state clean vehicle policies are implemented. The scenarios were developed in collaboration with the Oregon Department of Environmental Quality and are intended to bound the range of potential outcomes relevant to the state's ongoing clean transportation rulemaking process.

1. Business as Usual (BAU)

   The BAU scenario represents a reference case in which current market trends continue without additional policy intervention beyond regulations already in place as of the base year. The scenario was calibrated to Oregon DMV 2024 registration data and validated against Oregon Clean Fuels Program 2024 reported fuel consumption targets, achieving agreement within across all major fuel types. New vehicle sales shares in the base year 2025 are anchored to observed market conditions; passenger car sales comprise 68% internal combustion engine vehicles (ICEVs), 23% hybrid electric vehicles (HEVs), 8% battery electric vehicles (BEVs), and 1% PHEVs; light trucks comprise 64% ICE, 22% HEV, 8% BEV, and 5% PHEV.

   On-road fuel economy and travel per vehicle assumptions are reported in Appendix Tables B1 and B2. Beyond 2027, BAU sales shares evolve by continuation of current trend lines without additional regulatory pressure. Under this trajectory, ICEVs remain dominant across both light- and heavy-duty sectors. Passenger car and light truck zero-emission vehicle (ZEV) (defined as BEVs, PHEVs, and fuel cell electric vehicles) shares reach only 20% and 18% by 2050 respectively, while heavy-duty ZEV penetration remains negligible across most segments, with long-haul, vocational, and pickup trucks all below 8% ZEV sales share by 2050. Transit buses see higher BEV uptake at 40%, reflecting existing public fleet procurement trends already underway.

2. DEQ Low

   Department of Environmental Quality (DEQ) Low reflects the lower bound of Oregon DEQ's projected clean vehicle adoption pathway based on a more conservative estimate of possible market adoption of ZEVs. Passenger car and light truck ZEV shares reach 34.0% and 28.0% by 2050 respectively. Across all heavy-duty segments except transit buses, ZEV sales shares converge to 25% by 2050, driven primarily by BEV, with conventional fuels retaining the majority of new sales across haul, vocational, delivery, and pickup segments.

3. DEQ High

   DEQ High represents the upper bound of Oregon DEQ's projected adoption pathway, based on a less conservative estimate of potential market adoption of electric vehicles and PHEVs. Passenger car ZEV shares reaches 57% by 2050 with BEV at 52%, and light truck ZEV share reaches 47%. All heavy-duty ZEV sales shares except buses reaches 42% across all segments by 2050, with fuel cell vehicles contributing more meaningfully in long-haul, heavy-duty vocational, and heavy-duty pickup applications where energy intensity favors hydrogen.

4. ACC2 Delayed

   ACC2 Delayed is based on California's Advanced Clean Cars II regulation, which mandates 100% zero-emission new light-duty vehicle sales by 2035 (of which 20% may be PHEVs) and which Oregon has adopted under its authority under Clean Air Act Section 177 to follow California emissions standards.[7–9] The scenario reflects a delayed implementation trajectory relative to the original California timeline due to recent federal regulatory uncertainty. For the light-duty sector, ICEV sales phase out entirely by 2040, five years behind the original California mandate with both passenger cars and light trucks reaching 100% ZEV sales share at that point. In the heavy-duty sector, all segments including long-haul, short-haul, medium- and heavy-duty vocational, medium-duty delivery, transit bus, and heavy-duty pickup reach a 100% ZEV sales share by 2045.

