

A RECENT PROFILE OF MOTOR VEHICLE CHARACTERISTICS IN METROPOLITAN WASHINGTON

Analysis of 2023 Vehicle Registration Data

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Presentation Purpose – Why Now?

- Vehicle registration data, a.k.a. vehicle identification number (VIN) data, provide information about the composition of the current motor vehicle fleet in metropolitan Washington and are used to create key inputs for COG’s mobile emissions model (MOVES)
- TPB staff periodically obtains vehicle registration data from departments of motor vehicles through the state air agencies and COG’s Dept. of Environmental Programs (DEP) to ensure that MOVES inputs are current for the purposes of emissions forecasting
- Recently obtained 2023 vehicle registration data will be used for:
 - Upcoming air quality conformity analysis of Visualize 2050 Long-Range Transportation Plan (ozone-season pollutants)
 - Greenhouse gas (GHG) analyses
 - Upcoming State Implementation Plan (SIP) activities related to the 2015 National Ambient Air Quality Standards (NAAQS) for ozone



Presentation Outline

- Background
 - Why are Vehicle Characteristics Important?
 - What are Vehicle Registration Data?
 - History of Vehicle Registration Data Analysis
 - Study Area
- Analysis of 2023 Data
 - Regional Trends
- Key Findings
- Next Steps



Background



Why are Vehicle Characteristics Important?

- The **size, composition** and **age** of the vehicle fleet are important determinants of mobile source emissions calculations
- The current mobile emissions model (EPA's MOVES4) requires two key vehicle-related inputs to be specified by jurisdiction, obtained from vehicle registration data:
 - The number of vehicles by 13 vehicle classes
 - The age distribution by vehicle class



What are Vehicle Registration Data?

- A complete inventory of private, public, and commercial registered motor vehicles maintained by departments of motor vehicles (DMVs) at a specific point in time
- Data are obtained for specific jurisdictions that comprise the Ozone Nonattainment Area
- Registration data can be viewed as a list of Vehicle Identification Numbers (or “VINs”)



What are Vehicle Identification Numbers (VINs)?

- Can be viewed as the “fingerprint” of each vehicle
- A standardized 17-character code that, when decoded with decoding software, indicates the characteristics of each vehicle including manufacturer, model year, engine type, weight, vehicle type, and fuel type
- VINs were standardized in 1981 by the National Highway Traffic Safety Administration (NHTSA)
- *VIN data analysis requires substantial staff effort:*
 - *data cleaning*
 - *decoding*
 - *software and technical analysis*



History of TPB Staff's Vehicle Registration Data Analysis

- Vehicle registration data have been collected and analyzed since 2008
- Previous registration data collections corresponded to:
 - July 1, 2008
 - July 1, 2011
 - July 1, 2014
 - December 31, 2016
 - December 31, 2020 for Maryland and Virginia; July 1, 2020 for the District of Columbia
- Current data presented today:
 - December 2023 for Virginia and the District of Columbia, and January 2024 for Maryland



History of TPB Staff's Vehicle Registration Data Analysis (Cont.)

