

Alternative Fuel Vehicle Usage and Owner Demographics in New York State

An Analysis of 2017 National Household Travel Survey Data



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Buildings and Transportation Science Division

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August 2023

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New York State Department of Transportation

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EXECUTIVE SUMMARY

With mounting concerns over climate change and the environmental impact of fossil fuels, the United States has witnessed a growing interest in alternative fuel vehicles (AFVs). In 2021, approximately 1.5 million battery EVs (BEVs), 0.8 million plug-in hybrid EVs (PHEVs), and 5.5 million hybrid EVs (HEVs) were registered in the United States. In the state of New York, a total of 51,900 BEVs, 44,600 PHEVs, and 221,600 HEVs were registered in 2021. The current report presents the results of an analysis of AFV adoption patterns in New York State and the rest of the United States based on data from the 2017 National Household Travel Survey (NHTS). Overall, the report reveals the demographics and mobility factors (e.g., household income, homeownership, and trip length) that contribute to the adoption of AFVs. This study provides insights that can inform policy decisions aimed at promoting sustainable transportation solutions.

Geographical Variation of Households with AFVs

The 2017 NHTS data showed that the percentage of households owning at least one AFV is lower in New York City compared with that in other regions of New York State. From the NHTS samples, of the 25 households that owned at least one BEV in New York State, 15 households (60%) lived within a 5-mile radius, based on the great circle distance, of the nearest charging station, and 23 households (92%) lived within a 10-mile radius of the nearest charging station. Furthermore, among the 40 households in New York State that own at least one PHEV, 48% (19 households) lived within a 5-mile radius of the closest EV charging station, and 83% (33 households) lived within a 10-mile radius of the nearest charging station. The rest of the United States had a higher percentage of households that own at least one AFV compared with that of New York State. A comparison was made between EV adoption levels using NHTS and EValuateNY, which is a tool that gathers statistics on the electric car market in New York State. The estimates obtained from New York State household samples in NHTS were slightly lower than the data provided by EValuateNY.

Household and Individual Demographics for AFV Ownership

In New York State and the rest of the United States, households with higher incomes tended to have a higher proportion of AFV ownership compared with those with lower incomes. For example, households in New York State earning \$150,000 or more had an approximately 6% share of owning at least one AFV, which was markedly higher than those earning less than \$100,000 (less than 3%). Additionally, homeowners in New York State and the rest of the United States also exhibited a significantly higher share of AFV ownership compared with that of renters.

Mobility Patterns of Households with AFVs

In New York State, households that own at least one AFV tended to travel farther and had longer travel times compared with their counterparts without an AFV. In terms of households with at least one AFV, households with HEVs tended to have more person trips, longer person miles of travel, and more vehicle miles traveled, resulting in longer travel times than that of households with BEVs or PHEVs. Notably, households with AFVs had a slightly lower share of family and personal business trips but a higher share of social and recreational trips compared with households without AFVs. Additionally, households with at least one AFV tended to have a slightly higher share of walking trips than their counterparts without an AFV. However, the comparisons were not statistically significant. These travel patterns observed in New York State were consistent with those observed in other regions of the United States.

1. INTRODUCTION

1.1 BACKGROUND

As concerns over climate change and the environmental impact of fossil fuels continue to grow, interest has increased in alternative fuel vehicles (AFVs) in the United States. AFVs are vehicles that use nontraditional fuels or technologies, such as electricity, hydrogen fuel cells, or compressed natural gas, instead of gasoline or diesel fuel. These vehicles are seen as a way to reduce greenhouse gas emissions, improve air quality, and decrease dependence on foreign oil.

The most common types of AFVs are battery EVs (BEVs), plug-in hybrid EVs (PHEVs), hybrid EVs (HEVs), and fuel cell vehicles. BEVs are powered by electricity stored in batteries, and PHEVs use a combination of electricity and gasoline or diesel. HEVs are powered by an internal combustion engine in combination with one or more electric motors that use energy stored in batteries.

New York State’s Climate Act is one of the most ambitious climate policies in the United States. It mandates a 40% reduction from 1990 levels of economy-wide greenhouse gas emissions by 2030 and a minimum reduction of 85% by 2050 (New York State 2023a). The New York State Energy Research and Development Authority (NYSERDA) offers rebates and tax credits for the purchase of AFVs, as well as grants for charging infrastructure. Additionally, the New York State Department of Environmental Conservation (NYSDEC) offers incentives for the conversion of heavy-duty vehicles to run on alternative fuels (US Department of Energy 2022).

Approximately 1.5 million BEVs, 0.8 million PHEVs, and 5.5 million HEVs were registered in the United States in 2021 (US Department of Energy 2021). Based on the New York State EV original registration data, the total number of EV registrations in 2022 is 41 thousand, of which 66% is BEV. There is also an increase from 2021 to 2022, with BEV original registrations increasing from 22 thousand to 27 thousand (New York State 2023b).

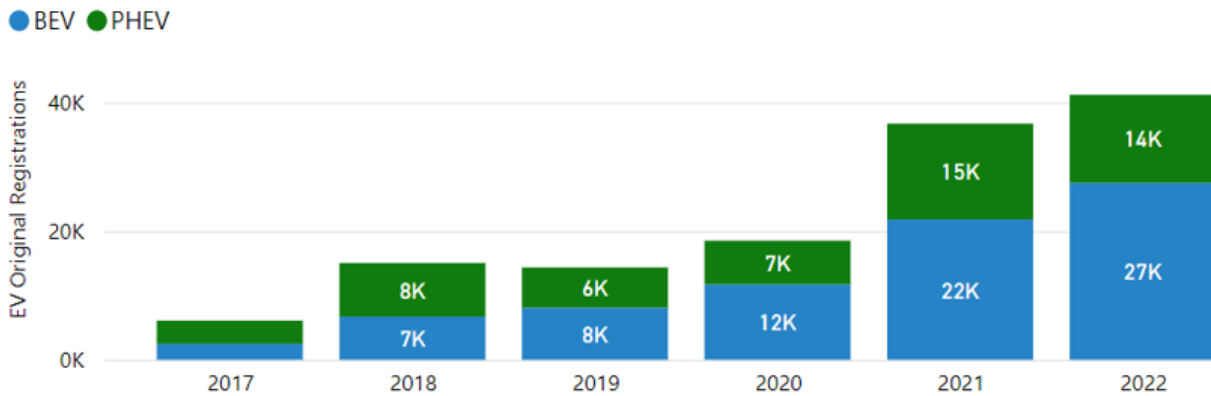


Figure 1-1. EV original registrations by year in New York State.
(Source: New York State 2023b)

1.2 OBJECTIVE

The purpose of the present study was to use the 2017 National Household Travel Survey (NHTS) data as the primary data source to conduct a comprehensive evaluation of AFV adoption, as well as study travel patterns of households and populations that own AFVs. The focus was to investigate the potential of AFV

adoption and its effect on household travel behavior, which is important to New York State’s sustainable transportation planning needs. Specifically, this study aimed to perform the following:

- Analyze AFV adoption patterns (e.g., adoption rate and type of AFV) in New York City, the rest of New York State, and the rest of the United States
- Analyze AFV adoption patterns by geographic characteristics
- Analyze AFV adoption patterns by household and individual demographics
- Examine the travel patterns of households with at least one AFV

Notably, a low number of AFVs existed in 2017; consequently, the number of AFV-owning households sampled by NHTS was low. As a result, caution must be taken when interpreting the estimates presented in this report. To determine whether the estimates associated with different categories are statistically significant, margins of error were calculated at a 95% confidence level. Because of the small sample size of households with AFVs, some analyses and comparisons were not presented (e.g., the comparison between New York City and the rest of New York State).

1.3 A BRIEF DESCRIPTION OF DATA SOURCES

1.3.1 2017 NHTS Data

The NHTS is a large-scale survey conducted by the US Department of Transportation that collects data on travel patterns of households and individuals in the United States. The survey includes information on trip origins and destinations, travel modes, and trip purposes, as well as sociodemographic characteristics of the travelers. Data collected in NHTS can also be used to analyze the factors that influence the adoption of AFVs in the United States. By examining the travel patterns of households and individuals who already own AFVs, researchers can identify patterns and characteristics that are associated with AFV adoption.

Since 1990, the NHTS has been facilitating planning and policymaking efforts at state and regional levels by encouraging the participation of add-on partners who can purchase supplemental samples of the survey in their state or metropolitan planning organization (MPO) area through a pooled-fund effort. By including additional sample sizes from these add-on areas, states and MPOs can conduct more in-depth analyses and obtain data from smaller geographic units such as cities or counties. In 2017, 13 states/MPOs, including New York State, participated in the add-on program.

The present study used 2017 NHTS data for AFV adoption analysis. The 2017 NHTS was conducted from March 2016 to May 2017, with the New York State add-on covering April 2016 to April 2017. The survey gathered data from 129,696 households, which included a national sample of 26,000 households and an additional 103,696 samples purchased by the 13 states or MPOs. In total, the survey collected information from 17,209 households in New York State, including data from the add-on programs. In Section 2 of this study, we utilized information at the household level to gain insights into the geographical perspectives of EV adoption in New York State.

In the 2017 NHTS data, sampling rate for St. Lawrence County is higher than that of Schenectady County in New York State. However, these sampling rates did not align with the respective populations of the two counties. Therefore, to ensure data consistency, weighting adjustments at the county level for the entire state of New York were performed based on American Community Survey data.

1.3.2 EV Charging Stations in New York State

This data set included data for EV charging stations in New York State. A station appears as one point in the data set, regardless of the number of fuel dispensers or charging outlets at that location. This data set was published by NYSEERDA through the Open Data NY portal (New York State 2023c). It recorded the

data about the charging stations such as the name of the station, the street address, hours of operation, longitude, latitude, and information update time. The full database of alternative fuel station locations nationwide was collected and maintained by the US Department of Energy.

1.3.3 EV Registrations in New York State

Using data from the New York State Department of Motor Vehicles, NYSERDA developed EValuateNY, which is a tool that compiles statistics on the electric car market, such as which year and where registrations are, the type of technology, and the type of vehicle model (New York State 2023d). EValuateNY also incorporates additional data from the US Department of Energy, the US Census Bureau, and other sources to provide information about the demographics of communities with high electric car ownership. A full version of these data sets was also included for further use by researchers.

1.4 GEOGRAPHICAL REGIONS

In this report, we conducted comparisons across various geographical regions in New York City, the rest of New York State, New York State statewide, and the rest of the United States. The specific definitions of these regions can be found in Table 1-1.

Table 1-1. Definition of the major geographical regions

Region	Description
New York City (NYC)	Five counties/boroughs: New York County, Kings County, Queens County, Richmond County, and Bronx County
Rest of New York State	A combined geographic region when comparing behaviors from those who lived elsewhere in the New York State (i.e., outside NYC)
NYS Statewide	All areas in the NYS as a whole
Rest of US	A combined geographic region when comparing behaviors from those who lived elsewhere in the United States (i.e., outside the NYS)

1.5 ORGANIZATION OF REPORT

Section 2 of this report outlines the adoption patterns of AFVs based on geographical factors. The adoption patterns of EVs in New York State, specifically BEVs and PHEVs, were analyzed against the data from electric charging stations and EValuateNY. In Section 3, the report delves into the AFV adoption patterns by household and individual demographics, taking into account factors such as income, race, homeownership, age, and gender. Section 4 provides an in-depth analysis of travel patterns of households and populations owning at least one AFV, including person trips and vehicle trips.

2. AFV ADOPTION BY HOUSEHOLD GEOGRAPHY

2.1 COMPARISON BETWEEN NEW YORK CITY, NEW YORK STATE, AND THE REST OF THE UNITED STATES

Figure 2-1 displays the distribution of vehicle ownership among households in New York City, New York State, and the rest of the United States. The figure distinguishes between households with no vehicles, households with at least one vehicle but without any AFVs, and households with at least one AFV. The data revealed that the percentage of households owning at least one AFV is lower in New York City compared with other regions of New York State. Additionally, a higher percentage of households owning at least one AFV was observed in the rest of the United States (4%) than that in New York State (2%).