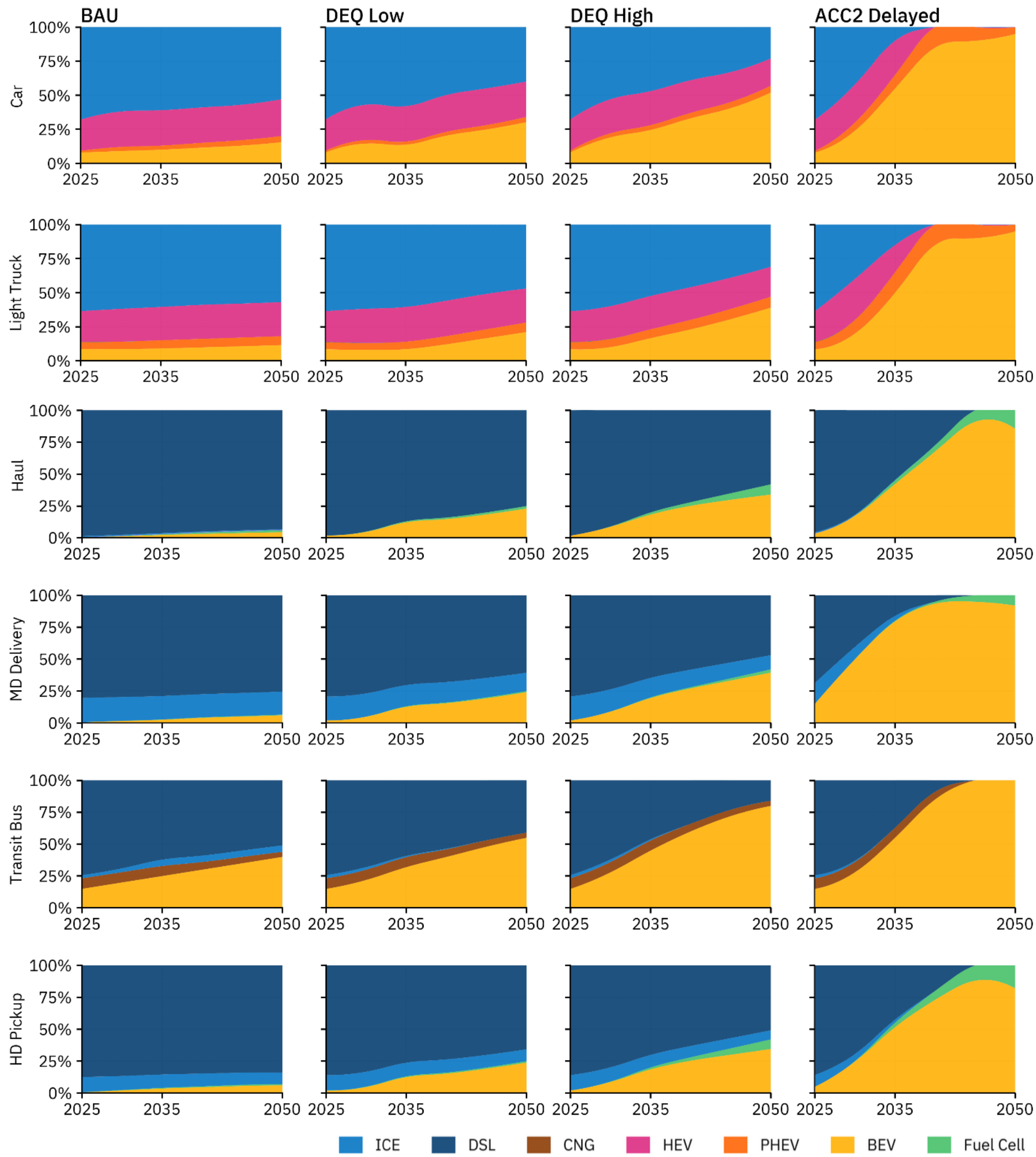


Figure 2 : New vehicle sales share by technology and scenario across all vehicle segments. (ICE, internal combustion engine; DSL, diesel; CNG, compressed natural gas) Each panel shows the annual share of new sales by powertrain type under the four scenarios—BAU, DEQ Low,

DEQ High, and ACC2 Delayed—for passenger cars, light trucks, haul trucks, medium-duty delivery, transit buses, and heavy-duty pickups.