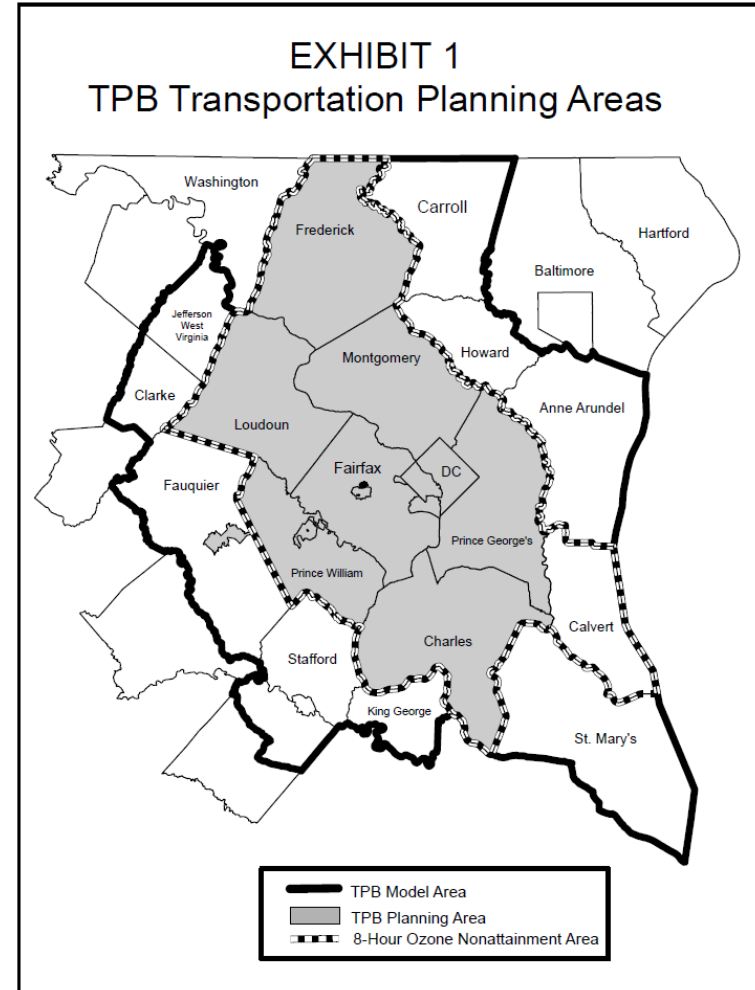
- Some of the state air agencies have adopted a year-end data collection cycle as opposed to a July 1 data collection cycle that had been implemented prior to 2016
- The analysis of December data may introduce some bias when comparing to prior July data
- July 2020 dataset was selected for the District of Columbia (rather than December 2020), because the District Department of Energy and Environment staff noted that the December 2020 dataset was a less representative dataset due to a backlog in processing of vehicle registrations in the District in the second part of 2020 due to the COVID-19 restrictions
