2022 Maryland Commuter Survey
Final Report

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Executive Summary

A New Annual Survey

The Maryland Commuter Survey (MCS) is a new survey of adult workers in Maryland designed to measure annual trends in commuting and remote work. The 2022 MCS is its first iteration, providing baseline understanding of commuting rates and patterns as Maryland exits the COVID-19 pandemic. This survey and future iterations will shed light on topics including how Marylanders are returning to in-person work, whether remote and hybrid workers are moving farther from workplaces, and how transit and other alternative modes are competing with automobility in the post-COVID transportation landscape.

Key Findings from 2022

Remote Work

- The majority of Maryland workers are hybrid or remote
- Remote workers are demographically diverse: predominantly female and people of color
- Hybrid workers tend to have the highest incomes and levels of education
- Remote and hybrid work may displace as much as 17% of statewide VMT

Commute Patterns

- Most commutes are 5–25 miles
    - Urban residents tend to commute less than 5 miles
    - Suburban and rural residents tend to commute more than 10 miles
- Most commutes are within the same county
- Lower income and fully in-person workers have shorter commutes

Commute Modes

- Driving is the dominant mode for commuting: nearly 90% of commuters drive regularly
- Many workers with walkable and bikeable commutes or access to transit nonetheless drive
- Transit would take five times as long as driving for the average commuter
- Women are considerably less likely to use transit or slow modes—walking, biking, scooting—than men

Commuter Priorities

- Maryland workers do not tend to prioritize commuting when choosing where to live
- Remote workers aren't interested in moving farther from work
- Increasing safety and multimodal options are high priorities for transportation improvements

Introduction

A New Normal?

Commuting patterns in Maryland may be undergoing an historic shift as workers emerge from the COVID-19 pandemic. While some have returned to pre-pandemic routines of in-person work, many have normalized hybrid and remote work patterns that allow them to commute less often or not at all. The American Community Survey (ACS) estimates that the proportion of Maryland workers who work primarily from home increased from 6% to 18% between 2019 and 2021 (USCB, 2019; 2021).[1] The National Capital Region's 2022 State of the Commute Survey indicates a much higher percentage of workers, 66%, telecommute at least occasionally (LDA Consulting, 2022). The 2022 Maryland Commuter Survey (MCS), the focus of this report, corroborates this substantial level of telecommuting. It finds that as many as 29% of Maryland workers always telecommute and an additional 35% sometimes telecommute. Moreover, the majority of those who commute would prefer to do so less often.

This reduction in commuting may have substantial implications for highway and transit demand. Many of Maryland's transportation systems have been designed to accommodate peak commuting volumes to job centers in and around Baltimore and Washington, D.C. If high rates of remote work continue as a "new normal," roadway congestion may be somewhat alleviated but revenues from tolls and fareboxes could diminish substantially. Changing commuting patterns may also affect other aspects of the transportation system, such as the modes used for non-work activities. In the long-term, the ability to work remotely may affect where Marylanders choose to live, further modifying their transportation needs. Tracking how Marylanders commute, therefore, is important for forecasting future needs and appropriately planning transportation investments.

The Maryland Commuter Survey (MCS) is intended to provide annual snapshots of commuting patterns as well as longitudinal trends as the survey is repeated. Whereas a previous survey, conducted in 2021, was designed to measure how travel behaviors were shaped by the COVID-19 pandemic, the MCS is designed to more specifically focus on commuting and be applicable to the post-COVID landscape. It will eventually track changes in how Marylanders are commuting, both as they emerge from COVID and in response to more general changes in how they live and work. While the MCS focuses on commuting, it also measures other aspects of how respondents live, work and travel in order to examine how commuting patterns relate to Marylanders' broader lifestyles.

This report summarizes the approach and findings from the 2022 MCS, which provides baseline evidence of the state of commuting in Maryland in that year.

[1] Based on 1-year estimates from Table B08301

Summary of Findings

Remote Work

The majority of Maryland workers are remote or have hybrid schedules. These workers are sociodemographically diverse, but tend to be more highly educated, have higher incomes, and live in more urban areas than those who work in-person. Remote and hybrid workers are in a broad range of industries and have both office-related and manual work activities; working on a computer and driving a vehicle are the activities mostly strongly associated with remote and hybrid schedules. Remote work is most common among a cosmopolitan segment of the workforce we call *Wireless White Collars*, who are demographically diverse, tend to live in urban and suburban areas and are more likely than others segments to work in professional services and use active transportation modes for non-work activities. Hybrid work is most common among *Flourishing Families* and *Seasoned Professionals*. The former tend to be suburban and have children living at home; the latter tend to be older, predominantly white, and higher income. In-person work is predominant among *Blue Collar Commuters*, who tend to have lower incomes, work in retail, food, or lodging, have shorter commute distances, and use more alternative modes for commuting. These segments demonstrate how opportunities to work remotely and with hybrid schedules are distributed unequally among Maryland workers.

Remote and hybrid work are potentially displacing substantial volumes of travel within Maryland. If all remote and hybrid workers drove to work five days a week, this might add as much as 17% to statewide VMT. Conversely, if they used transit to commute one day a week at rates similar to the general working population, they might generate nearly three quarters of a million additional transit trips each week. Remote and hybrid work may offer substantial benefits for transportation sustainability, congestion, and safety, but are likely substantially curbing transit demand and revenues.

Commute Patterns

Workers who commute tend to travel moderate distances, between 5 and 25 miles, between home and work. Those living in urban areas tend to travel the shortest distances—more than half of them travel less than 5 miles—while those living in suburban and rural areas tend to travel at least 10 miles. Most commutes are within the same county, though there are substantial flows between counties within the Baltimore and Washington, D.C. metro areas. The dominant direction of inter-county flows within these regions are toward the urban centers, though there are measurable reverse and circumferential flows, even within the limited MCS sample.

Commute distance analyses indicate that lower-income and fully in-person workers tend to have shorter commutes than their higher-income and more remote counterparts. This may reflect an economic imperative to economize commuting among those for whom it represents a comparatively high cost. Lower-income workers were also, however, more likely to commute long distances than their higher-income counterparts, suggesting that they may seek lower-cost

housing that is farther from job centers. Both these patterns reinforce the importance of planning housing that is attainable by low- and moderate-income Marylanders and provides efficient access to job centers.

Commute Modes

Driving is by far the most common mode that Marylanders use for commuting. Nearly 90% of commuters report regularly driving alone or carpooling, while fewer than 20% report regularly using transit or slow modes, such as walking, bicycling, or riding an electric scooter. Nearly 70% of those who commute by driving never carpool, while only 8% never drive alone. These low rates of using alternative modes indicate that there is substantial potential for reduced driving, but also hint at the difficulty of developing viable alternatives on commutes for which driving has a strong precedent. Nearly 10% of commuters, not including those who work fully remotely, live within one mile of work, yet nearly 90% of these regularly drive. These commuters are well-positioned to use slow modes, including walking, bicycling and new forms of micromobility, such as electric scooters, but well-developed bike lanes and other infrastructures will be required to make these viable alternatives. The majority of commuters report that commuting by transit would be possible, but these hypothetical transit commutes would take five times longer, on average, than driving. This time inefficiency makes transit unviable for many Marylanders.

Commuter Priorities

Commuting tends to be a lower priority than other factors for Maryland workers who are deciding where to live. While more than 50% of workers consider low commute time and the ability to commute by transit to be important, much larger proportions emphasize home- and neighborhood-related factors, such as home spaciousness or proximity to friends and relatives. The majority of workers report being satisfied living their current distance from work, while about a third would prefer to move closer to work. Very few, even those who work remotely, are interested in moving farther from work. This suggests that, while there is some potential for Marylanders to reduce commuting distances if they have the opportunity to move, they are most likely to prioritize other factors and maintain similar commutes. Remote workers are unlikely to move considerably farther from their employers.

The vast majority of Maryland workers consider safety and security of transportation systems to be a priority for MDOT in the coming years. Expanding transit and other multimodal options, and improving user experience, are also strong priorities. These policy priorities suggest a mandate for planners to make transportation alternatives safe and accessible for a broader range of Marylanders.

Summary of Methodology

Survey Design

The MCS is designed to collect basic information about how Marylanders commute alongside information about where and how they live and work, their demographics, as well as their

transportation resources, attitudes, and priorities. The full survey questionnaire is included in Appendix 5.

Rather than being designed as a travel survey, which typically uses a travel diary to document trips taken across one or more example days, the MCS collects more general information about typical commuting behavior. This dramatically reduces respondent burden—the survey takes less than 15 minutes to complete—and better accounts for travel that does not occur every day, which is important for capturing hybrid commuting schedules. However, this technique relies more heavily on respondent recall and provides less specificity about trips. It does not, for example, allow for precise estimation of daily commuting volumes. It does, nonetheless, provide valuable information about who commutes in different ways, the spatial and temporal characteristics of commutes, and factors that contribute to commuting decisions. The form of this survey provides an efficient window into commuting patterns through a moderately-sized sample.

Fielding

The 2022 MCS was fielded in an online format using Qualtrics software and distributed to a panel of Maryland residents maintained by Qualtrics Research Services. Questions at the beginning of the survey were used to screen respondents, ensuring that they consented to participate, were at least 18 years old, currently employed, and residents of Maryland. The survey used recruitment quotas to collect a sample that was approximately representative of the population of adult Maryland workers. Quotas were defined for gender, age, race and ethnicity, and urban-rural balance, based on 5-year estimates from the 2021 American Community Survey (ACS) (U.S. Census Bureau, 2021; Table 1). Some quotas, such as those for non-Hispanic Black residents, were inflated above ACS proportions to ensure sufficient participation among demographics that are traditionally underrepresented in survey research. Once quotas were filled, the survey declined participation from additional respondents with those characteristics, reducing the likelihood of a sample that was overwhelmingly biased toward a particular demographic. While sampling was not randomized, it nonetheless approximated the population of Maryland workers across several dimensions.

Table 1. Demographic segments used to set recruitment quotas. Columns show estimated proportions of Maryland workers in each category based on 2021 1-year ACS data, recruitment quotas designed to oversample difficult-to-recruit segments, and the final sample.

	ACS	Quota	Sample
Gender			
Female	51%	50%	53%
Male	49%	50%	45%
Non-Binary or Not Identifying			2%
Age			
18-34	29%	30%	30%
35-54	35%	30%	33%
55+	37%	40%	36%
Race & Ethnicity			
Non-Hispanic White	51%	40%	45%
Non-Hispanic Black	29%	35%	30%
Hispanic	10%	15%	15%
Other Race	10%	10%	10%
Geography			
Urban or Suburban	85%[2]	85%	85%
Rural	15%	15%	15%

Participation in the survey was entirely voluntary and respondents were compensated for completing the full survey. Compensation was provided by Qualtrics at levels that varied between based on the difficulty of recruiting respondents with certain demographics; traditionally underrepresented subjects were paid more. Compensation levels were advertised to respondents prior to participation and likely ranged between $1.50 and $3. Many respondents in this pool regularly complete surveys for market research and are compensated for multiple surveys at regular intervals.

Despite efforts to reduce sampling bias, some groups were overrepresented in the final sample. Notably, hispanic respondents, who were expected to be difficult to reach, instead participated at disproportionately high rates, filling their entire 15% quota. Male respondents, meanwhile, were more difficult to recruit than anticipated. Quotas for these groups may be adjusted for the

[2] Based on Tract-level populations in 2020 Census Urban Areas

2023 survey to yield more representative samples along these dimensions. The methods used to collect the survey may also have contributed to unmeasured biases.

The online format of the survey likely limited participation among older and lower-income respondents with less access to or familiarity with computers and the internet. The survey was designed to be easily taken on mobile phones, broadening its reach, though testers reported that it was still easier to take on a desktop or laptop computer. It was also likely easier for workers who interact frequently with computers and have flexible schedules to participate, potentially skewing responses toward higher-income professionals.

Data Cleaning & Post-Processing

The raw survey data, with 766 respondes, included numerous poor-quality records due to what appeared to be both unintentional errors and intentional negligence by respondents. We manually reviewed all records and either excluded or corrected those that appeared to contain errors. More than 15% of the raw records contained substantial logical inconsistencies or nonsensical responses. We decided to entirely exclude these records, yielding a “full sample” of 651 responses. Among these, 93 records were flagged as containing a small number of errors that could be either manually corrected with a high degree of confidence or partially excluded from analyses.

We also identified a subsample of 468 records with home and work locations that were precise enough to allow for analysis of commuting routes: the “location subsample.” The survey asked respondents to locate their home and work based on street name and nearest cross street, with the aim of balancing specificity and privacy. While attractive in theory, this approach yielded responses that varied greatly in quality. Some respondents provided no cross street, others misspelled street names, some provided no street at all, and still others named streets that we could not identify. We used custom-coded software to manually review and map each surveyed location, make corrections to street or city names, and geocode locations as precisely as possible. Ultimately, street-level home locations were identified for 96% of the final sample, and street-level work locations were identified for nearly 80%. The majority of remaining locations were geocoded at the city level, while some were only available at the state level.

We post-processed records to impute additional information and refactor values so they were more usable for analysis. The Google Maps API was used to estimate commute travel times and distances by driving, transit, and walking. These imputed routes offered comparisons with travel times reported by respondents and evidence of whether non-auto commutes were a practical option.

We also refactored the raw survey data into formats that were more usable for analysis. Categorical responses, for example, were converted into dummy variables. Meaningful null values were refactored into interpretable values. Remote workers, for example, were not asked how many days they commuted each week, but zero days could be reasonably assumed. We custom-coded software to aid with cleaning, post-processing, and analyzing the survey data. Cleaning and postprocessing procedures were scripted or documented in markdown files for

automated reproducibility. Additional information about data cleaning and post-processing is included in Appendix 2.

Weighting

While recruitment quotas helped to reduce sampling biases, the final sample nonetheless overrepresented some population segments and underrepresented others. Weights were calculated to adjust for these biases, and expansion factors were calculated to scale survey responses across the entire population of adult Maryland workers. Weighting involved counting survey responses within bins representing overlapping demographic segments (e.g., rural, non-Hispanic Black, between ages 35 and 54), then calculating a coefficient for each bin to scale their counts so they represented the appropriate portion of the statewide population. These bins needed to be narrow enough to reflect the complexities of statewide demographics, but broad enough that each contained a large enough sample to be reliably representative. We examined which combinations of demographic segments were imbalanced across the sample to identify three factors for weighting, each with between two and four segments: urban vs. rural home locations, four race and ethnicity segments, and three age segments.

Detailed information about the weighting procedure is included in Appendix 3. Final weights ranged from 32% for rural hispanic workers from 18 to 34 years old, suggesting that this segment of the population was substantially overrepresented, to 219% for rural hispanic workers aged 55+, indicating that they were substantially underrepresented. More than half of responses were weighted within 20 percentage points of 100%, demonstrating that most of the sample needed little adjustment to appropriately reflect the Maryland population.

Final Sample

The final sample of 651 adult Maryland workers was well-balanced across statewide demographics (Table 1, Figure 1) and geographies (Figure 2). Female, younger, and hispanic workers were slightly overrepresented in the raw sample, while male, older, and white workers were slightly underrepresented. The overall balance of urban and rural workers, based on self-reported location types, was consistent with statewide trends, though some demographic segments were disproportionately represented in urban or rural counties. The weighting procedure described above was used to correct for these imbalances, though weighting did not have a dramatic effect on the survey results.

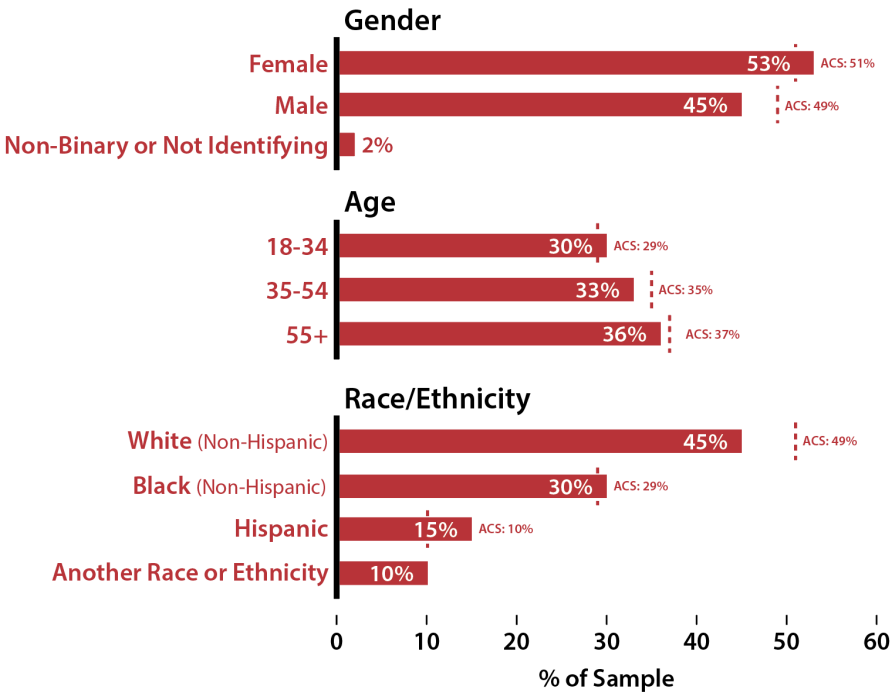


Figure 1. Demographic characteristics of the unweighted MCS sample (bars) compared with statewide adult workers estimated from the ACS (dashed lines). The unweighted sample overrepresented female, younger, and hispanic workers, and undersamples male, older, and white workers. Weighting aligned the sample with ACS estimates for age and race/ethnicity as well as urban-rural balance by county (not shown in this figure).