Results

Light Duty Vehicles

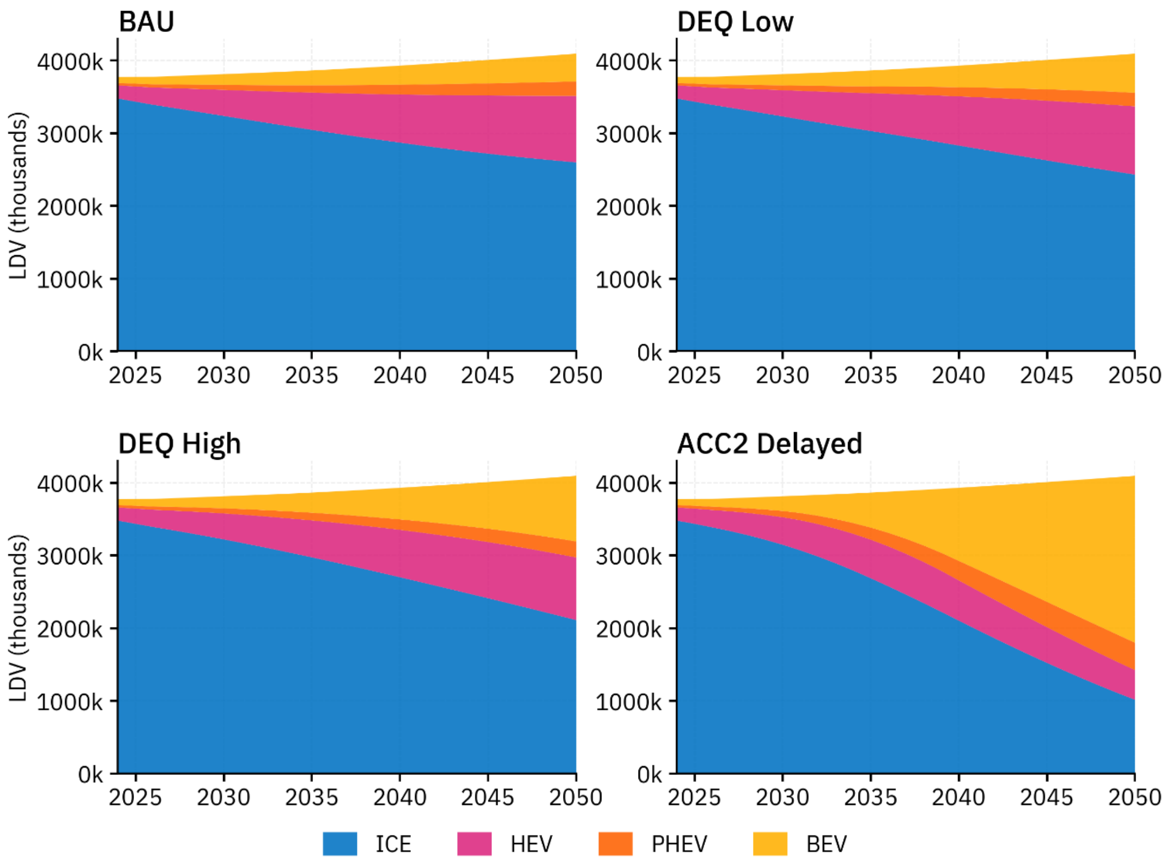


Figure 3: Light-duty vehicle fleet stock by powertrain technology and scenario, 2025–2050 (thousands of vehicles)

Oregon's light-duty vehicle fleet totals approximately 3.7 million registered vehicles in the base year 2025, comprising roughly 46% passenger cars and 54% light trucks—a composition that reflects the broader national shift toward SUVs and crossovers that has accelerated over the past decade. This ratio widens progressively through the projection period, with light trucks growing to represent over 70% of the combined light-duty vehicle fleet by 2050 across all scenarios. In 2025, ICEVs account for 91% of total fleet stock, with hybrid electric vehicles (HEVs) at 6%, plug-in electric hybrids (PHEV) at 1%, and battery electric vehicles (BEVs) at approximately 2%. Despite scenario differences in new sales assumptions, the fleet composition in the near term remains largely similar across all four scenarios owing to the slow turnover rate of the existing stock.

The divergence across scenarios becomes pronounced only as the fleet turns over through the 2030s and 2040s. Under the Business as Usual scenario, ZEV stock share reaches only 14% by 2050, with BEVs accounting for 9% of the total fleet. DEQ Low and DEQ High achieve ZEV stock shares of 18% and 27% respectively by 2050, while the ACC2 Delayed scenario produces the most dramatic transformation, reaching a 65% ZEV stock share by 2050, with BEVs alone accounting for 56%.