- The 2023 VIN data were collected at nearly the same point in time in all states



Study Area

VIN data are collected for the **Ozone Nonattainment Area** (dashed line on map):

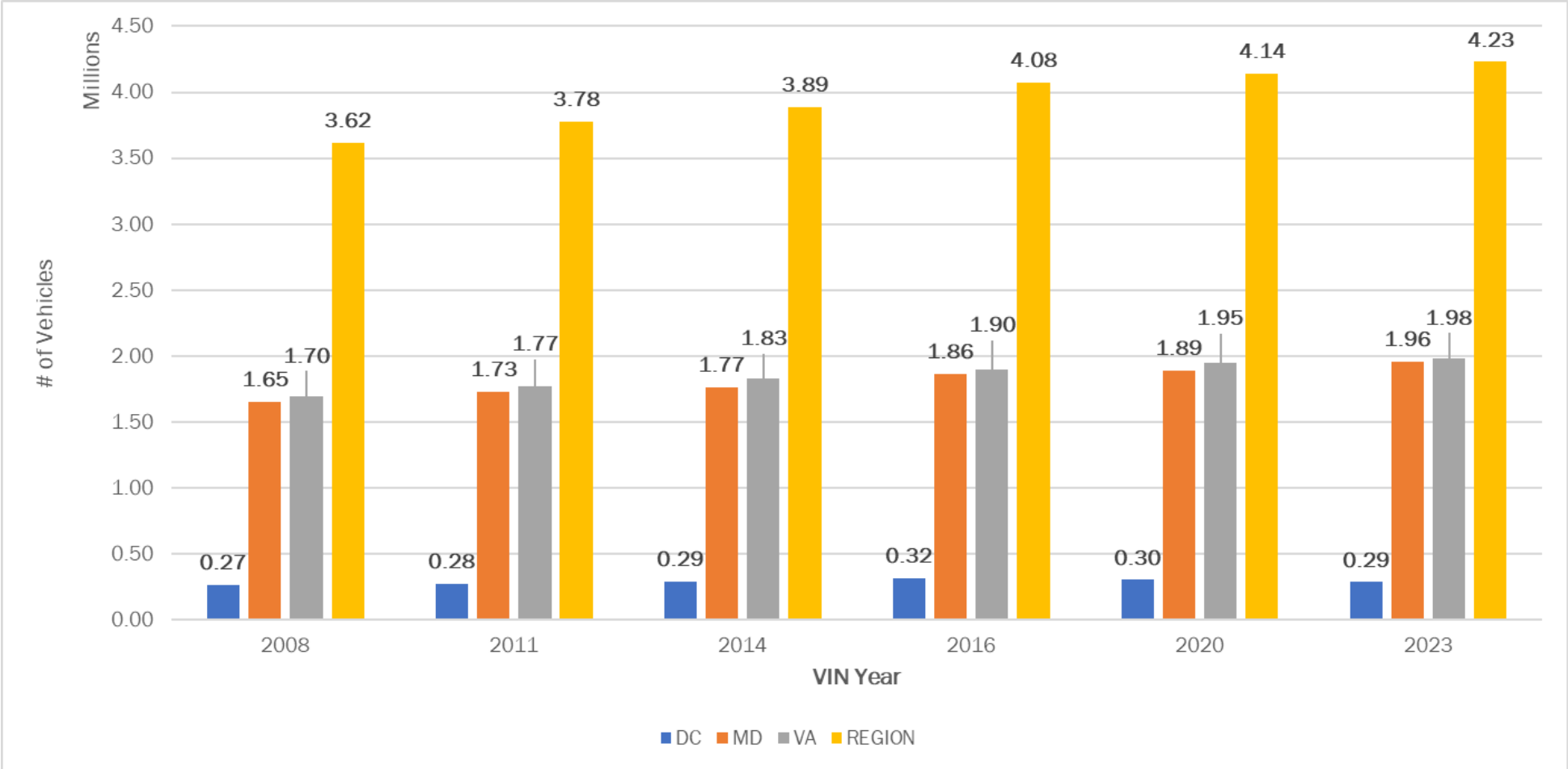
- District of Columbia
- Maryland:
 - Calvert County
 - Charles County
 - Frederick County
 - Montgomery County
 - Prince George's County
- Virginia:
 - Arlington County
 - City of Alexandria
 - Fairfax County and Cities
 - Loudoun County
 - Prince William County and Cities