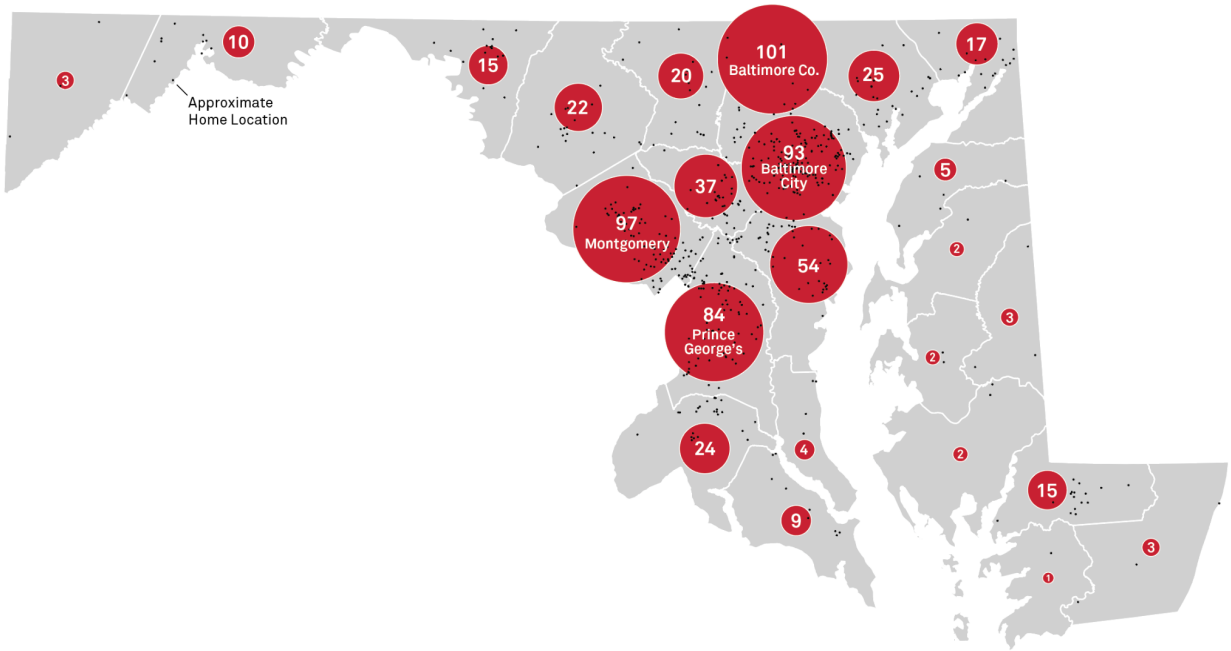


Figure 2. Home locations of unweighted MCS respondents. Circles show totals by county. Includes all respondents with home locations identifiable at the county level (N=648). Based on unweighted survey responses.

A subsample of 468 workers, the *Location Subsample*, had high-quality home and work locations that allowed for analyses of commuting patterns. This subsample excluded respondents with home and work locations reported at only the state level. More detailed information about this subsample is included in Appendix 2.

Findings

Remote Work

The Majority of Workers are Remote or Hybrid

The MCS indicates that only about a third of Maryland workers have fully in-person schedules that involve always commuting to an official workplace (Figure 3). Approximately two thirds, meanwhile, work remotely at least some of the time. Nearly half of these (29%) work remotely all the time. While these heavy rates of remote work may be holdovers from the COVID-19 pandemic, they demonstrate continued willingness on the part of both workers and employers to reduce in-person work to degrees that substantially impact commuting demand.

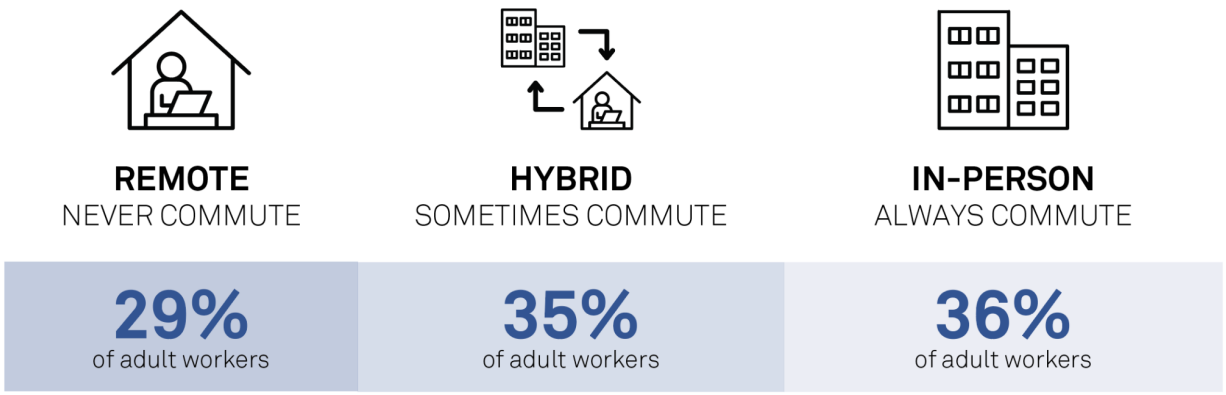


Figure 3. Rates of fully remote, hybrid, and fully in-person workers. Based on weighted survey responses.

Rates of remote work are substantially higher than they were prior to the pandemic, but appear to be holding steady even as pandemic restrictions subside. The Maryland COVID-19 Travel Behavior Survey, conducted by NCSG in 2021, found that only a third of working respondents telecommuted regularly prior to the pandemic, while 69% telecommuted during the peak of the pandemic (Erdoğan et al., 2021).[3] This latter rate is only 4% higher than that from the 2022 MCS, suggesting that high rates of telecommuting are persisting. The Metropolitan Washington

[3] These results were not weighted to the statewide population, but were from a quota-based sample (n=459 workers) similar to that from the MCS.

Council of Governments (MWCOG) State of the Commute survey similarly shows that 34% of workers telecommuted regularly in 2019, before the pandemic, but 65% telecommuted in 2022 (LDA Consulting, 2022). The 2022 MWCOG rate is nearly identical to that from the MCS. This both validates the accuracy of both surveys and reinforces the similarities in commuting behavior between Maryland and the partially overlapping Washington metro region.

High levels of preference and capability for remote work also suggest that it will continue to be common into the future. Forty-six percent of in-person workers, and 60% of hybrid workers, would prefer to work more remotely than they currently do, while only 8% of fully remote workers would prefer to work less remotely. Nearly 71% of workers, meanwhile, report that their current job responsibilities could be met with either a hybrid or fully remote schedule. These findings suggest that there is room for growth in remote work if employers are willing to allow it.

Who Works Remotely?

A diverse array of Marylanders work remotely or with hybrid schedules. Fully remote workers are more likely to be female and people of color than are hybrid and in-person workers (Figure 4). Hybrid workers, however, tend to have more advanced degrees and higher incomes, while in-person workers have the least education and lowest incomes. Remote and hybrid workers are also more likely to live in urban and suburban areas where they, paradoxically, have higher access to jobs than those in rural areas who tend to commute more often. This suggests that hybrid workers may be the most sociodemographically privileged segment of the workforce. Hybrid schedules may allow those with the greatest means to choose where and when they work, potentially offering the best of both in-person and remote options.

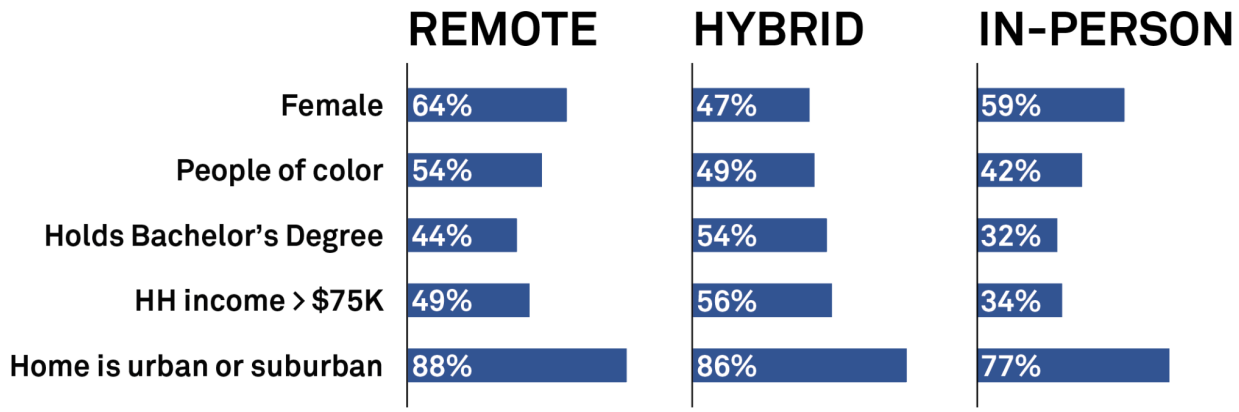


Figure 4. Demographic characteristics of remote, hybrid, and in-person workers. Based on weighted survey responses.

We used a regression model to examine the characteristics of hybrid and remote workers while holding other factors statistically constant (see Appendix 4). Model results indicate that remote and hybrid work are associated with more diverse work activities, industries, and workplace types than might be expected. Those who work on a computer are, unsurprisingly, nearly three times more likely to work remotely, and two and a half times more likely to have a hybrid schedule than to work in-person (Figure 5). Teaching is also strongly associated with remote

work. Surprisingly, those who drive a vehicle for work are also twice as likely to be fully remote, and three times as likely to have a hybrid schedule than work in-person. These may include gig economy workers, such as Uber drivers, who never visit an official workplace, or mobile tradespeople, such as plumbers, who may go to a central workplace only on certain days. This indicates the breadth of jobs that may be done remotely or with hybrid schedules, including those that do not take place in a home office and are, in some senses, inherently remote.

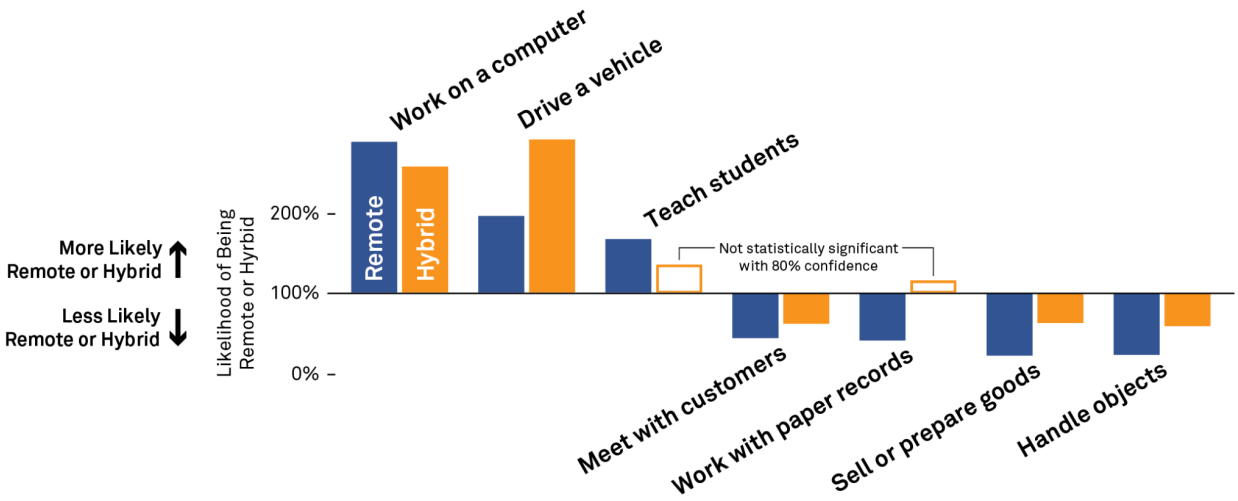


Figure 5. Modeled likelihoods of remote (blue bars) or hybrid (orange bars) work by labeled work activities. Likelihoods are in reference to an in-person alternative and are based on odds ratios from the logistic regression model reported in Appendix 4. Based on unweighted survey responses.

Conversely, job activities that are unlikely to be performed remotely include meeting with clients or customers, working with paper records, selling or preparing goods, and handling objects. These activities also suggest the breadth of industries, job types, and employer skills that are associated with in-person work. Both high-income professionals and lower-income service workers, for example, may need to work in-person to interface with clients or customers. Some level of in-person work may be required within most industries.

Indeed, only a few industries are strongly associated with remote work. *Professional, technical, or business services* is the sole industry in which workers are significantly more likely to work both remotely and with hybrid schedules than in-person. Workers in *arts, entertainment, and recreation* and *information services*, which includes publishing and media, tend to have hybrid schedules, but not fully remote ones. This underscores how even industries with substantial computing-based workforces may require some in-person work, either by certain employees or for particular tasks. Work activities may be a stronger indicator of remote work capability than industries.

Workplace types associated with remote and hybrid work also show that it takes diverse forms. Those who work in office settings are highly likely to be remote or hybrid, but so are those who work in construction, agriculture, or mining settings. Those working in food and accommodation

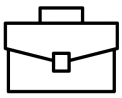
settings are also likely to be fully remote. Many workers in these non-office settings nonetheless report work activities that are often associated with office environments, such as computing and meeting with clients and colleagues, which might be accomplished remotely. Activities such as driving or delivering may also be done remotely, as previously discussed. These results demonstrate how remote and hybrid work may extend well beyond conventional office workers, especially as jobs involve a diverse array of skills and activities.

Remote Worker Types

We used a cluster analysis to further examine the characteristics of workers who commute and work in different ways. This analysis, described in further detail in Appendix 4, uses individual and household characteristics, employment attributes, home and work location attributes, and commute characteristics to group workers based on their similarities and differences. It identifies four main types of workers, which we have named according to their distinguishing characteristics: *flourishing families* (20% of workers)*, wireless white collars* (21%)*, blue collar commuters* (33%)*, and seasoned professionals* (26%) (Table 2). A key differentiator between the types is their propensity to work remotely. Two of them—flourishing families and seasoned professionals—tend to have hybrid schedules, though the former works in-person more often and latter works more remotely. Wireless white collars tend to work fully remotely, while blue collar commuters tend to work fully in-person. While this typology describes only major trends in the composition of the Maryland workforce—some workers may not fit well into any of the types—it is nonetheless useful for understanding who tends to commute in different ways.

Flourishing Families are composed of commuters who are middle-aged and more racially diverse, with the highest percentage of Hispanic workers and other people of color. On average, they have larger households with five members, two children, and own two cars. The majority have incomes ranging between $75k to $150k. Their average education level is between some college and an Associate's degree. Their homes are located in suburban or rural areas, while their workplaces are primarily in suburban regions. They mostly prefer a hybrid work setup with a bias towards in-person work three times a week. While driving is their primary commute mode, they use transit and active modes and higher levels than others. Although most work in office settings, they include a relatively high proportion (45%) of manual workers. Workers of this type primarily work healthcare, professional services, education, and government.

Table 2. Workers types identified through cluster analysis. Based on unweighted survey responses.

 **Flourishing Families**	 **Wireless White Collars**	 **Blue Collar Commuters**	 **Seasoned Professionals**
Hybrid (Leaning In-Person)	Remote	In-Person	Hybrid (Leaning Remote)
20% of Workers	21% of Workers	33% of Workers	26% of Workers
Tend to:			
● be a person of color ● have children ● live in a suburban location ● work in suburban location ● have at least 2 cars in household	● be female ● be a person of color ● live in an urban or suburban location	● make less than $75K ● work in retail, food, or lodging ● have manual work activities ● have some college education ● commute less than 10 miles each way	● be white ● be older than 55 ● make more than $75K ● live in a suburban location ● commute more than 20 miles each way ● prefer working remotely ● have office-based work activities
More likely than other types to:			
● commute by walking or micro modes	● have an out-of-state employer ● use active modes for non-work activities ● have non-manual work activities ● work in professional services	● live in an urban location ● commute at odd hours ● commute by transit or walking ● be disabled	● work full time ● work in an urban location ● live in a rural location ● commute by automobile ● work in government

Wireless White Collars tend to be fully remote with a strong preference for remote work. Some work for employers outside Maryland or neighboring states. They are disproportionately female, tend to be middle-aged, and live in single-car households with two members and without children. Most workers in this type have some college education or an Associate's degree and have moderate incomes: 30% make between $35,000 and $75,000, while 40% make between

$75,000 and $150,000 annually. They tend to live in either urban or suburban areas, with more living in the suburbs. They tend to prioritize home-related factors when deciding where to live, and are less concerned with commuting factors. They are the strongest users of walking and micromobility —biking and electric scooters—for non-commuting activities and tend to be office workers in professional services, healthcare, and banking/finance/insurance.

The largest cluster, Blue Collar Commuters, are primarily in-person workers. Most have manual job activities and tend to be employed in retail, food, or lodging industries. They are less racially diverse than other types, tend to be middle-aged, and tend to live in two-person households without children. They have some college education on average, but a significant proportion have only a high school diploma. Their incomes tend to be lower than other types, with most earning less than $75,000 and many earning less than $35,000. They tend to live in both urban and suburban areas, but have the highest share of urban residents among any of the types. These are mostly Baltimore-oriented commuters who have the shortest average commutes of any type, with a median length less than 6 miles. This type has the highest percentage of workers who commute during odd hours: late night or early morning. They are also most likely to commute by transit and walking.