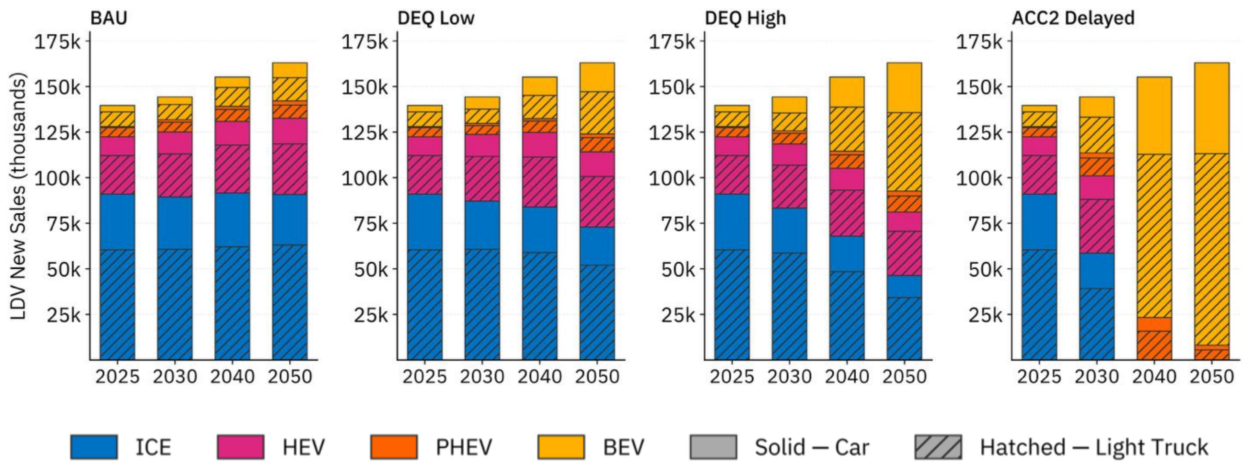


Figure 4 : Annual new LDV sales by powertrain technology and scenario, 2025–2050, with solid fills representing passenger car sales and hatched fills representing light truck sales (thousands of vehicles).

On the annual sales side, new vehicle sales in Oregon are estimated at approximately 140,000 to 160,000 units per year, split roughly evenly between cars and light trucks. In 2025, BEV new sales share stood at 8% for cars and 9% for light trucks. Under the Business as Usual scenario, BEV sales shares grows slowly reaching only 13% of combined light-duty vehicle sales by 2050. DEQ High pushes BEV sales to 43% of new light-duty sales by 2050, while ACC2 Delayed mandates a full ZEV sales transition by 2040, at which point ICEV and HEV sales reach zero, and BEV accounts for 85% of new sales with the remainder being PHEV. The HEV segment plays a transitional role across all non-ACC2 scenarios, maintaining a sustained sales share of 22% to 27% through the 2030s before gradually declining as BEV cost and range competitiveness improves in the later projection years.

Medium- and Heavy-Duty Vehicles

Oregon's combined medium- and heavy-duty vehicle fleet totals approximately 339,000 registered vehicles in the base year 2025. The fleet composition is heavily skewed toward heavy-duty pickups, which account for 70% of total medium- and heavy-duty vehicle stock in 2025 reflecting the large number of work-related pickup trucks registered in Oregon. Long haul combination trucks represent the next largest segment at 9%. Transit buses, vocational vehicles, and medium-duty delivery trucks collectively represent a small but policy-relevant share of the fleet. In 2025, conventional fuels accounted for essentially 99% of the medium- and heavy-duty vehicle fleet across all scenarios, with the sole exception of transit buses, which already carry 5% ZEV stock from prior public fleet procurement. Total medium- and heavy-duty vehicle fleet size grows modestly from 339,000 to 405,000 vehicles by 2050 across all scenarios.