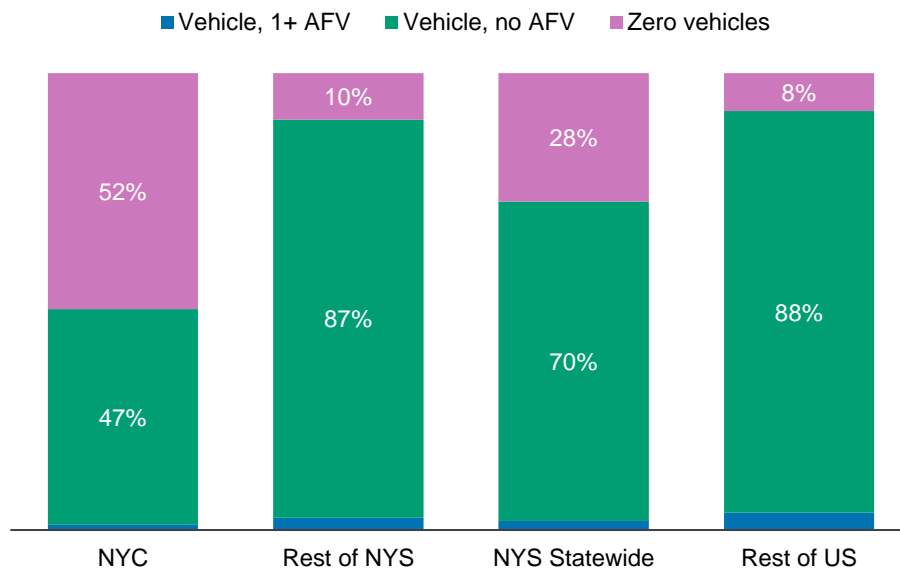


Figure 2-1. Share of households with different AFV adoption and vehicle ownership. NYC is New York City, and NYS is New York State.

The present report sought to estimate the share of households owning EVs, including HEVs, PHEVs, and BEVs, using data from the 2017 NHTS. Because of limited sample sizes, households with PHEVs and BEVs were combined, resulting in two distinct categories of AFV ownership: (1) households with at least one HEV and (2) households with at least one BEV or PHEV. To ensure equal representation, the 98 households in the national NHTS sample that owned both HEVs and BEV/PHEVs were randomly assigned to the two categories in a 50/50 split.

Figure 2-2 displays the distribution of different types of AFVs among households with at least one AFV. New York State exhibited a greater proportion of households with HEVs among those with at least one AFV compared with that of the rest of the United States. However, the state's proportion of households with BEVs or PHEVs was lower when compared with their counterparts in other regions of the country.

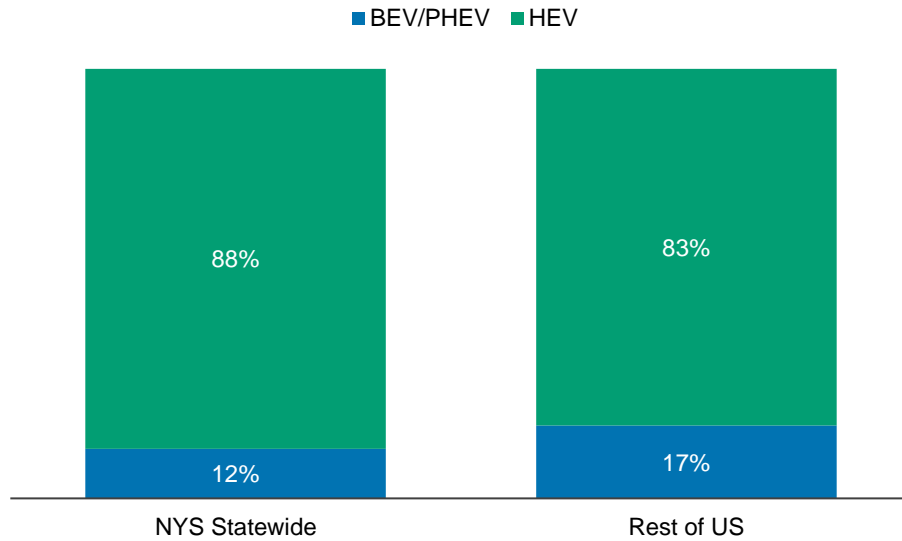


Figure 2-2. Share of households with different types of AFV. NYS is New York State.

Figure 2-3 presents the distribution of vehicles with various fuel types. Notably, the proportion of AFVs was higher in New York City (1.7%) compared with that of the rest of New York State (1.5%). However, the difference was not statistically significant. The remaining regions of the United States exhibited a greater proportion of AFVs (2.1%) compared with that of New York State (1.6%). However, this difference was also not statistically significant.

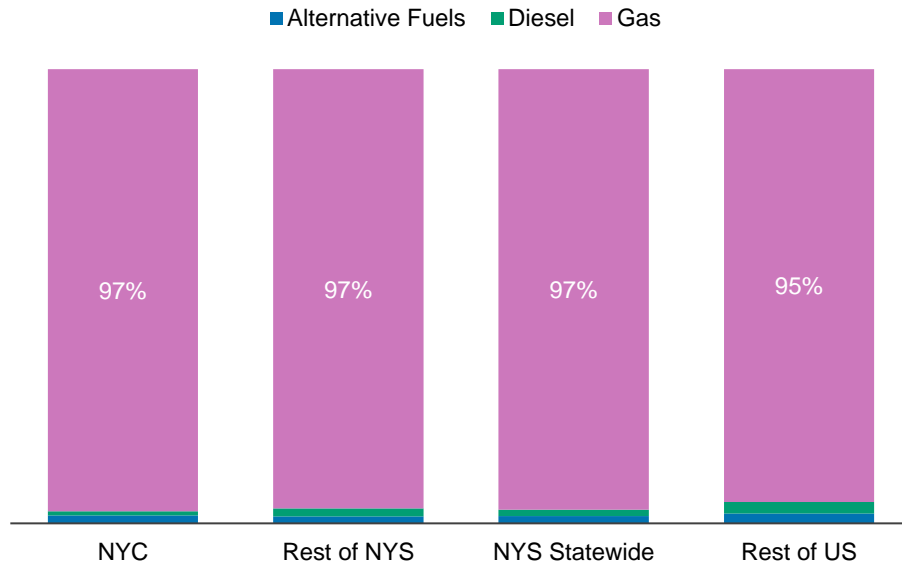


Figure 2-3. Share of vehicles with different types of fuels. NYC is New York City, and NYS is New York State.

2.2 COMPARISON OF URBAN CLASSIFICATION

The analysis of AFV adoption in New York State was differentiated by urban and nonurban regions, as defined by their respective Metropolitan Planning Organizations (MPOs). New York State has 14 MPOs. Urban areas are defined as the MPO area, and any areas outside of MPOs are defined as nonurban areas.

Figure 2-4(a) depicts the distribution of households according to their AFV adoption status and urban classification in New York State. Notably, urban areas exhibited a higher proportion of households with AFVs (2%) compared with that of their nonurban counterparts (1%). However, the difference was not statistically significant. Figure 2-4(b) displays the distribution of households by urban classification. Notably, not much variation existed in the proportion of households with BEV/PHEV and HEV ownership across urban and nonurban areas.

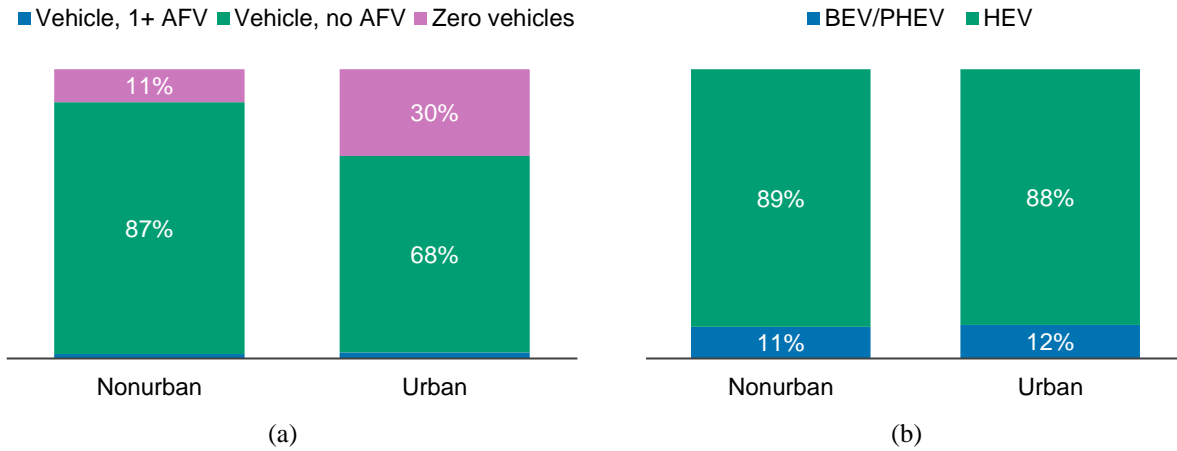


Figure 2-4. Share of households by urban classification. (a) Share of households by AFV adoption and urban type, and (b) share of households by AFV type and urban type.

Figure 2-5 shows the share of vehicles by fuel type and urban classification. The results indicated that urban areas exhibited a slightly greater proportion of AFVs (2%) compared with that of their nonurban counterparts (1%). However, this difference was not statistically significant.

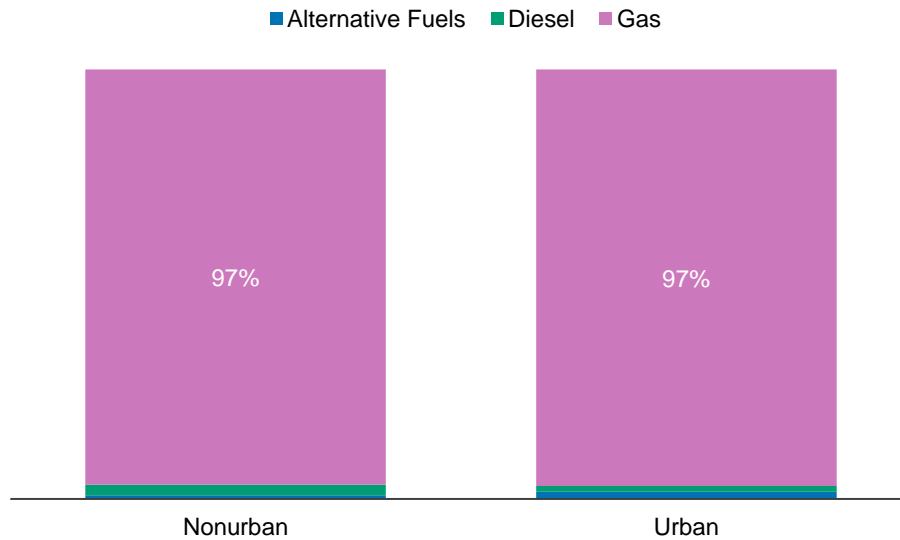


Figure 2-5. Share of households by fuel type and urban type.

2.3 EV ADOPTION

To gain a more comprehensive understanding of the EV adoption patterns in New York State, analyses drew on data from the 2017 NHTS, as well as electric charging station locations and EV registration data.

2.3.1 Charging Stations and New York State Household Locations

Figure 2-6 depicts the geographical distribution of EV charging stations and households in possession of BEVs or PHEVs in New York State. Notably, none of the households in the NHTS samples from New York State owned both an HEV and a BEV or PHEV. The map shows that most of the sampled households were located close to the charging stations.

The great circle distance between household locations and EV charging stations was also compared in this study. Among the 25 households that owned at least one BEV in New York State, 15 households (60%) lived within a 5-mile radius, based on the great circle distance, of the nearest charging station, and 23 households (92%) lived within a 10-mile radius. Among the 40 households that owned at least one PHEV in New York State, 19 households (48%) lived within a 5-mile radius of the nearest charging station, and 33 households (83%) lived within a 10-mile radius.