Seasoned professionals are predominantly white and tend to be older, with a median age greater than 55. Most have two-person households without children and with two cars. They are well-educated, with the majority holding a Bachelor's degree. Most are employed full-time, and have the highest share earning more than $150,000. Their job locations are primarily in urban areas but most live in suburban and rural areas. They tend to have hybrid schedules and the longest commutes, with a median over 16 miles. They also exhibit a strong preference for remote work. Workers in this type tend to have Washington, D.C-oriented jobs in government, healthcare, professional services, and education. They are the least likely to use alternative transportation modes for either work or non-work activities.

Impacts on Travel Demand

A key impact of remote work is reduced demand for auto, transit, and other transportation systems. This has potential consequences for congestion, environmental impacts, and revenue streams. While the limited sample of the MCS cannot be used to precisely estimate impacts on specific infrastructure or systems, it does provide broad estimates of how remote work impacts travel demand.

Hybrid schedules have the potential to produce fewer vehicle miles traveled (VMT) than in-person work because they involve fewer commute trips. However, hybrid workers tend to live significantly farther from work than their in-person counterparts, effectively nullifying these savings (Figure 6). While in-person workers would produce about 51 VMT each week if they drove alone, hybrid workers would produce about 49 VMT, a difference that is statistically insignificant. Remote workers tend to live similar distances from their employers as hybrid workers, but do not commute regularly, yielding substantial VMT savings. Hybrid work, therefore, may not produce substantial benefits for VMT relative to in-person work, while fully remote work offers a strategy for VMT reduction.

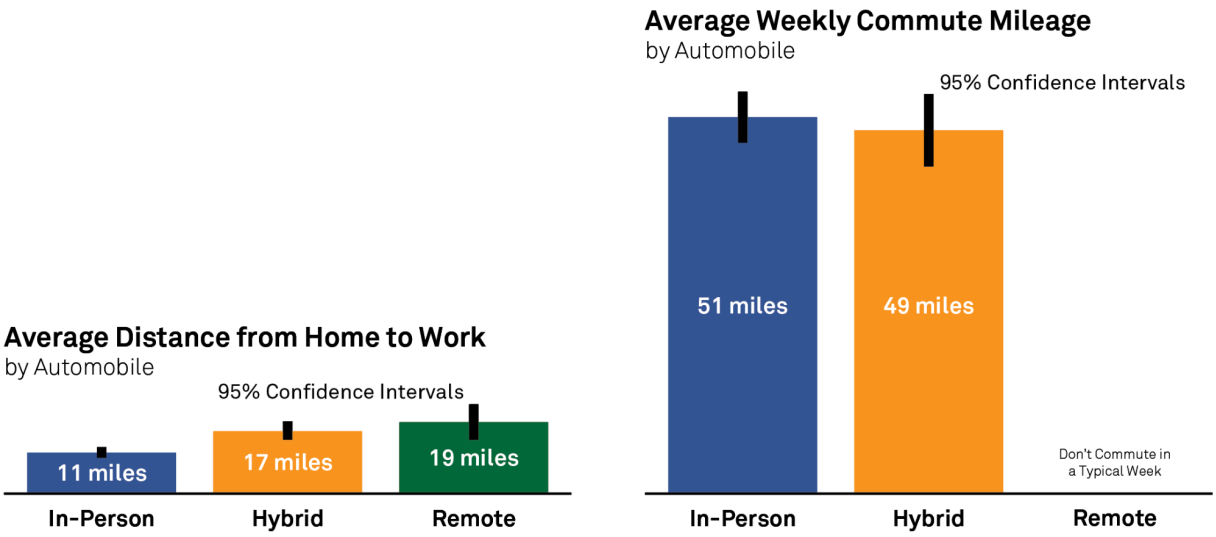


Figure 6. Average distances from home to work and estimated weekly commuting mileage for in-person, hybrid, and remote workers. Based on weighted survey responses.

If hybrid and remote workers began regularly commuting between their current home and employer locations, however, it could dramatically increase statewide VMT. Survey results indicate that remote workers would accumulate an additional 140 VMT per week on average if they instead commuted by driving alone five days a week. Hybrid workers would accumulate 67 additional VMT per week on average if they drove all five days.[4] Scaled statewide, remote and hybrid workers, they could accumulate as many as 203 million additional VMT per week, equivalent to 19% of statewide VMT in 2021, if they instead commuted by driving five days a week (Figure 7; MDOT SHA, 2022). This estimate is highly approximate and likely liberal, given that not all would likely drive and some might choose to move closer to work. It suggests, however, that fully remote work may substantially reduce demand on Maryland's roadways with commensurate benefits for maintenance, congestion, safety, air quality, and greenhouse gas emissions.

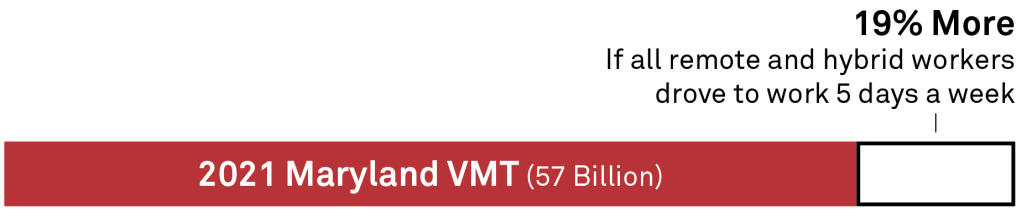


Figure 7. Statewide VMT might increase 19% from 2021 levels if all remote and hybrid workers drove alone to work five days a week. Based on weighted survey responses.

Remote and hybrid work may also have substantial repercussions for transit revenues. The MCS indicates that about 18% of commuters regularly use transit, though not necessarily every

[4] Includes remote and hybrid workers who reported precise home and employer locations and live within 50 driving miles of their employer.

day, and 55% could feasibly use transit. If these proportions of hybrid and remote workers commuted by transit just one day a week, it might generate between 730,000 and 2.2 million additional trips each week. By comparison, the total number of transit boardings across systems throughout and intersecting Maryland, including those in the Washington, D.C. and Philadelphia metro areas, averaged 9 million per week in 2022, down from 16 million per week in 2019 (USDOT FTA, 2022). If remote and hybrid workers adopt more frequent commuting schedules and use transit, this might substantially help ridership rebound from its pandemic low.

Commute Patterns

Most Commutes are Between 5 and 25 Miles

More than half of Maryland commuters travel moderate distances to work: between 5 and 25 miles (Figure 8). Approximately a third travel short distances: less than 5 miles. Only 1% are “stretch commuters”, traveling more than 50 miles. These statistics include commutes by all transportation modes, though driving is the dominant mode for commutes of all distances.

Figure 8. Percent of commuters by one-way driving distance from home to work. Based on weighted survey responses.

Suburban and Rural Residents Have Longer Commutes

Unsurprisingly, suburban and rural commuters tend to live farther from work than their urban counterparts (Figure 9). The majority of urban commuters (57%) travel less than five miles to work, while 30% commute moderate distances of 5 to 25 miles and only 13% commute farther than 25 miles. Suburban and rural commuters, by contrast, tend to travel at least 10 miles to work. A sizable number of suburban commuters, nearly a quarter, also travel less than 5 miles, while rural commuters skew toward longer distances.

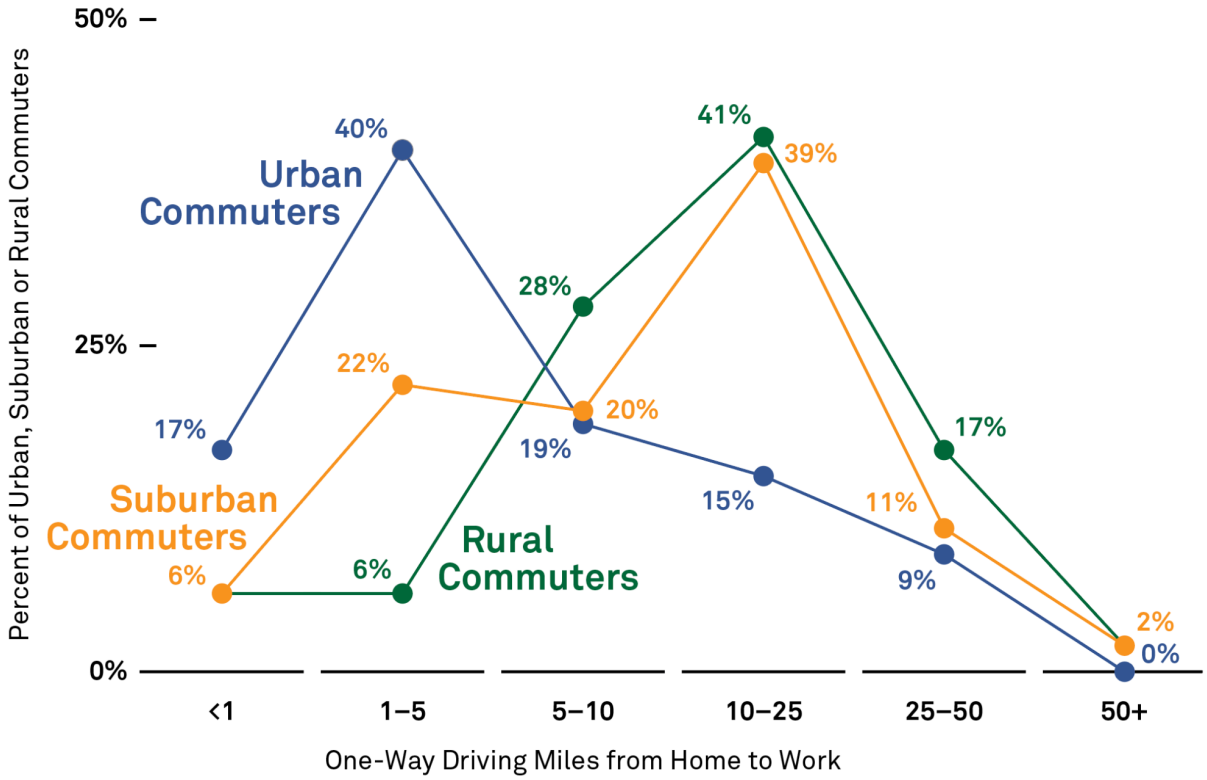


Figure 9. Percent of urban, suburban, and rural commuters by one-way distance from home to work. Based on weighted survey responses.

The relatively shorter commutes of urban and suburban residents are consistent with the majority of their workplaces being located in urban and suburban areas (Figure 10). Fifty-eight percent (58%) of commuters who live in suburban areas also work within suburbs, suggesting substantial demand for circumferential or intra-suburban transportation systems.

Rural commuters are, unsurprisingly, more likely than their urban and suburban counterparts to work in rural areas. Nonetheless, the vast majority have more urban workplaces. Many, in fact, leapfrog the suburbs to work in urban centers. Rural commuters are even more likely to work in urban areas than are suburban commuters. This strong commute flow between rural home and urban work locations may reflect *Seasoned Professional* commuters, who tend to have long commutes and professional jobs, often in government, that are located in urban centers. Nearly a third of commuters living in urban areas, meanwhile, appear to reverse commute to suburban workplaces.

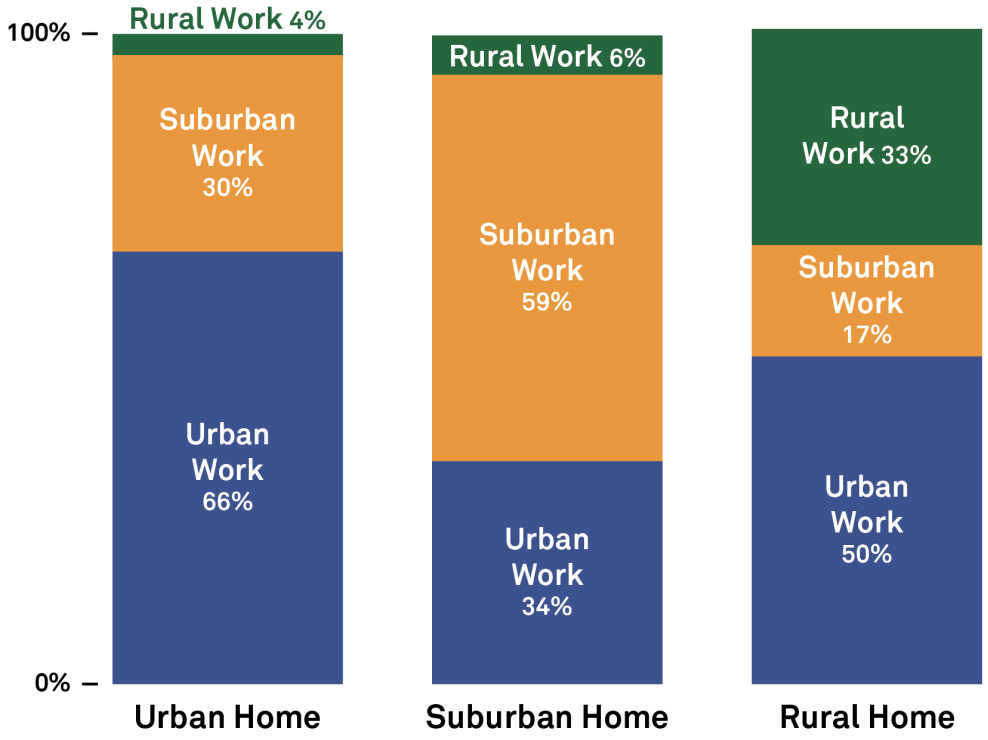


Figure 10. Proportions of work location types by home location types. Based on weighted survey responses.

Most Commutes are Within-County

Most surveyed commuters live and work within the same county. Figure 11 shows one-way commute flows at the county level. The largest commuting volumes are within Baltimore City (51), Montgomery County (47), Baltimore County (30), Prince George's County (29), and Anne Arundel County (29). Much smaller portions of commuters traveled between counties. Only 16% of Baltimore City commuters, for example, travel to another county. Higher proportions, but still the minority of Montgomery and Baltimore County Commuters travel across county lines: 23% and 47% respectively. The largest inter-county flow is from Baltimore County and Baltimore City (23). A similar number of respondents, 26, report commuting to Washington, D.C. from three different Maryland Counties: Montgomery (8), Prince George's (14), and Charles (4). These volumes only represent survey respondents from the Location Subsample who report commuting regularly (n=374). They are not weighted to reflect county-level populations; Baltimore City, for example, is substantially over-represented. Nonetheless, they demonstrate that most commutes are within the same county. Commutes between counties tend to be oriented toward the urban centers of Baltimore and Washington, D.C.

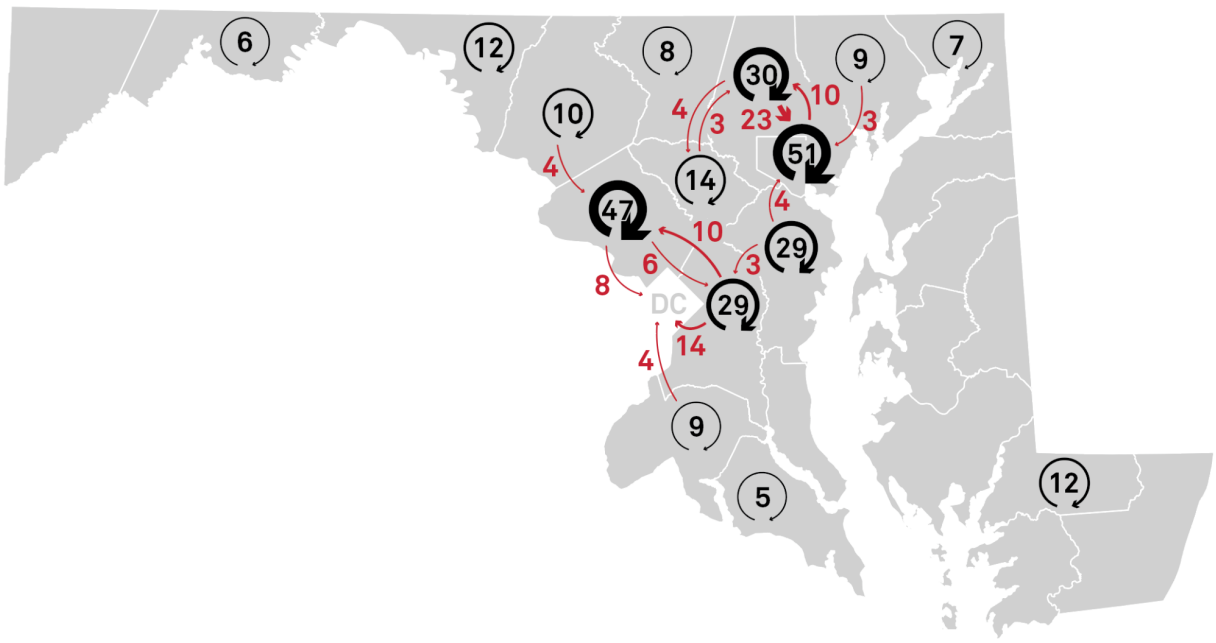


Figure 11. One-way commute flows within and between Maryland counties and Washington, D.C. Flows within counties are shown in black; those between counties are shown in red. Includes survey respondents from the Location Subsample who commuted regularly (n=374). Based on unweighted survey responses.

Lower-Income and Frequent Commuters Tend to Have Shorter Commutes

Higher-income Maryland workers tend to live farther from their workplaces than their lower-income counterparts (Figure 12). The majority of commuters with household incomes lower than $35,000 (52%) travel 5 miles or less, indicating that lower-income workers are more likely to live closer to their jobs. As income increases, however, the proportion of these short-distance commuters declines: 44% of those with incomes between $35,000 and $75,000, 25% with incomes between $75,000 and $150,000, and only 12% with incomes $150,000 or higher. The reverse pattern is true for commutes exceeding 10 miles. The proportion of moderate-to-long distance commutes consistently increases with income. Fifty-five percent (55%) of commuters earning between $75,000 and $150,000 travel farther than 10 miles, while 18% travel 25 miles or more. Among the highest-income workers, who earn $150,000 or more, more than half commute between 10 and 25 miles.