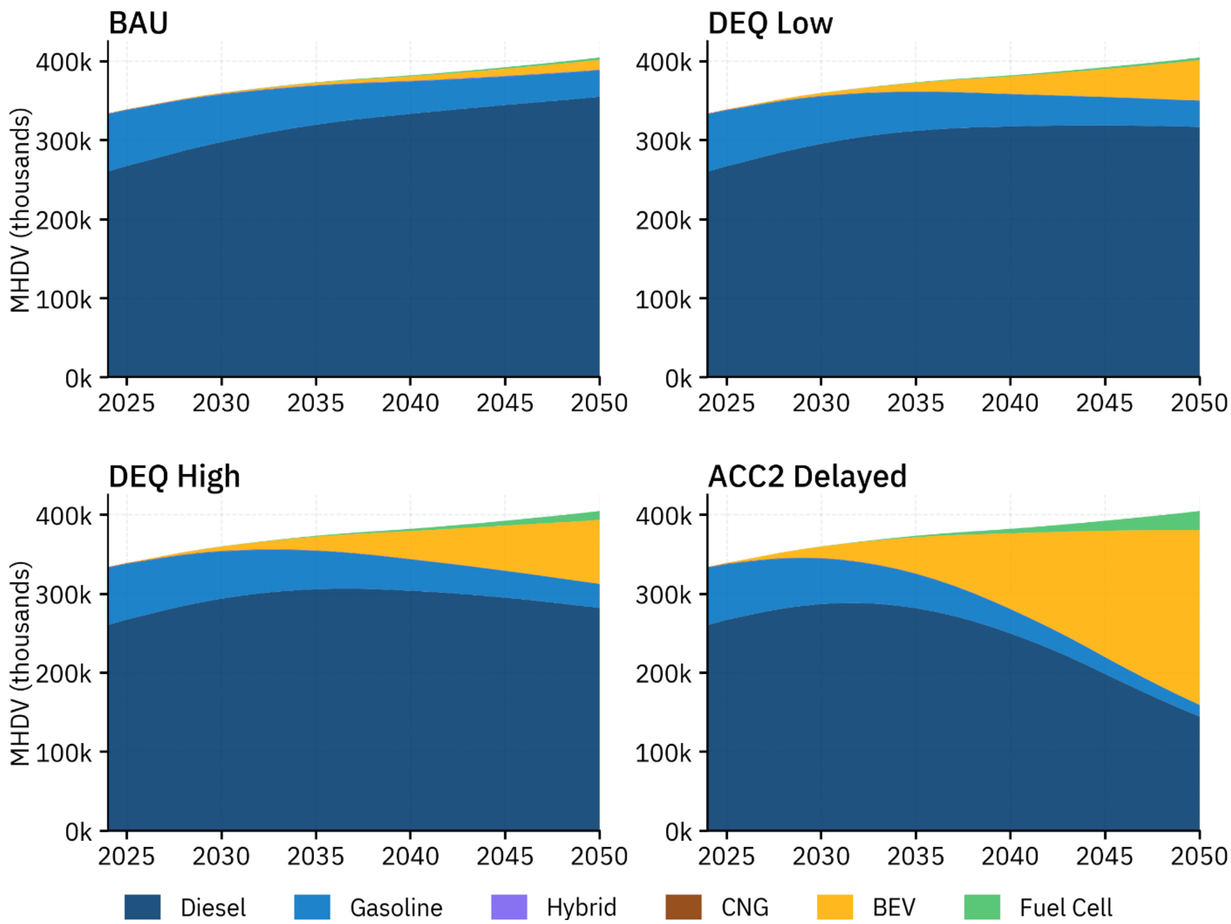


Figure 5 : Medium and Heavy-duty vehicle fleet stock by powertrain technology and scenario, 2025–2050 (thousands of vehicles).

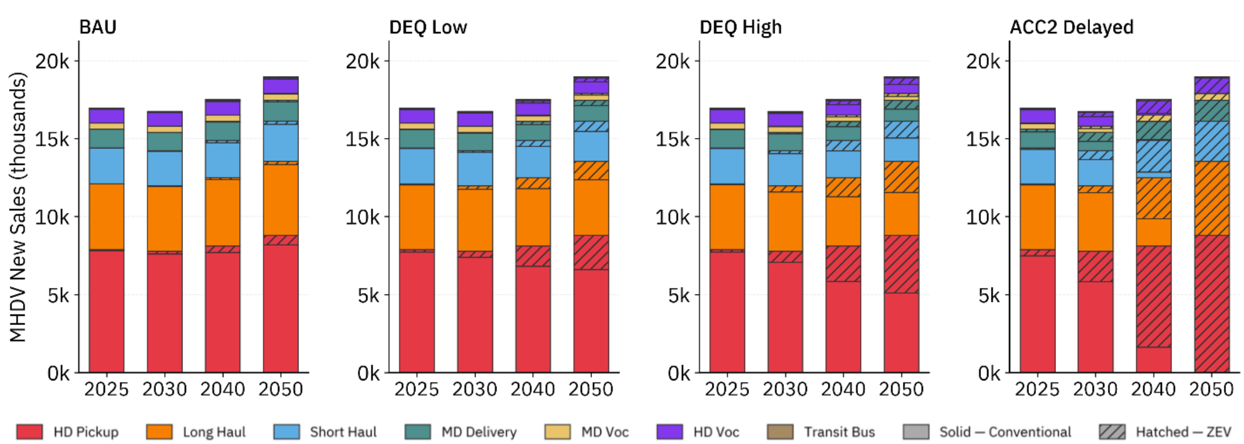


Figure 6: Annual new MHDV sales by vehicle segment and scenario, 2025–2050, with solid fills representing conventional powertrain sales and hatched fills representing zero-emission vehicle sales (thousands of vehicles). (HD, heavy duty; MD, medium duty; Voc, vocational)

Scenario divergence in ZEV stock penetration is gradual through 2035 but accelerates sharply in the 2040s. Under the Business as Usual scenario, the ZEV stock share across the combined medium- and heavy-duty vehicle fleet reaches only 4% by 2050, with diesel remaining dominant at 88% of the total stock. DEQ Low achieves a 13% ZEV stock share by 2050, while DEQ High reaches 23%. The ACC2 Delayed scenario produces the most transformative outcome—a 61% ZEV stock share by 2050, with BEVs accounting for 55% and fuel cell vehicles for 6%. Diesel is substantially displaced under ACC2, declining from 79% to 36% of total medium- and heavy-duty vehicle stock by 2050, with the heavy-duty pickup stock alone shedding approximately 89,000 diesel vehicles over the projection period.