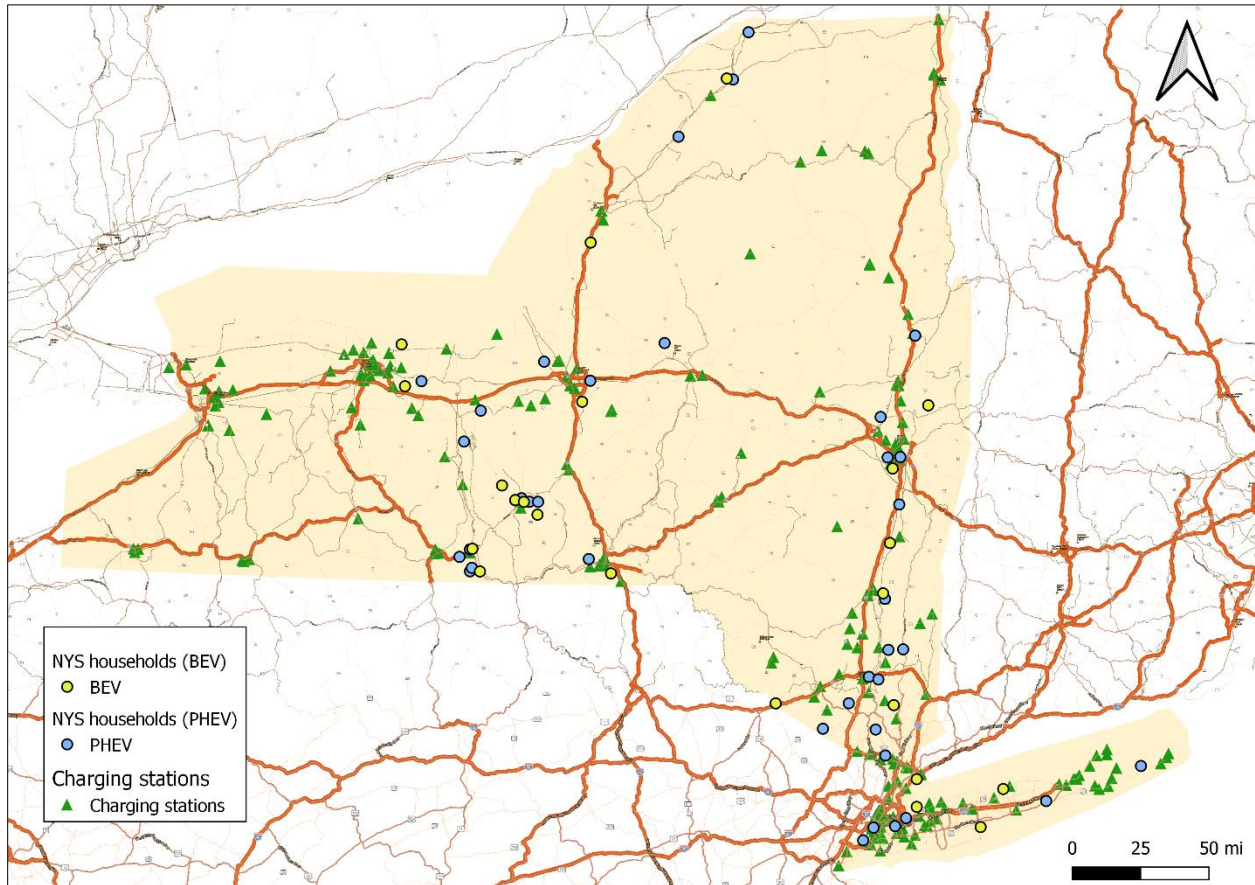


Figure 2-6. Locations of New York State charging stations and households with AFVs.

Charging station density, calculated as the number of charging stations per 100,000 people, is estimated at the county level. Table 2-1 presents 10 counties with the highest charging station density in 2017.

Table 2-1. Top 10 New York State counties by charging station density (2017)

County	Population	Number of charging stations per 100,000 people
New York County	1,653,877	11.7
Yates County	25,083	8.0
Warren County	64,701	7.7
Ulster County	180,129	6.7
Otsego County	60,750	6.6
Essex County	38,233	5.2
Clinton County	81,224	4.9
Chemung County	86,883	4.6
Cortland County	48,334	4.1
Steuben County	97,539	4.1

2.3.2 Comparison of NHTS Samples, EV Registrations and Charging Stations

To gauge EV adoption levels, the EValueNY initiative employed the metrics of BEVs per 1,000 people and PHEVs per 1,000 people. To facilitate comparison, these same metrics were calculated using the weighted population in New York State based on the NHTS samples. Table 2-2 presents the BEV and PHEV share per 1,000 people in New York State. Notably, the estimates obtained from New York State household samples in NHTS were slightly lower than the data provided by EValueNY from the same year.

Table 2-2. Share of BEVs and PHEVs in New York State from NHTS and EValueNY (2017)

Number of EV charging stations	BEVs		PHEVs	
	BEVs per 1,000 people (NHTS)	BEVs per 1,000 people (EValueNY)	PHEVs per 1,000 people (NHTS)	PHEVs per 1,000 people (EValueNY)
441	0.34	0.44	0.51	0.82

3. AFV ADOPTION BY HOUSEHOLD AND INDIVIDUAL DEMOGRAPHICS

3.1 HOUSEHOLD INCOME

Figure 3-1 shows the distribution of households in New York State and in the rest of the United States based on vehicle ownership and household income. Households with a higher income exhibited a higher share of AFV ownership compared with those with a lower income. For instance, the proportion of households possessing at least one AFV in the income bracket of \$150,000 or more was approximately 6%, which was a markedly greater percentage than those earning less than \$100,000 (which had a proportion less than 3%) in New York State. This trend was also evident in the rest of the United States.

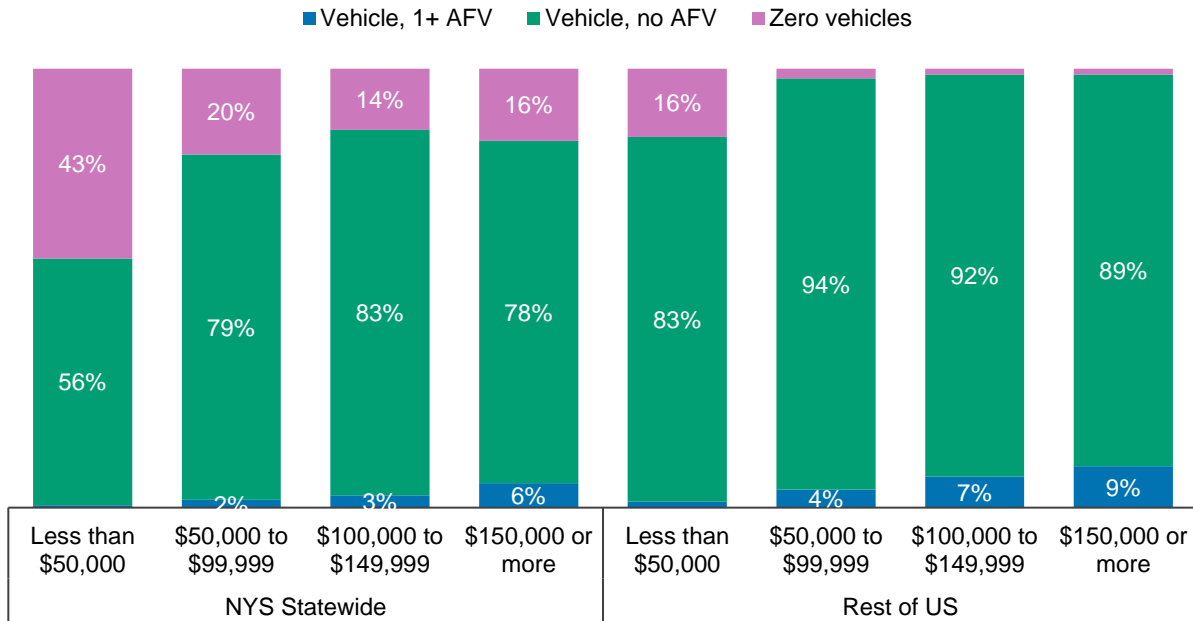


Figure 3-1. Share of households by vehicle ownership and household income. NYS is New York State.

Figure 3-2 demonstrates the proportion of households owning different types of AFVs based on their annual income. In the case of New York State, a greater percentage of households with an annual income of at least \$50,000 possessed BEVs or PHEVs compared with those earning less than \$50,000. However, this difference was not statistically significant. In the rest of the United States, households with a higher income exhibited a greater share of ownership of BEVs or PHEVs. For instance, households earning an annual income of over \$150,000 possessed a significantly higher (27%) proportion of BEVs or PHEVs compared with those with incomes between \$100,000 and \$150,000 (16%).

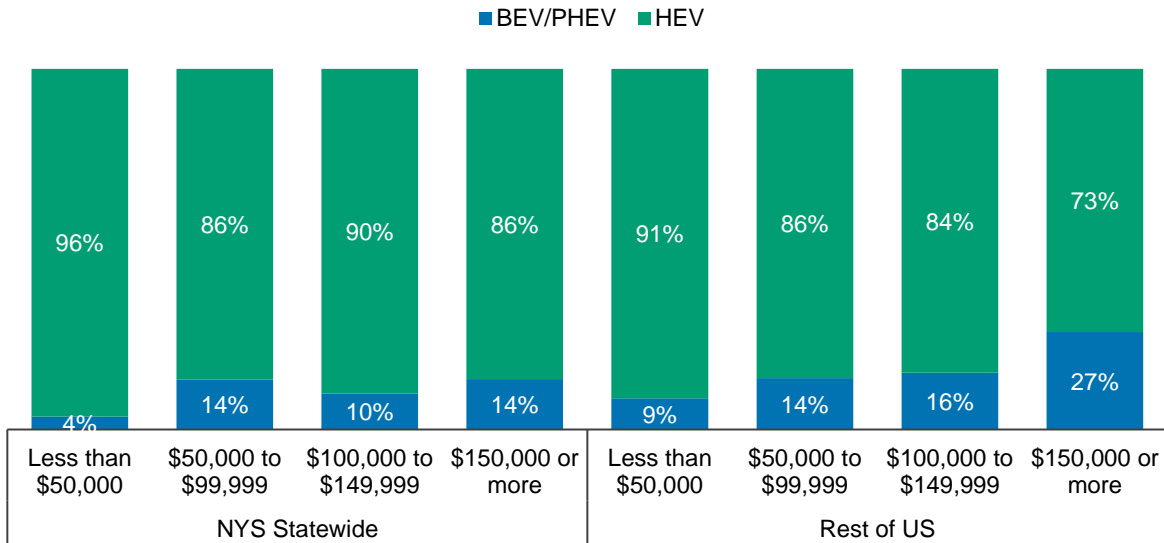


Figure 3-2. Share of households by AFV type and household income. NYS is New York State.

3.2 HOUSEHOLD RACE

Figure 3-3 reveals the relationship in New York State and the rest of the United States between race and the household share of vehicle ownership. In New York, white households exhibited a slightly greater proportion of ownership of at least one AFV (2%) compared with that of nonwhite households (1%), but this difference was not statistically significant. The same pattern held for the rest of the United States, where white households exhibited a higher share of ownership of at least one AFV (4%) than that of their nonwhite counterparts (3%). However, the difference for the United States was also not statistically significant. These observations offer valuable insights into the dynamics of vehicle ownership across different racial groups in the United States.

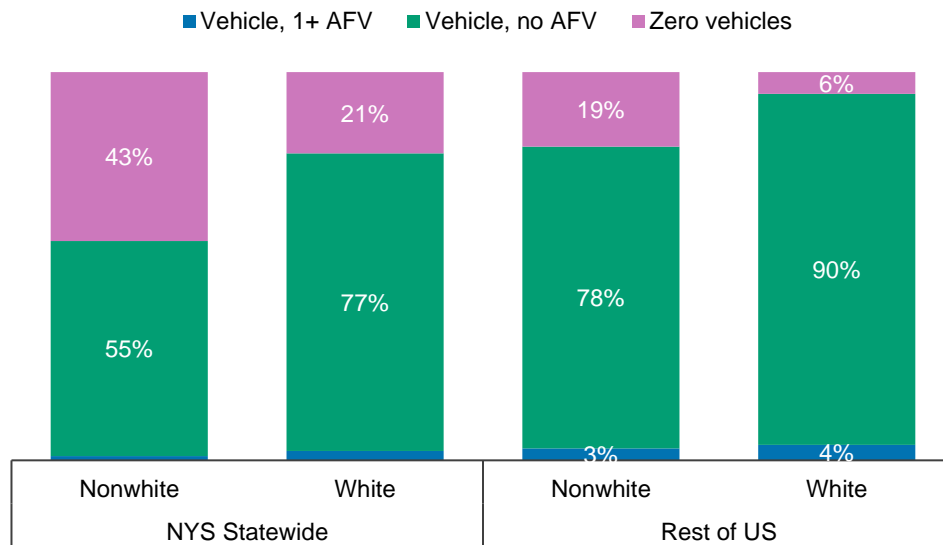


Figure 3-3. Share of households by vehicle ownership and race. NYS is New York State.