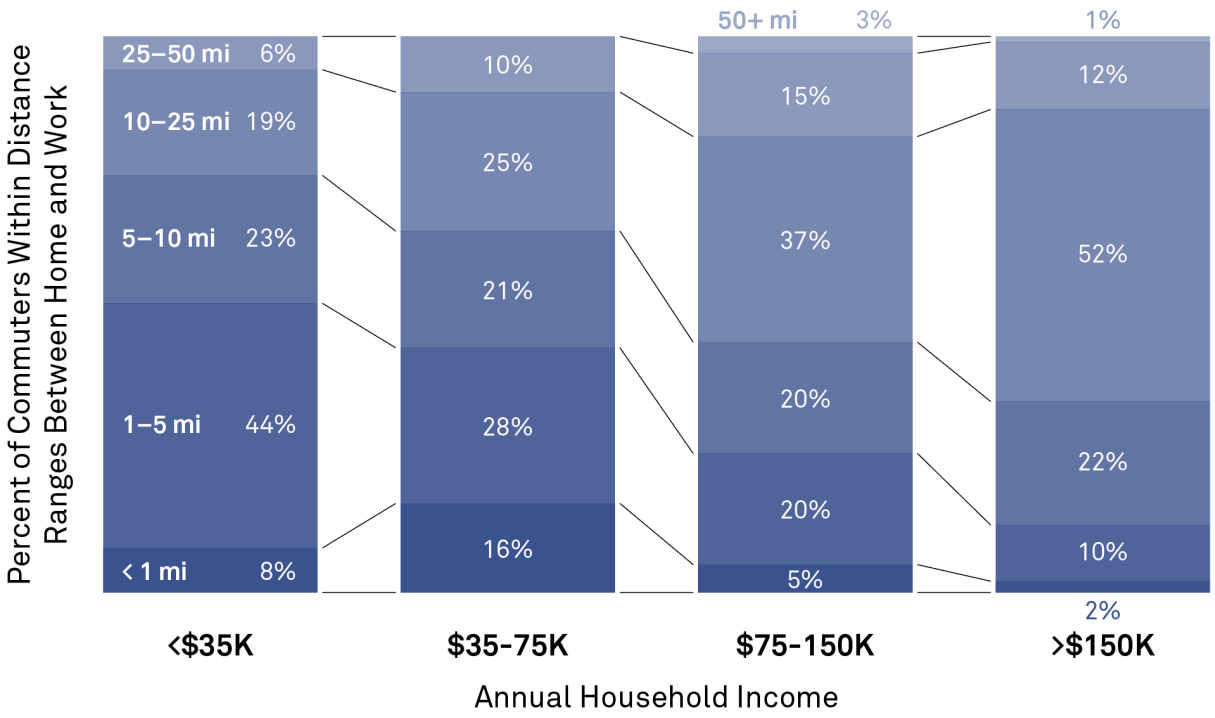


Figure 12. Driving distance between home and work by annual household income. Based on weighted survey responses.

Workers who commute more often also tend to live closer to their jobs (Figure 13). Those who rarely commute (<1 day) tend to travel the longest distances; nearly a third travel more than 25 miles. The majority of occasional commuters, who go to work 1-2 days a week, commute 10 miles or more, while 17% travel more than 25 miles. This suggests that rare-to-occasional commuters may have more flexibility in where they choose to live and work, and may be willing to travel longer distances on the days they do commute. More than half of those commuting 3-4 days a week travel less than 10 miles, while three in ten travel less than 5 miles. This could be because these workers have established routines and are more likely to choose jobs that are closer to their homes. Meanwhile, 42% of workers who commute 5+ days a week travel less than 5 miles. This may indicate either that frequent commuters seek housing closer to their workplaces, or that those who live close to their workplaces may be more willing to take jobs that require regular commuting.

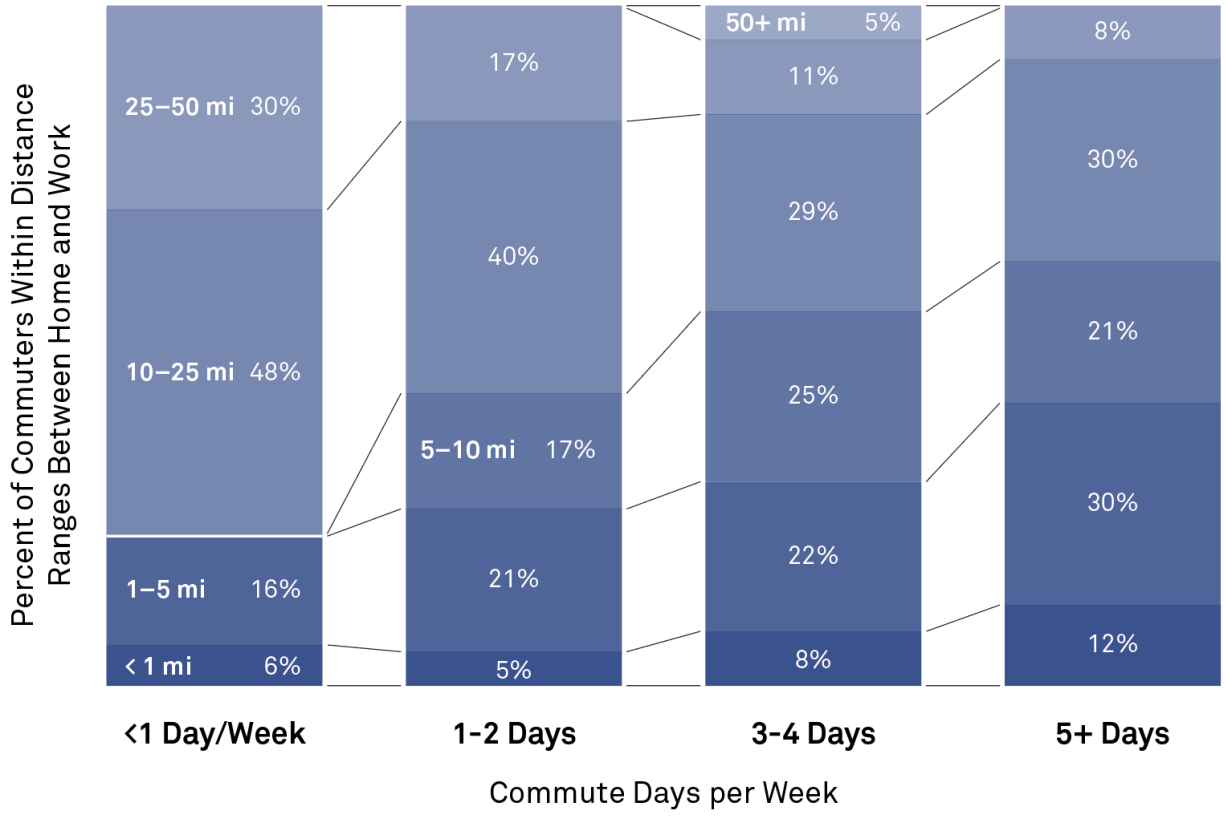


Figure 13. Driving distance between home and work by weekly commute frequency. Based on weighted survey responses.

Commute Modes

Maryland workers report using a diverse array of modes for commuting, including driving, transit, and slow modes such as walking, bicycling, and electric scooters. Driving continues to be most common, with nearly 90% of commuters either driving alone or carpooling regularly (Figure 14). Transit and slow modes are both used by about 20% of commuters. Walking is the most common non-auto mode. About 17% of commuters regularly walk, either their whole commute or in combination with another mode. The dominance of driving reflects Maryland's heavily suburban commute patterns and long distances—nearly 60% of commuters travel more than 5 miles each way[5]—which are difficult to serve by transit and slow modes.

[5] Based on driving routes between surveyed home and work locations calculated by Google Maps

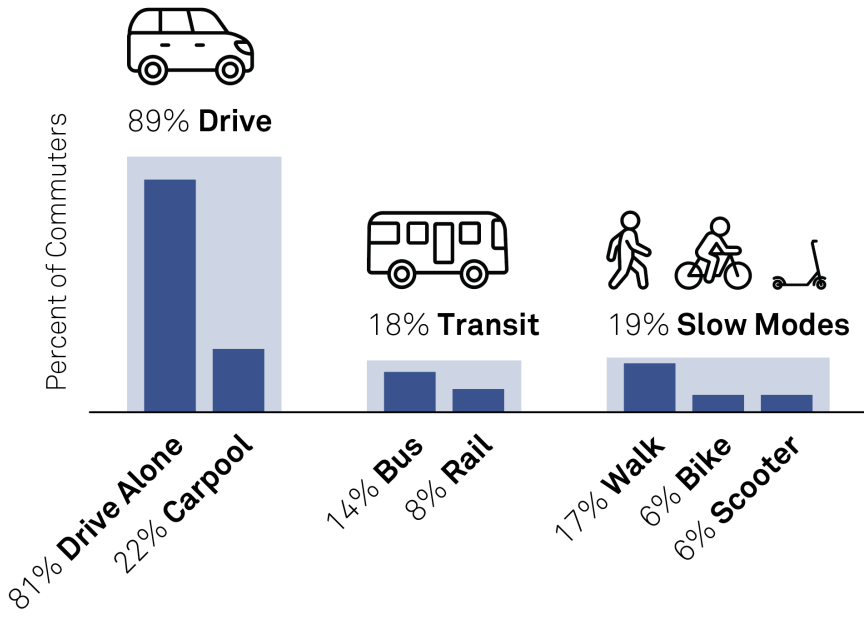


Figure 14. Proportions of commuters who regularly use each transportation mode. Light blue bars show totals for combined auto, transit, and slow modes; light blue bars show individual modes. Proportions sum to more than 100% because many commuters use more than one mode. Based on weighted survey responses.

There are substantial demographic differences between users of different modes. Commuters who drive alone are significantly more likely to be white and have higher incomes compared with those who use transit and slow modes. Driving and transit use are not significantly associated with age, but users of slow modes tend to be younger than those who do not use them. Commuters who identify as male are also significantly more likely to use transit and slow modes than those who identify as female. These trends suggest inequities in access to modes that are likely most convenient, such as driving. It may also be prudent to prioritize access to alternative modes, such as transit, walking, biking, and scooting, for less privileged communities who are their strongest users.

Driving is Dominant

The vast majority of Maryland commuters regularly drive to work, either alone or in carpools. Driving alone is by far the most common: 67% of commuters report driving alone and never carpooling. Another 14% report sometimes driving alone while other times carpooling; 8% carpool and never drive alone. Only 11% of commuters don't regularly drive, and even fewer—8%—report that commuting by automobile is not a viable option. This suggests that nearly all Maryland commuters who have access to an automobile use it regularly for commuting.

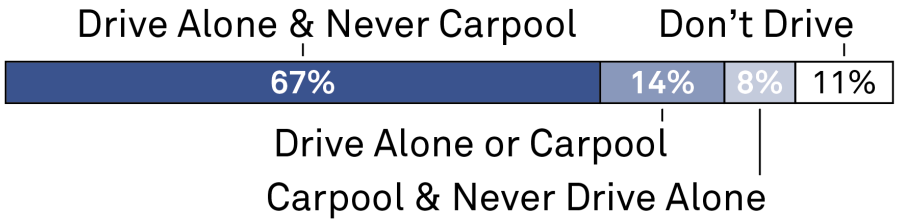


Figure 15. The vast majority of Maryland commuters regularly drive alone or carpool to work. Based on weighted survey responses.

For many Maryland commuters, driving is their only feasible option. Nearly 45% of commuters report that commuting by bus or rail transit is not viable, while more than 97% report that driving alone or carpooling is a viable option. Automobile commutes typically take substantially less time than alternatives. Marylanders who regularly commute by driving alone or carpooling report that their one-way commutes take 27 minutes on average. Those who regularly commute by transit report that their commutes take an average of 40 minutes. If those who drive regularly instead took transit, their commutes would average more than five times longer. Substantially more extensive and convenient transit networks would likely be needed to meaningfully divert commuting mode share away from driving. In the near-term, this reinforces the importance of Maryland's highways and other automobile infrastructures for enabling efficient travel to work.

Carpooling may offer a relatively easy way for Marylanders to reduce the social and environmental costs of driving without dramatic changes in transportation systems or land use patterns. Nearly a quarter of automobile commuters already carpool—commuting with one or more other people—at least one day a week. Incentivizing or reducing barriers to more frequent carpooling may allow commuters to leverage arrangements they have already made for carpooling. Only 40% of commuters who regularly drive alone report that carpooling is completely infeasible. This suggests that as many as 760,000 Maryland workers who do not regularly carpool may be able to do so. Even if only a portion of this carpooling displaced single occupancy vehicle trips, it would have the potential to meaningfully reduce congestion, greenhouse gas emissions, and out-of-pocket costs for Maryland workers.

Opportunities for Alternatives

Despite the dominance of driving, survey results show substantial potential for growth in alternative modes, particularly for short commutes. An estimated 9% of commuters—not including fully remote workers—live within one mile of work, and 35% live within five miles. Nonetheless, almost all commuters within these distances regularly drive. Ninety percent of those living less than one mile from work drive at least one day each week. Only 20% of these commuters regularly walk, 15% take transit, and 10% bike.[6] There remains substantial room for greater adoption of alternative modes by those with short commutes. And because such a large

[6] Many commuters report using a variety of modes, either in combination on the same day or on different days, so percentages sum to more than 100%

proportion of commuters live within walking or biking distances of work, mode shifts within these distances may substantially reduce statewide automobile mode share.

There is also substantial potential for a shift toward transit. Fifty-five percent of commuters report that bus or rail transit is a viable option for commuting, more than three times as many as regularly use these modes. There are potential transit routes serving as many as 63% of commutes,[7] though these may be infeasible for certain commuters based on scheduling, personal mobility, or other constraints. While current transit options tend to take substantially longer than commuting by automobile, improvements to transit that increase its competitiveness have the potential to be useful for a substantial portion of Maryland commuters.

Obstacles to Alternatives

While it may be possible for the majority of Maryland commuters to use transit, it remains an inconvenient alternative to driving for most. Among survey respondents for whom transit commutes are possible, they would take nearly five times as long on average as commuting by automobile. Only 10% of potential transit commutes are less than two times the duration of their driving alternatives. Commuters who regularly use transit, meanwhile, report one-way commute times that are 50% higher on average than those who regularly drive. Those who *could* use transit, but do not currently, would have estimated transit commutes that are 40% longer on average than current transit commuters. This suggests that those for whom transit is most feasible—the relatively "low hanging fruit"—are already most likely to be using it. Because travel times have such a strong influence on travel choices—62% of commuters consider low overall commute time an important factor in their decisions about how to commute—transit mode share is unlikely to increase without substantial improvements in time competitiveness with driving.

There are also substantial gender differences in use of alternative modes, suggesting that women may face more obstacles to non-auto modes than men (Figure 16). While women and non-binary commuters drive at slightly higher rates than men, this difference is not statistically significant. Men, meanwhile, are significantly more likely to take transit, bike, and use electric scooters. They are also more likely to walk, though this difference is only marginally significant. These results indicate that driving and walking are not substantially gender biased, while transit and wheeled micromobility are relatively unattractive to women. This may be due to concerns about personal safety. Survey results show that women are marginally more likely than men to consider crime safety when deciding how to commute, but are substantially more likely to consider sharing personal spaces with strangers, a key characteristic of transit. Interestingly, however, women are significantly more likely than men to consider the affordability of commute options. This suggests that they may be eager to embrace more affordable alternatives to driving if they are sufficiently comfortable to use.

[7] Based on transit routes between surveyed home and work locations calculated by Google Maps

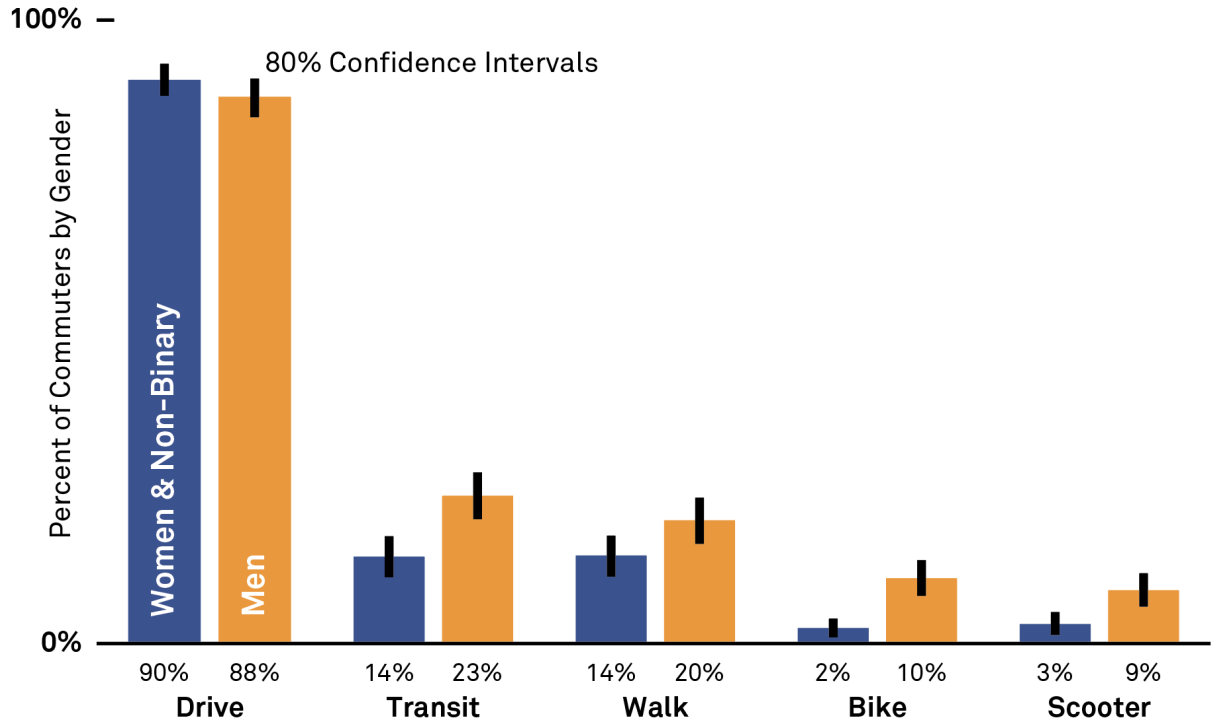


Figure 16. Percent of commuters by gender who regularly use each mode, weighted. Blue bars show commuters identifying as women and non-binary (NB). Yellow bars show those identifying as men. Based on weighted survey responses.