Fuel cell vehicles play a more meaningful role in the heavier freight segments than elsewhere, particularly in applications where battery weight penalties and long refueling times make hydrogen an operationally attractive alternative. Across long-haul trucks, fuel cells represent 17% of ZEV new sales by 2050 under ACC2, and contribute meaningfully in heavy-duty vocational (14%) and heavy-duty pickup (18%) in the same scenario. In contrast, medium-duty delivery, medium-duty vocational, and transit buses remain overwhelmingly BEV-dominated within their ZEV mix. The fuel cell trajectories modeled here reflect a moderated adoption pathway relative to earlier projections due to recent uncertainty around federal hydrogen infrastructure funding and the rollback of key clean energy provisions.

Conclusions

This report has documented the application of the Transportation Transitions Model to Oregon's on-road vehicle fleet, projecting stock, sales, and technology composition from 2024 through 2050 across four policy scenarios developed with the Oregon Department of Environmental Quality. The model was initialized on Oregon DMV registration records, calibrated against Clean Fuels Program reported values, and applied consistently across scenarios that differ only in the assumed technology composition of new vehicle sales.

The results are governed throughout by fleet inertia. Near-term fleet composition is nearly identical across all four scenarios despite substantial divergence in their sales assumptions, and differences emerge only as turnover proceeds through the 2030s and 2040s. This lag is clearest under ACC2 Delayed. Although new light-duty sales become entirely zero-emission from 2040 and heavy-duty sales from 2045, ZEVs still constitute only 65% of light-duty and 61% of medium- and heavy-duty stock by 2050. Under less aggressive trajectories, the ZEV percentages remain even lower, with light-duty ZEV stock reaching 14% under Business as Usual, 18% under DEQ Low, and 27% under DEQ High, and 4%, 13% and 23%, respectively, for medium- and heavy-duty vehicles. Because the fleet also grows over the period, absolute conventional vehicle counts decline more slowly than these shares suggest.

These projections form the input to the next stage of this work, in which the Fuel Portfolio Scenario Model will be applied to Oregon to project fuel demand and assess Clean Fuels Program compliance under each scenario. Fuel consumption, CFP credit market impacts, and greenhouse gas results will be documented in that subsequent publication.

Acknowledgements

This work was supported by the Oregon Department of Environmental Quality under grant #031-26.

References

1. Brown, A. L. *et al.* Driving California's Transportation Emissions to Zero. https://doi.org/10.7922/G2MC8X9X (2021) doi:10.7922/G2MC8X9X.

2. Ro, J. W., Murphy, C. W. & Wang, Q. Fuel Portfolio Scenario Modeling (FPSM) of 2030 and 2035 Low Carbon Fuel Standard Targets in California. https://doi.org/10.7922/G2S46Q8C (2023) doi:10.7922/G2S46Q8C.

3. Murphy, C. W. & Ro, J. W. Updated Fuel Portfolio Scenario Modeling to Inform 2024 Low Carbon Fuel Standard Rulemaking. https://doi.org/10.7922/G25719BV (2024) doi:10.7922/G25719BV.

4. Ramji, A., Fulton, L. & Sperling, D. Sustainable EV Market Incentives: Equitable Revenue-Neutral Incentives for Zero-emission Vehicles in the United States. https://escholarship.org/uc/item/6qx2x5zz.

5. Miller, M., Fulton, L., Yang, H., Zhao, J. & Burke, A. Technology and Fuel Transition Scenarios to Low Greenhouse Gas Futures for Cars and Trucks in California to 2050. https://escholarship.org/uc/item/40k5w5h9.

6. United States Department of Transportation. NHTSA Product Information Catalog and Vehicle Listing - Home. https://vpic.nhtsa.dot.gov/.