3.3 HOMEOWNERSHIP

Figure 3-4 shows the relationship in New York State and the rest of the United States between homeownership and the share of households with AFV vehicle ownership. The data indicated a statistically significant disparity in the proportion of households owning at least one AFV based on their homeownership status in New York State. Homeowners displayed a significantly higher share of vehicle ownership (3%) compared with that of renters (1%). This pattern was also observable in the rest of the United States, where homeowners exhibited a significantly higher proportion (5%) of vehicle ownership of at least one AFV compared with that of renters (2%). These findings highlighted the role of homeownership status as an important factor influencing AFV ownership patterns in the United States.

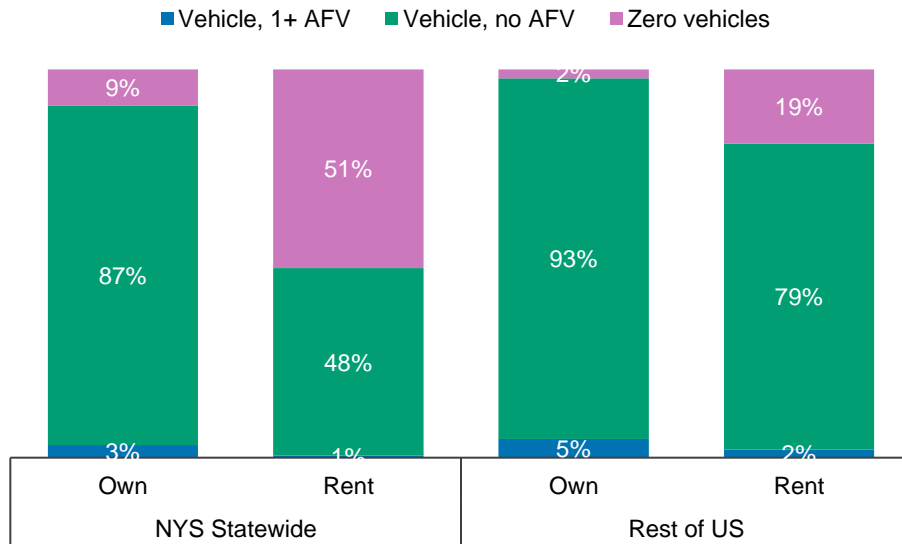


Figure 3-4. Share of households by vehicle ownership and homeownership. NYS is New York State.

Figure 3-5 provides insights into the relationship between vehicle ownership, homeownership, and AFV type in New York State and the rest of the United States. The data revealed that, similar to the pattern observed in Figure 3-4, homeowners in New York State had a slightly higher share of ownership of BEVs or PHEVs (13%) compared with that of renters (5%). However, this difference was not statistically significant. The same pattern held for the rest of the United States, where homeowners exhibited a slightly higher proportion (18%) of ownership of BEVs or PHEVs than that of renters (12%).

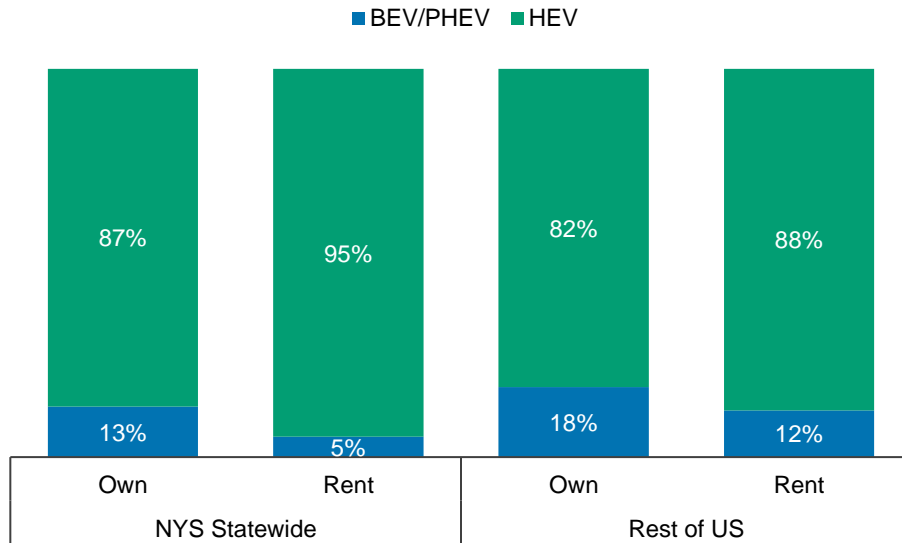


Figure 3-5. Share of households by AFV type and homeownership. NYS is New York State.

3.4 GENDER OF THE PRIMARY DRIVER

The analysis on individual vehicle ownership was conducted, but there was a discrepancy between the proportion of people who owned at least one AFV and those who did not own AFV, with the former group representing a much smaller percentage (i.e., 2%). As a result, the relationship between gender and vehicle ownership was not demonstrated.

Figure 3-6 illuminates the relationship between AFV type and the gender of the primary driver of the AFV in New York State and the rest of the United States. The data indicated that in New York State, males had a slightly higher share of ownership of BEVs or PHEVs than that of females. However, this difference was not statistically significant. In the rest of the United States, this pattern was similar, with males displaying a higher share of ownership of BEVs or PHEVs (20%) compared with that of females (17%). These findings highlighted the potential influence of gender on AFV ownership patterns in the United States and suggested that further research could be useful in understanding the factors driving these differences.

3.5 AGE OF THE PRIMARY DRIVER

Similar to the gender pattern at individual level, the proportion of people who owned at least one AFV is much smaller than the proportion of people who did not own AFV. As a result, the relationship between age and vehicle ownership was not demonstrated.

Figure 3-7 examines the relationship between the age of the primary driver who owns at least one AFV and the type of AFV in use in New York State and the rest of the United States. The data suggested that in New York State, individuals between the ages of 25 and 44 displayed a slightly higher share of ownership of BEVs or PHEVs compared with that of other age groups. However, this difference was not statistically significant. In contrast, the share of HEV and BEV or PHEV ownership among different age groups in the rest of the United States was more comparable. Note that the share of BEV or PHEV ownership is much lower among those aged 45 to 64 in New York State compared to other age groups; however, this trend is not observed in the rest of the United States. To investigate further, we analyzed the unreported responses for fuel type information. It is found that the rate of unreported responses for the age group 45 to 64 in New York State is notably higher than among their counterparts in the rest of the country (0.31% in New

York State vs. 0.02% in the rest of the United States). This elevated rate of unreported responses could potentially account for the lower share of BEV or PHEV ownership among the 45 to 64 age group in New York State.

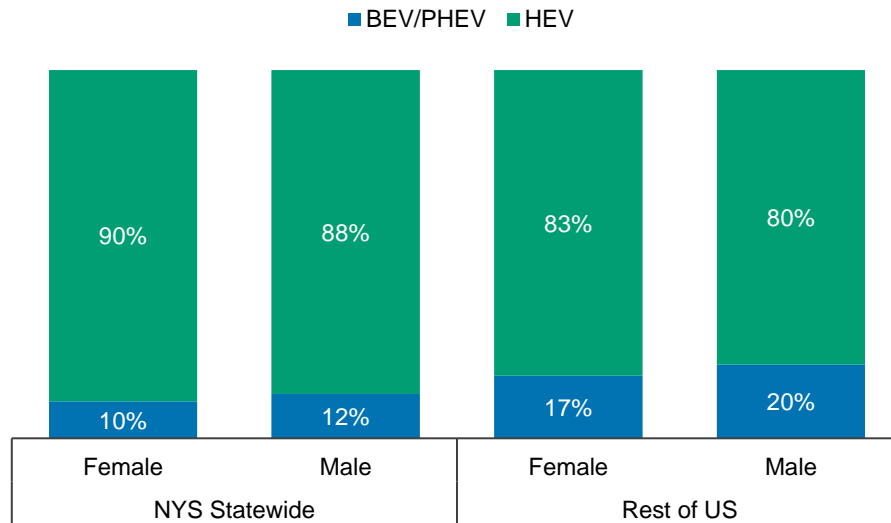


Figure 3-6. AFV type by gender of the primary driver of the AFV. NYS is New York State.

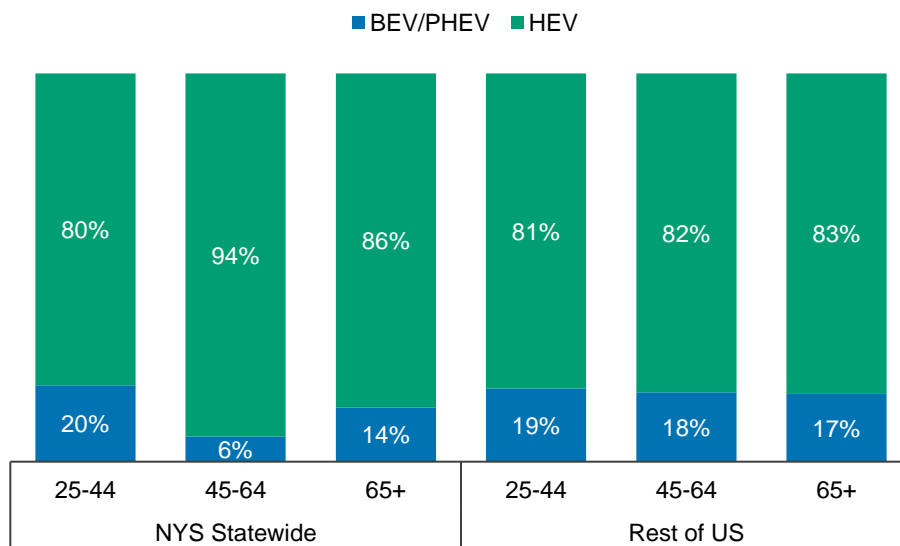


Figure 3-7. AFV type by age of the primary driver of AFV. NYS is New York State.

4. TRAVEL PATTERNS OF HOUSEHOLDS THAT OWN AFV

4.1 PERSON TRIPS

Figure 4-1 displays the mean number of person trips per person per day by vehicle ownership status. In New York State and the rest of the United States, households with at least one AFV exhibited more person trips than those without an AFV. In New York State, little difference existed in the number of person trips between households with or without AFVs and households with zero vehicles. However, in the rest of the United States, households with no vehicles made significantly fewer trips (2.6 person trips) than their counterparts with at least one AFV (3.8 person trips).

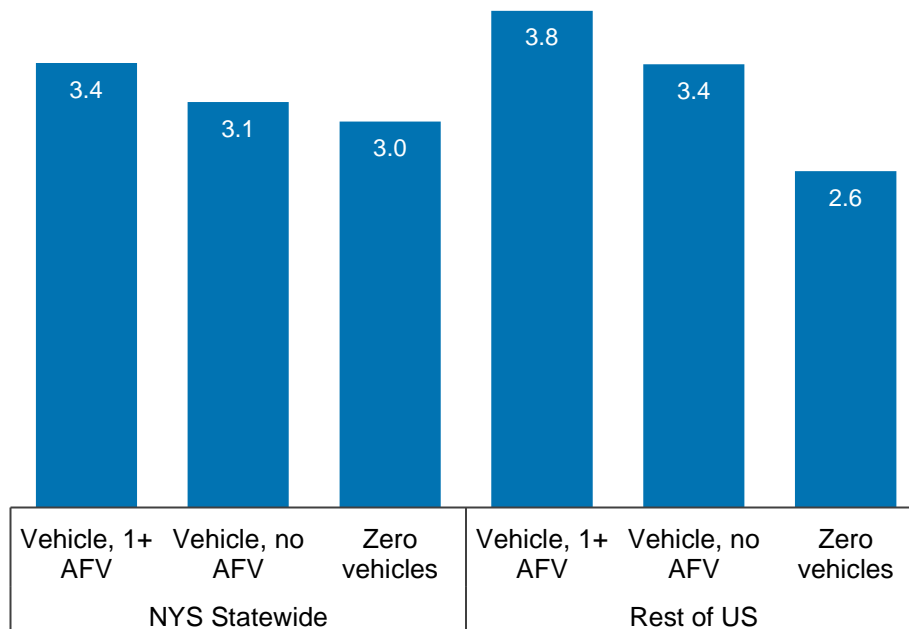


Figure 4-1. Average number of daily person trips by vehicle ownership. NYS is New York State.