Lack of appropriate resources and attitudinal objections may also hinder adoption of alternative modes. While 85% of commuters report owning or having regular access to an automobile, only 30% own a bicycle or have a bike share membership, and 34% have smartphone apps installed for accessing shared mobility services such as electric scooters, bicycles, or ridehail vehicles. Sizable numbers of commuters also report prioritizing factors that may conflict with alternative modes. More than 20% aim to minimize walking in their commutes and 34% report concern about getting hot or sweaty on their commute. More than 30% consider crime safety an important influence on their commute decisions, and 26% are concerned with sharing space with strangers. While none of these factors appear to be strong drivers for the majority of commuters, they demonstrate the breadth of considerations that impact mode choices. Ultimately, most Maryland commuters would have to live considerably closer to their workplaces for considerations beyond travel time and distance to be important for incentivising higher use of alternative modes.

Commuter Priorities

Commuting is Not a Priority for Residential Location

Shortening commutes or having the ability to commute by transit does not appear to be a priority for Maryland workers when deciding where to live. Characteristics of homes and

neighborhoods are likely to be much stronger priorities. Those who live in rural locations place greater emphasis on home factors, while those living in urban areas tend to prioritize neighborhood factors (Figure 17). Home factors, such as spaciousness of houses and yards, having a detached single family house, and privacy from neighbors, are considered important by workers living in rural areas at significantly higher rates than those living in more urbanized areas. Indeed, nearly 100% of rural workers consider these factors important. Suburban workers also consider home factors important at higher rates than urban workers. This is consistent with the expectation that workers might move to less dense areas to satisfy preferences for more spacious and private homes at a lower cost.

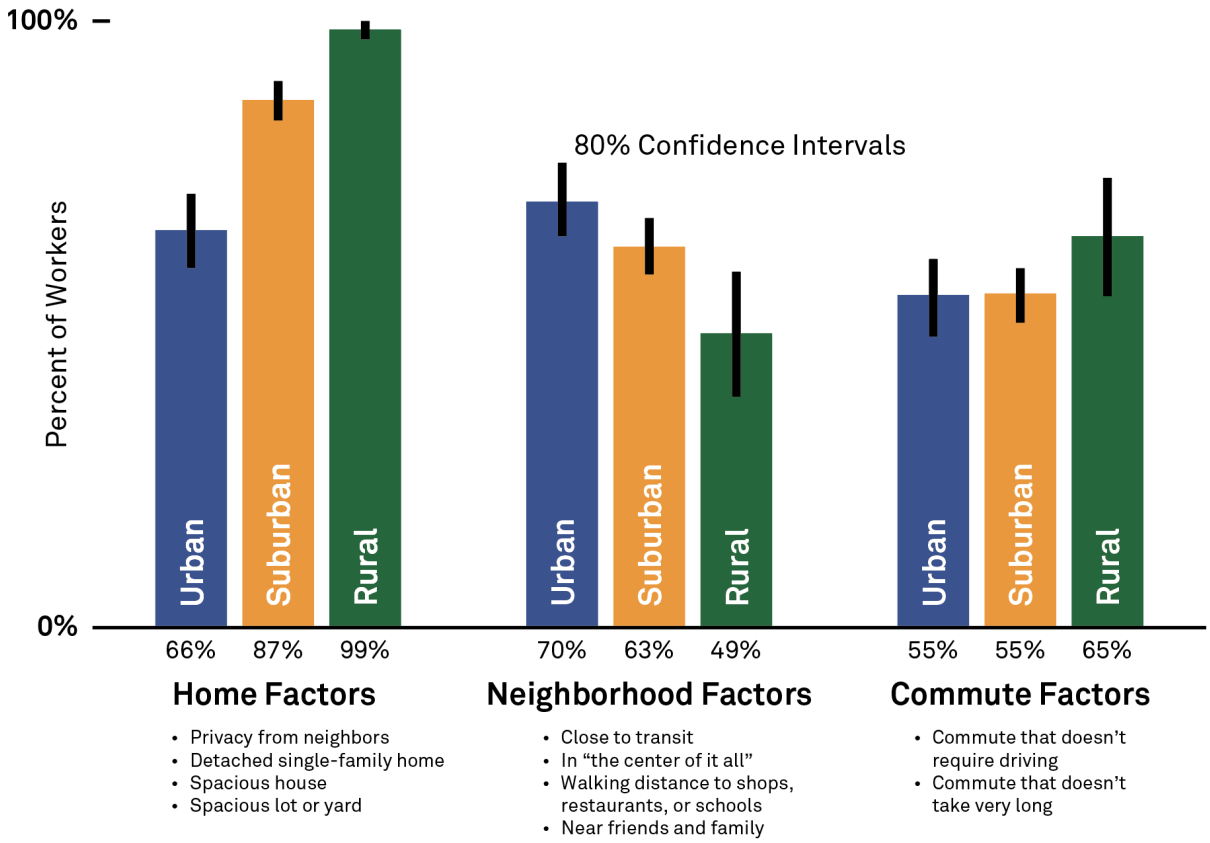


Figure 17. Factors that workers considered important for deciding where to live, broken out by urban, suburban and rural home locations. Commute factors were similarly important across all location types, while home factors were more often important for rural workers and neighborhood factors were more often important for urban workers. Based on weighted survey responses.

Those living in urban areas, by contrast, consider neighborhood factors to be important at a significantly higher rate than urban workers, though similar to suburban workers. These factors include proximity to transit, being within walking distance of everyday destinations, proximity to friends and family, and being "in the center of it all." The relatively strong preference of suburban

workers for both neighborhood and home factors suggests that they may view suburban areas as opportunities to satisfy both.

There are no significant differences in importance of commute-related factors, which include the ability to commute without driving and having a commute that doesn't take very long. Slightly higher concern for commute factors among rural workers may be attributable to their longer average commute times. Ultimately, however, commute factors appear to be a weaker priority for most Maryland workers when deciding where to live than home- and neighborhood-based factors.

Remote Workers Aren't Interested in Moving Farther from Work

Because remote workers do not have to commute, they might be interested in living farther from their employer in order to prioritize housing factors other than commute distance. Survey results, however, indicate that remote workers are no more interested in moving farther from work than their commuting counterparts. The majority of workers—remote included—are satisfied with living the distance from work they already do (Figure 18). Approximately a third of workers, including those who are remote, would prefer to live closer. Unsurprisingly, fully in-person workers are the most interested in living closer, though by a margin of less than 5%. These results suggest that remote and hybrid work are unlikely to reshape where Maryland workers live and how far they commute. Indeed, the sizable portion of all workers who are interested in moving closer suggests that policies to increase housing availability and affordability near job centers may have substantial potential to reduce commute distances with concomitant savings for vehicle miles, emissions, congestion, and safety.

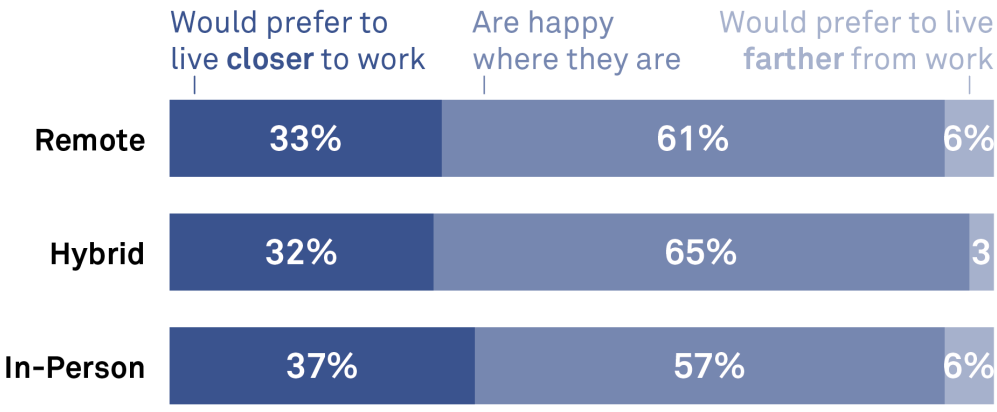


Figure 18. Preferences for living closer, their current distance, or farther from work broken out by remote work status. Remote and hybrid workers do not tend to prefer living farther from work. Based on weighted survey responses.

Safety and Expanding Multimodal Options are High Priorities

The MCS asked respondents which policy goals they think are most important for MDOT to address in the coming years (Figure 19). Ensuring a safe and secure transportation system is by far the most common goal, identified by nearly three quarters of respondents. Approximately half of respondents also identified goals related to improving transit services, improving user experience, providing more transportation choices, and ensuring that streets are safe for non-auto users. These results suggest that, despite relatively low use of alternative modes for commuting, Marylanders have a strong interest in developing and improving infrastructure that would make these modes more viable. Safety considerations may also, of course, factor strongly into decisions about whether to use alternative modes. There appears to be a strong mandate to ensure that diverse modes are safe and accessible for Maryland workers.

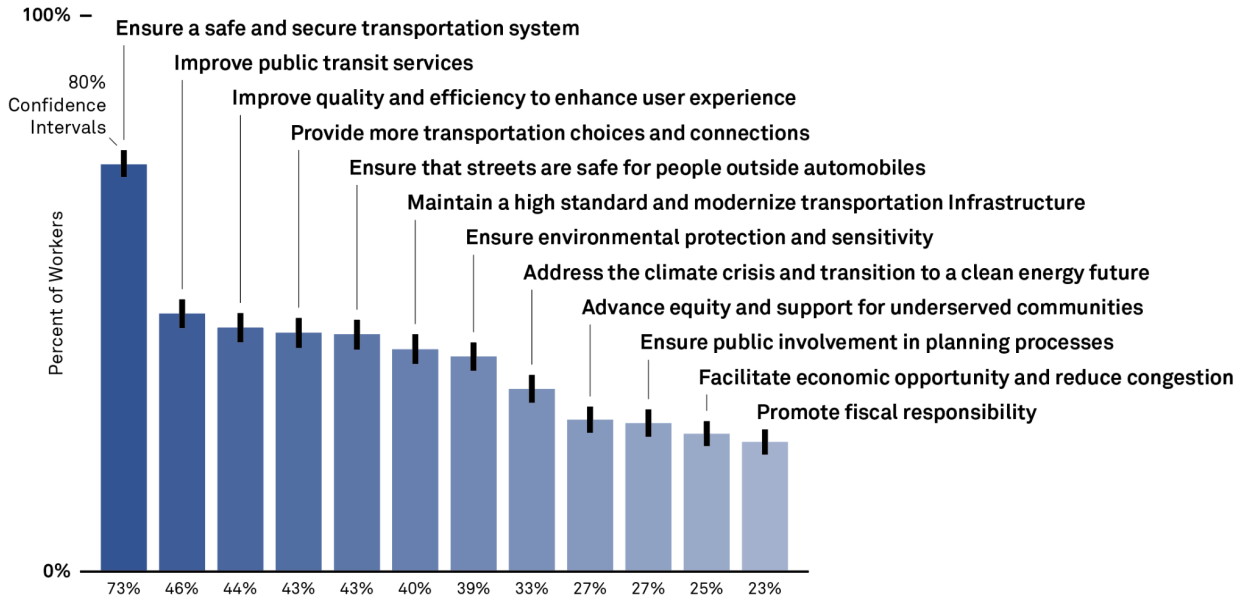


Figure 19. Proportions of workers who identified each policy goal as a priority for MDOT. Based on weighted survey responses.

Conclusions

The 2022 MCS offers several key conclusions that can inform transportation and land use policy affecting commuting and other travel within Maryland. First, the survey demonstrates that remote work remains widespread toward the end of the COVID-19 pandemic. In-person work appears unlikely to return to pre-pandemic levels within the near future. Second, Marylanders are well-positioned and eager to embrace modes other than driving, though they face obstacles such as uncompetitive transit travel times and commute distances that are infeasible for slow modes such as walking and biking. Finally, Maryland workers appear unlikely to move away from dense job centers in response to remote work. Indeed, approximately a third of remote and hybrid workers would still prefer to live closer to work.

Together, these conclusions suggest a near-term transportation and land use landscape with greater opportunity to prioritize alternatives to automobility that improve quality of life outside the specific purpose of commuting. Nonetheless, there will continue to be a need for transportation systems to support substantial commuting loads, as the majority of Maryland workers still commute either full time or on hybrid schedules. The proliferation of hybrid work will also make it more difficult to predict commuting demand, requiring systems that are resilient and responsive to fluctuations in traffic and revenues. Even with lower overall demand, this will mean that demand management remains an important aspect of planning and operating transportation systems.

In-Person Work is Unlikely to Return to Pre-Pandemic Levels

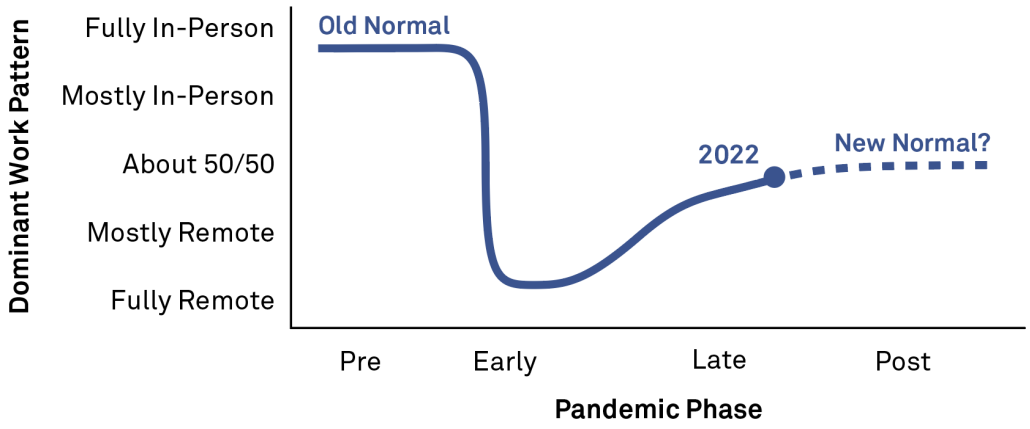


Figure 20. Generalized trend of work patterns throughout the COVID-19 pandemic. Post-pandemic patterns are unlikely to rebound to the pre-pandemic equilibrium. Adapted from findings by Tahlyan et al., 2022.

While more than a third of workers continue to work fully in-person, the majority of Maryland workers are now remote and hybrid. This finding is consistent with trends identified by other research showing a partial rebound of in-person work, but a flattening curve that suggests that

hybrid work will become a new normal (Tahlyan et al., 2022; Figure 20). Future iterations of the MCS will help establish whether the current rate of remote work is a long-term equilibrium or a point along a continued trend toward more conventional in-person schedules. Either way, remote work is likely to be more commonplace than it was before the pandemic. This indicates the need to adapt transportation systems so they are not dependent on historic commuting volumes and are designed to prioritize more contemporary, non-commuting demands.

Supporting commuting will also, however, be important for promoting transportation equity. In-person workers tend to be lower-income, and rural Marylanders tend to commute at higher rates than their urban and suburban counterparts. Improving transportation infrastructures that enable lower-income and rural workers to efficiently access job opportunities may be an important mechanism for reinforcing equity. Remote and hybrid workers, meanwhile, also tend to be demographically diverse, with strong representation of women and people of color. Planning for the needs of remote workers, therefore, also addresses a diverse spectrum of the Maryland population. Neither in-person nor remote workers represent a distinctly privileged segment of the population.

Marylanders Want More Transportation Options

The MCS shows that Maryland workers are eager for alternatives to automobility and many are well-positioned to use alternative modes. Nearly 10% of commuters live within one mile of work, and more than third live within 5 miles, making slow modes such as walking and bicycling a reasonable option for a sizable portion of workers. More than half of commuters, meanwhile, report that it would be possible to use transit for traveling to work. Hybrid workers, who tend to live in urban settings and use a wider variety of modes than their in-person counterparts, may be especially good candidates for commuting by transit or slow modes. Nonetheless, transit systems serving Maryland commuters tend to be highly uncompetitive with driving. Those who currently use transit spend approximately 50% more time commuting than if they drove. Transit would take five times longer than driving for the average commuter. This high time cost likely poses a substantial barrier to further adoption of transit for commuting trips.