Analysis of 2023 Data



Vehicle Growth over Time by State



* Based on Cleaned Total DMV Records



Historical Changes in Average Vehicle Age

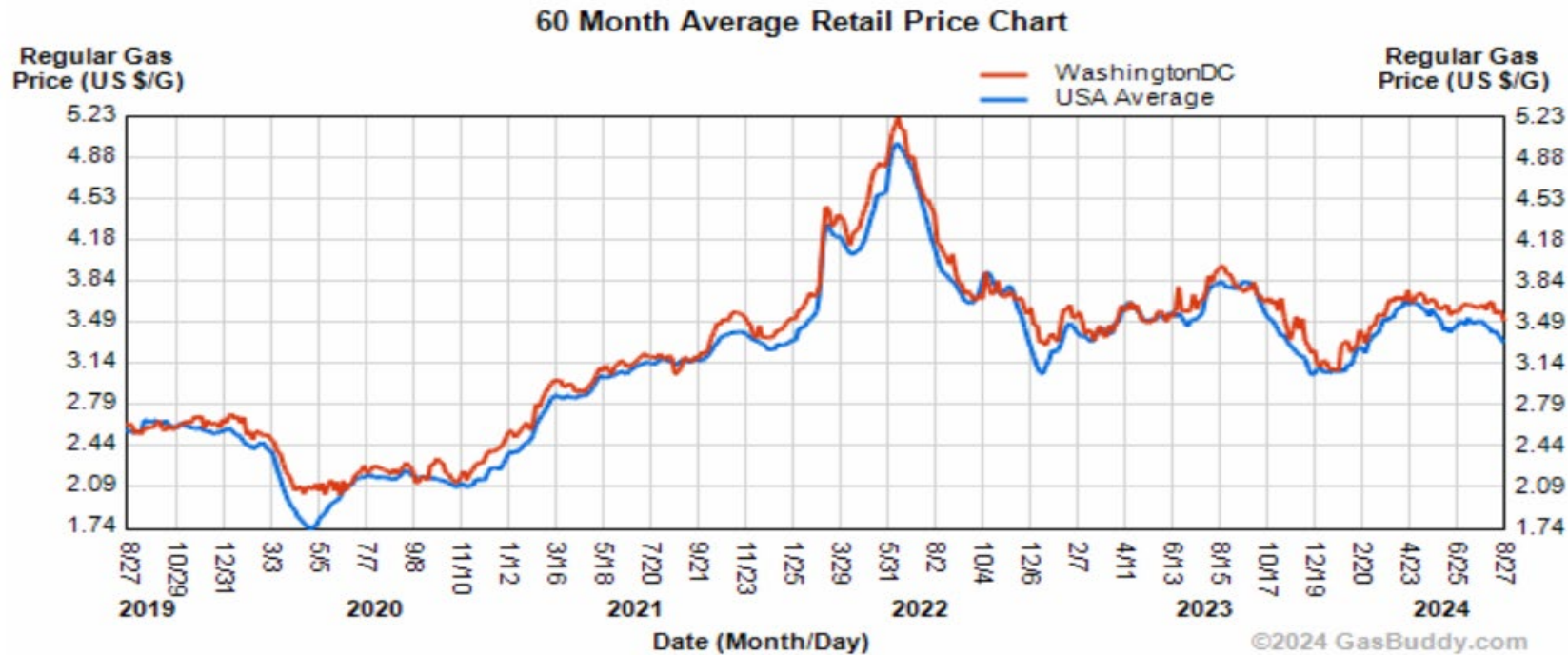
- Average vehicle age continues to increase
- Average vehicle age for All Vehicle Types combined in 2023 is the highest among all VIN analysis years