Figure 4-2 depicts the average number of daily person trips among households that own at least one AFV, categorized by AFV type. In New York State, households with HEVs had marginally more person trips (3.4 person trips) than their counterparts with BEVs or PHEVs (3.3 person trips). However, this disparity was not statistically significant. A similar trend was apparent in the rest of the United States.

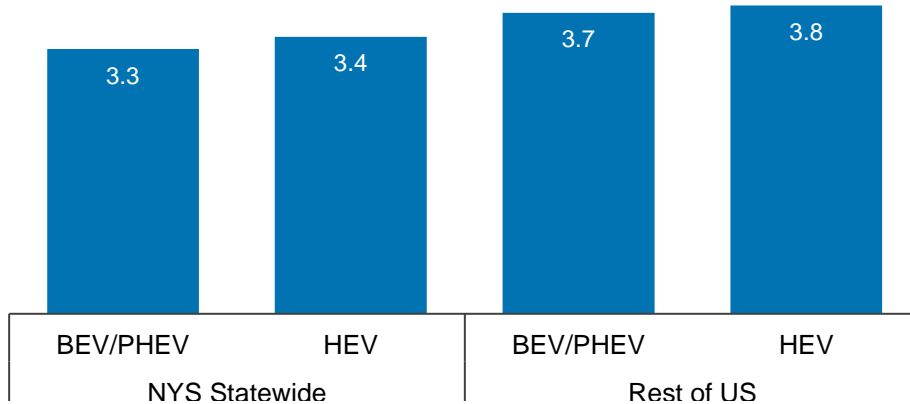


Figure 4-2. Average number of daily person trips by AFV type. NYS is New York State.

4.2 PERSON MILES OF TRAVEL

Figure 4-3 shows the average daily person miles of travel (PMT) by vehicle ownership. Households that own at least one AFV had a slightly higher average PMT at 29.9 miles compared with that of households without AFVs, which was 28 miles. Moreover, households that had at least one vehicle in New York State and the rest of the United States had significantly higher PMT than those without any vehicles.

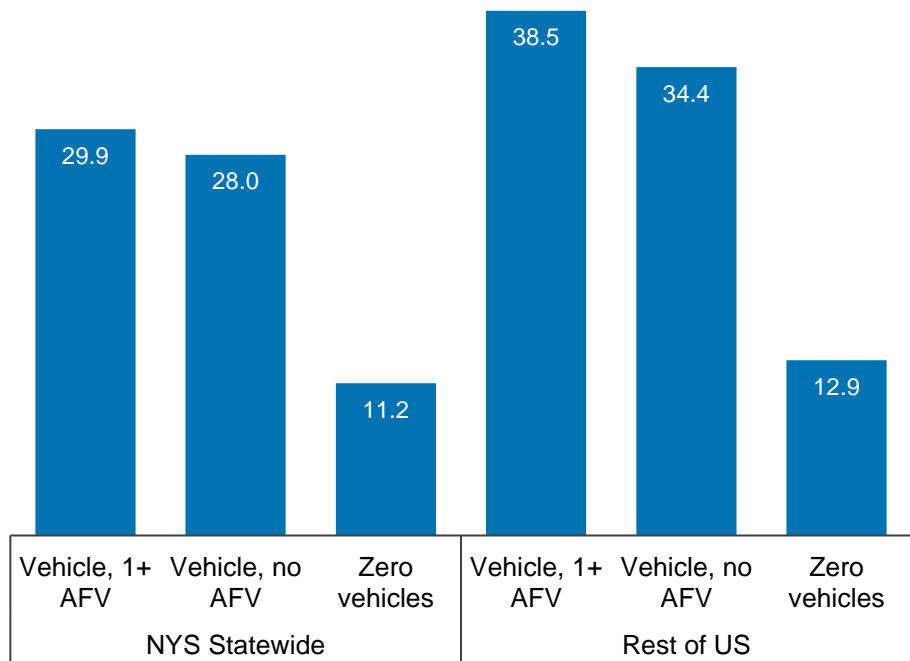


Figure 4-3. Average daily PMT by AFV adoption. NYS is New York State.

Figure 4-4 shows the average daily PMT by AFV type. Households that own HEV had a higher average PMT compared with that of households that own BEVs or PHEVs in New York State and the rest of the United States. However, the differences were not statistically significant. Households who owned BEVs/PHEVs in the rest of the United States had a higher PMT (32.5 miles) than that of New York State (23.6 miles). However, the differences were not statistically significant.

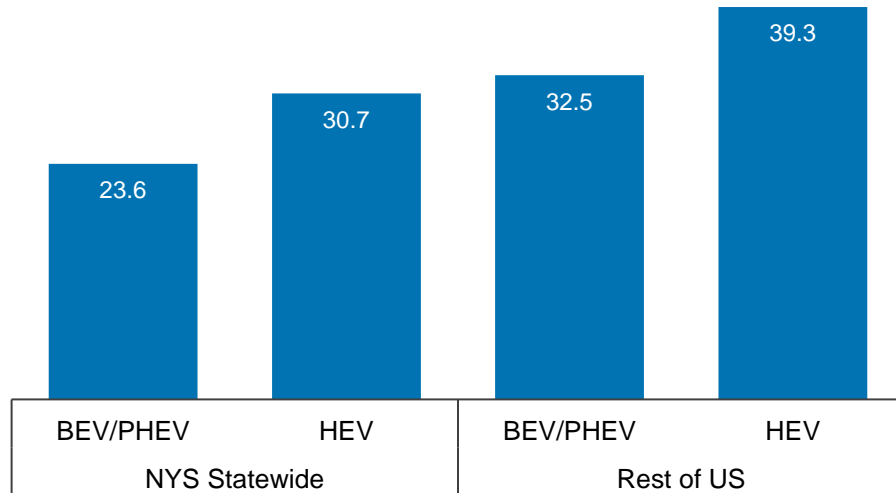


Figure 4-4. Average daily PMT by AFV type. NYS is New York State.

4.3 PERSON TRIP TRAVEL TIME

Figure 4-5 illustrates the average travel time per person trip in minutes, broken down by vehicle ownership. In New York State, households with at least one AFV had a slightly longer travel time (81.9 min) than that of their counterparts without an AFV (74.8 min), though this difference was not statistically significant. Notably, households with zero vehicles had the longest person trip travel time (85.4 min) compared with that of the other two groups. Across the rest of the United States, the average person trip travel time for households with at least one AFV was comparable to that in New York State.

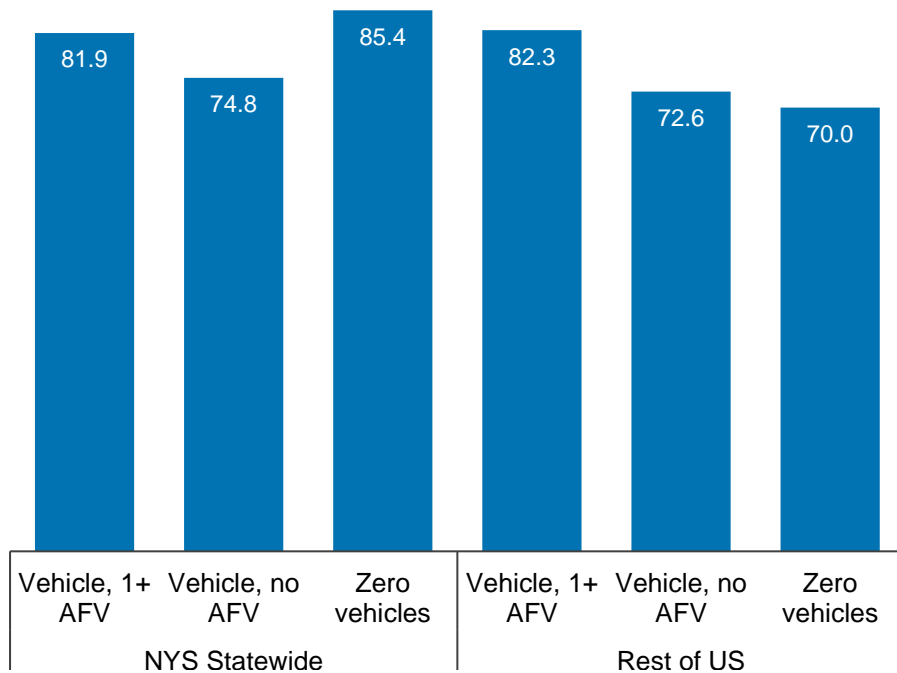


Figure 4-5. Average person trip travel time in minutes by AFV adoption. NYS is New York State.

As shown in Figure 4-6, in New York State and the rest of the United States, households that owned HEVs had longer travel times than those that owned BEVs or PHEVs. However, these differences were not statistically significant. The average person trip travel time for households with HEVs was comparable in New York State and the rest of the United States. Households with BEVs or PHEVs had a slightly longer travel time in the rest of the United States (80.3 min) compared with that of their New York State counterparts (74.7 min).

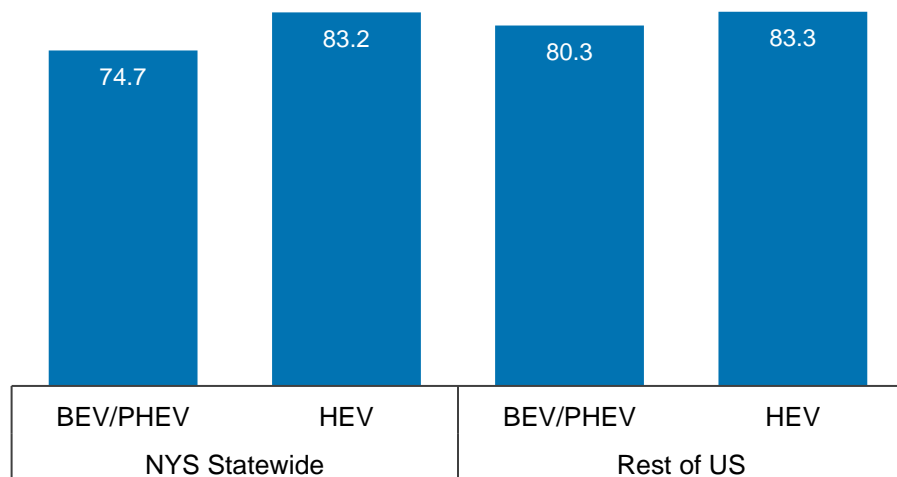


Figure 4-6. Average person-trip travel time in minutes by AFV type. NYS is New York State.

4.4 SHARE OF PERSON TRIPS BY MODE OF TRANSPORTATION

Figure 4-7 displays the percentage of person trips by mode of transportation and vehicle ownership. In New York State, households with at least one AFV had a slightly lower share of trips taken by privately owned vehicles (POVs, 68%) than that of their counterparts with no AFVs (73%). However, in the rest of the United States, the percentage of POV trips was similar for both groups. In New York State and the rest of the United States, households with at least one AFV had a slightly higher share of walking trips compared with that of their counterparts with no AFV. However, these differences were not statistically significant.