Reductions in commuting due to remote and hybrid work pose a substantial threat, however, to the viability of traditional transit. Ridership on Maryland-area transit systems remains down by more than 50% from pre-pandemic levels (USDOT FTA, 2022). The high rates of remote and hybrid work among urban and suburban residents, and for commuters to urban workplaces, disproportionately compromise transit systems, which are concentrated in these areas. To meet demand for transit outside the traditional pattern of downtown-focused commuting, transit systems may need to provide more spatially- and temporally-distributed services, potentially through microtransit models that use smaller vehicles and more on-demand scheduling.

Remote Work May Not Substantially Shift Residential Locations

A potential ramification of remote and hybrid work is that those with reduced need to commute may move farther from urban centers, increasing the length of periodic commutes and non-work

travel, reducing the viability of alternative modes, and modifying the geography of travel patterns. This shift, however, does not appear to be occurring at a dramatic scale. While hybrid and remote workers do tend to live farther from work than their in-person counterparts, they are still more likely to live in urban and suburban areas. Moreover, the majority of all workers, including remote and hybrid, report being satisfied with the distance they currently live from work, while approximately a third, even among those who are fully remote, would prefer to live closer to their employer. This suggests that remote work is not causing Marylanders to retreat to lower-cost areas that are farther from urban cores. If anything, remote and hybrid workers appear to be more interested in urban lifestyles that offer access to a variety of transportation options along with consumer and cultural amenities in suburban and urban areas. The key for land use and transportation planners will be to reimagine how urbanized areas can be developed not just for working and commuting, but for high quality of life that retains workers who want easy access to both workplaces and other daily needs.

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Appendix 1: Review of Telecommuting Literature

The relationship between telework, or telecommuting, and travel has been extensively studied for the past few decades in various geographic contexts. In the transportation sector, telework is generally regarded as a desired travel demand management tool to provide congestion relief and reduce the overall amount of travel by offering workers a full-time or part-time option to work from home or in other flexible work arrangements instead of commuting to and from the office (Tayyaran & Khan, 2003). Having the potential to decrease peak-hour congestion levels as teleworkers can opt to commute outside of rush hours or eliminate trips by not commuting at all, working remotely has also been linked to a reduction in greenhouse gas (GHG) emissions and travel-related energy savings (Reitveld, 2011). From a policy perspective, travel-related decision-making of teleworkers has been of particular interest to the US transportation policy-makers to inform land use-transport policies that support the sought-after effects of telework relating to motorized travel, and peak-hour traffic congestion, energy use, and air pollution (Singh et al., 2013).

However, no theoretical and empirical consensus has been reached on the travel effects of telecommuting. As one of the forms of ICT activities, telecommuting was theorized to impact travel by substituting or complementing overall travel (frequency of trips, distance, and duration), modifying existing travel choices and patterns that include commute mode or when to depart to/from work and causing no change (Salomon, 1986). Earlier studies suggested that telecommuting was more likely to substitute than complement commute travel lowering the average frequency of work trips, work trips during peak hours and per-capita vehicle-miles distance traveled (VMT) of telecommuters compared to non-telecommuters (Nilles, 1991; Mokhtarian, 1991, 2004; Pendyala, 1991; Ory and Mokhtarian, 2005). Mokhtarian and Varma (1998) also found air quality improvements from reduced VMT on telecommuting days. These studies primarily relied on small regional samples like the 1988-1998 telecommuting pilot program comprised of 218 California state agency employees which, according to Mokhtarian (1995), do not represent the population as a whole and might inaccurately reflect telework-related effects on travel as it becomes mainstream. Among these studies, some also found that telecommuters lived farther from their jobs than non-telecommuters resulting in longer one-way commute distances, which, however, did not offset net travel reductions for those who teleworked frequently (Nilles, 1991; Mokhtarian, 1991, 2004; Ory and Mokhtarian, 2005).

Longer one-way commutes observed for telecommuters contribute to the conflicting evidence on whether telework induces further individual and household-level travel both in the short and long run. Any negative net travel effects obtained from not commuting on teleworking days might be partially or fully recouped by longer commutes on non-teleworking days. Frequent telecommuters might consider moving further away from work to more desirable and affordable residential locations and opt to overcome longer distances on commuting days as telecommuting eases the spatial and temporal constraints previously imposed on a worker's decision on where to live (Nilles, 1991; Mokhtarian et al., 1995, 1997, 2004; Mokhtarian, 1998; Ory and Mokhtarian, 2005, Zhu, 2011, 2012; Zhu and Mason, 2014; Zhu et al., 2018; Caldarola

and Sorrell, 2022). The long-term effect of telecommuting on residential location choices was also linked to residential dispersion and “telesprawl” as the ability to telecommute would no longer necessitate workers to live in urban centers allowing them to move to more distant suburban locations (Tayyaran and Khan, 2007). Conversely, Kim et al. (2012) found that telecommuters lived in more suburban areas because jobs offering telecommuting options were concentrated in these areas with shorter commute distances for their workers. Ellen and Hemstead (2002) alternatively reported that telecommuters were more likely to be located in urban centers rather than in suburbs. The causal role of telecommuting in informing residential choice alongside many other confounding factors such as housing costs and accessibility to rich amenities is poorly understood. Zhu (2012) used an instrumental variable approach to examine the causal effects of telecommuting on commute time from the 2001 and 2009 National Household Travel Survey. He found that teleworking increased one-way commute distances by 21% in 2001 and 43% in 2009 compared to non-teleworkers. Additionally, the household structure mediated the influence of telecommuting on the residential locations: two-worker households tended to move closer to the non-teleworker’s workplace (Zhu, 2013).

Moreover, several studies based on large nationwide travel surveys found evidence for increased daily travel for teleworkers on teleworking days compared to their commuting counterparts. Telecommuters were hypothesized to generate more non-work trips on telecommuting days than non-telecommuters due to reasons such as “cabin fever”, having difficulty organizing trip chains for non-work activities such as childcare, and more time available for leisure and social trips (Reitveld, 2011; Zhu, 2012; Zhu and Mason, 2014; Lachapelle et al., 2018; Kim et al., 2015; Kim, 2016). Additionally, teleworkers choosing to live farther away from their workplaces might drive an additional distance to work in locations outside of the home such as coffee shops, parks, and libraries (Lachapelle et al., 2017). Using NHTS data for 2001 and 2009, Zhu (2011, 2012) empirically revealed the importance of telecommuting for personal and household travel patterns as telecommuters experienced longer one-way commute distances, more frequent and longer daily total work and total non-work trips, compared to non-telecommuters, particularly, in a latter year. Zhu (2011) suggested that more telecommuters have chosen to move farther away from their jobs over the time period between 2001 and 2009, leading to more pronounced complementary effects on overall travel in the latter year. Zhu and Mason (2014) also found higher VMT for telecommuters for both daily work and non-work trips with driving 38 miles more daily in 2001 and 45 more in 2009 than non-telecommuters. Specifically, they found teleworking was positively associated with most types of non-work travel, such as shopping, family, medical, and recreational trips. Zhu and Mason (2014) also estimated significantly higher levels of GHS emissions from the increases in VMT. Using the 2006 Seoul Household Travel Survey, Kim et al. (2015) found that vehicle kilometers traveled by head-of-household telecommuters for non-work purposes were 24.2 km greater per day, and 1.5 km greater for other household members, than for non-telecommuting households. However, non-work vehicle travel increases were only significant for households with a limited mobility budget - 1 car per household - meaning that more travel conducted by other household members was most likely due to the availability of a vehicle previously used for commuting. This finding points out potential intra-household effects that are concerned with how telecommuting status of one household member can influence the travel of other household members.

Conversely, however, Zhu (2013) and Melo and de Abreu e Silva (2017) did not find evidence of intra-household effects, so these relationships are inconclusive.

More recently, Budnitz et al. (2020) examined the trip-making of teleworkers in Great Britain and showed that they made more trips for non-work purposes than those who did not telework. Budnitz et al. (2020) also pointed out that despite more frequent non-work trips, the distance traveled by telecommuters for these purposes is contingent on the accessibility of the residence to various points of interest, such as shopping. This reinforces the importance of residential location choices in determining how telecommuting affects the overall travel amount. Caldarola and Sorrell (2022) found that English telecommuters traveled less frequently for both work and non-work purposes, but traveled longer distances throughout the week than non-telecommuters. Additionally, they found that more frequent teleworkers - 3 or more times a week - traveled around 7% less distance than non-teleworkers. Caldarola and Sorrell (2022) suggest that despite frequent telecommuters traveling marginally less, net travel effects are likely to be insignificant.

Several studies have explored the mode choices of telecommuters with their implications for transportation-specific reductions in GHG emissions and energy use. They found that teleworkers were more likely to participate in physical activities using active travel modes such as bicycling and walking than non-teleworkers reducing their carbon footprint. For example, Lachapelle et al. (2018) estimated that it was 77% more likely for telecommuters to meet recommended physical activity levels, including from active travel, than for non-telecommuters. Using 2009 NHTS data, Chakrabarti (2018) found that telecommuting more than four times a month was associated with a 41% greater likelihood of walking or bicycling more than a mile, and a 71% greater likelihood of satisfying recommended daily physical activity among telecommuters who were more physically active and environmentally conscious. Ozbilen et al. (2021) found that those who worked remotely more frequently spent less overall time on motorized modes, including auto and transit. Caldarola and Sorrell (2022) argued that the increase in the number of trips and distance traveled by telecommuters might not always lead to more energy being consumed during travel as some of these trips could be completed by using travel modes other than a private car.

Although the findings of the reviewed theoretical and empirical research are useful for understanding the mechanisms through which telework influences travel patterns, they may not accurately reflect the present and future effects of telework considering the major disruptions of the COVID-19 pandemic, during which rates of teleworking have increased dramatically. Over the past decade, US studies on telecommuting have used 2001 and 2009 NHTS data that reveal moderate growth in the share of the workforce who telecommute at least once a month, from 5.7% to 7.6%. Those who telecommute at least once a week have increased from 3.8% to 4.0% (Chakrabarti, 2018). Brynjolfsson et al. (2020) conducted a nationwide survey between February and May 2020 that showed that, with the onset of the COVID-19 pandemic, over 30% of the US workforce transitioned to working from home full-time leading to over half of the workforce teleworking. Another US survey reports that while only one-fourth of working adults worked from home pre-pandemic, this number grew to 71% during the pandemic (Parker et al.,

2020). More significantly, Parker et al. (2020) also revealed that 54% of workers would prefer to continue working from home in the post-pandemic future. The multiple waves of the nationwide survey by Barrero et al. (2021) projected that about one-fourth of full workdays will be carried from home post-pandemic, four times than before. Compared to the more even figure (54%) by Parker et al. (2020) that showed the post-pandemic decision to telework was divisive among workers, Barrero et al. (2021) found that most demographic and socioeconomic groups preferred this working pattern with a majority of workers willing to reduce their salaries for working from home two or three days per week. Barrero et al. (2021) outlined the reasons why working from home would stick in the post-pandemic world including infection fears, better-than-expected experiences and diminished stigma around working from home, new investments in physical and human capital, and recent tech advances facilitating telework. The high degree of telework adoption during a pandemic, however, might not be sustained long-term due to various concerns expressed by both employers and employees [add citation]. From the employer's perspective, working from home on a regular basis can be detrimental to the company culture as well as the engagement and loyalty of their employees among others [add citation]. From the employee's perspective, high levels of telework were linked to reduced productivity barring personal satisfaction with the "workability of the home environment", increased social isolation, lack of support from an employer to carry out remote work, and difficulty to maintain a work-life balance. Nonetheless, a general consensus remains that various hybrid mixing of in-person and telework will become the "new normal" in the post-pandemic world as employees will continue to be offered various options to work remotely [add citation].

The COVID-19 pandemic has also demonstrated that benefits and barriers associated with working remotely are disproportionately distributed across different sociodemographic groups. The benefits of teleworking commonly cited in the literature include work productivity improvements, time saved from not commuting to work, flexibility to choose a work location whereas job responsibilities require physical on-site presence, lack of necessary technology to conduct work remotely, and distractions from other household members were found to present main barriers for teleworking [add citations]. Salon et al. (2021) presented the nationwide survey findings suggesting that telecommuting will mainly benefit those with university degrees and annual household incomes of over $100,000 who were able to switch to remote work during a pandemic and are significantly more likely to expect conducive work arrangements for frequent telecommuting after pandemic ends. "Essential" workers who have to physically commute to work such as service employees faced higher infection risks unless they quit their jobs to avoid getting the virus. The workers in the roles not suitable for remote work were also found to experience higher risks of COVID-19 exposure from using public transit and not having access to alternative transportation modes including a private car or living in a bike- or walk-friendly environment. For example, Wang et al. (2022) found that residents of areas with low-to-medium socioeconomic status in North Carolina continued to visit retail establishments and offices on regular basis during the lockdown stage suggesting the presence of "essential" workers in these areas who were also more likely to rely on the public transit during the pandemic. Moreover, frequent telecommuters largely benefited from work location flexibility during the pandemic as they transition to virtual work for most of the week significantly expanded their residential location opportunities compared to those for whom remote work was not accessible. Moving

further away allowed these telecommuting movers to relocate to less populous areas with lower infection risks, or find housing that would be more affordable or better fit their residential preferences. van Wee and Witlox (2021) suggested that the quality of living environments will become more important in deciding where to live if working from home on a regular basis persists post-pandemic. In their findings, Salon et al. (2021) pointed out that in the wake of the pandemic, over one-fourth of employed movers in dense urban areas were primarily motivated to move due to their teleworking status and not for the reasons such as health concerns and housing preferences compared to only 9% of other movers. It is worth noting that not all telecommuters are equally satisfied with their experiences of working remotely during the pandemic. Tahlyan et al. (2022) modeled telework satisfaction among 318 adults across the country showing lower satisfaction levels among younger and older individuals and those with children attending online school from home. Tahlyan et al. (2022) also found teleworking benefits were lower for Black and Hispanic or Latino individuals whereas essential workers and those with children studying virtually were identified to have the highest barriers to telework.

Most importantly, recent research efforts were dedicated to examining pandemic-induced travel behavior changes including the decline in the overall travel demand and vehicle distance traveled, new commuting and non-commuting travel trends, and modal shifts from shared to private transportation. Some of these changes have the potential to be lasting in the post-pandemic future. Barrero et al. (2020) estimated about 10 billion hours of total time savings in the US from not needing to commute in the first six months of the pandemic. One-third of these time savings were reinvested back into primary work while the rest was used for leisure and household-related activities. Salon et al. (2021) estimated infrequent commutes will lead to a reduction in car distance traveled by about 15% and those preferring a private vehicle as the primary commute mode will not change significantly post-pandemic. van Wee and Witlox (2021) projects frequencies of trips and rush hour traffic will continue to be lower in the post-pandemic future as teleworking individuals are more flexible in deciding when to travel. Based on the US county-level mobility data, research by Rafiq et al. (2022) showed in counties with a higher share of workforce telecommuting, the number of workplace visits, and the corresponding average person-miles traveled (PMT) have reduced during the early phase of the pandemic. The decreases in non-work activity visits but only those associated with work-related trips and in average PMT generated by these visits were found, particularly, for metropolitan counties. Rafiq et al. (2022) also cautioned that the reduction in commuting levels can deteriorate public transit service operation and ridership that took a serious toll in terms of service cuts and low fare revenues amid infection fears during the pandemic. Salon et al. (2021) anticipates that the post-pandemic future will see a significant decline in transit commute trips (by about 40%). Using both survey and GPS data, Parker et al. (2021) measured the changes in average weekly trips and distance traveled of transit riders and non-riders during the pandemic showing that the travel of those who rely on public transit were disrupted more signficantly than of those who do not. Parker et al. (2021) also pointed out that low-income transit riders were significantly less likely to reduce their travel than higher-income ones suggesting despite concerns of infection risks or service changes, they were less flexible with their choice of the travel mode or less likely to work remotely continuing to use the public transit at pre-pandemic levels. These results raise the importance to address the needs of severely disadvantaged transit riders as the US public

transit recovers from the impacts of the COVID-19 pandemic. Several studies found that a lot more people used or showed positive attitudes toward active travel modes such as walking and biking, particularly, among telecommuters during the pandemic. Salon et al. (2021) found that one-third of people in the US are expected to take walks more often and 15% are expected to bike more for either transportation or recreation purposes. van Wee & Witlox argue policymakers and transport planners should take advantage of the growing interest in active travel by providing sufficient pedestrian and biking infrastructure.

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Appendix 2: Data Processing

Geocoding

Survey respondents provided home and work locations based on street name, nearby cross-street, city, and state. Some respondents provided only a subset of their fields. Others provided nonsensical responses, including streets that did not appear to exist or cross-streets that did not intersect their primary street. We developed a workflow to search for originally-provided home and work locations, manually edit these searches to improve the quality of results, and geocode them as approximate latitude and longitude points.

To facilitate this process, we developed a custom-coded computer interface that allowed us to search for addresses in Google Maps, adjust search queries, view results on a map, and then save them back to the dataset. The interface was programmed in Python and accessed through a Jupyter notebook. It compiled surveyed street names, cities, and states into a standard address format and queried these addresses with the Google Maps API. We then manually corrected address formatting issues, misspellings, cross-streets that did not appear to exist, and other apparent errors, to identify locations that could be mapped with the highest available degree of precision. In some cases, this meant limiting locations to the city or state level. Using this system, we identified street-level home locations for 96% of the final sample, and street-level work locations for nearly 80% of commuters.

Location Subsample

Based on the geocoded home and work locations, we developed a subsample of respondents with high-quality location information. This subsample excluded those who reported no home or work location, reported only state-level locations, or who reported commuting (either in-person or hybrid work) but appeared to have identical home and work locations. The number of respondents removed due to each of these conditions is reported below. We did not identify substantial demographic biases among respondents removed for the location subsample.