Average Age of the Regional Vehicle Fleet by VIN Year

Year	Light-duty Cars/Motorcycles	Light-duty Trucks	Heavy-duty Vehicles/Buses	All Vehicle Types
2008	8.51	7.53	9.21	8.18
2011	9.25	8.55	10.56	9.05
2014	9.62	9.09	11.30	9.49
2016	9.32	8.68	11.29	9.16
2020	10.05	8.74	11.51	9.51
2023	11.04	8.87	12.07	9.97



Historical Retail Gas Prices by Year

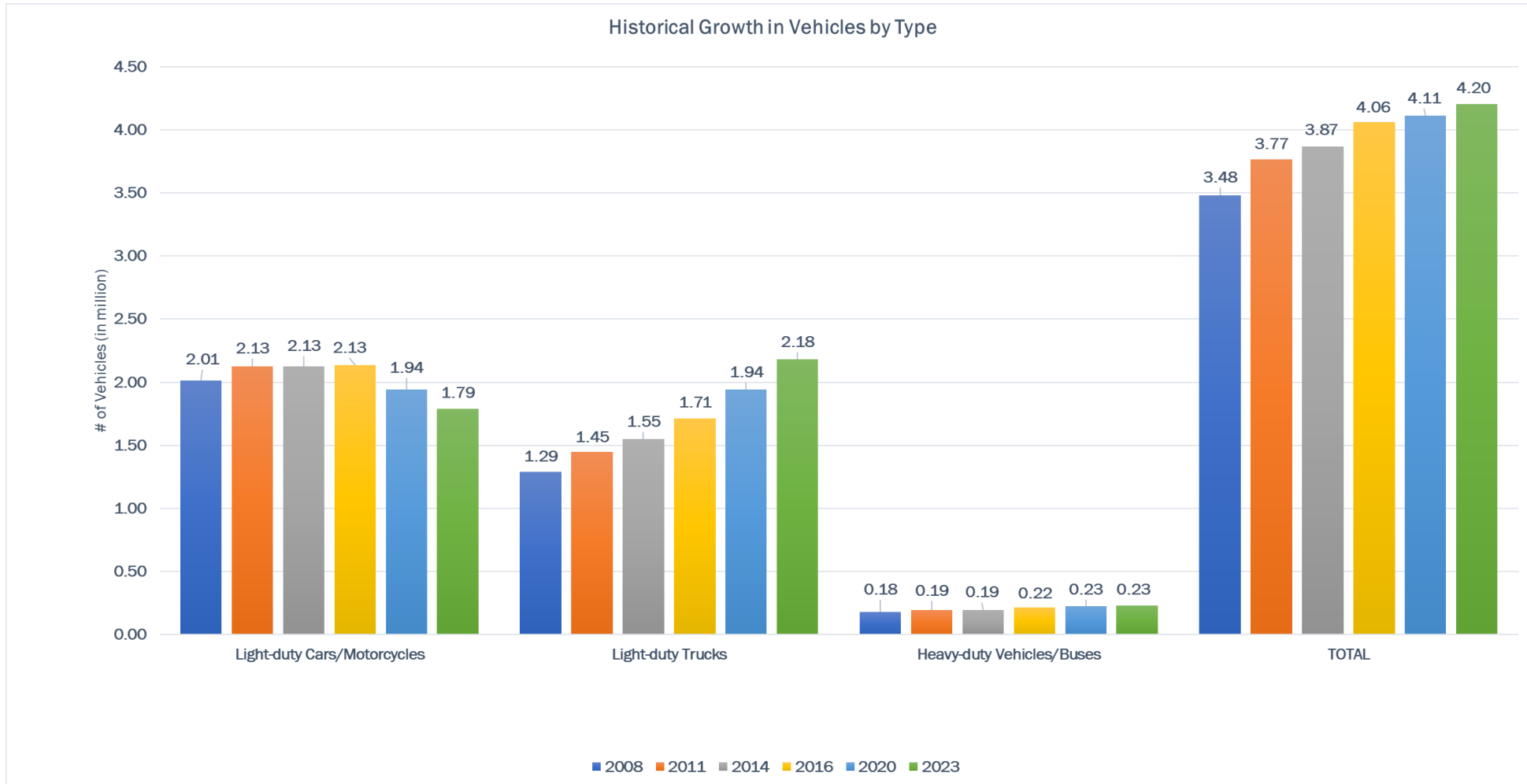


Source: <https://www.gasbuddy.com/charts>