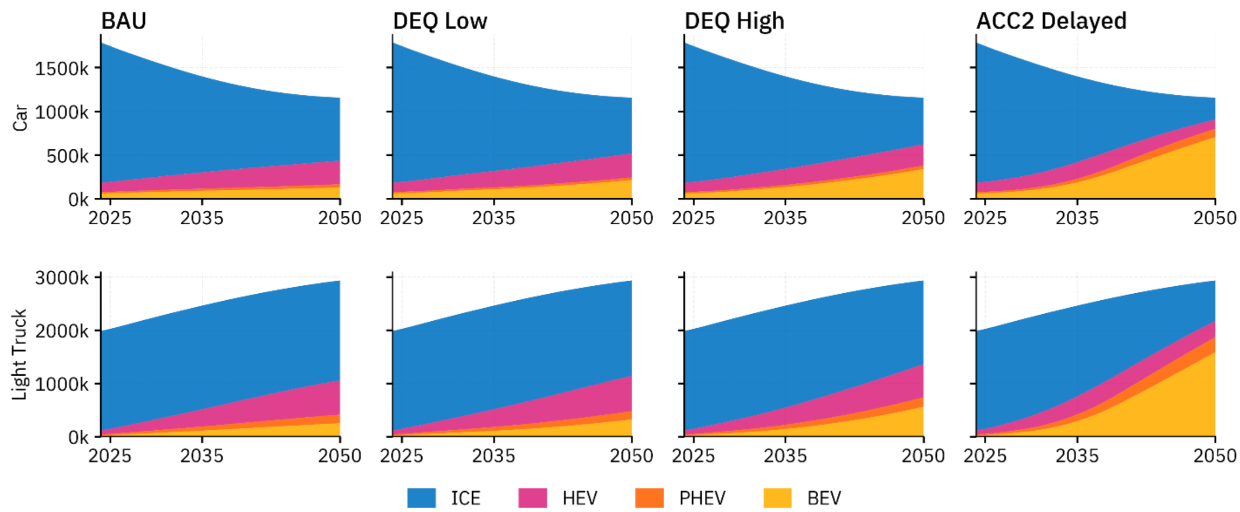
7. CARB. California moves to accelerate to 100% new zero-emission vehicle sales by 2035. https://ww2.arb.ca.gov/news/california-moves-accelerate-100-new-zero-emission-vehicle-sales-2035.

8. Congress. Clean Air Act: A Summary of the Act and Its Major Requirements. https://www.congress.gov/crs-product/RL30853.

9. CARB. Advanced Clean Cars II | California Air Resources Board. https://ww2.arb.ca.gov/our-work/programs/advanced-clean-cars-program/advanced-clean-cars-ii (2023).

Appendix

Disaggregated fleet stock by vehicle segment and powertrain technology is provided here for reference, separating light-, medium-, and heavy-duty trucks across all four scenarios from 2025 to 2050.



. Light-duty vehicle fleet stock disaggregated by segment—passenger cars (top) and light trucks (bottom)—by powertrain technology and scenario, 2025–2050 (thousands of vehicles).