Table A2.1. Summary of records removed to form the location subsample.

Full Sample	**651**
Removed respondents who reported no home or work location	-5
Removed respondents who reported only state-level locations	-123
Removed respondents who reported in-person or hybrid work but had identical home and work locations	-55
Location Subsample	**468**

The home and work locations of respondents in the location subsample were further classified into urban, suburban, and rural contexts based on Local Classifications from the National Center for Education Statistics (NCES). City and Town NCES Locales were considered urban.

Table A2.2. Relationship between MCS location classifications and NCES socales

MCS Location Classification	NCES Locale
Urban	City; Town
Suburban	Suburban
Rural	Rural

Route Imputation

Geocoded home and work locations allowed us to compute hypothetical commuting routes using the Google Maps API. We developed a Python script to query the API for estimated travel time and distance of the most time-efficient driving, transit, and walking routes between available home and work location pairs. All routes were calculated based on an 8 am departure time traveling from home to work on a Wednesday. The API automatically accounted for typical traffic congestion and transit schedules at that time and day of the week.

Remote Work Categories

The survey asked respondents “Do you work remotely?” with four options: “Always,” “Almost Always”, “Sometimes,” and “Never.” Nearly two-thirds of respondents selected either “Always” or “Never”.

Table A2.3. Counts (N) of survey respondents who reported working in raw remote work categories.

Do you work remotely?	N
Always	182
Almost Always	107
Sometimes	142
Never	220

Other survey questions, including those about commuting days of the week, indicated that sixteen respondents who “Almost Always” worked remotely had similar commuting schedules to

those who were “Always” remote, while the remaining 91 were more similar those which were “Sometimes” remote. These respondents were manually reclassified to produce a new, simplified variable that more parsimoniously represented the structure of remote work with only three categories.

Table A2.4. Counts (N) of respondents classified into simplified remote work categories.

Remote Status	N
Remote	198
Hybrid	233
In-Person	220

Appendix 3: Weighting

Weights were calculated based on 24 bins representing a cross tabulation of urban and rural home locations, four race and ethnicity categories, and three age brackets. Urban and rural home locations were categorized at the county level based on designations from the Maryland Department of Public Health. There were 18 rural counties: Allegany, Calvert, Caroline, Carroll, Cecil, Charles, Dorchester, Frederick, Garrett, Harford, Kent, Queen Anne's, Somerset, St. Mary's, Talbot, Washington, Wicomico, and Worcester. The remaining six counties, including the City of Baltimore, were considered urban.

Other demographic data were gathered from 5-years estimates from the 2021 American Community Survey (ACS). Because no single ACS table provides breakdowns by age, employment, and race and ethnicity in categories that directly aligned with those collected by the Maryland Community Survey (MCS)—ACS employment statistics, for example, are reported for those age 16 and older rather than 18 and older—data were merged from three ACS tables to estimate populations within each of 24 weighting bins. Table B03002 provided base populations for each county. Table B01001 was used to calculate the percentages of each race and ethnicity segment that were in each age bracket. Table C23002 was used to calculate the percentages of each race and ethnicity segment that were employed. The weighting procedure first estimated the number of workers in each county for each race and ethnicity segment. It then estimated what proportion were in each age bracket. Counts of workers by race/ethnicity and age bracket were summed across rural and urban counties to estimate total counts for each weighting bin. Weights were then calculated as the proportion between the percentage of the state's overall workforce within each bin and the percentage of the survey sample within each bin. The sum of weights assigned to each survey record was equal to the overall sample size.

Expansion factors were calculated to estimate the number of Maryland workers represented by each record within the survey sample. These were calculated as the proportion between the count of the state's overall workforce within each bin and the count of survey records within each bin. The sum of expansion factors assigned to each survey record was equal to the statewide adult workforce.

Final weights and expansion factors for each bin are listed in Tables A1 and A2. Counts of survey records within each bin are listed in Table A3.

Table A3.1. Weights by race/ethnicity, age, and urban vs. rural residency

Race & Ethnicity	Age	Urban	Rural
Hispanic	18-34	0.41	0.32
	35-54	1.46	0.85
	55+	2.19	0.34
Non-Hispanic Black	18-34	1.12	1.04
	35-54	0.94	0.89
	55+	1.28	0.58
Non-Hispanic White	18-34	1.98	1.60
	35-54	0.94	1.46
	55+	0.98	1.05
Other	18-34	0.59	0.77
	35-54	0.98	0.47
	55+	0.72	0.50

Table A3.2. Expansion factors by race/ethnicity, age, and urban vs. rural residency

Race & Ethnicity	Age	Urban	Rural
Hispanic	18-34	1994.10	1552.50
	35-54	7065.82	4141.40
	55+	10593.20	1633.60
Non-Hispanic Black	18-34	5421.98	5041.13
	35-54	4557.78	4305.91
	55+	6192.58	2798.71
Non-Hispanic White	18-34	9597.32	7739.24
	35-54	4576.10	7069.23
	55+	4764.62	5077.81
Other	18-34	2871.32	3735.60
	35-54	4735.78	2297.56
	55+	3497.95	2421.40

Table A3.3. Counts of survey records by race/ethnicity, age, and urban vs. rural residency

Race & Ethnicity	Age	Urban	Rural
Hispanic	18-34	51	12
	35-54	17	5
	55+	5	5
Non-Hispanic Black	18-34	44	8
	35-54	60	11
	55+	43	14
Non-Hispanic White	18-34	25	21
	35-54	63	30
	55+	87	57
Other	18-34	31	5
	35-54	23	9
	55+	20	5

Appendix 4: Statistical Modeling

Logistic Regression

A multinomial logistic regression model was used to examine relationships between remote work, the response variable, and commuter characteristics, the predictor variables. The model held each predictor statistically constant so that relationships between them and telecommuting outcomes can be evaluated independently.

Remote work was modeled at three levels: remote, hybrid, and in-person (See Appendix 2 for a description of this variable). In-person was treated as the reference category.

Logistic Regression Equation:

$$ln(p_i/1 - p_i) = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + ... \beta_k X_k$$

Log-Likelihood *Independent Variables*

In the above equation, $(p_i/1 - p_i)$ is the probability of remote work/probability of non-remote work for each observation, i. $ln(pi/1 - pi)$ is called 'logit', 'logit odds', or 'log-likelihood,' which ranges from -∞ to +∞. Dependent variables, $\{X_1, X_2, \ldots X_k\}$, include categorical variables like income, gender, education level, race & ethnicity, work activity (work on a computer, teach students, work with paper records), work industry (professional, technical or business services, arts, entertainment or recreation) and workplace type (construction, agriculture, or mining, office including home office, food or accommodation). Coefficients, $\{\beta_1, \beta_2, \ldots \beta_k\}$, are estimated for each independent variable and for a constant, β_0, using a maximum likelihood technique.

The final model specification was developed through a manual backward stepwise approach in which all major demographic and other survey variables were initially entered as predictors. Variables that were not statistically significant with at least 80% confidence for either of the response levels were iteratively removed. Non-significant income and education levels were maintained to simplify reference categories. Non-significant work activities, work industries, and workplace types were dropped.

All predictors in the final model, summarized in the table below, are boolean. Effects are reported as odds ratios, which can be interpreted as likelihoods of an outcome given a true value for the predictor. Odds ratios greater than one indicate a positive relationship; those less than one indicate a negative relationship. The model indicates that a male worker, for example, is only 67% as likely to work remotely as—or rather, 33% less likely than—a female or

non-binary worker. A worker with an associate's degree, however, is 179% as likely—or rather, 79% more likely—to work remotely as one with no college degree.

Table A4.1. Odds ratios from the logistic regression model predicting remote or hybrid work with reference to in-person work.

	Odds Ratio	
Predictor	**Remote**	**Hybrid**
Income		
Low income	0.72	0.63*
Moderate income (reference)		
High income	0.85	1.06
Gender		
Female or Non-Binary (reference)		
Male	0.67*	1.13
Education		
No college degree (reference)		
Associate's degree	1.79*	2.20**
Bachelor's degree	1.08	1.38
Master's degree	0.84	1.70*
Doctoral degree	2.56	3.21*
Race & Ethnicity		
White only (reference)		
Black	1.39*	1.39*
Latinx	1.58*	2.64***
Asian	2.53*	2.36*
Other Person of Color (incl. Native American)	8.50***	5.53***
Work Activity		
None of below (reference)		

Work on a computer	2.90***	2.59***
Drive a vehicle on public roadways	1.97*	2.93***
Teach students	1.68*	1.36
Meet or talk with clients or customers	0.44***	0.62*
Work with paper records	0.41***	1.16
Sell, serve, prepare, or stock retail goods, food, or drink	0.22***	0.63*
Handle or move objects	0.23***	0.59*
Work Industry		
None of below (reference)		
Professional, Technical or Business Services	3.19***	2.66**
Arts, Entertainment or Recreation	1.53	3.35**
Information Services, including Publishing or Media	1.52	2.67*
Workplace Type		
None of below (reference)		
Construction, agriculture, or mining	4.77***	5.79***
Office (including a home office)	4.63***	3.34***
Food or accommodation	3.28**	1.52

* P ≤ 0.2 ** P ≤ 0.05 *** P ≤ 0.01

Clustering

The K-means clustering algorithm was used to cluster the location sub-sample which contains only survey participants with accurate work and home location information. K-means clustering looks for similarities between data points and groups them together into clusters by selecting a k number of clusters and assigning each data point to the nearest cluster, based on the similarity of their characteristics. After that, it calculates the centroid of each cluster and reassigns the data points to their nearest centroid. This process is repeated until the centroids of each cluster no longer move. Finally, you will have k clusters of data points similar to each other based on their characteristics.

To conduct the cluster analysis, several important characteristics were included. The individual attributes included gender, age, race, higher education years, and disability status whereas the household attributes such as household income, household size, household car ownership, and the number of children in the household were used. Employment characteristics consisted of

full-time status, industry, work activities, remote work status, preferences, and capability. The remote work status and capability were transformed from categorical into continuous variables by coding them as follows: -1 is in-person, 0 is hybrid, 1 is remote. The remote work preferences were coded as follows: -2 is fully in-person, -1 is more in-person, 0 is equally in-person and remote, 1 is more remote, and 2 is fully remote. Home and work location attributes included types of home and work areas, preferences for the distance away from work, and factors influencing a decision on where to live. Preferences for the distance away from work were coded as follows: -1 is farther, 0 is no change, and 1 is closer. Commute characteristics include days per week, time of day, travel mode choices for work and non-work activities, and travel distance. All the continuous variables were standard scaled.

To determine the optimal number of clusters, the elbow technique was used by plotting the number of clusters against distortion scores which are mean sums of squared distances to centroids for each cluster. The plot forms a curve that looks like an arm, hence it is called the "elbow" method (Figure A4.1). The "elbow point" on the plot indicates the optimal number of clusters where adding more clusters no longer significantly improves the overall clustering performance. After applying the elbow technique to our sample, it was partitioned into four clusters of the following sizes: 96, 103, 151, and 123. The characteristics of the four clusters are shown in Table A4.2. Based on comparison of the clusters, they were labeled as follows: Flourishing Families, Wireless White Collars, Blue Collar Commuters, and Seasoned Professionals. For a more detailed interpretation of the four clusters, refer to the Remote Work section in the main report.

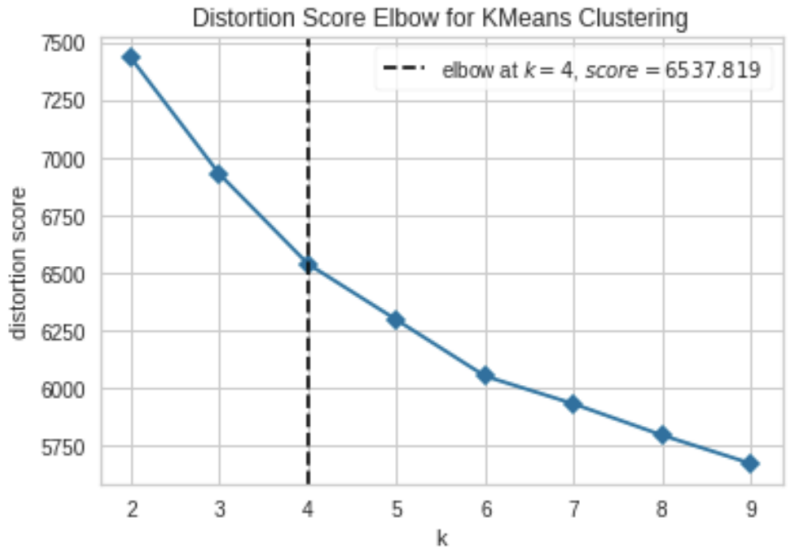

Figure A4.1. Elbow score plot.

Table A4.2. Characteristics of four clusters based on K-means analysis

Characteristic	Statistic or Category	Flourishing Families	Wireless White Collars	Blue Collar Commuters	Seasoned Professionals
Cluster Size		96	103	151	123
Age	Mean	41	45	43	57
Gender	Male	54%	33%	50%	47%
Race & Ethnicity	Non-Hispanic White	34%	33%	49%	60%
	Non-Hispanic Black	30%	33%	30%	20%
	Hispanic	24%	7%	11%	11%
	Other	12%	27%	10%	9%
Disability	Disabled	4%	10%	13%	7%
Higher Education Years	Mean	2.6	2.5	1.4	4.5
Income	<$35K	15%	20%	28%	2%
	$35K-$75K	27%	30%	52%	20%
	$75K-$150K	50%	40%	16%	54%
	>$150K	8%	10%	5%	25%
Household Size	Mean	5	2.7	2.2	2.3
Children in Household	Mean	2.2	0.7	0.3	0.3
Cars in Household	Mean	2.4	1.5	1.4	1.9
Employment	Full-Time	78%	72%	72%	88%
Work Activity	Manual	46%	20%	71%	22%
	Office	69%	84%	63%	94%
Work Industry	Arts, entertainment, or recreation	3%	4%	1%	4%
	Banking, finance, or insurance	5%	10%	2%	3%
	Construction	5%	2%	9%	1%
	Education	13%	6%	9%	14%
	Food or lodging	6%	5%	21%	2%
	Government	10%	6%	5%	24%
	Healthcare	16%	14%	10%	15%
	Information, publishing, or media	4%	5%	1%	7%

Characteristic	Statistic or Category	Flourishing Families	Wireless White Collars	Blue Collar Commuters	Seasoned Professionals
	Manufacturing	3%	5%	3%	5%
	Professional services	14%	22%	5%	15%
	Real Estate	2%	0%	0%	5%
	Retail	5%	7%	17%	2%
	Transportation or warehousing	6%	4%	8%	1%
	Utilities	4%	2%	2%	0%
	Wholesale	1%	3%	2%	0%
	Agriculture, forestry, or fishing	0%	3%	1%	1%
Remote Work Capability	Mean on scale from -1 (no capability) to 1 (full capability)	-0.1	0.8	-0.8	0.4
Remote Work Preference	Mean on scale from -2 (prefer in-person) to 2 (prefer remote)	0.1	1.6	-0.5	0.6
Remote Work Status	Mean on scale from -1 (fully in-person) to 1 (fully remote)	-0.4	0.9	-0.9	-0.2
Work Area	City	32%	40%	41%	50%
	Suburban	56%	42%	45%	39%
	Rural	10%	9%	10%	4%
	Town	1%	0%	3%	5%
	Outside DMV	0%	10%	1%	2%
Home Area	City	29%	26%	36%	16%
	Suburban	64%	66%	50%	68%
	Rural	3%	7%	11%	15%
	Town	3%	1%	2%	2%
	Outside DMV	1%	0%	0%	0%
Home Choice Factors	Neighborhood Factors	48%	47%	57%	51%
	Home Factors	85%	72%	66%	81%
	Commute Factors	41%	35%	62%	62%
Home-work Distance Preference	Mean on scale from -1 (would prefer to live farther from	0.3	0.3	0.3	0.3

Characteristic	Statistic or Category	Flourishing Families	Wireless White Collars	Blue Collar Commuters	Seasoned Professionals
	work) to 1 (would prefer to live closer to work)				
Commute Distance	Miles	12.3	0.5	8.8	22
Weekly Commute	<1 days	10%	95%	1%	13%
	1-2 days	16%	4%	3%	25%
	3-4 days	37%	1%	22%	37%
	5+ days	38%	0%	75%	25%
Commute Time of Day	Early Morning	12%	0%	15%	10%
	Morning	70%	3%	70%	84%
	Midday	19%	2%	16%	11%
	Afternoon	56%	2%	64%	70%
	Evening	26%	3%	25%	32%
	Late night	10%	0%	15%	0%
Commute Mode	Drive	92%	3%	82%	86%
	Transit	16%	2%	23%	13%
	Micromobility	14%	0%	7%	5%
	Walk	18%	1%	19%	8%
Other Activities Travel Mode	Drive	80%	84%	80%	92%
	Transit	17%	14%	21%	6%
	Micromobility	17%	17%	12%	9%
	Walk	29%	44%	33%	26%

Appendix 5: Questionnaire

2022 Maryland Commuter Survey

Welcome to the Maryland Commuter Survey. This annual survey is conducted by researchers at the University of Maryland (UMD) National Center for Smart Growth (NCSG) and the Maryland Department of Transportation (MDOT). It asks questions about where and how you commute, where you commute from, teleworking, and your household and demographic characteristics. This information will be used to examine how Marylanders are commuting so that MDOT can make more informed decisions about how it plans for and operates transportation infrastructure

around the state.

Participants must be at least 18 years old, currently employed, and live or work in Maryland. The survey will take approximately 12 minutes to complete.