- Could be a factor in vehicle purchase decisions
- Washington, D.C. data show higher retail gas price than the national average
- Decrease of average gas prices during the height of the stay-at-home orders designed to stop the spread of COVID-19 appears on the chart in 2020



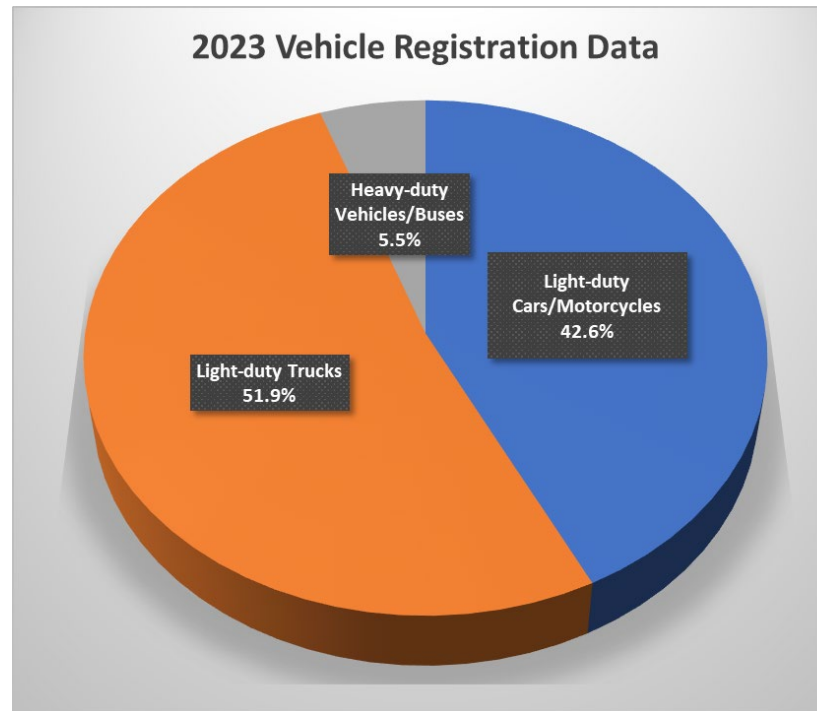
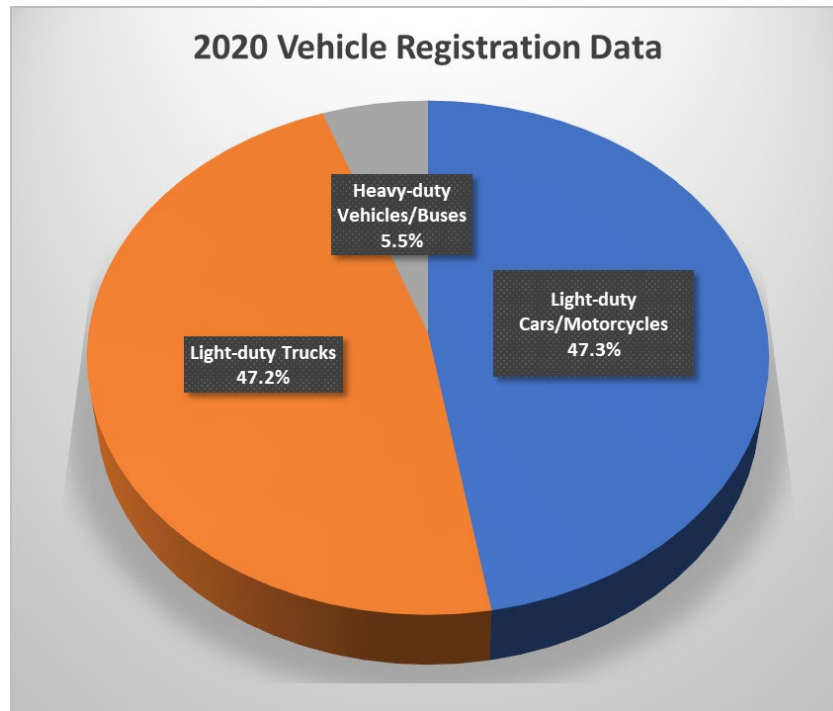
Historical Growth in Vehicles by Type