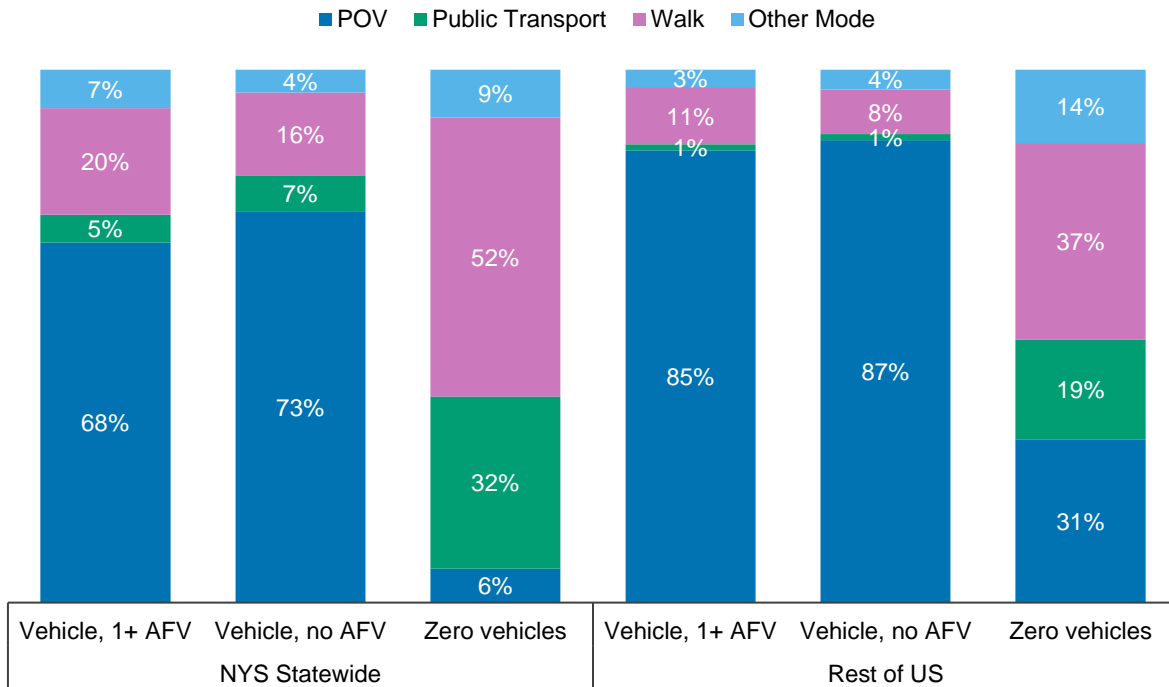


Figure 4-7. Share of person trips by mode of transportation and AFV adoption. NYS is New York State.

Figure 4-8 displays the share of person trips by mode of transportation and AFV type for households with at least one AFV. In New York State, households with HEVs had a higher share of walking trips (21%) compared with those with BEVs or PHEVs (14%). However, households with HEVs in New York State had a lower share of public transit trips (4%) than those with BEVs or PHEVs (13%). Also, the share of person trips by mode of transportation for households with HEVs and BEVs or PHEVs was comparable with the rest of the United States.

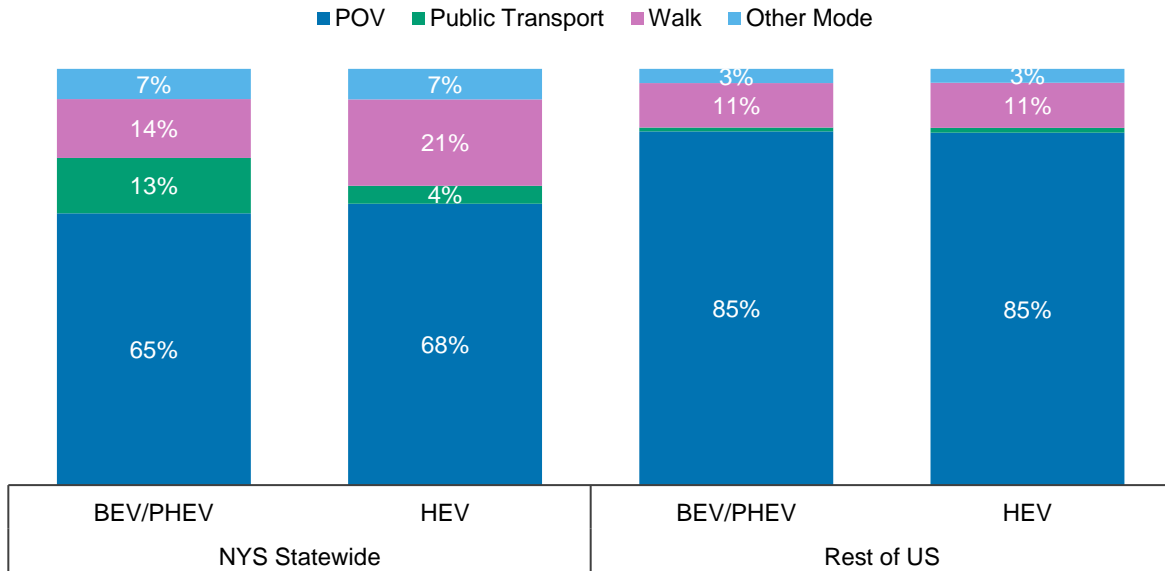


Figure 4-8. Share of person trips by mode of transportation and AFV type. NYS is New York State.

4.5 SHARE OF PERSON TRIPS BY TRIP PURPOSE

Figure 4-9 displays the share of person trips by trip purpose and vehicle ownership. In New York State, households with at least one AFV had comparable shares of person trips with that of their counterparts that had no AFV. However, households with at least one AFV had a slightly lower share of family and personal business trips (36%) than that of their counterparts that had no AFV (38%). Also, households with at least one AFV had a slightly higher share of social and recreational trips (31%) than that of their counterparts that had no AFV (29%) in New York State.

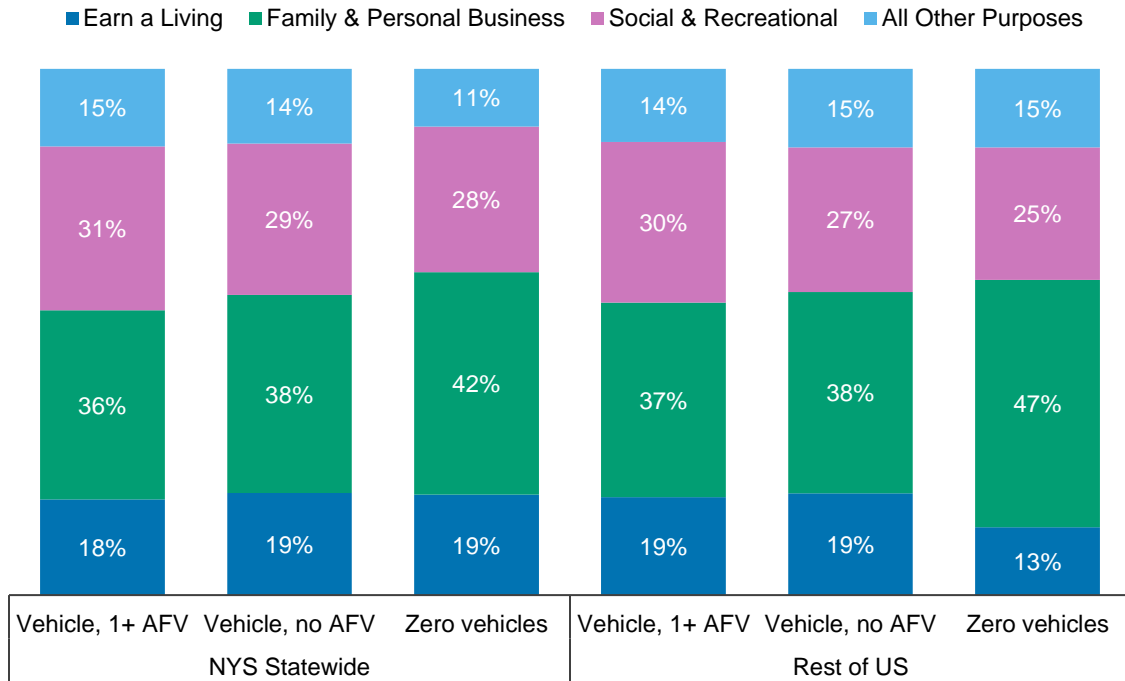


Figure 4-9. Share of person trips by trip purpose and vehicle ownership. NYS is New York State.

Figure 4-10 presents the share of person trips by trip purpose and AFV type. In New York State, households with HEVs had a lower share of working trips (17%) than that of their counterparts with BEVs or PHEVs (24%). Additionally, households with HEVs had a higher share of social and recreational trips (32%) than that of their counterparts with BEVs or PHEVs (22%). However, in the rest of the United States, the trip purpose distribution was relatively comparable for both groups.

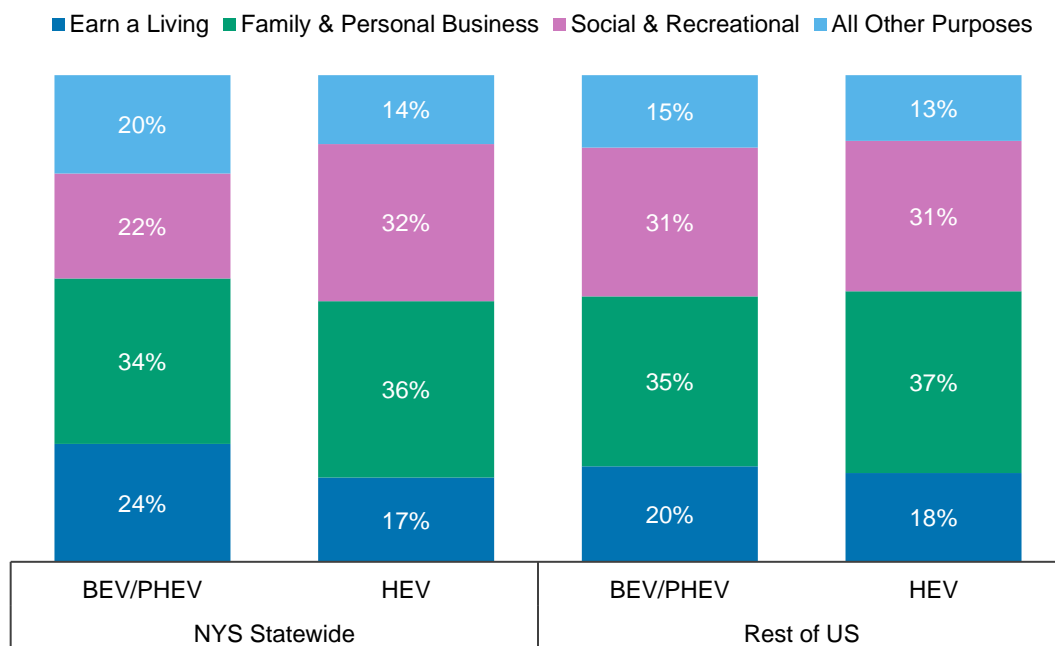


Figure 4-10. Share of person trips by trip purpose and AFV type. NYS is New York State.

4.6 VEHICLE MILES OF TRAVEL

In Figure 4-11, the average daily vehicle miles of travel (VMT) are presented by vehicle ownership. The figure shows that in New York State, households with at least one AFV had similar VMT (24.3 miles) compared with that of households without AFV (23.9 miles). Households with at least one AFV had slightly higher VMT (31.6 miles) than that of their counterparts without AFV (29.2 miles) in the rest of the United States, but this difference was not statistically significant.

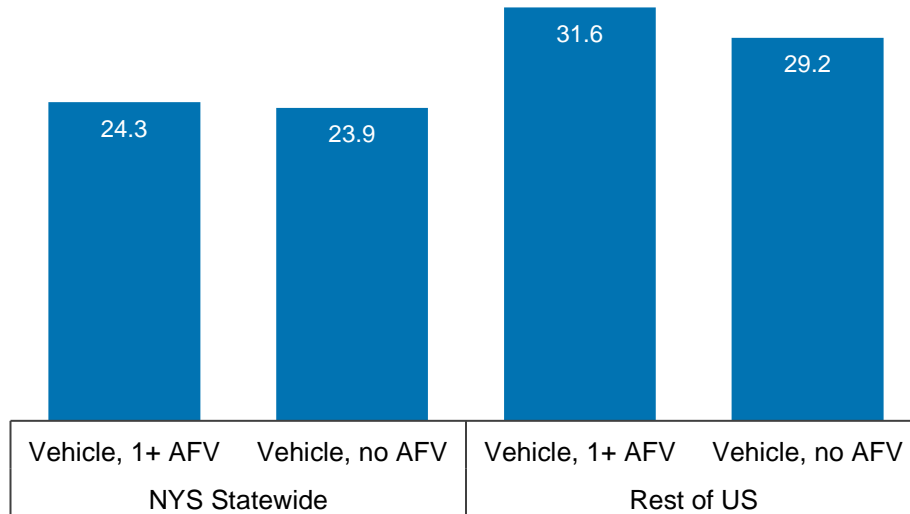


Figure 4-11. Average daily VMT by AFV adoption. NYS is New York State.