If we write a report or article about this research project, your identity will be protected to the maximum extent possible. Your information may be shared with representatives of the University of Maryland, College Park or governmental authorities if you or someone else is in danger or if we are required to do so by law. Your participation in this research is completely voluntary. You may choose not to take part at all. If you decide to participate in this research, you may stop participating at any time. Individual responses will be stored in a password-protected UMD Box or Google Drive account and will be accessible only by members of the UMD research team. Aggregated or otherwise de-identified data will be shared with MDOT and reported publicly in formats such as reports and articles.

You will have the option to provide your email address to be contacted for follow-up research. Collected email addresses will be deleted by December 31, 2025.

If you have questions about the survey, please contact Chester Harvey, Director of the NCSG Transportation Policy Research Center, at cwharvey@umd.edu.

If you have questions about your rights as a research participant or wish to report a research-related injury, please contact:

University of MarylandCollege Park
Institutional Review Board Office
1204 Marie Mount Hall
College Park, Maryland, 20742
Email: irb@umd.edu
Telephone: 301-405-0678

For more information regarding participant rights, please visit:
https://research.umd.edu/research-resources/research-compliance/institutional-review-board-irb/research-participants

This research has been reviewed according to the University of Maryland, College Park IRB procedures for research involving human subjects (IRBNet Package number 1895887-1).

To proceed with the survey, please confirm that you are at least 18 years old, reside or work within the state of Maryland, and that you agree to participate:

- ○ Yes, I am at least 18 years old, currently employed, live or work in Maryland, and agree to participate

○ No, I do not meet these requirements or do not agree to agree to participate

How old are you?

○ younger than 18

○ 18-24

○ 25-34

○ 35-44

○ 45-54

○ 55-64

○ 65-74

○ 75+

Terminate survey if "younger than 18" is selected.

What is your gender identity?

○ Male

○ Female

○ Non-binary or non-conforming

○ Prefer not to identify

How do you identify racially and/or ethnically? (select all that apply)

- [ ] Asian/Pacific Islander
- [ ] American Indian or Alaskan Native
- [ ] Black/African American/African Descent
- [ ] Latino/Hispanic
- [ ] Middle Eastern or North African
- [ ] Native Hawaiian or Pacific Islander
- [ ] White
- [ ] Other: _____
- [ ] Prefer not to identify

What is your highest level of education?

- ○ Less than high-school graduation
- ○ High-school graduation
- ○ Some college
- ○ Associate's degree
- ○ Bachelor’s degree
- ○ Master's or professional degree
- ○ Doctoral degree

Do you identify as a person with a disability?

- ○ Yes
- ○ No
- ○ Prefer not to identify

What state do you live in?

▼ List of states

Terminate survey if any state other than MD is selected.

How would you best describe where you live?

- ○ Urban
- ○ Suburban
- ○ Rural

To show that you are paying attention, please select "None of the above".

- ○ Strongly agree
- ○ Agree
- ○ Disagree
- ○ Strongly disagree
- ○ None of the above

Terminate survey if “None of the above” is not selected.

Your Work

The following questions ask about where you work. If you have more than one job, please consider the one to which you regularly commute the farthest.

Are you currently: (select the best option)

- ○ Working full-time (30 or more hours per week)
- ○ Working part-time (fewer than 30 hours per week)
- ○ Working full or part-time with multiple jobs
- ○ Student who also works
- ○ Not employed

Terminate survey if “Not employed” is selected.

Where is your job located?

This will be used to determine how far you live from your job.

Do not include the street number.

If you always work remotely, where would you go if you had to visit the office, or where is the nearest location maintained by your employer?

If your employer doesn't have any physical location, please enter "fully remote" in all fields.

- ○ Street Name _____
- ○ Name of nearby cross street _____
- ○ City _____

○ State _____

In what industry is your job?

○ Agriculture, Forestry, Fishing or Hunting

○ Arts, Entertainment or Recreation

○ Banking, Finance or Insurance

○ Construction

○ Education

○ Health Care or Social Assistance

○ Hotel, Accommodation, Restaurant or Food Services

○ Information Services, including Publishing or Media

○ Manufacturing

○ Mining, Quarrying or Oil and Gas Extraction

○ Professional, Technical or Business Services

○ Real Estate or Rental and Leasing Services

○ Retail Trade

○ Transportation or Warehousing

○ Utilities

○ Wholesale Trade

- ○ Government, including all federal and state
- ○ Other: _____

What activities do you typically perform at this job? (select all that apply)

- ☐ Work on a computer
- ☐ Work with paper records
- ☐ Meet with colleagues
- ☐ Meet or talk with clients or customers
- ☐ Teach students
- ☐ Sell, serve, prepare, or stock retail goods, food, or drink
- ☐ Maintain, repair, or clean spaces or equipment
- ☐ Operate machines, tools, or equipment
- ☐ Handle or move objects
- ☐ Drive a vehicle on public roadways
- ☐ Other: _____

Which best describes where you work?

- ○ Office (including a home office)
- ○ Factory or warehouse
- ○ Retail or entertainment
- ○ Food or accommodation
- ○ Construction, agriculture, or mining
- ○ School or university
- ○ Hospital or other healthcare facility
- ○ Other: _____

Remote Work

The following questions ask about working remotely. This refers to working anywhere other than your employer's or client's official workplace.

Do you work remotely?

- ○ Always
- ○ Almost Always
- ○ Sometimes
- ○ Never

How much of your job <u>could</u> you perform remotely?

- ○ All (I can do 100% of my job remotely)

- ○ Some (I can do some of my job remotely, but other parts require being at work in-person)
- ○ None (my job is incompatible with remote work)

How much would you <u>like</u> to work remotely versus in-person?

- ○ Always remote
- ○ More remote than in-person
- ○ About equally remote and in-person
- ○ More in-person than remote
- ○ Always in-person

If remote work:
How often do you work in each of these types of places?

My home	▼ Almost every day (1) ... Never (4)
Someone else's home	▼ Almost every day (1) ... Never (4)
Vacation rental or hotel	▼ Almost every day (1) ... Never (4)
Coffee shop or restaurant	▼ Almost every day (1) ... Never (4)
Library, park, or other public space	▼ Almost every day (1) ... Never (4)
Coworking space (example: WeWork)	▼ Almost every day (1) ... Never (4)

If you had a choice between going to work in-person or working remotely, which consideration would be most important to you?

Working in-person because:

- ○ ...I am more productive.
- ○ ...I like to spend time with my colleagues and team.
- ○ ...I am more likely to get promoted.
- ○ ...I like to get out of the house.

○ ...another reason (please specify): _____

Working remotely because:

○ ...I am more productive.

○ ...I get to spend more time on non-work activities.

○ ...it's more physically comfortable.

○ ...I wouldn't have to spend time commuting.

○ ...I wouldn't have to pay to commute.

○ ...another reason (please specify): _____

If remote work:
On days that you work remotely, do you tend to... (select all that apply)

☐ ...not leave the house all day.

☐ ...recreate outside. (examples: walking the dog or jogging)

☐ ...accompany children or other household members to school or other activities.

☐ ...go to stores, restaurants, or other locations in your home town.

☐ ...go to stores, restaurants, or other locations in another town.

☐ ...work remotely for part of the day, then travel to work for another part of the day.

☐ Other: _____

If in-person work:
Your Commute

The following questions ask about commuting: travel to and from work.

How many days a week do you currently commute to your employer's or client's workplace?

- ○ 5+ days a week
- ○ 4 days a week
- ○ 3 days a week
- ○ 2 days a week
- ○ 1 day a week
- ○ less than 1 day a week

You said that you currently commute *[fill from previous question]* days per week. On which day(s) do you most commonly commute? (select all that apply)

- ☐ Most Sundays
- ☐ Most Mondays
- ☐ Most Tuesdays
- ☐ Most Wednesdays
- ☐ Most Thursdays
- ☐ Most Fridays
- ☐ Most Saturdays

- [ ] No days are most typical. I don't have a regular schedule.

What time do you typically leave home, going to work?

- ○ Early Morning (2am to 6am)
- ○ Morning (6am to 10am)
- ○ Midday (10am to 2pm)
- ○ Afternoon (2pm to 6pm)
- ○ Evening (6pm to 10pm)
- ○ Late Night (10pm to 2am)
- ○ No time is typical. I don't have a regular schedule.

What time do you typically leave work, returning to home?

- ○ Early Morning (2am to 6am)
- ○ Morning (6am to 10am)
- ○ Midday (10am to 2pm)
- ○ Afternoon (2pm to 6pm)
- ○ Evening (6pm to 10pm)
- ○ Late Night (10pm to 2am)
- ○ No time is typical. I don't have a regular schedule.

About how many minutes does your one-way commute usually take?

Note: If your morning and afternoon commutes take different amounts of time, please report the longer of the two.

_____

Which of the following transportation modes do you use for commuting to work and for other activities in your day-to-day life?

Please fill in all labeled dropdowns with the best option.

	Day-to-Day Travel
Drive Alone	▼ Almost every day ...
Drive with another person (carpool)	▼ Almost every day ...
Vanpool	▼ Almost every day ...
Motorcycle, moped, or motor scooter	▼ Almost every day ...
Uber, Lyft, or Taxi	▼ Almost every day ...
Bus Transit	▼ Almost every day ...
Rail Transit	▼ Almost every day ...
Paratransit	▼ Almost every day ...
Personal Bike	▼ Almost every day ...
Bike Share (examples: Capital Bikeshare, JUMP)	▼ Almost every day ...
Personal Electric Scooter	▼ Almost every day ...
Scooter Share (example: Lime, LINK)	▼ Almost every day ...
Walk	▼ Almost every day ...
Other (optional):	▼ Almost every day ...

For both remote and in-person workers:
Which of the following transportation modes do you use in your day-to-day life?

Please fill in all labeled dropdowns with the best option.

	Day-to-Day Travel
Drive Alone	▼ Almost every day ...
Drive with another person (carpool)	▼ Almost every day ...
Vanpool	▼ Almost every day ...
Motorcycle, moped, or motor scooter	▼ Almost every day ...
Uber, Lyft, or Taxi	▼ Almost every day ...

Bus Transit	▼ Almost every day ...
Rail Transit	▼ Almost every day ...
Paratransit	▼ Almost every day ...
Personal Bike	▼ Almost every day ...
Bike Share (examples: Capital Bikeshare, JUMP)	▼ Almost every day ...
Personal Electric Scooter	▼ Almost every day ...
Scooter Share (example: Lime, LINK)	▼ Almost every day ...
Walk	▼ Almost every day ...
Other (optional):	▼ Almost every day ...

Below is a list of factors you might consider when deciding how to commute to work. Which are important to you? (select all that apply)

- [ ] Low overall commute time
- [ ] Not having to wait in traffic
- [ ] Not having to share space with strangers
- [ ] Concern about COVID
- [ ] Opportunity for exercise
- [ ] Not getting hot and sweaty
- [ ] Getting to be outside
- [ ] Not having to be exposed to weather
- [ ] Having to wait for a bus or train
- [ ] Affordability
- [ ] Crash safety
- [ ] Crime safety
- [ ] Minimal walking

☐ Environmental friendliness

☐ Reliability

☐ Enjoyability

☐ Parking availability/cost

☐ Commuting benefits from my employer

☐ Showers or changing facilities at work

☐ Other: _____

Bikeshare (e.g., Capital Bikeshare, JUMP) and scooter share (e.g., Lime, LINK) are increasingly available as transportation modes. Would you say that bike and scooter share are… (select all that apply)

☐ …safe.

☐ …reliable.

☐ …affordable.

☐ …fun.

☐ …environmentally friendly.

☐ …opportunities for exercise.

☐ …available when and where I want them to be.

☐ …a useful alternative to walking.

☐ …a useful alternative to riding my own bike or scooter.

☐ …a useful alternative to taking transit.

☐ …a useful alternative to Uber, Lyft, or Taxi.

☐ …useful because I don't have my own bike or scooter.

☐ …not useful.

☐ Other: _____

Your Home

Where do you live in Maryland?

This will be used to determine how far you live from your job and other characteristics of your neighborhood. Do not include your street number.

○ Street name _____

○ Name of nearby cross street _____

○ City _____

Which option best describes where you would prefer to live?

○ Closer to work than I do now, meaning a shorter commute

○ About the same distance from work that I do now, meaning a similar commute

○ Farther from work than I do now, meaning a longer commute

Why have you not moved *[closer to / farther from]* work? (select all that apply)

☐ Housing is more affordable where I currently live

- [ ] I am settled here and don't want to move
- [ ] I can work remotely
- [ ] My commute would take just as much time if I moved
- [ ] My commute would cost more if I moved
- [ ] I prefer the type of housing where I currently live
- [ ] I prefer recreational opportunities where I currently live
- [ ] I prefer stores or restaurants where I currently live
- [ ] I have family, friends, or community ties where I currently live
- [ ] The schools are better where I currently live, or my children would have to change schools if we moved
- [ ] My spouse or partner would have a worse commute
- [ ] My home is more spacious where I currently live
- [ ] I enjoy privacy from neighbors where I currently live
- [ ] Housing costs aside, it would be too expensive to move
- [ ] There is less crime where I currently live
- [ ] Other: _____

Below is a list of factors that you might consider when deciding where to live. Which are important to you? (select all that apply)

- [ ] A detached single-family home
- [ ] Walking distance to shops, restaurants, or schools
- [ ] A commute that doesn't take very long
- [ ] Privacy from neighbors
- [ ] Close to transit
- [ ] Spacious lot or yard
- [ ] Spacious house
- [ ] A commute that doesn't require driving
- [ ] Living in "the center of it all"
- [ ] Living near friends and family

Including you, how many people live in your household?

Note: If you live with unrelated roommates from whom you are financially independent, please do not include your roommates as part of your household.

_____

How many children under the age of 18 live in your household?

_____

How many automobiles does your household currently own and/or lease?

_____

Does your household currently own or lease a fully electric vehicle (EV)?

Note: This does not include partially gas-powered vehicles such as hybrids.

- ○ Yes
- ○ No

If not an EV owner:
Would you consider purchasing or leasing a fully electric vehicle (EV) in the future?

- ○ Yes, within the next five years
- ○ Yes, in the distant future
- ○ No, never

If not an EV owner:
If you owned an electric vehicle (EV), would you be able to charge it at home?

- ○ Yes
- ○ No
- ○ I don't know

If an EV owner:
Are you able to charge your electric vehicle (EV) at home?

- ○ Yes
- ○ No

Which of these places do you visit regularly and know that you could charge an electric vehicle (EV)? (select all that apply)

- [ ] My workplace
- [ ] Store, restaurant, or shopping center
- [ ] Gas station
- [ ] School, college, or university
- [ ] Government office or other civic building
- [ ] Park or recreational area
- [ ] Independent parking lot or garage
- [ ] Another location (please specify)

  _____
- [ ] There are no charging stations in places I visit regularly
- [ ] I don’t know if there are charging stations in places I visit regularly

What transportation resources are available to you? (select all that apply)

- [ ] I have a driver's license
- [ ] I have my own automobile
- [ ] I share an automobile with others in my household
- [ ] I have a motorcycle, moped, or motor scooter
- [ ] I have a bicycle

- [ ] I have an electric scooter
- [ ] I have a bikeshare membership
- [ ] I have a transit pass provided by my employer
- [ ] I have a mobile device with transportation service apps (e.g., Uber, Lime)
- [ ] Someone else in my household supports me with their automobile
- [ ] Someone else outside my household supports me with their automobile
- [ ] Other: _____

For statistical purposes, we need information about your income. All responses will be kept confidential. What was your total household income before taxes in 2021?

- ○ Less than $20,000
- ○ $20,000 to $34,999
- ○ $35,000 to $49,999
- ○ $50,000 to $74,999
- ○ $75,000 to $99,999
- ○ $100,000 to $149,999
- ○ Greater than $150,000

Compared to before the COVID-19 pandemic (March 2020), I currently… (select one from each group)

Job

- [ ] ...have the same job (or still don't have a job).
- [ ] ...got a different job.
- [ ] ...lost my job.

Drive

- [ ] ...drive about the same amount (or still don't drive).
- [ ] ...drive more.
- [ ] ...drive less.

Transit

- [ ] ...use transit about the same amount (or still don't take transit).
- [ ] ...use transit more.
- [ ] ...use transit less.

Bike

- [ ] ...bike about the same amount (or still don't bike).
- [ ] ...bike more.
- [ ] ...bike less.

Walk

- [ ] ...walk about the same amount (or still don't walk).

- [ ] ...walk more.
- [ ] ...walk less.

Home

- [ ] ...live in the same place.
- [ ] ...moved farther from my job.
- [ ] ...moved closer to my job.
- [ ] ...moved, but it's about the same distance to my job.

Which of the following goals do you think are most important for the Maryland Department of Transportation to address in the coming years? (select all that apply)

- [ ] Ensure a safe and secure transportation system
- [ ] Ensure environmental protection and sensitivity
- [ ] Improve quality and efficiency to enhance user experience
- [ ] Provide more transportation choices and connections
- [ ] Ensure public involvement in planning processes
- [ ] Promote fiscal responsibility
- [ ] Address the climate crisis and transition to a clean energy future
- [ ] Ensure that streets are safe for people outside automobiles
- [ ] Advance equity and support for underserved communities

- [ ] Maintain a high standard and modernize transportation Infrastructure
- [ ] Improve public transit services
- [ ] Facilitate economic opportunity and reduce congestion
- [ ] Another goal: _____

Would you be willing to participate in a follow-up survey or interview?

Your email address will be stored securely and will not be shared outside our University of Maryland research team.

- ○ Yes, I can be reached at this email address:

  _____
- ○ No, please do not contact me about future research.