* Based on Decoded VIN Results



Changes in Regional Vehicle Composition: 2020 vs. 2023 Vehicle Registration Data

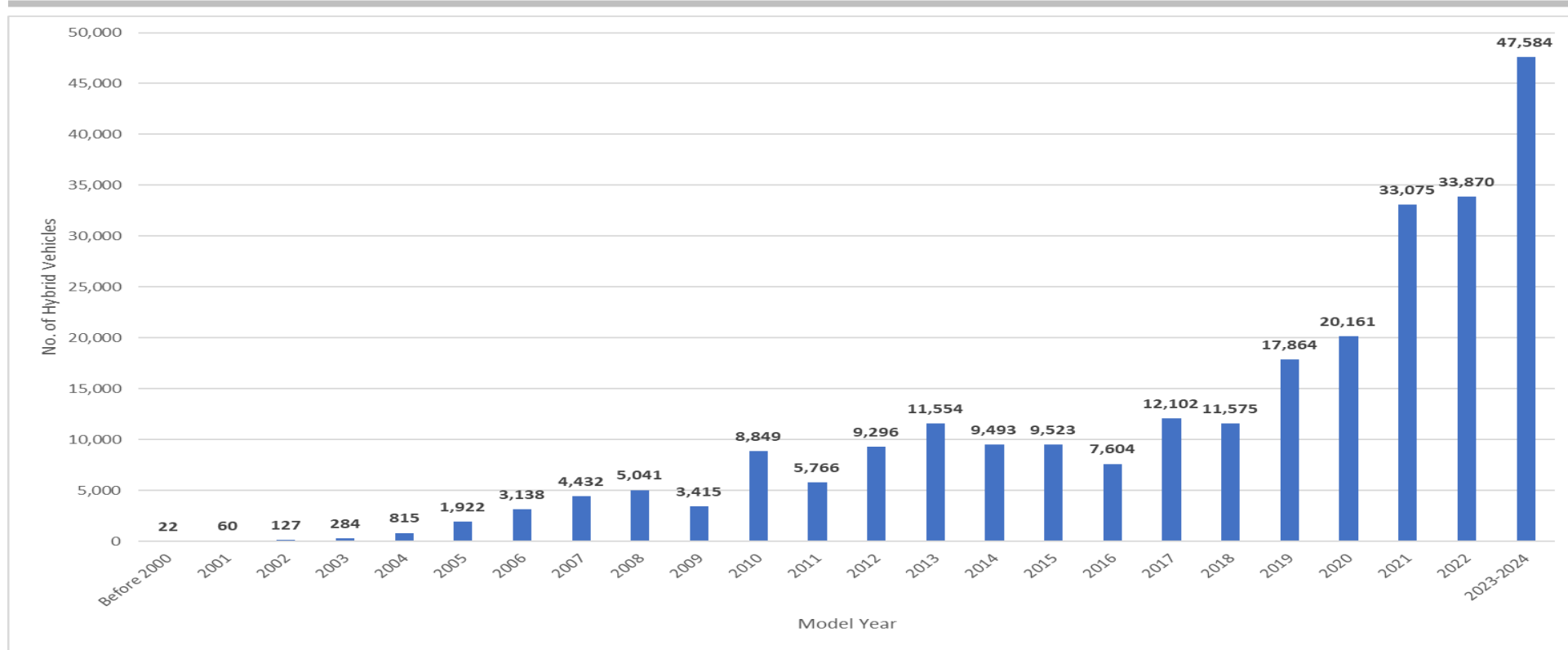


Between 2020 and 2023:

- Share of light-duty trucks (including SUVs) increased by 4.7 percentage points
- Share of heavy-duty vehicles remains the same (5.5%)
- Share of light-duty cars decreased by 4.7 percentage points



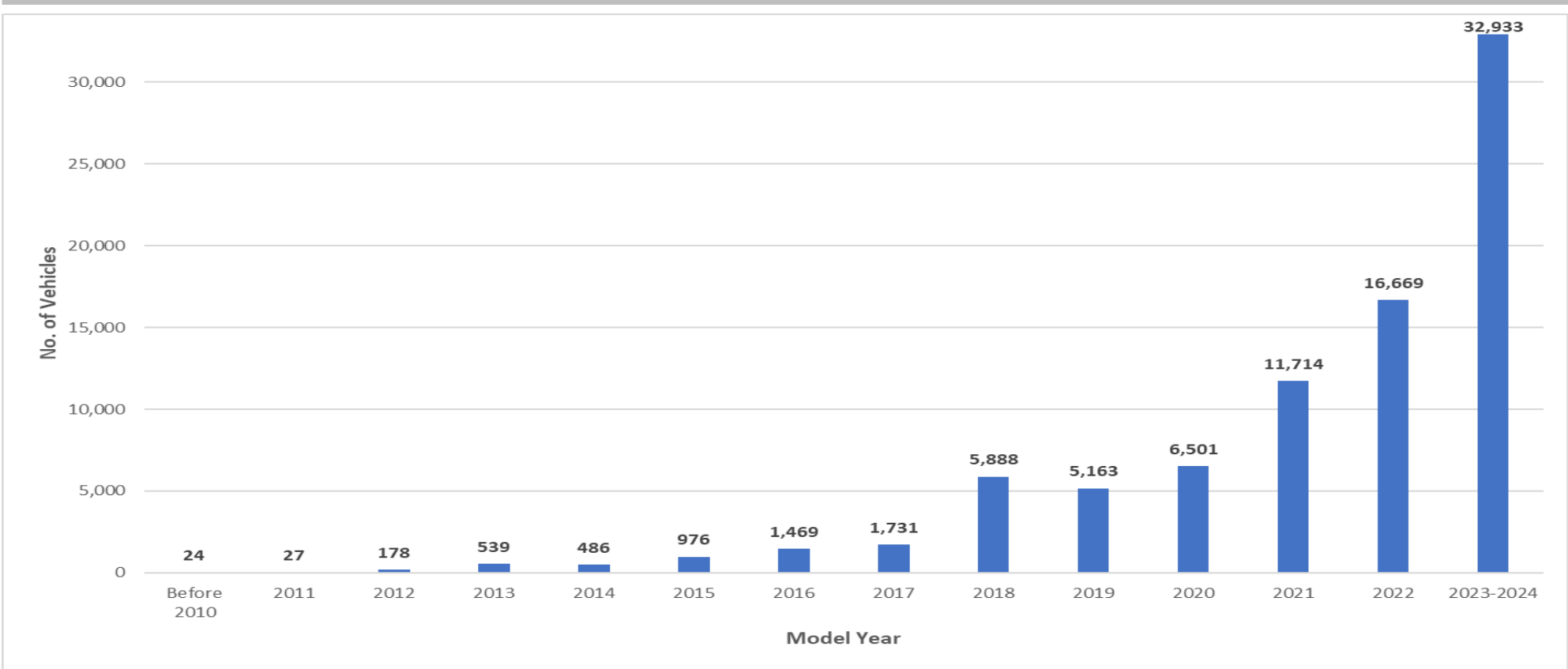
Current Distribution of Hybrid Vehicles by Model Year