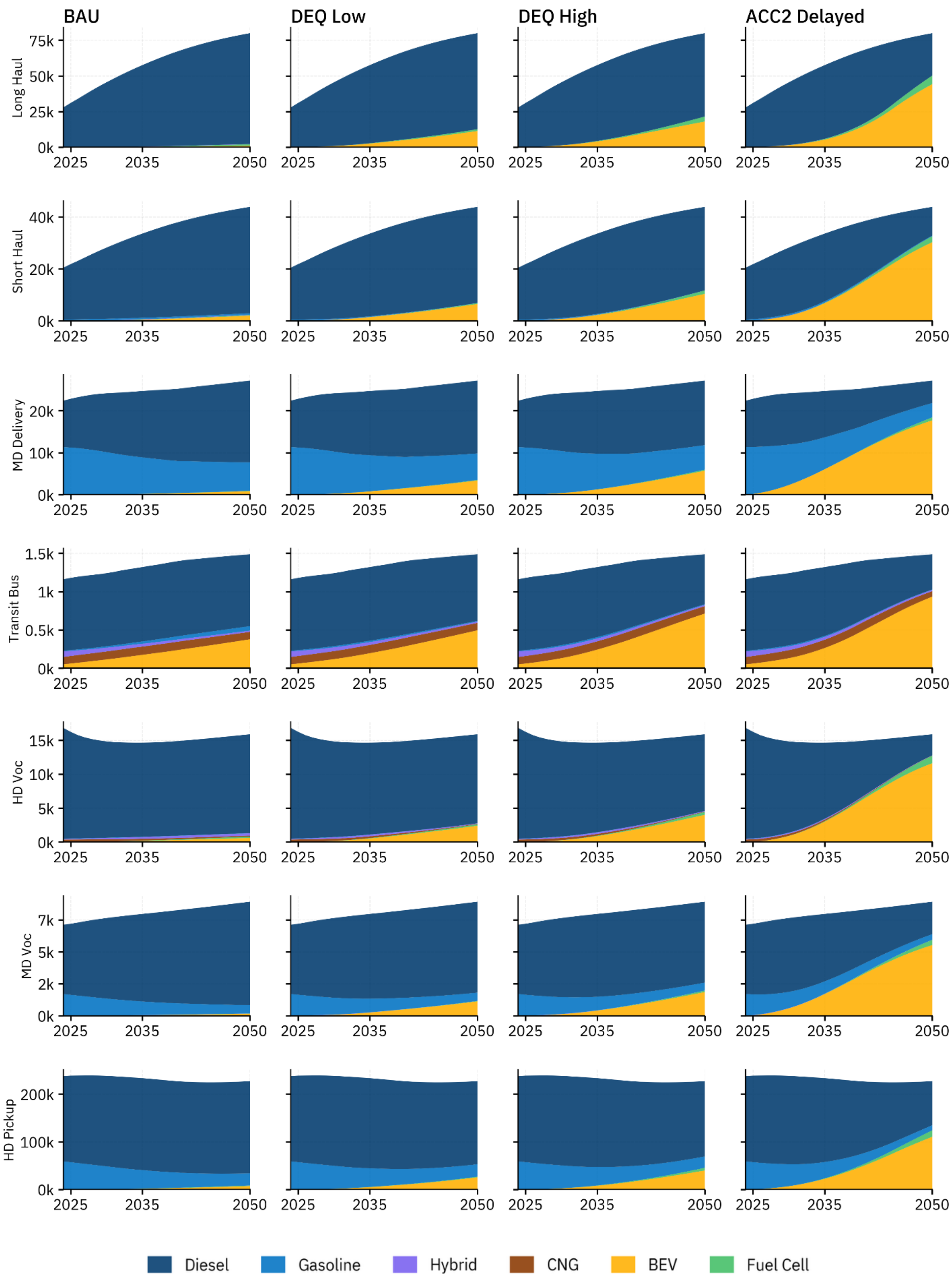


Figure 7. Medium- and heavy-duty vehicle fleet stock disaggregated by vehicle segment and powertrain technology across four scenarios, 2025–2050 (thousands of vehicles)

The technology and activity assumptions underlying the projections are summarized below. Table B1 reports new vehicle fuel economy by segment and powertrain in 2025 and 2050, given as ICEV, hybrid, and BEV for light-duty vehicles, and as diesel, gasoline, and battery electric for medium- and heavy-duty vehicles. Values are on-road rather than laboratory-rated and are expressed in miles per gallon for liquid fuels and miles per gallon equivalent for electricity. These assumptions are common to all four scenarios; the scenarios differ only in the technology composition of new vehicle sales. Table B2 reports annual travel per vehicle by age, drawn from EMFAC for light-duty segments and from the EPA MOVES Oregon database for medium- and heavy-duty segments. Travel generally declines with vehicle age, so fleet-average travel per vehicle varies across the projection period as a consequence of changes in the age composition of the stock rather than any change in the underlying curve.

Table 3: New vehicle fuel economy by segment and powertrain, 2025 and 2050. (Each set of three values reported are percentages of ICEV, hybrid electric vehicles, BEV for light-duty vehicles; and diesel, gasoline, and BEV for medium- and heavy-duty vehicles.)

Vehicle segment	Fuel economy, 2025	Fuel economy, 2050
Passenger car	49 / 64 / 118	63 / 81 / 168
Light truck	36 / 33 / 76	46 / 48 / 109
Long haul	6.8 / 6.7 / 16	8.7 / 8.9 / 19
Short haul	5.8 / 5.9 / 20	7.0 / 7.0 / 24
MD delivery	8.6 / 8.0 / 35	10.3 / 9.5 / 42
MD vocational	9.3 / 8.6 / 35	11.4 / 10.5 / 43
HD vocational	4.3 / 6.0 / 15	5.2 / 7.0 / 18
Transit bus	4.9 / 7.6 / 16	5.9 / 8.3 / 19
HD pickup	18 / 18 / 76	25 / 25 / 102

Table 4: Annual travel per vehicle by age by year and segment

Vehicle segment	Age 0	Age 5	Age 10	Age 15	Age 20	Age 20+
Passenger car	16,024	10,457	8,577	7,419	6,586	5,677
Light truck	16,513	11,346	9,600	8,517	7,721	6,892
Long haul	87,646	74,469	45,091	28,835	28,174	28,067
Short haul	48,446	45,835	45,715	35,840	31,383	27,406
MD delivery	27,620	22,530	16,246	12,121	12,962	12,568
MD vocational	6,373	5,900	5,303	4,720	4,716	4,710
HD vocational	18,973	17,922	15,736	15,364	16,527	15,622
Transit bus	20,177	20,452	23,101	12,010	11,033	11,842
HD pickup	18,183	13,293	10,587	8,900	7,676	6,601