Figure 4-12 shows the average daily VMT of households with at least one AFV by AFV type. In New York State, households with HEVs had a higher VMT (24.9 miles) than that of their counterparts with BEVs or PHEVs (20 miles). A similar pattern was observed in the rest of the United States. However, the differences were not statistically significant.

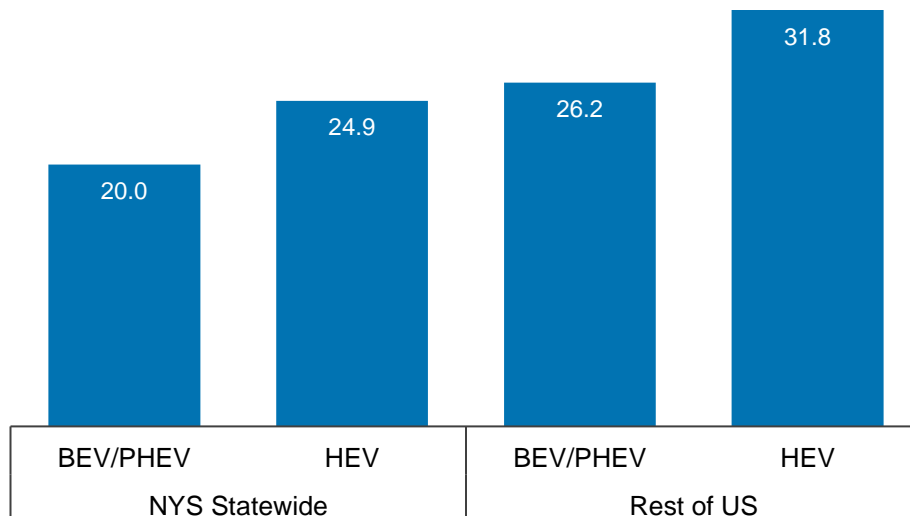


Figure 4-12. Average daily VMT by AFV type. NYS is New York State.

4.7 VEHICLE TRIP TRAVEL TIME

Figure 4-13 shows the average vehicle trip travel time in minutes by vehicle ownership. Households with at least one AFV in New York State had a comparable vehicle trip travel time with their counterparts without AFVs. Households with at least one AFV in the rest of the United States had a slightly higher vehicle trip travel time (61.6 min) than that of their counterparts without AFV (56.8 min).

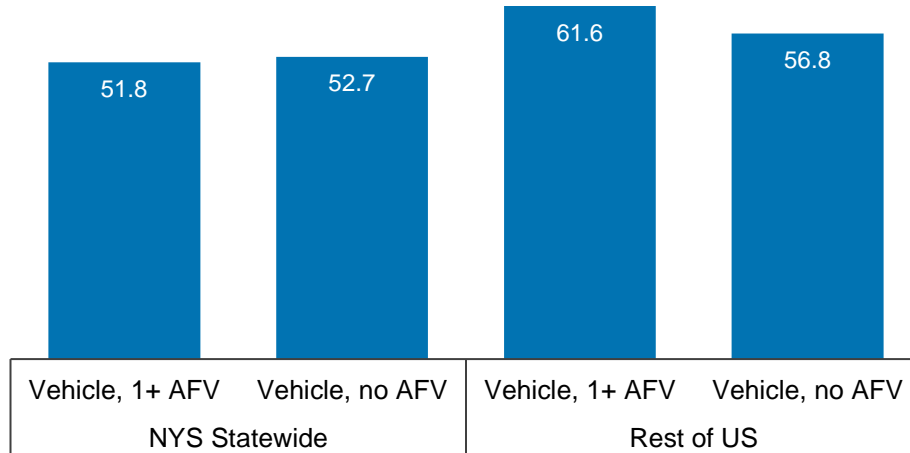


Figure 4-13. Average vehicle trip travel time in minutes by AFV adoption. NYS is New York State.

Figure 4-14 shows the average vehicle trip travel time in minutes by AFV type. Households with HEVs in New York State had a higher travel time (53.3 min) than that of their counterparts with BEVs or PHEVs (39.1 min). However, the difference was not statistically significant. The travel time was comparable for both groups in the rest of the United States.

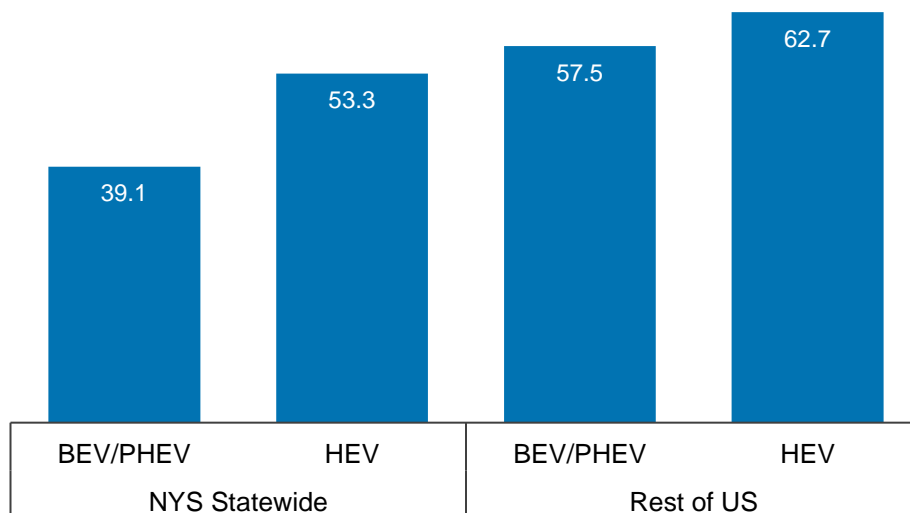


Figure 4-14. Average vehicle trip travel time in minutes by AFV type. NYS is New York State.

4.8 SHARE OF VEHICLE TRIPS BY TRIP PURPOSE

Figure 4-15 shows the share of vehicle trips by trip purpose. Across New York State and the rest of the United States, households with at least one AFV had a comparable share of vehicle trips by trip purpose with that of their counterparts with no AFV.

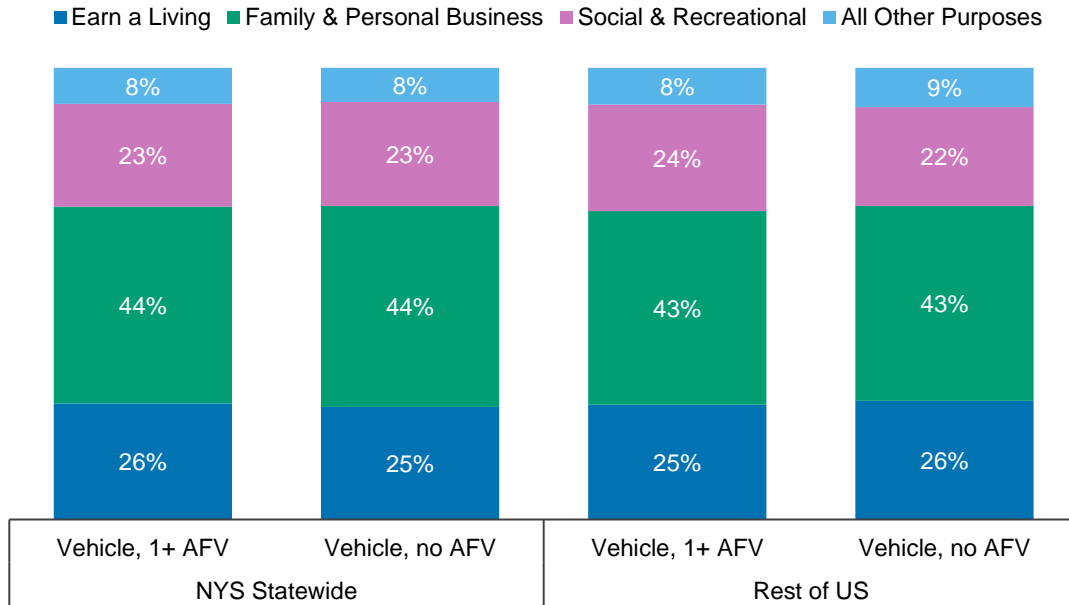


Figure 4-15. Share of vehicle trips by trip purpose and AFV adoption. NYS is New York State.

Figure 4-16 shows the share of vehicle trips of households with at least one AFV by trip purpose and AFV type. Households with at least one AFV had a comparable share of vehicle trips by trip purpose for households with HEVs and BEVs or PHEVs in New York State and the rest of the United States.

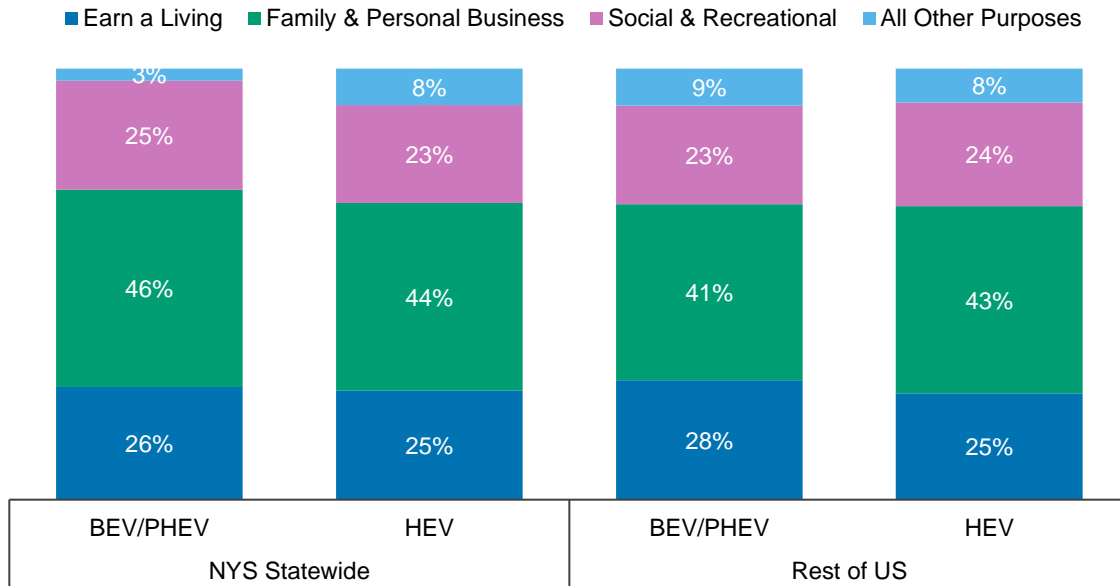


Figure 4-16. Share of vehicle trips by trip purpose and AFV type. NYS is New York State.

5. CONCLUSIONS

This report analyzed the usage and demographics of AFV owners in New York State based on the 2017 NHTS data. The objectives of this study were to evaluate AFV adoption and trip patterns within households, analyze adoption patterns by geographical, household and individual demographics, examine the travel behavior of households with at least one AFV, and assess EV adoption patterns. The following sections list key findings from this study.

Geographical Variation of Households with AFVs

- The percentage of households owning at least one AFV was lower in New York City than other regions of New York State.
- Of the 40 households in New York State that owned at least one PHEV according to the NHTS samples, 48% (19 households) lived within a 5-mile radius, based on the great circle distance, of an EV charging station, and 83% (33 households) lived within a 10-mile radius of the nearest charging station.
- The rest of the United States had a higher percentage of households that owned at least one AFV compared with New York State.
- A comparison was made between EV adoption levels using NHTS and EValueNY, a tool that gathers statistics on the electric car market in New York State. The estimates obtained from New York State household samples were slightly lower than the data provided by EValueNY.