- Hybrid vehicles include hybrid electric (HEVs) and plug-in hybrid electric vehicles (PHEVs)
- Regional hybrids total = 258k vehicles; 6.5% out of the light duty vehicle fleet; 6.1% out of all vehicles
- Number of registered hybrid vehicles in the fleet increased by 62.0% between 2020 and 2023 data



Current Distribution of Battery Electric Vehicles (BEVs) by Model Year



- Regional BEV total = 84k vehicles; 2.1% out the light duty vehicle fleet; 2.0% out of all vehicles
- Number of registered BEVs in the fleet increased by 265% between 2020 and 2023 data



Historical Shares of Electric and Hybrid Vehicles Through Time

- Shares of vehicles that are electric and hybrid continue to increase
- Just 15 years ago, hybrid and electric vehicles accounted for just over 1% of the vehicle fleet; in 2023, they represented over 8% of all vehicles

Share of Electric and Hybrid Vehicles by VIN Year

Year	Battery Electric Vehicles (BEVs)	Hybrid Vehicles (PHEVs + HEVs)	All Vehicles	Share of BEVs	Share of Hybrids	BEVs and Hybrids Share
2008	0	42,827	3,499,114	0.0%	1.2%	1.2%
2011	0	71,633	3,767,741	0.0%	1.9%	1.9%
2014	1,405	100,557	3,837,089	0.0%	2.6%	2.7%
2016	4,172	120,450	4,026,751	0.1%	3.0%	3.1%
2020	23,066	158,971	4,101,231	0.6%	3.9%	4.4%
2023	84,298	257,572	4,189,273	2.0%	6.1%	8.2%

*No BEVs were recorded in 2008 and 2011 VIN datasets



Key Findings

- Vehicle purchasing in the region seems to have recovered from the COVID-19 pandemic impact, resulting in a greater increase in registered vehicles
- The total number of vehicles in the region keeps increasing over time: 4.08M in 2016, 4.14M in 2020 and to 4.23M in 2023
- The vehicle composition is changing between 2020 and 2023:
 - ✓ Share of LD trucks (SUVs) increased by 4.7 percent points
 - ✓ Share of LD cars decreased by 4.7 percent points
 - ✓ Share of HDV/buses remains the same (5.5%)



Key Findings (Cont.)

- Average age of the vehicle fleet has increased from 9.51 years in 2020 to 9.97 in 2023
- Hybrid vehicles account for 6.1% of the vehicle fleet
- Electric vehicles account for 2.0% of the vehicle fleet, but the size of EV fleet has increased at a fast rate over time
- While the growth in electric and hybrid vehicles is great news, an older vehicle fleet and a shift toward light duty trucks and away from light duty cars could lead to negative impacts on emissions (in 2023, for the first time in our region, number of LD trucks > number of LD cars)
 - Negative impacts on emissions resulting from this shift could be dampened by better fuel economy of newer light duty (passenger) trucks

Next Steps

- Assemble vehicle population, vehicle composition and vehicle age distribution inputs for the MOVES model based on the 2023 dataset
- Apply in:
 - Air quality conformity analysis of the constrained element of the Visualize 2050 Long-Range Transportation Plan
 - GHG Analysis of the Visualize 2050 Long-Range Transportation Plan
 - 2015 National Ambient Air Quality Standards Ozone SIP
 - Other air quality emissions projects requiring MOVES modeling



Appreciation

- The state air agencies and DEP staff for granting access to the 2023 vehicle registration data
- Daniel Son for data cleaning, VIN decoding and conducting detailed analysis of the data



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