AFV Household and Individual Demographics

- In New York State and the rest of the United States, households with higher incomes tended to have a higher proportion of AFV ownership compared with those with lower incomes.
- Homeowners in New York State and the rest of the United States exhibited a significantly higher share of AFV ownership compared with renters.

AFV Households' Mobility Patterns

- In New York State, households that owned at least one AFV tended to travel farther and have longer travel times compared with their counterparts without an AFV.
- Among households with at least one AFV, those with HEV tended to have more person trips and longer PMT and VMT, resulting in longer travel times, compared with households with BEV or PHEV.
- Households with AFVs had a slightly lower share of family and personal business trips but a higher share of social and recreational trips compared with those without AFVs.
- Households with at least one AFV tended to have a slightly higher share of walking trips than their counterparts without an AFV, but the differences were not statistically significant.

5.1 LIMITATIONS

Owing to the relatively low number of AFVs in 2017, the sample size of households with AFVs was small. Thus, the precision of the estimates was limited, and certain analyses and comparisons were prevented from being presented, such as the comparison between New York City and the rest of New York State. Furthermore, the low sample size rendered the comparisons not statistically significant, which inhibited a more thorough investigation of the relationship between AFV adoption and geographic, household, and individual demographics.

Future studies could benefit from using more recent NHTS data (i.e., NextGen NHTS Core data) or alternative data sources to explore AFV adoption patterns and their effects on travel behavior with larger sample sizes. By doing so, more accurate and reliable estimates can be obtained, enabling more comprehensive analyses and facilitating the development of informed policies and strategies aimed at promoting sustainable transportation planning in New York State.

5.2 EXPECTED IMPROVEMENTS

Anticipating advancements in the landscape of AFVs in New York State is crucial for comprehensive planning and policy development. As the state continues its drive towards transportation decarbonization, several key improvements could be envisaged.

Enhanced Charging Infrastructure Accessibility: Recognizing the pivotal role of charging infrastructure in facilitating AFV adoption, it is imperative to continue bolstering efforts to improve charger access across the state. Expanding charging networks will be necessary to alleviate range anxiety and encourage wider AFV ownership.

Affordability for All Income Segments: To ensure equitable access to AFVs, future strategies could concentrate on making these vehicles financially viable for individuals across the income spectrum. While higher-income populations have demonstrated greater AFV adoption rates, targeted programs that address the financial barriers faced by lower-income populations can contribute to a more inclusive transition to decarbonization.

Integration of Updated Incentive Programs: Incorporating information on newly introduced or revised incentive programs, especially those aimed at making AFVs more affordable and attractive to a broader audience, could enrich the report's insights and recommendations. These programs, if effective, could serve as catalysts for accelerating the shift towards AFVs in New York State.

ACKNOWLEDGEMENTS

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APPENDIX A. GLOSSARY OF NHTS TERMS

APPENDIX A. GLOSSARY OF NHTS TERMS

This glossary provides the most commonly used terms in the NHTS, as well as terms used in this report, and definitions of those terms. These definitions are provided to assist the user in the interpretation of the NHTS data.

Adult	For NHTS, an <i>adult</i> is defined as a person 18 years or older.
Alternative fuel vehicle (AFV)	Vehicles that use nontraditional fuels or technologies, such as electricity, hydrogen fuel cells, or compressed natural gas, in place of gasoline or diesel fuel
Battery electric vehicle (BEV)	Vehicles that use electric motors and motor controllers instead of internal combustion engines for propulsion—it is a type of EV
Destination	For travel day trips, the destination is the point at which there is a break in travel, except if the break is only to change vehicles or means of transport
Driver	A driver is a person who operates a motorized vehicle. If more than one person drives on a single trip, the person who drives the most miles is classified as the principal driver.
Employed	A person is considered employed if they worked for pay, either full time or part time, during the week before the NHTS survey interview. This definition includes persons who work at home or persons who have more than one job.
Electric vehicle (EV)	Vehicles that use one or more electric motors for propulsion
Household	A group of persons whose usual place of residence is a specific housing unit; these persons may or may not be related to each other. The total of all US households represents the total civilian noninstitutionalized population. A household does not include group quarters (i.e., 10 or more persons living together, none of whom are related).
Household income	Household income is the money earned by all family members in a household, including those temporarily absent. Annual income consisted of the income earned 12 months preceding the NHTS survey interview. Household income includes monies from all sources, such as wages and salary, commissions, tips, cash bonuses, income from a business or farm, pensions, dividends, interest, unemployment or workmen’s compensation, social security, veterans’ payments, rent received from owned property (minus the operating costs), public assistance payments, regular gifts of money from friends or relatives not living in the household, alimony, child support, and other kinds of periodic money income other than earnings. Household income excludes in-kind income such as room and board, insurance payments, lump-sum inheritances, occasional gifts of money from persons not living in the same household, withdrawal of savings from banks, tax refunds, and the proceeds of the sale of one’s house, car, or other personal property.
Household members	Household members include all people, whether present or temporarily absent, whose usual place of residence is in the sample unit. Household members also include people staying in the sample unit who have no other usual place of residence elsewhere.
Household vehicle	A household vehicle is a motorized vehicle that is owned, leased, rented, or company-owned and available to be used regularly by household members during the 2-week travel period. Household vehicles include vehicles used solely for business purposes or

business-owned vehicles as long as they are driven home and can be used for the home-to-work trip (e.g., taxicabs and police cars). Household vehicles include all vehicles that were owned or available for use by members of the household during the travel period, even though a vehicle may have been sold before the NHTS survey interview. Vehicles excluded from household vehicles are those which were not working and were not expected to be working within 60 days of the travel day, as well as vehicles that were purchased or received after the designated travel day.

Hybrid electric vehicle (HEV)

Vehicles that are powered by an internal combustion engine in combination with one or more electric motors that use energy stored in batteries

Journey-to-work trips (commute trips)

Includes travel to and from a place where one reports for work; does not include any other work-related travel, and does not include any trips for persons who work at home

Means of transportation

A mode of travel used for going from one place (origin) to another (destination), including private and public transit modes and walking

The following transportation modes, grouped by major mode, are included in the NHTS data.

Active modes: includes modes where a person must actively move from one place to the next

1. Walk: This category includes walking and jogging.
2. Bicycle: This category includes bicycles of all speeds and sizes that do not have a motor.

Private vehicle: a stipulation for being a private vehicle is that the vehicle is privately operated, including rental cars

1. Car: This category includes cars and station wagons. Leased and rented cars are included if they are privately operated and not used for picking up passengers in return for fare.
2. Sport utility vehicle: This category includes vehicles that are a hybrid of design elements from a van, a pickup truck, and a station wagon. Examples include a Ford Explorer, Jeep Cherokee, or Nissan Pathfinder.
3. Van: This category includes vans or minivans designed to carry 5 to 13 passengers or to haul cargo.
4. Pickup truck: This category includes vehicles with an enclosed cab that usually accommodates two to three passengers and has an open cargo area in the rear. Late-model pickups often have a back seat that allows for total seating of four to six passengers. Pickup trucks usually have the same size wheelbase as a full-size station wagon. This category also includes pickups with campers.
5. Motorcycle/moped: This category includes large, medium, and small motorcycles and mopeds.
6. Motorcycle/moped: This category includes large, medium, and small motorcycles and mopeds.
7. RV (motor home, ATV, snowmobile): An RV or motor home includes a self-powered recreational vehicle that is operated as a unit without being towed by another vehicle (e.g., a Winnebago motor home). This category also includes ATVs and snowmobiles.

8. Rental car: This category includes Zipcar and Car2Go in addition to commercially rented cars for private use.
9. Golf cart/segway: This category includes all electric or gas-operated vehicles designed for use on a golf course but whose use has recently extended to use within smaller, often gated, communities. NOTE: Travel via golf cart is NOT included in vehicle trips and vehicle miles of travel.

Public transportation: as used in Federal Highway Administration publications and analysis of NHTS data, typically includes the following, that are indicated in bold below, public or commuter bus, commuter rail, and subway/elevated rail/light rail/streetcar.

Bus

1. Public or commuter buses: These are local public transit buses that are available to the general public and buses used for short-distance public transport purposes (e.g., city bus or public bus, school buses).
2. Private/charter/tour/shuttle buses: These are private buses operating on a fixed schedule between population centers, and are buses that shuttle passengers from one fixed place to another (e.g., airport shuttles).
3. City-to-city buses: These are buses that run from one urban center to another (e.g., Greyhound).

Train

1. Amtrak/commuter rail: These include trains that run from one urban center to another.
2. Subway/elevated rail/light rail/street car (also known as rail rapid transit): This is a high-capacity system operated on a fixed rail or guide way system on a private right-of-way. Vehicles that run on a fixed rail system are powered by electricity obtained from an overhead power distribution system.

Other Modes

1. School buses
2. Paratransit/dial-a-ride
3. Taxi/limo: Taxis include the use of a taxicab by a passenger for fare, including limousines. In 2017, this category also included ridesharing such as Uber and Lyft.
4. Airplane: Airplanes include commercial airplanes and smaller planes that are available for use by the general public in exchange for a fare. Private and corporate planes and helicopters are also included.
5. Boat/ferry/water taxi: This includes travel by passenger line ferries.
6. Something else: This category includes any type of transportation not previously listed (e.g., skate boards, roller blades, sailboats, and cruise ships).

Motorized vehicle	Motorized vehicles are all vehicles that are licensed for highway driving. Snow mobiles and minibikes are specifically excluded.
New York City	New York City is defined in this report as the five county area: Bronx, Kings, Queens, New York (Manhattan), and Richmond.
Occupancy	<i>Occupancy</i> is the number of persons, including driver and passenger(s), in a vehicle.

Occupancy rate	NHTS occupancy rates are generally defined as the mileage-weighted averages of the number of persons on a vehicle trip.
Origin	Origin is the starting point of a trip.
Passenger	For a specific trip, a passenger is any occupant of a motorized vehicle other than the driver.
Person miles of travel (PMT)	PMT is a primary measure of person travel. When one person travels 1 mile, 1 person mile of travel results. When two or more persons travel together in the same vehicle, each person makes the same number of person miles as the vehicle miles. Therefore, four persons traveling 5 miles in the same vehicle results in 20 person miles ($4 \times 5 = 20$).
Person trip	A person trip is a trip by one or more persons in any mode of transportation. Each person is considered to make one person trip. For example, four persons traveling together in one automobile are counted as 4 person trips.
Plug-in hybrid electric vehicle (PHEV)	Vehicles that use batteries to power an electric motor, as well as another fuel, such as gasoline or diesel, to power an internal combustion engine or other propulsion source—a type of EV
Privately owned vehicle (POV)	A privately-owned vehicle or privately-operated vehicle is a vehicle that is not available to the public for a fee, such as a bus, subway, or taxi.
Travel day	A travel day is a 24-hour period from 4:00 a.m. to 3:59 a.m. designated as the reference period for studying trips and travel by members of a sampled household.
Travel day trip	A travel day trip is defined as any time the respondent went from one location to another by private motor vehicle, public transportation, bicycle, walking, or other means during the NHTS-assigned reporting travel day. However, a separate trip is not counted in two instances: <ol style="list-style-type: none"> 1. When the sole purpose for the trip is to get to another vehicle or mode of transportation to continue to the destination 2. Travel within a shopping center, mall, or shopping areas of 4–5 blocks, which is to be considered as travel to one destination
Vehicle	In the 2017 NHTS, the term vehicle includes autos, passenger vans, sport utility vehicles, pickups and other light trucks, RVs, motorcycles and mopeds owned or available to the household.
Vehicle miles of travel (VMT)	VMT is a unit to measure vehicle travel made by a private vehicle, such as an automobile, van, pickup truck, or motorcycle. Each mile traveled is counted as one vehicle mile regardless of the number of persons in the vehicle.
Vehicle trip	A trip by a single POV regardless of the number of persons in the vehicle
Work-related travel	These are trips related to business activities except travel to the place of work. For example, a plumber drives to a wholesale dealer to purchase supplies for his business, or a company executive travels from his office to another firm to attend a business meeting. Business, out-of-town trips, and professional conventions are also included.

